Monthly Report of
Operation of Water
Treatment Plant
Form 100

Operator Signature: R Smith Date: 12/07/2020

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Dale Pershing

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Month: November
Year 2020

		Filters		Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Filter Run (hours)_ TOTAL	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
11/1/2020	0.193			72.54	10.36	14	2		7.80			0.00			1.00		3.50		1.90	
11/2/2020	0.138			72.46	7.25	10	1		7.70			0.00			1.00		3.70		2.20	
11/3/2020	0.200			70.00	10.00	14	2		7.80			0.00			0.90		3.30		2.20	
11/4/2020	0.179			67.04	5.59	12	1		7.80			0.00			1.00		3.40		1.90	
11/5/2020	0.176			73.86	11.36	13	2		7.70			0.00			0.90		3.30		2.10	
11/6/2020	0.202			69.31	9.90	14	2		7.70			0.00			2.80		3.40		1.70	
11/7/2020	0.177			79.10	5.65	14	1		7.70			0.00			0.90		3.60		2.00	
11/8/2020	0.146			68.49	6.85	10	1		7.70			0.00			0.80		3.80		2.10	
11/9/2020	0.199			65.33	10.05	13	2		7.80			0.20			1.00		3.00		2.20	
11/10/2020	0.185			70.27	10.81	13	2		7.70			0.10			0.90		3.30		2.40	
11/11/2020	0.180			66.67	11.11	12	2		7.70			0.00			1.10		2.70		1.60	
11/12/2020	0.167			65.87	5.99	11	1		7.80			0.00			0.90		3.10		2.00	
11/13/2020	0.207			67.63	9.66	14	2		7.70			0.10			1.00		3.80		2.10	
11/14/2020	0.191			73.30	10.47	14	2		7.70			0.00			0.90		3.40		1.40	
11/15/2020	0.184			65.22	10.87	12	2		7.70			0.20			0.90		3.70		2.10	
11/16/2020	0.147			68.03	6.80	10	1		7.70			0.10			0.90		3.20		2.40	
11/17/2020	0.344			81.40	8.72	28	3		7.80			0.10			1.10		3.80		1.80	
11/18/2020	0.456			59.21	8.77	27	4		7.70			0.10			1.10		3.90		2.70	
11/19/2020	0.146			82.19	6.85	12	1	360	7.70	360	2.70	0.00	0.09	0.08	1.00		3.30		2.50	
11/20/2020	0.187			69.52	10.70	13	2		7.70			0.10			0.90		3.30		2.20	
11/21/2020	0.166			84.34	6.02	14	1		7.70			0.00			0.90		2.90		2.00	
11/22/2020	0.193			82.90	10.36	16	2		7.70			0.00			2.80		3.00		1.60	
11/23/2020	0.114			87.72	17.54	10	2		7.80			0.00			1.40		3.00		1.90	
11/24/2020	0.191			78.53	10.47	15	2		7.80			0.00			1.20		2.60		2.30	
11/25/2020	0.180			72.22	11.11	13	2		7.70			0.00			2.00		2.60		1.90	
11/26/2020	0.187			80.21	10.70	15	2		7.80			0.00			1.10		2.80		1.80	
11/27/2020	0.207			72.46	9.66	15	2		7.80			0.10			2.80		3.10		2.10	
11/28/2020	0.127			78.74	15.75	10	2		7.90			0.00			0.90		2.80		2.00	
11/29/2020	0.196			66.33	10.20	13	2		7.70			0.00			0.80		2.80		2.00	
11/30/2020	0.190			63.16	5.26	12	1		7.80			0.00			0.90		3.50		2.40	
Total	5.76	0.0	0.000	2174.04	284.85	413	54	360	232.30	360	2.70	1.10	0.09	0.08	35.80	0.00	97.60	0.00	61.50	
Average	0.19	#DIV/0!	#DIV/0!	72.47	9.49	14	2	360	7.74	360	2.70	0.04	0.09	0.08	1.19	#DIV/0!	3.25	#DIV/0!	2.05	
Min	0.11	0.0	0.000	59.21	5.26	10	1	360	7.70	360	2.70	0.00	0.09	0.08	0.80	0.00	2.60	0.00	1.40	
Max	0.46	0.0	0.000	87.72	17.54	28	4	360	7.90	360	2.70	0.20	0.09	0.08	2.80	0.00	3.90	0.00	2.70	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 1/06/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Dale Pershing

Month:	December
Year	2020
Leap Year?	No

				Filters		Chemicals (LBS/MG)		Chemicals (lbs)			Physical and Chemical Data (mg/L)							Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	High Service (MGD)	Surface H2O (MGD)	Filter Run (hours)_ TOTAL	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
12/1/2020	0.291					68.73	10.31	20	3		7.70			0.10			0.90		3.70		2.50	
12/2/2020	0.103					58.25	9.71	6	1		7.70			0.20			0.90		3.40		2.80	
12/3/2020	0.186					53.76	5.38	10	1		7.80			0.00			0.80		3.70		2.50	
12/4/2020	0.193					67.36	10.36	13	2		7.80			0.10			1.10		3.80		2.60	
12/5/2020	0.212					70.75	9.43	15	2		7.70			0.00			0.90		3.90		2.80	
12/6/2020	0.182					71.43	10.99	13	2		7.70			0.10			0.90		3.40		2.80	
12/7/2020	0.210					71.43	9.52	15	2		7.80			0.20			0.90		3.70		2.40	
12/8/2020	0.156					70.51	6.41	11	1		7.70			0.10			1.00		3.50		2.60	
12/9/2020	0.167					77.84	5.99	13	1		7.80			0.10			1.00		3.50		2.40	
12/10/2020	0.164					91.46	12.20	15	2		7.70			0.00			2.70		3.40		2.10	
12/11/2020	0.192					62.50	10.42	12	2		7.70			0.00			1.20		3.30		2.00	
12/12/2020	0.059					84.75	33.90	5	2		7.70			0.00			1.10		1.90		0.50	
12/13/2020	0.144					69.44	6.94	10	1		7.80			0.00			1.20		2.90		2.50	
12/14/2020	0.180					72.22	5.56	13	1		7.70			0.10			0.90		3.20		2.70	
12/15/2020	0.188					74.47	10.64	14	2		7.80			0.00			0.90		3.70		2.60	
12/16/2020	0.253					75.10	7.91	19	2	340	7.80	360	2.25	0.00	0.10	0.08	1.00		3.30		2.90	
12/17/2020	0.186					75.27	10.75	14	2		7.70			0.10			0.80		3.70		2.40	
12/18/2020	0.167					77.84	5.99	13	1		7.80			0.10			1.00		3.90		2.60	
12/19/2020	0.151					72.85	13.25	11	2		7.80			0.10			1.00		3.20		2.60	
12/20/2020	0.204					68.63	9.80	14	2		7.90			0.10			1.00		3.40		2.70	
12/21/2020	0.151					66.23	13.25	10	2		7.90			0.20			0.90		2.90		2.00	
12/22/2020	0.228					70.18	8.77	16	2		7.70			0.00			1.00		3.10		2.10	
12/23/2020	0.144					62.50	20.83	9	3		7.70			0.00			2.70		2.80		2.60	
12/24/2020	0.151					79.47	13.25	12	2		7.80			0.00			0.90		2.50		2.20	
12/25/2020	0.164					60.98	12.20	10	2		7.70			0.00			2.60		2.60		2.10	
12/26/2020	0.172					75.58	5.81	13	1		7.80			0.10			2.80		3.30		2.20	
12/27/2020	0.195					66.67	10.26	13	2		7.80			0.10			1.10		3.20		2.10	
12/28/2020	0.195					66.67	10.26	13	2		7.80			0.10			3.00		3.30		2.20	
12/29/2020	0.198					75.76	10.10	15	2		7.90			0.00			2.80		2.90		2.50	
12/30/2020	0.158					69.62	12.66	11	2		7.70			0.30			1.70		2.70		2.30	
12/31/2020	0.214					65.42	9.35	14	2		7.80			0.10			1.00		3.20		2.70	
Total	5.56	0.00	0.00	0.0	0.000	2193.66	332.17	392	56	340	240.70	360	2.25	2.30	0.10	0.08	41.70	0.00	101.00	0.00	74.00	
Average	0.18	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	70.76	10.72	13	2	340	7.76	360	2.25	0.07	0.10	0.08	1.35	#DIV/0!	3.26	#DIV/0!	2.39	
Min	0.06	0.00	0.00	0.0	0.000	53.76	5.38	5	1	340	7.70	360	2.25	0.00	0.10	0.08	0.80	0.00	1.90	0.00	0.50	
Max	0.29	0.00	0.00	0.0	0.000	91.46	33.90	20	3	340	7.90	360	2.25	0.30	0.10	0.08	3.00	0.00	3.90	0.00	2.90	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 2/4/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information

IDEM Field Rep: Dale Pershing

January
2021

		Filters		Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Filter Run (hours) TOTAL	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
1/1/2021	0.145			68.97	6.90	10	1	340	7.80	360	2.30	0.20	0.07	0.04	1.00		3.10		2.80	
1/2/2021	0.207			77.29	9.66	16	2		7.80			0.10			0.90		3.20		2.70	
1/3/2021	0.150			66.67	6.67	10	1		7.80			0.20			0.90		3.10		2.60	
1/4/2021	0.197			65.99	10.15	13	2		7.80			0.10			1.00		3.00		2.90	
1/5/2021	0.194			72.16	10.31	14	2		7.80			0.10			0.90		3.40		2.10	
1/6/2021	0.184			70.65	10.87	13	2		7.90			0.20			1.10		3.10		2.70	
1/7/2021	0.322			74.53	9.32	24	3		7.80			0.10			0.80		3.50		3.10	
1/8/2021	0.180			83.33	11.11	15	2		7.80			0.00			0.90		3.70		3.90	
1/9/2021	0.210			57.14	9.52	12	2		7.80			0.00			0.90		3.80		3.10	
1/10/2021	0.117			128.21	8.55	15	1		7.70			0.00			2.80		3.50		3.10	
1/11/2021	0.204			83.33	4.90	17	1		7.90			0.20			0.90		3.20		3.90	
1/12/2021	0.219			82.19	9.13	18	2		7.80			0.20			0.70		3.70		3.60	
1/13/2021	0.179			67.04	11.17	12	2		7.80			0.20			0.90		3.20		2.90	
1/14/2021	0.191			62.83		12	0		7.80			0.00			0.90		3.20		2.50	
1/15/2021	0.164			67.07	6.10	11	1		7.90			0.20			0.80		3.40		2.50	
1/16/2021	0.202			64.36	9.90	13	2		7.90			0.00			0.90		3.30		2.50	
1/17/2021	0.157			63.69	12.74	10	2		7.90			0.00			0.90		2.90		2.60	
1/18/2021	0.229			61.14	8.73	14	2		7.90			0.20			1.10		2.90		2.70	
1/19/2021	0.191			62.83	10.47	12	2		7.80			0.10			1.00		3.60		2.30	
1/20/2021	0.195			66.67	10.26	13	2		7.90			0.00			1.10		3.40		2.60	
1/21/2021	0.194			72.16	10.31	14	2		7.80			0.10			0.80		3.80		2.80	
1/22/2021	0.189			52.91	10.58	10	2		7.80			0.00			1.00		3.20		2.60	
1/23/2021	0.161			86.96	6.21	14	1		7.80			0.00			0.80		3.30		2.70	
1/24/2021	0.202			54.46	9.90	11	2		7.80			0.00			2.80		2.60		2.40	
1/25/2021	0.173			80.92	11.56	14	2		7.80			0.30			2.40		3.10		2.90	
1/26/2021	0.240			70.83	8.33	17	2		7.80			0.00			1.10		3.60		2.80	
1/27/2021	0.133			52.63	7.52	7	1		7.90			0.10			1.30		3.20		3.10	
1/28/2021	0.179			67.04	5.59	12	1		7.90			0.00			1.00		3.20		2.80	
1/29/2021	0.222			63.06	9.01	14	2		7.90			0.10			1.00		3.20		2.30	
1/30/2021	0.165			78.79	6.06	13	1		7.90			0.00			1.00		3.30		2.60	
1/31/2021	0.211			47.39	9.48	10	2		7.90			0.00			1.00		2.90		2.10	
Total	5.91	0.0	0.000	2173.35	271.01	410	52	340	242.90	360	2.30	2.70	0.07	0.04	34.60	0.00	101.60	0.00	86.20	
Average	0.19	#DIV/0!	#DIV/0!	70.10	9.03	13	2	340	7.84	360	2.30	0.09	0.07	0.04	1.12	#DIV/0!	3.28	#DIV/0!	2.78	
Min	0.12	0.0	0.000	47.39	4.90	7	0	340	7.70	360	2.30	0.00	0.07	0.04	0.70	0.00	2.60	0.00	2.10	
Max	0.32	0.0	0.000	128.21	12.74	24	3	340	7.90	360	2.30	0.30	0.07	0.04	2.80	0.00	3.80	0.00	3.90	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Operator Signature: Michael J Mark Date: 3/4/2021

Certification # WT190134

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

Indiana American Water

IDEM Field Rep: Dale Pershing

Sheridan-Plant
PWS-ID:5229014

Month:	February
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
2/1/2021	0.148		47.30	6.76	7	1		7.90			0.12			1.00		2.80		2.70	
2/2/2021	0.152		59.21	13.16	9	2		7.90			0.06			1.00		2.80		2.80	
2/3/2021	0.225		53.33	8.89	12	2		7.90			0.02			0.90		2.70		2.80	
2/4/2021	0.133		52.63	7.52	7	1		8.00			0.00			1.00		2.70		2.60	
2/5/2021	0.251		55.78	3.98	14	1		7.90			0.00			1.10		3.10		2.00	
2/6/2021	0.154		51.95	12.99	8	2		8.00			0.02			1.00		2.80		2.30	
2/7/2021	0.172		58.14	11.63	10	2		8.00			0.00			2.80		2.30		2.40	
2/8/2021	0.222		54.05	9.01	12	2		7.90			0.15			2.80		2.80		2.60	
2/9/2021	0.234		55.56	8.55	13	2		7.90			0.00			1.50		3.50		2.30	
2/10/2021	0.199		60.30	10.05	12	2		7.80			0.02			0.90		3.00		2.60	
2/11/2021	0.163		61.35	6.13	10	1		7.90			0.06			1.00		2.90		2.70	
2/12/2021	0.178		61.80	11.24	11	2		7.80			0.19			1.10		3.20		2.70	
2/13/2021	0.123		105.86	8.14	13	1		7.90			0.06			1.10		2.80		2.90	
2/14/2021	0.161		55.90	12.42	9	2		7.80			0.00			1.10		3.00		2.60	
2/15/2021	0.207		72.46	9.66	15	2		8.00			0.03			2.50		2.80		2.60	
2/16/2021	0.250		64.00	12.00	16	3		7.90			0.05			1.00		3.30		2.30	
2/17/2021	0.194		56.70	10.31	11	2		7.90			0.01			1.10		3.20		2.90	
2/18/2021	0.162		74.07	12.35	12	2	360	7.80	360	2.53	0.00	0.08	0.05	1.60		3.00		2.80	
2/19/2021	0.215		55.81	9.30	12	2		7.90			0.02			1.00		3.10		2.70	
2/20/2021	0.177		67.80	5.65	12	1		7.90			0.00			1.10		2.50		2.30	
2/21/2021	0.192		72.92	10.42	14	2		7.80			0.05			1.10		2.90		2.90	
2/22/2021	0.262		64.89	11.45	17	3		8.00			0.00			1.20		3.20		2.40	
2/23/2021	0.240		54.17	8.33	13	2		7.90			0.00			0.80		3.20		2.70	
2/24/2021	0.160		75.00	6.25	12	1		7.90			0.03			0.80		2.90		2.80	
2/25/2021	0.221		45.25	9.05	10	2		7.90			0.13			0.90		3.00		2.40	
2/26/2021	0.164		54.88	12.20	9	2		7.90			0.04			1.00		2.70		2.80	
2/27/2021	0.167		59.88	11.98	10	2		7.80			0.03			0.90		2.80		2.60	
2/28/2021	0.194		56.70	10.31	11	2		7.90			0.00			1.00		3.30		2.50	
Total	5.32	0.000	1707.69	269.71	321	51	360	221.10	360	2.53	1.15	0.08	0.05	34.30	0.00	82.30	0.00	72.70	
Average	0.19	#DIV/0!	60.99	9.63	11	2	360	7.90	360	2.53	0.04	0.08	0.05	1.23	#DIV/0!	2.94	#DIV/0!	2.60	
Min	0.12	0.000	45.25	3.98	7	1	360	7.80	360	2.53	0.00	0.08	0.05	0.80	0.00	2.30	0.00	2.00	
Max	0.26	0.000	105.86	13.16	17	3	360	8.00	360	2.53	0.19	0.08	0.05	2.80	0.00	3.50	0.00	2.90	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 4/06/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Dale Pershing

Month:	March
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
3/1/2021	0.200		60.00	10.00	12	2		7.90			0.00			0.70		3.00		2.80	
3/2/2021	0.237		63.29	8.44	15	2		7.90			0.00			1.00		3.40		2.00	
3/3/2021	0.152		59.21	6.58	9	1		7.90			0.00			0.90		3.00		3.00	
3/4/2021	0.156		57.69	6.41	9	1	360	7.80	340	2.70	0.04	0.07	0.05	0.90		2.80		2.60	
3/5/2021	0.183		65.57	5.46	12	1		7.90			0.00			1.00		3.30		2.10	
3/6/2021	0.222		63.06		14	0		7.90			0.00			1.00		3.40		1.80	
3/7/2021	0.161		49.69	12.42	8	2		7.90			0.03			1.00		3.10		2.70	
3/8/2021	0.186		69.89	10.75	13	2		7.90			0.07			0.90		2.90		2.90	
3/9/2021	0.181		60.77	11.05	11	2		7.90			0.00			1.00		3.20		2.70	
3/10/2021	0.211		71.09	9.48	15	2		7.80			0.02			0.80		3.10		2.10	
3/11/2021	0.153		58.82	13.07	9	2		7.80			0.00			1.00		2.60		2.80	
3/12/2021	0.158		63.29	12.66	10	2		7.70			0.00			1.20		3.20		2.60	
3/13/2021	0.258		46.51	7.75	12	2		7.70			0.11			1.10		2.80		2.60	
3/14/2021	0.101		128.71	19.80	13	2		7.80			0.03			1.10		3.60		2.90	
3/15/2021	0.235		59.57	8.51	14	2		7.80			0.02			0.90		2.70		1.60	
3/16/2021	0.171		64.33	11.70	11	2		7.80			0.01			1.00		2.50		2.60	
3/17/2021	0.153		78.43	13.07	12	2		7.80			0.00			1.00		2.90		2.50	
3/18/2021	0.234		64.10	8.55	15	2		7.80			0.00			1.00		3.10		1.40	
3/19/2021	0.150		46.67	13.33	7	2		7.80			0.00			1.10		2.60		2.50	
3/20/2021	0.153		71.90	13.07	11	2		7.90			0.01			0.90		3.00		2.50	
3/21/2021	0.165		72.73	12.12	12	2		7.90			0.00			1.00		3.50		2.50	
3/22/2021	0.227		66.08	4.41	15	1		7.70			0.00			0.80		3.60		2.10	
3/23/2021	0.237		59.07	8.44	14	2		7.70			0.01			0.80		3.00		1.90	
3/24/2021	0.146		68.49	6.85	10	1		7.70			0.02			0.90		3.00		2.70	
3/25/2021	0.159		56.60	6.29	9	1		7.70			0.05			0.80		3.00		2.70	
3/26/2021	0.189		63.49	10.58	12	2		7.70			0.01			0.80		3.00		2.80	
3/27/2021	0.195		56.41	10.26	11	2		7.70			0.00			0.80		3.60		2.60	
3/28/2021	0.220		63.64	9.09	14	2		7.70			0.01			0.80		3.40		2.40	
3/29/2021	0.169		71.01	5.92	12	1		7.70			0.03			0.90		3.10		2.20	
3/30/2021	0.225		62.22	8.89	14	2		7.70			0.03			0.90		3.50		2.20	
3/31/2021	0.164		73.17	6.10	12	1		7.70			0.02			0.80		3.30		2.90	
Total	5.75	0.000	2015.53	291.05	367	52	360	241.60	340	2.70	0.52	0.07	0.05	28.80	0.00	96.20	0.00	75.70	
Average	0.19	#DIV/0!	65.02	9.70	12	2	360	7.79	340	2.70	0.02	0.07	0.05	0.93	#DIV/0!	3.10	#DIV/0!	2.44	
Min	0.10	0.000	46.51	4.41	7	0	360	7.70	340	2.70	0.00	0.07	0.05	0.70	0.00	2.50	0.00	1.40	
Max	0.26	0.000	128.71	19.80	15	2	360	7.90	340	2.70	0.11	0.07	0.05	1.20	0.00	3.60	0.00	3.00	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 5/6/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Dale Pershing

Month:	April
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist Cl2 Free	Dist CL2 Total	Remarks
4/1/2021	0.177		67.80	5.65	12	1		7.70			0.00			0.90		3.10		2.80	
4/2/2021	0.197		65.99	10.15	13	2		7.80			0.00			0.70		3.00		2.30	
4/3/2021	0.214		60.75	9.35	13	2		7.90			0.00			0.90		3.10		1.90	
4/4/2021	0.216		64.81	13.89	14	3		7.90			0.00			0.90		2.80		2.40	
4/5/2021	0.163		61.35	6.13	10	1		7.80			0.10			1.00		3.50		2.80	
4/6/2021	0.217		69.12		15	0		7.70			0.00			1.00		3.10		2.80	
4/7/2021	0.232		73.28	8.62	17	2		7.70			0.00			0.90		3.70		2.50	
4/8/2021	0.253		59.29	7.91	15	2		7.70			0.00			0.90		3.70		1.90	
4/9/2021	0.244		77.87	8.20	19	2		7.70			0.00			0.90		3.50		2.80	
4/10/2021	0.181		55.25	11.05	10	2		7.70			0.10			0.90		3.20		2.90	
4/11/2021	0.168		65.48	11.90	11	2		7.70			0.00			1.00		3.00		2.80	
4/12/2021	0.253		75.10	7.91	19	2		7.70			0.00			0.90		3.70		2.80	
4/13/2021	0.267		63.67	7.49	17	2	360	7.70	360	2.60	0.00	0.06	0.05	0.80		3.50		2.89	
4/14/2021	0.198		60.61	10.10	12	2		7.70			0.00			1.00		3.40		2.90	
4/15/2021	0.200		60.00	10.00	12	2		7.70			0.00			0.90		3.20		2.90	
4/16/2021	0.212		61.32	9.43	13	2		7.80			0.10			0.90		3.20		2.80	
4/17/2021	0.207		67.63	9.66	14	2		7.80			0.10			1.40		3.00		2.50	
4/18/2021	0.248		60.48	8.06	15	2		7.70			0.00			0.90		2.70		2.50	
4/19/2021	0.273		65.93	7.33	18	2		7.80			0.20			0.90		3.20		2.80	
4/20/2021	0.232		47.41		11	0		7.80			0.20			1.00		2.10		2.90	
4/21/2021	0.194		67.01	10.31	13	2		7.80			0.10			1.00		3.70		2.50	
4/22/2021	0.242		70.25	8.26	17	2		7.80			0.00			0.90		3.80		2.00	
4/23/2021	0.148		54.05	6.76	8	1		7.80			0.00			0.90		3.00		2.70	
4/24/2021	0.171		52.63	11.70	9	2		7.70			0.00			0.90		3.20		2.70	
4/25/2021	0.227		74.89	4.41	17	1		7.70			0.00			1.00		3.30		2.30	
4/26/2021	0.214		65.42	9.35	14	2		7.70			0.00			1.00		3.30		2.70	
4/27/2021	0.242		61.98	8.26	15	2		7.70			0.00			0.90		3.70		3.00	
4/28/2021	0.203		64.04	9.85	13	2		7.70			0.00			1.10		3.70		2.30	
4/29/2021	0.234		68.38	8.55	16	2		7.70			0.00			1.00		3.70		2.30	
4/30/2021	0.194		61.86	10.31	12	2		7.70			0.00			0.80		3.50		3.20	
Total	6.42	0.000	1923.65	250.58	414	53	360	232.30	360	2.60	0.90	0.06	0.05	28.20	0.00	98.60	0.00	78.59	
Average	0.21	#DIV/0!	64.12	8.95	14	2	360	7.74	360	2.60	0.03	0.06	0.05	0.94	#DIV/0!	3.29	#DIV/0!	2.62	
Min	0.15	0.000	47.41	4.41	8	0	360	7.70	360	2.60	0.00	0.06	0.05	0.70	0.00	2.10	0.00	1.90	
Max	0.27	0.000	77.87	13.89	19	3	360	7.90	360	2.60	0.20	0.06	0.05	1.40	0.00	3.80	0.00	3.20	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Operator Signature: _____ Date: 6/08/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

Indiana American Water

IDEM Field Rep: Dale Pershing

Sheridan-Plant
PWS-ID:5229014

Month:	May
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
5/1/2021	0.163		49.08	12.27	8	2		7.80			0.00			0.84		2.82		2.49	
5/2/2021	0.210		61.90	9.52	13	2		7.80			0.00			0.84		2.82		2.18	
5/3/2021	0.232		60.34	4.31	14	1		7.70			0.03			0.99		3.02		2.67	
5/4/2021	0.261		76.63	7.66	20	2		7.80			0.04			0.98		3.36		1.82	
5/5/2021	0.138		57.97	7.25	8	1		7.70			0.02			0.97		3.27		2.45	
5/6/2021	0.209		66.99	9.57	14	2		7.70			0.07			0.90		3.55		2.58	
5/7/2021	0.156		57.69	6.41	9	1		7.70			0.03			0.98		3.49		2.34	
5/8/2021	0.274		65.69	7.30	18	2		7.80			0.03			0.98		3.39		2.87	
5/9/2021	0.203		59.11	9.85	12	2		7.70			0.01			1.10		3.33		2.29	
5/10/2021	0.406		64.04	4.93	26	2		7.70			0.05			0.96		3.74		2.85	
5/11/2021	0.157		70.06	12.74	11	2	320	7.60	308	2.55	0.00	0.08	0.06	1.04		3.56		0.97	
5/12/2021	0.331		60.42	6.04	20	2		7.70			0.02			1.48		3.20		2.76	
5/13/2021	0.313		47.92	6.39	15	2		7.60			0.00			2.00		3.10		2.31	
5/14/2021	0.151		59.60	6.62	9	1		7.70			0.02			1.03		2.67		0.87	
5/15/2021	0.182		65.93	10.99	12	2		7.80			0.00			0.93		2.63		1.17	
5/16/2021	0.179		67.04	11.17	12	2		7.80			0.02			1.05		3.03		2.44	
5/17/2021	0.222		58.56		13	0		7.60			0.04			1.03		2.68		1.01	
5/18/2021	0.233		64.38	8.58	15	2		7.60			0.05			1.07		2.72		2.58	
5/19/2021	0.166		90.36	12.05	15	2		7.70			0.00			1.56		2.32		1.84	
5/20/2021	0.182		65.93	10.99	12	2		7.60			0.04			0.83		2.80		0.50	
5/21/2021	0.240		66.67	8.33	16	2		7.60			0.00			0.70		2.90		2.30	
5/22/2021	0.209		47.85		10	0		7.60			0.04			0.90		2.78		1.59	
5/23/2021	0.265		83.02	7.55	22	2		7.60			0.02			0.97		2.74		2.38	
5/24/2021	0.174		63.22		11	0		7.70			0.04			1.02		2.68		1.68	
5/25/2021	0.246		60.98	8.13	15	2		7.60			0.00			0.80		2.78		1.58	
5/26/2021	0.408		58.82	7.35	24	3		7.60			0.00			1.01		2.79		2.08	
5/27/2021	0.242		61.98	8.26	15	2		7.60			0.07			0.96		3.28		1.88	
5/28/2021	0.199		60.30	10.05	12	2		7.80			0.00			0.89		3.29		2.21	
5/29/2021	0.203		59.11	4.93	12	1		7.70			0.00			0.87		3.51		2.39	
5/30/2021	0.193		51.81	5.18	10	1		7.70			0.00			0.68		2.99		2.33	
5/31/2021	0.329		63.83	9.12	21	3		7.60			0.07			0.96		2.83		2.00	
Total	7.08	0.000	1947.26	233.55	444	52	320	238.20	308	2.55	0.71	0.08	0.06	31.32	0.00	94.07	0.00	63.41	
Average	0.23	#DIV/0!	62.81	8.34	14	2	320	7.68	308	2.55	0.02	0.08	0.06	1.01	#DIV/0!	3.03	#DIV/0!	2.05	
Min	0.14	0.000	47.85	4.31	8	0	320	7.60	308	2.55	0.00	0.08	0.06	0.68	0.00	2.32	0.00	0.50	
Max	0.41	0.000	90.36	12.74	26	3	320	7.80	308	2.55	0.07	0.08	0.06	2.00	0.00	3.74	0.00	2.87	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 7/02/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	June
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
6/1/2021	0.139		57.55	7.19	8	1		7.80			0.00			1.24		3.13		2.81	
6/2/2021	0.196		71.43	10.20	14	2		7.70			0.00			0.83		3.27		2.65	
6/3/2021	0.237		63.29	8.44	15	2		7.90			0.00			0.63		3.45		2.49	
6/4/2021	0.309		55.02	9.71	17	3		7.90			0.00			0.66		3.12		2.55	
6/5/2021	0.253		71.15	7.91	18	2		7.80			0.01			0.70		2.87		2.29	
6/6/2021	0.216		60.19	4.63	13	1		7.70			0.00			0.60		2.46		2.01	
6/7/2021	0.233		72.96	8.58	17	2		7.20			0.00			0.90		3.15		1.33	
6/8/2021	0.204		53.92	9.80	11	2		7.70			0.10			0.74		3.18		1.39	
6/9/2021	0.266		67.67	7.52	18	2		7.60			0.01			0.85		3.07		1.92	
6/10/2021	0.166		72.29		12	0	360	7.30	240	2.14	0.06	0.06	0.05	0.79		3.31		1.54	
6/11/2021	0.241		78.84	8.30	19	2		7.30			0.00			0.87		3.07		1.58	
6/12/2021	0.277		57.76	10.83	16	3		7.30			0.03			0.76		3.05		1.59	
6/13/2021	0.168		65.48		11	0		7.10			0.03			0.91		2.97		1.79	
6/14/2021	0.252		59.52	11.90	15	3		7.90			0.00			0.76		3.21		2.79	
6/15/2021	0.254		59.06	7.87	15	2		7.80			0.00			0.63		3.47		2.68	
6/16/2021	0.236		63.56	8.47	15	2		7.80			0.00			0.88		3.30		2.57	
6/17/2021	0.256		54.69	7.81	14	2		7.80			0.02			0.93		3.60		2.14	
6/18/2021	0.215		97.67	9.30	21	2		7.70			0.00			0.73		3.05		1.63	
6/19/2021	0.230		34.78	8.70	8	2		7.80			0.05			0.71		2.91		2.33	
6/20/2021	0.204		49.02	9.80	10	2		7.90			0.00			0.66		2.82		3.01	
6/21/2021	0.301		66.45	6.64	20	2		7.70			0.00			1.35		2.40		1.59	
6/22/2021	0.237		59.07	8.44	14	2		7.50			0.00			0.78		2.77		1.54	
6/23/2021	0.192		57.29	10.42	11	2		7.50			0.05			0.82		2.68		1.19	
6/24/2021	0.242		53.72	8.26	13	2		7.50			0.00			1.19		2.14		1.64	
6/25/2021	0.271		62.73	7.38	17	2		7.60			0.00			0.74		2.99		1.27	
6/26/2021	0.154		64.94	12.99	10	2		7.50			0.01			0.51		3.34		1.63	
6/27/2021	0.214		46.73	9.35	10	2		7.80			0.01			0.75		2.56		2.16	
6/28/2021	0.211		71.09	9.48	15	2		7.80			0.03			0.70		3.68		2.16	
6/29/2021	0.240		41.67	8.33	10	2		7.60			0.03			0.79		2.88		1.12	
6/30/2021	0.254		59.06	7.87	15	2		7.60			0.05			0.74		2.89		1.42	
Total	6.87	0.000	1848.58	246.15	422	57	360	229.10	240	2.14	0.49	0.06	0.05	24.15	0.00	90.79	0.00	58.81	
Average	0.23	#DIV/0!	61.62	8.79	14	2	360	7.64	240	2.14	0.02	0.06	0.05	0.81	#DIV/0!	3.03	#DIV/0!	1.96	
Min	0.14	0.000	34.78	4.63	8	0	360	7.10	240	2.14	0.00	0.06	0.05	0.51	0.00	2.14	0.00	1.12	
Max	0.31	0.000	97.67	12.99	21	3	360	7.90	240	2.14	0.10	0.06	0.05	1.35	0.00	3.68	0.00	3.01	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 8/9/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	July
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
7/1/2021	0.181		27.62	11.05	5	2	242	7.70	296	2.47	0.00	0.06	0.03	0.77		2.56		1.72	
7/2/2021	0.169		59.17	11.83	10	2		7.60			0.00			0.90		3.12		0.96	
7/3/2021	0.192		57.29	10.42	11	2		7.70			0.01			0.94		2.86		2.31	
7/4/2021	0.210		66.67	14.29	14	3		7.60			0.02			0.70		3.40		1.99	
7/5/2021	0.213		56.34	4.69	12	1		7.60			0.03			0.65		3.25		2.16	
7/6/2021	0.275		61.82	7.27	17	2		7.60			0.00			0.71		3.16		1.19	
7/7/2021	0.230		60.87	8.70	14	2		7.60			0.00			0.70		3.24		2.13	
7/8/2021	0.259		61.78	7.72	16	2		7.70			0.04			0.82		2.98		1.26	
7/9/2021	0.233		60.09	8.58	14	2		7.50			0.06			1.09		2.39		0.79	
7/10/2021	0.174		68.97	11.49	12	2		7.60			0.02			0.72		3.21		2.34	
7/11/2021	0.200		65.00	10.00	13	2		7.80			0.03			0.70		3.55		2.15	
7/12/2021	0.277		68.59	7.22	19	2		7.70			0.00			0.76		3.01		1.70	
7/13/2021	0.228		61.40	8.77	14	2		7.60			0.00			0.86		3.15		1.42	
7/14/2021	0.149		67.11	13.42	10	2		7.60			0.03			0.76		2.33		1.37	
7/15/2021	0.239		71.13	8.37	17	2		7.60			0.00			1.50		3.15		0.85	
7/16/2021	0.192		52.08	15.63	10	3		7.70			0.06			0.71		3.80		1.86	
7/17/2021	0.242		70.25	8.26	17	2		7.70			0.03			1.02		2.88		1.56	
7/18/2021	0.271		36.90		10	0		7.60			0.00			0.69		2.86		1.58	
7/19/2021	0.258		65.89	7.75	17	2		7.70			0.04			1.01		2.68		0.98	
7/20/2021	0.209		81.34	9.57	17	2		7.70			0.00			0.97		3.21		1.59	
7/21/2021	0.221		67.87	9.05	15	2		7.70			0.01			0.98		3.04		1.26	
7/22/2021	0.169		53.25	11.83	9	2		7.70			0.06			0.71		3.09		2.27	
7/23/2021	0.208		57.69	9.62	12	2		7.70			0.03			0.72		2.44		2.28	
7/24/2021	0.308		58.44	9.74	18	3		7.80			0.02			0.81		3.54		1.94	
7/25/2021	0.207		57.97	9.66	12	2		7.60			0.03			1.04		2.99		2.46	
7/26/2021	0.277		61.37	7.22	17	2		7.70			0.00			0.66		3.13		1.94	
7/27/2021	0.223		58.30	8.97	13	2		7.60			0.02			1.31		2.64		1.64	
7/28/2021	0.343		64.14	5.83	22	2		7.70			0.00			0.60		3.19		1.86	
7/29/2021	0.152		52.63	13.16	8	2		7.70			0.00			0.95		3.19		1.57	
7/30/2021	0.341		64.52	5.87	22	2		7.60			0.00			0.70		3.00		1.60	
7/31/2021	0.164		42.68	12.20	7	2		7.70			0.00			0.80		2.30		1.30	
Total	7.01	0.000	1859.18	288.18	424	62	242	237.40	296	2.47	0.54	0.06	0.03	26.26	0.00	93.34	0.00	52.03	
Average	0.23	#DIV/0!	59.97	9.61	14	2	242	7.66	296	2.47	0.02	0.06	0.03	0.85	#DIV/0!	3.01	#DIV/0!	1.68	
Min	0.15	0.000	27.62	4.69	5	0	242	7.50	296	2.47	0.00	0.06	0.03	0.60	0.00	2.30	0.00	0.79	
Max	0.34	0.000	81.34	15.63	22	3	242	7.80	296	2.47	0.06	0.06	0.03	1.50	0.00	3.80	0.00	2.46	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 9/08/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	August
Year	2021
Leap Year?	No

	Chemicals (LBS/MG)				Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
8/1/2021	0.260		69.23	7.69	18	2		7.60			0.00			0.71		3.19		1.27	
8/2/2021	0.244		45.08	8.20	11	2		7.60			0.00			0.74		3.17		1.34	
8/3/2021	0.254		59.06	11.81	15	3		7.70			0.00			0.75		3.10		1.32	
8/4/2021	0.282		53.19	10.64	15	3	280	7.70	300	2.57	0.03	0.07	0.05	0.79		3.03		1.29	
8/5/2021	0.206		58.25	9.71	12	2		7.70			0.00			0.93		2.36		1.31	
8/6/2021	0.293		58.02	10.24	17	3		7.70			0.04			0.93		3.07		1.56	
8/7/2021	0.221		54.30	9.05	12	2		7.60			0.05			0.80		3.01		2.23	
8/8/2021	0.283		53.00	10.60	15	3		7.70			0.01			0.93		2.95		2.08	
8/9/2021	0.252		75.40	11.90	19	3		7.60			0.05			0.74		3.13		2.03	
8/10/2021	0.304		36.18	6.58	11	2		7.60			0.04			0.72		2.95		1.70	
8/11/2021	0.277		61.37	10.83	17	3		7.60			0.00			0.83		3.02		2.04	
8/12/2021	0.250		52.00	12.00	13	3		7.70			0.00			1.30		3.06		2.60	
8/13/2021	0.284		52.82	10.56	15	3		7.70			0.02			1.03		2.96		3.32	
8/14/2021	0.316		34.81	6.33	11	2		7.60			0.00			0.83		3.01		3.50	
8/15/2021	0.133		120.30	22.56	16	3		7.70			0.00			0.84		2.97		2.10	
8/16/2021	0.257		50.58	11.67	13	3		7.60			0.00			1.26		2.94		2.24	
8/17/2021	0.281		56.94	7.12	16	2		7.70			0.02			0.84		3.13		2.40	
8/18/2021	0.215		69.77	13.95	15	3		7.60			0.00			0.86		3.05		1.74	
8/19/2021	0.210		47.62	14.29	10	3		7.60			0.00			0.90		3.13		2.90	
8/20/2021	0.289		44.98	10.38	13	3		7.60			0.02			0.74		3.02		1.94	
8/21/2021	0.178		56.18	11.24	10	2		7.60			0.02			1.50		2.63		1.55	
8/22/2021	0.215		69.77	9.30	15	2		7.50			0.00			0.93		2.99		1.81	
8/23/2021	0.294		54.42	10.20	16	3		7.60			0.03			0.75		2.96		2.05	
8/24/2021	0.243		49.38	12.35	12	3		7.60			0.00			1.22		2.90		1.80	
8/25/2021	0.252		63.49	11.90	16	3		7.60			0.04			0.75		2.99		1.88	
8/26/2021	0.206		58.25	14.56	12	3		7.80			0.05			0.80		2.83		1.72	
8/27/2021	0.303		49.50	9.90	15	3		7.80			0.01			0.80		2.54		1.56	
8/28/2021	0.145		62.07	13.79	9	2		7.60			0.00			0.85		1.68		1.40	
8/29/2021	0.244		61.48	12.30	15	3		7.60			0.02			1.13		2.73		2.01	
8/30/2021	0.169		53.25	11.83	9	2		7.50			0.05			0.86		2.56		2.70	
8/31/2021	0.318		62.89	9.43	20	3		7.60			0.00			1.09		2.47		2.95	
Total	7.68	0.000	1793.60	342.92	433	82	280	236.70	300	2.57	0.50	0.07	0.05	28.15	0.00	89.53	0.00	62.34	
Average	0.25	#DIV/0!	57.86	11.06	14	3	280	7.64	300	2.57	0.02	0.07	0.05	0.91	#DIV/0!	2.89	#DIV/0!	2.01	
Min	0.13	0.000	34.81	6.33	9	2	280	7.50	300	2.57	0.00	0.07	0.05	0.71	0.00	1.68	0.00	1.27	
Max	0.32	0.000	120.30	22.56	20	3	280	7.80	300	2.57	0.05	0.07	0.05	1.50	0.00	3.19	0.00	3.50	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: [signature] Date: 10/05/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	September
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)			Physical and Chemical Data (mg/L)							Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
9/1/2021	0.159		56.60	12.58	9	2		7.60		2.66	0.00	0.14	0.07	0.76		2.78		2.90	
9/2/2021	0.196		56.12	10.20	11	2		7.60			0.02			1.07		1.60		2.82	
9/3/2021	0.278		68.35	10.79	19	3		7.60			0.02			1.15		3.06		1.50	
9/4/2021	0.210		57.14	14.29	12	3		7.60			0.00			0.84		2.77		1.50	
9/5/2021	0.164		60.98	12.20	10	2		7.70			0.02			0.75		2.52		2.50	
9/6/2021	0.242		61.98	12.40	15	3		7.60			0.00			0.80		2.64		1.80	
9/7/2021	0.226		57.52	8.85	13	2		7.60			0.00			1.20		2.67		1.27	
9/8/2021	0.279		60.93	10.75	17	3		7.50			0.00			0.89		2.79		1.58	
9/9/2021	0.202		59.41	14.85	12	3		7.50			0.00			1.25		1.91		1.28	
9/10/2021	0.321		56.07	9.35	18	3	280	7.60	240		0.02			0.95		2.46		2.50	
9/11/2021	0.210		71.43	9.52	15	2		7.50			0.00			0.97		1.70		2.24	
9/12/2021	0.246		52.85	12.20	13	3		7.70			0.02			1.80		2.67		1.74	
9/13/2021	0.188		69.15	10.64	13	2		7.50			0.04			1.54		2.69		1.19	
9/14/2021	0.242		53.72	8.26	13	2		7.50			0.04			0.89		2.37		0.98	
9/15/2021	0.292		54.79	10.27	16	3		7.60			0.00			1.04		2.42		1.76	
9/16/2021	0.195		61.54	15.38	12	3		7.60			0.02			0.87		2.56		1.78	
9/17/2021	0.270		59.26	11.11	16	3		7.70			0.01			0.81		2.91		1.50	
9/18/2021	0.204		53.92	9.80	11	2		7.80			0.02			0.97		2.57		1.72	
9/19/2021	0.204		53.92	9.80	11	2		7.60			0.00			0.91		2.33		1.80	
9/20/2021	0.263		60.84	11.41	16	3		7.50			0.04			0.84		1.98		1.11	
9/21/2021	0.219		59.36	13.70	13	3		7.50			0.00			0.80		2.55		1.04	
9/22/2021	0.275		58.18	7.27	16	2		7.50			0.01			0.90		2.54		1.10	
9/23/2021	0.182		60.44	10.99	11	2		7.50			0.01			0.78		2.38		0.94	
9/24/2021	0.231		56.28	12.99	13	3		7.50			0.01			0.82		2.36		0.72	
9/25/2021	0.221		76.92	9.05	17	2		7.50			0.00			0.77		2.36		0.86	
9/26/2021	0.228		65.79	13.16	15	3		7.50			0.01			0.70		2.27		1.26	
9/27/2021	0.248		60.48	8.06	15	2		7.40			0.04			0.84		2.36		0.74	
9/28/2021	0.212		70.75	9.43	15	2		7.50			0.01			0.72		1.96		0.62	
9/29/2021	0.212		99.06	14.15	21	3		7.50			0.03			0.70		2.56		0.94	
9/30/2021	0.194		67.01	10.31	13	2		7.50			0.02			0.77		2.09		1.17	
Total	6.81	0.000	1860.80	333.77	421	75	280	226.80	240	2.66	0.41	0.14	0.07	28.10	0.00	72.83	0.00	44.86	
Average	0.23	#DIV/0!	62.03	11.13	14	3	280	7.56	240	2.66	0.01	0.14	0.07	0.94	#DIV/0!	2.43	#DIV/0!	1.50	
Min	0.16	0.000	52.85	7.27	9	2	280	7.40	240	2.66	0.00	0.14	0.07	0.70	0.00	1.60	0.00	0.62	
Max	0.32	0.000	99.06	15.38	21	3	280	7.80	240	2.66	0.04	0.14	0.07	1.80	0.00	3.06	0.00	2.90	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 11/04/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	October
Year	2021
Leap Year?	No

	Chemicals (LBS/MG)				Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
10/1/2021	0.236		84.75	8.47	20	2		7.40			0.04			0.74		2.55		0.75	
10/2/2021	0.173		57.80	11.56	10	2		7.50			0.00			0.76		2.26		1.56	
10/3/2021	0.229		91.70	8.73	21	2		7.60			0.03			1.10		3.05		1.55	
10/4/2021	0.236		55.08	12.71	13	3		7.50			0.00			0.71		2.52		1.24	
10/5/2021	0.272		80.88	11.03	22	3		7.50			0.01			0.75		2.48		1.06	
10/6/2021	0.157		63.69	12.74	10	2		7.40			0.00			1.03		2.35		1.04	
10/7/2021	0.252		79.37	7.94	20	2		7.50			0.00			0.76		2.58		1.07	
10/8/2021	0.251		83.67	11.95	21	3		7.50			0.00			0.88		2.77		1.14	
10/9/2021	0.297		57.24	6.73	17	2		7.50			0.00			0.73		2.65		0.94	
10/10/2021	0.262		72.52	11.45	19	3		7.40			0.00			0.87		2.43		1.32	
10/11/2021	0.180		55.56	11.11	10	2		7.40			0.02			0.89		1.82		0.92	
10/12/2021	0.290		68.97	10.34	20	3		7.40			0.02			0.90		1.79		0.88	
10/13/2021	0.212		66.04	9.43	14	2		7.40			0.00			0.87		3.04		1.29	
10/14/2021	0.188		63.83	10.64	12	2	260	7.40	300	2.60	0.00	0.07	0.04	0.94		2.54		1.14	
10/15/2021	0.208		76.92	14.42	16	3		7.40			0.02			0.89		2.75		1.21	
10/16/2021	0.212		70.75	9.43	15	2		7.40			0.00			1.12		2.96		1.38	
10/17/2021	0.154		51.95	12.99	8	2		7.50			0.00			0.87		2.02		1.50	
10/18/2021	0.263		72.24	11.41	19	3		7.40			0.00			0.94		2.38		1.12	
10/19/2021	0.217		73.73	9.22	16	2		7.50			0.03			1.00		2.87		1.04	
10/20/2021	0.221		63.35	9.05	14	2		7.50			0.00			0.85		2.57		1.23	
10/21/2021	0.208		91.35	9.62	19	2	280	7.40			0.00			0.92		2.60		1.40	
10/22/2021	0.163		79.75	18.40	13	3		7.40			0.03			0.82		2.06		1.37	
10/23/2021	0.236		76.27	8.47	18	2		7.60			0.01			0.92		2.52		2.55	
10/24/2021	0.245		77.55	12.24	19	3		7.40			0.02			0.98		1.96		1.29	
10/25/2021	0.151		59.60	13.25	9	2		7.60			0.03			1.09		1.89		1.60	
10/26/2021	0.247		76.92	8.10	19	2		7.50			0.01			0.93		2.64		1.18	
10/27/2021	0.210		76.19	14.29	16	3		7.50			0.00			0.89		2.56		1.24	
10/28/2021	0.177		84.75	11.30	15	2		7.40			0.03			0.70		2.48		1.32	
10/29/2021	0.183		65.57	10.93	12	2		7.40			0.02			0.81		1.99		1.14	
10/30/2021	0.261		80.46	11.49	21	3		7.40			0.02			0.90		2.18		0.80	
10/31/2021	0.174		63.22	11.49	11	2		7.50			0.01			0.98		1.88		0.72	
Total	6.77	0.000	2221.68	340.95	489	73	540	231.20	300	2.60	0.35	0.07	0.04	27.54	0.00	75.14	0.00	37.99	
Average	0.22	#DIV/0!	71.67	11.00	16	2	270	7.46	300	2.60	0.01	0.07	0.04	0.89	#DIV/0!	2.42	#DIV/0!	1.23	
Min	0.15	0.000	51.95	6.73	8	2	260	7.40	300	2.60	0.00	0.07	0.04	0.70	0.00	1.79	0.00	0.72	
Max	0.30	0.000	91.70	18.40	22	3	280	7.60	300	2.60	0.04	0.07	0.04	1.12	0.00	3.05	0.00	2.55	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: R Smith Date: 12/08/2021

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	November
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
11/1/2021	0.206		67.96	14.56	14	3		7.50			0.01			0.83		2.05		1.19	
11/2/2021	0.244		73.77	8.20	18	2		7.50			0.03			0.94		2.18		1.32	
11/3/2021	0.179		72.63	16.76	13	3		7.40			0.02			0.87		2.45		1.18	
11/4/2021	0.194		72.16	10.31	14	2	300	7.50	340	2.55	0.01	0.11	0.04	0.81		2.42		1.32	
11/5/2021	0.219		77.63	9.13	17	2		7.40			0.01			0.79		2.34		1.44	
11/6/2021	0.199		75.38	10.05	15	2		7.80			0.01			0.86		2.20		0.80	
11/7/2021	0.156		70.51	12.82	11	2		7.90			0.07			1.30		1.50		1.40	
11/8/2021	0.214		65.42	9.35	14	2		7.40			0.03			0.73		2.32		1.23	
11/9/2021	0.216		69.44	9.26	15	2		7.40			0.02			0.75		2.18		1.34	
11/10/2021	0.221		67.87	9.05	15	2		7.50			0.02			0.89		1.96		1.20	
11/11/2021	0.226		75.22	13.27	17	3		7.50			0.04			0.84		1.92		1.46	
11/12/2021	0.177		62.15	11.30	11	2		7.40			0.03			0.69		2.62		1.12	
11/13/2021	0.218		73.39	9.17	16	2		7.50			0.03			0.84		2.34		0.94	
11/14/2021	0.227		74.89	13.22	17	3		7.50			0.01			0.77		2.32		1.04	
11/15/2021	0.189		63.49	10.58	12	2		7.40			0.03			0.83		2.42		1.14	
11/16/2021	0.260		65.38	7.69	17	2		7.50			0.01			0.77		2.38		0.96	
11/17/2021	0.202		84.16	14.85	17	3		7.40			0.03			0.91		2.26		1.72	
11/18/2021	0.236		63.56	8.47	15	2	320	7.40			0.02			0.85		2.03		1.09	
11/19/2021	0.181		77.35	11.05	14	2		7.50			0.00			0.88		2.41		2.00	
11/20/2021	0.195		71.79	10.26	14	2		7.70			0.00			0.70		2.08		1.56	
11/21/2021	0.158		75.95	12.66	12	2		7.70			0.03			0.64		1.74		1.45	
11/22/2021	0.212		75.47	9.43	16	2		7.50			0.00			0.80		2.75		1.10	
11/23/2021	0.217		78.34	13.82	17	3		7.50			0.00			0.84		3.04		0.94	
11/24/2021	0.209		86.12	9.57	18	2		7.40			0.03			0.85		2.62		0.84	
11/25/2021	0.188		85.11	10.64	16	2		7.50			0.00			0.84		3.00		0.76	
11/26/2021	0.205		82.93	14.63	17	3		7.50			0.00			0.86		2.56		1.10	
11/27/2021	0.207		77.29	9.66	16	2		7.50			0.00			0.78		2.63		0.84	
11/28/2021	0.159		75.47	12.58	12	2		7.50			0.01			0.86		2.32		0.91	
11/29/2021	0.170		76.47	11.76	13	2		7.40			0.02			0.83		2.00		0.89	
11/30/2021	0.238		84.03	8.40	20	2		7.50			0.00			0.79		2.18		0.92	
Total	6.12	0.000	2221.36	332.52	453	67	620	225.10	340	2.55	0.52	0.11	0.04	24.94	0.00	69.22	0.00	35.20	
Average	0.20	#DIV/0!	74.05	11.08	15	2	310	7.50	340	2.55	0.02	0.11	0.04	0.83	#DIV/0!	2.31	#DIV/0!	1.17	
Min	0.16	0.000	62.15	7.69	11	2	300	7.40	340	2.55	0.00	0.11	0.04	0.64	0.00	1.50	0.00	0.76	
Max	0.26	0.000	86.12	16.76	20	3	320	7.90	340	2.55	0.07	0.11	0.04	1.30	0.00	3.04	0.00	2.00	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 1/06/2022

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	December
Year	2021
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
12/1/2021	0.196		81.63	10.20	16	2		7.50		2.54	0.04	0.06	0.04	0.86		1.74		0.88	
12/2/2021	0.251		63.75	11.95	16	3	320	7.40	340		0.00			0.78		1.68		0.82	
12/3/2021	0.203		73.89	9.85	15	2		7.60			0.03			0.82		1.15		0.96	
12/4/2021	0.142		70.42	14.08	10	2		7.80			0.00			0.70		0.70		0.67	
12/5/2021	0.163		67.48	12.27	11	2		7.30			0.01			0.79		1.01		0.51	
12/6/2021	0.216		97.22	13.89	21	3		7.40			0.00			0.76		1.98		0.57	
12/7/2021	0.216		87.96	9.26	19	2		7.40			0.00			0.89		2.26		0.59	
12/8/2021	0.207		91.79	9.66	19	2		7.60			0.02			0.79		2.10		0.52	
12/9/2021	0.298		67.11	6.71	20	2		7.50			0.02			0.82		2.76		1.65	
12/10/2021	0.214		116.82	9.35	25	2		7.50			0.01			0.94		2.88		0.82	
12/11/2021	0.169		88.76	11.83	15	2		7.30			0.02			0.82		2.96		1.14	
12/12/2021	0.231		90.91	8.66	21	2		7.30			0.00			0.75		3.24		0.81	
12/13/2021	0.163		92.02	12.27	15	2		7.40			0.01			0.71		2.55		1.71	
12/14/2021	0.236		84.75	8.47	20	2		7.50			0.00			0.80		2.32		1.14	
12/15/2021	0.219		82.19	13.70	18	3		7.40			0.03			0.86		2.05		1.09	
12/16/2021	0.164		79.27	12.20	13	2		7.40			0.00			0.75		2.00		1.11	
12/17/2021	0.236		80.51	8.47	19	2		7.50			0.05			0.60		1.93		0.83	
12/18/2021	0.138		86.96	14.49	12	2		7.50			0.00			0.74		1.25		0.62	
12/19/2021	0.162		80.25	12.35	13	2		7.70			0.00			0.60		1.40		0.50	
12/20/2021	0.218		87.16	13.76	19	3		7.60			0.04			0.61		1.94		1.70	
12/21/2021	0.296		77.70	6.76	23	2	300	7.40			0.00			0.84		2.32		1.26	
12/22/2021	0.244		73.77	8.20	18	2		7.50			0.00			0.62		1.63		0.86	
12/23/2021	0.157		82.80	12.74	13	2		7.40			0.01			0.88		2.72		1.70	
12/24/2021	0.149		87.25	13.42	13	2		7.40			0.00			0.94		2.06		1.23	
12/25/2021	0.297		87.54	10.10	26	3		7.50			0.01			0.97		2.21		0.94	
12/26/2021	0.163		104.29	12.27	17	2		7.50			0.00			0.94		2.91		1.34	
12/27/2021	0.140		71.43	14.29	10	2		7.40			0.00			0.92		2.41		1.06	
12/28/2021	0.169		82.84	11.83	14	2		7.40			0.03			1.00		2.86		1.23	
12/29/2021	0.207		86.96	14.49	18	3		7.40			0.00			0.88		2.71		1.04	
12/30/2021	0.220		86.36	13.64	19	3		7.40			0.01			0.84		1.96		0.97	
12/31/2021	0.160		125.00	12.50	20	2		7.40			0.00			0.88		2.80		1.14	
Total	6.24	0.000	2636.80	353.67	528	69	620	231.30	340	2.54	0.34	0.06	0.04	25.10	0.00	66.49	0.00	31.41	
Average	0.20	#DIV/0!	85.06	11.41	17	2	310	7.46	340	2.54	0.01	0.06	0.04	0.81	#DIV/0!	2.14	#DIV/0!	1.01	
Min	0.14	0.000	63.75	6.71	10	2	300	7.30	340	2.54	0.00	0.06	0.04	0.60	0.00	0.70	0.00	0.50	
Max	0.30	0.000	125.00	14.49	26	3	320	7.80	340	2.54	0.05	0.06	0.04	1.00	0.00	3.24	0.00	1.71	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 2/02/2022

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	January
Year	2022
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Total Cl2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff Cl2 Free	Eff Cl2 Total	Dist Cl2 Free	Dist Cl2 Total	Remarks
1/1/2022	0.202		39.60	9.90	8	2		7.90		2.39	0.03			0.75		1.20		1.40	
1/2/2022	0.171		87.72	11.70	15	2		7.60			0.04			0.70		1.13		0.62	
1/3/2022	0.257		89.49	7.78	23	2		7.50			0.04			1.06		2.96		1.32	
1/4/2022	0.224		80.36	8.93	18	2		7.60			0.03			0.87		2.79		0.80	
1/5/2022	0.177		107.34	16.95	19	3		7.50			0.01			0.85		2.12		0.79	
1/6/2022	0.176		107.95	11.36	19	2		7.50			0.03			0.89		2.02		1.34	
1/7/2022	0.233		94.42	8.58	22	2	320	7.40	320		0.01	0.05	0.02	0.79		1.96		1.24	
1/8/2022	0.243		74.07	8.23	18	2		7.50			0.00			0.94		2.53		1.42	
1/9/2022	0.158		107.59	12.66	17	2		7.40			0.01			0.82		2.01		0.94	
1/10/2022	0.241		74.69	12.45	18	3		7.50			0.03			0.86		2.17		0.64	
1/11/2022	0.220		72.73	9.09	16	2		7.40			0.02			0.93		1.32		0.91	
1/12/2022	0.266		78.95	7.52	21	2		7.50			0.02			0.81		2.20		1.04	
1/13/2022	0.222		72.07	13.51	16	3		7.40			0.00			0.85		2.21		0.94	
1/14/2022	0.242		74.38	8.26	18	2		7.50			0.02			0.91		2.14		1.04	
1/15/2022	0.146		61.64	13.70	9	2		7.30			0.04			0.78		1.69		1.02	
1/16/2022	0.235		51.06	8.51	12	2		7.40			0.02			0.82		1.90		0.88	
1/17/2022	0.156		70.51	19.23	11	3		7.50			0.04			0.78		1.33		0.91	
1/18/2022	0.250		56.00	8.00	14	2		7.40			0.03			0.73		0.60		0.51	
1/19/2022	0.206		63.11	14.56	13	3		7.40			0.06			0.70		1.90		0.91	
1/20/2022	0.230		78.26	8.70	18	2		7.30			0.03			0.68		1.24		0.98	
1/21/2022	0.202		89.11	14.85	18	3		7.10			0.03			0.68		1.98		1.08	
1/22/2022	0.151		86.09	13.25	13	2		7.50			0.00			0.76		2.22		0.94	
1/23/2022	0.211		90.05	9.48	19	2		7.30			0.04			0.95		2.62		1.22	
1/24/2022	0.234		89.74	8.55	21	2		7.40			0.05			0.71		2.80		1.76	
1/25/2022	0.219		105.02	13.70	23	3	300	7.30			0.01			0.97		2.62		1.59	
1/26/2022	0.276		108.70	10.87	30	3		7.40			0.04			0.82		3.13		2.35	
1/27/2022	0.197		101.52	10.15	20	2		7.40			0.00			0.88		3.70		1.72	
1/28/2022	0.240		79.17	8.33	19	2		7.50			0.00			0.94		3.03		2.03	
1/29/2022	0.219		82.19	13.70	18	3		7.40			0.04			0.86		3.29		2.11	
1/30/2022	0.186		102.15	10.75	19	2		7.50			0.02			0.91		3.10		1.82	
1/31/2022	0.249		84.34	12.05	21	3		7.40			0.00			0.93		3.37		1.91	
Total	6.64	0.000	2560.05	345.30	546	72	620	230.70	320	2.39	0.74	0.05	0.02	25.93	0.00	69.28	0.00	38.18	
Average	0.21	#DIV/0!	82.58	11.14	18	2	310	7.44	320	2.39	0.02	0.05	0.02	0.84	#DIV/0!	2.23	#DIV/0!	1.23	
Min	0.15	0.000	39.60	7.52	8	2	300	7.10	320	2.39	0.00	0.05	0.02	0.68	0.00	0.60	0.00	0.51	
Max	0.28	0.000	108.70	19.23	30	3	320	7.90	320	2.39	0.06	0.05	0.02	1.06	0.00	3.70	0.00	2.35	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 3/02/2022

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	February
Year	2022
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
2/1/2022	0.275		83.64	10.91	23	3		7.30			0.01			0.81		3.02		1.83	
2/2/2022	0.151		86.09	13.25	13	2	300	7.30	340	2.50	0.03	0.15	0.04	0.72		2.93		1.75	
2/3/2022	0.225		80.00	8.89	18	2		7.40			0.00			0.80		2.83		1.69	
2/4/2022	0.188		90.43	10.64	17	2		7.40			0.01			0.79		2.39		1.84	
2/5/2022	0.210		71.43	9.52	15	2		7.30			0.00			0.76		2.35		1.64	
2/6/2022	0.189		84.66	10.58	16	2		7.40			0.01			0.82		2.74		1.62	
2/7/2022	0.247		72.87	12.15	18	3		7.40			0.00			0.69		3.06		2.03	
2/8/2022	0.203		88.67	9.85	18	2		7.30			0.01			0.76		2.99		1.96	
2/9/2022	0.286		76.92	10.49	22	3		7.40			0.00			0.79		3.50		1.94	
2/10/2022	0.163		73.62	12.27	12	2		7.40			0.01			0.77		3.26		1.46	
2/11/2022	0.194		108.25	10.31	21	2		7.40			0.00			0.76		3.27		1.84	
2/12/2022	0.198		85.86	15.15	17	3		7.30			0.00			0.77		3.20		1.29	
2/13/2022	0.212		75.47	9.43	16	2		7.30			0.01			0.79		3.11		1.44	
2/14/2022	0.207		77.29	9.66	16	2		7.40			0.02			0.61		3.06		1.82	
2/15/2022	0.294		71.43	6.80	21	2		7.30			0.00			0.86		3.37		1.89	
2/16/2022	0.204		83.33	9.80	17	2		7.40			0.03			0.80		2.81		1.72	
2/17/2022	0.166		126.51	18.07	21	3		7.40			0.04			0.82		3.06		1.92	
2/18/2022	0.211		90.05	14.22	19	3		7.40			0.05			0.78		2.86		1.88	
2/19/2022	0.182		60.44	10.99	11	2		7.30			0.04			0.82		3.14		1.94	
2/20/2022	0.232		56.03	8.62	13	2		7.50			0.04			0.80		3.10		2.02	
2/21/2022	0.305		55.74	9.84	17	3		7.40			0.03			0.77		3.16		1.77	
2/22/2022	0.134		134.33	14.93	18	2	300	7.50			0.02			0.77		3.00		1.96	
2/23/2022	0.136		88.24	14.71	12	2		7.40			0.00			0.68		3.07		1.47	
2/24/2022	0.210		90.48	9.52	19	2		7.40			0.01			0.75		3.26		1.19	
2/25/2022	0.233		72.96	8.58	17	2		7.50			0.00			0.80		3.15		1.94	
2/26/2022	0.161		99.38	12.42	16	2		7.40			0.01			0.77		3.45		2.02	
2/27/2022	0.226		84.07	13.27	19	3		7.50			0.00			0.90		3.17		2.11	
2/28/2022	0.150		100.00	13.33	15	2		7.50			0.04			0.76		3.44		2.16	
Total	5.79	0.000	2368.18	318.21	477	64	600	206.90	340	2.50	0.42	0.15	0.04	21.72	0.00	85.75	0.00	50.14	
Average	0.21	#DIV/0!	84.58	11.36	17	2	300	7.39	340	2.50	0.02	0.15	0.04	0.78	#DIV/0!	3.06	#DIV/0!	1.79	
Min	0.13	0.000	55.74	6.80	11	2	300	7.30	340	2.50	0.00	0.15	0.04	0.61	0.00	2.35	0.00	1.19	
Max	0.31	0.000	134.33	18.07	23	3	300	7.50	340	2.50	0.05	0.15	0.04	0.90	0.00	3.50	0.00	2.16	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 4/06/2022

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	March
Year	2022
Leap Year?	No

			Chemicals (LBS/MG)		Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
3/1/2022	0.206		87.38	14.56	18	3		7.40			0.00			0.61		2.15		1.86	
3/2/2022	0.186		80.65	10.75	15	2		7.50			0.01			1.14		2.90		2.04	
3/3/2022	0.194		77.32	10.31	15	2		7.40			0.01			0.71		3.20		1.84	
3/4/2022	0.188		85.11	15.96	16	3		7.50			0.00			0.72		3.42		1.69	
3/5/2022	0.211		75.83	9.48	16	2		7.40			0.01			0.74		2.92		2.04	
3/6/2022	0.217		82.95	9.22	18	2		7.50			0.00			0.73		2.70		1.86	
3/7/2022	0.208		91.35	9.62	19	2		7.50			0.04			1.20		2.40		1.70	
3/8/2022	0.173		75.14	11.56	13	2		7.50			0.00			1.20		2.00		1.70	
3/9/2022	0.194		77.32	10.31	15	2		7.60			0.00			0.69		2.80		1.74	
3/10/2022	0.197		76.14	10.15	15	2	320	7.50	380	2.51	0.04	0.09	0.04	0.60		2.89		1.98	
3/11/2022	0.186		86.02	10.75	16	2		7.40			0.01			0.67		2.88		2.02	
3/12/2022	0.214		70.09	14.02	15	3		7.40			0.10			0.66		2.00		1.81	
3/13/2022	0.205		78.05	9.76	16	2		7.50			0.08			0.72		2.91		2.25	
3/14/2022	0.190		73.68	10.53	14	2		7.40			0.05			0.65		2.87		2.02	
3/15/2022	0.268		63.43	7.46	17	2		7.40			0.02			0.76		2.51		2.10	
3/16/2022	0.180		88.89	11.11	16	2		7.50			0.01			0.70		3.24		2.14	
3/17/2022	0.170		76.47	17.65	13	3		7.40			0.00			0.76		2.56		1.82	
3/18/2022	0.253		83.00	11.86	21	3		7.50			0.00			0.93		2.74		1.68	
3/19/2022	0.186		86.02	10.75	16	2		7.40			0.01			0.92		2.62		2.01	
3/20/2022	0.188		69.15	10.64	13	2		7.50			0.00			0.95		2.50		1.87	
3/21/2022	0.193		77.72	15.54	15	3		7.90			0.08			0.71		3.10		2.10	
3/22/2022	0.203		93.60	9.85	19	2		7.50			0.01			0.88		2.85		2.02	
3/23/2022	0.204		83.33	9.80	17	2	340	7.40			0.00			0.80		2.37		1.85	
3/24/2022	0.181		55.25	16.57	10	3		7.50			0.04			0.83		3.01		1.47	
3/25/2022	0.241		78.84	8.30	19	2		7.40			0.01			0.91		2.94		1.77	
3/26/2022	0.219		54.79	9.13	12	2		7.90			0.05			1.50		2.60		1.50	
3/27/2022	0.133		120.30	22.56	16	3		7.90			0.07			0.61		2.30		2.01	
3/28/2022	0.200		90.00	10.00	18	2		7.90			0.03			0.87		2.70		2.20	
3/29/2022	0.207		77.29	9.66	16	2		7.50			0.00			0.75		3.00		1.94	
3/30/2022	0.193		88.08	15.54	17	3		7.60			0.01			0.84		3.06		2.04	
3/31/2022	0.214		98.13	9.35	21	2		7.50			0.00			0.90		3.30		2.20	
Total	6.20	0.000	2501.34	362.75	497	71	660	233.20	380	2.51	0.69	0.09	0.04	25.66	0.00	85.44	0.00	59.27	
Average	0.20	#DIV/0!	80.69	11.70	16	2	330	7.52	380	2.51	0.02	0.09	0.04	0.83	#DIV/0!	2.76	#DIV/0!	1.91	
Min	0.13	0.000	54.79	7.46	10	2	320	7.40	380	2.51	0.00	0.09	0.04	0.60	0.00	2.00	0.00	1.47	
Max	0.27	0.000	120.30	22.56	21	3	340	7.90	380	2.51	0.10	0.09	0.04	1.50	0.00	3.42	0.00	2.25	

Comments: Chemicals are measured in wet lbs unless otherwise noted

Monthly Report of
Operation of Water
Treatment Plant
Form 100

Indiana American Water

Sheridan-Plant
PWS-ID:5229014

Operator Signature: _____ Date: 5/09/2022

Certification # WT072357

I certify, under penalty of law, by this signature that this document was prepared by me, or under my direction, and the information submitted is to the best of my knowledge and belief, true, accurate and complete. I am also aware that there are significant penalties for submitting false information.

IDEM Field Rep: Lily Alexander

Month:	April
Year	2022
Leap Year?	No

	Chemicals (LBS/MG)			Chemicals (lbs)		Physical and Chemical Data (mg/L)								Chlorine Residual (mg/L)				Misc
Date	Treated Water (MGD)	Wash Water (MGD) Total	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Total CL2 (chlorine)	Phosphate-Blend (PO4)	Eff Alk	Eff pH	Eff Hard	Raw Iron	Eff Iron	Raw Mn	Eff Mn	Eff PO4	Eff CL2 Free	Eff CL2 Total	Dist CL2 Free	Dist CL2 Total	Remarks
4/1/2022	0.215		74.42	9.30	16	2		7.90			0.11			0.72		2.30		1.70	
4/2/2022	0.213		79.81	14.08	17	3		7.70			0.03			0.81		2.71		1.98	
4/3/2022	0.197		76.14	10.15	15	2		7.60			0.00			0.84		2.63		1.50	
4/4/2022	0.204		83.33	9.80	17	2	300	7.40	320	3.18	0.00	0.09	0.04	0.83		2.40		1.69	
4/5/2022	0.156		83.33	12.82	13	2		7.50			0.01			0.84		2.40		1.70	
4/6/2022	0.188		111.70	10.64	21	2		7.40			0.02			0.87		2.90		1.91	
4/7/2022	0.203		68.97	9.85	14	2		7.50			0.02			0.93		2.43		1.74	
4/8/2022	0.195		82.05	10.26	16	2		7.40			0.00			0.67		2.67		2.14	
4/9/2022	0.171		99.42	17.54	17	3		7.80			0.04			1.20		2.90		1.90	
4/10/2022	0.213		89.20	9.39	19	2		7.90			0.02			0.88		2.90		2.01	
4/11/2022	0.196		76.53	15.31	15	3		7.60			0.02			0.74		3.11		1.59	
4/12/2022	0.225		88.89	8.89	20	2		7.70			0.01			0.68		3.04		1.65	
4/13/2022	0.240		79.17	8.33	19	2		7.50			0.02			0.73		0.75		1.87	
4/14/2022	0.173		86.71	17.34	15	3		7.60			0.02			0.82		2.53		1.72	
4/15/2022	0.222		90.09	9.01	20	2		7.70			0.00			0.80		2.98		1.62	
4/16/2022	0.212		84.91	9.43	18	2		7.60			0.01			0.83		2.69		1.74	
4/17/2022	0.284		88.03	10.56	25	3		7.70			0.02			0.81		2.99		1.82	
4/18/2022	0.240		75.00	12.50	18	3		7.60			0.04			0.80		2.76		1.56	
4/19/2022	0.283		91.87	10.60	26	3	340	7.60			0.00			0.70		2.84		1.77	
4/20/2022	0.343		78.72	8.75	27	3		7.70			0.00			0.68		3.14		2.01	
4/21/2022	0.291		85.91	10.31	25	3		7.60			0.01			0.72		2.72		2.21	
4/22/2022	0.186		75.27	10.75	14	2		7.70			0.00			0.72		2.91		1.86	
4/23/2022	0.200		105.00	10.00	21	2		7.90			0.02			0.70		2.20		2.20	
4/24/2022	0.212		94.34	9.43	20	2		7.80			0.01			0.90		3.11		2.90	
4/25/2022	0.275		80.00	18.18	22	5		7.70			0.01			0.69		2.72		1.78	
4/26/2022	0.177		96.05	16.95	17	3		7.40			0.00			0.71		2.24		1.69	
4/27/2022	0.231		86.58	8.66	20	2		7.50			0.01			0.70		3.07		2.04	
4/28/2022	0.256		74.22	11.72	19	3		7.60			0.03			0.73		3.13		1.94	
4/29/2022	0.175		108.57	11.43	19	2		7.70			0.00			1.17		2.57		1.63	
4/30/2022	0.197		86.29	15.23	17	3		7.60			0.01			0.90		2.63		1.77	
Total	6.57	0.000	2580.51	347.23	562	75	640	228.90	320	3.18	0.49	0.09	0.04	24.12	0.00	80.37	0.00	55.64	
Average	0.22	#DIV/0!	86.02	11.57	19	3	320	7.63	320	3.18	0.02	0.09	0.04	0.80	#DIV/0!	2.68	#DIV/0!	1.85	
Min	0.16	0.000	68.97	8.33	13	2	300	7.40	320	3.18	0.00	0.09	0.04	0.67	0.00	0.75	0.00	1.50	
Max	0.34	0.000	111.70	18.18	27	5	340	7.90	320	3.18	0.11	0.09	0.04	1.20	0.00	3.14	0.00	2.90	

Comments: Chemicals are measured in wet lbs unless otherwise noted

AGREEMENT

THIS AGREEMENT is by and between **Indiana-American Water Company, Inc.** (Owner) and _____ (Design/Builder). Owner and Design/Builder, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1 – THE WORK

1.01 Design/Builder shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

Design, construct, renovate, start-up, commission, turn over and warrant facilities for **Indiana-American Water Company Sheridan Water Treatment Facility**

ARTICLE 2 - THE PROJECT

2.01. The Project for which the Work under the Contract Documents may be the whole or only a part is generally described as follows:

Indiana American Water Company
Sheridan Water Treatment Facility

ARTICLE 3 - CONTRACT TIMES

3.01. Dates for Substantial Completion and Final Payment

The Work will be substantially completed in accordance with paragraph 13.05 of the General Conditions on or before **August 31, 2024** and completed and ready for final payment in accordance with paragraph 13.08 of the General Conditions on or before **December 31, 2024**. In addition the following interim milestones will be met:

Design Memo Completion: _____ days – Defined as number of days from Notice of Award to completion of the Design Memorandum.

Design Phase Completion: _____days – Defined as number of days from Notice of Award to completion of the Final Design.

3.02. Liquidated Damages
Design/Builder and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in paragraph 3.01 above, plus any extensions thereof allowed in accordance with paragraph 11.02 of the General Conditions. The parties also recognize the delays, expenses, and difficulties involved in proving the actual loss suffered by Owner if the

Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Design/Builder agree that as liquidated damages for delay (but not as a penalty) Design/Builder shall pay Owner $**2,000** for each day that expires after the time specified in paragraph 3.01 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Design/Builder shall neglect, refuse, or fail to complete the remaining Work within the time specified in paragraph 3.01 for completion and readiness for final payment or any proper extension thereof granted by Owner, Design/Builder shall pay Owner $**500** for each day that expires after the time specified in paragraph 3.01 for completion and readiness for final payment.

ARTICLE 4 - CONTRACT PRICE

4.01 Owner shall pay Design/Builder for completion of the Work in accordance with the Contract Documents a sum equal to the Cost of the Work plus a Design/Builder's Fee for overhead and profit, both of which will be determined as provided in Article 5 and Article 6 of this agreement.

ARTICLE 5 - COST OF THE WORK

5.01 Cost of the Work shall be determined as provided in paragraph 10.01 of the General Conditions, as revised or amended by the Supplementary Conditions and shall include the following agreed to amounts which shall be subject to increases or decreases for changes in the Work as provided in Article 8 hereof:

A. Lump Sum: $_____for Design Professional Services - Preliminary Design up to and including issuing of the Design Memorandum.

B. Lump Sum: $_____for Design Professional Services – Completion of Final Design Phases.

C. Lump Sum: $_____for Design Professional Services – Construction/Operational Phase.

D. Lump Sum: $ _____for Pre-Construction Services during Design Phase.

E. Lump Sum: $_____for Construction Supervision and Superintendence as described in the Supplementary Conditions.

F. A Lump Sum of: $_____ for the premium for the required bonds (based on $_____construction cost estimate).

5.02. At final completion should the Cost of the Work, as audited and approved by the Owner exceed the Target Cost, the Design/Builder shall be entitled to a 50% payment for the difference between the Final Cost of the Work and the Target Cost as provided.

5.03 At final completion should the Cost of the Work as audited and approved by the Owner be less than the Target Cost, an additional payment shall be made to the Design/Builder

equal to 50% of the difference between final Cost of the Work and Target Cost as an incentive to the Design/Builder to reduce the project cost to Owner.

5.04. It is understood that the Contract Price has been calculated on the basis of Conceptual Documents and that further development will occur as necessary to produce Final Contract Drawings and Specifications necessary to complete the design, to obtain regulatory approvals and to perform the Work. No adjustment will be made to the Contract Price unless future development of these Conceptual Documents during the Preliminary Design Phase results in material changes in the scope, extent or character of the work to be performed or furnished or in the quality or function of the intended completed project not reasonably inferable or anticipatable from the Conceptual Documents by a Design/Builder experienced in the construction of water treatment facilities.

ARTICLE 6 - DESIGN/BUILDER'S FEE

6.01. The Design/Builder's fee shall be determined as follows:

A. A lump sum fee of _____dollars ($_____) which shall be subject to increases or decreases for changes in the Work as provided in paragraph 8.01.A below.

ARTICLE 7 - GUARANTEED MAXIMUM PRICE

7.01. Not Used.

ARTICLE 8 - CHANGES IN THE CONTRACT PRICE

8.01. The amount of any increases or decreases in the Design/Builder's Fee which results from a change in the work shall be set forth in the applicable document amending the Contract Documents subject to the following:

A. Design Phase Changes: For changes in the Work ordered by Owner prior to completion of the Design Phase, the fixed fee will be adjusted by 5% of the estimated construction cost increase or decrease associated with the change. For changes involving cost increases, if during the Design Phase, Owner and Design/Builder are unable to agree to, or establish, the estimated construction cost increase associated with the change, this determination will be deferred to the Construction Phase at which time the actual Cost of the Work associated with the change is to be determined and used to make the 5% fixed fee adjustment.

B. Construction Phase Changes: After completion of the Preliminary (60%) Design Phase, and approval of the final construction cost estimate, no adjustments to the fixed fee shall be made unless Owner orders additions or deletions to the Work which directly result in the Cost of the Work being greater than 110%, or less than 90% of the final construction cost estimate. In such case the fixed fee shall be increased by 10% of the actual cost directly attributable to the change above 110% of the estimate or decreased by 5% of the cost directly attributable to the change below 90% of the approved estimate.

Documents amending the Contract Documents as applicable will be issued to document Owner additions or deletions to work.

8.02. The amount of any increase or decrease in the Lump Sum Amounts provided in Article 5 hereof in shall include only direct costs (i.e. no fee) and shall be determined in accordance with paragraph 10.01 C of the General Conditions as may be revised or amended by the Supplementary Conditions.

ARTICLE 9 - PAYMENT PROCEDURES

9.01. Design/Builder shall submit and Owner will process Applications for Payment in accordance with Article 13 of the General Conditions. Applications for Payment will indicate the amount of the Design/Builder's Fee then payable.

A. Progress Payments; Retainage. Owner shall make progress payments on account of the Contract Price on the basis of Design/Builder's Applications for Payment on or about the end of each month during performance of the Work as provided in paragraphs 9.01.A.1 and A.2 below. All such payments will be measured by the acceptable Schedule of Values established in paragraph 2.06 of the General Conditions (and in the case of Unit Price Work based on the number of units completed).

1. For Cost of the Work: Progress payments on account of the Cost of the Work will be made:

a. Prior to Substantial Completion, in an amount equal to the percentage indicated below, but in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold in accordance with paragraph 13.03.B of the General Conditions.

(1) Unless otherwise agreed to in advance by Owner for specific subcontracts or material/equipment purchase orders, 95% of Cost of the Work completed (with the balance being retainage) with the exception of the lump sum amounts identified in paragraph 5.01 hereof.

(2) Unless otherwise agreed to in advance by Owner for specific subcontracts or material/equipment purchase orders, 95% of the cost of materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to Owner as provided in paragraph 13.02.A of the General Conditions).

(3) 100% (no retainage) of the Work completed relative to the lump sum items to be included in the Cost of the Work identified in paragraph 5.01 hereof.

b. The Design/Builder shall submit a Progress Payment Application to the Owner on or about the end of each Calendar month that includes the following:

(1) The Design/Builder's estimate of the total expenditure that they will incur and the sums that they will be due them in the month succeeding the month in which the request is made, provided that in the first month the Design/Builder may submit their estimate for that month at its beginning; and

(2) The total of the Design/Builder's actual expenditure and sums due him for the month preceding the month in which the request is made;

(3) Any amount previously certified by the Owner in respect of the Design/Builder's estimated expenditure and sums due them for the preceding month.

(4) The Design/Builder's Progress Payment Application shall be supported by all relevant documentary evidence and show the manner in which the total requested has been calculated. In addition, the Design/Builder will submit with all Progress Payment Applications, except Final Progress Payment, a conditional waiver and release duly executed by the Design/Builder and their subcontractors and suppliers on the form in the Supplementary Conditions. For the Design Builder's Final Progress Payment Application, the Design/Builder will submit an unconditional waiver and release duly executed by Design/Builder and their subcontractors and suppliers on the form in the Supplementary Conditions.

c. Upon Substantial Completion and receipt of Release of Liens from suppliers and subcontractors whose Work is completed on the Project, in an amount to increase the total payments to the Design/Builder such that retained funds will be approximately equal to the value of the remaining Work. Value to be agreed upon by Owner and Design/Builder, less such amounts as Owner shall determine that Owner may withhold, in accordance with paragraph 13.04.B of the General Conditions.

2. For Design/Builder's Fee*:* Progress payments on account of the Design/Builder's Fee will be made:

a. If the Design/Builder's Fee is a fixed fee: payments will be in an amount equal to 100% of such fee earned to the date of the approved Application for Payment (less in each case payments previously made on account of such fee) based on the progress of the Work measured by the Schedule of Values established as provided in paragraph 2.06.A of the General Conditions.

B. Final Payment*.* Upon final completion and acceptance of the Work in accordance with paragraph 13.09 of the General Conditions, Owner shall pay the remainder of the Contract Price.

9.02 All invoices shall be submitted to Taulia at:

http://supplierinfo.taulia.com/americanwater

9.03 All undisputed invoices shall be due and payable within forty-five (45) calendar days of receipt by Owner. Should Contractor utilize American Water's Supplier Portal for E-Invoicing, Contractor may select a Dynamic Payment Term (DPT). Selection of such DPT shall expressly amend the payment term herein and all other provisions of this Agreement shall remain unchanged.

ARTICLE 10 - INTEREST

10.01. Not Used.

ARTICLE 11 - DESIGN/BUILDER'S REPRESENTATIONS

11.01. To induce Owner to enter into this Agreement, Design/Builder makes the following representations:

A. Design/Builder has examined and carefully studied the Contract Documents (including the Addenda) listed in paragraphs 13.01.A through J and the other related data identified in the Request for Proposals but excluding the documents described in paragraph 13.01.K.

B. Design/Builder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Design/Builder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Design/Builder has carefully studied all: (1) reports of explorations and tests of subsurface conditions (if any) at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site which have been identified or made available by Owner and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site which have been identified or made available by Owner.

E. Design/Builder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

F. Design/Builder has correlated the information known to Design/Builder, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.

G. Design/Builder has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Design/Builder has discovered in the Contract Documents and the written resolution thereof by Owner is acceptable to Design/Builder.

H. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 12 - ACCOUNTING RECORDS

12.01. Design/Builder shall keep such full and detailed accounts of all materials, equipment, and labor entering into the Work as may be necessary for proper financial management under this Agreement, and the accounting methods shall be satisfactory to Owner. Owner shall be afforded access to all Design/Builder's records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and other similar data relating to the Cost of the Work and Design/Builder's fee. Design/Builder shall preserve all such documents for a period of three years after final payment by Owner.

ARTICLE 13 - CONTRACT DOCUMENTS

13.01. The Contract Documents consist of the following:

A. This Agreement (pages A-1 to **A-9**, inclusive);

B. Performance Bond (pages _____ to _____, inclusive);

C. Payment Bond (pages _____ to _____, inclusive);

D. Other Bonds, identified as Exhibits _____ and consisting of _____ pages;

E. Standard General Conditions of the Contract Between Owner and Design/Builder (pages 1 to **28**, inclusive);

F. Supplementary Conditions (pages **SC-1** to **SC-14**, inclusive);

G. Conceptual Documents identified in the Request for Proposals;

H. Design/Builder's Proposal;

I. Addenda numbers _____ through _____ inclusive;

J. Exhibits to this Agreement (pages _____ to _____, inclusive);

K. Documentation submitted prior to the effective date of the Agreement;

L. The following, which may be delivered, prepared, or issued after the Effective Date of this Agreement and are not attached hereto:

1. Notice to Proceed;

2. All Work Change Directives, and Change Orders amending, modifying or supplementing the Contract Documents pursuant to paragraph 3.04.A of the General Conditions;

3. Specifications as defined in Paragraph 1.01.A.40 of the General Conditions; and

4. Drawings as defined in Paragraph 1.01.A.18 of the General Conditions.

13.02. The documents listed in paragraph 13.01 above are attached to this Agreement (except as expressly noted otherwise above).

13.03. There are no Contract Documents other than those listed above in this Article 13.

13.04. The Contract Documents may only be amended, modified, or supplemented as provided in paragraph 3.03.A of the General Conditions.

ARTICLE 14 - MISCELLANEOUS

14.01. The Standard General Conditions of the Contract Between Owner and Design/Builder are referred to herein as the General Conditions.

14.02. Terms used in this Agreement will have the meanings indicated in the General Conditions.

14.03. No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

14.04. Owner and Design/Builder each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

14.05. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Design/Builder, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

14.06. Government Regulations: The following clauses, where applicable, are incorporated in this Agreement by reference as is fully set out; the Equal Opportunity Clause prescribed in 41 CFR 60-1.40, the Affirmative Action Clause prescribed in 41 CFR 60-250.4, regarding veterans and veterans of the Vietnam Era, and the Affirmative Action Clause for Handicapped Workers prescribed in 41 CFR 60-741.4.

14.07. Design/Builder accepts this Agreement and will supply any information relating to federal or state laws, rules or regulations relating to the above.

IN WITNESS WHEREOF, Owner and Design/Builder have signed this Agreement in duplicate. One counterpart each has been delivered to Owner and Design/Builder. All portions of the Contract Documents have been signed, initialed, or identified by Owner and Design/Builder.

This Agreement will be effective on (which is the Effective Date of the Agreement).

OWNER:	DESIGN/BUILDER:
INDIANA-AMERICAN WATER CO., INC.	
By:	By:
Title:	Title:
Date:	(If Design/Builder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)
Witness:	Witness:
Address for giving notices:	Address for giving notices:
Indiana-American Water Company, Inc.	
153 N. Emerson Avenue	
Greenwood, Indiana 46143	
	[License No.:
	(Where applicable)
	Agent for service of process:
Designated Representative:	Designated Representative:
Name:	Name:
Title:	Title:
Address:	Address:
Phone:	Phone:
Fax:	Fax:

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the Controlling Law.

STANDARD GENERAL CONDITIONS OF THE CONTRACT BETWEEN OWNER AND DESIGN/BUILDER

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

ACEC
American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN COUNCIL OF ENGINEERING COMPANIES

AMERICAN SOCIETY OF CIVIL ENGINEERS

These General Conditions have been prepared for use with either one of the two Agreements between Owner and Design/Builder (Nos. D-520 and D-525, 2002 Editions) of the Engineers Joint Contract Documents Committee. Their provisions are interrelated and a change in one may necessitate a change in the others. The suggested language and instructions contained in the Guide to Use of EJCDC Design/Build Documents (No. D-001, 2002 Edition) is also carefully interrelated with the language of these General Conditions. The Guide also contains comments concerning the use of the General Conditions.

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 Defined Terms

A. Wherever used in the Contract Documents and printed with initial or all capital letters, the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

1. *Addenda* – Written or graphic instruments issued prior to the opening of Proposals which clarify, correct or change the Request for Proposals or the Contract Documents.

2. *Agreement* – The written instrument which is evidence of the agreement between Owner and Design/Builder covering the Work.

3. *Application for Payment* – The form which is to be used by Design/Builder in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos* – Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bonds* – Performance and payment bonds and other instruments of security.

6. *Change Order* – A written order which is signed by Design/Builder and Owner which authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

7. *Claim* – A demand or assertion by Owner or Design/Builder seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a claim.

8. *Conceptual Documents* – The drawings and specifications and/or other graphic or written materials, criteria and information concerning Owner's requirements for the Project, such as design objectives and constraints, space, capacity and performance requirements, flexibility and expandability, including those items enumerated in the Request for Proposals which show or describe the character and scope of, or relate to, the Work to be performed or furnished and which have been prepared by or for Owner.

9. *Construction* – The result of performing or furnishing of labor, the furnishing and incorporating of materials and equipment into the Work and the furnishing of services (other than Design Professional Services) and documents, all as required by the Contract Documents.

10. *Construction Subagreement* – A written agreement between Design/Builder and a construction Subcontractor for provision of Construction.

11. *Contract* – The entire and integrated written agreement between Owner and Design/Builder concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents* – Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents.

13. *Contract Price* – The moneys payable by Owner to Design/Builder for completion of the Work in accordance with the Contract Documents.

14. *Contract Times* – The numbers of days or the dates stated in the Agreement to (i) achieve Substantial Completion, and (ii) complete the Work so that it is ready for final payment in accordance with paragraph 13.08.

15. *Design/Builder* – The individual or entity with whom Owner has entered into the Agreement.

16. *Design Subagreement* – A written agreement between Design/Builder and a design professional for provision of Design Professional Services.

17. *Design Professional Services* – Services related to the preparation of Drawings, Specifications, and other design submittals specified by the Contract Documents and required to be performed by licensed design professionals, as well as other services provided by or for licensed design professionals during Bidding/Negotiating, Construction, or Operational phases.

18. *Drawings* – Those portions of the Contract Documents prepared by or for Design/Builder and approved by Owner consisting of drawings, diagrams, illustrations, schedules and other data which show the scope, extent, and character of the Work.

19. *Effective Date of the Agreement* – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the

date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

20. *Field Order* – A written order issued by Owner which orders minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *Hazardous Environmental Condition* – The presence at the Site of Asbestos, Hazardous Waste, PCB's, Petroleum Products or Radioactive Materials in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto on connection with the Work.

22. *Hazardous Waste* – The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

23. *Laws or Regulations* – Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities and courts having jurisdiction.

24. *Liens* – Charges, security interests or encumbrances upon real property or personal property.

25. *Milestone* – A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

26. *Notice of Award* – The written notice by Owner to the successful proposer stating that upon compliance by the successful proposer with the conditions precedent included therein, within the time specified, Owner will sign and deliver the Agreement.

27. *Notice to Proceed* – A written notice given by Owner to Design/Builder fixing the date on which the Contract Times will commence to run and on which Design/Builder shall start to perform the Work.

28. *Owner* – The individual or entity with whom Design/Builder has entered into the Agreement and for whom the Work is to be performed.

29. *Owner's Consultant* – An individual or entity with whom the Owner may contract to furnish services to Owner with respect to the Project and who is identified as such in the Supplementary Conditions.

30. *Partial Utilization* – Use by Owner of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

31. *PCBs* – Polychlorinated biphenyls.

32. *Petroleum* – Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Wastes and crude oils.

33. *Project* – The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

34. *Proposal* – The documents submitted by Design/Builder in response to the Request for Proposals setting forth the design concepts, proposed prices, and other conditions for the Work to be performed.

35. *Radioactive Material* – Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Request for Proposals* – The document prepared by or for Owner specifying and describing Owner's objectives and the procedure to be followed in preparing and submitting a Proposal and awarding a contract.

37. *Resident Project Representative* – The authorized representative of Owner who may be assigned to the Site or any part thereof.

38. *Schedule of Values* – A schedule prepared by Design/Builder and acceptable to Owner indicating that portion of the Contract Price to be paid for each major component of the Work.

39. *Site* – Lands or other areas designated in the Contract Documents as being furnished by Owner upon which Construction is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for use of Design/Builder.

40. *Specifications* – The part of the Contract Documents prepared by or for Design/Builder and approved by Owner consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.

41. *Subcontractor* – An individual or entity other than a Supplier having a direct contract with Design/Builder or with any other Subcontractor for the performance of a part of the Work.

42. *Submittal* – A written or graphic document prepared by or for Design/Builder which is required by the Contract Documents to be submitted to Owner by Design/Builder. Submittals may include Drawings, Specifications, progress schedules, shop drawings, samples, cash flow projections, and Schedules of Values. Submittals other than Drawings and Specifications are not Contract Documents.

43. *Substantial Completion* – The time at which the Work (or a specified part) has progressed to the point where it is sufficiently complete, in accordance with the

Contract Documents, so that the Work (or a specified part) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

44. *Supplementary Conditions* – The part of the Contract Documents which amends or supplements these General Conditions.

45. *Supplier* – A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with Design/Builder or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Design/Builder or any Subcontractor.

46. *Unit Price Work* – Work to be paid for on the basis of unit prices.

47. *Work* – The entire construction or the various separately identifiable parts thereof required to be performed or furnished under the Contract Documents. Work includes and is the result of performing or furnishing Design Professional Services and Construction required by the Contract Documents.

48. *Work Change Directive* – A written directive to Design/Builder, issued on or after the Effective Date of the Agreement and signed by Owner ordering an addition, deletion or revision in the Work, or responding to differing site conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

A. Intent of Certain Terms or Adjectives:

1. The word "day" shall constitute a calendar day of 24 hours measured from midnight to the next midnight.

2. The word "defective," when modifying the word "Construction" refers to Construction that is unsatisfactory, faulty, or deficient in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to Owner's final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion) provided that the defect was not caused by Owner.

3. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

4 The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials or equipment or equipment complete and ready for intended use.

5. The words "perform" or "provide" when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

6. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Design/Builder, "provide" is implied.

7. Unless stated otherwise in the Contract Documents, words or phrases which have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with that meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 Delivery of Bonds

A. When Design/Builder delivers the executed Agreements to Owner, Design/Builder shall also deliver to Owner such Bonds as Design/Builder may be required to furnish in accordance with paragraph 5.01.A.

2.02 Commencement of Contract Times; Notice to Proceed

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement, or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within thirty days after the Effective Date of the Agreement. Unless agreed to in writing by Owner and Design/Builder, the Contract Times will commence to run no later than the ninetieth day after the last day for receipt of the Proposal or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.03 Starting the Work

A. Design/Builder shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.04 Before Starting the Work

A. *Design/Builder's Review of Contract Documents:* Before undertaking each part of the Work, Design/Builder shall carefully study and compare those Contract Documents prepared by Owner and check and verify pertinent figures therein and all applicable field measurements. Design/Builder shall promptly report in writing to Owner any conflict, error, ambiguity, or discrepancy which Design/Builder may discover and shall obtain a written interpretation or clarification from Owner before proceeding with any Work affected thereby; however, Design/Builder shall not be liable to Owner for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Design/Builder knew or reasonably should have known thereof.

B. *Preliminary Schedules:* Within 10 days after commencement of the Contract Times (unless otherwise specified in the Contract Documents), Design/Builder shall submit the following to Owner for its timely review:

1. A preliminary progress schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. A preliminary schedule of Submittals which will list each required Submittal and the times for submitting, reviewing and processing each Submittal;

3. A preliminary Schedule of Values for all of the Work which will include quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work; and

4. A preliminary cash flow projection estimating that portion of the Contract Price to be due during each month of performance.

C. *Evidence of Insurance:* Before any Work at the Site is started, Design/Builder and Owner shall each deliver to the other, certificates of insurance as required by paragraph 5.03 which Design/Builder and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.05 Initial Conference

A. Within twenty days after the Contract Times start to run, Design/Builder will arrange a conference attended by Owner and Design/Builder and others as appropriate to establish a working understanding among the parties as to the Work and to discuss the design concepts, schedules referred to in paragraph 2.04.B, procedures for handling Submittals, processing Applications for Payment, maintaining required records, items required pursuant to paragraph 8.01.A.6 and other matters.

2.06 Initial Acceptance of Schedules

A. At least ten days before submission of the first Application for Payment (unless otherwise provided in the Contract Documents), Design/Builder will arrange a conference attended by Design/Builder, Owner and others as appropriate to review for acceptability the schedules submitted in accordance with paragraph 2.04.B. Design/Builder shall have an additional ten days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Design/Builder until the acceptable schedules are submitted to Owner.

1. The progress schedule will be acceptable to Owner if it provides an orderly progression of the Work to completion within any specified Milestones and the Contract Times. Such acceptance will not impose on Owner responsibility for the progress schedule, for sequencing, scheduling or progress of the Work nor interfere with nor relieve Design/Builder from Design/Builder's full responsibility therefor.

2. Design/Builder's schedule of Submittals will be acceptable to Owner if it provides a workable arrangement for reviewing and processing the required Submittals.

3. Design/Builder's Schedule of Values will be acceptable to Owner as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 Intent

A. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be designed and constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended result will be furnished and performed whether or not specifically called for at no additional cost to Owner.

3.02 Reference Standards

A. Standards, Specifications, Codes, Laws or Regulations.

1. Reference to standards, specifications, manuals or codes of any technical society, organization or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect on the last day for receipt of Proposals except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, code, or instruction of a Supplier shall be effective to change the duties and responsibilities of Owner, Design/Builder, or any of their subcontractors, consultants, agents, or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Owner any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 Resolving Discrepancies

A. In the event of a discrepancy between the Conceptual Documents on the one hand and the Proposal or Drawings or Specifications on the other hand, the Conceptual Documents will control except when Owner has approved a Submittal pursuant to paragraph 6.17.B.

B. Except as otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

1. The provisions of any such standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Contract Documents); or

2. The provisions of any such Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 Amending and Supplementing Contract Documents

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof in one or more of the following ways:

1. Owner's approval of required Submittals (pursuant to paragraph 6.17.B);

2. A Work Change Directive;

3. A Change Order;

4. A Field Order.

3.05 ***Reuse of Documents***

A. All documents including Drawings and Specifications prepared or furnished by Design/Builder pursuant to this Agreement are for Design/Builder's own use, and Design/Builder shall retain an ownership and property interest therein whether or not the Project is completed. Owner may make and retain copies for information and reference in connection with the use and occupancy of the Project by Owner and others. However, such documents are not intended or represented to be suitable for reuse by Owner or others on extensions of the Project or on any other project. Any reuse or any continued use after any termination without written verification or adaptation by Design/Builder for the specific purpose intended will be at Owner's sole risk and without liability or legal exposure to Design/Builder and Owner shall indemnify and hold harmless Design/Builder and Subcontractors from all claims, damages, losses and expenses including attorneys' fees arising out of or resulting therefrom. Any such verification or adaptation will entitle Design/Builder to further compensation at rates to be agreed upon by Owner and Design/Builder.

3.06 Electronic Data

A. Copies of data furnished by Owner to Design/Builder or Design/Builder to Owner that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data’s creator.

ARTICLE 4 – AVAILABILITY OF LANDS; DIFFERING SITE CONDITIONS; REFERENCE POINTS; HAZARDOUS ENVIRONMENTAL CONDITIONS

4.01 Availability of Lands

A. Owner shall furnish the Site. Owner shall notify Design/Builder of any encumbrances or restrictions not of general application but specifically related to use of the Site which Design/Builder will have to comply in performing the Work. Unless otherwise provided in the Contract Documents, Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Design/Builder and Owner are unable to agree on entitlement to or the amount or extent of any adjustments in the Contract Price or the Contract Times as a result of any delay in Owner's furnishing the Site, Design/Builder may make a Claim therefor as provided in Article 9.

B. Upon reasonable written request, Owner shall furnish Design/Builder with a current statement of record legal title and legal description of the lands upon which the Construction is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's lien against such lands in accordance with applicable Laws or Regulations.

C. Design/Builder shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 Differing Site Conditions

A. Design/Builder shall promptly, and before the conditions are disturbed, give a written notice to Owner of (i) subsurface or latent physical conditions at the Site which differ materially from those indicated in the Contract Documents, or (ii) unknown physical conditions at the Site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character called for by the Contract Documents.

B. Owner will investigate the Site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Design/Builder's cost of, or the time required for, performing any part of the Work, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the Contract Price or Times modified in writing by Change Order in accordance with Article 9.

C. No request by Design/Builder for an equitable adjustment under paragraph 4.02 shall be allowed unless Design/Builder has given the written notice required; provided that the time prescribed in 9.03.A for giving written notice may be extended by Owner.

D. The provisions of this paragraph 4.02 are not intended to apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

4.03 Reference Points

A. Design/Builder shall be responsible for laying out the Work and shall protect and preserve the reference points and property monuments established by Owner pursuant to paragraph 8.01.A.6.e, and shall make no changes or relocations without the prior written approval of Owner. Design/Builder shall report to Owner whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 Hazardous Environmental Condition at Site

A. Design/Builder will not be responsible for any Hazardous Environmental Condition encountered at the Site which was not identified in the Contract Documents to be within the scope of the Work. Design/Builder shall be responsible for materials creating a Hazardous Environmental Condition created by any materials brought to the Site by Design/Builder, Subcontractors, Suppliers or anyone else for whom Design/Builder is responsible.

B. If Design/Builder encounters a Hazardous Environmental Condition, Design/Builder shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Construction in connection with such condition and in any area affected thereby (except in an emergency as required by paragraph 6.16); and (iii) notify Owner (and thereafter confirm such notice in writing). Owner shall promptly determine the necessity of retaining a qualified expert to evaluate such condition or take corrective action, if any.

C. Design/Builder shall not be required to resume Construction in connection with such Hazardous Environmental Condition or in any such affected area until after Owner has obtained any required permits related thereto and delivered to Design/Builder written notice (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Construction, or (ii) specifying any special conditions under which such Construction may be resumed safely. If Owner and Design/Builder cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of such Construction stoppage or such special conditions under which Construction is agreed to be resumed by Design/Builder, either party may make a Claim therefor as provided in Article 9.

D. If after receipt of such special written notice Design/Builder does not agree to resume Construction based on a reasonable belief it is unsafe, or does not agree to resume such Construction under such special conditions, then Owner may order such portion of the Work that is related to such Hazardous Environmental Condition to be deleted from the Work. If Owner and Design/Builder cannot agree as to entitlement to or the amount or extent of an adjustment, if any, in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Article 9. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

E. To the fullest extent permitted by Laws or Regulations, Owner shall indemnify and hold harmless Design/Builder, Subcontractors, Suppliers and the officers, directors, partners, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or resulting from such Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Contract Documents to be included in the scope of the Work, and (iii) was not created by Design/Builder or by anyone for whom Design/Builder is responsible. Nothing in this paragraph 4.04.E shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

F. To the fullest extent permitted by Laws or Regulations, Design/Builder shall indemnify and hold harmless Owner, Owner's Consultant and the officers, directors, partners, employees, agents, other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or resulting from such Hazardous Environmental Condition created by Design/Builder or anyone for whom Design/Builder is responsible. Nothing in this paragraph 4.04.F shall obligate Design/Builder to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

ARTICLE 5 – BONDS AND INSURANCE

5.01 Performance, Payment and Other Bonds

A. Design/Builder shall furnish performance and payment Bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all Design/Builder's obligations to furnish, provide and pay for Work and related materials under the Contract Documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as provided otherwise by Laws or Regulations or by the Contract Documents. Design/Builder shall also furnish such other Bonds as are required by the Contract Documents.

B. All Bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 by the Audit Staff, Bureau of Government Financial Operations, U.S. Department of the Treasury. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

C. If the surety on any Bond furnished by Design/Builder is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of paragraph 5.01.B and 5.02, Design/Builder shall within twenty days thereafter substitute another Bond and surety, both of which shall comply with the requirements of paragraphs 5.01.B and 5.02.

5.02 Licensed Sureties and Insurers

A. All Bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Design/Builder shall be obtained from surety or insurance companies that are duly licensed or authorized in the

jurisdiction in which the Project is located to issue Bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 Certificates of Insurance

A. Design/Builder shall deliver to Owner, with copies to each additional insured indicated in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Design/Builder is required to purchase and maintain. Owner shall deliver to Design/Builder, with copies to each additional insured indicated in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Design/Builder or any other additional insured) which Owner is required to purchase and maintain.

5.04 Design/Builder's Liability Insurance

A. Design/Builder shall purchase and maintain such liability and other insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Design/Builder's performance of the Work and Design/Builder's other obligations under the Contract Documents, whether it is to be performed by Design/Builder, any Subcontractor or Supplier or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. Claims under workers' compensation, disability benefits and other similar employee benefit acts;

2. Claims for damages because of bodily injury, occupational sickness or disease, or death of Design/Builder's employees;

3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than Design/Builder's employees;

4. Claims for damages insured by reasonably available personal injury liability coverage which are sustained (i) by any person as a result of an offense directly or indirectly related to the employment of such person by Design/Builder, or (ii) by any other person for any other reason;

5. Claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. Claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by paragraph 5.04.A shall:

1. With respect to insurance required by paragraphs 5.04.A.3 through 5.04.A.6 inclusive, (subject to any customary exclusion in respect of professional liability) include as additional insureds Owner and Owner's Consultants and any other persons or entities indicated in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, partners, and employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. Include at least the specific overages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. Include completed operations insurance;

4. Include contractual liability insurance covering Design/Builder's indemnity obligations under paragraphs 6.11.A.3 and 6.21;

5. Contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least thirty days' prior written notice has been given to Owner and each other additional insured indicated in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Design/Builder pursuant to paragraph 5.03 will so provide);

6. Remain in effect at least until final payment and at all times thereafter when Design/Builder may be correcting, removing or replacing defective Construction in accordance with paragraphs 12.06 and 12.07; and

7. With respect to completed operations insurance, and any other insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment (and Design/Builder shall furnish Owner and each other additional insured indicated in the Supplementary Conditions to whom a certificate of insurance has been issued evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter).

5.05 Owner's Liability Insurance

A. In addition to the insurance required to be provided by Design/Builder under paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense

Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 Property Insurance

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Construction at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws or Regulations). This insurance will:

1. Include the interests of Owner, Owner's Consultant, Design/Builder, Subcontractors, and any other individuals or entities indicated in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

2. Be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Construction, temporary buildings, falsework and all materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws or Regulations, water damage, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. Include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. Cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Construction, provided that such materials and equipment have been included in an Application for Payment approved by Owner;

5. Allow partial utilization in accordance with paragraph 13.06;

6. Include testing and startup; and

7. Be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner and Design/Builder with thirty days' written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery insurance or additional property insurance as may be required by the Supplementary Conditions or Laws or Regulations which will include the interests of Owner, Owner's Consultants, Design/Builder, Subcontractors, and any other individuals or entities indicated in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by Owner in accordance with paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days' prior written notice has been given to Design/Builder and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance to protect the interests of Design/Builder, Subcontractors, Suppliers, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount, will be borne by Design/Builder, Subcontractor or others suffering any such loss and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Design/Builder requests in writing that other special insurance be included in the property insurance policies provided under paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Design/Builder by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Design/Builder whether or not such other insurance has been procured by Owner.

5.07 Waiver of Rights

A. Owner and Design/Builder intend that all policies purchased in accordance with paragraph 5.06 will protect Owner, Owner's Consultant, Design/Builder, Subcontractors, Suppliers, and all other individuals or entities indicated in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or additional insureds thereunder. Owner and Design/Builder waive all rights against each other and their respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition,

waive all such rights against Owner's Consultant, Subcontractors, Suppliers, and all other individuals or entities indicated in the Supplementary Conditions to be listed as insureds or additional insureds under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Design/Builder, Subcontractors, and Suppliers and the officers, directors, employees and agents of any of them for:

1. Loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property caused by, arising out of or resulting from fire or other peril whether or not insured by Owner; and

2. Loss or damage to the completed Project or any part thereof caused by, arising out of. or resulting from fire or other insured peril or cause or loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to paragraph 13.06, after Substantial Completion pursuant to paragraph 13.05, or after final payment pursuant to paragraph 13.08.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Design/Builder, Subcontractors, Owner's Consultant, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them.

5.08 Receipt and Application of Insurance Proceeds

A. Any insured loss under the policies of insurance required by paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the insureds, as their interests may appear, subject to the requirements of any applicable mortgage clause and of paragraph 5.08.B. Owner shall deposit in a separate account any money so received, and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached the damaged Construction shall be repaired or replaced, the moneys so received applied on account thereof and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 Acceptance of Bonds and Insurance; Option to Replace

A. If either Owner or Design/Builder has any objection to the coverage afforded by or other provisions of the Bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of their not complying with the Contract Documents, the objecting party shall so notify the other party in writing within ten days after receipt of the certificates (or other evidence requested) required by paragraph 2.04.C. Owner and Design/Builder shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the Bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent Bonds or insurance to protect such other party's interests at the expense of the party who was supposed to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 Partial Utilization, Acknowledgment of Property Insurance

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in paragraph 13.06, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – DESIGN/BUILDER'S RESPONSIBILITIES

6.01 Design Professional Services

A. *Standard of Care.* The standard of care for Design Professional Services performed or furnished under this Agreement will be the care and skill ordinarily used by members of the engineering profession practicing under similar conditions at the same time and locality.

B. *Preliminary Design Phase.* After the Contract Times commence to run, Design/Builder shall:

1. Consult with Owner to understand Owner's requirements for the Project and review available data;

2. Advise Owner as to the necessity of Owner's providing or obtaining from others additional reports, data, or services of the types provided in paragraph 8.01.A.6.a-g and assist Owner in obtaining such reports, data, or services;

3. Identify and analyze requirements of governmental authorities having jurisdiction to approve the portions of the Project designed or specified by Design/Builder with whom consultation is to be undertaken in connection with the Project;

4. Obtain such additional geotechnical and related information which it deems necessary for performance of the Work;

5. On the basis of the Conceptual Documents and Design/Builder's Proposal, prepare preliminary design documents consisting of final design criteria, preliminary drawings, outline specifications, and written descriptions of the Project;

6. Furnish the preliminary design documents to and review them with Owner within the times indicated in the schedules described in paragraphs 2.06.A.1 and 2.06.A.2; and

7. Identify any variations in the preliminary design documents from the Contract Documents in accordance with 6.17.B.

C. *Final Design Phase.* After written acceptance by Owner of the preliminary design phase documents Design/Builder shall:

1. On the basis of the accepted Preliminary Design Phase documents, prepare final Drawings showing the scope, extent, and character of the Construction to be performed and furnished by Design/Builder and Specifications (which will be prepared, where appropriate, in general conformance with the sixteen division format of the Construction Specifications Institute);

2. Provide technical criteria, written descriptions and design data required for obtaining approvals of such governmental authorities as have jurisdiction to review or approve the final design of the Project, and assist Owner in consultations with appropriate authorities;

3. Furnish the above documents, Drawings, and Specifications to and review them with Owner within the times indicated in the schedules described in paragraphs 2.06.A.1 and 2.06.A.2; and

4. Identify any deviations from other Contract Documents in accordance with paragraph 6.17.B.

6.02 Supervision and Superintendence of Construction

A. Design/Builder shall supervise, inspect and direct the Construction competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to provide the Construction in accordance with the Contract Documents. Design/Builder shall be solely responsible for the means, methods, techniques, sequences and procedures of Construction. Design/Builder shall be responsible to see that the completed Construction complies accurately with the Contract Documents and shall keep Owner advised as to the quality and progress of the Construction.

B. At all times during the progress of Construction, the Design/Builder shall assign a competent resident superintendent thereto, who shall not be replaced without written notice to Owner except under extraordinary circumstances. The superintendent will be Design/Builder's representative at the Site and shall have authority to act on behalf of Design/Builder. All communications given to or received from the superintendent shall be binding on Design/Builder.

6.03 Labor, Working Hours

A. Design/Builder shall provide competent, suitably qualified personnel to perform the Work as required by the Contract Documents. Design/Builder shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise indicated in the Contract Documents, all Construction at the Site shall be performed during regular working hours, and Design/Builder will not permit overtime work or the performance of Construction on Saturday, Sunday or any legal holiday without Owner's written consent, which will not be unreasonably withheld.

6.04 Services, Materials, and Equipment

A. Unless otherwise specified in the Contract Documents, Design/Builder shall furnish or cause to be furnished and assume full responsibility for materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the Work.

B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All warranties and guarantees specifically called for by the Contract Documents shall expressly run to the benefit of Owner. If reasonably required by Owner, Design/Builder shall furnish satisfactory

evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment. All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise provided in the Contract Documents.

6.05 Progress Schedule

A. Design/Builder shall adhere to the progress schedule established in accordance with paragraph 2.06.A as it may be adjusted from time to time as provided below:

1. Design/Builder shall submit to Owner for acceptance proposed adjustments in the progress schedule that will not change the Contract Times (or Milestones). Such adjustments will conform generally to the progress schedule then in effect.

2. Proposed adjustments in the progress schedule that will change the Contract Times (or Milestones) shall be submitted in accordance with the requirements of Article 11.02. Such adjustments may only be made by a Change Order or .

6.06 Concerning Subcontractors, Suppliers, and Others

A. Design/Builder shall not employ any Subcontractor, Supplier, or other individual or entity against whom Owner may have reasonable objection. Design/Builder shall not be required to employ any Subcontractor, Supplier or other individual or entity to furnish or perform any of the Work against whom Design/Builder has reasonable objection.

B. Design/Builde0r shall be fully responsible to Owner for all acts and omissions of the Subcontractors, Suppliers and other individuals or entities performing or furnishing any of the Work just as Design/Builder is responsible for Design/Builder's own acts and omissions. Nothing in the Contract Documents shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner and any such Subcontractor, Supplier, or other individual or entity, nor shall it create any obligation on the part of Owner to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws or Regulations.

C. Design/Builder shall be solely responsible for scheduling and coordinating Subcontractors, Suppliers and other individuals and entities performing or furnishing any of the Work under a direct or indirect contract with Design/Builder.

D. Design/Builder shall require all Subcontractors, Suppliers and such other individuals and entities performing or furnishing any of the Work to communicate with the Owner through Design/Builder.

E. All Work performed for Design/Builder by a Subcontractor or Supplier will be pursuant to an appropriate Design Subagreement or Construction Subagreement between Design/Builder and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner. Whenever any such agreement is with a Subcontractor or Supplier who is listed as an additional insured on the property insurance provided in paragraph 5.06, the agreement between the Design/Builder and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Design/Builder, Owner's Consultant, and all other additional insureds (and their officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them) for all losses and damages caused by any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Design/Builder will obtain the same.

6.07 Patent Fees and Royalties

A. Design/Builder shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Conceptual Documents for use in the performance of the Construction and if to the actual knowledge of Owner its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Conceptual Documents.

B. To the fullest extent permitted by Laws or Regulations, Design/Builder shall indemnify and hold harmless Owner and Owner’s Consultant, and the officers, directors, partners, employees or agents, and other consultants of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or resulting from any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device not identified in the Conceptual Documents.

C. To the fullest extent permitted by Laws or Regulations, Owner shall indemnify and hold harmless Design/Builder and its officers, directors, partners, employees or agents, Subcontractors and Suppliers from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or resulting from any

infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product or device required by the Conceptual Documents.

6.08 Permits

A. Unless otherwise provided in the Contract Documents, Design/Builder shall obtain and pay for all necessary permits, licenses, and approvals of governmental authorities having jurisdiction over the Work. Owner shall assist Design/Builder, when necessary, in obtaining such permits, licenses and approvals. Design/Builder shall pay all governmental charges and inspection fees necessary for the performance of the Work, which are applicable on the last day for receipt of Proposals. Design/Builder shall pay all charges of utility owners for connections to the Work, and Owner shall pay all charges of such utility owners for capital costs related thereto.

6.09 Laws or Regulations

A. Design/Builder shall give all notices required by and comply with all Laws or Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, Owner shall not be responsible for monitoring Design/Builder's compliance with any Laws or Regulations.

B. If Design/Builder performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Design/Builder shall bear all costs arising therefrom.

C. Changes in Laws or Regulations not known on the date of receipt of Proposals having an effect on the cost or time of performance may be the subject of a change in Contract Price or Contract Times.

6.10 Taxes

A. Design/Builder shall pay all sales, consumer, use, and other similar taxes required to be paid by Design/Builder in accordance with the Laws or Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 Use of Site and Other Areas

A. Limitation on Use of Site and Other Areas.

1. Design/Builder shall confine construction equipment, the storage of materials and equipment, and the operations of construction workers to the Site and other areas permitted by Laws or Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Design/Builder shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof or of any adjacent land or areas, resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of Work, Design/Builder shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws or Regulations, Design/Builder shall indemnify and hold harmless Owner, Owner's Consultants and anyone directly or indirectly employed by any of them from and against all claims, costs, losses and damages (including, but not limited to, fees of engineers, architects, attorneys and other professionals and court and arbitration or other dispute resolution costs) arising out of or resulting from any claim brought by any such owner or occupant against Owner, or any other party indemnified hereunder to the extent caused by or based upon Design/Builder's performance of the Construction.

B. *Removal of Debris.* During the performance of the Construction, Design/Builder shall keep the premises free from accumulations of waste materials, rubbish, and other debris resulting from the Construction. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws or Regulations.

C. *Cleaning.* Prior to Substantial Completion, Design/Builder shall clean the Site and make it ready for utilization by Owner. At completion of Construction, Design/Builder shall remove all tools, appliances, construction equipment, temporary construction and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures.* Design/Builder shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Design/Builder subject any part of the Construction or adjacent property to stresses or pressures that will endanger it.

6.12 Record Documents

A. Design/Builder shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Field Orders and Work Change Directives in good order and annotated to show all changes made during performance of the Work. These record documents together with all approved Submittals will be available to Owner for reference. Upon completion of the Work, these record documents and Submittals, including a reproducible set of record drawings, will be delivered to Owner.

6.13 Safety and Protection

A. Design/Builder shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Design/Builder shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. All persons on the Site or who may be affected by the Work;

2. All Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. Other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground facilities not designated for removal, relocation, or replacement in the course of construction.

B. Design/Builder shall comply with applicable Laws or Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Design/Builder shall notify owners of adjacent property and of underground facilities and utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. All damage, injury, or loss to any property referred to in paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Design/Builder, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Design/Builder.

D. Design/Builder's duties and responsibilities for safety and for protection of the construction shall continue until such time as all the Work is completed and Owner has issued a notice to Design/Builder in accordance with paragraph 13.08.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 Safety Representative

A. Design/Builder shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 Hazard Communication Programs

A. Design/Builder shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 Emergencies

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Design/Builder is obligated to act to prevent threatened damage, injury or loss. Design/Builder shall give Owner prompt written notice if Design/Builder believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If a change in the Contract Documents is required because of the action taken by Design/Builder in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 Submittals

A. Owner will review and approve Submittals in accordance with the schedule of required Submittals accepted by Owner as required by paragraph 2.06.A. Owner's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the construction, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Owner's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

B. Owner's review and approval of Submittals shall not relieve Design/Builder from responsibility for any variation from the requirements of the Contract Documents unless Design/Builder has in a separate written communication at the time of submission called Owner's attention to each such variation and Owner has given written approval.

C. Construction prior to Owner's review and approval of any required Submittal will be at the sole risk of Design/Builder.

6.18 Continuing the Work

A. Design/Builder shall continue the Work and adhere to the progress schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending

resolution of any disputes or disagreements, except as Design/Builder and Owner may otherwise agree in writing.

6.19 Post-Construction Phase

A. Design/Builder shall:

1. Provide assistance in connection with the start-up, testing, refining and adjusting of any equipment or system.

2. Assist Owner in training staff to operate and maintain the Work.

3. Assist Owner in developing systems and procedures for control of the operation and maintenance of and record keeping for the Work.

6.20 Design/Builder's General Warranty and Guarantee

A. Design/Builder warrants and guarantees to Owner that all Construction will be in accordance with the Contract Documents and will not be defective. Design/Builder's warranty and guarantee hereunder excludes defects or damage caused by:

1. Abuse, modification or improper maintenance or operation by persons other than Design/Builder, Subcontractors, or Suppliers or any other individual for whom Design/Builder is responsible; or

2. Normal wear and tear under normal usage.

B. Design/Builder's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Design/Builder's obligation to perform the Work in accordance with the Contract Documents:

1. Observations by Owner;

2. The making of any progress or final payment;

3. The issuance of a certificate of Substantial Completion;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any acceptance by Owner or any failure to do so;

6. Any review and approval of a Submittal;

7. Any inspection, test or approval by others; or

8. Any correction of defective Construction by Owner.

6.21 Indemnification

A. To the fullest extent permitted by Laws or Regulations, Design/Builder shall indemnify and hold harmless Owner, Owner's Consultants, and the officers, directors, partners, employees, agents, other consultants and subcontractors of each from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or resulting from the performance of Construction, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom) but only to the extent caused by any negligent act or omission of Design/Builder, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform or furnish any of the Work.

B. In any and all claims against Owner, Owner's Consultant or any of their respective consultants, agents, officers, directors, partners or employees by any employee (or the survivor or personal representative of such employee) of Design/Builder, any Subcontractor, any Supplier, any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, the indemnification obligation under paragraph 6.21.A shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for Design/Builder or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts or other employee benefit acts.

C. The indemnification obligations of Design/Builder under paragraph 6.21.A shall not extend to the liability of Owner's Consultant, and their officers, directors, partners, employees, agents, other consultants, and subcontractors arising out of the preparation or approval of maps, drawings, opinions, reports, surveys, designs, or specifications.

ARTICLE 7 – OTHER CONSTRUCTION

7.01 Related Work at Site

A. Owner may perform other Work related to the Project at the Site by Owner's employees, or let other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. Written notice thereof will be given to Design/Builder prior to starting any such other work; and

2. Design/Builder may make a Claim therefor as provided in Article 9 if Design/Builder believes that such performance will involve additional expense to Design/Builder or requires additional time and the parties are unable to agree as to the amount or extent thereof.

B. Design/Builder shall afford each other contractor who is a party to such a direct contract and each utility owner (and Owner, if Owner is performing the additional work with Owner's employees) proper and safe access to the Site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work and shall properly connect and coordinate the Work with theirs. Unless otherwise provided in the Contract Documents, Design/Builder shall do all cutting, fitting, and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. Design/Builder shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of Owner and the others whose work will be affected. The duties and responsibilities of Design/Builder under this paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Design/Builder in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Design/Builder's Work depends upon work performed or services provided by others under this Article 7, Design/Builder shall inspect such other work and appropriate instruments of service and promptly report to Owner in writing any delays, defects or deficiencies in such other work or services that render it unavailable or unsuitable for the proper execution and results of Design/Builder's Work. Design/Builder's failure so to report will constitute an acceptance of such other work as fit and proper for integration with Design/Builder's Work except for latent or nonapparent defects and deficiencies in such other work.

7.02 Coordination

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. The individual or entity who will have authority and responsibility for coordination of the activities among the various prime contractors will be identified;

2. The specific matters to be covered by such authority and responsibility will be itemized; and

3. The extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility in respect of such coordination.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 General

A. Owner shall do the following in a timely manner so as not to delay the services of Design/Builder:

1. Designate in writing a person to act as Owner's Representative with respect to the services to be rendered under this Agreement. Such person shall have complete authority to transmit instructions, receive information, interpret and define Owner’s policies, make decisions with respect to performance of the Work, and shall provide such other services as may be agreed upon;

2. Provide such legal services as Owner may require with regard to legal issues pertaining to the Project including any that may be raised by Design/Builder;

3. If requested in writing by Design/Builder, furnish reasonable evidence satisfactory to Design/Builder that sufficient funds are available and committed for the entire cost of the Project. Unless such reasonable evidence is furnished, Design/Builder is not required to commence or continue any Work, or may, if such evidence is not presented within a reasonable time, stop Work upon 15 days notice to the Owner;

4. Make payments to Design/Builder promptly when they are due as provided in paragraph 13.03 and 13.08;

5. Furnish the Site as set forth in paragraph 4.01.A;

6. Furnish to Design/Builder, as required for performance of Design/Builder's Services the following, all of which Design/Builder may use and rely upon in performing services under this Agreement:

a. Environmental assessment and impact statements;

b. Property, boundary, easement, right-of-way, topographic, and utility surveys;

c. Property descriptions;

d. Zoning, deed, and other land use restrictions;

e. Engineering surveys to establish reference points for design and construction which in Owner's judgment are necessary to enable Design/Builder to proceed with the Work;

f. Assistance to Design/Builder in filing documents required to obtain necessary permits, licenses, and approvals of governmental authorities having jurisdiction over the Project;

g. Permits, licenses, and approvals of government authorities Owner is specifically required to obtain by the Contract Documents; and

h. All subsurface data at or contiguous to the Site which Owner may have obtained.

7. Review Submittals subject to Owner review pursuant to paragraph 6.17.A; and

8. Provide information known to or in the possession of Owner relating to the presence of materials and substances at the Site which could create a Hazardous Environmental Condition.

8.02 Insurance

A. Owner's responsibilities in respect of purchasing and maintaining liability and property insurance are set forth in Article 5.

8.03 Limitations on Owner's Responsibilities

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Design/Builder's means, methods, techniques, sequences, or procedures of construction or the safety precautions and programs incident thereto, or for any failure of Design/Builder to comply with Laws or Regulations applicable to the furnishing or performance of the Work. Owner will not be responsible for Design/Builder's failure to perform the Work in accordance with the Contract Documents.

8.04 Undisclosed Hazardous Environmental Condition

A. Owner's responsibility in respect of undisclosed Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Materials uncovered or revealed at the Site is set forth in paragraph 4.04.

8.05 Resident Project Representation

A. Owner may furnish a Resident Project Representative to observe the performance of Construction. The duties, responsibilities and limitations of authority of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions.

8.06 Owner's Consultant

A. Owner's Consultant, if any, has no duties, responsibilities, or authorities with respect to Design/Builder, unless so provided in the Supplementary Conditions.

ARTICLE 9 – CHANGES IN THE WORK; CLAIMS

9.01 Authorized Changes in the Work

A. Without invalidating the Agreement and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work within the general scope of the Contract by a Change Order or a Work Change Directive. Upon receipt of any such document, Design/Builder shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

9.02 Unauthorized Changes in the Work

A. Design/Builder shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any Work performed that is not required by the Contract Documents as amended, modified and supplemented as provided in paragraph 3.04, except in the case of an emergency as provided in paragraph 6.16 or in the case of uncovering Construction as provided in paragraph 12.04.

9.03 Claims

A. *Notice.* If Owner and Design/Builder are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or an adjustment of the Contract Times that should be allowed as a result of any order of Owner pursuant to paragraph 9.01.A or other occurrence for which the Contract Documents provide that such adjustment(s) may be made, a Claim may be made therefor. Written notice of intent to make such a Claim shall be submitted to the other party promptly and in no event more than 15 days after the start of the occurrence or event giving rise to the Claim.

B. *Documentation.* Substantiating documentation shall be submitted by the claiming party within 30 days after delivery of the notice required by paragraph 9.03.A.

C. *Decision.* The other party shall render a decision on the Claim no more than 30 days after the receipt of the substantiating documentation required by paragraph 9.03.B. This decision will be final and binding unless the claiming party gives notice of intention to exercise its rights under Article 15 within 30 days of receipt of the decision and exercises such rights within 30 days of giving the notice of intent.

D. *Time Limit Extension.* The time limits of paragraphs 9.03.B and 9.03.C may be extended by mutual agreement.

9.04 Execution of Change Orders

A. Owner and Design/Builder shall execute appropriate Change Orders covering:

1. Changes in the Work which are (i) ordered by Owner pursuant to paragraph 9.01, (ii) required because of acceptance of defective Construction under paragraph 12.08 or Owner's correction of defective Work under paragraph 12.09 or (iii) agreed to by the parties; and

2. Changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive.

9.05 Notice to Sureties

A. If notice of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times) is required by the provisions of any Bond to be given to a surety, the giving of any such notice will be Design/Builder's responsibility. The amount of each applicable Bond will be adjusted to reflect the effect of any such change.

ARTICLE 10 – COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

10.01 Cost of the Work

A. *Costs Included.* The term Cost of the Work means the sum of all costs necessarily incurred and paid by Design/Builder in the proper performance of the Work. When the value of Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Design/Builder will be only those additional or incremental costs required because of the change of the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall include only the following items, and shall not include any of the costs itemized in paragraph 10.01.B:

1. Payroll costs for employees in the direct employ of Design/Builder in the performance of the Work under schedules of job classifications agreed upon by Owner and Design/Builder.

a. Such employees shall include without limitation superintendents, foremen, and other personnel employed full-time at the Site. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits which shall include social security contributions, unemployment, excise and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work after regular working hours, on Saturday, Sunday or legal holidays, shall be included in the above to the extent authorized by Owner.

b. Such employees shall also include engineers, engineering technicians, architects, and others providing Design Professional Services. For purposes of this paragraph 10.01.A.1, Design/Builder shall be entitled to payment for such employees an amount equal to salary costs times a factor, both as designated in the Agreement, for all services performed or furnished by such employees engaged on the Project.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Design/Builder unless Owner deposits funds with Design/Builder with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Design/Builder shall make provisions so that they may be obtained.

3. Payments made by Design/Builder to Subcontractors (excluding payments for Design Professional Services pursuant to paragraph 10.01.A.4) for Work performed or furnished by Subcontractors. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Design/Builder's Cost of the Work and fee.

4. Payments made by Design/Builder for Design Professional Services provided or furnished under a Design Subagreement.

5. Costs of special consultants (including but not limited to testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

6. Supplemental costs including the following items:

a. The proportion of necessary transportation, travel and subsistence expenses of Design/Builder's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office and temporary facilities at the Site and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Design/Builder.

c. Rentals of all construction or engineering equipment and machinery and the parts thereof whether rented from Design/Builder or others in accordance with rental agreements approved by Owner, and the costs of transportation, loading, unloading, installation, dismantling and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Design/Builder is liable, imposed by Laws or Regulations.

e. Deposits lost for causes other than negligence of Design/Builder, any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses, damages, and related expenses caused by damage to the Work not compensated by insurance or otherwise, sustained by Design/Builder in connection with the furnishing and performance of the Work provided they have resulted from causes other than the negligence of Design/Builder, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Design/Builder's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, expressage, and similar petty cash items in connection with the Work.

i. Cost of premiums for all Bonds and insurance Design/Builder is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded.* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Design/Builder's officers, executives, principals (of partnerships and sole proprietorships), general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks and other personnel employed by Design/Builder whether at the Site or in Design/Builder's principal or a branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in paragraph 10.01.A.1, all of which are to be considered administrative costs covered by the Design/Builder's fee.

2. Expenses of Design/Builder's principal and branch offices other than Design/Builder's office at the Site.

3. Any part of Design/Builder's capital expenses, including interest on Design/Builder's capital employed for the Work and charges against Design/Builder for delinquent payments.

4. Costs due to the negligence of Design/Builder, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in paragraph 10.01.A.

C. *Design/Builder's Fee.* When all the Work is performed on the basis of cost-plus, Design/Builder's fee shall be as set forth in the Agreement. When the value of the Work covered by a Change Order is determined on the basis of Cost of the Work, Design/Builder's fee shall be determined as set forth in paragraph 11.01.C.

D. *Documentation.* Whenever the cost of any Work is to be determined pursuant to paragraph 10.01.A and 10.01.B, Design/Builder will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Owner an itemized cost breakdown together with supporting data.

10.02 Cash Allowances

A. The Contract Price includes all allowances so named in the Contract Documents. Design/Builder shall cause the Work so covered to be performed for such sums as may be acceptable to Owner. Design/Builder agrees that:

1. The allowances include the cost to Design/Builder (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Except as set forth in the Contract Documents, Design/Builder's costs for unloading and handling on the Site, labor, installation costs, overhead, profit, and other expenses contemplated for the allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

B. Prior to final payment, an appropriate Change Order will be issued to reflect actual amounts due Design/Builder on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

10.03 Unit Prices

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all of Unit Price Work an amount equal to the sum of the established unit prices for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Design/Builder will be made by Owner.

B. Each unit price will be deemed to include an amount considered by Design/Builder to be adequate to cover Design/Builder's overhead and profit for each separately identified item.

C. Design/Builder or Owner may make a Claim for an adjustment in the Contract Price in accordance with Article 9 if:

1. the quantity of any item of Unit Price Work performed by Design/Builder differs materially and significantly from the estimated quantity of such item indicated in the Contract Documents;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Design/Builder believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes it is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 11 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

11.01 Change of Contract Price

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice delivered by the party making the Claim to the other party promptly in accordance with paragraph 9.03.A.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of paragraph 10.03); or

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with paragraph 11.01.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under paragraph 11.01.B.2, on the basis of the Cost of the Work (determined as provided in paragraph 10.01) plus a Design/Builder's Fee for overhead and profit (determined as provided in paragraph 11.01.C).

C. Design/Builder's Fee: The Design/Builder's fee for overhead and profit on Change Orders shall be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under paragraphs 10.01.A.1.a and 10.01.A.2, the Design/Builder's fee shall be 15 percent;

b. For costs incurred under paragraph 10.01.A.3 10.01.A.4, 10.01.A.5 and 10.01.A.6, the Design/Builder's fee shall be five percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of paragraphs 11.01.C.1 and 11.01.C.2.a is that the Subcontractor who actually performs or furnishes Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under paragraphs 10.01.A.1 and 10.01.A.2 and that any higher tier Subcontractor and Design/Builder will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. The amount of credit to be allowed by Design/Builder to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Design/Builder's fee by an amount equal to five percent of such net decrease; and

e. When both additions and credits are involved in any one change, the adjustment in Design/Builder's fee shall be computed on the basis of the net change in accordance with paragraphs 11.01.C.2.a through 11.01.C.2.d, inclusive.

11.02 Change of Contract Times

A. The Contract Times (or Milestones) may only be changed by a Change Order. Any Claim for an adjustment of the Contract Times (or Milestones) shall be based on written notice pursuant to paragraph 9.03.A.

B. *Delays Beyond Design/Builder's Control.* Where Design/Builder is prevented from completing any part of the Work within the Contract Times (or Milestones) due to delay beyond the control of Design/Builder, the Contract Times (or Milestones) will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in paragraph 11.02.A. Delays beyond the control of Design/Builder shall include, but not be limited to, acts or neglect by Owner, governmental agencies, acts or neglect of utility owners or other contractors performing other construction work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

C. If Owner or other contractor or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Design/Builder shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Design/Builder's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Design/Builder's ability to complete the Work within the Contract Times.

D. If Design/Builder is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Design/Builder, then Design/Builder shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Design/Builder's ability to complete the Work within the Contract Times. Such an adjustment shall be Design/Builder's sole and exclusive remedy for the delays described in this Paragraph 11.02.C.

E. Owner and Owner's Consultant shall not be liable to Design/Builder for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Design/Builder on or in connection with any other project or anticipated project.

F. Design/Builder shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Design/Builder. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Design/Builder.

ARTICLE 12 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE CONSTRUCTION

12.01 Notice of Defects

A. Owner shall give Design/Builder prompt written notice of all defective Construction of which Owner has actual knowledge. All defective Construction may be rejected, corrected or accepted as provided in this Article 12.

12.02 Access to Construction

A. Owner, Owner's Consultants, other representatives and personnel of Owner, independent testing laboratories and governmental agencies with jurisdictional interests will have access to the Site and the Construction at reasonable times for their observation, inspecting, and testing. Design/Builder shall provide them proper and safe conditions for such access and advise them of Design/Builder's Site safety procedures and programs so that they may comply therewith as applicable.

12.03 Tests and Inspections

A. If the Contract Documents or Laws or Regulations of any public body having jurisdiction require any part of the Construction specifically to be inspected, tested or approved, Design/Builder shall assume full responsibility for arranging and obtaining such inspections, tests or approvals, pay all

costs in connection therewith, and furnish Owner the required certificates of inspection or approval. Design/ Builder shall also be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's acceptance of materials or equipment to be incorporated in the Work or of materials, mix designs, or equipment submitted for approval prior to Design/Builder's purchase thereof for incorporation in the Work.

B. Design/Builder shall give Owner reasonable notice of the planned schedule for all required inspections, tests, or approvals.

C. If any Construction (or the construction work of others) that is required to be inspected, tested, or approved is covered by Design/Builder without written concurrence of Owner, it must, if requested by Owner, be uncovered for observation at Design/Builder's expense unless Design/ Builder has given Owner timely notice of Design/Builder's intention to cover the same and Owner has not acted with reasonable promptness in response to such notice.

12.04 Uncovering Construction

A. If any Construction is covered contrary to the written request of Owner, it must, if requested by Owner, be uncovered for Owner's observation and recovered at Design/Builder's expense.

B. If Owner considers it necessary or advisable that covered Construction be observed by Owner or inspected or tested by others, Design/Builder, at Owner's request, shall uncover, expose or otherwise make available for observation, inspection or testing as Owner may require, that portion of the Construction in question, furnishing all necessary labor, material and equipment. If it is found that such Construction is defective, Design/Builder shall pay all costs and damages caused by or resulting from such uncovering, exposure, observation, inspection and testing and of satisfactory replacement or reconstruction, (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals, all court or arbitration or other dispute resolution costs, and all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price, and, if the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Article 9. If, however, such Construction is not found to be defective, Design/Builder shall be allowed an increase in the Contract Price or an extension of the Contract Times (or Milestones), or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Design/Builder may make a Claim therefor as provided in Article 9.

12.05 Owner May Stop Construction

A. If Construction is defective, or Design/Builder fails to supply sufficient skilled workers or suitable materials or equipment, or fails to furnish or perform Construction in such a way that the completed Construction will conform to the Contract Documents, Owner may order Design/Builder to stop Construction or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop Construction will not give rise to any duty on the part of Owner to exercise this right for the benefit of Design/Builder or any other party.

12.06 Correction or Removal of Defective Construction

A. Owner will have authority to disapprove or reject defective Construction and will have authority to require special inspection or testing of the Construction whether or not the Construction is fabricated, installed or completed. If required by Owner, Design/Builder shall promptly, as directed, either correct all defective Construction, whether or not fabricated, installed or completed, or, if the Construction has been rejected by Owner, remove it from the Site and replace it with non-defective Construction. Design/Builder shall bear all direct, indirect, and consequential costs of such correction or removal (including but not limited to fees and charges of engineers, architects, attorneys and other professionals and all court, arbitration, or other dispute resolution costs) arising out of or relating to such correction or removal.

12.07 Correction Period

A. If within one year after the date of Substantial Completion of the entire Work or such longer period of time as may be prescribed by Laws or Regulations or by the terms of any applicable special guarantee required by the Contract Documents or by any specific provision of the Contract Documents, any Construction is found to be defective, Design/Builder shall promptly, without cost to Owner and in accordance with Owner's written instructions, (i) correct such defective Construction, or, if it has been rejected by Owner, remove it from the Site and replace it with Construction that is not defective, and (ii) satisfactorily correct or remove and replace any damage to other Construction or the work of others resulting therefrom. If Design/Builder does not promptly comply with the terms of such instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Construction corrected or the rejected Construction removed and replaced, and all costs, losses, and damages caused by or resulting from such removal and replacement (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals, all court or arbitration or other dispute resolution costs, and all costs of repair or replacement of work of others) will be paid by Design/Builder.

B. In special circumstances where a particular item of equipment is placed in continuous service before Substantial

Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Conceptual Documents.

C. Where defective Construction (and damage to other Construction resulting therefrom) has been corrected, removed or replaced under this paragraph 12.07, the correction period hereunder with respect to such Construction will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

12.08 Acceptance of Defective Construction

A. If, instead of requiring correction or removal and replacement of defective Construction, Owner prefers to accept it, Owner may do so. Design/Builder shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Construction. If any such acceptance occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents, and Owner shall be entitled to an appropriate decrease in the Contract Price reflecting the diminished value of the Construction so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Article 9. If the acceptance occurs after final payment, an appropriate amount will be paid by Design/Builder to Owner.

12.09 *Owner May Correct Defective Construction*

A. If Design/Builder fails within a reasonable time after written notice from Owner to correct defective Construction or to remove and replace rejected Construction as required by Owner in accordance with paragraphs 12.06.A or 12.07.A, or if Design/Builder fails to perform the Construction in accordance with the Contract Documents, or if Design/Builder fails to comply with any other provision of the Contract Documents, Owner may, after seven days' written notice to Design/Builder, correct and remedy any such deficiency.

B. In exercising the rights and remedies under this paragraph 12.09 Owner shall proceed expeditiously. In connection with such corrective and remedial action, Owner may exclude Design/Builder from all or part of the Site, take possession of all or part of the Construction, and suspend Design/Builder's services related thereto, take possession of Design/Builder's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Construction all materials and equipment stored at the Site or for which Owner has paid Design/Builder but which are stored elsewhere. Design/Builder shall allow Owner, Owner's Consultant, Owner's representatives, agents, employees, and other contractors access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All costs, losses, and damages (included but not limited to fees and charges of engineers, architects, attorneys and other professionals, all court or arbitration or other dispute resolution costs and all costs of repair or replacement of work of others) incurred or sustained by Owner in exercising such rights and remedies under this paragraph 12.09 will be charged against Design/Builder and a Change Order will be issued incorporating the necessary revisions in the Contract Documents, and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Article 9.

D. Design/Builder shall not be allowed an extension of the Contract Times (or Milestones) because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this paragraph 12.09.

ARTICLE 13 – PAYMENTS TO DESIGN/BUILDER AND COMPLETION

13.01 *Schedule of Values*

A. The Schedule of Values established as provided in paragraph 2.06.A will serve as the basis for progress payments. Progress payments on account of Unit Price Work will be based on the number of units completed.

13.02 *Application for Progress Payment*

A. On or about the date established in the Agreement for submission of each application for progress payment (but not more often than once a month), Design/Builder shall submit to Owner for review an Application for Payment filled out and signed by Design/Builder covering the Work completed as of the date indicated on the Application and accompanied by supporting documentation as required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect Owner's interest therein, all of which will be satisfactory to Owner.

B. Beginning with the second Application for Payment, each Application shall include an affidavit of Design/Builder stating that all previous progress payments received on account of the Work have been applied on account to discharge Design/Builder's legitimate obligations associated with prior Applications for Payment.

C. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

13.03 *Progress Payments*

A. *Procedure.* Progress payments shall be made by the Owner to the Design/Builder according to the following procedure:

1. Owner will, within ten days of receipt of each Application for Payment, either indicate in writing its acceptance of the Application and state that the Application is being processed for payment, or return the Application to Design/Builder indicating in writing its reasons for refusing to accept the Application. Not more than ten days after accepting such Application the amount will become due and when due will be paid by Owner to Design/Builder.

2. If Owner should fail to pay Design/Builder at the time the payment of any amount becomes due, then Design/Builder may, at any time thereafter, upon serving written notice that he will stop the Work within seven days after receipt of the notice by Owner, and after such seven day period, stop the Work until payment of the amount owing has been received. Written notice shall be deemed to have been duly served if sent by certified mail to the last known business address of Owner.

3. Payments due but unpaid shall bear interest at the rate specified in the Agreement.

4. No Progress Payment nor any partial or entire use or occupancy of the Project by Owner shall constitute an acceptance of any Work not in accordance with the Contract Documents.

B. *Reduction in or Refusal to Make Payment.* Owner may refuse to make the whole or any part of any such payment, or because of subsequently discovered evidence or the results of subsequent inspections or tests, nullify any previous payment, to the extent that is reasonably necessary to protect Owner from loss because:

1. the Construction is defective, or completed Construction has been damaged requiring correction or replacement; or

2. the Contract Price has been reduced by Change Order; or

3. Owner has been required to correct defective Construction or complete Work in accordance with paragraph 12.09.A; or

4. Owner has actual knowledge of the occurrence of any of the events enumerated in paragraphs 14.02.A.; or

5. Claims have been made against Owner on account of Design/Builder's performance or furnishing of the Work; or

6. Liens have been filed in connection with the Work, except where Design/Builder has delivered a specific Bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

7. There are other items entitling Owner to a set off against the amount for which application is made.

C. If Owner refuses to make payment of the full amount requested by Design/Builder, Owner must give Design/Builder immediate written notice stating the reasons for such action and promptly pay Design/Builder any amount remaining after deduction of the amount withheld. Owner shall promptly pay Design/Builder the amount withheld or any adjustment thereto agreed to when Design/Builder corrects to Owner's satisfaction the reason for such action.

13.04 *Design/Builder's Warranty of Title*

A. Design/Builder warrants and guarantees that title to all Construction, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

13.05 *Substantial Completion*

A. When Design/Builder considers the Work ready for its intended use Design/Builder shall notify Owner in writing that the Work is substantially complete (except for items specifically listed by Design/Builder as incomplete) and request that Owner issue a certificate of Substantial Completion. Promptly thereafter, Owner and Design/Builder shall make an inspection of the Work to determine the status of completion. If Owner does not consider the Work substantially complete, Owner will notify Design/Builder in writing giving the reasons therefor. If Owner considers the Work substantially complete, Owner will prepare and deliver to Design/Builder a certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a list of items to be completed or corrected before final payment. At the time of delivery of the certificate of Substantial Completion Owner will deliver to Design/Builder a written determination as to division of responsibilities pending final payment between Owner and Design/Builder with respect to security, operation, safety, protection of Construction, maintenance, heat, utilities, insurance and warranties and guarantees.

B. Owner will have the right to exclude Design/Builder from the Site after the date of Substantial Completion, but Owner will allow Design/Builder reasonable access to complete or correct items on the list of items to be completed.

13.06 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Construction which (i) has specifically been identified in the Contract Documents, or (ii) Owner and Design/Builder agree constitute a separately functioning and usable part of the Construction that can be used by Owner for its intended purpose without significant interference with Design/ Builder's performance of the remainder of the Construction, subject to the following:

1. Owner at any time may request Design/Builder in writing to permit Owner to use or occupy any such part of the Construction which Owner believes to be ready for its intended use and substantially complete. If Design/Builder agrees that such part of the Work is substantially complete, Design/Builder will certify to Owner that such part of the Construction is substantially complete and request Owner to issue a certificate of Substantial Completion for that part of the Construction. Design/Builder at any time may notify Owner in writing that Design/Builder considers any such part of the Work ready for its intended use and substantially complete and request Owner to issue a certificate of Substantial Completion for that part of the Work. Within a reasonable time after either such request, Owner and Design/Builder shall make an inspection of that part of the Work to determine its status of completion. If Owner does not consider that part of the Work to be substantially complete, Owner will notify Design/Builder in writing giving the reasons therefor. If Owner considers that part of the Work to be substantially complete, the provisions of paragraph 13.05 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

2. No use or occupancy of part of the Construction will be accomplished prior to compliance with the requirements of paragraph 5.10 regarding property insurance.

13.07 *Final Inspection*

A. Upon written notice from Design/Builder that the entire Work or an agreed portion thereof is complete, Owner will make a final inspection with Design/Builder and will notify Design/Builder in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Design/Builder shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

13.08 *Final Payment*

A. Application for Payment.

1. After Design/Builder has completed all such corrections to the satisfaction of Owner and delivered in accordance with the Contract Documents all maintenance and operating instructions, schedules, guarantees, Bonds, certificates or other evidence of insurance, certificates of inspection, record documents (as provided in paragraph 6.12) and other documents, Design/Builder may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (unless previously delivered) by: (i) all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by paragraph 5.04.B.7; (ii) consent of the surety, if any, to final payment; and (iii) complete and legally effective releases or waivers (satisfactory to Owner) of all Liens arising out of or filed in connection with the Work.

3. In lieu of such releases or waivers of Liens specified in paragraph 13.08.A.2 and as approved by Owner, Design/Builder may furnish receipts or releases in full and an affidavit of Design/Builder that: (i) the releases and receipts include all labor, services, material and equipment for which a Lien could be filed, and (ii) all payrolls, material and equipment bills and other indebtedness connected with the Work for which Owner or Owner's property might in any way be responsible have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Design/Builder may furnish a Bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. Final Payment and Acceptance. If Owner is satisfied that the Work has been completed and Design/Builder's other obligations under the Contract Documents have been fulfilled, Owner will, within ten days after receipt of the final Application for Payment, give written notice to Design/Builder that the Work is acceptable. Otherwise, Owner will return the Application to Design/Builder, indicating in writing the reasons for refusing to process final payment, in which case Design/Builder shall make the necessary corrections and resubmit the Application.

C. *Payment Becomes Due.* Thirty days after the presentation to Owner of the acceptable Application and accompanying documentation, in appropriate form and substance and with Owner's notice of acceptability, the amount will become due and will be paid by Owner to Design/Builder.

13.09 *Final Completion Delayed*

A. If, through no fault of Design/Builder, final completion of the Work is significantly delayed, Owner shall, upon receipt of Design/Builder's final Application for Payment, and without terminating the Agreement, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if Bonds

have been furnished as required in paragraph 5.01.A, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Design/Builder to Owner with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

13.10 ***Waiver of Claims***

A. The making and acceptance of final payment will constitute:

1. A waiver of all Claims by Owner against Design/Builder, except Claims arising from unsettled Liens, from defective Construction appearing after final inspection pursuant to paragraph 13.07, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Design/Builder's continuing obligations under the Contract Documents; and

2. A waiver of all Claims by Design/Builder against Owner other than those previously made in writing and still unsettled.

ARTICLE 14 – SUSPENSION OF WORK AND TERMINATION

14.01 ***Owner May Suspend Work***

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 days by notice in writing to Design/Builder which will fix the date on which Work will be resumed. Design/Builder shall resume the Work on the date so fixed. Design/Builder shall be allowed an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Design/Builder makes a Claim therefor as provided in Article 9.

14.02 ***Owner May Terminate for Cause***

A. The occurrence of any one or more of the following events justifies termination for cause:

1. Design/Builder's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the progress schedule established under paragraph 2.06.A as adjusted from time to time pursuant to paragraph 6.05).

2. Design/Builder's disregard of Laws or Regulations of any public body having jurisdiction.

3. Design/Builder's violation in any substantial way of provisions of the Contract Documents.

B. If one or more of the events identified in paragraph 14.02.A occur, Owner may, after giving Design/Builder (and the surety, if any) seven days' written notice, terminate the services of Design/Builder, take possession of any completed Drawings and Specifications prepared by or for Design/Builder (subject to the indemnification provisions of paragraph 3.05.A), exclude Design/Builder from the Site, and take possession of the Work and of all Design/Builder's tools, appliances, construction equipment and machinery at the Site and use the same to the full extent they could be used by Design/Builder (without liability to Design/Builder for trespass or conversion), incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Design/Builder but which are stored elsewhere, and finish the Work as Owner may deem expedient. In such case Design/Builder shall not be entitled to receive any further payment until the Work is finished. If the unpaid balance of the Contract Price exceeds all costs, losses and damages sustained by Owner arising out of or resulting from completing the Work (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) such excess will be paid to Design/Builder. If such costs, losses and damages exceed such unpaid balance, Design/Builder shall pay the difference to Owner. Such costs, losses and damages incurred by Owner will be incorporated in a Change Order. When exercising any rights or remedies under this paragraph Owner shall not be required to obtain the lowest price for the Work performed.

C. Notwithstanding paragraph 14.02.B, Design/ Builder's services will not be terminated if Design/Builder begins, within seven days of receipt of notice of intent to terminate, to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

D. Where Design/Builder's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Design/Builder then existing or which may thereafter accrue. Any retention or payment of moneys due Design/Builder by Owner will not release Design/Builder from liability.

14.03 ***Owner May Terminate for Convenience***

A. Upon seven days' written notice to Design/Builder, Owner may, without cause and without prejudice to any other right or remedy of Owner, elect to terminate the Contract. In such case, Design/Builder shall be paid (without duplication of any items) for:

1. Completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. Expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. Amounts paid in settlement of terminated contracts with Subcontractors, Suppliers and others (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs incurred in connection with termination of contracts with Subcontractors, Suppliers and others); and

4. Reasonable expenses directly attributable to termination.

B. Except as provided in paragraph 14.03.C, Design/Builder shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

14.04 ***Design/Builder May Stop Work or Terminate***

A. If, through no act or fault of Design/Builder, the Work is suspended for a period of more than 90 days by Owner or under an order of court or other public authority, or Owner fails to act on any Application for Payment within thirty days after it is submitted or Owner fails for thirty days to pay Design/Builder any sum finally determined to be due, then Design/Builder may, upon seven days' written notice to Owner, and provided Owner does not remedy such suspension or failure within that time, terminate the Agreement and recover from Owner payment on the same terms as provided in paragraph 14.03.A. In lieu of terminating the Agreement and without prejudice to any other right or remedy, if Owner has failed for 30 days to pay Design/Builder any sum finally determined to be due, Design/Builder may upon seven days' written notice to Owner stop the Work until payment is made of all such amounts due Design/Builder, including interest thereon. The provisions of this paragraph 14.04.A are not intended to preclude Design/Builder from making Claim under Article 9 for an increase in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Design/Builder's stopping Work as permitted by this paragraph.

ARTICLE 15 – DISPUTE RESOLUTION

15.01 ***Methods and Procedures***

A. Dispute resolution methods and procedures, if any, shall be as set forth in the Supplementary Conditions. If no such method and procedure has been set forth, Owner and Design/Builder may exercise such rights or remedies as either may otherwise have under the Contract Documents or by Laws or Regulations in respect of any dispute.

ARTICLE 16 – MISCELLANEOUS

16.01 ***Giving Notice***

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by certified mail, postage prepaid, to the last business address known to the giver of the notice.

16.02 ***Computation of Times***

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

16.03 ***Cumulative Remedies***

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by:

1. Laws or Regulations; or

2. any special warranty or guarantee; or

3. other provisions of the Contract Documents.

B. The provisions of paragraph 16.03.A will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right and remedy to which they apply.

16.04 ***Survival of Obligations***

A. All representations, indemnifications, warranties and guarantees made in, required by or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive

final payment, completion and acceptance of the Work and termination or completion of the Contract.

16.05 ***Controlling Law***

A. The Contract Documents will be construed in accordance with the law of the place of the Project.

SUPPLEMENTARY CONDITIONS

The Supplementary Conditions amend or supplement the General Conditions (Standard General Conditions of the Contract between Owner and Design/Builder, 2002 Edition, EJCDC D-700) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and affect.

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SUPPLEMENTARY CONDITIONS

The terms used in these Supplementary Conditions that are defined in the Standard General Conditions of the Contract between Owner and Design/Builder (EJCDC D-700, 2002 Edition) have the meanings assigned to them in the General Conditions.

SC-1.01 Definitions

Delete paragraph 1.01.A.27 of the General Conditions in its entirety and insert the following in its place:

27. Contract times will commence to run on the Effective Date of the Agreement.

Add the following definitions after General Conditions 1.01.A.48

49. Target Cost – The Target Cost for the Work shall be defined as follows:

a. After award of the contract, the Design/Builder shall prepare and submit a preliminary budget construction cost estimate with the Design Memorandum. Section III, Scope of Design Services, Paragraph A.9. included in the RFP provides a brief description of this requirement.

b. Upon completion of 60% design, including incorporation of Owner's comments, the Design/Builder shall develop and present a final detailed estimate of the cost of the construction activities to the Owner. The Supplementary Conditions, SC-6.01 Design Professional Services, and SC-10.01 Cost of the Work included in the RFP provides a detailed description of this requirement.

SC-1.02 Terminology

Add the following terms after General Conditions 1.02.A.7

8. Whenever the term "Water Company" is used in these Contract Documents, it shall have the same meaning as Owner.

9. Whenever the terms CONTRACTOR or CONSULTANT (upper or lower case spellings) is used it shall have the same meaning as Design/Builder.

SC-2.02 Commencement of Contract Times; Notice to Proceed

Delete paragraph 2.02.A of the General Conditions in its entirety and insert the following in its place:

The Contract Times will commence to run on the Effective Date of the Agreement.

SC-3.05 Reuse of Documents

Delete paragraph 3.05.A of the General Conditions in its entirety and insert the following in its place:

Drawings, specifications, and other work products of the Design/Builder for this project, except working notes and internal documents, become the property of the Owner upon delivery thereof to Owner and payment for the services that produced said documents in accordance with this Agreement. Reuse of any of these drawings, specifications, or other work products of the Design/Builder by the Owner for other than the specific project covered in this Agreement, or modification and use by the Owner of any documents connected with this Agreement, without the written permission of the Design/Builder shall be at the Owner's risk and the Owner agrees to defend, indemnify, and hold harmless the Design/Builder from all claims, damages and expenses including attorney's fees arising out of such unauthorized reuse of the Design/Builder work product by the Owner or by others acting through the Owner. The Design/Builder shall be entitled to a reproducible copy of all material furnished to the Owner. Any uncompleted work of the Design/Builder delivered to the Owner due to cancellation of all or portions of the work or contract termination, which are utilized by the Owner in any way, shall have the Design/Builder name removed, and the Owner agrees to defend, indemnify, and hold harmless the Design/Builder from all claims, damages, and expenses including attorney's fees arising from any use by Owner of such uncompleted work.

SC-4.03 Reference Points

Amend the first sentence of paragraph 4.03.A of the General Conditions to read as follows:

Design/Builder shall be responsible for laying out the construction and shall protect and preserve the reference points established by Design/Builder and shall make no changes or relocations without the prior written approval of Owner.

SC-4.04 Hazardous Environmental Conditions at Site

Add a new paragraph immediately after paragraph 4.04.F, which is to read as follows:

G. In accordance with the intent of the Federal Occupation Safety and Health Administration (OSHA) Standard Section 29CRF-1910.12, Hazard Communication with effective date May 25, 1986, as amended from time to time, the Owner hereby notifies the Design/Builder Work is to be performed on property where the Design/Builder's employees may be exposed to hazardous materials existing on the premises.

Chemicals known to be used or stored by the Owner and required to be disclosed by said OSHA Standard Section 29CFR-1910.12 are as follows:

- *Sodium Hypochlorite*
- *Polymer*
- *Ortho-Phosphate*

NOTE: Hydrofluosilicic Acid is <u>not</u> used at this facility

Owner, Design/Builder and any Subcontractors will each provide or make available to the others: (a) any written hazard communication program required to be maintained with respect to the site and any material data sheet and other hazard communication required to be provided in accordance with applicable Laws and applicable Regulations, or (b) in the event that applicable

Laws and Regulations do not require the provision or exchange of such hazard communications, Design/Builder and any Subcontractors shall, nevertheless, provide or make available to Owner and any other employers at the site a written hazard communication program, material safety data sheets and any other hazard communication information of the type consistent with the intent of OSHA Standard Section 29CFR-1910.12 and acceptable to Owner. Design/Builder shall be responsible for coordinating any such required exchange of documents or information between or among Owner, and any other employers at the site, or any of them. Design/Builder shall include the provisions of this paragraph SC-4.04.G in any subcontract for any part of the Work at the site.

SC-5.01 Performance, Payment and Other Bonds

Delete Paragraph 5.01 of the General Conditions in its entirety and replace with the following:

A. Design/Builder agrees to include in its subcontracts with major subcontractors a requirement for such subcontractors to furnish a Performance Bond and a Labor and Material Payment Bond, each in an amount equal to the Subcontract price and each naming the Owner and Design/Builder as co-obligees, as security for the faithful performance and payment of all such subcontractors' obligations under their respective subcontract documents. These Bonds shall remain in effect at least until one year after the date when final payment becomes due, except as otherwise provided by Laws or Regulations. All bonds furnished in compliance with the above shall be executed by sureties having a rating of "A" by the most recent Best's Key Rating Guide and as are named in the current list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Audit Staff, Bureau of Government Financial Operations, U.S. Treasury Department. All Bonds signed by an agent must be accompanied by a certified copy of such agent's authority to act.

B. Design/Builder is not required to furnish a Performance or Labor and Material Payment Bond at the time of award. If Owner requests at a later date that such bonds be furnished, Design/Builder will provide the bonds from a surety meeting the requirements of Paragraph 5.01A above. In this case Design/Builder's Fee will be increased in an amount equal to the premium paid for the bonds requested by Owner.

SC-5.04 Design/Builder's Liability Insurance

The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

Workmen's Compensation Insurance: The Design/Builder shall carry Workmen's Compensation Insurance during the life of the Contract to insure his statutory liability to his employees in the state or states in which the work under this Contract is to be performed, including $1,000,000 Employers Liability Coverage. A Waiver of Subrogation endorsement must accompany the certificate of insurance.

General Liability: The Design/Builder shall carry Commercial General Liability Insurance during the life of the Contract. The policy shall be written on an occurrence basis and shall include broad form property damage coverage. The required limits for this coverage are to meet the limits shown in the sample Certificate of Insurance included in Appendix A of these Supplementary Conditions.

Automobile Liability: The Design/Builder shall carry the Comprehensive form of Automobile Liability and Property Damage Insurance during the life of the Contract. The required limits for this coverage are to meet those shown in the sample Certificate of Insurance included in Appendix A of these Supplementary Conditions.

Umbrella and/or Excess Liability: The Design/Builder shall carry Umbrella and/or Excess Liability Insurance during the life of the Contract with limits meeting those shown in the sample Certificate of Insurance included in Appendix A of these Supplementary Conditions.

Professional Liability Insurance: The Design/Builder shall carry Professional Liability Insurance covering Design/Builder's liabilities for loss due to error, omission, negligence, mistakes or failure to take appropriate action in the performance of business or professional duties of their employees during the life of the Contract with the limits meeting those shown in the sample Certificate of Insurance included in Appendix A of these Supplementary Conditions.

ADD the following language at the end of paragraph 5.04.B.1 of the General Conditions:

The following individuals or entities are to be included on the indicated policies as additional insureds:

- **Owner**

SC-5.06 Property Insurance

Add a new paragraph immediately after paragraph 5.06.E which is to read as follows:

F. The Design/Builder shall bear all risks of all loss or damage to the materials and works until the WORK is finally accepted by the Owner, except that the Design/Builder may claim reimbursement under the Owner's builder's risk insurance policy as herein provided and limited. Owner shall carry "All Risk" Builder's Risk Insurance subject to deductibles, terms and conditions as stated in the policy and below with Design/Builder as an additional insured. It is the obligation and responsibility of the Design/Builder to make appropriate claim to the insurance company for all losses claimed under the policy.

Such insurance shall cover the full value of the cost of replacement to the Owner, less applicable deductibles, of all completed portions of the work to be performed throughout the entire time of construction. The deductibles on each separate and unrelated loss are (1) 5% of the value of loss caused by earthquake and (2) $25,000 on all other losses. Owner will furnish to the Design/Builder evidence of the insurance coverage provided.

Any amounts not reimbursed by the Owner's Builder's Risk Insurance, including without limitation deductible amounts, shall be Cost of the Work and chargeable to the Owner at actual cost in accordance with General Conditions 10.02.

SC-5.07 Waiver of Rights

Delete the last sentence of paragraph 5.07.A of the General Conditions in its entirety.

SC-6.01 Design Professional Services

Add the following to Paragraph 6.01 B after Item 7:

8. Upon completion of 60% design, including reconciliation of Owner's comments, the Design/Builder shall develop and present a detailed estimate of the Cost of the Work to the Owner. The estimate shall be prepared and presented in general conformance with the Sixteen (16) Division Format of the Construction Specifications Institute (CSI). The estimate shall identify the following costs as applicable for each area of Work.

- Direct Labor
- Permanent Materials
- Permanent Equipment
- Subcontract Work
- Allowances and Contingencies
- Temporary Construction
- Construction Equipment, Small Tools, Expenditures, etc.
- Permits, Inspections & Testing
- Utility Connections and Utility Usage
- Miscellaneous

Upon review, comment and approval by Owner, this estimate will form the basis for the Target Cost for the project. With the exception of the purchase of long lead equipment or materials as recommended by Design/Builder and approved by Owner, Design/Builder shall not proceed with construction on the project until such time that the approved Target Cost is established.

SC-6.04 Major Materials and Equipment

Design/Builder shall direct purchase the major materials and equipment for the project. Materials and equipment to be furnished by subcontractors shall be submitted by Design/Builder to Owner for review/comment prior to completion of the Preliminary Design Phase.

SC-6.06 Subcontractors, Suppliers and Others

Add the following to paragraph 6.06A:

Design/Builder shall include a provision in all Subcontracts, Procurement contracts and Purchase Orders stating that by acceptance of the Subcontract, Procurement Contract or Purchase Order the Subcontractor or Supplier provides advanced consent to the assignment of the Subcontract, Procurement Contract or Purchase Order from the Design/Builder to the Owner if desired by the Owner. Under such assignment Owner will assume all benefits, rights and responsibilities of the Design/Builder.

SC-6.08 Permits

Delete paragraph 6.08 of the General Conditions in its entirety and insert the following in its place:

A. Unless otherwise provided in the Contract Documents, Design/Builder shall directly or through one or more Subcontractors obtain all necessary permits and licenses.

Owner shall pay for all necessary permits and licenses, and assist Design/Builder, when necessary, in obtaining such permits and licenses. Owner shall pay all governmental charges and inspection fees necessary for the prosecution of the Construction. Owner shall pay all charges of utility owners for connections to the Work, and Owner shall pay all charges of such utility owners for capital costs related thereto.

B. The necessary permits are to be investigated by Design/Builder and identified in the Design Memorandum.

Any fees that may be required as a result of resubmittal requirements due to incomplete permit applications prepared by the Design/Builder shall be at the cost of the Design/Builder.

SC-6.10 Taxes

Add the following language after Paragraph 6.10.A of the General Conditions which is to read as follows:

The Owner is exempt from State and local privilege (“sales”) and use taxes on certain installation labor, materials and equipment to be incorporated into the project. Design/Builder agrees to work with Owner or Owner’s legal counsel in order to identify nontaxable labor, materials and equipment and taxes on such nontaxable items shall not be included in the Contract Price. See below:

A copy of the Guidelines for the state in which the Project is located is included in Appendix C attached to the Supplementary Conditions.

Design/Builder shall indemnify and hold harmless the Owner for any sales and use tax, which Owner is required to pay by reason of Design/Builder's failure to seek and to implement any available Sales and Use Tax Exemption and Design/Builder's failure to obtain any necessary exemption certificate.

Owner may set off against monies otherwise due Design/Builder hereunder the amount of any sales and use tax, or any other tax, which Owner is required to pay by reason of Design/Builder's failure to comply with Paragraph 6.07 of the General Conditions.

Design/Builder shall furnish evidence satisfactory to Owner that Design/Builder has paid all sales, consumer, use and other similar taxes required to be paid by Design/Builder. Owner reserves the right to audit the Design/Builder's statement prior to release of retainage and final payment.

SC-6.13 Safety and Precaution

Add the following immediately after Paragraph 6.13 B.

Design/Builder shall comply with the applicable requirements of Owner’s safety program. The following Owner safety programs are applicable to the Work:

- American Water - Cut-Off and Ring Saw Safety Operations Practice: PRA-OPS01/02, May 1, 2019.

Design/Builder shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. If Design/Builder notices any conflicts, errors, ambiguities, or discrepancies with Owner's safety program, Design/Builder shall promptly give Owner written notice, and confirm written resolution thereof by Owner is acceptable to Design/Builder.

Design/Builder shall inform Owner and RPR of the specific requirements of Design/Builder's safety program with which Owner's and RPR's employees and representatives must comply while at the Site.

Owner requires that Design/Builder must be registered with and in compliance with Owner's contractor safety management vendor. A Design/Builder not in compliance will not be permitted to perform work for the Owner, unless the Design/Builder receives a variance/waiver by the Owner. A Design/Builder who has received an approved variance/waiver may be subject to additional requirements by the Owner.

SC-8.01 Owner's Responsibility General

Delete paragraph 8.01.A.6.e in its entirety.

Delete paragraph 8.01.A.6.h in its entirety.

SC-8.05 Resident Project Representation

Add the following after paragraph 8.05 A.

The duties, responsibilities and limitations of authority of the Resident Project Representative shall be as follows:

A. General

The Resident Project Representative (RPR) is Owner's agent at the site, will act as directed by and under the supervision of Owner.

B. Duties and Responsibilities of RPR

1. Conference and Meetings: Attend meetings with Design/Builder, such as preconstruction conferences, progress meetings, job conferences and other project-related meetings.

2. Liaison: Serve as Owner's liaison with Design/Builder working principally through Design/Builder's superintendent and assist in understanding the intent of the Contract Documents; and assist the Owner in serving as liaison with Design/Builder when Design/Builder's operations affect Owner's on-site operations.

3. Shop Drawings and Samples: Advise Owner and Design/Builder of commencement of any Work requiring a Shop Drawing or sample if the submittal has not been approved by Design/Builder's design professional or Owner.

4. Review of Work, Rejection of Defective Work, Inspections and Tests:

a. Conduct on-site observations of the Work in progress to assist Owner in determining if the Work is in general proceeding in accordance with the Contract Documents.

b. Report to Owner whenever RPR believes that any Work is unsatisfactory, faulty or defective or does not conform to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made.

c. Verify that tests, equipment and systems startup and operating and maintenance training are conducted in the presence of appropriate personnel, and that Design/Builder maintains adequate records thereof.

5. Modifications: Consider and evaluate Design/Builder's suggestions for modifications in Drawings or Specifications and report with RPR's recommendations to Owner. Transmit to Design/Builder decisions as issued.

6. Payment Requests: Review applications for payment with Design/Builder for compliance with the established procedure for their submission and forward with recommendations to Owner, noting particularly the relationship of the payment requested to the schedule of values, Work completed and materials and delivered at the site but not incorporated in the Work.

7. Completion:

a. Before Owner issues a certificate of Substantial Completion, submit to Design/Builder a list of observed items requiring completion or correction.

b. Conduct final inspection in the company of Owner and Design/Builder and prepare a final list of items to be completed or corrected.

c. Observe that all items on final list have been completed or corrected and make recommendations to Owner concerning acceptance.

C. Limitations of Authority

Resident Project Representative

1. Shall not authorize any deviation from the Contract Documents or substitution of materials or equipment unless authorized by Owner.

2. Shall not exceed limitations of Owner's authority as set forth in the Agreement or the Contract Documents.

3. Shall not undertake any of the responsibilities of Design/Builder, subcontractors or Design/Builder's superintendent.

4. Shall not issue directions relative to, or assume control over, any aspect of the means, methods or techniques of construction unless such directions or control are specifically required by the Contract Documents.

SC-10.01 Cost of the Work

Add the following language immediately after paragraph 10.01.A of the General Conditions:

The Cost of the Work shall include lump sum amounts for Supervision and Superintendence of Construction (including temporary facilities), Design Professional Services for a. Preliminary Design Phase, b. Final Design Phase and c. Construction/operations phase.

The lump sum amount for Supervision and Superintendence of Construction shall include the responsibilities described in General Conditions Article 6.02 and the duties described in General Requirements, Section 1010 - Summary of Work, Paragraph 3.02; Section 1075 – Basis of Payment, Paragraph 1.03; and Section 1500 - Temporary Construction Facilities, Paragraphs 1.01 Water Supply; 1.02 Temporary Heat/Air Conditioning - to include general temporary heating/air conditioning of site office facilities and onsite storage of equipment and materials but not to include permanent heating and air conditioning of plant facilities:, 1.03 Electrical Supply - to include temporary electric for site office facilities and that needed to perform construction but not to include permanent power supply and use for testing and start-up of plant facilities and equipment; 1.04 Temporary Lighting- to include temporary lighting of site offices and exterior security lighting but not to include temporary lighting of construction areas; 1.07 Parking - to include parking for supervisory personnel at the site offices but not to include parking areas for construction personnel; 1.08 Progress Cleaning; 1.09 Sanitary Facilities and 1.10 Field Offices. This lump sum shall cover all project supervisory, administrative and engineering personnel costs including salary, payroll labor burden, vehicles, relocation, travel and living expenses. Also included is field office facility complex costs including trailers, office supplies, office equipment, telephone, postage, blueprinting, utilities and miscellaneous. General site facilities furnished by Design/Builder for use by all contractors and subcontractors shall also be included in this lump sum.

The lump sum amounts for Design Professional Services shall include the work described in General Conditions 6.01. as amended by these Supplementary Conditions and work described in the Scope of Design Services including listed attachments.

Add the following language immediately before paragraph 10.01.A of the General Conditions:

Design/Builder Self Performed Work: The Design/Builder is eligible to perform Work with its own forces either through a negotiated lump sum price or through successful bidding in competition with qualified subcontractors. No later than completion of the Preliminary Design Phase, the Design/Builder shall notify Owner of specific Work they desire to perform with their own forces either through a negotiated price or as the result of competitive bidding. Design/Builder shall provide justification for Work desired to be performed through a negotiated price. If Owner agrees with the justification, Design/Builder shall provide a firm Lump Sum Proposal with a detailed cost breakdown as backup.

If Owner accepts the proposal, the agreed to price will constitute a lump sum cost to be included in the Cost of the Work. The Design/Builder is responsible for completion of the specified Work in accordance with the Contract Documents including warranty provisions for the price

submitted. If Owner rejects the Design/Builder's proposal to self perform specific Work, this Work shall be competitively bid to qualified Subcontractors including the Design/Builder if desired and approved by Owner.

Add the following language at the end of paragraph 10.01.A.2:

To the fullest extent practical, the Design/Builder shall purchase all permanent materials and equipment through documented competitive bidding. Materials and equipment not purchased through competitive bidding shall have prior approval from the Owner.

Add the following language at the end of paragraph 10.01.A.3:

To the fullest extent practical, the Design/Builder shall award all subcontracts through documented competitive bidding. Subcontracts not awarded through competitive bidding shall have prior approval from the Owner.

Add the following language at the end of paragraph 10.01.A.5:

The cost of special consultants shall only be included in the Cost of the Work if they have been authorized by the Owner prior to the furnishing of service.

Add the following language at the end of paragraph 10.01.A.6

The Equipment rental rates to be paid for under a Cost of the Work basis are to be no higher than those prevailing in the locality of the project and shall not exceed 80% of the monthly rental rate determined through proper application of the Equipment Rental Rate Blue Book published by KIII Directory. Monthly operating costs shall be determined by multiplying the blue book estimated hourly operations cost by 120 hours. Prior to using construction equipment owned by Design/Builder or any subsidiary company, provide to Owner a comparison of equipment rental costs between using Design/Builder's equipment versus equipment rented from others.

SC-11 Change of Contract Price

Add the following language immediately before paragraph 11.01 of the General Conditions:

Design/Builder's Fee and provisions for adjustment are provided in the Agreement. In Article 11 of the General Conditions, delete all references to Design/Builder's fee or allowances for overhead and profit. Fee provisions of Article 11 of the General Conditions are applicable to subcontractors performing Work on a Cost of the Work basis per Paragraph 11.01.B.3.

SC-12.03 Tests and Inspections

Add the following language at the end of paragraph 12.03.A of the General Conditions:

All firms and/or inspectors employed by the Design/Builder for the purpose of inspection or testing shall be acceptable to Owner.

SC-13.03 Progress Payments

Amend the second sentence of paragraph 13.03.A.1 of the General Conditions by striking out ten days and inserting twenty days in its place.

SC-13.06 Partial Utilization

SC-13.06.B Add a new paragraph immediately after paragraph 13.06.A.2 of the General Conditions which is to read as follows:

13.06.B. Owner may at any time submit a written request to Design/Builder to permit Owner to take over operation of any such part of the Construction although it is not substantially complete. Owner and Design/Builder shall make an inspection of that part of the Construction to determine its status of completion and will prepare a list of the items remaining to be completed or corrected thereon before final payment. If Design/Builder does not object in writing to Owner that such part of the Construction is not ready for separate operation by Owner, Owner will finalize the list of items to be completed or corrected and will deliver such list to Design/Builder together with a written division of responsibilities pending final payment between Owner and Design/Builder with respect to security, operation, safety, maintenance, utilities, insurance, warranties and guarantees for that part of the Construction which will become binding upon Owner and Design/Builder at the time when Owner takes over such operation. During such operation and prior to substantial completion of such part of the Construction, Owner shall allow Design/Builder reasonable access to complete or correct items on said list and to complete other related Construction.

SC-13.08 Final Application for Payment

Add the following language at the end of paragraph 13.08 A:

With the final payment request, Design/Builder, Subcontractor and Suppliers shall execute and deliver to the Owner their release of liens on forms supplied by Owner. Blank forms are included in Appendix B of these Supplementary Conditions.

SC-16.06 Diversity Subcontractors and Suppliers

Add the following after Paragraph 16.05:

16.06 *Diversity Subcontractors and Suppliers*

A. Definition of a Diversity Subcontractor and Diversity Supplier: A business that provides services or materials to Contractor in fulfillment of this Contract which is at least 51% owned, operated and controlled on a daily basis by a person of one or more of the following characteristics: American citizens of ethnic minority classifications, women, veteran, disabled veteran owned businesses, and disabled owned businesses.
B. It is the Owner's desire that qualified Diversity Subcontractors/Suppliers be utilized as part of the Contract, where the Diversity Subcontractor/Supplier meets the form, fit, and function of the goods and services, and is commercially competitive. The Owner's goal is that at least 20% of the Contract Price be directed to qualified Diversity Subcontractors/Suppliers.
C. Contractor agrees to use best efforts to award subcontracts to qualified Diversity Subcontractors/Suppliers, and in connection therewith Contractor shall complete and submit the

"Supplier Diversity Questionnaire".

D. If Contractor utilizes Diversity Subcontractors/Suppliers to fulfill any portion of this Contract, including freight, Contractor shall report the following to Owner's representative:
   i. Subcontractor's/Supplier's name
   ii. Contact person, including email and phone number
   iii. Subcontractor's/Supplier's Diversity classification and copy of certificate
   iv. Value of subcontract provided to Diversity Subcontractor/Supplier
E. In cases where the Owner's goal is not met, Contractor shall provide documentation of his reasonable effort made in order to meet said goal. Owner has the right to reject Bidder's Bid proposal, in the event that the goal is not met and this documentation of reasonable effort is not sufficient.
F. Contractor shall provide such report on January 30, April 30, July 30 and October 30 for the previous quarter during the contract period and/or not later 30 days prior to Contractor's application for final payment. Contractor shall also report if no Diversity Subcontractors/Suppliers are used in fulfillment of the Contractor's obligations under the Contract.
G. Report to be provided to:

American Water Company
Attn.: Diversity Reporting
Online: https://amwater.quantumsds.com

SUPPLEMENTARY CONDITIONS

APPENDIX A

SAMPLE CERTIFICATE OF INSURANCE

ACORD®

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
VENDOR'S INSURANCE BROKER AND ADDRESS	PHONE (A/C, No, Ext):	FAX (A/C, No):
	E-MAIL ADDRESS:	
	PRODUCER CUSTOMER ID #:	

INSURED	INSURER(S) AFFORDING COVERAGE	NAIC #
CATEGORY 6 DESIGN BUILD - HIGH RISK VENDOR/CONTRACTOR/SUPPLIER ADDRESS	INSURER A : ABC INSURANCE COMPANY	
	INSURER B : DEF INSURANCE COMPANY	
	INSURER C : XYZ INSURANCE COMPANY	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	**GENERAL LIABILITY** [X] COMMERCIAL GENERAL LIABILITY [X] [ ] CLAIMS-MADE [X] OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: [X] POLICY [ ] PRO-JECT [ ] LOC	[X]	[X]	CGL1234	01/01/2016	01/01/2017	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 1,000,000 $ 1,000,000 $ 5,000 $ 1,000,000 $ 1,000,000 $ 1,000,000
A	**AUTOMOBILE LIABILITY** [X] ANY AUTO [ ] ALL OWNED AUTOS [ ] SCHEDULED AUTOS [ ] HIRED AUTOS [ ] NON-OWNED AUTOS	[X]	[X]	AL5678	01/01/2016	01/01/2017	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $
B	[X] **UMBRELLA LIAB** [X] OCCUR **EXCESS LIAB** [ ] CLAIMS-MADE DEDUCTIBLE RETENTION $	[X]	[ ]	XS9876	01/01/2016	01/01/2017	EACH OCCURRENCE AGGREGATE	$ 9,000,000 $ 9,000,000
A	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y / N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? [ ] N / A **(Mandatory in NH)** If yes, describe under SPECIAL PROVISIONS below	N / A	[X]	WC5432	01/01/2016	01/01/2017	[X] WC STATU-TORY LIMITS [X] OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	 $ 1,000,000 $ 1,000,000 $ 1,000,000
C	PROFESSIONAL LIABILITY OR ERRORS & OMISSIONS	[X]	[ ]				EACH CLAIM POLICY LIMIT	$ 5,000,000 $ 5,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

(Reference Project Location or Contract No.) Certificate Holder is included as Additional Insured, except for workers compensation, with respect to liability arising out of the Named Insured's operations as required by written contract. Any coverage afforded to the Certificate Holder shall apply as primary and non-contributory to any other insurance or self insurance available to Certificate Holder. Waiver of subrogation shall apply to all insurance.

CERTIFICATE HOLDER

AMERICAN WATER WORKS SERVICE COMPANY, INC., ITS SUBSIDIARY AND AFFILATED COMPANIES
C/O AVETTA PO BOX 51387 IRVINE, CA, 92619

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

SUPPLEMENTARY CONDITIONS

APPENDIX B

RELEASE OF LIENS

RELEASE OF LIENS

WHEREAS, we, the undersigned, have installed or furnished labor, materials and/or equipment for the installation of the Project entitled **Sheridan Water Treatment Facility**, installed pursuant to a written agreement dated _____, 20___, between the **Water Company**, having an office at 153 N Emerson Ave, Greenwood, IN 46143 , hereinafter called Owner and _____, having an office at _____, hereinafter called Design/Builder, which said facilities are owned by the Owner and described and located as follows:

Sheridan Water Treatment Facility
Sheridan, IN

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the Owner, or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation;

NOW THESE PRESENTS WITNESS that we the undersigned, in consideration of the premises, and of the sum of One Dollar ($1.00) in hand paid by the said Owner, at and before the sealing and delivery hereof, the receipt whereof we do hereby acknowledge, have remised, released and forever quitclaimed, and by these presents do remise, release and forever quitclaim, unto the said Owner, its successors and assigns, any and all manner of liens, claims and demands whatsoever which we now have, or might or could have, on or against the said facilities, or the owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the Owner, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have, or might or could have against the same if these presents had not been made.

IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Company Name _____ (SEAL)

By _____

Title _____

Dated _____, 20___

Sworn to and subscribed before me,
a Notary Public, this _____ day
of _____, 20___.

_____ (SEAL)
Notary Public

I, _____, duly authorized representative of _____, designated as Design/Builder, do hereby state that the parties whose names are signed to the attached releases, pages 1 through ____, are all of the parties who have furnished labor, materials or equipment in connection with the construction of the facilities mentioned above; excepting only such materials as may have been furnished by the Owner.

Dated: _____, 20__

_____
Representative's Signature

Sworn to and subscribed before me,
a Notary Public, this _____ day
of _____, 20___.

_____ (SEAL)
Notary Public

RELEASE OF LIENS

WHEREAS, we, the undersigned, have installed or furnished labor, materials and/or equipment for the installation of the Project entitled **Sheridan Water Treatment Facility**, installed pursuant to a written agreement dated _____, 2020, between the Water Company, having an office at 153 N Emerson Ave, Greenwood, IN 46143, hereinafter called Owner and _____, having an office at _____, hereinafter called Design/Builder, which said facilities are owned by the Owner and described and located as follows:

Sheridan Water Treatment Facility
Sheridan, IN

WHEREAS, we, the undersigned, have agreed to release any and all claims and liens which we have, or might have, against the Owner or said facilities by reason of the labor, materials and equipment furnished by us in connection with said installation;

NOW THESE PRESENTS WITNESS that we, the undersigned, in consideration of the premises, and of the sum of One Dollar ($1.00) in hand paid by the said Owner, at and before the sealing and delivery hereof, the receipt whereof we, do hereby acknowledge, have remised, released and forever quitclaimed, and by these presents do remise, release and forever quitclaim, unto the said Owner, its successors and assigns, any and all manner of liens, claims and demand whatsoever which we now have, or might or could have, on or against the said facilities, or the owner thereof, for work done, or for equipment or materials furnished in connection with the installation thereof. It is the intent of this release that the Owner, its successors and assigns shall and may hold, have, use and enjoy the said facilities free and discharged from all liens and demands whatsoever which we now have, or might or could have against the same if these presents had not been made. And we do further certify and acknowledge, that we have received of and from the said Design/Builder, payment in full on account of labor done or materials or equipment furnished for or in connection with said facilities.

IN WITNESS WHEREOF, we have hereunto set our hand and seal the day written opposite our signature.

Company Name _____ (SEAL)
By _____
Title _____
Dated _____, 20___

Sworn to and subscribed before me, a Notary Public,

this _____ day of _____, 20_____. _____ (SEAL)

SUPPLEMENTARY CONDITIONS

APPENDIX C

TAX GUIDANCE FOR INDIANA CONTRACTORS

GUIDELINES FOR **INDIANA** CONTRACTORS

USE OF THIS GUIDELINE:

This guideline may not be complete or current as of the date of the Contract or CONTRACTOR's performance of the Contract. State laws are subject to change. This guideline does not alter the CONTRACTOR's obligations under the Contract to properly determine and pay applicable taxes.

GENERAL RULE:

Contractor's purchases of property which is classified as supply plant and expenses, pumping plant and expenses or water treatment plant and expenses under the Uniform System of Accounts of the Indiana Utility Regulatory Commission and used by utility to furnish water are not taxable.

INTERPRETATION OF GENERAL RULE:

The Indiana Department of Revenue selected certain accounts which are included in the Uniform System of Accounts adopted by the Indiana Utility Regulatory Commission. Property purchased by a utility or its contractor and used by a utility to furnish water is not taxable if the purchase is classified under one of the following accounts:

Source of Supply Plant

310. Land and land rights
311. Structure and improvements
312. Collecting and impounding reservoirs
313. Lake, river and other intakes
314. Wells and springs
315. Infiltration galleries and tunnels
316. Supply mains
317. Other water source plant

Source of Supply Expenses

600. Operation supervision and engineering
601. Operation labor and expenses
602. Purchased water
603. Miscellaneous expenses
604. Rents
610. Maintenance supervision and engineering
611. Maintenance of structures and improvements
612. Maintenance of collecting and impounding reservoirs

613. Maintenance of lake, river and other intakes
614. Maintenance of wells and springs
615. Maintenance of infiltration galleries and tunnels
616. Maintenance of supply mains
617. Maintenance of miscellaneous water source plant

Pumping Plant

320. Land and land rights
321. Structures and improvements
322. Boiler plant equipment
323. Other power production equipment
324. Steam pumping equipment
325. Electric pumping equipment
326. Diesel pumping equipment
327. Hydraulic pumping equipment
328. Other pumping equipment

Pumping Expenses

620. Operation supervision and engineering
621. Fuel for power production
622. Power production labor and expenses
623. Fuel or power purchased for pumping
624. Pumping labor and expenses
625. Expenses transferred--cr.
626. Miscellaneous expenses
627. Rents
630. Maintenance supervision and engineering
631. Maintenance of structures and improvements
632. Maintenance of power production equipment
633. Maintenance of pumping equipment

Water Treatment Plant

330. Land and land rights
331. Structures and improvements
332. Water treatment equipment

Water Treatment Expenses

640. Operation supervision and engineering
641. Chemicals
642. Operation labor and expenses
644. Rents

650. Maintenance supervision and engineering
651. Maintenance of structures and improvements
652. Maintenance of water treatment equipment

PROCEDURE FOR CLAIMING EXEMPTION:

The utility must furnish the contractor with an exemption certificate for property included in any exempt account so that the contractor can provide the seller with the exemption certificate. The contractor also must be registered with Indiana as a retailer.

SUPPLEMENTARY CONDITIONS

APPENDIX D

SUPPLIER DIVERSITY QUESTIONNAIRE

AMERICAN WATER SUPPLIER DIVERSITY SUBCONTRACTING PLAN

Required for submission with all responses to Requests for Proposals, quarterly reports and with final payment application (with actuals). Tier 1 prime suppliers are required to submit quarterly Tier 2 diversity spend reporting is required through the Supplier Diversity Portal found at https://amwater.quantumsds.com/.

COMPANY OVERVIEW

Prime Supplier Business Name:	
Corporate Address:	
City, State, Zip:	
Prime Supplier Contact Person's Name:	
Email Address:	
Phone Number ☐ Office ☐ Mobile**:**	

Supplier Diversity Business Classifications: "Certified" means currently certified by an authorized certifying body. "Owned" means at least 51% minority-owned operated and controlled. The company must be a profit enterprise and physically located in the U.S. or its trust territories.

Is your business a certified diverse supplier? If yes, please provide copy of certification(s) with your bid response.	☐ Yes	☐ No
☐ **Minority Business Enterprise (MBE)**	☐ **Other Disadvantaged Business**	
☐ MBE-AF - Minority Owned Business African American ☐ MBE-AP - Minority Owned Business Asian Pacific ☐ MBE-H - Minority Owned Business Hispanic ☐ MBE-NA - Minority Owned Business Native American	☐ DBE - Disable Owned Business ☐ HUB – Historically Underutilized Business ☐ LGBTQ - Lesbian, Gay, Bisexual, Transgender	
☐ **Veteran Business Enterprise (VBE)**	☐ **Women Business Enterprise (WBE)**	
☐ SDVBE - Service-disabled Veteran Owned Business		

BID / PROJECT SUBMISSION

Please describe the goods and or services being provided by your company:

Total Contract Value ($):	**Total Subcontracted ($):**	
	Projected spend with the following diversity classes:	
American Water Regulated State Operations:	Minority Business Enterprise (MBEs) $	
	Veteran Business Enterprise (VBEs) $	
	Woman Business Enterprise (WBEs) $	
	Other Disadvantaged Business (DBE) $	

DETAILED SUBCONTRACTING PLAN

Detailed plan for use of M/W/VBEs and other disadvantage businesses as subcontractors, distributors, value added resellers are counted towards your contractual supplier diversity goal. Small business spend is tracked but not counted towards the diversity spend goal. **For every product and service, you intend to use, provide the following information (attach additional sheets if necessary)**

Company Name	Classification (MBE/WBE/VBE/LGBT/DBE)	Principal Owner Gender (M/F)	Certification Agency	Certification Expiration	Products or Services to be provided	Estimated Amount of Spend ($):
ABC Example Co	*MBE*	*M*	*NMSDC*	*05/2025*	Excavation	$150,000

OUR PRIME SUPPLIER DIVERSITY PROGRAM

Firms interested in doing business with American Water should register on the Supplier Portal to use the database to search for diverse suppliers and to report diverse spend quarterly once a project is awarded.

OVERVIEW OF HOW IT WORKS

American Water is focused on opportunities for minority suppliers who provide a wide array of products and services. In our efforts to ensure we are consistent in what we define as diverse businesses enterprises, the determination is that small business is not defined as a diverse business category. American Water continues to support and engage small business in all that we do in addition to creating opportunity for both social and economically disadvantaged business (Diverse). The business units within American Water are aware of the importance of supplier diversity when making their decisions.

BID/AWARD PROCESS

Qualified firms invited to bid on specific contracts are sent a Request for Proposal (RFP). Some RFPs require the bidder to attend pre-bid meetings to review procedures and specifications. Bidders are strongly encouraged, and sometimes required, to attend these meetings and submit proposals by the due date in order to be considered for a contract. On occasion, purchase orders are used to test and evaluate the product and services of new and promising firms and can often lead to larger bidding opportunities. Bids and proposals that meet specified requirements are thoroughly evaluated, and awards are made to the firms offering the best value to American Water.

2ND TIER PROGRAM

American Water's 2nd Tier Spend Program increases the opportunities available to diversity certified suppliers in our business and ensures a diversity certified supplier pool across the supply chain. We believe these efforts will stimulate the local economy by creating jobs. 2nd Tier spend consists of payments made from a prime supplier to a diversity certified supplier for the purchase of products or services used directly in support of a contract with American Water. Direct and Indirect expenditures with Minority Business Enterprise (MBE), Women Business Enterprise (WBE), Veteran Business Enterprise (VBE), Service-Disabled Veteran Business Enterprise (SDVBE), Disabled Veteran Business Enterprise (DVBE), Lesbian, Gay, Bisexual, Transgender Business Enterprise (LGBTBE), Disability Owned Business Enterprise (DOBE), Disadvantaged Business Enterprise (DBE) or Historically Underutilized Business (HUB) as subcontractors, distributors, value added resellers are counted towards the contractual supplier diversity goal.

NATIONAL SUPPLIER DIVERSITY

For more information on our program, visit https://www.amwater.com/corp/About-Us/Supplier-Diversity/supplier-diversity-strategy **Contact Us:** For more information about American Water's National Supplier Diversity Strategy, please use the contact our team through email at supplierdiversity@amwater.com or work with your state procurement buyer or national category lead.

DISCLAIMER AND SIGNATURE

Prime Supplier agrees that it will maintain all necessary documents and records to support its efforts to achieve its MBE/WBE/VBE/DBE participation goal(s). Prime Supplier also acknowledges the fact that it is responsible for identifying, soliciting and qualifying MBE/WBE/VBE/DBE subcontractors, distributors and value-added resellers.

The following individual, acting in the capacity of MBE/WBE/VBE/DBE coordinator for Prime Supplier will administer the MBE/WBE/VBE/DBE participation plan, submit summary reports quarterly through the Supplier Portal found at https://amwater.quantumsds.com/ and cooperate in any studies or surveys as may be required in order to determine the extent of compliance by the Prime Supplier with the participation plan.

Name:	
Title:	
Authorized Signature:	
Date Submitted:	

SUPPLEMENTARY CONDITIONS

APPENDIX E

CUT-OFF AND RING SAW SAFETY OPERATIONS POLICY

Cut-Off and Ring Saw Safety Operations Practice

Practice Number: PRA-OPS01/02

Applicability: American Water Works Company, Inc., and its controlled subsidiaries (together "American Water" or the "Company")

Effective Date: May 01, 2019

ELT Sponsor: Walter Lynch, EVP & COO of Regulated Business

Document Approver: Operational Risk Management Service Delivery Council

Document Author: Corporate Health and Safety

I. PURPOSE

This practice provides Company requirements for use of Cut-Off saws (aka CutQuick Cut-Off Machines, Quick Cut saws) and Ring saws (aka Power Cutter). This practice provides employees and Company contractor's rules and requirements for the safe use of these saws and the minimum personal protective equipment required when they are used. Adherence to this practice will reduce exposure to potential hazards that can occur with the use of these saws.

II. SUMMARY

The following are the major sections covered within the Key Activities section of this practice:

- Cut-off and Ring saw use and applications
- Application to contractors and sub-contractors
- Procedures to follow when the use of a cut-off or ring saw by employees is allowed by supervision and this American Water Practice
- Hazards
- Saw Maintenance and Operation
- Storage and Use of Quick-cut saws
- Personal Protective Equipment
- Types of cutting wheels
- Cutting wheel inspection
- Training
- Alternatives to Gas Powered Cut-off and Ring saws
- Definitions

This practice contains attachments for the following:

- Appendix A – Cut-off and Ring Saw Safety Checklist

- Appendix B – American Water Pipe Saw Matrix/Guidelines
- Appendix C – Summary of Policies Related to Cut Off and Ring saw Safety Operations Practice

III. KEY ACTIVITIES

The following sections detail enterprise activities involving the use of Cut-off and Ring saws

Section 1: Cut-off and Ring saw Use and Applications

The use of cut-off and ring saws is prohibited unless permanently secured in an approved cart. Cut off saws or ring saws may be used for pavement cutting when used in accordance with the requirements of this practice. This requirement is effective on May 01, 2019.

- Cut-off and Ring saws may be used for pavement cutting if equipped with an approved abrasive or diamond tipped blade, which requires a constant flow of water. The saw (applicable to Cut Off saws), must be properly and permanently mounted in a cart approved by the manufacturer and designed specifically for the saw model in use. All manufacturers' recommendations, warnings, and safeguards must be followed.

- A job safety analysis must be prepared and reviewed with employees as part of their training prior to using cart mounted cut off saws or ring saws for pavement cutting. Additionally, when there are specific hazards or safety concerns at the job site, these will also be reviewed prior to the commencement of work.

- Newly purchased cut off saws must be permanently secured to an approved cart. Safety Management and the Operations group purchasing the saw must review and approve the saw model.

Section 2: Application to Contractors and Sub-contractors

Contractors and subcontractors performing work for American Water will conform to the following requirements. To the extent necessary, agreements and related statements of work will be amended to enforce the requirements.

- The use of cut-off and ring saws is prohibited unless permanently secured in an approved cart.

- Cut-off and ring saws may be used for pavement cutting if equipped with an approved abrasive or diamond tipped blade, which requires a constant flow of water. The saw must be properly and permanently mounted in a cart approved by the manufacturer and designed specifically for the saw model in use. All manufacturers' recommendations, warnings, and safeguards must be followed.

- The use of diamond tipped cut off wheels can only be used when operated with a constant flow of water, dry cutting is prohibited.

- Cut off saws may be used, without being attached to a cart, to cut concrete masonry block (concrete masonry units [CMU]) if equipped with the appropriate blade. All manufacturer's recommendations, warnings, and safeguards must be followed.
- It remains the contractor/subcontractor's responsibility to train their respective employees on the proper use and application of all equipment, to follow manufacturer recommendations and to comply with all applicable Federal, State, and local health and safety regulations.
- Local Management reserves the right to prohibit the use of any or all cut-off and ring saw operations by contractors/subcontractors.

Contractors must be informed of the requirements applicable to them and contractors will be required to conform to the restrictions no later than May 01, 2019. These dates will also apply to sub-contractors performing work for American Water.

Section 3: When the use of cut-off or ring saw by employees is allowed, the following procedures shall apply.

Example of Prohibited Saw

Cart Used for Pavement Cutting (examples)

Diamond Blades are allowed with the use of water

Section 3.1: Responsibilities

AW employees shall ensure the safe condition and maintenance of all tools and equipment.

- All tools shall be maintained in a condition that does not endanger the worker
- Tools shall not be used while they are defective or hazardous
- A copy of the tool manufacturer's operating manual shall be read, understood, reviewed, and kept readily available in the work area.

Tools shall be inspected by the operator before being used. Never operate or allow others to operate tools or equipment that is damaged, improperly adjusted or not completely and securely assembled.

The supervisor shall ensure that operators of cutting tools are properly trained and authorized to assure safe operation of the cutting tool, including any limitations of use.

A Job Safety Analysis (JSA) or other methods that include similar information must be utilized as part of the training and shall include:

- Each step of the job or task
- What hazards are involved
- How to perform the job safely and control potential hazards
- Capabilities and limitations of the tools and/or equipment

Section 3.2: Operating Procedures

Employees shall comply with the following safety precautions and operating procedures to prevent injury.

Operating Procedures:

- A cut-off and ring saw checklist must be completed by the operator of the saw prior to each use. (Appendix A)
- Follow the manufacturers recommended starting instructions.
- Start the saw only on a hard smooth surface. Start the saw with the blade facing away from co-workers or bystanders.
- DO NOT operate with other workers or pedestrians near the saw. Reference manufacturer's guidelines for clearance distances.
- DO NOT disengage or remove any wheel guards.
- Always protect the cutting wheel from striking the ground or other nearby objects to help prevent damage that can cause the wheel to shatter during operation.
- Use only cutting attachments authorized by the manufacturer of your saw.

Section 3.3: Hazards

The use of cut-off and ring saws may involve both safety and health hazards.

Safety hazards are caused by the high-speed rotation and exposure of the cutting wheel or blade during operation. Rotational kickback caused by improper use or pinching can cause serious injury. The potential for injury exists from the following but not limited to:

- Use of inappropriate cutting wheels and blades for the operation
- Improper starting of saw
- Kickback and pull-away
- Shifting of the material during cutting
- Improper cutting stance and grip

Potential health hazards are caused by noise exposure and exhaust from the internal combustion engine (if so equipped); the common power source. The cutting operation may also create clouds of dust or showers of hot sparks.

Section 3.4: Controlling hazards and Precautions

Major safety hazards can be controlled by:

- Only using the saws when mounted in a cart.
- Training operators to use saws properly and to utilize appropriate personal protective equipment.
- Inspecting and maintaining saws in good working condition, per the manufacturer's guidelines**.**
- Using the saw with all guards in place and in good working order.
- Keeping work secured to prevent it from shifting during cutting.
- Keeping non-essential personnel away from the worksite.

Precautions:

- Verify RPM rating on the blade is within acceptable ranges of the cut saw.
- Know the application, limitation, and potential hazards of the saw used.
- Only use cutting wheels authorized by the saw manufacturer.
- Select the proper cutting equipment for the job.
- Keep all guards in place and in working order.
- Maintain working areas free of clutter.
- Keep alert to potential hazards in the working environment such as damp locations or the presence of highly combustible materials.
- Dress properly to prevent loose clothing from being caught in moving parts.
- Wear the proper PPE listed in this Practice.
- Establish barriers to distance the public or any non-essential personnel from the job site.
- Do not surprise or distract anyone using a power tool.

Section 3.5: Health Concerns

A gas-powered saw produces exhaust that contains hazardous materials, (e.g. carbon monoxide, which cannot be detected without special monitoring equipment). To reduce the risk of serious or fatal injury from inhalation of this exhaust, never run the saw indoors or in poorly ventilated areas.

Exposure to airborne Asbestos fibers may cause serious illness. Cut off and ring saws are NOT to be used on asbestos-containing material. See Health and Safety Procedure “Asbestos Containing Materials” for required work practice information.

Exposure to Crystalline silica compounds may cause serious illness. Crystalline silica is a common compound found in many elements including sand, quartz, flint, and slate. The silica compound is not hazardous unless it is exposed in the air. This often occurs when concrete is crushed, ground, or cut with a saw.

Section 3.6: Saw Maintenance and Operation

A gas-powered saw must be serviced and maintained in accordance with the manufacturer's instructions. Guards and air-intakes should be inspected and cleaned regularly. Cutting wheels shall be inspected for damage before, and after use of the saw. Replace the cutting wheel immediately if it is cracked or warped. Never use a wheel that wobbles or has ever wobbled. Never transport the saw with the wheel attached. Doing so can damage the equipment and may not be detected during subsequent use resulting in serious injury. Store cutting wheels on a flat surface in a dry place, preferably at a constant temperature where there is not a risk of freezing. Do not store the cut-off saw with a wheel mounted on the machine. Follow all manufacturers’ guidelines for use, storage and replacement of parts.

Section 3.7: Storage and use of Fuel

- Store flammable materials away from the work site.
- Wear appropriate PPE while refueling.
- Fuel your saw in a well-ventilated area, outdoors only.
- Always shut off the engine and allow it to cool before refueling.
- Never smoke while refueling.
- Verify and only use the proper fuel/fuel mixture for the specific saw.
- Never refuel close to an open flame.
- Dust may collect on the powerhead, especially around the carburetor, and may absorb gasoline resulting in the danger of fire. Clean dust from the powerhead regularly.
- Relieve fuel tank pressure by loosening fuel cap slowly.
- Select bare ground for refueling and move at least 10 feet from fueling area before starting the engine.
- Wipe off any spilled fuel before starting your saw and check for leakage.
- Fuel saw before starting a new cut.
- If fuel is spilled onto clothes, immediately remove clothing, rinse the affected area and change into clean clothing.
- Fuel saws and store fuel away from areas where spills may contaminate the water treatment process.
- Ensure the fuel storage container is approved and properly labeled.

Section 3.8: Protective Equipment

- Clothing must be sturdy and form-fitting, but allow complete freedom of movement. No loose clothing, jewelry, unconfined long hair or anything that could become caught on any obstacles or moving parts. Avoid wearing hooded sweatshirts or other clothing that has strings or other materials that can become entangled in any moving part of the saw or cutting wheel.

- Minimum PPE to be worn:
    - Safety glasses or goggles meeting ANSI/ISEA Z-87.1 standards
    - Face shield meeting ANSI/ISEA Z-87.1-2015 standards
    - Steel or composite toed boots meeting ASTM F2413 standards
    - Hard hat
    - Hearing protection
    - Gloves

- Additional PPE that should be considered:
    - Leather chaps to protect the legs from sparks;
    - NIOSH approved dust respirator to limit inhalation of hazardous dust. Consult with Operational Risk Management on the proper respirator selection and use in accordance with the OSHA Respiratory Protection Standard (29 CFR 1910.134) and company practice.
    - Reflective vest or approved garment if performing work on or near a roadway.

Refer to the Pipe Saw Matrix (Appendix B) in this Practice for additional detail and requirements.

Note: Ensure that proper ventilation is available when working in spaces with limited air circulation. Gasoline-fueled saws produce carbon monoxide and other exhaust contaminants.

Section 3.9: Types of Cutting Wheels (Cut off saws)

Before the use of a gas powered cut-off or ring saws, you must inspect the cutting wheel by making sure that the correct wheel is on the machine, and see if it needs to be changed (i.e. dull, warped, loose teeth, cracks, chips). Cutting wheels, diamond-tipped, and carbide-tipped cutting wheels are the three basic types available. All cutting wheels must only be used to cut the materials specified by the manufacturer for that particular wheel. The cutting wheels must be compatible with the saws horsepower, RPM range, and rotational speed. The Table below provides general information about the types of cutting wheels and what materials they should be used to cut. Always check the cutting wheel manufacturer's specifications to determine the proper use.

Cutting Wheel Type	Summary	Materials
Abrasive	Used for steel, masonry, and general purpose. Made with aluminum oxide and silicon carbide materials to improve durability.	Reference manufacturer's recommendations.
Diamond Tipped	All-around use, most economical for cutting concrete and masonry. Water-cooling is recommended to increase disk life and reduce dust. Use of diamond tipped blades can only be used in cart-mounted saws while cutting concrete, asphalt or masonry.	Reference manufacturer's recommendations.
Metal	Used for steel, or multi-use purposes. Metal blades may be used as long as they are applied within the limits of the practice.	Reference manufacturer's recommendations.

Warning – Use only cutting wheels recommended by the Cut Off saw manufacturer/distributor and allowed by American Water for pavement and concrete masonry cutting applications. Refer to a manufacturer/distributor selection guide.

Section 3.10: Cutting Wheel and Blade Inspection

Always inspect the cutting wheel or blade prior to use. Conduct a 360-degree inspection looking for cracks, damage or excessive wear. Check with your supervisor for the cutting wheel or blade "end of service life". End of service life is defined as the date of purchase and the number of hours in use. This is contained in the manufacturer's literature. Change as specified or more frequently if any damage is suspected or observed to avoid breakage and possible injury.

Additional considerations are as follows:

- DO NOT use a cutting wheel or blade that has been dropped
- DO NOT cut any material for which the abrasive wheel or blade is not authorized.
- DO NOT grind on the side of the abrasive wheel.
- The cutting wheel or blade must be rated for the maximum spindle speed of the saw.
- Never store and re-use a cutting wheel that has been used with water. Use these abrasive wheels only on the same day.
- Remove the wheel from the saw before transporting and store in a flat position not standing on the cutting edge.
- Test each wheel immediately after installation for approximately one minute at maximum speed without cutting, making sure to keep bystanders away.

Section 3.11: Training

- Employees operating Cut Off saws or Ring saws need to be trained and classified as authorized users.
- New employees will be trained and classified as authorized users prior to the use of cutting equipment.
- Employees will not use any new cutting tools until they have received the required training
- After initial training, employees will receive refresher training annually
- Only trained employees who have been designated as authorized users are permitted to use cutting tools
- All manufacturers' recommendations for use of any cutting tool must be followed at all times.

Section 3.12: Alternatives to Gas Powered Cut-off and Ring Saws

There are several alternatives to gas-powered cut-off and ring saws. Refer to Appendix C: the "American Water Pipe Saw Matrix/Guidelines".

IV. MARKET-BASED BUSINESS VARIANCES

- This practice is relevant for MBB.

V. WAIVERS

Any deviation, waiver or exception from this practice requires the prior written approval of the Document Author or ELT sponsor of this practice. If the deviation, waiver or exception conflicts with any policy, approval from the ELT Sponsor of that policy is required. The Document Author, or her or his designee, is responsible for tracking all requests for waivers, decisions with respect to those requests, and maintaining documentation related to each waiver request. Each individual receiving a waiver is responsible for retaining documentation of the waiver that was granted.

VI. DEFINITIONS

- Cutting Wheels (may be referred to as a blade or disc) - The cutting component of the cut off saw consisting of abrasive grains held together by organic or inorganic bonds. Diamond and reinforced cutting wheels are included and can be identified by the label on both the cutting wheel and the package. Only abrasive and diamond tipped blades will be used with cut-off saws attached to a cart assembly.

Use only manufacturer recommended and approved cutting wheels. Use of the wrong cutting wheel for which it was not designed may cause the wheel to shatter causing serious or fatal injury.

- Blade – The cutting band on a ring saw. These blades are composed of diamond tipped abrasive teeth.
- Cut-Off saw – A class of gas-powered handheld saws that can be used for cutting a variety of materials based on the abrasive wheel used. These are also referred to as “quick-saws, chop-saws and may have the brand name of Cutquick ® saw. This saw is prohibited if unattached to a cart assembly.
- Gas Powered Cut-Off and Ring saws – Handheld portable circular saws, used for cutting concrete, reinforced concrete, asphalt and masonry products.
- Kickback – The sudden reaction that causes the power cutter and cutting wheel to be thrown from an object when the upper quadrant of the abrasive wheel, known as the kickback zone, touches an object.
- Kickback zone – The upper quadrant of the abrasive wheel on Cut off Saws and Ring saws (from 1 o’clock to 3 o’clock relative position).
- Ring saw - A class of gas-powered handheld saws that can be used for cutting a variety of materials. These saws do not have a solid blade, but rather utilize a circular cutting band that rotates by direct contact with rollers. The cutting bands are diamond tipped abrasive material.

VII. NON-COMPLIANCE

Any employee who violates or circumvents the practice may be subject to disciplinary action up to and including termination.

VIII. PRACTICE REVIEW

This Practice will be reviewed and revised as necessary. Not to exceed 3-year intervals

Next Review By:
Approval Date:
Last Reviewed:

Appendix A – Safety Checklist – For Use When Pavement Cutting

LEAD PERSON: _____

SAW OPERATOR: _____ Time: _____

(Please Print)

DATE:_____ LOCATION: _____

Follow the manufacturer's safe operating instructions, use two hands, and don the required personal protective equipment including Hard hat, safety glasses, face shield, hearing protection, work gloves, safety vest, steel or composite toe boots.

Confirm each of the following. If any item cannot be confirmed, DO NOT PROCEED and consult with your supervisor prior to use.

	Item	Y	N
1.	Cut off or ring saws will not be used for any American Water project unless used in an approved cart.		
2.	Cut off or ring saws will only be used for pavement cutting when used in accordance with the practice.		
3.	Cut off or ring saws will not be used unless mounted in a cart, exclusively for pavement, asphalt or concrete cutting.		
4.	The operator of the saw is trained and authorized to operate this equipment.		
5.	The blade is approved by the manufacturer for the model used and the material to be cut.		
6.	The blade has been inspected with no defects found.		
7.	The saw guard is in place, secure and in good working order.		
8.	The cutting wheel is installed so that the arrow on the wheel points in the direction of the rotation of the spindle.		
9.	Only the 3-6 o'clock position of the wheel will be used for cutting.		
10.	Required PPE (listed above) is worn.		

If any questions are marked "N" do not proceed, consult a supervisor.

Return this form to your supervisor at the end of the shift

AMERICAN WATER

Appendix B – American Water Pipe Saw Matrix/Guidelines

American Water Cutting Guidelines

Material Type

	Cast iron[4]	DICL[4]	Asbestos Cement [1]	PVC Pipe[4]	Clay Pipe[4]	Pavement[5]
4"	A,B,C,G,I	A,C,G	A,B,D	B,D,E,I	A,D	F[3,5],G,H[3,5]
6"	A,B,C,G,I	A,C,G	A,B,D	B,D,E,I	A,D	
8"	A,B,C,G,I	A,C,G	A,B,D	B,D,E,I	A,D	
10"	A,B,C,G,I	A,C,G	A,B,D	B,D,E,I	A,D	
12"	A,B,C,G,I	A,C,G	A,B,D	B,D,E,I		
16"	A,B,C,G	A,C,G		B,D,E		
18"	A,B,C,G	A,G				
20">	A,B,C,G	A,G				

Required PPE

	Cutting Options	Face Shield	Safety Glasses	Ear Plugs	Gloves	Safety Vest	Safety Shoes	Hard Hat	Specialized PPE i.e. Tuff N Lite garment
A	Manual Hinged 4-Wheel Cutter	N	Y	N	Y	Y	Y	Y	N
B	Hydraulic "Snap" Cutter	N	Y	N	Y	Y	Y	Y	N
C	Wachs Guillotine Saw	N	Y	Y	Y	Y	Y	Y	N
D	Hand Saw	N	Y	N	Y	Y	Y	Y	N
E	Reciprocating Saw	Y	Y	N	Y	Y	Y	Y	N
F	Stihl 420 or equivalent Cut Saw w/ fixed guard mounted in an approved cart	Y	Y	Y	Y	Y	Y	Y	As determined through a Job Safety Analysis (JSA)
G	"Chain" Saw specifically approved for pipe cutting - hydraulic, pneumatic or gas powered	Y	Y	Y	Y	Y	Y	Y	N
H	Ring Saw	Y	Y	Y	Y	Y	Y	Y	N
I	Exact 360 Saw	Y	Y	Y	Y	Y	Y	Y	N

FOOTNOTE [1]: Asbestos Containing Materials must be cut using wet methods

FOOTNOTE [2]: Diamond blades are allowed when used with a constant flow of water.

FOOTNOTE [3]: A Cut Off Saw Safety checklist must be completed by the operator of the saw prior to each use.

FOOTNOTE [4]: All pipe inside an excavation is required to be supported before making any cuts to prevent pinching of the cutting tool.

FOOTNOTE [5]: Cut off Saws and Ring Saws must be properly mounted in a cart for pavement cutting.

Use of Cut Off or Ring Saws to Cut Pipe, Metal, Rebar or the like is prohibited on American Water projects.
All employees are to follow all OSHA and Manufacturers' Guidelines when operating pipe cutting tools.

Cutters	Unit Weight	Pipe Size	Pipe Material	Pro's	Con's	Manufacturer & Model
PowerGrit Saw (Chainsaw), Hydraulic	27.3 lbs.	Varies with bar length	Cast Iron, DICL, PVC, HDPE	Can cut from the bottom up, 35 to 50 cuts per chain	hydraulic power source, water supply can freeze in winter months	ICS PowerGrit/US Saw
PowerGrit Saw (Chainsaw), Pneumatic	27.3 lbs.	Varies with bar length	Cast Iron, DICL, PVC, HDPE	Can cut from the bottom up, 35 to 50 cuts per chain	pneumatic powered is easily bogged down, water supply can freeze in winter months	ICS PowerGrit/US Saw
PowerGrit Saw (Chainsaw), Gas	27.3 lbs.	Varies with bar length	Cast Iron, DICL, PVC, HDPE	Can cut from the bottom up, 35 to 50 cuts per chain	exhaust fumes, noise	ICS PowerGrit/US Saw ICS Model 633FS
EZ Saw, Pneumatic or electric	11 lbs.	1 into 12 in	SS, DICL & Cast Iron			
Guillotine Saw, Diamond wire	75 lbs.	4 into 16 in	cold steel, cast iron & DICL	made quick cuts, only requires 2.5 inches of clearance, 30+ cuts per blade	16 in max cut. $700 per blade. NOTE Lg diameter pipe models are available.	E.H. Wachs
Hydraulic Pipe Cutters	85 - 269 lbs.	2 into 20 in	Cart Iron, Tile, & Concrete	minimal clearance needed to make cuts, no sparks, noise or fumes; cuts remotely	Very heavy, not always a clean cut. Not for use with ductile	Wheeler Rex Model 3890
Hinge Cutters	21 - 68 lbs.	2 into 12 in	Cast iron	works well in slight spaces, make clean cuts, reasonable cost	takes extra physical effort to use, limited pipe size it will cut	Reed Tool
Rotary Cutter	41 - 295 lbs.	18 into 36 in	SS, DICL & Cast Iron	works well in slight spaces, make clean cuts, reasonable cost	takes extra physical effort to use, limited pipe size it will cut	Reed Tool/Ridged Tool
Snap Cutters, Ratcheting	17 - 24 lbs.	2 into 15 in	Cast Iron	no exhaust fumes		
Snap Cutters, single stroke	26 - 33 lbs.	2 into 15 in	Cast Iron	No moving parts	Heavy, cumbersome, 8 inch max cut	Wheeler Rex Model 3890
Universal Pipe Cutter, pneumatic	138 Lbs. Total NOTE: single heaviest component: 28 Lbs.	6 into 48 in	Cast Iron, ductile, clay & concrete	easily set-up, no exhaust fumes	needs 12” clearance, needs a water supply and air compressor (50 CFM & 90 psi)	Reed Tool Model UPC648A

Appendix C – Summary of Policies Related to Cut Off and Ring saw Operations Safety Practice

Practice	Related Policy
	Health and Safety Policy

SUPPLEMENTARY CONDITIONS

APPENDIX F

ASSET DATA COLLECTION REQUIREMENTS

INDIANA-AMERICAN WATER COMPANY, INC.

ASSET DATA COLLECTION REQUIREMENTS FOR REPLACEMENT / RELOCATION PROJECTS BY THE RESIDENT PROJECT REPRESENTATIVE

A. The Contractor shall collect GPS points via digital collection device (iPad) and prepare Sketch cards. 3-point tie-down measurements are to be shown on valve, hydrant and blow-off sketch cards. GPS points shall be collected at all locations identified below. Preferred method of collection is with open trench – in the event that open trench collection is not possible, please refer to the GPS Asset Exposure Legend (*sections B & H)*. Contractor to identify GPS collection point team in order to ensure continuity of data collection.

1. Tie In Locations (to include water mains, fittings, and valves) **(A)**

2. Depths that vary more than 6" from minimum cover shown on the Drawings **(B)**

3. Fittings, including **(B)**
   a. caps & plugs – to include where retired pipe ends
   b. crosses
   c. tees
   d. bends
   e. sleeves & couplings
   f. adapters

4. Corporation stops **(B)**

5. Casings **(B)**

6. Raw/Finished Water Mains (not greater than 50-foot intervals unless approved by Owner) **(C)**

~~**7.** Service Lines, only if not installed in generally straight line **(C)**~~

8. Valves **(D)**

9. Fire and Flushing Hydrants **(D)**

~~**10.** Meter Pits **(D)**~~

~~**11.** Curb Stop **(D)**~~

12. Raw water wells and vaults **(D)**

13. Aeration/Detention tanks **(D)**

14. Filters **(D)**

15. Filtration facility **(D)**

16. Emergency Stand-by generator **(D)**

17. Chemical feed rooms **(D)**

18. High Service Pumps **(D)**

19. Backwash pumps **(D)**

20. Sewer laterals and pump stations **(B)**

21. Chemical Feed lines and vaults **(B)**

22. Electrical feed/conduit and vaults **(B)**

23. Fiber Optic feed/conduit and vaults **(B)**

24. Chemical unloading station piping **(B)**

25. Backwash Tanks/Lagoons **(D)**

26. Property corners **(D)**

B. **GPS Asset Exposure Legend**: The above assets MUST be collected with the following priority:

A. Must GPS with Open Trench

B. GPS with open trench or use vertical riser pipe

C. GPS with open trench preferred, but can GPS after backfilling complete

D. GPS after backfilling is acceptable

C. In addition to coordinates, each point shall include ALL the attributes required on the digital collection method (using standard terminology submitted to and approved by the Owner) at a minimum:

1. Fittings
2. Valves
3. Hydrants
4. Mains
5. Other, as required by Owner

D. The Owner requires one photograph taken of each location where a tie in is completed. This photograph can be attached to the nearest GPS fitting collected in the area. This photograph should clearly show the uncovered tie in and the surround pipe *(see Exhibit A)*.

E. In addition to digital collection, the Owner requires one sketch card *(see Exhibit B)* per following asset. Each asset sketch will be drawn with 3-point tie downs and match the asset number on the collection device *(i.e. V1, H1, etc.).*

1. Valves (to include hydrant valves)
2. Hydrants
3. Blow-offs

F. Contractor may choose to use equipment provided and configured by the Owner or may purchase equipment of equal or better specification to be configured in conjunction with the Owner for purposes of GPS data collection. All data from such collection will be processed and stored by the Owner.

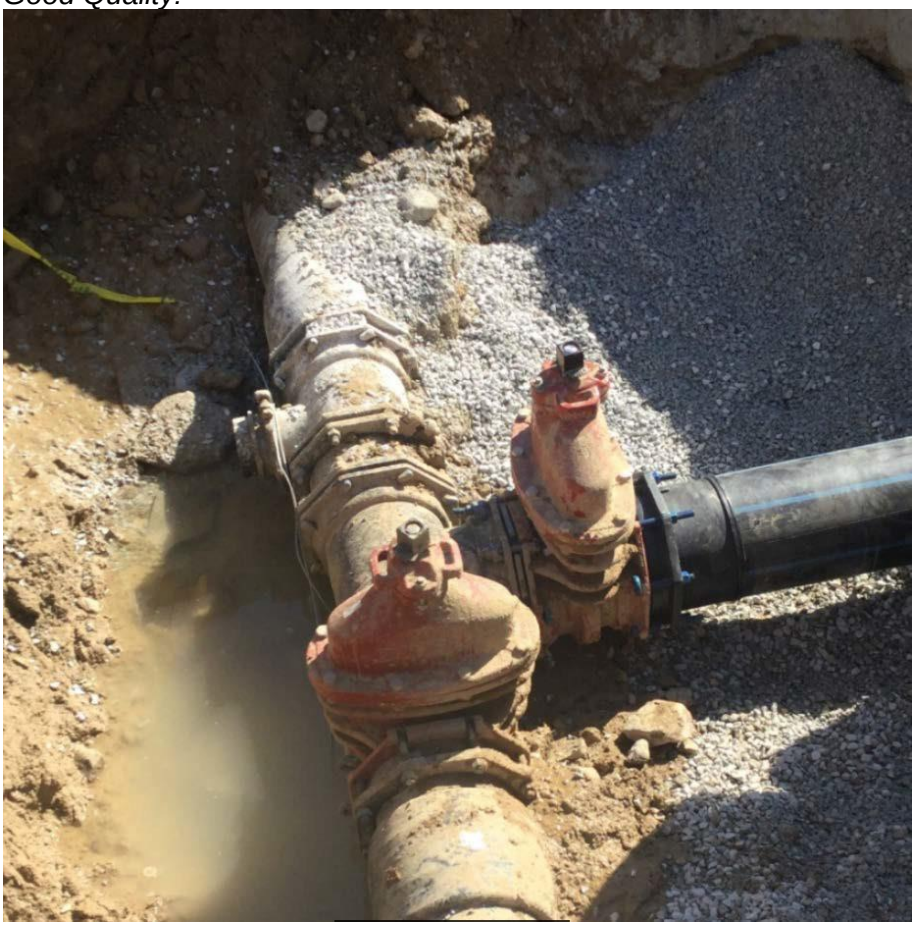
G. <u>In the event Contractors GPS representative(s) is unable to be on site</u>, contractor shall provide provisions such as vertical riser pipe to allow collection of the GPS data for any areas requiring backfill prior to collection of the GPS data. Unless otherwise directed by the Owner, vertical riser pipes must be installed at each fitting, corporation stop, and any location where the depth exceeds minimum cover (*see section A, priority B)* for the purpose of GPS collection. Riser pipes must be removed, backfilled and the surface restored

following their removal. It is the responsibility of the RPR to coordinate with the onsite contractor if this method must be used.

H. The Contractor shall work in conjunction with the GIS Department to resolve any issues or questions that arise. The GIS Department will also ensure that the collection standards are being met and the correct data is being submitted to the Owner.

EXHIBIT A

Good Quality:



Poor Quality:

EXHIBIT B

INDIANA AMERICAN WATER

WBS #	R10-0181.17.0001
Asset #	V1

Location	
	6 FT 0 IN E OF CL / ___ BL / ___ PL OF Main Street
	7 FT 3 IN N OF CL / ___ BL / ___ PL OF 1st Street
	10 FT 4 IN S OF CL / S BL / ___ PL OF 501 Main Street

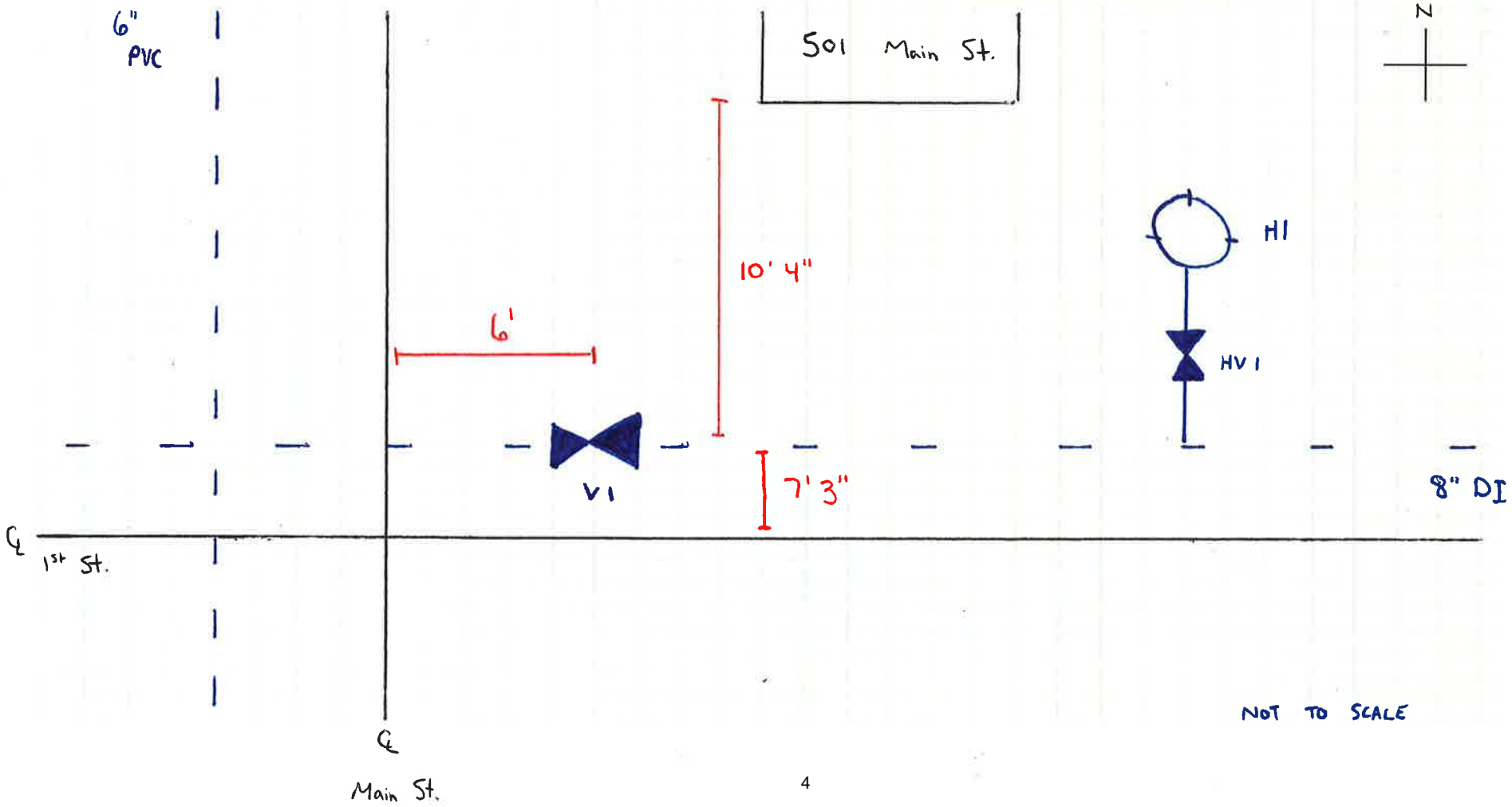


EXHIBIT C

INDIANA AMERICAN WATER

SERVICE LINE

WBS # R10-01B1.17-0001

SERVICE: INSTALL | SERVICE: LONG / SHORT (CIRCLE)

DISTRICT & PLANNING PLANT: INDIANA AMERICAN WATER

PROJECT MANAGER: Joe Smith

CONTRACTOR: ABC Contracting

INSPECTOR: Matt Jones

STREET NO: 123

STREET NAME: Main Street

CROSS STREET NAME: 1st Street

CITY: Greenwood

ZIP CODE: 46142

SUBDIVISION: Countryside Estates

LOT #: 23

COUNTY: Johnson

TOWNSHIP: White River

MUNICIPALITY: Greenwood

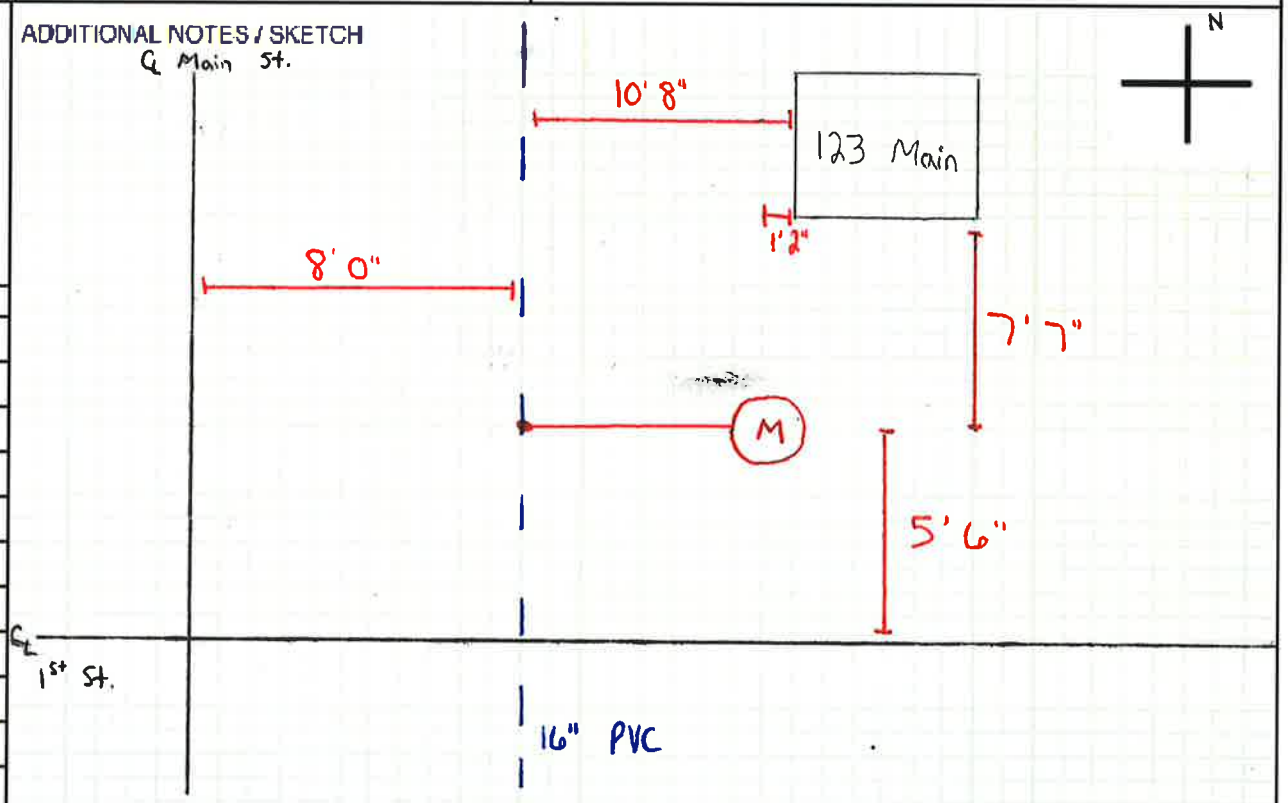
DETAILED DESCRIPTION OF WORK

Tapped 6" PVC main and ran short side service to single meter pit

MATERIALS USED

- 1 - Pit
- 1 - Lid
- 1 - Setter
- 1 - 3/4" Copper X Copper
- 18' - 3/4" CTS Plastic
- 4 - Inserts

ADDITIONAL NOTES / SKETCH



CL = Center of Road BL = Building Line PL = Property Line

TAP CORP

5 FT 6 IN N OF CL OF 1st Street

10 FT 8 IN W OF W BL OF 123 Main Street

8 FT 0 IN E OF CL / ___ BL / ___ PL OF Main Street

POINT OF CONTROL

5 FT 6 IN N OF CL OF 1st Street

1 FT 2 IN W OF W BL OF 123 Main Street

7 FT 7 IN S OF CL / S BL / ___ PL OF 123 Main Street

ALL FIELDS REQUIRED: FILL IN OR CIRCLE (IF OTHER FILL IN CORRECT INFORMATION)

IN-SERVICE DATE: 1/1/2018	WBS # R10-01B1.17-0001
SERVICE ADDRESS: 123 Main Street	PREMISE NO: INDIANA AMERICAN WATER

COMPANY SERVICE LINE	
SIZE	(0.75") / 1" / 2"
MATERIAL	PE
(CIRCLE ALL THAT APPLY)	(DOMESTIC) / IRRIGATION
TYPE	(SINGLE) / DUAL
DUAL CONNECTION ADDRESS	

WATERMAIN TAPPED	
SIZE	2" / 3" / 4" / (6") / 8" / 10" / 12" / 16" / 20"
MATERIAL	(PVC) / DI / HDPE / PE
DEPTH	5 FT 6 IN

CUSTOMER SERVICE LINE	
SIZE	(0.75") / 1" / 2"
MATERIAL	Copper

POINT OF CONTROL (POC)	
DISTANCE TAP TO POC	1 FT 6 IN
TYPE	(METER PIT) / CURB STOP
LOCATION	(GRASS) / SIDEWALK / DRIVEWAY
IF CURB STOP FILL IN BELOW	
VALVE #:	
SAP ID:	
MANUFACTURER	
MODEL NO.	
YEAR MANUFACTURED	
VALVE TYPE	BALL
OPEN DIRECTION	LEFT / RIGHT
APPLICATION	SERVICE LINE
.....IF SERVICE LINE	DOMESTIC / COMBINED
ACTUATOR TYPE	MANUAL
NUMBER OF TURNS	0.25
NORMAL POSITION	OPEN / CLOSED
VALVE SIZE	
PIPE MATERIAL	PE
ACCESS TYPE	VALVE BOX / METER PIT / VAULT
JOINT TYPE	THREADED / COMPRESSION

SECTION 01010

SUMMARY OF WORK

PART 1: GENERAL

1.01 WORK UNDER THIS CONTRACT

The design and construction of the Sheridan Water Treatment Facility includes the work as described in the Design Concepts included as Attachment A to the RFP.

1.02 LOCATION

The Sheridan Facility is located on property owned by Indiana American Water Company at 801 East Second St, Sheridan, Indiana.

1.03 WORK BY OTHERS

None.

1.04 OWNER FURNISHED PRODUCTS

Owner shall supply all chemicals required as part of the process to treat the Water during start up and commissioning.

1.05 DESIGN/BUILDER USE OF SITE (AND PREMISES)

No work will be permitted on Sundays or holidays, unless approved in advance by the OWNER or in case of emergency.

1.06 SECURITY

Background checks will be required for all Design/Build personnel and their sub DESIGN/BUILDERs performing work at the existing WTP facilities in accordance with Specification Section 01075.

1.07 FUTURE WORK

Not Used.

1.08 WORK SEQUENCE

Work shall be sequenced such that existing facilities are maintained in service at all times. Further criteria are defined in Specification Section 1046 – Continuity of Owner Operations and Work Sequence.

1.09 CHANGE PROCEDURES

The OWNER may issue to the DESIGN/BUILDER a Proposal Request which includes a detailed description of a proposed change with supplementary or

revised drawings and specifications, a change in Contract Times for executing the change and the period of time during which the requested price will be considered valid. DESIGN/BUILDER will prepare and submit an estimate within 15 working days. The estimate shall contain a detailed breakdown of the labor, equipment, material, subcontract, equipment rental, contingencies, overhead, and profit costs associated with the requested change. The estimate shall also include any requested adjustments to Contract Times including the window of time the OWNER has to render a decision on the matter.

1.10 **DEFINED TERMS**

Not Used.

PART 2: PRODUCTS

Not used.

PART 3: EXECUTION

3.01 **FIELD SURVEY WORK**

Not Used.

3.02 **COORDINATION AND MEETINGS**

A. Any construction work requiring the shut-down of facilities must be scheduled and performed only at such times as shall be authorized by the OWNER. Such work must be completed during the specific periods authorized by the OWNER. It may be necessary that work will be performed during several shut-down periods and/or during periods of premium time payment to accomplish the desired construction. All costs to perform the DESIGN/BUILDER work, including premium time payments, shall be borne by the DESIGN/BUILDER and are included in the Target Cost.

B. **In addition to the above, the DESIGN/BUILDER shall:**

1. Coordinate scheduling, submittals, and work of the various sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

2. Verify the utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

3. Coordinate space requirements and installation of mechanical and electrical work, which are indicated diagrammatically on drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place

runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

4. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

5. Coordinate completion and clean up of Work of separate sections in preparation for substantial completion and for portions of Work designated for OWNER's partial occupancy.

6. After OWNER occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.

C. **Construction Progress Meetings**

Progress meetings will generally be held monthly. The DESIGN/ BUILDER'S attendance shall be required.

1. Schedule - The OWNER will establish the meeting place, time and date, notify participants and administer the meeting. The DESIGN/BUILDER shall notify major subdesign/builders and suppliers, as appropriate.

2. Attendance
   a. Resident project representative.
   b. DESIGN/BUILDER project manager, design members and project superintendent
   c. OWNER's representative
   d. Subdesign/builders, as appropriate to the agenda
   e. Suppliers, as appropriate to the agenda
   f. Other parties as determined by OWNER or DESIGN/BUILDER

3. Agenda
   a. Review minutes of previous meeting.
   b. Review of work progress since previous meeting.
   c. Review field observations, problems, conflicts.
   d. Review problems which impede construction schedules.
   f. Review of off-site fabrication, delivery schedules.
   g. Review corrective measures and procedures to regain projected schedule.
   h. Review revisions to construction schedules.
   i. Review plan progress, schedule, during succeeding work period.
   j. Review coordination of schedules.
   k. Review submittal schedules; expedite as required.
   l. Review maintenance of quality standards.
   m. Review proposed changes for:
      (1) effect on construction schedule and on completion date
      (2) effect on other contracts of the project
   n. Other business

4. Minutes - The DESIGN/BUILDER will prepare meeting minutes and distribute copies to participants and OWNER for review prior to the next meeting.

End of Section

SECTION 1046

CONTINUITY OF OWNER OPERATIONS AND WORK SEQUENCE

PART 1: GENERAL

1.01 INTENT OF SECTION

The following descriptions of shutdown criteria and work sequence, as it relates to continuity of plant operations, provides the DESIGN/BUILDER with a suggested approach to implement the work while minimizing impacts and interruptions of the OWNER's operation. The OWNER understands that implementation of the work will require shutdowns of all or part of the plant and shutdown criteria has been established and included within this specification. The criteria herein identifies the areas of work that may restrict operations and allows the Owner and DESIGN/BUILDER to negotiate the permissible down time for specific Work and suggest other provisions for continuous or partial operations.

1.02 SHUTDOWN CRITERIA

In general, the criticality of a shutdown has been defined by its' impact to the water treatment plant's filtration units. Shutdowns shall be defined as minor, major and critical shutdowns. Shutdown criteria are provided in Appendix 1 to this specification.

Minor shutdowns shall be permitted during regular business hours, Monday through Thursday. The OWNER shall make every effort to accommodate such requests but may postpone such shutdowns due to reasonable operational reasons. The DESIGN/BUILDER shall provide adequate verbal communication detailing the work plan to be employed to assure completion of the shutdown within the permitted duration, but shall provide written notification to the on-site RPR at least 24 hours prior to commencement of the shutdown. Approval of said minor shutdowns is at the sole discretion of the on-site plant supervisor.

Major shutdowns may be permitted during regular business hours, Monday through Thursday, or during premium business hours, based on criteria provided in appendix 1. Major shutdowns shall require written work plans and notifications as defined elsewhere in this specification. The OWNER may require major shutdowns requested for non-premium period to be performed during premium periods due to reasonable operational concerns. OWNER shall provide a written denial to DESIGN/BUILDER, and DESIGN/BUILDER shall reschedule the shutdown to premium periods. The OWNER shall have the right to require up to two (2) requested non-premium shutdowns to be performed during premium periods, at no additional cost to the OWNER. Premium costs of subsequent denials shall be reimbursable as a change order.

It has been determined that in order to maintain satisfactory service to the customers, critical shutdowns shall not be scheduled unless additional clearwater storage is available. Critical shutdowns shall only be permitted during premium weekend periods as defined in appendix 1. Critical shutdowns shall require written work plans and notifications as defined elsewhere in this specification. The DESIGN/BUILDER shall make presentations of said work plan to the OWNER and ENGINEER in sufficient detail to cause

OWNER to approve the requested shutdown. The DESIGN/BUILDER may also be requested to attend meetings and make presentations to city, regulatory and/or emergency management groups.

1.03 WORKPLAN

The DESIGN/BUILDER shall submit written work plans for major and critical shutdowns, prior to requesting a shutdown for each phase of the work, to give the OWNER and ENGINEER assurance that the DESIGN/BUILDER has planned the work to minimize interruptions. For major and critical shutdowns, the plan shall be detailed in maximum one half-hour increments and shall include manpower, equipment, material and spare part requirements. Critical shutdown work plans shall include risk analyses and contingency strategies to assure service will be restored within the approved shutdown. Work plans provide the opportunity for the OWNER and ENGINEER to review the DESIGN/BUILDER's assumptions regarding interruptions of the OWNER's operation. The work plan shall provide sufficient flexibility to accommodate changes requested by the OWNER and ENGINEER to minimize the interruptions.

PART 2: PRODUCTS

Not Used

PART 3: EXECUTION

3.01 NOTIFICATIONS

The DESIGN/BUILDER shall provide a written "Notice of Intention" a minimum of 72 hours prior to minor shutdowns, a minimum of seven (7) calendar days prior to major shutdowns, and a minimum of fourteen (14) days prior to critical shutdowns. Notices shall include a copy of the final approved work plan. Also, the on-site plant supervisor shall be alerted in writing of the DESIGN/BUILDER's "Intent to commence shutdown" 24-hours prior to any shutdown. This shall be in addition to previous "Notice of Intention."

End of Section

Spec. 01046
APPENDIX 1

INDIANA AMERICAN WATER
KOKOMO DISTRICT

Sheridan Water Treatment Facility

PLANT SHUTDOWN CRITERIA

	Required Shutdown	Status of other units	Maximum Duration	Seasonal Limitations	Work Period	Notification Requirements	Possible Need

SECTION 01075

BASIS OF PAYMENT

PART 1: GENERAL

1.01 SCOPE

Not Used.

1.02 SUPPLEMENTAL UNIT PRICE ITEMS

None Required.

1.03 SCHEDULE OF CASH ALLOWANCES

A. Section 02200 Earthwork – Testing
Section 02510 Asphalt Concrete Paving – Testing
Section 03300 Cast-in-Place Concrete –Testing

The DESIGN/BUILDER shall include in the Target Cost an Allowance of **$10,000** for providing the services of an independent testing laboratory to perform testing for concrete, soils, asphalt, structural steel bolting and welding, and steel tank painting inspection as specified in the contract documents. Approval by the OWNER of the independent testing laboratory is required before commencement of work at the project site.

During the course of the work the independent testing laboratory shall perform for the DESIGN/BUILDER and OWNER such tests as are required to verify conformance to the requirements of the specifications. Such tests are not intended to provide the DESIGN/BUILDER with information required by him for proper execution of the work and their performance shall not relieve the DESIGN/BUILDER of the necessity to perform tests for that purpose.

B. **Section 1500 - RPR Special Equipment and Supplies**

In addition to the RPR field trailer, equipment and supplies included as temporary facilities in Specification Section 01500, the DESIGN/BUILDER shall include in the Target Cost an allowance of **$10,000** for special equipment and supplies. These equipment and supplies may include, but are not limited to, computer, printer, fax, scanner, telephone, digital camera and office supplies. The allowance shall also be used to pay on a monthly basis the telephone usage bills for telephone lines designated for RPR use. The costs reimbursed shall be for the actual cost incurred and shall not include any DESIGN/BUILDER markups. All purchases for RPR equipment and supplies shall be approved by the OWNER. If the actual cost of the equipment, supplies and telephone bills are greater than or less than allowance amount, a Contract Change Order will be processed to account for the difference.

C. Security

The DESIGN/BUILDER shall include in the Target Cost a Cash Allowance of **$5,000** for providing background checks for the DESIGN/BUILDER's key employees including subdesign/builders.

The OWNER will require that key employees of the DESIGN/BUILDER working on the project site to have a background checks completed. The DESIGN/BUILDER shall conduct a background check on each of its key employees prior to the employee performing any function or activity under this Agreement involving any on-site work at the OWNER's operating facilities. The background check conducted by the DESIGN/BUILDER shall consist of a check of at least the following: previous employers and dates of employment; education; driving record; criminal history (state and federal); references and credit history. Prior to commencing work DESIGN/BUILDER shall provide proof to the OWNER that the requirements of this paragraph have been met. DESIGN/BUILDER shall make available to the OWNER, upon request, the documentation and results of the background check with respect to any employee of DESIGN/BUILDER performing any function under this Agreement involving any on-site work at the OWNER's operating facilities.

(The OWNER employs BackTrack (see below for additional information) to perform their background checks and advises that to avoid delays the DESIGN/BUILDER employee this same company. However, the DESIGN/BUILDER may hire other companies to perform background checks providing the DESIGN/BUILDER receives prior approval by the OWNER. Confirm with BackTrack for the most current prices.)

BackTrack
8200A Tyler Boulevard
Mentor, Ohio 44060
Attention: Robin Doran
800-991-9694

The services provided by BackTrack include: county criminal search, federal court search, employment history for 5 years (4-work places), education, financial and driving records for a cost of **$100.00**, plus additional fees for criminal tracking and for the checking of multi-terrorist database. The services are provided in three to four weeks.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.01 BEFORE STARTING WORK

A. Preliminary Progress Schedule

The DESIGN/BUILDER shall prepare and submit to the OWNER for approval, a preliminary schedule. This submittal is to be made within ten (10) days from the Effective Date of Agreement. The method of schedule preparation required is generally referred to as the Critical Path Method (CPM).

This CPM Schedule will be a computer-generated construction schedule, using Primavera Project Planner (P3), a project management and control software developed by Primavera Systems, Inc., Two Bala Plaza, Bala Cynwyd, Pennsylvania 19004, (800) 423-0245 or (215) 667-8600 or the latest version of SureTrak.

In developing the project schedule, the DESIGN/BUILDER shall utilize the Precedence Diagramming Method (PDM) option of P3. The work day to calendar date correlation of the construction schedule shall be based on a 40-hour work week with adequate allowance for holidays, adverse weather and all other special requirements of the work.

The DESIGN//BUILDER will be required to submit with the preliminary progress schedule, and all subsequent updates, a Primavera Project Planner generated back-up diskette. This back-up diskette must contain all descriptions, durations, logic, constraints, coding, cost information, and any other information required for computer analysis and generation of schedule and cost reports and plots. If resource loading is utilized, all resource loading, minimum and maximum limits, and any other information required for computer analysis must be provided.

The schedule shall include, as a minimum, the following separate activities:

1. Preliminary design, final design.

2. Physical construction (includes mobilization, demobilization, setup time, lags, etc.).

3. Issuance by DESIGN//BUILDER of purchase orders for material and equipment and submittal of shop drawings and samples to the OWNER.

4. Review by Design Professional for each submittal of samples and shop drawings.

5. Fabrication time for materials and equipment.

6 Delivery of materials and equipment.

7 Installation of materials and equipment.

8. Testing, start-up and training for individual pieces of equipment or entire systems as appropriate.

9. Winter affected activities.

10. Outages or interruptions of OWNER's facilities required to perform work.

11. Demolition or removal work under this Contract.

Activity durations shall represent the best estimate of elapsed time considering the scope of the Work involved in the activity and the resources planned for accomplishing the activity expressed in working days.

Activity descriptions shall clearly define the scope of work associated with each activity. If activity descriptions contained in the schedule are not sufficient to describe the work, a supplemental narrative description is to be provided.

The construction work shall be detailed to an extent that progress can be readily monitored on a daily basis. In general, the construction work shall be detailed such that no construction activity shall have a duration greater than fifteen (15) work days.

Each activity shall be coded by the DESIGN/BUILDER as necessary for proper and efficient utilization of the schedule. As a minimum, each activity shall be coded by:

1. Activity type (i.e., submittal, Design Professional's review, delivery, construction, etc.).

2. Responsibility (i.e., Design/Builder, Engineer, subcontractor A, subcontractor B, OWNER, etc.).

3. Area (i.e., Building A, Building B, sitework, etc.).

4. Task Order (i.e., OWNER assigned number required for monthly invoicing requirements).

The above schedule development requirements are a minimum and the DESIGN/BUILDER shall develop the schedule as necessary to properly control and manage the project.

The preliminary progress schedule shall be submitted in a network analysis format and shall include, as a minimum, a graphic representation of all significant activities and events involved in the construction of the project, and a written statement explanatory thereof for a complete understanding of the diagram.

The network graphic representation and statement must clearly depict and describe the sequence of activities planned by the DESIGN/BUILDER, their interdependence and the times estimated to perform each activity. The network shall be submitted on sheets 24" x 36" or larger and may be divided into as many separate sheets as required.

Accompanying the network graphic representation of the Construction Schedule, the following computer generated schedule reports shall be submitted as part of the network analysis:

1. Detailed Activity Report - This report shall be sorted by activity number and shall include, as a minimum, the following information:
   a. activity number
   b. activity description
   c. estimated duration
   d. early start date (calendar dated)
   e. early finish date (calendar dated)
   f. latest allowable start date (calendar dated)
   g. latest allowable finish date (calendar dated)
   h. total float
   i. activity codes
   j. detailed predecessor(s) and successor(s)
   k. free float

2. Early Start Report - This report shall be sorted by activity type in an early start order.

3. Critical Path Report - This report shall be sorted by total float in an early start order.

4. Activity Cost Values - This report shall list the activity number, description and cost value assigned to it. Once approved, the DESIGN/BUILDER will be provided work order numbers to be assigned to each activity for input into the schedule codes.

The schedule reports shall be bound in booklet form and tabbed.

B. Shop Drawings and Samples Submittal Schedule

The preliminary progress schedule shall contain activities in the network representing submittal and review of shop drawings and material samples. The shop drawing and sample submittal schedule shall be developed by sorting these activities from the progress schedule. The schedule shall be presented in a report format containing the following information:

1. activity number
2. activity description (including reference to the appropriate specification section)
3. early and late start dates
4. early and late finish dates

5. total and free float
6. successor activities

C. Schedule of Values

The DESIGN/BUILDER shall submit to the OWNER a schedule of values representing a detailed subdivision of the Cost of the Work. This subdivision, when approved by the OWNER, will become the basis for computing the DESIGN/BUILDER'S monthly progress payments. If practical, the schedule of values shall be developed by assigning a cost value to the appropriate activities contained in the preliminary progress schedule. If activities, or other line items, in the schedule of values contain costs associated with material, labor or subcontracts these costs are to be identified separately by listing the activity multiple times and identifying material, labor and subcontract with a suffix M, L and S respectively. Cost values for activities representing materials/equipment only shall be assigned to the activity representing delivery of such material/equipment to the job site.

D. Schedule of Property Unit Values

In addition to the Schedule of Values, DESIGN/BUILDER shall provide a breakdown of the construction cost by Property Units in accordance with the list of Property Units identified in the Attachment to this specification section. The detailed arrangement for submittal of the construction cost by Property Units shall be discussed at the initial conference.

E. Cash Flow Schedule

Accompanying the CPM Schedule required above, the DESIGN/BUILDER shall also submit to the OWNER, for approval, a Cash Flow Schedule. The Cash Flow Schedule shall show the amounts of money by months which will be required to reimburse the DESIGN/BUILDER for Work performed during each month of the Contract Times. The sum of all the monthly cash requirements shall equal the Target Cost. The monthly cash requirements shall be proportioned based on the CPM Schedule. The initial cash flow schedule shall depict monthly cash requirements based on the early start dates of the CPM Schedule as well as the monthly cash requirements based on late start dates of the CPM Schedule. The approved cash flow schedule will be developed by the OWNER and will reflect the DESIGN/BUILDER'S schedule performance as of the date of approval. This process of approving cash flow schedules will occur with each required schedule update.

The approved Cash Flow Schedule will be used by the OWNER to program funds for progress payments to the DESIGN/BUILDER. Monthly payments will be made to the DESIGN/BUILDER in accordance with the Contract Agreement, but at no time will the aggregate amount of payments exceed the accumulated amount of payments for the same period of the approved Cash Flow Schedule.

F. Preconstruction Digital Recording

Prior to mobilization at the site, furnish to OWNER a CD or DVD recording of all planned construction areas, material storage areas, areas adjacent to these areas, including but not limited to, streets, driveways, sidewalks, curbs, ditches, fencing, railing, visible utilities, retaining structures and adjacent building structures. The purpose of the recording is to document existing conditions and to provide a fair measure of required restoration. Care should be taken to record all existing conditions which exhibit deterioration, imperfections, structural failures or situations that would be considered substandard.

The recording shall be performed by a professional firm specializing in audio-video work. The tapes shall be high quality, color and in a digital format. Temporary lighting shall be provided as necessary to properly tape areas where natural lighting is insufficient (indoors, shadows, etc.). The recording shall include an audio soundtrack to provide the following information:

- detailed description of location being viewed referenced to Contract Drawings (i.e. station no., building designation, pipeline route etc.)
- direction (N, S, E, W, looking up, looking down, etc.) of camera view
- date, time, temperature, environmental conditions at time of taping.

Any areas not readily visible by the recording shall be described in detail. Unless otherwise approved by OWNER, recording shall not be performed during inclement weather or when the ground is covered partially or totally with snow, ice, leaves, etc.

Prepare and provide as many CD/DVD as are necessary to satisfy the requirements of this section. The original recording shall be submitted to the OWNER accompanied by a detailed log of the contents of each CD/DVD. The recording will be maintained by the OWNER during construction and may be viewed at any time upon request. Upon final acceptance, the recording will become the permanent property of the OWNER.

1.02 FINALIZING SCHEDULES

The DESIGN/BUILDER shall be prepared to present and discuss at the preconstruction meeting, the schedules submitted in accordance with this specification. Unless additional information is required to be submitted by the DESIGN/BUILDER, the OWNER will, within 15 working days of the preconstruction conference, provide comments to the DESIGN/BUILDER. The DESIGN/BUILDER shall then resubmit the affected schedules addressing the OWNER's comments.

Approval of the final schedules by the OWNER is advisory only and shall not relieve the DESIGN/BUILDER of responsibility for accomplishing the work within the Contract Times. Omissions and errors in the approved CPM schedule shall not excuse performance less than that required by the Contract. Approval by the OWNER in no way makes the OWNER an insurer of the success of those schedules or liable for time or cost overruns flowing from shortcomings in such schedules.

1.03 REQUIREMENTS FOR CONFORMING WITH SCHEDULE

If, in the opinion of the OWNER, the DESIGN/BUILDER falls behind the progress schedule, the DESIGN/BUILDER shall take such steps as will be necessary to improve his progress, and OWNER may require DESIGN/BUILDER to increase the number of shifts and/or overtime operations, days of work, and/or the amount of construction planned, and to submit for approval such supplementary schedule or schedules as may be deemed necessary to demonstrate the manner in which the agreed rate of progress will be regained, all without additional cost to the OWNER. An updated cash flow schedule will be required in this occurrence and will be provided with the supplementary schedules referenced above.

1.04 UPDATING SCHEDULES

The DESIGN/BUILDER shall submit to the OWNER monthly updates of the schedules required per this specification section.

Progress and shop drawing schedule updates shall reflect the progress to date by providing actual start dates for activities started, actual finish dates for completed activities, and identifying out of sequence work, schedule logic changes and any circumstances or events impacting the current schedule. The updates shall also contain the DESIGN/BUILDER's best estimate of the remaining duration for activities not complete as of the date of the update. All graphic presentations, reports and computer discs required per the initial submittal of these schedules shall be provided with each update.

The schedule of values and cash flow schedules shall be updated to reflect any changes.

1.05 ADJUSTMENT OF PROGRESS SCHEDULE AND CONTRACT TIMES

A. If the DESIGN/BUILDER desires to make changes in his method of operating which affect the approved progress schedule, he shall notify the OWNER in writing stating what changes are proposed and the reason for the change. If the OWNER approves these changes, the DESIGN/BUILDER shall revise and submit for approval, without additional cost to the OWNER, all of the affected portions of the schedule.

B. Shop drawings and samples which are not approved on the first submittal or within the schedule time shall be immediately rescheduled, as well as any work which fails to pass specified tests or has been rejected.

C. The Contract Times will be adjusted only for causes specified in the General Conditions. In the event the DESIGN/BUILDER requests an adjustment of the Contract times, he shall furnish such justification and supporting evidence as the OWNER may deem necessary for a determination as to whether the DESIGN/BUILDER is entitled to an adjustment of Contract Times under the provisions of the General Conditions. The OWNER will, after receipt of such justification and supporting evidence, make findings of fact and will advise the DESIGN/BUILDER in writing thereof. If the OWNER finds that the

DESIGN/BUILDER is entitled to any adjustment of the Contract Times, the OWNER's determination as to the total number of days adjustment shall be based upon the currently approved progress schedule and on all data relevant to the adjustment. The DESIGN/BUILDER acknowledges and agrees that actual delays in activities which, according to the progress schedule, do not affect the Contract completion date shown by the critical path in the network will not be the basis for an adjustment of Contract Times.

D. From time to time it may be necessary for the progress schedule and/or Contract Times to be adjusted by the OWNER to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the OWNER, and other unforeseeable conditions which may indicate schedule and/or Contract Times adjustments. Under such conditions, the OWNER shall direct the DESIGN/BUILDER to reschedule the work and/or Contract Time to reflect the changed conditions, and the DESIGN/BUILDER shall revise his schedule accordingly. No additional compensation shall be made to the DESIGN/BUILDER for such changes except as provided in the General Conditions. Unless otherwise directed, the DESIGN/BUILDER shall take all possible actions to minimize any extension to the Contract Times and any additional cost to the OWNER.

1.06 SHOP DRAWINGS

The DESIGN/BUILDER shall promptly supply to the Design Professional for approval, shop drawings with details and schedules for all items requiring submittals. All shop drawings are required to be submitted to OWNER for use during construction. A list of shop drawings requiring OWNER's review and approval will be defined by the OWNER during the preliminary design phase.

A sufficient number of copies to allow the OWNER to retain four (4) reviewed copies of all drawings, schedules and brochures shall be submitted for approval. Black line prints, blue line prints or reproducible transparencies are required. Blueprints (white lines on a blue background) are not acceptable. Each submittal shall have the job name on it and the appropriate specification section or contract drawing reference.

Shop drawings shall be numbered with the OWNER's file number **xxxx-xxxx-xxx Rev. YY**. Detailed procedures for numbering will be outlined at the pre-construction meeting.

Each submittal shall have an identifying title stamp as follows:

Indiana-American Water Company
Sheridan Water Treatment Facility
Specification Section _____
Shop Drawing No. _____ Rev. _____

Each copy of the submittals shall also be stamped with the DESIGN/BUILDER's approval indicating that the shop drawing has been reviewed for conformance to the Contract Documents and has been coordinated with all other work and/or trades. For shop drawings being resubmitted, the DESIGN/BUILDER shall identify

and bring to the attention of the OWNER any revisions other than those originally requested by the OWNER.

Submittals smaller than 8½x11 inches shall be secured to paper 8½x11 inches.

1.07 SAMPLES

When required by the OWNER or where noted in other Sections of these Specifications, samples or materials shall be submitted for approval.

Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

Submit samples of finishes from the full range of manufacturer's standard colors, textures, and patterns for OWNER's selection.

Include identification on each sample, with full project information.

Submit the number or samples specified in individual specification sections; one of which will be retained by OWNER.

Reviewed samples which may be used in the Work are indicated in individual specification sections.

1.08 PROGRESS PAYMENTS

The detailed arrangement for submittal of progress payments shall be discussed at the initial conference. In general, progress payments shall be submitted monthly in a format acceptable to the OWNER. The progress payment request shall be based on the approved schedule of values and should provide the percentage of completion, total dollar value completed, dollar value completed prior to the current payment, and the amount requested for this progress payment for each line item contained in the schedule of values. Progress payment requests for material and/or equipment suitably stored but not yet incorporated into the work shall be accompanied by a copy of the appropriate manufacturers invoice, shipping order, bill of lading, etc. and the progress payment amount shall be the direct cost to the DESIGN/BUILDER, or subDESIGN/BUILDER, for such material and/or equipment. Payment will not be made to the DESIGN/BUILDER if, upon inspection by the OWNER, it is determined that the material and/or equipment does not conform to the requirements of the Contract Documents including proper storage, receipt of approved shop drawings, receipt of any special guarantees, Bonds, insurance coverage, any evidence of damage or imperfections, etc.

1.09 DESIGN/BUILDER'S DAILY CONSTRUCTION REPORTS

The DESIGN/BUILDER shall prepare and submit daily reports containing the following information:

1. The number of craftsmen and hours worked of each DESIGN/BUILDER and subDESIGN/BUILDER,

2. The number of hours worked by each trade,
3. The number of hours worked of each type of equipment,
4. A description of work activities performed,
5. A description of any material or equipment deliveries,
6. Description of obstructions encountered,
7. Temperature and weather conditions.

The daily reports shall be submitted on a weekly basis, on the following Monday of each week.

Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents. Notice shall be as required therein.

1.10 OPERATING AND MAINTENANCE INSTRUCTION MANUALS

A. The DESIGN/BUILDER shall prepare complete written Operation and Maintenance Instruction Manuals covering each item of equipment finished or modified under this Contract. The DESIGN/BUILDER shall submit in duplicate, at least eight (8) weeks prior to initial start-up, a draft form of the manual for review by the ENGINEER. After the manual has been approved, **four (4)** hard copies and one (1) electronic copy of the Operations and Maintenance Manuals shall be furnished to the ENGINEER. The final copies shall be received by the ENGINEER prior to start-up operations.

B. The Operation and Maintenance Manual shall include, but not be limited to, the following information: detailed description of the process and operating procedures as applicable; instruction for all components of the equipment whether manufactured by the supplier or not, including valves, controllers and other miscellaneous components; recommended lubrication and maintenance procedures and schedules including a detailed schedule of the manufacturer's preventative maintenance requirements; appropriate parts lists; exploded and/or sectional views; internal and external wiring and piping diagrams numbered to correspond to the installation; and all other pertinent information of value to obtain peak performance.

C. Equipment manufacturer's Operation and Maintenance Manuals which DESIGN/BUILDER shall procure from the manufacturer shall include the following:

1. Plant Specific Operating Instructions

2. Maintenance and Lubrication Schedules and Lubricant Recommendations including recommended preventive maintenance schedules listed as daily, weekly, monthly, quarterly, semi-annually and annually.

3. Recommended Spare Parts List

4. Plant Specific Troubleshooting guides with solutions recommended.

5. Start-up Procedures

6. Shut-down Procedure including extended shut-down recommend-dations.

7. Emergency Operations

8. Overhaul Procedures

9. Selected drawings and exploded views.

10. Internal wiring and piping diagrams.

11. Complete catalog of parts used in final assembly of equipment.

12. Service Centers List

13. Manufacturer's name, contract number, model number and serial number of the equipment on the cover of each manufacturer's manual.

14. Other pertinent information of value to obtain peak performance.

D. Equipment manufacturer's manuals shall be written for average journey men mechanics without prior knowledge of the specific equipment.

E. The Manuals shall be assembled in **four (4)** sets and bound in 3 or 4 inch post type, first quality, hard cover, heavy duty three post binders and one (1) electronic copy of CD. One or more numbered volumes shall be provided as required. Each item of equipment shall be placed in a logical sequential order, as listed or ordered in the Contract Documents.

F. Provide a table of contents at the front of each volume showing the equipment items in the order in which they appear in the volume. Each equipment item shall include the functional name, applicable specification section(s) and the plant sheet listing, if any.

G. The preventive maintenance schedule shall be bound in the front of each section immediately following the index tab sheet. The schedule shall be identified with respect to the piece of equipment it is referring to.

Sheet size shall be 8½ x 11-inches.

Imprint on the front cover and spine of each binder the following:

Indiana-American Water Company
Sheridan Water Treatment Facility
Operations and Maintenance Manual
Volume No. -----

H. Prior to release of Final Payments, revise and resubmit copies of the instructions to accord with any changes in procedures or equipment made during start-up or initial operation. Resubmittals are also required for changes made during the guarantee period.

1.11 CONSOLODATED SUMMARY OF MAJOR COMPONENT SERVICE LIFE

A. Provide a consolidated summary of key components with known periodic replacement cycles (OSG cell, UV lamp, chemical storage tank, etc.).

1. Descriptive Name of Equipment
2. Manufacturer Name of Equipment (as of 2019)
3. Manufacturer Part Number (as of 2019)
4. Expected service life before replacement
5. Equipment unit cost (as of 2019)

B. Furnish electronic copies of this summary in PDF and Excel form on 2 CDs.

1.12 CONTRUCTION PHOTOGRAPHS

C. Provide construction photographs taken within the first three working days of each month. Take a minimum of twelve (12) digital exposures each and submit three (3) prints and digital copies of each exposure.

D. When work is complete take twelve (12) additional digital photographs and submit three (3) prints and electronic copies of each exposure.

E. Employ a mutually acceptable commercial photographer who has shown OWNER samples of his/her work. Photographer shall be equipped at all times to make either interior or exterior exposures.

F. Prints shall be color, with smooth surface, glossy finish, 8 x 10- inch size, single weight paper, mounted with 1-inch binding edge. Identify each print on the back with name of project, description of view, date and name of DESIGN/BUILDER. Name and address of photographer may appear on back. Digital copies shall be in JPEG (Joint Photographic Experts Group) format.

G. Consult with OWNER for instructions concerning view required at each specified visit to the site. Provide one suitable size 3-ring binder for each set of prints. Binders shall be furnished in sufficient quantity to hold all photographs taken for the duration of the Contract. Each binder shall be labeled on the front with the project name. Provide digital copies on computer disks.

Deliver prints and three (3) computer disks monthly to OWNER.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SPECIFICATION 01300
ATTACHMENT - LIST OF PROPERTY UNITS

PROPERTY UNIT CATALOG

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5000	Structure	Land		Acres		
5001	Structure	Easement/Right-of-Way		Acres		
5002	Structure	Landscaping		EA		
5003	Structure	Lake/Reservoir		EA		
5004	Structure	Door or Hatch		EA		
5005	Structure	Window		EA		
5006	Structure	Roofing System		EA		
5007	Structure	Floor Covering		SF		
5008	Structure	Railing and Grating		EA		
5009	Structure		Barrier, Gate, Masonry, Palisade,Wire Mesh, Wooden	FT		
5010	Structure	Wood Building		SF		
5011	Structure	Metal Building		SF		
5012	Structure	Masonry Building		SF		
5013	Structure	Concrete Building		SF		
5014	Structure	Composite Building		SF		
5015	Structure	Paving	Parking Lot, Sidewalk, Driveway, Road, Access Ramp (ADA)	SF		
5016	Structure	Manhole/Catch Basin		EA		
5017	Structure	Vault/Chamber/Pit	Concrete, Fiberglass, Plastic, Steel	EA		
5018	Structure	Boat Dock		EA		
5019	Structure	Bridge		EA		
5020	Structure	Concrete		EA		
5021	Structure	Earthen		EA		
5022	Structure	Masonry		EA		
5023	Structure	Steel		EA		
5024	Structure	Retaining Wall		EA		
5025	Structure	Tunnel		EA		
5026	Structure	Wastewater Facility		EA		
6900	Structure	Facility or Lrg Asset Ident Signage		EA		
5413	Treatment	Pre-Sed Basin		EA		
5414	Treatment	Aerator		EA		
5415	Treatment	Stripping Tower		EA		
5417	Treatment	Mechanical Mixer	Agitator, paddle, screw, propellor	EA		
5418	Treatment	In Line Static Mixer		EA		
5419	Treatment	Pneumatic Mixer		EA		
5420	Treatment	Mixing/Flocculation Tank	Steel, Concrete	EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5422	Treatment	Decanter		EA		
5423	Treatment	Plate Settler		EA		
5424	Treatment	Rotating Discs		EA		
5425	Treatment	Tube Settler		EA		
5426	Treatment	Upflow		EA		
5427	Treatment	Micro Sand		EA		
5428	Treatment	Buoyant Media		EA		
5429	Treatment	Clarification Tank		EA		
5430	Treatment	Media		EA		
5431	Treatment	Membrane Filtration		EA		
5432	Treatment	Reverse Osmosis Equipment		EA		
5433	Treatment	Trough		EA		
5434	Treatment	Surface Wash		EA		
5435	Treatment	Air Wash		EA		
5436	Treatment	Underdrain		EA		
5437	Treatment	Gravity Filter Box		EA		
5438	Treatment	Pressure Filter		EA		
5440	Treatment	Clearwell		EA		
5441	Treatment	Baffle Curtain or Wall		EA		
5442	Treatment	Ultraviolet Equipment		EA		
5443	Treatment	Sludge Collection Equipment		EA		
5444	Treatment	Wash Water Waste Holding Tank		EA		
5445	Treatment	Residuals Holding Tank		EA		
5446	Treatment	Press		EA		
5447	Treatment	Conveyor		EA		
5448	Treatment	Drying Bed		EA		
5449	Treatment	Lagoon		EA		
5450	Treatment	Communitor		EA		
5451	Treatment	Scraper		EA		
5452	Treatment	Grit Removal Equipment		EA		
5453	Treatment	Sand Washing Equipment		EA		
5454	Treatment	Waste Distribution Equipment		EA		
5455	Treatment	Elevator/Lift		EA		
5456	Treatment	Lifting Equipment		EA		
5457	Treatment	Blower		EA		
5458	Treatment	Compressor		EA		
5459	Treatment	Coupler/Coupling		EA		
5460	Treatment	Gearbox		EA		
5461	Treatment	Lubrication Equipment		EA		
5462	Treatment	Pressure Vessel		EA		
5463	Treatment	Fuel Tank		EA		
5464	Treatment	Waste Oil Hopper		EA		
5564	Wells and Intakes	Well Casing		EA		
5565	Wells and Intakes	Well Screen		EA		
5566	Wells and Intakes	Uncased Well		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5567	Wells and Intakes	Wellhead Protection		EA		
5568	Wells and Intakes	Radial Collector Well		EA		
5569	Wells and Intakes	Spring Infiltration Gallery		EA		
5570	Wells and Intakes	Side Channel Intake		EA		
5571	Wells and Intakes	Bar Rack		EA		
5572	Wells and Intakes	Traveling Screen		EA		
5573	Wells and Intakes	Intake Screen		EA		
5027	Chemical Feed	Liquid-Metering Pump/Feeder		EA		
5028	Chemical Feed	Liquid-Bulk Storage Tank		EA		
5029	Chemical Feed	Liquid-Day Tank		EA		
5030	Chemical Feed	Liquid-Transfer Pump		EA		
5031	Chemical Feed	Liquid-Generator	Chlorine Dioxide, Hypochlorite	EA		
5032	Chemical Feed	Gas-Dispenser	Chlorinator, Ammoniator, Sulfonator	EA		
5033	Chemical Feed	Gas-Vacuum Regulator		EA		
5034	Chemical Feed	Gas-Evaporator	Chlorine, Ammonia, Sulfor Dioxide	EA		
5035	Chemical Feed	Gas-Liquefied Storage Tank		EA		
5036	Chemical Feed	Gas-Softener		EA		
5037	Chemical Feed	Gas-Scrubber	Wet, Dry	EA		
5038	Chemical Feed	Gas-Generator	Ozone	EA		
5039	Chemical Feed	Dry-Feeder	Loss in Weight, Volumetric	EA		
5040	Chemical Feed	Dry-Bulk Storage/Silo		EA		
5041	Chemical Feed	Dry-Day Storage/Hopper		EA		
5042	Chemical Feed	Ejector/Inductor		EA		
5128	Commmunication	TV/DVD/VCR		EA		
5129	Commmunication	Public Address/Sound System		EA		
5130	Commmunication	Video Projection System		EA		
5131	Commmunication	Telephone System		EA		
5132	Commmunication	Server Rack		EA		
5133	Commmunication	Two-Way Voice Radio		EA		
5044	Computer Hardware and Software	Desktop Computer		EA		
5045	Computer Hardware and Software	Laptop Computer		EA		
5046	Computer Hardware and Software	Printer/Plotter		EA		
5047	Computer Hardware and Software	Server		EA		
5048	Computer Hardware and Software	Data Storage		EA		
5049	Computer Hardware and Software	Networking Equipment	Router, Switch, Hub	EA		
5050	Computer Hardware and Software	Camera/Recorder		EA		
5051	Computer Hardware and Software	Projector		EA		
5052	Computer Hardware and Software	Custom Software		EA		
5053	Computer Hardware and Software	Commercial Off-the-Shelf Software		EA		
5054	Computer Hardware and Software	Electronically Delivered Software		EA		
6360	Computer Hardware and Software	Monitor/Display		EA		
5055	Electrical	Battery	Gel Cell, Lead Acid, Lithium Ion, NiC	EA		
5056	Electrical	Battery Charger	Fixed Current, Fixed Voltage	EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5057	Electrical	Busbar/Busduct		EA		
5058	Electrical	Cathodic Protection	Impressed Current, Sacrificial Anode	EA		
5059	Electrical	Changeover/Transfer Switch	Auto, Manual	EA		
5060	Electrical	Choke	AC, DC	EA		
5061	Electrical	Circuit Breaker	Oil, Air, Gas, Ground Fault, Molded Case, Vacuum, Vacuum Contactor	EA		
5062	Electrical	Fuses		EA		
5063	Electrical	Disconnect	Fused, Manual, Spring Loaded	EA		
5064	Electrical	Distribution/Lighting Panel		EA		
5065	Electrical	Earthing/Grounding Equipment	Earthing Grid / Zone, High Voltage, Lightning Conductor	EA		
5066	Electrical	Lighting	High Pressure Sodium, Incandescent, Mercury Vapor, Fluorescent	EA		
5067	Electrical	Motor Starter/Motor Control Center		EA		
5068	Electrical	Power Cable		EA		
5069	Electrical	Power Supply Equipment	DC Supply, Fuel Cells, Hydroelectric, Phase Converter, Portable Light Plant, Power Inverter, Solar Panel, Uninterruptible Power Supply, Voltage Regulator, Wind Generator	EA		
5070	Electrical	Power Switch		EA		
5071	Electrical	Power Pole		EA		
5072	Electrical	Protective Relay/Device	Electro-Magnetic / Electronic	EA		
5073	Electrical	Surge/Transient Equipment	Lightning Arrestors	EA		
5074	Electrical	Transformer		EA		
5075	Electrical	Electric Meter		EA		
5076	Electrical	Motor	DC, Induction, Synchronous / Exciter, Wound Rotor (Slip Ring)	EA		
5077	Electrical	Engine		EA		
5078	Electrical	Generator	Alternator - AC, DC; Driver - Diesel, Dual Fuel, Natural Gas, Gasoline, Hydraulic, Pneumatic, Turbine, Steam	EA		
5079	Electrical	Turbine		EA		
5080	Electrical	Wiring/Conduit		EA		
5154	Flow Meters	Displacement 1/2"		EA		
5155	Flow Meters	Displacement 1/2" x 3/4"		EA		
5156	Flow Meters	Displacement 5/8"		EA		
5157	Flow Meters	Displacement 5/8" x 3/4"		EA		
5158	Flow Meters	Displacement 3/4"		EA		
5159	Flow Meters	Displacement 1"		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5160	Flow Meters	Displacement 1-1/2"		EA		
5161	Flow Meters	Displacement 2"		EA		
5162	Flow Meters	Turbine 1-1/2"		EA		
5163	Flow Meters	Turbine 2"		EA		
5164	Flow Meters	Turbine 3"		EA		
5165	Flow Meters	Turbine 4"		EA		
5166	Flow Meters	Turbine 6"		EA		
5167	Flow Meters	Turbine 8"		EA		
5168	Flow Meters	Turbine 10"		EA		
5169	Flow Meters	Turbine 12"		EA		
5170	Flow Meters	Compound 2"		EA		
5171	Flow Meters	Compound 3"		EA		
5172	Flow Meters	Compound 4"		EA		
5173	Flow Meters	Compound 6"		EA		
5174	Flow Meters	Compound 8"		EA		
5175	Flow Meters	Compound 10"		EA		
5176	Flow Meters	Compound 12"		EA		
5177	Flow Meters	Fire Service 3"		EA		
5178	Flow Meters	Fire Service 4"		EA		
5179	Flow Meters	Fire Service 6"		EA		
5180	Flow Meters	Fire Service 8"		EA		
5181	Flow Meters	Fire Service 10"		EA		
5182	Flow Meters	Process	Closed Pipe Time of Flight, Magnetic, Multi-jet, Porgrammable, Open Channel, Ultrasonic, Paddle, Propeller, Thermal Mass Flow, Ultrasonic, Vortex, Rotameter	EA		
5183	Flow Meters	Meter Reading Equipment	Handheld, MU - Meter Interface Unit	EA		
5184	Flow Meters	Meter Settings/Installations	Yoke, Copperhoen	EA		
6221	Flow Meters	Unitized Measuring Element (UME)		EA		
5082	HVAC / Plumbing	Boiler	Electrode, Fire Tube, Water Tube Dual Fuel, Flare Stack, Gas Fired (Matural - Corgi), Gas Fired	EA		
5083	HVAC / Plumbing	Burner	(Sludge), Oil, Solid Fuel	EA		
5084	HVAC / Plumbing	Condensate Trap		EA		
5085	HVAC / Plumbing	Dehumidifier	Electric, Gas	EA		
5086	HVAC / Plumbing	Humidifier		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5087	HVAC / Plumbing	Heat Exchanger	Plate, Radiator, Shell and Tube	EA		
5088	HVAC / Plumbing	Heating Equipment	Electric Heater, Gas Heater, Trace Heating	EA		
5089	HVAC / Plumbing	HVAC Equipment	Air Condition Unit / Air Chiller, Heat Pump	EA		
5090	HVAC / Plumbing	Gas Meter		EA		
5091	HVAC / Plumbing	Ventilation	Dust Collector, Motorized Louver, Ventilation (Stationary)	EA		
5092	HVAC / Plumbing	Hot Water Heater		EA		
5093	HVAC / Plumbing	Fixtures - Aggregate	Sinks, Shower, Toilets	EA		
5094	HVAC / Plumbing	Septic Tank		EA		
5095	HVAC / Plumbing	Irrigation System		EA		
5096	HVAC / Plumbing	Ducting System		EA		
5097	HVAC / Plumbing	Piping System	Hot Water, Cold Water, Waste	EA		
5530	Hydrants and Valves	Fire Hydrant		EA		
5531	Hydrants and Valves	Yard Hydrant/Sampling Station		EA		
5532	Hydrants and Valves	Gate Valve		EA		
5533	Hydrants and Valves	Butterfly Valve		EA		
5534	Hydrants and Valves	Other Valve		EA		
5535	Hydrants and Valves	Valve Actuator		EA		
5536	Hydrants and Valves	Valve/Curb Box		EA		
5537	Hydrants and Valves	Valve Assembly		EA		
5098	Instrumentation	Analytical Water Monitorng Instrmnt	Ammonia, Chlorine, Conductivity, Dew Point, Dissolved Oxygen, Fluoride, Hardness,Hydrogen Sulphide, Iron, Multi-Parameters, Nitrate, Auto Liquid Sampler, Orbisphere, Oxidation Reduction Potential, Oxygen, Ozone, Particle Counter, pH, Phosphate, Sludge Density, Suspended Solids, Total Organic Carbon, Triple Validation Unit, Turbidimeter, Zeta Potential	EA		
5099	Instrumentation	Analytical Equipment		EA		
5100	Instrumentation	Fiber Optic Cable		EA		
5101	Instrumentation	Signal Cable		EA		
5102	Instrumentation	Annunciator Panel		EA		
5103	Instrumentation	Auto Dialers		EA		
5104	Instrumentation	Chart Recorder		EA		
5105	Instrumentation	Antenna		EA		
5106	Instrumentation	Data Radio		EA		
5107	Instrumentation	Telemetry Equipment	Tone, Pulse Duration, Pilar	EA		
5108	Instrumentation	Control Console		EA		
5109	Instrumentation	Hydraulic System		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5110	Instrumentation	Modem		EA		
5111	Instrumentation	PCS90		EA		
5112	Instrumentation	Data Logger		EA		
5113	Instrumentation	DPC/RTU		EA		
5114	Instrumentation	PID Controller		EA		
5115	Instrumentation	Programmable Logic Controller		EA		
5116	Instrumentation	Filter Console		EA		
5117	Instrumentation	Gas Detection Equipment	Ammonia, Carbon Dioxide, Chlorine, Hydrogen, Hydrogen Sulphide, Methane, Multi-Parameters, Oxygen Dewpoint, Ozone, Sulpher Dioxide	EA		
5118	Instrumentation	Leak Detection Equipment	Acoustical, Connectivity Probe, Pressure Monitored	EA		
5119	Instrumentation	Level Measurement Device	Capacitance, Debubbler, Electrode, Inductance, Level Switch, Radar, Resistance, Pressure Transducer / Transmitter, Ultrasonic	EA		
5120	Instrumentation	Power Monitoring Equipment	Voltage, Current, Power Factor, Wattage, kVA	EA		
5121	Instrumentation	Pressure Measurement Device	Gauge, Pressure Switch, Differential Pressure Transducer / Transmitter, Pressure Transducer / Transmitter	EA		
5122	Instrumentation	Speed Monitoring Device	Tachometer	EA		
5123	Instrumentation	Tank Truck (WW) Volume Logger		EA		
5124	Instrumentation	Temperature Monitoring Device	RTD, Temperature Switch, Thermocouple	EA		
5125	Instrumentation	Weather Measurement Equipment	Barometer, Anemometer	EA		
5126	Instrumentation	Weight Scale	Load Cell, Mechanical	EA		
5135	Laboratory	Cabinetry and Countertop		EA		
5136	Laboratory	Analytical Instrument		EA		
5137	Laboratory	Dishwasher		EA		
5138	Laboratory	Refrigerator		EA		
5139	Laboratory	Oven		EA		
5140	Laboratory	Distiller		EA		
5141	Laboratory	Air Pump		EA		
5142	Laboratory	Analytical Balance		EA		
5143	Laboratory	Autoclave		EA		
5144	Laboratory	Centrifuge		EA		
5145	Laboratory	Fume Hood		EA		
5146	Laboratory	Hot Plate/Burner		EA		
5147	Laboratory	Illuminator		EA		
5148	Laboratory	Incubator		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5149	Laboratory	Microscope		EA		
5150	Laboratory	Sample Pump		EA		
5151	Laboratory	Shaker		EA		
5152	Laboratory	Water Bath		EA		
5538	Mobile Equipment	Lt Duty Vehicle (<10,000 lbs GVW)	Car, Van, Pickup, SUV, Utility Truck	EA		
5539	Mobile Equipment	Med Duty Vehicle (10k lbs-26k lbs)	Car, Van, Pickup, SUV, Utility Truck	EA		
5540	Mobile Equipment	Hvy Duty Vehicle (>26,000 lbs GVW)	Car, Van, Pickup, SUV, Utility Truck	EA		
5541	Mobile Equipment	Hybrid or Electric Vehicle	Car, Van, Pickup, SUV, Utility Truck	EA		
5542	Mobile Equipment	Backhoe		EA		
5543	Mobile Equipment	Bicycle		EA		
5544	Mobile Equipment	Boat		EA		
5545	Mobile Equipment	Crane		EA		
5546	Mobile Equipment	Excavator		EA		
5547	Mobile Equipment	Fork Lift		EA		
5548	Mobile Equipment	Bulldozer		EA		
5549	Mobile Equipment	Golf Cart		EA		
5550	Mobile Equipment	Loading Shovel		EA		
5551	Mobile Equipment	Mower	Push, Tractor	EA		
5552	Mobile Equipment	Portable Lighting		EA		
5553	Mobile Equipment	Road Roller		EA		
5554	Mobile Equipment	Skimmer		EA		
5555	Mobile Equipment	Traffic Sign Board		EA		
5556	Mobile Equipment	Tractor		EA		
5557	Mobile Equipment	Trailer		EA		
5558	Mobile Equipment	Utility Truck		EA		
5559	Mobile Equipment	Vacuum Truck		EA		
5560	Mobile Equipment	Dump Truck		EA		
5561	Mobile Equipment	Compressor		EA		
5562	Mobile Equipment	Portable Generator		EA		
6300	Mobile Equipment	Portable Power Op Valve Operator		EA		
6860	Mobile Equipment	Pressure Washer		EA		
5186	Office Equipment	Furniture	Bookcase, Cabinet, Chair, Credenza	EA		
5187	Office Equipment	Replication Device	Copier, Fax, Printer, Scanner	EA		
5188	Office Equipment	General Equipment	Shredder, Postage Machine	EA		
5189	Office Equipment	Appliances	Oven, Microwave, Refrigetator	EA		
5191	Pipe and Fittings	Ductile Iron 3"		FT		
5192	Pipe and Fittings	Ductile Iron 4"		FT		
5193	Pipe and Fittings	Ductile Iron 6"		FT		
5194	Pipe and Fittings	Ductile Iron 8"		FT		
5195	Pipe and Fittings	Ductile Iron 10"		FT		
5196	Pipe and Fittings	Ductile Iron 12"		FT		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5197	Pipe and Fittings	Ductile Iron 14"		FT		
5198	Pipe and Fittings	Ductile Iron 16"		FT		
5199	Pipe and Fittings	Ductile Iron 18"		FT		
5200	Pipe and Fittings	Ductile Iron 20"		FT		
5201	Pipe and Fittings	Ductile Iron 24"		FT		
5202	Pipe and Fittings	Ductile Iron 30"		FT		
5203	Pipe and Fittings	Ductile Iron 36"		FT		
5204	Pipe and Fittings	Ductile Iron 42"		FT		
5205	Pipe and Fittings	Ductile Iron 48"		FT		
5206	Pipe and Fittings	Ductile Iron 54"		FT		
5207	Pipe and Fittings	Ductile Iron 60"		FT		
5208	Pipe and Fittings	Ductile Iron 64"		FT		
5209	Pipe and Fittings	PVC 4"		FT		
5210	Pipe and Fittings	PVC 6"		FT		
5211	Pipe and Fittings	PVC 8"		FT		
5212	Pipe and Fittings	PVC 10"		FT		
5213	Pipe and Fittings	PVC 12"		FT		
5214	Pipe and Fittings	PVC 14"		FT		
5215	Pipe and Fittings	PVC 16"		FT		
5216	Pipe and Fittings	PVC 18"		FT		
5217	Pipe and Fittings	PVC 20"		FT		
5218	Pipe and Fittings	PVC 24"		FT		
5219	Pipe and Fittings	PVC 30"		FT		
5220	Pipe and Fittings	PVC 36"		FT		
5221	Pipe and Fittings	PVC 42"		FT		
5222	Pipe and Fittings	PVC 48"		FT		
5223	Pipe and Fittings	Copper 3"		FT		
5224	Pipe and Fittings	Copper 4"		FT		
5225	Pipe and Fittings	Cast Iron 2"		FT		
5226	Pipe and Fittings	Cast Iron 3"		FT		
5227	Pipe and Fittings	Cast Iron 4"		FT		
5228	Pipe and Fittings	Cast Iron 6"		FT		
5229	Pipe and Fittings	Cast Iron 8"		FT		
5230	Pipe and Fittings	Cast Iron 10"		FT		
5231	Pipe and Fittings	Cast Iron 12"		FT		
5232	Pipe and Fittings	Cast Iron 14"		FT		
5233	Pipe and Fittings	Cast Iron 16"		FT		
5234	Pipe and Fittings	Cast Iron 18"		FT		
5235	Pipe and Fittings	Cast Iron 20"		FT		
5236	Pipe and Fittings	Cast Iron 24"		FT		
5237	Pipe and Fittings	Cast Iron 30"		FT		
5238	Pipe and Fittings	Cast Iron 36"		FT		
5239	Pipe and Fittings	Cast Iron 42"		FT		
5240	Pipe and Fittings	Cast Iron 48"		FT		
5241	Pipe and Fittings	Cast Iron 54"		FT		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5242	Pipe and Fittings	Cast Iron 60"		FT		
5243	Pipe and Fittings	Cast Iron 64"		FT		
5244	Pipe and Fittings	High Density Polyethylene(HDPE) 4"		FT		
5245	Pipe and Fittings	High Density Polyethylene(HDPE) 5"		FT		
5246	Pipe and Fittings	High Density Polyethylene(HDPE) 6"		FT		
5247	Pipe and Fittings	High Density Polyethylene(HDPE) 8"		FT		
5248	Pipe and Fittings	High Density Polyethylene(HDPE) 10"		FT		
5249	Pipe and Fittings	High Density Polyethylene(HDPE) 12"		FT		
5250	Pipe and Fittings	High Density Polyethylene(HDPE) 13"		FT		
5251	Pipe and Fittings	High Density Polyethylene(HDPE) 14"		FT		
5252	Pipe and Fittings	High Density Polyethylene(HDPE) 16"		FT		
5253	Pipe and Fittings	High Density Polyethylene(HDPE) 18"		FT		
5254	Pipe and Fittings	High Density Polyethylene(HDPE) 20"		FT		
5255	Pipe and Fittings	High Density Polyethylene(HDPE) 22"		FT		
5256	Pipe and Fittings	High Density Polyethylene(HDPE) 24"		FT		
5257	Pipe and Fittings	High Density Polyethylene(HDPE) 26"		FT		
5258	Pipe and Fittings	High Density Polyethylene(HDPE) 28"		FT		
5259	Pipe and Fittings	High Density Polyethylene(HDPE) 32"		FT		
5260	Pipe and Fittings	High Density Polyethylene(HDPE) 34"		FT		
5261	Pipe and Fittings	High Density Polyethylene(HDPE) 36"		FT		
5262	Pipe and Fittings	High Density Polyethylene(HDPE) 42"		FT		
5263	Pipe and Fittings	High Density Polyethylene(HDPE) 48"		FT		
5264	Pipe and Fittings	High Density Polyethylene(HDPE) 54"		FT		
5265	Pipe and Fittings	High Density Polyethylene(HDPE) 63"		FT		
5266	Pipe and Fittings	Steel (non-galvanized) 4"		FT		
5267	Pipe and Fittings	Steel (non-galvanized) 5"		FT		
5268	Pipe and Fittings	Steel (non-galvanized) 6"		FT		
5269	Pipe and Fittings	Steel (non-galvanized) 8"		FT		
5270	Pipe and Fittings	Steel (non-galvanized) 10"		FT		
5271	Pipe and Fittings	Steel (non-galvanized) 12"		FT		
5272	Pipe and Fittings	Steel (non-galvanized) 14"		FT		
5273	Pipe and Fittings	Steel (non-galvanized) 16"		FT		
5274	Pipe and Fittings	Steel (non-galvanized) 18"		FT		
5275	Pipe and Fittings	Steel (non-galvanized) 20"		FT		
5276	Pipe and Fittings	Steel (non-galvanized) 22"		FT		
5277	Pipe and Fittings	Steel (non-galvanized) 24"		FT		
5278	Pipe and Fittings	Steel (non-galvanized) 26"		FT		
5279	Pipe and Fittings	Steel (non-galvanized) 28"		FT		
5280	Pipe and Fittings	Steel (non-galvanized) 30"		FT		
5281	Pipe and Fittings	Steel (non-galvanized) 32"		FT		
5282	Pipe and Fittings	Steel (non-galvanized) 34"		FT		
5283	Pipe and Fittings	Steel (non-galvanized) 36"		FT		
5284	Pipe and Fittings	Steel (non-galvanized) 38"		FT		
5285	Pipe and Fittings	Steel (non-galvanized) 40"		FT		
5286	Pipe and Fittings	Steel (non-galvanized) 42"		FT		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5287	Pipe and Fittings	Steel (non-galvanized) 44"		FT		
5288	Pipe and Fittings	Steel (non-galvanized) 46"		FT		
5289	Pipe and Fittings	Steel (non-galvanized) 48"		FT		
5290	Pipe and Fittings	Steel (non-galvanized) 50"		FT		
5291	Pipe and Fittings	Steel (non-galvanized) 52"		FT		
5292	Pipe and Fittings	Steel (non-galvanized) 54"		FT		
5293	Pipe and Fittings	Steel (non-galvanized) 60"		FT		
5294	Pipe and Fittings	Steel (non-galvanized) 66"		FT		
5295	Pipe and Fittings	Steel (non-galvanized) 72"		FT		
5296	Pipe and Fittings	Steel (non-galvanized) 78"		FT		
5297	Pipe and Fittings	Steel (non-galvanized) 84"		FT		
5298	Pipe and Fittings	Steel (non-galvanized) 90"		FT		
5299	Pipe and Fittings	Steel (non-galvanized) 96"		FT		
5300	Pipe and Fittings	Steel (non-galvanized) 102"		FT		
5301	Pipe and Fittings	Steel (non-galvanized) 108"		FT		
5302	Pipe and Fittings	Steel (non-galvanized) 114"		FT		
5303	Pipe and Fittings	Steel (non-galvanized) 120"		FT		
5304	Pipe and Fittings	Steel (non-galvanized) 126"		FT		
5305	Pipe and Fittings	Steel (non-galvanized) 132"		FT		
5306	Pipe and Fittings	Steel (non-galvanized) 138"		FT		
5307	Pipe and Fittings	Steel (non-galvanized) 144"		FT		
5308	Pipe and Fittings	Steel (galvanized) 3"		FT		
5309	Pipe and Fittings	Steel (galvanized) 4"		FT		
5310	Pipe and Fittings	Concrete 12"		FT		
5311	Pipe and Fittings	Concrete 15"		FT		
5312	Pipe and Fittings	Concrete 16"		FT		
5313	Pipe and Fittings	Concrete 18"		FT		
5314	Pipe and Fittings	Concrete 20"		FT		
5315	Pipe and Fittings	Concrete 21"		FT		
5316	Pipe and Fittings	Concrete 24"		FT		
5317	Pipe and Fittings	Concrete 27"		FT		
5318	Pipe and Fittings	Concrete 30"		FT		
5319	Pipe and Fittings	Concrete 33"		FT		
5320	Pipe and Fittings	Concrete 36"		FT		
5321	Pipe and Fittings	Concrete 39"		FT		
5322	Pipe and Fittings	Concrete 42"		FT		
5323	Pipe and Fittings	Concrete 48"		FT		
5324	Pipe and Fittings	Concrete 54"		FT		
5325	Pipe and Fittings	Concrete 60"		FT		
5326	Pipe and Fittings	Concrete 66"		FT		
5327	Pipe and Fittings	Concrete 72"		FT		
5328	Pipe and Fittings	Concrete 78"		FT		
5329	Pipe and Fittings	Concrete 84"		FT		
5330	Pipe and Fittings	Concrete 90"		FT		
5331	Pipe and Fittings	Concrete 96"		FT		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5332	Pipe and Fittings	Concrete 102"		FT		
5333	Pipe and Fittings	Concrete 108"		FT		
5334	Pipe and Fittings	Concrete 114"		FT		
5335	Pipe and Fittings	Concrete 120"		FT		
5336	Pipe and Fittings	Concrete 132"		FT		
5337	Pipe and Fittings	Concrete 144"		FT		
5338	Pipe and Fittings	Asbestos Cement 4"		FT		
5339	Pipe and Fittings	Asbestos Cement 6"		FT		
5340	Pipe and Fittings	Asbestos Cement 8"		FT		
5341	Pipe and Fittings	Asbestos Cement 10"		FT		
5342	Pipe and Fittings	Asbestos Cement 12"		FT		
5343	Pipe and Fittings	Asbestos Cement 14"		FT		
5344	Pipe and Fittings	Asbestos Cement 16"		FT		
5345	Pipe and Fittings	Asbestos Cement 18"		FT		
5346	Pipe and Fittings	Asbestos Cement 20"		FT		
5347	Pipe and Fittings	Asbestos Cement 21"		FT		
5348	Pipe and Fittings	Asbestos Cement 24"		FT		
5349	Pipe and Fittings	Asbestos Cement 27"		FT		
5350	Pipe and Fittings	Asbestos Cement 30"		FT		
5351	Pipe and Fittings	Asbestos Cement 33"		FT		
5352	Pipe and Fittings	Asbestos Cement 36"		FT		
5353	Pipe and Fittings	Asbestos Cement 39"		FT		
5354	Pipe and Fittings	Asbestos Cement 42"		FT		
5355	Pipe and Fittings	Clay 3"		FT		
5356	Pipe and Fittings	Clay 4"		FT		
5357	Pipe and Fittings	Clay 6"		FT		
5358	Pipe and Fittings	Clay 8"		FT		
5359	Pipe and Fittings	Clay 10"		FT		
5360	Pipe and Fittings	Clay 12"		FT		
5361	Pipe and Fittings	Clay 15"		FT		
5362	Pipe and Fittings	Clay 18"		FT		
5363	Pipe and Fittings	Clay 21"		FT		
5364	Pipe and Fittings	Clay 24"		FT		
5365	Pipe and Fittings	Clay 27"		FT		
5366	Pipe and Fittings	Clay 30"		FT		
5367	Pipe and Fittings	Clay 36"		FT		
5368	Pipe and Fittings	Clay 39"		FT		
5369	Pipe and Fittings	Clay 42"		FT		
5370	Pipe and Fittings	Clay 48"		FT		
5371	Pipe and Fittings	Copper 1/2"		FT		
5372	Pipe and Fittings	Copper 5/8"		FT		
5373	Pipe and Fittings	Copper 3/4"		FT		
5374	Pipe and Fittings	Copper 1"		FT		
5375	Pipe and Fittings	Copper 1-1/4"		FT		
5376	Pipe and Fittings	Copper 1-1/2"		FT		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5377	Pipe and Fittings	Copper 1-3/4"		FT		
5378	Pipe and Fittings	Copper 2"		FT		
5379	Pipe and Fittings	Polyethylene (PE) 1/2"		FT		
5380	Pipe and Fittings	Polyethylene (PE) 3/4"		FT		
5381	Pipe and Fittings	Polyethylene (PE) 1"		FT		
5382	Pipe and Fittings	Polyethylene (PE) 1-1/4"		FT		
5383	Pipe and Fittings	Polyethylene (PE) 1-1/2"		FT		
5384	Pipe and Fittings	Polyethylene (PE) 2"		FT		
5385	Pipe and Fittings	Polyethylene (PE) 2-1/2"		FT		
5386	Pipe and Fittings	Polyethylene (PE) 3"		FT		
5387	Pipe and Fittings	PVC 1/2"		FT		
5388	Pipe and Fittings	PVC 5/8"		FT		
5389	Pipe and Fittings	PVC 3/4"		FT		
5390	Pipe and Fittings	PVC 1"		FT		
5391	Pipe and Fittings	PVC 1-1/4"		FT		
5392	Pipe and Fittings	PVC 1-1/2"		FT		
5393	Pipe and Fittings	PVC 2"		FT		
5394	Pipe and Fittings	PVC 2-1/2"		FT		
5395	Pipe and Fittings	PVC 3"		FT		
5396	Pipe and Fittings	Steel (galvanized) 1/2"		FT		
5397	Pipe and Fittings	Steel (galvanized) 5/8"		FT		
5398	Pipe and Fittings	Steel (galvanized) 3/4"		FT		
5399	Pipe and Fittings	Steel (galvanized) 1"		FT		
5400	Pipe and Fittings	Steel (galvanized) 1-1/4"		FT		
5401	Pipe and Fittings	Steel (galvanized) 1-1/2"		FT		
5402	Pipe and Fittings	Steel (galvanized) 2"		FT		
5403	Pipe and Fittings	Steel (galvanized) 2 1/2"		FT		
5404	Pipe and Fittings	Polybutylene (PB) 1/2"		FT		
5405	Pipe and Fittings	Polybutylene (PB) 5/8"		FT		
5406	Pipe and Fittings	Polybutylene (PB) 3/4"		FT		
5407	Pipe and Fittings	Polybutylene (PB) 1"		FT		
5408	Pipe and Fittings	Polybutylene (PB) 1-1/4"		FT		
5409	Pipe and Fittings	Polybutylene (PB) 1-1/2"		FT		
5410	Pipe and Fittings	Polybutylene (PB) 2"		FT		
6560	Pipe and Fittings	Steel (non-galvanized) 2"		FT		
7021	Pipe and Fittings	High Density Polyethylene(HDPE) 4"		FT		
7022	Pipe and Fittings	High Density Polyethylene(HDPE) 4"		FT		
7023	Pipe and Fittings	High Density Polyethylene(HDPE) 2"		FT		
5466	Pumping Equipment	Horizontal Centrifugal Pump	Axial Flow, End Suction, Split Case	EA		
5467	Pumping Equipment	Submersible Centrifugal Pump		EA		
5468	Pumping Equipment	Vertical Turbine Pump	Surface Mount, Canned	EA		
5469	Pumping Equipment	Positive Displacement Pump	Gear, Helical Rotor, Hydro-Pneumat	EA		
5471	Saftey, Security and Fire	Camera/Intrusion System		EA		
5472	Saftey, Security and Fire	Carbon Monoxide Detector		EA		
5473	Saftey, Security and Fire	Electric Gate Opener		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5474	Saftey, Security and Fire	Video Monitor/Recorder		EA		
5475	Saftey, Security and Fire	Eye Wash/Drench		EA		
5476	Saftey, Security and Fire	Retrieval System		EA		
5477	Saftey, Security and Fire	Safety Climb Equipment		EA		
5478	Saftey, Security and Fire	Self Contained Breathing Apparatus		EA		
5479	Saftey, Security and Fire	Fire Suppression Equipment	Hose, Extinguisher, Flame Retarder	EA		
5480	Saftey, Security and Fire	Trench Box		EA		
6820	Saftey, Security and Fire	Personal Protective Equipment		EA		
5482	Storage Tanks	Painted Steel Ground Storage Tank		EA		
5483	Storage Tanks	Painted Steel Standpipe		EA		
5484	Storage Tanks	Painted Steel Elev Storage Tank		EA		
5485	Storage Tanks	Concrete Ground Storage Tank		EA		
5486	Storage Tanks	Concrete Standpipe		EA		
5487	Storage Tanks	Composite Elevated Storage Tank		EA		
5488	Storage Tanks	Glass Fused Bolted Gnd Strge Tank		EA		
5489	Storage Tanks	Glass Fused Bolted Standpipe		EA		
5490	Storage Tanks	Wood Ground Storage Tank		EA		
5491	Storage Tanks	Re-Coating/Re-Paint for Strge Tank		EA		
5493	Tools and Small Equipment	Power Saw		EA		
5494	Tools and Small Equipment	Tapping Machine		EA		
5495	Tools and Small Equipment	Core Drill Machine		EA		
5496	Tools and Small Equipment	Drill Press/Pedestal Drill		EA		
5497	Tools and Small Equipment	Drilling Machine		EA		
5498	Tools and Small Equipment	Engraver		EA		
5499	Tools and Small Equipment	Fixed Hydrol Press		EA		
5500	Tools and Small Equipment	Forge		EA		
5501	Tools and Small Equipment	Former		EA		
5502	Tools and Small Equipment	Gas Welding Equipment		EA		
5503	Tools and Small Equipment	Guillotine		EA		
5504	Tools and Small Equipment	Lathe		EA		
5505	Tools and Small Equipment	Milling Machine		EA		
5506	Tools and Small Equipment	Mortiser		EA		
5507	Tools and Small Equipment	Planer		EA		
5508	Tools and Small Equipment	Sand Blaster		EA		
5509	Tools and Small Equipment	Shear		EA		
5510	Tools and Small Equipment	Threading Machine		EA		
5511	Tools and Small Equipment	Vehicle Lift		EA		
5512	Tools and Small Equipment	Welder		EA		
5513	Tools and Small Equipment	Miscellaneous		EA		
5514	Tools and Small Equipment	Tamper		EA		
5515	Tools and Small Equipment	Pipe Cleaning/Lining Equipment		EA		
5516	Tools and Small Equipment	Snow/Ice Removal Equipment		EA		
5517	Tools and Small Equipment	Ladder		EA		
5518	Tools and Small Equipment	Electrical Testing Equipment		EA		
5519	Tools and Small Equipment	Ditch Pump		EA		

Property Unit ID	Category	Property Unit	Examples	Units	Quanity	Contract Amount
5520	Tools and Small Equipment	Boring Equipment		EA		
5521	Tools and Small Equipment	Jack Hammer		EA		
5522	Tools and Small Equipment	Leak Detection Equipment		EA		
5523	Tools and Small Equipment	Metal Detector		EA		
5524	Tools and Small Equipment	Meter Testing Equipment		EA		
5525	Tools and Small Equipment	Pile Driver		EA		
5526	Tools and Small Equipment	Pressure Testing Equipment		EA		
5527	Tools and Small Equipment	Surveying Equipment		EA		
5528	Tools and Small Equipment	Equipment Storage/Work Bench		EA		
5529	Tools and Small Equipment	Trencher		EA		
6620	Tools and Small Equipment	Hydraulic Shoring Struts		EA		
6740	Tools and Small Equipment	Sewer Root Cutter		EA		

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES

PART 1: GENERAL

1.01 WATER SUPPLY & DISPOSAL

If reasonably available, water for the purpose of this Contract will be supplied to the DESIGN/BUILDER by the OWNER. The DESIGN/BUILDER shall furnish and install all necessary meters, temporary piping and valves in connection with such water supply.

The OWNER reserves the right to impose limitations upon the DESIGN/BUILDER'S use of water as the OWNER, in its sole discretion, determines may be necessary to assure it of its continued ability to meet the demands of its customers and the volumes and pressures required for fire protection. Any water required by the DESIGN/BUILDER in excess of the quantities the OWNER provides to the DESIGN/BUILDER must be furnished by the DESIGN/BUILDER at his own cost.

DESIGN/BUILDER will be responsible for disposal of all wastewater (including dechlorinating highly concentrated wastes that are the result of disinfection) from the sites.

1.02 TEMPORARY HEAT/AIR CONDITIONING

The DESIGN/BUILDER shall provide approved type heating or air conditioning apparatus with the necessary power in order to protect the work. The stored materials and finished work shall be protected at all times from damage by the weather elements.

1.03 ELECTRICAL SUPPLY

The DESIGN/BUILDER shall pay all fees, obtain necessary permits and have meter installed for power and light as may be required for the prosecution of his work. OWNER shall pay for all fees and costs to have permanent power provided to the site. DESIGN/BUILDER shall be responsible for all temporary electrical power (furnishing and installing) that is needed to perform construction, but not permanent power and not power for use for startup and testing.

1.04 TEMPORARY LIGHTING

The DESIGN/BUILDER shall provide and maintain incandescent lighting for construction operations and lighting to exterior staging and storage areas after dark for security purposes as may be necessary.

1.05 BARRIERS

The DESIGN/BUILDER shall provide barriers to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations and demolition. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing buildings. Provide protection for plant life designated to remain. Replace damaged plant life.

1.06 FENCING AND SECURITY

DESIGN/BUILDER shall be responsible for protection of the Site, and all Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

No Claim shall be made against OWNER by reason of any act of an employee or trespasser, and DESIGN/BUILDER shall make good all damage to OWNER's property resulting from DESIGN/BUILDER's failure to provide security measures as specified.

Security measures shall be at least equal to those usually provided by OWNER to protect OWNER's existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, watchman services, and other measures as required to protect the Site.

All existing fences affected by the Work shall be maintained by DESIGN/BUILDER until completion of the Work. Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates shall be kept closed and locked at all times when not in use.

On completion of the Work across any tract of land, DEISGN/BUILDER shall restore all fences to their original or to a better condition and to their original locations.

1.07 PARKING

Arrange for temporary gravel parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking. Designate two parking spaces each for the OWNER, and Resident Project Representative.

1.08 PROGRESS CLEANING

DESIGN/BUILDER shall keep the premises free at all times from accumulations of waste materials and rubbish. DESIGN/BUILDER shall provide adequate trash receptacles about the Site and shall promptly empty the containers when filled.

Construction materials, such as concrete forms and scaffolding, shall be neatly stacked when not in use. DESIGN/BUILDER shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

Volatile wastes shall be properly stored in covered metal containers and removed daily.

Wastes shall not be buried or burned on the Site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the Site and disposed of in a manner complying with local ordinances and antipollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

1.09 SANITARY FACILITIES

The DESIGN/BUILDER shall provide suitable temporary facilities and enclosures for the use of workmen and shall maintain same in a sanitary condition.

The DESIGN/BUILDER is advised that the OWNER is in the business of providing potable water and the DESIGN/BUILDER'S sanitary arrangements shall not endanger the OWNER'S facilities.

1.10 FIELD OFFICES

The DESIGN/BUILDER shall provide, at a location designated or otherwise approved by the OWNER, field offices for the DESIGN/BUILDER and the Resident Project Representative (RPR). Unless otherwise approved, the DESIGN/BUILDER's field office shall be large enough, and furnished, to conduct progress meetings. The DESIGN/BUILDER's field office is to be an official place of business for the DESIGN/BUILDER at which an authorized agent of the DESIGN/BUILDER will be present while work is in progress. The record documents required to be maintained by the DESIGN/BUILDER shall be kept at the DESIGN/BUILDER's field office.

The DESIGN/BUILDER shall provide a separate field office for the RPR and visiting Owner’s personnel. The office shall be not less than 256 square feet (8' x 32') and be provided with an outside entrance door with a substantial lock; glazed windows suitable for light and ventilation; and adequate heating, air conditioning, and lighting facilities. DESIGN/BUILDER shall pay all electricity and heating bills. At a minimum the field office shall include the following:

- (2) desks (built-in type, one at each end of trailer),
- (2) free standing desks(30”x60”), (2) office chairs & (4) padded folding chairs
- (3) 4-drawer file cabinets
- drawing table, drafting stool, plan rack and plan hangers

- (1) small (2'x4') and (1) large (4'x6') white boards, with markers and erasers
- wall shelves - minimum 16 lineal feet of 12" wide wood shelving
- (2) wastebaskets
- telephone service: 2 services, one for voice telephone, one for facsimile machine. Telephone with speakers attachment for conference calls, speed dial capabilities and answering machine (integral or separate). (NOTE: DESIGN/BUILDER to arrange and pay for hook-up, OWNER to pay subsequent monthly phone bills.)
- copying machine – desktop unit is acceptable, DESIGN/BUILDER to service and maintain throughout the project.
- High Speed internet connection: 1 service (DSL , cable, or equivalent), for internet connectivity and electronic communications to the RPR. DESIGN/BUILDER to arrange and pay for hook-up and monthly charges.
- water, hot and cold at sink. Water service and drains to be frostproof.
- sanitary facilities: flush type water closet with accessories including a wall mirror, paper towel holder and paper holder. Facilities shall be connected to the local sanitary sewer system or a holding tank provided. Facilities shall be stocked and maintained by the DESIGN/BUILDER.
- weekly janitorial service. DEISGN/BUILDER shall employ a professional cleaning service.
- fire extinguisher, and first-aid kit
- electric water cooler with hot and cold water faucets and an accessory refrigerator
- digital video camera (from cash allowance)

The DESIGN/BUILDER shall be responsible for cleaning and upkeep of the Resident Project Representative's space or field office.

The field offices shall be maintained until final acceptance of the project unless otherwise approved by the OWNER.

A 24-inch by 35-inch plywood sign shall be erected on the outside wall of the field office in a location determined by the OWNER. The sign shall be painted white with blue, 3-inch high lettering, neatly arranged as follows:

Field Offices
INDIANA-AMERICAN WATER COMPANY,
And
DESIGN/BUILDER

1.11 DUST CONTROL

1. DESIGN/BUILDER shall take all necessary measure to control dust from his operations, and to prevent spillage of excavated materials on public roads.

2. DESIGN/BUILDER shall remove all spillage of excavated materials, debris or dust from public roads by methods approved by the OWNER.

3. DESIGN/BUILDER shall sprinkle water at locations and in such quantities and at such frequencies as may be required by the OWNER to control dust and prevent it from becoming a nuisance to the surrounding area.

4. Dust control and cleaning measures shall be provided at no additional cost to the OWNER.

1.12 **USE OF PROJECT SITE**

DESIGN/BUILDER shall construct and maintain suitable and safe crossings over trenches or provide detours as necessary to care for public and private traffic. Provide flagmen at junctions of public traffic and DESIGN/BUILDER vehicles and equipment.

1.13 **PROJECT SIGN**

1. The DESIGN/BUILDER shall erect a sign at the Project site identifying the project. The sign shall be erected prior to mobilization and shall be in accordance with the Specifications and details included in this Section. The project sign and sign panel shall be furnished, erected and maintained by the DESIGN/BUILDER at the location designated by the OWNER. Wording and colors shall be identified by the OWNER.

2. The project sign shall be fabricated, erected and maintained by the DESIGN/BUILDER in accordance with the following specifications:

A) Sign Panel: The sign panel shall be constructed of ¾ inch minimum thickness marine plywood rebated into a 2 inch by 4 inch wood frame. All fasteners used in the construction of the sign shall be of a rustproof nature.

B) Painting: All supports, trim and back of the sign panel shall be painted with at least two (2) coats of the same paint used for the sign face. All paint used shall be exterior grade paint, suitable for use on wood signs.

C) Sign Supports: The supports for the project sign shall be at least two 4 inch by 4 inch treated wood posts. The sign panel shall be securely fastened to the sign supports with at least six (6) 3/8” galvanized bolts, nuts and washers. The positioning and alignment of the sign shall be as determined by the OWNER.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SECTION 01600

PRODUCTS

PART 1: GENERAL

1.01 PROTECTION OF MATERIAL AND EQUIPMENT

All electrical and mechanical equipment shall be stored in a warm, dry shelter with proper ventilation. Under no circumstances shall motors, electrical control equipment or any other electrical or mechanical equipment be stored under polyethylene plastic covers or tarpaulins. When space is available inside existing structures, and the OWNER approves, the DESIGN/BUILDER will be allowed to store equipment inside them. Should such space not be available, the DESIGN/BUILDER shall construct a shelter with a source of heat and proper ventilation as approved by the OWNER for the storage of equipment.

The interior of all pipe and accessories shall be kept free from dirt and foreign matter at all times.

After valves and hydrants have been inspected, the DESIGN/BUILDER shall properly store them prior to use. In order to prevent entry of foreign material that could cause damage to the seating surfaces, the valves and hydrants shall be stored in a fully closed position unless recommended otherwise by the manufacturer. Resilient seated valves shall be stored in accordance with the manufacturer's recommendations. This may include storage with protective covers for rubber seats and in marginally open condition. Valves and hydrants should be stored indoors.

If valves must be stored outdoors, the DESIGN/BUILDER shall protect the operating mechanism, such as gears, motor, actuators and cylinders, from weather elements. Valve ports and flanges must be protected from the weather and foreign materials. If valves are subject to freezing temperatures, all water must be removed from the valve interior and the valve closed tightly before storage, unless specifically recommended otherwise by the manufacturer. Valves shall be stored on pallets with the discs in a vertical position to prevent rainwater from accumulating on top of the disc, seeping into the valve body cavity and freezing and cracking the casting.

1.02 SERVICING EQUIPMENT

The DESIGN/BUILDER shall check all equipment upon acceptance to determine if oil reservoirs are full and areas to be greased are properly packed with grease. The DESIGN/BUILDER will provide the proper grease or oil for use in lubricating the required areas in the equipment. Any service to equipment while in storage, or installed pending acceptance, is the responsibility of the DESIGN/BUILDER and shall be performed per manufacturer's requirements, industry standards or as stated specifically in the technical specifications.

1.03 MATERIAL/EQUIPMENT FURNISHED BY OWNER

Not used.

PART 2: PRODUCTS

2.01 GENERAL

Unless otherwise specifically provided for in these Specifications, all equipment, materials and articles incorporated in the work shall be new, in current production and the best grade obtainable consistent with general construction usage.

2.02 COORDINATION OF DIMENSIONS

The DESIGN/BUILDER shall verify and make necessary corrections to construction dimensions so that all specified and/or alternative equipment, can be installed and will function within the intent of the Contract Drawings and Specifications.

2.03 SAFETY AND HEALTH REQUIREMENTS

All materials, equipment, fixtures and devices furnished shall comply with applicable Laws and Regulations.

All equipment furnished and installed under this Contract shall be equipped with suitable and approved safety guards and devices required for the safety of the public and operating personnel. Such guards and safety devices shall be in accord with the latest requirements of safety codes approved by the American National Standards Institute as well as the safety requirements of applicable Laws and Regulations. Where said safety codes of the ANSI are incompatible with applicable Laws and Regulations, said Laws and Regulations shall prevail.

PART 3: EXECUTION

3.01 INSTALLATION

Material and equipment shall be installed in accordance with the appropriate Sections of these Specifications.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

The DESIGN/BUILDER shall arrange for a qualified service representative from each company, manufacturing or supplying certain equipment as required by the individual Specification Sections to perform the duties herein described.

After installation of the applicable equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The

inspection shall include, but shall not be limited to, the following points as applicable:

A. soundness (without cracked or otherwise damaged parts)
B. completeness in all details, as specified
C. correctness of setting, alignment, and relative arrangement of various parts
D. adequacy and correctness of packing, sealing and lubricants

The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.

On completion of his Work, the manufacturer's or supplier's representative shall submit to the OWNER a complete signed report of the result of his inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustments made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the Contract Documents and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.

After the OWNER has reviewed the reports from the manufacturers' representatives, the DESIGN/BUILDER shall make arrangements to have the manufacturers' representatives present when the mechanical performance tests are made.

End of Section

SECTION 01650

TESTING AND COMMISSIONING

PART 1: GENERAL

1.01 DESCRIPTION

A. This Section covers testing in accordance with the Specifications, as shown on the Drawings, and as necessary for a complete and satisfactory installation. Testing shall include equipment checkout, equipment and systems testing and startup, and equipment, systems and plant commissioning. Equipment shall be considered for this specification as any separate and individual equipment, component, part or structure.

B. No equipment, system or subsystem shall be checked, started up or placed into service unless all components of that system or subsystem required to be available and in service, including instrumentation, safety and other ancillary and pre-requisite systems, are complete and operable as intended by the contract documents.

C. Unless specified elsewhere in the contract documents, DESIGN/BUILDER shall provide all labor, special tools, special testing devices or equipment, chemicals, lubricants, operating fluids, fuel, electricity, water, filters, and other expendables required for checkout, startup and commissioning.

D. No equipment, system or subsystem shall be commissioned prior to the completion of training of the OWNER's personnel, receipt by the OWNER of applicable approved Operations and Maintenance Manuals, and receipt by OWNER of applicable spare parts and special equipment required for the equipment, system or subsystem.

1.02 PIPELINES

All pipelines, valves, appurtenances, etc. installed per these Contract Documents shall be tested in the manner described by the technical specifications. Unless otherwise stated, all pipelines shall be hydrostatically tested, with no leakage, at a pressure at least equal to the maximum operating pressure of the pipeline.

1.03 WATER CONTAINING VESSELS

Prior to backfilling around water containing vessels, the DESIGN/BUILDER shall fill said vessels with water for a period of at least 7 days in order to insure vessels are watertight. If any vessel leaks, it shall be repaired to the satisfaction of the OWNER and retested until no leakage occurs.

1.04 LIQUID CHEMICAL STORAGE TANKS

Prior to filling bulk storage tanks, batch and day tanks with appropriate chemicals, each tank shall be filled with water for a period of at least 7 days in order to insure each tank is watertight. If any tank leaks, it shall be replaced or repaired by a factory trained representative to the satisfaction of the OWNER, and retested until no leakage occurs.

1.05 DAMPPROOFING AND PAINTING

During the application of dampproofing and painting, the DESIGN/BUILDER shall have the manufacturer's representative check the dry mil thickness of each coating and certify to the OWNER in writing that the thickness is in compliance with the Specifications. If deficiencies in the dry mil thickness of any coat are found, they shall be corrected by the application of an additional coat(s) to the said deficient area. The certificate shall also state that all surfaces were properly cleaned prior to the application of dampproofing and paint, specified meetings and inspections were made, the quantity of dampproofing and paint were applied in accordance with their recommendations, and all other requirements stated in the Specifications have been satisfactorily completed.

1.06 HVAC SYSTEMS

Checkout, startup and commissioning of heating, ventilation and air conditioning systems are dependent upon the time of year that the checkout, startup and commissioning is initiated. The DESIGN/BUILDER and manufacturer’s Representatives shall b required to return to the site at the beginning of the next appropriate season (whichever is applicable) to checkout and commission the systems.

1.07 EQUIPMENT CHECKOUT

The DESIGN/BUILDER shall develop and maintain a detailed Equipment Checkout Schedule. The schedule shall become a part of the DESIGN/BUILDER’s overall Commissioning Plan. All equipment shall be checked and certified by the DESIGN/BUILDER, equipment supplier and/or manufacturer’s representative, in accordance with the applicable technical specifications. The intent of equipment checkout is to certify that equipment has been properly installed and is functioning such that it may be safely operated by the DESIGN/BUILDER to facilitate further equipment testing, system testing or other DESIGN/BUILDER performed checkout and testing. If no specific requirements are specified, the DESIGN/BUILDER shall check out and certify that the installation is complete, correct and meets the equipment manufacturer’s installation requirements. Written certification shall be provided. The DESIGN/BUILDER shall maintain all responsibilities for equipment until such equipment is commissioned and turned over to the OWNER.

1.08 EQUIPMENT TESTING

The DESIGN/BUILDER shall develop and maintain a detailed Equipment Testing Schedule. The schedule shall become a part of the DESIGN/BUILDER’s overall Commissioning Plan. The DESIGN/BUILDER shall determine if equipment

testing shall immediately follow checkout, or whether system testing or ancillary systems are required to be complete in order to properly complete equipment testing. The intent of equipment testing is to certify that equipment is operating and functioning within the performance requirements of the technical specifications. Equipment testing shall be completed and documented in accordance with the technical specifications and the manufacturer's requirements. Written certification shall be provided by the DESIGN/BUILDER. All testing verifications and data shall be documented and attached to the certification. The DESIGN/BUILDER shall maintain all responsibilities for equipment until such equipment is commissioned within a system and turned over to the OWNER.

1.09 SYSTEM TESTING

The DESIGN/BUILDER shall develop and maintain a detailed System Testing schedule. The schedule shall become a part of the DESIGN/BUILDER's Commissioning Plan. The intent of system testing is to certify that all equipment within a system have been properly integrated and operate and function in concert with other equipment to meet the performance requirements for the entire system. As a minimum, the DESIGN/BUILDER shall verify and certify that all equipment and components within a system meet the technical specifications for materials of construction for the intended service, performance range and settings, and all equipment within a system has been checked out, tested and certified for further testing and startup. Where appropriate, water shall be used in lieu of the intended chemical or process fluid for the system. Equipment and devices shall be tested, calibrated and documented in accordance with the technical specifications and the manufacturer's requirements. Written certification shall be provided. All testing verifications, data and calibration results shall be documented and attached to the certification. The DESIGN/BUILDER shall maintain all responsibilities for systems until such system is commissioned and turned over to the OWNER.

Subsequent to individual system testing, the DESIGN/BUILDER shall operate systems to facilitate other testing and training of OWNER personnel. The DESIGN/BUILDER shall operate and maintain the equipment and systems, but said operation shall not constitute the acceptance of the systems or commencement of any warranty periods. Operation and maintenance of the systems by the DESIGN/BUILDER shall not impact the OWNER's continuing operations.

1.10 SYSTEMS START-UP

As part of the DESIGN/BUILDER's Commissioning Plan or in order to comply with a request by the OWNER for partial utilization of any part of the Work, the DESIGN/BUILDER shall start-up systems utilizing the appropriate chemical or process fluid. Prior to start-up of any system, the DESIGN/BUILDER shall confirm that all equipment and components within a system have been tested and certified, and that all pre-requisite systems, analyzers and safety systems and devices are functioning and available for service.

During system start up, chemical or process fluid shall be introduced to the system. Equipment shall be retested as appropriate and calibration verified. As defined elsewhere, individual systems shall be operated by the DESIGN/BUILDER until acceptable to the OWNER.

1.11 COMMISSIONING OF THE WORK

A. General

1. As a prerequisite to the OWNER's issuance of the Certificate of Substantial Completion, the DESIGN/BUILDER shall be responsible to start up equipment and systems in a sequence and manner to place into service all the Work. The DESIGN/BUILDER shall conduct performance testing as described hereafter. The DESIGN/BUILDER shall perform all tests with his own forces and such equipment representatives and other experts (hereinafter collectively referred to as "DESIGN/BUILDER's personnel") as may be required by the Specifications or necessary for a successful test. All operations and coordination of the tests from their beginning to their satisfactory completion shall be the responsibility of the DESIGN/BUILDER.

2. All operating costs, until satisfactory completion of all performance tests, or until the facility is put into operation by the OWNER, whichever comes first, shall be paid for by the DESIGN/BUILDER and shall be included as a part of the lump sum price bid for the Project. Operating costs shall be understood to include, but not be limited to, the costs of: **labor, fuel, heating and lubricants**. OWNER will be responsible for the costs of: **electrical power and all treatment chemicals**. The DESIGN/BUILDER shall also be responsible for maintenance during the testing period and for repair of any damage resulting from the testing procedure. If the DESIGN/BUILDER does not have sufficient personnel to handle an emergency and the OWNER must make repairs with his own forces of damage caused by the DESIGN/BUILDER's actions or inactions, the DESIGN/BUILDER shall reimburse the OWNER for this work.

3. Wages and salaries of DESIGN/BUILDER's personnel as may be required by any and all tests specified herein shall be paid for by the DESIGN/BUILDER and included in the lump sum price bid. Such wages and salaries shall include any premium time costs incurred to complete the tests as scheduled or as required.

4. The DESIGN/BUILDER shall dispose of all water used during the tests, in addition to wastes resulting from the tests. The method of disposing the water and wastes shall be in accordance with all applicable Laws and Regulations and shall be subject to approval by the OWNER. The DESIGN/BUILDER will not be allowed to pump water for testing into the distribution system until its quality meets requirements for public water supplies. Costs for the disposal of water and wastes shall be included in the lump sum price bid.

5. Include costs for the above and below mentioned tests in unit and lump sum price bid for the Project.

B. Commissioning Plan

As required by Section 1300, the DESIGN/BUILDER shall prepare a detailed Commissioning Plan. The general sequencing of the testing shall be developed by the DESIGN/BUILDER. In general the sequence shall focus on the testing of individual pieces of equipment prior to testing entire systems including automatic control systems.

C. Prior To Commissioning

At least 30 days prior to the proposed testing, the DESIGN/BUILDER shall conduct a meeting with the OWNER to discuss the DESIGN/BUILDER's Commissioning Plan and to finalize roles, responsibilities, proposed schedules and required documentation of the tests. Such discussions shall in no way relieve the DESIGN/BUILDER of his responsibility for conducting the test expeditiously and with an adequate number of personnel to handle all emergencies. Subsequent to the meeting and before testing begins, the DESIGN/BUILDER shall make changes to the Plan as determined at the meeting, and issue the final Commissioning Plan. No testing shall begin until the final Plan is issued to all parties.

D. Mechanical Performance Demonstration (MPD)

The DESIGN/BUILDER shall give the OWNER at least 14 days written notice prior to the commencement of mechanical performance demonstration and training. The DESIGN/BUILDER's personnel shall demonstrate to the OWNER, in the presence of Engineer's personnel, that the manual and automatic controls, performance over full operative range, efficiency, safety items, alarms, etc., of each mechanical and electrical item of equipment will operate in accordance with the design intent as indicated by the Drawings and/or described in the Specifications. At this time, the DESIGN/BUILDER's personnel shall also instruct and train the OWNER's personnel in the operation of all equipment, controls, safety devices, etc.

E. Initial Plant Performance Tests (IPPT)

After the mechanical performance demonstration has been successfully completed, in the opinion of the OWNER, the DESIGN/BUILDER shall commence the initial plant performance test. The test shall consist of a preliminary 24-hour operation test of the facility or subsystem. The 24-hour test shall commence after all Work has been started up and operating integrally with all systems. If, in the opinion of the OWNER, the results of the operational test are satisfactory, the OWNER will give the DESIGN/BUILDER written notice to proceed with the Final Mechanical Performance Tests. If, in the opinion of the OWNER, the results of the operational test are unsatisfactory, the OWNER shall provide the DESIGN/BUILDER in writing the deficiencies requiring correction prior to retest. The OWNER reserves the right to have the DESIGN/BUILDER rerun a portion of or the entire operational test until, in the opinion of the OWNER, the facilities are completely operational.

F. Final Plant Performance Tests (FPPT)

1. Final Plant Performance Tests shall cover a continuous **two-week** period while the facility is in continuous normal operation. During the Final Plant Performance Tests, the DESIGN/BUILDER's personnel shall demonstrate, to the satisfaction of the OWNER, with Engineer's personnel present, that all equipment is coordinated and operating properly; that all controls, safety features, and alarms operate satisfactorily in coordination with the equipment installed; and that installed equipment complies in all respects mechanically and electrically with applicable Drawings and Specifications. The DESIGN/BUILDER is responsible for mechanical operation of the facilities. The OWNER will be present during the entire test period to provide direction to the DESIGN/BUILDER's personnel in regards to water treatment requirements and plant production rates. Upon completion of the test period, the DESIGN/BUILDER shall be provided with a written list of any operating problems, equipment malfunctions, or other deficiencies related to plant operations. The DESIGN/BUILDER must correct these deficient items and retest the affected system. The retesting shall be performed for a time period sufficient to demonstrate the proper operation of the system. This time period will not exceed two-weeks.

G. After Commissioning

After the DESIGN/BUILDER receives from the OWNER written acceptance of the Final Plant Performance Tests, the DESIGN/BUILDER's responsibilities relative to operation of the facility shall be terminated, and the OWNER will assume the responsibility. The DESIGN/BUILDER shall, however, remain responsible for any further training or extended run-in or adjustment periods for specific pieces of equipment or systems as required by the Specifications.

PART 2: **PRODUCTS**

Not applicable to this section.

PART 3: **EXECUTION**

Not applicable to this section.

End of Section

SECTION 01656

DISINFECTION OF WATER MAINS

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for disinfection of water mains, including chemical feed lines.

B. Related Sections:
SECTION 01658 - DISINFECTION OF STRUCTURES AND EQUIPMENT

1.02 REFERENCES

A. American National Institue:
1. ANSI/NSF Standard 60, Listing of Certified Drinking Water Treatment Chemicals – Health Effects.

A. American Water Works Association:
1. AWWA B300, Standard for Hypochlorites.
2. AWWA B301, Standard for Liquid Chlorine.
3. AWWA C600, Standard for Installation of Ductile Iron Water Mains and their Appurtenances.
4. AWWA C651, Standard for Disinfecting Water Mains.
5. AWWA Manual M12, Simplified Procedure for Water Examination.

1.03 SUBMITTALS

A. Bacteriological Test Results: See Bacteriological Tests below.

B. Wastewater Disposal Plan:
1. The DESIGN/BUILDER shall develop a plan for safe disposal of chlorinated wastewater from disinfection/testing of pipelines, structures, etc. Submit the Plan to the ENGINEER for review and to OWNER for review and approval at least two weeks in advance of disinfection/testing activities. Do not perform disinfection/testing prior to receipt of approval from the OWNER.
2. The disposal plan shall include provisions for neutralizing chlorine and any other contaminants to levels acceptable to OWNER.
3. Specific methods and devices designed to prevent erosion and subsequent sedimentation at the point(s) of discharge shall also be included in the DESIGN/BUILDER Plan.

1.04 **QUALITY ASSURANCE**

A. Bacteriological Tests:
1. See AWWA Standard C653, Sections 1 and 4.
a. Required Number of Samples:
1) Raw Water Main: One sample
2) Filter Influent: One sample each filter
3) Filter Effluent: Two samples each filter
4) Filter Washwater: One each line
5) Plant Water Service: One sample
6) Well: One sample
7) Well Discharge: One sample
8) Backwash Water: One sample
9) Finish Water Main: Two samples

1.05 **DELIVERY, STORAGE, AND HANDLING**

A. Transport, handle, and store specified disinfection products in manner recommended by respective manufacturers to prevent contamination and deterioration of products.

B. When handling disinfection products, due caution is advisable. Wear gloves, apron, goggles, and suitable vapor mask.

1.06 **PROJECT CONDITIONS**

A. Environmental Requirements:
1. Do not test or disinfect water mains if air temperature is expected to fall below 35 degrees F.
2. Keep pipe interior clean. Close open end of pipe with water tight plug when pipe laying is not in progress.

B. Operational Requirements:
1. Notify Owner a minimum of 24 hours in advance of any flushing operation.
2. Owner's representative must be present for operating valves required to fill mains. Valves may only be operated by Owner's personnel.
3. Flushing will be monitored by the Owner.

PART 2: PRODUCTS

2.01 **MATERIALS**

A. Hypochlorites: AWWA Standard B300.

B. Liquid Chlorine: AWWA Standard B301.

C. Provide NSF Standard 60 certified products per Listing of Certified Drinking Water Treatment Chemicals – Health Effects.

PART 3: EXECUTION

3.01 WATER MAIN DISINFECTION

A. Disinfect water main installed under this Contract before placing in service.

B. Form of Chlorine for Disinfection: With OWNER's approval, follow either of these two designated methods of procedure.

1. Liquid Chlorine: Apply chlorine gas-water mixture with solution feed chlorinating device in combination with booster pump for injecting chlorine gas-water mixture into main to be disinfected. Use only if DESIGN/BUILDER can demonstrate to OWNER that person supervising operation is thoroughly familiar and experienced in handling chlorine gas, suitable equipment is used, and proper safety equipment is available. Provide device with means to prevent backflow of water into chlorine cylinder. DESIGN/BUILDER to comply with all local, State, and Federal regulatory requirements.

2. Calcium Hypochlorite Solution: Prepare chlorine-water solution of 1 percent available chlorine using granular calcium hypochlorite. Inject or pump solution into pipeline. Prepare chlorine-water solution of 1 percent available chlorine by mixing approximately 1 pound of calcium hypochlorite with 8 gallons of water.

C. Preparation:

1. Preliminary Flushing: Prior to disinfection, thoroughly flush section of water main being disinfected with available water pressure and outlets.

2. Flush after pressure and leakage tests are complete.

D. Chlorination:

1. Chlorine Application: Apply hypochlorite solution to water main with gasoline or electrically-powered chemical feed pump. For smaller applications, prepare solution in a barrel and pump into main with hand pump, such as a hydraulic test pump. Apply at dosage rate resulting in chlorine concentration in water in pipe is a minimum of 25 mg/l free

chlorine. Table below gives amount of calcium hypochlorite and quantity of 1 percent hypochlorite solution required to produce 25 mg/l chlorine concentrate in 100 feet of pipe:

CALCIUM HYPOCHLORITE AND CHLORINE SOLUTION REQUIRED TO PRODUCE 25 MG/L CONCENTRATION IN 100-FEET OF PIPE

Pipe Size Inches	Contents in 100-ft.		Section Gals.	Quantity of Calcium Hypochlorite		1% Chlorine Solution Gallons
	Cu.Ft.	Lbs.		Ounces	Pounds	
3	4.90	306	37	1/5	0.012	0.09
4	8.73	545	66	1/3	0.021	0.16
6	19.65	1,227	147	3/4	0.046	0.36
8	34.90	2,178	261	1-3/8	0.083	0.65
10	54.28	3,388	406	2-1/8	0.131	1.02
12	78.48	4,899	587	3-0	0.185	1.44
16	139.98	8,738	1,047	5-3/8	0.334	2.60
20	218.06	13,611	1,631	7-3/4	0.486	4.08
24	314.16	19,603	2,350	11-5/32	0.698	5.88
30	490.87	30,630	3,672	16-3/32	1.090	9.19
36	706.86	44,108	5,287	25-1/8	1.570	13.23
42	962.11	60,036	7,197	34-5/16	2.144	17.99
48	1,256.64	78,414	9,400	44-13/16	2.801	23.50
54	1,590.43	99,243	11,896	56-23/32	3.544	29.74
66	2,375.83	148,252	17,771	84-23/32	5.295	44.43

Feet of Pipe in Which 1 Ounce of Calcium Hypochlorite Will Produce 25 mg/l Available Chlorine

3"	4"	6"	8"	10"	12"	16"	20"	24"	30"	36"	42"	48"	54"	66"
576	324	144	79	51	36	20	13	9	6	4	3	2	1.8	1.2

2. Point of Application: Apply chlorinating agent at high end of pipeline section being chlorinated and through a corporation stop inserted in top of new pipe. If water for preparation of chlorine solution is supplied from tap on existing pipeline, provide a physical break between injector supply and injector or pump.

3. Rate of Application: Pump chlorine solution slowly into new pipeline. Do not cease chlorine application until entire main is filled with chlorine solution. If required by Engineer, measure chlorine residual at several points along section of main being disinfected to ensure that proper dosage and distribution of chlorine solution is obtained.

4. Prevention of Reverse Flow: Exercise great care in manipulating valves, so strong chlorine solution in line being treated will not flow back into adjoining water distribution system.

5. Retention Period and Chlorine Concentration: Retain chlorinated water in main for at least 24 hours. Operate all valves and hydrants in section in order to disinfect appurtenances. At end of this 24 hour period, maintain 10 mg/l chlorine residual throughout length of main.

6. Final Flushing: Following chlorination, thoroughly flush heavily chlorinated water from main at its extremities until replacement water throughout its length, is tested comparable to quality of water in existing distribution system.

7. Flushing Water: Owner will provide water for flushing, however, do not operate valves on water distribution system without presence of duly qualified representative of Owner.

E. Bacteriological Tests: After final flushing and before each treated water main is placed in service, collect samples from end of line. Test samples for bacteriological quality in accordance with Standard Methods to show absence of coliform organisms. Take samples of water that has been standing in main for at least 16 hours after final flushing has been completed. All required tests will be made by OWNER at no expense to the DESIGN/BUILDER. The DESIGN/BUILDER shall assist the OWNER in collecting samples for OWNER's tests.

F. Redisinfection: If initial disinfection fails to produce satisfactory bacteriological samples, reflush and resample main. If check samples show presence of coliform organisms, rechlorinate main as specified previously. DESIGN/BUILDER shall reimburse the OWNER for costs associated with retesting the lines.

G. DESIGN/BUILDER shall be responsible for furnishing all water required for disinfection and flushing of waterlines and any additional disinfecting or flushing, required.

H. Include costs for disinfection of water main in unit or lump sum prices bid for Work. No separate payment will be made for disinfection.

3.02 WATER MAIN CONNECTION DISINFECTION

A. General: If not possible to disinfect piping, valves, and fittings installed at certain connections in manner specified in Article 3.01, DESIGN/BUILDER will proceed as follows:

B. Installation of Connections: During installation, observe every precaution to prevent foreign material and trench water from entering piping connections, fittings, and valves.

C. Disinfection: Swab interior of piping connections, fittings, and valves with 5 percent hypochlorite solution. Obtain 5 percent hypochlorite solution by mixing approximately 3 pounds of granulated calcium hypochlorite with 5 gallons of water.

D. Flushing: After pipe, fittings, and valves have been swabbed, thoroughly flush with water in a manner to be addressed in the Wastewater Disposal Plan. During installation, use extreme care to ensure foreign material is kept out of pipe.

End of Section

SECTION 01658

DISINFECTION OF STRUCTURES AND EQUIPMENT

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for disinfection of plant structures and equipment.

B. Related Sections:
SECTION 01656 - DISINFECTION OF WATER MAINS

1.02 REFERENCES

A. American National Standards Institute:
ANSI/NSF Standard 60, Listing of Certified Drinking Water Treatment Chemicals – Health Effects.

B. American Water Works Association:
AWWA B300, Standard for Hypochlorites.
AWWA B301, Standard for Liquid Chlorine.
AWWA C653, Disinfection of Water Treatment Plants.

1.03 SCHEDULE OF DISINFECTION

A. Coordination: Equipment is to be disinfected just prior to the Final Mechanical Performance Tests.

B. Items to be Disinfected:
1. Mixing Chambers
2. Clarifiers
3. Process Piping
4. Pump Suction Wells
5. Clearwells, including ceiling

1.04 SUBMITTALS

A. Bacteriological Test Results: See Paragraph 1.05 A.1.

B. Wastewater Disposal Plan:
1. The DESIGN/BUILDER shall develop a plan for safe disposal of chlorinated wastewater from disinfection/testing of pipelines, structures, etc. Submit the Plan to the ENGINEER for review and to OWNER for review and approval at least two weeks in advance of disinfection/testing activities. Do not perform disinfection/testing prior to receipt of approval from OWNER.
2. The disposal plan shall include provisions for neutralizing chlorine and any other contaminants to levels acceptable to Owner.

3. Specific methods and devices designed to prevent erosion and subsequent sedimentation at the point(s) of discharge shall also be included in the Design/Builder's Plan.

1.05 QUALITY ASSURANCE

A. Bacteriological Tests:
See Standard AWWA C653, Sections 1 and 4.
Number of Samples Required: Reference 1.03B above for corresponding items.
1.03B.1 – One sample each unit
1.03B.2– One sample each
1.03B.3 – Two samples each
1.03B.4 – One sample each
1.03B.5 – Two samples each clearwell

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Transport, handle and store disinfection products in a manner recommended by respective manufacturers to prevent contamination and deterioration of products.

B. When handling disinfection products, due caution is advisable. Wear gloves, apron, goggles, and suitable vapor mask.

PART 2: PRODUCTS

2.01 MATERIALS

A. Hypochlorites: Standard AWWA B300.

B. Liquid Chlorine: Standard AWWA B301.

C. Provide NSF Standard 60 certified products per Listing of Certified Drinking Water Treatment Chemicals – Health Effects.

PART 3: EXECUTION

3.01 FLUSHING AND DISINFECTING WATER

A. Obtain flushing and disinfecting water for disinfection of structure at water treatment plant from Owner.

B. Incur all costs in utilizing and disposing of flushing and disinfecting water.

C. Owner will not charge for water used to initially flush and disinfect a structure. If any structure has to be reflushed and/or redisinfected, cost of obtaining this additional water from Owner will be at Design/Builder’s expense.

D. Include costs for disinfection of structures and equipment in unit or lump sum prices bid for work as no separate payment will be made for disinfection.

E. Bacteriological Tests: All required tests will be made by OWNER at no expense to the DESIGN/BUILDER. The DESIGN/BUILDER shall assist the OWNER in collecting samples for OWNER's tests.

3.02 CLEANING AND PRELIMINARY FLUSHING

A. Clean items to be disinfected of dirt, debris, residual formed on sides of items, and any other foreign material. Thoroughly flush with water prior to disinfection.

3.03 CHLORINATION

A. General: After being thoroughly flushed, disinfect specified structure by chlorination.

B. Form of Chlorine: Apply chlorine in a chlorine gas-water mixture, calcium hypochlorite solution, or chlorine spray solution.

C. Methods of Application:
   1. General: Submit methods of application to Engineer for approval.
   2. Chlorine Gas-Water Mixture: Apply chlorine gas-water mixture by means of a solution feed chlorination device. Provide device with means to prevent backflow of water into chlorine cylinder.
   3. Calcium Hypochlorite Solution: Inject or pump a solution consisting of 5 percent calcium hypochlorite powder and 95 percent water by weight into the lines.
   4. Chlorine Spray Solution: Apply chlorine spray solution, having a concentration of at least 200 ppm. Apply uniformly to all interior surfaces, including equipment by fruit tree sprayers, fire hoses, or other approved equipment. After spraying, fill holding basin to a depth of 6 inches with water containing at least 50 ppm chlorine.

3.04 POINTS OF APPLICATION

A. If chlorine spray solution is not going to be used for basins, inject disinfecting solution into water as it enters each basin or inject into influent main.

3.05 RATE OF APPLICATION

A. Control water to be used in disinfection process to flow slowly into basins.

3.06 PREVENTION OF REVERSE FLOW

A. Exercise great care that strong chlorine solution in areas being treated will not flow back into water supply where water for disinfection is being obtained.

3.07 RETENTION PERIOD AND CHLORINE CONCENTRATION

A. Retain chlorinated water in above specified items at least twenty four (24) hours. After chlorine treated water has been retained for required time, the chlorine residual is to be at least 25.0 ppm. Should initial procedure fail to result in specified conditions, repeat chlorination procedure at no additional expense until results are obtained.

3.08 FINAL FLUSHING

A. Following chlorination, completely flush all treated water from above specified items until replacement water throughout each facility, upon test, is proven to have a combined chlorine residual of approximately 2.0 ppm.

3.09 CHLORINE CONCENTRATION AFTER DISINFECTION

A. After disinfection and during subsequent mechanical performance tests, maintain chlorine residual in all units of plant at a concentration satisfactory to Engineer. If chlorine residual drops to zero (0), Engineer has option to require redisinfection of any or all units of plant at no additional cost to Owner.

End of Section

SECTION 01700

PROJECT CLOSEOUT

PART 1: GENERAL

1.01 TESTING OF FACILITIES

The DESIGN/BUILDER shall produce a facility that meets the performance requirements and all Work shall be tested under operating conditions and pressures and any leaks or malfunctions shall be repaired to the satisfaction of and at no additional expense to the OWNER. This provision with reference to leakage shall also apply to water tightness of buildings.

The new water treatment plant shall achieve a high level of finished water quality that complies with all applicable state and federal water quality and treatment requirements. In addition to these requirements, the plant should also achieve compliance with the following:

1. Finished water free chlorine residual of between 1.0 mg/L and 2.0 mg/L suitable for distribution system.

2. Production of a stable, non-corrosive water. Finished water must allow Indiana American Water Company to comply with the Lead and Copper Rule, and also minimize corrosion, precipitation, and deposition within the distribution system. Finished water shall be compatible with the existing water produced at the Indiana American Water Company's treatment plant.

3. Fully automated treatment facility capable of unattended operation.

4. Exterior architectural design that is aesthetically pleasing to neighbors and customers/visitors.

5. Minimization of capital costs.

6. Minimization of operating costs, including costs associated with waste disposal.

1.02 CLOSEOUT PROCEDURES

Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for OWNER's inspection. Provide submittals to OWNER that are required by governing or other authorities. Submit Application for final payment identifying total adjusted Contract sum, previous payments, and sum remaining due.

1.03 FINAL CLEANING

Execute final cleaning prior to final inspection. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean debris from roofs, gutters, downspouts, and drainage systems. Clean site; sweep paved areas, rake clean landscape surfaces. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.04 PROJECT RECORD DOCUMENTS

Maintain on site, one set of the following record documents; record actual revisions to the Work:

A. contract drawings
B. specifications
C. addenda
D. change orders and other modifications to the Contract
E. reviewed shop drawings, product data, and samples

Store record documents separate from documents used for construction. Record information concurrent with construction progress.

Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

A. manufacturer's name and product model and number
B. product substitutions or alternates utilized
C. changes made by addenda and modifications

Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:

A. Measured depths of foundations in relation to finish floor datum.
B. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
C. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
D. Field changes of dimension and detail.
E. Details not on original Contract Drawings.

Submit documents to OWNER with final Application for Payment.

Record Drawings shall be submitted as follows:

A. 2 sets of electronic files in AutoCAD format on CD
B. 2 sets of paper copies (24 x 36)
C. 5 sets of paper copies (11 x 17)

1.05 **SPARE PARTS AND MAINTENANCE MATERIALS**

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections. DESIGN/BUILDER shall confirm with OWNER during the design phase the requirements for spare parts.

B. Deliver to **project sites** and place in location as directed by OWNER; obtain receipt prior to final payment.

1.06 **GUARANTEES AND WARRANTIES**

The DESIGN/BUILDER expressly warrants that all workmanship and materials performed or furnished under this Contract will conform to the Specifications, Drawings, samples and other applicable descriptions furnished or adopted by the DESIGN/BUILDER and with all applicable laws, provisions and requirements of the Contract Documents. The DESIGN/BUILDER shall remedy any defects due to faulty materials or workmanship, which shall appear within a period of one (1) year from the date of issuance of certificate of Substantial Completion hereunder and pay for any damage to other work resulting there from. The OWNER shall give notice of observed defects with reasonable promptness. The DESIGN/BUILDER warranty hereunder is in addition to, and not in limitation of, any obligations found elsewhere in the Contract Documents, any special guarantees provided by the DESIGN/BUILDER or his suppliers, and any obligations imposed by law.

In addition to the above requirements, the DESIGN/BUILDER shall assign material and equipment guarantees and warranties from all manufacturers and suppliers to the OWNER and deliver copies of such guarantees and warranties and the assignments thereof to the OWNER in order to assure OWNER of the full benefit of such guarantees and warranties.

1.07 **RESTORATION**

The DESIGN/BUILDER shall restore and/or replace paving, curbing, sidewalks, gutters, shrubbery, fences, sod or other disturbed surfaces and structures to a condition equal to that before the work began and to the satisfaction of the OWNER and shall furnish all labor and materials incidental thereto.

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

End of Section

SECTION 01820

DEMONSTRATION AND TRAINING

PART 1: GENERAL

1.1 DESCRIPTION

A. Provide the services of factory-trained maintenance specialists to instruct OWNER'S operations and maintenance personnel in the recommended operation and the preventive maintenance procedures for equipment specified in the equipment Sections.

B. The qualifications of specialists shall be subject to approval by OWNER.

C. Coordinate these services at times acceptable to OWNER with a minimum of seven (7) days prior notice.

D. Manufacturer shall provide a combination of classroom and field training. All training shall be conducted at the Facility, unless otherwise stated in the equipment Sections. Class size shall be limited to no more than fifteen (15) trainees. Manufacturer shall provide training for all plant shifts, or as approved by OWNER.

E. Manufacturer shall allow any and all training sessions to be videotaped by OWNER.

F. Section 01650, Testing includes additional requirements for manufacturer's and supplier's field and test data.

G. Instruction of OWNER'S personnel shall commence only after the equipment has been started, approved Operation and Maintenance Manuals have been turned over to the OWNER, and acceptance tests have been completed according to the provisions in Section 01650.

H. DESIGN/BUILDER shall submit a copy of this Section to all manufacturers of equipment for this contract.

1.2 TRAINING SCHEDULE

A. Each manufacturer shall provide as a minimum the following hours of training. Travel time and expenses are responsibility of manufacturer and are not included in training schedule time:

EQUIPMENT	TRAINING HOURS
Pumping Equipment	8
Ventilation Equipment	2
Variable Frequency Drives	4

EQUIPMENT	TRAINING HOURS
Control System	4
UV Disinfection System	8
Chemical Feed Equipment	4

1.3 SUBMITTAL

A. Submit for approval:

1. Proposed Lesson Plan for each scheduled instruction thirty (30) days prior to commencement of training. Lesson plans shall be approved a minimum of seven (7) days prior to scheduled instruction.
2. Credentials of their designated operations and maintenance instructor. Credentials shall include a brief resume and specific details of the instructor's experience pertaining to operation of, maintenance of, and training for the equipment specified.

1.4 INSTRUCTION LESSON PLAN

A. Instruction Lesson Plan shall include the following as a minimum:

1. Equipment Operation:
   a. Describe equipment's operating (process) function.
   b. Describe equipment's fundamental operating principals and dynamics.
   c. Identify equipment's mechanical, electrical and electronic components and features.
   d. Identify all support equipment associated with the operation of subject equipment (e.g., air intake filters, valve actuators, motors).
   e. Recommend standard operating procedures to cover start-up, routine monitoring and shut down of the equipment.
2. Detailed Component Description:
   a. Identify and describe in detail each component's function.
   b. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.
   c. Identify and describe in detail equipment safeties and control interlocks.
3. Equipment Preventive Maintenance (PM):
   a. Describe PM inspection procedures required to:
      1) Perform an inspection of the equipment in operation.
      2) Spot potential trouble symptoms and anticipate breakdowns.
      3) Forecast maintenance requirements (predictive maintenance).
   b. Define the recommended PM intervals for each component.
   c. Provide lubricant and replacement part recommendations and limitations.
   d. Describe appropriate cleaning practices and recommend intervals.
   e. Identify and describe the use of special tools required for maintenance of the equipment.
   f. Describe component removal/installation and disassembly/assembly procedures.

g. Perform at least two “hands-on” demonstrations of preventive maintenance procedures.
h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
i. Define recommended torquing, mounting, calibration and/or alignment procedures and settings, as appropriate.
j. Describe recommended procedures to check/test equipment following a corrective repair.

4. Equipment Troubleshooting:
   a. Define recommended systematic troubleshooting procedures.
   b. Provide component specific troubleshooting checklists.
   c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.

B. Manufacturer’s proposed Lesson Plan shall detail specific instruction topics. Training aids to be utilized in the instruction shall be referenced and attached where applicable to the proposed Lesson Plan. “Hands-On” demonstrations planned for the instruction shall be described in the Lesson Plan.

C. The manufacturer shall indicate the estimated duration of each segment of the training Lesson Plan.

1.5 TRAINING AIDS

A. The manufacturer’s instructor shall incorporate training aids as appropriate to assist in the instruction. As a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:
   1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
   2. Equipment cutaways and samples (e.g., spare parts and damaged equipment).
   3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments).

B. The manufacturer’s instructor shall utilize descriptive class handouts during the instruction. Photocopied class handouts shall be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed especially for the instruction are encouraged. Handouts planned for the instruction shall be attached with the manufacturer’s proposed Lesson Plan.

1.6 HANDS-ON” DEMONSTRATIONS

A. The manufacturer’s instructor shall present “hands-on” demonstrations of operations and maintenance of the equipment for each scheduled

group. The proposed “hands-on” demonstrations should be described in the manufacturer’s proposed Lesson Plan.

PART 2: PRODUCTS (NOT USED)

Not Used.

PART 3: EXECUTION (NOT USED)

Not Used.

TRAINING REQUEST FORM
SPECIFICATION SECTION 01820
INSTRUCTION OF OPERATIONS AND MAINTENANCE PERSONNEL

Equipment Name: _____

Equipment Tag Number: _____

Equipment Description: _____

Specification Section: _____

Operations and Maintenance Data Submitted/Approved: _____

Start-up and Testing Complete/Date: _____

Lesson Plan Submitted/Approved: _____

Training Aids Submitted/Approved: _____

Hands-on Demonstration: _____

Training Schedule (Dates, Time, No. of Sessions): _____

_____

_____

_____

_____

_____

_____

_____

_____

END OF SECTION

American Water Works Service Co., Inc.

American Water Engineering

Voorhees, NJ

Process / Out-Source Design Projects / Network – Drawing Standards

Revision Date: June 20, 2007

Table of Contents

Software

1. AutoCad software is the preferred drawing software. The most recent version of AutoCad should be used.

Drafting Procedures

EXTERNALLY REFERENCED DRAWING

1. Begin a new drawing with the Awwborder space template file, **AWWBORDER.DWT.**

AutoCAD Template Files

FILENAME	DESCRIPTION
AWWMODEL. DWT	This template is to be used for all full-scale (real world) Model Space drafting.

2. Draw all items in real world measurements. Ex: a pipe that is 100 feet long shall be drawn at 100 feet.

3. Save Drawing as per AWW file naming procedure (page 2) for externally referenced drawing using the normal save command icon.

Layering Convention

All layer names shall follow the AIA National CAD Standard layering standard. Absolutely **NO** numbers will be used as layer names.

Color Scheme

Colors shall determine the line weight of the object being drawn; the color scheme shall be as follows with the first color being the heaviest and the last being the lightest. CYAN (4), GREEN (3), RED (1), BLUE (5), WHITE (7), YELLOW (2). Color MAGENTA (6) shall be used for all existing objects. The appropriate color will correspond with the discipline of the dwg. Ex: A concrete foundation will be color (4) Cyan on the structural dwgs but will be color (7) white on the mechanical dwgs for new items. All non specific discipline items will be color (7) white. Text and dimensions shall always be color yellow (2). All bold text shall be color cyan (4). All new hatch patterns will be color 253 on all disciplines except if that item is being described or detailed then you would use a heavier color such as blue or red (new items). The color will be changed on the contract dwg (layout) to agree with the

discipline of that dwg. All discipline driven items shall be color (4) cyan or color (3) green or color (1) red or color (5) blue depending on the complexity of the individual detail and its viewport scale. EX: If a detail shows information regarding a complex steel detail and if cyan was used, the detail bleeds into other items after it was plotted, then you would use color green or red to clearly show the information after it has been plotted. This will be at the user's desecration. Typically, cyan is used for the discipline driven item. All none discipline items will always be color (7) white. All existing items on all disciplines will always be color (6) magenta. The Standard .ctb file will be supplied by AW for plotting to follow the above color scheme.

File Naming Procedure
Externally Referenced (XREF) Drawings

Xref drawing files should conform to an eight.three (XXXXXXXX.DWG) naming structure and should identify the objects being drawn as clearly as possible. The following procedure shall be used to name and save Xref drawings:

First Character = X

Second & Third Characters = Location/Building Designation
- AV = Altitude Valve Vault
- BW = Backwash Tank
- CB = Chemical Building
- CW = Clearwell
- ET = Elevated Tank
- FB = Filter Building
- GE = Generator
- GS = General Site
- GST = Ground Storage Tank
- LM=Location Map
- OF = Office
- OF = Outfall Structure
- PS = Pump Station
- RWI=Raw Water Intake
- SB = Sed Basin
- TP=Treatment Plant
- WW = Washwater Tank

Fourth Character = Dash (-)

Fifth Character = Discipline code
- A = Architectural
- C = Civil/Site work
- E = Electrical
- H = HVAC
- I = Instrumentation
- M = Mechanical
- P = Process
- PL = Plumbing
- R = Removals
- S = Structural

Sixth & Seventh Characters = Drawing Type

DT = Detail
EL = Elevation
FP = Floor Plan
PR = Profile
RP=Roof Plan
SC = Section

Externally Referenced (XREF) Drawings (cont'd)

Eighth Character	=	SH = Schematic Floor Level or Revision (if necessary, otherwise don't use) Could also be the Section Number (1,2) or Elevation Direction (N, S, E or W)

For Example:

XCB-MFP1.DWG would be the Chemical Building, Mechanical first floor plan.

XAV-SSCA.DWG would be the Altitude Vault, Structural Section "A".

XFB-AE.DWG would be the Filter Building, Architectural Elevation.

Contract or Sheet Drawings

1. Begin a new drawing with the paper space template file, **AWWBORDER.DWT.** The **AWWBORDER.DWT** shall be used for all disciplines. **The AWWBORDER.dwt shall never be exploded, revised, renamed or scaled. Also, the AWWBORDER.dwt will not be xreferenced into a drawing, a new drawing shall be started each time using the AWWBORDER.dwt.** The limits will remain at **0,0** & **36,24** and be plotted at 1:1. All attributes inside the AWWBORDER.DWT will be filled out according to AWW naming convention for new drawings. AWW uses a document management program and it is **VITAL** that the border template and block remain as is.

AutoCAD Template Files

TEMPLATE NAME	DESCRIPTION
AWWBORDER.DWT	This template is to be used for all layouts and annotation in the Paper Space environment. This template is to be used for all drawings slated to be xrefs once the title block information is deleted.

2. Enter necessary information into the AWW title block with DDATTE icon.

3. Save the drawing as per the AWW File Naming Procedure for Contract Drawings. See attached .pdf file.

4. Toggle to Model Space. Attach the required xref's while on the **G-Anno-Refr** layer.

5. Toggle back to Paper Space and create all necessary viewports with the MVIEW command while on the Defpoints layer.

6. All dimensions shall be on the model space of the xref drawing following the Autocad normal standard procedure for dimensions, all other annotation to the drawing shall be on paper space of the contract drawing utilizing the AWW Text and Dimension Styles as defined on page 5.

7. All contract Dwgs shall be plotted at a scale of 1:1. They will include a graphic scale and north arrow.

8. The title block shall contain all required pertinent information related to the project such as project title, location, engineer of record, date, WBS number, drawing number, sheet numbers and revision dates. In the case of CAD files the file path shall be placed on the drawing along with the plot date using AutoCAD's plot stamp.

9. Generally all drawings shall be aligned with project north to the top of the drawing sheet. A north arrow shall be placed on the drawing in a prominent location.

10. Each drawing shall display project notes in a tabular format when required. Notes shall be project specific as determined by the Project Manager or Designer. Drawing notes shall consist of, but not be limited to, items such as construction/restoration specification, reference map information, utility information etc.

If the drawing contains topographic information the drawing shall include a vertical datum note, which shall indicated the vertical datum utilized on the plan. It will also include surveyor information. Where a specific horizontal datum is utilized, a horizontal datum note shall be shown on the plan.

11. All drawing revisions made after official release of the drawing shall be dated and noted in the revision block.

12. All drawings that are issued outside of E&TS shall be updated in the title block as follows:

(a) "Preliminary" – used for issue of any drawing prior to approval of Final Design. Drawings issued for permitting purposes shall not be stamped.

(b) "Permit Set" – used for the issue of any drawing intended for permits.

(c) "Bid Set" – used for the issue of any drawing intended for bidding.

(d) "Issued for Construction" – used for issue of any drawing intended for construction.

(e) "Record Drawing" – used for as-built drawings.

13. Standard survey note shall be added to the topo graphic sheet and read as follows: "All survey information is taken from a survey information is taken from a survey prepared by (name), (city), (state), registered card surveyor, (number #), prepared (date) for (water company)".

14. All drawing sets shall include cover sheet with drawing index, logo, water co. name, project title, aww engineering name, and month/year.

IF the contractor uses their own title block/border due to their document management sytem, they shall insert the block named Awwblock.dwg and fill out all attributed information according to the AWW Standarads outside of the contractors border. This will allow the AWW document management tracking to take place.

File Naming Procedure

Contract Dwgs

- Design contract drawings are assigned numbers, which are based on a 3 to 4 digit company number, a 3 to 4 digit series number and a 2 to 4 digit discipline sheet number (A = Architectural, G = General, E = Electrical, H = HVAC, I = Instrumentation, M = Mechanical, P = Process, PL = Plumbing, R = Removal, S = Structural).
- For Example:

A drawing prepared for New Jersey American Water Company, Lakewood District, and is an Architectural Dwg would be 350-1234-A1, a Mechanical Dwg would be 350-1234-M1. The following sheets in the discipline would be consecutive, M2, M3, M4 etc.

- Drafting personnel in the System Engineering Corporate Office in Voorhees, NJ, assign drawing numbers. A detailed list is kept for all districts within a Water Company. Since all projects are unique, each drawing set must also have a unique number. To avoid any confusion or duplication of drawing numbers, please contact System Engineering for all drawing numbers. Please provide the following information when calling in: Project Name & Station (location), BP Number, Name of Consultant (if one is used), and approximate number of drawings in the

set. System Engineering drafting personnel will then issue a drawing number for the contract drawings and the sequential number for manufacturer's information drawings.

- The project design engineer prior to the start of drafting should prepare a drawing development schedule. The development schedule will provide the title of the project (line 1) and the discipline, location and type of drawing information (lines 2, 3 and 4) required to complete the title block of each drawing. Drawings should be numbered in accordance with this list.

- The electronic drawing filename should conform to an eight or nine.three (XXXXXXXX.DWG) naming structure and **WILL EQUAL** the AWW drawing number but without the dashes. Call System Engineering Cad Department for numbers (856)-727-6133

- For Example:

  A drawing prepared for New Jersey-American Water Company, Lakewood District whose assigned drawing number is 350-1234-A1, would be electronically filed and saved as 3501234A1.DWG.

IF the contractor uses their own numbering system, all files shall be renamed electronically to follow the AWW standard listed above for final acceptance. The AWW design group will receive a CD containing all electronic drawing files numbered according to the AWW numbering system, including any xrefs, image files and .ctb files.

The table below lists the standard AWW text styles that are to be used when annotating drawings.

AutoCAD Text Styles

TEXT STYLE NAME	FONT	HEIGHT	DESCRIPTION
ROMANS	Roman Simplex	.1	Leaders & Notes & Dimensions
ROMAND	Roman Duplex	.15	Room Names, General Notes Title
ROMANDLG	Roman Duplex	.2	Headings, Titles
STANDARD*	Txt	N/A	Not Used

*AutoCAD Default Style – not used on AWW drawings.

AutoCAD Dimension Styles

Dimensions shall conform to the normal practices as set forth by Autocad for dimensions in model space, xrefs and viewports. All settings within the dimension variables will produce the final size in the viewports, text = .1, text style = Romans, arrow size = .125. Dimension styles shall conform to the following standard: ex: Structural Dimension for a viewport set at 1/4"=1'-0" = S-DIM-48, Architectural Dimension A-DIM-96 for a viewport set at 1/8"=1'-0", this will be repeated for all disciplines and viewports.

HATCH PATTERNS

Standard Hatch Patterns

PATTERN	SCALE	ANGLE	DESCRIPTION
Steel			Sections through Steel Members
ANSI-37			Plans & Sections of Block Walls
AR-B816C			Elevations of Block Walls
ANSI-31			Plans of Brick Walls
AR-BRSTD			Sections of Brick Walls
BRICK			Elevations of Brick Walls
AR-CONC			Sections through Concrete
EARTH		45	Grade - New or Existing
INSUL			Sections through Wall Insulation
INSUL			Sections through Roof Insulation (other than batt)
GRATE			Grating - FRP or Aluminum
HOUND			Select fill (under slabs)
AR-SAND			Sand (i.e. Filter Media, Sub-base Material)
Aggregate			Broken Stone (under footers)
Sqshngle			Roof Shingles (elevation view)
Chainlnk			Chain link Fence (elevation view)
Chkdl			Checkered Plate (double line)

PATTERN	SCALE	ANGLE	DESCRIPTION
Chkds			Checkered Plate (single line)

NOTE: Scale of the hatch pattern shall be left up to the cad operator.

Design Drawing Development Schedule

AMERICAN WATER
SYSTEM ENGINEERING DEPARTMENT
IN-HOUSE DESIGN DRAWING DEVELOPMENT SCHEDULE

1ST LINE: PROJECT TITLE AS INDICATED IN BP MEMORANDUM

	2ND LINE	3RD LINE	4TH LINE
GENERAL	COVER SHEET		
CIVIL	CIVIL	LOCATION & VICINITY	PLANS
	CIVIL	SITE WORK & GRADING	PLANS
	CIVIL	SOIL EROSION & SED. CONTROL	PLANS
	CIVIL	SITE WORK	MISCELLANEOUS DETAILS
	CIVIL	OUTSIDE PIPING	PLANS
	CIVIL	OUTSIDE PIPING	PROFILES
REMOVALS	REMOVALS	LIMITS OF CLEARING	PLAN
	REMOVALS	PARTICULAR STRUCTURE	PLANS (at several elevations)
	REMOVALS	PARTICULAR STRUCTURE	SECTIONS
ARCHITECTURAL	ARCHITECTURAL	PARTICULAR STRUCTURE	PLANS (at several elevations)
	ARCHITECTURAL	PARTICULAR STRUCTURE	ELEVATIONS
	ARCHITECTURAL	PARTICULAR STRUCTURE	WALL SECTIONS
	ARCHITECTURAL	PARTICULAR STRUCTURE	DETAILS & SCHEDULES
STRUCTURAL	STRUCTURAL	PARTICULAR STRUCTURE	PLANS (at several elevations)
	STRUCTURAL	PARTICULAR STRUCTURE	SECTIONS
	STRUCTURAL	PARTICULAR STRUCTURE	DETAILS
MECHANICAL	PROCESS	OVERALL PLANT	SCHEMATIC
	PROCESS	OVERALL PLANT	HYDRAULIC PROFILE
	MECHANICAL	INTAKE/PUMP STATION/	PLANS (at several elevations)
	MECHANICAL	INTAKE/PUMP STATION/	SECTIONS
	MECHANICAL	CLARIFIER/FILTER BLDG./	DETAILS
	CHEMICAL PIPING	CLEARWELL/PUMP STATION	SCHEMATICS
	CHEMICAL PIPING	ETC.	PLANS (at several elevations)
	CHEMICAL PIPING	ETC.	SECTIONS & DETAILS
	PLUMBING	ETC.	PLANS
	PLUMBING	ETC.	SECTIONS
	PLUMBING	ETC.	DETAILS
ELECTRICAL	INSTRUMENTATION	OVERALL PLANT	PROCESS & INST. DIAGRAM
	INSTRUMENTATION	OVERALL PLANT	MOUNTING DETAILS
	ELECTRICAL	OVERALL PLANT	LEGENDS

ELECTRICAL	OVERALL PLANT	MISCELLANEOUS DETAILS
ELECTRICAL	OVERALL PLANT	SITE PLAN
ELECTRICAL	OVERALL PLANT	ONE LINE DIAGRAM
ELECTRICAL	OVERALL PLANT	SCHEMATIC DIAGRAMS
ELECTRICAL	PARTICULAR STRUCTURE	PLANS (at several elevations)
ELECTRICAL	PARTICULAR STRUCTURE	SECTIONS & DETAILS
ELECTRICAL	PARTICULAR STRUCTURE	CONDUIT SCHEMATIC
ELECTRICAL	PARTICULAR STRUCTURE	CABLE & CONDUIT SCHEDULE

NOTES:

Water Company No's.

Contact AWWSC Engineering for Drawing Prefixes
(856)-346-8282

Miscellaneous Procedures

Addendum Sketches

Addendum Sketches are 8 1/2" x 11" (A-size) drawings that are prepared during the bid phase to inform all potential contractors of a change in design. The need for such sketches usually arises during the contractors' review and bid preparation for a project. The Design Engineer for the specific project usually provides input for the Addendum Sketch.

An 8 1/2" x 11" attributed title block has been created and saved as N:\ACADCOM\BORDERS\81-2X11A.DWG and should be inserted **into** a modified or newly prepared plan, section or detail. The size of the sketch has been selected for ease in faxing to the contractors. If a large area of an original drawing is affected by the change/clarification, the entire D-size sheet will be revised and reissued to the all bidding contractors. All clarifying plans, sections or details must also be added to the original bid set of documents for incorporation into the As-built or Record set. Each affected bid set drawing should be updated in a timely manner and the revision should be noted in the Revision block of the title block. Annotation should include: the Addendum number, the drafter's initial, and the current date. Leave space for the approving engineer to initial the revision.

The Addendum Sketch title block contains the following information: Title of Sketch (4 lines), Drafter's Initials, Project Engineer's Initials, Date Sketch was prepared, Project BP Number, Scale of Sketch, Addendum Sketch Number, Sketch Revision Date, and Reference Drawing Number. The Reference Drawing Number is the drawing number of the original design drawing in the bid set where the plan, section or detail was drawn. The Addendum Sketches are assigned drawing numbers in the following format: ADD-001, ADD-002, ADD-003, etc. Senior Drafting Personnel will assign drawing numbers. The original sketch will be filed with the Senior Design Drafter and a copy will be sent to the Approving Engineer for further markup or development.

Working Sketches

Working Sketches are 8 1/2" x 11" (A-size) drawings that are prepared after the project has gone to bid and has been awarded to a contractor. The need for such sketches usually arises during construction and should provide answers to the contractor's questions regarding field changes to the original design. The Design Engineer and/or the Construction Engineer for the specific project usually provide input for the Working Sketch.

An 8 1/2" x 11" attributed titleblock has been created and saved as N:\ACADCOM\BORDERS\81-2X11W.DWG and should be inserted **into** a modified or newly prepared plan, section or detail. The size of the sketch has been selected for ease in faxing to the contractor. If a large area of an original drawing is affected by the change/clarification, the entire D-size sheet will be revised and reissued to the contractor. All clarifying plans, sections or details must also be added to the original bid set of documents for incorporation into the As-built or Record set. Each affected bid set drawing should be updated in a timely manner and the revision should be noted in the Revision block of the title block. Annotation should include: a description of the change, the drafter's initial, and the current date. Leave space for the approving engineer to initial the revision.

The Working Sketch title block contains the following information: Title of Sketch (4 lines), Drafter's Initials, Project Engineer's Initials, Date Sketch was prepared, Project BP Number, Scale of Sketch, Working Sketch Number, Sketch Revision Date, and Reference Drawing Number. The Reference Drawing Number is the drawing number of the original design drawing in the bid set where the plan, section or detail was drawn. The Working Sketches are assigned drawing numbers in the following format: WS-001, WS-002, WS-003, etc. Senior Drafting Personnel will assign drawing numbers. The original sketch will be filed with the Senior Design Drafter and a copy will be sent to the Approving Engineer for further markup or development.

Redlining Procedure For Contract Drawings

Check prints of design contract drawings should be reviewed by the drafting group as well as by the engineering group before they are sent to external agencies for their review,

comments or action. The following should be used as a guideline for redlining these drawings in a concise and consistent manner.

- Red Ink - should be used to indicate all revisions and corrections to a drawing
- Green Ink - should be used to indicate any desired deletions to a drawing
- Yellow Ink - should be used to indicate that any new or revised work has been done correctly
- Blue Ink - should be used by drafting personnel to indicate that a redlined item has been incorporated into the drawing. This will also assist personnel when reviewing the updated check print.
- Pencil - should be used to indicate notes or directions to drafting (things that drafting should do, but not things that should appear on the final drawing - i.e. "Move this electrical cabinet over 3 feet to the right").

Appendix A
AWW Abbreviations

Abbreviation	Description
A.B.	Anchor Bolt
ADJ	Adjacent
ALUM.	Aluminum
ANSI	American National Standards Institute
APPROX.	Approximate
ARCH.	Architectural
AMP	Ampere
ASME	American Society of Mechanical Engineers
ASSY	Assembly
ASTM	American Society for Testing and Materials
UTO.	Automatic
AUX.	Auxiliary
AVG	Average
BLDG	Building
B.O.M.	Bill of Material
B.O.C.	Bottom of concrete
B.O.S.	Bottom of steel
BR	Bronze
BR	Brass
BTM	Bottom
C	Channel
°C	Centigrade, or Celsius
C to C	Center to Center
CFM	Cubic feet per minute

CHKD	Checked/Checkered (as in plate)
CI	Cast Iron pipe
CL.	Clearance
CM	Centimeter
COL.	Column
C.O.	Cleanout
CONC.	Concrete
CONSTR.	Construction
CONT.	Continued
CPLG	Coupling
CU.	Cubic
DEG(°)	Degrees
DIA.	Diameter
D.I.P.	Ductile Iron Pipe
DIM.	Dimension
DISCH.	Discharge
DN	Down
DPI	Differential Pressure Indicator
DWG	Drawing
E	East
EA.	Each
EA	Exhaust Air
E.F.	Each face
EL.	Elevation
ELL	Elbow
EQUIP.	Equipment
E.S.	Each Side
E.W.	Each way
EXIST.	Existing
EXPAN.	Expansion
F	Fan
°F	Fahrenheit
FD	Floor drain
FIG.	Figure
FL.	Floor
FLG	Flange
FLGD	Flanged
FPS	Feet per second
FS	Far side
FT(‘)	Foot or feet
FTG	Fitting
GAL.	Gallon(s)
GALV.	Galvanized
GPM	Gallons per minute
GND	Ground (as in electrical)
H	Height
HB	Hose Bibb

HEX	Hexagon(al)
HORIZ.	Horizontal
HP	Horsepower
HVAC	Heating, ventilation, and air conditioning
HZ	Hertz (frequency)
I.D.	Inside Diameter
IN.(“)	Inches
INV.	Invert (inside bottom of pipe)
JT.	Joint
KG	Kilogram
KVA	Kilovolt amperes
KW	Kilowatts
L	Length
LBS	Pounds
LR	Long Radius (of elbow)
M	Meter
MATL	Material
MAX.	Maximum
MCC	Motor Control Center
MECH.	Mechanical
MFR.	Manufacturer
MH	Manhole
MJ	Mechanical Joint (Pipe)
MIN.	Minimum
MISC.	Miscellaneous
MM	Millimeter
MVA	Megavolt amperes
N	North
N/A	Not applicable
NC.	Normally Closed
N.O.	Normally Open
NO.	Number
NOM.	Nominal
NPS	National pipe size
NPT	National pipe thread
NS	Near Side
NTS	Not to scale
OA	Outside air
O.D.	Outside Diameter
OH	Overhead
OPN’G.	Opening
ORIG.	Original
O.S.D.	Open Site Drain
P&ID	Process & Instrumentation Diagram
PE	Plain End (Pipe, etc.)
PERP.	Perpendicular
PL	Plate

PRESS.	Pressure
PRV	Pressure reducing/regulating valve
PSI	Pound per square inch
PSIA	Pound per square inch absolute
PSIG	Pound per square inch gauge
PVC	Polyvinyl chloride
QTY	Quantity
QUAD.	Quadrant
RED.	Reducing/Reducer
REINF.	Reinforcing/Reinforcement
REQ'D.	Required
REV.	Revision
RPM	Revolutions per minute
S	South
SCH or SCHED.	Schedule
SHT	Sheet
SLV	Sleeve
SQ.	Square
SR	Short Radius (of elbow)
S.S.	Stainless Steel
STD	Standard
STRUCT.	Structure/Structural
SUCT.	Suction
TEMP.	Temperature
THRU	Through
T.O.C.	Top of concrete
T.O.P.	Top of pipe
T.O.S.	Top of steel
TYP.	Typical
UG	Underground
UH	Unit heater
V	Volts
VERT.	Vertical
W	Watts
W	West
W	Width

MINIMUM STANDARDS FOR DRAWINGS FOR DEVELOPER INSTALLED WATER MAIN PACKET

Three complete sets of design drawings are to be submitted to the Water Company for preliminary review; one set will be returned to the Developer that will include corrections or alterations. One set of final plans signed and sealed by the project engineer and one set of diskettes with the drawings prepared in the Auto CAD version used by the Water Company will then be submitted by the Developer to the Water Company.

1. Design drawings shall be drawn on 24-inch by 36-inch sheets and shall show all water mains and appurtenances (as applicable.) The drawings will have a north arrow and the drawing scale indicated. The acceptable drawing scales are 1" = 20' or 1" = 50'. The name of the subdivision as well as name and address of the Developer and Engineer will be shown on the drawings. Site elevation information will be shown when dictated by site/pipe route topography which will allow adequate assessment of the main being installed. Drawings will show the location, size and type of existing sanitary and storm sewers, storm drains, water mains, culverts, power lines, gas lines and other existing surface structures. Drawings will also illustrate the layout, type and size of proposed utilities and structures such as water mains, sanitary laterals and mains, storm mains, culverts, other drainage structures, street improvements, gas and power lines.

2. Include an overall location and key map for the entire project at a scale not to exceed 1 inch = 200 feet and a vicinity map with a scale not to exceed 1 inch = 2,000 feet.

3. The minimum specific requirements for items shown on water main drawings is as follows:

    i) R-O-W width and centerline of road.

    ii) Back of curb with dimension.

    iii) Dedicated, exclusive or drainage and utility easements.

    iv) Property lines.

    v) Length, type, pressure rating of water main must be shown.

    vi) Location and dimension to main within easement and relative to back of curb and R-O-W.

    vii) Depth of cover over main.

    viii) Show all fittings, blow-offs, fire hydrants, valves and other appurtenances along with method of restraint.

4. The Water Company Standard Details for water main construction shall apply.

5. All water mains shall be shown on the drawings and constructed within a dedicated Water Company easement or public right of way. The minimum width of easements required shall be 20 feet. Due to specific site constraints, the Water Company may require wider easements than stated.

Infrastructure Wiring
Bid Specification

Version 2018-001

Updated – November 2018

American Water

AMERICAN WATER

TABLE OF CONTENTS

AMERICAN WATER

Owner
Technical Specification

PART 1 GENERAL

1.1 SUMMARY

A. This Technical Specification defines requirements for the installation of the structured cabling infrastructure to support communications for Information Technology, Security, and SCADA systems for all new/remodeled Owner (also referred to as Owner Company) facility locations. This specification provides a detailed description of the products to be used and the layout of the subsystems of the network infrastructure architecture. The product instructions and layout must be strictly adhered to.

B. Product specifications, general design considerations, and installation guidelines are provided in this document.

C. This document does not apply to the installation field instruments for Production instrumentation and control systems.

D. All references to Legrand, Legrand/Ortronics, and Ortronics are noted only as Ortronics throughout this document.

1.2 RELATED SECTIONS

A. Division 17 – Instrumentation

B. Division 16 – Electrical

C. Division 27 – Communications

C. Division 28 – Electric Safety and Security

D. Section 01300 Submittals

1.3 ABREAVATIONS

A.	ANSI	American National Standards Institute
B.	BICSI	Building Industry Consulting Services International
C.	ESSDRM	Electronic Safety and Security Design Reference Manual
D.	TDMM	Telecommunications Distribution Methods Manual
E.	CIP	Certified Installer Plus
F.	CIP-ESP	Certified Installer Plus – Enterprise Solutions Partner

G.	CSA	Canadian Standards Association
H.	CSI	Construction Specifications Institute
I.	EMR	Electromagnetic Radiation
J.	EMT	Electro Metallic Tubing
K.	ETL	Intertek Testing Service (ETL Logo)
L.	F	Fahrenheit
M.	IDF	Intermediate Distribution Frame (Wiring Closet)
N.	LIU	Lightguide Interface Unit
O.	MAC	Moves, Adds, and Changes
P.	MDF	Main Distribution Frame (Telecom Room)
Q.	NEC	National Electrical Code
R.	NFPA	National Fire Protection Agency
S.	RCDD	Registered Communications Distribution Designer
T.	TBB	Telecommunications Bonding Busbar
U.	TIA	Telecommunications Industry Association
V.	UL	Underwriters Laboratories
W.	UTP	Unshielded Twisted Pair

1.4 DEFINITIONS

A. Backbone: A facility (e.g. pathway, cable or bonding conductor) for cabling Subsystem 2 and Cabling Subsystem 3.

B. Horizontal: Cabling installed within the same subsystem.

1.5 REFERENCES

A. ANSI/TIA-568.0-D, Generic Communications Cabling for Customer Premises, September 2015

B. ANSI/TIA-568.1-D, Commercial Building Communications Cabling Standard Part 1: General Requirements, September 2015

C. ANSI/TIA-568-C.2, Balanced Twisted-Pair Communications Cabling and Components Standard, August 2009

D. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standards, June 2008

E. ANSI/TIA–569-D, Commercial Building Standard for Communications Pathways and Spaces, November 2015

F. ANSI/TIA–606-B, Administration Standard for Communications Infrastructure of Commercial Buildings, June 2012

G. ANSI/TIA–607-C, Commercial Building Grounding and Bonding Requirements for Communications, November 2015

H. TIA–758-B, Customer-Owned Outside Plant Communications Cabling Standard, March 2012.

I. BICSI - TDMM, Building Industries Consulting Services International, Communications Distribution Methods Manual (TDMM) –13th^{h} Edition.

J. BICSI ESS, Electronic Safety and Security Design Reference Manual (ESSDRM) – 2nd Edition.

K. National Fire Protection Agency (NFPA – 70), National Electrical Code (NEC) -2014

1.6 SCOPE OF WORK

A. The work included under this section consists of furnishing all labor, equipment, materials, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Communications contractor will provide and install all of the required material necessary to create a complete system whether specifically addressed in the technical specifications or not.

B. The work shall include, but not be limited to the following:

1. Furnish and install a complete communications wiring infrastructure per provided drawings or requirements

2. Furnish, install, and terminate all UTP, F/UTP and Optical Fiber cable

3. Furnish and install all wall plates, jacks, patch panels, and patch cords

4. Furnish required cabinets and racks as required and as indicated

5. Furnish any other material required to form a complete system

6. Perform link or channel testing (100% of horizontal and/or backbone links/channels) and certification of all components

7. Furnish test results of all cabling to the owner in electronic format or on disk listed by each closet, then by workstation ID. Provide owner training and documentation. (Testing documentation and As-built drawings)

8. Installation of open relay racks and/or cabinets and enclosures

9. Installation of vertical and horizontal pathway support systems

10. Installation of fire stopping systems, sleeves and other approved penetration methods

11. Installation of cable runway, racks and cable management

12. Testing and certification of the installed system

13. Patch cabling based on owner requirements

C. Quantities of communications outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. If the bid documents are in conflict, this specification shall take precedence.

D. The Communications Contractor shall use only material from the Owner approved parts, referenced throughout this document, during installation. The Telecommunications Contractor shall provide normal consumables for this project. Owner reserves the right to purchase and supply material components.

1.7 REGULATORY REFERENCES:

A. All work and materials shall conform in every detail to the rules and requirements of the National Fire Protection Association (NFPA), the local Construction Codes and present manufacturing standards.

B. All materials shall be UL Listed and shall be marked as such. If UL has no published standards for a particular item, then other national independent testing standards shall apply and such items shall bear those labels. Where UL has an applicable system listing and label, the entire system shall be so labeled.

C. The cabling system described in this document is derived from the recommendations made in recognized communications industry standards.

D. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents. The Contractor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

1.8 SUBMITTALS FOR REVIEW

A. Submittals at Bid Time

1. A copy of the company certification documents or approval letter from Ortronics must be submitted with the bid response in order for such response to be valid.

B. Shop Drawings

Under the provisions of this request for proposal, prior to the start of work the communications contractor shall:

1. Submit copies of the certification of the company and names of staff that will be performing the installation and termination of the installation to provide proof of compliance of this specification.

2. Submit proof from manufacturer of contractor's good standing in manufacturer's program.

3. Submit appropriate cut sheets and samples for all products, hardware and cabling.

C. Work shall not proceed without the Owner's approval of the submitted items.

D. The approved communications contractor shall receive approval from the Owner on all substitutions of material. No substituted materials shall be installed except by written approval from Owner.

1.9 SUBMITTALS FOR CLOSEOUT

A. Furnish test results of all cabling to the owner in electronic format or on disk listed by each closet, then by workstation

B. Furnish nCompass™ Limited Lifetime Premium Warranty documentation. The nCompass System includes Ortronics and Superior Essex products. Ortronics is a product brand name manufactured by Legrand.

C. Provide As-Built Drawings

D. Provide manufacturers O&M information

1.10 COMMUNICATIONS CONTRACTOR QUALIFICATIONS

The Communications Contractor **must,** at a minimum, possess the following qualifications:

A. Ortronics certified installer at the CIP or CIP-ESP (preferred) level and follow the CIP-ESP protocols (see appendix A).

B. Have a favorable Experience Modification Rate (EMR)

B. Be in business a minimum of five (5) years

C. Communications Contractor shall demonstrate satisfaction of sound financial condition and shall be adequately bonded and insured per owners' requirements.

D. Possess those licenses/permits required to perform communications installations in the specified jurisdiction.

E. Personnel knowledgeable in local, state, province and national codes and regulations. All work shall comply with the latest revision of the codes and regulations. When conflict exists between local and national codes or regulations, the most stringent codes or regulations shall be followed.

F. Must possess and provide proof of current owner's insurance certificates

G. Communications Contractor must be registered with BICSI and have at least one RCDD or equivalent who is responsible for the implementation of this project.

H. The Communications Contractor must be an approved Ortronics Certified Installer Plus and/or ESP (CIP-ESP preferred). The Communications contractor is responsible for workmanship and installation practices in accordance with the Ortronics CIP-ESP Program. The Ortronics CIP and/or CIP-ESP communications contractor shall be a company specializing in communication cabling installation. At least 30 percent of the approved contractor's installation crew must be Ortronics certified on proper installation and testing of copper and fiber structured cabling systems. Technicians with BICSI Level 1 and 2 Copper and Fiber credentials or BICSI Technician credentials are also acceptable.

I. The Contractor must have prior experience with this type of installation or work activity. The customer may, with full cooperation of the contractor, visit client installations to observe equipment operations and consult with references. Specified visits and discussion shall be arranged through the contractor; however, the contractor's personnel shall not be present during discussions with references. The contractor must provide a minimum of three (3) reference accounts at which similar work, both in scope and design, have been completed by The contractor within the last two (2) years. If the contractor has performed work for owner and wishes to list their previous project(s) as a single reference, they may do so.

1.11 PREFERRED NATIONAL DISTRIBUTOR

A. Primary Distributor:

Graybar is our preferred logistics supplier and all material for the project should be purchased through Graybar. The Owner material pricing has been negotiated with Graybar. The Telecommunications Contractor shall be in good credit standing with Graybar before responding to the Request For Quote (RFQ). Bill Maney or Aldo Ambrogio at 201.596.2600.

Secondary Distributor:

As a secondary distribution partner, all material for the project should be purchased through Communication Supply Corporation (CSC). The Owner material pricing has been negotiated with CSC. The Communications Contractor shall be in good credit standing with CSC before responding to the Request For Quote (RFQ). All quotes shall go through Marilyn Mroposki 732.346.1550 x122, mmroposki@gocsc.com.

1.12 DRAWINGS

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the communications contractor in bidding the job. The communications contractor shall make allowance in the bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The communications contractor shall verify all dimensions at the site and be responsible for their accuracy.

C. Prior to submitting the bid, the communications contractor shall call to the attention of the engineer any materials or apparatus the communications contractor believes to be inadequate and to any necessary items of work omitted.

PART 2 PRODUCTS

2.1 APPROVED PRODUCTS

A. 4-pair UTP Cable: Superior Essex DataGain Category 6 Cable (Plenum):

B. 4-pair UTP Cable: Superior Essex 10Gain XP Category 6A Cable (Plenum):

C. 4-pair F/UTP Cable: Superior Essex 6T-272-xB ScTP Cable (Plenum):

D. Optical Fiber Cable manufacturer: Superior Essex

E. UTP connector product manufacturer: Ortronics Clarity 6 TracJack

F. F/UTP connector product manufacturer: Ortronics Clarity 6 Shielded TracJack

G. Fiber Optic cabinet product manufacturer: Ortronics FC Series

H. Fiber Optic connectors/splices/couplers: Ortronics Infinium Field-Installable Anaerobic Connectors.

I. Open Rack manufacturer(s): Ortronics, Great Lakes, and Chatsworth Products, Inc. (CPI)

J. Cabinet manufacturer: Ortronics, Great Lakes, and IBM.

K. Patch Panel manufacturer: Ortronics Clarity 6, 24 and/or 48 ports in an angled configuration.

L. Patch Panel manufacturer: Ortronics Clarity Shielded 6, 24 and/or 48 in an angled configuration

M. UTP Patch Cord manufacture: Ortronics Clarity 6

N. F/UTP Patch Cord manufacturer: Ortronics Clarity Shielded 6

O. Cable tray manufacturer: Cablofil all size requirements per construction documents

P. Surface Mount Boxes: Wiremold all size and model requirements per construction documents.

Q. Poke Through and Floor Boxes: Wiremold all size and configuration requirements per construction documents.

Note: See applicable sections in this document for detailed information on products required. Legrand is the manufacturer for Ortronics, Cablofil, and Wiremold products.

2.2 WORK AREA OUTLETS

A. Faceplates

1. Shall be Ortronics TracJac 2, 4, or 6 port faceplate to accommodate the Clarity 6 modular jack.

2. Acceptable part numbers:

Part Number	Color	Description
OR-40300548	Fog White	2 port TracJack Faceplate
OR-40300546	Fog White	4 port TracJack Faceplate
OR-40300545	Fog White	6 port TracJack Faceplate
OR-403STJ12	Stainless Steel	2 port TracJack Faceplate
OR-403STJ14	Stainless Steel	4 port TracJack Faceplate
OR-403STJ16	Stainless Steel	6 port TracJack Faceplate

B. Voice / Data Jacks

1. Voice/Data jacks shall be 8-position modular jacks and shall be Category 6 performance as defined by the references in this document including ANSI/TIA/EIA-568-C.2. All pair combinations must be considered, with the worst-case measurement being the basis for compliance.

2. The modular jack shall be the following for a nCompass™ Cat6+ Solution:

Part Number	Color	Description
OR-TJ6A	White	Cat-6A jack, 180 deg exit
OR-TJ6A-36	Blue	Cat-6A jack, 180 deg exit
OR-TJ600	White	Cat-6 jack, 180 deg exit
OR-TJ600-36	Blue	Cat-6 jack, 180 degree exit
OR-TJS600		Shielded Cat-6 jack 180 degree exit
OR-42100002	White	Blanks – Pack of 10

The four port faceplate shall be terminated with white module on the top left and blue module on the top right and blanks in the two bottom openings.

Figure 1.0 (White & Stainless 2 Position Faceplate Layout)

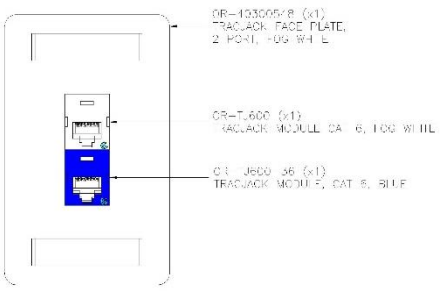
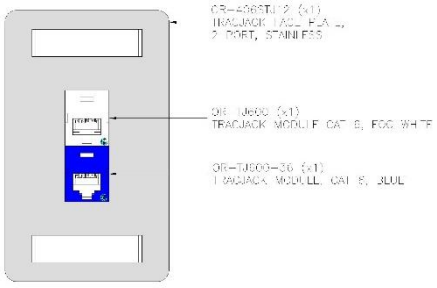
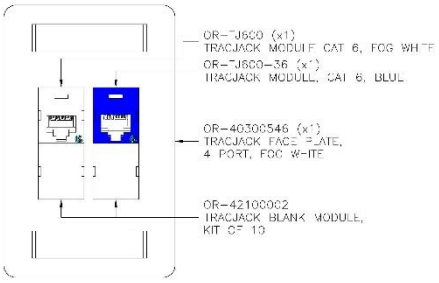


Figure 2.0 (White & Stainless 4 Position Faceplate Layout)





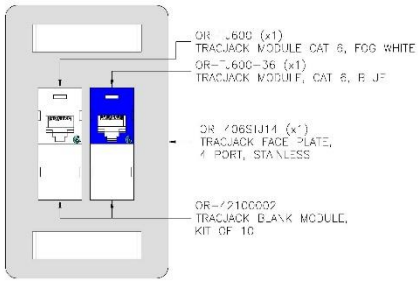
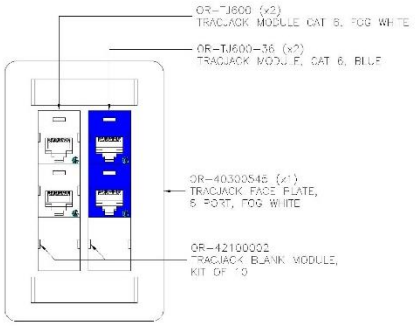
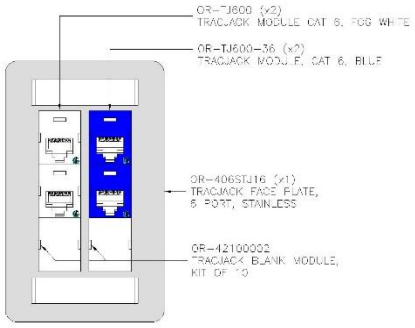


Figure 3.0 (White & Stainless 6 Position

F





2.3 11

A. 110 Block Kits

1. Shall include both the wiring block in a 50, 100 and 300 pair footprint and the connecting block C6110C4

2. Approved part numbers:

Part Number	Description
OR-110ABC6050	110 Block Kit: 50-Pair
OR-110ABC6100	110 Block Kit: 100-Pair
OR-110ABC6300	110 Block Kit: 300-Pair

B. 110 Cross-Connect System Backboard Channels Shall

1. Approved part numbers:

Part Number	Description
OR-806003246	110 Wall Mount Backboard Channel, 300-pair
OR-30200132	110 Wall Mount Backboard Channel, 900-pair

C. 110 Wall Mount Vertical Trough Shall

1. Be available in single channel or dual channel configurations.

2. Approved part numbers:

Part Number	Description
OR-806003194	110 Wall Mount Vertical Trough, Single Channel, 300-pair
OR-806003196	110 Wall Mount Vertical Trough, Single Channel, 900-pair
OR-806003197	110 Wall Mount Vertical Trough, Dual Channel, 300-pair
OR-806003199	110 Wall Mount Vertical Trough, Dual Channel, 900-pair

2.4 MODULAR PATCH PANELS

A. The Modular Patch Panels shall

1. Modular patch panel shall be one of the following for a nCompass Cat6+ Solution:

OR-PHA6AU24	Angled Clarity 6A Modular 110 Patch Panel, 24port
OR-PHA6AU48	Angled Clarity 6A Modular 110 Patch Panel, 48port
OR-PHA66U24	Angled Clarity 6 Modular 110 Patch Panel, 24-port
OR-PHA66U48	Angled Clarity 6 Modular 110 Patch Panel, 48-port
OR-PHDTKSU24	Shielded Unloaded patch panel 24-port
OR-PHDTKSU48	Shielded Unloaded patch panel 48-port
OR-TKS6A	Shielded tool less Cat6A jack for patch panel

2.5 RACKS & CABINETS

A. RACKS

The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment

on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Racks and wire management shall be black in color to match the patch panels and cable management. All racks and wire management shall be Chatsworth Products, Inc. (CPI) or Ortronics.

1. Free-Standing Rack - Indoor
    a. **Chatsworth 2 post 7' Rack** – 55053 703
    b. Chatsworth double sided vertical manager – 14831 703
    c. Ladder rack and hardware shall be 12" Chatsworth or Ortronics
    d. **Ortronics 2 post 7' Rack** – OR-19-84-T2SD
    e. Ortronics double side vertical manager – OR-DVMS0706
2. Overhead Rack System (Data Center)
    a. Mighty Mo Overhead Cable Pathway Rack – OR-60401001

B. CABINETS / ENCLOSURES

All racks and wire management shall be Ortronics, IBM, or Great Lakes specific. The equipment rack shall provide vertical cable management and support for the patch cords at the front of the rack and wire management, support, and protection for the horizontal cables inside the legs of the rack. Waterfall cable management shall be provided at the top of the rack for patch cords and for horizontal cables entering the rack channels for protection and to maintain proper bend radius and cable support. Wire management shall also be mounted above each patch panel and/or piece of equipment on the rack. The rack shall include mounting brackets for cable tray ladder rack to mount to the top of the rack. Velcro cable ties shall be provided inside the rack channels to support the horizontal cable. Cabinets shall be black in color to match the patch panels and cable management.

1. Wall Mounted Cabinet – Indoor
    a. **Legrand Ortronics** Wall Mount/Swing Out Cabinet 12RU Part# SWM12RUPL-26-26 with Plexiglass Door
    b. **Legrand Ortronics** Fan Kit 115VAC Part # VWMFK-115
    c. **Great Lakes Wall Mount/Swing Out Enclosure** 24H x 24W x 24D Part #GL24WS-PS 11 RU Enclosure w/Glass Door
    d. Great Lakes Fan Assembly w/Guards Part #7217WS. (2) 75 CFM Fans w/Guard

e. Great Lakes 6 Position RM Power Strip w/Breaker Part #7219 19” RM w/Cord

2. Wall Mount Cabinet (Low Profile)- Indoor

   a. **Legrand Ortronics** Simplified Edge 4RUx36”H Part # VWMSD-4RU-36-B-002

   b. **Legrand Ortronics** Fan Kit 115VAC Part # VWMFK-115

   c. **Great Lakes Wall Mount Low Profile** 36"H x 27"W x 10"D Part # GL36WLP *(GL24WLP for 24”H and GL48WLP for 48”H)*

   d. Great Lakes Single Fan Assembly with fan guard, 75 CFM Part # 7217-04

3. Wall Mounted Cabinet NEMA 12 (Harsh Environment) - Indoor

   a. Great Lakes Wall Mount Enclosure 24H x 24W x 24D Part #GL240N12 12RU, can accept 1 FFKN12-A4 filtered fan pack

   b. Great Lakes Wall Mount Enclosure 36H x 24W x 24D Part #GL360N12 19RU, can accept 2 FFKN12-A4 filtered fan packs

   c. Great Lakes Wall Mount Enclosure 48H x 24W x 24D Part #GL480N12 26RU, can accept 3 FFKN12-A4 filtered fan packs

   d. Filtered Fan Pack, Part #FFKN12-A4

4. Free-Standing Full Cabinet NEMA 12 (Harsh Environment) – Indoor

   a. Great Lakes Enclosure 84H x 24W x 42D Part #GL840N12-2442 45RU, can accept FFKN12-A1 / A2 / A3 filtered fan pack

   b. Filtered Fan Pack, Part #FFKN12-A1 (230CFM)

   c. Filtered Fan Pack, Part #FFKN12-A2 (295CFM)

   d. Filtered Fan Pack, Part #FFKN12-A3 (368CFM)

5. Free-Standing Full Cabinet – Indoor

   a. Ortronics T6 Series Cabinet 42U

      A. Server Cabinet part # TR601

      B. Network Cabinet part # TR01

   b. Configurable cabinet available upon request.

6. Enclosures – Special Use

    a. Outdoor enclosure NEMA 3R – Hoffman WEATHERFLO with Fan, Part Series #WFxxLP

    b. Telephone Enclosure (Indoor / Outdoor) NEMA 4 with standard modular wall jack – GAI-Tronics Part #255-001

2.6 HORIZONTAL DISTRIBUTION CABLE

A. 100 OHM Category 6A UNSHIELDED TWISTED PAIR CABLE (UTP)

B. Category 6A Horizontal Cable:

C. Superior Essex 10Gain XP Cable

D. 100 OHM Category 6 UNSHIELDED TWISTED PAIR CABLE (UTP)

Category 6+ Horizontal Cable:

E. Superior Essex DataGain® Cable
F. UL listed CMP or CMR as required by installation location
G. Support of sustainable design and installation through
H. Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) documented via third party
I. Manufactured in a facility that is third party certified as Zero Waste to Landfill
J. Green Circle Multi-Attribute Label qualified per federal mandates
K. Superior Essex Part Numbers:
L. Plenum Rated Blue Cable is 66-240-xB; where x = color
M. Riser Rated Blues Cable is 66-240-2A; where x = color

1. Approved Part Numbers: Superior Essex DataGain UTP and Superior Essex 10Gain XP (CMP Plenum-PVC Alloy)

Color	Box
White	66-240-4B
Blue	66-240-2B
White	6H-272-4B
Blue	6H-272-2B

2.7 HORIZONTAL DISTRIBUTION CABLE (SHIELDED)

A. 100 OHM Category 6 Shielded Twisted Pair F/UTP

B. Superior Essex Cat 6 Shielded Cable

C. UL listed CMP or CMR as required by installation location

D. Support of sustainable design and installation through
E. Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs) documented via third party
F. Manufactured in a facility that is third party certified as Zero Waste to Landfill
G. Green Circle Multi-Attribute Label qualified per federal mandates
H. Superior Essex Part Numbers:
I. Plenum Rated Blue Cable is 6T-272-xB; where x = color
J. Riser Rated Blues Cable is 6T-272-xA; where x = color

Color	Box
White	6T-272-4B
Blue	6T-272-2B

2.8 BACKBONE CABLE

A. Indoor/Outdoor Optical Fiber Non-Conductive Plenum (OFNP) Loose Tube with Laser Enhanced 50/125 Optical Fibers approved Part Numbers base on final design of specific environment:

1. Superior Essex optical fiber cable with TeraFlex Bend Resistant Laser Optimized 50/125

a. Part #-F460-006U30-E991 (6 strands)

b. Part # F460-012U30-E991 (12 strands)

c. Part # F460-024U30-E991 (24 strands)

d. Part # F460-048U30-E991 (48 strands)

B. Optical Fiber NON CONDUCTIVE Plenum (OFNP) Tight Buffered with 10 Gigabit Laser Optimized 50/125 Optical Fibers approved Part Numbers base on final design of specific environment:

1. Superior Essex Premise Distribution fiber optic Cable with TeraFlex Bend Resistant laser optimized 50/125 micron Multimode fiber

a. Part # 44006NG01 (6 strands)

b. Part # 44012NG01 (12 strands)

c. Part # 44024NG01 (24 strands)

d. Part # 44048NG01 (48 strands)

A. Indoor/Outdoor Superior Essex TeraFlex Bend Resistant Laser Optimized 50/125 Loose Tube with Enhanced (Low Water Peak) **Single-mode** Optical Fibers

1. Superior Essex TeraFlex I/O

a. Part # F460-006U10-E991 (6 strands)

b. Part # F460-012U10-E991 (12 strands)

c. Part # F460-024U10-E991 (24 strands)

d. Part # F460-048U10-E991 (48 strands)

2.9 FIBER OPTIC CONNECTOR OPTIONS

A. LC Fiber Optic Connectors shall be utilized for all locations.

1. Be an Ortronics Infinium Field-Installable Anaerobic fiber connector

2. Approved Part Numbers:

Part Number	Description
OR-205KAN9GA-MM	LC, multimode, single pack
OR-205KAN9GB-MM	LC, multimode, 25-pack
OR-205KAN9GA-SM	LC, singlemode, single pack
OR-205KAN9GB-SM	LC, singlemode, 25-pack

B. Contractor shall install LC connectors using termination kits from Ortronics (p/n OR-85400010) and related polishing kits (p/n OR-85400012 for multimode and OR-85400011 for single mode).

C. Fiber patch cabinet Ortronics - Infinium HD series

Part Number	Description
INFC01U-M4	LC, 36 Fibers 1RU
INFC02U-M4	LC, 72 Fibers 2RU
INFC04U-M4	LC, 144 Fibers 4RU

D. Wall mount LIU surface mount fiber cabinet

Part Number	Description
OR-615SMFC-LX-12P	LC, 24 Fibers
OR-615SMFC-24P	LC, 48 Fibers
OR-615SMFC-48P	LC, 96 Fibers

E. For both the fiber patch and wall mount cabinets use LC Connector adapter number OR-OFP-LCD12LC

2.8B Data Center Fiber Optics (pre-terminated)

A. Fiber Optic Cassettes Ortronics M4 Series and Premium Components

Part Number	Description
OR-RFPHD01U	High Density Flush Mounting Rails
OR-M4LCQ24-50EA3A1	M4 High Density Cassette LC quad 24fiber 50mc OM4
OR-TADPLFFUAUA075F	Premium Performance Fiber Optic Trunk cable 50mc OM4
OR-P3DFG1PAZAZ003M	Premium Performance Fiber Patch Cord 50mc OM4

2.10 COPPER CABLE PROTECTION UNITS

A. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the TC ground point. Approved manufacturers of protection units are Porta Systems, Edco, and ITW. Protection units shall be approved for use with CISCO PoE products.

2.11 PATCH CORDS (COPPER AND FIBER)

A. The contractor shall provide Ortronics factory terminated and tested Category 6A UTP, 6 UTP, F/UTP and optical fiber patch cords and equipment cords for the complete cabling system per owner's color requirements. Fiber patch cords shall have color coded boots per owner's color requirements. Other patch cords are not acceptable.

B. Copper (UTP) patch cords:

1. Approved part numbers:

Part Number	Description
OR-MC603-xx	Clarity 6 Modular Patch Cord, 3ft.
OR-MC605-xx	Clarity 6 Modular Patch Cord, 5ft.
OR-MC607-xx	Clarity 6 Modular Patch Cord, 7 ft.
OR-MC610-xx	Clarity 6 Modular Patch Cord, 10 ft.
OR-MC615-xx	Clarity 6 Modular Patch Cord, 15 ft.
OR-MC625-xx	Clarity 6 Modular Patch Cord, 25 ft.
OR-RDC61003-xx	Clarity 6A Reduced Diameter Patch Cord, 3ft
OR-RDC61005-xx	Clarity 6A Reduced Diameter Patch Cord, 5ft
OR-RDC61007-xx	Clarity 6A Reduced Diameter Patch Cord, 7ft
OR-RDC61010-xx	Clarity 6A Reduced Diameter Patch Cord, 10ft
OR-RDC61015-xx	Clarity 6A Reduced Diameter Patch Cord, 15ft
OR-RDC61025-xx	Clarity 6A Reduced Diameter Patch Cord, 20ft
EZFPR603Q12-XX	3ft EZ Patch™ Flat Pack Reduced Diameter Cat6 12pkg
EZFPR605Q12-XX	5ft EZ Patch Flat Pack Reduced Diameter Cat6 12pkg
EZFPR607Q12-XX	7ft EZ Patch Flat Pack Reduced Diameter Cat6 12pkg
EZFPR609Q12-XX	9ft EZ Patch Flat Pack Reduced Diameter Cat6 12pkg
EZFPR6A03Q12-xx	3ft EZ Patch Flat Pack Reduced Diameter Cat6A 12pkg

EZFPR6A05Q12-xx	5ft EZ Patch Flat Pack Reduced Diameter Cat6A 12pkg
EZFPR6A07Q12-xx	7ft EZ Patch Flat Pack Reduced Diameter Cat6A 12pkg
EZFPR6A09Q12-xx	9ft EZ Patch Flat Pack Reduced Diameter Cat6A 12pkg

Note: “xx” designates color, where 02=red, 04=yellow, 06=blue, 08=gray, 09=white, 00=black.

C. Copper (F/UTP) Shielded Patch Cords:

1. Approved part numbers:

Part Number	Description
OR-MCS603-xx	Clarity 6 Modular Patch Cord, 3ft. - shielded
OR-MCS605-xx	Clarity 6 Modular Patch Cord, 5ft. - shielded
OR-MCS607-xx	Clarity 6 Modular Patch Cord, 7 ft. - shielded
OR-MCS610-xx	Clarity 6 Modular Patch Cord, 10 ft. - shielded
OR-MCS615-xx	Clarity 6 Modular Patch Cord, 15 ft. - shielded
OR-MCS625-xx	Clarity 6 Modular Patch Cord, 25 ft. - shielded

Note: “xx” designates color, where 02=red, 04=yellow, 06=blue, 08=gray, 09=white, 00=black.

D.Optical Multimode Fiber patch cords shall:

1. Approved part numbers:

Part Number	Description
OR-P1DF2LRGZGZ0xxM	OptiMo Duplex LC-LC, multimode
OR-P1DF2LRFZGZ0xxM	OptiMo Duplex SC-LC, multimode
OR-P1DF2LREZGZ0xxM	OptiMo Duplex ST-LC, multimode

Note: “xx” designates length in meters.

E. Optical SingleMode Fiber patch cords shall:

1. Approved part numbers:

Part Number	Description
OR-P1DC21RSZSZ0xxM	OptiMo Duplex LC-LC, single-mode
OR-P1DC21RRZSZ0xxM	OptiMo Duplex SC-LC, single-mode
OR-P1DC21RQZSZ0xxM	OptiMo Duplex ST-LC, single-mode

Note: “xx” designates length in meters.

Note: The standard boot colors for fiber patch cords are white and black to maintain the correct polarity, which apply to the above part numbers. The required colors for this specification are determined by the Owner. Part numbers will be assigned by Ortronics at time of order.

2.12 BONDING AND GROUNDING

A. All installed products shall be properly grounded and bonded per national electric code

B. Products shall be from Ortronics

2.13 FIRESTOP

A. A fire stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

B. Products shall be Flame Stopper from Wiremold. An example of a UL System to utilize when installing the Flame Stopper is WL-3264.

2.14 POKE-THRU & FLOOR BOXES

A. Poke-Thru and Floor Boxes will be utilized per the construction documents with sizes of 6” or 8” as specified for the Poke-Thru. These will be configured based on the construction and design requirements.

B. Products shall be Poke-Through Devices and/or Floor Boxes from Legrand Wiremold

C. Flush mount boxes are preferred

2.15 BASKET TRAY

A. The basket tray shall be basket in nature and colored per the specific design.

B. Products shall be Cablofil

PART 3 EXECUTION

3.1 GENERAL

A. Work Sequence

1. Review of all Contract Documents, including specifications, drawings, appendices, examples pictures and addenda.

2. Review of related electrical and communication drawings for coordination with other trades.

3. Preparation of all pre-construction submittals.

4. Field surveys of all plywood, electrical outlets, conduits, sleeves, and cable tray, provided by others, to be used in the installation of the Communications Cable Plant.

5. Complete installation, testing, and commissioning of all Communications Cable Plant and preparation of progress report submittals.

6. Participation during all move-in phases of the project.

7. Preparation of post-construction submittals including as-built drawings, field test reports, warranty, and closeout documentation.

8. Provide digital pictures of 20% of the Communications Room's, the outlets and 1 picture of the Main Telecommunication Room at completion of job to be compared to appendix drawings.

3.2 DELIVERY, STORAGE, HANDLING AND PROTECTION

A. Delivery and receipt of products shall be at the site described in the Scope Section.

B. Cable shall be stored according to manufacturer's recommendations at a minimum. In addition, cable must be stored in a location protected from vandalism and weather. If cable is stored outside, it must be covered with opaque plastic or canvas with provision for ventilation to prevent condensation and for protection from weather. If air temperature at cable storage location will be below 40 degrees F., the cable shall be moved to a heated (50 degrees F. minimum) location. If necessary, cable shall be stored off site at the contractor's expense.

C. If the communications contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the Owner.

D. Installation shall include the delivery, unloading, setting in place, fastening to walls, floors, ceilings, counters, or other structures where required, interconnecting wiring of the system components, equipment alignment and adjustments, and all other work whether or not expressly required herein which is necessary to result in complete operational systems.

E. During the installation, and up to the date of final acceptance, the Communication Contractor shall be under obligation to protect his finished and unfinished work against damage and loss. The Telecommunication Contractor shall also be under obligation to protect the finished work of other contractors while the communication installation is underway.

3.3 SAFETY

The Communication Contractor shall comply with all Owner's and the Construction Manager's safety guidelines and regulations and those established for the project. Contractor is required to have an established safety program and is responsible for the safety of his staff. The Contractor will adhere to all Federal, State and Local occupational health and safety regulations applicable to the project.

3.4 GENERAL

A. All cables, connectors, hardware, and equipment that comprise the Communications Cable Plant shall be installed according to ANSI/TIA -569-D Commercial Building Communications Standards and ORTRONICS Clarity® Installation Practices and Owner requirements. The installation must result in a Clarity® Category 6 Certification, which includes a nCompass Warranty.

B. The Telecommunication Contractor shall purchase or otherwise procure installation guides from vendors and become familiar with the installation requirements prior to commencement of the work. Any discrepancies between specifications, drawings, field conditions, and the manufacturers' recommendations shall be brought to the attention of the Construction Manager immediately in writing. The Construction Manager shall forward to the Telecommunication Engineer for review and comment.

C. The plans and specifications indicate the general arrangement and scope of work. To facilitate the installation and coordination with other trades, the Telecommunication Contractor may deviate from this general arrangement so long as the scope does not change. All such changes shall be submitted to Owner prior to implementation. The Telecommunication Engineer must approve the work prior to the implementation of the proposed change. The approved change must be noted on shop drawings.

3.5 CABLING DISTRIBUTION

A. General

AMERICAN WATER

1. All cables shall be inspected as they are pulled off the reel for any obvious defects. Report immediately any defects to the Telecommunication Engineer and Owner then halt further use of the cable from that reel, pending a determination of the quality of the reel by the manufacturer.

2. Pulling and laying cable on sharp edges is not permitted.

3. The pulling tension for a 4-pair balanced twisted pair cable shall not exceed 110 N (25 lbf) during installation. For multipair cable, manufacturer's pulling tension guidelines shall be followed.

4. The Communication Contractor shall not exceed the prescribed maximum pulling tension recommended by the manufacturer.

5. All cables shall be continuous, with no factory or field splices.

6. At no time shall a cable be supported on the fluorescent light fixtures, ceiling tiles, electrical conduits, HVAC ducts, ceiling tiles, or other building system fixtures.

7. All copper circuits shall be provided with protection between each building with an entrance cable protector panel. All building-to-building circuits shall be routed through this protector. The protector shall be connected with a #6 AWG copper bonding conductor between the protector ground lug and the MDF/IDF ground point.

B. Copper Station Cable

1. Install a complement of two (2) Category 6 4 pair-UTP Station cables to each communication outlet location (WLN), unless otherwise indicated on the construction drawings.

2. 10-feet of slack for every modular furniture work station cable bundle shall be coiled and stored in the ceiling above the outlet, provided the 285-foot limit is not exceeded.

3. The copper station cable shall be terminated at the station end into Category 6 jacks. The termination shall be T568B

4. The copper station cable shall be terminated at the MDF or IDF end onto Category 6 568B 24-port or 48-port patch panels. A-Side station cables shall be terminated on the 19-inch rack designated for A-Side station cables and B-Side station cables shall be terminated on the 19-inch rack designated for B-Side station cables as shown on the construction drawings.

5. Cables entering the MDF/IDF shall enter through 4" EMT conduit

6. Each cable shall be uniquely identified on the faceplate and patch panel. Additionally, all station cables shall be labeled at both ends prior to termination.

The labels should be typed or machine produced with a label making device. Hand written labels will not be allowed or accepted.

7. When terminating the station cables at the communications outlets and patch panel, untwisting of the pairs shall be kept to a minimum but no greater than a ½ inch.

8. Route the station cable in the cable tray in the ceiling. Where cable tray or conduit is not provided, use j-hooks mounted 4-foot on center with Plenum Hook & Loop ties bundling the cables.

9. UTP cables shall be run a minimum of 5-inches from AC power distribution cable unless in separate steel channels. In the floor a speed bump should be utilized to comply with this requirement of the installation.

C. Work Area

1. Work area cables shall each be terminated at their designated work area location in the connector types described in the subsections below. Included are modular telecommunication jacks. These connector assemblies shall snap into a front loading TracJack® faceplate.

2. ORTRONICS Clarity® TracJack Category 6 connector modules shall be installed at each workstation outlet with ORTRONICS faceplates and surface mount boxes.

3. The Communications Outlet Assembly shall accommodate:

   a. A minimum of two (2) front loading modular jacks

   b. Additional accommodations for specific locations as noted in the plans for optical fiber and/or additional copper cables as necessary

   c. A blank/filler will be installed when extra ports are not used.

   d. Modular Snap-In dust covers (part number OR-20300121) to be used where appropriate.

   e. Multiple jacks that are identified in close proximity on the drawings (but not separated by a physical barrier) may be combined in a single assembly. The communications contractor shall be responsible for determining the optimum compliant configuration based on the products proposed.

   f. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the communications contractor shall submit the proposed configuration for each outlet assembly for review by the Owner.

g. The modular jack shall incorporate printed label strip on the dust cap module for identifying the outlet.

4. Communications Outlets

a. Install two (2) four (4) or six (6) Category 6 in each faceplate, as shown on Section 2.2.

b. Each jack should be identified with the appropriate label

3.6 MDF/IDF

A. The Telecommunication Contractor is responsible for surveying the work area and coordinating with other trades.

B. Provide and install the termination hardware for a complete cable plant, as shown on the detail drawings, appendix drawings and described in this specification.

C. All termination hardware shall be mounted in the open bay racks, as shown on the construction drawings. Bolt the racks to the floor slab, support from cable tray, and bond to the building structure with the manufactures approved method.

D. Station Cable within the MDF/IDF shall be tie wrapped in bundles of 48 cables (where applicable) using black Plenum Hook & Loop ties. Cables in a particular bundle shall be terminated on the same patch panel.

E. Cable bundles shall route along the overhead cable tray maintaining their bundles of 48 cables (where applicable) until after they leave the MDF/IDF and enter the distribution pathway system. Cables shall exit the MDF/IDF through designated A-Side and B-Side penetrations.

3.7 WORK AREA OUTLETS

A. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer’s bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. No more than 12” of UTP and 36” of fiber slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.

B. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA/ -568.1- D, manufacturer's recommendations and best industry practices.

C. Pair untwist at the termination shall be as close to zero as possible and not exceed 12 mm (one-half inch).

D. Bend radius of the horizontal cable shall not be less than 4 times the outside diameter of the cable.

E. The cable jacket shall be maintained to within 25mm (one inch) of the termination point.

F. Blue jacks in horizontally oriented faceplates shall occupy the right-most position(s).

G. Blue jacks in vertically oriented faceplates shall occupy the bottom most position(s)

H. Refer to drawings in section 2.2

3.8 HORIZONTAL DISTRIBUTION CABLE INSTALLATION

A. All horizontal data station cable and voice cable shall terminate on modular patch panels (copper or fiber), 110 cross-connecting blocks (copper), or patch/splice cabinets (fiber) in their respective Communications Room or Equipment Room as specified on the drawings.

B. All cables shall be inspected as they are pulled off the reel for any obvious defects. Report immediately any defects to the Telecommunication Engineer and Owner, then halt further use of the cable from that reel, pending a determination of the quality of the reel by the manufacturer

1. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.

2. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

3. Cable raceways shall not be filled greater than the ANSI/TIA -569-D maximum fill for the particular raceway type or 40%.

4. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.

5. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.

6. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.

7. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 4-foot on center (1.2 meter) intervals. J-hooks should be staggered in distance to avoid harmonics. At no point shall cable(s) rest on acoustic ceiling grids or panels.

8. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

9. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

10. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the contractor shall install appropriate carriers to support the cabling.

11. At no time shall a cable be supported on the fluorescent light fixtures, ceiling tiles, electrical conduits, HVAV ducts, ceiling tiles, or other building system fixtures.

12. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

13. Cables shall be identified by a self-adhesive label in accordance with the System Documentation Section of this specification and ANSI/TIA/ -606-B. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.

14. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

15. Pulling tension on 4-pair UTP cables shall not exceed 25-lbf for a four-pair UTP cable.

16. The ultimate breaking strength of the completed cable, measured in accordance with ASTM D 4565 (Ref B135), shall be 90 lbs minimum. The maximum pulling tension shall not exceed 40 lbs to avoid stretching the conductors.

3.9 HORIZONTAL CROSS CONNECT INSTALLATION

The voice cross connect shall be a passive connection between the horizontal termination blocks and the backbone termination blocks. The wall mount frames shall be field terminated kits including all blocks, connecting blocks, and designation strips. Management rings shall be mounted between vertical columns of blocks to provide management of cross-connect wire. Backbone and horizontal blocks shall use 4-pair connecting blocks. Blocks shall be oriented so that backbone terminations are located on the left and horizontal frames are located on the right of the termination field when facing the frame assembly.

A. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA -568latest standard, manufacturer's recommendations and best industry practices.

B. Pair untwist at the termination shall not exceed 12 mm (0.5 inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. The cable jacket shall be maintained as close as possible to the termination point.

F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.10 OPTICAL FIBER TERMINATION HARDWARE

A. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.

C. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.

D. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.

E. A maximum of 12 strands of fiber shall be spliced in each tray

F. All spare strands shall be terminated

G. Unused terminated connectors shall be capped

3.11 BACKBONE CABLE INSTALLATION

A. Backbone cables shall be installed separately from horizontal distribution cables

B. A pull cord (nylon; 1/8" minimum) shall be co-installed with all cable installed in any conduit.

C. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits.

D. Where backbone cables are installed in an air return plenum, riser rated cable shall be installed in metallic conduit.

E. Where backbone cables and distribution cables are installed in a cable tray or wire way, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.

F. All backbone cables shall be securely fastened to the sidewall of the IDF on each floor.

G. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.

H. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.

I. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.

3.12 COPPER TERMINATION HARDWARE

A. Cables shall be dressed and terminated in accordance with the recommendations made in the most current ANSI/TIA -568 standard, manufacturer's recommendations and best industry practice.

B. Pair untwist at the termination shall be kept to a minimum but not exceed 12 mm (one-half inch).

C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.

D. Cables shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

E. The cable jacket shall be maintained to within 25 mm (one inch) of the termination point.

F. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

3.13 RACKS / CABINETS

A. Racks shall be securely attached to the floor using minimum 3/8” hardware and/or as required by local codes.

B. Racks shall be placed with a minimum of 36inch clearance from the walls on all sides of the rack. When mounted in a row, maintain a minimum of 36 inches from the wall behind and in front of the row of racks and from the wall at each end of the row.

C. All racks shall be grounded to the communications ground bus bar in accordance with Section 3.15 of this document.

D. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with the rack upon completion of the installation.

E. Wall mounted termination block fields shall be mounted on 4’ x 8’ x .75” void free plywood. The plywood shall be mounted vertically 12” above the finished floor. The plywood shall be painted with two coats of white fire retardant paint.

F. Wall mounted termination block fields shall be installed with the lowest edge of the mounting frame 18” from the finished floor.

3.14 FIRESTOP SYSTEM

A. All fire stop systems shall be installed in accordance with the manufacturer’s recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cable system acceptance.

B. A fire stop system is comprised of the item or items penetrating the fire rated structure, the opening in the structure and the materials and assembly of the materials used to seal the penetrated structure. Fire stop systems comprise an effective block for fire, smoke, heat, vapor and pressurized water stream.

C. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate fire stop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure). Any penetrating item i.e., riser slots and sleeves, cables, conduit, cable tray, and raceways, etc. shall be properly fire stopped.

D. Fire stop systems shall be UL Classified to ASTM E814 (UL 1479) and shall be approved by a qualified Professional Engineer (PE), licensed (actual or reciprocal) in the state where the work is to be performed. A drawing showing the proposed fire stop system, stamped/embossed by the PE shall be provided to the Owner’s Technical Representative prior to installing the fire stop system(s).

3.15 BONDING SYSTEM

A. The TBB shall be designed and/or approved by a qualified PE, licensed in the state that the work is to be performed. The TBB shall adhere to the recommendations of

the ANSI/TIA -607-C standard, and shall be installed in accordance with best industry practice.

B. Installation and termination of the main bonding conductor to the building service entrance ground shall be performed by a licensed electrical contractor.

C. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all communications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA -607-C Communications Bonding and Grounding Standard.

D. The main entrance facility/equipment room in each building shall be equipped with aPrimary Bonding Busbar (PBB). Each communications room shall be provided with aSecondary Bonding Busbar (SBB). The PBBshall be connected to the building electrical entrance grounding facility. The intent of this system is to provide a grounding system that is equal in potential to the building electrical ground system. Therefore, ground loop current potential is minimized between communications equipment and the electrical system to which it is attached.

E. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MDF/IDF shall be bondedto the respective SBB or PBB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.

F. All wires used for communications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap of green tape. All cables and bus bars shall be identified and labeled in accordance with the System Documentation Section of this specification.

3.16 IDENTIFICATION AND LABELING

A. The contractor shall develop and submit for approval a labeling system for the cable installation if the required labeling scheme is not detailed in the design drawings or appendices, the Owner will negotiate an appropriate labeling scheme with the successful contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and outlets. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme. Labeling shall follow the guidelines of ANSI/TIA-606-B.

B. All label printing will be machine generated by an approved label equipment manufacturer.

C. Self-laminating labels will be used on cable jackets, appropriately sized to the OD of the cable, and placed within view at the termination point on each end. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.

D. Labeling schema shall follow:

1. MDF name should include floor number, for example MDF01 (MDF_{floor})

2. IDF name should include floor number and unit number, for example IDF01-01 ($IDF_{floor\ -\ unit}$)

3. MDF/IDF To End Station (aka Horizontal Cabling)

    a. MDF/IDF Jack Labels (A-Side) A001-999 / (B Side) B001-999

    b. Station Jack Labels (1^{st} Jack) IDF01-01-A001 - 999 / (2^{nd} Jack) IDF01-01-B001 - 999

4. MDF To IDF(s) (aka Vertical Cabling)

    a. MDF Jack Labels IDF01-01-001

    b. IDF Jack Labels MDF01-001

3.17 TESTING AND ACCEPTANCE

A. General Procedures

1. All testing shall be performed to the satisfaction of ORTRONICS and Superior Essex so the required nCompass Limited Lifetime Warranty can be extended to American Water.

2. All testing shall be performed in accordance with Ortronics recommended testing guidelines and procedures.

3. Cable testing shall be performed on 100% of all installed cable infrastructure.

4. Test results of (pass*) are not acceptable.

5. The results of all test and analyses shall be kept on file and provided to Owner at completion of the project.

B. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of the most current revision of ANSI/TIA -568 series standard. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed

through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.

C. All cables shall be tested in accordance with this document, the ANSI/TIA standards, the Ortronics Certified Technician Installation Field Guide and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

3.18 APPROVED TESTING EQUIPMENT

A. UTP Testing Equipment

a. Fluke DSX5000, DSX8000 or DTX1800 certified tester approved by Ortronics for Category 6 Link and Channel Testing using the tester's manufacturer approved patch cords and connectors only.

B. Fiber Optic Testing Equipment

b. Fluke Versiv Certifiber Pro or DSX5000 certified tester approved by Ortronics for Fiber Optic Cable Testing.

C. Copper Channel Testing

1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Horizontal cabling shall be tested using a Level III test unit for Category 6 performance compliance as specified in the most current revision of ANSI/TIA -568 standards.

2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Shielded/screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the most current ANSI/TIA -568 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.

4. Category 6 Performance Test

a. Follow the Standards requirements established in ANSI/TIA/EIA-568.1-D

b. A Level IV test unit is required to verify category 6 performances.

c. The basic tests required are:

   i. Wire Map

   ii. Length

   iii. Attenuation

   iv. NEXT (Near end crosstalk)

   v. Return Loss

   vi. ELFEXT Loss

   vii. Propagation Delay

   viii. Delay skew

   ix. PSNEXT (Power sum near-end crosstalk loss)

   x. PSELFEXT (Power sum equal level far-end crosstalk loss)

d. Attenuation

   i. All cable pairs to be tested for signal attenuation must pass the tests

   ii. Attenuation shall be measured in dB/100 m

   iii. Record the Worst Pair Attenuation of a cable

   iv. Near End Cross Talk (NEXT), Equal Level Far End Cross Talk (ELFEXT), Power Sum NEXT and Power Sum ELFEXT

   v. All cable pairs to be tested for NEXT and ELFEXT must pass the tests

   vi. NEXT, ELFEXT, power sum NEXT and power sum ELFEXT shall be measured in dB

   vii. Record the readings for each measurement between

      - Pair 1 and Pair 2

- Pair 1 and Pair 3
- Pair 1 and Pair 4
- Pair 2 and Pair 3
- Pair 2 and Pair 4
- Pair 3 and Pair 4

viii. Record the Worst pair of every measurement for each cable

e. Return Loss

a) All cable pairs to be tested for Return Loss must pass the tests

b) Values shall be measured in dB

c) Record the Return Loss of a cable

d) The Worst Pair ACR and Return Loss shall not exceed the values specified by the cable manufacturer and TIA/EIA-568-C Standard

f. Propagation Delay and Delay Skew

a) All cable pairs to be tested for Delay must pass the tests

b) Delay shall be measured in ns/100 m.

c) The Propagation Delay and Delay Skew shall not exceed the values specified by the cable manufacturer

D. Fiber Testing

1. All fiber testing shall be performed on all fibers in the completed end to end system. There shall be no splices unless clearly defined in an RFP. Testing shall consist of an end to end power meter test performed per EIA/TIA-455-53A. The system loss measurements shall be provided at 850 and/or 1300 nanometers for multimode fibers and 1310 and/or 1550 nanometers for single mode fibers. These tests also include continuity checking of each fiber.

2. Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm (or 1310 and 1550 nm for single mode) in both directions.

3. Test set-up and performance shall be conducted in accordance with ANSI /TIA-526-14 Standard, Method B. A one jumper test method is preferred.

4. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. Only link test is required. The contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above. The values for calculating loss shall be those defined in the ANSI/TIA Standard.

3.19 POST-INSTALLATION TESTING

A. The Communication Contractor shall be responsible for testing and troubleshooting every fiber optic strand of every installed and terminated fiber optic cable.

B. Testing Procedures

1. Perform and end-to-end, bi-directional power loss tests at 850 nm and 1300 wavelengths for MulitiMode Fiber with an optical loss test set.

2. The cable runs should meet the optical transmission performance for both cables and connectors, specified by the cable manufacturer for cables and connectors respectively.

3. For those fiber strands of a cable run that exceed the specified maximum power loss, re-test by using an OTDR. By reading the OTDR trace, determine whether it is the fiber strand or the connector that exceeds the power loss margin.

4. If the fiber strands exceed the specified loss budget, then re-pull the fiber optic cable containing the fiber strand at fault and repeat the testing procedures above.

5. Record and document all power loss readings in relative decibels (dB). Indicate as part of the testing documentation those runs that exceeded the power loss margins and the action taken.

3.20 SYSTEM DOCUMENTATION

A. Upon completion of the installation, the communications contractor shall provide three (3) full documentation sets to the Engineer for approval. Documentation shall include the items detailed in the sub-sections below.

B. Documentation shall be submitted within ten (10) working days of the completion of each testing phase (e.g. subsystem, cable type, area, floor). This is inclusive of all test result and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase. Communications contractor shall provide copies of the original test results.

C. The Engineer may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the communications contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% re-test. This re-test shall be at no additional cost to the Owner.

3.21 TEST RESULTS

A. Test documentation shall be provided on disk within three weeks after the completion of the project. The disk shall be clearly marked on the outside front cover with the words “Project Test Documentation”, the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.

B. The field test equipment shall meet the requirements of the most current ANSI/TIA - 568 series including applicable TSB’s and amendments. The appropriate Level IV tester shall be used to verify Category 6 cabling systems.

C. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. The communications contractor must furnish this information in electronic form on a CD-ROM.

D. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.

3.22 AS-BUILT DRAWINGS

A. The drawings are to include outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The Owner will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added. These documents will be modified accordingly by the communications contractor to denote as-built information as defined above and returned to the American Water.

B. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD)

PART 4 WARRANTY AND SERVICES

4.1 WARRANTY

A. The nCompass Warranty provides the warranty directly to American Water.

B. A Limited Lifetime Premium Warranty shall be provided to include the backbone and the entire channel provided that Ortronics patch cords are utilized. The warranty shall cover the system to perform to the specifications listed in the nCompass data sheets in effect at the start of the installation. The Limited Lifetime Warranty will be in effect for the expected usable life of the building which shall not exceed forty (40) years. The contractor shall provide a 1-year warranty on the physical installation.

4.2 CONTINUING MAINTENANCE

A. Moves-Adds-Changes (MACs) shall be performed by an Ortronics CIP-ESP Contractor and shall be added to the nCompass warranty when registered with Ortronics.

4.3 FINAL ACCEPTANCE & SYSTEM CERTIFICATION

Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a two-week period will constitute acceptance of the system. Upon successful completion of the installation and subsequent inspection, the end user shall be provided with a numbered certificate, from Ortronics, registering the installation.

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APPENDIX A – CIP-ESP Protocols

CIP-ESP National Network Protocols for Providing Replicated Support and Value:

The CIP-ESP program is designed to offer end-users seamless installation coverage on a national basis. End-users with multiple locations have traditionally had the burden of managing each and every location as unique, one-time projects. This is largely because channel partners have often placed the burden on the customer. There are very few national contractors; distributors operate as individual locations; and manufacturers pay their sales people on point of sale, which has the unwanted effect of making the local sales person unresponsive to the national needs of a customer.

The Ortronics ESP program addresses every one of these issues by offering solutions created to enhance the value of all three components of the channel. For national installation coverage, the CIP-ESP network addresses national opportunities by coordinating a team of the best contractors in the industry, dedicated to the replication of the customer's standard design and product choice. The network offers the customer value by reducing project management responsibilities, improving on-time completion of installations, simultaneously providing multiple installations to multiple regions, and providing the value that comes from having all locations standardized and protected by the nCompass warranty. In order for the CIP-ESP network to be able to meet these goals, certain protocols must be followed and supported. These protocols have been created with one thing in mind: the members of the network understand that these protocols are in place to provide better support for the end-users' needs, and by working as team, are able to follow the customer's standards and specifications and operate as one entity, in a coordinated fashion.

Every member of the CIP-ESP network must commit to the following list of protocols:

- ✓ Precisely replicate the customer's standard design, product choices and communication protocols
- ✓ Work closely with the distributor of choice in order to minimize lead time issues and to work seamlessly with the customer's logistics partner
- ✓ Handle all channel disputes internally and never put the end-user in the middle of channel conflict
- ✓ Constantly search for improved process opportunities Fully understand the value of the ESP program in order to serve as an extension of the Ortronics sales team.

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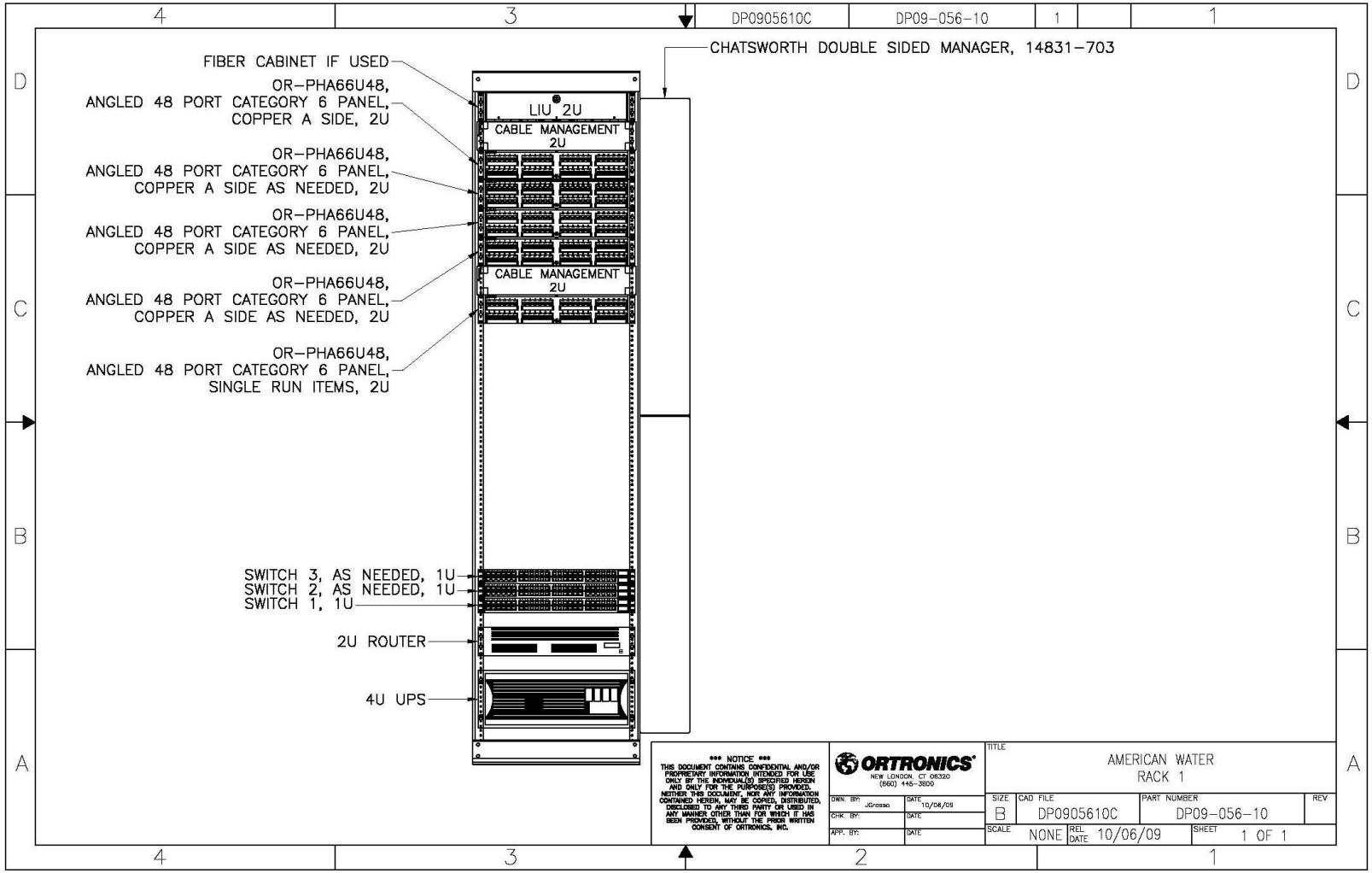
APPENDIX B – RACK ELEVATION DRAWINGS

Sample Rack Elevation – 1 rack space



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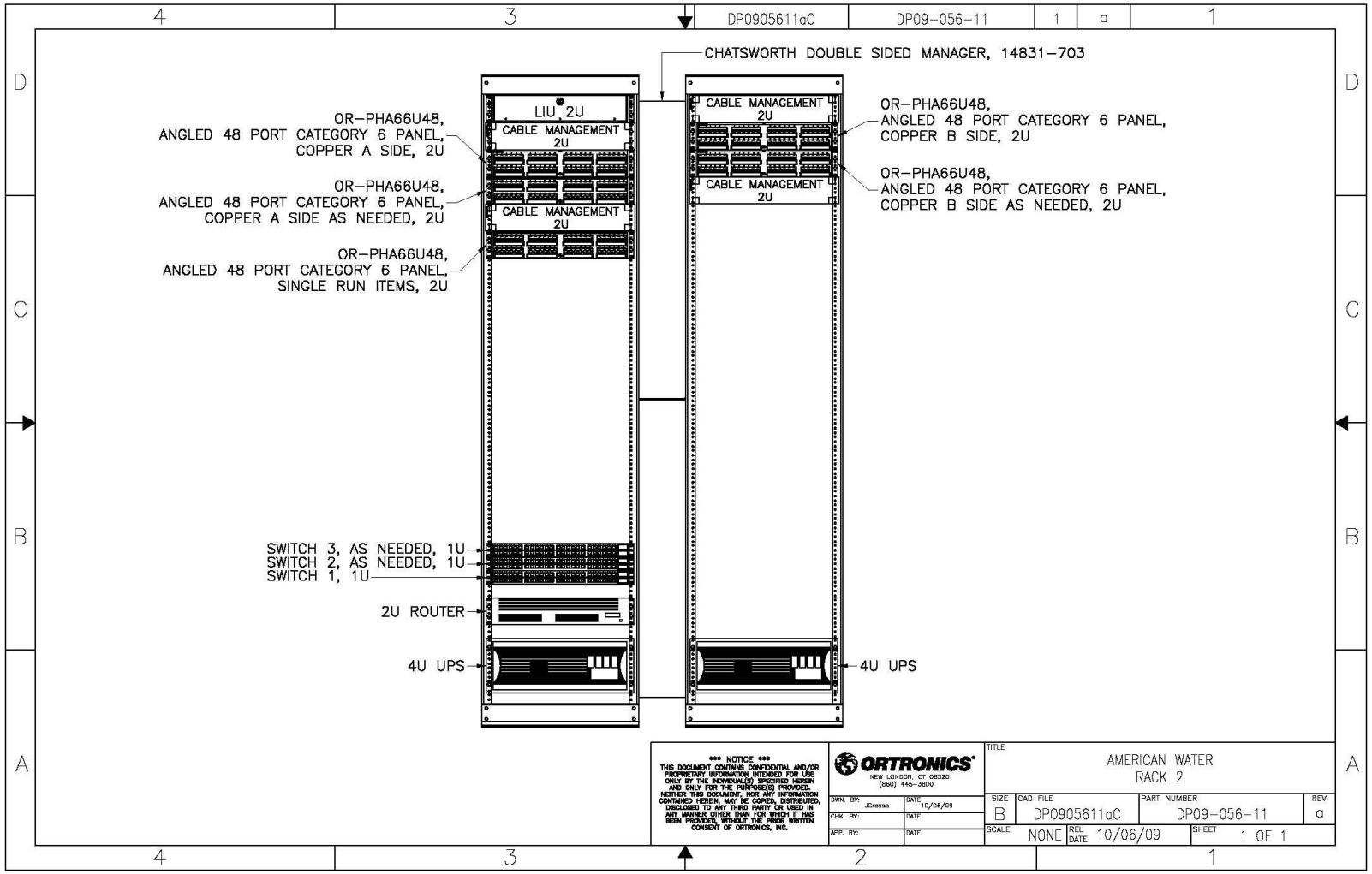
Sample Rack Elevation – 2 rack space



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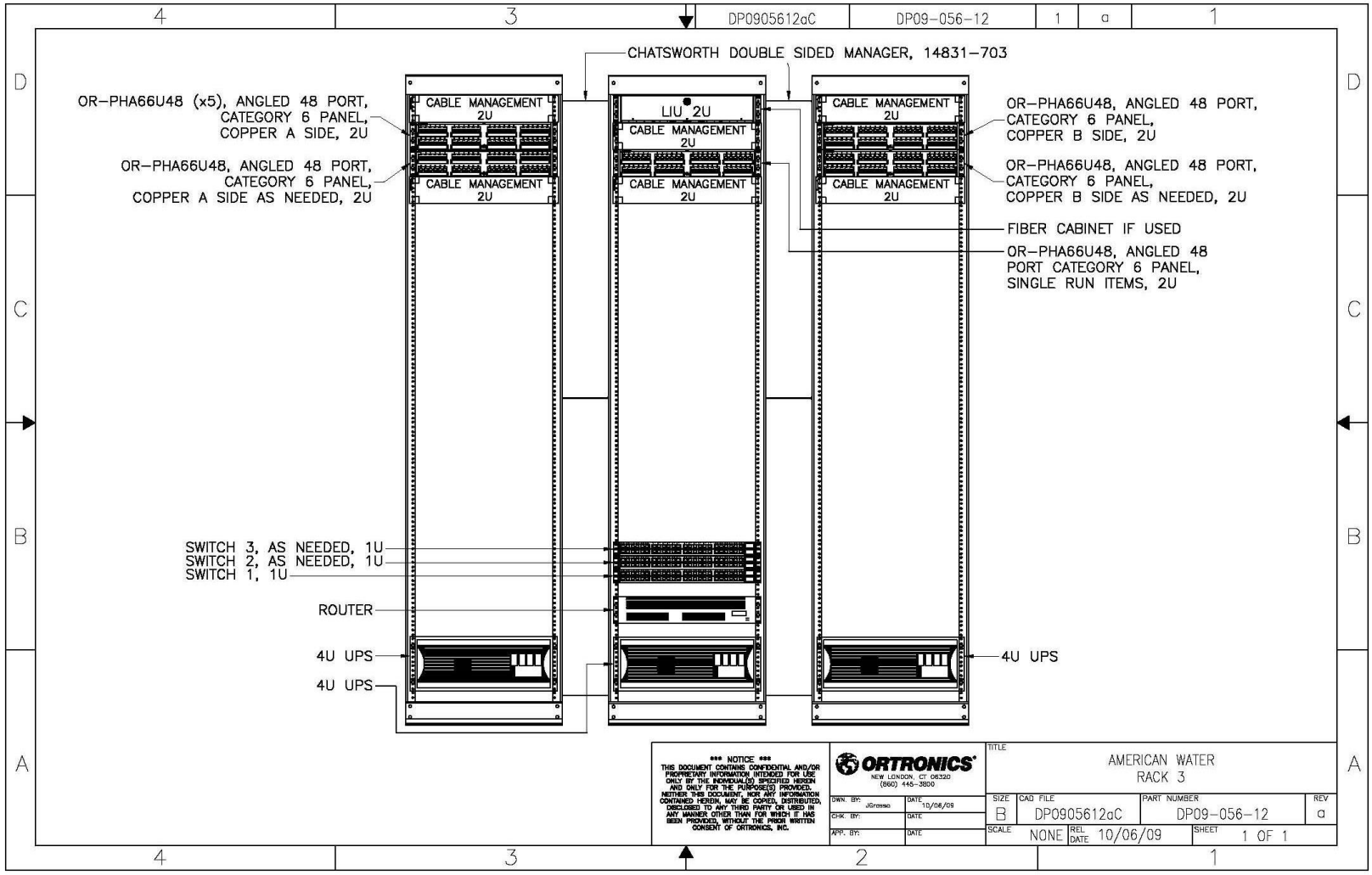
Sample Rack Elevation – 3 rack space



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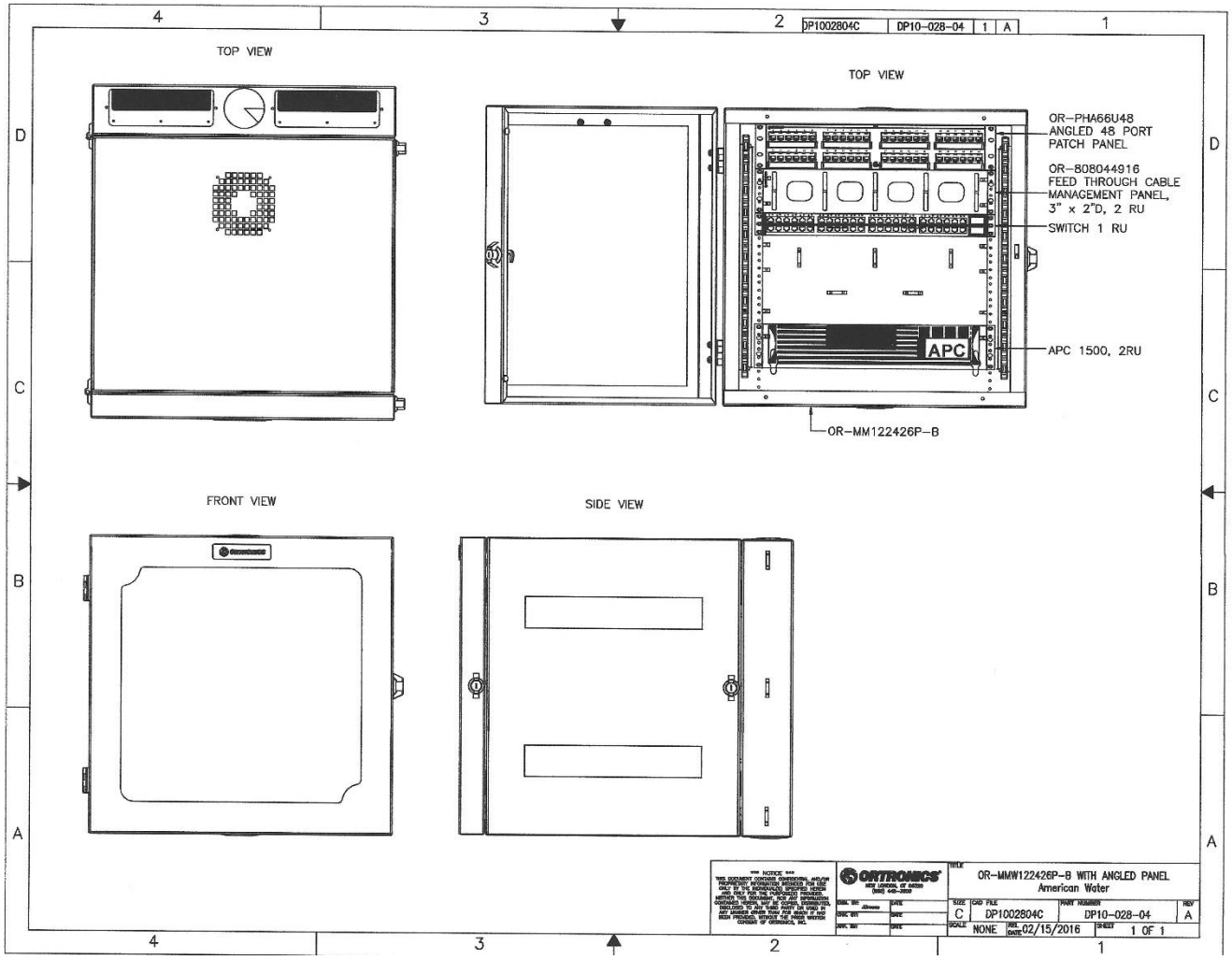
Sample Rack Elevation – Wall Mount Cabinet



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APPENDIX C – COLOR CODING

Copper Patch Cords

Red	SCADA
Yellow	Workstation / IP Phone / Printer
Blue	Servers
Grey	Special
White	Network Infrastructure
Black	Security
Orange	Audio/Video

Fiber Patch Boot

Red	SCADA
White	IT
Black	Security

APPENDIX C-5

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RECOMMENDED GUIDELINES AND STANDARDS FOR

DESIGN AND INSTALLATION OF SCADA SYSTEMS

AMERICAN WATER ENGINEERING
1 Water Street
Camden, New Jersey 08102
April 2015

PAGES 461 THROUGH 506 REDACTED
DUE TO HOMELAND SECURITY CONCERNS

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PIPELINE SPECIFICATIONS

NOVEMBER-2019

TECHNICAL SPECIFICATIONS- 2019

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SECTION 01000

SUMMARY OF WORK

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Contractor shall provide all labor, materials (except as herein noted), tools, equipment, services and means to construct the pipeline(s) and other Work as described in the Contract Documents (including these Specifications) and shown on the Drawings. The Work for which the Contractor is responsible includes, but is not limited to, the following:

1. Call for utility locations;
2. Acquisition of any additional temporary easements or other written authorizations necessary to perform the Work, including access and storage areas;
3. Pavement removal, including saw cutting, as required;
4. Construction and maintenance of bridges and other structures as required for traffic control;
5. Furnishing of flagmen, traffic warning and control as required;
6. Protection, temporary removal and replacement of signage and traffic control devices where affected by the Work;
7. Sheeting, bracing and support of trench and adjoining ground where necessary;
8. Furnish and install thrust blocking and pipe restraints as required;
9. Handling drainage and water removal;
10. Guarding the site and materials on site;
11. All necessary safety equipment, devices, and other precautions;
12. Furnishing materials not provided by the Owner to the site (see article 1.03)
13. Unloading, loading, hauling, distributing, laying and testing the pipe and appurtenances;
14. Protection, temporary support and/or rearranging of sewer lateral and other utility pipes, ducts, wires, cables and poles where necessary;
15. Excavation and backfilling of trenches and pits;
16. Restoration of paved and concrete surfaces including roadways, curbing, driveways, and sidewalks;
17. Removal and proper disposal of surplus excavated material and debris;
18. Installation of required pipe, fittings and appurtenances;

19. Performance of pressure and leakage tests and correction of any deficiencies;
20. Flush & clean pipeline;
21. Disinfecting of pipeline (and dechlorination of discharge);
22. Site cleaning;
23. Maintenance of street or other surfaces for the required period of time;
24. Ground restoration and planting;
25. Submit schedules, Shop Drawings and as-built records;
26. Erosion and sediment control.

B. Contractor shall refer to the Standard General Conditions of the Construction Contract for definitions of the Owner, Contractor, Engineer and other terminology that may be used in these Specifications.

C. Contractor shall refer to Section 01011 Special Provisions, for specific criteria, which are set by the Engineer or Owner's local Operations District and supplement or supersede other sections within these Specifications.

D. The above general outline of principal features does not in any way limit the responsibility of the Contractor to perform all Work and furnish the required materials, equipment, labor and means as shown or required by the Contract Documents.

E. Materials, equipment, labor, etc., obviously a part of the Work and necessary for the proper operation and installation of same, although not specifically indicated in the Contract Documents, shall be provided as if called for in detail without additional cost to the Owner.

F. Where the following acronyms are used on the Schedule of Prices or elsewhere in these Specifications, they shall be defined as follows:

1. OFCI = Owner Furnished Contractor Installed (materials or equipment to be furnished by the Owner but installed by the Contractor)
2. CFCI = Contractor Furnished Contractor Installed (materials or equipment to be furnished and installed by the Contractor)
3. Where neither acronym is indicated for a particular Bid Item, refer to this section, Section 01011 and Section 01075 for clarification.

1.02 WORK BY OWNER

A. Owner may perform certain items of Work related to this project which may include the following

1. Mark locations of existing water mains, services, and valves;
2. Other work, if any, as described below:

a. Operate all valves necessary to shut-off, flush and reactivate its existing pipelines;
b. Install Pipe taps;
c. Provide meter sets;
d. Install meters;
e. Perform flushing (use of valves and hydrants);
f. Collect bacteriological samples;
g. Monitor Contractor's dechlorination plan;
h. Perform all bacteriological testing of samples and provide confirmation of passing and results upon request.

B. See Special Provisions (Section 01011), Section 01075 and the Schedule of Prices for applicable list of tasks provided by Owner and additional clarification of materials furnished by Owner. In the case of conflicts regarding Owner-furnished materials, the Schedule of Prices shall govern (if Schedule of Prices is silent, Section 01011 shall govern, followed by Section 01075).

C. See Section 01011 for specific local requirements with regard to all other Specification sections.

1.03 MATERIALS FURNISHED BY OWNER

A. The following materials will be furnished by the Owner unless otherwise indicated in the Schedule of Prices, Section 01011 and/or Section 01075; and when so furnished, these materials shall be installed by the Contractor.

1. Ductile iron pipe and standard pipe gaskets for push-on joints
2. Restrained joint ductile iron pipe and compatible standard gaskets (16-inch and larger; also for smaller sizes when ductile iron pipe is identified on the Drawings for HDD applications)
3. Field-Lok gaskets (12-inch and smaller)
4. AWWA C900 PVC pipe (excluding Certa-Lok) and standard gaskets
5. Valves for buried service 4-inch diameter and greater with standard MJ ends and gaskets, including hydrant isolation valves (excluding metal-seated gate valves, tapping valves as noted below, and other horizontally-oriented gate valves)
6. Fire hydrant barrels (with Storz connections where required) and bottom shoes
7. Polyethylene encasement
8. Water meters.

B. Material to be furnished by Owner will typically be delivered to the job-site; however, certain materials may be delivered to the Owner's local Operations District property. Contractor is responsible for unloading all Owner-furnished material and transporting (both at job site and Owner's property) and shall reload and transport to the job site all items delivered to the Owner's property.

C. At Owner's discretion, Owner may furnish de-chlorination equipment (but not de-chlorination chemical) for the Contractor's temporary use on the Work under this Contract only.

D. All materials required to complete the Work, but not listed above, shall be furnished and installed by the Contractor. For example, unless otherwise noted in Section 01011, Section 01075, or the Schedule of Prices, the following materials will **not** be furnished by the Owner:

1. HDPE pipe
2. Certa-Lok™ PVC pipe
3. Ductile iron fittings and gaskets
4. Ductile iron anchor couplings
5. Fire hydrant laterals
6. Flushing hydrants
7. Valve boxes
8. Tapping sleeves, saddles, and tapping valves (except where standard MJ, vertically-oriented gate valves 12-inch diameter and smaller can be used)
9. Rods, bolts, lugs, gaskets
10. Retaining glands, couplings, and other external joint restraint devices for pipe, fittings, valves,
11. Service line piping (except where ductile iron pipe is required)
12. Corporation and curb stops
13. Identification tape
14. Tracer wire
15. Tape for polyethylene encasement
16. Pipe insulation materials
17. Air valves and blow-off assemblies
18. All other piping specialties and related components.

E. See Section 01075, Section 01011, and Schedule of Prices for applicable list of materials furnished by Owner

F. See Section 01011 for specific local requirements with regard to all other Specification sections.

1.04 LOCATIONS

A. All Work shall be performed on Owner's property, public rights of way, and/or public or private easements obtained by the Owner. Approximate right of way and easement limits are shown on the Drawings and/or described in the

Specifications. No work shall be performed by the Contractor outside of these limits.

B. It is the obligation and responsibility of the Contractor to determine the exact limitations of the rights of way and/or easements and any conditions limiting or affecting the use of the right of way by the Owner and/or the Contractor. All agreements respecting rights of way and the easements that are available to the Owner can be made available upon request. The Contractor agrees to indemnify and hold harmless the Owner against any claims made by any property owner, including any claim that the Contractor has failed to keep Contractor work, equipment, materials, or workmen within the limits authorized by the right of way and/or easement or any claim that the Contractor has failed to comply with any condition or requirement, or agreement respecting the right of way and/or easement.

C. Some of the locations shown or described in the Contract Documents, such as tie-ins, are approximate. All tie-ins shall be performed per the Contract Documents unless specifically directed by the Owner. It is the responsibility of the Contractor for pinpointing the exact locations.

D. Contours, topography and profiles of the ground as may be shown on the Drawings are believed to be reasonably correct, but are not guaranteed and are presented only as an approximation. It is the Contractor's responsibility to verify proposed pipeline elevations.

PART 2: PRODUCTS

2.01 GENERAL

Specifications for the materials and equipment to be provided by the Contractor are detailed in the respective Specification sections.

PART 3: EXECUTION

3.01 FIELD SURVEY WORK

Contractor shall lay out the Work in accordance with Article 4 Section 4.05 of the General Conditions. The Contractor shall utilize a Registered Land Surveyor to stake the existing right of way, proposed right of way and easements. Contractor shall stake the proposed alignment to insure compliance with the Contract Documents and Specifications. The Contract Documents shall include bench marks and control points for reference. Where necessary, Owner will furnish additional reference points as noted on the Drawings in paper or electronic format.

3.02 COORDINATION

A. Coordinate work; phase the construction operations; and provide and maintain any temporary connections necessary to prevent interference to operation of

Owner's facilities. Any construction work requiring the shutdown of facilities must be scheduled and performed only at such times as shall be authorized by the Owner. Such Work must be completed during the specific periods authorized by the Owner.

B. Refer to Section 15000 for further requirements regarding coordination of shutdowns and other interruptions to Owner's facilities.

3.03 REGULATORY REQUIREMENTS

When the Work is to be done in a third party's transportation or utility right of way, Contractor shall coordinate with the third party in accordance with Sections 01570, 02025, 02610 and 02620, and, where required by the third party, make necessary arrangements to have an inspector and/or traffic controllers/signalmen assigned to the Project by the third party.

Contractor shall comply with the third party's requirements and shall coordinate with the third party and its inspector / traffic controllers / signalmen as required throughout the duration of the Work. Work requiring inspection by the third party's inspector and/or traffic control/signaling by the third party shall only be performed when authorized by the third party. All costs in connection with third party inspections and traffic control/signaling mandated by third party transportation and utility authorities shall be paid by the Contractor.

END OF SECTION

SECTION 01010

DRAWING INDEX

PART 1: GENERAL

1.01 DRAWINGS

A. The following Drawings, dated [Date on Drawings], and prepared by Engineers company name [Engineering firm's name] ,accompany these Specifications and are a part thereof. Drawings are the property of the Owner and shall not be used for any purpose other than that intended by the Specifications.

Sheet No.	*Title, Description*
1	*TITLE*
2	*INDEX & DATA*
3-X	*WATER MAIN PLAN & PROFILE*
X	*WATER MAIN STANDARD DETAILS*

B. The following detail Drawings are provided and are to be incorporated in the Drawings:

Sheet No.	*Title, Description*
…	

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01011

SPECIAL PROVISIONS

PART 1: GENERAL

This section is intended call out requirements that are unique to individual Operations Districts of the Owner. The content of this section shall replace or supplement the requirements in other sections of the Specifications for Work within the individual Operations Districts as noted herein. **If any other article of this section suggests the use of any materials, means and methods but is excluded or modified in this Section 01011, this section shall have priority and shall supersede conflicting requirements in other sections.** If there are conflicts between the Drawings provided and these Specifications, contact Owner immediately for clarification.

FROM SECTION 15150 GATE VALVES

A. Valves located in the Terre Haute Operations District shall open right.

FROM SECTION 15155 BUTTERFLY VALVES

A. Valves located in the Terre Haute Operations District shall open right.

FROM SECTION 15180 FIRE HYDRANTS

When the Contractor is required to furnish fire hydrants, hydrants shall be furnished and equipped according to the below schedule. Touch-up paint color shall also conform to this schedule.

	Allowed Manufacturers			*Storz Outlet Required*	
District	*Kennedy*	*American Darling*	*Mueller*		**Color**
Crawfordsville	X	X	X	Yes	Safety Yellow - Company Red - Private
Johnson County			X	Yes	Safety Yellow - Company Red - Private
Kokomo	X		X	Yes	Safety Yellow - Company Red - Private
Mooresville			X	Yes	Safety Yellow - Company Red - Private
Muncie			X	Yes	Safety Yellow - Company Red - Private

District	Allowed Manufacturers			*Storz Outlet Required*	Color
	Kennedy	*American Darling*	*Mueller*		
Newburgh			X	Yes	Safety Yellow - Company Red - Private
Noblesville	X		X	Yes	Safety Yellow - Noblesville White with blue cap - Fishers Red - Private
Northwest	X		X	Yes	Safety Orange or Omaha Orange - Company Red - Private
Richmond			X	No	Safety Yellow - Company Red - Private
Seymour			X	No	Safety Yellow - Company Red - Private
Shelbyville			X	Yes	Safety Yellow - Company Red - Private
Sheridan	(1)	(1)	(1)	(1)	(1)
Somerset	No fire hydrants				
Southern-Clarksville, Jeffersonville, New Albany	X		X	Yes	Safety Yellow - Company Red - Private
Southern-Charlestown	(1)	(1)	(1)	(1)	(1)
Southern-Georgetown	(1)	(1)	(1)	(1)	(1)
Sullivan			X	Yes	Safety Yellow - Company Red - Private
Summitville			X	Yes	Safety Yellow - Company Red - Private
Terre Haute (incl. Farmersburg)			X	Yes	Safety Yellow - Company Red - Private
Wabash	X	X	X	Yes	Safety Yellow - Company Red - Private

District	Allowed Manufacturers			*Storz Outlet Required*	Color
	Kennedy	*American Darling*	*Mueller*		
Warsaw	X	X	X	Yes	Safety Yellow - Company Red - Private
West Lafayette	X		X	Yes	Safety Yellow - Company Red - Private
Winchester			X	No	Safety Yellow - Company Red - Private

(1) Confirm with local INAWC Operations

FROM SECTION 15190 Air Valves, Blow-off Assemblies and Sampling taps

A. Flushing Hydrants for Permanent Blow-off Assemblies

1. Johnson County- Above ground type.
2. All others- Confirm with local INAWC Operations

FROM SECTION 15200 SERVICE LINES

The Contractor shall supply all required meter pits, setters or yoke bars, valves, lids, service line, other listed products, and miscellaneous items required to install new residential service connections per the following schedule:

B. Crawfordsville

1. **Meter Pit:** 48” long.
2. **Meter Pit Ring/Cover and Lid:** Vestal 20” #RMRC-21L W/SN W/TR
3. **Yoke Bar or Setter:** A.Y. McDonald 14-2P
4. **Dual Meter sets:** A.Y. McDonald #08U3m 1 x ¾” x 7.5 u-branch
5. **Supports:** ¾” standpipes
6. **Inlet Angle Ball Valve:** A.Y. McDonald #4604BY ¾” x ¾” x 02
7. **Outlet Valve:** A.Y. McDonald #4779Y-22 ¾”x 02
8. **Service Line Material:** ¾” for individual services and 1” to supply dual meter settings; HDPE SDR-9 (200 psi) minimum.
9. **Corporation Stop:** Mueller #E-25009 1x1x1

C. Johnson County

1. **Meter Pit:** 48” long x 20” Diameter (single & dual)
2. **Meter Pit Ring/Cover and Lid:** Vestal 20” Model #RMC-20L W/SN W/TR (Single) and Model #RMC-20L W/SN W/2TR (Dual)
3. **Meter:** ¾” x 5/8” Furnished and installed by INAWC.
4. **Yoke Bar:** Mueller # H-5020P
5. **Branch Piece (Dual Set Only):** Mueller H-15363-254N
6. **Supports:** ¾” standpipes
7. **Inlet Ball Valve:** Mueller B-24278-250N (3/4”) Mueller B-24278-250N (1”)
8. **Outlet Ell:** Mueller #H-14207-250N (3/4”) and H-14207-250N (1”)
9. **Service Line Material:** ¾” for individual services and 1” to supply dual meter settings; HDPE SDR-9 (200 psi) minimum.
10. **Corporation Stop:** Mueller #H-15008N-250N (¾”) or #H-15008N-330N (1”)

D. Kokomo & Russiaville

1. **Meter Pit:** 48” x 20” Diameter (single) 24” (dual)
2. **Meter Pit Ring/Cover and Lid:** (Single) Vestal # 32-277 - RMRC-215-L W/SN W/RTR Ring & Lid or Ford # A53-REC463-T Ring & Lid. (Dual Set) Vestal # 32-046 - ER-2024 Ring with 32-501 - Monitor Ring & Lid W/SN W/2RTR or Ford # MC-24-REC463-TT Ring & Lid. (1” Set) Vestal # 32-046 - ER-2024 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR or Ford # MC-24-REC463-T Ring & Lid.
3. **Meter:** ¾” x 5/8” Furnished and installed by INAWC.
4. **Copper Setter:** (5/8”) A.Y. McDonald # 731-1--WXQQ33, Ford # VB81W-44-33-Q-NL, Mueller # B-2474N. (1”) A.Y. McDonald # 731-4--WXQQ44, Ford # VB84W-44-44-Q-NL, Mueller # B-2474N

2. **Yoke U-Branch Assembly (Dual Set Only):** A.Y. McDonald # 708UQQ or Mueller # H-15373N (1” x ¾” x 7.5”).

3. **Supports:** ½” Black Iron Pipe as vertical standpipe (Earth), ¾” Sch-80 PVC as horizontal cross bar (Rock).

4. **Service Line Material:** ¾” for individual services and 1” to supply dual meter settings; PE CTS SDR-9 (200 psi) minimum. Pipe stiffener inserts shall be plastic.

5. **Corporation Stop:** (3/4”) A.Y. McDonald # 74701T, Ford # F1000-3-Q-NL, Mueller # H-15008. (1”) A.Y. McDonald # 74701T, Ford # F1000-4-Q-NL, Mueller # H-15008N.

6. **Manufactured Meter Pit Setter:**

a. **1.5" Meter:** Pit: Ford# PMBB-688-36HB-48-SB4-G-NL (13" laylength, 18" lid to meter) Lid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR

b. **2" Meter:** Pit: Ford# PMBB-788-36HB-48-SB4-G-NL (17" laylength, 18" lid to meter) Lid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR

E. Mooresville

1. **Meter Pit:** 48" long x 20" Diameter (single) 24" (dual & 1" meters).
2. **Meter Pit Ring/Cover and Lid:** confirm with Local Operations.
3. **Meter:** confirm with Local Operations Furnished and installed by INAWC.
4. **Yoke Bar:** Mueller # H-5020P
5. **Supports:** ¾" standpipes
6. **Branch Piece (Dual Set Only):** Mueller H-15363-245N
7. **Inlet Ball Valve:** Mueller B-24278-250N (3/4" & 1")
8. **Outlet Ell:** Mueller #H-14207-250N (3/4" & 1")
9. **Service Line Material:** 1" diameter to supply single and dual meter settings; PE CTS SDR-9 (200 psi) minimum.
10. **Corporation Stop:** Mueller # H-15008-250N (¾") or H-15008-330N (1")

F. Muncie

1. **Meter Pit:** 48" long x 20" Diameter (single) 24" (dual).
2. **Meter Pit Ring/Cover and Lid:** (Single) Vestal # 32-277 - RMRC-215-L W/SN W/RTR Ring & Lid or Ford # A53-REC463-T Ring & Lid. (Dual Set) Vestal # 32-046 - ER-2024 Ring with 32-501 - Monitor Ring & Lid W/SN W/2RTR or Ford # MC-24-REC463-TT Ring & Lid. (1" Set) Vestal # 32-046 - ER-2024 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR or Ford # MC-24-REC463-T Ring & Lid.
3. **Meter:** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Copper Setter:** A.Y. McDonald # 31-1-WXQQ33
5. **Yoke U-Branch Assembly (Dual Set Only):** A.Y. McDonald # 708UQQ or Mueller # H-15373N (1" x ¾" x 7.5").
6. **Supports:** ½" Black Iron Pipe as vertical standpipe (Earth), ¾" Sch-80 PVC as horizontal cross bar (Rock).
7. **Inlet Angle Ball Valve:** Mueller # B24273-200
7. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTS SDR-9 (200 psi) minimum. Pipe stiffener inserts shall be plastic.

8. **Corporation Stop:** Mueller ¾" # H-15008N

G. Newburgh

1. **Meter Pit:** 24" diameter (single and dual meters) x 24" long
2. **Meter Pit Ring/Cover and Lid:** Vestal #RMC-20L W/SN W/2TR
3. **Meter Pit Adapter Ring:** Vestal ER-2024
4. **Meter:** Confirm with local operations" Furnished and installed by INAWC.
5. **¾" Setter:** A.Y. McDonald # MD 760H212 WX 3D 33x15
6. **1" Setter:** A.Y. McDonald #MD 760H415 WX 3D 44x15
7. **Supports:** standpipes
8. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTS DR-9 (200 psi) minimum.
9. **Corporation Stop:** A.Y. McDonald #74701-22
10. **Tapping Saddles:** A.Y. McDonald SS Strap Saddle - 3835 (preferred—see also Section 15170)

H. Noblesville

1. **Meter Pit:** *Corrugated HDPE,* 48" long *20"* Diameter*. (Single), 24" (Dual or 1" Set).*
2. **Meter Pit Ring/Cover and Lid:** (*Single) Vestal # 32-277 - RMRC-215-L W/SN W/RTR Ring & Lid or Ford # A53-REC463-T Ring & Lid. (Dual Set) Vestal # 32-046 - ER-2024 Ring with 32-501 - Monitor Ring & Lid W/SN W/2RTR or Ford # MC-24-REC463-TT Ring & Lid. (1" Set) Vestal # 32-046 - ER-2024 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR or Ford # MC-24-REC463-T Ring & Lid.*
3. **Meter** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar:** Mueller # H5010-P; A.Y. McDonald 14-1P, 14-2P, 14-3P, or 14-4P; or Ford Y501
5. **Supports:** ¾" standpipes
6. **Inlet Angle Ball Valve:** Mueller #H-14278-250, A.Y. McDonald 4604BY, or Ford AV91-313WNL
7. **Outlet Ell:** Mueller #H-14207-250
8. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTS SDR-9 (200 psi) minimum.
9. **Corporation Stop:** Mueller #H-15008N-250 (¾") or #H-15008N-330 (1"); A.Y. McDonald #74701-22 or Ford F1000-3-NL (¾") or F1000-1-NL (1")
10. **Manufactured Meter Pit Setter:**
    a. **1.5" Meter:** Pit: Ford# PMBB-688-36HB-48-SB4-G-NL (13" laylength, 18" lid to meter) Đid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR.

b. **2" Meter:** Pit: Ford# PMBB-788-30HB-48-SB4-G-NLFord# MC-30-REC463-T Ring & Lid or Vestal # 32-048 - ER-2030 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR

I. Northwest

1. **Meter Pit:** 48" long x 20" Diameter (single) 24" Diameter (dual meter & 1" services)
2. **Meter Pit Ring/Cover:** Vestal # 32-454 RMRCL W/SN W/TR (frost proof)
3. **Meter Pit Lid:** Vestal 32-776 w/ Electronic Meter Read Modules
4. **Meter Pit Frost Pan:** Vestal 32-777
5. **Meter:** ¾" x 5/8" Furnished and installed by INAWC.
6. **Yoke Bar:** A.Y. McDonald 14-2P or Ford Y502 (no prongs);
7. **Supports:** Standard support: (2) #6 rebar horizontal. Alternate support: ½" diameter vertical schedule 40 pipe.
8. **Outlet Angle Ball Valve:** (3/4") A.Y. McDonald 74602YQ, (1") A.Y. McDonald 74602Y-22; (3/4") Ford AV94-323W-Q-NL, (1") Ford AV94-324W-Q-NL.
9. **Inlet Ell:** (3/4") A.Y. McDonald 74779Y-22; (1") A.Y. McDonald 74779Y-22; (3/4") Ford L94-23-Q-NL
10. **Service Line Material:** HDPE SDR-9 (200 psi) minimum. Pipe stiffener inserts shall be stainless steel.
11. **Corporation Stop:** Mueller ¾" # H-15008N-3/4; A.Y. McDonald 74701BQ; Ford ¾" # F1000-3-Q-NL
12. **Curb Stop:** (3/4") Ford Ball Valve Curb Stop B44-333-Q-NL; Curb Box Ford 5604; Riser Rod: A.Y. McDonald # 5560

J. Richmond

1. **Meter Pit:** 48" long x 20" Diameter (single) 24" (dual)
2. **Meter Pit Ring/Cover and Lid:** (Single) Vestal # 32-277 - RMRC-215-L W/SN W/RTR Ring & Lid or Ford # A53-REC463-T Ring & Lid. (Dual Set) Vestal # 32-046 - ER-2024 Ring with 32-501 - Monitor Ring & Lid W/SN W/2RTR or Ford # MC-24-REC463-TT Ring & Lid. (1" Set) Vestal # 32-046 - ER-2024 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR or Ford # MC-24-REC463-T Ring & Lid.
3. **Meter:** ¾" x 5/8" Furnished and installed by INAWC.
4. **Meter Setter:** (5/8"x3/4") A.Y. McDonald # 731-2--WXQQ33, Ford # VB82W-44-33-Q-NL, Mueller # B-2474N. (1") A.Y. McDonald # 731-4--WXQQ44, Ford # VB84W-44-44-Q-NL, Mueller # B-2474N.
5. **Yoke U-Branch Assembly (Dual Set Only):** A.Y. McDonald # 708UQQ or Mueller # H-15373N (1" x ¾" x 7.5").
6. **Meter Idler:** A.Y. McDonald 740MJ07

7. **Support:** ½" Black Iron Pipe as vertical standpipe (Earth), ¾" Sch-80 PVC as horizontal cross bar (Rock).

8. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE DR-9 (200 psi) minimum. Pipe stiffener inserts shall be plastic.

9. **Corporation Stop:** (3/4") A.Y. McDonald # 74701T, Ford # F1000-3-Q-NL, Mueller # H-15008. (1") A.Y. McDonald # 74701T, Ford # F1000-4-Q-NL, Mueller # H-15008N.

K. Seymour

1. **Meter Pit:** 30" long.
2. **Meter Pit Ring/Cover and Lid:** Vestal 20" ring Model #RMRC-215L R&C W/SN W/TR (Single) and Model #RMRC-215L R&C W/SN W/2TR (Dual)
3. **Meter:** Confirm with local operations. Furnished and installed by INAWC.
4. **Meter Setter:** A.Y. McDonald 3/4" X 5/8"
5. **Support:** standpipes
6. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTSDR-9 (200 psi) minimum.
7. **Corporation Stop:** A.Y. McDonald # 4701BT

L. Shelbyville

1. **Meter Pit:** 36" long x 20" Diameter (single) 24" (dual)
2. **Meter Pit Ring/Cover and Lid:** Vestal 20" ring Model #RMRC-215L R&C W/SN W/TR (Single) and Model #RMRC-215L R&C W/SN W/2TR (Dual)
3. **Meter:** ¾" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar:** Mueller #H-5020P
5. **Supports:** ¾" standpipes
6. **Branch Piece (Dual Set Only):** Mueller H-15363-254N
7. **Inlet Ball Valve:** Mueller B-24278-250N
8. **Outlet Elbow:** Mueller #H-14207-250N
9. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE DR-9 (200 psi) minimum.
10. **Corporation Stop:** Mueller #H-15008N-250 (3/4") or H-15008N-330N (1")

M. Sheridan

1. **Meter Pit:** 36" long
2. **Meter Pit Ring/Cover and Lid:** Vestal #RMRC-215L R & C W/SN W/TR; A.Y. McDonald 74M53AT or Ford C53-T

3. **Meter** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar:** Mueller # H5010-P; A.Y. McDonald 14-1P, 14-2P, 14-3P, or 14-4P; or Ford Y501
5. **Supports:** ¾" standpipes
6. **Inlet Angle Ball Valve:** Mueller #H-14278-250, A.Y. McDonald 4604BY, or Ford AV91-313WNL
7. **Outlet Ell:** Mueller #H-14207-250
8. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTS SDR-9 (200 psi) minimum.
9. **Corporation Stop:** Mueller #H-15008N-250 (¾") or #H-15008N-330 (1"); A.Y. McDonald #74701-22 or Ford F1000-3-NL (¾") or F1000-1-NL (1")

N. Somerset

1. **Meter Pit:** 36" long, 20" Diameter (single- 5/8" meter); 24" (dual meters, and 1" meters)
2. **Meter Pit Ring/Cover and Lid:** Ford Meter Box W3-T (20" X 11" X 4") or Vestal #RMRC-20L W/SN W/TR
3. **Meter:** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar or Setter:** Ford Meter Box 501P (5/8") or A.Y. McDonald #14-1P
5. **Supports:** ¾" standpipes
6. **Branch Piece (Dual Set Only):** Mueller 1" X ¾" H-15363N-333
7. **Inlet Angle Ball Valve:** Ford Meter Box AV94313 ¾ PJ CTS X 5/8 or A.Y. McDonald # 4642BY-22 ¾" CTS X 5/8
8. **Outlet fitting:** ¾" X 5/8" yoke outlet – CTS X meter LLB or A.Y McDonald yoke 90# 4779Y-22
9. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTS DR-9 (200 psi) minimum.
10. **Corporation Stop:** Ford Meter Box F1000-3 (3/4") or F1000-4 (1"); or Mueller B-25008N (¾") (CC X CTS)

O. Southern Indiana (Clarksville, Jeffersonville, New Albany)

1. **Meter Pit:** 24" long x 20" diameter (single) 24" (dual); 30" diameter. (1" meter).
2. **Meter Pit Ring/Cover and Lid:** Vestal 20" ring Model # 32-424 #RMRC-215L R&C W/SN W/TR (Single) and Model # 32-462 #RMRC-215L R&C W/SN W/2TR (Dual); Cover Model # 32-058.
3. **Meter:** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar:** A.Y. McDonald 5/8" #14-1P; Ford Y501P
5. **Supports:** ¾" vertical standpipes
6. **Inlet Angle Ball Valve:** A.Y. McDonald # 4642BY-22; Ford AV94313WNL

7. **Outlet Ell:** A.Y. McDonald # 4779Y-22 ¾"x 01; Ford L9413NL
8. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE DR-9 (200 psi) minimum.
9. **Corporation Stop:** Mueller ¾" # H-15008N; Ford (3/4") F1000-3; (1") F1000-4
10. **Permanent Blow-off Assembly:** Kupferle TF500 only.
11. **Minimum Depth of cover for watermains shall be 42-inches.**

P. Southern Indiana (Georgetown & Charlestown)

1. **Meter Pit:** 24" long x 20" diameter (single) 24" diameter (dual); 30" diameter. (1" meter).
2. **Meter Pit Ring/Cover and Lid:** Vestal 20" ring Model # 32-424 #RMRC-215L R&C W/SN W/TR (Single) and Model # 32-462 #RMRC-215L R&C W/SN W/2TR (Dual); Cover Model # 32-058.
3. **Meter:** 3/4" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar:** A.Y. McDonald 5/8" #14-2P; Ford Y502P
5. **Supports:** ¾" vertical standpipes
6. **Inlet Angle Ball Valve:** A.Y. McDonald # 4642BY-22; Ford AV94313WNL
7. **Outlet Ell:** A.Y. McDonald # 4779Y-22 ¾"x 01; Ford L9413NL
8. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE DR-9 (200 psi) minimum.
9. **Corporation Stop:** Mueller ¾" # H-15008N; Ford (3/4") F1000-3; (1") F1000-4
10. **Permanent Blow-off Assembly:** Confirm with Local Operations.
11. **Minimum Depth of cover for watermains shall be 42-inches.**

Q. Sullivan

1. **Meter Pit:** 48" long, 20" Diameter (single) 24" Diameter (dual)
2. **Meter Pit Ring/Cover and Lid:** Sigma MB-63DF-LBTH (rim) and MB632CF-LB (lid)
3. **Meter:** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar or Setter:** Ford Meter Box Y501P (3/4") or Y504P (1")
5. **Supports:** ¾" standpipes
6. **Inlet Angle Ball Valve:** Ford AV96-313-W-NL (3/4") or AV96-444-W-NL (1")
7. **Outlet Elbow:** Ford L96-13(3/4") or L96-44 (1")
8. **Service Line Material:** ¾" for short-side individual services, 1" for long-side services and to supply dual meter settings; HDPE SDR-11 (200 psi) minimum **IPS (NOT CTS)**

9. **Corporation Stop:** Confirm with local Operations District

R. Summitville

1. **Meter Pit:** 36" long, 20" Diameter (single- 5/8" meter); 24" Diameter (dual meters, and 1" meters)
2. **Meter Pit Ring/Cover and Lid:** Ford Meter Box W3-T (20" X 11" X 4") or Vestal #RMRC-20L W/SN W/TR
3. **Meter:** 5/8" x 5/8" Furnished and installed by INAWC.
4. **Yoke Bar or Setter:** Ford Meter Box 501P (5/8") or A.Y. McDonald #14-1P
5. **Supports:** ¾" standpipes
6. **Branch Piece (Dual Set Only):** Mueller 1" X ¾" H-15363N-333
7. **Inlet Angle Ball Valve:** Ford Meter Box AV94313 ¾ PJ CTS X 5/8 or A.Y. McDonald # 4642BY-22 ¾" CTS X 5/8
8. **Outlet Fitting:** ¾" X 5/8" yoke outlet – CTS X meter LLB or A.Y McDonald yoke 90# 4779Y-22
9. **Service Line Material:** ¾" for individual services and 1" to supply dual meter settings; PE CTS DR-9 (200 psi) minimum.
10. **Corporation Stop:** Ford Meter Box F1000-3 (3/4") or F1000-4 (1"); or Mueller B-25008N (¾") (CC X CTS)

S. Terre Haute (including Farmersburg)

1. **Meter Pit:** 48" long. xx" Diameter (single) xx" Diameter (dual)
2. **Meter Pit Ring/Cover and Lid:** Sigma MB-63DF-LBTH (rim) and MB632CF-LB (lid)
3. **Meter:** 5/8" x 5/8"" Furnished and installed by INAWC
4. **Yoke Bar:** Ford Meter Box Y501-P (3/4") or Y504-P (1")
5. **Supports:** ¾" standpipes
6. **Inlet Angle Ball Valve:** Ford AV96-313-W-NL (3/4") or AV96-444-W-NL (1")
7. **Outlet Elbow:** Ford L96-13(3/4") or L96-44 (1")
8. **Service Line Material:** ¾" diameter individual services, 1" diameter dual meter settings; HDPE SDR-11 (200 psi) minimum **IPS (NOT CTS)**
9. **Corporation Stop:** (3/4") Ford # F1001-3, (1") Ford # F1000-4.

T. Wabash

1. **Meter Pit:** 36" long, 20" Diameter (single- 5/8" meter); 24" Diameter (dual meters, and 1" meters)
2. **Meter Pit Ring/Cover and Lid:** Ford Meter Box W3-T (20" X 11" X 4")
3. **Meter:** 5/8" Furnished and installed by INAWC.
4. **Yoke Bar or Setter:** Ford Meter Box 501P (5/8") or A.Y. McDonald #14-1P
5. **Supports:** ¾" standpipe

6. **Branch Piece (Dual Set Only):** Mueller 1” X ¾” H-15363N-333
7. **Inlet Angle Ball Valve:** Ford Meter Box AV94313 ¾ PJ CTS X 5/8 or A.Y. McDonald # 4642BY-22 ¾” CTS X 5/8
8. **Outlet Fitting:** ¾” X 5/8” yoke outlet – CTS X meter LLB or A.Y McDonald yoke 90# 4779Y-22
9. **Service Line Material:** ¾” and 1”: PE CTS SDR-9 (200 psi) minimum

   2” diameter: PE CTS or IPS SDR-9.
10. **Corporation Stop:** Ford Meter Box F1000-3 (3/4”) or F1000-4 (1"); or Mueller B-25008N (¾”) (CC X CTS)
11. **Manufactured Meter Pit Setter:**
    a. **1.5” Meter:** Pit: Ford# PMBB-688-36HB-48-SB4-G- Lid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR
    b. **2” Meter:** Pit: Ford# PMBB-788-36HB-48-SB4-G-NL Lid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR

U. Warsaw

1. **Meter Pit:** 36” long, 20” Diameter (single- 5/8” meter); 24” Diameter (dual meters, and 1” meters)
2. **Meter Pit Ring/Cover and Lid:** Ford A3-C-REC463-T
3. **Meter:** 5/8” Furnished and installed by INAWC.
4. **Yoke Bar:** A.Y. McDonald #14-1P (5/8")
5. **Supports:** ¾” (#6) horizontal rebar
6. **Branch Piece (Dual Set Only):** Mueller 1” X ¾” H-15363N-333
7. **Inlet Angle Ball Valve:** A.Y. McDonald # 4642BY-22 ¾” CTS X 5/8
8. **Outlet Fitting:** ¾” X 5/8” yoke outlet CTX X meter LLB, A.Y. McDonald yoke 90 # 4779Y-22
9. **Service Line Material:** PE CTS SDR-9 (200 psi) minimum. 1” diameter to supply single and dual meter settings; 2” diameter: PE CTS or IPS SDR-9. Pipe stiffener inserts shall be stainless steel.
10. **Corporation Stop:** Mueller B-25008N (¾”) (CC X CTS)
11. **Insulator Ring:** 24”
12. **Manufactured Meter Pit Setter:**
    a. **1.5” Meter:** Pit: Ford# PMBB-688-36HB-48-SB4-G-NL Lid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR
    b. **2” Meter:** Pit: Ford# PMBB-788-36HB-48-SB4-G-NL Lid: Ford# MC-36-REC463-T Ring & Lid or Vestal # 32-049 - ER-2036 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR

V. West Lafayette

1. **Meter Pit:** 48” long 20” Diameter (single) 24” Diameter (dual)
2. **Meter Pit Ring/Cover and Lid:** Vestal 20” RMRC-21L W/SN W/TR
3. **Meter:** ¾” x 5/8” Furnished and installed by INAWC.
4. **Yoke Bar:** A.Y. McDonald #14-2P
5. **Supports:** ¾” standpipes
6. **Branch Piece (Dual Set Only):** A.Y. McDonald #08U3m 1x ¾”x 7.5 u-branch.
7. **Inlet Angle Ball Valve:** A.Y. McDonald #4604BY ¾” x ¾” x 02
8. **Outlet Valve:** A.Y. McDonald #4779Y-22 ¾” x 02
9. **Service Line Material:** ¾” for individual services and 1” to supply dual meter settings; PE CTS DR-9 (200 psi) minimum. Pipe stiffener inserts shall be plastic.
10. **Corporation Stop:** Confirm with local Operations District
11. **Curb Ball Valve:** Mueller #E-25009 1x1x1

W. Winchester

1. **Meter Pit:** 48” long. x 20” Diameter (single) 24” Diameter (dual)

2. **Meter Pit Ring/Cover and Lid:** (Single) Vestal # 32-277 - RMRC-215-L W/SN W/RTR Ring & Lid or Ford # A53-REC463-T Ring & Lid. (Dual Set) Vestal # 32-046 - ER-2024 Ring with 32-501 - Monitor Ring & Lid W/SN W/2RTR or Ford # MC-24-REC463-TT Ring & Lid. (1” Set) Vestal # 32-046 - ER-2024 Ring with 32-478 - Monitor Ring & Lid W/SN W/RTR or Ford # MC-24-REC463-T Ring & Lid.

3. **Meter:** 5/8” x 5/8” Furnished and installed by INAWC.
4. **Meter Setter:** A.Y. McDonald 732-107WX2233 (¾”) or 732-410WX2244 (1”).
5. **Meter Idler:** A.Y. McDonald 740MJ05
6. **Supports:** ¾” horizontal cross bar
7. **Service Line Material:** ¾” for individual services and 1” to supply dual meter settings; PE CTS SDR-9 (200 psi) minimum.
8. **Corporation Stop:** Mueller P-15008N (¾”) or P-15108N (1”)

END OF SECTION

SECTION 01075

BASIS OF PAYMENT

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Work to be performed under this Contract shall be paid for in accordance with the Schedule of Prices of the bid. The cost of labor, equipment, materials, tools, and services called for in the Specifications, shown on the Drawings, or necessary for a complete and satisfactory installation, but which are not specifically mentioned in this section shall be included in the appropriate bid item by the Contractor at no additional expense to the Owner**.**

B. Refer to Section 01000 for further information regarding materials to be furnished by the Owner.

C. Where reference is made herein to other section(s) of the Specifications, it shall not be interpreted to exclude sections that are not listed. For each bid item, Contractor shall fully comply with all applicable sections of the Specifications, whether or not individually listed herein.

D. The cost for connections shall be included in the corresponding bid items below. Such cost shall include all required coordination and any overtime, premium time, or other related costs associated with making connections outside of normal working hours when required by the Owner and/or Engineer as specified in this section and Section 15000.

E. Nothing included within this section shall supersede the technical and other requirements of other sections of the Specifications.

1.02 BID (PAYMENT) ITEMS

A. The prices shown in the Schedule of Prices of the Bid include all costs to construct the pipeline(s) under this Contract. Final payment will be made on the in place measurement of length(s) of pipeline(s) installed.

1. General Items
   a. Payment will be made at the Contract Unit Price per lump sum for the General Items Line Charge. The cost of mobilization and any other initial expense required for the start of Work will be included in the item, including but not limited to bonds, pre/post-construction videos and photos, surveying and staking, transporting/handling of Owner-furnished materials, clearing and grubbing (Section 02105), erosion and sedimentation control (Section 02540), and traffic regulation (Section 01570). This item shall include all Record Documents and other closeout items not listed elsewhere herein. The lump sum price bid for Trench Mobilization Line Charge and Closeout is limited to a maximum of 5% of the Total Bid Price.

The lump sum price bid for Handling of Owner Furnished Material is limited to a maximum of 3% of the Total Bid Price. The Work shall consist of the assembling and setting up for the project, including but not limited to the Contractor's general plant, including Contractor's general offices, shops, plants, storage areas, temporary signs, sanitary and any other facilities, as required by Section 01500, Section 01700 and other standard and special requirements of the Contract, as well as by local or State Law and regulation.

b. Initial Payment: Forty percent (40%) of the price bid for General Items Line Charge will be payable to the Contractor whenever the Contractor shall have completed five percent (5%) of the Work of the Contract. For the purposes of this item, five percent (5%) of the Work shall be considered completed based upon the total of payments earned, exclusive of the amount bid for this item and stored materials, as shown on the monthly billing of the approximate quantities of work done.
c. Final Payment: The final sixty (60%) of the price bid for General Items Line Charge will be payable to the Contractor whenever the Contractor completes the following:
    i. Completed all of the Work
    ii. Cleaned up and made final restoration
    iii. Delivered all required documents enumerated in the Specifications including, but not limited to the following:
        1) Required warranties and guarantees
        2) Special bonds
        3) Equipment and material certifications from manufacturer(s)
        4) Certificates from regulating agencies and/or authorities, where applicable
        5) Approved Record Documents
        6) Waiver of Liens
        7) Post-construction video and photos.

2. Pipeline Installation: Excavation, Laying, Jointing, and Backfilling of Pipe
    a. Payment will be made at the Contract Unit Price per linear foot for the size class and installation method (open cut, horizontal directional drill, or pipe bursting) of pipe installed, complete in place, including but not limited to excavation, Foundation Material, bedding, Common Fill embedment, laying, jointing, polyethylene encasement, tracer wire, identification tape, filter fabric (where required), saw cutting of pavement, dewatering, potholing and potholing restoration, Common Fill for backfill, trench dams/plugs (where required), adapters, temporary fittings, anchor collars, solid sleeves, marker posts, etc., all as required by the Owner and necessary to make a complete and satisfactory installation. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures necessary for the construction of the pipeline(s). The minimum width and depth of the pipe trench shall be in accordance with the requirements of Section 02210. All costs to complete the pipeline installation are included in the unit price per linear foot of pipeline, regardless of whether the Contractor uses sloped slides or shoring and sheeting when excavating the pipe trench. Any additional soil borings and other work necessary to design or perform directionally drilled installations are also included in this bid Item. All other items of work not listed in the

Schedule of Prices will be paid for inclusive in this bid item, including, but not limited to, the work required for disinfection of the pipeline.

b. Fitting installation: Payment will be made at the Contract Unit Price for each new fitting, complete in place including blocking or other pipe restraint. Unit price shall include all labor, materials (except where materials are furnished by the Owner), excavation and backfilling, tools, and all incidental work required to install each fitting complete as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation.

3. Casing Installation
   a. Payment will be made at the Contract Unit Price per linear foot of casing installed by any of the methods described in and according to Section 02220 including but not limited to open cut, horizontal directional drilling and jack and bore. Location to be shown on the Drawings or as directed by the Owner. The Contract Unit Price shall include all casing pipe, end seals, casing spacers, insulators as required by Section 02220 or as necessary for a complete and satisfactory installation. In addition, the Contract Unit Price shall include all excavation (soil or rock) de-watering, jacking, ramming, drilling or boring (rock or soil), backfilling, installation of end caps, sheeting, bracing, shoring, temporary construction, safety measures, etc., all as necessary excluding restoration for a complete and satisfactory installation. Restoration will be paid by the respective Restoration Pay on a square yard basis as indicated on the Drawings. Installation of the water main in the casing will be made at the Contract Unit Price per linear foot of pipe installed. The casing Contract Unit Price will also include all measures required to protect roadways, railroad tracks and embankments from settlement or damage of any type.
4. Tapping Sleeve & Valve
   a. Payment will be made at the Contract Unit Price per each for the size of tapping sleeve and valve to be installed, complete in place, as required by the Owner.
   b. Contract Unit price shall include all labor, materials (except where materials are furnished by the Owner), excavating and backfilling, tools, and all incidental work required to install the tapping sleeve and valve complete as shown on the Drawings, excluding surface restoration. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures necessary for the installation of the tapping sleeve and valve. Contractor shall furnish Owner with the removed tapping “coupon”.
   c. Restoration will be paid by the respective Restoration bid item(s) separately on a square yard basis. Contractor will be paid for restoration of an area no larger than 6 feet by 6 feet (4 square yards) for all tapping sleeves without prior authorization from Owner.
5. Gate Valve and Butterfly Valve Installation
   a. Payment will be made at the Contract Unit Price for each new valve (excluding hydrant valve in item 16) in accordance with Section 15150 or 15155, complete in place, including valve box and extension stem (when

required) per Section 15130. Ball valves for small diameter water mains will also be included in this item in accordance with Section 15200. Unit price shall include all labor, materials (except where materials are furnished by the Owner), excavation backfilling and restoration, tools, and all incidental work required to install each valve complete as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation.

6. Valve Replacement
   a. Payment will be made at the Contract Unit Price for each replacement valve (excluding hydrant valve in item 16) in accordance with Section 15185 and Section 15150 or 15155, complete in place, including new valve box and extension stem (when required) per Section 15130. Unit price shall include all labor, materials (except where materials are furnished by the Owner), excavation, backfilling and restoration, tools, and all incidental work required to install each valve complete as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation, including removal of old pipe and/or valve to accommodate replacement valve.

7. Fire Hydrant Installation
   a. Complete in place: Payment will be made at the Contract Unit Price for each fire hydrant installation in accordance with Section 15180. The unit price shall include all costs to install any materials furnished by Owner as well as Contractor-furnished material. The Contract Unit Price will include excavation, backfill, furnishing of material (except where furnished by Owner), and installation of fire hydrant, watch valve, valve box, piping, reaction blocking, crushed stone, and all restoration etc., all as required by the Specifications, Owner's Standard Detail Drawings or as necessary to make a complete and satisfactory installation.

8. Air Valve
   a. Payment will be made at the Contract Unit Price for each air release valve assembly installed, complete in place. Unit price shall include all labor; materials (except where materials are furnished by the Owner); excavation, backfilling and restoration; tools; furnishing and installing manhole frames and covers; ladders; painting; furnishing, installing and testing of all piping, valves, air valves, fittings, vent piping, small piping and piping appurtenances; and all incidental work required to construct each structure complete as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation in accordance with Section 15190.

9. Permanent Blow Off Assembly
   a. Payment will be made for each blow-off assembly at the Contract Unit Price for Blow-off Assembly, complete in place in accordance with Section 15190. Unit price shall include all labor, materials (except where materials are furnished by the Owner), excavation, backfilling and restoration, tools, and all incidental work required to construct each blow off assembly complete as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation.

10. Shut Down and Tie-In
    a. Payment will be made at the Contract Unit Price per each for the size of existing mains shut down and tie-in to be installed, complete in place, as required by the Owner.
    b. Contractor shall perform tie-in (unless otherwise indicated on the Drawings). Contract unit price shall include all labor, materials (except where materials are furnished by Owner), excavation and backfilling, tools, and all incidental work required to install the shut down and tie-in complete as shown on the Drawings, excluding surface restoration. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures necessary for the installation of the shut down and tie-in(s). The Owner will operate all valves necessary to shut off and reactivate its pipelines.
    c. Restoration will be paid by the respective Restoration bid item(s) separately on a square yard basis. Contractor will be paid restoration of an area no larger than 6 feet by 6 feet (4 square yards) for each shut down and tie-in without prior authorization from Owner.

11. Shut Down, Cut and Cap
    a. Payment will be made at the Contract Unit Price per each for the size of shut down, cut and cap and line stop to be installed, complete in place, as required by the Owner.
    b. Contractor shall perform cut and cap unless otherwise indicated on the Drawings. Contract unit price shall include all labor, materials (except where materials are furnished by Owner), excavation and backfilling, tools, and all incidental work required to install the shutdown, cut and cap complete as shown on the Drawings excluding surface restoration. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures necessary for the installation of the shutdown, cut and cap(s). The Owner will operate all valves necessary to shut off and reactivate its pipelines.
    c. Contractor shall perform line stop (except as noted in Section 01011 or the Drawings). The Contractor unit price shall include all labor, materials (expect where materials are furnished by Owner), excavation and backfilling, tools, and all incidental work required to install the line stop complete as shown on the Drawings excluding surface restoration. The Contractor shall be solely responsible for the means, methods, techniques, sequences and procedures necessary for the installation of the line stop.
    d. Restoration will be paid by the respective Restoration bid item(s) separately on a square yard basis. Contractor will be paid restoration of an area no larger than 6 feet by 6 feet (4 square yards) for each shut down and cut and cap location and for each line stop location without prior authorization from Owner.

12. Rock Excavation
    a. Payment will be made at the Contract Unit Price per vertical foot of depth per linear foot of trench. No payment will be made for excavation made outside the limits described in Section 02210. Unit Price includes removal, hauling, bedding and embedment material, and proper disposal of all material. Rock is defined as per Section 02210.

13. Select Fill
    a. Payment will be made at the Contract Unit Price per linear foot of specified type of select fill for embedment and final backfill. This bid item also includes the removal, hauling and proper disposal of all excavated material. No payment will be made for select fill needed outside the maximum normal trench width as described in Section 02210. If for any reason the trench width exceeds the maximum trench width defined in Section 02210, the Contractor shall provide the additional select fill for embedment and final backfill at no cost to the Owner as described in Section 02210.

14. Flowable Fill
    a. Payment will be made at the Contract Unit Price per linear foot of flowable fill in place where required. This bid item also includes the removal, hauling and proper disposal of all excavated material. No payment will be made for flowable fill needed outside the maximum normal trench width as described in Section 02210. If for any reason the trench width exceeds the defined maximum trench width, the Contractor shall provide the additional flowable fill for backfilling at no cost to the Owner as described in Section 02210.

15. Extra Trench Depth
    a. When directed by the Engineer/Owner or otherwise required to install the pipe deeper than the depth shown on the Drawings or specified, and as approved in advance by the Resident Project Representative, payment will be made at the Contract Unit Price per additional vertical foot of depth below the designed trench depth per linear foot of trench. Trench depth to be in accordance with the requirements of Section 02210. Quantities will be determined by Resident Project Representative.

16. Exploratory Excavation
    a. Payment will be made at the Contract Unit Price per cubic yard of material excavated as authorized or directed by the Owner for exploratory excavations not otherwise required by the Drawings or Specifications. Payment will only be made when the excavation and the location have been approved by the Owner as additional Work, and inclusion of this bid item does not relieve the Contractor of its obligation to perform potholing and other exploratory excavations as required by other sections of the Specifications at no additional cost to the Owner. The unit price will include all materials, equipment and labor necessary for the excavation and backfilling and/or proper disposal of the excavated material. Specific restoration materials will be paid for under the appropriate bid item (e.g., concrete work, paving, etc.).

17. Dewatering
    a. No additional payment shall be made for dewatering in accordance with Section 02020, including any necessary traffic warning systems or any work necessary to restore the site to its original condition, including any damaged facilities.

18. Concrete Sidewalks & Drives and Gravel Drives
    a. Payment for concrete sidewalk and driveway restoration associated with pipe line installation will be made at the Contract Unit Price per linear foot of sidewalk or driveway installed or as required by state, municipal, or other

local authorities. The unit price shall include stone bedding, concrete, and finishing, including restoration of surrounding surfaces, complete in place conforming to the requirements of Section 03310 and/or any state, municipal, or other local requirements that may apply.

b. Payment for concrete sidewalk and driveway restoration associated with tapping sleeves and valves, tie-ins, cut and caps, access pits (for pipe bursting, horizontal directional drilling, and jack and bore) will be made at the Contract Unit Price per square yard of sidewalk or driveway installed, width to be as shown on drawing or as required by the state, municipal, or other local authorities. The unit price shall include stone bedding, concrete, and finishing, complete in place conforming to the requirements of Section 03310 and/or any state, municipal, or other local requirements that may apply.
c. Handicap Ramps will be made at the contract unit price for each handicap ramp installed. The unit price shall include stone bedding, concrete, and finishing, complete in place conforming to the requirements of Section 03310 and/or any state, municipal, or other local requirements that may apply.
d. Payment for gravel driveway restoration associated with pipe line installation will be made at the Contract Unit Price per linear foot of driveway installed or as required by the state, municipal, or other local authorities. The unit price shall include stone bedding and finishing, complete in place conforming to the requirements of Section 02620 and any state, municipal, or other local requirements that may apply.
e. No separate payment will be made for any concrete thrust and reaction blocking. All concrete blocking for pipeline installation is to be included in bid item Pipeline Excavation, Laying, Jointing and Backfilling of Pipe.

19. Curb Replacement
    a. Payment will be made at the Contract Unit Price per linear foot for the type of curbing installed. The unit price shall include excavation, stone bedding, concrete and finishing, backfilling, complete in place and conforming to the requirements of Section 03310 and/or any state, municipal, or other local requirements that may apply.

20. Temporary Asphaltic Paving
    a. Payment for temporary asphaltic pavement associated with pipeline installation will be made at the Contract Unit Price per linear foot of temporary paved trench, where required or directed by the Owner. The contract price shall include the furnishing and installation of temporary bituminous material in accordance with Section 02610, Part 3.01, or as otherwise required by Federal, State or Local Authorities. The Owner may choose to include cost of temporary asphalt in pipe installation cost if so noted in Section 01011.
    b. Payment for temporary asphaltic pavement restoration associated with tapping sleeves and valves, tie-ins, cut and caps, access pits (for pipe bursting, horizontal directional drilling, and jack and bore) will be made at the Contract Unit Price per square yard of area permanently paved as required. The contract price will include the furnishing and installation of permanent pavement material in accordance with Section 02610 or as otherwise required by Federal, State or Local Authorities. The bid item includes wearing course and line painting. The Owner may choose to

include cost of temporary asphalt in pipe installation cost if so noted in Section 01011.

21. Permanent Pavement Restoration
    a. Payment for permanent pavement restoration associated with pipeline installation will be made at the Contract Unit Price per linear foot of trench permanently paved as required. The contract price will include the furnishing and installation of permanent pavement material in accordance with Section 02610 or as otherwise required by Federal, State or Local Authorities. This bid item includes wearing course and line painting.
    b. Payment for permanent pavement restoration associated with tapping sleeves and valves, tie-ins, cut and caps, access pits (for pipe bursting, horizontal directional drilling, and jack and bore) will be made at the Contract Unit Price per square yard of area permanently paved as required. The contract price will include the furnishing and installation of permanent pavement material in accordance with Section 02610 or as otherwise required by Federal, State or Local Authorities. The Bid item includes wearing course and line painting.

22. Pavement Overlay – Outside of normal trench width
    a. Overlay Only: Payment will be made at the Contract Unit Price per square yard of pavement overlay. The contract price will include preparing the existing surface (as required) and the furnishing and installation of a minimum of 1 ½" paving material (unless a greater depth is required or specified). Materials and installation will be in accordance with Section 02610 or as otherwise required by Federal, State or Local Authorities. Restoration over pipeline trench line is not included in this bid item.
    b. Mobilization for Milling: Payment will be made at the Contract Unit Price lump sum Mobilization for milling. The contract price will include bringing equipment to the work site in preparation to perform milling operations and maintaining such equipment on-site on a standby basis as needed to support the Work.
    c. Milling and Overlay: Payment will be made at the Contract Unit Price per square yard of overlay. The contract price will include preparing, milling grinding of the existing surface and the furnishing and installation of a minimum of 1 ½" paving material (unless a greater depth is required or specified). Materials and installation will be in accordance with Section 02610 or as otherwise required by Federal, State or Local Authorities. Restoration over pipeline trench line is not included in this bid item.

23. Topsoil and Seed
    a. Payment for topsoil and seed associated with pipeline installation will be made at the Contract Unit Price per linear foot topsoil and seed (as measured along the pipe centerline), complete in place, all in accordance with the requirements of Section 02820. Unit price shall include all labor, materials, raking and grading, tools, and all incidental work required to install topsoil, seed, and straw matting (see Section 02820) as shown on the Drawings and as specified.
    b. Payment for topsoil and seed associated with exploratory excavations, tapping sleeves and valves, tie-ins, cut and caps, access pits (for pipe bursting, horizontal directional drilling, and jack and bore) will be made at the Contract Unit Price per square yard of topsoil and seed, complete in

place, all in accordance with the requirements of Section 02820. Unit price shall include all labor, materials, raking and grading, tools, and all incidental work required to install topsoil, seed, and straw matting (see Section 02820) as shown on the Drawings and as specified. The allowable width shall be defined as the nominal trench width plus fifteen feet where top soil, seed and straw matter are required. Trench width shall be as described in Section 02210.

24. Sod – New and Replace
    a. Payment for sod associated with pipeline installation will be made at the Contract Unit Price per linear foot of sod (as measured along the pipe centerline), complete in place, all in accordance with the requirements of Section 02820. Unit price shall include all labor, materials, raking and grading, tools, and all incidental work required to install sod as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation.
    b. Payment for sod associated with exploratory excavations, tapping sleeves and valves, tie-ins, cut and caps, access pits (for pipe bursting, horizontal directional drilling, and jack and bore) will be made at the Contract Unit Price per square yard of sod, complete in place, all in accordance with the requirements of Section 02820. Unit price shall include all labor, materials, raking and grading, tools, and all incidental work required to install sod as shown on the Drawings, as specified and necessary to make a complete and satisfactory installation. The square yards allowed shall be defined as the nominal trench width plus fifteen feet, times the appropriate length of the trench where top soil and sod are required. Trench width shall be as described in Section 02210.

25. Transfer Existing Small Diameter Services (¾" – 1"), install New Small Diameter Services (¾" – 1"), and Meter Pit Installations
    a. Payment will be made at the Contract Unit Price for the installation of each of the following:
        i. Service Transfers New and Renewal: Service transfers include installation of corporation, and connection of existing service line shall be either union or length of pipe and union.
        ii. Short Side Service Line, New or Renewal: Short side service lines, new or renewal, include complete installation of service line from corporation to curb stop or meter pit and connection or re-connection of customers' line on outlet side of curb stop or customer's side of meter pit. This includes each service whose length is less than half (½) the improved road width.
        iii. Long Side Service Line, New or Renewal: Long side service lines, new or renewal, include complete installation of service line from corporation to curb stop or meter pit and connection or re-connection of customers' line on outlet side of curb stop or customer's side of meter pit. This includes each service whose length equals or exceeds half (½) of the improved road width.
    b. All of the above include complete installation in place including permanent restoration. Meter pits and/or Curb Stops will normally be installed in the tree space or at the property line. All installations shall be in accordance with Section 15200. Payment will be made under only one bid item per service.

c. Meter Pit Replacement in Landscaping: Includes complete installation of meter pit, service brass (requirements to be provided by each local operation), and specified meter pit lid. Also includes labor required to install pit and reconnection to customer service line and all restoration within a landscaped area.
d. Meter Pit Replacement in Concrete: Includes complete installation of meter pit, service brass (requirements to be provided by each local operation), and specified meter pit lid. Also includes labor required to install pit and reconnection to customer service line and all restoration within a concrete sidewalk or driveway.

26. Transfer Existing Large Diameter Services (2" and larger), install New Large Diameter Services (2" and larger), and Meter Chamber Installations
    a. Payment will be made at the Contract Unit Price for the installation of each of the following:
        i. Service Transfers New and Renewal: Service transfers include installation of corporation, and connection of existing service line shall be either union or length of pipe and union.
        ii. Short Side Service Line, New or Renewal: Short side service lines, new or renewal, include complete installation of service line from corporation to curb stop and connection or re-connection of customers' line on outlet side of curb stop. This includes each service whose length is less than half (½) of the improved road width.
        iii. Long Side Service Line, New or Renewal: Long side service liens, new or renewal, include complete installation of service line from corporation to curb stop and connection or re-connection of customers' line on outlet side of curb stop. This includes each service whose length equals or exceeds half (½) of the improved road width.
    b. All of the above include complete installation in place including permanent restoration. Curb stops will normally be installed in the tree space or at the property line. All installations shall be in accordance with Section 15200 and/or 15125 unless otherwise shown on the Drawings or directed by the Engineer. Payment will be made under only one bid item per service.

27. Service Retirement
    a. The unit price specified to be paid for the performance of this item shall be per each complete water service abandoned and removed and shall include all material, labor, and equipment to retire each service in accordance with Section 15185. Performance of this item shall include but is not limited to excavation, hauling, backfill, removal of old valve box, street / curb / driveway / sidewalk restoration, site restoration, and all other items necessary for a complete retirement of each service as specified and required by the Owner.
    b. Meter Pit Retirement in Landscaping: The unit price specified to be paid for the performance of this item shall include all material, labor, and equipment to retire each meter pit located within a landscaped area. Performance of this item shall include but is not limited to excavation, hauling, backfill, remove meter pit, site restoration, and all other items necessary for a complete retirement.
    c. Meter Pit Retirement in Concrete: The unit price specified to be paid for the performance of this item shall include all material, labor, and equipment to retire each meter pit located within a concrete sidewalk or concrete

driveway. Performance of this item shall include but is not limited to excavation, hauling, remove meter pit lid, site restoration and all other items necessary for a complete retirement.

28. Fire Hydrant Retirement
    a. Payment will be made at the Contract Unit Price for each existing fire hydrant retirement, which includes watch valve retirement and watch valve box removal. The unit price shall include all labor, materials, excavation backfilling and restoration, tools, hauling, removal, restoration, and all incidental work required to disconnect the existing fire hydrant.

29. Valve Retirement
    a. In Asphalt: The unit price specified to be paid for the performance of this item per each valve abandoned and valve box removal shall include all material, labor, and equipment to retire each valve located within an asphalt area in accordance with Section 15185. Performance of this item shall include but is not limited to excavation, hauling, remove valve box, backfill, road restoration, and all other items necessary for a complete retirement of each valve.
    b. In Concrete: The unit price specified to be paid for the performance of this item per each valve abandoned and valve box removal shall include all material, labor, and equipment to retire each valve located within a concrete area in accordance with Section 15185. Performance of this item shall include but is not limited to excavation, hauling, remove valve box, backfill, and all other items necessary for a complete retirement of each valve
    c. In Landscaping: The unit price specified to be paid for the performance of this item per each valve abandoned and valve box removal shall include all material, labor, and equipment to retire each valve located within a landscaped area in accordance with Section 15185. Performance of this item shall include but is not limited to excavation, hauling, remove valve box, and all other items necessary for a complete retirement of each valve

B. Where the following acronyms are used on the Schedule of Prices or elsewhere in these Specifications, they shall be defined as follows:

    1. OFCI = Owner Furnished Contractor Installed (materials or equipment to be furnished by the Owner but installed by the Contractor)
    2. CFCI = Contractor Furnished Contractor Installed (materials or equipment to be furnished and installed by the Contractor)

C. Where neither acronym is indicated for a particular bid item, refer to this section, Section 01000 and Section 01011 for clarification.

PART 2: PRODUCTS

Not Used

PART 3: EXECUTION

Not Used

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. Contractor shall prepare and submit detailed Progress Schedule, Cash Flow Schedule, Schedule of Values, Pre-Construction Video(s) and photos, Shop Drawings to the Engineer for approval in accordance with Article 2 Sections 2.05 and 2.07 of the General Conditions. Work shall not commence until these submittals have been approved by the Engineer except as otherwise authorized in writing by the Owner or Engineer.

B. Schedule of Values shall be in accordance with Standard General Conditions of the Construction Contract.

C. Contractor shall update schedules and submit Contractor's Daily Reports, progress payment requests, and other required information throughout the Work as required herein or elsewhere in the Contract Documents.

D. As-built drawings and related information shall be maintained and submitted as required herein and in Section 01700.

1.02 CONSTRUCTION PROGRESS SCHEDULE

A. A Progress Schedule shall be submitted by the Contractor in a Gantt chart / bar graph format and shall include, as a minimum, a graphic representation of all significant activities and events involved in the construction of the project. The graphic representation and statement must clearly depict and describe the sequence of activities planned by the Contractor, their interdependence and the times estimated to perform each activity**.** Develop the Progress Schedule as necessary to properly control and manage the project.

1.03 CASH FLOW SCHEDULE

A. In addition to the Progress Schedule required above, submit to the Engineer, for approval, a Cash Flow Schedule. The Cash Flow Schedule shall show the amounts of money by months, which will be required to reimburse the Contractor for Work performed during each month of the Contract Time. The sum of all the monthly cash requirements shall equal the total price of the Contract. The monthly cash requirements shall be proportioned with the aid of the Progress Schedule.

B. The approved Cash Flow Schedule will be used by the Owner to program funds for progress payments to the Contractor. Monthly payments will be made to the Contractor in accordance with the Contract Agreement, but at no time will the aggregate amount of payments exceed the accumulated amount of payments for the same period of the Cash Flow Schedule.

1.04 FINALIZING SCHEDULES

A. Contractor shall present and be prepared to discuss at the preconstruction meeting the schedules submitted in accordance with this section. Unless additional information is required to be submitted by the Contractor, the Engineer will, within 15 working days of the preconstruction conference (or within 15 working days of receipt of the schedules or additional required information, whichever is later), provide comments to the Contractor. Contractor shall then resubmit the affected schedules addressing the Engineer's comments.

B. Approval of the final schedules by the Engineer or Owner is advisory only and shall not relieve the Contractor of responsibility for accomplishing the Work within the Contract Times. Omissions and errors in the approved schedule shall not excuse performance less than that required by the Contract. Approval by the Engineer or Owner in no way makes the Engineer or Owner an insurer of the success of those schedules or liable for time or cost overruns flowing from shortcomings in such schedules.

1.05 UPDATING SCHEDULES

A. Contractor shall submit to the Engineer and Owner monthly updates of the schedules required per this section.

B. The Cash Flow Schedule shall be updated to reflect actual progress to date and any other changes.

1.06 ADJUSTMENT OF PROGRESS SCHEDULE AND CONTRACT TIMES

A. Shop Drawings which are not approved on the first submittal or within the scheduled time shall be immediately rescheduled, as well as any work which fails to pass specified tests or has been rejected. When impacted, other scheduled activities shall be rescheduled accordingly.

B. If the Contractor desires to make changes in the method of operating that affect the approved Progress Schedule, notify the Engineer and Owner in writing stating what changes are proposed and the reason(s) for the changes. If the Engineer or Owner approves these changes, revise and submit for approval, without additional cost to the Owner, all of the affected portions of the schedule.

C. The Contract Times will be adjusted only for causes specified in the General Conditions. In the event the Contractor requests an adjustment of the Contract Times, furnish such justification and supporting evidence as the Engineer may deem necessary for a determination as to whether the Contractor is entitled to an adjustment of Contract Times under the provisions of the General Conditions. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing. If the Engineer finds that the Contractor is entitled to any adjustment of the Contract Times, the Engineer's determination as to the total number of days adjustment shall be based upon the currently-approved Progress Schedule and on all data relevant to the adjustment. The Contractor acknowledges and agrees that actual delays in activities which,

according to the Progress Schedule, do not affect the Contract completion date shown by the critical path in the schedule will not be the basis for an adjustment of Contract Times.

D. From time to time it may be necessary for the Progress Schedule and/or Contract Times to be adjusted by the Owner to reflect the effects of job conditions, weather, technical difficulties, strikes, unavoidable delays on the part of the Owner, and other unforeseeable conditions that may indicate schedule and/or Contract Times adjustments. Under such conditions, the Engineer shall direct the Contractor to reschedule the Work and/or Contract Time to reflect the changed conditions. Revise the Progress Schedule accordingly. No additional compensation shall be made to the Contractor for such changes except as provided in the General Conditions. Unless otherwise directed, take all possible actions to minimize any extension to the Contract Times and any additional cost to the Owner.

1.07 REQUIREMENTS FOR CONFORMING TO SCHEDULE

A. If, in the opinion of the Engineer, the Contractor falls behind the Progress Schedule, Contractor shall take such steps as will be necessary to improve progress and ensure Work is accomplished within the Contract Times. Engineer may require Contractor to increase the number of shifts and/or overtime operations, days of work, and/or the amount of construction planned (daily or weekly), and to submit for approval such supplementary schedule or schedules as the Engineer deems necessary to demonstrate the manner in which the agreed rate of progress will be regained—all without additional cost to the Owner. An updated Cash Flow Schedule will be required in this occurrence and will be provided with the supplementary schedules referenced above.

1.08 MONTHLY VALUE OF WORK (VOW)

A. Contractor shall submit monthly VOW to Owner's project manager with approval from Resident Project Representative no later than the date requested by the Owner's staff. Contractor shall project totals for any days remaining in month.

B. Monthly VOW shall include any stored material, if applicable, and any lump sum line items for that month.

C. Monthly VOW shall also include any related restoration for the work performed that month.

D. Owner reserves the right to require VOW to be submitted weekly if the above requirements have not been followed for existing or previous month(s).

1.09 SHOP DRAWINGS

A. Prior to mobilizing to the Work site or otherwise beginning Work, Contractor shall promptly submit to the Engineer for review and approval Shop Drawings with manufacturers' literature and product data, certifications, details, and other required information for all equipment and materials to be provided or furnished by

the Contractor, as well as other required submittals as required by the Contract Documents and/or required by the Engineer. Shop Drawings shall be provided in compliance with all requirements indicated on the Drawings and in the following sections of the Specifications:

1. Section 01570 Traffic Regulation
2. Section 01600 Products
3. Section 01700 Project Closeout
4. Section 02020 Dewatering
5. Section 02210 Trenching, Backfilling and Compacting
6. Section 02220 Casing Installation
7. Section 02350 Pipe Bursting of Water Mains
8. Section 02458 Horizontal Directional Drilling (HDD)
9. Section 02540 Erosion and Sedimentation Control
10. Section 02558 Identification/Location Guide
11. Section 02610 Roadway Paving and Surfacing
12. Section 02820 Lawn Restoration and Landscaping
13. Section 03305 Cast-In-Place Concrete for Pipe Work
14. Section 03310 Cast-In-Place Concrete for Paving, Driveways, Sidewalks, Curbs and Paved Ditches
15. Section 03450 Precast Concrete Structures
16. Section 15000 Piping – General Provisions
17. Section 15020 Disinfecting Pipelines
18. Section 15025 Flushing and Cleaning Pipelines
19. Section 15030 Pressure and Leakage Tests
20. Section 15105 Ductile Iron Pipe and Fittings
21. Section 15120 Polyvinyl Chloride (PVC) Pipe
22. Section 15125 High Density Polyethylene (HDPE) Pipe
23. Section 15130 Piping Specialties
24. Section 15150 Gate Valves
25. Section 15155 Butterfly Valves
26. Section 15180 Fire Hydrants
27. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps
28. Section 15200 Service Lines

B. Contractor shall submit all Shop Drawings electronically in portable document format (.pdf) or other format acceptable to the Engineer.

C. If requested by the Owner or Engineer, Contractor shall also provide one (1) hard copy, which shall be stapled or 3-ring bound. Submittals smaller than 8-1/2 by 11 inches shall be secured to paper 8-1/2 by 11 inches. Submittals larger than 8-1/2 by 11 inches shall be neatly folded to fit within a 9 by 11-1/2 inch folder.

1.10 PRE-CONSTRUCTION & POST CONSTRUCTION VIDEO/ELECTRONIC PHOTOS

A. Prior to mobilization at the site, provide to the Engineer on DVD a video recording of all planned construction areas, material storage areas, areas adjacent to these areas, including but not limited to streets, driveways, sidewalks, curbs, ditches, fencing, railing, visible utilities, retaining structures and adjacent building structures. The purpose of the video is to document existing conditions and to provide a fair measure of required restoration. The video shall incorporate all surrounding areas that could be impacted by construction activities. Care shall be taken to record all existing conditions which exhibit deterioration, imperfections, structural failures or situations that would be considered substandard.

B. Where necessary to adequately document pre-construction conditions and/or where required by Engineer, electronic photographs of specific locations shall be provided to supplement the electronic video.

C. Following Final Completion upon authorization by the Engineer or Owner, Contractor shall provide to the Engineer on DVD a video recording of all areas impacted by the Work, including storage areas, and all adjacent areas, showing the same details as required for pre-construction videos. The purpose of this video is to document conditions upon completion of the Work in order to establish if subsequent claims are related to the Work or circumstances unrelated to the Work.

D. The videos shall be high quality, color and in an approved electronic format. Temporary lighting shall be provided as necessary to properly video areas where natural lighting is insufficient (indoors, shadows, etc.). The videos shall include audio soundtrack to provide the following information:

1. Detailed description of location being viewed referenced to Contract Drawings (i.e., well location, building designation, pipeline route, etc.);
2. Direction (N, S, E, W, looking up, looking down, etc.) of camera view;
3. Date, time, temperature, and environmental conditions during recording.
4. Any areas not visible by video/photo methods shall be described in detail.

E. Unless otherwise approved by Engineer, videos shall not be performed during inclement weather or when the ground is covered partially or totally with snow, ice, leaves, etc.

F. Contractor shall submit one copy of the original documents to the Engineer accompanied by a detailed log of the contents of each DVD. The log shall include location descriptions with corresponding file name to facilitate the quick location of information contained on the DVDs. The DVDs will be maintained by the Engineer during construction and may be viewed at any time by Contractor upon request.

Upon final acceptance, the DVDs will become the permanent property of the Owner.

G. Approval of the pre-/post-construction videos/photos by the Engineer and/or Owner is advisory only and shall not relieve the Contractor of responsibility for complying with the requirements of this section. Failure of the Contractor to adequately document pre-construction conditions shall not result in any additional costs to the Owner. Approval by the Engineer in no way makes the Owner or Engineer liable for additional costs resulting from shortcomings in such documentation. In the event that the pre-construction videos and photos fail to adequately document pre-existing conditions, the Contractor shall be responsible for restoring all affected areas to the satisfaction of the property owner or agency with jurisdiction at no additional cost to the Owner.

H. In the event of claims by property owners regarding damages or loss potentially related to the Work, whether received during or after construction, the videos shall be used to verify the property owner's claims.

1. If the videos and photos clearly show the area in question and substantiate the property owner's claim, the Contractor will be responsible for satisfactorily resolving the claim (including payment of any damages) and restoring conditions to the pre-Work conditions within the terms of the Contract Documents.

2. If the videos and/or photos clearly show the area in question and fail to justify the claim, the claim will be denied by the Owner.

3. If the area in question is not included in the pre-construction video or insufficient detail is shown to evaluate the property owner's claim, the Owner and Contractor will review the claim in light of other available documentation.

4. If the pre-construction video and/or photos clearly show the area in question but the post-construction video and photos do not show the area in question or fail to establish the condition upon completion of the Work, the Contractor will be responsible for satisfactorily resolving the claim (including payment of any damages) and restoring conditions to the pre-Work conditions within the terms of the Contract Documents.

5. If the Owner feels that the area in question should have been shown in the pre-construction video, the Contractor will be responsible for satisfactorily resolving the property owner's claim (including payment of any damages) and restoring conditions to the pre-Work conditions within the terms of the Contract Documents.

1.11 PROGRESS PAYMENTS

A. The detailed arrangement for submittal of progress payments shall be discussed at the preconstruction meeting. In general, progress payments shall be submitted monthly in a format acceptable to the Engineer. The progress payment request shall be based on the unit prices and should provide the percentage of completion, total dollar value completed, dollar value completed prior to the current payment,

and the amount requested for this progress payment for each line item contained in the schedule of values. Progress payment requests for material and/or equipment suitably stored but not yet incorporated into the Work shall be accompanied by a copy of the appropriate manufacturer's invoice, shipping order, bill of lading, etc.; and the progress payment amount shall be the direct cost to the Contractor, or Subcontractor, for such material and/or equipment. Payment will not be made to the Contractor if, upon inspection by the Engineer, it is determined that the material and/or equipment does not conform to the requirements of the Contract Documents including proper storage, receipt of approved Shop Drawings, receipt of any special guarantees, Bonds, insurance coverage, any evidence of damage or imperfections, etc.

B. Contractor shall submit pay application for previous month to Resident Project Representative for review and approval prior to submittal to Owner.

C. Contractor shall send an electronic copy of the approved pay application to the Owner's project manager and Resident Project Representative by the 5th day of the month.

D. Pay application should include the following items:

1. Contractor Invoice Cover Sheet
2. Project Summary Sheet signed by the Contractor, the Resident Project Representative on the project and the INAWC Project Manager.
3. VOW spreadsheet with all final quantities for the month

1.12 CONTRACTOR'S DAILY REPORTS

A. The Contractor shall complete daily reports containing at least the following information:

1. A description of daily work activities performed, including but not limited to:
   a. size and quantity of main installed,
   b. size and quantity of fittings, valves, and hydrants installed,
   c. quantity of granular fill installed,
   d. description and quantity of other equipment and materials installed,
2. Description and quantity of underground obstructions encountered;
3. A description of daily material or equipment deliveries;
4. The temperature and weather conditions;
5. The names and number of hours worked by each trade (General Contractor);
6. The number of craftsmen and hours worked by each Subcontractor;
7. The number of hours worked by each type of equipment;
8. Downtime due to equipment failure;
9. Detailed description of issues that may cause the Contractor to incur delays, including quantity and types of issues.

B. The daily reports shall be available upon request from Owner.

C. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents. Notice shall be as required therein.

1.13 PROJECT RECORD DOCUMENTS (BY CONTRACTOR)

A. The Contractor shall complete and maintain on-site one set of the following Record Documents, which shall record all actual revisions to the Work concurrent with construction progress and shall be available upon request (during working hours or on the next business day) by the Owner, Engineer or Resident Project Representative.

1. Drawings;
2. Specifications;
3. Addenda;
4. Change orders and other modifications to the Contract;
5. Approved Shop Drawings and other submittals;
6. Field sketches.

B. The Record Documents shall be updated daily (red-line markups). The Owner reserves the right to stop Work at Contractor's expense until red-line markups are up to date. Red-line markups shall contain but are not limited to the following information.

C. Store Record Documents separate from documents used for construction.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. manufacturer's name and product model and number,
2. product substitutions or alternates utilized,
3. changes made by addenda and modifications.

E. Record Drawings, Documents and Shop Drawings: Legibly mark each item to record actual construction including:

1. Original Drawings with Red-Line markings including measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements as stated in Section 01300 Submittals.
2. Field changes of dimension and detail
3. Pipe restrained joint lengths
4. Actual fitting and valve locations with horizontal dimensions measured from permanent structures.

5. Depths that exceed the minimum cover
6. Details not on original Drawings.
7. Pre and Post Construction videos
8. Electronic photographs
9. Others as required in other sections of the Specifications.

F. Submit documents to Engineer with final Application for Payment.

G. The Owner will issue a notice of Final Completion to the Contractor when the Work is in-service and up-to-date Record Documents have been provided by the Contractor.

1.14 GPS DATA COLLECTION BY RESIDENT PROJECT REPRESENTATIVE

A. Resident Project Representative shall collect GPS points, prepare record cards, and hand-drawings of field changes. GPS points shall be collected at all locations identified below on a daily basis:

1. water mains
2. depths varying 6-inches greater than minimum/maximum cover shown on the Drawings,
3. valves,
4. hydrants,
5. fittings,
6. corporation stops,
7. meter pits,
8. service lines

B. In addition to coordinates, each point shall include the attributes required on the digital collection method (using standard terminology submitted to and approved by the Owner) at a minimum:

1. fittings
2. valves
3. hydrants
4. main
5. others as required by the Owner

C. Resident Project Representative may choose to use equipment provided and configured by the Owner or may purchase equipment of equal or better specification to be configured in conjunction with the Owner for purposes of GPS data collection. All data from such collection will be processed and stored by the Owner.

D. Contractor shall assist and coordinate with Resident Project Representative in the collection of GPS points. Contractor shall provide safe access as needed and

adequate supplemental information for Resident Project Representative to document this information.

E. In the event RPR is unable to be on site, Contractor shall provide provisions such as vertical riser pipe to allow collection of the GPS data for any areas requiring backfill prior to collection of the GPS data. Unless otherwise directed by the Resident Project Representative, vertical riser pipes must be installed at each fitting and at every 50' to allow measure down to the pipe as well as collection of the GPS point. Riser pipes must be removed, backfilled and the surface restored following their removal.

1.15 RED-LINE DRAWINGS AND OTHER RECORD DOCUMENTATION BY RESIDENT PROJECT REPRESENTATIVE

A. Resident Project Representative shall maintain a separate set of red-line drawings updated each day that they are on-site and cross-checked to the Contractor's red-line markups. Elevation views—show vertical changes that are greater than 6" from the design elevation as well as any fittings used for vertical offsets. Red-line drawings to show the new main and the main that was retired. Do not include the proposed design location.

B. Resident Project Representative shall prepare sketches showing actual field installation at all intersections and tie-ins. The sketches shall indicate configuration, dimensions and elevations of all new mains and all existing utilities in the area.

C. Asset Record Cards are required to be completed by Resident Project Representative.

D. Resident Project Representative shall transfer red line drawings and other record documents to the Owner at the same time. This information will then be transferred to the final record drawings.

E. Resident Project Representative shall observe:

a. Tapping Sleeve & Valve installation

b. Shutdown and Tie-in

c. Shutdown and Cut/Cap

d. Pipe installation - First Day and first fitting

e. Valve installation – first installation

f. Crossing of large storm, sanitary, gas

g. Offsets under/over other utilities

h. Casing installation - open cut, HDD or Jack and Bore

i. Road crossings that require short term closure or partial closures

j. Service & Meter Pit Installation - First Day

k. Railroad crossing - throughout the duration

l. HDD installation - pullback of pipe

m. Pressure testing of pipe

n. Chlorination & De-Chlorination of pipe

o. Customer notifications as required by District

p. Final Walk thru

1.16 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01600 Products

E. Section 01700 Project Closeout

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this Section consists of providing all labor, materials, tools, equipment, and services required to maintain existing facilities, provide temporary facilities, and perform related work as indicated on the Drawings and as specified within this section and related sections of the Specifications.

1.02 WATER SUPPLY

A. All use of existing water systems during construction by the Contractor shall be with the approval and direction of the Owner. The Contractor shall be responsible for all temporary piping, temporary meter provisions, temporary backflow preventer provisions and other water utility requirements for supplying water during construction. The Contractor shall use the existing water system only at locations, times and conditions as set forth by the Owner.

B. Temporary water supply, including temporary services, fire hydrants, and valves shall be provided as specified in Section 15000 where existing water services and/or fire hydrants would otherwise be out of service for more than eight (8) hours due to pipe bursting or other construction activities associated with the Work.

C. When and where available, Owner shall supply water for filling, testing, flushing, and disinfecting the new pipeline(s) and appurtenances. The water usage will be tracked by Owner, and there will be no cost to the Contractor for water supplied up to ten (10) times the volume of the new pipeline(s). If additional water is needed for filling, testing, flushing, and disinfecting, due to poor workmanship or defects in material or equipment furnished by the Contractor, Owner shall furnish the additional water (if and when available) and reserves the right to charge the Contractor for the additional water usage at prevailing rates.

D. The Contractor shall contact the Owner's local Operations District office forty eight (48) hours prior to filling and flushing to obtain a meter with backflow device. Contractor shall furnish and install all necessary temporary piping and valves in connection with such water supply. Only Owner shall operate valves on the existing water system. When the new pipeline is already connected to the existing water main and is to be filled directly from the existing main through a main line valve (whether new or existing), only Owner shall operate this valve.

E. If water is not readily available at the site or the Owner cannot provide the volume of flow required by the Contractor, Contractor shall supply water as needed from an off-site location at no additional cost to the Owner.

F. Contractor shall supply all water needed for lawn restoration and any other purposes not identified above. All water used from the Owner's water system by the Contractor for such purposes shall be metered through an Owner-approved metering assembly installed by the Contractor. Contractor shall furnish and install all necessary temporary piping, valves, and required backflow prevention devices in connection with such water supply.

G. The Owner reserves the right to impose limitations upon the Contractor's use of water as the Owner, in its sole discretion, determines may be necessary to assure it of its continued ability to meet the demands of its customers and the volumes and pressures required for fire protection. Any water required by the Contractor in excess of the quantities the Owner provides to the Contractor must be purchased from Owner by the Contractor at Contractor's expense.

1.03 TEMPORARY HEAT

A. Contractor shall provide approved type heating apparatus with the necessary fuel in order to protect and/or dry out the Work. Do not leave stored fuel unsecured. The stored materials and finished Work shall be protected at all times from damage by the weather elements. If required by weather factors to meet the coatings manufacturer's specifications, forced curing of the paint will be required.

1.04 ELECTRICAL SUPPLY

A. Contractor shall pay all fees, obtain necessary permits, have meter installed for power and light, and pay all monthly charges as may be required for completing the Work.

1.05 TEMPORARY LIGHTING

A. Contractor shall provide and maintain lighting for construction operations and lighting to exterior staging and storage areas after dark as necessary for security purposes.

1.06 BARRIERS

A. Contractor shall provide barriers to prevent unauthorized entry to construction areas. Barriers shall be sufficient to protect people, existing facilities, and adjacent properties from damage or injury. Provide protection for plant life designated to remain. Replace damaged plant life in kind at no additional cost to Owner.

1.07 FENCING

A. Refer to Part 1.06 Barriers of this Section for temporary barrier requirements.

1.08 PARKING

A. Contractor shall arrange for temporary parking to accommodate construction personnel, Resident Project Representative, and other persons requiring access to the work site.

B. Continual parking in grass areas in the right of way by the Contractor shall not be allowed.

1.09 PROGRESS CLEANING

A. Contractor shall maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition. Remove debris and rubbish from closed or remote spaces prior to enclosing the space. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust. Remove waste materials, debris, and rubbish from site weekly and dispose off-site.

1.10 SANITARY FACILITIES

A. Contractor shall provide suitable temporary facilities and enclosures for the use of workers and site visitors and shall maintain same in a sanitary condition.

B. The Contractor is advised that the Owner is in the business of providing potable water, and the Contractor's sanitary arrangements shall not endanger the Owner's facilities.

1.11 FIELD OFFICES

A. Furnishing a field office is not required unless otherwise indicated under Section 01011 or 01075.

1.12 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01010 Drawing Index

C. Section 01011 Special Provisions

D. Section 01075 Basis of Payment

E. Section 01570 Traffic Regulation

F. Section 01700 Project Closeout

G. Section 02025 Existing Utilities and Structures

H. Section 15000 Piping – General Provisions

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01570

TRAFFIC REGULATION

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this Section consists of providing all labor, materials, tools, equipment, and services required to maintain and regulate traffic as necessary to perform the Work, maintain traffic flow and protect the general public as indicated on the Drawings and as specified within this Section and related sections of the Specifications.

B. Contractor shall furnish and install all traffic barricades, markers, signs, controls and provide flaggers, traffic police and other facilities required by the Federal, State and local government authorities and the Engineer to protect general public and maintain the existing roads, streets and highways.

1.02 GENERAL REQUIREMENTS

A. Traffic control methods and materials shall conform to the latest editions of applicable State DOT Standard Specifications for Road and Bridge Construction and USDOT Manual on Uniform Traffic Control Devices for Streets and Highways.

B. Competent traffic personnel suitably attired for safety shall be employed at every location where the Contractor's equipment is working immediately adjacent to, or is entering, leaving or crossing, active traffic lanes. The traffic personnel shall be employed continuously for the full time such conditions exist.

C. Special attention shall be given to the protection of pedestrians and, in particular, children going to and coming from school. Ingress and egress shall be maintained for all properties abutting the pipeline.

1.03 COORDINATION OF WORK

A. Prior to the start of construction, assign one individual at a supervisory level who will be responsible to coordinate and oversee maintenance and protection of traffic. See General Conditions article 6.

B. Notify the State and local police, ambulance services and fire departments of daily traffic diversions.

C. Be fully responsible to complete all obligations of the Contract regardless of any restrictions which may be imposed by Federal, State or local authorities.

1.04 MAINTAINING TRAFFIC

A. Traffic Diversion: Whenever it is necessary to divert traffic from its normal channel into another channel, such diversion shall be clearly marked by cones, drums, barricades or temporary guardrail. If the markers are left in place at night, suitable lights shall be provided and maintained.

B. One Way Traffic: Whenever one way traffic is established, at least two (2) flaggers shall be provided and adhere to all requirements of the local police and street regulator having jurisdiction.

C. Street Closing: When permitted by Federal, State or local authorities having jurisdiction, the Contractor may close streets to through traffic for minimum periods of time. Notify and secure the permission of the local police and fire departments and such other public authorities. Contractor shall comply with all laws, ordinances and regulations regarding notification to the occupants of premises bordering the affected streets. Give all occupants reasonable notice with respect to the closing of any street, in whole or in part, even when not required by any law, ordinance, or regulation. Schedule work such that the time the street is closed is kept to a minimum and make suitable provisions for access by local residents, school buses, and mail delivery vehicles, unless otherwise authorized by the Engineer. Provide access for police, fire, ambulance and emergency vehicles at all times. Fire hydrants and other public utility valves shall be kept accessible at all times.

1.05 TRAFFIC SIGNALS AND CONTROLS

A. The installation and operation of all traffic signals and traffic control devices shall conform to the requirements of Federal, State and local government highway departments. The replacement of pavement markings disturbed during construction or the installation of temporary markings is the sole responsibility of the Contractor.

B. To protect persons from injury and to avoid property damage, adequate barricades including flasher and reflectorized construction signs and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for traffic and pedestrians to use the construction area.

C. When permitted to close a street or road to traffic, furnish, erect, maintain and remove barricades, suitable and sufficient red lights, and other lights or reflecting material at the limits of the project, where side streets intersect, and at other points of public access to the project. Furnish, erect and maintain advance warning signs and barricades on side street at the first street intersection beyond the one closed by construction indicating “Street Closed, One Block Ahead”. Furnish, erect, maintain and remove detour marking signs on temporary routes.

1.06 TRENCH AND STORED MATERIALS MARKINGS

A. Before completion of each day’s work, in traveled areas, the pipe trench shall be completely backfilled and tamped, and the necessary temporary paving installed.

Compacted aggregate or compacted granular backfill shall be used in sidewalk and walkway areas according to local building requirements. Compacted aggregate shall be used in driveway areas. These areas are not to be left open, impassable or unsafe through the night. In the event that the pipe trench cannot be completely backfilled and tamped, temporary bridges and crossings shall be used to accommodate through traffic and the general public. The job site will be left in a neat and satisfactory condition at the end of each day. The requirements of this Section are in addition to any requirements of Federal, State or local laws, rules, regulations or ordinances or any requirements found elsewhere in the Contract Documents.

B. At night, any material or equipment stored between the street and sidewalk or within 5 feet behind any raised curbs, whether on or outside the paved street, shall be clearly outlined with light or other dependable warning devices that are approved by the Engineer. Equipment and material stored on the street shall be marked at all times. In addition, provide any other lights, barricades, etc., that may be needed for the protection of pedestrian traffic.

1.07 OTHER REQUIREMENTS

A. Trucks and/or trailers used as protective vehicles to protect workers or work equipment from errant vehicles on roadways with posted speed limits of 50 MPH or greater shall be equipped with Truck-Mounted Attenuators conforming to the National Cooperative Highway Research Program (NCHRP) Report 350 “Recommended Procedures for the Safety Performance Evaluation of Highway Features”.

B. The protective truck must be positioned a sufficient distance in front of the workers or equipment being protected to allow for appropriate vehicle roll-ahead, but not so far that errant vehicles will travel around the vehicle and strike the workers/equipment. Attenuators should be in the full down-and-locked position.

C. For stationary operations, the truck’s parking brake should be set and, when possible, the front wheels turned away from the work site. Turning the front wheels should be based on specific conditions at the site such that the after-impact trajectory is into a safe area.

D. If the regulation of traffic and controls are not being provided in accordance with this Section 01570, and the public is inconvenienced or its safety is being endangered, in the judgment of the Engineer or Owner, the Owner may take such steps as it deems advisable to provide such services; and all costs in providing such services will be deducted from any payment which may be due or may thereafter become due the Contractor.

1.08 SUBMITTALS

The Contractor shall prepare and submit a Maintenance of Traffic Plan to the Engineer and local traffic law enforcement agency for review. The Maintenance of Traffic Plan shall show the location of all barricades, signs, devices and alternate routes for local traffic and pedestrian safety. Erection of the appropriate safety and warning devices in

accordance with the USDOT "Manual of Uniform Traffic Control Devices" (MUTCD) shall be completed prior to beginning work and maintained until all construction is completed and the site restored.

1.09 PERMITS

A. Owner will obtain the Indiana DOT Right of Way Permit where required for Work shown on the Drawings. Contractor shall apply and pay for all other permits and pay all other inspection fees required by federal, state, local and private transportation authorities having jurisdiction over the Work area.

B. Contractor is responsible for complying with all requirements of such permits (including those obtained by the Owner), attending Board of Public Works meetings upon request, paying for all required inspections and/or traffic control by third-parties (e.g. off-duty police), at no additional cost to the Owner. Contractor's Construction Schedule shall allow sufficient time for all permitting processes.

1.10 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01010 Traffic Regulation

C. Section 01011 Special Provisions

D. Section 01075 Basis of Payment

E. Section 01300 Submittals

F. Section 02610 Roadway Paving and Surfacing

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 01600

PRODUCTS

PART 1: GENERAL

1.01 PROTECTION OF MATERIAL AND EQUIPMENT

A. Provide for the safe storage of all material furnished or purchased until it has been incorporated in the completed project and accepted by the Engineer. Bear the risk of loss and/or damage to the materials and Work until the Work is finally accepted by the Engineer. If space is available, the Contractor may store material and equipment at the Owner's local property. All storage shall be approved by the Owner's local Operations Superintendent prior to any items being placed on Owner's property.

All electrical and mechanical equipment shall be stored in a warm, dry shelter with proper ventilation. Under no circumstances shall motors, electrical control equipment or any other electrical or mechanical equipment be stored under polyethylene plastic covers or tarpaulins. When space is available inside existing structures at the Owner's local property, the Contractor will be allowed to store equipment inside the structures subject to the stipulations in the preceding paragraph. Contractor may store equipment at a secure off-site facility subject to inspection by the Engineer. Owner may stipulate additional requirements and require additional documentation before making payment for materials stored at any location other than the Project site or an Owner's facility.

B. The interior of all pipe, fittings, and accessories shall be kept free from dirt, foreign matter and standing water at all times.

C. After valves and hydrants have been inspected, properly store them prior to use. In order to prevent entry of foreign material that could cause damage to the seating surfaces, the valves and hydrants shall be stored in a fully closed position unless recommended otherwise by the manufacturer. Resilient seated valves shall be stored in accordance with the manufacturer's recommendations. This may include storage with protective covers for rubber seats and in marginally open condition. Valves and hydrants shall be stored indoors unless otherwise approved by the Engineer.

D. If valves must be stored outdoors, protect the operating mechanism, such as gears, motor, actuators and cylinders, from weather elements. Valve ports and flanges must be protected from the weather and foreign materials. If valves are subject to extreme (freezing or excessively hot) temperatures, all water must be removed from the valve interior and the valve closed tightly before storage, unless specifically recommended otherwise by the manufacturer. Valves shall be stored on pallets with the discs in a vertical position to prevent rainwater from accumulating on top of the disc, seeping into the valve body cavity, freezing, and cracking the casting.

1.02 SERVICING EQUIPMENT

A. Check all equipment upon acceptance to determine if oil reservoirs are full and areas to be greased are properly packed with grease. Provide the proper grease or oil for use in lubricating the required areas of the equipment. Any service to equipment while in storage, or installed pending acceptance, is the responsibility of the Contractor and shall be performed per manufacturer's requirements, industry standards or as stated specifically in the Specifications.

1.03 RESPONSIBILITY FOR MATERIAL AND EQUIPMENT

A. Under no circumstances shall equipment, pipe, valves, fittings, or appurtenances be dropped or dumped from any trucks or equipment. When received from the Carrier and at time of unloading, inspect all pipe and accessories for loss or damage. No shipment of material shall be accepted by the Contractor unless loss or damage (if present) has been described on the Bill of Lading by the Carrier's agent. Any discrepancies between the Bill of Lading and the physical material shall be noted on the Bill of Lading. All demurrage charges on carloads or truckloads of pipe or other material shall be paid by the Contractor. Owner Furnished Contractor Installed materials shall require Contractor to sign the carriers delivery packing slips and return the original copy to the Owner or Owners representative within 3 business days.

B. After acceptance of material and/or equipment by Contractor at point of delivery, the Contractor assumes full responsibility for safe and secure storage, handling, servicing and installation of such material and/or equipment in accordance with manufacturer's recommendations, industry standards or specific requirements of the Contract Documents. Once in his possession, assume full responsibility for, and protect all material from theft and damage. Any lost or stolen materials shall be replaced at the Contractor's expense.

C. Re-inspect all material for defects, correct size, and quantity in the field prior to installation. Immediately report all material found to be defective, improperly sized, or deficient in quantity to the Owner.

D. The Contractor is responsible for all material furnished by the Contractor and Contractor's suppliers. All such material that is defective in manufacture or has been damaged in transit or has been damaged after delivery shall be replaced by the Contractor at his expense.

E. Owner Furnished, Contractor Installed materials: Certain material and equipment will be furnished by the Owner as noted in the Contract Documents. The Contractor's responsibility for material and/or equipment furnished by the Owner shall begin upon the Contractor's acceptance of such material and/or equipment at the point of delivery. All material and equipment shall be examined and items found to be defective in manufacture and/or otherwise damaged shall be rejected by the Contractor at the time and place of delivery. The Owner will thereupon repair or replace the damaged items. Thereafter, any material and/or equipment found to be defective prior to project acceptance by the Engineer shall be repaired or replaced by Contractor at no additional cost to Owner unless

Contractor submits proof that such defect was latent and could not have been detected by Contractor when performing their duties and responsibilities under these Contract Documents.

F. Owner Furnished, Contractor Installed materials: Contractor's and Owner's responsibilities for providing guarantees or warranty and manufacturer's representatives for service, inspection, certification of installation, installation, field training, start-up, etc. for material and/or equipment furnished by Owner shall be as follows unless otherwise specified: Owner will provide the warranty and Contractor shall coordinate with the Owner and assist in coordinating with manufacturer's representatives for all necessary field service, start-up service, installation certifications, installation, field training of Owner's personnel, etc. for Owner-furnished material and/or equipment as required for acceptance of such material and/or equipment in the completed project. Contractor shall cooperate in the discovery of defective Owner Furnished Contractor Installed (OFCI) materials. When requested by Owner, Contractor shall provide labor, equipment, and tools (but not materials) to assist with correcting or replacing Owner-furnished materials. Contractor shall be reimbursed by the Owner or material supplier for labor and materials incurred as a result of the defective material item.

1.04 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer’s literature and product data, installation instructions, Operating and Maintenance Manuals, certifications, and other required submittals in accordance with Section 01300 for products furnished where submittals are required under the corresponding section of the Specifications.

1.05 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

PART 2: PRODUCTS

2.01 GENERAL

A. Unless otherwise specifically provided for in these Specifications, all equipment and materials incorporated in the work shall be new, in current production and in accordance with the Specifications and Drawings.

B. Product manufacturers, models, and part numbers identified in these Specifications are the only approved products that will be accepted for the Work. No substitutions, “or equal,” or other manufacturers/products not specifically listed in these Specifications may be furnished or installed by the Contractor without prior written approval from the Owner. Any proposed substitutions, “or equal,” or other manufacturers/products proposed to be incorporated into the Work shall be submitted by the Contractor for review and approval by Indiana American Water Company Engineering, Greenwood, Indiana.

2.02 COORDINATION OF DIMENSIONS

Verify and make necessary corrections to construction dimensions so that all specified and/or alternative equipment, which is approved by the Engineer, can be installed and will function within the intent of the Drawings and Specifications. Promptly notify the Engineer of all necessary corrections required.

2.03 SAFETY AND HEALTH REQUIREMENTS

A. All materials, equipment, fixtures and devices furnished shall comply with applicable Laws and Regulations.

B. All material and equipment furnished and installed under this Contract shall be equipped with suitable and approved safety guards and devices required for the safety of the public and operating personnel. Such guards and safety devices shall be in accord with the latest requirements of safety codes approved by the American National Standards Institute as well as the safety requirements of applicable Laws and Regulations. Where said safety codes of the ANSI are incompatible with applicable Laws and Regulations, said Laws and Regulations shall prevail.

PART 3: EXECUTION

3.01 INSTALLATION

A. Material and equipment shall be installed in accordance with the appropriate sections of these Specifications.

3.02 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. Arrange for a qualified service representative from each company manufacturing or supplying certain equipment as required by the individual Specifications sections to perform the duties herein described.

B. After installation of the applicable equipment has been completed and the equipment is presumably ready for operation, but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The

inspection shall include, but shall not be limited to, the following points as applicable:

1. soundness (without cracked or otherwise damaged parts);
2. completeness in all details, as specified;
3. correctness of setting, alignment, and relative arrangement of various parts;
4. adequacy and correctness of packing, sealing and lubricants.

C. The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.

END OF SECTION

SECTION 01700

PROJECT CLOSEOUT

PART 1: GENERAL

1.01 TESTING OF FACILITIES

All work shall be tested under operating conditions and pressures; and any leaks or malfunctions shall be repaired to the satisfaction of the Engineer at no additional expense to the Owner.

1.02 CLOSEOUT PROCEDURES

Submit written notification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection. Provide submittals to Engineer that are required by governing or other authorities. Submit Application for final payment identifying total adjusted Contract sum, previous payments, and sum remaining due. Contractor shall submit original Maintenance Bond and Waiver of Liens for all subcontractors.

1.03 PROGRESS CLEANING AND FINAL CLEANING

A. Periodically, or as directed during the progress of the Work, remove and properly dispose of the resultant dirt and debris and keep the premises reasonably clear. Upon completion of the Work, remove all temporary construction facilities and unused materials provided for the Work and put the premises in a neat and clean condition and do all cleaning required by the Specifications. Trash and combustible materials shall not be allowed to accumulate in construction locations.

B. Execute final cleaning prior to final inspection. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances. Clean equipment and fixtures to a sanitary condition. Clean debris. Clean site; sweep paved areas, rake clean landscape surfaces. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.04 PROJECT RECORD DOCUMENTS

A. Maintain project record documents in accordance with Section 01300.

B. Submit documents to Engineer with final Application for Payment.

C. The Owner will issue a notice of Substantial Completion to the Contractor when the Work is in-service and up-to-date Record Documents have been provided by the Contractor.

1.05 SURPLUS MATERIALS

A. The Contractor shall return surplus Owner-furnished material to the Owner's local Operations District's property or other location(s) specified by the Engineer within fourteen (14) days of the notice of Substantial Completion is issued.

B. Refer to Section 15185 for requirements regarding removal of abandoned hydrants, valve boxes, air valves, meter installations, and curb stops.

C. Unless otherwise directed by the Engineer, the Contractor shall return the following components from abandoned facilities that were removed as part of the Work to the Owner's local Operations District's property or other location(s) specified by the Engineer within fourteen (14) days after the notice of Substantial Completion is issued. If directed by the Engineer, the Contractor shall dispose of these abandoned materials at no additional cost.

1. Fire hydrants
2. Valve boxes and lids (only if in good condition)
3. Automatic air valves
4. Meter pits, covers, and lids
5. Meter setting components, including meter setters, yoke bars, branches, ball valves, and other components as directed by the Engineer.

1.06 GUARANTEES AND WARRANTIES

A. The Contractor expressly warrants that all workmanship and materials performed or furnished under this Contract will conform to the Specifications, Drawings and other applicable descriptions furnished or adopted by the Contractor and with all applicable laws, provisions and requirements of the Contract Documents. Remedy any defects due to faulty materials or workmanship which are discovered within a period of one (1) year from the date of acceptance of the Work in this project and pay for any damage or associated loss resulting from faulty materials or workmanship, including value of any water lost since the acceptance date due to faulty materials or workmanship. Quantity of water lost shall be as estimated by the Engineer and/or Owner based on best available information, calculations, modeling, and professional judgement. The Owner shall give notice of observed defects with reasonable promptness. The Contractor warranty hereunder is in addition to, and not in limitation of, any obligations found elsewhere in the Contract Documents, any special guarantees provided by the Contractor or Contractor suppliers, and any obligations imposed by law.

B. In addition to the above requirements, assign material and equipment guarantees and warranties from all manufacturers and suppliers to the Owner and deliver copies of such guarantees and warranties and the necessary assignments to the Owner in order to assure the Owner of the full benefit of such guarantees and warranties.

1.07 RESTORATION

A. Restore and/or replace paving, guardrails, curbing, sidewalks, gutters, shrubbery, fences, signs, mailboxes, sod and all other disturbed surfaces, structures, utilities, and any other items required by the Drawings and/or Specifications to a condition equal to or better than that before the Work began and to the satisfaction of the Resident Project Representative and Owner.

1.08 MAINTENANCE OF SURFACES

Following the written Substantial Completion acceptance issued by Engineer, maintain the surfaces of all areas disturbed by the Work, including paved and unpaved areas, adjacent curbs and gutters, sidewalks, fencing, and sod for a period of one (1) year thereafter or longer as required by state, county or local authorities unless otherwise stipulated in writing by the Engineer. Supply all material, equipment, tools, labor and services required for the maintenance of the restored surfaces and structures; and perform the Work in a manner satisfactory to the Engineer. Contractor shall repair or replace (at the Engineer's discretion) any pavement, sidewalks, curbs, fencing, signs, utilities, structures, landscaping, and other items that are damaged due to trench settlement or other residual effects of the Work.

1.09 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 02610 Roadway Paving and Surfacing

F. Section 02820 Lawn Restoration and Landscaping

G. Section 15185 Abandonment of Mains and Hydrants

PART 2: PRODUCTS

Not Used.

PART 3: EXECUTION

Not Used.

END OF SECTION

SECTION 02020

DEWATERING

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this Section consists of providing all labor, materials, tools, equipment, and services required to dewater pipeline excavations as indicated on the Drawings and as specified within this Section as necessary for proper construction of the pipeline(s) under dry conditions.

A. If ground water, surface water, and/or other sources of water are encountered that impact the Work and cannot be adequately drained, Contractor shall furnish and operate pumping equipment of sufficient capacity to dewater the excavation and adequately control hydrostatic pressures. Dewater the excavation so that the laying and joining of the pipe is made in a dry environment so as to prevent water from entering the pipe during construction.

B. No additional payment will be made for any dewatering operation, overtime, equipment rental or any other expense incurred due to the occurrence of ground water, surface water or water from possible leakage from existing buildings, structures or piping in the vicinity of the Contractor's operations. If Contractor believes excessive wet conditions exist beyond what could have been anticipated, he shall immediately notify Engineer and propose appropriate dewatering measures. Engineer shall determine whether Contractor is entitled to additional compensation.

C. Discharge shall be in strict accordance with state and/or local requirements. Contractor's dewatering pump discharge shall include an approved filtration device. Convey all water removed from the excavation to a natural drainage channel or storm sewer without causing any property damage as approved by the local governing body.

D. Dispose of silt and debris from dewatering operations that accumulates during construction in strict accordance with state and/or local requirements. Any such materials removed from Right of Way owned by the State of Indiana must be disposed of in an INDOT certified dump site.

1.02 SUBMITTALS

Contractor shall submit the following submittals for Work under this section in accordance with Section 01300:

A. Name of dewatering subcontractor, if applicable.

B. Shop Drawings indicating the following:

1. Plans showing the methods and location of dewatering and discharge including a sufficient number of detailed sections to clearly illustrate the scope of work.
2. Relationship of the dewatering system, observation wells, and discharge line to existing buildings, other structures, utilities, streets, and new construction.
3. Utility locations.
4. Drawings shall bear the seal and signature of the qualified Registered Professional Engineer in charge of preparing the drawings.
5. List of materials and equipment to be used.
6. A sample of all well record forms to be maintained during construction.

C. Detailed description of the sequence of dewatering operations.

D. Evidence of written approval from the local storm water governance authority.

E. Emergency observation plans to be put into operation during failure of the dewatering system.

F. Monthly Dewatering System Monitoring Reports containing the following data on approved forms:

1. For observation wells, daily piezometric levels shall be identified by date, time, well number and system (subsystem if multiple pumps are used) pumping rate. Piezometric levels shall be noted in feet of drawdown and groundwater elevation.
2. For dewatering wells, suspended material test results shall be identified by date, time, well number, well pumping rate (if monitored) and system (subsystem if multiple pumps are used) pumping rate.
3. Installation records for new wells.

G. Schedule and records of all maintenance tests for primary and standby dewatering systems including the following:

1. Maintenance tests and water quality tests for suspended matter at the discharge point including date, time of day, elapsed times of tests procedures, components tested, suspended particles, resultant observations and well readings.
2. Daily discharge rates.
3. Installation and removal of wells.
4. General observations of the system such as equipment running times, and failures.

H. Dewatering well removal records.

I. Observation well removal records.

1.03 QUALITY ASSURANCE

A. Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the Work described herein.

B. Dewatering shall prevent the loss of fines, seepage, boils, quick conditions or softening of the foundation strata while maintaining stability of the sides and bottom of the excavation, and providing dry conditions for construction operations.

1.04 PERMITS

A. Contractor shall obtain and pay for any permits required for dewatering and disposal.

1.05 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 02540 Erosion and Sedimentation Control

H. Section 15000 Piping – General Provisions

PART 2: PRODUCTS

2.01 MATERIALS

A. Materials, especially the well screen, shall be carefully chosen to be compatible with the environment to prevent erosion, deterioration, and clogging.

PART 3: EXECUTION

3.01 DESIGN

A. The dewatering system shall be capable of relieving all hydrostatic pressure against the height of the excavation walls and of lowering the hydrostatic level to a minimum of six inches (6”) below the bottom of the required excavation in the work areas.

B. Provide, operate and maintain all ditches, berms, site grading, sumps and pumping facilities to divert, collect and remove all surface water from work areas. All collected water shall be discharged into the outfall pipe.

C. Carry the dewatering system discharge through pipes out of the area of the excavation into the outfall junction manhole shown on the Drawings (if applicable) or as otherwise approved by the Engineer. If required as a condition of the applicable permit or by applicable law, ordinance or code, provide meters to measure the discharge flow.

D. Provide observation wells to determine compliance with dewatering requirements as indicated on the Contract Drawings, Shop Drawings, permits, or as otherwise directed by the Engineer.

3.02 INSTALLATION

A. Install the dewatering system from the existing ground surface or from the bottom of an excavation which is located above the natural ground water level.

B. Observation wells shall consist of a standpipe or riser of minimum 1.0-inch inside diameter and a minimum three (3) foot long well-point screen or slotted PVC section at the bottom.

3.03 DEWATERING PROCEDURE

A. Place the dewatering system into operation and lower the water level prior to excavation.

B. Operate the dewatering system continuously twenty-four (24) hours per day, seven (7) days per week until waterlines and structures have been satisfactorily constructed in the dewatering area. Contractor shall be responsible for observation and maintenance of the dewatering operation to ensure satisfactory performance. When required by federal, state or local authorities with jurisdiction, Contractor shall provide continuous, 24-hour per day, 7-day per week on-site monitoring by a competent person.

END OF SECTION

SECTION 02025

EXISTING UTILITIES AND STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to verify, coordinate, survey, accommodate, protect, repair and restore existing utilities and structures as specified within this section and related sections of the Specifications.

A. It is the responsibility of the Contractor to verify all existing structures and utilities. Prior to submitting a bid for the proposed Work, Bidders shall visit and familiarize themselves with the entire project area, including all discernible existing structures and utilities. As needed for the purpose of accurately preparing their bids for the proposed Work, Bidders shall take appropriate measures to determine the presence, location, size, and character of such structures and utilities.

B. Certain information regarding the reputed presence, size, character, and location of existing underground facilities such as pipes, drains, storm sewer, sanitary sewers, sanitary sewer laterals, electrical lines, telephone lines, cable TV lines, gas lines, and water lines has been shown on the Contract Drawings and/or provided in the Contract Documents. This information is provided by the Engineer and Owner to the best of its knowledge in accordance with conditions described in the General Conditions and for information purposes only.

C. Prior to commencement of the Work, the Contractor shall, at his own expense, take such surveys as may be necessary to establish the existing conditions, including the actual presence, location, size, and character of all existing structures and utilities (including individual utility services and private utilities) in proximity to the Work as necessary for the purpose of performing construction activities associated with the proposed Work.

1.02 NOTIFICATION OF UTILITIES

A. Notify the applicable State Agency with jurisdiction over underground facilities and/or all utility companies that construction work under this Contract will pass through areas containing their underground facilities. Notify these parties a minimum of 72 hours in advance, as required by the organization with jurisdiction, to support the construction work. All excavation in the vicinity of existing underground utilities shall be performed in accordance with applicable regulations.

1.03 BRIDGE CROSSINGS

A. Notify the applicable State Agency and Transportation Organization with jurisdiction over bridge facilities and/or all utility companies that construction work under this Contract will pass at or near the bridge structure. Notify these parties a minimum of 72 hours in advance, or as required by the organization with jurisdiction to support the construction work. All construction in the vicinity of existing bridge structures shall be performed in accordance with applicable regulations.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01500 Temporary Facilities

E. Section 01600 Products

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 15000 Piping – General Provisions

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the Engineer shall determine which requirements shall prevail.

A. Statewide Alternative Technical Standards: Water Main Separation Distances From Existing Sanitary and Storm Sewers as approved by Indiana Department of Environmental Management

PART 2: PRODUCTS

2.01 MATERIALS

A. Furnish all materials for temporary support, adequate protection, and maintenance of all underground and surface utility structures, pipes, conduits, wires/cables, supports, drains, and other obstructions encountered in the progress of the Work.

PART 3: EXECUTION

3.01 OBSTRUCTIONS BY OTHER UTILITY STRUCTURES

A. Support, relocate, remove, or reconstruct existing utility structures that obstruct installation of the proposed utility such as conduits, cables, ducts, pipes, branch connections to main sewers, or drains. The obstruction shall be permanently supported, relocated, removed or reconstructed where they obstruct the grade or alignment of the pipe. Contractor must do so in cooperation with the owners of such utility structures. Before proceeding, the Contractor must reach an agreement with the Engineer on the method to work around the obstruction.

B. No deviation shall be made from the required line, grade, or depth without the consent of the Engineer.

3.02 REPAIRS

A. Repair or replace any damage to existing structures, utilities, work, materials, or equipment damaged by Contractor's operations.

B. Repair all damage to streets, roads, curbs sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, trees, shrubs or other public or private property caused by transporting equipment, materials or personnel to or from the work site. Make satisfactory and acceptable arrangements with the persons or agencies having jurisdiction over the damaged property concerning repair or replacement

C. Brace and support existing pipes or conduits crossing the trench, or otherwise exposed to prevent trench settlement from disrupting the line or grade of the pipe or conduit. The Contractor shall submit an acceptable method of bracing and supporting such pipes or conduits, which must be approved by the Engineer before proceeding with the Work. All repairs and replacement of damaged structures and utilities shall be coordinated with and meet the approval of the applicable utility and local governance authority. Contractor shall repair or replace all utility services broken or damaged at once to avoid inconvenience to customers. Storm sewers shall not be interrupted overnight. Use temporary arrangements, as approved by the Engineer, until any damaged items can be permanently repaired. Contractor shall maintain all items damaged or destroyed by construction and subsequently repaired until project acceptance.

3.03 SEPARATION OF WATER MAINS AND SANITARY SEWERS

A. General

Consider the following factors when determining adequate separation:

1. Separation requirements shall comply with the current Indiana Administrative Code governance.
2. Materials and type of joints and restraints for water and sanitary sewer pipes,

3. Soil conditions & backfill materials,
4. Service and branch connections into the water main and sanitary sewer line,
5. Compensating variations in horizontal and vertical separations,
6. Space for repair and alterations of water and sanitary sewer pipes,
7. Off-setting of pipes around manholes.

B. Parallel Installation

Install water mains a minimum of 10 feet horizontally from any existing or proposed sanitary sewer. Measure the distance from edge to edge.

C. Crossings

Whenever water mains must cross sanitary sewer laterals or sanitary sewers, lay the water main at such an elevation that the water main is 18 inches above or below as measured from outside of water main to outside of the sanitary sewer pipe. Contractor shall install the water main so that a pipe joint does not exist at the point of intersection. Maintain this vertical separation for the portion of the water main located within 10 feet horizontally of any sanitary sewer it crosses. The 10 feet is measured as a perpendicular distance from sanitary sewer line to the water line. Where water mains must cross under a sanitary sewer, additional protection shall be provided by:

1. Adequate structural support for the sanitary sewer to prevent excessive deflection of the joints and the settling on and breaking of the water line, and
2. Centering the section of water pipe at the point of the crossing so that the joints shall be equidistant and as far as possible from the sanitary sewer line.

3.04 SEPARATION OF WATER MAINS AND STORM SEWERS

Where water mains and storm sewers are proposed to be installed parallel, lay water mains at least 10 feet horizontally from the existing or proposed storm sewer (measured from edge to edge). Where storm sewers and water mains must cross, place water mains at least 18 inches vertically from the storm sewer as measured from edge to edge of pipes.

3.05 EXCEPTIONS

A. The Owner has obtained approval from Indiana Department of Environmental Management of “Statewide Alternative Technical Standards: Water Main Separation Distances From Existing Sanitary and Storm Sewers”. The Drawings are designed to incorporate these alternative technical standards. Where the Drawings clearly show deviation from the above specified horizontal and vertical separation requirements, the Drawings are to take precedence.

B. In other cases where it is impossible or not practical to maintain the specified horizontal and vertical separation as stipulated above, Contractor shall notify Engineer and shall not proceed with the installation. Upon request, Contractor

shall assist the Engineer in coordination with Indiana Department of Environmental Management to obtain a separation exception at no additional cost to the Owner. The Contractor shall install the water main as directed by the Engineer in writing based on either the approved Statewide Alternative Technical Standards or an approved separation exception.

C. The Engineer may allow other deviations on a case by case basis.

END OF SECTION

SECTION 02105

CLEARING AND GRUBBING

PART 1: GENERAL

The work under this section consists of providing all labor, materials, tools, equipment, and services required to clear and grub the Work area as indicated on the Drawings and as specified within this section and related sections of the Specifications. This Work includes all related disposal as required.

1.01 SCOPE OF WORK

A. As necessary to perform the work, Contractor shall clear the construction area within the Contract Limit Lines, including removal of grass, brush, shrubs, trees, loose debris and other encumbrances. Trees marked to remain shall not be cleared or otherwise disturbed. Comply with State and local code requirements when disposing of trees, shrubs and all other materials removed under this section.

B. Protect existing trees, shrubs and bushes located outside the clearing limits from damage for the life of this Contract. Relocating trees and shrubs, so indicated on the Drawings, to designated areas.

C. All injury to trees, shrubs, and other plants caused by site preparation or other construction activities associated with the Work shall be repaired immediately. Work shall be done by qualified personnel in accordance with standard horticultural practice and as approved by the Engineer.

D. Only where designated on the Drawings, Contractor shall remove topsoil to its full depth (not less than 4-inches) and stockpile on site where shown on the Drawings or directed by the Resident Project Representative for use in restoration of the area. Install silt fence around topsoil stockpiles and preserve all topsoil for use during final restoration in accordance with Section 02820.

E. Remove from the site and dispose of all debris resulting from work under this Section. Contractor shall bear all expenses to obtain a suitable disposal area including transport to the disposal area, disposal fees and handling at the disposal area.

1.02 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 02210 Trenching, Backfilling and Compacting

E. Section 02230 Stream Crossing

F. Section 02540 Erosion and Sedimentation Control

G. Section 02820 Lawn Restoration and Landscaping

H. Section 15000 Piping – General Provisions

PART 2: PRODUCTS

Not Used

PART 3: EXECUTION

3.01 CLEARING AND GRUBBING

Clear and grub only the minimum area necessary to complete the Work.

A. Clear and grub the work site within easement and/or clearing limit lines shown on the Drawings or as shown elsewhere in the Contract Documents, but only to the extent necessary to perform the Work and/or as directed in writing by the Engineer or Owner. Remove those items that are designated for removal and/or obstruct construction. This includes, but is not limited to; trees, downed timber, shrubs, bushes, vines, roots, stumps, undergrowth, rubbish, paving materials, debris, and all other objectionable materials. Site objects outside clearing limits shall not be removed. Only those portions of the construction area which are absolutely necessary and essential for construction shall be cleared. Minimize the length of time of ground disturbance as much as practical, especially within environmentally sensitive areas. Ground shall not be cleared and grubbed until immediately prior to construction.

B. Notify the Engineer of locations where additional trees and shrubs will interfere with installation of facilities. Do not remove additional trees or shrubs without written permission of Engineer or Owner.

C. Conduct operations to minimize disturbance of trees and shrubs. Trim trees and roots in accordance with the best horticultural practices, including sealing cuts to preserve the tree.

D. Excavation resulting from the removal of trees, roots, structures, and the like shall be filled with suitable material, as approved by the Engineer.

3.02 CLEARING (IMPROVED AREA)

A. Remove site improvement objects such as signs, lawn ornaments, etc. which interfere with construction. Removed site improvement objects shall be stored in a manner protecting objects for reinstallation after construction is complete. Relocate mailboxes as necessary. Provide temporary traffic control signs as required. When permanent signs must be removed for construction, either move

signs to an approved temporary location or remove signs and provide temporary signs. Temporary signs shall be worded to match permanent signs, except as necessary to be compatible with construction operations. Reinstall permanent signs and mailboxes as soon as work is completed in the area unless otherwise directed by the Engineer.

B. Remove pavement, curb and sidewalk by saw-cutting, milling or removal by trench machine in accordance with governing agency requirements and as specified in these Contract Documents. Cut the full depth of the pavement with straight and continuous lines and squared edges. Contractor shall minimize horizontal offsets in the pavement removal and replacement. Saw cuts may be eliminated where paving abuts curb or roadway expansion joints or construction joints, and pavement can be removed without damaging or disturbing curbs or remaining pavement. Remove sidewalks in full squares only. Saw cut sidewalks if no true joint exists.

3.03 DISPOSAL

A. Burning of logs, stumps, roots, cuttings and other material on the site shall not be permitted.

B. All materials obtained as a result of the clearing and grubbing operations shall be disposed of in accordance with the requirements of the applicable governing agencies. Any such materials removed from Right of Way owned by the State of Indiana must be disposed of in an INDOT certified dump site.

C. Chipping of brush materials will be permitted. Contractor shall bear all costs to dispose of the resultant chips at an approved location.

END OF SECTION

SECTION 02210

TRENCHING, BACKFILLING AND COMPACTING

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to accomplish all trenching, trench support, bedding, embedment, backfilling, compacting, and related work for all piping and appurtenances to be installed as indicated on the Drawings and as specified within this section and related sections. Contractor shall provide all required foundation, bedding, embedment, and backfill materials and other related materials required to perform the Work specified in this section.

1.02 GENERAL REQUIREMENTS

A. This section provides common, general requirements related to trenching, bedding, embedment, and backfilling of water pipelines and appurtenances. This section does not purport to cover all conditions or every possible situation that might be encountered.

B. If any underground condition or situation is encountered that is not addressed within this section, another section, or on the Drawings, Contractor shall immediately stop work and notify Engineer and Owner of the condition and/or situation discovered. Contractor shall not proceed with work in such cases until so directed by the Engineer and subject to the Engineer's requirements.

C. Federal, State, and/or local governmental or quasi-governmental bodies may have jurisdiction over the site of the Work, particularly within road rights-of-way. Contractor shall be responsible for identifying, understanding, and complying with all requirements of each authority with jurisdiction in the work area, regardless of whether or not such requirements are stipulated on the Drawings or in the Specifications and despite any conflicting requirements herein. In the case of conflicting requirements, Contractor shall coordinate with Owner and Engineer to resolve such conflicts before proceeding with the Work.

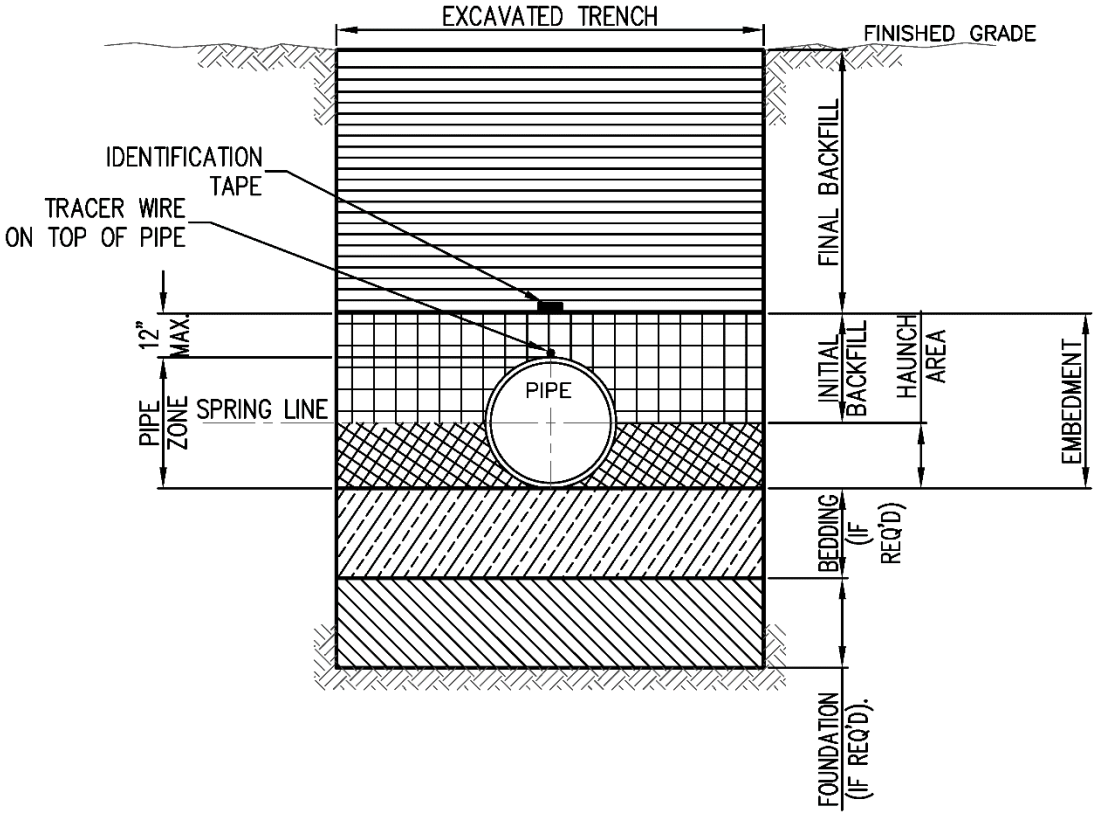
D. Contours, topography and profiles of the ground shown on the Drawings are believed to be reasonable approximations and are not guaranteed.

E. The Contractor is responsible for verifying the backfill requirements to be used prior to submitting bids. Contractor accepts the construction site with the conditions that existed at the time of bidding.

F. Reference Special Conditions and Drawings for additional information and requirements.

1.03 DEFINITIONS

Unless otherwise defined herein, terminology shall be per ASTM F1668 or ASTM F412 (for terms not defined in ASTM F1668). Embedment material shall include both the fill material used in the haunch area and the initial backfill—but not the bedding. As applicable, other references shall be consulted for terminology not defined in the above references. The following detail represents the usage of terms within this Section.



1.04 SUBMITTALS

A. Prior to beginning work, Contractor shall submit all submittals required by this section and in accordance with Section 01300.

B. Contractor shall submit samples of all bedding, embedment, and backfill materials to an approved testing agency for analysis, as required by the Engineer. Test all such materials, whether obtained from the trench excavation or from an off-site source, as directed by the Engineer, including at least classification and gradation tests. Submit the testing agency's test results and report to the Engineer for approval.

1. B-Borrow Sand testing results shall be submitted prior to installation for:

    1. Visual classification according to Unified Soil Classification System (ASTM D2488)

2. Lab tests, including grain size (sieve analysis), natural moisture, and Atterburg limits.

2. The report must state that the materials meet the requirements of these Specifications and any applicable specifications of Federal, State and local authorities (applicable specifications shall be individually listed).

C. All bedding, embedment, and backfill materials, including Common Fill and Select Fill shall be approved by the Engineer and the governing authority prior to placing the materials in the pipe trench.

D. For any spoils or debris removed from the right of way under the jurisdiction of the State of Indiana, furnish the Engineer with satisfactory evidence that they were disposed of in an approved INDOT-certified disposal site.

E. Submit the mix design for flowable fill to the Engineer for approval. A trial batch demonstration may be required. The mix design shall include a list of all ingredients, the source of all materials, the gradation of all aggregates, the names of all admixtures and dosage rates, and the batch rates. Document and justify minor mix design changes, after the trial batch verification, prior to implementation. This does not include adjustments to compensate for routine moisture fluctuations. Resubmit the mix design for approval of changes in the source of materials, the addition or deletion of admixtures, or changes in cementitious materials.

1.05 PERMITS

A. The Contractor shall obtain and pay for any permits required for the Work specified in this section unless otherwise indicated in Section 01000, 01011, or 01075.

1.06 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 01570 Traffic Regulation

G. Section 01600 Products

H. Section 01700 Project Closeout

I. Section 02020 Dewatering

J. Section 02025 Existing Utilities and Structures

K. Section 02105 Clearing and Grubbing

L. Section 02230 Stream Crossing

M. Section 02540 Erosion and Sedimentation Control

N. Section 02558 Identification/Location Guide

O. Section 02610 Roadway Paving and Surfacing

P. Section 02620 Gravel Roads and Driveways

Q. Section 02820 Lawn Restoration and Landscaping

R. Section 03305 Cast-in-Place Concrete for Pipe Work

S. Section 03310 Cast-in-Place Concrete for Paving, Driveways, Sidewalks, Curbs, and Paved Ditches

T. Section 15000 Piping – General Provisions

1.07 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM D 2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

B. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping

C. ASTM F412 – Standard Terminology Relating to Plastic Piping Systems

D. ASTM F1668 – Standard Guide for Construction Procedures for Buried Plastic Pipe

E. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

F. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

G. AWWA Manual M23 - PVC Pipe - Design and Installation.

H. AWWA Manual M55 – PE Pipe Design and Installation

I. Indiana Department of Transportation Standard Specifications (INDOT)

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All pipe bedding and embedment materials (including haunch area fill and initial backfill) shall be stable, sufficiently workable to be readily distributed and placed under the sides of the pipe to provide satisfactory haunching, and readily compactable to achieve required soil densities.

B. All final backfill materials shall be stable, sufficiently workable to be readily distributed and placed in the trench without forming voids, and readily compactible to achieve required soil densities.

2.02 COMMON FILL

A. Common Fill shall be earth materials entirely free of vegetation; refuse; garbage; lumber; construction debris; and soft or organic materials. Large rocks, stones, frozen clods, and other debris greater than 1½ inch (measured in the longest dimension) shall be removed and disposed of off-site or in a location approved by the Engineer prior to placement in the trench. Maximum aggregate (stone or rock) size in Common Fill material used in contact with pipe shall be further limited based on the pipe size as specified in Paragraph 2.04.

B. Common Fill material shall conform to ASTM D2487 using the “Unified Soil Classification System” and shall be one of the following:

1. Class II soil type designation. Class II soil types include GW, GP, SW, and SP (or any soil beginning with one of these symbols) and are described as clean, coarse grained, non-cohesive, well graded soils containing up to 12% fines
2. Class III soil type designation. Class III soil types include GM, GC, SM, and SC (or any soil beginning with one of these symbols) described as clean coarse grained natural soil and ML and CL (or any soil beginning with one of these symbols) described as sandy or gravelly fine grained natural soil material with >=30% retained on a No. 200 sieve.

C. Common fill material may be obtained from the trench excavation provided it has been approved by the Engineer, who may, at his discretion, require testing in accordance with the requirements of Paragraph 1.04 above.

D. Contractor shall furnish the necessary approved common fill materials from an off-site source whenever approved material obtained from the trench excavation is insufficient to complete the backfill.

2.03 SELECT FILL

The following selected granular and aggregate materials shall be used as specified for Select Fill materials:

A. ¾ inch Clean Granular Fill Material shall meet the sieve analysis requirements of AASHTO as follows:

1. 1" sieve passing 100%
2. ½" sieve passing 0-5% and
3. No. 4 sieve passing 0-1%.

B. ¾ inch Minus or Modified Granular Fill Material contains additional fine material and may be used as indicated herein for specific pipe materials or as directed by the Engineer. Material shall meet the sieve analysis requirements of AASHTO as follows:

1. 1" sieve passing 100%,
2. ¾" sieve passing 80-90%,
3. No. 4 sieve passing 25-50%,
4. No. 10 sieve passing 0-20%, and
5. No. 200 sieve passing 0-5%.

C. 1" Coarse Aggregates (i.e. 100% passing 1½" sieve):

1. #53 crushed limestone coarse aggregate as specified in INDOT Section 904.03.
2. #5 or #43 coarse aggregate as specified in INDOT Section 904.03.

D. ¾" Coarse Aggregates (i.e. 100% passing 1" sieve):

1. #73 crushed limestone coarse aggregate as specified in INDOT Section 904.03.
2. #8 coarse aggregate as specified in INDOT Section 904.03.

E. 3/8" and ½" Coarse Aggregates (i.e. 100% passing ¾" sieve):

1. #9 coarse aggregate as specified in INDOT Section 904.03.
2. #11 or #12 coarse aggregate as specified in INDOT Section 904.03.

F. Maximum aggregate size in Select Fill materials used in contact with pipe shall be limited based on the pipe size as specified in Paragraph 2.04.

G. B-Borrow Sand as defined in INDOT Section 211.02 and as follows:

1. No. 4 sieve passing 100% and
2. No. 200 sieve passing 0-10%.

3. INDOT No. 23 and No. 24 Fine Aggregates as specified in INDOT Section 904.02h.
4. INDOT No. 4 Structure Backfill as specified in INDOT Section 904.05, with demonstrated particle gradation within the limits stated in Table 2. Only material that is classified as Unified Soil Classification System soil types SW, SW-SM, or SW-SC may be used as B-Borrow Sand. Poorly-graded sands, including soils classified as SP shall not be used.
5. Table 2- Gradation Requirements for B-Borrow Sand

Table 2 - Gradation Requirements for B-Borrow Sand

Sieve	Minimum %	Maximum %
3/8"	100	100
#4	95	100
#8	80	100
#16	50	80
#30	25	60
#50	7	30
#100	1	10
#200	0	3

2.04 MAXIMUM AGGREGATE SIZE IN CONTACT WITH PIPE

A. Unless otherwise specified below or directed by the Engineer, the maximum aggregate size in Common and Select Fill materials used in contact with pipe shall be limited based on the pipe size (nominal diameter) as follows:

1. For pipes up to 4-inch diameter, the maximum stone or rock size is limited to ½-inch (i.e. 100% passing ½" sieve).
2. For pipes, 6-inch to 8-inch diameter, the maximum stone or rock size is limited to ¾-inch (i.e. 100% passing 1" sieve).
3. For pipes 10-inch to 16-inch diameter, the maximum stone or rock size is limited to 1-inch (i.e. 100% passing 1½" ieve).
4. For pipes larger than 16-inch diameter, the maximum stone or rock size is limited to 1½-inch (i.e. 100% passing 1½" sieve).

2.05 FILTER FABRIC

A. Filter fabric shall be non-woven, synthetic fiber material with sieve design to prevent fine soil particles from migrating through the material. The filter fabric shall have a minimum thickness of 15 mils, tensile strength of 130 lbs., elongation at break of 64%, and trapezoidal tear strength of 70 lbs.

2.06 FLOWABLE FILL

A. Flowable fill (controlled low strength material) shall be a uniform mixture of sand, Type II Portland cement, fly ash, admixtures and water. The mix design shall produce a flowable material with little or no bleed water, which produces a minimum compressive strength of 50 psi and maximum compressive strength of 100 psi at 56 days. The cured material shall be excavatable and have a maximum dry weight of 100 pounds per cubic foot. Slump of mix at the point of application shall be 7-inches to 10-inches.

B. Admixtures specifically designed for flowable fill shall be used to improve flowability, reduce unit weight, control strength development, reduce settlement and reduce bleed water. Admixtures shall be Rheocell-Rheofill by Master Builders, Inc.; Darafill by Grade Construction Products. Cement and all other materials shall be as specified in Section 03305.

C. Fine Aggregate (Sand) shall consist of natural or manufactured siliceous sand, clean and free from deleterious substances, and graded within the following limits:

Sieve Size	Percent Passing by Weight
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100*	2 to 10

*For manufactured sand, the percent passing the No. 100 Sieve may be increased to 20%.

D. Materials are to be measured by weight and/or volumetric methods. The flowable fill may be mixed in a central concrete mixer, a ready mix truck, or by other acceptable methods. The flowable fill shall be transported to the point of placement in a revolving drum mixer or in an agitator unit.

E. The Contractor may be required to provide test data from a laboratory inspected by the Cement and Concrete Reference Laboratory and approved by the governing authority that shows the proposed mix design is in accordance with the requirements listed above.

F. Consistency shall be tested by placing a three inch (3”) diameter by six inch (6”) high open ended cylinder on a smooth, nonporous, level surface and filling it to the top with the flowable fill. Pull the cylinder straight up within 5 seconds of filling and measure the spread of the fill. The minimum diameter of the spread shall be eight inches (8”).

2.07 FOUNDATION MATERIAL

A. Where required, foundation material shall be No. 2 stone or Revetment, Class 1 Riprap, or Uniform Riprap, per INDOT 904.04, or other material appropriate for the conditions, as approved by the Engineer.

2.08 TRENCH DAMS/PLUGS

Trench dams or plugs shall be one of the following:

A. Compacted earthen trench dams or plugs shall consist of compacted, cohesive, impervious soils meeting ASTM D2487 classification GC, SC, CL, or ML, and compacted to 95 percent of maximum density at or near the optimum moisture content (ASTM D698). Compacted trench dams shall be 3 ft. thick (along the pipe).

B. Engineered trench dams shall consist of two parallel fabricated anti-seep collars spaced at least one foot (1') apart (spacing between anti-seep collars shall not be less than the pipe nominal diameter) filled with a well-mixed, engineered core material that consists of rounded stone and dry bentonite clay powder (approximately 80% stone by weight and 20% bentonite by weight). Core material shall be poured in a dry state and shall "flow" around and under the pipe, conforming to the pipe shape and filling voids and inconsistencies in the surrounding soils. Once exposed to water (by natural processes), the hydrated core material shall expand and form a water-tight seal while remaining somewhat flexible. Engineered trench dams shall be by AquaBlok.

C. Trench dams or plugs shall extend the full depth of the bedding and embedment (and at least 12 inches above top of pipe) and the full width of the trench from wall to wall.

PART 3: EXECUTION

3.01 CONSTRUCTION EQUIPMENT

A. All excavation, backfilling, and materials handling equipment shall have rubber tires when mains are located in or adjacent to pavements unless otherwise approved by the Engineer and authorities with jurisdiction. Track equipment will generally be permitted only when there is no danger of damaging pavement or when all pavement will be replaced under the Contract promptly following pipeline installation.

B. It is the Contractor's responsibility, to repair, at their expense, any damages due to the use of any equipment to complete the Work.

3.02 NOISE, DUST AND ODOR CONTROL

A. Conduct all construction activities so as to avoid all unnecessary noise, dust and odors.

B. Contractor shall take all necessary measures to control dust from his operations and to prevent spillage of excavated materials onto public roads.

C. Appropriate measures acceptable to the Owner and applicable federal, state, and local authorities shall be taken to prevent blowing dust. Contractor shall sprinkle water at locations and in such quantities and at such frequencies as may be required by the Owner to control dust and prevent it from becoming a nuisance to the surrounding area.

D. Contractor shall remove all spillage of excavated materials, debris, and dust from public roads by methods approved by the Owner.

E. Contractor shall operate and maintain equipment with the proper mufflers, baffles, panels, and other sound-attenuating devices in place and in good operating condition so as to control noise levels in the work area.

F. Contractor shall take any other reasonable measures required by the Owner to control noise and prevent it from becoming a nuisance to the surrounding area.

3.03 PROTECTION OF TREES

A. Clearing and grubbing shall comply with the requirements of Section 02105.

B. Take special care to avoid damage to trees and their root system. Open trenching shall not be used near established trees in areas marked on the Drawings and designated “Tree Protection”. In a “Tree Protection” open-cut excavation shall be provided by hand exposing and excavation around existing tree roots, and/or tunneling or boring.

C. In other areas where established trees are to remain with roots in the path of the trench line, as indicated on the Drawings or otherwise required, the Contractor shall install pipe through tree roots by acceptable means approved by the Engineer. In these areas, methods to be used may include careful cutting (not ripping or tearing) of larger tree roots if authorized by the Engineer.

D. In all cases, operate equipment within the drip line in a manner that will not injure trees, trunks, branches, or their roots. Extra care shall be taken when employing booms, storing materials, and handling excavated materials.

E. Contractor is solely responsible for tree replacement damaged as a result of the Work and all construction activities.

3.04 TRENCH SUPPORT

A. Support open cut excavation for mains where trenching may cause danger to life, unnecessary damage to street pavement, trees, structures, poles, utilities, or other private or public property. Support the sides of the excavation by adequate and suitable sheeting, shoring, bracing or other approved means in accordance with all applicable Federal, State, County, Municipal, and OSHA rules and regulations during the progress of the Work.

B. Maintain the trench support materials and equipment in place until backfilling operations have progressed to the point where the supports may be withdrawn without endangering life or property per General Conditions Article 6 on safety issues.

C. Contractor is solely responsible for trench support and safety of the work area and all construction activities. Refer to requirements of Section 15000.

3.05 TRENCH EXCAVATION AND BOTTOM PREPARATION

A. General Earth Excavation:

1. General excavation shall consist of the satisfactory removal and disposal of all material taken from within the limits of the Work contracted, meaning the material lying between the original ground line and the finished ground line as shown on the Drawings regardless of whether the original ground line is exposed to air or is covered by water. Excavation below existing ground line to enable any required construction or removals is included. It is distinctly understood that any reference to earth, rock, silt, debris or other materials on the Drawings or in the Specifications is solely for information and shall not be taken as an indication of classification of excavation or the quantity of earth, rock, silt, debris or other material encountered.
2. Excavate to the lines and grades indicated on the Drawings or established in the field by the Engineer. Backfill and compact over-excavated areas with approved fill material. All labor and materials associated with over-excavation shall be furnished at the Contractor's expense.
3. Keep all excavations free from water. Maintain groundwater a minimum of 6 inches below excavations in accordance with Section 02020. Remove soil which is disturbed by pressure or flow of groundwater and replace with free draining material.
4. Remove pavement over excavations made in paved roadways by saw cutting, milling, or removal by a trench machine. Cut the full depth of the pavement with straight lines and squared edges. Pavement cuts are to be continuous lines, minimizing horizontal offsets as shown on the Drawings and approved by the Engineer. Saw cuts may be eliminated where paving abuts curb or roadway expansion joints or construction joints, and pavement can be removed without damaging or disturbing curbs or remaining pavement. Remove sidewalks in full squares only. Saw cut sidewalks straight and perpendicular if no joint exists.
5. The Contractor shall be required to remove and dispose off-site all excess excavated materials, spoils and debris, and excavated materials unsuitable for backfilling. If spoils and debris are removed from the right of way under the jurisdiction of the State of Indiana, they must be disposed of in an approved INDOT certified dump site.

B. Rock Excavation:

1. If the Contract includes a unit price for rock excavation, the unit price shall include the removal, hauling, stockpiling and/or proper disposal of the rock per Section 01075 Basis of Payment. Rock is defined as:
   a. Boulders or loose rock having a volume of one cubic yard or more;
   b. Material which cannot be loosened or broken down by ripping with a hydraulic ripper or other Engineer-approved devices and equipment designed to remove rock; or
   c. Material that requires systematic blasting, backhoe ramming, barring, or wedging for removal.
2. Notify the Engineer promptly upon encountering rock. No payment will be made for rock removed without Engineer's approval.
3. Strip rock for measurements as directed by the Engineer. No payment will be made for rock excavated or loosened before measurement. Only rock actually removed will be paid for. Payment width shall be a maximum of pipe barrel plus 24 inches (12 inches each side of pipe). Unless otherwise shown on the Drawings, the payment depth shall be 6 inches below bottom of pipe, unless additional depth has been removed at the direction of Engineer. The Engineer's determination as to whether the material meets the definition of rock and Engineer's measurement of the volume of rock removal for which the Contractor is entitled to payment will be final and conclusive.

C. Trench Width:

Widths of trenches shall be held to a minimum to accommodate the pipe and appurtenances and permit proper installation and joint assembly. The trench width shall be measured at the top of the pipe barrel and shall conform to the following limits:

<u>Earth:</u>

Minimum:	Outside diameter of the pipe barrel plus 8 inches (i.e. 4 inches each side).
Maximum:	Nominal pipe diameter plus 24 inches (i.e. 12 inches each side).

<u>Rock:</u>

Minimum:	Outside diameter of the pipe barrel plus 24 inches (i.e. 12 inches each side).
Maximum:	Nominal pipe diameter plus 30 inches. (Contractor will only be compensated for the minimum described above.)

D. Excessive Trench Width:

Provide additional backfill, embedment, and bedding material, as specified above and as approved by the Engineer, to fill any trench excavation that exceeds the maximum trench width defined in Paragraph 3.05.E.

E. Trench Depth and Bottom Preparation:

1. Provide prescribed minimum cover from the top of the pipe barrel to the top of the finished grade, unless otherwise authorized by the Engineer, or as shown on the Drawings.
2. Earth: Excavate to the depth required, so as to provide a uniform and continuous bearing and support for the pipe barrel on solid and undisturbed ground at every point between joints. It will be permissible to disturb the finished trench bottom over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle, provided such disturbed areas are filled with the embedment material. Provide bell holes at each bell joint. Prepare the finished trench bottom accurately using hand tools. When required for the pipe material, excavate to sufficient depth to allow for the required bedding; and prepare a pipe bed using bedding material as specified for the pipe material.
3. Rock: Excavate trenches in rock or boulders 6-inches below the pipe barrel unless otherwise directed by the Engineer. Remove all loose material from the trench bottom. Prepare a pipe bed using bedding material as specified for the pipe material.
4. For both earth and rock excavation, a bedding shall be constructed if the trench bottom contains alternating hard and soft areas or rock particles larger than permitted in the embedment material. In such cases, Contractor shall excavate to sufficient depth to allow for the required bedding as specified for the pipe material and prepare a pipe bed using bedding material as specified for the pipe material. Contractor shall perform continuous evaluation of the trench bottom in areas with changing conditions.
5. Unsuitable Bottom: Notify the Engineer whenever fluid or unstable trench subgrade (i.e. unsuitable material incapable of supporting the pipe without settlement, differential settlement, or soil displacement) is found. Remove the material over the area and to the depth determined by the Engineer. Provide compacted foundation and/or bedding material as directed to restore the trench bottom to the required grade in these areas. Where foundation material is used, prepare a pipe bed on top of the foundation using bedding material as specified for the pipe material.

F. Open Trench Length:

The length or size of excavation shall be controlled by the pipe laying length and the particular surrounding conditions, but shall always be confined to that which can be safely maintained and does not unreasonably restrict access. The length of open trench required for installation of fused HDPE pipe shall be in accordance with AWWA Manual M55. The Owner and Engineer reserve the right to limit the length or size of the excavation. If the excavation becomes a hazard, or if it excessively restricts traffic or other access at any point, Owner or Engineer may require special construction procedures, such as limiting the length of the open trench or prohibiting placing excavated material in the street. Contractor shall take precautions to prevent hazard or injury to the public due to open trenches. All trenches, excavated material, equipment, or other obstacles accessible to the public, shall be well lighted.

3.06 GENERAL TRENCH BEDDING, EMBEDMENT, AND BACKFILL REQUIREMENTS

A. **General Requirements:**

1. Wherever specific materials are stated on the Drawings for bedding, embedment, and/or backfill, those requirements supersede the material requirements indicated in this section, unless such requirements conflict with backfill requirements of governing authorities.
2. Mechanical equipment may be used to place the bedding, embedment, and backfill materials. Place the materials in such a manner that the materials do not free fall, but rather flow onto the previously placed material. Crushed aggregate and other materials with angular stones larger than ¾-inch (measured in largest dimension) shall not be dumped directly onto the pipe (regardless of pipe material).
3. When trench walls are supported by trench boxes or other temporary devices (e.g. sheeting, bracing, shoring, etc.), do not compact bedding or embedment materials against the walls of the trench supports and then move the supports, which would compromise the structural integrity of the pipe. Follow appropriate procedures to ensure that compaction within the pipe bedding and embedment zones is performed for the full width between the trench walls and subsequently undisturbed.
4. Do not compact embedment or backfill with mechanical equipment such as wheeled vehicles until cover depth over the pipe exceeds requirements to prevent damage to the pipe, as recommended by the most stringent applicable standard or manufacturer's recommendations.
5. For pipe installation under roads or within road rights-of-way, maximum lift thickness and compaction densities shall further meet requirements of the governing authority, which may be more stringent.

B. **Bedding:**

1. All pipe and fittings shall be uniformly and continuously supported over the entire length on firm, stable material. Bedding shall be compacted by appropriate, approved compaction methods and to appropriate density for the bedding material type as indicated in the applicable standard(s) referenced in Part 1 above or as directed by the Engineer.
2. Prepare pipe bedding immediately before pipe is installed.
3. It will be permissible to disturb the finished bedding over a maximum length of 18 inches near the middle of each length of pipe by the withdrawal of pipe slings or other lifting tackle, provided such disturbed areas are filled with the embedment material. Provide bell holes at each bell joint.
4. Blocking shall not be used under piping except as specifically required in other sections.

C. **Embedment (Haunch Area and Initial Backfill):**

1. The embedment is the most important zone in terms of pipe performance. The pipe embedment shall be stable and placed in such a manner as to evenly support and physically shield the pipe from damage. Embedment material in the haunch area (from the bottom of the pipe to the pipe springline) provides the most resistance to pipe deflection and is essential to the integrity of flexible pipe. Initial backfill provides some pipe support and helps protect the pipe from damage.
2. Embedment material in the haunch area shall be placed under the pipe haunches by dumping and slicing with a shovel and hand tamping to fill all voids. Extra care shall be taken to ensure all voids are filled when using crushed aggregate.
3. Embedment materials shall be placed in compacted layers (or lifts) not exceeding 6-inches each, in such manner as to completely fill all voids and eliminate the possibility of settlement.
4. Compaction shall be performed by appropriate compaction methods, in appropriate lift thicknesses, and to appropriate densities for the embedment material type as indicated in the applicable standard(s) referenced in Part 1 above or as directed by the Engineer.
5. Distribute material on both sides of the pipe evenly to maintain alignment. Do not allow more than half the pipe diameter or one lift thickness (maximum 6”) difference in elevation of the material on opposite sides of the pipe.
6. Maintain pipe alignment. When placing fill in the haunch area and initial backfill, take care to avoid moving the pipe or damaging pipe or joints. When compacting material in the haunch area, prevent pipe from raising due to the compaction effort.
7. Do not dump embedment material into a large pile in the trench prior to spreading it into layers for compaction.

D. **Final Backfill**

1. Place final backfill in approximately-uniform compacted layers (or lifts) not exceeding 12 inches each, in such manner as to fill the trench completely so that there are no voids and no settlement occurs. Final backfill is critical to the integrity of roads, driveways, parking areas, sidewalks, and structures. Under or within five feet (5’) of driveways, roads, parking areas, sidewalks, or structures, maximum lift thickness shall not exceed 6 inches.
2. Compaction shall be performed by appropriate compaction methods in appropriate lift thicknesses not exceeding those indicated in the below schedule, and to at least the densities specified below, which refer to percentages of maximum density as determined by the noted test methods, for the backfill material type and the finished surface type. In cases where the applicable standard(s) referenced in Part 1 above are stricter or as otherwise directed by the Engineer, those requirements shall govern.

	Density % Std. Proctor (D698)	Density % Mod. Proctor (D1557)	Max. Lift Thickness as Compacted Inches
Backfill Around Structures	95	92	8
Select Sand	--	98	8
Crushed Stone Pipe Bedding	**	**	12
Backfill in Pipe Trenches – Open Terrain (Including Lawns and Other Grass Areas)	95	92	12
Backfill in Pipe Trenches – Under Roadways*, Driveways, Parking Lots, Sidewalks, Curbs, and Other Paved or Concreted Areas	98	95	8

* Backfill and compaction within five feet (5') horizontally of roadways shall be the same as under roadways.

** The aggregate shall be compacted to a degree acceptable to the Engineer by use of a vibratory compactor and/or crawler tractor.

3. Each layer shall be sufficiently compacted during backfill operations to uniformly develop lateral passive soil forces such that all trench backfilling shall be stable with surrounding soil and no settlement of adjacent soils or structures occurs.

E. **Filter Fabric**

1. Contractor shall install filter fabric at all interfaces between coarse and fine materials in the following situations:

   a. in areas with visible or otherwise known or suspected groundwater movement

   b. anywhere fine or soft consistency soils are encountered, bedding material shall be wrapped in filter fabric (trench bottom, side, and over top of haunch area) to prevent the migration of finer grained soils into this material or the migration of this material into the trench bottom or sidewall

   c. prevent migration of soil fines into, out of, or between layers of the embedment material

   d. when using ¾ inch minus or modified granular fill for bedding or embedment in coarse-graded soils to prevent fine particles from eroding into the surrounding soils

   e. if trench excavation is in unsuitable soils that extend above the foundation, Contractor shall place filter fabric between the unsuitable soils and all bedding, embedment, and backfill materials

   f. where required by the Drawings

   g. where directed by the Engineer

F. **Trench Dams/Plugs**

1. Under any of the following conditions, Contractor shall install trench dams or plugs. Trench dams shall be installed at intervals as shown on the Drawings or as directed by the Engineer (but not to exceed spacing of 400 ft.).
2. On both sides of any lake, pond, river, creek, or stream crossing installed by open-cut methods.
3. When any Select Fill bedding and/or embedment material is used in any of the following cases:
   a. Areas with known or suspected groundwater movement.
   b. Areas with maximum annual groundwater level above the bottom of the trench (excluding foundation).
   c. If subsurface flowing water is intercepted by the trench, trench dams shall be installed on both sides.
4. Where required by the Drawings.
5. Where directed by the Engineer.

3.07 BEDDING, EMBEDMENT, AND BACKFILLING – OPEN TERRAIN (INCLUDING LAWNS AND OTHER GRASS AREAS)

A. **Ductile Iron Pipe:**

1. Bedding:
   a. In Suitable Soil – When trench subgrade is free of rock particles larger than permitted in the embedment material, consistent (i.e. free of alternating hard and soft areas), and suitable to support the pipe without settlement, differential settlement, or soil displacement, bedding is not required (unless indicated on the Drawings or required in Section 01000, 01011, and/or 01075). When no bedding is required, pipe shall be laid directly on undisturbed soil prepared as specified in paragraph 3.05 G. 2.
   b. In Rock or Unsuitable Soil – Bedding shall consist of Common Fill or a Select Fill material having a maximum aggregate size as specified in Part 2 for the pipe size, with a minimum bedding depth of 4 inches.
   c. Regardless of the native soils, when pipe cover depths exceed the following limits, bedding shall consist of any Select Fill material, having a maximum aggregate size as specified in Part 2 for the pipe size, with a minimum bedding depth of 6 inches.
      i. 3” and 4” diameter: >60 ft. depth
      ii. 6” diameter: >30 ft. depth
      iii. 8” diameter: >20 ft. depth
      iv. 10” and 12” diameter: >15 ft. depth
      v. 16” and larger diameter: >10 ft. depth
2. Embedment:
   a. Haunch Area – Fill used in haunch areas shall consist of Common Fill or any Select Fill material having a maximum aggregate size as specified in Part 2 for the pipe size. However, where pipe bedding is provided, the

same material that is used for the bedding shall also be used in the haunch area.

b. Initial Backfill (to top of pipe) – Initial backfill shall consist of Common Fill or any Select Fill material having a maximum aggregate size as specified in Part 2 for the pipe size.
c. For any ductile iron pipe installed with cover depth exceeding the following limits, embedment shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
    i. 8" and smaller diameter: >30 ft. cover.
    ii. 10" to 20" diameter: >25 ft. cover.
    iii. 24" and Larger diameter: >20 ft. cover.

3. Final Backfill:
    a. Final backfill shall be Common Fill. Surface restoration (including topsoil where applicable) shall be in accordance with the applicable Specification section.

B. **PVC Pipe:**

1. Bedding:
    a. Bedding shall consist of any Select Fill non-crushed, coarse aggregate (including ¾ inch Clean Granular Fill) having a maximum aggregate size as specified in Part 2 for the pipe size or B-Borrow Sand, with a minimum bedding depth of 6 inches.
    b. ¾ inch Minus and Modified Granular Fill Material is not permitted for bedding under PVC pipe.
    c. Aggregate over ¾-inch with angular edges shall not be used in contact with PVC pipe, regardless of pipe size.

2. Embedment:
    a. Haunch Area – Fill used in haunch areas shall be the same Select Fill non-crushed, coarse aggregate or B-Borrow Sand used for the pipe bedding. ¾ inch Minus and Modified Granular Fill Material or aggregate over ¾ inch with angular edges are not permitted in the haunch area for PVC pipe.
    b. Initial Backfill (to 12-inches above top of pipe) – Initial backfill shall consist of any non-crushed Select Fill material or B-Borrow Sand having a maximum aggregate size as specified in Part 2 for the pipe size. Aggregate over ¾ inch with angular edges are not permitted for initial backfill of PVC pipe.
    c. For any PVC pipe installed with cover depth exceeding the following limits, embedment shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
        I. DR 14 (<=12" size): >25 ft. cover.

3. Final Backfill:
    a. Final backfill shall be Common Fill. Surface restoration (including topsoil where applicable) shall be in accordance with the applicable Specification section.

C. **HDPE Pipe:**

1. Bedding:
   a. Bedding shall consist of any Select Fill material having a maximum aggregate size as specified in Part 2 for the pipe size, with a minimum bedding depth of 6 inches.
2. Embedment:
   a. Haunch Area – Fill used in haunch areas shall be the same Select Fill material used for the pipe bedding.
   b. Initial Backfill (to 6-inches above top of pipe) – Initial backfill shall consist of the same Select Fill material used in the haunch area.
   c. For any HDPE pipe installed with cover depth exceeding the following limits, embedment material shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
      i. DR 11 (any size): >20 ft. cover.
      ii. DR 9 or DR 7.3 (>12" size): >20 ft. cover.
      iii. DR 9 or DR 7.3 (<=12" size): >25 ft. cover.
3. Final Backfill:
   a. Final backfill shall be Common Fill. Surface restoration (including topsoil where applicable) shall be in accordance with the applicable Specification section.

3.08 BEDDING, EMBEDMENT, AND BACKFILLING – UNDER OR WITHIN FIVE FEET OF ROADWAYS, DRIVEWAYS, PARKING LOTS, SIDEWALKS, AND OTHER PAVED OR CONCRETED AREAS (AND LOCATIONS WHERE FLOWABLE FILL IS USED AS FINAL BACKFILL)

Local City/Town standards may specify backfilling materials in conjunction with those specified below and shall be met by the Contractor.

A. **Ductile Iron Pipe (All Sizes):**

1. Bedding:
   a. Bedding shall consist of any Select Fill material having a maximum aggregate size as specified in Part 2 for the specified pipe diameter with a minimum bedding depth of 4 inches.
2. Embedment (Haunch Area and Initial Backfill to Top of Pipe):
   a. Fill used for pipe embedment shall be the same Select Fill material used for the pipe bedding. No other materials are permitted for pipe embedment.
   b. For any ductile iron pipe installed with cover depth exceeding the following limits, embedment shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
   c. 8" and smaller diameter: >30 ft. cover.
   d. 10" to 20" diameter: >25 ft. cover.
   e. 24" and Larger diameter: >20 ft. cover.

f. Final Backfill:

3. Final backfill shall be #53 crushed limestone coarse aggregate. Surface restoration (including topsoil where applicable) shall be in accordance with the applicable Specification section.

B. **Plastic Pipe (PVC or HDPE) 10" to 12":**

1. Bedding:
   a. Bedding shall consist of any Select Fill material having a maximum aggregate size as specified in Part 2 for the specified pipe diameter with a minimum bedding depth of 6 inches.
   b. Aggregate over ¾-inch with angular edges shall not be used in contact with PVC pipe.
   c. B-Borrow Sand
2. Embedment (Haunch Area and Initial Backfill):
   a. Fill used for pipe embedment shall be the Select Fill material used for the pipe bedding. No other materials are permitted for pipe embedment. Aggregate over ¾-inch with angular edges shall not be used in contact with PVC pipe.
   b. For any PVC pipe installed with cover depth exceeding the following limits, embedment shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
      i. DR 14 (10" to 12" size) : >25 ft. cover.
   c. For any HDPE pipe installed with cover depth exceeding the following limits, embedment material shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
      i. DR 11 (any size): >20 ft. cover.
      ii. DR 9 or DR 7.3 (>12" size): >20 ft. cover.
      iv. DR 9 or DR 7.3 (<=12" size): >25 ft. cover.
3. Final Backfill:
   a. Final backfill shall be #53 crushed limestone coarse aggregate. Surface restoration (including topsoil where applicable) shall be in accordance with the applicable Specification section.

C. **Plastic Pipe (PVC or HDPE) Smaller than 10":**

1. Bedding:
   a. Bedding shall consist of any Select Fill material having a maximum aggregate size as specified in Part 2 for the pipe size, with a minimum bedding depth of 6 inches. If required by the Engineer or governing authority, bedding material shall be crushed coarse aggregate having a maximum aggregate size as specified in Part 2 for the pipe size.
   b. Aggregate over ¾-inch with angular edges shall not be used in contact with PVC pipe.
2. Embedment (Haunch Area and Initial Backfill):
   a. Fill used for pipe embedment shall be the same Select Fill material (or the same crushed coarse aggregate, if required by the Engineer or governing

authority) used for the pipe bedding. Aggregate over ¾-inch with angular edges shall not be used in contact with PVC pipe.

b. For any PVC pipe installed with cover depth exceeding the following limits, embedment shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
   i. DR 14 (<=10" size): >25 ft. cover.

c. For any HDPE pipe installed with cover depth exceeding the following limits, embedment material shall be as shown on the Drawings or directed by the Engineer as designed for the specific conditions.
   i. DR 11 (any size): >20 ft. cover.
   ii. DR 9 or DR 7.3 (<=12" size): >25 ft. cover.

3. Final Backfill:
   a. Final backfill shall be #53 crushed limestone coarse aggregate. Surface restoration shall be in accordance with the applicable Specification section.

3.09 SPECIAL BACKFILLING USING FLOWABLE FILL

Flowable fill shall be used for final backfill (not for pipe bedding or embedment) if required by the governing authority (e.g. if required by the right of way excavation permit) or at the Contractor's option in lieu of the above requirements for backfilling under or within five feet (5') of driveways and roads.

A. Bedding and Embedment:

1. When flowable fill is used for final backfill, pipe bedding and embedment shall be as specified above for installations under or within five feet (5') of roadways, driveways, and other paved and concreted areas.

B. Final Backfill:

1. Final backfill shall be flowable fill. Surface restoration shall be in accordance with the applicable Specification section.
2. Placement: Discharge the mixture from the mixing equipment into the space to be filled by a means approved by the Engineer. The flowable fill shall be brought up uniformly to the fill line. Each filling stage shall be as continuous as practicable. Do not place concrete on the flowable fill until all bleeding water has disappeared and the resistance, as measured by ASTM C403, is at least 60 psi, or as directed by Engineer. Do not place asphalt until at least 24 hours after the fill is completely in place.
3. Limitations: Do not place flowable fill on frozen ground. Protect flowable fill from freezing until the material has stiffened and bleeding water has disappeared. As the temperature nears freezing, additional curing time shall be allowed as needed or as required by the Engineer.

C. When Contractor uses this method at his discretion in lieu of final backfill as specified above, it shall be provided at no additional cost to the Owner.

3.10 MAINTENANCE OF SURFACE CONDITIONS

Attend to the trench surface regularly during the course of the Contract. Take prompt corrective measures to correct any settlement or wash-out. Maintain the trench surface in a safe condition that does not interfere with natural drainage. Any material required for backfilling the trenches or for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at his expense.

3.11 TRENCH MAINTENANCE

Contractor shall be fully responsible for the condition of the trenches for a period of one (1) year from the date of the final acceptance of the Contractor's Work, or as required by federal, state, or local authorities. Any materials required for filling depressions caused by settlement or wash-out shall be supplied and placed by the Contractor at their expense.

END OF SECTION

SECTION 02220

CASING INSTALLATION

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this section consists of providing all labor, materials, tools, equipment, and services required to perform all casing installation and related work as indicated on the Drawings and as specified within this section and related sections of the Specifications. Contractor shall furnish and install all products that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 GENERAL REQUIREMENTS

A. The installation of casing pipe shall conform to these Specifications and any Federal, State or local Highway requirements or applicable Railroad requirements whichever may be more restrictive.

B. Contractor shall perform any general excavation and boring required prior to placing casing pipe. Material resulting from boring shall be disposed of off-site by the Contractor in a suitable manner. Contractor shall provide all necessary access including access ladders, ramps, etc. to bore and receiving pits in compliance with all applicable safety requirements prior to the commencement of the boring and jacking operations.

C. Contractor shall furnish the names and experience records of all Subcontractors proposed for this Work. The Contractor or Subcontractor performing the boring and jacking construction shall have a minimum of three (3) years' experience in boring and jacking casing pipe on similar projects of similar pipe diameters.

D. Highway crossings shall comply with standards set forth in the INDOT policies and procedures, Division of Highways (latest revision), and the "Standard Specifications for Highway Bridges" from AASHTO (latest revision).

E. Railway crossings shall comply with standards set forth under "Standard Specifications for Pipelines Conveying Non-Flammable Substances" in the *Manual of Railway Engineering* from the American Railway Engineering and Maintenance-of-Way Association,

F. The materials covered by these Specifications are intended to be standard materials of proven reliability and as manufactured by reputable manufacturers having experience in the production of such materials. The materials furnished shall be designed, constructed, and installed in accordance with the best practices and methods.

1.03 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300, including the following:

A. Casing pipe Shop Drawings and material data from casing pipe manufacturer.

B. Bore pit excavation details including footprint drawing of bore pit, design and calculations for any sheeting or shoring utilized signed and sealed by a professional engineer registered in the State of Indiana.

C. Construction sequence plan including drilling, casing, and grouting placement procedures.

D. Casing spacer manufacturer's data and Shop Drawings.

E. Casing end seal manufacturer's data and Shop Drawings.

F. Casing field weld procedure details to be used, which shall be in accordance with AWWA C206 Sec. 4.6.

G. Experience qualifications of Contractor or Subcontractor.

H. Results of welder qualification testing conducted by an independent testing agency in accordance with American Welding Society D1.1 requirements. Results of previous qualification tests performed within six months from the date of pipe installation will be acceptable. Results from qualification tests performed prior to six months from the date of pipe installation will not be acceptable.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 01570 Traffic Regulation

G. Section 01600 Products

H. Section 02020 Dewatering

I. Section 02025 Existing Utilities and Structures

J. Section 02105 Clearing and Grubbing

K. Section 02210 Trenching, Backfilling and Compacting

L. Section 02230 Stream Crossing

M. Section 02540 Erosion and Sedimentation Control

N. Section 02558 Identification/Location Guide

O. Section 02610 Roadway Paving and Surfacing

P. Section 02620 Gravel Roads and Driveways

Q. Section 02820 Lawn Restoration and Landscaping

R. Section 03310 Cast-in-Place Concrete for Paving, Driveways, Sidewalks, Curbs, and Paved Ditches

S. Section 15000 Piping – General Provisions

T. Section 15105 Ductile Iron Pipe & Fittings

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

B. ASTM A139 – Electro-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

C. AWWA C200 – Steel Water Pipe, 6 In. and Larger

D. AWWA C206 – Field Welding of Steel Water Pipe

E. AWWA C600 – AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances

F. AASHTO "Standard Specifications for Highway Bridges"

G. INDOT policies and procedures

H. *Manual of Railway Engineering*, The American Railway Engineering and Maintenance-of-Way Association

PART 2: PRODUCTS

2.01 CASING PIPE

A. The casing pipe shall be smooth wall, longitudinally-rolled or spiral welded steel pipe. Smooth wall steel plates with a nominal diameter of over 54 inches shall not be permitted. Casing pipe shall be leak-proof construction and be capable of withstanding highway or railroad loadings where applicable. Casing pipe shall be steel pipe in sizes 8-inches nominal and larger manufactured from steel having a minimum yield stress strength of 35,000 psi.

B. The steel casing pipe diameter and wall thickness shall be as indicated in the table below or as indicated on the Drawings, whichever is larger. All casing thicknesses are for uncoated casings. The inside diameter of the casing pipe shall be at least four (4) inches greater than the outside diameter of the carrier pipe joints or couplings for carrier pipe less than six (6) inches in diameter and at least six (6) inches greater than the outside diameter of the carrier pipe joints or couplings for carrier pipe six (6) inches and greater in diameter. Contractor shall ensure that casing pipe size is large enough to comply with these requirements and to afford easy removal of the carrier pipe without disturbing the casing pipe or roadbed. Consideration shall be given to the specific pipe product, joint types, joint restraints, and casing spacers to be used. If larger casing pipe size than indicated in the following table is necessary, Contractor shall provide the larger casing pipe at no additional cost to the Owner.

Casing Outside Diameter (inches)	Carrier Pipe Nominal Sizes Allowed (inches)	Casing Wall Thickness (inches)	
		Highway Crossings	Railroad Crossings
8.625	<=2	0.250	0.250
10.75	<=2	0.250	0.250
12.75	<=3	0.250	0.250
14	<=3	0.250	0.281
16	<=4	0.250	0.375
18	<=6	0.250	0.375
20	<=8	0.3125	0.375
22	<=10	0.375	0.375
24	<=12	0.375	0.406
30	<=16	0.500	0.469
36	<=20	0.500	0.532
42	<=24	0.5625	0.688
48	<=30	0.625	0.688
54	<=36	0.719	0.781
60	<=42	0.719	0.844
66	<=48	0.750	0.938
72	<=54	0.750	1.000

C. The casing pipe shall conform to AWWA C200 and ASTM A139, Grade B (without hydro-test) or ASTM A53, Grade B (without hydro-test).

2.02 SPLIT CASINGS

In locations where a casing is required to be installed around an existing water main, the Contractor shall install one of the following casing types:

A. Steel casing pipe as specified above, which is cut into two equal halves longitudinally (along the length of the pipe) by the supplier prior to shipment to the project site. The two halves shall be assembled over the existing water main, with casing spacers already installed; and the casing pipe shall be welded along the seam as specified herein. Only stainless steel casing spacers shall be used when this type of split casing is used (since plastic coatings could be damaged by welding of casing).

B. Split steel casings with weldable split sleeve and weld protection liner, to protect the carrier pipe and casing spacers, as manufactured by Westatlantic Tech Corp. Except when flanged gasketed maintenance pipe casing is used, all split casings installed on carrier pipes made of PVC, HDPE, fiberglass and other materials potentially subject to damage from welding shall be split steel casings with weld protection liners unless otherwise approved by the Engineer.

2.03 CARRIER PIPE

In cases where required by the Drawings or otherwise approved by the Engineer, water tight split casings shall be flanged gasketed galvanized steel maintenance pipe with EPDM or NBR seals and bolted, flanged fasting joints. End seals shall be supplied by the casing manufacturer and shall be water tight unless otherwise indicated on the Drawings. Flanged gasketed maintenance pipe shall be as manufactured by Westatlantic Tech Corp.

A. The carrier pipe shall be ductile iron restrained joint pipe as specified in Section 15105, unless otherwise indicated in Section 01011 or shown on the Drawings.

2.04 GROUT

A. Grout shall be composed of Portland Cement and sand, consisting of one part Portland Cement to three parts sand. Sand shall conform to the requirements of ASTM C144. Water amount shall be the minimum amount necessary to achieve desired consistency without compromising strength requirements. The minimum compressive strength at 28 days shall be 4000 psi.

B. For annular spaces wider than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added.

C. Contractor or boring Subcontractor may use admixture approved by the Engineer to allow workability of grout at his option and at no additional cost to the Owner.

2.05 CASING SPACERS

A. Casing spacers shall be sized according to the manufacturer's specifications for pipe sizes from the following list of approved manufacturers and casing types:

1. Cascade Water Works Manufacturing Company (Stainless Steel only).
2. Pipeline Seal and Insulator, Inc. (Carbon Steel with polyvinyl chloride or the Ranger II model).
3. Advanced Products and Systems, Inc. (Model SI).
4. Power Seal Pipeline Products Corp. (Model 4810).
5. RACI (polyethylene model F-60 for 12-inch carrier pipe and smaller). RACI shall not be used for carrier pipe larger than 12-inch.

B. At the sole discretion of the Engineer, alternate manufactures in lieu of those described above and new or improved products by the same manufactures may be permitted. To seek approval, adequately describe any proposed alternate product and submit the same with Shop Drawings and specifications to the Engineer. The Contractor shall not proceed to employ said alternate products prior to receiving written approval of from the Engineer.

C. Timber skids are not allowed.

2.06 CASING END SEALS

A. End seals shall consist of pull-over type rubber seals that are designed to be installed after pipe installation by wrapping the seal around the pipes and securing the overlapping seam with pressure-sensitive butyl mastic (or other approved adhesive) to seal the seam.

B. End seals shall be at least 1/8-inch thick EPDM or Neoprene rubber.

C. End seals shall be attached to the casing and carrier pipe with Type 304 or 316 stainless steel bands, at least ½-inch wide, with entirely non-magnetic worm gear mechanism.

D. End seals and bands shall be properly sized for the casing and carrier pipe with the manufacturer's recommended seam overlap.

E. Acceptable Manufacturers:

1. Cascade Waterworks Manufacturing Model CCES
2. Advance Products Systems Model AW

PART 3: EXECUTION

3.01 EXCAVATION

Excavation, backfilling and compaction for jacking and receiving pits and for open cut installation shall conform to the requirements set forth in Section 02210.

3.02 ALIGNMENT AND GRADE

Locate pipelines to cross roadways or tracks at approximately right angles where practicable, but preferably at not less than 45 degrees. Do not place pipelines in culverts or under bridges where there is a likelihood of their restricting the area required for the purposes for which the bridges or culverts were built, or of endangering the foundations. Install the casing pipe on an even grade for its entire length and sloped to one end or as noted in a profile plan if provided. Satisfy a maximum tolerance of 1.5% (18” in one hundred feet) with the desired location of the casing or as otherwise required by regulation or specified on the Drawings, whichever is more restrictive.

3.03 WELDING

A. Connect steel casing sections by full-circumference metal arc-welding. All joints shall be butt welded with a full depth, single "V" groove weld. Welding shall conform to AWWA Standard C206.

B. Welding shall be performed by certified welders. The Contractor shall be responsible for the qualification of welders with qualification testing conducted by an independent testing agency in accordance with American Welding Society D1.1 requirements. All costs associated with qualification testing shall be included in the unit prices bid.

3.04 DEPTH OF INSTALLATION

Unless the depth of casing pipe is specifically specified on the Drawings, the casing pipe depth shall be in accordance with highway or railroad requirements.

3.05 INSTALLATION OF CASING

Refer to Indiana American Water Standard Detail Drawings for a typical casing installation detail.

Install casing pipes by one of the following methods:

A. Jacking:

This method shall be in accordance with the current American Railway Engineering and Maintenance-of-Way Association Specifications, Chapter 1,

Part 4, Section 15, "Earth Boring and Jacking Culvert Pipe through Fills", except that steel pipe shall be used with welded joints. Conduct this operation without hand mining ahead of the pipe and without the use of any type of boring, auguring or drilling equipment.

Design the bracing, backstops, and jacks so that the jacking can progress without stoppage (except for adding lengths of pipe).

B. Drilling:

This method employs the use of an oil field type rock roller bit, or a plate bit made up of individual roller cutter units, welded to the pipe casing being installed. Turn the pipe for its entire length from the drilling machine to the head to give the bit the necessary cutting action against the ground being drilled. Inject high density slurry (oil field drilling mud) through a supply line to the head to act as a cutter lubricant. Inject this slurry at the rear of the cutter units to prevent any jetting action ahead of the pipe. Advance the drilling machine on a set of steel rails (thus advancing the pipe) by a set of hydraulic jacks. The method can be used to drill earth or rock.

If required, casing installation may be accomplished by the directional drill method with the following criteria: The drilling operation shall not result in a boring hole larger than 24” in diameter.

C. Boring:

This method consists of pushing the pipe into the fill with a boring auger rotating within the pipe to remove the soil. When augers or similar devices are used for pipe placement, the front of the pipe shall be provided with mechanical arrangements or devices that will positively prevent the auger and cutting head from leading the pipe so that there will be no unsupported excavation ahead of the pipe. The auger and cutting head arrangement shall be removable from within the pipe in the event an obstruction is encountered. The over-cut by the cutting head shall not exceed the outside diameter of the pipe by more than one-half inch. The face of the cutting head shall be arranged to provide reasonable obstruction to the free flow of soft or poor material.

If an obstruction is encountered during installation that stops the forward action of the pipe, and if it becomes evident that it is impossible to advance the pipe, operations will cease and the pipe shall be abandoned in place and filled completely with grout.

If voids are encountered or occur outside the casing pipe, grout holes shall be installed in the top section of the casing pipe at 4 foot (maximum) centers and the voids filled with grout with sufficient water added to produce a flowable mixture and at sufficient pressure to prevent settlement. The Contractor shall be prepared to bore through weathered or partially weathered rock, if encountered, with a specialized bit or hand-mine. Costs associated with this provision shall be deemed as included in the Unit Price Bid for each location and no additional payment will be made. Grout holes shall only be used in casings where it is feasible. Grout around outside of casing pipe when bore hole diameter is great than outside diameter of casing pipe by more than 1 inch.

In the event an obstruction is encountered during the boring and jacking operation, and the casing pipe is at least 30-inches in diameter, the auger shall be withdrawn and the obstruction removed. If a boulder is encountered and is removed by blasting or other approved method, the void shall be filled with grout, as previously specified. No blasting shall be permitted until a detailed blasting plan is submitted to and approved by the INDOT, and the Engineer. No blasting shall be permitted within railroad right of way.

The recommended methods and details shown on the Drawings and specified herein, are intended to indicate the minimum acceptable standard of quality required for the casing/tunnel installation. Other methods of installation, based on acceptable industry standards and techniques, may be acceptable for the installation. Under no conditions shall jetting or wet boring of the casing/tunnel be allowed.

Prior to the beginning of any casing/tunnel excavation, a surface settlement monitoring grid system shall be installed on the highway/railroad. This grid shall consist of PK nails installed along the tunnel centerline at ten foot intervals. Additional lines of PK nails shall be installed ten feet each side of the centerline. These points shall be initially read and the elevations recorded prior to the start of the casing/tunnel construction. If no visible settlement is occurring during casing/tunnel excavations, these points shall be read only at such times as the Contractor's surveyor is present to transfer the line and grade into the casing/tunnel. These points shall be checked and elevations recorded on a daily basis, until the casing/tunnel installation is completed. Elevations of casing and pavement or railroad tracks shall be referenced to the nearest benchmark elevation and recorded on the record drawings.

3.06 CARRIER PIPE INSTALLATION

The carrier pipe and casing shall be separated by casing spacers. The spacing of casing spacers shall be in accordance with the manufacturer’s recommendation to support the weight of the pipe and contents. As a minimum, a casing spacer shall be placed within a maximum of 3 feet on each side of a joint and evenly spaced along the carrier pipe with 3 casing spacers per each length of carrier pipe—or more frequently if recommended by the casing spacer manufacturer. Maximum distance between casing spacer and internal wall of casing pipe shall be 2-inches. The required procedure to install the carrier pipe is to attach the casing spacers and assemble the pipe joints outside the casing and push the assembled carrier pipe through the casing on the casing spacers. Timber skids are not allowed. Polyethelene encasement is not required on the carrier pipe located inside the casing.

3.07 PROTECTION AT ENDS OF CASING

A. After installation of the carrier pipe within the casing and successful pressure testing of the carrier pipe, provide casing end seals in accordance with the Owner’s standard details at each end of casing pipe as a barrier against backfill

debris and seepage. End seals shall be as specified above and shall be installed in accordance with manufacturer's recommendations.

B. Prior to installation of end seals, the carrier pipe shall be properly and sufficiently secured to prevent movement.

C. End seals shall overlap the casing pipe by at least two inches (2"). Bands shall be placed approximately 1½-inches from each edge of the end seal.

D. Grout shall not be used to seal casing pipe ends or to fill the annular space within the casing.

END OF SECTION

SECTION 02230

STREAM CROSSING

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this section consists of providing all labor, materials, tools, equipment, and services required to perform stream crossings as indicated on the Drawings and as specified within this section and related sections of the Specifications.

A. Perform the stream crossings in such a manner as to protect the water main from erosion and to restore, as much as practicable, the stream banks and bottom to their original condition and in compliance with requirements of the regulating agencies.

B. Protect the water main from erosion by concrete encasement around the pipe or by a sufficient depth of compacted backfill as shown on the Drawings.

1.02 PROFILES AND TOPOGRAPHY

A. Contours, topography and profiles of the ground as may be shown on the Drawings are believed to be reasonably correct, but are not guaranteed and are presented only as an approximation. It is the Contractor's responsibility to verify proposed centerline elevations at a maximum spacing of 50-feet, including deepest channel point, prior to attempting the installation.

B. The Contractor accepts the construction site with the conditions that existed at the time of bidding. Contractor is responsible for documenting any change in conditions since bidding and shall notify Engineer and provide all such documentation prior to commencing the stream crossing.

1.03 PERMITS

A. Owner or Engineer shall provide Contractor with applicable permits for stream crossing construction activities.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 02020 Dewatering

E. Section 02105 Clearing and Grubbing

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 02458 Horizontal Directional Drilling (HDD)

H. Section 02540 Erosion and Sedimentation Control

I. Section 02558 Identification/Location Guide

J. Section 02820 Lawn Restoration and Landscaping

K. Section 03305 Cast-in-Place Concrete for Pipe Work

L. Section 15000 Piping - General Conditions

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly.

A. Indiana Administrative Code Title 327 Water Pollution Control Division (327 IAC)

B. Indiana Administrative Code Title 327 (327 IAC) 8-3.2-10 Water mains near surface water bodies.

PART 2: PRODUCTS

2.01 MATERIALS

A. Valves shall be installed on both sides of the stream crossing outside of the floodway or as otherwise shown on the Drawings and/or directed by the Engineer.

B. Marker posts shall be installed on both sides of the stream crossing outside of the floodway or as otherwise shown on the Drawings and/or directed by the Engineer.

PART 3: EXECUTION

3.01 CONSTRUCTION PROCEDURE

A. The Drawings shall indicate the methodology to be used for the required stream crossing (i.e., open cut, directional drill or jack and bore) in compliance with the applicable stream opening permit(s). Any and all required permits shall be

obtained by the Owner. Contractor shall comply with construction procedures stipulated in the permit(s) and indicated on the Drawings. The methodology shown on the Drawings shall be used and not altered in any way.

3.02 OPEN CUT CROSSING

A. Stream Division

1. Construct a cofferdam or barricade of sheet piling, sandbags or a turbidity curtain to keep the stream from continually flowing through the disturbed areas. Turbidity curtains shall be a pre-assembled system and used only parallel to flow.
2. Stage construction by confining first one-half of the channel until work there is completed and stabilized, then move to the other side to complete the crossing.
3. Route the stream flow around the work area by bridging the trench with a rigid culvert, pumping or constructing a temporary channel. Temporary channels shall be stabilized by rock or completely lining the channel bottom and side slopes with geotextile fabric.

B. The crossing width of clearing shall be minimized through the riparian area. The limits of disturbance shall be as shown on Drawings.

C. Clearing shall be done by cutting NOT grubbing. The roots and stumps shall be left in place to help stabilize the banks and accelerate revegetation. Roots and stumps within the trench area shall only be removed when the water main is being installed.

D. Material excavated from the trench shall be placed at least 20 feet from the streambanks and in compliance with regulatory requirements. To the extent other constraints allow, stream shall be crossed during periods of low flow.

E. Water mains installed under a stream shall be provided with a minimum five feet (5') of cover below the stream bed and a minimum five feet (5') of cover at the stream banks.

F. The time between initial disturbance of the stream area and final stabilization shall be kept to a minimum. Excavation within the stream area, including between top of bank and top of bank and an additional 10 feet on each side, shall not begin until all the materials required for the entire crossing are on-site and ready for installation. When possible, pipe and fittings shall be preassembled. Once excavation begins within the stream area, all construction work shall be accomplished as expeditiously as possible in accordance with the Drawings, applicable permit(s) and as directed by the Engineer.

3.03 DEWATERING

A. Dewatering or pumping water containing sediment shall not be discharge directly to a stream. The flow shall be routed through a settling pond, silt sack,

dewatering sump or a flat, well-vegetated area adequate for removing sediment before the pumped water reaches the stream or drainage system.

B. Dewatering operations shall not cause significant reductions in stream temperatures. If groundwater is be discharged in high volumes during summer months, it shall first be routed through a settling pond or overland through a flat well-vegetated area.

3.04 STREAM BANK RESTORATION

A. Restore the stream banks by backfilling the main trench with mechanically compacted backfill of earth or rip rap, approved by the Engineer and in compliance with regulatory requirements, to the original ground surface or as shown on Drawings. The limits of compaction shall extend from the top of bank to top of bank on each side of the crossing as determined by the Engineer or as shown on the detail drawings provided. Where stream bank exceeds a 3:1 slope, special erosion control and anchoring are required as shown on the Drawings or otherwise directed by the Engineer.

B. Immediately following the completion of a stream crossing, place straw bales or silt-fence along the trench excavation on each stream bank from within two (2) feet of the edge of water to beyond the limits of the excavated trench width per detail on straw bale and fabric fence. Straw bales or silt-fence shall remain in place until after the stream banks have been fine graded, fertilized and seeded, and the seeding has grown sufficiently to protect the stream banks from erosion.

3.05 STREAM BOTTOM RESTORATION

If the Drawings call for open cut across the stream bottom, backfill the trench within the stream bank (high water to high water) with mechanically compacted earth or riprap that has been approved by the Engineer and meeting regulatory requirements. Rip rap placement must be flush with existing stream bottoms from upstream to downstream.

3.06 TRENCHLESS CROSSINGS

In cases where stream crossings are made by horizontal directional drilling or boring and jacking (with casing installation), installation shall conform to Section 02458 or 02220, respectively.

A. Maximum depth of cover shall not exceed 8 feet below the bottom of stream without Engineers approval, unless otherwise indicated.

B. Minimum depth of cover shall exceed 5 feet below the bottom of stream without Engineers approval, Unless otherwise indicated.

END OF SECTION

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SECTION 02350

PIPE BURSTING OF WATER MAINS

PART 1 -- GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to construct new piping by pipe bursting as indicated on the Drawings and as specified within this section and related sections, resulting in a complete, finished water main installation. Contractor shall furnish and install all piping and other required materials that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

B. The pipe bursting process involves the replacement of existing water main by installing new pipe material within the enlarged bore created by the use a static, hydraulic, or pneumatic hammer "moling" device, suitably sized to break the existing pipe or by using a modified boring "knife" with a flared plug that crushes the existing pipe. Forward progress of the "mole" or the "knife" may be aided by hydraulic equipment or other apparatus. Replacement pipe is pulled into the bore. Water services are reconnected to the new pipe through small excavations from the surface. All excavations required for reconnecting of service flows, entry pits, exit pits, obstruction removal, point repairs, among others, are to be kept to a minimum and all damage to surface and underground features, facilities, utilities, and improvements are to be repaired by Contractor at no additional cost to Owner.

C. Only the static pipe bursting method is permitted and covered by this section. Hydraulic or pneumatic methods of pipe bursting are only permitted where shown on the Drawings, specified in Section 01011, or allowed in writing by the Engineer. If hydraulic or pneumatic methods are permitted, Contractor shall submit equipment to be used, detailed procedures, and Work Plan, which must be approved by the Engineer prior to beginning Work.

D. Pre-chlorinated pipe bursting method is permitted and covered by this section. This method is permitted only when approved by the Owner and in locations indicated on the drawings. Prior to undertaking any Work, Contractor shall submit a detailed pre-chlorination procedure, which shall include any modifications to the flushing, testing, and disinfection procedures specified in Sections 15020, 15025, and 15030. The pre-chlorination procedure shall be approved by the Owner prior to commencing Work.

1.02 GENERAL REQUIREMENTS

A. Pipe bursting Contractor/Subcontractor is directed to and shall comply with all related sections indicated below under Related Work.

B. All Work performed under this section shall be in conformance with all other applicable sections of the Specifications, regardless of whether or not individually identified herein.

C. Contractor shall provide adequate site security and shall be responsible for the integrity of the pipe until after the installation, final testing of the pipeline, and acceptance of the Work by the Engineer and Owner.

1.03 COORDINATION OF WORK

A. Contractor shall coordinate all pipe bursting Work performed under this section by Contractor or Subcontractor and shall be responsible to ensure a complete, finished system as required by and in full conformance with the Drawings and these Specifications.

B. Coordinate and schedule shutdowns, connections to existing pipelines, flow bypass, temporary water service and all other Work as required by Sections 01000, 15000 and other sections of the Specifications.

C. Coordinate with other utilities and structures as requires by Section 02025 and this section. The kinds, locations and sizes of the existing underground utilities which may be shown on the Drawings are intended only as a guide to the Contractor and are not guaranteed. Contractor shall be responsible for notifying all utility owners along the route and in the vicinity of the pipe bursting installation prior to the construction and for all required test borings and excavations. Contractor shall be required to perform soft digs to verify existing utility locations and depths of all existing utilities in proximity to the water main to be pipe burst, and this work shall be at no additional cost to the Owner or Engineer.

D. Coordinate all pipe bursting work, including connections to existing pipelines with Engineer and Owner (refer to Section 15000 for further requirements). The Engineer and Owner must be notified 48 hours in advance of starting each phase of the Work. Pipe bursting shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the Work as authorized under the Contract. It shall be the responsibility of Engineer or Owner to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

E. If the Contractor fails to begin the pipe bursting at the agreed time, the Engineer or Owner shall establish the next mutually convenient time to begin. To avoid undue hardship of either party, reasonable and mutual cooperation should be exercised where starting times are concerned. If one party fails to meet the agreed schedule, the other party is expected to consider a delayed start if the installation cannot be completed during daylight hours.

1.04 PROFILES AND TOPOGRAPHY

A. Contours, topography and profiles of the ground as may be shown on the Drawings are believed to be reasonably correct, but are not guaranteed and are presented only as an approximation. It is the Contractor's responsibility to verify proposed pipeline elevations as necessary prior to attempting the pipe bursting. Contractor shall notify Owner and Engineer of any discrepancies from the Drawings identified.

B. Prior to performing Work, Contractor shall verify by potholing horizontal location and vertical elevation of each existing utility including all structures that are in proximity to the existing pipeline to be pipe bursted. Contractor shall maintain a written record of such items and furnish Owner written report of existing data. No contract price adjustment will be allowed for field verification of existing information. Contractor shall be responsible for all damages incurred to existing facilities damaged as a result of pipe bursting operations.

1.05 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer’s literature and product data, certifications and other required submittals for all products furnished under this section in accordance with Section 01300 as well as the following information:

A. QUALIFICATIONS OF PIPE BURSTING CONTRACTOR/SUBCONTRACTOR

The Qualifications of the pipe bursting Contractor/Subcontractor shall be submitted. The pipe bursting Contractor/Subcontractor shall show that he has completed at least 5 successful static pipe bursting projects of similar size and length within the past 5 years. These Qualifications shall include detailed descriptions of the following, which shall be sufficient to verify the requirements of Article 1.04 below:

1. Name, business address and telephone number of the pipe bursting Contractor/Subcontractor.
2. A list of at least five references of previously-completed projects of similar size and length, including project engineer’s and customer’s names, addresses, telephone numbers, pipe materials (existing and new), pipes sizes (existing and final diameters), and lengths where the static pipe bursting method was used.
3. Name(s) of all supervisory personnel to be directly involved with pipe bursting for this project. For each individual, list previous pipe bursting projects and the individual’s responsibilities on that project.
4. Verification of training by the pipe bursting system manufacturer utilized stating that the operators and supervisory personnel have been fully trained in the use of the pipe bursting system by an authorized representative of the equipment manufacturer.
5. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the

supervisory personnel for the pipe bursting method will be directly involved with and used on this project.

B. WORK PLAN

The following Work Plan and other information is required from the Contractor or pipe bursting Contractor/Subcontractor and shall also be supplied to the pipe supplier or manufacturer promptly upon request:

1. Pipe bursting equipment information and certification indicating the applicability of equipment, operator, and methods commensurate with the size and scope of the project, including any proposed lubricants (if applicable) to be used in the operation.
   a. Pipe Bursting Machine Detail Sheet
   b. Bursting/Splitting Head Detail Sheet
   c. Expander and Pulling Head Connection Detail Sheet
   d. Pipe Material Detail Sheet
   e. Fluid/Chemical MSDS
   f. Certifications
2. Written description of the construction methods and equipment to be used, with access shaft or pit sizes required for equipment and material.
3. Engineering drawings and details for the particular pipe bursting process to be employed on the Work, including maximum pulling forces and capabilities for injection of lubricant to assist in the installation.
4. Contingency plan, including the following:
   a. Unforeseen obstructions that stop or delay the operation
   b. Unforeseen deflections that would over bend the HDPE pipe
   c. Excessive surface heaving or subsidence
   d. Damage to existing utility installations
   e. Required spot repairs of the existing line
5. For each pipe bursting operation, indicate all excavation locations (including insertion and access pits, valve and fitting replacements, and other excavations), excavation dimensions, interfering utilities, and flow bypass.
6. A flow bypass and temporary water service plan in accordance with Sections 01000, 01500 and 15000.
7. Work schedule identifying construction sequencing, work hours, and working dates for each installation.

C. Pre-chlorination procedures when pre-chlorination will be used.

D. Approval: No field work shall commence without approval by the Engineer. Details and design calculations shall be submitted and approved in advance of the pipe bursting operation to prevent delays in work. All final layout work, including grades, shall be the Contractor's responsibility.

E. The Contractor shall provide a Maintenance of Traffic Plan in accordance with Section 01570. Specifically note in the Maintenance of Traffic Plan any street

intersections that are to remain open as required during the pipe bursting operation, or traffic detours to be implemented. Contractor shall install a temporary sleeve across the street intersections through which the pipe can be pulled or shall construct a temporary bridge for the pipe over the intersections as required.

F. As-built Records:

1. The Contractor shall furnish red-line plan and profile drawings, on the same horizontal and vertical control datum shown on the Contract Documents, based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation.
2. Other as-built information and Record Documents shall be as required in Sections 01300 and 01700.

1.06 QUALITY ASSURANCE

A. The pipe bursting equipment operator(s) shall be trained to operate the specific equipment for the Owner's project with at least 3 years' experience in pipe bursting obtained within the last five years. Perform pipe bursting operations under the constant direction of a pipe bursting supervisor who shall remain on site and be in responsible charge throughout the pipe bursting operation. The Contractor's supervisor shall have supervised pipe bursting of a minimum of 5,000 linear feet of pipe of a similar or greater diameter, of similar materials, over similar lengths, and with similar subsurface conditions.

B. Substitutions of pipe bursting personnel and/or methods will not be allowed without written authorization of the Engineer. If pipe bursting is performed by non-approved personnel or methods, it may result in removal of that pipe bursting Contractor/Subcontractor from the project; and any work performed by the non-approved personnel or by non-approved methods will be rejected.

C. The completed pipeline interior shall be smooth and continuous, without unacceptable deflection (based on the pipe manufacturer's recommendations, Section 15125, and the relevant standards referenced therein), over the entire length of the installation. Owner and Engineer reserve the right to perform any suitable internal inspections of the completed pipeline before or after acceptance to verify adherence to these requirements.

D. Adherence to this section, or the Engineer's approval of any aspect of any pipe bursting operation covered by this section, shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the Work authorized under the Contract.

1.07 WARRANTY

A. The Contractor shall warrant a useable pipeline that is of the diameter, pressure rating, and other characteristics specified in the Contract Documents. The pipeline shall be smooth and continuous over the entire length of the installation.

B. The Contractor shall also warrant that the equipment used on this Project, where covered by patents or license agreements, is furnished in accordance with such agreements and that the prices bid for the Work on the Project cover all applicable royalties and fees in accordance with such license agreements. The Contractor shall defend, indemnify and hold the Owner and Engineer harmless from and against any and all cost, loss, or damage or expense arising out of or in any way connected with any claim of infringement of patent, trademark, or violation of license agreement.

1.08 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 01570 Traffic Regulation

G. Section 01600 Products

H. Section 01700 Project Closeout

I. Section 02020 Dewatering

J. Section 02025 Existing Utilities and Structures

K. Section 02210 Trenching, Backfilling and Compacting

L. Section 02540 Erosion and Sedimentation Control

M. Section 02558 Identification/Location Guide

N. Section 02820 Lawn Restoration and Landscaping

O. Section 15000 Piping – General Provisions

P. Section 15020 Disinfecting Pipelines

Q. Section 15025 Flushing and Cleaning Pipelines

R. Section 15030 Pressure and Leakage Tests

S. Section 15105 Ductile Iron Pipe and Fittings

T. Section 15125 High Density Polyethylene (HDPE) Pipe

U. Section 15130 Piping Specialties

V. Section 15170 Tapping Sleeves, Saddles and Valves

W. Section 15185 Abandonment of Mains and Hydrants

X. Section 15200 Service Lines

1.09 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AWWA Manual M55 – PE Pipe Design and Installation

B. *Guideline for Pipe Bursting*, International Pipe Bursting Association, Division of NASSCO, Owings Mills, MD.

C. *Pipe Bursting Good Practices Guidelines*, Bennett, D., Ariaratnam, S. and Wallin, K., The North American Society for Trenchless Technology.

PART 2 -- PRODUCTS

2.01 PIPE MATERIALS

Unless otherwise specified in the Contract Documents, pipe installed by pipe bursting shall be solid-wall DR 9 high density polyethylene (HDPE) pipe in compliance with Section 15125 or 15200 and specifically recommended by the manufacturer for pipe bursting.

2.02 INSPECTION OF PIPE

All pipe and fittings used in the Work may be factory inspected by a recognized third-party inspection agency engaged by the Engineer or Owner. Inform the Engineer, Owner and the inspection agency of the name and address of the manufacturing plant or other sources of materials to be used in the Work and

shall coordinate with the manufacturer to assure that the inspection agency has access at the manufacturer's plant and adequate assistance and notice so that each item may be examined. All reports shall be made to the Engineer and Owner and the cost of the services of the inspection agency shall be borne by the Owner. Such third-party inspection by the Owner shall not relieve the Contractor of his responsibility to furnish materials in accordance with the applicable standards.

2.03 BURSTING LUBRICANTS

A. Bursting lubricants may be used at the request of the Contractor upon written approval of the Engineer.

2.04 ALLOWABLE TYPES OF PIPE BURSTING SYSTEMS

A. STATIC PIPE BURSTING SYSTEMS:

1. Static pipe bursting systems shall be characterized by a tapered or blunt nosed pull head being pulled through the host pipe and breaking the host pipe by applying radial pressure to the host pipe. The host pipe fails by 'hoop' tensile stress applied by the head, and is fragmented and pushed into the surrounding bedding and soil as the pull head progresses. When required to burst existing pipe material, pull head shall include a pipe splitter.
2. The pull head shall be followed by an expansion head which shall further push the fragmented pipe into the surrounding soil and bedding to a diameter that allows the insertion of the new pipe (with tracer wires) behind it. Under no circumstances shall the pipe pull head be attached directly to the new pipe and used to expand or otherwise increase the diameter of the host pipe (or fragmented host pipe) without the use of an expander.
3. The pull head may be advanced by a hydraulic or winching mechanism.
4. Equipment shall be configured with adequate knives or other appropriate devices to minimize interruptions in the installation process due to obstruction removal and other problems.

B. PNEUMATIC OR PERCUSSIVE BURSTING SYSTEMS SHALL NOT BE ALLOWED unless specified in Section 01011 or allowed in writing by the Engineer.

2.05 PIPE PULL HEADS

A. Pipe pull heads shall be utilized and employ a positive through-bolt design assuring a smooth wall against the pipe cross-section at all times.

B. Pipe pull heads shall be designed for use with the existing host pipe and new HDPE pipe, and shall be as recommended by the pipe manufacturer.

C. The diameter of the pulling/pushing head shall be at least 0.5-inch greater than the bell outside diameter of the pipe being pulled, unless otherwise approved by the Engineer.

2.06 LOCATION (TRACER) WIRE

Location (tracer) wire shall be provided as specified for pipe bursting applications in Section 02558.

PART 3 -- EXECUTION

3.01 GENERAL

A. Protect the new pipe and components during all phases of Work, including hauling, installation, entry into the entry pit, and prevention of scarring or gouging of the pipe or components. Refer to Section 15000 for further requirements.

B. Contractor shall take care not to damage any new materials during pipe bursting operations. All pipes shall be visually inspected for gouges. Gouges in excess of ten percent (10%) of the pipe wall thickness are excessive and are not acceptable. Refer to Section 15125 for requirements in the event of excessive gouges or other damage.

C. Owner, Engineer and Resident Project Representative shall have access at all times to any measuring or gauging devices used for the horizontal drill as well as any drilling logs maintained by the Contractor.

3.02 SITE DISTURBANCE AND SOIL EROSION

A. All soil erosion and sediment control Work shall be performed in accordance with Section 02540.

B. The Contractor shall be responsible for the preservation of all existing trees, plants, and other vegetation that are to remain within or adjacent to the construction site and shall also be responsible for protecting existing concrete curb, fence, utilities, and other structures that are located within or adjacent to the construction site.

C. The Contractor assumes all liability for damage resulting from pipe bursting operations.

3.03 PERSONNEL REQUIREMENTS:

A. Provide a competent and experienced supervisor representing the pipe bursting Contractor/Subcontractor who must be present at all times during actual operations. A responsible representative, who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control

of the operation at all times. In all cases the supervisor must be continually present at the job site during the actual pipe bursting operations. Supervisor shall have minimum 5 years pipe bursting experience.

B. Have a sufficient number of competent workers on the job at all times to insure the pipe bursting is completed in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the pipe bursting operation must be on the job site at the beginning of work. If HDPE is specified, HDPE pipe thermal butt fusion welding shall be completed by a welder certified by the manufacturer of the pipe or pipe welding equipment, in accordance with the Plastic Pipe Institute "Handbook of Polyethylene Pipe," Polyethylene Joining Procedures, and 49 CFR 192, Subpart F, latest edition and in accordance with the requirements in Section 15125.

3.04 FLOW BYPASS AND TEMPORARY WATER SERVICE

A. Unless otherwise indicated in Section 01011, flow bypass, temporary valves, temporary fire hydrants (where existing fire hydrants are present) and temporary water service shall be provided for all existing pipelines to be replaced by pipe bursting (and any other pipelines that must be shut down during the Work) in conformance with the Drawings, Section 15000, and other requirements of the Contract Documents.

B. Traffic on roadways shall not be impeded by temporary water service piping, and Contractor shall maintain vehicular access to all driveways throughout the Work as specified in Section 15000. Temporary water service piping shall be protected at driveways and road crossings with cross-over ramps or by other methods approved by the Resident Project Representative and the agency with jurisdiction over the roadway.

3.05 CLEANING, TV INSPECTION, AND PREPARATION OF EXISTING PIPELINE

A. The host pipe shall be cleaned and inspected by CCTV prior to the bursting operation as directed by the Engineer.

B. Cleaning and CCTV inspection of the host pipe shall indicate condition of host pipe and suitability of host pipe for HDPE pipe insertion by pipe bursting methods.

C. Location of all service connections, fittings, valves and appurtenances shall be recorded.

D. Obstructions considered detrimental to the pipe bursting operation which may include corporation taps, fittings, valves, and valve bodies, and deformed piping shall be remedied prior to bursting and HDPE pipe insertion.

E. All existing valves, tees, bends, and other fittings within the limitations of the pipe bursting shall be replaced prior to pipe bursting (or after pipe bursting if these points are used as insertion/access pits).

F. Spot repairs (if applicable) shall be made in accordance with the Contract Documents.

G. The Contractor shall be aware that there may be sediment and buildup of tuberculation inside the existing water lines, and proposed pipe bursting equipment and methods shall properly account for this possibility.

H. Any known pre-existing concrete encasements shall be excavated and broken out prior to the bursting operation to allow the steady and free passage of the pipe bursting head.

3.06 LOCATION AND PROTECTION OF UNDERGROUND UTILITIES

A. Contractor shall positively identify and verify location, depth and size of all existing underground utilities and facilities potentially impacted by pipe bursting or other project activities and provide the Engineer with a comprehensive report of these facilities before starting any construction. Contractor shall take necessary precautions to protect all such utilities and facilities from damage, including exposing all existing utilities and facilities that are located in proximity to the water main to be pipe burst—i.e. within an envelope of possible impact of the bursting operation as determined for the project specific site conditions. It is the Contractor's responsibility to determine this envelope, safe burial depth and offset from existing utilities, subject to approval by the Owner. This will include, but is not limited to soil conditions and layering, utility proximity and material, pipe bursting system and equipment, and foreign subsurface material.

B. If existing utilities or other obstructions prohibit pipe bursting, or if other unusual site conditions are discovered, the Contractor shall request a review of site conditions by the Engineer and shall propose an alternate construction method (e.g. open-cut) for review and approval by the Engineer.

C. The Contractor shall be held completely and solely responsible for any damages incurred. Damage caused by the Contractor or pipe bursting Contractor/Subcontractor shall be repaired or replaced at the Contractor's cost and responsibility, regardless of whether such utilities or facilities are shown on the Drawings or not.

3.07 EXCAVATION AND ACCESS PITS

A. Location and number of insertion or launching pits shall be as indicated on the Contract Drawings.

B. Access pit length shall be such that the minimum bending radius for the HDPE pipe is not exceeded. Sheeting, shoring and bracing requirements shall be in accordance with the Contract Documents and applicable jurisdictional standards.

C. Access pit excavations shall be performed at all points where the new pipe will be inserted into the existing pipeline. When possible, access pit excavations

shall coincide with host pipe lateral connection points or other appurtenance installations.

3.08 PRE-CHLORINATED PIPE BURSTING

Chlorination of pipes prior to bursting shall be carried out per AWWA C651 standard for disinfecting water mains and in cooperation with the Owner's maintenance personnel. This method shall include the following:

A. Disinfect all equipment, tools, end caps, pipe fittings or products that may contact the pipe.

B. Disinfection shall be carried out by immersing or rinsing items in a sodium hypochlorous acid solution containing one to five percent chlorine measured by weight.

C. Pipe shall be fused into a string of sufficient length to complete the designated section. Maximum allowable length of pre-chlorinated pipe segments is 800 feet.

D. If required by the Engineer, surface upon which the product pipe rests during chlorination shall be relatively impervious, such as asphalt, concrete or stone, and free from visible contamination.

E. Coiled pipe must be laid horizontally to allow all air to be expelled.

F. Swabbing, chlorination and testing shall be accomplished by:

1. Swab inserted at the lowest end of the pipe.
2. Swabs shall be designated by the manufacturer as suitable for potable water system use and be manufactured by Knapp Industries or equal.
3. Calcium hypochlorite granules in accordance with Section 15020 shall be placed behind the swab.
4. Pressure tight end cap shall be mounted to the low end of the pipe by fusing or mechanical assembly.
5. Potable water shall be introduced through the end cap at a controlled rate such that the swab is propelled at a velocity less than or equal to one foot per second. All air shall be dispelled from the pipe.
6. Upon discharge of the swab from the elevated end of the pipe, elevated end shall be capped with a pressure tight seal. Seal shall have a NPT threaded tapped access hole sized in accordance with Section 15025 to purge air, flush, pressure test, disinfect, and sample the pipeline. Additional potable water shall be added after capping to ensure no air remains between the caps.
7. Pressure test the pipe as required in Section 15030.
8. Chlorinated solution shall be maintained for a minimum of 24 hours prior to flushing when the water temperature is above 41 degrees F or 48 hours when

water temperature is 41 degrees F or less. Time for retention of chlorinated solution shall not exceed 72 hours as required by Section 15020 so as to prevent damage to the pipe or end caps.

9. After designated holding time, the pipe shall be drained, flushed and filled with potable water to expel the highly chlorinated solution. Spent chlorinated solution shall be dechlorinated and disposed of, and pipe shall be tested and flushed, all in accordance with Sections 15020 and 15025.
10. Drain the section of pipe prior to pipe bursting. Pipe shall be drained on the day of pipe bursting and sealed after draining. Dispose of chlorinated water per Section 15020.

G. Dilute chlorinated solutions for pre-chlorinated pipe bursting over five days old shall be disposed of properly and not used as a disinfection agent.

3.09 PIPE BURSTING OPERATION

A. Pipe fusion process shall be in accordance with Section 15125. Pipe shall be assembled and fused on the ground in sections equivalent to the length of the anticipated pull. During installation, all bending and loading of the pipe shall be in conformance with manufacturer's recommendations and shall not damage the pipe.

B. Pipe shall be secured to the pulling/pushing device in accordance with standard practice.

C. The new HDPE pipe shall be inserted immediately behind the bursting head in accordance with the pipe manufacturer's recommended procedures. The bursting equipment shall be specifically designed and manufactured for the type of insertion process being used.

D. The Contractor shall provide equipment, planning, and job execution necessary to accomplish the work in an efficient manner and consistent with the objectives of this Section, including preventing damage to existing infrastructure, maintaining pedestrian and vehicle access, and providing continual water service to customers.

E. The Contractor shall utilize pipe bursting/crushing equipment with adequate pulling/pushing force to complete pulls in a timely manner. The Contractor shall provide equipment on the pulling mechanism to verify the pulling/pushing force exerted on the pipe does not exceed the manufacturer's recommendation for allowable pulling force to prevent damage to the pipe. Allowable pulling force for all diameters shall be determined by the Contractor depending on the pipe size, wall thickness, manufacturer, field conditions, pull distance, bearing capacity of soils, adjacent infrastructure, related equipment and cable strength, and related considerations.

F. Interruptions in the installation process shall be avoided or minimized to the extent possible.

G. Equipment used to perform the Work shall be located away from buildings so as not to minimize noise impact. Provide silencers or other devices to reduce machine noise as required by the Engineer or local requirements.

3.10 JOB CONDITIONS

A. Any nighttime work is strictly regulated and will be allowed only with prior approval granted by the Owner subject to regulatory agencies having jurisdiction. All pipe bursting operations shall be accomplished during daylight hours, unless approved by the Engineer. Pipe bursting work shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours, unless approved by the Engineer. The Contractor shall provide a Work Plan submittal indicating the proposed hours of operation and length of work week. All work plans shall be subject to compliance with all applicable regulatory requirements for construction activities and any off site impacts.

B. When hazards of nighttime work are carefully considered and determined to be insignificant, nighttime work may be allowed only to complete a properly planned pipe bursting installation, and only if, in the opinion of the Engineer, a delay was caused by reasonably-unavoidable circumstances and such nighttime work is necessary to avoid placing an undue economic hardship on the Contractor.

C. In emergency situations, or where delay would increase the likelihood of a failure, nighttime work may be allowed to complete a delayed pipe bursting installation.

D. Pipe pullback operations shall continue on a 24-hour per day basis until pipe pullback is complete, but work shall be properly planned and scheduled to avoid or minimize pipe pullback operations at night to the extent possible.

3.11 INSTALLATION ACCEPTANCE AND CLEANUP

A. Defects which may affect the integrity or strength of the pipe in the opinion of the Engineer shall be repaired or the pipe replaced at the Contractor's expense.

B. All exposed pipe that is pulled into the receiving pit behind the pull head shall be inspected for damage. Depending on the gouging, abrading or damage witnessed, the pipe may be accepted, de-rated, reinstalled, or abandoned as unusable per the Contract Documents. If the newly installed pipe is deemed damaged and unusable, the Contractor shall dig and replace the pipe to the extent directed by the Engineer at no additional expense to the Owner.

C. Following the installation, the project site shall be returned to a condition equal to or better than the pre-construction condition of the site. All excavations will be backfilled and compacted and all surfaces shall be restored per the Contract Documents.

D. Contractor shall verify that all utilities, structures, and sub-surface features within the envelope of possible impact of the bursting operation as determined for the project specific site conditions are sound and in proper working order.

3.12 FLUSHING, PRESSURE/LEAKAGE TESTING AND DISINFECTION

A. Prior to pipe pullback, perform an allowable leakage test in accordance with AWWA C600 and Section 15030 or a low pressure air test (procedure shall be proposed by Contractor and approved by Engineer) on the full length of pipe after all sections have been welded, fused or assembled. In the event that available lay down area does not permit assembly of the entire pipe length prior to pullback, the two assembled sections shall be tested independently.

B. A hydrostatic pressure test shall also be performed on the complete, installed pipe (i.e. after completion of all pipe bursting procedures) in accordance with AWWA C600 and as described in Section 15030.

C. The pipe shall be flushed and disinfected as described in Sections 15020 and 15025 or as otherwise approved in advance by the Engineer. Contractor shall provide Engineer with full work plan including any alternative testing methods.

3.13 CONNECTION TO ADJOINING PIPE

A. Perform connections in accordance with Sections 01000, 15000, 15105, 15120, 15125, 15130, and 15170, as applicable, from the pipe installed by pipe bursting to adjacent pipe, with support, backfill and compaction per Section 02210.

END OF SECTION

SECTION 02458

HORIZONTAL DIRECTIONAL DRILLING (HDD)

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to construct new piping by horizontal directional drilling as indicated on the Drawings and as specified within this section, resulting in a complete, finished water main installation. Contractor shall furnish and install all piping and other required materials that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 GENERAL REQUIREMENTS

A. HDD Contractor/Subcontractor is directed to and shall comply with all related sections indicated below under Related Work.

B. All Work performed under this section shall be in conformance with all other applicable sections of the Specifications, regardless of whether or not individually identified herein.

C. Contractor shall provide adequate site security and shall be responsible for the integrity of the pipe until after the pullback, final testing of the pipeline, and acceptance of the Work by the Engineer and Owner.

1.03 COORDINATION OF WORK

A. Contractor shall coordinate all work by HDD Contractor/Subcontractor and shall be responsible to ensure a complete, finished system as required by and in full conformance with the Drawings and these Specifications.

B. Coordinate and schedule connections to existing pipelines and all other Work as required by Sections 01000, 15000 and other sections of the Specifications.

C. Coordinate with other utilities and structures as requires by Section 02025 and this section. The kinds, locations and sizes of the existing underground utilities which may be shown on the Drawings are intended only as a guide to the Contractor and are not guaranteed. Contractor shall be responsible for notifying all utility owners along the route and in the vicinity of the HDD installation prior to the construction and for all required test borings and excavations. Contractor may be required to perform soft digs to verify existing utility depths, and this work shall be at no additional cost to the Owner or Engineer.

D. Coordinate all HDD work, including connections to existing pipelines with Engineer and Owner (refer to Section 15000 for further requirements). The Engineer and Owner must be notified 48 hours in advance of starting each phase of the Work. The directional bore shall not begin until the Engineer is present at the job site and agrees that proper preparations for the operation have been made. The Engineer's approval

for beginning the installation shall in no way relieve the Contractor of the ultimate responsibility for the satisfactory completion of the Work as authorized under the Contract. It shall be the responsibility of Engineer or Owner to provide inspection personnel at such times as appropriate without causing undue hardship by reason of delay to the Contractor.

E. If the Contractor fails to begin the directional bore at the agreed time, the Engineer or Owner shall establish the next mutually convenient time to begin. To avoid undue hardship of either party, reasonable and mutual cooperation should be exercised where starting times are concerned. If one party fails to meet the agreed schedule, the other party is expected to consider a delayed start if the installation cannot be completed during daylight hours.

1.04 PROFILES AND TOPOGRAPHY

A. Contours, topography and profiles of the ground as may be shown on the Drawings are believed to be reasonably correct, but are not guaranteed and are presented only as an approximation. It is the Contractor's responsibility to verify proposed centerline elevations at a maximum spacing of 50-feet (including deepest channel point where applicable) prior to attempting the directional bore.

B. Prior to performing Work, Contractor shall verify by potholing horizontal location and vertical elevation of each existing utility including all structures that will be along the pipeline route. Contractor shall maintain a record of such items on the Contractor’s red-line markups and other Record Documents as necessary to fully document existing data (refer to Section 01300). No contract price adjustment will be allowed for field verification of existing information. Contractor shall be responsible for all damages incurred to existing facilities damaged as a result of directional drilling operations.

1.05 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer’s literature and product data, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300 as well as the following information:

A. QUALIFICATIONS OF HDD CONTRACTOR/SUBCONTRACTOR

The Qualifications of the horizontal directional drilling Contractor/Subcontractor shall be submitted. The HDD Contractor/Subcontractor shall show that he has completed at least 5 successful HDD projects of similar size and length within the past 5 years. These Qualifications shall include detailed descriptions of the following, which shall be sufficient to verify the requirements of Article 1.04 below:

1. Name, business address and telephone number of the horizontal directional drilling Contractor/Subcontractor.
2. A list of at least five references of previously-completed projects of similar size and length, including project engineer’s and customer’s names, addresses, telephone numbers, pipe materials, pipes sizes, and lengths where the HDD method was used.

3. Name(s) of all supervisory personnel to be directly involved with HDD for this project. For each individual, list previous HDD projects and the individual's responsibilities on that project.
4. Verification of training by the directional drilling system manufacturer utilized stating that the operators and supervisory personnel have been fully trained in the use of the system by an authorized representative of the equipment manufacturer.
5. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel for the HDD method will be directly involved with and used on this project.

B. When required, the Contractor shall provide a Work Plan submittal indicating the proposed hours of operation and length of work week. All work plans shall be subject to compliance with all applicable regulatory requirements for construction activities and any off site impacts.

C. Submit to the Engineer copies of a report of schedules, calculations, field survey information, procedures and any supplemental subsurface soil condition investigations performed along the path of the proposed directional bore. Number of copies of the report shall be as specified in Section 01300. The report shall summarize the subsurface conditions that are known to the Contractor, including the proposed pipeline installation procedure based upon factual, best available information. If the subsurface conditions are known to the Contractor by previous work or geotechnical studies done in the immediate area, the information shall be recorded in the report along with any additional geotechnical studies performed by the Contractor. The report shall include the following:

1. Subsurface Information (if available)
   a. Report any subsurface conditions known to the Contractor by previous work or prior geotechnical studies performed in the immediate project area (except information included in the Contract Documents).
   b. Additional borings performed by the Contractor and analysis of soils along the path of the proposed directional bore: The Contractor shall be responsible for obtaining and including in his bid price the cost of any additional borings along the pipe alignment that may be necessary to design the proposed directionally drilled installation. For installations 16-inch nominal diameter or larger (or where otherwise required by the Contract Documents), supplemental borings shall be performed by the Contractor. In such cases, test borings shall be performed to a minimum depth of ten (10) feet below the proposed pipe invert unless rock is encountered, in which case test borings shall penetrate at least two feet into rock. Testing shall include standard United States Geological Survey (USGS) classification of soils, standard penetration tests, split spoon sampling and sieve analysis. Rock sampling and analysis shall include Mohr's Hardness and friction coefficient.
2. Drilling Equipment and Methods
   a. Submit details of equipment and written procedure with working drawings describing in detail the proposed boring method and the entire operation to be used. This shall include, but not be limited to, entry and exit pits; settlement pit; size, capacity and arrangement of drilling and pulling equipment; layout of carrier pipe; details and spacing of pipe rollers; type of

current head; method of monitoring and controlling line and grade; method of detection of surface movement; and layout of any proposed construction staging areas.

b. In addition, submit for approval nameplate data for the drilling equipment, mobile soil spoils removal unit, and Material Safety Data Sheets (MSDS) information for the drilling slurry compounds. This must be submitted and reviewed by the Engineer before Work can proceed.

3. Piping
   Submit Shop Drawings showing the pipe lengths, design details, joint details and structural performance data for the Engineer's review. Submittals shall include, but are not limited to, the following:
   a. All welding or fusion procedures to be used in fabrication of the different pipe materials and installation methods.
   b. Certified records for hydrostatic testing of all pipe materials to be used.
   c. An affidavit stating that all pipe materials furnished under this section have been manufactured in the United States of America and comply with all applicable provisions of referenced AWWA standards.

4. Proposed Alignment
   Submit a graph in plan and profile plotting the pilot drilling hole alignment for review, including entry/exit angles and radius of curvature. After completion of the directional bore, submit a final pipe alignment drawing.

5. Schedule (when required)
   Time schedule for completing the Directional Drilling, including any delays due to anticipated soil conditions.

6. Calculations (for all HDD installations 16-inch nominal diameter and larger and any other installations where required by the Owner or Engineer):
   a. Submit detailed design calculations for several representative loading conditions for the proposed directional bore. If requested by the Engineer, submit calculations to support the design of any particular location of pipe anywhere along the length of the directional bore at no additional cost to the Owner.
   b. Design calculations shall be presented in a neat, readable format, with all figures, values and units included to facilitate ease of verification.
   c. Calculations shall be submitted to demonstrate that the pipe thickness design is sufficient to meet all design criteria specified.
   d. Calculations shall address the following loading conditions:
      i. Pre-installation: Hoop and longitudinal stress during hydrostatic test; spanning stress with pipe full of water and supported on installation rollers, and maximum roller / support spacing.
      ii. Installation/Post-Installation: Longitudinal stress from pulling force; longitudinal curvature stress at point of entry and in final position; external pressure from drilling fluid, overburden, and loads from the obstacle being crossed.
      iii. Post-Installation/In-Service: Hoop and longitudinal stress during hydrostatic test; internal working and surge pressure; buckling with internal vacuum (50-year unconstrained critical collapse pressure).
   e. Perform and submit to the Engineer fluids pressure versus overburden strength calculations. These calculations shall be performed to determine minimum acceptable cover requirements and prevent drilling fluids breakout to the ground surface.
   f. All calculations shall bear the seal of a Registered Professional Engineer.

Licensure in the State that the work is performed is required.

D. Approval: No field work shall commence without approval by the Engineer. Details and design calculations (when required) shall be submitted and approved in advance of the drilling operation to prevent delays in work. All final layout work, including grades, shall be the Contractor's responsibility.

E. The Contractor shall provide a Maintenance of Traffic Plan in accordance with Section 01570 (when applicable). Specifically note in the Maintenance of Traffic Plan any street intersections that are to remain open as required during the pipe pullback operation, or traffic detours to be implemented. Contractor shall install a temporary sleeve across the street intersections through which the pipe can be pulled or shall construct a temporary bridge for the pipe over the intersections as required.

F. As-built Records:

1. During pullback, maintain records for submission to Engineer and Owner indicating job, date, time, constant pipe footage progress, mud flow rates, pulling forces required and torque readings. Document the pull head location for each length of drill stem pipe for as-built records. The MGS pullback data shall be recorded for every pilot hole drill stem length during the actual directional bore operation.
2. The Contractor shall furnish “as-built” plan and profile drawings, on the same horizontal and vertical control datum shown on the Contract Documents, based on these recordings showing the actual location horizontally and vertically of the installation, and all utility facilities found during the installation.
3. In addition, Contractor shall maintain a daily project log of drilling operations and guidance system log. Daily logs shall include as a minimum the following every 15 minutes throughout each drill pass, back ream pass, or pipe installation pass: Drilling fluid pressure, drilling fluid flow rate, drill thrust pressure, drill pullback pressure, and drill head torque.
4. Other as-built information and Record Documents shall be as required in Sections 01300 and 01700.

1.06 QUALITY ASSURANCE

A. The HDD equipment operator(s) shall be trained to operate the specific Horizontal Directional Drilling equipment for the Owner’s project with at least 3 years’ experience in directional drilling obtained within the last five years. Perform HDD operations under the constant direction of a drilling supervisor who shall remain on site and be in responsible charge throughout the drilling operation. The Contractor’s supervisor shall have supervised directional drilling of a minimum of 5,000 linear feet of pipe of a similar or greater diameter, of similar material, over similar lengths, and with similar subsurface conditions such as soil only, rock, mixed face.

B. The requirements set forth in this section specify a wide range of procedural precautions necessary to insure that the basic, essential aspects of a proper directional bore installation (a.k.a. HDD installation) are adequately controlled.

Strict adherence shall be required under specifically covered conditions outlined in this section.

C. Perform the Work in general conformance with ASTM Standard F1962.

D. Adherence to the requirements contained herein, or the Engineer's approval of any aspect of any directional bore operation covered by this section, shall in no way relieve the Contractor of its ultimate responsibility for the satisfactory completion of the Work.

1.07 WARRANTY

A. The Contractor shall warrant a useable pipeline that is of the diameter, pressure rating and other characteristics specified in the Contract Documents. The pipeline shall be smooth and continuous over the entire length of the installation.

B. The Contractor shall also warrant that the equipment used on this Project, where covered by patents or license agreements, is furnished in accordance with such agreements and that the prices bid for the Work on the Project cover all applicable royalties and fees in accordance with such license agreements. The Contractor shall defend, indemnify and hold the Owner and Engineer harmless from and against any and all cost, loss, or damage or expense arising out of or in any way connected with any claim of infringement of patent, trademark, or violation of license agreement.

1.08 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 01570 Traffic Regulation

G. Section 01600 Products

H. Section 01700 Project Closeout

I. Section 02025 Existing Utilities and Structures

J. Section 02210 Trenching, Backfilling and Compacting

K. Section 02220 Casing Installation

L. Section 02230 Stream Crossing

M. Section 02540 Erosion and Sedimentation Control

N. Section 02558 Identification/Location Guide

O. Section 02820 Lawn Restoration and Landscaping

P. Section 03305 Cast-In-Place Concrete for Pipe Work

Q. Section 15000 Piping - General Provisions

R. Section 15020 Disinfecting Pipelines

S. Section 15025 Flushing and Cleaning Pipelines

T. Section 15030 Pressure and Leakage Tests

U. Section 15105 Ductile Iron Pipe and Fittings

V. Section 15120 Polyvinyl Chloride (PVC) Pipe

W. Section 15125 High Density Polyethylene (HDPE) Pipe

X. Section 15130 Piping Specialties

Y. Section 15170 Tapping Sleeves, Saddles and Valves

1.09 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit under Obstacles, Including River Crossings

B. AWWA C200 - Steel Water Pipe, 6 In. and Larger

C. AWWA C206 - Field Welding of Steel Water Pipe

D. AWWA C213 - Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

E. AWWA Manual M55 – PE Pipe Design and Installation

F. Ductile Iron Pipe Research Association (DIPRA) Horizontal Directional Drilling with Ductile Iron Pipe Handbook

PART 2: PRODUCTS

2.01 PIPE MATERIALS

Unless otherwise specified in the Contract Documents, pipe installed by horizontal directional drilling shall either be high density polyethylene pipe (HDPE), Certa-Lok™ restrained joint C900 polyvinyl chloride (PVC) pipe, steel casing pipe, or ductile iron pipe specifically recommended by the manufacturer for directional drilling. Unless otherwise specified in the Contract Documents, the water main pipe shall be installed without a casing pipe.

A. POLYETHYLENE PIPE

1. High density polyethylene (HDPE) pipe shall be AWWA C906 compliant, NSF 61 certified, and furnished in forty (40) to fifty (50) foot lengths. HDPE pipe and its installation shall conform to the requirements of Section 15125.
2. Minimum thickness of HDPE pipe shall be determined by the Contractor's calculations (as specified herein) for the specific installation (including proposed radius of curvature and resulting pull stresses) but shall not be less than DR 11 wall thickness when measured in accordance with ASTM D2122. If any portion of the pipe will be installed with more than 20 feet of cover, the entire pipe installed by HDD shall be not less than DR 9.
3. Pipes shall be jointed to one another by thermal butt-fusion in accordance with ASTM D3261 and Section 15125. Electrofusion shall not be permitted.

B. RESTRAINED JOINT POLYVINYL CHLORIDE (PVC) PIPE (12-INCH DIAMETER AND SMALLER)

1. PVC pipes used for HDD shall be restrained joint in accordance with Section 15120. Fused joint PVC shall not be permitted.
2. Restrained joint polyvinyl chloride (PVC) pipe shall be AWWA C900 compliant, NSF 61 certified, and furnished in twenty foot (20') lengths. Restrained joint PVC pipe and its installation shall conform to the requirements of Section 15120.
3. Restrained joint PVC pipe used for HDD installations shall be DR 14 wall thickness when measured in accordance with ASTM D2122. PVC pipe shall not be used if the minimum required thickness determined by the Contractor's calculations (as specified herein) for the specific installation (including proposed radius of curvature and resulting pull stresses) is greater than the thickness of DR 14 C900 PVC pipe.

C. DUCTILE IRON PIPE

1. Ductile iron pipe and its installation shall conform to the requirements of Section 15105.
2. Ductile iron pipe class shall be determined by the Contractor's calculations (as specified herein) for the specific installation but shall be not less than the

pressure class requirements specified in Section 15105. Utilize ductile iron pipe equipped with restrained joints recommended for the installation by the pipe manufacturer and suitable for the specific design conditions. Gripping push-on joint gaskets, retainer ring gaskets, or restrained joint type gaskets are not permitted.

3. All ductile iron pipe shall be installed per Ductile Iron Pipe Research Association (DIPRA) Horizontal Directional Drilling with Ductile Iron Pipe Handbook to include strict adherence to maximum joint deflection allowances. All pipe shall be encased in two layers of polyethylene encasement per DIPRA installation procedures as specified in Section 15130.

D. STEEL CASING PIPE

1. Steel pipe shall only be used as a casing pipe and shall meet the requirements of AWWA C200 and Section 02220. Pipe shall be either spiral seam or longitudinally rolled pipe.
2. Steel pipe sections shall be connected by welding. All welding shall conform to AWWA C206.
3. Minimum thickness of steel pipe shall be determined by the Contractor's calculations (as specified herein) for the specific installation but shall not be less than a diameter to thickness ratio of 180. When installed under a roadway or railroad, minimum casing pipe thickness shall be as specified in Section 02220 unless otherwise indicated on the Drawings.

2.02 PIPE THICKNESS DESIGN

A. The following design criteria shall be used in calculating pipe thickness for HDPE, PVC, steel, or ductile iron pipe:

• Working Pressure	150 psi unless otherwise indicated on the Drawings or specified
• Test Pressure	Per Section 15030
• Surge Pressure	Working pressure + 100 psi
• Dead Load	Earth cover as shown on Drawings, but not less than 15 feet.
• Buckling Design	Considering dead load, internal vacuum, HS-20 Wheel Loading and a hydrostatic load over top of pipe to grade.
• Max. Allowable Joint Deflection	One half manufacturer's recommended deflection for size and type of joint supplied (ductile iron pipe only)
• Minimum Design Radius	As specified herein
• Radius of Curvature	90% of Actual Design Radius
• Downhole Friction Factor	1.0
• Factor of Safety for Drilling Fluid Density	1.5

B. The stresses in the pipe shall be calculated for the pre-installation, installation, and post installation loading conditions specified in Part 1 of this section. Thickness

shall be selected so that stresses do not exceed the following under any of the loading conditions.

- All conditions except internal surge pressure — 50% of minimum yield point
- Internal surge pressure condition — 75% of minimum yield point

C. The Contractor shall increase the minimum “in-service” thickness as necessary to support the stresses and loadings that are expected to be encountered during the installation of the HDD pipeline. The final selected thickness shall be supported by calculations as required herein. No additional cost shall be considered by the Owner for pipe thickness greater than the specified minimum “in-service” thickness.

2.03 DEVIATIONS

Contractor’s submittal of a “Voluntary” Alternate bid using material that does not meet all the requirements of these Specifications, shall include a description of the deviation with data showing the magnitude of the deviation. Acceptance of such deviations to these Specifications shall be subject to the review and approval of the Owner before a contract can be awarded.

2.04 INSPECTION OF PIPE

All pipe and fittings used in the Work may be factory inspected by a recognized third-party inspection agency engaged by the Engineer or Owner. Inform the Engineer, Owner and the inspection agency of the name and address of the manufacturing plant or other sources of materials to be used in the Work and coordinate with the manufacturer to assure that the inspection agency has access at the manufacturer's plant and adequate assistance and notice so that each item may be examined. All reports shall be made to the Engineer and Owner and the cost of the services of the inspection agency shall be borne by the Owner. Such third-party inspection by the Owner shall not relieve the Contractor of his responsibility to furnish materials in accordance with the applicable standards.

2.05 EQUIPMENT

A. General: All equipment for the directional bore shall have the capacity, stability, and necessary safety features required to fully comply with the Specifications and requirements of this section without showing evidence of undue stress or failure. It shall be the responsibility of the Contractor to assure that the equipment to be used in the directional bore is in sound operating condition. Backup equipment shall be required in the event of an equipment breakdown and where the condition of the equipment to be used indicates that routine component replacement or repair will likely be necessary during the directional bore.

B. Directional Drilling System: The directional drilling system shall consist of over the road transportable field power unit, mud-mixing and recycling unit, a trailer or carriage-mounted drill unit, and all other support accessory vehicles and equipment. All system components shall be in sound operating condition with no broken welds, excessively worn parts, badly bent, or otherwise misaligned

components. All drill pipe, reamers, pullback heads, swivels, drill heads and collars, pipe cradles, pipe rollers, ropes, cables, clamps, and other non-mechanical but essential items shall be in sound condition and replaced immediately when need is apparent. The equipment must be capable of drilling the specified length in a single bore.

1. Mud-Mixing and Recycle Units: The mud-mixing and recycle unit shall be a self-contained system designed to provide a supply of high-pressure bentonite based cutting fluid to the drill unit. It shall contain a fluid storage tank and a complete bentonite and drilling fluid additive(s) mixing system. The cutting fluid shall be mixed on site. The cutting fluid shall be formulated for this specific project and anticipated conditions. It shall permit changes to be made to the bentonite and drilling fluid additive(s) concentrations during drilling in response to changing soil conditions. The field power unit shall contain the high pressure cutting fluid pumping system. The recycle units shall be of a capacity to minimize the production of new cutting fluid and maximize the reuse and recirculation of original cutting fluid produced.

2. Directional Drill System: A carriage-mounted version of the drill system shall include a thrust frame. Both the trailer-mounted and carriage-mounted drill system shall be designed to rotate and push 10-foot (3-meter) minimum hollow drill sections into the tunnel being created by the boring head. The drill sections shall be made of a high strength S-grade steel that permits them to bend to a 30-foot (9-meter) radius without yielding. Drill end fittings shall permit rapid makeup of the drill sections while meeting the torque, pressure and lineal load requirements of the system. The boring head itself shall be capable of housing a probe used by the Magnetic Guidance System (MGS) to determine tool depth and location from surface and to orient the head for steering. The MGS shall have a minimum accuracy of plus (+) or minus (-) two (2) percent of the vertical depth.

   The drilling equipment must be fitted with a permanent alarm system capable of detecting an electric current. The system shall have an audible alarm to warn the operator when the drill head nears electrified cables. The drilling equipment shall be grounded, protected, and operated in accordance with manufacturer's requirements for electric strike safety.

   The control console shall contain a calibrated display of inclination, azimuth, tool face location, mud pump rates, and torque pressures. The downhole steering system accuracy shall be plus or minus one percent (± 1.0%) of the horizontal bore length such that the difference between actual depth and machine calculated depth is not more than 1 foot per hundred feet.

4. Restrictions: Other devices or utility placement systems for providing horizontal thrust other than those previously defined in the preceding sections shall not be used unless approved by the Engineer prior to commencement of the Work. The proposed device or system shall be evaluated prior to approval or rejection on its potential ability to complete the pipe placement satisfactorily without undue stoppage and to maintain line and grade within the tolerances prescribed by the particular condition of the project. Water sluicing methods, jetting with compressed air, or boring or tunneling devices with vibrating type heads that do not provide positive control of the line and grade shall not be allowed.

C. Spoils Equipment: The cutting fluid removal system shall include a self-contained vacuum truck which has sufficient vacuum and tank capacity to remove excess cutting fluid mixture and cuttings from the project site as required or directed by the Engineer. Spoils are not to be discharged into sewers or storm drains.

The Contractor shall contain all drilling and pipe lubricating mud by taking special measures to prevent run-off into adjacent properties and/or waterways. All surplus drilling and pipe lubricating mud shall be removed from the site and properly disposed of by the Contractor. The Contractor shall also be responsible for all required erosion control measures.

D. Magnetic Guidance System: A Magnetic Guidance System (MGS) probe and location of the drill head during the drilling operation. The tracker shall be capable of tracking at all depths up to one hundred feet and in any soil condition, including hard rock. It shall enable the driller to guide the drill head by providing immediate information on the tool face, azimuth (horizontal direction), and inclination (vertical direction). The tracker shall be accurate to +/-2% of the vertical depth of the borehole at sensing position at depths up to one hundred feet. Ferrous materials shall not influence or affect the MGS readings or accuracy.

Components: The Contractor shall supply all components and materials to install, operate, and maintain the MGS. This shall include, but not be limited to the following:

- MGS Probe and Interface
- Computer, Printer, and Software
- DC Power Source, Current Control Box, and Coil/Tracking Wire.

The Magnetic Guidance System (MGS) shall be a Tensor TruTracker MGS, or other licensed and industry approved wire guidance system. The Engineer shall be advised of the unit to be used and is subject to his approval. Set up and operate the MGS using personnel experienced with this system.

E. "Walk-over" Cable locating and tracking system: For watermains 12-inch diameter and smaller, a "Walk-over" tracking system shall be used as approved by the Engineer. Contractor shall provide Engineer with current calibration certification of MGS in accordance with manufacturer's specifications.

F. If equipment breakdown or other unforeseen stoppages occur and forward motion of the directional cutting head is halted at any time other than for reasons planned in advance (addition of drill stems, etc.), the boring path shall be filled with a proper bentonite solution immediately, or as directed by the Engineer.

G. The boring tool shall have steering capability and have an electronic tool detection system. The position of the tool during operation shall be capable of being determined accurately, horizontally within 1% of the horizontal distance of the borehole and vertically within 2% of the vertical depths of the borehole. The boring tool shall have a nominal steering radius of 9 meters (30 feet).

2.06 DRILLING FLUIDS:

A. A mixture of Bentonite drilling clay, project specific cutting fluid additives, and potable water shall be used as the cutting fluid (MUD) and over ream hole filler for the directional bore. The drilling fluid mixture used shall have a pH of 7 or higher,

less than 2 percent sand, and a clean fluid density less than 10.5 pounds / gallon. The following minimum viscosities as measured by a March Funnel are provided as a guideline:

- Rock Clay 60 sec.
- Hard Clay 40 sec.
- Soft Clay 45 sec.
- Sandy Clay 90 sec.
- Stable Sand 80 sec.
- Loose Sand 110 sec.
- Wet Sand 110 sec.

These viscosities may be varied to best fit the soil conditions encountered as recommended by the drilling mud and fluid additive manufacturer, and as approved by the Engineer.

B. Where sandy or granular materials are encountered, a cement slurry or polymer supplement shall be considered for added strength and stability of the bore and over ream hole.

C. Clay must be totally inert and contain no risk to the environment. Contractor shall utilize one or more of the following additives to the drilling fluid: Hydrogel 125 Bentonite, Extra High Yield Bentonite, Soda Ash, Dril-Trol QD, Thinz-It, Borzan, or Plugz-it Max.

D. Provide Owner, Engineer, and have on site at all times the Material Safety Data Sheets (MSDS) for all drilling compounds and chemicals. No drilling fluid materials or additives shall be used that are determined to be detrimental to streams or watercourses should an accidental discharge occur.

2.07 LOCATION (TRACER) WIRE

Location (tracer) wire shall be provided as specified for directional drilling applications in Section 02558.

PART 3: EXECUTION

3.01 GENERAL

A. Protect the new pipe and components during all phases of Work, including hauling, installation, entry into the entry pit, and prevention of scarring or gouging of the pipe or components. Refer to Section 15000 for further requirements.

B. Contractor shall take care not to damage any materials during HDD operations. All HDPE and PVC (restrained joint C900) pipes shall be visually inspected for gouges. Gouges in excess of ten percent (10%) of the pipe wall thickness are excessive and are not acceptable. Refer to Section 15120 or 15125, as applicable, for requirements in the event of excessive gouges or other damage.

3.02 SITE DISTURBANCE AND SOIL EROSION

A. Sediment barriers shall be constructed as shown on the Drawings or where directed by the Engineer. All soil erosion and sediment control Work shall be performed in accordance with Section 02540.

B. The Contractor shall be responsible for the preservation of all existing trees, plants, and other vegetation that are to remain within or adjacent to the construction site and shall also be responsible for protecting existing concrete curb, fence, utilities, and other structures that are located within or adjacent to the construction site.

C. The Contractor assumes all liability for environmental damage and cleanup due to inadvertent discharges of slurry or other causes. Slurry materials shall be selected based on the soil conditions encountered to minimize the risk of mud returns.

3.03 PERSONNEL REQUIREMENTS:

A. Provide a competent and experienced supervisor representing the drilling Contractor/Subcontractor who must be present at all times during actual operations. A responsible representative, who is thoroughly familiar with the equipment and type work to be performed, must be in direct charge and control of the operation at all times. In all cases the supervisor must be continually present at the job site during the actual directional pilot hole, over reaming and pullback operations. Supervisor shall have minimum 5 years directional drilling experience.

B. Have a sufficient number of competent workers on the job at all times to insure the directional bore is made in a timely and satisfactory manner. Adequate personnel for carrying out all phases of the actual directional bore operation must be on the job site at the beginning of work. If HDPE is specified for the carrier pipe, HDPE pipe thermal butt fusion welding shall be completed by a welder certified by the manufacturer of the pipe or pipe welding equipment, in accordance with the Plastic Pipe Institute “Handbook of Polyethylene Pipe,” Polyethylene Joining Procedures, and 49 CFR 192, Subpart F, and in accordance with the requirements in Section 15125.

C. If steel pipe is specified for the casing pipe, welding shall be performed by certified welders according to the requirements of Section 02220.

3.04 ALIGNMENT AND GRADE

A. Contractor shall positively identify and verify location, depth, and size of all existing underground utilities and facilities in the vicinity of the proposed HDD installation and provide the Engineer with a comprehensive report of these facilities before starting any construction. Contractor shall take necessary precautions to protect all such utilities and facilities from damage, including exposing those utilities and facilities that are located within the possible influence of the directional drilling operations as determined for the project specific conditions. It is the Contractor’s responsibility to determine this zone of influence, safe burial depth and offset from existing utilities. This will include, but is not limited to soil conditions and layering, utility proximity and material, boring system and equipment, and foreign subsurface material.

B. Contractor shall be held completely and solely responsible for any damages incurred. Damage caused by the Contractor or drilling Contractor/Subcontractor

shall be repaired or replaced at the Contractor's cost and responsibility, regardless of whether such utilities or facilities are shown on the Drawings or not.

C. If utilities of unknown depth or other obstructions require grade or alignment deviations from the Drawings, the grade and/or alignment may be adjusted with Engineer's approval. All adjustments shall permit gradual bends of the pipe to the original alignment beyond the directional bore section. At unusual site conditions, the Contractor may request a review of site conditions by the Engineer for additional adjustment, and such determination shall be final. An adjustment in alignment, position, or elevation approved by Engineer shall not be cause for an adjustment of costs.

D. Pilot hole shall be drilled along the path shown on the Drawings with the following tolerances:

1. Vertical tolerance: Minimum cover below channel bottom as specified on the plans.
2. Horizontal tolerance: Horizontal tolerance shall be plus/minus two feet (24 inches) from the centerline of the proposed pipe alignment as shown on the Drawings.
3. Design Curve Radius: No curve is acceptable with a radius less than 40 times the outer diameter for HDPE pipe, 100 times the outer diameter for ferrous pipe, or 300 times the nominal diameter of restrained joint PVC pipe.
4. Alignment: 5% of depth per 100 feet.
5. Entry Point Location: The pilot shall initially penetrate the ground surface at the exact location intended, which shall not deviate more than two feet (2') from the centerline of the proposed pipe alignment as shown on the Drawings. The entry point may be moved along the pipeline alignment up to twenty-five feet (25') further from the original entry point only with Engineer's approval.
6. Exit Point Location: The pilot hole shall finally penetrate the ground surface within plus or minus two (2) feet of the alignment shown on the Drawings and within plus or minus twenty five feet (25') of the length shown on the Drawings. Exit point lengths greater than twenty-five (25) feet from the original point shown on the Drawings require Engineer's approval.
7. Entry and exit points normally will not be allowed closer to the banks of a waterway being crossed than shown on the Drawings.
8. The installed pipeline cover requirements as shown on the Drawings, or as specified herein, is mandatory.

E. Any installation that deviates from the plan by more than these tolerances may be rejected and any rejected installation shall be reconstructed at the Contractor's expense.

F. The vertical profile as shown on the Drawings is the minimum depth to which the pipeline shall be installed. Contractor may, at his option and with the permission of Engineer and Owner, elect to install the pipe at a greater depth than shown on the Drawings, at no additional cost to the Owner. Contractor to verify that any changes in vertical or horizontal alignment will not result in exceeding the design stress of the pipe and result in stretching of the pipe.

3.05 INSTALLATION:

A. The following is a general outline of steps for the directional bore operation, which shall be followed except as otherwise approved by the Engineer:

1. Clear the right of way and temporary work space as shown on the Drawings. Contractor to install and maintain all soil erosion and sediment control devices, until project completion with approved permanent site stabilization.

2. Lay out the HDD pipe alignment using a qualified land survey team to confirm accurate horizontal distances, either physically measured or shot by Electronic Distance Measurement. Entry and exit points shall be located and marked with survey hubs or markers.

3. Haul, string, and assemble restrained pipe. Except when the cartridge method is used where site constraints prevent pre-assembly of the pipe (as approved by the Engineer), perform leakage test of the assembled pipeline section prior to installation as specified below. If sufficient linear footage of lay down area for the pipe string is not available, the finished pipeline may be assembled in as few sections as possible, with each section leakage tested separately. The Contractor shall be responsible for ensuring that the drill rig has adequate pullback capacity to overcome the increased frictional resistance resulting from the stoppage of pipe pullback to perform the final weld, fusion or assembly of pipe sections.

   All assembled pipe sections shall be securely plugged at the end of each work day. The pipe interior shall be protected at all times against dirt, dust, drilling mud, pipe cuttings, debris, animal access, and other sources of contamination.

4. Provide adequate support rollers for the pipeline during pullback of the pipe string into the pre-drilled hole. The rollers and cradles shall be of a type that will prevent damage to the pipe and tracer wires and shall be of sufficient number, as recommended by pipe manufacturer, to prevent over stressing due to sag bends during the pullback procedure. The pipe shall be supported at all times, including pullback, to maintain a free stress arc which limits pipe bending and internal hoop stresses to within manufacturer's limits.

   Pipe which is not properly protected and supported and shows indications of excessive stressing, gouges exceeding allowance specified above, cuts, abrasions or other damage which may affect the operational performance intended for the pipe, as recommended by pipe manufacturer, shall be removed from the site and replaced at no additional cost as directed by the Owner or Engineer.

5. Mobilize the drilling equipment, erect the rig, drill a pilot hole, enlarge the hole as necessary to a minimum diameter of 1.5 times the nominal diameter of the pipe, and pullback the prefabricated pipe string.

   Prior to beginning the pilot hole over reaming, furnish to the Engineer an as-built plan and profile of the actual pilot hole installation to confirm the installation is in compliance with the Contract Documents. Pilot hole alignment

shall be accepted by Engineer or Owner in writing prior to reaming and pipe installation.

The Contractor shall be responsible for selecting the reaming process to be utilized, whether forward and/or back reaming will be undertaken, and the number of reaming passes to be made.

6. Supply portable mud tanks or construct temporary mud pits to contain excess drill fluids during construction and slurry material displaced by the pipe during installation. Mud pits are to be protected at all times against unauthorized access and shall be stabilized at all times against surface water runoff and containment berm failure. Pump, haul and dispose of any drill cuttings and excess drill fluids to a receiving site permitted to accept the spoils, all in a manner consistent with the local and state regulations at no additional cost to the Owner.
7. Pull back the bore pipe in one continuous section using a swivel to minimize the rotation of the pipe during pullback. Swivel shall utilize lubricated internal bearings which are fully protected from external contamination and over lubrication. Demonstrate the swivel operation prior to the Engineer prior to the pullback operation. Ensure pullback forces do not exceed 5 percent strain on HDPE pipe.
8. Concrete anchor collars shall be constructed as shown on the Drawings or where directed by the Engineer.

B. Water used to fill the carrier pipe to counter pipe flotation shall be potable water. Contractor shall disinfect all piping and hoses used for water addition to the carrier pipe.

C. Regardless of the pipe material, unless not permitted by the right-of-way owner, inject a low strength cement slurry into the bore hole for approximately 50 feet at each end of the drilled pipeline. Where cement slurry cannot be used, provide restraint at both ends of the pipeline outside the bore to hold the pipe in place. The type of restraint shall be submitted to the Engineer in advance of the Work and must be approved by the Engineer prior to the start of construction.

D. Owner, Engineer and Resident Project Representative shall have access at all times to any measuring or gauging devices used for the horizontal drill as well as any drilling logs maintained by the Contractor.

E. In the event that the Contractor must abandon the drill hole before completion of the directional bore, the Contractor shall seal the borehole with neat cement grout starting at the low point or end of the drill hole and redrill the directional bore at no extra cost to Owner.

F. HDPE pipe shall be installed so as to not exceed manufacturer’s design maximum tensile stress with a factor of safety of 2.0.

G. Contractor shall monitor the ground surface within the vicinity of the directional bore during HDD operations for any evidence of drilling fluid fracture. Where the directional bore crosses under a stream or other waterway, Contractor shall monitor the stream or waterway for any evidence of drilling fluid fracture. In the event that a drilling fluid fracture, inadvertent returns, or returns loss occurs during

pilot hole drilling operations, Contractor shall cease drilling, wait at least 30 minutes, inject a quantity of drilling fluid with a viscosity exceeding 120 seconds as measured by a Marsh funnel and then wait another 30 minutes. If mud fracture or return loss continues, Contractor shall cease operations and notify Engineer. Corrective procedures shall be reviewed and approved by the Engineer prior to resuming work.

3.06 JOB CONDITIONS

A. Any nighttime work is strictly regulated and will be allowed only with prior approval granted by the Owner subject to regulatory agencies having jurisdiction. All HDD operations shall be accomplished during daylight hours, unless approved by the Engineer. HDD work shall not begin after the hour pre-established as the latest starting time that will allow completion during daylight hours, unless approved by the Engineer. The Contractor shall provide a Work Plan submittal indicating the proposed hours of operation and length of work week. All work plans shall be subject to compliance with all applicable regulatory requirements for construction activities and any off site impacts.

B. When hazards of nighttime work are carefully considered and determined to be insignificant, nighttime work may be allowed only to complete a properly planned HDD installation, and only if, in the opinion of the Engineer, a delay was caused by reasonably-unavoidable circumstances and such nighttime work is necessary to avoid placing an undue economic hardship on the Contractor.

C. In emergency situations, or where delay would increase the likelihood of a failure, nighttime work may be allowed to complete a delayed HDD installation.

D. Pipe pullback operations shall continue on a 24-hour per day basis until pipe pullback is complete, but work shall be properly planned and scheduled to avoid or minimize pipe pullback operations at night to the extent possible.

3.07 INSTALLATION ACCEPTANCE AND CLEANUP

A. Defects which may affect the integrity or strength of the pipe in the opinion of the Engineer shall be repaired or the pipe replaced at the Contractor's expense.

B. All exposed carrier pipe that is pulled into the receiving pit behind the pull head shall be inspected for damage. Depending on the gouging, abrading or damage witnessed, the pipe may be accepted, de-rated, reinstalled, or abandoned as unusable per the Contract Documents. If the newly installed pipe is deemed damaged and unusable, the Contractor shall dig and replace the pipe to the extent directed by the Engineer at no additional expense to the Owner.

C. Following the installation, the project site shall be returned to a condition equal to or better than the pre-construction condition of the site. All excavations will be backfilled and compacted and all surfaces shall be restored per the Contract Documents.

D. Contractor shall verify that all utilities, structures, and sub-surface features within the envelope of possible impact of the HDD operation as determined for the project specific site conditions are sound and in proper working order.

3.08 FLUSHING, PRESSURE/LEAKAGE TESTING AND DISINFECTION

A. Except when the cartridge method is used where site constraints prevent pre-assembly of the pipe (as approved by the Engineer), perform an allowable leakage test in accordance with AWWA C600 and Section 15030 or a low pressure air test (procedure shall be proposed by Contractor and approved by Engineer) on the full length of pipe prior to pipe pullback but after all sections have been welded, fused or assembled. In the event that available lay down area does not permit assembly of the entire pipe length prior to pullback, the two assembled sections shall be tested independently.

B. A hydrostatic pressure test shall also be performed on the complete, installed pipe (i.e. after completion of all HDD procedures) in accordance with AWWA C600 and as described in Section 15030.

C. The carrier pipe shall be flushed and disinfected as described in Sections 15020 and 15025 or as otherwise approved in advance by the Engineer.

D. As an alternative, but only when approved by the Owner, the carrier pipe can be filled with potable water, pressure tested and disinfected prior to insertion. Contractor shall provide Engineer with full work plan to employ this alternative.

3.09 CONNECTION TO ADJOINING PIPE

A. Perform connections in accordance with Sections 01000, 15000, 15105, 15120, 15125, 15130, and 15170, as applicable, from the directionally drilled pipe to adjacent pipe, with support, backfill and compaction per Section 02210.

END OF SECTION

SECTION 02540

EROSION AND SEDIMENTATION CONTROL

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this section consists of providing all labor, materials, tools, equipment, and services required to design, perform and maintain all temporary and permanent erosion and sedimentation control throughout the Work area (including borrow, storage and disposal areas) as indicated on the Drawings and as specified within this section and related sections of the Specifications.

A. Erosion and sedimentation control shall include excavation, grading, temporary seeding, permanent seeding, maintenance, legal sediment disposal, permits and all other required Work and shall be in accordance with the IDEM SWQM.

B. In addition to the requirements of these Specifications, comply with all local Soil and Water Conservation District (SWCD) laws, rules and regulations and all other Federal, State, County and local requirements for erosion and sedimentation control. Contractor shall be required to install and maintain all required Soil and Erosion Control measures as required by the controlling authority and as detailed in the Contract Documents. If the contract's erosion control permit falls under the authority of a proposed road project, the Contractor shall maintain all Soil and Erosion Control measures installed by others. If the Contractor damages the existing Soil and Erosion control measures during installation of the mains, the Contractor shall repair or replace the items as required.

C. The Contractor shall be responsible for implementing the Best Management Practices (BMPs) to prevent and minimize erosion and resultant sedimentation in all cleared and grubbed areas during and after construction. This section covers the work necessary for the installation of pipe lines and measures for the prevention of soil erosion and control of sedimentation. The Contractor shall furnish all material, labor and equipment necessary for the proper installation, maintenance, inspection, monitoring, reporting and removal of erosion prevention and sediment control measures and, if applicable, to cause compliance with all local permits and the State of Indiana Department of Environmental Management and State of Indiana Department of Natural Resources.

1. For disturbances over one (1) acre, the Owner or Engineer shall submit under Indiana Department of Environmental Management (IDEM) Rule 5 a Notice of Intent (NOI) for coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit Rule for Stormwater Discharges Associated with Construction Activity. Upon request, Contractor shall provide any required supporting documents, including Storm Water Pollution Prevention Plan (SWP3). The construction site shall comply with all terms and conditions of the General Permit Rule 327 IAC 15-5 (Rule 5).

2. Contractor shall not commence construction activities until given notice from the Owner or Engineer, which is typically after thirty (30) calendar days following submittal of the NOI. Contractor shall verify requirements governed by specific community MS4 districts that may have additional requirements that shall be met prior to initiation of land disturbance.
3. Construction activities shall not begin prior to verification that the Construction Plan meets the minimum requirements of the Rule and the submittal of the NOI letter.
4. Contractor must notify IDEM and the review authority of the actual start date within 48 hours of starting land disturbance activities.
5. Contractor shall implement the Construction Plan throughout the life of the project. The Construction Plan must be implemented before, during, and after construction activities.
6. Contractor shall post the approved NOI Stormwater permit at the Work site.
7. Contractor shall comply and maintain fueling area spill containment.
8. Contractor shall provide dewater pump discharge water filtration bags.

D. The project will be inspected by the local MS4 Coordinators, any and all fines or penalties related to an issued Notice of Violation (NOV) accessed by the controlling authority shall be the responsibility of the Contractor.

1.02 GENERAL REQUIREMENTS

A. Any disturbance as the result of modifications to the site drainage's features or topography requires protection from erosion and sedimentation.

B. All excavations shall be in conformity with the lines, grades, and cross sections shown on the Contract Drawings or established by the Engineer.

C. It is the intent of this Specification that the Contractor conducts the construction activities in such a manner that erosion of disturbed areas and off site sedimentation be absolutely minimized.

1.03 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300 as well as the following submittals:

1. Certificate of compliance with the standards specified below for each source of each material.
2. List of disposal sites for waste and unsuitable materials and evidence of all required approvals and permits for use of those sites.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02105 Clearing and Grubbing

H. Section 02210 Trenching, Backfilling and Compacting

I. Section 02230 Stream Crossing

J. Section 02820 Lawn Restoration and Landscaping

K. Section 15000 Piping General Provisions

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, Engineer shall determine which requirements shall prevail.

A. Indiana Administrative Code Title 327 Water Pollution Control Division (327 IAC)

B. Indiana Construction/Land Disturbance Storm Water Permitting General Permit Rule 327 IAC 15-5 (Rule 5).

C. Indiana Department of Environmental Management (IDEM) Storm Water Quality Manual (SWQM) Chapter 7: Storm Water Quality Measures – Construction and Land-Disturbing Activities.

D. IDEM Rule 5 Guidance for Construction Plan/Storm Water Pollution Prevention Plan Development.

PART 2: PRODUCTS

2.01 MATERIALS - GENERAL

A. Materials for use in erosion and sedimentation control devices shall be in accordance with IDEM SWQM, local SWCD and MS4 requirements, the Drawings, and the SWP3.

PART 3: EXECUTION

3.01 INSTALLATION AND MAINTENANCE

A. All installation and maintenance shall be conducted in accordance with this Specification and the IDEM SWQM. In the event of a discrepancy between this Specification, Manufacturer's recommendations and the IDEM SWQM, the more stringent requirements shall take precedence.

B. If applicable, all requirements of the NPDES Permit shall be followed. In the event of a discrepancy between this Specification and the NPDES Permit requirements, the more stringent requirements shall take precedence.

C. If possible, erosion and sedimentation control devices shall be established prior to clearing operations in a given area. Where such practice is not feasible, the erosion and sedimentation control device(s) shall be established concurrent with the clearing operations or immediately following completion of the clearing operations.

D. The Contractor shall furnish the labor, materials and equipment required for routine maintenance of all erosion and sedimentation control devices. At a minimum, maintenance shall be scheduled as required for a particular device to maintain the removal efficiency and intent of the device. Note that specific maintenance intervals for various measures and practices are specified within the IDEM SWQM. Of the maintenance requirements specified herein and in the IDEM SWQM, the more stringent shall take precedence for each and every sediment and erosion control measure utilized on the site. Maintenance shall include but not be limited to 1) the removal and satisfactory, legal disposal of accumulated sediment from traps or silt barriers and 2) replacement of filter fabrics used for silt fences and stone impaired by sediment in stone filters, gravel construction entrances, etc. Maintenance as noted in items 1) and 2) above shall be performed as required, and at least once every 3 months for the duration of construction activities. Sediment removed from erosion and sedimentation control devices shall be disposed of in locations that will not result in off-site sedimentation as acceptable to the Engineer, at no additional cost to the Owner. If no suitable on site locations are available, all such sediment will be legally disposed of off site, at no additional cost to the Owner.

3.02 ADDITIONAL REQUIREMENTS

A. The Contractor shall provide adequate means to prevent any sediment from entering any storm drains, curb inlets (curb inlet filter box), ditches, streams, or bodies of water downstream of any area disturbed by construction. Excavation materials shall be placed upstream of any trench or other excavation to prevent sedimentation of offsite areas. Silt fence will be provided, at no additional cost to

the Owner, around excavation materials if deemed necessary by the Engineer. In areas where a natural buffer area exists between the work area and the closest stream or water course, this area shall not be disturbed.

B. The Engineer may direct the Contractor to place any additional sediment and erosion control devices at other locations not shown on the Drawings.

3.03 INSPECTIONS AND MAINTENANCE

A. The Contractor shall designate an Authorized Representative to perform inspections and maintenance as described within the General Permit.

END OF SECTION

SECTION 02558

IDENTIFICATION/LOCATION GUIDE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this Section consists of providing all labor, materials, tools, equipment, and services required to provide identification tape, location (tracer) wire, test/tracer boxes, and marker posts as indicated on the Drawings and as specified within this section and Sections 01011, 02210, and 15000. Contractor shall furnish tracer wire, identification tape, test/tracer boxes, marker posts, and all other materials that are not furnished by Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications and other required Submittals for all products furnished under this section in accordance with Section 01300.

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 15000 Piping – General Provisions

I. Section 15130 Pipe Specialties

1.04 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI, etc.) shall mean the most current available revision.

PART 2: PRODUCTS

2.01 DETECTABLE IDENTIFICATION TAPE (FOR WATER MAINS AND HYDRANT BRANCHES)

A. Detectable identification tape shall be manufactured of laminated polyethylene with a minimum overall thickness of 6 mil, including a 0.3-mil thick metallic foil core encased between two layers of clear polyethylene film. The tape and ink shall be chemically inert and highly resistant to alkalis, acid and other destructive agents found in soil. Detectable tape width shall be 2 inches.

B. Detectable tape shall have Blue background color (per APWA color code standards) and shall be imprinted "CAUTION - WATER LINE BURIED BELOW" with abrasion-resistant black letters using permanent ink. Imprint shall repeat itself a minimum of once every 2 feet for entire length of the tape.

C. Tape shall conform to the following requirements:

Property	Method	Value
Width		2 inches
Overall Thickness	ASTM D-2103	6.0 mil
Thickness Foil Core	ASTM D-2103	0.3 mil
Foil Purity	-	>= 99%
Weight	ASTM D-2103	34 lbs./1000 sq. ft.
Tensile Strength	ASTM D-882	3600 psi (45 lbf. for 2" tape)
Elongation	ASTM D-882	60%
PPT Resistance	ASTM D-2582	15.5 lbf.
Printability	ASTM D-2578	>= 40 Dynes
Tape Color	APWA	Blue
Imprint (black)		"CAUTION – WATER LINE BURIED BELOW"

D. Detectable identification tape shall be Terra Tape® Sentry Line® detectable tape as manufactured by Reef Industries, Inc., Houston, Texas.

E. Splices shall be made with Terra Clips manufactured by Reef Industries, Inc.

2.02 LOCATION (TRACER) WIRE

A. For piping installed by open cut or bore-and-jack (i.e. casing installations per Section 02220):

1. Location wire shall be direct burial #10 or #12 AWG (0.1019- or 0.0808-inch diameter conductor, respectively), 21% conductivity solid annealed copper-clad, carbon steel core high-strength tracer wire, with at least **430 pounds average tensile break load**, minimum 10% elongation, with 30 mil high-molecular weight, high-density, blue polyethylene jacket complying with ASTM D1248, 30 volt rating.

2. Location wire shall be from Copperhead Industries, LLC, part number 1230B-HS (#12 AWG); DURAtrace CCS (**#10 AWG**) by DURAtrace; PRO-TRACE HF-CCS PE30 (**#10 AWG**) as manufactured by Pro-Line.

B. For piping installed by directional drilling (per Section 02458):

1. Location wire shall be direct burial #10 or #12 AWG (0.1019- or 0.0808-inch diameter conductor, respectively), 21% conductivity solid annealed copper-clad, high-carbon steel core hard drawn extra-high strength horizontal directional drill tracer wire with at least **1,150 pounds average tensile break load**, minimum 1% elongation, with 45 mil high-molecular weight, high-density, blue polyethylene jacket complying with ASTM D1248, 30 volt rating.
2. Splices shall not be permitted on tracer wire installed by HDD.
3. Location Wire for HDD applications shall be from Copperhead Industries, LLC, SoloShot part number 1245B-EHS (#12 AWG) or PRO-TRACE HDD-CCS PE45 (#12 AWG) as manufactured by Pro-Line.

C. For piping installed by pipe bursting method (per Section 02350)

1. Location wire shall be direct burial copperclad steel reinforced tracer wire specifically designed for use in pipe bursting applications.
2. Wire shall be 7 X 7 stranded copper clad steel with 0.208-inch bare outside diameter, a 50 mil HDPE jacket and at least **4,700 pounds average tensile break load**. Wire shall be rated 30 volts, and insulation shall be rated 600 volts.
3. Splices shall not be permitted on tracer wire installed by pipe bursting.
4. Location wire for pipe bursting applications shall be SoloShot Xtreme from Copperhead Industries, LLC.

D. Wire shall be blue in color per APWA color code.

E. Wire insulation shall be highly resistant to alkalis, acid and other destructive agents found in soil.

F. The location wire shall have water-blocking characteristics, be corrosion resistant, and have UV protection.

G. All splices shall be encased with a waterproof connector rated at 30 Volts for direct bury and submersion applications that is recommended by the wire manufacturer for the intended application and installation method. Connectors shall be furnished by the same supplier as the wire.

2.03 TEST/TRACER BOXES

A. All test/tracer boxes shall be 18-inch long, adjustable-to-grade, 4-inch inside diameter, ABS plastic box flared and squared at base with a 1 ½" cast iron flange at top for heavy-duty installation at grade. Lid shall be a one piece locking cast iron lid with "Test Station" marked on lid and shall contain 5 screw-type brass terminals (or other quantity as approved) on a non-conductive terminal board, which shall be secured in place beneath the lid.

B. Test/tracer boxes shall be Model T4 as manufactured by Handley Industries, Inc., Jackson, Michigan.

2.04 MARKER POSTS

A. Marker posts shall be fiber-composite marker posts with a minimum length of 66-inches, 4-inch width, and a concave design that allows the post to flatten out completely upon vehicle or direct tire impact at highway speed, then snap back to its normal upright position. Tensile strength as tested per ASTM D-638 shall be at least 50,000 psi. The posts shall be UV-stabilized for fade resistance, and color shall be standard blue for water. Posts shall be temperature stable and remain flexible from -40 to at least 140 degrees F.

B. The decals must be UV stable, all-weather type with a no dig symbol and standard 811 logo. Decals shall use contrasting color-fast vertical white lettering on blue background (except as otherwise indicated below).

Installed Location	Text	Rhino Decal
Pipeline	WARNING: WATER PIPELINE	GD8-1333K
Butterfly & Gate Valves	WARNING: WATER VALVE	GD8-5226K
Blow-Off Assemblies	WARNING: WATER LINE BLOW OFF (blue lettering on white background)	GD-5411K (plus 811 patch decal)
Air Valves	WARNING: AIR RELEASE VALVE	GD-5472K

C. All marker posts shall be Rhino FiberCurve™ with SunCoat™ coating or Carsonite Curv-Flex™ Marker. Where required in Section 01011, marker posts shall be provided with PolyTech Coating™. Marker posts shall be manufactured by one of the following approved manufacturers:

Rhino Marking and Protection Systems
A Division of REPNET, Inc.
280 University Drive Southwest
Waseca, MN 56093
1-800-522-4343

Carsonite International
605 Bob Gifford Boulevard
Early Branch, SC 29916
1-800-648-7916

PART 3: EXECUTION

3.01 GENERAL

A. Install identification tape and location wire over the centerline of all buried potable water mains, hydrant branches, and trenched services as indicated on the Drawings and as specified within this Section and Sections 02210 and 15000

3.02 INSTALLATION OF DETECTABLE IDENTIFICATION TAPE

A. Install detectable identification tape with all trenched potable water lines (including mains and fire hydrant branches, but not service lines) in accordance with the manufacturer's installation instructions and as specified herein. This

tape shall provide an early warning at shallow depth excavation and assists with locating the pipe during excavation.

B. Install identification tape one foot above the top of the pipe, but not less than one foot below finished grade.

Detectable identification tape shall be installed continuous from valve to valve and valve to hydrant. Splice detectable identification tape per manufacturer's instructions to maintain electrical continuity.

3.03 INSTALLATION OF LOCATION (TRACER) WIRE

A. Install location (tracer) wire with all pipe (regardless of pipe material, size, or function) in accordance with the manufacturer's installation instructions and as specified herein and in Sections 02210, 02458, and 15000.

B. For piping installed by open cut method:

1. Install the location wire directly on top of the buried pipe, but outside the polyethylene encasement (when applicable), prior to placing backfill. Wire shall be taped to the pipe or polyethylene encasement with polyethylene tape at a minimum spacing of 10 feet.
2. The wire shall be contiguous except at test stations, valve boxes (where approved), and where splicing is permitted as specified herein. Splices shall be completed per the manufacturer's recommendations and shall be watertight.
3. At every valve box (including fire hydrant branch valves), the wires (one in each direction) shall be extended upward along the exterior of the valve box for connection of locating equipment and taped to the valve box approximately twelve inches (12") below grade with polyethylene tape. Provide adequate slack in the wire leads both above and below the tape to reduce breakage from pulling or settlement. Each wire shall penetrate the valve box through a drilled hole fitted with a rubber grommet approximately six inches (6") below grade. If directed by the Owner, loop the location wire into the valve box to maintain continuity of the wire through the valve box installation. Wires shall be provided with at least three feet (3') of extra slack on each tracer wire (total of 6' extra wire when looped) at each valve box. Neatly coil the extra wire inside the valve box within easy reach. Do not allow wires to become twisted together.
4. Maximum spacing between accessible test points shall be 1,250 feet. Where spacing between valve boxes exceeds 1,250 feet, location wire shall be terminated at a separate test/tracer wire box.
5. Contractor shall test continuity of all wires upon completion of backfill. Any wire that fails the continuity test shall be replaced by the Contractor.

C. For piping installed by bore-and-jack (i.e. casing installations per Section 02220), horizontal directional drilling (per Section 02458), or pipe bursting (per Section 02350):

1. Wire shall either be wrapped around the pipe or taped with polyethylene tape to the pipe at a minimum spacing of 10 feet before installation.

2. The wire shall be contiguous between drill/bore entry and exit with no splices. Install a test/tracer wire box at each end.
3. Regardless of the piping material, a minimum of three (3) tracer wires shall be affixed to the pipe and installed simultaneously with pullback of the pipe (HDD) or jacking of the pipe (casing installations).
4. When ductile iron pipe is used, tracer wires shall be installed outside the polyethylene encasement.
5. Contractor shall test continuity of all wires upon completion of HDD pipe pullback (or upon sealing the casing ends for casing installations). If all wires fail the continuity test, the directional drill or casing installation will be rejected.
6. Connectors shall be furnished by the same supplier as the wire. Connectors shall be connected to one or the three installed tracer wires.

3.04 INSTALLATION OF TEST/TRACER WIRE BOXES

A. Unless otherwise indicated in Section 01011 or directed by the Owner, install test/tracer wire boxes at every dead-end, at the beginning and end of every project, at other locations as necessary to provide access to tracer wire at intervals not to exceed 1250 feet, and at other locations designated on the Drawings.

B. Test/tracer wire boxes shall be installed flush with grade in non-traffic areas unless otherwise noted.

C. Wires shall be connected to the provided terminals and shall be provided with at least three feet (3') of extra slack on each tracer wire at each box. Do not allow wires to become twisted together.

3.05 INSTALLATION OF MARKER POSTS

A. Install marker posts using manual driver equipment designed for their installation per the manufacturer's guidelines. Place at locations indicated on the Drawings, in Section 01011, or as directed by the Engineer.

B. If soil conditions dictate (i.e. in order to avoid damage to the posts), use a pilot hole driver designed for the purpose.

C. Install marker posts to a depth of approximately 18 inches or more as recommended by the manufacturer.

END OF SECTION

SECTION 02610

ROADWAY PAVING AND SURFACING

PART 1: GENERAL

1.01 SCOPE OF WORK

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to perform paving and related Work as indicated on the Drawings and as specified within this section and related sections of the Specifications.

A. This section includes replacement of all pavement, traffic control devices (including traffic detector loops), pavement striping, traffic calming features, and signage that are damaged or disturbed as a result of the Work or related activities and all other such Work as shown on the Drawings.

B. The Drawings shall indicate the extent of paving criteria required. However, **the Contractor shall be responsible to verify applicable local/municipality paving requirements prior to submitting bids and shall comply with all applicable paving requirements at no additional cost to the Owner.**

C. All Work under this section shall be performed as required by applicable local, state, and federal regulations. Replacement will be at least equal to the type of pavement and related items that existed before the Work began and to the satisfaction of the Resident Project Representative and agencies with jurisdiction.

D. Paving Subcontractor shall spread and roll and/or tamp temporary bituminous pavement, complete, in place, and maintain the same all as specified or as directed by the Resident Project Representative.

E. During the entire period of construction of the project, keep all streets, curbs, drives and walks in clean, usable, and safe conditions for public use. Keep the work area free from accumulations of waste material, rubbish and other debris resulting from the Work. Clean all roadways daily. Sweep, scrape, shovel or use whatever other approved means, including mechanical pickup sweeper that may be necessary to clean and maintain the roadways to the satisfaction of Owner and the agency having jurisdictional control over said road.

F. After the new main is installed and backfilled, the Contractor shall be responsible for trimming the existing pavement edges to insure a substantially straight line edge between existing pavement and new pavement. The trimming is to remove any ragged edges incurred during construction.

G. Before final acceptance, any trench settlement is to be corrected to the satisfaction of the Resident Project Representative and agency having jurisdictional control over the road. Contractor shall replace pavement, curbs, drives and walks designated by the Engineer with the type of replacement specified.

1.02 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300. In addition, the Qualifications of the paving Subcontractor shall be submitted as follows:

A. The paving Subcontractor shall show that he has performed satisfactory asphalt paving work for at least the past five (5) consecutive years. These Qualifications shall include detailed descriptions of the following, which shall be sufficient to verify the requirements of Article 1.04 below:

   1. Name, business address and telephone number of the paving Subcontractor.
   2. A list of at least five references of previously-completed projects of similar size or larger demonstrating experience over the past 5 consecutive years, including project engineer's and customer's names, addresses and telephone numbers.
   3. Name(s) of all supervisory personnel to be directly involved with paving for this project. For each individual, list previous paving projects and the individual's responsibilities on that project.
   4. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel for the paving work will be directly involved with and used on this project.

B. Paving Subcontractor shall be authorized by the state, municipality, or other local agency having jurisdiction over the roadway to perform the required Work.

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 01570 Traffic Regulation

G. Section 01600 Products

H. Section 01700 Project Closeout

I. Section 02025 Existing Utilities and Structures

J. Section 02210 Trenching, Backfilling and Compacting

K. Section 02540 Erosion and Sedimentation Control

L. Section 02820 Lawn Restoration and Landscaping

M. Section 03310 Cast-In-Place Concrete for Paving, Driveways, Sidewalks, Curbs, and Paved Ditches

N. Section 15000 Piping – General Provisions

O. Section 15130 Piping Specialties

1.04 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. Indiana Department of Transportation (INDOT) Standard Specifications

PART 2: PRODUCTS

2.01 MATERIALS

A. Temporary Asphalt - Cold mix asphalt will not be allowed as permanent pavement; all paving must be completed using hot mix asphalt. With the approval of the local municipality, in conditions when hot mix asphalt is not available, the Contractor shall cap all trenches with concrete to 1.5” below existing grade and provide cold mix asphalt on top as temporary asphalt to finish the trench to grade. The cold patch material shall be maintained by the contractor to the satisfaction of the Resident Project Representative and the agency with jurisdiction over the roadway until hot mix asphalt is available. When conditions allow, the Contractor shall remove the cold mix asphalt and provide hot mix asphalt over the concrete using a tack coat between the layers. Cold mix asphalt and tack coat materials shall be as specified in INDOT Standard Specifications Section 403 and 406, respectively.

B. Permanent Asphalt Pavement - All work including materials and placement of hot mix asphalt (HMA) shall be provided in accordance with INDOT Standard Specifications Sections 402 and 900. Local pavement standard cross-sections shall apply where available. Where not available, pavement sections including all layers listed for the applicable road type (as determined by the authority with jurisdiction) shall be used according to the table below:

Asphalt Pavement Sections			
Layer	Residential	Collector	Arterial/Comm.
1	HMA Surface, Type A, 9.5mm, 1.5 in.	HMA Surface, Type B, 9.5mm, 1.5 in.	HMA Surface, Type B, 9.5mm, 1.5 in.
2	HMA Inter., Type A, 19mm, 2.5 in.	HMA Inter., Type B, 19mm, 2.5 in.	HMA Inter., Type B, 19mm, 2.5 in.
3	HMA Base, Type A, 25mm, 2.5 in.	HMA Base, Type B, 25mm, 4 in.	HMA Base, Type B, 25mm, 4 in.
4	HMA Base, Type A, 25mm, 4 in.	HMA Inter., Type B (Open-Graded), 19mm, 2 in.	HMA Inter., Type B (Open-Graded), 19mm, 2 in.
5	INDOT Subgrade Type 1A	HMA Base, Type B, 25mm, 3 in.	HMA Base, Type B, 25mm, 6 in.
6		INDOT Subgrade Type 1A	INDOT Subgrade Type 1A

C. Asphalt Sealer, where called for on the Drawings, shall be provided as specified in INDOT Standard Specifications Section 404 and Section 902. Other materials suitable for asphalt sealer as listed in Section 902 may be provided as approved by the Engineer.

D. Concrete Pavement - All work, including materials associated with rigid Portland cement concrete pavement (PCCP) shall be provided in accordance with Section 03310. Aggregates shall be as specified in INDOT Standard Specifications Section 900. Placement shall be in accordance with Section 03310 and INDOT Standard Specifications Section 500. Local pavement standard cross-sections shall apply where available. Where not available, pavement sections including all layers listed for the applicable road type (as determined by the authority with jurisdiction) shall be used according to the table below:

	Concrete Pavement Sections			
		Layer Thickness		
Layer	Material	Residential	Collector	Arterial/Comm.
1	PCCP (in.)	6	9	10
2	#8 Compacted Agg. (in.)	NA	3	3
3	#53 Compacted Agg. (in.)	6	6	6
4	Subgrade Prep.	INDOT Type 1A	INDOT Type 1A	INDOT Type 1A

E. Concrete Cap – Concrete caps in trenches and other similar situation shall be provided in accordance with Section 03310. Aggregates shall be as specified in INDOT Standard Specifications Section 900. Placement shall be in accordance with Section 03310 and INDOT Standard Specifications Section 500. The thickness shall be the same thickness as the existing pavement section. The concrete cap may extend up to grade or stop 1.5" below grade to receive an asphalt surface coat, also provided by the Contractor, as directed by the Engineer.

F. Traffic control devices (including traffic detector loops), pavement striping, traffic calming features, and signage shall be replaced to match conditions prior to the Work (or as otherwise indicated on the Drawings or required by the authority with jurisdiction) and shall meet all federal, state, municipal, and other local requirements.

PART 3: EXECUTION

3.01 INSTALLATION

A. Paving Subcontractor performing the Work under this section shall have performed satisfactory asphalt paving work for at least the past five (5) consecutive years and be authorized by the state, municipality, or other local agency having jurisdiction over the roadway to perform the required Work.

B. Saw or line cut the existing pavement, where necessary, as required by local, State or Federal regulations. The edges of the face of the old pavement or base shall be left vertical. Trim ragged edges so as to provide a substantially straight line juncture between the old and new surfaces.

C. Mill & grind - Contractor shall mill, grind, scarify existing surface to ensure adequate bond between the new asphalt and existing surface. Contractor shall

protect existing concrete curbs, gutters, manhole structures and storm sewer inlets.

D. Place the pavement replacement so as to conform in grade to the existing streets, drives and sidewalks. The type of pavement replacement shall be as shown on the pavement replacement details in accordance with applicable Federal, State or local standards. If there are no such applicable standards, replacement will be made to the satisfaction of the Engineer in accordance with this section.

E. After restoration of all asphalt surfaces, the Contractor shall be responsible for sealing all asphalt joints with INDOT approved joint sealer.

F. Roll and tamp in place a 2 inch thick (minimum) course of bituminous material over trenches where temporary pavement is ordered. Remove temporary pavement prior to the placing the permanent pavement. The cost shall be included in the contract price. The finished temporary surface shall be flush with the adjacent undisturbed surface. Maintain the temporary bituminous surface until the temporary surface is replaced.

G. Before the completion of each day's work, in traveled areas, pave the pipe trench with 6 inches of stabilized base, unless another method of pavement restoration is required by the authorized agency with jurisdiction over the roadway. Place final paving over the stabilized base, overlap each side of the trench a minimum of 6 inches, and feather to meet the existing pavement; unless another method of pavement restoration is required by the agency with jurisdiction over the roadway.

H. No permanent bituminous top paving shall be placed within twenty (20) days, or other specified timeframe required by law or regulation, after the backfilling is completed, except by order of the Engineer. Place final pavement at least 20 days and not more than 45 days or other specified timeframe required by law or regulation after the backfilling is completed, unless otherwise directed by the Engineer.

I. Instead of temporary paving, the use of steel roadway plates may be required if an excavation within traveled areas is subject to repeated access prior to backfill/final paving. The use of steel roadway plates shall be in strict accordance all applicable regulations with the Federal, State, County, and/or Local Agency having jurisdiction. Properly secure the steel roadway plates so that they will not be "dragged" from place by a braking truck or "pushed" from place by a snowplow. Submit load bearing calculations, when requested by the Engineer, sealed by a Professional Engineer who is licensed to practice in the State of Indiana. Calculations must demonstrate that the steel roadway plate is properly designed and installed to accommodate HS-20 or higher vehicular loadings, as applicable, based upon plate dimensions (L x W x T), steel strength, and the size of the excavation (L x W) to be protected.

3.02 MAINTENANCE

A. Following the certification of completion by the Engineer, maintain the surfaces of curbs and gutters, paved surfaces and sidewalks for a period of one year thereafter, or for such greater period as may be required by Federal, State or local authorities. Supply all material and labor required for such maintenance. The Work shall be done in a manner satisfactory to the Owner at no additional cost to the Owner.

END OF SECTION

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SECTION 02620

GRAVEL ROADS AND DRIVEWAYS

PART 1: GENERAL

1.01 SCOPE OF WORK

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to perform construction, repair, reconstruction and replacement of gravel roads and driveways as indicated on the Drawings and as specified within this section and related sections of the Specifications.

A. This section shall include replacement of gravel roads and driveways that have been damaged or disturbed during the course of the Work.

B. All Work under this section shall be performed as required by applicable local, state, and federal regulations. Replacement will be at least equal to the type of pavement and related items that existed before the Work began and to the satisfaction of the Resident Project Representative and agencies with jurisdiction.

C. During the entire period of construction of the project, keep all roads and driveways in clean, usable, and safe conditions for public use. Keep the work area free from accumulations of waste material, rubbish and other debris resulting from the Work. Clean all roadways daily. Scrape, shovel or use whatever other approved means that may be necessary to clean and maintain the roadways to the satisfaction of Owner and the agency having jurisdictional control over said road.

D. Before final acceptance, any trench settlement is to be corrected to the satisfaction of the Resident Project Representative and agency having jurisdictional control over the road.

1.02 GENERAL REQUIREMENTS

A. All new gravel roads and driveways shall be constructed to the limits, grades, thicknesses and types as shown on the Drawings but not less than the thicknesses specified herein.

B. Repair, reconstruction and replacement of existing gravel roads and driveways (or any portion thereof) shall match the types, limits, grades, and thicknesses of existing roads or driveways, unless otherwise indicated.

C. Except as otherwise provided in the Specifications or on the Drawings, all work shall be in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications, latest edition except that any reference to "INDOT", "Department" or "Unit" shall mean the "Owner".

D. **The Contractor shall be responsible to verify applicable local paving requirements prior to submitting bids.**

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01500 Temporary Facilities

E. Section 01570 Traffic Regulation

F. Section 01600 Products

G. Section 01700 Project Closeout

H. Section 02025 Existing Utilities and Structures

I. Section 02210 Trenching, Backfilling and Compacting

J. Section 02540 Erosion and Sedimentation Control

K. Section 02610 Roadway Paving and Surfacing

L. Section 02820 Lawn Restoration and Landscaping

M. Section 03310 Cast-In-Place Concrete for Paving, Driveways, Sidewalks, Curbs, and Paved Ditches

N. Section 15000 Piping – General Provisions

O. Section 15130 Piping Specialties

PART 2: PRODUCTS

2.01 GRAVEL

A. All materials used for gravel roads and driveways shall be in accordance with INDOT Section 904, Aggregates.

B. Unless otherwise approved by the Engineer, materials shall be in accordance with the following:

1. Coarse Aggregate, Class D or Higher, Size No. 53
2. Coarse Aggregate, Class D or Higher, Size No. 73

PART 3: EXECUTION

3.01 INSTALLATION

A. All work associated with gravel roads and driveways shall be in accordance with INDOT Section 904, Aggregate.

B. All gravel shall be free of soil contamination, large rocks and other debris.

C. Subgrade shall be compacted in accordance with INDOT 207.04 (as shown on the Drawings, where so indicated). In areas of 500 ft or less in length, or for temporary runarounds, proofrolling will not be required. Proofrolling will not be required in trench sections where proofrolling equipment cannot be used.

D. Unless otherwise approved by the Resident Project Representative, aggregate shall not be placed when the air temperature is less than 35°F. Aggregate shall not be placed on a frozen subgrade. Frozen aggregates shall not be placed.

E. The Aggregate shall be spread in uniform lifts with a spreading and leveling device approved by the Engineer. The spreading and leveling device shall be capable of placing aggregate to the depth, width, and slope specified. The compacted depth of each lift shall be a minimum of 3 in. and a maximum of 6 in., except where utilized as a shoulder. The compacted depth of a lift for a shoulder shall be a minimum of 3 in. and a maximum of 9 in. The aggregate shall be handled and transported to minimize segregation and loss of moisture. In areas inaccessible to mechanical equipment, approved hand spreading methods may be used.

F. Aggregates shall be immediately compacted to a minimum of 100% of the maximum dry densities in accordance with AASHTO T99. Compaction equipment shall be in accordance with INDOT 409.03 (d). Density of the compacted aggregate will be determined in accordance with INDOT 203.24(b). The aggregate shall meet the compaction requirements at the time subsequent courses are placed. All displacement or rutting of the compacted aggregate shall be repaired prior to placing subsequent material.

G. The top of each aggregate course shall be checked transversely and all deviations in excess of ½ in shall be corrected. If additional aggregate is required, the course shall be remixed and re-compacted.

END OF SECTION

SECTION 02820

LAWN RESTORATION AND LANDSCAPING

PART 1: GENERAL

1.01 DESCRIPTION

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to perform restoration of lawn and other grassy areas and to perform landscaping as indicated on the Drawings and as specified within this section and related sections of the Specifications.

A. This section shall include final grading, topsoiling, seeding, and miscellaneous site work not included under other sections, but required to complete the Work as shown on the Drawings and specified herein. Under this section, all areas of the project site disturbed by excavation, materials storage, temporary roads, etc., shall be reseeded, sodded or otherwise restored as specified herein, except for areas to be restored per Sections 02610, 02620 or 03310.

B. Restore and replace shrubbery, fencing, or other disturbed surfaces or structures to conditions equal to that before the Work began and to the satisfaction of the Resident Project Representative.

1.02 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300, including the following:

A. Grass Seed Mix composition

B. Top soil composition

C. Fertilizer composition

D. Mulch (Seed Cover)

E. Certification of all materials.

F. Product certificates signed by manufacturers certifying that their products comply with specified requirements.

1. Manufacturer's certified analysis for standard products.
2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
3. Label data substantiating that trees, shrubs, plants and planting materials comply with specified requirements.

G. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and week seed content. Include the year of production and date of packaging.

H. Planting schedule indicating anticipated dates and locations for trees, bushes, and other special landscaping required on the Drawings or in Section 01011.

I. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.03 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Final Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.

C. Remove and replace dead planting materials immediately. All plants to be replaced in-kind and size specified in the original design.

D. Replace planting materials that are in an unhealthy condition at end of warranty period.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01570 Traffic Regulation

F. Section 01600 Products

G. Section 01700 Project Closeout

H. Section 02105 Clearing and Grubbing

I. Section 02210 Trenching, Backfilling and Compacting

J. Section 02540 Erosion and Sedimentation Control

K. Section 15000 Piping – General Provisions

L. Section 15130 Piping Specialties

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM D5268 Topsoil Used for Landscaping Purposes

B. ASTM D 977 / AASHTO M140 Emulsified Asphalt

C. ASTM D2397 / AASHTO M208 Cationic Emulsified Asphalt

D. ANSI Z60.1 American Standard for Nursery Stock

E. ANSI A300 Standards

F. 2013 Weed Control Guide for Ohio and Indiana (Ohio State University Extension)

PART 2: PRODUCTS

2.01 CONTRACTOR'S RESPONSIBILITIES

A. Furnish and submit certification for materials used as specified in the General Conditions, Division 1 and Division 2.

2.02 TOPSOIL

A. Upon completion and approval of the rough grading, the Contractor shall place clean topsoil over all areas disturbed during construction under any contract except those areas which will be paved, graveled or rip rapped. Topsoil shall not be placed in a frozen or muddy condition and shall contain no toxic materials harmful to grass growth. Topsoil shall be as defined.

B. Topsoil shall not contain more than 40 percent clay in that portion passing a No. 10 sieve. Topsoil shall contain between 5 percent and 20 percent organic matter as determined by loss on ignition of samples oven-dried to constant weight at 212 degrees Fahrenheit.

C. Provide new topsoil which is fertile, friable, natural loam, surface soil, free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones and other extraneous or toxic matter harmful to plant growth. Topsoil shall be weed-free and shall have been previously treated for weed control.

D. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site and approved by the Engineer. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 6 inches.

E. Topsoil is considered the surface layer of soil and sod, suitable for use in seeding and planting. It shall contain no mixture of refuse or any material toxic to plant growth.

2.03 FERTILIZER

A. Fertilizer shall be a complete commercial fertilizer of neutral character with components derived from commercial sources. Fertilizer shall include fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium.

B. Fertilizer analysis to be used shall be determined from post-construction field soil sampling in appropriate number taken by the Contractor and analyzed by the Office of Indiana State Chemist (OISC) or other qualified independent soil testing laboratory. Contractor shall provide fertilizer in accordance with the recommendations of the OISC.

C. If authorized by the Resident Project Representative, in lieu of field soil sampling, fertilizer shall be lawn or turf grade 12-12-12.

D. Fertilizer shall be delivered in standard size bags marked with the weight, analysis of contents, and the name of the manufacturer. Fertilizer shall be stored in weatherproof storage areas and in such a manner that its effectiveness will not be impaired.

E. Fertilizer for trees, shrubs and ornamental plants shall be a complete, commercially available inorganic material. Fertilizer shall contain sulfur coated slow release components.

2.04 GRASS SEED

A. Grass Seed: Fresh, clean dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.

B. <u>Lawns and all other areas:</u>

Seed areas where lawns are or have been regularly maintained, whether residential, commercial or office areas, with the following mixture or a mixture as required by the Soil Conservation District or other governing authority. Grass seed mix shall be as follows:

Seed Description	Percent by Weight
Turf Type Tall Fescue Blend	80%
Kentucky Bluegrass	10%
Perennial Ryegrass (Lolium multiflorm)	10%

2.05 SOD

A. Where sod is required it shall be green, freshly cut, and of good quality with grass free from all noxious weeds. It shall contain all the dense root system of the grass and shall not be less than 1-1/2 inches thick. Provide strongly rooted sod, not less than two years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant).

B. Sod seed mixture shall consist of the seed mixture as stated in Part 2 Products, paragraph 2.04 Grass Seed.

C. Sod shall be mowed prior to cutting.

D. Size of sod pad shall be cut not less than 12 inches x 24 inches nor more than 42 inches x 96 inches. Torn or uneven ends are unacceptable.

E. Sod shall not break apart when handled and be moist and shall be fresh upon arrival to site.

F. Sod shall be scrim free during installation.

2.06 MULCH (SEED COVER)

A. Unless otherwise indicated on the Drawings or otherwise required by the Contract Documents and/or approved permits, seed covering blanketing (mulch) shall consist of straw with biodegradable materials reasonably free of weed seed and foreign materials that could affect plant growth. Seed coverings with nylon mesh or nylon binders are not acceptable.

B. Peat Mulch (where required): Provide Dakota peat moss in natural, shredded, or granulated form, of fine texture, with a pH range of 4 to 6 and a water-absorbing capacity of 1100 to 2000 percent.

C. Fiber Mulch (where required): Biodegradable dyed-wood cellulose-fiber mulch, nontoxic, free of plant growth- or germination-inhibitors, with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Asphalt Emulsion Tackifier (where required): Asphalt emulsion, ASTM D 977, Grade SS-1, nontoxic and free of plant growth- or germination-inhibitors.

E. Nonasphaltic Tackifier (where required): Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth- or germination-inhibitors.

F. Mineral Mulch (where required): Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of following type, size range, and color:

1. Type: Decomposed granite.
2. Size Range: 1/2 inch (19 mm) maximum, 1/4 inch (6 mm) minimum.
3. Color: Readily available natural gravel color range, similar to naturally occurring onsite materials.

2.07 ASPHALT EMULSION (WHERE REQUIRED)

A. Emulsion shall be non-toxic to plants and shall conform to AASHTO M140 or AASHTO M208.

2.08 TREES, SHRUBS AND ORNAMENTAL PLANTS

A. Trees, shrubs and ornamental plants that replace existing trees, shrubs and ornamental plants shall be the same types as those removed, unless otherwise shown on the Drawings.

B. New trees, shrubs and ornamental plants shall be as shown on the Drawings.

C. Provide nursery-grown trees, shrubs, and ornamental plants with healthy root systems developed by transplanting or root pruning complying with recommendations and requirements of ANSI Z60.1 "Standard for Nursery Stock" and as specified.

D. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

E. Grade: Provide trees, shrubs and ornamental plants of sizes and grades conforming to ANSI Z60.1 for type of trees, shrubs and ornamental plants required. Trees, shrubs and ornamental plants of a larger size may be used if acceptable to Resident Project Representative, with a proportionate increase in size of roots or balls.

F. Label ten percent (10%) of all trees, shrubs, and ornamental plants, but at least one (1) of each variety, and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

G. Plants protected by federal trademark or patent must include labels with the correct name with genus and species along with registered cultivar name and be attached to all plants delivered and planted.

2.09 STAKES

A. Upright Stakes: Round, 2 inch, pressure-preservative-treated lodge poles, free of knots, holes and other defects.

B. Tie Wire: ASTM A641 (ASTM A641M), Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.

C. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.

D. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

PART 3: EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

B. Trees, shrubs and ornamental plants: Do not prune before delivery, except as approved by Resident Project Representative. Protect bark, branches, and root systems from sunburn, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.

C. Carefully deliver and unload trees, shrubs and ornamental plants from trucks and trailers. Do not drop trees, shrubs or ornamental plants. Deliver trees, shrubs, ground covers, and ornamental plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist. Contractor is responsible for providing water to plant material on site.

D. Do not remove container-grown stock from containers before time of planting.

E. Water root systems of trees, shrubs and ornamental plants stored on site with a fine-mist spray. Water as necessary to maintain root systems in a moist condition.

3.02 PREPARATION OF SODDED OR SEEDED LAWN AREAS

A. Topsoil Areas

Prior to preparation of areas to be sodded or seeded, remove existing grass, vegetation, and turf. Dispose of such material outside of Owner's property. Remove and dispose of all imported granular fill, grass, weeds, roots, sticks, stones, and other debris 1-inch or greater in diameter. Do not turn over any removed material into the soil being prepared for sodding or seeding.

1. Loosen subgrade of areas to be seeded or sodded to a minimum depth of 4 inches. Remove stones over 1-1/2inch in any dimension and sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.
2. Place 6 inches of topsoil over area to be seeded. Place 4 inches of topsoil in areas to be sodded.
   a. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement.
   b. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil.
   c. Allow for sod thickness in areas to be sodded.
3. Grade areas to be seeded or sodded to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
4. Moisten prepared areas to be seeded or sodded before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
5. Restore areas to be seeded or sodded to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
6. Topsoil shall be spread in place for sufficient quantity for certain plant beds and backfill or shrubs and trees as specified.

B. Ditch and Swale Erosion Protection

1. All ditches and swales indicated on the Contract Drawings shall be lined with a rolled erosion control product (RECP). Installation shall be in accordance with Section 02540 Erosion and Sedimentation Control.

3.03 FERTILIZING

A. Apply fertilizer uniformly to all areas to be seeded at the rate of 1 pound per 100 square feet in topsoil. Disk, harrow, or rake the fertilizer thoroughly into the soil to a depth of not less than 2 inches. Immediately before sowing the seed, rework the surface until it is a fine, pulverized, smooth seed bed varying not more than 1 inch in 10 feet.

3.04 GRASS SEEDING

A. Seed between February 15 and June 1 and between August 15 and November 1. Do not sow seed during adverse weather conditions. Do not broadcast seed during high wind. Do not sow seed when the moisture content of the soil is too low or too high for seed germination.

B. Seed immediately after preparation and fertilization of the seed bed. Mix the seed thoroughly and sow it evenly over the prepared areas at the rate of 3 pounds per

1,000 square feet. Sow the seed dry or hydraulically. After sowing, rake or drag the area to cover the seed to a depth of approximately 1/4 inch.

C. Sod or erosion control blanketing shall be required on all areas with slopes greater than 10%.

3.05 HYDROSEEDING

Hydroseeding shall be required where indicated on the Drawings, specified in Section 01011 or 01075, or otherwise required by authorities with jurisdiction over the Work area. Otherwise, Contractor shall perform seeding by hydroseeding method only when and where authorized by Resident Project Representative. Commercial hydromulching equipment shall be used.

A. New Lawns:

Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application with the hydromulching equipment.

1. Hydroseed mixture shall contain the following:

Material	Quantity
Seed	2 lbs./1,000 S.F.
Fertilizer	As indicated by Laboratory Analysis
Wood Fiber	1,500 lbs./acre

2. Mix slurry with nonasphaltic tackifier.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry application at the minimum rate of 500 lbs. per acre (5.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1,000 lbs. per acre (11 kg per 100 sq. m).

B. Existing Lawns:

After the surface treatment is completed and accepted by the Resident Project Representative, seed mix shall by hydroseeded. The following materials shall be combined to form a seed mulch mixture for hydroseeded applications.

1. Seed mix
2. Binder
3. Wood Fiber Mulch
4. Sufficient water to form a homogenous mixture capable of being applied by hydromulching equipment.

C. Hydroseeding that is deposited on adjacent trees, shrubs, ornamental plants, roadways, driveways, sidewalks, in paved drainage ditches, on structures, and upon any area where seeding is not specified, as well as hydroseeding that is placed in excessive depths on seeding areas shall be removed.

D. Seeding areas flooded or eroded as a result of irrigation shall be repaired, reseeded, and re-fertilized by the Contractor at his expense.

E. Care During Construction: The Contractor shall be responsible for protecting and caring for seeded areas until final acceptance of the Work and shall repair, at his expense, any damage to seeded areas caused by pedestrian or vehicular traffic, erosion due to excessive water application or other causes.

F. Germination: Seed germination is dependent upon a variety of factors, many of which are interacting. Temperature, light, time of year, internal seed dormancy, gas exchange, and moisture are involved in seed germination. If necessary for proper germination and to establish the seeding, a temporary aboveground irrigation system shall be designed, installed and maintained by the Contractor to germinate and establish seeding (the use of a water truck for this purpose is not acceptable). A temporary irrigation controller capable of providing a minimum of six irrigation run cycles per day shall be installed along with temporary remote control valves.

1. Watering should not be so much that it runs off or puddles. Frequent light applications of water are generally needed for good germination results. It may be necessary to irrigate several times per day if it is hot, windy, or the soil is well drained or sloped. Irrigation up to 6 times per day is not uncommon. Irrigation should be checked daily for runoff and drying between cycles. Careful attention by the Contractor is required because too wet or too dry of conditions will affect germination.
2. Following germination of approximately 80% of the Pure Live Seed, or as accepted by the Resident Project Representative, the Contractor shall request start of the seed establishment period. The establishment period shall be for 90 days from the start date set by the Resident Project Representative.
3. Establishment: Establishment is considered to be after germination and before plant maturity. Water during the establishment period shall be that of gradual decrease in water application. The intent is to provide water in soil profiles where it is retained and where root growth occurs. Note: Decreasing the water frequency allows for natural characteristics of drought tolerance to develop.
4. The Contractor shall inspect the ground closely as soon as plants have emerged, as many seedlings are small and inconspicuous. Adjust water frequency accordingly. Inspection of plants and soil will determine the watering requirements during the establishment period. Wilting is an obvious sign of water stress. Overwatered plants may appear yellow due to nutrient deficiency or very lush with excess growth. Overwatered plants will not develop drought resistance.
5. Water after germination should be 1 to 3 times per week on average, however, this is a variable depending on many factors. Water should be allowed to soak the soil profile as deeply as possible to encourage deep rooting. As the plants mature and develop woody tissue, the water can be decreased dramatically and temporary irrigation can be suspended or removed.

6. The Contractor shall be responsible to re-apply hydromulch and seed until establishment is acceptable to the Resident Project Representative with no increased costs to the Contract.

3.06 SODDING

A. Sod all areas as noted in the Drawings. As a minimum, sod shall be fibrous, well rooted approved grass type. The grass shall be cut to a height of less than three (3) inches. Edges of sod shall be cleanly cut, either by hand or machine, to a uniform thickness of not less than one and one-half (1-%) inches, to a uniform width of not less than sixteen (16) inches, and in strips of not less than three (3) feet in length. Sod shall be free from all primary noxious weeds as defined by the applicable Indiana Seed Law (IC 15-15-1).

B. Lay sod with tight staggered joints. On slopes, start placement at the foot of the incline. Use wood pegs driven flush to hold sod in place on slopes 4:1 or greater. Use two wood pegs per strip of sod. Roll the sod lightly after placement. Fill any open joints with topsoil and/or sod.

C. Lay sod perpendicular to direction of slope and in a manner permitting end of pad joints to alternate. Lay sod tightly together. Do not stretch pad or overlap joints. Tamp, secure sod on slopes greater than one vertical to three horizontal. Netting scrim must be removed.

D. Water sod immediately after installation to a depth of 1 inch below sod. After a short drying period, roll sod and smooth minor surface irregularities.

3.07 MULCHING

A. All lawn restoration shall be mulched using straw mulch or straw mats per the following schedule:

   1. For slopes less than 2:1 grade: tack down straw with emulsion per article 3 3.08.
   2. For slopes greater than 2:1 grade; Western Excelsior Excel SS-2 Rapid-Go straw matting pinned with 6” long by 1” crown 11 gauge staples per manufacturers recommendation.

B. Place mulching material evenly over all seeded areas within 48 hours of seeding. Place mulch at the rate of approximately 2 tons per acre, when seeding is performed in recognized growing season and at the approximate rate of 3 tons per acre when seeding is performed in a recognized non-growing season if applicable.

C. No mulch shall be incorporated into backfill of planted areas. Mulch only on surface at final grade.

3.08 EMULSION

A. Keep mulching materials in place with asphalt emulsion applied at a minimum rate of 60 gallons per ton of mulch or by other methods approved by the Engineer. When mulch is displaced, immediately repair any damage to the topsoil and fertilizer, reseed, and re-mulch per the requirements of this section.

3.09 PLANTING GROUND COVER AND PLANTS

A. Space ground cover and plants as indicated.

B. Space ground cover and plants not more than 48 inches (600 mm) apart.

C. Dig holes large enough, 1 ½ times rootball size, to allow spreading of roots, and backfill with planting soil. Water thoroughly after planting.

3.10 PREPARATION FOR TREES, SHRUBS AND ORNAMENTAL PLANTS

A. Examine areas to receive landscaping for compliance with specified requirements and for conditions affecting performance of work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Lay out individual tree, shrub and ornamental plant locations and areas for multiple plantings. Stake locations, outline areas, and secure Owner's or Resident Project Representative's acceptance before the start of planting work.

C. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

D. Mix soil amendments and fertilizers with topsoil at rates indicated for lawn areas. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.

E. Backfill for trees, shrubs and ornamental plants shall be native soil.

3.11 EXCAVATION AND PLANTING FOR TREES, SHRUBS AND ORNAMENTAL PLANTS

A. For pits and trenches, excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation. For container-grown trees, shrubs and ornamental plants: Excavate to 1-1/2 time the container width. Follow ANSI A300 Standards for planting.

B. Obstructions: Notify Engineer if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations. For hardpan layer, increase planting pit.

C. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees, shrubs and ornamental plants.

D. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.

1. Carefully remove containers so as not to damage root balls.
2. Place stock on setting layer of compacted planting soil.
3. Place backfill around ball in layers, tamping to settle backfill. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

E. Perform planting in accordance with ANSI A300 Standards.

3.12 PRUNING AND STAKING OF TREES, SHRUBS AND ORNAMENTAL PLANTS

A. Prune, thin, and shape trees, shrubs and ornamental plants according to ANSI A300 Standards.

B. Upright Staking and Tying: Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1800 mm) above grade.

C. Set vertical stakes and space to avoid penetrating balls or root masses. Support trees with 2 strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.13 WATERING

A. Thoroughly water seed and sod immediately after seeding and sodding.

B. Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches (100 mm).

C. Contractor shall provide temporary water supply in accordance with Section 01500.

3.14 MAINTENANCE

A. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

B. Carefully maintain, tend, and water all seeded and sodded areas necessary to secure a good turf. Fill, grade, and reseed or re-sod all areas that have settled. Maintain the condition of the sodded areas for a period sufficient for the grass to root into the topsoil. Maintain the condition of the seeded areas in accordance with

the requirements of this section for a period of one year from the date of final completion. Maintain the condition of the sodded areas for a period sufficient for the grass to root into the topsoil.

C. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than 60 days after date of final acceptance.

D. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season. Lawns shall be substantially complete when entire area is covered uniformly.

E. Maintain and establish lawns by watering, fertilizing, weeding, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

F. During the growing season, the Contractor and Owner shall be required to re-visit the site within 30 days after seeding, if germination is less than 40%, the Contractor shall be required to overseed the areas. If after an additional 30 days the germination is less than 50%, the Contractor shall be required to remove the straw mats, prepare and rake the soils, re-seed the insufficient areas and re-mulch the entire area.

G. The Contractor shall be responsible for maintaining all seeded areas through the end of his warranty period. Maintenance shall include but not be limited to, annual fertilization, repair of seeded areas, and weed control. The Contractor shall maintain, at his own expense, all seeded areas until acceptance of the Work. Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly at the Contractor's expense.

H. All seeded areas shall be inspected on a regular basis and any necessary repairs or reseedings made within the planting season, if possible. If the stand should be over 60% damaged, it shall be re-established following the original seeding recommendations.

I. Weed growth shall be maintained mechanically and/or with herbicides. When chemicals are used, the Contractor shall follow the current 2013 Weed Control Guide for Ohio and Indiana (Ohio State University Extension) weed control recommendations and adhere strictly to the instructions on the label of the herbicide. No herbicide shall be used without prior approval of the Engineer.

J. Maintain trees, shrubs and ornamental plants by cultivating, watering, weeding, fertilizing, tightening and repairing stakes, and resetting to proper grades or vertical position. Spray as required to keep trees, shrubs and ornamental plants free of insects and disease. Maintain trees, shrubs and ornamental plants for 1 year following final acceptance.

K. Maintain ground cover and plants by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings for 3 months following final acceptance.

3.15 CLEANUP

A. During landscaping, keep pavements clean and work area in an orderly condition.

B. The Contractor shall remove from the site and legally dispose of all surplus soil and waste material, including excess subsoil excavated from his work, unsuitable soil, trash and all other debris including, but not limited to, branches, paper, and rubbish in all landscape areas, and remove temporary barricades as the work proceeds.

C. All areas shall be kept in a neat, orderly condition at all times. Prior to final acceptance, the Contractor shall clean up the entire landscaped area to the satisfaction of the Engineer.

D. After restoration is completed, the Contractor shall return to the site and remove the straw matting after germination has been established. The removal of the straw matting will be established by the Owner.

END OF SECTION

SECTION 03305

CAST-IN-PLACE CONCRETE FOR PIPE WORK

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this section consists of providing all labor, materials, tools, equipment and services required for the placing of all cast-in-place concrete for thrust blocking, pipe encasement, anchor collars, earth retaining walls, manhole bases and other below-grade cast-in-place concrete for water main projects as shown on the Drawings or required by the Engineer. Section 03310 specifies cast-in-place concrete for paving, driveways, sidewalks, curbs and paved ditches.

1.02 SUBMITTALS

Contractor shall submit the following in accordance with Section 01300:

A. Concrete Mix Designs: Submit a mix design for each class of concrete required for the project including:

1. Mix proportions by weight, water/cement ratio, slump range and air content.
2. Sieve analysis of fine and coarse aggregate.
3. Documentation of average compressive strength.
4. Complete list of materials specified in Paragraph 2.01 with product information verifying compliance with all specified requirements.

1.03 QUALITY ASSURANCE

Perform Work in accordance with ACI 301 and ACI 304.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 03310 Cast-in-Place Concrete for Paving, Driveways, Sidewalks, Curbs, and Paved Ditches

H. Section 03450 Precast Concrete Structures

I. Section 15000 Piping – General Provisions

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ACI 301 - Specifications for Structural Concrete

B. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete

C. ACI 305 - Hot Weather Concreting

D. ACI 306 - Cold Weather Concreting

E. ACI 308 - Guide to Curing Concrete

F. ACI 309 - Recommended Practices for Consolidation of Concrete

G. ASTM C33 - Standard Specification for Concrete Aggregates

H. ASTM C94 - Standard Specification for Ready-Mixed Concrete

I. ASTM C136 - Standard Method for Sieve Analysis of Fine and Coarse Aggregate

J. ASTM C150 - Standard Specification for Portland Cement

K. ASTM C494 - Standard Specifications for Chemical Admixtures for Concrete

L. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

M. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars

N. ASTM C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

O. NRMCA: National Ready Mixed Concrete Association

PART 2: PRODUCTS

2.01 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I or Type II.

B. Fly Ash: ASTM C618, Type C or Type F.

C. Slag (GGBFS): ASTM C989

D. Fine Aggregate: ASTM C33.

1. Natural Sand: clean, hard, durable particles.

E. Coarse Aggregate: ASTM C33.

1. Washed gravel and/or crushed stone: clean, hard, durable particles, uniformly graded with a maximum size of 1 inch.
2. Tested for gradation in accordance with ASTM C136.

F. Water: ASTM C1602.

G. Water-Reducing Admixture: ASTM C494, Type A.

H. Retarding Admixture: ASTM C494, Type B

I. Accelerating Admixture: ASTM C494, Type C.

2.02 CONCRETE MIXES

A. Proportion concrete mixes to provide workability and consistency to allow concrete to be easily worked into corners of the forms and around reinforcement without segregation or excessive bleeding.

1. Fly ash or slag shall be used as a cement replacement with a maximum substitution rate as listed in ACI 301 Table 4.2.2.7.b.2.

B. Slump shall be 5 to 8 inches for all mixes containing a water-reducing admixture and 3 to 5 inches for all mixes not containing a water-reducing admixture.

C. Concrete Mix Classes: Fly ash and/or slag required for all mixes.

1. Class A1 concrete: thrust blocking, pipe encasement, anchor collars
   a. Minimum compressive strength at 28 days: 3,500 psi
   b. Air content: optional
   c. Admixtures: optional
2. Class B concrete: manhole bases, concrete fill.
   a. Minimum compressive strength at 28 days: 3,000 psi
   b. Air content: optional
   c. Admixtures: optional

2.03 REINFORCING STEEL

A. Reinforcing bars shall be billet steel grade conforming to the requirements of ASTM A615, Grade 60. All reinforcing shall be deformed bars.

B. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.

PART 3: EXECUTION

3.01 FORMWORK

A. Build all forms mortar tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Construct and maintain forms so as to prevent warping and the opening of joints.

B. The forms shall be substantial and unyielding. Design the forms so that the finished concrete conforms to the proper dimensions and contours. Design the forms to take into account the effect of the vibration of concrete during placement.

3.02 PLACING REINFORCING STEEL

A. Place all steel reinforcement accurately in the positions shown on the Drawings. Secure the steel reinforcements firmly in place during the placing and setting of concrete. When placed in the Work, it shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material.

B. Maintain distances from the forms by means of stays, blocks, ties, hangers or other approved supports. Furnish all reinforcement in full lengths as indicated on the Drawings. Splicing of bars will not be permitted without the approval of the Engineer, except where shown on the Drawings. Stagger splices as far apart as possible. Unless otherwise shown on the Drawings, bars shall be lapped 36 diameters to make the splice.

C. Lap welded wire mesh at least 1/2 mesh plus end extension of wires but not less than six (6) inches in slabs on the ground.

D. Laps of welded wire fabric shall be in accordance with ACI 301. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3.03 CONVEYING AND PLACING CONCRETE

A. No concrete shall be placed prior to approval of the concrete mix design. Concrete placement shall conform to the recommendations of ACI 304.

B. Convey concrete from the mixer to the forms as rapidly as practical by approved methods which will prevent segregation and loss of ingredients.

C. Clean formwork of dirt and construction debris, drain water, and remove snow and ice. After the forms have been inspected, deposit the concrete in approximately horizontal layers to avoid flowing along the forms. Place all concrete in the dry free from standing water. Deposit all concrete continuously or in layers of a thickness such that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the sections. Place the concrete to create a monolithic structure where the component parts of which are securely bonded together. Compact the concrete during placement by suitable means. Work the concrete around the reinforcement and embedded fixtures and into corners and angles of forms, taking care to avoid overworking which may result in segregation.

   Do not drop concrete into forms from a height greater than 5 feet. Use a spout to deposit concrete from a greater height; or, provide openings in the forms to limit the height of drop. Obtain the approval of the Engineer before using any other method of placing concrete from a height greater than 5 feet.

D. Direct concrete through chutes to prevent it from striking reinforcement or sides of the form above the level of placement. Avoid segregation and coating of the surfaces with paste which may dry before concrete reaches its level.

E. Submit a concrete mix design to the Engineer for approval prior to placing any concrete by pumping.

F. All concrete shall be placed in the structure within 90 minutes after batching per ASTM C94. Do not place concrete which has partially hardened or been contaminated by debris.

3.04 BATCHING AND MIXING CONCRETE

A. Batch and mix concrete in accordance with ASTM C94. Mix concrete until a uniform distribution of materials is achieved.

B. No water shall be added to the concrete during transport. The addition of water to the concrete at the site shall be in accordance with ASTM C94 and ASTM C1302 and have the approval of the Resident Project Representative

C. Provide one copy of concrete delivery ticket to the Resident Project Representative immediately upon arrival to the site. The delivery ticket shall list the quantity of concrete in the load, the concrete class, the design strength and all admixtures.

D. Place concrete in all slabs, mats and beams for the full depth of the member to prevent a horizontal cold joint from occurring.

E. Site mixed concrete shall not be used unless approved by the Engineer.

3.05 CURING

A. Perform work in accordance with ACI 308.

B. Maintain concrete in a moist condition for a minimum of 1 day The Contractor shall use one of the following methods to insure that the concrete remains in a moist condition for the minimum period stated above.

1. Ponding or continuous fogging or sprinkling.
2. Application of mats or fabric kept continuously wet.
4. Application of sheet materials conforming to ASTM C171.

C. Formed surfaces may be cured by leaving forms in place. When forms are removed before the end of the curing period, place cotton mats, sheet material or curing compound on concrete surfaces.

D. If a curing compound is employed, it shall be applied per the manufacturer's direction and recommended rate of application. Surfaces damaged by construction operations during curing shall be resprayed at the same rate.

3.06 HOT WEATHER CONCRETING

A. Follow the provisions of ACI 305, ACI 308, and Paragraph 3.05 when ambient temperature is greater than 90°F at time of placement.

B. Transport, place and finish concrete as quickly as practicable.

C. Maximum temperature of concrete during placing is 90°F. Ice or liquid nitrogen may be added to the concrete at the batch plant.

3.07 COLD WEATHER CONCRETING

A. Follow the provisions of ACI 306 when the ambient temperature is less than 40°F at time of placement or expected to be less than 40°F during the curing period.

B. Control concrete setting time with the use of accelerating admixtures as required to facilitate placing and finishing operations. Do not use calcium chloride in excess of 2% by weight in the concrete free of steel reinforcement.

C. Exposed subgrade, formwork and reinforcing shall be warmer than 35°F prior to placement of concrete.

D. The temperature of the concrete during placing shall be between 55°F and 90°F. Provide proper protection of concrete from direct ambient air temperatures below 40°F for a minimum of 3 days or as approved by the Engineer.

3.08 THRUST BLOCKING

A. Refer to Indiana American Water Company Standard Detail Drawings for additional thrust blocking requirements. Notify the Engineer whenever field conditions are more restrictive than the thrust block design data included on Standard Detail Drawings.

B. Construct blocking against the vertical face of undisturbed earth or sheeting left in place. Prevent the concrete from enclosing more than half the circumference of the pipe unless it is a straddle block. Keep the concrete away from joints and bolts in the piping.

C. If thrust blocks are employed at fire hydrants, place thrust blocking to allow the hydrant to drain.

END OF SECTION

SECTION 03310

CAST-IN-PLACE CONCRETE FOR PAVING, DRIVEWAYS, SIDEWALKS, CURBS, AND PAVED DITCHES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required for the placing, finishing and curing of all cast-in-place concrete for paving, driveways, parking lots, sidewalks, curbs and paved ditches as indicated on the Drawings and as specified within this section. Cast-in-place concrete may be used as slope protection where specifically approved by the Engineer. Section 03305 specifies cast-in-place concrete for thrust blocking, pipe encasement, anchor collars, earth retaining walls, manhole bases and other below-grade cast-in-place concrete

B. The Drawings shall indicate the extent of new or replacement concrete work required. In addition, the Contractor shall replace all other curbs, driveways, parking lots and sidewalks damaged or removed incidental to water main construction. The Contractor shall be responsible to verify current ADA standards and requirements of local municipalities and other authorities for concrete requirements prior to submitting bids. Adhere to the most stringent requirements between local requirements and this Specification. Current ADA standards for width and grade shall supersede conflicting requirements herein, and existing sidewalks shall be installed in compliance with current ADA standards.

C. All permanent restoration of driveways and parking lots shall conform to the construction as originally placed and to the original lines and grades, unless otherwise directed by the Engineer or required by local requirements. However, in no case shall the thickness be less than four inches (4”) for residential driveways or six inches (6”) for commercial and industrial driveway and parking lots—both with at least 6x6x6/6 woven wire mesh.

D. All permanent restoration of sidewalks shall conform to the manner of construction as originally constructed and placed (brick, block or stone) and shall be of the same width and thickness as the original sidewalk if not otherwise required. However, in no case shall the thickness be less than four inches (4”), with 6x6x10/10 wire mesh. Replacement sidewalks shall match the existing lines and grades. All new sidewalks (including where the entire sidewalk is replaced) shall slope ¼ inch per foot across the width of the walk toward the street. Sidewalks shall receive a broom finish at right angles to the walkway.

E. All replacement curb (and gutter) shall be of the same type and thickness as the curb (and gutter) which it abuts. The grade of the restored curb (and gutter) shall conform with the grade of the existing adjacent curb (and gutter), unless

otherwise authorized by the Engineer, and shall be installed to insure no ponding of water occurs.

F. All permanent restoration of paved ditch areas shall conform to the construction as originally placed and to the original lines and grades in accordance with the current appropriate state transportation department guidelines.

1.02 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications and other required submittals for the products furnished under this section as follows and as required by Section 01300 for the products specified in this section.

A. Concrete Mix Designs: Submit a mix design for each class of concrete required for the project including:

1. Mix proportions by weight, water/cement ratio, slump range and air content.
2. Sieve analysis of fine and coarse aggregate.
3. Documentation of average compressive strength.
4. Complete list of materials specified in Paragraph 2.01 with product information verifying compliance with all specified requirements.

B. Certificate of Conformance for Concrete Production Facilities: Submit certificate for each ready-mixed concrete batch plant which will supply concrete for the project.

C. Shop Drawings: Submit Shop Drawings indicating locations of construction joints, control joints, and embedded items.

D. Admixtures: Manufacturer's data on all admixtures and curing compounds stating compliance with the required standard.

E. Product Information: Submit product information for materials specified in Paragraph 2.02 verifying compliance with all specified requirements.

F. Concrete Placement Records: Submit at the completion of project.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 304.

B. Ready mixed concrete shall be furnished from a production facility with a current, valid NRMCA "Certificate of Conformance for Concrete Production Facilities".

1.04 WEATHER REQUIREMENTS

A. Concrete shall not be placed during rain, sleet or snow.

B. Hot weather: Refer to Paragraph 3.11.

C. Cold weather: Refer to Paragraph 3.12.

1.05 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02025 Existing Utilities and Structures

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 02540 Erosion and Sedimentation Control

I. Section 02610 Roadway Paving and Surfacing

J. Section 02820 Lawn Restoration and Landscaping

K. Section 03305 Cast-In-Place Concrete for Pipe Work

1.06 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AASHTO M148 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

B. ACI 301 – Specifications for Structural Concrete

C. ACI 304 – Guide for Measuring, Mixing, Transporting, and Placing Concrete

D. ACI 305 – Hot Weather Concreting

E. ACI 306 – Cold Weather Concreting

F. ACI 308 – Guide to Curing Concrete

G. ASTM C31: Standard Practice for Making and Curing Concrete Test Specimens in the Field

H. ASTM C33: Standard Specification for Concrete Aggregates

I. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

J. ASTM C94: Standard Specification for Ready-Mixed Concrete

K. ASTM C138: Standard Test Method for Density, Yield, and Air Content of Concrete

L. ASTM C143: Standard Test Method for Slump of Hydraulic Cement Concrete

M. ASTM C150: Standard Specification for Portland Cement

N. ASTM C171: Standard Specification for Sheet Materials for Curing Concrete

O. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete

P. ASTM C173: Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

Q. ASTM C231: Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

R. ASTM C260: Standard Specification for Air-Entraining Admixtures for Concrete

S. ASTM C309: Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

T. ASTM C494: Standard Specifications for Chemical Admixtures for Concrete

U. ASTM C618: Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

V. ASTM C989: Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

W. ASTM C1064: Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete

X. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete

Y. ASTM C1602: Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

Z. NRMCA: National Ready Mixed Concrete Association

PART 2: PRODUCTS

2.01 CONCRETE MATERIALS

All concrete shall conform to ASTM C150 and the following requirements:

A. Portland Cement: ASTM C150, Type I or Type II.

B. Fly Ash: ASTM C618, Type C or Type F

C. Slag (GGBFS): ASTM C989

D. Fine Aggregate: ASTM C33, Natural sand: clean, hard, durable particles.

E. Coarse Aggregate: ASTM C33, Washed gravel and/or crushed stone: clean, hard, durable particles, uniformly graded with a maximum size of 1 inch.

F. Water: ASTM C1602.

G. Synthetic Fibers: ASTM C1116

H. Air Entraining Admixture: ASTM C260.

I. Water-Reducing Admixture: ASTM C494, Type A.

J. Retarding Admixture: ASTM C494, Type B

K. Accelerating Admixture: ASTM C494, Type C.

L. High-Range Water-Reducing Admixture: ASTM C494, Type F.

2.02 RELATED MATERIALS

A. Curing Materials:

1. Cotton Mats
2. Sheet Material: ASTM C171
   a. Polyethylene film
3. Curing Compound: ASTM C309
   a. Non-staining acrylic type
   b. Curing compounds shall not be used on water-retention structures.
4. Curing compound shall conform to AASHTO M148, Type II, clear, and shall consist of a practically colorless impervious liquid that will thoroughly seal the concrete surface and will not impart a slippery surface thereto. The quality and quantity to be used shall be approved by the Engineer. The use of material that would impart a slippery surface to the concrete or alter its natural color will not be permitted. The colorless, impervious compound shall contain not less than twenty-five percent (25%) solids.

B. Preformed Joint Filler: ASTM D1752, Type III

C. Patching Grout: Use to repair honeycombed and other defective concrete.

2.03 CONCRETE MIXES

A. Proportion concrete mixes to produce homogeneous mixes with the required average strength based on the appropriate amount of overdesign as required by ACI 301 Section 4.2.

B. Proportion concrete mixes to provide workability and consistency to allow concrete to be easily worked into corners of the forms and around reinforcement without segregation or excessive bleeding.

C. Mix designs shall be based on saturated surface dry aggregates. Adjust the amount of mixing water for the moisture condition of the aggregates.

D. Fly ash or slag shall be used as a cement replacement with a maximum substitution rate as listed in ACI 301 Table 4.2.2.7.b.2. In mixes containing fly ash and/or slag, the water/cement (w/c) ratio shall be computed as the water/cementitious material (w/cm) ratio, where cementitious material is the sum of the weights of Portland cement, fly ash and slag.

E. Slump shall be 5 to 8 inches for all mixes containing a high-range water-reducing admixture and 3 to 5 inches for all mixes not containing a high-range water-reducing admixture.

F. Concrete Mix Classes: Fly ash and/or slag required for all mixes.

1. Class E concrete:
   a. Minimum compressive strength at 28 days: 4,500 psi
   b. Maximum water-cementitious material ratio: 0.45
   c. Air content: 6% ± 1½%
   d. Retarding admixture required, except during cold weather periods
   e. Water-reducing admixture required

2.04 REINFORCING STEEL

A. Welded wire fabric reinforcing shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings.

B. Bar reinforcing shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel reinforcing. All reinforcing steel shall be from domestic mills and shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on Drawings.

C. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.

1. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete in all Seismic Design Categories and shall be "Epcon C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, " HIT-HY 200 Adhesive Anchoring System" as manufactured by Hilti, Inc. “SET-XP Epoxy Adhesive Anchors” as manufactured by Simpson Strong-Tie Co. or “PE-1000+ Epoxy Adhesive Anchor System” by Powers Fasteners. Fast-set epoxy formulations shall not be acceptable. No or equal products will be considered, unless pre-qualified and approved.
2. All holes shall be drilled in accordance with the manufacturer’s instructions. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer’s instructions with compressed air and a wire brush prior to installation of adhesive and reinforcing bar.
3. The embedment depth of the bar shall be as shown on the Drawings. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer’s ICC-ES ESR.

PART 3: EXECUTION

3.01 PREPARATION

A. All base and subbase material as approved by local building code/requirements shall be thoroughly compacted and leveled to support the new and replacement installations without settlement.

B. Where water mains are installed (perpendicularly) through concrete driveways, parking lots, sidewalks, curbs and paved ditches, new concrete shall extend laterally a distance of at least 1 foot beyond the trench wall on each side of the trench to provide a bearing shelf onto native/undisturbed soils.

C. Remove debris from forms and other areas in which concrete will be placed.

D. Provide reinforcing bars anchored into hardened concrete with a dowel adhesive system as required by the Drawings.

E. No patching of concrete sidewalks, driveway, parking lot areas or paved ditches will be allowed between existing joints or control joints.

3.02 BATCHING AND MIXING

A. Batch and mix concrete in accordance with ASTM C94. Mix concrete until a uniform distribution of materials is achieved.

3.03 PLACING REINFORCING STEEL

A. Welded wire fabric shall be supported on slab bolsters spaced not less than 30 inches on centers, extending continuously across the entire width of the reinforcing mat and supporting the reinforcing mat in the plane shown on the Drawings.

B. Lap welded wire mesh at least 1/2 mesh plus end extension of wires but not less than six (6) inches in slabs on the ground.

C. The length of lap for reinforcing bars and dowels shall be as shown on the Drawings.

3.04 FIELD QUALITY CONTROL

A. The Resident Project Representative or an independent Testing Agency employed by the Owner will perform field testing at the Owner's direction. The Resident Project Representative shall have the authority to reject concrete due to delays in placement or failed tests of slump, air content, or temperature.

3.05 PLACING

A. Where water mains are installed (perpendicularly) through concrete driveways, parking lots, sidewalks, curbs and paved ditches, new concrete shall extend laterally a distance of at least 1 foot beyond the trench wall on each side of the trench to provide a bearing shelf onto native/undisturbed soils.

B. No water shall be added to the concrete during transport. The addition of water to the concrete at the site shall be in accordance with ASTM C94, Paragraph 11.7 and have the approval of the Resident Project Representative.

C. Provide one copy of concrete delivery ticket to the Resident Project Representative immediately upon arrival to the site. The delivery ticket shall list the quantity of concrete in the load, the concrete class, the design strength and all admixtures.

D. Place concrete at a rate such that the concrete is at all times plastic and flows easily between reinforcement and into corners of forms without segregation. Limit vertical drop of concrete to 4 feet, unless appropriate equipment is used to prevent segregation.

E. The concrete may be pumped into the structure. Use pumping equipment with appropriate design and capacity to provide a continuous flow of concrete without segregation. Do not add water to facilitate pumping. The concrete mix design for pumped concrete shall be submitted and approved prior to placement.

F. All concrete shall be placed in the structure within 90 minutes after batching per ASTM C94. Do not place concrete which has partially hardened or been contaminated by debris.

G. Thoroughly consolidate concrete with high frequency vibrators working the concrete thoroughly around reinforcement and into the corner of the forms. Do

not use vibrators to transport concrete within the forms. Provide at least one standby vibrator on site.

H. Place and consolidate concrete as directed by the Resident Project Representative.

3.06 FINISHING SLABS

A. Slab tolerance shall be ½ inch in 10 feet.

B. Screeding: Immediately after placing, strike off excess concrete with a straightedge to bring the concrete surface to the proper elevation and contour. Complete screeding before any bleed water is present on the surface.

C. Bull Floating: Immediately after screeding, bull float the concrete surface, eliminating high and low spots, smoothing the surface and embedding the coarse aggregate. Avoid overworking the concrete. Do not seal the concrete surface. Complete bull floating before any excess bleed water is present on the surface.

D. Floating:

1. Begin floating operations when bleed water has disappeared from the concrete surface and when the concrete has hardened sufficiently to support the operation. Do not use dry cement, sand or other material to absorb bleed water.
2. Hand or power float the concrete surface, removing slight imperfections and producing an even surface with a uniform texture. Avoid overworking the concrete. Do not seal the concrete surface.

E. Final Finishing:

1. Broom Finish: Slip-resistant surfaces.
   a. Immediately after floating, use a broom to produce a slip resistant surface.
   b. Edge Finish: Immediately after surface finishing, provide perimeter edging finish to match existing surfaces.

3.07 FINISHING FORMED SURFACES

A. Rough Form Finish: All surfaces unless otherwise specified.

1. Chip off fins and projections exceeding 1/4 inch in projection.
2. After being cleaned and dampened, fill tie holes solid with patching mortar.

3.08 JOINTS

A. Minimum control/construction joint width spacing shall be 3 feet as measured from the new construction joint to the existing driveway/sidewalk construction/control joint. Contractor shall align new joints with existing joints

and concrete corners to minimize development of stress cracking. Contractor shall remove existing slabs less than 3 feet width and place new concrete “cold joint” against the existing slab.

B. Construction Joints: Locate construction joints at 40 feet” maximum so as not to impair the strength of the structure or as shown on the Drawings. Thoroughly clean the concrete surface at construction joints and remove laitance before placing adjoining concrete.

C. Control Joints: Locate control joints as shown on the Drawings. Control joints shall be sawcut or hand-tooled. Maximum spacing of joints is 20 feet for pavement. For pavement less than 15 feet in width, joints shall be spaced at a distance no greater than the width of the pavement. Maximum spacing of joints is 6 feet for 3-ft. wide sidewalks and 8 feet for 4-ft. wide sidewalks.

1. Sawcut joints as soon as possible after the concrete hardens. Complete saw cutting before shrinkage stresses become sufficient to produce cracking. Joints must be sawcut the same day concrete is placed. Sawcut joints in straight lines.
2. Hand-tool joints with hand groovers in straight lines.

D. Expansion joints: Locate expansion joints for driveways at a maximum spacing of 40 feet. Maximum spacing of expansion joints for curbs is 12 feet.

3.09 CURING

A. Perform work in accordance with ACI 308.

B. Maintain concrete in a moist condition for a minimum of 3 days, except as modified by the provisions of Paragraph 3.12.

C. Place mats, sheet material or curing compound on concrete slab surfaces immediately after final finishing.

D. Formed surfaces may be cured by leaving forms in place. When forms are removed before the end of the curing period, place cotton mats, sheet material or curing compound on concrete surfaces.

E. If a curing compound is employed, it shall be applied per the manufacturer's direction and recommended rate of application. Surfaces damaged by construction operations during curing shall be resprayed at the same rate.

3.10 REPAIR OF DEFECTIVE AREAS

A. Repair honeycombed and other defective concrete. Remove defective concrete to sound concrete. Cut and chip edges perpendicular to the surface or slightly undercut.

B. Dampen areas to be patched. Patch with patching material in accordance with manufacturer’s instructions.

C. Consolidate the patching material and strike off leaving the patched area slightly higher than the surrounding surface. After initial shrinkage has occurred, strike off and finish to match the surrounding surface.

D. Provide curing to the patched areas and maintain for 48 hours minimum.

3.11 HOT WEATHER CONCRETING

A. Follow the provisions of ACI 305, ACI 308, and Paragraph 3.09 when the rate of evaporation of surface moisture from the concrete exceeds 0.2 lb/ft2/hr (ACI 308, Fig.1).

B. Before placing concrete, spray the subgrade, forms and reinforcement with water to cool them and to prevent absorption of water from the concrete.

C. Transport, place and finish concrete as quickly as practicable.

D. Maximum temperature of concrete during placing is 90°F. Ice or liquid nitrogen may be added to the concrete at the batch plant.

3.12 COLD WEATHER CONCRETING

A. Follow the provisions of ACI 306, ACI 308 and Paragraph 3.09 when the ambient temperature is less than 40°F at time of placement or expected to be less than 40°F during the curing period.

B. Retarding admixture may be eliminated from the mix design. Control concrete setting time with the use of accelerating admixtures as required to facilitate placing and finishing operations. Do not use calcium chloride in the concrete.

C. Subgrade, formwork and reinforcing shall be warmer than 35°F prior to placement of concrete.

D. The temperature of the concrete during placing shall be between 55°F and 75°F. Maintain the temperature of the concrete between 55°F and 75°F for a minimum of 3 days by providing insulating blankets, heated enclosures, or other methods of thermal protection. Provide proper curing for a minimum of 3 days.

E. Protect all earth supported concrete from damage due to frost heave.

3.13 TESTING

A. The Owner will employ a Testing Agency for concrete testing at its discretion. Contractor shall notify Resident Project Representative prior to all concrete placement. The Contractor shall cooperate with the Resident Project Representative and Testing Agency by providing the following:

1. 24-hour notification of concrete placements.
2. Assistance in obtaining fresh concrete samples.

3. Identifying an acceptable designated area for storing concrete test cylinders during the initial curing period and for field-cured concrete test cylinders.
4. Assistance in retrieval of concrete test cylinders.

B. Field tests shall be performed by certified ACI Field Testing Technicians, Grade I. Field tests shall include these tests and/or other tests requested by the Owner.

1. Temperature test: ASTM C1064
2. Slump test: ASTM C143
3. Air content test: ASTM C173 or ASTM C231
4. Unit Weight test: ASTM C138

C. Concrete test samples shall be obtained for each day's placement for each concrete mix supplied. Obtain one test sample for each placement under 50 cu. yd., plus one test sample for each additional 100 cu. yd. or fraction thereof. Concrete shall be sampled in accordance with ASTM C172.

D. Concrete test specimens shall be made and cured in accordance with ASTM C31 and tested in accordance with ASTM C39.

E. For acceptance testing for specified compressive strength, cylinders shall be 6" X 12" or 4" X 8".

F. Six 6" X 12" cylinders or seven 4" X 8" cylinders shall be made from each test sample. Compressive strength tests shall be performed as follows:

1. One field-cured cylinder at 7-days
2. One lab-cured cylinder at 7 days
3. Two field-cured cylinders at 28-days
4. Two 6" X 12" or three 4" X 8" lab-cured cylinders at 28-days

Additional cylinders may be required by the Owner or requested by the Contractor for early-age strength verification for formwork removal or opening to traffic.

G. Test results shall be reported in writing to Owner, Contractor and ready-mixed concrete producer.

3.14 PROTECTION

A. All concrete work shall be protected by barricades, lights, etc. to protect the concrete during the curing period until adequate strength is achieved.

END OF SECTION

SECTION 03450

PRECAST CONCRETE STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to construct precast concrete manholes, vaults, meter boxes, and other below-ground precast concrete structures as indicated on the Drawings and as specified within this section and related sections of the Specifications.

1.02 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, Operating and Maintenance Manuals, certifications and other submittals as follows and as required by Section 01300 for the products specified in this section.

A. Complete layout and installation Drawings and schedules with clearly marked dimensions.

B. Material certificates on all piping materials.

C. Structural design calculations sealed by a Professional Engineer in the State of Indiana for all precast structures of vertical depth greater than 5 feet. Design calculations for precast manholes, vaults, and other below ground structures of vertical depth 5 feet or greater shall include confirmation of structure adequately to resist flotation/buoyancy at the condition whereas structure is totally empty and subjected to groundwater submergence at full height of structure.

D. Results of leakage test.

1.03 QUALITY ASSURANCE

A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, spalls, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the Owner.

B. Connections that require welding shall be performed by welders certified in accordance with AWS D1.1. Certifications of field welders shall be submitted prior to performing any field welds.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 15000 Piping – General Provisions

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM A 123 - Zinc (Hot Galvanized) Coatings on Iron and Steel Products

B. ASTM C478 - Precast Reinforced Concrete Manhole Sections

C. ASTM C857 - Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

D. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals

E. ASTM C990 - Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

PART 2: PRODUCTS

2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

A. Precast utility structures shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C 478 and ASTM C857 with the following modifications there to:

1. Structures shall meet the following:
   a. Each precast wall section shall have an internal diameter of 4'-0", unless noted otherwise.
   b. Minimum wall thicknesses shall be 5 inches for 4 foot and 5 foot diameter structures, 6 inches for 6 foot diameter structures and 7 inches for 7 foot diameter structures.
   c. Manholes and other utility structures shall include ballast concrete and/or other means necessary to insure structures resist flotation when empty and subjected to groundwater full height of structure.
2. The date and name of manufacturer shall be marked inside each precast section.
3. No more than two lift holes may be cast or drilled in each section.
4. Dimensions shall be as shown on the Drawings.
5. Covers and frames shall be as specified in article 2.09.
6. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.

B. Joints between manhole and utility structures riser sections and at base slabs shall be groove type.

2.02 CONCRETE

A. Concrete materials including Portland Cement, aggregates, water, and admixtures shall conform to Section 03305, Cast-in-Place Concrete for Pipe Work.

B. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4000 psi, unless otherwise specified.

C. Prestressed concrete items shall not be used without the approval of the Engineer.

2.03 GROUT

A. Cement grout shall be composed of Portland Cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated,

cement grout shall consist of one part Portland Cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland Cement shall be mixed with the Portland Cement as required to match color of adjacent concrete.

B. Grout for joints between panels shall be cement grout with a minimum compressive strength at 7 days of 3,000 psi. All other grout shall be cement grout with minimum compressive strength at 28 days of 4,000 psi.

2.04 REINFORCING STEEL

A. Reinforcing bars shall be billet steel grade (60,000 psi minimum yield) conforming to the requirements of ASTM A615, Grade 60. Reinforcing bars shall be new stock, free from rust, scale, or other coatings that tend to destroy or reduce bonding.

2.05 PRESTRESSING STRANDS

A. Prestressing strands are not be used without the approval of the Engineer.

2.06 MANHOLE SECTIONS

A. Manhole riser sections shall be designed, manufactured, tested, finished and marked in accordance with the Drawings and ASTM C478, "Precast Reinforced Concrete Manhole Sections".

2.07 BRICK

A. Brick used to bring manholes or other structures to grade shall comply with ASTM C62, Grade SW.

2.08 LADDER / STEPS

A. Manholes and other structures indicated on the Drawings and/or that require personnel access for any reason shall be provided with a polypropylene vault ladder that meets ASTM C497 load requirements and is in accordance with OSHA regulations, including 1910.26 and 1910.27 specifications, . Rungs shall be 12-inches on center steel reinforced copolymer polypropylene with 10-inch clear tread width, 1-5/8 inch by 1-1/4 inch with molded finger grips, and drop front design. Rails shall be 1-3/4 inch square aluminum reinforced copolymer polypropylene. Polypropylene shall conform to ASTM D4101. Ladders shall be provided with appropriate adjustable mounting bracket and a pull-up handrail that extends to 42-inch height above the top of structure. Ladders shall be manufactured by Lane International Corporation.

B. If approved by the Owner for locations requiring infrequent personnel access, individual manhole steps conforming to ASTM C478 and AASHTO No. M-199-811 may be provided in lieu of ladders. Rungs shall be polypropylene coated ½

or 5/8 inch grade 60 deformed rebar with 11-inch clear tread width conforming to ASTM A615 and D4101. Each step shall have a minimum load resistance of 800 pounds and a minimum pull-out resistance of 400 pounds. Manhole steps shall be by Lane International Corporation, PS1-PF by M.A. Industries. Rungs shall be installed into preformed holes in cured concrete (at least 3,000 psi) at 16-inch vertical spacing, center-to-center.

C. Where individual manhole steps are allowed in lieu of a ladder, a Type 304 stainless steel telescoping safety post with 42-inch extension shall be provided. Post shall be tubular and shall automatically lock in position when fully extended. Acceptable manufacturers are The Bilco Company (Ladder-up model LU-3), Halliday Products (Series L1E, Model A Safety Extension). Contractor shall confirm compatibility of safety post and mounting hardware with manhole steps.

D. All hardware shall be Type 316 stainless steel.

2.09 FRAME AND COVER

A. Manholes and other structures shall be provided with flush mount covers unless otherwise indicated on the Drawings or specified in Section 01011.

B. For installations in roadways, locations subject to potentially fast-moving traffic and/or routinely subject to vehicular traffic, or where indicated on the Drawings, a heavy duty manhole frame with vented lid shall be installed such as Neenah Foundry Company's R-1752 Series Heavy Duty (36” round).

C. For locations with limited vehicular traffic (i.e. infrequent and slow-moving), a 36”X36” square H20-rated aluminum floor, vault and sidewalk door (hatch) shall be installed.

D. Installations in non-traffic areas shall be mounted 8 – 12” above the surrounding surface and shall be provided with a 36”X36” square aluminum floor, vault and sidewalk door (hatch) rated for 300 pounds per square foot.

E. Aluminum hatches shall meet the following requirements:

1. Mill finished aluminum covers of checkered or diamond plate or other approved non-slip suface, with channel frames for drainage.
2. Frames and doors shall be at least ¼-inch thick.
3. Comply with applicable provisions of ASTM A123.
4. Door shall pivot open so that no part of the cover protrudes beyond the channel frame into the opening. A full, unobstructed 36”X36” opening shall be provided.
5. All hardware shall be Type 316 stainless steel.
6. Door cover shall have torsion bars, springs or other approved means for counter-balanced operation.
7. Cover shall be equipped with Type 316 stainless steel hold-open devices fastened to the frame with ½-inch bolts.

8. Cover shall be provided with a recessed hasp, designed to receive a padlock, covered by a hinged lid flush with cover surface.
9. Warranty: Hatches shall operate properly and be free of defects in material and workmanship for a period of five years from date of purchase. Should any part break or fail to function in normal use during this period, Manufacturer shall furnish replacement parts at no charge to Owner.
10. Acceptable Manufacturers:
    a. H20-rated hatches shall be JAL-H20 Series by The Bilco Company, Type H1C by Halliday Products.
    b Non-traffic rated hatches shall be JAL Series by The Bilco Company, Type W1C by Halliday Products.

2.10 PIPE CONNECTIONS

The connection may be made with any of the following types:

A. Unless otherwise indicated on the Drawings, openings in structures for pipe connections shall be circular with flexible and watertight seals. “Dog-house” or “mouse-hole” pipe openings shall not be used unless shown on the Drawings or approved by the Engineer.

B. Pipe shall be sealed in the wall opening with a resilient connector meeting the requirements of ASTM C923. Connector shall consist of a rubber sleeve with Type 304 stainless steel banding and shall be one of the following products:

1. KOR-N-SEAL 106-406 Series as manufactured by Trellebor
2. Lockjoint Flexible Manhole Sleeve as manufactured by Interpace Corporation
3. PSX Direct Drive Manhole Connector by Press-Seal Gasket Corporation
4. Z-Lok Cast In Boot Connector by A-LOK Products, Inc.

C. Resilient connector shall either be cast integrally into the wall of the manhole section at time of manufacturer or shall be installed by mechanical means in openings cut into manhole wall per ASTM C923.

D. Each seal shall be of a size specifically designed for the opening size, pipe outside diameter and pipe material.

E. Flexible seals shall allow for up to fifteen degrees (15°) deflection in pipe alignment.

F. No mortar shall be placed around the connector on the inside or outside of the structures unless directed by the Resident Project Representative.

G. Where required on the Drawings, pipe connections shall be sealed with mechanical link-type seals suitable for 20 psi working pressure and corrosive service. Mechanical seals shall be provided with EPDM seal element, Delrin pressure plate, and Type 316 stainless steel bolts and nuts. Mechanical seals shall be accessible from one side. Mechanical seals shall be Link-Seal by Thunderline Corporation.

2.11 ACCESSORIES

A. Connecting and Supporting Devices: ASTM A 36 carbon steel plates, angles, items cast into concrete.

1. Steel devices outside building walls or exposed to weather shall be hot-dip galvanized in accordance with ASTM A153.
2. All connection plates and devices on the interior of the building and not exposed to view may be unfinished steel and no primer or paint is required.

B. Bearing Pads: A homogeneous blend of ozone-resistant rubber elastomer and high strength random synthetic fiber cords, cured together to form a pad with uniform behavior in all directions. Provide where indicated or required by the member design.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include but are not limited to the following:
   a. JVI Inc.
   b. Voss Engineering, Inc.
   c. Alert Manufacturing

C. Bearing Strips: Tempered hardboard, smooth both sides, or minimum compression plastic, as shown on approved Shop Drawings.

D. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations. For exposed to view concrete surfaces and for all units used in exterior construction, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI Class 1) or stainless steel protected (CRSI Class 2).

E. Provide connection plates between precast members where indicated on the Drawings, or where required by manufacturer's calculations for overall stability.

PART 3: EXECUTION

3.01 HANDLING

A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least 5 days has elapsed since casting, unless otherwise permitted by the Engineer.

B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.

C. Lift and move all precast concrete components using suitable lifting slings and plugs that will not damage the precast lip.

D. Thoroughly repair all damage to precast sections in the presence of the Engineer. Repair and patch minor breaks by chipping and scarifying the defective area before applying grout. Allow sufficient curing time before the precast sections are put together. Form and key concrete cast-in-place bases specially to accommodate the bottom precast section.

3.02 INSTALLATION

A. Compaction shall be accomplished in accordance with Section 02210.

B. Unless otherwise noted on the Drawings, support bases uniformly on a 6-inch mat of compacted crushed stone or gravel placed over a base of sound, level, undisturbed earth.

C. Place concrete base and wall sections so that all pipes are at proper grade and alignment.

D. Clean the exterior of the pipe thoroughly before installing through the wall opening. Set the pipes securely in the wall opening and complete seal per the seal manufacturer's instructions at the correct line and grade. Provide clearance between the outside of the pipe and the manhole opening in accordance with the seal manufacturer's recommendations and properly tighten the seal. Do not grout the opening unless directed by the seal manufacturer.

E. Bring the top of all precast structures to proper grade for receiving manhole frames or other required covers/hatches. If proposed structure top grade is to be flush to ground surface grade, the top of the manhole ring and cover (or other lids/hatches) shall be within one inch (1") of surrounding grade. If proposed structure top grade is to be above ground surface grade, the top of the manhole ring and cover (or other lids/hatches) shall be between 8 and 12 inches above surrounding grade unless otherwise indicated on the Drawings.

F. Install ladders, hatches, and other devices in full conformance with the manufacturer's instructions.

END OF SECTION

SECTION 15000

PIPING - GENERAL PROVISIONS

PART 1: GENERAL

1.01 SCOPE OF WORK

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to perform piping work as indicated on the Drawings and as specified within this section and related sections of the Specifications. Performance of Work specified under this section is integral to Work specified throughout the Specifications.

1.02 DRAWINGS

Dimensions shown on Drawings are approximate only. Verify all piping geometry in the field to ensure proper alignment and fit of all piping consistent with the intent of the Drawings. Submit field layout drawings when required for approval.

1.03 GENERAL REQUIREMENTS

A. The Contractor shall comply with American Water safety monitoring system for Contractor Safety requirements. The Contractor shall provide protection for the general safety of workers, pedestrians, the traveling public and others within the Work area throughout this project. Existing surface improvements and underground facilities and utilities shall also be protected. Damage caused by the Contractor shall be repaired at his own expense. Protection to be provided includes, at a minimum:

1. Provide adequate barricades, warning lights, signs, and other warning devices appropriate for the conditions for excavations and obstructions.
2. Contractor is solely responsible for trench support and safety of the work area and all construction activities.
3. All other protections required by the Drawings and/or other sections of the Specifications.
4. Comply with all requirements of federal, state, and local authorities with jurisdiction over the Work area.

B. Replacement of and/or connection to existing pipelines may require shutdown(s) of Owner facilities and may require that Work be performed during one or more shutdown periods, which may have associated time constraints and/or other special requirements and limitations (e.g. shutdowns only on certain days, only during certain hours, and/or only when a tank is above an allowable minimum level). Contractor shall closely coordinate construction work and connections with the Engineer and Owner, and shall make all required connections at such times as directed by the Owner at the Contract prices with no claim for premium time or other additional costs. The Owner has the final determination in regard to

all interruptions of the existing water system. The Contractor shall perform all related coordination in accordance with this section; Sections 01000, 01011, 01500; and all other applicable requirements of the Contract Documents.

1.04 COORDINATION OF WORK

A. Closely coordinate construction work, all interruptions and connections with the Owner through the Engineer as specified herein. The Engineer, in consultation with the Owner, may select the day(s) and time(s) for pipe bursting (if applicable) and/or connection to existing pipelines, which will, in the opinion of the Engineer, cause the least inconvenience to the Owner and/or its customers. This may require work by the Contractor during evenings, nights, Saturdays, Sundays, and/or holidays. Contractor shall perform all pipe bursting (if applicable), all interruptions, and make all connections at such times as may be directed by the Owner through the Engineer at the Contract prices, with no claim for premium time or additional costs.

B. Contractor shall schedule the Work so that the existing water system is maintained in continuous operation during the construction period except during Owner-approved interruptions as specified herein. All short-term shutdowns and diversions shall be approved by the Owner. Long-term shutdowns and diversions shall conform to the requirements hereinafter specified and shall be minimized by the Contractor as much as possible. If in the judgment of the Owner a requested shutdown is not required for the Contractor to perform the Work, the Contractor shall utilize approved alternative methods to accomplish the Work. All shutdowns shall be coordinated with and scheduled at times suitable to the Owner. Shutdowns shall not begin until all required materials are on hand and ready for installation. Each shutdown period shall commence at a time approved by the Owner, and the Contractor shall proceed with the Work continuously, start to finish, until the Work is completed and normal operation is restored. If the Contractor completes all required Work before the specified shutdown period has ended, the Owner may immediately place the existing system back into service.

C. Contractor shall schedule short-term and long-term shutdowns in advance and shall present all desired shutdowns in the Construction Schedule (see Section 01300). Shutdowns shall be fully coordinated with the Owner at least 48 hours before the scheduled shutdown. Owner personnel shall operate Owner's facilities involved in the short-term and long-term shutdowns and diversions.

D. Short-term shutdowns will be allowed for tie-ins to existing facilities, installation of permanent caps (to abandon pipes), etc. as indicated on the Drawings or elsewhere in the Contract Documents. All such shutdowns shall be scheduled for low flow periods (which may require weekend or night work) and shall be limited to less than two (2) hours.

E. Any shutdown of two (2) hours or longer duration shall be defined as a long-term shutdown. For long-term shutdowns, Contractor may be required to provide appropriate temporary water supply and/or flow bypass facilities to be approved by the Owner at no additional cost to the Owner when critical water customers, critical fire protection needs, or other Owner requirements so dictate. Contractor

may be allowed additional time for short-term interruptions if no critical water needs exist. The schedule and duration of short-term shutdowns shall be at the discretion of the Owner.

F. Any temporary work, facilities, roads, walks, protection of existing structures, piping, blind flanges, valves, equipment, etc. that may be required within the Contractor's work limits to maintain continuous and dependable operation of the Owner's facilities shall be furnished by the Contractor at the direction of the Engineer at no extra cost to the Owner.

G. Owner shall have the authority to order Work stopped or prohibited Work that would, in his opinion, unreasonably result in interrupting necessary operations of the Owner's water system.

H. If the Contractor impairs performance or operation of the water system as a result of not complying with specified provisions for maintaining operations, then the Contractor shall immediately make all repairs or replacements and do all work necessary to restore the water system to operation to the satisfaction of the Engineer. Such work shall progress continuously to completion on a 24 hours per day, seven work days per week basis.

I. Contractor shall provide the services of emergency repair crews on call 24 hours per day to affect repairs to portions of the water system affected by the Contractor's operations.

J. Preparation Prior to Making Connections into Existing Piping Systems

1. Approximate locations for existing piping systems are shown on the Drawings. Prior to making connections into existing piping systems, the Contractor shall:
   a. Field verify location, size, piping material, and piping system of the existing pipe.
   b. Obtain all required fittings, which may include saddles, sleeve type couplings, flanges, tees, or others as shown on the Drawings.
   c. Have installed all temporary piping in accordance with established connection plans.
2. Have on hand necessary pipe stoppers, pancake flanges or other items which may be necessary should an existing valve or appurtenance fail to seal properly.
3. Unless otherwise approved by the Engineer in writing, new piping systems shall be completely assembled and successfully tested prior to making connections into existing pipe systems.

K. Flow Bypass and Temporary Water Service

1. Potable water service and water for fire protection purposes shall be maintained in continuous service at all times during construction except for short term interruptions required for tie-ins and long-term interruptions shorter than eight (8) hours when approved by the Owner. For long-term shutdown periods greater than eight (8) hours duration (and for shorter long-term interruptions where required), temporary water shall be provided to all

impacted services. This can include the use of temporary waterlines that have been disinfected and flushed in accordance with State standards and regulations for potable water use.

2. A flow bypass and temporary water service plan shall be submitted to the Owner and Engineer for approval. The plan shall indicate location of temporary piping, temporary waterline sizes, street and driveway crossing methods, location of connection to water distribution system, type of connection used to connect temporary water piping to water system, location and type of temporary fire hydrants, and the water services served. All temporary outages shall be shown or listed in the project schedule provided to the Engineer.
3. All temporary water services shall allow for the water to pass through the customer's existing water meter. At no time shall a customer be provided unmetered water.
4. Traffic on roadways shall not be impeded by temporary water service piping, and Contractor shall maintain vehicular access to all driveways throughout the Work. Temporary water service piping shall be protected from traffic at driveways and road crossings with cross-over ramps or by other methods approved by the Engineer, Resident Project Representative and the agency with jurisdiction over the roadway. Contractor shall submit and provide acceptable methods at no additional cost to the Owner.
5. The Contractor shall also comply with requirements included in Section 02025.

1.05 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications, and other required submittals for all piping products furnished in accordance with Section 01300. Submittals shall include the following:

A. Field layout drawings (when required)

B. Flow bypass and temporary water service plan, including products and methods for protecting temporary piping at road and driveway crossings without impeding traffic (when flow bypassing and/or temporary water service is required for the Work)

C. Calculations and details of temporary thrust blocking at temporary caps and other temporary deadends

D. If any main is flooded, submit a plan to correct the condition as required by article 3.04.

E. Contractor shall execute and submit the applicable documentation of compliance with American Water Pipe Cutting Policy prior to performing Work.

F. Contractor shall execute and submit the applicable documentation of compliance with American Water PICS Contractor Safety requirements prior to performing Work.

1.06 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01010 Drawing Index

C. Section 01011 Special Provisions

D. Section 01075 Basis of Payment

E. Section 01300 Submittals

F. Section 01500 Temporary Facilities

G. Section 01570 Traffic Regulation

H. Section 01600 Products

I. Section 01700 Project Closeout

J. Section 02020 Dewatering

K. Section 02025 Existing Utilities and Structures

L. Section 02105 Clearing and Grubbing

M. Section 02210 Trenching, Backfilling and Compacting

N. Section 02230 Stream Crossing

O. Section 02540 Erosion and Sedimentation Control

P. Section 02558 Identification/Location Guide

Q. Section 02610 Roadway Paving and Surfacing

R. Section 02620 Gravel Roads and Driveways

S. Section 02820 Lawn Restoration and Landscaping

T. Section 03305 Cast-In-Place Concrete for Pipe Work

U. Section 03310 Cast-in-Place Concrete for Paving, Driveways, Sidewalks, Curbs, and Paved Ditches

V. Section 15020 Disinfecting Pipelines

W. Section 15025 Flushing and Cleaning Pipelines

X. Section 15030 Pressure and Leakage Tests

Y. Section 15105 Ductile Iron Pipe and Fittings

Z. Section 15120 Polyvinyl Chloride (PVC) Pipe

AA. Section 15125 High Density Polyethylene (HDPE) Pipe

BB. Section 15130 Piping Specialties

CC. Section 15185 Abandonment of Mains and Hydrants

DD. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

EE. Section 15200 Service Lines

1.07 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. NSF/ANSI 14 Plastics Piping System Components and Related Materials

B. NSF/ANSI 61 Drinking Water System Components – Health Effects

C. NSF/ANSI 372 Drinking Water System Components – Lead Content

D. Indiana Administrative Code Title 327 Water Pollution Control Division (327 IAC)

PART 2: PRODUCTS

2.01 REDUCTION OF LEAD IN DRINKING WATER ACT COMPLIANCE

All products shall comply with the requirements and standards of the Reduction of Lead in Drinking Water Act. Products shall be “lead free’ as required by that act and as enforced by agencies with jurisdiction. Contractor shall be responsible for ensuring full compliance with all applicable federal, state, and local laws, ordinances, codes, rules, and regulations governing the Reduction of Lead in Drinking Water Act.

2.02 DOMESTIC AND FOREIGN PRODUCTS

Except as specially allowed in the individual Sections, all products provided by the Contractor shall be produced solely in the United States; and no foreign-manufactured items shall be allowed.

2.03 RUBBERIZED-BITUMEN BASED SPRAY-ON UNDERCOATING

A. Where required by the Engineer, an aerosol applied rubberized coating corrosion protection for exposed buried metal (not for stainless steel, Xylan, or FluoroKote #1 hardware) shall be provided. The material shall be rapid dry and specifically designed for corrosion protection. 3M Rubberized Undercoating 08883 or equivalent rubberized-bitumen based spray-on undercoating may be used. Follow manufacturer's recommendations for storage and application.

2.04 BRIDGE CROSSING AND OTHER AERIAL PIPE

A. The pipe material to be used for bridge crossings shall be ductile iron as called out in the Drawings and approved by the Engineer.

B. For bridge crossings using ductile iron pipe, all ductile iron pipe to be fully restrained meeting requirements provided in Section 15105 as applicable. Only factory-fabricated push-on restrained joints are permitted for bridge crossing pipe or other aerial pipelines. Push-on restraining gaskets with integral stainless steel locking segments are not permitted for exposed pipe. Flanged joints are not permitted for aerial pipelines. All ductile iron pipe shall have factory-installed cement mortar lining coated with an asphaltic seal coating on the interior in accordance with AWWA C110 and factory-applied epoxy primer with field-applied finish coating on the exterior as specified in Section 01011 or otherwise required by the Engineer.

C. Bridge crossing and other aerial piping shall be insulated in accordance with Section 15130.

PART 3: EXECUTION

3.01 PACKAGING, HANDLING, DELIVERY, OFF-LOADING AND STORAGE

A. The manufacturer shall package the pipe and fittings in a manner designed to ensure that they arrive at the project neat, clean, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to assure that the pipe is properly supported, stacked, and restrained during transport such that the pipe is not cut, nicked, gouged, deformed, or otherwise physically damaged. Nesting of pipe shall not be permitted.

B. Each pipe shipment shall be checked for quantity and proper pipe size, color and type. Each pipe shipment shall be inspected prior to unloading to see if the load has shifted or otherwise been damaged. Notify Owner or Engineer immediately if

more than insignificant damage is found. Any pipe damaged in shipment shall be replaced by the Contractor as directed by the Owner or Engineer.

C. Pipe shall be loaded, off-loaded, and otherwise handled in accordance with the pipe manufacturer's guidelines and the applicable standards referenced in the individual pipe sections of the Specifications.

D. Contractor shall inspect all pipe, fittings, and appurtenances (whether furnished by the Owner or Contractor) for defects prior to installation in the trench. Contractor shall set aside defective, damaged or unsound material and hold material for inspection by the Engineer.

E. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

F. Protection of Pipe: Contractor shall install all devices and other equipment required to protect the pipe from damage during installation. Lubrication shall may be used as recommended by the manufacturer and specified in the individual pipe material sections of the Specifications. Under no circumstances will the pipes be stressed beyond their elastic limit.

3.02 CONTRACTOR'S RESPONSIBILITY FOR MATERIAL

A. Examine all material carefully for defects. Do not install material which is known, or thought to be defective.

B. The Engineer reserves the right to inspect all material and to reject all defective material shipped to the job site or stored on the site. Failure of the Resident Project Representative, Engineer or Owner to detect damaged material shall not relieve the Contractor from any responsibility for the Work.

C. Lay all defective material aside for final inspection by the Engineer. The Engineer will determine if corrective repairs may be made, or if the material is rejected. The Engineer shall determine the extent of the repairs.

D. Classify defective pipe prior to Engineer's inspection as follows:

1. Damage to interior and/or exterior paint seal coatings (DI, steel).
2. Damage to interior cement-mortar or epoxy lining (DI,steel).
3. Piping that has received a blow that may have caused an incident fracture, even though no such fracture is visible (PVC). All such pipe shall be marked as rejected and removed from the job site immediately upon Engineer's inspection.
4. Insufficient interior cement-mortar lining or epoxy thickness.
5. Excessive pitting of pipe (DI, steel)
6. Poor quality exterior paint seal coat (DI, steel).

7. Pipe out of round (all pipe).
8. Pipe barrel area damaged to a point where pipe class thickness is reduced (all pipe).
9. Denting or gouges in plain end of pipe (all pipe).
10. Excessive slag on pipe affecting gasket seal (DI).
11. Any visible cracks, holes (PVC, HDPE).
12. Embedded foreign materials (PVC, HDPE).
13. Non-uniform color, density and other physical properties along the length of the pipe (PVC, HDPE).

E. Contractor shall be responsible for all material, equipment, fixtures, and devices furnished. These materials, equipment, fixtures and devices shall comply with the requirements and standards of all Federal, State, and local laws, ordinances, codes, rules, and regulations governing safety and health.

F. Contractor shall be solely responsible for the safe storage and handling of all material furnished to or by him (including material furnished by the Owner) until the material is incorporated in the completed project and accepted by the Engineer. If any material furnished by the Owner is damaged after its receipt by the Contractor, the Contractor shall replace or repair the item in a satisfactory manner (at the Engineer's discretion) at the Contractor's own expense. If any defective or damaged item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor at the Contractor's own expense.

G. Load and unload pipe, fittings, valves, hydrants and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop materials or damage interior/exterior. Pipe handled on skidways shall not be skidded or rolled against other pipe. Handle this material in accordance with AWWA C600, C605 or C906, and manufacturers' guidelines as applicable.

H. Drain, store, and protect fittings and valves in accordance with Section 01600.

3.03 INSTALLATION - GENERAL REQUIREMENTS

A. Lay and maintain all pipe to the required lines and depths. Minimum depth of cover shall be as indicated on the Drawings. Measure the depth from the final surface grade to the top of the pipe barrel. Do not deviate from the required alignment, depth or grade without the written consent of the Engineer.

B. Buried steel lugs, rods, brackets, and flanged joint nuts and bolts are not permitted unless specifically shown on the Drawings or approved in writing by the Engineer. When allowed, these items shall be as specified in Section 15130.

C. Bolts shall be carefully tightened in increments, with a final torque value not exceeding the manufacturer's recommendations. Contractor shall ensure that bolts are properly re-tightened where appropriate following a sufficient time for gaskets to undergo compression set.

D. Install fittings, valves and hydrants in strict accordance with the Specifications at the required locations with joints centered, spigots home, and all valve and hydrant stems plumb. Contractor shall install pipe in accordance with minimum cover requirements as indicated on Drawings.

E. If during the course of pipeline installation the Contractor identifies or suspects the presence of petroleum products or any unknown chemical substance in the native soil, Contractor shall stop installing piping in the area of suspected contamination and notify the Engineer immediately. Contractor shall not resume installing piping in the area of suspected contamination until direction is provided by the Engineer.

F. Do not lay pipe in a wet trench, on subgrade containing frost, or when trench conditions are unsuitable for such work. If all efforts fail to obtain a stable dry trench bottom and the Engineer determines that the trench bottom is unsuitable for such work, the Engineer will specify in writing the type of stabilization to be used. In all cases, water levels must be at least 6” below the bottom of the pipe during pipe joint installation. See Section 02020, Dewatering.

G. Lay pipe with the bell ends facing in the direction of work progress, unless otherwise shown on the Drawings or directed by the Engineer. Exercise care to ensure that each length abuts the next in such a manner that no shoulder or unevenness of any kind occurs in the pipe line.

H. Do not wedge or block the pipe during laying unless by written order of the Engineer.

I. Before joints are made, bed each section of pipe the full length of the barrel, at the required grade, and at the invert matching the previously laid pipe. Dig bell holes sufficiently large to permit proper joint making. Do not bring succeeding pipe into position until the preceding length is embedded and secure in place.

J. Remove and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying. Remove, such in-place pipe sections found to be defective and replace them with new pipe. Removal, installation, and replacement will be at the Contractor's expense.

K. Place enough backfill over the center sections of the pipe to prevent floating. Take all other necessary precautions to prevent the floating of the pipeline by the accumulation of water in the trench, or the collapse of the pipeline from any cause. Should floating or collapse occur, restoration will be at the Contractor's expense.

L. Bedding materials and concrete work for the pipe bedding and thrust restraint shall be as specified in Divisions 2, 3, and 15 as well as indicated on the Drawings.

M. Cutting of the pipe in the field shall be limited to only two pieces of pipe per pipeline; and this shall be for closure purposes only, unless otherwise approved by the Owner. Such cuts shall be made carefully in a neat workmanlike manner using approved methods to produce a clean square cut perpendicular to the longitudinal axis. Contractor shall propose method of cutting pipe, which shall be

subject to approval by the Owner. Contractor shall comply with American Water Pipe Cutting Policy. Re-mark the “home” line on the cut end spigot end per pipe manufacturer’s recommendations for the specific pipe material, size, and joint type.

1. When ductile iron pipe is cut in the field, the cut end shall be conditioned for use by filing or grinding a bevel at an angle of approximately 30 degrees with a heavy file or grinder to remove all sharp edges and shape the pipe for insertion into the adjacent pipe, valve or fitting; and coat all exposed metal to match pipe interior coating as specified.
2. When PVC pipe is cut in the field, the cut end shall be conditioned for use by filing a bevel at an angle recommended by the pipe manufacturer with a heavy file to remove all sharp edges and shape the pipe for insertion into the adjacent pipe.
3. When HDPE pipe is cut in the field, the cut end shall be conditions in accordance with the manufacturer’s recommendations.

N. In distributing material at the site of the Work, unload each joint as close as possible to where it is to be laid in the trench. If the pipe is to be strung out, do so in a straight line or in a line conforming to the curvature of the street. Block each length of pipe adequately to prevent movement. Block stockpiled pipe adequately to prevent movement. Do not place pipe, material, or any other object on private property, obstructing walkways or driveways, or in any manner that interferes with the normal flow of traffic.

O. Exercise special care to avoid damage to the bells, spigots or flanged ends of pipe during handling, temporary storage, and construction. Replace damaged pipe that cannot be repaired to the Engineer's satisfaction, at the Contractor's expense.

P. Remove all existing pipe, fittings, valves, pipe supports, blocking, and all other items in accordance with Section 15185 as necessary to provide space for making connections to existing pipe and installing all piping required under this Contract. Contractor shall make connections to existing pipeline(s) in such a manner so as to cause the least amount of disruption to water service to the Owner’s customers. Where existing pipe is corroded, deformed, or otherwise not acceptable for connection in the opinion of the Resident Project Representative, Engineer or Owner, the pipe shall be exposed and cut back until pipe in acceptable condition is exposed; and connection shall be made to existing pipe that is acceptable to the Resident Project Representative, Engineer and/or Owner.

Q. Maintain the minimum required distance between the water main and other utility lines in strict accordance with all Federal, State, and local requirements and all right of way limitations.

R. Provide and install polyethylene encasement for ductile iron pipe, fittings, valves, and other appurtenances per Section 15130. Contractor shall install polyethylene encasement on the pipe directly prior to the installation of the piece of pipe.

S. Use short lengths of pipe (minimum length 3 feet, no more than three short sections), when approved by the Engineer, to make curves that cannot be made with full length sections of pipe without exceeding the allowable deflection. Making these curves will be at no additional cost to the Owner. Joints in curves shall be restrained where required by the Drawings.

T. Furnish air valve assemblies in accordance with the Drawings, the Owner's Standard Detail Drawings for air valves and as specified in Section 15190. Any proposed deviation from these requirements that are proposed by the Contractor must be approved in writing by the Engineer.

U. Exercise particular care so that no high points are established where air can accumulate. If the Engineer determines that unforeseen field conditions necessitate a change in the pipe profile that requires the installation of an air valve and concrete structure, then an air valve and concrete structure will be provided at the unit price bid. If no applicable unit price was established in the Contract then this will be added as Extra Work in accordance with the Contract Documents. If the Contractor requests a change in the pipe profile solely for ease of construction, and the requested change requires the installation of an air valve and concrete structure as determined by the Engineer, the cost of furnishing and installing the air valve and concrete structure will be at the expense of the Contractor.

3.04 CONSTRUCTION METHODS TO AVOID CONTAMINATION

A. String pipe delivered for construction so as to keep foreign material out of the pipe.

B. Remove all dirt and foreign matter from pipe before lowering it into the trench. Do not place debris, hand tools, clothing or other materials in the pipe. Thoroughly clean the pipes, fittings and valves before they are installed; and keep these materials clean. Clean the sealing surface of the spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets immediately before assembly.

C. Do not roll, drop or dump pipe or appurtenances into the trench.

D. Keep pipe clean during and after laying. Take precautions to protect the interior of pipes, fittings, and valves against soil, debris, runoff and other foreign materials entering the pipe and other contamination during installation. Do not place debris, tools, clothing, or other materials in the pipe during laying operations. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons such as rest breaks or meal periods when the exposed pipe will be unattended. If approved by the Owner, use rodent-proof plugs approved by Engineer where watertight plugs are not practical and where thorough flushing or cleaning will be performed. If water, soil, backfill material, or other debris accumulates in the trench, keep the plugs in place until the trench is dry and the pipe end has been completely uncovered.

E. Handle sealing material and gaskets in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be NSF-certified for use in potable water line and in accordance with pipe manufacturer's recommendations. Lubricant shall be stored, handled, and applied as recommended by the pipe manufacturer. Avoid using too much lubricant. Excessive lubricant use can make disinfection more difficult and cause taste and odor problems when the line is placed in service.

F. If dirt enters the pipe, and in the opinion of the Engineer the dirt will not be removed by the flushing operation, clean the interior of the pipe by mechanical means, then swab with a 1% hypochlorite disinfecting solution. Clean using a pig, swab, or "go-devil" only when approved by the Engineer and Owner.

G. If the main is flooded during construction, the flooded section must be isolated from the remainder of the installation as soon as practical. Contractor shall submit a plan to the Engineer to correct the condition and shall not proceed until authorized by the Engineer. Any required replacement of pipe, cleaning and disinfection required shall be at no additional cost to the Owner.

3.05 TRACER WIRE

A. Contractor shall install tracer wire and test connection points along all buried piping (water mains, hydrant branches, and services), regardless of pipe material or installation method, in accordance with Sections 02458, 02558 and 15130, as applicable.

3.06 THRUST RESTRAINT

A. Provide all plugs, caps, tees, and bends (both horizontal and vertical) with concrete thrust blocking and/or restrained joint pipe and fittings as indicated on the Drawings, or specified in the Specifications.

B. Place concrete thrust blocking between undisturbed solid ground and the fitting to be anchored. Install the concrete thrust blocking in accordance with Section 03305 and Owner's Standard Detail Drawing for thrust blocking. Ensure proper placement of polyethylene encasement where specified prior to pouring concrete for thrust blocking; and locate the thrust blocking to contain the resultant thrust force while keeping the pipe and fitting joints accessible for repair, unless otherwise shown or directed.

C. Provide temporary thrust restraint at temporary caps and plugs. Submit calculations and details of temporary restraint to the Engineer for review.

3.07 BRIDGE CROSSINGS

A. Supply cement-lined ductile iron pipe, related hardware, equipment, and labor to install water main in a dedicated utility bay beneath the bridge deck. Supply and install all required bends from bridge utility bay to meet required alignments to proposed buried DIP.

B. For ductile iron pipe installation, provide at least one support per length of pipe Provide proper lateral and vertical support as needed to prevent “snaking.”

C. Size, supply, and install all required pipe roller supports for attachment to bridge. (Maximum spacing between supports is 10 feet.) Submit Shop Drawings to Owner for approval.

D. If construction of bridge is proposed at the same time as main installation, coordinate all activities with Bridge Contractor and Governing Agency, including supplying and installation of steel sleeve, pipe roller supports and all appurtenant items required for water main installation.

END OF SECTION

SECTION 15020

DISINFECTING PIPELINES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Work under this section consists of providing all labor, materials, tools, equipment, and services required to disinfect all piping, valves, and appurtenances installed under these Contract Documents as specified in this section. This includes the operation of valves, hydrants, and blow-off assemblies on the new pipeline during the disinfection process except as otherwise specified.

B. Contractor shall provide all taps required for testing, disinfection, and sampling as required herein and in Sections 15025, 15030, and 15190, and shall remove and plug all such taps as required by Sections 15185 and 15190 unless otherwise directed by the Owner.

C. All disinfection activities will be performed under the supervision of the Owner.

D. Contractor shall identify appropriate disposal locations for flushed water and secure all required approvals and permits. All disposal locations shall be authorized by the appropriate stormwater governance authority. Contractor assumes all responsibility for any permit violations, erosion, flooding, fish kills, and other damage or injury resulting from flushing activities.

E. When pre-chlorination is proposed for HDPE pipe to be installed by pipe bursting method, Contractor shall comply with the additional requirements and procedures specified in Section 02350.

1.02 WORK BY OWNER

A. Owner reserves the option to furnish the dechlorination equipment, which the Contractor shall use at no additional cost. Owner will furnish water for testing, flushing, and disinfecting pipelines in accordance with Section 01500 up to ten (10) times the volume of the new pipeline(s). If additional water is needed, then the Owner will furnish the water and may charge the Contractor for the additional water as specified in Section 01500. Unless otherwise indicated in Sections 01000 and/or 01011, the Owner will collect all water samples required for water quality and disinfection testing and perform all bacteriological testing required. The Owner will provide the Contractor a written report with the test results within 24 hours of the Owner completing the test.

1.03 COORDINATION OF WORK

A. Coordinate disinfection activities with flushing and cleaning activities and comply with Section 15025. Coordinate disposal of chlorinated water as required in

article 3.04 below and Section 15025. Contractor shall coordinate with the local storm sewer and/or sanitary sewer department as required in Section 15025.

B. Contractor shall secure all approvals as required in this section and in Section 15025.

C. Contractor shall schedule the disinfection activities with the Owner and Resident Project Representative at least 48 hours in advance for a mutually-acceptable time. Contractor shall coordinate disinfection activities and associated sampling requirements with the Owner. Owner reserves the right to require that all sampling occur during the Owner's normal business hours, in which case Contractor shall schedule disinfection activities to accommodate such requirement.

1.04 SUBMITTALS

Contractor shall submit the following in accordance with Section 01300:

A. Contractor shall submit to the Owner for approval the proposed method of disinfection (from the options specified herein),

B. Contractor shall submit to the Owner for approval the proposed method of dechlorination and a plan for disposal of flushed water.

C. Contractor shall submit results of all chlorine residual tests.

1.05 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01500 Temporary Facilities

G. Section 15000 Piping – General Provisions

H. Section 15025 Flushing and Cleaning Pipelines

I. Section 15030 Pressure and Leakage Tests

J. Section 15170 Tapping Sleeves, Saddles and Valves

K. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

L. Section 15200 Service Lines

1.06 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ANSI/AWWA B300 Hypochlorites

B. ANSI/AWWA B301 Liquid Chlorine

C. ANSI/AWWA C651 Standard for Disinfecting Water Mains

D. ANSI/AWWA C655 Field Dechlorination

E. AWWA Manual M12 Simplified Procedures for Water Examination

F. Indiana Administrative Code Title 327 Water Pollution Control Division (327 IAC)

G. Standard Methods for the Examination of Water and Wastewater

PART 2: PRODUCTS

2.01 MATERIALS

A. Furnish liquid chlorine (gas) and injection equipment and/or calcium hypochlorite (HTH) as needed to disinfect all pipelines and appurtenances.

B. Liquid chlorine (gas) contains 100% available chlorine and is packaged in steel containers, usually of 100 lb, 150 lb, or 1 ton net chlorine weight. Liquid chlorine (gas) shall be furnished in accordance with AWWA B301.

C. Calcium hypochlorite shall be in granular form containing approximately 65% available chlorine by weight. The material shall be stored in a cool, dry, and dark environment to minimize its deterioration. Do not use calcium hypochlorite intended for swimming pool disinfection, as this material (containing trichloroisocyanuric acid) has been sequestered and is extremely difficult to eliminate from the pipe after the desired contact time has been achieved.

D. Calcium hypochlorite must conform to AWWA B300.

2.02 EQUIPMENT

A. A gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions shall be used for applying hypochlorite solution to the water

main. Feed lines shall be of such material and strength as to safely withstand the corrosion caused by the concentrated chlorine solutions and the maximum pressures that may be created by the pumps. Check all connections for tightness before the solution is applied to the main.

B. If liquid chlorine (gas) in solution is proposed by the Contractor and permitted by the Engineer and Owner, the preferred equipment for the gas application employs a vacuum-operated, solution feed type chlorinator to mix the chlorine gas, in combination with a booster pump for injecting the chlorine gas solution water into the main to be disinfected. Direct feed chlorinators shall not be used. (A direct feed chlorinator is one which operates solely from the pressure in the chlorine cylinder.)

PART 3: EXECUTION

3.01 PROTECTION

A. Chlorine disinfection and dechlorination shall be under the direct supervision of someone familiar with the physiological, chemical, and physical properties of the form of chlorine used. They shall be trained and equipped to handle any emergency that may arise. All personnel involved shall observe appropriate safety practices to protect working personnel and the public.

B. The forwards of AWWA Standards B300 and B301 contain information and additional reference material regarding the safe handling of hypochlorites and liquid chlorine. Contractor shall familiarize himself with this information prior to performing any disinfection work.

C. All water with chlorine residual higher than 0.05 ppm (mg/L) shall be disposed of as required in article 3.04 below and Section 15025 in full conformance with 327 IAC 2-1-6 (including Table 6-1).

3.02 PREPARATION

A. Unless the Owner has approved in writing the slug method for chlorination, complete flushing and cleaning in accordance with Section 15025 and pressure and leakage testing in accordance with Section 15030 before commencing disinfection of pipeline. All pipelines shall be cleaned of debris and dirt, flushed, purged of air, and successfully pressure and leakage tested prior to application of the disinfectant.

B. Contractor shall install sampling tap assemblies with the components as required in Section 15190 and 15200 on the new pipeline within ten feet (10') of each proposed connection to the existing water main, at each dead end, and at intervals not exceeding 1,200 feet along the entire pipeline(s). These sampling taps shall be used as necessary for the purpose of introducing the disinfectant, checking the chlorine residual, and obtaining samples.

C. Observe the precautions described in Section 15000 to avoid contamination during installation of the pipeline.

3.03 APPLICATION OF DISINFECTANT FOR WATER MAINS

Method to be used for disinfection shall be one of the two (2) described below as detailed in AWWA C651 Disinfecting Water Mains. Contractor shall use the Continuous Feed Method unless an alternate method is proposed by the Contractor in writing and approved in writing by the Owner. Under no circumstance shall the other methods described in AWWA C651 (i.e. using tablets of hypochlorite or spray disinfection) be allowed. Otherwise, information in the forward of AWWA Standard C651 will be helpful in determining the best method to be used.

Continuous Feed Method:

A. Set up:

1. The continuous feed method consists of completely filling the main with highly chlorinated potable water after pressure and leakage testing has been completed per Section 15030. The potable water shall be chlorinated, so that after the specified holding period in the main, there must be a free chlorine residual of not less than 10 mg/L in all collected samples (i.e. at every sampling tap). Disinfectant shall be disbursed throughout the entire length of new main.
2. Chlorine can be applied in advance of flushing by swabbing joints with bleach or placing hypochlorite granules in the pipe in areas where contamination is suspected. All tie-ins between the new main and existing mains shall utilize this method of disinfection.
3. During filling, Contractor shall ensure that main is completely filled and all air pockets are eliminated.

B. Chlorinating the Main:

1. Flow water from the existing water main through a new line valve, through an approved temporary connection from the existing distribution system or from other approved source of supply at a constant, measured rate into the newly laid water main. In the absence of a meter, approximate the rate by placing a pitot gauge in the discharge or measuring the time to fill a container of known volume. Ensure that all air is eliminated from the pipe so that highly chlorinated water comes into contact with all surfaces.
2. At a point not more than ten (10) feet downstream from the beginning of the new main, dose the water entering the new main with chlorine fed at a constant rate such that the water will have not less than 25 mg/L free chlorine residual. Measure the chlorine concentration at regular intervals to ensure that this concentration is provided. Measure chlorine in accordance with the procedures described in the current edition of the AWWA Manual M12 or Standard Methods for the Examination of Water and Wastewater.
3. Table 1 below indicates the amount of chlorine required for each 100 feet of clean pipe of various diameters. Solutions of 1 percent chlorine may be

prepared with calcium hypochlorite. The solution requires 1 pound of calcium hypochlorite in 8 gallons of water. Contractor is responsible to ensure adequate chlorine is used to account for any contamination in the main.

TABLE 1
Chlorine Required to Produce 25 mg/L
Concentration in 100 feet of Pipe by Diameter

Diameter Inches	100% Chlorine lbs	1% Chlorine Solution gallons
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60

4. Apply hypochlorite solution with approved equipment. Check all connections for tightness before the solution is applied to the main.
5. During the application of chlorine, utilize an approved backflow prevention valve so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Do not stop the chlorine application until the entire new main is filled with highly chlorinated water. Keep the chlorinated water in the new main for at least 24 hours, but not more than 72 hours unless approved in writing by the Engineer. During this holding time, operate all valves and hydrants in the section treated in order to disinfect the appurtenances. At the end of the 24-hour holding period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L free chlorine as established by testing at every sampling station.
6. Apply liquid chlorine (gas) in solution with approved equipment.
7. Provide dechlorination of all discharged water as specified herein.

Slug Method:

A. Setup:

1. The slug method consists of placing calcium hypochlorite granules in the main during construction and slowly flowing a slug of water containing 100 mg/L of free chlorine through the main so that all parts of the main and its appurtenances will be exposed to the highly chlorinated water for a period of not less than 3 hours. During filling, Contractor shall ensure that main is completely filled and all air pockets are eliminated.

B. Chlorinating the main:

1. Place calcium hypochlorite granules in the main during construction. The purpose of this procedure is to provide a strong chlorine concentration in the first flow of flushing water especially to fill annular spaces in pipe joints.

Slowly fill the main at a controlled velocity not more than 1.00 foot per second. Velocity shall be slow enough to avoid pushing the granules along the pipe. Disinfectant shall be disbursed throughout the entire length of new main (to maintain the required 100 mg/L concentration for at least 3 hours in every part of the main) and shall not be more heavily-concentrated at the end of the main due to granules being pushed to the end as the main is filled. Ensure that all air is eliminated from the pipe so that highly chlorinated water comes into contact with all surfaces.

2. At a point not more than ten (10) feet downstream from the beginning of the new main, dose the water entering the new main with chlorine fed at a constant rate such that the water will have not less than 100 mg/L free chlorine. During the chlorination process, utilize an approved backflow prevention valve so that the strong chlorine solution in the main being treated will not flow into water mains in active service. Do not stop the chlorination process until the slug has moved through the entire new main.
3. Measure chlorine in accordance with the procedures described in the current edition of the AWWA Manual M12 or Standard Methods for the Examination of Water and Wastewater. The chlorine shall be applied continuously and for a sufficient period to develop a solid column or "slug" of highly chlorinated water that will, as it moves through the main, expose all interior surfaces to a concentration of approximately 100 mg/L for at least 3 hours. Chlorine concentration shall be tested at a minimum at the beginning and end of the watermain to ensure uniform distribution of concentrated chlorine throughout the entire length of watermain.
4. The free chlorine residual shall be measured at each sampling tap in the water main as the slug moves through the main to ensure that this concentration is provided throughout the length of the pipeline for the required duration. If at any time the free chlorine residual drops below 50 mg/L in the slug, suspend the flow for not more than sixty (60) minutes, provide additional chlorination equipment at the head of the slug, and as flow is resumed, apply chlorine at a constant rate at the additional location to restore the free chlorine in the slug to not less than 100 mg/L while still applying chlorine at the beginning of the water main at the same rate as before.
5. As the highly chlorinated water flows past fittings and valves, operate related valves and hydrants so as to disinfect appurtenances and pipe branches.
6. The chlorinated water shall remain in the pipe for at least 24 hrs. If the water temperature is less than 41°F (5°C), the water shall remain in the pipe for at least 48 hrs. A detectable free chlorine residual (≥0.2 mg/L) shall be measured at each sampling point after the 24- or 48-hr period.

C. Upon completion of chlorinating the main, Contractor shall perform flushing in accordance with Section 15025 (to remove particulates) and pressure and leakage testing in accordance with Section 15025. Provide dechlorination of all discharged water as specified herein.

3.04 DISPOSAL OF CHLORINATED WATER

A. Do not keep highly chlorinated water in contact with pipe for more than 24 hours after the applicable holding period (i.e. all highly chlorinated water shall be flushed out within 72 hours of filling the main with highly-chlorinated water). In order to prevent damage to the pipe lining, corrosion damage to the pipe itself, or damage to valves, flush the highly chlorinated water from the main, fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the existing distribution system and is acceptable for domestic use.

B. Discharge of any and all water from the water main for any purpose shall be in conformance with Section 15025 and this section. All water discharged from the water main for any purpose (including during cleaning, flushing, testing, and disinfection procedures) shall be discharged to either an approved sanitary sewer system or an alternative disposal site(s) authorized by the appropriate stormwater governance authority. Any alternative disposal sites on private property or that are tributary to a private lake or pond or livestock water source shall also be approved in writing by the property owner(s).

C. Take all steps necessary to dechlorinate water discharged to any location (except when chlorinated water is discharged to an approved sanitary sewer system with the written permission of the local sewer department). Under no conditions may highly-chlorinated or low-chlorinated water be disposed of to any location other than an approved sanitary sewer system without adequate dechlorination as specified herein. Neutralize the chlorine residual of the water being disposed of by treating with one of the neutralizing chemicals listed in Table 2. Apply the reducing agent to the chlorinated water to be wasted to completely neutralize the chlorine residual remaining in the water. Do not overdose neutralizing chemicals as this may result in adverse environmental impacts. Only dose the amount required to neutralize the amount of chlorine present.

Table 2
Pounds of chemicals required to neutralize various
residual chlorine concentrations in 100,000 gallons of water.

Residual Chlorine mg/L	SulfurDioxide (SO_2)	Sodium Bisulfite ($NaHSO_3$)	Sodium Sulfite (Na_2SO_3)	Sodium Thiosulfate ($Na_2S_2O_35H_2O$)	Ascorbic Acid ($C_6O_8H_6$)
1	0.8	1.2	1.4	1.2	2.1
2	1.7	2.5	2.9	2.4	4.2
10	8.3	12.5	14.6	12	20.9
50	41.7	62.6	73	60	104

D. Test for chlorine residual throughout the disposal process to be sure that the chlorine is neutralized.

3.05 BACTERIOLOGICAL TESTING

A. After final flushing and before the water main is placed in service, the first of two consecutive sets of acceptable samples can be collected from the new main. The second set of samples shall be taken at least 24 hours after the first set of samples. The main shall not be flushed between collection of the first and second set of samples except to clear the sample site to collect the second sample. At least one set of samples shall be collected from every 1,200 feet of the new water main, plus one set from each end of the line and at least one set from each branch.

   1. Optional Method A: When approved by the Owner, the second set of samples shall be collected a minimum of 16 hours after the first set of samples.
   2. Optional Method B: When approved by the Owner, both sets of samples shall be collected a minimum of 15 minutes apart, with the first set collected after a minimum 16 hour rest period following completion of final flushing, during which rest period there shall be no water flow through the pipeline or water use from the pipeline. Sampling taps shall be left running continuously between the first and second set of samples.

B. Coordinate sample collection for testing of bacteriological (chemical and physical) quality with the Owner. Samples shall be collected by the Owner. Testing will be in accordance with Standard Methods of the Examination of Water and Wastewater. Samples shall show the absence of coliform organisms and the presence of a chlorine residual. Samples shall also be tested for turbidity, pH, and standard heterotrophic plate count (HPC). HPC levels must be consistent with levels normally found in the distribution system to which the new main will be connected.

C. Bacteriological tests of all samples must show complete absence of coliforms and acceptable HPCs. If tests show the presence of coliform or unacceptable HPCs, perform additional flushing and disinfection of the pipeline until acceptable tests are obtained, all at no cost to the Owner. Contractor will not be charged for the additional testing performed by the Owner but may be charged for any additional water used in accordance with Section 01500.

3.06 TESTING SOURCE WATER

A. At the time of initial flushing of the new main to remove material and test for air pockets, Contractor may, at its discretion, use the sampling tap installed near the feed point (i.e. within ten (10) feet of the beginning of the new main) to verify that the source water entering the new pipeline from the existing system contains a chlorine residual. This action will provide the Contractor assurance that the source water is chlorinated.

B. If the subsequent tests for bacteriological contamination conducted by the Contractor fail, the Contractor may again, at its discretion, use the same sampling tap installed near the feed point to verify that the source water entering the new pipeline from the existing system contains a chlorine residual. This action will provide the Contractor assurance that the source water is chlorinated for subsequent tests.

3.07 REMOVAL OF TEMPORARY TAPS

A. Upon successful completion of all flushing, testing, and disinfection, the Contractor shall remove temporary sampling taps and blow-off assemblies, including corporation stops, and plug the taps with brass plugs in accordance with Sections 15185 and 15190, and as approved by the Resident Project Representative. Any taps to remain permanently shall be completed in accordance with Section 15190.

END OF SECTION

SECTION 15025

FLUSHING AND CLEANING PIPELINES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to complete the following as specified for the piping, valves, and appurtenances installed under these Contract Documents as specified in this section.

B. Flush the pipelines to remove all particulate matter and air.

C. Clean the pipelines using foam pigs, swabs, or "go-devils", as described herein, whenever the specified flushing velocity cannot be achieved and/or normal flushing will not sufficiently remove dirt and debris that was introduced during construction.

D. Flushing and cleaning required by this section shall be completed prior to testing and disinfecting of the pipeline, except as modified when the slug method of disinfection is approved and followed.

E. Contractor shall identify appropriate disposal locations for flushed water and secure all required approvals and permits. All disposal locations shall be authorized by the appropriate stormwater governance authority. Contractor assumes all responsibility for any permit violations, erosion, flooding, fish kills, and other damage or injury resulting from flushing activities.

1.02 GENERAL REQUIREMENTS

A. New pipeline shall be connected to existing in-service water main at one end only in order to allow sufficient water flow rate to be introduced for successful completion of all required flushing, testing and disinfection. A new line valve (gate or butterfly) shall be installed at this connection point to isolate the new main from the existing water main during pressure testing and disinfection, unless otherwise authorized in writing by the Owner. At each other proposed connection to existing water main(s), Contractor shall provide a temporary plug or cap at the end of the new water main with adequate restraint and/or blocking to allow all flushing, testing, and disinfection to be completed prior to final connections to the existing main(s). Contractor shall also provide adequate temporary air release, blow-off assemblies, and sampling taps to accommodate filling, flushing, and disinfecting the pipeline(s) in accordance with Section 15190. Contractor shall take all possible precautions to prevent backflow into the existing water main during construction, filling, flushing, testing, and disinfection.

B. Flushing is no substitute for preventive measures during construction. Normal pipeline flushing is often inadequate to remove all the entrapped air, loose debris, and certain other contaminants, such as caked deposits, which resist flushing at

any feasible velocity. Contractor shall adhere to the requirements of Section 15000 to prevent contamination of the pipeline. In no case shall any objects be left in the main during installation.

C. In cases where, in the opinion of the Engineer, normal pipeline flushing is unable to remove all entrapped air and debris, Contractor shall use polyurethane foam pigs and/or polyurethane hard foam swabs to remove all foreign matter from the pipeline (i.e. "pig" the pipeline).

1.03 WORK BY OWNER

A. Owner will furnish water for testing and flushing, and disinfecting pipelines in accordance with Section 01500 up to ten (10) times the volume of the new pipeline(s). If additional water is needed, then the Owner will furnish the water and may charge the Contractor for the additional water as specified in Section 01500.

1.04 COORDINATION OF WORK

A. Coordinate with Engineer and Owner before flushing to ensure that an adequate volume of flushing water is available at sufficiently high pressure (to maintain at least 40 psi residual pressure unless otherwise approved by the water supply system's owner) and to determine any applicable time constraints or other special requirements. Owner may require flushing only during low demand hours and/or when the distribution system tower is above an allowable minimum level. Determine if the water can be disposed of safely and arrange disposal location(s) for chlorinated water per Section 15020. Notify the Owner, Engineer, Resident Project Representative, and the following prior to flushing or cleaning:

1. Local fire department
2. Other utilities, such as gas, electric and telephone companies, who may have underground facilities in the area.
3. Local storm sewer and sanitary sewer departments.
4. Customers who may be inconvenienced by reduced pressure or dirty water. Contractor shall coordinate with the Owner and Engineer to identify customers requiring notification.
5. Property owners where water will be disposed of to location(s) other than a sanitary sewer.

B. Coordinate with Owner, who shall operate any valves and/or hydrants on the operating distribution system. Close valves and hydrants sufficiently-slowly to prevent water hammer. Open each fire hydrant and blow-off valve slowly until the desired flow rate is obtained. When flushing from a dry barrel fire hydrant, open the hydrant valve fully to prevent water from escaping into the ground through the fire hydrant barrel drain and use the gate valve upstream of the hydrant for throttling purposes.

C. Contractor shall contact the local storm sewer and/or sanitary sewer department to obtain permission and coordinate disposal of water. Chlorinated water shall be discharged to a sanitary sewer system if available, if adequate capacity exists, and if approved by the sewer department. If an authorized sanitary sewer disposal location is not available, Contractor shall secure an authorized alternative disposal site(s).

D. Alternative disposal site(s) shall be a storm sewer system if available, if adequate capacity exists and if approved by the appropriate stormwater governance authority). Otherwise, alternative disposal site(s) shall be an adequately-sized waterway that is authorized by the appropriate stormwater governance authority and the property owner. In the event that no authorized discharge location with adequate capacity can be identified, Contractor shall obtain authorizations and construct a temporary ponding area of adequate size to detain the flushed water until it can be discharged to an authorized sewer or waterway or until it evaporates and percolates into the soil.

E. Any alternative disposal sites on private property or that are tributary to a private lake or pond or livestock water source shall also be approved in writing by the property owner(s). Contractor shall obtain permission and coordinate with affected property owners for disposal of all water discharged from water mains.

F. Contractor shall secure all approvals as required in this section and in Section 15020.

G. Coordinate flushing and cleaning activities with disinfection activities and comply with Section 15020.

1.05 PROTECTION DURING FLUSHING AND CLEANING

A. Protect the work staff and the public during operation of hydrants and valves. Keep children away from the flow of flushing water.

B. When needed to avoid damage to property (including soil erosion) and the flooding of streets or buildings, employ energy dissipators.

C. If flushed water is discharged into a sanitary or storm sewer, provide adequate barricades and warning devices around any open manhole lids or other safety hazards.

D. Proper dechlorination and disposal of flush water is the responsibility of the Contractor. All water with chlorine residual higher than 0.01 ppm (mg/L) shall be disposed of as required in Section 15020.

E. These safety considerations also apply to main cleaning, flushing, and disinfection activities specified in Section 15020. See General Conditions Article 6.

1.06 SUBMITTALS

Contractor shall submit the following in accordance with Section 01300:

A. Contractor shall submit the proposed temporary connection (when required) between existing water main and new pipeline for filling, flushing, and disinfection, including cut sheets for the proposed backflow preventer. The method to be used and backflow preventer must be approved by the Owner prior to filling the pipeline.

B. Before performing any cleaning activities, Contractor shall submit to the Engineer a proposed cleaning plan as required herein and cut sheets for any swabs and/or pigs proposed to be used.

C. Contractor shall submit copies of all written approvals obtained for disposal of flushed water.

1.07 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 15000 Piping – General Provisions (including construction methods to avoid contamination)

G. Section 15020 Disinfecting Pipelines

H. Section 15030 Pressure and Leakage Tests

I. Section 15170 Tapping Sleeves, Saddles and Valves

J. Section 15180 Fire Hydrants

K. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

L. Section 15200 Service Lines

1.08 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other

standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AWWA C651 Standard for Disinfecting Water Mains

B. ANSI/AWWA C655 Field Dechlorination

PART 2: PRODUCTS

2.01 MATERIALS AND EQUIPMENT

Provide the foam cleaning plugs (swabs or pigs) and other equipment as needed to clean pipelines as required and approved by the Engineer. Do not use pipe cleaning plugs which utilize bristles, wire brushes, carbide abrasives, steel studs, or any other type abrasive unless specifically approved by the Engineer in writing. Consult a manufacturer of pipe cleaning plugs, such as Knapp Polly Pig (Houston, Texas), to determine the type and size of cleaning plug best suited for the application. Two types of plugs may be considered and are described as follows:

A. Swabs:

1. Swabs used for cleaning mains shall be made of polyurethane foam. This foam has a density of 1 to 2 pounds per cubic feet. Swabs shall be purchased from commercial manufacturers of swabs for pipes. Both soft and hard grade foam swabs are available. New mains are typically cleaned with hard foam swabs.
2. Use swabs cut into cubes and cylinders slightly larger than the size of the pipe to be cleaned (typically up to one inch larger in width/diameter for pipe up to 12 inches diameter or up to 3 inches larger for pipe larger than 12 inches diameter). The swab width/diameter must be considered individually for each operation. Length of swabs shall be coordinated with the manufacturer. The Contractor is solely responsible for determining swab sizing and any consequences of using an inappropriately-sized swab.

B. Pigs

1. Alternatives such asa cleaning plug are available and are commonly referred to as a pig. Pipeline pigs, if used, shall be commercially manufactured for the specific purpose of cleaning pipes. They shall be made of polyurethane foam weighing 2 to 15 lb./cu.ft. Cleaning pigs are bullet shaped and come in various grades of flexibility and roughness. Cleaning pigs shall be sized for the specific pipe inside diameter and are typically 1/4 -inch to 1/2-inch larger in diameter than the pipe to be cleaned. The Contractor is solely responsible for ensuring that correctly-sized pigs are used and any consequences of using an inappropriately-sized cleaning pig.

PART 3: EXECUTION

3.01 FILLING AND FLUSHING

A. Prior to pressure and leakage testing or chlorination, Contractor shall fill the main to eliminate air pockets and flush the water main to remove particulates. Slowly fill each segregated section of pipeline with water at a velocity of approximately 1 foot per second ensuring that all air is expelled. Extreme care must be taken to ensure that all air is expelled from the pipeline during the filling of pipe prior to testing or disinfection.

B. The flushing velocity in the main shall be not less than 3.0 fps, unless insufficient water supply is available and/or, in the opinion of the Engineer, conditions do not permit the required flow to be discharged to waste. Unless otherwise approved by the Engineer, the required velocity must be achieved throughout the entire length of the pipeline, which may require installation of temporary taps or hydrant(s) at the end of the main. Table 1 shows the rates of flow required to produce a velocity of 3.0 fps in ductile iron pipes of various sizes up to 16-inch diameter. In mains of 24-inches or larger diameter, the main shall be broom-swept, carefully removing all sweepings prior to chlorinating the main. After sweeping, pipeline shall still be flushed at the flow rate indicated in Table 1. For other pipe materials and sizes, Contractor shall confirm required flushing rate to achieve 3.0 fps velocity with the Engineer.

C. Table 2 indicates the flow that can be achieved through each tap or 2½ inch hydrant outlet at 40 psi residual pressure. These should be used only as a guideline. The Contractor is responsible for determining the number of taps and/or hydrants that are needed to achieve the required flushing velocity and providing acceptable assurances to the Engineer that the required velocity is achieved.

TABLE 1
Required Flow to Flush Pipelines

Pipe Diameter (inches)	Flow required to produce 3.0 fps velocity in main (gpm)
2	30
3	90
4	120
6	260
8	470
10	730
12	1,060
16	1,880
20	3,200
24	4,600
30	7,100
36	10,200

1. This table is based on friction losses of ductile iron pipe. For PVC and HDPE, slightly lower flow rates will achieve the required velocity.
2. In mains of 24-inches or larger diameter, the main shall be broom-swept, carefully removing all sweepings prior to chlorinating the main. After sweeping, pipeline shall still be flushed at the indicated flow rate.

TABLE 2
Flow Produced Through Openings of Various Sizes

Opening Nominal Diameter (inches)	Flow (gpm)*
1 (open pipe)	40 †
1½ (open pipe)	80 †
2 (open pipe)	200 †
3 (open pipe)	300 †
4 (open pipe)	600 †
6 (open pipe)	2,100 †
8 (open pipe)	3,500 †
12 (open pipe)	7,000 †
2 (blow-off hydrant)	200
2½ (fire hydrant hose nozzle)	500
2-2½ (fire hydrant hose nozzles)	800
4½ (fire hydrant pumper nozzle)	1,200

* Based on 55 psi static pressure with a 40 psi residual pressure in the water main.

† Estimated allowable flowrates based on discharging through 5 feet of smooth, rigid pipe with two 90 degree elbows.

3.02 PRE-CLEANING PROCEDURES

A. Prepare a written cleaning plan for the Engineer's review,

B. Suggested pre-cleaning procedures include:

1. Identify mains to be cleaned on a map. Mark the location of the entry, water supply, exit points, any blow-offs to be used, valves to be closed, and the path of the swab or pig.
2. Under the Engineer's supervision and with Owner staff as required, inspect and operate all valves and hydrants to be used in the cleaning operation to ensure their correct operation and a tight shutdown.
3. Check location and type of hydrants, launch and exit location, and blow-offs to be used. Make blow-off tap connections, if necessary.
4. Determine the number and size of plugs to be used.

3.03 CLEANING PLUG INSTALLATION AND REMOVAL

A. Satisfactorily expose or install cleaning wyes, or other entry or exit points. Remove cleaning wye covers, etc., as required by the Engineer to insert the plug(s) into the pipeline(s).

B. If approved by the Engineer, stripped fire hydrants, air valves and blow-offs may serve as entry and exit points for smaller sized mains. The Engineer will examine these appurtenances and the connecting laterals to ensure that adequate openings exist through which a plug may be launched.

   1. If these appurtenances are used, a special launcher is required to ease the insertion and launching of the plug. If available, a pressurized water source such as a fire hydrant can be used to launch the plug. If water from the system is not available nearby, use a water truck with pump.
   2. If hydrants are used as entry and/or exit points, remove the internal mechanisms and plug the drains under the supervision of the Engineer. Insert the plug and replace the cap with a special flange with a 2-1/2-inch fitting. Connect the 2-1/2-inch fitting, with a pressure gauge and valve, to a pressurized water source. After closing the last valve isolating the section to be cleaned, open the hydrant supply valve. Propel the swab or pig into the main by opening the exit valve.

C. In mains greater than 8-inches nominal diameter, wyes shall be used at the entry and exit points. Fabricate the wye section one size larger than the main to ease the insertion and extraction of the plug. The use of wyes, as with the previously mentioned appurtenances, requires an outside source of pressurized water for launching. Cap the wye with a flange with a 2 to 6 inch fitting for connecting to the pressurized water source.

D. Many pigs are harder to insert into a pipe since they are less flexible than swabs. Other methods acceptable to insert pigs include:

   1. Winching with a double sling,
   2. Winching with a rope attached to the pig,
   3. Compression with a banding machine prior to insertion, and
   4. The use of a specially designed tapered steel pipe which is removed after use.

E. During swab or pig installation, leave as much water as possible in the main to be cleaned. The water suspends the material being removed from the pipe and minimizes the chance of the material forming a solid plug. Water in the pipe also keeps the swab or pig from traveling through the pipe at excessive rates. If swabs or pigs travel too fast, they will remove less material and wear more rapidly.

F. At the exit point or blow-off, install a wye long enough to house the swab or pig. Attach temporary piping to the end cap to allow the drainage of the water.

G. Take precautions to prevent backflow of purged water into the main when the cleaning plug exits through a dead end main. This can be accomplished by installing mechanical joint bends and pipe joints to provide a riser out of the trench. Additional excavation of the trench may serve the same purpose.

3.04 CLEANING PROCEDURE

Clean the pipeline using the following procedures and the Contractor's cleaning plan, as approved by the Engineer.

A. Swab Cleaning Procedures:

1. Open the water supply upstream of the swab. Throttle the flow in the main at the discharge (plug exit) point so that the swab passes through the main at a speed of 2 to 4 fps. (At this velocity, swabs will effectively clean pipes for distances of up to 4,000 feet before disintegrating to a size smaller than the main.) Use pitot gauges at the existing hydrant or blow-off to estimate the flow rate in the pipeline.
2. Note the time of entry of the swab into the main and estimate its time of exit. If the swab does not reach the exit point in 1.5 times the estimated time, then a blockage has probably occurred. Reverse the flow in the main, and note the time required for the swab to reach the original entry point. From the return travel time, estimate the location of the blockage. The Engineer may require the use of a swab containing a transmitter to accurately locate the blockage.
3. Swab repeatedly as needed. Stop swabbing when the water behind the swab emerging at the exit clears up within one minute. Ensure that all swabs inserted into the main are recovered and accounted for.
4. After the last swab has been recovered, flush the main to remove swab particles. This may require up to an hour of flushing.

B. Pig Cleaning Procedures:

1. Remove all air valves along the line. Ensure that each isolating valve to the air valve is completely closed. Operate system to prevent undesired buildup of air while air valves are out of service.
2. If the pig is inserted directly into the main, set it in motion by opening the temporary valved connection to the existing main and a downstream fire hydrant or blow-off valve (usually the valve on the capped end at the exit point). If the pig is launched from a wye, fire hydrant, or other appurtenance, use an external pressurized water source to inject the pig into the main as described in Paragraph 3.03 before using the temporary valved connection to the existing main to set it in motion.
3. Once the pig is launched, control its speed by throttling the discharge at a downstream fire hydrant or blow-off. Operate pigs at the typical speed of 1 ft./sec. This slow speed will help prevent pressure surges when the pig passes through undersized valves, enters smaller pipes, or turns through tees or crosses. Speeds of up to 2 ft./sec. can be used on straight runs with no restrictions or sharp turns.
4. Make sufficient passes of the pig to obtain thorough cleaning. Two pigs may be used in tandem to save time and water. Sufficient cleaning is established when the water discharging after the pig becomes clear within one minute.
5. Ensure that all pigs inserted into the main are recovered and accounted for.

3.05 POST CLEANING PROCEDURE

A. After successful cleaning; test, flush, and disinfect the main in accordance with requirements of this section and Sections 15020 and 15030.

3.06 DISPOSAL OF WATER

A. Discharge of any and all water from the water main for any purpose shall be in conformance with Section 15020 and this section. All water discharged from the water main for any purpose (including during cleaning, flushing, testing, and disinfection procedures) shall be discharged to either an approved sanitary sewer system or an alternative disposal site(s) authorized by the appropriate stormwater governance authority. Any alternative disposal sites on private property or that are tributary to a private lake or pond or livestock water source shall also be approved in writing by the property owner(s).

B. Dechlorinate discharged water in conformance with Section 15020. Under no conditions may highly-chlorinated or low-chlorinated water be disposed of to any location other than an approved sanitary sewer system without dechlorination as required by Section 15020.

END OF SECTION

SECTION 15030

PRESSURE AND LEAKAGE TESTS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Work under this section consists of providing all labor, materials, tools, equipment, and services required to test all piping, valves, and appurtenances installed under these Contract Documents as specified in this section.

B. Contractor shall provide the pump, pipe connections, and all necessary apparatus for the pressure and leakage tests including gauges and metering devices and all other required components. However, the Owner reserves the option to furnish the gauges and metering devices for the tests.

1.02 COORDINATION OF WORK

Contractor shall coordinate witnessing of the pressure testing procedure with the Resident Project Representative a minimum of two (2) full working days prior to the pressure testing.

1.03 SUBMITTALS

Contractor shall prepare and submit schedules and procedures to the Engineer for testing of all parts of the water main installed as part of the Work in accordance with Section 01300 and these Contract Documents. Submit the schedule at least seven days prior to any testing.

1.04 RELATED WORK

A. 01000 - Summary of Work

B. 01010 - Drawing Index

C. 01011 - Special Provisions

D. 01075 - Basis of Payment

E. 01300 - Submittals

F. 01500 - Temporary Facilities

G. 02540 - Erosion and Sedimentation Control

H. Section 15000 Piping – General Provisions

I. Section 15020 Disinfecting Pipelines

J. Section 15025 Flushing and Cleaning Pipelines

K. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

L. Section 15200 Service Lines

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

B. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

C. AWWA Manual M23 - PVC Pipe - Design and Installation

D. AWWA Manual M55 - PE Pipe Design and Installation

E. ASTM F2164 - Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure

PART 2: PRODUCTS

2.01 EQUIPMENT

Positive displacement pump capable of exceeding the specified test pressure. Volumetrically calibrated container/reservoir to sufficiently determine the volume of water added throughout the pressure testing.

Liquid filled pressure gauges, 0 to 300 psi, 4-inch diameter face.

PART 3: EXECUTION

3.01 GENERAL

A. Under no circumstances shall pneumatic (air) testing of water mains be permitted. As described herein, extreme care shall be taken to ensure that all air is expelled from the pipeline prior to pressure testing.

B. Perform hydrostatic pressure and leak tests in accordance with AWWA C600 Section 5.2 - Hydrostatic Testing (ductile iron pipe), AWWA C605 Section 10.3 – Hydrostatic Testing (PVC pipe) or ASTM F2164 and AWWA Manual M55 (Leak Testing: Testing Inside the Trench) (HDPE pipe), after the pipe or section of pipe has been laid, concrete thrust blocking has cured a minimum of 5 days (unless high-early strength concrete is used and a shorter cure time is authorized by the Engineer), the trench is completely or partially backfilled, and flushing has been completed as required in Section 15025. When the slug method of chlorination is used as described in Section 15020, pressure and leakage testing shall be performed after chlorination. Pressure and leakage testing shall be performed prior to disinfection activities when all other methods of chlorination are used. Pressure testing of the new pipeline shall be performed fully isolated from the active distribution system unless otherwise approved by the Engineer and Owner.

C. The Contractor may, at his option, completely backfill the trench or partially backfill the trench over the center portion of each pipe section to be tested. However, the Engineer may direct the Contractor to completely backfill the trench if local conditions require. Also, portions of the pipeline designed and installed with restrained joints shall be backfilled to the design depth to prevent movement of the pipe during pressurization of the pipeline.

D. Perform the hydrostatic test at a pressure of no less than 1.25 times the stated operating pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated operating pressure at the lowest elevation of the test section without exceeding the thrust restraint design pressures or 1.5 times the manufacturer’s specified pressure rating of the pipe (1.5 times the standard pressure class for HDPE pipe), joints, or appurtenances, whichever is less. In no case shall the test pressure at any point in the tested portion of the pipeline be less than 150 psi. Test pipeline in shorter sections if necessary to meet all these criteria.

E. The test pressure shall not exceed the rated working pressure or differential pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

F. A test pressure greater than the rated valve working pressure can result in trapped test pressure between the gates of a double-disc gate valve. For tests exceeding the rated valve working pressure, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve working pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or the valve can be fully opened if approved in writing by the Engineer.

G. Valves shall not be operated in either direction at a differential pressure exceeding the valve’s rated working pressure or differential pressure.

H. Prior to hydrostatic pressure testing specified herein, Contractor shall make each valve tight under its working pressure. Any defective parts shall be replaced at the Contractor's expense.

I. When installing a tapping sleeve and valve assembly to the main, pressure test the assembly prior to making the tap. The required test pressure shall be determined in the same manner as for pipe. The pressure test is acceptable if there is zero pressure drop in 15 minutes at test pressure.

3.02 TESTING (DUCTILE IRON AND PVC)

A. Prior to pressure and leakage testing or chlorination, Contractor shall fill the main to eliminate air pockets. Slowly fill each segregated section of pipeline with water at a velocity of approximately 1 foot per second ensuring that all air is expelled. Extreme care must be taken to ensure that all air is expelled from the pipeline during the filling of pipe prior to pressure testing. The line shall stand full of water for at least twenty-four hours after initial filling prior to testing to allow all air to escape and to saturate the cement mortar lining of any ductile iron pipe used. If necessary, tap the main at points of highest elevation in accordance with the requirements of Section 15190 to expel air as the pipe is filled.

B. Apply the specified test pressure using a pump connected to the pipe in a manner satisfactory to the Engineer. The hydrostatic test shall be of at least a two hours duration, during which the test pressure shall not vary by more than ± 5 psi. Test pressure shall be maintained within this tolerance by adding makeup water into the pipeline through the pressure pump as necessary. The amount of makeup water added shall be accurately measured (in gallons per hour) using a calibrated container or meter.

C. Leakage is defined as the maximum hourly volume of makeup water that must be added into the pipeline during the hydrostatic test to maintain pressure within ± 5 psi of the required test pressure throughout the test duration (after it is filled and purged of air).

D. No pipeline installation will be accepted if the leakage is greater than that shown in the following table or as allowed by Equation 1 in AWWA C600 5.2.1.4 (also AWWA C605 10.3.6).

Allowable Leakage per 1000 ft. of Pipeline*---gallons / hour

	Nominal Pipe Diameter - inches										
Avg. Test Pressure (psi)	4	6	8	12	16	20	24	30	36	42	48
100	0.27	0.41	0.54	0.81	1.08	1.35	1.62	2.03	2.43	2.84	3.24
125	0.30	0.45	0.60	0.91	1.21	1.51	1.81	2.27	2.72	3.17	3.63
150	0.33	0.50	0.66	0.99	1.32	1.66	1.99	2.48	2.98	3.48	3.97
175	0.36	0.54	0.72	1.07	1.43	1.79	2.15	2.68	3.22	3.75	4.29
200	0.38	0.57	0.76	1.15	1.53	1.91	2.29	2.87	3.44	4.01	4.59
225	0.41	0.61	0.81	1.22	1.62	2.03	2.43	3.04	3.65	4.26	4.86
250	0.43	0.64	0.85	1.28	1.71	2.14	2.56	3.21	3.85	4.49	5.13
275	0.45	0.67	0.90	1.34	1.79	2.24	2.69	3.36	4.03	4.71	5.38
300	0.47	0.70	0.94	1.40	1.87	2.34	2.81	3.51	4.21	4.92	5.62

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size. The table has been generated from the formula: $L = (S*D*P^{1/2} / 148{,}000)$ where L is the allowable leakage in gallons per hour, S is the length of pipe in feet, D is the nominal pipe diameter in inches, and P is the test pressure in psig.

E. All exposed pipe, fittings, valves, hydrants, and other appurtenances shall be carefully examined during the pressure test. Should any test disclose damaged or defective materials (pipe, fittings, valves, hydrants, other appurtenances, or joints), visible leaks, or leakage greater than that permitted, the Contractor shall, at Contractor's expense, locate and correct the problem to the satisfaction of the Engineer. All visible leaks shall be properly repaired by the Contractor. Contractor shall replace any damaged or defective materials with new materials in compliance with the Specifications, except that, if approved in writing by the Engineer and manufacturer, repairs may be made by approved methods. Materials used for repairs must be approved by the Engineer and comply with the Specifications.

F. Repeat the pressure and leakage testing until no visible leaks occur and the leakage is within the permitted allowance to the satisfaction of the Engineer.

3.03 TESTING (HDPE)

A. Prior to pressure and leakage testing or chlorination, Contractor shall fill the main to eliminate air pockets. Slowly fill each segregated section of pipeline with water at a velocity of approximately 1 foot per second ensuring that all air is expelled. Extreme care must be taken to ensure that all air is expelled from the pipeline during the filling of pipe prior to pressure testing. The line shall stand full of water for at least twenty-four hours after initial filling prior to testing to allow all air to escape stabilize the temperature. If necessary, tap the main at points of highest elevation in accordance with the requirements of Section 15190 to expel air as the pipe is filled.

B. When the test section is completely filled, purged of air, and stabilized, gradually increase the pressure in the test section to the required test pressure. If the test pressure cannot be attained, or if it takes an unreasonably long time to reach test pressure, there may be faults such as excessive leakage, entrapped air, or open valving, or the pressurizing equipment may be inadequate for the size of the test section. If such faults exist, discontinue pressurizing, and correct them before continuing.

C. Add make-up water as necessary to maintain maximum test pressure for four (4) hours.

D. Test Phase: Reduce the pressure by 10 psi and monitor pressure for one (1) hour. Do not increase pressure or add make-up water.

E. If no visual leakage is observed, and pressure during the test phase remains steady (within 5% of the test phase pressure) for the one hour test phase period, a passing test is indicated.

F. If retesting is necessary, depressurize the test section before attempting to correct any faults or leaks. The test section must be allowed to “relax” for at least eight (8) hours prior to re-pressurizing.

G. Under no circumstances shall HDPE pipe be pressure tested when the temperature of the pipe is above 80 degrees F.

H. When pre-chlorination is proposed for HDPE pipe to be installed by pipe bursting method, Contractor shall comply with the additional requirements and procedures specified in Section 02350, which shall supersede any conflicting requirements specified in this section. Nonetheless, this section shall apply in its entirety where not in conflict with Section 02350.

END OF SECTION

SECTION 15105

DUCTILE IRON PIPE AND FITTINGS

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this section consists of providing all labor, materials, tools, equipment, and services required to install and test all ductile iron (DI) pipe and fittings (4 inch through 48 inch nominal diameter) for water distribution and transmission as indicated on the Drawings and as specified within this section and related sections of the Specification. Contractor shall furnish and install all required pipe restraint components and other related components that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, and certifications for all products furnished under this section in accordance with Section 01300.

B. Required certifications include those specified under Quality Assurance below.

1.03 QUALITY ASSURANCE

A. Ductile iron pipe and fittings shall meet the minimum quality requirements by conforming to the below-referenced AWWA/ANSI standards as modified herein. Ductile iron pipe and fittings will be accepted on the basis of the Manufacturer’s certification that the materials conform to this section.

B. The certification for ductile iron fittings shall list a fitting description, quantity, bare fitting weight, source, and applicable AWWA standard (C110 or C153). The certification shall accompany each delivery of the material to the project site.

C. Owner reserves the right to sample and test these materials subsequent to delivery at the project site.

D. Bolt manufacturer’s certification of compliance must accompany each shipment.

E. If foreign-manufactured fittings are furnished, Contractor shall notify the Engineer in the Shop Drawing submittal and provide the necessary documentation to satisfy the Engineer and the Owner that the materials furnished meet the specified AWWA standards and, among other documentation that may be required, provide certificates of compliance on the components supplied.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 02558 Identification/Location Guide

H. Section 15000 Piping - General Provisions

I. Section 15020 Disinfecting Pipelines

J. Section 15025 Flushing and Cleaning Pipelines

K. Section 15030 Pressure and Leakage Tests

L. Section 15130 Piping Specialties

M. Section 15150 Gate Valves

N. Section 15155 Butterfly Valves

O. Section 15170 Tapping Sleeves, Saddles, and Valves

P. Section 15180 Fire Hydrants

Q. Section 15185 Abandonment of Mains and Hydrants

R. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

S. Section 15200 Service Lines

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASME / ANSI B1.1 - Unified Inch Screw Threads

B. ASME / ANSI B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

C. ASME / ANSI B18.2 - Square and Hex Bolts and Screws (Inch Series)

D. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

E. ASTM A536 – Standard Specification for Ductile Iron Castings

F. AWWA C104 / ANSI A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

G. AWWA C105 / ANSI A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems

H. AWWA C110 / ANSI A21.10 - Ductile-Iron and Gray-Iron Fittings

I. AWWA C111 / ANSI A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

J. AWWA C115 / ANSI A21.15 - Flanged Ductile-Iron Pipe with Threaded Flanges

K. AWWA C116 / ANSI A21.16 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

L. AWWA C150 / ANSI A21.50 - Thickness Design of Ductile-Iron Pipe

M. AWWA C151 / ANSI A21.51 - Ductile-Iron Pipe, Centrifugally Cast

N. AWWA C153 / ANSI A21.53 - Ductile-Iron Compact Fittings

O. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

P. NSF/ANSI 61 Drinking Water System Components – Health Effects

PART 2: PRODUCTS

2.01 GENERAL

A. No foreign-manufactured pipe or appurtenances, except for ductile iron fittings, shall be allowed. All pipe and restraints shall be produced solely in the United States.

B. All materials that come in contact with potable water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61.

2.02 DUCTILE IRON PIPE

A. Ductile iron pipe shall conform to the latest specifications as adopted by the American National Standards Institute, Inc., (ANSI) and the American Water Works Association (AWWA). Specifically, ductile iron pipe shall conform to AWWA C151 in standard supplied sizes, except as modified herein. Pipe shall be supplied in 18 or 20 foot nominal lengths or as required to meet the requirements of the Drawings.

B. The pipe exterior shall be coated with an asphaltic coating in accordance with AWWA C151. The pipe interior shall be cement mortar lined and asphaltic seal coated in compliance with the latest revision of AWWA C104.

C. Pipe Class: Pipe wall thickness shall be the required thickness class based on the design conditions in accordance with AWWA C150. The thickness class of pipe to be furnished shall be as required on the Drawings and/or as specified in Section 01011 but shall not be less than recommended by the pipe manufacturer or less than the minimum requirements indicated in Table 1.

Table 1

MINIMUM RATED WORKING PRESSURE FOR DUCTILE IRON PIPE MANUFACTURED IN ACCORDANCE WITH AWWA STANDARD C151

Pipe Nominal Size (Inches)	Thickness Class
12 and smaller	52 (See Note 2)
16 – 20	54
24 and larger	54

Note:

1. The noted thickness class is adequate to support 3/4 and 1-inch corporation stops by direct tapping. Provide a full tapping sleeve or saddle in accordance with Section 15170 and/or 15200 (as appropriate) for taps larger than 1-inch due to limited wall thickness.
2. 12-inch and smaller pipe: Engineer to determine Thickness Class increase to Thickness Class 54 to meet critical parameters due to operating pressures greater than 100 psi, high system criticality, high consequence of failure and accessibility for repair of the pipe.

D. Plain ends shall be suitably beveled to permit easy entry into the bell and shall have home marks to indicate when the spigot it fully seated in the bell.

E. All non-restrained joints for pipe to pipe connections shall be standard push-on joints recommended by the pipe manufacturer and conforming to AWWA C151 and C111. Mechanical joints are not allowed for pipe to pipe connections. Push-on joints shall be of a type which employs a single elongated groove gasket to effect the joint seal.

F. Restrained Joint Pipe (12-inch and smaller): Unless otherwise indicated on the Drawings or in Section 01011 or furnished by the Owner, restrained joints for

pipe to pipe connections 12-inch nominal size and smaller shall use push-on restraining gaskets with integral stainless steel locking segments recommended by the pipe manufacturer and conforming to AWWA C111. Restraint system shall be UL-listed and rated for a working pressure of 350 psi. Restraining gaskets shall not be used on connections to valves or fittings or for connections to pipe materials other than ductile iron (e.g. gray cast iron). If required by the Drawings or Section 01011 and/or if furnished by the Owner, restrained-joint pipe such as specified below for 16-inch and larger pipe shall be used for 12-inch and smaller piping.

G. Restrained Joint Pipe (16-inch and larger): Restrained joints for pipe to pipe connections (16-inch and larger) shall consist of factory-welded retainer bead or ring on the pipe spigot, and either factory manufactured bolted retainer rings, ductile iron locking segments held in place by rubber retainers, or ductile iron retaining rings that lock over the bell of the joint and are secured to prevent rotation. All components of the bolted or snap rings assemblies shall be constructed of corrosion-resistant, high-strength, low-allow steel and shall conform to AWWA C111 as applicable. Restrained joint pipe shall be U.S. Pipe TR Flex, Bolt-Lok, or HP LOK; Clow TR Flex or Super Lock; American Flex-Ring or Lok-Ring. Restrained system shall be suitable for the following minimum working pressures:

Size (Inch)	Pressure (psi)
12 and smaller	52(See Note 2, Table 1)
20	54
24	54
30 - 48	54

Gaskets utilizing integral locking segments such as Field Lok gaskets are not permitted for restraint of pipe 16-inch or larger. Restrained joint pipe per this article shall not be acceptable where ball and socket pipe is required by the Drawings, Section 01000, and/or Section 01011. Restrained joint ductile iron pipe installed by horizontal directional drill method shall also comply with Section 02458.

H. Ball and Socket Pipe:

Ball and socket pipe shall comply with AWWA C150 and C151 and shall be U.S. Pipe USIFLEX Boltless Flexible Joint Pipe, American Flex-Lok Ball Joint Pipe, McWane Ball and Socket Joint Pipe.

I. Flanged piping shall be Thickness Class 53 ductile iron unless otherwise required by the Drawings or Section 01011.

J. Acceptable ductile iron pipe manufacturers are:

1. United States Pipe & Foundry Co. (including Griffin Pipe)
2. McWane Family of Companies (Clow, Atlantic States, etc.)
3. American Cast Iron Pipe Company.

2.03 FITTINGS

A. Ductile Iron Fittings: Standard fittings shall be ductile iron conforming to AWWA C110. Compact ductile iron fittings shall meet the requirements of AWWA C153. Fittings shall be suitable for the following working pressures unless otherwise noted in AWWA C110 or C153. **No gray cast iron fittings are permitted.**

	Working Pressure Rating (psi)	
Size (inch)	MJ Fittings	Flanged Fittings
3 – 24	350	250
30 – 48	250	250

B. Coating and Lining: The fittings shall be coated on the outside with either asphaltic coating in accordance with AWWA C110 or fusion-bonded epoxy in accordance with AWWA C116, and the fittings shall be lined inside with either cement-mortar and asphaltic seal coating in accordance with AWWA C104 or fusion-bonded epoxy in accordance with AWWA C116.

C. All fittings shall have mechanical joint bell ends conforming to AWWA C111 unless otherwise shown on the Drawings. However, for pipe 16-inch and larger, fittings with restrained bell joints compatible with the restrained joint pipe used will be permitted when authorized by the Engineer or Owner.

D. Restrained MJ Joints (all sizes): Restrained joints shall be used for all connections to valves and fittings, and all such connections shall be restrained mechanical joint type using retainer glands as specified in Section 15130. However, when restrained joint pipe (with factory-welded retainer bead or ring on the pipe spigot) is used, fittings manufactured with restrained joints compatible with the restrained joint pipe may be used in lieu of fittings with restrained mechanical joints. Restraining gaskets with integral stainless steel locking segments (including MJ Field-Lok gaskets) are not permitted on valves or fittings.

E. Non-restrained mechanical and push-on joints are not allowed for connections to valves, hydrants, or fittings.

F. Acceptable ductile iron fittings manufacturers are:

1. Sigma through United States Pipe & Foundry Co. (domestic or foreign)
2. McWane Cast Iron Pipe Co. (Tyler Union domestic only)
3. Star Pipe Products (domestic or foreign)
4. Metalfit, through United States Pipe & Foundry Co. or American Cast Iron Pipe Company.

2.04 JOINTS – ADDITIONAL REQUIREMENTS

A. All gaskets for buried pipe and fittings shall be of styrene butadiene rubber (SBR), unless otherwise required by the Drawings, Section 01011, or as directed by the Engineer.

B. Anti-rotation T-bolts shall be used on mechanical joints, except where special bolts are supplied with the approved restraint device, and shall be of domestic origin meeting the current provisions of AWWA C111. T-bolts and nuts shall be high-strength, corrosion-resistant low-alloy steel with the characteristics listed in Table 6 of AWWA C111. T-bolts shall be Xylan or FluoroKote #1 (corrosion resistant).

C. Retainer glands of any style are not acceptable for pipe to pipe joints.

D. Anchor Couplings: Anchor couplings for anchoring the hydrant valve to pipeline tee's branch and for anchoring the hydrant to the valve shall consist of a plain end mechanical joint pipe with a rotating follower gland, retained by a welded ring, on one or both ends. Anchor couplings shall be installed for each hydrant branch and other locations where shown on the Drawings. Anchor couplings shall be manufactured from Thickness Class 53 ductile iron and shall meet the applicable requirements for both ductile iron pipe and fittings as specified in this section. Standard MJ gaskets as specified herein shall be used with anchor couplings.

E. Flanged: Flanged joints shall conform to AWWA C110 (for fittings) or AWWA C115 (for pipe) and also to ANSI B16.42 Class 150. Unless otherwise noted on the Drawings (including bridge crossings), all exposed ductile iron pipe and fittings shall have flanged joints. Flanged joints are not permitted in underground installations except where exposed within structures or if allowed for tapping sleeves, saddles, and valves as specified in Sections 15150 and/or 15170.

   1. Gaskets for all flanged joints shall be 1/8-inch thick, styrene butadiene rubber (SBR) or EPDM gaskets. Paper flange gaskets are not permitted.

   2. The bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Bolts and nuts hall be threaded in accordance with ASME/ANSI B1.1, Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. Material for bolts and nuts shall conform to ASTM A307, 60,000 psi tensile strength, Grade B, unless otherwise specified in Section 01011. Xylan or FluoroKote #1 hex bolts (corrosion resistant) shall be used on any buried flange bolts used with ductile or gray cast iron flanges.

   3. Each flange shall be fully compatible with its mating flange.

F. Connections to existing piping shall comply with Section 15000. When connecting to existing ductile iron pipe, connection shall be made either as described in this section or using couplings in accordance with Section 15130. A restrained mechanical joint solid sleeve as specified above for ductile iron fittings may be used to connect an existing plain spigot end to a new pipe plain spigot end. When connection is to be made to an existing pipe with a joint type not

allowed within this section, the existing pipe shall be cut to a plain spigot end unless otherwise approved by the Engineer.

PART 3: EXECUTION

3.01 INSTALLATION

Installation of ductile iron pipe and appurtenances shall be in full accordance with AWWA C600 except as modified herein. Contractor shall follow the provisions of Sections 02210 and 15000, other sections as applicable (including related sections listed in Part 1 above), and all manufacturers' recommendations, in addition to the following requirements:

A. All Joint Types:

Immediately prior to assembly, thoroughly clean the surfaces that the gasket will contact using a bacteria-free solution (bleach, potable water or NSF-61 compliant material).

B. Non-restrained Push-On Joints:

Insert the gasket into the groove in the bell. Apply a sufficient coating of manufacturer approved NSF-61 certified lubricant to the gasket and the spigot end of the pipe before assembling the joint in accordance with the manufacturer's requirements, AWWA C600, and other requirements of this section. The use of improper lubricants can damage gaskets, so ensure that only lubricants approved by the gasket manufacturer are used. Center the spigot end in the bell, and push home the spigot end. The maximum allowable deflection at the joints for push-on joint pipe shall be the lesser of manufacturer's recommendations or as described in the DIPRA Guideline, Installation Guide for Ductile Iron Pipe, as follows:

Size of Pipe	Deflection Angle	Maximum Deflection (18-ft Length)	Maximum Deflection (20-ft Length)
4" - 12"	5 degrees	19"	21"
14" - 42"	3 degrees	11"	12"
48" - 64"	3 degrees	N/A	12"

C. Restrained Push-On:

Assemble and install the restrained push-on joint with the pipes aligned in the same axis according to the manufacturer's recommendations. Use feeler gauge to check all joints installed with push-on restraining gaskets with integral stainless steel locking segments. Contractor shall not reuse restraining gaskets once a joint is disassembled. Check the retainer ring fastener where present. Unless otherwise directed by the manufacturer, joints shall not be deflected until the joint has been fully assembled and checked for proper assembly; deflection shall not exceed manufacturer's recommended allowances.

D. Restrained Mechanical Joints:

1. Use approved restrained joint device according to Section 15130. Slip the follower gland and gasket over the pipe plain end making sure that the small side of the gasket and lip of the gland face the bell socket. Insert the plain end into the bell socket. Push the gasket into position with fingers only, and seat gasket evenly. Slide gland into position, insert bolts, and tighten nuts by hand. Tighten MJ flange bolts alternately per manufacturer's recommendations to the manufacturer's recommended torque rating or, if not provided, to the following normal torques as specified in AWWA C111 Table A.1:

Bolt Size (inch)	Pipe Nominal Size (inches)	Range of Torque in Foot-Pounds
5/8	3	45 -60
3/4	4 – 24	75 – 90
1	30 – 36	100 – 120
1-1/4	42 – 48	120 - 150

2. Secure restrained joint device to pipe barrel in accordance with Section 15130 and the restraint device manufacturer's recommendations.

E. Ball and Socket Joints:

Assemble and install the ball and socket joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

F. Pipe Protection

1. Comply with requirements of Section 15000. Lift pipe in accordance with AWWA Standards C600 and manufacturer's recommendations, subject to the restrictions herein and in Section 15000.

2. Protect cement-mortar lining from damage during transportation (off- and on-site), preparation and installation. Transporting or lifting pipe by inserting lifting forks, chains, hooks, or any other device inside the pipe shall not be permitted. No exception shall be made during application of polyethylene encasement or any other time.

3. Protect asphaltic coating from damage during off- and on-site transportation, preparation and installation. Contractor shall not utilize metal chains, steel cable, etc. to lift or transport pipe. Transporting or lifting pipe using forks on construction equipment shall not be permitted unless the pipe is supported on pallets or lumber and lifted indirectly with the forks.

4. Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when assembling each pipe joint (i.e. "pushing home" every pipe). Wood or other suitable (non-metallic) material consistent with the pipe manufacturer's recommendations shall be used to push home the pipe.

END OF SECTION

SECTION 15120

POLYVINYL CHLORIDE (PVC) PIPE

PART 1: GENERAL

1.01 SCOPE OF WORK

The work under this section consists of providing all labor, materials, tools, equipment, and services required to install and test all polyvinyl chloride (PVC) pressure pipe (**4 inches through 12 inches nominal diameter only**) with ductile-iron-pipe-equivalent outside diameters for water distribution and transmission as indicated on the Drawings and as specified within this section and related sections of the Specifications. Contractor shall furnish and install all required pipe restraint components and other related components that are not furnished by the Owner. Refer to Sections 01000, 01011 and 01075 for materials to be furnished by the Owner.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, and certifications for all products furnished under this section in accordance with Section 01300.

B. Required certifications include those specified under Quality Assurance below.

1.03 QUALITY ASSURANCE

A. PVC pipe shall meet the minimum quality requirements by conforming to the below-referenced AWWA/ANSI standards as modified herein. PVC pipe will be accepted on the basis of the Manufacturer's certification that the materials conform to this section.

B. The Owner reserves the right to sample and test these materials subsequent to delivery at the project site.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 02558 Identification/Location Guide

H. Section 15000 Piping - General Provisions

I. Section 15020 Disinfecting Pipelines

J. Section 15025 Flushing and Cleaning Pipelines

K. Section 15030 Pressure and Leakage Tests

L. Section 15105 Ductile Iron Pipe and Fittings

M. Section 15130 Piping Specialties

N. 15150 Gate Valves

O. Section 15170 Tapping Sleeves, Saddles, and Valves

P. Section 15180 Fire Hydrants

Q. Section 15185 Abandonment of Mains and Hydrants

R. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

S. Section 15200 Service Lines

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM D1784 - Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

B. ASTM D2122 - Determining Dimensions of Thermoplastic Pipe and Fittings

C. ASTM D2152 Poly(Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion

D. ASTM D2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)

E. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

F. ASTM D2855 – Standard Practice for Making Solvent Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

G. ASTM F412 - Standard Terminology Relating to Plastic Piping Systems

H. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

I. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe

J. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

K. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In., for Water Transmission and Distribution

L. AWWA Manual M23 -- PVC Pipe - Design and Installation

M. NSF/ANSI 14 Plastic Piping System Components and Related Materials

N. NSF/ANSI 61 Drinking Water System Components – Health Effects

O. Plastic Pipe Institute TR-2, PVC Range Composition Listing of Qualified Ingredients

PART 2: PRODUCTS

2.01 GENERAL

A. No foreign-manufactured pipe shall be allowed. All pipe and restraints shall be produced solely in the United States.

B. PVC pipe shall be used where shown on the Drawings, specified in Section 01075, listed in the Bid “Schedule of Prices” and Bid Tab, or where otherwise approved by the Engineer and Owner.

C. All materials that come in contact with potable water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61.

2.02 PIPE MATERIALS

A. All PVC pipe shall be PVC 1120 pressure pipe made from clean, virgin class 12454 PVC compound conforming to resin specification ASTM D1784 with outside diameter dimensions of cast iron pipe and shall conform to all applicable requirements of ASTM D1784 and D2241. The PVC compounds shall be treated or certified suitable for potable water products by the National Sanitation Foundation (NSF) Testing Laboratory (NSF Standard No. 61). All PVC pipe shall be blue in color.

B. PVC pipe 4 inch through 12 inch nominal size shall meet the requirements of AWWA C900. When AWWA C900 conflicts with the listed ASTM standards, the requirements of AWWA C900 shall prevail.

C. Pipe Class: All PVC pipe installed shall be DR 14 (305 psi Pressure Class per AWWA C900) unless otherwise indicated in this section, on the Drawings and/or in Section 01011. In no case shall PVC pipe with a wall thickness less than DR 14 be permitted. The pipe shall be capable of withstanding the overburden pressure determined by the depth of burial in field. When Certa-Lok™ restrained joint C900 PVC pipe is installed by horizontal directional drilling method, it shall be DR 14 (305 psi Pressure Class per AWWA C900) unless otherwise indicated on the Drawings or specified in Section 01011. PVC pipe pressure classes were increased in the latest revision of AWWA C900; however, American Water does not allow pipe in its system to be fully subject to the revised Pressure Class pressures in AWWA C900 latest revision. DR 14 shall not be subjected to working pressures exceeding 200 psi.

D. Minimum pipe stiffness (F/dY) at 5% deflection shall be as follows when tested in accordance with D2241:

1. DR 14 pipe: 914 psi for all sizes

E. The pipe shall be designed to pass a quick burst test pressure of 985 psi (DR 14 pipe) applied in 60 to 70 seconds when tested in accordance with ASTM D1599, as referenced in ASTM D2241.

F. Standard laying lengths shall be 20-feet (±1 inch). Random lengths of not more than 15% of the total footage of each size may be shipped in lieu of the standard lengths. Reruns of reclaimed material shall not be accepted.

G. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints conforming to the requirements of ASTM 2672. Elastomeric gaskets shall conform to the requirements of ASTM F477 for high-head (>50 ft.) applications in all respects.

H. Restrained Joint Pipe: Appropriate restraint shall be provided at all fittings and valves and at other locations as shown on the Drawings or required in Section 01011. PVC pipe-to-pipe joints shall be restrained using an external restraint harness as specified in Section 15130. Gaskets utilizing integral locking segments such as Field-Lok gaskets are not permitted for use with PVC pipe. Certa-Lok™ restrained joint C900 pipe may be used where restrained joint pipe is required, including horizontal directional drilling applications where allowed by Section 02458 and approved by the Engineer. Restrained joint PVC pipe shall utilize couplings with high-strength, flexible thermoplastic splines, which shall be inserted into mating, precision-machined full-circumferential grooves in the pipe and coupling to provide full 360-degree restraint with evenly distributed loading. Couplings shall be designed for use at or above the pressure class of the pipe and shall incorporate twin elastomeric sealing gaskets meeting the requirements of ASTM F477. Joints shall meet the zero leakage test requirements of ASTM D3139. The pipe, couplings, and locking splines shall be completely non-metallic

and interchangeable; and the complete restrained joint pipe system shall meet all requirements of AWWA C900. Restrained joint "sweeps" shall not be used.

I. Fittings

No PVC fittings (including "sweeps") shall be permitted. All fittings for PVC pipe 4" diameter and larger shall be mechanical joint ductile iron fittings connected to PVC pipe with mechanical joint restraint devices as specified in Section 15130, unless otherwise indicated on the Drawings. Concrete thrust blocks shall be installed where shown on the Drawings.

2.03 MANUFACTURERS

Acceptable PVC pipe manufacturers are:

A. JM Eagle, Inc.
5200 West Century Boulevard
Los Angeles, CA 90045
(800) 621-4404
www.jmeagle.com

B. North American Pipe Corporation
2801 Post Oak Blvd., Suite 600
Houston, TX 77056
(713) 840-7473
www.northamericanpipe.com

C. Diamond Plastics Corporation
1212 Johnstown Road
Grand Island, NE 68803
(800) PVC-PIPE
www.dpcpipe.com

D. Northern Pipe Products
1302 39th Street NW
Fargo, ND 58102
800-747-7655
www.northernpipe.com

E. Sanderson Pipe
875 International Boulevard
Clarksville, TN 37040
800-669-3553
www.sandersonpipe.com

F. Vulcan Plastics, a division of Consolidated Pipe & Supply Company Inc.
1205 Hilltop Parkway
Birmingham, AL 35204
800-467-7261
www.consolidatedpipe.com

PART 3: EXECUTION

3.01 PACKAGING, HANDLING AND STORAGE

A. The manufacturer shall ensure that the interior of all pipe is clean and install plastic cleanliness plugs in all pipes to keep the pipe interiors clean or cover adequately to prevent dust or truck exhaust from entering pipes.

B. Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall not be used.

C. Any section of pipe showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture is visible, shall be marked as rejected and removed at once from the work.

3.02 INSTALLATION

Except as modified herein, installation of PVC pipe shall be in full accordance with AWWA C605, AWWA Manual M23, and the Uni-Bell "Handbook of PVC Pipe Design and Construction." In the event of conflicting requirements or guidelines within these referenced publications, the requirements of AWWA C605 shall prevail. Contractor shall also follow the provisions of Sections 02210 and 15000, other sections as applicable, and all manufacturers' recommendations, in addition to the following requirements:

A. Assemble pipe using the following types of joints:

1. Gasketed bell joint – Integral with the pipe,
2. Gasketed coupling – A double gasketed coupling as specified in Section 15130, or
3. Restrained mechanical joint (for pipe to fitting and pipe to valve joints only) – As specified in Section 15105.
4. Restrained Joint: Coupling – Joints for restrained joint PVC pipe (Certa-Lok™) shall be as specified in Article 2.02 above.

B. Assemble push-on joints in accordance with the pipe manufacturer's recommendations. Assemble mechanical joints in accordance with the fitting and restraint manufacturers' recommendations.

C. Do not remove factory installed gaskets. Keep the joint free of dirt, sand, grit, grease or any foreign material. Apply NSF certified lubricant when assembling gasketed joints in accordance with the pipe manufacturer's requirements. The use of improper lubricants can damage gaskets.

D. Good pipe alignment is essential for proper joint assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or "stab" the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the

proper depth of insertion, and Contractor shall use extreme caution to avoid over-inserting pipe into the bell.

E. Protect pipe from damage when assembling ("pushing home") pipe joints. Wood or other suitable (non-metallic) material consistent with the pipe manufacturer's recommendations shall be used as a cushion while pushing home the pipe. Avoid metal to plastic contact. Neither deflection of PVC pipe joints nor bending of PVC pipe are permitted. All angles shall be made with proper fittings.

F. PVC pipe shall not be installed with less than 3 feet of cover. DR 14 PVC pipe shall not be installed with more than 30 feet of cover.

G. Pressure testing of DR 14 PVC pipe shall not exceed 305 psi.

H. Only ductile iron fittings per specification 15105 may be used with PVC pipe. PVC fittings are not permitted. See detail drawings and Section 15130 for transitions between different pipe materials.

I. Research has documented that certain pipe materials (such as polyvinyl chloride, polyethylene, and polybutylene) and certain elastomers (such as those used in gasket material) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products specified in this section shall only be installed in soils that are free of both petroleum products and organic solvents. If during the course of pipeline installation, the Contractor identifies or suspects the presence of petroleum products or any unknown chemical substance in the native soil, Contractor shall stop installing pipe in the area of suspected contamination and notify the Engineer immediately. Contractor shall not resume installing piping in the area of suspected contamination until direction is provided by the Engineer.

J. Unless otherwise shown on the Drawings or indicated in Section 01011, PVC pipe shall not be installed at sites where frequent excavation can be anticipated in the vicinity of the pipe (including treatment plant and booster station sites), where the pipeline is laid on a river channel bottom, or with less than 3 feet of cover over the top of pipe. PVC pipe shall not be installed in any circumstance with less than 3 feet or more than 30 feet of cover over the crown of the pipe. Unless otherwise shown on the Drawings or approved in writing by the Engineer.

3.03 TAPPING

A. Use a tapping sleeve or saddle in accordance with Section 15170 and/or 15200 (as appropriate).

END OF SECTION

SECTION 15125

HIGH DENSITY POLYETHYLENE (HDPE) PIPE

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to provide and test all high density polyethylene (HDPE) pressure pipe and fittings (4 inches through 48 inches nominal diameter) with ductile-iron-pipe-equivalent outside diameters for water distribution and transmission as indicated on the Drawings and as specified within this section and related sections of the Specifications. This section shall also apply to installation of HDPE water mains smaller than 4-inch diameter to the extent applicable (materials for HDPE pipe smaller than 4-inch diameter are specified in Section 15200). Contractor shall furnish and install all required pipe, pipe restraint components, and other related components. HDPE pipe will not be furnished by the Owner. Refer to Sections 01000, 01011 and 01075 for materials to be furnished by the Owner.

B. When water mains smaller than 4-inch diameter are required, high density polyethylene pipe in accordance with Section 15200 shall be used.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications and other required submittals for all products furnished under this section in accordance with Section 01300.

B. The following product data is required from the pipe manufacturer:

1. Pipe Size
2. Dimensionality
3. Pressure Class
4. Color
5. Recommended Minimum Bending Radius
6. Recommended Maximum Safe Pull Force (if pipe will be used for directional drilling, pipe bursting, or other trenchless installation method)
7. Certificate of compliance from the pipe manufacturer that the product pipe is in compliance with Project requirements.

C. Submit fusion method(s), quality control procedures, and documentation for fusion process.

D. Fusion Technicians Certifications: Submit required certifications, including those specified under Quality Assurance below and all proposed fusion technicians'

applicable certifications and qualifications. Fusion Technicians' Certifications shall have been completed within the past two years.

E. Submit verification by the pipe manufacturer that the Contractor has been trained in the proper method of handling, joining, and installing the new pipe (including installation by directional drilling and/or pipe bursting where applicable). Contractor shall have satisfactorily performed a minimum of five (5) equivalent projects throughout the past five years.

F. POST-CONSTRUCTION SUBMITTALS

A fusion technician's joint report of as-recorded data for every fusion joint performed on the project, including joints that were rejected, shall be provided by the Contractor and/or fusion provider and shall also be supplied to the pipe supplier or manufacturer promptly upon request. Specific requirements of the fusion technician's joint report shall include:

1. Pipe Size and Thickness
2. Machine Size
3. Fusion Technician Identification
4. Job Identification
5. Fusion Joint Number
6. Fusion, Heating, and Drag Pressure Settings
7. Heat Plate Temperature
8. Time Stamp
9. Heating and Cool Down Time of Fusion
10. Ambient Temperature.

1.03 QUALITY ASSURANCE

A. HDPE pipe and fittings shall meet the minimum quality requirements by conforming to the below-referenced AWWA/ANSI and ASTM standards as modified herein. HDPE pipe and fittings will be accepted on the basis of the Manufacturer's certification that the materials conform to this section.

B. The certification for HDPE fittings shall list a fitting description, quantity, bare fitting weight, source, and applicable AWWA standard (C906). The certification shall accompany each delivery of the material to the project site.

C. Owner and Engineer reserve the right to witness pipe manufacturing at the manufacturer's facility where the pipe to be provided for the Work will be produced. Owner and Engineer reserve the right to inspect, sample, and test these materials subsequent to delivery at the project site. Such inspections shall in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and this section. Should the Engineer wish to witness the manufacture of specific pipes, the manufacturer shall provide the Engineer with adequate advance notice of when and where the production of

those specific pipes will take place. Approval of the products or tests is not implied by the Engineer's decision not to inspect the manufacturing, testing, or finished pipes.

D. HDPE pipe shall be fused only by certified fusion technicians, as documented by the pipe supplier or manufacturer, by the fusion machine manufacturer, or by other documentation acceptable to the Engineer. The fusion equipment operator shall be fully trained in the use of the respective equipment.

E. Owner and Engineer reserve the right to perform onsite card checks for fusion technicians' qualifications and to stop any fusion work being performed by personnel unable to promptly provide documentation of the required qualifications.

F. For HDPE installations 16-inch diameter and larger, Contractor shall, upon request by the Owner or Engineer, and at no additional cost to the Owner, arrange for the pipe manufacturer's field representative to be on-site during installation of HDPE to oversee the fabrication of five (5) butt fusion joints for each work crew installing this type of joint.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 02350 Pipe Bursting of Water Mains

H. Section 02458 Horizontal Directional Drilling (HDD)

I. Section 02558 Identification/Location Guide

J. Section 15000 Piping - General Provisions

K. Section 15020 Disinfecting Pipelines

L. Section 15025 Flushing and Cleaning Pipelines

M. Section 15030 Pressure and Leakage Tests

N. Section 15105 Ductile Iron Pipe and Fittings

O. Section 15130 Piping Specialties

P. Section 15150 Gate Valves

Q. Section 15155 Butterfly Valves

R. Section 15170 Tapping Sleeves, Saddles, and Valves

S. Section 15180 Fire Hydrants

T. Section 15185 Abandonment of Mains and Hydrants

U. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

V. Section 15200 Service Lines

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM D638 - Standard Test Method for Tensile Properties of Plastics

B. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

C. ASTM: D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D. ASTM D1505 - Standard Test Method for Density of Plastics by the Density-Gradient Technique

E. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping

F. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

G. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

H. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

I. ASTM F412 - Standard Terminology Relating to Plastic Piping Systems

J. ASTM F714 - Standard Specification for Polyethylene (PE) Pipe (SDR-PR) Based on Outside Diameter

K. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing

L. ASTM F1473 - Standard Test Method for North Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins

M. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

N. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe

O. ASTM F2206 - Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE) Plastic Pipe, Fittings, Sheet Stock, Plate Stock or Block Stock

P. ASTM F2620 - Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

Q. Plastic Pipe Institute TN 34 - Installation Guidelines For Electrofusion Couplings 14” and Larger

R. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

S. AWWA Manual M55 - PE Pipe Design and Installation

T. Plastic Pipe Institute (PPI) “Handbook of Polyethylene Pipe”

U. PPI TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe

V. NSF/ANSI 14 Plastics Piping System Components and Related Materials

W. NSF/ANSI 61 Drinking Water System Components – Health Effects

X. NSF/ANSI 372 Drinking Water System Components – Lead Content

PART 2: PRODUCTS

2.01 GENERAL

A. No foreign-manufactured items provided under this section shall be allowed. All pipe, fittings, saddles, and other HDPE appurtenances shall be produced solely in the United States.

B. HDPE pipe shall be used where shown on the Drawings and may be used where approved by the Engineer. HDPE pipe shall be used both for pipe bursting

applications installed in accordance with Section 02350 and for horizontal directional drilling applications installed in accordance with Section 02458 unless otherwise shown on the Drawings, specified in Section 01011 or 01075, listed in the Schedule of Prices, or otherwise approved by the Engineer and Owner.

C. The nominal pipe diameter shall be as specified on the Contract Drawings. HDPE pipe sizes shall be nominal diameters of 4", 6", 8", 12", 16", 20", 24", 30", 36", 42", or 48" only with outside diameters conforming to ductile iron pipe sizes (DIPS). HDPE pipe size shall be selected to provide the required inside diameter, which may require pipe to be upsized, at the Engineer's direction, to the next size listed above when HDPE pipe is used in place of ductile iron or PVC pipe.

D. HDPE fittings shall not be used except for saddles, adapters and temporary caps as specified below. All other fittings shall be ductile iron.

E. All materials that come in contact with potable water, including lubricants, shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61.

2.02 HDPE PIPE AND FITTINGS

A. All HDPE pipe and fittings shall fully meet the requirements of AWWA C906 and shall be made from the same virgin resin meeting the requirements of the Plastic Pipe Institute (PPI) material designation PE 3408/3608 or PE 4710 (where PE 4710 is required on the Drawings, in Section 01011, and/or in Section 01075, PE 3408/3608 shall not be permitted) with an ATSM D3350 minimum cell classification of PE 345464C. A higher number cell classification limit which gives a desirable higher primary property per ASTM D3350 may be submitted for approval by the Engineer and, if approved, may be used at no extra cost to the Owner.

B. The pipe and fittings shall contain no recycled compound except for rework material generated in the manufacturer's own plant that has the same cell classification as the material to which it is being added. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.

C. The material shall have a minimum Hydrostatic Design Basis (HDB) of 1,600 psi (11.03 MPA) at 73 degrees F per ASTM D 2837. The material shall be black with minimum 2% carbon black for ultraviolet protection. Permanent identification of water piping service shall be provided by co-extruding longitudinal blue stripes into the pipe outside surface at no less than two locations around the pipe's circumference, so at least one stripe is visible from any angle. The striping material shall be the same material as the pipe material except for color, which shall be blue. Stripes printed or painted on the outside surface shall not be acceptable.

D. All HDPE pipe and fittings shall be minimum Pressure Class 160 psi with wall thickness not less than dimension ratio (DR) 11, unless otherwise shown on the Drawings or specified in Section 01011, 02458 or this section. However, all HDPE pipe installed with more than 20 feet of cover and all HDPE pipe installed

by pipe bursting methods shall be minimum Pressure Class 200 psi and wall thickness not less than DR 9.0, unless otherwise shown on the Drawings or specified in Section 02350 or 01011. HDPE pipe shall not be subjected to working pressures exceeding the pipe's Pressure Class.

E. HDPE elbows/bends, tees, and crosses are not allowed.

2.03 FITTINGS, SADDLES, ADAPTERS AND TEMPORARY CAPS

A. Plain end butt fused mechanical joint adapter fittings shall be used when joining polyethylene pipe to valves, ductile iron fittings, or other pipe materials. Butt fusion fittings shall comply with ASTM D3261. When using a butt-fused adapter, a Type 316 stainless steel stiffener shall be used.

B. Butt fused IPS to DIPS adapters shall be used to connect DIPS-size HDPE pipe to IPS-size HDPE pipe.

C. Saddles for branch/service connections 2-inch diameter and smaller shall be conventional fusion type, side fusion (sidewall fused) tapping saddles in conformance with ASTM D1598, D1599, and AWWA C906, rated for at least 200 psi working pressure with NSF-61- and NSF-372-compliant female threaded brass alloy insert per AWWA C800 (CC threads unless otherwise specified in Section 01011) to receive a corporation stop. Saddle branch shall be PE 3408/3608 or PE 4710 HDPE per ASTM D3350 with cell classification 345454C or higher. A Type 304 or 316 stainless steel compression ring shall be provided around the outer diameter of the branch outlet opposing the threaded insert.

D. HDPE branch saddles for 3-inch diameter branch/service connections shall be conventional fusion or electrofusion type as directed and/or approved by the Owner or Engineer. 3-inch saddles shall be DR 11 or DR 9 PE 3408/3608 or PE 4710 with a pressure rating that equals or exceeds the water main Pressure Class. No HDPE saddles shall be permitted for branch/service connections larger than 3-inch.

E. Electrofusion fittings, couplings, and saddles shall only be used where permitted by the Engineer and shall not be permitted for use with HDD. Electrofusion fittings shall comply with ASTM F1055.

F. Mechanical (compression) fittings and couplings shall be as specified in Sections 15105 and 15130 and shall use gaskets and restraining devices specifically designed for, or tested and found to be acceptable for, use with polyethylene pipe. Type 316 stainless steel stiffeners shall be utilized in the HDPE pipe with all mechanical joint (compression) ductile iron fittings, couplings, and valves. Compression-type HDPE or PVC fittings shall not be used. T-bolts and nuts shall be high-strength, corrosion-resistant low-alloy steel with the characteristics listed in Table 6 of AWWA C111. T-bolts shall be Xylan or FluoroKote #1 (corrosion resistant). Other bolts and nuts shall be as specified in Section 15130.

2.04 PIPE ROLLERS

A. Pipe rollers shall be designed for the purpose of supporting and guiding pipe with minimal friction.

B. Pipe rollers shall be of sufficient size to fully support the weight of the pipe during handling and installation and shall not damage the pipe in any way. Spacing shall be as recommended by the HDPE pipe manufacturer and shall prevent pipe abrasions and additional stress on the piping.

2.05 ACCEPTABLE MANUFACTURERS—HDPE PIPE AND FITTINGS

A. Performance Pipe
A Division of Chevron Phillips Chemical Company
5085 West Park Blvd., Suite 500
P.O. Box 269006
Plano, Texas 75093

B. JM Eagle
5200 West Century Boulevard
Los Angeles, California 90045

C. WL Plastics Corporation Corporation
3575 Lone Start Circle, Suite 300
Fort Worth, TX 76177

D. Poly-Cam (Series 415 side fusion saddles only)
1101 McKinley St.
Anoka, MN 55303

E. ISCO Industries (adapters and fittings only*)
926 Baxter Ave.
Louisville, KY 40204
*Pipe manufactured by Performance Pipe or JM Eagle may be supplied through ISCO.

F. Georg Fischer Central Plastics LLC Pipe & Fabricated Products (formerly Independent Pipe Products Inc.) (adapters and fittings only)
39605 Independence
Shawnee, OK 74804

G. Nupi Americans Inc. (adapters and fittings only)
1511 Superior Way
Houston, TX 77039

H. Improved Piping Products, Inc. (adapters and fittings only)
4311 Director Drive
San Antonio, TX 78219

I. Improved Piping Products, Inc. (adapters and fittings only)
4311 Director Drive
San Antonio, TX 78219

PART 3: EXECUTION

3.01 PACKAGING, HANDLING, AND STORAGE

A. The manufacturer shall ensure that the interior of all pipe is clean and install plastic cleanliness plugs in all pipes to keep the pipe interiors clean or cover adequately to prevent dust or truck exhaust from entering pipes.

B. Contractor shall take care not to damage any HDPE pipe. All pipes shall be visually inspected for gouges. Gouges in excess of ten percent (10%) of the pipe wall thickness are considered excessive and are not acceptable. In areas where excessive gouges or other damage is present, the affected pipe section shall be cut out and removed. The remaining, undamaged portions of the pipe shall be rejoined by butt fusion to make a continuous section.

3.02 PIPE INSTALLATION

Installation of HDPE pipe and fittings shall be in full accordance with AWWA Manual M55, except as modified herein. Contractor shall follow the provisions of Sections 02210, 02350, 02458, and 15000; other sections as applicable; and all manufacturers' recommendations, in addition to the following requirements:

A. Trenching, bedding, and backfilling shall be comply with Section 02210. Trenching shall be performed in accordance with ASTM D2774.

B. Unless authorized in writing by the Engineer on a case-by-case basis, changes in direction shall be accomplished by bending the pipe in lieu of installing a fitting, subject to approval by the Engineer. Maximum pipe bending radius shall be in conformance with AWWA Manual M55 and the manufacturer's recommendation for the specific diameter and dimension ratio (DR) of the pipe. The following table shows minimum bending radius based upon the allowable strain of the pipe wall. Potential flow restrictions, surge and other non-trench stability and pipe strain issues may reduce the values shown here per the Engineer's and/or manufacturer's recommendations. The minimum bend radius multiplier determines the minimum (cold) radius of the pipe curvature, which is calculated by multiplying the outside diameter of the pipe by the multiplier for the appropriate DR used. Bending radius allowed by the manufacturer can vary, so Contractor shall verify the multiplier with the manufacturer prior to ordering the pipe. In no case shall the installed radius be less than 125% of the manufacturer's permitted bending radius.

PE pipe Dimension Ratio (DR)	Minimum Bending Radius Multiplier*
11.0	25 times pipe O.D.
9.0	20 times pipe O.D.

*When installed by HDD, minimum bending radius shall be as specified in Section 02458.

C. The HDPE pipe shall be continuously or partially supported on rollers or other Engineer-approved friction-decreasing implements during joining and installation, such that the pipe is not over-stressed or critically abraded prior to or during installation. A sufficient quantity of rollers or other approved implements, spaced per the pipe manufacturer's guidelines, shall be used to assure adequate support and resist excessive sagging of the pipe during installation. Contractor shall ensure that pipe is not permitted to slide sideways on the rollers or other implements.

D. Tracer wires shall be installed with the HDPE pipe as specified in Section 02458 and 02558.

E. HDPE pipe shall not be employed with directional drilling through rock or other abrasive conditions unless it is encased and only with approval of the Engineer.

F. Research has documented that certain pipe materials (such as polyethylene, polybutylene, polyvinyl chloride, and asbestos cement) and certain elastomers, such as used in jointing gaskets and packing glands, may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products supplied in this section shall only be installed in soils that are free of both petroleum products and organic solvents. If during the course of pipeline installation the Contractor identifies or suspects the presence of petroleum products or any unknown chemical substance in the native soil, Contractor shall stop installing piping in the area of suspected contamination and notify the Engineer immediately. Contractor shall not resume installing piping in the area of suspected contamination until direction is provided by the Engineer.

G. Unless otherwise shown on the Drawings or indicated in Section 01011, HDPE pipe shall not be installed at sites where frequent excavation can be anticipated in the vicinity of the pipe (including treatment plant and booster station sites) or where the pipeline is laid on a river channel bottom (except when installed by HDD). HDPE pipe shall not be installed in any circumstance with less than 3 feet or more than 25 feet of cover over the crown of the pipe.

3.03 PIPE AND FITTING JOINING

A. All HDPE pipe joining shall be by butt fusion procedures. Electrofusion shall be used only as permitted by the Engineer. Service connections shall be as specified in Article 3.04 below.

B. HDPE pipe thermal butt fusion welding is to be performed in accordance with the Plastic Pipe Institute "Handbook of Polyethylene Pipe," Polyethylene Joining Procedures, and 49 CFR 192, Subpart F, latest edition.

C. Butt fusion and electrofusion procedures shall be in accordance with the manufacturer's recommendations and the requirements herein. Surfaces must be clean and dry before joining. The wall thicknesses of the adjoining pipes shall have the same DR at the point of fusion unless a specific fitting is specified.

D. Each butt-fused joint shall be precisely aligned and shall have uniform roll back beads resulting from the use of proper temperature and pressure. The joint interior surfaces shall be smooth. Internal bead projections shall not be greater than 3/16-inch, or they shall be removed. The fused joint shall be watertight. The tensile strength at yield of the butt-fusion joints shall not be less than that of the pipe. A specimen of pipe cut across the butt-fusion joint shall be tested in accordance with ASTM D-638.

E. Only appropriately sized and outfitted fusion machines that have been approved by the pipe manufacturer shall be used for the fusion process. Fusion machines must incorporate the following properties, including the following elements:

1. HEAT PLATE - Heat plates shall be in good condition with no deep gouges or scratches. Plates shall be clean and free of any debris or contamination. Heater controls shall function properly; cord and plug shall be in good condition. The appropriately sized heat plate shall be capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused, per the pipe manufacturer's guidelines.
2. CARRIAGE – Carriage shall travel smoothly with no binding at less than 50 psi. Jaws shall be in good condition with proper inserts for the pipe size being fused. Insert pins shall be installed with no interference to carriage travel.
3. GENERAL MACHINE - Overview of machine body shall yield no obvious defects, missing parts, or potential safety issues during fusion.
4. DATA LOGGING DEVICE - The current version of the pipe manufacturer's recommended and compatible software shall be used. Data logging device operations and maintenance manual shall be with the unit at all times. If fusing for extended periods of time, an independent 110V power source shall be available to extend battery life.

F. Integrity of heating plate in the fusion equipment shall be checked a minimum of twice per each 8 hour work shift for temperature uniformity.

G. Other equipment specifically required for the fusion process shall include the following:

1. Pipe rollers shall be used for support of pipe to either side of the machine
2. A weather protection canopy that allows full machine motion of the heat plate, fusion assembly and carriage shall be provided for fusion in inclement and /or windy weather.
3. Fusion machine operations and maintenance manual shall be kept with the fusion machine at all times.
4. Facing blades shall be appropriate for cutting HDPE pipe.

H. JOINT RECORDING

1. Butt fusion equipment shall be equipped with a Datalogger. Records of each weld (including, as a minimum, heater temperature, fusion pressure, and a graph of the fusion cycle) shall be appropriately identified and provided to the Engineer daily.
2. Each fusion joint shall be recorded and logged by an electronic monitoring device (data logger) connected to the fusion machine. The fusion data logging and joint report shall be generated by software developed specifically for the butt-fusion of thermoplastic pipe. The software shall register and/or record the parameters required by the pipe manufacturer and these Specifications. Data not logged by the data logger shall be recorded manually and be included in the Fusion Technician's joint report.

I. Electrofusion reports of each weld shall be appropriately identified and provided to the Engineer. The reports shall include, as a minimum, the fusion date, time, ambient temperature, fitting type and size, user ID, and the manufacturer of the part.

J. Quality Control of HDPE fusion process (both butt fusion and electrofusion, as applicable) shall be adhered to and monitored by Contractor with all related documentation submitted to the Engineer.

K. All fused joints will be subject to acceptance by the Engineer prior to pipe installation. All defective joints shall be cut out and replaced at no cost to the Owner. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, if in the opinion of the Engineer any section of pipe has other defects, including those hereinafter listed, that may indicate damaged, improperly manufactured, faulty, or substandard pipe, said pipe shall be discarded or returned to the manufacturer and not used. Defects warranting pipe rejection include the following: concentrated ridges, discoloration, excessive spot roughness, and pitting; insufficient or variable wall thickness; pipe damage from bending, crushing, stretching or other stress; pipe damage that impacts the pipe strength, the intended use, the internal diameter of the pipe, internal roughness characteristics; or any other defect of manufacturing or handling.

L. Unless otherwise approved in writing by the Owner and Engineer, mechanical (compression) fittings shall be used only when joining polyethylene materials to other piping materials or valves and shall be installed as specified in Sections 15105 and 15130. Blocking must be provided at changes in direction for any mechanical fittings.

M. ELECTROFUSION

1. Electrofusion joining shall be done in accordance with the fitting and pipe manufacturers' recommended procedures and ASTM F 1290 and PPI TN 34. The process of electrofusion requires an electricity source, a transformer (commonly called an electrofusion box) that has wire leads, a method to read

electronically (by laser or otherwise) input from the barcode of the fitting, and a fitting that is compatible with the type of electrofusion box used. The electrofusion box shall be capable of reading and storing the input parameters and the fusion results for later download to a record file.

2. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this application. For a pipe surface to be properly prepared for electrofusion, the outer layer or "skin" of the pipe shall be removed to expose a clean, virgin pipe material. This can be achieved by using one of several types of approved scraping tools. Wood rasps or metal files are not acceptable methods. It is very important to note that abrasive materials, such as sandpaper or emery cloth, should never be used in place of a scraping tool. A minimum of 0.007 to 0.010 inch of the pipe's surface material shall be removed during the scraping process in order to expose a clean virgin material. The pipe surface shall be clean and free from any type of contaminants that may be spread before scraping begins. Should the pipe surface be contaminated with dirt, mud or drilling fluids before scraping, plain water shall be used to remove the surface level of these contaminates. However, water shall not be used to clean the pipe surfaces once the virgin material has been exposed. In those instances, a minimum 70% isopropyl alcohol concentration, with no additional additives, shall be used as a cleaning agent. For applications where a fitting will be moved around on the pipe, such as a repair application where a coupling will be pushed completely over one end of the pipe, the pipe shall be scraped for the entire length of the coupling to prevent a clean fitting from being contaminated by unscraped pipe.
3. Marks may be made on the outer surface of the pipe as a visual aid to help indicate the required scraper coverage. Marks made on the pipe shall not be made with a "grease pencil" or other type of petroleum based marker that will leave a contaminant behind.
4. Care shall be taken to ensure that the polyethylene pipe is not out-of-round before attempting the electrofusion process. Out of round pipe shall be removed or corrected in accordance with the pipe manufacturer's instructions.
5. All pipe that shall be fitted with electrofusion couplings shall be restrained or sufficiently supported on each side of the pipe to restrict movement during the fusion and cooling process and alleviate or eliminate sources of stress and/or strain until both the fusion cycle and the cooling cycle are completed. Electrofused fittings shall be cooled for the time required by the manufacturer.
6. Electrofusion fittings shall only be re-fused in the event of an input power interruption, i.e. fusion leads were detached during fusion, generator runs out of fuel, processor malfunction, or other circumstance that results in processor input power interruption.

N. Polyethylene pipe shall be joined to ductile iron pipe by the use of butt-fused mechanical joint adapters as specified in Part 2. When using a butt-fused adapter to connect to a valve or to another pipe material, a Type 316 stainless steel stiffener shall be used.

O. Flange adapters, when required, shall be butt fused to the polyethylene pipe and shall use Type 316 stainless steel stiffener rings. Flange bolts must span the entire width of the flange joint, and provide sufficient thread length to fully engage the nut. MJ Adapter kit shall include HDPE anchor fitting, standard rubber gasket, extra length corrosion resistant T-bolts, internal Type 316 stainless steel stiffener, and C-153 (2”-12”) or C-110 (14”-24”) heavy body ductile iron gland ring.

3.04 SERVICE CONNECTIONS AND TAPPING

A. Unless specifically indicated on the Contract Drawings, no mechanical service saddles or taps are permitted on HDPE pipe without written approval by the Owner.

B. Side-fusion (sidewall fused) polyethylene hot tapping saddles shall be provided for each 2-inch nominal diameter and smaller branch/service connection to HDPE mains as specified in Part 2 above, and branch saddles for 3-inch branch/service connections to HDPE mains shall be provided as specified in Part 2 above. HDPE main shall be tapped with a tapping tool or machine that meets the pipe and saddle manufacturers’ requirements. Installation of sidewall fused polyethylene saddles and HDPE branch saddles shall be in accordance with AWWA Manual M55, PPI TR-33, ASTM F2620 and shall be by the conventional saddle fusion method unless otherwise approved in writing by the Owner.

C. Connections to new mains larger than 3-inch nominal diameter shall be made with ductile iron tees in accordance with Section 15105 and 15130.

D. For connections larger than 3-inch nominal diameter to existing HDPE mains, mechanical clamps or tapping sleeves or saddles designed for HDPE pipe (of the correct outside diameter) and meeting the requirements of Section 15170 shall be used unless otherwise indicated on the Drawings and/or specified in Section 01011 and/or 01075.

3.05 ANCHOR RESTRAINTS

A. Concrete anchor collars located at each end of the watermain shall be provided.

3.06 TESTING

A. Pressure testing shall be conducted in accordance with the Manufacturer’s recommended procedures and Section 15030, or as otherwise recommended in writing by the Engineer.

B. Stream Crossings shall be pressure testing prior to chlorination and disinfection.

C. A ¾-inch NPT test nipple and plug shall be provided on each tapping saddle to allow pre-testing of the saddle assembly before making the tap.

D. Any third party inspections will be paid for by the Owner.

END OF SECTION

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SECTION 15130

PIPING SPECIALTIES

PART 1: GENERAL

1.01 SCOPE OF WORK

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to provide the various miscellaneous piping specialties addressed herein as indicated on the Drawings; as specified within this section and Sections 01011, 02210, and 15000; and as required to provide a complete, operational installation that fulfills the requirements of the Contract Documents. Contractor shall furnish all piping specialties that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 GENERAL REQUIREMENTS

This section is intended to supplement the other sections of the Specifications, and the items covered in this section are directly related to work specified in the related sections. All work specified in this section shall also comply fully with all other applicable sections, such as 15000, 15105, 15120, 15125, 15150, and 15155—regardless of whether or not direct references are included herein.

1.03 SUBMITTALS

A. Contractor shall submit Shop Drawings, installation instructions, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300. The following submittals shall be submitted:

1. Polyethylene encasement
2. Valve boxes
3. Ultra-compact restrained MJ adapters
4. T-bolts (shall be Xylan or Fluorokote #1, corrosion resistant).
5. Flange adapters
6. Restraint harnesses for PVC pipe joints
7. Couplings for joining dissimilar pipe materials or sizes
8. Mechanical joint retaining glands
9. Insulation and weatherproof jacketing (where applicable)
   a. Submittals for insulation shall identify thickness, k-value, and accessories.
   b. Submittals for insulation intended for freeze protection shall include an energy analysis report by the insulation manufacturer using appropriate conditions and assumptions for the specific installation to estimate the time for non-flowing water (or water flowing at a minimum velocity indicated by

the Engineer) in the pipeline to reach 32 degrees Fahrenheit and subsequent additional time to freeze solid.

c. Submittals for exposed insulation shall include available colors (at least white and silver) to be selected by the Owner.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 02558 Identification/Location Guide

I. Section 15000 Piping – General Provisions

J. Section 15020 Disinfecting Pipelines

K. Section 15025 Flushing and Cleaning Pipelines

L. Section 15030 Pressure and Leakage Tests

M. Section 15105 Ductile Iron Pipe and Fittings

N. Section 15120 Polyvinyl Chloride (PVC) Pipe

O. Section 15125 High Density Polyethylene (HDPE) Pipe

P. Section 15150 Gate Valves

Q. Section 15155 Butterfly Valves

R. Section 15170 Tapping Sleeves, Saddles & Valves

S. Section 15180 Fire Hydrants

T. Section 15190 Air Valves, Blow-off Assemblies and Sampling Taps

U. Section 15200 Service Lines

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASME / ANSI B1.1 - Unified Inch Screw Threads

B. ASME / ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

C. ASME / ANSI B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

D. ASME / ANSI B18.2 - Square and Hex Bolts and Screws (Inch Series)

E. ASTM A36 – Standard Specification for Carbon Structural Steel

F. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

G. ASTM A536 – Standard Specification for Ductile Iron Castings

H. AWWA C104 / ANSI A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

I. AWWA C105 / ANSI A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems

J. AWWA C110 / ANSI A21.10 - Ductile-Iron and Gray-Iron Fittings

K. AWWA C111 / ANSI A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

L. AWWA C116 / ANSI A21.16 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

M. AWWA C153 / ANSI A21.53 - Ductile-Iron Compact Fittings

N. AWWA C213 – Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

O. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances

P. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In., for Water Transmission and Distribution

Q. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 65 In. (100 mm Through 1,650 mm), for Waterworks

R. Ductile Iron Pipe Research Association (DIPRA) Field Polyethylene Installation Guide

S. NSF/ANSI 61 Drinking Water System Components – Health Effects

T. NSF/ANSI 372 Drinking Water System Components – Lead Content

PART 2: PRODUCTS

2.01 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement for pipe and pipe-shaped appurtenances shall be tube-form made of virgin polyethylene and conforming to AWWA C105. Tube sizes shall be per AWWA C105 and as recommended by the manufacturer. For wrapping odd-shaped appurtenances and making repairs, either flat sheet or split-tube polyethylene may be used. All polyethylene encasement shall have a minimum thickness of 12 mils.

B. The polyethylene film supplied shall be blue in color (or as specified in Section 01011) and distinctly marked (at minimum 2 foot intervals) with the following information:

1. manufacturer's name (or trademark),
2. year manufactured,
3. minimum film thickness and material type (i.e. LLDPE or HDCLPE),
4. range of nominal pipe diameter size
5. ANSI/AWWA C105/A21.5 (compliance)
6. a warning: "WARNING–CORROSION PROTECTION–REPAIR ANY DAMAGE
7. labeled "WATER"

C. ACCEPTABLE MANUFACTURERS: POLYETHELNE ENCASEMENT

a. Marshall Plastic Film, Martin, Michigan, as supplied by Peistrup Paper Products, Inc., 1185 Research Blvd., St. Louis, MO 63132, (314) 993-0970,. http://www.marshallplastic.com/#).

b. AA Thread Seal Tape, Inc. 1275 Kyle Court, Wauconda, IL 60084 (800) 537-7139, www.aathread.com

D. Tape used with polyethylene encasement shall be standard gray or black duct tape a minimum of 1.5" wide. Tape shall bond securely to both metal surfaces and polyethylene film.

2.02 VALVE BOXES

A. Valve boxes shall be round cast iron as specified herein and approved by the Engineer. Valve boxes shall be of the standard, adjustable, cast iron extension type, multiple piece, 5¼-inch shaft, screw type, and of such length as necessary to extend from the valve to finished grade. Cast iron valve boxes shall be hot coated inside and out with an asphaltic compound.

B. The casting shall be manufactured of ¼-inch thick clean, even grain, gray cast iron with minimum tensile strength of 21,000 psi. The valve box shall be smooth; true to pattern; free from blowholes, sand holes, projections, and other harmful defects.

C. Top section (excluding cover) shall weigh at least 2 pounds per inch height. Extensions shall weigh at least 15 pounds per foot height. Cover shall weigh at least 9 pounds.

D. Valve boxes shall be designed so as to prevent the transmission of surface loads directly to the valve or piping.

E. Valve box bases for gate valves through 12-inch diameter shall conform to the following:

Valve Size	Minimum Base	Minimum Weight
12" and smaller	round, 8" in height, 10-7/8" diameter at bottom	30 pounds

F. Valve boxes for butterfly valves and gate valves larger than 20-inch diameter shall have a minimum shaft diameter of 5-1/4 inches, wall thickness of at least ¼ inch, and a weight of at least 60 pounds (for 2-piece valve box at standard depth).

G. Top section shall be adjustable to fit the installed depth of cover over the valve. The seating surface of both the top section and the lid cover shall be cast so the cover will not rock after it has been seated and will fit tightly with little or no play in the fit. Cover shall have the word “WATER” cast into the top.

H. For each valve, whether furnished by the Contractor or Owner, the Contractor shall furnish and install an HDPE valve box alignment device. The alignment device shall be two-pieces that lock together under the operating nut without requiring removal of the nut. Valve box alignment devices shall be BoxLok as manufactured by Emma Sales, LLC or American Flow Control as follows:

1. For 10” and smaller valves, provide model # BoxLok-2.
2. For 12” and larger valves, provide model # BoxLok-1.

I. Valve boxes shall be fitted with cast iron or steel extension stems where necessary to raise the operating nut to within five feet (5’) of finished grade, such that valves are easily operable with a standard 6-ft. length T-wrench. Extension stems shall be suitably sized to transmit the maximum torques required to operate the valve with appropriate safety factor. Hardware for extension stems shall be Type 316 stainless steel. Stainless steel centering rings (marked with proper opening direction) shall be provided to stabilize extension stems in the valve box.

J. Acceptable Manufacturers:

1. Bingham & Taylor
2. Star Pipe Products
3. E. J. Prescott
4. Tyler Union
5. Clay and Bailey Manufacturing Co.

2.03 ULTRA-COMPACT RESTRAINED MJ ADAPTERS

A. Where multiple fittings are required in proximity to one another and/or a fitting is required in proximity to a valve, an ultra-compact restrained MJ adapter may be used in lieu of pipe spool piece and multiple restrained MJ retainer glands.

B. Ultra-compact restrained MJ adapters shall meet the requirements for ductile iron fittings as specified in Section 15105, shall have either asphaltic seal coating in accordance with AWWA C104 and C110 or fusion bonded epoxy coating conforming to AWWA C116 inside and out, and all materials that come in contact with potable water shall be NSF 61 certified.

C. Ultra-compact restrained MJ adapters shall use a bolt-through positive restraint design allowing the bolts to pass around the fitting while providing a metal surface to compress the MJ gaskets.

D. Ultra-compact restrained MJ adapters shall not be used to connect directly to a butterfly valve without the valve manufacturer's approval, and Contractor shall ensure that operation of the butterfly valve is unaffected by the adjacent fitting, regardless of flow direction.

E. Ultra-compact restrained MJ adapters shall be manufactured within the United States. No foreign products will be acceptable.

F. Acceptable Manufacturers:

1. Foster Adaptors by Infact Corporation

2.04 RODS, BOLTS, LUGS, BRACKETS, AND CORROSION-PROTECTION

A. Anti-rotation T-bolts shall be used on mechanical joints and shall be of domestic origin meeting the current provisions of AWWA C111. T-bolts and nuts shall be high-strength, corrosion-resistant low-alloy steel with the characteristics listed in Table 6 of AWWA C111. T-bolts shall be Xylan or FluoroKote #1 (corrosion resistant).

B. Flange bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Bolts and nuts hall be threaded in accordance with ASME/ANSI B1.1, Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. Material for bolts and nuts

shall conform to ASTM A307, 60,000 PSI Tensile Strength, Grade B, unless otherwise specified in Section 01011. Xylan or FluoroKote #1 hex bolts (corrosion resistant) shall be used on any buried flange bolts, except as otherwise specified in Section 15170.

C. All other bolts, steel rods (threaded and non-threaded), lugs and brackets used for buried service, shall be either Type 304 or 316 stainless steel or ASTM A36 or A307 carbon steel with Xylan or FluoroKote #1 corrosion resistant coating. Threaded stainless steel components shall be coated with an anti-seize coating to prevent galling.

D. Where threaded rods are permitted, the rods and tabs shall be designed for the pressure class (or pressure rating) of the pipe or the specified restraint system design pressure, whichever is greater. Threaded rods shall have lengths less than 10 feet between fittings.

2.05 RESTRAINED FLANGE ADAPTERS

A. Flange adapters shall only be used in exposed locations; they are not permitted for buried applications. All flange adapters shall be restrained.

B. Restrained flange adapters shall be made of ductile iron conforming to ASTM A536 and shall be rated for the same working pressure as the pipe on which they're used. Country of origin and date/date code shall be cast or stamped on for traceability. Flange adapters shall have ANSI Class 150 bolt patterns compatible with AWWA C110.

C. Restrained flange adapters shall be capable of deflection during assembly and allow for pipe to be field-cut. Adapters shall be able to accommodate a gap between the end of the pipe and the mating flange of at least 0.6 inch for nominal pipe sizes up to 8-inch, at least 1.0 inch for nominal pipe sizes from 12-inch to 20-inch, and at least 1.25 inches for nominal pipe sizes greater than 20-inch, without affecting the integrity of the seal.

D. Restraint shall consist of multiple individual actuated gripping wedges fitted with torque-limiting actuating screws to ensure proper initial set of gripping wedges.

E. Flange adapters, including casting bodies, wedge assemblies, and related parts, shall be coated both internally and externally with a fusion bonded epoxy, electrostatically-applied and heat-cured polyester-based powder coating, or equal to provide corrosion-, impact-, and UV-resistance.

F. Acceptable manufacturers:

1. EBAA Iron, Inc. (MegaFlange Series 2100)
2. ROMAC Industries, Inc. (Style RFCA).
3. No other manufacturers will be accepted as equal.

G. All restrained flange adapters shall be produced solely in the United States; no foreign-manufactured items shall be allowed (even if named herein).

H. All materials that come in contact with potable water shall be NSF 61 certified.

2.06 RESTRAINT HARNESSES FOR PVC PIPE JOINTS

A. Where restraint of PVC pipe to pipe joints is required, all joints shall be bell and spigot joints with external split serrated restraint harnesses.

B. Joint restraint systems shall be rated for a pressure equal to the pressure class of the pipe on which it is used (per AWWA C900) or the specified restraint system design pressure, whichever is greater.

C. Restraint harnesses shall utilize a split serrated ring to grip the plain-end of the pipe and a split serrated ring to grip the barrel of the pipe behind the bell. No more than two bolts shall be used to join each split serrated ring, which shall tighten the ring against the pipe. A sufficient number of thrust rods in accordance with article 2.04 above shall connect the two restraint rings to each other. Restraints shall require only conventional tools and installation procedures per AWWA C900. Other types of restraining devices, including devices with a non-serrated ring on the bell-end, shall not be accepted.

D. Restraint rings shall be made of ductile iron conforming to ASTM A536 and shall be coated both internally and externally with a fusion bonded epoxy or electrostatically-applied and heat-cured polyester-based powder coating to provide corrosion-, impact-, and UV-resistance. Country of origin and date/date code shall be cast or stamped on for traceability.

E. Restraint bolts, steel rods (threaded and non-threaded), nuts and washers shall be either Type 304 or 316 stainless steel or ASTM A36 or A307 carbon steel with Xylan or FluoroKote #1 corrosion resistant coating.

F. Restraint devices shall be either listed by Underwriter Laboratories or approved by Factory Mutual.

G. All restraint harnesses shall be produced solely in the United States; no foreign-manufactured items shall be allowed (even if named herein).

H. Acceptable manufacturers:

1. EBAA Iron, Inc. (Series 1900)
2. Romac Industries, Inc. (Series 600)
3. Ford Meter Box Company, Inc. (Series 1390)
4. No other manufacturers will be accepted as equal.

2.07 COUPLINGS FOR JOINING DISSIMILAR PIPE MATERIALS OR SIZES

A. When connecting HDPE pipe to pipe of another material, the preferred method shall be to utilize an appropriate plain end butt-fused mechanical joint adapter fitting (as specified in Section 15125) fused to the HDPE pipe and make a restrained mechanical joint connection. However, when approved by the

Engineer, a coupling per this subsection may be utilized to join HDPE pipe to pipe of another material.

B. Type 316 stainless steel pipe stiffeners shall be provided at all mechanical connections to HDPE pipe unless otherwise approved in writing by the Engineer.

C. Where approved by the Engineer, couplings for joining dissimilar pipe materials (and/or pipes of different outside diameters) shall be sleeve type consisting of a center sleeve and, on each end, an end ring, a multi-range gasket, stainless steel spanner, and one or two Type 304 stainless steel bolts and nuts. Bolts shall be coated with an anti-seize coating to prevent galling.

D. Coupling body sleeve shall be fabricated of ductile iron or carbon steel and shall be fusion-epoxy coated per AWWA C116 or C213 and shall be NSF 61 certified.

E. End ring shall be fabricated of ductile iron or carbon steel and shall compress the gasket when the bolt(s) is/are tightened. End ring shall be epoxy coated.

F. Gaskets shall be EPDM or nitrile, as approved by the Engineer, and shall be NSF-61 certified.

G. Couplings shall be completely factory-assembled and shall not require any field disassembly.

H. Pressure rating shall be at least equal to the minimum pressure class of the two pipes to be joined and shall maintain rated sealing under the following conditions:

1. Angular deflection of 4 – 10 degrees per end (depending on pipe size) to a total of 8 – 20 degrees,
2. Longitudinal pipe movement of up to 10 mm.

I. All couplings shall be produced solely in the United States; no foreign-manufactured items shall be allowed (even if named herein).

J. Where indicated on the Drawings, required by Section 01011, or directed by the Engineer, couplings shall be adequately restrained for the maximum potential pressure. Restraint may be provided by an approved mechanical joint harness or by a concrete thrust collar designed or approved by the Engineer. Proper anchor flanges approved by the Engineer shall be provided where concrete thrust collars are used.

K. Acceptable manufacturers:

1. Krausz Industries Ltd. (Hymax® Coupling),
2. ROMAC Industries, Inc. (Macro HP),
3. No other manufacturers will be accepted as equal.

2.08 MECHANICAL JOINT RETAINING GLANDS AND OTHER MECHANICAL JOINT RESTRAINT DEVICES

A. All mechanical joint restraint devices shall conform to the requirements of AWWA C111 and/or C153. Joint restraint systems shall be rated for a pressure equal to the pressure class of the pipe on which it is used (per AWWA C151, C900, or C906, as applicable) or the specified restraint system design pressure, whichever is greater.

B. All mechanical joints for connecting pipe to valves, fittings, or other components, shall utilize restrained mechanical joint retaining glands with restraint consisting of multiple individual actuated gripping wedges fitted with torque-limiting actuating screws to ensure proper initial set of gripping wedges. Glands shall require only conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Set screws, pins, and other types of restraining devices shall not be accepted.

C. Gland body, wedges, and wedge actuating components shall be made of ductile iron conforming to ASTM A536 Grade 65-45-12. Country of origin and date/date code shall be cast or stamped on for traceability. Gripping wedges shall be heat treated within a range of 370 to 470 BHN. Every retaining gland shall be designed for the specific pipe material and diameter on which it is used.

D. Restraint systems, including casting bodies, wedge assemblies, and related parts, shall be coated both internally and externally with a fusion bonded epoxy or electrostatically-applied and heat-cured polyester-based powder coating to provide corrosion-, impact-, and UV-resistance.

E. Split retaining rings shall be provided where necessary to restrain existing mechanical joints on existing piping.

F. Restraint devices shall be either listed by Underwriter Laboratories or approved by Factory Mutual.

G. Acceptable manufacturers of retaining glands are:

1. EBAA Iron, Inc. (MegaLug),
2. Tyler Union (TUFGrip, domestic only),
3. Romac Industries, Inc. (RomaGrip with Romabond).
4. No other manufacturers will be accepted as equal.

H. Mechanical joint couplings used to connect two plain pipe ends shall be fully restrained to prevent axial separation. The restraint system shall consist of retaining glands as specified above. Where approved by the Engineer, mechanical couplings may be sleeve type restrained mechanical joint couplings as manufactured by:

1. EBAA Iron, Inc. (Mega-Coupling)
2. ROMAC Industries, Inc. (400RG Restraint Coupling).
3. ROMAC Industries, Inc. (ALPHA restrained joint coupling)
4. No other manufacturers will be accepted as equal.

I. To restrain otherwise unrestrained couplings, external restrained harnesses shall be provided. External restrained harnesses shall use wedge-type retaining glands as specified above connected by threaded rods or tie bars to restrain the two pipes to each other. Restraint harnesses shall be manufactured by:

1. EBAA Iron, Inc.,
2. Tyler Union (domestic only),
3. Romac Industries, Inc.
4. No other manufacturers will be accepted as equal.

J. Restrained harnesses connecting PVC pipe ends may be of the serrated ring style as specified above for PVC pipe-to-pipe joints.

K. All retaining glands and other joint restraint devices shall be produced solely in the United States; no foreign-manufactured items shall be allowed (even if named herein).

L. Gaskets shall meet the requirements of Sections 15105, 15120, and/or 15125, as applicable.

2.09 INSULATION AND WEATHERPROOF JACKETING SYSTEM FOR EXPOSED SMALL PIPING, VALVES, AND FITTINGS (<=8-INCH NOMINAL DIAMETER)

A. Flexible unicellular, closed-cell elastomeric piping insulation: ASTM C 534, Type I. AP Armaflex by Armacell Company.

B. Insulation shall be mold-resistant and shall be non-wicking.

C. Minimum insulation thickness shall be 1-1/2 inches for 4" diameter pipe and larger, and 1 inch for smaller pipe.

D. Jackets for exterior insulation shall be either:

1. Smooth or embossed ASTM C 921 Type I aluminum metal jacket with weather-proof construction. Minimum jacket thickness shall be 0.031 inches for exterior installations. Fastening shall use preformed "2"-lock seam with 2 inch butt strap with sealant. Bonds shall be 1/2 inch aluminum with wing seals. Fittings

shall be prefabricated 0.031 inch thickness aluminum as manufactured by ITW Insulation Systems, Houston, Texas or Metro Supply Company, Woodland Park, NJ.

E. Insulation for valves, fittings and flanges shall be mitered segments of the same product used as pipe insulation. As an alternative to insulation with separate jackets, flexible elastomeric insulation with laminated polymeric membrane covering as specified for larger piping may be used for valves, fittings and flanges.

F. Pipe insulation jackets shall be at least 36" long as measured along the pipe.

G. Special care shall be taken to make all exterior insulation jackets completely waterproof by the use of appropriate sealants at all joints, etc.

H. Staples, Bands, Wires, Adhesives, Cement, Tapes and Sealers: As recommended by insulation manufacturer for applications indicated.

2.10 INSULATION AND WEATHERPROOF JACKETING SYSTEM FOR EXPOSED LARGE PIPING, VALVES, AND FITTINGS (>8-INCH NOMINAL DIAMETER)

A. Flexible unicellular, closed-cell elastomeric insulation with a 16 mil thickness laminated polymeric membrane covering that is UV-, puncture- and tear-resistant—i.e. a UV protective blended polymeric top surface and a puncture-resistant blended polymeric base, around a scrim reinforced core. ArmaTuff PLUS II by Armacell Company. Flexible elastomeric insulation shall be by the same manufacturer as flexible elastomeric piping insulation provided for smaller piping.

B. Insulation shall be mold-resistant and shall be non-wicking.

C. Minimum insulation thickness shall be 2 inches.

D. The membrane shall have a 10-year warranty against breakdown due to UV radiation. Insulation layer between outer layer of duct and exterior jacket shall be a mold-resistant flexible elastomeric thermal insulation.

E. Insulation for valves, fittings and flanges shall be mitered segments of the same product used as pipe insulation.

F. Pipe insulation jackets shall be at least 36" long as measured along the pipe.

G. Special care shall be taken to make all exterior insulation jackets completely waterproof by the use of appropriate sealants at all joints, etc.

H. Staples, Bands, Wires, Adhesives, Cement, Tapes and Sealers: As recommended by insulation manufacturer for applications indicated.

2.11 INSULATION AND WATERPROOF JACKETING SYSTEM FOR BURIED PIPING, VALVES, AND FITTINGS

INSULATING MATERIALS:

A. Flexible Elastomeric Cellular:

1. Material: Flexible expanded closed-cell structure with smooth skin on both sides.
2. Form: Tubular materials conforming to ASTM C 534, Type I.
3. Thermal Conductivity: 0.30 average maximum at 75 degrees F.
4. Coating: Water-based latex enamel coating or other as recommended by insulation manufacturer.

B. Cellular Glass:

1. Insulation: Cellular glass block insulation conforming to ASTM C552, “Specification for Cellular Glass Block and Pipe Thermal Insulation”.
2. Jacketing: Flexible, resilient membrane waterproof against most soil and water conditions. PITTWRAP Jacketing by Pittsburgh Corning Corporation.
3. Asphalt Coating: PITTCOTE 300 Finish, by Pittsburgh Corning Corp.
4. Reinforcing Fabric: PC Fabric 79, by Pittsburgh Corning Corp.
5. Strapping Tape: Glass fiber reinforced, 1" width, Scotch Brand #880 by 3M.
6. Bore Coating: Hydrocal B-11, by U.S. Gypsum.
7. High Temperature Sealant: Maximum temperature limit, 500 degree F. RTV 736 by Dow Corning Corporation.

C. Thickness: Thickness of insulation shall be at least as shown in the table below, as recommended by the manufacturer.

MINIMUM PIPE INSULATION THICKNESS	
Nominal Pipe Diameter	**Insulation Thickness**
Less than 6"	As recommended by manufacturer
6" - 8"	2.5"
10" - 12"	3.5"
Greater than 12"	As recommended by manufacturer

D. Adhesive shall be solvent-based, contact adhesive recommended by insulation manufacturer.

JACKETING:

A. General: ASTM C 921, Type 1, except as otherwise indicated.

B. PVC Jacketing: High-impact, ultra-violet-resistant PVC, 20-mils thick, roll stock ready for shop or field cutting and forming to indicated sizes. Adhesive shall be as recommended by insulation manufacturer.

C. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultra-violet-resistant PVC. Adhesive shall be as recommended by insulation manufacturer.

D. Other jacketing as recommended by the insulation manufacturer for the intended buried service may be used with approval of the Engineer.

E. Flexible, vapor-barrier sealing compounds with a temperature range of at least negative 20 to 180 degrees Fahrenheit shall be as recommended by the insulation manufacturer for the intended buried service with approval of the Engineer.

ACCESSORIES AND ATTACHMENTS:

A. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:

1. Galvanized Steel: 0.005 inch thick.
2. Aluminum: 0.007 inch thick.
3. Brass: 0.01 inch thick.
4. Nickel-Copper Alloy: 0.005 inch thick.

B. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.

C. Select accessories compatible with pipe and insulation materials suitable for the service. Select accessories that do not corrode, soften, or otherwise attack the insulation or jacket in either wet or dry conditions.

ACCEPTABLE MANUFACTURERS:

Subject to compliance with above requirements, provide products by one of the following:

A. Flexible Elastomeric Cellular:

1. ArmaCell AP Armaflex
2. K-Flex USA / NOMACO / IMCOA.

B. Cellular Glass:

1. Pittsburgh Corning Corporation FOAMGLAS Insulation.

PART 3: EXECUTION

3.01 INSTALLATION, GENERAL

A. Install “piping specialties” in accordance with the general provisions provided in Sections 01000, 15000, and 15105 and the additional requirements herein.

3.02 INSTALLATION OF POLYETHYLENE ENCASEMENT

A. Encase all ductile iron piping, all valves, and all metallic appurtenances in polyethylene to prevent contact with surrounding backfill and bedding material.

B. The Contractor shall install polyethylene encasement on the pipe directly prior to the installation of the piece of pipe. Install the polyethylene material in accordance with the DIPRA Field Polyethylene Installation Guide and AWWA C105. Polyethylene tubes shall be installed per Method A described in AWWA C105. Polyethylene shall fit snugly and not tightly stretched.

C. The Contractor shall be responsible for the means, methods, techniques, sequences and procedures necessary for the installation of the polyethylene encasement in compliance with current DIPRA recommendations.

D. All holes or tears shall be repaired with tape. Large holes or tears shall be repaired by taping another piece of polyethylene over the hole.

E. Dig bell holes, and slide polyethylene encasement over the adjacent pipe providing a minimum of 1 foot of overlap of each adjacent pipe section.

F. Where polyethylene-wrapped pipe being installed connects to a pipe that is not wrapped (including existing pipe), extend the wrap a minimum of 3 feet onto the previously uncovered pipe. This includes service lines which shall be wrapped in polyethylene or dielectric PVC tape.

G. Tape joint overlaps and at every 3 foot interval along the barrel of the pipe (2 foot intervals when installed below the water table). Tightly secure polyethylene encasement using two to three circumferential passes of adhesive tape on the pipe to polyethylene encasement connection and the overlap polyethylene encasement to polyethylene encasement connection.

H. Store all polyethylene encasement and tape out of the sunlight.

I. Exposure of wrapped pipe to sunlight should be kept to a minimum. Pipe can be stored with the polyethylene encasement on the pipe for a maximum of 14 days.

J. At no time shall the polyethylene-encased pipe be subjected to a point load during handling, temporary storage, or installation. The polyethylene encasement must be moved away from the timbers or hoisting device while on the pipe to prevent point loads and resulting pin holes.

K. The polyethylene encasement shall be installed up to the operating nut level on all valve boxes, leaving the operating nut of the valve exposed and free to be

operated. Polyethylene encasement shall be installed up to the ground surface on all fire hydrants.

L. Install two layers of polyethylene encasement where pipe is installed within 100 feet of a cathodically-protected pipeline (e.g. conveying natural gas, petroleum, etc.).

M. Polyethylene encasement shall be properly secured in place prior to forming or pouring any concrete encasement or thrust blocking.

N. Openings in the encasement shall be provided for branches, air valves, blow-off assemblies, and similar appurtenances by making an X-shaped cut in the encasement and temporarily folding back the film. After installation of the appurtenance, tape the slack securely to the appurtenance and repair the cut and any other damaged areas with tape. Continue installation of polyethylene on ductile iron pipe branches, overlapping and taping the first piece of polyethylene encasement to the adjacent installation.

O. Direct service taps for polyethylene-encased pipe shall follow the procedure described in AWWA C105 and C600. Access to the main for tapping through polyethylene is accomplished by making two to three circumferential passes of adhesive tape around the pipe and over the polyethylene encasement. The tap is to be made directly through the tape and polyethylene encasement.

P. Two layers of polyethylene encasement shall be installed and secured on all pipe installed by horizontal directional drilling as specified in Section 02458 per DIPRA installation procedures, including those in DIPRA's Horizontal Directional Drilling with Ductile Iron Pipe Handbook.

3.03 INSTALLATION OF VALVE BOXES

A. Valve boxes shall be provided for all buried valves.

B. Valve boxes shall be supported so that no load can be transmitted from the valve box to the valve. Refer to Indiana American Water Standard Detail Drawing for typical valve and valve box installation.

C. Install a self-centering alignment ring at the operating nut. Ensure that the bottom of the valve box is centered over the operating nut.

D. All sections of each valve box shall be aligned and plumb directly over the operating nut. Valve boxes shall be carefully backfilled evenly around the full circumference to maintain alignment.

E. Extension stems shall be installed plumb and centered within the valve box. Extension stems shall be securely attached to the operating nut (and to each other) so the shaft will not pull off the operator. Install stainless steel centering rings for all extension stems.

F. Tracer wire shall be installed at the valve and extend upward along the exterior of the valve box for connection of location equipment in accordance with Section 02558.

3.04 INSTALLATION OF COUPLINGS AND JOINT RESTRAINT DEVICES

A. All couplings and joint restraint devices shall be installed per the manufacturer's instructions and in conformance with all other applicable sections.

B. All couplings and joint restraint devices shall be wrapped with polyethylene encasement.

3.05 STORAGE, HANDLING, PROTECTION, AND INSTALLATION OF INSULATION AND JACKETING (ALL TYPES)

A. Protect pipe insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. The Contractor shall protect the insulation from moisture at all times until fully installed. Comply with the Manufacturer's recommendations for handling, storage, and protection during installation.

B. Insulation of exposed piping shall not be installed until piping has been field tested, painted (where required) and approved by the Owner.

C. The Contractor shall insure that surfaces of pipes, valves, and fittings are clean, free of foreign materials (including rust, scale, and dirt), and dry prior to installation of insulation. Insulation shall be installed so as to make surfaces smooth, straight, even, and substantially flush with the adjacent insulation.

D. The Contractor shall follow the manufacturer's printed instructions for the materials used.

E. Apply insulation continuously over fittings, valves, and specialties, except as otherwise indicated. Apply insulation with a minimum number of joints.

F. Tightly butt longitudinal seams and end joints. Bond with adhesive or as recommended by the manufacturer. For cellular glass block insulation, taper ends at 45 degree angle and seal with lagging adhesive.

G. Seal joints and seams to maintain vapor barrier on insulation requiring a vapor barrier. Seal openings, punctures, and breaks in vapor barrier jackets and exposed insulation with vapor barrier compound. Seal penetrations for hangers, supports, anchors, and other projections in insulation requiring a vapor barrier.

H. Apply adhesives and coatings at the manufacturer's recommended coverage rate.

I. Apply insulation with integral jackets per the manufacturer's instructions and as follows:

1. Pull jacket tight and smooth.

2. Overlap circumferential joints or cover with butt strips at least 3-inches wide and of same material as insulation jacket. Secure joints with adhesive or as recommended by the manufacturer.

3. Overlap longitudinal seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Secure seams as recommended by the manufacturer. Do not staple longitudinal laps on insulation applied to piping systems with surface temperatures at or below 35 degrees F.

3. Vapor Barrier Coatings: Where vapor barriers are indicated, apply on seams and joints, over staples, and at ends butt to flanges, unions, valves, and fittings.

4. Repair damaged insulation jackets per the manufacturer's recommendations as approved by the Engineer. Extend the repair at least 2 inches in both directions beyond the damaged insulation jacket and around the entire circumference of the pipe.

3.06 INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION:

A. Slip insulation on the pipe before making connections wherever possible. Seal joints with adhesive. Where the slip-on technique is not possible, cut one side longitudinally and apply to the pipe.

B. Cut ends of flexible elastomeric cellular insulation square and seal with adhesive. Seal seams and joints with adhesive.

C. Valves, Fittings, and Flanges: Cut insulation segments from pipe or sheet insulation. Bond to valve, fitting, and flange and seal joints with adhesive. Miter cut materials to cover elbows and tees. Overlap adjoining pipe insulation.

3.07 INSTALLATION OF INSULATION AND WATERPROOF JACKETING SYSTEM FOR BURIED PIPING:

In addition to the above requirements, the following are additional requirements for insulation applied to piping installed below ground:

A. Terminate insulation at anchor blocks.

B. Exterior Wall Penetrations: For penetrations of below grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor barrier coating.

C. Apply insulation continuously through sleeves and manholes, except as otherwise directed by the Engineer.

D. Finishing: Seal insulation materials as recommended by the manufacturer. If no other directions are provided, and if compatible with the insulation and jacketing, apply 3 coats of asphaltic mastic to a finish thickness of 3/16 inch over insulation materials. Apply 10 x 10 mesh glass cloth between coats. Overlap edges of glass cloth by 2 inches.

END OF SECTION

SECTION 15150

GATE VALVES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to install and test all buried gate valves as indicated on the Drawings and as specified within this section. Contractor shall furnish retaining glands and other related components not furnished by the Owner. Contractor shall fully furnish and install gate valves that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

B. This section does not apply to gate valves to be installed above ground or otherwise exposed.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, Operating and Maintenance Manuals, and certifications, for all products furnished under this section in accordance with Section 01300. In addition, if insertion valves are provided, Contractor shall submit documentation validating the installing company's current certification by the valve manufacturer.

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 02558 Identification/Location Devices

I. Section 15000 Piping - General Provisions.

J. Section 15020 Disinfecting Pipelines

K. Section 15025 Flushing and Cleaning Pipelines

L. Section 15030 Pressure and Leakage Tests

M. Section 15105 Ductile Iron Piping and Fittings

N. Section 15120 Polyvinyl Chloride (PVC) Pipe

O. Section 15125 High Density Polyethylene (HDPE) Pipe

P. Section 15130 Piping Specialties

Q. Section 15170 Tapping Sleeves, Saddles, & Valves

R. Section 15180 Fire Hydrants

1.04 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service

B. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service

C. AWWA C550 – Protective Interior Coatings for Valves and Hydrants

D. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

E. ASME / ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

F. ASME / ANSI B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

G. NSF/ANSI 61 Drinking Water System Components – Health Effects

H. NSF/ANSI 372 Drinking Water System Components – Lead Content

PART 2: PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated on the Contract Drawings and/or in Section 01011, all valve 3-inch through 12-inch nominal size shall be resilient-seated gate valves per this section. Unless otherwise indicated, valves 16-inch and larger nominal size shall be butterfly valves per Section 15155. Where gate valves 16-inches nominal size and larger are required by the Drawings and/or by Sections 01000, 01011, and/or 15170, such large gate valves shall be resilient-seated per this section. All valves shall have openings through the body of the same or greater cross-sectional area as that of the pipe to which they are attached.

B. Larger gate valves shall only be used for tapping valves or where specifically called out on the Contract Drawings.

C. All gate valves shall have cast or ductile iron body with non-rising stem and square nut operator suitable for buried service conforming to AWWA C509 or C515, as applicable.

D. Valve ends shall be mechanical joint (MJ) in accordance with AWWA C111 unless otherwise shown on the Drawings or Alpha-Romac restrained joint push-on joint valves. In no case shall non-MJ, push-on joint valves be provided.

E. Elastomers shall be Buna-N or EPDM.

F. The interior and exterior of all gate valves shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA C550 (6 - 8 mil average, 4 mil minimum).

G. Bolts and nuts shall be stainless steel for Bonnet, stuffing box, and wrench nut cap screw.

H. All valves shall be designed to operate in the vertical position, except as otherwise specified herein. Gate valve shall only be installed in a horizontal orientation when required by the Drawings or when approved in writing by the Owner due to insufficient available depth of cover to permit vertical orientation.

I. Valve shafts shall be suitably sized to transmit the torques required to operate the valve with the rated pressure on one side and atmospheric pressure on the other with appropriate safety factor.

J. Vertical gate valves 24-inch nominal size and larger shall be provided with spur gear operators.

K. All valves shall be NSF 61 and NSF 372 certified.

L. Valves shall open left unless otherwise indicated in Section 01011.

M. Large gate valves shall be provided with integral bypass valves when recommended by the manufacturer for the specified pressure rating.

N. All valves and restraints shall be produced solely in the United States. Manufacturers and models indicated in this section shall only be allowed if the valves are assembled and tested in the United States.

O. All valves furnished by the Contractor shall be obtained from a vendor approved by the Owner.

2.02 RESILIENT-SEATED GATE VALVES

A. Resilient-seated gate valves shall comply fully with AWWA C509 or C515 except as modified herein. Stems shall be made of a bronze alloy with low zinc content in accordance with AWWA C509 4.2.3.5.3 (2009) or C515 4.2.3.3.3 (2009). Stem seals shall be double or triple O-ring stem seals.

B. The valves shall be designed for a minimum working pressure of 250 psi and a differential pressure of 250 psi.

C. All valves shall be tested (Operation Test and Hydrostatic Tests) at the manufacturer's plant in accordance with AWWA C509 or C515, as applicable. Internal hydrostatic test pressure shall be at least 500 psi unless otherwise noted on the plans. Provide the Engineer with certified copies of all factory test reports prior to shipment. The Engineer reserves the right to observe all tests.

2.03 RESILIENT-SEATED GATE VALVES WITH RESTRAINED JOINTS

A. Resilient-seated gate valves shall comply fully with AWWA C509 or C515 except as modified herein. Stems shall be made of a bronze alloy with low zinc content in accordance with AWWA C509 4.2.3.5.3 (2009), C515 4.2.3.3.3 (2009), or 314 stainless steel. Stem seals shall be double or triple O-ring stem seals.

B. The valves shall be designed for a minimum working pressure of 250 psi and a differential pressure of 250 psi.

C. All valves shall be tested (Operation Test and Hydrostatic Tests) at the manufacturer's plant in accordance with AWWA C509 or C515, as applicable. Internal hydrostatic test pressure shall be at least 500 psi unless otherwise noted on the plans. Provide the Engineer with certified copies of all factory test reports prior to shipment. The Engineer reserves the right to observe all tests.

D. Grippers shall be ductile (nodular) iron, meeting or exceeding ASTM A 536, Grade 65-45-12. Machine sharpened and heat treat-ed. Xylan 1424 coated. Draw Hooks shall be uncoated 304 stainless steel; Ramp Runners shall be Nylon 66, Black, 14% Glass filled; coating for Center ring shall be Romacote fusion bonded epoxy, NSF 61 Certified. End rings are Romabond polyester. Bolts, nuts and hardware shall be 304 stainless steel.

2.04 HORIZONTALLY-ORIENTED GATE VALVES

Horizontally-oriented gate valves will only be permitted as indicated above.

A. Horizontally-oriented gate valves shall be resilient-seated valves as specified above conforming to the applicable requirements of AWWA C515 (as modified herein) and shall be designed and manufactured for horizontal installation. Unless otherwise approved in writing by the Engineer, horizontal valves shall be provided with bronze rollers housed in a bronze scraper on both sides of the wedge traveling in a Type 316 stainless steel track to clean the track when the valve is closing. Plastic wedges or scrapers are not acceptable. All horizontally-oriented gate valves shall have enclosed bevel gears, regardless of valve size.

2.05 INSERTION VALVES

A. Where shown on the Drawings or otherwise directed by the Owner, an insertion gate valve shall be installed on an existing pipeline. Insertion valves shall be in strict accordance with these requirements.

B. Insertion valves shall be resilient gate valves in conformance with AWWA C509 or C515 with a 250 psi pressure rating. Valves shall have ductile iron or stainless steel body and bonnet with a triple bonnet to body seal, including two O-rings above and one below the thrust collar. Ductile iron components Interior and exterior of the valve shall be coated with a minimum 10 mils fusion-bonded epoxy in compliance with AWWA C550 and certified to NSF 61. Insertion valves resilient wedge shall be materials specified in AWWA C509, C515 or reinforced EPDM. Insertion valves shall also meet the other requirements specified herein for resilient-seated gate valves.

C. Insertion valves and equipment used for installation shall be capable of installation while the pipeline is under pressure without interrupting the flow of water. Valve and equipment shall include a means of inspecting and cleaning the seating surface under pressure. Once installed, valve shall provide a clear, unobstructed waterway. Valve shall be operational in unbalanced pressure conditions; pressure equalization shall not be necessary to open the valve.

D. Valve gate shall be fully encapsulated in rubber, shall operate within body channels that guide the gate, and shall seal against the valve body without ever touching the host pipe. Valves that seal against the pipe shall not be acceptable.

E. The bonnet shall have a triple O-ring seal around the stem.

F. All moving parts of the valve shall be replaceable without depressurizing the main.

G. Valve shall be compatible with the existing pipe material, shall have mechanical joint ends conforming to AWWA C111, and shall be permanently restrained to the pipe at both ends with split restrained mechanical joint glands conforming to the requirements of Section 15130. Valve connection shall allow for removal/replacement of the downstream pipe with the valve closed without removing pressure from the upstream side of the valve.

2.06 ACCEPTABLE MANUFACTURERS

A. Resilient Seated Gate Valves:

1. Mueller Company, Decatur, Illinois;
2. McWane, Inc. (Clow, Kennedy, and M&H Divisions) Oskaloosa, Iowa, Corona, California, Elmira, New York, and Anniston, Alabama, respectively;
3. United State Pipe Decatur, Illinois;
4. American Flow Control, Birmingham, Alabama;

B. Resilient Seated Gate Valves with Restrained Joints:

1. Romac Industries, Inc. ALPHA restrained joint by American Flow Control, Birmingham, Alabama.

C. Horizontally-oriented Gate Valves

1. McWane (Clow, Kennedy, and M&H Divisions)
2. American Flow Control, Birmingham, Alabama;

D. Insertion Valves

1. InsertValve by Team Industrial Services
2. Insta-Valve 250 Patriot™ by Hydra-stop, 8-inch diameter and smaller.

PART 3: EXECUTION

3.01 INSTALLATION

A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and seating surfaces, handling damage, and cracks. Correct defective valves or hold for inspection by the Engineer.

B. Install the valves in strict accordance with the requirements contained in Section 15000 and detail drawings. All gate valves shall be restrained in accordance with Sections 15000, 15105, 15120, 15125, and 15130, as applicable.

C. Set valve and join to the pipe in the manner specified in Sections 15105, 15120, 15125, and 15130, as applicable. Provide crushed stone and concrete pads as shown on Owner's Standard Detail Drawings for valve installation, so that the pipe is not supporting the weight of the valve. Do not use valves to bring misaligned pipe into alignment during installation. Set valve plumb with operating nut facing straight upward.

D. Insertion valves shall be installed in accordance with the manufacturer's recommendations by a company authorized by the manufacturer. After installation of the valve body on the pipe, a pressure test of 1.5 times the working

pressure shall be sustained for at least 15 minutes prior to proceeding with the installation. If the valve body is repositioned, the test shall be repeated. The tapping machine shall remove a complete spool piece of the pipe intact. Flow through the pipe shall not be interrupted at any time throughout installation of the valve unless authorized in writing by the Owner. Seating surface shall be inspected and cleaned under pressure to ensure a clean seat.

E. Make all valves tight under their working pressures after they have been placed and before the main is placed in operation. Any defective parts shall be replaced at the Contractor's expense.

F. Provide a valve box for each valve per Section 15130. Set the top of the valve box neatly to existing grade, unless directed otherwise by the Engineer. Do not install in a way that allows the transfer shock or stress to the valve. Center and plumb the box over the wrench nut of the valve. Tracer wire shall be terminated at the valve box and extended to grade. Refer to Owner’s Standard Detail Drawing for a typical valve box installation.

G. Valve shall be polyethylene encased, per Section 15130 prior to backfill. The polyethylene encasement shall be installed up to the operating nut and over the lower portion of the valve box leaving the operating nut exposed and free to be operated within the valve box.

H. Provide valve marking posts and concrete pads at locations designated by the Engineer and as shown on Owner’s Standard Detail Drawing for typical valve box installation.

3.02 PROTECTION

A. If polyethylene encasement is applied to the pipe, the entire valve shall be encased in polyethylene encasement per Section 15130 prior to backfill. The polyethylene encasement shall also encase the valve box up to the operating nut level, leaving the operating nut exposed and free to be operated within the valve box.

END OF SECTION

SECTION 15155

BUTTERFLY VALVES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to install and test all buried butterfly valves as indicated on the Drawings and as specified within this section. Contractor shall furnish retaining glands and other related components not furnished by the Owner. Contractor shall fully furnish and install butterfly valves that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

B. This section does not apply to butterfly valves to be installed above ground or otherwise exposed.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, Operating and Maintenance Manuals, and certifications for all products furnished under this section in accordance with Section 01300. Shaft and operator orientation of each valve shall be clearly indicated on the Shop Drawings. Also, Shop Drawings shall include end clearance dimensions when the disc is in the full open position.

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 02558 Identification/Location Guide

I. Section 15000 Piping - General Provisions

J. Section 15020 Disinfecting Pipelines

K. Section 15025 Flushing and Cleaning Pipelines

L. Section 15030 Pressure and Leakage Tests

M. Section 15105 Ductile Iron Piping and Fittings

N. Section 15125 High Density Polyethylene (HDPE) Pipe

O. Section 15130 Piping Specialties

1.04 REFERENCES

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AWWA C504 – Rubber-Seated Butterfly Valves, 3 In. Through 72 In.

B. AWWA C550 – Protective Interior Coatings for Valves and Hydrants

C. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

D. NSF/ANSI 61 Drinking Water System Components – Health Effects

E. NSF/ANSI 372 Drinking Water System Components – Lead Content

PART 2: PRODUCTS

2.01 GENERAL—RUBBER-SEATED BUTTERFLY VALVES

A. Unless otherwise indicated on the Contract Drawings and/or in Section 01011, all valves 16” and larger shall be butterfly valves per this section, except for tapping valves, which shall be gate valves per Sections 15150 and 15170.

B. Valve ends shall have integrally-cast mechanical joint (MJ) ends in accordance with AWWA C111 unless otherwise shown on the Drawings. In no case shall non-MJ, push-on joint valves be provided.

C. Valve (or at least all valve components in contact with the water) shall be NSF 61 and NSF 372 certified.

D. Shaft orientation of butterfly valves shall be as specified in Part 3 of this section.

E. Manual buried operators shall be either worm gear or traveling nut type and shall be furnished with 2-inch square AWWA operator nuts suitable for buried service. All operators shall be fully-gasketed and grease packed and designed to withstand submersion in water to 10 psi. Operators shall require a minimum of 30 turns for 90 degrees or full stem valve travel. The capacity of the manual operator shall be adequate to drive the valve under a differential pressure equal to the valve's pressure rating and at maximum anticipated flow. Input required at nuts to produce required output torque shall be less than 150 ft.-lbs. Operators shall be designed to withstand an input at the nut of at least 450 ft.-lbs. without damage to any operator components.

F. Valves shall open left unless otherwise indicated in Section 01011.

G. Butterfly valves shall be tight-closing, rubber-seated and shall fully conform to AWWA C504 except as modified herein.

H. Valves shall meet the full structural requirements of the applicable class of AWWA C504. Butterfly valves shall be Class 150B unless otherwise indicated on the Drawings and/or in Section 01011.

I. All butterfly valves bodies shall be ductile iron (conforming to ASTM A536, Grade 65-45-12) or gray cast iron (conforming to ASTM A126, Grade B) with thicknesses strictly in accordance with AWWA C504.

J. Valve disc shall be ductile iron (conforming to ASTM A536, Grade 65-45-12) or cast iron (conforming to either ASTM A126, Grade B or ASTM A48, Class 40C) and shall have ASTM A276 Type 316 stainless steel edges (seating surfaces). All disc seating edges shall be smooth and polished. Disc shall rotate a full 90-degrees from the tight shut position to the full open position.

K. The interior and exterior of all butterfly valves (including the disc) shall be epoxy coated at the factory by the valve manufacturer in accordance with AWWA C550 (6 - 8 mil average, 4 mil minimum).

L. Valve bearings shall be permanently self-lubricating nylon sleeves or Teflon PTFE-lined sleeves with non-metallic backing. The shaft seal shall be self-adjusting, self-compensating type, monolithic V-Type packing. Packing shall be as manufactured by Chevron, or equal.

M. Valves shall be intended for buried service and designed to allow valve operation after long periods of inactivity without damage to the valve or leakage. Valves shall be mounted with all Type 316 stainless steel nuts, bolts, and other hardware.

N. All valves shall be tested (performance tests, leakage tests, and hydrostatic tests) at the manufacturer's plant in accordance with AWWA C504. Internal hydrostatic test pressure shall be at least twice the rated pressure. Provide the Engineer with certified copies of all factory test reports prior to shipment. The Engineer reserves the right to observe all tests.

O. All valves and restraints shall be produced solely in the United States. Manufacturers and models indicated in this section shall only be allowed if the valves are assembled and tested in the United States.

P. All valves furnished by the Contractor shall be obtained from a vendor approved by the Owner.

2.02 RUBBER-SEATED BUTTERFLY VALVES SMALLER THAN 24-INCH SIZE

A. Valve seats shall be bonded-in, recess-mounted Buna-N or EPDM seats meeting the test procedures outlined in ASTM D-429 Method B and must be simultaneously molded in, vulcanized, and bonded to the body and the seat.

B. Valve shaft shall consist of a one-piece unit constructed of 18-8 Type 304 stainless steel and extending full-size through the discs and bearings. Shaft diameter shall be in accordance with Table 3 of AWWA C504 at a minimum and shall be suitably sized to transmit the torques required to operate the valve with the rated pressure on one side and atmospheric pressure on the other with appropriate safety factor. Valve disc shall be securely attached to the shaft by means of conservatively-sized stainless steel pins, mechanically secured. O-ring seal shall be provided on pin if required to prevent leakage.

C. The valve assembly shall be designed to ensure centering of the disc in the body with positive disc alignment without play at all times.

2.03 RUBBER-SEATED BUTTERFLY VALVES 24-INCH AND LARGER SIZE

A. Disc shall be of the “offset” design to provide a full 360-degree seating surface with no external ribs transverse to flow.

B. Valve seats shall be Buna-N or EPDM recess-mounted and securely fastened in the valve body by mechanical means without use of devices located in the flow stream. Any required seat attachment hardware shall be 316 stainless steel (neither snap rings nor spring loaded retainer rings are permitted). Mechanically-fastened seats shall be capable of being replaced in the field without removing the valve from the line or moving the disc along the shaft axis. Bonded-in seats will not be permitted.

C. Valve shall utilize a two-piece “stub-shaft” constructed of 18-8 Type 304 stainless steel. Shaft diameter shall be in accordance with Table 3 of AWWA C504 at a minimum and shall be suitably sized to transmit the torques required to operate the valves with the rated pressure on one side and atmospheric pressure on the other with appropriate safety factor. Valve disc shall be securely attached to the shaft by means of conservatively-sized stainless steel pins, mechanically secured. O-ring seal shall be provided on pin if required to prevent leakage.

D. Valve bodies shall have integral trunnions for housing shaft bearings and seals. The valve assembly shall be furnished with a factory set two-way thrust bearing designed to center the valve disc in the valve seat at all times. Thrust bearing assembly shall be fastened to the bottom of the valve shaft with 316 stainless

steel hardware that is not exposed to the fluid, and thrust-collar cavity shall be packed with grease and fully gasketed to prevent leakage.

2.04 ACCEPTABLE MANUFACTURERS

A. Henry Pratt Co. (Groundhog MJ X MJ)

B. Mueller Co. (Lineseal III, Catalog No. 3211-20 or 3211-23)

C. DeZurik (Bulletin 43 BAW style, MJ ends)

D. No other manufacturers shall be allowed unless otherwise indicated in Section 01011.

PART 3: EXECUTION

3.01 INSTALLATION

A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and seating surfaces, handling damage, and cracks. Correct defective valves or hold for inspection by the Engineer.

B. Butterfly valves shall be installed in strict accordance with the requirements of AWWA C504, Section 15000, and this section. All butterfly valves shall be restrained in accordance with Sections 15000, 15105, 15120, 15125, and 15130, as applicable.

C. Set valve and join to the pipe in the manner specified in Sections 15105, 15120, 15125, and 15130, as applicable. Provide crushed stone and concrete pads as shown on Owner's Standard Detail Drawings for valve installation, so that the pipe is not supporting the weight of the valve. Do not use valves to bring misaligned pipe into alignment during installation.

D. If a combination of Class 150B and Class 250B valves are used on the same Contract, Contractor shall ensure that the appropriate valve class is used in each location as shown on the Drawings or directed by the Engineer.

E. Butterfly valves installed in horizontal piping shall be installed with the shaft in a horizontal orientation unless otherwise shown on the Drawings, required by this section or Section 01011, or directed by the Engineer. Set valve plumb with operating nut facing straight upward.

F. Where a butterfly valve is installed in proximity to a pipe bend(s), the valve shall be installed at least two (2) pipe diameters upstream of the bend(s). Butterfly valves installed downstream of a bend(s) shall be located at least five (5) pipe diameters away from the nearest bend. If a butterfly valve is installed downstream of a vertical bend and within five (5) pipe diameters, the valve shall be installed with the shaft in a vertical orientation.

G. Make all valves tight under their working pressures after they have been placed and before the main is placed in operation. Any defective parts shall be replaced at the Contractor's expense.

H. Provide a valve box for each valve per Section 15130. Set the top of the valve box neatly to existing grade, unless directed otherwise by the Engineer. Do not install in a way that allows the transfer shock or stress to the valve. Center and plumb the box over the wrench nut of the valve. Tracer wire shall be terminated at the valve box and extended to grade. Refer to Owner's Standard Detail Drawing for a typical valve box installation.

I. Valve shall be polyethylene encased, per Section 15130 prior to backfill. The polyethylene encasement shall be installed up to the operating nut and over the lower portion of the valve box leaving the operating nut exposed and free to be operated within the valve box.

J. Provide valve marking posts and concrete pads at locations designated by the Engineer and as shown on Owner's Standard Detail Drawing for typical valve box installation.

3.02 PROTECTION

A. If polyethylene encasement is applied to the pipe, the entire valve shall be encased in polyethylene encasement per Section 15130 prior to backfill. The polyethylene encasement shall also encase the valve box up to the operating nut level, leaving the operating nut exposed and free to be operated within the valve box.

END OF SECTION

SECTION 15170

TAPPING SLEEVES, SADDLES AND VALVES

PART 1: GENERAL

1.01 SCOPE OF WORK

The Work under this section consists of providing all labor, materials, tools, equipment, and services required to install and test all tapping sleeves, tapping valves, and tapping saddles as indicated on the Drawings and as specified within this section. Contractor shall furnish and install all materials specified under this section that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 SUBMITTALS

Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, certifications and other required submittals for all products furnished under this section in accordance with Section 01300.

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 02025 Existing Utilities and Structures

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 15000 Piping - General Provisions

I. Section 15030 Pressure and Leakage Tests

J. Section 15105 Ductile Iron Piping and Fittings

K. Section 15120 Polyvinyl Chloride (PVC) Pipe

L. Section 15125 High Density Polyethylene (HDPE) Pipe

M. Section 15130 Piping Specialties

N. Section 15150 Gate Valves

O. Section 15200 Service Lines

1.04 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. AWWA C110 – Ductile-Iron and Gray-Iron Fittings

B. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

C. AWWA C207 – Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In.

D. AWWA C550 – Protective Interior Coatings for Valves and Hydrants

E. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances

F. AWWA C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

G. AWWA C800 – Underground Service Line Valves and Fittings

H. AWWA Manual M9 – Concrete Pressure Pipe

I. ASTM A182 – Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service

J. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

K. ASTM A285 – Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength

L. ASTM A380 – Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

M. ASTM A536 - Standard Specification for Ductile Iron Castings

N. ASTM A743 – Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

O. ASME / ANSI B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300

P. ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings

Q. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (Inch)

R. ANSI MSS SP-60 – Connecting Flange Joints Between Tapping Sleeves and Tapping Valves

S. NSF/ANSI 61 Drinking Water System Components – Health Effects

T. NSF/ANSI 372 Drinking Water System Components – Lead Content

U. *Tapping Guide for PVC Pressure Pipe*, UNI-PUB-8, Uni-Bell PVC Pipe Association.

PART 2: PRODUCTS

2.01 GENERAL

A. Taps 2-inch nominal diameter and smaller may be made with either a tapping sleeve or tapping saddle, unless otherwise indicated on the Drawings and/or specified in Section 01011. Neither tapping saddles nor outlet-seal tapping sleeves are permitted for taps 3-inch diameter or larger, which require a tapping sleeve with a full-circumference seal around the existing pipe.

B. All tapping sleeves shall be stainless steel with flanged joint branch outlet unless otherwise indicated on the Drawings and/or specified herein or in Section 01011. All taps the same nominal size as the pipe to be tapped (i.e. size-on-size) on pipe larger than 12-inch diameter shall be made with cast iron/ductile iron (mechanical joint) tapping sleeves as specified herein. Stainless steel tapping sleeves shall not be permitted for size-on-size taps larger than 12-inch.

C. Except as otherwise specified or indicated on the Drawings, all tapping saddles (2-inch and smaller) shall be designed for a minimum working pressure of 150 psi. All tapping sleeves shall be designed for a minimum working pressure of 200 psi for 12-inch and smaller and at least 150 psi for larger than 12-inch.

D. All tapping sleeves and saddles shall be appropriate for the existing pipe material, outside diameter, and condition. Mechanical tapping saddles are not allowed on HDPE piping. Refer to Section 15125 for fusion saddle requirements.

E. A ¾-inch NPT test nipple and plug shall be provided on each tapping sleeve (½-inch NPT for cast iron/ductile iron tapping sleeves) in compliance with ANSI/ASME B1.20.1 to allow pre-testing of the sleeve assembly before making the tap.

F. All gaskets and seals shall be formed from vulcanized EPDM or Buna-N (NBR) with antioxidant ingredients to resist swelling and set after installation. No reclaimed or recycled materials shall be used.

G. All tapping sleeves and saddles shall be NSF 61 and NSF 372 certified.

H. Markings: Each sleeve shall bear indelible markings, stenciled, coded or marked in a satisfactory manner to indicate:

1. Manufacturers name
2. Part Number
3. Date of manufacture
4. Serial Number – metal stamp on edge of flange
5. Rated Working Pressure
6. Test Pressure
7. Certified to ANSI/NSF-61
8. U/L Stamp Approval for all Materials

I. Quality control & Testing: Quality control procedures shall be employed to insure that the shell, gaskets, lug, armor plate, gasket and related hardware are manufactured to be free of any visible defects. All sleeves shall have been factory tested to 1.5 times the rated working pressure.

J. Warranty: The manufacturer shall warrant the sleeves to be free from defects and perform as advertised for a period of 10 years from the date of manufacture.

K. The following table indicates the allowable branch connection types, including the allowable application of the various types of tapping saddles and sleeves specified herein, based on the nominal size of the main to be tapped and the nominal branch/tap size. Other connection methods and/or application of tapping saddles and sleeves shall only be used if authorized in writing by the Owner.

<table>
<tr><th colspan="7">Allowable Branch Connection Types</th></tr>
<tr><th rowspan="2">Main Size (Nominal-inches) and Material</th><th colspan="6">Branch/Tap Size (Nominal, inches)</th></tr>
<tr><th>½ to 1</th><th>1½ to 2</th><th>3</th><th>4 - 12</th><th>>= 16 (smaller than main)</th><th>>= 16 (size-on-size)</th></tr>
<tr><td>2 (PE)</td><td colspan="2">2.05 or brass tee*</td><td>N/A</td><td>N/A</td><td>N/A</td><td>N/A</td></tr>
<tr><td>3 (HDPE)</td><td colspan="2" rowspan="2">side-fusion or electrofusion saddle*</td><td rowspan="2">HDPE branch saddle*</td><td rowspan="2">HDPE branch saddle*</td><td>N/A</td><td>N/A</td></tr>
<tr><td>>= 4 (HDPE)</td><td>Owner approval required</td><td>Owner approval required</td></tr>
<tr><td>4 – 12 (PVC)</td><td>2.02 or 2.03</td><td>2.02, 2.03, or 2.05</td><td>2.05</td><td>2.05</td><td>N/A</td><td>N/A</td></tr>
<tr><td>4 – 12 (CI/DIP)</td><td rowspan="2">direct tap, 2.02, 2.03, 2.06</td><td rowspan="2">2.02, 2.03, 2.05, 2.06</td><td>2.05</td><td>2.05</td><td>N/A</td><td>N/A</td></tr>
<tr><td>>= 16 (CI/DIP)</td><td>2.05</td><td>2.05</td><td>2.05</td><td>2.04</td></tr>
<tr><td colspan="7">* In accordance with Sections 15125 and 15200.</td></tr>
<tr><td rowspan="5">Connections Types Specified in this Section:</td><td colspan="6">2.02 = Tapping Saddle – Ductile Iron</td></tr>
<tr><td colspan="6">2.03 = Tapping Saddle – Stainless Steel</td></tr>
<tr><td colspan="6">2.04 = Tapping Sleeve – Cast Iron/Ductile Iron (MJ)</td></tr>
<tr><td colspan="6">2.05 = Tapping Sleeve – Stainless Steel</td></tr>
<tr><td colspan="6">2.06 = Tapping Saddle – Brass</td></tr>
</table>

2.02 TAPPING SADDLES – DUCTILE IRON

A. Tapping saddles shall only be used for taps 2-inch diameter and smaller. Taps 1-inch diameter and smaller in ductile iron pipe may be direct tapped without a tapping saddle except when otherwise required by the Specifications.

B. Saddles shall have either threaded or flanged outlets as required for the application.

C. Ductile iron tapping saddles shall consist of ductile iron outlet casting, attached to the pipeline with one or two wide, high strength stainless steel strap(s). Tapping saddles shall be manufactured and tested in accordance with applicable parts of AWWA C800. Body shall be high strength ductile iron conforming to ASTM A536 or A395. Castings shall be sealed to pipeline with a heavy-duty rubber o-ring or gasket conforming to ASTM-D2000. All saddles shall be sized for the specific piping application. One side of the saddle shall have closed bolt lugs, and the other side may have open or closed bolt lugs. The ductile iron body and lugs shall be finished with factory epoxy coating.

D. Threaded outlets shall conform to AWWA C800 for high pressure class. Flanged outlets shall conform to AWWA C110 and ANSI B16.42, shall be counter bored and compatible for use with tapping valves and tapping equipment.

E. Bolts, washers, and nuts shall be as specified below.

F. Acceptable manufacturers and models (Only threaded models are listed here; if flanged saddle is required, Contractor shall submit comparable model for approval.):

1. Mueller (DR1S or DR2S)
2. JCM Industries (Models 403 and 404)
3. Ford (Style FS101, FS202, or FSD202)
4. Romac Industries (Model 101S)
5. Cascade (Style CNS).

2.03 TAPPING SADDLES – STAINLESS STEEL

A. Tapping saddles shall only be used for taps 2-inch diameter and smaller. Saddles shall have either threaded or flanged outlets as required for the application.

B. Stainless steel tapping saddles shall consist of a Type 304 (18-8) stainless steel shell (either one or two piece) and Type 304 stainless steel tapped outlet. Tapping saddles shall be manufactured and tested in accordance with applicable parts of AWWA C800. All metal surfaces shall be passivated after fabrication in compliance with ASTM A380. Shell shall be sealed to pipeline with a heavy-duty rubber o-ring or gasket conforming to ASTM-D2000. All saddles shall be sized for the specific piping application. Saddle shall have closed bolt lugs, and the other side may have open or closed bolt lugs.

C. Threaded outlets shall conform to AWWA C800 for high pressure class. Flanged outlets shall conform to ANSI B16.5 and shall be counter bored and compatible for use with tapping valves and tapping equipment.

D. Each saddle shall be stenciled, coded or marked in a satisfactory manner to identify the size range. The markings shall be permanent type, water resistant, that will not smear or become illegible.

E. Bolts, washers, and nuts shall be as specified below.

F. Acceptable manufacturers and models (Only threaded models are listed here; If flanged saddle is required, Contractor shall submit comparable model for approval.):

1. Ford (Style FS300),
2. Cascade (Style CS or CSC).

2.04 TAPPING SLEEVES – CAST IRON/DUCTILE IRON (MECHANICAL JOINT)

A. Cast iron/ductile iron tapping sleeves are required for size-on-size taps 16-inch diameter and larger unless otherwise indicated on the Drawings and/or specified in Section 01011. Cast iron/ductile iron tapping sleeves shall not be used for other taps unless authorized in writing by the Owner.

B. Cast iron/ductile iron tapping sleeves shall be solid-body mechanical joint cast iron (or ductile iron) meeting ASTM A536 with full-circumference O-Ring type gaskets at each end and side seal gaskets. The sleeves shall be made in two halves which can be assembled and bolted around the main. Split-ring mechanical joint retaining glands (per Section 15130) shall be used to secure the gasket at each end of the sleeve and restrain the sleeve to the pipe.

C. Cast iron/ductile iron tapping sleeves shall have a working pressure rating of 150 psi minimum.

D. All sleeves shall include the end joint accessories and split glands necessary to assemble sleeve to pipe.

E. Test Plug Outlet and Plug: The test plug shall be ½-inch minimum NPT threaded 304 brass plug.

F. Bolts, washers, and nuts shall be as specified below.

G. Cast iron sleeves shall be factory epoxy coated inside and out.

H. Acceptable manufacturers and models:

   a. U.S. Pipe / Mueller (Catalog number H-615, H-616, or H-619)

   b. American Flow Control (Series 2800 ductile iron)

2.05 TAPPING SLEEVES – STAINLESS STEEL

A. The entire fitting, including the outlet and outlet flange, shall be stainless steel type 304 (18-8). A 14 gauge minimum Type 304 stainless armor plate shall be vulcanized into the gasket to span the lug area. The body, lug, and gasket armor plate shall be in compliance with ASTM A240. All metal surfaces, including welds, shall be fully chemically passivated after fabrication in compliance with ASTM A380.

B. All stainless steel tapping sleeves shall be provided with integral flanged joint outlets. Outlet shall be a one-piece Type 304 stainless steel casting provided with an outlet flange that is either integral to the outlet or welded to the outlet with outside seam MIG weld and inside seam TIG weld. Outlet flange shall be in conformance with AWWA C207 Class D (175 – 150 psi), ANSI B16.5 Class 150 and either ASTM A240 or ASTM A743 and shall be compatible with AWWA C110/ANSI 21.10 flange to accept a flanged by mechanical joint (FL X MJ) gate valve and may be recessed per MSS SP-60. Tapping sleeve (including flanged outlet) shall be suitable for use with the tapping/gate valve to be used..

C. Shell: Top shell (branch side) shall be Type 304 stainless steel 11 gauge minimum. Back shell shall be Type 304 stainless steel 14 gauge minimum.

D. The sleeve construction shall provide a positive means of preventing gasket cold flow and/or extrusion.

E. Bolt Lugs and Bolts, Washers, Nuts: The bolt lugs shall be 7 gauge minimum MIG welded (GMAW) to the shell at all contact points. The lug shall have a pass-through, removable-bolt design to avoid alignment problems. Finger lug designs are not approved, and bolts shall NOT be integrally welded to the sleeve. Tapping sleeve shall have a lug design similar to the approved models listed below. Bolts and washers shall be T-304 SST 5/8-11. Nuts shall be T-304 SST with factory-applied internal anti-seize coating to prevent galling.

F. Test Plug Outlet and Plug: The test plug outlet shall be ¾-inch NPT threaded type 304 stainless steel with brass plug. Stainless steel plugs shall not be used in stainless steel tapping sleeves unless approved by the Engineer and unless an anti-seize coatings and Teflon tape is used to prevent galling.

G. Shell Gasket: The gasket shall be virgin SBR with ¼-inch grid-pattern design and provide a complete 360 degree watertight sealing surface around the pipe. Size and shape to provide an adequate compressive force against the pipe to insure a positive seal under all combinations of joint and gasket tolerances. Section of gasket that bridges gap between shells shall have a T-304 SST armor. Armor shall be 3-inch minimum width and shall extend the full length of the sleeve. Armor to be TIG welded (GTAW) to the branch shell.

H. Branch Gasket: Shall be Virgin SBR with double O-ring and hydraulic lip. Gasket shall have Type 304 stainless steel ring insert molded within to prevent radial expansion under pressure. Gasket shall have twin O-ring seals on backside for protection.

I. Tapping Sleeve units for concrete, steel cylinder pipe shall be furnished with load bearing setscrews on the gland flange to transfer loads on the outlet away from the steel cylinder and onto the sleeve.

J. If required on the Drawings or in Section 01011, unit shall be protected by electrostatically applied baked epoxy or polyurethane.

K. Acceptable manufacturers and models:

1. Mueller (Catalog No. H-304),
2. JCM Industries (Model 432),
3. Ford (Style FTSAS),
4. Romac Industries (Model SSTIII), (Style 304 for 2-inch PE)
5. Cascade (Style CST-EX).

2.06 TAPPING SADDLES – BRASS

L. Tapping saddles shall only be used for taps 2-inch diameter and smaller. Taps 1-inch diameter and smaller in ductile iron pipe may be direct tapped without a tapping saddle except when otherwise required by the Specifications.

M. Saddles shall have threaded outlets as required for the application.

N. Brass tapping saddles shall attach to the pipeline with two wide, high strength bronze straps. Tapping saddles shall be manufactured and tested in accordance with applicable parts of AWWA C800. Castings shall be sealed to pipeline with a heavy-duty rubber o-ring or gasket conforming to ASTM-D2000. All saddles shall be sized for the specific piping application. One side of the saddle shall have closed bolt lugs, and the other side may have open or closed bolt lugs.

O. Threaded outlets shall conform to AWWA C800 for high pressure class.

P. Bolts, washers, and nuts shall be brass.

Q. Acceptable manufacturers and models

1. Ford (Style 202BS-Brass)
2. Or Approved Equal

2.07 TAPPING VALVES

A. Except as modified in this section, all tapping valves 3-inch nominal diameter and larger shall be gate valves fully complying with Section 15150. All tapping gate valves shall have ductile iron bodies (no gray cast iron). All tapping valves (i.e. corporation stops) 2-inch nominal diameter and smaller shall comply with Section 15200.

B. All tapping gate valves shall be flanged end by mechanical joint end (FL X MJ) unless otherwise indicated on the Drawings.

C. Flanged tapping gate valves with an alignment ring conforming to MSS-SP 60 shall be provided with an alignment ring. The tapping sleeve used shall be provided with a compatible recessed outlet flange.

D. Tapping gate valves (3-inch and larger) shall be designed for a minimum differential pressure of 250 psi, as specified in Section 15150. Smaller diameter tapping valves shall be designed for a minimum differential pressure of 150 psi.

E. Tapping valves shall have an opening larger than the nominal diameter of the tap to accept a full-size shell cutter.

F. Acceptable manufacturers and models

a. Mueller Company, Decatur, Illinois;

b. McWane, Inc. (Clow, Kennedy, and M&H Divisions) Oskaloosa, Iowa, Corona, California, Elmira, New York, and Anniston, Alabama, respectively;

c. United State Pipe Decatur, Illinois;

d. American Flow Control, Birmingham, Alabama;

2.08 BOLTS

A. All bolts shall have American Standard heavy hexagonal head and nut dimensions all as specified in ANSI B18.2, except for stainless steel tapping sleeves designed for use with carriage bolts.

B. Bolts, nuts and washers for stainless steel tapping sleeves and saddles shall be high strength, type 304 (18-8) stainless steel. Stainless steel bolts and nuts shall be factory coated to prevent galling.

C. Bolts, nuts and washers for ductile and gray cast iron tapping sleeves and saddles shall be high strength, Xylan or FluoroKote #1 suitable for direct bury in corrosive soils as specified in Sections 15105 and 15130.

D. Bent or damaged bolts will be rejected.

PART 3: EXECUTION

3.01 SITE INVESTIGATION

A. Upon providing the required advance notice to the Owner and receiving authorization, Contractor shall excavate the existing pipe at the proposed tap location prior to ordering the tapping sleeve or saddle.

B. Contractor shall fully expose the pipe within the limits of the proposed tapping sleeve or saddle and shall verify the type of existing pipe, the outside diameter, roundness, and condition of the pipe on which the tapping sleeve/saddle is to be installed.

C. If any existing joint, fitting, tap, or other obstruction is located at the proposed tap location, the Contractor shall coordinate with the Engineer to determine the appropriate adjustment to the proposed tap location.

3.02 INSTALLATION

A. Only wet taps (with the existing water main under pressure) shall be permitted. Operating conditions (e.g. flow rates, operating pressure, etc.) shall be confirmed with the Owner or Engineer prior to ordering materials. Equipment and methods used to perform the tap shall be appropriate for the operating conditions.

B. Install the tapping sleeves, saddles, and valves in strict accordance with the manufacturers' instructions and requirements of Section 15000. Tapping

sleeve/saddle outlets shall be installed horizontal and level unless otherwise approved by the manufacturer and Engineer.

C. Contractor shall ensure compatibility of tapping valve and tapping sleeve prior to installation. Contractor shall properly assemble tapping valve to sleeve or saddle and assure proper alignment between the sleeve/saddle and valve to ensure proper passage of the cutter during the tapping procedure.

D. All bolts and nuts shall be kept clean and shall be handled carefully. Bolts and nuts shall be kept free of nicks and shall not be tossed or thrown. Bolts/nuts shall not be over-torqued. Pneumatic wrenches shall not be used unless approved by the sleeve/saddle manufacturer. Stainless steel bolts and nuts shall be assembled with an anti-seize coating to prevent galling.

E. The tapping procedure shall be completed in accordance with the tapping machine manufacturer's instructions. Unless otherwise approved by the Engineer, a full-size shell cutter (i.e. equal to or larger than the tap nominal diameter) shall be used.

F. Taps on prestressed concrete cylinder pipe (PCCP) shall be made by the pipe manufacturer or other Subcontractor experienced in tapping PCCP and authorized by the Engineer. Tapping of PCCP shall be in full accordance with the pipe manufacturer’s recommendations, and tapping sleeves/saddles shall be compatible with PCCP.

G. Taps on asbestos cement (A-C) pipe require appropriate protective equipment and special procedures not addressed herein. Only properly certified and experienced individuals employed by a properly licensed Subcontractor may make taps on A-C pipe.

3.03 PROTECTION

A. The entire sleeve and valve assembly shall be encased in polyethylene encasement per Section 15130 prior to backfill.

3.04 PRELIMINARY TESTING

A. Perform a hydrostatic test of the tapping sleeve and valve assembly in accordance with Section 15030 after installation of the tapping sleeve and valve, but prior to making the tap. The test shall be made with the valve open using a tapped mechanical joint cap. No leakage is acceptable. The test pressure shall be maintained for a minimum of 15 minutes.

B. Perform hydrostatic test of tapping saddles as recommended by the manufacturer.

END OF SECTION

SECTION 15180

FIRE HYDRANTS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to install fire hydrants at the locations shown on the Drawings (or where designated by the Engineer) and as specified within this section and related sections of the Specification. Contractor shall install all fire hydrants and accessories furnished by the Owner; Contractor shall provide (both furnish and install) all fire hydrants and accessories that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

1.02 COORDINATION

A. Contact the local water district and obtain written fire hydrant mechanical details (including number and sizes of hose and pumper nozzle outlets) for the water district prior to ordering any fire hydrants for the Work.

1.03 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, Operating and Maintenance Manuals, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300.

1.04 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01500 Temporary Facilities

F. Section 01600 Products

G. Section 01700 Project Closeout

H. Section 02025 Existing Utilities and Structures

I. Section 02210 Trenching, Backfilling and Compacting

J. Section 02558 Identification/Location Guide

K. Section 15000 Piping – General Provisions

L. Section 15020 Disinfecting Pipelines

M. Section 15025 Flushing and Cleaning Pipelines

N. Section 15030 Pressure and Leakage Tests

O. Section 15105 Ductile Iron Pipe and Fittings

P. Section 15130 Piping Specialties

Q. Section 15150 Gate Valves

R. Section 15185 Abandonment of Mains and Hydrants

1.05 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASME / ANSI B18.2 - Square and Hex Bolts and Screws (Inch Series)

B. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength

C. AWWA C104 / ANSI A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

D. AWWA C105 / ANSI A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems

E. AWWA C110 / ANSI A21.10 - Ductile-Iron and Gray-Iron Fittings

F. AWWA C111 / ANSI A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

G. AWWA C116 / ANSI A21.16 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

H. AWWA C150 / ANSI A21.50 - Thickness Design of Ductile-Iron Pipe

I. AWWA C151 / ANSI A21.51 - Ductile-Iron Pipe, Centrifugally Cast

J. AWWA C153 / ANSI A21.53 - American National Standard for Ductile-Iron Compact Fittings

K. ANSI/AWWA C502 Dry-Barrel Fire Hydrants

L. ANSI/AWWA C550 Protective Interior Coatings for Valves and Hydrants

M. AWWA C600 - AWWA Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances

PART 2: PRODUCTS

2.01 MATERIALS

A. All fire hydrants shall be ductile and/or gray cast iron and conform to the requirements of AWWA C502, traffic-model break-away type fire hydrants. The hydrant shall be break-away traffic flange, 5-1/4" valve opening, 6" mechanical joint pipe connection.

B. Fire hydrants shall be rated for at least 250 psi operating pressure and tested to 500 psi.

C. Hydrants shall be 3-way outlet unless otherwise required. The number and sizes of hose and pumper nozzle outlets is dependent on the local regulation. (Most typical is two (2) bronze male threaded 2-1/2" hose outlet nozzles and one (1) bronze male threaded 4-1/2" pumper outlet nozzle with American National Fire Hose Connection Screw Threads (NH).) Where indicated in Section 01011 or otherwise required by the local fire department authority, each hydrant shall be furnished with a Storz quick-connect outlet connection on the pumper nozzle. Prior to ordering any hydrants without a Storz outlet connection, Contractor shall confirm with both the local fire department authority and the Owner's local Operations District.

D. The hydrant interior ferrous surfaces downstream of the main valve shall be factory coated by the hydrant manufacturer with a water-based enamel, epoxy or approved equivalent coating. Coating may be applied in two or three coats, according to coating manufacturer's recommendations, for total dry film thickness of 12 – 18 mils.

E. The inside of the hydrant shoe shall be coated with liquid or powder (thermosetting or fusion-bonded) epoxy coating system that conforms to NSF 61 in accordance with AWWA Standard C550 (6 – 8 mil average dry film thickness, 4 mil minimum).

F. The hydrant exterior shall be factory coated by the hydrant manufacturer with coating system as follows:

1. Exterior Above Traffic Flange (Including Bolts & Nuts):
   a. Surface preparation shall be in accordance with coating manufacturer's specifications.

b. Primer, intermediate and top coats shall be enamel, epoxy, polyurethane or approved equivalent coating (8 – 12 mil average dry film thickness).

2. Exterior Below Traffic Flange:
   a. Surface preparation shall be in accordance with coating manufacturer's specifications.
   b. Primer and intermediate coats shall be coal tar epoxy in general conformance with SSPC Paint Specification No. 16. Apply two (2) coats with dry film thickness (DFT) of 8 – 10 mils each for total DFT of 16 – 20 mils.
   c. Finish coat shall be in accordance coating and hydrant manufacturers' specifications. Apply one coat with dry film thickness of 6 – 8 mils.

G. All fire hydrants shall open left and be clearly marked on the top of the hydrant with a 1-1/2" pentagon top nut.

H. Each hydrant shall utilize not less than two (2) O-ring seals where the stem passes through the bonnet.

I. All hydrants shall have a standard mechanical joint bell inlet connection compatible with the anchor couplings to be used.

J. All hydrants shall be tested and certified in conformance with NSF 61.

2.02 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers and models, subject to the specifications set forth, include:

1. American Darling B-84-B-5 with ALPHA restraint joint (by the American Flow Control Division of ACIPCO), 5-1/4" valve opening, with optional Storz outlet connection where required
2. Kennedy Guardian Figure K81D (by Kennedy Valve Company Division of McWane, Inc.), 5-1/4" valve opening, or Figure K-81A with Storz outlet where required
3. Mueller Super Centurion 250 Model A-423, 5-1/4" valve opening, with integral Storz pumper outlet connection option where required.

B. Refer to Section 01011 for manufacturers accepted in each of the Owner's Operations Districts. For each Operations District, only the manufacturer(s) indicated in Section 01011 as allowed for that district shall be provided.

C. No other hydrant manufacturers or models shall be accepted.

D. All fire hydrants furnished shall be produced solely in the United States. Manufacturers and models indicated in this section shall only be allowed if the hydrants are assembled and tested in the United States.

PART 3: EXECUTION

3.01 INSPECTION PRIOR TO INSTALLATION

A. Contractor shall inspect all fire hydrants upon receipt. Cycle each hydrant to full open and full closed positions to ensure that no internal damage or breakage has occurred during shipment and handling. Check all external bolts for proper tightness. Inspect condition of internal and external coatings.

B. After inspection, close the hydrant valves and replace the outlet nozzle caps to prevent the entry of foreign matter. Protect stored hydrants from the weather/elements with the inlets facing downward.

3.02 INSTALLATION

A. Locate hydrants as shown on the Drawings or as directed by the Engineer and in compliance with local regulations. The location shall provide complete accessibility and minimize the possibility of damage from vehicles or injury to pedestrians. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than eighteen to twenty-four inches, depending on local requirements, from the gutter face of the curb. All hydrants shall stand plumb with the pumper nozzle facing the curb. Set hydrants with nozzles at least eighteen inches above the finished grade as shown on the Indiana American Water Standard Detail Drawing for fire hydrants. Set the break flange at least two but no more than six inches (2" – 6") above finished grade, or as directed by the Engineer.

B. Unless otherwise shown on the Drawings, all hydrant laterals shall be ductile iron material with polyethylene encasement, assembled with the hydrant connected to an independent six-inch isolation (watch) gate valve with a six-inch anchor coupling; and each hydrant lateral shall be connected to the water main with a six inch anchor coupling. All hydrant assemblies shall be restrained from the hydrant back to the main. Anchor couplings shall be as specified in Section 15105.

C. Engineer may require hydrant protection using steel pipe bollards when hydrant installations have a greater than normal exposure to vehicular damage (e.g. parking lot installations, unusual driving situation, etc.). Contractor shall install all such protection designated by the Engineer. Locate bollards as necessary adjacent to the hydrant and in such a manner as to not interfere with the ability to connect hoses or operate the hydrant. Refer to Indiana American Water Standard Detail Drawing for typical fire hydrant installation. Additionally, locate the bottom of the bollard and encasement higher than (but not directly above) the hydrant supply piping and valve to prevent the possibility of damage to the piping should the bollard be displaced when hit. Payment for bollards shall be per the supplemental unit price schedule.

D. Unless otherwise directed by the Engineer, excavate a drainage pit two feet in diameter and two feet deep below but not beyond each hydrant. Fill the pit with compacted ¾ inch clean granular fill under and around the base of the hydrant to

a level 6 inches above the hydrant drain opening. No hydrant drainage pit shall be connected to a sewer.

E. The fire hydrant lead, gate valve, and fire hydrant barrel shall be encased in polyethylene encasement up to finish grade per Section 15130 prior to backfill. The polyethylene encasement shall not interfere with drainage of the hydrant.

F. Notify the Engineer of situations where the ground water table is above the drain opening of dry barrel hydrants. If directed by Engineer, plug the drain opening using a method acceptable to the hydrant manufacturer. No drainage pit is required when the hydrant drain is plugged. Mark the hydrant, in a manner acceptable to the Owner, to indicate that the drain opening has been plugged. Operation of a hydrant with plugged drain leaves the hydrant barrel full of water, thus Contractor shall pump the hydrant barrel dry after each use until Final Acceptance.

G. Thrust blocking at the base of each hydrant must not obstruct the drainage outlet of the hydrant. The size and shape of concrete thrust blocking shall be approved by the Engineer. Use the thrust blocking material specified in Section 03305.

3.03 TESTING

After installation and before backfilling (and after pressure testing the water main) test the hydrant as follows:

A. Pressure Test

1. Open the hydrant fully and fill with water; close all outlets.
2. To prevent caps from being blown off dry-barrel hydrants and to prevent other possible damage, vent air from the hydrant by leaving one of the caps slightly loose as the hydrant is being filled. After all air has escaped, tighten the cap before proceeding.
3. Apply line pressure.
4. Check for leakage at flanges, nozzles and operating stem.
5. If leakage is noted, repair or replace components or complete hydrant until no leaks are evident.
6. Record static pressure at hydrant.

B. Flow Test

1. Coordinate with Owner for hydrant flow testing.
2. Remove the cap from one 2-½ inch nozzle, and fully open the hydrant.
3. Use a pitot gauge and a chart specific to the pitot gauge used to estimate the hydrant flow rate.

C. Drainage Test for Dry-Barrel Hydrants

1. Following the pressure test and flow test, close hydrant.

2. Remove one nozzle cap and place pylon or hand over nozzle opening.
3. Drainage rate should be sufficiently rapid to create a noticeable suction.
4. After backfilling, operate the hydrant to flush out any foreign material.
5. Tighten nozzle caps, then back them off slightly so that they will not be excessively tight; leave tight enough to prevent removal by hand.

D. After installation, testing and surface restoration, clean all hydrants above the bury line and touch up any damaged paint in accordance with the hydrant manufacturer's recommendations and the Owner's local Operations District's standards (see Section 01011 for required colors). Surfaces to be painted shall be prepared in accordance with the manufacturer's recommendations and shall be coated with two (2) coats of the hydrant manufacturer's recommended exterior UV-resistant paint compatible with the factory paint system and of the same color. Take extreme care to avoid getting any paint on the "O" ring under the top operating nut or on the hydrant nozzles. Should paint be found on the "O" ring, the Contractor shall remove the paint and replace the "O" ring at its expense. Any paint on the hydrant nozzles shall be removed at the Contractor's expense.

END OF SECTION

SECTION 15185

ABANDONMENT OF MAINS AND HYDRANTS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment, and services required to abandon and demolish water mains, valves, hydrants, and other related appurtenances as indicated on the Drawings and as specified within this section and in Section 01011.

1.02 GENERAL REQUIREMENTS

A. Install new hydrants; successfully complete all required flushing, testing, and disinfection; make designated connections to existing water lines; and transfer all existing services from existing water mains to new pipelines prior to abandoning existing water mains or hydrants. Minimize service interruptions; do not disconnect existing services or depressurize existing water mains until all services have been transferred to the new pipeline.

B. Water mains shall generally remain in place without further action unless otherwise indicated on the Contract Drawings, specified in Section 01011, or otherwise directed by the Engineer. When water mains are judged to be of questionable structural condition, they shall be filled with grout or flowable fill. Pipe located above ground (e.g. mounted on bridges, etc.) shall be removed, together with hangers and hardware, whether or not so indicated elsewhere in the Contract Documents.

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01700 Project Closeout

E. Section 02025 Existing Utilities and Structures

F. Section 02210 Trenching, Backfilling and Compacting

G. Section 15000 Piping – General Provisions

H. Section 15105 Ductile Iron Pipe and Fittings

I. Section 15120 Polyvinyl Chloride (PVC) Pipe

J. Section 15125 High Density Polyethylene (HDPE) Pipe

K. Section 15130 Piping Specialties

L. Section 15150 Gate Valves

M. Section 15155 Butterfly Valves

N. Section 15170 Tapping Sleeves, Saddles and Valves

O. Section 15180 Fire Hydrants

P. Section 15190 Air Release, Blow-off Outlets and Sampling Taps

Q. Section 15200 Service Lines

PART 2: PRODUCTS

Not Used

PART 3: EXECUTION

3.01 CUTTING AND PLUGGING (CAPPING)

A. Disconnect all service lines from existing main to be abandoned by cutting, crimping, plugging or isolation of the corporation stop valve.

B. Once all services have been disconnected from the main to be abandoned, cut the existing pipeline to provide a break between the portion of the system remaining in use and the portion to be abandoned, remove all hydrants designated to be abandoned, and cap, restrain and concrete thrust block all remaining live ends of the existing mains including hydrant laterals.

C. Immediately prior to disconnection of the main to be abandoned, completely cover existing hydrants designated to be abandoned to prohibit use until the hydrants are removed.

D. Unless otherwise directed by the Engineer, the Contractor shall completely remove all abandoned hydrants, air valves, water meter installations, and curb stops. Unless otherwise directed by the Engineer, the Contractor shall either completely remove the valve box or remove the top section and fill the remainder of the valve box with an Owner-approved material by approved methods, The retired valve may remain unless otherwise indicated on the Drawings or required by the Engineer. Contractor shall exercise care not to damage materials that are required to be returned to the Owner.

E. For any valve boxes not removed from abandoned valves, Contractor shall remove the upper 6-inches of the valves box and fill the existing valve box with concrete flush to existing grade and remove any portion of the valve box extending above grade.

F. Where required by the Engineer, Contractor shall dispose of these abandoned components as directed by the Engineer at no additional cost to the Owner.

G. Refer to Section 15185 for requirements regarding delivery of these removed products to the Owner.

H. Cut the existing pipe at the point shown on the Contract Drawings or designated by the Engineer. The method of cutting shall be in accordance with Section 15000.

I. Cut and caps of existing mains to be abandoned shall be completed with the use of mechanical joint caps and restrained by retainer glands attached to the end of the existing main. Cut and caps shall be installed at the nearest existing tee and valve to minimize dead-end segments of retired mains connected to the in-service watermain. Materials shall be compatible with the pipe being capped and shall meet the applicable requirements of Section 15105, 15120, and/or 15125. After the cap is installed, provide concrete blocking to adequately brace the cap. Temporary blocking shall be placed against the abandoned pipe, and a permanent, approved concrete thrust block shall be poured between the two caps to hold both in place. Additional permanent blocking of the live main may be required by the Engineer such that future disturbances of the abandoned pipe shall not affect the permanent blocking of the live main. If required by the Engineer, a concrete anchor collar (a.k.a. deadman) shall be installed to anchor the pipe in place. When a concrete anchor collar is required, a keyway shall be excavated around the pressurized pipeline, a split restrained anchor collar per Section 15130 shall be installed around the pipe, and concrete shall be poured around the pipe within the keyway. Also, if required by the Engineer to adequately restrain existing pipe, external restraining harnesses in accordance with Section 15130 shall be installed on existing pipe joints.

J. After the water line has been capped and the permanent concrete blocking has been installed, backfill the excavation as specified in Section 02210.

K. Remove all temporary blow-off assemblies and sampling taps as required by Sections 15020, 15025 and 15190.

3.02 ASBESTOS CEMENT PIPE

A. Whenever possible and unless otherwise required by the Contract Drawings and/or Section 01011, asbestos cement (AC) pipe to be abandoned shall be abandoned in place entirely intact.

B. To the extent possible, any pipe required to be removed, shall be removed in such a way that it is not crumbled, pulverized or reduced to powder. United States EPA considers intact asbestos cement pipe to be a Category II nonfriable

asbestos-containing material (ACM) as defined in the revised Clean Air Act National Emissions Standards for Hazardous Air Pollutants for asbestos (Asbestos NESHAP) in 40 CFR Section 61.141. However, this material becomes regulated asbestos-containing material (RACM) as defined in 40 CFR Section 61.141 when it becomes “friable asbestos material” or when it “has a high probability of becoming or has become crumbled, pulverized or reduced to powder by the forces expected to act on the material during the course of demolition or renovation operations regulated by [40 CFR Part 61 Subpart M].” Consequently, if any AC pipe will be (or has a high probability of being) cut, crushed, or otherwise becoming friable, that pipe shall be completely removed from the site and transported as asbestos waste material, in accordance with CRF Section 61.150, to an approved landfill that accepts asbestos waste material.

C. All cutting, crushing, handling, removal, and transportation of AC pipe shall only be performed by a company and personnel properly licensed, trained, and specialized in handling RACM who will strictly adhere to all relevant regulations and standards. Owner will arrange for and pay for all such specialized activities related to AC pipe affected by this Contract.

D. Under no circumstances shall any crushed or otherwise friable AC pipe be buried or otherwise disposed of on the construction site without the express written permission of the Owner, Engineer, and property owner, all of which shall be obtained by the Contractor. Such written permission shall acknowledge the following:

1. The backfilling and burial of any crushed AC pipe in place would cause these locations to be considered active waste disposal sites and therefore subject to the requirements in 40 CFR Section 61.154. Contractor shall be responsible for compliance with all such requirements for a period of one year following Substantial Completion.
2. Furthermore, if no additional asbestos-containing waste material is buried at that location for a year, the site would become an inactive waste disposal site subject to the requirements of 40 CFR Section 61.151(e) and Section 61.154(h). Contractor shall be responsible for any work, permitting, etc. associated with converting the site to inactive status.
3. Subsequently, the owner of the land shall be required to comply with the requirements for active and inactive waste disposal sites discussed above. Contractor shall provide written notice to the property owner of all applicable regulations and requirements and shall provide copies of all related permits, notifications, etc.

END OF SECTION

SECTION 15190

AIR VALVES, BLOW-OFF ASSEMBLIES AND SAMPLING TAPS

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The work under this section consists of providing all labor, materials, tools, equipment and services required to provide air valves, blow-off assemblies and sampling tap assemblies at locations shown on the Drawings (or where designated by the Engineer) and as specified within this section and related sections of the Specifications. Contractor shall furnish and install all air valves, blow-off assemblies, sampling taps and related appurtenances that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

B. Sampling taps are used for disinfection of the water mains and related sampling as described in Section 15020. Sampling tap assemblies shall be installed at locations approved by the Engineer consistent with the requirements of Sections 15020. A sampling tap shall be installed near the proposed connection to any existing main (within 10 feet of beginning of new main), at all dead-ends and at intervals not exceeding 1,200 feet along the entire pipeline(s).

C. Copper pipe, corporation stops, curb stops, and miscellaneous fittings shall be provided in accordance with Section 15200.

D. All automatic air valve installations shall be installed within a precast concrete structure in accordance with Section 03450.and the Owner's Standard Details.

E. Automatic air valve installations shall not be located in areas subject to flooding or in areas of high groundwater where flooding of the manhole may occur. Air valve structures should drain to the ground surface, or to drainage/absorption pits underground. The manholes shall not connect to any storm drain or sanitary sewer.

F. Whenever the term "air valve" is used within this section, it is intended to mean a combination air valve that provides the functions of both an air release valve and an air/vacuum valve. Only air valves that include all these functions shall be installed.

G. Sizing of blow-off assemblies shall be coordinated with the requirements of Section 15025. Installed blow-off assemblies shall be adequate to achieve the required flushing velocity in the water main.

H. Blow-off assemblies may be permanent or temporary as directed or approved by the Engineer. Permanent blow-off assemblies shall be installed with above- or below-grade flushing hydrants, whereas temporary blow-off assemblies may be installed without flushing hydrants.

I. Marker posts shall be installed for air valves and blow-off assemblies in accordance with Section 02558 where shown on the Drawings, Specified in Section 01000 or Section 01075, or otherwise required by the Owner or Engineer.

1.02 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, installation instructions, operating and maintenance manuals, certifications, and other required submittals for all products furnished under this section in accordance with Section 01300.

B. Air valve submittals shall include documentation indicating the following:

1. Pressure rating
2. Inlet and outlet connection size(s) and types (i.e. threaded or flanged)
3. Air intake and exhaust orifice size(s)
4. Air intake and exhaust capacity vs. pressure differential
5. All appurtenances and options to be supplied
6. Dimensions, including complete assembled height

1.03 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 02558 Identification/Location Guide

I. Section 03450 Precast Concrete Structures

J. Section 15000 Piping – General Provisions

K. Section 15020 Disinfecting Pipelines

L. Section 15025 Flushing and Cleaning Pipelines

M. Section 15030 Pressure and Leakage Tests

N. Section 15105 Ductile Iron Pipe and Fittings

O. Section 15130 Piping Specialties

P. Section 15150 Gate Valves

Q. Section 15170 Tapping Sleeves, Saddles and Valves

R. Section 15180 Fire Hydrants

S. Section 15200 Service Lines

1.04 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ANSI/AWWA C512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

B. NSF/ANSI 61 Drinking Water System Components – Health Effects

C. NSF/ANSI 372 Drinking Water System Components – Lead Content

PART 2: PRODUCTS

2.01 GENERAL

A. All products furnished under this section shall meet all applicable AWWA standards and shall meet the requirements of NSF 61 and NSF 372.

B. All 2” and smaller piping, corporation stops, curb stops, ball valves, and other service line fittings shall be provided in conformance with Section 15200. All 2” and smaller piping used for air valves and blow-off assemblies shall be Type K copper or threaded brass as shown on the Owner’s Standard Detail Drawings and directed by the Engineer.

C. All 3” and larger piping shall be ductile iron provided in conformance with Section 15105.

D. All air valves and other components shall be compatible with the pipe material to be used. Contractor shall provide all required adapters, pipe nipples, spool

pieces, and other miscellaneous supplies as required for a complete and functioning installation.

2.02 AIR VALVES

A. All air valves provided under this section shall be combination air valves that provide the following functions:

1. Quickly release large volume of air during pipeline filling
2. Release small volume of accumulated air from the pressurized pipeline at a controlled rate
3. Quickly admit large volume of air in the event of water main depressurization (i.e. below atmospheric pressure).

B. Provide 1” air valves for water mains 12” nominal diameter and smaller unless noted otherwise on the Drawings or authorized by the Engineer. Provide 2” air valves for water mains 16” nominal diameter and larger unless noted otherwise on the Drawings. For the air/vacuum functions of the valve, air valves shall allow unrestricted airflow both ways through the valve without any restrictions smaller than the full nominal pipe size (i.e. 0.785 and 3.14 square inches for 1” and 2” valves, respectively).

C. Air valve bodies shall be either ASTM A126 Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron. Floats and other internal parts shall be stainless steel. Seats shall be Buna-N or EPDM rubber.

D. Combination air valves shall be provided with NPT threaded or ANSI flanged inlet and outlet(s) compatible with inlet and outlet piping.

E. Combination air valves shall be rated for at least 150 psi operating pressure (but not less than the actual system operating pressure) and tested to 150% of rated operating pressure.

F. Size of air release orifice shall be appropriate for the operating pressure at the installed location, as recommended by the air valve manufacturer.

G. Acceptable manufacturers and models, subject to the specifications set forth, include:

1. GA Industries DUOJET, Data Sheet 970.03 (2” only)
2. DeZurik APCO Series 140C
   a. Model No. 143C (1”)
   b. Model No. 145C (2”)
3. Val-Matic
   a. Model 201C.2 (1”)
   b. Model 202C.2 (2”)
4. Crispin C-Series
   a. Model C10 (1”)
   b. Model C21 or C22 (2”)

5. Mueller-Pratt WCV Series
   a. Model WCV 10-564-300 (1”)
   b. Model WCV 20-332-300 (2”)

H. No other air valve manufacturers or models shall be accepted unless otherwise indicated in Section 01011 or specifically identified on the Drawings.

I. All air valves furnished shall be produced solely in the United States. Manufacturers and models indicated in this section shall only be allowed if the air valves are assembled and tested in the United States.

2.03 BLOW-OFF ASSEMBLIES AND SAMPLING TAP PIPE AND FITTINGS

A. Piping for blow-off assemblies shall be copper, polyethylene, or ductile iron in accordance with Section 15200, 15125, or 15105, respectively. Sizing shall be as indicated on the Drawings or otherwise directed otherwise by the Engineer and shall be coordinated with the requirements of Section 15025. Installed blow-off assemblies shall be adequate to achieve the required flushing velocity in the water main.

B. Piping for sampling taps shall be ¾-inch copper or polyethylene in accordance with Section 15200 and this section.

2.04 FLUSHING HYDRANTS FOR BLOW-OFF ASSEMBLIES

A. Blow-off assemblies for permanent applications shall include an above- or below-ground flushing hydrant as shown on the Drawings, specified in Section 01075, or directed by the Engineer. Flushing hydrants shall be self-draining, non-freezing, and have MJ inlets. Above-ground flushing hydrants shall have NST hose nozzle outlets and 1-1/2” pentagon operating nuts. All working parts shall be serviceable from above with no digging required.

B. Acceptable manufacturers and models, subject to the specifications set forth, include:

1. Eclipse #2 Post Hydrant by the Kupferle Foundry (above-ground)
2. Truflo #TF500 by the Kupferle Foundry (below-ground)
3. Mueller A-411 2-1/8” Post Type Fire Hydrant (above-ground)
4. Mueller A-412 2-1/8” Flush Type Fire Hydrant (below-ground)

C. All flushing hydrants furnished shall be assembled and tested in the United States.

PART 3: EXECUTION

3.01 INSPECTION PRIOR TO INSTALLATION

A. Contractor shall inspect all air valves and flushing hydrants prior to installation. Cycle each flushing hydrant to full open and full closed positions to ensure that no internal damage or breakage has occurred during shipment and handling. Check all external bolts for proper tightness. Inspect condition of coatings.

B. After inspection, close the flushing hydrant valve and replace the outlet nozzle cap to prevent the entry of foreign matter. Protect stored air valves and flushing hydrants from the weather/elements with the inlets facing downward.

3.02 INSTALLATION (GENERAL)

A. Refer to Section 15000 for pipe installation. Refer to the Owner's Standard Detail Drawings for typical installation details for air valve assemblies and blow-off assemblies. Refer to section 15200 for information about selected components (copper pipe, corporation stops, curb stops, curb boxes) common to service lines.

B. Provide appropriate protection between dissimilar metals. Provide dielectric unions at corporation stops to prevent transfer of any electrical stray currents from copper piping to water main.

C. Utilize a minimum of interconnecting fittings.

D. Air valve outlets and blow-off assemblies shall not connect to any storm drain or sanitary sewer.

3.03 INSTALLATION OF AIR VALVES

A. Taps for air valves shall be made on the top (crown) of the water main at a location with the highest elevation or as indicated on the Drawings. Air valve installations shall be installed plumb vertically.

B. A full-port brass or bronze ball valve with vinyl-coated handle shall be installed on the inlet side of the air valve to allow the air valve to be isolated from the water main for maintenance.

C. The outlet of the air valve shall be piped and extended to at least one foot above grade and provided with a screened, downward-facing elbow. Outlet piping shall be the same size as the inlet piping. For air valves with a separate, smaller-size outlet connection for the air release portion of the valve, the smaller outlet piping shall be connected to the main outlet pipe with a tee below grade. A union shall be installed in each outlet piping near the air release valve to facilitate removal of the valve for maintenance.

D. Air valve and outlet piping shall not interfere with personnel access into the structure.

E. Unless otherwise directed by the Engineer, excavate a drainage pit at least two feet deep and four square feet (4 sq. ft.) in surface area around or adjacent to each automatic air valve structure. Fill the pit and around the structure with

compacted ¾ inch clean granular fill to a level 6 inches above the structure's floor. No air valve structure drain shall be connected to a sewer.

3.04 INSTALLATION OF PIPE AND FITTINGS FOR BLOW-OFF ASSEMBLIES AND SAMPLING TAPS

A. Install corporation stop as required by Section 15200. Install polyethylene or copper pipe between the corporation stop and the curb stop location making only gradual changes in grade or alignment, as required. Do not make bends greater than 15 degrees in any direction. Install curb stops with the operating nut in the vertical position.

B. Sampling taps shall consist of a ¾-inch corporation stop and ¾-inch polyethylene or copper service line extended above ground and secured to a wood post or other suitable stationary object or structure. A curb stop or other suitable valve acceptable to the Owner shall be installed at the end of the pipe. The outlet end of this valve shall be kept clean and shall be adequately covered to prevent contamination to the satisfaction of the Resident Project Representative.

C. Temporary blow off assemblies shall terminate above ground.

D. Unless otherwise directed by the Owner, upon successful completion of all flushing, testing and disinfection, the Contractor shall completely remove temporary blow-off assemblies and sampling taps above and below ground, including the corporation stop, piping, appurtenances, etc. Upon removal of each temporary corporation stop, Contractor shall immediately plug the tap with a brass plug. Contractor shall coordinate timing and method of removing and plugging corporation stops with the Owner and Resident Project Representative. Refer also to Section 15185 for related requirements

E. Temporary blow-off sizing shall be as shown on the Owner's Standard Detail Drawings.

F. Open the corporation stop slowly to fill the line. When the line is full and all air has been removed, completely open the corporation stop and close the curb stop valve. Perform a visual leak inspection of all piping, fittings, and taps prior to backfilling. Zero leakage is allowed in 10 minutes.

3.05 INSTALLATION OF FLUSHING HYDRANTS FOR PERMANENT BLOW-OFF ASSEMBLIES

A. Locate flushing hydrants as shown on the Drawing or as directed by the Engineer. The location shall provide complete accessibility and shall be outside of vehicular traffic areas.

B. Engineer may require hydrant protection using steel pipe bollards when hydrant installations have a greater than normal exposure to vehicular damage (e.g. parking lot installations, unusual driving situation, etc.). Contractor shall install all such protection designated by the Engineer. Locate bollards as necessary adjacent to the hydrant and in such a manner as to not interfere with the ability to

operate the hydrant. Refer to the Owner's Standard Detail Drawing for typical fire hydrant installation for requirements for bollards. Additionally, locate the bottom of the bollard and encasement higher than (but not directly above) the blow-off assembly piping and valve to prevent the possibility of damage to the piping should the bollard be displaced when hit. Payment for bollards shall be per the supplemental unit price schedule.

C. Notify the Engineer of situations where the ground water table is above the drain opening prior to installation of the flushing hydrant. Where possible, with the Engineer's approval, relocate flushing hydrants to another location.

D. Connect each flushing hydrant to the main with an independent valve, unless otherwise shown on the Drawings.

E. Install below-ground flushing hydrant within a standard meter pit. All flushing hydrants shall be vertically plumb. Refer to the Owner's Standard Detail Drawing for typical blow-off assembly installation.

F. Unless otherwise directed by the Engineer, excavate a drainage pit two feet in diameter and two feet deep below each hydrant. Fill the pit with compacted ¾ inch clean granular fill under and around the base of the hydrant to a level at least 6 inches above the hydrant drain opening and above the bottom of the meter pit.

G. Unless otherwise directed by the Engineer, the permanent blow-off assembly piping, and valve shall be encased in polyethylene encasement up to finish grade per Section 15130 prior to backfill. The polyethylene encasement shall not interfere with drainage of the hydrant.

H. After installation and before backfilling (and after pressure testing the water main) test the flushing hydrant as follows:

1. Pressure Test
    a. Open the hydrant valve slightly to vent air from the hydrant.
    b. After all air has escaped, securely tighten the cap before proceeding.
    c. Open the hydrant valve fully to apply line pressure.
    d. Check complete flushing hydrant assembly for leakage. No leakage is allowed in 10 minutes.
    e. If leakage is noted, repair or replace components or complete hydrant until no leaks are evident.
2. Drainage Test
    a. Following the pressure test, close hydrant.
    b. Remove the hydrant cap and place pylon or hand over nozzle opening.
    c. Drainage rate should be sufficiently rapid to create a noticeable suction.
    d. After backfilling, operate the hydrant to flush out any foreign material.
    e. Secure cap.

END OF SECTION

SECTION 15200

SERVICE LINES

PART 1: GENERAL

1.01 SCOPE OF WORK

A. The Work under this section consists of providing all labor, materials, tools, equipment, and services required to install service lines originating at the water main and terminating at either a curb stop connection or a meter pit (including connection to existing service when applicable) as indicated on the Drawings and as specified within this section and related sections of the Specification (including Section 01011). This section shall also apply to HDPE water mains smaller than 4-inch diameter, which shall meet the requirements of this section, except that installation of HDPE water mains smaller than 4-inch diameter shall also be in accordance with Section 15125 to the extent applicable. Contractor shall furnish and install all items that are not furnished by the Owner. Refer to Sections 01000, 01011, and 01075 for materials to be furnished by the Owner.

B. This section does not include service lines beyond the meter pit or meter installations beyond the curb stop (as applicable).

C. When water mains smaller than 4-inch diameter are required, high density polyethylene pipe in accordance with this section shall be used.

D. Owner shall furnish and install the meter and radio read sensors (if required).

1.02 GENERAL REQUIREMENTS

Refer to Owner's Standard Details for a typical service line installation.

1.03 COORDINATION OF WORK

Contractor shall coordinate with the applicable Owner's Operations District to ensure all Work is provided consistent with applicable requirements of that district.

1.04 SUBMITTALS

A. Contractor shall submit Shop Drawings, manufacturer's literature and product data, certifications, and other required submittals for all products furnished under this section (including those listed under this section within Section 01011) in accordance with Section 01300.

1.05 QUALITY ASSURANCE

A. All furnished products shall meet the minimum quality requirements by conforming to the below-referenced standards and other applicable standards.

1.06 RELATED WORK

A. Section 01000 Summary of Work

B. Section 01011 Special Provisions

C. Section 01075 Basis of Payment

D. Section 01300 Submittals

E. Section 01600 Products

F. Section 01700 Project Closeout

G. Section 02210 Trenching, Backfilling and Compacting

H. Section 02558 Identification/Location Guide

I. Section 15000 Piping – General Provisions

J. Section 15020 Disinfecting Pipelines

K. Section 15025 Flushing and Cleaning Pipelines

L. Section 15030 Pressure and Leakage Tests

M. Section 15125 High Density Polyethylene (HDPE) Pipe

N. Section 15130 Piping Specialties

O. Section 15170 Tapping Sleeves, Saddles & Valves

1.07 REFERENCE

Unless otherwise indicated, all references herein to other standards (e.g. AWWA, ASTM, ASME, ANSI etc.) shall mean the most current available revision. The following referenced documents are a part of this section. Comply with all applicable provisions and recommendations of the following documents, except as otherwise specified herein. Where a referenced document contains references to other standards, those other standards are included as references under this section as if referenced directly. In the event of a conflict between the requirements of this section and those of the referenced documents, the requirements of this section shall prevail.

A. ASTM B88 – Standard Specification for Seamless Copper Water Tube

B. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping

C. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

D. ASTM D3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter

E. ASTM D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

F. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

G. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe

H. ASTM F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure

I. AWWA C600 Installation of Ductile-Iron Mains and Their Appurtenances

J. AWWA C605 Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings

K. AWWA C800 Underground Service Line Valves and Fittings

L. AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ In. Through 3 In., for Water Service

M. AWWA Manual M55 PE Pipe—Design and Installation

N. NSF/ANSI 14 Plastics Piping System Components and Related Materials

O. NSF/ANSI 61 Drinking Water System Components – Health Effects

P. NSF/ANSI 372 Drinking Water System Components – Lead Content

Q. *Tapping Guide for PVC Pressure Pipe*, UNI-PUB-8, Uni-Bell PVC Pipe Association.

PART 2: PRODUCTS

2.01 GENERAL

A. All products furnished under this section (including components specified under this section in Section 01011) shall meet all applicable AWWA standards and shall meet the requirements of NSF 61 and NSF 372, except for components that will not come in contact with potable water (e.g. meter yokes).

B. Service line material shall be as shown on the Drawings, as required by the Owner's Operations District, and/or as directed by the Engineer.

C. All corporation stops, curb stops, ball valves, and other service line and meter installation fittings shall be compatible with the service line material to be used. Regardless of the part numbers specified, it is the Contractor's responsibility to ensure compatibility of all products.

2.02 POLYETHYLENE SERVICE LINE MATERIAL

A. High density, ultra-high molecular weight (UHMW) polyethylene service line manufactured from PE 4710 resin shall be Pressure Class 200 (DR9) conforming to AWWA Standard C901. Pipe sizes (3/4", 1", 1-1/2", 2" and 3") shall be as shown on the Drawings, as indicated in Section 01075, or as directed by the Engineer.

B. Polyethylene pipe sizing shall be copper tube size (CTS) or outside-diameter controlled iron pipe size (IPS) as required by the Owner's local Operations District or as directed by the Engineer. Unless otherwise specified in Section 01011, all service line pipe shall be CTS, except that all 3" HDPE pipe shall be IPS.

C. HDPE fittings shall not be used other than as specified in Section 15125, unless otherwise approved in writing by the Owner.

D. Polyethylene service line color shall be blue.

E. Acceptable manufacturers:

1. Endot Industries, Inc. (EndoPure or Endopoly)
2. J-M Manufacturing Company, Inc.
3. JM Eagle

2.03 COPPER SERVICE LINE MATERIAL

Copper pipe shall be Type L or Type K, as specified, meeting the requirements of ASTM Standard B88. The pipe size (3/4", 1", 1-1/2", or 2") and type are to be determined by the Engineer. Type K is normally required in corrosive environments where polyethylene is not allowed.

2.04 CORPORATION STOPS

A. Corporation stops shall be of the brass, ball valve type manufactured in accordance with AWWA Standard C800. The inlet connection shall have standard AWWA tapered threads unless otherwise specified in Section 01011 or required by the Engineer. The outlet connection shall be copper or brass compression connection end or pack joint for polyethylene pipe, as required (refer to Section 01011). The sizes shall range from 1/2" to 2" and shall match the size of specified service line material.

B. Acceptable manufacturers and model numbers are:

1. Ford Meter Box Company - FB400 thru FB1600 (unless otherwise listed in Section 01011)
2. Mueller - B-25000N (unless otherwise listed in Section 01011)
3. A.Y. McDonald – 4701B Series (unless otherwise listed in Section 01011)

2.05 CURB STOPS

A. Curb stops (when required) shall be bronze body construction, ball valves, with double O-ring stem seals. Curb stops (when required) shall conform to AWWA Standard C800. End connections shall be suitable for copper or brass compression connection or pack joint for polyethylene pipe, as required. Sizes shall be from 3/4" to 2" and shall match the service line size.

B. Acceptable manufacturers and model numbers:

1. Ford Meter Box Company – B22 Series (unless otherwise listed in Section 01011)
2. Mueller - B-25204N (unless otherwise listed in Section 01011)
3. A.Y. McDonald - 6100 Series (unless otherwise listed in Section 01011)

2.06 CURB BOXES

A. Curb boxes (when required) shall be standard cast iron, sliding or screw type, 1" or 2-1/2" as required, complete with lid and head bolt. Boxes shall be adjustable from 18-inches to 66-inches. The box size will be determined by the Engineer.

B. Acceptable manufacturers:

1. Bingham & Taylor
2. Mueller
3. Handley Industries
4. Clay & Bailey
5. A.Y. McDonald
6. Quality Water Products

2.07 METER PITS, RINGS/COVERS, AND LIDS

A. Unless otherwise indicated in Section 01011, meter pits for services 2-inch and smaller shall be round corrugated (or ribbed) plastic tile with straight walls and an inside diameter as indicated in the following table based on the service size. Meter pit length/depth shall be as indicated in Section 01011 for each individual Operations District. Meter pits shall have a white interior and include an integral anti-settling flange on the bottom.

Service size (in.) Meter (Single or Dual)	Meter Pit Inside Diameter (in.)	Manufactured Pit Setter Ford Meter Box Co. Pit, Components, Cover, Lid	Ford Meter Box Co. Cover and Lid	A.Y. McDonald Cover and Lid	Vestal Cover/Ring and Lid
5/8 and ¾ (Single)	20	-	As specified in Section 01011		
5/8 and ¾ (Dual)	24	-	As specified in Section 01011		
1	24	-	MC-24-T	74M24-T	As specified in Section 01011
1½	30/36	As specified in Section 01011	MC-30-T	74M30-T	Per local Operations District
2	36	As specified in Section 01011	MC-36-T	74M36-T	Per local Operations District
>=3	Precast concrete	As specified in Section 01011	As specified in Section 03450		

B. Acceptable Manufacturers (meter pits):

1. Series B Molded polymer enclosures manufactured by DFW Plastics, Inc.
2. Round polyethylene blend Heavywall Meter Pits manufactured by Carson Plastic by Oldcastle, Inc.
3. Plastic Meter Pits by EJ USA (East Jordan)
4. White dual wall, corrugated HDPE Meter Pits manufactured by ADS (only where named in Section 01011)
5. Corrugated HDPE Meter Pits manufactured by FRATCO, Franceville, IN.

C. Meters pits for 3-inch and larger meters shall be precast concrete structures per Section 03450.

D. Covers and lids for 20-inch diameter meter pits shall be as specified in Section 01011 for each individual Operations District. Covers and lids for 24-inch and larger meter pits shall be monitor covers as indicated in the above table unless otherwise specified in Section 01011 for individual Operations Districts. Lids shall one or two 1¾-inch diameter hole(s) where required to accept a touch-read encoder pad.

E. Acceptable Manufacturers (covers and lids):

1. Vestal Manufacturing Enterprises, Inc.
2. Ford Meter Box Co.
3. A.Y. McDonald
4. Sigma (only where listed in Section 01011)

F. METER PIT RING & COVER: TRAFFIC LOAD RATED: Ford Meter Box Co., Model A3H, or approved equal.

2.08 METER SETTING COMPONENTS

A. Meter setting components, including the following items (where required), shall be as specified in Section 01011 for each Operations District.

1. Yoke bars
2. Setters
3. Branches
4. Ball valves
5. Angle valves
6. Outlet valves
7. Outlet ells / fittings
8. Expansion nuts
9. Meter idlers
10. Adapters

B. Each meter yoke and setter shall be supported by two vertical ½-inch or ¾-inch galvanized steel standpipes (sized to fit the yoke or setter) unless otherwise specified in Section 01011; however, only one standpipe may be used with yokes that are designed for only a single standpipe or where allowed by the Owner (all dual sets shall use two standpipes). Where indicated in Section 01011, a horizontal ¾-inch galvanized steel cross bar shall be installed instead of vertical standpipes to support the yoke or setter; and yoke/setter shall be secured to the cross bar by an approved method.

2.09 MISCELLANEOUS SERVICE LINE FITTINGS

A. Miscellaneous service line fittings such as couplings, adapters, saddles, bends, plugs, service line electrical insulators, etc. shall conform to AWWA Standard C800.

B. Tapping sleeves and saddles shall be as specified in Sections 15170 and 15125.

C. Acceptable manufacturers:

1. Ford Meter Box
2. Mueller
3. A.Y. McDonald

PART 3: EXECUTION

3.01 PACKAGING, HANDLING, AND STORAGE

Refer to Section 15000.

3.02 INSTALLATION (GENERAL)

A. Provide appropriate protection between dissimilar metals. Where metallic service lines are installed or already exist, dielectric unions shall be used at corporation stops to prevent transfer of any electrical stray currents from metallic service lines to metallic water main.

B. Utilize a minimum of interconnecting fittings.

C. All plastic service line connections shall use non-metallic insert stiffeners of the appropriate length and size at the connection between the plastic service line and the corporation stop outlet, except as otherwise specified in this section or Section 01011.

D. After completion of service line installation, but prior to backfilling, open the corporation stop slowly to fill the line. When the line is full and all air has been removed, completely open the corporation and close the curb stop (if applicable). Visually inspect that all piping, fittings, and taps for leaks. Backfill and restore the surface the service line trench in accordance with Division 2 of these Specifications.

E. Services, including meter installations, shall be installed consistent with the Owner's Standard Details, except as otherwise specified in this section or Section 01011 or directed by the Resident Project Representative.

3.03 INSTALLATION OF CORPORATION STOPS

A. Use experienced craftsmen familiar with installation of water service lines when tapping water mains. Make all taps with a suitable tapping machine (Mueller, Ford, Hays or Dresser type) using the proper combined drill and tap. Hand held drilling equipment is not acceptable.

B. Before making the tap, inspect corporation stops for cleanliness, damaged threads, and proper operation of the ball valve prior to installation. Do not install corporation stops that fail this inspection.

C. The main may be tapped along the top half of the pipe at a 45-degree orientation or as shown on the Standard Details. Use a tapping sleeve or saddle for all taps 1½-inch or larger (in ductile iron pipe) and other situations where the water main wall thickness or material (PVC, HDPE, concrete or A-C pipeline material) make it unsuitable for direct tapping. All taps larger than 3-inch shall use a tapping sleeve. Tapping sleeves and saddles shall be in accordance with Sections 15170 and 15125, except where Section 01011 includes district-specific requirements. Verify sleeve or saddle use with Engineer.

D. In the case of multiple services of small diameter (less than 1-inch diameter), corporation stops shall be at least 12 inches apart and at least 22-1/2 degrees above or below the location of any adjacent tap(s) and curb stops and boxes shall be at least one foot apart. In the case of multiple medium diameter (2 inch to 3 inch diameter) services, tap at least 24 inches apart and at least 22-1/2 degrees above or below the location of any adjacent tap(s). However, services 4-inch diameter and larger shall be tapped only on the 3 o'clock or 9 o'clock positions and shall be tapped at least 5 feet apart.

E. Install all corporation stops so that between 2 and 3 threads extend beyond the inside wall of the main. If necessary, make a test tap with the boring bar marked to the proper depth. The corporation stop, when properly installed, will not be shouldered with the main. Do not use lubricants of any type when installing the corporation stop.

F. Use the procedures outlined in AWWA Standard C600 for installing taps on grey iron or ductile iron mains encased in polyethylene.

3.04 SERVICE CONNECTIONS TO PVC PIPE

A. Install service connections in accordance with AWWA Standard C605 and the manufacturer's recommendations using the following methods:

1. Tapping is only permitted through the use of service clamps or saddles.
2. Using injection molded couplings with threaded outlets.
3. Tapping with large service connections through appropriately sized tapping sleeves and valves.
4. Direct tapping of service connections is not permitted. Use only service saddles for AWWA Standard C900 pipe, for nominal pipe sizes 6 inch through 12 inch. Corporation stops shall be threaded and conform to AWWA Standard C800.

3.05 SERVICE CONNECTIONS TO HDPE PIPE

B. Install service connections in accordance with Section 15125, AWWA Manual M55, and the manufacturer's recommendations using the following methods:

1. Direct tapping of service connections is not permitted. Use of tapping saddles or sleeves is only permitted with written authorization by the Owner.
2. Tapping for service connections 2-inch nominal diameter and smaller on water mains larger than 2-inch nominal diameter is only permitted through the use of polyethylene side-fusion saddles in accordance with Section 15125. HDPE electrofusion branch outlets in accordance with Section 15125 shall not be provided unless otherwise approved by the Owner in writing.
3. Connection of service connections to water mains 2-inch nominal diameter and smaller is only permitted through the use of brass tees with adapter couplings. HDPE electrofusion branch outlets in accordance with Section 15125 shall not be provided unless otherwise approved by the Owner in writing.
4. Tapping for service connections 3-inch nominal diameter is only permitted through the use of HDPE branch outlets in accordance with Section 15125 unless otherwise approved by the Owner in writing.
5. Tapping for service connections larger than 3-inch nominal diameter shall be in accordance with Sections 15125 and 15170.

3.06 INSTALLATION OF SERVICE LINE AND FITTINGS

A. Research has documented that certain pipe materials (such as polyethylene, polybutylene, polyvinyl chloride, and asbestos cement) and certain elastomers (such as used in jointing gaskets and packing glands) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Polyethelene service line shall only be installed in soils that are free of both petroleum products and organic solvents. If during the course of pipeline installation the Contractor identifies or suspects the presence of petroleum products or any unknown chemical substance in the native soil, Contractor shall stop installation of service line and notify the Engineer immediately. Contractor shall not resume installing service line in the area of suspected contamination until direction is provided by the Engineer.

B. Excavate the service line trench in accordance with Section 02210. Where augering or moling is permitted, follow guidelines provided by the equipment manufacturer, including making a proper size hole to launch and receive the unit. If moling or augering is employed, take appropriate precautions to avoid damaging other utilities and disturbing the unexcavated surface.

C. Install service line between the tap connection and the curb stop location making only gradual changes in grade or alignment as required. Sharp bends (greater than 15 degrees) in any direction are not allowed unless approved by the Engineer. Installation shall be in accordance with Section 15000 and the Standard Details and in accordance with local regulations.

D. Install all service lines straight, perpendicular to the main, and in line with the new (if applicable) or existing meter pit, curb stop, or customer service line (as applicable). If this cannot be accomplished (as approved by the Resident Project Representative), provide the Owner with accurate as-built dimensions to the tee or

corporation stop. In no case shall service lines be installed parallel to the water main.

E. If fusion of service line is required, it shall be conducted in accordance with Section 15125 or as otherwise approved by the Engineer.

F. All trenched services shall be installed with detectable identification tape per Section 02558.

G. All services shall be installed with location (tracer) wire per Section 02558.

3.07 INSTALLATION OF CURB STOPS

A. Curb stops are typically only required for services with existing indoor meters, other services where a meter pit is not installed, or for permanent sampling or blow-off installations. Curb stops and curb boxes shall be provided where required on the Drawings, in Section 01011, elsewhere in the Specifications, or by the Resident Project Representative. Install curb stops with the operating nut in the vertical position and the curb box centered over the nut. Install curb boxes plum and adjusted to be flush with finished grade. Install and lock curb boxes immediately after installation.

3.08 INSTALLATION OF METER PITS AND METER SETTING COMPONENTS

A. Meter pits shall be located as shown on the Drawings, in accordance with the Owner's Standard Details and local requirements, and as directed by the Resident Project Representative.

B. Meter pit depth shall be as specified in Section 01011 for the Owner's local Operations District.

C. Meter pits shall not be installed within an existing or planned driveway or sidewalk.

D. All specified meter setting components and other miscellaneous service line fittings shall be installed as shown on the Drawings, Standard Details, and directed by the Resident Project Representative.

3.09 POLYETHYLENE ENCASEMENT

A. Provide polyethylene encasement, or other protective wrap approved by the Engineer, on all metal service lines and fittings (valves, stops, etc.) when they are made of different materials than the water main. When the polyethylene is applied on the main, it shall extend for a minimum clear distance of three feet (3') away from the main when services are not being renewed or extend from the main connection to and including the curb stop or curb meter setter for all new copper service lines. Encasement material and installation shall be per Section 15130.

3.010 TESTING OF SERVICES

A. Open the corporation stop slowly to fill the service line. When the line is full and all air has been removed, completely open the corporation stop. Perform a visual leak inspection of all piping, fittings, and taps prior to backfilling. Zero leakage is allowed in 10 minutes.

END OF SECTION

AMERICAN WATER

RECOMMENDED ELECTRICAL DESIGN CRITERIA AND STANDARDS

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Version Date: March 28, 2022

AMERICAN WATER ENGINEERING
RECOMMENDED ELECTRICAL DESIGN CRITERIA AND STANDARDS

INTRODUCTION

Design of safe, reliable, and cost effective electrical power distribution systems is an essential aspect of the design of water and wastewater pumping, storage, and treatment facilities. Safety begins with proper sizing, coordination, selection, and installation of appropriate materials and power system components, all of which are critical to minimize the risk of worker injury and equipment damage from electrical hazards. Reliability is also tied to proper design and equipment selection because power system components are subject to unique thermal, magnetic, and vibration forces on an often continuous basis. Cost-effectiveness is impacted by numerous design decisions, including equipment location/layout, operating voltage, equipment specifications, design safety factors, environment, etc.

The purpose of this standard is to provide recommendations for electrical system design criteria and standards that American Water Engineering has found to be effective for maximizing value by assuring safe, reliable, and cost-effective electrical power system installations. None of the recommendations included herein shall be construed as superseding local building code requirements, and all facility designs and installations must fully comply with current electrical and building code requirements applicable to the project. In addition, it is the responsibility of the designer to develop a fully integrated and complete set of design plans and specifications based to the degree possible on these design recommendations.

Included with this guidance document are the following other reference attachments:

1. Attachment – Power System Studies & Arc Flash Hazard Analysis Requirements. Provides detailed requirements for performing electrical coordination analysis and arc flash hazard assessments. These requirements are considered essential for a complete, coordinated design and should be included as part of a consultant's design scope of services.

2. Attachment – Acceptable Electrical Equipment Manufacturers List. Identifies acceptable manufacturers for electrical equipment and systems. This listing is to be reviewed with the Owner prior to implementing the design in order to establish preferred sourcing of equipment and suppliers based on Owner preference, service/support and availability. The list is not intended to establish an order of preference; only manufacturers who have demonstrated capability to provide materials and quality of construction for the intended installations and applications. Other sources may be considered if accepted by the Owner in advance of the Design Memorandum submission. Any revisions are to be documented in writing with this submission.

Other References Available but not included at this time include:

3. Attachment C - SEL Relay Device Monitoring Points (Modbus to SCADA /RTU): Identifies typical data acquired from the various SEL metering and protective relay devices provided on AW Projects. This list is not intended to capture all data that may be necessary nor is intended to limit the actual devices provided.

4. Attachment D – Power Monitoring Equipment Configuration and Monitoring Points

DESIGN CONSIDERATIONS - POWER DISTRIBUTION AND ARC FLASH HAZARD CONSIDERATIONS

Arc flash hazard evaluations have continually shown that the incoming (line-side) terminations on 277/480 VAC and/or 480 VAC services pose significant risk due to high incident energy levels. Frequently, incident energy at the incoming service exceeds 40 cal/cm2, or PPE-4 level of protective equipment. To address this issue, AW recommends installing the incoming main service disconnect device in a separate enclosure, and then sub-feeding from this over-current protection device (OCPD) to a main lug panel or distribution assembly. While this may still pose the risks at this service-entrance location, it is intended that the design and selection of the main device will lower the incident energy associated with the downstream equipment to a level below the PPE-4 maximum protective equipment available for any energized work required.

AW recommends only circuit breakers (no fusible switch equipment) be used for this main service over-current protection device. This allows the operator to “reset” the main in the event of a “trip” incident without having to “open” the equipment (to check fuses, etc.). This “main” should also be provided with the metering input components and devices as outlined herein under item #12 – “Power Monitoring/Metering and Protective Relaying” where this metering is desired by the Owner.

For those facilities where it is intended to also provide permanent or portable standby generator power, the following recommendations should be considered.

1. LV (low voltage, i.e. 1000V and less) and MV (medium voltage, i.e. above 1000V) feeder systems, upon selection of electrical gear manufacturer develop model of oneline to select OCPD models that maintain proper short circuit current per utility data, provide selective coordination and reduce incident energy.

    a. LV systems to use trip units with LSIG or thermomagnetic up to 12 calories per centimeter squared, above 12 calories use protective relays as described in [Section 10(h)], LSIG breaker to be selectively coordinated to trip after protective relay on systems above 12 calories per centimeter squared. Note thermomagnetic OCPD typically have poor selective coordination and use to be discussed with owner during design phase.

    b. MV systems to use protective relaying as described in [Section 10(h)].

2. On 120/208-240 VAC power systems where Available Fault Current is less than 10 KAIC, AW recommends considering the use of circuit breaker transfer equipment in lieu of the individually mounted “main” circuit breaker and contactor-based transfer equipment (e.g., typical Asco transfer switch). Benefits include combined (but shielded) circuit breakers for the utility and generator protection, UL service-entrance listed as well as UL-1008 listed/labeled for automatic transfer switch (ATS) applications and non-automatic operation associated with portable generator installations. AW has developed a configuration including standard and “optional” features associated with this equipment. The potential for high Incident Energy levels above 40 cal/cm2 and resulting PPE in these low voltage installations typically does not exceed the PPE available to workers and contractors; the 277/480 VAC Systems are where the highest concerns regarding Incident Energy and “Danger – No Safe PPE Exists” equipment labeling have thus far been determined.

    Overall, this circuit breaker type ATS equipment typically represents a lower cost and requires less physical space within the facility providing a cost-effective solution where appropriate and where provided. For those facilities and service areas where contactor-based ATS equipment

is already in service, the Owner may elect to continue to provide this type of equipment. However, the features and functions outlined as needed for OCP and Arc Flash Hazard isolation and protection shall be met.

3. On our 277/480 VAC Systems it is recommended to use the separately enclosed "Main" Circuit Breaker to isolate the Utility from the rest of the power distribution system. The use of contactor based ATS equipment requires the use of this separate "Main" as well as an additional "generator circuit breaker" for those applications involving portable generator connections. Additionally, and as a minimum, a shunt-trip interface (i.e. E-Stop control station) shall be provided at the Automatic Transfer Switch (ATS) for disconnection of power associated with any permanently installed generator.

4. Where provided, portable standby generator installations offer unique challenges. Many of our portable generators are over-sized for the smaller stations they serve. As such, the OCPD on the generator will typically be larger than the service equipment ampacity ratings in the facility. This is the reason for the "generator circuit breaker" recommended above. Without this additional device, the station equipment is not adequately protected against an over-current event. The shunt-trip device mentioned previously is necessary to "trip" the circuit breaker on the permanently installed generator in order to isolate this power from the building system in the event of an emergency (fire or similar event). The use of the circuit breaker type ATS equipment addresses this concern and is part of the reason AW recommends consideration of this type equipment.

Connection of portable generators is another area which is to be carefully considered. The use of portable generators with large cables and connector bodies poses risks during the installation and connection of these devices to the station. To address this, AW recommends using a color coded pin and sleeve type connector assembly similar to Trystar's Generator Docking Station (complete with cam-lock connections and generator cabling color coded for voltage rating) for those installations 200 Amperes and larger in lieu of the three-phase connector plug and receptacle method. This allows easier and safer connectivity of the equipment by operational staff during an event. In locations where portable generators may be connected for extended periods of time, the transfer switch's control conductors are to be wired to a twist-lock style two-pole grounding receptacle locally mounted near the generator's connector assembly. This will allow the portable unit with remote starting capability to auto-start upon loss of power. Also, where environmental conditions warrant, provide a separate receptacle of suitable voltage and rating for connection of the generator's battery charger and water jacket heater.

TECHNICAL CRITERIA AND DESIGN STANDARDS

1. Basic Electrical Materials and Raceways

a. All materials shall be suitable for the location and environment where installed. Specifically, AW Engineering has identified the following areas/environments as not being compatible with Stainless Steel (SS) enclosures and supports.
    1) Chlorine and chlorinous vapors
    2) Fluosilicic acid and vapors
    3) Orthophosphate and vapors (zinc orthophosphate, phosphoric acid)
    4) Other potential areas and compatibility of materials are to be reviewed with the Owner for final selection of installed systems

b. Control panels and related enclosures in corrosive areas shall generally be non-metallic type with non-metallic hardware; NEMA 12 metallic or non-metallic in non-corrosive areas unless

otherwise accepted. The use of stainless steel enclosures should be limited to areas not exposed to chlorine fluoride fumes. Provide NEMA 4X non-metallic enclosures in these and other corrosive areas. It is acceptable to install NEMA 3R enclosures outdoors where the area of installation does not include corrosive atmosphere. VFDs are not recommended to be installed in NEMA 4X enclosures due to issues with localized heating within the enclosure. These enclosures do not have the ability to ventilate using outside air, which potentially overheats the enclosure where a VFD would be installed. It is recommended to install VFDs in NEMA 3R enclosures when installed outdoors and only installed in NEMA 1 or NEMA 12 enclosures when installed indoors in non-corrosive areas. For VFDs installed in corrosive areas indoors, a NEMA 4X enclosure would need to be evaluated to determine if a local mounted AC unit to cool the enclosure is required.

c. All feeders (and branch circuits rated 100 amps and larger) shall be provided in rigid hot-dipped galvanized steel (RGS) or aluminum conduit. The use of fiberglass conduit is an acceptable alternative where approved by the Owner. Other building areas to utilize raceway materials as outlined herein (see 2 below) unless otherwise indicated. Exposed exterior locations may utilize hot-dipped RGS or aluminum conduit where determined suitable for the application. Additionally, the use of fiberglass conduit is acceptable where determined to be suitable for the location and application. The use of intermediate metal conduit (IMC) is prohibited anywhere on the project. The use of electro-metallic tubing (EMT) is prohibited on any Industrial Buildings and Related Type Areas as outlined below.

d. All conduit fittings to utilize gasketed screw covers; clip cover fastening type fittings are prohibited. Provide “Myers hub” type connectors associated with exterior and wet location enclosures.

e. Where served from overhead or above, raceway penetrations into buried or below grade equipment / enclosures and exposed exterior equipment enclosures shall not enter the top; they shall enter the bottom side and be provided with a means for draining moisture from the raceway and sealed between the raceway and the enclosure with duct-seal material. These enclosures shall be provided with a vapor corrosion inhibitor (Cortec, or equivalent) sized appropriately for the interior volume of the cabinet.

f. Receptacles and switches to be heavy-duty rated, 20 ampere minimum rated; material type and configuration to be suitable for the application.

g. Control Station devices should be NEMA 12 minimum; NEMA 4X rated in corrosive and damp locations where available; all devices to be 30 mm minimum size for gloved operation. All pilot lights are to be high intensity 120 VAC LED type; red for “run”, green for ‘off” ”, amber for “alarm”, and white for general indication. Other colors to be coordinated with the Water Company to match existing conventions or as requested; generally in accordance with NFPA-79, Table 10.3.2.

h. All electrical distribution equipment (i.e., switchgear, switchboards, transformers, panelboards, control panels, etc.) are to be installed to allow required NEC working clearances. The walkway of this working clearance area is to be covered with industrial safety matting. Matting shall be non-slip corrugated style and shall meet ASTM D178-01 for Class 2, Type II installations and shall be resistant to UV, ozone and most standard industrial chemicals. At a minimum, the matting is to be 1/4” thick, dielectric strength of 30,000v, proof tested over entire length at 20,000v and have a maximum use of 17,000v.

2. Raceway Material and General Applications

a. GENERAL NOTE:

1) Raceways are not permitted to be installed concealed in water-bearing walls. All equipment, devices and raceways shall be installed on the dry-side wall surface using nominal 7/8" non-metallic channel support stand-offs installed vertically to allow ventilation air to pass behind equipment and raceways. Fastening hardware to be 316 Stainless Steel or other accepted materials where required due to the environmental conditions of the area
2) No raceway is permitted to penetrate the floor or wall into the containment area of a chemical room. Note: final connections and raceway installations serving equipment located within this containment zone shall be supplied from outlets and equipment enclosures mounted above the maximum containment level identified. All penetrations, outlets, and equipment are to be located above the containment zone in the room. This prevents a failure of the raceway system from potentially becoming a "drain".

The following general criteria are to be used for raceway material selection and installations. This listing is not intended to address all applications and/or specific equipment requirements which may be outlined elsewhere on the Engineer's Drawings or indicated in the Specifications.

b. Industrial Buildings and Related Type Facilities or Areas:

1) Chemical Storage and Dispensing (non-hazardous materials)

i. Exposed from Finished Floor to 8"-0" AFF

a. PVC Coated rigid galvanized steel (RGS) Conduit and Liquidtight Flexible Metal Conduit are recommended. PVC Schedule 40 Conduit and Non-Metallic Liquid-tight Flexible raceways may be used in areas where not subject to physical damage from O&M activities such as chemical deliveries or vehicular traffic.
   i. Alternate Materials: the selective use of fiberglass conduit provides another means of addressing corrosion resistance and maintaining a non-metallic installation. [Note: AW Engineering does not recommend the use of PVC conduit, even Schedule 80 PVC where subject to physical damage
b. Outlet and Junction Boxes - PVC Coated, Cast Type, FD capacity for use with the PVC Coated RS Conduit. As above, where non-metallic raceways are utilized, the use of non-metallic outlet and junction boxes may be provided.
c. All outlet cover plates to be "in-use", weather-protected type and gasketed.

ii. Exposed 8'-0" AFF and above within the room

a. PVC Schedule 40 Conduit may be used in lieu of PVC Coated RS Raceways. Where provided, the Contractor shall include the use of expansion and axial connectors as recommended by the non-metallic raceway Manufacturer (not just at building expansion points).
b. Junction Boxes - PVC, FD capacity for use with the PVC Conduit System.

iii. *NOTE: No "in-floor" conduit or floor penetrations are permitted within chemical containment areas.*

iv. As above, the use of fiberglass conduit systems is permitted to be used in place of the PVC Coated RGS raceways and PVC Schedule 40 Conduit hybrid systems outlined above as well as other locations throughout the facility. As above, no penetrations within the chemical containment areas are permitted.

Engineers NOTE - Potentially, a listing or some other form for identifying which chemicals / areas require the use of seal-offs will need to be determined and included in the Contract Documents (below)

v. Transitions from Chemical Storage and Dispensing Areas to other building areas shall utilize PVC Coated RS Conduit within the area and transition to RGS material where extending to a non-chemical area. Provide seal-off fittings and appropriate sealing material (as specified) to prevent vapor transmission through the raceway system at this transition point inside the chemical area.

2) "Damp" Areas, including those areas involving enclosed tanks and piping, but do not involve direct wash-down or similar use of water, and where the ambient temperature of the space may drop below 65 degrees F.

i. Rigid Galvanized Steel (RGS) Conduit and fittings.
ii. Liquidtight Flexible Metal Conduit.
iii. Exposed outlets - Cast Type, FD capacity.
iv. Recessed Outlets (where permitted) - one-piece galvanized steel (expandable metal outlets not permitted).
v. Cover plates – stainless steel or cast cover type or as specified and/or indicated on the Drawings.

3) "Wet" Areas, including those areas involving exposed/open tanks and direct wash-down and similar applications, where water is routinely present.

i. Rigid Galvanized Steel (RGS) Conduit and fittings or PVC Coated RGS Conduit and PVC Coated fittings as indicated on the Drawings.
ii. Liquidtight Flexible Metal Conduit.
iii. Exposed outlets - Cast Type, FD capacity (PVC Coated where coated raceway systems are indicated on the Drawings.
iv. Recessed Outlets (where permitted) - one-piece galvanized steel (expandable metal outlets not permitted).
v. All outlet device cover plates to be "in-use", weather-protected and gasketed type.

Engineers Note - "Damp" and "Wet" terms will need to be defined and included in the Contract Documents.

Owner's Note – AWBSE has found metallic raceway systems provide higher reliability and longevity than PVC systems, but Owner may consider the use of non-metallic raceway systems on projects involving limited conduit lengths and where risks for damage to raceway is considered minimal.

4) Electrical, Mechanical (HVAC) and General Equipment Storage Rooms

i. Rigid Galvanized Steel (RGS) Conduit and fittings.
ii. Flexible Metal Conduit - Lighting Fixtures and similar type equipment.
iii. Liquidtight Flexible Metal Conduit - motor (and similar equipment involving close proximity to water and/or oil) connections.
iv. Exposed outlets - Cast Type, FD capacity.

v. Recessed Outlets (where permitted) - one-piece galvanized steel (expandable metal outlets not permitted).
vi. Cover plates - companion type as specified and/or indicated in Specifications or on the Drawings.

5) Hangers, Supports and Fasteners

i. In chemical and corrosive areas, FRP Threaded Rod with non-metallic FRP channel supports and fasteners shall be provided. In areas other than Chlorine and Fluoride environments, the use of 316 Stainless Steel threaded rod and fasteners also is permitted. Where the weight of the installation exceeds that permitted by the FRP materials, the use of 316 SS channel supports and threaded rod will be considered acceptable. PVC Coated steel channel supports is not accepted.

ii. In all other areas channel supports shall be hot-dipped galvanized and threaded rod shall be galvanized steel. All fasteners shall be 316 Stainless Steel.

6) Cable Tray and Trough Systems

i. The use of aluminum or FRP cable tray is an acceptable practice for wiring of equipment; especially in pipe galleries, alongside of walkways and similar tight areas where access to equipment is very restricted.
ii. Solid-bottom (or ventilated bottom) cable trough systems are also considered acceptable for locations where ladder type cable tray is not appropriate due to special considerations of the work.
iii. The use of cable tray and / or trough systems is to be reviewed with and accepted by the Owner prior to the start of design. The Design Memorandum shall include a description of what is being proposed and wiring systems to be included.
iv. Cable types to be UL Listed for the applications and isolation between voltages, including low voltage and instrumentation systems shall be included in the design.

c. Administrative Buildings and Related Type Facilities or Areas

1) All areas within conditioned rooms (those spaces where heating and/or air conditioning/ventilation is provided to maintain a nominal ambient temperature of 68 degrees and higher).

2) General Installations

i. Conduits 1-¼” and smaller may be EMT. This raceway type may be provided for either exposed or concealed raceways. All EMT connectors and fittings shall be compression type only (the use of set-screw fittings is NOT permitted)
ii. Rigid Galvanized Steel (RGS) Conduit and fittings shall be used for all raceways 1-½” and larger.
iii. PVC Conduit is NOT to be used for any application other than for approved in-floor (or other encased in concrete) applications as outlined elsewhere in these Documents.
iv. Flexible Metal Conduit - Recessed Lighting Fixture connections and similar type equipment terminations. Alternatively, the use of MC Cable is permitted for lighting fixture installations where determined acceptable by the Owner.
v. Liquidtight Flexible Metal Conduit is to be used for motor and transformer terminations as well as other equipment where vibration and/or access is required that would

otherwise be impeded by a fixed raceway installation. Connections are to utilize stainless steel fittings; PVC Coated where installed in chemical and corrosive atmospheres

vi. Exposed outlets - Cast Type, FD capacity.
vii. Recessed Outlets - one-piece galvanized steel (expandable metal outlets not permitted).
viii. Cover plates - companion type as specified and/or indicated on the Drawings.

3) In-floor (or other encased in concrete) Installations

i. PVC Schedule 40 for 120 volt and greater general power / branch circuits; transition to metallic or fiberglass raceway system for continuation in or on wall as identified above. (Note - refer to VFD cabling installation requirements for special installation considerations).
ii. EMT for Data, Instrumentation and low voltage signal (less than 50 V) circuits; maintain metallic raceway system for continuation in or on wall as identified above.
iii. All conduits embedded in concrete floor to be compliant with ACI-318 criteria for minimum embedment and spacing requirements to assure structural integrity of structure.
iv. All transitions from "in-floor" to above floor in any area or room where water is also supplied in the room shall utilize PVC Coated RS Conduit sweeps to provide corrosion / physical protection; extend PVC Coated raceway minimum 6" AFF. Alternatively, the use of fiberglass raceways may be accepted if approved by the Owner. No transitions to be installed where raceway penetrates floor finish on an angle of the radius.

d. Underground and Similar Raceway Applications

1) Encased in Concrete Raceway Installations - (Ductbanks, Equipment Bases, etc) as identified on the Drawings

i. Minimum size conduits for underground installation to be 1”.
ii. Conduits smaller than 2" in diameter - PVC Schedule 40 Conduit with PVC Schedule 40 sweep radius horizontal bends and PVC Coated RS raceway sweep radius bends for vertical transitions to above grade or concrete surface.
iii. Conduits 2” in diameter and greater - PVC Schedule 40 Conduit with RGS or fiberglass sweep radius horizontal bends and PVC Coated RS Conduit sweep radius bends for vertical transitions to above grade or concrete surface.
iv. Alternative use of fiberglass raceways is acceptable where approved by the Owner for those underground horizontal and vertical transitions to above grade or floor / concrete base.
v. Note - Refer to VFD cabling installation requirements for special installation considerations that may alter the criteria outlined above.
vi. Conduit supports, spacing and concrete / reinforcement to be as specified.

2) Direct Burial Raceway Installations - Ductbanks, Branch Circuits and Feeders as Identified on the Drawings

i. Conduits smaller than 2" in diameter - PVC Schedule 40 Conduit with PVC Schedule 80 sweep radius horizontal bends and PVC Coated RS raceway sweep radius bends for vertical transitions to above grade or concrete surface.

ii. Conduits 2” in diameter and greater - PVC Schedule 40 Conduit with RGS sweep radius horizontal bends and PVC Coated RS Conduit sweep radius bends for vertical transitions to above grade or concrete surface. .
iii. Alternative use of fiberglass raceways may be considered acceptable where approved by the Owner for those underground horizontal and vertical transitions to above grade or floor / concrete base.
iv. Note - Refer to VFD cabling installation requirements for special installation considerations that may alter the criteria outlined above
v. Conduit spacing and protective concrete cover to be as specified below or as detailed on the Drawings. Note, Direct Burial installations do not use conduit "chairs" or separators; embedment is provided by screening material only.
vi. Provide 5” thick concrete protective pour with 10 x 10 WWF over top of screening backfill for physical protection and vehicular wheel loading. Where crossing roadways or drives, conduit work to be reinforced, concrete encased as in #d.1 above; extended a minimum 10’ on either side of pavement.
vii. Transitions from underground to building or other structure to be provided as detailed on the Drawings

e. Special Applications and Locations:
i. Wastewater installations rating to be established by NFPA 820 and installations in compliance with Article 501 of the NEC
ii. Hazardous locations where determined are to be installed in accordance with the NEC while addressing the use of corrosive-resistant materials as outlined above.
Provide raceway seal-offs and fire seals as required by Code. Additional raceway seal-offs to be provided to prevent the migration of corrosive vapors from a chemical area into an adjoining area and sealed with a non-water soluble compound material

3. Lighting Systems

a. Indoor Locations:
1) Fluorescent lighting systems are not to be used unless there is a reason LED lighting would not work effectively. Discussions with owner during design phase for exception.

2) The use of LED lighting sources and devices has become more popular in recent time as their costs have become more competitive with other systems. As a result, AW Engineering recommends an initial evaluation be considered to address initial costs as well as maintainability of the systems. These systems are to be considered and used upon approval from the Owner and after review of the life-cycle costs associated with total installations. The Engineer shall identify and provide all information regarding potential rebates, off-setting cost programs, etc. available for the use

3) Night-lighting / means of egress lighting fixtures shall be incorporated in the normal lighting layout / scheme to ensure that all passages and exits remain illuminated in the event of a power failure. These fixtures may be switched in areas where required providing they include the lighting transfer device integral with the fixture. (i.e... training and AV presentation areas, operational control rooms, etc.). This pass-thru/night lighting should be otherwise be un-switched; other lighting in the area or room to be controlled by means of suitable occupancy sensors

4) Separate battery-powered emergency lighting units shall also be provided to augment this night-lighting system and provide Code required means of egress lighting in the

event of a power failure of the Utility and/or Stand-By Power System. Provide a remote battery-controlled lamp on the exterior of building exit doors connected to the interior unit to provide illumination away from the building. These units are to be powered from the local area night-lighting circuits and wired ahead of any switching. . All emergency lights, including outdoor remote head, are to be provided with twin lamps so failure of one lamp does not leave area in total darkness

5) Lighting fixtures types are to be suitable for the environments where installed and shall be located (serviceable and accessible) for routine maintenance. Provide calculations and fixture catalog data/specification sheets for review and acceptance by the Water Company.

b. Outdoor Locations:
   1) The use of LED type lighting fixtures shall be used in the design for the exterior of the building; HID lighting (HPS) shall be an acceptable alternative for exterior use where providing similar type to match existing. Illumination levels to be as recommended by IES for the space and tasks being performed.

   2) Wall mounted lighting units to be coordinated with AW Security Group for illumination of areas where specifically required.

   3) Pole mounted fixtures to utilize tapered aluminum poles; height as required to meet lighting illumination levels in area. Pole heights and locations to also address maintainability issues for Owner replacement and repair.

   4) Outdoor lighting design is to comply with local ordinances for trespass lighting, up-lighting, pole height, and additional requirements the AHJ may have for the installation location
c. Where otherwise required by the authority having jurisdiction , provide means of egress and emergency lighting systems in conformance with NFPA 101 (the Life Safety Code)

d. Illuminated Exit Signs: IF REQUIRED by CODE, provide LED type and placed inside the facility per the latest requirements of NFPA 101 (the Life Safety Code) as applicable. Otherwise, provide non-illuminated, non-metallic exit signage for general egress direction and identification as determined by the engineer/architect and/or building official.

4. Cables

a. Low Voltage Wire and Cable:

   1) All conductors to be copper

   2) Those rated for 480V and below shall be listed as XHHW-2 for general underground, damp and wet locations and other similar areas. In addition, only XHHW-2 insulated conductor material is to be used with any variable frequency drive application.

   3) Dual-rated THHN/THWN type is for use ONLY in interior, *(Administrative Buildings and Related Type Facilities or Areas as previously defined)* dry locations. *[NOTE: on projects involving multiple environmental conditions, AW has found that allowing both types of insulation has often resulted in field errors of the wrong type wire being installed. As a result, AW Engineering*

recommends using the Type XHHW-2 insulated wire throughout the project to eliminate this situation.]

4) Insulation shall be UL listed for at least 90 degrees centigrade but applied at its 75 degree ampacity rating (maximum). Provide specific information in the Documents outlining where each type of conductor insulation material for review and acceptance by the Water Company

5) Multi-conductor, Tray Rated Cable to be provided for cable tray applications as outlined. All cables to be 600 volt insulated, 90 ^{0}C rated / applied at 75 ^{0}C ampacity rating. In general, provide;
   i. Type A – XHHW-2 (XLP) insulated conductors with ICEA Method E-1 or E-2 color coding; note this info on the Drawings. Cable to have PVC outer jacket. Uses include power and control devices.
   ii. Type B – THHN/THWN-2 with black insulated conductors with white printed numbers, #14 AWG, number of conductors as required; PVC overall jacket. Uses include control / monitoring interface with SCADA/RTU equipment and field devices
   iii. Other types and specific color coding to be provided based on voltage application for power conductors and control wiring for interface with SCADA/RTU equipment in accordance with AW Standards for these applications.

6) VFD Cables
   i. Acceptable Manufacturers (included herein to identify basis of material design for these special cables) Refer to AW Acceptable Manufacturers List for additional/supplemental information:
      a. Belden 29 Series (600VAC Rated Cable); wire gauge as indicated on the Drawings
      b. AmerCable, Inc. – CIR Type (600VAC Rated) VFD Power Cable Gexol Insulated; wire gauge as indicated on the Drawings.
   ii. Description: Three-conductor plus ground with cross-linked polyethylene or polyolefin listed insulation with fully-rated and identified equipment grounding conductor(s); 90 degree C listed for Wet or Dry applications with outer PVC jacket.
   iii. Conductor: Tinned-Copper, multi-conductor cable, size as indicated on the Drawings.

b. Medium Voltage Cable:
   1) Provide Type MV-105 shielded medium voltage cable for all normal power and feeder installations unless specifically required otherwise by the serving Utility Company for materials associated with a medium voltage service entrance installation.

   2) For medium voltage motor installations, provide shielded conductors (Type MV-105) along with means for terminating the cable shields (and bonding to the equipment grounding conductor) before entering the motor termination box on the motor.

   3) All conductors to be copper.

5. Grounding

a. General - Unless otherwise indicated or required, all facility installations shall utilize grounded power distribution systems. Normally, all will be solidly-grounded; provide resistance-grounded systems only where determined to be required for equipment and/or life-safety protection.

b. The electrical system and equipment grounding is to be in compliance with the National Electrical Code. A buried grounding grid or counterpoise is to be provided for the new switchgear equipment, transformers and standby generators.

c. Conductors shall be No. 2 AWG stranded copper (minimum) for interconnecting ground rods and for connection to transformers and MCC's and other major electrical equipment. All connections to this underground earthing system shall be made using exothermic weld process. Connections to reinforcement steel in foundations shall utilize hydraulic compression fittings. Bolted connections shall only be provided where accessibility and temporary removal for testing is required. All electrical equipment shall be bonded to the grounding system including motors, transformers, panelboards, other equipment, metal stairs / ladders, etc. and metallic raceway systems. All conduits containing power and control wiring shall be provided with a separate "green" grounding conductor; use of the raceway system as a sole means of grounding is not permitted.

d. Provide test well for grounding system testing at main service bonding to ground rod and other locations as determined appropriate by the Owner. Ground test well to be minimum 12' x 12" with tamper-resistant stainless steel bolted cover and "Ground" cast into the cover plate.

e. Increased conductor sizing to be as required by Code and/or grounding calculations where associated with switchgear substations and lightning protection system installations.

f. Instrumentation Grounding – review and provide grounding associated with the special requirements for this system.

6. Medium Voltage Equipment

a. The following criteria apply to 5 KV – 15 KV maximum installations *(higher voltage applications to be coordinated with AWBSE).*

b. Medium Voltage Transformers
   1) AWBSE recommends the use of dry-type transformers over liquid-cooled units to avoid potential environmental concerns and risks as well as reduced maintenance requirements and associated O&M costs. Our preferred equipment uses cast-coil, epoxy encapsulated windings on the primary and secondary windings. Other possible solutions involve the use of VPE insulated assemblies which provide a higher degree of protection over the standard VPI insulated units.
   2) The use of liquid-cooled units is generally only recommended where transformers are needed for 5 MVA and larger service applications; the type and associated ratings, cooling capabilities and auxiliary features and appurtenances to be coordinated with Utility and Owner criteria as outlined in the RFP for the project.
   3) Provide alarm monitoring for reporting to the process control system and include provisions for forced air cooling were appropriate
   4) All transformers are to utilize copper winding material – primary and secondary coils.

c. Medium Voltage Switchgear
   1) Type of Equipment: Plated copper bus as determined suitable for the installation/location and environmental conditions, 3-phase, 3-wire plus ground operating at 60 Hz. Utilize draw-out vacuum circuit breakers and/or fusible type switchgear assemblies where

specifically identified in the RFP. All components are U.L. listed. Switchgear equipment shall consist of standardized, freestanding structures bolted together for form a single dead-front panel assembly containing circuit breakers, control devices, protective relay and metering units and all interlocking and miscellaneous control / interface devices.

2) Fusible sections (where applicable) to be configured from left to right; use of front to back fuse arrangements are not permitted.
3) Protective relaying and/or metering to be as outlined in #12 below. Relay coordination settings and ratings to be selected by the Engineer based on the Protective Coordination and Arc Flash Hazard analysis outlined in Attachment A
4) In general, Metal-Enclosed Switchgear is considered acceptable. Provide Metal-Clad Switchgear type design where required or indicated or otherwise due to specific design and/or Utility considerations.

d. Medium Voltage Motor Controllers
   1) Type of Equipment: Tin-plated copper bus (phase and ground), 3-phase, 3-wire plus ground operating at 60Hz. All components are U.L. listed. MCC equipment shall consist of standardized, freestanding structures bolted together for form a single dead-front panel assembly containing combination vacuum contactor motor controller units; feeder units; metering, relaying, and interlocking and miscellaneous control devices. Provide magnetically-held or mechanically latched type of vacuum contactor controllers as required for the application or equipment served.
   2) Fusible sections to be configured from left to right; use of front to back fuse arrangements are not permitted. Fuse types and ratings to be selected by the Engineer based on the Protective Coordination and Arc Flash Hazard analysis outlined in Attachment A
   3) Starters:
      i. Full-Voltage or Reduced Voltage NEMA rated fusible switch / contactor type combination controllers as outlined in the RFP or otherwise determined by the Engineer and Owner. The use of IEC rated controller is prohibited.
      ii. Solid-state reduced voltage motor starters shall be utilized where required due to power utility requirements, process control of hydraulic transients, and/or engine-generator sizing considerations.
      iii. The Engineer shall coordinate starter types with the Water Company.
   4) Control power – provide each starter with individual 120 VAC CPT rated for minimum 100 VA above that required for loads served; min 150 VA. CPT's to be fused on primary and secondary.
   5) Control devices – provide minimum 30 mm diameter devices for all control switches, push buttons and pilot lights. Pilot lights to be high intensity, 120 VAC LED type; color as outlined herein or otherwise required by Owner.
   6) Protective relaying and/or metering to be as outlined below. Relay coordination settings and ratings to be selected by the Engineer based on the Protective Coordination and Arc Flash Hazard analysis outlined in Attachment A.

7. Low Voltage Motor Control Centers/Motor Controllers

a. Type of Equipment: Tin-plated copper bus (phase and ground), 600V, 3-phase, 3-wire plus ground operating at 60Hz; provide a neutral bus (3-phase, 4-wire plus ground applications) only in those MCC assemblies where required. All components are U.L. listed. MCC equipment shall consist of standardized, freestanding structures bolted together for form a single dead-front panel assembly containing combination motor control units; feeder units; metering, relaying, and interlocking and miscellaneous control devices and will be of the per definitions in the latest edition of NEMA ICS 3 and UL 845.

b. Starters:
   1) Full-Voltage NEMA rated (Size 1 minimum) combination magnetic starters shall be utilized as required. The use of IEC rated starters is prohibited.
   2) Solid-state reduced voltage motor starters may be utilized where required due to power utility requirements, process control of hydraulic transients, and/or engine-generator sizing considerations.
   3) The Engineer shall coordinate starter types with the Water Company.

c. Circuit Breaker Compartments and Circuit Breakers: Control center disconnects shall be three-pole, single-throw, 600-volt, molded-case circuit breakers
   1) Feeder and branch circuit breakers to be thermal-magnetic or solid-state trip type as required for the loads served, protective coordination and arc-flash hazard considerations.
   2) Circuit breakers associated with combination starters shall be magnetic motor circuit protector (MCP) type where appropriate.
   3) All shall be manually operated with quick-make, quick-break, trip-free toggle mechanism.

d. Control power – provide each starter with individual 120 VAC CPT rated for minimum 100 VA above that required for loads served; min 150 VA. CPT's to be fused on primary and secondary

e. Control devices – provide minimum 30 mm diameter devices for all control switches, push buttons and pilot lights. Pilot lights to be high intensity, 120 VAC LED type; color as outlined herein or otherwise required by Owner.

f. Protective relaying and/or metering to be as outlined in #12 below. Relay coordination settings and ratings to be selected by the Engineer based on the Protective Coordination and Arc Flash Hazard analysis outlined in Attachment A.

g. VFD Installations – while not recommended, where VFD's are required to be installed in MCC type construction, locations and general arrangements to address ventilation requirements of equipment. These installations typically will necessitate use of NEMA 1 configurations to avoid undue costs for the overall assembly; special attention to this is required to coordinate the design. Where it is determined NEMA 12 (or NEMA 4X) is necessary, VFD's shall not be included in MCC type construction.

h. Enclosure Type: Typically NEMA 1 is acceptable for conventional MCC construction utilizing only starters and circuit breakers. Match existing NEMA ratings in equivalent areas of the plant. Engineer shall also propose modifications to the NEMA rating if appropriate for intended service.

8. Variable Frequency Drives (VFDs)

a. In general, 6 pulse VFDs with line reactors are to be used for motor loads 50 HP and smaller. On motors greater than 50 HP but less than 100 HP evaluation of drive type to be determined based on base load versus non-linear loading. On all drives where harmonics at the Owner's equipment bus is potentially determined to be greater than 5% TDD. Provide VFD with passive or active harmonics filter / line conditioning unit.

b. In general, 18 pulse VFDs are to be used on motors 100 HP and larger. However, final determination from harmonics analysis and evaluation of linear versus non-linear loading is to be taken into account in making final selection. Harmonics at the Owner's equipment is to be

below 5% TDD. Provide harmonics filtering / line conditioning as required to meet these criteria.

c. For motor applications involving long cable feeders between the VFD and the motor (e.g., ~100'+ or as defined by manufacturer), provide dv/dt output filters based on VFD and motor criteria for selected equipment.

d. VFD's installed in damp locations to be provided as NEMA 12 type equipment; those installed in locations such as dedicated electrical equipment rooms may be NEMA 1 type. However, all drives to be provided with door filter units mounted on exterior for access where possible.

e. All VFDs shall be rated as Industrial Duty / Heavy Duty type and be rated for a 50 ^{0}C ambient location. The use of 40 ^{0}C rated equipment and "HVAC" rated VFDs are not permitted.

f. Unless specifically accepted, all VFDs shall be stand-alone enclosed, wall or floor mounted equipment; do not combine in common enclosures or MCC construction.

g. VFDs shall be provided with Bypass starters where outlined in the RFP. Bypass starter type and rating to be as outlined; FVNR or RVSS types are typically required based on starting and hydraulic concerns in the system.

Note: Ventilation / Air Conditioning – AWBSE recommends ventilation air be used as the primary means of cooling for VFD applications and installation locations. The use of Air Conditioning (A/C) is not typically required in most geographic locations. Where A/C is determined to be necessary, the units shall be provided with an economizer mode which uses outside air as the first stage. Additionally, ventilation system should be designed to withdraw heat from above VFD enclosures and introduce cooling air near lower air intake section of VFD.

9. Miscellaneous Power Distribution:

a. Panelboards and Switchboards: Circuit breakers will be of the "Bolt-On" type;"Push-On" / "Plug-On" type circuit breakers are not allowed. Use plated copper bus and ensure U.L. labeling of entire system.
b. Provide a Surge Protective Device (SPD) on the main of each power distribution panel where applicable. In addition, provide an SPD on panels serving sensitive electronic equipment and instrumentation devices. For more specific requirements for the protection of sensitive electronic instrumentation, see Instrumentation section.

c. Lighting and General Power Transformers: Dry type to limit maintenance items. A minimum of (2) taps will be provided above rated voltage (in 2.5% increments) and a minimum of (2) taps will be provided below rated voltage (in 2.5% increments). Open type transformer cases are not allowed. All units located in wet or chemical areas will be of sealed type construction. Provide open ventilated type enclosures for other general dry, environmentally ventilated/conditioned spaces. All transformers to utilize copper windings; 115 degree C rated. The Engineer shall examine the need to install transformers with a higher than average Basic Impulse Level (BIL) that is not normally required in the 480V class.

10. **Power Monitoring/Metering and Protective Relaying**

a. General: AW objective is to provide power monitoring to allow trouble-shooting, harmonics assessment, and data collection for evaluating efficiency, etc.

b. AW has a national contract agreement with SEL and is our preferred manufacturer for new work. Refer to RFP for systems involving modifications / upgrades to existing installations

c. Low Voltage Systems: For small stations involving a limited number of motors / loads, metering as outlined below alone is sufficient. On larger low voltage systems, addition protective relays and monitoring may be appropriate to allow evaluation of sub-distribution equipment and systems and data collection of power characteristics to be captured by the SCADA system for evaluation and reporting. Specific criteria associated with metering and equipment monitoring/protection is to be reviewed with the Owner at the initial design memorandum stage of the project.

d. Make provisions for power monitoring/metering on incoming three-phase electrical services (main) as follows:
   - All 480/277 VAC services are to provide 3-PTs and CTs wired to field terminal blocks for connection to metering equipment.
   - On installations where the metering is provided by Owner, allow physical space next to main incoming OCP device for meter enclosure installation.
   - On installations where metering is to be provided with equipment, refer to the RFP for specific criteria or review with Owner to define requirements.

e. Medium Voltage Systems: Power distribution systems involving medium voltage motors and equipment are to be provided with the protective relaying/monitoring devices for not only equipment protection, but also to allow data collection of power characteristics to be captured by the SCADA system for evaluation and reporting. Provide 3- PT / CT input devices and control voltage for power metering and protective relays as required for system protective schemes required by the design.

f. Data Collection: The use of fiber-optic interface between devices and to SCADA is a preferred method of communicating the data transfer between devices and into the process control system. Applications involving the use of copper are to be specifically approved by the Owner. Where available, dual-port communications capabilities of the protective relays shall be utilized and the devices configures in a loop with IP addressing. The design and configuration of the communications loop and serial connectivity is to be developed as part of the instrumentation design effort.

g. Power Monitoring/Metering;
   1) Provide microprocessor based SEL 735 metering unit on main incoming feeder circuit breaker. Unit shall compute voltage, amperes, power factor, kilowatt-hour, etc. Communications will be via fiber-optic cable back to a port on a plant's process control system.

h. Protective Relaying;
   1) Provide SEL 710 motor protective units on all medium voltage motors wired to plant's process control system for monitoring, trending and archiving.
   2) Provide SEL 849 motor protective units on 480 VAC motor loads typically larger than 50 horsepower *(exact application to be coordinated with Project requirements and Owner*) wired to plant's process control system RTU for monitoring, trending and archiving
   3) Provide SEL 751A Feeder protective units on
      i. LV Feeders where incident energy on load side of OCPD is greater than 12 calories per centimeter squared wired to plant's process control system for monitoring, trending and archiving

ii. MV Feeders wired to plant's process control system for monitoring, trending and archiving
iii. LV (as noted in i) and MV systems
a. CTs to be rated for short circuit current
b. Fiber optic
i. Point source sensor in main breaker
ii. Loop sensor in distribution gear

4) Non contact inspection provide
i. Infrared (IR) inspection Iriss VPT-100 IR windows over line and load side of main and tie OCPDs
ii. Absence of voltage testers line and load side of main, tie and generator OCPDs (non-probe LED type with self test)
5) Other protective relays as outlined in Attachment C and provided as applicable to the Project

i. Other SEL protective relays to be provided as determined through the design; reviewed and accepted by the Owner.

j. SCADA / RTU communications and data acquisition information to be monitored is outlined in Attachment C - SEL Device Monitoring Points (Modbus to SCADA /RTU. This baseline data is to be evaluated and supplemented as appropriate for the project as well as other potentially beneficial data for trend analysis, wire-to-water calculations, and preventative maintenance.

k. Refer to RFP for additional and/or supplemental information regarding protective relays, applications and coordination of Ethernet communications requirements.

ATTACHMENTS

A. Power System Studies & Arc Flash Hazard Analysis Requirements

B. Acceptable Electrical Equipment Manufacturers List

C. SEL Device Monitoring Points (Modbus to SCADA /RTU)

AMERICAN WATER

ATTACHMENT A

AMERICAN WATER
POWER SYSTEM STUDY AND
ARC FLASH ANALYSIS REQUIREMENTS

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Version Date: April 2018

Revision Date: February 2021

AMERICAN WATER POWER SYSTEM STUDY AND ARC FLASH ANALYSIS REQUIREMENTS

1. DESCRIPTION OF WORK REQUIRED

A. Provide all items of labor, materials and equipment necessary for data collection, development, evaluation and report generation of the work described in this Section. The entire power distribution system (all equipment), new and existing is to be included in the study being provided for this Project. The actual Power System Study / Analyses work shall be conducted by a qualified, licensed Professional Engineer as outlined in Article 3.A below.

B. Visit the site to determine actual conditions, equipment and settings and related elements necessary to prepare a complete oneline diagram of the entire power distribution system associated with the Hays Mine WTP. Provide this oneline diagram identifying all equipment (utilizing existing naming/labeling information) as well as their loads/ratings, cable and raceway information and other data associated with the installations. This information will allow evaluation and calculation of the various Studies to be provided in the Report outlined herein. Where required, coordinate field work with the Owner and shall follow all applicable safety standards for the activities required.
   1. Those involved with the field data collection work shall review / compare the Owner's operational and safety standards with their own and provide adequate Personal Protective Equipment (PPE) for those individuals involved in any data gathering activities as outlined by applicable Regulatory Agencies. No extra compensation will be allowed by failure to determine existing conditions.

C. Furnish a complete Short-Circuit, Protective Coordination, and Arc Flash Hazard Analysis Study per the requirements set forth in the criteria established for the Project, the criteria outlined herein this document, and as identified in the latest version of NFPA 70E– 2015 Edition; *Standard for Electrical Safety in the Workplace and as outlined herein regarding American Water Site Specific PPE Category Labeling criteria*. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2018 Edition*;* modified as hereinafter identified.

D. Arc-Flash Equipment Labeling shall be provided upon acceptance of the Engineer's final report. Labeling shall be provided for all equipment as identified herein this document.

E. In addition, where indicated in the Scope of Work identified by the Owner, provide a Load Flow analysis using the power systems software identified herein to model the operational scenarios required for the project and requested by the Owner. These Load Flow analysis reports are to be provided in accordance with the Owner's criteria for loading and report submission.

F. Any Drawings and Material Data Sheets / Product Information provided by the Owner is considered as generally indicative of Power System but is not to be considered as matching actual site conditions. Modifications/field changes may have occurred which were not recorded; therefore, provide field verification as necessary to validate the Power System as Work under this project in preparation of the Short-Circuit, Protective-Coordination and Arc-Flash Study and Analysis.

G. The general (not limited) approach to the evaluation and analysis work included in this assignment shall include the following effort;

1. Collect system and “as-installed” data associated with all electrical equipment, feeders, and devices associated with this Study/Report. This effort shall also include obtaining the necessary load-history and available fault current (max and min) and Utility Overcurrent Protective Device (OCP) device(s) from the serving Power Utility Company along with the technical data associated with their system and transformer equipment being provided as applicable to the specific site/facility being evaluated.
2. Determine system modes of operation by conducting interviews with Owner’s Operational / Production Staff
3. Determine bolted short-circuit and arc fault currents
4. Determine protective device characteristics and duration of arcs
5. Document system voltages and classes of equipment
6. Evaluate existing equipment short circuit ratings against computed available fault currents.
7. Arc Flash Hazard Analysis to select working distances as outlined herein, determine incident energy for all equipment and determine flash-protection boundary zones for all affected equipment. Conduct arc flash analysis based on the utility fault current and at a value approximately 50% of this or as otherwise determined from the fault current range as provided by the serving Utility Company.
    a. In addition, where Standby power (generator) is also provided as part of the Project, evaluate the arc flash hazard based on this power source. Summarize each evaluation and develop arc flash labeling based on the worst case scenario or as otherwise accepted by the Owner.
        1) Where the installation includes the use of a portable generator, provide a cautionary label on both the transfer switching equipment and on the outdoor generator termination enclosure as outlined in Attachment D.
    b. Furthermore, provide analysis of any arc flash reduction methods being utilized or included for the equipment. While these devices are not considered in actual labeling, they are to be clearly identified and reported for potential use by maintenance staff when required activities include conducting work on energized and exposed electrical equipment. Provide full analysis of these devices including effects on the downstream equipment being served where applicable.
    c. Finally, where power distribution systems involve the application of “Main – Tie – Main” or similar multi-operational configurations, provide analysis for these schemes in order to determine effects of the operational differences with regard to loading, short-circuit, protective coordination and arc flash hazard. As above, each operational scenario is to be clearly identified in the reports submitted.

2. REFERENCES

A. ANSI – American National Standards Institute, Inc.
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

B. ASTM – American Society for Testing and Materials

C. IEEE – Institute of Electrical and Electronic Engineers
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 1584-2018 – Guide for Performing Arc-Flash Hazard Calculations

D. IPCEA – Insulated Power Cable Engineers Association

E. NEMA – National Electrical Manufacturers Association

F. NESC – National Electrical Safety Code

G. NFPA – National Fire Protection Association
1. NFPA 70 – National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition

3. STUDY REQUIREMENTS

A. The Work associated with this assignment must comply with all Federal and State, municipal or other authority's laws, rules and/or regulations. These services shall be provided by a qualified, licensed Professional Engineer (hereinafter referred to as Engineer and/or Engineer-of-Record) to conduct the actual analysis, evaluation and development of the Report and Arc Flash labeling. The Engineer shall be registered in the State (or Commonwealth) where the facility is located. Submit information regarding the Engineer proposed to the Owner for review and/or comment.

B. The Power System Study / Analysis is to include all electrical equipment; and specifically include / address the following:
1. In general (not limited to) and starting at the incoming power supply (hereinafter noted as “Utility”), all electrical equipment including the main service transformer where applicable, the Utility OCP device and system ratings shall be evaluated and included in this Study.
2. Where provided within the power system of the facility, all medium voltage equipment, motors, transformers (primary and secondary) shall be included as applicable, as well as all 480 VAC low voltage equipment, motors nominally 20 HP (or as otherwise outlined) and larger, all transfer switch equipment, safety disconnect switches rated 100 amps and above, all automatic and manual transfer switches, panelboards, transformers (primary and secondary locations) and other electrical equipment requiring routine inspection or maintenance while energized (including Infrared (IR) Scans). Motors less than HP may be grouped into single load blocks for the purposes of this power system analyses.
3. 120/208-240 VAC Low Voltage Power Equipment Criteria:
   a. 120/208-240 VAC Three phase equipment shall be included in the Study in accordance IEEE-1584, 2018 and relevant criteria from NFPA-70E criteria, and as outlined herein below.
   b. 120/240 VAC Single phase equipment need not be included in the actual analyses where the fault current is determined to be less than 10 kAIC, but these panelboards and related transformers, etc. shall be shown on the facility’s oneline diagrams for identification and labeling shall be provided as outlined herein below.
4. Refer to other criteria and reporting requirements are outlined elsewhere in this Document.

C. 120/208-240 VAC, Three Phase Power Systems – American Water Corporate Engineering has developed the following recommendations for Arc Flash Hazard labeling on 120/208 – 240 VAC, three-phase grounded and ungrounded power systems:
    1. Utilize the "two-second" evaluation criteria permitted by IEEE-1584 and NFPA-70E when calculating the clearing time of the upstream overcurrent protective device in the calculations for all 120/208-240 VAC Systems. *NOTE: The use of this "two-second" criteria associated with max clearing time is **ONLY** permitted for use on these low voltage installations*
    2. Service-Entrance and sub-distribution locations:
        a. AW Engineering recommends the application of a "standard" Arc Flash PPE Category 1 label (see Attachment B herein) at those locations where the Main OCP device is equal to or less than 125 amps or the supplying transformer is 30 KVA or less. (These installations result in maximum available fault current values of less than 2000 Amps where sustainable arcs are less likely in three-phase 208-240 VAC operating systems.)
        b. Equipment Arc Flash PPE Category Labeling not meeting "a" above – Utilizing the "two-second" time restraint associated with the upstream overcurrent protective device, calculate the Incident Energy and provide the appropriate Arc Flash PPE Category Label.
    3. Applicable voltages associated with this criteria include;
        a. 120/208 VAC, 3-phase, 4-wire (grounded WYE); or
        b. 120/240 VAC, 3 –Phase, 4-wire ("High-leg Delta"); or
        c. 240 VAC, 3-phase, 3-wire (Ungrounded Delta)

D. 120/240 VAC, Single-Phase Power Systems – American Water Corporate Engineering has developed the following recommendations for Arc Flash Hazard labeling on 120/240 VAC, single-phase grounded power systems:
    1. All 120/240 VAC Single Phase installations shall be provided with the application of a "standard" Arc Flash Hazard PPE label (see Attachment C herein) at those locations.

E. The Report(s) with calculations must be supplied to the Owner before final equipment labels are printed and applied before the work is considered accepted or approved. The Engineer shall provide documentation for all presumptions / assumptions related to machine impedances, cable impedances (both resistance and inductance), transformer impedances and other equipment values used to complete the computations where obtaining actual data is not available.

F. The Engineer shall consider fault conditions under minimum, maximum, and average power consumption scenarios based on facility operations as well as in the varying Utility fault conditions outlined previously. The Engineer shall also develop fault scenarios with standby power generators where included and used instead of or in conjunction with the electric utility source along with the other scenarios outlined. Arc Flash Hazard analysis and equipment evaluations to be provided as hereinafter indicated.

G. All oneline diagrams included in the Study / Report shall utilize naming conventions and identifiers matching the Design Documents or actual equipment field labels; generic identifiers are not considered appropriate. Coordinate equipment naming / identifiers with the Owner taking into account any existing terminology used. Individual oneline diagrams are required for each of the following evaluations as well as each scenario associated with the work outlined for various operational modes, arc reduction methods/devices and multiple configuration capabilities within the power distribution

system. The following ones identified are listed only to establish the primary categories associated the overall scope of evaluations to be included; include supplemental documentation as necessary to clearly and individually identify the study scenario and/or evaluation being considered.

1. Provide annotated onelines for the Power Distribution System identifying all equipment and naming conventions as stated above.
2. Provide annotated onelines identifying the available short-circuit current at each piece of equipment; include this in the Report; tabbed as associated with this topic.
3. Provide annotated onelines identifying the settings associated with the protective device settings at each piece of equipment; include this in the Report; tabbed as associated with this topic. Additional setting details associated with electronic trip devices, relays, etc. are to be clearly identified and included on the partial oneline clips associated with the protective coordination TCC diagrams.
4. Provide annotated onelines identifying the Incident Energy and Arc Flash Hazard Level at each piece of equipment; include this in the Report; tabbed as associated with each Topic and Evaluation
5. All onelines shall be legible and readable with a minimum 10 point (Arial or similar) font size; coordinate drawing size (not to exceed 22” x 34”) accordingly. Provide sleeved drawing holders where printed size is larger than 11” x 17”.

H. Short Circuit, Protective Coordination and Arc Flash Hazard Analysis Study

1. A short circuit, protective coordination and arc flash hazard analysis study shall be made for the entire distribution system in accordance with ANSI/IEEE C37.10 & C37.13, IEEE Std. 141, 242 and 399 beginning at Utility connections and ending at the largest feeder from each motor control center or panel as applicable for the system and analysis being conducted in coordination with paragraph “B” above.
2. Actual Utility data including system and equipment impedances, X/R Ratios, OCP device(s) and other applicable ratings are to be obtained by the Engineer; include this data as provided by the Utility Company (or resultant Study data) in the Report provided.
3. The protective coordination study shall consist of the following:
   a. All protective devices contained in the scope of work shall be evaluated. The coordination study shall include computer generated log-log plots of phase overcurrent and where applicable, ground overcurrent protection devices on log-log time-current characteristic paper as produced by the engineering software used for these evaluations and analyses. Complete plots of these devices will be accurately plotted through their operating range. Each TCC Plot shall include a oneline sketch showing the device identifications and ratings. The Engineer shall identify areas of non-coordination where considerations for modification may be determined. Actual modifications are not necessarily considered included in the scope of services under this project. Any suggested modifications affecting equipment and modifications to the system that the Owner may wish to consider will be handled as a change in the Contract. Appropriate maximum fault levels, transformer inrush currents, conductor insulation withstand curves and transformer damage curves / withstand points shall be plotted on each coordination plot sheet to assure adequate component protection and maximum system reliability.
   b. Where included in the power distribution system, each current transformer shall be checked for saturation to ensure that they accurately translate all

fault currents which may be available on the system.

c. All protective relay and solid-state device settings; fuse sizes; and low-voltage circuit breaker settings shall be tabulated and included on the respective TCC.
d. A complete set of coordination curves (complete with device settings indicated on the TCC) are to be prepared starting with the Utility Company's OCP device(s) and the main distribution devices protecting the Owner's service down through and including all on-site services, feeders, sub-feeders, transformers and secondary main and branch circuit devices, shall be included in the Study. These shall be arranged to provide a uniform approach to the review and device coordination for the system and shall include a "snap-shot"/annotated oneline diagram on each TCC sheet outlining the devices included. Provide sufficient overlap on the TCC evaluations included to demonstrate "upstream / downstream" coordination.
e. The Engineer shall also evaluate ground fault protection where provided in conjunction with the project. Provide Time Current Characteristic (TCC) curves for all GFI circuit breaker equipment protection as outlined above.
f. Motor starting current profiles for all large motors (over 25 HP or as otherwise determined and accepted by the Owner) shall be included on the appropriate TCC's to identify coordination and provided based on the starter type being provided; other motors to be configured as combined loads as applicable to the application
g. Tabulations shall include a listing of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings. This tabulation shall also include indication of acceptability or, in the event of a noted deficiency, provide recommended solution for corrective action.
h. As indicated, points of non-coordination shall be brought to the attention of the Owner; provide existing TCC identifying the issue and a separate TCC outlining proposed modifications and/or adjustments recommended for corrective action.
i. The Study shall include all electrical equipment as included in the Scope of Work for this assignment. The use of documentation and record information as may be provided by the Owner shall not be construed as providing all data necessary; the EOR shall be responsible to conduct or obtain field verification necessary to determine / obtain all required data in establishing the power distribution one-line diagram for the system being evaluated.
j. Submissions and approval of these studies are required as outlined herein after in this document.

4. Arc Flash Hazard Analysis
   a. The arc flash hazard analysis shall include the incident energy and flash boundary calculations.
      1) Unless otherwise specified or approved in writing by the Owner, the EOR shall utilize a Working Distance of 18 inches for ALL voltage levels (low & medium voltage values). Typical other typical distances (i.e... 24" or 36") for low voltage systems and/or 36" for medium voltage systems as otherwise permitted under NFPA-70E / IEEE are not permitted.
      2) As indicated, calculated incident energy values shall be provided for both line and load sides of all transformers and the overcurrent protective devices served from these transformers or other separately derived

sources and labeling developed to identify both calculated Incident Energy and Site-specific Arc Flash PPE Category values in addition to other equipment and devices as previously outlined herein. Equipment Arc Flash Hazard Analysis labeling to be provided with this and other labeling information as outlined herein to properly identify and notify workers to the hazards present.

b. The Engineer shall furnish the Arc Flash Hazard Analysis Study per the latest edition of NFPA 70E - *Standard for Electrical Safety in the Workplace*, reference Article 130.3, Annex D – *Incident Energy and Arc Flash Boundary Calculation Methods*.
c. The analysis shall utilize the appropriate short-circuit and clearing times associated with the over-current protective devices. Where this information is not available, alternative methods for similar devices shall be identified and submitted in the study for review and comment by the Owner.
    1) The arc flash study shall be run under a minimum of the following scenarios in order to account for varying source conditions and available Utility deviations. The worst case from these scenarios shall be considered in developing the PPE and Arc Flash Labeling for the equipment unless otherwise discussed and accepted by the Owner. Power Study scenarios to be considered include;
        a) Utility at nominal short circuit contribution,
        b) Utility at 50% of nominal contribution (or as otherwise determined based on available range of Utility data), and
        c) Standby (generator) contribution (where applicable)
        d) Other scenarios as previously indicated.
    2) Incident energy is greatly influenced by protective device clearing time, which is determined by the available short circuit current at that location. The intent for utilizing a 50% source is to provide some measure of assurance that a “low” utility source will not result in incident energy values higher than those indicated on the equipment labels.
    3) The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system as outlined herein.
d. The Arc-Flash Hazard Analysis shall include all medium voltage and 480/277 volt locations, as well as those three phase locations associated with the 240 volt and 208 volt systems as previously outlined..
e. All electrical equipment as herein outlined shall be labeled regardless of the arc-flash energy / incident energy level determined.
f. Safe working distances shall be identified for calculated fault locations based upon a calculated arc flash boundary considering a minimum Incident Energy level of 4 cal/cm^2; site-specific Arc Flash PPE Category as identified in Attachment D. Working distances shall be based on 18” as outlined previously and in accordance with the general criteria as outlined in IEEE 1584. The calculated arc flash protection boundary shall be determined using this working distances.
g. The Arc Flash Hazard analysis shall include calculations for contributions of fault current magnitude (based on the available fault-current values and not the AIC ratings of the equipment) as previously outlined herein. The calculations shall include all motor and other sources that can contribute to the available fault current. Where necessary, the Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these

conditions differ from worst-case bolted fault conditions.

h. As previously noted, Arc flash computations shall include line and load side calculations associated with the “main” (service-entrance) breaker as well as any other transformer OCP devices associated with internal power distribution. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. AW does not consider the use of this IEEE Exception to be appropriate. (Maximum clearing time of 2 seconds *based on IEEE 1584 is not acceptable except as previously identified*)

i. Results of the Analysis shall be submitted in tabular form, include device or bus name, (based on actual naming ID as identified on the Facility Oneline Diagram; not simply an ID assigned by the software), bolted fault and arcing fault current levels at the various scenarios outlined herein, flash protection boundary distances, personal-protective equipment classes and the arc flash incident energy levels determined. These results shall also be included on the oneline diagram associated with the specific study/scenario being evaluated.

j. The Report shall also include identification of the Personnel-Protective Equipment (PPE) Categories and identify minimum PPE required for each location. This information shall be included in the Report but not shown on the equipment labels.

k. Arc Flash Labeling of Electrical Equipment: Provide copies of the Arc Flash Labels (see sample attached below) in the Report for documentation of the information being identified on the equipment in a separately tabbed section of the report. Include in this section definitions of the terms and distances outlined along with information on the various PPE equipment classifications indicated.

4. POWER SYSTEM STUDY AND ARC FLASH ANALYSIS QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled (*minimum of 10 years of demonstrated experience in conducting power systems studies; provide qualifications upon request*) in performing and interpreting the power system studies. The final report, including copies of the Arc Flash Labels, shall be sealed and signed by the EOR.

5. ENGINEERING STUDY / REPORT SUBMISSIONS

A. Submit the following Reports for AW Engineering / Owner Review and Comment. Coordinate these submissions with the Design Criteria / Documentation Submissions as outlined for the Project. In general, the “Preliminary” Report should be provided with the 30% Design (or otherwise defined Project) Submission; the “Pre-Final” Report with the 60% submission and the “Final” Report provided with the 100% submission. Final adjusted report information, including final equipment labels to be provided once all field adjustments and acceptance testing has been completed. This Record Document Report shall be provided as part of the Operation and Maintenance Documents.

1. Preliminary – Submission to contain an annotated One-line Power Riser Distribution Diagram with OCP devices and other basic configurations associated with the power distribution system included; not a completely detailed and documented diagram. This diagram is intended to show the available power

sources and devices which comprise the system and it's configuration for operation. Additionally, this initial diagram is to include the major loads and presumptions for miscellaneous general power requirements which may be appropriate in considering Load Flow evaluations where necessary.

a. As part of this Preliminary effort, consideration related to new equipment selections shall be included. Provide initial discussion and/or indication related to proposed equipment for Owner consideration and comment.
b. Include the overall oneline diagram utilizing this simplified computer modeling approach. This information and modeling will allow basic configuration, operations and evaluations associated with equipment short-circuit ratings and types of devices to be considered / developed with the Owner.

2. Pre-Final – Report to contain an annotated One-line Power Riser Distribution Diagram with OCP devices, device ratings/settings and cable feeders (conductor size/type and raceway size/type) identified.
   a. As part of this continuing effort, consideration related to equipment selections shall include type of device and over-current protective features needed for protective coordination with other elements of the power distribution system and loads served. (including type of trip unit, potential arc flash reduction methods as applicable, etc.).
   b. Calculations associated with Short-Circuit AIC values and Equipment suitability along with Arc-Flash Hazard Analysis Report and sample of proposed / typical ANSI Z535.* label information (**current edition*) documentation are to be included.
   c. Included in this Report, Oneline Drawings for the overall Power Distribution Power Riser diagram, an annotated oneline outlining the Short-Circuit ampacity values calculated, and an annotated oneline showing the Arc Flash Incident Energy and PPE Levels calculated.
   d. In addition, a copy of the oneline diagram with the OCP devices indicated shall be included with the Protective Coordination TCC's. Each TCC shall include the partial oneline drawing associated with the protective coordination elements being evaluated and included.

3. Final - Provide a written response to Owner comments provided regarding Pre-Final Study Report. Finalize the information; update data, settings and other appropriate information including any accepted recommendations and/or modifications.
   a. Provide three hard-copies of each submission Report as well as editable Word electronic formatted Report document with the Final submission. Power Distribution Riser Diagrams shall be provided for all analysis configurations conducted including, but not limited to, short-circuit models for minimum and maximum operational scenarios and arc flash hazard models. Include hardcopies of equipment reports and calculations performed.
   b. Submit an electronic copy of the final Arc Flash Hazard Analysis and One-line Power Riser Diagram, complete with all associated equipment databases formatted with the engineering software used and as outlined herein.
   c. It is recommended that the final report include the following sections:
      1) Executive Summary including Introduction, Scope of Work and Results/Recommendations
      2) Short-Circuit Methodology Analysis Results and Recommendations
      3) Short-Circuit Device Evaluation Table

4) Protective Device Coordination Methodology Analysis Results and Recommendations
5) Annotated and revised oneline diagrams (all) as outlined in “2” above shall be provided with the Final Report.
6) Protective Device Settings Table associated with the field installed devices.
7) Time-Current Coordination Graphs and Recommendations
8) Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
9) Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as actual copies of the label images.
10) One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

B. Upon acceptance of the Final Report, provide labeling of the power distribution equipment in accordance with ANSI Z535.4– Product Safety Signs and Labels; label size to be 4” x 6”. Labels to be provided as outlined in Articles 1.03, C and 3.03 below. Label materials furnished to be suitable for either the interior or exterior locations where they are to be applied; provide samples for review and approval by the Owner along with data sheets from the Manufacturer outlining these applications.

C. As part of the final documentation associated with the project Record Drawing data, provide a copy of the oneline diagram that includes the essential equipment and devices without ratings to provide a concise representation of the power distribution system. All equipment and devices shall be identified based on the actual nameplates and identifiers developed under the project design; coordinate with final nameplates provided. Drawing size to be based on size of power distribution system but shall be large enough to provide clear reading of the text based on an Arial 10 point font or equivalent of the equipment naming and identifiers; maximum sheet size to be 22” x 34”. Provide multiple drawings for systems where information cannot be legibly contained on a single sheet. This diagram is to include all revisions and modifications determined through the course of construction.

6. COMPUTER ANALYSIS SOFTWARE AND EVALUATION CRITERIA FOR ELECTRICAL EQUIPMENT ENCLOSURES AND CONFIGURATIONS

A. The studies shall be performed using ETAP power systems software as provided by Operation Technology, Inc. (OTI), or SKM Systems Analysis Power Tools for Windows (PTW) software program.

B. Provide a final electronic file copy of all data, reports and the oneline diagram in electronic engineering database (ETAP or SKM) format to the Owner prior to final acceptance of the Project. This information is to be validated by the EOR as representing “As-Built” conditions including all over-current protective devices and their

settings, feeder conductors and raceway information and load data; including inductive, resistive and combination loads.

C. The files shall contain all Reports (in Microsoft Word) conducted including Short-Circuit evaluations, Protective Coordination and Load Flow Studies as well as the Arc Flash analysis values determined as well as copies of the Arc Flash labels. The EOR for the Study shall attest to this validation in writing when submitting the final electronic copy of the project.

D. Evaluation Criteria for Electrical Equipment Enclosure Analysis:

1. Medium Voltage and Low Voltage Draw-out Switchgear and Switchboards: HCB

2. Medium Voltage and Low Voltage Motor Control Center Assemblies: HCB

3. Medium Voltage and Low Voltage Disconnect Switches (Fusible and Non-Fusible): HCB

4. Low Voltage Fixed Breaker Switchboards and Panelboards: VCBB

5. Outdoor Exposed Bus Substation Equipment: VOA or HOA as Applicable based on location and type of exposure.

7. FIELD INVESTIGATION / DATA COLLECTION AND IMPLEMENTATION ACTIVITIES

A. The Engineer (or authorized designee of the Engineer) conducting the field data collection work shall review and provide compliance with the following:
   1. Continuity of Service:
      a. If any service or system must be interrupted, the Engineer shall request permission in writing stating the date, time, etc. the same will be interrupted and the areas affected. This request shall be made in sufficient time (approximately 1 week minimum in advance) for proper arrangements to be made. Written permission shall be obtained from the Owner before any interruption to electrical power is permitted.
   2. Lock-Out / Tag-Out Procedures
      a. The Engineer shall provide his own lock-out / tag-out equipment in coordination with the Owner's program; coordinate with the Owner's field operational and maintenance staff.
      b. The Engineer shall have in effect a written safety program that includes a lock-out / tag-out safety program in accordance with OHSA under Part 1910, Subpart S.
   3. Electrical Safety Program
      a. The Engineer shall review the Owner's Electrical Safety Program and take the necessary precautions, in conjunction with his own safety program for employee protection.
      b. The Engineer is to have in effect a written electrical safety program that includes all applicable provisions of the NFPA-70E which has been adopted by OHSA under Part 1910, Subpart S.

B. The Engineer shall provide written documentation indicating that his employees, those working on American Water projects, have been trained and certified on all provisions applicable to B and C above upon request from the Water Company.

C. The Engineer's employees shall follow all provisions of "B" and "C" above including, but not limited to, the use of personal protective equipment (PPE), establish protective barriers, approach boundaries and documentation for such activities. Provide a written statement attesting to the above requirements prior to the start of the Field Investigation / Data Collection activities.

D. Field Adjustment
   1. The Engineer shall adjust protective devices settings based on the final accepted Study/Report provided by the Engineer; settings to be listed in a table format and submitted as part of the final O&M Manual for the equipment / system.

E. Arc Flash Warning Labels
   1. Provide an ANSI Z535.4 compliant (size 4 in. x 6 in.) thermal transfer or equivalent type two color die-cut arc flash label as provided by DuraLabel or Brady for each work location analyzed and included in this project. Material type to be suitable for the locations; IE indoor, outdoor, chemical resistively, etc.
   2. The label shall have either an orange header with black lettering and the wording, "**WARNING, ARC FLASH HAZARD**", or a red header with white lettering and the wording, **"DANGER, ARC FLASH HAZARD".** Include the ANSI Safety Symbol in the header as recommended. The Danger signal wording shall be provided for all calculated incident energy values greater than 40 Cal/cm^2; Warning to be used for all calculated incident energy values below 40 Cal/cm^2. These labels shall include the following information:
      a. Location designation
      b. Shock Hazard Information including; Nominal voltage, Limited Approach and Restricted Approach with Covers Removed
      c. Flash protection boundary
      d. Site-specific Arc Flash PPE Category
      e. Available Fault Current – include reference to Power Study as outlined on sample labels included in the Attachments to this criteria
      f. Incident energy (calculated based on Incident Energy Analysis Method)
      g. Working distance (18" typical for all equipment and applications)
      h. Engineer, report number, revision number and issue date
      i. Reference to "Owner's Arc Flash Procedures Manual" in lieu of actual listing of clothing and glove requirements.

      Refer to Attachment at end of this document for Sample Label and Information to be included
   3. Labels shall be machine printed, with no field markings. The size of the lettering is to be in accordance with ANSI-Z535.4 recommendations for a safe viewing distance of 3' minimum based on favorable viewing conditions and information to be included.
   4. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended over-current device settings. Coordinate the data provided with the Arc Flash Study results and the ANSI labeling requirements. Quantities outlined below are considered minimum quantities necessary; provide additional labeling as may be required by Regulatory or Inspection Agencies at no additional cost to the project.
      a. For each transformer, 480 and applicable 240 and/or 208 volt panelboard, individually-mounted circuit breaker and safety disconnect device, one arc flash label shall be provided

b. For each motor control center, one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
c. For each low voltage switchboard, one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
d. For each low voltage switchgear, one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
e. For each medium voltage switchgear, one arc flash label shall be provided for each cell within each vertical section *(see footnote below).*
f. For medium voltage switches one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
g. For each motor power terminal box, 25 horsepower and larger, one arc flash label shall be provided.
h. Additional arc flash labels to address installations and specific equipment requirements to be provided based on an individual evaluation basis and coordinated with the Owner.
i. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

(Footnote – where control center, switchboard, or switchgear assemblies are dual-fed, provide an arc flash label at each main entrance device or section as well as at any "Tie" device location. For equipment that is front and rear accessible, provide the same labeling on the rear sections as outlined above.)

5. Labels shall be field installed by the (Contractor or Engineer) at the conclusion of the project after acceptance by the Owner.

8. ATTACHMENTS

A. Sample Labels - Three Phase Systems involving calculated incident energy analysis:
   1. DANGER
   2. WARNING

B. Sample Labels – Three Phase 120/208-240 VAC Systems associated with AW Standardized labeling
   1. WARNING

C. Sample Labels – Single Phase 120/240 VAC Systems associated with AW Standardized labeling
   1. WARNING

D. AW Engineering Criteria for Portable Generator Transfer Switch and Termination Enclosure Identification

E. AW Engineering Criteria for Site Specific Arc Flash PPE Category Identification

ATTACHMENT A –
Three Phase Systems involving calculated incident energy analysis

DANGER

Energized Work Prohibited
No Safe PPE Exists

Arc Flash Boundary: 10.6 Feet
Incident Energy: 60.06 cal/cm^2
Working Distance: 18 inches
Shock Hazard when covers removed
Shock Hazard Exposure: 480 VAC
Limited Approach Boundary: 3.5 feet
Restricted Approach Boundary: 1 feet

Arc Flash PPE Category
FCT Not Determined
PPE: See AW AF Manual for Minimum Arc Rating of Clothing

Refer to Power Study for Equipment's Available Fault Current

Equipment: MAIN-CB
File: PAAW ROUTE 19 BPS w GEN

Engineer: AWBSE, MIL, GO

Date: 09-08-2014

WARNING

Arc Flash and Shock Hazard Present
Appropriate PPE Required

Arc Flash Boundary: 0.8 Feet
Incident Energy: 0.330006 cal/cm^2
Working Distance: 18 inches
Shock Hazard when covers removed
Shock Hazard Exposure: 480 VAC
Limited Approach Boundary: 3.5 feet
Restricted Approach Boundary: 1 feet

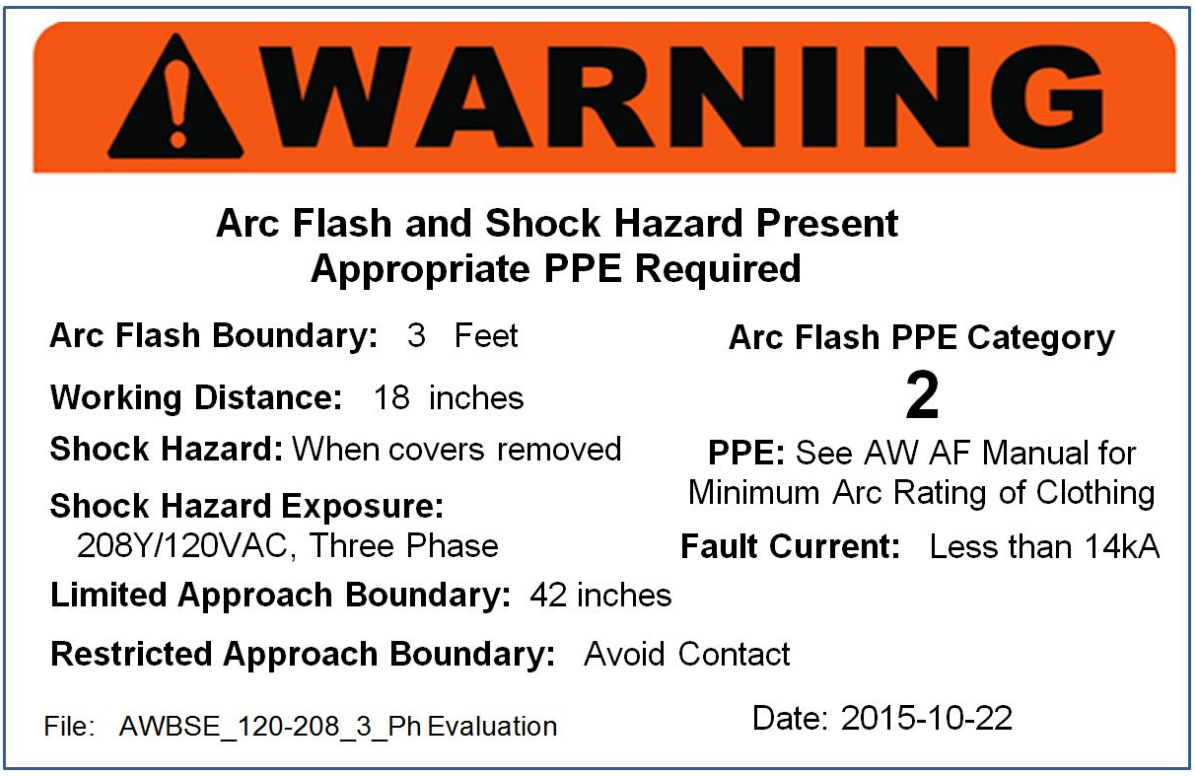
Arc Flash PPE Category
1
PPE: See AW AF Manual for Minimum Arc Rating of Clothing

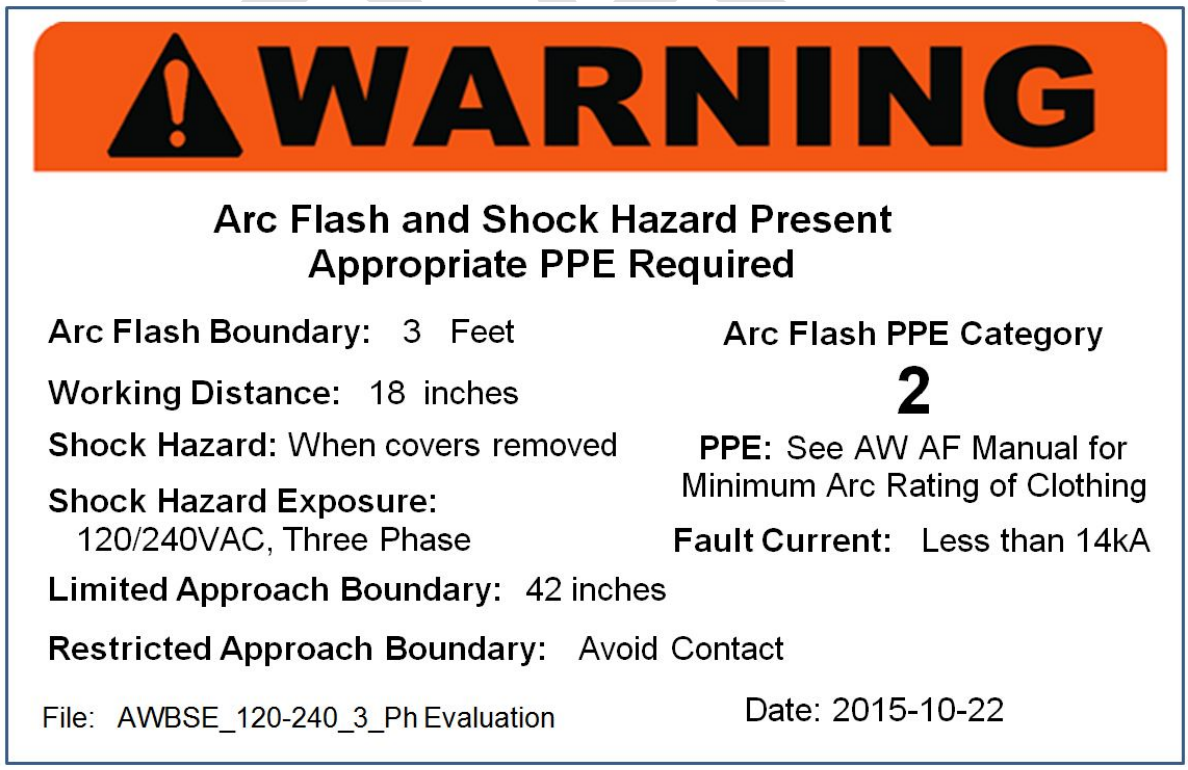
Refer to Power Study for Equipment's Available Fault Current

Equipment: LV-XFRMR-LINE
File: PAAW ROUTE 19 BPS w GEN

Engineer: AWBSE, MIL, GO

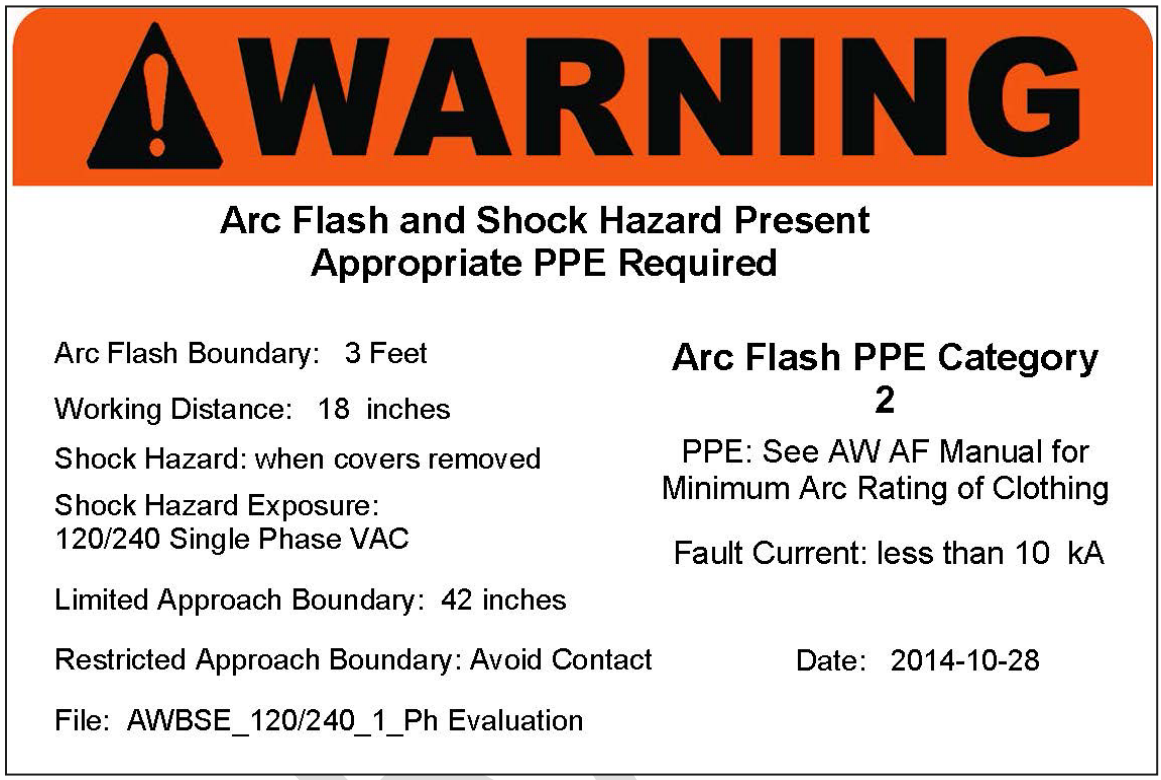
ATTACHMENT B -
Three Phase 120/208-240 VAC Systems associated with AW Standardized labeling





ATTACHMENT C –

Single Phase 120/240 VAC Systems associated with AW Standardized labeling



ATTACHMENT D –

AW Engineering Criteria for Portable Generator Transfer Switch and Termination Enclosure Identification

ATTACHMENT E –

American Water Engineering Criteria for Site Specific Arc Flash PPE Category Identification

Incident Energy Range (cal/cm^2)	Arc Flash PPE Category
0 – 4.0	1
4.01 – 8.0	2
8.01 – 25.0	3
25.01 – 40.0	4
40.01 and above	DANGEROUS (No Safe PPE Exists)

AMERICAN WATER

ATTACHMENT A

AMERICAN WATER
POWER SYSTEM STUDY AND
ARC FLASH ANALYSIS REQUIREMENTS

Prepared by:
American Water Corporate Engineering
3906 Church Road
Mt Laurel, NJ 08054

Version Date: April 2018

Revision Date: February 2021

AMERICAN WATER POWER SYSTEM STUDY AND ARC FLASH ANALYSIS REQUIREMENTS

1. DESCRIPTION OF WORK REQUIRED

A. Provide all items of labor, materials and equipment necessary for data collection, development, evaluation and report generation of the work described in this Section. The entire power distribution system (all equipment), new and existing is to be included in the study being provided for this Project. The actual Power System Study / Analyses work shall be conducted by a qualified, licensed Professional Engineer as outlined in Article 3.A below.

B. Visit the site to determine actual conditions, equipment and settings and related elements necessary to prepare a complete oneline diagram of the entire power distribution system associated with the Hays Mine WTP. Provide this oneline diagram identifying all equipment (utilizing existing naming/labeling information) as well as their loads/ratings, cable and raceway information and other data associated with the installations. This information will allow evaluation and calculation of the various Studies to be provided in the Report outlined herein. Where required, coordinate field work with the Owner and shall follow all applicable safety standards for the activities required.
   1. Those involved with the field data collection work shall review / compare the Owner's operational and safety standards with their own and provide adequate Personal Protective Equipment (PPE) for those individuals involved in any data gathering activities as outlined by applicable Regulatory Agencies. No extra compensation will be allowed by failure to determine existing conditions.

C. Furnish a complete Short-Circuit, Protective Coordination, and Arc Flash Hazard Analysis Study per the requirements set forth in the criteria established for the Project, the criteria outlined herein this document, and as identified in the latest version of NFPA 70E– 2015 Edition; *Standard for Electrical Safety in the Workplace and as outlined herein regarding American Water Site Specific PPE Category Labeling criteria*. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584-2018 Edition*;* modified as hereinafter identified.

D. Arc-Flash Equipment Labeling shall be provided upon acceptance of the Engineer's final report. Labeling shall be provided for all equipment as identified herein this document.

E. In addition, where indicated in the Scope of Work identified by the Owner, provide a Load Flow analysis using the power systems software identified herein to model the operational scenarios required for the project and requested by the Owner. These Load Flow analysis reports are to be provided in accordance with the Owner's criteria for loading and report submission.

F. Any Drawings and Material Data Sheets / Product Information provided by the Owner is considered as generally indicative of Power System but is not to be considered as matching actual site conditions. Modifications/field changes may have occurred which were not recorded; therefore, provide field verification as necessary to validate the Power System as Work under this project in preparation of the Short-Circuit, Protective-Coordination and Arc-Flash Study and Analysis.

G. The general (not limited) approach to the evaluation and analysis work included in this assignment shall include the following effort;

1. Collect system and “as-installed” data associated with all electrical equipment, feeders, and devices associated with this Study/Report. This effort shall also include obtaining the necessary load-history and available fault current (max and min) and Utility Overcurrent Protective Device (OCP) device(s) from the serving Power Utility Company along with the technical data associated with their system and transformer equipment being provided as applicable to the specific site/facility being evaluated.
2. Determine system modes of operation by conducting interviews with Owner’s Operational / Production Staff
3. Determine bolted short-circuit and arc fault currents
4. Determine protective device characteristics and duration of arcs
5. Document system voltages and classes of equipment
6. Evaluate existing equipment short circuit ratings against computed available fault currents.
7. Arc Flash Hazard Analysis to select working distances as outlined herein, determine incident energy for all equipment and determine flash-protection boundary zones for all affected equipment. Conduct arc flash analysis based on the utility fault current and at a value approximately 50% of this or as otherwise determined from the fault current range as provided by the serving Utility Company.
    a. In addition, where Standby power (generator) is also provided as part of the Project, evaluate the arc flash hazard based on this power source. Summarize each evaluation and develop arc flash labeling based on the worst case scenario or as otherwise accepted by the Owner.
        1) Where the installation includes the use of a portable generator, provide a cautionary label on both the transfer switching equipment and on the outdoor generator termination enclosure as outlined in Attachment D.
    b. Furthermore, provide analysis of any arc flash reduction methods being utilized or included for the equipment. While these devices are not considered in actual labeling, they are to be clearly identified and reported for potential use by maintenance staff when required activities include conducting work on energized and exposed electrical equipment. Provide full analysis of these devices including effects on the downstream equipment being served where applicable.
    c. Finally, where power distribution systems involve the application of “Main – Tie – Main” or similar multi-operational configurations, provide analysis for these schemes in order to determine effects of the operational differences with regard to loading, short-circuit, protective coordination and arc flash hazard. As above, each operational scenario is to be clearly identified in the reports submitted.

2. REFERENCES

A. ANSI – American National Standards Institute, Inc.
1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

B. ASTM – American Society for Testing and Materials

C. IEEE – Institute of Electrical and Electronic Engineers
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems

2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 1584-2018 – Guide for Performing Arc-Flash Hazard Calculations

D. IPCEA – Insulated Power Cable Engineers Association

E. NEMA – National Electrical Manufacturers Association

F. NESC – National Electrical Safety Code

G. NFPA – National Fire Protection Association
1. NFPA 70 – National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition

3. STUDY REQUIREMENTS

A. The Work associated with this assignment must comply with all Federal and State, municipal or other authority's laws, rules and/or regulations. These services shall be provided by a qualified, licensed Professional Engineer (hereinafter referred to as Engineer and/or Engineer-of-Record) to conduct the actual analysis, evaluation and development of the Report and Arc Flash labeling. The Engineer shall be registered in the State (or Commonwealth) where the facility is located. Submit information regarding the Engineer proposed to the Owner for review and/or comment.

B. The Power System Study / Analysis is to include all electrical equipment; and specifically include / address the following:
1. In general (not limited to) and starting at the incoming power supply (hereinafter noted as “Utility”), all electrical equipment including the main service transformer where applicable, the Utility OCP device and system ratings shall be evaluated and included in this Study.
2. Where provided within the power system of the facility, all medium voltage equipment, motors, transformers (primary and secondary) shall be included as applicable, as well as all 480 VAC low voltage equipment, motors nominally 20 HP (or as otherwise outlined) and larger, all transfer switch equipment, safety disconnect switches rated 100 amps and above, all automatic and manual transfer switches, panelboards, transformers (primary and secondary locations) and other electrical equipment requiring routine inspection or maintenance while energized (including Infrared (IR) Scans). Motors less than HP may be grouped into single load blocks for the purposes of this power system analyses.
3. 120/208-240 VAC Low Voltage Power Equipment Criteria:
   a. 120/208-240 VAC Three phase equipment shall be included in the Study in accordance IEEE-1584, 2018 and relevant criteria from NFPA-70E criteria, and as outlined herein below.
   b. 120/240 VAC Single phase equipment need not be included in the actual analyses where the fault current is determined to be less than 10 kAIC, but these panelboards and related transformers, etc. shall be shown on the facility’s oneline diagrams for identification and labeling shall be provided as outlined herein below.
4. Refer to other criteria and reporting requirements are outlined elsewhere in this Document.

C. 120/208-240 VAC, Three Phase Power Systems – American Water Corporate Engineering has developed the following recommendations for Arc Flash Hazard labeling on 120/208 – 240 VAC, three-phase grounded and ungrounded power systems:
    1. Utilize the "two-second" evaluation criteria permitted by IEEE-1584 and NFPA-70E when calculating the clearing time of the upstream overcurrent protective device in the calculations for all 120/208-240 VAC Systems. *NOTE: The use of this "two-second" criteria associated with max clearing time is **ONLY** permitted for use on these low voltage installations*
    2. Service-Entrance and sub-distribution locations:
        a. AW Engineering recommends the application of a "standard" Arc Flash PPE Category 1 label (see Attachment B herein) at those locations where the Main OCP device is equal to or less than 125 amps or the supplying transformer is 30 KVA or less. (These installations result in maximum available fault current values of less than 2000 Amps where sustainable arcs are less likely in three-phase 208-240 VAC operating systems.)
        b. Equipment Arc Flash PPE Category Labeling not meeting "a" above – Utilizing the "two-second" time restraint associated with the upstream overcurrent protective device, calculate the Incident Energy and provide the appropriate Arc Flash PPE Category Label.
    3. Applicable voltages associated with this criteria include;
        a. 120/208 VAC, 3-phase, 4-wire (grounded WYE); or
        b. 120/240 VAC, 3 –Phase, 4-wire ("High-leg Delta"); or
        c. 240 VAC, 3-phase, 3-wire (Ungrounded Delta)

D. 120/240 VAC, Single-Phase Power Systems – American Water Corporate Engineering has developed the following recommendations for Arc Flash Hazard labeling on 120/240 VAC, single-phase grounded power systems:
    1. All 120/240 VAC Single Phase installations shall be provided with the application of a "standard" Arc Flash Hazard PPE label (see Attachment C herein) at those locations.

E. The Report(s) with calculations must be supplied to the Owner before final equipment labels are printed and applied before the work is considered accepted or approved. The Engineer shall provide documentation for all presumptions / assumptions related to machine impedances, cable impedances (both resistance and inductance), transformer impedances and other equipment values used to complete the computations where obtaining actual data is not available.

F. The Engineer shall consider fault conditions under minimum, maximum, and average power consumption scenarios based on facility operations as well as in the varying Utility fault conditions outlined previously. The Engineer shall also develop fault scenarios with standby power generators where included and used instead of or in conjunction with the electric utility source along with the other scenarios outlined. Arc Flash Hazard analysis and equipment evaluations to be provided as hereinafter indicated.

G. All oneline diagrams included in the Study / Report shall utilize naming conventions and identifiers matching the Design Documents or actual equipment field labels; generic identifiers are not considered appropriate. Coordinate equipment naming / identifiers with the Owner taking into account any existing terminology used. Individual oneline diagrams are required for each of the following evaluations as well as each scenario associated with the work outlined for various operational modes, arc reduction methods/devices and multiple configuration capabilities within the power distribution

system. The following ones identified are listed only to establish the primary categories associated the overall scope of evaluations to be included; include supplemental documentation as necessary to clearly and individually identify the study scenario and/or evaluation being considered.

1. Provide annotated onelines for the Power Distribution System identifying all equipment and naming conventions as stated above.
2. Provide annotated onelines identifying the available short-circuit current at each piece of equipment; include this in the Report; tabbed as associated with this topic.
3. Provide annotated onelines identifying the settings associated with the protective device settings at each piece of equipment; include this in the Report; tabbed as associated with this topic. Additional setting details associated with electronic trip devices, relays, etc. are to be clearly identified and included on the partial oneline clips associated with the protective coordination TCC diagrams.
4. Provide annotated onelines identifying the Incident Energy and Arc Flash Hazard Level at each piece of equipment; include this in the Report; tabbed as associated with each Topic and Evaluation
5. All onelines shall be legible and readable with a minimum 10 point (Arial or similar) font size; coordinate drawing size (not to exceed 22” x 34”) accordingly. Provide sleeved drawing holders where printed size is larger than 11” x 17”.

H. Short Circuit, Protective Coordination and Arc Flash Hazard Analysis Study

1. A short circuit, protective coordination and arc flash hazard analysis study shall be made for the entire distribution system in accordance with ANSI/IEEE C37.10 & C37.13, IEEE Std. 141, 242 and 399 beginning at Utility connections and ending at the largest feeder from each motor control center or panel as applicable for the system and analysis being conducted in coordination with paragraph “B” above.
2. Actual Utility data including system and equipment impedances, X/R Ratios, OCP device(s) and other applicable ratings are to be obtained by the Engineer; include this data as provided by the Utility Company (or resultant Study data) in the Report provided.
3. The protective coordination study shall consist of the following:
   a. All protective devices contained in the scope of work shall be evaluated. The coordination study shall include computer generated log-log plots of phase overcurrent and where applicable, ground overcurrent protection devices on log-log time-current characteristic paper as produced by the engineering software used for these evaluations and analyses. Complete plots of these devices will be accurately plotted through their operating range. Each TCC Plot shall include a oneline sketch showing the device identifications and ratings. The Engineer shall identify areas of non-coordination where considerations for modification may be determined. Actual modifications are not necessarily considered included in the scope of services under this project. Any suggested modifications affecting equipment and modifications to the system that the Owner may wish to consider will be handled as a change in the Contract. Appropriate maximum fault levels, transformer inrush currents, conductor insulation withstand curves and transformer damage curves / withstand points shall be plotted on each coordination plot sheet to assure adequate component protection and maximum system reliability.
   b. Where included in the power distribution system, each current transformer shall be checked for saturation to ensure that they accurately translate all

fault currents which may be available on the system.

c. All protective relay and solid-state device settings; fuse sizes; and low-voltage circuit breaker settings shall be tabulated and included on the respective TCC.
d. A complete set of coordination curves (complete with device settings indicated on the TCC) are to be prepared starting with the Utility Company's OCP device(s) and the main distribution devices protecting the Owner's service down through and including all on-site services, feeders, sub-feeders, transformers and secondary main and branch circuit devices, shall be included in the Study. These shall be arranged to provide a uniform approach to the review and device coordination for the system and shall include a "snap-shot"/annotated oneline diagram on each TCC sheet outlining the devices included. Provide sufficient overlap on the TCC evaluations included to demonstrate "upstream / downstream" coordination.
e. The Engineer shall also evaluate ground fault protection where provided in conjunction with the project. Provide Time Current Characteristic (TCC) curves for all GFI circuit breaker equipment protection as outlined above.
f. Motor starting current profiles for all large motors (over 25 HP or as otherwise determined and accepted by the Owner) shall be included on the appropriate TCC's to identify coordination and provided based on the starter type being provided; other motors to be configured as combined loads as applicable to the application
g. Tabulations shall include a listing of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings. This tabulation shall also include indication of acceptability or, in the event of a noted deficiency, provide recommended solution for corrective action.
h. As indicated, points of non-coordination shall be brought to the attention of the Owner; provide existing TCC identifying the issue and a separate TCC outlining proposed modifications and/or adjustments recommended for corrective action.
i. The Study shall include all electrical equipment as included in the Scope of Work for this assignment. The use of documentation and record information as may be provided by the Owner shall not be construed as providing all data necessary; the EOR shall be responsible to conduct or obtain field verification necessary to determine / obtain all required data in establishing the power distribution one-line diagram for the system being evaluated.
j. Submissions and approval of these studies are required as outlined herein after in this document.

4. Arc Flash Hazard Analysis
   a. The arc flash hazard analysis shall include the incident energy and flash boundary calculations.
      1) Unless otherwise specified or approved in writing by the Owner, the EOR shall utilize a Working Distance of 18 inches for ALL voltage levels (low & medium voltage values). Typical other typical distances (i.e... 24" or 36") for low voltage systems and/or 36" for medium voltage systems as otherwise permitted under NFPA-70E / IEEE are not permitted.
      2) As indicated, calculated incident energy values shall be provided for both line and load sides of all transformers and the overcurrent protective devices served from these transformers or other separately derived

sources and labeling developed to identify both calculated Incident Energy and Site-specific Arc Flash PPE Category values in addition to other equipment and devices as previously outlined herein. Equipment Arc Flash Hazard Analysis labeling to be provided with this and other labeling information as outlined herein to properly identify and notify workers to the hazards present.

b. The Engineer shall furnish the Arc Flash Hazard Analysis Study per the latest edition of NFPA 70E - *Standard for Electrical Safety in the Workplace*, reference Article 130.3, Annex D – *Incident Energy and Arc Flash Boundary Calculation Methods*.
c. The analysis shall utilize the appropriate short-circuit and clearing times associated with the over-current protective devices. Where this information is not available, alternative methods for similar devices shall be identified and submitted in the study for review and comment by the Owner.
    1) The arc flash study shall be run under a minimum of the following scenarios in order to account for varying source conditions and available Utility deviations. The worst case from these scenarios shall be considered in developing the PPE and Arc Flash Labeling for the equipment unless otherwise discussed and accepted by the Owner. Power Study scenarios to be considered include;
        a) Utility at nominal short circuit contribution,
        b) Utility at 50% of nominal contribution (or as otherwise determined based on available range of Utility data), and
        c) Standby (generator) contribution (where applicable)
        d) Other scenarios as previously indicated.
    2) Incident energy is greatly influenced by protective device clearing time, which is determined by the available short circuit current at that location. The intent for utilizing a 50% source is to provide some measure of assurance that a “low” utility source will not result in incident energy values higher than those indicated on the equipment labels.
    3) The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system as outlined herein.
d. The Arc-Flash Hazard Analysis shall include all medium voltage and 480/277 volt locations, as well as those three phase locations associated with the 240 volt and 208 volt systems as previously outlined..
e. All electrical equipment as herein outlined shall be labeled regardless of the arc-flash energy / incident energy level determined.
f. Safe working distances shall be identified for calculated fault locations based upon a calculated arc flash boundary considering a minimum Incident Energy level of 4 cal/cm^2; site-specific Arc Flash PPE Category as identified in Attachment D. Working distances shall be based on 18” as outlined previously and in accordance with the general criteria as outlined in IEEE 1584. The calculated arc flash protection boundary shall be determined using this working distances.
g. The Arc Flash Hazard analysis shall include calculations for contributions of fault current magnitude (based on the available fault-current values and not the AIC ratings of the equipment) as previously outlined herein. The calculations shall include all motor and other sources that can contribute to the available fault current. Where necessary, the Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these

conditions differ from worst-case bolted fault conditions.

h. As previously noted, Arc flash computations shall include line and load side calculations associated with the “main” (service-entrance) breaker as well as any other transformer OCP devices associated with internal power distribution. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. AW does not consider the use of this IEEE Exception to be appropriate. (Maximum clearing time of 2 seconds *based on IEEE 1584 is not acceptable except as previously identified*)

i. Results of the Analysis shall be submitted in tabular form, include device or bus name, (based on actual naming ID as identified on the Facility Oneline Diagram; not simply an ID assigned by the software), bolted fault and arcing fault current levels at the various scenarios outlined herein, flash protection boundary distances, personal-protective equipment classes and the arc flash incident energy levels determined. These results shall also be included on the oneline diagram associated with the specific study/scenario being evaluated.

j. The Report shall also include identification of the Personnel-Protective Equipment (PPE) Categories and identify minimum PPE required for each location. This information shall be included in the Report but not shown on the equipment labels.

k. Arc Flash Labeling of Electrical Equipment: Provide copies of the Arc Flash Labels (see sample attached below) in the Report for documentation of the information being identified on the equipment in a separately tabbed section of the report. Include in this section definitions of the terms and distances outlined along with information on the various PPE equipment classifications indicated.

4. POWER SYSTEM STUDY AND ARC FLASH ANALYSIS QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled (*minimum of 10 years of demonstrated experience in conducting power systems studies; provide qualifications upon request*) in performing and interpreting the power system studies. The final report, including copies of the Arc Flash Labels, shall be sealed and signed by the EOR.

5. ENGINEERING STUDY / REPORT SUBMISSIONS

A. Submit the following Reports for AW Engineering / Owner Review and Comment. Coordinate these submissions with the Design Criteria / Documentation Submissions as outlined for the Project. In general, the “Preliminary” Report should be provided with the 30% Design (or otherwise defined Project) Submission; the “Pre-Final” Report with the 60% submission and the “Final” Report provided with the 100% submission. Final adjusted report information, including final equipment labels to be provided once all field adjustments and acceptance testing has been completed. This Record Document Report shall be provided as part of the Operation and Maintenance Documents.

1. Preliminary – Submission to contain an annotated One-line Power Riser Distribution Diagram with OCP devices and other basic configurations associated with the power distribution system included; not a completely detailed and documented diagram. This diagram is intended to show the available power

sources and devices which comprise the system and it's configuration for operation. Additionally, this initial diagram is to include the major loads and presumptions for miscellaneous general power requirements which may be appropriate in considering Load Flow evaluations where necessary.

a. As part of this Preliminary effort, consideration related to new equipment selections shall be included. Provide initial discussion and/or indication related to proposed equipment for Owner consideration and comment.
b. Include the overall oneline diagram utilizing this simplified computer modeling approach. This information and modeling will allow basic configuration, operations and evaluations associated with equipment short-circuit ratings and types of devices to be considered / developed with the Owner.

2. Pre-Final – Report to contain an annotated One-line Power Riser Distribution Diagram with OCP devices, device ratings/settings and cable feeders (conductor size/type and raceway size/type) identified.
   a. As part of this continuing effort, consideration related to equipment selections shall include type of device and over-current protective features needed for protective coordination with other elements of the power distribution system and loads served. (including type of trip unit, potential arc flash reduction methods as applicable, etc.).
   b. Calculations associated with Short-Circuit AIC values and Equipment suitability along with Arc-Flash Hazard Analysis Report and sample of proposed / typical ANSI Z535.* label information (**current edition*) documentation are to be included.
   c. Included in this Report, Oneline Drawings for the overall Power Distribution Power Riser diagram, an annotated oneline outlining the Short-Circuit ampacity values calculated, and an annotated oneline showing the Arc Flash Incident Energy and PPE Levels calculated.
   d. In addition, a copy of the oneline diagram with the OCP devices indicated shall be included with the Protective Coordination TCC's. Each TCC shall include the partial oneline drawing associated with the protective coordination elements being evaluated and included.

3. Final - Provide a written response to Owner comments provided regarding Pre-Final Study Report. Finalize the information; update data, settings and other appropriate information including any accepted recommendations and/or modifications.
   a. Provide three hard-copies of each submission Report as well as editable Word electronic formatted Report document with the Final submission. Power Distribution Riser Diagrams shall be provided for all analysis configurations conducted including, but not limited to, short-circuit models for minimum and maximum operational scenarios and arc flash hazard models. Include hardcopies of equipment reports and calculations performed.
   b. Submit an electronic copy of the final Arc Flash Hazard Analysis and One-line Power Riser Diagram, complete with all associated equipment databases formatted with the engineering software used and as outlined herein.
   c. It is recommended that the final report include the following sections:
      1) Executive Summary including Introduction, Scope of Work and Results/Recommendations
      2) Short-Circuit Methodology Analysis Results and Recommendations
      3) Short-Circuit Device Evaluation Table

4) Protective Device Coordination Methodology Analysis Results and Recommendations
5) Annotated and revised oneline diagrams (all) as outlined in “2” above shall be provided with the Final Report.
6) Protective Device Settings Table associated with the field installed devices.
7) Time-Current Coordination Graphs and Recommendations
8) Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
9) Arc Flash Labeling section showing types of labels to be provided. Section will contain descriptive information as well as actual copies of the label images.
10) One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.

B. Upon acceptance of the Final Report, provide labeling of the power distribution equipment in accordance with ANSI Z535.4– Product Safety Signs and Labels; label size to be 4” x 6”. Labels to be provided as outlined in Articles 1.03, C and 3.03 below. Label materials furnished to be suitable for either the interior or exterior locations where they are to be applied; provide samples for review and approval by the Owner along with data sheets from the Manufacturer outlining these applications.

C. As part of the final documentation associated with the project Record Drawing data, provide a copy of the oneline diagram that includes the essential equipment and devices without ratings to provide a concise representation of the power distribution system. All equipment and devices shall be identified based on the actual nameplates and identifiers developed under the project design; coordinate with final nameplates provided. Drawing size to be based on size of power distribution system but shall be large enough to provide clear reading of the text based on an Arial 10 point font or equivalent of the equipment naming and identifiers; maximum sheet size to be 22” x 34”. Provide multiple drawings for systems where information cannot be legibly contained on a single sheet. This diagram is to include all revisions and modifications determined through the course of construction.

6. COMPUTER ANALYSIS SOFTWARE AND EVALUATION CRITERIA FOR ELECTRICAL EQUIPMENT ENCLOSURES AND CONFIGURATIONS

A. The studies shall be performed using ETAP power systems software as provided by Operation Technology, Inc. (OTI), or SKM Systems Analysis Power Tools for Windows (PTW) software program.

B. Provide a final electronic file copy of all data, reports and the oneline diagram in electronic engineering database (ETAP or SKM) format to the Owner prior to final acceptance of the Project. This information is to be validated by the EOR as representing “As-Built” conditions including all over-current protective devices and their

settings, feeder conductors and raceway information and load data; including inductive, resistive and combination loads.

C. The files shall contain all Reports (in Microsoft Word) conducted including Short-Circuit evaluations, Protective Coordination and Load Flow Studies as well as the Arc Flash analysis values determined as well as copies of the Arc Flash labels. The EOR for the Study shall attest to this validation in writing when submitting the final electronic copy of the project.

D. Evaluation Criteria for Electrical Equipment Enclosure Analysis:

1. Medium Voltage and Low Voltage Draw-out Switchgear and Switchboards: HCB

2. Medium Voltage and Low Voltage Motor Control Center Assemblies: HCB

3. Medium Voltage and Low Voltage Disconnect Switches (Fusible and Non-Fusible): HCB

4. Low Voltage Fixed Breaker Switchboards and Panelboards: VCBB

5. Outdoor Exposed Bus Substation Equipment: VOA or HOA as Applicable based on location and type of exposure.

7. FIELD INVESTIGATION / DATA COLLECTION AND IMPLEMENTATION ACTIVITIES

A. The Engineer (or authorized designee of the Engineer) conducting the field data collection work shall review and provide compliance with the following:
   1. Continuity of Service:
      a. If any service or system must be interrupted, the Engineer shall request permission in writing stating the date, time, etc. the same will be interrupted and the areas affected. This request shall be made in sufficient time (approximately 1 week minimum in advance) for proper arrangements to be made. Written permission shall be obtained from the Owner before any interruption to electrical power is permitted.
   2. Lock-Out / Tag-Out Procedures
      a. The Engineer shall provide his own lock-out / tag-out equipment in coordination with the Owner's program; coordinate with the Owner's field operational and maintenance staff.
      b. The Engineer shall have in effect a written safety program that includes a lock-out / tag-out safety program in accordance with OHSA under Part 1910, Subpart S.
   3. Electrical Safety Program
      a. The Engineer shall review the Owner's Electrical Safety Program and take the necessary precautions, in conjunction with his own safety program for employee protection.
      b. The Engineer is to have in effect a written electrical safety program that includes all applicable provisions of the NFPA-70E which has been adopted by OHSA under Part 1910, Subpart S.

B. The Engineer shall provide written documentation indicating that his employees, those working on American Water projects, have been trained and certified on all provisions applicable to B and C above upon request from the Water Company.

C. The Engineer's employees shall follow all provisions of "B" and "C" above including, but not limited to, the use of personal protective equipment (PPE), establish protective barriers, approach boundaries and documentation for such activities. Provide a written statement attesting to the above requirements prior to the start of the Field Investigation / Data Collection activities.

D. Field Adjustment
   1. The Engineer shall adjust protective devices settings based on the final accepted Study/Report provided by the Engineer; settings to be listed in a table format and submitted as part of the final O&M Manual for the equipment / system.

E. Arc Flash Warning Labels
   1. Provide an ANSI Z535.4 compliant (size 4 in. x 6 in.) thermal transfer or equivalent type two color die-cut arc flash label as provided by DuraLabel or Brady for each work location analyzed and included in this project. Material type to be suitable for the locations; IE indoor, outdoor, chemical resistively, etc.
   2. The label shall have either an orange header with black lettering and the wording, "**WARNING, ARC FLASH HAZARD**", or a red header with white lettering and the wording, **"DANGER, ARC FLASH HAZARD".** Include the ANSI Safety Symbol in the header as recommended. The Danger signal wording shall be provided for all calculated incident energy values greater than 40 Cal/cm^2; Warning to be used for all calculated incident energy values below 40 Cal/cm^2. These labels shall include the following information:
      a. Location designation
      b. Shock Hazard Information including; Nominal voltage, Limited Approach and Restricted Approach with Covers Removed
      c. Flash protection boundary
      d. Site-specific Arc Flash PPE Category
      e. Available Fault Current – include reference to Power Study as outlined on sample labels included in the Attachments to this criteria
      f. Incident energy (calculated based on Incident Energy Analysis Method)
      g. Working distance (18" typical for all equipment and applications)
      h. Engineer, report number, revision number and issue date
      i. Reference to "Owner's Arc Flash Procedures Manual" in lieu of actual listing of clothing and glove requirements.

      Refer to Attachment at end of this document for Sample Label and Information to be included
   3. Labels shall be machine printed, with no field markings. The size of the lettering is to be in accordance with ANSI-Z535.4 recommendations for a safe viewing distance of 3' minimum based on favorable viewing conditions and information to be included.
   4. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended over-current device settings. Coordinate the data provided with the Arc Flash Study results and the ANSI labeling requirements. Quantities outlined below are considered minimum quantities necessary; provide additional labeling as may be required by Regulatory or Inspection Agencies at no additional cost to the project.
      a. For each transformer, 480 and applicable 240 and/or 208 volt panelboard, individually-mounted circuit breaker and safety disconnect device, one arc flash label shall be provided

b. For each motor control center, one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
c. For each low voltage switchboard, one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
d. For each low voltage switchgear, one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
e. For each medium voltage switchgear, one arc flash label shall be provided for each cell within each vertical section *(see footnote below).*
f. For medium voltage switches one arc flash label shall be provided at the top of each vertical section *(see footnote below).*
g. For each motor power terminal box, 25 horsepower and larger, one arc flash label shall be provided.
h. Additional arc flash labels to address installations and specific equipment requirements to be provided based on an individual evaluation basis and coordinated with the Owner.
i. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work.

(Footnote – where control center, switchboard, or switchgear assemblies are dual-fed, provide an arc flash label at each main entrance device or section as well as at any "Tie" device location. For equipment that is front and rear accessible, provide the same labeling on the rear sections as outlined above.)

5. Labels shall be field installed by the (Contractor or Engineer) at the conclusion of the project after acceptance by the Owner.

8. ATTACHMENTS

A. Sample Labels - Three Phase Systems involving calculated incident energy analysis:
   1. DANGER
   2. WARNING

B. Sample Labels – Three Phase 120/208-240 VAC Systems associated with AW Standardized labeling
   1. WARNING

C. Sample Labels – Single Phase 120/240 VAC Systems associated with AW Standardized labeling
   1. WARNING

D. AW Engineering Criteria for Portable Generator Transfer Switch and Termination Enclosure Identification

E. AW Engineering Criteria for Site Specific Arc Flash PPE Category Identification

ATTACHMENT A –
Three Phase Systems involving calculated incident energy analysis

DANGER

Energized Work Prohibited
No Safe PPE Exists

Arc Flash Boundary: 10.6 Feet
Incident Energy: 60.06 cal/cm^2
Working Distance: 18 inches
Shock Hazard when covers removed
Shock Hazard Exposure: 480 VAC
Limited Approach Boundary: 3.5 feet
Restricted Approach Boundary: 1 feet

Arc Flash PPE Category
FCT Not Determined
PPE: See AW AF Manual for Minimum Arc Rating of Clothing

Refer to Power Study for Equipment's Available Fault Current

Equipment: MAIN-CB
File: PAAW ROUTE 19 BPS w GEN

Engineer: AWBSE, MIL, GO

Date: 09-08-2014

WARNING

Arc Flash and Shock Hazard Present
Appropriate PPE Required

Arc Flash Boundary: 0.8 Feet
Incident Energy: 0.330006 cal/cm^2
Working Distance: 18 inches
Shock Hazard when covers removed
Shock Hazard Exposure: 480 VAC
Limited Approach Boundary: 3.5 feet
Restricted Approach Boundary: 1 feet

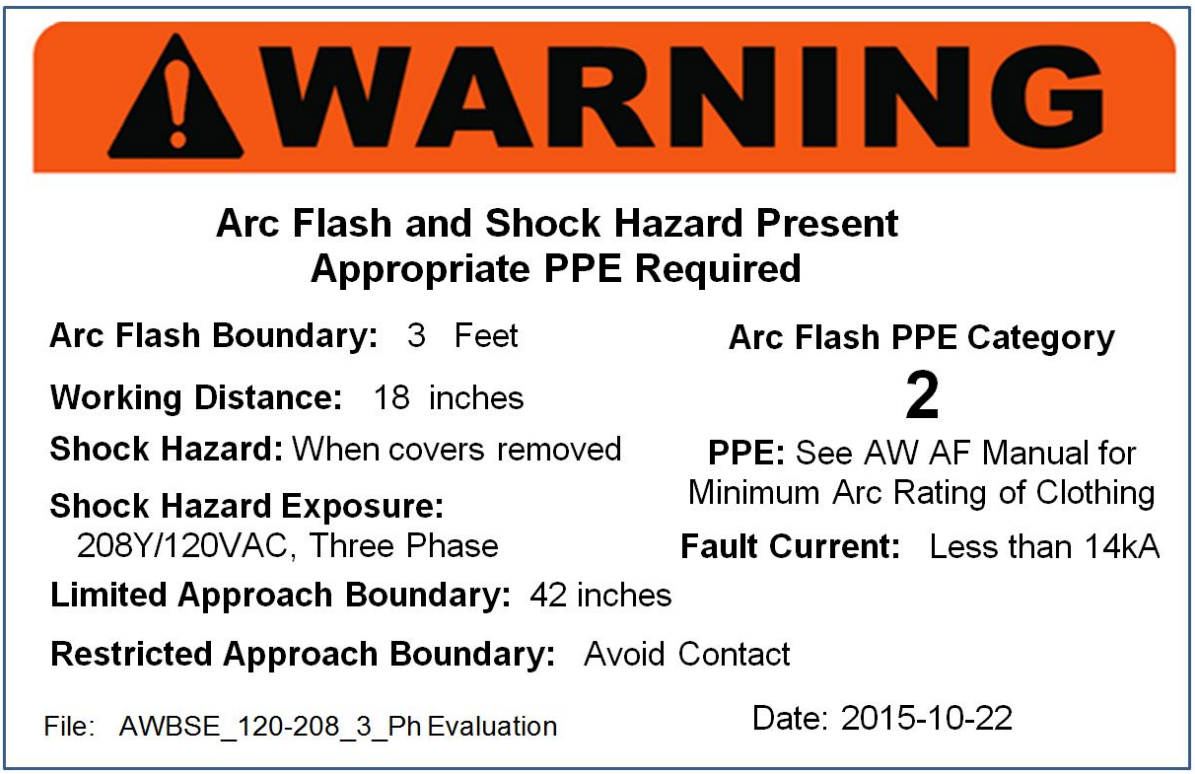
Arc Flash PPE Category
1
PPE: See AW AF Manual for Minimum Arc Rating of Clothing

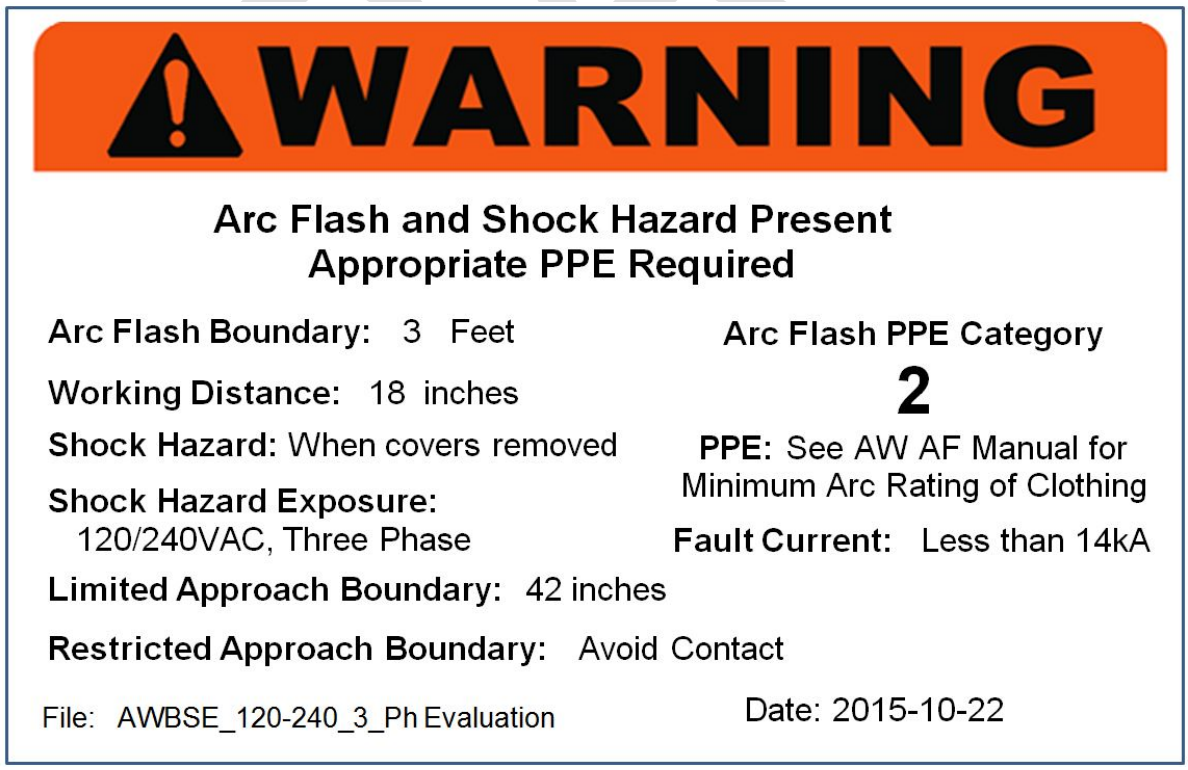
Refer to Power Study for Equipment's Available Fault Current

Equipment: LV-XFRMR-LINE
File: PAAW ROUTE 19 BPS w GEN

Engineer: AWBSE, MIL, GO

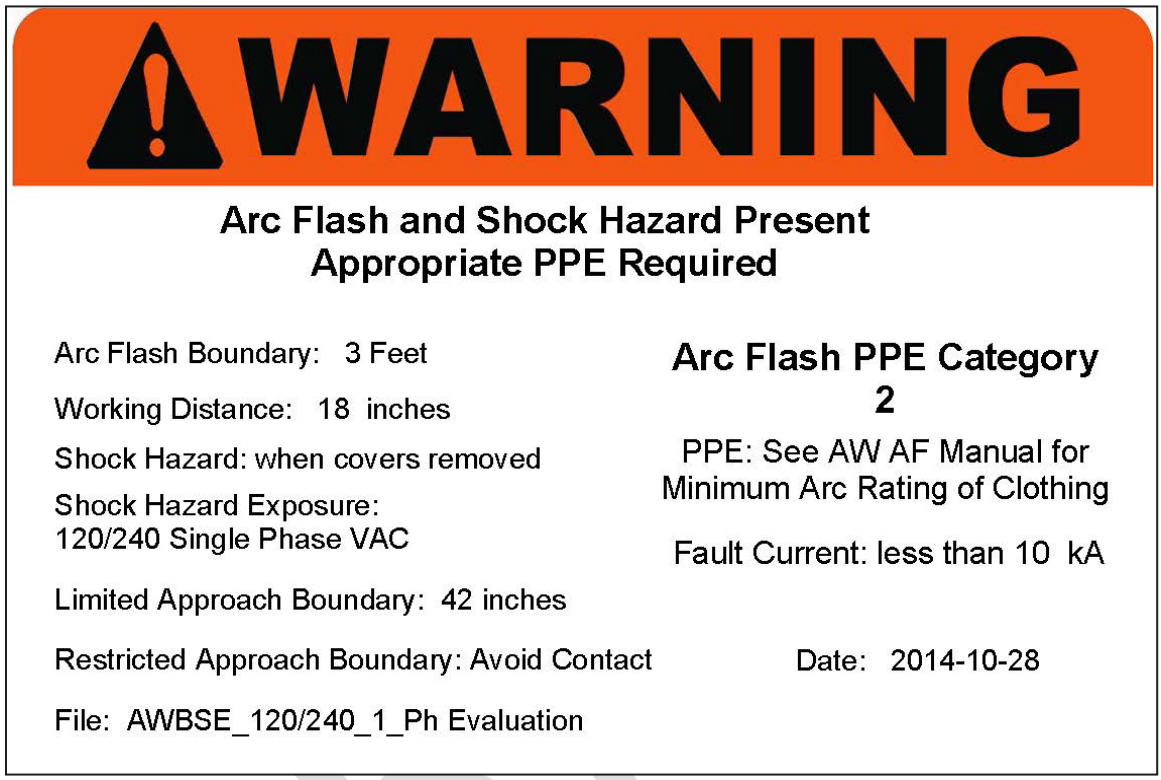
ATTACHMENT B -
Three Phase 120/208-240 VAC Systems associated with AW Standardized labeling





ATTACHMENT C –

Single Phase 120/240 VAC Systems associated with AW Standardized labeling



ATTACHMENT D –

AW Engineering Criteria for Portable Generator Transfer Switch and Termination Enclosure Identification

ATTACHMENT E –

American Water Engineering Criteria for Site Specific Arc Flash PPE Category Identification

Incident Energy Range (cal/cm^2)	Arc Flash PPE Category
0 – 4.0	1
4.01 – 8.0	2
8.01 – 25.0	3
25.01 – 40.0	4
40.01 and above	DANGEROUS (No Safe PPE Exists)

ATTACHMENT B
AMERICAN WATER
ACCEPTABLE ELECTRICAL EQUIPMENT MANUFACTURERS AND SUPPLIERS

The following listing is intended to identify those manufacturers that are generally acceptable and capable of meeting American Water's Recommended Design Standards, and provides a unified approach in design, maintenance and operation across the entire Company.

Unless specifically indicated, the naming of the manufacturers outlined below is not intended to provide the specified "order" for equipment selections. The list should be reviewed with the Water Company during the initial design phase to add or eliminate any manufacturers that are preferred or rejected by the local Operations team. The Consultant may propose other suppliers/manufacturers for Owner review and acceptance based on the specific nature of the Work and site location and/or conditions. The Consultant shall include a listing of proposed major electrical equipment manufacturers with the Design Memorandum for consideration by the Owner. The Basis of Design shall be established based on the Owner's preferences.

Note: These manufacturers and descriptions below are intended to outline the basis for the equipment design and criteria for development in the project; not exclusive approval.

Equipment Description	Manufacturers
MV Switchgear – Vacuum Breaker, Draw-Out	Cutler-Hammer Square D ABB Siemens General Electric
Medium Voltage Automatic Transfer Switchgear (Circuit Breaker Transfer Equipment – Manual or Automatic)	Cutler-Hammer Square D ABB Siemens General Electric Or Acceptable Manufacturer from above provided by Generator Equipment Manufacturer (subject to Owner approval)
MV Fusible Switchgear	Cutler-Hammer Square D *(Note - HVLcc Type Equip Not Accepted)* ABB Siemens General Electric S&C
MV Switchgear – SF6 Type	*Not Preferred Equipment*
MV Motor Control Equipment, MC Lineups (FVNR, RVSS Equipment)	Cutler-Hammer ABB Siemens General Electric
MV Variable Frequency Drives	Toshiba Allen Bradley – Voltage Source Equipment (not Current Source Drive) Cutler-Hammer Siemens/Robicon

Equipment Description	Manufacturers
LV Power Distribution Equipment – (Swgr, Swbds, Panelboards, Circuit Breakers, etc)	Cutler-Hammer Square D ABB Siemens General Electric
Transformers – Dry Type, VPI, VPE Insulation	Cutler-Hammer Square D/Sorgel Siemens ABB
Transformers – Cast-Coil	Square D/Sorgel ABB
Transformers – Liquid-Filled	*Not Preferred Equipment*
Protection Relays & Monitoring Relays for Voltage, Current, Phase Loss, Etc.	SEL (Schweitzer Engineering Laboratories) *Other acceptable manufacturers may include the following (subject to prior approval by AW Engr / Owner)* All to be provded with Fiber-Optic Communications over Ethernet / Modbus TCP/IP
Power Quality Metering, Motor Monitoring & Feeder Protection Relays	SEL 735, SEL 710, SEL 751A, SEL-489 Other SEL devices as applicable for the design of the power distribution system. *Communications to utlilize fiber-optic interface; dual-port for loop configuration where available. Copper communications to be utilized only where specifically indicated. All to be provded with Fiber-Optic Communications capability Ethernet / Modbus TCP/IP and DNP3*
Low Voltage Motor Control Centers	Cutler-Hammer Square D ABB Siemens General Electric
Full Voltage Motor Starters	Cutler-Hammer Square D ABB Siemens General Electric
Reduced Voltage (Solid-State, Soft Start) Motor Starters	Cutler-Hammer Square D ABB Siemens General Electric Danfoss Benshaw

Equipment Description	Manufacturers
Low Voltage Variable Frequency Drives – Stand Alone Applications (Free-Standing or Wall Mounted Units) *NOTE: Basic Criteria - All VFD equipment to be "Heavy Duty" / "Industrial Duty", rated for 50 C. and suitable for full load rating with 3% voltage unbalance. Cooling fans shall be accessible without requiring total dismantling of the drive assembly; top outlet discharge preferred.* *"HVAC Rated" Drives are Not Permitted* *** NEMA4X Note: Drive assembly to be rated NEMA 4x by manufacturer; use of open chassis or NEMA 1 drives installed in NEMA 4x enclosure is not suitable in meeting this criteria.*	Free-Standing – Wall or Floor Mounted Square D Cutler-Hammer Allen Bradley Toshiba ABB Siemens/Robicon Danfoss Benshaw Yaskawa NEMA 4X Type (where required)** Allen Bradley Yaskawa T B Woods Others as determined suitable for the application Harmonic Filters (where required) TCI Mirrus MTE
Low Voltage Variable Frequency Drives – Part of MCC Lineup/Equipment *(Not an AW preferred method)*	Cutler-Hammer Square D ABB Seimens General Electric
Low Voltage Automatic or Manual Transfer "Switches" – Contactor Type assembly	ASCO 4000 Series (unless otherwise suitable) Other potential Suppliers include: Cutler-Hammer GE/Zenith Russelectric
Low Voltage (*Service Entrance Rated where applicable*) Automatic Transfer Equipment (Circuit Breaker Transfer Equipment – Manual or Automatic) *NOTE: Circuit Breaker – Main and Circuit Breaker – Standby (where identified) REQUIRED unless specifically accepted otherwise*	Cutler-Hammer/Eaton Square D ASCO 4000 Series Russelectic Switchgear General Electric Cummins
Uninterrupted Power Supplies	APC Eaton Powerware General Electric Mesta Liebert MCG

Equipment Description	Manufacturers
Surge Protective Devices (UL-1449, Rev 4 Compliant and **Listed/Labeled**) *Note: use of integral SPD with panelboards and equipment not permitted; provide stand-alone external devices only unless otherwise specifically approved*	APT – Advanced Protection Technologies "XDS" Series MCG Cutler-Hammer "SPD" Series
NOTE: The following descriptions provide general guidelines for lighting fixtures and applications. As LED technology continues to be available at lower costs, American Water recommends evaluation between LED and Fluorescent lamps/fixtures. Where fluorescent fixtures are used (T-5 and T-8 fluorescent lamps), provide Programmed / Rapid-Start Ballasts. (*note- the use of Instant-Start ballasts is prohibited*) The use of LED technology is recommended for all exterior applications unless special aesthetic and/or other site-specific criteria is established by the Owner or Regulatory Authority	
Lighting Fixtures – Fluorescent T-8 lamps, Program-Start Ballasts, Indoor Enclosed and Gasketed Fluorescent for Damp and Wet Locations (Process and Chemical Rooms)	EPCO GFF Series w/SS Latches, Simkar EN 2 or 3 w/SS Latches, Holophane ERS Series, Lithonia FSW or FHE Series, ILS Others as accepted by Owner *(Note – the use of fixtures similar to Lithonia DMR Series, Columbia LUN Series, Simkar OV450, etc are generally prohibited due to on-going physical / performance issues associated with this type of design (limited latches retaining sealed integrity of the assembly)). Fixture selection is to take into consideration lamp output, lumen maintenance, and environmental factors associated maintainability of the overall system.*
Lighting Fixtures – Fluorescent T-8 lamps, Program-Start Ballasts, Indoor dry applications	Benjamin, Philips, Keene, Lithonia and Others as accepted by Owner
Lighting Fixtures – Fluorescent T-8 lamps, Program-Start Ballasts, Indoor Hazardous Locations	Appleton Crouse-Hinds Killark Others as accepted by Owner
Lighting Fixtures – LED Indoor	Lithonia Philips Cree Others as accepted by Owner
All LED luminaires must be UL Listed (e.g. UL8753 / UL8750) and tested to IESNA LM-79 and LM-80 standards and that the results of those tests must be submitted to the Owner as part of the submittal review process. LED fixtures to be provided with a minimum 5 year warranty covering the driver, the LED components and the luminaire.	
Lighting Fixtures – LED Outdoor	RAB Cree Philips Dialight Lithonia Others as accepted by Owner
Lighting Fixtures – HPS Outdoor	Holophane, Infranor Devine, Philips Others as accepted by Owner

Equipment Description	Manufacturers
Lighting Control - Occupancy Sensors	Sensor Switch (High Humidity / Low Temperature Type) – process & chem. Areas Leviton, Hubbell, P&S along with others mfgrs and products to be provided as determined suitable for the location and environment where installed. *NOTE: Technology (passive IR, ultrasonic, or dual) to be based on location where installed*.
Lighting Control – Daylight Harvesting and/or Special Function and Dimming	Lutron Wattstopper Day Light Controls Others as accepted by Owner
Control and Timing Relays (“Ice-cube” relay style)	Diversified Potter Brumfield Syrelec Allen Bradley Square D Cutler-Hammer Seimens Releco Others as accepted by Owner
Push Buttons, Selector Switches & Pilot Lights (30 mm minimum size devices, NEMA 4X style preferred and high-intensity LED pilot lamps)	Cutler-Hammer Square D Seimens Allen Bradley Kraus & Naimer
Definite Purpose Relays and Contactors	Cutler Hammer Square D Siemens Allen Bradley
PVC Coated Rigid Steel Conduit	Ocal Robroy
Fiberglass Conduit	Champion FRE
Power Generation Equipment – (Diesel engine driven units)	Onan/Cummins Caterpillar Kohler Others only as determined accepted by Owner
Industrial and Corrosion Resistant Wiring Devices	Cooper Industries Legrand Leviton Hubbell Meltric Woodhead, http://www.woodheadsales.com

ADDENDUM NO. 01

June 30, 2022

To the Request for Proposal Documents for
Indiana-American Water Company, Inc.
Sheridan Water Treatment Facility
Dated June 2022

This Addendum is made part of the above noted Contract Documents. Receipt of this Addendum shall be indicated by inserting the number and date in the space provided on page PF-2 of the Proposal.

This addendum includes 4 pages as listed.

Proposals shall be based on information provided in the Request for Proposal and Addenda. Oral statements and visuals are not binding.

Item 1
General Project Comments

Comment No. 01

The attached Design Concept REPLACES the original Design Concept provided in the Request for Proposal. Revisions to the Design Concept are presented in red text.

One key change to be noted is the number of High Service Pumps to be provided. The number is being increased to allow for operation of two separate pressure gradients originating at the water treatment faciltiy.

Comment No. 02

An exhibit depicting the existing water distribution system at the Indiana American Water WTF/WWTF site is being provided.

Item 2
Questions from Proposers and Responses from Indiana-American Water (INAW)
Questions No. 01 to 13.

Question No. 01

The desired chemical feed systems do not include fluoride. Please confirm.

INAW Response – Confirmed. Indiana-American Water has no plans to provide fluoride storage and feed systems.

Question No. 02

Chemical storage capacity is requested for 30 days of treatment at 6 MGD. We believe “6 MGD” is a typo, please clarify.

INAW Response – Confirmed. This typo has been corrected in the Design Concept.

Question No. 03

A finite element analysis of pump vibrations is required. We typically see this request for large pump stations. Please confirm that the analysis is required.

INAW Response – This analysis has been removed from the Design Concept.

Question No. 04

There is no listed preferred equipment manufacturer for aerators. Please advise.

INAW Response – The following manufacturers for aerators are preferred:
Bastin Logan
Westech

Question No. 05

Is there currently well data information available for the (3) existing wells on site that can be forwarded for review?

INAW Response – Information for the wells is provided as an attachment.

Question No. 06

Confirm the demolition of the existing WTF structure is to be included in the scope of work. Also confirm the depths of demolition (3’ below grade or complete removal)

INAW Response – Confirmed. The existing WTF structure is to be demolished to 3’ below grade. Indiana-American Water will identify any equipment to be retained. All other equipment and the WTF structure are to be removed to 3’ below grade and legally disposed. The detention chamber shall be filled with granular fill up to 3’ below grade, and native material may be used to bring to grade. The final project Record Drawings are to depict and note the location of this structure for future reference.

Question No. 07

Is the existing backwash lagoon lined or unlined? Are there any special considerations that need to be taken into account for the closing of that existing lagoon?

INAW Response – It is not known if this lagoon is lined or unlined. IDEM has regulatory requirements for closure of lagoons which would need to be followed. Indiana-American Water is not aware of any particular considerations that need to be taken into account.

Question No. 08

Has The Company made a determination which existing Well will be retired?

INAW Response – Well #4 will be retired.

Question No. 09

What is the current and anticipated total dynamic hydraulic head for the distribution high service pumps?

INAW Response – A copy of the hydraulic model will be furnished to the selected Design-Builder. The existing Sherdian pressure gradient is operated at a general pressure of 45-50psi. Details of the future pressure gradient are to be determined.

Question No. 10

Design Concept, Page 4, paragraph B.1 requires a free chlorine residual between 0.8 and 1.5 mg/L suitable for the water distribution system. Page 17, paragraph 1 also states that the sodium hypochlorite system shall provide breakpoint chlorination to neutralize the naturally occurring ammonia present in the raw water supply.
On Page 18 under Liquid Ammonium Sulfate (LAS) Feed System, it is stated that the purpose of the LAS system is to stabilize the chloramine output of the plant with an optimal chlorine to ammonia ratio of 4.5:1.
Is it the intent of the plant design to provide a free chlorine residual for primary disinfection, followed by the addition of ammonium sulfate to create a chloramine residual for use as a secondary disinfectant within the distribution system?

INAW Response – Refer to Design Concept, Page 5, Process Summary Item 2. Design-Builder is expected to conduct an evaluation to determine if a stable chloramine is needed or would be a more cost effective solution than breakpoint chlorination. If production of a stable chloramine is identified as the present need, the intent is assure the sodium hypochlorite facilities can be upgraded to do breakpoint chlorination in the future without notable changes other than upsizing bulk storage tanks and day tank. The Basis of Design Memorandum is to identify all changes required to upgrade the system, including any modifications that would need to be made to chemical feed piping sizes, etc.

Question No. 11

Does the water system plan to perform a conversion from chloramine to free chlorine on a periodic or seasonal basis to control biological growth within the distribution system?

INAW Response – Provision should be made for seasonal free chlorine operation.

Question No. 12

Is a hydraulic model or a map of the water distribution system available?

INAW Response – A copy of the hydraulic model will be furnished to the selected Design-Builder.

Question No. 13

The RFP mentions pilot testing. Is the pilot testing to be completed by INAW direct or by the design builder? If design builder, is the pilot testing to be included in our design or preconstruction fees?

INAW Response – Pilot testing is to be performed by the Design-Builder, and completion of this effort should be included in the design fees.

INDIANA AMERICAN WATER COMPANY
KOKOMO DISTRICT

SHERIDAN WATER TREATMENT FACILITY

DESIGN CONCEPT
ADDENDUM #1

INDIANA-AMERICAN WATER COMPANY
153 N Emerson Avenue
Greenwood, Indiana 46143
June 2022

ATTACHMENT A
PROJECT BACKGROUND

A. INTRODUCTION

Indiana-American Water (INAW) provides water service to approximately 1,400 customers in its Sheridan service area (Kokomo District) in Hamilton County, Indiana. The service area includes the Town of Sheridan. The total demand averaged 0.21 million gallons per day (MGD) in 2021. The historic maximum day usage of 0.46 MGD occurred in November 2020.

The District obtains its water supply from three groundwater wells at the existing water treatment facility which is located on the east side of Sheridan.

The total production capacity of the three wells is 1.85 MGD based on operating experience. The firm capacity of these wells is 1.12 MGD with the largest well out of service. The groundwater is treated by aeration, chemical oxidation, and filtration. Gaseous chlorine is used for chemical oxidation and disinfection, polymer is used as a filter aid, and blended ortho/polyphosphate is used for corrosion control. Due to naturally occurring ammonia in the groundwater, the system currently utilizes chloramines as the means of distribution system disinfection.

The Sheridan system produces high quality water that meets or surpasses all applicable US Environmental Protection Agency (EPA) and Indiana Department of Environmental Management (IDEM) standards.

To satisfy the treatment requirements, filtration, chemical treatment and pumping are required. INAW owns property for the proposed Water Treatment Facility (WTF) at 801 East Second St, Sheridan, Indiana. The WTF shall provide an immediate firm capacity of 1.5 MGD/rated capacity of 2.0 MGD, expandable to a rated capacity of 4.0 MGD.

B. EXISTING SYSTEM CONFIGURATION

The existing facility has remote operation and monitoring capability through a SCADA system. The SCADA system consists of an Allen Bradley remote telemetry unit (RTU) linked via radio telemetry to a human-machine interface (HMI) computer at the District office located in Kokomo.

Company personnel perform daily laboratory analyses on grab samples to assess raw and finished water iron and manganese, pH, phosphate, as well as finished water chlorine residuals and fluoride concentrations. Weekly samples are performed for alkalinity and hardness. The analyses are performed at the laboratory located at the District office.

C. WATER QUALITY

The source water has consistent levels of iron, manganese and ammonia as shown below.

	Average	Maximum
Iron, mg/l	2.5	3.3
Manganese, mg/l	0.08	0.15
Ammonia, mg/l	1.2	1.5

There are indications of natural organic matter being present in the existing groundwater. In the past, testing for trihalomethanes and haloacetic acids has found levels close to 50% of the MCL for these disinfection byproducts (DPBs), Management of tank turnover and use of naturally occurring ammonia to form chloramines has resulted in a substantial decrease of these DBPs, but it is uncertain whether or not this is an ongoing water quality concern, and further evaluation is necessary.

Additional water quality sampling and analysis are required for design considerations of the proposed water treatment plant processes. The Design/Builder shall be responsible for all additional water quality sampling and analysis. This may be completed during the Design Memorandum preparation phase after issuance of the Notice To Proceed.

D. TREATMENT FACILITY SITE

The proposed WTF will be located at 801 East Second St on approximately 10 acres of property where the existing water treatment facility is also located.

The following utilities are available for the proposed site:

- Electric – Duke Energy
- Gas – Center Point
- Telephone – Swayzee/Fiberhawk
- Digital Data (T-1) Service – Swayzee/Fiberhawk
- Sanitary Sewer –American Water Kokomo Operations

E. EXISTING TREATMENT FACILITY

The existing water treatment facility has a firm capacity of 0.40 MGD and a rated capacity of 0.65 MGD, and employs aeration, chemical oxidation, and filtration for the removal of iron. The existing facility must remain in-service throughout construction of the proposed facility. The water treatment facility site plan drawing is included in Appendix D.

F. DISTRIBUTION SYSTEM

The proposed WTF will connect to the existing distribution system at the existing water treatment facility property.

ATTACHMENT B
DESIGN SCOPE

A. INTRODUCTION

The design and construction of the proposed Sheridan WTF shall be based on the background information outlined above and the following design information. In general, the scope of work shall include the following facilities:

- Raw Water Piping
- Aeration/Detention Tanks
- Horizontal Pressure Filters
- Chemical Storage and Feed Systems
    - Sodium Hypochlorite
    - Polymer
    - Sodium Permanganate (if required)
    - Liquid Ammonium Sulfate (if required)
    - Phosphate for Corrosion Control
    - Truck Unloading Containment
- Treatment Building to House the Chemicals, Electrical Gear, and Maintenance/Parts Storage Room
- Space for Future Treatment Processes for Perfluorinated Compounds
- Finished Water Storage
- High Service Pumping Station
- Backwash Residuals/Recycle Facilities
- Residuals Management
- Office and Administrative Space
- Parking Space for Employees and Visitors
- Electrical Power Distribution Equipment
- Emergency Power Generator
- Instrumentation and Control (I&C) Systems
- Associated Site Work

A listing of acceptable equipment manufacturers is included in Appendix A. Appendix C includes American Water's Engineering Standard for Liquid Chemical Feed Systems (T-2).

B. PERFORMANCE REQUIREMENTS

The proposed WTF shall achieve a high level of finished water quality that complies with all applicable state and federal water quality and treatment requirements. In addition to these requirements, the plant should also achieve compliance with the following:

1. Finished water free chlorine residual of between 0.8 mg/L and 1.5 mg/L suitable for the distribution system.

2. Production of a stable, non-corrosive water. Finished water must allow INAW to comply with the Lead and Copper Rule, and minimize corrosion, precipitation, and deposition within the distribution system.

3. Finished water must comply with the Stage 2 Disinfectants and Disinfection Byproducts Rule.

4. Total finished water iron and manganese levels that are below the respective secondary maximum contaminant levels, as well as the treatment goals of ≤0.10 mg/l for iron and ≤0.02 mg/l for manganese.

5. Fully automated treatment facility capable of unattended operation.

6. Exterior architectural design that is aesthetically pleasing.

7. Minimization of total project lifecycle costs, factoring in both capital and operating costs.

C. GENERAL

Process Summary

1. It is anticipated that treatment will include aeration, detention and pressure filtration with the addition of chemicals as outlined below. Raw water will be pumped to aerators to oxidize iron, as well as strip any supersaturated gases, from the well water supply. To ensure the oxidation process is complete prior to filtration, the water will be retained in detention tanks directly below the aerators. Following aeration, the water will flow by gravity to the pressure filters. Chlorine will be added to the detention tank effluent to further promote manganese oxidation and removal with the manganese dioxide coated filter media. Effluent from the filters will then flow by gravity to a treated water storage tank prior to the distributive pumps. The distributive pumps will pump finished water from the treated water storage tank to the distribution system.

2. As noted, there is naturally occurring ammonia in the source water which could impact the ability to regenerate manganese dioxide coated filter media, and natural organic material in the source water that could require continued use of chloramines to manage DBP formation in the distribution system. The Design-Builder is to evaluate the source water, including pilot testing as necessary, and recommended a design solution to provide the required treatment. As part of their review, the Design-Builder shall contemplate the possibility that future system demands may be met by connection from a system that does not currently use chloramines. This evaluation is foremost to consider solutions necessary to achieve the performance requirements noted above, and then to evaluate best value between comparable alternatives (e.g.: breakpoint chlorination to neutralize naturally occurring ammonia may be more costly than use of liquid ammonium sulfate to provide a stable chloramine; chemical oxidation may eliminate need for aeration/detention facilities.)

3. Dedicated pumps will provide wash water from the finished water storage tank for filter backwashing. Spent backwash water will be sent to onsite backwash detention basins, from which supernatant will be discharged to the adjacent Little Cicero Creek.

4. Space shall be allocated in the Treatment Building for the following Chemical Feed Systems: sodium hypochlorite for disinfection, sodium permanganate for oxidation (if required), polymer for aid in filtration, liquid ammonium sulfate for chloramine disinfection (if required), and phosphoric acid for corrosion protection in the distribution system and customer plumbing.

5. The Treatment Building will be constructed to house the filter face piping, chemical systems, distributive pumps, and ancillary electrical and I&C systems. The building will also include a small laboratory and a utility/storage room.

6. The Treatment Building will include an electrical room and new electric service. The remote telemetry unit and touch-screen interface control panel will be provided in the building.

7. Space shall be allocated for a future treatment process for perfluorinated compounds.

8. The Design/Builder should evaluate alternatives for providing the most cost-effective solution for the proposed WTF.

General Design Criteria

1. *Plant Staffing*: The WTF shall be designed for fully automatic, unattended operation. A supervisory/maintenance staff will make daily visits Monday through Friday. The plant will be unattended on Saturday and Sunday. The plant shall operate 24 hours per day and the control system shall be capable of remote access via INAW's wide area network.

2. *Input/Output Lists*: The Design/Builder is required to develop a complete I/O list based on the final design details.

3. *Acceptable Equipment Manufacturers*: Those provided in Appendix A of the Design Concept and Attachment B to the Recommended Electrical Design Criteria and Standards are manufacturers that are acceptable to INAW. This does not preclude the Design/Builder from suggesting other manufacturers of comparable or higher quality. It is also the Design/Builder's responsibility to recommend other manufacturers to facilitate competition for the specific application.

4. *Critical Equipment Procurement:* Design/Builder shall identify critical equipment with long lead times in the Proposal, and will complete sufficient level of design by the 30% Design Phase to enable release for early procurement.

Common Equipment and Materials

1. *General*: Information regarding specific equipment or materials that are common to many areas of the facility is provided in this section.

2. *Process Piping*: Cement-lined ductile iron pipe unless otherwise noted. Appropriate pressure class pipe shall be provided for all above and below

ground piping at the plant. Thickness class CL54 as a minimum shall be provided for all pressurized yard piping on the treatment plant site.

3. *Process Piping Joints*: All onsite below ground pressure-rated process piping shall have properly restrained joints. All onsite above ground (plant) pressure-rated process piping shall have flanged joints. Grooved or Victaulic joints are permissible for above ground piping where substantial cost savings may be achieved. Friction type restrained joints (e.g. Megalugs) are only permitted where required to accommodate buried valves or fittings. Set-screw flanges and retainer glands are not acceptable.

4. *Process Valves*: AWWA butterfly valves. Rubber seats shall be applied to the body. Rubber seats applied to the disc are not acceptable. Use plug valves for waste lines.

5. *Operators for Automatic Process Valves*: Electric operators.

6. *Yard Piping*: Piping to backwash residuals management system and other non-pressure pipe may be PVC or ductile iron.

7. *Motors*: All small (fractional) and medium (integral) squirrel-cage induction motors shall be premium efficiency, “NEMA Premium” rated, and shall be designed, constructed, and tested in accordance with NEMA MG-1 and IEEE 112, Test Method B. All motors, ½ horsepower and larger, shall be rated at 480 volts, three-phase. All motors less than ½ horsepower will be rated 120 volts, single phase.

8. *In-plant Water Supply Piping*: Copper inside filter room, and Schedule 80 PVC at all other locations.

9. *In-plant Plant Water Supply Valves*: Bronze ball valves unless otherwise noted.

10. *Backflow Preventers*: Reduced pressure zone type required on all individual connections to in-plant potable water. A common backflow preventer may be provided on the plant water supply. A full-size by-pass line shall be provided, also equipped with a backflow preventer.

11. *Metering*: Magnetic meters with electronic, smart-type type transmitters are preferred. Insert type and strap on type flow meters of any type are not acceptable. The manufacturer’s recommendations for minimum straight runs of pipe upstream and downstream of the meter will be strictly adhered to. Locate meters in above ground accessible building locations wherever possible. Below ground meter vaults, if required, shall provide adequate space for meter maintenance and adequate ventilation for confined space requirements.

12. *Level Monitoring*: Ultrasonic level probes for liquid level monitoring.

13. *Sampling Locations*: Specifics defined in each section below. On-line analytical instruments should be located as close as possible to the sample point. Manual taps shall be provided at all sample points to allow for a grab sample. Velocities

in sample lines where pumping is required should be approximately 5 ft/sec. Provide insertion-type paddle-wheel flow sensors on the discharge of all sample pumps. Use PVC pipe for all sample lines.

14. *Painting*: All exposed metal piping to be color coded per Ten State Standard requirements. All mechanical equipment and other potentially corrosive surfaces shall be coated. PVC or other flexible piping shall either be purchased in the appropriate color (if available) or wrapped or striped with appropriate colored tape. Any and all PVC piping exposed to sunlight shall be painted to protect from UV degradation. Stainless steel is not acceptable in chlorinous atmospheres.

D. SYSTEM DEMANDS / PLANT CAPACITY

General Design Criteria

1. *Maximum Day*: 1.5 MGD Firm Plant Capacity / 2.0 MGD Rated Plant Capacity

2. *Average Day*: 1.02 MGD

3. *Minimum Day*: 0.72 MGD

4. *Hydraulic Capacity*: 4.0 MGD for all piping and facilities based on all present and future pressure filters simultaneously operating at design capacity.

5. *Operating Capability*: All components of the plant shall be fully capable of operating over the specified range of flows per manufacturer's recommendations.

6. *Redundancy*: Provide for all major process mechanical equipment such that the plant could continue to operate at firm capacity if a single largest process unit were out of service.

7. *Optimum Efficiency of Mechanical/Electrical Equipment*: Based on average day demand.

8. *Expandability:* The plant shall be designed for future capacity expansion up to a rated capacity of 4.0 MGD.

E. WATER TREATMENT FACILITY SITE

General Design Criteria

1. *Roadways*: Concrete paving. The existing gravel drive from the Sheridan Wastewater Treatment Facility to the new water treatment facility is to be paved.

2. *Entrances*: Automated sliding gate with proximity card access. Provide space for one semi-trailer to park in driveway before automated sliding gate.

3. *Parking*: Provide parking area for minimum of seven (7) passenger vehicles

and four (4) utility trucks.

4. *Landscaping*: Provide landscaping plan for approval by INAW and conforming to local ordinances and standards. Landscaping shall be minimal to provide aesthetically pleasing view from frontage street.

5. *Signage*: Indiana American Water name and logo at entrance. Signage shall comply with local ordinances.

6. *Exterior Lighting*: Provide where required for security and safety purposes.

7. *Security*: See Section N – Building Requirements for additional design criteria related to site and plant security.

F. SOURCE OF SUPPLY

General Design Criteria

1. *Summary*: One new production well will be constructed and one existing production well will be retired.

2. *Location*: The new well will be centered between Wells #5 & #6.

3. *Type of Pumping Units*: Vertical Turbine Well pumps.

4. *Capacity of Pumping Units*: 400 gpm

5. *Drivers for Pumping Units*: Full voltage motor starter.

6. *Pumping Unit Appurtenances*: Pump discharge flow meters, air and vacuum valves, and a pressure gauge on the discharge of each individual pump. Butterfly isolation valves on the discharge of each pump.

7. *Motor Voltage Monitoring*: Motors for all major equipment shall have microprocessor based motor voltage monitors. The monitors shall protect against phase loss, phase reversal, voltage unbalance, and under voltage on any one or more phases. The monitors shall reactivate after the power line conditions return to an acceptable level. Trip and reset delays shall prevent nuisance tripping due to rapidly fluctuating power line conditions.

8. *Well Head Enclosure*: Well heads shall be elevated to be above the 500 yr flood elevation. Well head and enclosure shall be designed to allow access for well pump removal and well maintenance activities.

Raw Water Transmission Mains

1. *General*: A raw water transmission main shall be installed to convey on-site source of supply to the new treatment facility. Provision shall be made to extend the raw water transmission main to the east and west edges of the water treatment facility property for development of future off-site source of supply.

2. *Pipeline Size:* The transmission main shall have a carrying capacity of not less than 3.5 MGD at a maximum velocity of 6 ft/s.

3. *Material of Construction:* The pipeline shall be constructed of cement-lined ductile iron. Buried steel lugs, rods, brackets, and flanged joints are not permitted. The DESIGN/BUILDER shall also evaluate if the use of high-density polyethylene (HDPE) piping in lieu of ductile iron would result in significantly lower cost and/or superior performance/longevity. However, base proposal pricing shall be based on ductile iron piping.

4. *Thrust Restraint:* Provide all plugs, caps, tees, valves and bends with mechanical restrained joint pipe; proprietary to the pipe manufacturer. Concrete thrust blocks shall be used at connections to existing piping. Thrust blocks shall be appropriately positioned so that the resultant thrust force is contained while keeping the pipe and fitting joints accessible for repair. Restrained joints shall be used within pumping station and treatment plant battery limits.

5. *Corrosion Prevention:* Wrap the pipeline with polyethylene bagging installed in accordance with the pipe manufacturer's instructions. As part of the design effort, DESIGN/BUILDER shall sample soils along the selected route and analyze the potential for corrosion to ductile iron pipe in accordance with AWWA C105.

Chemical Application

1. *Location*: Provide chemical application prior to filtration.

2. *Water Quality Sampling*: True raw water sample taps at each wellhead.

3. *Online Monitoring*: Online sample points, which will be directed to a sample sink, shall be provided in the following locations:

   a. upstream of the filters, into the common raw water main

G. AERATION (if required)

General

1. *General:* Pre-filter chemical oxidation may be sufficient for iron & manganese removal. However, aeration may be necessary to remove dissolved gases such as carbon dioxide or hydrogen sulfide. Pilot testing shall be performed by the Design-Builder to determine if the aeration process is necessary.

2. *Facility Layout:* Footprint and yard piping connections for future aeration/ detention facilities are to be provided if these are not constructed with this project.

Design Criteria

1. *Type of Aerator:* Forced draft, tray type. Wood slats in the aerators are not acceptable.

2. *Minimum No. of Aerator Units:* One; at least one future

3. *Location/Orientation:* Mount aerator(s) on top of a suitable sized detention tank.

Detention tank shall have sufficient side water depth to allow gravity flow through the pressure filters at the maximum water level in the finished water reservoir.

4. *No. of Blowers:* 2 per aerator

5. *Drivers for Blower Unit:* Constant speed electric motors.

6. *Detention Tank Number:* TBD

7. *Detention Tank Sizing:* 30 minutes at 4.0 MGD at full capacity buildout.

8. *Detention Tank Material:* Steel or concrete.

9. *Aeration System By-Pass:* Provide a by-pass system to allow the plant to remain in-service with chemical oxidation while the aerator and/or detention tank are out of service for maintenance/repairs.

10. *Expandability:* Provide space and buried piping connections to allow for future construction of additional aeration/detention tank systems.

Chemical Application

1. *Location*: An application point for sodium hypochlorite shall be provided at the top of the detention tank.

2. *Water Quality Sampling*: Provide a common raw water sample tap immediately upstream of the aerator. If Backwash Equalization facilities are provided, a separate sample tap shall be provided for the recycle water.

3. *Online Monitoring*: Online sample points, which will be directed to a sample sink, shall be provided in the following locations:

    a. Upstream of the finished water storage tank, downstream of the sodium hypochlorite and phosphoric acid ~~and fluoride~~ feed points with adequate distance for complete mixing.
    b. Filter effluent

H. FILTRATION

General Design Criteria

1. *Type of Filters*: Two-cell, horizontal pressure filters.

2. *No. of Units*: Three (3) minimum with a total of five (5) at total facility expansion.

3. *Capacity of Each Unit*: 700-1050 gpm. Individual unit capacities and sizing of the proposed filters shall be equal to provide for economies of scale.

4. *Maximum Loading Rate of Units*: In accordance with Ten States Standards, 3.0-4.0 gpm/sf with one filter cell out of service.

5. *Vessel Diameter*: 10 foot, minimum.

6. *Vessel Materials of Construction*: SA516 Grade 70 carbon steel with suitable NSF-certified epoxy lining system

7. *Pressure Rating*: 100 psi minimum. The Design/Builder shall evaluate well pump shut-off head capacities and distribution system operating pressures to determine final pressure rating requirements. Suitable pressure/air relief devices shall also be provided.

8. *Type of Underdrain*: Concrete-encased header/lateral system with nozzles. Flat plate underdrain system with stainless steel baffles will be considered as an alternate.

9. *Media*:

   a. Manganese oxide coated sand – 18 inches (to be confirmed during design phase)

   b. Anthracite – 18 inches (to be confirmed during design phase)

   Effective media size to be selected in accordance with AWWA standards to minimize head loss and ensure adequate bed expansion during filter backwashing. Pilot testing of the filter media shall be performed by the Design-Builder to determine type of manganese oxide coated filter media for optimum iron and manganese removal.

10. *Media Removal/Installation*: Provide 24" access manway for each filter section to assist in the change out of media.

11. *Location*: The pressure filters should be located outdoors, with the dished head containing the connection nozzles, valves, and vessel face-piping inside the proposed Treatment Building.

12. *Method of Operation*: Rate of flow control to match combined well production rate.

13. *Influent Metering*: Magnetic meters with electronic, smart-type type transmitters with adequate upstream and downstream straight runs of pipe.

14. *Loss of Head*: Loss of head measurement shall be provided by electronic, smart-type type differential pressure transmitters.

15. *Backwash Control Schedule*:
    - Time
    - Differential pressure (head loss)
    - Effluent turbidity
    - Filter Run Hours

16. *Water Quality Sampling*: Individual and common filter effluent sample taps.

17. *On-Line Monitoring*: One common filter effluent turbidimeter.

18. *Humidity Control in Filter Room/Gallery*: Provide air conditioning or dehumidification in the filter room.

Backwash Capabilities

1. *Method*: Means to operate in filter-to-waste mode shall also be provided.

2. *Means of Supplying Wash Water*: Supply is from wash water supply pumps drawing water from the onsite storage reservoir. The wash water supply pumps shall be co-located with and similar in style as the distributive pumps. Two wash water pumps (one duty and one stand-by) shall be provided.

3. *Capacity of Wash Water Supply System*: Adequate to provide a maximum bed expansion of at least 30% (approximately 17 gpm/ft^2 - verify with filter media supplier).

4. *Method of Backwash Rate Control*: Magnetic meter with electronic, smart-type type transmitters and globe-style rate of flow control valve.

Chemical Application

1. *Location*: Application points shall be provided in the following locations:

   a. On the common piping between the detention tank and the filter influent for sodium hypochlorite, filter aid polymer, and sodium permanganate (if required).

   b. On the common piping between the filter effluent and the finished water storage tank for sodium hypochlorite, liquid ammonium sulfate (if required), and phosphate for corrosion control.

2. *Water Quality Sampling*: Filter effluent prior to chemical feed points.

3. *On-Line Chemical Monitoring*: On-line sample points, which will be directed to analyzers and/or a sample sink, shall be provided in the following locations:

   a. Upstream of the filters after the sodium hypochlorite application point, upstream of the finished water storage tank, downstream of the sodium hypochlorite and phosphoric acid ~~and fluoride~~ feed points

I. FINISHED WATER STORAGE

General Design Criteria

1. *Summary:* Finished water storage will be provided for plant flow equalization and wash water storage.
2. *Configuration and sizing criteria*: The finished water storage tank shall be an at-grade structure sized to provide approximately 500,000 gallons of storage.

Considerations for backwash must be included in clearwell sizing. Design/Builder will be responsible for final sizing of the finished water storage tank.

3. *Materials of Construction:* To be determined by the Design/Builder during design. Design/Builder shall provide costs for both welded steel and post-tensioned concrete finished water storage tanks.

4. *Expandability:* Provide space and buried piping connections to allow for future construction of additional finished water storage tank systems.

Chemical Application

1. *Location*: A application point for sodium hypochlorite shall be provided downstream of the finished water storage tank.

2. *Water Quality Sampling*: Effluent from the finished water storage tank just after the sodium hypochlorite feed point.

3. *On-Line Chemical Monitoring*: On-line sample points, which will be directed to analyzers and/or a sample sink, shall be provided in the following locations:

    - Downstream of the finished water storage tank.

J. DISTRIBUTIVE PUMPING FACILITIES

General Design Criteria

1. *Type of Pumping Units*: Either can-style vertical turbine pumps or horizontal split-case pumps. Design/Builder shall evaluate different type of pumps suitable for use in the proposed system, including recommendations for impeller materials of construction to ensure long life.

2. *Minimum No. of Pumping Units*: Six (6). Three are to be set up to pump towards the City of Sheridan distribution system (west side of facility). Three pumps are to be set up to pump to a future pressure gradient east of the facility.

3. *Capacity of Pumping Units*: Provide a minimum firm capacity of 1.5 MGD with one pump out of service. Provide space for additional distributive pump(s) for a future total pump capacity of 4.0 MGD. Capacity and arrangement to be determined by Design/Builder with input from INAW during design phase. All pumps shall utilize variable frequency drives for flow adjustments.

4. *Drivers for Pumping Units*: Premium efficiency inverter duty electric motors and adjustable frequency drives.

5. *Pumping Unit Appurtenances*: Suction and discharge butterfly isolation valves, check valve, air release valve, and differential pressure transmitters between the suction and discharge of each individual pump as appropriate. A common pressure transmitter shall be provided on the discharge header. Design shall provide access to pump for maintenance and removal or a means of removal

for maintenance purposes.

6. *Motor Monitoring Equipment*: Motors controlled by adjustable frequency drives shall be furnished with at least one automatic reset winding temperature switch per phase. Temperature switch contacts shall be normally closed and rated 5 amps at 120 volts ac. The contacts shall be wired in series with the ends leads brought out to the motor terminal box.

~~X. *Finite Element Analysis*: The Design/Builder shall perform a finite element analysis for all pumping units to ensure that the design addresses potential vibration and natural frequency concerns. Since more than one pump manufacturer will be specified, the development of the finite element model shall begin during the design phase based on assumed pump and motor manufacturers and be completed after the specific pump and motor manufacturers have been selected. The analysis shall encompass one of each sized pump that is selected in the final design.~~

7. *Location*: The distributive pumps and backwash pumps shall be located within the Treatment Building. The building shall be configured to permit interior access to distributive pump room from the administrative portion of the building.

8. *Finished Water Pipeline*: Design of the on-site portion of the finished water transmission mains shall be included in the Design/Builder's scope of work. The Design/Builder's responsibility will end at the property line. Finished water transmission mains from the property line to the distribution system will be provided by others. Design/Builder shall coordinate the termination point with INAW. At minimum, finished water transmission mains will be upsized between the new treatment facility and the point of connection to the Sheridan distribution system (at the entrance to the Wastewater Treatment Facility on Second Street). It is anticipated that an additional water transmission main will be extended to the east edge of the treatment facility property line.

9. *Finished Water Metering*: Provide a common magnetic flowmeter, with electronic, smart-type type transmitters.

10. *Surge Control*: Design/Builder shall perform a complete surge analysis of the distribution pumping system. Normal start/stop surge control shall be by means of pump discharge control valves while power outage transients shall be controlled by a surge anticipator valve discharging to the pump suction piping or by other means as indicated in the surge analysis. Separate, independent surge anticipator valves shall be provided for each pressure gradient. INAW will provide all information pertaining to the distribution system piping to the Design/Builder for the analysis.

K. CHEMICAL FEED FACILITIES

General Design Criteria

1. *Applicable American Water Engineering Standard*: T-2 (Liquid Chemical Storage, Feed, and Containment). The intent of the standard (i.e. spill containment, overfeed prevention, etc.) must be met for all designs. A copy of this standard is included in Appendix J.

2. *Dosages*: Dosage requirement shall be provided during the design phase by INAW.

3. *Location*: Chemicals will be stored in the proposed treatment building. The chemical feed facilities shall be located as close to the points of application as possible, and totally isolated (separated by walls) from the rest of the treatment plant. Design enclosures to provide fire rated protection if required by code.

4. *Orientation of Chemical Feed Equipment*: All rooms shall be laid out such that the need to step over piping or conduit is eliminated or minimized. All rooms shall also be oriented similarly such that safety devices (eyewashes) are located in a common place (such as near the door) in each room.

5. *Access*: All enclosed rooms with non-bulk storage shall include secure double doors for loading drums or bags into and out of the room. Access into chemical containment areas shall be by stairs with railings (no ladders) up and over the wall or down into a recessed containment area. Consideration for removal and replacement of bulk storage tanks should be provided in the design. For non-bulk storage rooms, hand truck access ramp systems shall be designed with a maximum 1:12 slope if possible. Safe access to equipment mounted to the top of any tanks shall be provided via platforms and ladders.

6. *Operating Range of Equipment*: All chemical feed equipment shall be fully capable of operating over a feed range corresponding to max day/max dosage down to min day/min dosage. If necessary, a second set of pumps shall be provided.

7. *Operation of Equipment*: All chemical feed equipment shall be flow paced. Cascade loop capabilities shall be provided as specified below. The sample supply for all analytical devices used for cascade loop control shall be minimized to prevent loop delays.

8. *Redundancy*: All chemical feed equipment shall have 100% redundancy such that one system can be isolated while the chemical continues to be fed from the redundant system under all possible flow rates and dosages. This redundancy applies to all components of the feed system including appurtenances such as pumps, anti-siphon valves, etc. but does not apply to bulk and day tanks, drums, scales, and calibration columns.

9. *Tank Sizing*: The required day tank sizes per Engineering Standard T-2 shall consider that the bottom and top of the tanks are typically not useful storage.

10. *Chemical Bulk Storage*: Except for bulk sodium hypochlorite, shall be based on 30 days of storage at the total plant capacity of 4.0 MGD, plus a factor of safety as set forth in Engineering Standard T-2. Bulk sodium hypochlorite shall be based on 15 days of storage at the total plant capacity of 4.0 MGD, plus a factor of safety as set forth in Engineering Standard T-2. Consideration shall be given to tank volumes that will accept full load chemical deliveries.

11. *Drum Feed Systems*: Provide a single scale for mounting a suitably sized day tank.

12. *Transfer Pumps*: Sized to limit manual transfer time to no more than two minutes, where practical. The use of automatic shutoff shall be provided for large day tanks where operator fatigue could be an issue. A drum pump should be provided for transferring chemicals from portable delivery drums to a day tank.

13. *Bulk Tank Fill Connections*: Lockable with shutoff valves and appropriately labeled. Chemical spill containment during the unloading of bulk chemicals should be based on the entire tank truck volume. The largest tank truck volume is 5,000 gallons for hydrofluosilicic acid. Containment system shall be designed to allow isolation from storm water drainage during tank truck unloading operations.

14. *Priming*: All metering pumps shall be oriented so that they have flooded suction. Sodium hypochlorite metering systems shall have liquid conditioning valve off-gas relief systems.

15. *Flushing Systems*: Provide flushing tap at the point of entry into the chemical piping system (downstream of all special valves) for each feed system. Provide means for flushing suction piping.

16. *Bulk Tank Access:* Design-Builder is to evaluate ability to access bulk tank level monitoring and mixing equipment. Where necessary, provide FRP platforms adjacent to each bulk tank to enable access to maintain and replace level monitoring and mixing equipment. Platforms must not obstruct ability to remove and replace bulk tanks in the future, or must be configured in a manner that allows disassembly and reassembly for tank replacement.

Chlorination System

1. *General*: A bulk sodium hypochlorite system shall be provided in the Treatment Building. The Design-Builder shall design the sodium hypochlorite system to provide breakpoint chlorination for neutralization of the naturally occurring ammonia in the source water. For the current project, owner may elect to utilize bulk storage tanks sized for continued chloramine operation, and replace with larger bulk storage tanks in the future. The Basis of Design Memorandum shall discuss the required storage and dosage rates for both operating modes.

2. *Specific Chemical*: Sodium hypochlorite

3. *Product Form*: Liquid

4. *Product Density*: 12.5%

5. *Type of Storage Required*: 15 days of bulk storage

6. *Points of Application*:

    a. Detention tank influent, dual application points with manual flush/relief

    b. Combined filter influent, dual application points with manual flush/relief

c. Combined filter effluent, dual application points with manual flush/relief

d. Downstream of the finished water storage tank, prior to the distributive pumps, dual application points with manual flush/relief

7. *Feed Method*: Peristaltic metering pump(s)

8. *Chemical Dose*: 1.0 mg/L minimum and 3.5 mg/L maximum. To be confirmed during the design phase.

9. *Cascade Loop Control*: Free chlorine residual analyzers (pre, intermediate, and post)

10. *Isolation*: Located in an isolated room with adequate ventilation and no windows. All piping and equipment in room to be suitable corrosion resistant material.

11. *HVAC:* HVAC system shall maintain room temperature between 55°F and 65°F year-round.

Filter Aid Polymer

1. *General*: This chemical feed system will be utilized to feed filter aid polymer.

2. *Specific Chemical*: To be selected during design phase

3. *Product Form*: Liquid

4. *Product Density*: To be determined during design phase

5. *Type of Storage Required*: Day tank and delivery drum storage.

6. *Points of Application*:

a. Combined filter influent

7. *Feed Form:* Liquid
8. *Feed Method*: Polyblend dilution system with batch mixing tank and peristaltic metering pump(s)

9. *Chemical Dose*: 0.005 mg/L minimum and 0.050 mg/L maximum. To be confirmed during the design phase.

10. *Isolation*: Located in an isolated room with adequate ventilation and no windows. All piping and equipment in room to be suitable corrosion resistant material.

Sodium Permanganate Feed System (if required)

1. *General:* This chemical feed system will be utilized primarily for oxidation of

manganese. Pilot testing shall be performed by the Design-Builder to evaluate the benefit of sodium permanganate for the treatment process.

2. *Specific Chemical:* Sodium permanganate

3. *Product Form:* Liquid

4. *Product Density*: 100%

5. *Type of Storage Required*: 30 days of bulk storage.

6. *Point of Application*:

    a. To be determined

7. *Feed Form*: Liquid

8. *Feed Method*: Peristaltic metering pump(s)

9. *Chemical Dose*: 0.5 mg/L minimum and 1.5 mg/L maximum. To be confirmed during the design phase.

10. *Isolation*: Located in an isolated room with adequate ventilation.

<u>Liquid Ammonium Sulfate Feed System (if required)</u>

1. *General:* This chemical feed system will be utilized to stabilize the chloramine output of the facility to the optimal ratio of 4.5:1 (ammonia to chlorine) for chloramination.

2. *Specific Chemical:* Liquid ammonium sulfate

3. *Product Form:* Liquid

4. *Product Density*: To be determined during the design phase and verified with product supplier.

5. *Type of Storage Required*: 30 days of bulk storage.

6. *Point of Application*:

    a. Combined filter effluent

7. *Feed Form*: Liquid

8. *Feed Method*: Peristaltic metering pump(s)

9. *Chemical Dose*: To be confirmed during the design phase.

10. *Isolation*: Located in an isolated room with adequate ventilation.

Corrosion Inhibitor Feed System

1. *General:* This chemical feed system will be utilized to feed phosphoric acid.

2. *Specific Chemical:* Phosphoric Acid

3. *Product Form:* Powder or liquid

4. *Product Density*: To be determined during the design phase and verified with product supplier.

5. *Type of Storage Required*: Day tank and dry product or delivery drum storage. If powder form is selected, a mixer is to be provided on day tank.

6. *Point of Application*: Combined filter effluent

7. *Feed Form*: Liquid

8. *Feed Method*: Peristaltic metering pump

9. *Chemical Dose*: 0.5 mg/L minimum to 1.5 mg/L maximum. To be confirmed during the design phase.

10. *Chemical Dose*: To be confirmed during the design phase.

11. *Isolation*: Located in an isolated room with adequate ventilation.

L. TREATMENT RESIDUALS MANAGEMENT

PROPOSAL BASE CONCEPT

Backwash Detention Basins

1. *General*: Spent filter backwash will be sent to onsite backwash detention basins from which supernatant will be discharged to the adjacent Little Cicero Creek. A new NPDES permit will be required for this discharge.

2. *Number of Detention Basins*: To be determined during the design phase.

3. *Size of Detention Basins*: Detention basins shall be sized to contain a volume of ten times the total quantity of wash water discharged during any 24-hour period at rated facility capacity of 4 MGD. Assume 48 hour filter runs.

PROPOSAL MANDATORY ALTERNATE #1 CONCEPT

Backwash Equalization

1. *General*: Spent filter backwash will be treated onsite. Backwash equalization/settling tanks will operate in batch fill, settle, draw mode. The clarified supernatant will be recycled to the common raw water line downstream

of the aerator, but prior to the chemical feed points. The remaining settled residuals will be disposed of to the sanitary sewer. The backwash equalization basins must be covered, watertight and have a vent.

2. *Number of Equalization Tanks*: Two (2)

3. *Size of New Equalization Tank*: Size each tank to provide equalization of one complete backwash from three filter vessels, plus a minimum 25% factor of safety.

4. *Decant Mechanism*: Floating.

5. *Backwash Recycle Pump Station*: Provide a separate pump station to recycle clarified backwash wastewater to the head of the plant.

6. *Recycle Pump Type*: Provide redundant pumps.

7. *Recycle Pump Capacity:* 10% max of influent flow

8. *Plant Expansion*: Provide master plan for modifying and/or replacing recycle pumps as additional filters and other treatment units are added.

9. *Recycle PS Appurtenances*: Provide variable speed drives for the backwash recycle pumps. Also provide a recycle flow meter to allow automatic flow adjustment based on a percentage of the raw water flow to the WTP.

10. *Sludge Pump Station*: Provide a separate pump station and force main to route settled residuals to the Sheridan Wastewater Treatment Facility.

11. *Sludge Pump Type*: Provide redundant submersible pumps.

12. *Sludge Pump Capacity*: To be determined by Designer based on Sanitary Sewer Owner requirements.

13. *Sludge PS Appurtenances*: Provide a magnetic flow meter to measure the wastewater rates and volumes being discharged to the sanitary sewer. Designer shall coordinate pumping system design to satisfy Sanitary Sewer Owner requirements.

M. ELECTRICAL

General

1. *Electrical Design Criteria and Standard:* Refer to Appendix G for detailed electrical design requirements.

2. *Electric Service to the Site:* The existing electrical service to this site may need to be removed and totally replaced under the scope of this project due to the upgrades outlined in the RFP. A new (larger capacity) service or a conversion from 230V 3-phase power to 480V 3-phase power may be required. The

Design/Builder shall provide all coordination and construction activities associated with this effort and provide the new installations as outlined.

3. *Number of Services*: 1

4. *Type of Feed*: Duke is the local energy provider. Design/Builder shall coordinate directly with utility supplier but shall keep INAW informed of any design decisions that may have a financial impact on INAW's electric bills. Design/Builder shall account for lightning protection for buildings and other structures as appropriate.

5. *Electric Meter*: Primary electric meter shall be designed in accordance with electric utility requirements. Sub-metering shall be provided to allow INAW to measure and record power usage and demand from major equipment components.

6. *Surge Suppression*: Design using the appropriate level of transient threat as defined in ANSI/I.E.E.E. Standard C62.41. All transient voltage surge suppression equipment shall be tested in accordance with the appropriate parts of ANSI/I.E.E.E. Standard C62.45 and UL Standard 1449. The Design/Builder shall review the following issues and summarize their findings to INAW: length and amplitude of spikes caused by capacitor switching, recloser switching, or other pieces of equipment that can cause problems on a customer's power system and provide the appropriate protective equipment on INAW's side of the power system.

7. *Voltage Drops*: Develop a protection scheme to ensure that the transfer switch and other items (such as induction motors) are adequately protected from under voltage, voltage unbalance, contact chatter, etc.

8. *Harmonic Evaluation*: Perform harmonic analysis in accordance with IEEE 519 at each site where variable frequency drives are used.

9. *Grounding*: The electrical system and equipment will be grounded in compliance with the National Electrical Code. Conductors shall be No. 4/0 AWG copper, minimum, for interconnecting ground rods and for connection to transformers and MCC's and other major electrical equipment. A grounding ring will be required for the proposed building and major structures. Electrical equipment, devices, panelboards, and metallic raceways will be connected to the ground conductors.

<u>Motor Control Centers</u>

1. *Type of Equipment*: 600V, 3-phase, 4-wire plus ground operating at 60Hz. All components are U.L. listed. MCC equipment shall consist of standardized, freestanding structures bolted together for form a single dead-front panel assembly containing combination motor control units; feeder units; metering, relaying, and interlocking and miscellaneous control devices and will be of the per definitions in the latest edition of NEMA ICS 3 and UL 845.

2. *Factory Testing of Equipment*: Witnessed by INAW or by certified test report. This will be determined during detailed design.

3. *Enclosure Type*: NEMA 1. Design/Builder shall provide HVAC equipment designed with air filtration to ensure that particulate matter cannot track on to pieces of electrical equipment.

4. *Heat Dissipation*: Design/Builder shall provide for adequate heat dissipation based on guidelines listed in I.E.E.E. Standard 141, Typical Efficiencies of Electrical equipment. Calculations shall be submitted to INAW prior to final design specification review.

5. *Main Bus Capacity*: Design for 1.1 times present connected and identified future loads for other potential future loads.

6. *Momentary and Interrupting Ratings*: Determined by the Design/Builder during detailed design. Calculations must be supplied to INAW before final specifications are approved. Calculations can be computer or other INAW approved method per the guidelines listed in I.E.E.E. 141 (latest edition). The Design/Builder shall provide documentation of all assumptions for machine impedances, cable impedances (both resistance and inductance), and transformer impedances to complete the computations. Since INAW prefers a grounded secondary service, both balanced and unbalanced fault computations will be prepared and presented to INAW for review and approval. The equipment vendor will make detailed final calculations during construction and shop drawing approval. The Design/Builder shall develop fault conditions under minimum, maximum, and average power consumption scenarios based on the way the plant is to be operated. The Design/Builder shall also develop fault scenarios with local generators used instead of the electric utility.

7. *Circuit Breaker Compartments and Circuit Breakers*: Control center disconnects shall be three-pole, single-throw, 600-volt, molded-case air circuit breakers. Circuit breakers of combination starters shall be magnetic motor circuit protector type. Feeder circuit breakers shall be thermal-magnetic type and shall be manually operated with quick-make, quick-break, trip-free toggle mechanism.

8. *Power Monitoring*: Provide microprocessor-based GE Multi-Lin unit on main incoming feed. Unit shall compute voltage, amperes, power factor, kilowatt-hour, etc. Communications will be ethernet communication back to a port on a plant remote terminal unit (RTU). Provide individual power transducers on all rotating loads larger than 25 horsepower using Load Controls Inc. PH-3A or equal. Transducers shall be wired to plant RTU for monitoring, trending and archiving.

9. *Surge Suppression*: Transient voltage surge suppressors shall be provided integral to each MCC assembly. Design using the appropriate level of transient threat as defined in ANSI/I.E.E.E. Standard C62.41. All transient voltage surge suppression equipment shall be tested in accordance with the appropriate parts of ANSI/I.E.E.E. Standard C62.45 and UL Standard 1449. The Design/Builder shall review the following issues and summarize their findings to INAW: length and amplitude of spikes caused by capacitor switching, recloser switching, or other pieces of equipment that can cause problems on a

customer's power system and provide the appropriate protective equipment on INAW's side of the power system.

10. *Main Circuit Breaker*: Microprocessor based with adjustable trip and delay settings for long-time and short time tripping characteristics in addition to instantaneous and I^2t (for ground fault).

11. *Starters*: Full-Voltage combination magnetic starters shall be utilized as required. Solid-state reduced voltage motor starters may be utilized where required due to power utility requirements and/or engine-generator sizing considerations.

12. *Power Factor Correction*: Power factor correction capacitors will be applied to correct motor power factor to within 90 to 95 percent for all motor starters rated 50 hp and larger. Capacitors will be installed at the motor. Capacitors will not be applied where the motor is served by a VFD.

13. *Variable Frequency Drives:* VFD's shall be remotely mounted and be fed from a dedicated 480 volt, three-phase MCC feeder breaker. The drives shall be 6 pulse, 18 pulse or Active Front End (AFE), fully digital, microprocessor controlled and shall incorporate a diode bridge rectifier and a transistorized inverter section. IGBT type power transistor modules shall be utilized in the inverter section to invert a fixed DC bus voltage to a symmetrical three-phase pulse-width modulated (PWM) output voltage. VFD's for motors smaller than 50 hp shall be 6 Pulse. VFD's for motors 50 hp and larger shall be 18 Pulse or Active Front End.

14. *Compartment*: Equipped with the ability to lock out the starter for testing during maintenance.

15. *Pilot Lights*: Oil, dust, and water resistant with push to test type operation.

16. *Bus*: Tin plated copper.

17. *Control Power Transformers*: Sized for at least 110% of the required load to allow for future expansion.

18. *Wiring Configuration*: NEMA Class 2B

19. *Gasketing*: Required

20. *Lightning Arrestors*: Provide on the incoming lines based on the isokeraunic number (number of thunderstorms per year).

21. *Surge Capacitors*: To be provided for steep wave transient capacitors.

22. *Basic Impulse Level (BIL) Requirements*: Design/Builder to coordinate to establish a protective margin based on the perceived transient threat caused by switching of capacitor banks.

23. *Thermostats*: Design/Builder shall evaluate the need for the use of

condensation control inside each starter to prevent moisture build-up on components and install if required.

24. *Arc Flash*: Provide arc flash protection in accordance with American Water Health & Safety Procedures Manual. Refer to Appendix G for the power system & arc flash study requirements.

Miscellaneous Power Distribution

1. *Circuit Panel*: Circuit breakers will be of the bolt-on type. Push-on type circuit breakers are not allowed. Use copper type bus and ensure U.L. labeling of entire system. Provide a transient voltage surge suppresser on the main of each power distribution panel. For more specific requirements for the protection of sensitive electronic instrumentation, see Instrumentation section. All distribution panels will have hinged doors.

2. *Cables*: Those rated for 480V and below shall be dual listed as XHHW-2 type insulation listed for at least 90 degrees centigrade. In order to maintain a 90 degrees centigrade rating, all of the connectors and lugs at each end of the cable shall be U.L. listed for 90 degrees centigrade per the U.L. Green and White Books.

3. *Lighting and Power Transformers*: Dry type to limit maintenance items. A minimum of (2) taps will be provided above rated voltage (in 2.5% increments) and a minimum of (2) taps will be provided below rated voltage (in 2.5% increments). Open type transformer cases are not allowed. All units will be of sealed type construction. The Design/Builder shall examine the need to install transformers with a higher than average Basic Impulse Level (BIL) that is not normally required in the 480V class.

Lighting Fixtures

1. *LED Type Fixtures*: Units shall be sealed and water resistant, and of the highest efficiency available. In order to facilitate conformance with NFPA 101 (the Life Safety Code), the facilities shall include separate emergency lighting fixtures to ensure that all passages and exits remain illuminated in the event of a power failure. Design shall achieve adequate lighting at lowest possible energy demand.

2. *Exit Signs*: LED type and placed inside the facility per the latest requirements of NFPA 101 (the Life Safety Code). Ensure exit lights are connected to backup power with bug eye lighting.

3. *Exterior Lighting*: LED with light pollution shielding, photocell type, wall mounted, and vandal proof. Pole lighting is acceptable but must not compromise surveillance video camera effectiveness.

Automatic Transfer Switch

1. *General*: Furnish and tested by the generator set manufacturer to function as one standby power system. The transfer switch shall be UL listed per Standard

1009 and rated for total system load. The Design/Builder shall be expected to specify the close and withstand ratings of the switch components based on the available fault current at the point of installation (based on length of feeder cable run, presence of local generation, etc.). The switch shall be of the contactor type and shall be designed to carry 100% of rated current continuously based on ambient temperature of 120-degree Fahrenheit. Transfer switches using interlocked circuit breakers or molded case switches are not acceptable. The transfer switch shall be performance tested per the requirements of IEEE-587 (latest edition) for voltage surge and withstand capability.

2. *Type of Construction*: Over center double throw. This construction allows for positive electrical and mechanical interlocking via a mechanical beam to prevent simultaneous closing (break-before make-operation).

3. *Lugs*: Double set to allow connection of a load bank to the unit for generator testing. The lugs shall be rated for normal, standby, and neutral load conductors inside the cabinet.

4. *Main Switch Contacts*: High pressure silver alloy to resist burning and pitting for long life operation.

5. *Transition*: Closed transition with storm mode.

Automatic Transfer Switch Controls

1. *General*: Solid state and accessible from the front of the lockable enclosure. The voltage rating of the transfer switch depends upon the selection of the in-plant voltage.

2. *Voltage Sensors*: Solid state and simultaneously monitoring all phases of the normal source and all phases of the standby source. The sensor pick-up settings shall be adjustable from a minimum of 85% to a maximum of 98% of nameplate voltage. Dropout settings shall be adjustable from a minimum of 75% to a maximum of 98% of the pick-up settings with a fixed dropout time delay of .5 seconds. Voltage sensors shall be temperature compensated. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase of the normal or emergency source. A reverse voltage sequence relay shall be interlocked to the operation of the transfer switch.

3. *Frequency Sensors*: Solid state and monitoring normal and emergency power sources. Sensors shall be adjustable for a pick-up of minimum of +4/-4% to a maximum of +/-20% of nominal frequency. Drop out and time delay settings shall be adjustable.

4. *Operation*: The engine-generator set shall start upon signal from normal source voltage sensors. Solid-state time delay start shall be adjustable and shall avoid nuisance start-ups on momentary voltage dips or interruptions. The switch shall transfer the load to the standby power system when the voltage and frequency are within the limits after a specified time delay. The transfer switch shall retransfer the load to the normal source after normal power restoration. An adjustable solid-state time delay retransfer and controls shall be provided to match phases and achieve seamless transfer back to normal service. The

retransfer shall be interlocked with the generator to stop after the retransfer of the load to the normal source. Generator run times shall be recorded and tracked through SCADA.

5. *Built-In LED Status Indicator*: Functions to include shall consist of source 1 OK, start genset, source 2 OK, transfer timing, transfer complete, retransfer timing, retransfer complete.

6. *Auxiliary Switch*: Include a Form C 10 Amp 250 VAC auxiliary switch on both the normal and emergency side of the switch. These contacts shall be factory wired to a terminal block to allow interface to the remote telemetry unit digital inputs for transfer switch status.

7. *Test Switch*: Simulates loss of power to the control unit. Controls shall allow for a system test with or without load transfer.

8. *Normal Operating Position Switch*: Restores the load to the normal source after test and time delays.

9. *Retransfer Switch*: Momentary type to allow for a bypass of the retransfer time delays and cause immediate return to normal source after outage.

10. *Pilot Lights*: Provided on the front of the switch to indicate the switch is on normal power, the switch is on standby power, normal source available, and emergency source available.

Generator Set

1. *General*: The Design/Builder shall be responsible for providing the ratings of continuous capacity and select the appropriate operation under a specified voltage dip. The generator set shall 480V. State allowable voltage dip.

2. *Number of Units*: 1.

3. *Type*: Composite outdoor water cooled 4 cycle unit rated for standby duty with integral subbase fuel storage tank and secondary containment. The engine shall run on #2 diesel fuel and shall be equipped with a water separator type oil filter, water pump, and air filter. The fuel tank shall be sized for 24 hours of continuous operation. Although it is not expected that a natural gas generator in this size will be cost effective, the Design/Builder shall evaluate this alternative with consideration of air permitting issues and load curtailment.

4. *Sizing*: The unit shall be capable of keeping the plant operating and treating and pumping water at a flow rate equal to 1.5 MGD. Provision is to be made for upsizing the unit when the facility capacity is increased to 4 MGD. As an alternative, design shall include provisions for a temporary connection of a portable generator for powering the following plant equipment: 1 high-service pump, chemical feed systems, SCADA system, and general lighting and electrical items. The DCS, lighting and other miscellaneous loads should be included when calculating the generator loadings.

5. *Fuel Tank:* The fuel tank shall be double wall, and be furnished with an interstitial space leak detector, a digital low fuel indicator and an analog fuel gauge.

6. *Noise Attenuation*: Soundproofing, consisting of sound walls, berms, prefabricated enclosures or a building shall ensure that all local sound ordinances are met. Adjoining properties are zoned residential and should be considered in the design.

7. *Batteries*: Lead acid type

8. *Battery Charger*: Trickle type

9. *Engine Block Heater*: Resistance heater

10. *Engine Controls*: The generator shall be equipped with a complete start-stop control that automatically starts the engine on closing contacts and stops the engine on opening contacts. The engine shall run for an adjustable period under the test function described in the transfer switch.

11. *Engine Instruments Required*: Lubricating oil pressure gauge, engine temperature gauge, and battery charge rate ammeter.

12. *Insulation*: Class F as defined in NEMA MG1-1.65

13. *Minimum Acceptable Performance Standards*: Frequency regulation shall be +/- 0.25% of its mean value for constant loads from no load to full load. Voltage regulation shall be +/- 2% of its mean value for varying loads and +/- 1% of its mean value for constant load.

14. *Control Panel*: Include main circuit breaker, frequency meter, elapsed run time meter, voltage adjusting rheostat, AC voltmeter (dual range indicating all voltages), AC ammeter (dual range indicating all currents), engine controls and instruments, and heater for control of condensation. Provide a common dry contact alarm for the control panel to the DCS. Individual common faults do not need to be annunciated at the DCS. Provide KW or KVA meter.

15. *Communication*: The generator shall be equipped with a ModBus Controls Interface typed to SCADA, and provided with ethernet connection to SCADA.

N. INSTRUMENTATION

General

1. *Operation of the Treatment Plant*: Designed to operate in an unattended, totally automated mode. A supervisory/maintenance staff will be on site periodically; however, the plant will be unattended most of the time.

2. *Remote Control/Monitoring*: The ability to monitor/control the proposed facility, including the well pumps, from a remote site or sites by means of a wide area network (WAN) will be required as part of this project. Only designated,

authorized operators and supervisors shall have remote access to control systems via laptops or otherwise. This facility will have a dedicated HMI system. An interface to Kokomo will remain for management oversight and assistance from Kokomo staff, as necessary. This does not preclude remote "monitoring only" access by others. Routers, firewalls, and other security functions shall be furnished to prevent unauthorized access to the plant control network.

3. *System Architecture:* The communication link between RTUs within the WTF shall be via fiber optic cable. Provide a certified fiber optic cable test report which details the wavelength that is used to test the cable as well as the fiber optic testing equipment used. The master RTU shall communicate with the remote sites via cellular modem operating on the AW VPN. The SCADA system shall consist of a process control local area network (LAN) controlled from redundant HMI computers. The HMI software used will be Ignition Software. Ignition Software will be used to dial out alarms to local operations. System architecture shall provide for remote access from the office and business network.

4. *Conventional/Redundant Instrumentation*: Not required.

Modes of Operation

1. *Local/Remote Capabilities*: Each piece of process equipment will be equipped with a Hand-Off-Auto selector switch (at the piece of equipment) to allow the location of control to be changed. In order to ensure that the RTU in the Remote Manual or Remote Automatic Mode has control, an additional contact blocks will be added to the selector switch to monitor the Hand and Auto positions. The output of the contact block will drive a digital input that will serve as a permissive in the DCS. If the DCS attempts to control a device from the RTU when it is not in the Auto mode, a failure condition will be delineated at the operator's interface. Package systems with a local control panel may not be used.

2. *Local-Manual*: An operator at a piece of process equipment will turn the device on and off and make adjustments. Required for all equipment.

3. *Local-Automatic*: Controls are hardwired into pieces of equipment by a vendor (such as prepackaged process equipment).

4. *Remote-Manual*: An operator turns items on and off via the operator interface terminal (OIT) connected to the DCS. Required for all equipment.

5. *Remote-Automatic*: The DCS turns items on and off and performs all control. Required for equipment as necessary for overall plant coordinated control.

Remote Telemetry Units

1. *Processors*: For the treatment facility and the well pumps, two Allen Bradley Control Logix Controllers in a redundant configuration..

2. *Cabinets*: Include compact lighting fixture activated by a door switch. Each

RTU shall have battery backup/DC UPS Units. RTU's shall be located indoors in a controlled environment with fans and heaters. RTU's for the well pumps shall be outdoor rated enclosures (NEMA 4X, SS) with sunshades, thermostatically controlled heaters and coolers.

3. *Terminal Blocks*: Multilevel terminal blocks are not permitted.

4. *Spare Wired Terminals*: Provide in each cabinet to facilitate future expansion (10% minimum).

5. *Convenience Receptacles*: Use ground-fault interrupter type only.

6. *Separation of Power Cable and Signal Wires*: 120 VAC control cable shall be physically separated from 4-20 mA signals and DC wiring as much as practicable inside control cabinets.

7. *I/O Slots*: As required.

8. *Remote Input/Output (RIO) Boards*: Remote I/O, Flex I/O or Remote Racks will be permitted. 20% spare equipment, rounded to the higher quantity should be provided for all components.
9. *3 Wire Control*: Required for all pieces of equipment (one normally closed contact for stop and one normally open for start, etc.) except for metering pumps (which only require 1 contact for the start and the stop functions).

10. *Modulating Valves*: Analog control with full open and full closed feedback or open closed control with position feedback and full open and full closed feedback.

11. *Signal Configuration:* Analog inputs and outputs shall be 4-20 mA DC: Interrogation voltage for discrete inputs shall be 24 VDC. Isolated dry relay contacts shall be furnished for all discrete outputs – relays may be integral to the I/O module. Interposing relays shall be furnished in cases where the I/O module relay contacts do not have adequate electrical ratings.

12. *Uninterruptible Power Supply:* A smart type, ethernet connected 24VDC UPS shall be furnished to power the control room personal computers, printers, data concentrators, and other network equipment. The control room UPS shall be a floor mounted type with static bypass switch and alarms for overload, equipment over temperature, low battery and load on bypass. All RTU's and analyzers containing programming shall be powered from a battery backup. Battery backups for RTU's and field analyzers shall be mounted in the RTU panels. The UPS or battery backup shall provide a minimum of 30 minutes of backup power.

<u>Server Configuration</u>

1. Software will be a redundant Ignition package with three Stratus 4910 servers, two designated as redundant control servers and one as a database server.

2. Ignition Gateways will be configured with 4 CPUs, 16GB of RAM, and a

minimum of 200 GB of Disk Space.

3. The Database Server will be configured with 4 CPUs, 32GB of RAM, a minimum of 200 GB of OS Disk Space and an additional 2 TB of Data Storage for Historical Data.

4. Synology NAS Backup Server DS1821+ with 4 TB RAID one configuration.

5. Ignition Software Modules will be configured with the following:

   - Alarm Notification
   - Voice Notification
   - SMS Notifications
   - TTS Voice_en_us_Katherine
   - SQL Bridge
   - Tag Historian
   - Enterprise Administration Agent
   - Ignition Platform
   - OPC-UA / OpcCom
   - Modbus Driver
   - Allen-Bradley Driver
   - Perspective (Unlimited)
   - Symbol Factory
   - Reporting
   - Cirrus Link MQTT Transmission
   - **Redundancy (for redundant systems)**
   - **Totalcare Support (includes upgrades)**

6. The Database Server will be configured with Microsoft Sequel 2019 with a 5 CAL configuration.

Operator Interface Hardware and Software

1. *General*: Since computer technology rapidly changes, the DESIGN/BUILDER will specify all items listed under this section at the time of purchase.

2. *Personal Computers*: Two computers and monitors at the proposed facility to allow monitoring and control of the treatment facility and well field while an operator is on site. Users shall employ cryptic passwords complying with the American Water SCADA Acceptable Use Practice and related Company policies. INAW will purchase the computers.

   - Workstations will be Dell 7090 with two 24 inch monitors each.
   - Workstations to be configured for a total of 4 video outputs.

3. *Software*: The software shall be Ignition Software human-machine interface software. INAW will provide the software.

4. *Local Area Network*: The personal computers and printers shall be placed on a process control local area network (LAN). The LAN shall be implemented

using Ethernet type cards in each operator interface personal computer. The LAN shall be interconnected to various computers using a 100-base T stackable hub. The cable between devices on the LAN shall be Category 6 type cable or fiber optic. LAN cables between devices in different buildings shall be fiber optic.

5. *LAN Connection*: Shall be provided in the filter gallery (and other strategic locations in the plant) to allow for connection of a laptop computer should an operator desire to watch a filter while it is backwashing.

Operator Interface Functions

1. *Screens*: The Design/Builder shall include paragraph descriptions of the OIT and HMI screens (including a listing of each specific I/O point required on each screen) to give the system integrators an understanding of the level of detail required. Each screen shall utilize INAW's standard color conventions for stop, run, open, closed, and intermediate conditions. Text- based screens shall be considered in the design. An operator (or supervisor only) shall have the capability to manually enter data onto the screen that is not generated by the system but is appropriate to be displayed on a screen, such as a manual valve change for a chemical feed point of application. Control programs shall include limiting parameters for operator inputs, such as chemical feed dosages, to prevent excursions. Only supervisors shall have access to modify those parameters. Provide a list of all screens to be created by the system integrator. Provide sample screens to establish the minimum acceptable level of graphic detail.

    - Screen designs and configuration to be per AW standards related to the utilization of High Performance Graphic designs designated by the company.

2. *Reports*: Reporting shall be from one Ignition Reporting System. At a minimum, the reports shall consist of Form 100, System Hydraulic, Plant Data and Well Withdrawal. Provisions shall be made for the data to be edited. The original data shall not be changed; however, additional fields shall allow a manual value to be entered into reports. User entering manual data and a comment shall be maintained to explain the reason for the change. The person logged in shall be recorded as a field. Reporting data not provided by the SCADA PLCs will have the ability to be manually entered on the Data Entry Screen. This screen shall allow operators to enter lab data and other data for use in the Form 100 and other reports as needed.

3. *Alarms*: An alarm summary table shall be developed by the Design/Builder and reviewed with INAW during design. The table shall include specific initial values for all high and low alarm set points. Analog set points are also to be configurable on the graphic displays. The specific software package that is ultimately selected must have auto dialing capabilities such that alarms conditions can notify On-Call personnel without the need for a separate auto dialer. Operators shall not have access to modify alarm set points without special authorization.

4. *Database*: Provide Ignition Database package to store process data and act as

a server to database users outside the process control system. This shall be installed on an existing server and fully integrated into the existing control system. INAW will provide the software.

System Factory Test

1. INAW and Design/Builder shall witness a complete factory acceptance test (FAT) of the entire control system prior to its shipment to the job site. The Design/Builder shall provide written approval for shipment following acceptance of the factory test.

2. The factory test shall be conducted by the Systems Integrator using simulated inputs to assure all I/O are provided and all inputs, outputs and application software is functioning according to the intent of the plans and specifications. Additional distributed control units shall be provided, if necessary, to accommodate the project phasing requirements. The test procedure shall include simulated system faults and failures. The factory tests shall be staged in two parts: the first to review all I/O and hardware and the second to assure functionality of the system.

3. The factory test shall demonstrate all graphics, report generation and alarm functions of the system.

4. Provide at least a four-week written notification to INAW prior to the start of the witnessed factory test. Provide a written factory acceptance test procedure for INAW review prior to the start of the factory acceptance test.

Training

1. *General*: INAW shall advise the Design/Builder as to the amount of training to be performed relative to the distributed control system. It is expected that the DCS system supplier will furnish videotapes of the training. These videotapes will be turned over to INAW at the end of training program. All training received during the startup and calibration of equipment is considered incidental training and does not count for the requirements listed below.

2. *Operator Training:* Operating training has the following goals:

    a. Use workstations, touch screens, and keyboards

    b. Retrieve and interpret all standards displays including graphics, overview displays, group displays, trends, point summaries, and alarm summaries.

    c. Enter data manually

    d. Change control parameters and set points

    e. Assume manual control of equipment and control it from the HMI

    f. Print Reports

g. Acknowledge Alarms

h. Respond to software and hardware errors

i. Historical Data Collection, archival and retrieval

j. Capabilities and configurability: reports, alarm reporting, setting passwords, and system hardware configuration.

k. Database backup and recovery

3. *Maintenance Training*: This training equips INAW personnel with the skills required to diagnose, trouble shoot, and repair the components of the system. As a minimum, maintenance training shall provide technicians with the ability to:

   a. Power-up, boot strap, and shut down all of the hardware devices

   b. Perform scheduled maintenance functions on all components

   c. Describe the theory of operation for all circuit boards.

   d. Setup and use off-line diagnostics to determine hardware failures to the fault board or module.

   e. Use workstations, keypads, or keyboards to retrieve and interpret displays which shall provide on-line diagnostic information

   f. Remove and replace all removable boards/modules.

   g. Maintenance training shall be at least 75% hands-on instruction and shall be designed for personnel that do not have any familiarity with the equipment furnished.

4. *Supervisor Training*: This training is for personnel who will need to make access changes to the DCS. This training consists of the following basic tasks:

   a. Log-on and log-off to the HMI and OIT

   b. Setting and clearing passwords

   c. Configuring access levels for various process parameters and set points

   d. Printing and configuring reports

5. *Calibration*: It is expected that a detailed calibration plan will be developed during the construction phase of the project. The Design/Builder will review the instrumentation installed and provide guidance to INAW as to the number of follow-up visits for calibration, the type of calibration documentation to be furnished, and the calibration equipment to be furnished to allow INAW personnel to maintain the equipment after project completion.

Protection of Sensitive Electronic Equipment

1. *General*: The Design/Builder shall follow guidelines for the powering and grounding of sensitive electronic equipment listed in I.E.E.E. Standard 1100-1999. Controls and power voltage are not permitted to be mixed.

2. *Transient Voltage Surge Suppression (TVSS)*: Provide TVSS at point of use for all instrumentation loads. Required for all 4 wire instruments (such as a chlorine residual analyzer) and placed on the 120 VAC branch circuit and on the 4-20 mA portion of the circuit. The transient voltage surge suppression on the 4-20 mA wiring shall be located on the RTU end. For all two wire 4-20 mA instruments that have signal cable running from outdoor to indoor locations (or signal wire run between buildings), transient voltage surge suppression on the field side of the 4-20 mA signal is required.

3. *Grounding*: Each RTU cabinet shall be provided with a direct connection to the ground grid via a driven rod in addition to the equipment safety ground required by the National Electrical Code. Daisy chaining of grounds is not acceptable. A grounding detail showing the interface between the RTU cabinet and the proposed grounding system is required. Instrumentation shields shall be grounded at the DCS end only. The electrical grounding specifications must be cross referenced to the instrumentation and control specifications so that it is understood that the system integrator monitors the quality of system grounding. In order to facilitate an electrically conductive ground mass, provide connections to structural steel and interface them to the grounding system that results in a ground impedance of 1 ohm or less.

4. *Power Supplies*: Separate power supplies shall be provided for analog inputs and PLC's, and digital outputs.

5. *Conduit Spacing*: Required between power and signal/control cables as listed in I.E.E.E Standard 518-1982.

Communications Equipment

1. *Data Highway*: Fiber optic cable is required between RTU's. Cable runs should be installed in metal conduit.

2. *Spare Parts*: The Design/Builder shall confer with INAW for the required spare parts associated with communication cables.

    - 20% Minimum, rounding to the higher quantity, for PLC equipment.

Signal/Control Wiring for Corrosive Areas

1. Use Schedule 80 PVC conduit in all chemical storage areas. Where possible, enclosures for control and electrical components should be located outside of the chemical storage rooms. Where this is not possible, the enclosures shall be fiberglass NEMA 4X type enclosures.

O. BUILDING REQUIREMENTS

General

1. The proposed treatment building shall be as specified herein, and as determined by the Design/Builder during the design phase.

Administrative Area

1. *Office Space:* Provide two offices, a lobby with space for an operation support representative, a conference room for 12 people, a break room and restrooms. Approximately 1600 square feet. The conference and break room shall have at least one large screen monitor per room and shall be connected to the SCADA system.
2. *Operator/lab Area*: Approximately 200 ft^2. Provide operator worktable/desk and UPS. Provide lab cabinet, counter space with sink and a service sink for samples and analyzer waste. Provide countertop space to perform routine wet chemistry. Other details to be provided by INAW during design phase.
3. *Maintenance Storage Area*: Approximately 100 ft^2. Provide space for INAW provided wall shelving units.
4. *Restroom:* One women's restroom and one men's restroom, which shall be ADA compliant
5. Furniture: Will be purchased by the Design/Builder with the exception of the maintenance shelving, which will be provided by INAW.
6. Local Area Network: The office space is to be equipped for a business services local area network (LAN2). This network will be completely separate from the process control local area network (LAN1). The LAN shall be interconnected to various devices using a 100-base T stackable hub. The cable between devices on the LAN shall be Category 6 type cable. At least two LAN connections are to be provided in each office and in the break room, and at least six LAN connections are to be provided in the conference room.
7. LAN Room: Approximately 100 ft^2.

Utilities and HVAC

1. *Water Service*: In plant water service to be metered and individual backflow preventers provided where necessary. Provide redundant booster pumps if distribution system pressure is not adequate for plant service needs when plant is not running. The Design/Builder shall review this requirement with the OWNER during preparation of the Design Memorandum to determine if booster pumps will be required.
2. *Sanitary Waste*: Coordinate design of sanitary sewer line with backwash waste disposal and design and construct an onsite sanitary lift station if required.

3. *Heating*: Electric heat or natural gas, if available and cost effective, for heat and hot water.

4. *Air Conditioning*: Provide air conditioning in the administrative areas. Provide dehumidification equipment for all necessary spaces.

5. *Telephone Service*: Design/Builder shall coordinate with the local telephone utility to provide this connection.

6. *Broadband Internet:* Broadband internet service will be required to support the business service local area network (LAN 2), security communications and the fire alarm system.

Architecture

1. *Treatment Plant Layout*: A common structure is preferred.

2. *Exterior*: Exterior appearance to meet local building ordinance. Anticipate brick or color-tinted split face block; color selections by Owner.

3. *Roof*: Precast concrete panels with built up insulation and single ply membrane system. Metal deck and standing seam metal roof is acceptable provided it is cost effective and not exposed to chemical areas.

4. *Interior Walls*: The chemical areas shall have painted block. Drywall with metal frame and/or painted block in remainder areas of the plant as required.

5. *Floors*: Sealed concrete in process areas. Provide chemical resistant concrete coatings in all chemical rooms per T-2 Standard. Provide epoxy coated flooring or commercial tile in operator/lab area and restroom.

Control Room / Operator's Office

1. *Construction*: Totally enclosed room (no outside doors).

2. *Configuration*: Area dedicated to operator control workstations.

3. *Fire Suppression Equipment*: Include equipment such as a fire extinguisher that will not damage computer equipment in the event of a fire. Equipment to comply with the latest requirements of the National Fire Protection Association Codes and standards.

4. *Control Room Furniture*: Will be purchased by Design/Builder.

Safety/Security

1. *Smoke and Fire Alarms*: Provided in areas where fire potential is high. Suppression system(s) shall be designed only if required by code or local ordinance.

2. *Security System*: Designed by Others. Security requirements will be determined by the Owner based on the 60 percent complete design drawings.

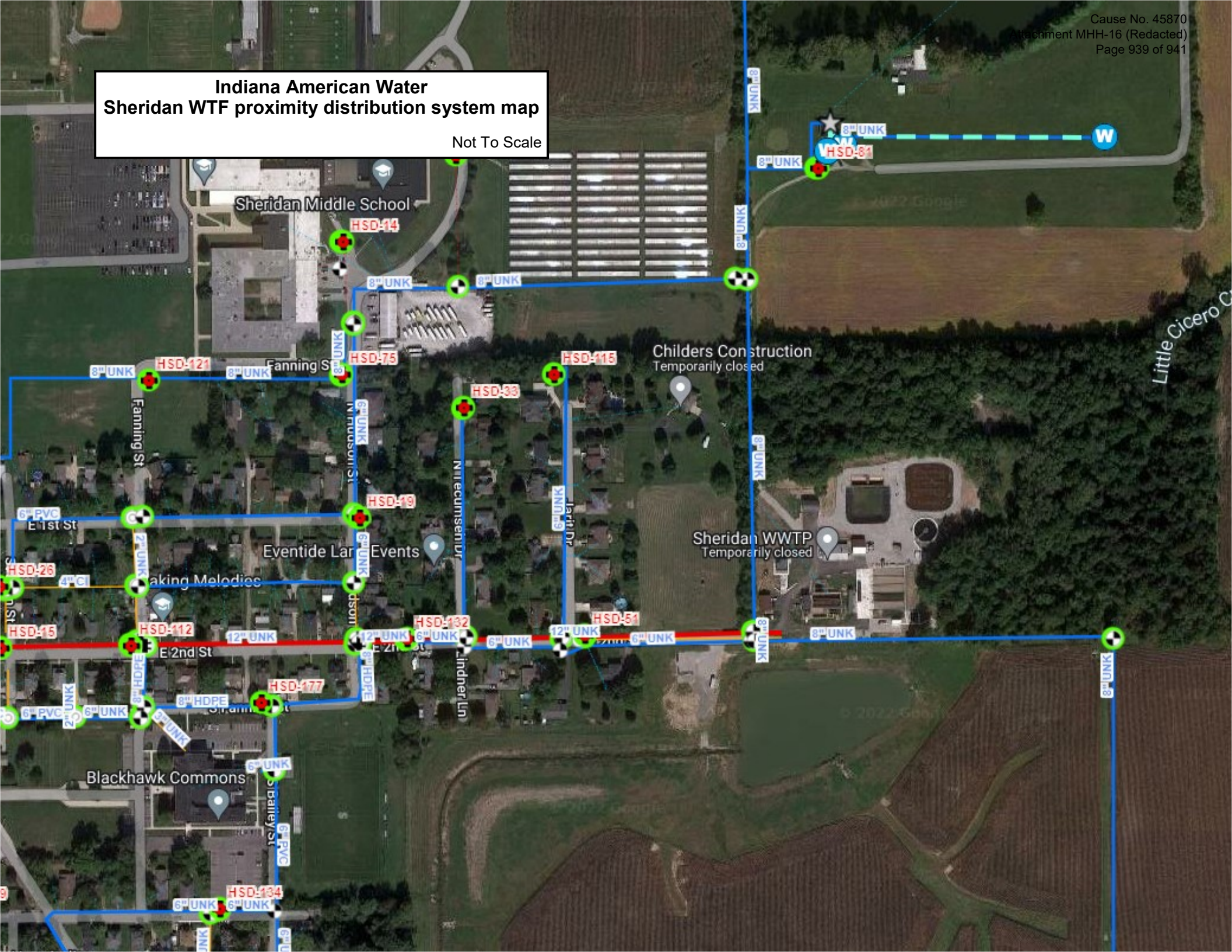
The Owner will provide the Design/Builder with details of the security system design to incorporate into the final design documents. The Design/Builder will be required to furnish and install basic electrical components, such as conduit, conductors, switches, support poles, wire, etc., to support the final installation of the security system, which shall be completed by others.

Security system is to provide badge access and gate operator to main gate adjoining the wastewater treatment facility.

3. *Lighting:* Lighting will be placed on structures such that CCTV cameras are not blinded by perimeter lights.

4. *Fencing:* Fence surrounding property will be set back from property line as required by local codes. Design/Builder to verify during design. Area outside of fence will be kept clear so as to provide indication of intrusion. Fencing concept will be further developed during design phase.

5. *Site Design:* Site grading and access drives shall be sloped to facilitate drainage away from the buildings and structures.


Indiana American Water
Sheridan WTF proximity distribution system map
Not To Scale
Sheridan Middle School
HSD-14
HSD-81
HSD-121
HSD-75
HSD-115
HSD-33
HSD-19
HSD-26
HSD-15
HSD-112
HSD-132
HSD-51
HSD-177
HSD-134
Childers Construction
Temporarily closed
Sheridan WWTP
Temporarily closed
Eventide Lar Events
Blackhawk Commons
Fanning St
E 1st St
E 2nd St
Tecumseh
Lindner Ln
Little Cicero C
8" UNK
6" UNK
12" UNK
8" HDPE
6" PVC
4" CI
2" UNK
3" UNK

WELL CONSTRUCTION SUMMARY
INDIANA AMERICAN WATER
SHERIDAN WELL FIELD

	IDNR Well Log #	Date Installed	Ground Elevation [Feet, msl]	Top of Casing Elevation [Feet, msl]	Rated Capacity [gpm]	Capacity in 2020 [gpm]	Well Depth [Feet, TOC]
WELL 4	146929	1961	950		475	352	153
WELL 5	147038	1961	940		500	320	132
WELL 6	421316	5/20/2010	945		500	500	155

	Well Diameter [Inches]	Screen Length [Feet]	Depth to Top of Screen [Feet, TOC]	Top of Screen Elevation [Feet, msl]	Comments
WELL 4	8	18	124	826	18 feet of 0.040 slot screen
WELL 5	10	10	116	824	10 feet of 0.060 slot screen
WELL 6	16	20	135	810	20 feet of 0.050 slot screen

Rated Capacity and 2020 Capacity are based on information from Peerless Midwest.

ADDENDUM NO. 02

July 8, 2022

To the Request for Proposal Documents for
Indiana-American Water Company, Inc.
Sheridan Water Treatment Facility
Dated June 2022

This Addendum is made part of the above noted Contract Documents. Receipt of this Addendum shall be indicated by inserting the number and date in the space provided on page PF-2 of the Proposal.

This addendum includes 1 page as listed.

Proposals shall be based on information provided in the Request for Proposal and Addenda. Oral statements and visuals are not binding.

Item 1
Questions from Proposers and Responses from Indiana-American Water (INAW)
Questions No. 14 to 15.

Question No. 14

Please confirm if Tonka will be considered an acceptable manufacture for the Aerator and Horizontal Pressure Filter work.

INAW Response – Tonka will not be considered an acceptable manufacture for the Aerator and Horizontal Pressure Filter work.

Question No. 15

PDF Page 180 of 942 appears to show an existing headwall and 12" VCP for the existing backwash. Page 20 of the Design Concept states that the Base Concept will need to include a new NPDES permit. Please confirm this existing discharge is not viable for the current project..

INAW Response – Indiana-American Water has not used this discharge and has no information regarding when this discharge was used, when it ceased to be used, or if there is an easement in place for the offsite extents. If the condition of the headwall and 12” VCP are determined to be in sound condition, use of this discharge would be viable for the current project, subject to verification or acquisition of easements for the offsite extents.

ATTACHMENTS MHH-17-22 ARE CONFIDENTIAL

DETAILED ESTIMATE OF COST

Company: **Indiana American Water Company**
District: **Kokomo**

Project Title: **Sheridan Water Treatment Facility**
Funding Project No.: **I10-100018**

		5-Year Plan			
	DATE	4/6/22	8/19/22	Date of Est	Date of Est
	PROJECT STAGE	Implementation	Implementation	Project Stage	Project Stage
	TOTAL Project Cost	$21,487,166	$29,542,795	$0	$0
	COMPANY FUNDED Project Cost	$21,487,166	$29,542,795	$0	$0
Planning Costs		Project Stage	Project Stage	Project Stage	Project Stage
Water Company Labor		[redacted]			
Engineering Planning					
All Other Costs					
Other Costs					
Other Costs					
Planning Costs Sub-Total					
Preliminary Costs		Project Stage	Project Stage	Project Stage	Project Stage
Water Company Labor		[redacted]			
Land and Easement Acquisition					
Preliminary Engineering					
Design, Bidding and Award					
Permit Acquisition					
Other Costs					
Other Costs					
Other Costs					
Water Company Labor Sub-Total					
All Other Costs					
Land and Easement Acquisition					
Preliminary Engineering					
Design Services					
Design-Build Stipend					
Bidding and Award					
Other Costs					
Other Costs					
All Other Costs Sub-Total					
Preliminary Costs Sub-Total					
Implementation Costs		Project Stage	Project Stage	Project Stage	Project Stage
Water Company Labor		[redacted]			
Construction Administration					
Technical Review Services					
Resident Observation					
Other Costs					
Other Costs					
Other Costs					
Water Company Labor Sub-Total					
All Other Costs					
Design Professional Services					
Resident Observation					
Construction Supervision and Superintendence					
Design-Builder Fees					
Construction Estimate					
Raw Water Main					
Other Costs					
DB Stipend					
JCI - Security					
Other Services (Testing, Permits, etc)					
Small Equipment/Furnishings					
Property Acquisition					
Other Costs					
Other Costs					
Other Costs					
Contingency					
All Other Costs Sub-Total					
Implementation Costs Sub-Total					
Contributions or Advances		Project Stage	Project Stage	Project Stage	Project Stage
Description		[redacted]			
Description					
Description					
Description					
Contributions or Advances Sub-Total					
Cost of Removals		Project Stage	Project Stage	Project Stage	Project Stage
Demo of existing facilities		[redacted]			
Description of Asset or Asset Group					
Description of Asset or Asset Group					
Description of Asset or Asset Group					
Description of Asset or Asset Group					
Cost of Removals Sub-Total					
Overhead and AFUDC Costs (calculated in SAP)		Project Stage	Project Stage	Project Stage	Project Stage
Labor Overhead		[redacted]			
Indirect Capital Overhead					
AFUDC					

PLAN FOR FUTURE SOURCE OF SUPPLY
CRAWFORDSVILLE DISTRICT

INDIANA
AMERICAN WATER

153 N. Emerson Avenue
Greenwood, IN 46143

March 2023

Table of Contents

1 Need for Source of Supply Property Rights

The Crawfordsville District is a drinking water system in Montgomery County and is owned by Indiana American Water. Source of supply improvements are anticipated in the Crawfordsville District due to prior maximum day demands exceeding the safe-yield of the existing source of supply and anticipated development due to recently completed utility and transportation infrastructure investment.

The Crawfordsville District currently has a single wellfield located at the existing water treatment facility. The existing Sugar Creek Wellfield has a safe yield of 2.5-mgd and a short-term yield of 3.0-mgd (Eagon and Associates, 2006). The maximum day demand was 2.56-mgd in 2021 and 2.57-mgd in 2022.

Indiana American Water entered into an agreement with Montgomery County in 2019. The agreement extended drinking water service to the county's infrastructure development zone in the southeastern portion of the Crawfordsville District where service was not previously provided. The completed infrastructure improvements will provide drinking water to approximately 2,000-acres for future development. The proposed land use allocates approximately 1,000-acres to industrial usage and approximately 1,000-acres to residential, commercial, and mixed uses. The projected maximum day demand for the proposed development area is 1.8-mgd at full buildout (Arcadis, 2021). The projected maximum day demand for the existing Crawfordsville system and proposed development is 4.4-mgd.

The Crawfordsville District has received over 15 requests for information since mid-2021 from Montgomery Country related to Indiana Economic Development Corporation (IEDC) opportunities. Multiple requests have included drinking water demands over 500,000-gallons per day.

The City of Crawfordsville and Montgomery County are also planning future infrastructure improvements on the south side of the Crawfordsville District. The intent of these improvements is to attract additional commercial and residential development to the area.

Indiana American Water has initiated a preliminary hydrogeologic study to evaluate potential locations for development of ground water source of supply in the area. Ground water source of supply is preferred and anticipated to be available for the projected demands. Alternatively, development of a surface water source of supply could be evaluated. The development of surface water requires additional challenges and time that may not be available depending on rate of drinking water demand growth.

2 Schedule for Source of Supply Development

Acquisition of property rights and development of additional source of supply is recommended to be completed as soon as feasible to meet the existing deficit between the recent maximum day demands and the safe-yield of the Sugar Creek wellfield. It is further recommended that the source of supply acquisition consider short-term and long-term growth projected for the area with the recently completed infrastructure improvements and economic development interest. The projected source of supply deficit is 1.9-mgd. The development schedule is not known. However, recent interest from multiple industrial developments have included demands exceeding 500,000-gallons per day. As such, it is expected the development of the source of supply will be within the next fifteen years. Once the potential site for the source of supply is identified, it would be prudent to secure ownership rights to the site so that it does not otherwise develop in a fashion that would not be conducive to a source of supply.

3 Cost Estimate for Source of Supply Development

Table 2: Crawfordsville District Source of Supply Plan Cost Estimate			
Estimate Item (1 to 2-mgd)	Low	Base	High
Property Rights Acquisition	$0.6M	$0.8M	$1.0M
Source of Supply Development	$4.0M	$5.0M	$6.5M
Total Acquisition and Development	**$4.6M**	**$5.8M**	**$7.5M**
Low Estimate is 80% of Base and High Estimate is 130% of Base			

4 Appendix: Referenced Studies

EAGON & ASSOCIATES, INC.
Consulting Geologists

JAN 27 2006

100 Old Wilson Bridge Road, Suite 115 / Worthington, Ohio 43085 / (614) 888-5760 / FAX (614) 888-5763

January 25, 2006

Mr. Dan Haddock, P.E.
Indiana American Water Company, Inc.
555 E. County Line Rd.
Greenwood, IN 46143

RE: Crawfordsville, Indiana

Dear Dan:

The purpose of this letter is to provide you with information regarding the possibilities of expanding the ground-water production capacity of the Crawfordsville water-supply system. Two well fields are currently in use: the Little Sugar Creek Well Field and the Todd Well Field. Production data and water-level data from these well fields have been analyzed to evaluate the potential for increased production from these well fields. Also included in this letter is information regarding a property west of Todd Well Field where significant additional capacity might be developed.

Little Sugar Creek Well Field

The Little Sugar Creek Well Field is located east of Crawfordsville along Little Sugar Creek. The first production well (Well No. 2) at the well field was installed and tested in 1996. Based on analysis of the Well No. 2 pumping-test data, it was estimated that the safe yield for the well field was on the order of 2.5 to 3.0 million gallons per day (MGD) (Eagon & Associates, Inc., Aquifer Test Analysis, Little Sugar Creek Well Field, August 19, 1996). Well-field development proceeded in 1997 with the installation of three additional productions wells (Wells 1, 3, and 4) and the construction of a water-treatment facility. Production from the well field began in 1998.

Figure 1 is a graph showing production from the Little Sugar Creek Well Field along with monthly precipitation totals and water levels from an observation well on the IMI property southeast of the well field. Water levels have been recorded once an hour at this location since July 1997. This graph shows that well-field production has generally been around 1.5 to 2.5 MGD and production above 2.5 MGD has not been common. Aquifer water levels show a relatively large range of fluctuation. Examination of Figure 1 shows that some of the water-level fluctuations correlate with changes in production, but some of the variation is seasonal and is due to variations in aquifer recharge from precipitation. The lowest water levels observed were in late 1999 and late

2005. These were periods when production was above 2 MGD and precipitation amounts were relatively low. The water-level data also show that water levels can rise quite rapidly in response to significant rainfall. This rapid recharge may occur during flood events along Little Sugar Creek.

Figures 2 through 5 are graphs showing pumping levels at each production well along with total well-field production. The depth to the top of the well screen is also indicated on each graph. Water levels from Wells 1 and 3, shown on Figures 2 and 4, show about the same relationship to pumping as is indicated by Figure 1. Some of the pumping-level fluctuations correlate with production changes and others are due to seasonal recharge variations. Overall Figures 2 and 4 do not indicate any particular change in well performance over time at Wells 1 and 3. Even when water levels were at their lowest in 1999 there was ten feet or more of available drawdown above the top of the well screen at each of these wells. Specific capacity data from these wells also indicates very good performance with relatively little loss of performance over time. Specific capacities from the Little Sugar Creek wells are summarized on Table 1.

Water levels from Well No. 2 are shown on Figure 3. Water levels at Well No. 2 were below the top of the well screen in 1999. Available drawdown has been as much as 12 feet during times when aquifer water levels are high. Well No. 2 has always had the lowest specific capacity of the Little Sugar Creek wells. The specific capacity of Well No. 2, as shown on Table 1, dropped from around 47 gpm/ft in 1996 to 27 gpm/ft in 2005. Rehabilitation in May 2005 brought the specific capacity back up to about 41 gpm/ft, but this is still below the original specific capacity.

Water levels from Well No. 4 are shown on Figure 5. Water levels at Well No. 4 were below the top of the well screen in 1999 and have been below the top of the well screen most of the time since 2004. A noticeable decline in well performance is evident beginning around the first part of 2003. Pumping levels after that time are consistently lower. As shown on Table 1, the specific capacity of Well No. 4 dropped significantly from 1997 to 2002. Rehabilitation in 2002 appears to have recovered most of the specific capacity decline, but the pumping levels shown on Figure 5 would seem to indicate that well performance has since declined.

Overall analysis of the data from the Little Sugar Creek Well Field indicates that the safe yield of the well field is about 2.5 MGD. During periods when water levels are high, production above 2.5 MGD is available, but cannot be sustained when precipitation amounts are below normal for extended periods. During a prolonged drought, even 2.5 MGD may be pushing the upper limit of available capacity. There may be some benefit to adjusting production rates of individual wells. Increasing pumping rates at Wells 1 and 3 and decreasing rates at Wells 2 and 4 would keep pumping levels a little higher at Wells 2 and 4. Well No. 4 should be cleaned. Pumping with water levels in the well screen will only hasten the decline in well performance and will make it more difficult and costly to achieve satisfactory rehabilitation. Based on the original pumping tests of the wells, Well No. 2 is located in an area of lower aquifer hydraulic conductivity, so well performance above what has been observed cannot be expected. The original pumping tests of Well No. 4 did

not indicate any great difference in aquifer hydraulic conductivity as compared with Wells 1 and 3. However, the original stepped-rate test did show that the specific capacity declined more with increasing pumping rate than it did at Wells 1 and 3. Figure 6 is a cross section through Wells 1, 3, and 4. This cross section shows that there is more unconsolidated material above the well screen in the vicinity of Well No. 4. Under pumping conditions, the upper part of this material is probably dewatered and the oxidation of these previously saturated materials could be causing changes in water quality that are affecting Well No. 4.

Todd Well Field

Two wells, Wells 1 and 2, are in service at the Todd Well Field. The location of the Todd Well Field is shown on Figure 7. Well No. 1 is a replacement for the original Well 1 and was installed in 1986. Well No. 2 was installed in 1993. The original specific capacity of Well No. 1 was around 80 gpm/ft at 630 gpm and the safe capacity was determined to be 400 gpm. The original specific capacity of Well No. 2 was around 22 gpm/ft at pumping rates between 200 and 500 gpm. The safe capacity of well No. 2 was 200 gpm. Current pumping rates for the wells are around 250 gpm for Well No. 1 and 80 to 90 gpm for Well No. 1. Both wells require frequent rehabilitation to maintain higher capacities and well performance declines rapidly. Production from the Todd Well Field is limited due to the effect of negative aquifer boundaries and the lack of induced stream recharge. The pumping test analysis of Well No. 2 is documented in the report "Pumping Test Analysis, Todd Well No. 2" (Eagon & Associates, Inc., June 1, 1993) and additional information regarding the aquifer characteristics is contained in the report "Water Supply Expansion, Todd/Jackman Site"(Keck Consulting Services, Inc., October 7, 1985).

Production data from the Todd Well Field since 1997 are shown graphically on Figures 8 and 9 along with pumping levels from Wells 1 and 2, respectively. The production data show that well field production was as much as 0.75 MGD (520 gpm) prior to 2001. Production since then has been no more than about 0.35 MGD (250 gpm). Figure 8 shows that pumping levels at Well No. 1 have been quite variable ranging from about 10 to 35 feet. The lowest pumping levels were in 2003. Precipitation totals during this time, shown on Figure 1, were relatively high, so the low pumping levels are probably due to a decline in well performance. Pumping levels since that time have generally been between 10 and 20 feet above the top of the well screen. Pumping levels at Well No. 2, shown on Figure 9, have been relatively consistent and have been 10 to 15 feet above the well screen. Based on the pumping levels, some additional capacity would seem to be available from the Todd wells, but the amount is probably only a few hundred gpm. Given the high degree of maintenance that would be necessary to maintain these wells at high performance levels, it is probably not worth trying to increase production.

Possibilities for Expansion

There are a few possibilities for developing additional capacity in the Crawfordsville area. The best of these possibilities is at a former gravel quarry located west of the Todd Well Field at the northeast corner of County Road 400 West and Division Road. Figure 7 is a location map of the Todd Well Field area. According to the well log (Figure 10), the well at Map No. 22 was reported to be capable of approximately 1300 gpm production with 17 feet of drawdown. This would result in a specific capacity of 75 gpm/ft. The well casing is 12 inches in diameter and the well is 170 feet deep with 40 feet of well screen. The well log indicates that the formation is fairly stratified ranging from fine sand to medium gravel. Cross sections were developed through the area to try to define the extent of the aquifer. The cross-section traces are shown on Figure 7 and the cross sections are shown on Figures 11 and 12. In general, the cross sections show that the formation has a relatively narrow north to south extent of approximately 1.5 miles. The east to west extent appears to be greater along Sugar Creek to the east and the formation thins substantially to the west. The ground-water availability map for Montgomery County (Plate 1 of IDNR, Division of Water Bulletin No. 36, 1974) indicates that there may be significant extent to the sand and gravel to the southwest. Land west and southwest of Section 34 is largely agricultural and there are few available well logs, so it is difficult to confirm this possibility.

Based on the extent of formation and the specific capacity of Well 22, it would seem that production of at least one MGD could be obtained from a well or wells in this area. If the aquifer is in good hydraulic connection with Sugar Creek, recharge by induced streambed infiltration would help support ground-water withdrawals and higher production capacities might be possible. Test drilling at the site and an aquifer test would be required to refine production estimates to any greater degree. Experience in the Crawfordsville area would suggest that 2.0 MGD would be about as much as could be expected.

Some potential contamination sources are shown on Figure 7. There are two auto scrap yards south of the gravel quarry along County Road 400 West. There is also a hog farm to the north. It is also possible that there is or has been fuel storage at the gravel quarry. There are a couple of maintenance buildings at the quarry and a track hoe was there in December, although the gate was locked and there did not appear to be any activity at the quarry. This is an unsewered area so all residences have on lot septic systems. If further investigation of this area is performed, it might be worth while to collect a sample from Well 22 so that any existing ground-water contamination could be identified before proceeding with any drilling or aquifer testing.

At this time, we would recommend obtaining property maps and attempting to get an option on at least some of this property. The best location for a test well would be to the east toward Sugar Creek, assuming that suitable formation materials are present there. Then an aquifer test could be designed that would allow for analysis of induced streambed infiltration. Production wells on the

east side of the property would also reduce the distance that water would have to be piped back to the water treatment plant at Todd Well Field.

A second possibility for expanding the capacity of the Crawfordsville system would be to try and find available property along Sugar Creek between Todd Well Field and Crawfordsville. If a location could be found where suitable aquifer materials are in good hydraulic connection with Sugar Creek, recharge from induced streambed infiltration would help support production withdrawals. If suitable aquifer materials are present along the Sugar Creek Valley, it might also be possible to install a series of wells east and west of Todd Well Field along Sugar Creek to augment the supply from Todd Well Field.

A third possible location for additional production wells is along Walnut Fork northeast of the intersection of State Routes 32 and 47. This area is shown on Figure 13. Cross sections developed for the Little Sugar Creek Well Field indicate that there may be good aquifer materials in this area (cross-section A-A' is attached as Figure 6) and the bedrock topography map (Plate 2 of IDNR Division of Water Bulletin 36) indicates that bedrock elevations are below 600 feet in this area. The ground elevation is around 750, so unconsolidated materials could be over 150 feet thick. This area is about a mile west of the Little Sugar Creek Well Field. If the aquifers at these locations are hydraulically connected, it may be too close. Cross-section A-A' shows that the aquifer pinches out against a bedrock high to the west of Little Sugar Creek Well Field. However, the aquifer may be continuous along the creek valley north of the bedrock high. Residential ground-water use in this area presents another problem. West of Walnut Fork there are a few subdivisions that were not connected to the Crawfordsville supply and wells at these residences generally only penetrate the upper part of the saturated aquifer. Since it would probably be necessary to connect all of these residences, the production gained might not offset the additional demand. This location is also closer to a number of industrial potential contamination sources and is about a mile southeast of the closed landfill.

Please call if you want to discuss this information or if you require anything else.

Sincerely,

Stephen J. Champa
Hydrogeologist

SJC/mr
encl.

cc: Stan Scott

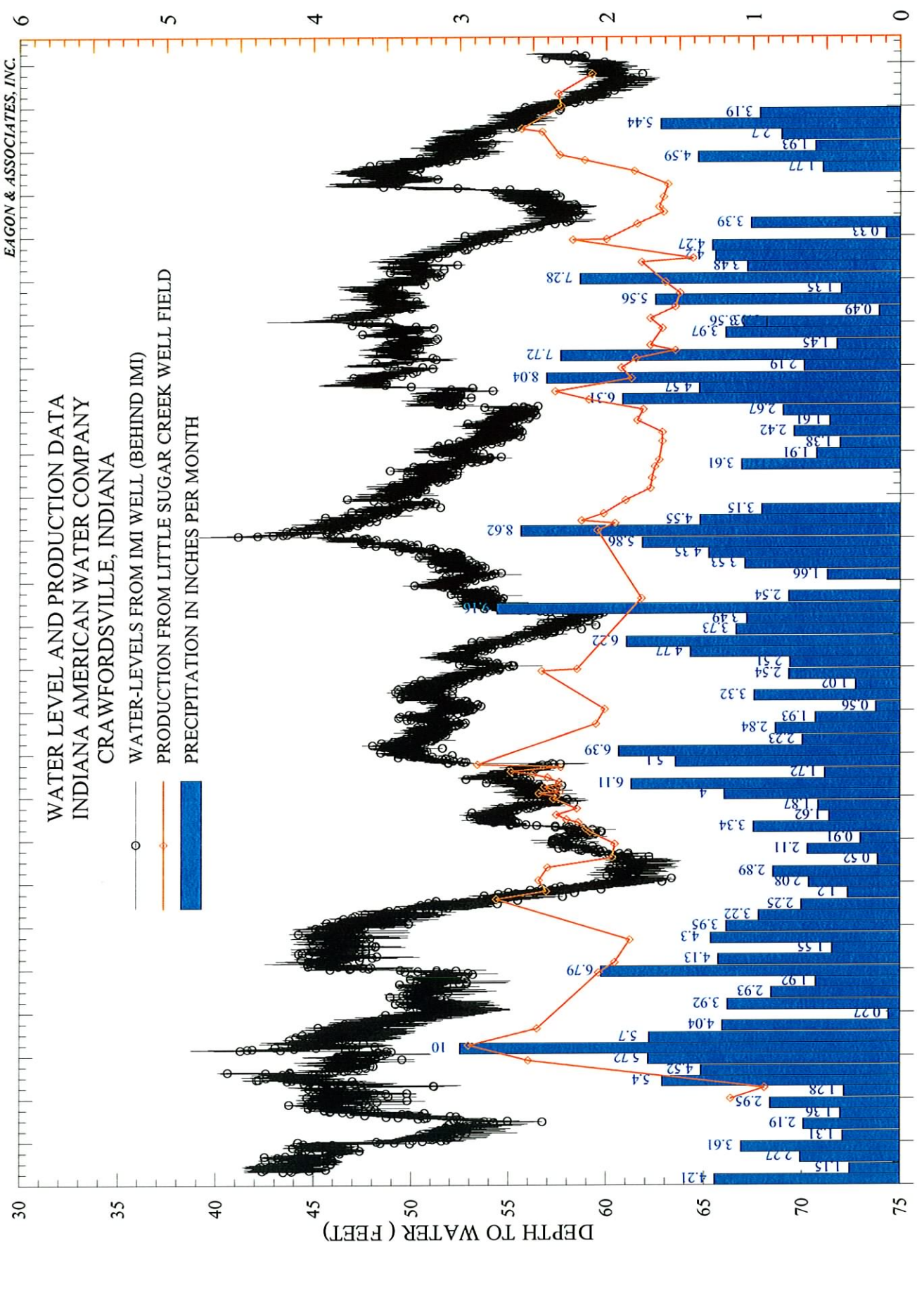
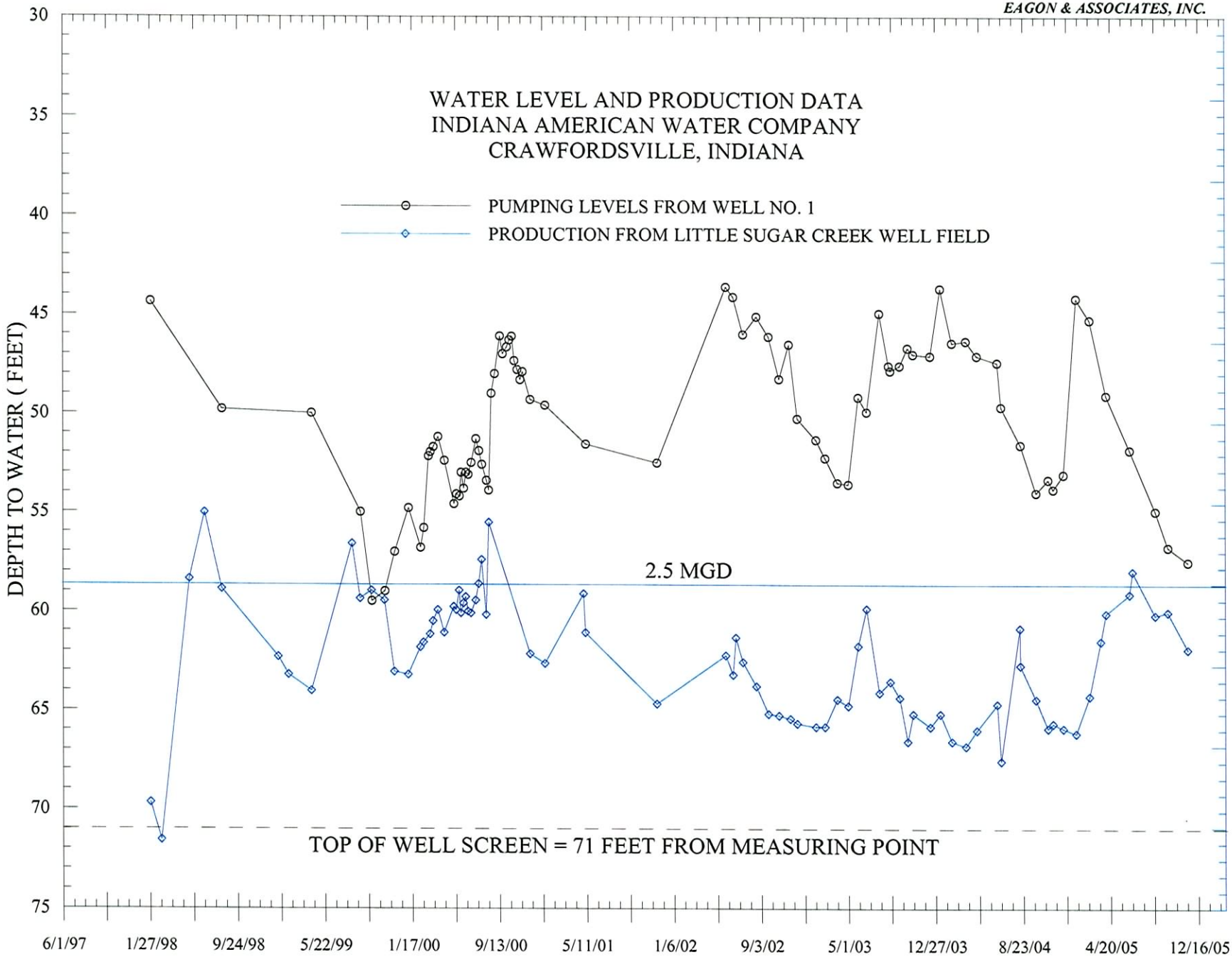


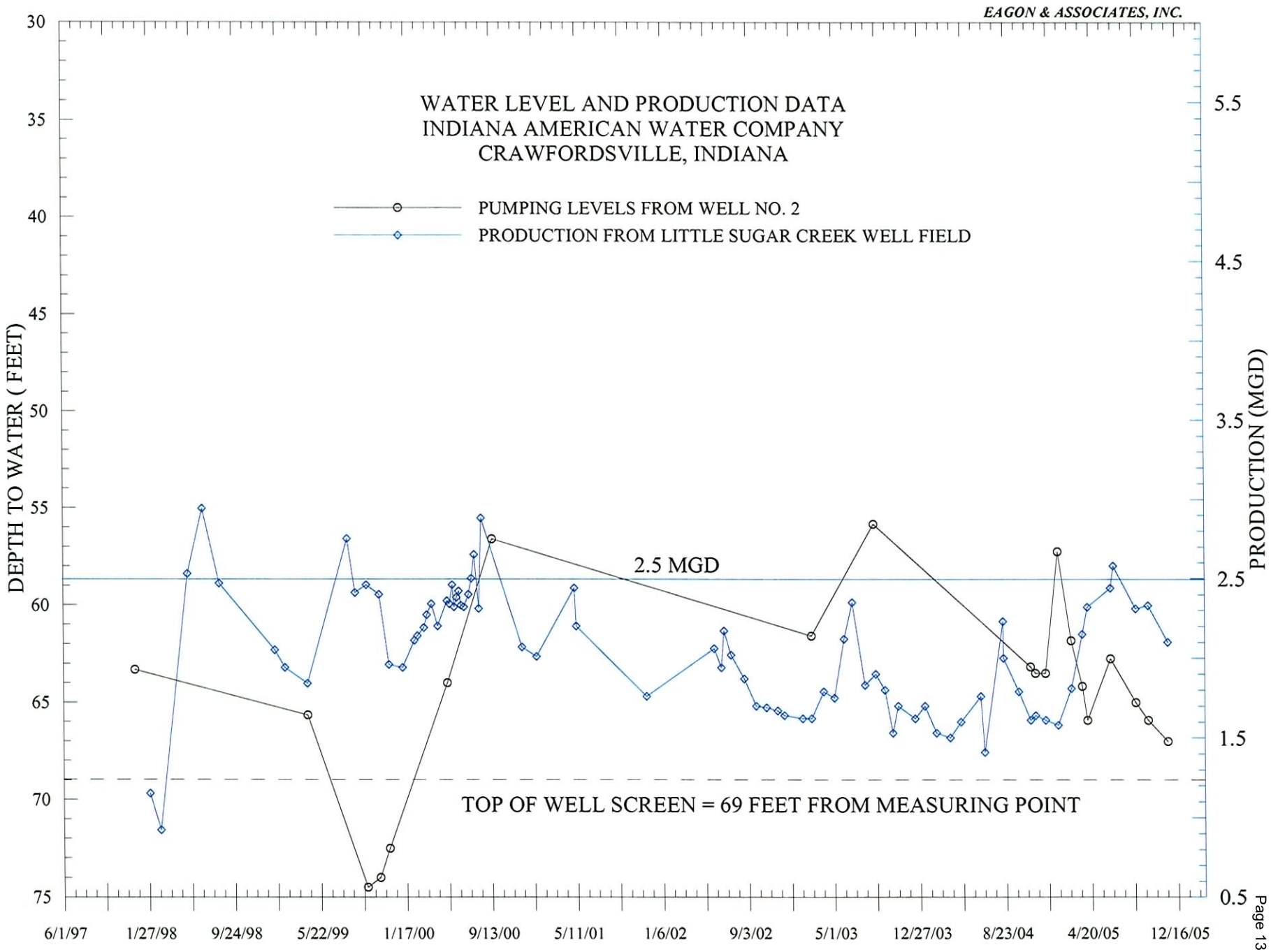
FIGURE 1.

CRAWFORD/WLMON/IMI&PROD&PRECIP.GRF
1/23/06



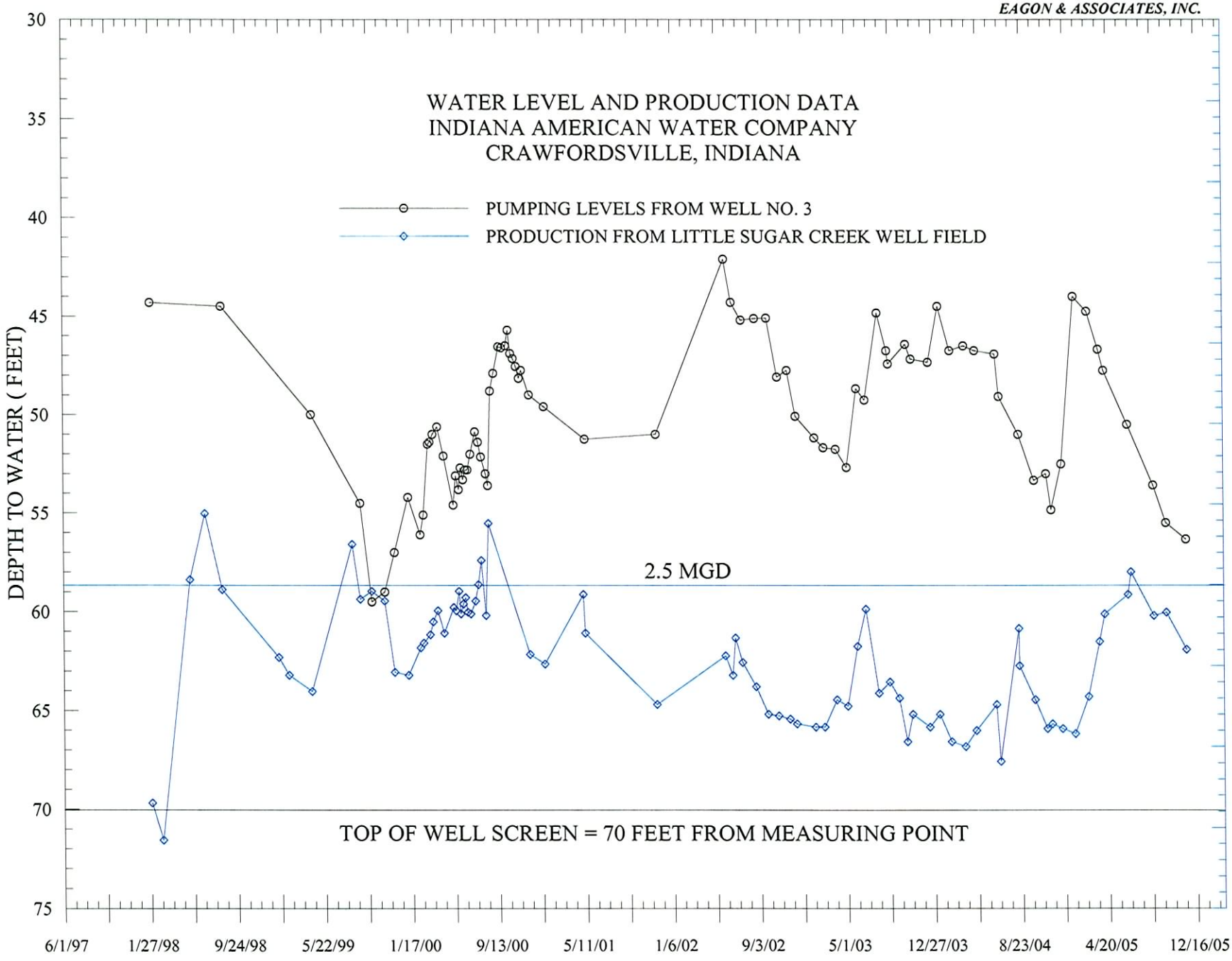
CRAWFORD/LSC1&PROD.GRF
1/25/06

FIGURE 2.



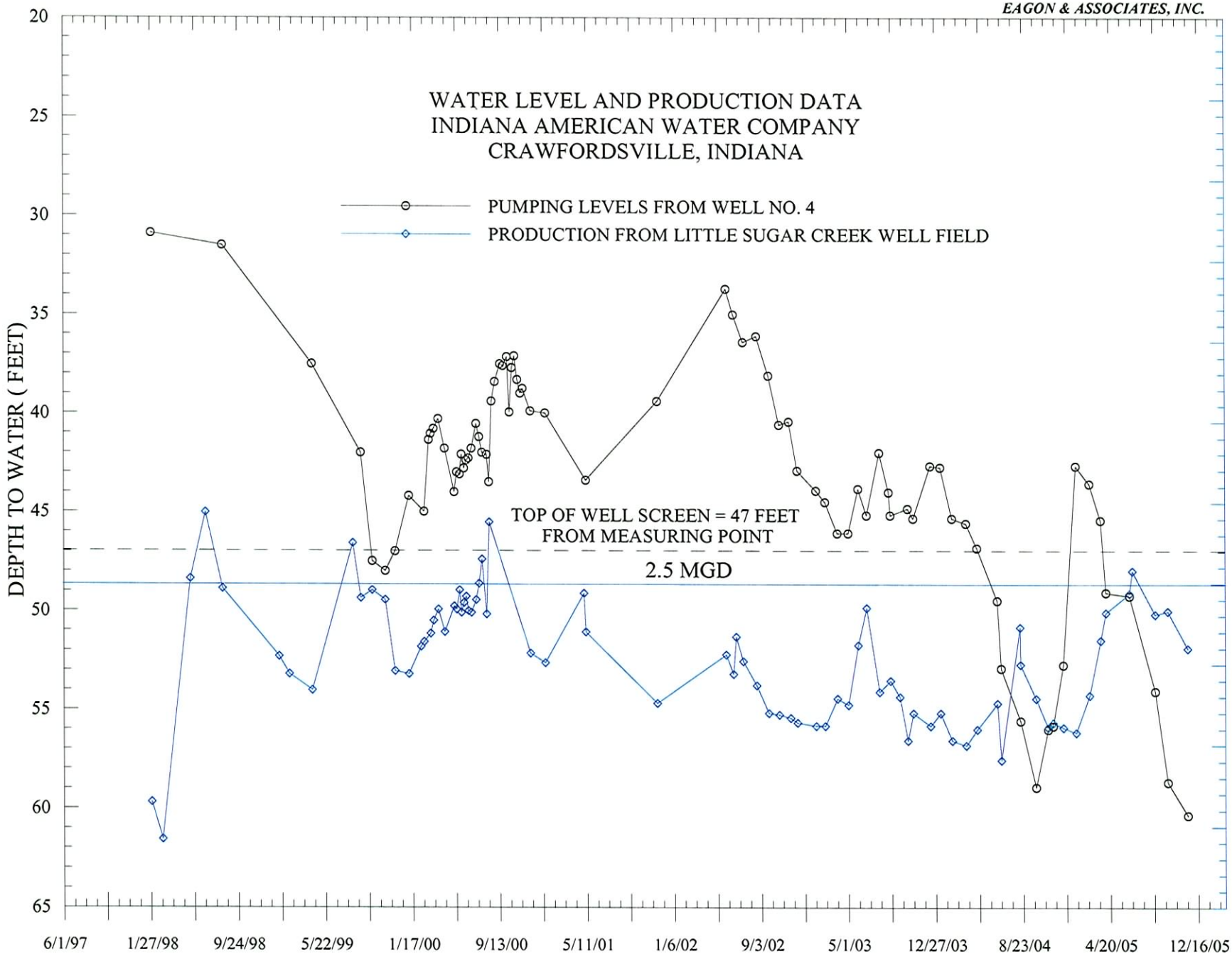
CRAWFORD/LSC2&PROD.GRF
1/25/06

FIGURE 3.



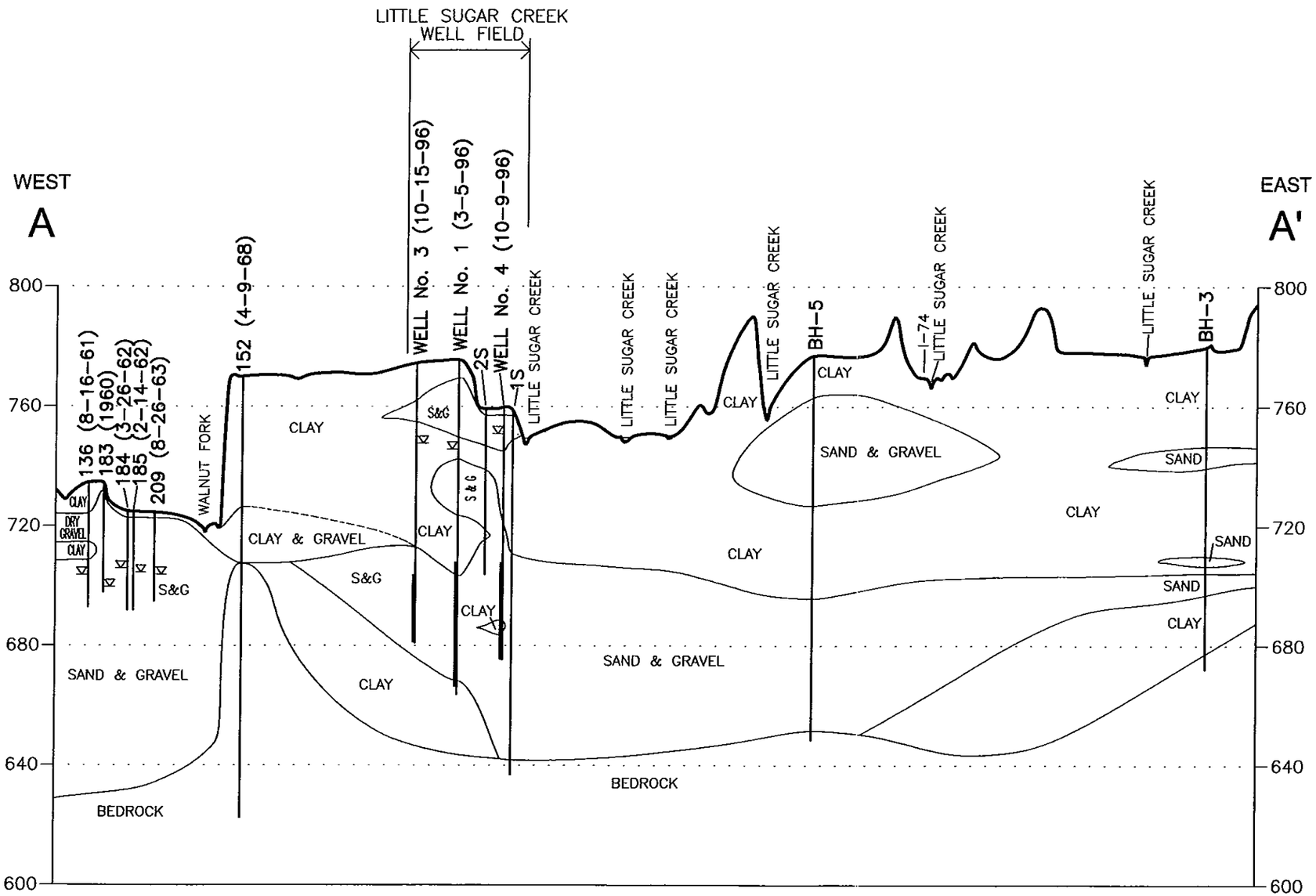
CRAWFORD/WLMON/LSC3&PROD.GRF
1/25/06

FIGURE 4.

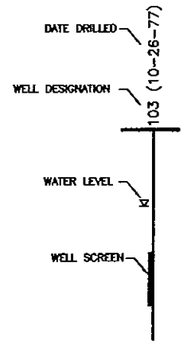


CRAWFORD/LSC4&PROD.GRF
1/25/06

FIGURE 5.



LEGEND



0 40 80
VERTICAL GRAPHIC SCALE IN FEET

0 2000 4000
HORIZONTAL GRAPHIC SCALE IN FEET

COMPILED BY: SJC	FIGURE TITLE: GEOLOGICAL CROSS SECTION A-A'
DRAWN BY: RMH	PROJECT TITLE: LITTLE SUGAR CREEK WELL FIELD - INAWC CRAWFORDSVILLE
CHECKED BY: SJC	PREPARED BY: *EAGON & ASSOCIATES, INC.* 100 OLD WILSON BRIDGE ROAD, SUITE 320 WORTHINGTON, OHIO 43085
APPROVED BY: HBE	FIGURE NUMBER: 6
DATE: JAN. 24, 2006	

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BEN HUR SPEEDWAY
HOG FARM
TODD WELL FIELD PROPERTY LINE
JACKMAN
AUTO SCRAP YARDS
PW-1
PW-2
A
A'
B
B'
CRAWFORDSVILLE
R I P L E Y

LEGEND
- RESIDENTIAL WELL
- BORING
- TEST WELL
- SUPPLY WELL

BASE MAP SOURCE: USGS 7-½ minute quadrangle topographic map: CRAWFORDSVILLE, IND. 1956 (Revised 1992)

0 2000 4000
GRAPHIC SCALE IN FEET

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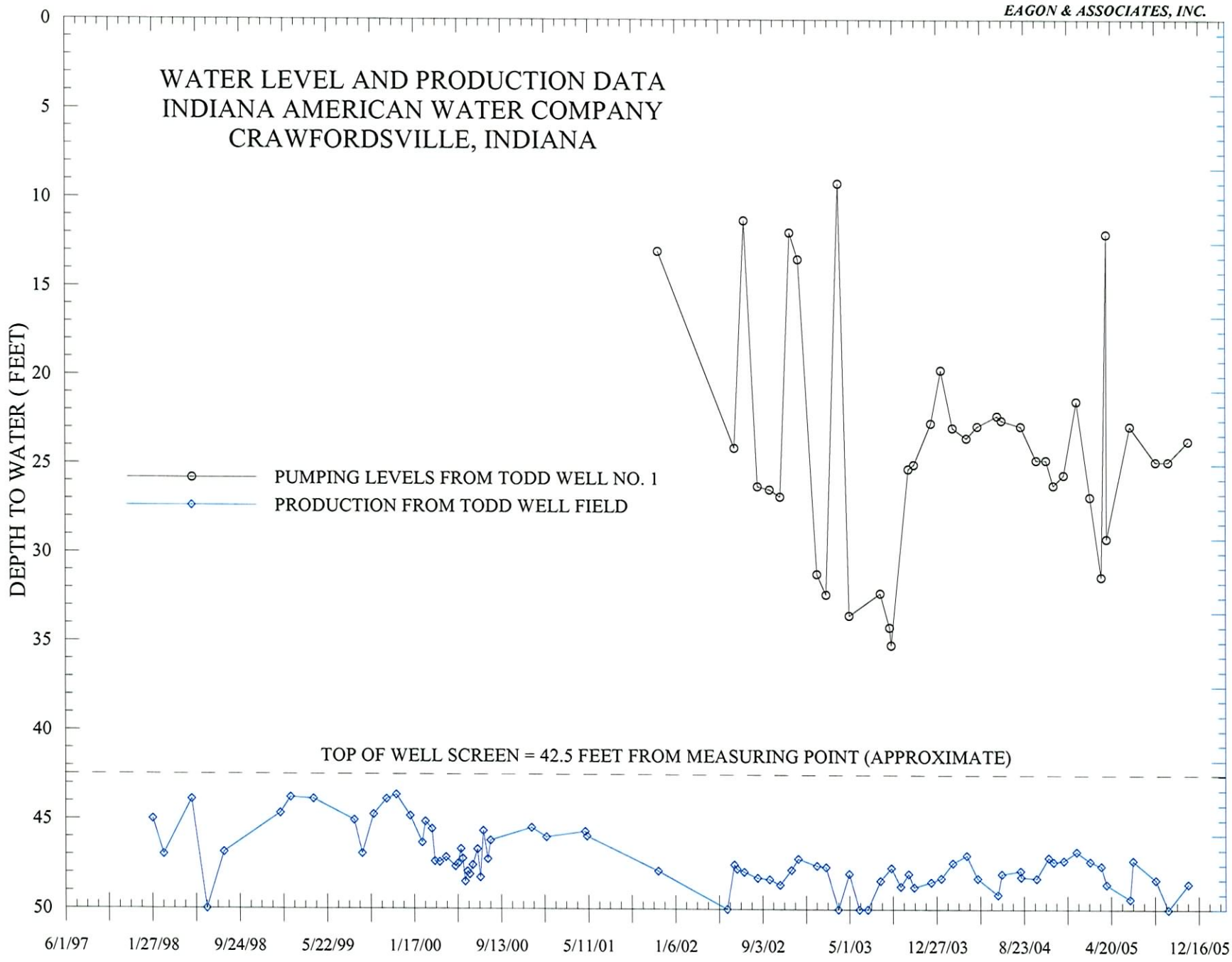
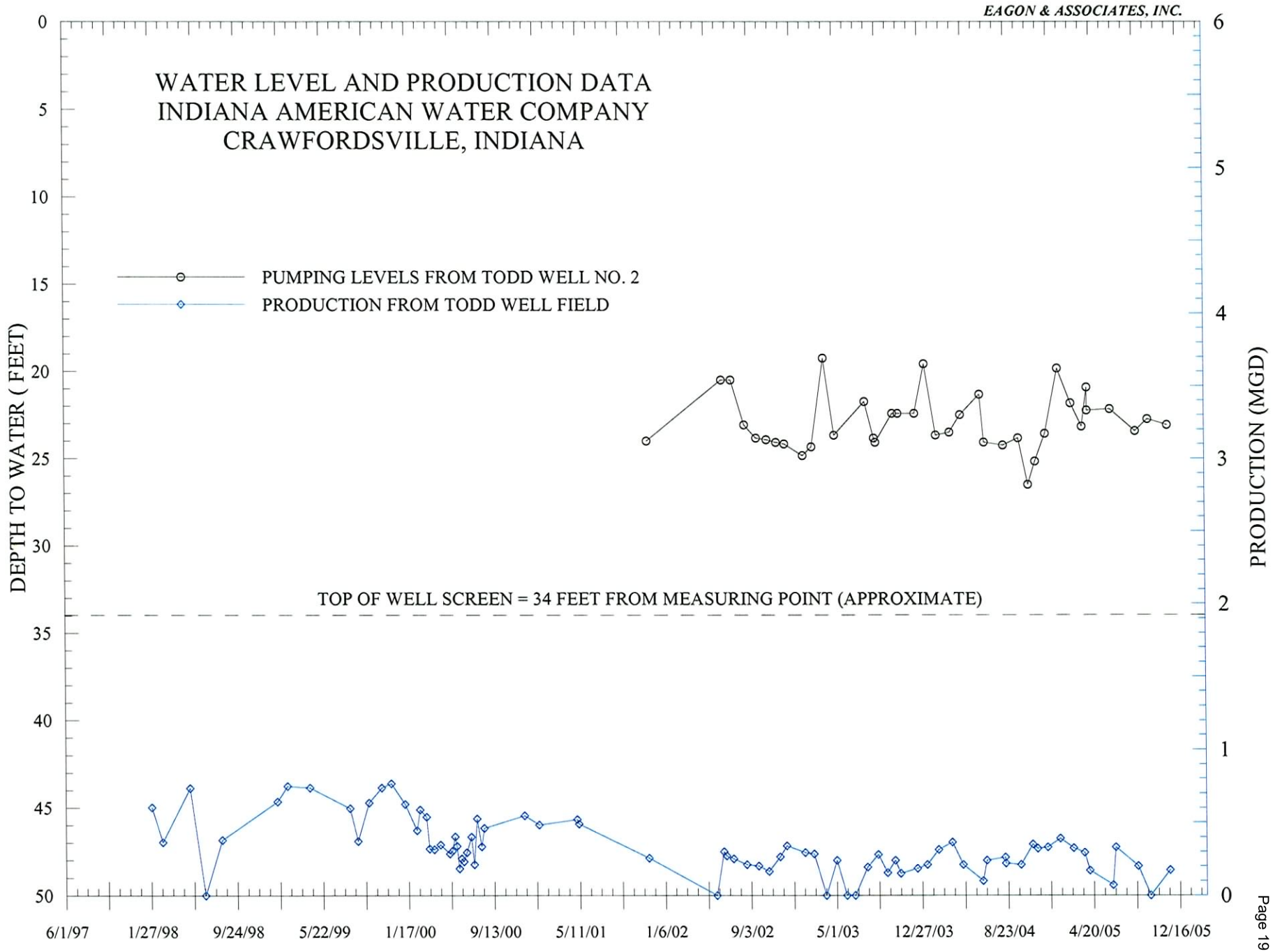
FIGURE 7. LOCATION MAP AND CROSS-SECTION TRACES



CRAWFORD/TODD1&PROD.GRF
1/25/06

FIGURE 8.



CRAWFORD/TODD2&PROD.GRF
1/25/06

FIGURE 9.

Record of Water Well

Indiana Department of Natural Resources

Reference Number	*Driving directions to well*	*Date completed*
97548	SR32 W., CROSS YOUNTSVILLE BRIDGE (SUGAR CREEK), N. TO JOG IN RD.	Aug 01, 1978

Owner-Contractor	*Name*	*Address*	*Telephone*
Owner	MAYOR & CHETOWER GRAVEL CO.	CRAWFORDSVILLE, IN	0 -
Driller	HOLT BROS.	DARLINGTON, IN	0 -
Operator	L.HOLT	License: null	0 -

Construction Details

Well	*Use:* INDUSTRIAL	*Drilling method:* Cable Tool	*Pump type:*
	Depth: 170.0	*Pump setting depth:*	*Water quality:*
Casing	*Length:* 130.0	*Material:*	*Diameter:* 12.0
Screen	*Length:* 40.0	*Material:*	*Diameter:* 12.0 *Slot size:* 16,16,8

Well Capacity Test

Type of test: *Test rate:* gpm for hrs. *BailTest rate:* 1275.0 gpm for hrs.
Drawdown: ft. *Static water level:* 65.0 ft. *Bailer Drawdown* 17.0 ft.

Grouting Information

Material: *Depth:* from to
Installation Method: *Number of bags used:*

Well Abandonment

Sealing material: *Depth:* from to
Installation Method: *Number of bags used:*

Administrative

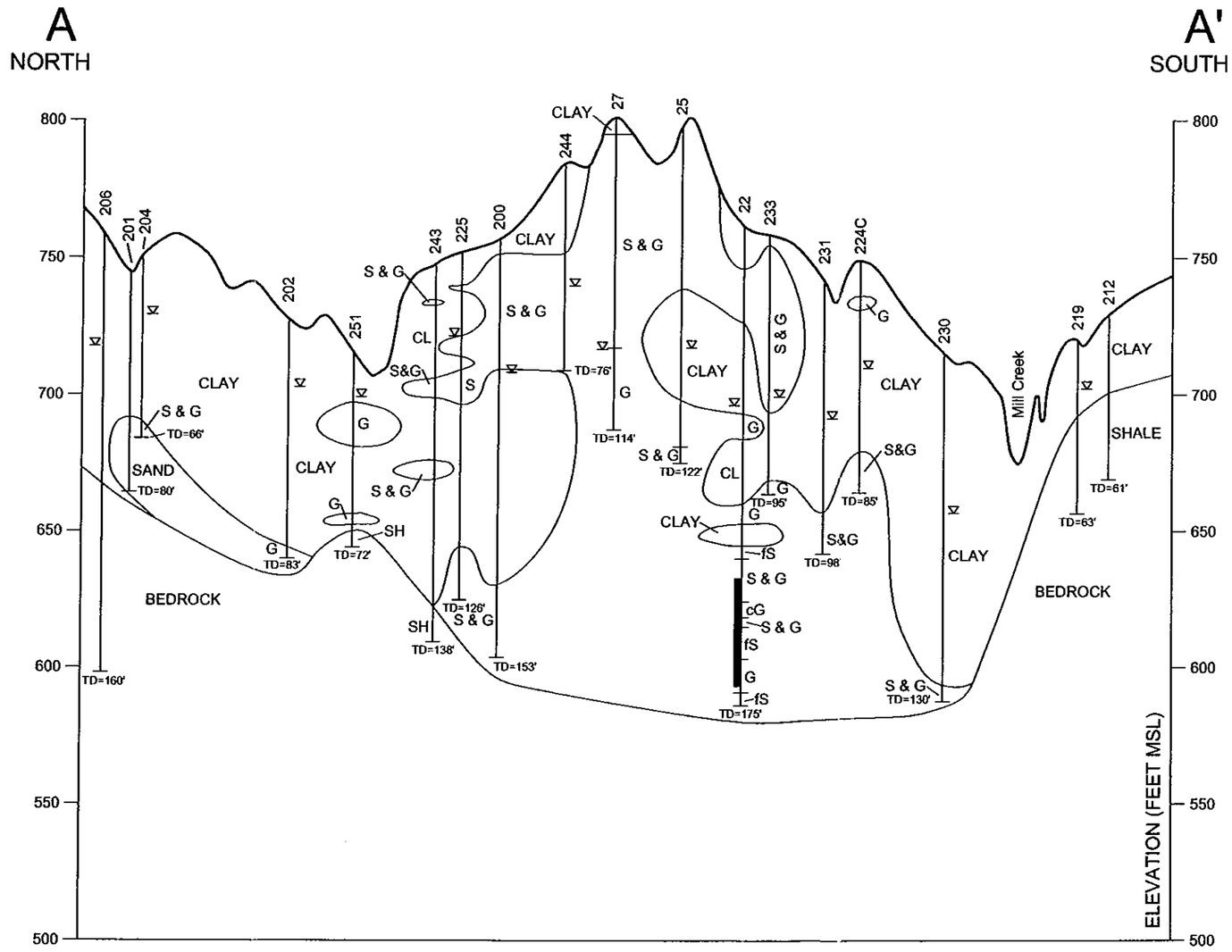
County: Montgomery *Township:* 19N *Range:* 5W
Section: SW1/4 of the SW1/4of the SW1/4 of Section 34 *Topo map:* Crawfordsville
Grant Number:
Field located by: A *on:* Aug 01, 1994
Courthouse location by: *on:*
Location accepted w/o verification by: *on:*
Subdivision name: *Lot number:*
Ft W of EL: *Ft N of SL:* 100.0 *Ft E of WL:* 250.0 *Ft S of NL:*
Ground elevation: 761.0 *Depth to bedrock:* *Bedrock elevation:* *Aquifer elevation:* 591.0
UTM Easting: 501835.0 *UTM Northing:* 4431935.0

Well Log

Top	Bottom	Formation
0.0	15.0	CLAY
15.0	35.0	DRY GRAV
35.0	68.0	CLAY
68.0	78.0	GRAV
78.0	103.0	CLAY
103.0	109.0	GRAV
109.0	118.0	CLAY
118.0	122.0	FN SAND
122.0	138.0	S&G
138.0	144.0	CRS SAND
144.0	147.0	S&G
147.0	159.0	FN SAND
159.0	171.0	MD GRAV
171.0	175.0	FN SAND

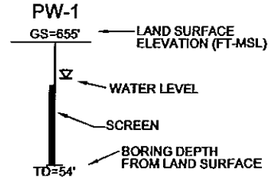
Comments MC 591. ADDITIONAL PUMP DATA AVAILABLE. STILL SAND AT 175'. VERIFIED BY NEIGHBOR. SEE MAP.

FIGURE 10. WELL LOG FOR MAP NO. 22



LEGEND

S&G - SAND & GRAVEL
G - GRAVEL
cG - COARSE GRAVEL
cS - COARSE SAND
fS - FINE SAND
SH - SHALE



0 2000 4000
HORIZONTAL GRAPHIC SCALE IN FEET

0 50 100
VERTICAL GRAPHIC SCALE IN FEET

VERTICAL EXAGGERATION = 40X

TODD WELL FIELD

FIGURE 11. CROSS-SECTION A-A'

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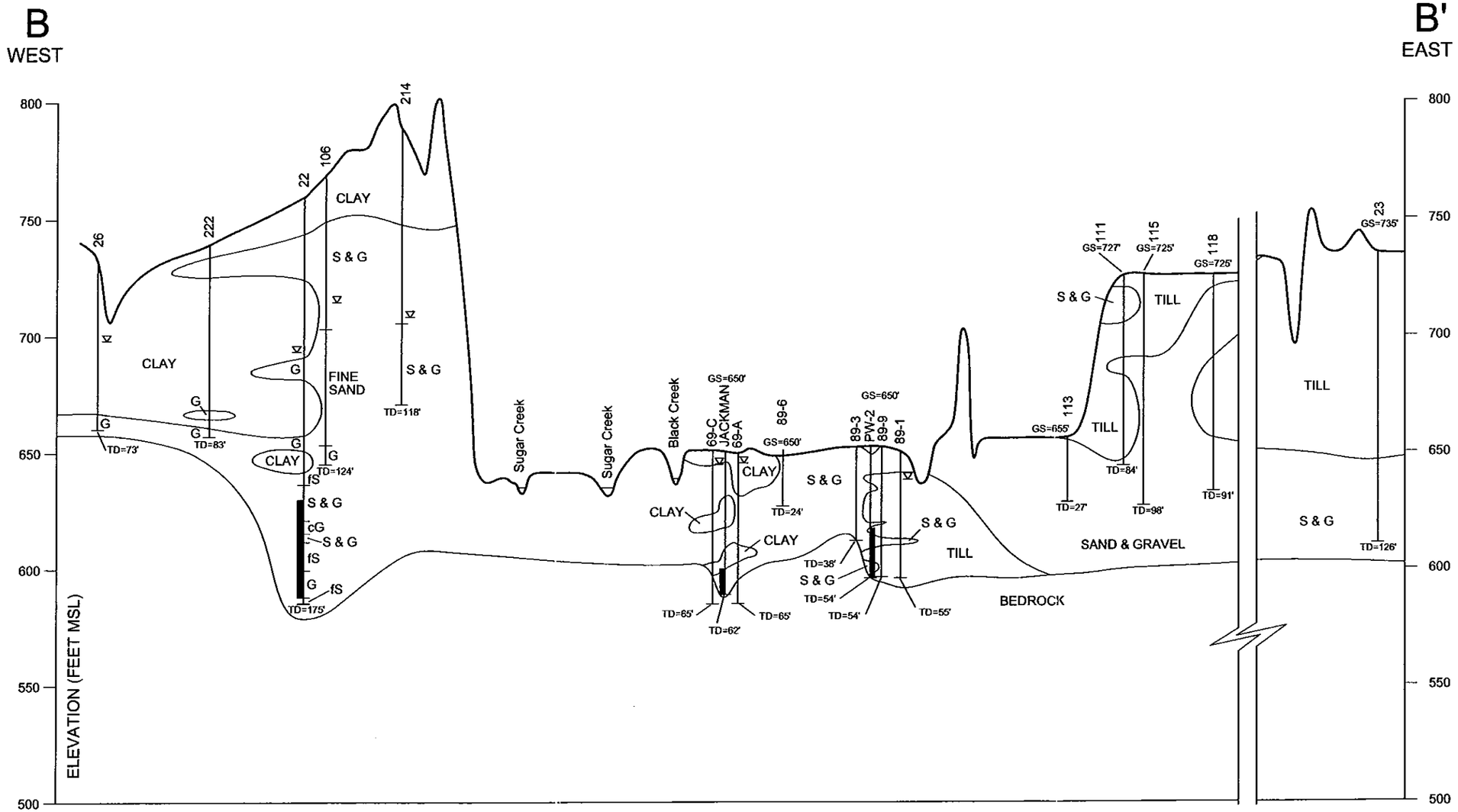

LEGEND

S&G - SAND & GRAVEL
G - GRAVEL
cG - COARSE GRAVEL
cS - COARSE SAND
fS - FINE SAND

PW-1
GS=655' — LAND SURFACE ELEVATION (FT-MSL)
WATER LEVEL
SCREEN
TD=54' — BORING DEPTH FROM LAND SURFACE

0 2000 4000
HORIZONTAL GRAPHIC SCALE IN FEET

0 50 100
VERTICAL GRAPHIC SCALE IN FEET

VERTICAL EXAGGERATION = 40X

TODD WELL FIELD

FIGURE 12. CROSS-SECTION B-B'

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CLOSED LANDFILL

POTENTIAL
WELL FIELD EXPANSION AREA

INDIANA–AMERICAN WATER Co.
LITTLE SUGAR CREEK WELL FIELD
54–04256–PS

TEST WELL 1
WELL 1
WELL 3
WELL 4
TEST WELL 3
WELL 2
PILOT WELL 3 (96–C)
MW3
BARN WELL
OW–1A
OW–2
OW–7
BH–1
BH–2
BH–3
BH–4
BH–5
BH–6

A
A'
B
B'
C
C'
D
D'

CRAWFORDSVILLE

LEGEND

- PRODUCTION WELL
- SAND & GRAVEL WELL
- BEDROCK WELL
- SAND & GRAVEL TEST WELL
- SAND & GRAVEL BORING

0 2000 4000
GRAPHIC SCALE IN FEET

INAWC CRAWFORDSVILLE, INDIANA
LITTLE SUGAR CREEK WELL FIELD

FIGURE 13.
WELL LOCATIONS
and CROSS–SECTION TRACES

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TABLE 1.
SPECIFIC CAPACITY DATA
LITTLE SUGAR CREEK WELL FIELD
CRAWFORDSVILLE, INDIANA

Date	Static Depth to Water (feet)	Pumping Rate (GPM)	Drawdown (feet)	Specific Capacity (GPM/ft.)
Well No. 1				
May 23, 1997	33.52	446	2.13	209.4
		627	3.06	204.9
		798	4.11	194.2
		1001	5.40	185.4
May 1997	33.05	1200	7.59	158.1
September 22, 2003	45.5	632	4.70	134.5
September 25, 2003	45.5	974	3.50	278.3
Well No. 2				
April 6, 1996	28.80	421	8.95	47.0
		636	13.34	47.7
		805	17.11	47.0
		1001	21.56	46.4
1996	28.80	1000	20.55	48.7
May 17, 2005	49.70	797	29.50	27.0
May 20, 2005	49.70	797	19.50	40.9
Well No. 3				
May 30, 1997	32.60	446	2.35	189.8
		609	3.33	182.9
		812	4.92	165.0
		1001	6.17	162.2
1997	38.15	1200	6.22	192.9
June 7, 2004	44.06	682	5.84	116.8
June 10, 2004	48.80	1000	3.00	333.3
Well No. 4				
May 19, 1997	10.85	408	2.51	162.5
		599	4.20	142.6
		805	6.29	128.0
		1001	8.47	118.2
1997	17.44	1200	10.41	115.3
May 22, 2002	23.8	726	22.9	31.7
May 28, 2002	24.8	759	7.2	105.4

ARCADIS Design & Consultancy for natural and built assets

Indiana-American Water Company

DRAFT

HYDRAULIC MODELING ANALYSIS

Crawfordsville Water Main Extension Project

04/02/2021

HYDRAULIC MODELING ANALYSIS

Crawfordsville Water Main Extension Project

Prepared for:

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Project Manager
Indiana-American Water Company, Inc.
153 N. Emerson Avenue Greenwood, IN 46143

Stephane Jousset, PE
Project Manager

Ben Chenevey, PE
Hydraulic Modeling Lead

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Our Ref:

30043285

Date:

04/02/2021

CONTENTS

TABLES

FIGURES

1 INTRODUCTION AND BACKGROUND

Indiana-American Water Company (INAW) owns and operates the Crawfordsville (CRW) Water Treatment Facility (WTF), which currently supplies drinking water to approximately 15,000 persons in Crawfordsville, Indiana located in Montgomery County. Montgomery County has requested a new water main be installed to supply water from the Crawfordsville WTF to the east, where future users are anticipated. INAW has begun design and permitting of a new 20" transmission main, which will be implemented in three phases as follows (also shown in Figure 1):

1. Phase I: From the WTF along SR 32 from Banjo Dr. to Nucor Rd (to be placed in service by end of 2020)
2. Phase II: Along Nucor Rd. from SR 32 to E 100 S
3. Phase III: Along Nucor Rd. from E 100 S to 500 S/Ladoga Rd (to be placed in service by November 2021)

Arcadis performed hydraulic modeling of the new 20" transmission main to determine the optimal pumping and/or storage modifications to address the increasing customer base using INAW's existing hydraulic model. The overall project goal was to determine the optimal system modifications to address this increased service area and customer base.

Figure 1. Proposed Installation of the New CRW Transmission Main (Phase 1 - green, Phase 2 - red, Phase 3 - orange)

1.1 Study & Report Approach

The hydraulic modeling analysis was performed in two phases. The initial phase included an investigation of existing conditions without any improvements, and analysis and screening of several improvement scenarios to support the new transmission main. These investigations utilized the existing hydraulic model and are detailed in Sections 2 and 3. After results from the first phase of the project, a second phase was initiated to further refine anticipated improvements. A standalone pump station scenario was selected, and feasibility was assessed along with identifying optimal pump stages and design points. This feasibility analysis is detailed in Section 4.

1.2 Levels of Service

Hydraulic evaluations of pipe networks focus on key parameters to determine if levels of service are being maintained; these include measurable parameters like pressure, fire flow, and velocity. Based on discussion with INAW and industry guidelines based on AWWA Manual of Practice No. 32, levels of service were established for this project. Table 1 lists these evaluation parameters and their associated requirements; each of these criteria were then compared with model simulations to help evaluate the existing system and potential improvement scenarios.

Table 1. Crawfordsville Levels of Service

Parameter	Level of Service
Max Pipe Velocity	< 4-6 ft/s
Max Headloss Gradient	< 2-3 ft/1000ft
Min Pressure	> 60 psi average day
	> 50 psi during peak
	> 20 psi during fire flow
Max WTF Discharge Pressure	< 110 psi
Max Water Age	Minimized

1.3 Modeling Assumptions

There is some uncertainty in the expected water usage (i.e., number and timing of customers) along the future transmission main. Initially, demands will be low and will mainly be from the existing truck stop near I-74 and some potential residential water users in the area. Ultimate buildout of the transmission main may include large industrial users at the end of the system, but the timing and water usage are currently

unknown. Based on discussions with INAW, possible ranges were estimated, and values were selected to use for modeling (Table 2).

Table 2. Uncertainties and Variables in CRW Transmission Main Modeling

Component	Potential Range of Conditions	Selected Basis for Modeling
Ultimate Max Day Demands (industry)	1 - 2 MGD	Based on 1 MGD for model runs and sizing*
Expected Max Day Diurnal (industry)	12- or 24-hour operation	Based on 24-hour for model runs and sizing*
Available Fire Flow	1,500 – 3,500 gpm	Based on 3500 gpm in model*
Low Flow Demands	Truck Stop Only or County Phased Buildout	Based on county phased buildout as low truck stop demand would be hard to compare in model results
County Phased Buildout Demands	Timing & extent of future water users along transmission main (not including ultimate industrial user)	Demands estimated using county phase information (see Table 3)

* System capacity curves show results for additional demand configurations

While ultimate buildout demands were estimated based on potential future industrial expansion during Phase 3, there are also benefits to utilizing expected average or low demands for understanding water age. Therefore, zoning plans proposed by Montgomery County were used to estimate potential future water usage for Phases 1 and 2 as well. Based on these projected zoning areas' land use and acreage, the potential number of customers was estimated and projected into future average water use using historic per capita water usage for Crawfordsville (Table 3).

Table 3. Crawfordsville Future Development Demand Estimates

Zone	Area (Acres)	Proposed Land Use	Final # of Units or Cust.	Assumptions	Total Average Demand (gpm)
A	1083	Industrial/Commercial	-	Ignored for average demands	0.00
C	72	Mixed	72	Residential land use 50%	6.33
			12	Commercial land use 50%	5.97
D	60	Retail/Office	20	1 retail per 3 acres	9.95
E	26	Retail/Office	9	1 retail per 3 acres	4.31
F	45	Residential/Flex	68	2 houses per acre (3/4 usable space)	5.94
G	389	Industrial/Commercial	-	Zone not planned anymore	0.00
H	86	Retail/Office	-	Zone not planned anymore	0.00
I	235	Residential	353	2 houses per acre (3/4 usable space)	31.00
B	635	Residential	953	2 houses per acre (3/4 usable space)	83.77
Total Residential demands (Phase 1 & 2)					**127**
Total Retail/Office/Commercial demands (Phase 1 & 2)					**20**

Exact development locations are also not known at this time, while the transmission main route is fairly understood to follow Nucor Rd during Phases 2 and 3. Therefore, modeled pressures are based on the ground elevations for the transmission main. It's assumed that high elevation points along the transmission main are also representative of high elevations at the end customers. Actual future customer service pressures may vary depending on corresponding connection elevations. Appendix A shows elevation contours of the surrounding area that can be used to understand potential end customer pressures based on their specific locations.

2 EXISTING CONDITIONS

Existing conditions were evaluated using the hydraulic model by adding the future transmission main piping (by phase, see Figure 2), while keeping all existing operational controls and demands. This allowed for static condition and system capacity evaluations, as well as the creation of baseline conditions to compare against potential improvement scenarios.

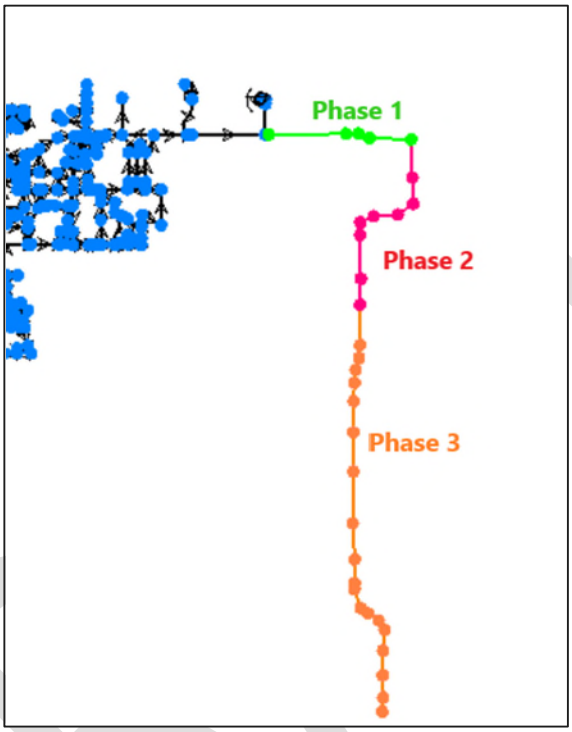

Figure 2. Model Representation of Future Transmission Main

2.1 Normal Operations

The hydraulic model was run for each phase to retrieve static pressure ranges throughout the maximum day scenario (without any additional water usage along the transmission main) as shown in Table 4. Phase 2 and 3 include significantly higher elevations than Phase 1, which results in lower pressures. Note that pressure included here and throughout the report are provided along the transmission main where elevations are based on the proposed route which follows the established roadway elevation; actual future customer service pressures may vary depending on corresponding connection elevations. Appendix A shows elevation contours of the surrounding area that can be used to understand potential end customer pressures based on their specific locations.

Table 4. Max Day Model Results for Existing Conditions

Location	Elevation (ft)	Pressure (psi)
Phase 1	791 – 815	30 - 55
Phase 2	772 – 835	22 - 74
Phase 3	812 – 869	7 - 57

Further investigation revealed that the model's WTF pumps are controlled based on Franklin Tank. During Max Day Demand operations, HSP #3 is operated as a VFD with typical speed at 81% when flowing (other pumps and/or speed are utilized as lag operations). While normally the pumps' VFD speed is adjusted depending on tank levels, the pumps sometimes completely shut off at max tank levels. This results in the low pressures show in Table 4 since discharge pressures from the plant, which are typically at approx. 71 psi, drop to approx. 45 psi. Figure 3 shows additional flow and pressure data from the model, while Section 2.2 provides additional details on how WTF controls could be revised to reduce the low-pressure time periods.

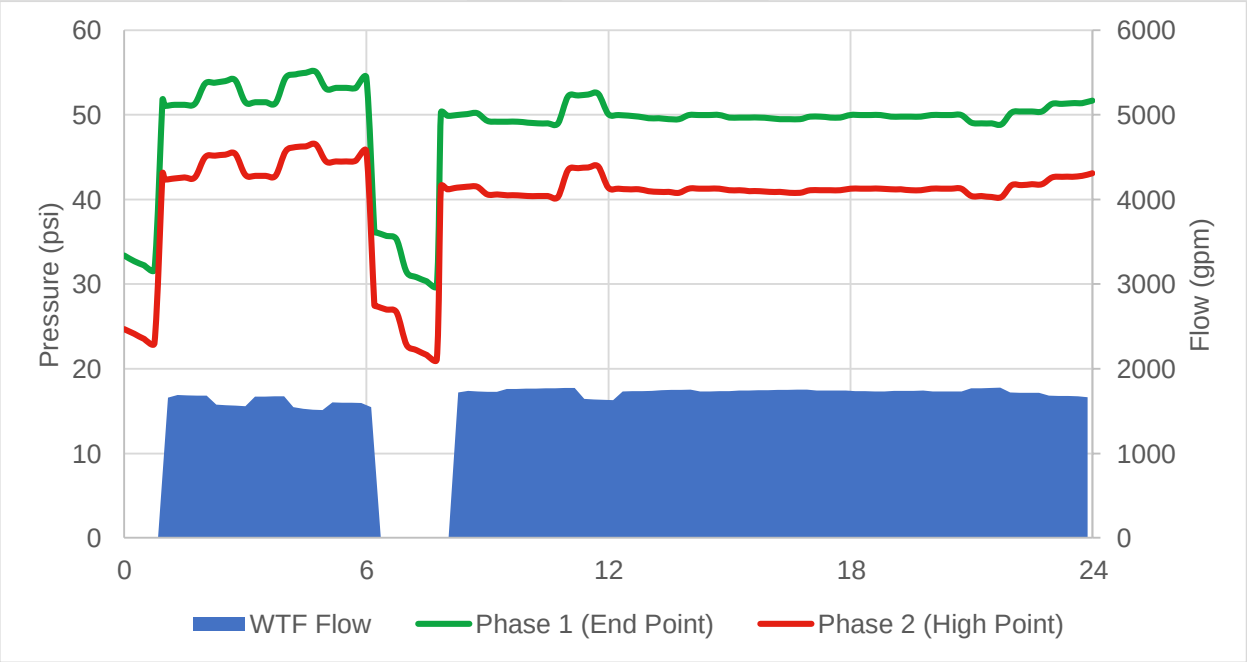

Figure 3. Existing Conditions Max Day Model Results

2.2 Revised Operations

Controls were modified at the treatment facility pumps to prevent the low pressures along the transmission main that occur when pumps turn off (Figure 3). In the existing model, the pump turns off

when Franklin Tank reaches a high level (28 feet) to allow the tank to drain and cycle. A number of test simulations were performed with different sets of controls including:

- Ramp the pump P3 speed down (to 0.7) instead of a full shutoff at high tank levels
- Turn on the smaller P2 pump at a reduced speed (0.9) when pump P3 turns off at high tank levels.
- Use VFD control setpoints on P2 pointed along the transmission main to force pressure during peak time periods

The hydraulic model was run under these different operational controls for existing conditions along Phases 1 and 2 to retrieve static pressure ranges throughout the maximum day scenario (without any additional water usage along the transmission main). Generally, all three conditions behaved similarly: the tank is allowed to drain and cycle, but pressures still drop along the transmission main. While the two can be balanced, there is not a perfect option that allows both constraints to be satisfied. For example, Figure 4 shows results for flows and pressure with P3 speed adjustments and can be compared to the original results found in Figure 3. The model shows that these adjustments results in about 10 psi increase in the minimum pressure for Phase 1 and Phase 2. However, both of these pressures still drop below the 50 psi level of service. Other operational conditions resulted in similar results with the best low pressure for Phase 1 being approx. 45 psi and Phase 2 being approx. 35 psi (resulting operational controls can be found in Table 5).

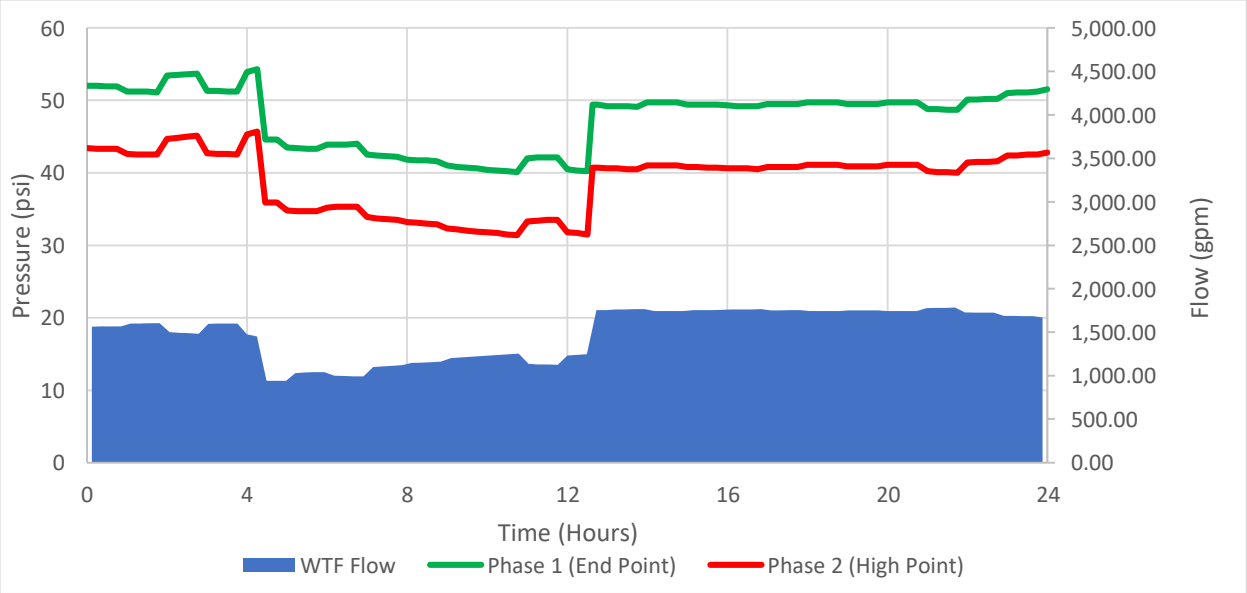

Figure 4. Existing Conditions Model Results with Revised Operation

Table 5. Original and Revised Operating Controls for Existing Conditions

Original Operating Controls for WTF Pump
IF Franklin Tank Level < 20.00 ft THEN WTF P3 Pump Setting = .81
IF Franklin Tank Level >= 28.00 ft THEN WTF P3 Pump Status = OFF
Revised Operating Controls for WTF Pump
IF Franklin Tank Level < 20.00 ft THEN WTF P3 Pump Setting = 0.81
IF Franklin Tank Level >=28.00 ft THEN WTF P3 Pump Setting = 0.70

Conversely, average day results show Phase 1 pressures at approx. 55 psi and Phase 2 being approx. 45 psi. This indicates that Phase 1 pressure drops may be more likely during max day demands than on average. This points to the probability that Phase 1 conditions are acceptable and Phase 2 conditions are dependent on customer locations and the need to maintain 50 psi at the high elevation locations if there is no demand in that area. Note that pressure included here and throughout the report are provided along the transmission main where elevations are based on the proposed route which follows the established roadway elevation; actual future customer service pressures may vary depending on corresponding connection elevations.

2.3 Fire Operations

Because of this study's emphasis on the ability to support anticipated fire demands, additional firefighting related analysis was performed. Based on discussions with INAW, in the event of a fire, the treatment plant would be able to turn on all pumps to support residual pressures if needed. Therefore, all pumps were utilized to perform fire analysis along the future transmission main.

In the event of a fire along the transmission main, pressures at the treatment plant were analyzed under normal operating conditions to determine if the event would be detectable at the plant. Table 6 shows discharge pressures at a variety of fire flow rates. At a lower fire flow rate that is more commonly required for residential firefighting, the plant discharge pressure still drops by approx. 10 psi and should be detectable by system operators. Therefore, operators or manual SCADA triggers would be able to turn on additional pumps at the plant to raise discharge and residual pressures during the event. Since the plant is not manned 24/7, programming into the SCADA system may be required so that once a pressure drop is detected, the treatment plant would be able to respond to this type of fire event; this may increase the operational complexity at the plant and result in additional challenges.

Table 6. WTF Discharge Pressure at Start of Fire Event Under Normal Operating Conditions

Fire Flow (gpm)	WTF Discharge Pressure (psi)
0	67.5
1500	54.8
3500	34.5

Plant discharge pressures were also analyzed during fire flow events to ensure pressures did not exceed the level of service when all pumps were in operation. For all existing system conditions, discharge pressures ranged from about 69 psi to 90 psi depending on the size and location of the fire demand.

This initial investigation was primarily focused on the ability to detect a pressure drop at the WTP, and therefore be able to respond if needed. The response requirement depends on the flow rate necessary to fight the fire along the transmission main. If only 1,500 gpm is necessary, a single pump may only be necessary while a large 3,500 gpm flow may require two to three pumps at the plant being active. While the impact on the rest of the Crawfordsville system was not fully investigated, if the flows are balanced between required flow and pumped flow then the system seems to behave well. If too much or to little is pump from the plant during a fire event, then it may have negative impacts on the distribution system (e.g. tanks overfilling or draining out). This points to the importance of proper programing and anticipating the likely fire demands based on the pressure drop magnitude observed at the plant.

2.4 System Capacity

To better understand when improvements may be necessary, the water system capacity was evaluated for all three phases. This information assesses how much normal (base) flow and fire flow can be supplied along the transmission main while maintaining desired pressures. Note that these results are only for the system capacity and do not consider system supply or storage volumes; a discussion of supply availability can be found in Section 3.

Figure 5 shows system capacity results at the end of the Phase 1 pipe under max day conditions; the specific location can be seen in Appendix A. The blue shaded area indicates normal operating flow ranges, which should be coupled with the normal operating curves for three different VFD pump speed factors; these indicate a range of pressures that could be seen under a given base demand based on typical pump operations. The typical pump operations represent having a single pump (HPS 3) in operation and does not consider the diurnal operation and pump shutoff that produces lower pressures as discussed in Section 2.1 and 2.2. The yellow shaded area highlights expected firefighting conditions and are valid for the red fire operations curve; here, all treatment plant pumps are on, such that pressures and available flow are higher. At any given base or base plus fire flow rate, expected pressures can be determined based on the curves and compared against levels of service. Note that these pressures may represent maximum capacity conditions; if no pumps are online during normal operations or if less pumps are in operation during a fire event, then pressures along the pipeline may be lower.

For Phase 1 piping, the desired 50 psi static pressure during normal operations can be maintained while supplying up to approx. 1,200 gpm of additional demand along the transmission main; conversely, base plus fire flow can reach up to 6,000 gpm while maintaining 20 psi residual or greater in the transmission main. Based on these model results and anticipated demand and usage during Phase 1, it is likely that existing system capacity and infrastructure can support these conditions.

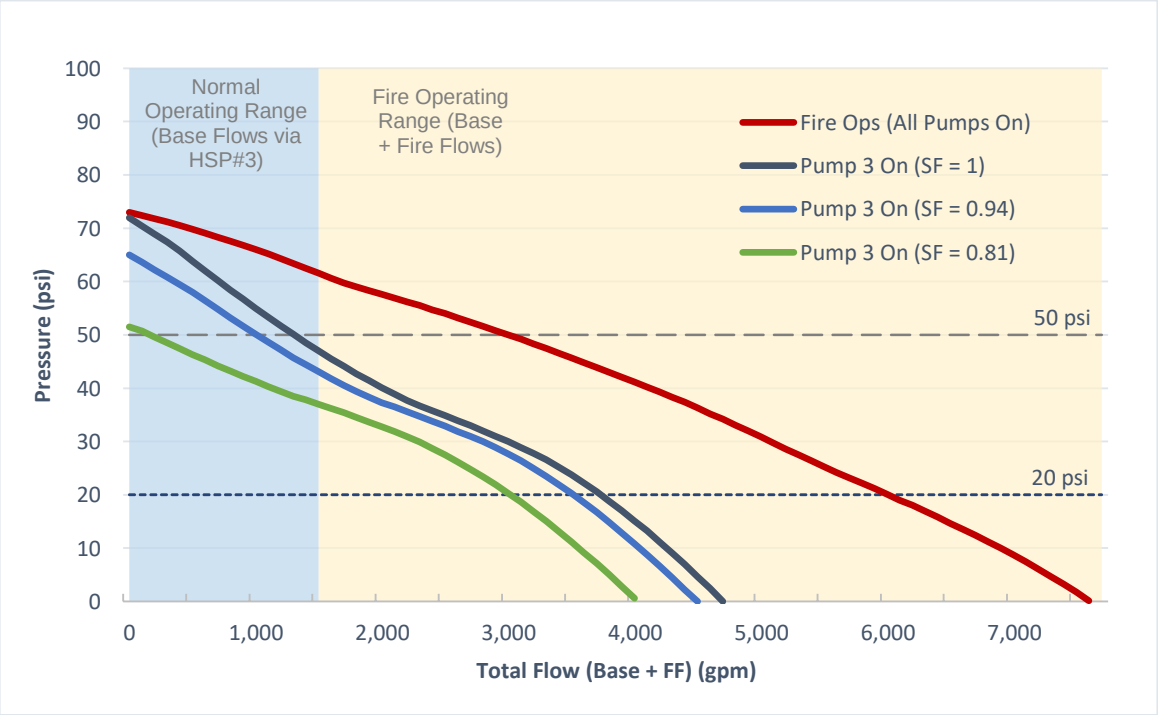

Figure 5. System Capacity Results for Existing Conditions + Phase 1

Figure 6 shows system capacity results at the high point on Phase 2 pipe (near the midpoint); the specific high point location can be seen in Appendix A. Capacity under normal and fire flow conditions have dropped because of the higher elevations and further distance from the WTF. For normal operating conditions, base flows up to approx. 700 gpm can be supported; note that this doesn't consider timeframes during which the plant pumps are turned off or reduced to cycle Franklin Tank (Section 2.1 and 2.2). Conversely, base plus fire flow can reach up to approx. 4,500 gpm while maintaining 20 psi residual in the transmission main. Based on these model results, water usage during Phase 2 may be partially supported depending on specific water demands and required fire flows in the area. While capacity and pressures can be met while pumps at the plant are in operation, static conditions when the pump is reduced or off during diurnal operation will not satisfy levels of service based on findings in Section 2.2.

Figure 7 shows system capacity results for the endpoint of the Phase 3 pipe; the specific location can be seen in Appendix A. Capacity under normal and fire flow conditions have dropped even further because of the higher elevations and further distance from the WTF. For normal operating conditions, static pressures are close to 50 psi without any additional demands along the transmission main, which indicates little to no additional demands could be supported while meeting the desired level of service.

Meanwhile, base plus fire flow could only reach up to approx. 2,200 gpm (less than the 3,500 gpm maximum industrial fire flow level of service) while maintaining 20 psi residual or greater in the transmission main . Based on these results, it is unlikely that the Phase 3 pipe or anticipated demands could be supported without infrastructure improvements to increase system capacity.

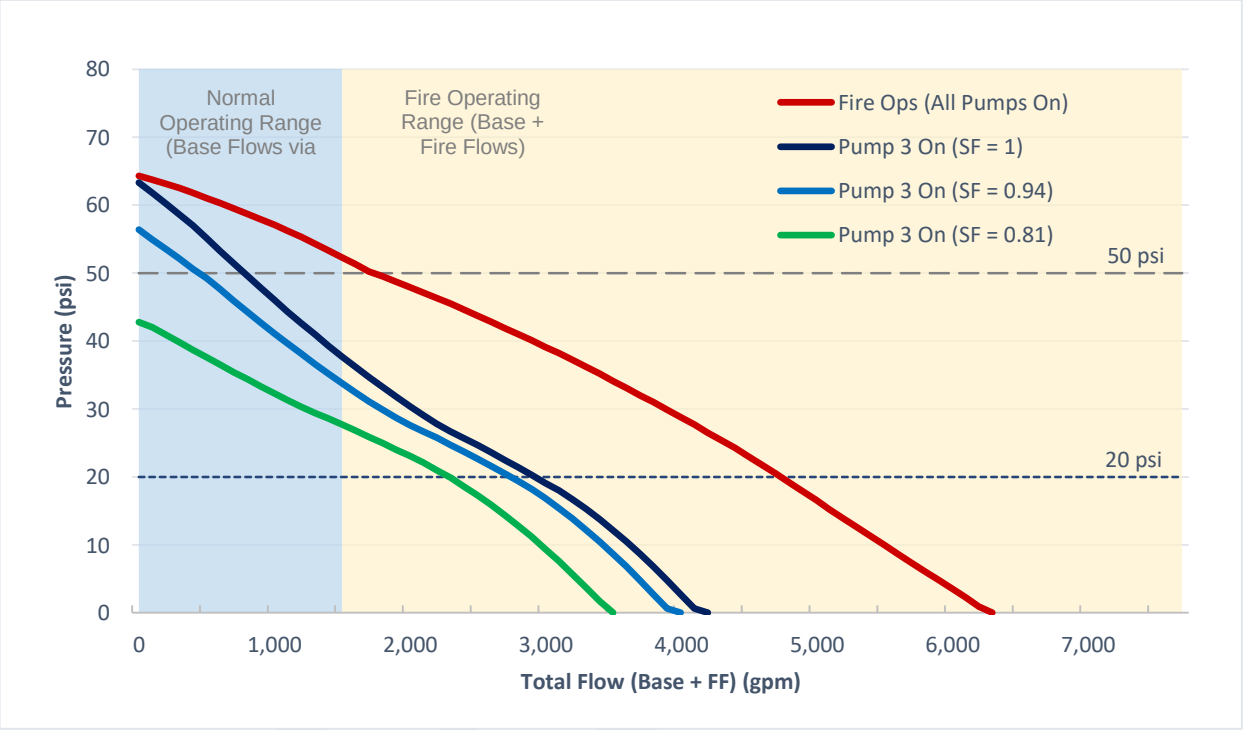

Figure 6. System Capacity Results for Existing Conditions + Phase 2

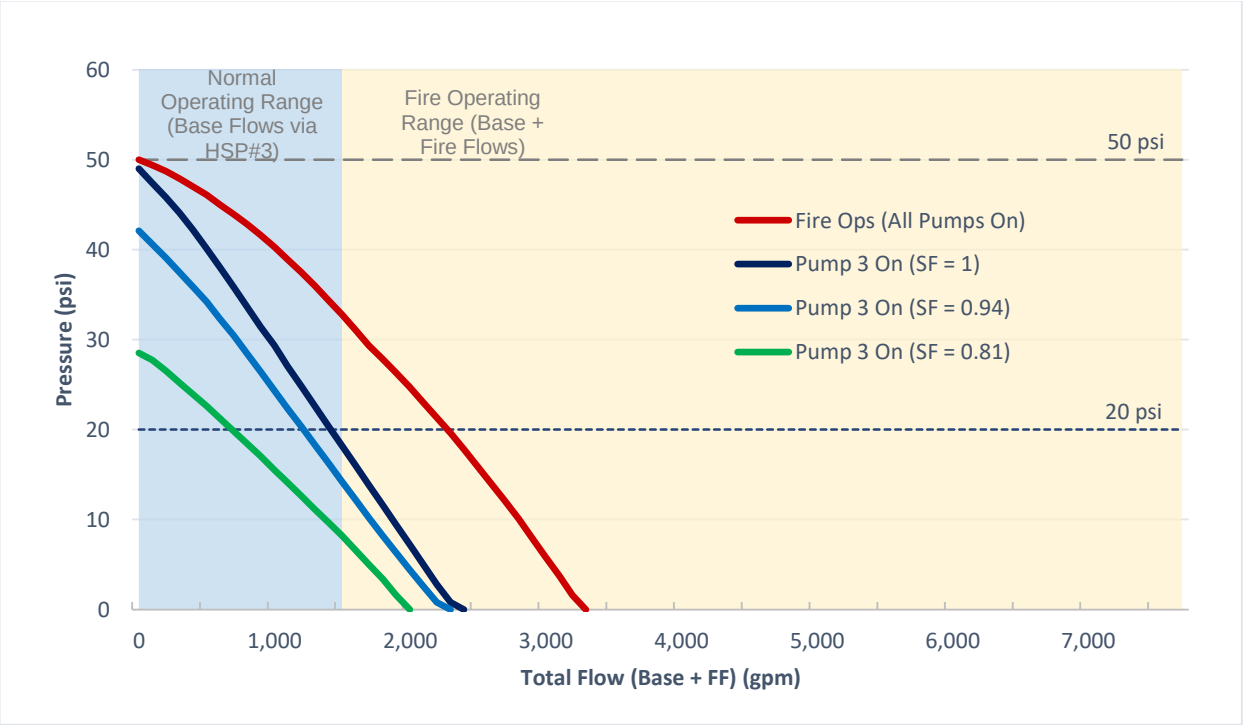

Figure 7. System Capacity Results for Existing Conditions + Phase 3

3 IMPROVEMENT SCENARIO SCREENING

Three improvement scenarios were selected and analyzed using the hydraulic model to determine their effectiveness in increasing system capacity along the entire proposed transmission main (i.e., Phases 1 – 3) and to satisfy all level of service considerations. To help guide when improvements would be necessary, improvements were run for both ultimate buildout (Phase 3) and partial buildout (Phase 2) transmission main piping and anticipated demands.

3.1 Scenario 1 – Inline Booster Station & Elevated Tank

To support firefighting along the transmission main, Scenario 1 includes adding a new inline booster pump station near the WTF (along Phase 1 pipeline), which provides flow into a new elevated tank; the booster pump station is anticipated to be a duplex installation with one duty pump and one redundant pump. The elevated tank is utilized for equalization and for firefighting supply and is located for this analysis at the high point within the Phase 2 pipe.

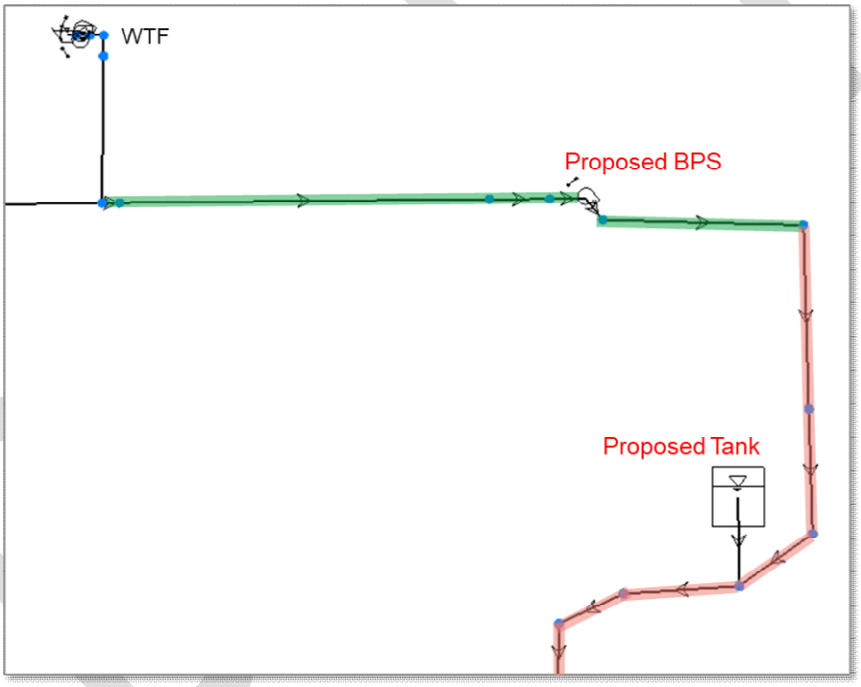

Figure 8. Model Representation of Scenario 1 Layout

3.1.1 Phase 3 – Ultimate Buildout Results

Scenario 1 was evaluated assuming Phase 3 transmission piping is complete, and the expected demands are in place as per Table 2. Iterations were performed to determine the ideal pump and tank characteristics that would satisfy all required levels of service; these characteristics are presented in Table 7.

Table 7. Scenario 1 Proposed Pump & Tank

Proposed Booster Pump Characteristics	
Flow (gpm)	1000
Head (ft)	100

Proposed Elevated Tank Characteristics	
Riser Height (ft)	150
Total Height (ft)	180
Volume (gallon)	500,000

With the pump and tank detailed above, the model output meets all levels of service as shown in Table 8. However, because of the tank location and large fire flow requirements, the tank height must be substantially tall to satisfy the residual pressures at the end of the Phase 3 pipe. Note the ground elevation at the selected tank site is 835 feet and represents the high point of the phase 2 transmission main; I lower riser site may be utilized if a site with higher ground elevation is available farther away from the transmission main.

Table 8. Scenario 1 Model Results Summary

Parameter	Level of Service	Model Result
Max Pipe Velocity	< 4-6 ft/s	0.7
Max Headloss Gradient	< 2-3 ft/1000ft	0.11
Min Pressure	> 50 psi during peak	59
	> 20 psi during fire flow	21
Max Discharge Pressure	< 110 psi	90
Max Water Age	Minimized	1 day (peak of over 3 days during tank drain)

In the model, the proposed pump was operated based on level controls to allow cycling of the proposed elevated tank. Figure 9 shows pump flow and tank levels throughout the max day. Controls were set to ensure cycling occurred throughout the day, the pump was not kicking on/off quickly or frequently, and levels in the tank never dropped below required equalization volumes.

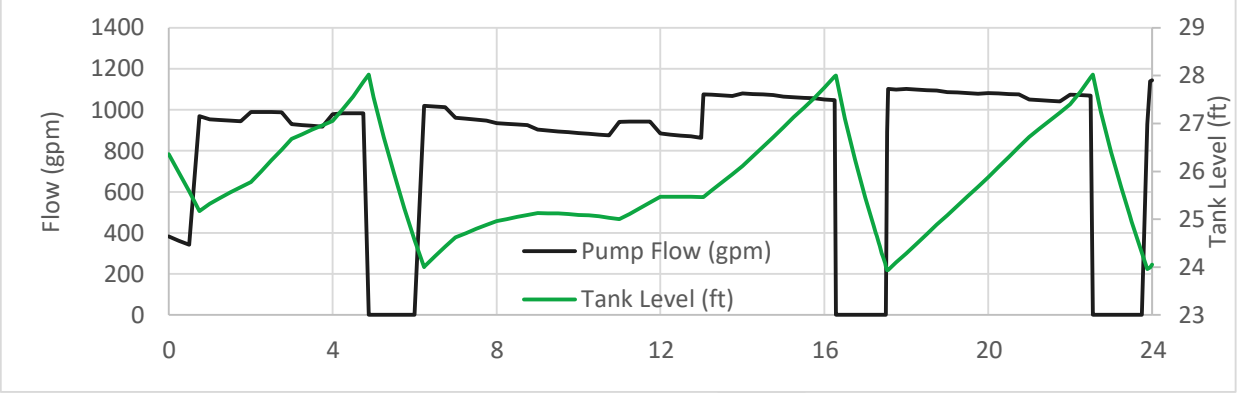

Figure 9. Proposed Tank and Booster Pump – Model Max Day Level and Flow

Finally, system capacity was evaluated at the end of the Phase 3 pipe. Figure 10 shows the system capacity and can be compared with Figure 7 for the existing conditions. For Scenario 1, normal and firefighting condition curves are the same since they are both driven jointly by the booster pump and elevated tank. Compared with existing conditions, both normal operating pressures and fire operating pressures have improved significantly.

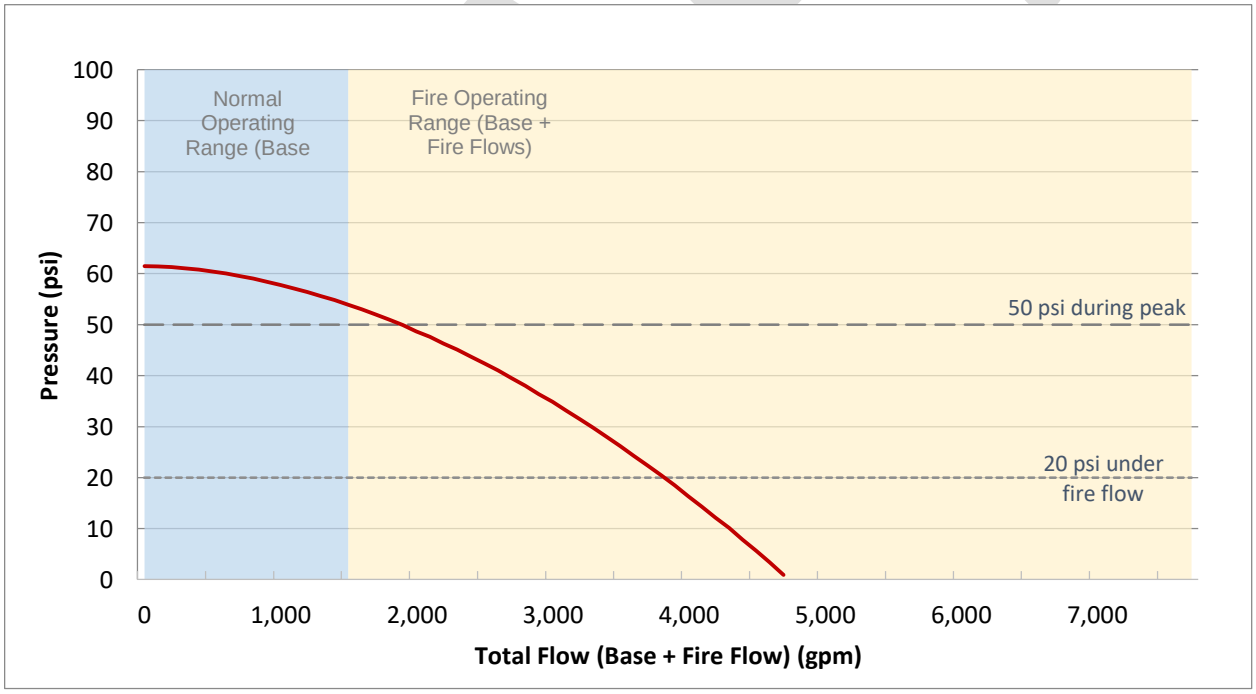

Figure 10. System Capacity Results at End of Phase 3 Pipe for Scenario 1

3.1.2 Phase 2 – Partial Buildout Results

Because of concerns with size and location of the elevated tank under ultimate buildout conditions, the elevated tank was also evaluated under Phase 2 transmission main piping. Because of shorter pipe runs and lower elevations, pressures are higher under these conditions assuming the same tank and pump sizes as presented in Table 7; both maximum day and fire flow minimum pressures were approx. 70 psi.

Since both of these are well above the levels of service, the pump and tank were adjusted accordingly. The elevated tank was lowered to 125 feet in total height and the booster pump head was reduced to 50 feet. With these revised sizes, minimum pressures sat much closer to levels of service goals and the tank continued to cycle as presented previously.

- Minimum Pressures in Phase 2 - taller tank (180 ft)
  - During Peak Demand = 74 psi
  - Fire Flow Residual = 69 psi
- Minimum Pressures in Phase 2 – shorter tank (125 ft)
  - During Peak Demand = 50 psi
  - Fire Flow Residual = 38 psi

Figure 11 shows system capacity results for Phase 2 transmission main pipes with the original proposed pump and tank size and the reduced sizes that are optimized for Phase 2. Under both normal and fire operating conditions, the reduced tank size is still able to provide supply for expect flows. Since the elevated tank cannot be upsized after installation, only one tank height can be selected for this scenario based on anticipated development and demands.

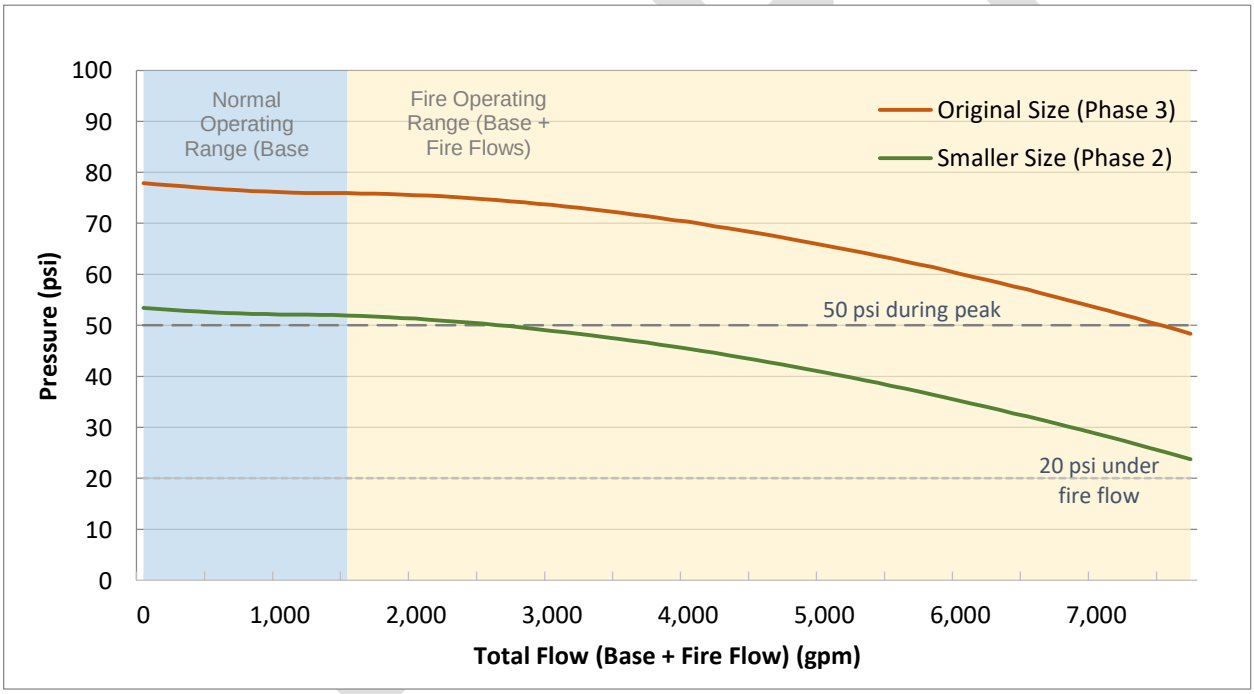

Figure 11. System Capacity Results for Phase 2 Pipe for Scenario 1

3.1.3 Scenario 1 Results Summary

Scenario 1 includes adding a new inline booster pump station and a new elevated tank. Based on model results, key conclusions for this scenario follow:

- The large height required for the elevated tank to satisfy levels of service during Phase 3 will drive up capital costs.

- A lower elevated tank could be utilized if only Phase 2 is considered. Alternatively, a different location for the tank could results in a lower height, but this will likely only benefit Phase 3 development and could have a negative impact on water quality since it is farther from the source.
- There is less of an opportunity for phased approach with the elevated storage tank. This could present challenges given uncertainties with future demands.
- Water age will be high (1 – 3 days) in the elevated storage tank unless significant demand is present along transmission main. Prior to these demands, area will require flushing and frequent tank cycling.
- Elevated tank presents the benefit of providing a buffer during fire events and not being reliant on treatment plant storage and pump operation.

3.2 Scenario 2 – Parallel Pumps at WTF

For Scenario 2, a new high service pump was added at the WTF with a dedicated line to supply water to the new transmission main. To support fire demands, an additional dedicated fire pump was also added at the WTF. In this way, all supply for the transmission main would come directly from the WTF.

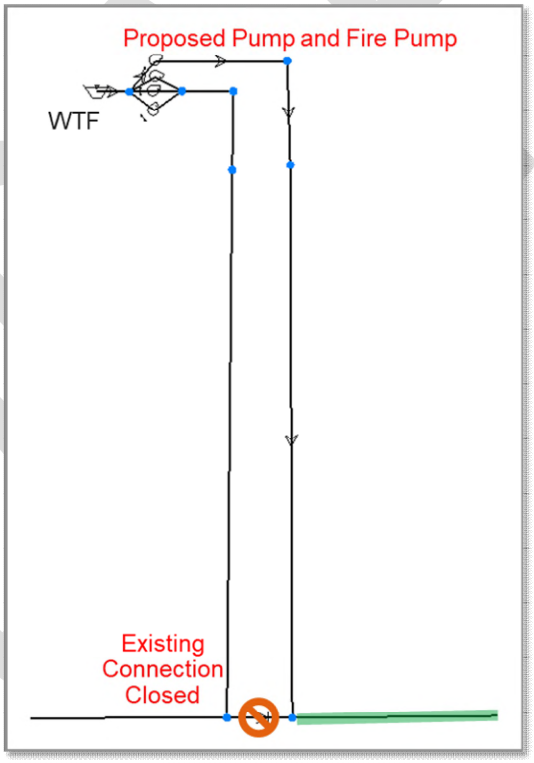

Figure 12. Model Representation of Scenario 2 Layout

3.2.1 Phase 3 – Ultimate Buildout Results

Scenario 2 was evaluated assuming Phase 3 piping is complete, and the expected demands are in place as per Table 2. Iterations were performed to determine the ideal pump characteristics that would satisfy

all required levels of service; these characteristics are presented in Table 9. With these pumps in the model, the output meets all levels of service as shown in Table 10.

Table 9. Scenario 2 Proposed Pumps

Proposed Pump Operating Point	
Flow (gpm)	1,000
Head (ft)	185

Proposed Fire Pump Operating Point	
Flow (gpm)	3,750
Head (ft)	240

Table 10. Scenario 2 Model Results Summary

Parameter	Level of Service	Model Result
Max Pipe Velocity	< 4-6 ft/s	0.8
Max Headloss Gradient	< 2-3 ft/1000ft	0.14
Min Pressure	> 50 psi during peak	52
	> 20 psi during fire flow	21
Max Discharge Pressure	< 110 psi	98
Max Water Age	Minimized	0.7 days

System capacity was evaluated at the end of the Phase 3 pipe. Figure 13 shows the system capacity and can be compared with Figure 7 for existing conditions. Compared with existing conditions, both normal operating pressures and fire operating pressures have improved significantly.

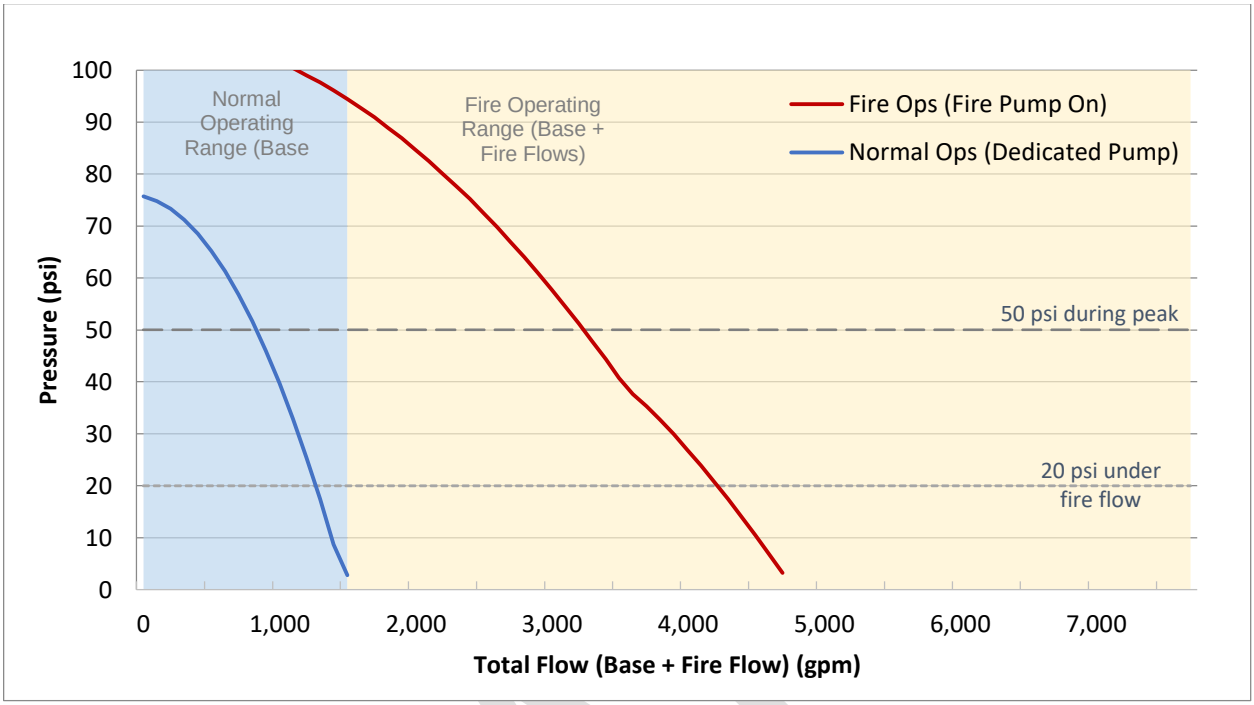

Figure 13. System Capacity Results at End of Phase 3 Pipe for Scenario 2

3.2.2 Phase 2 – Partial Buildout Results

To better understand timing of improvements, the new dedicated pumps under this scenario were also evaluated under Phase 2 transmission main piping. Because of shorter pipe runs and lower elevations, pressures are higher under these conditions assuming the same pump sizes presented in Table 9; both maximum day and fire flow minimum pressures are approx. 70 psi. Since both of these are well above the levels of service, the pumps were adjusted accordingly. The proposed pump speed was reduced to 94% of the original proposed capacity and the proposed fire pump was reduced to 81%. With these revised sizes, minimum pressures are much closer to levels of service goals.

- Minimum Pressures in Phase 2 - large pump size
  - During Peak Demand = 67 psi
  - Fire Flow Residual = 70 psi
- Minimum Pressures in Phase 2 – smaller pump size
  - During Peak Demand = 55 psi
  - Fire Flow Residual = 31 psi

System capacity results for Phase 2 pipes with the original proposed pump sizes and the reduced sizes show that under both normal and fire operating conditions, the pump is able to provide supply for anticipated flows. If expansion to Phase 3 is expected during design and installation of the proposed pumps, then Phase 3 sizes (Table 9) could be used but VFDs could be included to scale back the pumps during Phase 2 conditions and demands.

An additional analysis was performed to understand the importance of the dedicated fire pump for Scenario 2. While normal operating conditions can be maintained with the proposed pump only, it cannot

supply significant flows beyond the expected 1 MGD base flow along the transmission main. However, an additional option to supplement fire supply would be to add a check valve south of treatment plant that joins the rest of the distribution system to the transmission main (labeled as Existing Connection Closed in Figure 12). This check valve may not allow flow during normal conditions (depending on operations and hydraulics); however, during a fire event the three existing pumps could be turned on and utilized to allow flow through the check valve and into the transmission main. Model system capacity results for Phase 2 under different conditions (assuming the reduced capacity described above) are shown in Figure 14. These results show that with the check valve, base plus fire flow demands could equal approx. 5,000 gpm while maintaining 20 psi residuals and is comparable to results with the fire pump active. The increase in capacity from the check valve is largely only present during Phase 2; model results for Phase 3 show minimal improvements and less capacity than having a dedicated fire pump.

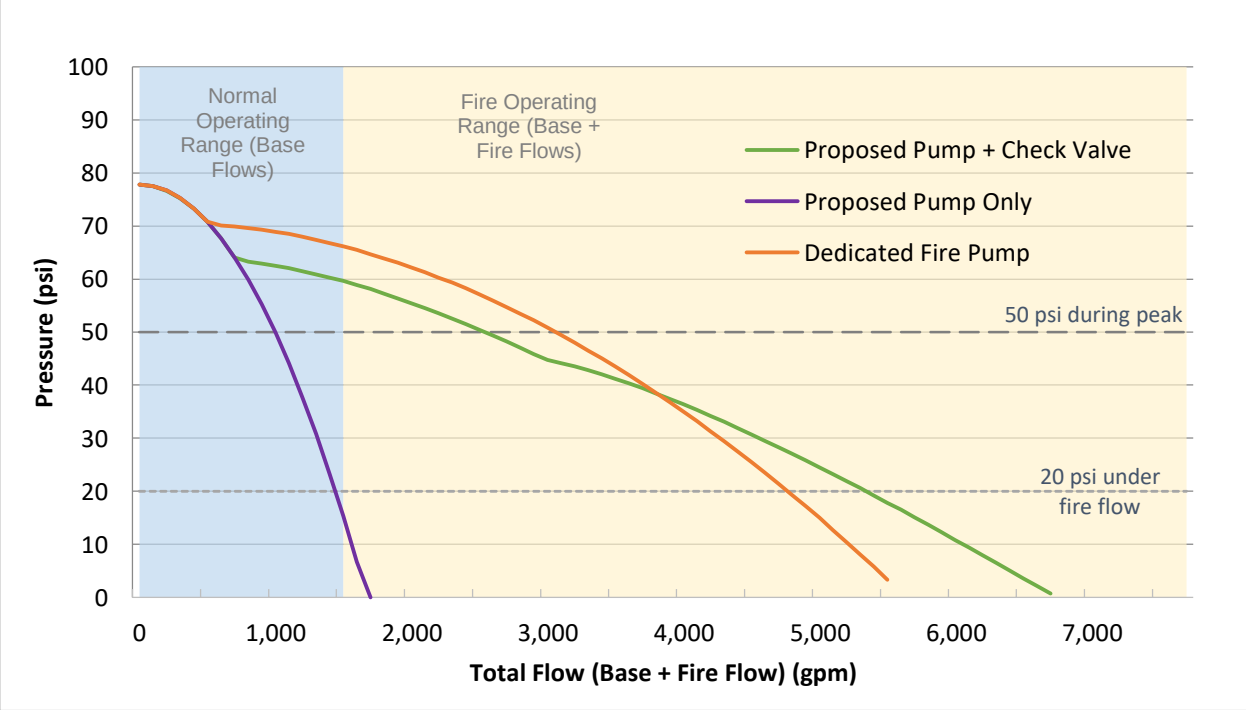

Figure 14. System Capacity Results for Phase 2 Pipe Under Different Scenario 2 Alternatives

3.2.3 Scenario 2 Results Summary

Scenario 2 includes adding a new dedicated pump at the treatment plant. Based on model results, key conclusions for this scenario follow:

- Ultimate Phase 3 piping and demands would require both a dedicated pump and fire pump to satisfy all levels of service. With only one pump can available at the plant, the addition of a two pumps may have significant capital considerations.
- This scenario relies on plant clearwell storage and quick pump operations during fire events.

- Depending on the timing of design and construction, this scenario allows scaling possibilities (using VFDs) for different phases and demand conditions.
- Based on modeling results, there is the possibility of utilizing a check valve south of the plant that adds additional support for fire events during Phase 2. This may soften the requirement of having a dedicated fire pump prior to Phase 3 development.
- The method of using a single pump and control/check valve prior to phase 3 would require automated controls and may create additional operational complexity. There may also not be reliable capacity for the new pressure zone since there would not be a redundant service pump for that area. Operations would have to use the existing three high service pumps if the new pump failed; however, this would create additional challenges trying to balance flow to the main service area and while allowing some flow through the control valve into the transmission main.

3.3 Scenario 3 – WTF Pump Upsize and PRV

For Scenario 3, all existing pumps at the WTF were upsized based on the requirements along the new transmission main. To ensure conditions throughout the rest of the distribution system remain similar to existing conditions, a pressure reducing valve (PRV) was added west of the WTF (see Figure 15).

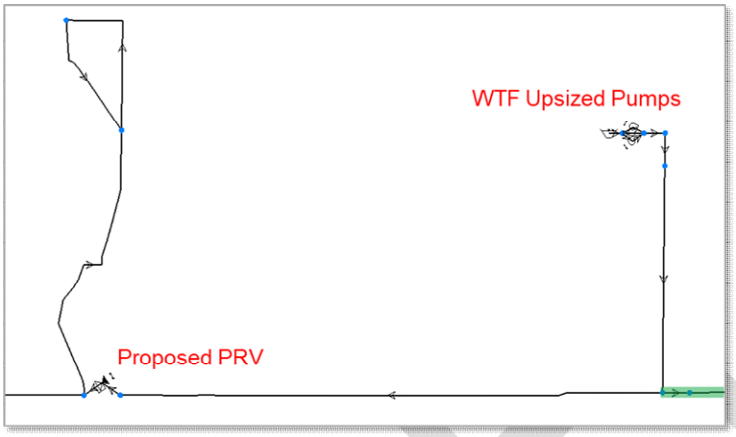

Figure 15. Model Representation of Scenario 3 Layout

3.3.1 Phase 3 – Ultimate Buildout Results

Scenario 3 was first evaluated assuming Phase 3 piping is complete, and the expected demands are in place as per Table 2. To satisfy all required levels of service, all pumps were scaled up by approx. 20%. All pumps were set with VFDs to allow for speed adjustments during operation based on tank levels. Additionally, the pumps and the PRV were controlled to adjust settings. Simultaneous control was necessary to allow the Franklin Tank to cycle while also maintaining pressures along the transmission main. Additionally, a control was added to prohibit high discharge pressures from occurring. Controls for the pump and PRV can be found in Table 11. With the upsized pumps and revised operational controls, the model output meets all levels of service as shown in Table 12.

Table 11. Model Controls for Scenario 3

Normal Operating Controls for Upsized WTF Pump
IF Franklin Tank Level < 20.00 ft THEN WTF P3 Pump Setting = 1.200
IF Franklin Tank Level >= 28.00 ft THEN WTF P3 Pump Setting = 1.050
Normal Operating Controls for Proposed PRV
IF Franklin Tank Level < 20.00 ft THEN PRV-1 Valve Pressure = 100.0 psi
IF Franklin Tank Level >=28.00 ft THEN PRV-1 Pressure Valve Pressure = 80.0 psi

Table 12. Scenario 3 Model Results Summary

Parameter	Level of Service	Model Result
Max Pipe Velocity	< 4-6 ft/s	0.8
Max Headloss Gradient	< 2-3 ft/1000ft	0.14
Min Pressure	> 50 psi during peak	58
	> 20 psi during fire flow	26
Max Discharge Pressure	< 110 psi	100
Max Water Age	Minimized	0.5 days

The model required multiple iterations to determine a feasible set of controls (Table 11) that would satisfy all requirements for the system. Figure 16 shows tank levels and pressures throughout the max day. Controls for both the pump speed and PRV pressure setting changed to ensure cycling occurred throughout the day, and levels in the tank never went beyond normal operating ranges, and transmission pressures always remained above 50 psi.

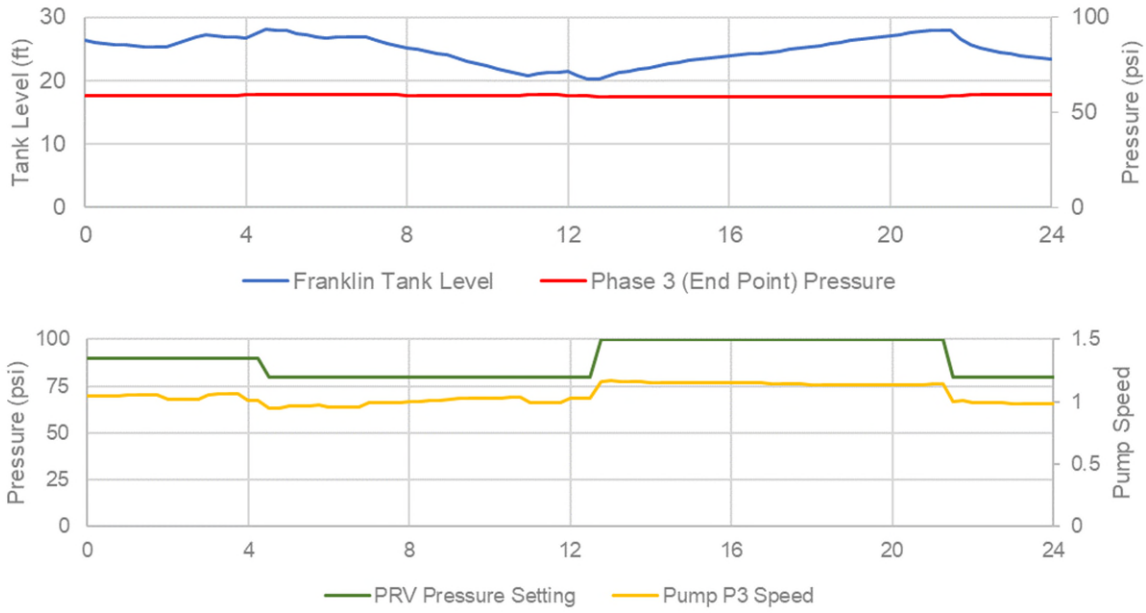

Figure 16. Scenario 3 – Model Max Day Operations and Results

System capacity was evaluated at the end of the Phase 3 pipe. Figure 17 show the system capacity and can be compared with Figure 7 for existing conditions. Compared with existing conditions, both normal operating pressures and fire operating pressures have improved significantly.

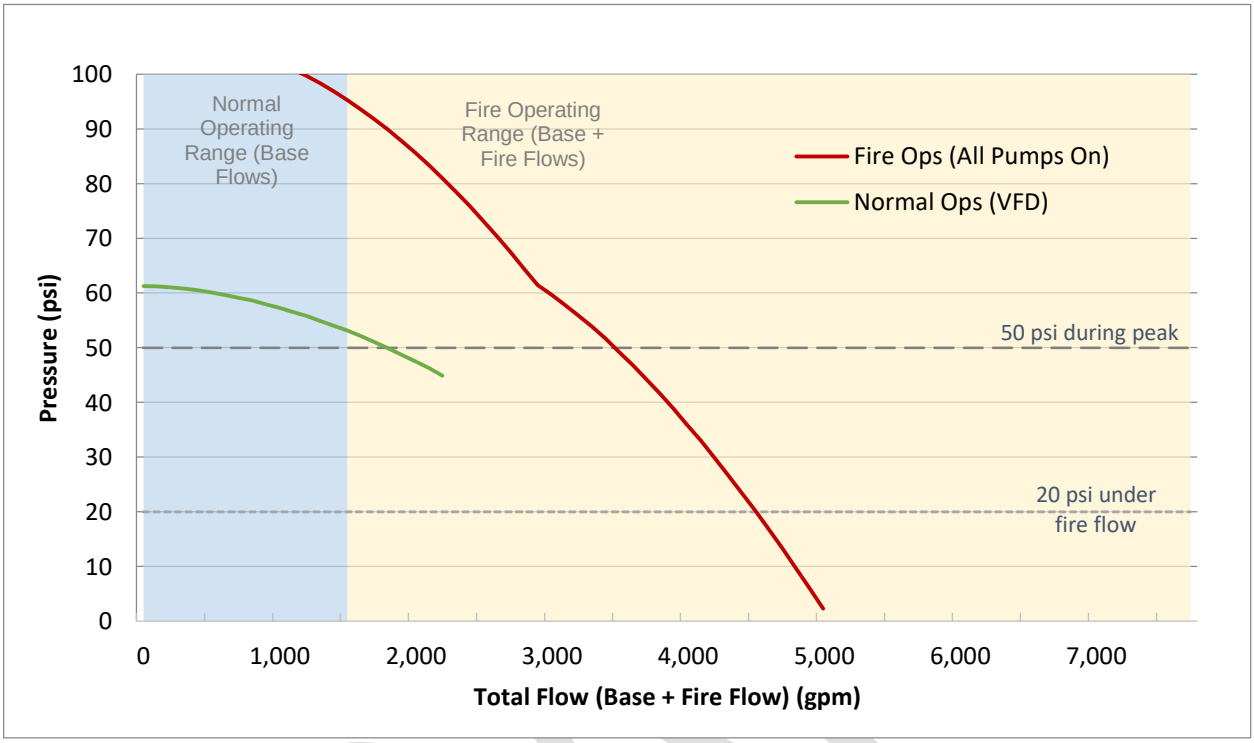

Figure 17. System Capacity Results at End of Phase 3 Pipe for Scenario 3

3.3.2 Phase 2 – Partial Buildout Results

To better understand timing of improvements, the upsized pumps under this scenario were also evaluated under Phase 2 transmission main piping. Because of shorter piping runs and lower elevations, pressures are higher under these conditions; both maximum day and fire flow minimum pressures are approx. 70 psi. Since both of these are well above the levels of service, the pumps were adjusted accordingly. The proposed pump speed was reduced by 10% (resulting in a 10% increase over current sizes). With these revised sizes, minimum pressures are much closer to levels of service goals for Phase 2.

- Minimum Pressures in Phase 2 – larger pump size
  - During Peak Demand = 72 psi
  - Fire Flow Residual = 75 psi
- Minimum Pressures in Phase 2 – smaller pump size
  - During Peak Demand = 55 psi
  - Fire Flow Residual = 40 psi

System capacity results for Phase 2 pipes with both proposed pump sizes (20%) and the reduced sizes (10%) show that under both normal and fire operating conditions, the pumps were able to meet the level of service goals. If expansion to Phase 3 is expected during pump replacements, then the larger Phase 3 sizes (20% larger than existing) could be used and VFDs could be included to scale back the pumps during Phase 2 conditions and demands.

3.3.3 Scenario 3 Results Summary

Scenario 3 includes upsizing the pumps at the treatment plant and adding a PRV to the East. Based on model results, key conclusions for this scenario follow:

- Because of this scenario's additional infrastructure and level of service requirements on both sides of the plant, operational complexity increases significantly. Model iterations were required to balance Franklin Tank cycling, WTF discharge pressure, and transmission main pressures. Actual operations may require more dedicated operator attention and/or complex control logic development.
- Depending on the timing of design and construction, this scenario allows scaling possibilities (using VFDs) for different phases and demand conditions.
- The timing and need for an upgrade to the plant's existing pumps should be considered in relation to the potential planning of a future water treatment plant.

3.4 Supply Considerations

To understand supply from the treatment plant during the different scenarios, the available plant capacity and storage was analyzed. Based on information from INAW, the plant's capacity is 4.5 MGD based on the aerators' treatment capacity; also, there is 0.75 MG of finished water storage. Based on these numbers (and assuming 75% of clearwell storage is usable), a comparison to modeled outflows for existing conditions and each scenario are shown in Table 13. Each scenario includes average flows during the max day (MDD), peak hour flows (PHD), and max day plus fire flow (MDD + FF) simulations. Max day plus fire flow for Scenario 2 and 3 do come close to available supply (within 100,000 gallons), but no scenario exceeds available supply.

Table 13. Available Storage Under Various Scenarios

Scenario	Type	Required Flow (MGD) [1]	Required Volume (MG)	Available Volume (MG)	Difference / Excess Storage (MG)
Existing	MDD	2.4	2.4	5.1	2.6
Scenario 1	MDD	3.2	3.2	5.1	1.9
	PHD	3.9	0.2	0.8	0.6
	MDD + FF	4.8	0.6	1.1	0.5
Scenario 2	MDD	3.4	3.4	5.1	1.7
	PHD	3.9	0.2	0.8	0.6
	MDD + FF	8.3	1.0	1.1	0.1
Scenario 3	MDD	3.5	3.5	5.1	1.6
	PHD	4.6	0.2	0.8	0.6
	MDD + FF	8.4	1.1	1.1	0.1

[1] Required flow is simulated flow from the plant that is necessary to meet level of service criteria. This varies per scenario based on operation at the plant (e.g., number of pumps and operating point) and scenario improvements (e.g., tank reduces requirement for plant supply during fire event).

3.5 Energy Costs

Energy costs associated with pumping operation will constitute the major portion of the additional operations and maintenance (O&M) costs and were solely evaluated for the three scenarios described above, including the existing baseline conditions. Table 14 contains a summary of assumptions, average design conditions and resulting energy costs to implement the three alternatives. Pump and motor efficiency for the existing and the new pumps were assumed to be 80% and 90%, respectively as shown. Unit charge of 0.09 $/kWh was used per Crawfordsville Electric Light and Power's schedule for Municipal General Service Rate Unit energy charge. The average flow rate and pump head at steady state conditions for the scenarios were obtained from the model runs.

Table 14. Summary of Estimated Annual Energy Costs by Scenario

Parameter	Baseline	Scenario 1		Scenario 2		Scenario 3
	Existing pump P2[1]	Existing pump P3[2]	New Booster pump	Existing pump P2[1]	New high service pump P4	Upsized Existing pump P2[1]
Assumptions						
Pump Efficiency (%)			80%			
Motor Efficiency (%)			90%			
Energy Cost ($/kWh)			0.09			
Design Conditions						
Average day Steady State Flowrate (gpm)	1,700.4	2,394.8	694.4	1,700.4	694.4	2,394.8
Average day Steady State TDH (ft)	159.9	193.0	93.0	159.9	216.9	223.8
Calculated Values						
Average Energy Demand (kW)	71.1	120.9	16.9	71.1	39.4	140.2
Annual Average Energy Usage (kWh)	623,080	1,058,939	147,965	623,080	345,140	1,228,094
Annual Pumping Energy Cost ($/year)[3]	$57,000	$96,000	$14,000	$57,000	$32,000	$111,000
	$57,000	**$110,000**		**$89,000**		**$111,000**
Additional cost relative to baseline ($/year)[3]	**-**	**$53,000**		**$32,000**		**$54,000**
Additional cost relative to baseline (%)	**-**	**93%**		**56%**		**95%**

[1] Existing model utilizes P2 during average day demands and P3 during maximum day demands
[2] A different pump was necessary on average day demands due to increased flow along the new transmission main
[3] Costs are rounded up to the nearest $1000

As shown in Table 14, scenario 2 had the lowest annual energy costs of $89,000 for pumping operation based on average conditions followed by scenario 1 and scenario 3 at $110,000 and $111,000, respectively. Compared to the existing conditions, there is increase in annual energy costs in the range of $32,000 to $54,000 based on the scenario selected.

3.6 Screening Conclusions

The new transmission main was evaluated using the existing hydraulic model to determine the optimal pumping and/or storage modifications to address anticipated customer base increases. Existing conditions along the transmission main were evaluated along with three improvement scenarios under future demand conditions. Based on model results, conclusions were drawn about necessary improvements to the system along with information about their timing. The following provides a summary of the phasing, model observations, and a possible set of recommendations. It is important to consider that these recommendations are based on current information on demands which may change in the future. Additionally, this analysis does not include other important factors like capital costs which may influence final decision-making.

Phase 1

Based on model results, there is currently sufficient capacity along the Phase 1 pipeline. Anticipated future demands are small in this area and should be supported based on available infrastructure, and both normal operating and fire flow levels of service can be met (Figure 5). A caveat is that model results show that when treatment plant pumps turn off, pressures do drop slightly below 50 psi even with modification to pump controls (Section 2.2). Note that minimum pressures requirements identified for the project are well above the 35 psi found in AWWA's M-32 manual; these periodic drops in pressure are still above this limit.

Phase 2

Based on model results, there is limited capacity for additional demands during normal operating conditions with available infrastructure (Figure 6). Conversely, fire flows should be sufficient even without improvements to the system. Even with no additional demands, pressures also still drop below 50 psi even with modification to pump controls (Section 2.2); note that minimum pressures also drop below the 35 psi limit found in AWWA M-32 manual in this phase. To increase capacity during normal operating conditions, improvements to the system will be necessary during this phase as demands are added. The model results for system capacity during Phase 2 are compared in Figure 18. These results show that significant improvements in capacity are possible for all scenarios. However, Scenario 2 with the optional check valve installed south of the plant presents several advantages, as all levels of service are maintained through a wide range of possible future demands and fire flow conditions, and this scenario results in the lowest O&M costs (Table 14). This also allows the most flexibility of expansion in the future with VFD speed adjustments and additional improvements during Phase 3. This is preferable compared with the construction of a storage tank under Scenario 1, or the operational complexity of Scenario 3.

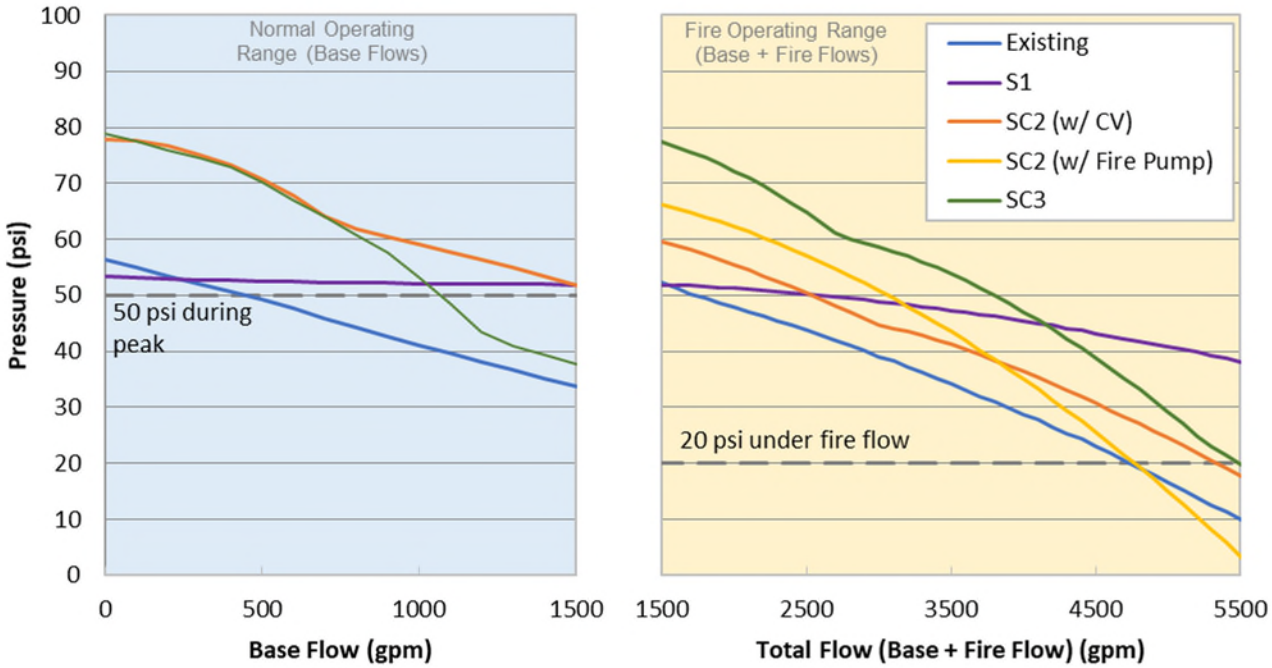

Figure 18. System Capacity Comparison for Phase 2 Conditions under Different Scenarios

Phase 3

Based on model results, there is no capacity for additional demands during normal operating conditions with available infrastructure (Figure 7), and even static conditions result in low pressures because of high elevations in the area. Therefore, improvements are required during this phase of the transmission main buildout. If the recommendations for Phase 2 are in place (Scenario 2), then additional improvements would still be necessary. During Phase 3 piping and demands, the pump would need to be scaled up (increased VFD setting) to support the system during normal operating conditions. The system would also need additional support for fire fighting events; the model evaluated the addition of a fire pump which would provide water during these high flow events. Based on supply evaluations, the treatment plant should have sufficient storage during these events (Section 3.4), but capacity is nearly at its limit. An additional option is the construction of an elevated storage tank at this time. If only built during Phase 3 for fire events when the new pump is already in place, the elevated tank could potentially be located in the Phase 3 portion of the transmission main which would reduce the required height that was observed with the Scenario 1 tank location. The addition of the fire pump and/or elevated storage tank during Phase 3 is highly dependent on demand and usage types along the transmission main; therefore, these final improvements may need to be evaluated again once this future water usage is better understood leading to the Phase 3 pipeline construction.

4 FEASIBILITY ANALYSIS

Based on scenario screening results presented in Section 3 along with discussions with INAW, a standalone pump station was selected as the final improvement to meet the service levels for Phase 2 and 3 of the Crawfordsville east side expansion project. The planned improvement includes a standalone, above-ground pump station with up to four pumps. The pump station is tentatively planned to be constructed on the site of the existing WTF and would draw from the existing clearwell discharge.

The goal of the feasibility analysis presented in this section is to identify/recommend the optimal configuration of pumps and pump design points for this future pump station that would satisfy anticipated development in the area. Consideration was given to ensuring that service level goals can be met for areas that can reasonably be served by the new 'high-zone'. Distinct demand conditions were evaluated using the hydraulic model while also accounting for gradual development and increases in water usage in the area.

4.1 Improvement Scenario Description

For the feasibility analysis, a single improvement scenario was selected and analyzed. This scenario includes a standalone booster station that provides direct supply to the proposed transmission main; these improvements were added to the existing Crawfordsville hydraulic model (Figure 19). The booster pump station is tentatively located directly east of the WTF. A 20" suction line is directly connected to the WTF clearwell, while a 20" discharge line leaves the booster station and proceeds along SR 23 and the proposed transmission main. Four pumps are located within the proposed booster station, with pumps 1-3 having 10" pipe connections and pump 4 having a 12" pipe connection. Minor losses were estimated based on anticipated fittings and added to corresponding pipes within the booster station. The elevation of the proposed booster station is assumed to be 780 based on local ground elevations and WTF elevations found in the model.

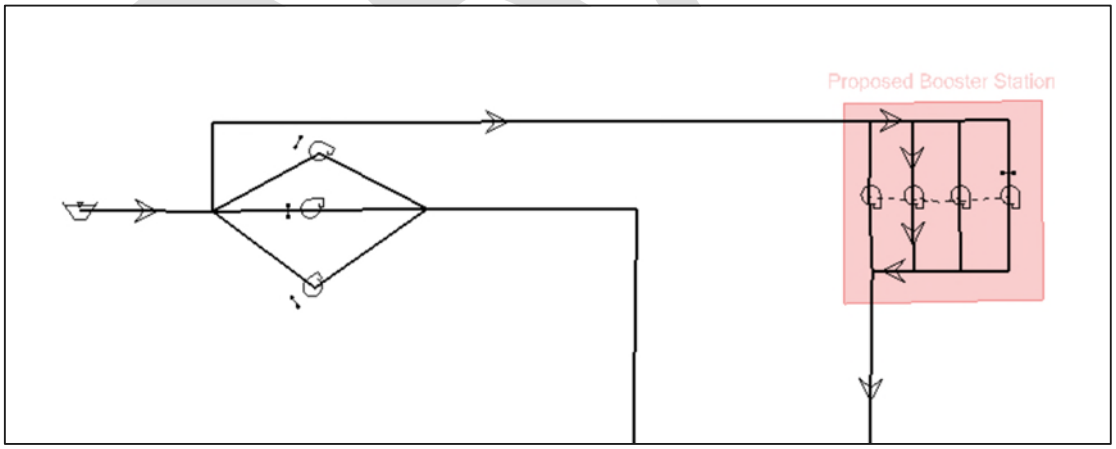

Figure 19. Model Representation of Proposed Booster Station Layout

4.2 Demand/Buildout Scenarios

Multiple demand scenarios were conceptualized to help evaluate the proposed booster pump station. The demand scenarios are based on gradual build out of the area along the transmission main and incorporates considerations discussed during previous analysis (see Sections 1 and 3). Table 15 provides details for the demand scenarios used in the feasibility analysis. Each scenario includes a sub-scenario for (a) max day demands and (b) firefighting conditions. Table 15 also lists corresponding estimated max day demands that were used for each of these scenarios. Scenario 1 and 2 are low to medium demand conditions based on a local rest stop and County projections found in Table 3. Scenario 3 and 4 represent the addition of a large industrial user either within the Phase 2 or Phase 3 piping area. Scenario 5 represents the same demands as Scenario 4 but with the addition of an elevated tank in the Phase 3 area of the transmission main pipeline.

Table 15. Feasibility Analysis Demand Scenarios

#	Scenario	Demands	Fireflow	Comment
1	Low Demand for Phase 2	10 gpm		Rest/Truck stop only
2a	Medium Demand for Phase 2	10 gpm, 147 gpm		Res/Com from County data and previous projection
2b	Medium Demand + FF for Phase 2	10 gpm, 147 gpm	2,500 gpm	Res/Com 2-hour fire event
3a	Medium/High Demand for Phase 2	10 gpm, 147 gpm, 1 MGD		Industrial demand during Phase 2
3b	Medium/High Demand + FF for Phase 2	10 gpm, 147 gpm, 1 MGD	3,500 gpm	Industrial 3-hour fire event
4a	Medium/High Demand for Phase 3	10 gpm, 147 gpm, 1 MGD		Industrial demand during Phase 3
4b	Medium/High Demand + FF for Phase 3	10 gpm, 147 gpm, 1 MGD	3,500 gpm	Industrial 3-hour fire event
5a	Medium/High Demand for Phase 3	10 gpm, 147 gpm, 1 MGD		Industrial User with Elevated Tank
5b	Medium/High Demand + FF for Phase 3	10 gpm, 147 gpm, 1 MGD	3,500 gpm	Industrial User with Elevated Tank

It's anticipated that these development and buildout demands will increase gradually in the area, but that these scenarios represent some of the primary anticipated conditions that should be expected or that may trigger further improvements. Based on discussions with INAW, it is expected that an industrial user added during either Phase 2 or 3 will trigger the construction of an elevated tank (Scenario 5) for fire protection. Therefore, Scenarios 3 and 4 were considered interim scenarios where full levels of service were not designed for (especially for fire conditions) since the elevated tank would maintain service in the area once constructed. These scenarios were still kept and analyzed in order to help understand how critical the tank construction trigger is as well as providing understanding of service availability between potential lags between a new industrial customer contract and design/construction of the new tank.

4.3 Optimized Pumping

The demand scenarios found in Table 15 were utilized to create staging of the pump station to support development in the area. Figure 20 shows the four anticipated stages of the proposed pump station development, and which demand scenarios each of the scenarios includes. It should be noted that the transition from Stage B to C and/or D are distinct with the addition of a large user, while the transition from Stage A to B is more gradual and indistinct. More information following this transition is presented later in this section.

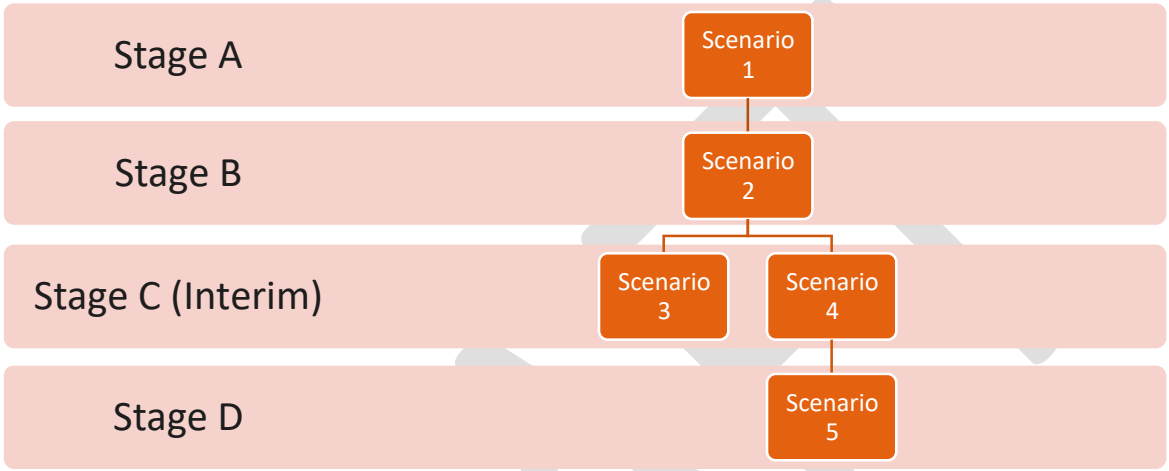

Figure 20. Stages of Proposed Pump Station Improvements

Based on the stages outlined in Figure 20, a set of improvements necessary to maintain service for each scenario were developed by utilizing the hydraulic model. Table 16 identifies new additions during each stage in order to main service and also account for firm capacity (largest pump out of service) of the pump station.

Table 16. Proposed Booster Station Improvements for Development Stages

	Scenarios	Pump 1	Pump 2	Pump 3	Pump 4	Storage	Comments
Stage A	1	**Jockey**	**Jockey**				
Stage B	2	Jockey	**Medium**	**Medium**	**Fire**		
Stage C	3 or 4	**Medium**	Medium	Medium	Fire		(1)
Stage D	5	Medium	Medium	Medium	Fire	**Tank**	(2)

(1) Interim Stage that will likely trigger Elevated Tank following Industrial User. Additions can maintain partial FF support and full normal demand support during this stage, or can be skipped and combined with Stage D.

(2) When elevated tank installed, fire pump will not be necessary but left for backup.

Joining the scenarios in Table 15 and the development stages found in Table 16, the model was utilized to size the corresponding pumps. Design points were selected to maintain levels of service, primarily low pressures during the peak hour and residual pressures during fire flows. Also, consideration was given to finding pump sizes that supported ultimate buildout but could be scaled back via VFD speeds for lower flow conditions. The final design points for the pumps based on this modeling are found in Table 17. Note

that the model uses the design point and automatically develops a pump curve around it; therefore, specific design point of the pump may have flexibility dependent on the pump type and characteristics of the corresponding head-flow curve.

Table 17. Proposed Booster Station Pump Design Points

Jockey Pump Design Point	
Flow (gpm)	15[1]
Head (ft)	136

Medium Pump Design Point	
Flow (gpm)	500
Head (ft)	250

Fire Pump Design Point	
Flow (gpm)	1250
Head (ft)	250

1. The proposed capacity is preliminary and may be adjusted during design to optimize the transition from jockey to medium pumps arrangement.

As part of this feasibility assessment, we preliminarily identified the following pump models as potentially suitable to meet the target design points (subject to confirmation during design):

- Jockey: we are not able to identify vertical turbine pumps able to meet the low flows required for the jockey pumps. However, we are evaluating options including the installation of a small skid-style booster pump within the basement of the proposed building along with a 500 gallon bladder tank. Final arrangement will be decided with INAW during final design.
- Medium: the medium pump will be a can style installed in a similar manner as at the WTF with a header coming in through the basement and the pump motor and discharge on the first floor. It is anticipated that the medium pump setup would include a 50 Hp motor driving a 4-stage vertical turbine pump.
- Fire: the fire pump will also be a can style pump installed in a similar fashion as the medium pump.

As discussed, an industrial user along the transmission main may trigger the construction of an elevated storage tank, especially to support larger fire fighting flows anticipated under that condition. For Scenario 5, the elevated tank was placed at the end of the Phase 3 pipe since this was generally the highest ground elevation along the transmission main that would allow for a lower tower height. The characteristics of the tank were first based off the elevated tank detailed in Section 3.1 but revise to support both the normal operating conditions and large flow (Table 18).

Table 18. Proposed Elevated Tank for Scenario 5

Proposed Elevated Tank Characteristics	
Riser Height (ft)	94
Total Height (ft)	124
Ground Elev (ft)	872
Overflow Elev (ft)	996
Volume (gallon)	750,000

With the pump station staging and characteristics described above. The model shows the service area is able to maintain pressures during simulated conditions. A summary of modeled conditions and results is shown in Table 19. All operating conditions are noted in the table along with max day and fire flow results. All normal operating pressures satisfy level of service goals; further details on pressures along the transmission main can be found in model maps in Appendix B. Similar to all previous pressures included in this report, modeled pressure were determined along the transmission main where elevations are based on the proposed route which follows the established roadway elevation; actual future customer service pressures may vary depending on corresponding connection elevations. Appendix A shows elevation contours of the surrounding area that can be used to understand potential end customer pressures based on their specific locations. Based on this comparison, if minimum pressures at a customer location are not met then pump VFD speeds may need adjusted for a given demand scenario.

Table 19. Feasibility Modeling Results for Proposed Pump Station

	1 MDD	2a MDD	2b FF	3a MDD	3b FF	4a MDD	4b FF	5a MDD	5b FF
Pump 1 Type and Setting	**Jockey 100%**	Jockey Off	Jockey Off	Medium Off	**Medium 100%**	Medium Off	**Medium 100%**	Medium Off	Medium Off
Pump 2 Type and Setting	Jockey Off	**Medium 75%**	**Medium 100%**	**Medium 85%**	**Medium 100%**	**Medium 90%**	**Medium 100%**	**Medium 100%**	**Medium 100%**
Pump 3 Type and Setting		Medium Off	Medium Off	**Medium 85%**	**Medium 100%**	**Medium 90%**	**Medium 100%**	**Medium 100%**	**Medium 100%**
Pump 4 Type and Setting		Fire Off	**Fire 100%**	Fire Off	**Fire 100%**	Fire Off	**Fire 100%**	Fire Off	Fire Off
Min MDD Pressure (psi)	52.2	54.9		53.8		50.8		50.2	
Available Fire Flow (gpm)			2,500		3,300[(1)]		2,500[(1)]		3,500
PS Flow Range (gpm)	3 - 15	56 - 259	56 – 2,704	751 - 953	750 – 4,198	751 - 953	751 – 3,398	0 – 1,269	0 – 1,370
PS Daily Flow (MG)	0.015	0.258	0.558	1.3	1.9	1.3	1.7	1.3	1.6
PS Utilization	100%	100%	100%	100%	100%	100%	100%	74%	85%

(1) *Full fire flow is not satisfied in this scenario, but lower flows can be achieved by running all pumps at the pump station. Since this is an interim scenario prior to tank construction (Scenario 5), no pump or design point adjustments were made.*

Table 19 also includes flow ranges, daily total flow volume, and pump station utilization through the day for each Scenario. For all scenarios except for Scenario 5, the pump station has pumps running throughout the day to satisfy normal demands in the closed transmission system. Under a given MDD scenario, a VFD speed setting was identified and set for the pump for the entire day. Speeds were not varied throughout the day which resulted in a range of operating heads on the pump. Figure 21 shows the

pump curves (generated by the model based on the design points in Table 17) and operating points throughout the day for every maximum day demand scenario.

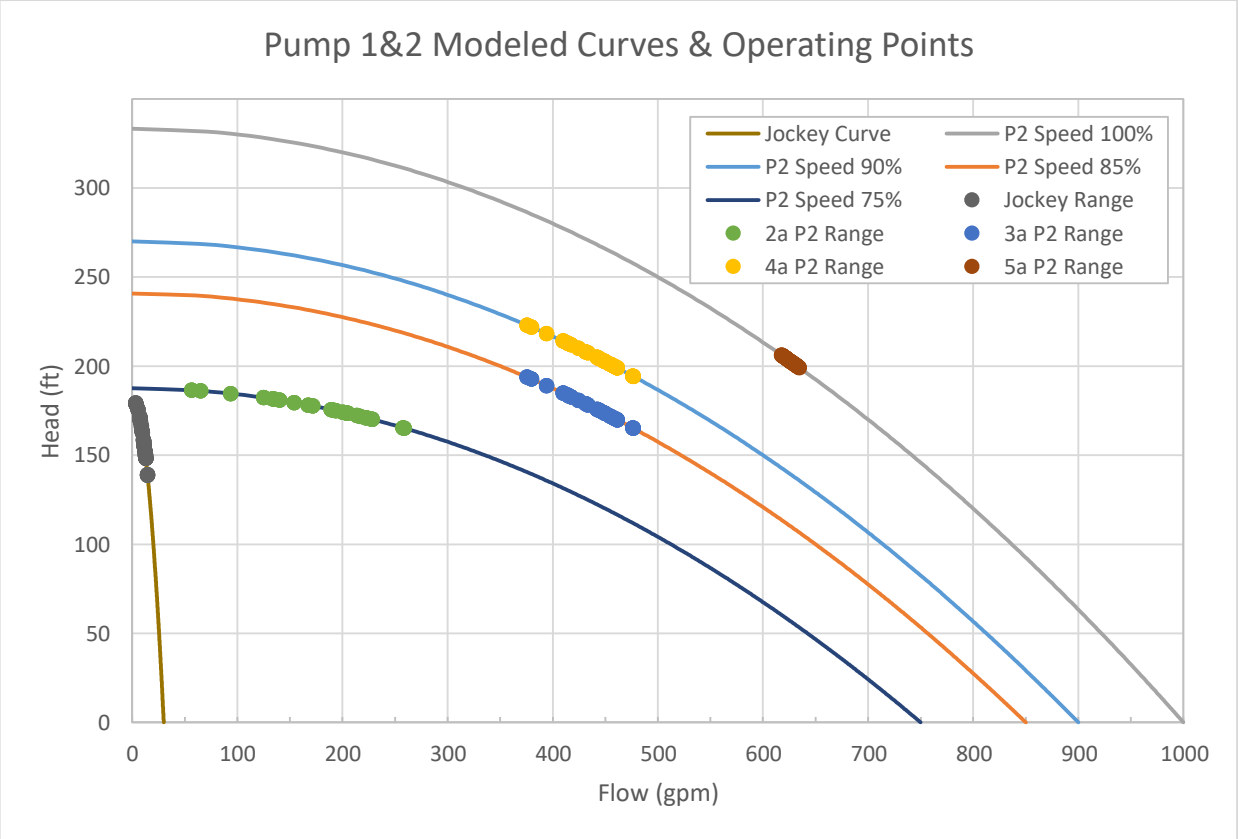

Figure 21. Pump 1 & 2 Modeled Curves & Operating Points

4.4 Feasibility Conclusions

The feasibility analysis above identified and recommended the optimal configuration of pumps and pump design points for a future pump station that would satisfy anticipated development in the area. The planned stand-alone booster station provides direct supply to the proposed transmission main and is tentatively located directly east of the WTF. Potential development stages were identified and modeled to identify four anticipated buildout stages of the proposed pump station. For each optimal pump configurations, pump design points, and operational information were determined.

Preliminary identification of pump models was performed to confirm ability to meet the target design points. The main focus of the pump station design will be to select a set of jockey pumps that allow low flow conditions which cannot be achieved by the medium pump at reduced speed. A set of pumps was identified that can satisfy modeled demand conditions.

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PLAN FOR FUTURE SOURCE OF SUPPLY
NOBLESVILLE DISTRICT AND SHERIDAN DISTRICT

INDIANA
AMERICAN WATER

153 N. Emerson Avenue
Greenwood, IN 46143

March 2023

Table of Contents

1 Need for Source of Supply Property Rights

The Noblesville District and Sheridan District are drinking water systems in Hamilton County and are owned by Indiana American Water. The population of Hamilton County grew over 25% from 2010 to 2020. The population growth and drinking water demand are anticipated to continue in Hamilton County and both districts. The projected drinking water demand in both districts and regionalization in the area are anticipated to require acquisition of property rights for future source of supply.

The Noblesville District has an effective source of supply capacity of 11.2-mgd (Eagon & Associates, Inc., 2023). The Noblesville maximum day demand is projected to be 10.2 to 11.4-mgd by 2030 and 11.0 to 12.5-mgd by 2035. This equates to a projected deficit up to 0.2-mgd by 2030 and 1.3-mgd by 2035. In 2014, Indiana American Water acquired a property in Noblesville with a source of supply capacity potential of 2 to 3-mgd. The acquired property has not been developed.

The Sheridan District has a source of supply capacity of 1.15-mgd (Eagon & Associates, Inc., draft 2021) and improvements are in progress to increase the capacity to an estimated 1.7-mgd. The Sheridan maximum day demand is projected to be 1.1 to 1.5-mgd by 2035.

Indiana American Water entered into agreement with Hamilton County to provide drinking water to the Hamilton County Regional Utility District (HCRUD) with initial water demands in 2024. The initial HCRUD demands are 0.72-mgd. HCRUD forecasts average day demands to reach 2.5-mgd and peak daily flows to reach 6.0-mgd. The maximum day demand is estimated to be 3.9-mgd based on a max to average ratio of 1.6. The initial connection and supply to HCRUD will be from the Sheridan District with a future connection to the Noblesville District.

Noblesville and Sheridan's current source of supply capacity is approximately 12.4-mgd. Noblesville, Sheridan, and HCRUD have a combined projected demand of up to 20-mgd by 2035. A source of supply deficit up to 7.6-mgd is projected based on the maximum HCRUD demand and the 2035 demands for Sheridan and Noblesville. Additional source of supply development is recommended to accommodate the projected demands of HCRUD, Noblesville, and Sheridan.

The rate of growth and development in Hamilton County creates the present need to obtain property rights for future source of supply. Indiana American Water is competing for property rights with development firms that intend to develop property for other purposes. Property with potential source of supply is a limited resource.

Indiana American Water has initiated a preliminary hydrogeologic study to evaluate potential locations for development of ground water source of supply in the area. Ground water source of supply is preferred and anticipated to be available for the projected demands. Alternatively, development of surface water source of supply could be evaluated. The development of surface water requires additional challenges and time that may not be available depending on rate of drinking water demand growth.

2 Schedule for Source of Supply Development

Development of additional sources of supply is recommended to meet the 2035 projected deficit of 7.6-mgd. Combined demand from Noblesville, Sheridan, and HCRUD is projected to exceed 85% of the effective source of supply by 2025. This is a general utilization indicator for when additional source of supply development is recommended to occur, dependent on other factors determined with population growth and water demand studies. The current developed source of supply capacity of 12.4-mgd is anticipated to be fully utilized by 2030. As indicated by the utilization rate shown in Table 1, additional source of supply development is recommended as early as 2025.

Table 1: Noblesville, Sheridan, HCRUD Source of Supply Plan

Year	Project Maximum Day Demands (mgd)								Source of Supply				
	Noblesville		Sheridan		HCRUD*		Combined		Developed	Surplus/Deficit		Utilization	
	Base	High	Base	High	Base	High	Base	High	(mgd)	Base	High	Base	High
Current	8.2	8.2	0.4	0.4			8.6	8.6	12.4	3.7	3.7	70%	70%
2025	9.6	10.2	0.6	0.7	0.6	0.6	10.8	11.5	12.4	1.6	0.8	87%	93%
2030	10.2	11.4	0.9	1.1	1.0	3.0	12.1	15.4	12.4	0.3	-3.1	98%	125%
2035	11.0	12.5	1.1	1.5	3.9	6.0	15.9	20.0	12.4	-3.6	-7.6	129%	162%

*HCRUD maximum day demands estimated based on Hamilton County Build Operate Transfer RFP/Q, April 2022

3 Cost Estimate for Source of Supply Development

The following cost estimate anticipates the development of the undeveloped property in Noblesville acquired in 2014, the acquisition and development of a new wellfield near Sheridan, and the acquisition and development of an additional wellfield to serve the combined area.

Table 2: Noblesville and Sheridan Source of Supply Plan Cost Estimate			
Noblesville Undeveloped 2014 (2 to 3 mgd)			
Estimate Item	Low	Base	High
Property Rights Acquisition*	$0.6M	$0.6M	$0.6M
Source of Supply Development	$4.0M	$5.0M	$6.5M
Total Acquisition and Development	**$4.6M**	**$5.6M**	**$7.1M**
Sheridan Proposed Wellfield (1 to 2 mgd)			
Estimate Item	Low	Base	High
Property Rights Acquisition	$0.6M	$0.8M	$1.0M
Source of Supply Development	$4.0M	$5.0M	$6.5M
Total Acquisition and Development	**$4.6M**	**$5.8M**	**$7.5M**
Additional Proposed Wellfield (4 to 6 mgd)			
Estimate Item	Low	Base	High
Property Rights Acquisition	$1.8M	$2.3M	$3.0M
Source of Supply Development	$6.0M	$7.5M	$9.8M
Total Acquisition and Development	**$7.8M**	**$9.8M**	**$12.7M**
Combined Source of Supply Estimate (7 to 11 mgd)			
Estimate Item	Low	Base	High
Property Rights Acquisition	$3.0M	$3.7M	$4.6M
Source of Supply Development	$14.0M	$17.5M	$22.8M
Total Acquisition and Development	**$17.0M**	**$21.2M**	**$27.3M**
*Noblesville Undeveloped 2014 property was previously acquired and actual cost listed.			
Low Estimate is 80% of Base and High Estimate is 130% of Base			

4 Appendix: Referenced Studies

GROUNDWATER CAPACITY EVALUATION
INDIANA AMERICAN WATER
NOBLESVILLE, INDIANA

Prepared for:

Indiana American Water
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Greenwood, Indiana 46143

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January 5, 2023

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INTRODUCTION

The purpose of this report is to present the results of an analysis of the groundwater capacity that is available to the Indiana American Water (INAW) water supply system in Noblesville from their existing well fields. INAW currently operates four well fields in Noblesville: White River North, Riverwood, Allisonville Road (fka Prairie Property), and Forest Park. INAW also owns the White River Christian Church Property but does not operate the test/production well that was installed on the property at the time of this report. Locations of the well fields and the production wells are shown on Figure 1. Table 1 summarizes the well construction details for the production wells by well field.

The groundwater capacity analysis presented in this report is based on available water-level, well performance, and water withdrawal data from INAW, Bastin Logan Water Services (Bastin Logan), and the Indiana Department of Natural Resources (IDNR). The well-field capacity evaluation is based on current (most recent documented) conditions and performance of the wells, and are compared to past estimates of well-field capacities. The report should be considered with the source-of-supply evaluation (January 20, 2022) which includes recommendations for well replacement, test drilling options to verify conditions at potential new well sites, and operational procedures that could prolong the life of wells at the well field.

HYDROGEOLOGIC SETTING

Geology

The Noblesville area is located in the Tipton Till Plain physiographic province (Arihood, 1982). Glacial drift covers most of the area. The drift is composed of glacial till with interspersed sands that can be of significant thickness and lateral extent. The drift thickness can be over 100 feet in the Noblesville area. Wells at the White River North, Riverwood, Allisonville Road, Forest Park, and White River Christian Church Property Well Fields are completed in Pleistocene sand and gravel glacial outwash deposits within the White River Valley. These deposits are overlain by more recent alluvial silts and clays. The thickness of the fine-grained

surficial materials varies from as much as 41 feet at Well 1 at the White River North Well Field to three feet at Test Boring 09-3 at the Riverwood Well Field. The outwash deposits are generally more extensive southwest of Noblesville (Herring, 1971).

Unconsolidated deposits in the area are underlain by Silurian and Devonian-age carbonate bedrock (Arihood, 1982). Wells 4 and 5 at Wayne Street and the Forest Park Well Field, respectively, are completed in the carbonate bedrock. The bedrock topography shown on Plate 1 is based on a map published by the U.S. Geological Survey (USGS) (Arihood, 1982) modified using more recent data from logs of water wells and test borings. The bedrock topography map shows a complex pre-glacial drainage pattern and generally indicates that pre-glacial drainage was to the northwest. Bedrock relief is over 200 feet in the Noblesville area. Cross-section traces also are shown on Plate 1. The hydrogeologic cross-sections, shown on Plate 2, were developed using well logs obtained from IDNR, Division of Water and logs of other area wells and test borings.

WATER USE

Annual groundwater withdrawal reported to IDNR by the INAW Noblesville public water supply system from 2011 through 2020 is shown on Figure 2. Average daily production increased from 3.9 million gallons per day (MGD) in 2011 to 4.7 MGD in 2017. Since 2017, average daily production has remained relatively consistent ranging from a low of 4.5 MGD in 2018 to 4.6-4.7 MGD in 2019 and 2020. Daily production data by water treatment plant (WTP) were provided by INAW from January 2020 through November 2021. Figure 3 is a graph of the daily production data by WTP along with White River stage data from the USGS gauge at Noblesville. Production is shown for the three INAW WTPs: Wayne Street, Edith Avenue, and Allisonville Road. Average total daily production from the three WTPs for the summer months (June-August) in 2020 was 6.1 MGD with a peak day demand of 8.5 MGD on June 19, 2020. Average total production from all three WTPs in 2021 through November was 4.6 MGD and the peak day demand in 2021 was 7.2 MGD. The graph shows the seasonal variation of groundwater demand of the Noblesville system. Periods of higher demand typically correlate with lower river stage (i.e., drier periods in

the summer and early autumn). The graph also illustrates the increase in production from the Allisonville Road Well Field starting in May 2020.

The capacity of each well field, based on previous analyses, is listed below. The total capacity of the four existing INAW well fields is 11.8 MGD as presented in the January 24, 2022 Source of Supply Recommendations Project Memorandum for Hamilton County, Indiana (Champa to Stefanich):

Allisonville Road – 2.0 MGD
White River North – 6.0 MGD
Riverwood – 1.3 MGD
Forest Park – 2.5 MGD

The capacity of each well field has been maximized as determined by analysis of the pumping tests performed on the production wells installed at each well field and represents the capacity of the aquifer at each property. Individual well performance will diminish over time and reduce the effective capacity of the well fields. Well-field capacities discussed below are based on the condition of the wells from the most recent available flow tests performed in Fall 2021. Recommended effective (safe) capacity of each well field is based on the Fall 2021 flow tests.

ALLISONVILLE ROAD WELL FIELD

Water Levels and Production

Figure 4 is a hydrograph of water-level data from observation wells at the Allisonville Road and White River North Well Fields. Production well and observation well locations at the Allisonville Road Well Field are shown on Figure 5. Production well construction details are shown on Table 1. The water-level data shown on Figure 4 were collected on an hourly basis using pressure transducers. Transducers installed in observation wells 09-1 (abandoned during installation of Well 2) and 09-4 have been used since 2009 to measure water levels at the Allisonville Road Well Field. As shown on Figure 4, water levels at the well field show approximately seven to eight feet of seasonal fluctuation prior to 2020. Water-level changes

largely correlate with changes in river stage and precipitation (also plotted on Figure 4). Well 1 was not used extensively prior to the treatment plant upgrades in 2019 and Observation Well 09-1 was located about 600 feet from Well 1. Observation Well 09-4 is located about 10 feet from Well 1 and drawdown is correspondingly greater than it was at 09-1.

Production from the well field increased in May 2020 after completion of Well 2 and the water treatment plant upgrades. Since May 18, 2020, when consistent daily production from Wells 1 and 2 began, the average daily production has been 1.97 MGD. Peak daily production was 2.76 MGD in September 2021. After increasing production in May 2020, water levels at Observation Well 09-4 have dropped approximately 15 to 20 feet from their seasonal lows recorded between 2010 and 2019. Some of the change is due to the proximity of Observation Well 09-4 to Well 1 and the influence that daily pumping has on the recorded levels. Drawdown and water level changes away from the pumping wells are now more difficult to evaluate. Based on the data collected during flow tests of Wells 1 and 2 performed in September 2021, water levels in the production wells show similar declines to those seen in Observation Well 09-4. Water levels in the production wells are approximately 11 to 19 feet lower than when originally installed. Some of the difference can be attributed to seasonal fluctuation, and it is unknown whether the other well was operating at the time each flow test was performed, which would result in interference drawdown affecting the water level measurements. Either way, lower water levels reduce the amount of available drawdown which limits the rate at which a well can be pumped.

Allisonville Road Well Field has only been in significant operation for two years. Even though groundwater levels are lower since well-field startup in May 2020, it is too early to determine if this is a long-term decreasing trend. A decreasing trend in groundwater levels would indicate that pumping withdrawals from the aquifer are exceeding available recharge. Water-level monitoring should continue to determine if current withdrawal is exceeding available recharge.

Drawdown and Capacity Analysis

Graphs of specific capacity versus pumping rate for Wells 1 and 2 at the Allisonville Road Well Field are included in Appendix A. A separate curve is plotted for each available flow test. The curves on each graph show how specific capacity has varied over time. Lower specific capacity at equal or lower pumping rates indicates a decline in well performance. The effect of well cleanings is evidenced by higher specific capacity at similar or higher pumping rates.

Current effective groundwater production capacity was evaluated for the Allisonville Road Well Field based on well performance data from the most recent flow test performed at each well in September 2021. Drawdown at each pumping well is a combination of well loss, formation drawdown and interference drawdown. Well loss is drawdown in a well that results from the turbulent flow of water in and near the well that causes the water level in a pumping well to be lower than the water level in the aquifer outside of the well. For sand and gravel wells, turbulence can be induced by the vertical flow of water in the well to the pump intake and by stratification and grain-size differences in the aquifer at the well screen/aquifer interface. The condition of the well screen and degree of mineral encrustation also affects the flow of water into the well and can create additional turbulence. Well loss is not a constant and varies with pumping rate and condition of the well. Well loss does not vary with run-time of a well. Formation drawdown is drawdown in the aquifer that varies with pumping rate and pumping duration and is dependent on aquifer characteristics. Interference drawdown is drawdown at a well that is induced by pumping of another well or wells.

Groundwater production capacity of the Allisonville Road Well Field has been estimated at 2.0-2.9 MGD under specified pumping scenarios as presented in the Well 2 installation and testing report (Eagon, 2019). Evaluation of the individual wells under current conditions (September 2021) was performed to estimate the current effective capacity of the Allisonville Road Well Field and to compare with previous estimates.

Well 1

Well 1 was originally drilled and tested in 2009 and completed as a production well in 2012. Well 1 was constructed with 20.8 feet of 20-inch diameter telescoping 0.120-inch slot well screen openings from 58 feet, below ground level (feet, bgl) to 78.8 feet, bgl. The well screen transmitting capacity is 3,176 gpm at the design entrance velocity of 0.1 foot/second or 1,588 gpm if 50 percent well screen blockage is assumed. A graph of specific capacity data from flow tests performed on Well 1 since installation is included in Appendix A. The original pumping test of Well 1 occurred in October 2009. Of note on the graph is that a second test of Well 1 was completed after it was hooked into the distribution system to eliminate the potential for aquifer recharge from the discharged water during the pumping test. Specific capacities of Well 1 from the September 2021 flow test are close to the original specific capacities from the 2009 test. No apparent decline in well performance is evident. Well 1 is rated at 1,400 gpm, and based on performance from the September 2021 flow test, is still capable of producing 1,400 gpm.

Well 2

Well 2 was installed in 2019. Well 2 was constructed with a 30-inch diameter telescoping well screen with 90-slot (0.090-inch) screen openings from 53 to 58 feet, bgl. and from 65 to 73 feet, bgl. A tight-wrapped section of screen was installed from 58-65 feet, bgl. The total length of open screen slots is 13 feet. The well screen used was Johnson Hi-Q stainless-steel, wire-wrapped screen and the well screen design transmitting capacity is 1,592 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well screen transmitting capacity is 796 gpm. A graph of specific capacity data from flow tests performed on Well 2 since installation is included in Appendix A. The original pumping test was performed in May 2019. The September 2020 test showed a slight improvement in well performance as compared to the May 2019 data, but the September 2021 test showed a drop in specific capacity of 12 to 22 percent from original. In addition to the lower specific capacities, analysis of the 2021 flow test data showed that the water level during the final step of the test (1,320 gpm) was below the top of the well screen. Over pumping a well (i.e., pumping a well at a rate higher than designed and/or pumping with a water level below the top of the well screen) can lead to mineralization of

the well screen, gravel pack, and formation material which leads to additional drawdown or reduction of the flow rate of the well. Pumping levels should be tracked and pumping rates should be adjusted so that water levels do not drop into the screened interval of the well. Exposure of the formation to oxygen can lead to excessive mineralization and a rapid deterioration of well performance which can be difficult to remediate with traditional cleaning methods.

Well 2 is currently equipped with a 1,400-gpm pump. Recommendations based on analysis of the original pumping test data indicated that Well 2 could sustain a pumping rate of 1,400 gpm, but that 1,400 gpm is over 85 percent of the well screen transmitting capacity and that Well 2 should be pumped at lower rates when possible. Based on the current (September 2021) performance of Well 2, reducing the pumping rate of Well 2 is recommended. A lower pumping rate will reduce entrance velocities and could result in an increase in the life of the well with lower maintenance requirements. If the next flow test of Well 2 continues to show reduced specific capacities, well cleaning is recommended.

Effective Well Field Capacity

Table 2 shows four pumping scenarios at the Allisonville Well Field based on September 2021 conditions. Static water levels shown are from the September 2021 flow tests performed by Bastin Logan. Pumping levels shown on the table were based on individual well performance from the September 2021 flow tests. As a general recommendation, pumping levels under normal conditions should not exceed 70 percent of the available drawdown. Available drawdown is the amount of water above the top of the well screen under static (i.e., non-pumping) conditions. The remaining 30 percent of the available drawdown is left to account for seasonal water-level fluctuations, abnormally dry conditions, and loss of well performance over time. Interference drawdown between the two production wells were calculated for the proposed pumping rates (700, 1,000, and 1,400 gpm) using the data collected during the long-term pumping test of Well 2 in 2019. The amount of interference drawdown is only due to aquifer characteristics and pumping rates and does not change over time.

The first scenario listed on Table 2 shows the amount of drawdown in Wells 1 and 2 when operating only Well 1 at 1,400 gpm (2.0 MGD). Using static water levels at the time of testing and short-term pumping levels in Well 1 at 1,400 gpm, 28.9 percent of available drawdown remains in Well 1 and 62.7 percent of available drawdown remains in Well 2. The second scenario is based on Well 1 pumping at 1,000 gpm and Well 2 pumping at 700 gpm for a combined output of 1,700 gpm (2.4 MGD). As shown, this scenario results in acceptable pumping levels in both wells. The third scenario assumes both wells pumping at 700 gpm for a combined output of 1,400 gpm (2.0 MGD). The third scenario leaves 61.4 percent of available drawdown remaining in Well 1 and 25.2 percent remaining in Well 2. 25.2 percent is only slightly less than the recommended 30 percent. Scenarios 1, 2, and 3 are recommended production options at a total rate range of 2.0-2.4 MGD based on September 2021 conditions. The fourth scenario shown on Table 2 is a maximum pumping rate for Well 2 based on September 2021 conditions. As shown, the maximum rate recommended for Well 2 operating by itself is 800 gpm. At 800 gpm, 33.3 percent of available drawdown would remain.

Conclusions and Recommendations

Water levels at the well field indicate a strong correlation with river levels and show significant seasonal variation. The lower water levels measured in both wells during the September 2021 flow tests can be attributed to a combination of seasonal variation and interference drawdown. The lower water levels since 2019 shown on Figure 4 are due to the closer relative distance between the transducer and nearest production well (move from 19-1 to 19-4), and high average groundwater production from the well field during September 2021 (2.5 MGD) when the flow tests were performed. Lower water levels mean less available drawdown which limits overall production capacity. Figure 6 illustrates the correlation between water levels measured in Observation Well 09-4, increased groundwater production from Allisonville Well Field, and stage height of the White River USGS gauge at Noblesville since early 2020. Based on the September 2021 performance of Well 2, a maximum pumping rate of 800 gpm is recommended for Well 2. A slightly lower rate would be recommended when operating Well 2 simultaneously with Well 1. Lowering the pumping rate at Well 2 will prevent water levels from dropping below the top of the

well screen during seasonal low periods which can reduce maintenance costs and lengthen the life of the well.

Based on analysis of September 2021 well field conditions, we recommend rehabilitation of Well 2 and limiting the total well field withdrawal to 2.0-2.4 MGD using either Well 1 only at 1,400 gpm or Wells 1 and 2 simultaneously at reduced rates. During times of lower demand, Well 2 can be operated by itself at up to 800 gpm (1.1 MGD). Average production from the Allisonville Road Well Field since May 18, 2020 is 1.96 MGD. Increased capacity realized from rehabilitation of Well 2 could increase its recommended operating rate and the overall well field capacity.

WHITE RIVER NORTH WELL FIELD

Water Levels and Production

Figure 7 is a hydrograph of water-level data from Observation Wells 94-E and 94-G and average daily withdrawal/production data by year from the Edith Avenue WTP as reported to IDNR (Facility Number 04181 in Hamilton County). Note that reported withdrawal data from the Edith Avenue WTP includes withdrawal from the White River North Well Field and Riverwood Well Field since water from both well fields is treated at the Edith Avenue WTP. As of this report, Allisonville Road WF wells have been added to IDNR Facility Number 04181, but production from the Allisonville Road WF wells was not included in the withdrawal data provided by IDNR through 2021. Most of the historical withdrawal data submitted to IDNR and shown on Figure 7 is from the White River North Well Field. Production well and observation well locations at White River North Well Field are shown on Figure 8. Production well construction details are shown on Table 1. The water-level data shown on Figure 7 were collected on an hourly basis using pressure transducers. Transducers installed in observation wells 94-E and 94-G have been used since 1997 to measure water levels at the White River North Well Field.

As shown on Figure 7, water levels at the well field show approximately five to ten feet of seasonal fluctuation. Also shown on Figure 7 is a gradual decrease in water levels since 1997 of

approximately 14 feet. Seasonal lows in 2000 and 2001 of 33 feet measured in Observation Well 94-G decreased to lows of 46 to 47 feet in 2016-2019. The drop in water levels corresponds with an increase in production and addition of wells from the White River North Well Field from 1.0 to 1.5 MGD prior to 2003 to 3.0 to 3.5 MGD since 2012. Although water levels have decreased since 1997, levels have been relatively consistent since 2012 when production was routinely over 3.0 MGD. Reported withdrawal declined in 2020 and 2021, coincident with the increase in production from Allisonville Road, and a corresponding increase in water levels at Observation Well 94-G has occurred.

Drawdown and Capacity Analysis

Graphs of specific capacity versus pumping rate for Wells 1, 3, 4, 5 and 9 at the White River North Well Field are included in Appendix A. Well 2 was replaced by Well 9 in 2018. A separate curve is plotted for each available flow test. The curves on each graph show how specific capacity and pumping rate have varied over time. Lower specific capacity at equal or lower pumping rates indicates a decline in well performance. The effect of well cleanings is evidenced by higher specific capacity at similar or higher pumping rates.

Current effective groundwater production capacity was evaluated for the White River North Well Field based on well performance data from the most recent flow test performed at each well in September/October 2021. Well 3 was not tested in 2021. The performance of Well 3 was based on the flow test performed in September 2020. Drawdown at each pumping well is a combination of well loss, formation drawdown and interference drawdown.

Groundwater production capacity of the White River North Well Field has been estimated at 6.0 MGD (3.3 MGD with the best well, Well 1 or Well 9, out of service) as presented in the Well 9 installation and testing report (Eagon, 2018) and the 2021 Wellhead Protection Area Delineation Update report (Eagon, 2021). Figure 9 is a graph showing daily production from the Edith Avenue WTP and water levels in Observation Well 94-G and the White River from January 2020 through October 2021. Production from the Edith Avenue WTP (the majority of which is from the White River North Well Field) has generally decreased from a high of 3.5 MGD

in 2019 to less than 2.0 MGD as of October 2021 reflecting the increased withdrawal from the Allisonville Road Well Field. Evaluation of the individual wells under current conditions (September/October 2021) was performed to estimate current effective production capacity of the White River North Well Field and to compare with previous estimates and current demand.

Well 1

Well 1 was installed in 2000. Well 1 is constructed with 31 feet of 20-inch diameter telescoping 0.100-inch slot well screen openings from 71 feet, bgl to 102 feet, bgl. The well screen transmitting capacity is 2,816 gpm at the design entrance velocity of 0.1 foot/second or 1,408 gpm if 50 percent well screen blockage is assumed. A graph of specific capacity data from flow tests performed on Well 1 since installation is included in Appendix A. The original flow test of Well 1 occurred in April 2000. Specific capacities of Well 1 have maintained close to or above the original specific capacities from the April 2000 test with no evident decline in well performance. Well 1 is rated at 2,000 gpm, and based on performance from the September 2021 flow test, is still capable of producing 2,000 gpm.

The static water level measured in Well 1 during the September 2021 flow test was 52 feet, which is considerably lower than the static water levels measured in the other wells. The lower water level could be attributed to Well 9 being in operation during the time of testing of Well 1. The static water level from September 2020 was applied to Well 1 to reflect water levels similar to those observed at Wells 3, 4, 5, and 9 during September 2021. In a confined aquifer, specific capacity is not affected by static water level, but reduced available drawdown due to lower static water levels limits well capacity.

Well 3

Well 3 was installed in 1997. Well 3 was constructed with a 24-inch diameter telescoping well screen with 100-slot (0.100-inch) screen openings from 62 to 87 feet, bgl. The well screen used was Johnson Hi-Q stainless-steel, wire-wrapped screen and the well screen design transmitting capacity is 2,782 gpm at an entrance velocity of 0.1 foot per second. If 50 percent

screen blockage is assumed, the well screen transmitting capacity is 1,391 gpm. A graph of specific capacity data from flow tests performed on Well 3 since installation is included in Appendix A. The original pumping test was performed in May 1997. A flow test was not performed on Well 3 in 2021, so the September 2020 flow test data were used as the most recent data to analyze current conditions. Specific capacity has dropped over time since May 1997 and has required increased cleaning frequency of 1-2 years in order to maintain a specific capacity of approximately 50 gpm/ft, which is less than the original specific capacity by almost 40 percent. The reported pumping rate of Well 3 is 900 gpm. According to the September 2020 flow tests, the maximum rate tested was 704 gpm with a specific capacity of 43.7 gpm/ft.

The specific capacity of Well 3 is much lower than the specific capacities of Wells 1 and 9 pumping at 2,000 gpm of 167 gpm/ft, and 137.8 gpm/ft, respectively. Plate 3 shows a cross section through the White River North and Riverwood Well Fields. As shown on Plate 3, Well 3 is completed shallower than Wells 1 and 9. Drilling of a test boring east of Well 3 toward Cumberland Road is recommended to determine if deeper, higher transmissivity aquifer materials such as those encountered at Wells 1 and 9 are present. If suitable aquifer is present at the test boring location, Well 3 could be replaced.

Well 4

Well 4 was installed in 2004. Well 4 was constructed with a 24-inch diameter telescoping well screen with 70-slot (0.070-inch) screen openings from 55 to 66 feet, bgl. and from 78 to 87.5 feet, bgl. A tight-wrapped section of screen was installed from 66-78 feet, bgl. The total length of open screen slots is 20.5 feet. The well screen used was Johnson Hi-Q stainless-steel, wire-wrapped screen and the well screen design transmitting capacity is 1,845 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well screen transmitting capacity is 923 gpm. A graph of specific capacity data from flow tests performed on Well 4 since installation is included in Appendix A. The original pumping test was performed in July 2004. Specific capacity has dropped significantly over time and Well 4 did not respond to the recent well cleaning performed in 2020. The September 2021 specific capacity of Well 4

was 13.6 gpm/ft at 445 gpm which is a reduction from the original specific capacity of approximately 66 percent.

As shown on Plate 3, Well 4 was completed in the unconsolidated materials just above bedrock. Drilling deeper into potentially higher transmissivity materials near Well 4 is not an option. A future replacement of Well 4 could be considered, but anticipated specific capacities would be comparable to the original of 35 to 40 gpm/ft.

Well 5

Well 5 was installed in 2009. Well 5 was constructed with a 24-inch diameter telescoping well screen with 100-slot (0.100-inch) screen openings from 58 to 63 feet, bgl. and 120-slot (0.120-inch) screen openings from 63 to 72 feet, bgl. The total length of open screen slots is 14 feet. The well screen used was Johnson Hi-Q stainless-steel, wire-wrapped screen and the well screen design transmitting capacity is 1,703 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well screen transmitting capacity is 852 gpm. A graph of specific capacity data from flow tests performed on Well 5 since installation is included in Appendix A. The original pumping test was performed in June 2009. Specific capacity has dropped over time. The September 2021 specific capacity of Well 5 was 22.1 gpm/ft at 796 gpm which is a reduction from the original specific capacity of approximately 37 percent.

The specific capacity of Well 5 is similar to Well 3. Just like Well 4, Well 5 was completed in the unconsolidated materials just above bedrock. Drilling deeper into potentially higher transmissivity materials near Well 5 is not an option. A future replacement of Well 5 could be considered, but anticipated specific capacities would be comparable to the original of only 33 to 38 gpm/ft.

Well 9

Well 9 was installed in 2017 as a replacement for Well 2. Well 9 was constructed with a 24-inch diameter telescoping well screen with 70-slot (0.070-inch) screen openings from 85.5 to

113 feet, bgl and 100-slot (0.100-inch) from 113 to 128 feet, bgl. The total length of open screen slots is 42.5 feet. The well screen used was Johnson Hi-Q stainless-steel, wire-wrapped screen and the well screen design transmitting capacity is 4,111 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well screen transmitting capacity is 2,056 gpm. A graph of specific capacity data from flow tests performed on Well 9 since installation is included in Appendix A. The original flow test of Well 9 occurred in August 2018. Specific capacities of Well 9 have been maintained close to the original specific capacities from the August 2018 test with no evident decline in well performance. Well 9 is rated at 2,000 gpm and, based on performance from the September and October 2021 flow tests, is still capable of producing 2,000 gpm.

Effective Well Field Capacity

Table 3 shows three pumping scenarios at the White River North Well Field based on September 2021 conditions. Static water levels shown are from the September 2021 flow tests performed by Bastin Logan with the exception of Well 3 (which was not tested in 2021) and Well 1. The static water level in Well 1 during September 2021 did not correlate with the static water levels from the other wells and was inferred to be influenced by pumping of Well 9. The static water level shown for Wells 1 and 3 are from the September 2020 flow tests. Pumping levels shown on the table were based on individual well performance from the September 2021 flow tests (and September 2020 for Well 3). Also shown on Table 3 under Scenario 1 is the reported operating rates for each well. As presented in the following section under various operation scenarios, September 2021 well performance indicates Wells 3 and 4 should be operated at slightly lower rates than reported. Well 3 should be operated at a maximum rate of 700 gpm and Well 4 should be operated at a maximum rate of 300 gpm. As a general recommendation, pumping levels under normal conditions should not exceed 70 percent of the available drawdown. Interference drawdowns applied to the pumping scenarios presented under current (September 2021) conditions were based on varying pumping rates extrapolated from projected 180-day formation drawdowns during the Well 9 72-hour pumping test. Using interference drawdowns from data extrapolated to 180 days is a conservative approach to estimating capacity.

The amount of interference drawdown is only due to aquifer characteristics and pumping rates and does not change over time.

The first scenario (Scenario 1) listed on Table 3 shows pumping levels in each well (including interference drawdown) while operating Wells 1 and 9 at 2,000 gpm each for a combined output of 5.8 MGD. Note that the water levels at Wells 3, 4, and 5 are right above or within the well screen under this scenario. In the conclusions and recommendations section of the Well 9 Installation Report (Eagon, 2018), interpretation of long-term interference drawdown data from the addition of Well 9 at 2,000 gpm indicated that pumping levels at Wells 3 and 4 would be below the tops of the well screens. Scenario 1 confirms that interpretation.

Scenario 2 is based on a combined output of 2,000 gpm or 2.9 MGD. This can be achieved by operating either Well 1 or Well 9 at 2,000 gpm. 2.9 MGD is in line with recent production from the Edith Avenue WTP of 1.0 to 3.0 MGD. An additional 300 gpm (0.4 MGD) can be produced by operating Well 4 in conjunction with either Well 1 or Well 9 for a combined output of 2,300 gpm (3.3 MGD). However, we do not recommend concurrent operation of Well 3 or Well 5 at 700 gpm and 450 gpm, respectively, with Wells 1 or 9 under current well conditions. Operation of Well 3 or Well 5 with Wells 1 or 9 would put pumping levels at the top of the well screens in Well 3 and 5.

Scenario 3 shows Wells 3, 4, and 5 can be operated together under current conditions to produce a combined 1,450 gpm or 2.1 MGD. If demand is lower than 2.1 MGD, the following well combinations can be operated as necessary:

Wells in Operation	Combined Output
Well 3 (700 gpm) and Well 5 (450 gpm)	1,150 gpm (1.66 MGD)
Well 3 (700 gpm) and Well 4 (300 gpm)	1,000 gpm (1.44 MGD)
Well 5 (450 gpm) and Well 4 (300 gpm)	750 gpm (1.08 (MGD)

Conclusions and Recommendations

Water levels at the White River North Well Field indicate a strong correlation with river levels and show significant seasonal variation. The lower water levels shown on the long-term water-level monitoring graph (Figure 7) can be attributed to a combination of seasonal variation and an increase in total groundwater production from the well field between 1997 and 2019. Lower water levels mean less available drawdown which limits overall production. Since 2012 water levels have remained within a relatively stable range when average production was consistently above 3.0 MGD. Water levels since 2019 have been higher reflecting decreased production from the White River North and Riverwood wells and an increase in production from the Allisonville Road wells. Even when water levels are lower, Wells 1 and 9 have enough available drawdown to account for seasonal lows. The wells at the White River North Well Field should continue to be tested annually and cleaned as necessary to maintain specific capacities.

Actual production from the White River North Well Field (Edith Avenue WTP) has ranged from 1.0 MGD to 3.0 MGD since October 2020. Based on analysis of current (September 2021) conditions, multiple operation scenarios exist for the White River North Well Field to meet the range in demand observed since October 2020. During periods of high demand, the White River North Well Field is capable of producing 4,000 gpm or 5.8 MGD with Wells 1 and 9 operating at 2,000 gpm each.

Drilled a test boring east of Well 3 is recommended to determine if deeper, higher transmissivity aquifer materials such as those encountered at Well 9 are present. If suitable aquifer is present at the test boring location, Well 3 could be replaced. Well 3 is currently the third-best well in the White River North Well Field and should continue to be utilized under various demand scenarios as outlined above. If deeper formation is present at the test boring location east of Well 3, a third deep well with specific capacity similar to Well 1 and Well 9 would provide redundancy, but would not result in a significant increase in well-field capacity.

Well 4 has not responded well to recent frequent cleanings. Due to the low specific capacity of less than 20 gpm/ft, it should be valved to operate at no more than 300 gpm and can be

operated with either Well 1 or Well 9, or operated simultaneously with Wells 3 and 5. During periods of lower demand, operating a combination of Wells 3, 4, and 5 would reduce use of Wells 1 and 9.

RIVERWOOD WELL FIELD

Water Levels

Figure 10 is a hydrograph of water-level data from Observation Well 09-2 and river stage data from the USGS gauge on the White River at Noblesville. Production well and observation well locations at the Riverwood Well Field are shown on Figure 11. Well 8 is a replacement for Well 6, which was replaced due to a rapid and unrecoverable decline in well performance that likely resulted from over-pumping. Current production well construction details are shown on Table 1. The water-level data shown on Figure 10 were collected on an hourly basis using a pressure transducer. The transducer installed in Observation Well 09-2 has been used since 2009 to collect water level data at the Riverwood Well Field.

As shown on Figure 10, water levels at the well field show up to 10 feet of seasonal fluctuation and a strong response to changes in river stage. Production data is not tracked for the Riverwood Well Field wells specifically. Production from the Riverwood Well Field is included in the production data reported for the Edith Avenue WTP, which also includes production from the White River North Well Field. Water levels since well field startup in July 2010 have been fairly consistent. Static water levels measured during flow tests of Wells 7 and 8 performed in September and November 2021 by Bastin Logan are slightly lower than when originally tested, but in line with water levels when Well 6 was in operation. Water-level monitoring should continue to determine if current withdrawal is exceeding available recharge.

Drawdown and Capacity Analysis

Graphs of specific capacity versus pumping rate for Wells 7 and 8 at the Riverwood Well Field are included in Appendix A. Both wells were installed in 2017. A separate curve is plotted

for each available flow test. The curves on each graph show how specific capacity and pumping rate have varied over time. Lower specific capacity at equal or lower pumping rates indicates a decline in well performance. The effect of well cleanings is evidenced by higher specific capacities at similar or higher pumping rates.

Current effective groundwater production capacity was evaluated for the Riverwood Well Field based on well performance data from the most recent flow test performed at each well in September 2021. Well 8 was cleaned and tested again in November 2021. Drawdown at each pumping well is a combination of well loss, formation drawdown and interference drawdown.

Groundwater production capacity of the Riverwood Well Field has been estimated as high as 2.0 MGD as presented in the Aquifer Test Analysis and Well-Field Capacity Evaluation - Riverwood Well Field report (Eagon, March 2010). However, due to the rapid performance deterioration of Well 6, a more conservative approach to the operation and maintenance of Wells 7 and 8 has been implemented. Current pumping rates reported by INAW for Wells 7 and 8 of 200 to 300 gpm and 300 to 400 gpm, respectively, are lower than would typically be recommended and lower than Well 6 was operated. Lower pumping rates have been used at Wells 7 and 8 to maintain well performance levels. Lower pumping rates reduce entrance velocities in each well and help reduce mineralization of the well screens, gravel pack (Well 7), and formation material. Evaluation of the individual wells under current conditions (September/November 2021) was performed to estimate current effective production capacity of the Riverwood Well Field considering the need to reduce pumping rates.

Well 7

Well 7 was installed in 2017 as a gravel pack well. 16-inch diameter steel casing and pipe-size screen were installed inside of the 24-inch borehole. Red Flint #50 gravel pack was installed between the well screen and the 24-inch borehole. Eighteen feet of well screen was set between 50 and 68 feet, bgl. The well screen used was Johnson Hi-Q stainless-steel, wire-wrapped screen with 0.050-inch slot openings. The well screen design transmitting capacity is 1,400 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well

screen transmitting capacity is 700 gpm. A graph of specific capacity data from flow tests performed on Well 7 since installation is included in Appendix A. The original flow test of Well 7 occurred in March 2017. Specific capacities of Well 7 have been maintained close to the original specific capacities from the March 2017 test, but the specific capacities measured during the September 2021 flow test are almost 20 percent lower than original. The specific capacity of Well 7 is lower than the specific capacity of Well 8 but has shown a normal decline in performance over time when compared to abandoned Well 6 and Well 8.

Well 8

Well 8 was also installed in 2017 near abandoned Well 6. Well 8 was constructed as a 24-inch diameter natural pack well with a screen slot size of 0.070-inch. Twenty feet of Johnson Hi-Q stainless-steel, wire-wrapped telescoping well screen was set between 51 and 71 feet, bgl. The well screen design transmitting capacity is 1,786 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well screen transmitting capacity is about 893 gpm. A graph of specific capacity data from flow tests performed on Well 8 since installation is included in Appendix A. The original pumping test was performed in April 2017. As shown on the graph, Well 8 was cleaned in 2019 and 2021, but the specific capacity has dropped since April 2017. The flow test performed in October 2019 showed a significant drop in performance of over 35 percent from original. The well cleaning in December 2019 was successful in restoring well performance to within 15 percent of original. The flow test performed in September 2021 also showed a significant drop in performance, but the specific capacity improved to within 15 percent of original after cleaning.

The specific capacity of Well 8 is higher than the specific capacity of Well 7 and Well 8 is capable of producing significantly more water than the 300-400 gpm that it is currently operated. However, Well 8 should continue to be operated at the lower pumping rate to prolong the life of the well.

Effective Well Field Capacity

Table 4 shows a pumping scenario based on conditions of Wells 7 and 8 during the September/November 2021 flow tests. Static water levels shown are from the September and November 2021 flow tests performed by Bastin Logan. Well 8 was cleaned and flow tested again in November 2021. Water levels shown for Well 8 are from November 2021. Pumping levels shown on the table were based on individual well performance from the September 2021 flow test of Well 7 and the November 2021 flow test of Well 8. As a general recommendation, pumping levels under normal conditions should not exceed 70 percent of the available drawdown. Because the pumping rates are reduced for Well 8, the target pumping level in Well 8 should not exceed 50 percent of the available drawdown. Interference drawdowns applied to the pumping scenario presented under current (September/November 2021) conditions were extrapolated from projected 180-day formation drawdowns during the Well 7 and 8 constant-rate pumping tests. Using interference drawdowns from data extrapolated to 180 days is a conservative approach to estimating capacity. The amount of interference drawdown is only due to aquifer characteristics and pumping rates and does not change over time. Additional modeled interference drawdown from operation of the White River North Well Field was also factored in as shown on Table 4.

The scenario shown on Table 4 indicates that under current conditions, an output of 0.94 MGD can be reasonably produced. Pumping rates of 280 gpm for Well 7 and 370 gpm for Well 8 would leave approximately 26 percent and 53 percent, respectively, of available drawdown remaining. Limiting production of Well 8 to approximately 370 gpm or 0.5 MGD is recommended to extend its life and to reduce excessive well maintenance costs.

Conclusions and Recommendations

Well 7 (200 to 300 gpm) and Well 8 (300 to 400 gpm) are currently operated at pumping rates that result in a total capacity of approximately 1.0 MGD from the Riverwood Well Field. Actual production from each well is not available but based on current (Fall 2021) conditions and well performance since installation in 2017 we recommend that the wells continue to be operated

at similar rates. The lower pumping rates used at Wells 7 and 8 help to maintain well performance and reduce well maintenance requirements.

Well 7 has not shown much decline in performance since installation, but the September 2021 flow test indicates that Well 7 could be cleaned. Well 8 has shown a drop in performance from original, but the well cleanings performed in 2019 and 2021 improved the performance to within 15 percent of original. Yearly flow testing is recommended and frequent well cleanings of every two years for Well 8 should be expected to maintain current performance. We continue to recommend paying close attention to pumping levels and specific capacities of both wells, but particularly of Well 8, so that significant reductions in performance can be observed before well performance declines to unacceptable levels.

FOREST PARK WELL FIELD

Water Levels and Production

Production well and observation well locations at the Forest Park Well Field are shown on Figure 12. Well 4 is located at the Wayne Street WTP, but is considered part of the Forest Park Well Field in this analysis. Most of the current production from the well field is from bedrock Wells 4 and 5. Well 2 is a sand and gravel well that is currently operated around 300 gpm. Well 3 was a sand and gravel well that was abandoned due to a hole in the well screen. Production well construction details are shown on Table 1. No transducers are set for long-term water level monitoring at the Forest Park Well Field because no bedrock observation wells are present. Production from the bedrock wells shows limited drawdown in the sand and gravel.

Water from the Forest Park Well Field and Well 4 is treated at the Wayne Street WTP. Figure 13 shows historical annual withdrawal data from the Forest Park wells reported to IDNR since 1985. Average daily withdrawal from the Forest Park Well Field has been around 1.0 MGD since 2008. Figure 3 shows the daily production from the Wayne Street WTP from January 2020 through November 2021. Average daily production reported for the Wayne Street WTP was about 1.0 MGD in 2020 and 0.76 MGD through November 2021. Maximum daily production

reported from the Wayne Street WTP between January 2020 and November 2021 was 1.91 MGD on June 20, 2020, March 29, 2021, and April 5, 2021.

Drawdown and Capacity Analysis

Graphs of specific capacity versus pumping rate for Wells 2, 4, and 5 at the Forest Park Well Field are included in Appendix A. A separate curve is plotted for each available flow test. The curves on each graph show how specific capacity and pumping rate have varied over time. Lower specific capacity at equal or lower pumping rates indicates a decline in well performance. The effect of well cleanings is evidenced by higher specific capacities at similar or higher pumping rates.

Current effective groundwater production capacity was evaluated for the Forest Park Well Field based on well performance data from the most recent flow test performed at each well in September 2021. Drawdown at each pumping well is a combination of well loss, formation drawdown and interference drawdown. For bedrock wells, well loss is typically higher than sand and gravel wells due to vertical variability in hydraulic conductivity of the bedrock and flow through discrete fractures. Well loss is not a constant and varies with pumping rate and condition of the well. Well loss does not vary with run-time of a well.

Groundwater production capacity of the Forest Park Well Field has been estimated at 2.8 MGD (1.8 MGD with the best well out of service) as presented in the Report of Installation and Testing – Well 5 report (Eagon, 2018). Overall bedrock aquifer production capacity from the Forest Park Well Field has been maximized with the addition of Well 5. Evaluation of the individual wells under current conditions (September 2021) was performed to estimate current effective production capacity of the Forest Park Well Field.

Well 2

Well 2 (Listed as Well 2R on Table 1) was installed in 2004. Well 2 was constructed as a 20-inch diameter natural pack well with a screen slot size of 0.100-inch. Twelve feet of Johnson

Hi-Q stainless-steel, wire-wrapped telescoping well screen was set between 38 and 50 feet, bgl. The well screen design transmitting capacity is 1,090 gpm at an entrance velocity of 0.1 foot per second. If 50 percent screen blockage is assumed, the well screen transmitting capacity is about 545 gpm. A graph of specific capacity data from available flow tests performed on Well 2 since installation is included in Appendix A. The earliest flow test available for Well 2 occurred in April 2010 and showed a specific capacity of 70.3 gpm/ft at 366 gpm according to flow test data from Bastin Logan. Performance of Well 2 has dropped since April 2010. The most recent well cleaning performed in 2019 brought specific capacities back to only 22 percent of the April 2010 capacity. The flow test performed in September 2021 was approximately 93 percent lower than April 2010 with a specific capacity range of only 9-12 gpm/ft. Specific capacities this low necessitate reducing the pumping rate to prevent water levels from dropping into the well screen. Pumping rates necessary to prevent water levels from dropping into the well screen are low enough to consider replacement of Well 2.

Well 4

Well 4 is a bedrock well installed in 1961. Well 4 has 12-inch black steel pipe advanced to 135 feet, bgl and open borehole to a total depth of 334 feet, bgl. The open borehole diameter is 12-inches from 135 feet, bgl to 300 feet, bgl and 8-inches from 300 feet, bgl to 334 feet, bgl. A graph of specific capacity data from available flow tests performed on Well 4 is included in Appendix A. No cleaning records are available for Well 4, but it appears that Well 4 has not been cleaned since November 2015. As shown on the graph in Appendix A, current (September 2021) performance of Well 4 has dropped over 50 percent since November 2015, reducing the rate at which Well 4 operates. Cleaning of Well 4 is recommended.

Well 5

Well 5 is a bedrock well installed in 2017. Well 5 has 12-inch steel casing advanced to 110 feet, bgl and open borehole to a total depth of 280 feet, bgl. The open borehole diameter is 12-inches from 135 feet, bgl to 280 feet, bgl. A graph of specific capacity data from flow tests performed on Well 5 since installation is included in Appendix A. As shown on the graph, current

(September 2021) performance of Well 5 has increased by approximately 30 percent since May 2017 when originally tested. Some of this increase can be attributed to a shorter pumping interval during the flow tests, but shows that performance has not decreased since May 2017.

Effective Well Field Capacity

Table 5 shows two pumping/production scenarios based on September 2021 conditions. Static water levels shown are from the September 2021 flow tests performed by Bastin Logan. The static water level for Well 4 was much lower than typical due to assumed interference from Well 5 operating during the flow test of Well 4. The static and pumping levels for Well 4 were adjusted to the reflect the same static water-level elevation measured at Well 5 during the September 2021 flow test. Pumping levels shown on the table were based on individual well performance from the September 2021 flow tests. As a general recommendation, pumping levels under normal conditions should not exceed 70 percent of the available drawdown. Available drawdown is the amount of water above the top of the well screen under static (i.e., non-pumping) conditions. For bedrock wells, the bottom of the well casing is used to calculate available drawdown. Pumping levels should be maintained within the well casing in bedrock wells as much as possible to prevent dewatering of any water-producing zones in the bedrock. Pumping levels that fall below the well casing are not necessarily an issue if levels are kept above any significant water-producing zones. Dewatering of producing zones in the bedrock would lead to a reduced well capacity and cascading water in the well that could result in precipitation of minerals on the borehole wall and a need for more frequent well rehabilitation. Interference drawdowns applied to the pumping scenarios presented under current (September 2021) conditions were extrapolated from projected 180-day formation drawdowns during the Well 5 constant-rate pumping test performed in 2017. Using interference drawdowns from data extrapolated to 180 days is a conservative approach to estimating capacity. 180-day interference drawdown measured at bedrock Well 5 from Well 2 operating at 550 gpm was four feet. Interference drawdown from Well 2 was proportionately adjusted in the pumping scenarios presented on Table 5.

The reported operating rates for bedrock Wells 4 and 5 are 700 gpm each. Under current (September 2021) conditions, Well 4 and Well 5 can operate independently at 700 gpm (1.0 MGD)

each without approaching the bottom of the well casing. However, based on current conditions, Well 4 should be valved back to a maximum rate of 600 gpm when operated simultaneously with Well 5 (at 700 gpm). Scenario 1 listed on Table 5 shows that under current conditions, Wells 4 and 5 can operate at 600 gpm and 700 gpm, respectively, for a combined output of 1.9 MGD. Both water levels are within the well casing under Scenario 1, but close attention should be paid to pumping levels in Well 4 to ensure they are maintained above any water-producing zones. If levels are dropping below the bottom of the well casing, and potentially below any water-producing zones, the pumping rate of Well 4 should be further reduced until Well 4 can be cleaned.

Scenario 2 is a combined output of 1.2 MGD with Well 5 operating at 700 gpm and Well 2 operating at 150 gpm. Well 2 could also be operated with Well 4 for a combined output up to 1.2 MGD (see Scenario 1). The reported operating rate for Well 2 is between 250-350 gpm. Based on current conditions, only 200 gpm (0.3 MGD) can be achieved from Well 2 operating by itself without pumping levels falling into the well screen. If Well 2 is operated in conjunction with either of the bedrock wells, a maximum pumping rate of 150 gpm should be set to prevent pumping levels from falling significantly into the screened interval. Even at 150 gpm, pumping levels in Well 2 may fall into the screened interval. 0.6 feet of available drawdown at Well 2 is too narrow of an operating margin to account for seasonal low levels or further reduction in capacity. Well 2 could be cleaned or potentially replaced to increase capacity from the sand and gravel at the Forest Park Well Field. Until Well 4 is cleaned and well performance is reassessed, production from the Forest Park Well Field should be limited to only Wells 4 and 5 operating at 500 gpm and 700 gpm, respectively, for a combined output of 1.7 MGD. This is slightly less than the maximum production of 1.9 MGD since January 2020.

Conclusions and Recommendations

Based on current (September 2021) conditions, Wells 4 and 5 can be pumped at 600 gpm and 700 gpm, respectively, for a combined output of 1.9 MGD. Without the best well in service (Well 5), capacity of the Forest Park Well Field is limited to a maximum of 1.2 MGD from Well 2 (150 gpm) and Well 4 (700 gpm) under current conditions. 1.2 MGD exceeds the average daily production from 2021 of 0.76 MGD.

Flow testing and water-level monitoring under static and pumping conditions should be performed so that any decline in well performance can be identified and well maintenance can be performed. Well maintenance should be performed before a significant loss of well performance occurs. Wells 2 and 4 have both shown a significant loss of well performance based on flow tests performed in September 2021. Well 4 should be cleaned and flow tested to reassess sustainable operating rates. The specific capacity of Well 5 has increased since originally tested in 2017 and does not need to be cleaned.

Well 2 is a shallow sand and gravel well with limited available drawdown above the well screen. Due to the reduction in performance of Well 2, we recommended cleaning or considering replacement of Well 2. Well 4 has also shown a reduction in well performance, but lowering the operating rate below 700 gpm if operated in conjunction with Well 5 until it can be cleaned will prevent water levels from dropping below the well casing. After Well 4 is cleaned the pumping rate can most likely be increased to 700 gpm while operating simultaneously with Well 5. Well 5 has shown an improvement in specific capacity since originally tested and a continued pumping rate of 700 gpm is recommended.

2022 EFFECTIVE CAPACITY – NOBLESVILLE WELL FIELDS

The effective capacity of each well field, based on September 2021 conditions, is listed below. The total effective capacity of the four existing INAW well fields is 11.2 MGD:

Allisonville – 2.4 MGD
White River North – 6.0 MGD
Riverwood – 0.94 MGD
Forest Park – 1.9 MGD

11.2 MGD is 2.7 MGD more than the peak daily demand of 8.5 MGD from June 2020, but lower than the combined estimated capacity of 11.8 MGD due to loss of well performance, specifically at Riverwood and Forest Park Well Fields. Additional capacity of 2.0 MGD has been estimated at the White River Christian Church (WRCC) Property. A transducer has been in place

in a sand and gravel observation well (14-1) at WRCC since June 2018 to see if water levels in the sand and gravel at WRCC are affected by bedrock pumping at Forest Park Well 5 and Wayne Street Well 4. The sand and gravel has not been visibly affected by operation of the bedrock wells. A bedrock well could be installed at the WRCC Property to potentially supplement the estimated production of 2.0 MGD from the sand and gravel.

A test boring completed east of the White River, south of Field Drive at the Baptist Church property did not show any suitable formation material above bedrock for a production well.

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FIGURES