FILED
September 22, 2016
INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE PETITION OF BLOOMINGTON, INDIANA, FOR AUTHORITY TO ISSUE BONDS, NOTES, OR OTHER OBLIGATIONS, FOR AUTHORITY TO INCREASE ITS RATES AND CHARGES FOR WATER SERVICE, AND FOR APPROVAL OF A NEW SCHEDULE OF WATER RATES AND CHARGES	**)**	**CAUSE NO. 44855**

PETITION

The Petitioner, the City of Bloomington, Indiana ("Bloomington"), by counsel, herewith files its Petition requesting the Indiana Utility Regulatory Commission (the "Commission") to approve a new schedule of rates and charges for water service and the issuance of water utility revenue bonds. In support of its Petition, Bloomington states that:

1. Customers and Area Served. Bloomington owns and operates a water utility that serves approximately 25,000 customers, including 9 wholesale customers, both within the municipal corporate limits of Bloomington and outside of its municipal corporate limits in Monroe County, Indiana.

2. Jurisdiction. Bloomington's utility is a "municipally owned utility" for purposes of Indiana Code § 8-1-2-1(h) and is subject to the jurisdiction of the Commission to the extent provided by the Public Service Commission Act, Ind. Code Art. 8-1, *et seq.*, as amended, and other laws.

3. Existing Rates Insufficient. Bloomington's existing schedule of rates and charges for water utility service was approved by the Commission in Cause No. 43939 by order issued on March 2, 2011 (the "Rate Order"). In Cause No. 43939, the Commission approved a settlement by and among Bloomington, the Indiana Office of the Utility Consumer Counselor (the "OUCC"), and Washington Township Water Corporation of Monroe County (n/k/a Washington Township Water Authority) that authorized a two-phase increase in revenues of approximately 50.57% and the issuance of water utility revenue bonds in an amount not to exceed $43 million. Such rates and charges no longer produce sufficient revenue to (a) pay all the legal and other necessary expenses incident to the operation of the utility, including maintenance costs, operating charges, upkeep, repairs, depreciation, and interest charges on bonds or other obligations; (b) provide a sinking fund for the liquidation of bonds or other obligations; (c) provide a debt service reserve for bonds and other obligations; (d) provide adequate money for working capital; (e) provide adequate money for making extensions and replacements to the extent not provided for through depreciation; (f) provide money for the payment of any taxes that may be assessed against the utility; and (g) compensate Bloomington for taxes that would be due Bloomington on the utility property if it were privately owned. The existing rates are, therefore, insufficient, confiscatory, and unlawful under IC 8-1.5-3-8.

4. Proposed Bonds. Bloomington must continue to make necessary additions, extensions, replacements, and improvements to its waterworks system (the "Capital Projects"). Bloomington proposes to obtain the necessary funds for these Capital Projects from revenues of the utility and from the issuance of new water utility revenue bonds (the "Proposed Bonds"). The Proposed Bonds will be issued in an amount not to exceed Four Million Six Hundred Thousand and no/100

Dollars ($4,600,000.00). Bloomington's current rates and charges do not produce sufficient revenue to pay debt service expense on the Proposed Bonds. The principal and interest of the Proposed Bonds will be payable solely from the future revenues of Bloomington's water utility. Further, the Proposed Bonds will be issued on parity with previously issued and outstanding waterworks revenue bonds and will not affect those bonds or the rights of the holders thereof.

5. Proposed Revenue Increase. Bloomington needs to increase its annual revenues and income so that it can continue to operate and maintain its water utility system in satisfactory physical and financial condition to render reasonably adequate water service to its customers and to meet the requirements for reasonable and just rates and charges for services under IC 8-1.5-3-8(c) and (d). Therefore, Bloomington proposes to increase its revenues by 22% through an across-the-board increase of its existing rates, as more fully set forth in its case-in-chief.

6. No Outstanding Federal Indebtedness. As required by Ind. Code § 8-1-2-61(a), Bloomington does not have any outstanding indebtedness to the federal government payable from the revenues of its water utility. (While Bloomington does not have any current outstanding debt directly with the federal government, Bloomington has outstanding debt with the Indiana State Revolving Fund ("SRF"). The SRF receives some portion of its funds from the federal government).

7. Test Year. Bloomington proposes a test year for purposes of determining Bloomington's actual and pro forma operating revenues, expenses and revenue requirement under present and proposed rates based on the twelve (12) months ended December 31, 2015, and believes the financial and accounting data, when

properly adjusted pursuant to Bloomington's evidence, fairly reflect Bloomington's annual operations. Such test year, as adjusted, therefore, is a proper basis for fixing the requested new rates for Bloomington and testing the effect of those rates.

8. Applicable Statutes and Rules. Bloomington considers Ind. Code §§ 8-1-2-42, 8-1.5-2-19 and 8-1.5-3-8, among other related statutes, and 170 IAC 1-1.1, *et seq.*, to be applicable to the relief requested by this Petition.

9. Attorneys. The attorneys authorized to represent Bloomington in this proceeding, each of which is authorized to accept service of papers in this proceeding:

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BINGHAM GREENEBAUM DOLL LLP
212 W. 6th Street
Jasper, Indiana 47546
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10. Procedural Schedule; Waiver of Prehearing Conference. Bloomington entered into discussions with the OUCC and Washington Township Water prior to filing its Petition and stipulated to a procedural schedule. Bloomington is filing a Stipulation to Procedural Schedule, Waiver of Prehearing Conference, and Issuance of Proposed Docket Entry Establishing Procedural Schedule concurrently with this Petition. Should the Commission find that a prehearing

conference is necessary in this matter, Bloomington requests that the Commission promptly fix a date for such prehearing conference.

WHEREFORE, Bloomington respectfully requests that the Commission publish such notice and conduct a prehearing conference (if such prehearing conference is deemed necessary by the Commission) and such other hearings as are necessary or appropriate and thereafter issue a final order approving a new schedule of rates and charges for water utility service provided by Bloomington and the issuance of the Proposed Bonds and granting Bloomington all other appropriate relief.

Respectfully submitted,

By: _____

David T. McGimpsey (21015-49)

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Attorneys for Petitioner,
The City of Bloomington, Indiana

CERTIFICATE OF SERVICE

I hereby certify that two (2) copies of the foregoing document were served by hand delivery or that one (1) copy was served by electronic service on this 22nd day of September, 2016, to the following:

Office of Utility Consumer Counselor
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Indianapolis, Indiana 46204
Infomgt@oucc.in.gov

An Attorney for Petitioner,
The City of Bloomington, Indiana

Additional service copy to:

Daniel M. Le Vay, Esq.
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Courtesy copy to:

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Counsel to Washington Township Water Authority

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IN THE MATTER OF THE PETITION OF BLOOMINGTON, INDIANA, FOR AUTHORITY TO ISSUE BONDS, NOTES, OR OTHER OBLIGATIONS, FOR AUTHORITY TO INCREASE ITS RATES AND CHARGES FOR WATER SERVICE, AND FOR APPROVAL OF A NEW SCHEDULE OF WATER RATES AND CHARGES	**)**	**CAUSE NO. 44855**

STIPULATION TO PROCEDURAL SCHEDULE, WAIVER OF PREHEARING CONFERENCE, AND ISSUANCE OF PROPOSED DOCKET ENTRY ESTABLISHING PROCEDURAL SCHEDULE

The City of Bloomington, Indiana ("Petitioner" or "Bloomington"), by counsel, files this Stipulation to Procedural Schedule, Waiver of Prehearing Conference, and Issuance of Proposed Docket Entry Establishing Procedural Schedule (this "Stipulation") with the Indiana Utility Regulatory Commission in this Cause. Prior to filing its petition initiating this Cause, Petitioner met with the Indiana Office of the Utility Consumer Counselor (the "OUCC") and with its wholesale customers, including Washington Township Water Authority ("Washington Township"). Given the OUCC's nature as a statutory party and Washington Township's understood intent to intervene in this Cause, Bloomington desired to agree with those parties on a procedural schedule, on the waiver of the prehearing conference, and on a proposed docket entry establishing the procedural schedule in this Cause. Bloomington reports that the parties have agreed upon each of those items, as evidenced by the OUCC's signature hereto and Washington Township Water's consent to this Stipulation.

Procedural Schedule

Bloomington, the OUCC stipulate to the following procedural schedule, to which Washington Township consents:

September 22, 2016	Petitioner files case-in-chief
Preferably on or before November 10, 2016:	Field Hearing, subject to Commission availability
December 15, 2016	OUCC and Intervenors file cases-in-chief
January 19, 2017	Petitioner files rebuttal
Week of February 20, 2017 (one day):	Evidentiary Hearing, subject to Commission availability

Further, the parties stipulate (and Washington Township consents) to the following procedural matters:

1. Test Year and Adjustment Period. The test year shall be the twelve (12) months ended December 31, 2015. Adjustments may be made for changes that are fixed, known and measureable for rate-making purposes through the twelve (12) months following the end of the test year.

2. Electronic Service. All documents may be served electronically.

3. Discovery. Ten (10) calendar day turnaround for discovery prior to filing of OUCC's and Intervenor's cases-in-chief. Five (5) business day turnaround for discovery after filing of OUCC's and Intervenor's cases-in-chief. Discovery served after 12:00 noon on a day immediately preceding a non-business day will be treated as being served on the next business day.

4. Workpapers. Parties will serve all parties with workpapers within 2 business days of the filing of the testimony to which the workpapers relate.

5. Objections. Objections to pre-filed testimony must be filed at least one (1) week prior to the evidentiary hearing.

Waiver of Prehearing Conference

Bloomington and the OUCC stipulate (and Washington Township agrees) that a prehearing conference is unnecessary and agree to waive the holding of a prehearing conference.

Stipulated Proposed Docket Entry Establishing Procedural Schedule

Bloomington and the OUCC stipulate (and Washington Township agrees) that the Stipulated Proposed Docket Entry Establishing Procedural Schedule attached hereto as Attachment 1 is reasonable and should be issued in substantially the same form as shown in Attachment 1.

WHEREFORE, the City of Bloomington, Indiana, and the Indiana Office of Utility Consumer Counselor submit their Stipulation to Procedural Schedule, Waiver of Prehearing Conference, and Issuance of Proposed Docket Entry Establishing Procedural Schedule and request that the Commission approve the foregoing procedural schedule, dispense with the prehearing conference, and issue the stipulated proposed scheduling order.

Respectfully submitted,

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dlevay@oucc.in.gov

Attorney for the Indiana Office of the Utility
Consumer Counselor

Consent of Washington Township Water Authority:

Washington Township Water Authority hereby consents and agrees to the foregoing Stipulation to Procedural Schedule, Waiver of Prehearing Conference, and Issuance of Proposed Docket Entry Establishing Procedural Schedule.

Washington Township Water Authority

By: _____
Mark W. Cooper,
Its Attorney

ATTACHMENT 1

To

Stipulation to Procedural Schedule, Waiver of Prehearing Conference, and Issuance of Proposed Docket Entry Establishing Procedural Schedule

Proposed Docket Entry Establishing Procedural Schedule

[Indiana Utility Regulatory Commission Letterhead]

IN THE MATTER OF THE PETITION	**)**	
OF BLOOMINGTON, INDIANA, FOR	**)**	
AUTHORITY TO ISSUE BONDS, NOTES,	**)**	
OR OTHER OBLIGATIONS, FOR	**)**	
AUTHORITY TO INCREASE ITS RATES	**)**	**CAUSE NO. 44855**
AND CHARGES FOR WATER SERVICE,	**)**	
AND FOR APPROVAL OF A NEW	**)**	
SCHEDULE OF WATER RATES AND	**)**	
CHARGES	**)**	

You are hereby notified that on this date the Indiana Utility Regulatory Commission (the "Commission") has caused the following entry to be made:

On September 22, 2016, the City of Bloomington, Indiana (the "Petitioner") filed its petition (the "Petition") with the Commission initiating this Cause. Petitioner and the Indiana Office of the Utility Consumer Counselor (the "OUCC") concurrently filed a Stipulation to Procedural Schedule, Waiver of Prehearing Conference, and Issuance of Proposed Scheduling Order (the "Stipulation"). Washington Township Water Authority ("Washington Township") consented to the Stipulation.

In the Stipulation, Petitioner and the OUCC have stipulated to a procedural schedule, waiver of a prehearing conference, and other procedural matters in this Cause, to which Washington Township consented and agreed. Petitioner and the OUCC attached an Proposed Scheduling Order to the Stipulation. As indicated above, Washington Township consented to the Stipulation and therefore, the Proposed Scheduling Order. Petitioner also requested waiver of a prehearing conference given that the parties have stipulated to a procedural schedule and other procedural matters.

The Presiding Officers, having reviewed the Petition and the Stipulation, hereby waive the prehearing conference in this Cause and establish the following procedural schedule in this matter:

1. **Test Year and Accounting Method.** The test year for determining Petitioner's actual and pro forma operating revenues, expenses and operating income under present and proposed rates shall be the 12 months ended December 31, 2015, adjusted for changes that are fixed, known, and measurable for rate-making purposes and that occur within 12 months following the end of the test year.

2. **Petitioner's Prefiling Date.** The Petitioner prefiled with the Commission its prepared testimony and exhibits constituting its case-in-chief on September 22, 2016.

3. **Field Hearing.** A field hearing will be convened in this Cause on _____, 2016, at a time and place to be determined at a later date.

4. **OUCC's and Intervenors' Prefiling Date.** The OUCC and all Intervenors should prefile with the Commission the prepared testimony and exhibits constituting their respective cases-in-chief on or before December 15, 2016.

5. **Petitioner's Rebuttal Prefiling.** The Petitioner should prefile with the Commission its prepared rebuttal testimony on or before January 19, 2017.

6. **Evidentiary Hearing on the Parties' Cases-in-Chief.** The cases-in-chief of the Petitioner, the OUCC and any Intervenors should be presented in an evidentiary hearing to commence at ____ on February __, 2017, in Room ____ of the PNC Center, 101 West Washington Street, Indianapolis, Indiana. At such time, the direct evidence of the respective parties should be presented and their respective witnesses examined. Thereafter, Petitioner should present its prefiled rebuttal evidence as well as any additional evidence rebutting evidence adduced on cross-examination of the OUCC's or Intervenors' witnesses. If the parties reach settlement, the agreement should be submitted to the Commission ten (10) business days prior to the Evidentiary Hearing.

7. **Sworn Testimony.** Any witness testimony to be offered into the record of this proceeding should be made under oath or affirmation. In accordance with 170 IAC 1-1.1-18(h), if the prefiled testimony of a witness is to be offered into evidence at the Evidentiary Hearing, and the witness sponsoring the prefiled testimony is not required to, and does not, attend the Evidentiary Hearing, the prefiled testimony should be accompanied by the witness's sworn affidavit or written verification at the time the evidence is offered into the record.

8. **Discovery.** Discovery is available for all parties and should be conducted on an informal basis. Any response or objection to a discovery request should be made within ten (10) calendar days of the receipt of such request. Upon the filing of the OUCC's case-in-chief, any response or objection to a discovery request shall be made within five (5) business days. Discovery served after 12:00 noon on a day immediately preceding a non-business day shall be treated as being served on the following business day.

9. **Prefiling of Workpapers.** When prefiling technical evidence with the Commission, each party shall file copies of the workpapers used to produce that evidence within two business days after the prefiling of such technical evidence. Copies of same shall also be served on the other parties to this Cause. When submitting workpapers to the Commission, two (2) copies of each document shall be filed with the Secretary of the Commission.

10. **Number of Copies/Corrections.** With the exception of workpapers, the parties shall file with the Commission an original and two (2) copies of all prefiled testimony and exhibits. Any corrections to prefiled testimony shall be made in writing as soon as possible after discovery of the need to make such corrections. Although the Commission's rules require that original copies be one-sided, it is the Commission's preference that duplicate copies use both sides of the paper.

Parties may also elect to file documents with the Commission using the Commission's Electronic Filing System in lieu of filing paper documents. Pursuant to the terms and conditions of the Electronic Filing System, documents filed electronically are deemed filed the date they are submitted, subject to verification and acceptance by the Commission, and will receive an electronic file stamp. For filings greater than thirty (30) pages in length, a party shall file with the Commission an original and two (2) paper copies within two (2) business days of the electronic filing. When supplying such copies, the party must provide a copy of the email reflecting the electronic filing was accepted by the Commission.

11. **Objections to Prefiled Testimony and Exhibits.** Any objections to the admissibility of prefiled testimony or exhibits shall be filed with the Commission and served on all parties of record no less than seven (7) calendar days prior to the date scheduled for commencement of the hearing at which the testimony or exhibit will be offered into the record.

12. **Intervenors.** Any party permitted to become an Intervenor in this Cause should be bound by the record as it stands at the time its Petition to Intervene is granted, pursuant to 170 IAC 1-1.1-11.

IT IS SO ORDERED.

_____
_____, Commissioner

_____
_____, Administrative Law Judge

Date: _____

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<u>SUBMISSION OF DIRECT TESTIMONY AND EXHIBITS</u>

The City of Bloomington, Indiana ("Petitioner"), by counsel, hereby submits its Direct Testimony and Exhibits in this Cause, including:

1. Verified Direct Testimony of Vic Kelson (Petitioner's Exhibit 1) and Attachments VK-1 through VK-5, as identified therein;
2. Verified Direct Testimony of Mayor John Hamilton (Petitioner's Exhibit 2);
3. Verified Direct Testimony of Timothy Mayer (Petitioner's Exhibit 3) and Attachments TM-1 through TM-3, as identified therein; and
4. Verified Direct Testimony of John R. Skomp (Petitioner's Exhibit 4) and Attachment JRS-1, as identified therein.

Respectfully submitted,

By:_____
David T. McGimpsey (21015-49)

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Attorneys for Petitioner,
The City of Bloomington, Indiana

CERTIFICATE OF SERVICE

I hereby certify that two (2) copies of the foregoing document were served by hand delivery or that one (1) copy was served by electronic service on this 22nd day of September, 2016, to the following:

Office of Utility Consumer Counselor
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Indianapolis, Indiana 46204
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An Attorney for Petitioner,
The City of Bloomington, Indiana

Additional Service Copy to:

Daniel M. Le Vay, Esq.
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Courtesy copy to:

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PETITIONER'S EXHIBIT 1

Direct Testimony of Vic Kelson
with Attachments VK-1 through VK-5

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Attorneys for Petitioner,
The City of Bloomington, Indiana

VERIFIED DIRECT TESTIMONY OF VIC KELSON
ON BEHALF OF THE CITY OF BLOOMINGTON, INDIANA

Cause No. 44855

INTRODUCTION

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

A. My name is Vic Kelson. I am the Director of the City of Bloomington ("Bloomington") Utilities Department ("CBU"). My business address is 600 E. Miller Dr., Bloomington, IN 47401.

Q. Please describe your educational and business background.

A. I hold a Bachelor of Science degree in Chemical and Petroleum-Refining Engineering from Colorado School of Mines and a Ph.D. in Environmental Science from Indiana University. My doctoral concentration was in groundwater modeling.

Prior to entering graduate school in 1990, I worked as a process engineer in a chemical fertilizer facility in Terre Haute for almost 3 years, then as a process control systems engineer at a plastic film plant. Throughout my career as an engineer, I have primarily been involved in process improvement activities,

working to enhance efficiency and resilience of engineered systems, protect the environment and reduce operational costs, especially for energy.

After completing my doctorate, I worked for two years as a Senior Engineer for the South Florida Water Management District (the "SFWMD"). My primary duties were in the development of models that represent the natural and engineered hydrologic systems of South Florida.

In 2000, I left SFWMD to join Wittman Hydro Planning Associates ("WHPA"), a small consulting firm that later merged with Layne Christensen Company ("Layne"). My duties at Layne included the design and testing of industrial and municipal well fields, studies of surface water flow and reservoir yield, and innovative strategies for water supply development. My work at Layne heavily involved a project in Baton Rouge, Louisiana, that went on to receive the 2015 Groundwater Supply Development Award from the National Groundwater Association.

In addition, while employed at WHPA and Layne, I served for six years on the Monroe County Council, with two of those years as Council President.

I formally joined CBU in the capacity as Director on April 25, 2016.

Q. Please describe your responsibilities as the Director of CBU.

A. As the Director of CBU, I am responsible for overseeing and directing CBU's operations and personnel. CBU is a department of Bloomington with 171 employees and a 2017 budget of approximately $40 million. CBU is composed of water, sewer and stormwater utilities. I prepare, present and manage the budgets of all three utilities and oversee all aspects of the CBU's finances and operations.

Q. What is the purpose of your testimony?

A. My testimony is in support of the proposed increase in CBU's water rates and charges and the related request to issue waterworks revenue bonds to finance infrastructure improvements for CBU. My testimony also provides background on Bloomington's water utility and a roadmap of the case-in-chief. I testify to the capital improvements proposed for bond funding and discuss the elements of the rate increase needed to deal with recent environmental issues at CBU. The proposed increase will provide the necessary revenue that will allow the water utility to maintain its financial integrity, to undertake needed infrastructure improvements, for which Bloomington proposes to issue bonds to partially finance, and to maintain compliance with water quality standards. Finally, I will offer my opinion on the reasonableness of the rate increase and the proposed bond issuance.

BLOOMINGTON'S WATER UTILITY

Q. Please describe Bloomington's water utility.

A. Bloomington's water utility includes one water treatment plant (the "Monroe Water Treatment Plant"); seven booster stations; seven water storage tanks with a total of 23.6 million gallons of storage; and over 420 miles of water lines. The source of supply for the water utility is Lake Monroe, which has a firm yield of 45 to 90 million gallons per day ("mgd"). The water utility provides service to over 25,000 customer accounts, including Indiana University and nine (9) wholesale customers, as well as customers located both inside and outside Bloomington's municipal corporate limits.

Q. Please describe the governance structure of Bloomington's water utility.

A. Bloomington's water utility is operated by CBU and is governed by a utilities service board (the "USB") under Ind. Code § 8-1.5-3-3. The USB is comprised of nine (9) members and has broad oversight of CBU's utility policies and activities. The Mayor appoints four (4) members to the USB, and the Common Council of the City of Bloomington (the "City Council") appoints three (3) members to the USB. The remaining two (2) USB members are ex-officio, non-voting members, that are appointed one each by the Mayor and the City Council.

Pursuant to Ind. Code § 8-1.5-3-4(a)(7), the USB recommends reasonable and just rates for Bloomington's water utility to the City Council. The City Council then approves Bloomington's water utility rates pursuant to Ind. Code § 8-1.5-3-8(f),

subject to review and approval by the Indiana Utility Regulatory Commission (the "Commission").

Q. Please list the individuals, in addition to yourself, that will be providing direct testimony in support of the requested relief in this Cause.

A. Direct testimony will be provided by three (3) individuals in addition to me:

1. John Hamilton, the Mayor of Bloomington, will testify concerning the public policy considerations impacting the rate increase and his vision for future rate design by Bloomington's water utility.
2. Timothy Mayer, a member of the City Council and the USB, will testify as to the actions of the USB and the City Council concerning the requested rate and financing relief.
3. John Skomp, a Certified Public Accountant and Partner with Crowe Horwath LLP ("Crowe Horwath"), will provide information regarding the proposed rate increase and the issuance of water revenue bonds.

Q. Has Bloomington engaged a financial consultant to assist it with the rate and financing aspects of these matters?

A. Yes. As identified above, Bloomington engaged Crowe Horwath to study CBU's water utility revenue requirements, to render a rate study and to assist with the issuance of water revenue bonds. Crowe Horwath's rate study is sponsored by Mr. Skomp in this Cause as Petitioner's Attachment JRS-1.

THE PROPOSED RATE INCREASE

Q. When did Bloomington last seek rate relief for its water utility from the Commission?

A. Bloomington last sought rate relief in 2010 through its petition filed on August 19, 2010, which initiated Cause No. 43939. The Commission issued its final order in Cause No. 43939 on March 2, 2011, approving a settlement agreement between Bloomington, the Indiana Office of the Utility Consumer Counselor (the "OUCC") and Washington Township Water Corporation of Monroe County (n/k/a Washington Township Water Authority) ("Washington Township") that authorized a phased, 50.57% rate increase and allowed for the expansion of Bloomington's Monroe Water Treatment Plant, a new 36" transmission main, and additional storage capacity. The construction of those improvements is complete, and they have been placed into service without exceeding the construction budget. The actual Phase II rate increase was lower (25.99%) than the authorized rate increase (30.23%). Bloomington's Submission of True-Up Report on November 28, 2011, in Cause No. 43939 identifies these figures.

Q. What factors drive the need for the proposed rate increase?

A. While Bloomington's last rate increase was significant, the rates have now been in place for approximately five (5) years without an increase. Moreover, a large share of that prior rate increase went toward the capital projects I identified earlier. The rate increase proposed in this case is needed to cover the rising costs of energy, chemicals, labor, insurance, and other costs that have increased over

the five (5) intervening years since rate relief was last granted. Additionally, a portion of the rate increase involves Bloomington undertaking certain capital improvements. CBU also has undertaken and continues to undertake preventive measures to remediate elevated levels of disinfection byproducts ("DBPs") that have recently appeared in its water distribution system, and these preventive measures have costs associated with them.

All of these measures and drivers need to be satisfied through increased rates to ensure CBU continues to supply its customers with a safe, secure and reliable supply of quality drinking water.

CAPITAL IMPROVEMENTS

Q. Generally describe the capital improvements proposed by Bloomington.

A. Bloomington has three categories of capital projects that serve separate but intertwined goals: (1) infrastructure replacement for greater capacity, for improved water quality and for replacement of aging water mains; (2) process improvements at the Monroe Water Treatment Plant for water quality improvement and reduction of DBPs; and (3) major capital projects throughout CBU's water system.

For the infrastructure replacement component, Bloomington splits this category into two components: first, a program for the replacement of water mains aged 75 years and older over a 20 year period, and second, a strategic infrastructure

replacement project developed in coordination with Monroe County. Bloomington proposes to fund the first year of replacement projects, totaling $2,300,000, and the strategic infrastructure project, totaling approximately $1,780,000, through the issuance of water utility revenue bonds. Subsequent infrastructure replacement projects, the Monroe Water Treatment Plant process improvement projects, and the major capital projects throughout CBU's system are proposed to be funded out of future CBU revenues.

CBU's rate case presentations to the USB and to the City Council detailed these project categories and goals to ensure those bodies were properly informed of the need for rate relief and for re-investment in CBU's system. Further, these goals form the basis of the CBU's 5 Year Capital Improvement Plan (the "CIP"). The CIP consists of a table with a comprehensive list of capital improvement projects along with a progress report for projects undertaken or those with the highest priority and is attached as Petitioner's Attachment VK-1.

Infrastructure Replacement

Q. Please discuss the infrastructure replacement category of the capital improvements.

A. CBU determined to engage in a proactive effort to replace its oldest infrastructure that is at the highest risk of failure and to undertake a strategic infrastructure replacement project that takes advantage of current circumstances to significantly lower CBU's overall total cost of the project. To accomplish this goal, CBU

inventoried its aging pipe infrastructure and developed a schedule to replace that infrastructure which is at or has exceeded its useful life. That inventory is attached as Petitioner's Attachment VK-2 (the "Inventory"). The Inventory identifies each pipe that is at least 75 years old in CBU's system by installation date, pipe diameter, length, unit replacement cost and total replacement cost in present dollars. Those pipes listed on the Inventory with an unknown installation year are believed to pre-date 1920 based upon CBU's current state of research.

The Inventory identifies 80 miles (of 420 miles) of water pipe that is at least 75 years old. That amounts to nearly 20% of our water pipes having been in service for 75 years or more. Moreover, much of that pipe is 100 years old or older and some of the pipe dates to 1890 and possibly before. Having 80 miles of pipe significantly past its useful life portends trouble if a plan is not devised to replace that infrastructure. CBU has developed a plan to replace this category of aging infrastructure over the next 20 years, so that the youngest of the pipes will be 95 years in service by the time they are replaced.

The vast majority of these old pipes are unlined cast iron pipes, many of which have poured lead joints and are the most likely to have lead service connections. Although our water conditioning is such that we lay down a film of calcium carbonate to cover lead, copper, and the inside of unlined cast iron pipes, records of main breaks in this category of distribution piping, together with diminished

flow rates, indicate a need for replacement rather than rehabilitation. Removing all lead from Bloomington's system is also an important water quality objective.

Further, the character of our downtown and surrounding area, where most of the older piping is located, has changed and continues to change. What were once single family neighborhoods have transitioned and are transitioning to commercial and high-rise apartment buildings geared toward Indiana University students. Higher flow rates for fire protection are required in these instances, and therefore, replacement with larger diameter pipes is in order, rather than rehabilitating existing pipe. Higher flow rates are needed in these areas regardless of increased water conservation. The pipes simply need to be larger to accommodate the necessary flows for fire protection. This is a public safety issue, in addition to a water quality and service reliability issue.

Q. How does CBU propose to tackle this infrastructure replacement program?

A. CBU proposes to make long-term investments over the next 20 years, in order to make significant headway into replacing the 80 miles of pipe that is old, has exceeded its useful life, holds a high risk of failure, and needs to be replaced to accommodate the changes in character of its use since it was installed and to protect water quality.

CBU proposes to use $2,300,000 of bond proceeds in the first year to fund these replacements to kick start the infrastructure replacement program, since CBU will

not yet have realized sufficient revenue from this rate increase by the time construction season begins. In year two and thereafter, the infrastructure replacement program will be funded at a level of $1,800,000 per year from revenues rather than out of the more expensive bond capital. CBU believes re-investing in CBU's infrastructure as outlined in my testimony is a prudent and responsible use of ratepayer funds. The total cost of this program over the first five years is $9,500,000. I also note that the Inventory uses present dollar values for unit replacement cost and total replacement cost, so these figures will be pushed higher over time as replacement costs increase. Additionally, other pipes will be added to the list of pipes aged 75 years and over as time progresses, which could push costs up. CBU anticipates dealing with the changed costs of its infrastructure replacement program in a future rate proceeding.

CBU is reviewing the available data regarding pipe age, pipe manufacture and locations and dates of water main breaks to develop a methodology for setting priorities in the infrastructure replacement program. We are currently using geographic information systems ("GIS") to create heat maps that spatially illustrate the relative frequency of water main breaks within our distribution system. Multiple heat maps will be constructed based on different sets of assumptions. For example, a heat map based on the season when breaks occurred can help to identify the effects of water temperature.

We will use the heat maps and our records for water main repairs to identify factors that are correlated with the likelihood of main breaks, and use them as a basis for classifying regions within the distribution system and setting priorities for replacement efforts. These factors will include pipe age, past history of nearby breaks, pipe materials, soil type, amount of downstream pipe that might be affected by a main break, and other factors. For each factor, a relative weight will be assigned based on the importance of the factor to overall operations. Each water main in our inventory will be scored based on the numerical factors and the weight for each factor. Finally, we will generate a GIS map that will be used to guide the replacement priorities for the first year based on the spatial regions with the highest scores.

After the first year's replacement efforts are complete, we will update the scoring system to include any additional factors that were identified during the pipe replacement work. We will re-run the scoring system to include those new factors identified and other data developed during the first year of the infrastructure replacement program, *e.g.*, additional main breaks. We will use the updated scoring system to set priorities for year 2. This process may be repeated in each following year.

CBU believes this flexible approach to the infrastructure replacement program will allow CBU to adapt to information collected during the infrastructure replacement process and thereby make more effective and efficient infrastructure

replacements than had CBU locked itself into a rigid replacement plan incapable of adaptation to changing circumstances.

Q. When you indicate that CBU will fund infrastructure out of revenues, are you proposing that CBU bases its rate request for increased revenues on an extension and replacement program?

A. No. Bloomington has opted to recover its depreciation expense in rates rather than use extensions and replacements as a component of its rate request. In describing its capital program that is funded out of revenues rather than bond funds, CBU desires to keep the Commission and the OUCC informed of its infrastructure program, so that the Commission and the OUCC know that CBU is investing in its system and using its funds wisely.

Q. What is the strategic infrastructure replacement project you identified?

A. The strategic infrastructure project is water line replacement and upsizing at Rhorer Road and Gordon Pike, which is part of the Fullerton Pike Phase I project. This project involves a major county road improvement project underway that entails lowering CBU's 36" water main in the area, for which CBU is being reimbursed for the relocation. This 36" water main is less than 75 years old, which is why this constitutes a second component of the infrastructure replacement category.

While the county road construction is proceeding, CBU believes its best interests are served by leveraging this opportunity to improve the distribution system along this major transmission line. By improving this aging line now, CBU will avoid expensive excavation costs needed to replace the line in the future. Further, upgrading the line now pushes off that replacement farther into the future, so CBU will realize savings both from a timing standpoint (expenses pushed further into the future) and from a raw cost standpoint (lower replacement costs now due to lower installation costs). The net cost to CBU of the project is approximately $1,780,000, which again Bloomington proposes to bond fund.

CBU's 2003 Long Range Capital Plan (the "LRCP") prepared by Black & Veatch, which plans for CBU's utility infrastructure through 2030, specifically identified the Fullerton Pike project (see page 7-7 of the LRCP where it is identified as the "West branch main"). The LRCP is attached as Petitioner's Attachment VK-3. The timing of the county road project helps CBU save money on the reimbursable work that CBU had planned to expend in the future. The City/County Utility Reimbursement Agreement (the "Reimbursement Agreement") for the Fullerton Pike Phase I project that identifies CBU's non-reimbursable costs is attached as Petitioner's Attachment VK-4.

Water Quality Improvement and Reduction of Disinfection Byproducts

Q. Please discuss the DBP issue in greater detail.

A. In recent years, CBU has encountered elevated concentrations of trihalomethane (*i.e.*, TTHM) and haloacetic acid (*i.e.*, HAA5) in the finished water supply at the Monroe Water Treatment Plant and within the distribution system. These chemical compounds result from the reaction between the hypochlorite disinfectant utilized in the Monroe Water Treatment Plant and trace organic chemicals that naturally occur in the source water from Lake Monroe. CBU anticipates that over time, as Lake Monroe becomes more eutrophic, the concentration of organic material, known as total organic carbon ("TOC"), within the source water will increase. Especially in late summer and early fall, the concentration of TOC and of organisms such as cyanobacteria reaches a seasonal maximum. The combination of warm water, elevated TOC and hypochlorite results in a seasonal increase in DBPs. In addition, use of chlorine that exceeds the minimum amount necessary for disinfection can result in elevated DBP concentrations, even in cooler weather.

Q. How is CBU addressing the DBP issue?

A. In November 2015, CBU hired Black & Veatch to conduct a benchmarking study regarding DBP formation in the Monroe Water Treatment Plant. The study concluded that DBPs could be significantly reduced in finished water by ending the practice of adding hypochlorite in the primary rapid-mix and prior to coagulation, flocculation and sedimentation. The study recommended that hypochlorite be added only in the secondary rapid-mix and prior to the filters.

These changes should greatly reduce the amount of contact time for disinfection, and furthermore would eliminate the potential for the hypochlorite disinfectant to react with particulate organic material in the basins. A copy of the study, titled Monroe Water Treatment Plan Water Quality Assistance – Disinfection Byproduct Rule Assistance Technical Memorandum and dated March 18, 2016, is attached as Petitioner's Attachment VK-5.

The Indiana Department of Environmental Management ("IDEM") approved these changes in March 2016, and CBU implemented the changes at the Monroe Water Treatment Plant in early April 2016. CBU achieved significant reductions in DBPs in April and May relative to the values from March. However, as the weather warms and source water TOC increases, CBU continues to work to optimize the operation of the Monroe Water Treatment Plant. We expect that in the coming years, significant capital expenditures will be necessary to control DBPs and to manage future changes in the EPA DBP rule.

The strategies and infrastructure improvements identified in Section 7 of Petitioner's Attachment VK-5 are incorporated into Section 2 of the CIP and have an estimated cost of $11,600,000.

Other Major Capital Projects

Q. Please discuss CBU's other major capital project needs in greater detail.

A. Initially, I note that these improvements are needed throughout CBU's system. As with any production facility, process equipment ages and repairs or replacements are necessary at the Monroe Water Treatment Plant. In addition, some of our critical infrastructure, *e.g.*, the emergency low-service pumps and generator facility require improvement to prevent and repair weather damage. We also anticipate the need to improve our electrical substation and make other electrical improvements. Furthermore, we must expand our ability to manage and dispose of sludge. The need for additional sludge management facilities and equipment arises in part from increasing demand and also from the movement of the disinfection point for DBP reduction. The elimination of hypochlorite addition from the primary rapid-mix may increase sludge volumes owing to summer algal growth that was previously prevented by the hypochlorite disinfectant. These projects all have significant costs associated with them.

CBU also anticipates the need for significant capital improvements in its distribution system, including investment and improvements in our metering infrastructure.

A complete list of the expected capital needs is provided in the CIP (Petitioner's Attachment VK-1). These capital projects total $13,200,000, which CBU will revenue fund as contrasted to bond fund.

CITY LEVEL APPROVALS

Q. Does Bloomington's City Council support the rate increase requested in this Cause?

A. Yes. The ordinance reflecting the City Council's support of the requested rate increase is sponsored by Mr. Mayer as Petitioner's Attachment TM-2 in this Cause.

Q. Does Bloomington's City Council support the financing proposed for approval in this Cause?

A. Yes. The ordinance reflecting the City Council's support of the financing proposed for approval is sponsored by Mr. Mayer as Petitioner's Attachment TM-3 in this Cause.

Q. Does the USB support the requested rate increase and the financing proposed for approval in this Cause?

A. Yes. The resolution reflecting the USB's support and recommendation is sponsored by Mr. Mayer as Petitioner's Attachment TM-1 in this Cause.

BOND FUNDING

Q. Please provide a high level overview of the financing proposed in this case.

A. Bloomington proposes to issue $4,600,000 in water utility revenue bonds. The bond proceeds will be used as discussed earlier in my testimony: to provide a

$2,300,000 kick start to the infrastructure replacement program and to fund the Fullerton Pike Phase I project in the amount of $1,780,000. CBU witness Skomp provides the financial aspects of the proposed bond issuances.

Q. Are the projects proposed to be funded by the bonds reasonable and necessary?

A. Yes. Those projects are reasonable and necessary for Bloomington's water utility to continue providing safe and reliable water utility service to its customers.

Q. Are the bonds a reasonable method of funding the projects?

A. Yes. Bloomington requests a 22% increase in rates. Without the bonds, Bloomington would have to revenue fund the projects, which would result in an even higher rate increase needed to continue providing safe and reliable drinking water service to its customers. I believe the split between bond-funding and revenue-funding the projects strikes an appropriate balance for the utility.

Q. USB Resolution 2016-3 and City Council Ordinance 2016-09 reference approval of bond anticipation notes ("BANs")? Will Bloomington be issuing BANs?

A. No. BANs were included in USB Resolution 2016-3 and City Council Ordinance 2016-09 because of the possibility that CBU would need to fund the Fullerton Pike Phase I project in December 2016. That date would have been prior to the anticipated date that the Commission would have approved of the Proposed

Bonds, so Bloomington at one time thought that BANs might be necessary. With the execution of the Reimbursement Agreement (Petitioner's Attachment VK-4), however, the time pressure to fund the Fullerton Pike Phase I project subsided, and the need for the BANs dissipated. Section 8 of the Reimbursement Agreement provides that CBU can spread its payments for the Fullerton Pike Phase I project out over time, rather than CBU needing all of the funds up front.

PUBLIC OUTREACH

Q. Please describe CBU's public outreach efforts with respect to the proposed rate increase.

A. Bloomington has made numerous outreach efforts with its ratepayers and the public. On several occasions, CBU and others within the City of Bloomington administration have publicly addressed the need for a rate increase. Mayor John Hamilton discussed the need for a rate increase in one of his early speeches concerning the state of the city. Other members of CBU's administration and I have made ourselves available for multiple media interviews, including multiple print stories in the *Bloomington Herald Times* and *Indiana Daily Student*, and television stories on FOX 59, among other channels.

We emailed our e-bill customers and mailed a paper bill insert to paper bill customers in early May 2016 to inform customers of Bloomington's upcoming rate analysis, anticipated rate increase, and opportunities for public input. The CBU website was updated in May 2016 with the same information sent to

customers. We also posted the slide deck from CBU's presentation to the USB on CBU's website.

Additionally, we held targeted meetings throughout May 2016 with a number of stakeholders, including Indiana University, the Bloomington Chamber of Commerce, the Monroe County Commissioners, and our wholesale customers. At these meetings, the background information on the need for the rate increase was presented and discussed, and our meeting partners had full opportunity to ask questions and make their own determination on the need for the rate increase.

These efforts extended into June when the City Council was considering the rate increase and bond financing. For example, on June 8, 2016, CBU made a presentation to the Bloomington Chamber of Commerce's advocacy committee concerning the need for the rate increase.

CBU most recently met with our wholesale customers on September 13, 2016, to update them on the rate case and anticipated filing and other procedural dates, along with other matters of interest concerning CBU's provision of water service to them.

Finally, we complied with all compulsory notice requirements as identified later in my testimony.

Q. Has CBU undertaken efforts to keep the OUCC informed about the requested rate increase?

A. Yes. Representatives of the CBU also met with the OUCC on August 31, 2016, to explain the necessity for the requested rate increase, provide the OUCC an opportunity to ask questions concerning Bloomington's proposed rate increase, and discuss the procedural schedule. The OUCC was very helpful in the meeting, and Bloomington took the OUCC's suggestions into account when compiling its case-in-chief.

COMPLIANCE WITH PUBLIC NOTICE REQUIREMENTS

Q. Has Bloomington complied with public notice requirements?

A. Yes. Bloomington provided or will provide public notices related to the proposed rate increase in the following ways:

- Bloomington published notice of the public hearing on the rate increase before the City Council in accordance with Ind. Code § 8-1.5-3-8.1(c) and with Ind. Code § 5-3-1;
- Bloomington mailed notice of the public hearing on the rate increase before the City Council to customers outside its city limits in accordance with Ind. Code § 8-1.5-3-8.1(c); and
- Bloomington will send registered mail notice to its wholesale customers of the filing of the petition initiating this Cause in accordance with Ind. Code § 8-1-2-61.6.

CONCLUSION

Q. Is the rate relief requested by Bloomington reasonable, just and nondiscriminatory?

A. Yes.

Q. Is the financing proposed in this Cause a reasonable method to fund the projects?

A. Yes.

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

A. Yes.

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: _____ Dated: 9/21/2016
Vic Kelson

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT VK-1

CITY OF BLOOMINGTON WATER WORKS

Bloomington, Indiana

5 YEAR CAPITAL IMPROVEMENT PLAN

Prepared by City of Bloomington Utilities Engineering Department

	2016	2017	2018	2019	2020	Total
Water Treatment						
Security Video System Replacement	$115,000					$115,000
Monroe WTP LS Pump 4 AFD Replacement						
Professional Services	$20,000	$10,000				$30,000
Construction		$240,000				$240,000
Addition of an AFD to a Low Service Pump						
Professional Services		$50,000				$50,000
Construction		$350,000				$350,000
Monroe WTP HS Pump 5 AFD						
Professional Services	$10,000	$10,000				$20,000
Construction		$100,000				$100,000
HSP-5 Pipe Support Improvements	$26,000					$26,000
Drying Bed	$28,000					$28,000
Storage Building for Emergency Pumping Equip.		$40,000				$40,000
Sludge Press Equipment Rehabilitation			$175,000			$175,000
GAC Filter Cap Evaluation - Prof. Services	$100,000					$100,000
UV Disinfection						
Planning/Engineering	$100,000	$600,000	$300,000	$300,000		$1,300,000
Construction			$3,000,000	$3,000,000		$6,000,000
Phosphate Chemical Feed System						
Planning/Engineering		$50,000	$50,000			$100,000
Construction			$200,000			$200,000
Sodium Chlorite Feed System						
Planning/Engineering		$50,000	$50,000			$100,000
Construction			$200,000			$200,000
On-site Chlorine Dioxide Generation						
Professional Services			$450,000	$75,000	$75,000	$600,000
Construction				$1,500,000	$1,500,000	$3,000,000

Regulatory Compliance Assistance						
Professional Services	$65,000	$50,000	$50,000	$50,000	$50,000	$265,000
Monroe WTP Substation Transformer Upgrade						
Professional Services			$40,000	$40,000		$80,000
Construction				$400,000		$400,000
Monroe WTP Standby Power Improvements						
Professional Services			$250,000	$125,000	$125,000	$500,000
Construction				$1,250,000	$1,250,000	$2,500,000
Monroe WTP Capacity Expansion (30 to 36 MGD)						
Professional Services				$350,000	$350,000	$700,000
Distribution System						
10th St. and Woodlawn Av, Improvements	$82,000					$82,000
Woodlawn Av. Water Line - 9th to 10th	$32,000					$32,000
Jordan Av. Water Line Replacement	$130,000					$130,000
Fullerton Pike Water Line Phase I	$1,780,000					$1,780,000
Fullerton Pike Water Line Phase II		$165,000				$165,000
Woodyard Road Water Line for Service to Ellettsville	$175,000					$175,000
Showers Rd. 12" Water Line (Oversizing Cost)	$125,000					$125,000
Showers Rd. 12" Water Line (Phase II by CBU)		$135,000				
Gentry Booster - Addition of Pump No. 3	$25,000					$25,000
Monroe Reservoir Repairs						
Professional Services		$30,000				$30,000
Construction		$160,000				$160,000
East Tank Painting						
Professional Services				$50,000	$25,000	$75,000
Constuction					$500,000	$500,000
Water Storage Tank Inspections		$5,000	$5,000	$10,000	$5,000	$25,000
West Leg Water System Improvements						
Professional Services		$15,000	$15,000	$15,000	$15,000	$60,000
Constuction		$100,000	$100,000	$100,000	$100,000	$400,000
West Booster Station Rehabilitation						
Professional Services			$57,000			$57,000
Constuction				$380,000		$380,000

South Booster Station Rehabilitation						
Professional Services				$63,000		$63,000
Constuction					$425,000	$425,000
Southeast Booster Station 12 to 24 MGD						
Professional Services				$60,000	$15,000	$75,000
Constuction					$400,000	$400,000
Water Main Replacement Program (CBU Forces)		$1,800,000	$1,800,000	$1,800,000	$1,800,000	$7,200,000
Hydrant Replacement Program		$75,000	$75,000	$75,000	$75,000	$300,000
Water Quality Improvement Projects		$150,000	$150,000	$150,000	$150,000	$600,000
Bulk Water Sales Stations		$125,000		$125,000		$250,000
Hydrants	$70,000					$70,000
Meters	$60,000	$120,000	$120,000	$120,000	$120,000	$540,000
Other						
Capital Lease for Vehicles and Equipment	$148,000	$265,000	$265,000	$265,000	$265,000	$1,208,000
Sofware License - New World	$10,000					$10,000
GIS Related Costs	$11,600	$14,100	$8,700	$8,000	$8,000	$50,400
Griffy Plant De-Construction			$10,000	$300,000		$310,000
Fixed Base Metering System		$8,000	$1,400,000	$1,400,000		$2,808,000
Operations and Laboratory Building Renovations				$ -		
Planning		$ 14,000				$ 14,000
Architect/Engineer			$ 70,000	$ 10,000	$ 10,000	$ 90,000
Construction				$ 300,000	$ 300,000	$ 600,000
Service Center Property Maintenance	$74,000	$15,000	$15,000	$15,000	$15,000	$134,000
Total Capital Improvement Plan	$3,186,600	$4,096,100	$8,855,700	$12,336,000	$7,578,000	
	2016	**2017**	**2018**	**2019**	**2020**	

CITY OF BLOOMINGTON UTILITIES DEPARTMENT
Bloomington, Indiana

REPORT ON

WATER PROJECTS

5 YEAR CAPITAL IMPROVEMENT PLAN

SUBMITTAL

May 10, 2016

Prepared by:
Mike Hicks, Capital Projects Manager
City of Bloomington Utilities
Engineering Department

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SECTION 1

MONROE WATER TREATMENT PLANT
GENERAL IMPROVEMENTS

1.1 SECURITY VIDEO IMPROVEMENTS

The security video system at the Monroe WTP is of antiquated technology and presently about 90% non-operational. Most of CBU's video security systems are local, site specific systems. It is desired to upgrade and become a part of the City's adopted, networked system. City ITS will become responsible for managing and maintaining the system following the upgrade.

The accepted, quoted cost for work is $77,030.91.

The contractor is Netech Corporation and work is to begin May, 2016.

The CBU funding number is WS15-20303 and is to be paid from the 2015 budget.

1.2 LOW SERVICE PUMP NO. 4 (LSP-4) ADJUSTABLE FREQUENCY DRIVE REPLACEMENT

The adjustable frequency drive (AFD) for LSP-4 is antiquated and parts are no longer available. The drive has been non-functioning for over two (2) years and thus, LSP-4 has not been in service and available for use. This pump with an adjustable frequency drive is needed to provide flexibility in matching water demands.

The estimated cost is $270,000. This includes $30,000 for engineering services and $240,000 for contract labor, equipment, and installation.

1.3 ADDITION OF AN ADJUSTABLE FREQUENCY DRIVE TO A LOW SERVICE PUMP

The Low Service Pumping Station is presently equipped with one pump that is capable of varying it's pumpage rate. The addition of an adjustable frequency drive to another pump will provide for reliability by redundancy and flexibility with matching water demands.

The estimated cost is $350,000. This includes $50,000 for engineering services and $300,000 for contract labor, equipment, and installation.

1.4 HIGH SERVICE PUMP NO. 5 (HSP-5) ADJUSTABLE FREQUENCY DRIVE

HSP-5 was installed with a constant speed drive as is typical of two other high service pumps. The installation of an adjustable frequency drive will provide needed flexibility and allow for more use of this 6 MGD high service pump.

The estimated cost is $120,000. This includes $20,000 for engineering services and $100,000 for contract labor, equipment, and installation.

1.5 ADDITIONAL SUPPORT FOR HSP-5 SUCTION AND DISCHARGE HEADERS

During start-up of HSP-5 movement of the suction and discharge header was observed. In addition, concern was raised by the pump manufacturer that the condition may cause damage to the pump. Corrective measures have been designed.

The estimated cost for contract labor, material, and installation is $26,000.

1.6 ADDITIONAL DRYING BED

An additional drying bed is needed to increase the capacity of the plant's drying bed system. The area is sized to be 78' x 130' and will be constructed at the location south of the plant that is the last remaining area suitable for a bed on the plant property.

Construction will be by CBU T&D staff and the estimated cost of materials is $28,000.

1.7 STORAGE BUILDING FOR EMERGENCY PUMPING EQUIPMENT

A storage building is needed to secure and protect the emergency pumping equipment. The structure is planned to be metal sided, metal roofed, pole type with a concrete slab floor.

The estimated cost to contract for the construction is $40,000.

1.8 SLUDGE PRESS EQUIPMENT REHABILITATION

Upgrades to sludge press due to equipment age. Replacement includes several plates and filter cloths.

The estimated cost to contract for the construction is $175,000.

SECTION 2

MONROE WATER TREATMENT PLANT
TREATMENT PROCESS AND WATER QUALITY IMPROVEMENTS

2.1 GAC FILTER CAP EVALUATION

This is an evaluation by professional services to determine if a granular activated carbon (GAC) filter cap would provide water quality benefits with respect to taste, odor, and removal of algal toxins.

The estimated cost of professional services is $100,000.

2.2 ULTRAVIOLET (UV) DISINFECTION

Installation of UV disinfection equipment post-transfer pump station to assist with meeting DBPR requirements. UV disinfection will allow reduction in chlorine dosage to meet virus inactiviation requirements. Giardia inactivation requirements would be met with UV. UV would also position CBU to meet cryptosporidium inactivation requirements in the future if required.

2.4 PHOSPHATE CHEMICAL FEED SYSTEM

Phosphate chemical feed system will provide phosphate base coating protection to pipelines in the distribution system to help reduce lead leaching and copper corrosion.

2.5 SODIUM CHLORITE FEED SYSTEM

Sodium chlorite addition to support reduction of nitrification issues.

2.6 ON-SITE CHLORINE DIOXIDE GENERATION AND FEED SYSTEM

Chlorine dioxide for algae control. Chlorine dioxide can also have a beneficial impact on DBP formation.

SECTION 3

MONROE WATER TREATMENT PLANT
STANDBY POWER AND ELECTRICAL SERVICE IMPROVEMENTS

3.1 SUBSTATION TRANSFORMER UPGRADE / REPLACEMENT

The plant expansion facilities constructed in 2014 was served electrically by a complete new service from Duke Energy which included a new ground-style transformer. The existing plant facility remains to be served by the original 1966 bank of mounted transformers. This project upgrades and replaces the antiquated transformers and is needed for reliability.

The estimated cost is $480,000. This includes $80,000 for three phases of engineering services and $400,000 for contract labor, equipment, and installation.

3.2 STANDBY POWER IMPROVEMENTS

Addition of a new 1000 KW generator at the MWTP to parallel the existing generator and replacement of the intake generator with a new 1500 KW generator. A construction cost estimate has not yet been prepared nor has a timeline/schedule.

SECTION 4
MONROE WATER TREATMENT PLANT
CAPACITY EXPANSION

4.1 CAPACITY EXPANSION (30 TO 36 MGD)

Design of the filter building expansion from two to four filters to provide increased plant capacity and to provide flexibility in the plant operations.

SECTION 5

DISTIBUTION SYSTEM PROJECTS

5.1 10TH ST. AND WOODLAWN AV. IMPROVEMENTS

This is a City DPW and Indiana University joint project to improve the intersection of E. 10th St. and N. Woodlawn Av. This will allow CBU to replace the existing 8" water line in 10th St. from N. Forrest Av. west to N. Park Av. The 8" will be replaced with a 12" water line which is needed for increased capacity in this area. The estimated cost of materials is $82,000.

5.2 WOODLAWN AV. WATER LINE 9TH ST. TO 10TH ST.

In association with the E. 10th St and N. Woodlawn Av. project, CBU will install 425 feet of 8" water line in N. Woodlawn Av. from the alley north of E. 8th St. to E. 10th St. The estimated cost of materials is $32,000.

5.3 JORDAN AV WATER LINE REPLACEMENT

This is a City DPW and Indiana University joint project to improve the intersection of E. 3rd St. and S. Jordan Av. This will allow CBU to replace a 6" water line on S. Jordan Av. with a 12" from E. Atwater Av. north to the Jordan River bridge. The estimated cost of materials is $130,000.

5.4 FULLERTON PIKE WATER LINE PHASE I

This is a Monroe County Highway Department project to extend improvements of Fullerton Pk. which are occurring at the interchange with I69. The Phase I project requires the lowering of CBU's 36" water line at the intersection of E. Rhorer Rd. and S. Walnut St. Pk. In addition, a segment of 24" water line will be installed in E. Rhorer Rd. and W. Gordan Pk. A 12" water line will also be installed in S. Walnut St. from the Wendy's/Kroger entrance north to the car wash entrance. Work will be a part of the Monroe County Highway Department contract for roadway improvements. CBU's cost to be paid for non-reimbursable work is estimated to be $1,780,000.

5.5 FULLERTON PIKE WATER LINE PHASE II

This is the second phase of a Monroe County Highway Department project extending improvements of Fullerton Pk. which shall occur with Phase I. This road improvement project is timed such that CBU forces can install the needed water line work prior to the Monroe County Highway Department project start. The water line work includes an estimated 940 feet of 24" water line. The estimated cost is $165,000 which includes $150,000 for materials and $15,000 for engineering design services.

5.6 WOODYARD RD WATER LINE – SERVICE TO ELLETTSVILLE

This project includes the installation of approximately 2,600 feet of 12" water line along W. Woodyard Rd. from N. Smith Pk. To W. Loesch Rd. The water line installation is a

condition of an agreement with Ellettsville Utilities to provide a master meter near the intersection of W. Woodyard Rd. and N. Loesch Rd.

5.7 SHOWERS RD WATER LINE

The construction of I69 creates conflict with CBU's existing 6" water line which is in present State Road 37 right-of-way from Bean Blossom Creek north to Ellis Rd. The I69 Developer is responsible for remedying the conflict and is working with CBU to relocate the water line. CBU desires to upsize the water line to 12" from 6" for the purpose of improving flow (distribution capacity) to a region that historically has insufficient water service. The existing 6" water line along State Road 37 is also service to a master meter for Washington Township Water Co. Recent improvements that Washington Township Water Co. has made, which include a new pumping station near the master meter, causes a need for CBU to provide increased flow (capacity) to the master meter location.

The I69 Developer will be responsible for installing approximately 5,850 feet of 12" water line through easements and along N. Showers Rd. Through CBU Rules and Regulations, the cost of upsizing the water line from 6" to 12" is estimated to be $125,000 and will be paid by CBU.

Additionally, in order to replace all of the 6" water line along N. Showers Rd. with 12", CBU forces will construct approximately 2290 feet of 12" water line. The estimated cost of materials and county road repair is $135,000.

5.8 GENTRY BOOSTER STATION – ADDITION OF PUMP NO. 3

Gentry Booster Station which is located on S. Smith Road is a pumping station for the purpose of increasing water pressure to a select service area. The pumping station was installed in 1998 and sized to meet the needs of a fully built-out service area. Presently two pumps serve the area and a third is needed to keep up with demand. The pump station is set up for a third pump to be installed. The estimated cost is $25,000.

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT VK-2

CBU PIPE INVENTORY FOR REPLACEMENT PROGRAM

*0 value = year unknown

Installation Year*	Pipe Diameter	Total feet	Unit Replacement Cost	Total Replacement Cost
0	4	7,654	$90	$688,860
0	6	22,083	$140	$3,091,620
0	8	3,745	$150	$561,750
0	10	4,033	$190	$766,270
0	12	4,330	$195	$844,350
0	14	4,165	$245	$1,020,425
0	16	8,520	$245	$2,087,400
0	18	2,886	$250	$721,500
0	20	15,860	$270	$4,282,200
0	24	1,902	$350	$665,700
1890	4	1,165	$90	$104,850
1890	6	1,104	$140	$154,560
1893	8	3,924	$150	$588,600
1893	12	5,291	$195	$1,031,745
1895	4	1,463	$90	$131,670
1895	6	37	$140	$5,180
1910	4	6,735	$90	$606,150
1910	6	11,591	$140	$1,622,740
1910	8	7,191	$150	$1,078,650
1915	6	379	$140	$53,060
1915	12	6,594	$195	$1,285,830
1922	4	6,245	$90	$562,050
1922	6	40,931	$140	$5,730,340
1922	8	1,342	$150	$201,300
1925	4	2,354	$90	$211,860
1925	6	1,721	$140	$240,940
1925	8	243	$150	$36,450
1925	14	74	$245	$18,130
1925	16	4,845	$245	$1,187,025
1925	18	7,651	$250	$1,912,750
1926	6	4,356	$140	$609,840
1927	6	2,940	$140	$411,600
1928	6	3,865	$140	$541,100
1929	6	3,253	$140	$455,420
1930	4	363	$90	$32,670
1930	6	311	$140	$43,540
1931	6	1,492	$140	$208,880
1934	6	7,779	$140	$1,089,060
1935	6	4,811	$140	$673,540
1936	8	175	$150	$26,250
1937	6	3,522	$140	$493,080
1938	6	610	$140	$85,400
1940	4	34	$90	$3,060
1940	6	1,001	$140	$140,140
		221,072		$36,307,535

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT VK-3

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

January 2003

Prepared by
Black & Veatch Corporation
Cincinnati, Ohio

P.N. 131434

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

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EXECUTIVE SUMMARY

A. INTRODUCTION

This Executive Summary provides an overview of the principle findings and recommendations included in the Long Range Water Capital Plan for the City of Bloomington Utilities (CBU). The Water Capital Plan provides a long-range plan for meeting water requirements through the year 2030.

B. POPULATION PROJECTIONS

Population is the most commonly used basis for estimating future water use. The Indiana Business Research Center (IBRC) forecasted the 2010 population for the City of Bloomington and Monroe County to be 64,391 and 120,000, respectively. The 2000 Census population for the City of Bloomington and Monroe County was 69,291 and 120,563, respectively. Since the Year 2010 population projections were already exceeded in 2000, revised population growth rates were required.

Three sets of projections were determined. The first set was based on the 1980-1990 growth rate. The second set was based on the 1990-2000 growth rate. The third set was based on a linear regression of the Census population between 1940 through 2000. The 1980-1990 growth rate produced more conservative results and was used for this Water Capital Plan. The population projections utilized for this study are presented in Table ES-1.

Table ES-1
Population Projections

Year	Bloomington	Monroe County
2005	75,008	126,783
2010	80,724	133,003
2020	94,043	146,729
2030	109,560	161,871

On January 10, 2003, it was announced that the Interstate 69 Corridor would be routed through Bloomington. The estimated time to completion is anywhere from eight to fourteen years. This Water Capital Plan does not take into consideration the effect of the Corridor on the geographical distribution of the population or future development in the CBU service area because of the unknowns associated with its construction. Any future Water Capital Plans should take this into consideration.

C. WATER REQUIREMENTS

The projected water use for the CBU system was based on the population projections. Rates most important in the design and operation of a water system are average day (AD), maximum day (MD), and maximum hour (MH). A summary of the average day, maximum day, and maximum hour water use for base year 2000 and years 2010, 2020, and 2030 utilized for this study are presented in Table ES-2.

Table ES-2
Projected Water Use

Year	Average Day, mgd	Maximum Day, mgd	Maximum Hour, mgd
2000	13.1	20.6	24.5
2010	15.2	24.2	28.7
2020	17.2	27.7	32.9
2030	19.6	32.2	38.1

D. EXISTING FACILITIES

The City of Bloomington Utilities has relied on the 24 mgd Monroe Water Treatment Plant (WTP) as the sole source of treated water since the Griffy WTP was retired from service in 1996. The Monroe WTP treats water withdrawn from Lake Monroe to meet all current regulatory standards. The processes at the

Monroe WTP include rapid mixing, sedimentation, filtration, and disinfection. The facility is connected to the Bloomington water distribution system by a single 36-inch transmission main that conveys treated water approximately 8 miles from the plant to the City. Any interruption in service, either at the WTP, along the transmission main, or with any of the critical ancillary water treatment facilities, for more than a few hours could result in a significant reduction or total suspension of water service to CBU's customers.

E. REGULATORY REQUIREMENTS

CBU's proposed new water treatment plant or expansion of the existing Monroe WTP will be designed and constructed during a period of rapid and unprecedented changes within the water industry. These changes are being driven by new regulations implemented in response to federal legislation; by the introduction of new water treatment processes, which have expanded many utilities' capabilities to meet specific treatment requirements; and by rising consumer expectations regarding the quality of their water supplies.

Review of pending and anticipated future regulatory requirements suggests that there are several water quality/treatment-related parameters that will likely need to be addressed in the design of any future treatment expansion utilizing either the existing Lake Monroe supply or a new surface water or ground water supply. For expansion scenarios utilizing surface water sources, provisions for the following will likely need to be included:

- Capability to consistently achieve finished water turbidities of 0.1 NTU or lower in order to minimize the potential for passage of microbial pathogens through the treatment process.

- Ability to maintain TTHM and HAA5 concentrations at less than 0.080 mg/L and 0.060 mg/L, respectively, throughout the entire CBU distribution system.

- Incorporation of a process to inactivate *Cryptosporidium* oocysts, if required under the impending Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). This would likely involve primary disinfection utilizing ultraviolet light irradiation, or (if the LT2ESWTR is promulgated as currently drafted) use of membrane technology to remove oocysts.

For expansion scenarios utilizing ground water sources, compliance with regulatory requirements would generally be more easily achieved than for surface water supplies. However, compatibility issues would need to be carefully evaluated in order to avoid conditions where intermixing of existing surface water supplies and new ground water supplies could lead to water quality problems within CBU's distribution system. Generally this would involve adjustment of finished water pH and alkalinity to ensure that precipitation or dissolution of existing deposits does not occur upon mixing of the treated ground water and surface water supplies.

CBU has expressed interest in membrane technology to meet future turbidity and possible *Cryptosporidium* removal requirements, and to provide their customers high quality drinking water. CBU, with the assistance of B&V, completed a membrane filtration pilot study in Year 2002. The pilot study indicated good results using membrane filtration with Lake Monroe as a water source. The pilot study indicated that with membranes, CBU could consistently achieve finished water turbidities of less than 0.1 NTU. Therefore, membrane technology has been assumed for expansion of the existing Monroe WTP or a new WTP using a surface water supply. In addition, if a new WTP is constructed with membrane filtration, CBU would like to include membranes at the existing Monroe WTP as well. Therefore, alternatives that involve a new WTP will also include retrofitting the existing Monroe WTP with membranes.

F. HYDRAULIC ANALYSES

Hydraulic analyses were performed for maximum day and maximum hour conditions for Base Year 2000 and Design Year 2030 to identify distribution

system deficiencies and to evaluate water treatment expansion alternative improvements. Analyses were not necessary for Design Years 2010 and 2020 since there were very little distribution system improvements required between 2000 and 2030 to meet the future water use conditions.

In addition to the Base Year 2000 and Design Year 2030 analyses, a series of year 2030 maximum day analyses were conducted with water demands increased globally to 36 mgd to match three water treatment plant expansion alternatives that CBU is considering to meet future water demands. The three alternatives, designated as Alternative A, B, and C, are described as follows:

- **Alternative A.** Expand the 24 mgd Monroe WTP to a capacity of 36 mgd. This alternative would require another 30-inch raw water line to be installed from the intake to the plant and a parallel 36-inch finished water transmission main from the plant to the proposed 30-inch Southeast main that connects to the existing 36-inch main near Harrell Road and Moffat Lane. This alternative also includes the proposed 30-inch Southeast main along Harrell Road; a new Southeast pump station and tank located near Harrell and Rhorer Roads; a 36-inch main along Rhorer to Sare Road; a 24-inch North branch main along Sare Road to the existing 24-inch main in Moores Pike and a 24-inch West branch main along Rhorer Road, then north along South Rogers Street to West Country Club Drive, then west along Country Club Drive to connect to the two existing 24-inch mains at the intersection of Rockport and West Tapp Roads.

- **Alternative B.** Construct a new 12 mgd Dillman WTP expandable to 24 mgd, adjacent to the Dillman WWTP near Dillman Road and Victor Pike. Raw water would be conveyed through a 36-inch transmission main from a new intake located near the Indiana Department of Natural Resources site on Lake Monroe. From the Dillman WTP's high service pumps, finished water would be conveyed through a 36-inch transmission main into two 24-inch Central service level mains at Rockport and Tapp Roads and a 16-inch main

along West Country Club Drive between Rockport Road and South Old SR 37. The capacity of the Monroe WTP would remain at 24 mgd.

- **Alternative C.** Construct a new North 12 mgd WTP expandable to 24 mgd, near Bottom Road and new State Route 37. Raw water would be conveyed through a 36-inch transmission main to the new plant. From the new North plant, finished water would be conveyed through a 36-inch transmission main to the Central service level mains near Stonemill Road and Old State Route 37. If the North plant is expanded to 24 mgd, then the 36-inch main should be extended as a 24-inch main along Walnut Street to the existing 24-inch main on 20th Street. The capacity of the Monroe WTP would remain at 24 mgd.

G. EVALUATION OF WATER SYSTEM IMPROVEMENTS

A list of advantages and disadvantages were developed as part of the evaluation of the alternatives. The following is a summary of the advantages and disadvantages identified during the evaluation process:

1. Alternative A – Expand Monroe WTP from 24 mgd to 36 mgd

a. Advantages

- The proposed Southeast transmission main will provide redundancy to the existing 36-inch transmission main from the Monroe WTP to the South Tanks.

- If a break should occur in one of the two finished water transmission mains, CBU can continue to provide up to 24 mgd to the distribution system.

- The proposed Southeast pump station would provide water to the Central service level if the South-Central pump station is off-line or if there is a break in the existing 36-inch transmission main serving the South-Central pump station.

- Lake Monroe is used, which has an abundant supply of good quality raw water.

- There is familiarity with the water supply.

- Expanding the Monroe WTP is the most economical of the three alternatives.

b. Disadvantages

- It does not provide an independent second water source.

- The Monroe WTP cannot be easily expanded past 36 mgd.

2. Alternative B – Construct a new 12 mgd Dillman WTP

a. Advantages.

- The intake facility can be expanded easily to a capacity of 24 mgd.

- Residuals can be pumped to the Dillman WWTP for processing, thereby eliminating the need for a residuals dewatering facility.

- Treated water is pumping directly into the Central service level, thereby eliminating the need for the Fullerton pump station and tank previously proposed by CBU.

- Provides 12 mgd of treated water to the system in the event that the Monroe WTP or intake is off-line or if there is a break in the existing 36-inch finished water transmission main.

- Having two separate withdrawal locations on Lake Monroe provides a greater level of security than with a single supply and treatment facility.
- Lake Monroe is used, which has an abundant supply of good quality raw water.
- There is familiarity with the water supply.

b. Disadvantages

- Increases O&M costs by having a second water treatment plant and staff.
- Has high capital cost.

3. Alternative C – Construct a New 12 mgd North WTP

a. Advantages

- The water supply is independent of Lake Monroe, and provides a greater level of security as compared to a single supply and treatment facility.
- Provides 12 mgd of treated water to the system in the event that the Monroe WTP or intake is off-line or if there is a break in the existing 36-inch finished water transmission main.
- Less pumping head is required conveying water to the northern extremities of the distribution system from the proposed North WTP than from the existing Monroe or proposed Dillman WTP.
- Residuals can be pumped to the Blucher Poole WWTP for processing, thereby eliminating the need for a residuals dewatering facility.

b. Disadvantages

- Increases O&M costs by having a second water treatment plant and staff.
- Requires a new collector well and associated piping to expand the plant to 24 mgd.
- Has water quality compatibility concerns related to the mix of treated surface water and groundwater.
- Has high capital cost.

4. Option to Alternative C – Construct a New 12 mgd North WTP Using Surface Water Supply (Lake Lemon, Bean Blossom Creek, and Griffy Lake).

a. Advantages

- Water supply is independent from Lake Monroe, which provides a greater level of security as compared to a single supply and treatment facility.
- Provides 12 mgd of treated water to the system in the event that the Monroe WTP or intake is off-line or if there is a break in the existing 36-inch finished water transmission main.
- Less pumping head is required conveying water to the northern extremities of the distribution system from the proposed North WTP than from the existing Monroe or proposed Dillman WTP.
- Residuals can be pumped to the Blucher Poole WWTP for processing, thereby eliminating the need for a residuals dewatering facility.

b. Disadvantages

- The water source likely does not have sufficient yield to support expansion of the proposed 12 mgd plant in the future without other sources to supplement the North supply.
- Increases O&M costs by having a second water treatment plant and staff.

The proposed treatment processes for each alternative are described in Chapter 7. The recommended water supply, treatment, and distribution system improvements are shown on Figure 7-1.

H. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION AND PROJECT COSTS

All of the probable construction and project costs presented herein reflect price levels for the Year 2002. The probable construction costs include an allowance of 20 percent for contingencies, but do not include any allowance for administration, legal, and engineering costs; CBU staff salaries or expenses related to the project; permit or plan review fees; or costs for surveying, subsurface investigations, land acquisition, easements, or unusual construction conditions other than those specifically identified herein.

The total probable project costs for each alternative includes the probable construction costs; administration, legal, and engineering costs; costs for surveying and subsurface investigations; cost for pilot studies and investigations; land and easement acquisition; and bond issuance costs.

The opinion of probable construction costs, probable project costs, and projected additional increase in water rates in Year 2008 for the alternatives is as follows:

EXECUTIVE SUMMARY

Alternative	Total Probable Construction Cost	Total Probable Project Cost	Projected 2008 Additional Rate Increase
Alternative A Expand the existing Monroe WTP from 24 to 36 mgd using membrane filtration.	$46,200,000	$58,970,000	51.3 %
Option to Alternative A Expand the existing Monroe WTP from 24 mgd to 30 mgd, initially using membrane filtration.	$39,900,000	$50,916,000	44.3 %
Alternative B New 12 mgd Dillman WTP with Lake Monroe supply using membrane filtration. Retrofit existing Monroe WTP with 24 mgd membranes.	$62,400,000	$79,982,000	72.8 %
Alternative C New 12 mgd North WTP with groundwater supply using membrane filtration and RO for softening. Retrofit existing Monroe WTP with 24 mgd membranes.	$74,100,000	$95,427,000	91.7 %

Alternative	Total Probable Construction Cost	Total Probable Project Cost	Projected 2008 Additional Rate Increase
Option 1 to Alternative C New 12 mgd North WTP with groundwater supply using gravity media filtration and RO for softening. Retrofit the existing Monroe WTP with 24 mgd membranes.	$68,400,000	$88,120,000	83.6 %
Option 2 to Alternative C New 12 mgd North WTP using Lake Lemon, Bean Blossom Creek, and Griffy Lake supplies. Retrofit the existing Monroe WTP with 24 mgd membranes.	$46,500,000	$60,155,000	55.6 %

I. PROPOSED ALTERNATIVES

The financial evaluation indicates that expanding the capacity of the Monroe WTP (Alternative A) is the most economical of the alternatives. This alternative includes expanding the capacity of the Monroe WTP using membrane filtration; constructing new parallel raw and finished water mains to convey the additional flow; and constructing the Southeast Water System Improvements which will convey the additional treated water from the South service level to the Central service level. The new and existing finished water transmission mains and the firm pumping capacity between the South service level and Central service level would support up to 42 mgd of flow. It may be feasible that the Monroe WTP could ultimately be expanded to 42 mgd in the future. The disadvantages to this option are that the treatment facilities and site would not easily support further

expansion, and would not provide the same level of redundancy as compared to a new separate treatment facility.

The North WTP alternative using Lake Lemon, Bean Blossom Creek and Griffy Lake as a water supply (Option 2 to Alternative C) is only slightly more expensive than expanding the Monroe WTP. The proposed North WTP would have a capacity of 12 mgd and could be used as a peaking plant, supplementing the Monroe WTP to meet maximum day demands. Based on past yield studies, the North surface water sources should have a firm annual yield of approximately 6 mgd. However, this plant could provide up to 12 mgd of treatment capacity as long as the annual average plant capacity remained at approximately 6 mgd. This alternative provides several benefits, including the security of having two water sources and good hydraulics associated with providing water to customers from the North. It should be noted that this water source may not have sufficient yield to support expansion of the proposed WTP beyond 12 mgd in the future without other sources to supplement the North supply. Other sources may include blending groundwater with the North surface water supplies or possibly conveying raw water from another surface water source to the North plant as a supplement. If this alternative is selected, a study should be performed to verify the yield and water quality of the water sources and the proposed treatment processes.

Both the proposed Dillman WTP using Lake Monroe as the water supply (Alternative B) and the North WTP using a groundwater supply (Alternative C and Option 1 to Alternative C) have several non-economic advantages over the other alternatives. These include the security and reliability of two separate plants and their ability to be easily expanded from 12 mgd to 24 mgd in the future. The existing Monroe WTP also could be expanded, if additional capacity is needed in the future.

J. IMPROVEMENTS SCHEDULE

As the projected water demands for the Year 2010 is expected to exceed the capacity of the existing Monroe WTP, it is recommended that the proposed water system improvements be completed and operational in the Year 2008. This will necessitate starting construction by January 2006. CBU should complete any final pilot studies and/or investigations by Spring 2004 and begin design by late Spring or early Summer 2004 to ensure sufficient time is allowed to complete the design phase; obtain all permits and approvals; acquire all necessary land and easements; accept bids; and award the construction contract by January 2006.

As this capital improvements program represents an important and critical decision on the direction of the water utility, it is paramount to include the public in the selection of the alternatives described herein. The schedule allows several months for obtaining input and comments through public meetings prior to making a decision and proceeding with the capital improvements program.

It is recommended that CBU make a final decision regarding the proposed water system improvements in the Year 2003. This should allow adequate time to complete all phases of the project and have the new facilities operational by mid-Year 2008.

1. INTRODUCTION

A. PURPOSE

This Long Range Water Capital Plan report has been prepared to provide the City of Bloomington Utilities (CBU) with a long-range plan for improving and expanding its water treatment facilities and distribution system. The Water Capital Plan recommendations provide a basis for the design, construction, and financing of the improvements needed to meet CBU's anticipated growth. The recommended improvements will be required at various stages during the study period to provide an adequate and dependable supply of water to existing and future customers. The recommendations in this Water Capital Plan do not promote or encourage growth but are required to ensure that the City of Bloomington Utilities can provide an adequate supply of water and keep pace with projected growth in the City and County.

B. SCOPE

The Study Area covered by this Water Capital Plan includes the City of Bloomington and Monroe County, Indiana, as shown on Figure 1-1. The study period is from year 2000 through 2030. Existing and projected populations, historical water production, and metered water sales were used to estimate water use for the base year 2000 and projected for the design years 2010, 2020, and 2030. The water treatment facilities and the distribution system improvements recommended in this Water Capital Plan are staged to correct existing system deficiencies and to coincide with anticipated development. Opinions of probable construction costs, probable project costs, and rate impacts also are included.

1. INTRODUCTION

Figure 1-1

1. INTRODUCTION

The principal elements of study included the following:

- An evaluation of historical trends in population growth and water use.
- A projection of future population and water requirements.
- A description of existing water treatment, transmission, and distribution system facilities.
- An update of the existing WaterCAD hydraulic model to reflect existing and future conditions.
- System analyses with the model to determine the ability of CBU's water treatment facilities and distribution system to hydraulically satisfy present and future water requirements.
- The development of a plan of recommended system improvements including a construction program and opinions of probable cost.
- An analysis of the impact to water rates associated with construction of the recommended improvements.

C. ABBREVIATIONS

Abbreviations used in this report are as follows:

ACOE	Army Corp of Engineers
AD	Average day
CBU	City of Bloomington Utilities
CT	Concentration and Time
DBP	Disinfection By-Products
DBPR	Disinfection By-Products Rule

1. INTRODUCTION

EPA	Environmental Protection Agency
ft	Feet
gpcd	Gallons per capita per day
gpm	Gallons per minute
gpd	Gallons per day
HAA5	Haloacetic Acid (5 specific)
HGL	Hydraulic Grade Line
hp	Horsepower
IBRC	Indiana Business Research Center
ICI	Industrial/Commercial/Institutional
ICR	Information Collection Rule
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
IESWTR	Interim Enhanced Surface Water Treatment Rule
in	Inch
ISO	Insurance Services Office
LT1ESWTR	Long Term 1 Enhanced Surface Water Treatment Rule
LT2ESWTR	Long Term 2 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
MD	Maximum Day
MG	Million Gallons
mgd	Million gallons per day
MH	Maximum Hour
msl	Mean sea level
MRDL	Maximum Residual Disinfectant Level
PS	Pump Station
psi	Pounds per square inch
rpm	Revolutions per minute
SDWA	Safe Drinking Water Act
SWTR	Surface Water Treatment Rule
TOC	Total Organic Carbon
TTHM	Total Trihalomethane

USGS	United States Geological Survey
UV	Ultraviolet
WTP	Water Treatment Plant
WWTP	Wastewater Treatment Plant

D. BACKGROUND MATERIAL

Background reference material for this Water Capital Plan includes the following:

- 1986, Water Supply Treatment and Distribution for Bloomington, Indiana, Black & Veatch.
- 1991, City of Bloomington, Growth Policies Plan, 1st Draft.
- 1993, City of Bloomington Utilities Water Facilities Capital Improvement Program Assessment, Black & Veatch, Cincinnati, Ohio.
- 1996, Monroe County Comprehensive Land Use Plan.
- 1997, Insurance Services Office, Inc (ISO) Report.
- 1999, City of Bloomington Utilities Water System Improvements, Drinking Water State Revolving Fund Preliminary Engineering Report, Black & Veatch, Cincinnati, Ohio.
- 2000, New Water Treatment Plant Siting Study, Black & Veatch, Cincinnati, Ohio.
- 2000 Census, U.S. Census Bureau.
- 2001, City of Bloomington Utilities, SDWA Regulatory Compliance Review, Black & Veatch, Cincinnati, Ohio.

- 2002, City of Bloomington, Growth Policies Plan, 4th Draft.
- 2002, City of Bloomington Utilities, Power Point presentation of the Utilities' Water History.
- 2002, City of Bloomington Utilities, Water Treatment Plant Membrane Filtration Pilot Study, Black & Veatch, Cincinnati, Ohio.
- 2002, City of Bloomington Utilities, Monroe Water Treatment Plant Improvements Design Report, Black & Veatch, Cincinnati, Ohio.
- 2002, City of Bloomington Utilities, Preliminary System Improvements Study, Groundwater Feasibility Study, HNTB, Indianapolis, Indiana.

E. HISTORY OF BLOOMINGTON'S WATER SUPPLY AND TREATMENT

Throughout its existence, Bloomington has experienced water shortages caused by weather conditions, lack of natural water supplies, and water storage imbalances. It also has an excellent record of achievements in providing safe water to its customers. As in the past, the importance of making today's timely decisions will only be verified by the future. This Water Capital Plan will provide CBU with options to maintain a safe and reliable drinking water well into the future. Future water supply, usage, and development are, and should be, a concern to every water utility. This concern applies to both quantity and quality. As Bloomington has experienced, without properly developing and managing the water supply and treatment facilities, shortages can and will occur.

1. INTRODUCTION

A timeline of Bloomington's most significant water achievements follows:

- 1818 Monroe County founded
- 1860 Cisterns built on Courthouse Square and contaminated by human and animal wastes.
- 1885 Courthouse well drilled 2,670 feet – dry
- 1891 Water Franchise established
- 1892 Upper Twin Lake built
- 1893 Twin Lakes WTP constructed
- 1894 Twin Lakes WTP placed on line
- 1898 Plant sold to City
- 1899 Plant shut down due to lack of water
- 1902 Plant shut down due to lack of water
- 1905 Lower Twin Lake built
- 1909 Weimer (Wapehani) Lake built
- 1911 University Lake built
- 1915 Leonard Springs Lake built
- 1922 Plant shut down three days per week due to lack of water
- 1924 Private water company formed
- 1925 Griffy Lake built and Griffy WTP begins operation
- 1939 City buys back water company
- 1953 Lake Lemon built
- 1954 Griffy WTP expanded
- 1965 Lake Monroe built
- 1967 Monroe WTP placed on line
- 1990 Monroe WTP expanded
- 1996 Griffy WTP retired

2. POPULATION

Population is the most commonly used basis for estimating future water use. The development of a comprehensive water system capital plan thus begins with an evaluation of the service area's historical population trends and a projection of its future population. To predict future water demands accurately, it is necessary to determine the appropriate rate, direction, and characteristics of the area's future population changes.

A. CURRENT AND PROJECTED FUTURE POPULATION

Current populations and population projections for the City of Bloomington and Monroe County were obtained from the Bloomington Planning Department, the Monroe County Planning Department, and the U.S. Census Bureau. Data from the 2000 Census indicates that the prior population projections obtained from the City of Bloomington 2002 Growth Policies Plan and the Monroe County Comprehensive Land Use Plan underestimated the actual growth. This underestimation may be the result of the record high student enrollment (37,076) at Indiana University in 2002 and the higher amount of land annexation.

Population forecasts, prepared by the Indiana Business Research Center (IBRC) and published in its 1988 projection series, indicated that Bloomington's population would increase to 64,391 by the year 2010. The 2000 U.S. Census data, however, shows that Bloomington's population (69,291) has already exceeded the IBRC 2010 projection. Likewise, Monroe County was projected to exceed 120,000 people by the year 2010 and the 2000 Census data shows Monroe County to currently have a population of 120,563.

Since the population projections obtained from the Bloomington and Monroe County Planning Departments for 2010 were already exceeded in 2000, revised population growth rates were required. For this Water Capital Plan, population estimates for years 2000 through 2030 were determined using current and projected population figures. Three sets of population projections were determined. The first set was based on the assumption that the 1980-1990 growth rate of 16.5%

2. POPULATION

(or 1.6% per year) for Bloomington and 10.3% (or 1.0% per year) for Monroe County occur in the future. The second set was based on the assumption that the 1990-2000 growth rate of 14.3% (or 1.4% per year) for Bloomington and 10.6% (or 1.0% per year) for Monroe County occur in the future. The final set was based on linear regression of the Census population from 1940 through 2000. The historical and projected populations for the City of Bloomington and Monroe County are shown in Table 2-1.

Table 2-1
Historical and Projected Population

Year	Bloomington Historical Population		Monroe County Historical Population (Including Bloomington)		Monroe County Historical Population (Excluding Bloomington)
	Population	Change	Population	Change	
1940	20,870	-	36,534	-	15,664
1950	28,163	7,293	50,080	13,546	21,917
1960	31,357	3,194	59,225	9,145	27,868
1970	43,262	11,905	85,221	25,996	41,959
1980	52,044	8,782	98,785	13,564	46,741
1990	60,633	8,589	108,978	10,193	48,345
2000	69,291	8,658	120,563	11,585	51,272
Projected Populations using 1980-1990 Growth Rate[a]					
2005	75,008	5,716	126,783	6,220	51,776
2010	80,724	5,717	133,003	6,220	52,279
2020	94,043	13,319	146,729	13,726	52,686
2030	109,560	15,517	161,871	15,142	52,311
Projected Populations using 1990-2000 Growth Rate[b]					
2005	73,620	4,329	126,970	6,407	53,350
2010	79,185	5,565	133,378	6,408	54,193
2020	90,492	11,307	147,556	14,178	57,064
2030	103,160	12,668	163,241	15,685	60,081

2. POPULATION

Table 2-1 Historical and Projected Population					
Year	Bloomington Historical Population		Monroe County Historical Population (Including Bloomington)		Monroe County Historical Population (Excluding Bloomington)
	Population	Change	Population	Change	
Projected Populations using Linear Regression[c]					
2005	72,521	3,230	131,092	10,529	58,571
2010	76,644	4,123	138,404	7,312	61,760
2020	84,890	8,246	153,027	14,623	68,137
2030	93,136	8,246	167,650	14,623	74,514

a. Bloomington growth rate of 1.6% per year; Monroe County growth rate of 1.0% per year

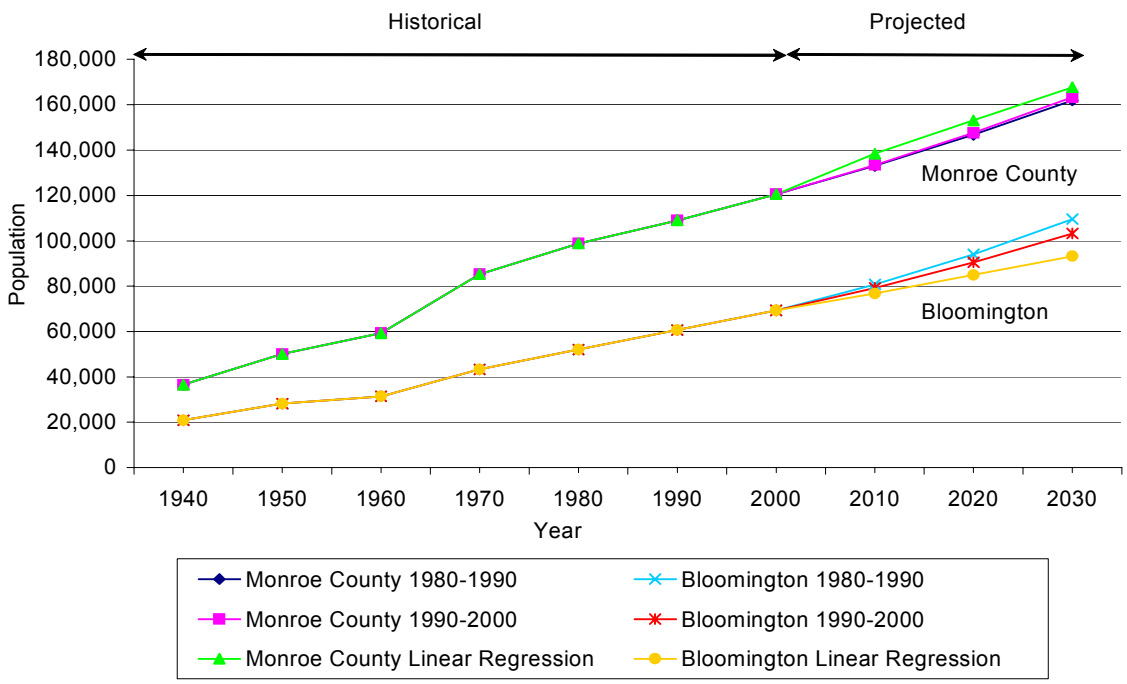
b. Bloomington growth rate of 1.4% per year; Monroe County growth rate of 1.0% per year

c. Bloomington: Y=8246X+10676, R^2 = 0.9883; Monroe County: Y=14623X+21420, R^2 = 0.9845

Figure 2-1 shows the historical and projected populations based on the 1980-1990 growth rate, the 1990-2000 growth rate, and linear regression for the City of Bloomington and Monroe County.

2. POPULATION

Figure 2-1
Historical and Projected Population



The population projections illustrated in Figure 2-1 indicate little difference between the 1980-1990 and the 1990–2000 growth rates for Bloomington and Monroe County. Although growth is expected to continue steadily for both Bloomington and Monroe County, the County will probably grow at a lower rate than the City assuming annexation and student population continues at an increased rate. The 1980-1990 growth rate produces slightly more conservative results and was used for this study. The population projections utilized for this study are listed in Table 2-2.

2. POPULATION

Table 2-2 Population Projections		
Year	**Bloomington**	**Monroe County**
2005	75,008	126,783
2010	80,724	133,003
2020	94,043	146,729
2030	109,560	161,871

B. GEOGRAPHICAL DISTRIBUTION OF POPULATION

The geographical distribution of the population within the CBU service area will continue to change. The City's 2002 Growth Policies Plan presented a land use map, shown on Figure 2-2, that identifies the current service area boundaries and eleven land use types geographically. CBU does not anticipate the current service area boundaries indicated in the land use map to change.

The Growth Policies Plan also identified critical subareas, shown on Figure 2-2, that require additional development recommendations regarding future development. For each critical subarea, the Growth Policies Plan described the intent, overall land use policy, urban service or infrastructure issues, and site design recommendations, i.e., preservation of greenspace or common architectural themes.

Based on the land use plan, the prime growth areas are on the south and west sides of Bloomington. The areas of future development include the State Road 37 corridor, Acuff Road/Kinser Pike, State Road 37/Tapp Road, North College Mall District, Huntington Farms/Moores Pike, East Jackson Creek, Winston-Thomas, Ramsey Farm, Adams Street/Patterson Drive, West 17th Street, Twin Lakes Park North, and the McDoel Switchyard area.

2. POPULATION

Figure 2-2

2. POPULATION

Table 2-3 presents the prime growth areas that will affect the geographical distribution of the population and water use.

Table 2-3
Prime Growth Areas in CBU Service Area

Area	Location	Land Use Designation
State Road 37 Corridor	State Road 37	Employment-based, with supporting commercial and residential components
Acuff Road/Kinser Pike	Acuff Road, Kinser Pike, and State Road 37	Employment-based; Corporate offices, light manufacturing, and small scale retail
State Road 37/Tapp Road	North of Fullerton Pike, east of State Road 37, south of Tapp Road, and east of the Woolery Farm PUD	Employment-based; Medical and corporate office with light manufacturing, retail, and assisted living
North College Mall District	North of 3rd Street, east of State Road 45/46 Bypass, south of 10th Street/ State Road 45, and west of Bell Trace Retirement Community/ Park Ridge Neighborhood	Urban Residential
Huntington Farms/ Moores Pike	North of Moores Pike, east of Smith Road, West of State Road 446, and bounded on the north by the Gentry Honours PUD, Gentry Estates, and Hearthstone residential development	Urban Residential
East Jackson Creek	South of Rogers Road, west of Snoddy Road, east of Canada Farm PUD and Sherwood Oaks Christian Church	Urban Residential
Winston-Thomas	West of Old State Road 37 and north of Gordon Pike	Employment, institutional, and commercial
Ramsey Farm	South of Moores Pike, west of Sare Road, and east and north of Sycamore Knolls neighborhood	Urban Residential

2. POPULATION

Table 2-3 Prime Growth Areas in CBU Service Area		
Area	**Location**	**Land Use Designation**
Adams Street/ Patterson Drive	West of Walker Street, south and west of Rose Hill Cemetary, west of Landmark PUD, and south to Bloomfield Road	Community Activity Center
West 17th Street	East of State Road 37, south of State Road 45/46 Bypass, West of Arlington Road, and north of Crestmont/ Bloomington Housing Authority	Urban Residential
Twin Lakes Park North	East of State Road 37, north of Bloomfield Road, west of Shady Acres and Cory Lane Estates, and south of 3rd Street.	Urban Residential
McDoel Switchyard	Extends from Country Club Drive to Adams Street along the railroad line	Urban Greenway; with adjacent retail, housing, and recreation

1. Interstate 69 Corridor

On January 10, 2003, Governor O'Bannon and State Transportation Commissioner Nicol announced, near the completion of this Water Capital Plan, that the Interstate 69 Corridor would be routed through Bloomington. They estimated the time to completion being anywhere from eight to fourteen years. This Water Capital Plan does not take into consideration the effect of the Corridor on the geographical distribution of the population or future development in the CBU service area because of the unknowns associated with its construction. Any future Water Capital Plans should take this into consideration.

3. WATER REQUIREMENTS

A water utility supplies water to meet its user's demands at flow rates that fluctuate yearly, monthly, daily, and hourly. Water demands are typically higher during dry years and in hot months. Water demand follows a diurnal (daily) pattern that is generally low at night and high in the early morning and late in the day. The most significant demands in the design and operations of a water system are the annual Average Day (AD), the Maximum Day (MD) and the Maximum Hour (MH) demands.

Average day demand is defined as the total annual water pumped to distribution divided by the number of days in the year. The average day demand is utilized in estimating future average day, future maximum day, and future maximum hour demands. The average day demand is used to determine the required yield of water supply sources and used indirectly in determining estimated future revenues and operating costs.

Maximum day demand is defined as the largest quantity of water pumped to distribution on any one day during the year. The maximum day demand is utilized in sizing most water supply and treatment facilities.

Maximum hour demand is defined as the largest quantity of water pumped to distribution, adjusted for any inflow and outflow from system storage, in any one-hour period during the year. Since minimum distribution system pressures are commonly experienced during the maximum hour, the sizes and locations of distribution facilities are determined considering maximum hour conditions. Maximum hour demands are met using strategically located system storage. The use of system storage minimizes the required capacity of the treatment facilities, the water transmission mains, and the pumping facilities. It also results in a more uniform and economical operation of the water system as a whole.

3. WATER REQUIREMENTS

A. HISTORICAL WATER USE

1. Historical System Water Use and Peaking Factors

The annual average day, maximum day, and maximum hour water demands for the period 1985 through 2001 are summarized in Table 3-1. The ratios of maximum day demand to the average day demand (MD/AD) and the maximum hour demand to average day (MH/AD) demand also are listed in the table.

Table 3-1
Historical Water Demands and Peaking Factors

Year	Water Demand, mgd			Peaking Factors	
	Average Day	Maximum Day	Maximum Hour	MD/AD Ratio	MH/AD Ratio
1985	11.93	15.50	17.50	1.30	1.47
1986	11.58	14.70	18.20	1.27	1.57
1987	12.69	16.10	18.30	1.27	1.44
1988	13.84	22.50	24.40	1.63	1.76
1989	11.98	14.70	17.60	1.23	1.47
1990	11.83	17.30	17.30	1.46	1.46
1991	11.72	18.80	21.20	1.60	1.81
1992	11.68	16.30	21.90	1.40	1.87
1993	12.31	17.30	17.70	1.41	1.44
1994	13.03	19.30	20.70	1.48	1.59
1995	12.03	17.70	22.70	1.47	1.89
1996	12.62	17.40	22.30	1.38	1.77
1997	12.96	17.40	22.90	1.34	1.77
1998	12.98	19.10	24.00	1.47	1.85
1999	13.85	20.30	24.80	1.47	1.79
2000	13.19	17.30	23.50	1.31	1.78
2001	13.09	18.80	22.90	1.44	1.75
			Average Peaking Factor	1.41	1.68
			Largest Peaking Factor	1.63	1.89
			Smallest Peaking Factor	1.23	1.44
			Peaking Factors Used for Design	**1.60**	**1.90**

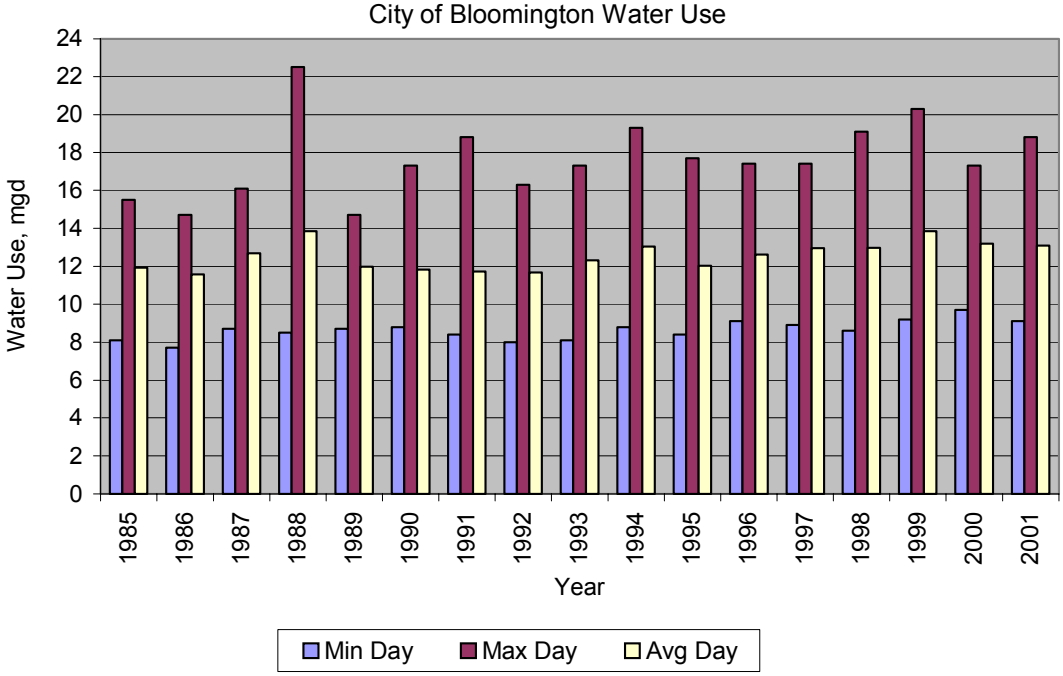
3. WATER REQUIREMENTS

Table 3-1 shows that during the period 1985 through 2001, the largest ratio of maximum day to average day (MD/AD) water demand was 1.63. From experience, for medium-sized communities with populations between 20,000 to 75,000 have their largest MD/AD ratio in the range of 1.30 to 1.75. CBU's ratio of 1.63 is in the typical range for medium sized communities. Larger communities or communities with large industrial water use commonly have their largest MD/AD ratio in the range of 1.20 to 1.60. Affluent, rapidly growing systems where lawn irrigation is practiced extensively can have MD/AD ratios as high as 2 or 3. The largest MD/AD ratio for the CBU system is only slightly higher than the commonly largest MD/AD ratio. Since university students account for approximately 65 percent of the City's population while school is in session, the water use pattern of the university students greatly influences the City's water demand ratios. During the summer, the student population decreases dramatically, which reduces demands during the typical high use summer period. After reviewing the data listed in Table 3-1, it was determined that 1999 was the best (most conservative) year to use in establishing system-wide demands. The MD/AD factor of 1.60 was used for design purposes.

Figure 3-1, which follows, illustrates a slightly rising trend in average day demands for the CBU system over the past seventeen years. During this time, the average day demand increased approximately 20 percent or 1.2% per year.

3. WATER REQUIREMENTS

Figure 3-1
City of Bloomington Water Use

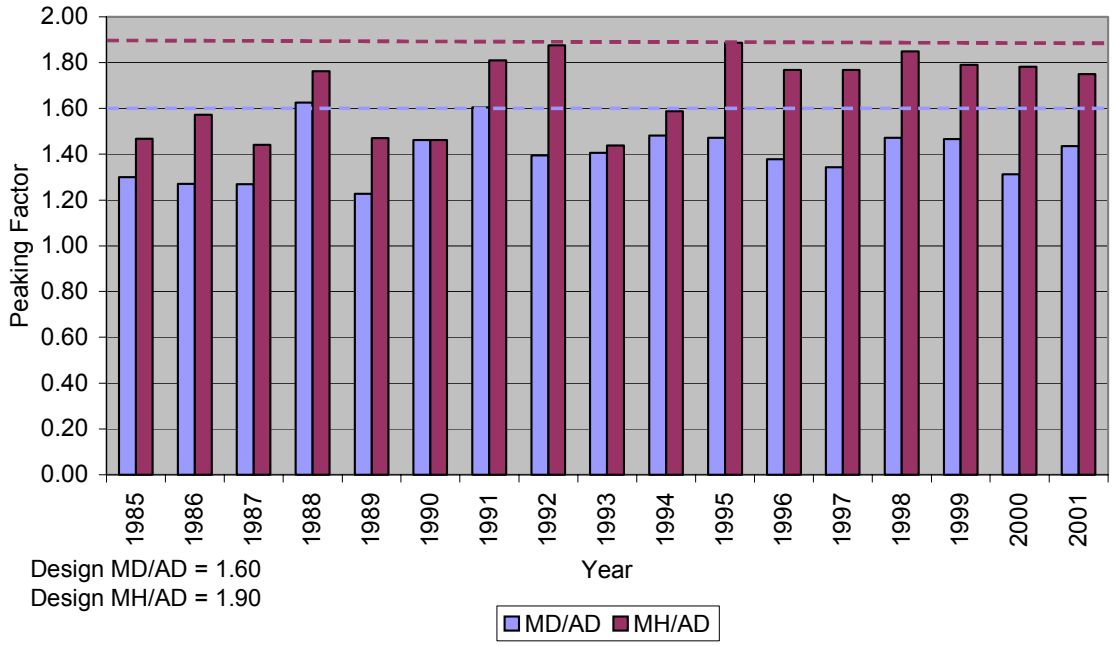


Experience has shown that the largest ratio of the maximum hour to average day (MH/AD) water demand is typically 1.1 to 1.5 times the largest maximum day to average day ratio (MD/AD). Applying these experienced factors to CBU's 1.63 largest MD/AD ratio gives a MH/AD ratio of 1.8 to 2.4. In the seventeen years listed in Table 3-1, the largest ratio for MH/AD was 1.89 and is consistent with experience. Since 1999 was the more conservative year to use in establishing system-wide demands, the MH/AD factor of 1.90 was used for design purposes.

In the following Figure 3-2, the peaking factors for maximum day and maximum hour water demands from 1985 through 2001 are shown. The peaking factors used in projecting future water requirements for design are consistent with conditions historically experienced by CBU.

3. WATER REQUIREMENTS

Figure 3-2
CBU System Peaking Factors



A risk analysis was performed to determine the appropriate return period desired for peaking factor development for maximum day and maximum hour demands, and to aid in understanding the implications of these factors. If a water system improvements program is planned based on subjectively low design peaking factors, it would be anticipated that the future peak demands would exceed the capacity of the system, and water restrictions would need to be imposed too often. Conversely, if an improvements program is planned based on high peaking factors, the additional and premature cost of capital improvements may not be warranted. The return period of historical peaking factors was evaluated to aid in the selection of peaking factors used for water demand projections.

3. WATER REQUIREMENTS

Frequency distribution plots were prepared using the data in Table 3-1 and are shown on Figures 3-3 and 3-4. The figures show the percent probability of a peaking factor being exceeded, based on historical data. The figures also show the design peaking factors used for this study. As indicated previously, for design purposes, a MD/AD ratio of 1.60 and a MH/AD ratio of 1.90 was used. As shown in Figure 3-3, the selected MD/AD factor represents a return period of 9 years. Statistically, based on a 9-year return period, the risk of being exceeded in any year would be approximately 11%. As shown in Figure 3-4, the MH/AD factor represents a return period of 20 years and statistically the risk of being exceeded in any year would be 5%.

Other return rates were considered, but developing facilities that have a lower return rate (frequency less than once every 10 years) cause a significant increase in system costs, without providing a corresponding increase in distribution system reliability. If the peak period water use exceeds the projected needs, then low-pressure problems in some localized areas water use may result. Those problems are dealt with more appropriately using water restrictions than by expensive distribution system improvements. Typically a 10-year return is desired, however, a 9-year return is considered acceptable.

3. WATER REQUIREMENTS

Fig 3-3

3. WATER REQUIREMENTS

Fig 3-4

3. WATER REQUIREMENTS

Total water pumped, population, and water use per capita per day from 1985 through 2000 are presented in Table 3-2. Overall, water use has been relatively constant over the past 15 years. Although the population increased from 1990 to 1995, the amount of water used per capita decreased. Since 1995, water use per capita has increased to about the same as it was in 1985.

Table 3-2
Water Use Per Capita

Year	Total Water Pumped, gallons	Population	Water Use[a], gal/capita/day
1985	3,946,692,000	56,338	192
1990	4,317,950,000	60,633	195
1995	4,398,500,000	64,962	185
2000	4,818,000,000	69,291	190

a. Includes residential, ICI, Indiana University, wholesale, and unaccounted-for water use

2. Residential, ICI, Indiana University, and Wholesale Water Sales

System water use for residential, commercial, and wholesale have steadily increased at a moderate rate over the last several years. This has been due to the combined affect of new residential, commercial, and some minor expansion of the wholesale service area. Actually, the industrial component of the Industrial/Commercial/Institutional (ICI) user class has decreased. It is anticipated that CBU's water demands will continue to increase at a similar rate for the foreseeable future. Residential, ICI, Indiana University (IU), and wholesale water use for the years 1990 through 2001 are presented in Table 3-3, which follows.

3. WATER REQUIREMENTS

Table 3-3
System-wide Residential, ICI, Indiana University, and Wholesale Water Use

Year	Residential[a,b]		ICI[a,c]		Indiana University (IU)[a,d]		Wholesale[a]		Total Water Use
	MG	%	MG	%	MG	%	MG	%	MG
1990	895	23	2,103	34	768	20	902	23	3,899
1991	1,000	24	2,284	33	877	21	957	23	4,241
1992	941	24	2,102	33	764	19	957	24	3,899
1993	972	24	2,126	33	760	19	991	24	4,241
1994	1,063	25	2,258	33	811	19	1,008	23	4,038
1995	1,093	26	2,045	30	807	19	1,003	24	4,116
1996	984	23	2,195	34	762	18	1,034	25	4,357
1997	1,587	34	2,000	27	727	16	1,090	23	4,696
1998	1,692	38	1,680	22	700	16	1,069	24	4,419
1999	1,843	38	1,974	32	416	9	1,062	22	4,869
2000	1,615	37	1,656	31	320	7	1,040	24	4,294
2001	1,678	38	1,703	29	413	9	1,014	23	4,394

a. Percent of Total Residential, ICI, IU, and Wholesale water sales.

b. Residential does not include Indiana University on-campus housing.

c. ICI includes Industrial, Commercial, and Institutional (with the exception of IU) categories.

d. University water use is understated for years 1999, 2000, and 2001.

a. Residential Metered Water Use

Residential water use is currently about 38 percent of the total water used. As presented in Table 3-3, the percentage of residential water use has increased steadily over the past twelve years from a low of around 23 percent in 1990 to nearly 40 percent in 2001.

3. WATER REQUIREMENTS

Residential use consists of water used by domestic customers in single-family dwellings and duplexes. Residential use does not include Indiana University on-campus housing, such as sororities, fraternities, campus apartments, and campus real estate.

b. ICI and Indiana University Metered Water Use

Excluding Indiana University, the percentage of water used by ICI customers averaged about 30 percent of the total water use. As shown in Table 3-3, the percentage of ICI water use has steadily decreased from a high of around 35 percent in 1990 to nearly 30 percent in 2001. The decrease in water use is attributed to the City's loss of several industrial customers.

The percentage of water used by Indiana University averaged about 15 percent of the total water use. The water used since 1999 is considerably lower than in previous years. CBU indicated that this was attributed to meters that were not read.

CBU's industrial customers include large industries such as General Electric and Otis Elevator. Commercial and institutional use consists of water used by apartment complexes, hotels, businesses, schools, hospitals, and similar establishments. Metered water use for the top 35 retail customers for January through September of 2002 is summarized in Table 3-4. These 35 large users represent about 65 percent of the total ICI sales, including Indiana University.

3. WATER REQUIREMENTS

Table 3-4 Top 35 Retail Water Users for 2002			
No.	**Customer**	**Total Water Use, MG**	**Average Water Use, mgd**
1	Indiana University	475	1.741
2	Bloomington Hospital	45	0.163
3	General Electric	27	0.100
4	Baxter Pharmaceutical	27	0.097
5	Cook, Inc.	15	0.055
6	Capstone Development Corp.	15	0.053
7	Bloomington Country Club	14	0.050
8	R H S Water Corp.	13	0.049
9	City of Bloomington Parks and Recreation	12	0.045
10	Woodbridge Apartments III	12	0.045
11	Arlington Valley Mobile Home LLC	12	0.044
12	Irving Materials, Inc.	11	0.042
13	Regency Fountain Park Apartments	11	0.041
14	Fontanbleu Nursing Center	9	0.033
15	Heatherwood Park Mobile Est.	8	0.030
16	Monroe County Community School Corp.	8	0.029
17	Southcrest Mobile Home Manor	7	0.027
18	Basswood LLC	7	0.027
19	Monroe County Commissioners	7	0.025
20	Regency Meadow Park Apartments	6	0.022
21	Meadowood Retirement Community	5	0.019
22	Schulte Corp.	5	0.018
23	Rolling Ridge Apartments	5	0.018
24	Robert Eads	5	0.018
25	Henderson Courts	5	0.017
26	Otis Elevator Co.	4	0.016
27	Maple Court	4	0.015
28	Hyde Park Development	4	0.015
29	Garden Hills Mobile Home Park	4	0.015
30	Summit Pointe LLC	4	0.014
31	Bloomington Kinser Hotel Assn.	4	0.013
32	Bradford Ridge Apartments	4	0.013

3. WATER REQUIREMENTS

Table 3-4 Top 35 Retail Water Users for 2002			
No.	**Customer**	**Total Water Use, MG**	**Average Water Use, mgd**
33	FSF Woodland Springs Assn., LLC	4	0.013
34	Redbud Hills	3	0.012
35	Monroe County Parks and Recreation	3	0.010
	Total	**804**	**2.946**

c. Wholesale Metered Water Use.

CBU's wholesale customers are primarily nearby rural water companies. The customers include B&B Water Project, Inc., East Monroe Water Corporation, Ellettsville Utilities, Town of Nashville, Southern Monroe Water Corporation, Van Buren Township, and Washington Township Water Corporation. Water is supplied to the wholesale customers through a series of master meters. Six of the seven wholesale water users have agreements with the City that contain language regarding the minimum and maximum quantities allowed.

Wholesale water use increased from about 900 MG in 1990 to 1,000 MG in 2000, as presented in Table 3-3. Wholesale water use has steadily grown and has amounted to nearly 25 percent of the total water use for the past ten years. Based on City billing information, water use by CBU's wholesale customers from 1997 through 2000 is shown in Table 3-5.

Table 3-5 Wholesale Customer Water Use (1997-2000)							
Customer	Total Annual Water Use, MG					Annual Avg Use, mgd	Percent of Total Wholesale
	1997	1998	1999	2000	Avg		
B&B	114	108	118	118	114	0.31	10.7
East Monroe	162	124	99	125	128	0.35	12.0
Ellettsville	301	342	285	285	303	0.83	28.6
Nashville	40	24	8	16	22	0.06	2.0
Russell Rd. Water Corp.	9	11	7	NA	9	0.02	0.7
Shady Side Dr.	1	1	1	1	1	0.00	0.1
Southern Monroe	247	232	279	244	250	0.68	23.4
Van Buren Twp.	135	144	172	152	151	0.41	14.1
Washington Twp.	81	85	92	99	89	0.24	8.3
Total	**1,090**	**1,069**	**1,062**	**1,040**	**1,067**	**2.90**	**100**

3. Unaccounted-for Water.

Unaccounted-for water is the water lost in the system expressed as a percentage of the total volume of water pumped. It is determined by subtracting the metered water use in the system and the estimated unmetered water use from the volume pumped from the water treatment facilities. Unaccounted-for water is generally attributable to causes such as distribution system leakage, meter inaccuracies, unauthorized connections, water used by street sweepers, hydrant flushing, and fire fighting. The unaccounted-for water for the years 1990 through 2001 is summarized in Table 3-6. For the 12-year period, it ranged from a low of 0.85 percent to a high of 10.46 percent. The percentage of unaccounted-for water averaged 6.58 percent and met the American Water Works Association Leak Detection and Water Accountability Committee recommended goal of less than 10 percent.

Table 3-6 Unaccounted-for Water				
Year	Water Treatment Plant High Service Pumping, mgd	Total Metered Sales, mgd	Unaccounted-for Water	
			mgd	Percent of Total Pumped
1990	11.83	10.68	1.15	9.69
1991	11.72	11.62	0.10	0.85
1992	11.68	10.96	0.72	6.16
1993	12.31	11.20	1.11	9.02
1994	13.03	11.86	1.17	8.98
1995	12.03	11.34	0.69	5.74
1996	12.62	11.54	1.08	8.56
1997	12.96	12.81	0.15	1.16
1998	12.98	12.17	0.81	6.24
1999	13.85	13.36	0.49	3.54
2000	13.19	11.81	1.38	10.46
2001	13.09	12.04	1.05	8.01
		Average	**0.83**	**6.58**

B. WATER USE PROJECTIONS

Water use projections were developed for the total system for the base year (year 2000) and years 2010, 2020, and 2030. The base year water use represents the theoretical water use that would have occurred in year 2000, using the same criteria as for the projected water requirements.

3. WATER REQUIREMENTS

1. Total System Design Criteria

Historical water use and population projections were used to estimate the average water use on a per capita basis for residential customers for the base year 2000 and years 2010, 2020, and 2030. The average day residential water use was determined by multiplying the per capita water use by the population. The average day ICI, Indiana University, wholesale, and unaccounted-for water use was estimated on a proportional basis. The design criteria used for calculating the average day water requirements are summarized in Table 3-7.

Table 3-7
Design Criteria for Average Day Water Use Calculations

Design Criteria	2000	2010	2020	2030
Population[a]	53,154	64,187	77,506	93,023
Base Residential Use[b]	85 gpcd	85 gpcd	85 gpcd	85 gpcd
Residential/ICI Ratio (%)	38/62	40/60	42/58	44/56
Unaccounted - for (%)[c]	10	10	10	10
MD/AD Ratio	1.60	1.60	1.60	1.60
MH/AD Ratio	1.90	1.90	1.90	1.90

a. The population shown is the residential population less IU on-campus housing occupants.

b. The base residential use was determined by dividing the total residential water use of 4.5 mgd by 53,154 people (year 2000 population of 69,291 less IU on-campus housing population of 16,137).

c. For design, it is typical to allow 10% for the unaccounted-for water. Even though CBU averages 6.5% unaccounted-for water, 10% was used for design calculations.

3. WATER REQUIREMENTS

The average day water use by class is summarized in Table 3-8.

Table 3-8
Base Year and Projected Average Day Water Use by Class

User Class	2000		2010		2020		2030	
	mgd	%	mgd	%	mgd	%	mgd	%
Residential	4.5	34	5.5	36	6.6	38	7.9	40
ICI	2.7	20	3.5	22	4.0	23	4.7	24
IU	1.8	14	1.8	12	1.8	10	1.8	9
Wholesale	2.9	22	3.0	20	3.2	19	3.4	17
Subtotal	**11.9**	**90**	**13.8**	**90**	**15.6**	**90**	**17.8**	**90**
Unaccounted-for	1.2	10	1.4	10	1.6	10	1.8	10
Total	**13.1**	**100**	**15.2**	**100**	**17.2**	**100**	**19.6**	**100**

The maximum day and maximum hour water use were determined by applying the MD/AD peaking factor of 1.60 and the MH/AD peaking factor of 1.90, respectively, to the average day water use. Although these peaking factors typically are used system-wide (i.e. assigning the same factor to each user class) to project future water requirements for design, assigning each user class its own factor was more appropriate. This is mainly due to the affect of residential water use on the distribution system as compared to other user classes.

The peaking factors for residential use are typically higher than the overall average and those for ICI, IU, wholesale, and unaccounted-for use are usually lower. Residential water use has a greater influence on the distribution system than any other user because of variations in use. Residential areas have increases in water usage due to watering the lawn, washing cars, and recreational uses. Industrial areas have flow patterns that repeat as manufacturing begins and ends each weekday. Also, it is anticipated that ICI, IU, wholesale, and unaccounted-for water will have limited growth. Therefore, their corresponding factors will be less than that used for residential.

3. WATER REQUIREMENTS

Peaking factors by class were calculated for the base year and each design year. The factors were adjusted slightly so that the sum of the water use would match the total system water use. The design peaking factors by class are summarized in Table 3-9.

Table 3-9
Design Peaking Factors by Class

User Class	MD/AD	MH/AD
Residential	2.2	2.6
ICI	1.4	1.7
IU	1.2	1.4
Wholesale	1.2	1.4
Unaccounted-for	1.0	1.0
System-wide	**1.6**	**1.9**

Using the peaking factors shown in Table 3-9, the maximum day and maximum hour water demands by user class were determined for base year 2000 and design years 2010, 2020, and 2030 and are summarized in Table 3-10.

Table 3-10
Base Year and Projected
Maximum Day and Maximum Hour Water Use by Class

User Class	2000		2010		2020		2030	
	MD mgd	MH mgd	MD mgd	MH mgd	MD mgd	MH mgd	MD mgd	MH mgd
Residential	9.9	11.9	12.1	14.5	14.5	17.4	17.4	20.9
ICI	3.8	4.6	4.9	5.9	5.6	6.7	6.6	7.9
IU	2.2	2.6	2.2	2.6	2.2	2.6	2.2	2.6
Wholesale	3.5	4.2	3.6	4.3	3.8	4.6	4.1	4.9
Subtotal	**19.4**	**23.3**	**22.8**	**27.3**	**26.1**	**31.3**	**30.4**	**36.3**
Unaccounted-for water	1.2	1.2	1.4	1.4	1.6	1.6	1.8	1.8
Total	**20.6**	**24.5**	**24.2**	**28.7**	**27.7**	**32.9**	**32.2**	**38.1**

3. WATER REQUIREMENTS

A summary of the average day, maximum day, and maximum hour water use for the base year 2000 and design years 2010, 2020, and 2030 is presented in Table 3-11.

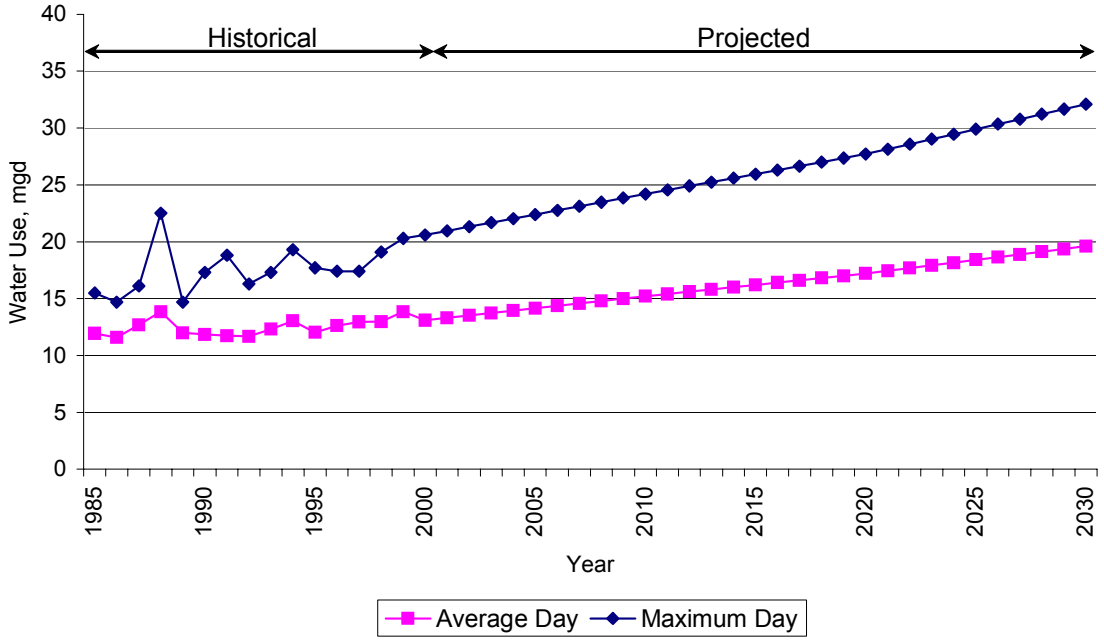
Table 3-11
Projected Water Use

Year	Average Day, mgd	Maximum Day, mgd	Maximum Hour, mgd
2000	13.1	20.6	24.5
2010	15.2	24.2	28.7
2020	17.2	27.7	32.9
2030	19.6	32.2	38.1

The historical and projected average day and maximum day water use for the CBU system are shown on Figure 3-5.

3. WATER REQUIREMENTS

Figure 3-5
Historical and Projected Water Use



C. FIRE FLOW REQUIREMENTS

To establish appropriate fire insurance premiums for residential and commercial properties, the Insurance Services Office (ISO) needs reliable, up-to-date information about a municipality's fire protection services. The ISO collects information on a community's public fire protection, analyzes the data, and assigns a public protection classification number between 1 and 10. Class 1 represents the best public protection, and Class 10 indicates less than the minimum recognized protection.

To determine the public protection classification, the ISO evaluates the water supply system. This includes the supply capacity for each pressure zone, treatment facilities, transmission facilities, and storage. Also included are such

items as the condition and maintenance of hydrants, and the amount of available water compared with the amount needed to suppress fires.

The ISO calculates the needed fire flow for selected locations, determines the water-flow capabilities at those locations, and calculates a ratio considering the need and the availability. The ratio is then used in calculating credit points. The needed fire flow for an individual building is based on the building's area, construction, occupancy, and exposure. To obtain full credit, the water supply must be able to deliver water at 20 psi and at the specified rate of flow for a specified period of time. Needed fire flows for individual buildings range from a minimum of 500 gpm to a maximum of 12,000 gpm.

The ISO determines the needed fire flows for residential areas with one- and two-family dwellings by considering the distance between buildings as listed in Table 3-12.

Table 3-12
Needed Fire Flow for Residential Areas

Distance, feet	Needed Fire Flow, gpm
≤ 10	1,500
11 to 30	1,000
31 to 100	750
>100	500

The ISO does not consider the needed fire flow at certain high-demand properties in the public protection classification. Those properties include buildings graded and coded by the ISO as protected by an automatic sprinkler system meeting applicable National Fire Protection Association standards and buildings with a needed fire flow in excess of 3,500 gpm. ISO individually grades the protection of buildings with a needed fire flow in excess of 3,500 gpm and their public protection classification may differ from that of the community

providing their fire protection.

The ISO report for the City of Bloomington was completed in late 1996, with the City receiving the results in 1997. The results indicated that the City of Bloomington's public protection classification is Class 4. Bloomington received a total credit of 60.10% out of a possible 100%. The Water Supply portion of the rating received 26 points out of possible 40 points and the Fire Department received 34 points out of 60 points. To receive a Class 3 rating, both the Water Supply and Fire Department would need to increase by about 2 and 8 points, respectively for a total of 70 points. The current overall rating was reduced by 2.6 points because of the divergence between the Water Supply and Fire Department. To be classified as a Class 1, the City would need to have a total credit of 90% or more. This classification applies to properties with a needed fire flow of 3,500 gpm or less.

4. EXISTING FACILITIES

CBU's existing facilities were outlined in the 1986 Water Supply, Treatment, and Distribution Report, the 1993 Water Facilities Capital Improvement Program Assessment, and the 2000 New Water Treatment Plant Siting Study prepared by Black & Veatch. This chapter provides a review of the facilities that are currently in use by the City of Bloomington.

A. SUPPLY

Water supply considerations for Bloomington were studied and reported upon most recently in 1986, 1993, and again in 2000. The following discussion summarizes the prior source and capacity considerations and provides an update with respect to current conditions and projected needs.

In the 1986 study, titled "Water Supply Treatment and Distribution for Bloomington, Indiana", alternative sources were considered that included Lake Monroe to the south; and Lake Lemon, Griffy Reservoir, and Bean Blossom Creek to the north. The following information on the yield of the potential sources, the source water quality, the treatment requirements, and other factors are provided for use in considering, selecting, or expanding CBU's source water supply.

1. Lake Monroe

Lake Monroe is located approximately seven miles southeast of Bloomington and has been in operation since 1966. It is owned by the Indiana Department of Natural Resources (IDNR), managed by the U.S. Army Corps of Engineers (ACOE), and is used for water supply, flood control, and recreation. The lake has a total storage volume of 18,450 acres, a drainage area of 432 square miles, a spillway elevation of 556.0 feet, and a maximum water elevation of 556.2 ft. msl recorded on May 15, 2002. CBU purchases raw lake water, under an existing purchase agreement with IDNR for its Lake Monroe Plant, which is located about

a half mile west of the lake. The present cost to purchase raw water from IDNR is $33.00 per million gallons.

Based on a 1964 IDNR study, it was determined that Lake Monroe, with a 12+ foot drop from the top of its conservation pool at elev. 538.0 to elev. 525.75, could safely provide a uniform flow of 47 mgd for one year without any runoff being re-supplied to the Lake. The firm yield of Lake Monroe was conservatively estimated to be 50 percent more than the 47 mgd, or approximately 70 mgd. The estimated yield assumed continuous releases of 50 cfs to maintain flow in Salt Creek, 500 cfs to maintain flow in East Fork of White River at Shoals, and 1400 cfs from April to September 15 and 1000 cfs during the remainder of the year to White River at Petersburg.

Another study, completed in 1976 titled "Review of Monroe Reservoir Water Purchase Agreement" by Franklin Consultants, Inc. and McCullough and Associates, stated that the firm yield of Lake Monroe was about 122 mgd and allocated 25% (30 mgd) for direct withdrawal by CBU and 75% (92+/- mgd) for downstream uses.

Lake Monroe has sufficient yield to satisfy CBU's needs throughout and well beyond the study period. Using a combination of other potential (northern) supplies, in addition to the Lake Monroe (southern) supply, may be necessary in the future, but for the foreseeable future it is unnecessary. Any thoughts, at this time, of using another (northern) supply would be based strictly on economic feasibility or political considerations.

4. EXISTING FACILITIES

Lake Monroe

a. Monroe Intake.

The intake tower is located on the shore of Lake Monroe, approximately a half mile east of the treatment plant. The intake is divided into two cells; each cell is equipped with three inlet ports for selective withdrawal of water at different depths. The inlet ports are located at Elevation 510, 520, and 530 feet and are equipped with a sluice gate to shutoff flow. At each port, water passes through a manual bar screen into a compartment and then through a traveling screen into a wetwell. Each wetwell contains two low service pumps, which convey water to the treatment plant as described below.

4. EXISTING FACILITIES

Monroe Intake

b. Monroe Low Service Pumps.

The Monroe Low Service Pumps convey raw water from Lake Monroe to the Monroe Water Treatment Plant through a 36-inch transmission main. Characteristics of the low service pumps are listed in Table 4-1.

4. EXISTING FACILITIES

Table 4-1
Monroe Intake

Pump No.	Installation Date	Manufacturer	Nominal Capacity		Head (feet)	Motor Hp
			gpm	mgd		
1	1967	Worthington	10,400	15	220	700
2[a]	1967	Layne	8,700	12	225	700[b]
3	1967	Layne	4,200	6	225	300
4	1967	Layne	4,200	6	225	300

a. Pump equipped with an adjustable frequency drive.
b. Motor was replaced under the 1999 Engine Generator Project

Normally, the low service pumps operate continuously and are shut down only for emergencies. Low service pumping can be controlled from the Monroe WTP or from the intake facility. Cinergy Corporation provides electrical power service to the intake facility. Power to the intake facility is supplied at 2400 volts, 3 phase, 60 hertz. The intake facility has an on-site substation that receives electrical power from either the Smith Road Substation or the Rogers Street Substation via the Cinergy power transmission system. Either substation can feed the facility. The intake has a standby engine generator to provide power during an outage.

2. Lake Lemon/Bean Blossom Creek

Lake Lemon is a manmade lake located on Bean Blossom Creek about 9 miles northeast of Bloomington. The lake was completed in 1953 and was intended for water supply. Housing development and park facilities, however, have led to significant recreational use of the lake. The lake has a normal pool (spillway) elevation of 630 ft msl and a drainage area of 71 square miles. Lake Lemon has a surface area of 1,650 acres and originally had a storage volume of approximately 14,420 acre-feet. Since its construction, the lake has lost storage

volume due to the accumulation of sediments. The rate of sedimentation was determined to be approximately 0.341 ac-ft/sq mile/year. Applying this rate results in a net water storage volume of 12,500 ac-ft through 2020. Seepage and groundwater loss was assumed to be 0.1 mgd.

Water released from Lake Lemon flows about 8 miles down Bean Blossom Creek to a low head diversion dam just east of Old Highway 37. The dam creates a pool about 8 feet deep. Downstream from Lake Lemon the yield of the creek, with an additional 41 sq. miles of contributing drainage area plus the yield of Lake Lemon was determined to be 10.1 mgd. Since the Monroe WTP was built in the 1960s, however, no water has been taken for consumption from Lake Lemon and Bean Blossom Creek. The only water taken from this source has been used to run the low service pumps for maintenance service.

Lake Lemon

4. EXISTING FACILITIES

Bean Blossom Creek

3. Griffy Lake

Griffy Lake is located on Griffy Creek about 2.5 miles north of Bloomington. The 1,900 ac-ft lake was formed with the construction of a dam on Griffy Creek in 1924. The present lake has a normal water surface elevation of 635 feet msl and a drainage area of 8 square miles. The lake has a surface area of approximately 130 acres and is expected to have a net storage volume of 1,700 ac-ft. in 2020, assuming sedimentation deposits are similar to those determined for Lake Lemon. The ultimate yield of Griffy Lake was determined to be 1.3 mgd. The retired Griffy Water Treatment Plant, built in 1926, is located adjacent to the lake.

4. EXISTING FACILITIES

Griffy Lake

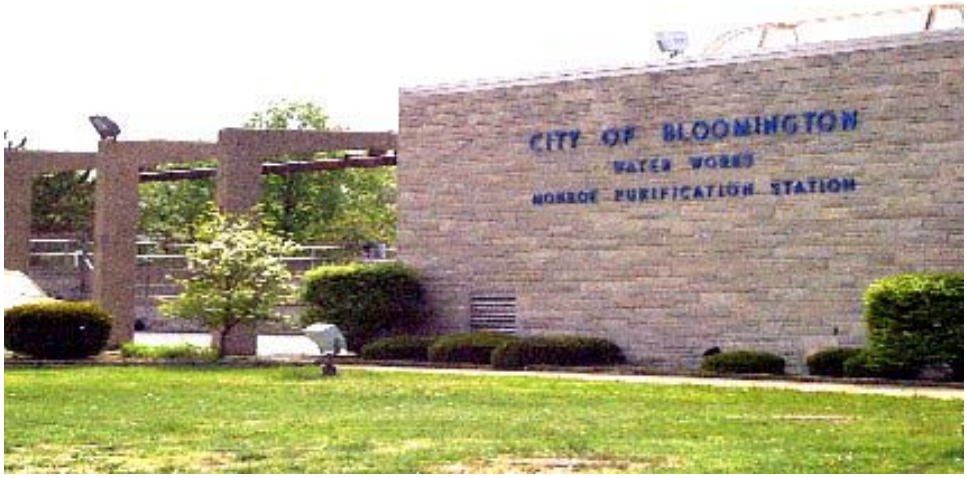
B. TREATMENT

1. Monroe Water Treatment Plant

The Monroe WTP was constructed in 1967 with modifications in 1977, 1988, 1999, and 2000. The City of Bloomington Utilities has relied on the Monroe WTP as the sole source of treated water since the 6 mgd Griffy WTP was retired from service in 1996. The Monroe WTP has a rated treatment capacity of 24 million gallons per day (mgd). The facility is a conventional settling/filtration plant with two treatment basins and four mixed-media filters. The finished water is conveyed to a finished water reservoir and is pumped to the distribution system through a single 36-inch transmission main.

4. EXISTING FACILITIES

Monroe Water Treatment Plant



A schematic of the Monroe WTP is shown on Figure 4-1.

4. EXISTING FACILITIES

Fig 4-1

4. EXISTING FACILITIES

A summary of the major treatment components is presented in Table 4-2.

Table 4-2 Monroe WTP Components	
Monroe WTP	
Flow, mgd	24
Primary Rapid Mix	
Number	1
Size, ft	6.75 x 6.75
Depth, ft	18.5
Volume, ft^3	840
Detention Time, sec	23
Motor, hp	5
Flocculation Basins	
Number	2
Size, ft	28.5 x 69.5
Depth, feet	12.5
Volume per Basin, ft^3	24,759
Detention Time, min	23
Flocculators per Basin	2
Motor, hp	4
Sedimentation Basins	
Number	2
Zones	4
Size, ft	77 x 77
Depth, ft	12
Volume per Zone, ft^3	71,150
Tube Settlers Depth, ft	2.5
Tube Settlers Surface Area per Basin, ft^2	3,580
Loading Rate Over Tube Settlers per Basin, gpm/ft^2	2.3
Secondary Rapid Mix	
Number	1
Size, ft	6.75 x 6.75
Depth, ft	16
Volume, ft^3	729
Detention Time, sec	20
Motor, hp	5

4. EXISTING FACILITIES

Table 4-2 Monroe WTP Components	
Filters	
Number	4
Dimensions, ft	30 x 35
Depth, ft	9.5
Media	
Anthracite	
Depth, inches	26
Effective size, mm	1.0
Sand	
Depth, inches	12
Effective size, mm	0.5
Filter Rate, gpm/ft^2	4
Backwash Rate, gpm/ft^2	20
Average Unit Filter Run Volume, gal/ft^2	12,100
Average Backwash Volume, gal/ft^2	202,000
Average Unit Filter Backwash Volume, gal/ft^2	192
Transfer Pumps	
Number	4
Capacity, gpm	8,400 Pump No. 1 (AFD) 4,200 Pump Nos. 2 and 3 8,400 Pump No. 4
Rated Head, ft	35
Speed, rpm	900
Motor, hp	51 Pump Nos. 2 and 3 106 Pump Nos. 1 and 4
Finished Water Reservoir	
Number	1
Capacity, gal	5,000,000
Wash Water Tank	
Number	1
Capacity, gal	250,000
Filter Surface Wash Pump	
Number	1
Capacity, gpm	700
Rated Head, ft	170
Speed, rpm	1,800
Motor, hp	40

4. EXISTING FACILITIES

Table 4-2 Monroe WTP Components	
Wash Water Transfer Pump	
Number	1
Capacity, gpm	4,200
Rated Head, ft	42
Speed, rpm	1,200
Motor, hp	60
High Service Pumps	
Number	4
Capacity, gpm	5,600 Pump No. 1 (AFD)
	5,600 Pump No. 2 (AFD)
	5,600 Pump No. 3 (Constant)
	10,400 Pump No. 4 (Constant)
Head, ft	210 Pump Nos. 1, 2, and 3
	150 Pump No. 4
Speed, rpm	885 Pump Nos. 1, 2, and 3
	880 Pump No. 4
Motor, hp	500
Backwash Holding Basin	
Number	1
Diameter, ft	65
Side Wall Depth, ft	22
Side Water Depth, ft	21
Capacity, gal	500,000
Motor, hp	4
Backwash Holding Basin Pumps	
Number	3
Capacity, gpm	800
Head, ft	25
Speed, rpm	1750
Motor, hp	7.5

4. EXISTING FACILITIES

Table 4-2 Monroe WTP Components	
Backwash Clarifier	
Number	1
Diameter, ft	42
Side Wall Depth, ft	12
Side Water Depth, ft	10.33
Maximum Hydraulic Loading, gpm/ft^2	2
Average Hydraulic Loading, gpm/ft^2	1.4
Backwash Clarifier Pumps	
Number	2
Capacity, gpm	2,000
Head, ft	25
Speed, rpm	1760
Motor, hp	18
Residuals Holding Basin	
Number	1
Diameter, ft	65
Side Wall Depth, ft	19
Side Water Depth, ft	11
Capacity, gal	255,000
Residuals Holding Basin Pumps	
Number	3
Capacity, gpm	85
Rated Head, ft	25
Speed, rpm	3330
Motor, hp	3.8
Gravity Thickener	
Number	1
Diameter, ft	40
Side Wall Depth, ft	14
Side Water Depth, ft	12.17
Solids Loading Rate, lb/hr/ft^2	0.2

4. EXISTING FACILITIES

Table 4-2 Monroe WTP Components	
Decant Pump	
Number	1
Capacity, gpm	400
Rated Head, ft	105
Speed, rpm	1750
Motor, hp	20
Sludge Drying Beds	
Number	8
Total Area, ft^2	59,232
Depth, inches	12 – 14
Total Volume, ft^3	59,232 – 69,104
Pressure Filter Press	
Maximum Inlet Feed Pump Pressure, psi	70
Maximum Squeeze, psi	100
Total Volume, ft^3	175
Number of Chambers	94
Plate Size, ft x ft	5 x 5
Hydraulic Clamping Pressure, psi	3,300
Relief Valve Setting, psi	3,700
Hydraulic Cylinder Size, inch Bore x inch Stroke	12 x 30
Hydraulic Reservoir Capacity, gal	16
Pressure Filter Press Feed Pumps	
Number	2
Capacity, gpm	300
Rated Head, psi	20
Speed, rpm	1160
Motor, hp	40
Sludge Lagoon Pump	
Number	2
Type	Submersible
Capacity, gpm	-
Rated Head, ft	50
Speed, rpm	1,700
Motor, hp	5

Table 4-2 Monroe WTP Components	
Filtrate Pump	
Number	1
Capacity, gpm	300
Rated Head, ft	-
Speed, rpm	1,800
Motor Size, hp	20

a. Primary Rapid Mixing

Raw water entering the plant flows through the Parshall flume to the primary rapid mix basin where alum, polymer, and chlorine are added. Powdered activated carbon is added occasionally for taste and odor control. The rapid mix basin is equipped with a 5-hp vertical turbine mixer. The chemically treated water flows out of the rapid mix basin to the flocculation/sedimentation process.

b. Flocculation/Sedimentation

Flow leaving the rapid mix is divided into two separate parallel flocculation/sedimentation basins, the North and South Basins. Each basin consists of two flocculation zones followed by two sedimentation zones, the East and West sedimentation zones. The flocculation zones are separated from the sedimentation zones by offset wood dividing walls. Each flocculation zone is equipped with original horizontal shaft paddle flocculators. The East sedimentation zone in each basin contains Eimco, center-drive, rotary solids collection systems. The West sedimentation zone in each basin is equipped with tube settlers to increase the flow capacity. Clarified water from the tube settlers flows into the secondary rapid mix basin prior to filtration.

Under normal operations, residuals from the sedimentation basin are drawn off and directed to the residuals holding basin. Residuals also can be directed to the backwash holding basin or the upper lagoon. From the holding basin, flow is routed to the gravity thickener.

c. Secondary Rapid Mixing

The flow leaving the sedimentation basins enters the secondary rapid mix basin where chlorine, ammonia, lime, and fluoride are added prior to filtration. The secondary rapid mix basin is equipped with a 5-hp vertical turbine mixer. The chemically treated water flows out of the rapid mix basin to filter influent troughs.

d. Filtration

Water from the secondary rapid mix basin flows to four gravity rapid rate filters. Each filter has a conventional anthracite, sand, and support gravel filter media system with a Leopold Clay underdrain system. The filters also are equipped with a surface wash system consisting of a surface wash pump and rotary surface wash piping.

The filter media for Filters 1 and 2 was replaced in 1990 while media in Filters 3 and 4 was replaced in 1979. While anthracite has been replaced and added as needed, overall replacement of the media has not occurred. The Leopold Clay underdrain systems are original, installed in 1967. The filter media in Filter 2 has increased in depth over the past few years. Black & Veatch evaluated the filter and it appears to be a build-up of calcium carbonate.

The hydraulic loading rate for 24 mgd with all four filters in service is approximately 4 gpm/ft^2 and approximately 5.3 gpm/ft^2 with one of the filters removed from service for backwashing. The Indiana Department of Environmental Management (IDEM) requires the filters to be sized for a

maximum loading rate of 4 gpm/ft^2 with one filter out of service for backwashing purposes.

Filter run times between backwashing events historically have averaged approximately 89 hours, with a minimum run time of 66 hours to a maximum of 119 hours. The filters are backwashed using potable water when a predetermined loss of head is exceeded. The backwashing process is enhanced with a surface wash system. The washwater is stored in a 250,000 gallon Washwater storage tank. Spent backwash water is stored in a 500,000 gallon holding basin where it is either pumped to the head of the plant or to the backwash clarifier for treatment. Under normal operating conditions the water is directed to the backwash clarifier.

e. Finished Water Reservoir

Filtered water is transferred to the 5.0 MG finished water reservoir via the transfer pump station. The 150-feet diameter reservoir is a prestressed concrete ground storage tank with a side water depth of 40 feet. The reservoir was constructed in 1990 as part of the expansion to the Monroe WTP. Water from the reservoir is pumped to the distribution system by high service pumps.

4. EXISTING FACILITIES

5.0 MG Monroe Finished Water Reservoir

f. Transfer Pump Station

The Transfer pump station was constructed as part of the 1990 Monroe WTP expansion. It is located on the southwest side of the Filter Building and transfers filter effluent to the 5.0 MG finished water reservoir. Transfer pumping can be directed to the high service pumps during periods when the reservoir is out of service. The transfer pump station is designed to be expandable to 36 mgd but is currently rated at a firm capacity of 24 mgd.

g. High Service Pumping

High service pumping equipment is located in the Filter Building. Four high service pumps discharge treated water into the South service level and fill the 1.0 MG South tank and the 3.0 MG South tank. The units take suction directly from the 5.0 MG finished water reservoir. Two of the pumps are equipped with

an adjustable frequency drive while the remaining pumps are equipped with a constant speed drive.

h. Residuals Management Facilities

The Residuals Management Facilities consist of a backwash holding basin, backwash clarifier, residuals holding basin, gravity thickener, and dewatering equipment (pressure filter press).

Backwash Holding Basin

The backwash holding basin is a 500,000 gallon basin that stores spent backwash water, dewatering filtrate, and gravity thickener overflow. The basin is equipped with mixers to keep solids in suspension. The water in the basin can be pumped to either the head of the plant or to the backwash clarifier for treatment. Polymer, sodium bisulfite, and muriatic acid are injected into the backwash transfer pump discharge line.

Backwash Clarifier

The backwash clarifier treats the water received from the backwash holding basin prior to its discharge to Lake Monroe. Effluent from the backwash clarifier can be directed to Outfall No. 1 or to the head of the treatment plant. The clarifier is equipped with clarifying equipment consisting of an influent center well, sludge collector mechanism, tube settlers, and effluent troughs with weirs. Solids are withdrawn and discharged to the residuals holding basin.

Residuals Holding Basin

This holding basin stores residuals generated during the sedimentation process and from the backwash clarifier. The basin has a nominal capacity of 255,000 gallons and is equipped with mixers to keep the solids in suspension. Residuals

can be pumped from the basin to either the gravity thickener or the drying beds. Under normal conditions, flow is routed to the gravity thickener. Polymer is injected into the residuals discharge line prior to the gravity thickener.

Gravity Thickener

The gravity thickener receives residuals primarily from the residuals holding basin. Alternately, residuals from the lagoons can be sent to the gravity thickener by manually opening and closing valves buried outside the Dewatering Building. Residuals settle at the bottom of the gravity thickener and the supernatant flows over the weir and flows by gravity to the filtrate pump station. Thickened residuals can be pumped to either the pressure filter press located in the Dewatering Building or to the drying beds. Under normal operations, the thickened residuals are pumped to the pressure filter press for dewatering and drying.

i. Chemical Feed Systems

The existing chemical feed systems consist of carbon, chlorine, alum, lime, ammonia, fluoride, and polymer feed systems. Normally, alum, polymer, and chlorine are added at the primary rapid mix basin while lime, fluoride, ammonia, and chlorine are added at the secondary rapid mix basin. Powdered activated carbon is fed occasionally at the primary rapid mix basin for taste and odor control.

Alum

Alum is fed at the primary rapid mix basin as a coagulant for the sedimentation process. The alum feed system was placed into operation in 1967 and consists of two 8,000 gallon storage tanks, a transfer pump, and two feeder pumps which are not working at this time. A rotodip feeder is being used instead of the feeder

pumps for feeding alum. The alum feed system is located in the Chemical Area of the Main Plant Building.

Coagulant Polymer

Polymer is introduced at the primary rapid mix basin as a coagulant aid. The coagulant polymer feed system was placed into operation in 1993 and consists of a polymer day tank and metering pump. It is located in the chemical loading area of the Main Plant Building.

Chlorine

Chlorine is introduced at both the primary and secondary rapid mix basins for disinfection. The chlorine feed system was placed into operation in 1967. Chlorine is stored in the Chlorine Storage Room of the Main Plant Building in one-ton gas cylinders. The chlorine feed system consists of primary and secondary chlorinators with backup units, a chlorine solution distribution panel, and two booster pumps. The chlorinators and the distribution panel are located in a separate room adjacent the Chlorine Storage Room. Chlorine gas is fed to the chlorinators by an automatic feed assembly located in the Chlorine Storage Room. The booster pumps are located adjacent the Chlorinator Room and feed water to the chlorinators to form a chlorine solution. From the chlorinators, the chlorine solution is fed to the primary and secondary rapid mix basin.

The Chlorine Storage Room is equipped with a two-ton monorail and a chlorine gas leak detector. The Chlorinator Room is equipped with a chlorine gas leak detection system and an exhaust system which is designed to operate when the door to the Chlorinator Room is opened. The Chlorine Storage Room does not have a scrubber, which is recommended for safety reasons and typically required by the Uniform Fire Code.

4. EXISTING FACILITIES

CBU plans to convert the disinfection system from gaseous chlorine to sodium hypochlorite, which is safer and easier to handle and store.

Powdered Activated Carbon

Powdered Activated Carbon (PAC) is introduced seasonally at the primary rapid mix basin for taste and odor control. Typically, PAC is fed only a few weeks a year in the Spring and Fall during algae blooms. The PAC feed system was placed into operation in 1967 and consists of two carbon slurry tanks, two carbon slurry mixers, and two feed pumps. The carbon slurry tanks are underground storage tanks located near the Slow Mix Building. Each tank is provided with a carbon slurry mixer which helps to keep the PAC in suspension. The two carbon feed pumps are located in the basement of the Slow Mix Building.

Lime

Lime is introduced at the secondary rapid mix basin for pH adjustment. The lime feed system was placed into operation in 1967 and consists of two lime storage tanks, two lime slakers, and two lime slurry feed pumps. The lime feed system is located in the Chemical Area of the Main Plant Building. Lime is delivered and stored in the lime storage tanks in the form of pellets. It is fed from the storage tanks to the lime slakers where it is mixed with water to form a lime slurry. The lime slurry is fed to the secondary rapid mix basin by the lime slurry booster pumps.

Lime adds turbidity to the settled water that must be removed during filtration. To meet required turbidity limits set forth in the Interim Enhanced Surface Water Treatment Rule, CBU needs to be able to adjust pH without adding turbidity. Unlike lime, sodium hydroxide does not add turbidity to the settled water. Therefore, CBU plans to switch to sodium hydroxide, which is easier to handle and more effective than lime.

Fluoride

Fluoride is introduced in the form of hydrofluorosilicic acid at the secondary rapid mix basin for tooth enamel protection. The fluoride system was placed into operation in 1981 and consists of an outdoor 5,800 gallon storage tank, 55 gallon day tank, and metering pump. The fluoride storage tank is located on the south side of the Filter Building adjacent the ammonia tank. The fluoride day tank and metering pump are located in the southwest corner on the operating floor of the Filter Building. The hydrofluorosilicic acid flows by gravity to the day tank and is pumped to the chemical feed box of the secondary rapid mix basin by the fluoride metering pump.

Ammonia

Ammonia is introduced at the secondary rapid mix basin with chlorine solution to form chloramines for disinfection purposes. The ammonia feed system was placed into operation in 1982 and consists of an anhydrous ammonia storage tank, remote vacuum ammoniator, and vacuum regulator check unit. Ammonia gas is contained in a 1,000 gallon storage tank located on the south side of the Filter Building. The vacuum regulator check unit and ammoniator are located inside the Filter Building near the chemical feed box for the secondary rapid mix basin. Ammonia gas mixes with water in the ammoniator to form an ammonia solution which is fed to the secondary rapid mix basin and mixed with chlorine to form chloramines.

j. Electrical

Cinergy Corporation provides electrical power service to the Monroe WTP. Power to the plant is supplied at 2.4 kV, 3 phase, 60 hertz. The WTP has an on-site Cinergy substation that receives electrical power from either Cinergy's Smith Road Substation or the Rogers Street Substation via the Cinergy power transmission line system. Cinergy can manually select either substation to feed

the WTP.

The WTP has a standby engine generator that is capable of powering one of the high service pumps and one of the transfer pumps and all the remaining electrical loads at the treatment facility at any time. The generator is connected to an existing 2.4 kV motor control lineup inside the Filter Building.

C. DISTRIBUTION SYSTEM

1. Service Levels

Service levels in a distribution system are necessary to prevent extremes of high or low pressures where large differences in ground elevation exist. Bloomington is divided into three service levels. The current boundaries of the South, Central, and West service levels are shown on Figure 4-2. Ground elevations within the South service level are below 730 feet (USGS datum). Ground elevations in the Central service level range between 730 and 888 feet. Elevations in the West service level are above 850 feet.

4. EXISTING FACILITIES

Fig 4-2

4. EXISTING FACILITIES

The static hydraulic grade line (HGL) elevation for each of the service levels is established by the maximum normal operating water level in storage facilities in each service level. Service level boundaries are established to maintain acceptable distribution system pressures. The boundaries should have sufficient flexibility to allow minor modifications to provide adequate service, particularly at higher elevations and in developing areas.

2. Pump Stations

The total installed and firm capacities for the CBU pumping stations are summarized in Table 4-3. Firm capacity represents the hydraulic capacity with the largest pump out of service.

Table 4-3
Distribution System Pump Stations

Service Level	Pump Station	No. of Pumps	Capacity, mgd	
			Installed	Firm[a]
Central	South-Central	5	30	24
	Gentry	2	2.88	1.44
	Linglebach (IU)	4	4.2	2
West	West	3	11.3	7.2
	Southwest	3	6	4

a. Firm capacity for a pump station is based on the largest pump out of service.

a. South-Central Pump Station. The South-Central pump station is located adjacent to the CBU Service Center on Henderson Street and receives water from the 1.0 MG South tank, the 3.0 MG South tank, and the Monroe WTP transmission main. This pump station conveys water from the South service level to the Central service level, and fills the East, Red Bud, and Dyer tanks. Since water use in the South service level is relatively low, the majority of water produced at the plant is pumped to the Central service level. Currently, the

4. EXISTING FACILITIES

South-Central pump station is the only means of water supply for the Central service level with nearly all water supply for the Bloomington and surrounding areas passing through this pump station. One pump is on-line at all times. The operating sequence of the pumps is changed frequently so that running hours are distributed evenly. The South-Central pump station is equipped with four constant-speed pumps and one variable speed pump as shown in Table 4-4.

Table 4-4
South-Central Pump Station

Pump No.[a]	Installation Date[b]	Manufacturer	Nominal Capacity		Head, feet	Motor Hp
			gpm	mgd		
1	1999	Layne	4,200	6	140	250
2	1999	Layne	4,200	6	140	250
3	1999	Layne	4,200	6	140	250
4	1975	Worthington	4,200	6	140	200
5	1975	Worthington	4,200	6	140	200

a. One of the pumps is equipped with a variable speed drive.
b. After pump and motor refurbishing

4. EXISTING FACILITIES

South-Central Pump Station

Power supply to the South-Central pump station comes from two separate feeders. The pump station also has a standby engine generator to provide power during an outage. The pump station is monitored continuously with the starting and stopping of pumps initiated by operators at the CBU service center.

b. Gentry Pump Station. There is a small booster district in the Park Ridge/ Gentry Estates/Eastern Heights area, which receives water from the Central service level through a small package pump station. The Gentry pump station consists of two pumps, each with a rated capacity of 1,000 gpm at 140 feet of head. One pump is on-line at all times.

4. EXISTING FACILITIES

Gentry Pump Station

c. Linglebach Pump Station. Indiana University has a boosted zone in the area around the Redbud tank. This zone is supplied by the Linglebach pump station. The zone provides water to the fraternities on North Jordan, the Foster Quadrangle, the Briscow Quadrangle, Redbud Apartments, and other Indiana University housing. The Linglebach pump station is equipped with four constant-speed pumps as shown in Table 4-5.

4. EXISTING FACILITIES

Table 4-5 Linglebach Pump Station						
Pump No.	Installation Date	Manufacturer	Nominal Capacity		Head, feet	Motor Hp
			gpm	mgd		
1	2001	Cornell	150	0.2	140	10
2	2001	Cornell	600	0.9	140	40
3	2001	Cornell	600	0.9	140	40
4	2001	Cornell	1,500	2.2	140	75

Linglebach Pump Station

d. West Pump Station. The West pump station, located near the intersection of Monroe Street and 17th Street, conveys water from the Central service level to the West service level. The station receives water from the Dyer tank, which acts as a dedicated wetwell, and pumps to customers in the West service level or to

4. EXISTING FACILITIES

the West tank and Southwest tank. The station contains two constant speed 3.6 mgd pumps, and one 4.1 mgd variable speed pump. Pump operation is controlled automatically by the water level in the West tank. Pertinent data for the three pumps are listed in Table 4-6.

Table 4-6
West Pump Station

Pump No.	Installation Date	Manufacturer	Nominal Capacity		Head, feet	Motor Hp
			Gpm	mgd		
1	1967	Worthington	2,500	3.6	130	200
2	1967	Worthington	2,500	3.6	130	200
3[a]	1992	Peerless Pump	2,850	4.1	150	150

a. Variable speed pump

West Pump Station

4. EXISTING FACILITIES

The West pump station is not operated on a continuous basis. It is operated alternatively with the Southwest pump station. Pump control is automatically initiated based on the water level in the West tank. The variable speed pump is always the first in the sequence of operation.

e. Southwest Pump Station. The Southwest pump station, located near the intersection of West Tapp Road and Adams Street, pumps water from the Central service level to the West service level. The station provides redundant capacity to that of the West pump station. The station contains three constant speed 2 mgd pumps. Pump operation is controlled automatically by the water level in the Southwest tank. Pertinent data for the three pumps are listed in Table 4-7.

Table 4-7
Southwest Pump Station

Pump No.	Installation Date	Manufacturer	Nominal Capacity		Head, feet	Motor Hp
			Gpm	mgd		
1	1995	Cornell	1,390	2	105	100
2	1995	Cornell	1,390	2	105	100
3	1995	Cornell	1,390	2	105	100

4. EXISTING FACILITIES

Southwest Pump Station

3. Storage Facilities

Storage facilities are used to store water at system pressure and to supplement high service pumping during maximum hour or fire flow conditions. The stored water is available during emergencies resulting from power outages, equipment failures, or transmission line breaks. With the exception of the 5.0 MG Finished Water Reservoir at the Monroe WTP, the storage facilities in the CBU service area consist of steel ground and standpipe tanks. The total system storage capacity is about 21.5 million gallons. Information on the facilities is presented in Table 4-8.

4. EXISTING FACILITIES

Table 4-8 Storage Facilities								
Service Level	Storage Facility	Type	Date in Service	Capacity, MG	Side Water Depth, feet	Diameter, feet	Elevation, feet	
							Base	Overflow
South	South	Ground	1967	1.0	40	66	820	860
	South	Ground	2001	3.0	40	113	820	860
Central	Dyer	Ground	1954	2.0	60	74	876	936
	East	Standpipe	1967	1.5	80	57	876	956
	Red Bud	Ground	1974	4.7	68	110	888	956
West	West	Standpipe	1966	2.0	93	62	937	1030
	Southwest	Standpipe	1995	2.0	84	64	946	1030

South Service Level

1.0 MG South Tank

3.0 MG South Tank

4. EXISTING FACILITIES

Central Service Level

2.0 MG Dyer Tank

1.5 MG East Tank

4.7 MG Redbud Tank

4. EXISTING FACILITIES

West Service Level

2.0 MG West Tank

2.0 MG Southwest Tank

4. Distribution Mains

The CBU distribution system is composed of mains ranging in size from 2 to 48 inches in diameter. Information on distribution water mains was obtained from the City of Bloomington Utilities. At the time of data collection, the total length of pipelines, greater than 2 inches in diameter, in the distribution system was approximately 365 miles. It is recognized this figure is rapidly changing as CBU continues to expand the system and construct new mains. Table 4-9 presents a breakdown for the lengths of pipe based on diameter. Pipe materials include cast and ductile iron, pre-stressed concrete cylinder pipe, polyvinyl chloride (PVC), polyethylene, galvanized and steel.

4. EXISTING FACILITIES

Table 4-9 Length of Existing Water Distribution Mains	
Diameter, inches	**Length, miles**
2	12
3	0.3
4	20.1
6	160.4
8	50.2
10	4.2
12	67.8
14	1.2
16	7.7
18	4.6
20	16.6
24	11.8
30	0.1
36	8.6
48	0.1
Total	**365.7**

5. REGULATORY CONSIDERATIONS

A. GENERAL

CBU's proposed new water treatment plant or expansion of the existing Monroe WTP will be designed and constructed during a period of rapid and unprecedented changes within the water industry. These changes are being driven by new regulations implemented in response to federal legislation; by the introduction of new water treatment processes, which have expanded many utilities' capabilities to meet specific treatment requirements; and by rising consumer expectations regarding the quality of their water supplies.

This chapter presents a detailed discussion of the current, impending and anticipated future drinking water regulations which may affect design and operation of the proposed new treatment facilities. At the end of this section is a summary of CBU's Monroe WTP compliance and compliance considerations for the proposed new treatment facilities.

One of the major challenges to be faced by water utilities in complying with these regulatory standards will involve "balancing" the particular requirements of different rules such that complying with one regulation does not result in violating a different regulation. As an example, water must be disinfected, but disinfecting chemicals might produce undesirable disinfection byproducts. Recent public health incidents in several large cities (most notably Milwaukee, Wisconsin) which were attributed to the presence of the protozoan parasite *Cryptosporidium* have served to heighten public awareness regarding the quality of drinking water supplies. Under impending and proposed future rules, removal requirements for *Cryptosporidium* have been promulgated, and additional requirements for inactivation of these pathogens are considered likely. Other recently enacted regulations reduce the allowable concentrations of trihalomethanes and haloacetic acids (by-products of disinfection using chlorine) in the treated water. Thus, utilities will be faced with reducing the concentrations of disinfection by-products, while at the same time increasing the removal and inactivation of *Cryptosporidium.*

5. REGULATORY CONSIDERATIONS

The first national regulatory standards for drinking water quality were established by the U.S. Public Health Service in 1914. The standards were revised in 1925, 1942, 1946, and 1962. In 1974, the Safe Drinking Water Act (SDWA) transferred responsibility for public water supplies to the U. S. Environmental Protection Agency (EPA). EPA later revised the SDWA to regulate a broad spectrum of contaminants. This section discusses current, pending, and anticipated future drinking water regulations.

B. CURRENT REGULATIONS

1. Safe Drinking Water Act of 1974

The Safe Drinking Water Act was promulgated in 1974. It mandated that National Primary Drinking Water Regulations be established for a number of chemical, physical, and biological contaminants. The regulations set maximum contaminant levels (MCLs) for individual contaminants and identified treatment technologies that could be used to remove the contaminants.

Following passage of this law, EPA promulgated National Interim Primary Drinking Water Regulations, which became effective in June 1977. These regulations established MCLs for ten inorganic chemicals, six organic chemicals, two radioactive categories, turbidity, and coliforms. In 1979, an MCL for trihalomethanes of 0.10 mg/L was added, and in April 1986, EPA promulgated an MCL for fluoride of 4.0 mg/L, and a Secondary MCL (SMCL) of 2.0 mg/L. While the fluoride SMCL is not a federally enforceable standard, individual State Regulatory Agencies are free to make the SMCL mandatory for public water supplies. However, EPA requires water systems which exceed the SMCL to notify their consumers.

5. REGULATORY CONSIDERATIONS

2. 1986 Amendments to the Safe Drinking Water Act

In June 1986, Congress passed comprehensive Amendments to the SDWA which have affected the operation of virtually every public water system in the United States. The Amendments empowered EPA to set enforceable standards for contaminants in drinking water based on the degree of removal that could be achieved using the "best available technology". EPA was also granted enforcement powers through the use of administrative orders. Thus, EPA is no longer limited to the legal system in its efforts to correct deficiencies in water supply systems.

The Amendments required EPA to initially develop regulations for 83 contaminants. Additional contaminants were to be added every three years, although the subsequent 1996 Amendments modified this requirement. Specific aspects of several existing regulations promulgated under the 1986 SDWA Amendments are discussed below.

a. Surface Water Treatment Rule. The Surface Water Treatment Rule (SWTR) pertains to utilities which use surface water sources or groundwater sources "under the direct influence of surface water". Major provisions of the SWTR are as follows:

- Filtered water turbidity is to be equal to or less than 0.5 NTU in 95 percent of the monthly samples collected. The maximum allowable interval between turbidity measurements is four hours.

- The disinfectant concentration in the water entering the distribution system must be at least 0.2 mg/L

- The disinfectant residual within the distribution system must be "detectable" in at least 95 percent of the monthly monitoring samples.

5. REGULATORY CONSIDERATIONS

- Removal and/or inactivation of *Giardia* cysts must be at least 3.0 logs (99.9 percent), and removal and/or inactivation of enteric viruses must be at least 4.0 logs (99.99 percent).

b. Lead and Copper Rule. The Lead and Copper Rule, promulgated during May 1991, establishes "Action Levels" for lead and copper. Based on first-draw samples collected at taps within the distribution system, lead and copper concentrations must be less than 0.015 mg/L and 1.3 mg/L, respectively, in ninety percent of the samples. Selected sample sites must consist of single-family residences which contain copper pipes with lead solder installed after 1982, which contain lead pipes, or which are served by a lead service line. Following implementation of state-specified "optimal" treatment to minimize lead and copper concentrations at consumer taps, annual follow-up monitoring is required. If the results of follow-up monitoring indicated that the system is consistently in compliance with the lead and copper Action Levels, the state may elect to reduce the annual monitoring requirements. Should follow-up monitoring indicate noncompliance, the utility is required to initiate a public education program, collect additional water quality samples, and possibly begin a program of replacing lead service lines.

c. Phase II, Phase V SOC/IOC Regulations. The Phase II regulation for synthetic organic chemicals (SOCs) and inorganic chemicals (IOCs) lists MCLs and Maximum Contaminant Level Goals (MCLGs) for 30 SOCs and 9 IOCs. Establishment of limits for three Phase II SOCs (aldicarb, aldicarb sulfone, and aldicarb sulfoxide) has been delayed. (A final rule for aldicarb is not expected to be promulgated until August 2005.) The Phase V regulation lists MCLs and MCLGs for an additional 23 contaminants (18 SOCs and 5 IOCs). The MCL and MCLG for nickel included in the Phase V regulation were remanded by the US District Court during February 1995. Therefore, while utilities must continue to monitor for nickel in their treated water supplies, there currently is no EPA legal limit on the amount of nickel in drinking water supplies. Contaminants regulated

under the Phase II and Phase V regulations are primarily volatile organic compounds and pesticides/herbicides.

d. Total Coliform Rule. During June 1989, EPA promulgated revisions to the current regulation governing total coliform levels in water distribution systems. The revised rule expands current coliform monitoring requirements and specifies new MCLs. Compliance with the monthly MCL under the Coliform Rule is determined based on the presence or absence of coliform organisms. The Coliform Rule allows for up to 5 percent of the monthly water quality samples collected within the distribution system to test positive for coliforms. Fecal or *Escherichia* coliform levels are to be monitored for each sample where the presence of total coliforms is indicated. Public notification by electronic media (TV or radio) is required within 72 hours if a positive result indicates the presence of either fecal or *Escherichia* coliforms.

EPA subsequently modified the Total Coliform Rule to allow states to use a variance procedure for utilities encountering nonfecal biofilm problems in their distribution systems. Some coliform species, which are not classified as fecal, produce positive analytical results in total coliform and fecal coliform tests. Under the revised rule, states are allowed to disregard any coliform-positive analytical results that are speciated and not found to be of fecal origin.

3. 1996 Amendments to the Safe Drinking Water Act

The Safe Drinking Water Act was further amended in 1996, primarily to:

- Strengthen preventive approaches such as protecting source waters and providing operator certification.

- Provide consumers with more and better information about their water systems.

- Implement regulatory improvements regarding contaminant selection, cost-benefits, and application of regulations to small systems.

- Establish a Drinking Water State Revolving Fund to assist communities in installing and upgrading drinking water treatment facilities.

Under the 1986 SDWA Amendments, utilities typically were allowed 18 months to comply with new regulations following final promulgation. The 1996 Amendments extend the compliance period following promulgation to three years; EPA or individual states may grant an additional 2 years if necessary to implement significant capital improvements. The 1996 Amendments establish specific schedules for promulgation of new regulations governing disinfection by-products (DBPs), microbial contaminants, arsenic, radon, and disinfection of groundwater supplies, and require EPA and the Centers for Disease Control to conduct a joint study of the potential health impacts of sulfate in drinking water supplies.

4. Stage 1 Disinfection By-Products Rule

Stage 1 of the Disinfection By-Products Rule (DBPR) was finalized during late November 1998, and became effective during January 2002 for systems serving 10,000 or more consumers. The primary objective of this rule is to protect human health by reducing the concentrations of disinfection by-products (DBPs) in drinking water. Major provisions of the Stage 1 DBPR are as follows:

- The MCL for total trihalomethanes has been reduced to 0.080 mg/L.

- New MCLs have been established for total haloacetic acids, bromate (a by-product of disinfection using ozone), and chlorite ion (a by-product of disinfection using chlorine dioxide).

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- Maximum Residual Disinfectant Levels (MRDLs) and MRDL Goals (MRDLGs) have been established for free chlorine, chloramine, and chlorine dioxide.

- A treatment technique has been established which requires that surface water systems (or groundwater systems under direct surface water influence) operate in either an enhanced coagulation or enhanced softening mode to achieve specified removals of total organic carbon (TOC).

As stated above, under the Stage 1 DBPR, the MCL for total trihalomethanes has been reduced to 0.080 mg/L. In addition, a new MCL of 0.060 mg/L has been established for total haloacetic acids, referred to as HAA5, as 5 of the 9 known haloacetic acid compounds are regulated under the Stage 1 rule. New MCLs for bromate and chlorite ion of 0.010 mg/L and 1.0 mg/L, respectively, also have been established. Compliance with these MCLs is assessed based on the "running annual average" of quarterly monitoring data.

Under the Stage 1 DBPR, the maximum allowable disinfectant residual in the water leaving the treatment facility, based on a running annual average of monthly monitoring data, is 4.0 mg/L for free chlorine and chloramines, and 0.8 mg/L for chlorine dioxide. Higher residuals are permissible on a short-term basis if necessary to address specific water quality problems, providing that running annual average concentrations do not exceed the MRDLs.

A primary goal of the DBPR is to reduce the levels of organic/humic compounds, collectively referred to as DBP precursors, which react with chlorine-based disinfectants to form DBPs. This is to be accomplished through operation of treatment facilities in an "enhanced coagulation" or "enhanced softening" mode, which will typically involve increases in coagulant dosages and/or adjustment of operating pH to optimize the removal of the precursor compounds. Precursor removal is to be quantified by measuring the removal of TOC across the

treatment process. In general, for systems with average source water TOC concentrations exceeding 2.0 mg/L, enhanced coagulation/enhanced softening treatment will be required. Minimum TOC removal levels are summarized in Table 5-1. TOC removals must be determined monthly, and compliance is assessed quarterly based on a running annual average of monthly TOC removals.

Table 5-1
Step 1 TOC Removal Requirements
for Enhanced Coagulation/Enhanced Softening

Source Water TOC, mg/L	Percent TOC Removal Required at Indicated Source Water Alkalinity		
	0 – 60 mg/L	**>60 – 120 mg/L**	**>120 mg/L[a]**
>2.0 – 4.0	35%	25%	15%
>4.0 – 8.0	45%	35%	25%
>8.0	50%	40%	30%

a. Systems practicing softening must meet the TOC removals shown in this column.

The Stage 1 DBP rule also provides alternative compliance criteria that are independent of the criteria discussed above. Systems can be exempted from the enhanced coagulation/enhanced softening requirements if any of the following conditions are met:

- The system's source water TOC is less than 2.0 mg/L, calculated quarterly as a running annual average of monthly monitoring data.
- The system's treated water TOC is less than 2.0 mg/L, calculated quarterly as a running annual average of monthly monitoring data.

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- The system's source water TOC is less than 4.0 mg/L, the source water alkalinity is greater than 60 mg/L as $CaCO_3$, and the system is achieving TTHM concentrations less than 0.040 mg/L and HAA5 concentrations less than 0.030 mg/L.

- The system's running annual average TTHM concentration is less than 0.040 mg/L, and annual average HAA5 concentration is less than 0.030 mg/L, when only free chlorine is used for disinfection and maintenance of a residual in the distribution system. Systems using chloramines would not comply with these conditions.

- The system's source water specific UV absorbance (SUVA, defined as the ratio of the water's ultraviolet absorbance at 254 nm (UV_{254}) to its dissolved organic carbon (DOC) concentration) prior to any treatment is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average of monthly monitoring data.

- The system's finished water SUVA is less than or equal to 2.0 L/mg-m, calculated quarterly as a running annual average of monthly monitoring data. This measurement must be made prior to the addition of a chemical oxidant, which will likely be problematic for most utilities.

Systems that elect to utilize one of these alternative criteria must still conduct monthly monitoring of source water TOC and alkalinity concentrations, and treated water TOC concentrations. Systems practicing lime softening may demonstrate compliance if they meet any of the six alternative compliance criteria listed above, or one of the following criteria:

- Softening that results in a reduction in the alkalinity of the treated water to less than 60 mg/L as $CaCO_3$, measured monthly and calculated quarterly as a running annual average.

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- Softening that results in removal of at least 10 mg/L of magnesium hardness as $CaCO_3$, measured monthly and calculated quarterly as a running annual average.

Following the first 12 months of TOC removal monitoring, if a system determines that it cannot achieve the TOC removals specified in Table 5-1 on a running annual average basis, and it does not meet any of the alternative compliance criteria listed above, it will be required to perform bench-scale or pilot-scale testing to set an alternative TOC removal requirement. This is referred to as Step 2 testing. Results of this testing must be reported to the state within three months of failing to achieve the TOC removal percentages presented in Table 5-1.

Under the Stage 1 DBPR, utilities serving more than 10,000 consumers must collect four DBP samples per quarter per treatment plant, and at least 25 percent of these samples must be collected at locations which reflect maximum system residence time. The Stage 1 rule also includes provisions for reduced monitoring if the following conditions are met:

- Source water TOC concentration prior to any treatment is less than or equal to 4.0 mg/L based on a running annual average of monthly TOC data.

- The system annual average TTHM and HAA5 concentrations are less than or equal to 0.040 mg/L and 0.030 mg/L, respectively.

Systems that meet these requirements will be required to collect only one TTHM/HAA5 sample per quarter per plant at a distribution system location considered to reflect maximum residence time. Systems on a reduced monitoring schedule may remain on that schedule as long as running annual TTHM and HAA5 concentrations remain at 0.060 mg/L and 0.045 mg/L,

respectively, and the annual average source water TOC concentration remains at 4.0 mg/L or less.

5. Interim Enhanced Surface Water Treatment Rule

The Interim Enhanced Surface Water Treatment Rule (IESWTR) was finalized during late November 1998, and became effective during January 2002 for systems serving 10,000 or more consumers. The rule applies to systems using surface water, or groundwater supplies under the influence of surface water. The primary objectives of this rule are to improve the control of microbial pathogens in drinking water, particularly *Cryptosporidium*, and to guard against significant increases in microbial risk that might occur when systems implement the Stage 1 DBPR. Primary requirements of the IESWTR are as follows:

- Systems with DBP levels exceeding or approaching the Stage 1 MCLs for trihalomethanes and haloacetic acids (0.080 mg/L and 0.060 mg/L, as discussed above) may consider changing their disinfection practices in order to comply with the new limits. However, in an effort to avoid increasing the risk from microbial contaminants while attempting to lower DBPs, EPA will require systems which have annual average DBP concentrations within 80% of the new MCLs (i.e., >0.064 mg/L for TTHMs or 0.048 mg/L for HAA5) for the most recent 12-month monitoring period to prepare a “disinfection profile” for state review prior to altering disinfection practices. The disinfection profile is a compilation of daily criteria that affect the overall efficacy of the disinfection process, collected over a minimum of one year. The average level of microbial inactivation for each month is developed from the disinfection profile, and the lowest monthly average inactivation becomes the disinfection benchmark. A minimum of one year, and a maximum of three years of daily disinfection performance data must be used to develop the disinfection profile. If the State does

not approve changes in disinfection, systems must develop alternate ways of reducing DBPs to meet the new MCLs.

- For those systems that do not have four quarters of distribution system HAA5 monitoring data available, HAA5 monitoring must be conducted for four consecutive quarters and completed by March 2000.

- Allowable finished water turbidity is reduced from the present 0.5 NTU allowed under the SWTR to 0.3 NTU. This standard applies to the combined filtered water, and a minimum of 95 percent of the monthly turbidity measurements must meet the revised turbidity criteria. The turbidity of the combined filter effluent cannot exceed 1 NTU at any time. The current SWTR allows for a maximum filter effluent turbidity of 5 NTU.

- Continuous turbidity monitoring is required for each filter, and specific performance criteria will apply to each filter. Systems must record the results of individual filter turbidity monitoring at 15-minute intervals, and must maintain records of individual filter performance for a minimum of three years.

- Systems treating surface water or groundwater under direct surface water influence and serving more than 10,000 consumers must achieve at least a 2-log (99%) removal of *Cryptosporidium*. The regulation states that systems that comply with the revised turbidity requirement of 0.3 NTU are assumed to be achieving compliance with the 2-log *Cryptosporidium* removal requirement.

- States will be required to conduct sanitary surveys for all public water systems, regardless of size, no less frequently than every 3 years.

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Under the IESWTR, systems are required to provide "an exceptions report to the State on a monthly basis". Exceptions to be reported consist of the following:

- Any individual filter with a turbidity level greater than 1.0 NTU based on 2 consecutive measurements 15 minutes apart.

- Any individual filter with a turbidity level greater than 0.5 NTU at the end of the first 4 hours of operation, based on 2 consecutive measurements 15 minutes apart.

A "filter profile" is to be produced if "no obvious reason for the abnormal filter performance can be identified". Other requirements are as follows:

- If an individual filter has turbidity levels greater than 1.0 NTU, based on 2 consecutive measurements 15 minutes apart at any time in each of three consecutive months, the water system is required to conduct a self-assessment of the filter utilizing "relevant portions" of guidance issued by EPA under its Comprehensive Performance Evaluation (CPE) program.

- If an individual filter has turbidity levels greater than 2.0 NTU based on 2 consecutive measurements 15 minutes apart at any time in each of two consecutive months, the water system must arrange for a CPE to be conducted by the State or a third party approved by the State. The State will ensure that the recommendations resulting from the CPE are implemented.

Methods for conducting CPEs and individual filter performance assessments are detailed in the April 1999 EPA publication "Guidance Manual for Compliance with the Interim Enhanced Surface Water Treatment Rule: Turbidity Provisions".

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6. Consumer Confidence Reports Rule

As directed by the 1996 SDWA Amendments, all Public Water Systems serving more than 500 consumers will need to prepare annual reports (beginning no later than October 1999) to advise their users of the quality of the distributed water. The reports must contain a specific list of material such as information on the source water, an explanation of terms such as MCLs and MCLGs, data on levels of currently-regulated contaminants in the treated water, and information regarding potential health effects of the contaminants. A copy of CBU's 2002 Consumer Confidence Report is included in Appendix A.

7. Secondary MCLs

Secondary Maximum Contaminant Levels (SMCLs) for 13 contaminants were initially set in 1979. Contaminants included in these secondary regulations do not have a direct impact on consumer health; however, if present in excessive amounts, they may affect the palatability and aesthetic quality of the water. SMCLs are not federally enforceable, although state regulatory agencies may elect to promulgate enforceable MCLs for any of the contaminants included in the secondary regulations. The SMCL for fluoride was revised in 1986, and new SMCLs for aluminum and silver were added in 1991.

8. Arsenic

EPA proposed revisions to the current drinking water standard for arsenic during May 2000, and promulgated a new MCL of 0.01 mg/L during January 2001. The new MCL becomes effective 5 years after promulgation, i.e., during January 2006. Some aspects of the rule, such as monitoring and reporting requirements, will be effective prior to January 2006, but the original MCL of 0.05 mg/L will remain effective until January 2006. Utilities must begin providing health information and data on treated water arsenic concentrations in their annual

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Consumer Confidence Report by July 2002 if the water supply contains more than 0.005 mg/L of arsenic.

Considerable controversy currently surrounds the regulation of arsenic in drinking water supplies, and during March 2001, EPA announced its intention to withdraw this regulation as currently promulgated to allow further review. During July 2001, EPA requested additional comment on whether to set the new arsenic MCL at 0.003, 0.005, 0.010, or 0.020 mg/L. However, on October 31, 2001, the EPA Administrator announced that the Agency would retain the 0.01 mg/L MCL, and that the original compliance date of January 2006 would not be altered.

9. Radionuclides

Radionuclides normally present problems for systems that treat groundwater from deep wells or that are located downstream from an industrial source of radiation. A proposed rule for several radionuclides (radon, radium, alpha, beta, and photon emitters, and radium) was released in 1991, but not finalized until December 2000. This rule established a new MCL for uranium of 30 µg/L; however, EPA elected to retain the MCLs for radium and alpha, beta, and photon emitters established under the original SDWA in 1976 with no modifications. The new regulation does include separate monitoring requirements for radium-228 under the combined MCL for radium-226 and radium-228.

10. Filter Backwash Recycling Rule

The Filter Backwash Recycling Rule (FBRR) was proposed concurrently with the LT1ESWTR during April 2000, but promulgated as a separate regulation during June 2001. Provisions of the FBRR addressing in-plant recycling of waste streams apply to all systems. In addition to filter backwash flows, recycle streams covered under this regulation consist of sludge thickener supernatant, and flows associated with sludge dewatering processes. Plants practicing recycle of these streams within the treatment plant must return them to a location

such that all unit processes of a system's conventional or direct filtration process are employed in the treatment of the recycle flow. This location will typically be the plant headworks prior to the addition of coagulant. All systems that recycle these flows must submit a plant process schematic to the state regulatory agency for review by December 2003 showing the current recycle return location and the proposed return location that will be used to establish compliance. Data on typical recycle flow rates, maximum recycle flow rates, and the plant design capacity and state-approved maximum operating capacity must also be submitted to the state regulatory agency by December 2003. Systems must also collect and maintain additional information on filter operating data, recycle flow treatment provided, physical dimensions of recycle flow equalization and/or treatment units, and recycle flow rate and frequency data for review and evaluation by the state regulatory agency beginning June 2004.

Systems must comply with the recycle return provisions of the FBRR no later than June 2004. If the system requires capital improvements to modify the location of the recycle return, these improvements must be in place and operational by June 2006.

The regulation does not address recycle of filter-to-waste flows. Process solids recycle flows from lime softening and contact clarification units are also not covered by the FBRR. However, softening systems may not return spent filter backwash, thickener supernatant, or liquids from solids dewatering processes to a location that does not incorporate all unit treatment processes.

11. Summary of Current MCLs and SMCLs

Current drinking water standards, MCLs and Maximum Contaminant Level Goals (MCLGs), are summarized in Table 5-2. Table 5-2 includes only currently effective, or "enforceable" MCLs.

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Table 5-2
Current Drinking Water Standards (as of November 2002)

Contaminant	Regulation	MCL, mg/L	MCLG, mg/L
Organic substances			
Acrylamide	Phase II	Treatment Technique	Zero
Alachlor	Phase II	0.002	Zero
Atrazine	Phase II	0.003	0.003
Benzene	Phase I	0.005	Zero
Benzo(a)pyrene	Phase V	0.0002	Zero
Carbofuran	Phase II	0.04	0.04
Carbon tetrachloride	Phase I	0.005	Zero
Chlordane	Phase II	0.002	Zero
2,4-D	Phase II	0.07	0.07
Dalapon	Phase V	0.2	0.2
Di(2-ethylhexyl) adipate	Phase V	0.4	0.4
Di(2-ethylhexyl) phthalate	Phase V	0.006	Zero
Dibromochloropropane (DBCP)	Phase II	0.0002	Zero
p-dichlorobenzene	Phase I	0.075	0.075
o-dichlorobenzene	Phase II	0.6	0.6
1,2-dichloroethane	Phase I	0.005	Zero
1,1-dichloroethylene	Phase I	0.007	0.007
cis-1,2-dichloroethylene	Phase II	0.07	0.07
Trans-1,2-dichloroethylene	Phase II	0.1	0.1
Dichloromethane (methylene chloride)	Phase V	0.005	Zero
1,2-dichloropropane	Phase II	0.005	Zero
Dinoseb	Phase V	0.007	0.007
Diquat	Phase V	0.02	0.02
Endothall	Phase V	0.1	0.1
Endrin	Phase V	0.002	0.002
Epichlorohydrin	Phase II	Treatment Technique	Zero
Ethylbenzene	Phase II	0.7	0.7
Ethylene dibromide	Phase II	0.00005	Zero
Glyphosate	Phase V	0.7	0.7
Haloacetic Acids (total)	Stage 1 DBPR	0.060	-
Heptachlor	Phase II	0.0004	Zero
Heptachlor epoxide	Phase II	0.0002	Zero
Hexachlorobenzene	Phase V	0.001	Zero
Hexachlorocyclopentadiene	Phase V	0.05	0.05
Lindane	Phase II	0.0002	0.0002
Methoxychlor	Phase II	0.04	0.04
Monochlorobenzene	Phase II	0.1	0.1
Oxamyl (vydate)	Phase V	0.2	0.2

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Table 5-2
Current Drinking Water Standards (as of November 2002)

Contaminant	Regulation	MCL, mg/L	MCLG, mg/L
Pentachlorophenol	Phase II	0.001	Zero
Picloram	Phase V	0.5	0.5
Polychlorinated byphenols	Phase II	0.0005	Zero
Simazine	Phase V	0.004	0.004
Styrene	Phase II	0.1	0.1
2,3,7,8-TCDD (dioxin)	Phase V	3×10^{-8}	Zero
Tetrachloroethylene	Phase II	0.005	Zero
Toluene	Phase II	1	1
Toxaphene	Phase II	0.003	Zero
2,4,5-TP (silvex)	Phase II	0.05	0.05
1,2,4-trichlorobenzene	Phase V	0.07	0.07
1,1,1-trichloroethane	Phase I	0.2	0.20
1,1,2-trichloroethane	Phase V	0.005	0.003
Trichloroethylene	Phase I	0.005	Zero
Trihalomethanes (total)	Stage 1 DBPR	0.080	NA
Vinyl chloride	Phase I	0.002	Zero
Xylenes (total)	Phase II	10	10
Inorganic Substances			
Antimony	Phase V	0.006	0.006
Arsenic	Interim	0.05	NA
Asbestos (fibers/L > 10 um)	Phase II	7 million	7 million
Barium	Phase II	2	2
Beryllium	Phase V	0.004	0.004
Bromate	Stage 1 DBPR	0.010	Zero
Cadmium	Phase II	0.005	0.005
Chlorite	Stage 1 DBPR	1.0	0.8
Chromium (total)	Phase II	0.1	0.1
Copper	LCR	Treatment Technique	1.3
Cyanide	Phase V	0.2	0.2
Fluoride	-	4	4
Lead	LCR	Treatment Technique	Zero
Mercury	Phase II	0.002	0.002
Nitrate (as N)	Phase II	10	10
Nitrite (as N)	Phase II	1	1
Nitrate + Nitrite (both as N)	Phase II	10	10
Selenium	Phase II	0.05	0.05
Thallium	Phase V	0.002	0.0005

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Table 5-2
Current Drinking Water Standards (as of November 2002)

Contaminant	Regulation	MCL, mg/L	MCLG, mg/L
Radionuclides			
Beta-particle and photon emitters	Interim	4 mrem	Zero
Alpha emitters	Interim	15 pCi/L	Zero
Radium 226 + 228	Interim	5 pCi/L	Zero
Microorganisms			
Cryptosporidium	IESWTR	2-log Removal	Zero
Escherichia coli	TCR	Treatment Technique	Zero
Fecal coliforms	TCR	Treatment Technique	Zero
Giardia lamblia	SWTR	Treatment Technique	Zero
Heterotrophic bacteria	SWTR	Treatment Technique	NA
Legionella	SWTR	Treatment Technique	Zero
Total coliforms	TCR	(a)	Zero
Turbidity	SWTR	0.3[b]	NA
Viruses	SWTR	Treatment Technique	Zero

a. No more than 5 percent of monthly samples may be positive for presence of coliforms.
b. Performance standard; no more than 5 percent of monthly samples may exceed 0.3 NTU.
DBPR = Disinfection By-Products Rule
IESWTR = Interim Enhanced Surface Water Treatment Rule
LCR = Lead and Copper Rule
SWTR = Surface Water Treatment Rule
TCR = Total Coliform Rule

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Current Secondary Maximum Contaminant Levels are summarized in Table 5-3.

Table 5-3
Current Secondary Drinking Water Standards

Contaminant	SMCL
Aluminum	0.05 - 0.2 mg/L
Chloride	250 mg/L
Color	15 Color Units
Copper	1.0 mg/L
Corrosivity	Non-corrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 Threshold Odor Units
PH	6.5 – 8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

C. PENDING REGULATIONS

1. Stage 2 Disinfection By-Products Rule

As part of the 1996 amendments to the SDWA, Congress established deadlines for promulgation of new regulations governing both disinfection by-products and microbial contaminants. These deadlines include a requirement that EPA promulgate a Stage 2 regulation for disinfection by-products, and a Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR, as discussed in the following section of this document) by May 2002. These two rules are closely related, and are referred to collectively as the Stage 2 M-DBP. The Advisory

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Committee convened by EPA during early 1999 to develop recommendations for implementation of these regulations reached consensus during September 2000 on an agreement to be presented to EPA. The "Stage 2 M-DBP Agreement in Principle" summarizes the committee's recommendations for implementation of these rules, and will be the basis for EPA's development of the Stage 2 DBPR and the LT2ESWTR. A draft version of the proposed Stage 2 DBPR was made available for comment during November 2001. These two regulations are currently scheduled to be proposed during June 2003 and promulgated during October 2004. The Stage 2 DBPR requirements will apply to all community water systems and non-transient non-community water systems that add a disinfectant other than UV or deliver water that has been disinfected. Key points pertaining to the Stage 2 DBPR are summarized below.

Review of disinfection by-products occurrence data obtained under the Information Collection Rule suggests that many systems have been achieving compliance with the original TTHM regulation by selecting quarterly monitoring dates to obtain samples that may not be representative of the actual variations in DBP formation that occur throughout the year. This was often accomplished by avoiding monitoring when water temperatures are warmest and when DBP formation rates are highest. The Advisory Committee has therefore developed recommendations regarding appropriate monitoring intervals to correct this problem under the Stage 2 rule. The Stage 2 MCLs would remain at the levels established under the Stage 1 rule, i.e., TTHMs=0.080 mg/L and HAA5=0.060 mg/L. However, monitoring procedures and schedules would be modified to ensure that the data obtained more closely represent actual long-term exposure conditions. Initial compliance efforts will focus on identifying points within the system where DBP concentrations are typically highest, and would involve the following:

- For systems serving 10,000 or more consumers; one year of monitoring of TTHM and HAA5 concentrations at 60-day intervals (±3 days) at eight additional locations within the distribution system. Systems served by more than one treatment facility would be required

to monitor at eight locations per treatment plant. For systems that maintain a free chlorine residual within the distribution system, the eight monitoring sites per plant would consist of (1) one sample near the distribution system entry point, (2) two sites considered to reflect "average" system DBP concentrations, and (3) five sites considered to reflect "maximum" system DBP concentrations. For systems that maintain a chloramine residual within the distribution system, the eight monitoring sites per plant would consist of (1) two samples near the distribution system entry point, (2) two sites considered to reflect "average" system DBP concentrations, and (3) four sites considered to reflect "maximum" system DBP concentrations. This monitoring, referred to in the draft proposed regulation as the Initial Distribution System Evaluation (IDSE) monitoring study, would be conducted in addition to the quarterly compliance monitoring conducted under the current TTHM regulation and the impending Stage 1 DBPR. A report summarizing the IDSE monitoring results must be submitted to the State/Primacy Agency within two years of promulgation of the Stage 2 DBPR. The draft proposed rule includes provisions for exemption from IDSE monitoring requirements, based on low historical system DBP concentrations.

- Following completion of the IDSE, systems will recommend new or revised monitoring sites to their State/Primacy Agency based on their ISDE study. Monitoring site locations (four per system if served by a single treatment plant; four per system per plant if served by multiple treatment plants) are to be selected as follows:

  - One location representative of average conditions from among current Stage 1 DBPR monitoring locations.

  - One location representative of highest HAA5 concentrations identified under the IDSE.

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- Two locations representative of highest TTHM concentrations identified under the IDSE.

Quarterly monitoring of DBP concentrations at four locations per plant within the distribution system would continue to be conducted for compliance monitoring purposes. At least one quarterly monitoring period would be required to reflect "peak historical" DBP formation level periods, and systems will be required to monitor on a regular schedule of approximately every 90 days. MCL compliance will be determined based on a "Locational Running Annual Average" (LRAA) basis, i.e., a running annual average must be calculated at each monitoring location. Systems will be required to comply with the Stage 2 MCLs in two phases:

- 3 years after promulgation, all systems must comply with locational running annual average MCLs of 0.120 mg/L for TTHMs and 0.100 mg/L for HAA5 at current Stage 1 DBPR monitoring sites, while continuing to comply with the Stage 1 MCLs of 0.080 mg/L for TTHMs and 0.060 mg/L for HAA5. These are currently being referred to as "Stage 2A" requirements.

- 6 years after promulgation, with an additional two-year extension available if capital improvements are required, large and medium-sized systems must comply with locational running annual average MCLs of 0.080 mg/L for TTHMs and 0.060 mg/L for HAA5 at the approved sampling locations identified under the IDSE. These are currently being referred to as "Stage 2B" requirements.

Should an MCL be exceeded at one or more system monitoring points based on annual running average DBP concentrations, the system would be considered to be in violation of the Stage 2 regulation, regardless of results for the remaining monitoring sites. This represents a major change from current TTHM and

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Stage 1 DBP regulations, as the "system averaging" concept would be eliminated under the Stage 2 regulation.

During Stage 2A, systems that maintain system running annual average TTHM and HAA5 concentrations of less than or equal to 0.040 mg/L and 0.030 mg/L, respectively, may reduce quarterly monitoring frequency for TTHMs and HAA5 to one sample per treatment plant at a site representative of maximum system residence time. Systems on a reduced monitoring schedule may remain on that reduced schedule as long as running annual average TTHM and HAA5 concentrations for all samples collected are no more than 0.060 mg/L and 0.045 mg/L, respectively. During Stage 2B, systems that have completed one year of routine monitoring at IDSE sites, and that exhibit TTHM and HAA5 locational running annual average concentrations of no more than 0.040 mg/L and 0.030 mg/L, respectively, and annual average source water TOC levels of 4.0 mg/L or less will be allowed to reduce the number of DBP samples collected to two per quarter per treatment plant. For each quarterly sample pair, one sample would need to be collected at a location reflecting maximum TTHM levels, while the remaining sample would need to be collected at a location reflecting maximum HAA5 levels.

The Advisory Committee also recommended that systems review peaks in TTHM and HAA5 concentrations that may occur in their distribution systems as part of the sanitary survey process, and EPA has adopted this recommendation in the draft proposed Stage 2 DBPR. EPA defines a peak as any individual sample with a TTHM concentration of 0.100 mg/L or greater, and/or with an HAA5 concentration of 0.075 mg/L or greater (these values exceed the Stage 2 MCLs by 25 percent). Utilities experiencing these peaks would be required to work with their state primacy agencies to reduce the severity of these excursions; EPA will be preparing guidance for systems and State primacy agencies on how to conduct peak excursion evaluations and how to reduce peaks.

5. REGULATORY CONSIDERATIONS

The following is proposed by EPA in the draft Stage 2 DBPR as Best Available Technology (BAT) for compliance with the LRAA MCLs when free chlorine is used as the primary and secondary (system residual) disinfectant:

- GAC adsorbers with at least 10 minutes of empty bed contact time and an annual average carbon reactivation/replacement frequency no greater than 120 days.

- GAC adsorbers with at least 20 minutes of empty bed contact time and an annual average carbon reactivation/replacement frequency no greater than 240 days.

- Nanofiltration using a membrane with a molecular weight cutoff of 1000 Dalton or less or demonstrated to reject at least 80% of the influent TOC concentration under typical operating conditions.

Considerable pressure to reduce the Stage 1 MCL for bromate to 0.005 mg/L or less currently exists, as ongoing research suggests that this contaminant may be more carcinogenic than originally believed. This change would primarily impact utilities practicing ozonation for primary disinfection and/or utilities that employ high dosages of sodium hypochlorite. However, the draft proposed Stage 2 DBPR recommends that the MCL for bromate remain at the current value of 0.010 mg/L. As recommended by the Advisory Committee, EPA would review the bromate MCL as part of the 6-year regulatory review process required under the Safe Drinking Water Act to determine whether the MCL should remain at 0.010 mg/L or be reduced to 0.005 mg/L or lower.

2. Long-Term Enhanced Surface Water Treatment Rule

A long-term Enhanced Surface Water Treatment Rule which extends the IESWTR requirements to systems serving less than 10,000 consumers was promulgated during January 2002 and will become effective during January

2005. This regulation is referred to as the Stage 1 Long-Term Enhanced Surface Water Treatment Rule, or LT1ESWTR.

A long-term Stage 2 ESWTR, currently being referred to as the LT2ESWTR, is expected to be promulgated during October 2004. This rule will apply to all public water systems that use surface water or groundwater under the direct influence of surface water. Recommendations presented in the Stage 2 M-DBP Agreement in Principle and a subsequent November 2001 draft proposed rule include an initial period of raw water microbial monitoring, with treatment requirements established based on microbial contaminant levels present in the supply. Utilities serving 10,000 or more consumers and practicing "conventional treatment" (coagulation, sedimentation, and filtration) would be required to conduct monthly monitoring of the raw water supply for *Cryptosporidium* (using EPA Method 1622/23 with minimum 10L samples), *E. coli*, and turbidity over a 24-month period. Specific regulatory compliance requirements would then be established based on the following:

- If monthly samples are collected, classification is to be based on the highest 12-month running annual average.

- If the system conducts monitoring twice per month, classification is to be based on a 2-year mean value of all monitoring data. This increased monitoring must be conducted at evenly distributed time intervals over the 2-year period.

Systems serving 10,000 or more consumers must complete this monitoring and submit a report summarizing the monitoring results to their State/Primacy Agency within two and one half years of promulgation of this regulation. Additional treatment requirements under the LT2ESWTR, based on average raw water *Cryptosporidium* oocyst concentrations, are summarized in Table 5-4.

5. REGULATORY CONSIDERATIONS

Table 5-4 *Cryptosporidium* Treatment Requirements under LT2ESWTR	
Raw Water *Cryptosporidium* Concentration, oocysts per Liter[a]	**Additional Treatment Required for Conventional Treatment Systems in Full Compliance with IESWTR**
Cryptosporidium < 0.075/L	No action required
0.075/L ≤ *Cryptosporidium* <1.0/L	1-log treatment[b]
1.0/L ≤ *Cryptosporidium* <3.0/L	2-log treatment[c]
Cryptosporidium ≥ 3.0/L	2.5-log treatment[c]

a. Based on maximum value for 12-month running annual average, or 2-year mean if twice-monthly monitoring is conducted.
b. Systems may use any combination of technologies to achieve 1-log credit.
c. Systems must achieve at least 1.0-log of total treatment requirement using ozone, chlorine dioxide, UV, membranes, bag/cartridge filters, or in-bank filtration.

Under the recommendations presented in the Agreement in Principle, systems would chose technologies to comply with additional treatment requirements from a “toolbox” of options, including improved watershed control, improved treatment system and/or disinfection performance, and additional treatment barriers. Specific “tools” identified, and associated log treatment credits, as presented in the November 2001 pre-proposal draft rule, are summarized in Table 5-5. It is emphasized that EPA has requested comment on the proposed log credits presented in Table 5-5, and may modify assigned credits in the final rule based on comments received.

5. REGULATORY CONSIDERATIONS

Table 5-5
Microbial Toolbox Options, Log Credits, and Design/Implementation Criteria

Toolbox Option	Proposed *Cryptosporidium* Log Credit
Watershed Control Program	0.5-log credit for State-approved program comprising EPA specified elements; Potential for additional credit based on *Cryptosporidium* reduction demonstrated through monitoring.
Alternative Source/Intake Management	No presumptive credit. Systems may be assigned to a lower bin based on *Cryptosporidium* monitoring at new intake location. Re-binning would occur after system begins using new intake location.
Off-Stream Raw Water Storage[a]	0.5-log credit for reservoir with hydraulic residence time (HRT) of at least 21 days: 1.0-log credit for reservoir with HRT of a least 60 days.
Presedimentation Basin[a]	0.5-log credit with continuous operation and coagulant addition. Max loading rate of 1.6 gpm/ft^2, mean influent turbidity ≥ 10 NTU or max influent turbidity ≥ 100 NTU.
Lime Softening	0.5-log credit for second stage softening with coagulant addition.
Bank Filtration[a]	0.5-log credit for 25 ft. setback; 1.0-log credit for 50 ft. setback.
Lower Finished Water Turbidity	0.5-log credit for combined filter effluent turbidity ≤ 0.15 NTU in 95% of samples each month. 1.0-log credit for individual filter effluent turbidity ≤ 0.15 NTU in 95% of samples each month.
Slow Sand Filters	2.5-log credit as add-on technology.
Second Stage Filtration	0.5-log credit for second separate filtration stage in treatment process.
Membranes (MF, UF, NF, RO)	Log credit equivalent to removal efficiency demonstrated in challenge test for device if supported by direct integrity testing.
Bag Filters	1-log credit with demonstration of at least 2-log removal efficiency in challenge test; State may award greater credit.
Cartridge Filters	2-log credit with demonstration of at least 3-log removal efficiency in challenge test; State may award greater credit.
Chlorine Dioxide	Log credit based on demonstration of compliance with CT table or alternative values approved by State.
Ozone	Log credit based on demonstration of compliance with CT table or alternative values approved by State.
UV	Log credit based on demonstration of compliance with UV dose table or alternative values approved by State.
Demonstration of Performance	1.0-log credit if average spore removal ≥ 4-log based on one year of weekly monitoring.

a. Credit available only if source water *Cryptosporidium* monitoring conducted prior to Option.

5. REGULATORY CONSIDERATIONS

Four years after completion of initial system classification, EPA will initiate a stakeholder process to review available microbial analytical methods and the classification structures. This process will develop the basis for a second round of national assessment monitoring. Six years after completion of initial system classification, systems will be required to conduct a second round of source water monitoring "equivalent or superior to the initial round from a statistical perspective". This process could result in system reclassification to determine additional treatment requirements for *Cryptosporidium* under the current regulatory structure, or in promulgation of a revised regulation, which reflects recommended changes, developed during the stakeholder process.

Compliance schedules for the LT2ESWTR will be contingent upon (1) the availability of sufficient analytical capacity at approved laboratories to conduct the required *Cryptosporidium* and *E. coli* analyses, and (2) the availability of software for transferring, storing, and evaluating the results of all of the microbial analyses. If either of these two items is determined to be insufficient to support the level of analytical testing required, then monitoring, implementation, and compliance schedules for both the LT2ESWTR and the Stage 2 DBPR will be delayed by an equivalent time period. Comments by EPA during December 2002 suggest that the Agency currently believes that both analytical capacity and software availability will be adequate to allow promulgation of this regulation as currently scheduled.

If the scenario discussed above is promulgated as currently recommended, many utilities practicing conventional treatment may need to begin to think in terms of having a process to provide an additional 1-log to 2.5-log removal/inactivation of *Cryptosporidium* oocysts in operation by October 2010. (October 2012, if significant capital improvements are required, with state regulatory agency approval). Based on current research results, it appears that only ozone and ultraviolet (UV) irradiation are serious contenders for inactivation of *Cryptosporidium* oocysts. The recommended plan suggests that membrane

filtration processes, such as microfiltration and ultrafiltration, would be an acceptable substitute for inactivation processes.

The Agreement in Principle states that "Based on available information, EPA believes that ultraviolet (UV) disinfection is available and feasible", and that "The availability of UV disinfection is a fundamental premise of this Agreement in Principle". However, it is recognized that additional information is needed with regard to engineering issues and to assist Stage regulatory agencies in approving this technology. Concurrent with publication of the proposed LT2ESWTR, EPA therefore will publish the following:

- Information on UV doses and contact times required to achieve up to 3 logs inactivation of *Giardia* and *Cryptosporidium*, and up to 4 logs inactivation of viruses.

- Minimum standards to determine if UV systems are acceptable for compliance with drinking water requirements, including a Validation Protocol and a description of onsite monitoring requirements to ensure ongoing compliance with required dosage levels.

- A UV Guidance Manual, which is to facilitate design and planning of UV systems and to familiarize State/Primacy Agencies and utilities with design and operational issues.

The November 2001 pre-proposal draft of the LT2ESWTR includes disinfection profiling and benchmarking requirements for *Giardia* cysts and viruses similar to those included in the Interim Enhanced Surface Water Treatment Rule. These requirements would apply only to surface water systems that are also required to monitor source water *Cryptosporidium* concentrations under the LT2ESWTR, or (for small systems) if disinfection by-product concentrations in the distribution system exceed specified levels. Disinfection profiles must be prepared using weekly *Giardia* and virus inactivation data over a one-year period; this data must

be representative of inactivation levels provided through the entire treatment facility, and not just for certain treatment segments. Systems serving more than 10,000 consumers will need to begin collecting data needed to develop disinfection profiles within 24 months of promulgation of the LT2ESWTR. The draft proposed rule does include provisions for utilization of existing ("grandfathered") *Giardia* and virus inactivation data in preparing disinfection profiles, providing that the existing data meets specified requirements.

3. Radon

EPA proposed new regulations for radon during October 1999, and it is anticipated that a final rule will be issued during December 2003. Two alternative compliance approaches were included in the proposed radon rule:

- States can elect to develop programs to address the health risks from radon in indoor air through adoption and implementation of a multimedia mitigation program. Under this approach, individual water systems would be required to reduce radon levels in the treated water to 4,000 pCi/L or lower. EPA will encourage States to adopt this approach, as it is considered the most cost-effective way to achieve the greatest reduction in radon exposure risk.

- If the State elects not to develop a multimedia radon mitigation program, individual water systems will be required to reduce radon levels in their system's treated water to 300 pCi/L, or to develop local multimedia mitigation programs and reduce radon levels in drinking water to 4,000 pCi/L.

Systems with radon levels at or below 300 pCi/L would not be required to treat their water to remove radon. States will likely be granted fairly wide latitude in developing and implementing the multimedia mitigation programs, and it is expected that the programs will differ significantly from state to state. The need

for radon treatment will be based on results of quarterly monitoring. If the state regulatory agency commits to the multimedia mitigation and alternative MCL compliance approach within 90 days of final promulgation of the rule, it will be granted an additional 18 months to achieve compliance. Considerable controversy currently surrounds the regulation of radon in drinking water supplies, and modification of this regulation as currently proposed could significantly alter the requirements contained in the final rule.

4. Ground Water Rule

The Ground Water Rule (GWR) was proposed in May 2000, and is currently scheduled for promulgation during August 2003. Communities that use ground water as a source of drinking water either for their entire supply or a portion of their supply are covered under this regulation. Public water systems that use ground water under the influence of surface water, or that blend ground water with surface water prior to treatment are not affected by this regulation. A key aspect of the GWR is whether shallow ground water supplies are susceptible to microbial contamination. These supplies will be termed “vulnerable”, and disinfection will be required. State-led sanitary surveys will determine if disinfection is necessary. Other aspects of the proposed Ground Water Rule are as follows:

- Sanitary surveys; to be conducted by the State every 3 years.
- Hydrogeologic Sensitivity Assessment; will apply only to those systems that do not provide disinfection/treatment to achieve at least 4-log removal/inactivation.
- Source Water Monitoring; again, will apply only to those systems that do not provide disinfection/treatment to achieve at least 4-log removal/inactivation.

- Corrective Actions; necessary only for systems found to have significant deficiencies or fecal contamination in the source water.

- Compliance Monitoring; required reporting to the State regarding disinfection concentrations.

5. MTBE

EPA's semi-annual rulemaking agenda published in the May 13, 2002 *Federal Register* indicated that the Agency plans to propose a Secondary Maximum Contaminant Level for MTBE, based primarily on taste/odor concerns. However, the Agency's most recent rulemaking agenda published in the December 9, 2002 Federal Register indicates that the schedule for proposal and promulgation of an SMCL for MTBE is uncertain at this time.

D. FUTURE REGULATIONS

1. General

In addition to the pending regulations discussed above, there are several additional regulations that will eventually be promulgated under the current SDWA agenda. These rules will be promulgated under the procedures established by the 1996 Amendments to the SDWA, meaning that EPA will no longer establish an MCL for a contaminant based solely on projected health related issues. The Amendments require the use of sound science, and allow for consideration of other factors such as cost, benefits, and competing risks.

2. Drinking Water Contaminants Candidate List

During March 1998, EPA finalized the first Drinking Water Contaminant Candidate List (CCL), which will be used to set regulatory, research, and occurrence-investigation priorities. This list included 19 chemicals and one

microbial contaminant, which the Agency considered as "high priority" with respect to determination of the need to regulate. Since the March 1998 publication of the CCL, EPA narrowed the list of 20 contaminants to a total of 9; these contaminants are summarized in Table 5-6. During June 2002, the Agency announced its preliminary decision that no regulatory action is needed for these 9 contaminants.

Table 5-6 Contaminants to be Considered for Future Regulation
Acanthamoeba (guidance for contact lens wearers)
Naphthalene
Hexachlorobutadiene
Aldrin
Dieldrin
Metribuzin
Sodium (guidance)
Manganese
Sulfate

3. Total Coliform Rule Revisions/Distribution System Rule

As part of the mandated 6-year regulatory review process, EPA announced during August 2002 that it will decline to revise MCLs for 68 contaminants regulated prior to 1997, but that it is considering revisions to the 1989 Total Coliform Rule. These revisions may be expanded into a Distribution System Rule, and may consider issues such as cross connection control, nitrification, impact of biofilms, and the sanitary condition of storage tanks.

4. Other Rules

Additional rules are likely to be proposed by EPA, but these will primarily address administrative issues such as the reformatting of drinking water amendments, streamlining of public notification requirements, and analytical methods updates. EPA presently plans to defer action on regulation of contaminants such as nickel

and atrazine, and has indicated that it likely will not propose a new regulation for aldicarb until August 2004, with a final regulation expected by August 2005.

E. REGULATORY SCHEDULE

EPA's current regulatory promulgation schedule is presented in Table 5-7. Table 5-7 includes both existing and pending/future SDWA regulations.

Table 5-7
Schedule for Promulgation of SDWA Regulations (as of January 2003)

Regulation	Proposed	Final	Effective
Fluoride	11/1985	04/1986	10/1987
8 VOCs (Phase I)	11/1985	07/1987	01/1989
Surface Water Treatment Rule	11/1987	06/1989	06/1993
Coliform Rule[a]	11/1987	06/1989	12/1990
Lead & Copper Minor Revisions	08/1988 04/1998	06/1991 01/2000	01/1992[b] 01/2001
26 Synthetic Organic Contaminants[c], 7 Inorganic Contaminants (Phase II)	05/1989	01/1991	07/1992
MCLs for barium, pentachlorophenol (Phase II)	01/1991	07/1991	01/1993
Phase V Organics, Inorganics	07/1990	07/1992	01/1994
Information Collection Rule (ICR)	02/1994	05/1996	07/1997
Consumer Confidence Reports Rule (CCR)	02/1998	08/1998	09/1998
Unregulated Contaminants (monitoring)[d]	02/1999	09/1999	01/2001
Radionuclides (Phase III) – except radon Radon	07/1991 11/1999	12/2000 12/2003	12/2003 12/2006[e]
Disinfectants / Disinfection By-Products Stage 1 Stage 2	 07/1994 06/2003	 12/1998 10/2004	 01/2002[f,g] 10/2010[h]
Interim Enhanced SWTR Stage 1 – Long-Term Enhanced SWTR Stage 2 – Long-Term Enhanced SWTR	07/1994 04/2000 06/2003	12/1998 01/2002 10/2004	01/2002[f] 01/2005 10/2010[i]
Filter Backwash Recycling Rule (FBRR)	04/2000	06/2001	06/2004[j]

5. REGULATORY CONSIDERATIONS

Table 5-7 Schedule for Promulgation of SDWA Regulations (as of January 2003)			
Ground Water Rule (GWR)	05/2000	08/2003	08/2006[e]
Arsenic	06/2000	01/2001	01/2006[k]
MCLs for aldicarb, aldicarb sulfoxide, aldicarb sulfone	08/2004	08/2005	08/2008[e]

a. Revisions expected by 2005; revised TCR may become Distribution System Rule.
b. Start date for tap monitoring; systems serving more than 50,000 consumers.
c. MCL, MCLG for atrazine to be reconsidered.
d. Tiered monitoring approach pending availability of analytical methods.
e. Assumes regulation in effect 3 years after final promulgation.
f. For systems serving more than 10,000 consumers.
g. Effective 01/2004 for groundwater and small surface water systems.
h. Phased compliance schedule; 10/2010 is projected deadline for compliance with locational TTHM and HAA5 values of 0.080 mg/L and 0.060 mg/L, respectively.
i. Phased compliance schedule; 10/2010 is projected deadline for compliance with additional *Cryptosporidium* treatment requirements.
j. Deadline for modifying recycle point location, if required. 2-year extension available if capital improvements required.
k. Deadline for compliance with revised arsenic MCL.

F. SUMMARY OF MONROE WTP COMPLIANCE

Treated water from the Monroe WTP typically complies with all current state and federal water quality requirements. A separate Monroe WTP regulatory compliance review was prepared and submitted to CBU in September 2001 and again in December 2002. The following is a summary of the Monroe WTP compliance:

- CBU currently complies with the requirement that the turbidity of water produced by individual filters be monitored and recorded at 15 minute intervals. New Hach 1720 D turbidimeters were installed on all filters, and were interfaced with the SCADA system prior to the January 1, 2002 deadline for recording individual filter turbidities.

5. REGULATORY CONSIDERATIONS

- In 2002, the Monroe WTP exceeded the 0.3 NTU turbidity requirement in January and March. The January non-compliance was attributed to problems with the SCADA system. A filter-aid polymer feed system is currently under design to assist CBU with meeting the turbidity requirements.

- The average combined chlorine residual at the plant discharge is maintained at approximately 2.0 mg/l. CBU complies with current disinfection CT requirements for both *Giardia* and viruses, and typically maintain conditions that provide inactivation levels in excess of current minimum requirements. Concerns regarding system security following the events of September 11, 2001 resulted in a decision to increase free chlorine across the flocculation/sedimentation basins from 0.2 mg/l to between 0.7 mg/l and 1.0 mg/l. This resulted in increased concentrations of regulated DBPs in the finished water during late 2001 and early/mid 2002. Following additional evaluation of disinfection practices during September 2002, free chlorine residuals across the basins were reduced to levels utilized prior to September 11, 2001.

- TTHM concentration was 0.051 mg/l for the four quarter running average ending December 2002. Therefore, CBU's distribution system complied with the current TTHM MCL of 0.80 mg/l enacted beginning January 2002. It was noted that TTHM levels during the fourth quarter of 2001 and the second quarter of 2002 were significantly higher than for previous monitoring periods. It is likely that the higher free chlorine concentrations maintained across the flocculation/sedimentation basins between fall 2001 and fall 2002 contributed to the increased TTHM concentrations.

- As utilities were not required to initiate HAA5 monitoring for compliance purposes until the first quarter of 2002, CBU had limited data on HAA5 in the Years 1999 and 2000 and none in 2001. It was noted that HAA5 concentrations for the first two quarters of 2002 were considerably higher

than for the previous four quarters for which monitoring data exists and in both cases exceeded the recently enacted MCL of 0.06 mg/L. As discussed above, while additional evaluation would be required to identify specific causes of the increase, it is considered likely that increases in free chlorine residuals across the flocculation/ sedimentation basins initiated during the fall of 2001 contributed to these higher HAA5 concentrations.

In summary, with the addition of the filter-aid polymer system and changes to coagulation and disinfection practices, the Monroe WTP should meet all current regulatory requirements.

G. CONSIDERATIONS FOR NEW TREATMENT FACILITIES

CBU staff have expressed the desire to design and construct a new facility that is capable of meeting all current and "anticipated future" water quality and treatment requirements. This position is based on the staff's desire to avoid the need for costly modifications of the new treatment facilities soon after startup, in order to maintain compliance with evolving SDWA regulations. In addition, CBU staff has indicated the desire to construct a new facility that can be easily automated.

Review of pending and anticipated future regulatory requirements suggests that there are several water quality/treatment-related parameters that will likely need to be addressed in the design of any new treatment facilities utilizing either the existing Lake Monroe supply or a new surface water or groundwater supply.

For water system expansion scenarios utilizing surface water sources, provisions for the following will likely need to be included:

- Capability to consistently achieve finished water turbidities of 0.1 NTU or lower in order to minimize the potential for passage of microbial pathogens through the treatment process.

5. REGULATORY CONSIDERATIONS

- Ability to maintain TTHM and HAA5 concentrations at less than 0.080 mg/L and 0.060 mg/L, respectively, throughout the entire CBU distribution system.

- Incorporation of a process to inactivate *Cryptosporidium* oocysts, if required under the impending Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR). This would likely involve primary disinfection utilizing ultraviolet light irradiation, or the use of membrane technology to remove oocysts if the LT2ESWTR is promulgated as currently drafted.

CBU has expressed interest in membrane technology to meet future turbidity and possible *Cryptosporidium* removal requirements, and to provide their customers high quality drinking water. CBU, with the assistance of B&V, completed a membrane filtration pilot study in Year 2002. The pilot study indicated good results using membrane filtration with Lake Monroe as a water source. The pilot study indicated that with membranes, CBU could consistently achieve finished water turbidities of less than 0.1 NTU. Therefore, membrane technology has been assumed for expansion of the existing Monroe WTP or a new WTP using a surface water supply. In addition, if a new WTP is constructed with membrane filtration, CBU would like to include membranes at the existing Monroe WTP as well. Therefore, alternatives that involve a new WTP will also include retrofitting the existing Monroe WTP with membranes.

For expansion scenarios utilizing groundwater sources, compliance with regulatory requirements would generally be more easily achieved than for surface water supplies. However, compatibility issues would need to be carefully evaluated in order to avoid conditions where intermixing of existing surface water supplies and new ground water supplies could lead to water quality problems within CBU's distribution system. Generally this would involve adjustment of finished water pH and alkalinity to ensure that precipitation or dissolution of existing deposits does not occur upon mixing of the treated ground water and surface water supplies.

5. REGULATORY CONSIDERATIONS

For a new groundwater plant, it is anticipated that the water treatment process will include iron and manganese removal and softening. Iron and manganese would be oxidized and removed by filtration. Filtration could include either conventional granular media filtration or microfiltration/ultrafiltration membrane technology. Unless the groundwater source is considered under the influence of surface water and would require *Cryptosporidium* removal or inactivation, conventional filtration would be adequate and more economical than membranes.

It is assumed that a new groundwater source is likely to have a high hardness level; therefore, a new groundwater plant will require softening. A conventional process such as lime softening would be appropriate; however, this type of process requires more operator attention and could not be easily automated. A membrane process such as reverse osmosis could be implemented for softening and could be automated to function with little operator intervention; however, this process would be more costly than conventional softening processes. CBU has expressed interest in softening the water using reverse osmosis as well as having a plant that is automated. Thus, reverse osmosis for softening and either conventional filtration or membrane filtration has been assumed.

6. HYDRAULIC ANALYSES

A. GENERAL

Hydraulic analyses were conducted to identify deficiencies in the CBU's distribution system and to establish an improvement program to reinforce and expand the existing system to meet projected water demands through the year 2030. Alternative improvements were investigated to identify those most effective in meeting projected water demands. Criteria used to develop the improvement program include increasing system reliability, simplifying system operations, more effectively utilizing system storage to meet peak demands, and maintaining pressures of 35 psi under maximum hour demand conditions. This chapter discusses the development of the hydraulic computer model and the results of the analyses performed.

B. EXISTING MODEL

A review of CBU's existing hydraulic model, identified as Basemap6, indicated the following:

- A water demand of 20 gpm was allocated to nearly every node;
- The tanks did not contribute to the system;
- The assigned pipe friction coefficient "C" values were not consistent with standard practice;
- The assigned pump curves did not match the curves from the shop drawings;
- The model was analyzed only for the maximum hour condition.

6. HYDRAULIC ANALYSES

Typically, a hydraulic model is analyzed for both the maximum day and maximum hour condition. The existing model indicated that the Monroe WTP provided water at maximum hour water use conditions. Water supply and treatment facilities are usually designed to meet maximum day water demands without system storage contribution. Usually, distribution storage provides rates to meet demands in excess of the maximum day use, such as, maximum hour and fire fighting needs.

C. MODEL DEVELOPMENT

1. Computer Software Program

Computerized hydraulic analyses provide a tool for predicting the system's hydraulic gradient pattern, pressures, and flows under a specified set of conditions. The hydraulic gradient pattern varies with the magnitude and location of system water use, the characteristics of the pipes in the distribution system, and the flows and gradients at network boundaries, such as at reservoirs and pump stations. The headloss through each pipe is a function of flow rate, pipe diameter, length, and internal roughness. The available pressure or head at any ground point in the network is the difference between the hydraulic gradient and the ground elevation.

The software program utilized for the analyses was CBU's licensed copy of WaterCAD, Version 4.5 by Haestad Methods. Running under the Windows operating system as a stand-alone program, WaterCAD provides an integrated environment for editing input data, running hydraulic simulations, and viewing results.

6. HYDRAULIC ANALYSES

2. Distribution System Piping and Facilities

CBU's computer model included about 400 junctions and 500 pipes totaling 125 miles in length. The modeled pipe length accounted for about 35 percent of the total pipe length within the CBU system. The hydraulic model contained about 100 percent of the 14-inch and larger mains, about 70 percent of the 12-inch mains, 85 percent of the 10-inch mains, 27 percent of the 8-inch mains, 7 percent of the 6-inch mains, and 2 percent of the 4-inch mains within the CBU system. Ground elevations for all of the nodes and the pipe diameters and lengths from the existing model were assumed to be correct.

The age of CBU's distribution mains range from mains newly constructed to mains installed prior to 1930. The pipe friction coefficient, "C" value, in the Hazen-Williams empirical equation for pipe flow, is representative of a pipe's hydraulic capacity. The "C" value is dependent upon a number of factors including pipe material, type of lining, pipe age, cross-sectional area, amount of tuberculation, and thickness of any calcium carbonate deposits. High "C" values indicate smooth interior surfaces. The "C" value for a new cement-lined ductile iron pipe, for example, is 130 or more; while for a 20-year-old pipe, it is typically 100. Prior to the 1950s, mains generally were not cement mortar lined. This caused tuberculation to form more quickly and lower "C" values to develop. The "C" values assigned in CBU's computer model were not consistent with standard practice and were deleted from the existing model. New "C" values were assigned to the mains as listed in Table 6-1.

6. HYDRAULIC ANALYSES

Table 6-1
Pipe Friction Coefficients ("C" Values)

Age, years	Diameter, inches	Year 2000 Friction Coefficient[a]	Year 2030 Friction Coefficient
<12	6-10	110	100
	12-18	110	100
	20-24	120	110
	36-48	120	110
13-23	6-10	100	90
	12-18	110	100
	20-24	110	100
	36-48	120	110
24-32	6-10	90	80
	12-18	100	90
	20-24	110	100
	36-48	120	110
33-42	6-10	80	70
	12-18	90	80
	20-24	100	90
	36-48	110	100
>42	6-10	60	50
	12-18	80	70
	20-24	90	80
	36-48	100	90

a. A "C" value of 130 was assigned to the 36-inch transmission main between the Monroe WTP and the South Storage Tanks.

Some of the pump curves found in CBU's model did not match the shop drawing curves, so they were adjusted accordingly. CBU's model was then modified to incorporate main improvements and system modifications that have occurred since 1999, the last time the model was updated. Thus, the modified model used was representative of the year 2001 CBU system.

6. HYDRAULIC ANALYSES

3. Water Demand Allocation

The total system maximum day and maximum hour water use for Base Year 2000 and Design Year 2030 replaced CBU's existing hydraulic model water demands and were allocated to the network nodes by service level and user class. Residential water use was allocated on an area basis by census tract, which assumes the population is distributed uniformly within the census tract. Commercial and industrial water use was assigned based on land use. Water use for the 35 largest ICI customers was allocated individually to specific nodes near the respective customer meters. The large customers' allocated water use was based on actual 2002 metered water use data. The water use for wholesale customers was allocated to the network nodes nearest the master metering points. Unaccounted-for water was allocated throughout the distribution system as a percentage of the total water use.

D. MODEL VERIFICATION

Prior to beginning the design hydraulic analyses, it was necessary to determine whether the hydraulic model is an accurate representation of the actual distribution system. To best make this assessment, a verification analysis was conducted to confirm that the computer model simulates actual system conditions with reasonable accuracy. Essentially, the verification process consists of selecting a known system condition using data collected from field testing and operation records.

Based upon pumping rates, varying tank levels, and the system water use during the selected test, water use factors in the distribution system model are adjusted so that the allocated water use correlates closely to the actual water use. The analysis is then performed, and the resulting pump station flows, pressures, and tank levels are compared with actual values from the records. If the calculated and actual values are substantially the same, the model is considered to be

verified. If the values do not agree, the hydraulic model is revised and the analysis is repeated.

In this study, verification refinements were not performed because much of the data needed to perform a refined correlation analysis was not available.

E. HYDRAULIC ANALYSES

Hydraulic analyses were performed for maximum day and maximum hour conditions for Base Year 2000 and Design Year 2030 to identify distribution system deficiencies and to evaluate water treatment expansion alternative improvements. Analyses were not necessary for Design Years 2010 and 2020 since there were very little distribution system improvements required between 2000 and 2030 to meet the future water use conditions. The maximum day analyses determine the ability of the system to maintain storage facilities in a full condition. The maximum hour analyses determine the ability of the system to maintain adequate pressure during peak water use. Distribution system improvements were based on providing a system pressure of at least 40 psi under non-emergency conditions. As a goal, it is desirable to maintain a minimum pressure of 40 to 50 psi under maximum day conditions.

As discussed earlier, water use within a distribution system typically follows a 24-hour diurnal pattern, being low at night and peaking in the early morning and again in the late afternoon/early evening. It should be recognized, that each analysis represents an instantaneous condition within the distribution system, in essence a snapshot of the distribution system operation at a particular instant. In particular, the maximum day analyses are meant to represent the operation of the distribution system at a time when the instantaneous rate of water use is approximately equal to the average water use during the whole day.

6. HYDRAULIC ANALYSES

For discussion purposes, it is generally assumed that each maximum day analysis represents a point in time during the late afternoon, just prior to the start of the peak demand period. Ideally, the distribution system storage should be full or nearly full at this time of day, and the storage contribution rates should be essentially zero. It is desirable to have full system storage at this point in the day in order to ensure that there is a maximum volume of water available for meeting water use during the upcoming peak water use period. Additionally, it is desirable to have storage contribution rates at or near zero under the average day and maximum day water use conditions because the water stored in the system storage needs to be reserved for use during the peak water use period and for fighting fires.

In addition to the Base Year 2000 and Design Year 2030 analyses, a series of year 2030 maximum day analyses were conducted with water demands increased globally to 36 mgd to match three water treatment plant expansion alternatives that CBU is considering to meet future water demands. The three alternatives, designated as Alternative A, B, and C, are described as follows:

- **Alternative A.** Expand the 24 mgd Monroe WTP to a capacity of 36 mgd. This alternative would require another 30-inch raw water line to be installed from the intake to the plant and a parallel 36-inch finished water transmission main from the plant to the proposed 30-inch Southeast main that connects to the existing 36-inch main near Harrell Road and Moffat Lane. This alternative also includes the proposed 30-inch Southeast main along Harrell Road; a new Southeast pump station and tank located near Harrell and Rhorer Roads; a 36-inch main along Rhorer to Sare Road; a 24-inch North branch main along Sare Road to the existing 24-inch main in Moores Pike and a 24-inch West branch main along Rhorer Road, then north along South Rogers Street to West Country Club Drive, then west along Country Club Drive to connect to the two existing 24-inch mains at the intersection of Rockport and West Tapp Roads.

6. HYDRAULIC ANALYSES

- **Alternative B.** Construct a new Dillman 12 mgd WTP expandable to 24 mgd, adjacent to the Dillman WWTP near Dillman Road and Victor Pike. Raw water would be conveyed through a 36-inch transmission main from a new intake located near the Indiana Department of Natural Resources site on Lake Monroe. From the Dillman WTP's high service pumps, finished water would be conveyed through a 36-inch transmission main into two 24-inch Central service level mains at Rockport and Tapp Roads and a 16-inch main along West Country Club Drive between Rockport Road and South Old SR 37. The capacity of the Monroe WTP would remain at 24 mgd.

- **Alternative C.** Construct a new North 12 mgd WTP expandable to 24 mgd, near Bottom Road and new State Route 37. Raw water would be conveyed through a 36-inch transmission main to the new plant. From the new North plant, finished water would be conveyed through a 36-inch transmission main to the Central service level mains near Stonemill Road and Old State Route 37. If the North plant is expanded to 24 mgd, then the 36-inch main should be extended as a 24-inch main along Walnut Street to the existing 24-inch main on 20th Street. The capacity of the Monroe WTP would remain at 24 mgd.

1. Base Year 2000

Hydraulic analyses were completed for the Base Year 2000 model to identify deficiencies in the existing distribution system. These analyses identified current and short-term deficiencies. The pumping information for maximum day and maximum hour conditions is summarized in Table 6-2 and shown on Figures 6-1 and 6-2.

6. HYDRAULIC ANALYSES

Table 6-2 Base Year 2000 Hydraulic Analyses Pump Station Summary						
Pump Station	Rated Capacity		Maximum Day Analysis		Maximum Hour Analysis	
	Flow, mgd	TDH, ft	Flow, mgd	TDH, ft	Flow, mgd	TDH, ft
South-Central						
No. 1	6	140	4.35	135	2.21	141
No. 2	6	140	7.47	135	7.20	141
No. 3	6	140	7.47	135	7.20	141
No. 4	6	140	Off	-	6.05	141
No. 5	6	140	Off	-	Off	-
Gentry						
No. 1	1.44	140	Off	-	Off	-
No. 2	1.44	140	0.92	163	0.95	162
West						
No. 1	3.6	130	Off	-	2.09	116
No. 2	3.6	130	4.01	116	2.61	116
No. 3	4.1	150	Off	-	Off	-
Southwest						
No. 1	2	105	Off	-	Off	-
No. 2	2	105	Off	-	Off	-
No. 3	2	105	Off	-	Off	-

6. HYDRAULIC ANALYSES

Fig 6-1 2000 MD

6. HYDRAULIC ANALYSES

Fig 6-2 2000 MH

6. HYDRAULIC ANALYSES

The tank information for Base Year 2000 maximum day and maximum hour conditions is summarized in Table 6-3 and shown on Figures 6-1 and 6-2.

Table 6-3
Base Year 2000 Hydraulic Analyses
Tank Summary

Tank	Calculated Hydraulic Gradient, ft		Initial Level, ft		Status		Inflow[b], mgd	
	MD	MH	MD	MH	MD	MH	MD	MH
Monroe Finished Water Reservoir	770	770	30	30	Draining	Draining	-20.45	-24.01
South Tank[a]	850	850	30	30	Filling	Filling	0.03	0.03
Red Bud	955	951	67	63	Draining	Draining	-1.47	-1.77
East	955	951	79	75	Filling	Filling	1.46	1.76
Dyer	926	926	50	50	Draining	Steady	-0.01	0.00
Southwest	1,029	1,025	83	79	Draining	Draining	-1.42	-1.66
West	1,029	1,025	92	88	Filling	Filling	1.43	1.68

a. For simplicity, the 1.0 MG and 3.0 MG South Tanks were modeled as one 4.0 MG tank.

b. Negative value indicates the tank is draining, while a positive value indicates the tank is filling.

In the Central service level, the East and Redbud tanks operate at the same hydraulic gradient elevation and fill and drain at approximately the same rate for MD and MH conditions, respectively. The East tank will overflow before the Redbud tank is replenished. To allow the Redbud tank to replenish, an altitude valve should be installed on the East tank.

6. HYDRAULIC ANALYSES

In the West service level, the West and Southwest tanks operate at the same hydraulic gradient elevation. For MD and MH conditions, the West and Southwest tanks are draining and filling at approximately the same rate, respectively. The West pump station fills the West tank, while the Southwest pump station is off-line and the Southwest tank supplies water to the West service level.

The existing distribution system is capable of meeting current maximum day and maximum hour water use conditions.

2. Design Year 2030

Analyses for Design Year 2030 were performed using the projected water use requirements presented in Chapter 3. The projected 2030 maximum day and maximum hour water use is 32.2 mgd and 38.1 mgd, respectively. The pumping information for Design Year 2030 maximum day and maximum hour conditions is summarized in Table 6-4 and shown on Figures 6-3 and 6-4.

6. HYDRAULIC ANALYSES

Table 6-4 Design Year 2030 Hydraulic Analyses Pump Station Summary						
Pump Station	Rated Capacity		Maximum Day Analysis		Maximum Hour Analysis	
	Flow, mgd	TDH, ft	Flow, mgd	TDH, ft	Flow, mgd	TDH, ft
South-Central						
No. 1	6	140	7.87	125	4.30	119
No. 2	6	140	7.87	125	8.14	119
No. 3	6	140	Off	-	8.14	119
No. 4	6	140	Off	-	Off	-
No. 5	6	140	Off	-	Off	-
Southeast						
No. 1			5.36	154	6.35	130
No. 2			5.35	154	6.35	130
No. 3			5.35	154	Off	-
No. 4			Off	-	Off	-
No. 5			Off	-	Off	-
Gentry						
No. 1	1.44	140	Off	-	Off	-
No. 2	1.44	140	0.96	162	1.00	161
West						
No. 1	3.6	130	2.19	107	2.41	99
No. 2	3.6	130	Off	-	Off	-
No. 3	4.1	150	Off	-	Off	-
Southwest						
No. 1	2	105	Off	-	Off	-
No. 2	2	105	3.55	69	3.51	70
No. 3	2	105	Off	-	Off	-

6. HYDRAULIC ANALYSES

Fig 6-3

6. HYDRAULIC ANALYSES

Figure 6-4

6. HYDRAULIC ANALYSES

The tank information for Design Year 2030 maximum day and maximum hour conditions is summarized in Table 6-5 and shown on Figures 6-3 and 6-4.

Table 6-5
Design Year 2030 Hydraulic Analyses
Tank Summary

Tank	Calculated Hydraulic Gradient, ft		Initial Level, ft		Status		Inflow[b], mgd	
	MD	MH	MD	MH	MD	MH	MD	MH
Monroe Finished Water Reservoir	770	770	30	30	Draining	Draining	-31.77	-31.98
South[a]	850	850	30	30	Draining	Draining	-0.62	-5.55
Southeast	850	850	50	50	Draining	Filling	-0.29	3.04
Red Bud	955	946	67	58	Draining	Draining	-0.85	-3.07
East	955	946	79	70	Filling	Filling	1.89	1.20
Dyer	926	926	50	50	Draining	Draining	-0.004	-0.004
Southwest	1,029	1,020	83	74	Filling	Filling	1.04	0.63
West	1,029	1,020	92	83	Draining	Draining	-1.19	-1.62

a. For simplicity, the 1.0 MG and 3.0 MG South Tanks were modeled as one 4.0 MG tank.

b. Negative value indicates the tank is draining, while a positive value indicates the tank is filling.

In the Central service level, the East and Redbud tanks operate at the same hydraulic gradient elevation and fill and drain at approximately the same rate for MD conditions, respectively. For MH conditions, however, this appears to not be case. The East and Redbud tanks fill and drain at different rates. The East tank will overflow before the Redbud tank is replenished. To allow the Redbud tank to replenish, an altitude valve should be installed on the East tank.

6. HYDRAULIC ANALYSES

In the West service level, the West and Southwest tanks operate at the same hydraulic gradient elevation. For MD conditions, the West and Southwest tanks drain and fill at approximately the same rate, respectively. For MH conditions, however, this appears to not be the case. The West and Southwest tanks drain and fill at different rates. The Southwest pump station fills the Southwest tank, while both the West pump station and West tank supplies water to the West service level.

Improvements between years 2000 and 2030 are needed to serve new development areas and to improve hydraulic conditions in the system.

Three additional Design Year 2030 maximum day analyses were conducted with the demand increased to 36 mgd to evaluate the WTP expansion alternatives. Results of these analyses are shown on Figures 6-5, 6-6, and 6-7. For Alternative A, the results indicate that the East tank will overflow before the Redbud tank is replenished. To allow the Redbud tank to replenish, an altitude valve should be installed on the East tank. For Alternative B, an altitude valve is not required on either the East or Redbud tanks. For Alternative C, Redbud tank will overflow before the East tank is replenished. To allow the East tank to replenish, an altitude valve should be installed on the Redbud tank. Overall, the results indicate that with the improvements described for each alternative, in place, the distribution system will be able to accommodate 36 mgd.

6. HYDRAULIC ANALYSES

Fig 6-5 2030 MD alt A

6. HYDRAULIC ANALYSES

Fig 6-6 2030 MD alt b

6. HYDRAULIC ANALYSES

Fig 6-7 2030 MD Alt C

6. HYDRAULIC ANALYSES

F. SYSTEM STORAGE EVALUATION

Storage facilities in a distribution system serve a number of purposes, including flow equalization, fire reserve, and emergency supply. Without storage facilities, the supply, treatment, pumping, and transmission facilities would have to be sized to meet instantaneous peak water use within the service area. Designing a water system in this manner would be impractical and uneconomical. However, by constructing appropriately sized reservoirs at strategic locations throughout the service area, the required capacity of the other major system components can be reduced.

The amount of equalization storage needed is a function of an area's demand characteristics and the capacities of the major system components. It is generally most economical to size supply, treatment, pumping, and transmission facilities to meet maximum day water use and to provide equalizing storage to meet water use in excess of this rate. Thus, on a day of maximum water use, storage facilities will generally contribute water when water use is greater than the daily rate and will fill when water use is less than the daily rate.

Typically, a water utility provides sufficient fire storage to meet the fire flow requirements established by the Insurance Services Office. Each storage facility should have sufficient capacity to meet fire flow requirements within an area of influence. The influence area is a function of the distribution network and water use patterns.

Emergency storage is used in the event that regular service is disrupted by main breaks, equipment failures, power outages, raw water supply contamination, or natural disasters. The amount of emergency storage included within a particular water system is the utility's option based on an assessment of risk and the desired degree of reliability. Unlike equalization and fire storage, which should be available at all reservoir sites, emergency storage may be included at only a few sites.

6. HYDRAULIC ANALYSES

1. Equalization Storage

Equalization storage should be adequate to supply the maximum hour rate in excess of the maximum day rate for at least a 6-hour peak period. For CBU's design demand ratios, this equates to 1.5-MG of Equalization Storage or about 5 percent of the maximum day use. On a maximum demand day, storage facilities will generally contribute water when demands are greater than the instantaneous average daily rate, and will refill when demands are less than the instantaneous average daily rate.

2. Fire Storage

Fire storage is based on supplying fire flow for required durations. The Insurance Services Office (ISO) grades municipal fire defense capabilities for insurance rating purposes. The 1980 ISO Fire Suppression Rating Schedule considers three areas of evaluation: Receiving and Handling Fire Alarms, Fire Department, and Water Supply.

Part of an ISO evaluation consists of determining needed and available fire flows at various locations throughout a water utility. The needed fire flow is calculated based on the size, construction, occupancy, and exposure of each building or complex. Needed fire flows can range from 500 to 12,000 gpm. A flow of 1,000 gpm is generally sufficient for fighting fires in residential structures no higher than two stories if they are more than 10 feet apart. The fire flow is required for a specified duration, generally 2 to 3 hours, at a residual pressure of 20 psi. The system should be capable of supplying the required fire flow during the maximum day demand conditions.

For insurance rating purposes, 3,500 gpm for a 3-hour duration is the maximum fire flow required to be supplied by a municipal water system. This rate would require a Fire Storage of 0.63 MG. Fire flow requirements in excess of

3,500 gpm that cannot be met by the water system may affect the rating of the individual building. However, the overall municipal rating will not be affected.

3. Emergency Storage

Emergency storage provides a reserve supply source in the event that the water supply is disrupted by water main breaks, equipment failures, power outages, or natural disasters. The amount of emergency storage required is a CBU policy issue, considering the risk of supply disruption and the desired degree of reliability. The volume required to meet demands during an outage depends on the system demand and the duration of the outage. A reasonable guideline for emergency storage is about one average day's demand, or in the case of CBU, about 20 MG for Year 2030.

CBU currently has about 12.6 MG of system storage excluding clearwell storage at the Monroe WTP and the proposed Southeast tank. Based on 12.6 MG of total system storage, less the previously discussed volumes for Equalization and Fire Storage, the CBU system will have about 10.5 MG of Emergency Storage, or 80 percent of current average day use and about 53 percent of year 2030 average day use.

4. Storage Allocation

It is very unlikely that a maximum hour demand, a 3,500 gpm fire flow, and a major main break and/or a power outage would occur at the same time. Consensus in today's water industry is that it is very conservative and often very expensive to add each storage component together to determine the total required system storage.

In general, system storage should be allocated in terms of position in the storage reservoir. Storage for equalization should occupy the top portion of the reservoir, because equalization storage usually amounts to about one half of the total

storage volume within the top 20 feet of the reservoir. Fire storage is positioned next, "under" equalization storage, and emergency storage is at the bottom of the reservoir. The importance of designating levels for types of storage is to ensure that the storage volume has the correct hydraulic grade line for the intended purpose. For example, fire storage may be required at a time when the equalization storage has been depleted. System analysis should ensure that fire storage is available at the hydraulic grade line equal to the "bottom" of fire storage volume allocation. Storage levels would vary from full to depletion-of-equalization volume (or half full) as demand varies throughout the day.

Based on 12.6 MG storage capacity for the CBU system, the following storage allocation can be made for the CBU water distribution system:

Storage	Capacity, MG
Equalization	1.5
Fire	0.6
Emergency	10.5
Total	12.6

As previously discussed, emergency storage requirement is usually a CBU policy issue. The guideline of having one average day use of emergency storage is not a design standard. However, CBU should consider a limited vulnerability assessment to determine the emergency storage requirements.

7. EVALUATION OF WATER SYSTEM IMPROVEMENTS

A. GENERAL

The primary responsibility of a domestic water purveyor is to provide its customers with a plentiful supply of high quality water. While meeting this primary responsibility, the purveyor also is expected to provide satisfactory service and operate the water system in a financially responsible manner. Within the water works industry, it is generally accepted that distribution facilities should be designed to provide an acceptable degree of reliability. The facilities also must maintain adequate residual pressures throughout the system while supplying maximum hour water use and a reasonable amount of water for fire fighting.

Based on the results of the hydraulic analyses conducted during this study, a long-range capital improvement program was established for the City of Bloomington Utilities. Various system configurations were evaluated to identify the configuration that was most appropriate for meeting current and projected water use. The resulting improvement plan is designed to keep pace with projected growth and provide a reliable base for future development.

The recommended water supply, treatment, and distribution system improvements shown on Figure 7-1 update and supersede the improvements recommended in our 1986 and 1993 reports. Some of the 1993 report improvements have been modified or deleted as a result of changes in projected growth patterns and water requirements and the moving of previously recommended improvements to more desirable locations.

It is recommended water works practice to provide water supply and treatment facilities with sufficient capacity to meet projected maximum day demands. Current projections indicate the maximum day demands will reach approximately 24 mgd by Year 2010 and 32 mgd by Year 2030. As discussed earlier in this report, the current rated capacity of its existing Monroe WTP is 24 mgd.

7. WATER SYSTEM ALTERNATIVES EVALUATION

During this study, three treatment expansion alternatives were evaluated to provide sufficient firm capacity to meet projected maximum day demands. The three plans that were identified and discussed in Chapter 6 – Hydraulic Analyses were as follows:

Alternative A – Expand the Monroe WTP from 24 to 36 mgd
Alternative B – Construct a new 12 mgd Dillman WTP
Alternative C – Construct a new 12 mgd North WTP

All of the plans are feasible from an engineering stand point and will meet CBU's projected short- and long-range water requirements.

B. POTENTIAL INCREASE IN WHOLESALE WATER USE

It should be recognized that the water use projections discussed in this report were based on supplying water to current and future customers within CBU's existing retail service area and on meeting current contractual requirements with existing wholesale customers. Although it is impossible to know for certain at this time, it is entirely possible that CBU's current wholesale customers may want to increase their contractual amounts in the future. The recommendations developed during this study will need to be reviewed and possibly modified to accommodate any significant future increases in wholesale water use.

Elletsville, Southern Monroe, and Van Buren Township appear to have the greatest potential need for additional water purchases from CBU. These customers are experiencing growth, and it is therefore conceivable that they may want to purchase additional water from CBU in the future. If one or more of the existing wholesale customers are to be provided significant additional water above that currently anticipated, CBU will be faced with the issue of how best to provide the additional finished water.

7. WATER SYSTEM ALTERNATIVES EVALUATION

With the exception of Elletsville, CBU supplies water to its wholesale customers at a maximum hour rate. Since Elletsville has several tanks in its system and the tanks are turned over regularly, CBU can supply water to the Town at the maximum day rate and the Town can meet the difference between the maximum hour and maximum day rates from their system storage. Southern Monroe, Washington Township, and B&B Water Project, Inc. also have storage tanks, but are supplied at the customers' required maximum hourly rate. As water use increases, CBU may be required to supply all of their wholesale customers at the customers' maximum day rates and require the customers to provide any additional maximum hour water needs from the customers' own system storage.

C. DISTRIBUTION MAINS

The distribution main improvements are shown on Figure 7-1 with a corresponding reference number. Current development patterns and growth expectations were reviewed and considered in developing these recommendations. Once installed, the improvements will provide the required capacity and reliability to meet projected water demands through the Year 2030. Many of the distribution mains listed below were identified by CBU for maintaining and improving its current distribution system, independent of growth and will be constructed in the next 5 years.

The following distribution improvements were included in the hydraulic analyses for each water treatment expansion alternative. The improvement number in parentheses corresponds with the reference number on Figure 7-1.

1. West Service Level

- **Knapp Road Main (Improvement No. 1).** A new 12-inch main connecting the 12-inch stub off of Vernal Pike to the 8-inch main along Knapp Road is needed to improve flow and pressures.

7. WATER SYSTEM ALTERNATIVES EVALUATION

- **Tie Mains (Improvement No. 2).** Two 10-inch tie mains connecting the existing 20-inch main along Park Square Drive are needed.

2. Central Service Level

- **Grant Street Main (Improvement No. 3).** A new 24-inch main along Grant Street between East 3rd Street and West Allen Street is needed to improve flow and pressures.

- **Allen Street Main (Improvement No. 4).** A new 12-inch main along Allen Street connecting the 24-inch mains along Walnut and Rogers Streets is needed to improve flow and pressures.

- **South Patterson Drive Main (Improvement No. 5).** A new 12-inch main is needed to replace the existing 16-inch main between 3rd and 2nd Streets.

- **Adams Street Main (Improvement No. 6).** A new 12-inch main is needed along Adams Street between Allen Street and Tapp Road.

- **Kinser Pike Main (Improvement No. 7).** A new 12-inch extension to Acuff and Prow Roads is needed.

- **Indiana Avenue Main (Improvement No. 8).** A new 20-inch main is needed along Indiana Avenue between 3rd and 10th Streets to improve flow and pressures.

- **Indiana Avenue Main (Improvement No. 9).** A new 16-inch main is needed along Indiana Avenue between 10th and 17th Streets to improve flow and pressures.

7. WATER SYSTEM ALTERNATIVES EVALUATION

- **10th Street Main (Improvement No. 10).** A new 16-inch main is needed between Dunn Street and Forrest Avenue to improve flow and pressures.

- **10th Street Main (Improvement No. 11).** A new 12-inch main is needed between Forrest Avenue and Fee Lane.

- **East Tank Altitude Valve (Improvement No. 12).** A new altitude valve should be installed on the East tank to prevent overflowing when the Redbud tank is replenishing (for Alternative A only).

- **Redbud Tank Altitude Valve (Improvement No. 13).** A new altitude valve should be installed on the Redbud tank to prevent overflowing when the East tank is replenishing (for Alternative C only).

- **Walnut Street Main (Improvement No. 14).** A new 24-inch main along Walnut Street, from Stonemill Road and Old State Route 37 to the existing 24-inch main along 20th Street, is needed only if the 12 mgd North WTP (Alternative C) is expanded to 24 mgd.

7. WATER SYSTEM ALTERNATIVES EVALUATION

Fig 7-1

7. WATER SYSTEM ALTERNATIVES EVALUATION

D. EVALUATION OF ALTERNATIVE PLANS

To meet future water requirements, CBU will need to either expand its Monroe WTP from 24 mgd to 36 mgd (Alternative A) or construct either a new 12 mgd Dillman (Alternative B) or North (Alternative C) water treatment facility. From an economic standpoint, it may be favorable to expand the Monroe WTP, however, from a security standpoint, constructing the Dillman or North facility would be preferable. From a hydraulic standpoint, Alternative C provides the benefit of serving customers from the north.

The following discusses the improvements required for each alternative. The improvements were based on the results of the hydraulic modeling, the advantages and disadvantages, the required treatment processes, as well as the implementation requirements and project schedule discussed below.

1. Alternative A – Expand Monroe WTP from 24 mgd to 36 mgd. Expand the 24 mgd Monroe WTP to a capacity of 36 mgd and replace the existing conventional gravity filters with a 36 mgd submerged-type membrane filtration system. This alternative would require a parallel 30-inch raw water line to be installed from the intake to the plant and a parallel 36-inch finished water transmission main from the plant to the proposed 30-inch Southeast main that would connect to the existing 36-inch transmission main near Harrell Road and Moffat Lane. This alternative also includes the proposed 30-inch Southeast main along Harrell Road; a new Southeast pump station and tank located near Harrell and Rhorer Roads; a 36-inch main along Rhorer to Sare Road; a 24-inch North branch main along Sare Road to the existing 24-inch main in Moores Pike and a 24-inch West branch main along Rhorer Road, then north along South Rogers Street to West Country Club Drive, then west along Country Club Drive to connect to the two existing 24-inch mains at the intersection of Rockport and West Tapp Roads.

7. WATER SYSTEM ALTERNATIVES EVALUATION

a. Advantages

- The proposed Southeast transmission main will provide redundancy to the existing 36-inch transmission main from the Monroe WTP to the South Tanks.
- If a break should occur in one of the two finished water transmission mains, CBU can continue to provide up to 24 mgd to the distribution system.
- The proposed Southeast pump station would provide water to the Central service level if the South-Central pump station is off-line or if there is a break in the existing 36-inch transmission main serving the South-Central pump station.
- Lake Monroe is used, which has an abundant supply of good quality raw water.
- There is familiarity with the water supply.
- Expanding the Monroe WTP is the most economical of the three alternatives.

b. Disadvantages

- It does not provide an independent second water source.
- The Monroe WTP cannot be easily expanded past 36 mgd.

c. Required Treatment Processes

The Lake Monroe water quality for the Year 2002 is presented in Table 7-1.

7. WATER SYSTEM ALTERNATIVES EVALUATION

Table 7-1 2002 Lake Monroe Water Quality Data		
Constituent	**Average**	**Range**
Alkalinity	27.3	20-38
Total Hardness	46.4	24-62
Turbidity	7.6	2.6-22.0
pH	7.3	6.1-7.8
a. All values in mg/L as $CaCO_3$ except pH, Turbidity in NTUs.		

The design objective for the Monroe WTP is to provide economical and efficient water treatment that will:

- Achieve finished water turbidities consistently below 0.1 NTU.
- Maintain TTHM and HAA5 concentrations at less than 0.08 mg/L and 0.06 mg/L, respectively, throughout the CBU distribution system.
- Incorporate a process to inactivate or remove *Cryptosporidium* oocysts.

The following treatment processes are available for obtaining the design treatment objectives:

- Turbidity Removal

  Fine particles, such as organic solids, viruses, bacteria, algae, and other substances that scatter light in the drinking water cause turbidity. By definition, turbidity is the measure of the scattered light from a controlled source measured at 90 degrees to the path of light. MF/UF membranes are capable of high particle removal rates due to their ability to provide an absolute barrier to particles and other constituents larger than their pore size.

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Since MF/UF membranes are capable of removing turbidity, particles, and total suspended solids, water can be treated using such membranes.

The use of membrane filters as an alternative to conventional gravity media filters is proposed based on the demonstrated ability to achieve high levels of suspended solids/turbidity removal. MF and UF membranes are physical processes in which particles larger than 0.1 microns for microfiltration and larger than 0.01 microns for ultrafiltration are removed from the water by straining through a porous medium. The membrane filtration processes provide exceptional removal of turbidity and can produce treated water with turbidities of less than 0.10 NTU. Since MF/UF membranes are capable of removing turbidity, particles, and total suspended solids, as demonstrated in the 2002 Membrane Filtration Pilot Study, the water will be treated with these membranes.

- Disinfectant Byproduct Removal

  Although a disinfectant (free chlorine) residual is required, it is recognized that an excessive amount of disinfectant residual may pose a threat to health as well as contribute to increased formation of undesirable disinfection byproducts. The precursors of disinfection byproduct formation are naturally occurring organic substances. When combined with any of the disinfectants, DBPs will form. To meet regulations, CBU must maintain TTHM and HAA5 concentrations throughout the distribution system at less than 0.08 mg/L and 0.06 mg/L, respectively. Since MF/UF membranes are capable of removing some of the DBP precursors, as demonstrated in the 2002 Membrane Filtration Pilot Study, the water will be treated with these membranes.

- *Cryptosporidium* Removal

  Systems treating surface water and serving more than 10,000 consumers must achieve at least a 2-log (99%) removal of *Cryptosporidium*. Research

7. WATER SYSTEM ALTERNATIVES EVALUATION

and outbreaks of water-borne diseases have shown that certain viruses and bacteria, such as *Cryptosporidium* resist conventional treatment. Therefore, alternate treatment technologies are desirable. As the pore sizes are significantly smaller than *Cryptosporidium* oocysts (2 to 5 microns), MF/UF membranes provide excellent removal of these microbial contaminants. MF/UF is an alternate treatment technology that will improve the control of microbial pathogens in the drinking water, particularly *Cryptosporidium*.

In addition to the existing treatment components, a flocculation/sedimentation basin with plate settlers and MF/UF membranes are proposed for Alternative A.

Sodium hypochlorite and sodium hydroxide, which will be installed as part of another project, will be added at the finished water reservoir influent. The reservoir will be baffled to achieve adequate CT. Sodium hypochlorite and aqueous ammonia will be added at the finished water reservoir effluent to maintain the needed residual in the distribution system.

A schematic showing the proposed treatment processes for this alternative is shown on Figure 7-2.

7. WATER SYSTEM ALTERNATIVES EVALUATION

Fig 7-2

7. WATER SYSTEM ALTERNATIVES EVALUATION

2. Alternative B – New 12 mgd Dillman WTP. Construct a 12 mgd membrane filtration water treatment plant that is expandable to 24 mgd, adjacent to the Dillman Wastewater Treatment Plant (WWTP), near Dillman Road and Victor Pike. Raw water would be conveyed through a 36-inch transmission main from a new intake located near the Indiana Department of Natural Resources (IDNR) site on Lake Monroe. From the Dillman WTP's high service pumps, finished water would be conveyed through a 36-inch transmission main into two 24-inch Central service level mains at Rockport and Tapp Roads and a 16-inch main along West Country Club Drive between Rockport Road and South Old SR 37. This alternative also includes retrofitting the Monroe WTP with a 24 mgd submerged-type membrane filtration system installed in the existing conventional gravity filter boxes to provide the same high quality water as the new Dillman WTP.

a. Advantages.

- The intake facility can be expanded easily to a capacity of 24 mgd.
- Residuals can be pumped to the Dillman WWTP for processing, thereby eliminating the need for a residuals dewatering facility.
- Treated water would be pumped directly into the Central service level, thereby eliminating the need for the Fullerton pump station and tank previously proposed by CBU.
- Provides 12 mgd of treated water to the system in the event that the Monroe WTP or intake is off-line or if there is a break in the existing 36-inch finished water transmission main.
- Having two separate withdrawal locations on Lake Monroe provides a greater level of security than with a single supply and treatment facility.

7. WATER SYSTEM ALTERNATIVES EVALUATION

- Lake Monroe is used, which has an abundant supply of good quality raw water.

- There is familiarity with the water supply.

b. Disadvantages

- Increases O&M costs by having a second water treatment plant and staff.

- Has high capital cost.

c. Required Treatment Processes

The Dillman WTP will treat water from Lake Monroe, the quality of which was identified earlier in this chapter. The design objective for the Dillman WTP is to provide economical and efficient water treatment that will:

- Achieve finished water turbidities consistently below 0.1 NTU.

- Maintain TTHM and HAA5 concentrations at less than 0.08 mg/L and 0.06 mg/L, respectively, throughout the CBU distribution system.

- Incorporate a process to inactivate or remove *Cryptosporidium* oocysts.

- Develop a layout that offers future ease of expansion.

The treatment processes available for obtaining the design treatment objectives are as described earlier for Alternative A. The proposed treatment components for Alternative B consist of a raw water intake, pump station, rapid mix, flocculation/sedimentation, MF/UF membranes, and a finished water reservoir. Some of the MF/UF waste could be recovered with a small packaged treatment

system, which would include coagulant and polymer addition and plate settlers. The effluent would be returned to the head of the main plant.

Sodium hypochlorite, sodium hydroxide, and fluoride will be added at the finished water reservoir influent. The reservoir will be baffled to achieve adequate CT. Sodium hypochlorite and aqueous ammonia will be added at the finished water reservoir effluent to maintain the needed residual in the distribution system.

The proposed intake and raw water pump station should be sized for 24 mgd so the future pumps and associated valves, piping, electrical and instrumentation can be installed when additional capacity is needed.

A schematic showing the proposed treatment processes for Alternative B is shown on Figure 7-3.

7. WATER SYSTEM ALTERNATIVES EVALUATION

Fig 7-3

7. WATER SYSTEM ALTERNATIVES EVALUATION

3. Alternative C – New 12 mgd North WTP Using Groundwater Supply. Construct a 12 mgd North membrane filtration water treatment plant that is expandable to 24 mgd, near Bottom Road and State Route 37 or adjacent to the Blucher Poole WWTP. Groundwater from a collector well, located approximately 12 miles north of Bloomington near the confluence of the White River and Bean Blossom Creek, would be conveyed through a 36-inch transmission main to the new plant. The plant will treat the water using membrane filtration for solids removal and reverse osmosis for softening. Another consultant has already completed a preliminary study for CBU that evaluated using a groundwater supply. The water supply has not been classified as strictly groundwater or as under the direct influence of surface water at this time. If the water supply to the North is considered to be strictly groundwater, using MF/UF membranes prior to RO membranes would not be recommended from an economical standpoint; oxidation of any iron and manganese followed by conventional gravity media filters would be recommended in lieu of the MF/UF membranes. From the new North plant, finished water would be conveyed through a 36-inch transmission main to the Central service level mains near Stonemill Road and Old State Route 37. If the North plant is expanded to 24 mgd, then the 36-inch main should be extended as a 24-inch main along Walnut Street to the existing 24-inch main on 20th Street. Alternative C also includes retrofitting the Monroe WTP with a 24 mgd submerged-type membrane filtration system to provide the same high quality water as the new North WTP.

a. Advantages

- The water supply is independent of Lake Monroe, and provides a greater level of security as compared to a single supply and treatment facility.

- Provides 12 mgd of treated water to the system in the event that the Monroe WTP or intake is off-line or if there is a break in the existing 36-inch finished water transmission main.

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- Less pumping head is required conveying water to the northern extremities of the distribution system from the proposed North WTP than from the existing Monroe or proposed Dillman WTP.

- Residuals can be pumped to the Blucher Poole WWTP for processing, thereby eliminating the need for a residuals dewatering facility.

b. Disadvantages

- Increases O&M costs by having a second water treatment plant and staff.

- Requires a new collector well and associated piping to expand the plant to 24 mgd.

- Has water quality compatibility concerns related to the mix of treated surface water and groundwater.

- Has high capital cost.

c. Required Treatment Processes

As available data are limited on the groundwater quality in the area near the confluence of the White River and Bean Blossom Creek, a conservative approach was used to develop probable treatment facility requirements. Before treatment processes can be finalized, additional water quality data will need to be collected and reviewed. The classification of the groundwater also will need to be determined since treatment requirements are different depending on whether the groundwater is considered under the influence of surface water or strictly groundwater. If the water source is classified as a groundwater supply, the provisions of the SWTR will not apply. If the water source is classified as under the influence of surface water, the principal implications would be in the monitoring and disinfection aspects of the SWTR. It is anticipated that the raw

7. WATER SYSTEM ALTERNATIVES EVALUATION

water will be considered a groundwater source not under the influence of surface water.

Preliminary data, as presented in another consultant's study, and listed in Table 7-2, was utilized to make initial evaluations of the groundwater quality in the area and possible treatment schemes. The water is quite hard and requires softening as well as iron and manganese removal.

Table 7-2
Groundwater Quality Data

Constituent	Concentration[a,b]
Alkalinity	241
Total Hardness	385
Iron	1.80
Manganese	0.22
Fluoride	0.28
pH	7.2
Turbidity	0.20

a. Values shown are for groundwater not under the direct influence of surface water.
b. All values in mg/L except pH, Turbidity in NTUs.

The design objective for the North WTP is to provide economical and efficient water treatment that will:

- Reduce iron and manganese concentrations to below 0.3 mg/L and 0.05 mg/L, respectively.
- Reduce total hardness of the finished water to 150 mg/L as $CaCO_3$.
- Achieve finished water turbidities consistently below 0.1 NTU.

7. WATER SYSTEM ALTERNATIVES EVALUATION

- Maintain TTHM and HAA5 concentrations at less than 0.08 mg/L and 0.06 mg/L, respectively, throughout the CBU distribution system.

- Incorporate a process to inactivate or remove *Cryptosporidium* oocysts, if the groundwater is under the influence of surface water.

- Stabilize the finished groundwater to prevent corrosive conditions and the precipitation or dissolution of existing deposits when mixed with finished surface water in the CBU distribution system.

- Develop a layout that offers future ease of expansion.

The following treatment processes are available for obtaining the design treatment objectives:

- Iron and Manganese Removal

  Iron and manganese are commonly found in well water supplies and are generally attributed to the solution of rocks and minerals; chiefly metal oxides, sulfides, carbonates, and silicates. To avoid stains in laundry and on plumbing fixtures, iron concentrations should be less than 0.3 mg/L and manganese concentrations should be less than 0.05 mg/L.

  There are several methods available to remove iron and manganese in public water supplies. They can be removed by:

  1. Aeration, Chemical Oxidation, and Filtration (Gravity Filters Equipped with "Synthetic" Greensand, Microfiltration (MF), or Ultrafiltration (UF)).

     The raw water is aerated, thereby oxidizing the soluble iron and manganese and converting them to insoluble compounds. Potassium permanganate is added after aeration to speed the manganese reactions,

7. WATER SYSTEM ALTERNATIVES EVALUATION

which are otherwise very slow. Nearly all of the iron and manganese reactions will be completed during a typical 30 minute retention process. If aeration is not used, oxidation can be accomplished by using chemicals only. The precipitates of iron and manganese that form can then be removed by a filtration process. Gravity filters equipped with "synthetic" greensand media or MF/UF membranes can physically remove the oxidized iron and manganese. "Synthetic" greensand filters use a base material, comprised of sand or anthracite, coated with manganese oxide and remove any residual soluble manganese.

2. Removal in Conjunction with Lime-Soda Softening.

Lime-soda softening is a process of removing carbonate and non-carbonate hardness by the addition of lime for carbonate hardness removal; and soda ash, or lime plus soda ash for the removal of non-carbonate hardness. The primary purpose of the lime-soda softening process is to remove calcium and magnesium hardness. When the alkalinity of the raw water is raised to precipitate the calcium and magnesium, iron and manganese are converted to insoluble iron and manganese hydroxide precipitates and are removed by sedimentation and filtration.

- Hardness Removal

Water hardness is a measure of the dissolved calcium and magnesium compounds in the water. There are two types of hardness, carbonate and noncarbonate. Carbonate hardness is caused by the carbonates and bicarbonates of calcium and magnesium. Noncarbonate hardness is caused by the nitrates, chlorides, and sulfates of calcium and magnesium. MF/UF membranes cannot remove dissolved hardness.

7. WATER SYSTEM ALTERNATIVES EVALUATION

The total hardness will be reduced to 150 mg/L as $CaCO_3$. Although the hardness will be greater than that leaving the Monroe WTP (65 mg/L as $CaCO_3$), 150 mg/L is more economically feasible and should be acceptable to the users.

Some common methods of softening include:

1. Reverse Osmosis (RO) Membranes

   RO membranes have a pore size typically less than 0.001 microns and can remove particles down to ion size, including the molecules that cause hardness. This softens the water. It is not necessary to treat all the water leaving filtration (MF/UF membranes or conventional gravity media filters) with RO membranes. To obtain a desired finished water hardness of 150 mg/L, approximately 30% of the MF/UF filtered water would bypass the reverse osmosis membranes and then be blended with the softened water to achieve the 150 mg/L hardness goal. Bypassing less flow could proportionately reduce the finished water hardness, but would affect the amount of RO membranes needed. This process could be automated to function with little operator intervention; however, this process would be more costly than conventional softening processes.

2. Ion Exchange Softening

   In ion exchange softening, two sodium ions are put into solution for each calcium or magnesium ion that is removed. The process uses an exchange resin to replace the calcium and magnesium ions with sodium ions, thereby softening the water. Once the resin exchange capacity has been exhausted, it must be regenerated using a sodium chloride (salt) solution. Disposal of the removed calcium and magnesium chloride from regeneration can be and may become more problematic as regulations on

discharges become more stringent. The process is typically more economical and more easily operated than lime-soda softening.

3. Lime-Soda Softening

Lime-soda softening adds alkalinity to the water to precipitate hardness causing calcium and magnesium compounds. Lime alone is used to precipitate carbonate hardness. Soda ash, soda ash and lime, or caustic soda (sodium hydroxide) are used to precipitate noncarbonate hardness. The effluent from the lime-soda process is typically caustic and high in pH. The water contains calcium hydroxide, which must be converted to calcium carbonate and then to calcium bicarbonate to stabilize the water. This neutralization process is accomplished by recarbonation, typically through the addition of carbon dioxide. Lime-soda softening requires more operator attention and is not easy to automate.

- Turbidity Removal

Fine particles, such as organic solids, viruses, bacteria, algae, and other substances that scatter light in the drinking water cause turbidity. By definition, turbidity is the measure of the scattered light from a controlled source measured at 90 degrees to the path of light. Conventional gravity media filters or MF/UF membranes could be used to remove turbidity. MF/UF membranes are capable of high particle removal rates due to their ability to provide an absolute barrier to particles and other constituents larger than their pore size. Since MF/UF membranes are capable of removing turbidity, particles, and total suspended solids, water can be treated using such membranes.

If the groundwater is classified as under the influence of surface water, it is recommended that MF/UF membranes be implemented. If the water source

is determined to be "strictly" groundwater, then conventional gravity media filtration would be appropriate.

- Disinfectant Byproduct Removal

  Although a disinfectant (free chlorine) residual is required, it is recognized that an excessive amount of disinfectant residual may pose a threat to health as well as contribute to increased formation of undesirable disinfection byproducts. The precursors of disinfection byproduct formation are naturally occurring organic substances. When combined with any of the disinfectants, DBPs will form. To meet regulations, CBU must maintain TTHM and HAA5 concentrations throughout the distribution system at less than 0.08 mg/L and 0.06 mg/L, respectively. Since MF/UF membranes have been found to be capable of removing some of the DBP precursors, their use should be considered.

- *Cryptosporidium* Removal

  Systems treating surface water or groundwater under the direct influence of surface water and serving more than 10,000 consumers must achieve at least a 2-log (99%) removal of *Cryptosporidium*. Research and outbreaks of water-borne diseases have shown that certain viruses and bacteria, such as *Cryptosporidium* resist conventional treatment. Therefore, alternate treatment technologies are desirable. MF/UF membranes are a physical process in which particles larger than 0.1 microns for microfiltration and larger than 0.01 microns for ultrafiltration are removed from the water by straining through a porous medium. As these pore sizes are significantly smaller than *Cryptosporidium* oocysts (2 to 5 microns), MF/UF membranes provide excellent removal of these microbial contaminants. MF/UF is an alternate treatment technology that will improve the control of microbial pathogens in the drinking water, particularly *Cryptosporidium*.

7. WATER SYSTEM ALTERNATIVES EVALUATION

If the groundwater is classified under the direct influence of surface water, the proposed treatment components for Alternative C consist of a collector well, pump station, MF/UF membranes, reverse osmosis membranes, and a finished water reservoir. If the water source is determined to be "strictly" groundwater, then conventional gravity media filtration could be implemented in lieu of MF/UF membranes.

CBU has expressed interest in softening the water using reverse osmosis as well as having an automated plant. Conventional filtration, membrane filtration, and reverse osmosis can be easily automated. Thus, either conventional filtration or membrane filtration, and reverse osmosis for softening have been proposed.

Sodium hypochlorite, sodium hydroxide, and fluoride will be added at the finished water reservoir influent. The finished water reservoir will be baffled to achieve adequate CT. Sodium hypochlorite and aqueous ammonia will be added at the finished water reservoir effluent to maintain the needed residual in the distribution system.

The RO waste cannot be recovered with a small packaged treatment system, like Alternative B, very cheaply. The only means of recovering the waste include a thermal process, essentially distillation, and that would be uneconomical. The RO waste would be discharged to a nearby sewer for treatment at the Blucher Poole WWTP.

If the North WTP is expanded in the future, another collector well will need to be constructed.

A schematic showing the proposed treatment processes for Alternative C is shown on Figure 7-4.

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Fig 7-4

7. WATER SYSTEM ALTERNATIVES EVALUATION

4. Option to Alternative C – New 12 mgd North WTP Using Surface Water Supply (Lake Lemon, Bean Blossom Creek, and Griffy Lake). Construct a new 12 mgd North water treatment plant, near State Route 37 and Bean Blossom Creek. Surface water from Lake Lemon, Bean Blossom Creek, and Griffy Lake will be treated using MF/UF membrane filtration. This option also includes retrofitting the Monroe WTP with a 24 mgd submerged-type MF/UF membrane filtration system to provide the same high quality water as the new North WTP.

a. Advantages

- Water supply is independent from Lake Monroe, which provides a greater level of security as compared to a single supply and treatment facility.
- Provides 12 mgd of treated water to the system in the event that the Monroe WTP or intake is off-line or if there is a break in the existing 36-inch finished water transmission main.
- Less pumping head is required conveying water to the northern extremities of the distribution system from the proposed North WTP than from the existing Monroe or proposed Dillman WTP.
- Residuals can be pumped to the Blucher Poole WWTP for processing, thereby eliminating the need for a residuals dewatering facility.

b. Disadvantages

- The water source likely does not have sufficient yield to support expansion of the proposed 12 mgd plant in the future without other sources to supplement the North supply.
- Increases O&M costs by having a second water treatment plant and staff.

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c. Required Treatment Processes

Water quality data for the proposed raw water sources were reviewed to identify constituents that would affect the treatment of the water for domestic use. Since water quality data are not available at this time, it was assumed that the water quality was the same as that presented in the 1986 Master Plan Report and as listed in Table 7-3. Before treatment processes can be finalized, water quality data will need to be collected and reviewed. The hardness concentration of the combined raw water to the North facility is expected to be acceptable, so no softening is anticipated. In the event that the surface water supply is supplemented with groundwater, it is likely that softening will be required. Therefore, provisions for adding RO membranes should be addressed during the design of the facility.

Table 7-3
1986 Lake Lemon, Bean Blossom Creek, and Griffy Lake Water Quality Data

	Lake Lemon		Bean Blossom Creek		Griffy Lake	
Constituent	**Average**	**Range**	**Average**	**Range**	**Average**	**Range**
Alkalinity	44	36-56	48	38-56	95	92-100
Total Hardness	97	83-113	114	89-135	248	222-298
Calcium	28	24-34	34	26-43	88	77-108
Magnesium	6.3	5.8-6.7	6.7	6.0-7.1	7.0	7.0-7.1
Iron	1.5	1.3-1.6	1.4	0.7-2.0	1.0	0.3-2.0
Manganese	0.10	0.07-0.14	0.13	0.0-0.24	0.08	0.04-0.14
Chloride	7	2-9	6	1-9	6	1-9
Sulfate	34	26-43	28	21-235	25	25-26
Fluoride	0.12	0.11-0.13	0.11	0.08-0.13	0.12	0.10-0.13
Total Dissolved Solids	128	114-154	124	98-158	179	176-184
Turbidity	15	12-18	17	14-20	14	5-23
pH	7.3	6.9-7.6	7.4	7.2-7.5	7.3	6.9-7.6

a. All values in mg/L except pH, Turbidity in NTUs.

7. WATER SYSTEM ALTERNATIVES EVALUATION

The design objective for the North WTP using a surface water supply is to provide economical and efficient water treatment that will:

- Reduce iron and manganese concentrations to below 0.3 mg/L and 0.05 mg/L, respectively.
- Reduce total hardness of the finished water to 150 mg/L as $CaCO_3$.
- Achieve finished water turbidities consistently below of 0.1 NTU.
- Maintain TTHM and HAA5 concentrations at less than 0.08 mg/L and 0.06 mg/L, respectively, throughout the CBU distribution system.
- Incorporate a process to inactivate or remove *Cryptosporidium* oocysts.
- Develop a layout that offers future ease of expansion.

The treatment processes available for obtaining the design treatment objectives are as described earlier for Alternative C. The proposed treatment components for the surface water supply consist of an intake/pump station, rapid mix, flocculation/sedimentation, MF/UF membranes, and a finished water reservoir.

Sodium hypochlorite and potassium permanganate will be used to oxidize iron and manganese. Sodium hypochlorite, sodium hydroxide, and fluoride will be added at the finished water reservoir influent. The reservoir will be baffled to achieve adequate CT. Sodium hypochlorite and aqueous ammonia will be added at the finished water reservoir effluent to maintain the needed residual in the distribution system.

7. WATER SYSTEM ALTERNATIVES EVALUATION

E. FUTURE REGULATORY CONSIDERATIONS

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) is intended to protect the public health from excessive exposure to *Cryptosporidium* and applies to all systems that use surface water or groundwater under the influence of surface water. *Cryptosporidium* is very small and chemically resistant and therefore difficult to capture, destroy, or inactivate. The Rule incorporates system specific treatment requirements based on source water *Cryptosporidium* monitoring. Stage 2 of the Rule may require additional treatment, such as ozone, chlorine dioxide, ultraviolet (UV) irradiation, membranes, bag/cartridge filters, or in-bank filtration, depending on monitoring results. It is anticipated that Stage 2 of the Rule takes effect by 2008.

CBU has expressed a strong interest in using membranes to comply with future turbidity requirements, possible *Cryptosporidium* removal requirements and to provide high quality water to its customers. Membranes provide a positive barrier to Cryptosporidium and are a strong candidate for use, especially at a new water treatment plant. Since the Monroe WTP is presently in compliance with finished water turbidity requirements, CBU should consider evaluating UV for *Cryptosporidium* inactivation at the Monroe WTP before making a final decision to implement membranes. UV testing on a pilot-scale would be required before any decision could be made on full-scale implementation. If UV was implemented and the Monroe WTP expanded in capacity, additional gravity media filters would be required. Because either 24 mgd or 36 mgd of membranes would need to be installed at the Monroe WTP, it is likely that an expansion using conventional gravity media filters and implementation of UV for *Cryptosporidium* inactivation would be more economical than membrane filtration.

UV disinfection has proven to be effective at inactivating *Cryptosporidium*. Ultraviolet light penetrates the bacteria's cell wall and alters the genetic makeup,

7. WATER SYSTEM ALTERNATIVES EVALUATION

DNA, and renders the bacteria incapable of replication and terminates its life cycle. UV disinfection is a relatively low-cost technology.

The advantages of UV include:

- Lower costs than for comparable microbial control process (ozone or microfiltration);
- Requires little space and can usually be easily incorporated into existing plants;
- Does not produce any known toxic or significant nontoxic byproducts.

F. WATER SYSTEM IMPROVEMENTS SCHEDULE

The maximum day water demands are projected to be 24 mgd by 2010 as discussed in Chapter 3, Water Requirements. Therefore, the 2010 maximum day water demand is expected to exceed the capacity of the Monroe WTP. As water treatment plants are typically sized to provide maximum day water demands, it is recommended that the water system improvements be completed and operational in the Year 2008.

To ensure ample time, CBU should allow 30 months for construction and start-up of the new facilities. In addition, approximately 20 months should be allowed for preliminary design; detailed design; obtain all permits and approvals; acquire all necessary land and easements; accept bids; and award the construction contract. Thus the total time from beginning of the preliminary design through construction is estimated to be 50 months. A schedule indicating the major project milestones is shown in Table 7-4.

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As this capital improvements program represents an important and critical decision on the direction of the water utility, it is paramount to include the public in the selection of the alternatives described herein. The schedule allows several months for obtaining input and comments through public meetings prior to making a decision and proceeding with the capital improvements program.

7. WATER SYSTEM ALTERNATIVES EVALUATION

Table 7-4

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

A. GENERAL

This chapter presents the preliminary opinion of probable construction costs for the alternatives presented in Chapters 6 and 7. All of the costs presented herein reflect price levels for the year 2002 and include an allowance of 20 percent for contingencies. The costs do not include administration, legal, and engineering costs; CBU staff salaries or expenses related to the project; permit or plan review fees; or costs for surveying, subsurface investigations, land acquisition, easements, or unusual construction conditions other than those specifically identified herein.

B. ALTERNATIVES

The following alternatives were described in detail in Chapter 7.

1. Alternative A. Expand the 24 mgd Monroe WTP to 36 mgd and replace the existing filters with a membrane filtration system with a capacity of 36 mgd.

Expansion of the Monroe WTP to 36 mgd will necessitate upgrading the existing intake facility to increase the pumping capacity. The existing intake facility was designed to accommodate expansion to 36 mgd. The existing pump intake ports are sized to handle 36 mgd with a velocity through the ports of less than 2 fps. Modifications to the existing intake facility will include removal and replacement of two existing 6 mgd low service pumps with two new 12 mgd pumps, upgrade of the existing potassium permanganate feed system, and upgrade of the existing electrical substation. It is assumed that the existing traveling screens are sized adequately to handle 36 mgd. Other miscellaneous piping and valve modifications will be made, as required to convey 36 mgd.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

A new 30-inch raw water main is recommended to transfer the additional flow from the intake facility to the plant. The new raw water piping will connect to the existing 36-inch line outside the intake facility. Additional valves will be provided, as required for isolation. The length of the new raw water main is approximately 3,000 linear feet.

A preliminary hydraulic profile analysis indicates that the expansion of the Monroe WTP to a capacity of 36 mgd will require construction of one flocculation/sedimentation basin adjacent the existing basins. The new basin will have a rated capacity of 12 mgd and will be provided with flocculators, circular clarifying equipment, and stainless steel plate settlers.

Modifications to the Filter Building will include removal of the existing filter media and underdrain system and installation of new submerged-type membranes, sized for 36 mgd, in the existing filter boxes. As part of retrofitting the Filter Building, new piping additions and some piping modifications will be required to accommodate the membranes. Also, it is anticipated that a new pre-engineered metal building will be required to house the membrane auxiliary equipment. The building will have an approximate area of 3,000 ft^2.

The firm capacity of the existing Transfer Pump Station will need to be increased from 24 mgd to 36 mgd. This will include the installation of two 6 mgd pumps in the open pump slots and associated piping and valve installations. The existing high service pumps have a firm capacity of 24 mgd; therefore, improvements will be required to increase the capacity to 36 mgd. Two of the 8 mgd pumps will need to be replaced with 14 mgd pumps.

The existing chemical feed systems will need to be upgraded to handle increased chemical dosages associated with the 36 mgd of flow. The upgrades to the existing chemical feed system will include installation of additional equipment, tanks, piping, valves, and associated electrical and controls.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

The existing electrical substation at the treatment plant will need to be upgraded to accommodate the additional electrical load.

A new 36-inch finished water transmission main will be constructed from the Monroe WTP to Harrell and Moffat Roads and will connect to the existing 36-inch finished water transmission main and to the proposed Southeast Transmission Main. The new piping will accommodate the additional flow and provide redundancy to the existing 36-inch finished water piping. The length of the new finished water main is approximately 17,000 linear feet.

For the expansion of the Monroe WTP, additional storage and pumping capacity is required in the South service level to convey water to the Central service level. CBU and Black & Veatch have studied a project, the Southeast Water System Improvements, to provide reliability to the existing transmission main and the South-Central pump station. For Alternative A, this project will be constructed to convey the additional flow and to provide reliability. The Southeast pump station will have an initial firm capacity of 12 mgd, expandable to a firm capacity of 18 mgd, giving a total firm capacity of 36 mgd, expandable to 42 mgd, for the South-Central and Southeast pump stations.

Some basic assumptions have been made regarding the construction materials, components, equipment, and processes. These assumptions are discussed below:

<u>Existing Monroe Intake Facility</u>

- Remove two 6 mgd pumps and replace with 12 mgd pumps.
- Upgrade potassium permanganate feed system.
- New piping and valves.
- Upgrade electrical substation.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Flocculation/Sedimentation Basin

- One 12 mgd flocculation/sedimentation basin.
- Stainless steel lamella plates.
- Standard clarifier.
- Standard flocculators.
- Cast-in-place concrete construction.

Membrane Treatment Facility

- Submerged type membranes installed in existing filter boxes.
- Pre-engineered metal building for auxiliary equipment.
- Automation and controls.
- Piping modifications.

Existing Transfer Pump Station

- Install new 6 mgd pumps in each of the two open pump slots.
- Electrical and controls.

Existing High Service Pump Station

- Remove two 8 mgd pumps and replace with 14 mgd pumps.
- New adjustable frequency drives.
- Electrical and controls.

Southeast Pump Station

- 12 mgd firm capacity pump station, expandable to 18 mgd firm capacity.
- One engine generator for standby power.
- Single story, brick and block building.
- Concrete foundation.
- 3 pumping units each with 6 mgd capacity, with space for one future pump.
- Pipes installed in pipe chases, no basement.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Southeast Ground Storage Tank

- 2 MG capacity.
- Prestressed concrete or steel construction.
- 60 foot side water depth.
- 80 foot diameter.

Southeast Transmission Main

- Prestressed concrete or ductile iron piping.
- 8,000 linear feet of 30-inch piping along Harrell Road between Moffat and Rhorer Roads.
- 4,000 linear feet of 36-inch piping along Rhorer Road between Harrell and Sare Roads.
- 12,000 linear feet of 24-inch piping along Sare Road between Rhorer Road and Moores Pike.
- 16,000 linear feet of 24-inch piping along Rhorer Road and Gordon Pike to South Rogers Street then north on South Rogers Street to West on Tapp Road to Rockport Road.
- Valves.
- Fire Hydrants.
- Air Release Manholes.

The opinion of probable cost for Alternative A is presented in Table 8-1. This cost includes the associated electrical and instrumentation costs. All costs for the facilities and water mains assume rock excavation. In addition, the finished water mains cost includes pavement replacement for approximately half of the alignment.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-1
Opinion of Probable Construction Cost for Alternative A
Expand the 24 mgd Monroe WTP to 36 mgd

Item	Cost
Intake Facility Improvements	$ 800,000
Expand Monroe WTP to 36 mgd	
Flocculation/Sedimentation Basin (12 mgd)	$ 3,000,000
Membrane Treatment Facility (36 mgd)	$15,000,000
Chemical Feed System Improvements	$ 500,000
Transfer Pump Station Improvements	$ 300,000
High Service Pump Station Improvements	$ 300,000
Electrical Substation Upgrade	$ 500,000
Sitework	$ 600,000
Miscellaneous	$ 1,500,000
Subtotal Expand Monroe WTP to 36 mgd	$21,700,000
Raw and Finished Water Mains (20,000 LF)	$ 5,000,000
Subtotal Intake, Monroe WTP, Water Mains	**$27,500,000**
Southeast Water System Improvements	
Pump Station (12 mgd expandable to 18 mgd)	$ 2,200,000
Ground Storage Tank (2 MG)	$ 1,300,000
Transmission Mains (40,000 LF)	$ 7,500,000
Subtotal Southeast Water System Improvements	**$11,000,000**
Subtotal Probable Cost for Alternative A	**$38,500,000**
Contingencies (20%)	$ 7,700,000
Total Probable Cost for Alternative A	**$46,200,000**

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

As an option to Alternative A, CBU could expand the 24 mgd Monroe WTP in two phases; expand to 30 mgd initially and replace the existing filters with a membrane filtration system with a capacity of 30 mgd. This option reduces the initial capital investment and only those facilities and improvements necessary to supply and treat 30 mgd would be constructed. As water demands increase, the plant would be expanded to 36 mgd. It should be noted that the overall construction cost to complete the expansion in two phases will be more than completing the work in a single phase.

This option would be the same as Alternative A with the following exceptions:

- Only one intake facility pump would be replaced to provide a firm pumping capacity of 30 mgd.
- Only one high service pump would be replaced to provide a firm pumping capacity of 30 mgd.
- The third basin train at the plant would not be constructed until the plant is expanded to 36 mgd.
- Install 30 mgd membrane filtration system in the existing filter boxes instead of 36 mgd.

The new facilities would allow for easy expansion to 36 mgd in the future. The piping would be sized to accommodate a flow of 36 mgd.

The opinion of probable cost for the option to Alternative A is presented in Table 8-2. The cost includes associated electrical and instrumentation costs. All costs for the facilities and water mains assume rock excavation.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-2
Opinion of Probable Construction Cost for Option to Alternative A
Expand the 24 mgd Monroe WTP to 30 mgd

Item	Cost
Intake Facility	$ 700,000
Expand Monroe WTP to 30 mgd	
Membrane Treatment Facility (30 mgd)	$13,000,000
Chemical Feed System Improvements	$ 500,000
Transfer Pump Station Improvements	$ 300,000
High Service Pump Station Improvements	$ 300,000
Electrical Substation Upgrade	$ 500,000
Sitework	$ 400,000
Miscellaneous	$ 1,500,000
Subtotal Expand Monroe WTP to 30 mgd	$16,500,000
Raw and Finished Water Mains (20,000 LF)	$ 5,000,000
Subtotal Intake, Monroe WTP, Water Mains	**$22,200,000**
Southeast Water System Improvements	
Pump Station (12 mgd expandable to 18 mgd)	$ 2,200,000
Ground Storage Tank	$ 1,300,000
Transmission Mains (40,000 LF)	$ 7,500,000
Subtotal Southeast Water System Improvements	**$11,000,000**
Subtotal Probable Cost for Option to Alternative A	**$33,200,000**
Contingencies (20%)	$ 6,700,000
Total Probable Cost for Option to Alternative A	**$39,900,000**

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

2. Alternative B. New 12 mgd water treatment plant, expandable to 24 mgd, with membrane filtration, and adjacent the Dillman WWTP. This alternative includes an intake located at the IDNR site on Lake Monroe and retrofit of the 24 mgd Monroe WTP with membrane filtration with a capacity of 24 mgd.

The new water treatment plant will consist of the following:

- Flocculation/sedimentation basins (two trains, each with 6 mgd capacity)
- 12 mgd membrane filtration facility
- Chemical feed and storage facility
- High service pump station
- Administrative Facilities
- Laboratory
- Finished water storage reservoir
- Residuals pumping station
- Site work
- Engine Generators for standby power

For the opinions of probable construction cost for Alternative B, some basic assumptions have been made regarding the facility's construction materials, components, equipment, and processes. These assumptions are discussed below:

<u>Intake Facility</u>

- Pumping and Chemical Feed Structure constructed on the lake shore approximately 50 feet by 50 feet in plan.
- Crib structure located in the lake approximately 15 feet by 15 feet in plan.
- Two directional bore tunnels between the pump and crib structures.
- Cast-in-place concrete construction.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

- Two separate wetwells in the pump structure for maintenance.
- Two traveling screens.
- 2 pumps equipped with adjustable frequency drives.
- An electrical room.
- A chemical feed room.
- A piping gallery below the operating floor level for pump discharge piping.
- Traveling bridge crane.
- An engine generator for standby power.

Flocculation/Sedimentation Basins

- Two 6 mgd flocculation/sedimentation basin trains.
- Stainless steel lamella plates in each basin.
- Standard clarifier in each basin.
- Standard flocculators in each basin.
- 2-cell rapid mix basin.
- Cast-in-place concrete, common wall construction.

Membrane Treatment Facility

- Submerged or cartridge type membranes (12 mgd capacity).
- Concrete boxes to house the submerged membranes or a building with a slab on grade to house the cartridge membranes.
- Pumping equipment.
- Auxiliary equipment.
- Automation and controls.
- Single story, brick & block building.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Chemical Feed and Storage Facility

- Single story, brick & block building.
- Cast-in-place concrete foundation.
- Chemical storage and day tanks, designed for liquid storage where practical.
- Metering and feed pumps.

High Service Pump Station

- Brick & block building.
- Cast-in-place concrete foundation.
- 3 pumps at 6 mgd each, with space for 2 additional pumps in the future.
- 2 pumps equipped with adjustable frequency drives.
- Pipe gallery below the operating floor for suction and discharge piping.

Administrative Facilities

- Single story, brick & block building.
- Cast-in-place concrete foundation.
- Offices, storage space, and break room.
- Control room with SCADA system
- Bathrooms with locker facilities.
- Janitor's closet.

Operator Laboratory

- Single story, brick & block building.
- Basic laboratory analysis equipment.
- Laboratory benches and cabinets.

Finished Water Storage

- 2.4 MG prestressed concrete circular reservoir.
- Constructed at grade.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Residuals Pump Station

- Three submersible residuals pumps.
- Cast-in-place concrete basin (50,000 gallon capacity).

Site Work

- Excavation of soil for new facilities.
- Finish grading and top soil.
- Yard piping.
- Yard valves.
- Miscellaneous yard structures.
- Drive and access road.

Engine Generator

- An engine generator for standby power at the new WTP.

The high service pump station structure will include three high service pumps and space for two future high service pumps. A finished water clearwell with a capacity of 2.4 MG will be provided. The residuals pump station will be used to convey the residuals stream generated at the new water treatment plant to the existing Dillman WWTP.

The intake facility for this plant will be located on Lake Monroe at the IDNR site. The intake structure initially will consist of three 6 mgd pumps for a firm capacity of 12 mgd, with space for two future pumps. The intake facility will be provided with an engine generator for standby power. A new 36-inch raw water main will be installed from the intake facility to the new plant and will include one bored roadway crossing. In addition, a new 36-inch finished water main will be installed from the plant to the distribution system. The total length of raw and finished water piping will be approximately 45,000 feet. The finished water main would convey water directly to the Central service level.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Retrofitting the existing Monroe WTP will involve removal of the existing filter media and underdrain system and installation of new submerged-type membranes in the existing filter cells. Initially, the total capacity of the membranes will be 24 mgd. Additional membranes can be added in the future, as additional capacity is required. As part of retrofitting the Filter Building, new piping additions and some piping modifications will be required to accommodate the membranes. Also, it is anticipated that a new pre-engineered metal building will be required to house the membrane auxiliary equipment. The building will have an approximate area of 3,000 square feet.

The opinion of probable cost for Alternative B is presented in Table 8-3. This cost includes the associated electrical and instrumentation costs. All costs for the facilities and water mains assume rock excavation.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-3
Opinion of Probable Construction Cost for Alternative B
New 12 mgd WTP Adjacent to Dillman WWTP

Item	Cost
Intake Facility	$ 7,500,000
New Water Treatment Plant	
Flocculation/Sedimentation Basins	$ 2,500,000
Membrane Treatment Facility (12 mgd)	$ 6,500,000
Chemical Feed and Storage Facility	$ 2,000,000
High Service Pump Station	$ 3,700,000
Administrative Facilities	$ 500,000
Laboratory	$ 300,000
Finished Water Storage	$ 1,500,000
Residuals Pump Station	$ 500,000
Site Work	$ 2,000,000
Engine Generator	$ 500,000
Miscellaneous	$ 2,500,000
Subtotal New Water Treatment Plant	$22,500,000
Raw and Finished Water Mains (45,000 LF)	$10,000,000
Subtotal Intake, New WTP, Water Mains	**$40,000,000**
Retrofit Monroe WTP	
24 mgd Membrane Filtration System	$11,000,000
Miscellaneous	$ 1,000,000
Subtotal Retrofit Monroe WTP	**$12,000,000**
Subtotal Probable Cost for Alternative B	**$52,000,000**
Contingencies (20%)	$10,400,000
Total Probable Cost for Alternative B	**$62,400,000**

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

3. Alternative C. New 12 mgd North water treatment plant using groundwater and treatment using membrane filtration for solids removal and reverse osmosis for softening. This alternative also includes retrofitting the Monroe WTP with a membrane filtration system with a capacity of 24 mgd.

Under Alternative C, a new 12 mgd water treatment plant will be constructed north of Bloomington, possibly near the Blucher Poole WWTP or along Route 37 near Bean Blossom Creek. The new water treatment plant will consist of the following:

- Collector well (14 mgd capacity)
- Ultrafiltration/microfiltration membrane facility (14 mgd capacity).
- Reverse osmosis facility for softening (treating approximately 70 percent of the plant flow).
- Chemical feed and storage facility.
- High service pump station.
- Administrative facilities and laboratory.
- Finished water storage reservoir.
- Residuals pump station.
- Site work.
- Engine generators for standby power.

Because water quality data has not been collected at the proposed groundwater sites, it is estimated that the reverse osmosis membranes will have a recovery of approximately 80 percent (20 percent reject stream). Therefore, a 14 mgd collector well and treatment facilities prior to reverse osmosis are required to provide a finished water capacity of 12 mgd.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

For the opinions of probable construction cost for Alternative C, basic assumptions have been made regarding the facility's construction materials, components, equipment, and processes. These assumptions are discussed below.

Collector Well

- Approximately 100 foot deep collector well.
- Caisson constructed of concrete (16 foot diameter).
- Approximately 30 foot by 30 foot pump structure supported by the caisson.
- 3 pumps, each with a 7 mgd capacity.
- 2 pumps equipped with adjustable frequency drives.
- Cast-in-place concrete construction.
- An engine generator for standby power.

Membrane Treatment Facility

- Submerged or cartridge type membranes (14 mgd capacity).
- Concrete boxes to house the submerged membranes or a building with a slab on grade to house the cartridge membranes.
- Pumping equipment.
- Automation and controls.
- Single story, brick and block building.

Reverse Osmosis Facility

- Single story, brick and block building.
- Cast-in-place concrete slab foundation.
- Approximately 13,000 square foot of area.
- Reverse osmosis membranes (7.7 mgd capacity).
- Piping and valves.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Chemical Feed and Storage Facility

- Single story, brick and block building.
- Cast-in-place concrete foundation.
- Chemical storage and day tanks, designed for liquid storage where practical.
- Metering and feed pumps.

High Service Pump Station

- Brick and block building.
- Cast-in-place concrete foundation.
- 3 pumps at 6 mgd each, with space for 2 additional pumps in the future.
- 2 pumps equipped with adjustable frequency drives.
- Pipe gallery below the operating floor for suction and discharge piping.

Administrative Facilities

- Single story, brick and block building.
- Concrete foundation.
- Offices, storage space, and break room.
- Control room with SCADA system
- Bathrooms with locker facilities.
- Janitor's closet.

Operator Laboratory

- Single story, brick and block building.
- Basic laboratory analysis equipment.
- Laboratory benches and cabinets.

Finished Water Storage

- Prestressed concrete circular reservoir.
- Constructed at grade.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Residuals Pump Station

- Minimum of three residuals pumps.
- Cast-in-place concrete basin (50,000 gallon capacity).

Site Work

- Excavation of soil for new facilities.
- Finish grading and top soil.
- Yard piping.
- Yard valves.
- Miscellaneous yard structures.
- Drive and access road.

Engine Generators

- An engine generator for standby power at the new WTP.

For the raw and finished water mains construction, it has been assumed that no rock excavation will be required based on available information. Also, a minimal amount of pavement replacement and one bored roadway crossing has been assumed. If the North WTP is located near the Blucher Poole WWTP, approximately 64,000 linear feet of raw water main and 18,500 linear feet of finished water main will be required. Therefore, the opinion of probable construction cost is based on 82,500 linear feet of 36-inch diameter ductile iron water main.

Retrofitting the existing Monroe WTP will involve removal of the existing filter media and underdrain system and installation of new submerged-type membranes in the existing filter cells. Initially, the total capacity of the membranes will be 24 mgd. Additional membranes can be added in the future, as additional capacity is required. As part of retrofitting the Filter Building, new piping additions and some piping modifications will be required to accommodate

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

the membranes. Also, it is anticipated that a new pre-engineered metal building will be required to house the membrane auxiliary equipment. The building will have an approximate area of 3,000 square feet.

The opinion of probable cost for Alternative C is presented in Table 8-4. This cost includes the associated electrical and instrumentation costs. All costs for the facilities and water mains assume no rock excavation. However, it is assumed that the new facilities may need to be constructed using deep foundations. In particular if the new plant is located near the Blucher Poole WWTP.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-4
Opinion of Probable Construction Cost for Alternative C
New 12 mgd North WTP using Membrane Filtration

Item	Cost
Collector Well	$ 3,000,000
New Water Treatment Plant	
Membrane Treatment Facility (14 mgd)	$ 7,200,000
Reverse Osmosis Membrane Facility (7.7 mgd)	$10,000,000
Chemical Feed and Storage Facility	$ 2,000,000
High Service Pump Station	$ 3,700,000
Administrative Facilities	$ 500,000
Laboratory	$ 300,000
Finished Water Storage	$ 1,500,000
Residuals Pump Station	$ 500,000
Site Work	$ 2,000,000
Engine Generator	$ 500,000
Miscellaneous	$ 2,500,000
Subtotal New Water Treatment Plant	$30,700,000
Raw and Finished Water Mains (85,000 LF)	$16,000,000
Subtotal Well, New WTP, Water Mains	**$49,700,000**
Retrofit Monroe WTP	
24 mgd Membrane Filtration System	$11,000,000
Miscellaneous	$ 1,000,000
Subtotal Retrofit Monroe WTP	**$12,000,000**
Subtotal Probable Construction Cost for Alternative C	**$61,700,000**
Contingencies (20%)	$12,400,000
Total Probable Construction Cost for Alternative C	**$74,100,000**

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

As an option to Alternative C (Option 1), the new 12 mgd North water treatment plant would treat the groundwater supply using conventional gravity media filters, in lieu of microfiltration/ultrafiltration membranes, and reverse osmosis for softening. This option also includes retrofitting the existing Monroe WTP with a membrane filtration system with a capacity of 24 mgd.

For the opinions of probable construction cost for Option 1 to Alternative C, basic assumptions have been made regarding the Filter Building's construction materials, components, and equipment. These assumptions are discussed below:

Filter Building

- 4 filters, each with 4.7 mgd capacity at 4 gpm/ft^2 (14 mgd with one filter out of service).
- Cast-in-place concrete boxes.
- Piping gallery.
- Single story, brick and block building.
- Electrical and controls.

The opinion of probable construction cost for Option 1 to Alternative C is presented in Table 8-5. This cost includes the associated electrical and instrumentation costs. All costs for the facilities and water mains assume no rock excavation. However, it is assumed that the new facilities may need to be constructed using deep foundations. In particular if the new plant is located near the Blucher Poole WWTP.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-5
Opinion of Probable Construction Cost for Option 1 to Alternative C
New 12 mgd North WTP using Gravity Media Filters

Item	Cost
Collector Well	$ 3,000,000
New Water Treatment Plant	
Filter Building	$ 2,500,000
Reverse Osmosis Membrane Facility (7.7 mgd)	$10,000,000
Chemical Feed and Storage Facility	$ 2,000,000
High Service Pump Station	$ 3,700,000
Administrative Facilities	$ 500,000
Laboratory	$ 300,000
Finished Water Storage	$ 1,500,000
Residuals Pump Station	$ 500,000
Site Work	$ 2,000,000
Engine Generator	$ 500,000
Miscellaneous	$ 2,500,000
Subtotal New Water Treatment Plant	$26,000,000
Raw and Finished Water Mains (85,000 LF)	$16,000,000
Subtotal Well, New WTP, Water Mains	**$45,000,000**
Retrofit Monroe WTP	
24 mgd Membrane Filtration System	$11,000,000
Miscellaneous	$ 1,000,000
Subtotal Retrofit Monroe WTP	**$12,000,000**
Subtotal Probable Construction Cost for Option 1 to Alternative C	**$57,000,000**
Contingencies (20%)	$11,400,000
Total Probable Construction Cost for Option 1 to Alternative C	**$68,400,000**

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

A second option to Alternative C is to treat water from Lake Lemon, Bean Blossom Creek, and Griffy Lake. The water qualities of Lake Lemon, Bean Blossom Creek, and Griffy Lake have been assumed to be similar to that of Lake Monroe. Therefore, this option assumes that the treatment processes utilized at the North WTP would be the same as those proposed for the Dillman WTP discussed under Alternative B. This option would include a new intake screen at the Bean Blossom Creek's low head dam and possibly some modifications to the Lake Lemon and Griffy Lake control structures. This option also includes retrofitting the existing Monroe WTP with a membrane filtration system with a capacity of 24 mgd.

Approximately 10,000 linear feet of 30-inch raw and finished water mains are included. It has been assumed that no rock excavation and a minimal amount of pavement restoration will be required for the construction of the mains.

The opinion of probable construction cost for Option 2 to Alternative C is presented in Table 8-6. This cost includes the associated electrical and instrumentation costs. All costs for the facilities and water mains assume no rock excavation. However, it is assumed that the new facilities may need to be constructed using deep foundations.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-6
Opinion of Probable Construction Cost for Option 2 to Alternative C
New 12 mgd North WTP Using Lake Lemon, Bean Blossom Creek, and Griffy Lake

Item	Cost
Intake Facility	$ 2,000,000
New Water Treatment Plant	
Flocculation/Sedimentation Basins	$ 2,500,000
Membrane Treatment Facility (12 mgd)	$ 6,500,000
Chemical Feed and Storage Facility	$ 2,000,000
High Service and Transfer Pump Station	$ 3,700,000
Administrative Facilities	$ 500,000
Laboratory	$ 300,000
Finished Water Storage	$ 1,500,000
Residuals Pump Station	$ 500,000
Site Work	$ 2,500,000
Engine Generator	$ 500,000
Miscellaneous	$ 2,500,000
Subtotal New Water Treatment Plant	$23,000,000
Raw and Finished Water Mains (10,000 LF)	$ 1,700,000
Subtotal Intake, New WTP, Water Mains	**$26,700,000**
Retrofit Monroe WTP	
24 mgd Membrane Filtration System	$11,000,000
Miscellaneous	$ 1,000,000
Subtotal Retrofit Monroe WTP	**$12,000,000**
Subtotal Probable Cost for Option 2 to Alternative C	**$38,700,000**
Contingencies (20%)	$ 7,800,000
Total Probable Cost for Option 2 to Alternative C	**$46,500,000**

A summary of the opinion of probable construction costs for the alternatives is presented in Table 8-7.

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

Table 8-7

8. PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COSTS

C. DISTRIBUTION SYSTEM IMPROVEMENTS

As indicated in Chapter 7, there are several water main improvements necessary to satisfy future water demand requirements. Also included in the list of improvements are planned improvements identified by CBU to be constructed within the next five years. CBU has indicated that the main improvements will be constructed with CBU staff. Therefore, an opinion of probable construction cost has not been developed for the main improvements.

The distribution system improvements also may include an altitude valve. As indicated in Chapter 7, if Alternative A is selected, an altitude valve for the East tank is recommended. If Alternative C is selected, an altitude valve for the Redbud tank is recommended. In either case, a 20-inch altitude valve is recommended. The opinion of probable construction cost for a 20-inch altitude valve, isolation valves, piping, Sitework, and a concrete valve vault is $220,000 including 20 percent contingencies. This does not include legal, administration, and engineering costs.

9. PROJECTED IMPACT ON WATER RATES

An economic assessment of each alternative and its impact on the current financial situation is a critical component to the selection of any alternative. This chapter presents a preliminary estimate of the impact that each alternative discussed previously would have on CBU's water rates. For the purposes of this evaluation, the following projections and assumptions have been made, and will be outlined further in this chapter:

- The full capital costs of each alternative.
- The annual debt service and debt service coverage requirements.
- The incremental cost of operating and maintaining the proposed facilities.
- The total projected incremental annual costs at Year 2002 cost levels compared to projected annual water service revenues under existing rates.
- The total projected incremental annual costs inflated to Year 2008 levels compared to projected Year 2008 water rates.

A. SUMMARY OF PROBABLE CAPITAL COSTS

Presented in Tables 9-1 through 9-3b are the probable capital costs associated with each of the three alternatives and options discussed previously in this report. The costs include the probable construction costs presented in Tables 8-1 through 8-6, in Year 2002 dollars, and estimated Year 2006 figures adjusted for inflation. Construction for all alternatives is assumed to begin in 2006 with facility startup targeted for 2008.

The following costs factor into the total costs for each alternative as outlined in Tables 9-1 through 9-3b.

- Probable construction costs include a 20 percent allowance for contingencies, as discussed in Chapter 8.

9. PROJECTED IMPACT ON WATER RATES

- For Alternative A, land costs associated with the Southeast Water System Improvements are estimated at $50,000 and easement costs are assumed to be $250,000. No land cost for the Alternative A WTP or intake has been included because all work will be performed on existing land owned by CBU. Under Alternative B, the maximum probable cost of land for the intake facility is $150,000 and for the treatment plant site is $450,000. For Alternative C, the cost of land for the new treatment plant and collector well is estimated to be $450,000 and $150,000, respectively.

- Pilot studies for the MF/UF membrane and RO facilities under Alternative C will be required. The probable cost of these pilot studies is $350,000. Additionally, a well study is also necessary to obtain capacity and water quality information. This study is estimated at $50,000.

- The probable construction costs provided in Tables 8-1 through 8-6 do not include any allowance for administration, legal, engineering costs, CBU staff salaries and expenses related to the project, and subsurface investigations. An allowance of 15 percent of probable construction cost is considered reasonable for such costs.

The probable total cost for the raw water mains and finished water mains in each alternative were similarly developed. Factors considered include the following:

- Total allowances for the raw water and finished water mains vary for each Alternative based on the length of mains required.

- An allowance of 15 percent of probable construction costs for administration, legal, engineering costs, CBU staff salaries and expenses related to the project, and subsurface investigations.

9. PROJECTED IMPACT ON WATER RATES

Table 9-1
Summary of Probable Capital Costs
Alternative A

Line No.	Item	2002 Cost	2006 Cost
	Intake Facility and Monroe WTP		
1	Probable Construction Cost[a]	$27,000,000	$30,389,000
2	Other[b]	4,050,000	4,558,000
3	Subtotal Intake Facility and Monroe WTP	31,050,000	34,947,000
	Raw and Finished Water Mains		
4	Probable Construction Cost[a]	6,000,000	6,753,000
5	Easements	120,000	135,000
6	Other[b]	900,000	1,013,000
7	Subtotal Raw and Finished Water Mains	7,020,000	7,901,000
	Southeast Water System Improvements		
8	Probable Construction Cost[a]	13,200,000	14,857,000
9	Land	50,000	56,000
10	Easements	250,000	281,000
11	Other[b]	1,980,000	2,229,000
12	**Subtotal Southeast Water System Improvements**	15,480,000	17,423,000
13	**Subtotal Probable Capital Costs**	53,550,000	60,271,000
14	Debt Issuance Costs[c]	5,420,000	6,101,000
15	**Total Probable Project Capital Costs**	**$58,970,000**	**$66,372,000**
16	Annual Debt Service[d]	3,946,000	4,441,000
17	Debt Service Coverage Requirement[e]	987,000	1,110,000

(a) From Table 8-1.
(b) Represents OH and engineering costs. Estimated at 15% of construction cost.
(c) Estimated @ 2.5% of total bond issuance. Includes debt service reserve requirements.
(d) Equal annual debt service payments with a 5.25% interest rate and a term of 30 years.
(e) Equal to 25% of annual debt service payment.

9. PROJECTED IMPACT ON WATER RATES

Table 9-1a
Summary of Probable Capital Costs
Option to Alternative A

Line No.	Item	2002 Cost	2006 Cost
	Intake Facility and Monroe WTP		
1	Probable Construction Cost[a]	$20,640,000	$23,231,000
2	Other[b]	3,096,000	3,485,000
3	Subtotal Intake Facility and Monroe WTP	23,736,000	26,716,000
	Raw and Finished Water Mains		
4	Probable Construction Cost[a]	6,000,000	6,753,000
5	Easements	120,000	135,000
6	Other[b]	900,000	1,013,000
7	Subtotal Raw and Finished Water Mains	7,020,000	7,901,000
	Southeast Water System Improvements		
8	Probable Construction Cost[a]	13,200,000	14,857,000
9	Land	50,000	56,000
10	Easements	250,000	281,000
11	Other[b]	1,980,000	2,229,000
12	**Subtotal Southeast Water System Improvements**	15,480,000	17,423,000
13	**Subtotal Probable Capital Costs**	46,236,000	52,040,000
14	Debt Issuance Costs[c]	4,680,000	5,268,000
15	**Total Probable Project Capital Costs**	**$50,916,000**	**$57,308,000**
16	Annual Debt Service[d]	3,407,000	3,835,000
17	Debt Service Coverage Requirement[e]	852,000	959,000

(a) From Table 8-2.
(b) Represents OH and engineering costs. Estimated at 15% of construction cost.
(c) Estimated @ 2.5% of total bond issuance. Includes debt service reserve requirements.
(d) Equal annual debt service payments with a 5.25% interest rate and a term of 30 years.
(e) Equal to 25% of annual debt service payment.

9. PROJECTED IMPACT ON WATER RATES

Table 9-2
Summary of Probable Capital Costs
Alternative B

Line No.	Item	2002 Cost	2006 Cost
	Intake Facility and New WTP		
1	Probable Construction Cost[a]	$36,000,000	$40,518,000
2	Land[b]	600,000	600,000
3	Other[c]	5,400,000	6,078,000
4	Subtotal Intake Facility and New WTP	42,000,000	47,196,000
	Raw and Finished Water Mains		
5	Probable Construction Cost[a]	12,000,000	13,506,000
6	Easements	270,000	304,000
7	Other[c]	1,800,000	2,026,000
8	Subtotal Raw and Finished Water Mains	14,070,000	15,836,000
	Retrofit Monroe WTP		
9	Probable Construction Cost[a]	14,400,000	16,207,000
10	Other[c]	2,160,000	2,431,000
11	**Subtotal Monroe WTP Retrofit**	16,560,000	18,638,000
12	**Subtotal Probable Capital Costs**	72,630,000	81,670,000
13	Debt Issuance Costs[d]	7,352,000	8,267,000
14	**Total Probable Project Capital Costs**	**$79,982,000**	**$89,937,000**
15	Annual Debt Service[e]	5,352,000	6,018,000
16	Debt Service Coverage Requirement[f]	1,338,000	1,505,000

(a) From Table 8-3.
(b) Estimated cost of new Treatment Plant site and IDNR intake site.
(c) Represents OH and engineering costs. Estimated at 15% of construction cost.
(d) Estimated @ 2.5% of total bond issuance. Includes debt service reserve requirements.
(e) Equal annual debt service payments with a 5.25% interest rate and a term of 30 years.
(f) Equal to 25% of annual debt service payment.

9. PROJECTED IMPACT ON WATER RATES

Table 9-3
Summary of Probable Capital Costs
Alternative C

Line No.	Item	2002 Cost	2006 Cost
	Collector Well and New WTP		
1	Probable Construction Cost[a]	$40,440,000	$45,516,000
2	Land[b]	600,000	675,000
3	Collector Well Study	50,000	56,000
4	MF/UF Membranes & RO Pilot Study	350,000	394,000
5	Other[c]	6,066,000	6,827,000
6	Subtotal Collector Well and New WTP	47,506,000	53,468,000
	Raw and Finished Water Mains		
7	Probable Construction Cost[a]	19,200,000	21,610,000
8	Easements	510,000	574,000
9	Other[c]	2,880,000	3,242,000
10	Subtotal Raw and Finished Water Mains	22,590,000	25,426,000
	Retrofit Monroe WTP		
11	Probable Construction Cost[a]	14,400,000	16,207,000
12	Other[c]	2,160,000	2,431,000
13	**Subtotal Monroe WTP Retrofit**	16,560,000	18,638,000
14	**Subtotal Probable Capital Costs**	86,656,000	97,532,000
15	Debt Issuance Costs[d]	8,771,000	9,872,000
16	**Total Probable Project Capital Costs**	**$95,427,000**	**$107,404,000**
17	Annual Debt Service[e]	6,386,000	7,187,000
18	Debt Service Coverage Requirement[f]	1,597,000	1,797,000

(a) From Table 8-4.
(b) Estimated cost of new Treatment Plant site and collector well site.
(c) Represents OH and engineering costs. Estimated at 15% of construction cost.
(d) Estimated @ 2.5% of total bond issuance. Includes debt service reserve requirements.
(e) Equal annual debt service payments with a 5.25% interest rate and a term of 30 years.
(f) Equal to 25% of annual debt service payment.

9. PROJECTED IMPACT ON WATER RATES

Table 9-3a
Summary of Probable Capital Costs
Option 1 to Alternative C

Line No.	Item	2002 Cost	2006 Cost
	Collector Well and New WTP		
1	Probable Construction Cost[a]	$34,800,000	$39,168,000
2	Land[b]	600,000	675,000
3	Collector Well Study	50,000	56,000
4	RO Pilot Study	200,000	225,000
5	Other[c]	5,220,000	5,875,000
6	Subtotal Collector Well and New WTP	40,870,000	45,999,000
	Raw and Finished Water Mains		
7	Probable Construction Cost[a]	19,200,000	21,610,000
8	Easements	510,000	574,000
9	Other[c]	2,880,000	3,242,000
10	Subtotal Raw and Finished Water Mains	22,590,000	25,426,000
	Retrofit Monroe WTP		
11	Probable Construction Cost[a]	14,400,000	16,207,000
12	Other[c]	2,160,000	2,431,000
13	**Subtotal Monroe WTP Retrofit**	16,560,000	18,638,000
14	**Subtotal Probable Capital Costs**	80,020,000	90,063,000
15	Debt Issuance Costs[d]	8,100,000	9,116,000
16	**Total Probable Project Capital Costs**	**$88,120,000**	**$99,179,000**
17	Annual Debt Service[e]	5,897,000	6,637,000
18	Debt Service Coverage Requirement[f]	1,474,000	1,659,000

(a) From Table 8-5.
(b) Estimated cost of new Treatment Plant site and collector well site.
(c) Represents OH and engineering costs. Estimated at 15% of construction cost.
(d) Estimated @ 2.5% of total bond issuance. Includes debt service reserve requirements.
(e) Equal annual debt service payments with a 5.25% interest rate and a term of 30 years.
(f) Equal to 25% of annual debt service payment.

9. PROJECTED IMPACT ON WATER RATES

Table 9-3b
Summary of Probable Capital Costs
Option 2 to Alternative C

Line No.	Item	2002 Cost	2006 Cost
	Intake Facility Well and New WTP		
1	Probable Construction Cost[a]	$30,000,000	$33,765,000
2	Land[b]	600,000	675,000
3	Pilot Study	350,000	394,000
4	Other[c]	4,500,000	5,065,000
5	Subtotal Intake Facility and New WTP	35,450,000	39,899,000
	Raw and Finished Water Mains		
6	Probable Construction Cost[a]	2,040,000	2,296,000
7	Easements	270,000	304,000
8	Other[c]	306,000	344,000
9	Subtotal Raw and Finished Water Mains	2,616,000	2,944,000
	Retrofit Monroe WTP		
10	Probable Construction Cost[a]	14,400,000	16,207,000
11	Other[c]	2,160,000	2,431,000
12	**Subtotal Monroe WTP Retrofit**	16,560,000	18,638,000
13	**Subtotal Probable Capital Costs**	54,626,000	61,481,000
14	Debt Issuance Costs[d]	5,529,000	6,223,000
15	**Total Probable Project Capital Costs**	**$60,155,000**	**$67,704,000**
16	Annual Debt Service[e]	4,025,000	4,531,000
17	Debt Service Coverage Requirement[f]	1,006,000	1,133,000

(a) From Table 8-6
(b) Estimated cost of new Treatment Plant site and IDNR intake site.
(c) Represents OH and engineering costs. Estimated at 15% of construction cost.
(d) Estimated @ 2.5% of total bond issuance. Includes debt service reserve requirements.
(e) Equal annual debt service payments with a 5.25% interest rate and a term of 30 years.
(f) Equal to 25% of annual debt service payment.

9. PROJECTED IMPACT ON WATER RATES

The financial analysis presented in this report assumes that CBU will use revenue bonds to finance the selected alternative. The cost of using this debt instrument is included as a separate line item cost in each table. It should be noted that alternative financing mechanisms such as the use of State Revolving Fund (SRF) monies may result in lower or higher water rate impacts, depending on bond market conditions.[1] Currently, CBU qualifies for SRF funds within the lowest interest rate tier – 3.3 percent.

Tables 9-1 through 9-3b assume revenue bond issuance costs of 2.5 percent and a debt service reserve equal to one-year of principal and interest (P&I) payments. The annual debt service for the revenue bonds assumes equal annual debt service payments with an average interest rate of 5.25 percent over a period of 30 years.

In addition to having sufficient revenues to meet debt service and operation and maintenance expenses, the revenue bond ordinances require additional revenues equal to at least 25 percent of the annual debt service costs. This additional revenue ensures that revenues will be sufficient to meet all of the requirements of the utility. Revenues that are not needed for operation and maintenance expense or debt service may be retained or used for cash financed capital improvements. The debt service coverage requirement is also provided as a separate line item cost on the tables.

B. PROBABLE INCREMENTAL OPERATION AND MAINTENANCE EXPENSE

For all alternatives with a new WTP, additional employees to operate and maintain the plant are required. Expenses at the new WTP for cost items such as power for low and high service water pumping and chemicals would be essentially the same if the water is being produced at the Monroe WTP or the new WTP. Other expenses, such as plant utilities, general materials and

[1] Impact of the I69 project has not been considered. Financing incentives may be offered in the future.

9. PROJECTED IMPACT ON WATER RATES

supplies, and vehicle costs represent added expenses. For Alternative C, the operation and maintenance costs for the reverse osmosis facility are also provided. The probable incremental annual operation and maintenance expense for each alternative is presented in Table 9-4. The probable costs are at Year 2002 cost levels and are based on the budgeted costs for similar items at the Monroe WTP.

Table 9-4
Probable Incremental Operation & Maintenance Expense

		Alternative			
Item	Quantity	B	C	Option 1 to C	Option 2 to C
Additional Plant Operators	4	$199,000	$190,000	$190,000	$190,000
Additional Maintenance Personnel	1	46,000	46,000	46,000	46,000
Utilities		50,000	50,000	35,000	5,000
Materials & Supplies		69,000	50,000	50,000	69,000
Membrane Materials & Supplies		0	150,000	0	0
RO Materials & Supplies		0	344,000	344,000	0
Vehicles		10,000	10,000	10,000	10,000
Total		**$320,000**	**$840,000**	**$675,000**	**$320,000**

It is projected that four additional plant operators will be needed to provide full time staffing at the new WTP at an annual cost of $190,000 for wages and benefits. The addition of one maintenance employee is also projected at an annual cost of $46,000. Annual allowances of $5,000 for general utilities, $69,000 for materials and supplies (other than treatment chemicals), and $10,000 for vehicles are shown in Table 9-4. For Alternative C and Option 1 to Alternative C, an annual allowance of $50,000 is assumed for materials and supplies. Additional allowances for utilities (primarily electricity), membrane materials and RO-related supplies are included for Alternative C and Option 1 to Alternative C.

9. PROJECTED IMPACT ON WATER RATES

C. PROJECTED IMPACT ON WATER RATES

The projected impact on water rates for each alternative is summarized on Table 9-5 based on Year 2002 cost levels and existing rates, Year 2008 projected cost levels and projected Year 2008 water rates.

Table 9-5
Summary of Impact on Water Rates

Line No.	Description	Alternatives A	Option to A	B	C	Option 1 to C	Option 2 to C
	Impact on Current Rates						
1	Total Annual Debt Service[a]	3,946,000	3,407,000	5,352,000	6,386,000	5,897,000	4,025,000
2	Debt Service Coverage[a]	987,000	852,000	1,338,000	1,597,000	1,474,000	1,006,000
3	Incremental O&M Expense[b]	0	0	320,000	840,000	675,000	320,000
4	Total Annual Incremental Cost	4,933,000	4,259,000	7,010,000	8,823,000	8,046,000	5,351,000
5	Projected Yr 2002 Revenues under Existing Rates[c]	9,669,700	9,669,700	9,669,700	9,669,700	9,669,700	9,669,700
6	**Total Annual Incremental Cost @ Yr 2002 Levels as a Percentage of Revenues under Existing Rates**	**51.0%**	**44.0%**	**72.5%**	**91.2%**	**83.2%**	**55.3%**
	Impact on Yr 2008 Rates						
7	Total Annual Debt Service[a]	4,441,000	3,835,000	6,018,000	7,187,000	6,637,000	4,531,000
8	Debt Service Coverage[a]	1,110,000	959,000	1,505,000	1,797,000	1,659,000	1,133,000
9	Incremental O&M Expense[b]	0	0	360,000	945,000	760,000	360,000
10	Total Annual Incremental Cost	5,551,000	4,794,000	7,883,000	9,929,000	9,056,000	6,024,000
11	Projected Yr 2008 Revenues, without Additional Plant, with Rates Adopted Yr 2004[d]	10,830,100	10,830,100	10,830,100	10,830,100	10,830,100	10,830,100
12	**Projected Additional Increase in Water Rates for New WTP Plant in Yr 2008.**	**51.3%**	**44.3%**	**72.8%**	**91.7%**	**83.6%**	**55.6%**

Line 4 of Table 9-5 summarizes the incremental cost for each alternative in Year 2002 dollars. The total incremental cost includes debt service, minimum debt service coverage, and the incremental operation and maintenance expense.

9. PROJECTED IMPACT ON WATER RATES

Line 5 presents the estimated annual water service revenues under existing rates. Black & Veatch is currently modifying its 2001 study and the figures on Line 5 reflect the actual timing of the approved 2002 rate increase. In order for CBU to support any of the given alternatives at current cost levels, current rates would need to be increased by the average percentage indicated on Line 6. For example, for Alternative B, the projected costs for the project would require a 72.5 percent rate increase.

Lines 7 through 10 summarize the projected incremental cost for each option in Year 2008 dollars. Construction costs and operation and maintenance expenses have been inflated at a rate of 3 percent per year.

The 2001 Black and Veatch study projected that with inflation and other planned capital improvements, water rates would need to be increased by 9 percent in Year 2004 and an additional 8 percent in Year 2006. Current revisions to the 2001 study indicate that due to the timing of the 2002 increase and lower than expected sales, the Year 2004 increase will be on the order of 11 percent. The analyses summarized in earlier chapters of this report recommend that the Fullerton project not be built and that the Southeast project is required for Alternative A capital improvements only. Incorporating these recommendations into the rate study indicates that no additional rate increase would be needed in 2006 in the absence of a new WTP project.

The assumed 27.5 percent increase plus projected growth in water sales results in annual revenues of $10,830,100 for Year 2008 once the Year 2004 rates are adopted. This revenue is shown on Line 11 of Table 9-5. Line 12 illustrates the impact each alternative will have on water rates in Year 2008. The figures shown are the percentages required in Year 2006 (the year of the bond sale) that will generate the additional revenues to meet capital, operational, and bond ordinance requirements. For example, under Alternative B, a 72.8 percent increase is required over adopted Year 2004 rates. Cumulatively, for

9. PROJECTED IMPACT ON WATER RATES

Alternative B, water rates would experience a 98.4 percent increase over current (Year 2002) rates.

The capital financing option used in this analysis was revenue bond financing. To illustrate the impact alternative financing options may have on the level of rate increase required, Table 9-5 has been reproduced assuming SRF-sourced financing. For each alternative, SRF bonding is assumed using an average interest rate of 3.3 percent for a period of 20 years and use of a surety for the debt service reserve requirement. The results of using SRF funding is presented in Table 9-5a and illustrates the impact that financing can have on water rates.

Table 9-5a
Summary of Impact on Water Rates Using SRF Funds

Line No.	Description	Alternatives A	Option to A	B	C	Option 1 to C	Option 2 to C
	Impact on Current Rates						
1	Total Annual Debt Service[a]	3,854,000	3,328,000	5,121,000	6,237,000	5,759,000	3,932,000
2	Debt Service Coverage[a]	964,000	832,000	1,280,000	1,559,000	1,440,000	983,000
3	Incremental O&M Expense[b]	0	0	320,000	840,000	675,000	320,000
4	Total Annual Incremental Cost	4,818,000	4,160,000	6,721,000	8,636,000	7,874,000	5,235,000
5	Projected Yr 2002 Revenues under Existing Rates[c]	9,669,700	9,669,700	9,669,700	9,669,700	9,669,700	9,669,700
6	**Total Annual Incremental Cost @ Yr 2002 Levels as a Percentage of Revenues under Existing Rates**	**49.8%**	**43.0%**	**69.5%**	**89.3%**	**81.4%**	**54.1%**
	Impact on Yr 2008 Rates						
7	Total Annual Debt Service[a]	4,338,000	3,745,000	5,758,000	7,020,000	6,482,000	4,425,000
8	Debt Service Coverage[a]	1,085,000	936,000	1,440,000	1,755,000	1,621,000	1,106,000
9	Incremental O&M Expense[b]	0	0	360,000	945,000	760,000	360,000
10	Total Annual Incremental Cost	5,423,000	4,681,000	7,558,000	9,720,000	8,863,000	5,891,000
11	Projected Yr 2008 Revenues, without Additional Plant, with Rates Adopted Yr 2004[d]	10,830,100	10,830,100	10,830,100	10,830,100	10,830,100	10,830,100
12	**Projected Additional Increase in Water Rates for New WTP Plant in Yr 2008.**	**50.1%**	**43.2%**	**69.8%**	**89.7%**	**81.8%**	**54.4%**

10. CONCLUSIONS

The City of Bloomington Utilities is about to embark on a major capital improvements program to ensure that their customers continue to receive high quality drinking water at sufficient quantities to keep pace with anticipated growth. Based on population and water demand projections, the maximum day demands for Year 2010 are expected to be 24 mgd. Therefore, CBU is expected to have insufficient treatment capacity by Year 2010.

A. PROPOSED ALTERNATIVES

For the purpose of this study, the Year 2030 was determined to be the design year for determining the required capacity of the proposed facilities. The maximum day demands for 2030 are projected to be approximately 32 mgd. Therefore, the alternatives evaluated will increase CBU's water treatment and distribution capacity from 24 mgd to 36 mgd to ensure sufficient capacity is provided through 2030. Several alternatives were evaluated to meet the anticipated water requirements. The alternatives evaluated include expanding the capacity of the Monroe WTP (Alternative A); constructing a new Dillman WTP to the southwest of Bloomington using Lake Monroe as the water source (Alternative B); and constructing a new North WTP using either a groundwater or surface water supply (Alternative C).

The financial evaluation indicates that expanding the capacity of the Monroe WTP is the most economical of the alternatives evaluated. This alternative includes expanding the capacity of the Monroe WTP using membrane filtration; constructing new parallel raw and finished water mains to convey the additional flow; and constructing the Southeast Water System Improvements which will convey the additional treated water from the South service level to the Central service level. The new and existing finished water transmission mains and the firm pumping capacity between the South service level and Central service level would support up to 42 mgd of flow. It may be feasible that the Monroe WTP could ultimately be expanded to 42 mgd in the future. The disadvantages to this option is that the treatment facilities and site would not easily support further

expansion, and would not provide the same level of redundancy as compared to a new separate treatment facility.

The North WTP alternative using Lake Lemon, Bean Blossom Creek and Griffy Lake as a water supply (Option 2 to Alternative C) is only slightly more expensive than expanding the Monroe WTP. The proposed North WTP would have a capacity of 12 mgd and could be used as a peaking plant, supplementing the Monroe WTP to meet maximum day demands. Based on past yield studies, the North surface water sources should have a firm annual yield of approximately 6 mgd. However, this plant could provide up to 12 mgd of treatment capacity as long as the annual average plant capacity remained at approximately 6 mgd. This alternative provides several benefits, including the security of having two water sources and good hydraulics associated with providing water to customers from the North. It should be noted that this water source may not have sufficient yield to support expansion of the proposed WTP beyond 12 mgd in the future without other sources to supplement the North supply. Other sources may include blending groundwater with the North surface water supplies or possibly conveying raw water from another surface water source to the North plant as a supplement. If this alternative is selected, a study should be performed to verify the yield and water quality of the water sources and the proposed treatment processes.

Both the proposed Dillman WTP using Lake Monroe as the water supply (Alternative B) and the North WTP using a groundwater supply (Alternative C and Option 1 to Alternative C) have several non-economic advantages over the other alternatives. These include the security and reliability of two separate plants and their ability to be easily expanded from 12 mgd to 24 mgd in the future. The existing Monroe WTP also could be expanded, if additional capacity is needed in the future.

B. TREATMENT PROCESSES

CBU has expressed a strong interest in using membranes to comply with future turbidity requirements, possible *Cryptosporidium* removal requirements, and to provide high quality water to its customers. Membranes provide a positive barrier to *Cryptosporidium* and are a strong candidate for use, especially at a new water treatment plant. Since the Monroe WTP is presently in compliance with finished water turbidity requirements, CBU should consider evaluating Ultraviolet (UV) irradiation for *Cryptosporidium* inactivation before making a final decision to implement membranes at the Monroe WTP. UV testing on a pilot-scale would be required before any decision could be made on a full-scale implementation. It is likely that expansion in the capacity of the Monroe WTP using conventional gravity media filters and implementing UV for *Cryptosporidium* inactivation would be more economical than membrane filtration.

If the groundwater supply alternative is selected and the water source is determined to be "under the influence" of surface water, it is recommended that MF/UF membranes be implemented. If the water source is determined to be "strictly" groundwater, then conventional gravity media filtration would be appropriate. The water source determination is made by the Indiana Department of Environmental Management.

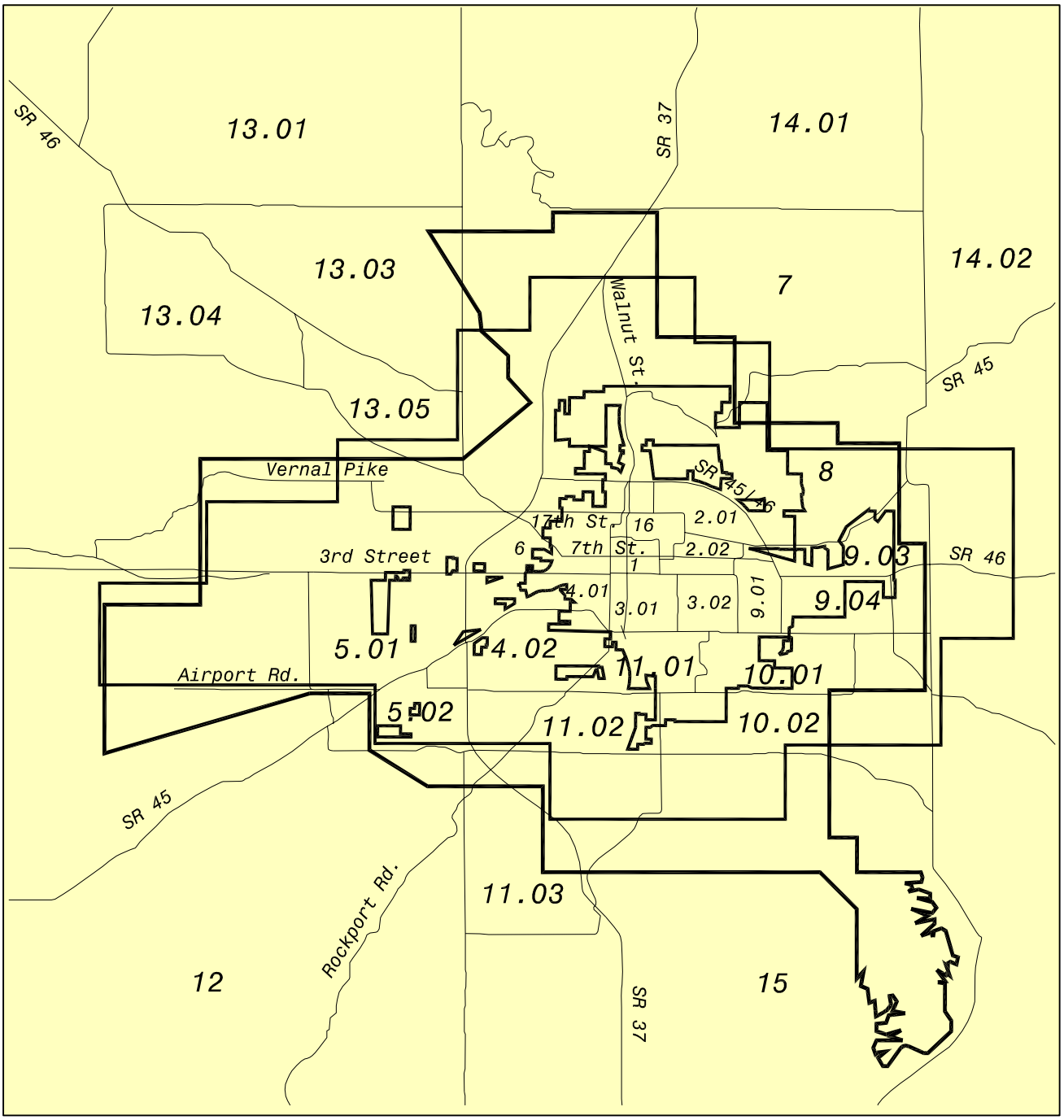
C. IMPROVEMENTS SCHEDULE

As the projected water demands for the Year 2010 is expected to exceed the capacity of the existing Monroe WTP, it is recommended that the proposed water system improvements be completed and operational in the Year 2008. This will necessitate starting construction by January 2006. CBU should complete any final pilot studies and/or investigations by Spring 2004 and begin design by late Spring or early Summer 2004 to ensure sufficient time is allowed to complete the design phase; obtain all permits and approvals; acquire all necessary land and easements; accept bids; and award the construction contract by January 2006.

10. CONCLUSIONS

As this capital improvements program represents an important and critical decision on the direction of the water utility, it is paramount to include the public in the selection of the alternatives described herein. The schedule allows several months for obtaining input and comments through public meetings prior to making a decision and proceeding with the capital improvements program.

It is recommended that CBU make a final decision regarding the proposed water system improvements in the Year 2003. This should allow adequate time to complete all phases of the project and have the new facilities operational by mid-Year 2008.



NOT TO SCALE

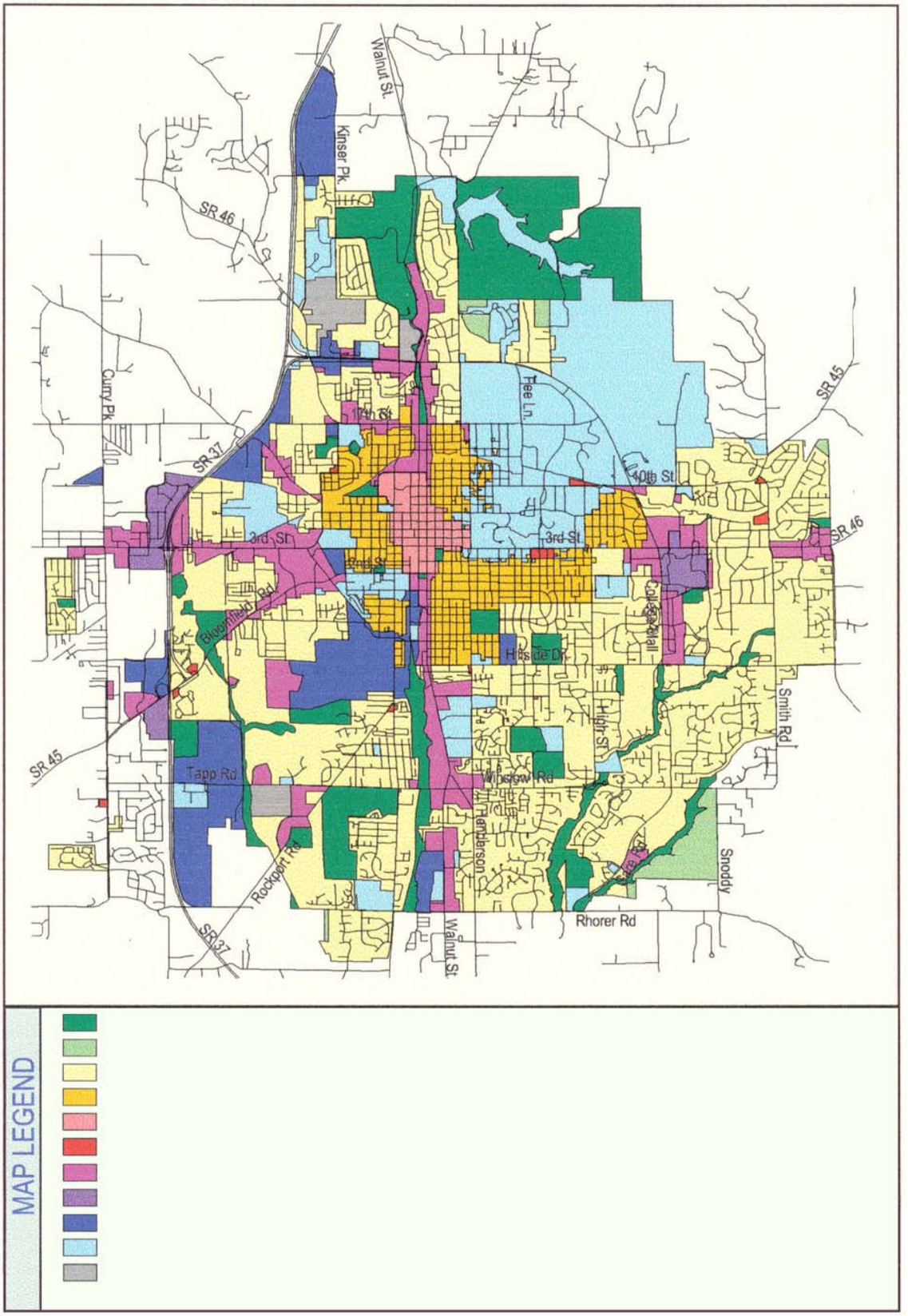
BLOOMINGTON CITY LIMITS

URBAN AREA BOUNDARY

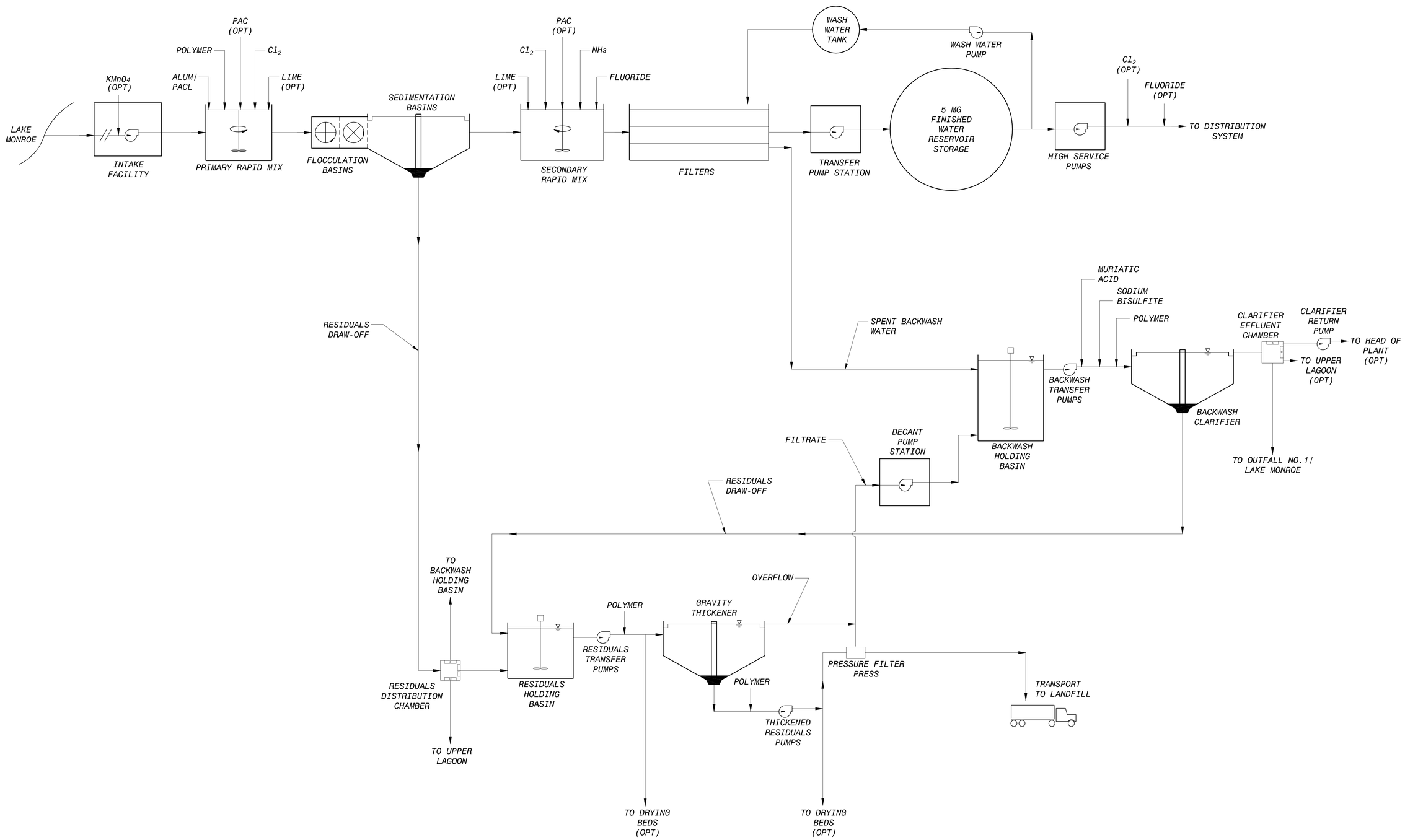
WATER UTILITY JURISDICTIONAL BOUNDARY

CENSUS TRACK BOUNDARY

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN
STUDY AREA
FIGURE 1-1



City of Bloomington Utilities
Water System Master Plan
Land Utilization Plan
Figure 2-2



MONROE WTP SCHEMATIC
NO SCALE

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USER: FAU37423 SW-ACAD-20001 XREF5 ID:

BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

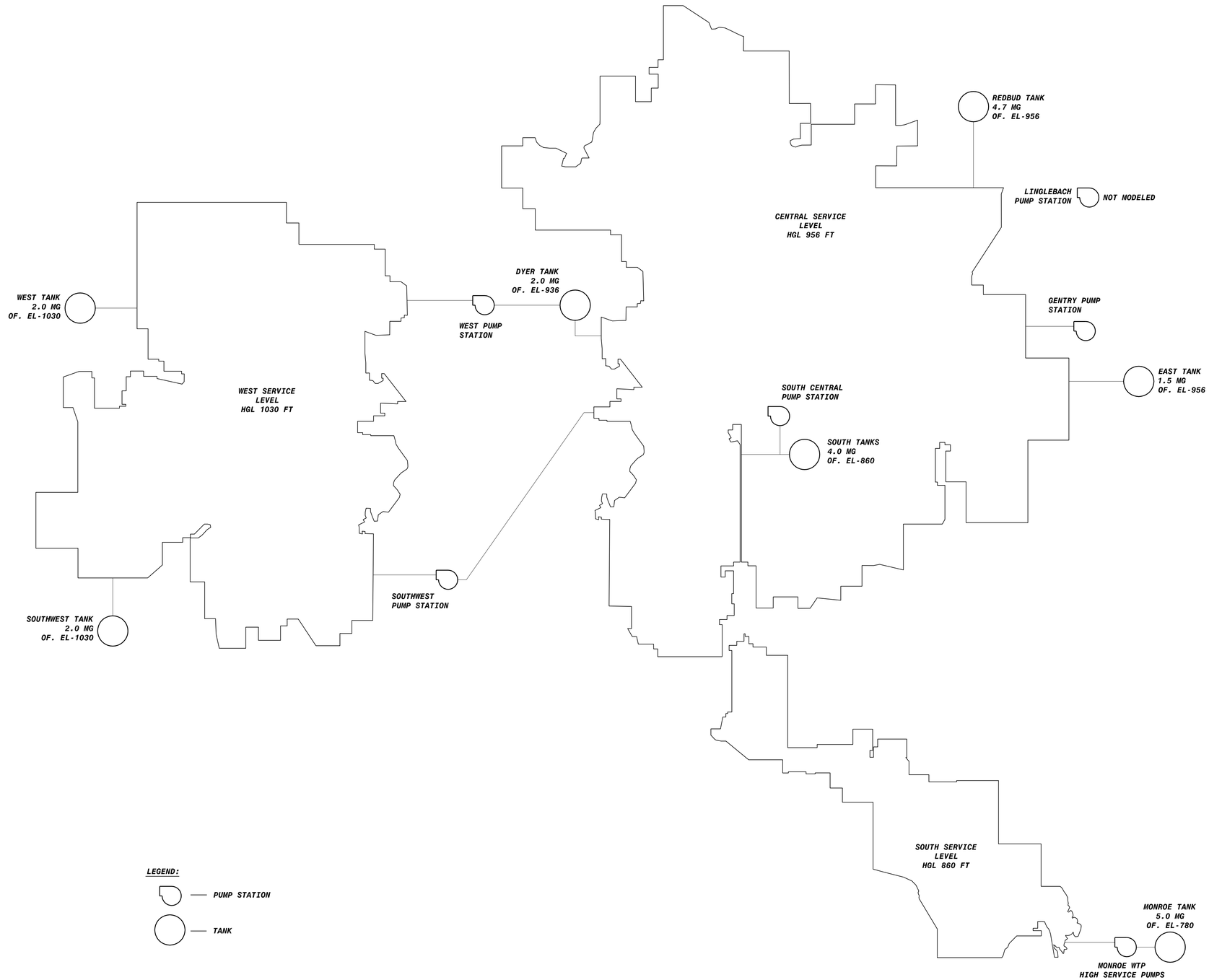
MONROE WTP SCHEMATIC

DESIGNED: ALB
DETAILED: RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
4-1

FD5000
D5009



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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

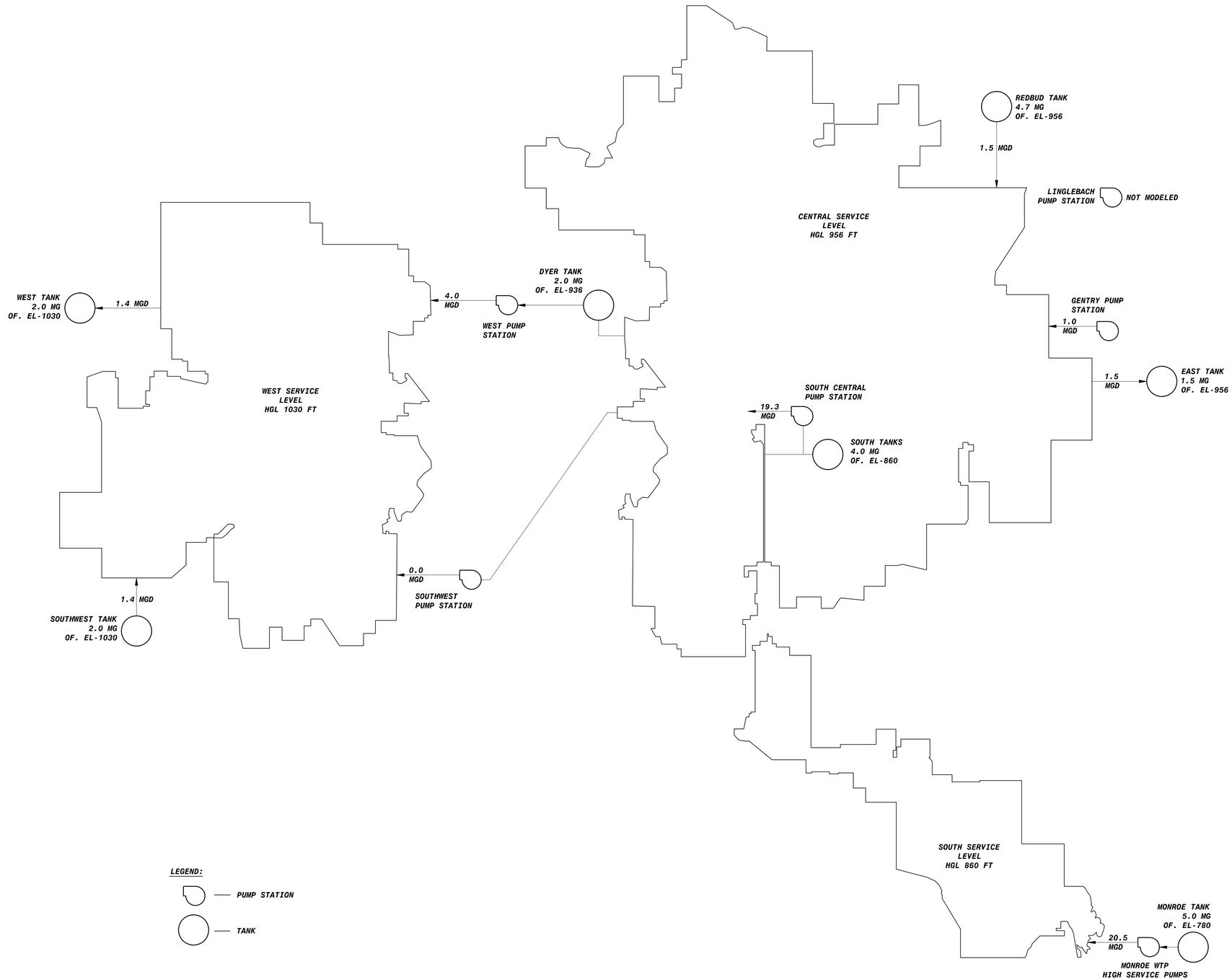
SERVICE LEVEL BOUNDARIES

DESIGNED: ALB
DETAILED: RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
4-2

FD5000
D5009



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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

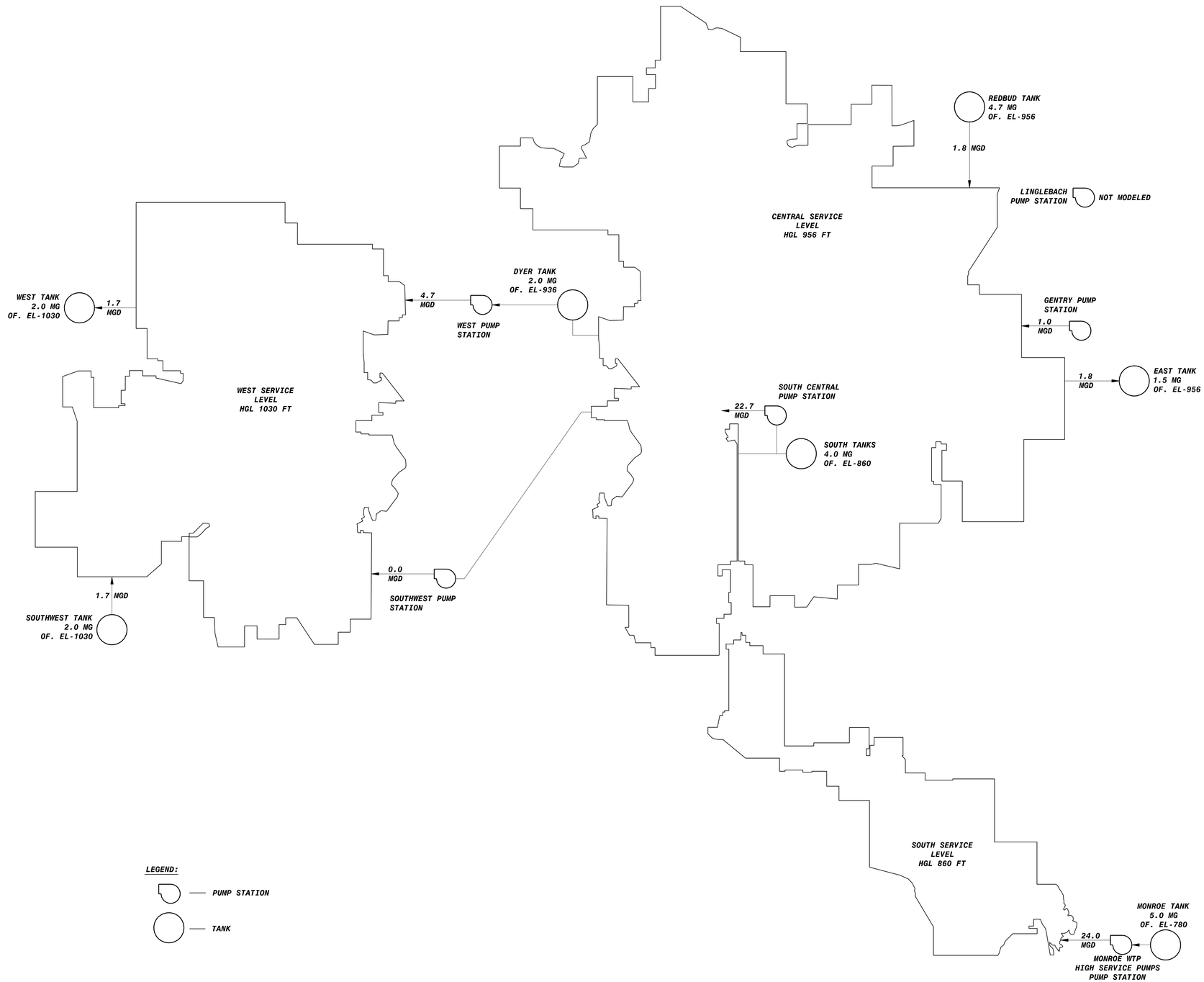
SYSTEM INPUTS FOR 2000
MAXIMUM DAY

DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-1

FD5000
D5009



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BLACK & VEATCH
Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

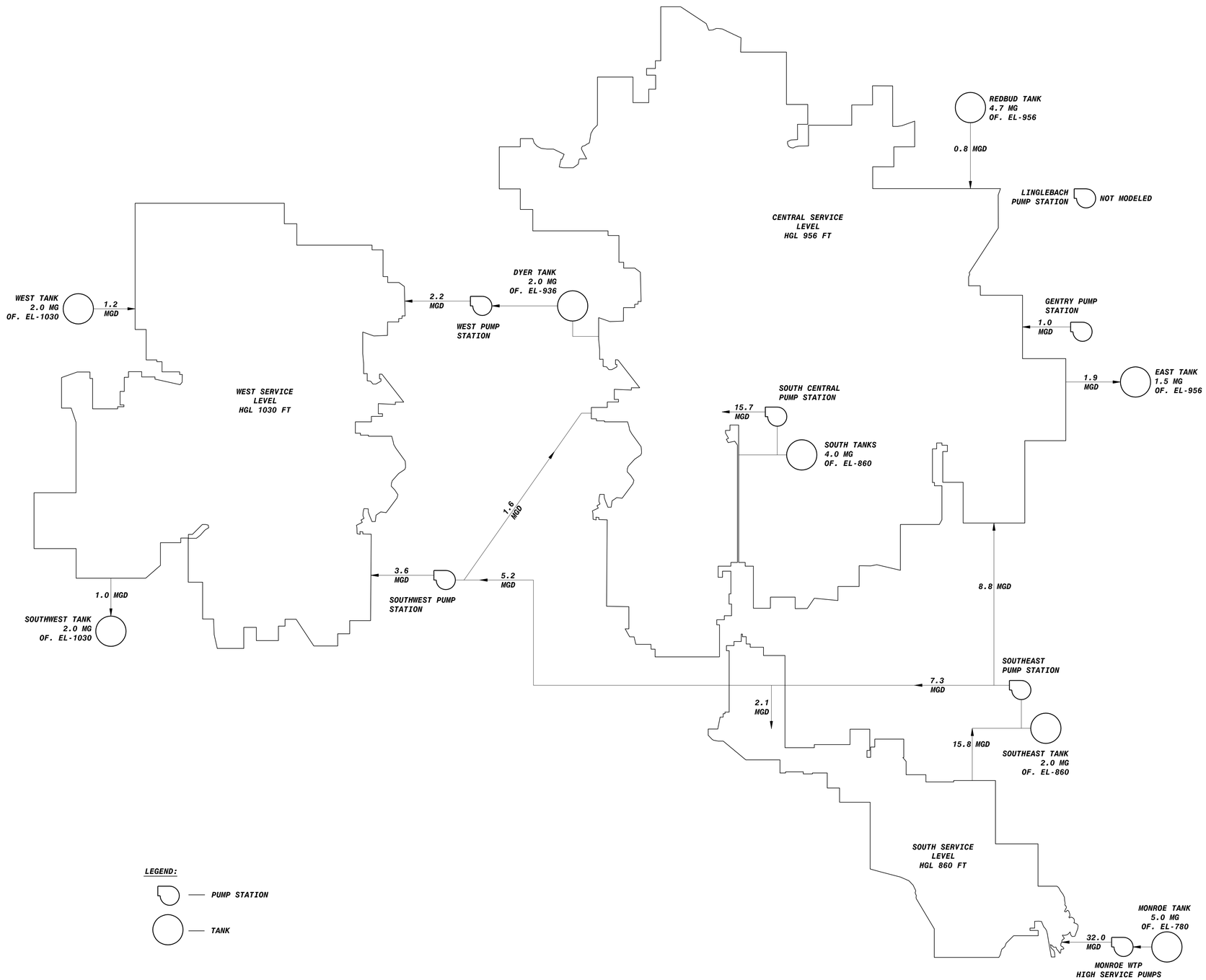
SYSTEM INPUTS FOR 2000
MAXIMUM HOUR

DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-2

F05000
D5009



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REVISIONS AND RECORD OF ISSUE

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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

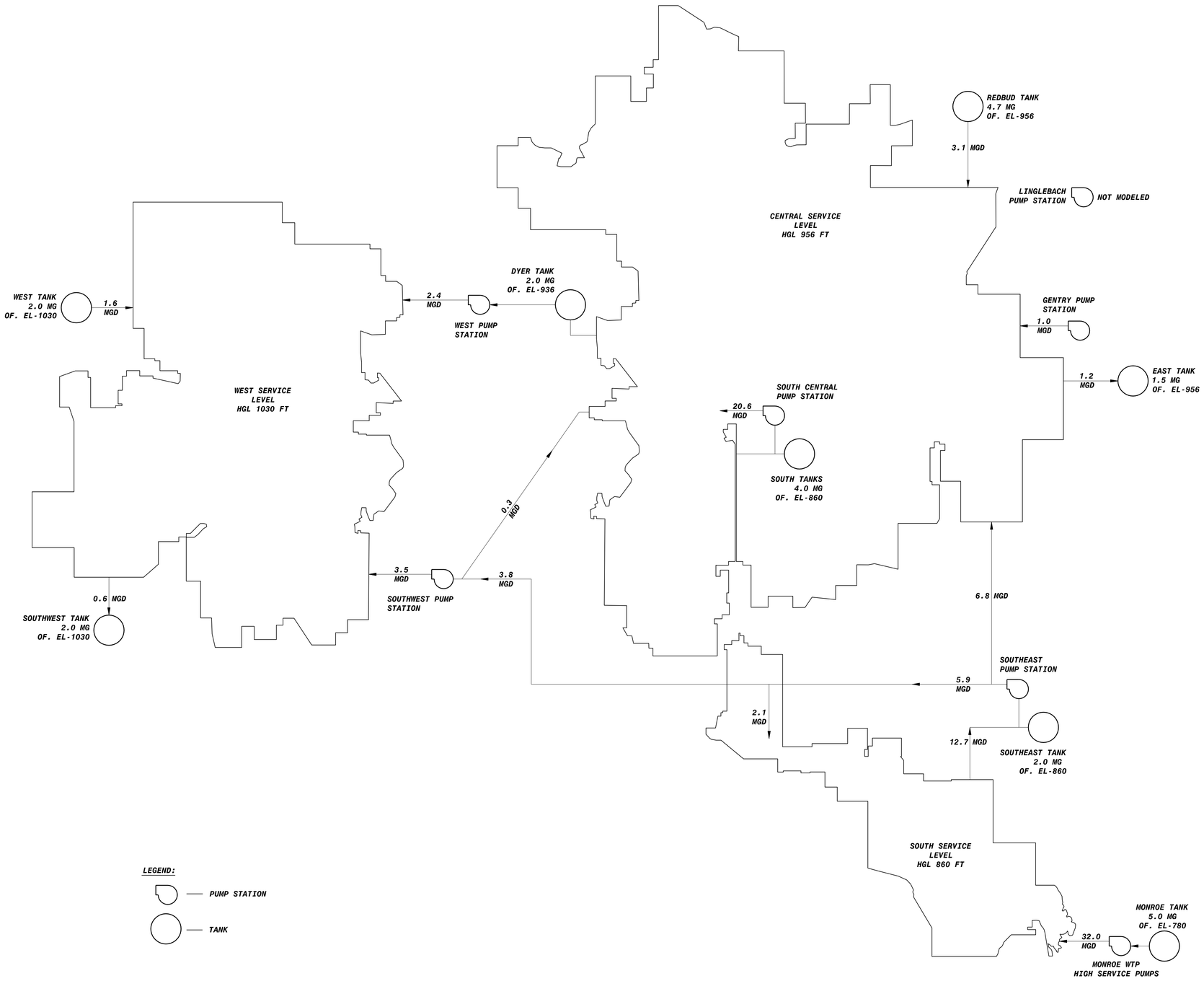
SYSTEM INPUTS FOR 2030
MAXIMUM DAY

DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-3

FD5000
D5009



NO.	BY	CK	APP

REVISIONS AND RECORD OF ISSUE

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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

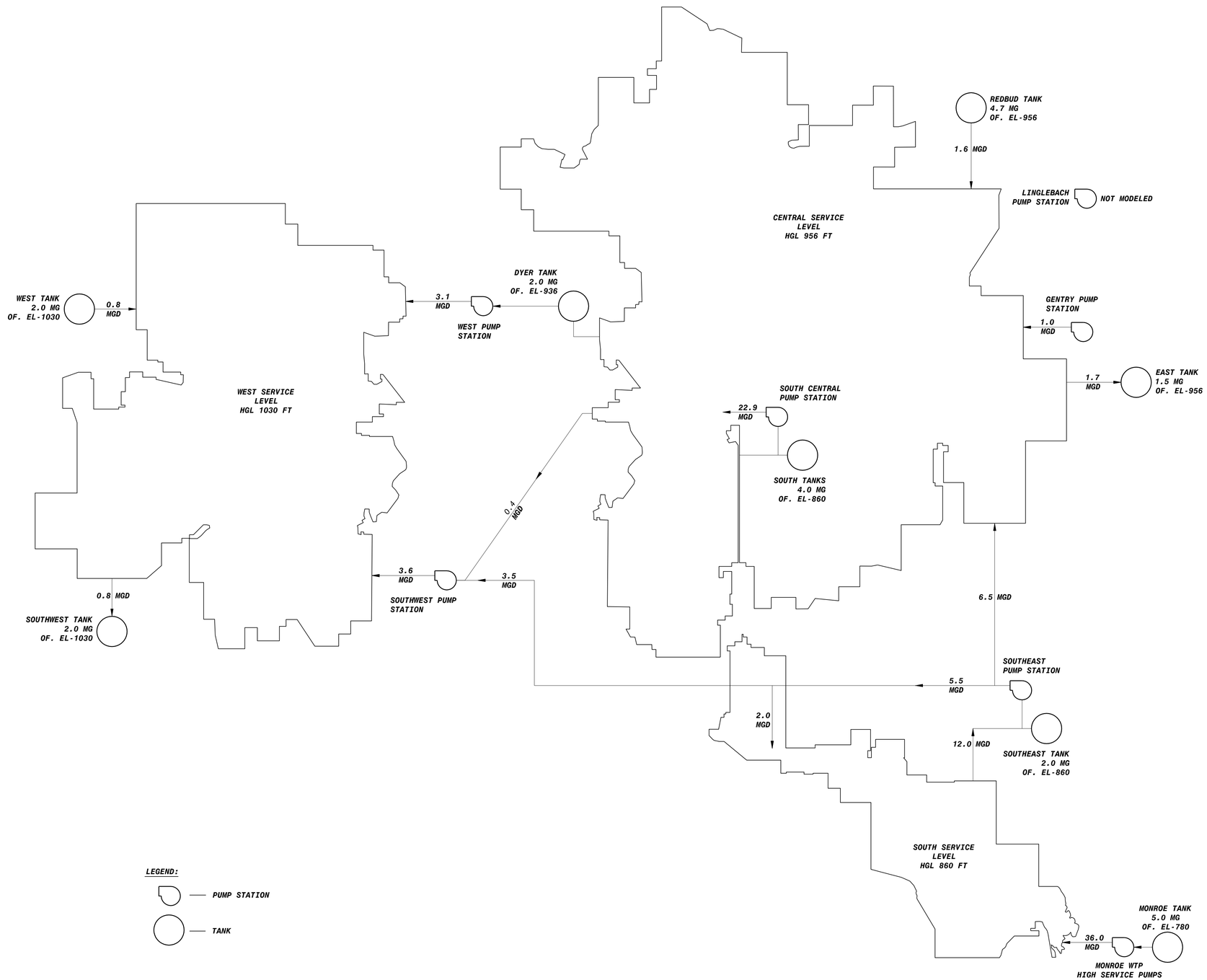
SYSTEM INPUTS FOR 2030
MAXIMUM HOUR

DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-4

FD5000
D5009



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REVISIONS AND RECORD OF ISSUE

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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

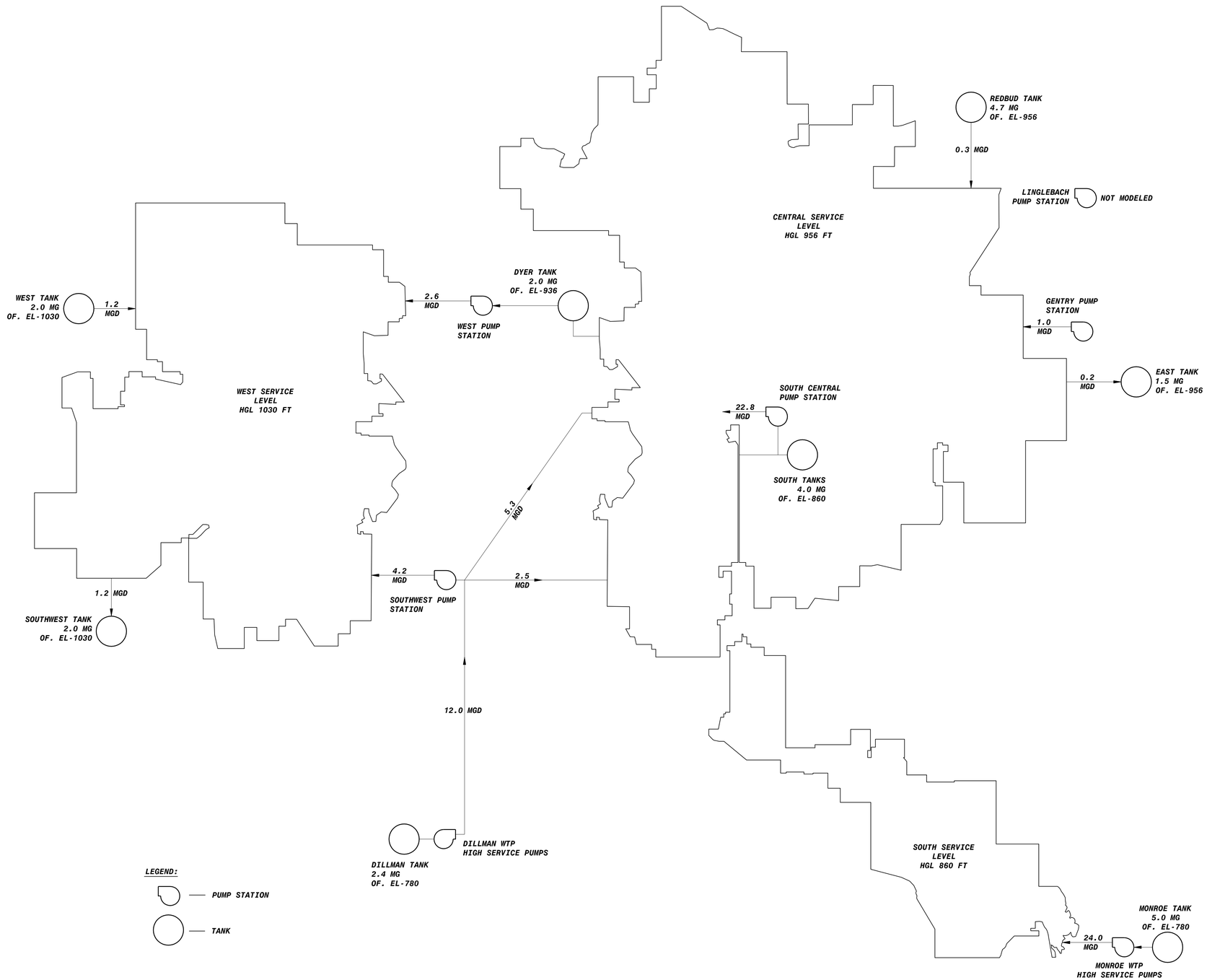
SYSTEM INPUTS FOR 2030
MAXIMUM DAY - ALTERNATIVE A

DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-5

FD5000
D5009



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REVISIONS AND RECORD OF ISSUE

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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

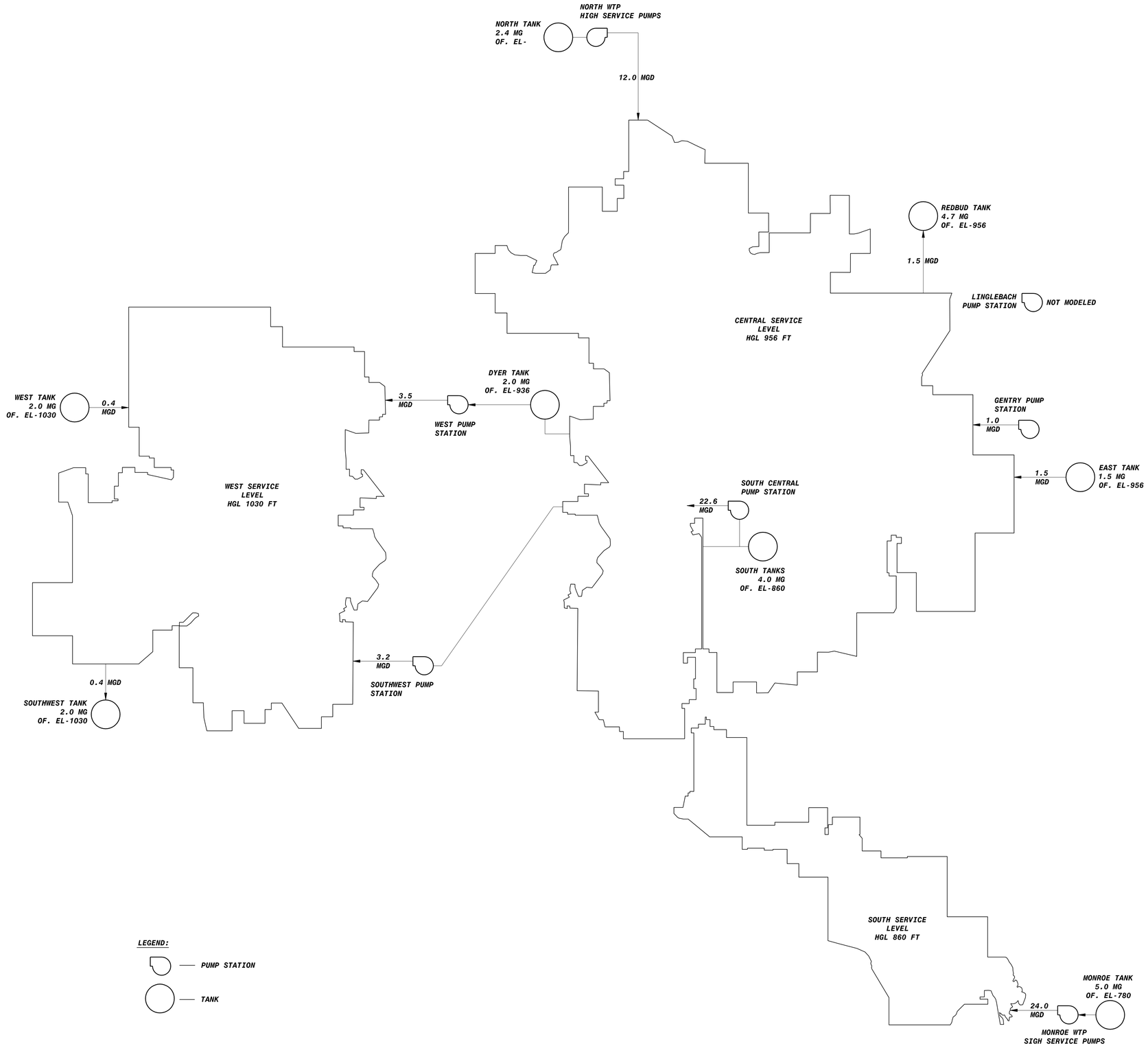
SYSTEM INPUTS FOR 2030
MAXIMUM DAY - ALTERNATIVE B

DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-6

FD5000
DS009



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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

SYSTEM INPUTS FOR 2030
MAXIMUM DAY - ALTERNATIVE C

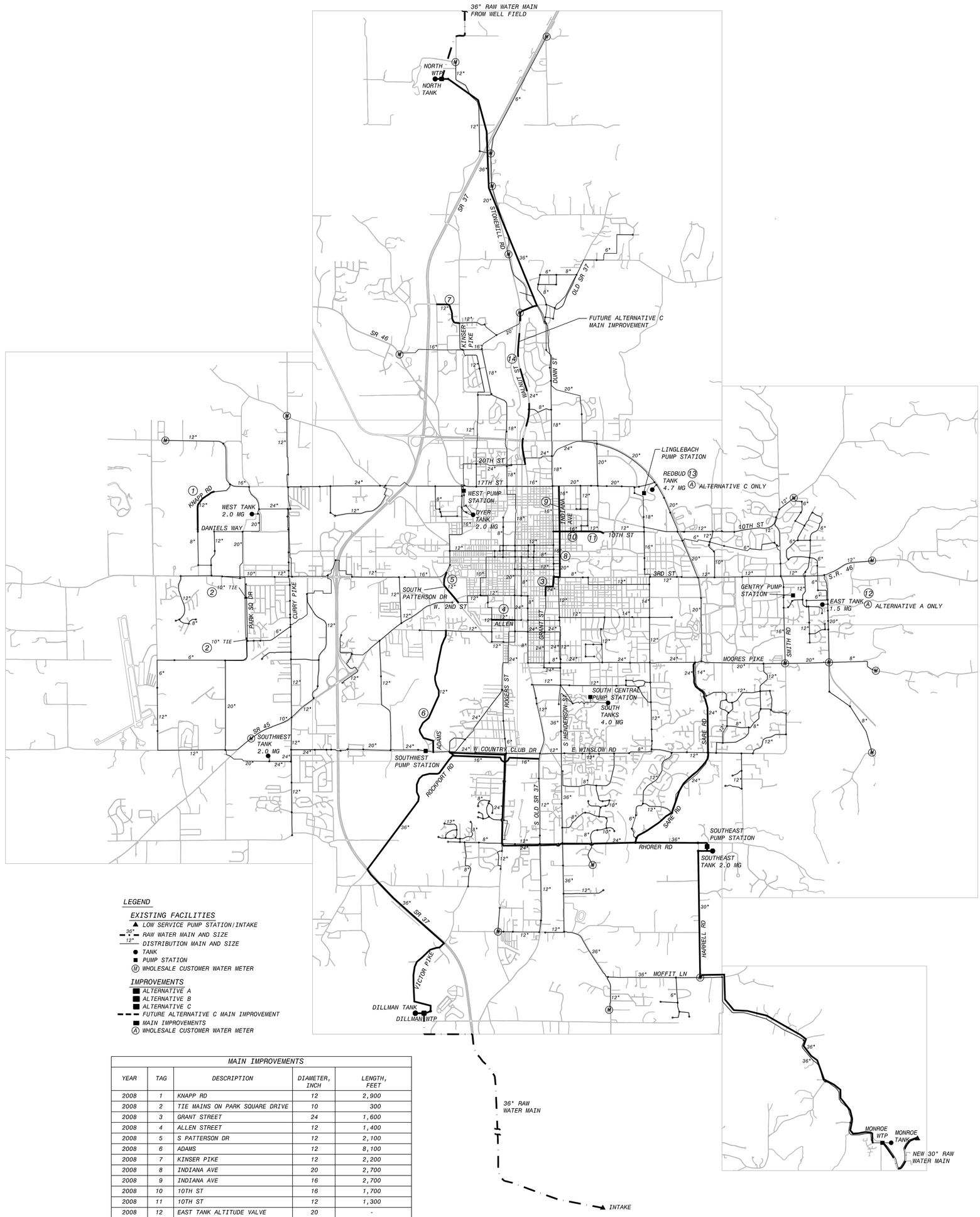
DESIGNED: ALB
DETAILED: BLH, RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
6-7

FD5000
D5009

FD5000
D5009



LEGEND

EXISTING FACILITIES
- ▲ LOW SERVICE PUMP STATION/INTAKE
- 36" RAW WATER MAIN AND SIZE
- 12" DISTRIBUTION MAIN AND SIZE
- ● TANK
- ■ PUMP STATION
- Ⓦ WHOLESALE CUSTOMER WATER METER

IMPROVEMENTS
- ALTERNATIVE A
- ALTERNATIVE B
- ALTERNATIVE C
- FUTURE ALTERNATIVE C MAIN IMPROVEMENT
- MAIN IMPROVEMENTS
- Ⓐ WHOLESALE CUSTOMER WATER METER

MAIN IMPROVEMENTS

YEAR	TAG	DESCRIPTION	DIAMETER, INCH	LENGTH, FEET
2008	1	KNAPP RD	12	2,900
2008	2	TIE MAINS ON PARK SQUARE DRIVE	10	300
2008	3	GRANT STREET	24	1,600
2008	4	ALLEN STREET	12	1,400
2008	5	S PATTERSON DR	12	2,100
2008	6	ADAMS	12	8,100
2008	7	KINSER PIKE	12	2,200
2008	8	INDIANA AVE	20	2,700
2008	9	INDIANA AVE	16	2,700
2008	10	10TH ST	16	1,700
2008	11	10TH ST	12	1,300
2008	12	EAST TANK ALTITUDE VALVE	20	-
2008	13	REDBUD TANK ALTITUDE VALVE	20	-
2008	14	WALNUT ST	24	10,200

FIGURE 7-1

PROJECT NO. 131434

DATE:
APPROVED:
CHECKED:
DETAILED: RSF, BLH
DESIGNED: ALB

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

WATER SYSTEM ALTERNATIVES

BLACK & VEATCH Corporation
Cincinnati, Ohio

DATE	REVISIONS AND RECORD OF ISSUE	NO.	BY	CK	APP

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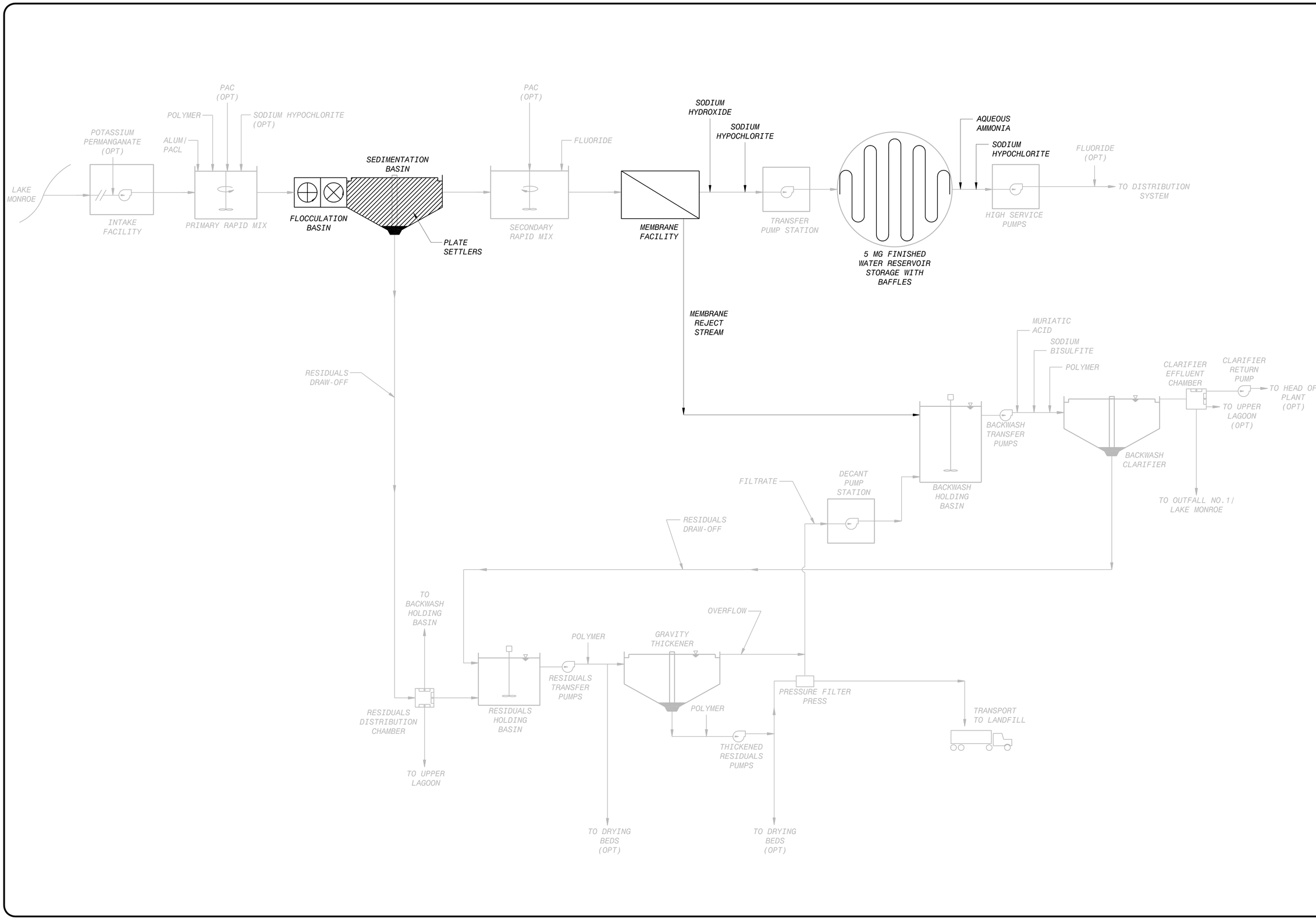

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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

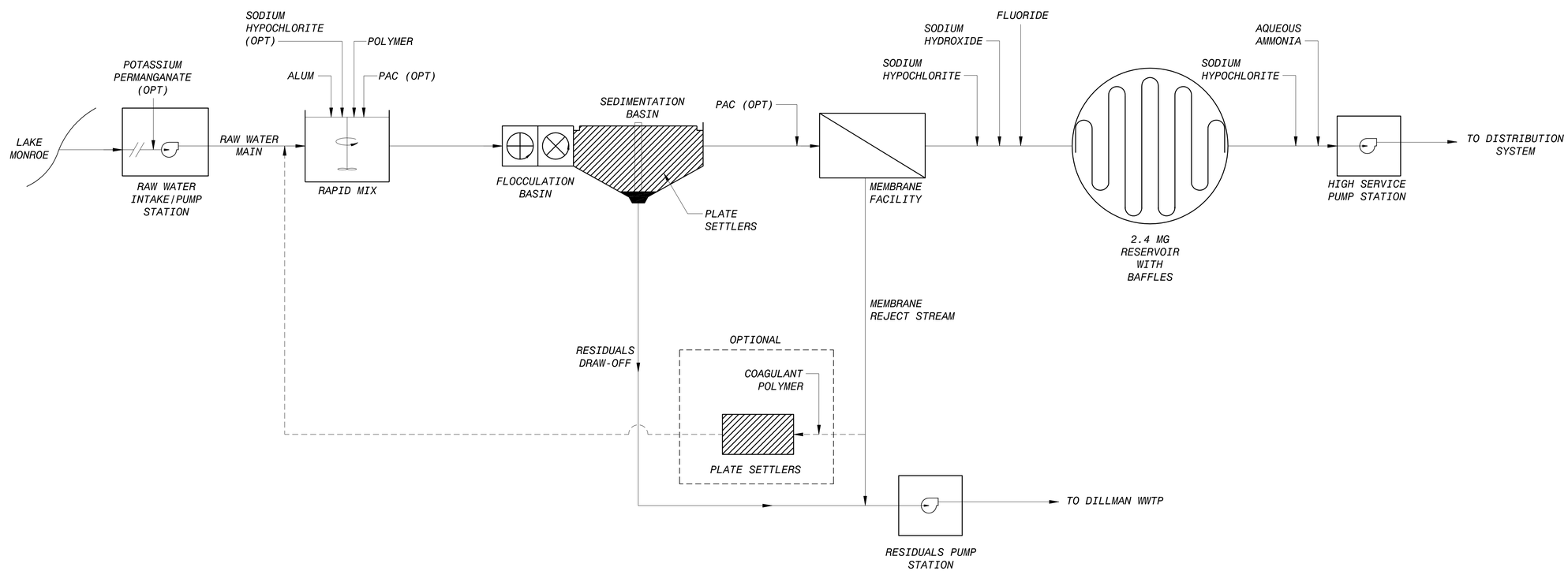
ALTERNATIVE A
MONROE WTP SCHEMATIC

DESIGNED: ALB
DETAILED: RSF
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
7-2

FD5000
DS009



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REVISIONS AND RECORD OF ISSUE

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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

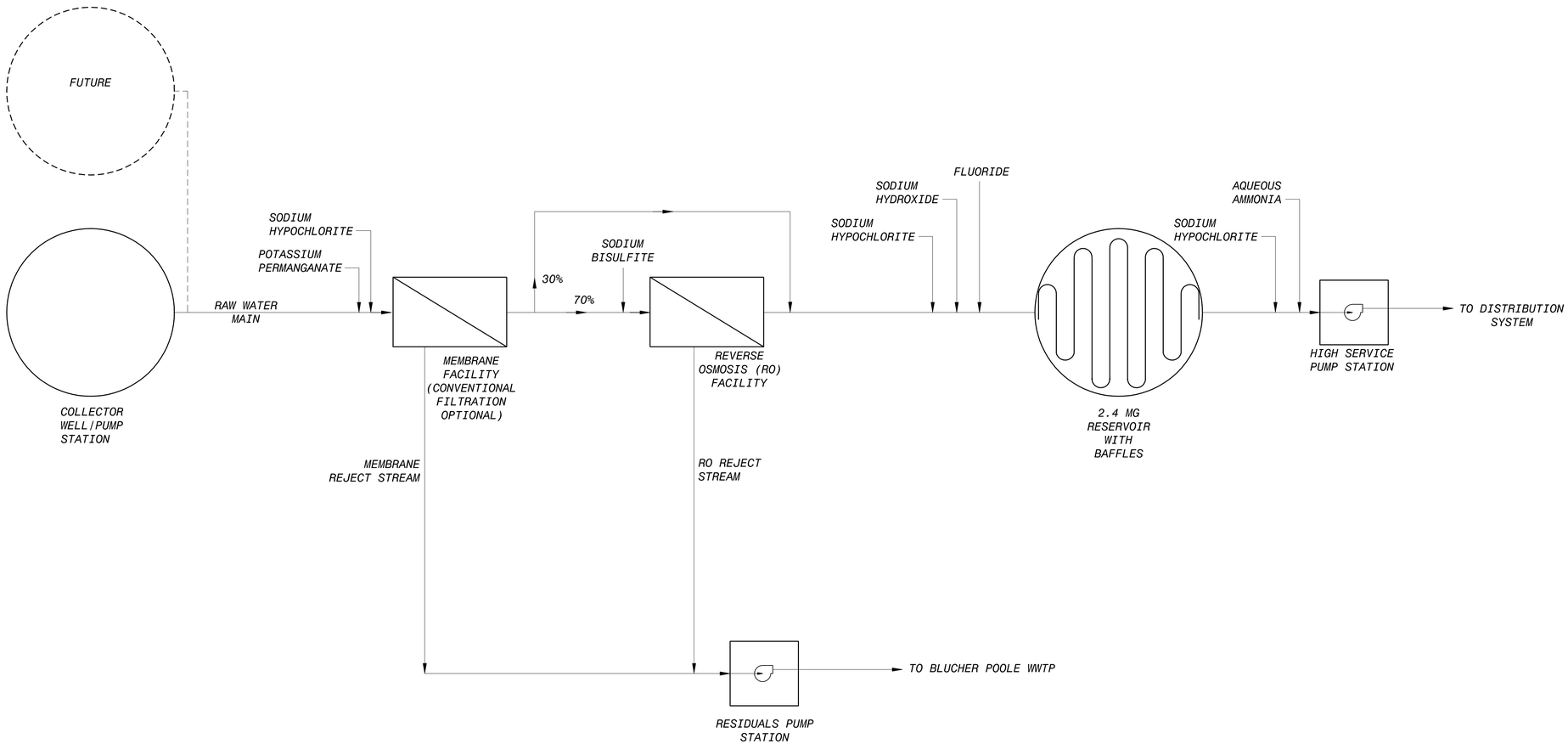
ALTERNATIVE B
DILLMAN WTP SCHEMATIC

DESIGNED: ALB
DETAILED: BLH
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
7-3

F05000
D5009



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BLACK & VEATCH Corporation
Cincinnati, Ohio

CITY OF BLOOMINGTON UTILITIES
LONG RANGE WATER CAPITAL PLAN

ALTERNATIVE C
NORTH WTP SCHEMATIC

DESIGNED: ALB
DETAILED: BLH
CHECKED:
APPROVED:
DATE:

PROJECT NO.
131434

FIGURE
7-4

FD5000
D5009

Table 7-4

Water System Improvements Schedule

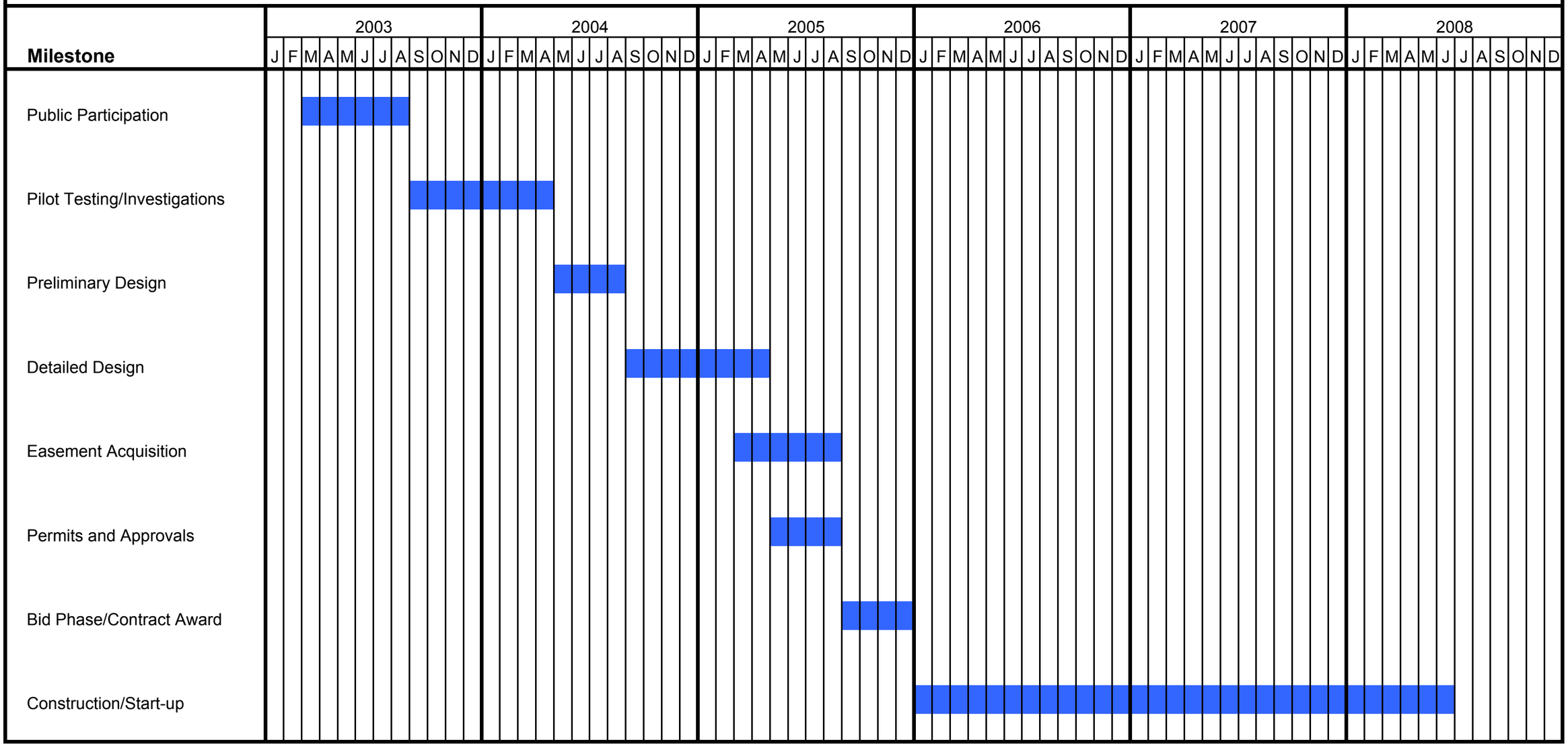


Table 8-7
Summary of the Opinion of Probable Construction Costs

Options	New Water Treatment Plant				Retrofit/Expand Existing Monroe WTP				Southeast Water System Improvements				Subtotal Probable Construction Cost	Contingencies (20%)	Total Probable Construction Cost
	Raw Water Intake or Collector Well	New Water Treatment Plant	Raw and Finished Water Mains	Subtotal New Water Treatment Plant	Intake Facility Improvements	Plant Improvements	Raw and Finished Water Mains	Subtotal Expand/ Retrofit Existing Monroe WTP	Pump Station	Tank	Transmission Main	Subtotal Southeast Water System Improvements			
Alternative A Expand the existing Monroe WTP to 36 MGD using Membranes. Add a second raw water and finished water line. Construct Southeast PS, Tank and Transmission Main.	-	-	-	$0	$800,000	$21,700,000	$5,000,000	$27,500,000	$2,200,000	$1,300,000	$7,500,000	$11,000,000	$38,500,000	$7,700,000	$46,200,000
Option to Alternative A Expand the existing Monroe WTP initially to 30 MGD using Membranes. Add a second raw water and finished water line. Construct Southeast PS, Tank and Transmission Main.	-	-	-	$0	$700,000	$16,500,000	$5,000,000	$22,200,000	$2,200,000	$1,300,000	$7,500,000	$11,000,000	$33,200,000	$6,700,000	$39,900,000
Alternative B New 12 MGD membrane plant expandable to 24 MGD located adjacent to Dillman WWTP and Intake at IDNR site along Lake Monroe. Retrofit existing Monroe WTP with 24 MGD membranes	$7,500,000	$22,500,000	$10,000,000	$40,000,000	-	$12,000,000	-	$12,000,000	-	-	-	$0	$52,000,000	$10,400,000	$62,400,000
Alternative C New 12 MGD North WTP with Groundwater Supply using membrane filtration and RO for softening. Retrofit existing MWTP with 24 MGD membranes.	$3,000,000	$30,700,000	$16,000,000	$49,700,000	-	$12,000,000	-	$12,000,000	-	-	-	$0	$61,700,000	$12,400,000	$74,100,000
Option 1 to Alternative C New 12 MGD North WTP with Groundwater Supply using gravity media filtration and RO for softening. Retrofit the existing MWTP with 24 MGD membranes.	$3,000,000	$26,000,000	$16,000,000	$45,000,000	-	$12,000,000	-	$12,000,000	-	-	-	$0	$57,000,000	$11,400,000	$68,400,000
Option 2 to Alternative C New 12 MGD North WTP using Lake Lemon, Bean Blossom Creek, and Griffy Lake. Retrofit the existing MWTP with 24 MGD membranes.	$2,000,000	$23,000,000	$1,700,000	$26,700,000	-	$12,000,000	-	$12,000,000	-	-	-	$0	$38,700,000	$7,800,000	$46,500,000

APPENDIX A

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT VK-4

CITY/COUNTY UTILITY REIMBURSEMENT AGREEMENT

Agreement Amount:	$2,304,750.21	Des No.:	0801059
Agreement Type:	Work-In-Contract	Project No.:	0801059
Work Description:	Relocation of water and sanitary lines	Road:	Rhorer Road/Gordon Pike
		County:	Monroe

THIS AGREEMENT, made and entered into this 25th day of July, 2016, by and between The City of Bloomington Utilities, 600 East Miller Drive, Bloomington, Indiana 47402, (hereinafter referred to as the "Utility"), and Monroe County Board of Commissioners, Courthouse Room 323, Bloomington, Indiana 47404, acting by and through its appropriate elected official, (hereinafter referred to as the "Local Public Agency").

WITNESSETH:

WHEREAS, the LPA desires to improve and/or maintain the condition of the above referenced road and has determined that the construction designated by the above project number (hereinafter referred to as the "project") is necessary for the improvement and/or maintenance of the roadway;

WHEREAS, the State of Indiana, through the Indiana Department of Transportation, (hereinafter referred to as "INDOT") has agreed to recommend approval of this project to the Federal Highway Administration for construction with funds apportioned to the State under Title 23, United States Code and Acts amendatory thereof and supplementary thereto; and

WHEREAS, INDOT will advertise for bids for construction of the project, award the contract, and act as liaison agent for the LPA with the Federal Highway Administration. The LPA will supervise the construction of the project; and

WHEREAS, the project will require certain adjustments, removals, alterations and/or relocations of the existing facilities of the Utility as shown on the plan marked **Exhibit "A"**, attached hereto and incorporated by reference; and

WHEREAS, it is necessary for the parties hereto to comply with the applicable terms and provisions of the FHWA Program Guide: Utility Relocation and Accommodation on Federal Aid Highway Projects (hereinafter called the Program Guide), dated January 2003, and 23 CFR 645 Subpart A, incorporated by reference, in order to receive reimbursement for the costs of the adjustments, removals, alterations and/or relocations of the existing facilities of the Utility; and

WHEREAS, it is in the best interests of the Utility and the LPA, for the necessary utility adjustments, removals, alterations and/or relocations of its existing facilities as shown on Exhibit "A" to be made by a contractor paid under the contract let by INDOT.

NOW, THEREFORE, in consideration of the premises and the mutual agreements and covenants herein contained (the adequacy of which considerations as to each of the parties to this Agreement are hereby mutually acknowledged), and other good and valuable consideration, the receipt of which is hereby acknowledged and intending to be legally bound, the parties hereby covenant and agree as follows:

SECTION 1: PREPARATION OF RELOCATION PLANS

The Utility shall prepare, or cause to be prepared, all plans, specifications and a preliminary itemized cost estimate, for relocation of the Utility's facilities that need to be relocated in order to construct the LPA's project. The construction contract will require the contractor, which is awarded the contract, to list the Utility as an additional named insured. In addition, the construction contract will provide that the Utility is a third-party beneficiary with respect to the relocation work. No changes to the plans or specifications for relocation of the Utility's facilities shall be made without the written approval of the Utility. INDOT will prepare the final engineer's estimate for the construction contract.

SECTION 2: AWARDING OF CONSTRUCTION CONTRACT

INDOT will advertise one (1) contract for bids which includes the plans and specifications for relocation of the Utility's facilities and the plans and specifications for the LPA's project. Upon receipt of an acceptable bid in accordance with State law, INDOT will award a contract for construction of the work. The Utility agrees to have the contractor to whom INDOT awards the contract relocate the Utility's facilities.

SECTION 3: CONSTRUCTION TESTING AND INSPECTION

The LPA will provide, or cause to provide, construction inspection and testing services to monitor the contractor's relocation of the Utility's facilities. The Utility may inspect, at its own cost, the relocation of the Utility's facilities. The Utility shall timely advise the LPA, in writing, of any deficiencies that are observed. Prior to INDOT's final acceptance of the construction contract, the Utility shall make an inspection of the Utility's relocation work and advise the LPA in writing of the Utility's acceptance thereof. Such acceptance shall not be unreasonably withheld.

SECTION 4: SUBORDINATION OF RIGHTS

The existing facilities are located on public right-of-way and/or an easement. If such facilities are located on property, other than public right-of-way, and the Utility either has an easement thereon or a continuing right to maintain the facilities in that location, the Utility, for and in consideration of this agreement, shall subordinate the Utility's rights herein to those of the LPA in the roadway right-of-way by executing an individual subordination agreement.

SECTION 5: REIMBURSEMENT

A. 40% of the construction plans, the cost to design and prepare specifications and preliminary itemized cost estimate for relocation of the Utility's facilities shall be borne by the LPA.

B. 21.7% of the cost to provide testing and inspection services for relocation of the Utility's facilities shall be borne by the LPA.

C. 100% of the cost of relocating the Utility's facilities shall be borne by the LPA, see **Exhibit "B"**, attached hereto and incorporated by reference.

The cost of relocation of the Utility's facilities, provided for in (c) shall equal the amount paid to the contractor based upon the actual units of work performed at the unit prices set out in the contractor's itemized proposal or in change orders.

The estimated cost of relocation is $2,304,750.21, see exhibit "B" for an itemized estimate of all anticipated costs, including but not limited to, materials, labor, and equipment costs.

The estimated cost of non-reimbursable relocation work to the utility's facilities is $1,778,501.61. The Utility has appropriated, duly made and entered of record, the amount of $1,778,501.61 to apply to the cost of the project. A copy of the Utility's official record wherein such appropriation was made is attached as Exhibit "C", attached hereto and incorporated by reference. If the appropriation is zero dollars, such shall be noted in the attached Exhibit "C".

SECTION 6: COMPLETION OF PROJECT

Upon final acceptance of the contractor's work (the construction contract), the Utility shall be responsible for maintenance, repair, and/or reconstruction of the Utility's facilities.

SECTION 7: WAIVER

The Utility waives any claim, demand, or expectation it may have in the future against INDOT and/or the LPA based upon any negligent omission and/or commission by the contractor performing the relocation of the Utility's facilities.

SECTION 8: PAYMENTS

Within forty-five (45) days after the contract is awarded, the Utility shall pay the LPA a sum equal to fifty percent (50%) of the Utility's share of the bid price for construction as stated above in Section 5.

The remaining fifty percent (50%) of the Utility's share shall be paid to the LPA in four quarterly payments as follows:

Within 90 days from initial payment - 12.5%

Within 180 days from initial payment – 12.5%

Within 270 days from initial payment – 12.5%

Within 360 days from initial payment – 12.5%

If a Change Order is approved which increases the Utility's share of the project cost, the Utility shall pay INDOT within thirty (30) days a sum equal to one hundred percent (100%) of such increased cost. If the Utility's share is less than the amount the utility has contributed, then INDOT will refund the difference within thirty (30) days.

All payments shall be made in arrears in conformance with State fiscal policies and procedures and, as required by IC 4-13-2-14.8. Payment will be made by electronic funds transfer to the

financial institution designated by the Utility in writing unless a specific waiver has been obtained from the Auditor of State. No payments will be made in advance of receipt of the goods or services that are the subject of this agreement except as permitted by IC 4-13-2-20

SECTION 9: BINDING UPON SUCCESSORS OR ASSIGNS

This Agreement shall be binding upon the parties and their successors and assigns.

SECTION 10: GENERAL LIABILITY PROVISIONS

The Utility for itself, its employees, agents and representatives, shall indemnify, protect and save harmless the Indiana Department of Transportation, the State of Indiana, and the LPA from and against any and all legal liabilities and other expenses, claims, cost, losses, suits or judgments for damages, or injuries to or death of persons or damage to or destruction of property (hereafter "Claim"), arising out of intentional tortious acts or whether due in whole or in part to the negligent acts or omissions of the Utility, its employees or agents or contractors, in relation to or in connection with any work performed or to be performed pursuant to this agreement, provided however, that where the State has been found liable by a court, tribunal or governing body entitled to make such a determination for intentional tortious acts and/or negligence with respect to the occurrence or occurrences giving rise to the Claim, the Utility shall have no duty to indemnify, protect, or save harmless either the Department of Transportation or the State.

SECTION 11: INCORPORATION OF THE UTILITY POLICY GUIDE

The Program Guide forms an essential part of this Agreement, and the terms or provisions of this Agreement in no way abrogate or supersede the terms or provisions set forth in said Program Guide.

SECTION 24: BUY AMERICA CERTIFICATION

The Utility agrees that all steel and cast iron materials and products to be used under this agreement will be produced and manufactured in the United States of America pursuant to the requirements of Ind. Code 5-16-8-1, et al. and 23 CFR 635.410.

IN WITNESS HEREOF the parties hereto separately and severally have caused this instrument to be executed in their respective names by and through their duly authorized officers.

CITY OF BLOOMINGTON:

Vic Kelson, Director
City of Bloomington Utilities

Sam Frank, President
Utility Service Board

ATTEST:

Kim Alexander, Secretary
Utility Service Board

John Hamilton, Mayor
City of Bloomington

ACKNOWLEDGEMENT

STATE OF INDIANA)
) SS:
COUNTY OF MONROE)

Before me, the undersigned Notary Public in and for said County and State, personally appeared **Vic Kelson**, Director for the City of Bloomington Utilities, and acknowledged the execution of the foregoing contract on this 25 day of July, 2016.

Witness my hand and seal the said last day.

My Commission Expires Sept 2018

Michael T. Carter
(Signature)

(Seal)

MICHAEL T. CARTER
(Printed or Typed) (Notary Public)

STATE OF INDIANA)
) SS:
COUNTY OF MONROE)

Before me, the undersigned Notary Public in and for said County and State, personally appeared **Sam Frank**, President of the City of Bloomington Utilities Service Board, and acknowledged the execution of the foregoing contract on this 25 day of July, 2016.

Witness my hand and seal the said last day.

My Commission Expires Sept 2018

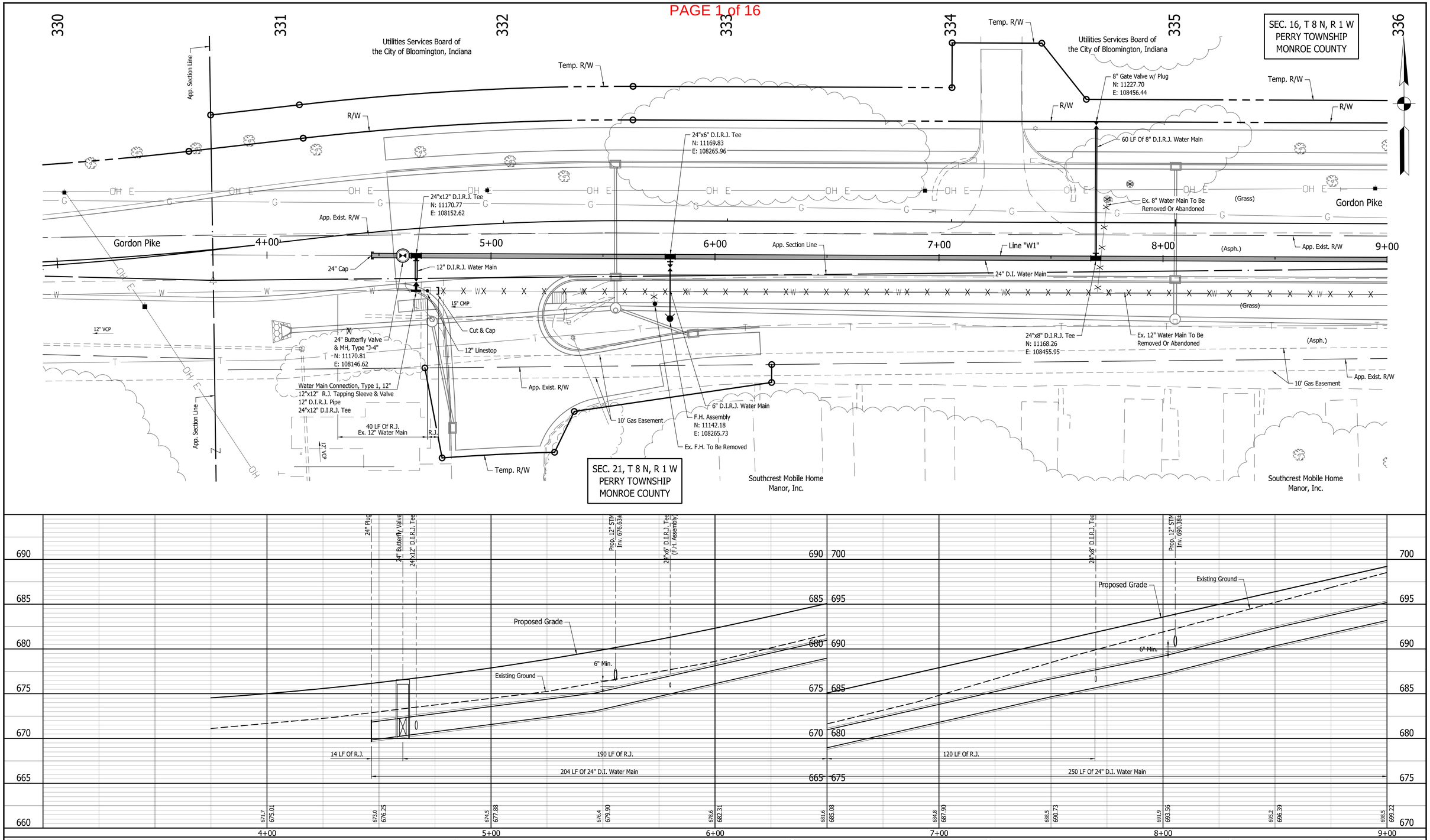
Michael T. Carter
(Signature)

(Seal) (Printed or Typed) (Notary Public)

MICHAEL T. CARTER

CITY OF BLOOMINGTON
Legal Department
Reviewed By:
DATE: 7-15-16

CITY OF BLOOMINGTON
Controller
Reviewed by:
DATE: 7/15/16
FUND/ACCT:



NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W1", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

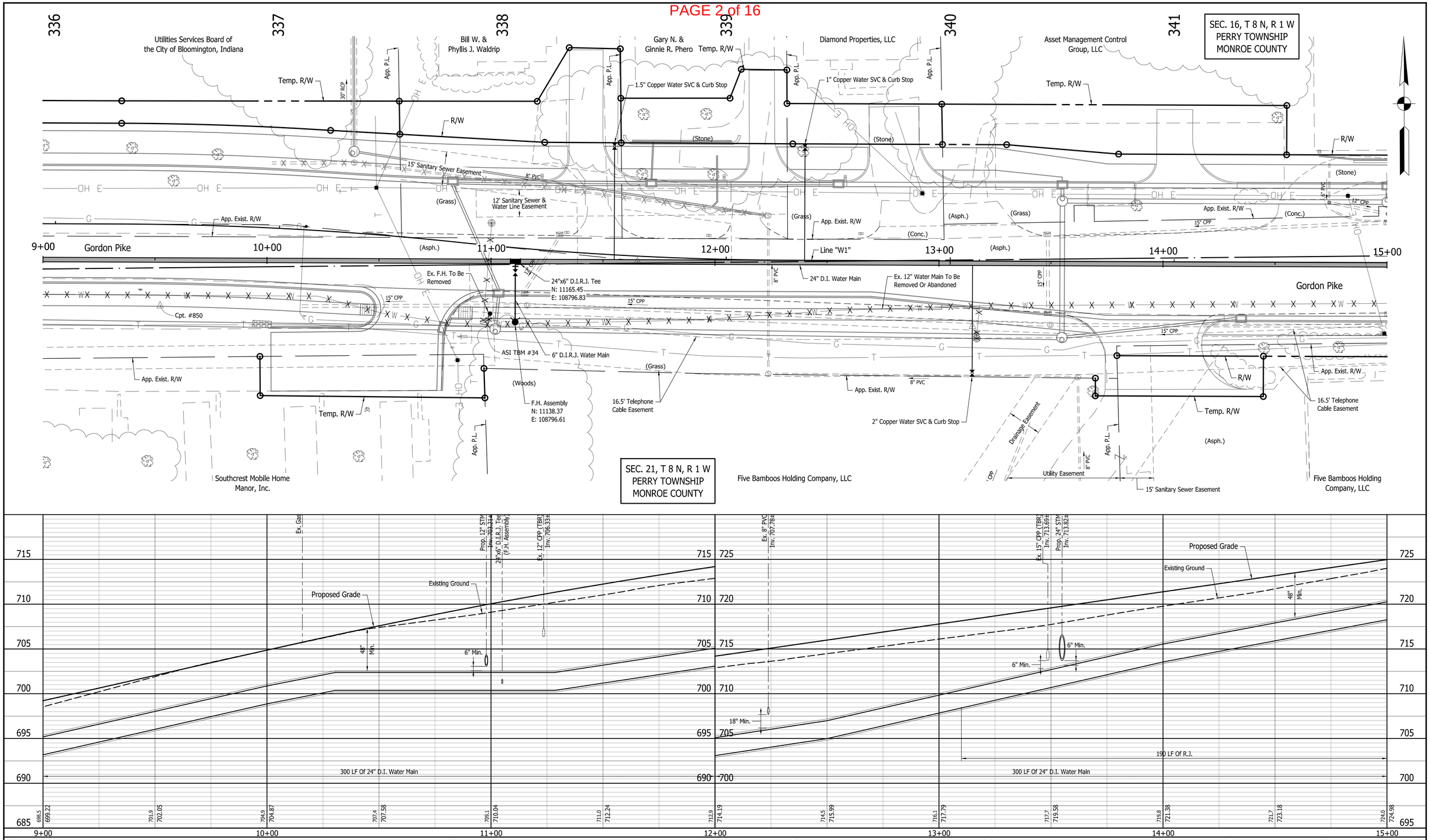
DESIGNED:	DRH	DRAWN:	PJT
CHECKED:	JFF	CHECKED:	DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS		
N/A	27	of	136
CONTRACT	PROJECT NO.		
R-31902	0801059		



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4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

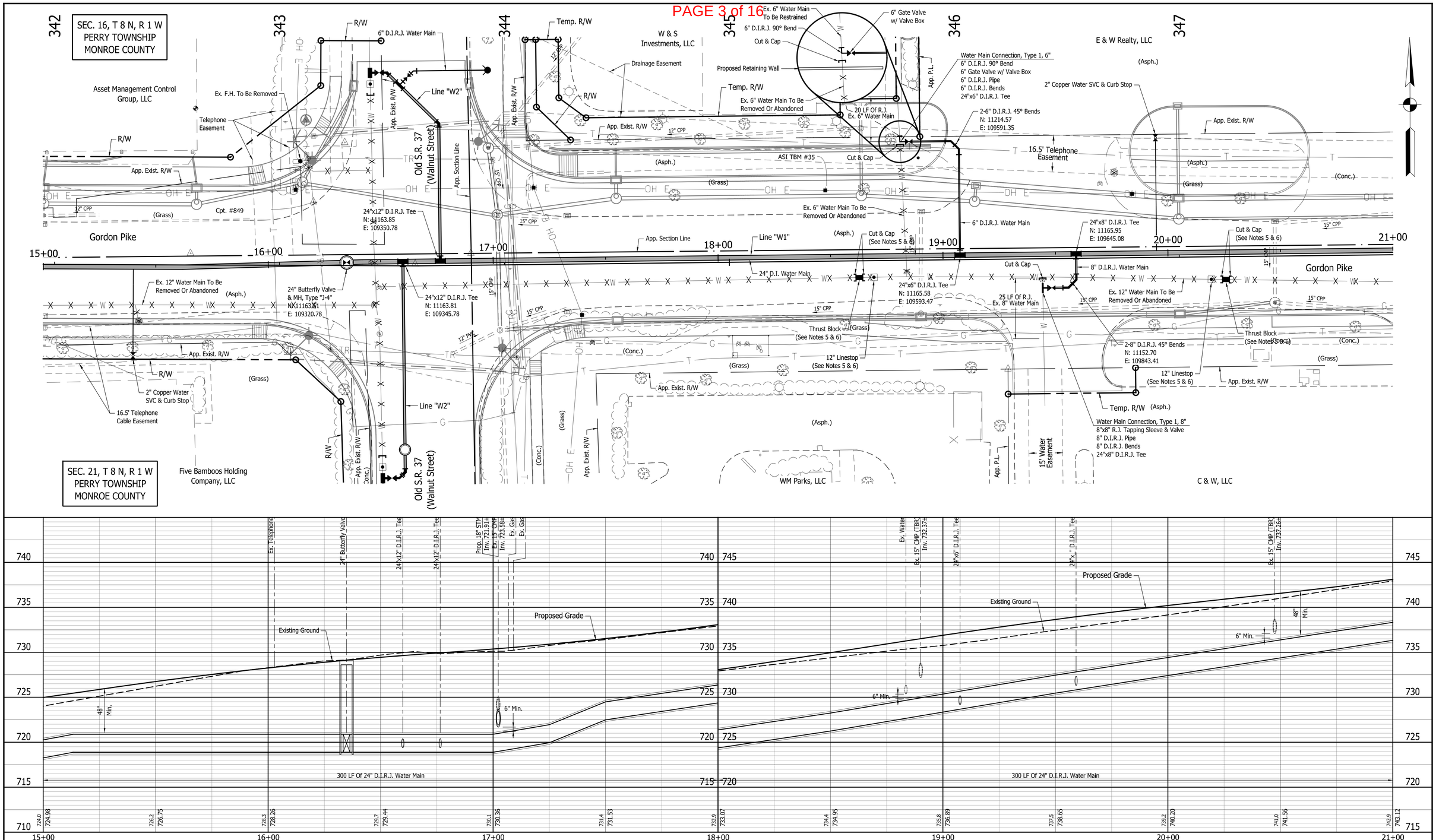
DESIGNED: DRH	DRAWN: PJT
CHECKED: JFF	CHECKED: DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS
N/A	28 of 136
CONTRACT	PROJECT NO.
R-31902	0801059



NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W1", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.
5. Refer To Seq. Of Construction. If Contractor Deviates From Proposed Seq. Of Construction, This May Not Be Req'd.
6. Linestop Location, Cut & Cap, & Thrust Blocking Design Shall Be Coordinated By The Contractor.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS		
N/A	29	of	136
CONTRACT	PROJECT NO.		
R-31902	0801059		

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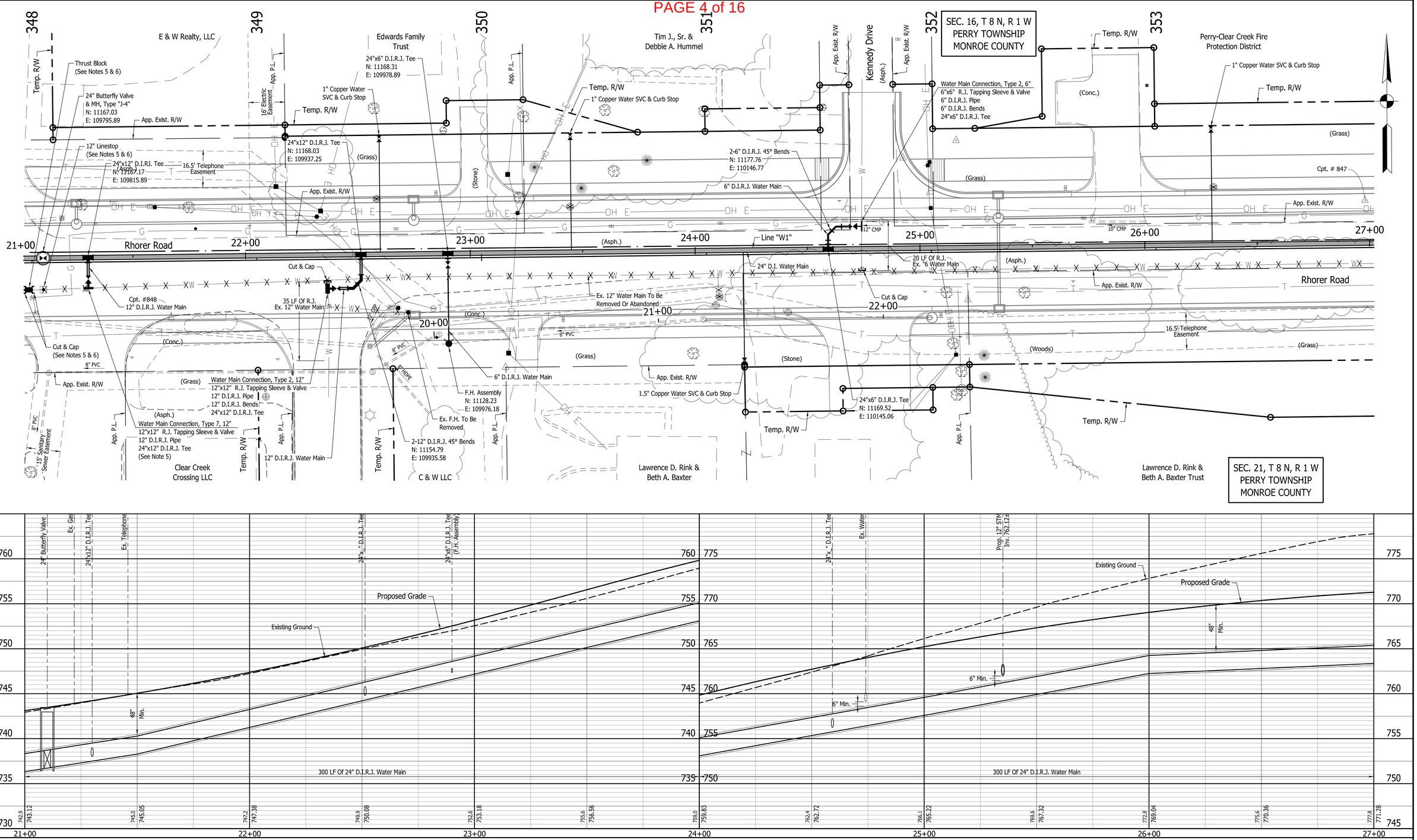

NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W1", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.
5. Refer To Seq. Of Construction. If Contractor Deviates From Proposed Seq. Of Construction, This May Not Be Req'd.
6. Linestop Location, Cut & Cap, & Thrust Blocking Design Shall Be Coordinated By The Contractor.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA
DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS
N/A	30 of 136
CONTRACT	PROJECT NO.
R-31902	0801059

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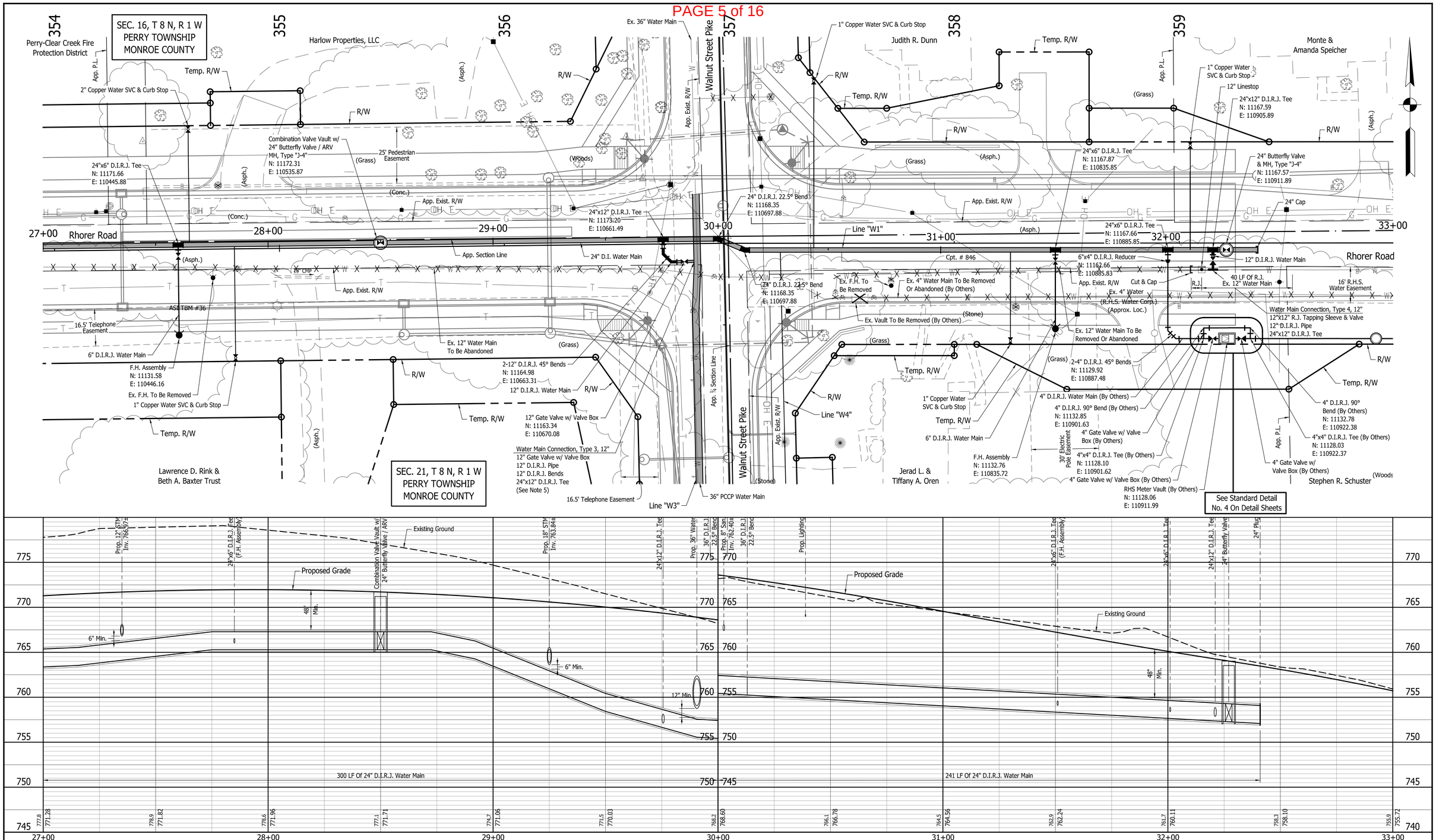


NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W1", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.
5. Contractor Shall Coordinate w/ " Forterra " To Install A 12" Mechanical Joint Bell Outlet On The 36" PCCP Pipe During Pipe Fabrication

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

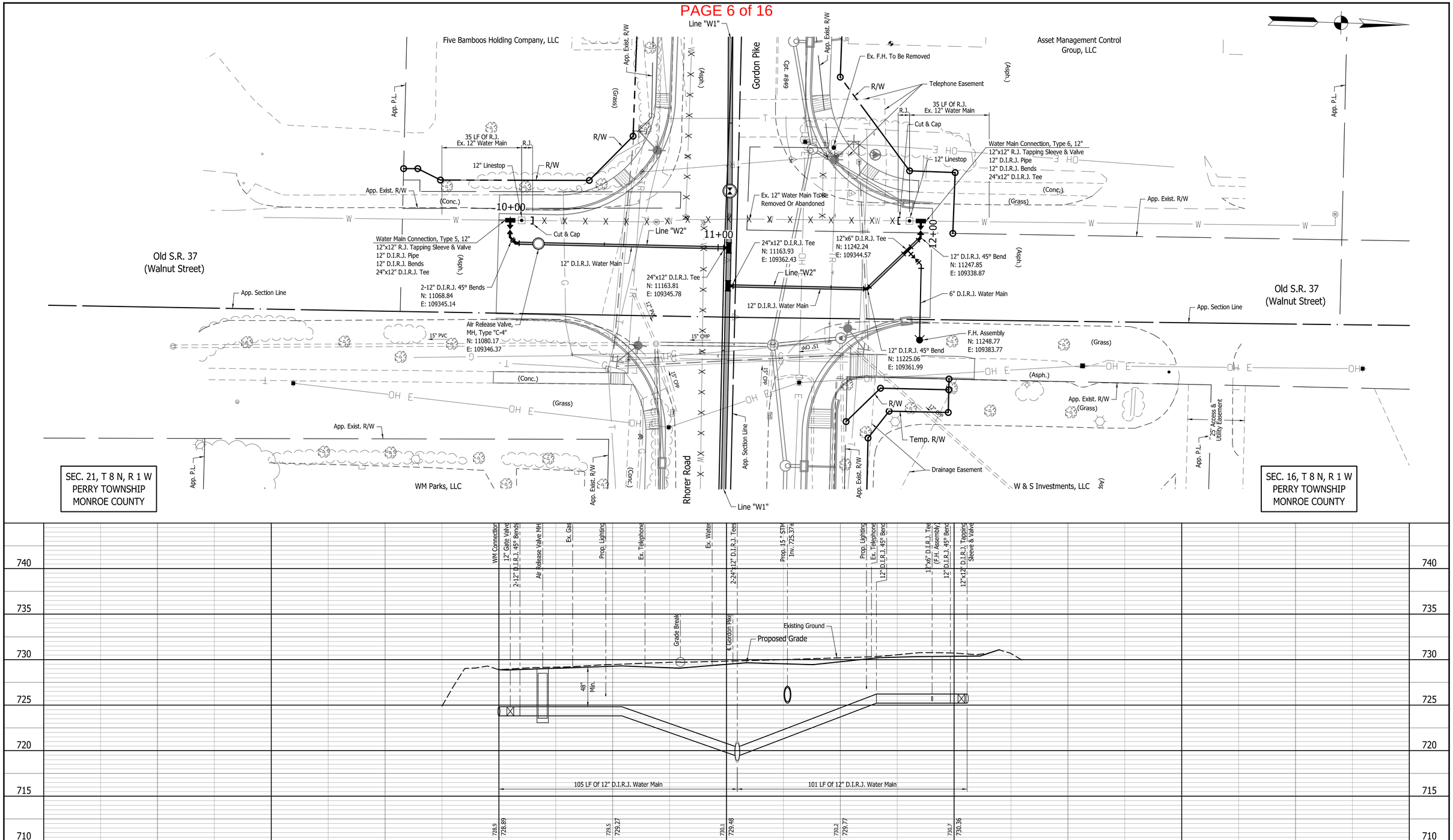
DESIGNED:	DRH	DRAWN:	PJT
CHECKED:	JFF	CHECKED:	DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS	
N/A	31 of	136
CONTRACT	PROJECT NO.	
R-31902	0801059	



NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W2", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

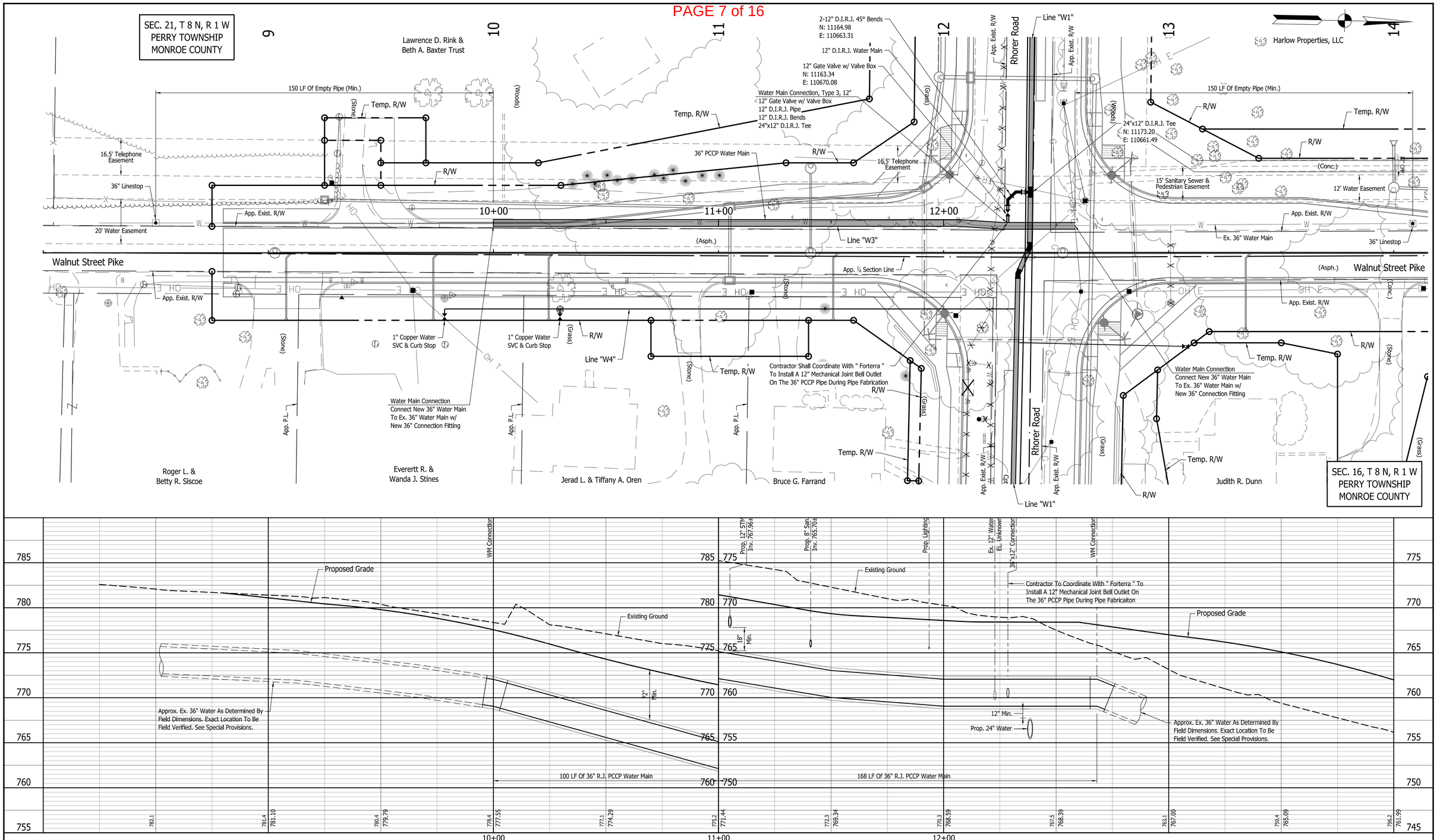
DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA
DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W2"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS
N/A	32 of 136
CONTRACT	PROJECT NO.
R-31902	0801059



NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W3", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.
5. Contractor Shall Coordinate w/ " Forterra " In The Field To Determine The Requirements For 36" PCCP Pipe (Refer To Special Provisions) And During Installation To Ensure That Pipe Is Installed Per Pipe Manufacturer's Instructions.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

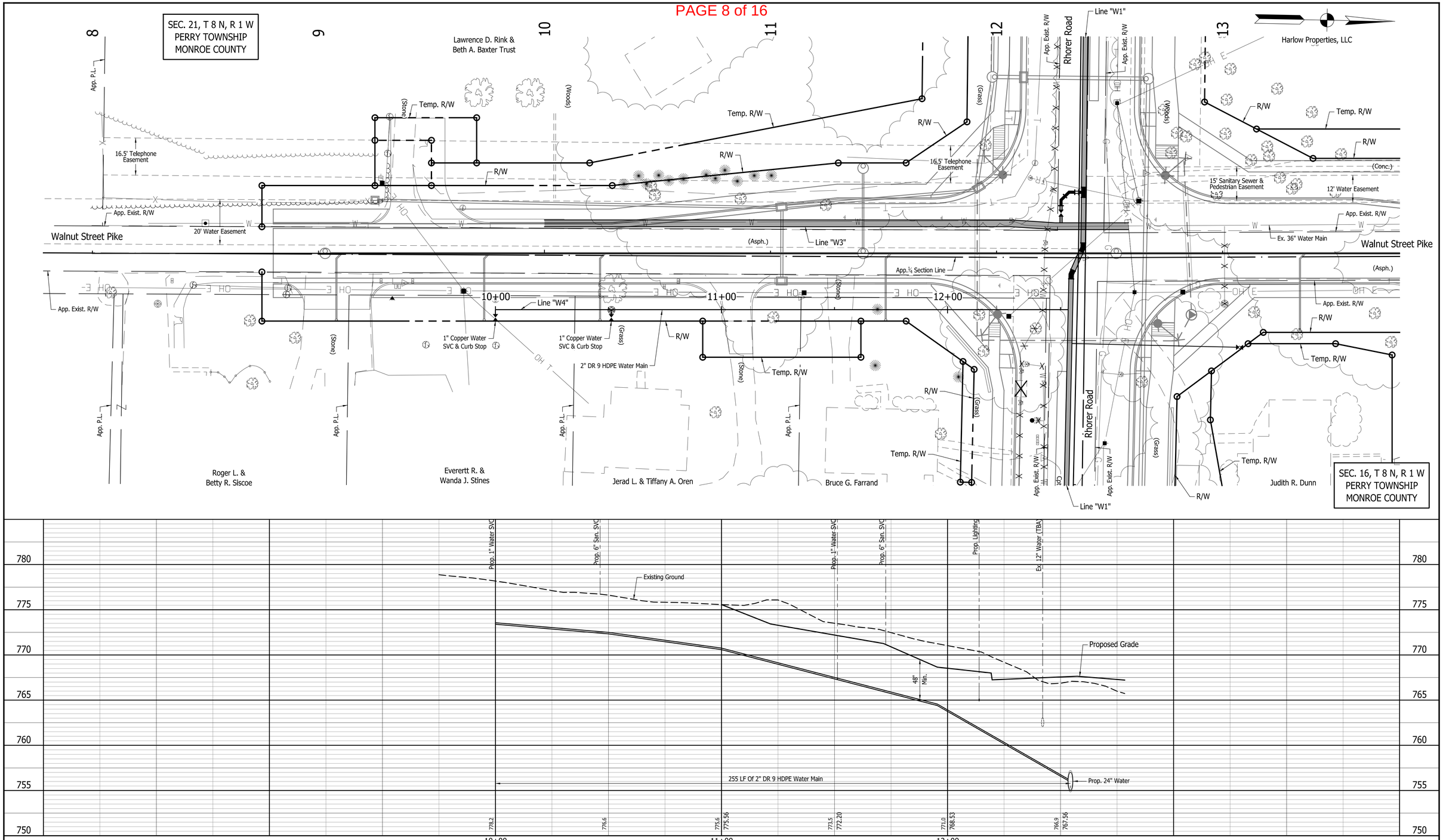
DESIGNED: DRH	DRAWN: PJT
CHECKED: JFF	CHECKED: DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W3"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS
N/A	33 of 136
CONTRACT	PROJECT NO.
R-31902	0801059



NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W4", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

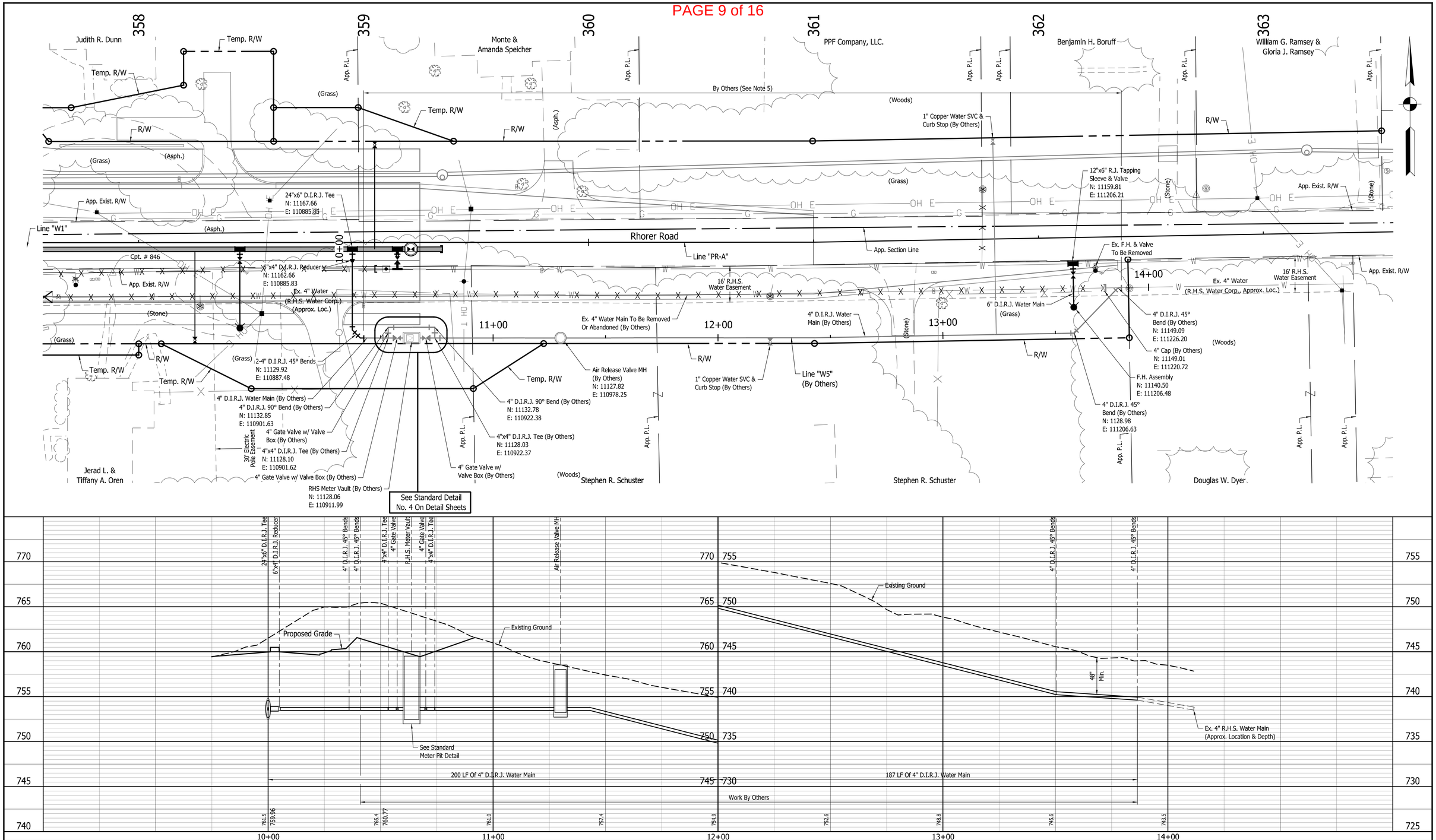
RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

DESIGNED:	DRH	DRAWN:	PJT
CHECKED:	JFF	CHECKED:	DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W4"

HORIZONTAL SCALE	1" = 20'
VERTICAL SCALE	1" = 5'
BRIDGE FILE	N/A
DESIGNATION NO.	0801059
SURVEY BOOK	N/A
SHEETS	34 of 136
CONTRACT	R-31902
PROJECT NO.	0801059



NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Water Main Features Are Described From Line "W5", Unless Otherwise Noted.
3. The Minimum Cover Above Proposed Water Main Shall Be From Proposed Grade. Contractor Shall Be Responsible For Providing Sufficient Cover During Construction Activities To Prevent Damage To Pipes If Less Than 48" Until Final Fill And Grade Is Established.
4. Contractor Shall Be Responsible For Coordination w/ CBU For All Water Service And Active Water Main Connections.
5. All Work Within The Designated Limits To Be Done By Others. Contractor Shall Coordinate As Req'd.

LEGEND

X X X	Utility Abandonment Or Removal		Fire Hydrant
	Valve		Cap
	Butterfly Valve & Valve Vault		Reducer
	Curb Stop		Water Main
	Fittings		

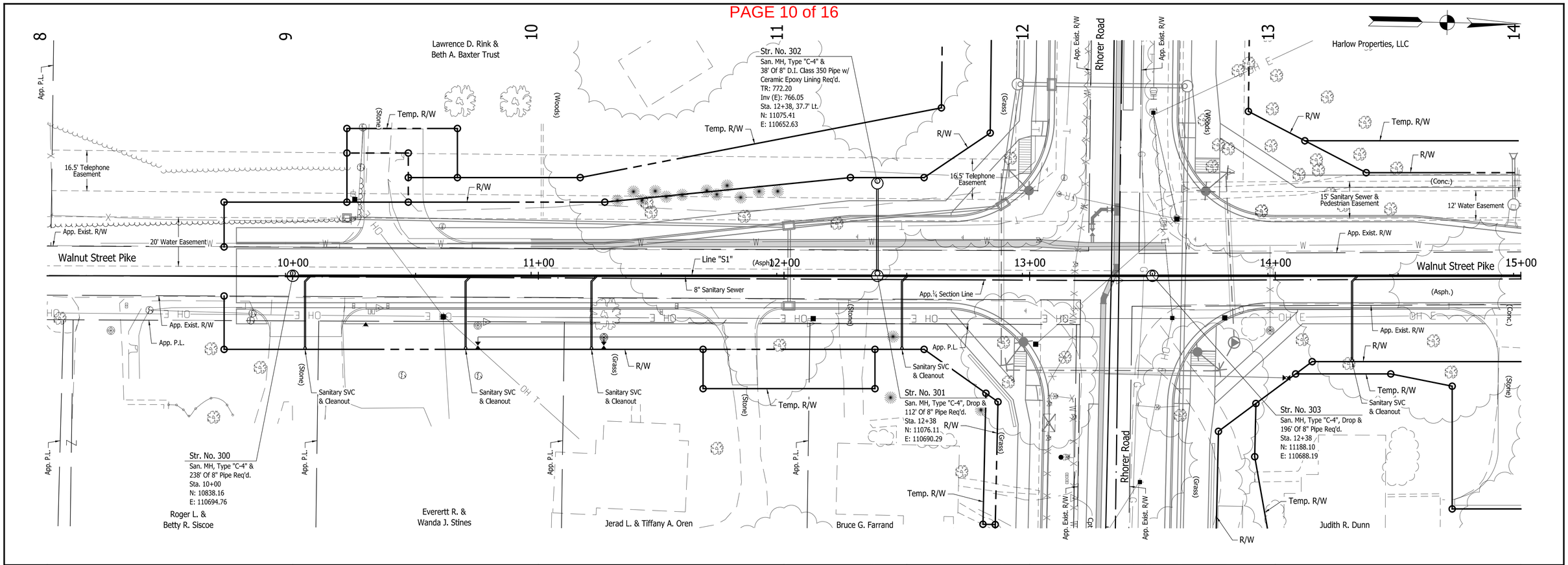
RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

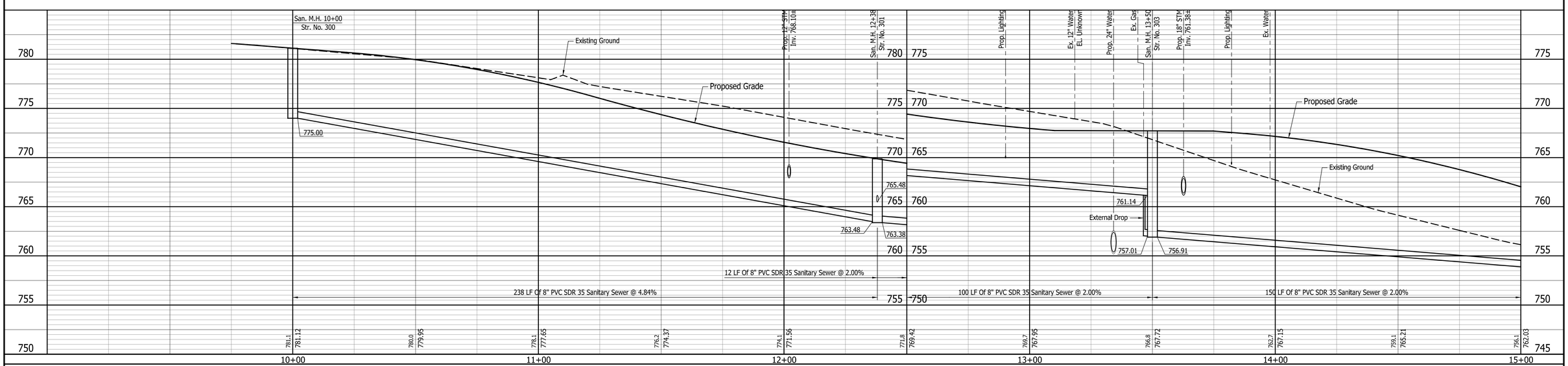
DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
WATER MAIN - LINE "W5"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059
SURVEY BOOK	SHEETS
N/A	35 of 136
CONTRACT	PROJECT NO.
R-31902	0801059





NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Sanitary Sewer Features Are Described From Line "S1", Unless Otherwise Noted.
3. Contractor Shall Coordinate w/ Homeowners To Determine Locations Of Lateral Cleanouts At R/W Line Prior To Installation Of Sanitary Sewer.

LEGEND

X X X	Utility Abandonment Or Removal
	Sanitary Manhole
	Sanitary Sewer
	Sanitary Cleanout

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
SANITARY SEWER - LINE "S1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059
SURVEY BOOK	SHEETS
N/A	36 of 136
CONTRACT	PROJECT NO.
R-31902	0801059

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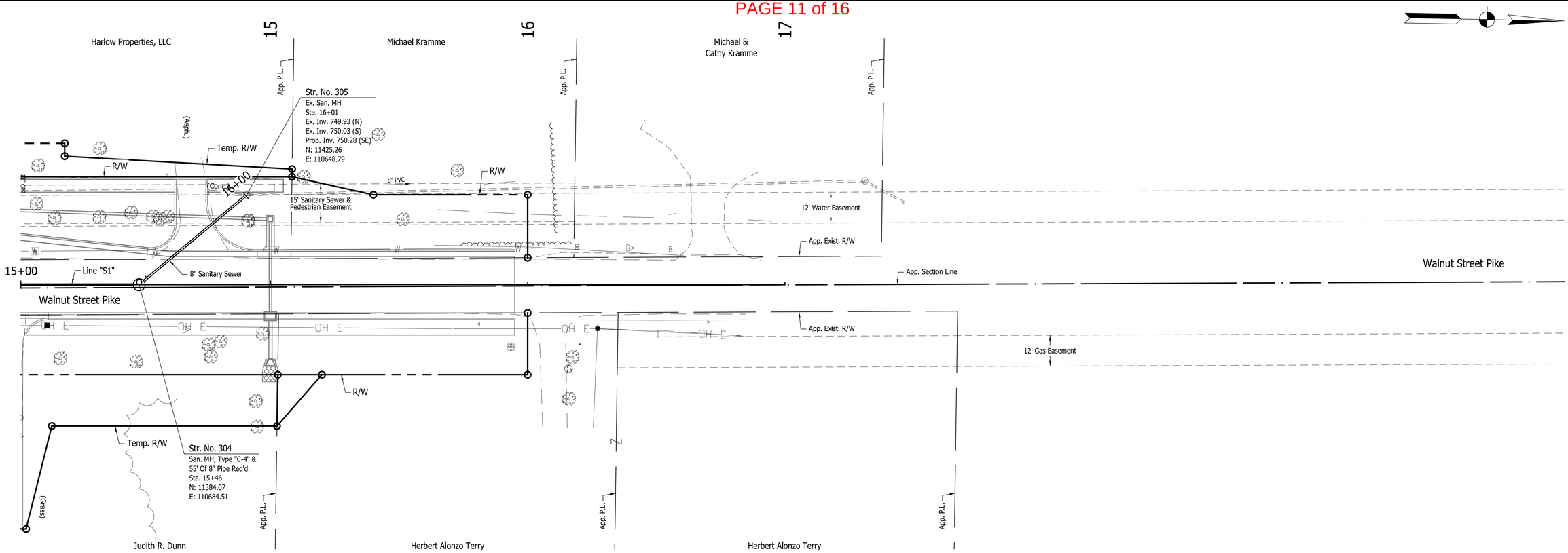
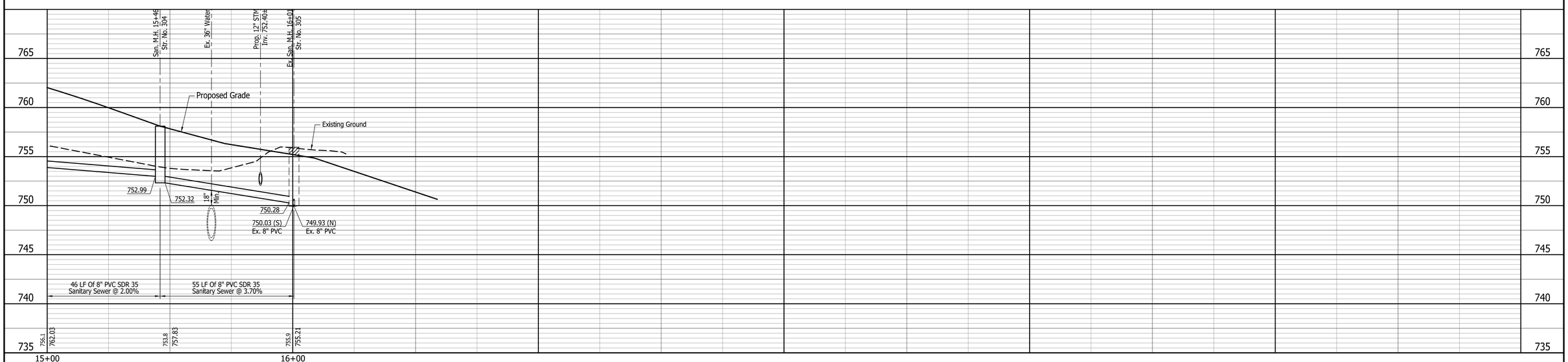




NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Sanitary Sewer Features Are Described From Line "S1", Unless Otherwise Noted.
3. Contractor Shall Coordinate w/ Homeowners To Determine Locations Of Lateral Cleanouts At R/W Line Prior To Installation Of Sanitary Sewer.

LEGEND

X X X	Utility Abandonment Or Removal
	Sanitary Manhole
	Sanitary Sewer
	Sanitary Cleanout

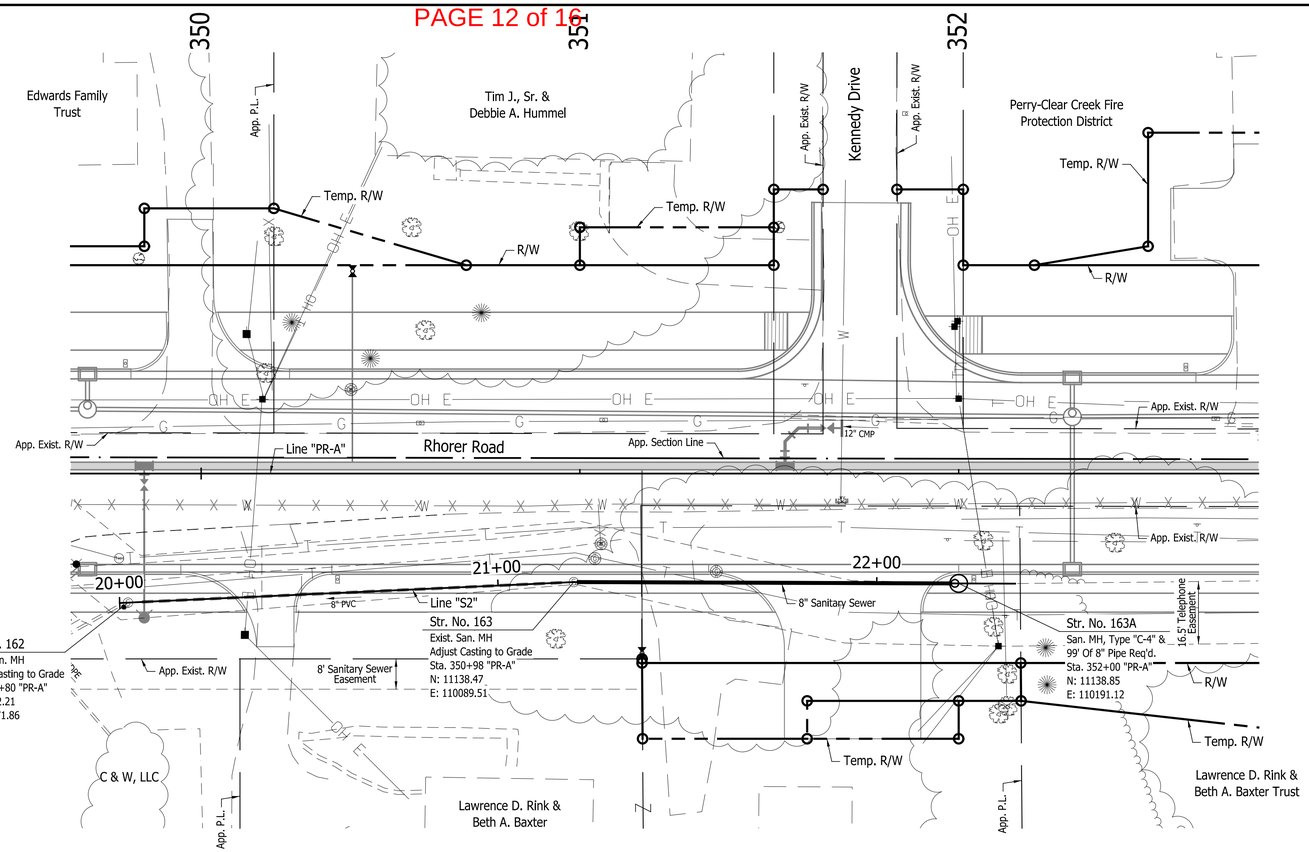
RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

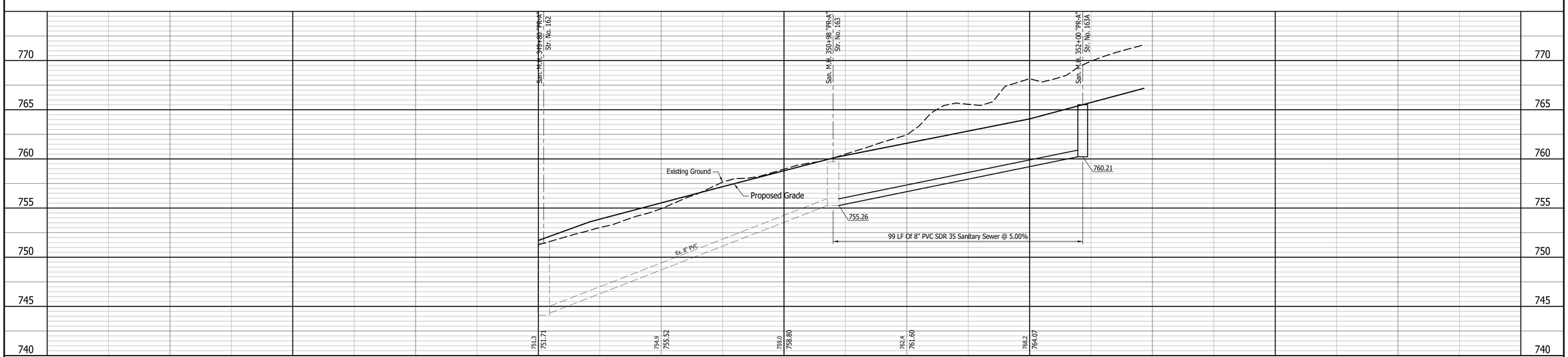
DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA
DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
SANITARY SEWER - LINE "S1"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059
SURVEY BOOK	SHEETS
N/A	37 of 136
CONTRACT	PROJECT NO.
R-31902	0801059





NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Sanitary Sewer Features Are Described From Line "S1", Unless Otherwise Noted.
3. Contractor Shall Coordinate w/ Homeowners To Determine Locations Of Lateral Cleanouts At R/W Line Prior To Installation Of Sanitary Sewer.

LEGEND

X X X	Utility Abandonment Or Removal
	Sanitary Manhole
	Sanitary Sewer
	Sanitary Cleanout

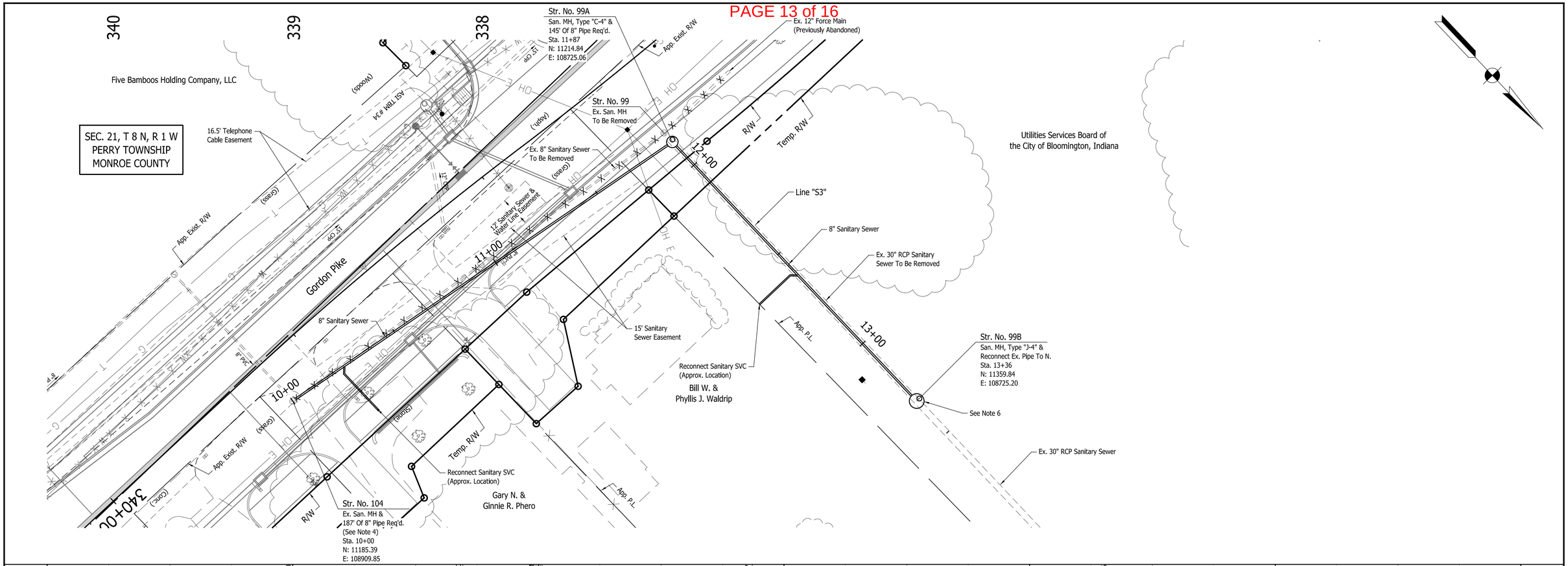
RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

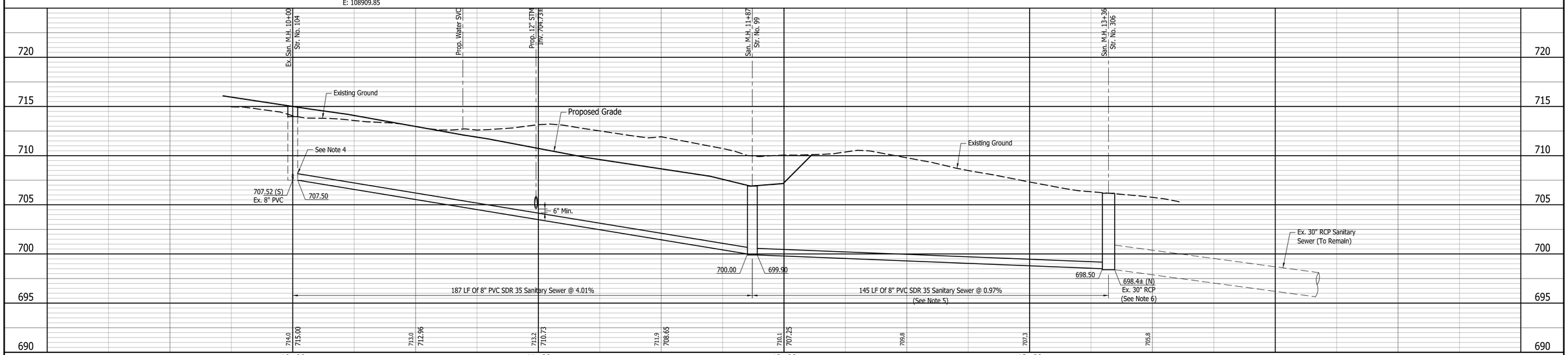
DESIGNED: JRG DRAWN: JRG
CHECKED: JMM CHECKED: PKW

INDIANA
DEPARTMENT OF TRANSPORTATION

PLAN AND PROFILE
SANITARY SEWER - LINE "S2"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059
SURVEY BOOK	SHEETS
N/A	38 of 136
CONTRACT	PROJECT NO.
R-31902	0801059





NOTES:

1. Contractor Shall Field Verify All Existing Utilities And Report Any Discrepancies To The Engineer, Prior To Construction.
2. All Sanitary Sewer Features Are Described From Line "S3", Unless Otherwise Noted.
3. Contractor Shall Coordinate w/ Homeowners To Determine Locations Of Lateral Cleanouts At R/W Line Prior To Installation Of Sanitary Sewer.
4. Proposed 8" Sanitary Sewer To Tie Back Into Ex. Str. No. 104 At EL. 707.50.
5. Existing 30" RCP Sewer To Be Removed, Not Shown For Clarity.
6. Contractor Shall Field Verify Invert Of Existing 30" RCP Sewer At This Location And Coordinate w/ Engineer Before Initiating Construction.

LEGEND

X X X	Utility Abandonment Or Removal
⊙	Sanitary Manhole
═══	Sanitary Sewer
∘	Sanitary Cleanout

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

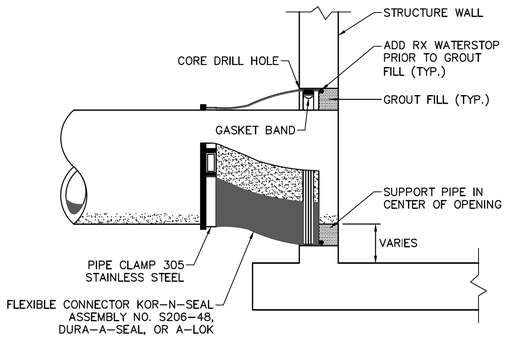
DESIGNED:	DRH	DRAWN:	PJT
CHECKED:	JFF	CHECKED:	DRH

INDIANA DEPARTMENT OF TRANSPORTATION

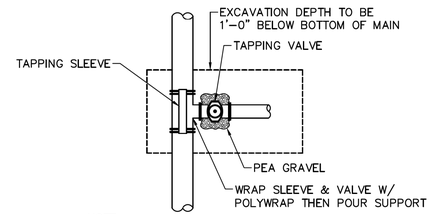
PLAN AND PROFILE
SANITARY SEWER - LINE "S3"

HORIZONTAL SCALE	BRIDGE FILE
1" = 20'	N/A
VERTICAL SCALE	DESIGNATION NO.
1" = 5'	0801059

SURVEY BOOK	SHEETS		
N/A	39	of	136
CONTRACT	PROJECT NO.		
R-31902	0801059		



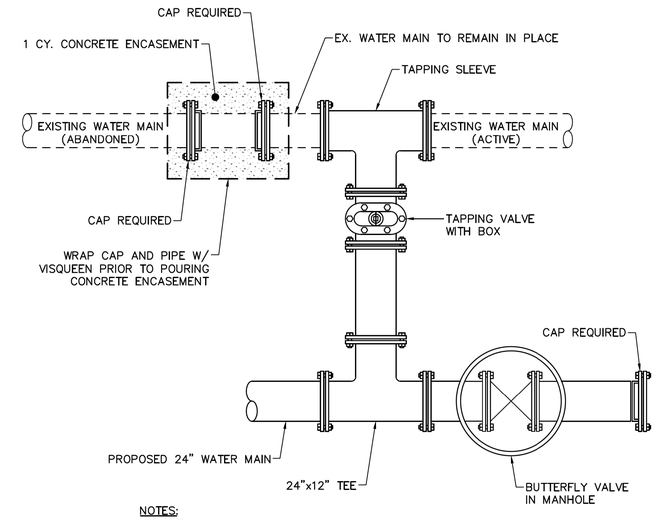
NEW CONNECTION TO EXISTING MANHOLE
NOT TO SCALE



NOTE:

REFER TO CBU STANDARDS FOR TAPPING SLEEVE AND VALVE REQUIREMENTS.

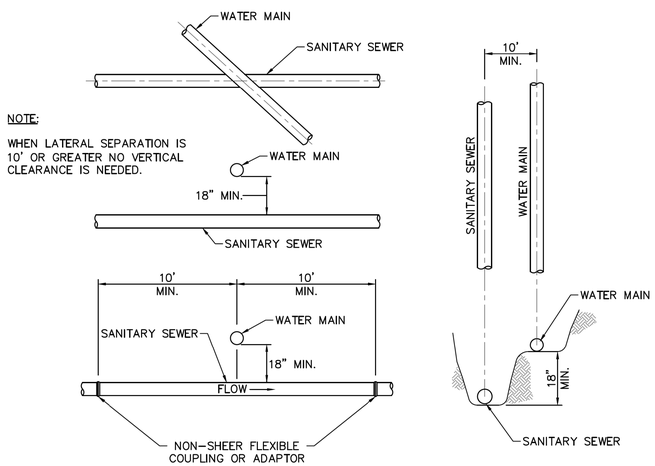
LIVE WATER MAIN CONNECTION DETAIL
NOT TO SCALE



NOTES:

1. USE RESTRAINED JOINTS UNLESS OTHERWISE SHOWN OR SPECIFIED.

TYPICAL WATER MAIN CONNECTION AND ABANDONMENT
(12"x24" CONNECTION)
NOT TO SCALE



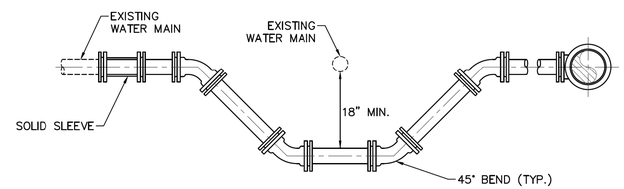
NOTE:

WHEN LATERAL SEPARATION IS 10' OR GREATER NO VERTICAL CLEARANCE IS NEEDED.

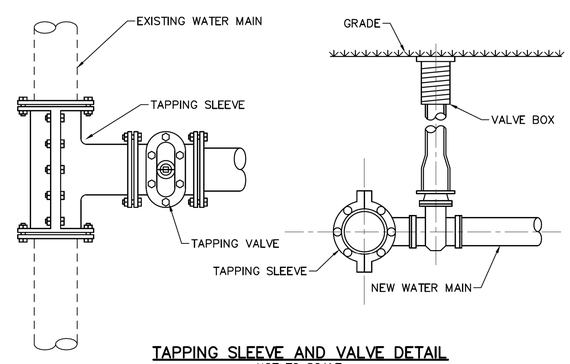
CROSSOVER & SEPARATION NOTES:

1. WHEN LATERAL SEPARATION IS 10' OR GREATER NO VERTICAL CLEARANCE IS NEEDED.
2. WHEN SANITARY SEWER CROSSES WATER MAIN, THE CROSSING MUST BE A MINIMUM OF 45° MEASURED FROM THE CENTERLINES OF THE SEWER AND WATER MAIN WITH A MINIMUM OF 18-INCHES VERTICALLY BETWEEN THE PIPES. THE VERTICAL SEPARATION SHALL BE MAINTAINED FOR 10 FEET EACH WAY OF THE CROSSING.
3. IF THE CROSSING ANGLE IS LESS THAN 45° OR THE DISTANCE BETWEEN PARALLEL MAINS IS LESS THAN 10 FEET, THE SANITARY SEWER SHALL BE DESIGNED AND CONSTRUCTED EQUAL TO WATER PIPE WITH MINIMUM 200 PSI PRESSURE RATING, ACTUAL LEAKAGE SHALL BE THAT OF NORMAL SANITARY SEWER PIPE PER CBU SPEC PG. 37, SECT. 4-5-1-7-3. THE PIPES SHALL NOT TOUCH, SEWER JOINTS SHALL BE A COMPRESSION TYPE JOINT PLACED EQUIDISTANT FROM THE WATER MAIN, WATER AND SEWER SHALL BE ON SEPARATE TRENCH SHELVES.
4. MANHOLES SHALL BE A MINIMUM OF 8 FEET (OUTSIDE TO OUTSIDE) FROM A WATER MAIN.

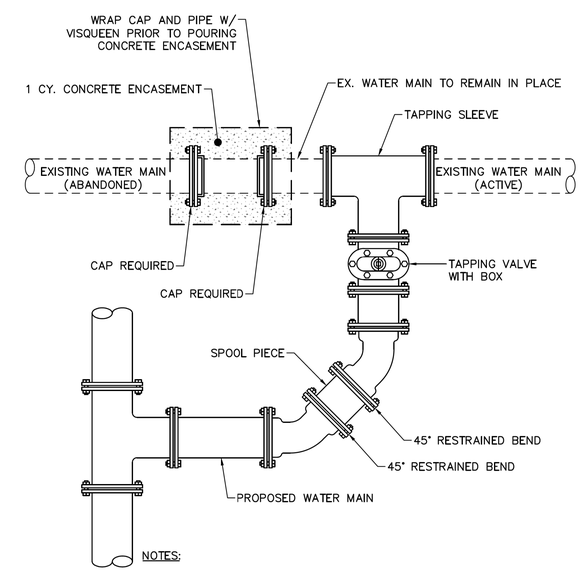
MIN. CROSSOVER AND SEPARATION REQUIREMENTS FOR WATER MAINS AND SANITARY SEWERS
NOT TO SCALE



45° VERTICAL BENDS TO AVOID EXISTING WATER MAIN CONFLICTS
NOT TO SCALE



TAPPING SLEEVE AND VALVE DETAIL
NOT TO SCALE



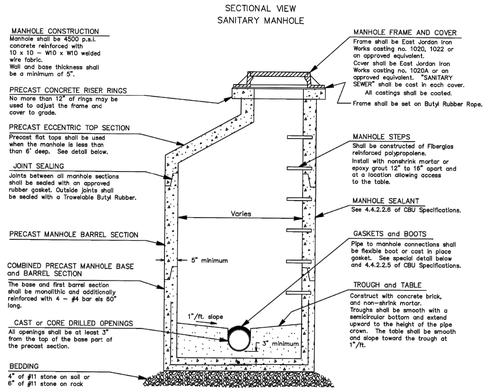
NOTES:

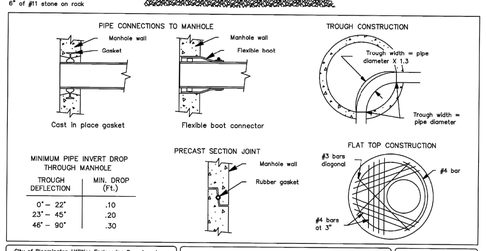
1. USE RESTRAINED JOINTS UNLESS OTHERWISE SHOWN OR SPECIFIED.

TYPICAL WATER MAIN CONNECTION AND ABANDONMENT
(6"x24" OR 8"x24" CONNECTIONS)
NOT TO SCALE

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE	INDIANA DEPARTMENT OF TRANSPORTATION	HORIZONTAL SCALE: N/A	BRIDGE FILE: N/A
		VERTICAL SCALE: N/A	DESIGNATION NO.: 0801059
DESIGNED: DRH / DRAWN: PJT	STANDARD DETAILS	SURVEY BOOK: N/A	SHEETS: 40 of 136
CHECKED: JFF / CHECKED: DRH	WATER MAIN AND SANITARY SEWER	CONTRACT: R-31902	PROJECT NO.: 0801059

SECTIONAL VIEW SANITARY MANHOLE





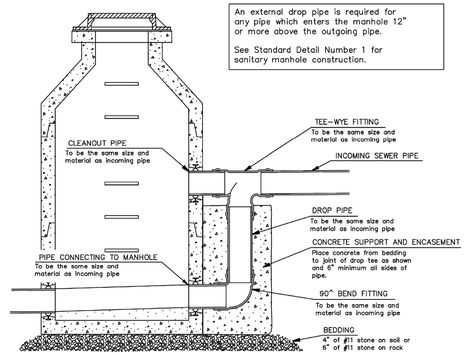
MINIMUM PIPE INVERT DROP THROUGH MANHOLE	
TROUGH DEFLECTION	MIN. DROP (Ft.)
0° – 22°	.10
23° – 45°	.20
46° – 90°	.30

City of Bloomington Utilities Engineering Department | NO SCALE 2/21/94 by: M. Hicks | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD 1.DGN REVISED 02/18/08 T.A. | STANDARD SANITARY MANHOLE | STANDARD DETAIL NUMBER 1

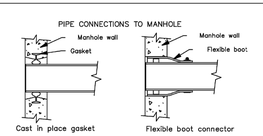
EXTERNAL DROP PIPE DETAIL FOR SANITARY MANHOLE

An external drop pipe is required for any pipe which enters the manhole 12" or more above the outgoing pipe.

See Standard Detail Number 1 for sanitary manhole construction.



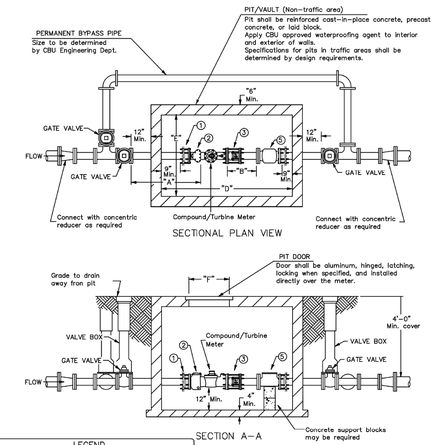
SECTIONAL VIEW



MINIMUM PIPE INVERT DROP THROUGH MANHOLE	
TROUGH DEFLECTION	MIN. DROP (Ft.)
0° – 22°	.10
23° – 45°	.20
46° – 90°	.30

City of Bloomington Utilities Engineering Department | NO SCALE 10/8/98 by: M. Hicks | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD2.DGN REVISED 02/18/08 T.A. | EXTERNAL DROP PIPE DETAIL FOR SANITARY MANHOLE | STANDARD DETAIL NUMBER 2

STANDARD METER PIT DETAIL 3"–10" Meter Installation



LEGEND

1. Megaflange 2100 Series
2. STRAINER, Plate Type Only!
3. Dismantling Joint, Romac DJ400 or DJ405 (Set at Nominal Length w/ O-ring gasket toward spool)
5. Swing Arm Check Valve

NOTES

All construction and materials shall meet CBU specifications.

- If an 8" Rockwell manifold meter is used add 33".
- Use of any other type of strainer must be approved by CBU Engineering.

METER SIZE	"A" Min. length straight pipe before meter (Includes strainer)	"B" Min. length straight pipe after meter	"C" 2" test plug min. distance after meter	"D" Pit minimum inside length	"E" Pit minimum inside width	"F" Min. pit door size
3"	21"	15"	*TEST PLUG NOW	70"	48"	36"x36"
4"	28"	20"	PART OF METER	78"	48"	36"x36"
6"	42"	30"	ASSEMBLY	91"	60"	36"x48"
8"	56"	40"		124" *	96"	48"x48"
10"	70"	50"		150"	96"	48"x48"

City of Bloomington Utilities Engineering Department | NO SCALE 2/21/94 by: M. Hicks | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD4.DGN Revised: 7/15/2014 G.N. | STANDARD METER PIT DETAIL 3"–10" Meter Installation | STANDARD DETAIL NUMBER 4

STANDARD FIRE HYDRANT AND CONNECTION DETAIL

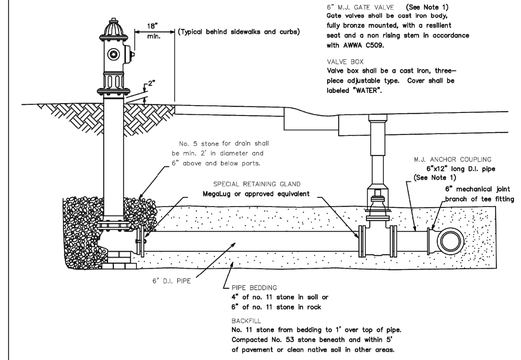
NOTES

1. For connection to existing water mains, a 6" tapping valve and saddle shall be used in place of the gate valve and anchor coupling.

FIRE HYDRANT

Fire hydrants shall conform to ANSI/AWWA C502 and must be Kennedy Guardian model K81 or Mueller Super Centurion 200 (catalog no. A-423) or Waterous Pacer Classic. These are dry-barrel type firehydrants with a 5" main valve opening, two hose nozzles and one pumper nozzle. Hydrants shall have a mechanical joint type connection and shall be painted according to 4.4.4.4. FIRE HYDRANTS.

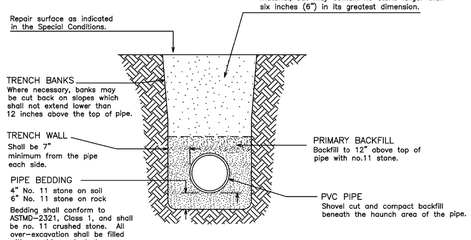
Install fire hydrant at a minimum of 2' from structures or obstructions and set the hydrant bury line 2" above finished grade. The pumper nozzle must face the street.



REVISED 02/15/2011 G.N.
REVISED 02/23/2010 T.L.
REVISED 02/08/2008 T.A.

City of Bloomington Utilities Engineering Department | NO SCALE 9/1/94 M. Hicks | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD8.DGN | STANDARD FIRE HYDRANT AND CONNECTION DETAIL | STANDARD DETAIL NUMBER 8

TYPICAL TRENCH SECTION



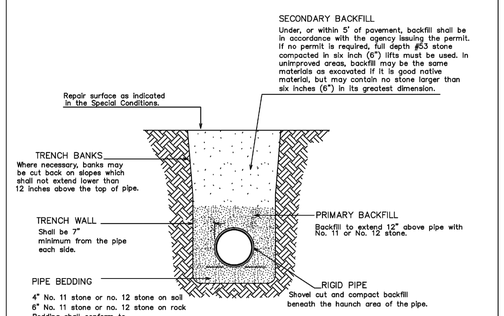
TRENCH SAFETY SYSTEMS
All trench work shall be in compliance with OSHA Part 26 of the Code of Federal Regulations.

EXCAVATION DEPTH
When pipe grades are not defined on the contract drawings, maintain a minimum of 48 inches of cover over the top of the pipe except as otherwise ordered by the Engineer.

Revised 2/11/2011 G.N.
Revised 2/13/2008 T.A.

City of Bloomington Utilities Engineering Department | NO SCALE 10/8/98 M. Hicks | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD11.DGN | BEDDING AND BACKFILL DETAIL FOR PVC AND HDPE PIPE | STANDARD DETAIL NUMBER 11

TYPICAL TRENCH SECTION



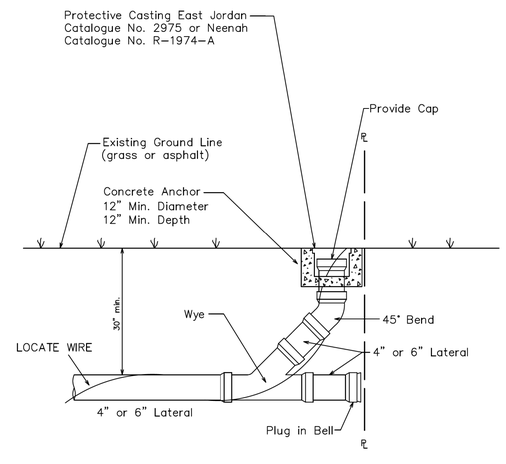
EXCAVATION DEPTH
When pipe grades are not defined on the contract drawings, maintain a minimum of 48 inches of cover over the top of the pipe except as otherwise ordered by the Engineer.

TRENCH SAFETY SYSTEMS
All trench work shall be in compliance with OSHA Part 26 of the Code of Federal Regulations.

Revised 2/15/2011 G.N.
Revised 2/13/2008 T.A.

City of Bloomington Utilities Engineering Department | NO SCALE 02/01/08 | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD12.DGN | BEDDING AND BACKFILL DETAIL FOR ALL RIGID PIPES | STANDARD DETAIL NUMBER 12

STANDARD SANITARY LATERAL CLEAN-OUT FOR 4" AND 6" PIPES

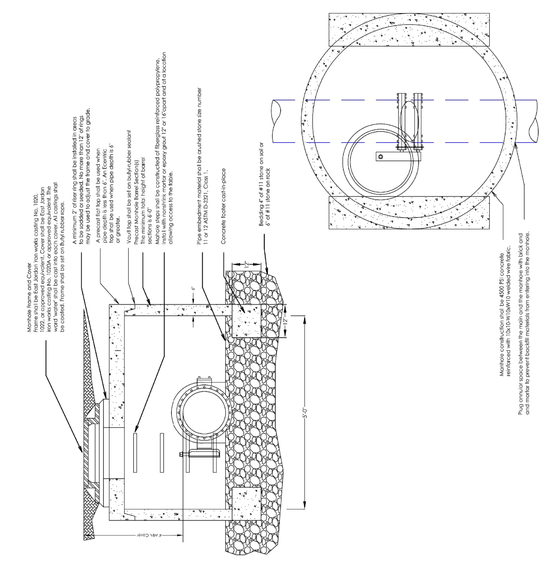


#10 solid insulated locate wire required from the city main to the clean-out at the property line.

PROFILE

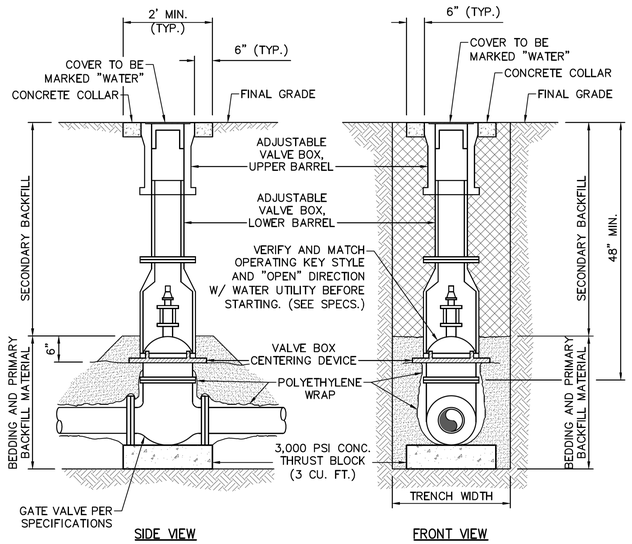
City of Bloomington Utilities Engineering Department | NO SCALE REVISED 02/25/10 | Drawing File: I:\COMMON\STANDARD DRAWINGS\STD19.DGN | STANDARD SANITARY LATERAL CLEAN-OUT FOR 4" AND 6" PIPES | STANDARD DETAIL NUMBER 19

Valve Vault with Butterfly Valve



CITY OF BLOOMINGTON UTILITIES ENGINEERING | NO SCALE 03/12/12 L.WOOD | Drawing File: /u/common/standard drawing\STD27.dwg | Valve Vault with Butterfly Valve | STANDARD DETAIL NUMBER 27

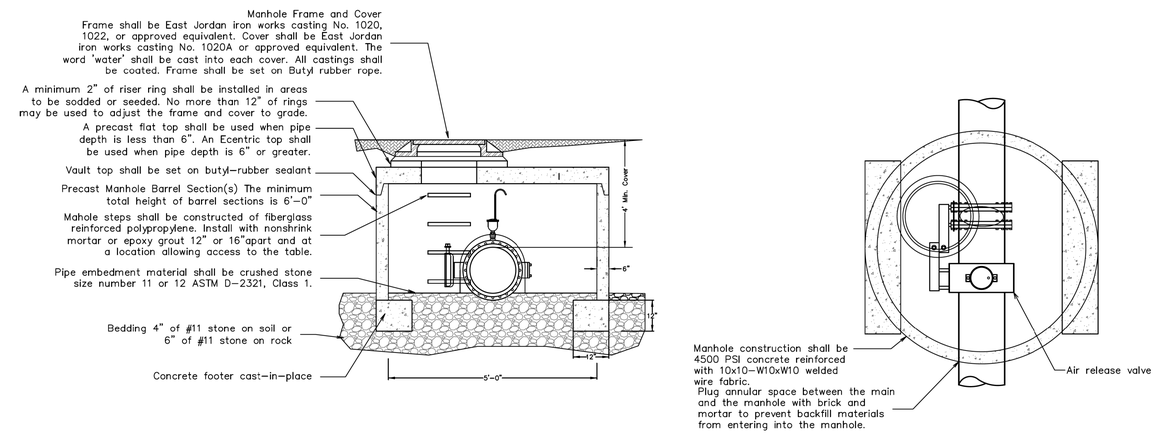
RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE	INDIANA DEPARTMENT OF TRANSPORTATION	HORIZONTAL SCALE: N/A	BRIDGE FILE: N/A
		VERTICAL SCALE: N/A	DESIGNATION NO.: 0801059
DESIGNED: DRH DRAWN: PJT	STANDARD DETAILS	SURVEY BOOK: N/A	SHEETS: 41 of 136
CHECKED: JFF CHECKED: DRH	WATER MAIN AND SANITARY SEWER	CONTRACT: R-31902	PROJECT NO.: 0801059



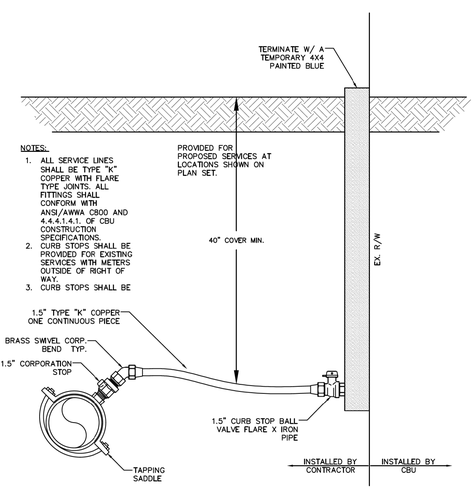
NOTES:

1. WRAP VALVE IN POLYETHYLENE WRAP BEFORE INSTALLING SUPPORT OR THRUST BLOCK.
2. CONCRETE COLLAR SHALL BE 6" THICK AND MADE OF 4000 PSI CONCRETE.

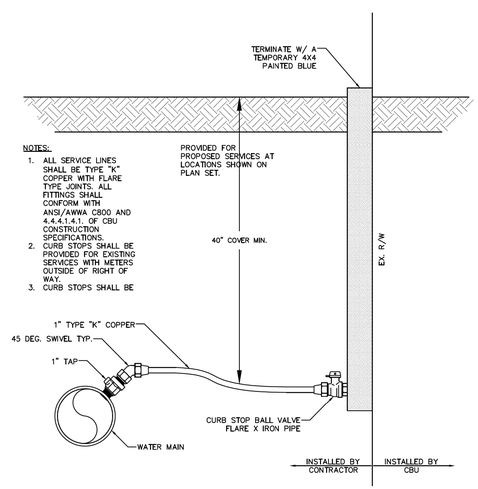
GATE VALVE AND BOX DETAIL
(FOR VALVES LESS THAN 16")
NOT TO SCALE



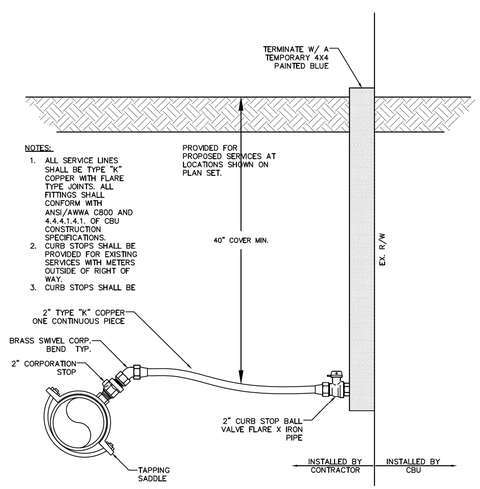
COMBINATION VALVE VAULT WITH 24" BUTTERFLY VALVE / ARV
NOT TO SCALE



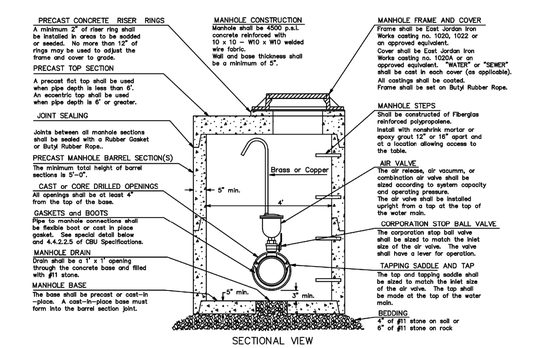
(DR) TYPICAL "DOUBLE RESIDENTIAL" SERVICE LINE DETAIL
(WATER MAINS 4" AND LARGER)
NOT TO SCALE



(SR) TYPICAL "SINGLE RESIDENTIAL" SERVICE LINE DETAIL
(WATER MAINS 4" AND LARGER)
NOT TO SCALE



(C2) TYPICAL "COMMERICIAL" SERVICE LINE DETAIL
(WATER MAINS 4" AND LARGER)
NOT TO SCALE



City of Bloomington Utilities Engineering Department		STANDARD AIR VALVE VAULT 12" OR SMALLER PIPE	STANDARD DETAIL NUMBER 3
NO SCALE 2/21/94 Ygr. M. Hess	Drawing File: I:\DOMAIN\STANDARD DRAWINGS\UTILS.DGN REVISED 02/16/11 G.N.		

RECOMMENDED FOR APPROVAL _____ DESIGN ENGINEER DATE

DESIGNED: DRH DRAWN: PJT
CHECKED: JFF CHECKED: DRH

INDIANA DEPARTMENT OF TRANSPORTATION

STANDARD DETAILS
WATER MAIN AND SANITARY SEWER

HORIZONTAL SCALE	BRIDGE FILE
N/A	N/A
VERTICAL SCALE	DESIGNATION NO.
N/A	0801059
SURVEY BOOK	SHEETS
N/A	42 of 136
CONTRACT	PROJECT NO.
R-31902	0801059

SUMMARY OF COST ESTIMATE
DES 0801059
Fullerton Pike Phase I

CBU Water & Sewer Relocation - Reimbursable	$	309,291.41
Design – Reimbursable	$	42,920.00
Construction Inspection - Reimbursable	$	38,220.16
CBU Water & Sewer Relocation – County	$	109,766.79
Design – County	$	12,486.00
Construction Inspection – County	$	13,564.24
CBU Water & Sewer Relocation – Non-Reimbursable	$	1,508,942.61
Design – Non-Reimbursable	$	83,094.00
Construction Inspection – Non Reimbursable work	$	186,465.00
Total Cost of CBU Work In Contract	$	2,304,750.21

Summary of expenses:
Cost of project to be borne by utility $ 1,778,501.61
Cost of project to be borne by Monroe County $ 526,248.60**

**Cost of project eligible to use Federal Funds $ 390,431.57
Federal funds can only be utilized if funds are available

Method of cost assignment (Work in INDOT Contract):
The utility qualifies for reimbursement by LPA for the cost of the relocation.

AMERICAN STRUCTUREPOINT INC.

QUANTITY COST ESTIMATE

Federally Reimbursable

Project No.: 201401135

Des. No.: 0801059

ESTIMATED PROJECT COST
Total: $309,291.41
0.0% Contingency: $0.00
ESTIMATED TOTAL: $309,291.41

Design Fee: $42,920

ID	Item No.	Description	Quantity	Unit	Unit Price	Item Total
0001	000-00001	WATER MAIN, PCCP, 36 IN	268.00	LFT	$300.00	$80,400.00
0002	000-00002	WATER MAIN, HDPE, 2 IN	255.00	LFT	$50.00	$12,750.00
0006	000-00006	DUCTILE IRON FITTINGS (COMPACT FITTINGS)	485.00	LBS	$6.50	$3,152.50
0007	105-06845	CONSTRUCTION ENGINEERING	1.00	LS	$5,775.75	$5,775.75
0008	110-01001	MOBILIZATION AND DEMOBILIZATION	1.00	LS	$14,728.16	$14,728.16
0009	202-93047	MANHOLE, REMOVE	1.00	EACH	$700.00	$700.00
0012	202-96133(2)	PIPE, REMOVE, *WATER MAIN, PCCP, 36 IN*	268.00	LFT	$100.00	$26,800.00
0013	202-96133(3)	PIPE, REMOVE, *SANITARY SEWER, RCP, 30 IN*	150.00	LFT	$70.00	$10,500.00
0014	202-96133(4)	PIPE, REMOVE, *SANITARY SEWER, PVC, 8 IN*	185.00	LFT	$5.00	$925.00
0016	203-02010	EXCAVATION, ROCK	184.00	CYS	$75.00	$13,800.00
0020	715-04995	LINE STOP, *36 IN*	2.00	EACH	$45,000.00	$90,000.00
0022	715-05408	PIPE SANITARY SEWER, *PVC SDR 35*, 8 IN	332.00	LFT	$80.00	$26,560.00
0038	715-11879	SEWER, SANITARY LATERAL, CONNECTIONS	2.00	EACH	$2,600.00	$5,200.00
0039	715-96629	WATER SERVICE LINE, COMMERCIAL COPPER, 1 IN	2.00	EACH	$2,000.00	$4,000.00
0041	715-98265	WATER MAIN, DUCTILE IRON, 4 IN	50.00	LFT	$80.00	$4,000.00
0042	720-45410	MANHOLE, C4	1.00	EACH	$4,500.00	$4,500.00
0043	720-95422	MANHOLE, J4	1.00	EACH	$5,500.00	$5,500.00

Prepared By:_____Date:_____Checked By:_____Date: _____

AMERICAN STRUCTUREPOINT INC.

QUANTITY COST ESTIMATE

Country Reimbursable

Project No.: 201401135

Des. No.: 0801059

ESTIMATED PROJECT COST

Total: $109,766.79

0.0% Contingency: $0.00

ESTIMATED TOTAL: $109,766.79

Design Fee: $12,486

ID	Item No.	Description	Quantity	Unit	Unit Price	Item Total
0007	105-06845	CONSTRUCTION ENGINEERING	1.00	LS	$2,049.80	$2,049.80
0008	110-01001	MOBILIZATION AND DEMOBILIZATION	1.00	LS	$5,226.99	$5,226.99
0016	203-02010	EXCAVATION, ROCK	58.00	CYS	$75.00	$4,350.00
0022	715-05408	PIPE SANITARY SEWER, *PVC SDR 35* , 8 IN	601.00	LFT	$80.00	$48,080.00
0023	715-05408(1)	PIPE SANITARY SEWER, *DI CLASS 350* , 8 IN	38.00	LFT	$120.00	$4,560.00
0038	715-11879	SEWER, SANITARY LATERAL, CONNECTIONS	5.00	EACH	$2,600.00	$13,000.00
0042	720-45410	MANHOLE, C4	3.00	EACH	$4,500.00	$13,500.00
0046	720-98625	MANHOLE, C4, DROP	2.00	EACH	$9,500.00	$19,000.00

Prepared By:_____Date:_____Checked By:_____Date: _____

AMERICAN STRUCTUREPOINT INC.

QUANTITY COST ESTIMATE

CBU Costs

Project No.: 201401135

Des. No.: 0801059

ESTIMATED PROJECT COST	
Total:	**$1,508,942.61**
0.0% Contingency:	**$0.00**
ESTIMATED TOTAL:	**$1,508,942.61**

Design Fee: $83,094

ID	Item No.	Description	Quantity	Unit	Unit Price	Item Total
0003	000-00003	VALVE WITH MANHOLE, RESTRAINED BUTTERFLY, DUCTILE IRON, 24 IN	4.00	EACH	$9,500.00	$38,000.00
0004	000-00004	VALVE WITH MANHOLE, RESTRAINED BUTTERFLY, DUCTILE IRON, 24 IN, WITH AIR RELEASE VALVE	1.00	EACH	$10,500.00	$10,500.00
0005	000-00005	AIR RELEASE VALVE WITH MANHOLE	1.00	EACH	$5,000.00	$5,000.00
0006	000-00006	DUCTILE IRON FITTINGS (COMPACT FITTINGS)	790.00	LBS	$6.50	$5,135.00
0007	105-06845	CONSTRUCTION ENGINEERING	1.00	LS	$28,178.20	$28,178.20
0008	110-01001	MOBILIZATION AND DEMOBILIZATION	1.00	LS	$71,854.41	$71,854.41
0010	202-96133	PIPE, REMOVE, *WATER MAIN, DUCTILE IRON, 6 IN*	60.00	LFT	$15.00	$900.00
0011	202-96133(1)	PIPE, REMOVE, *WATER MAIN, DUCTILE IRON, 12 IN*	3,001.00	LFT	$20.00	$60,020.00
0015	202-96133(5)	PIPE, REMOVE, *WATER MAIN, DUCTILE IRON, 8 IN*	40.00	LFT	$17.50	$700.00
0016	203-02010	EXCAVATION, ROCK	1,105.00	CYS	$75.00	$82,875.00
0017	715-01902	WATER SERVICE LINE, COMMERCIAL COPPER, 2 IN	4.00	EACH	$2,500.00	$10,000.00
0018	715-02185	WATER SERVICE LINE, COMMERCIAL COPPER, 1.50 IN	2.00	EACH	$2,250.00	$4,500.00
0019	715-02532	VALVE WITH BOX, RESTRAINED GATE, DUCTILE IRON, 8 IN	1.00	EACH	$1,600.00	$1,600.00
0021	715-04995(1)	LINE STOP, *12 IN*	7.00	EACH	$17,000.00	$119,000.00
0024	715-07794	WATER MAIN CONNECTION, *TYPE 1, 12 IN*	1.00	EACH	$16,500.00	$16,500.00
0025	715-07794(1)	WATER MAIN CONNECTION, *TYPE 2, 12 IN*	1.00	EACH	$21,250.00	$21,250.00
0026	715-07794(2)	WATER MAIN CONNECTION, *TYPE 3, 12 IN*	1.00	EACH	$11,550.00	$11,550.00
0027	715-07794(3)	WATER MAIN CONNECTION, *TYPE 4, 12 IN*	1.00	EACH	$16,500.00	$16,500.00
0028	715-07794(4)	WATER MAIN CONNECTION, *TYPE 5, 12 IN*	1.00	EACH	$33,550.00	$33,550.00
0029	715-07794(5)	WATER MAIN CONNECTION, *TYPE 6, 12 IN*	1.00	EACH	$33,000.00	$33,000.00
0030	715-07794(6)	WATER MAIN CONNECTION, *TYPE 7, 12 IN*	1.00	EACH	$16,500.00	$16,500.00
0031	715-07794(7)	WATER MAIN CONNECTION, *TYPE 1, 8 IN*	1.00	EACH	$14,850.00	$14,850.00
0032	715-07794(8)	WATER MAIN CONNECTION, *TYPE 1, 6 IN*	1.00	EACH	$12,200.00	$12,200.00
0033	715-07794(9)	WATER MAIN CONNECTION, *TYPE 2, 6 IN*	1.00	EACH	$11,500.00	$11,500.00
0034	715-11571	WATER MAIN, DUCTILE IRON 8 IN	60.00	LFT	$105.00	$6,300.00
0035	715-11849	RESTRAIN EXISTING JOINT, *WATER MAIN, 12 IN*	17.00	EACH	$790.00	$13,430.00
0036	715-11849(1)	RESTRAIN EXISTING JOINT, *WATER MAIN, 8 IN*	3.00	EACH	$575.00	$1,725.00
0037	715-11849(2)	RESTRAIN EXISTING JOINT, *WATER MAIN, 6 IN*	6.00	EACH	$525.00	$3,150.00
0039	715-96629	WATER SERVICE LINE, COMMERCIAL COPPER, 1 IN	9.00	EACH	$2,000.00	$18,000.00
0040	715-97419	WATER MAIN, DUCTILE IRON, 24 IN	2,795.00	LFT	$285.00	$796,575.00
0044	720-96999	FIRE HYDRANT ASSEMBLY	7.00	EACH	$5,800.00	$40,600.00
0045	720-97009	FIRE HYDRANT ASSEMBLY, REMOVE	7.00	EACH	$500.00	$3,500.00

Prepared By:_____Date:_____Checked By:_____Date: _____

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT VK-5

BLACK & VEATCH
Building a world of difference.

18 March 2016

Mr. Mike Bengtson, Assistant Director of Engineering
City of Bloomington Utilities
600 East Miller Drive
Bloomington, IN 47401

RE: Monroe Water Treatment Plant
Water Quality Assistance
Disinfection Byproduct Rule Assistance Technical Memorandum

Dear Mike,

Black & Veatch is pleased to submit the Disinfection Byproduct Rule (DBPR) Assistance Technical Memorandum (TM) for the Monroe Water Treatment Plant Water Quality Assistance project. The technical memorandum discusses the results of the DBPR and provides recommendations to support regulatory compliance.

If you have any questions or comments, please contact us.

Very truly yours,

BLACK & VEATCH CORPORATION

Adam Westermann, P.E.
Project Manager

cc: John Langley, CBU
Rachel Atz, CBU
Donnie Ginn, Black & Veatch
Doug Elder, Black & Veatch
Amber McDonough, Black & Veatch

MONROE WATER TREATMENT PLANT WATER QUALITY ASSISTANCE

Disinfection Byproduct Rule Assistance Technical Memorandum

BLACK & VEATCH PROJECT NO. 190493

PREPARED FOR

City of Bloomington Utilities

18 MARCH 2016

BLACK & VEATCH
Building a world of difference.

BLACK & VEATCH CORPORATION · 8415 Allison Pointe Blvd · Suite 410 ·Indianapolis, IN 46250 USA · Telephone: 317.570.8331

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Appendix A: Disinfection CT Compliance Requirements

TECHNICAL MEMORANDUM

City of Bloomington Utilities
Monroe Water Treatment Plant Water Quality Assistance
Disinfection Byproduct Rule Assistance

B&V Project 190493
B&V File 41.1000
March 18, 2016

To: Mike Bengtson – City of Bloomington Utilities

From: Adam Westermann, Doug Elder – Black & Veatch

1. INTRODUCTION

1.1 Project Description

Black & Veatch was retained by the City of Bloomington Utilities (CBU) to assist with a water quality evaluation at the Monroe Water Treatment Plant (WTP). The purpose of this technical memorandum (TM) is to determine how the Safe Drinking Water Act (SDWA) regulations, with emphasis on Stage 2 Disinfection By-Product Rule (DBPR), affect CBU's Monroe WTP, and to determine resulting improvements or modifications that may be necessary to comply with the regulatory requirements. Concentrations of regulated DBPs in the system served by the Monroe WTP have increased over the past several years. While DBP concentrations have not exceeded their respective Maximum Contaminant Levels (MCLs), concentrations at several system monitoring locations have approached their respective MCLs on a running annual average basis. Monitoring locations on a running annual average is the current method for assessing compliance. In addition, one of CBU's wholesale customers, B&B Water Project Inc., was notified by the Indiana Department of Environmental Management (IDEM) for exceeding a MCL for DBPs during the fourth quarter of 2015.

This TM summarizes results of a review of recent water quality monitoring data and water treatment practices at the Monroe WTP as they relate to formation of regulated DBPs, and presents recommended improvements to assure continued compliance with DBP regulatory requirements throughout CBU's distribution system and within those of its wholesale water customers.

1.2 Abbreviations

Abbreviations used in this TM are as follows:

AOB	Ammonia oxidizing bacteria
CBU	City of Bloomington Utilities
$Cl0_2$	Chlorine Dioxide
CT	Product of disinfectant concentration and effective (T10) contact time
DBP(s)	Disinfection byproduct(s)
DBPR	Disinfectants and Disinfection Byproducts Rule
GAC	Granular Activated Carbon
HAA(s)	Haloacetic acid(s)
HAA_5	Haloacetic acids (sum of 5 regulated HAA compounds)
IDEM	Indiana Department of Environmental Management
IDSE	Initial Distribution System Evaluation
IX	Ion exchange
LT2ESWTR	Long-Term 2 Enhanced Surface Water Treatment Rule
MCL	Maximum Contaminant Level
mg/L	Milligrams per liter
NOM	Natural organic matter
PAC	Powdered activated carbon
SDWA	Safe Drinking Water Act
TCM	Trichloromethane (chloroform)
THM(s)	Trihalomethane(s)
TM	Technical Memorandum
TOC	Total organic carbon
TTHMs	Total trihalomethanes
ug/L	Micrograms per liter
USEPA	United States Environmental Protection Agency
UV_{254}	UV absorbance at 254 nanometers wavelength
WTP	Water Treatment Plant

2. CURRENT DISINFECTION PRACTICES

Current disinfection practices at the Monroe WTP consist of the following:

- Addition of chlorine at the primary rapid mix chamber at the plant headworks to maintain a low free chlorine residual, approximately 0.2 to 0.5 mg/L, across the flocculation/sedimentation basins.
- Application of additional chlorine at the secondary rapid mix/filter influent to ensure continuous maintenance of a low free chlorine residual, approximately 0.3 to 0.5 mg/L, across the filters.
- Addition of ammonia and chlorine at the combined filter discharge to yield a combined chlorine (chloramine) residual of approximately 2.0 to 2.5 mg/L within the 5 MG finished water reservoir and in the treated water leaving the plant to limit concentrations of regulated DBPs.

Prior to August 2015, chlorine was added at the primary rapid mix at doses sufficient to maintain a free chlorine residual across the flocculation/sedimentation basins and the filters. There was no chlorine added at the secondary rapid mix/filter influent. However, in response to concerns that this practice could be resulting in increased formation of chlorine-based DBPs within the basins at the residual concentrations required, a split chlorine application approach was implemented to permit reductions in free chlorine residual concentrations within the basins.

CBU periodically reverts to a free chlorine residual within the distribution system to ensure effective control of ammonia oxidizing bacteria (AOB), which can lead to development of nitrification conditions within the system if AOB are allowed to proliferate. Nitrification typically results in difficulties with maintaining effective chloramine residuals throughout the distribution system. Short-term conversion to a free chlorine residual was last initiated during late November 2015, and continued for approximately four weeks. This modification is scheduled such that DBP compliance samples are not collected during the period when a free chlorine residual is present in the system.

Ammonia addition for conversion of the free chlorine residual at the filter discharge to the combined chlorine/chloramine form is controlled by monitoring free ammonia present in the treated water at the plant discharge. Operators currently target a free ammonia concentration of approximately 0.05 to 0.07 mg/L to ensure that no free chlorine is present in the finished

water while minimizing free ammonia in the finished water. Free ammonia present in sufficient quantities can encourage growth of nitrifying bacteria in the distribution system. This is common for many systems that practice chloramination and have continuous ammonia monitoring capability. While it is theoretically possible to operate with zero free ammonia in the treated water, from a practical standpoint maintaining chlorine/ammonia ratios which consistently eliminate free ammonia in the finished water is extremely difficult, and generally not something readily achievable. Operating experience of other utilities suggests that if free ammonia is maintained at less than 0.10 mg/L, development potential of nitrification within the distribution system is minimized.

Disinfection CT compliance assessments based on anticipated worst-case water quality and plant operating conditions have been previously reviewed and approved by IDEM; therefore, daily tracking of CT compliance is not required. However, CBU has established treatment goals which include minimum chlorine residual concentrations to ensure continuous compliance with CT requirements. Monroe WTP chlorine feed rates are continually adjusted in response to changes in source water quality, chlorine demand, and plant throughput rates to maintain compliance with these goals.

3. DISINFECTION BYPRODUCTS FORMATION BACKGROUND

During the early 1970s, it was discovered that disinfectants commonly used in the production of potable water react with naturally-occurring organic compounds to form byproducts which are considered to be potential carcinogens. In response to this concern, the United States Environmental Protection Agency (USEPA) has promulgated increasingly-restrictive regulations which establish MCLs for DBPs. The primary DBPs of concern when chlorine is used for disinfection are trihalomethanes (THMs) and haloacetic acids (HAAs). USEPA currently regulates four THM compounds (chloroform, bromodichloromethane, dibromochloromethane, and bromoform) under a single MCL for total trihalomethanes (TTHMs). Five of the nine known HAA compounds (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid) are also collectively regulated under a single MCL for total haloacetic acids (referred to as HAA_5). For utilities treating surface water supplies and using chlorine as the primary disinfectant, chloroform is typically the predominant THM species present in the finished water, and dichloracetic and trichloroacetic acids are the predominant HAA species present.

DBP formation rates and ultimate concentrations in the finished water are affected by the following:

Chlorine Contact Time: In general, DBP concentrations increase with increasing contact times with free chlorine.

Chlorine Dose / Residual Concentration: As applied chlorine doses and free chlorine residual concentrations increase, the driving force for formation of DBPs also increases.

Water Temperature: DBP formation rates increase as water temperatures increase.

Source Water Organic Concentrations: The amount of total organic carbon (TOC) in the water at the point of chlorine application also impacts DBP formation. TOC is an aggregate measurement of all of the organic compounds present in the water. Some of those compounds react with disinfectants to form regulated byproducts. These reactive TOC compounds are referred to as DBP precursors. While different species of raw water organics react differently with chlorine to form regulated byproducts, in general, higher concentrations of source water TOC typically results in higher levels of DBP formation upon addition of chlorine.

In addition, the presence of bromide in the source water can shift the formation of DBPs to the brominated species, which are suspected of being potentially more carcinogenic than the non-brominated DBP species. The impact of pH conditions during chlorination of source water is DBP species-specific, but in general, high pH conditions result in accelerated rates of TTHM formation, and in increased formation of some HAA_5 species, such as dichloracetic acid and trichloroacetic acid. A strong correlation has also been noted between a water's ultraviolet absorbance at 254 nanometers (UV_{254}) and the presence of organic materials, which are precursors to DBP formation. Higher UV_{254} values are considered to be indicative of greater tendency to form regulated DBPs upon contact with free chlorine.

Research sponsored by the Water Research Foundation and the American Water Works Association concluded that commercial bulk sodium hypochlorite solution can contain HAAs at levels sufficient to contribute significantly to HAA concentrations in the finished water for plants utilizing purchased hypochlorite solution for disinfection. The study ("Analysis of Bulk Sodium Hypochlorite Feedstock for the Presence of HAAs and Other DBPs", Water Research Foundation, 2013) included analysis of 30 individual sodium hypochlorite samples collected from 24 utilities for total chlorine, THMs, HAAs, and hexavalent chromium. All of the bulk hypochlorite solutions contained concentrations of HAAs that could potentially contribute to HAA levels in the finished water. While significant levels of three HAAs (monochloroacetic acid, dichloroacetic acid, and trichloroacetic acid) were detected, THMs were typically not present in

the samples. For applied chlorine doses ranging from 1 to 4 mg/L of free available chlorine, the contribution of HAAs from the delivered bulk hypochlorite solution on average ranged from approximately 4 ug/L to 16.4 ug/L of HAA_5 (6.8 to 27.3 percent of the current 60 ug/L MCL for HAA_5). The report summarizing this research also suggests that potential seasonal/temperature impacts could lead to higher contributions of HAAs to the finished water during the warmer summer months. Potential methods to minimize HAA_5 contributions from bulk hypochlorite solution are discussed in Section 5 of this TM.

4. DISINFECTION BYPRODUCTS REGULATORY REQUIREMENTS

USEPA's Stage 1 Disinfectants & Disinfection Byproducts Rule (DBPR), which became effective in January 2002 for large systems treating surface water supplies, established a revised MCL for TTHMs of 0.080 mg/L. This regulation also included a new MCL for total haloacetic acids (HAA_5) of 0.060 mg/L. While USEPA convention is to express MCLs in concentration units of "mg/L", DBP concentrations throughout this memorandum are expressed in units of "ug/L". The actual MCL for TTHMs of 0.080 mg/L is equivalent to 80 ug/L, and the MCL for HAA_5 of 0.060 mg/L is equivalent to 60 ug/L. Compliance with these MCLs was based on a running annual average of quarterly monitoring data for all system monitoring sites. New MCLs were also promulgated for bromate and chlorite ion. Chlorite ion is a byproduct of disinfection using chlorine dioxide. In addition, a treatment technique was established which required systems to achieve specified removals of organic/humic compounds collectively referred to as DBP precursors which react with chlorine-based disinfectants to form DBPs. This is accomplished through operation of the treatment facility to achieve specified removals of TOC, with compliance evaluated based on a running annual average of monthly TOC removal percentages.

The Stage 2 DBPR, which became effective during April 2012, retained the Stage 1 MCLs for TTHMs and HAA_5. Monitoring procedures and schedules were modified to ensure that the DBP data obtained more closely represent actual long-term exposure conditions for all consumers. Compliance with the MCLs under the Stage 2 DBPR is assessed on a Locational Running Annual Average basis (i.e., a running annual average must be calculated at <u>each</u> system monitoring location). Should an MCL be exceeded at one or more system monitoring points, based on running annual average DBP concentrations, the system is in violation of the Stage 2 DBPR regulation, regardless of the results obtained for the remaining monitoring sites. This approach represents a major change from the Stage 1 DBPR, as the "total system averaging" compliance approach is eliminated under the Stage 2 DBPR regulation.

Under the Stage 2 rule, the number of required quarterly monitoring sites increased from four sites under the preceding Stage 1 rule to eight sites. CBU initiated system monitoring at the revised compliance sites during April 2012.

It is emphasized that MCLs established by USEPA for DBPs reflect long-term exposure concerns, based on up to one excess case of cancer per million people consuming two liters of water per day over a 70-year lifetime.

Under the Stage 2 DBPR, systems must determine if they have exceeded an operational evaluation level at any monitoring site, which is calculated using their routine quarterly system monitoring results. The operational evaluation level is intended to provide an early warning of potential future MCL violations, which enables the system to initiate measures to remain in compliance. An operational evaluation level is exceeded at any monitoring location where (1) the sum of the two previous quarters' TTHM results plus twice the current quarter's TTHM result, divided by 4 to derive an average, exceeds 80 ug/L, or (2) the sum of the two previous quarters' HAA_5 results plus twice the current quarter's HAA_5 result, divided by 4 to derive an average, exceeds 60 ug/L. While not considered a violation, a system that exceeds an operational evaluation level is required to do the following:

- Conduct an evaluation to examine its treatment and distribution operational practices. This evaluation must consider storage tank operations, excess storage capacity, distribution system flushing practices, changes in sources or source water quality, and treatment changes or problems that may contribute to TTHM and HAA_5 formation. The primacy agency may limit the scope of the evaluation if the cause of the operational evaluation level exceedence can be readily identified.
- Submit a written report to the primacy agency not later than 90 days after receiving the DBP analysis results that caused the exceedence.

Under USEPA's Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR), systems that will need to make significant changes in disinfection practices to maintain compliance with the Stage 2 DBPR will be required to develop disinfection profiles and calculate disinfection benchmarks for *Giardia lamblia* and viruses. Prior to modifying the disinfection process, systems must notify the State, and must submit the following information:

- A completed disinfection profile and benchmark for *Giardia lamblia* and viruses.
- A description of the proposed change(s) in disinfection practice.
- An analysis of how the proposed changes will affect the current level of disinfection.

Significant changes to disinfection practice are defined in the LT2ESWTR as the following:

- Changes to the point of disinfection.
- Changes to the disinfectant(s) used in the treatment plant.
- Changes to the disinfection process.
- Any other modification identified by the State as a significant change to disinfection practice.

5. WATER QUALITY AND OPERATIONS REVIEW

The following operations and water quality monitoring data were provided by CBU for review:

- Monthly Monroe WTP operations summaries (2012 through 2015)
- Quarterly distribution system DBP monitoring results (2008 through 2015)
- DBP speciation data (2010 through 2015)
- December 2008 “Initial Distribution System Evaluation” report
- Monthly raw and treated water TOC monitoring results (Oct. 2008 through Dec. 2015)
- Monthly raw water UV absorbance (UV_{254}) data (Oct. 2008 through Dec. 2015)

Monroe WTP operations staff also provided additional information on past and current disinfection practices, including typical chlorine residual concentrations at various points in the treatment process which are not included in the Monroe WTP monthly operations summaries.

The range of locational running annual average DBP concentrations for CBU’s system monitoring sites from 2009 through 2015 are shown on Figure 1.

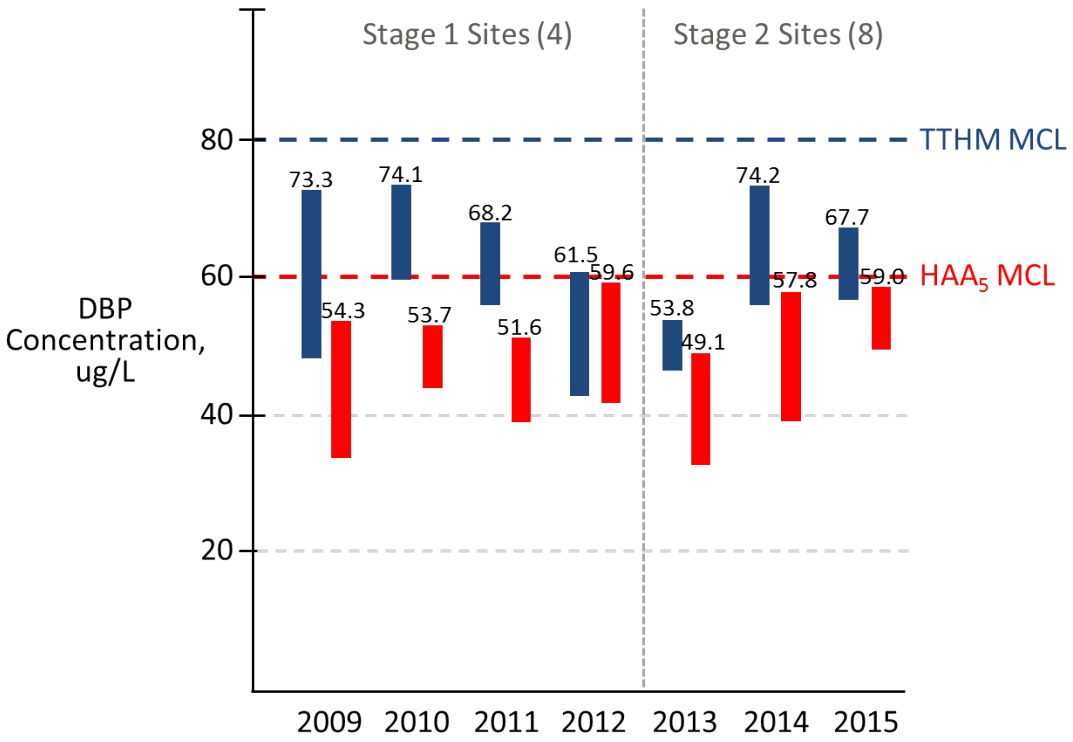

Figure 1: Running Annual Average DBP Concentrations

Maximum locational running annual average DBP concentrations at each monitoring site for 2009 through 2015 are shown in Table 1, and maximum single-sample DBP concentrations at each site for 2008 through 2015 are summarized in Table 2. As shown on Figure 1, maximum running annual average TTHM concentrations were notably higher during 2014 and 2015 than for the previous several years. With the exception of 2012, when running annual average HAA_5 concentrations at one site also approached the MCL of 60 ug/L, running annual average HAA_5 concentrations were also higher during 2014 and 2015 than for the previous several years. In addition, CBU exceeded the operational evaluation level of 60 ug/L for HAA_5 during the 2nd quarter of 2014 and the 4th quarter of 2015.

Table 1 Highest Locational Running Annual Average DBP Concentrations (2009 – 2015)				
Monitoring Location	TTHMs		HAA_5	
	Concentration, ug/L	Quarter	Concentration, ug/L	Quarter
Marlin School	74.2	4th 2014	59.6	1st 2012
College Mall	69.4	4th 2014	56.5	4th 2015
Bloomington Hospital	69.5	4th 2014	56.8	4th 2015
Service Center	69.6	4th 2014	58.6	4th 2015
Blucher Poole	71.9	4th 2014	58.3	4th 2015
Profile Parkway	70.2	4th 2014	59.0	4th 2015
Gentry East	73.7	4th 2014	55.5	4th 2015
Miller Showers	73.1	4th 2014	57.8	4th 2014

Table 2 Maximum Single-Sample DBP Concentrations (2008 – 2015)				
Monitoring Location	TTHMs		HAA_5	
	Concentration, ug/L	Quarter	Concentration, ug/L	Quarter
Marlin School	137.6	3rd 2010	93.3	3rd 2011
College Mall	117.1	3rd 2010	80.0	3rd 2011
Bloomington Hospital	127.4	3rd 2010	82.1	3rd 2011
Service Center	127.2	3rd 2010	82.4	3rd 2011
Blucher Poole*	87.8	3rd 2015	68.0	2nd 2015
Profile Parkway*	84.3	3rd 2015	70.0	2nd 2015
Gentry East*	89.6	3rd 2015	68.0	2nd 2014
Miller Showers*	87.2	3rd 2014	73.2	3rd 2012
*Monitoring at this location initiated during 2nd quarter 2012.				

Quarterly DBP monitoring reports include concentrations for individual THM and HAA species. The four THM and five HAA species concentrations for each monitoring quarter and relative percentages of each DBP species were tabulated for DBP compliance monitoring samples collected between March 2010 (first quarter) and October 2015 (fourth quarter). Review of these monitoring results revealed no statistically-significant changes in the relative percentages of each THM species during the period evaluated. Chloroform is the predominant species present, averaging approximately 91 percent of the total THM concentration for the period evaluated, with the remaining 9 percent present as bromodichloromethane. It was noted that the relative percentages of chloroform were typically higher during the spring and summer monitoring periods; this is as typically observed for plants treating surface water sources, due

to higher water temperatures during these periods, which tend to accelerate formation rates. With regard to HAA speciation, it was also noted that the percentage of dichloroacetic acid relative to trichloroacetic acid decreases during the third and fourth quarter monitoring periods during 2013 through 2015. The basis for this change cannot be readily discerned from existing plant operational data, but it is likely that source water temperature conditions and/or variations in coagulation pH during these periods contributed to the shift in HAA speciation. Regardless, this shift is not significant from an overall DBP control perspective.

Water quality parameters and Monroe WTP operational parameters from 2012 through 2015 were reviewed to determine their potential impact to DBP concentrations in the finished water. A summary of the data reviewed is presented in Table 3, and source water TOC concentrations since 2009 are shown on Figure 2.

Table 3
Water Quality & Plant Operating Parameters (2012 – 2015)[1]

Parameter	2012	2013	2014	2015
Average System TTHMs, ug/L	51.2	52.7	71.4	62.7
Average System HAA_5, ug/L	50.0	34.6	55.2	56.8
Raw Water Quality:				
UV_{254}	0.088	0.089	0.127	0.105
Turbidity, NTU	6.8	6.5	8.9	6.4
pH, units	7.42	7.41	7.18	7.40
Alkalinity, mg/L as $CaCO_3$	28.9	29.5	30.7	31.4
Temperature, degrees F	62	60	60	62
TOC:				
Raw water, mg/L	3.43	3.69	3.93	3.74
Finished Water, mg/L	1.93	2.06	2.28	2.16
Removed, mg/L	1.50	1.63	1.65	1.58
Plant Operating Parameters:				
Raw Water Treated, mgd	16.9	15.6	16.2	16.1
Applied Chlorine Dose, mg/L	4.3	4.4	5.1	6.2
Chlorine Demand, mg/L[2]	2.4	2.3	3.0	3.9
Alum Dose, mg/L	24.4	26.7	32.6	34.9
Alum/TOC Removed Ratio	16.3	16.4	19.8	22.1

[1]Average annual values
[2]Applied chlorine dose less finished water chlorine residual

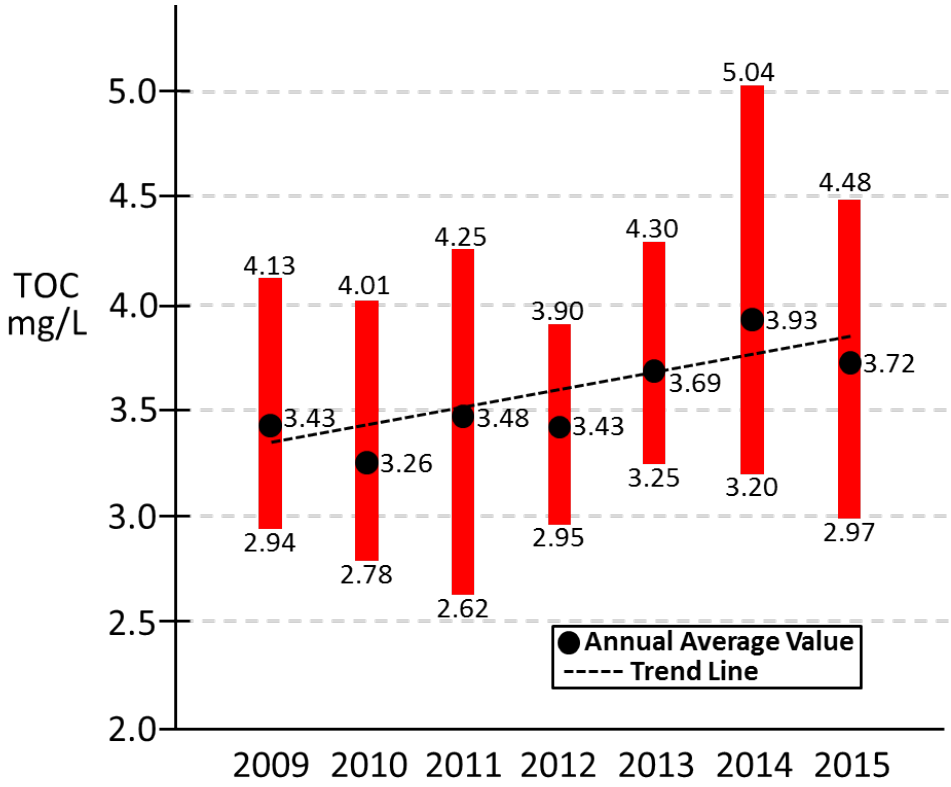

Figure 2: Source Water TOC Concentrations

Review of this data indicates the following:

- Average raw water UV_{254} values were significantly higher during 2014 and 2015 than during previous years. As noted in Appendix A, UV_{254} correlates well with the presence of organic compounds (humic, fulvic acids) which are precursors to DBP formation. Therefore, elevated levels of UV_{254} in the raw water would suggest an increased potential for formation of regulated DBP compounds upon addition of chlorine.
- Although not significantly higher, average raw water TOC concentrations during 2014 and 2015 were higher than during previous years, and as shown on Figure 2, annual average TOC trends are trending upward.
- Applied chlorine doses at the Monroe WTP, and chlorine demand (applied chlorine dose less chlorine residual in the finished water leaving the plant) were notably higher during 2014 and 2015 than during previous years.

The ratio of alum dose to TOC removed was notably higher during 2014 and 2015 than for previous years. While it is recognized that required alum doses are dependent on several other factors, including raw water turbidity, pH, and alkalinity, those parameters were not significantly different during 2014 and 2015 than for previous years.

Considered in total, this information suggests that changes in the characteristics of water from Lake Monroe during 2014 and 2015 likely contributed to increased levels of DBPs in the finished water conveyed to the CBU system.

Weekly *Giardia* inactivation data from July 2014 through June 2015 were developed for profiling and benchmarking purposes concurrently with preparation of this TM. Calculated *Giardia* inactivation conditions which were maintained across Basin Train 3 around the time of routine quarterly system DBP sample collection are summarized in Table 4. As discussed in the disinfection profiling/benchmarking report, hydraulic detention time for Basin 3 is approximately half of that for Basins 1 and 2. Therefore, *Giardia* inactivation levels provided by Basins 1 and 2 would be higher than those calculated for Basin 3 due to their longer detention times. As shown in Table 4, disinfection provided within the Monroe WTP basins during the third and fourth quarters of 2014 (as measured by calculated *Giardia* log inactivation levels, based on plant flow, chlorine residual, pH and water temperature conditions) were significantly greater than the minimum required 0.5-log.

Table 4
Disinfection Conditions at Monroe WTP vs. Average System DBP Concentrations

Monitoring Quarter	System Monitoring Date	Avg. System DBPs, ug/L		Disinfection Profiling Date	Free Cl_2 Residual, mg/L[1]	Log *Giardia* Inactivation[2]
		TTHMs	HAA_5			
3rd 2014	07/22/14	83	69	07/17/14	0.5	2.67
				07/24/14	0.7	3.71
4th 2014	10/22/14	70	71	10/16/14	0.5	2.03
				10/23/14	0.7	2.66
1st 2015	1/20/15	33	66	01/15/15	0.6	0.72
				01/22/15	0.5	0.95
2nd 2015	4/21/15	51	59	04/16/15	0.3	0.64
				04/23/15	0.3	0.89

[1]Residual concentration at top of filters
[2]Calculated inactivation provided across Basin 3 by free chlorine; does not include additional *Giardia* inactivation provided across filters and within the 5 MG finished water reservoir.

The relatively high levels of disinfection maintained during the third and fourth quarters of 2014 could have contributed to elevated DBP concentrations experienced within the distribution system. However, it is emphasized that the Monroe WTP must maintain conditions which result in the continuous presence of a free chlorine residual across the basins. Ability to consistently maintain lower free chlorine residuals of approximately 0.1 to 0.2 mg/L at the end of the basins is complicated by routine variations in plant production rates, raw water quality conditions, and by wind and sun exposure impacts on the large uncovered basins, particularly during the warm summer and fall months. Considering these challenges, and the need to maintain continuous disinfection which complies with pathogen inactivation requirements, a DBP control strategy incorporating reductions in free chlorine residuals across the basins would be difficult to implement and maintain, and would therefore not be recommended. Operational changes to reduce chlorine residual concentrations across the basins were implemented during late summer 2015. However, based on review of third and fourth quarter 2015 DBP monitoring results, these changes did not achieve significant reductions in DBP concentrations in the finished water.

DBP monitoring results also suggest that the majority of DBP formation is occurring within the Monroe WTP, prior to addition of ammonia at the filter discharge to halt further formation. Data on DBP concentrations at the Monroe WTP discharge during 2014 and 2015, and distribution system DBP monitoring results are summarized in Table 5.

Table 5
Plant Discharge vs. Average System DBP Concentrations

Month/Year	TTHM Concentration, ug/L		HAA_5 Concentration, ug/L	
	Plant Discharge	System Average	Plant Discharge	System Average
July 2014	76	83	46	50
October 2014	70	70	49	48
January 2015	48	33	27	44
April 2015	49	51	62	65
July 2015	94	89	61	57
October 2015	55	72	44	62
6-Quarter Avg.	65	66	48	54

With a chloramine residual present in the finished water leaving the plant, and no free chlorine, additional formation of regulated DBPs within the distribution system should be minimal. DBP monitoring results at the Monroe WTP discharge for July 2014 through July 2015 are essentially equal to concentrations monitored within the distribution system, when the relative accuracy

of analytical techniques for DBP determination are considered. However, for the October 2015 reporting period, average concentrations of both TTHMs and HAA_5 were considerably higher than were measured at the plant discharge. TTHM concentrations increased an average of approximately 31 percent as compared to the value recorded at the Monroe WTP discharge. For the same period, average HAA_5 values in the distribution system increased by approximately 41 percent. While existing data is not sufficient to identify the probable cause of this increase, DBP increases of this magnitude would suggest that a small amount of free chlorine may have been present in the finished water leaving the plant. However, the differences in average DBP concentrations between the distribution system monitoring points and at the plant discharge may also reflect the impact of residence time of the water within the system. DBP concentrations for samples collected from the system may not reflect current treatment and/or water quality conditions at the Monroe WTP. However, data presented in Table 5 suggests that changes in current disinfection practices to reduce DBP concentrations at the Monroe WTP discharge should be implemented to ensure continued ability to comply with DBP regulations.

The extent to which HAAs in the sodium hypochlorite solution used at the Monroe WTP for disinfection could be contributing to elevated finished water HAA_5 concentrations cannot be determined without conducting analysis of the product directly received from the supplier and/or samples prepared for HAA_5 analysis by dissolving the hypochlorite product in deionized water. CBU should consider requesting a certificate of analysis from the hypochlorite supplier which includes the three HAA compounds of concern discussed in Section 3. Also, practices which can be implemented to minimize degradation of the hypochlorite solution during in-plant storage, thereby reducing the ratio of HAA compounds present to available chlorine in the hypochlorite solution, include the following:

- Storage of bulk hypochlorite at low temperatures.
- Minimizing the presence of metals which can significantly accelerate product degradation rates by specifying use of filtered hypochlorite solution.
- Maximizing turnover rates of hypochlorite solution in storage.

6. TREATMENT GOALS / OBJECTIVES

While compliance with DBP requirements represents a continual balance between the desire to provide the highest quality water possible to consumers and the need to maintain

reasonable/sustainable treatment costs, many utilities have adopted DBP compliance goals similar to the following:

- Maintain maximum locational running average DBP concentrations no greater than approximately 75 to 80 percent of their respective MCLs (TTHMs less than 60 - 65 ug/L, and HAA_5 levels less than 45 - 50 ug/L) at all system monitoring sites.
- Consistently maintain DBP concentrations at levels which will not result in the need to conduct an Operational Evaluation.

7. REGULATORY COMPLIANCE STRATEGIES

While addition of chlorine at the plant headworks has historically been practiced at many WTPs, it is emphasized that very few utilities treating surface water supplies have been able to continue this practice since promulgation of increasingly-stringent restrictions on allowable levels of chlorine-based DBPs in the finished water.

Review of CBU's recent DBP monitoring data suggests that disinfection practices must be modified to maintain compliance with regulatory requirements and to continue to provide drinking water that meets established standards for protection of public health. Strategies for reducing DBP concentrations in the finished water which are typically considered when concentrations approach their respective MCLs include the following:

- Reducing the concentrations of organic DBP precursor compounds prior to initial application of chlorine.
- Conversion to a primary disinfectant which does not form regulated chlorine-based DBPs, such as ozone, chlorine dioxide, or UV irradiation.
- Removal of DBPs following formation, through adsorption processes or air stripping.

A preliminary assessment of treatment options to reduce DBP concentrations in the treated water was discussed with CBU during a project initiation meeting at the Monroe WTP on December 8, 2015. The following treatment options were discussed:

- Enhanced removal of organics / TOC at the plant headworks prior to initial application of chlorine at the primary rapid mix. This would consist of (1) a TOC adsorption process consisting of addition of powdered activated carbon (PAC) in a mechanically-mixed

contact basin upstream of the primary rapid mix, or (2) construction of an ion exchange (IX) system using an anion-based resin to reduce DBP precursors concentrations.

- Relocation of the point of initial chlorine application to the secondary rapid mix/filter influent.
- Conversion to ozone as the primary disinfectant, with new ozone contact facilities located immediately prior to the existing filters.
- Conversion to post-filter UV disinfection.
- Aeration of the finished water to remove previously-formed DBPs.
- Post-filter GAC adsorption to remove previously-formed DBPs.

It was noted during these discussions that aeration, while effective for removal of some TTHM compounds, is ineffective in removing HAA_5 compounds, and would therefore not be an appropriate DBP mitigation technique. In addition, reliance on high doses of PAC in a mechanically-mixed contact basin at the plant headworks to reduce DBP precursor concentrations prior to chlorine addition would increase overall plant residual solids production, and would not be compatible with current mechanical dewatering system capabilities. Finally, use of ion exchange to reduce DBP precursor concentrations at the plant headworks would require a significant amount of mechanical equipment, and disposal of the resulting high total dissolved solids residual stream produced during periodic regeneration of the IX resin would be problematic. Disposal to the sanitary sewer system, which is typically practiced at treatment facilities utilizing IX treatment, is not feasible at the Monroe WTP.

Following discussion of these treatment alternatives, the following were identified as the most-desirable candidates for further consideration and are discussed in more detail in the following paragraphs:

- Relocation of the point of initial chlorine application.
- Relocation of the point of initial chlorine application, in conjunction with addition of chlorine dioxide at the plant headworks as a preoxidant.
- Conversion to post-filter UV disinfection
- Conversion to ozone as the primary disinfectant, with new ozone contact facilities located immediately prior to the existing filters.

Preliminary opinions of probable construction costs are also included for each conceptual alternative. These planning level estimates are Class 5 with +50 or -30 percent level of accuracy

in accordance with the Association for the Advancement of Cost Engineering. The costs were developed using published industry cost information and other readily available data from similar projects and are intended to provide only general order of magnitude comparisons.

7.1 Alternative 1 – Chlorine Feed Point Modifications

The most readily implementable alternative to reduce DBP concentrations in the treated water would be to shift the point of initial chlorine addition to a location later in the treatment process. The recommended point of initial chlorine addition would be at the secondary rapid mix (filter influent). A free chlorine residual would be maintained across the filters to satisfy a portion of the *Giardia* and virus inactivation requirements and to ensure effective removal of manganese through catalytic adsorption onto the filter media. Ammonia and additional chlorine would be fed at the filter discharge to provide the desired chloramine residual in the finished water at the plant discharge. Baffles installed in the existing 5 MG finished water reservoir during the most recent plant upgrade/expansion project will maximize available chloramine contact times, which will be used in conjunction with free chlorine contact time across the filters to achieve compliance with requirements for inactivation of *Giardia* and viruses.

Minimum free chlorine residuals which must be maintained at the filter discharge to comply with *Giardia* and virus inactivation requirements under anticipated worst-case water temperature and plant throughput rate conditions were summarized in the Basis of Design Memorandum for the most recent Monroe WTP expansion. An updated/revised summary which incorporates more recent plant operating conditions is included at the end of this memorandum as Appendix A.

This alternative would offer the following benefits:

- It provides the opportunity to reduce concentrations of DBP precursor compounds prior to chlorine addition through alum coagulation and adsorption by PAC.
- Elimination of a free chlorine residual within the flocculation and sedimentation basins results in improved ability to utilize PAC for adsorption of taste and odor-causing compounds and algal toxins.
- Reduced algal cell destruction/lysing within the treatment basins due to elimination of a free chlorine residual reduces the potential for presence of algal toxins within the treated water. Coagulation and settling of algal cells by conventional

flocculation/sedimentation does not achieve complete removal; however, some removal would be expected within the basins.

- Reduced chlorine demand attributable to removal of organics/TOC prior to chlorine addition.
- Construction of additional treatment units/infrastructure is not required; provisions for implementing this change are already in place.

A potential disadvantage of this approach is increased opportunity for growth/accumulation of algae and nuisance organisms within the flocculation and sedimentation basins. This excessive accumulation of nuisance organisms in the basins could be minimized through addition of chlorine dioxide at the plant headworks, which is included in Alternative 2. In addition, both chlorine contact time across the filters and chloramine contact time within the 5 MG finished water reservoir will need to be monitored and maintained at appropriate levels in order to comply with microbial pathogen inactivation requirements. Increased monitoring of the disinfection process will also be necessary. CBU should consider developing a plant-specific spreadsheet model to assist operators in maintaining appropriate disinfection conditions under anticipated variations in plant throughput rates and water temperature, pH, and chlorine/chloramine residual conditions.

DBP formation model projections were prepared to quantify the likely reduction in DBP concentrations associated with delaying initial chlorine application until the filter influent. Potential reductions in DBP concentrations in the finished water were projected using a formation model developed by USEPA ("Water Treatment Model, Version 2.0"). DBP concentrations were projected using both current plant operational and water quality conditions, and for proposed delayed addition of chlorine at reduced free chlorine contact times and lower applied chlorine doses for two levels of TOC removal across the flocculation/sedimentation basin trains. Projected results are summarized in Table 6. While it is emphasized that no model can be expected to provide definitive results unless calibrated using actual water quality monitoring data over extended periods, these results provide an indication of the significant reductions in DBP concentrations that can be achieved through modification of current chlorine application practices. Bench-scale testing to confirm the extent to which modified chlorine addition practices can reduce DBP concentrations could also be performed.

Table 6 USEPA DBP Formation Model Results*			
Parameter	Current Conditions	With Delayed Chlorine Addition	
TOC, mg/L	3.8	2.5	2.2
Chlorine Dose, mg/L	5.5	4	4
Bromide, mg/L	0.1	0.1	0.1
Water Temperature, C°	17	17	17
pH, units	6.5	6.5	6.5
Contact Time, hours	3	0.5	0.5
Projected DBP Formation TTHMs, ug/L HAA_5, ug/L	 67 68	 33 31	 29 27
*USEPA Water Treatment Model v2.0			

As facilities are currently in place to shift the point of initial chlorine addition to the secondary rapid mix/filter influent, there are no costs associated with implementation of Alternative 1.

7.2 Alternative 2 – Chlorine Feed Point Modifications + Preoxidant Addition

This alternative would be essentially identical to Alternative 1, but with provisions for addition of chlorine dioxide (ClO_2) at the head of the plant at low dosages on an "as needed" basis to control algae/nuisance organism accumulations within the flocculation/sedimentation basins, and as a preoxidant which can potentially reduce DBP formation.

ClO_2 is a very effective disinfectant/oxidant currently used by more than 500 US water utilities, either continuously or seasonally for disinfection, taste and odor control, oxidation of iron and manganese, and/or to reduce chlorine-based DBPs in finished water. It is used most frequently early in the treatment process as a substitute preoxidant for free chlorine. ClO_2 does not react with organic compounds to form TTHMs and HAA_5. However, experience at other utilities indicates that ClO_2 can chemically alter DBP precursor compounds by partially oxidizing them, which renders them less amenable to conversion to regulated DBPs when chlorine is applied later in the treatment process. Because of its unstable nature, ClO_2 must be generated onsite. Byproducts of oxidation with chlorine dioxide include chlorite and chlorate ion. Chlorite concentrations in the finished water are currently regulated. While chlorite ion can be removed by adding ferrous iron, which converts the chlorite to soluble chloride ion, most

utilities elect to limit ClO_2 doses such that chlorite concentrations in the treated water remain at less than the MCL of 1.0 mg/L.

In addition to control of nuisance organisms within the treatment basins, another benefit of chlorine dioxide addition is that the resulting chlorite residual in the treated water has been shown to be very effective in controlling ammonia-oxidizing bacteria which can initiate nitrification within the distribution system. Ability to control nitrification has been noted at chlorite concentrations as low as approximately 0.20 mg/L.

A potential disadvantage of chlorine dioxide addition is the need for daily chlorite residual monitoring at the distribution system entry point to ensure continuous compliance with the MCL of 1.0 mg/L. Also, as the Monroe WTP uses sodium hypochlorite solution as the chlorine source, a system which does not require chlorine gas to generate ClO_2 would be needed. There are multiple systems available which can effectively generate chlorine dioxide without the need for gaseous chlorine. For example, three-chemical systems using sodium hypochlorite, hydrochloric acid, and sodium chlorite solution, and systems which utilize proprietary chlorite/chlorate solutions and sulfuric or hydrochloric acid can be used.

A conceptual planning level opinion of probable project cost to implement a chlorine dioxide generation system at the Monroe WTP is approximately $3.0 Million ($500,000 for planning/engineering and $2.5 Million for construction).

7.3 Alternative 3 – Chlorine Feed Point Modifications + UV Disinfection

For this alternative, addition of chlorine at the head of the plant would be discontinued, and primary disinfection to achieve compliance with requirements for inactivation of *Giardia* cysts would be provided by post-filtration UV irradiation. A low free chlorine residual concentration would be maintained across the filters to provide for inactivation of viruses and to ensure effective removal of manganese by filtration. Viruses are not readily inactivated by UV disinfection.

UV light, historically used in this country primarily to disinfect wastewater effluents, is rapidly emerging as the preferred primary disinfectant when provisions for inactivation of microbial pathogens such as *Giardia* and *Cryptosporidium* are required, and/or where continued use of chlorine for primary disinfection is not feasible due to DBP formation concerns. There are more than 1,000 US facilities that are currently utilizing UV for disinfection of public drinking water supplies, including several major installations within Indiana. While most utilities have installed

UV disinfection to address recently-enacted requirements for inactivation of *Cryptosporidium* oocysts (which have not been detected in Lake Monroe water at levels which would mandate provisions for removal/inactivation), UV is also extremely effective for inactivation of *Giardia* cysts. Many water utilities that rely on surface water sources are taking preemptive measures to ensure the continued safety of their customers with respect to exposure to chlorine-resistant pathogens such as *Cryptosporidium*. Because of the relatively high benefit-to-cost ratio, many utilities have come to view UV disinfection as an additional barrier against potential outbreaks of waterborne disease.

UV system designs typically utilize medium-pressure or low-pressure high-output lamps enclosed in stainless steel pipe-type reactor vessels, which facilitate incorporation into existing treatment facilities. Standby UV reactors are included to provide reliability/redundancy to assure uninterrupted disinfection should a single unit require servicing. UV reactors are installed downstream of the filtration process, where water quality is highest and ability of the UV light to readily penetrate into the process stream is maximized. Most UV systems are highly automated to minimize the need for routine operator attention, and integration into the plant's SCADA system facilitates automated preparation of monthly compliance monitoring reports which must be submitted to the state regulatory agency.

Benefits of addition of UV for primary disinfection include:

- Significant reductions in formation of chlorine-based DBPs due to ability to minimize required free chlorine contact times.
- Provides an additional barrier to microbial pathogens within the treatment process at significantly lower costs than for comparable microbial control processes (ozone, membrane filtration).
- Ease of operation to comply with pathogen inactivation requirements as compared to conventional chlorine plus chloramine disinfection.

Potential disadvantages include:

- Potential for fouling/plating of the quartz sleeves which house the UV lamps.
- Reliability/accuracy of the UV sensors used to monitor process effectiveness.

Post-filtration UV disinfection at the Monroe WTP could be installed in the treatment system between the transfer pumps and the finished water reservoir. The transfer pumps would pump through the UV reactors into the reservoir. A conceptual planning level opinion of probable project cost to implement UV disinfection at the Monroe WTP is approximately $7.3 Million ($1.3 Million for planning/engineering and $6.0 Million for construction).

Provisions for post-filtration granular activated carbon (GAC) adsorption could also be added to further enhance ability to minimize DBP concentrations in the finished water, in addition to providing improved taste and odor control and removal of algal toxins. The GAC contactors would be located downstream of the UV reactors and prior to the 5 MG finished water reservoir. Use of post-filter GAC treatment would require additional changes in disinfection to minimize or eliminate free chlorine residual concentrations at the GAC influent, as chlorine is removed by GAC and will reduce effective GAC life prior to replacement. As manganese control is currently achieved at the Monroe WTP by maintaining a free chlorine residual across the existing granular media filters, elimination of the free chlorine residual across the filters to accommodate the downstream GAC contactors could compromise ability to effectively remove manganese. Additional evaluation of manganese control practices would therefore be required prior to implementation of post-filter GAC treatment. Provisions for a brief free chlorine contact period following GAC would also be required to ensure effective inactivation of biomass which may periodically slough from the GAC media. Ability to accommodate the additional head loss associated with the GAC contactors and additional post-filter chlorine contact using the existing transfer pumps would need to be evaluated.

7.4 Alternative 4 – Ozone Disinfection / Oxidation

Ozone is currently the most powerful oxidant and disinfectant available to the water industry. More than 300 US water utilities are currently using ozone or have ozone systems under design or construction. In addition to disinfection, direct benefits of using ozone include reduction of tastes and odors, oxidation of algal toxins, improvements in filtered water turbidity when applied immediately preceding filtration, microcoagulation of dissolved organic contaminants, and oxidation of color, iron, and manganese. Ozone is applied in gaseous form, and because of its instability, must be generated onsite and applied in baffled, covered contact basins.

The known byproducts of ozonation can be readily removed to acceptable levels by operating the plant filters in a biologically active mode. While continued concerns regarding the potential health impacts of bromate may limit its use if effective bromate formation control measures cannot be implemented, bromide levels in Lake Monroe are reported to be low enough to

preclude significant bromate formation (a byproduct of ozonation of waters containing low levels of bromide, and a suspected carcinogen). Ozone is effective for inactivation of *Giardia* over the range of Lake Monroe water temperature conditions typically experienced. However, while ozone is effective for inactivation of *Cryptosporidium* oocysts in warm water, its effectiveness decreases rapidly at temperatures lower than approximately 10 degrees Celsius (50 degrees Fahrenheit), which may reduce its attractiveness for inactivation of this microbial contaminant. Generally, ozone applied at dosages sufficient to provide primary disinfection also achieves high levels of taste- and odor-causing compound (geosmin and MIB) oxidation and algal toxin removal.

An important consideration for retrofitting of ozone into an existing plant is the point of application. Ozone is typically applied at either the plant headworks ("preozonation"), or at the sedimentation basin discharge, just prior to filtration. Preozonation can often be accomplished without added pumping or other accommodations to the hydraulic profile, but application at this location generally requires higher applied ozone dosages than for systems located later in the treatment process. For most applications, addition of ozone just prior to filtration is the most cost-effective approach. However, application at this point can also be more complex with regard to plant geometry and hydraulics. As contact basin entrance/exit losses and the need for a discharge weir often consumes 1.0 to 1.5 feet of hydraulic head, construction of prefiltration ozone contacting facilities may require addition of intermediate pumping facilities to fit the contact basin within the plant's hydraulic profile. While the configuration of the ozone contact facilities depends on site-specific treatment goals, contactors with baffles to provide a serpentine flow pattern and with theoretical hydraulic detention times of 8 to 10 minutes can typically be applied if the objective is primary disinfection and oxidation of taste and odors and algal toxins.

In addition to ozone contacting facilities, ancillary facilities for ozone generation and for destruction of any residual ozone present in contactor off-gas are required. Facilities to provide a clean source of oxygen for ozone generation are also required; in most cases, this is accomplished through purchase and onsite storage of high-quality liquid oxygen. As generation of ozone will increase the plant's electrical load, upgrading of the plant's electrical supply capability may be needed.

Ozonation of water containing moderate-to-high concentrations of manganese can lead to the formation of colloidal manganese oxide particles which can be difficult to remove by conventional filtration. However, experience at other locations indicates that application of an

appropriate filter aid polymer is generally effective in maintaining manganese concentrations in the filtered water at or less than the typical detection limit.

While ozone effectiveness and dose requirements can be evaluated using bench-scale testing methods, site-specific pilot-scale testing is typically required to accurately assess both potential benefits and drawbacks associated with ozone treatment, and to facilitate obtaining regulatory agency approval. As a result, pilot testing would be necessary prior to any recommendation to implement ozone treatment at the Monroe WTP. Application of chlorine prior to the filters to obtain disinfection CT credit and to enhance the filters ability to remove manganese would no longer be feasible if biological filtration for ozone byproducts control were to be implemented. Provisions for a brief 2 to 3 minute period of free chlorine contact at the filter discharge prior to conversion to a chloramine residual will need to be provided to ensure effective control of microbes that may slough periodically from the biologically-active filters.

A conceptual planning level opinion of probable project cost to implement ozone disinfection at the Monroe WTP is approximately $12 Million ($2 Million for planning/engineering and $10 Million for construction).

7.5 Discussion of Treatment Options

All of the disinfection alternatives discussed above would be considered to represent a "significant change" in disinfection practices, as defined by USEPA's (LT2ESWTR) and Indiana Title 327 (327 IAC 8-2.6-9). CBU will therefore need to complete a disinfection profiling and benchmarking report for *Giardia* and viruses, and submit that report to IDEM prior to making changes in disinfection practices. A disinfection profiling & benchmarking report, complying with LT2ESWTR and Indiana Title 327 requirements, was prepared by Black & Veatch using one year of weekly disinfection monitoring data provided by the Monroe WTP operating staff. The report was submitted to IDEM on February 25, 2016, based on modifications outlined in Alternative 1.

Elimination of a free chlorine residual within the flocculation and sedimentation basins may result in increased tendency for accumulation of algae on basin walls, baffles, and effluent weirs, particularly during the summer months when water temperatures increase and sunlight exposure is at a maximum. Other than presenting a potential aesthetic/visual concern, the primary impact generally observed with algae is increased potential for release of taste and odor-causing compounds into the process stream. Other water utilities rely on a variety of non-chlorine control strategies, ranging from addition of alternative oxidants (potassium

permanganate, chlorine dioxide) and/or algaecides (copper sulfate, proprietary copper-based compounds) to mechanical/non-chemical strategies such as covering of basins to exclude sunlight, periodic manual cleaning, and sonication (use of submerged transducers emitting ultrasonic waves at frequencies intended to disrupt algae growth). References on control of algal growth within treatment facilities were reviewed as part of this evaluation. One of these references ("Strategies for Controlling and Mitigating Algal Growth within Water Treatment Plants", Water Research Foundation, 2009) presents results obtained from nationwide surveys of algal control practices at 76 treatment plants. In general, the most common and effective control methodology employed by the utilities surveyed is periodic manual cleaning of the basins to remove algae accumulations. Effectiveness of addition of potassium permanganate or chlorine dioxide appears to be site-specific, as is addition of NSF-approved copper-based algaecide compounds at the plant headworks. Use of algaecides appears to be most effective when applied over a 12 to 24 hour period approximately every 2 weeks Continuous application of copper sulfate results in development/accumulation of copper-resistant algal species. Applied algaecide doses vary significantly, but periodic application at doses of 0.5 to 0.8 mg/L (as copper) is reported to be effective in keeping basins free of excessive algal accumulations while still ensuring compliance with the copper Action Level of 1.4 mg/L under the Lead & Copper Rule.

CBU should be aware that application of oxidants or algaecides which have the ability to control algal accumulations within the flocculation and sedimentation basins also increases the potential for lysing of the algal cells and release of taste and odor-causing compounds and intracellular algal toxins into the process stream. These compounds should therefore be applied judiciously and only as needed, and with the understanding that addition of PAC could be necessary to address the associated algal byproduct concerns.

8. CONCLUSIONS / RECOMMENDATIONS

Based on ability to quickly implement necessary changes without the need for construction of additional treatment facilities, CBU should immediately proceed with Alternative 1. Prior to implementing the change in chlorine feed points, CBU should investigate methods for monitoring of the disinfection process to ensure that conditions which will ensure compliance with microbial pathogen requirements are continuously maintained. Following IDEM review and approval of the disinfection profiling/benchmarking report, CBU should proceed with moving the point of initial chlorine addition to the filter influent / secondary rapid mix. This will provide immediate reductions in the levels of DBPs in the finished water.

Should CBU elect to also incorporate addition of chlorine dioxide as a preoxidant at the head of the plant in conjunction with chlorine feed point changes, equipment options for generation and feeding of chlorine dioxide should be evaluated and the necessary modifications implemented in order to have the improvements in place when water temperatures and potential for nuisance organism accumulations in the treatment basins increase.

CBU should also consider having the current sodium hypochlorite supply analyzed for the presence of HAA compounds. This testing should include determination of both the free available chlorine content of the sample(s) analyzed and the three HAA compounds of concern (monochloroacetic acid, dichloroacetic acid, and trichloroacetic acid). The current hypochlorite supplier may be able to provide a certificate of analysis which includes typical HAA compound content. CBU may also want to implement measures to minimize degradation of the hypochlorite prior to addition, as discussed in Section 5 of this TM.

Finally, CBU should seriously consider addition of post-filter UV disinfection or pre-filter ozone oxidation/disinfection to reduce dependence on free chlorine for inactivation of microbial pathogens, thereby reducing the potential for formation of chlorine-based DBPs. UV will also provide additional assurances that CBU's consumers are protected against potential waterborne disease outbreaks associated with *Cryptosporidium. Cryptosporidium* has not been detected in Lake Monroe at levels which would mandate provisions for additional removal/inactivation at the Monroe WTP; however, a USEPA-mandated two-year source water monitoring program for *Cryptosporidium* is currently underway. In addition to providing enhanced disinfection for inactivation of *Giardia* cysts, ozone would also provide an additional barrier to the presence of algal toxins in the finished water.

Appendix A

Disinfection CT Compliance Requirements

The following summarizes CT compliance requirements for initial addition of chlorine at the filter inlet, with a free chlorine residual maintained across the filters and additional disinfection credit provided by chloramine contact within the existing 5 MG finished water reservoir.

Assumptions

The following assumptions were used in assessing CT compliance requirements:

- 0.5-log *Giardia*, 2.0-log virus inactivation required.
- *Giardia* inactivation is achieved through a combination of free chlorine contact across the filters and chloramine contact across the 5 MG finished water reservoir.
- 10% "factor of safety" (log inactivations provided exceed minimum required values 10%)
- 30 mgd maximum plant throughput rate (Phase 1 expansion), and 36 mgd ultimate maximum plant throughput rate (Phase 2 expansion).
- Maximum filtered water pH of 7.0.
- Minimum winter water temperature of 3 degrees C.
- Maximum winter plant production rate is 67 percent of total production capacity, i.e., 20 mgd for the Phase 1 expansion, and 24 mgd for the Phase 2 expansion.
- CT requirements for the Phase 1 expansion are based on 5 filters on-line, and one filter out of service for backwashing. CT requirements for the Phase 2 expansion are based on 7 filters on-line, and one filter out of service for backwashing.
- Available chlorine contact times for the filters are based on total of (1) the volume of water above the media, and (2) the volume of water contained within the media & support gravel (40 inches total depth, 50% average porosity assumed). CT contribution attributable to water volume within the underdrains and influent/effluent piping is considered negligible.
- T_{10}/DT ratio ("baffle factor") of 0.7 for filters.
- Minimum finished water reservoir operating level of 50% of full volume, i.e., 2.5 MG.
- Minimum chloramine residual of 2.0 mg/L at the finished water reservoir discharge.

Minimum Chorine Residual Requirements

Based on the assumptions listed above, minimum required free chlorine residuals across the filters to achieve 0.5-log inactivation of *Giardia* cysts and 2.0-log inactivation of viruses are summarized in Tables 1 and 2 below.

Table 1 Free Chlorine Residual Requirements for CT Compliance At Current 30 mgd Plant Capacity				
Condition	Plant Flow Rate, mgd	Min. Water Temperature	Minimum Free Chlorine Residual at Filter Discharge (mg/L) vs. Reservoir Baffle Factor[1]	
			0.5	0.4
Winter Max	20	3	1.70	1.90
Summer Max	30	15	0.86	1.01
		20	0.43	0.58
		25	0.13	0.33
[1]Reservoir operating at minimum of 50% of full capacity, 2.0 mg/L chloramine residual.				

Table 2 Free Chlorine Residual Requirements for CT Compliance At 36 mgd Expanded Plant Capacity				
Condition	Plant Flow Rate, mgd	Min. Water Temperature	Minimum Free Chlorine Residual at Filter Discharge (mg/L) vs. Reservoir Baffle Factor[1]	
			0.5	0.4
Winter Max	24	3	1.53	1.67
Summer Max	36	15	0.83	0.93
		20	0.48	0.57
		25	0.17	0.26
[1]Reservoir operating at minimum of 50% of full capacity, 2.0 mg/L chloramine residual.				

Should initial application of chlorine at the plant influent need to be discontinued to reduce the formation of chlorine-based DBPs, the information presented above indicates that CT requirements can be readily achieved by maintaining a free chlorine residual across the filters and a chloramine residual across the finished water reservoir.

FILED
September 22, 2016
INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE PETITION OF BLOOMINGTON, INDIANA, FOR AUTHORITY TO ISSUE BONDS, NOTES, OR OTHER OBLIGATIONS, FOR AUTHORITY TO INCREASE ITS RATES AND CHARGES FOR WATER SERVICE, AND FOR APPROVAL OF A NEW SCHEDULE OF WATER RATES AND CHARGES	)	**CAUSE NO. 44855**

PETITIONER'S EXHIBIT 2

Direct Testimony of John Hamilton

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VERIFIED DIRECT TESTIMONY OF JOHN HAMILTON
ON BEHALF OF THE CITY OF BLOOMINGTON, INDIANA

Cause No. 44855

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

2 A. My name is John Hamilton. I am the elected Mayor of the City of Bloomington,
3 Indiana ("Bloomington"). My business address is 401 N. Morton Street, Suite
4 210, Bloomington, Indiana, 47404.

5

6 **Q. Please describe your educational and business background.**

7 A. I am a native Hoosier, born in Bloomington and also growing up in Evansville
8 and Indianapolis. A product of public schools in Indiana, I graduated from
9 Harvard College and received a law degree from the Indiana University Maurer
10 School of Law.
11 As a professional, I have been a public servant most of my life. I was elected
12 Mayor of Bloomington in November 2015, and took office in January 2016. I am
13 a former Secretary of the Indiana Family and Social Services Administration,
14 where I oversaw the implementation of Medicaid and welfare programs, services
15 for the elderly, disabled, mentally ill, and children at risk, as well as state-wide
16 community development and housing programs, on a $6 billion annual budget.
17 Additionally, I am a former Commissioner of the Indiana Department of

Environmental Management, where I oversaw that agency's regulation of environmental issues on a statewide basis. I was the President of City First Enterprises, a nonprofit organization I founded, which is the umbrella organization for City First Homes and City First Bank, a $250 million community development financial institution located in Washington, D.C. I have also served as Adjunct Faculty at the Indiana University School of Public and Environmental Affairs, where I taught high-performance government and administrative law.

Q. What is the purpose of your testimony?

A. My testimony focuses on the public policy and rationale behind the proposed rate increase and discusses my intentions with respect to rate design in a future Bloomington rate case. Given the 22% rate increase requested and my strong feelings on rate design, I felt it important for the Indiana Utility Regulatory Commission (the "Commission"), the Office of the Utility Consumer Counselor and other parties to this proceeding to know that Bloomington's chief executive is engaged in the process, has carefully considered the level of the requested rate relief, and has critically thought about rate design issues and how those should look in future rate cases.

PUBLIC POLICY GOALS OF PROPOSED WATER RATE INCREASE

Q. What public policy goals would the requested rate increase serve?

A. Broadly speaking, the requested rate increase would allow Bloomington to maintain a fiscally sustainable water utility, to comply with environmental regulations, and to replace infrastructure that has reached the end of its useful life.

Q. Please discuss fiscal sustainability as a public policy goal.

A. Having a water utility that maintains adequate revenues to provide a safe, secure and reliable supply of drinking water is a critical public policy goal. In the years since Bloomington's last rate increase, it seems public water systems across the United States have constantly been dealing with serious issues affecting their provision of drinking water. The Flint, Michigan, crisis is the most recent to gain national headlines. No one likes to increase rates, but rate increases provide revenues that, among other things, allow the utility to replace infrastructure that has exceeded its useful life and to avoid deferred maintenance on infrastructure. The additional revenues in this case will ensure that Bloomington has the resources in the near term to protect this vital public asset, Bloomington's water system, from falling into disrepair, which might compromise Bloomington's ability to provide a safe, secure and reliable water supply to its customers.

Q. Please discuss the environmental compliance public policy aspect you mentioned.

A. As a former Commissioner of the Indiana Department of Environmental Management, environmental compliance is an issue with which I have direct experience and which is of the utmost importance. Bloomington has recently

experienced water quality issues. Levels of disinfection byproducts ("DBPs") have been rising at certain points in our water distribution system for the past several years. The DBPs have not exceeded limits within Bloomington's system, but the increase in DBP levels is concerning. Bloomington's water utility needs additional revenues in part to maintain its environmental compliance program, including testing for elevated levels of DBPs, so that Bloomington's water utility avoids violations. Regulatory compliance is an important public policy goal because it safeguards a dependable and secure supply of drinking water and enhances public confidence in the water utility.

Q. Please discuss infrastructure replacement as a public policy goal.

A. Replacement of aging infrastructure is a national issue and is tied to the prior two public policy goals I have discussed. Replacing infrastructure puts the utility in a position to be successful by avoiding problems caused by obsolete pipes and other infrastructure, whether those problems involve leaking water or cause poor water quality. Infrastructure replacement proactively manages our system so that Bloomington's water utility is not reactionary but can focus its energy more on avoiding future problems rather than solving existing problems.

REASONABLENESS OF WATER RATE INCREASE

Q. Is the proposed 22% rate increase a reasonable rate increase?

A. I believe so. By the time a final order is issued in this Cause, the Commission will not have approved a rate increase for Bloomington in nearly six years.

Additionally, the rate increase is a result of taking the next step to improve Bloomington's water utility through proactive asset management and strengthened environmental compliance measures. The water bill for a 3,000 gallon per month residential user will increase by approximately $3.48 per month, which is a reasonable increase to ensure the continued delivery of safe drinking water.

RATE DESIGN

Q. You mentioned rate design earlier. Please address your rate design issues.

A. Bloomington has requested a 22% increase in existing rates and charges based on the rate design used in its prior rate cases. Unfortunately, when I entered office earlier this year, the utility needed the rate increase proposed in this Cause, and there simply wasn't sufficient time to do the work on a new rate design before rate relief was requested. I am here today to explain the basic tenets of a rate design that Bloomington's water utility will propose in a future rate case.

I am a firm believer in the human right to water. Water is different than other services offered by utilities. Energy is important and makes life more convenient but is not necessary for life. Likewise with communications. Water, again, is different. Humans cannot survive without it. I believe we need to view water service in a broader context than simply as a commodity. An approach that recognizes the human right to water, while also maintaining a fiscally sound utility is in order.

Accordingly, I have instructed CBU to review cost data evidence to support a general lifeline rate, consistent with the Commission's prior decisions in Cause No. 35780-S8 dated March 24, 1982 and April 21, 1982, respectively. It is my understanding that those decisions would allow for such a rate, provided that sufficient cost data evidence supports the rate design. I would specifically point to Paragraph 6 of the Commission's April 21, 1982 Order, which stated that the rejection of a general lifeline rate in that matter, "should not be interpreted as a rejection of and/or prohibition against the adoption and approval of a 'cost based' Lifeline Rate structure …. Such a rate structure proposal, when supported by sufficient cost data evidence in a rate-making proceeding, may be adopted [] and approved[.]"

I want to expressly distinguish the general lifeline rate design from targeted lifeline rate designs. The Commission has made clear that targeted lifeline rates are impermissible, most recently through its orders in Cause Nos. 44644 and 44685. General lifeline rates, unlike targeted lifeline rates, however, have not been rejected on a *prima facie* basis by the Commission or Indiana courts as illegal. In the Cause No. 35780-S8 decisions cited earlier, the Commission explicitly left open the possibility of approving a general lifeline rate.

Q. How will such a rate design affect Bloomington's water conservation efforts?

A. I do not believe a general lifeline rate will impact Bloomington's conservation efforts. I envision the general lifeline rate structure to provide an as-yet-to-be-determined, subsistence level of water at a significantly lower rate block than

currently exists. Bloomington customers are some of the most conservation-minded water customers in the state, with approximately 48% of our customers using at or less than 3,000 gallons per month. I believe the general lifeline rate could provide an incentive for Bloomington customers to be even more efficient and conservation-minded with their water use.

Other utilities around the country have adopted general lifeline rate structures, including communities in arid regions where conservation is much more a way of life than it is in Indiana. For example, water conservation is a priority in Texas, and the City of San Antonio enacted a general lifeline rate as part of its 2015 rate structure for its water utility, the San Antonio Water System. And on DC Water's website, lifeline rates are explicitly described "as an incentive to conserve water[.]" https://www.dcwater.com/about/rates/default.cfm (last visited September 22, 2016).

These forward-thinking utilities recognize the policy justifications for general lifeline rates and have adopted general lifeline rates demonstrating that policy support. Enacting a general lifeline rate will demonstrate Bloomington's commitment to the human right to water and from a policy perspective, is the right thing to do.

CONCLUSION

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

A. Yes, it does.

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: _____ Dated: Sept 21, '16

John Hamilton

FILED
September 22, 2016
INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE PETITION OF BLOOMINGTON, INDIANA, FOR AUTHORITY TO ISSUE BONDS, NOTES, OR OTHER OBLIGATIONS, FOR AUTHORITY TO INCREASE ITS RATES AND CHARGES FOR WATER SERVICE, AND FOR APPROVAL OF A NEW SCHEDULE OF WATER RATES AND CHARGES	)	**CAUSE NO. 44855**

PETITIONER'S EXHIBIT 3

Direct Testimony of Timothy Mayer with Attachments TM-1 through TM-3

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Attorneys for Petitioner,
The City of Bloomington, Indiana

VERIFIED DIRECT TESTIMONY OF TIMOTHY MAYER
ON BEHALF OF THE CITY OF BLOOMINGTON, INDIANA

Cause No. 44855

INTRODUCTION

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

A. My name is Timothy Mayer, and I am a member of the City of Bloomington ("Bloomington") Common Council (the "City Council") as an At-Large Member. I am also the City Council's representative to Bloomington's Utilities Service Board (the "USB"), which governs Bloomington's Department of Utilities ("CBU"). I am an ex-officio, non-voting member of the USB. My home address is 1001 S. Jordan Ave., Bloomington, Indiana, 47401.

Q. Please describe your educational and business background.

A. I received a Bachelor of Fine Arts degree from the Kansas City Art Institute in 1967. I received a Master of Fine Arts degree from Indiana University – Bloomington in 1970. I was hired by the Purdue University Editor's Office in 1970 as a Graphic Designer. From 1971 to 1976, I was a faculty member at the Indiana University School of Fine Arts. From 1976 to 1986, I held the position of General Manager at Channel-Kor, Inc., an exhibit design and production company. From 1986-2014, I was the Principal of TMDesign, a visual

communication design firm specializing in corporate communications and book/journal design and production. I retired in 2014.

My civic involvement has included two separate stints on the City Council from 1983 - 1987 and from 1996 - present. In addition to my appointment to the USB, I also serve as the City Council's appointments to the Community Development Block Grant program for physical improvements and to the Jack Hopkins Social Service Fund. I also served as a member of Bloomington's Planning Commission from 1988 - 1996. I have served on the Mayor's Commission to advise on the IU Health/Bloomington Hospital relocation and reuse of the current site, and I volunteer at the Community Kitchen of Monroe County.

Q. Please describe your responsibilities specifically as they relate to your service on the USB.

A. I fully participate in all of the USB meetings. My role is to report to the City Council regarding the actions of the USB. I also represent the City Council's interests before the USB.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to support the requested rate relief and the financing approval requested in this Cause. I sponsor the USB's resolution recommending a 22% rate increase to the City Council and the ordinances adopting the rate increase and authorizing the issuance of bonds. I further explain

the role, functions, and overall purpose of the USB and the extensive vetting process that the proposed capital improvements went through at both the USB and the City Council levels.

UTILITIES SERVICE BOARD ACTION

Q. Please explain the role and functions of the USB.

A. The USB has general supervisory power over Bloomington's water utility as provided by Ind. Code § 8-1.5-3-4. The USB is composed of nine (9) members, as described by Mr. Kelson. Day-to-day matters are handled by CBU staff. The USB is charged with the overall governance of Bloomington's water utility, including operations and finances. Concerning the rates and charges of Bloomington's water utility, the USB recommends to the City Council proposed rate increases. The City Council is ultimately responsible for adopting rate increases, subject to the approval of the Indiana Utility Regulatory Commission (the "Commission").

Q. Please describe the process the USB undertook when recommending the rate increase proposed in this Cause.

A. As stewards of the water utility, the USB wanted to take a proactive approach to the process. The USB entered into a contract with Crowe Horwath LLP ("Crowe") to proceed with a rate study for any rate increase that might be in order. During the course of the USB's analysis of the need for the rate increase, the USB simultaneously worked with Crowe to determine the ultimate impact on rates. Based on information provided by CBU and its ongoing operation of the

water utility, the rate report prepared by Crowe, and consideration by the USB members at its public meetings, the USB determined to propose a 22% increase to the City Council.

Q. When did the USB recommend the 22% rate increase to the City Council?

A. The USB approved a resolution recommending a 22% rate increase at its meeting on May 31, 2016. I was unable to attend that meeting, but as an ex-officio, non-voting member of the USB, I was aware of the deliberations concerning the rate proposal and the approval of the resolution. The USB adopted Resolution 2016-3 at its May 31, 2016, meeting, which recommends the requested rate increase and which is attached as Petitioner's Attachment TM-1 (without exhibits). At that point, the rate increase was still subject to the approval of the City Council and the Commission.

Q. Did the public have an opportunity to provide input during the USB's deliberations?

A. Yes, the public had an opportunity to provide input at the USB's May 31, 2016 meeting, but no statements by the public were made.

CITY COUNCIL ACTION

Q. When did the City Council begin consideration of the rate increase?

A. The ordinance to approve the rate increase was introduced at the June 1, 2016 meeting of the City Council, where it was introduced as Ordinance 16-08

("Ordinance 16-08"). Ordinance 16-09 ("Ordinance 16-09") (Ordinance 16-08 and Ordinance 16-09, together, the "Ordinances") to approve the issuance of water revenue bonds was also introduced at the June 1, 2016, City Council meeting. After introduction, the City Council held a committee meeting on June 8, 2016, on the Ordinances. Given the magnitude of the rate increase, the committee meeting was a "committee of the whole" meeting, meaning that the entire City Council convened to consider the Ordinances in the committee meeting. The committee meeting lasted approximately 3 hours and involved significant discussion. After substantial debate and public input received at these committee meetings, each member of the City Council was persuaded to support the rate increase and issuance of bonds.

I would also note that City Council members received updates throughout the USB process at meetings of the City Council by me, as its ex-officio representative on the USB.

Q. Did the City Council receive any public input during its deliberations?

A. Yes. The City Council heard from two citizens during the Committee of the Whole meeting on June 8, 2016. Their concern was the amount of the increase, though they did understand the need for maintenance and upgrades to the system.

Q. When did the City Council approve the rate increase and bond issuance?

A. The Ordinances were adopted on July 12, 2016. Ordinance 16-08, which approves the rate increase by unanimous vote, is attached as Petitioner's Attachment TM-2. Ordinance 16-09, which approves the issuance of $4.6 million in bonds for the proposed capital improvements by unanimous vote, is attached as Petitioner's Attachment TM-3.

Conclusion

Q. Would you like to state any other information for the Commission's review?

A. The new administration (Mayor Hamilton and CBU Director Mr. Kelson) along with CBU staff have developed a list of priorities and capital projects that address both current and future needs in the processing and delivery of safe drinking and domestic water for Bloomington. The priorities and capital projects are necessary for the continued provision of safe and reliable drinking water and are consistent with and build upon the utility's past operations.

Q. Do you believe the capital projects to be funded by the proposed bonds are reasonable and necessary for Bloomington?

A. Yes, I believe the capital projects are reasonable and necessary for Bloomington to continue to supply water in a safe, secure and reliable manner to meet its customers' needs. I believe the capital projects and the rate increase in general also serve many other policy goals as outlined by Mayor Hamilton in his testimony.

Q. Do you believe the proposed water revenue bonds are a reasonable method to finance the capital projects?

A. Yes. I believe water revenue bonds are a reasonable method to pay for the capital projects.

Q. Please summarize your testimony.

A. The proposed capital improvement projects are reasonable and necessary for Bloomington, and they, along with the other cost increases experienced by the utility, justify the requested 22% rate increase. The governing bodies for Bloomington's water utility, the USB and the City Council, have thoroughly reviewed the need for the capital projects and the proposed rate increase. The capital projects and the proposed rate increase are supported by the community and are needed to ensure sufficient, safe and reliable water for Bloomington's customers.

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

A. Yes.

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: Timothy Mayer

Timothy Mayer

Dated: 09/20/16

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT TM-1

UTILITY SERVICE BOARD
OF THE CITY OF BLOOMINGTON, INDIANA
RESOLUTION NO. 2016-3

RESOLUTION OF THE UTILITY SERVICE BOARD OF THE CITY OF BLOOMINGTON, INDIANA, CONCERNING THE ACQUISITION, CONSTRUCTION, INSTALLATION AND EQUIPPING OF IMPROVEMENTS AND EXTENSIONS TO THE CITY'S SEWAGE WORKS AND WATERWORKS UTILITIES, APPROVING THE FORMS OF ORDINANCES ADJUSTING THE RATES AND CHARGES FOR THE USERS OF SUCH SEWAGE WORKS AND WATERWORKS UTILITIES AND THE FORMS OF ORDINANCES AUTHORIZING THE ISSUANCE AND SALE OF REVENUE BONDS AND BOND ANTICIPATION NOTES IN ANTICIPATION OF THE ISSUANCE OF SUCH BONDS AND RECOMMENDING ITS ADOPTION TO THE COMMON COUNCIL OF THE CITY, AND OTHER RELATED MATTERS

WHEREAS, the City of Bloomington, Indiana (the "City"), has previously established and constructed and now owns and operates through its Utility Service Board (the "Board"): (i) a sewage works (the "Sewage Works"), for the collection and treatment of sewage and other wastes pursuant to Indiana Code 36-9-23, as amended, and (ii) a municipal waterworks utility (the "Waterworks") furnishing the public supply of water to the City and its inhabitants pursuant to Indiana Code 8-1.5, as amended; and

WHEREAS, the Board desires to acquire and construct certain additional improvements and extensions necessary for the operation of the Sewage Works (the "Sewage Works Project") and certain additional improvements and extensions necessary for the operation of the Waterworks (the "Waterworks Project" and, together with the Sewage Works Project, the "Projects"), said improvements and extensions being collectively and generally described as set forth in the respective Bond Ordinances (as hereinafter defined); and

WHEREAS, in order to finance the cost of the Sewage Works Project, it will be necessary to issue Sewage Works Revenue Bonds of the City (the "Sewage Works Bonds") in an

aggregate amount not to exceed Seven Million Three Hundred Thousand Dollars ($7,300,000) payable out of the net revenues of the Sewage Works (defined as gross revenues after deduction only for the payment of the reasonable expenses of operation, repair and maintenance), and, if necessary, bond anticipation notes of the City (the "Sewage Works BANs") to provide interim construction financing in an aggregate amount not to exceed Seven Million Three Hundred Thousand Dollars ($7,300,000); and

WHEREAS, a proposed form of (i) an ordinance modifying the rates and charges for the users of the Sewage Works (the "Sewage Works Rate Ordinance") and (ii) an ordinance authorizing the issuance of the Sewage Works Bonds to finance the costs of the Sewage Works Project and the costs of issuance of the Sewage Works Bonds and, if necessary, the Sewage Works BANs (the "Sewage Works Bond Ordinance") have been duly considered by the Board and found satisfactory, copies of which are attached hereto as Exhibit A and Exhibit B, respectively; and

WHEREAS, in order to finance the cost of the Waterworks Project, it will be necessary to issue Waterworks Revenue Bonds of the City (the "Waterworks Bonds") in an aggregate amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000) payable out of the net revenues of the Waterworks (defined as gross revenues after deduction only for the payment of the reasonable expenses of operation and maintenance), and, if necessary, bond anticipation notes of the City (the "Waterworks BANs") to provide interim construction financing in an aggregate amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000); and

WHEREAS, a proposed form of (i) an ordinance modifying the rates and charges for the users of the Waterworks (the "Waterworks Rate Ordinance") and (ii) an ordinance authorizing the issuance of the Waterworks Bonds to finance the costs of the Waterworks Project and the costs of issuance of the Waterworks Bonds and, if necessary, the Waterworks BANs (the "Waterworks Bond Ordinance" and, together with the Sewage Works Bond Ordinance, the "Bond Ordinances")

have been duly considered by the Board and found satisfactory, copies of which are attached hereto as Exhibit C and Exhibit D, respectively; and

WHEREAS, the Board desires to recommend the adoption of the proposed Sewage Works Rate Ordinance, Sewage Works Bond Ordinance, Waterworks Rate Ordinance and Waterworks Bond Ordinance to the Common Council of the City (the "Common Council");

NOW, THEREFORE, BE IT RESOLVED BY THE UTILITY SERVICE BOARD OF THE CITY OF BLOOMINGTON, INDIANA, AS FOLLOWS:

1. The Board requests the Common Council to authorize (i) the modification of the rates and charges for the users of the Sewage Works as set forth in the proposed form of the Sewage Works Rate Ordinance presented at this meeting, by the adoption of such Sewage Works Rate Ordinance, in substantially the form attached hereto as Exhibit A, and (ii) the issuance of the Sewage Works Bonds in an amount not to exceed Seven Million Three Hundred Thousand Dollars ($7,300,000) and, if necessary, the Sewage Works BANs in an aggregate amount not to exceed Seven Million Three Hundred Thousand Dollars ($7,300,000), on the terms and conditions set out in the proposed form of the Sewage Works Bond Ordinance presented at this meeting, by the adoption of such proposed Sewage Works Bond Ordinance, in substantially the form attached hereto as Exhibit B.

2. The Board requests the Common Council to authorize (i) the modification of the rates and charges for the users of the Waterworks as set forth in the proposed form of the Waterworks Rate Ordinance presented at this meeting, by the adoption of such Waterworks Rate Ordinance, in substantially the form attached hereto as Exhibit C, and (ii) the issuance of the Waterworks Revenue Bonds in an aggregate amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000) and, if necessary, the Waterworks BANs in an aggregate amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000), on the terms and

conditions set out in the proposed form of the Waterworks Bond Ordinance presented at this meeting, by the adoption of such proposed Waterworks Bond Ordinance, in substantially the form attached hereto as Exhibit D.

3. The Secretary of the Board is hereby directed to present a copy of this Resolution, the Estimate and Request of the Board and said proposed Sewage Works Rate Ordinance, Sewage Works Bond Ordinance, Waterworks Rate Ordinance and Waterworks Bond Ordinance to the Clerk of the City for presentation to the Common Council as soon as may be done.

4. This Resolution shall be in full force and effect after its adoption by the Board.

* * * * *

PASSED AND ADOPTED THIS 31TH DAY OF MAY, 2016.

CITY OF BLOOMINGTON, INDIANA

By and Through its Utility Service Board

Chairman

Member

Member

Member

Member

Member

Member

ATTEST:

Kim Alexander

Secretary

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT TM-2

ORDINANCE 16-08

TO AMEND TITLE 9
OF THE BLOOMINGTON MUNICIPAL CODE ENTITLED "WATER"
(Rate Adjustment)

WHEREAS, the City of Bloomington, Indiana ("City") owns and operates a waterworks system, through its Utilities Service Board, pursuant to IC 8-1.5-2 and IC 8-1.5-3, as amended ("Act"), which waterworks system is subject to the jurisdiction of the Indiana Utility Regulatory commission ("Commission"); and,

WHEREAS, the current rates and charges of the waterworks system of the City were established by Order of the Commission in Cause No. 43939 on the 2nd Day of March, 2011; and,

WHEREAS, the City, through its Utilities Service Board, recommends necessary construction of additions and improvements to the waterworks, including maintaining and improving water quality, replacement and rehabilitation of water mains, tanks, booster stations and hydrants; and,

WHEREAS, the City, through its Utilities Service Board, determined that it will be necessary to finance said additions and improvements through the issuance of bonds and, if necessary, bond anticipation notes; and,

WHEREAS, the City, through its Utilities Service Board, engaged Crowe Horwath, LLP to study the revenue requirements for the waterworks system pursuant to the provisions of the Act; and,

WHEREAS, Crowe Horwath, LLP studied the revenue requirements of the waterworks system pursuant to the provisions of the Act and determined that the waterworks system annual operating revenues from water service do not produce sufficient revenues to meet the requirements of the Act and that said revenues need to be increased to provide income sufficient to pay the debt service on the proposed financing of the additions and improvements to the waterworks and otherwise provide for the revenue requirements set forth in the Act, specifically IC 8-1.5-3-8; and,

WHEREAS, the City, through its Utilities Service Board, upon consideration of the study prepared by Crowe Horwath, LLP, recommends that the Common Council approve a 22% increase in the rates and charges of the waterworks; and,

WHEREAS, based upon the aforementioned study, and the recommendations of the Utility Service Board, the Common Council of the City finds that the rates and charges of the waterworks system of the City should be increased as set forth herein and take effect at such time as may be determined in an upcoming proceeding before the Indiana Utility Regulatory Commission, so as to produce sufficient revenues to meet the requirements of the Act; and,

WHEREAS, the Common Council of the City finds that the rates and charges set forth herein are nondiscriminatory, reasonable and just and are based upon the cost of providing service to the customers of the waterworks system of the City;

NOW, THEREFORE, BE IT ORDAINED BY THE COMMON COUNCIL OF THE CITY OF BLOOMINGTON, MONROE COUNTY, INDIANA, THAT:

SECTION 1. Section 9.08.010 of the City Code of Bloomington ("Code"), entitled "Monthly rates generally" is hereby amended and restated as follows:

9.08.010 Monthly rates generally.

The following rates and charges are established for the use of and service rendered by the water utility of the city. The schedule of rates and charges for the use of the water utility as set forth in this chapter reflects the rates and charges of the water utility as adopted by ordinance of the common Council of the City and may not necessarily reflect the actual rates and charges of the water utility, which are subject to the approval of the Indiana Utility Regulatory commission ("Commission"). The actual rates and charges of the water utility as approved by the Commission are set forth in the most recent tariff of the water utility on file with the Commission and the Clerk of the City and open for public inspection. Appropriate Indiana Sales Tax will also apply to billings for customers that are not tax-exempt. Each customer will pay a monthly charge according to the following schedule:

Monthly Usage Charge Applicable to Residential, Commercial, Governmental, Interdepartmental, Industrial, Indiana University – Master Metered, Indiana University – Non-Master Metered, and Irrigation Classes.

Category	Rate Per 1,000 gallons
Residential	3.79
Commercial, Governmental, Interdepartmental	3.21
Industrial	2.96
Indiana University – Master Metered	2.40
Indiana University – Non-Master Metered	3.21
Irrigation	3.48

Monthly Service Charge, in Addition to Monthly Usage for the Customer Categories Listed Above.

Meter Size	Charge	Meter Size	Charge
5/8"	5.99	3"	61.52
¾"	7.99	4"	101.17
1"	10.76	6"	200.31
1 ½"	18.69	8"	299.45
2"	26.62	10"	398.57

Monthly Surcharges for Fire Protection Service for the customer categories listed above (excluding Indiana University – Master Metered).

Meter Size	Charge Inside City	Outside City	Meter Size	Charge Inside City	Outside City
5/8"	1.99	3.33	3"	34.78	58.43
¾"	2.98	5.01	4"	59.62	100.13
1"	4.97	8.36	6"	124.24	208.61
1 ½"	9.94	16.68	8"	178.90	300.38
2"	15.90	26.72	10"	288.21	483.96

The monthly Fire Protection Charge for Indiana University – Master Metered accounts as a group shall be $1,823.45.

SECTION 2. Section 9.08.020 of the Code, entitled "Contract sales for resale" is hereby amended and restated as follows:

9.08.020 Contract sales for resale.

The rate for contract sales for resale shall be $2.43 per one thousand gallons.

Monthly Service Charge in Addition to Monthly Usage Charge.

Meter Size	Charge	Meter Size	Charge
5/8"	5.99	3"	61.52
¾"	7.99	4"	101.17
1"	10.76	6"	200.31
1 ½"	18.69	8"	299.45
2"	26.62	10"	398.57

SECTION 3. Section 9.08.040 of the Code, entitled "Private fire connections per connection" is hereby amended and restated as follows:

9.08.040 Private fire connections per connection.

Line Size	Monthly	Annually
4 inch line or smaller	10.02	120.19
6 inch line	27.84	334.08
8 inch line	57.06	684.71
10 inch line	99.93	1,199.16
12 inch line	157.55	1,890.61

SECTION 4. All ordinances and parts of ordinances in conflict herewith are hereby repealed; provided, however, that the existing rates and charges of the waterworks system of the City shall remain in full force and effect until the rates and charges fixed by this ordinance shall be approved by order of the Commission and the tariff reflecting said approved rates and charges shall have been filed with and approved by the Commission.

SECTION 5. In the event the rates and charges of the waterworks system approved by the Commission shall differ from the rates and charges set forth herein, the Common Council hereby approves said rates and charges as adjusted by the Commission without further action of the Common Council. The rates and charges of the waterworks system of the City as reflected in the tariff filed with and approved by the Commission shall be filed with the Clerk of the City and be open for public inspection.

SECTION 6. If any section, sentence, or provision of this ordinance or the application thereof to any person or circumstance shall be declared invalid, such invalidity shall not affect any of the other parts of this ordinance which can be given effect without the invalid part, and to this end the provisions of this ordinance are declared to be severable.

SECTION 7. This ordinance shall be in full force and effect from and after its passage by the Common Council of the City and approval of the Mayor.

PASSED and ADOPTED by the Common Council of the City of Bloomington, Monroe County, Indiana, upon this 12th day of July, 2016.

ANDY RUFF, President
Bloomington Common Council

ATTEST:

NICOLE BOLDEN, Clerk
City of Bloomington

PRESENTED by me to the Mayor of the City of Bloomington, Monroe County, Indiana, upon this 13th day of July, 2016.

NICOLE BOLDEN, Clerk
City of Bloomington

SIGNED and APPROVED by me upon this 13th day of July, 2016.

JOHN HAMILTON, Mayor
City of Bloomington

SYNOPSIS

This ordinance amends the rates and charges in Title 9 of the Bloomington Municipal Code, entitled "Water", to reflect increased costs of supplying water and services to customers, and to make debt service payments on bond financing for required capital improvements.

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT TM-3

ORDINANCE 16-09

AN ORDINANCE OF THE COMMON COUNCIL OF THE CITY OF BLOOMINGTON, INDIANA, AUTHORIZING THE ACQUISITION, CONSTRUCTION, INSTALLATION AND EQUIPPING BY THE CITY OF BLOOMINGTON, INDIANA, OF CERTAIN IMPROVEMENTS AND EXTENSIONS TO THE CITY'S WATERWORKS, THE ISSUANCE AND SALE OF REVENUE BONDS TO PROVIDE FUNDS FOR THE PAYMENT OF THE COSTS THEREOF, THE ISSUANCE AND SALE OF BOND ANTICIPATION NOTES IN ANTICIPATION OF THE ISSUANCE AND SALE OF SUCH BONDS, AND THE COLLECTION, SEGREGATION AND DISTRIBUTION OF THE REVENUES OF SUCH WATERWORKS AND OTHER RELATED MATTERS

WHEREAS, the City of Bloomington, Indiana (the "City") has heretofore established and constructed and currently owns and operates a waterworks for the provision of public water supply to the City and its inhabitants (the "Waterworks"), in accordance with the provisions of Indiana Code 8-1.5, as amended (the "Act"); and

WHEREAS, the Utility Service Board of the City (the "Board") has represented to the Common Council of the City (the "Common Council"), and the Common Council hereby finds, that certain improvements and extensions to the Waterworks are necessary; and American Structurepoint Inc of Indianapolis, Indiana, the consulting engineers employed by the City, and/or such other engineers as may be employed by the City (collectively, the "Consulting Engineers"), have prepared and filed or will prepare and file plans, specifications and detailed descriptions and estimates of the costs of the necessary improvements and extensions to the Waterworks, which plans, specifications, descriptions and estimates, to the extent required by law, have been or will be duly submitted to and approved by the Board and all governmental authorities having jurisdiction thereover (the improvements and extensions to the Waterworks as described in the Consulting Engineers' plans and specifications and below in Section 2 hereof are referred to herein as the "Project"); and

WHEREAS, the Common Council further finds that the estimates prepared with respect to the costs of acquisition, construction, installation and equipping of such improvements and extensions to the Waterworks, and including all authorized costs relating thereto, including the costs of issuance of bonds and, if necessary, bond anticipation notes (the "BANs") on account of the financing of all or a portion thereof, will be in the estimated amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000); and

WHEREAS, the Common Council finds that to provide funds necessary to pay for all or a portion of the costs of the Project, it will be necessary for the City to issue waterworks revenue bonds in an amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000), and, if necessary, BANs in an amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000); and

WHEREAS, the City desires to authorize the issuance of the BANs, if necessary, to provide interim financing of the Project in the maximum aggregate principal amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000) and the issuance of waterworks revenue bonds, in one or more series, payable from the Net Revenues (as hereinafter defined) of the Waterworks, in the maximum aggregate principal amount of Four Million Six Hundred Thousand Dollars ($4,600,000), issued to finance all or a portion of the aforementioned costs of the Project and to refund the BANs, if issued; and

WHEREAS, pursuant to a certain Ordinance adopted by the Common Council (the "2000 Ordinance"), the City has heretofore issued its waterworks revenue bonds payable from the Net Revenues of the Waterworks, designated "Waterworks Revenue Bonds of 2000, Series A," currently outstanding in the aggregate principal amount of Four Million Nine Hundred Seventy-Five Thousand Dollars ($4,975,000), bearing interest at the per annum rate of 2.90%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2021, inclusive, ending January 1, 2021 (the "2000 Bonds"); and

WHEREAS, pursuant to Ordinance No. 01-42, adopted by the Common Council on December 5, 2001 (the "2003 New Money Ordinance"), the City has heretofore issued its waterworks revenue bonds payable from the Net Revenues of the Waterworks, (i) designated "Waterworks Revenue Bonds of 2003, Series A," currently outstanding in the aggregate principal amount of One Million Eight Hundred Thirty-One Thousand Dollars ($1,831,000), bearing interest at the per annum rate of 3.30%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2023, inclusive, ending January 1, 2023, and (ii) designated "Waterworks Revenue Bonds of 2003, Series B," currently outstanding in the aggregate principal amount of Four Million Two Hundred Sixty-Four Thousand Dollars ($4,264,000), bearing interest at the per annum rate of 3.30%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2025, inclusive, ending January 1, 2025 (collectively, the "2003 New Money Bonds"); and

WHEREAS, pursuant to Ordinance No. 03-10, adopted by the Common Council on April 2, 2003 (the "2003 Refunding Ordinance"), the City has heretofore issued its waterworks revenue bonds payable from the Net Revenues of the Waterworks, designated "Waterworks Refunding Revenue Bonds of 2003," currently outstanding in the aggregate principal amount of Two Million Forty Thousand Dollars ($2,040,000), bearing interest at the per annum rate of 4.50%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2020, inclusive, ending January 1, 2020 (the "2003 Refunding Bonds"); and

WHEREAS, pursuant to Ordinance No. 05-12, adopted by the Common Council on April 20, 2005, as amended (as amended, the "2006 Ordinance"), the City has heretofore issued its waterworks revenue bonds payable from the Net Revenues of the Waterworks, designated "Waterworks Revenue Bonds of 2006, Series A" (as amended), currently outstanding in the aggregate principal amount of Three Million Two Hundred Seventeen Thousand Three Hundred Dollars ($3,217,300), bearing interest at per annum rates ranging from 4.55% to 4.83%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2027, inclusive, ending January 1, 2027 (the "2006 Bonds"); and

WHEREAS, pursuant to Ordinance No. 10-07, adopted by the Common Council on May 17, 2010 (the "2011 Ordinance"), the City has heretofore issued its waterworks revenue bonds payable from the Net Revenues of the Waterworks, (i) designated "Waterworks Revenue Bonds of 2011, Series A," currently outstanding in the aggregate principal amount of Four Million Nine Hundred Forty-Five Thousand Dollars ($4,945,000), bearing interest at the per annum rate of 3.746%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2029, inclusive, ending January 1, 2029, and (ii) designated "Waterworks Revenue Bonds of 2011, Series B," currently outstanding in the aggregate principal amount of Thirty-Three Million Three Hundred Twenty Thousand Dollars ($33,320,000), bearing interest at per annum rates ranging from 3.00% of 4.00%, and maturing semiannually on January 1 and July 1 in the years 2016 to 2029, inclusive, ending January 1, 2029 (collectively, the "2013 Bonds"); and

WHEREAS, the 2000 Ordinance, the 2003 New Money Ordinance, the 2003 Refunding Ordinance, the 2006 Ordinance and the 2011 Ordinance (collectively, the "Prior Ordinances") permit the issuance of additional bonds ranking on a parity with the outstanding 2000 Bonds, 2003 New Money Bonds, 2003 Refunding Bonds, 2006 Bonds and 2011 Bonds (collectively, the "Prior Bonds"), provided that certain

conditions are met, and the City finds that the finances of the Waterworks will enable the City to meet the conditions for the issuance of additional parity bonds and that, accordingly, the revenue bonds authorized herein shall constitute a first charge on the Net Revenues of the Waterworks, on parity with the Prior Bonds; and

WHEREAS, the Common Council now finds that all conditions precedent to the adoption of an ordinance authorizing the issuance of one or more series of waterworks revenue bonds, on a parity basis with the Prior Bonds, and BANs, if necessary, to provide the necessary funds to be applied to the costs of the Project and all authorized costs relating thereto, and the refunding of the BANs, if issued, have been complied with in accordance with the provisions of the Prior Ordinances, the Act and other applicable laws; and

WHEREAS, the Common Council consequently seeks to authorize the issuance of waterworks revenue bonds and BANs to finance the acquisition, construction, installation and equipping of the Project pursuant to the Act and other applicable laws, the sale of one or more series of such revenue bonds at public sale pursuant to the provisions of Indiana Code 5-1-11 or to the Indiana Finance Authority (the "Authority") pursuant to the provisions of Indiana Code 4-4-11 and 13-18-21, and the sale of such BANs pursuant to the provisions of the Act and other applicable laws, subject to and dependent upon the terms and conditions hereinafter set forth; and

WHEREAS, if the Bonds are sold to the Authority, the City would expect to enter into a Financial Assistance Agreement (as hereinafter defined) with the Authority, pertaining to the Project and the financing thereof; and

WHEREAS, the Board has considered the matter of the financing of the Project and has adopted a resolution approving the same; and

WHEREAS, prior to the issuance of the bonds authorized by this ordinance, the City shall first obtain the approval of the Indiana Utility Regulatory Commission (IURC) for the issuance of said bonds; and

WHEREAS, certain preliminary expenditures related to the payment of the costs of the Project have been or will be incurred by or on behalf of the City prior to the issuance and delivery of such waterworks revenue bonds and BANs; and

WHEREAS, the Common Council desires to express its intention to reimburse such expenditures as have been or may be incurred prior to the issuance of such waterworks revenue bonds and BANs, pursuant to Indiana Code 5-1-14-6 and in compliance with Section 1.150-2 of the U.S. Treasury Regulations promulgated by the Internal Revenue Service (the "Treasury Regulations"); now, therefore,

BE IT ORDAINED BY THE COMMON COUNCIL OF THE CITY OF BLOOMINGTON, INDIANA, THAT:

SECTION 1. Acquisition, Construction, Installation and Equipping of the Project. The City is hereby authorized to acquire any and all necessary property and proceed with the acquisition, construction, installation and equipping of improvements and extensions to the Waterworks, pursuant to the Act and in accordance with the plans, specifications and cost estimates heretofore prepared and filed with the Board and the Common Council by the Consulting Engineers and/or City engineering, which plans, specifications and cost estimates are hereby adopted and approved and, by reference, incorporated fully into this Ordinance, and two copies of which are now on file in the office of the Clerk of the City (the "Clerk") and are open for public inspection. The actions of the City in connection with the acquisition of any and all necessary property and the acquisition, construction, installation, equipping and financing of such improvements and extensions to the Waterworks are hereby authorized, approved, ratified and confirmed.

Where used in this Ordinance, the term "City" shall be construed also to include any department, board, commission or officer or officers of the City or of any City department, board or commission. The terms "Waterworks," "waterworks," "works" and similar terms used in this

Ordinance shall be construed to mean and include the existing structures and property of the Waterworks for the provision of public water supply, and all enlargements, improvements, extensions and additions thereto, and replacements thereof, now or subsequently constructed or acquired, whether from the proceeds of the bonds and BANs authorized herein or otherwise. Such improvements and extensions shall be constructed and the bonds and BANs herein authorized shall be issued pursuant to the provisions of this Ordinance, the Act and other applicable laws.

SECTION 2. Description of the Project. The Project is more fully described in, and shall be in accordance with the plans and specifications and cost estimates heretofore prepared and filed with the Board and the Common Council by the Consulting Engineers and/or City engineering referenced in Section 1 hereof. In summary, the Project consists of the acquisition, construction, installation and equipping of additions and improvements to the Waterworks, including maintaining and improving water quality, and replacement and rehabilitation of water mains, tanks, booster stations and hydrants.

The City shall proceed with the acquisition, construction, installation and equipping of the Project and shall enter into all contracts necessary or appropriate for such purpose, in conformity with and subject to the requirements and conditions set forth in this Ordinance and in the Act.

SECTION 3. The Bonds. In accordance with the Act and for the purpose of providing funds with which to pay the costs of the Project, together with all authorized costs relating thereto including the costs of issuance of the Bonds, as hereinafter defined, and refunding the BANs, if any, described below, the City shall issue its waterworks revenue bonds, in one or more series, in an aggregate principal amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000) (the "Bonds"). The total principal amount of Bonds issued pursuant to this Ordinance shall not exceed Four Million Six Hundred Thousand Dollars ($4,600,000). The principal of and redemption premium, if any, and interest on the Bonds shall be payable solely out of the Waterworks Sinking Fund referred to below, on a parity with the Prior Bonds.

Any other provisions of this Ordinance to the contrary notwithstanding, the Bonds shall be issued on a parity with the Prior Bonds, and none of the provisions of this Ordinance shall be construed to affect the rights of the holders of the Prior Bonds. The Controller of the City (the "Controller") is authorized to employ Crowe Horwath LLP, Indianapolis, Indiana, the financial advisor to the City (the "Financial Advisor"), or any other certified public accountant or firm of certified public accountants to perform any and all computations necessary to confirm the preliminary evidence and findings demonstrating compliance with the conditions set forth in the Prior Ordinances for the issuance of additional revenue bonds on parity with the Prior Bonds. The City shall not issue the Bonds without first receiving a certificate from the Financial Advisor or other certified public accountant or firm of certified public accountants in form and substance satisfactory to the Controller and Faegre Baker Daniels LLP, Indianapolis, Indiana, bond counsel for the City, and to the effect that the City and the Waterworks are in complete compliance with the conditions set forth in the Prior Ordinances for the issuance of additional revenue bonds on parity with the Prior Bonds.

The Bonds shall be designated as the "City of Bloomington, Indiana, Waterworks Revenue Bonds of 201__" (with the blank to be filled in with the last digit of the calendar year in which such series of the Bonds is issued, with an appropriate series designation in the event more than one series of Bonds is expected to be issued in such calendar year). Each series of the Bonds shall be issued as fully registered bonds in denomination or denominations of Five Thousand Dollars ($5,000) and any integral multiples thereof not exceeding the aggregate principal amount of such Bonds maturing in any one year, or in the event that any series of the Bonds is sold to the Authority pursuant to Section 9 hereof, the Bonds of such series shall be in multiples of One Dollar ($1) or such other denomination as is acceptable to the Authority. The Bonds shall be numbered consecutively from ___R-1 upward (with the blank to be filled in with the last two digits of the calendar year in which such series of the Bonds is issued, with an appropriate series designation in the event more than one series of Bonds is expected to be issued in such calendar year) and shall bear interest at a rate or rates not exceeding five percent (5.0%) per annum, the exact rate or rates to be determined by negotiation with the Authority (with such rate to be set forth in the Financial Assistance Agreement with respect to any series of the Bonds that is sold to the Authority) or by bidding. Said interest rate or rates on the Bonds shall be in multiples of one-eighth (1/8) or one-hundredth (1/100) of one percent (1%). Interest on each series of the Bonds

shall be calculated on the basis of twelve (12) thirty (30)-day months for a three hundred sixty (360)-day year and shall be payable semiannually on January 1 and July 1 of each year (each, an "Interest Payment Date"), commencing not earlier than July 1, 2017, with the first interest payment date to be determined by (i) the Controller with the advice of the Financial Advisor and set forth in the Controller's Certificate (as hereinafter defined) if such series of Bonds is sold by public bidding or (ii) negotiation with the Authority (as provided in the Financial Assistance Agreement between the City and the Authority (the "Financial Assistance Agreement")), until principal is fully paid. The principal of each series of the Bonds shall mature serially and semi-annually on January 1 and July 1 of each year, commencing not earlier than July 1, 2017 (or commencing on such other date as provided in the Financial Assistance Agreement, if such series of the Bonds is sold to the Authority) and ending not later than July 1, 2037, on the dates and in the principal amounts as set forth in the Controller's Certificate. The Bonds will mature in such amounts that will produce, on an aggregate basis, as level annual debt service as practicable, except as otherwise provided in the Financial Assistance Agreement if the Bonds are sold to the Authority.

The Bonds shall bear an original issue date which shall be the date of delivery of the Bonds or the first day of the month in which the Bonds are delivered, as determined by the Controller with the advice of the Financial Advisor and set forth in the Controller's Certificate (unless otherwise provided in the Financial Assistance Agreement in the event the Bonds are sold to the Authority), and each Bond shall also bear the date of its authentication. Any Bond authenticated on or before the fifteenth day of the calendar month immediately preceding the first Interest Payment Date shall pay interest from its original issue date (unless otherwise provided in the Financial Assistance Agreement in the event the Bonds are sold to the Authority). Any Bond authenticated thereafter shall pay interest from the Interest Payment Date next preceding the date of authentication of such Bond to which interest thereon has been paid or duly provided for, unless such Bond is authenticated after the fifteenth day of the calendar month immediately preceding an Interest Payment Date and on or before such Interest Payment Date, in which case interest thereon shall be paid from such Interest Payment Date.

In the event that the Bonds or the BANs of any series are sold to the Authority or any other purchaser who so agrees pursuant to Section 9 of this Ordinance, it is understood that principal shall not be payable and interest shall not accrue on such series of the Bonds or the BANs until such principal amount has been advanced pursuant to requests made by the City to the Authority or to any such other purchaser, with advances to be allocable to the Bonds in order of maturity. If the Bonds of any series are sold to the Authority, to the extent that (a) the total principal amount of such series of the Bonds is not paid by the purchaser or drawn down by the City or (b) proceeds remain in the Construction Account established under Section 10 of this Ordinance and are not applied to the Project (or any modifications or additions thereto approved by the Authority), the City shall reduce the principal amount of such Bonds' maturities to effect such reduction in a manner that will still achieve as level an annual debt service as practicable as described in this Section 3 subject to and upon the terms forth in the Financial Assistance Agreement.

The Controller is hereby authorized to appoint a registrar and a paying agent for any series of the Bonds or BANs (the "Registrar" and the "Paying Agent," and in both such capacities, the "Registrar and Paying Agent"). The Registrar and Paying Agent shall be charged with and shall by appropriate agreement undertake the performance of all of the duties and responsibilities customarily associated with each such position, including, without limitation, the authentication of the Bonds and BANs. The Controller is authorized and directed to enter into such agreements and understandings with the Registrar and Paying Agent and any subsequent Registrar and Paying Agent as will enable and facilitate the performance of its duties and responsibilities, and is authorized and directed to pay such fees as the Registrar and Paying Agent may reasonably charge for its services in such capacity, and such fees may be paid from the Waterworks Sinking Fund created under the Prior Ordinances and continued herein.

If the Bonds or the BANs are registered in the name of any purchaser that does not object to such designation, the Controller shall be designated as the Registrar and Paying Agent and shall be charged with the performance of all of the duties and responsibilities of Registrar and Paying Agent.

The Registrar and Paying Agent, if not the Controller, may at any time resign as Registrar and Paying Agent upon giving thirty (30) days' notice in writing to the City and by first-class mail to each registered owner of the Bonds or BANs then outstanding, and such resignation will take effect at the end of such thirty (30) days or upon the earlier appointment of a successor Registrar and Paying Agent by the City. Any such notice to the City may be served personally or sent by certified mail. The Registrar and Paying Agent may also be removed at any time as Registrar and Paying Agent by the City, in which event the City may appoint a successor Registrar and Paying Agent. The City shall notify each registered owner of the Bonds or BANs then outstanding by first-class mail of the removal of the Registrar and Paying Agent. Notices to registered owners of the Bonds or BANs shall be deemed to be given when mailed by first-class mail to the addresses of such registered owners as they appear on the registration books kept by the Registrar. Any predecessor Registrar and Paying Agent shall deliver all of the Bonds or BANs and cash in its possession with respect thereto, together with the registration books, to the successor Registrar and Paying Agent. The Controller is hereby authorized to act on behalf of the City with regard to any of the aforementioned actions of the City relating to the resignation or removal of the Registrar and Paying Agent and appointment of a successor Registrar and Paying Agent.

Principal of and any redemption premium on the Bonds, and principal and interest on the BANs, shall be payable at the principal corporate trust office of the Paying Agent. Interest on the Bonds shall be paid by check or draft mailed or delivered by the Paying Agent to the registered owner thereof at the address as it appears on the registration books kept by the Registrar as of the fifteenth day of the calendar month immediately preceding the Interest Payment Date or at such other address as may be provided to the Paying Agent in writing by such registered owner. Notwithstanding anything in this Ordinance to the contrary, so long as The Depository Trust Company, New York, New York ("DTC"), or its nominee, or any successor thereto, is the registered owner of any series of the Bonds or BANs, the principal of and premium, if any, and interest on such series of the Bonds or BANs will be paid directly to DTC or successor depository by wire transfer on the payment date in same-day funds by the Paying Agent. Notwithstanding the foregoing, principal of and interest on the Bonds or BANs, if registered in the name of the Authority, shall be paid by wire transfer to a financial institution if and as directed by the Authority, on the due date of such payment or, if such date is a day when financial institutions are not open for business, on the business day immediately preceding such due date. So long as the Authority is the registered owner of the Bonds or BANs, the Bonds or BANs shall be presented for payment as directed by the Authority. All payments on the Bonds and the BANs shall be made in any coin or currency of the United States of America which, on the dates of such payments, shall be legal tender for the payment of public or private debt.

Each Bond or BAN shall be transferable or exchangeable only on the books of the City maintained for such purpose at the principal corporate trust office of the Registrar, by the registered owner thereof in person, or by his or her attorney duly authorized in writing, upon surrender of such Bond or BAN together with a written instrument of transfer or exchange satisfactory to the Registrar duly executed by the registered owner or his or her attorney duly authorized in writing, and thereupon a new fully registered Bond or Bonds or BAN or BANs in the same aggregate principal amount and of the same maturity and series shall be executed and delivered in the name of the transferee or transferees or the registered owner, as the case may be, in exchange therefor. Each Bond or BAN may be transferred or exchanged without cost to the registered owner, except for any tax or other governmental charge which may be required to be paid with respect to such transfer or exchange. The Registrar shall not be obligated to make any transfer or exchange of any Bond or BAN (i) during the fifteen (15) days immediately preceding an Interest Payment Date or (ii) after the mailing of notice calling such Bond or BAN for redemption. The City, the Registrar and the Paying Agent may treat and consider the person in whose name any Bond or BAN is registered as the absolute owner thereof for all purposes including the purpose of receiving payment of, or on account of, the principal thereof, and redemption premium, if any, and interest thereon.

In the event any Bond or BAN is mutilated, lost, stolen or destroyed, the City may cause to be executed and the Registrar may authenticate a new Bond or BAN of like date, maturity, series and denomination as the mutilated, lost, stolen or destroyed Bond or BAN, which new Bond or BAN shall be marked in a manner to distinguish it from the Bond or BAN for which it was issued; provided, that in the case of any mutilated Bond or BAN, such mutilated Bond or BAN shall first be surrendered to the Registrar, and in the case of any lost, stolen or destroyed Bond or

BAN there shall be first furnished to the Registrar evidence of such loss, theft or destruction satisfactory to the City and the Registrar, together with indemnity satisfactory to them. In the event that any such mutilated, lost, stolen or destroyed Bond or BAN shall have matured or been called for redemption, instead of causing to be issued a duplicate Bond or BAN, the Registrar and Paying Agent may pay the same upon surrender of the mutilated Bond or BAN or upon satisfactory indemnity and proof of loss, theft or destruction in the case of a lost, stolen or destroyed Bond or BAN. The City and the Registrar and Paying Agent may charge the owner of any such Bond or BAN with their reasonable fees and expenses in connection with the above. Every substitute Bond or BAN issued by reason of any Bond or BAN being lost, stolen or destroyed shall, with respect to such Bond or BAN, constitute a substitute contractual obligation of the City pursuant to this Ordinance, whether or not the lost, stolen or destroyed Bond or BAN shall be found at any time, and shall be entitled to all the benefits of this Ordinance, equally and proportionately with any and all other Bonds or BANs duly issued hereunder.

In the event that any Bond or BAN is not presented for payment or redemption on the date established therefor, the City may deposit in trust with the Paying Agent an amount sufficient to pay such Bond or BAN or the redemption price thereof, as appropriate, and thereafter the owner of such Bond or BAN shall look only to the funds so deposited in trust with the Paying Agent for payment and the City shall have no further obligation or liability with respect thereto.

Any series of Bonds or BANs may, in compliance with all applicable laws, be issued and held in book-entry form on the books of the central depository system, DTC, its successors, or any successor central depository system appointed by the City from time to time (the "Clearing Agency"). The City and the Registrar may, in connection therewith, do or perform or cause to be done or performed any acts or things not adverse to the rights of the holders of the Bonds or BANs, as are necessary or appropriate to accomplish or recognize such book-entry form Bonds or BANs.

During any time that a series of Bonds or BANs is held in book-entry form on the books of a Clearing Agency (a) any such Bonds or BANs may be registered upon the books kept by the Registrar in the name of such Clearing Agency, or any nominee thereof, including Cede & Co., as nominee of DTC; (b) the Clearing Agency in whose name such Bonds or BANs are so registered shall be, and the City and the Registrar and Paying Agent may deem and treat such Clearing Agency as, the absolute owner and holder of such Bonds or BANs for all purposes of this Ordinance, including, without limitation, the receiving of payment of the principal of and premium, if any, and interest on such Bonds or BANs, the receiving of notice, and the giving of consent; (c) neither the City nor the Registrar and Paying Agent shall have any responsibility or obligation hereunder to any direct or indirect participant, within the meaning of Section 17A of the Securities Exchange Act of 1934, as amended, of such Clearing Agency, or any person on behalf of which, or otherwise in respect of which, any such participant holds any interest in any Bonds or BANs, including, without limitation, any responsibility or obligation hereunder to maintain accurate records of any interest in any Bonds or BANs or any responsibility or obligation hereunder with respect to the receiving of payment of principal of or premium, if any, or interest on any Bonds or BANs, the receiving of notice, or the giving of consent; (d) the Clearing Agency is not required to present any Bonds or BANs called for partial redemption prior to receiving payment so long as the Registrar and Paying Agent and the Clearing Agency have agreed to the method for noting such partial redemption; and (e) payment of the principal of and premium, if any, and interest on any Bonds or BANs may be made by wire transfer or other method acceptable to the Clearing Agency, as indicated in a Certificate of the Controller to such effect.

If either (i) the City receives notice from the Clearing Agency which is currently the registered owner of any Bonds or BANs to the effect that such Clearing Agency is unable or unwilling to discharge its responsibility as a Clearing Agency for such Bonds or BANs or (ii) the City elects to discontinue its use of such Clearing Agency as a Clearing Agency for such Bonds or BANs, then the City and the Registrar and Paying Agent each shall do or perform or cause to be done or performed all acts or things, not adverse to the rights of the holders of such Bonds or BANs, as are necessary or appropriate to discontinue use of such Clearing Agency as a Clearing Agency for such Bonds or BANs and to transfer the ownership of each of such Bonds or BANs to such person or persons, including any other Clearing Agency, as the holder of such Bonds or BANs may direct in accordance with this Ordinance. Any expenses of such discontinuance and

transfer, including expenses of printing new certificates to evidence such Bonds or BANs, shall be paid by the City.

During any time that any series of the Bonds or BANs is held in book-entry form on the books of a Clearing Agency, the Registrar and Paying Agent shall be entitled to request and rely upon a certificate or other written representation from the Clearing Agency or any participant or indirect participant with respect to the identity of any beneficial owners of such Bonds or BANs as of a record date selected by the Registrar and Paying Agent. For purposes of determining whether the consent, advice, direction or demand of a registered owner of such Bonds or BANs has been obtained, the Registrar and Paying Agent shall be entitled to treat the beneficial owners of such Bonds or BANs as the holders of such Bonds or BANs.

During any time that any series of the Bonds or BANs is held in book-entry form on the books of a Clearing Agency, the City is authorized to enter into a Blanket Letter of Representations agreement with the Clearing Agency, and the provisions of any such Blanket Letter of Representations or any successor agreement shall control on the matters set forth herein.

SECTION 4. The BANs. In anticipation of the issuance and sale of the Bonds authorized herein, and to provide interim financing to apply to the costs of the Project, the City is hereby authorized to have prepared and to issue and sell negotiable BANs of the City to an eligible purchaser of the BANs under Indiana Code 5-1-14-5 or to the Authority, pursuant to a Bond Anticipation Note Purchase Agreement (the "BAN Purchase Agreement") entered into between the City and the purchaser of the BANs, in one or more series, in an aggregate principal amount not to exceed Four Million Six Hundred Thousand Dollars ($4,600,000), to be designated "City of Bloomington, Indiana, Waterworks Revenue Bond Anticipation Notes of 201__" (with the blank to be filled in with the last digit of the calendar year in which such series of the BANs is issued, with an appropriate series designation in the event more than one series of BANs is expected to be issued in such calendar year). The BANs shall be issued pursuant to Indiana Code 5-1-14-5 if sold to an eligible purchaser thereunder, or pursuant to Indiana Code 4-4-11 and 13-18-21 if sold to the Authority. If the BANs are sold to the Authority, the Financial Assistance Agreement shall serve as the BAN Purchase Agreement. The BANs shall be issued in fully registered form, shall be numbered consecutively from ___R-1 (with the blank to be filled in with the last two digits of the calendar year in which such series of the BANs is issued, with an appropriate series designation in the event more than one series of BANs is expected to be issued in such calendar year) upwards, shall be in such denominations as the purchaser of the BANs shall request, shall be dated as of the date of delivery of the BANs, and shall bear interest at a rate or rates not exceeding five percent (5.0%) per annum (the exact rate or rates of interest to be determined by negotiations with the purchaser of the BANs and payable as provided in the BAN Purchase Agreement). The initial BANs delivered will mature on the date provided in the BAN Purchase Agreement. The BANs may be subject to renewal or extension, subject to the limitations set forth below, at an interest rate or rates not to exceed five percent (5.0%) per annum, with the exact rate to be negotiated with the purchaser of such BANs. The term of the BANs and all renewal BANs may not exceed five (5) years from the date of delivery of the initial BANs.

The principal of the BANs shall be refunded and retired out of the proceeds from the issuance and sale hereunder of the Bonds. The principal of the BANs, and the principal of and interest on the BANs prepaid in accordance with Section 5 hereof, shall be refunded by the issuance of the Bonds pursuant to, and in the manner prescribed by, the Act. The interest on the BANs shall be payable either from the Net Revenues of the Waterworks, subject to the prior lien thereon of the Prior Bonds, or from proceeds from the issuance and sale hereunder of the Bonds, as set forth in the BAN Purchase Agreement.

SECTION 5. Optional Prepayment of BANs; Optional Redemption of the Bonds; Term Bonds.

(a) Optional Prepayment of BANs. The BANs are prepayable by the City, in whole or in part, at any time upon seven (7) days' written notice to the owner of the BANs, without any premium. In the case of prepayment, the principal and accrued interest due on the BANs shall be paid only from proceeds of the Bonds, except that such principal and interest due on the BANs may also be paid from other revenues and funds legally available therefor, if any, including federal or state funds available for application to the Project; provided, however, that such funds are not pledged to the payment of the BANs.

(b) Optional Redemption of the Bonds. Each series of the Bonds shall be subject to redemption at the option of the City, in whole or in part (and if in part, in authorized denominations and in order of maturity determined by the City and by lot within any such maturity or maturities in such manner as may be designated by the Registrar), at times to be determined by the Controller with the advice of the Financial Advisor and set forth in the Controller's Certificate, at a redemption price equal to one hundred percent (100%) of the principal amount of each Bond to be redeemed, plus accrued and unpaid interest on the Bonds so redeemed to the redemption date, and according to premiums to be determined by the Controller with the advice of the Financial Advisor and set forth in the Controller's Certificate, not in excess of two percent (2%) of the par amount of the Bonds to be redeemed; provided, however, if any Bonds are sold to the SRF Program (as hereinafter defined) and registered in the name of the Authority, such Bonds shall not be redeemable at the option of the City unless and until consented by the Authority.

Official notice of such redemption of the Bonds shall be mailed by the Registrar and Paying Agent by certified or registered mail at least thirty (30) days (or, at least sixty (60) days, with respect to any series of the Bonds sold to the Authority) prior to the scheduled redemption date to each of the registered owners of the Bonds called for redemption (unless waived by any such registered owner) at the address shown on the registration books of the Registrar and Paying Agent, or at such other address as is furnished in writing by such registered owner to the Registrar; provided, however, that failure to give such notice by mailing, or any defect therein, with respect to any Bond shall not affect the validity of the proceedings for the redemption of any other Bonds. The notice shall specify the redemption price, the date and place of redemption, and the registration numbers (and, in case of partial redemption, the respective principal amounts) of the Bonds called for redemption. The place of redemption may be at the principal corporate trust office of the Registrar and Paying Agent or as otherwise determined by the City. Interest on the Bonds (or portions thereof) so called for redemption shall cease to accrue on the redemption date fixed in such notice, if sufficient funds are available at the place of redemption to pay the redemption price on the redemption date and when such Bonds (or portions thereof) are presented for payment. Any Bond redeemed in part may be exchanged for a Bond or Bonds of the same maturity in authorized denominations equal to the remaining principal amount thereof.

In addition to the foregoing notice, the City may also direct that further notice of redemption of Bonds be given, including, without limitation, and at the option of the City, notice described in paragraph (i) below given by the Registrar and Paying Agent to the parties described in paragraphs (ii) and (iii) below. No defect in any such further notice and no failure to give all or any portion of any such further notice shall in any manner defeat the effectiveness of any call for redemption of Bonds so long as notice thereof is mailed as prescribed above.

(i) If so directed by the City, each further notice of redemption given hereunder shall contain the information required above for an official notice of redemption plus (1) the CUSIP numbers of all Bonds being redeemed; (2) the date of issue of the Bonds as originally issued; (3) the rate of interest borne by each Bond being redeemed; (4) the maturity date of each Bond being redeemed; and (5) any other descriptive information needed to identify accurately the Bonds being redeemed.

(ii) If so directed by the City, each further notice of redemption shall be sent at least thirty-five (35) days before the redemption date by registered or certified mail or overnight delivery service to all registered securities depositories then in the business of holding substantial amounts of obligations of types comprising the Bonds and to one or more national information services that disseminate notices of redemption of obligations such as the Bonds.

(iii) If so directed by the City, each such further notice shall be published one time in The Bond Buyer of New York, New York or, if the Registrar believes such publication is impractical or unlikely to reach a substantial number of the holders of the Bonds, in some other financial newspaper or journal which regularly carries notices of redemption of other obligations similar to the Bonds, such publication to be made at least thirty (30) days prior to the date fixed for redemption.

Upon the payment of the redemption price of the Bonds (or portions thereof) being redeemed and if so directed by the City, each check or other transfer of funds issued for such purpose shall bear the CUSIP number identifying, by issue and maturity, the Bonds (or portions thereof) being redeemed with the proceeds of such check or other transfer.

(c) Term Bonds. All or a portion of the Bonds may be aggregated into one or more term bonds payable from mandatory sinking fund redemption payments (the "Term Bonds") required to be made as set forth below. The Term Bonds shall have a stated maturity or maturities of January 1 and July 1 in the years consistent with the maturity schedule for the Bonds, and such Term Bonds shall be subject to mandatory sinking fund redemption prior to maturity at a redemption price equal to one hundred percent (100%) of the principal amount thereof, plus accrued interest to the redemption date, but without premium, on January 1 and July 1 of the years and in the principal amounts consistent with the maturity schedule for the Bonds.

The Registrar and Paying Agent shall credit against any mandatory sinking fund redemption requirement for a Term Bond of a particular maturity, any Bonds of such maturity delivered to the Registrar and Paying Agent for cancellation or purchased for cancellation by the City and canceled by the Registrar and Paying Agent and not theretofore applied as a credit against any mandatory sinking fund redemption requirement. Each Bond so delivered or purchased shall be credited by the Registrar and Paying Agent at one hundred percent (100%) of the principal amount thereof against the mandatory sinking fund redemption requirements for the applicable Term Bond in inverse order of mandatory sinking fund redemption (or final maturity) dates, and the principal amount of such Term Bond to be redeemed on such mandatory sinking fund redemption dates by operation of the mandatory sinking fund requirements shall be reduced accordingly; provided, however, the Registrar and Paying Agent shall only credit Bonds against the mandatory sinking fund requirements to the extent such Bonds are received on or before forty-five (45) days preceding the applicable mandatory sinking fund redemption date.

The Registrar shall determine by lot (treating each $5,000 principal amount (or other authorized denomination) of each Bond as a separate Bond for such purpose) the Bonds within a Term Bond of a particular maturity to be redeemed pursuant to mandatory sinking fund redemption requirements on January 1 and July 1 of each year. With respect to optional redemption of Term Bonds, an amount equal to the principal amount of the Term Bonds redeemed will be credited toward the latest scheduled mandatory sinking fund payment or payments with respect to such Term Bonds unless otherwise directed by the City.

Notice of any such mandatory sinking fund redemption shall be given in the same manner as notice of optional redemption is required to be given pursuant to this Section 5. In the event any of the Bonds are issued as Term Bonds, the form of Bond described in Section 8 hereof shall be modified accordingly. Any reference to payment of principal on Bonds shall include payment of scheduled mandatory sinking fund redemption payments.

SECTION 6. Execution and Authentication of the Bonds and BANs. The Bonds and the BANs shall be executed in the name of the City by the manual or facsimile signature of the Mayor of the City (the "Mayor") and attested by the manual or facsimile signature of the Clerk, who shall cause the seal of the City or a facsimile thereof to be affixed to each of the Bonds and the BANs. The Bonds and the BANs shall be authenticated by the manual signature of the Registrar, and no Bond or BAN shall be valid or become obligatory for any purpose until the certificate of authentication thereon has been so executed. In case any official whose signature appears on any Bond or BAN shall cease to be such official before the delivery of such Bond or BAN, the signature of such official shall nevertheless be valid and sufficient for all purposes, the same as if such official had been in office at the time of such delivery. Subject to the provisions of this Ordinance regarding the registration of the Bonds and BANs, the Bonds and BANs shall be fully negotiable instruments under the laws of the State of Indiana.

SECTION 7. Security and Sources of Payment for the Bonds. The Bonds, when fully paid for and delivered to the purchaser or purchasers thereof, together with any bonds hereafter issued on a parity therewith (to be referred to hereinafter collectively as the "bonds," unless the context otherwise requires), as to both principal and interest, shall be valid and binding special and limited revenue obligations of the City, payable solely from and secured by an irrevocable pledge of and constituting a first charge, on a parity basis with the Prior Bonds, upon all of the

"Net Revenues" (herein defined as gross revenues of the Waterworks after deduction only for the payment of the reasonable expenses of operation and maintenance) derived from the Waterworks, including all such Net Revenues from the existing works, the Project and all additions and improvements thereto and replacements thereof subsequently constructed or acquired, to be set aside into the Waterworks Sinking Fund as herein provided. The City shall not be obligated to pay the Bonds or the interest thereon except from the Net Revenues of the Waterworks, and the Bonds shall not constitute an indebtedness of the City within the meaning of the provisions and limitations of the constitution of the State of Indiana.

SECTION 8. Form of the Bonds. The form and tenor of the Bonds shall be substantially as set forth in Appendix A, attached hereto and incorporated herein as if set forth at this place (with all blanks to be filled in properly and all necessary additions, modifications and deletions to be made prior to the delivery thereof).

SECTION 9. Issuance, Sale and Delivery of the Bonds and the BANs.

(a) Generally. The Controller is hereby authorized and directed to have the Bonds and the BANs prepared, and the Mayor and the Clerk are each hereby authorized and directed to execute and attest, respectively, the Bonds and the BANs in the form and manner herein provided. The Controller is hereby authorized and directed to deliver the Bonds and the BANs to the purchaser or purchasers thereof after sale made in accordance with the provisions of the Act and this Ordinance, provided that at the time of said delivery the Controller shall collect the full amount which the purchaser or purchasers have agreed to pay therefor, which shall be not less than ninety-nine percent (99.0%) of the par amount of the Bonds (or such higher percentage of the par value of the Bonds as determined by the Controller with the advice of the Financial Advisor of the City and set forth in the Controller's Certificate), plus accrued interest thereon to the date of delivery, if any, and in the case of the BANs, shall not be less than ninety-nine percent (99.0%) of the par amount of the BANs. The City may receive payment for the Bonds and the BANs in installments. The proceeds derived from the sale of the Bonds (or, instead, the BANs, if such BANs are issued), shall be and are hereby set aside for application to the costs of the Project, including all authorized costs relating thereto and the respective costs of issuance of the Bonds and the BANs. The authorized officers of the City are hereby authorized and directed to draw all proper and necessary warrants and to do whatever other acts and things that may be necessary or appropriate to carry out the provisions of this Ordinance.

(b) Issuance, Sale and Delivery of the BANs. The City, having satisfied all the statutory requirements for the issuance of the Bonds, may elect to issue its BAN or BANs to an eligible purchaser under Indiana Code 5-1-14-5 or to the Authority pursuant to the BAN Purchase Agreement, to be entered into between the City and the purchaser of the BANs. The Common Council hereby authorizes the issuance and execution of the BAN or BANs in lieu of initially issuing Bonds to provide interim construction financing for the Project until permanent financing becomes available. It shall not be necessary for the City to repeat the procedures for the issuance of its Bonds, as the procedures followed before the issuance of the BAN or BANs are for all purposes sufficient to authorize the issuance of the Bonds and the use of the proceeds to repay the BAN or BANs. The Mayor, the Controller and/or the Clerk are each hereby authorized and directed to execute and/or attest the BAN Purchase Agreement in such form or substance as they shall approve acting upon the advice of counsel. The Mayor, the Controller and the Clerk may also take such other action or deliver such other certificates as are necessary or desirable in connection with the issuance of the BANs or the Bonds and the other documents needed for the financing as they deem necessary or desirable in connection therewith.

(c) Issuance, Sale and Delivery of the Bonds.

(i) Public Sale. Any series of the Bonds may, in the discretion of the Controller based upon the advice of the Financial Advisor, be sold by public sale. In the event any series of the Bonds is sold by public sale, prior to the sale of such series of the Bonds, the Controller shall cause to be published a notice of intent to sell bonds two (2) times at least one (1) week apart in the Bloomington Herald Times, a newspaper of general circulation published in the City, and the Court & Commercial Record, a newspaper of general circulation published in Indianapolis, Indiana. The notice of such sale or a summary thereof may also be published in The Bond Buyer, a financial journal published in the City and State of New York and/or in other publications, in the discretion of the

Controller. The notice must state that any person interested in submitting a bid for such series of the Bonds may furnish in writing, at the address set forth in the notice, the person's name, address and telephone number, and that any such person may also furnish a telex number. The notice must also state: (A) the amount of the Bonds to be offered; (B) the denominations; (C) the dates of maturity; (D) the maximum rate or rates of interest; (E) the place of sale; and (F) the time within which the name, address and telephone number must be furnished, which time must not be less than seven (7) days after the last publication of the notice. Each person so registered shall be notified of the date and time bids will be received not less than twenty-four (24) hours before the date and time of sale. The notification shall be made by telephone at the number furnished by the person, and also by telex if the person furnishes a telex number. Such notice may also include such other information as the Controller shall deem necessary.

Such notice shall provide, among other things, that each bid shall be accompanied by a certified or cashier's check or a financial surety bond from an insurance company in the amount of one percent (1%) of the principal amount of such series of the Bonds to guarantee performance on the part of the bidder; that if the Bonds are awarded to a bidder who has submitted a financial surety bond to the City, then such bidder must submit the required amount of the good faith deposit to the City in the form of a certified or cashier's check (or a wire transfer consisting of immediately available funds to the City as instructed by the City) not later than 3:00 p.m. (local time) on the next business day following the award by the City; that if such check or wire transfer is not received by that time, the financial surety bond may be drawn upon by the City to satisfy the deposit requirements; and that in the event the successful bidder shall fail or refuse to accept delivery of and pay for the Bonds as soon as the Bonds are ready for delivery, or at the time fixed in the notice of intent to sell bonds, then such check or financial surety bond and the proceeds thereof shall become the property of the City and shall be considered as the City's liquidated damages on account of such default.

All bids for Bonds sold at public sale shall be sealed and shall be presented to the Controller at the Controller's office, and the Controller shall continue to receive all bids offered until the time fixed for the sale of the Bonds, at which time and place the Controller shall open and consider each bid. Bidders for the Bonds shall be required to name the rate or rates of interest which the Bonds are to bear, not exceeding five percent (5.0%) per annum. Such interest rate or rates shall be in multiples of one-eighth (1/8) or one-hundredth (1/100) of one percent (1%). Bids specifying more than one interest rate shall also specify the amount and maturities of the series of Bonds bearing each rate, and all Bonds of a series maturing on the same date shall bear the same rate of interest. The interest rate on a series of Bonds of a given maturity must be at least as great as the interest rate on Bonds of such series of any earlier maturity. Subject to the provisions set forth below, the Controller shall award the Bonds to the bidder offering the lowest net interest cost to the City, to be determined by computing the total interest on all of the Bonds from the date thereof to their maturities and deducting therefrom the premium bid, if any, or adding thereto the amount of any discount. No bid for less than ninety-nine percent (99.0%) of the par value of the Bonds (or such higher percentage of the par value of the Bonds as determined by the Controller with the advice of the Financial Advisor and set forth in the Controller's Certificate), plus accrued interest, if any, at the rate or rates named to the date of delivery, will be considered. The Controller shall have full right to reject any and all bids. In the event no acceptable bid is received at the time fixed for the sale of the Bonds, the Controller shall be authorized to continue to receive bids from day to day thereafter for a period not to exceed thirty (30) days, without readvertising, pursuant to Indiana law.

The Controller is hereby authorized to determine, in the Controller's discretion, to sell the Bonds pursuant to the general provisions of Indiana Code 5-1-11 (rather than Section 2(b) thereof), and in the event of such a determination, those portions of this Section 9 which conflict with such provisions shall be deemed inapplicable.

(ii) Sale to the Authority. Any series of the Bonds may, in the discretion of the Controller based upon the advice of the Financial Advisor, be sold to the Authority. The Mayor and the Controller are hereby authorized to submit an application to the Authority for participation in the drinking water loan program (the "SRF Program") under Indiana

Code 4-4-11 and 13-18-21. The Financial Assistance Agreement for the Bonds and the Project shall be executed by the City and the Authority. The form of Financial Assistance Agreement shall be in substantially the form of the financial assistance agreement previously approved by one or more of the Prior Ordinances, and the Mayor, the Controller and/or the Clerk are hereby authorized to execute and/or attest the same on behalf of the City and to approve any changes in form or substance to the Financial Assistance Agreement, such approval to be conclusively evidenced by their execution. The Financial Assistance Agreement may set forth the definitive terms and conditions for such sale including the purchase price and interest rate, but all of such terms and conditions must be consistent with the terms and conditions of this Ordinance, including, without limitation, the interest rates on the Bonds which shall not exceed the maximum rate of interest for the Bonds authorized pursuant to this Ordinance. Bonds sold to the Authority shall be accompanied by all documentation required by the Authority pursuant to Indiana Code 4-4-11 and 13-18-21, and the Financial Assistance Agreement, including, without limitation, an approving opinion of a nationally recognized bond counsel, certification and guarantee of signatures and certification as to no litigation pending, as of the date of delivery of the Bonds to the Authority, challenging the validity or issuance of the Bonds. In the event the Controller determines to sell the Bonds to the Authority, the entry by the City into the Financial Assistance Agreement, the execution of the Financial Assistance Agreement by the Mayor, and, if required, the entry by the City into a purchase agreement or any other agreement with the Authority and the execution thereof by the Mayor, in accordance with this Ordinance are hereby authorized, approved and ratified.

Notwithstanding anything contained herein, the City may accept any other forms of financial assistance, as and if available, from the SRF Program (including without limitation (1) any forgivable loans, grants or other assistance whether available as an alternative to any Bond related provision otherwise provided for herein or as a supplement or addition thereto and (2) one or more series or combination of series of Bonds and/or BANs). If required by the SRF Program to be eligible for such financial assistance, one or more of the series of the Bonds or BANs issued hereunder may be issued on a basis such that the payment of the principal of or interest on (or both) such series of Bonds is junior and subordinate to the payment of the principal of and interest on other series of Bonds issued hereunder (and/or any other revenue bonds secured by a pledge of Net Revenues, whether now outstanding or hereafter issued), all as provided by the terms of such series of Bonds as modified pursuant to this authorization. Such financial assistance, if any, shall be as provided in the Financial Assistance Agreement and the Bonds of each series of Bonds and the BANs of each series of BANs issued hereunder (including any modification made pursuant to the authorization in this paragraph to the form of Bond otherwise contained herein).

(d) Credit Enhancement; Opinion of Bond Counsel. Prior to the delivery of the Bonds and the BANs, the Controller (i) shall be authorized to investigate, negotiate and obtain bond insurance, other forms of credit enhancement and/or credit ratings on the Bonds (and the BANs, if issued) and (ii) shall obtain a legal opinion as to the validity of the Bonds (and the BANs, if issued) from Faegre Baker Daniels LLP, Indianapolis, Indiana, bond counsel for the City, with such opinion or opinions to be furnished to the purchaser or purchasers of the Bonds or to the purchaser of the BANs at the expense of the City. The costs of obtaining any such insurance, other credit enhancement and/or credit ratings, together with bond counsel's fee in preparing and delivering such opinion or opinions and in the performance of related services in connection with the issuance, sale and delivery of the Bonds and the BANs, shall be considered as a part of the cost of the Project and shall be paid out of the proceeds of the Bonds and BANs, respectively.

SECTION 10. Disposition of Proceeds of the Bonds and BANs; City of Bloomington, Waterworks Construction Account. All accrued interest, if any, received at the time of the delivery of the Bonds shall be deposited in the Waterworks Sinking Fund. The remaining proceeds from the sale of the Bonds, to the extent not used to refund the BANs, and BAN proceeds shall be deposited in a bank or banks which are legally qualified depositories for the funds of the City, in the special account to be designated as "City of Bloomington, Waterworks Construction Account" (the "Construction Account"). Amounts in the Construction Account shall be expended only for the purpose of paying the costs of the Project, refunding the BANs, if

issued, paying the costs of issuance of the Bonds and the BANs, if the BANs are issued, or as otherwise permitted or required by the Act. Any balance or balances remaining unexpended in the Construction Account after completion of the Project, which are not required to meet unpaid obligations incurred in connection with the acquisition, construction, installation or equipping of the Project, shall be used solely for one or more of the purposes permitted under the provisions of Indiana Code 5-1-13, as amended, or be applied upon the terms set forth in the Financial Assistance Agreement.

Notwithstanding the provisions of this Section 10, if BANs are issued, then the proceeds of the Bonds relating thereto shall be used to refund the BANs or to pay additional Project costs and are hereby pledged for such purposes, and any proceeds of the Bonds remaining after the BANs have been paid in full and after completion of the Project shall be used solely for one or more of the purposes permitted under the provisions of Indiana Code 5-1-13, as amended.

If the Bonds are sold to the Authority, to the extent that (i) the total principal amount of the Bonds is not paid by the purchaser or drawn down by the City or (ii) proceeds remain in the Construction Account and are not applied to the Project (or any modifications or additions thereto approved by the Authority), the City shall reduce the principal amount of the Bonds' maturities to effect such reduction in a manner that will still achieve as level an annual debt service as practicable as described in Section 3 of this Ordinance subject to and upon the terms forth in the Financial Assistance Agreement.

SECTION 11. Segregation and Application of Waterworks Revenues. All revenues derived from the operation of the Waterworks and from the collection of water rates and charges shall be deposited in a fund previously established and continued hereby and designated as the Waterworks Revenue Fund and segregated and kept separate and apart from all other funds and bank accounts of the City. Out of said revenues the proper and reasonable expenses of operation and maintenance of the Waterworks shall be paid, the requirements of the Waterworks Sinking Fund shall be made and fiscal agency charges of bank registrars and paying agents shall be paid, and the costs of replacements, extensions, additions and improvements shall be paid as hereinafter provided.

SECTION 12. Operation and Maintenance Fund. There is hereby continued from the Prior Ordinances an Operation and Maintenance Fund consisting of a General Account (the "General Account"). On the last day of each calendar month, there shall be credited from the Revenue Fund to the General Account a sufficient amount of the revenues of the Waterworks so that the balance maintained in the General Account shall be sufficient to pay the expenses of operation and maintenance of the Waterworks for the next succeeding two (2) calendar months. The moneys credited to the General Account shall be used for the payment of the reasonable and proper operation and maintenance expenses of the Waterworks on a day-to-day basis, but none of the moneys in such account shall be used for depreciation, payments in lieu of taxes, replacements, improvements, extensions or additions with respect to the Waterworks. Any moneys in the General Account may be transferred to the Waterworks Sinking Fund previously established and continued hereby if necessary to prevent a default in the payment of principal of or interest on outstanding bonds of the Waterworks.

All remaining revenues of the Waterworks shall be transferred from time to time to meet the requirements of the Waterworks Sinking Fund. Moneys in excess of those transferred to the Waterworks Sinking Fund may be transferred to the Waterworks Improvement Fund or may be retained in the General Account, in the discretion of the Board, and in a manner consistent with the requirements of this Ordinance.

SECTION 13. Waterworks Sinking Fund.

(a) There is hereby continued from the Prior Ordinances a Waterworks Sinking Fund (defined herein as the "Waterworks Sinking Fund" or "Sinking Fund") for the payment of the principal of and interest on revenue bonds which by their terms are payable from the Net Revenues of the Waterworks, and the payment of any fiscal agency charges in connection with the payment of such bonds and interest thereon. There shall be set aside and deposited in the Sinking Fund, as available, and as provided below, a sufficient amount of the Net Revenues of the Waterworks to meet the requirements of the Bond and Interest Account and the Debt Service Reserve Account previously established and continued hereby in the Sinking Fund. Such

payments shall continue until the balance in the Bond and Interest Account, plus the balance in the Debt Service Reserve Account, if any, equals the principal of and interest on all of the then outstanding bonds of the Waterworks to their final maturity and provision is made for the payment of all fiscal agency charges in connection therewith.

(b) Bond and Interest Account. There shall be credited on the last day of each calendar month to the Bond and Interest Account previously established and continued hereby, an amount of Net Revenues of the Waterworks equal to the sum of at least one-sixth (1/6) of the interest on all then outstanding bonds of the Waterworks payable on the then next succeeding Interest Payment Date, and at least one-sixth (1/6) of the principal of all then outstanding bonds of the Waterworks payable on the then next succeeding principal payment date, until the amount of interest and principal payable on the next succeeding respective principal and interest payment dates shall have been so credited; provided that such fractional amounts shall be appropriately increased, if necessary, to provide for the first interest and first principal payments on the Bonds. There shall similarly be credited to the account the amount necessary to pay the bank fiscal agency charges, if any, for paying principal and interest on outstanding bonds of the Waterworks as the same become payable. The City shall, from the sums deposited in the Sinking Fund and credited to the Bond and Interest Account, remit promptly to the registered owners of the outstanding bonds of the Waterworks or to the bank fiscal agency sufficient moneys to pay the principal and interest on the due dates thereof together with the amount of any bank fiscal agency charges.

(c) Debt Service Reserve Account. The City has funded with cash of has purchased Surety Bonds ("Outstanding Surety Bonds") to satisfy the reserve requirements for the Prior Bonds, which cash and Outstanding Surety Bonds are held in the Debt Service Reserve Account (the "Reserve Account") as a reserve for the Prior Bonds.

For each series of Bonds issued under this Ordinance, the City shall purchase a Surety Bond, or use Bond proceeds, funds on hand or a combination thereof, to fund the Reserve Account for said series of Bonds. Upon the issuance of each series of Bonds, the Reserve Account shall contain for said series of Bonds an amount equal to the least of (i) the maximum annual debt service on said series of Bonds, (ii) one hundred twenty-five percent (125%) of the average annual debt service on said series of Bonds, or (iii) ten percent (10%) of the proceeds of said series of Bonds; provided, however, that for so long as the Indiana Finance Authority is the owner of any Prior Bonds, the Bonds or any other bonds payable from the Net Revenues of the Waterworks, the total balance maintained in the Reserve Account (taking into account the Outstanding Surety Bonds, any other Surety Bonds, and any cash held therein) shall not be less than the maximum annual debt service on the Prior Bonds and the Bonds (the "Reserve Requirement").

The Reserve Account shall constitute the margin for safety as a protection against default in the payment of principal of and interest on the Prior Bonds and the Bonds (and any other parity bonds of the City payable from the Net Revenues of its Waterworks hereafter issued so long as the Reserve Requirement has been increased proportionately), and the moneys in the Reserve Account shall only be used to pay current principal and interest on the Bonds and the Prior Bonds to the extent that moneys in the Bond and Interest Account are insufficient for that purpose. If it becomes necessary to draw upon the Reserve Account to pay the Prior Bonds or the Bonds, the City shall first draw down the cash in the Reserve Account, if any, and next initiate draws on any Surety Bonds held therein, including the Outstanding Surety Bonds, on a pro rata basis, to meet such payments when due. Notwithstanding the foregoing sentence, if the Reserve Requirement for the Bonds is funded in whole or in part with cash rather than in whole with a Surety Bond, the City shall, if necessary to pay principal of or interest on the Bonds, use the cash in the Reserve Account to first pay such principal of or interest on the Bonds before such cash is used on the Prior Bonds. Any deficiency in the balance maintained in the Reserve Account shall be promptly made up from the next available Net Revenues remaining after credits into the Bond and Interest Account. In the event moneys in the Reserve Account are transferred to the Bond and Interest Account to pay principal and interest on the Prior Bonds or Bonds, respectively, then such depletion of the balance in the Reserve Account shall be made up from the next available Net Revenues after the credits into the Bond and Interest Account hereinbefore provided for. Any moneys in the Reserve Account in excess of the Reserve Requirement shall be transferred to the Waterworks Improvement Fund, and in no event shall such excess moneys be held in the Reserve Account.

(d) Depository Agreements. The Sinking Fund, containing the Bond and Interest Account and the Reserve Account, and/or the Construction Account may be held by a financial institution acceptable to the Authority, pursuant to terms acceptable to the Authority. If the Sinking Fund and the accounts therein are held in trust, the City shall transfer the monthly required amounts of Net Revenues to the Bond and Interest Account and the Reserve Account, and the financial institution holding such funds in trust shall be instructed to pay the required payments in accordance with the payment schedules for the City's outstanding bonds. The Common Council hereby authorizes the Mayor and the Controller to execute and deliver an agreement with a financial institution to reflect this trust arrangement for the Sinking Fund and/or the Construction Account.

SECTION 14. Waterworks Improvement Fund. As set forth in Section 12 hereof, revenues may be transferred or credited from the General Account to the "Waterworks Improvement Fund" hereby continued (the "Improvement Fund"). Subject to the provisions of the Prior Ordinances, the Improvement Fund shall be used for (a) improvements, replacements, additions and extensions of the Waterworks, (b) for payments in lieu of taxes, and (c) for any other lawful purpose related to the Waterworks. Moneys in the Improvement Fund shall be transferred to the Sinking Fund if necessary to prevent a default in the payment of principal and interest on the then outstanding bonds payable from the Sinking Fund or if necessary to eliminate any deficiencies in credits to or minimum balances, if any, in the Reserve Account. Moneys in the Improvement Fund also may be transferred to the Operation and Maintenance Fund to meet unforeseen contingencies in the operation and maintenance of the Waterworks.

SECTION 15. Priority of Payments. All revenues of the Waterworks shall be paid in the following order, with the priority as indicated:

(a) First to pay all expenses of the operation and maintenance of the Waterworks;

(b) Second, on a pari passu (parity) basis, to pay all principal of and interest on the Prior Bonds, the Bonds and any bonds hereafter issued which rank on a parity with the Bonds;

(c) Third, on a pari passu (parity) basis, to replenish any cash drawn from the Reserve Account if the Reserve Requirement (as defined in Ordinance No. 01-42) for the 2003 New Money Bonds or the 2003 Refunding Bonds is satisfied, in whole or in part, with cash and to replenish any surety bonds in place for either the Prior Bonds or the Bonds;

(d) Fourth to replenish any other cash drawn, if any, from the Reserve Account;

(e) Fifth to pay the costs of improvements, replacements, additions and extensions of the Waterworks and for payments in lieu of taxes; and

(f) All other lawful uses related to the Waterworks, including debt service payments on any junior and subordinate bonds.

SECTION 16. Separation of Funds; Investment of Moneys Therein. The Waterworks Sinking Fund shall be deposited in and maintained as a separate bank account or accounts from all other bank accounts of the City. The Operation and Maintenance Fund and the Waterworks Improvement Fund may be maintained in a single bank account, or accounts, but such bank account, or accounts, shall likewise be maintained separate and apart from all other bank accounts of the City and apart from the Waterworks Sinking Fund bank account or accounts. Each of the funds and accounts of the Waterworks shall be deposited, held, secured or invested in accordance with the laws of the State of Indiana relating to the depositing, holding, securing or investing of public funds, including, particularly, applicable provisions of Indiana Code 5-13-9, as amended. Any interest or income derived from any such investments shall become a part of the moneys in the fund or account so invested, provided, however, that income derived from investment of moneys in the Debt Service Reserve Account of the Waterworks Sinking Fund, if any, which result in the amount of moneys therein to be in excess of the Reserve Requirement shall be transferred to the Waterworks Improvement Fund.

SECTION 17. Books of Record and Accounts. The City shall keep proper books of record and accounts, separate from all of its other records and accounts, in which complete and correct entries shall be made showing all revenues collected from said works and deposited in said funds, and all disbursements made therefrom on account of the operation of the works, and to meet the requirements of the Waterworks Sinking Fund, and all other financial transactions relating to said works. There shall be prepared and furnished, upon written request, to any owner of the Bonds or BANs at the time then outstanding, not more than ninety (90) days after the close of each fiscal year, complete financial statements of the works, covering the preceding fiscal year, which annual statements shall be certified by the Controller or by licensed independent public accountants employed for that purpose. Copies of all such statements and reports shall be kept on file in the office of the Director of the City of Bloomington Utilities. Any owner or owners of the Bonds or BANs then outstanding shall have the right at all reasonable times to inspect the works and all records, accounts and data of the City relating thereto. Such inspections may be made by representatives duly authorized by written instrument.

If the Bonds or BANs are sold to the Authority, the City shall establish and maintain the books and other financial records of the Project (including the establishment of a separate account or subaccount for the Project) and the Waterworks in accordance with (i) generally accepted accounting standards for utilities, on an accrual basis, as promulgated by the Government Accounting Standards Board, and (ii) the rules, regulations and guidance of the State Board of Accounts.

SECTION 18. Covenant with Respect to Rates and Charges. The City shall establish, maintain and collect reasonable and just and equitable rates and charges for facilities and services afforded and rendered by the Waterworks, which shall to the extent permitted by law produce sufficient revenues at all times to pay all the legal and other necessary expense incident to the operation of the Waterworks, to include maintenance costs, operating charges, upkeep, repairs, interest charges on bonds or other obligations, to provide for the proper operation, repair and maintenance of the Waterworks, to provide the sinking fund and debt service reserve for the liquidation of bonds or other evidences of indebtedness, to provide adequate funds to be used as working capital, as well as funds for making extensions, additions and replacements, and also, for the payment of any taxes that may be assessed against the Waterworks, it being the intent and purpose hereof that such charges shall produce an income sufficient to maintain such utility property in a sound physical and financial condition to render adequate and efficient service. The rates and charges shall be established to the extent permitted by law, to produce Net Revenues sufficient to pay 1.20 times the annual debt service on the Prior Bonds, the Bonds and bonds hereafter issued on a parity with the Bonds. So long as any of the Bonds are outstanding, none of the facilities or services afforded or rendered by the Waterworks shall be furnished without a reasonable and just charge being made therefor. The City shall pay like charges for any and all services rendered by the Waterworks to the City, and all such payments shall be deemed to be revenues of the Waterworks. Such rates and charges shall, if necessary, be changed and adjusted from time to time so that the revenues therefrom shall always be sufficient to meet the expenses of operation and maintenance, and the requirements of the Sinking Fund.

SECTION 19. Defeasance. If, when the Bonds or BANs issued hereunder (or portions thereof) shall have become due and payable in accordance with their terms or shall have been duly called for redemption or irrevocable instructions to call the Bonds or BANs (or portions thereof) for redemption shall have been given, and the whole amount of the principal, the interest and the premium, if any, so due and payable upon all of the Bonds or BANs (or portions thereof) then outstanding shall be paid; or (i) sufficient moneys, or (ii) direct obligations of, or obligations the principal of and interest on which are unconditionally guaranteed by, the United States of America, the principal of and the interest on which when due will provide sufficient moneys, or (iii) time certificates of deposit fully secured as to both principal and interest by obligations of the kind described in (ii) above of a bank or banks the principal of and interest on which when due will provide sufficient moneys, shall be held in trust for such purpose, and provision shall also be made for paying all fees and expenses for the redemption, then and in that case the Bonds or BANs, as applicable (or portions thereof), issued hereunder shall no longer be deemed outstanding or entitled to the pledge of the Net Revenues of the City's Waterworks.

SECTION 20. Additional BANs and Bonds. The City reserves the right to authorize and issue additional BANs at any time ranking on a parity with the BANs so long as the interest is payable only on the same date(s) as that provided in the BAN Purchase Agreement and the principal is payable solely from the Bond proceeds. The City also reserves the right to authorize and issue additional bonds, payable out of the Net Revenues of its Waterworks, ranking on a parity with the Prior Bonds and with the Bonds authorized by this Ordinance, for the purpose of financing the cost of future additions, extensions and improvements to the Waterworks, or to refund obligations, subject to the following conditions:

(a) All required payments into the Sinking Fund and the accounts thereof shall have been made in accordance with the provisions of this Ordinance, and the interest on and principal of all bonds payable from the Net Revenues of the Waterworks shall have been paid to date in accordance with their terms. The Reserve Account must contain, for all outstanding bonds, upon the issuance of additional parity bonds, (i) the reserve requirement for all outstanding bonds or (ii) reserve insurance must be obtained for all outstanding bonds, and for the additional parity bonds, the Reserve Account must contain, upon the issuance of additional parity bonds, (i) the lesser of (1) maximum annual debt service on the additional parity bonds, (2) one hundred twenty-five percent (125%) of the average annual debt service on the additional parity bonds, or (3) ten percent (10%) of the proceeds of the additional parity bonds, provided, however, that for so long as the Indiana Finance Authority owns any Prior Bonds, such amount shall be equal to the maximum annual debt service on the additional parity bonds, or (ii) reserve insurance must be attained for the additional parity bonds. For purposes of this subsection, proceeds of the additional parity bonds shall mean the face amount of the additional parity bonds plus premium, if any, less original issue discount, if any. As long as the Surety Bond for the 2000 Bonds is in effect, only a Qualified Surety Bond (as defined in the 2000 Ordinance) may be used as reserve insurance and, for so long as the 2000 Bonds or the 2003 New Money Bonds are outstanding, any Surety Bond for the reserve must be from a company, and in a form, acceptable to the Indiana Finance Authority.

(b) The Net Revenues of the Waterworks in the calendar year immediately preceding the issuance of any such additional bonds ranking on a parity with the Bonds authorized by this Ordinance shall be not less than one hundred twenty-five percent (125%) of the maximum annual interest and principal requirements of the then outstanding bonds and the additional parity bonds proposed to be issued; or, prior to the issuance of said parity bonds, the water rates and charges shall be increased sufficiently so that said increased rates and charges applied to the previous calendar year's operations would have produced Net Revenues for said year equal to not less than one hundred twenty-five percent (125%) of the maximum annual interest and principal requirements of the then outstanding bonds and the additional parity bonds proposed to be issued. For purposes of this subsection, the records of the Waterworks shall be analyzed and all showings shall be prepared by a certified public accountant or nationally recognized financial consultant or consulting engineer employed by the City for that purpose. For purposes of this subsection, Net Revenues shall not include non-recurring revenues of the Waterworks as certified by the Board or any outstanding fund balances from prior years.

(c) The principal of said additional parity bonds shall be payable semiannually on January 1 and July 1 and the interest on said additional parity bonds shall be payable semiannually on January 1 and July 1 in the years in which such principal and interest are payable.

(d) To the extent required by law, the issuance of additional bonds and any necessary increase in water rates and charges shall be approved by the Indiana Utility Regulatory Commission.

(e) If the Bonds are sold to the Authority, (i) the City has obtained the consent of the Authority, (ii) the City has faithfully performed and is in compliance with each of its obligations, agreements and covenants contained in the Financial Assistance Agreement and this Ordinance, and (iii) the City is in compliance with its waterworks permits, except for non-compliance for which the bonds are to be issued, including refunding bonds issued prior to, but part of, the overall plan to eliminate such non-compliance.

SECTION 21. Additional Covenants of the City. For the purpose of further safeguarding the interests of the owners of the Bonds and BANs, it is specifically provided as follows:

(a) All contracts let by the City in connection with the construction of said additions and improvements to the Waterworks shall be let after due advertisement as required by the laws of the State of Indiana, and all contractors shall be required to furnish surety bonds in an amount equal to one hundred percent (100%) of the amount of such contracts, to insure the completion of said contracts in accordance with their terms, and such contractors shall also be required to carry such employer's liability and public liability insurance as are required under the laws of the State of Indiana in the case of public contracts, and shall be governed in all respects by the laws of the State of Indiana relating to public contracts.

(b) Said additions and improvements shall be constructed under the supervision and subject to the approval of the Consulting Engineers or such other competent engineer as shall be designated by the Common Council. All estimates for work done or material furnished shall first be checked by the Consulting Engineers and approved by the Common Council.

(c) The City shall at all times maintain its Waterworks in good condition and operate the same in an efficient manner and at a reasonable cost.

(d) So long as any of the Bonds or BANs are outstanding, the City shall maintain insurance coverage (which must be acceptable to the Authority if the Authority owns the Bonds or the BANs), including fidelity bonds, to protect the Waterworks and its operations on the insurable parts of said works of a kind and in an amount such as would normally be carried by private companies engaged in a similar type of business. All insurance shall be placed with responsible insurance companies qualified to do business under the laws of the State of Indiana. All insurance proceeds and condemnation awards shall be used in replacing or restoring the property destroyed, damaged or taken; alternatively, they may be applied as Net Revenues of the works, but only with the consent of the Authority, if the Bonds or BANs have been sold to the Authority.

(e) So long as any of the Bonds or BANs are outstanding, the City shall not mortgage, pledge or otherwise encumber such works, or any part thereof, nor shall it sell, lease or otherwise dispose of any portion thereof except to replace equipment which may become worn out or obsolete.

(f) If the Bonds or BANs are sold to the Authority to finance Eligible Costs (as defined in the Financial Assistance Agreement), the City shall not borrow any money, enter into any contract or agreement or incur any other liabilities in connection with the Waterworks, other than for normal operating expenditures, without the prior written consent of the Authority, if such undertaking would involve, commit or use the revenues of the Waterworks.

(g) Except as hereinbefore provided in Section 20 hereof, so long as any of the Bonds are outstanding, no additional bonds or other obligations pledging any portion of the revenues of said Waterworks shall be authorized, executed or issued by the City except such as shall be made subordinate and junior in all respects to the Bonds, unless all of the Bonds are redeemed, retired or defeased pursuant to Section 19 hereof coincidentally with the delivery of such additional bonds or other obligations.

(h) The provisions of this Ordinance shall constitute a contract by and between the City and the owners of the Bonds and BANs, and after the issuance of said Bonds and BANs, subject to the rights of the City under Sections 25 and 26 hereof, this Ordinance shall not be repealed or amended in any respect which will adversely affect the rights of the owners of said Bonds and BANs, nor shall the Common Council adopt any law, ordinance or resolution which in any way adversely affects the rights of such owners so long as any of said Bonds or BANs or the interest thereon remains unpaid. Except with respect to amendments described in Section 26(a) through (g) hereof, however, this Ordinance may be amended without the consent of the owners of the Bonds or the BANs (i) if, among other things, the Common Council determines, in its sole discretion, that such amendment would not adversely affect the owners of the Bonds or the BANs, respectively, and (ii) as otherwise permitted pursuant to Section 25 or 26 hereof; provided, however, that if the Bonds or BANs are sold to the Authority, the City shall obtain the prior written consent of the Authority.

(i) The provisions of this Ordinance shall be construed to create a trust in the proceeds of the sale of the Bonds and BANs for the uses and purposes herein set forth, and the owners of the Bonds and BANs shall retain a lien on such respective proceeds until the same are applied in accordance with the provisions of this Ordinance and of the Act. The provisions of this Ordinance shall also be construed to create a trust in the portion of the Net Revenues herein directed to be set apart and paid into the Waterworks Sinking Fund for the uses and purposes of said fund as in this Ordinance set forth. The owner of said Bonds and BANs shall have all of the rights, remedies and privileges under Indiana law in the event of default in the payment of the principal of or interest on any of the Bonds or BANs or in the event of default in respect to any of the provisions of this Ordinance or the Act.

SECTION 22. Permitted Actions Relating to Preservation of Exclusion of Interest from Federal Gross Income.

(a) The Controller is hereby authorized to invest moneys pursuant to the provisions of this Ordinance and Indiana Code 5-1-14-3 at a restricted yield (subject to applicable requirements of federal law to insure that any such investment is acquired for fair market value) to the extent necessary or advisable to preserve the exclusion from gross income of interest on the Bonds and BANs, or the tax exempt status of interest on the Bonds and BANs, under federal law.

(b) The Controller shall keep full and accurate records of investment earnings and income from moneys held in the funds and accounts created or referenced herein. In order to comply with the provisions of this Ordinance, the Controller is hereby authorized and directed to employ consultants or attorneys from time to time to advise the City as to requirements of federal law to preserve the tax exclusion or exemption.

SECTION 23. Tax Covenants. In order to preserve the exclusion of interest on the Bonds and BANs from gross income for federal income tax purposes and as an inducement to purchasers of the Bonds and BANs, the City represents, covenants and agrees that:

(a) No person or entity or any combination thereof, other than the City or any other governmental unit ("Governmental Unit") within the meaning of Section 141(b)(6) and Section 150(a)(2) of the Internal Revenue Code of 1986, as amended (the "Code"), will use more than ten percent (10%) of the proceeds of the Bonds or BANs or property financed by the Bond or BAN proceeds other than as a member of the general public. No person or entity or combination thereof, other than the City or any other Governmental Unit will own property financed by more than ten percent (10%) of the Bond or BAN proceeds or will have actual or beneficial use of such property pursuant to a lease, a management or incentive payment contract, an arrangement such as a take-or-pay or other type of output contract or any other type of arrangement that differentiates that person's or entity's use of such property from the use by the public at large, except pursuant to a management or similar contract which satisfies the requirements of IRS Revenue Procedure 97-13.

(b) No Bond or BAN proceeds will be loaned to any entity or person. No Bond or BAN proceeds will be transferred, directly or indirectly, or deemed transferred to a nongovernmental person in any manner that would in substance constitute a loan of the Bond or BAN proceeds.

(c) The City will not take, or cause or permit to be taken by it or by any party under its control, or fail to take or cause or permit to fail to be taken by it or by any party under its control, any action with respect to the Bonds or BANs that would result in the loss of the exclusion from gross income for federal income tax purposes of interest on the Bonds or BANs pursuant to Section 103 of the Code, nor will the City act in any other manner which would adversely affect such exclusion. The City further covenants that it will not make any investment or do any other act or thing during the period that any Bond or BAN is outstanding hereunder which would cause any Bond or BAN to be an "arbitrage bond" within the meaning of Section 148 of the Code and the regulations applicable thereto as in effect on the date of delivery of the Bonds or BANs.

(d) The City will, to the extent necessary to preserve the exclusion of interest on the Bonds and BANs from gross income for federal income tax purposes, rebate all required arbitrage profits on Bond and BAN proceeds or other moneys treated as Bond or BAN proceeds to the federal government and will set aside such moneys in a Rebate Account to be held by the Controller in trust for such purpose.

SECTION 24. Compliance with Tax Sections. Notwithstanding any other provisions of this Ordinance, the covenants and authorizations contained in this Ordinance (the "Tax Sections") which are designed to preserve the tax-exempt status of interest on the Bonds and BANs or the exclusion of interest on the Bonds and BANs from gross income under federal law (the "Tax Exemption") need not be complied with if the City receives an opinion of nationally recognized bond counsel that any Tax Section is unnecessary to preserve the Tax Exemption. In addition, the City is authorized to issue one or more series of Bonds or BANs, the interest on which is not excludable from gross income under federal law, in which case the Tax Sections of this Ordinance shall not apply to such series of Bonds or BANs.

SECTION 25. Supplemental Ordinances Without Consent. Without notice to or consent of the owners of the Bonds or BANs herein authorized, the City may, from time to time and at any time, adopt an ordinance or ordinances supplemental hereto (which supplemental ordinance or ordinances shall thereafter form a part hereof) for any of the following purposes:

(a) To cure any ambiguity or formal defect or omission in this Ordinance or in any supplemental ordinance or to make any other change authorized herein;

(b) To grant to or confer upon the owners of the Bonds and BANs any additional benefits, rights, remedies, powers, authority or security that may lawfully be granted to or conferred upon the owners of the Bonds and BANs or to make any change which, in the judgment of the City, is not to the prejudice of the owners of the Bonds or BANs;

(c) To modify, amend or supplement this Ordinance to permit the qualification of the Bonds or BANs for sale under the securities laws of the United States of America or of any of the states of the United States of America or to obtain or maintain bond insurance or other credit enhancement with respect to payments of principal of and interest on Bonds or BANs;

(d) To provide for the refunding or advance refunding of the Bonds;

(e) To procure a rating on the Bonds from a nationally recognized securities rating agency or agencies designated in such supplemental ordinance if such supplemental ordinance will not adversely affect the owners of the Bonds or any other bonds ranking on a parity with such Bonds; or

(f) To accomplish any other purpose which, in the judgment of the City, does not adversely affect the interests of the owners of the Bonds or BANs;

provided, however, that if the Bonds or BANs are sold to the Authority, the City shall obtain the prior written consent of the Authority..

SECTION 26. Supplemental Ordinances Without Consent. Subject to the terms and provisions contained in this Section 26 and Section 21(h) of this Ordinance, and not otherwise, the owners of not less than sixty-six and two-thirds percent (66-2/3%) in aggregate principal amount of the Bonds issued pursuant to this Ordinance and then outstanding shall have the right, from time to time, anything contained in this Ordinance to the contrary notwithstanding, to consent to and approve the adoption by the City of such ordinance or ordinances supplemental hereto as shall be deemed necessary or desirable by the City for the purpose of modifying, altering, amending, adding to or rescinding in any particular any of the terms or provisions contained in this Ordinance, or in any supplemental ordinance; provided, however, that if the Bonds or BANs are sold to the Authority, the City shall obtain the prior written consent of the Authority; and provided, further, that nothing herein contained shall permit or be construed as permitting:

(a) An extension of the maturity of the principal of or interest on any Bond issued pursuant to this Ordinance; or

(b) A reduction in the principal amount of any Bond or the redemption premium or the rate of interest thereon; or

(c) The creation of a lien upon or a pledge of the Net Revenues of the Waterworks ranking prior to the pledge thereof created by this Ordinance; or

(d) A preference or priority of any Bond or Bonds issued pursuant to this Ordinance over any other Bond or Bonds issued pursuant to the provisions of this Ordinance; or

(e) A reduction in the aggregate principal amount of the Bonds required for consent to such supplemental ordinance; or

(f) A reduction in the Reserve Requirement; or

(g) The extension of mandatory sinking fund redemption dates, if any.

If the owners of not less than sixty-six and two-thirds percent (66-2/3%) in aggregate principal amount of the Bonds outstanding at the time of adoption of such supplemental ordinance shall have consented to and approved the adoption thereof by written instrument to be maintained on file in the office of the Controller of the City, no owner of any Bond issued pursuant to this Ordinance shall have any right to object to the adoption of such supplemental ordinance or to object to any of the terms and provisions contained therein or the operation thereof, or in any manner to question the propriety of the adoption thereof, or to enjoin or restrain the City or its officers from adopting the same, or from taking any action pursuant to the provisions thereof. Upon the adoption of any supplemental ordinance pursuant to the provisions of this Section 26, this Ordinance shall be, and shall be deemed, modified and amended in accordance therewith, and the respective rights, duties and obligations under this Ordinance of the City and all owners of Bonds issued pursuant to the provisions of this Ordinance then outstanding, shall thereafter be determined, exercised and enforced in accordance with this Ordinance, subject in all respects to such modifications and amendments. Notwithstanding anything contained in the foregoing provisions of this Ordinance, the rights and obligations of the City and of the owners of the Bonds authorized by this Ordinance, and the terms and provisions of the Bonds and this Ordinance, or any supplemental ordinance, may be modified or altered in any respect with the consent of the City and the consent of the owners of all the Bonds issued pursuant to this Ordinance then outstanding.

SECTION 27. Reimbursement of Preliminary Expenditures. The Common Council hereby declares that, for the purpose of evidencing compliance with Indiana Code 5-1-14-6 and Section 1.150-2 of the Treasury Regulations, it reasonably expects to reimburse with the proceeds of the Bonds or BANs (in an amount not to exceed and payable from the sources set forth above) expenditures for the payment of the costs of the Project made by or on behalf of the City prior to the issuance of the Bonds or BANs during the period beginning on the date sixty (60) days prior to the effective date of this Ordinance until the date of issuance of the Bonds or BANs, as the case may be, which expenditures are expected to be paid initially from other legally available funds of the City.

SECTION 28. Repeal of Conflicting Ordinances. All ordinances, resolutions and orders, or parts thereof, in conflict with the provisions of this Ordinance, are, to the extent of such conflict, hereby repealed; provided, however, that this Ordinance shall not be deemed in any way to repeal, amend, alter or modify any of the Prior Ordinances, nor be construed as adversely affecting the rights of any of the owners of the outstanding Prior Bonds.

SECTION 29. Rates and Charges. The estimate of rates and charges which will be needed and charged to the general classes of users of property to be served by the Waterworks in order to provide sufficient moneys to make payments of principal of and interest on the Bonds, along with the other payments identified in this Ordinance, is set forth in Ordinance No. 16-08, adopted by the Common Council on June 15, 2016.

SECTION 30. Official Statement. Any series of the Bonds may be offered and sold pursuant to an Official Statement or other offering document with respect to such Bonds (the "Official Statement"), to be made available and distributed in such manner, at such times, for such periods and in such number of copies as may be required pursuant to Rule 15c2-12 promulgated by the United States Securities and Exchange Commission (the "Rule") and any and all applicable rules and regulations of the Municipal Securities Rulemaking Board. The City hereby authorizes the Controller (a) to authorize and approve a Preliminary Official Statement, as the same may be appropriately confirmed, modified and amended for distribution as the Preliminary Official Statement of the City; (b) on behalf of the City, to designate the Preliminary Official Statement a "final" Official Statement with respect to such Bonds, subject to completion as permitted by and otherwise pursuant to the Rule; and (c) to authorize and approve the Preliminary Official Statement to be placed into final form and to enter into such agreements or arrangements as may be necessary or advisable in order to provide for the distribution of a sufficient number of copies of the Official Statement under the Rule. The Mayor and the Controller are further authorized to execute and attest, respectively, an agreement in connection with the offering of such Bonds in accordance with the Rule by which the City agrees to undertake such continuing disclosure obligations as may be required under the Rule.

SECTION 31. Controller's Certificate. The Controller shall, prior to the sale of the Bonds, set forth in a certificate (the "Controller's Certificate") the principal payment schedule for the Bonds, the percentage of par at which the Bonds shall be sold and any other matters required by this Ordinance to be provided in the Controller's Certificate.

SECTION 32. Payments on Holidays. If the date of making any payment or the last date for performance of any act or the exercising of any right, as provided in this Ordinance, shall be a legal holiday or a day on which banking institutions in the City or in the town or city in which the Registrar and Paying Agent is located are typically closed, such payment may be made or act performed or right exercised on the next succeeding day not a legal holiday or a day on which such banking institutions are typically closed, with the same force and effect as if done on the nominal date provided in this Ordinance, and no interest shall accrue for the period after such nominal date. Notwithstanding the foregoing, with respect to any Bonds sold to the Authority pursuant to Section 9 of this Ordinance, if the date for making any payment is a day when financial institutions are not open for business, such payment shall be made on the business day immediately preceding such payment date.

SECTION 33. Separability. If any section, paragraph or provision of this Ordinance shall be held to be invalid or unenforceable for any reason, the invalidity or unenforceability of such section, paragraph or provision shall not affect any of the remaining provisions of this Ordinance.

SECTION 34. Captions. The captions in this Ordinance are inserted only as a matter of convenience and reference, and such captions are not intended and shall not be construed to define, limit, establish, interpret or describe the scope, intent or effect of any provision of this Ordinance.

SECTION 35. Effectiveness. This Ordinance shall be in full force and effect from and after its passage.

PASSED AND ADOPTED by the Common Council of the City of Bloomington, Monroe County, Indiana, upon this 12th day of July, 2016.

ANDY RUFF, President
Bloomington Common Council

ATTEST:

NICOLE BOLDEN, Clerk
City of Bloomington

PRESENTED by me to the Mayor of the City of Bloomington, Monroe County, Indiana, upon this 13th day of July, 2016.

NICOLE BOLDEN, Clerk
City of Bloomington

This Ordinance SIGNED and APPROVED by me upon this 13th day of July, 2016.

JOHN HAMILTON, Mayor
City of Bloomington

SYNOPSIS

This ordinance authorizes the issuance of waterworks revenue bonds in an amount not to exceed $4.6 million for improvements and extensions to the City's waterworks.

Please note that this ordinance was edited after it was issued in the Council's Legislative Packet, but before it was introduced at First Reading, to add a synopsis.

APPENDIX A

[Form of Bond]

UNITED STATES OF AMERICA
STATE OF INDIANA, COUNTY OF MONROE
CITY OF BLOOMINGTON, INDIANA,
WATERWORKS REVENUE BOND OF 20___

No. ___R-____

Interest Rate	[Maturity Date]	Original Date	Authentication Date	[CUSIP No.]

Registered Owner:

Principal Amount:

The City of Bloomington (the "City"), in Monroe County, State of Indiana, for value received, hereby promises to pay to the Registered Owner specified above, or registered assigns, upon surrender hereof, solely out of the special revenue fund hereinafter referred to, the Principal Amount stated above, [on the Maturity Date stated above][or so much thereof as may be advanced from time to time and be outstanding as evidenced by the records of the registered owner making payment for this Bond, on January 1 and July 1 on the dates and in the amounts as set forth on Schedule A attached hereto] (unless this bond be subject to and shall have been called for redemption prior to maturity as hereinafter provided), and to pay interest hereon until the Principal Amount is fully paid at the Interest Rate per annum stated above from the interest payment date to which interest has been paid next preceding the Authentication Date of this bond, unless this bond is authenticated after the fifteenth day of the calendar month immediately preceding an interest payment date and on or before such interest payment date, in which case it shall bear interest from such interest payment date, or unless this bond is authenticated on or before _____ 15, 20___, in which case it shall bear interest from the Original Date stated above. Interest on this bond shall be payable semiannually on January 1 and July 1 of each year, commencing _____ 1, 20____, and shall be calculated on the basis of twelve (12) thirty (30)-day months for a three hundred sixty (360)-day year.

The principal of and premium, if any, on this bond are payable at the principal office of _____ in the _____ of _____, Indiana, as Registrar and Paying Agent (which term shall include any successor registrar and paying agent). All payments of interest hereon shall be paid by check or draft mailed or delivered by the Paying Agent to the Registered Owner hereof at the address as it appears on the registration books of the Registrar as of the fifteenth day of the calendar month immediately preceding the applicable interest payment date or at such other address as is furnished to the Registrar and Paying Agent in writing by such Registered Owner. All payments on this bond shall be made in any coin or currency of the United States of America which, on the dates of such payments, shall be legal tender for the payment of public and private debts.

[Notwithstanding the foregoing, if payment of principal or interest is made to a depository, payment shall be made by wire transfer on the payment date in same-day funds.] [Notwithstanding the foregoing paragraph, so long as this bond is registered in the name of the Indiana Finance Authority (the "Authority"), principal of and interest on this bond shall be paid by wire transfer to a financial institution designated by the Authority on the due date of such payment or, if such date is a day when financial institutions are not open for business, on the business day immediately preceding such due date. So long as the Authority is the registered owner of this bond, this bond shall be presented for payment as directed by the Authority.]

[So long as the Authority is the registered owner of this bond, it is understood that the principal hereof shall not be payable and interest hereon shall not accrue until such principal amount has been advanced pursuant to a request made by the City to the Authority.]

This bond and the other bonds of this issue, together with the interest payable hereon and thereon, are payable solely from and secured by an irrevocable pledge of and constitute a first charge upon all of the Net Revenues (herein defined as the gross revenues of the waterworks of the City after deduction only for the payment of the reasonable expenses of operation and maintenance), derived from the waterworks of the City, including the existing works, the improvements and extensions acquired or constructed out of the proceeds of this bond and the issue of which it is a part, and all additions and improvements thereto subsequently acquired or constructed. This bond and the other bonds of this issue rank on a parity basis with the Prior Bonds, as defined in the Ordinance. The City shall not be obligated to pay the principal of or interest on this bond except from the special fund, entitled the "Waterworks Sinking Fund" (heretofore created by ordinance of the City and continued under the Ordinance as hereinafter described), provided from the Net Revenues of such waterworks, and neither this bond nor any of the bonds of the issue of which this bond is a part shall constitute an indebtedness of the City within the meaning of the provisions and limitations of the constitution of the State of Indiana.

This bond is one of an authorized issue of bonds of the City of Bloomington, Indiana, of like tenor and effect, except as to series, numbering, interest rate and date of maturity, in the aggregate principal amount of _____ Dollars ($_____) numbered from ___R-1 upward, issued for the purpose of providing funds to pay the cost of certain improvements and extensions to the waterworks of the City (the "Waterworks"), [and to refund notes issued in anticipation of the bonds,] and all expenses necessarily incurred in connection with the issuance of such bonds, as authorized by an ordinance adopted by the Common Council of the City on the _____ day of _____, 2016, entitled "An Ordinance of the Common Council of the City of Bloomington, Indiana, Authorizing the Acquisition, Construction, Installation and Equipping by the City of Bloomington, Indiana, of Certain Improvements and Extensions to the City's Waterworks, the Issuance and Sale of Revenue Bonds to Provide Funds for the Payment of the Costs Thereof, the Issuance and Sale of Bond Anticipation Notes in Anticipation of the Issuance and Sale of Such Bonds, and the Collection, Segregation and Distribution of the Revenues of Such Waterworks and Other Related Matters" (the "Ordinance"), and in strict compliance with the provisions of Indiana Code, Title 8, Article 1.5, and the laws amendatory thereof and supplemental thereto (the "Act").

Reference is hereby made to the Ordinance for a description of the nature and extent of the rights, duties and obligations of the owner of the bonds and the City and the terms on which this bond is issued, and to all the provisions of the Ordinance to which the owner hereof by the acceptance of this bond assents. [Reference is hereby made to the Financial Assistance Agreement between the City and the Authority as to certain terms and covenants pertaining to the sewage works project and this bond (the "Financial Assistance Agreement").]

This bond is issuable only in fully registered form in the denomination of _____ Dollars ($_____) or any integral multiple thereof not exceeding the aggregate principal amount of the bonds of this issue maturing in any one year[,unless this bond is of a series of bonds sold to the Authority, in which case it may be of such denomination as directed].

Pursuant to the provisions of the Act and the Ordinance, the principal of and interest on this bond and all other bonds of this issue, together with the Prior Bonds and any bonds hereafter issued on a parity herewith and therewith, are secured by and are payable solely from the Waterworks Sinking Fund heretofore created, and continued by the Ordinance, to be provided from the Net Revenues derived from the Waterworks, including the existing works, the improvements and extensions acquired or constructed out of the proceeds of this bond and the issue of which it is a part, and all additions and improvements thereto and replacements thereof subsequently constructed and acquired. This bond does not and shall not constitute an indebtedness of the City within the meaning of the provisions and limitations of the constitution of the State of Indiana, and the City is not and shall not be obligated to pay this bond or the interest thereon except from such special fund provided from such Net Revenues.

The City irrevocably pledges the entire Net Revenues of the Waterworks, to the extent necessary for such purposes, to the prompt payment of the principal of and interest on the bonds of this issue authorized pursuant to the Ordinance, including this bond, the Prior Bonds and any

bonds hereafter issued on a parity herewith and therewith. The City covenants that it will to the fullest extent permitted by law cause to be fixed, maintained and collected such rates and charges for services rendered by such works as are sufficient in each year for the payment of the proper and reasonable expenses of operation and maintenance of said works, to comply with and satisfy all covenants contained in the Ordinance [and the Financial Assistance Agreement], and for the payment of the sums required to be paid into said Sinking Fund under the provisions of said Act and said Ordinance. In the event the City, or the proper officers thereof, shall fail or refuse to so fix, maintain and collect such rates or charges, or if there be a default in the payment of the principal of or interest on this bond, the Registered Owner of this bond shall have all of the rights and remedies provided for under Indiana law.

The City further covenants that it will set aside and pay into its Waterworks Sinking Fund a sufficient amount of the Net Revenues of the Waterworks to meet (a) the interest on all bonds payable from the revenues of the Waterworks, as such interest shall fall due, (b) the necessary fiscal agency charges for paying all bonds and interest, (c) the principal of all bonds payable from the revenues of the Waterworks, and (d) an additional amount as a margin of safety to create the reserve required by the Ordinance.

The City reserves the right pursuant to the terms and conditions of the Ordinance to authorize and issue additional bonds hereafter payable out of the Net Revenues of the Waterworks, ranking on a parity herewith or junior hereto for the purpose of financing future extensions and improvements to the Waterworks or to refund outstanding waterworks revenue bonds.

The bonds of this issue maturing on or after _____ 1, 20___ are subject to redemption prior to maturity, at the option of the City, in whole or in part (and if in part, only in authorized denominations and in order of maturity determined by the City and by lot within any such maturity or maturities in such manner as may be designated by the Registrar), on any date on or after _____ 1, 20___, at a redemption price equal to one hundred percent (100%) of the principal amount of the bonds to be redeemed, plus accrued and unpaid interest on the bonds so redeemed to the redemption date, and with the following premium: _____ [(provided, however, if the bonds are sold to the SRF Program (as defined in the Ordinance) and registered in the name of the Authority, such bonds shall not be redeemable at the option of the City unless and until consented by the Authority)].

Notice of any such redemption shall be sent by registered or certified mail to the Registered Owner of this bond at least [thirty (30)][sixty (60)] days prior to the date fixed for redemption, unless such notice is waived by the Registered Owner. The notice shall specify the redemption price, the date and place of redemption, and the registration numbers (and in case of partial redemption, the respective principal amounts) of the bonds called for redemption. Interest on bonds so called for redemption shall cease to accrue on the redemption date fixed in such notice, so long as sufficient funds are available at the place of redemption to pay the redemption price on the redemption date or when presented for payment.

If this bond or a portion hereof shall have become due and payable in accordance with its terms or this bond or a portion hereof shall have been duly called for redemption or irrevocable instructions to call this bond or a portion hereof for redemption shall be given and the whole amount of the principal and the premium, if any, and interest, so due and payable upon this bond or such portion hereof shall be paid, or (i) sufficient moneys, or (ii) direct obligations of, or obligations the principal of and interest on which are unconditionally guaranteed by the United States of America, the principal of and the interest on which when due will provide sufficient moneys for such purpose, or (iii) time certificates of deposit of a bank or banks, fully secured as to both principal and interest by obligations of the kind described in (ii) above, the principal of and interest on which when due will provide sufficient moneys for such purpose, shall be held in trust for such purpose, and provision shall also be made for paying all fees and expenses for the redemption, then and in that case this bond or such portion hereof shall no longer be deemed outstanding, entitled to the pledge of the Net Revenues of the Waterworks or an obligation of the City.

If this bond shall not be presented for payment or redemption on the date fixed therefor, the City may deposit in trust with the Paying Agent an amount sufficient to pay such bond or the redemption price, as appropriate, and thereafter the Registered Owner shall look only to the funds so deposited in trust with the Paying Agent for payment, and the City shall have no further obligation or liability with respect thereto.

Subject to the provisions of the Ordinance regarding the registration of such bonds, this bond and all other bonds of this issue of which this bond is a part are fully negotiable instruments under the laws of the State of Indiana. This bond is transferable or exchangeable only on the books of the City maintained for such purpose at the principal office of the Registrar, by the Registered Owner hereof in person, or by his attorney duly authorized in writing, upon surrender of this bond together with a written instrument of transfer or exchange satisfactory to the Registrar duly executed by the Registered Owner or his attorney duly authorized in writing, and thereupon a new fully registered bond or bonds in the same aggregate principal amount and of the same maturity shall be executed and delivered in the name of the transferee or transferees or the Registered Owner, as the case may be, in exchange therefor. This bond may be transferred or exchanged without cost to the Registered Owner or his attorney duly authorized in writing, except for any tax or other governmental charge which may be required to be paid with respect to such transfer or exchange. The Registrar shall not be obligated to make any exchange or transfer of this bond (i) during the fifteen (15) days immediately preceding an interest payment date on this bond or (ii) after the mailing of any notice calling this bond for redemption. The City, the Registrar and any Paying Agent for this bond may treat and consider the person in whose name this bond is registered as the absolute owner hereof for all purposes including for the purpose of receiving payment of, or on account of, the principal hereof and the redemption premium, if any, and interest due hereon.

In the event this bond is mutilated, lost, stolen or destroyed, the City may cause to be executed and the Registrar may authenticate a new bond of like date, maturity and denomination as this bond, which new bond shall be marked in a manner to distinguish it from this bond; provided, that in the case of this bond being mutilated, this bond shall first be surrendered to the Registrar, and in the case of this bond being lost, stolen or destroyed, there shall first be furnished to the Registrar evidence of such loss, theft or destruction satisfactory to the City and to the Registrar, together with indemnity satisfactory to them. In the event that this bond, being mutilated, lost, stolen or destroyed, shall have matured or been called for redemption, instead of causing to be issued a duplicate bond the Registrar may pay this bond upon surrender of this mutilated bond or upon satisfactory indemnity and proof of loss, theft or destruction in the event this bond is lost, stolen or destroyed. In such event, the City and the Registrar may charge the owner of this bond with their reasonable fees and expenses in connection with the above. Every substitute bond issued by reason of this bond being lost, stolen or destroyed shall, with respect to this bond, constitute a substitute contractual obligation of the City, whether or not this bond, being lost, stolen or destroyed shall be found at any time, and shall be entitled to all the benefits of the Ordinance, equally and proportionately with any and all other bonds duly issued thereunder.

In the manner provided in the Ordinance, the Ordinance and the rights and obligations of the City and the owners of the bonds of this issue authorized thereunder, including this bond, may (with certain exceptions as stated in the Ordinance) be modified or amended with the consent of the owners of at least sixty-six and two-thirds percent (66-2/3%) in aggregate principal amount of such bonds exclusive of any such bonds which may be owned by the City.

The Registered Owner of this bond, by the acceptance hereof, hereby agrees to all the terms and provisions contained in the Ordinance.

The City, the Registrar and the Paying Agent may deem and treat the Registered Owner hereof as the absolute owner hereof for the purpose of receiving payment of or on account of principal hereof and the interest due hereon and for all other purposes, and none of the City, the Registrar or the Paying Agent shall be affected by any notice to the contrary.

This bond shall not be valid or become obligatory for any purpose or entitled to any security or benefit under the Ordinance herein described unless and until the certificate of authentication hereon shall have been executed by a duly authorized representative of the Registrar.

The City hereby certifies, recites and declares that all acts, conditions and things required to be done precedent to and in the preparation, execution, issuance and delivery of this bond have been done and performed in regular and due form as required by law.

IN WITNESS WHEREOF, the City of Bloomington, in Monroe County, State of Indiana, has caused this bond to be executed in its corporate name and on its behalf by the manual or facsimile signature of its Mayor and its corporate seal to be hereunto affixed or impressed by any means and attested by the manual or facsimile signature of its Clerk.

CITY OF BLOOMINGTON, INDIANA

By:_____

Mayor

(Seal of the City)

ATTEST:

_____

City Clerk

REGISTRAR'S CERTIFICATE OF AUTHENTICATION

This bond is one of the City of Bloomington, Indiana, Waterworks Revenue Bonds of 20___, issued and delivered pursuant to the provisions of the within-mentioned Ordinance.

_____

By:_____
Authorized Officer

ASSIGNMENT

FOR VALUE RECEIVED the undersigned hereby sells, assigns and transfers unto _____ (insert name and address) the within bond and all rights thereunder, and hereby irrevocably constitutes and appoints _____ attorney to transfer the within bond on the books kept for the registration thereof with full power of substitution in the premises.

Dated: _____

_____
NOTICE: The signature to this assignment must correspond with the name as it appears on the face of the within bond in every particular, without alteration or enlargement or any change whatsoever.

Signature Guarantee:

_____
NOTICE: Signature(s) must be guaranteed by an eligible guarantor institution participating in a Security Transfer Association recognized signature guarantee program.

[SCHEDULE A

PRINCIPAL PAYMENT SCHEDULE]

[End of Bond Form]

FILED
September 22, 2016
INDIANA UTILITY
REGULATORY COMMISSION

STATE OF INDIANA

INDIANA UTILITY REGULATORY COMMISSION

IN THE MATTER OF THE PETITION OF BLOOMINGTON, INDIANA, FOR AUTHORITY TO ISSUE BONDS, NOTES, OR OTHER OBLIGATIONS, FOR AUTHORITY TO INCREASE ITS RATES AND CHARGES FOR WATER SERVICE, AND FOR APPROVAL OF A NEW SCHEDULE OF WATER RATES AND CHARGES	)	**CAUSE NO. 44855**

PETITIONER'S EXHIBIT 4

Direct Testimony of John R. Skomp with Attachment JRS-1

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Attorneys for Petitioner,
The City of Bloomington, Indiana

VERIFIED DIRECT TESTIMONY OF JOHN R. SKOMP
ON BEHALF OF THE CITY OF BLOOMINGTON, INDIANA

Cause No. 44855

INTRODUCTION

1. Q PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A My name is John R. Skomp, and my business address is 10 West Market Street, Suite 2000, Indianapolis, Indiana 46204-2975.

2. Q BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A I am a Partner with Crowe Horwath LLP ("Crowe"), a certified public accounting and consulting firm. Crowe's Performance Municipal Advisory group and its predecessor, Municipal Consultants, have been providing rate and financial consulting services to various types of utility companies for over fifty years.

3. Q PLEASE SUMMARIZE YOUR EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS.

A I received a bachelor's degree in business with a major in accounting and a minor in economics from Indiana University-Purdue University at Indianapolis. During my employment, I have attended and made presentations at numerous seminars and conferences pertaining to accounting, utility and rate issues. Universities, utility

associations, accounting organizations, state regulatory associations, governmental entities and other organizations sponsored these seminars.

4. Q HOW LONG HAVE YOU BEEN EMPLOYED BY CROWE AND IN WHAT CAPACITIES?

A I have been employed by Crowe since 1992 and my responsibilities within Crowe's municipal advisory practice related to utility companies would include supervising and performing analysis on various rate engagements, fuel cost adjustment filings of electric utilities, feasibility studies, cost of service studies, cost of capital analysis, utility financial analysis, utility business valuations, asset valuation projects, and other projects related to a variety of utility issues.

I have worked with banks and financial institutions with regard to both financing and investing opportunities that were presented to our clients. While at Crowe, the utility engagements that I have worked on and been responsible for have included water, sewer, electric, and gas utilities that were established as not-for-profit, for-profit, governmental, or quasi-governmental entities. I have prefiled and given oral testimony to the Indiana Utility Regulatory Commission ("Commission") and courts on a variety of issues over the years including, but not limited to, revenue requirements calculations, accounting methodology and related areas, utility historical and pro forma financial information, cost of capital analysis, rate structure and cost of service issues, issuance of both long and short term debt, utility operating information, and a variety of other utility related issues.

5. Q PLEASE STATE YOUR EXPERIENCE PRIOR TO JOINING CROWE.

A Prior to joining Crowe, I was employed in various capacities in the Accounting Division of the Commission beginning as a staff accountant, advancing to the position of Principal Water and Sewer Accountant and moving into the administrative offices where I was employed as the Commission's Comptroller. I was then employed by the Office of Utility Consumer Counselor (OUCC) as the Director of Utility Analysis with the responsibility for supervising the Accounting, Engineering, and Economics and Finance Divisions. I have prepared and given testimony on behalf of the Commission, the OUCC, utility companies, and interveners during proceedings before the Commission. I am a Certified Public Accountant licensed in the State of Indiana and am a member of the American Water Works Association, the American Institute of Certified Public Accountants, and the Indiana CPA Society.

6. Q HAVE YOU COMPLETED THE REQUIREMENTS NECESSARY TO BE DESIGNATED AS A MUNICIPAL ADVISOR BY THE MUNICIPAL SECURITIES RULEMAKING BOARD ("MSRB")?

A Yes. As part of its expanded mandate under the Dodd-Frank Wall Street Reform and Consumer Protection Act, the MSRB is implementing the first qualifying examination for municipal advisors. MSRB Rule G-3, effective April 27, 2015, creates two classifications of municipal advisor professionals, representative and principal, with firms required to designate at least one principal to oversee the municipal advisory activities of the firm. All municipal advisor representatives and principals are required to take and pass the Series 50 exam to demonstrate the level of knowledge needed to be sufficiently qualified to perform municipal advisory activities. I passed the Series

50 pilot exam in 2016 and, because of that, am a Series 50-qualified municipal advisor representative. Crowe has designated me as one of the municipal advisor principals of the firm.

7. Q WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS CAUSE?

A The purpose of my testimony is to present the revenue requirements of the City of Bloomington ("City"), Indiana Municipal Water Utility ("Utility") based on our analysis of the Utility's books, records and other information. The September 16, 2016, Rate and Financing Report ("Report"), which is prefiled as Petitioner's Attachment JRS-1, documents the results of the analysis that was performed under my supervision and direction.

8. Q WERE THE EXHIBITS AND SCHEDULES (THE "EXHIBITS AND SCHEDULES") WHICH ARE INCLUDED IN THE REPORT PREPARED BY YOU OR PREPARED UNDER YOUR DIRECT SUPERVISION?

A Yes.

9. Q WHAT WERE THE SOURCES OF THE DATA USED TO PREPARE THE EXHIBITS AND SCHEDULES?

A The data used to prepare the Exhibits and Schedules was acquired from the Utility's normal business records. In my opinion, the type of data used in the Exhibits and Schedules of the Report is reliable and is used in the normal course of business for such purposes. Also, in my opinion, the Exhibits and Schedules accurately summarize the results of our analysis using such data.

10. Q PLEASE DESCRIBE SOME OF THE MATERIALS YOU REVIEWED IN ORDER TO PREPARE YOUR TESTIMONY IN THIS CAUSE.

A During my employment with Crowe, I have reviewed numerous documents as part of engagements related to the City's utilities. Some of the materials I reviewed to prepare my testimony would include, but not be limited to, the Utility's books and records, minutes of meetings of the City's Common Council, files of Crowe which are kept in the normal course of business, files of the Utility and our files regarding previous rate cases as well as other materials which are normally examined during an engagement to analyze utility rates and charges.

11. Q WHAT INCREASE IN OPERATING REVENUES IS NEEDED FOR THE UTILITY TO MEET ITS PRO FORMA REVENUE REQUIREMENTS?

A Exhibit G of the Report shows that a 22.45% overall increase in operating revenues is required in order for the Utility to meet its pro forma revenue requirements for: Operation and Maintenance Expenses; Taxes Other Than Income Taxes; Annual Current and Proposed Debt Service payments; Annual Capital Lease payments; and an annual amount for Extension and Replacements (Depreciation Expense). While the exact calculation comes to an increase of 22.45%, it should be noted that the City's Common Council has approved, and is requesting the Commission approve, an across-the-board rate increase of 22% which is a slightly different percentage than is derived from the exact calculation.

12. Q PLEASE PROVIDE AN EXPLANATION OF EXHIBIT A OF THE REPORT.

A Exhibit A represents the Balance Sheets of the Utility as of December 31, 2015, 2014 and 2013. Of note on Exhibit A is that the Utility's plant in service has increased significantly over the last few years. The Utility last petitioned the Commission for rate relief in 2010 in Cause No. 43939 which included approval of a bond issue to expand and upgrade the treatment plant and distribution system. As the Utility has completed those projects, the investment in assets has been capitalized and shown as Utility Plant in Service on Exhibit A.

As can also be seen on Exhibit A, the Operation and Maintenance Fund of the Utility has decreased approximately $917,000 between the year ending December 31, 2013, and December 31, 2015. As the Utility last petitioned the Commission for rate relief over six years ago, it has become apparent that rate relief is now needed in order to maintain the financial sustainability of the Utility. The Long Term Debt section of Exhibit A also shows the addition of the Revenue Bonds of 2011 which were issued after receiving the Commission approval in Cause No. 43939.

13. Q PLEASE EXPLAIN EXHIBIT B AND SCHEDULES B-1 THROUGH B-9 OF THE REPORT.

A Exhibit B represents a summary level overview of the annual debt service on the Utility's long term outstanding debt issuances shown in the Long Term Debt portion of the Balance Sheet (Exhibit A). Schedules B-1 through B-7 provide the detailed amortization schedules of the Waterworks Revenue Bonds of 2000, Series A; the Waterworks Revenue Bonds of 2003, Series A; the Waterworks Revenue Bonds of

2003, Series B; the Waterworks Refunding Revenue Bonds of 2003; the Amended Waterworks Revenue Bonds of 2006, Series A; the Waterworks Revenue Bonds of 2011, Series A; and the Waterworks Revenue Bonds of 2011, Series B (together, "Current Bonds"). Schedules B-8 and B-9 provide the Utility's allocated shares of certain Vehicle and Equipment Leases ("Leases"). The Leases are not included in summary information provided on Exhibit B. I note that the debt is "wrapped" such that the Utility's annual debt service is fairly consistent from year to year, even with the variable maturities of the long term debt.

14. Q PLEASE EXPLAIN EXHIBIT C.

A Exhibit C is the Utility's Statements of Income for the twelve months ended December 31, 2015, 2014, and 2013. The twelve months ended December 31, 2015, has been used as the test year in this Cause and, after reviewing the Utility's books and records and other documentation, I believe this test year fairly represents the Utility's normal operations. In my opinion, with the appropriate adjustments summarized on Exhibit D, including the detail shown on Schedule D-1 of the Report, the test year used in this Cause reasonably reflects current operations and is sufficiently reliable for ratemaking purposes.

15. Q PLEASE EXPLAIN EXHIBIT D OF THE REPORT.

A Exhibit D is the Adjusted Statement of Income that summarizes the adjustments detailed in Schedule D-1. Exhibit D begins with the Utility's historical test year financial information and makes appropriate adjustments for items that are fixed, known and measurable. The results of Exhibit D demonstrate that, without the rate

relief requested in this Cause, the Utility would generate a net operating income of approximately $2.725 million in a pro forma twelve-month period. The Utility's adjusted net operating income would normally be used to pay the combined principal and interest payments on the Current Bonds and the proposed Waterworks Revenue Bonds of 2016 ("Proposed Bonds") and combined annual payment of the Leases. As can be seen on Exhibit F, the five year average combined annual debt service (including the Proposed Bonds) is an estimated $5.6 million. The combined annual payment of the Leases is an additional $159,000. Therefore, the adjusted net operating income calculated in Exhibit D would not be sufficient to make the required payments for the Current Bonds, Proposed Bonds, and Leases, and would also not leave any available funds for cash funded capital projects (annual extensions and replacements).

16. Q PLEASE EXPLAIN ADJUSTMENT (1).

A Adjustment (1) adjusts the Utility's "Metered Sales Commercial" for a billing error which occurred in a previous period but was corrected and credited back to the customer during the test year. The result of this correction was that test year annual revenues were too low and Adjustment (1) reverses that entry so that the revenue shown in the Adjusted column can be reflective of a normal twelve month period.

17. Q WOULD YOU PLEASE EXPLAIN ADJUSTMENT (2), (3) AND (8) ON SCHEDULE D-1?

A Adjustments (2), (3), and (8) are to adjust the Utility's payroll and payroll related expenses. The pro forma salaries and wages amount in Adjustment (2) was calculated

using pay rate and salary information that was obtained from the budgets of the Utility, which are approved on a regular basis by the City's Common Council.

Adjustment (3) is made to adjust test year expenses for the change in the Utility's contributions to the Public Employees Retirement Fund (PERF). A related adjustment, Adjustment (8), allows for the change in the Federal Insurance Contribution Act (FICA) that resulted from the pro forma salaries and wages calculations that were made in Adjustment (2).

18. Q PLEASE EXPLAIN ADJUSTMENT (5) AND ADJUSTMENT (6).

A Adjustment (5) was made to annualize the payment to the City for certain General Services for which they provide to the Utility. The Utility makes the payments to the City on a quarterly basis for such services. However, due to timing of certain past payments, the Utility incurred seven (7) quarters of the General Service payments during the test year which include payments for both 2014 and 2015. Adjustment (5) allows the annual amount for General Services from the City to be reflective of a normal ongoing twelve month period. Adjustment (6) is made to allow for the pro forma amount of Insurance Expense that is allocated to the Utility from the City.

19. Q PLEASE EXPLAIN ADJUSTMENT (7).

A Adjustment (7) was made to adjust depreciation expense for the amount of the Utility Plant in Service plus the Construction Work in Progress as of the end of the test year using a two percent (2%) annual composite depreciation rate. The amount computed for Annual Depreciation Expense is being used in this Cause as an estimate of the

annual amount needed by the Utility for revenue funded capital projects. Therefore, on Exhibit G of the Report, Depreciation Expense is included in the calculation of the Utility annual revenue requirements.

20. Q DO ADJUSTMENTS (9) AND (10) AFFECT THE PRO FORMA AMOUNT OF TAXES OTHER THAN INCOME TAXES?

A Yes. Adjustment (9) adjusts the Utility's amount of utility receipts tax and Adjustment (10) makes an adjustment to allow for the appropriate level of Payment in Lieu of Property Taxes (PILOT) in accordance with the amount of Utility Plant in Service located within the City limits multiplied by the City's Gross Corporate tax rate. PILOT is paid quarterly to the City. The Utility incurred seven (7) quarters of the PILOT payments during the test year which include payments for both 2014 and 2015.

21. Q PLEASE EXPLAIN EXHIBIT E, SCHEDULE E-1 AND EXHIBIT F.

A Exhibit E shows the estimated sources and uses of funds for the Proposed Bonds. In addition to the construction costs provided by the Utility, the Utility is required to fund a debt service reserve for the Proposed Bonds as well as fund the various costs of issuance. Schedule E-1 is the Estimated Amortization Schedule for the Proposed Bonds. The Utility is requesting Commission approval to issue up to $4.6 million in revenue bonds at rates not to exceed five percent (5%) per annum. The interest rates shown on Schedule E-1 reflect market conditions as of March 4, 2016, using a general obligation "AA" rating plus one hundred (100) basis points. The five percent (5%)

interest rate is the maximum permissible interest rate as authorized in the bond ordinance for the Proposed Bonds.

As can be seen on Exhibit E and Schedule E-1, the Utility is currently projecting that the project can be completed with the issuance of $4.575 million of additional debt. However, given the timing of when the Proposed Bonds would actually be issued, the City and Utility have requested approval for the issuance of up to $4.6 million in additional debt in order to provide for a margin in case project costs or interest rates increase.

Exhibit F is the Estimated Combined Amortization Schedule for the Current Bonds and the Proposed Bonds. It provides a calculation of the Estimated Five Year Average Combined Annual Debt Service for the period 2017 through and including 2021.

22. Q IS THE ISSUANCE OF THE PROPOSED BONDS A REASONABLE METHOD OF FINANCING THE PROJECTS?

A Yes. As can be seen on Schedule E-1, the Proposed Bonds are to be issued for a term of twenty (20) years. It is anticipated that the improvements funded by the bond issue will benefit customers well into the future and specifically during the time the Proposed Bonds will be outstanding. I believe the issuance of the Proposed Bonds to fund the needed improvements is both reasonable and appropriate.

1 **23. Q WHAT IS THE UTILITY'S TOTAL PROPOSED REVENUE**
2 **REQUIREMENT?**
3 A The Utility's total pro forma revenue requirement total is $17,514,877, as shown on
4 Exhibit G. After deducting the operating revenues, the Utility has a revenue shortfall
5 of $3,078,113 before consideration of the utility receipts tax. When the utility receipts
6 tax is considered, the revenue shortfall is $3,121,818. The revenue requirement
7 necessitates a 22.45% overall increase in operating revenues in order for the Utility to
8 fully fund its revenue requirements.

9 **24. Q PLEASE EXPLAIN EXHIBIT H.**
10 A Exhibit H is a schedule showing the present rates of the Utility along with the
11 proposed rates that the Utility is requesting Commission approval using the 22%
12 across-the-board increase approved by the City's Common Council.

13 **25. Q DOES THIS CONCLUDE YOUR PREFILED DIRECT TESTIMONY?**
14 A Yes.

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: John R. Skomp

Dated: September 20, 2016

CITY OF BLOOMINGTON, INDIANA

PETITIONER'S ATTACHMENT JRS-1

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

RATE AND FINANCING REPORT

September 16, 2016

Crowe Horwath.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

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BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

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BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

PURPOSE OF THE REPORT

Crowe Horwath LLP has performed a study and analysis of the operating and financial reports, budgets, and other data pertaining to the City of Bloomington Municipal Water Utility ("Utility"). The results of our analysis are contained in this Rate and Financing Report ("Report").

The purpose of the Report is to estimate the Utility's cash flow and financial capacity to meet its on-going revenue requirements for operation and maintenance expenses, present and proposed debt service, and make capital improvements to the Utility's system. This Report is based on data for the twelve months ended December 31, 2015. The historical information used in this Report was taken from the books and records of the Utility and was adjusted as necessary for fixed, known and measurable items as discussed in the Exhibits and Schedules of this Report.

In the course of preparing this Report, we have not conducted an audit of any financial or supplemental data used in the accompanying Exhibits and Schedules. We have made certain projections that may vary from actual results because events and circumstances frequently do not occur as estimated and such variances may be material. We have no responsibility to update this Report for events and circumstances occurring after the date of this Report.

If you have any questions regarding this Report, please call John Skomp (317) 269-6699 or Angie Steeno (317) 269-2367.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Balance Sheets as of December 31, 2015, 2014, and 2013

	2015	2014	2013
ASSETS AND OTHER DEBITS			
Utility Plant			
Utility Plant in Service	$ 137,589,429	$ 120,162,984	$ 99,900,126
Less: Accumulated Depreciation	(45,076,564)	(42,574,201)	(40,356,842)
Accumulated Amortization	(49,649)	(46,609)	(43,569)
Net Utility Plant in Service	92,463,216	77,542,174	59,499,715
Add: Construction Work in Progress	1,600,920	17,359,143	35,805,761
Net Utility Plant	94,064,136	94,901,317	95,305,476
Restricted Assets			
Sinking Fund	422	2,588	4,485
Hydrant Meter Fund	35,850	32,200	35,150
Cash with Fiscal Agent	1,453,727	1,467,115	1,485,592
Debt Service Reserve Fund	5,639,105	5,639,133	5,643,615
Construction Fund	526,601	1,622,780	598,610
Total Restricted Assets	7,655,705	8,763,816	7,767,452
Current and Accrued Assets			
Operation and Maintenance Fund	2,907,539	3,313,594	3,824,687
Accounts Receivable - Net	683,305	717,657	682,978
Materials and Supplies	486,763	461,793	559,657
Prepaid Expenses	623	632	328
Total Current and Accrued Assets	4,078,230	4,493,676	5,067,650
Deferred Debits			
Unamortized Bond Discount	446,568	420,270	446,568
Unamortized Bond Issuance Costs	136,410	153,858	171,305
Deferral Loss on Advancement	220,859	276,074	331,288
Total Deferred Debits	803,837	850,202	949,161
Total Assets and Other Debits	$ 106,601,908	$ 109,009,011	$ 109,089,739

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Balance Sheets as of December 31, 2015, 2014, and 2013

LIABILITIES AND OTHER CREDITS	2015	2014	2013
Equity Capital			
Unappropriated Retained Earnings	$ 36,678,784	$ 34,452,978	$ 32,537,291
Current Year Earnings	647,802	2,157,670	1,915,687
Total Equity Capital	37,326,586	36,610,648	34,452,978
Long Term Debt			
Refunding Revenue Bonds of 2003	2,040,000	2,480,000	2,480,000
Revenue Bonds of 2006	3,217,300	3,720,000	3,720,000
Revenue Bonds of 2011	33,320,000	33,990,000	33,990,000
State Revolving Fund Loans	16,015,000	17,846,000	17,846,000
Long Term Lease	380,515	237,002	312,623
Total Long Term Debt	54,972,815	58,273,002	58,348,623
Current and Accrued Liabilities			
Accounts Payable	20,593	(77,716)	48,104
Revenue Bonds - Current	672,172	655,000	1,955,000
State Revolving Fund Loans - Current	-	-	1,775,000
Accounts Payable to Associated Company	418,703	420,791	985,863
Compensated Absences Payable	139,676	151,855	170,343
Customer Deposits	36,200	33,200	36,150
Unearned Revenue	99,479	60,151	53,910
Accrued Taxes	60,579	65,558	59,437
Accrued Payroll	87,577	76,716	62,055
Short Term Lease	109,179	38,017	37,197
Total Current and Accrued Liabilities	1,644,158	1,423,572	5,183,059
Deferred Credits			
Unamortized Bond Premium	255,281	316,439	324,226
Advances for Construction	378,935	361,217	389,659
Total Deferred Credits	634,216	677,656	713,885
Contributions in Aid			
Contributions in Aid of Construction	12,024,133	12,024,133	10,391,194
Total Liabilities and Other Credits	$ 106,601,908	$ 109,009,011	$ 109,089,739

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Combined Amortization Schedule

Year	2000 SRF Loan	2003 A SRF Loan	2003 B SRF Loan	2003 Refunding Bonds	Amended 2006 Bonds	2011 A SRF Loan	2011 B Bonds	Total
2016	$1,076,504	$ 294,493	$ 551,330	$ 561,625	$ 381,328	$ 482,430	$ 1,963,325	$ 5,311,035
2017	1,076,084	294,639	551,552	554,913	379,833	486,099	1,972,850	5,315,970
2018	1,075,867	294,521	551,313	567,638	382,739	484,205	1,961,625	5,317,908
2019	1,075,838	295,139	551,595	568,563	379,838	481,937	1,969,950	5,322,860
2020	1,075,954	295,443	551,399		381,207	484,200	2,544,726	5,332,929
2021		296,451	551,691		381,836	485,996	3,632,413	5,348,387
2022		295,145	551,455		376,721	482,229	3,654,500	5,360,050
2023			551,691		380,895	482,994	3,965,800	5,381,380
2024			551,349		374,101	483,292	4,002,800	5,411,542
2025					376,743	482,933	4,587,900	5,447,576
2026					378,382	487,106	4,634,300	5,499,788
2027						485,436	5,093,300	5,578,736
2028						483,205	5,155,900	5,639,105
Totals	$5,380,247	$2,065,831	$4,963,375	$2,252,739	$4,173,623	$6,292,062	$ 45,139,389	$ 70,267,266

Five Year Average Annual Debt Service (2017 though 2021) $ 5,327,611

Maximum Annual Debt Service (2028) $ 5,639,105

EXHIBIT B

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Waterworks Revenue Bonds of 2000, Series A
State Revolving Fund (SRF) Loan
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 467,000	2.9 %	$ 72,138	$ 539,138	
1/1/17	472,000	2.9	65,366	537,366	$1,076,504
7/1/17	480,000	2.9	58,522	538,522	
1/1/18	486,000	2.9	51,562	537,562	1,076,084
7/1/18	494,000	2.9	44,515	538,515	
1/1/19	500,000	2.9	37,352	537,352	1,075,867
7/1/19	508,000	2.9	30,102	538,102	
1/1/20	515,000	2.9	22,736	537,736	1,075,838
7/1/20	523,000	2.9	15,269	538,269	
1/1/21	530,000	2.9	7,685	537,685	1,075,954
Totals	$ 4,975,000		$ 405,247	$5,380,247	

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Waterworks Revenue Bonds of 2003, Series A
State Revolving Fund (SRF) Loan
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 117,000	3.3 %	$ 30,212	$ 147,212	
1/1/17	119,000	3.3	28,281	147,281	$ 294,493
7/1/17	121,000	3.3	26,318	147,318	
1/1/18	123,000	3.3	24,321	147,321	294,639
7/1/18	125,000	3.3	22,292	147,292	
1/1/19	127,000	3.3	20,229	147,229	294,521
7/1/19	129,000	3.3	18,134	147,134	
1/1/20	132,000	3.3	16,005	148,005	295,139
7/1/20	134,000	3.3	13,827	147,827	
1/1/21	136,000	3.3	11,616	147,616	295,443
7/1/21	139,000	3.3	9,372	148,372	
1/1/22	141,000	3.3	7,079	148,079	296,451
7/1/22	143,000	3.3	4,752	147,752	
1/1/23	145,000	3.3	2,393	147,393	295,145
Totals	$ 1,831,000		$ 234,831	$ 2,065,831	

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Waterworks Revenue Bonds of 2003, Series B
State Revolving Fund (SRF) Loan
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 205,000	3.3 %	$ 70,356	$ 275,356	
1/1/17	209,000	3.3	66,974	275,974	$ 551,330
7/1/17	212,000	3.3	63,525	275,525	
1/1/18	216,000	3.3	60,027	276,027	551,552
7/1/18	219,000	3.3	56,463	275,463	
1/1/19	223,000	3.3	52,850	275,850	551,313
7/1/19	227,000	3.3	49,170	276,170	
1/1/20	230,000	3.3	45,425	275,425	551,595
7/1/20	234,000	3.3	41,630	275,630	
1/1/21	238,000	3.3	37,769	275,769	551,399
7/1/21	242,000	3.3	33,842	275,842	
1/1/22	246,000	3.3	29,849	275,849	551,691
7/1/22	250,000	3.3	25,790	275,790	
1/1/23	254,000	3.3	21,665	275,665	551,455
7/1/23	258,000	3.3	17,474	275,474	
1/1/24	263,000	3.3	13,217	276,217	551,691
7/1/24	267,000	3.3	8,877	275,877	
1/1/25	271,000	3.3	4,472	275,472	551,349
Totals	$ 4,264,000		$ 699,375	$ 4,963,375	

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Waterworks Refunding Revenue Bonds of 2003
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 230,000	4.50 %	$ 45,900	$ 275,900	
1/1/17	245,000	4.50	40,725	285,725	$ 561,625
7/1/17	245,000	4.50	35,213	280,213	
1/1/18	245,000	4.50	29,700	274,700	554,913
7/1/18	255,000	4.50	24,188	279,188	
1/1/19	270,000	4.50	18,450	288,450	567,638
7/1/19	275,000	4.50	12,375	287,375	
1/1/20	275,000	4.50	6,188	281,188	568,563
Totals	$2,040,000		$ 212,739	$2,252,739	

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Amended Waterworks Revenue Bonds of 2006, Series A
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 115,700	4.55 %	$ 76,380	$ 192,080	
1/1/17	115,500	4.59	73,748	189,248	$ 381,328
7/1/17	120,300	4.59	71,097	191,397	
1/1/18	120,100	4.62	68,336	188,436	379,833
7/1/18	124,900	4.62	65,562	190,462	
1/1/19	129,600	4.64	62,677	192,277	382,739
7/1/19	129,400	4.64	59,670	189,070	
1/1/20	134,100	4.73	56,668	190,768	379,838
7/1/20	138,900	4.73	53,496	192,396	
1/1/21	138,600	4.75	50,211	188,811	381,207
7/1/21	143,300	4.75	46,920	190,220	
1/1/22	148,100	4.78	43,516	191,616	381,836
7/1/22	147,800	4.78	39,977	187,777	
1/1/23	152,500	4.80	36,444	188,944	376,721
7/1/23	157,200	4.80	32,784	189,984	
1/1/24	161,900	4.83	29,011	190,911	380,895
7/1/24	161,600	4.83	25,102	186,702	
1/1/25	166,200	4.83	21,199	187,399	374,101
7/1/25	170,900	4.83	17,185	188,085	
1/1/26	175,600	4.83	13,058	188,658	376,743
7/1/26	180,200	4.83	8,817	189,017	
1/1/27	184,900	4.83	4,465	189,365	378,382
Totals	$3,217,300		$ 956,323	$4,173,623	

Note: The 2006 A-1 Bonds were issued through the Indiana Bond Bank. The amortization schedule was amended March 26, 2015, and resulted in a reduction in the overall payments of approximately $480,000.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Waterworks Revenue Bonds of 2011, Series A
State Revolving Fund (SRF) Loan
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 150,000	3.746 %	$ 92,620	$ 242,620	
1/1/17	150,000	3.746	89,810	239,810	$ 482,430
7/1/17	155,000	3.746	87,001	242,001	
1/1/18	160,000	3.746	84,098	244,098	486,099
7/1/18	160,000	3.746	81,101	241,101	
1/1/19	165,000	3.746	78,104	243,104	484,205
7/1/19	165,000	3.746	75,014	240,014	
1/1/20	170,000	3.746	71,923	241,923	481,937
7/1/20	175,000	3.746	68,739	243,739	
1/1/21	175,000	3.746	65,461	240,461	484,200
7/1/21	180,000	3.746	62,184	242,184	
1/1/22	185,000	3.746	58,812	243,812	485,996
7/1/22	185,000	3.746	55,347	240,347	
1/1/23	190,000	3.746	51,882	241,882	482,229
7/1/23	195,000	3.746	48,323	243,323	
1/1/24	195,000	3.746	44,671	239,671	482,994
7/1/24	200,000	3.746	41,019	241,019	
1/1/25	205,000	3.746	37,273	242,273	483,292
7/1/25	210,000	3.746	33,433	243,433	
1/1/26	210,000	3.746	29,500	239,500	482,933
7/1/26	215,000	3.746	25,566	240,566	
1/1/27	225,000	3.746	21,540	246,540	487,106
7/1/27	225,000	3.746	17,325	242,325	
1/1/28	230,000	3.746	13,111	243,111	485,436
7/1/28	235,000	3.746	8,803	243,803	
1/1/29	235,000	3.746	4,402	239,402	483,205
Totals	$ 4,945,000		$ 1,347,062	$ 6,292,062	

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Waterworks Revenue Bonds of 2011, Series B
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total
7/1/16	$ 335,000	3.0 %	$ 646,675	$ 981,675	
1/1/17	340,000	3.0	641,650	981,650	$ 1,963,325
7/1/17	350,000	3.0	636,550	986,550	
1/1/18	355,000	3.0	631,300	986,300	1,972,850
7/1/18	355,000	3.0	625,975	980,975	
1/1/19	360,000	3.0	620,650	980,650	1,961,625
7/1/19	370,000	3.0	615,250	985,250	
1/1/20	375,000	3.5	609,700	984,700	1,969,950
7/1/20	660,000	3.5	603,138	1,263,138	
1/1/21	690,000	3.5	591,588	1,281,588	2,544,726
7/1/21	1,235,000	3.5	579,513	1,814,513	
1/1/22	1,260,000	4.0	557,900	1,817,900	3,632,413
7/1/22	1,295,000	4.0	532,700	1,827,700	
1/1/23	1,320,000	4.0	506,800	1,826,800	3,654,500
7/1/23	1,500,000	4.0	480,400	1,980,400	
1/1/24	1,535,000	4.0	450,400	1,985,400	3,965,800
7/1/24	1,580,000	4.0	419,700	1,999,700	
1/1/25	1,615,000	4.0	388,100	2,003,100	4,002,800
7/1/25	1,935,000	4.0	355,800	2,290,800	
1/1/26	1,980,000	4.0	317,100	2,297,100	4,587,900
7/1/26	2,035,000	4.0	277,500	2,312,500	
1/1/27	2,085,000	4.0	236,800	2,321,800	4,634,300
7/1/27	2,345,000	4.0	195,100	2,540,100	
1/1/28	2,405,000	4.0	148,200	2,553,200	5,093,300
7/1/28	2,465,000	4.0	100,100	2,565,100	
1/1/29	2,540,000	4.0	50,800	2,590,800	5,155,900
Totals	$ 33,320,000		$11,819,389	$ 45,139,389	

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Vehicle and Equipment Lease - 2013
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total	Water Portion (1)
7/15/16	$ 103,191	2.19 %	$ 5,775	$ 108,966		
1/15/17	104,320	2.19	4,645	108,965	$ 217,931	$82,061
7/15/17	105,463	2.19	3,503	108,966		
1/15/18	106,618	2.19	2,348	108,966	217,932	82,059
7/15/18	107,785	2.19	1,180	108,965	108,965	41,029
Totals	$ 527,377		$ 17,451	$ 544,828		

(1) The Vehicle and Equipment Lease - 2013 payments are allocated between the Utility and the Bloomington Municipal Sewage Works. The Utility's allocated share is approximately thirty-eight percent (38%).

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Vehicle and Equipment Lease - 2014
Amortization Schedule

Date	Principal	Coupon	Interest	Period Total	Fiscal Total	Water Portion (1)
7/1/16	$ 155,809	2.28 %	$ 14,790	$ 170,599		
1/1/17	157,585	2.28	13,014	170,599	$ 341,198	$ 76,443
7/1/17	159,382	2.28	11,217	170,599		
1/1/18	161,199	2.28	9,400	170,599	341,198	76,474
7/1/18	163,037	2.28	7,563	170,600		
1/1/19	164,895	2.28	5,704	170,599	341,199	76,507
7/1/19	166,775	2.28	3,824	170,599		
1/1/20	168,676	2.28	1,923	170,599	341,198	76,537
Totals	$ 1,297,358		$ 67,435	$1,364,793		

(1) The Vehicle and Equipment Lease - 2014 payments are allocated between the Utility, the Bloomington Municipal Sewage Works, and the Bloomington Municipal Stormwater Utility. The Utility's allocated share is approximately twenty-two percent (22%).

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Statements of Income for the Twelve Months Ended
December 31, 2015, 2014, and 2013

	2015	2014	2013
Operating Revenues			
Metered Sales Residential	$ 3,975,651	$ 4,061,955	$ 4,070,899
Metered Sales Commercial	1,388,105	1,768,416	2,977,058
Metered Sales Industrial	136,758	239,601	384,479
Sales to Public Authorities	1,561,736	1,573,285	1,407,746
Multiple Family Dwellings	3,054,909	3,169,034	3,101,245
Public Fire Protection	660,191	661,338	649,851
Private Fire Protection	611,910	624,481	615,663
Irrigation Sales	306,620	273,982	374,470
Sales for Resale	2,011,156	2,103,381	714,855
Forfeited Discounts	28,964	27,145	22,826
Connection Charges	210,614	282,559	258,400
Miscellaneous Operating Revenues	289,269	271,725	220,133
Total Operating Revenues	14,235,883	15,056,902	14,797,625
Operating Expenses			
Operation and Maintenance Expenses			
Source of Supply	1,499,331	1,637,122	1,567,340
Water Treatment	1,354,844	1,223,495	1,011,972
Transmission and Distribution	1,739,923	1,711,371	1,607,169
Customer Accounts	576,649	639,959	638,306
Engineering	407,467	413,563	412,614
Administrative and General	2,763,769	2,257,694	2,186,248
Total Operation and Maintenance Expenses	8,341,983	7,883,204	7,423,649
Depreciation Expense	2,766,205	2,432,722	2,107,069
Amortization Expense	3,040	3,040	3,040
Taxes Other Than Income Taxes			
Utility Receipts Tax	168,777	173,180	154,163
FICA	191,540	192,309	185,841
Payment in Lieu of Property Taxes	354,653	46,255	138,764
Total Taxes Other Than Income Taxes	714,970	411,744	478,768
Total Operating Expenses	11,826,198	10,730,710	10,012,526
Net Operating Income	2,409,685	4,326,192	4,785,099

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Statements of Income for the Twelve Months Ended
December 31, 2015, 2014, and 2013

	2015	2014	2013
Other Income			
Interest Income	$ (2,825)	$ 1,923	$ 13,883
Income from Contractors	40,233	10,638	33,922
Miscellaneous Other Income	44,719	190,407	12,721
Extraordinary Income	390,528	-	-
Total Other Income	472,655	202,968	60,526
Other Expenses			
Interest Expense	2,234,538	2,371,490	2,734,129
Transfer Adjustment	-	-	195,809
Total Other Expenses	2,234,538	2,371,490	2,929,938
Net Income	$ 647,802	$ 2,157,670	$ 1,915,687

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Adjusted Statement of Income

	December 31, 2015	Adjustments Amount	Ref.	Adjusted
Operating Revenues				
Metered Sales Residential	$ 3,975,651			$ 3,975,651
Metered Sales Commercial	1,388,105	$ 200,881	(1)	1,588,986
Metered Sales Industrial	136,758			136,758
Sales to Public Authorities	1,561,736			1,561,736
Multiple Family Dwellings	3,054,909			3,054,909
Public Fire Protection	660,191			660,191
Private Fire Protection	611,910			611,910
Irrigation Sales	306,620			306,620
Sales for Resale	2,011,156			2,011,156
Forfeited Discounts	28,964			28,964
Connection Charges	210,614			210,614
Miscellaneous Operating Revenues	289,269			289,269
Total Operating Revenues	14,235,883	200,881		14,436,764
Operating Expenses				
Operation and Maintenance Expenses	8,341,983	124,755	(2)	8,236,805
		32,522	(3)	
		(17,446)	(4)	
		(256,543)	(5)	
		11,534	(6)	
Depreciation Expense	2,766,205	(12,365)	(7)	2,753,840
Amortization Expense	3,040			3,040
Taxes Other Than Income Taxes	714,970	18,958	(8)	719,076
		33,324	(9)	
		(48,176)	(10)	
Total Operating Expenses	11,826,198	(113,437)		11,712,761
Net Operating Income	$ 2,409,685	$ 314,318		$ 2,724,003

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Detail of Adjustments

(1)
To adjust "Metered Sales Commercial" for billing correction.

Adjustment - Increase		$ 200,881

(2)
To adjust "Operation and Maintenance Expenses" for the pro forma salaries and wages.

Pro Forma Salaries and Wages	$ 2,798,005	
Less: Test Year	(2,673,250)	
Adjustment - Increase		$ 124,755

(3)
To adjust "Operation and Maintenance Expenses" for the estimated change in PERF expense due to the change in salaries and wages.

Pro Forma Salaries and Wages	$ 2,798,005	
Less: Pro Forma Salaries and Wages not eligible for PERF benefits	(46,396)	
Pro Forma Salaries and Wages (PERF Eligible)	2,751,609	
Times: PERF Rate	14.2%	
Pro Forma PERF Expense	390,728	
Less: Test Year	(358,206)	
Adjustment - Increase		$ 32,522

(4)
To adjust "Operation and Maintenance Expenses" for the removal of bond issuance expense.

Adjustment - Decrease		$ (17,446)

(5)
To adjust "Operation and Maintenance Expenses" to account for annual General Services expense allocated to the Utility for shared services.

Pro Forma General Services Expense	$ 367,914	
Less: Test Year (Includes Seven Quarters of Payments)	(624,457)	
Adjustment - Decrease		$ (256,543)

(6)
To adjust "Operation and Maintenance Expenses" for the increase in Insurance Services allocated to the Utility.

Pro Forma Insurance Services Expense	$ 876,018	
Less: Test Year	(864,484)	
Adjustment - Increase		$ 11,534

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Detail of Adjustments

(7)

To adjust "Depreciation Expense" for the increase in Utility Plant in Service

Utility Plant in Service as of December 31, 2015	$ 137,589,429	
Add: Construction Work in Progress	1,600,920	
Less: Land and Land Rights	(1,437,571)	
Less: Amortizable Assets	(60,794)	
Depreciable Utility Plant in Service	137,691,984	
Times: Depreciation Rate	2%	
Pro Forma Depreciation Expense	2,753,840	
Less: Test Year	(2,766,205)	
Adjustment - Decrease		$ (12,365)

(8)

To adjust "Taxes Other Than Income Taxes" for the estimated change in FICA tax due to the change in salaries and wages.

Pro Forma Salaries and Wages	$ 2,798,005	
Less: Pro Forma Salaries and Wages not eligible for FICA benefits	(46,396)	
Pro Forma Salaries and Wages (FICA Eligible)	2,751,609	
Times: FICA Tax Rate	7.65%	
Pro Forma FICA Tax	210,498	
Less: Test Year	(191,540)	
Adjustment - Increase		$ 18,958

(9)

To adjust "Taxes Other Than Income Taxes" to annualize the utility receipts tax at the adjusted level of operating revenue.

Adjusted Operating Revenues	$ 14,436,764	
Less: Exemption	(1,000)	
Taxable Revenues	14,435,764	
Times: Utility Receipts Tax Rate	1.4%	
Adjusted Utility Receipts Tax	202,101	
Less: Test Year	(168,777)	
Adjustment - Increase		$ 33,324

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Detail of Adjustments

(10)

To adjust "Taxes Other Than Income Taxes" for the pro forma Payment in Lieu of Property Taxes (PILOT).

Net Utility Plant as of December 31, 2015	$ 92,463,216	
Add: Construction Work in Progress as of December 31, 2015	1,600,920	
Less: Outside City Utility Plant in Service	(58,202,095)	
Inside City Net Utility Plant as of December 31, 2015	35,862,041	
Times: Gross Corporate Tax Rate (per $100 Assessed Valuation)	0.8546	
Pro Forma Payment in Lieu of Property Taxes	306,477	
Less: Test Year (Includes Seven Quarters of Payments)	(354,653)	
Adjustment - Decrease		$ (48,176)

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Proposed Waterworks Revenue Bonds of 2016
Estimated Sources and Uses of Funds

Sources of Funds:	
Par Amount	$ 4,575,000
Total Sources of Funds	$ 4,575,000
Uses of Funds:	
Fullerton Pike Project (1)	$ 1,800,000
Water Main Replacement Program (1)	2,300,000
Debt Service Reserve Fund (2)	317,372
Underwriter's Discount (1% of Par)	45,750
Cost of Issuance	111,878
Total Uses of Funds	$ 4,575,000

(1) Provided by the Utility.
(2) Funded at Maximum Annual Debt Service taking into account the Proposed 2016 Bonds and all other outstanding Bonds of the Utility.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Proposed Waterworks Revenue Bonds of 2016
Estimated Amortization Schedule

Date	Principal	Coupon (1)	Interest	Period Total	Fiscal Total
7/1/17	$ 85,000	1.45 %	72,011	$ 157,011	
1/1/18	90,000	1.65	71,395	161,395	$ 318,406
7/1/18	90,000	1.65	70,653	160,653	
1/1/19	90,000	1.85	69,910	159,910	320,563
7/1/19	90,000	1.85	69,078	159,078	
1/1/20	90,000	2.05	68,245	158,245	317,323
7/1/20	90,000	2.05	67,323	157,323	
1/1/21	95,000	2.20	66,400	161,400	318,723
7/1/21	90,000	2.20	65,355	155,355	
1/1/22	100,000	2.40	64,365	164,365	319,720
7/1/22	100,000	2.40	63,165	163,165	
1/1/23	95,000	2.60	61,965	156,965	320,130
7/1/23	100,000	2.60	60,730	160,730	
1/1/24	100,000	2.80	59,430	159,430	320,160
7/1/24	100,000	2.80	58,030	158,030	
1/1/25	105,000	3.00	56,630	161,630	319,660
7/1/25	105,000	3.00	55,055	160,055	
1/1/26	105,000	3.10	53,480	158,480	318,535
7/1/26	110,000	3.10	51,853	161,853	
1/1/27	110,000	3.25	50,148	160,148	322,001
7/1/27	115,000	3.25	48,360	163,360	
1/1/28	110,000	3.35	46,491	156,491	319,851
7/1/28	115,000	3.35	44,649	159,649	
1/1/29	115,000	3.45	42,723	157,723	317,372
7/1/29	115,000	3.45	40,739	155,739	
1/1/30	125,000	3.50	38,755	163,755	319,494
7/1/30	125,000	3.50	36,568	161,568	
1/1/31	125,000	3.60	34,380	159,380	320,948
7/1/31	125,000	3.60	32,130	157,130	
1/1/32	130,000	3.70	29,880	159,880	317,010
7/1/32	130,000	3.70	27,475	157,475	
1/1/33	135,000	3.75	25,070	160,070	317,545
7/1/33	135,000	3.75	22,539	157,539	
1/1/34	140,000	3.80	20,008	160,008	317,547
7/1/34	140,000	3.80	17,348	157,348	
1/1/35	145,000	3.85	14,688	159,688	317,036
7/1/35	150,000	3.85	11,896	161,896	
1/1/36	150,000	3.90	9,009	159,009	320,905
7/1/36	155,000	3.90	6,084	161,084	
1/1/37	155,000	3.95	3,061	158,061	319,145
Totals	$ 4,575,000		$ 1,807,074	$ 6,382,074	

(1) Assumes "AA" rates plus 100 basis points as of March 4, 2016. Interest rates are estimated and subject to change.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Estimated Combined Amortization Schedule

Year	2000 SRF Loan	2003 A SRF Loan	2003 B SRF Loan	2003 Refunding Bonds	Amended 2006 Bonds	2011 A SRF Loan	2011 B Bonds	Estimated 2016 Bonds	Total
2016	$ 1,076,504	$ 294,493	$ 551,330	$ 561,625	$ 381,328	$ 482,430	$ 1,963,325		$ 5,311,035
2017	1,076,084	294,639	551,552	554,913	379,833	486,099	1,972,850	$ 318,406	5,634,376
2018	1,075,867	294,521	551,313	567,638	382,739	484,205	1,961,625	320,563	5,638,471
2019	1,075,838	295,139	551,595	568,563	379,838	481,937	1,969,950	317,323	5,640,183
2020	1,075,954	295,443	551,399		381,207	484,200	2,544,726	318,723	5,651,652
2021		296,451	551,691		381,836	485,996	3,632,413	319,720	5,668,107
2022		295,145	551,455		376,721	482,229	3,654,500	320,130	5,680,180
2023			551,691		380,895	482,994	3,965,800	320,160	5,701,540
2024			551,349		374,101	483,292	4,002,800	319,660	5,731,202
2025					376,743	482,933	4,587,900	318,535	5,766,111
2026					378,382	487,106	4,634,300	322,001	5,821,789
2027						485,436	5,093,300	319,851	5,898,587
2028						483,205	5,155,900	317,372	5,956,477
2029								319,494	319,494
2030								320,948	320,948
2031								317,010	317,010
2032								317,545	317,545
2033								317,547	317,547
2034								317,036	317,036
2035								320,905	320,905
2036								319,145	319,145
Totals	$ 5,380,247	$ 2,065,831	$ 4,963,375	$ 2,252,739	$ 4,173,623	$ 6,292,062	$ 45,139,389	$ 6,382,074	$ 76,649,340

Estimated Five Year Average Annual Debt Service (2017 though 2021) $ 5,646,558

Maximum Annual Debt Service (2028) $ 5,956,477

EXHIBIT F

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Statement of Revenue Requirements

	Revenue Requirements
Adjusted Operation and Maintenance Expenses (Exhibit D)	$ 8,236,805
Adjusted Taxes Other Than Income Taxes (Exhibit D)	719,076
Estimated Five Year Average Annual Debt Service (Exhibit F)	5,646,558
Annual Capital Lease Payment - 2013 (Schedule B-8)	82,061
Annual Capital Lease Payment - 2014 (Schedule B-9)	76,537
Annual Extensions and Replacements (Exhibit D) (Depreciation Expense)	2,753,840
Total Revenue Requirements	17,514,877
Less: Adjusted Operating Revenues (Exhibit D)	(14,436,764)
Deficit	3,078,113
Divide by: Revenue Conversion Factor	0.986
Revenue Increase Required	3,121,818
Divide by: Adjustable Operating Revenues (Exhibit D)	13,907,917
Percentage Rate Increase Required	22.45%

Note: The Common Council approved Ordinance 16-08 on July 12, 2016, which provided for a twenty-two percent (22.00%) rate increase.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Schedule of Present and Proposed Rates and Charges

	Present Rates (1)	Proposed Rates (2)
Monthly Usage Charge (Per 1,000 Gallons)		
Residential	$ 3.11	$ 3.79
Commercial, Governmental, Interdepartmental	2.63	3.21
Industrial	2.43	2.96
Indiana University - Master Metered	1.97	2.40
Indiana University - Non-Master Metered	2.63	3.21
Irrigation	2.85	3.48
Contract Sales for Resale Monthly Usage Charge (Per 1,000 Gallons)	$ 1.99	$ 2.43
Monthly Service Charge (in addition to Monthly Usage Charge)		
5/8 inch meter	$ 4.91	$ 5.99
3/4 inch meter	6.55	7.99
1 inch meter	8.82	10.76
1 1/2 inch meter	15.32	18.69
2 inch meter	21.82	26.62
3 inch meter	50.43	61.52
4 inch meter	82.93	101.17
6 inch meter	164.19	200.31
8 inch meter	245.45	299.45
10 inch meter	326.70	398.57

(1) Present Rates and Charges were approved by the Indiana Utility Regulatory Commission on March 2, 2011, and effective November 28, 2011.

(2) Reflects the twenty-two percent (22.00%) rate increase approved by the Common Council through Ordinance 16-08 on July 12, 2016.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Schedule of Present and Proposed Rates and Charges

		Present Rates (1)	Proposed Rates (2)
Monthly Public Fire Protection Charge - Inside City (excluding Indiana University - Master Metered)			
5/8	inch meter	$ 1.63	$ 1.99
3/4	inch meter	2.44	2.98
1	inch meter	4.07	4.97
1 1/2	inch meter	8.15	9.94
2	inch meter	13.03	15.90
3	inch meter	28.51	34.78
4	inch meter	48.87	59.62
6	inch meter	101.84	124.24
8	inch meter	146.64	178.90
10	inch meter	236.24	288.21
Monthly Public Fire Protection Charge - Outside City (excluding Indiana University - Master Metered)			
5/8	inch meter	$ 2.73	$ 3.33
3/4	inch meter	4.11	5.01
1	inch meter	6.85	8.36
1 1/2	inch meter	13.67	16.68
2	inch meter	21.90	26.72
3	inch meter	47.89	58.43
4	inch meter	82.07	100.13
6	inch meter	170.99	208.61
8	inch meter	246.21	300.38
10	inch meter	396.69	483.96
Monthly Fire Protection Charge - Indiana University - Master Metered		$1,494.63	$1,823.45

Monthly Private Fire Protection Charge (per connection)		Monthly	Annual	
4	inch line or smaller	$ 8.21	$ 98.52	$ 120.19
6	inch line	22.82	273.84	334.08
8	inch line	46.77	561.24	684.71
10	inch line	81.91	982.92	1,199.16
12	inch line	129.14	1,549.68	1,890.61

(1) Present Rates and Charges were approved by the Indiana Utility Regulatory Commission on March 2, 2011 and effective November 28, 2011.

(2) Reflects the twenty-two percent (22.00%) rate increase approved by the Common Council through Ordinance 16-08 on July 12, 2016.

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Typical Residential Monthly Bill Analysis

5/8 Inch Meter

Gallons	Present Charge	Proposed Charge	Difference
0	$ 6.54	$ 7.98	$ 1.44
1,000	9.65	11.77	2.12
2,000	12.76	15.56	2.80
3,000	15.87	19.35	3.48
4,000	18.98	23.14	4.16
5,000	22.09	26.93	4.84
6,000	25.20	30.72	5.52
7,000	28.31	34.51	6.20
8,000	31.42	38.30	6.88
9,000	34.53	42.09	7.56
10,000	37.64	45.88	8.24

3/4 Inch Meter

Gallons	Present Charge	Proposed Charge	Difference
0	$ 8.99	$ 10.97	$ 1.98
1,000	12.10	14.76	2.66
2,000	15.21	18.55	3.34
3,000	18.32	22.34	4.02
4,000	21.43	26.13	4.70
5,000	24.54	29.92	5.38
6,000	27.65	33.71	6.06
7,000	30.76	37.50	6.74
8,000	33.87	41.29	7.42
9,000	36.98	45.08	8.10
10,000	40.09	48.87	8.78

BLOOMINGTON MUNICIPAL WATER UTILITY
Bloomington, Indiana

Schedule of Non-Recurring Charges
(In Process) (1)

Description of Charges			Present Charges (2)
1)	5/8 to 1" Connection	- with tap	$ 848.14
		- without tap	776.18
2)	Greater than 1" Connection		Cost of connection but not less than charge for 5/8 to 1" connection
3)	Service Call	- During hours	$ 18.00
		- After hours	54.00
4)	Bad Check Charge		$ 25.00
5)	Late Payment Charge		3% of unpaid balance

This charge shall be paid only once and shall be based on the unpaid over-due balance.

6)	Deposit	- Residential	Not to exceed $25.00
		- Commercial	Not to exceed 1/6 of estimated annual bill

7) Meter Testing

The utility shall make a free test of the accuracy of a meter upon written request by a customer and a second free test may be requested twelve months subsequent to the first test. The fee for all meter tests requested within thirty-six months after the preceding test shall be $39.00 if the meter is found not to be at fault.

8) Inspection Charge

All inspections of new mains during normal business hours shall be free of charge. All inspections of new mains during overtime hours shall be based on the amount of time required for the inspection.

9) Temporary Service $10.00/week

$10.00 minimum plus a deposit equal to the cost of the meter and a charge for the water used.

10) Extension of Service

Free if estimated 3-year revenue is greater than the construction cost. Actual cost if not.

11) Unauthorized Use of Hydrants

Cost of water figured at 8 hours of flow from hydrants.

(1) Crowe is currently in process of analyzing the non-recurring charges. Crowe will discuss results with the Utility when completed.

(2) Present Rates and Charges were approved by the Indiana Utility Regulatory Commission on March 2, 2011.