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INDIANA UTILITY
REGULATORY COMMISSION

Petitioner's Exhibit 3

VERIFIED DIRECT TESTIMONY OF DREAMA E. DOOLITTLE
ON BEHALF OF THE CITY OF LAFAYETTE, INDIANA

Cause No. 45006

INTRODUCTION

Q. Please state your name, occupation and business address.

A. My name is Dreama E. Doolittle. I am an Executive Vice President with Wessler Engineering, Inc. ("Wessler"). My business address is 6219 South East Street, Indianapolis, Indiana 46227.

Q. Please describe your educational background.

A. I graduated from the University of Memphis in 1998 where I earned a Bachelor of Science in Civil Engineering degree. I acquire a minimum of 30 hours of continuing education every two years in fulfillment of keeping my P.E. license current.

Q. Please describe your professional experience.

A. I have been employed with Wessler Engineering for 19 years, hiring into the Drinking Water Group after graduating from college in 1998. Throughout my period of employment with Wessler, I have been designing, bidding, and

performing construction administration services for drinking water projects for our clients. I am experienced in feasibility studies and reports; water system hydraulic modeling; capital improvement plans; cost estimating, design of water supply wells, groundwater treatment plants, water distribution mains; and specifying water storage tanks.

Starting my career as an Engineer, I have advanced in technical knowledge and responsibility through the positions of Project Engineer, Project Manager, and Sr. Project Manager. I currently serve as a Sr. Project Manager, the Drinking Water Department Head, Executive Vice President, and Quality Assurance/Quality Control ("QA/QC") officer for Wessler.

As Sr. Project Manager, I undertake joint responsibility for client communications and the successful execution of each project or engagement in which I directly manage. During design, I communicate and hold meetings with each project team member to establish and maintain definition of the client's needs and schedules. I review and evaluate planning ideas, engineering calculations, capital improvement recommendations, estimates of construction costs, technical designs, construction drawings, and detailed specifications. I also perform bidding phase and construction phase services for projects.

As Department Head, I assign, monitor, and review the technical adequacy and schedules of the work performed by the Drinking Water Group consisting of two (2) Sr. Project Managers, one (1) Project Manager, two (2) Project Engineers, one (1) Engineer, and one (1) Sr. Designer. I mentor and provide opportunities for the

technical and professional development of members of the Drinking Water Group.

As QA/QC officer, every month I communicate with each Project Manager of every level in the company to review due dates for studies and design projects under their charge. Various engineering tasks (survey, engineering calculations, design, CAD, drawings and specifications, etc.), require QA/QC reviews at Wessler and are listed and tracked on a spreadsheet to substantiate the proper QA/QC reviews are being completed by experienced senior engineers in the company.

As Executive Vice President, my duties include assisting the President of Wessler with the overall management and operations of the company. Some specific duties include maintaining effective communications throughout the company; assisting with long-range planning and policies, including the Strategic Plan and Business Plan; reviewing qualifications, proposals, and contracts; conducting quarterly Individual Development Plans of staff assigned; assisting with hiring; and assisting with the management and resolution of day-to-day staff issues that arise.

Q. Are you a registered professional engineer?

A. Yes. I am a registered professional engineer in the State of Indiana.

Q. Was Wessler retained by the City of Lafayette, Indiana ("Lafayette"), to prepare a capital improvements plan?

A. Yes. Lafayette's Board of Public Works and Safety (the "Board") retained Wessler to prepare a capital improvements plan for Lafayette's water utility. We have prepared the Water System Capital Improvements Plan (the "CIP") attached to my testimony as Petitioner's Attachment DED-1.

Q. Please state the purpose of your testimony.

A. I am testifying in support of the rate increase requested by Lafayette in this Cause by presenting engineering evidence to demonstrate that certain capital improvements are needed in Lafayette's water utility. I will discuss the manner in which the CIP was prepared, how the capital projects were selected, and what alternative options were reviewed.

CIP PREPARATION

Q. Please discuss, at a high level, the process Wessler undertook in preparing the CIP?

A. Wessler engaged in a holistic process that involved several elements: detailed information gathering by way of field investigations and discussions with the water utility staff; hydraulic modeling; engineering computations and evaluations; and recorded findings of the results in a written report presented as the CIP.

Q. Please describe the information gathering phase of CIP preparation?

A. Wessler undertook a comprehensive process to gather information necessary to prepare the CIP. Wessler interviewed utility staff, including operators and management staff. Wessler examined and inventoried Lafayette's existing process water infrastructure during several weeks of field investigations alongside utility staff. All components of the system with a value greater than $5,000 were included in the examination and inventory.

During the examination and inventory process, each system component was logged and as applicable, information documented about the component including: name, manufacturer, type, location, capacity, physical characteristics, age, condition, system function, and other related information.

Wessler also examined historical water main break records (1987 to 2016), which the utility maintained. Lafayette's records of water main breaks included dates and locations, pipe material, and approximate age. The break locations were mapped in a GIS system to evaluate the data. We reduced the data set to only breaks occurring since 2001 because the large amount of data made it difficult to determine where recent problems were occurring in the system. High concentration areas of the more recent water main breaks were reviewed to determine if the breaks were occurring on the same water main, parallel mains, branch mains, or services. Significant attention was given to the age and break/repair history of the water mains as criteria for replacement.

Q. Please discuss the hydraulic modeling process that Wessler undertook in preparing the CIP?

A. To create the hydraulic model of the Lafayette water system in preparation of performing the work for the CIP, Wessler undertook several steps. Preliminarily, we compiled information on the following:

1) Existing major components comprising the Lafayette water system, including physical and operational characteristics of wells, well pumps, water mains, Columbian Park reservoir, Columbian Park Booster Station and high service pumps, water storage tanks, and the connectivity and controls of these components;
2) Water usage data and distribution of the water throughout the water system, with special consideration given to the location of heavy users;
3) The experience of Lafayette's water utility staff, which was used to calibrate the model to accurately reflect the operations of Lafayette's water system; and
4) Projections of the amount and areas of future growth were derived from a study already completed by the Tippecanoe County Area Plan Commission.

Q. How does the preparation of a hydraulic model assist with the preparation of a capital improvement program such as the CIP?

A. Hydraulic modeling of a water system allows for evaluation of a utility's ability to provide reliable water service to its customers in regards to maintaining adequate pressure, fire protection, water quality, and reliability of uninterrupted supply. Water demand is the driving force for the operation of a water system. The model allows us to easily replicate what happens in a water system if a water demand is needed in a specific portion of the system (such as to fight a fire or to provide service to a large water user), or if a physical change is made in the system (such as increasing the size of a water main). Modeling different situations in the system enables the utility to effectively forecast and plan future modifications and improvements that will make their water system more efficient and functional.

Q. Please discuss the computation and evaluation process that Wessler undertook in preparing the CIP?

A. After calibration, the hydraulic model was used to evaluate and verify capacity and hydraulic deficiencies in the existing system, and to identify needed improvements to serve future growth and development expected in the next 20-years.

Wessler prepared an asset management evaluation using information gathered from detailed field investigations. This asset management evaluation allowed us to determine which process and distribution assets pose a high risk to Lafayette in

maintaining a quality potable water supply to customers. A Business Risk Exposure ("BRE") rating was calculated and applied to each system component (again, $5,000 or more) to determine priority needs in the water system.

The evaluation and computation process CIP reflects both existing and future needs for improvements to the water system as determined from these investigation and evaluation processes.

CIP FINDINGS

Q. Please walk us through the CIP.

A. The CIP is organized into 8 sections:

1. Project Location – This section identifies the project and basic parameters within which the CIP was performed.
2. Current Needs – This section reports on the data gathered during the preparation process that identifies existing water consumption, water facilities (including information used to identify the BRE), and Lafayette's annual main replacement program.
3. Future Needs – This section analyzes projected 20-year population growth, population demands, land use and development, and system demands.
4. Evaluation of Alternatives – This section identifies potential alternatives to meet Lafayette's water utility needs.

5. Evaluation of Environmental Impacts – This section provides for environmental impacts in the event Lafayette chose to pursue state revolving fund financing.
6. Proposed Improvements – This section identifies the improvements proposed to meet Lafayette's infrastructure needs. A short-term project summary spreadsheet is found on page 75 of the CIP. The long-term capital projects identified in the CIP represent a total investment of over $126 million and are not included in this rate case.
7. Legal, Financial and Managerial Capabilities – This section provides for legal, financial and managerial capabilities in the event Lafayette chose to pursue state revolving fund financing.
8. Public Participation – This section provides for the requisite public input in the event Lafayette chose to pursue state revolving fund financing.

Q. Please describe your findings concerning the state of Lafayette's water system and identify any high priority system needs?

A. Lafayette's water system is generally in good shape, however, certain infrastructure investments are needed. As one might expect not having had a rate case in over 15 years and experiencing the type of growth that Lafayette has, the system needs investment. The investigation and evaluation process identified several components at a high-risk exposure rating in Lafayette's water system. The high priority system needs can be broken down as follows:

- Upper Pressure Zone – Additional Supply, Redundancy, Upgrades
- Upper Pressure Zone – Water Storage & Pressure
- Glick Well Field Operations
- Distribution System Improvements

Q. How did Wessler determine what were high priority system needs?

A. Wessler evaluated Lafayette's water system as I described above and assigned a BRE rating to Lafayette's infrastructure. I discuss the BRE ratings and their determination later in my testimony. Generally, the results of the BRE evaluation determined whether an asset is at low, moderate, high, or severe risk of failure and includes consideration of the consequence of failure of the asset. As I discuss later in my testimony, Wessler used the BRE as a component in determining which capital projects that Lafayette should undertake.

Q. Please discuss the Upper Pressure Zone – Additional Supply, Redundancy and Upgrade needs?

A. The Columbian Park Booster Station and the 5 million gallon ("MG") concrete groundwater reservoir are the sole means by which the Upper Pressure Zone receives its supply of water. Failure of the Columbian Park Booster Station or the 5 MG reservoir would have a devastating effect on the water supply to the customers located in the Upper Pressure Zone, where 81% of the utility's water demand is supplied (6.8 MG on an average day out of 8.4 MG total for the

system). Most large water users are in the Upper Pressure Zone and include critical facilities, such as schools and healthcare facilities, as well as a substantial load from industry.

To supply the reservoir with water, Lafayette's pumps water through the treatment facilities and into to the 5 MG reservoir. The Columbian Park Booster Station then pumps water from the reservoir to upper pressure zone customers and elevated water storage tanks. If the Columbian Park Booster Station is inoperable or if the 5 MG reservoir is inaccessible, the only source of supply left to the Upper Pressure Zone are the four (4) elevated water storage tanks with a combined maximum storage volume of 5 MG. This supply would be depleted within 18 hours at the average day water demand of the upper pressure zone. The upper zone would then be without potable water and without fire protection.

In its current configuration, Lafayette's water system is without additional means of supplying potable water to the Upper Pressure Zone, and this needs to be remedied through additional infrastructure to provide redundancy and additional capacity within the Upper Pressure Zone.

As to upgrades related to the 5 MG reservoir, that 5 MG reservoir is believed to be leaking and needs to be evaluated by a structural engineer specializing in storage tanks due to the high consequence of failure to the Upper Pressure Zone.

As to upgrades specific to the Columbian Park Booster Station, we noted that the electrical systems at the Columbian Booster Station are aged. Specifically, the electrical service disconnect and Motor Control Center ("MCC") are aging and

showing signs of wear. The consequence of failure for the Automatic Transfer Switch ("ATS") and MCC are both high due to the Columbian Park Booster Station's high consequence of failure. The pump starters, MCC and the main disconnect need to be replaced.

Accordingly, as the service area with over 80% of the system water usage, the Upper Pressure Zone requires an alternate source of supply and repairs to existing infrastructure in order to achieve redundancy, resiliency and adequate capacity in water delivery.

Q. Please discuss the Upper Pressure Zone – Water Storage and Pressure needs?

A. As I just discussed in response to the prior question, the aggregate storage capacity of the elevated water storage tanks in the Upper Pressure Zone does not meet the average day demand. The *Recommended Standards for Waterworks (10 States Standards)* provides for a recommended storage capacity of a water system meet the average day demand. The maximum water storage in the Upper Pressure Zone is currently 1.8 MG below the current average day demand of the Upper Pressure Zone. This needs to be remedied.

Moreover, fire protection to the Wea Ridge Elementary School, which is located in the Upper Pressure Zone and a significant distance from the Columbian Park Booster Station and the proposed Murdock Booster Station that I discuss later, is inferior to fire protection in the rest of Lafayette's water system. The water

system cannot provide a 2,000 gpm flow without dropping local pressures below 20 psi. This water pressure issue must be addressed.

Q. Please discuss the Glick Well Field Operations needs?

A. The Glick Well Field contains five (5) active groundwater wells, which are in the floodway of the Wabash River, that supply raw water to Lafayette. The pump motors are on elevated platforms above the 100-year flood elevation. When flooding occurs, the wells are inaccessible until the flood waters recede. Therefore, the electrical, controls, and SCADA systems for the wells, located in the Glick treatment building and used to cycle the well pumps on and off, are crucial to the operations of the Glick Well Field. The starters for the pump motors are showing significant wear and have a high probability of failure due to their age and physical condition. If a starter fails, the well will not be able to operate. These starters should be replaced.

Starters in the aged MCC in the Glick Well Field treatment facility are no longer in use, but other loads are powered from the MCC with circuit breakers. The facility has no standby power, but the wells each have dedicated power feeds. Controls for the wells are by a power line communication ("PLC") located in the treatment facility. It is necessary for the PLC and other local well control panels stay in service. The old MCC and disconnect need to be replaced.

A submersible well in the Glick Well Field operates to keep a plume of contamination away from the remaining five (5) wells. It is believed the well was

installed around 1980. It is unknown when the well was last cleaned and tested, or when the pump and motor were last rehabilitated or replaced. The continued operation of the well is extremely important to keep Lafayette's water supply in the Glick Well Field protected, so the well should be cleaned and a new submersible pump and motor should be installed.

Sodium hypochlorite is used to disinfect the water pumped from the Glick Well Field. Frequent repairs to the chemical feed system substantiate the need to replace the system, which has a high consequence of failure due to public safety concerns.

Accordingly, we believe no "greenfield" infrastructure is needed at the Glick Well Field, but existing infrastructure needs to be replaced due to its advanced age and resulting wear.

Q. Please discuss the Distribution System Improvements needed?

A. Lafayette's water utility contains approximately 390 miles of water main. Most pipes are made of cast iron, a brittle material used prior to the introduction of ductile iron pipe, and most water mains in the Lower Pressure Zone are over 100 years old. Lafayette has experienced and tracked numerous water main breaks over the years, many with multiple breaks on the same main. Water main breaks cause issues to the utility and its customers, including being out of service while the break is being repaired, water quality issues (potential boil orders), cost of emergency repairs, and danger to critical facilities such as hospitals, schools, and

elderly care facilities, loss of production of manufacturing facilities, cost of lost water, among numerous other expenses and inconveniences. Needs other than main breaks for water main replacements include low fire flow capacity, lead service lines, looping dead end mains for better water quality, and replacing mains that are located under streets that are being replaced. Lafayette's distribution system will need to undergo additional investment beyond the scope of what is being proposed in this rate case.

Q. Please summarize Lafayette's water system needs based on the findings in the CIP?

A. Lafayette needs water infrastructure improvements in four basic areas:

1. Booster Station and Reservoir – the existing Columbian Park Booster Station and 5 MG concrete reservoir are the sole source of supply to the Upper Pressure Zone. Upgrades to these facilities to replace aging equipment are required, and a new source of supply is required for redundancy, resiliency and growth accommodation;
2. Upper Pressure Zone Water Storage and Pressure – fire protection is deficient in the southern portion of Lafayette's service area, specifically within the vicinity of the Wea Ridge Elementary School. Additional water storage is also needed to serve projected demand in the southern portion of the service area. A new storage tank will alleviate storage needs and bolster fire protection where required;

3. Glick Well Field – existing electrical and chemical feed equipment are severely worn and aged and need to be replaced; and
4. Distribution System – Lafayette's distribution system contains a significant amount of main that needs to be replaced. This will be an ongoing issue for Lafayette as mains not replaced with money from this rate case will continue to deteriorate.

CAPITAL PROJECTS

Q. Please take us through the projects selected for inclusion in this rate case.

A. I will discuss the four project categories in the order discussed.

Upper Pressure Zone – Additional Supply, Redundancy and Upgrade Project

Q. Please identify the project alternative chosen and explain why the project was selected.

A. As I testified earlier, the Columbian Park Booster Station is operating at its capacity, which meets the current average day demand of the Upper Pressure Zone, but it barely keeps up with the current maximum day demand. The Columbian Park Booster Station and 5 MG reservoir are the sole source for moving water from the Lower Pressure Zone (where all the water wells are located) to the Upper Pressure Zone. An additional supply feed into the Upper Pressure Zone is needed to accommodate projected growth, to provide redundancy and resiliency, as well as additional water storage. If the Columbian

Park Booster Station or the 5 MG reservoir are not operable, the Upper Pressure Zone only has an 18-hour supply of water.

To solve the redundancy, resiliency and storage issues, a new booster station and ground storage reservoir is proposed at Murdock Park. The proposed booster station, known as the Murdock Booster Station, is proposed to handle 6 MGD with a ground storage reservoir of 3 MGD. This 9 MGD increase in firm capacity is projected to meet future maximum day demand in the Upper Pressure Zone. The addition of the Murdock Booster Station and ground storage reservoir will provide the needed redundancy to allow the Columbian Park Booster Station and reservoir to be taken off-line for maintenance and can handle the water supply needs of the Upper Pressure Zone in the event of a failure of the existing Columbian Park Booster Station and 5 MG reservoir.

The proposed Murdock Booster Station and 3 MG reservoir were selected because the projects met the requirement to provide for an additional feed into the Upper Pressure Zone and could be located in a geographical area that allowed the additional feed into the Upper Pressure Zone.

Q. What is the cost of the Murdock Booster Station and 3 MG reservoir project?

A. The estimated cost for the 6 MGD Murdock Booster Station and 3 MG reservoir, including building, pumps, piping, valves, chemical feed, electrical, plumbing,

HVAC, SCADA, water main extension, generator, other appurtenances, land purchase, and engineering is $10,569,000.

Q. Are any improvements to the Columbian Park Booster Station and 5 MG reservoir recommended?

Yes. Upgrades at the Columbian Park Booster Station and 5 MG reservoir are also recommended. These upgrades include a new MCC and disconnect and provide for inspection of the reservoir by a structural engineer for leaks. These recommended improvements are needed for continued reliable operation of the existing Columbian Park Booster Station and reservoir. The estimated cost for these projects is $232,000.

<u>Upper Pressure Zone Water Storage and Pressure Project</u>

Q. Please identify the project alternative chosen and explain why the project was selected.

A. Lafayette needs a new 2 MG elevated storage tank within the Upper Pressure Zone and on the southern side of Lafayette to maintain adequate pressure and bolster fire protection for the area and to supplement water storage in the Upper Pressure Zone. Larger diameter mains and attendant valves, hydrants, SCADA, and other components, will also be needed to provide proper operations of the proposed 2 MG elevated storage tank, which is identified in the CIP as the Wea Ridge Tank.

As I testified earlier, Lafayette's current water storage capacity in the Upper Pressure Zone does not meet the current average day demand. Under existing conditions, if the Columbian Park Booster Station or 5 MG reservoir are out of service, the customers in the Upper Pressure Zone will only have water for 18 hours maximum and then at reduced pressure.

Additionally, fire protection for and in the vicinity of the Wea Ridge Elementary School needs to be bolstered. The size of the water mains that service the school from the larger mains looping Lafayette are restrictions to high flows to the area. Increasing development to the south and projected growth in the Upper Pressure Zone creates need for additional storage and ample fire protection for those areas of Lafayette. The 20-year projected increase in average day demand for the Upper Pressure Zone is 2.2 MGD. The Upper Pressure Zone is currently 1.8 MG short of meeting the current average day demand storage, creating a future shortfall of 4 MG of emergency storage. Accordingly, the 2 MGD Wea Ridge Tank must be built to address these needs, in addition to enhancing the fire protection capabilities of the system in the southern portion of Lafayette's service area. Additionally, the proposed Wea Ridge Tank is approximately $300,000 less expensive than the other alternative studied to alleviate this need within Lafayette's water system as shown on page 59 of the CIP.

Q. Wouldn't the proposed Murdock Booster Station and 3 MG reservoir be sufficient for this purpose?

A. No. The Wea Ridge Tank is needed in addition to the proposed Murdock Booster Station and 3 MG reservoir. The hydraulic modeling results indicated that even with the Murdock Booster Station and 3 MG reservoir that fire protection would still be insufficient in the southern portion of Lafayette's service area. The two reservoirs (the existing 5 MG reservoir and the proposed 3 MG reservoir) are located a sufficient distance from the proposed Wea Ridge Tank such that additional water storage and pressure are needed in the area proposed for the Wea Ridge Tank. To draw 2,000 gpm fire flows from the reservoirs (by pumping) or form the other tanks to the Wea Ridge area, the water must travel a long distance such that the resulting head loss through the pipes reduces the pressure in the area.

Q. What is the cost of the Wea Ridge Tank project?

A. The cost of the water tank project, including the 16" water main connection to the 24" loop, hydrants, valves, site fencing, SCADA, appurtenances, and engineering is estimated to be $4,685,000.

<u>Glick Well Field Project</u>

Q. Please identify the project alternative chosen and explain why the project was selected.

A. To address the Glick Well Field project, our review and information studied during the CIP process led us to determine that the best solution was to replace existing equipment rather than construct entirely new infrastructure. The risk

exposure and consequence of failure of the Glick Well Field is rated as high. With the Glick Well Field being located in the floodway and inaccessible during high water, it is important to keep the operating components in good condition.

As I testified earlier, the improvements needed at the Glick Well Field primarily consist of electrical equipment, well upgrades, and chemical feed equipment. Accordingly, the following specific improvements are proposed at the Glick Well Field:

1. New MCC, electrical service disconnect, and five (5) well pump starters are needed due to the age and condition of these electrical components. The existing starters are showing significant wear and when a starter fails, the well pump will not operate. The MCC powers the remaining electrical system which needs to be in service for reliable operation of the well field.
2. The submersible pump and motor needs to be replaced and the well cleaned to maintain operation of this pump that diverges the plume of contaminations away from the other wells that pump to the water system.
3. On-site sodium hypochlorite generation is needed. Lafayette already has all it needs to produce sodium hypochlorite on-site, except for the generator. By acquiring the generator, Lafayette can avoid stockpiling and transporting sodium hypochlorite, a hazardous substance, and the attendant risks involved in doing so.

Q. What is the cost of these Glick Well Field projects?

A. The costs of the well field projects, including engineering, are estimated to be $633,000, which is made up of $383,000 for the electrical equipment and well-related upgrades and $250,000 for the generator.

Distribution System Projects

Q. Please identify and explain the need for the distribution system projects.

A. Wessler recommended 11 of the highest priority distribution system projects. The common theme running through each project is the gaining of efficiencies with other infrastructure projects within Lafayette. Most of the efficiencies stem from road construction projects, but a sewer interceptor project also allowed Lafayette to efficiently plan the main replacement projects.

The specific projects are set forth below:

1. Vinton Subdivision East End Water Main Replacement. The nearly 3 mile stretch of 8" and 4" cast iron main needs to be replaced. This project scored high on the priority replacement list in our analysis. Lafayette proposes to replace the existing main with a ductile iron main and to replace valves, hydrants and other appurtenances, along the route in conjunction with a road project, thereby maximizing value by not having to perform street cuts after the road is replaced. The project cost is $3,658,000.

2. South 4th St., Thise Ct., Woodview Ct. Water Main Replacement. This project consists of an approximately 2,845 foot section of 6" and 4" cast iron main that is proposed for replacement with ductile iron main, as well as valves, hydrants and other appurtenances. This is also proposed in conjunction with a road project. The project cost is $575,000.
3. Meharry St., Vinton St., North 21st St. Water Main Replacement. This project consists of an approximately 1,840 foot section of 8" and 4" cast iron main that is proposed for replacement with ductile iron main, as well as valves, hydrants and other appurtenances. This is also proposed in conjunction with a road project. The project cost is $464,000.
4. Wabash Avenue Water Main Replacement. This project consists of an approximately 2,710 foot section of 12" cast iron main that is proposed for replacement with HDPE water main to be installed using horizontal directional drilling, as well as valves, hydrants and other appurtenances. This is also proposed in conjunction with a road project. The project cost is $624,000.
5. Sagamore Parkway Water Main Replacement. This project consists of an approximately 2,500 foot section of main being replaced or installed as follows:
    a. 950 foot section of 6" cast iron pipe to be replaced with a new 6" ductile iron main that includes a new steel casing bored under the railroad;

b. 600 foot section of 6" pipe to be replaced with 12" pipe;

c. 950 foot section of new 6" ductile iron main.

As with the other projects, this project is proposed to be completed in conjunction with a road project. The project cost is $589,000.

6. Greenwich Rd., Haverford Dr., Hampton Dr. Water Main Replacement. This project consists of an approximately 3,655 foot section of 6" cast iron main that is proposed for replacement with ductile iron water main, as well as valves, hydrants and other appurtenances. This is also proposed in conjunction with a road project. The project cost is $720,000.

7. Brown St. Water Main Replacement. This project consists of an approximately 3,400 foot section of 8" cast iron main that is proposed for replacement with ductile iron water main, as well as valves, hydrants and other appurtenances. Additionally, 4" and 20" main reconnections will be made to the replaced main. Unlike the other projects on this list, this project is not proposed in connection with a road project but rather is proposed in conjunction with a sewer interceptor project. Accordingly, Lafayette will still realize efficiencies related to infrastructure installation. The project cost is $1,168,000.

8. Westridge Circle Water Main Replacement. This project consists of an approximately 500 foot section of 6" cast iron main that is proposed for replacement with ductile iron water main, as well as valves, hydrants and

other appurtenances. This is also proposed in conjunction with a road project. The project cost is $112,000.

9. Edgelea Addition Water Main Replacement. This project consists of an approximately 6,545 foot section of 6" cast iron main that is proposed for replacement with ductile iron water main, as well as valves, hydrants and other appurtenances. This is also proposed in conjunction with a road project. The project cost is $1,418,000.

10. Birch Lane Water Main Replacement. This project consists of an approximately 590 foot section of 4" cast iron main that is proposed for replacement with ductile iron water main, as well as valves, hydrants and other appurtenances. This is also proposed in conjunction with a road project. The project cost is $120,000.

11. Automatic Hydrant Flushing Equipment. Lafayette proposes to install 20 automatic flushing units on dead end pipes between Wildcat Creek and I-65 in order to address water quality concerns. The total installed cost for the proposed 20 units is $50,000.

Additional information on each of these projects is included in the CIP.

Q. You've provided individual project costs. What is the total cost of these distribution system projects?

A. The cost of the eleven priority water main replacement projects and hydrant flushing equipment is $9,498,000.

COST OF CAPITAL PROJECTS

Q. Please describe the methodology for determining the costs of the proposed capital projects?

A. Each component of the recommended projects was broken into detailed items and a construction cost applied to each item according to documented costs from recent projects that have publicly bid. The cost of individual items were summed and estimated engineering fees applied to get the total project cost.

CONCLUSION

Q. Do you believe the proposed capital projects are reasonable and necessary?

A. Yes. After intensive and extensive study of Lafayette's water utility system culminating in the CIP, I believe the capital projects proposed in this rate case are reasonable and necessary for Lafayette's continued provision of safe, secure and reliable drinking water for its current and future water utility customers.

Q. Do you believe the cost of the capital projects is reasonable?

A. Yes.

Q. Ms. Doolittle, please summarize your testimony.

A. Lafayette retained Wessler to prepare the CIP. The CIP identifies multiple capital needs for Lafayette's water utility, and Lafayette determined to implement certain

of the capital projects identified in the CIP. The capital projects included in this rate case involve water supply projects, water storage projects, booster station projects, and distribution system projects. All the system needs were evaluated and proposed projects were analyzed and alternatives were reviewed. The result is a set of reasonable and prudent capital improvements that, when completed, will greatly enhance Lafayette's water utility system and enable the continued provision of safe, clean drinking water to Lafayette's customers.

Q. Does this conclude your prefiled direct testimony at this time?

A. Yes, it does.

18591175

Verification

I hereby verify under the penalties for perjury that the foregoing representations are true to the best of my knowledge, information and belief.

Signature: Dreama E. Doolittle
Dreama E. Doolittle

Dated: 11/08/2017

Cause No. 45006

City of Lafayette, Indiana

Petitioner's Attachment DED-1: Capital Improvements Plan

Water System
Capital Improvements Plan

prepared for

BOARD OF PUBLIC WORKS AND SAFETY
CITY OF LAFAYETTE, IN

December 2016

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EXECUTIVE SUMMARY

Introduction

The City's last 20-year CIP was completed in 2000, but focus was quickly shifted from this plan to address government mandates resulting from September 11, 2001 including water utility vulnerability assessments, risk management, and security evaluations. This Water System Capital Improvements Plan (CIP) has been developed for the City of Lafayette (City) to evaluate the condition and capacity of their current water system assets and improvements needed to serve their customers in the next 20 years. Evaluation of water system assets is needed to address an operating budget deficit.

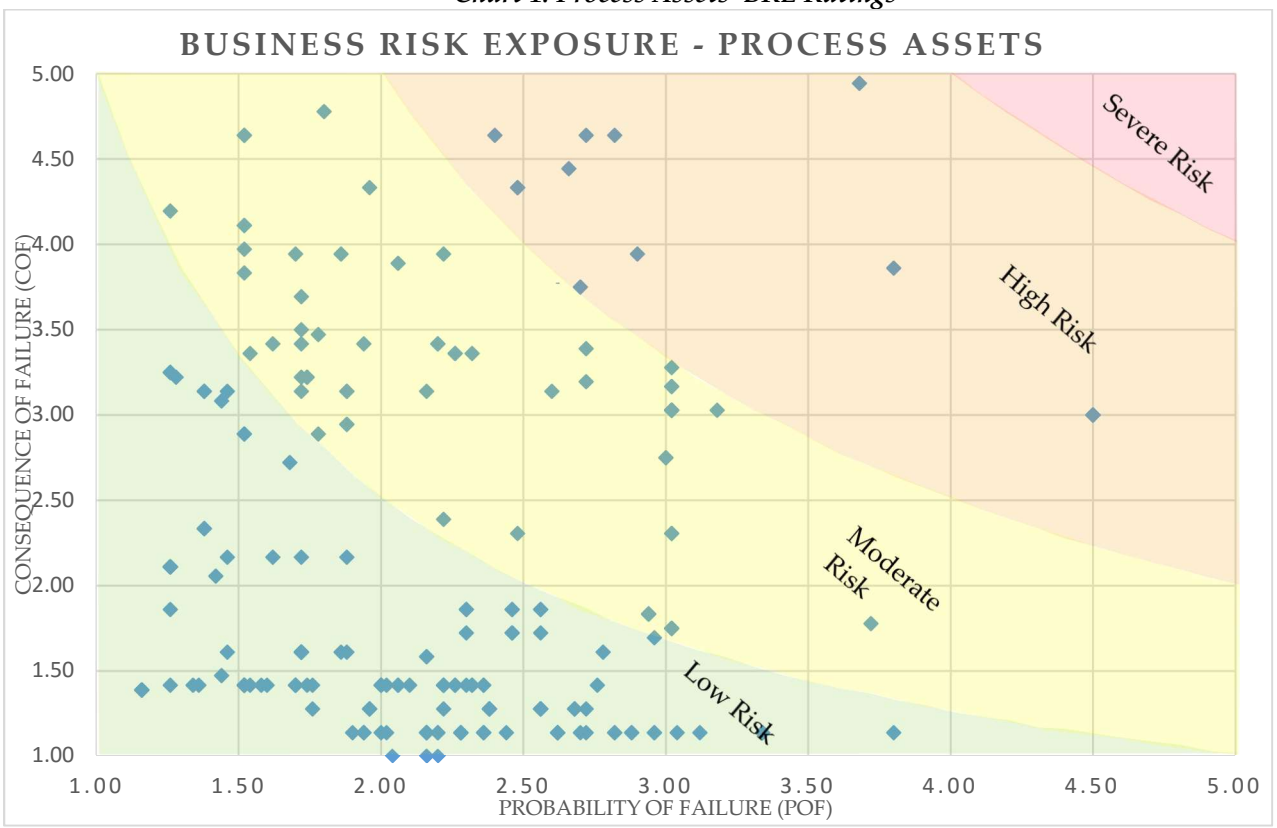
The improvements included in the CIP have been developed using two methods: (1) An asset management evaluation of existing water system components valued over $5,000 and (2) An analysis of the water system utilizing hydraulic modeling. Refer to **Figure A-1** in **Appendix A** for the service area included in this CIP.

Asset Management Evaluation

Process Assets - Results Summary

Process assets, consisting of pumps, motors, valves, wells, chemical feed systems, electrical, controls, buildings, and tanks, were evaluated and assigned a business risk exposure (BRE) rating. The BRE rating results are plotted on **Chart 1**, using their probability of failure and consequence of failure. Assets that are rated as "severe" or "high" are identified for rehabilitation or replacement.

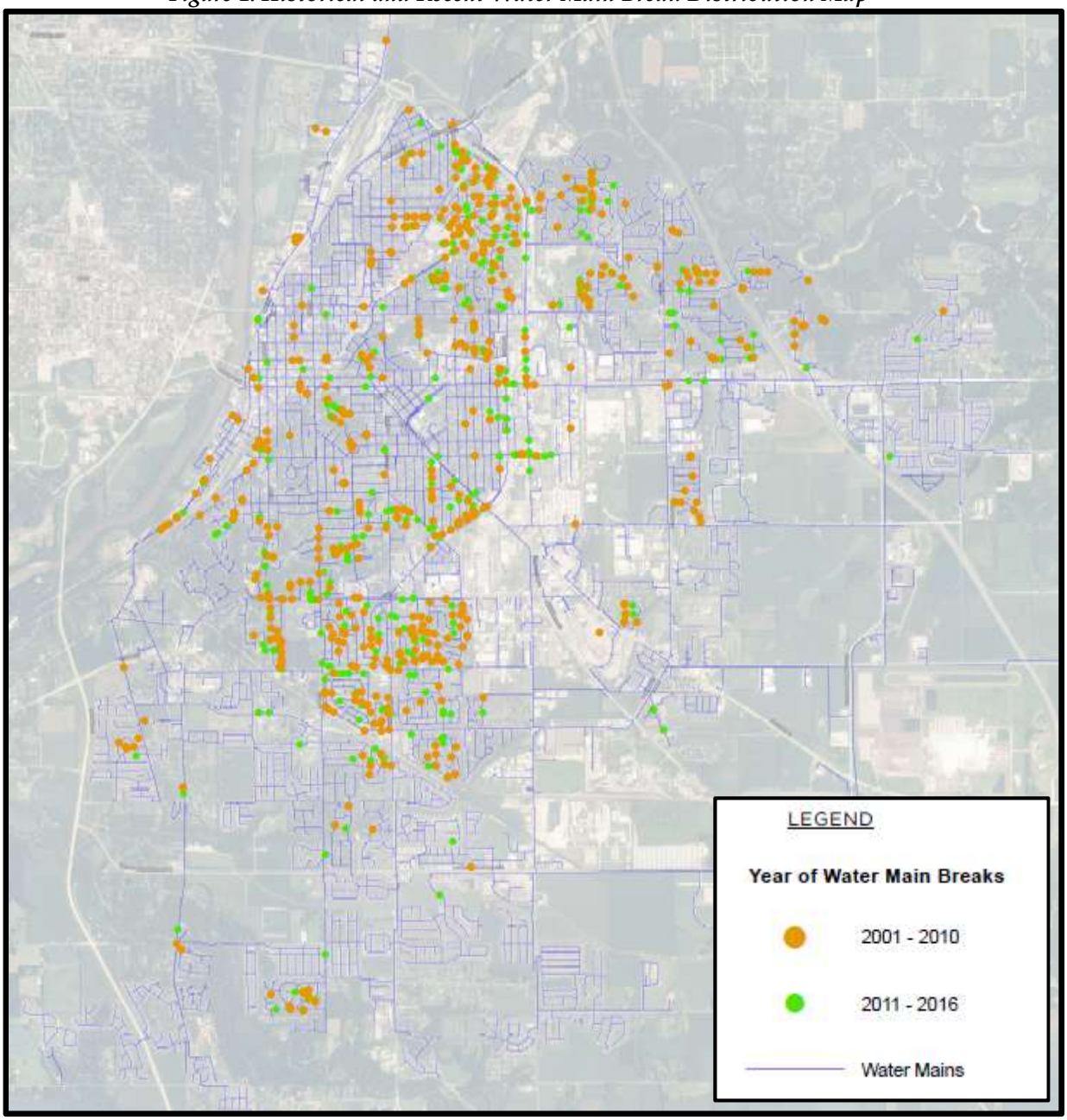
Chart 1: Process Assets' BRE Ratings



Distribution Assets - Results Summary

The distribution system was evaluated using water main break information from 1987-2016. Due to the large amount of water main break data available, it was difficult to determine which areas of the system were recently experiencing frequent, concentrated breaks. For this reason, only water main breaks from 2001-2016 were evaluated when scoping water main replacement areas. The water main breaks from 2001-2016 are shown on **Figure 1.** The majority of the water main breaks occurred in cast iron pipe with approximately 18% on mains over 100 years old and approximately 82% on mains between 60-100 years old. Once areas needing improvements were identified, a set of criteria was developed for a decision matrix to prioritize the projects.

Figure 1: Historical and Recent Water Main Break Distribution Map



Water System Evaluation

A hydraulic model of the City's water system was used to evaluate the existing system and to plan for future growth and development during the 20-year study period. The following were evaluated:

- Future demands from population increase in the City and from future development in Area 21, the A. Ross Watershed, Upper Julius Berlowitz area, and the LUR Southeast Expansion.
- Failure of the Columbian Park Booster Station and the effect on the supply of water to the Upper Pressure Zone. The station is the only means by which the Upper Pressure Zone receives its supply of water. If it were to be taken out of service, the Upper Pressure Zone would be without a supply of water.
- Feasibility of the Glick or Canal Well Fields supplying water directly to the Upper Pressure Zone to help meet future demands.
- New well field at the Aretz Airport site with an estimated pumping capacity of 4.8 million gallons of water per day to help meet future demands.
- Routes to connect the new well field to the existing distribution system.
- New 6.0 MGD booster station and 3.0 MG ground storage reservoir at Murdock Park to operate concurrently with the Columbian Park Booster Station to supply more water to the Upper Pressure Zone.
- Locations for new elevated water storage within the system for maintaining pressure and fire flow needs.
- Looping the 24-inch water main from the intersection of Union Street and Creasy Lane south and east to State Road 26 on the east side of Interstate 65 to convey more water throughout the Upper Pressure Zone.
- Upsizing of 6-inch water main to 12-inch at the intersection of Sagamore Parkway and South Street, to eliminate a hydraulic bottleneck in the distribution system.
- Replacement of the 6-inch water main between Sagamore Parkway and Earl Avenue to replace old mains that historically have had numerous breaks.
- Extending the 6-inch water main along Sagamore Parkway, south of Kossuth Street, to National Drive to complete a loop in the system to improve flow and water quality.
- Replacement of the 8-inch water main along Brown Street between 3rd and 13th Streets in advance of the City's interceptor sewer project along Brown and Erie Streets.

The water system evaluation identified needed improvements to meet the existing and future water demands of the City. These improvements are included in the Project Schedule section under short-term and long-term projects.

Project Summary

The projects were prioritized and planned for completion over the next 20-year period. This CIP includes additions to the water system to meet future demands and improvements to maintain the current system's capability of providing a high level of service to the community. The process assets were all considered to be priority improvements to address the existing needs of the community. To address the distribution system, a decision matrix was developed to prioritize projects. The decision matrix rated the projects based on the risk (BRE rating), number of lead service lines, water quality resulting from dead end mains, available fire flow, and planned road work. Each criterion was rated from one to five with the higher the rating, the higher the project priority.

Process Assets

The improvements generated from the process assets evaluation include work at the Columbian Park Booster Station and Glick Well Field. The 5.0 million-gallon concrete reservoir at the Columbian Park Booster Station needs to be inspected and rehabilitated to determine the best method of maintaining the structural integrity of the tank. Replacement of the aged MCC and main disconnect switch is also crucial at the Booster Station. At the Glick Well Field, rehabilitation or replacement of the submersible monitoring well pump and motor, and replacement of the electrical service disconnect, MCC, ammonia chemical feed skid, sodium hypochlorite chemical feed skid, and well starters are necessary. The estimated total project costs to complete improvements for these high priority assets are shown in **Table 1**. Refer to **Appendix B** for more detailed cost estimates.

Table 1: Process Assets Project Summary

Project No.	*Project Name*	*BRE Rating*	*Estimated Total Project Cost*
BS3	Columbian Park Booster Station Improvements	**14.21**	**$232,000**
WS7	Glick Well Field and Pumping Station Improvements	**10.32**	**$383,000**
		TOTAL	**$615,000**

Distribution System Assets

To address the distribution system, a decision matrix was developed to prioritize needs. **Table 2** shows the overall ratings from the decision matrix, project priority, and improvement costs. Refer to **Figure A-2** in **Appendix A** for an exhibit showing the water main replacement areas and **Appendix B** for more detailed cost estimates.

Table 2: Distribution System Project Summary

Project No.	*Name*	*Rating*	*Estimated Total Project Cost*
DS2-1	Berkshaft Dr, Mildex Ct, N 26th St	20.00	**$565,000**
DS2-2	Holloway Dr, Vernon Ln	16.40	**$410,000**
DS2-3	Valley St, Digby Dr, Memory Ln	16.20	**$853,000**
DS2-4	Vinton Subdivision East End	16.00	**$3,658,000**
DS2-5	Vinton Subdivision North End	16.00	**$1,219,000**
DS2-6	Golden Place, Pippin Ln, Rome Dr	16.00	**$415,000**
DS2-7	Rainbow Dr, Roselawn Ave, Sunrise Ave	15.80	**$794,000**
DS2-8	S 4th St, Thise Ct, Woodview Ct	15.80	**$575,000**
DS2-9	Meharry St, Vinton St, N 21st St	15.80	**$464,000**
DS2-10	Perrin Subdivision	15.60	**$825,000**
DS2-11	Pine Ln, Mulberry Dr, Cedar Ln	14.80	**$362,000**
DS2-12	Wabash Ave Water Main Replacement	14.80	**$624,000**
DS2-13	Sagamore Parkway	14.60	**$589,000**
DS2-14	Vinton Subdivision West End	13.40	**$1,257,000**
DS2-15	Greenwich Rd, Haverford Dr, Hampton Dr	13.20	**$720,000**
DS2-16	S 3rd St, and Green St	12.80	**$469,000**
DS2-17	Poplar Ln, Dogwood Ln	12.40	**$1,064,000**
DS2-18	North Ct	12.00	**$107,000**
DS2-19	Brown St.	11.80	**$1,168,000**
DS2-20	Sickle Ct, and Julia Ln	11.60	**$755,000**
DS2-21	Southlea Addition Central	11.00	**$510,000**

Project No.	*Name*	*Rating*	*Estimated Total Project Cost*
DS2-22	Parkway Ct, S 28th St	10.80	**$290,000**
DS2-23	S 23rd St, Kossuth St	10.60	**$813,000**
DS2-24	S 19th St, S 20th St, King St	10.60	**$522,000**
DS2-25	Westridge Cir	10.60	**$112,000**
DS2-26	Heatherfield Dr, Kingsmill Ct	10.40	**$173,000**
DS2-27	Edgelea Addition	9.80	**$1,418,000**
DS2-28	Crestview Ct	9.80	**$188,000**
DS2-29	S 13th St, Warren Dr, Oak Ave	9.60	**$489,000**
DS2-30	Sinton Ave	9.60	**$242,000**
DS2-31	Tecumseh Addition East End	9.00	**$2,225,000**
DS2-32	Walton St, and Fairfax Dr	8.80	**$682,000**
DS2-33	Birch Ln	8.80	**$120,000**
DS2-34	S 18th St	8.60	**$113,000**
DS2-35	Tecumseh Addition West End	7.40	**$1,812,000**
DS2-36	Robinwood and St. Joseph Subdivisions	7.40	**$1,399,000**
DS2-37	Southlea Addition West End	7.00	**$822,000**
DS2-38	Teal Rd, S 8th St	6.60	**$168,000**
DS2-39	Southlea Addition East End	6.00	**$674,000**
		TOTAL	**$29,665,000**

Water Main Replacement Program

Typical replacement rates of water mains for utilities across the country range from 0-2% per year. Assuming the replacement rate in the City is 1% of the system per year to achieve a system wide replacement rate of 100 years, additional water mains should be identified for replacement based on age and break concentration after the projects identified in this report have been completed. The City's system contains approximately 390 miles of water main, therefore a 1% replacement rate over the next 20 years would require the replacement of 78 miles of water main. The water main replacement projects identified in this report resulting from the BRE analysis total approximately 22.6 miles or 5.8% of the total length of the distribution system, therefore an additional 14.2% of the distribution system would need to be replaced to meet the 1% replacement per year. The estimated cost to maintain a 1% replacement rate per year is a total of **$64,660,000** over the 20-year planning period.

Lead Service Line Replacement Program

Lead service line replacement was also evaluated as part of the annual distribution system replacement program. The total amount of lead service lines was estimated to be 12,960. The estimated cost to replace all remaining lead service lines in the distribution system over the 20-year planning period is $21,708,000, or **$1,085,400 per year.** This cost does not include lead service line replacement within BRE project areas, as the service line replacement cost is already included in each project cost estimate.

Project Schedule

The improvements were separated into short term and long term needs. The short-term improvements are planned over the next 5 years and the long-term improvements are planned for years 6 through 20. Below is a list of the short term and long term improvements.

Short-Term Improvements (Years 1-5)

Short-term improvements include:

- Replacement of assets at the Glick Well Field and Treatment Facility identified through the asset management evaluation
- Addition of on-site sodium hypochlorite generation at Glick Treatment Facility
- Construction of a new 6.0 MGD booster station and 3.0 MG ground storage reservoir at Murdock Park
- Replacement of assets at the Columbian Park Booster Station identified through the asset management evaluation
- Construction of a new 2.0 MG elevated tank at Wea Ridge School.
- Vinton Subdivision East End Water Main Replacement
- S 4th St., Thise Ct., and Woodview Ct. Water Main Replacement
- Greenwich Rd., Haverford Dr., Hampton Dr. Water Main Replacement
- Meharry St., Vinton St., N 21st St. Water Main Replacement
- Wabash Ave. Water Main Replacement
- Sagamore Parkway and South Street Water Main Replacement
- Brown Street Water Main Replacement
- Westridge Circle Water Main Replacement
- Edgelea Addition Water Main Replacement
- Birch Lane Water Main Replacement
- Installation of automatic flushing hydrants between Wild Cat Creek and Interstate 65 to address water quality complaints from customers served from dead-end mains

The estimated total project cost for the short-term projects is **$25,617,000**.

Long-Term Projects (Years 6-20)

Long-term projects include:

- Development and construction of a new 4.8 MGD well field on the site of the old Aretz Airport with a new 24-inch water main connecting the well field to the existing system at the intersection of Creasy Lane and Union Street
- Addition of a generator for backup power at Glick Treatment Facility
- Berkshaft Dr, Mildex Ct., N 26th St. Water Main Replacement
- Vinton Subdivision North End Water Main Replacement
- Rainbow Dr., Roselawn Ave., Sunrise Ave. Water Main Replacement
- Holloway Dr., Vernon Ln. Water Main Replacement
- Golden Place, Pippin Ln., Rome Dr. Water Main Replacement
- Valley St., Digby Dr., Memory Ln. Water Main Replacement
- Perrin Subdivision Water Main Replacement
- Pine Ln., Mulberry Dr., Cedar Ln. Water Main Replacement
- Sickle Ct., and Julia Ln. Water Main Replacement
- Southlea Addition Central Water Main Replacement
- S 3rd St. and Green St. Water Main Replacement
- Vinton Subdivision West End Water Main Replacement
- Poplar Ln., Dogwood Ln. Water Main Replacement
- North Ct. Water Main Replacement
- S 13th St., Warren Dr., Oak Ave. Water Main Replacement
- Parkway Ct., S 28th St. Water Main Replacement

- Heatherfield Dr., Kingsmill Ct Water Main Replacement
- S 23rd St., Kossuth St. Water Main Replacement
- S 19th St., S 20th St., King St. Water Main Replacement
- Walton St., and Fairfax Dr. Water Main Replacement
- Crestview Ct. Water Main Replacement
- Sinton Ave. Water Main Replacement
- Tecumseh Addition East End Water Main Replacement
- S 18th St. Water Main Replacement
- Tecumseh Addition West End Water Main Replacement
- Robinwood and St. Joseph Subdivisions Water Main Replacement
- Southlea Addition West End Water Main Replacement
- Southlea Addition East End Water Main Replacement
- Teal Rd., S 8th St. Water Main Replacement
- Lead Service Line Replacement Program
- Water Main Replacement Program
- Construction of 12-inch and 24-inch water main extensions from the Aretz Well Field to serve future development in Area 21 northeast along State Road 25.
- 24-inch water main extension from Union Street/Creasy Lane to State Road 26 east of I-65

The estimated total project cost for the long-term projects is **$126,353,000**.

1.0 PROJECT LOCATION

1.1 Existing Service Area

The City of Lafayette is located in Tippecanoe County, Indiana, east of the Wabash River and west of Interstate 65. The nearest major city is West Lafayette, which is located on the west side of the Wabash River.

The service area is located within the Lafayette East, Lafayette West, Romney, and Stockwell Quadrangle Maps, T22N and T23N, R4W. Sections numbers within the service area are shown on the Project location map on **Figure A-1** in **Appendix A**. The City serves 27,926 customers, most of which are within the City's corporate limits. The City also provides wholesale water to the Town of Dayton located southeast of Lafayette on State Road 38.

1.2 Study Area

This CIP is based on a 20-year planning period from 2016 to 2036. The Study Area covers the City's existing water service area, including the Town of Dayton and customers located outside the City's corporate limits. The study area also includes the future 20-year service area. Refer to **Appendix A, Figure A-1** for the Project location map depicting the Study Area.

1.3 Projected 20-year Service Area

Projected 20-year development is expected to occur within the City's existing service area, as well as outside of it. The projected development outside of the City's existing service area is shown on **Figure A-1** in **Appendix A.**

1.4 Project Area

The proposed project areas include work within Townships 22N, 23N, and 24N and Ranges 3W and 4W. Some portions of the proposed projects are not located on City property or public rights-of-way so the City will need to purchase land or easements in these areas . **Appendix A, Figure A-1** shows the locations of the proposed projects.

2.0 CURRENT NEEDS

2.1 Existing Water Consumption

2.1.1 Population

The City distributes water to customers inside their corporate limits and outside, including the Town of Dayton, Indiana. The 2010 Census lists the total population of Tippecanoe County to be 172,780 and the population of the City to be 67,140. STATS Indiana estimated that in 2015 the population increased to 71,111, which equates to a 5.6% population increase. Using this increasing trend, the estimated population for the City in 2016 is 71,772.

Table 2.1.1.1 summarizes the historical and current population data for the County, City, and Town of Dayton, which was collected from the US Census Bureau and STATS Indiana.

Table 2.1.1.1: Historical and Projected Populations

Year	*Population*		
-	Tippecanoe Co.	Lafayette	Dayton
1990	*130,598*	*43,764*	*996*
2000	*148,955*	*56,397*	*1,120*
2010	*172,780*	*67,140*	*1,420*
2015	*185,826**	*71,111**	*1,578**
2016	*188,435***	*71,772***	*1,604***

****From STATS Indiana***
*****Calculated using historical trends from 2010 to 2015***

In addition to The Town of Dayton, the City has approximately 4,660 water service connections outside the corporate limits. Assuming an average of 2.38 persons per household, a population of 11,091 are served outside the City. **Table 2.1.1.2** shows the total population served by the City.

Table 2.1.1.2: Total Population Served by City

Year	*Population*			
-	Lafayette	Outside Customers	Dayton	**TOTAL**
2016	*71,772*	*11,091**	*1,604*	***84,417***

****Assumption of 2.38 persons per household connection was used from the Area Plan Commission of Tippecanoe Co.***

2.1.2 Water Customers

The City has 27,926 service connections, of which approximately 2,250 are commercial and industrial service connections. **Table 2.1.2.1** below includes a breakdown of water usage per customer type based on 2010-2015 billing records.

Table 2.1.2.1: Water Use per Customer Type

Account Type	*Percent of Water Use*
Residential	**92%**
Commercial & Industrial	**8%**

The twenty-five (25) largest water users are listed in **Table 2.1.2.2.**

Table 2.1.2.2: Large Water Users

No.	*Name*	*Average Day Demand*			*No.*	*Name*	*Average Day Demand*	
		(gpd)	*(gpm)*				*(gpd)*	*(gpm)*
1	Subaru	447,000	310		*14*	Crew Car Wash	34,000	24
2	Catepillar	252,000	175		*15*	Best Western	32,000	22
3	Cargill	206,000	143		*16*	IPI Industrial Plating	32,000	22
4	Fairfield Mfg	193,000	134		*17*	M&J Management	32,000	22
5	Franciscan Alliance (1)	83,000	58		*18*	Ice Cream Specialties	32,000	22
6	Edward Rose of IN	82,000	57		*19*	Wabash National Corp	29,000	20
7	Town of Dayton, IN	80,000	56		*20*	Greater Vision VI	29,000	20
8	IU Health Arnett	68,000	47		*21*	Franciscan Alliance	29,000	20
9	Friendly Village	50,000	34		*22*	Tipp County Jail	27,000	19
10	Coleman Cable LLC	49,000	34		*23*	A E Staleys	26,000	18
11	Claystone at the Crossing	48,000	34		*24*	Chauncey Village	22,000	15
12	TRW, Inc.	48,000	34		*25*	Franciscan Alliance	21,000	15
13	Lafayette School Corp	44,000	31					

2.1.3 Current Water Pumping Data

Table 2.1.3.1 includes a summary of average pumping data from 2010-2015 based on monthly reports of operation (MRO) data recorded from the master meters at the Canal and Glick treatment facilities. The City experienced an exceptional drought period in 2012 according to The National Drought Mitigation Center (http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?IN). An exceptional drought is the highest intensity category for drought conditions. According to MRO data for June and July 2012, the City had maximum day demands exceeding 16.7 MGD. For the purposes of this report, maximum water demands during the drought of 2012 were used to compute the average maximum day demand but were not used as the exclusive maximum day demand.

Table 2.1.3.1: 2010 – 2015 Pumping Data

Year	*Average Gallons Per Day*	*Average Gallons Per Minute*	*Maximum Gallons Per Day*	*Maximum Gallons Per Minute*
2010	7,900,000	5,500	11,340,000	7,900
2011	8,900,000	6,180	16,060,000	11,400
2012	9,300,000	6,450	16,759,000	11,650
2013	8,300,000	5,750	13,822,000	9,600
2014	7,700,000	5,350	10,965,000	7,600
2015	8,500,000	5,900	14,349,000	9,950
Average	**8,400,000**	**5,830**	**13,881,000**	**9,700**

The average daily pumping from 2010 to 2015 is assumed to be the City's existing average day demand. A peaking factor of 1.65 was computed by dividing the maximum day demand average for 2010-2015 by the average day demand. More detailed pumping data can be found in **Appendix F**.

2.1.4 Existing System Demands

The City's water demands come from two (2) pressure zones, the lower and upper. Water demands in the lower pressure zone are based on pumping records for each well field minus the demand from the upper pressure zone. Water demands in the upper pressure zone are based on pumping records at the Columbian Park Booster Station. It was calculated that 19% of the system demand comes from the lower pressure zone and 81% comes from the upper pressure zone. The current average and maximum day water demands are summarized in **Table 2.1.4.1.**

Table 2.1.4.1: Existing Water Demand Summary

	Average Day Demand		*Maximum Day Demand*	
	(MGD)	*(gpm)*	*(MGD)*	*(gpm)*
Lower System	1.6	1,100	2.6	1,850
Upper System	6.8	4,700	11.3	7,900
Total System	8.4	5,800	13.9	9,700

The current per capita average day demand is approximately 100 gallons per day, based on the current population served of 84,417 residents and the average day demand of 8.4 MGD. The current per capita maximum day demand is 165 gpd, using the calculated peaking factor of 1.65 for the existing system.

2.1.5 Non-Revenue Water

In 2015, the City billed for approximately 2,826 million gallons (7,743,000 gpd on average) based on available billing information for that period. During that same period, the City recorded approximately 3,100 million gallons (8,500,000 gpd on average) of pumping from the Canal and Glick well fields. Therefore, 274 million gallons or approximately 8% of the water pumped is considered non-revenue water. Potential sources for non-revenue water include master meter errors, unmetered water use (hydrant flushing, fire protection, unmetered services), unauthorized consumption, errors in records, water main breaks, and water main leaks. The City completed a water system audit in 2016 to quantify non-revenue water. A copy of the audit is included in **Appendix F**.

Table 2.1.5.1 summarizes the available pumping and billing data from 2015.

Table 2.1.5.1: Non-Revenue Water Summary

Period	*Pumped (MG)*	*Billed (MG)*	*Non-Revenue (MG)*
Jan. – Dec. 2015	3,100	2,826	274 (8%)

2.1.6 Water Quality

The City treats their raw groundwater with chlorine, fluoride, and phosphates. **Table 2.1.6.1** includes a summary of finished water quality information gathered in 2015 from their treatment facilities.

Table 2.1.6.1: Existing Water Quality Summary

Constituent	*Concentration*	*SMCL**
pH	7.3	6.5-8.5
Alkalinity	250 mg/L as CACO3	15 mg/L
Temperature	15.6 °C	Not regulated
Fluoride	0.24 mg/L	4 mg/L
Orthophosphate	0.66 mg/L	60 mg/L
Total Phosphate	1.66 mg/L	80 mg/L
Chloramines	0.94 mg/L	4.0 mg/L
Calcium	220 mg/L as CaCO3	Not regulated
Lead	Not detected	0.015 mg/L
Copper	0.336 mg/L	1.3 mg/L
Iron	0.221 mg/L	0.3 mg/L
Manganese	0.221 mg/L	0.05 mg/L
Magnesium	160 mg/L as CaCO3	Not regulated
Chlorides	13.06 mg/L	Not regulated
Sulfates	0.821 mg/L	250 mg/L
Conductivity	680 µm HOS/cm	Not regulated
Total Hardness	380 mg/L as CaCO3	Not regulated
Grains of Hardness	22 grains per gallon	Not regulated

**SMCL = secondary maximum contaminant level*

The U.S. Department of Health and Human Services recommends a Fluoride level of 0.7 mg/L to "maintain the protective decay prevention benefits of water fluoridation." Fluoridation of water is not required of Indiana municipal water systems. The City currently adds fluoride to their source water and the concentration is below the recommended amount.

The water quality supplied to the City's customers is very good. The City has not had any water quality violations in the past 5 years. However, the City has received water quality complaints from customers particularly on the southwest side of Wild Cat Creek, east of Interstate 65. This is most likely related to water quality issues at the end of larger dead-end mains in the system.

2.2 Existing Water Facilities

The City operates two (2) well fields containing a total of fourteen (14) groundwater wells to supply water to two (2) pressure zones. Both well fields provide water to the lower pressure zone which contains a 5 million gallon reservoir. A booster station draws water from the reservoir and pumps it to the upper pressure zone to fill four (4) elevated water storage tanks. An existing system map showing the water system and separation of pressure zones can be found in **Appendix A, Figure A-2**. A hydraulic schematic depicting the components of the water system can be found in **Appendix A, Figure A-3**.

The City's existing infrastructure was evaluated to identify areas of concern and risk to the City. To assist with making decisions on which assets pose a high risk to the City, an asset management evaluation was completed for the City's water system in addition to a system demand evaluation. The asset management evaluation includes two categories of assets: process and distribution. Process assets include assets at the well fields, treatment plants, and storage tanks. Distribution assets include water mains, hydrants, valves, and services. For the purpose of this report, an asset was included in the evaluation if it is related to the operation of the water system and exceeds $5,000 in replacement cost. The condition of these assets affect the level of service able to be provided by the City. If the assets are not actively managed, operation and maintenance (O&M) costs can increase and potentially exceed affordable levels.

The following is a discussion of the asset management evaluation, general condition, rated capacity, operating capacity, and age of the existing water system facilities. The capacity of each system component is compared to the system demand for determining if the components meet capacity requirements.

2.2.1 Business Risk Exposure (BRE) – Process Assets

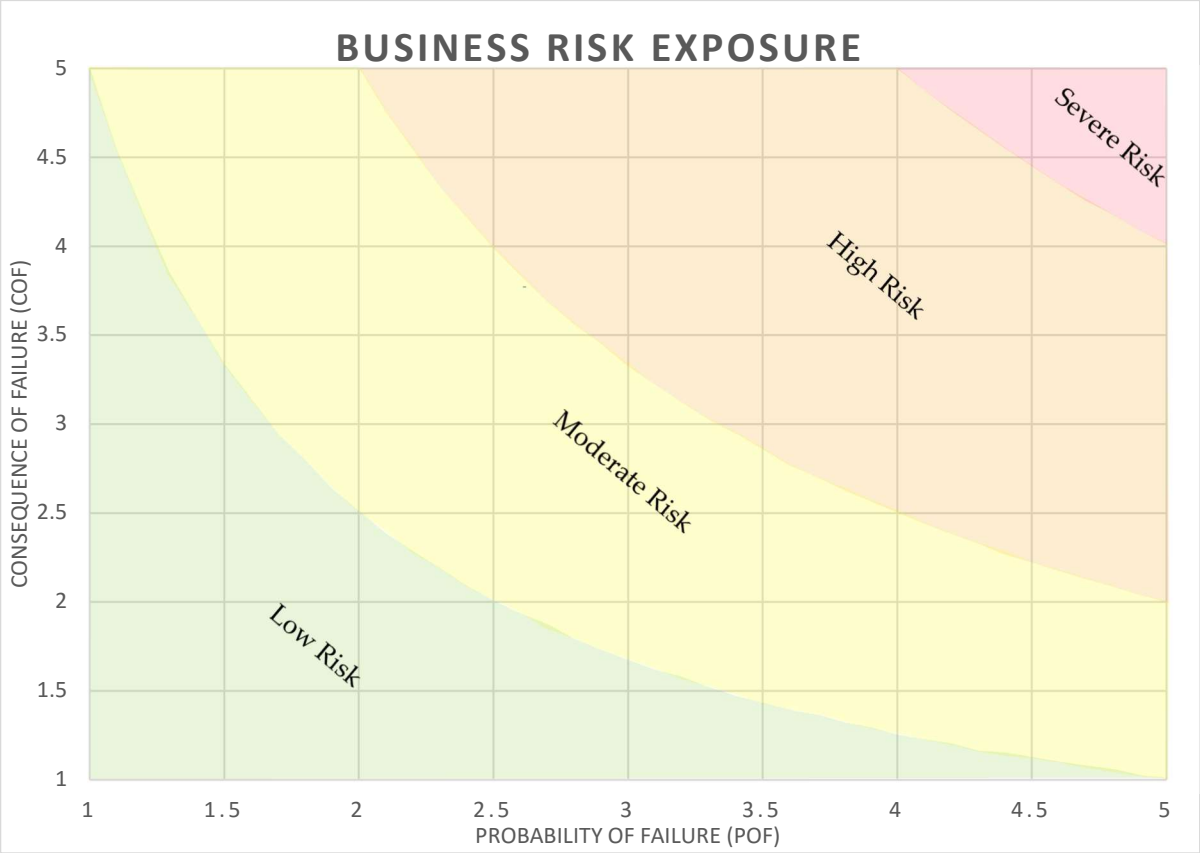
A probability of failure and consequence of failure rating was developed for each process asset. In addition, the process assets include a redundancy score to indicate the importance of the asset for the City to meet an acceptable level of service for the community. Using the probability of failure rating, consequence of failure rating, and redundancy score, a business risk exposure (BRE) rating is calculated. The BRE rating has a range of 0 to 25 where the higher the BRE rating, the higher the risk associated with that asset's failure. Categories for BRE rating ranges are listed in **Table 2.2.1.1**.

Table 2.2.1.1: BRE Rating Scale

BRE Rating	*Risk Category*	*Action*
20-25	Severe	Rehabilitate/ Replace
10-20	High	
5-10	Moderate	Routine Maintenance
0-5	Low	

Chart 2.2.1.1 shows the areas of varying risk based on the probability of failure and consequence of failure.

Chart 2.2.1.1: BRE Rating Scale Chart



Generally, assets that have a rating of "severe" or "high" need rehabilitation or replacement, while assets that have a rating of "moderate" or "low" only require maintenance at this time. Process assets with a BRE rating over 10 are listed in the report. A complete list of assets can be found in **Appendix E.**

2.2.1.1 *Process Assets*

2.2.1.1.1 Data Acquisition

Field investigations were completed at the Canal Street and Glick well fields and treatment facilities as well as the Columbian Park Booster Station. Historical information on the Union Street, Fairgrounds, Haggerty Lane, and Plaza South elevated storage tanks was used to evaluate those assets. While conducting the field investigations, information was gathered that included physical condition, operational condition, installation year, and photographs of each asset. For record keeping purposes, manufacturers, model numbers, and serial numbers of the assets were documented where possible. Refer to **Appendix E** for general asset information and **Appendix I** for photos of each asset (on DVD).

2.2.1.1.2 Asset Index and Grading Criteria

After gathering the field data and historical information, an asset index and grading criteria was developed for process assets. The grading criteria determine probability of failure, consequence of failure, and redundancy score values needed to determine the asset's BRE rating.

Probability of Failure

The probability of failure is the overall rating of weighted criteria for an asset's likelihood of failure. The criteria contributing to the probability of failure include physical condition, age, O&M protocols, repair history, and operation condition. A weight was given to each criterion, with input from the City, to identify the most important criteria. The probability of failure is the weighted average of the criteria ratings.

- **Physical Condition Rating**: The physical condition rating of an asset is based upon the visual inspection, input from the City on the asset, and historical information such as inspection reports.
- **Age Factor Rating**: The age factor rating is calculated from the age and effective life of the asset. The percentage of its useful life is used to determine the age factor rating. The effective life for each asset is based on the EPA's rating for water assets and previous experience for typical effective life for the assets in Indiana.
- **O&M Protocol Rating**: The O&M protocol rating takes into account whether or not O&M manuals are complete, written or online, and if they are easily accessible.
- **Repair History Rating**: The repair history rating is determined by the number of repairs required for an asset over the past 10 years.
- **Operational Condition Rating**: The operational condition rating evaluates the asset on how well it functions and whether the asset needs to be rebuilt or upgraded. The operational condition received the highest weight factor for the probability of failure criteria.

Table 2.2.1.1.2.1: Probability of Failure Criteria

Criteria	*Rating*					*Weighting Factor*
	5	*4*	*3*	*2*	*1*	
Physical Condition	Very Poor	Poor	Fair	Good	Very Good	0.8
Age Factor	Greater than 80% of useful life	Between 60%-80% of useful life	Between 40%-60% of useful life	Between 20%-40% of useful life	Age less than 20% of useful life	1.3
O&M Protocols	None	Written/ online, but not complete, not current or location unknown	Written/ online, but not complete, not current or not easily accessible	Complete, written/online, current, but not easily accessible	Complete, written/online, current, and easily accessible	0.3
Repair history	Very Poor (Repaired more than 15 times in the last 10 years)	Poor (Repaired 10 to 15 times in the last 10 years)	Moderate (Repaired 5 to 10 times in the last 10 years)	Good (Repaired 1 to 5 times in the last 10 years)	Very Good (Not repaired in the last 10 years)	1.1

Criteria	*Rating*					*Weighting Factor*
	5	*4*	*3*	*2*	*1*	
Operational Condition	Not operational and not repairable	Operational but needs to be rebuilt or upgraded	Operational but needs some restoration	Operational with minimal problems	No operational problems	1.5

Consequence of Failure

The consequence of failure is the overall rating of weighted criteria for the effect of failure an asset poses to the City. The criteria included for the consequence of failure are process, financial impact, safety, IDEM compliance, community disruption, and required response time. A weight was given to each criterion, with input from the City, to identify the most important criteria. The consequence of failure is the weighted average of the criteria ratings.

- **Process Rating**: The process rating considers how critical the asset is for completing the intended purpose of the process.
- **Financial Impact Rating**: The financial impact rating considers the impact of the failure of an asset on the City's budget.
- **Safety Rating**: The safety rating takes into account the effect of an asset failure on the health of personnel. Safety received the highest weight factor for the consequence of failure criteria.
- **IDEM Compliance Rating**: The IDEM compliance rating takes into account the importance of the asset and whether or not the issue is enforceable by IDEM.
- **Community Disruption Rating**: The community disruption rating provides a rating on the area of the community's service interrupted by the failure of the asset.
- **Required Response Time Rating**: The required response time rating takes into account how quickly the City's personnel need to address the issue in the event of an asset failure.

Table 2.2.1.1.2.2: Consequence of Failure Criteria

Criteria	*Rating*					*Weighting Factor*
	5	*4*	*3*	*2*	*1*	
Process	Mission Critical	Process shut-down	Loss of Redundancy	Potential process upset	No impact on process	1.17
Financial Impact	May require new borrowing or impact	May require transfer from reserves	Absorbed within current budget	Absorbed within applicable line item	Budgeted expense	0.83
Safety	Loss of life	Severe Injury to employees or public	Minor injury requiring treatment off-site or lost time	Minor injury requiring no medical treatment with no lost time	No injury	1.67

Criteria	*Rating*					*Weighting Factor*
	5	*4*	*3*	*2*	*1*	
IDEM Compliance	Enforcement action by IDEM	Major issue but no enforcement action	Localized issue	Minimal Issue	100% compliance	0.33
Disruption to the community	Long term impact; area wide disruption	Short term impact but substantial disruption	Sporadic service disruptions	Minor disruption	No disruption	1.5
Required response time	1/2 hour	1/2 to 2 hours	2 to 4 hours	4 to 8 hours	> 8 hours	0.5

Redundancy Score

The redundancy score is a value from zero to one which accounts for multiple assets of the same type above the required amount for system operation. The redundancy score is calculated by dividing the number of required assets by the total number of assets. For example, if two pumps are required but there are three pumps available, the redundancy score would be 0.67.

Results

The asset grading of individual criteria resulted in a BRE rating for each asset. The BRE asset rating was used to identify the assets in need of replacement, rehabilitation, or routine maintenance. Generally, assets with a BRE rating equal to and above 10 require rehabilitation or replacement and are typically included as a part of a capital improvements plan, while assets with a rating below 10 should receive routine maintenance. Multiple assets at a single facility were then grouped together into capital improvement projects. Refer to **Table 2.2.1.1.2.3** for the process asset project summary.

Table 2.2.1.1.2.3: Process Assets BRE Summary

Project No.	*Project Name*	*BRE Rating*
BS3	Columbian Park Booster Station Improvements	**14.21**
WS7	Glick Well Field and Pumping Station Improvements	**10.32**

A summary of BRE ratings and asset evaluation results of each facility is included in the following sections. Asset details can be found in **Appendices C** and **E.**

2.2.2 Water Source

The City obtains its water supply from the Canal Well Field and the Glick Well Field.

2.2.2.1 *Canal Well Field*

There are nine (9) active groundwater wells which serve the existing Canal Well Field. The well field and treatment facility are located at 1020 Canal Road. Power for the wells is provided from the Canal treatment building. The Canal Well Field motor control center (MCC) is a G.E. 8000 series Line Motor Control Center rated at 480V, 3 phase, 3 wire, 1600 amps. The well starters are Reduced Voltage Soft

Starters (RVSS) except for Well No. 6 which has a variable frequency drive (VFD). All the wells have a stationary standby power source available through two 600 kW diesel generators in parallel that can run all but two of the 150 HP wells at the same time. Refer to **Appendix F** for additional detailed information on the individual wells.

The Canal wells are controlled via the main plant Programmable Logic Controller (PLC) located in the treatment building electrical room. The wells are cycled on and off based on the level in an operator selected elevated storage tank. Operators use local computers employing client SCADA software that is streamed from the main SCADA server at City Hall. The SCADA computers are crucial to the system as they not only collect system data, but they are also needed to adjust system set points based on daily flow requirements.

The well capacities are summarized in **Table 2.2.2.1.1.**

Table 2.2.2.1.1: Canal Well Capacities

Canal Well	*Rated Capacity (gpm)*	*Operating Capacity (gpm)*
1	1,400	1,364
2	1,400	1,507
3	950	976
4	1,400	1,397
5	1,400	1,381
6	1,400	1,522
7	1,200	879
8	1,700	1,650
10	1,500	1,476
Total	12,350	12,152
Firm	10,650	10,502

2.2.2.1.1 Canal Well No. 1

Canal Well No. 1 was drilled in 1954 by Reynolds. The well is a gravel pack type with an 82.25-foot long, 17-inch diameter casing and a 25-foot screen with a slot size of 0.06 mm. The pump is a 3 stage, vertical turbine style pump manufactured by Worthington with a 10-inch discharge. The pump has a rated capacity of 1400 gpm and a current operating capacity of 1346 gpm at 253' of total dynamic head (TDH) with a 150 HP, 3-phase motor. The pump and motor were both replaced in 2008 and are in good condition. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.2 Canal Well No. 2

Canal Well No. 2 was drilled in 1954 by Reynolds. The well is a gravel pack type with an 82.58-foot long, 18-inch diameter casing and a 20-foot screen with a slot size of 0.09 mm. The pump is a 3 stage, vertical turbine style pump manufactured by Floway with a 10-inch discharge. The pump has a rated capacity of 1400 gpm and a current operating capacity of 1507 gpm at 244' of TDH with a 150 HP, 3-phase motor. The pump was installed in 2005 and the motor in 2008. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.3 Canal Well No. 3

Canal Well No. 3 was drilled in 1967 by Layne Northern. The well is a gravel pack type with an 81.5-foot long, 16-inch diameter casing and a 25-foot screen with a slot size of 0.04 mm. The pump is a 4 stage, vertical turbine style pump manufactured by J-Line with a 10-inch discharge. The pump has a rated capacity of 950 gpm and a current operating capacity of 976 gpm at 274' of TDH with a 150 HP, 3-phase motor. The pump was installed in 1998 and the motor in 2004. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.4 Canal Well No. 4

Canal Well No. 4 was drilled in 1967 by Layne Northern. The well is a gravel pack type with an 84.5-foot long, 16-inch diameter casing and a 20-foot screen with varying slot sizes. The pump is a 3 stage, vertical turbine style pump manufactured by Floway, installed in 2016 with a 10-inch discharge. The pump has a rated capacity of 1400 gpm and a current operating capacity of 1397 gpm at 263' of TDH with a 150 HP, 3-phase motor replaced in 2009. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.5 Canal Well No. 5

Canal Well No. 5 was drilled in 1971 by Reynolds and is located inside a well house. The well is a gravel pack type with an 87.33-foot long, 18-inch diameter casing and a 20-foot screen with a slot size of 0.09 mm. The pump is a 6 stage, vertical turbine style pump manufactured by Layne, installed in 1998 with a 10-inch discharge. The pump has a rated capacity of 1400 gpm and a current operating capacity of 1381 gpm at 248' of TDH with a 150 HP, 3-phase motor replaced in 2006. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

Canal Well No. 5

2.2.2.1.6 Canal Well No. 6

Canal Well No. 6 was drilled in 1989 by Layne Northern. The well is a gravel pack type with a 73.25-foot long, 16-inch diameter casing and a 30-foot screen with a slot size of 0.04 mm and 0.06 mm. The pump is a 4 stage, vertical turbine style pump manufactured by Simmons, last repaired in 2001 with a 10-inch discharge. The pump has a rated capacity of 1400 gpm and a current operating capacity of 1522 gpm at 262' of TDH with a 150 HP, 3-phase motor replaced in 2008. Canal Well No. 6 is also equipped with

a variable frequency drive (VFD). The motor VFD is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.7 Canal Well No. 7

Canal Well No. 7 was drilled in 1969 by Layne Northern and is located inside a well house. The well could not exceed pumping rates over 1200 gpm because the pump would pull gravel through the screens. Due to this the well received a new foundation and well bottom on April 16, 1999. And in 2008 Reynolds rehabilitated the well. Also in 2008, Reynolds coated the column and installed three new shafts. The well is a gravel pack type with a 79.33-foot long, 16-inch diameter casing and a 20-foot screen with a slot size of 0.06 mm. The pump is a 4 stage, vertical turbine style pump manufactured by Floway that was installed in 2008 by Reynolds with a 10-inch discharge. The pump's rated capacity is 1200 gpm, operating capacity is 879 gpm, and 364' of TDH with a 150 HP, 3-phase motor replaced in 2008. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.8 Canal Well No. 8

Canal Well No. 8 was drilled in 1980 by Layne Northern and is located inside a well house. The well is a gravel pack type with a 71.0-foot long, 18-inch diameter casing and a 30-foot screen with a slot size of 0.06 mm. The pump is a 6 stage, vertical turbine style pump manufactured by American Marsh, installed in 2016 with a 10-inch discharge. The pump has a rated capacity of 1700 gpm and a current operating capacity of 1650 gpm at 250' of TDH with a 150 HP, 3-phase motor installed in 2006. The well was cleaned and videoed by National Water in 2007. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.1.9 Canal Well No. 10

Canal Well No. 10 was drilled in 1989 by Layne Northern. The well is a gravel pack type with an 81.5-foot long, 16-inch diameter casing and a 25-foot screen with a slot size of 0.06 mm. The pump is a 3 stage, vertical turbine style pump manufactured by Worthington, last repaired in 2010 with a 10-inch discharge. The pump has a rated capacity of 1500 gpm and a current operating capacity of 1476 gpm at 251' of TDH with a 150 HP, 3-phase motor installed in 2004. The motor RVSS is located in the treatment building electrical room MCC and is in good condition.

2.2.2.2 *Glick Well Field*

There are five (5) active groundwater wells in the existing Glick Well Field. In addition to the five (5) production wells, there is a submersible well to draw a plume of contamination away from the remainder of the well field. The well field is located in McAllister Park south of Sagamore Parkway North along North 9th Street, north of the Canal Well Field. The wells are located within the floodway of the Wabash River and were constructed on elevated platforms above the 100-year flood elevation. When flooding occurs, the wells become inaccessible until the flood waters recede.

Glick Well No. 4

The wells have dedicated power feeds at each well head. The power to the Glick Well Field is monitored using current transformers located near the Glick Well Field treatment facility. The MCC in the treatment facility is a G.E. 7700 Line Control Center rated at 600 amps, 480V, 3 phase, 3 wire. Starters in the MCC are no longer in use, but there are miscellaneous loads powered out of the MCC with circuit breakers. The Glick Well Field does not have standby power. According to the *Recommended Standards for Waterworks*, a standby power supply is recommended to ensure continuous service when the primary power has been interrupted. Refer to **Appendix F** for additional detailed information on the individual wells.

All the wells are controlled using an Allen Bradley Compact Logix L33ERM PLC located in the treatment building. Local well control panels utilize an Allen Bradley 1734-AENT point I/O module which acts as an extension to the Glick treatment building PLC. The wells are cycled on and off through the PLC located in the Glick treatment facility. The local SCADA computer is a client based system that sends and receives data through the host server located at City Hall. The SCADA computer is crucial to operation of the Glick well field as operators must use it to not only collect data, but to adjust system set points based on daily flows.

The well capacities are summarized in **Table 2.2.2.2.1.**

Table 2.2.2.2.1.: Glick Well Capacities

Glick Well	*Rated Capacity (gpm)*	*Operating Capacity (gpm)*
1	1,400	1,167
2	1,000	1,107
3	1,000	1,000
4	1,000	1,086
5	1,000	1,167
Total	5,400	5,527
Firm	4,000	4,360

2.2.2.2.1 Glick Well No. 1

Glick Well No. 1 was drilled in 1975 by Layne Northern. In 2004, Bastin & Logan sleeved the well casing with a 16-inch steel sleeve because the original casing contained holes, and in 2005 Peerless performed a well profiling and videoed. The well is a gravel pack type with an 85.0-foot long, 36-inch diameter casing with a 16-inch casing liner installed in 1998 and a 25-foot screen with a slot size of 0.09 mm. The well has a 4 stage, vertical turbine, Floway pump that was installed in 2009 with a 10-inch discharge pipe diameter. The pump has a rated capacity of 1,400 gpm and a current operating capacity of 1,167 gpm at 229' of TDH with a 150 HP, 3-phase, 460V motor installed in 1994. The reason for the difference between operating capacity and rated capacity is not known. The starter is an across the line starter and showing significant wear. If the starter fails, the well will not be able to produce water until the starter is replaced.

2.2.2.2.2 Glick Well No. 2

Glick Well No. 2 was drilled in 1994 by Bastin & Logan. The well is a tube type with a 68.5-foot long, 29-inch diameter casing and a 38-foot screen with varying slot sizes. On October 8, 2008 Reynolds installed a new coated column and top motor shaft. The well has a 4 stage, vertical turbine, American Marsh pump that was installed in 2014 with a 10-inch discharge pipe diameter. The pump has a rated capacity of 1,000 gpm and a current operating capacity of 1,107 gpm at 255' of TDH with a 150 HP, 3-phase, 460V motor installed in 1994. The starter is an across the line starter and showing significant wear. If the starter fails, the well will not be able to produce water until the starter is replaced.

2.2.2.2.3 Glick Well No. 3

Glick Well No. 3 was drilled in 1994 by Bastin & Logan. The well is a tube type with a 61.5-foot long, 29-inch diameter casing and a 46-foot screen with varying slot sizes. The well has a 3 stage, vertical turbine, Floway pump that was installed in 2014 with a 10-inch discharge pipe diameter. The pump has a rated capacity of 1,000 gpm and a current operating capacity of 1,000 gpm at 242' of TDH with a 150 HP, 3-phase, 460V motor installed in 2014. The starter is an across the line starter and showing significant wear. If the starter fails, the well will not be able to produce water until the starter is replaced.

2.2.2.2.4 Glick Well No. 4

Glick Well No. 4 was drilled in 1994 by Bastin & Logan. The well is a tube type with a 71.6-foot long, 30-inch diameter casing and a 35-foot screen with a slot size of 0.08 mm. The well was cleaned in the years 2000, 2002, 2003, 2005, and 2014. On June 6, 2005, Peerless installed new column piping. The well has a 4 stage, vertical turbine, American Marsh pump that was installed in 2014 with a 10-inch discharge pipe diameter. The pump has a rated capacity of 1,000 gpm and a current operating capacity of 1,086 gpm at 249.5' of TDH with a 150 HP, 3-phase motor installed in 1994.

2.2.2.2.5 Glick Well No. 5

Glick Well No. 5 was drilled in 1994 by Bastin & Logan. The well is a tube type with a 70.5-foot long, 30-inch diameter casing and a 43-foot screen with a slot size of 0.08 mm. The well was cleaned in 2007, 2012, and 2013. The well has a 4 stage, vertical turbine, Peerless pump that was installed in 2014 with a 10-inch discharge pipe diameter. The pump has a rated capacity of 1,000 gpm and a current operating capacity of 1,167 gpm at 262' of TDH with a 150 HP, 3-phase, 460V motor installed in 1994. The starter is an across the line starter and showing significant wear. If the starter fails, the well will not be able to produce water until the starter is replaced.

This well is on settling soil. Improvements to the valve foundation have been made in the past to correct the issue, however the soil continues to settle underneath the check valve.

2.2.2.2.6 Submersible Well No. 1

The submersible well operates to keep a plume of contamination away from the remaining wells in the well field. As a result, the submersible well has a relatively high consequence of failure. It is essential that the plume of contamination is kept away from the remaining wells to ensure high quality groundwater from the Glick Well Field. There is not much available information on the submersible well. The well is believed to be installed around 1980. The submersible well has been maintained but it is unknown when the well was last cleaned and tested. In addition, it is unknown when the pump and motor were last rehabilitated or replaced. It is recommended to rehabilitate the submersible monitoring well and install a new submersible pump and motor.

Table 2.2.2.2.6.1 shows the submersible monitoring well BRE rating.

Table 2.2.2.2.6.1: Glick Pumping Station Rehabilitation Assets

Asset Name	*Probability of Failure*	*Consequence of Failure*	*Redundancy Score*	*BRE*
Submersible Monitoring Well	3.80	3.86	1.00	**14.67**

The submersible monitoring well has a high BRE rating due to its age, O&M protocols, potential impact on the process and IDEM compliance, and required response time.

2.2.2.3 *Source Capacity Analysis*

The two (2) well fields supply water to the lower pressure zone. According to the *Recommended Standards for Water Works*, the water source capacity must be able to meet or exceed the design maximum day demand with the largest producing pump out of service. **Table 2.2.2.3.1** shows the total well operating capacities and that they meet the maximum day demands in the system.

Table 2.2.2.3.1: Maximum Day Demand Capacity

Maximum Day Demand	*Well Fields Firm Operating*	*Meets Capacity Requirements?*
9,700 gpm (13.9 MGD)	14,900 gpm (21.4 MGD)	Yes

2.2.2.4 *Aretz Airport Site*

The City owns 16 acres of land on the old Aretz Airport site located east of Interstate 65 along State Road 25. They completed groundwater exploration and pumping tests in 2013 to potentially develop an additional source of supply for providing maximum day and future water demands to the upper pressure zone. Test wells were drilled and preliminary hydrogeological results indicate the Teays aquifer can sustain an additional source of water supply of 4.8 MGD, and may potentially yield between 5-8 MGD. No permanent pumping facilities have been constructed at this site. A copy of the hydrogeologic report is located in **Appendix G**.

2.2.3 Canal Water Treatment Facility

The Canal Water Treatment Facility houses the chemicals, laboratory, and SCADA system for the facility. The building was built in 1963 by U.S. Piping Inc. It contains , offices, garages, a motor control

center (MCC) to power the well motors, SCADA controls, two standby generators, a testing lab, and chemical treatment systems. Water from the nine onsite groundwater wells is pumped into the facility where it is treated with sodium hypochlorite, ammonium sulfate, fluoride, and polyphosphate chemicals before distributing to the community. In addition to the chemicals for treatment, the facility has one 43-ton salt brine tank and two water softeners.

2.2.3.1 *Chemical Feed Equipment*

The City's water treatment consists exclusively of chemical treatment. The chemicals used in the treatment process are described in more detail below.

2.2.3.1.1 Sodium Hypochlorite

Sodium hypochlorite is generated using an on-site generation system which electrifies a brine solution. The 0.8% sodium hypochlorite solution is injected to raw ground water for disinfection. The Canal Street facility has one on-site chlorine generator, one sodium hypochlorite tank, two sodium hypochlorite vent blowers, two chlorine chemical feed pumps, two motors, and one chlorine analyzer. The chlorine pumps are rated at 7.92 gpm continuously and 12.68 gpm intermittently.

2.2.3.1.2 Ammonium Sulfate

Ammonium sulfate is added after the post-chlorination feed point to create chloramines. Chloramines are used for post-disinfection to reduce the formation of disinfection by products (DBPs) in the water being distributed for consumption. DBPs are regulated by the Environmental Protection Agency (EPA) as a primary contaminant. DBPs can cause many health problems including cancer, according to the *Centers for Disease Control and Prevention*. The Canal treatment facility has one 150-gallon ammonium sulfate tank, one 360-gallon ammonium sulfate mixing tank, and one ammonium pump and a spare. The ammonia feed pumps are capable of pumping 5 gallons per hour.

2.2.3.1.3 Fluoride

Fluoride is added to the finished water for dental health benefits. The Canal facility contains two 150-gallon fluoride sodium tanks, one fluoride analyzer, and one fluoride pump skid.

2.2.3.1.4 Polyphosphate

Polyphosphate is added to finished water to prevent corrosion and iron staining of the distribution system. The Canal facility treatment process includes one 360-gallon blended polyphosphate mix tank, one 300-gallon polyphosphate tank, one polyphosphate pump skid, and one phosphate metering pump. A spare pump is not required since the polyphosphate feed is not required to meet regulatory requirements.

2.2.3.2 *Electrical*

The facility is supplied power through a 480/277V, 3 phase, 4 wire electrical service by Duke Energy. The facility has paralleling switch gear that sequences the two 600 kW standby diesel generators as well as distributes power to the facility. There are two sections of the MCC that house the starters for the wells. The MCC sections are rated at 480V, 3 phase, 3 wire, 1600 amps. The administrative building is supplied power through a 225 kVa, 480-120/208V distribution transformer. The onsite wells each have single phase lighting panels served by a 112.5 kVa, 480-120/208V, distribution transformer, and lighting panel board.

2.2.3.3 *Standby Power*

The Canal facility is supplied with standby power via two 600 kW, standby diesel generators operating in parallel. Generator No. 1 is a Caterpillar, 2003-Model 3412, 480/277V, 600 kW, 750 kVa standby rated generator. Generator No. 2 is a Caterpillar, 1997-Model 3412, 480/277V, 600 kW, 750 kVa standby rated generator. The generators are controlled through the paralleling switchgear which monitors for voltage and frequency matching prior to bringing the facility onto standby power. The generators can run all but two of the 150 HP wells. The estimate lighting/HVAC load is 150 kVa.

2.2.3.4 *SCADA and Controls*

The plant utilizes Allen Bradley control systems. The main plant PLC is an Allen Bradley Compact Logix L33ERM PLC which monitors and controls facility equipment including the onsite wells. Operators can adjust the SCADA system from the local client SCADA computers. The main SCADA server is located at City Hall and is the "traffic controller" of the entire network. All data and operator adjustments to the system are sent through the main SCADA server. The wells are controlled through the SCADA system and are operated based on a chosen system tank level.

2.2.4 Glick Water Treatment Facility

The Glick Water Treatment Building was built in 1978 by AVCO Construction, Inc. The building houses the chemicals and chemical treatment process, MCC, and SCADA system for the facility. Water from the Glick Well Field is pumped to the facility where it is chemically treatment. The treatment includes sodium hypochlorite, ammonium sulfate, fluoride, and polyphosphate chemicals. In addition to the chemicals for treatment, Glick has one 43-ton salt brine tank, one water softener in operation and two water softeners which are new and unused.

2.2.4.1 *Chemical Feed Equipment*

The chemicals used in the treatment process are described in more detail below.

2.2.4.1.1 Sodium Hypochlorite

Sodium hypochlorite is added to raw ground water as a form of treatment for purification, disinfection, and odor removal. The bulk bleach solution, which contains 12.5 percent chlorine, is delivered to the site via tank truck. The Glick facility has two sodium hypochlorite tanks, one sodium hypochlorite/ chlorine pump, one chlorine chemical feed pump and motor, and one chlorine analyzer. The chlorine chemical feed pump skid has been causing issues requiring frequent repair and is planned for replacement. The current Prominent chemical feed pumps are capable of pumping 5 gallons per hour. When the pumps are replaced with the new Watson Marlow chlorine feed pumps, the maximum feed rate is 7.92 gpm continuously and 12.68 intermittently.

Table 2.2.4.1.1.1 shows the asset with a BRE rating above 10.

Table 2.2.4.1.1.1: Chlorine Feed System Rehabilitation Asset

Asset Name	*Probability of Failure*	*Consequence of Failure*	*Redundancy Score*	*BRE*
Chlorine Chem. Feed	2.70	3.75	1.00	**10.13**

The chlorine chemical feed system has a high consequence of failure because of the disruption to the process, safety concerns, and required response time.

The City plans to add an on-site generator for sodium hypochlorite at the Glick facility. The City currently owns all the equipment needed for on-site generation except the generator. This improvement will reduce the volume of hazardous material stored on-site, improve safety for the public and City personnel, and eliminate liabilities associated with transporting hazardous materials.

2.2.4.1.2 Ammonium Sulfate

Ammonia Sulfate was previously added immediately after the post-chlorination feed point to create chloramines for disinfection to reduce the formation of disinfection by products (DBPs) in the distribution system. However, the City forms chloramines using naturally occurring ammonia from the Glick wells. The Glick treatment building contains one 360-gallon ammonium sulfate mix tank, one ammonium sulfate tank, and one ammonium pump skid. All three ammonium assets are currently not in operation and the City does not have plans to reinstate the ammonia feed as it is not required to maintain the existing chloramination process.

2.2.4.1.3 Fluoride

Fluoride is added to treated water for dental health benefits. The Glick facility contains two 150-gallon fluoride tanks, two fluoride pumps, and a one fluoride analyzer.

2.2.4.1.4 Polyphosphate

Polyphosphate is added to finished water to prevent corrosion and iron staining of the distribution system. The Glick treatment process comprises one 360-gallon polyphosphate mix tank, one polyphosphate mix tank, a second polyphosphate tank, and one phosphate meter pump skid. A spare pump is not necessary since the polyphosphate feed is not required to meet regulatory requirements.

2.2.4.1.5 Electrical

The Glick Water Treatment facility is powered by Duke Energy pole mount transformers. The Glick MCC is a G.E. 7700 Series rated at 480V, 3 phase, 3 wire, 600 amps. The MCC houses starters that are no longer in use, a lighting panel with transformer, and miscellaneous circuit breakers for onsite equipment. The electrical service disconnect, MCC, and well starters are aging and in poor or fair condition. The Glick Plant MCC has reached retirement age and parts are difficult to obtain.

The electrical components with BRE ratings for items identified for replacement have been summarized in **Table 2.2.4.1.5.1**.

Table 2.2.4.1.5.1: Glick Pumping Station Rehabilitation Assets

Asset Name	*Probability of Failure*	*Consequence of Failure*	*Redundancy Score*	*BRE*
Service Disconnect	2.82	4.64	1.00	**13.08**
MCC	2.40	4.64	1.00	**11.13**
Well 1 Starter	4.50	3.00	0.65	**8.78**
Well 2 Starter	4.50	3.00	0.65	**8.78**
Well 3 Starter	4.50	3.00	0.65	**8.78**
Well 4 Starter	4.50	3.00	0.65	**8.78**
Well 5 Starter	4.50	3.00	0.65	**8.78**

The service disconnect and MCC have a high consequence of failure due to the importance to the process, safety concerns, potential community disruption, and required response time. The well

starters have a high probability of failure because of their physical condition, age, O&M protocols, and operational condition.

2.2.4.1.6 Standby Power

The Glick facility does not have standby power. According to the *Recommended Standards for Water Works*, a standby power supply shall be provided through a dedicated portable or in-place auxiliary power of adequate supply and connectivity.

2.2.4.1.7 SCADA and Controls

The plant employs Allen Bradley control systems. The main plant PLC is an Allen Bradley Compact Logix L33ERM PLC which monitors and controls facility equipment including the onsite wells. The Glick wells have Allen Bradley 1734-AENT point I/O modules that work as extensions to the main plant PLC. Operators can adjust the SCADA system from the local client SCADA computers. The main SCADA server is located at City Hall and is the "traffic controller" of the entire network. All data and operator adjustments to the system are sent through the main SCADA server. The wells are controlled through the SCADA system and are operated based on a chosen system tank level.

2.2.5 Columbian Park Booster Station

The Columbian Park Booster Station is located at 1800 Scott St. It is the sole supply of water to the City's upper pressure zone and draws water from the Columbian Park reservoir. The booster station houses the booster pumps, motors, SCADA system, sodium hypochlorite injection equipment, a radio control tower, and the MCC. The booster pumps were replaced in 2000. The booster station has a stationary standby power source available through a 700 kW diesel generator.

Columbian Park Booster Station Pump Room

2.2.5.1 *Columbian Park Building*

The Columbian Park building was constructed in 1963 by U.S. Piping, Inc. and contains the chemical treatment systems, six (6) booster pumps, and the SCADA system.

2.2.5.2 *Booster Pumps and Motors*

The City only operates four (4) of the six (6) booster pumps. Booster pump 1 is currently not in operation. During maximum day demands, the City relies on their elevated water storage and four largest booster pumps to meet demands. Operating more than four pumps raises the discharge pressure from the station which has historically caused main breaks in smaller diameter water mains in the upper pressure zone. This pump operation limits the capacity of the station to 6,250 gpm or 9.0 MGD which is below the actual pumping capacity. The booster pump operating capacities summarized below in **Table 2.2.5.2.1** are from flow tests the City completed in 2015**.**

Table 2.2.5.2.1: Columbian Park Booster Pump Capacities

Columbian Booster Pump	*Rated Capacity (gpm)*	*Operating Capacity (gpm)*
1	2,100	1,600*
2	2,100	1,600
3	2,100	1,550
4	2,100	1,600
5	2,100	1,500
6	2,100	2,100**
Total	12,600	9,860
Firm	8,400	6,250

**Not in operation*

***Removed for Firm rating*

2.2.5.2.1 Columbian Booster Pump 1

Pump 1 is a horizontal split pump, installed in 2002, manufactured by Peerless Pump Co. with a 10-inch diameter discharge pipe. The pump has a 100 HP, 3-phase, 460V, G.E. motor that was installed in 2003. The motor is powered by an across the line starter located in the MCC. The City does not operate this booster pump on a routine basis.

2.2.5.2.2 Columbian Booster Pump 2

Pump 2 is a horizontal split pump, installed in 2003, manufactured by Aurora with a 10-inch diameter discharge pipe. The pump has a 100 HP, 3-phase, 460V, U.S. motor that was installed in 2003. The motor is powered by an across the line starter located in the MCC.

2.2.5.2.3 Columbian Booster Pump 3

Pump 3 is a horizontal split pump, installed in 2000, manufactured by Weinman/Mueller with a 10-inch diameter discharge pipe. The pump has a 100 HP, 3-phase, 460V, G.E. motor that was installed in 2000. The motor is powered by an across the line starter located in the MCC.

2.2.5.2.4 Columbian Booster Pump 4

Pump 4 is a horizontal split pump, installed in 2001, manufactured by Aurora with a 10-inch diameter discharge pipe. The pump has a 200 HP, 3-phase, 460V, Marathon motor that was installed in 2002. The motor is powered by an across the line starter located in the MCC.

2.2.5.2.5 Columbian Booster Pump 5

Pump 5 is a horizontal split pump, installed in 2000, manufactured by Aurora with a 10-inch diameter discharge pipe. The pump has a 200 HP, 3-phase, 460V, Marathon motor that was installed in 2001. The motor is powered by an across the line starter located in the MCC.

2.2.5.2.6 Columbian Booster Pump 6

Pump 6 is a horizontal split pump, installed in 2000, manufactured by Aurora with a 10-inch diameter discharge pipe. The pump has a 100 HP, 3-phase, 460V, G.E. motor that was installed in 2000. The motor is powered by an across the line starter located in the MCC.

2.2.5.3 *Chemical Feed Equipment*

At the booster station, the water is treated with sodium hypochlorite (12.5% chlorine) to boost the chlorine residual before entering the upper pressure zone. The station has one 850-gallon sodium hypochlorite bulk tank, one 55-gallon sodium hypochlorite day tank, one chlorine pump with spare, and two chlorine and pH analyzers, one for the station and one for the reservoir.

2.2.5.4 *Electrical*

The station is served by Duke Energy. The MCC is an Allen Bradley 2100 Centerline Series 480V, 3 phase, 3 wire, 1200 amp, and houses the distribution equipment for lighting loads as well as starters for the booster pumps. The electrical systems at the Columbian Park Booster Station appear to be aged but in fair condition. In particular, the electrical service disconnect and MCC are aging and showing signs of wear. Although parts are currently available for the MCC, it is recommended to replace it within the next 10 years. The consequence of failure for the Automatic Transfer Switch (ATS) and MCC are both high as Columbian Park is the only source of water for the upper pressure zone. It is recommended to replace the well starters, service disconnect, and MCC before these components deteriorate further. Despite the building having a BRE rating above 10 due to the consequence of failure, the building is in fair condition and does not require rehabilitation at this time.

The electrical components at the Columbian Park Booster Station with BRE ratings above 10 are summarized in **Table 2.2.5.4.1**.

Table 2.2.5.4.1: Columbian Park Booster Station Rehabilitation Assets

Asset Name	*Probability of Failure*	*Consequence of Failure*	*Redundancy Score*	*BRE*
MCC	2.72	4.64	1.00	**12.62**
Main Disconnect	2.66	4.44	1.00	**11.82**

The MCC and main disconnect have a high consequence of failure due to their importance to the system process, safety concerns, community disruption, and required response time.

2.2.5.5 *Standby Power*

The booster station has a Caterpillar Model 3412, 700 kW, 875 kVa, 480V, standby diesel generator. The generator is automatically brought online by an ASCO 7000 Series bypass isolation ATS during a power loss and has the capacity to run all but one of the 200 HP booster pumps. The estimated lighting/HVAC load is 75kVa.

2.2.5.6 *SCADA and Controls*

The booster station employs Allen Bradley control systems. The main plant PLC is an Allen Bradley Compact Logix L33ERM PLC which monitors and controls facility equipment including the booster pumps. Operators can adjust the SCADA system from the local client SCADA computers. The booster pumps are controlled through the SCADA system and are operated based on an operator chosen system tank level.

2.2.5.7 *Source Capacity Analysis*

According to the *Recommended Standards for Water Works,* the pumping capacity must be able to provide the maximum demand of the system with one pump out of service. **Table 2.2.5.7.1** shows the booster station operating capacity with four (4) pumps running compared to the maximum day demands in the upper pressure zone.

Table 2.2.5.7.1: Maximum Day Demand Capacity in Upper Pressure Zone

Maximum Day Demand	*Booster Station Firm Operating*	*Meets Capacity Requirements?*
7,900 gpm (11.3 MGD)	6,250 gpm (9.0 MGD)	No

The firm operating capacity of the Columbian Park Booster Station with four (4) pumps running does not meet capacity requirements for the current maximum demand day in the upper pressure zone. However, the City has managed to meet maximum day demands so far by pumping in conjunction with water supply from their elevated water storage tanks.

2.2.6 Storage

The City has a four (4) elevated tanks and one ground reservoir for finished water storage. The tanks and reservoir have a combined storage capacity of ten (10) million gallons.

Table 2.2.6.1 summarizes the City's existing water storage.

Table 2.2.6.1: Existing Water Storage

Storage Facility	*Pressure Zone*	*Existing Storage Capacity*	*Average Day Demand (gpd)*
Columbian Park Reservoir	Lower	5,000,000 gal	1,600,000 gpd
Union Street Tank	Upper	1,000,000 gal	6,800,000 gpd
Fairgrounds Tank	Upper	1,000,000 gal	
Plaza South Tank	Upper	1,000,000 gal	
Haggerty Lane Tank	Upper	2,000,000 gal	
TOTAL =		10,000,000 gal	8,400,000 gpd

For this report, the City's average day demand is used to determine the storage capacity for the upper and lower pressure zones. Water storage requirements are shown in **Table 2.2.6.2** below

Table 2.2.6.2: Water Storage Requirements

Pressure Zone	*Average Day Demand*	*Available*	*Additional Needed*
Lower	1,600,000 gal	5,000,000 gal	None
Upper	6,800,000 gal	5,000,000 gal	1,800,000 gpd

2.2.6.1 *Fairgrounds Elevated Tank*

The Fairgrounds Elevated Tank, built in 1963 by Pittsburgh Des Moines Steel Co., is located at 1900 South 18th Street. The 160-foot tall tower is a legged, steel tank with a capacity of one (1) MG, an overflow elevation of 813 feet, high level alarms at 98.5 and 99.0 feet, and low level alarms at 50.0 and 55.0 feet.

Tank input/output (I/O), including tank level, is communicated to the SCADA system via Allen Bradley 1734-AENT point I/O modules. The last tank inspection was performed in October of 2012 by Tank Industry Consultants (TIC). The City addressed all items identified by TIC. The Fairgrounds tank is in good condition and is not in need of repairs. The tank should be inspected again in 2017 to maintain a maximum 5-year inspection frequency.

Fairgrounds Tank

2.2.6.2 *Plaza South Elevated Tank*

The Plaza South Elevated Tank, built in 1994 by Landmark Structures Inc., is located at 330 Twyckenham Boulevard West. The 164.5-foot tall composite tower has a capacity of one (1) MG, an overflow elevation of 813 feet, high level alarms at 98.5 and 99.0 feet, and low level alarms at 50.0 and 55.0 feet. Tank I/O, including tank level, is communicated to the SCADA system via Allen Bradley 1734-AENT point I/O modules. The last tank inspection was performed in June of 2012 by TIC. The City has addressed all items identified by TIC. The Plaza South tank is in good condition and is not in need of repairs. The tank should be inspected again in 2017 to maintain a maximum 5-year inspection frequency.

Plaza South Tank

2.2.6.3 *Union Street Elevated Tank*

The Union Street Elevated Tank, built in 1963 by Pittsburgh Des Moines Steel Co., is located at 3210 Union Street. The 145-foot tall tower is a legged, steel tank with a capacity of one (1) MG, an overflow elevation of 813 feet, high level alarms at 98.5 and 99.0-feet, and low level alarms at 50.0 and 55.0 feet. Tank I/O, including tank level, is communicated to the SCADA system via Allen Bradley 1734-AENT point I/O modules. The last tank inspection was performed in July of 2011 by TIC. The City addressed all items identified by TIC. The Union Street tank is in good condition and does not appear to be in need of repairs. The tank was not inspected in 2016 and should be scheduled for inspection soon to further evaluate the condition of the tank.

Union Street Tank

2.2.6.4 *Haggerty Elevated Tank*

The Haggerty Elevated Tank, built in 1995 by Landmark Structures Inc., is located at 1855 Veterans Memorial Parkway East. The 127.5-foot tall composite tower has a concrete base and a steel tank with capacity of two (2) MG, an overflow elevation of 812.6-feet, high level alarms at 99.0 and 99.5-feet, and low level alarms 50.0 and 55.0 feet. The last tank inspection was performed in October of 2012 by TIC. The City addressed all items identified by TIC. The Haggerty tank is in good condition and is not in need of repairs. The tank should be inspected again in 2017 to maintain a maximum 5-year inspection frequency. Tank I/O, including valve position and tank level, is communicated to the SCADA system via Allen Bradley 1734-AENT point I/O modules.

Haggerty Tank

2.2.6.5 *Columbian Park Ground Storage Reservoir*

The Columbian Park Ground Storage Reservoir is located at 1915 Scott Street, next to the Columbian Park Booster Station. It was originally built around 1875 and has a capacity of five (5) MG with an overflow elevation of 724.5 feet. A metal roof was constructed over the reservoir in 1994. The reservoir has high level alarms at 26.5 and 26.7 feet, and low level alarms at 19.5 and 19.6 feet. Reservoir I/O is communicated to the SCADA system via Allen Bradley 1734-AENT point I/O modules.

Based upon the available information from the City, the Columbian Park reservoir has a moderate probability of failure. According to City personnel, the storage reservoir is leaking along the highest concrete joint of the tank on one side. The extent of the leak is unknown and should be evaluated. A qualified tank inspection company should be employed to perform an underwater inspection of the tank to determine the extent of the leak at the joint and the overall condition of this aging concrete structure. If failures in the joint are found, there are wet methods to temporarily seal the joints through epoxy injection. If the reservoir is out of service, the ability to provide water to the high pressure zone is significantly affected.

The BRE rating of the Columbian Park Ground Storage Reservoir is summarized in **Table 2.2.6.5.1**.

Table 2.2.6.5.1: Columbian Park Ground Storage Reservoir Asset Summary

Asset Name	*Probability of Failure*	*Consequence of Failure*	*Redundancy Score*	*BRE*
Columbian Park Ground Storage Reservoir	3.68	4.94	1.00	**18.20**

The ground storage reservoir has a high consequence of failure because of the importance to the process, financial impact, safety concerns, community disruption, and required response time. Without the reservoir, the upper pressure zone would not have a sufficient water source since the Columbian Park booster pumps pull water from the reservoir and pumps it into the upper pressure zone.

Columbian Park Reservoir

2.2.7 Water Distribution System

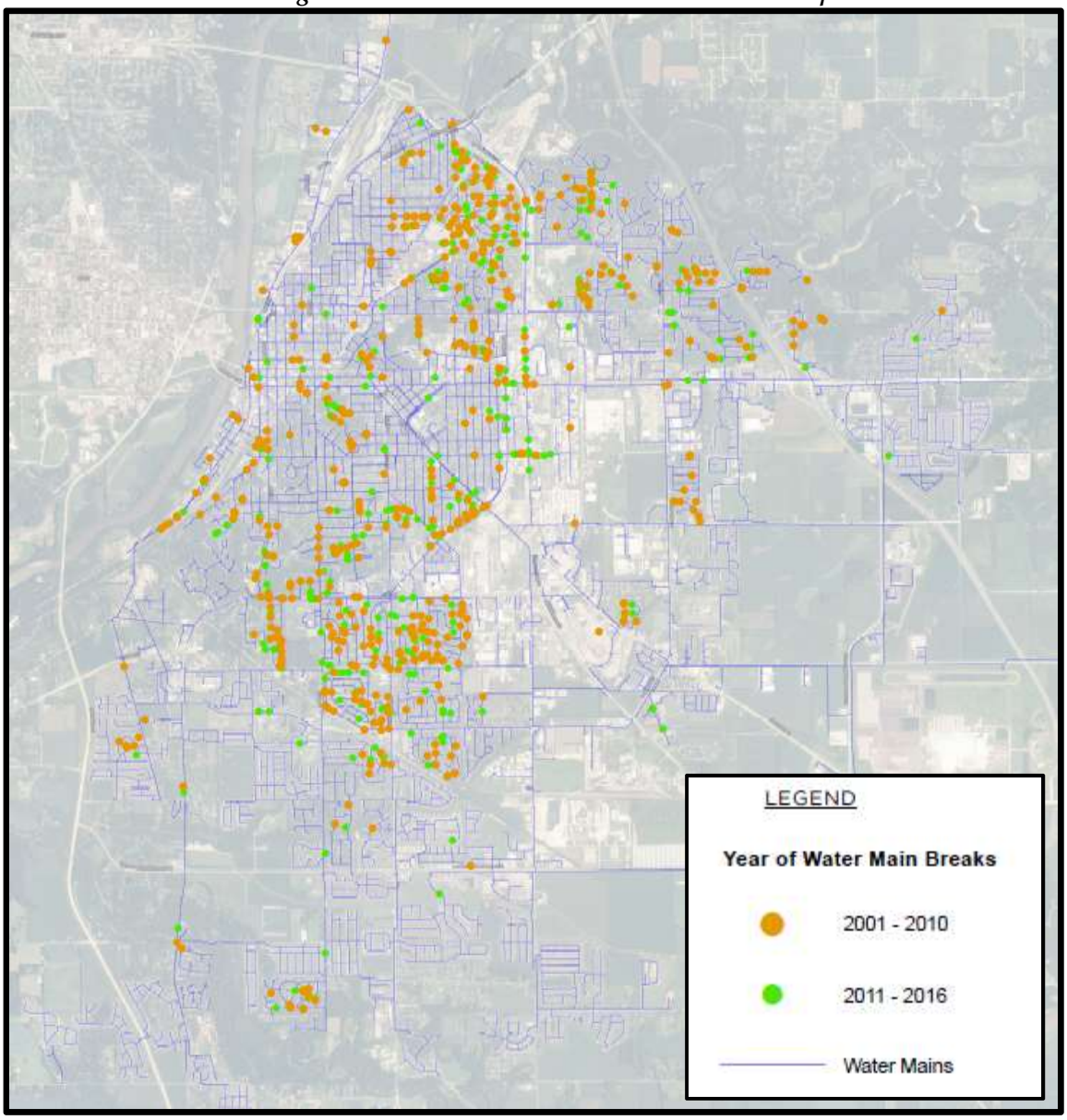
There is approximately 2,082,000 feet of water main ranging in size from 3/4-inch to 36-inch in diameter. The distribution system consists of 7,800 valves, with sizes ranging from 2-inch to 36-inch, and has 3,360 hydrants. The water distribution system is comprised of two (2) pressure zones. The lower pressure zone system is believed to have been installed in the late 1800's and the upper pressure zone system in the early to mid-1900's. Both zones have mostly looped mains, but the system does contain dead-end mains on the edges of the City's distribution system limits.

The system's water mains are primarily cast iron, with more recent improvements and new development being ductile iron. Typical system pressure is 62 psi. The City currently has a reported 28,700 service connections. It is estimated that 10% to 30% of the distribution system contains lead service lines, mostly located in the lower pressure zone. The City would like to replace all the lead service lines in the system in the next 20 years. The City is currently installing radio read devices on all service line meters.

The City flushes their hydrants in the spring and fall each year to help prevent excessive sediment buildup, maintain sufficient water quality to customers, and monitor the condition and operation of the hydrants in the system.

Historical water main break information was used to prepare the distribution system asset management evaluation. The date and location of each break was provided by the City and data was available from 1987 to 2016. The City also provided the approximate age of the water main and the pipe material where each break occurred. Water main breaks were mapped in a geographical information system (GIS) to evaluate the data points. Initially, the complete data set was reviewed for concentrated areas of water main breaks. However, due to the large amount of water main break data available, it was difficult to determine which areas of the system were recently experiencing frequent, concentrated breaks. For this reason, only water main breaks from 2001-2016 were considered when scoping water main replacement areas. Refer to **Figure 2.2.7.1** and **Figures A-5 and A-6** in **Appendix A** for exhibits illustrating the geographical concentration of water main breaks throughout the distribution system.

Figure 2.2.7.1: Water Main Break Distribution Map



High concentration areas of water main breaks were reviewed and compared to the City's distribution system map to determine if the high number of breaks were occurring on the same water main, parallel mains, branch mains, services, or failing appurtenances.

2.2.7.1 *Asset Index and Grading Criteria*

A distribution system asset index and grading criteria was developed to compare the areas of high water main break frequency. The probability and consequence of failure was used to determine the mains' BRE rating. A summary of the BRE rating results can be found in **Appendix C**.

2.2.7.1.1 Probability of Failure

The probability of failure is the overall rating of weighted criteria for an asset's likelihood of failure. The criteria contributing to the probability of failure for water mains include age and repair history. A

weight was given to each criterion to identify the most important criteria. The consequence of failure is the weighted average of the criteria ratings.

- **Age Factor Rating**: The age factor rating is calculated from the estimated age of the asset and the effective life of the asset. The percentage of its useful life is used to determine the age factor rating. As the installed date is unavailable for piping in the distribution system, age is estimated using pipe material type and approximate age as reported from City personnel.
- **Repair History Rating (2001-2010):** The repair history rating is calculated based on the total number of breaks within the water main area. The total number of breaks is divided by the years within the data set (e.g. 10 years) to determine the average number of breaks per year. As this criterion evaluates more historical (older) main breaks, a lesser weighting factor is applied.
- **Repair History Rating (2011-2016):** This criterion is calculated in the same manner as the 2001-2010 Repair History, however it considers main breaks from 2011-2016 (6-year data set). As this criterion evaluates more recent main breaks, a larger weighting factor is applied to consider that the issue causing these failures may be ongoing.

Table 2.2.7.1.1.1: Probability of Failure Criteria

Criteria	*Rating*					*Weighting Factor*
	5	*4*	*3*	*2*	*1*	
Age Factor	100% of useful life	Age between 75% and 100% of useful life	Age between 50% and 75% of useful life	Age between 25% and 50% of useful life	Age less than 25% of useful life	0.75
Repair History (2001-2010)	Very Poor (More than 2.0 breaks per year within the project area)	Poor (between 1.5 and 2.0 breaks per year within the project area)	Moderate (between 1.0 and 1.5 breaks per year within the project area)	Good (between 0.5 and 1.0 breaks per year within the project area)	Very Good (less than 0.5 breaks per year within the project area)	0.75
Repair History (2011-2016)	Very Poor (More than 2.0 breaks per year within the project area)	Poor (between 1.5 and 2.0 breaks per year within the project area)	Moderate (between 1.0 and 1.5 breaks per year within the project area)	Good (between 0.5 and 1.0 breaks per year within the project area)	Very Good (less than 0.5 breaks per year within the project area)	1.5

2.2.7.1.2 Consequence of Failure

The consequence of failure is the overall rating of weighted criteria for the effect of failure an asset poses to the City's distribution system. The criteria contributing to the consequence of failure include water main & area criticality, water main size, and service impact. These criteria evaluate the water main area's failure with respect to the water main and to the distribution system as a whole. A weight was given to each criterion to identify the most important criteria.

- **Water Main & Area Criticality Rating**: The water main & area criticality rating is determined by the area's importance to convey water throughout the distribution system. It is assumed that a failure would result in the entire project area being without service but not effect a larger area of the distribution system. If water could not be conveyed outside of the project area as a result of the failure, it would score high and if the failure had no service impact outside of the project area, it would score low. Consideration for important facilities such as schools and hospitals were considered in this rating.
- **Aggregate Water Main Size Rating**: The aggregate water main size rating is determined by calculating the weighted average water main size by length. It is assumed that a break on a large diameter main would be more difficult to repair and have greater potential for causing damage to surrounding infrastructure; therefore, it would score higher than a smaller diameter main.
- **Service Impact Rating**: The service impact rating is determined by the total number of customers within the service area. It is assumed that a failure would result in all customers within the area being impacted. Similarly, this factor is reflective of the number of customers whose level of service would be improved by replacing the water mains within the area.

Table 2.2.7.1.2.1: Consequence of Failure Criteria

Criteria	*Rating*					*Weighting Factor*
	5	*4*	*3*	*2*	*1*	
Main & Area Criticality (Impact on water mains adjacent to project area)	Mission Critical - Unable to convey water around the project area	Loss of Redundancy - Smaller diameter water main conveying water around project area	Loss of Redundancy- Identical size water main conveying water around project area	Loss of Redundancy - Larger diameter water main conveying water around project area	No impact outside the project area	0.5
Aggregate Water Main Size Rating	12-inch and greater	Greater than 8-inch to 10-inch	Greater than 6-inch to 8-inch	Greater than 4-inch to 6-inch	4-inch and less	1.0
Service Impact (number of customers impacted)	More than 150 customers within the project area	109-150 customers within the project area	67-108 customers within the project area	25-66 customers within the project area	Less than 25 customers within the project area	1.5

2.2.7.1.3 Redundancy Score

Since the main and area criticality and service impact ratings take into account the redundancy built into the distribution system in the event of a main break, the redundancy score was not used for the distribution system assets.

2.2.7.2 *Decision Matrix*

After the BRE rating was developed, a set of criteria was developed to account for important factors contributing to the priority areas including BRE rating, water quality, lead services, fire flow, and road work. Each criterion was given a weight to take into account the most important criteria to the City. Refer to **Table 2.2.7.2.1** for the criteria and rating descriptions.

Table 2.2.7.2.1: Distribution System Decision Matrix Criteria

Criteria	*Weight*	*Rating*				
		1	*2*	*3*	*4*	*5*
BRE Rating	2	1.00-5.00	5.01-10.00	10.01-15.00	15.01-20.00	20.01-25.00
Water Quality	3	No dead ends	1 dead end	2 dead ends	3 dead ends	4+ dead ends
Lead Services	5	0 service lines per 100 feet of new water main	1 service line per 100 feet of new water main	2 service lines per 100 feet of new water main	3 service lines per 100 feet of new water main	4+ service lines per 100 feet of new water main
Fire Flow	7	2,500+ gpm	2,000-2,499 gpm	1,500-1,999 gpm	1,000-1,499 gpm	0-999 gpm
Road Work	8	Resurface or rebuild within 10+ years	Resurface or rebuild within 8-10 years	Resurface or rebuild within 6-8 years	Resurface or rebuild within 3-5 years	Resurface or rebuild within 0-2 years

2.2.7.3 *Results*

Each water main replacement project scope was developed by first identifying the section of water main experiencing frequent breaks. Each project scope was then evaluated and, where appropriate, extended to consider contiguous sections of water mains with less frequent breaks. The final scope of each project was then determined by the practical limits of replacement during construction (i.e. to the nearest intersection or main line valve). A summary of the water main replacement priorities is included in **Table 2.2.7.3.1**. Refer to **Appendices C and D** for the BRE project tables and charts showing the individual water main replacement projects. Refer to **Figure A-4** in **Appendix A** for an overview of the water main replacement projects.

Table 2.2.7.3.1: Distribution System Project Ratings

Project No.	*Project Name*	*Rating*
DS2-1	Berkshaft Dr, Mildex Ct, N 26th St	20.00
DS2-2	Holloway Dr, Vernon Ln	16.40
DS2-3	Valley St, Digby Dr, Memory Ln	16.20
DS2-4	Vinton Subdivision East End	16.00
DS2-5	Vinton Subdivision North End	16.00
DS2-6	Golden Place, Pippin Ln, Rome Dr	16.00
DS2-7	Rainbow Dr, Roselawn Ave, Sunrise Ave	15.80
DS2-8	S 4th St, Thise Ct, Woodview Ct	15.80
DS2-9	Meharry St, Vinton St, N 21st St	15.80
DS2-10	Perrin Subdivision	15.60
DS2-11	Pine Ln, Mulberry Dr, Cedar Ln	14.80
DS2-12	Wabash Ave Water Main Replacement	14.80
DS2-13	Sagamore Parkway	14.60
DS2-14	Vinton Subdivision West End	13.40
DS2-15	Greenwich Rd, Haverford Dr, Hampton Dr	13.20
DS2-16	S 3rd St, and Green St	12.80
DS2-17	Poplar Ln, Dogwood Ln	12.40
DS2-18	North Ct	12.00
DS2-19	Brown St.	11.80
DS2-20	Sickle Ct, and Julia Ln	11.60
DS2-21	Southlea Addition Central	11.00
DS2-22	Parkway Ct, S 28th St	10.80
DS2-23	S 23rd St, Kossuth St	10.60
DS2-24	S 19th St, S 20th St, King St	10.60
DS2-25	Westridge Cir	10.60
DS2-26	Heatherfield Dr, Kingsmill Ct	10.40
DS2-27	Edgelea Addition	9.80
DS2-28	Crestview Ct	9.80
DS2-29	S 13th St, Warren Dr, Oak Ave	9.60
DS2-30	Sinton Ave	9.60
DS2-31	Tecumseh Addition East End	9.00
DS2-32	Walton St, and Fairfax Dr	8.80
DS2-33	Birch Ln	8.80
DS2-34	S 18th St	8.60
DS2-35	Tecumseh Addition West End	7.40
DS2-36	Robinwood and St. Joseph Subdivisions	7.40
DS2-37	Southlea Addition West End	7.00
DS2-38	Teal Rd, S 8th St	6.60
DS2-39	Southlea Addition East End	6.00

2.2.7.3.1 Berkshaft Dr, Mildex Ct, N 26th St Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a moderate number of service connections. As such, the

probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in the next 2 years and available fire flows less than 1,000 gpm.

2.2.7.3.2 Holloway Dr, Vernon Ln Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low**.** The project area has available fire flows less than 1,000 gpm.

2.2.7.3.3 Valley St, Digby Dr, Memory Ln Water Main Replacement

The 4-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in the next 2 years.

2.2.7.3.4 Vinton Subdivision East End Water Main Replacement

The 4-inch to 8-inch cast iron water mains located in this project area experienced a high number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is high. This project area has a large number of dead end mains and available fire flows between 1,000-1,499 gpm.

2.2.7.3.5 Vinton Subdivision North End Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in the next 3-5 years and has available fire flows between 1,000-1,499 gpm.

2.2.7.3.6 Golden Place, Pippin Ln, Rome Dr Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. The available fire flows in this project area are less than 1,000 gpm.

2.2.7.3.7 Rainbow Dr, Roselawn Ave, Sunrise Ave Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a moderate number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. The available fire flows in this project area are less than 1,000 gpm.

2.2.7.3.8 S 4th St, Thise Ct, Woodview Ct Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in the next 2 years.

2.2.7.3.9 Meharry St, Vinton St, N 21st St Water Main Replacement

The 4-inch and 8-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. However, the project area is moderately critical to the overall distribution system. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in the next 2 years.

2.2.7.3.10 Perrin Subdivision Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. There is road work planned in the next 3-5 years and has available fire flows between 1,000-1,499 gpm.

2.2.7.3.11 Pine Ln, Mulberry Dr, Cedar Ln Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a high number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. The available fire flows in this project area are less than 1,000 gpm.

2.2.7.3.12 Wabash Ave Water Main Replacement

The 12-inch cast iron water main serves as a transmission main between the upper and lower pressure zones. Although this main does not have any service connections, the service impact and main criticality contributed to a high consequence of failure. There is road work planned in the next 3-5 years and has available fire flows between 1,000-1,499 gpm.

2.2.7.3.13 Sagamore Parkway

The 6-inch cast iron water main along South Street between Sagamore Parkway and Earl Avenue is located on a major thoroughfare that is scheduled for road work under the Sagamore Parkway Phase III project. This portion of water main has historically had multiple breaks and is past its useful life.

2.2.7.3.14 Vinton Subdivision West End Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in the next 5-7 years and has available fire flows between 1,500-1,999 gpm.

2.2.7.3.15 Greenwich Rd, Haverford Dr, Hampton Dr Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a moderate number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. The project area has a high number of dead end water mains.

2.2.7.3.16 S 3rd St, and Green St Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. However, the main has exceeded its useful life. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. The available fire flows in this project area are between 1,000-1,499 gpm.

2.2.7.3.17 Poplar Ln, Dogwood Ln Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a moderate number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. There is road work planned in this project area over the next 2 years.

2.2.7.3.18 North Ct Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. There is road work planned in the next 5-7 years and has available fire flows between 1,500-1,999 gpm.

2.2.7.3.19 Brown St. Water Main Replacement

The 8-inch cast iron water main along Brown Street from 3rd Street to 13th Street located in this project area was scoped in coordination with Phases 1 and 2 of the City's combined sewer project. The project will also include replacement of 4-inch to 20-inch water main connections at intersections and approximately 30 lead service lines along the project route.

2.2.7.3.20 Sickle Ct, and Julia Ln Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a moderate number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate. The project area has a high number of dead end water mains.

2.2.7.3.21 Southlea Addition Central Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. The project area has a high number of dead end water mains and available fire flows between 1,000-1,499 gpm.

2.2.7.3.22 Parkway Ct, S 28th St Water Main Replacement

The 4-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low.

2.2.7.3.23 S 23rd St, Kossuth St Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a moderate number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate.

2.2.7.3.24 S 19th St, S 20th St, King St Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. However, the project area is moderately critical to the overall distribution system. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate.

2.2.7.3.25 Westridge Cir Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. The available fire flow in the project area is less than 1,000 gpm.

2.2.7.3.26 Heatherfield Dr, Kingsmill Ct Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. There is road work planned in the project area in the next 3-5 years.

2.2.7.3.27 Edgelea Addition Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate.

2.2.7.3.28 Crestview Ct Water Main Replacement

The 4-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. There is road work planned in the project area in the next 3-5 years.

2.2.7.3.29 S 13th St, Warren Dr, Oak Ave Water Main Replacement

The 4-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low. There are a high number of dead end water mains in the project area.

2.2.7.3.30 Sinton Ave Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. However, the project area is moderately critical to the overall distribution system. As such, the probability and consequence of failure ratings, and resultant BRE rating is low.

2.2.7.3.31 Tecumseh Addition East End Water Main Replacement

The 6-inch and 10-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is high.

2.2.7.3.32 Walton St, and Fairfax Dr Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low.

2.2.7.3.33 Birch Ln Water Main Replacement

The 4-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low.

2.2.7.3.34 S 18th St Water Main Replacement

The 4-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low.

2.2.7.3.35 Tecumseh Addition West End Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a high number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is high.

2.2.7.3.36 Robinwood and St. Joseph Subdivisions Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a high number of breaks and the project area contains a high number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is high.

2.2.7.3.37 Southlea Addition West End Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a moderate number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate.

2.2.7.3.38 Teal Rd, S 8th St Water Main Replacement

The 4-inch and 6-inch cast iron water mains located in this project area experienced a moderate number of breaks and the project area contains a low number of service connections. As such, the probability and consequence of failure ratings, and resultant BRE rating is low.

2.2.7.3.39 Southlea Addition East End Water Main Replacement

The 6-inch cast iron water mains located in this project area experienced a low number of breaks and the project area contains a low number of service connections. However, the project area is moderately critical to the overall distribution system. As such, the probability and consequence of failure ratings, and resultant BRE rating is moderate.

2.3 Annual Water Main Replacement Program

Each water main has an expected useful life based mostly on material composition and installation methods. To maintain an acceptable level of service to the community and maintain the distribution system, an annual water main replacement program (WMRP) should be developed. A WMRP will provide a plan to methodically replace at risk water mains, those that are aged and have a high number of breaks, that impact the system and customers in the community. To develop a successful long term WMRP, additional water main breaks and service areas should be evaluated. By doing so, a proactive approach can be adopted to replace aging water main infrastructure beyond the projects identified in this report. For this report, the historical number of main breaks were analyzed to determine the length of mains that would need to be replaced each year to maintain an acceptable rate of replacement for

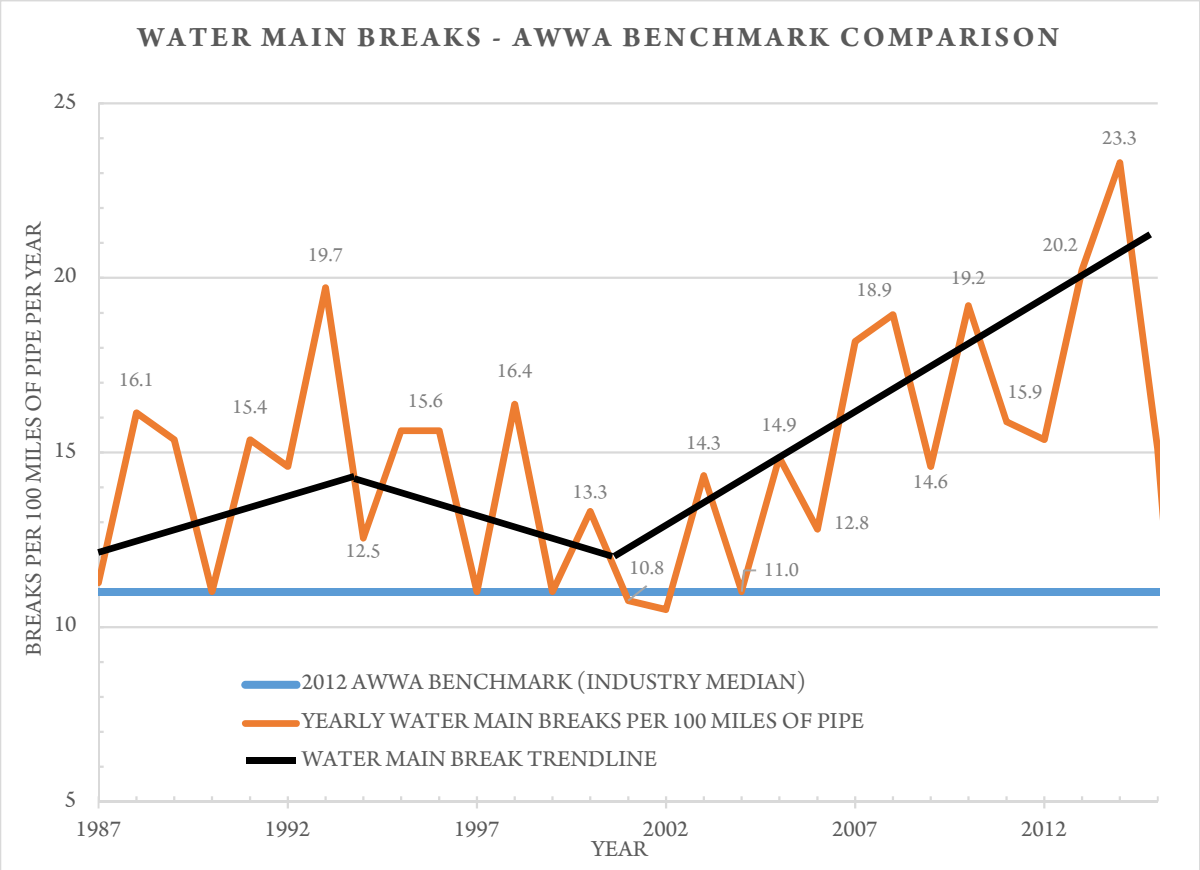
the City. Once these identified priority water mains are replaced, annual main replacement should continue to mitigate and reduce the number of annual breaks.

2.3.1 Water Main Break Rate

Per the 2012 AWWA benchmark survey, the median number of annual water main breaks for all pipe materials is 11 per 100 miles of pipe in systems of comparable size to the City's. From 1987 to 2016, the system experienced an average of 15 breaks per year per 100 miles of pipe. This is roughly 1.4 times greater than the AWWA median. In addition, the trend line of annual breaks in the City shows an increasing number of water main breaks per year, with a more dramatic increase in recent years. **Chart 2.3.1.1** shows the AWWA benchmark for water main breaks per 100 miles per year across the country compared to the number of water main breaks per 100 miles per year in the City over the past 29 years.

The majority of the City's water main breaks occurred in cast iron mains. Only a small number of breaks occurred in ductile iron pipe over the last 29 years.

Chart 2.3.1.1: 1987-2016 Water Main Break Comparison



2.3.2 Lead Service Line Replacement Program

Lead service line replacement was also evaluated as part of the annual distribution system replacement program. A distribution system map containing areas with lead service lines was provided by City personnel, and is located on **Figure A-4** in **Appendix A**. The older northwest portion of the City contains most of the lead service lines in the distribution system. The total number of lead service lines was estimated to be 12,960 based on the number of GIS parcels with street addresses in this area. This

number was reduced by approximately 900 services, to account for the lead service lines that are already included as a part of BRE capital projects, leaving 12,060 remaining for replacement.

2.3.3 WMRP Recommendations

Typical replacement rates for utilities across the country range from 0-2% per year. Assuming the replacement rate is 1% of the system per year to achieve a system wide replacement rate of 100 years, additional water mains should be identified for replacement based on age and break concentration after the BRE projects are complete. Water main breaks should be consistently documented to track and evaluate the trend in the future and identify future priority water main replacement needs. In addition to the information currently recorded, break type and weather conditions should be recorded to help understand what is causing the breaks. After replacing water mains at a certain unspecified rate, the number of water main breaks should begin to decrease over time. If the number of breaks continues to increase, the replacement rate should be increased. The goal is to have a replacement rate that allows for the number of water main breaks to decrease each year until reaching near the AWWA industry standard. The City's system contains a total of approximately 390 miles of water mains. The water main replacement projects identified in this report resulting from the BRE analysis total approximately 22.6 miles or 5.8% of the total length of the distribution system.

2.3.4 Fire Flow and Emergency Storage

The City's fire department requests 1,500 gpm to 2,000 gpm of fire flow. Hydrant flow tests were performed by the City at 25 different locations throughout the distribution system in 2015 to verify the needed fire flow could be met and satisfy their insurance requirements through the Insurance Service Organization (ISO). This was determined by flushing hydrants fully open while measuring flow, static and residual pressures. All flow tests sustained flows above 1,500 gpm without dropping the pressure below 20 psi. **Table 2.3.4.1** summarizes the hydrant flow testing locations and available fire flows.

A fire flow analysis was performed at the southern-most portion of the distribution system near the Wea Ridge Elementary School at 18th Street and East County Road 430 South. Based on the hydraulic model results during a maximum day scenario, fire flows of 2,000 gpm drop the residual system pressures in the area below 20 psi during maximum day demands. An elevated storage tank in the area would provide the necessary water availability to provide 2,000 gpm fire flows and sustain pressures above 20 psi.

Table 2.3.4.1: Available Fire Flow Summary

Static Hydrant Location	*Residual Hydrant Location*	*Flow Hydrant (gpm)*	*Flow Hydrant Static Pressure (psi)*	*Flow Hydrant Residual Pressure (psi)*	*Fire Flow (gpm rounded) @ 20 psi*
Golf View Drive	Golf View & 9th	1,405	83	70	9,100
8th & Union	9th & Union	1,350	67	55	10,000
25th & Ferry	25th & Cason	1,000	50	35	2,500
24th & Meharry	Erie & Greenbush	1,190	63	50	5,000
Earl & Kossuth	Kossuth & Sagamore	1,030	58	38	7,400
Farabee & South	South & Farabee	1,160	55	47	7,900
8th & Hitt	Hitt & 7th	1,130	58	45	3,100
Shenandoah & Union (SW)	Shenandoah & Union (NW)	1,160	55	48	7,700
Commerce Drive	Park East & South	1,190	59	50	5,900
9th & Twyckenham	Brady & Dover	1,250	67	55	6,900
Windmill & Ortman	18th & Ortman	1,275	65	57	6,900
Beck & Old US 231 (490' S)	Beck & Old US 231	1,300	67	60	10,500
1305 Audobun	Teal & 2524 Meadow Dr	1,080	68	38	4,600
2655 Teal Road	26th & Teal	1,250	62	55	6,500
CR 350 & 9th	CR 350 & 9th	1,300	70	60	7,000
38th & Professional	SR 38 & Professional	1,220	62	55	4,500
Wolflake & CR 500	SR 26 & CR 500	1,190	58	50	5,900
Union & Earl	Union & 31st	1,169	53	48	7,700
Kepner & Creasy	Kepner & Creasy	1,275	65	58	6,900
Imperial & Brady	Imperial & Brady	1,275	68	58	5,700
Veterans MP & Haggerty (SW)	Veterans MP & Haggerty (SE)	1,190	58	50	8,500
CR 400 S & Fiddlesticks	Fiddlesticks & Rockhill	1,405	89	70	6,600
Concord & Laf Wire Products	Concord & Ice Cream Specialties	1,250	64	55	6,600
Indian Brook W & CR 300 S	Indian Brook E & 300 S	1,350	74	65	7,700
Ivy Tech Main Entrance	Ivy Tech North of Bridge East Side	1,251	66	55	6,800

3.0 FUTURE NEEDS

3.1 Population

3.1.1 Population Projection

The Study is based on a 20-year planning period from 2016 to 2036. Population projections for the City, Town of Dayton, and the City's future service areas outside the corporate limits were obtained from the Area Plan Commission of Tippecanoe County, which can be found in **Appendix F**. The Area Plan Commission completed projections for 2045. To determine the population served in 2036, it was assumed that population trends followed a linear pattern. **Table 3.1.1.1** shows the calculation method.

Table 3.1.1.1: Projected Population

Item	*Value*
2016 Population Served by City	84,417
2045 Population Served by City**	119,870*
Population Change	35,453
# of People per Year from 2016 to 2045	1,223
Estimated % Increase (2016-2036)	29%
Estimated 2036 Lafayette Population	108,877

** From Tippecanoe County Area Plan Commission*

3.2 20-Year Population Demands

Table 3.2.1 summarizes the projected water demand from population increase for the 20-year planning period. Projected demands were calculated by multiplying the population change by the existing per capita water demand calculated in **Chapter 2**.

Table 3.2.1: Projected Population Water Demand

No.	*Item*	*Value*
1	2016 Population Served	84,417
2	2036 Population Served	108,877
3	Population Change	24,460
4	Additional Demand (*24,460 customers x 100 gpd per capita*)	2.4 MGD (1,700 gpm)

Table 3.2.2 shows the how the additional demand due to population increase is distributed between the lower and upper pressure zones. It is assumed based on the population projections for Tippecanoe County that 7% of the additional demand will come from the lower pressure zone and 93% will come from the upper pressure zone. The maximum day demand is calculated using the existing water system peaking factor of 1.65.

Table 3.2.2: Additional Demand from Projected Population

Item	*Average Day*		*Maximum Day*	
	MGD	*gpm*	*MGD*	*gpm*
Additional Demand	2.4	1,700	4.0	2,800
Lower Pressure Zone (7% of Additional Demand)	0.2	125	0.3	200
Upper Pressure Zone (93% of Additional Demand)	2.2	1,575	3.7	2,600

3.3 20-Year Development

Strategic planning for future development has been completed by the City and focuses on four (4) areas, all located in the upper pressure zone. Refer to **Figures A-8 through A-11** in **Appendix A** for location maps of the development areas. Proposed land use in these development areas is estimated to include residential, general business, commercial, medical, and industrial development.

- Area 21 – Tippecanoe County completed a strategic plan for development within the Heartland Corridor along S.R. 25 just outside of the City's existing service area. Area 21 is located between the intersection of I-65 and State Road 25 and the Tippecanoe/Carroll County line.
- A. Ross Watershed – area is bordered by roughly by State Road 26 to the north, Interstate 65 to the east, McCarty Lane to the South, and Park East Boulevard to the west.
- Upper Julius Berlowitz – area is directly south of and adjacent to the A. Ross Watershed, this area is bordered by McCarty Lane to the north, Veterans Memorial Parkway to the east, Haggerty Lane to the South, and Trillium Lane to the west.
- LUR Southeast Expansion – area is south of Veterans Memorial Parkway and is bordered by US Highway 52 to the east.

Proposed land use and estimated acreage for the four (4) future development areas are shown below in **Tables 3.3.1 through 3.3.4.**

Table 3.3.1: Area 21 Demand

Land Use	*Acres*
Single Family Residential	925
Multi-Family Residential	165
General Business	180
Commercial	195
Industrial	700

Table 3.3.2: A. Ross Watershed

Land Use	*Acres*
General Business	571

Table 3.3.3: Upper Julius Berlowitz

Land Use	*Acres*
Single Family Residential	22
General Business	29
Medical	72
Industrial	425

Table 3.3.4: LUR Southeast Expansion

Land Use	*Acres*
Industrial	170

3.4 Total 20-Year System Demand

The total 20-year system demand was calculated by adding the projected population demands to the existing demands. **Table 3.4.1** below summarizes the total water demands for the next 20 years. **Table 3.4.2** shows the total maximum day water demand for the next 20 years in the lower and upper pressure zones.

Table 3.4.1: 20-Year System Water Demands

Year	*2016*		*2036*	
	MGD	*gpm*	*MGD*	*gpm*
Average Day Demand	8.4	5,800	10.8	7,500
Maximum Day Demand	13.9	9,700	17.9	12,500

Table 3.4.2: 20-Year Maximum Day Demand/Capacity

Pressure Zone	*20 Year Maximum Day Demand*		*Existing Firm Operating Capacity*		*Additional Capacity Needed*	
	MGD	*gpm*	*MGD*	*gpm*	*MGD*	*gpm*
Lower	2.9	2,000	21.4	14,900	None	
Upper	15.0	10,500	9.0*	6,250	6.0	4,250
Total	17.9	12,500	21.4	14,900	None	

**Assumes operation of only four (4) pumps at the Columbian Park Booster Station*

The upper pressure zone will need an additional 6.0 MGD to meet the estimated 20-year maximum day demands.

4.0 EVALUATION OF ALTERNATIVES

4.1 Water Source

To assess improvements necessary to the City's water system for meeting future demands, a WaterCAD hydraulic model of the City's system was used to evaluate hydraulic aspects of the following alternatives where appropriate.

4.1.1 Alternative WS1 – No Construction Alternative

Should a no construction alternative be pursued, the City will not have sufficient water source capacities to supply 20-year maximum day demands. Specifically, the Columbian Park Booster Station will not have sufficient capacity to supply 20-year maximum day demands to the upper pressure zone.

4.1.2 Alternative WS2 – Glick Well Field Connectivity to the Upper Pressure Zone

Alternative WS2 evaluated connecting the Glick Well Field directly to the upper pressure zone to provide the additional capacity needed to meet future demands. The Canal Well field will continue to supply to the lower pressure zone. The firm operating capacity of the Glick Well Field in combination with the firm operating capacity of the Columbian Park booster station can meet the existing maximum day demands in the upper pressure zone. This will require modifications to the wells and the distribution system:

1. Modification or replacement of the Glick well pumps and motors to achieve the total dynamic head (TDH) required to pump to the overflow level of the elevated water storage tanks in the upper zone.
2. Connecting the well field directly to the upper pressure zone by using the existing 30-inch water main from the well field to the intersection of 17th Street and Union Street, and then installing a new 24-inch water main from the 30-inch east along Union Street approximately 4,400 feet to connect to the existing 24-inch water main at 30th Street and Union Street. See **Figure A-12** in **Appendix A** for a map of the route.

Isolation of the 30-inch water main will require:

- Closing approximately fifteen (15) isolation valves in the distribution system ranging in size from 6-inch to 24-inch
- Installation of two (2) new 6-inch isolation valves at Union and 17th Streets
- Installation of one (1) new 30-inch isolation valve at Union and 17th Streets
- Tie-in of 24-inch water main at Burroughs Street and 9th Street to the existing 14-inch along 9th Street.
- Tie-in of 6-inch water main at Marion Street and Canal Road into the 30-inch south along Canal Road.

Considerations:

- By increasing the head on the well pumps to pump to the upper pressure zone, the lower pressure zone will experience a large increase in pressure.
- Installation of the water main tie-ins and additional isolation valves will temporarily interrupt water service to customers.
- This alternative will only impact land that is already developed and owned by the City or existing right-of-way. No new easements or land purchases are anticipated.

The total pre-design estimated cost for Alternative WS2 is **$2,055,000**. A detailed cost estimate can be found in **Appendix B, Table B-1.**

This alternative is not selected because the 30-inch water main, and the water mains in the lower pressure zone (old part of City), exceed 100 years of age, are made of cast iron, and most likely will not be able to accommodate the additional pressure resulting from pumping into the upper pressure zone.

4.1.3 Alternative WS3 – Canal Well Field Connectivity to the Upper Pressure Zone

As an alternative to WS2, Alternative WS3 evaluated the connectivity of the Canal Well Field to the upper pressure zone to provide the additional capacity needed to meet future demands. The Glick Well Field can meet the 20-year maximum day demands of the lower pressure zone. Connection of the Canal Well Field to the upper pressure zone will require modifications to the wells and the distribution system:

1. Modification or replacement of the Canal well pumps and motors to achieve the total dynamic head (TDH) required to pump to the overflow level of the elevated water storage tanks in the upper zone.
2. Connecting the well field directly to the upper pressure zone will require isolating the existing 24-inch water main from the Canal well field to the intersection of Union Street and 18th Street, then installing a new 24-inch water main from the existing 24-inch east along Union Street approximately 4,000 feet to connect to the existing 24-inch water main at 30th Street and Union Street. See **Figure A-13** in **Appendix A** for a map of the route.
3. Isolation of the 24-inch water main will require closing approximately six (6) isolation valves in the distribution system ranging in size from 6-inch to 30-inch.

Considerations:

- By increasing the head on the well pumps to pump to the upper pressure zone, the lower pressure zone will experience a large increase in pressure.
- Installation of the water main tie-ins and additional isolation valves will temporarily interrupt water service to customers.
- This alternative will only impact land that is already developed and owned by the City or existing right-of-way. No new easements or land purchases are anticipated.

The total pre-design estimated cost for Alternative WS3 is **$2,447,000**. A detailed cost estimate can be found in **Appendix B, Table B-2.**

This alternative will not meet the need of the City and therefore is not given further consideration for the following reasons:

- The Columbian Park Reservoir will not continue to fill because the Glick Well Field operating capacity (5.8 MGD) is less than the Columbian Park Booster Station firm capacity (9.0 MGD).
- The older age of the 24-inch water mains, and the additional pressure these water mains will experience due to the increased TDH for pumping into the upper pressure zone, causes serious concerns of the main failing.
- If the Canal Well Field is operating at its firm operating capacity, the isolated 24-inch water main cannot handle the flows. At a flowrate of 10,500 gpm, the resulting headloss exceeds 40 psi.

4.1.4 Alternative WS4 – 4.8 MGD Aretz Well Field with Connection to 14-inch at Schuyler Avenue

Alternative WS4 evaluated developing and constructing a new 4.8 MGD well field at the old Aretz airport site and connecting the well field to the City's water distribution system by installing 11,000 feet of 24-inch water main from the well field southeast along State Road 25 to I-65, crossing underneath the interstate proceeding southeast along Schuyler Avenue to connect to an existing 14-inch water main along Schuyler Avenue northeast of Biltz Drive. Refer to **Figure A-14** in **Appendix A** for the route. This alternative will provide a total of 13.8 MGD to the upper pressure zone with the Columbian Park Booster Station operating at firm capacity (9.0 MGD), which does not meet the future maximum day demand of the upper pressure zone. To meet the future maximum day demand in the upper pressure zone, Alternative BS2 will also need to be constructed.

The new Aretz Well Field and connection to the existing system will require:

- Construction of 3-4 groundwater wells, pumps, motors, well houses, electrical, and controls on the 16 acres of land the City owns at the old Aretz Airport site.
- 12-inch and 16-inch discharge piping from each well.
- A 24-inch water main from the well field along State Road 25 to connect to the existing 14-inch water main.
- Installation of an isolation valve at Schuyler Avenue and Biltz Drive to move the 14-inch connection point to the upper pressure zone.

Considerations:

- When the proposed 24-inch water main reduces to 14-inch at the connection point to the existing system, the 14-inch causes a severe restriction and cannot handle the flows, resulting in headlosses through the 14-inch main exceeding 20 psi. The 14-inch water main could be upsized to 24-inch , but will require 8,000 feet of replacement south along Sagamore Parkway to Union Street, which will impact recent road improvements that were completed associated with Sagamore Parkway Phases I and II. This will be more expensive than subsequent alternatives evaluated for connecting to the existing distribution system.
- Water main borings under State Road 25, Interstate 65, and Wildcat Creek raises the cost of the project.
- The construction of the well field will impact land that is not developed but is owned by the City. The City will need to purchase easements for installing the water main from the Aretz Well Field to the connection point to the existing system.

The total pre-design estimated cost for Alternative WS4 is **$8,997,000**. This cost includes the upsizing of 8,000 feet of water main along Sagamore Parkway. A detailed cost estimate can be found in **Appendix B, Table B-3.**

This alternative is not selected because of the resulting hydraulic restriction through the 14-inch water main and the high costs to install a larger water main from the connection point to the distribution system.

4.1.5 Alternative WS5 – 4.8 MGD Aretz Well Field with Connection to 24-inch at Creasy Lane

As an alternative to WS4, Alternative WS5 evaluated connecting the Aretz Well Field to an existing 24-inch water main at the intersection of Creasy Lane and Union Street. It includes installing 15,000 feet of 24-inch water main from the proposed Aretz Well Field, south crossing under State Road 25 to

County Road North 400 East, proceeding south crossing County Road East 200 North and Wildcat Creek, turning southwest crossing under Interstate 65 at Eisenhower Road, and turning south on Creasy Lane to connect to an existing 24-inch water main at the intersection with Union Street. Refer to **Figure A-14** in **Appendix A** for the route.

With a 24-inch connection at Creasy Lane and Union Street, a continuous 24-inch water main runs from the Aretz Well Field to a 24-inch loop within the existing distribution system. This will maximize the flow of water from the Aretz Well Field into the City's upper pressure zone. Like Alternative WS4, this alternative will produce a total of 13.8 MGD of water demand capacity for the upper pressure zone with the Columbian Park Booster Station operating at firm capacity (9.0 MGD). Since this capacity does not meet the future maximum day demand of the upper pressure zone, Alternative BS2 will also need to be constructed. The headlosses through the 24-inch main from the Aretz Well Field to the connection point to the existing system will be less than 3 psi.

Considerations:

- Construction of the well field will impact land that is not yet developed but owned by the City. The City will likely need to purchase easements for installing water main from the Aretz Well Field to the connection point.
- Water main borings under Interstate 65 and Wildcat Creek raises the cost of the project.

The total pre-design estimated cost for Alternative WS5 is **$8,696,000**. A detailed cost estimate can be found in **Appendix B, Table B-4.**

4.1.6 Alternative WS6 – 4.8 MGD Aretz Well Field with Connection to 24-inch at State Road 26

As an alternative to WS5, Alternative WS6 evaluates connecting the Aretz Well Field to an existing 24-inch water main just east of the intersection of State Road 26 and Interstate 65. It includes installing approximately 20,000 feet of 24-inch water main from the proposed Aretz Well Field, south crossing under State Road 25 to County Road North 400 East, proceeding south to County Road East 200 North and turning east to a point 600 feet west of East Foxmoor Drive, thence turning south and proceeding cross country and under Wildcat Creek to Shady Creek Drive. The 24-inch water main will follow Shady Creek Drive to County Road East 50 North where it bends to the east and proceed south cross country to connect to an existing 24-inch water main along South Street. Refer to **Figure A-14** in **Appendix A** for the route.

With a 24-inch connection at State Road 26 and I-65, a continuous 24-inch water main runs from the Aretz Well Field to a 24-inch loop within the existing distribution system. This will maximize the flow of water from the Aretz Well Field into the City's upper pressure zone. In contrast to Alternative WS5, water will enter the City's upper pressure zone further to the east, which will provide additional flows more directly toward future demand areas in the A.Ross Watershed, Upper Julius Berlowitz, and LUR Southeast Expansion. Similar to Alternative WS5, Alternative BS2 will also need to be constructed to meet future maximum day demands.

The headlosses through the 24-inch main from the Aretz Well Field to the connection point to the existing system will be less than 4 psi.

Considerations:

- Construction of the well field will impact land that is not yet developed but owned by the City. The City will likely need to purchase easements for installing water main from the Aretz Well Field to the connection point.
- Water main borings under Wildcat Creek raises the cost of the project.
- Length of water main is more than Alternative WS5.

The total pre-design estimated cost for Alternative WS6 is **$10,203,000**. A detailed cost estimate can be found in **Appendix B, Table B-5.**

This alternative is not selected because there is no added value in comparison to Alternative WS5 and the cost of improvements are higher.

4.1.7 Alternative WS7 – Business Risk Exposure Improvements

4.1.7.1 *Glick Well Field and Pumping Station Improvements*

This alternative includes the replacement of the electrical service disconnect, MCC, and well starters. In addition, rehabilitation of the existing submersible monitoring well and a new submersible pump and motor are included. The estimated total project cost of this project is **$383,000**. Refer to **Table B-6** in **Appendix B** for a more detailed cost estimate.

4.1.8 Alternative WS8 – Miscellaneous Water Source Improvements

Alternative WS8 consists of miscellaneous improvements to the City's water sources. The improvements will improve the daily operation, maintenance, and safety of the City's water sources.

- WS8-1 - On-Site Sodium Hypochlorite Generation
  The City has all the necessary equipment at the Glick Treatment Facility, except the generator to produce onsite generation of sodium hypochlorite (0.8% chlorine). The City desires to replace the stored bulk sodium hypochlorite (12.5% chlorine) which is delivered to the site via tank truck. This will reduce the volume of hazardous material to be stored on-site, improve safety for the public and City personnel, and eliminate liabilities associated with transporting hazardous materials. The total estimated cost for the generator, appurtenances, and installation is $250,000.

- WS8-2 - Generator Replacements at Canal Treatment Facility
  The two (2) existing generator sets (600kW each) at the Canal Treatment Facility can operate 7 of the 9 well pump motors. Consideration was given to replacing the existing generators with two larger units (750kW each) to run all of the well motors in the event of a power outage. The total estimated cost for the equipment and installation is $700,000. Since the City can provide sufficient water supply with 7 wells, this improvement is a low priority and not selected. The existing generator sets are sufficient for operating the well field during a power outage.

- WS8-3 - Generator at Glick Treatment Facility
  The Glick Treatment Facility and Well Field do not have a backup power source. If power is lost at the well field, the City will lose 6.3 MGD of capacity. A single medium-voltage generator is proposed for installation at the treatment facility building, which is not located in the flood zone. This would serve the building and the Glick Well Field. The total estimated cost for equipment and installation is $800,000.

Installation of low voltage 480 volt generators at each individual well is also an option but each would need to be elevated above the 100-year flood elevation. There is not sufficient space on the existing well platforms for a generator to be placed. New platforms would need to be erected for each generator and a means by which to access them when flooding occurs.

4.2 Booster Station

4.2.1 Alternative BS1 – No Construction Alternative

Should a no construction alternative be pursued, the City's Columbian Park Booster Station can meet existing upper pressure zone average daily demand, but will not have sufficient capacity to meet the existing maximum day, 20-year average day, or 20-year maximum day demands in the upper pressure zone. The booster station is a bottleneck in the system and does not allow the full water supply of Glick and Canal Street well fields to be utilized.

4.2.2 Alternative BS2 – New Booster Station at Murdock Park

This alternative is to provide a supplemental source of water for the upper pressure zone by constructing a 6.0 MGD booster station and 3.0 MG ground storage reservoir south of Murdock Park, where the existing softball field is located south of Cason Street. This station will operate concurrently with the Columbian Park Booster Station, for moving water to the upper pressure zone, as well as provide a second pumping source if maintenance needs to be performed on the Columbian Park Booster Station. This alternative will produce a total of 15.0 MGD of water demand capacity for the upper pressure zone with the Columbian Park Booster Station operating at firm capacity (9.0 MGD). This capacity meets the future maximum day demand of the upper pressure zone.

This alternative will include the connection of a new 24-inch water to the existing 30-inch water main along 18th Street on the southwest side of Murdock Park to supply water to the new reservoir. The discharge water main from the booster station includes a new 24-inch water main north along 22nd Street and east along Cason Street to connect to an existing 24-inch water main at 30th Street in the upper pressure zone. Refer to **Figure A-15** in **Appendix A** for a layout of the alternative.

Considerations:

- Alternative BS2 may require easements for the new water mains along 22nd Street and Cason Street.
- Installation of the water main tie-ins to the existing system may interrupt water service to customers.

The total pre-design estimated cost for Alternative BS2 is **$10,569,000**. A detailed cost estimate can be found in **Appendix B, Table B-7.**

4.2.3 Alternative BS3 – Business Risk Exposure Improvements

4.2.3.1 *Columbian Park Booster Station Improvements*

This alternative includes the replacement of the electrical service disconnect and MCC at the Columbian Park Booster Station. In addition, the storage reservoir is suspected to be leaking along the highest concrete joint of the tank on one side. The extent of the leak is unknown and should be investigated. This alternative includes an inspection from a qualified tank inspection company to perform an underwater inspection of the highest concrete joint to determine the extent of possible failure. If failures in the joint are found, there are wet methods to temporarily seal the joints through

epoxy injection. The estimated total project cost of this project is **$232,000**. Refer to **Table B-8** in **Appendix B** for a more detailed cost estimate.

4.2.4 Alternative BS4 – Miscellaneous Booster Station Improvements

Alternative BS4 consists of miscellaneous improvements to the City's Columbia Park Booster Station. The improvements will improve the daily operation, maintenance, and safety of the City's water sources.

- Generator Replacement at Columbian Park
  The existing generator set (700kW) at the Columbian Park Booster Station can operate all the booster pump motors except one (1) of the 200 HP motors. Consideration was given to replacing the generator with a larger unit (900kW) to run all of the booster pump motors in the event of a power outage. The total estimated cost the equipment and installation is $285,000. The City does not operate more than four (4) pumps at the same time due to historical breaking of water mains in the area when a 5th pump is employed. Because of this, the existing generator set is sufficient operating Columbian Park during a power outage.

4.3 Water Storage

4.3.1 Alternative T1 – No Construction Alternative

Should a no construction alternative be pursued, the system will not have sufficient water storage on the south side for fire protection near the Wea Ridge Elementary School.

4.3.2 Alternative T2 – New Wea Ridge Tank at School

Alternative T2 evaluated constructing a new 2.0 MG composite elevated water storage tank at the Wea Ridge Elementary School to provide adequate fire flows in the southern portion of the distribution system, sustain pressures above 20 psi during a fire event, and also to satisfy the upper pressure zone having enough water storage to meet the average day demand. See **Figure A-16** in **Appendix A** for the tank location. This alternative also includes a new 16-inch water main from the tank location west along CR E 430 S and north along South 9th Street to connect to the existing 24-inch water main at Veterans Memorial Parkway. The 16-inch water main will allow the water level in the new tank to closely match that of the Haggerty Lane Tank and will maximize movement of water from this tank to the south-central side of the distribution system.

Considerations:

- A 2,000 gpm fire demand in the vicinity of the school results in pressures dropping below 20 psi during a peak demand day. The addition of a 2.0 MG tank will satisfy fire flow demands and sustain average day demands pressures during a 4-hour fire flow event.
- If the tank is constructed to match the overflow elevation of the other elevated water storage tanks in the upper pressure zone, the tank will fluctuate between 75-90% full during average day demand periods.
- This alternative will include a tank site fence, yard piping, valves and hydrants, tank telemetry equipment and an access drive.
- This alternative will require a land purchase from the Wea Ridge Elementary School. Easements for the water main may be required to the connection point.

The total pre-design estimated cost for Alternative T2 is **$4,685,000**. A detailed cost estimate can be found in **Appendix B, Table B-9.**

Should the City consider other tank storage volumes, **Table 4.3.2.3.1** summarizes the construction costs for the different sizes of elevated tanks.

Table 4.3.2.3.1 Alternative T2 – New Composite Tank Construction Cost Summary

Capacity	*Tank Cost*
1,250,000 gallons	$2,300,000
1,500,000 gallons	$2,600,000
2,000,000 gallons	$3,200,000

Costs shown only include tank construction and do not include site work, piping and non-construction costs.

4.3.3 Alternative T3 – New Wea Ridge Tank at Concord Road and Veterans Memorial Parkway

Alternative T3 proposes an alternative location for the Wea Ridge Tank on the southeast corner of Concord Road and Veterans Memorial Parkway. See **Figure A-17** in **Appendix A** for the tank location. The tank would connect to the existing 24-inch water main along Veterans Memorial Parkway. Placement of the tank at this intersection will maximize movement of water from this tank to the southcentral side of the distribution system via the existing 24-inch water main. If the tank is constructed to match the overflow elevation of the other elevated water storage tanks in the upper pressure zone, the tank will fluctuate between 75-90% full during average day demand periods.

Considerations:

- The addition of a 2.0 MG tank will satisfy fire flow demands and sustain average day demands pressures during a 4-hour fire flow event.
- This alternative will include a tank site fence, yard piping, valves and hydrants, tank telemetry equipment and an access drive.
- This alternative will require land be purchased at the intersection of Concord Road and Veterans Memorial Parkway for the construction of the tank and associated water mains. The sale of land at this intersection is assumed to be prime commercial property and will be expensive for the City to purchase.

The total pre-design estimated cost for Alternative T3 is **$5,336,000**. A detailed cost estimate can be found in **Appendix B, Table B-10.**

4.4 Distribution System

4.4.1 Alternative DS1 - No Construction Alternative

Should a no construction alternative be pursued, the City's distribution system will continue to experience water main breaks on its older water mains. The system is aging and in need of continued maintenance and upkeep. For this alternative, the City will continue to have difficulty maintaining the reliability of water distribution to its customers.

4.4.2 Alternative DS2 – Business Risk Exposure Improvements – Distribution System

A summary of the distribution system replacement projects is included in **Table 4.4.2.1**. Refer to **Appendices C and D** for the project tables and charts showing the individual distribution system projects.

Table 4.4.2.1: Distribution System Assets Capital Project Summary

Project No.	*Project Name*	*Priority Rating*	*Estimated Total Project Cost*
DS2-1	Berkshaft Dr, Mildex Ct, N 26th St	20.00	**$565,000**
DS2-2	Holloway Dr, Vernon Ln	16.40	**$410,000**
DS2-3	Valley St, Digby Dr, Memory Ln	16.20	**$853,000**
DS2-4	Vinton Subdivision East End	16.00	**$3,658,000**
DS2-5	Vinton Subdivision North End	16.00	**$1,219,000**
DS2-6	Golden Place, Pippin Ln, Rome Dr	16.00	**$415,000**
DS2-7	Rainbow Dr, Roselawn Ave, Sunrise Ave	15.80	**$794,000**
DS2-8	S 4th St, Thise Ct, Woodview Ct	15.80	**$575,000**
DS2-9	Meharry St, Vinton St, N 21st St	15.80	**$464,000**
DS2-10	Perrin Subdivision	15.60	**$825,000**
DS2-11	Pine Ln, Mulberry Dr, Cedar Ln	14.80	**$362,000**
DS2-12	Wabash Ave Water Main Replacement	14.80	**$624,000**
DS2-13	Sagamore Parkway	14.60	**$589,000**
DS2-14	Vinton Subdivision West End	13.40	**$1,257,000**
DS2-15	Greenwich Rd, Haverford Dr, Hampton Dr	13.20	**$720,000**
DS2-16	S 3rd St, and Green St	12.80	**$469,000**
DS2-17	Poplar Ln, Dogwood Ln	12.40	**$1,064,000**
DS2-18	North Ct	12.00	**$107,000**
DS2-19	Brown St.	11.80	**$1,168,000**
DS2-20	Sickle Ct, and Julia Ln	11.60	**$755,000**
DS2-21	Southlea Addition Central	11.00	**$510,000**
DS2-22	Parkway Ct, S 28th St	10.80	**$290,000**
DS2-23	S 23rd St, Kossuth St	10.60	**$813,000**
DS2-24	S 19th St, S 20th St, King St	10.60	**$522,000**
DS2-25	Westridge Cir	10.60	**$112,000**
DS2-26	Heatherfield Dr, Kingsmill Ct	10.40	**$173,000**
DS2-27	Edgelea Addition	9.80	**$1,418,000**
DS2-28	Crestview Ct	9.80	**$188,000**
DS2-29	S 13th St, Warren Dr, Oak Ave	9.60	**$489,000**
DS2-30	Sinton Ave	9.60	**$242,000**
DS2-31	Tecumseh Addition East End	9.00	**$2,225,000**
DS2-32	Walton St, and Fairfax Dr	8.80	**$682,000**
DS2-33	Birch Ln	8.80	**$120,000**
DS2-34	S 18th St	8.60	**$113,000**
DS2-35	Tecumseh Addition West End	7.40	**$1,812,000**
DS2-36	Robinwood and St. Joseph Subdivisions	7.40	**$1,399,000**
DS2-37	Southlea Addition West End	7.00	**$822,000**
DS2-38	Teal Rd, S 8th St	6.60	**$168,000**
DS2-39	Southlea Addition East End	6.00	**$674,000**
DS2-40	Lead Service Line Replacement Program	--	**$21,708,000**
DS2-41	Water Main Replacement Program	--	**$64,660,000**
		TOTAL	**$116,033,000**

4.4.2.1 *DS2-1 - Berkshaft Dr, Mildex Ct, N 26th St Water Main Replacement*

The Berkshaft Dr, Mildex Ct, N 26th St Water Main Replacement project consists of the replacement of approximately 2,525 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Berkshaft Dr, Mildex Ct, N 26th St, and Roosevelt Ave.

The estimated project cost is **$565,000**. Refer to **Table B-11** in **Appendix B** for a more detailed cost estimate.

4.4.2.2 *DS2-2 - Holloway Dr, Vernon Ln Water Main Replacement*

The Holloway Dr, Vernon Ln Water Main Replacement project consists of the replacement of approximately 1,410 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Holloway Dr, and Vernon Ln.

The estimated project cost is **$410,000**. Refer to **Table B-12** in **Appendix B** for a more detailed cost estimate.

4.4.2.3 *DS2-3 - Valley St, Digby Dr, Memory Ln Water Main Replacement*

The Valley St, Digby Dr, Memory Ln Water Main Replacement project consists of the replacement of approximately 3,305 feet of 4-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Valley St, Digby Dr, Memory Ln, and Center St.

The estimated project cost is **$853,000**. Refer to **Table B-13** in **Appendix B** for a more detailed cost estimate.

4.4.2.4 *DS2-4 - Vinton Subdivision East End Water Main Replacement*

The Vinton Subdivision East End Water Main Replacement project consists of the replacement of approximately 15,110 feet of 4-inch through 8-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on N 27th St, Longlois Dr, Elmwood Ave, Vinton St, Prairie Ln, N 29th St, Prairie Pl, Prairie Ct, and Longlois Ct. This project is planned for completion in 2017 in conjunction with a roadway construction project.

The estimated project cost is **$3,658,000**. Refer to **Table B-14** in **Appendix B** for a more detailed cost estimate.

4.4.2.5 *DS2-5 - Vinton Subdivision North End Water Main Replacement*

The Vinton Subdivision North End Water Main Replacement project consists of the replacement of approximately 4,585 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Ulen Ln, Elk St, Darby Ln, and Ulen Pl.

The estimated project cost is **$1,219,000**. Refer to **Table B-15** in **Appendix B** for a more detailed cost estimate.

4.4.2.6 *DS2-6 - Golden Place, Pippin Ln, Rome Dr Water Main Replacement*

The Golden Place, Pippin Ln, Rome Dr Water Main Replacement project consists of the replacement of approximately 2,130 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Golden Place, Pippin Ln, and Rome Dr.

The estimated project cost is **$415,000**. Refer to **Table B-16** in **Appendix B** for a more detailed cost estimate.

4.4.2.7 *DS2-7 - Rainbow Dr, Roselawn Ave, Sunrise Ave Water Main Replacement*

The Rainbow Dr, Roselawn Ave, Sunrise Ave Water Main Replacement project consists of the replacement of approximately 3,490 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Rainbow Dr, Roselawn Ave, Sunrise Ave, Tulip Ln, and Wayne Terrace.

The estimated project cost is **$794,000**. Refer to **Table B-17** in **Appendix B** for a more detailed cost estimate.

4.4.2.8 *DS2-8 - S 4th St, Thise Ct, Woodview Ct Water Main Replacement*

The S 4th St, Thise Ct, Woodview Ct Water Main Replacement project consists of the replacement of approximately 2,845 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. HDPE water main will be installed by HDD on S 4th St. The remaining project area is located on Thise Ct and Woodview Ct. This project is planned for completion in 2017 in conjunction with a roadway construction project.

The estimated project cost is **$575,000**. Refer to **Table B-18** in **Appendix B** for a more detailed cost estimate.

4.4.2.9 *DS2-9 - Meharry St, Vinton St, N 21st St Water Main Replacement*

The Meharry St, Vinton St, N 21st St Water Main Replacement project consists of the replacement of approximately 1,840 feet of 4-inch and 8-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Meharry St, Vinton St, and N 21st St. This project is planned for completion in 2020 in conjunction with a roadway construction project.

The estimated project cost is **$464,000**. Refer to **Table B-19** in **Appendix B** for a more detailed cost estimate.

4.4.2.10 *DS2-10 - Perrin Subdivision Water Main Replacement*

The Perrin Subdivision Water Main Replacement project consists of the replacement of approximately 3,700 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Tinkler St, Asher St, Rush St, Cason St, and Ferry St.

The estimated project cost is **$825,000**. Refer to **Table B-20** in **Appendix B** for a more detailed cost estimate.

4.4.2.11 *DS2-11 - Pine Ln, Mulberry Dr, Cedar Ln Water Main Replacement*

The Pine Ln, Mulberry Dr, Cedar Ln Water Main Replacement project consists of the replacement of approximately 2,215 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. HDPE water main will be installed by HDD along Pine St. The remaining project area is located on Mulberry Dr, and Cedar Ln.

The estimated project cost is **$362,000**. Refer to **Table B-21** in **Appendix B** for a more detailed cost estimate.

4.4.2.12 *DS2-12 - Wabash Ave Water Main Replacement*

The Wabash Ave Water Main Replacement project consists of the replacement of approximately 2,710 feet of 12-inch cast iron water main with ductile iron water main, including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Wabash Ave. This project is planned for completion in 2018 in conjunction with a roadway construction project.

The estimated project cost is **$624,000**. Refer to **Table B-22** in **Appendix B** for a more detailed cost estimate.

4.4.2.13 *DS2-13 - Sagamore Parkway and South Street Water Main Replacement*

The Sagamore and South St. Water Main Replacement project consists of the replacement of:

- Approximately 950 feet of 6-inch along South Street between Sagamore Parkway and Earl Street. This portion of old 6-inch cast iron pipe has historically had multiple leaks and breaks. A new steel casing pipe will be bored under the railroad crossing South Street.
- Approximately 600 feet of 6-inch with new 12-inch from the intersection of South Street and Sagamore Parkway east along Sagamore Parkway to connect to an existing 12-inch.
- Approximately 950 feet of 6-inch water main extension from National Drive to the north.

This water main replacement project will be completed in advance of the City's Sagamore Parkway Phase III road reconstruction project.

The estimated project cost is **$589,000**. Refer to **Table B-23** in **Appendix B** for a more detailed cost estimate.

4.4.2.14 *DS2-14 - Vinton Subdivision West End Water Main Replacement*

The Vinton Subdivision West End Water Main Replacement project consists of the replacement of approximately 6,115 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Dearborn St, Melbourne Rd, Arlington Rd, Whitcomb Ave, and Vinton St.

The estimated project cost is **$1,257,000**. Refer to **Table B-24** in **Appendix B** for a more detailed cost estimate.

4.4.2.15 *DS2-15 - Greenwich Rd, Haverford Dr, Hampton Dr Water Main Replacement*

The Greenwich Rd, Haverford Dr, Hampton Dr Water Main Replacement project consists of the replacement of approximately 3,655 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Greenwich Rd, Haverford Dr, Hampton Dr, Somerset Dr, Haverford Dr, Rosslyn Dr. This project is planned for completion in 2021 in conjunction with a roadway construction project.

The estimated project cost is **$720,000**. Refer to **Table B-25** in **Appendix B** for a more detailed cost estimate.

4.4.2.16 *DS2-16 - S 3rd St, and Green St Water Main Replacement*

The S 3rd St, and Green St Water Main Replacement project consists of the replacement of approximately 1,855 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. HDPE water main will be installed by HDD in the alley between S 3rd St and S 4th St. The remaining project area is located on S 3rd St, and Green St.

The estimated project cost is **$469,000**. Refer to **Table B-26** in **Appendix B** for a more detailed cost estimate.

4.4.2.17 *DS2-17 - Poplar Ln, Dogwood Ln Water Main Replacement*

The Poplar Ln, Dogwood Ln Water Main Replacement project consists of the replacement of approximately 4,020 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Poplar Ln, Dogwood Ln, Aspen St, Redbud Ave, and Butternut Ave.

The estimated project cost is **$1,064,000**. Refer to **Table B-27** in **Appendix B** for a more detailed cost estimate.

4.4.2.18 *DS2-18 - North Ct Water Main Replacement*

The North Ct Water Main Replacement project consists of the replacement of approximately 400 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on North Ct.

The estimated project cost is **$107,000**. Refer to **Table B-28** in **Appendix B** for a more detailed cost estimate.

4.4.2.19 *DS2-19 - Brown Street Water Main Replacement*

The City has a combined sewer pipe along Brown Street which is to be replaced with a large-diameter interceptor sewer between 3rd Street and 13th. The City needs to replace approximately 3,400 feet of 8-inch cast iron water main including valves, hydrants, service lines and other related appurtenances along Brown Street in advance of the interceptor sewer construction. The water main replacement will also include reconnections of existing 4-inch to 20-inch water main at intersections with Brown Street.

The estimated project cost is **$1,168,000**. Refer to **Table B-29** in **Appendix B** for a more detailed cost estimate.

4.4.2.20 *DS2-20 - Sickle Ct, and Julia Ln Water Main Replacement*

The Sickle Ct, and Julia Ln Water Main Replacement project consists of the replacement of approximately 3,265 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. HDPE water main will be installed by HDD under McCarty Ln. The remaining project area is located on Sickle Ct, and Julia Ln.

The estimated project cost is **$755,000**. Refer to **Table B-30** in **Appendix B** for a more detailed cost estimate.

4.4.2.21 *DS2-21 - Southlea Addition Central Water Main Replacement*

The Southlea Addition Central Water Main Replacement project consists of the replacement of approximately 2,450 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located primarily in existing backyard easements in the central portion of the Southlea Addition.

The estimated project cost is **$510,000**. Refer to **Table B-31** in **Appendix B** for a more detailed cost estimate.

4.4.2.22 *DS2-22 - Parkway Ct, S 28th St Water Main Replacement*

The Parkway Ct, S 28th St Water Main Replacement project consists of the replacement of approximately 1,270 feet of 4-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Parkway Ct, and S 28th St.

The estimated project cost is **$290,000**. Refer to **Table B-32** in **Appendix B** for a more detailed cost estimate.

4.4.2.23 *DS2-23 - S 23rd St, Kossuth St Water Main Replacement*

The S 23rd St, Kossuth St Water Main Replacement project consists of the replacement of approximately 3,170 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on S 23rd St, and Kossuth St.

The estimated project cost is **$813,000**. Refer to **Table B-33** in **Appendix B** for a more detailed cost estimate.

4.4.2.24 *DS2-24 - S 19th St, S 20th St, King St Water Main Replacement*

The S 19th St, S 20th St, King St Water Main Replacement project consists of the replacement of approximately 2,310 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on S 19th St, S 20th St, and King St.

The estimated project cost is **$522,000**. Refer to **Table B-34** in **Appendix B** for a more detailed cost estimate.

4.4.2.25 *DS2-25 - Westridge Circle Water Main Replacement*

The Westridge Circle Water Main Replacement project consists of the replacement of approximately 500 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Westridge Circle. This project is planned for completion in 2021 in conjunction with a roadway construction project.

The estimated project cost is **$112,000**. Refer to **Table B-35** in **Appendix B** for a more detailed cost estimate.

4.4.2.26 *DS2-26 - Heatherfield Dr, Kingsmill Ct Water Main Replacement*

The Heatherfield Dr, Kingsmill Ct Water Main Replacement project consists of the replacement of approximately 630 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Heatherfield Dr, and Kingsmill Ct.

The estimated project cost is **$173,000**. Refer to **Table B-36** in **Appendix B** for a more detailed cost estimate.

4.4.2.27 *DS2-27 - Edgelea Addition Water Main Replacement*

The Edgelea Addition Water Main Replacement project consists of the replacement of approximately 6,545 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located primarily in existing backyard easements on the east portion of the Edgelea Addition. This project is planned for completion in 2019 in conjunction with a roadway construction project.

The estimated project cost is **$1,418,000**. Refer to **Table B-37** in **Appendix B** for a more detailed cost estimate.

4.4.2.28 *DS2-28 - Crestview Ct Water Main Replacement*

The Crestview Ct Water Main Replacement project consists of the replacement of approximately 760 feet of 4-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Crestview Ct.

The estimated project cost is **$188,000**. Refer to **Table B-38** in **Appendix B** for a more detailed cost estimate.

4.4.2.29 *DS2-29 - S 13th St, Warren Dr, Oak Ave Water Main Replacement*

The S 13th St, Warren Dr, Oak Ave Water Main Replacement project consists of the replacement of approximately 2,300 feet of 4-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on S 13th St, Warren Dr, Oak Ave, Ocala Ct, S 12th St, and Ocala Ave.

The estimated project cost is **$489,000**. Refer to **Table B-39** in **Appendix B** for a more detailed cost estimate.

4.4.2.30 *DS2-30 - Sinton Ave Water Main Replacement*

The Sinton Ave Water Main Replacement project consists of the replacement of approximately 900 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Sinton Ave.

The estimated project cost is **$242,000**. Refer to **Table B-40** in **Appendix B** for a more detailed cost estimate.

4.4.2.31 *DS2-31 - Tecumseh Addition East End Water Main Replacement*

The Tecumseh Addition East End Water Main Replacement project consists of the replacement of approximately 8,610 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Sequoya Dr, Apache Dr, Maumee Pl, Oswego Ln, Iroquois Tr, and Manitoba Dr.

The estimated project cost is **$2,225,000**. Refer to **Table B-41** in **Appendix B** for a more detailed cost estimate.

4.4.2.32 *DS2-32 - Walton St, and Fairfax Dr Water Main Replacement*

The Walton St, and Fairfax Dr Water Main Replacement project consists of the replacement of approximately 2,120 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Walton St, and Fairfax Dr.

The estimated project cost is **$682,000**. Refer to **Table B-42** in **Appendix B** for a more detailed cost estimate.

4.4.2.33 *DS2-33 - Birch Ln Water Main Replacement*

The Birch Ln Water Main Replacement project consists of the replacement of approximately 590 feet of 4-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Birch Ln. This project is planned for completion in 2019 in conjunction with a roadway construction project.

The estimated project cost is **$120,000**. Refer to **Table B-43** in **Appendix B** for a more detailed cost estimate.

4.4.2.34 *DS2-34 - S 18th St Water Main Replacement*

The S 18th St Water Main Replacement project consists of the replacement of approximately 460 feet of 4-inch cast iron water main with HDPE water main installed by HDD, including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on S 18th St.

The estimated project cost is **$113,000**. Refer to **Table B-44** in **Appendix B** for a more detailed cost estimate.

4.4.2.35 *DS2-35 - Tecumseh Addition West End Water Main Replacement*

The Tecumseh Addition West End Water Main Replacement project consists of the replacement of approximately 8,570 feet of 6-inch cast iron water main with ductile iron water main including valves,

hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Hiawatha Ln, Cayuga Tr, Kiowa Dr, Kickapoo Dr, Potawatomi Dr, Iroquois Tr, Osage Dr, and Shoshone Dr.

The estimated project cost is **$1,812,000**. Refer to **Table B-45** in **Appendix B** for a more detailed cost estimate.

4.4.2.36 *DS2-36 - Robinwood and St. Joseph Subdivisions Water Main Replacement*

The Robinwood and St. Joseph Subdivisions Water Main Replacement project consists of the replacement of approximately 5,125 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Robinwood Dr, Bennett Rd, Meadowlark Ln, Cardinal Ct, Lourdes Ln, Ellen Dr, and Southern Dr.

The estimated project cost is **$1,399,000**. Refer to **Table B-46** in **Appendix B** for a more detailed cost estimate.

4.4.2.37 *DS2-37 - Southlea Addition West End Water Main Replacement*

The Southlea Addition West End Water Main Replacement project consists of the replacement of approximately 3,850 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located primarily in existing backyard easements on the west side of the Southlea Addition.

The estimated project cost is **$822,000**. Refer to **Table B-47** in **Appendix B** for a more detailed cost estimate.

4.4.2.38 *DS2-38 - Teal Rd, S 8th St Water Main Replacement*

The Teal Rd, S 8th St Water Main Replacement project consists of the replacement of approximately 980 feet of 4-inch through 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located on Teal Rd, and S 8th St.

The estimated project cost is **$168,000**. Refer to **Table B-48** in **Appendix B** for a more detailed cost estimate.

4.4.2.39 *DS2-39 - Southlea Addition East End Water Main Replacement*

The Southlea Addition East End Water Main Replacement project consists of the replacement of approximately 3,300 feet of 6-inch cast iron water main with ductile iron water main including valves, hydrants, service lines and other related appurtenances necessary for installation. The project area is located primarily in existing backyard easements on the east end of the Southlea Addition.

The estimated project cost is **$674,000**. Refer to **Table B-49** in **Appendix B** for a more detailed cost estimate.

4.4.2.40 *DS2-40 - Lead Service Line Replacement Program*

The alternative includes the replacement of all existing lead service lines within the 20-year project planning period. Assuming $1,800 per individual service line replacement, the estimated cost to replace all remaining lead service lines in the distribution system is $21,708,000, or **$1,085,400 per year.** This

cost does not consider lead service line replacement within BRE project areas, as their estimated cost is already included in each project cost estimate.

As lead poses a health risk when consumed, IDEM's Office of Land Quality (OLQ) was consulted to determine if special provisions are required when abandoning lead service lines, and if they have to be removed when abandoned. The OLQ indicated that existing service lines could be abandoned in place, however, if portions of the lead service line had to be removed from the ground, the removed section would have to be taken to a recycling facility and not disposed via general trash removal service.

4.4.2.41 *DS2-41 - Water Main Replacement Program*

This alternative includes future water mains that should be replaced as a part of the water main replacement program over the 20-year planning period. Additional projects need to be identified over the 20-year planning period to maintain a 1% replacement rate for the distribution system. Considering a 1% main replacement rate over the 20-year planning period, and subtracting the total BRE projects cost ($27,930,000) and lead service line replacement costs, the remaining water main replacement cost for the 20-year planning period is $64,660,000 or **$4,845,000 per year.**

4.4.3 Alternative DS3 – Miscellaneous Distribution System Improvements

Alternative DS3 consists of miscellaneous improvements to the City's water distribution system that are based upon existing needs, current projects, and future needs. These improvements will improve the daily operation and maintenance of the Town's water system and facilitate meeting future water demands.

- DS3-1 - Area 21 Water Main Extension
  This component includes a new 24-inch water main from the proposed Aretz Well Field northeast along State Road 25 to serve the future development in Area 21. The 24-inch water main will extend 2.1 miles along State Road 25 to connect to a new 1.0 MG elevated water storage tank. See **Figure A-18** in **Appendix A** for the tank location and **Figures A-19** and **A-20** for the water main route. Constructing an elevated tank in Area 21 will help to stabilize pressure fluctuations that will occur in the far east limits of Area 21 and provide fire protection to this area, which are nearly 4 miles from the proposed Aretz Well Field. A new 12-inch water main will extend 2.1 miles from the tank to the unincorporated community of Buck Creek.

  The City will likely have to obtain easements parallel to State Road 25 for the proposed water main and purchase land to construct the tank.

  The total pre-design estimated cost is **$7,653,000**. Costs for water distribution within Area 21 were not evaluated in this report. A detailed cost estimate can be found in **Appendix B, Table B-50.**

- DS3-2 - Union Street/Creasy Lane Water Main Loop
  Looping the existing 24-inch water main from the intersection of Union Street and Creasy Lane to the east under Interstate 65 and then southeast along Frontage Road to State Road 26 will provide a continuous 24-inch loop in the water distribution system and nearly double the flow through this pipe restriction between the connection points. The loop will aid in moving water around the upper pressure zone, particularly in coordination with the proposed Murdock Park Booster Station. Total length of the water main loop is approximately 7,600 feet. Refer to **Figure A-21** in **Appendix A** for the project extents.

The City will likely have to obtain easements for the water main loop route east of Courtland Avenue. Coordination with residential home owners will be needed for the portion of water main installation east of Courtland Avenue. An INDOT permit and temporary or permanent easements will be needed during construction for the jack and bore of casing pipe under I-65.

The total pre-design estimated cost is **$2,619,000**. A detailed cost estimate can be found in **Appendix B, Table B-51.**

- DS3-3 - Hydrant Automatic Flushing
  Automatic flushing units are needed on the City's dead end water mains between Wild Cat Creek and Interstate 65 to address water quality concerns from water customers. It is estimated that 20 automatic flushing units will be installed on hydrants to maintain water quality in this area. The total estimated cost including equipment and installation is **$50,000**.

5.0 EVALUATION OF ENVIRONMENTAL IMPACTS

An evaluation of environmental impacts resulting from the improvements selected is required for a State Revolving Fund (SRF) submission of a PER. If SRF funding is selected as a funding source for any projects, this chapter will be developed to evaluate the environmental impacts to the affected project areas.

6.0 PROPOSED IMPROVEMENTS

6.1 Description

The proposed improvements were determined after evaluation of probable construction costs, feasibility of construction, need for improvements, and prioritization of benefits to the City. The proposed improvements consists of the following components separated into short term (first 5 years) and long term (next 15 years) needs. Refer to **Table 6.1.1** for the short-term projects and **Table 6.1.2** for the long-term projects. The distribution system alternatives are broken down into smaller projects that are identified by a project number in each of the tables.

Table 6.1.1: Short-Term Project Summary

Alt. No.	*Project Name*	*Estimated Total Project Cost*
WS7	Glick Business Risk Exposure Improvements	**$383,000**
WS8-1	On-Site Sodium Hypochlorite Generator at Glick	**$250,000**
BS2	New Booster Station at Murdock Park	**$10,569,000**
BS3	Columbian Park Business Risk Exposure Improvements	**$232,000**
T2	New Wea Ridge Tank at School	**$4,685,000**
DS2-4	Vinton Subdivision East End	**$3,658,000**
DS2-8	S 4th St, Thise Ct, Woodview Ct	**$575,000**
DS2-9	Meharry St, Vinton St, N 21st St	**$464,000**
DS2-12	Wabash Ave	**$624,000**
DS2-13	Sagamore Parkway	**$589,000**
DS2-15	Greenwich Rd, Haverford Dr, Hampton Dr	**$720,000**
DS2-19	Brown St.	**$1,168,000**
DS2-25	Westridge Cir	**$112,000**
DS2-27	Edgelea Addition	**$1,418,000**
DS2-33	Birch Ln	**$120,000**
DS3-3	Automatic Hydrant Flushing Equipment	**$50,000**
	TOTAL	**$25,617,000**

Table 6.1.2: Long-Term Project Summary

Alt. No.	*Project Name*	*Estimated Total Project Cost*
WS5	New 4.8 MGD Aretz Well Field and Water Main Extension	**$8,696,000**
WS8	New Generator at Glick Treatment Facility	**$800,000**
DS2-1	Berkshaft Dr, Mildex Ct, N 26th St	**$565,000**
DS2-2	Holloway Dr, Vernon Ln	**$410,000**
DS2-3	Valley St, Digby Dr, Memory Ln	**$853,000**
DS2-5	Vinton Subdivision North End	**$1,219,000**
DS2-6	Golden Place, Pippin Ln, Rome Dr	**$415,000**
DS2-7	Rainbow Dr, Roselawn Ave, Sunrise Ave	**$794,000**
DS2-10	Perrin Subdivision	**$825,000**
DS2-11	Pine Ln, Mulberry Dr, Cedar Ln	**$362,000**
DS2-14	Vinton Subdivision West End	**$1,257,000**

Alt. No.	*Project Name*	*Estimated Total Project Cost*
DS2-16	S 3rd St, and Green St	**$469,000**
DS2-17	Poplar Ln, Dogwood Ln	**$1,064,000**
DS2-18	North Ct	**$107,000**
DS2-20	Sickle Ct, and Julia Ln	**$755,000**
DS2-21	Southlea Addition Central	**$510,000**
DS2-22	Parkway Ct, S 28th St	**$290,000**
DS2-23	S 23rd St, Kossuth St	**$813,000**
DS2-24	S 19th St, S 20th St, King St	**$522,000**
DS2-26	Heatherfield Dr, Kingsmill Ct	**$173,000**
DS2-28	Crestview Ct	**$188,000**
DS2-29	S 13th St, Warren Dr, Oak Ave	**$489,000**
DS2-30	Sinton Ave	**$242,000**
DS2-31	Tecumseh Addition East End	**$2,225,000**
DS2-32	Walton St, and Fairfax Dr	**$682,000**
DS2-34	S 18th St	**$113,000**
DS2-35	Tecumseh Addition West End	**$1,812,000**
DS2-36	Robinwood and St. Joseph Subdivisions	**$1,399,000**
DS2-37	Southlea Addition West End	**$822,000**
DS2-38	Teal Rd, S 8th St	**$168,000**
DS2-39	Southlea Addition East End	**$674,000**
DS2-40	Lead Service Line Replacement Program	**$21,708,000**
DS2-41	Water Main Replacement Program	**$64,660,000**
DS3-1	Area 21 Water Main Extension	**$7,653,000**
DS3-2	Union Street/Creasy Lane Water Main Loop	**$2,619,000**
	TOTAL	**$126,353,000**

6.2 Estimated Cost of Proposed Project

The probable pre-design cost for the short-term alternatives is **$25,617,000**. The Project cost for long term alternatives is **$126,353,000**. The total 20-year project cost is **$151,970,000**.

6.3 Project Permits

The anticipated required permits include, but are not limited to:

- IDEM Drinking Water Branch Construction Permit
- FAA – Obstruction to Aviation Permit
- INDOT Right-of-Way Construction Permit
- IDEM Rule 5 Permit
- Tippecanoe County Highway Department
- Railroad Permit

6.4 Project Schedule

The anticipated schedule for the proposed short-term improvements is listed on the following page. The schedule shows the order by which the projects could reasonably be completed and the costs each year allocated to complete the improvements in years 1-5. Projects identified as long-term will be completed based on the City's judgement in years 6 through 20. No schedule is included in this report for the long-term projects.

CAPITAL IMPROVEMENTS PLAN - SHORT TERM PROJECT SUMMARY

Alt. No.	CIP Item	Total Project Cost	Yearly Cost				
			2017	2018	2019	2020	2021
Water Source							
WS7	Glick Business Risk Exposure Improvements	$ 383,000	$ -	$ 383,000	$ -	$ -	$ -
WS8-1	On-Site Sodium Hypochlorite Generation at Glick Treatment Facility	$ 250,000	$ -	$ 250,000	$ -	$ -	$ -
Distribution							
DS2-4	Vinton Subdivision East End Water Main Replacement	$ 3,658,000	$ 300,000	$ -	$ -	$ 1,679,000	$ 1,679,000
DS2-8	S 4th St., Thise Ct., and Woodview Ct. Water Main Replacement	$ 575,000	$ -	$ -	$ 575,000	$ -	$ -
DS2-9	Meharry St., Vinton St., N 21st St. Water Main Replacement	$ 464,000	$ -	$ -	$ 464,000	$ -	$ -
DS2-12	Wabash Ave. Water Main Replacement	$ 624,000	$ -	$ 624,000	$ -	$ -	$ -
DS2-13	Sagamore Parkway Water Main Replacement	$ 589,000	$ 294,500	$ 294,500	$ -	$ -	$ -
DS2-15	Greenwich Rd., Haverford Dr., Hampton Dr. Water Main Replacement	$ 720,000	$ -	$ -	$ 720,000	$ -	$ -
DS2-19	Brown Street Water Main Replacement	$ 1,168,000	$ 584,000	$ 584,000	$ -	$ -	$ -
DS2-25	Westridge Circle Water Main Replacement	$ 112,000	$ -	$ -	$ 112,000	$ -	$ -
DS2-27	Edgelea Addition Water Main Replacement	$ 1,418,000	$ -	$ -	$ -	$ -	$ 1,418,000
DS2-33	Birch Lane Water Main Replacement	$ 120,000	$ -	$ -	$ 120,000	$ -	$ -
DS3-3	Automatic Hydrant Flushing Equipment	$ 50,000	$ 50,000	$ -	$ -	$ -	$ -
Storage Tanks							
T2	Wea Ridge Elevated Water Storage Tank (2 MG)	$ 4,685,000	$ -	$ -	$ -	$ 2,342,500	$ 2,342,500
Booster Stations							
BS2	New Booster Station at Murdock Park	$ 10,569,000	$ -	$ 5,284,500	$ 5,284,500	$ -	$ -
BS3	Columbian Park Business Risk Exposure Improvements	$ 232,000	$ 232,000	$ -	$ -	$ -	$ -
	TOTAL ESTIMATED COST	**$ 25,617,000**	**$ 1,460,500**	**$ 7,420,000**	**$ 7,275,500**	**$ 4,021,500**	**$ 5,439,500**

7.0 LEGAL, FINANCIAL AND MANAGERIAL CAPABILITIES

Legal, financial, and managerial capabilities information is required for an SRF submission of a PER. If SRF funding is selected as a funding source for certain projects, this chapter will be developed to meet the requirements of SRF. Crowe Horwath LLP prepared a preliminary rate and financing report to estimate cash flow and financial capacity, and also to determine necessary increases to water rates. The report is located in **Appendix J**.

7.1 Financial Status of Existing Facilities

Based upon the report prepared by Crowe Horwath LLP, the City has been operating their water utility on an average deficit of $789,000 for the past three years. Increased equipment costs, insurance expenses, employee wages, and fringe benefits are contributing factors in the operating deficit. The City has not passed a new rate ordinance to increase water rates to customers since 2001. See **Appendix J** for the City's water utility operating expenses and revenue for 2014, 2015 and 2016.

8.0 PUBLIC PARTICIPATION

Per SRF requirements, a copy of this PER must be available for public review ten days prior to the public hearing and for five days after the public hearing. If SRF funding is selected as a funding source for certain projects, this chapter will be updated with the date of the public viewing period and public hearing. In addition, public comments must be recorded and submitted to the applicable funding agency.