Preliminary Engineering Report

Lake Huron Water Supply

Karegnondi Water Authority

September 2009

Prepared by:

AECOM
Jones & Henry Engineers, LTD
Lockwood, Andrews and Newnam, Inc.
O'Malia Consulting
ROWE Professional Services Company
Wade Trim, Inc.

Member Communities:

City of Flint
Genesee County
Lapeer County
Sanilac County

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Prepared By:

AECOM
Gannett Fleming, Inc.
Jones and Henry Engineers, Ltd.
Lockwood, Andrews, and Newnam, Inc.
O'Malia Consulting
ROWE Professional Services Company
Wade Trim, Inc.

Study Participants

This study of a new water supply has been developed for the following governmental units and agencies.

City of Flint

Genesee County

- Genesee County Drain Commissioner – Division of Water and Waste Services
  - City of Burton
  - Clayton Township
  - City of Clio
  - Davison Township
  - Flint Township
  - City of Flushing
  - Flushing Township
  - Gaines Township
  - Genesee Township
  - Grand Blanc Township
  - City of Montrose
  - Montrose Township
  - City of Mt. Morris
  - Mt. Morris Township
  - Mundy Township
  - Richfield Township
  - City of Swartz Creek
  - Thetford Township
  - Vienna Township

Lapeer County

- Greater Lapeer County Utilities Authority
  - Village of Almont
  - City of Imlay City
  - City of Lapeer
  - Mayfield Township
  - Almont Township*
  - Elba Township*
  - Goodland Township*
  - Imlay Township*
  - Lapeer Township*
  - Oregon Township*

    **Do not currently provide water supply*

Sanilac County

- Worth Township
- Fremont Township
- Maple Valley Township
- Speaker Township

This report has been developed for planning purposes and considers data available through May 2009.

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Executive Summary

1 Introduction

The City of Flint (Flint), the Genesee County Drain Commissioner – Division of Water and Waste Services (GCDC-WWS), and the Greater Lapeer County Utilities Authority (GLCUA) are supplied water from the City of Detroit's Water and Sewerage Department (DWSD). Because of growing concerns regarding the reliability and cost of the DWSD supply, Flint, GCDC-WWS, and GLCUA have considered alternatives for water supply. The first formal study was completed in 1992; the most recent was completed in 2006.

This study considers two alternatives from the 2006 study. One alternative is the continued purchase of water from DWSD; the other alternative is the development of a new water supply from Lake Huron.

Both alternatives include the construction of a new pipeline. DWSD is planning the construction of a new pipeline to Flint to address concerns regarding reliability and capacity. Water rates for either alternative will be increased similarly to recover the capital investment in new facilities.

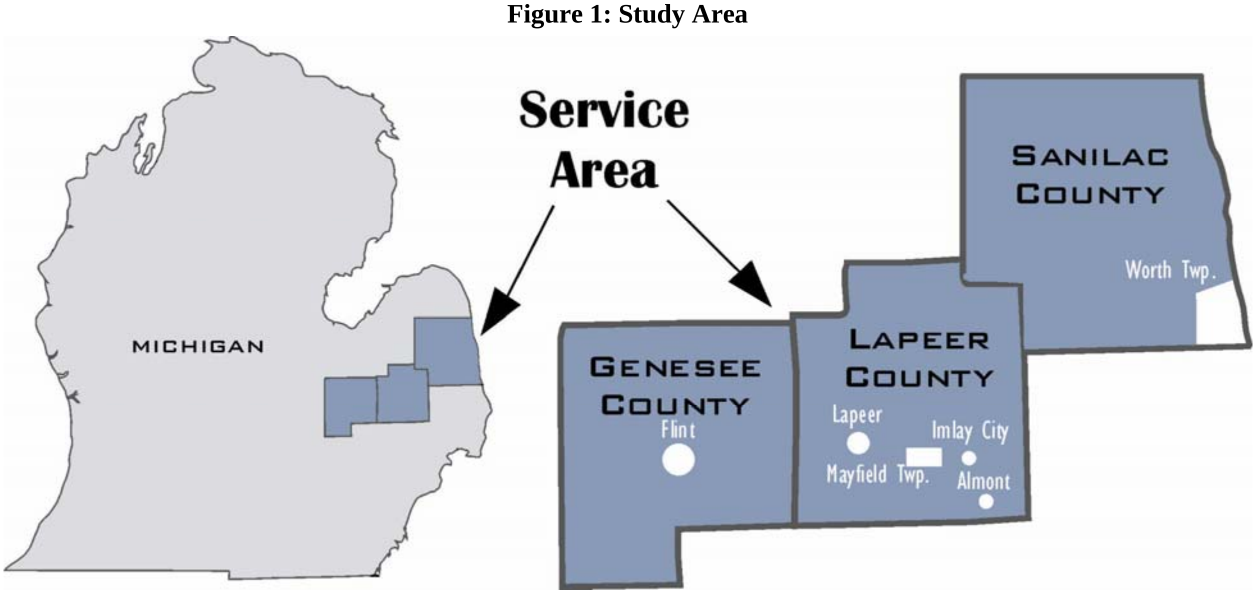
The second alternative, development of a new water supply from Lake Huron, provides the opportunity to supply water to additional communities. Sanilac County has joined Flint, GCDC-WWS, and GLCUA as participants in this study of water supply alternatives.

A new governmental authority, the Karegnondi Water Authority (KWA), is planned to develop and operate the new water supply. The KWA will be comprised of the communities supplied water.

2 Study Area

Figure 1 shows the study area.

Figure 1: Study Area



3 Demands

Table 1 shows the current and future (25 year) demands used for this study. Existing demands are based on records of recent water use; future demands have been developed from information provided by each community.

Table 1: Demands for Planning

	Initial (2014)		25 Year (2039)	
	Avg Day (mgd)	Max Day (mgd)	Avg Day (mgd)	Max Day (mgd)
Genesee County	14.2	25.0	16.2	32.5
City of Flint	16.5	25.0	19.2	28.8
Lapeer County	2.5	3.8	9.0	14.8
Sanilac County	0.1	0.1	0.1	0.1
Total	33.3	53.9	44.5	76.2

4 Alternative 1- Continued Supply by DWSD

Several options for continued DWSD supply to Flint, GCDC-WWS, and GLCUA have been discussed with DWSD representatives; however, there have been no formal negotiations or agreement regarding any particular option. Four options have been evaluated based on these discussions. Analysis indicates that the lowest cost option for continued supply from DWSD is a partnering arrangement with DWSD. This alternative is not available to Sanilac County.

With this option, a 30 year contract with DWSD for water service is required. Flint, GCDC-WWS, and GLCUA will be responsible to construct and operate a portion of the Flint Transmission System (FTS) which DWSD is planning to construct in 2010. By constructing and operating a portion of the FTS; water can be purchased by Flint, GCDC-WWS, and GLCUA at a lower rate.

DWSD estimates the portion of the FTS to be constructed by Flint, GCDC-WWS, and GLCUA at $346,000,000. Operating costs are projected to be $724,000 per year initially. In exchange for responsibility for the construction and operating costs; Flint, GCDC-WWS, and GLCUA will benefit by a 45% reduction in the purchase price of water from DWSD. Table 2 shows the cost of water for this option in 2011-2012, the year in which construction of the FTS is planned to be completed. The current water rate (2009-2010) is shown for comparison.

Table 2: Comparison of DWSD Cost of Water, Now and After Construction of FTS

	Flint & GCDC-WWS ($/MCF)	GLCUA ($/MCF)
DWSD Commodity	$8.70	$9.30
FTS Capital	$15.19	$14.53
Macomb Capital *	$0.00	$0.00
FTS O&M	$0.46	$0.46
Projected 2011-2012 Rate	$24.35	$24.29
2009-2010 Rate	$14.32	$16.11

*Planned for 2024; no cost impact until then

5 Alternative 2 – New Lake Huron Water Supply

The 2006 study evaluated several options for a new water supply. The 2009 update focuses on one of the options, the alternative of delivering raw water from Lake Huron to participating communities for local treatment and distribution.

GCDC-WWS purchased 230 acres of property adjacent to Lake Huron in southern Sanilac County in 2002. An intake to draw water from Lake Huron and a pumping station are planned for this site. Raw water will be pumped through a pipeline to an inland reservoir.

Inland from the reservoir, pipelines supply treatment facilities for Flint, GCDC-WWS, and GLCUA. Treatment facilities for Sanilac County can be located along the pipeline route.

Treatment by microfiltration has been planned for Sanilac County and GLCUA. A new conventional treatment plant is planned for GCDC-WWS. It is planned that raw Lake Huron water is delivered for treatment to Flint's existing treatment plant.

The planned water system provides for twin pipelines, storage, backup equipment and processes to provide a reliable supply. Facilities have been planned with capacity for the 25 year demands shown in Table 1, and provisions for further expansion.

Figure 2 is a schematic showing the new water supply.

Figure 2: Schematic Lake Huron Water Supply

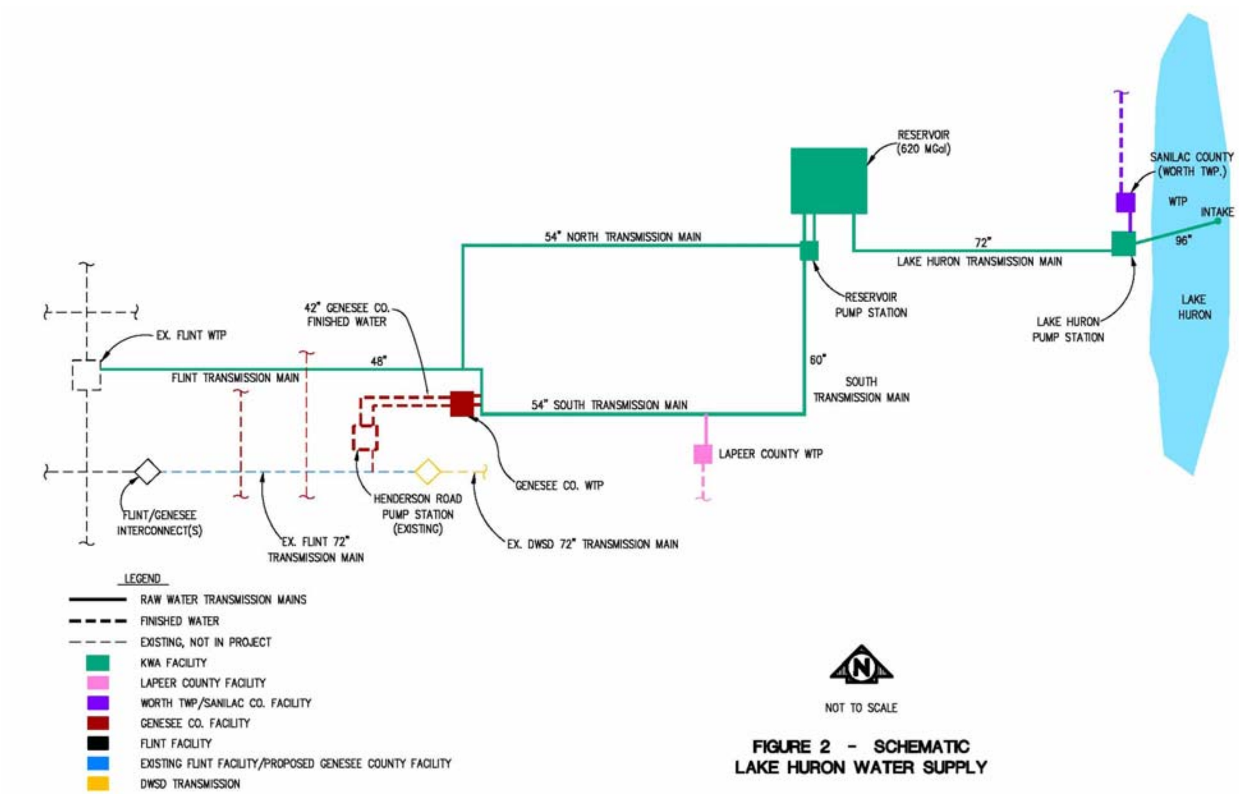


Table 3 summarizes the project cost of the new Lake Huron water supply which was studied.

Table 3: Summary of Cost of New Lake Huron Water Supply

Project Component	Total Project Cost	Sanilac Co. Share	Lapeer Co. Share	GCDC-WWS Share	Flint Share
KWA Lake Huron Water Supply	$443,885,767	$813,723	$86,312,736	$188,899,927	$167,859,381
New Sanilac Co. Facilities	$1,849,360	$1,849,360			
New Lapeer Co. Facilities	$40,009,060		$40,009,060		
New Genesee Co. Facilities / Upgrades	$110,038,554			$110,038,554	
New Flint Upgrades	$5,987,030				$5,987,030
Totals	$601,769,771	$2,663,083	$126,321,796	$298,938,481	$173,846,411

Table 4 shows the projected operating costs for the new Lake Huron water supply during the initial year of operation.

Table 4: Project Operating Expenses during Initial Year of New Lake Huron Water Supply

Community	KWA ($/MCF)	Local ($/MCF)	New Water Supply Treatment Cost (2014)	2009-2010 DWSD Rate
Sanilac County	$1.30	$41.56	$42.86	N.A.
Lapeer County (GLCUA)	$1.30	$3.11	$4.41	$16.10
GCDC-WWS	$1.30	$2.86	$4.16	$14.32
City of Flint	$1.30	$4.13	$5.43	$14.32

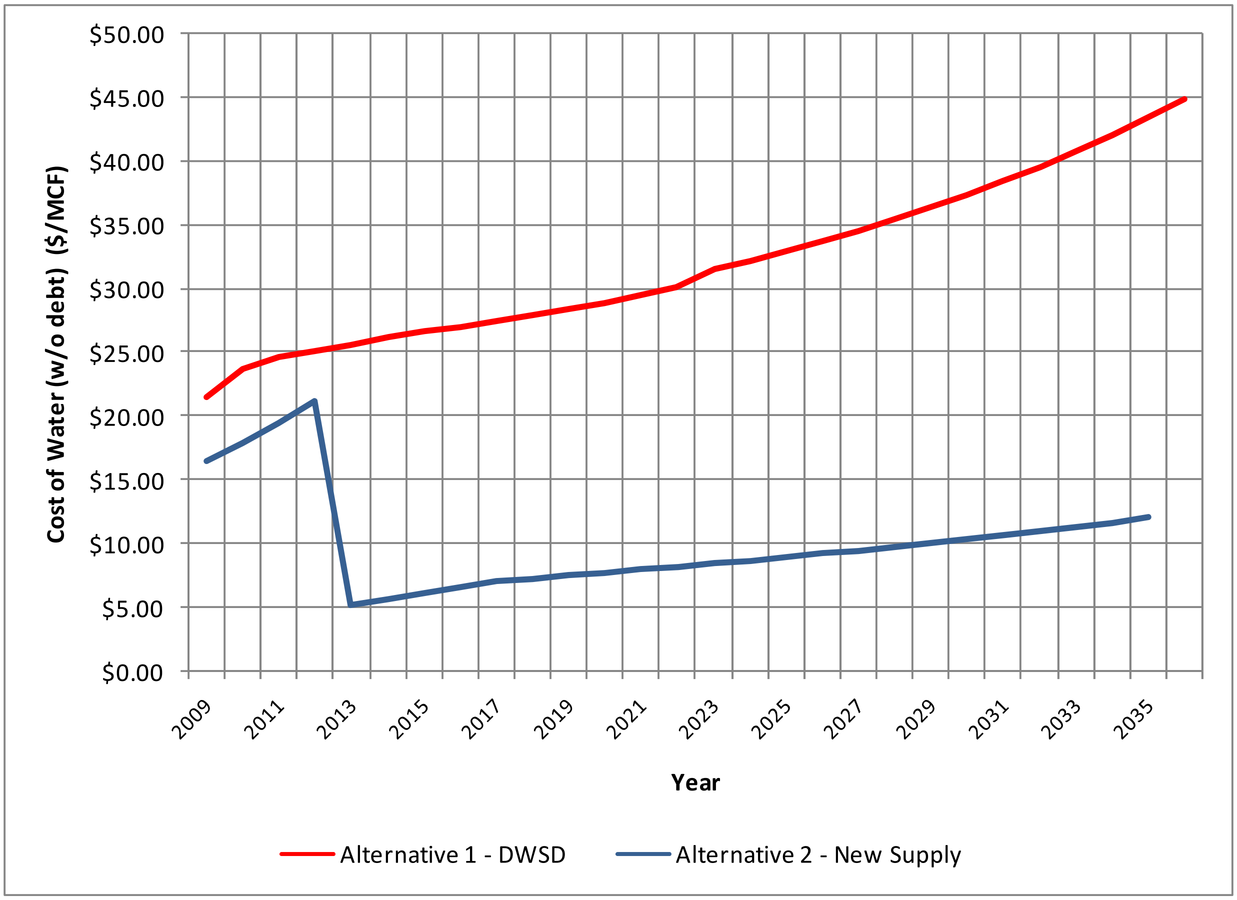
Notes
1. New water supply costs based on projected annual consumption of each community in year 2014.
2. Costs do not include debt retirement or depreciation expense.

6 Comparison of Alternatives

With the investments in facilities planned by DWSD, either of the alternatives considered are believed to provide a reliable, long-term water supply with sufficient capacity for the needs of the study area. Regardless of the alternative selected, a new pipeline and other facilities are planned for construction. As a result, the cost of water will increase with either alternative.

Figure 3 shows the projected cost of water for each alternative. For demonstration purposes, the cost of water for the new Lake Huron water supply alternative does not include the cost of repayment of debt incurred for its construction. The graph shows that without the debt of constructing the new system (or once the debt for its construction is repaid), the cost of water from the new supply will be substantially less than continuing to purchase water from DWSD.

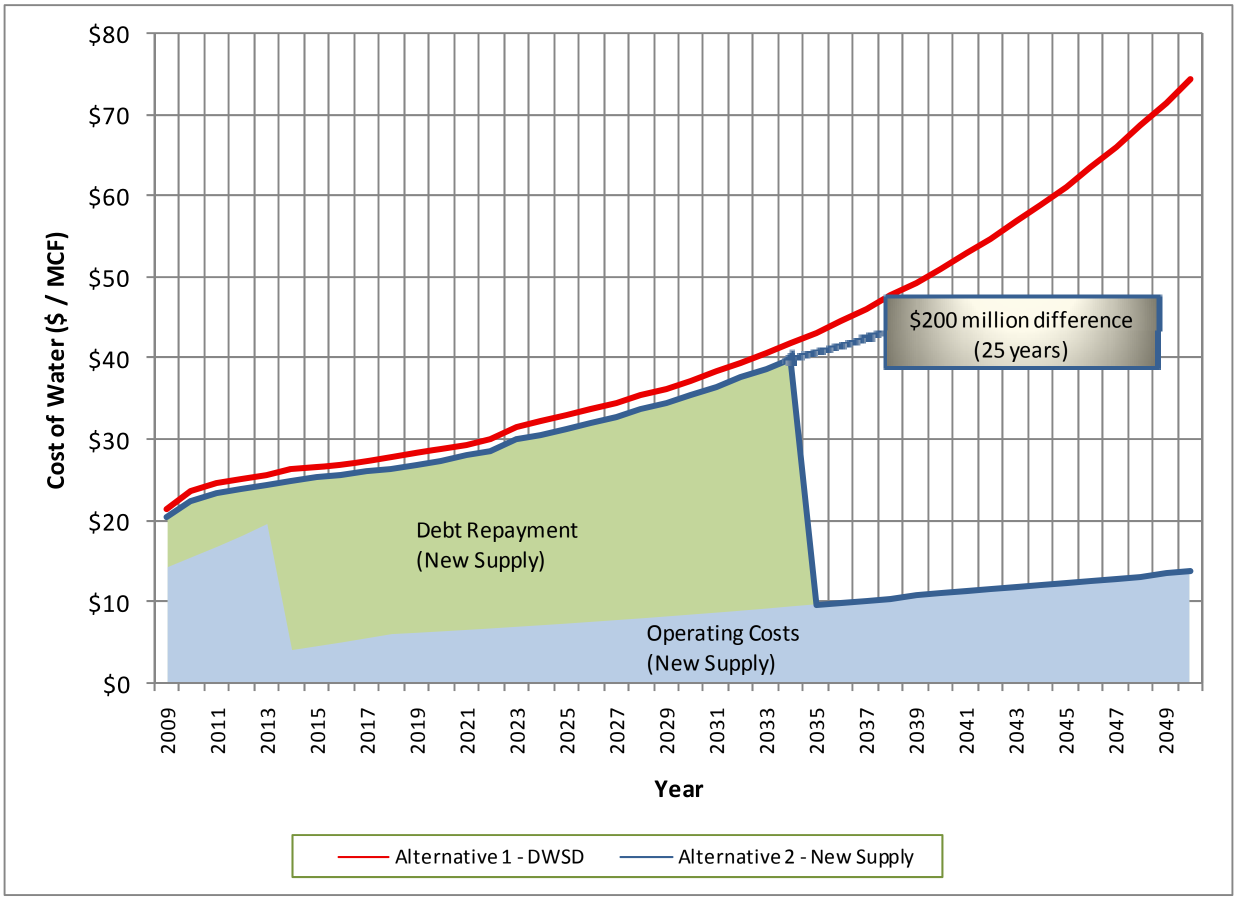
Figure 3: Projected Cost of Water



The cost of water for the DWSD alternative was developed using the DWSD rate methodology for recovery of capital investment. For comparison, the cost of water for the new Lake Huron supply should include the cost of financing its construction.

If 25-year bonds are used for financing the construction of the new Lake Huron supply, analysis has shown that the cost of water for the new Lake Huron supply can be less than with continuing service from DWSD. Over the 25-year life of the bonds, the total cost of water with continued DWSD supply is projected to be $200 million greater than with the new Lake Huron supply. Figure 4 demonstrates the cost savings resulting from new Lake Huron supply during the 25-year bond period

Figure 4: Comparison of Alternatives



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1 Introduction

The City of Flint (Flint), the Genesee County Drain Commissioner Division of Water and Waste Services (GCDC-WWS), and the Greater Lapeer County Utility Authority (GLCUA) operate community water systems. The Detroit Water and Sewerage Department (DWSD) has supplied these utilities with water since the 1960s.

Because of growing concerns regarding the reliability and cost of the DWSD supply, these utilities have studied other supply alternatives. The first formal study was completed in 1992; a 2006 study evaluated several alternatives for a long-term water supply.

This study focuses on two of the alternatives considered in the 2006 study. One alternative considers the impact of remaining customers of DWSD; the second alternative evaluates the feasibility of developing a new Lake Huron water supply.

DWSD is planning significant capital investments to address concerns with reliability and to provide sufficient capacity to meet the needs of their customers. The cost of planned facility improvements will be added to future rate increases to all customers. If DWSD continues to supply Flint, GCDC-WWS, and GLCUA; it is expected that their future rate increases will be greater than other DWSD customers because of the methodology for used for determining the cost of water. This study compares different options for remaining a customer of DWSD and uses DWSD's established rate structure to project the future cost of water.

The alternative studied for a new Lake Huron water supply can provide water supply on a regional basis, providing the potential for service to additional communities. As a result of this potential; Sanilac County is included as a participant in this study along with Flint, GCDC-WWS, and Lapeer County. This study develops the conceptual design of a new water supply to allow for estimates of the costs for its construction and operation for comparison with the alternative of continuing supply by DWSD.

A new governmental authority, the Karegnondi Water Authority (KWA), is planned to be established to develop and operate the new water supply. The KWA will include the communities supplied by the new water supply.

2 Scope

The alternatives for long term water supply are evaluated on the following criteria:

- Reliability – A new supply shall be planned with redundancy and backup provisions to maintain a continuous, safe supply of drinking water to customers.
- Cost – The concept studied shall be planned in sufficient detail to reasonably develop opinions of construction and operating costs, to allow for its comparison with existing water supplies.
- Quality – A new supply shall be planned with suitable provisions so drinking water will meet all current and anticipated regulations, and will consistently be of equal or better quality than current supplies.
- Quantity – The water supply shall be designed with sufficient capacity and provisions for expansion to meet the needs of the service area throughout the planning period.

- Security – Planned facilities shall have suitable provisions and measures to guard against disruption of service or contamination resulting from vandalism or malevolent activities.

The alternative of continuing supply from DWSD is developed using their current rate methodology and planned improvements to their facilities. This report provides an overview of the options for continued service by DWSD; Appendix 18 provides a detailed analysis.

The alternative of developing a new water supply for Flint, Genesee County, Lapeer County, and Sanilac County assumes that the KWA will develop and operate the new water supply, to deliver raw water from Lake Huron to each member community. Member communities will be responsible for local treatment and distribution of water to their customers.

The concept for a new water supply is developed through a series of technical memoranda that serve the following purposes.

a. Determine the facilities, processes, and capacities required to supply the proposed service area.
b. Establish budgets for construction and ongoing operating and maintenance (O&M)
c. Evaluate constructability (permitting, environmental concerns, right-of-way requirements).
d. Develop schedules for implementation.

This report provides an overview of the study undertaken to develop a new Lake Huron water supply. Details are provided in the technical memoranda as appendices to this report.

3 Planning Criteria

3.1 Criteria for Continued DWSD Supply Options

The following criteria were used to evaluate the alternative of remaining a customer of DWSD.

- Planning Period: 25 years
- Economics: Financing for DWSD capital improvements: 30-year bonds at 5% rate

3.2 Criteria for New Lake Huron Supply Option

Engineers and planners used the following criteria for the study and evaluation of a new Lake Huron water supply.

- Planning Period: Proposed facilities are planned to meet the projected 25-year needs, at a minimum, with provisions for future expansion.

- Design Capacity: Proposed water supply is planned with capacity adequate for maximum day demand (MDD); peak demands are assumed to be met through local storage.

- Economics:
  Based on the following assumptions:
  - Inflation Rate during Planning Period: 3% annually
  - Financing: 25-year bonds at 6% rate
  - Capitalized Interest: not included

- Engineer's Opinion of Construction Costs:
  - ENR Construction Cost Index: 8688
  - Construction Contingencies: 15% of construction cost

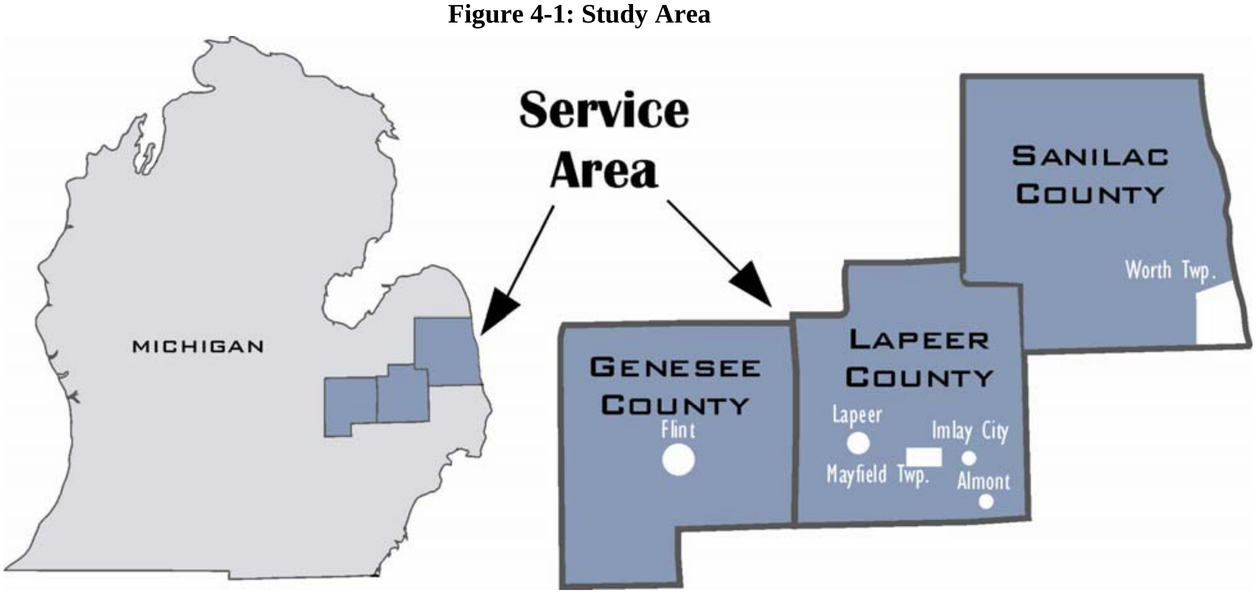
- Design Contingencies: 5% of construction cost
- Engineering, Legal, Bonds, and Administration: 17% of construction cost
- Land Acquisition Costs:
  - Easements: $0.15 per square foot
  - Land (Purchase): $6,000 per acre

- Operating and Maintenance Costs
  - Depreciation:
    - Equal to installed cost of equipment and facilities divided by their expected service life. Depreciation expenses are considered constant throughout the study period. Services lives are assumed as follows:
      - Pipe: 75 years
      - Mechanical Equipment: 20 years
      - Physical Plant: 75 years
  - Power: assumed $0.063 per kWh, in 2014 dollars
  - Labor
    - The following hourly rates are assumed, in 2014 dollars:
      - WTP Superintendent: $35 per hour
      - Supervisor: $30 per hour
      - Operators: $20 per hour
      - Maintenance Mechanics: $25 per hour
      - Mechanic's Helpers: $20 per hour
      - Instrument Technicians: $25 per hour
    - Fringe benefits add 62% to the preceding labor rates

4 Study Area

The study area is considered to include Genesee County, Flint, Lapeer County, and Sanilac County. Figure 4-1 below illustrates the study area.

Figure 4-1: Study Area



The City of Flint provides water to residential, business, and institutional customers throughout the city. The city is fully developed and adjacent areas are supplied water by GCDC-WWS, resulting in little potential for expansion of its service area.

GCDC-WWS provides water to nineteen villages, cities, and townships located in Genesee County. There is potential for expanded water service within the nineteen communities now served plus growth potential by serving new communities, within or adjacent to Genesee County.

Most cities and villages in Lapeer County operate community water systems. The City of Lapeer, the City of Imlay City, the Village of Almont, and Mayfield Township are members of GLCUA and purchase water from DWSD for distribution to their water customers. Lapeer, Imlay City, and Almont supply water to businesses and residences throughout their municipal boundaries. Mayfield Township provides water service only to a limited area within the township. Six other townships are members of GLCUA; however, they do not currently provide water service to their communities. Other county municipalities, including Columbiaville, Dryden, Metamora, and North Branch operate community water systems which utilize wells for supply. For this study, the initial service area for the new Lake Huron Supply is assumed to be the GLCUA communities. There is potential for increased water demands through continued development within existing GLCUA service areas, expansion of service to new areas, and agricultural irrigation.

Sanilac County is predominantly rural, with 80% of the land used agriculturally. Most villages and cities in the county operate community water systems. Four of the five townships which border Lake Huron operate community water systems which supply only the properties near the lakeshore. The proposed supply pipeline from Lake Huron provides the ability to serve to other areas of the county. For this study, it is assumed that one township (Worth Township) receives water from the new Lake Huron supply. Studying the requirements for providing service to Worth Township provides guidance regarding the costs for supplying other Sanilac County communities.

5 Demands

Communities and agencies within the study area are presently supplied water from other sources. Engineers and planners have reviewed records of past water use to determine the initial demands of the proposed water supply. In addition, officials representing communities within the service area have provided guidance for projecting future water use. Table 5-1 below summarizes the demands used for this study.

Table 5-1 Design Demands Used for Study

	Initial (2014)		25 Year (2039)		50 Year (2064)	
	Avg Day (mgd)	Max Day (mgd)	Avg Day (mgd)	Max Day (mgd)	Avg Day (mgd)	Max Day (mgd)
GCDC-WWS	14.2	25.0	16.2	32.5	22.5	45.0
Flint	16.5	25.0	19.2	28.8	24.0	36.0
GLCUA	2.5	3.8	9.0	14.8	11.7	19.7
Sanilac County	0.1	0.1	0.1	0.1	0.1	0.2
Total	33.3	53.9	44.5	76.2	58.3	100.9

6 Alternative 1 - Continued Supply from DWSD

Flint, GCDC-WWS, and GLCUA are currently supplied water from DWSD. Flint and GLCUA have contracts with DWSD for water service. GCDC-WWS is supplied water from Flint as a second-tier customer. This section considers options for continued supply by DWSD.

Sanilac County is not currently supplied by DWSD. This alternative is not available for Sanilac County.

6.1 DWSD Rate Methodology

DWSD establishes water rates for all of its customers through a uniform rate structure. The following variables are considered in the rate model:

- Annual average day flow
- Maximum day flow
- Peak hour flow
- Distance
- Elevation
- Meter size
- And combinations of the above

DWSD determines its cost to operate, maintain, and expand the water system on an annual basis. Costs are categorized regarding their impact by the preceding variables. Costs are combined with the variables established for each community and are used to compute the cost of water for each community annually.

DWSD indicates that rate increases are expected to average 7% through 2014, then 4% thereafter. These increases are considered the average of all DWSD customers. A review of historical records indicates that rate increases to Flint have averaged about 1% higher than the average of all suburban DWSD customers. Therefore, this study assumes increases of 8% through 2014 and 5% subsequently.

The geographical locations of Flint, GCDC-WWS, and GLCUA have a significant impact on their rates for water supply by DWSD. Historically, about 70% of the cost of water has been attributed to the "distance" and "elevation" components of the DWSD rate methodology.

DWSD is planning the construction of additional transmission facilities. Using the current rate methodology, the costs associated with the construction and operation of these facilities will be assigned to the "distance" and "elevation" categories. The cost of water to Flint, GCDC-WWS, and GLCUA are expected to increase more as DWSD adds these facilities.

6.2 Options for Continued DWSD Supply

DWSD has developed a new "Master Agreement for Water Supply". The new agreement provides a thirty year commitment for water supply and requires a commitment for purchase of a minimum volume of water each year. The agreement also provides customers the ability to specify the quantities and pressures of water to be supplied. The cost of water will be based upon the contracted quantities rather than historical demands. DWSD is not required to deliver water in excess of the contracted quantity. Where demands are exceeded by a community, DWSD may increase the cost of water to the community based on the actual demands experienced.

DWSD is encouraging all suburban customers to adopt the new agreement to provide for better planning, uniformity between all customers and less fluctuation in rates from year to year. For customers that do not elect to execute the new master agreement, the existing supply agreements will continue to be used. Where the existing agreements remain in use, rates will be established based on historical demands plus a twenty percent allowance for potential future increases in peak demand.

Through preliminary meetings with DWSD, several concepts have been identified for Flint, GCDC-WWS, and GLCUA to remain customers of DWSD. Four of these concepts have been studied. These are summarized in the following sections and are discussed in detail in Appendix 18.

6.2.1 Option 1 – No Change

This option assumes that Flint and GLCUA continue to purchase water from DWSD based on their existing water supply contract. GCDC-WWS is assumed to continue to purchase water as a second tier customer from Flint.

It is assumed that future water rates are established on the basis of historical demands plus a 20% proxy. It is also assumed that DWSD constructs the planned upgrades to their transmission facilities and that the cost of construction and operation are incorporated into the future cost of water.

Figure 6.1 shows the projected cost of water for Flint and GCDC-WWS; Figure 6.2 shows the projected cost of water for GLCUA.

6.2.2 Option 2 – Master Agreement (Current Demands, plus 5%)

This alternative assumes that Flint, GCDC-WWS, and DWSD execute the new master agreement. It is assumed that the contracted volumes are equal to historical demands, plus a five percent increase to provide for some growth. It is also assumed that DWSD constructs planned upgrades to their transmission facilities and that the cost of construction and operation are incorporated into the future cost of water.

Figure 6.1 shows the projected cost of water for Flint and GCDC-WWS; Figure 6.2 shows the projected cost of water for GLCUA.

6.2.3 Option 3 – Master Agreement (Future Demands)

This alternative assumes that Flint, GCDC-WWS, and GLCUA execute the new master agreement. It is assumed that the contracted volumes are equal to the projected demands assumed in Section 5. It is also assumed that DWSD constructs planned upgrades to their transmission facilities and that the cost of construction and operation are incorporated into the future cost of water.

Figure 6.1 shows the projected cost of water for Flint and GCDC-WWS; Figure 6.2 shows the projected cost of water for GLCUA.

6.2.4 Option 4 – Master Agreement (Partnering Arrangement with Capital Contribution)

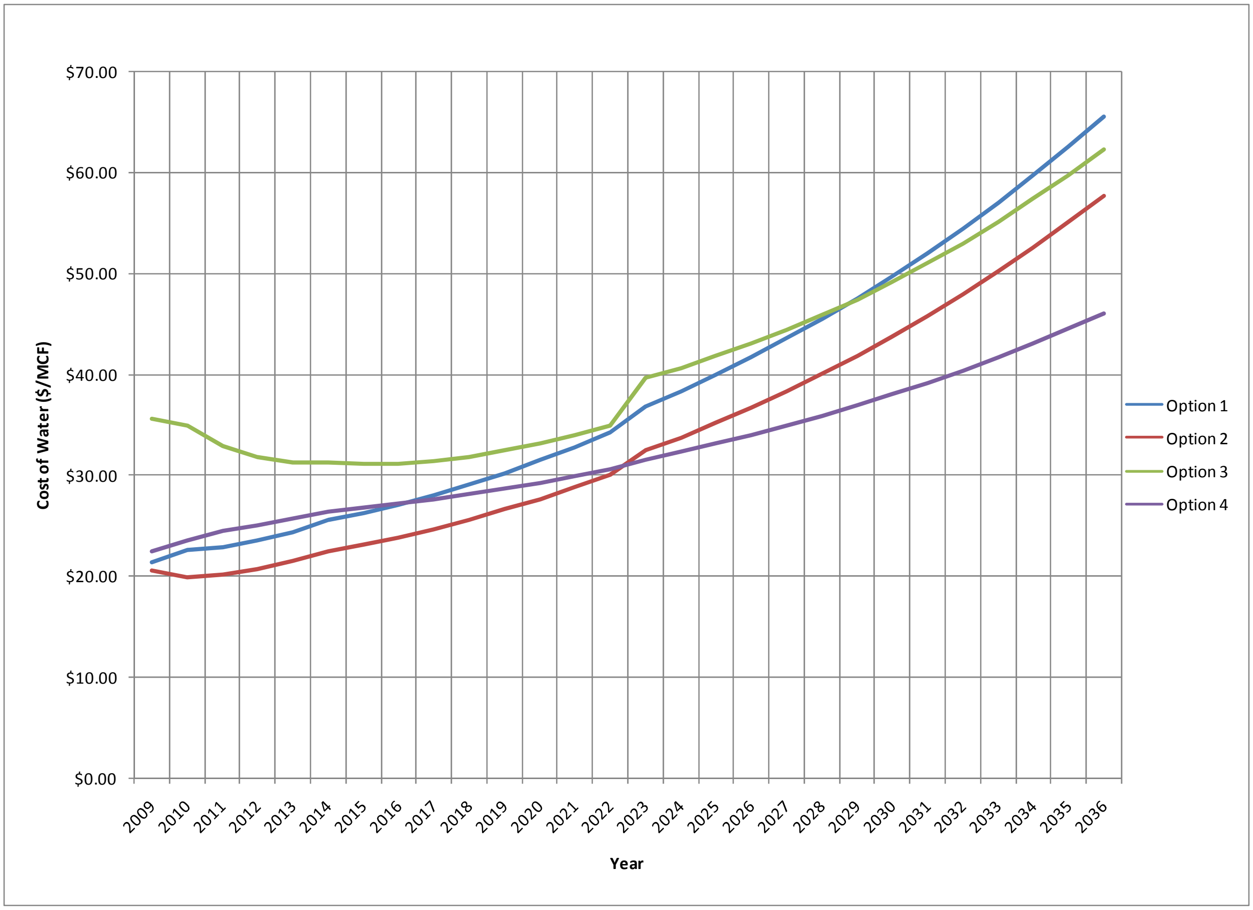
DWSD officials have indicated that Flint, GCDC-WWS, and GLCUA could realize reduced costs for water through a partnering arrangement. In this scenario, Flint, GCDC-WWS, and GLCUA would execute the new master agreement and would be responsible for the construction and operation of a portion of the transmission facilities upgrades planned by DWSD. Under this scenario, the distance and elevation factors used for establishing rates can be reduced.

Figure 6.1 shows the projected cost of water for Flint and GCDC-WWS; Figure 6.2 shows the projected cost of water for GLCUA.

Figures 6-1 and 6-2 show that over the 25-year planning period, option four results in the lowest cost of water of the four options considered for continued DWSD supply. This option will be compared against the alternative of constructing a new Lake Huron water supply.

Figure 6-1: Flint and GCDC-WWS Cost of Water

Figure 6-2: GLUCA Cost of Water



7 Alternative 2 – New KWA Lake Huron Water Supply

7.1 New Lake Huron Water Supply Concept

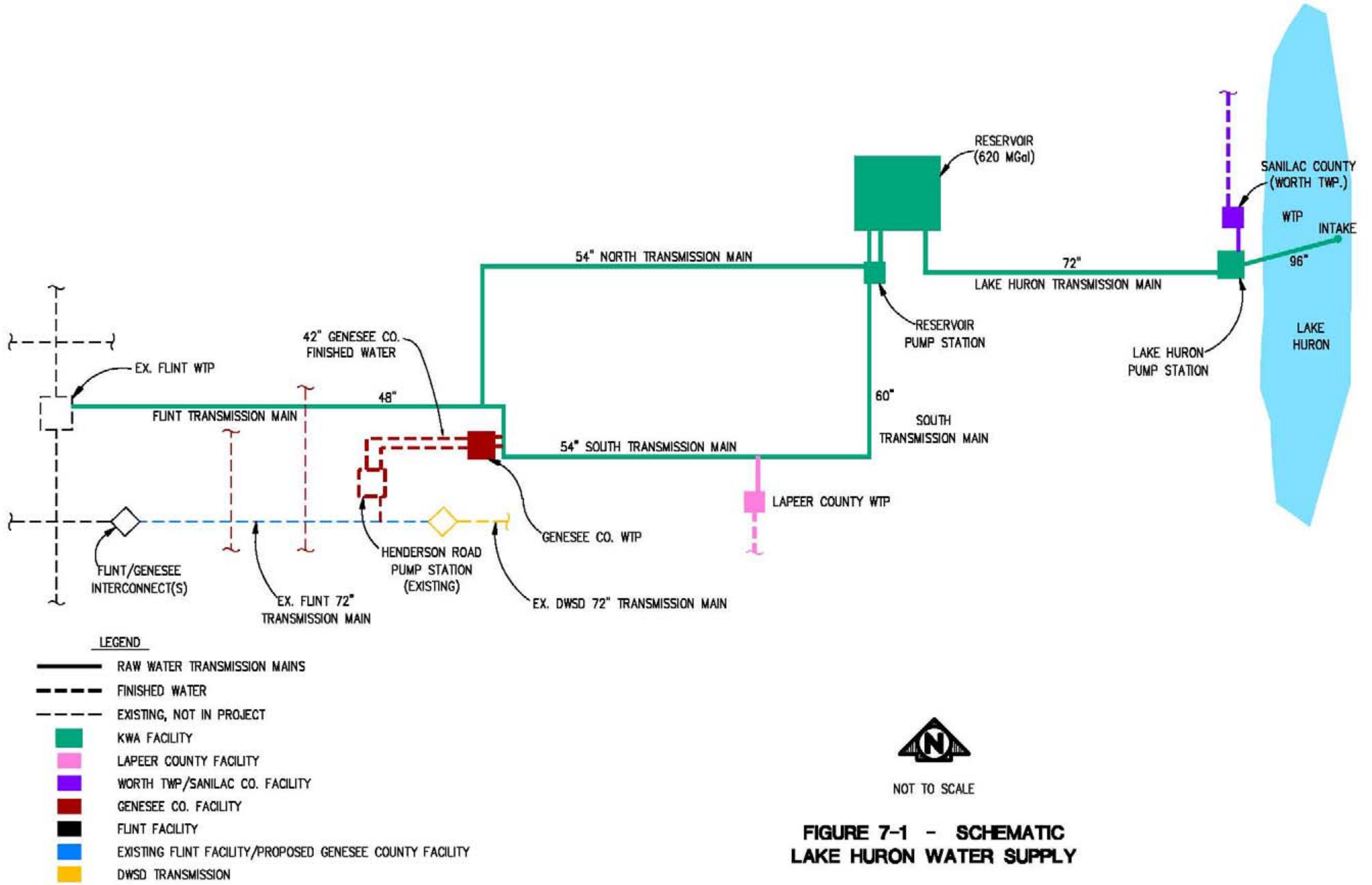
Figure 7-1 (page 9) schematically shows the proposed new water supply. Components are color coded to delineate the KWA's responsibilities and member communities' responsibilities.

The authority will be responsible for delivery of raw water to the member communities; each community will be responsible for the treatment and distribution of water to its customers.

7.1.1 Source

Water for the new supply is planned to be drawn from Lake Huron. In 2002, Genesee County purchased 230 acres of land adjacent to Lake Huron as a potential site for a new water supply facility. The site is located in Worth Township, Sanilac County, about 20 miles north of Port Huron, Michigan.

Figure 7-1: Schematic



7.1.2 Intake

A submerged crib intake is planned to be located about 3.2 miles from the shoreline, in 40 feet of water. It is believed that this location is far enough from shore to provide a steady supply of high-quality water from the upper lakes and is deep enough as to not interfere with shipping. The intake is planned with provisions for controlling zebra mussels and ice.

A single pipeline to convey water from the intake, located under the lake bottom, to a shorewell is planned. An inland reservoir will provide reliability for the single intake, which provides storage capacity for the MDD for a period of seven days. This period is considered adequate to allow for maintenance or repairs to the intake.

The proposed intake is planned with a capacity of 200 mgd, two times the projected 50-year MDD. The intake is planned to have greater capacity than other components due to the difficult construction conditions and relatively high cost, in relation to other project costs.

7.1.3 Lake Huron Pumping Station

The Lake Huron Pumping Station (LHPS) is proposed to be located adjacent to Lake Huron, pumping raw water from the intake shorewell to facilities located further inland for storage, treatment, and distribution. Two-stage pumping is planned: low-lift pumps will draw water from the shorewell and pump to adjacent ground storage tanks; high-service pumps will draw from the storage tanks and pump raw water to the inland reservoir.

The pump station facility is planned for the projected 50-year demand, although initial pumping equipment will be designed for the 25-year demand. The pump station is planned with provisions for expansion to 200-mgd capacity, consistent with the ultimate capacity of the intake.

Security provisions are planned for the pumping station facility. Backup power will be provided for system monitoring and control, security, lighting, and HVAC. Backup power for pumping is not planned; water can be supplied to customers from the inland reservoir for several days in the event of a power failure.

7.1.4 Transmission Mains

New pipelines will be necessary to transport water from the Lake Huron source to the customers.

Most of the area between Lake Huron and the proposed service area is rural. Elevations between the lake and Flint vary from a low of 590 feet to a high of 975 feet. Intermediate pumping between Lake Huron and Flint will be required to limit operating pressures.

Although specific routes have not been chosen, it is assumed that pipelines will primarily follow existing roads. Engineers have reviewed several routes to gain an understanding of road types and conditions, soil conditions, terrain, presence of existing utilities, stream and river crossings, land use, and environmental conditions that may be encountered with pipeline construction. Using this information, cost estimates for right-of-way acquisition, excavation, and restoration for the new pipelines have been developed, regardless of their route.

Engineers and planners have designed the proposed transmission mains to provide sufficient capacity for the 25-year MDD. The pipeline between Lake Huron and the inland reservoir is planned to be a single line; the reservoir will have sufficient storage to meet maximum demand over a consecutive seven-day period, allowing for repair or maintenance of the pipeline. Other pipelines are planned to be dual lines, except where alternative provisions for reliability are available.

A specific pipeline material has not been selected, however, it is assumed that pipe may be ductile iron pipe (DIP), concrete pressure pipe (CPP), or steel pipe. DIP is available in sizes up to 64 inches in diameter.

Pipeline capacity has been developed using the following criteria:
- Maximum operating pressure: 200 psi
- Hazen Williams C-factor: 120

Figure 7.1 (page 9) shows the proposed pipeline sizes to provide capacity for the 25-year MDD.

The following pipeline appurtenances have been included in the initial planning for transmission mains.
- Isolation valves: electric actuated gate valves, at six-mile intervals
- Provisions for flushing, draining, and surge relief: periodically at streams or drains
- Provisions for air release: at high points

Additional capacity in excess of the projected 25-year MDD can be provided by the addition of intermediate pumping facilities, construction of another pipeline, or additional reservoir storage. As demands approach the projected 25-year MDD, an evaluation of future needs and alternatives should be completed to develop a specific plan for future expansion.

7.1.5 Raw Water Reservoir and Pumping

The concept for a new water supply includes an inland reservoir. The planned reservoir provides storage inland, away from Lake Huron, which can supply water to KWA customers when the single pipeline between the lake and the reservoir or the intake is out of service for repairs or maintenance. The proposed reservoir has a capacity of 620 million gallons, which can supply the MDD of KWA customers for more than seven consecutive days.

A single-cell reservoir is planned initially, based upon 25-year demands. A second cell can be added for increased future demands. A specific site for the reservoir has not been selected, but at least 190 acres of land is recommended to provide space for future expansion.

Water from the LHPS will normally be discharged directly into the reservoir; a second pumping station located at the reservoir will draw water from the reservoir for pumping to downstream customers. Although the flow-through operation should minimize loss of water quality, provisions will be provided for chemical control of algae and other potential water quality concerns in the reservoir.

Twin pipelines are planned downstream of the reservoir to provide reliability; one pipeline will be available to supply water in the event one is out of service for repairs or maintained. Together, the two pipelines have capacity for the 50-year MDD; however, an individual pipeline will have capacity only for 75% of the MDD. During periods when one pipeline is out of service for repairs or maintenance, restrictions on outdoor water use may be required to reduce demands to this level.

The reservoir pump station is planned to pump concurrently to both pipelines. Five 20-mgd pumps are planned initially to deliver the 25-year MDD. Space is provided in the planned facility for the addition of two pumps to meet the 50 year demand.

Backup power for system control and monitoring, security, lighting, HVAC, and pumping are included for the planned facility.

7.2 Service to KWA Member Communities

The concept for a new Lake Huron water supply assumes that the KWA will deliver raw water to each member community and that each community will be responsible for its treatment and distribution. Additional facilities or modifications will be required by each member community to replace their existing water supply. Each member community has different needs described below.

7.2.1 Sanilac County

The new water supply can provide service to Sanilac County communities from any point along the proposed pipeline. For this study, it is assumed service is provided to Worth Township. The facilities and cost for providing service to Worth Township will be similar for other communities. Worth Township is presently supplied finished water from the Lexington Worth Township's Utility Authority (LWTUA); LWTUA is supplied water from the Village of Lexington. LWTUA distributes water to Worth Township properties along Lake Huron and M-25. The southerly end of the LWTUA distribution system is adjacent to the planned site for the intake and pumping station for the new KWA water supply.

To supply Worth Township with the new Lake Huron water supply, treatment will be required. Raw water from the LHPS ground storage tanks will be pumped to an adjacent treatment facility to be treated by microfiltration, and disinfection prior to re-pumping to the existing LWTUA distribution system. Microfiltration is a well established treatment process for treating Great Lakes water. Microfiltration equipment is modular, and future expansion, if necessary, is easily accomplished by the addition of modules and building expansion.

An analysis of the LWTUA distribution system to evaluate the impact of a new supply has not been completed.

7.2.2 Lapeer County

DWSD currently provides treated water to Lapeer County communities of Lapeer, Imlay City, Almont, and Mayfield Township. Provisions for water treatment will be required for the new supply, to provide service to these and other Lapeer County communities.

Alternatives for treatment include a single treatment plant for Lapeer County, treatment plants for individual communities, or supply of finished water from Genesee County. After preliminary consideration, the alternative of a single Lapeer County facility is included in this study. The selection of the best alternative for treatment should be made after customers and demands are finalized.

Transmission piping, to convey treated water from the treatment facility to the four communities, is included in the project costs for Lapeer County. Treatment by microfiltration is planned. Treatment equipment is modular, and facilities can be expanded relatively easily.

The proposed treatment facility and finished water transmission mains have been planned for the 25-year MDD. Treatment facilities can be easily expanded for increased demands. Pipeline capacity can be increased by constructing additional pipelines or adding pumping capacity.

7.2.3 Genesee County

If the current finished water supply from Flint and DWSD is replaced with the new Lake Huron supply, several modifications to the GCDC-WWS system will be required.

7.2.3.1 Water Treatment

GCDC-WWS currently purchases finished water for distribution to its customers. With the proposed KWA raw water supply, treatment will be required prior to distribution.

Conventional treatment by clarification and filtration is planned. Specific processes include rapid mixing, flocculation, high-rate plate settler clarification, and granular media filtration. Provisions are included for the future addition of treatment processes, if necessary for compliance with regulations or to improve treatment.

The water treatment plant is planned to have four equally sized pretreatment trains. The loading rate of filters at the initial MDD is conservative. It is assumed that once the plant is operational, plant-scale trials will demonstrate the suitability of high-filter surface loading rates, which are expected to ultimately provide sufficient capacity for the 50-year demand without the addition of more filters.

7.2.3.2 Henderson Road Pumping Station

Finished water from the planned GCDC-WWS water treatment plant will be pumped to the Henderson Road Pumping Station (HRPS). The HRPS currently pumps water to the east and north areas of Genesee County. With the planned new Lake Huron supply, the HRPS will provide high service pumping, supplying finished water to all of the GCDC-WWS distribution system. Additional pumps must be added for its increased service area.

Three pumps currently provide a firm capacity of 16 mgd and a total capacity of 30 mgd. Additional pumping capacity of 8 mgd is needed to meet the projected demands during the initial years of operation. Additional pumping capacity of 16 mgd (from current capacity) is required for the projected 25-year demands. Expansion of the HRPS building is required to accommodate both of the additional pumps. Emergency backup power is currently available at the HRPS facility and is adequate for operating three 8-mgd pumps.

The HRPS is presently supplied water by a 48-inch pipeline from Flint’s 72-inch transmission main. The 48-inch pipeline will need to be reconfigured to allow the HRPS to pump to the 72-inch transmission for distribution to the south and west areas of the county. This requires replacement of the meter and check valves with a control valve at the connection to the 72-inch main.

7.2.3.3 Flint’s 72-Inch Transmission Main

A transmission main supplies water from the DWSD system to Flint from DWSD’s Lake Huron treatment plant, just north of Port Huron. East of Genesee County, the pipeline is owned and operated by DWSD. The City of Flint owns and operates the 72-inch transmission main running from the DWSD meter located near the county line, through

Genesee County to the Flint water treatment plant. The GCDC-WWS distribution system is supplied through eight connections to the Flint 72-inch main.

Although the 72-inch main will no longer be necessary to convey water to Flint under this concept being studied, maintaining the main's operation will allow it to continue to supply the GCDC-WWS distribution system. In this role, future responsibility for the main should be transferred from Flint to GCDC-WWS.

7.2.4 Flint

Prior to contracting with DWSD in 1965 for water supply, the City of Flint treated water from the Flint River. DWSD delivers finished water to Flint, but the city's water treatment plant has been maintained and operated on a limited basis as a backup supply. Some modifications at the city's treatment plant will be necessary to allow it to reliably provide treatment on a continuous basis. Proposed modifications required for full-time operation and treatment of Lake Huron water include:

- Piping and metering to deliver raw water
- Power upgrades, including emergency / backup power
- Disinfection upgrades
- Chemical feed systems
- Finished water pumping
- Updated controls and monitoring
- Added security measures

7.3 Permitting

Construction of the proposed new water supply requires permits and approvals from federal, state, county, and local agencies, railroads, and utilities. It is expected all required permits and approvals can be obtained during design. A permit to withdraw water from Lake Huron has been issued by the MDEQ.

7.4 Engineer's Opinions of Cost

Engineers and planners have developed opinions of cost for construction of the new water supply and for its ongoing operation and maintenance, using the criteria identified in Section 3. Costs include contingency allowances of 20%, and engineering, legal, bond, and administrative allowances of 17%.

7.4.1 Construction Costs

Table 7-1 below summarizes the project cost of a new water supply; Table 7-2 (page 15) shows the cost distribution among the KWA member communities. KWA costs are distributed to members proportionally, based upon each community's share of the total capacity provided.

Table 7-1: Project Costs

	Engineer's Opinion of Cost
Construction Cost - New Water Supply (KWA)	$317,367,567
Construction Cost - City of Flint Treatment	$5,319,000
Construction Cost - GCDC-WWS Treatment	$76,607,003
Construction Cost - Lapeer County Treatment	$29,150,000
Construction Cost - Sanilac County Treatment	$1,328,000
Subtotal - Construction Cost	**$429,771,570**
Design Contingencies (5%)	$21,488,579
Construction Contingencies (15%)	$64,465,736
Engineering, Bond, Legal, & Administrative (17%)	$73,061,166
Utilities	$10,385,000
Property	$2,597,720
Total Project Cost	**$601,769,771**

Table 7-2: Project Costs for New Lake Huron Water Supply

Project Component	Total Project Cost	Sanilac Co. Share	Lapeer Co. Share	GCDC-WWS Share	Flint Share
KWA Lake Huron Water Supply	$443,885,767	$813,723	$86,312,736	$188,899,927	$167,859,381
New Sanilac Co. Facilities	$1,849,360	$1,849,360			
New Lapeer Co. Facilities	$40,009,060		$40,009,060		
New Genesee Co. Facilities / Upgrades	$110,038,554			$110,038,554	
New Flint Upgrades	$5,987,030				$5,987,030
Totals	$601,769,771	$2,663,083	$126,321,796	$298,938,481	$173,846,411

7.4.2 Treatment Costs

Table 7-3 summarizes the treatment costs during the first year of operation, assumed to be 2014. The costs for operating and maintaining the new KWA water supply water to each community is distributed on the basis of each community's projected annual consumption. These costs are combined with local treatment costs to determine the total cost for supplying treated water to each community. Costs are expressed in dollars per 1,000 cubic feet ($/MCF) to allow comparison with DWSD commodity units.

The last column of Table 7-3 below shows the current DWSD commodity charges, for comparison with the projected 2014 cost of treatment by the new Lake Huron supply being studied.

Table 7-3: Projected Initial Treatment Costs with New Lake Huron Water Supply

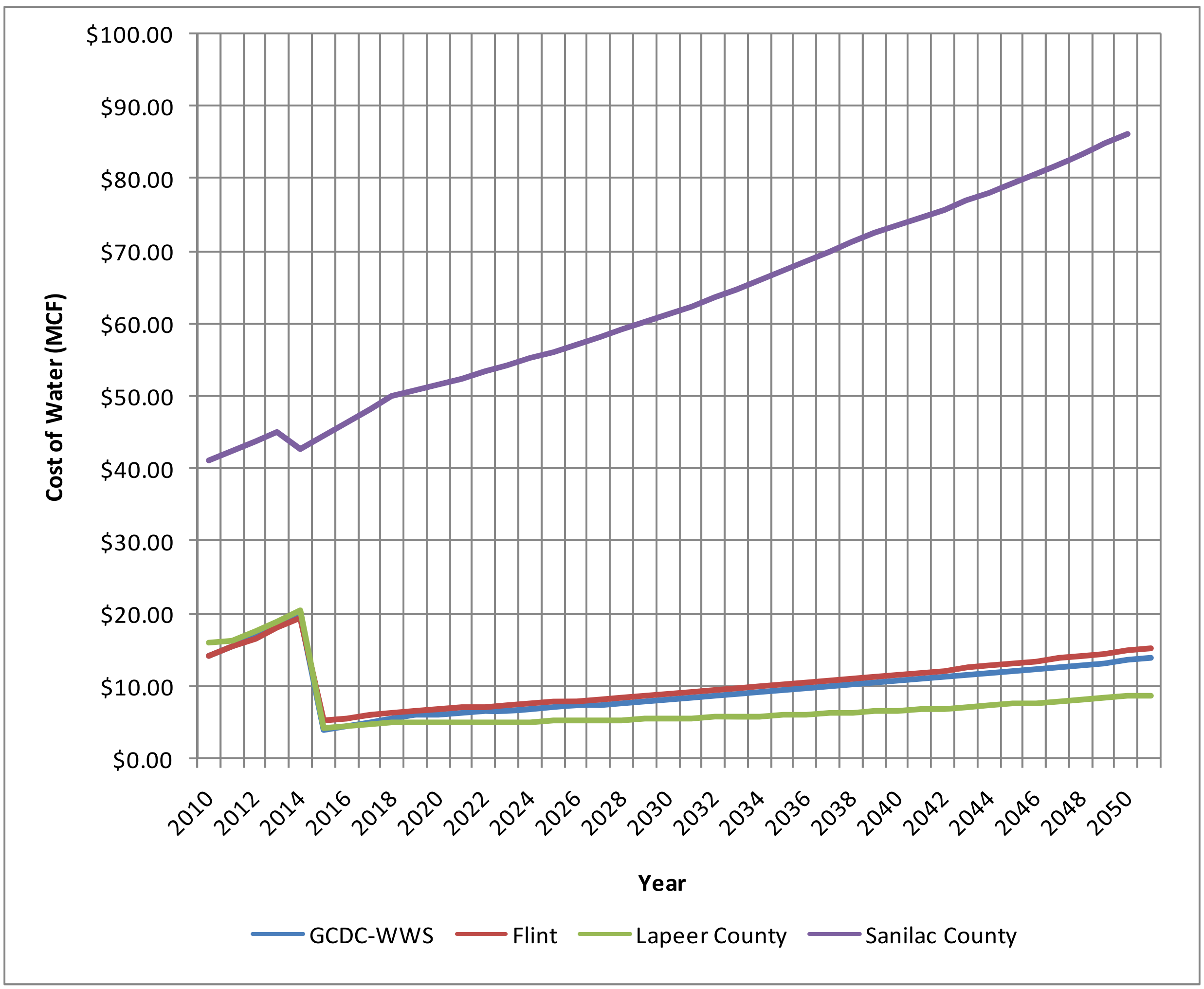
Community	KWA ($/MCF)	Local ($/MCF)	New Water Supply Treatment Cost (2014)	2009-2010 DWSD Rate
Sanilac County	$1.30	$41.56	$42.86	N.A.
Lapeer County (GLCUA)	$1.30	$3.11	$4.41	$16.10
GCDC-WWS	$1.30	$2.86	$4.16	$14.32
City of Flint	$1.30	$4.13	$5.43	$14.32

Notes
1. New water supply costs based on projected annual consumption of each community in year 2014.
2. Costs do not include debt retirement or depreciation expense.

7.4.3 Annual Treatment Costs

Projected average annual treatment costs resulting from the new water supply are shown through the year 2050 on Figure 7-2 (page 16). Neither debt retirement nor depreciation is included in the annual operating and maintenance expenses shown on Figure 7-2.

Figure 7-2: Cost of Treated Water



7.5 Alternatives for Cost Reduction

The concept developed for a new water supply is based on criteria established prior to beginning the study. There are alternatives which can reduce the cost of a new water supply, yet provide a safe, reliable supply. Project costs can be reduced by more than $100 million through incorporation of some of the alternatives identified here.

7.5.1 Cost-Reduction Alternatives – KWA Lake Huron Supply

- Provide a single supply pipeline (relocate reservoir further inland)
- Reduce the capacity of the Lake Huron intake and pumping station by 50%
- Negotiate an agreement with DWSD to provide backup and eliminate the reservoir
- Provide single-stage pumping at the LHPS
- Reduce size of transmission mains by either increasing operating pressures or reducing capacity

7.5.2 Cost-Reduction Alternatives – GCDC-WWS

- HRPS – construct additional 10-MG storage in lieu of redundant finished water pipeline
- Provide treatment by microfiltration instead of conventional treatment
- Locate WTP at HRPS site

7.5.3 Cost-Reduction Alternatives – Flint

- Reduce capacity of planned facilities

7.5.4 Cost-Reduction Alternatives – Lapeer County

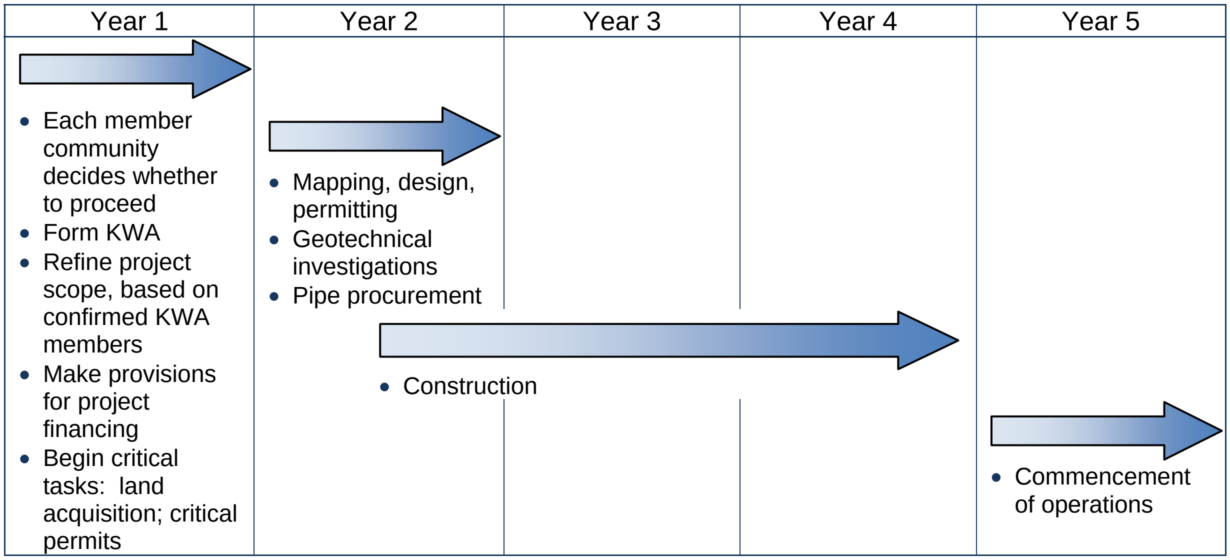
- Reduce capacity of planned facilities
- Other options for treatment and distribution may reduce costs once actual service area and demands are defined.

7.5.5 Cost-Reduction Alternatives – Sanilac County

- Identify specific customers for water supply and determine facilities and costs for specific conditions

7.6 Implementation

The following schedule shows that planning and design of the new water supply can be completed within four years. Early procurement of pipe and materials, division of construction work to allow for more contractors or crews, advance work on critical issues, and other measures can be incorporated in the proposed project to accelerate the schedule.

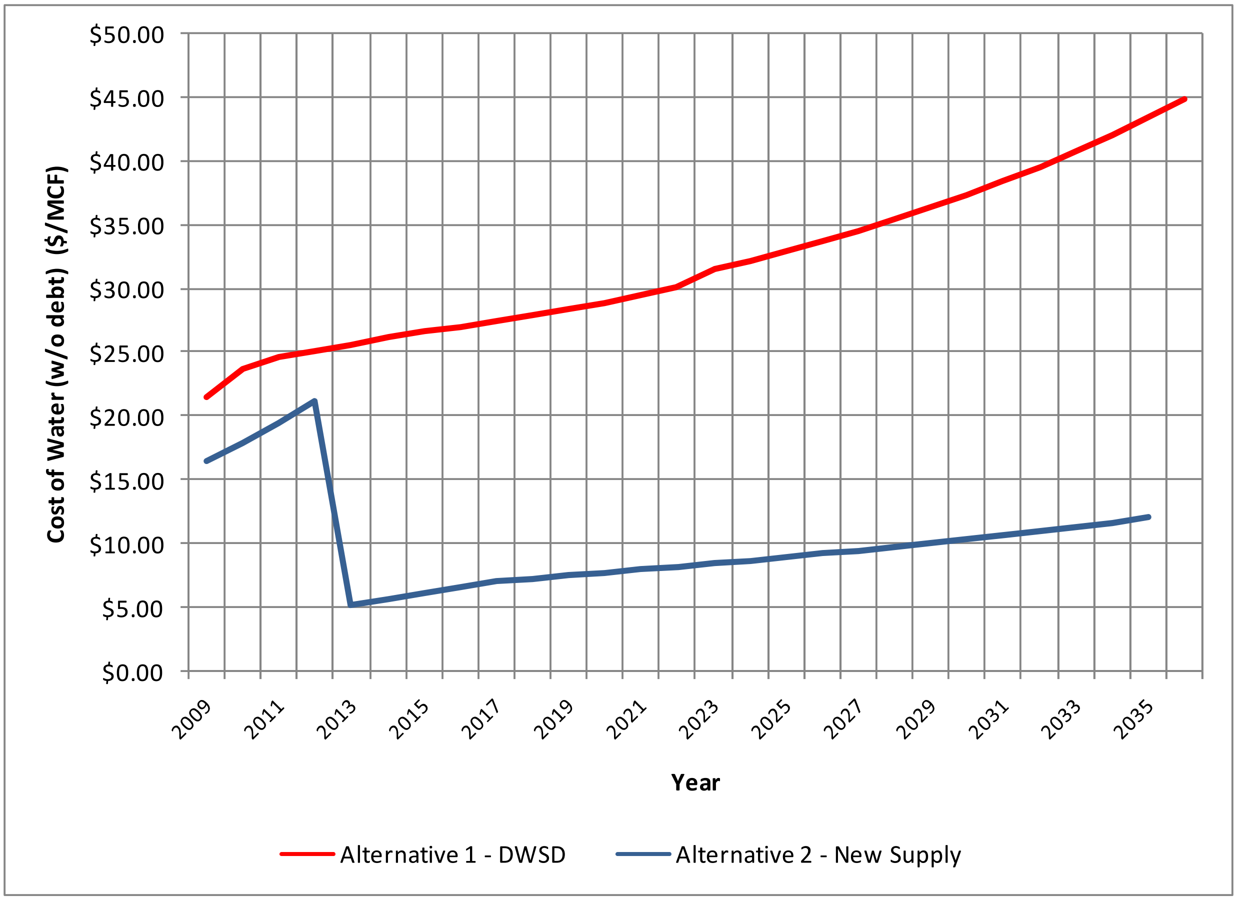


8 Comparison of Alternatives

With the investments in facilities planned by DWSD, either of the alternatives considered are believed to provide a reliable, long-term water supply with sufficient capacity for the needs of the study area. Both alternatives address the criteria established for reliability, water quality, quantity and security. The primary difference between the two alternatives is economics. Regardless of the alternative selected, a new pipeline and other facilities are planned for construction. As a result, the cost of water will increase regardless of the alternative selected; however, each will be affected differently.

Figure 8-1 shows the projected cost of water over the planning period for both alternatives. For demonstration purposes, the cost of water for the new Lake Huron water supply alternative does not include the cost of repayment of debt incurred for its construction. The graph shows that without the debt of constructing the new system (or once the debt for its construction is repaid), the cost of water from the new supply will be substantially less than continuing to purchase water from DWSD.

Figure 8-1: Comparison of Alternatives



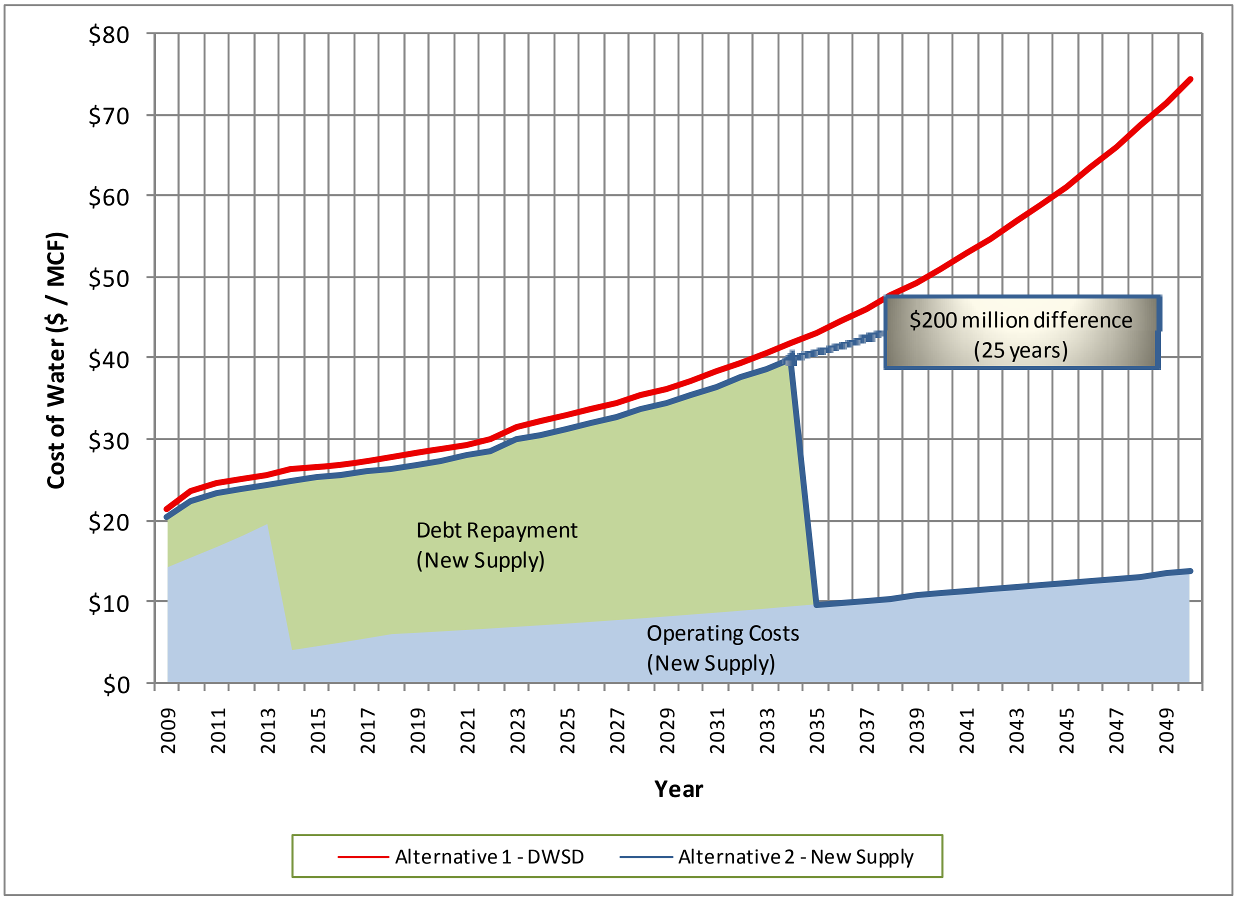
9 Debt Service

The cost of water for the DWSD alternative was developed using the DWSD rate methodology which includes recovery of capital investment. For comparison, the cost of water for the new Lake Huron supply should include the cost of financing its construction.

If 25-year bonds are used for financing the construction of the new Lake Huron supply, analysis has shown that the cost of water for the new Lake Huron supply can be less than with continuing service from DWSD. Over the 25-year life of the bonds, the total cost of water with continued DWSD supply is projected to be $200 million greater than with the new Lake Huron supply.

Figure 9-1 demonstrates the cost savings resulting from new Lake Huron supply during the 25-year bond period; the figure also shows the reduction of the cost of water with new Lake Huron supply once the debt in paid back.

Figure 9-1: Comparison of Alternatives



10 Other Impacts of Long-Term Water Supply Alternatives

In addition to the criteria established in Section 2 for comparison of long-term water supply alternatives, there will be other impacts. A review of some of these follow.

10.1 Employment

Either alternative will require the construction of new facilities. Depending on the alternative, up to 1,200 construction jobs will be created over a three-year period. With Alternative 1, the new facilities constructed by DWSD must comply with Executive Order 4001 of the Mayor of Detroit, which requires that either at least 50% of labor for construction is Detroit residents or a penalty is assessed against the contractor. Without the restrictions, Alternative 2 offers the Genesee, Lapeer, and Sanilac County region more opportunity to furnish local labor for construction.

Continued DWSD supply will result in a negligible increase in operation and maintenance staffing once the new facilities are constructed, since water will be supplied from an existing treatment plant. Approximately 45 new full-time positions will result from operation and maintenance of three new water treatment plants and other facilities consequential to the new Lake Huron water supply.

10.2 Facility Life

DWSD plans for construction of a new section of transmission main; this main is a small piece of the overall DWSD system. Although the facilities planned by DWSD will be new, most other components of the DWSD system are 50 to 100 years old. As a result of the age of the DWSD system, future operating and replacement costs are anticipated to continue to be greater with continued DWSD supply than with the new system provided by KWA.

10.3 Environmental Impacts

Both alternatives will result in approximately 70 miles of new transmission main. Since specific routes have not been determined, it is assumed that both alternatives will have similar impacts environmentally as a result of pipeline construction. Permitting for construction of either pipeline alternative is expected to be of a routine nature. Impacts are anticipated to be temporary, occurring only during the construction period.

Continued supply from DWSD provides for supply of water through an existing intake from Lake Huron. The alternative for a new supply requires construction of a new intake. Environmental impacts during construction of the new intake will be of a temporary nature. With either alternative, the total quantity of water drawn from Lake Huron will be equivalent. A permit for withdrawal from Lake Huron has been issued for the new water supply.

11 Glossary

25 Year Demand – The projected quantity of water needed in the future (in 25 years).

Average Day Demand – The quantity of water desired over a period of 24 hours, averaged over a year.

Capacity – The greatest quantity that can be conveyed or processed by a particular component, or the limiting quantity of a facility or series of components.

Clarification – Water treatment process providing for the removal of particles from water using gravity settling.

Construction Contingencies – An allowance in the project budget so money is available in the event unexpected conditions are encountered during the construction phase which requires additional work to finish the project.

Construction Cost – The cost of constructing proposed facilities; including labor, materials, and contractor's equipment charges and fees.

Crib – Submerged structure which surrounds inlet to intake pipe for protection.

Demand – The quantity of water desired by customers.

Design Contingencies – An allowance in the project budget so money is available in the event that design and permitting requirements result in the need for additional facilities, longer pipeline routes, more difficult construction conditions, or other conditions which increase the project cost.

Disinfection – Treatment process to destroy or prevent the growth of disease-carrying microorganisms.

Distribution –Delivery of water to customers (homes, businesses, institutions, etc.) by a pipe network.

ENR Construction Cost Index – An index for "time adjustment of construction costs". Engineering News- Record (ENR) is a long established publication serving the construction industry. The index is computed based upon the cost 200 hours of labor, 25 cwt structural steel, 1.128 tons cement, and 1,088 board feet of lumber. The index has been computed over a 100+ year history.

Filtration – Treatment process using a porous material to trap and remove suspended particles from water**.**

Finished water – Water that has received treatment and meets standards and regulations established for drinking water.

Firm Capacity – The maximum quantity of water that can be treated or pumped in the event that the largest mechanical component or pump is out of service.

Governmental Authority – A governmental entity, comprised of other governmental units (cities, townships, counties, etc.), for a special purpose such as sharing services (water utilities, public safety, libraries, etc.)

Ground Storage – Tank at ground level for the storage of water.

Hazen Williams C Factor – Engineering coefficient used for considering the effect of pipe material on hydraulic capacity.

High Service – Term used to describe pumping against high pressure, often resulting from elevation increases and friction in pipeline(s).

Intake – Submerged pipe inlet to draw water from a lake.

Local Storage – Water storage tanks located in the distribution system, often providing for supplying water for peak demands because of their proximity to the customers' locations.

Low Lift – Term used to describe pumping against relatively low pressure, usually where water must be lifted to provide for another treatment process.

Malevolent – Actions intended to result in harmful or malicious impact.

Maximum Day Demand (MDD) – The maximum quantity of water desired by customers over any 24 hour period.

Microfiltration – Treatment process using fine-pored synthetic membranes for removal of particles in water.

O&M – Acronym for operating and maintenance. Operating and maintenance is the ongoing cost for operation, including labor, power and utilities, chemicals and supplies, maintenance and repairs, supervision, and administration.

Peak Hour Demand – The greatest quantity of water desired for consumption during any one hour period.

Project Costs – The total cost of constructing proposed facilities; including the cost of construction plus other costs expected during the planning, design, and construction phases. Other costs often include land acquisition, utility service, engineering, legal fees, and appropriate contingencies.

Proxy – An allowance for future increased water use assumed by the water supplier, in absence of information provided by the water customer.

Raw Water – Water in its natural state, prior to treatment.

Reservoir – Earthen basin or tank for the storage of water.

Residuals – Solid materials resulting from the treatment of water. Residuals may include solids (silt, algae, etc.) removed from the source water or the precipitate resulting the addition of chemicals for treatment.

SCADA – Acronym for "Supervisory Control and Data Acquisition". SCADA is a term commonly used to describe the instrumentation to measure or monitor equipment and/or processes, and controls to operate equipment.

Shorewell – Vertical shaft located adjacent to lake, extending from the ground surface down to the intake pipe.

Zebra mussels – small shellfish introduced to Great Lakes through ballast discharge from international shipping. Zebra mussels are a concern to waterworks because they attach to submerged intakes and pipes, resulting in reduced capacity or plugging.

12 Abbreviations

CPP	Concrete Pressure Pipe
DIP	Ductile Iron Pipe
DWSD	Detroit Water and Sewerage Department
ENR	Engineering News-Record
GCDC-WWS	Genesee County Drain Commissioner – Division of Water and Waste Services
GLCUA	Greater Lapeer County Utilities Authority
HRPS	Henderson Road Pumping Station
HVAC	Heating, Ventilation, and Air Conditioning
KWA	Karegnondi Water Authority
kWh	Kilowatt-hour
LWTUA	Lexington Worth Townships Utilities Authority
MCF	1,000 Cubic Feet
MDD	Maximum Day Demand
MDEQ	Michigan Department of Environmental Quality
MG	Million Gallons
Mgd	Million Gallons per Day
O&M	Operating and Maintenance
SCADA	Supervisory Control and Data Acquisition
WTP	Water Treatment Plant

APPENDIX 1

Lake Huron Water Supply Study

Technical Memorandum

Population Projections and Projected Water Demands

Karegnondi Water Authority
City of Flint
Genesee County
Lapeer County
Sanilac County

February 20, 2009

WadeTrim

555 South Saginaw Street
Suite 201
Flint, Michigan 48502

Appendix 1 - Projected Water Demands

1.1 - General

Recent water records from Flint, GCDC-WWS, and GLCUA have been reviewed to evaluate historical water use. Working with representatives of these communities, projections of future water demands were developed. Table 1 shows the initial and projected water demands that have been assumed for this study, in regard to a new Lake Huron Water Supply. Water records from Sanilac County were unavailable; the Sanilac County demands shown in Table 1 have been assumed.

Table 1 - Design Demands for Planning New Lake Huron Water Supply

Customer	Initial (2014)			25-Year (2039)			50-Year (2064)		
	Min. Day Demand (MGD)	Avg. Day Demand (MGD)	Max. Day Demand (MGD)	Min. Day Demand (MGD)	Avg. Day Demand (MGD)	Max. Day Demand (MGD)	Min. Day Demand (MGD)	Avg. Day Demand (MGD)	Max. Day Demand (MGD)
Genesee County	10.66	14.21	25.00	12.19	16.25	32.50	16.88	22.50	45.00
City of Flint	12.39	16.52	25.00	14.44	19.25	28.88	18.00	24.00	36.00
Lapeer County	1.47	2.54	3.82	5.23	9.01	14.85	6.77	11.66	19.66
3% WTP Process	0.74	1.00	1.61	0.96	1.34	2.29	1.25	1.74	3.02
Subtotal:	**25.25**	**34.26**	**55.43**	**32.81**	**45.85**	**78.52**	**42.89**	**59.90**	**103.68**
Sanilac County	0.03	0.05	0.10	0.04	0.07	0.14	0.05	0.10	0.20
Total:	**25.28**	**34.31**	**55.53**	**32.85**	**45.92**	**78.66**	**42.94**	**60.00**	**103.88**

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 1A
Projected Water Demands

September 3, 2009

1.1 Withdrawal Permit

Based on the demands presented in Table 1of Appendix 1, Genesee County applied for a permit for withdrawal of 85 MGD of water from Lake Huron. The MDEQ issued the permit on August 28, 2009.

Lake Huron Water Supply Study

Karegnondi Water Authority

- **City of Flint**
- **Genesee County**
- **Lapeer County**
- **Sanilac County**

Appendix 10
Service to Lapeer County

February 21, 2009
Revised May 6, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

10.1 General

The Karegnondi Water Authority (KWA) is studying the development of a new Lake Huron water supply for Genesee, Lapeer, and Sanilac counties. This memorandum summarizes the concept studied for supplying water to Lapeer County.

10.2 Study Area

The study area includes all of Lapeer County. Lapeer County is generally rural, in nature. There are several cities and villages scattered throughout the county. Development and business activity within the county is generally concentrated along the I-69, M-24, and M-53 highway corridors.

The Lapeer County communities of Lapeer, Imlay City, Almont, and Mayfield Township are supplied water by the Greater Lapeer County Utility Authority (GLCUA). GLCUA is supplied water by the City of Detroit's Water and Sewerage Department (DWSD). Imlay City, Mayfield Township, and Lapeer are supplied water from DWSD's 72 inch transmission main running from the Imlay Pumping Station to Flint. Almont is supplied water from DWSD's 96 inch transmission main running from their Imlay Pumping Station to the Detroit area. DWSD supplies finished water to GLCUA members.

Several other communities in Lapeer County operate municipal water systems. These communities utilize wells to supply water to their customers. Additionally, there are several community water systems scattered across Lapeer County, providing water service to campgrounds and mobile home parks.

Businesses and residences in other areas of the county rely on individual wells for their water supply.

10.3 Growth within Lapeer County

Lapeer County population grew by 5.7% between 2000 and 2005 (annual rate of just over 1%). Lapeer County was the 12th fastest growing county in Michigan and the 495th (out of 3,141) fastest growing county in the United States during this period.

Although recent economic conditions have halted growth, prudent planning should anticipate continued growth in the future.

10.4 Projected Demands

Potential Lapeer County water demands are divided into the following four categories:

1. Existing DWSD Customers
2. Existing Type 1 Community Water Supplies (Well Supply)
3. Communities with No Public Water Supply
4. Agricultural Irrigation

10.4.1 Group1 - Existing DWSD Customers

The Greater Lapeer County Utility Authority (GLCUA) contracts with the Detroit Water and Sewerage Department (DWSD) for finished water. Ten Lapeer communities are members of GLCUA. Four communities (Lapeer City, Imlay City, Almont Village, and Mayfield Township) currently receive water from GLCUA. The other six communities have never received water from GLCUA nor currently have any municipal water facilities.

Table 10-1 summarizes initial water use based on DWSD records. Projections for future use for Imlay City and Almont have been developed assuming 20% growth over 25 years, which is just less than the growth experienced in the area between 2000 and 2005 (0.8 % vs. 1.1%). Projections for Mayfield Township have been based on 50% growth over 25 years, since the existing service area is quite small. The City of Lapeer provided projections of growth in their service area.

Table 10-1 - Existing DWSD Customer Demands

Existing DWSD Customers	Initial		25 Year		50 Year	
	Average (mgd)	Max Day (mgd)	Average (mgd)	Max Day (mgd)	Average (mgd)	Max Day (mgd)
- Lapeer City	1.44	2.03	7.29	11.35	9.31	14.49
- Imlay City	0.87	1.37	1.05	1.81	1.26	2.17
- Almont Village	0.21	0.38	0.25	0.46	0.30	0.55
- Mayfield Township	0.02	0.04	0.03	0.06	0.05	0.09
- Subtotal	2.54	3.82	8.62	13.68	10.92	17.30

10.4.2 Group 2 - Existing Type 1 Community Water Supplies (Well Supply)

Clifford, Columbiaville, Dryden, Metamora, and North Branch operate Type 1 community water systems, each utilizing wells for supply. The closest community is about five miles from the planned KWA supply. There has been no interest identified for replacing any of these existing supplies with the proposed KWA supply. For this analysis, it is assumed that none of these community water systems will replace their existing wells with the new supply planned by KWA.

Other community water supplies serve mobile home parks and campgrounds. Similarly, none of these are believed to be in close proximity to the proposed KWA supply and none are assumed to be future KWA customers.

10.4.3 Group 3 - Communities with No Public Water Supply

Although the Lapeer County communities without municipal water systems are generally rural in nature, local officials believe that communities adjacent to the I-69, M-53, and M-24 corridors have great potential for development. New water service to these areas could provide service to both existing residences in businesses and new development. Water supply to these areas will require construction of distribution (and perhaps storage) facilities.

As an example, Elba Township provides sewers to 175 units in the “Elba Village” area, plus 77 units for the Potters Lake area. County officials are aware of proposed developments which could add as much as 600 units of new development to the area. If served with water, these 852 units would result in an average demand of 268,000 gpd and a maximum day demand of 0.47 mgd.

It is conceivable that new areas in Lapeer County could experience development over the study period of 50 years and community water service. A maximum day demand of 0.47 mgd has been assumed for new water supplies over the next 50 years.

10.4.4 Group 4 - Irrigation

The 2002 Farm Census indicated that 19 farms accounted for most of the irrigated farmland in Lapeer County. These farms had a total of 1,787 acres under irrigation. Surface water sources provided 86% of the water used for irrigation.

Based on meteorological conditions from 2006 and the 2002 Farm Census records, a study prepared by the MDEQ estimated annual irrigation use in Lapeer County at 405 million gallons. This is equal to 227,000 gallons per acre annually, or the equivalent of 8.3 inches of rainfall.

The growing season is assumed to be 120 days in duration. It is also assumed that irrigation occurs 50% of the days during the growing season. Daily demand for irrigation during the growing season is therefore 2,500 gpd / acre. The following table summarizes daily irrigation requirements, based upon the acreage under irrigation.

Table 10-2 - Irrigation Demand

Acres	Daily Irrigation Demand (mgd)
100	0.25
500	1.26
1,000	2.52
1,500	3.78
2,000	5.04
2,500	6.31
3,000	7.57
3,500	8.83
4,000	10.09

It is assumed that irrigated farmland will increase in the future. As shown in Table 10-2, irrigation demands can be significant. However, obstacles with utilizing the KWA supply as a major irrigation source will include 1) the availability of other sources, and 2) the KWA supply's proximity with the prime farmland in Lapeer County.

In the future, regulations or environmental conditions may reduce the availability of the current sources or there may be additional costs for their use. Future changes may make the KWA supply a viable option for irrigation.

To develop projections of future demands, it is assumed that 750 acres of land are irrigated using the KWA supply.

Table 10-3 summarizes the current and projected demands used for this study.

Table 10-3 - Lapeer County Demands

	Initial		25 Year		50 Year	
Existing DWSD Customers	Average (mgd)	Max Day (mgd)	Average (mgd)	Max Day (mgd)	Average (mgd)	Max Day (mgd)
- Lapeer City	1.44	2.03	7.29	11.35	9.31	14.49
- Imlay City	0.87	1.37	1.05	1.81	1.26	2.17
- Almont Village	0.21	0.38	0.25	0.46	0.30	0.55
- Mayfield Township	0.02	0.04	0.03	0.06	0.05	0.09
- Subtotal	2.54	3.82	8.62	13.68	10.92	17.30
Communities w/Type 1 Supplies (wells)	0.00	0.00	0.00	0.00	0.00	0.00
Communities w/o Public Water	0.00	0.00	0.15	0.23	0.27	0.47
Irrigation	0.00	0.00	0.24	0.94	0.47	1.89
Total	2.54	3.82	9.01	14.85	11.66	19.66

10.5 Demands Used for this Study

For this study, it is assumed that KWA provides finished water to the four communities which are currently supplied by DWSD. The alternative studied considers developing the facilities necessary to supply customers for the projected 25 year demands.

10.6 Treatment

Although there are many alternatives for supplying these communities with water, it is assumed that a single water treatment plant, centrally located amongst the four communities is provided. This alternative includes the construction of a single pipeline from the treatment plant to each community. The proposed water main will supply water to the same locations as the current DWSD supply, except that only a single supply point is initially planned for the City of Lapeer. Lapeer presently is supplied by DWSD at three separate connections.

It is assumed that water treatment will be provided by direct filtration. This process has been used successfully by other Michigan communities for treatment of Lake Huron water. Assumed design criteria are based upon operating conditions from existing facilities. Design criteria for the studied alternative are summarized as follows:

Pretreatment:
- Screening (in-line strainers)
- Metering

Filtration
- Low pressure membrane modules (hollow fiber PVDF)
- Maximum capacity: 14.8 mgd
- Flux (all units in operation): 33 gfd
- Flux (1 out of service): 40 gfd
- Automatic backwash provisions
- In-place chemical cleaning provisions
- Automatic PLC controller

Disinfection
- Liquid chlorine feed

High Service Pumping

Process Water & Residuals
- Filter backwash will be pumped into the KWA raw water transmission main and combined with raw water for treatment at downstream WTP's.

Expansion
- Although not included, the building and appurtenances can be enlarged and configured to accommodate the future addition of membrane modules to increase treatment capacity.

Land Requirements
- Five acres assumed for WTP site

10.7 Transmission Pipeline

Although specific sites and routes have not been identified for the proposed water supply, approximately 22 miles of main will be necessary to connect the four communities based on geography. For this study, the supply main is designed to provide sufficient capacity for the 25 year demands. A minimum pipe size of 16 inch has been assumed. Figure 10-1 is a schematic summarizing the alternative studied for providing service to the existing DWSD customers in Lapeer County

10.7.1 Land Requirements

Ten percent of the length of the pipeline (22 miles) is assumed to require easements; easements are assumed to be 25 feet wide.

- 10% of 22 miles * 5,280 ft/mi * 25 ft = 290,400 sq. ft.
- 290,400 sq.ft. * $0.15/sq.ft. = $43,560

10.8 Opinions of Costs

The estimated construction cost for the providing service to the four Lapeer County communities is $25,955,000 assuming and ENR Construction Cost Index of 8688. Table 10-4 provides a breakdown showing the assumed project cost.

Table 10-4 Engineer's Opinion of Probable Construction Cost

Transmission & Storage			
Supply Pipeline	36"	5,000 ft	$1,125,000
Pipeline To Lapeer	30"	20,000 ft	$4,000,000
Pipeline To Imlay City & Almont	16"	40,000 ft	$4,600,000
Pipeline To Almont	16"	50,000 ft	$5,750,000
Lapeer City Pipeline	16”	4,000 ft	$460,000
Lapeer City Pipeline	24”	4,000 ft	$640,000
Lapeer City Storage	2 MG		$2,000,000
Meter Pits	4		$400,000
Transmission Pipelines Subtotal		22 miles	$18,975,000
WTP			
Equipment			$4,400,000
Building			$1,500,000
Mechanical / Electrical (incl. Generator)			$1,400,000
Sitework			$1,100,000
Contractor's OH&P (20%)			$1,680,000
WTP Subtotal			$10,080,000

Table 10-5 shows projected expenses for 2014.

Table 10-5 Annual Operating Expenses (2014)

Maintenance	$132,000
Labor	$213,000
Testing	$15,000
Chemicals	$33,000
Power	$98,000
Subtotal O&M Expenses	**$491,000**
Depreciation	
WTP	$328,000
Transmission Pipelines	$211,667
Subtotal Depreciation	**$539,667**
Total Expenses	**$1,030,459**

10.9 Construction Schedule

Construction of the proposed water treatment plant can be completed in about 12 months. Construction of 22 miles of water main at an average production rate of 400 feet per day will require about a year for completion.

Although not the critical time constraint for the overall KWA project, construction of the proposed water main utilizing multiple contracts will reduce overall construction time and likely reduce costs by providing opportunities for contractors without the resources required for the larger project(s).

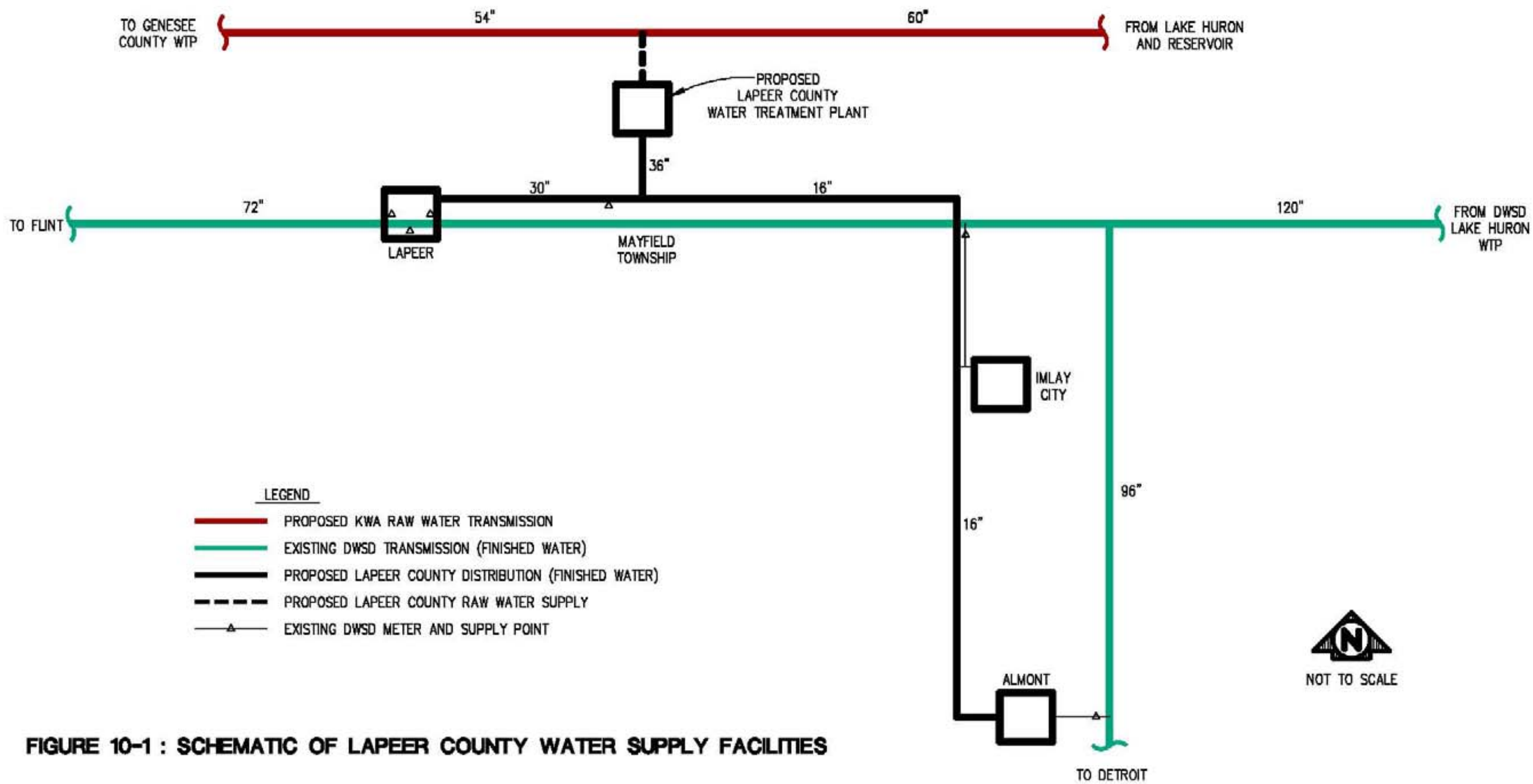


FIGURE 10-1 : SCHEMATIC OF LAPEER COUNTY WATER SUPPLY FACILITIES

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 11
Service to Sanilac County

February 21, 2009
Revised May 5, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

11.1 General

The Karegnondi Water Authority (KWA) is studying the development of a new Lake Huron water supply for Genesee, Lapeer, and Sanilac counties. This memorandum summarizes the concept studied for supplying water to Sanilac County.

11.2 Service Area

The proposed water supply can provide service to Sanilac County from any location along the proposed pipeline route. Most villages and cities within the county presently supply water to residences and businesses in their communities. All townships (except Forester) along the Lake Huron shoreline provide water service to properties along Lake Huron. No particular community(ies) or area(s) have been identified as customers of the proposed new water supply.

For this study, it is assumed that water is supplied to Worth Township. The assumption that the new Lake Huron water supply provides service to a specific community will allow for the study to identify and address specific conditions and facilities necessary to provide service to Sanilac County communities.

Worth Township is adjacent to the proposed new water supply and presently provides water service along and adjacent to State Highway M-25 and Lake Huron. Water is supplied by the Lexington – Worth Townships Utilities Authority (LWTUA). The authority purchases finished water from the Village of Lexington.

11.3 Demands

For this study, it has been assumed that Worth Township has an average day demand (ADD) of 50,000 gallons per day (0.05 mgd) and a maximum day demand (MDD) of 100,000 gallons per day (0.10 mgd. Although the costs and facilities considered will be based on supplying a community with an ADD of 0.05 mgd, the alternative considered can be easily adjusted for specific conditions where and when specific needs are defined.

11.4 Alternative Studied for Supply to Worth Township

The concept studied for a new Lake Huron water supply provides for the KWA to deliver raw to individual KWA customers. KWA customers are responsible for treatment and local storage and distribution.

This study assumes that a 0.1 mgd treatment plant is constructed adjacent to the KWA intake and Lake Huron Pumping Station (LHPS) for the purpose of treating water for delivery to Worth Township. Treatment is planned to be by direct filtration utilizing continuous flow membranes. This process has been utilized by other Michigan communities for treating high quality water from the Great Lakes. Design criteria will be established based upon the performance of established facilities.

Raw water from the storage tanks planned at the KWA's LHPS will be pumped to the Worth Township WTP. Treatment redundancy will be provided by duplicate process trains.

Backwash waste will be returned to the KWA shorewell, combined with the raw water supply which will ultimately receive treatment at one of the water treatment plants of the KWA customers.

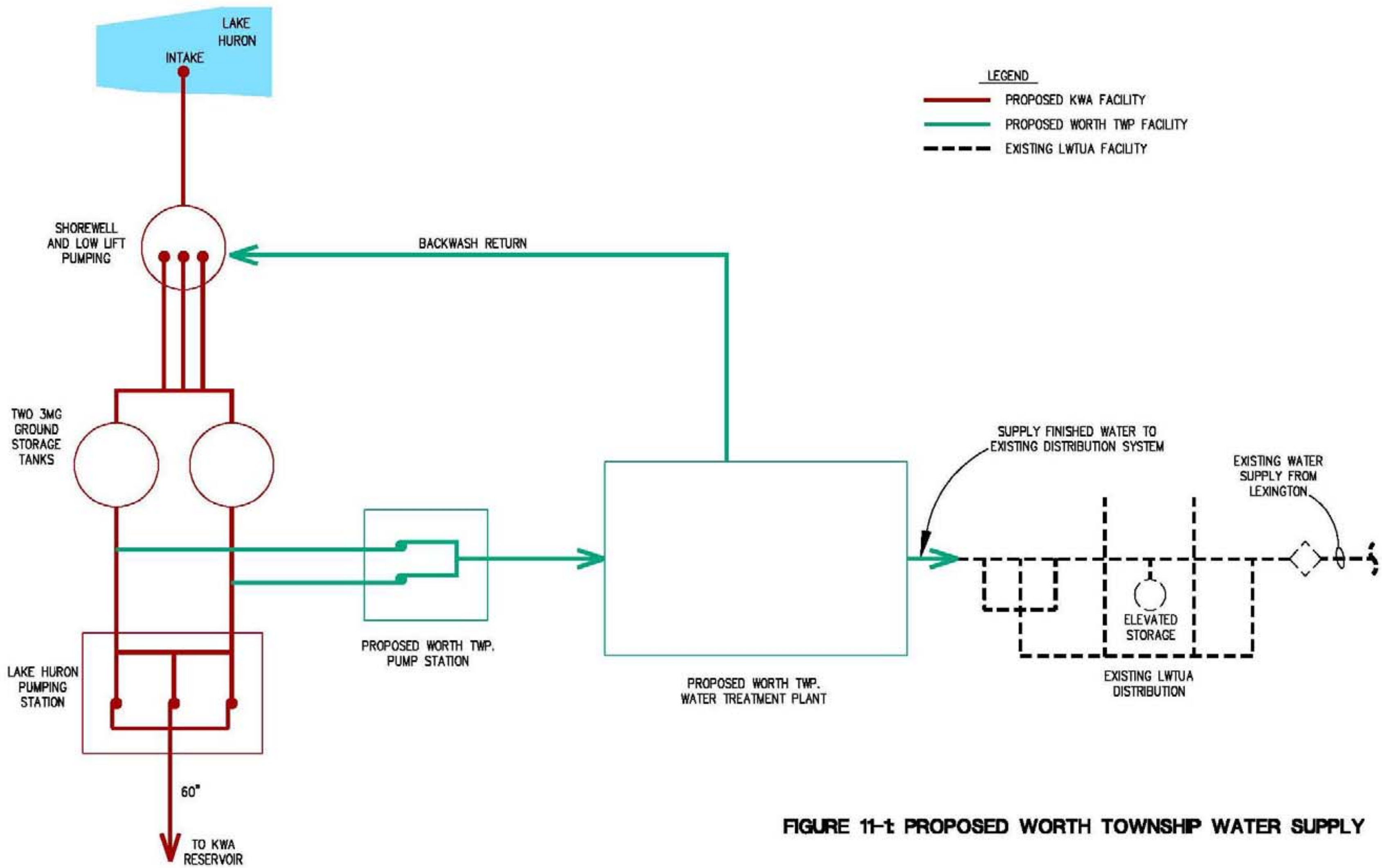


FIGURE 11-1: PROPOSED WORTH TOWNSHIP WATER SUPPLY

It has been assumed that the treatment facilities are fenced and that other suitable security provisions are provided.

Treated water will be pumped into the LWTUA distribution system for delivery to Worth Township water customers.

Figure 11-1 is a schematic of the alternative considered for supplying Worth Township with water.

A detailed analysis of the LWTUA distribution analysis has not been completed to evaluate if modifications are necessary to the existing distribution system to accommodate the new water supply.

11.5 Assumed Water Treatment Design Criteria

Design criteria for the alternative studied are summarized as follows:

Pretreatment:
- Screening (in-line strainers)
- Metering

Filtration
- Three low pressure membrane modules (hollow fiber PVDF)
- Maximum capacity: 100,000 gpd
- Flux (3 units in operation): 30 gfd
- Flux (2 units in operation): 44 gfd
- Automatic backwash provisions
- In-place chemical cleaning provisions
- Automatic PLC controller

Disinfection
- Liquid chlorine feed

High Service Pumping

Process Water & Residuals
- Filter backwash will be pumped into the KWA raw water transmission main and combined with raw water for treatment at downstream WTP's.

Expansion
- Although not included, the building and appurtenances can be enlarged and configured to accommodate the future addition of membrane modules to increase treatment capacity.

Land Requirements
- Five acres

11.6 Opinion of Costs

Projected construction costs are shown in Table 11-1. Costs based on an ENR Construction Cost Index of 8688.

Table 11-1 Engineer's Opinion of Probable Construction Cost

Equipment	$400,000
Building	$185,000
Mechanical / Electrical (incl. Generator)	$180,000
Sitework	$135,000
Water Main	$48,000
Contractor's OH&P (20%)	$180,000
	$1,128,000

In addition to the costs presented in Table 11-1, additional pumping may be required. Depending upon the location of a treatment facility along the proposed pipeline route, pipeline pressures may be too low to supply water for treatment. For the Worth Township site, the addition of two pumps (one for backup) are planned to draw water from a reservoir at the KWA's Lake Huron Pumping Station. A budget of $200,000 has been included for the additional pumping facilities.

Table 11-2 shows projected operating expenses and depreciation for the treatment facility for 2014.

Table 11-2 Annual Operating Expenses (2014)

Maintenance	$12,000
Labor	$89,000
Testing	$4,000
Chemicals	$1,000
Power	$5,000
Subtotal O&M Expenses	**$111,000**
Depreciation	
WTP	$32,000
Transmission Pipelines	$640
Subtotal Depreciation	**$32,640**
Total Expenses	**$143,640**

11.7 Construction Schedule

Construction of the proposed water treatment plant can be completed in about a year.

APPENDIX 12

Lake Huron Water Supply Study

Technical Memorandum

System Controls and Operation

Karegnondi Water Authority
City of Flint
Genesee County
Lapeer County
Sanilac County

February 20, 2009

WADETRIM

555 South Saginaw Street
Suite 201
Flint, Michigan 48502

Appendix 12 - System Controls and Operation

12.1 - Control System - SCADA

The proposed system will be designed to be a fully automated system, but each site will have individual, standalone equipment to allow each site to be operated automatically, semi-automatically, or in manual mode. A Supervisory Control and Data Acquisition (SCADA) system will consist of programmable logic controllers (PLCs), which will be connected in order to form a network at each site, as well as an overall network that will be able to be controlled from a designated “Head End” site. This Head End site is currently being designated as the GCDC WTP, and will have the capability of gathering reports from each of the remote sites, as well as controlling each of the remote sites. However, the ability for each site to remotely monitor sites that are part of the overall network will also be provided. The operator interface for the proposed control system will be made via industrial-classified personal workstations located at each facility or monitoring site. Designated water treatment plants (WTPs) will also have operator interface workstations distributed throughout the plants, as necessary, to both monitor and control.

The design objective of the instrumentation and control system is to provide redundancy at key levels in the system. The integrated system of hardware and software will provide checks and balances to allow greater system integrity, power, and reliability than standalone controls would provide. Dual PLCs will be located at each site to ensure continued, uninterrupted operation should a failure occur. Local control of major pieces of equipment will be located in the Main Control Panel (MCP) at each site to allow manual operation when needed.

The instrumentation and control system will incorporate the following sites/facilities. Note that it is assumed that the Sanilac County facility would not be interconnected nor monitored with the system as a whole.

- Lake Huron Pump Station
- Three (3) Remote Monitoring Meter Pits
- Reservoir and Reservoir Pump Station
- Henderson Road Pump Station
- GCDC Water Treatment Plant
- City of Flint Water Treatment Plant
- Lapeer County Treatment Plant

Based on the design objective of the control and instrumentation system, the following table details the anticipated costs associated with its construction and implementation. However, it should be noted that the following items were not included in the control system estimate:

- Uninterruptable Power Supplies; and,

- Local Area Network, including PCs that will need to be placed on a process control Ethernet

It is suggested that the proposed fiber-optic cable communication system be considered as a separate project, with one specialized fiber-optic design/installation company responsible for the system as a whole. By having only one company responsible and accountable for all the work, it is anticipated that costs associated with coordinating efforts of multiple stakeholders and multiple contracts would be mitigated. And, one would expect an economy of scale and reduction in fabrication and construction time as well.

Table 12.1 - Engineer's Estimate of Probable Construction Costs for Instrumentation and Control

Item Description	KWA	GCDC WTP	City of Flint WTP	Lapeer Co. WTP	Total
Lake Huron Pump Station	$ 72,000				$ 72,000
Three Remote Monitoring Meter Pits	$ 38,500				$ 38,500
Reservoir and Reservoir Pump Station	$ 15,500				$ 15,500
Henderson Road Pump Station		$ 38,500			$ 38,500
GCDC Water Treatment Plant		$ 107,500			$ 107,500
City of Flint Water Treatment Plant			$ 107,500		$ 107,500
Lapeer County Water Treatment Plant				$ 67,500	$ 67,500
Fiber Optic Cable, Conduit, and Demarcation Panels	$ 1,715,000	$ 50,000	$ 25,000	$ 25,000	$ 1,815,000
Testing	$ 24,000	$ 3,000	$ 3,000	$ 3,000	$ 33,000
Subtotal:	**$ 1,865,000**	**$ 199,000**	**$ 135,500**	**$ 95,500**	**$ 2,295,000**
15% Construction Contingency:	$ 280,000	$ 30,000	$ 20,000	$ 14,000	$ 344,000
5% Design Contingency:	$ 93,000	$ 10,000	$ 7,000	$ 5,000	$ 115,000
17% Engineering, Legal, Bond & Administrative:	$ 317,000	$ 34,000	$ 23,000	$ 16,000	$ 390,000
Total:	**$ 2,555,000**	**$ 273,000**	**$ 185,500**	**$ 130,500**	**$ 3,144,000**

Notes:

1. Estimate of construction costs are based on a projected *Engineering New Record* cost index value of 8688.

2. It is assumed that the Sanilac County facility will not be interconnected, nor monitored, with the system as a whole, and therefore costs have not been included in this estimate.

Lake Huron Water Supply Study

Karegnondi Water Authority

- **Genesee County**
- **City of Flint**
- **Lapeer County**
- **Sanilac County**

Appendix 13
Permitting

January 16, 2009

O'Malia Consulting
101 E. Grand River Avenue Williamston, MI 48895

Prior to initiating construction of project elements, permit applications will have to be developed/completed and submitted for review and approval to the following agencies. The permit application for Lake Huron withdrawal (1st item, 15.1) has been submitted.

13.1 Michigan Department of Environmental Quality

- Lake Huron new withdrawal based on the new legislation authorizing The Great Lakes Compact as signed into law, 2008, by the President,
- Public Act 399, to include; intake, shore well, raw water pumping, transmission, storage and treatment facilities and filed with Lansing District,
- Land and Water Application, regarding shoreline issues, and filed with the Saginaw District,
- Clean Water Act on residuals disposal,
- Dam Safety Act for raw water storage facility.

13.2 United States Army Corps of Engineers

- In lake soil borings,
- Intake and raw water line construction,
- Navigation issues,
- Floodplain issues that maybe associated with certain facilities.

13.3 Sanilac, St. Clair, Lapeer and Genesee County

- Zoning in relation to facility siting,
- Transmission main construction in County Roadways,
- Soil and erosion control.

13.4 Michigan Department of Transportation

- Transmission main in state roadways [if applicable].

13.5 Michigan Department of Natural Recourses

- Environmentally sensitive areas,
- Endangered species [Wildlife Division],
- Natural Rivers Program.

13.6 State Historic Preservation Office

- Historic/Archeologically sensitive areas.

13.7 Tribal Historic Preservation Office

- Religious or culturally significant tribal lands.

13.8 U. S. Fish and Wildlife Service

- Endangered and protected species.

13.9 Regional Planning Agencies

- SEMCOG,
- Genesee County Metropolitan Planning Commission,
- East Central Michigan Planning and Development.

13.10 U.S. Department of Agriculture

- Important/critical agricultural land,
- Irrigation use [if applicable]

Lake Huron Water Supply Study

Karegnondi Water Authority

- **City of Flint**
- **Genesee County**
- **Lapeer County**
- **Sanilac County**

Appendix 14
Cost Summary

February 21, 2009
Revised September 24, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

14.1 General

The Karegnondi Water Authority (KWA) is studying the feasibility of a new regional drinking water supply. The alternative studied will provide raw Lake Huron water to central Michigan communities.

The concept for the water supply has been studied and planned through a series technical memorandum, each addressing specific components of the planned facility. These memoranda included Engineer's opinions of construction costs and of ongoing operating and maintenance expenses for individual facility components.

This appendix collects and sums the individual costs from other appendices to allow for projecting the total project costs and its distribution.

14.2 Total Project Cost

Table 14-1 provides a summary of the total project costs for a new water supply. Project costs include construction costs; contingencies; engineering, legal, and administrative expenses; land acquisition; and utility service costs.

Table 14-1 also shows the costs for the new raw water supply (KWA Project Cost) and the costs attributable for each community to treat the raw water received from the KWA supply and deliver it to their distribution systems (GCDC-WWS, Flint, Lapeer Co., and Sanilac Co. Project Costs).

14.3 Annual Operating Expenses

Annual operating expenses for the KWA water supply and for providing treatment for each community are provided in Tables 14-2 through 14-6.

Figure 14.1 shows the projected operating costs for each community for the new water supply. The costs shown do not include depreciation expense nor debt retirement. Maintenance costs have been projected for 2014, and increased at the assumed rate of inflation thereafter. During the initial five years of operations, maintenance costs have been assumed to be 20% the initial year, 40% the second year, etc.

14.4 Individual Costs

Tables in this section provide a summary of the project and operating costs for each agency or community.

- Table 14-7: Summary of KWA Costs
- Table 14-8: Summary of GCDC Costs
- Table 14-9: Summary of City of Flint Costs
- Table 14-10: Summary of Lapeer County Costs
- Table 14-11: Summary of Sanilac County Costs (assuming one service with 0.10 mgd WTP)

To determine the total project costs for Genesee County, City of Flint, Lapeer County, and Sanilac County, KWA project costs from Table 14-7 have been distributed to each community proportionally on the basis of the system capacity (25 year MDD) provided for each. KWA operating costs have been distributed on the basis of the projected annual consumption for each community.

14-1 Summary of Project Costs - 25 Year Capacity

	Capital Components (Capital Costs Based on ENR CCI = 8688)	Cost Responsibility	Cost Source	Project Cost	KWA Project Cost	GCDC-WWS Project Cost	Flint Project Cost	Lapeer Co. Project Cost	Sanilac Co. Project Cost
1	Intake	KWA	Table 4-6	$39,706,000	$39,706,000				
2	Shorewell and Tunnel	KWA	Table 4-7	$6,629,000	$6,629,000				
3	Lake Huron Pumping Station (LHPS)	KWA	Table 4-8	$29,100,000	$29,100,000				
4	Reservoir	KWA	Table 7-1	$10,659,000	$10,659,000				
5	Reservoir Pumping	KWA	Table 7-2	$11,200,000	$11,200,000				
6	Lake Huron Transmission Pipeline	KWA	W5-8 & App 6	$115,799,513	$115,799,513				
7	North Transmission Pipeline, reservoir to GCDC-WWS WTP	KWA	W5-9 & App 6	$36,011,595	$36,011,595				
8	South Transmission Pipeline, reservoir to GCDC-WWS WTP	KWA	W5-10 & App 6	$35,722,630	$35,722,630				
9	Flint Transmission Pipeline	KWA	W5-11 & App 6	$30,674,829	$30,674,829				
10	Genesee Co. Finished Water Transmission Main	GCDC-WWS	W5-12 & App 6	$9,028,003		$9,028,003			
11	System Control and Monitoring - KWA	KWA	Table 12-1	$1,865,000	$1,865,000				
12	System Control and Monitoring - GCDC-WWS	GCDC-WWS	Table 12-1	$199,000		$199,000			
13	System Control and Monitoring - Flint	Flint	Table 12-1	$135,500			$135,500		
14	System Control and Monitoring - Lapeer	Lapeer Co.	Table 12-1	$95,000				$95,000	
15	GCDC-WWS WTP	GCDC-WWS	Table 8A-1	$65,880,000		$65,880,000			
16	GCDC-WWS Henderson Road Pump Station Modifications	GCDC-WWS	Appendix 17.2	$1,000,000		$1,000,000			
17	GCDC-WWS Existing Henderson Road 48" Pipeline Modifications	GCDC-WWS	Appendix 17.4	$500,000		$500,000			
18	Flint WTP	Flint	Table 9-3	$5,183,500			$5,183,500		
19	Lapeer WTP	Lapeer Co.	Table 10-4	$10,080,000				$10,080,000	
20	Lapeer Transmission Pipeline(s)	Lapeer Co.	Table 10-4	$18,975,000				$18,975,000	
21	Worth WTP	Sanilac Co.	Table 11-1	$1,128,000					$1,128,000
22	Worth Raw Water Pumps	Sanilac Co.	Appendix 11.6	$200,000					$200,000
23									
24	Total Estimated Construction Cost			$429,771,570	$317,367,567	$76,607,003	$5,319,000	$29,150,000	$1,328,000
25									
26	Design Contingency 5%			$21,488,579	$15,868,378	$3,830,350	$265,950	$1,457,500	$66,400
27	Construction Contingency 15%			$64,465,736	$47,605,135	$11,491,050	$797,850	$4,372,500	$199,200
28	Engineering, Bond, Legal, & Administrative 17%			$73,061,167	$53,952,486	$13,023,191	$904,230	$4,955,500	$225,760
29									
30	Power Service (Raw Water Pump Sta)	KWA		$4,200,000	$4,200,000				
31	Power Service (Reservoir Pumping)	KWA		$180,000	$180,000				
32	Power Service (GCDC-WWS WTP)	GCDC-WWS		$5,900,000		$5,900,000			
33	Power Service (Valves & Meters) 21 sites $5,000 per site	KWA		$105,000	$105,000				
34	Transfer 72" Flint Main to GCDC-WWS		Table 17-2			$1,300,000	-$1,300,000		
35	Land (Raw Water Pump Sta)	KWA			$2,300,000	-$2,300,000			
36	Land (Reservoir) 130 A $6,000 per A	KWA		$780,000	$780,000				
37	Land (GCDC-WWS WTP) 25 A $6,000 per A	GCDC-WWS		$150,000		$150,000			
38	Land (GCDC-WWS Finished Water Pipeline)	GCDC-WWS		$36,960		$36,960			
39	Land (KWA pipeline ROW)	KWA		$1,527,200	$1,527,200				
40	Land (Lapeer Co. WTP) 5 A 6000 per A	Lapeer Co.	Appendix 10.7.1	$30,000				$30,000	
41	Land (Lapeer Co. Transmission)	Lapeer Co.		$43,560				$43,560	
42	Land (Sanilac Co. WTP) 5 A 6000 per A	Sanilac Co.		$30,000					$30,000

Table 14-2 KWA O&M

Component:	Intake & Lake Huron Pumping Station						Transmission Mains				Reservoir and Reservoir Pumping Station					Administrative	Total
Year	Maintenance	Labor	Chemicals	Power	Residuals	Total O&M	Maintenance	Labor	Power	Total O&M	Maintenance	Labor	Chemicals	Power	Total O&M	KWA Administrative	
2010	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$200,000	$200,000
2011	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$206,000	$206,000
2012	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$212,180	$212,180
2013	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$218,545	$218,545
2014	$62,700	$203,840	$57,260	$1,141,000	$36,000	$1,500,800	$47,398	$14,580	$22,800	$84,778	$42,300	$39,886	$50,000	$168,626	$300,812	$225,102	$2,111,491
2015	$129,162	$209,955	$59,776	$1,191,133	$37,582	$1,627,608	$97,639	$15,017	$23,802	$136,458	$87,138	$41,083	$52,197	$176,035	$356,453	$231,855	$2,352,373
2016	$199,555	$216,254	$62,391	$1,243,247	$39,226	$1,760,673	$150,852	$15,468	$24,843	$191,163	$134,628	$42,315	$54,481	$183,737	$415,161	$238,810	$2,605,808
2017	$274,056	$222,741	$65,110	$1,297,416	$40,935	$1,900,258	$207,171	$15,932	$25,926	$249,028	$184,889	$43,585	$56,854	$191,742	$477,071	$245,975	$2,872,332
2018	$352,847	$229,424	$67,935	$1,353,716	$42,711	$2,046,633	$213,386	$16,410	$27,051	$256,846	$238,045	$44,892	$59,321	$200,063	$542,321	$253,354	$3,099,155
2019	$363,432	$236,306	$70,871	$1,412,227	$44,558	$2,127,394	$219,787	$16,902	$28,220	$264,909	$245,186	$46,239	$61,885	$208,710	$562,021	$260,955	$3,215,279
2020	$374,335	$243,396	$73,923	$1,473,029	$46,476	$2,211,159	$226,381	$17,409	$29,435	$273,225	$252,542	$47,626	$64,550	$217,696	$582,414	$268,783	$3,335,581
2021	$385,565	$250,697	$77,093	$1,536,209	$48,469	$2,298,035	$233,172	$17,932	$30,697	$281,801	$260,118	$49,055	$67,319	$227,033	$603,525	$276,847	$3,460,207
2022	$397,132	$258,218	$80,388	$1,601,854	$50,541	$2,388,133	$240,167	$18,470	$32,009	$290,646	$267,922	$50,526	$70,195	$236,735	$625,378	$285,152	$3,589,309
2023	$409,046	$265,965	$83,810	$1,670,055	$52,692	$2,481,569	$247,372	$19,024	$33,372	$299,768	$275,960	$52,042	$73,184	$246,814	$648,000	$293,707	$3,723,043
2024	$421,318	$273,944	$87,366	$1,740,907	$54,928	$2,578,462	$254,794	$19,594	$34,788	$309,176	$284,238	$53,603	$76,289	$257,285	$671,415	$302,518	$3,861,571
2025	$433,957	$282,162	$91,059	$1,814,506	$57,250	$2,678,935	$262,437	$20,182	$36,258	$318,878	$292,765	$55,212	$79,514	$268,162	$695,653	$311,593	$4,005,059
2026	$446,976	$290,627	$94,896	$1,890,955	$59,662	$2,783,116	$270,311	$20,788	$37,786	$328,884	$301,548	$56,868	$82,864	$279,460	$720,740	$320,941	$4,153,682
2027	$460,385	$299,346	$98,881	$1,970,357	$62,167	$2,891,136	$278,420	$21,411	$39,373	$339,204	$310,595	$58,574	$86,343	$291,195	$746,707	$330,570	$4,307,617
2028	$474,197	$308,326	$103,019	$2,052,822	$64,769	$3,003,133	$286,772	$22,054	$41,020	$349,847	$319,913	$60,331	$89,957	$303,382	$773,583	$340,487	$4,467,050
2029	$488,423	$317,576	$107,317	$2,138,461	$67,471	$3,119,248	$295,376	$22,715	$42,732	$360,823	$329,510	$62,141	$93,710	$316,039	$801,400	$350,701	$4,632,172
2030	$503,075	$327,103	$111,780	$2,227,392	$70,277	$3,239,627	$304,237	$23,397	$44,509	$372,142	$339,395	$64,005	$97,607	$329,182	$830,189	$361,222	$4,803,181
2031	$518,168	$336,916	$116,414	$2,319,733	$73,191	$3,364,421	$313,364	$24,099	$46,354	$383,817	$349,577	$65,925	$101,654	$342,828	$859,985	$372,059	$4,980,282
2032	$533,713	$347,024	$121,225	$2,415,610	$76,216	$3,493,788	$322,765	$24,821	$48,270	$395,856	$360,065	$67,903	$105,855	$356,998	$890,821	$383,221	$5,163,685
2033	$549,724	$357,435	$126,221	$2,515,152	$79,356	$3,627,888	$332,448	$25,566	$50,259	$408,273	$370,867	$69,940	$110,217	$371,709	$922,733	$394,717	$5,353,611
2034	$566,216	$368,158	$131,407	$2,618,493	$82,617	$3,766,890	$342,421	$26,333	$52,324	$421,078	$381,993	$72,039	$114,746	$386,982	$955,758	$406,559	$5,550,285
2035	$583,202	$379,202	$136,790	$2,725,770	$86,002	$3,910,967	$352,694	$27,123	$54,468	$434,285	$393,452	$74,200	$119,447	$402,836	$989,934	$418,756	$5,753,942
2036	$600,698	$390,579	$142,379	$2,837,128	$89,515	$4,060,298	$363,275	$27,937	$56,693	$447,904	$405,256	$76,426	$124,326	$419,293	$1,025,301	$431,318	$5,964,822
2037	$618,719	$402,296	$148,179	$2,952,713	$93,162	$4,215,069	$374,173	$28,775	$59,003	$461,950	$417,414	$78,718	$129,391	$436,375	$1,061,899	$444,258	$6,183,176
2038	$637,281	$414,365	$154,200	$3,072,681	$96,947	$4,375,473	$385,398	$29,638	$61,400	$476,436	$429,936	$81,080	$134,649	$454,105	$1,099,770	$457,586	$6,409,264
2039	$656,399	$426,796	$160,448	$3,197,189	$100,875	$4,541,707	$396,960	$30,527	$63,888	$491,375	$442,834	$83,512	$140,105	$472,506	$1,138,957	$471,313	$6,643,352
2040	$676,091	$439,600	$167,287	$3,333,469	$105,175	$4,721,622	$408,869	$31,443	$66,611	$506,923	$456,119	$86,018	$146,077	$492,646	$1,180,860	$485,452	$6,894,857
2041	$696,374	$452,788	$174,392	$3,475,049	$109,642	$4,908,245	$421,135	$32,386	$69,440	$522,962	$469,803	$88,598	$152,281	$513,570	$1,224,252	$500,016	$7,155,474
2042	$717,265	$466,371	$181,773	$3,622,123	$114,283	$5,101,815	$433,769	$33,358	$72,379	$539,506	$483,897	$91,256	$158,726	$535,306	$1,269,185	$515,017	$7,425,522
2043	$738,783	$480,362	$189,439	$3,774,895	$119,103	$5,302,582	$446,782	$34,359	$75,432	$556,573	$498,414	$93,994	$165,420	$557,884	$1,315,712	$530,467	$7,705,334
2044	$760,947	$494,773	$197,403	$3,933,572	$124,109	$5,510,804	$460,186	$35,389	$78,602	$574,178	$513,366	$96,814	$172,374	$581,334	$1,363,888	$546,381	$7,995,251
2045	$783,775	$509,616	$205,673	$4,098,373	$129,309	$5,726,747	$473,991	$36,451	$81,896	$592,338	$528,767	$99,718	$179,596	$605,690	$1,413,771	$562,772	$8,295,628
2046	$807,288	$524,905	$214,262	$4,269,522	$134,709	$5,950,686	$488,211	$37,545	$85,316	$611,071	$544,630	$102,710	$187,096	$630,984	$1,465,419	$579,656	$8,606,832
2047	$831,507	$540,652	$223,181	$4,447,251	$140,316	$6,182,908	$502,857	$38,671	$88,867	$630,395	$560,969	$105,791	$194,884	$657,250	$1,518,894	$597,045	$8,929,243
2048	$856,452	$556,872	$232,443	$4,631,802	$146,139	$6,423,707	$517,943	$39,831	$92,555	$650,329	$577,798	$108,965	$202,971	$684,524	$1,574,258	$614,957	$9,263,251
2049	$882,146	$573,578	$242,059	$4,823,423	$152,185	$6,673,390	$533,481	$41,026	$96,384	$670,891	$595,132	$112,234	$211,368	$712,844	$1,631,577	$633,405	$9,609,264
2050	$908,610	$590,785	$252,043	$5,022,372	$158,462	$6,932,273	$549,486	$42,257	$100,359	$692,102	$612,986	$115,601	$220,086	$742,246	$1,690,919	$652,408	$9,967,701

Notes:
1. Labor and maintenance expenses have been assumed to increase annually at the rate of inflation.
2. Chemicals, power, and residuals expenses vary based upon projected annual consumption and increase at the rate of inflation.
3. Maintenance costs have been been phased in over the initial five year period.

Table 14-3 GCDC O&M

Component:	GCDC-WWS WTP					
Year	Maintenance	Labor	Chemicals	Power	Residuals	Total O&M
2010						
2011						
2012						
2013						
2014	$170,440	$859,248	$276,300	$611,800	$64,400	$1,982,188
2015	$351,106	$885,025	$288,440	$638,681	$67,230	$2,230,483
2016	$542,459	$911,576	$301,060	$666,625	$70,171	$2,491,891
2017	$744,978	$938,923	$314,177	$695,670	$73,228	$2,766,976
2018	$959,159	$967,091	$327,810	$725,858	$76,406	$3,056,324
2019	$987,933	$996,104	$341,979	$757,231	$79,708	$3,162,956
2020	$1,017,571	$1,025,987	$356,703	$789,833	$83,140	$3,273,234
2021	$1,048,099	$1,056,767	$372,002	$823,710	$86,706	$3,387,283
2022	$1,079,541	$1,088,470	$387,899	$858,908	$90,411	$3,505,229
2023	$1,111,928	$1,121,124	$404,414	$895,477	$94,261	$3,627,204
2024	$1,145,286	$1,154,757	$421,571	$933,468	$98,260	$3,753,341
2025	$1,179,644	$1,189,400	$439,394	$972,931	$102,414	$3,883,783
2026	$1,215,033	$1,225,082	$457,906	$1,013,923	$106,729	$4,018,673
2027	$1,251,484	$1,261,835	$477,134	$1,056,498	$111,210	$4,158,162
2028	$1,289,029	$1,299,690	$497,103	$1,100,716	$115,865	$4,302,402
2029	$1,327,700	$1,338,680	$517,841	$1,146,635	$120,698	$4,451,555
2030	$1,367,531	$1,378,841	$539,376	$1,194,319	$125,718	$4,605,785
2031	$1,408,557	$1,420,206	$561,737	$1,243,832	$130,930	$4,765,262
2032	$1,450,813	$1,462,812	$584,955	$1,295,241	$136,341	$4,930,163
2033	$1,494,338	$1,506,697	$609,059	$1,348,615	$141,960	$5,100,669
2034	$1,539,168	$1,551,897	$634,084	$1,404,026	$147,792	$5,276,968
2035	$1,585,343	$1,598,454	$660,062	$1,461,548	$153,847	$5,459,254
2036	$1,632,903	$1,646,408	$687,027	$1,521,257	$160,132	$5,647,729
2037	$1,681,890	$1,695,800	$715,017	$1,583,234	$166,656	$5,842,598
2038	$1,732,347	$1,746,674	$744,068	$1,647,560	$173,427	$6,044,077
2039	$1,784,318	$1,799,074	$774,218	$1,714,321	$180,455	$6,252,386
2040	$1,837,847	$1,853,047	$807,220	$1,787,394	$188,147	$6,473,654
2041	$1,892,982	$1,908,638	$841,504	$1,863,308	$196,138	$6,702,571
2042	$1,949,772	$1,965,897	$877,119	$1,942,169	$204,439	$6,939,396
2043	$2,008,265	$2,024,874	$914,113	$2,024,085	$213,062	$7,184,399
2044	$2,068,513	$2,085,620	$952,538	$2,109,167	$222,018	$7,437,856
2045	$2,130,568	$2,148,189	$992,446	$2,197,533	$231,319	$7,700,055
2046	$2,194,486	$2,212,635	$1,033,890	$2,289,302	$240,979	$7,971,292
2047	$2,260,320	$2,279,014	$1,076,929	$2,384,600	$251,011	$8,251,873
2048	$2,328,130	$2,347,384	$1,121,619	$2,483,555	$261,427	$8,542,114
2049	$2,397,974	$2,417,806	$1,168,021	$2,586,301	$272,242	$8,842,344
2050	$2,469,913	$2,490,340	$1,216,198	$2,692,977	$283,471	$9,152,899

Notes:
1. Labor and maintenance expenses have been assumed to increase annually at the rate of inflation.
2. Chemicals, power, and residuals expenses vary based upon projected annual consumption and increase at the rate of inflation.
3. Maintenance costs have been been phased in over the initial five year period.

Table 14-4 Flint O&M

Component:	Flint WTP					
Year	Maintenance	Labor	Chemicals	Power	Residuals	Total O&M
2010						
2011						
2012						
2013						
2014	$79,000	$1,635,000	$530,000	$950,000	$135,000	$3,329,000
2015	$162,740	$1,684,050	$549,508	$984,968	$139,969	$3,521,236
2016	$251,433	$1,734,572	$569,710	$1,021,179	$145,115	$3,722,009
2017	$345,302	$1,786,609	$590,630	$1,058,677	$150,444	$3,931,660
2018	$444,576	$1,840,207	$612,292	$1,097,505	$155,961	$4,150,541
2019	$457,913	$1,895,413	$634,722	$1,137,710	$161,675	$4,287,433
2020	$471,651	$1,952,276	$657,947	$1,179,339	$167,590	$4,428,803
2021	$485,800	$2,010,844	$681,994	$1,222,443	$173,716	$4,574,796
2022	$500,374	$2,071,169	$706,892	$1,267,071	$180,057	$4,725,563
2023	$515,385	$2,133,304	$732,670	$1,313,276	$186,623	$4,881,259
2024	$530,847	$2,197,303	$759,358	$1,361,114	$193,421	$5,042,044
2025	$546,772	$2,263,222	$786,989	$1,410,640	$200,459	$5,208,083
2026	$563,176	$2,331,119	$815,593	$1,461,912	$207,745	$5,379,546
2027	$580,071	$2,401,053	$845,206	$1,514,992	$215,288	$5,556,609
2028	$597,473	$2,473,084	$875,861	$1,569,940	$223,097	$5,739,455
2029	$615,397	$2,547,277	$907,595	$1,626,822	$231,180	$5,928,271
2030	$633,859	$2,623,695	$940,445	$1,685,703	$239,547	$6,123,250
2031	$652,875	$2,702,406	$974,449	$1,746,654	$248,209	$6,324,592
2032	$672,461	$2,783,478	$1,009,647	$1,809,744	$257,174	$6,532,504
2033	$692,635	$2,866,982	$1,046,079	$1,875,048	$266,454	$6,747,199
2034	$713,414	$2,952,992	$1,083,789	$1,942,641	$276,060	$6,968,896
2035	$734,816	$3,041,582	$1,122,820	$2,012,602	$286,001	$7,197,822
2036	$756,861	$3,132,829	$1,163,218	$2,085,013	$296,291	$7,434,212
2037	$779,567	$3,226,814	$1,205,028	$2,159,957	$306,941	$7,678,307
2038	$802,954	$3,323,618	$1,248,301	$2,237,521	$317,963	$7,930,357
2039	$827,042	$3,423,327	$1,293,085	$2,317,794	$329,371	$8,190,620
2040	$851,854	$3,526,027	$1,345,024	$2,410,891	$342,600	$8,476,396
2041	$877,409	$3,631,808	$1,398,915	$2,507,488	$356,327	$8,771,947
2042	$903,731	$3,740,762	$1,454,828	$2,607,711	$370,569	$9,077,602
2043	$930,843	$3,852,985	$1,512,838	$2,711,691	$385,346	$9,393,702
2044	$958,769	$3,968,574	$1,573,019	$2,819,562	$400,675	$9,720,598
2045	$987,532	$4,087,631	$1,635,449	$2,931,465	$416,577	$10,058,654
2046	$1,017,158	$4,210,260	$1,700,209	$3,047,545	$433,072	$10,408,244
2047	$1,047,672	$4,336,568	$1,767,383	$3,167,951	$450,183	$10,769,757
2048	$1,079,103	$4,466,665	$1,837,057	$3,292,839	$467,930	$11,143,594
2049	$1,111,476	$4,600,665	$1,909,322	$3,422,369	$486,337	$11,530,168
2050	$1,144,820	$4,738,685	$1,984,268	$3,556,707	$505,427	$11,929,907

Notes:

1. Labor and maintenance expenses have been assumed to increase annually at the rate of inflation.
2. Chemicals, power, and residuals expenses vary based upon projected annual consumption and increase at the rate of inflation.
3. Maintenance costs have been been phased in over the initial five year period.

Table 14-5 Lapeer County O&M

Component:	Lapeer WTP					
Year	Maintenance	Labor	Chemicals	Testing	Power	Total O&M
2010						
2011						
2012						
2013						
2014	$26,400	$213,000	$33,000	$15,000	$98,000	$385,400
2015	$54,384	$219,390	$37,453	$15,450	$111,225	$437,902
2016	$84,023	$225,972	$42,144	$15,914	$125,155	$493,207
2017	$115,392	$232,751	$47,082	$16,391	$139,821	$551,437
2018	$148,567	$239,733	$33,000	$16,883	$155,254	$593,437
2019	$153,024	$246,925	$36,450	$17,389	$171,487	$625,276
2020	$157,615	$254,333	$40,078	$17,911	$188,554	$658,491
2021	$162,343	$261,963	$43,891	$18,448	$206,491	$693,137
2022	$167,214	$269,822	$47,896	$19,002	$225,335	$729,268
2023	$172,230	$277,917	$52,102	$19,572	$245,124	$766,944
2024	$177,397	$286,254	$56,518	$20,159	$265,897	$806,224
2025	$182,719	$294,842	$61,151	$20,764	$287,695	$847,171
2026	$188,200	$303,687	$66,012	$21,386	$310,563	$889,848
2027	$193,846	$312,798	$71,109	$22,028	$334,543	$934,324
2028	$199,662	$322,182	$76,453	$22,689	$359,683	$980,668
2029	$205,652	$331,847	$82,053	$23,370	$386,030	$1,028,951
2030	$211,821	$341,802	$87,920	$24,071	$413,634	$1,079,249
2031	$218,176	$352,057	$94,066	$24,793	$442,547	$1,131,638
2032	$224,721	$362,618	$100,501	$25,536	$472,823	$1,186,200
2033	$231,463	$373,497	$107,238	$26,303	$504,517	$1,243,016
2034	$238,407	$384,702	$114,288	$27,092	$537,686	$1,302,175
2035	$245,559	$396,243	$121,665	$27,904	$572,392	$1,363,764
2036	$252,926	$408,130	$129,382	$28,742	$608,697	$1,427,876
2037	$260,513	$420,374	$137,452	$29,604	$646,664	$1,494,608
2038	$268,329	$432,985	$145,890	$30,492	$686,362	$1,564,058
2039	$276,379	$445,975	$154,711	$31,407	$727,860	$1,636,331
2040	$284,670	$459,354	$161,227	$32,349	$758,516	$1,696,115
2041	$293,210	$473,135	$167,994	$33,319	$790,356	$1,758,014
2042	$302,006	$487,329	$175,023	$34,319	$823,423	$1,822,100
2043	$311,067	$501,948	$182,322	$35,348	$857,764	$1,888,450
2044	$320,399	$517,007	$189,902	$36,409	$893,424	$1,957,140
2045	$330,011	$532,517	$197,773	$37,501	$930,451	$2,028,253
2046	$339,911	$548,493	$205,944	$38,626	$968,896	$2,101,870
2047	$350,108	$564,947	$214,428	$39,785	$1,008,810	$2,178,079
2048	$360,611	$581,896	$223,236	$40,979	$1,050,248	$2,256,969
2049	$371,430	$599,353	$232,379	$42,208	$1,093,263	$2,338,633
2050	$382,573	$617,333	$241,870	$43,474	$1,137,914	$2,423,164

Notes:

1. Labor and maintenance expenses have been assumed to increase annually at the rate of inflation.
2. Chemicals, power, and residuals expenses vary based upon projected annual consumption and increase at the rate of inflation.
3. Maintenance costs have been been phased in over the initial five year period.

Table 14-6 Sanilac County O&M

Component:	Sanilac County					
Year	Maintenance	Labor	Chemicals	Testing	Power	Total O&M
2010						
2011						
2012						
2013						
2014	$2,400	$89,000	$1,000	$4,000	$5,000	$101,400
2015	$4,944	$91,670	$1,046	$4,120	$5,232	$107,013
2016	$7,638	$94,420	$1,095	$4,244	$5,474	$112,871
2017	$10,490	$97,253	$1,145	$4,371	$5,726	$118,985
2018	$13,506	$100,170	$1,198	$4,502	$5,988	$125,364
2019	$13,911	$103,175	$1,252	$4,637	$6,260	$129,236
2020	$14,329	$106,271	$1,309	$4,776	$6,543	$133,228
2021	$14,758	$109,459	$1,368	$4,919	$6,838	$137,342
2022	$15,201	$112,743	$1,429	$5,067	$7,145	$141,584
2023	$15,657	$116,125	$1,493	$5,219	$7,463	$145,957
2024	$16,127	$119,609	$1,559	$5,376	$7,795	$150,465
2025	$16,611	$123,197	$1,628	$5,537	$8,139	$155,112
2026	$17,109	$126,893	$1,700	$5,703	$8,498	$159,902
2027	$17,622	$130,700	$1,774	$5,874	$8,870	$164,840
2028	$18,151	$134,620	$1,851	$6,050	$9,257	$169,930
2029	$18,696	$138,659	$1,932	$6,232	$9,659	$175,178
2030	$19,256	$142,819	$2,016	$6,419	$10,078	$180,587
2031	$19,834	$147,103	$2,102	$6,611	$10,512	$186,164
2032	$20,429	$151,517	$2,193	$6,810	$10,964	$191,912
2033	$21,042	$156,062	$2,287	$7,014	$11,433	$197,838
2034	$21,673	$160,744	$2,384	$7,224	$11,920	$203,946
2035	$22,324	$165,566	$2,485	$7,441	$12,427	$210,243
2036	$22,993	$170,533	$2,591	$7,664	$12,953	$216,734
2037	$23,683	$175,649	$2,700	$7,894	$13,499	$223,426
2038	$24,394	$180,919	$2,813	$8,131	$14,067	$230,324
2039	$25,125	$186,346	$2,931	$8,375	$14,656	$237,434
2040	$25,879	$191,937	$3,071	$8,626	$15,355	$244,868
2041	$26,655	$197,695	$3,216	$8,885	$16,082	$252,534
2042	$27,455	$203,626	$3,368	$9,152	$16,839	$260,439
2043	$28,279	$209,734	$3,525	$9,426	$17,627	$268,592
2044	$29,127	$216,026	$3,689	$9,709	$18,447	$276,999
2045	$30,001	$222,507	$3,860	$10,000	$19,301	$285,669
2046	$30,901	$229,182	$4,038	$10,300	$20,189	$294,610
2047	$31,828	$236,058	$4,223	$10,609	$21,113	$303,830
2048	$32,783	$243,140	$4,415	$10,928	$22,074	$313,339
2049	$33,766	$250,434	$4,615	$11,255	$23,074	$323,144
2050	$34,779	$257,947	$4,823	$11,593	$24,114	$333,256

Notes:
1. Labor and maintenance expenses have been assumed to increase annually at the rate of inflation.
2. Chemicals, power, and residuals expenses vary based upon projected annual consumption and increase at the rate of inflation.
3. Maintenance costs have been been phased in over the initial five year period.

Figure 14-1 Treatment and Delivery Cost

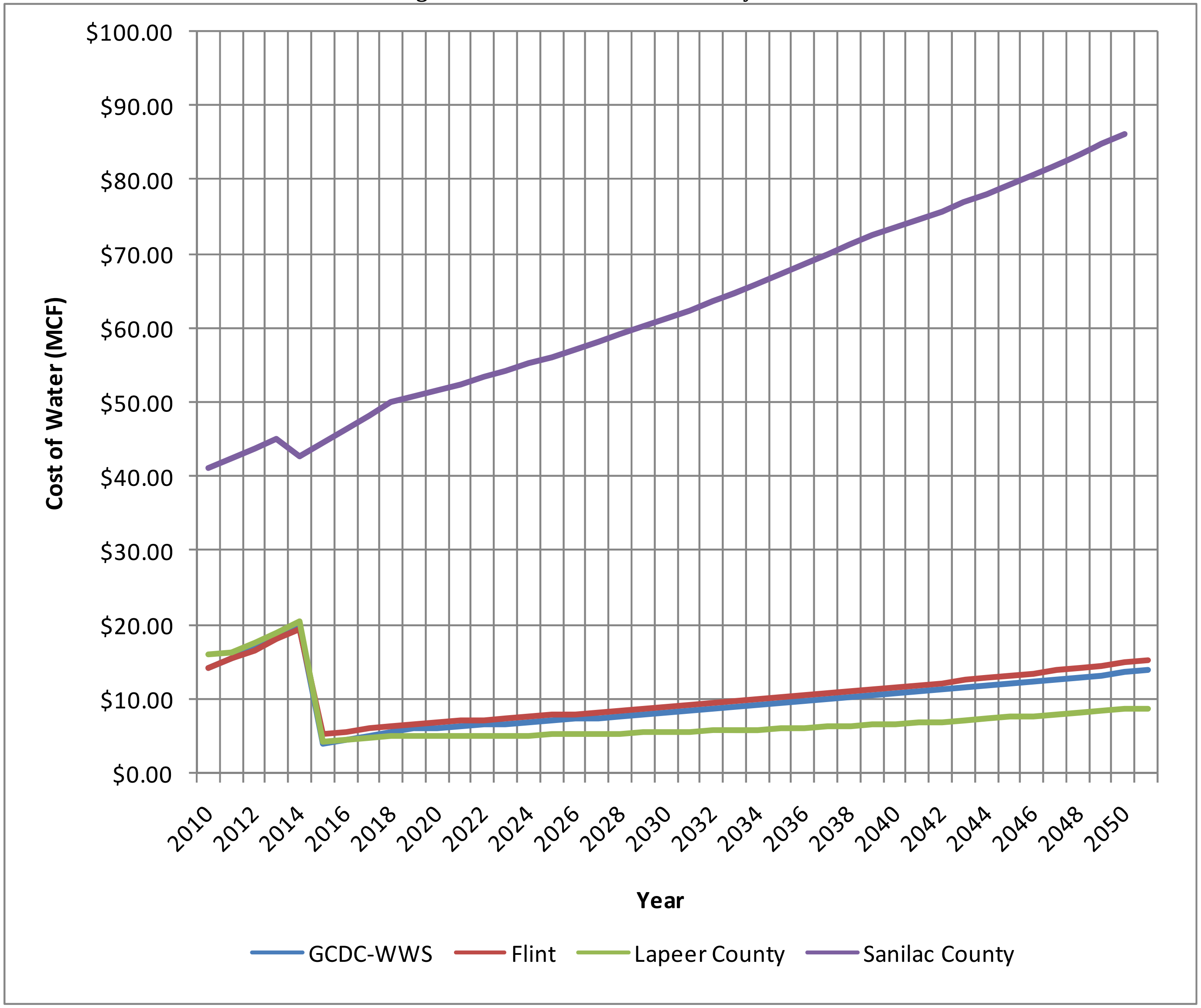


Table 14-7 Summary of KWA Costs

Capital Costs		
KWA Project Costs		$443,885,767
Operating Costs		
Year	**KWA O&M**	**$/MCF**
2010	$200,000	$0.13
2011	$206,000	$0.13
2012	$212,180	$0.13
2013	$218,545	$0.14
2014	$2,111,491	$1.30
2015	$2,352,373	$1.43
2016	$2,605,808	$1.56
2017	$2,872,332	$1.70
2018	$3,099,155	$1.81
2019	$3,215,279	$1.85
2020	$3,335,581	$1.90
2021	$3,460,207	$1.94
2022	$3,589,309	$1.99
2023	$3,723,043	$2.04
2024	$3,861,571	$2.09
2025	$4,005,059	$2.14
2026	$4,153,682	$2.20
2027	$4,307,617	$2.25
2028	$4,467,050	$2.31
2029	$4,632,172	$2.37
2030	$4,803,181	$2.43
2031	$4,980,282	$2.49
2032	$5,163,685	$2.55
2033	$5,353,611	$2.62
2034	$5,550,285	$2.69
2035	$5,753,942	$2.76
2036	$5,964,822	$2.83
2037	$6,183,176	$2.90
2038	$6,409,264	$2.98
2039	$6,643,352	$3.05
2040	$6,894,857	$3.13
2041	$7,155,474	$3.21
2042	$7,425,522	$3.29
2043	$7,705,334	$3.38
2044	$7,995,251	$3.46
2045	$8,295,628	$3.55
2046	$8,606,832	$3.64
2047	$8,929,243	$3.74
2048	$9,263,251	$3.83
2049	$9,609,264	$3.93
2050	$9,967,701	$4.04

Capital Costs

GCDC-WWS Project Costs	$110,038,554
GCDC-WWS Share of KWA Project Costs	$188,899,927
GCDC-WWS Capital Costs	$298,938,481
Bond Terms:	
interest rate	6.0%
period	25
Annual Debt Service (P&I)	$23,384,976

Operating Costs (2014)

GCDC-WWS O&M	$1,982,188
GCDC-WWS share of KWA O&M	$900,702
Total GCDC-WWS O&M (2014)	$2,882,890
Total Annual Cost (P&I + O&M) (2014)	$26,267,866

Summary - Cost of Water (2014)

GCDC-WWS Debt Service	$12.41 per Mcf
GCDC-WWS Share of KWA Debt Service	$21.31 per Mcf
GCDC-WWS O&M	$2.86 per Mcf
GCDC-WWS Share of KWA O&M	$1.30 per Mcf
Total Cost of Water (2014)	$37.88 per Mcf

Present Worth

Capital Costs	$298,938,481
Present Worth of O&M (2010 through 2050)	$227,217,832
Present Worth (2010 through 2050)	$526,156,313

Demand Summary

2014 Average Day Demand (GCDC-WWS)	14.21 mgd
2014 Annual Consumption (GCDC-WWS)	693,402 Mcf
2014 Average Day Demand (KWA - Adjusted)	33.31 mgd
2014 GCDC-WWS Share of KWA ADD	42.7%

Table 14-8 Summary of GCDC-WWS Costs

	O&M				Capital			DWSD	Cost of Water	Total Annual
Year	GCDC-WWS Facilities	GCDC-WWS Share of KWA	Total	$/MCF	GCDC-WWS Facilities	GCDC-WWS Share of KWA	Total	Commodity ($/MCF)	(no debt or depr.) ($/MCF)	Cost of Water ($/MCF)
					$110,038,554	$188,899,927	$298,938,481			
2009								$14.32	$14.32	$14.32
2010	$0	$85,314	$85,314	$0.12				$15.47	$15.59	$15.59
2011	$0	$87,874	$87,874	$0.13	$2,840,625	$4,876,417	$7,717,042	$16.70	$16.83	$27.96
2012	$0	$90,510	$90,510	$0.13	$5,767,330	$9,900,604	$15,667,934	$18.04	$18.17	$40.77
2013	$0	$93,225	$93,225	$0.13	$8,607,955	$14,777,021	$23,384,976	$19.48	$19.62	$53.34
2014	$1,982,188	$900,702	$2,882,890	$4.16	$8,607,955	$14,777,021	$23,384,976		$4.16	$37.88
2015	$2,230,483	$995,739	$3,226,222	$4.63	$8,607,955	$14,777,021	$23,384,976		$4.63	$38.16
2016	$2,491,891	$1,094,694	$3,586,585	$5.11	$8,607,955	$14,777,021	$23,384,976		$5.11	$38.46
2017	$2,766,976	$1,197,726	$3,964,703	$5.62	$8,607,955	$14,777,021	$23,384,976		$5.62	$38.77
2018	$3,056,324	$1,282,917	$4,339,241	$6.12	$8,607,955	$14,777,021	$23,384,976		$6.12	$39.09
2019	$3,162,956	$1,321,490	$4,484,446	$6.29	$8,607,955	$14,777,021	$23,384,976		$6.29	$39.07
2020	$3,273,234	$1,361,329	$4,634,564	$6.46	$8,607,955	$14,777,021	$23,384,976		$6.46	$39.06
2021	$3,387,283	$1,402,474	$4,789,758	$6.64	$8,607,955	$14,777,021	$23,384,976		$6.64	$39.06
2022	$3,505,229	$1,444,967	$4,950,196	$6.83	$8,607,955	$14,777,021	$23,384,976		$6.83	$39.07
2023	$3,627,204	$1,488,850	$5,116,054	$7.02	$8,607,955	$14,777,021	$23,384,976		$7.02	$39.08
2024	$3,753,341	$1,534,169	$5,287,510	$7.21	$8,607,955	$14,777,021	$23,384,976		$7.21	$39.10
2025	$3,883,783	$1,580,968	$5,464,752	$7.41	$8,607,955	$14,777,021	$23,384,976		$7.41	$39.13
2026	$4,018,673	$1,629,297	$5,647,970	$7.62	$8,607,955	$14,777,021	$23,384,976		$7.62	$39.17
2027	$4,158,162	$1,679,203	$5,837,364	$7.83	$8,607,955	$14,777,021	$23,384,976		$7.83	$39.22
2028	$4,302,402	$1,730,737	$6,033,139	$8.05	$8,607,955	$14,777,021	$23,384,976		$8.05	$39.27
2029	$4,451,555	$1,783,952	$6,235,507	$8.28	$8,607,955	$14,777,021	$23,384,976		$8.28	$39.33
2030	$4,605,785	$1,838,902	$6,444,687	$8.51	$8,607,955	$14,777,021	$23,384,976		$8.51	$39.40
2031	$4,765,262	$1,895,642	$6,660,904	$8.75	$8,607,955	$14,777,021	$23,384,976		$8.75	$39.48
2032	$4,930,163	$1,954,230	$6,884,393	$9.00	$8,607,955	$14,777,021	$23,384,976		$9.00	$39.56
2033	$5,100,669	$2,014,726	$7,115,394	$9.25	$8,607,955	$14,777,021	$23,384,976		$9.25	$39.66
2034	$5,276,968	$2,077,190	$7,354,158	$9.51	$8,607,955	$14,777,021	$23,384,976		$9.51	$39.76
2035	$5,459,254	$2,141,687	$7,600,941	$9.78	$8,607,955	$14,777,021	$23,384,976		$9.78	$39.88
2036	$5,647,729	$2,208,282	$7,856,011	$10.06	$5,767,330	$9,900,604	$15,667,934		$10.06	$30.12
2037	$5,842,598	$2,277,043	$8,119,641	$10.34	$2,840,625	$4,876,417	$7,717,042		$10.34	$20.17
2038	$6,044,077	$2,348,038	$8,392,115	$10.64	$0	$0	$0		$10.64	$10.64
2039	$6,252,386	$2,421,342	$8,673,728	$10.94	$0	$0	$0		$10.94	$10.94
2040	$6,473,654	$2,520,754	$8,994,408	$11.17	$0	$0	$0		$11.17	$11.17
2041	$6,702,571	$2,623,880	$9,326,451	$11.41	$0	$0	$0		$11.41	$11.41
2042	$6,939,396	$2,730,854	$9,670,250	$11.66	$0	$0	$0		$11.66	$11.66
2043	$7,184,399	$2,841,814	$10,026,213	$11.91	$0	$0	$0		$11.91	$11.91
2044	$7,437,856	$2,956,904	$10,394,760	$12.17	$0	$0	$0		$12.17	$12.17
2045	$7,700,055	$3,076,271	$10,776,326	$12.44	$0	$0	$0		$12.44	$12.44
2046	$7,971,292	$3,200,069	$11,171,361	$12.72	$0	$0	$0		$12.72	$12.72
2047	$8,251,873	$3,328,458	$11,580,331	$13.00	$0	$0	$0		$13.00	$13.00
2048	$8,542,114	$3,461,601	$12,003,715	$13.30	$0	$0	$0		$13.30	$13.30
2049	$8,842,344	$3,599,668	$12,442,011	$13.60	$0	$0	$0		$13.60	$13.60
2050	$9,152,899	$3,742,835	$12,895,734	$13.91	$0	$0	$0		$13.91	$13.91

Notes:

1. Future DWSD commodity charge assumed to increase by 8% annually. Proposed 2009 rate is $14.32 per MCF.
2. Debt for construction assumed to be phased over 3 year construction period (2011 to 2013.)
3. "Cost of Water (no debt or depr.)" is the projected operating and maintenance expenses. Neither debt nor depreciation expenses are included.
4. "Total Annual Cost of Water" includes operating and maintenance costs plus debt service for construction of the planned project. Depreciation expense is not included.

Capital Costs

Flint Project Costs	$5,987,030
Flint Share of KWA Project Costs	$167,859,381
Flint Capital Costs	$173,846,411
Bond Terms:	
interest rate	6.00%
period	25
Annual Debt Service (P&I)	$13,599,434

Operating Costs (2014)

Flint O&M	$3,329,000
Flint share of KWA O&M	$1,047,121
Total Flint O&M	$4,376,121
Total Annual Cost (P&I + O&M) (2014)	$17,975,555

Summary - Cost of Water (2014)

Flint Debt Service	$0.58 per Mcf
Flint Share of KWA Debt Service	$16.29 per Mcf
Flint O&M	$4.13 per Mcf
Flint Share of KWA O&M	$1.30 per Mcf
Total Cost of Water	$22.30 per Mcf

Present Worth

Capital Costs	$173,846,411
Present Worth of O&M (2010 through 2050)	$291,469,417
Present Worth (2010 through 2050)	$465,315,828

Demand Summary

2009 Average Day Demand (Flint)	16.52 mgd
2009 Annual Consumption (Flint)	806,123 Mcf
2009 Average Day Demand (KWA - Adjusted)	33.31 mgd
Flint Share of KWA ADD	49.6%

Table 14-9 Summary of Flint Costs

	O&M				Capital			DWSD	Cost of Water	Total Annual
Year	Flint Facilities	Flint Share of KWA	Total	$/MCF	Flint Facilities	Flint Share of KWA	Total	Commodity ($/MCF)	(no debt or depr.) ($/MCF)	Cost of Water ($/MCF)
					$5,987,030	$167,859,381	$173,846,411			
2009								$14.32	$14.32	$14.32
2010	$0	$99,183	$99,183	$0.12			$0	$15.47	$15.59	$15.61
2011	$0	$102,159	$102,159	$0.13	$155,959	$4,372,652	$4,528,612	$16.70	$16.83	$23.38
2012	$0	$105,223	$105,223	$0.13	$312,387	$8,758,436	$9,070,823	$18.04	$18.17	$31.27
2013	$0	$99,183	$99,183	$0.12	$468,345.71	$13,131,089	$13,599,434	$19.48	$19.61	$39.24
2014	$3,329,000	$1,047,121	$4,376,121	$5.43	$468,345.71	$13,131,089	$13,599,434		$5.43	$25.92
2015	$3,521,236	$1,158,607	$4,679,843	$5.77	$468,345.71	$13,131,089	$13,599,434		$5.77	$26.21
2016	$3,722,009	$1,274,833	$4,996,843	$6.12	$468,345.71	$13,131,089	$13,599,434		$6.12	$26.51
2017	$3,931,660	$1,395,994	$5,327,655	$6.48	$468,345.71	$13,131,089	$13,599,434		$6.48	$26.83
2018	$4,150,541	$1,496,530	$5,647,071	$6.82	$468,345.71	$13,131,089	$13,599,434		$6.82	$27.13
2019	$4,287,433	$1,542,793	$5,830,226	$7.00	$468,345.71	$13,131,089	$13,599,434		$7.00	$27.24
2020	$4,428,803	$1,590,595	$6,019,397	$7.18	$468,345.71	$13,131,089	$13,599,434		$7.18	$27.35
2021	$4,574,796	$1,639,984	$6,214,780	$7.37	$468,345.71	$13,131,089	$13,599,434		$7.37	$27.47
2022	$4,725,563	$1,691,012	$6,416,576	$7.56	$468,345.71	$13,131,089	$13,599,434		$7.56	$27.60
2023	$4,881,259	$1,743,733	$6,624,993	$7.76	$468,345.71	$13,131,089	$13,599,434		$7.76	$27.73
2024	$5,042,044	$1,798,202	$6,840,246	$7.96	$468,345.71	$13,131,089	$13,599,434		$7.96	$27.88
2025	$5,208,083	$1,854,474	$7,062,557	$8.17	$468,345.71	$13,131,089	$13,599,434		$8.17	$28.03
2026	$5,379,546	$1,912,610	$7,292,156	$8.38	$468,345.71	$13,131,089	$13,599,434		$8.38	$28.19
2027	$5,556,609	$1,972,669	$7,529,278	$8.60	$468,345.71	$13,131,089	$13,599,434		$8.60	$28.35
2028	$5,739,455	$2,034,713	$7,774,168	$8.83	$468,345.71	$13,131,089	$13,599,434		$8.83	$28.53
2029	$5,928,271	$2,098,808	$8,027,079	$9.06	$468,345.71	$13,131,089	$13,599,434		$9.06	$28.72
2030	$6,123,250	$2,165,020	$8,288,270	$9.30	$468,345.71	$13,131,089	$13,599,434		$9.30	$28.91
2031	$6,324,592	$2,233,418	$8,558,010	$9.54	$468,345.71	$13,131,089	$13,599,434		$9.54	$29.11
2032	$6,532,504	$2,304,074	$8,836,578	$9.80	$468,345.71	$13,131,089	$13,599,434		$9.80	$29.33
2033	$6,747,199	$2,377,060	$9,124,259	$10.06	$468,345.71	$13,131,089	$13,599,434		$10.06	$29.55
2034	$6,968,896	$2,452,453	$9,421,349	$10.32	$468,345.71	$13,131,089	$13,599,434		$10.32	$29.78
2035	$7,197,822	$2,530,332	$9,728,153	$10.60	$468,345.71	$13,131,089	$13,599,434		$10.60	$30.02
2036	$7,434,212	$2,610,776	$10,044,988	$10.88	$312,246	$8,754,497	$9,066,743		$10.88	$24.47
2037	$7,678,307	$2,693,871	$10,372,178	$11.17	$154,554	$4,333,259	$4,487,813		$11.17	$18.93
2038	$7,930,357	$2,779,702	$10,710,059	$11.47			$0		$11.47	$13.57
2039	$8,190,620	$2,868,359	$11,058,979	$11.77			$0		$11.77	$13.95
2040	$8,476,396	$2,969,907	$11,446,302	$12.07			$0		$12.07	$14.22
2041	$8,771,947	$3,075,031	$11,846,978	$12.37			$0		$12.37	$14.49
2042	$9,077,602	$3,183,855	$12,261,457	$12.68			$0		$12.68	$14.78
2043	$9,393,702	$3,296,504	$12,690,207	$13.00			$0		$13.00	$15.08
2044	$9,720,598	$3,413,112	$13,133,710	$13.32			$0		$13.32	$15.38
2045	$10,058,654	$3,533,812	$13,592,466	$13.66			$0		$13.66	$15.69
2046	$10,408,244	$3,658,746	$14,066,991	$14.01			$0		$14.01	$16.02
2047	$10,769,757	$3,788,059	$14,557,816	$14.36			$0		$14.36	$16.35
2048	$11,143,594	$3,921,900	$15,065,494	$14.73			$0		$14.73	$16.69
2049	$11,530,168	$4,060,425	$15,590,593	$15.11			$0		$15.11	$17.04
2050	$11,929,907	$4,203,794	$16,133,701	$15.49			$0		$15.49	$17.40

Notes:
1. Future DWSD commodity charge assumed to increase by 8% annually. Proposed 2009 rate is $14.32 per MCF.
2. Debt for construction assumed to be phased over 3 year construction period (2011 to 2013.)
3. "Cost of Water (no debt or depr.)" is the projected operating and maintenance expenses. Neither debt nor depreciation expenses are included.
4. "Total Annual Cost of Water" includes operating and maintenance costs plus debt service for construction of the planned project. Depreciation expense is not included.

Table 14-10 Summary of Lapeer County Costs

Capital Costs

Lapeer County Project Costs	$40,009,060
Lapeer County Share of KWA Project Costs	$86,312,736
Lapeer County Capital Costs	$126,321,796
Bond Terms:	
interest rate	6.00%
period	25
Annual Debt Service (P&I)	$9,881,740

Operating Costs (2014)

Lapeer County O&M	$385,400
Lapeer County share of KWA O&M	$160,998
Total Lapeer County O&M	$546,398
Total Annual Cost (P&I + O&M) (2014)	$10,428,138

Summary - Cost of Water (2014)

Lapeer County Debt Service	$25.25 per Mcf
Lapeer County Share of KWA Debt Service	$54.48 per Mcf
Lapeer County O&M	$3.11 per Mcf
Lapeer County Share of KWA O&M	$1.30 per Mcf
Total Cost of Water	$84.14 per Mcf

Present Worth

Capital Costs	$126,321,796
Present Worth of O&M (2010 through 2050)	$0
Present Worth (2010 through 2050)	$126,321,796

Demand Summary

2009 Average Day Demand (Lapeer County)	2.54 mgd
2009 Annual Consumption (Lapeer County)	123,944 Mcf
2009 Average Day Demand (KWA - Adjusted)	33.31 mgd
Lapeer County Share of KWA ADD	7.6%

	O&M					Capital					
Year	Lapeer Co. Facilities	Lapeer Co. Share of KWA	Total	Present Worth	$/MCF	Lapeer Co. Facilities	Lapeer Co. Share of KWA	Total	DWSD Commodity ($/MCF)	Cost of Water (no debt, depr) ($/MCF)	Total Annual Cost of Water ($/MCF)
						$40,009,060	$86,312,736	$126,321,796			
2009									$16.10	$16.10	$16.10
2010	$0	$15,250	$15,250	$14,806	$0.12			$0	$17.39	$16.22	$17.51
2011	$0	$15,707	$15,707	$14,806	$0.13	$1,032,827	$2,228,147	$3,260,974	$18.78	$17.51	$45.22
2012	$0	$16,178	$16,178	$14,806	$0.13	$2,096,951	$4,523,815	$6,620,765	$20.28	$18.91	$73.83
2013	$0	$16,664	$16,664	$15,211	$0.13	$3,129,777	$6,751,962	$9,881,740	$21.90	$20.42	$101.77
2014	$385,400	$160,998	$546,398	$497,494	$4.41	$3,129,777	$6,751,962	$9,881,740		$4.41	$84.14
2015	$437,902	$195,001	$632,903	$574,687	$4.63	$3,129,777	$6,751,962	$9,881,740		$4.63	$76.99
2016	$493,207	$232,874	$726,081	$657,503	$4.87	$3,129,777	$6,751,962	$9,881,740		$4.87	$71.10
2017	$551,437	$274,797	$826,234	$746,035	$5.11	$3,129,777	$6,751,962	$9,881,740		$5.11	$66.17
2018	$593,437	$315,531	$908,968	$818,374	$5.21	$3,129,777	$6,751,962	$9,881,740		$5.21	$61.85
2019	$625,276	$346,600	$971,876	$872,420	$5.19	$3,129,777	$6,751,962	$9,881,740		$5.19	$58.01
2020	$658,491	$379,034	$1,037,525	$928,517	$5.20	$3,129,777	$6,751,962	$9,881,740		$5.20	$54.67
2021	$693,137	$412,890	$1,106,027	$986,643	$5.21	$3,129,777	$6,751,962	$9,881,740		$5.21	$51.75
2022	$729,268	$448,225	$1,177,493	$1,047,033	$5.23	$3,129,777	$6,751,962	$9,881,740		$5.23	$49.16
2023	$766,944	$485,099	$1,252,043	$1,109,672	$5.27	$3,129,777	$6,751,962	$9,881,740		$5.27	$46.86
2024	$806,224	$523,574	$1,329,798	$1,174,526	$5.31	$3,129,777	$6,751,962	$9,881,740		$5.31	$44.80
2025	$847,171	$563,714	$1,410,884	$1,241,866	$5.37	$3,129,777	$6,751,962	$9,881,740		$5.37	$42.96
2026	$889,848	$605,585	$1,495,434	$1,311,554	$5.43	$3,129,777	$6,751,962	$9,881,740		$5.43	$41.30
2027	$934,324	$649,258	$1,583,582	$1,383,766	$5.50	$3,129,777	$6,751,962	$9,881,740		$5.50	$39.79
2028	$980,668	$694,802	$1,675,470	$1,458,452	$5.57	$3,129,777	$6,751,962	$9,881,740		$5.57	$38.43
2029	$1,028,951	$742,292	$1,771,243	$1,535,938	$5.65	$3,129,777	$6,751,962	$9,881,740		$5.65	$37.19
2030	$1,079,249	$791,805	$1,871,054	$1,616,043	$5.74	$3,129,777	$6,751,962	$9,881,740		$5.74	$36.05
2031	$1,131,638	$843,420	$1,975,059	$1,698,829	$5.83	$3,129,777	$6,751,962	$9,881,740		$5.83	$35.01
2032	$1,186,200	$897,220	$2,083,419	$1,784,666	$5.93	$3,129,777	$6,751,962	$9,881,740		$5.93	$34.06
2033	$1,243,016	$953,289	$2,196,305	$1,873,341	$6.04	$3,129,777	$6,751,962	$9,881,740		$6.04	$33.19
2034	$1,302,175	$1,011,716	$2,313,890	$1,964,920	$6.15	$3,129,777	$6,751,962	$9,881,740		$6.15	$32.39
2035	$1,363,764	$1,072,592	$2,436,356	$2,059,472	$6.26	$3,129,777	$6,751,962	$9,881,740		$6.26	$31.65
2036	$1,427,876	$1,136,013	$2,563,889	$2,157,429	$6.38	$2,096,951	$4,523,815	$6,620,765		$6.38	$22.86
2037	$1,494,608	$1,202,076	$2,696,684	$2,258,340	$6.51	$1,032,827	$2,228,147	$3,260,974		$6.51	$14.38
2038	$1,564,058	$1,270,884	$2,834,942	$2,362,451	$6.64			$0		$6.64	$6.64
2039	$1,636,331	$1,342,541	$2,978,871	$2,470,248	$6.78			$0		$6.78	$6.78
2040	$1,696,115	$1,392,678	$3,088,794	$2,548,299	$6.94			$0		$6.94	$6.94
2041	$1,758,014	$1,444,622	$3,202,636	$2,628,559	$7.12			$0		$7.12	$7.12
2042	$1,822,100	$1,498,436	$3,320,536	$2,710,642	$7.30			$0		$7.30	$7.30
2043	$1,888,450	$1,554,184	$3,442,634	$2,794,799	$7.48			$0		$7.48	$7.48
2044	$1,957,140	$1,611,935	$3,569,075	$2,881,307	$7.67			$0		$7.67	$7.67
2045	$2,028,253	$1,671,758	$3,700,011	$2,969,749	$7.86			$0		$7.86	$7.86
2046	$2,101,870	$1,733,727	$3,835,597	$3,060,642	$8.06			$0		$8.06	$8.06
2047	$2,178,079	$1,797,914	$3,975,994	$3,153,548	$8.27			$0		$8.27	$8.27
2048	$2,256,969	$1,864,399	$4,121,369	$3,248,498	$8.48			$0		$8.48	$8.48
2049	$2,338,633	$1,933,261	$4,271,894	$3,346,044	$8.69			$0		$8.69	$8.69
2050	$2,423,164	$2,004,583	$4,427,748	$3,445,718	$8.92			$0		$8.92	$8.92

Notes:
1. Future DWSD commodity charge assumed to increase by 8% annually. Proposed 2009 rate is $16.10 per MCF.
2. Debt for construction assumed to be phased over 3 year construction period (2011 to 2013.)
3. "Cost of Water (no debt or depr.)" is the projected operating and maintenance expenses. Neither debt nor depreciation expenses are included.
4. "Total Annual Cost of Water" includes operating and maintenance costs plus debt service for construction of the planned project. Depreciation expense is not included.

Capital Costs

Sanilac County Project Costs	$1,849,360
Sanilac County Share of KWA Project Costs	$813,723
Sanilac County Capital Costs	$2,663,083
Annual Debt Service (P&I)	$208,324

Operating Costs (2014)

Sanilac County O&M	$101,400
Sanilac County share of KWA O&M	$3,169
Total Sanilac County O&M	$104,569
Total Annual Cost (P&I + O&M) (2014)	$312,893

Summary - Cost of Water (2014)

Sanilac County Debt Service	$59.29 per Mcf
Sanilac County Share of KWA Debt Service	$26.09 per Mcf
Sanilac County O&M	$41.56 per Mcf
Sanilac County Share of KWA O&M	$1.30 per Mcf
Total Cost of Water	$128.24 per Mcf

Present Worth

Capital Costs	$2,663,083
Present Worth of O&M (2010 through 2050)	$6,535,844
Present Worth (2010 through 2050)	$9,198,926

Demand Summary

2009 Average Day Demand (Sanilac County)	0.05 mgd
2009 Annual Consumption (Sanilac County)	2,440 Mcf
2009 Average Day Demand (KWA - Adjusted)	33.31 mgd
Sanilac County Share of KWA ADD	0.2%

Table 14-11 Summary of Sanilac County Costs

	O&M				Capital			LWTUA	Cost of Water	Total Annual
Year	Sanilac Co. Facilities	Sanilac Co. Share of KWA	Total	$/MCF	Sanilac Co. Facilities	Sanilac Co. Share of KWA	Total	Commodity ($/MCF)	(no debt or depr.) ($/MCF)	Cost of Water ($/MCF)
					$1,849,360	$813,723	$2,663,083			
2010		$300	$300	$0.12			$0	$41.14	$41.26	$0.12
2011		$309	$309	$0.13	$48,218	$21,216	$69,434	$42.37	$42.50	$28.59
2012		$318	$318	$0.13	$96,451	$42,439	$138,890	$43.65	$43.78	$57.06
2013		$328	$328	$0.13	$144,669	$63,655	$208,324	$44.95	$45.09	$85.52
2014	$101,400	$3,169	$104,569	$42.86	$144,669	$63,655	$208,324		$42.86	$128.24
2015	$107,013	$3,539	$110,552	$44.60	$144,669	$63,655	$208,324		$44.60	$128.64
2016	$112,871	$3,930	$116,801	$46.39	$144,669	$63,655	$208,324		$46.39	$129.12
2017	$118,985	$4,342	$123,327	$48.23	$144,669	$63,655	$208,324		$48.23	$129.71
2018	$125,364	$4,695	$130,059	$50.10	$144,669	$63,655	$208,324		$50.10	$130.35
2019	$129,236	$4,882	$134,118	$50.90	$144,669	$63,655	$208,324		$50.90	$129.96
2020	$133,228	$5,075	$138,303	$51.72	$144,669	$63,655	$208,324		$51.72	$129.63
2021	$137,342	$5,275	$142,618	$52.57	$144,669	$63,655	$208,324		$52.57	$129.35
2022	$141,584	$5,483	$147,068	$53.44	$144,669	$63,655	$208,324		$53.44	$129.13
2023	$145,957	$5,699	$151,656	$54.33	$144,669	$63,655	$208,324		$54.33	$128.97
2024	$150,465	$5,922	$156,387	$55.26	$144,669	$63,655	$208,324		$55.26	$128.86
2025	$155,112	$6,153	$161,265	$56.20	$144,669	$63,655	$208,324		$56.20	$128.81
2026	$159,902	$6,393	$166,295	$57.18	$144,669	$63,655	$208,324		$57.18	$128.81
2027	$164,840	$6,642	$171,482	$58.18	$144,669	$63,655	$208,324		$58.18	$128.86
2028	$169,930	$6,899	$176,830	$59.21	$144,669	$63,655	$208,324		$59.21	$128.97
2029	$175,178	$7,166	$182,344	$60.27	$144,669	$63,655	$208,324		$60.27	$129.13
2030	$180,587	$7,443	$188,030	$61.36	$144,669	$63,655	$208,324		$61.36	$129.34
2031	$186,164	$7,730	$193,893	$62.48	$144,669	$63,655	$208,324		$62.48	$129.60
2032	$191,912	$8,027	$199,939	$63.62	$144,669	$63,655	$208,324		$63.62	$129.92
2033	$197,838	$8,335	$206,172	$64.80	$144,669	$63,655	$208,324		$64.80	$130.28
2034	$203,946	$8,654	$212,600	$66.01	$144,669	$63,655	$208,324		$66.01	$130.70
2035	$210,243	$8,984	$219,227	$67.26	$144,669	$63,655	$208,324		$67.26	$131.17
2036	$216,734	$9,327	$226,061	$68.53	$96,447	$42,437	$138,884		$68.53	$110.63
2037	$223,426	$9,682	$233,108	$69.84	$48,218	$21,216	$69,434		$69.84	$90.64
2038	$230,324	$10,049	$240,373	$71.19			$0		$71.19	$71.19
2039	$237,434	$10,430	$247,865	$72.56			$0		$72.56	$72.56
2040	$244,868	$10,877	$255,745	$73.61			$0		$73.61	$73.61
2041	$252,534	$11,341	$263,875	$74.69			$0		$74.69	$74.69
2042	$260,439	$11,823	$272,262	$75.81			$0		$75.81	$75.81
2043	$268,592	$12,323	$280,915	$76.96			$0		$76.96	$76.96
2044	$276,999	$12,841	$289,841	$78.15			$0		$78.15	$78.15
2045	$285,669	$13,380	$299,049	$79.38			$0		$79.38	$79.38
2046	$294,610	$13,938	$308,548	$80.65			$0		$80.65	$80.65
2047	$303,830	$14,518	$318,348	$81.96			$0		$81.96	$81.96
2048	$313,339	$15,119	$328,457	$83.31			$0		$83.31	$83.31
2049	$323,144	$15,743	$338,887	$84.69			$0		$84.69	$84.69
2050	$333,256	$16,390	$349,645	$86.12			$0		$86.12	$86.12

Notes:
1. LWTUA rates have not been made available.
2. Debt for construction assumed to be phased over 3 year construction period (2011 to 2013.)
3. "Cost of Water (no debt or depr.)" is the projected operating and maintenance expenses. Neither debt nor depreciation expenses are included.
4. "Total Annual Cost of Water" includes operating and maintenance costs plus debt service for construction of the planned project.
   Depreciation expense is not included.

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 15
Potential for Cost Reduction

February 23, 2009
Revised September 3, 2009

15.1 Introduction

The concept for a new Lake Huron Water Supply was developed consistent with the criteria established prior to beginning the study work.

Following development of the concept for a new water supply and opinions of costs, the concept was reviewed to identify potential alternatives for cost reduction. Alternatives for cost reduction have been considered only where the standards established for reliability, capacity, quality, and security have been maintained. Alternatives presented have neither been reviewed with regulatory agencies nor have been studied to the detail of the original concept.

Costs presented represent the magnitude of potential reduction. Alternatives are presented for the KWA and for individual members.

15.2 Potential Cost Reduction Alternatives – KWA Lake Huron Supply

Following are potential modifications to the water supply concept studied which could reduce the cost of new Lake Huron Water Supply. Savings resulting from these modifications will benefit all members of the KWA.

15.2.1 Reduce Intake Capacity

The proposed Lake Huron intake has been proposed with a capacity of 200 mgd. The proposed capacity is 2 1/2 times the projected 25 year demand and twice the projected 50 year demand of KWA member communities. The 200 mgd capacity was arbitrarily established at twice the 50 year demand to ensure sufficient capacity for possible future growth of service area. Future demands cannot be accurately projected and additional intake capacity was planned because of the high cost of the construction within Lake Huron. Increasing the intake size will be significantly less costly than constructing a second intake in the future.

If intake capacity is reduced to the projected 50 year demand of 104 mgd, the 96 inch intake pipeline can be replaced with a 72 inch intake. The capacity reduction will allow similar reductions with the intake crib and shorewell.

It is assumed that intake construction costs can be reduced by approximately 22% if capacity is reduced from 200 mgd to 100 mgd, as shown in Table 15-1.

Table 15-1 Potential Cost Reduction with Reduced Intake Capacity

	Cost As Planned 200 mgd Capacity	Adjusted Cost 100 mgd Capacity
Intake	$39,706,000	$29,840,000
Shorewell & Tunnel	$6,629,000	$4,640,300
Lake Huron Pumping Station	$29,100,000	$24,120,000
Subtotal	$75,435,000	$58,600,300
Design Contingencies (5%)	$3,771,750	$2,930,015
Construction Contingencies (15%)	$11,315,250	$8,790,045
Engineering, Legal, Bond, Admin. (17%)	$12,823,950	$9,962,051
Total Project Cost	**$103,345,950**	**$80,282,411**
Potential Cost Savings	**$23,063,539**	

15.2.2 Single Stage Pumping

The Lake Huron Pumping Station (LHPS) has been planned with two stage pumping. Low lift pumping to the LHPS ground storage tanks is provided by vertical turbine pumps in the shorewell. Horizontal split case pumps are planned to provide high service pumping, drawing raw water from the LHPS ground storage tank and pumping it to the planned inland reservoir.

Savings can be realized by utilizing one set of pumps. Vertical turbine pumps can draw directly from the shorewell and pump directly to the inland reservoir. In addition to the savings from providing only a single set of pumps, additional savings can be realized since the LHPS building can be smaller and there will be no need for the ground storage tanks.

Table 15-2 Potential Cost Reduction if LHPS Provided with Two Stage Pumping

	Cost As Planned Two Stage Pumping 200 mgd Capacity	Estimated Cost Two Stage Pumping 100 mgd Capacity	Estimated Cost Single Stage Pumping 100 mgd Capacity
Lake Huron Pumping Station	$29,100,000	$24,120,000	$18,900,000
Design Contingencies (5%)	$1,455,000	$1,206,000	$945,000
Construction Contingencies (15%)	$4,365,000	$3,618,000	$2,835,000
Engineering, Legal, Bonds, & Admin. (17%)	$4,947,000	$4,100,400	$3,213,000
Total Project Cost	**$39,867,000**	**$33,044,400**	**$25,893,000**
Potential Cost Savings		**$6,822,600**	**$13,974,000**

15.2.3 Eliminate North Transmission Main

The concept studied provides for a single raw water transmission main from Lake Huron. To provide system reliability, a reservoir is planned inland which provides sufficient capacity to supply water to customers during periods the single pipeline is out of service for either maintenance or repairs. Following the reservoir, either dual pipelines or other provisions are provided for system reliability.

Significant cost savings can be realized if a single pipeline is constructed following the proposed reservoir. The North Transmission Main has an estimated construction cost of $36,011,595 and the South Transmission Main has an estimated construction cost of $35,722,630.

To eliminate one of these mains, alternative provisions for system reliability must be provided. An alternative for eliminating one of the mains is relocating the inland reservoir to the proposed Genesee County WTP site. Because of the topography of the area, an additional pumping station and small reservoir will be required between Lake Huron and the Genesee County WTP site, otherwise system pressures in the supply pipeline will exceed the 200 psi limit established. Large tracts of land with suitable topography for reservoir construction will be more difficult to identify in the area where the treatment plant is planned. A single pipeline must be designed to carry the 25-year MDD and will be larger than originally planned. Table 15-3 shows the potential cost savings with this alternative.

Table 15-3 Potential Cost Reduction by Relocating Inland Reservoir

	Cost As Planned	Adjusted Cost
Reservoir (Intermediate)	$10,659,000	$3,000,000
Reservoir Pump Station (Intermediate)	$11,200,000	$11,200,000
North Transmission Main	$36,011,595	
South Transmission Main	$35,722,630	$42,160,300
Reservoir (WTP)		$10,659,000
Second Pump Station		$11,200,000
Subtotal	$93,593,225	$78,219,300
Design Contingencies (5%)	$4,679,661	$3,910,965
Construction Contingencies (15%)	$14,038,984	$11,732,895
Engineering, Legal, Bond, Admin. (17%)	$15,910,848	$13,297,281
Land (KWA Pipeline ROW)	$1,527,200	$1,117,669
Power Service (Valves & Meters)	$105,000	$85,000
Total Project Cost	**$129,854,918**	**$108,363,110**
Potential Cost Savings	**$21,491,808**	

15.2.4 Mutual Aid Agreement with DWSD

A backup water supply with another utility is another means of providing system reliability. Since Flint, GCDC-WWS and GLCUA are presently supplied finished water by DWSD, the current DWSD facilities can provide a backup water supply.

If a suitable agreement for a backup supply can be negotiated between the KWA and DWSD, the following provisions for system reliability planned for the new Lake Huron Water Supply can be eliminated, reducing the project cost.

a. Raw Water Reservoir – the reservoir has been included to provide at least seven days storage in event the intake or single pipeline from Lake Huron is out of service for repairs or maintenance. With the mutual aid agreement, the 620 MG reservoir will not be necessary. However, there will remain the need for the intermediate pumping station since topography of the area will require re-pumping at an intermediate location to keep pipeline pressures within the limits established. If the 620 MG reservoir is eliminated, the following provisions should be provided:
   - Provide variable frequency drives for operating the pumps at the Lake Huron Pumping Station
   - Provide a small reservoir (assumed to be 3 MG ground storage tank) at the intermediate pumping station

b. Dual Transmission Mains – dual pipelines have been included after the reservoir so that one line is available to supply customers in the event one line is out of service for repairs or maintenance. Each of the two pipelines has been planned with sufficient capacity to deliver 75% of the MDD. GCDC-WWS indicates that water consumption can be reduced to this level through emergency restrictions for outdoor water use. With an agreement for a backup water supply, there will be no need for a redundant pipeline. However, a single pipeline should be increased to provide capacity for 100% of MDD.

The following table summarizes the potential reduction in project cost, if a suitable agreement can be reached with DWSD for mutual aid.

Table 15-4 Potential KWA Cost Savings with DWSD Mutual Aid

	As Planned	Modifications with DWSD Mutual Aid
Eliminate Reservoir		
620 Mgal Reservoir	$10,659,000	$0
3 MG Ground Storage Tank	$0	$3,000,000
LHPS VFD's	$0	$1,400,000
Eliminate Dual Pipelines		
North Transmission Main	$36,011,595	$0
South Transmission (54" & 60")	$35,722,630	$0
South Transmission (66” & 72")		$42,160,300
Subtotal	$82,393,225	$46,560,300
Design Contingencies (5%)	$4,119,661	$2,328,015
Construction Contingencies (15%)	$12,358,984	$6,984,045
Engineering, Legal, Bond, Admin. (17%)	$14,006,848	$7,915,251
Land (KWA Pipeline ROW)	$1,527,200	$1,117,669
Power Service (Valves & Meters)	$105,000	$85,000
Total Project Cost	**$114,510,918**	**$64,990,280**
Potential Cost Savings	**$49,520,638**	

If an agreement for backup supply DWSD is established, some daily minimum supply from DWSD will also be required so that the supply pipeline volume remains fresh and ready for use in an emergency. This will result in a slight decrease in the demands of the new Lake Huron supply. The impact on costs resulting from purchase of this minimum daily volume from DWSD and reduced capacity needed with the new KWA supply has not been included in this analysis.

15.2.5 Reduce Transmission Main Size

Design criteria established for transmission mains provided capacity for the projected 25 year MDD and limited operating pressures to 200 psi. Transmission mains can be reduced in size if higher operating pressures are allowed. The following table summarizes the potential cost reduction if operating pressure limit is increased to 250 psi. As shown in Table 15-5, pump costs will increase because larger pumps will be required for the higher operating pressure.

Table 15-5 Potential Cost Savings with Reduced Transmission Main Size

	As Planned	Reduced Pipe Size
Transmission Main	$227,236,570	$222,857,263
LHPS	$29,100,000	$4,365,000
RPS	$11,200,000	$1,680,000
Subtotal	$267,536,570	$228,902,263
Design Contingencies (5%)	$13,376,829	$11,445,113
Construction Contingencies (15%)	$40,130,486	$34,335,339
Engineering, Legal, Bonds, & Admin. (17%)	$45,481,217	$38,913,385
Total Project Cost	**$366,525,101**	**$313,596,100**
Potential Cost Savings	**$52,929,001**	

Although construction costs will be reduced if operating pressures are increased, power costs over the life of the facility will be increased.

15.3 Potential Cost Reduction Alternatives – Genesee County

Following are potential modifications to the water supply concept which could reduce the cost of facilities to serve GCDC-WWS. Savings resulting from these modifications will benefit only GCDC-WWS.

15.3.1 WTP Process

Conventional treatment by flocculation and filtration has been planned. Membrane filtration is an alternative treatment process suitable for treatment of Great Lakes water.

Table 15-6 shows that WTP project costs can be reduced by about 16 percent with membrane filtration.

Table 15-6 Potential Costs Savings if Treatment Provided by Membrane Filtration

	Conventional Treatment	Membrane Filtration
Site Work	$6,100,000	$5,500,000
Pretreatment	$10,500,000	$250,000
Filtration	$13,100,000	$18,800,000
Chemical Facilities	$4,600,000	$4,000,000
Administration	$3,000,000	$3,000,000
Residual Handling	$2,400,000	$2,200,000
Finished Water Storage	$1,900,000	$3,600,000
High Service Pumping	$3,400,000	$400,000
Subtotal	$45,000,000	$37,750,000
Electrical (13%)	$5,850,000	$4,907,500
Mechanical (7%)	$3,150,000	$2,642,500
Subtotal	$54,000,000	$45,300,000
Contractor OH&P (22%)	$11,880,000	$9,966,000
Subtotal	$65,880,000	$55,266,000
Design Contingencies (5%)	$3,294,000	$2,763,300
Construction Contingencies (15%)	$9,882,000	$8,289,900
Engineering, Legal, Bonds, & Admin (17%)	$11,199,600	$9,395,220
Total Project Cost	**$90,255,600**	**$75,714,420**
Potential Cost Savings	**$14,541,180**	
	16%	

In addition to reduced construction costs, annual operating costs are expected to be reduced by fifteen percent.

15.3.2 Henderson Road Pump Station Modifications

The concept studied provides twin finished water pipelines between the WTP and the high service pumps (Henderson Road Pump Station). Although not a cost reduction, the investment in the second pipeline could be invested in additional storage at the Henderson Road facility.

If a mutual aid agreement with DWSD is negotiated, twin pipelines will not be needed to provide redundancy. A single 48" pipeline could suffice for the 25-year MDD. Table 15-7 shows the cost savings available with a single pipeline.

Table 15-7 Potential Savings with Single Finished Watermain

	Costs as planned with twin finished watermains	Costs, with single finished watermain
Twin 42" Main	$7,650,813	
Restoration	$1,377,190	$688,595
48" Main		$5,061,602
Subtotal	$9,028,003	$5,750,197
Design Contingencies (5%)	$451,400	$287,510
Construction Contingencies (15%)	$1,354,200	$862,530
Engineering, Legal, Bonds, & Admin (17%)	$1,534,760	$977,533
Total Project Cost	**$12,368,363**	**$7,877,770**
Potential Cost Savings	**$4,490,593**	

15.3.3 Locate Genesee Co. WTP at HRPS Site

Although GCDC-WWS does not presently own sufficient property at the HRPS site for construction of a WTP at the site, there is vacant land available adjacent to the site. Construction of the WTP at the HRPS site will result in construction savings through reduced sitework and the elimination of the utility charge for a new power service. There will also be some reduction in off-site piping. Costs for additional land and the treatment plant are assumed to be similar. Table 15-8 provides a summary of the potential project cost savings if the WTP is constructed at the HRPS site, rather than at a remote site as has been planned.

Table 15-8 Summary or Potential Savings by Relocating WTP to HRPS Site

	WTP As-Planned		WTP At HRPS Site	
Additional Raw Water Piping			2 miles-54"	$4,937,657
Sitework		$6,100,000		$5,200,000
Finished Water Piping	2.7 miles-twin 42"	$9,028,003	1/2 mile-twin 42"	$1,693,332
Subtotal		$15,128,003		$11,830,989
Design Contingencies (5%)		$756,400		$591,549
Construction Contingencies (15%)		$2,269,200		$1,774,648
Engineering, Legal, Bonds, & Admin. (17%)		$2,571,760		$2,011,268
Power Service		$5,900,000		
Total Project Cost		$26,625,363		$16,208,455
Potential Cost Savings	**$10,416,908**			

In addition to potential construction project savings, O&M costs will be less for a single facility.

15.4 Potential Cost Reduction Alternatives – City of Flint

For the concept studied, the portion of the project directly attributable to the City of Flint is limited to modifications at the city's WTP. Although other upgrades at the WTP were identified during this study, only the upgrades necessary to reliably treat raw water from Lake Huron have been included in the proposed project. Other than minor cost reduction through reducing the design capacity of the WTP, there is little opportunity for savings.

15.5 Potential Cost Reduction Alternatives – Lapeer County

Sixty percent of the project costs for providing service to Lapeer County is for the 22 miles of pipeline necessary to convey water from a treatment plant to the four communities: Lapeer, Mayfield Township, Imlay City, and Almont. The service area and the locations of communities to be served have a significant impact on the cost of service to Lapeer County.

Water treatment and local distribution to Lapeer, Mayfield Township, Imlay City, and Almont have been planned for a MDD of 14.8 mgd. This is a 290% increase over current demands. Table 15-9 shows the potential savings if water is supplied to the four communities (Lapeer, Mayfield Township, Imlay City, and Almont) to meet current demands plus a 20% allowance for growth.

Table 15-9 Potential Cost Reduction for Reduced Capacity

	As-Planned 14.8 mgd	Alternative Current + 20%
Pipeline	$15,875,000	$13,750,000
WTP	$10,080,000	$4,572,000
Subtotal	$25,955,000	$18,322,000
Design Contingencies (5%)	$1,297,750	$916,100
Construction Contingencies (15%)	$3,893,250	$2,748,300
Engineering, Legal, Bonds, & Admin. (17%)	$4,412,350	$3,114,740
Project Cost	**$35,558,350**	**$25,101,140**
Potential Savings	**$10,457,210**	

15.6 Potential Cost Reduction Alternatives – Sanilac County

The concept studied for Sanilac County was developed with an assumed MDD of 0.1 mgd. Although assumed to be constructed in Worth Township near Lake Huron, a WTP of the type considered can be easily provided at any location along the planned pipeline route. The modular nature of the membrane filtration equipment allows for WTP's to be developed to serve the specific needs of the county.

15.7 Potential Cost Reduction Alternatives-Summary

Table 15-10provides a summary of potential cost reductions available to reduce the total project cost of the planned Lake Huron water supply. Additional savings is possible if a mutual aid agreement for emergency water supply is negotiated. Table 15-10 shows the potential cost reductions "with" and "without" an appropriate mutual aid agreement.

Table 15-10 Summary of Potential Cost Savings

	Potential Savings New Water Supply	Potential Savings, New Water Supply with DWSD Mutual Aid Agreement
Reduced Intake	$23,063,539	$23,063,539
Single Stage Pumping	$13,974,000	$13,974,000
Eliminate north transmission (relocate reservoir)	$21,491,808	
Eliminate north transmission & reservoir		$50,442,744
Smaller Transmission Main	$52,929,001	$52,929,001
Total Potential Project Cost Savings	**$111,458,348**	**$140,409,284**

Lake Huron Water Supply Study

Karegnondi Water Authority

- **City of Flint**
- **Genesee County**
- **Lapeer County**
- **Sanilac County**

Appendix 16
Existing Water Supply Contracts

February 23, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

16.1 Introduction

The proposed member communities of the Karegnondi Water Authority (KWA) are all presently supplied water from other utilities. This appendix summarizes the current contract conditions for each member community.

16.2 Flint and Lapeer County

The City of Flint and the Greater Lapeer County Utility Authority (GLCUA) are presently supplied water as direct customers of the City of Detroit Water and Sewerage Department (DWSD). Table 16.1 summarizes the 2008-09 unit costs for water purchase from DWSD. Copies of the original water supply agreement and the subsequent amendment between Flint and DWSD are provided in Section 16.5.1 and 16.5.2. A copy of the current water supply agreement between the City of Detroit and GLCUA is provided in Section 16.5.3.

Table 16.1: Cost of Water – DWSD Customers

Community	Actual 2008-2009 Unit Cost of Water ($/MCF)	Proposed 2009-2010 Unit Cost of Water ($/MCF)	Difference	
			($)	(%)
Flint	$13.07	$14.32	$1.25	9.6%
GLCUA	$14.84	$16.10	$1.26	8.5%

16.3 Genesee County

The Genesee County Drain Commissioner – Division of Water and Waste Services (GCDC-WWS) purchases water from the City of Flint. GCDC-WWS is therefore a second tier customer of DWSD. The original agreement for water supply between Flint and Genesee County was executed on June 28, 1973. There have been four amendments to the original contract. Copies of the agreement and amendments are included in Sections 16.5.4 through 16.5.8.

16.4 Sanilac County

Worth Township is a member of the Lexington-Worth Townships Utilities Authority (LWTUA), which distributes finished water to customers in Lexington and Worth Townships. The service area for both communities is generally along Lake Huron, adjacent to Highway M-25. LWTUA purchases finished water from the Village of Lexington.

A copy of the LWTUA water supply contract has not been made available.

16.5 Water Supply Agreements

Copies of current water supply agreements for communities within the proposed service area are provided in this section.

16.5.1. Water Service Agreement between City of Detroit & City of Flint

WATER SERVICE AGREEMENT

CITY OF DETROIT - CITY OF FLINT

THIS AGREEMENT, made this 9th day of JUNE, 1964, by and between the CITY OF DETROIT, a municipal corporation organized under the laws of the State of Michigan, by its Board of Water Commissioners, (sometimes hereinafter referred to as the "Board"), party of the first part, and the CITY OF FLINT, a municipal corporation organized under the laws of the State of Michigan, (hereinafter referred to as the "City"), party of the second part.

WHEREAS, the City desires to finance, construct, operate and maintain its system of water mains, pumping stations, ground storage and auxiliary water works equipment and facilities, and all expansions thereof, required to supply its water requirements, and

WHEREAS, the City further desires to receive its supply of water from the water system of the City of Detroit, and specifically from Detroit's Lake Huron intake as soon as supply is available from that source;

NOW, THEREFORE, IT IS AGREED AS FOLLOWS:

1. The City of Detroit agrees to sell and deliver water to the City, and the City agrees to purchase water from the City of Detroit subject to conditions stated hereinafter.

2. The City of Detroit, to the best of its ability, shall provide and the City shall take water, at the designated points of connection of the City's facilities with the Detroit water system, in sufficient quantities and at sufficient pressures to meet all reasonable requirements of the City's customers, at controlled rates, as hereinafter provided.

3. The Board shall supply treated water to the City at Baxter and Potter Roads, on a maximum day basis, on which basis the City agrees to provide and utilize sufficient controlled storage to meet the demands of its customers without drawing from the Detroit water system at any rate in excess of that rate which, if maintained constantly through each 24-hour day, would provide the total quantity of water necessary to supply the requirements of all the City's customers during the same 24-hour day. Provided, further, that pressures shall be sufficient to supply the normal distribution requirements, insofar as they are presently met, within the present Flint Water Service Area as shown on Appendix "A" (attached hereto and made a part hereof) without re-pumping by the City except during seasonal peak load periods.

4. The City shall maintain suitable records of the numbers and sizes of service connections, the number of persons supplied, and the daily and hourly rates of consumption of Detroit system water through the City's facilities. These records shall be available to the Board at all reasonable times.

5. The distribution of Detroit system water within the boundaries of Genesee County shall be by the City and shall be limited to the area within the boundaries of Genesee County. The City agrees to take reasonable steps to negotiate contracts with Genesee County communities to supply water from the Detroit system as soon as practicable after it is available to the City. It is further provided that the City may supply water to such specific customers or areas beyond Genesee County limits as from time to time may be mutually agreed upon by the City and the Board. The Board agrees to review any proposed extension of service area and to answer within sixty (60) days of its receipt of such proposal.

6. Water shall be delivered by the Board to the City at Baxter and Potter Roads in Genesee County and at such other points as may, from time to time, be mutually agreed upon by the parties hereto.

7. All water furnished shall be measured by meters installed at the points of delivery. All such meters shall be furnished and installed at the expense of the City, under the supervision and inspection of the Board or its authorized agents. Said meters shall be of a size and make satisfactory to the Board, and subject to its inspection. The Board agrees to maintain said meters and to cause such repairs and/or adjustments as may from time to time be necessary, to be promptly made. Such repairs shall be made at no expense to the City unless it can be shown that the necessity for such repairs was brought about by an improper act or neglect on the part of the City. The City agrees to accept the Board's estimates of quantities of water supplied during all periods in which the meters fail to measure correctly all water supplied the City provided there is reasonable basis for such estimates.

8. (A) The rates for service under this contract shall be an average rate of $1.30 per thousand cubic feet of water for three years beginning when the Board makes service available, and an average rate of $1.38 per thousand cubic feet of water for the succeeding five years, except as factors outside the jurisdiction of the Board may render such rates unreasonable. The rates in effect at the end of the foregoing 8-year period shall continue unless altered by the Board from time to time. It is mutually understood that rates shall be uniform and shall always be reasonable in relation to the costs incurred by the City of Detroit for the supply of water. All money collected by the Board from the City for providing pure and wholesome water under the terms of this agreement, shall be used exclusively for the operation, maintenance, repairs, replacements, improvements and extensions of the entire water system of the City of Detroit.

4.6
18.4 per 1000 gal + 25% = 23¢ per 1000 gall

7.5) 13.8
75
630
600
300
300

.13

.180%
13.8) 25.00
138
1120
1104

8. (B) It is mutually understood and agreed that the City shall be subject to an annual minimum charge which shall be computed by applying the current rate to one-half of the estimated annual consumption of Detroit system water by the City, which estimate is agreed to be as follows:

Year	Estimated Water Consumption In Million Cubic Feet	Year	Estimated Water Consumption In Million Cubic Feet
1966	1,930	1977	3,010
1967	2,040	1978	3,090
1968	2,150	1979	3,170
1969	2,250	1980	3,250
1970	2,350	1981	3,330
1971	2,450	1982	3,410
1972	2,550	1983	3,490
1973	2,650	1984	3,560
1974	2,740	1985	3,630
1975	2,830	1986 and thereafter	3,700
1976	2,920		

The City agrees that the rates for water sales provided by City of Flint Ordinance No.   are presently deemed sufficient to provide the revenue necessary to finance all of the obligations of the Division of Water Supply including but not limited to a long-term contract for the purchase of water from the City of Detroit. If at any time during the life of said contract the water rates prove insufficient to finance all obligations including the purchase of water, then the rates for water sales shall be adjusted to provide such revenues. The Director of Finance may rely upon this guarantee of rate adjustment to affix his approval to the contract as provided in Section 28 of the City Charter.

(C) The Board shall give 90 days notice of any change in the rates and such notice shall be in writing and shall be delivered in person or by mail to the Director of Finance of the City. Bills for water service shall be rendered monthly and delivered to the Director of Finance of the City, and shall be payable on or before the due date shown thereon which shall be not less than 30 days from such delivery. There shall be a further charge of five per cent of the amount of the bill if not paid on or before the due date. All delinquent balances remaining unpaid for one year or more shall

8. (c) Cont'd.

be subject to an additional charge of six per cent per annum until paid. Water service to the City may be discontinued if any bill is not paid within sixty days of due date. The City hereby waives any and all claims for damages resulting from such discontinuance of service.

9. The City agrees to conform to all rules and regulations of the City of Detroit and/or Board pertaining to the control of or restriction to the use of water taken from the Detroit water system. The City further agrees to require similar performance by its suburban customers.

10. The City agrees that its installations of major transmission facilities will be of such standards and sizes as to not adversely affect the Board's ability to render satisfactory service under the terms of this contract.

11. For the benefit of the City and the Board, the Board will continue to keep a record of all systems supplied with water from the water system of the City of Detroit. For this purpose, the City shall furnish the Board with plans showing the location and size of all existing mains and facilities in the water systems of the City and its suburban customers. The City shall also furnish the Board all plans and specifications for any extensions and additions of water system facilities by the City and its suburban customers.

12. For the protection of the health of all consumers supplied with water from the water system of the City of Detroit, the City agrees to guard carefully against all forms of contamination, and that if at any time contamination should occur, the area or areas affected shall immediately be shut off and isolated and remain so until such conditions shall have been abated and the water declared again safe and fit for human consumption, by the properly constituted governmental health agencies having jurisdiction of the areas affected.

13. In the event it becomes necessary for the Board to discontinue temporarily all or part of the supply of water to the City or its suburban customers, no claims for damages for such discontinuance shall be made by the City against the Board.

14. It is understood and agreed that the City will not, under any circumstances, permit water from any other source or supply to be introduced into its water system, nor any part thereof, or to be mixed or mingled with water from the water system of the City of Detroit, without prior written approval of the Board, except in cases of emergency, and then only such water shall be used as shall meet the requirements of the Michigan State Department of Public Health, and in such quantities as shall be necessary to relieve the emergency. The Board agrees that "emergency" as used herein includes interruptions of service covered by the foregoing Sections 12 and 13.

15. The Board shall be permitted to use such of the City's streets, highways and alleys as may be approved by the City, for the purpose of constructing, operating and maintaining water transmission facilities to adequately supply the City and other areas. In the event of such construction the Board shall request the City to execute separate instruments granting rights-of-way. The Board shall restore all existing structures and/or improvements lying in the right-of-way of construction, to as good a condition as before the construction took place, and shall save harmless the City from any and all liability, claims, suits, actions or causes of action for damages for injuries or otherwise by reason of the construction, operation or maintenance work herein above provided for. Any such facilities constructed, maintained and operated under this section shall remain in perpetuity the property of the City of Detroit and shall not be operated or maintained by any other than employees of the Board or its authorized representatives.

16. It is mutually understood and agreed that the City's mains may be connected to the mains serving other suburban communities for flow in either direction, to provide an adequate water supply from the Detroit system to the City and to other areas and units of government, and to provide for efficient operation of the entire water supply system. The Board agrees that any connection made will be in accordance with accepted water system distribution practice, and that no connection will be made that will at any time adversely affect the water system of the City.

17. No failure or delay in performance of the executed water service agreement by either party shall be deemed to be a breach thereof when such failure or delay is occasioned by or due to any Act of God, strikes, lockouts, wars, riots, epidemics, explosions, sabotage, breakage or accident to machinery or lines of pipe, the binding order of any court or governmental authority, or any other cause, whether of the kind herein enumerated or otherwise, not within the control of the party claiming suspension; provided that no cause or contingency shall relieve the City of its obligation to make payment for water delivered by the Board.

18. The Board shall supply and sell water to the City from the water system of the City of Detroit, and the City shall receive and purchase such water in accordance with the terms of this Agreement for an indefinite period of time but at least for a period of thirty-five (35) years from date hereof. This Agreement may be terminated by either party after expiration of said 35-year period, upon one year's written notice served upon the other party by delivering the same to the Secretary of the Board or to the Clerk of the City as the case may be, or at any time upon mutual consent of both parties.

19. The City shall include such provisions in each of its contracts for supplying water to its suburban customers as may be necessary to effectuate the provisions of this Agreement.

20. This Agreement shall inure to the benefit of and be binding upon the respective parties hereto, their successors and assigns.

21. This Agreement shall take effect upon its adoption and execution by the respective parties hereto, and its approval by the Common Council of the City of Detroit.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their respective duly authorized officers as of the day and year first above written.

Witnesses:

CITY OF DETROIT
By its Board of Water Commissioners

By ____________ President

By ____________ Acting Secretary

Witnesses:

CITY OF FLINT

By ____________ Mayor

By ____________ Clerk

APPROVED AS TO FORM
____________ City Attorney

APPROVED AND CONFIRMED BY THE COMMON COUNCIL JUN 1 5 1964
____________ DEPUTY CITY CLERK

Approval as to sufficiency of funds for financing this contract is given at this time to make the contract operative and with the definite understanding that a water rate increase by the City of Flint will be necessary prior to any actual outlay of funds for the purchase of water from the City of Detroit.

Signed this 9th day of June, 1964.

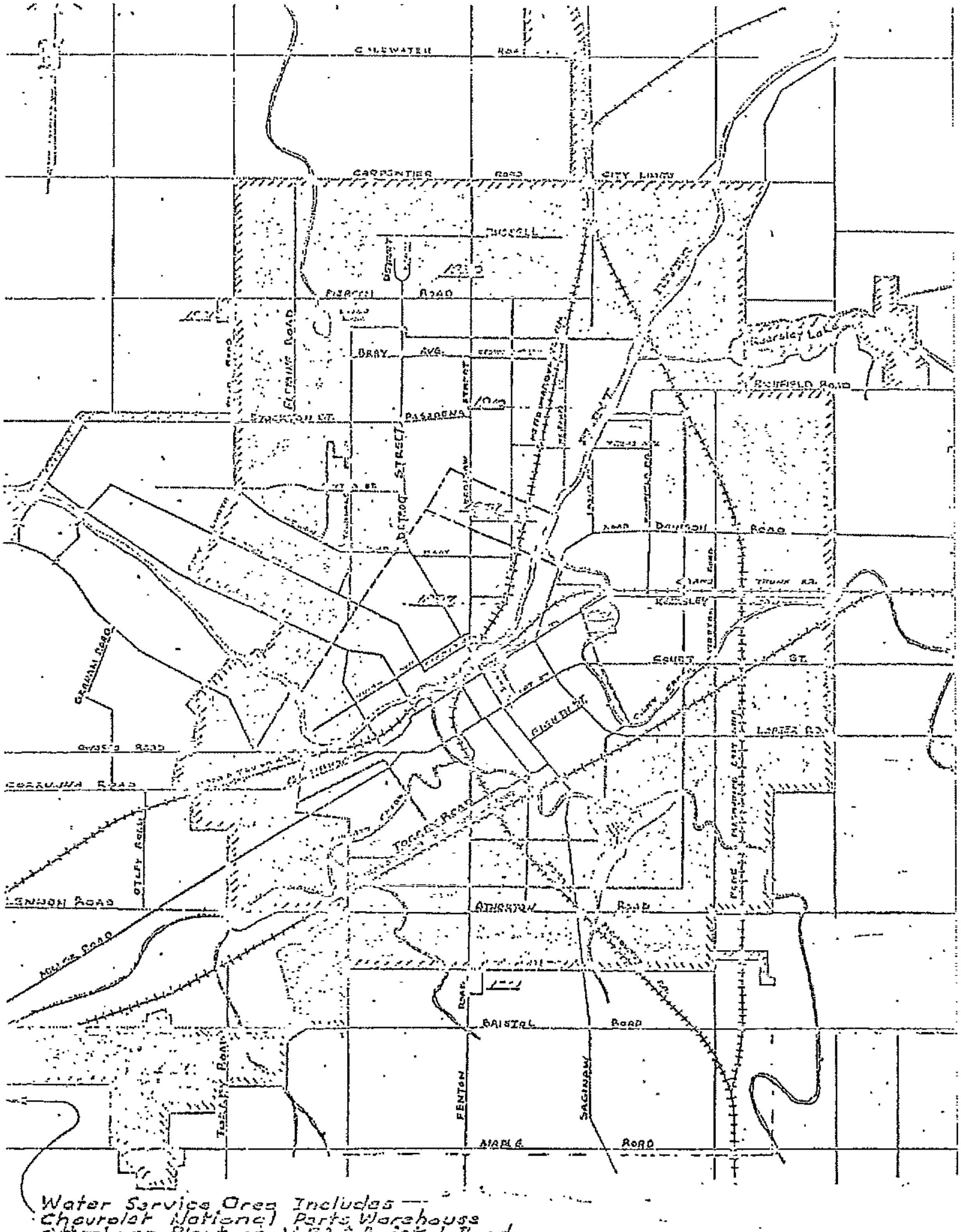
Witness:

Thomas Kay

Edward P. Joseph

Olney L. Craft,
Director of Finance

APPROVED AS TO LEGAL AND EXECUTION SUBJECT TO APPROVAL AND CONFIRMATION BY COMMON COUNCIL
____________ Corporation Counsel



Water Service Area Includes —
Chevrolet National Parts Warehouse
Atherburn Plant at M-78 & Bristol Road
(About 200 Acres) Supply requires booster pumping

CITY OF FLINT
WATER SERVICE AREA

AS OF

FEBRUARY 28, 1964

SCALE: 1" = 1 MILE

AREA DESIGNATION

APPENDIX "A"

16.5.2. Amendment to Water Service Agreement between City of Detroit & City of Flint

AMENDMENT
TO
WATER SERVICE AGREEMENT

CITY OF DETROIT - CITY OF FLINT

THIS AMENDATORY AGREEMENT, made this 18th day of January ~~December~~, 1965, by and between the City of Detroit, a municipal corporation, organized under the laws of the State of Michigan, by its Board of Water Commissioners (sometimes hereinafter referred to as the "Board"), party of the first part, and the City of Flint, a municipal corporation, organized under the laws of the State of Michigan (hereinafter referred to as the "City"), party of the second part.

WHEREAS, there is presently pending in the Circuit Court for the County of Genesee, Michigan, litigation wherein the validity of the Water Service Agreement, dated June 9, 1964, between the City of Detroit and the City of Flint, is being challenged by various taxpayers and residents of the City of Flint; and

WHEREAS, it would be imprudent for either the City of Detroit or the City of Flint to expend large sums of public monies leading towards the direct fulfillment of the aforementioned Water Service Agreement until its validity has been determined with some degree of finality by the Courts of the State of Michigan;

NOW, THEREFORE, in consideration of their mutual promises, it is hereby agreed by the Board and the City as follows:

1. Section 8(B) of the Water Service Agreement, dated June 9, 1964, between the City of Detroit and the City of Flint, is amended by mutual agreement of the parties hereto to provide as follows:

"Section 8(B). It is mutually understood and agreed that the City shall be subject to an annual minimum charge which shall be computed by applying the current rate to one-half of the estimated annual consumption of Detroit system water by the City, which estimate it is agreed shall be operative no later than twenty-four months after the validity of the Water Service Agreement has been judicially determined and shall be as follows:

Year	Estimated Water Consumption in Million Cubic Feet	Year	Estimated Water Consumption in Million Cubic Feet
1st	1,930	12th	3,010
2nd	2,040	13th	3,090
3rd	2,150	14th	3,170
4th	2,250	15th	3,250
5th	2,350	16th	3,330
6th	2,450	17th	3,410
7th	2,550	18th	3,490
8th	2,650	19th	3,560
9th	2,740	20th	3,630
10th	2,830	21st and thereafter	3,700
11th	2,920		

The City agrees that the rates for water sales provided by City of Flint Ordinance No. 1496 are presently deemed sufficient to provide the revenue necessary to finance all of the obligations of the Division of Water Supply including but not limited to a long-term contract for the purchase of water from the City of Detroit. If at any time during the life of said contract the water rates prove insufficient to finance all obligations including the purchase of water, then the rates for water sales shall be adjusted to provide such revenues. The Director of Finance may rely upon this guarantee of rate adjustment to affix his approval to the contract as provided in Section 28 of the City Charter."

2. It is mutually understood and agreed that this Amendatory Agreement does not rescind, revoke or amend any other provision of the Water Service Agreement and that said agreement remains in full force and effect.

IN WITNESS WHEREOF, the parties hereto have caused this Amendatory Agreement to be executed by their respective duly authorized officers as of the day and year first above written.

Witnesses:

CITY OF DETROIT
By its Board of Water Commissioners

By
John H. McCarthy, President

By
Philip Langwald, Acting Secretary

Witnesses:

CITY OF FLINT

By
Harry K. Cull, Mayor

By
Lloyd S. Henyon, Clerk

APPROVED AS TO FORM

Approval as to sufficiency of funds for financing this contract is given at this time to make the contract operative and with the definite understanding that a water rate increase by the City of Flint will be necessary prior to any actual outlay of funds for the purchase of water from the City of Detroit.

Signed this 5th day of ~~December,~~ January, 1965.

Witnesses:

By
Director of Finance

APPROVED AND CONFIRMED BY THE COMMON COUNCIL JAN 26 1965
DATE

DEPUTY CITY CLERK

APPROVED AS TO FORM AND EXECUTION SUBJECT TO APPROVAL AND CONFIRMATION BY COMMON COUNCIL

Corporation Counsel
Acting

3.

COMMISSIONERS
JOHN H. McCARTHY, President
WALTER BERKLICH
OSCAR A. WAGNER
JULIUS E. ALLEN
WILLIAM HANTON
LOUIS H. SCHIMMEL
CHARLES H. BEAUBIEN

City of Detroit
JEROME P. CAVANAGH, Mayor
BOARD OF WATER COMMISSIONERS
WATER BOARD BUILDING
DETROIT, MICHIGAN 48226
Telephone: 962-5550

GERALD J. REMUS
General Manager
PHILIP LANGWALD
Secretary

December 23, 1964

DEC 28 1964
DEPT. OF LAW
FLINT, MICH.

Mr. Thomas Kay, City Manager
Executive Office, City Hall
Flint, Michigan

Re: Water Service Agreement

Dear Sir:

There is being forwarded to you, herewith, an origanal and two copies of a formal addition to the Water Service Agreement between the City of Detroit and the City of Flint, which has been prepared for signature, and which apparently provides for what you requested in your letter of November 19, 1964.

If this amendment meets with your approval, please have the document executed and return, in triplicate, for action by this Board.

Very truly yours

BOARD OF WATER COMMISSIONERS

Philip Langwald

Philip Langwald, Secretary

Auth. by City Com. 1/4/65

16.5.3. Water Service Agreement – City of Detroit & Greater Lapeer County Utilities Authority

2C0A

WATER SERVICE AGREEMENT

CITY OF DETROIT - GREATER LAPEER COUNTY UTILITIES AUTHORITY

THIS AGREEMENT made this 8th day of March,

1969, by and between the CITY OF DETROIT, a municipal corporation organized under the laws of the State of Michigan, by its Board of Water Commissioners (sometimes hereinafter referred to as the "Board"), party of the first part, and the GREATER LAPEER COUNTY UTILITIES AUTHORITY, an authority organized under Act 233, Public Acts of Michigan, 1955, (hereinafter referred to as the "Authority", party of the second part.

WHEREAS, the Authority desires to receive a supply of water from the Detroit Metropolitan Water System;

NOW, THEREFORE, IT IS AGREED AS FOLLOWS:

1. The Board agrees to sell and deliver water to the Authority subject to conditions stated hereinafter.
2. The Authority agrees to purchase water from the Board subject to conditions stated hereinafter.
3. The Board, to the best of its ability, shall deliver water to the Authority at the point or points designated herein at the rates of flow and pressures needed to meet all reasonable requirements of the Authority's customers. The Authority's peak hour demand will be met to the extent that peak hour demand is met within the boundaries of the City of Detroit.
4. It is the understanding of both parties that the Board will provide such water system facilities as may be necessary to meet the terms of this agreement, and with the further understanding that the Board's responsibility in this respect does not run beyond said point or points of delivery, hereinafter more specifically set forth, it being clearly understood that the responsibility for distributing water from said points of delivery to the consumers lies entirely in the Authority.

5. The distribution by the Authority of water supplied by the Board shall be limited to its members in Lapeer County which are set forth in exhibit "A" attached hereto and made a part hereof.

6. Water shall be delivered by the Board to the Authority at the following locations:

(a) Oregon Road at East Side of Saginaw Street - Facing North

(b) Oregon Road at Calhoun Street - Facing South

and at such other points as may, from time to time, be mutually agreed upon by the parties hereto.

7. All water furnished shall be measured by meters installed at the points of delivery. All meters shall be furnished and installed at the expense of the Authority, or its members, under the supervision and inspection of the Board or its authorized agents. Said meters shall be of a size and make satisfactory to the Board, and subject to its inspection. The Board agrees to maintain said meters and to cause such repairs and/or adjustments as may from time to time be necessary, to be promptly made. Such repairs shall be made at no expense to the Authority unless it can be shown that the necessity for such repairs was brought about by an improper act or neglect on the part of the Authority. The Authority agrees to accept the Board's estimates of quantities of water supplied during all periods in which the meters fail to measure correctly all water supplied the Authority, provided the best available methods for estimating are used.

8. The Authority agrees to pay for all water supplied by the Board at such rates as the Board may establish from time to time, it being mutually understood that such rates shall always be reasonable in relation to the costs incurred by the Board for the supply of water to the Authority. Such quoted rates do not include any cost of water transmission main relocation. Should future construction by any local county, state or federal agency require relocation of these transmission mains, the cost incurred by the Board for such relocation will be charged in the future rates to those customers which receive water service from the relocated transmission main.

8. (Cont'd)

All money collected by the Board from the Authority for providing pure and wholesome water under the terms of this agreement, shall be used exclusively for the operation, maintenance, repairs, replacements, improvements and extensions of the Detroit Metropolitan Water System. It is mutually understood and agreed that the rates shall include an annual minimum charge which shall be computed by applying the current rate of one-half of the estimated annual consumption of Detroit system water by the Authority, which estimate is agreed to not be less than as follows for the City of Lapeer only:

It is also agreed that this estimate of annual consumption shall be increased in the year following the addition of a new community as listed in Exhibit "A" above mentioned. The estimate for purposes of this section shall be computed for each community by interpolation from the water demands for each community as shown on Exhibit "B" attached hereto and made a part thereof.

Year	Million Cubic Feet	Year	Million Cubic Feet
1968	34.6	1979	40.9
1969	35.0	1980	41.4
1970	35.5	1981	41.9
1971	36.0	1982	41.9
1972	36.5	1983	42.4
1973	37.5	1984	42.8
1974	38.0	1985	42.8
1975	38.5	1986	42.8
1976	39.0	1987	43.3
1977	39.5	1988 and thereafter	43.8
1978	40.4		

REVISED 3-75

The Board shall give at least 90 days notice of any change in the rates and such notice shall be in writing and shall be delivered in person or by mail to the Secretary of the Authority. Bills for water service shall be rendered monthly and delivered to the Secretary of the Authority and shall be payable on or before the due date shown thereon which shall be not less than 30 days from such delivery. There shall be a further charge of five per cent of the amount of the bill if not paid on or before the due date. All delinquent balances remaining unpaid for one

8. (Cont'd)

year or more shall be subject to an additional charge of six per cent per annum until paid. Water service to the Authority may be discontinued if any bill is not paid within sixty days of due date. The Authority hereby waives any and all claims for damages resulting from such discontinuance of service.

9. The Authority agrees to conform to all rules and regulations of the Board pertaining to the control of or restriction to the use of water taken from the Detroit water system.

10. The Authority agrees to conform to the minimum standards and specifications mutually adopted by both the Board and the Authority from time to time in effect, governing the installation of transmission and distribution system mains and facilities, and further agrees that plans and specifications for such mains and facilities shall be submitted to the Board for review and approval prior to installation in the Authority's water system.

11. It is understood and agreed that the Board shall have the right to inspect water system mains and facilities as set forth in Section 10 hereof during installation or installed in the Authority's system, for the purpose of insuring a uniform standard of construction for all areas served by the Board, and to avoid any damage to the Detroit Metropolitan Water System as a whole, arising from inferior material or workmanship in the component parts; with the understanding, however, that such inspection shall not relieve the Authority from full responsibility for the conformance of finished work with mutually acceptable standards and with approved plans and specifications.

12. For the protection of the health of all consumers supplied with water from the Detroit Metropolitan Water System, the Authority agrees to guard carefully against all forms of contamination, and that if at any time contamination should occur, the area or areas affected shall immediately be shut off and isolated and remain so until such conditions shall have been abated and the water declared again safe and fit for

12. (Cont'd)

human consumption, by the properly constituted governmental health agencies having jurisdiction of the areas affected.

13. In the event proper operation of the system required the Board to discontinue temporarily all or part of the supply of water to the Authority, prior notice shall be given wherever possible, and no claims for damages for such discontinuance shall be made by the Authority against either the City of Detroit or the Board of Water Commissioners.

14. It is understood and agreed that the Authority will not, under any circumstances, permit water from any other source or supply to be introduced into its water system, nor any part thereof, or to be mixed or mingled with water from the Detroit Metropolitan Water System without prior written approval of the Board.

15. The Board shall be permitted to use streets, highways alleys, and/or easements in the political boundaries of the Authority's constituent membership, for the purpose of constructing, maintaining and operating water system facilities to adequately supply the Authority and/or other areas. In the event of such construction, the Board shall request the constituent membership of the Authority to execute separate instruments granting rights of way in its streets, highways and alleys as maybe reasonably required by the Board. The Board shall restore all existing structures and/or improvements lying in the right of way of construction, to as good a condition as before construction took place, and shall save harmless, the constituent members of the Authority for any and all liability, claims, suits, actions or causes of action for damages for injuries or otherwise by reason of the construction work herein above provided for. Any such facilities constructed, maintained and operated under this section shall remain in perpetuity the property of the Board and shall not be operated or maintained by any other than employees of the Board or its authorized representatives.

16. It is mutually understood and agreed that the Authority's mains may be connected temporarily to the mains serving other suburban communities for flow in either direction, to provide an adequate water supply from the Detroit system to the Authority, and to other areas and units of

16. (Cont'd)

government, and to provide for efficient operation of the entire water supply system. The Board agrees that no connection will be made that is not in accordance with accepted water system distribution practice, provided such connection does not adversely affect the service of the Authority.

17. No failure or delay in performance of the executed water service agreement by either party shall be deemed to be a breach thereof when such failure or delay is occasioned by or due to any Act of God, strikes, lockouts, wars, riots, epidemics, explosions, sabotage, breakage or accident to machinery or lines of pipe, the binding order of any court or governmental authority, or any other cause, whether of the kind herein enumerated or otherwise, not within the control of the party claiming suspension; provided that no cause or contingency shall relieve the Authority of its obligation to make payment for water delivered by the Board.

18. The Board shall supply and sell water to the Authority from the Detroit Metropolitan Water System and the Authority shall receive and purchase such water in accordance with the terms of this Agreement for an indefinite period of time but at least for a period of thirty-five (35) years from date hereof. This Agreement may be terminated by either party after expiration of said 35-year period, upon one year's written notice served upon the other party by delivering the same to the Secretary of the Board or to the Secretary of the Authority as the case may be, or at any time upon mutual consent of both parties. X.

19. The parties hereto shall comply with all applicable fair employment practices, laws and ordinances, and require similar compliance by all parties contracted with pursuant to this Agreement. Failure to so comply or to require compliance may be considered a material breach of this Agreement.

20. This agreement shall inure to the benefit of and be binding upon the respective parties hereto, their successors and assigns.

21. This Agreement shall take effect upon its adoption and execution by the respective parties hereto, and its approval by the Common Council of the City of Detroit.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed by their respective duly authorized officers as of the day and year first above written.

Witnesses:

Harriett E. Abramsen

Beverly Furchak

CITY OF DETROIT
By its Board of Water Commissioners

By: John H. McCarthy, President

By: Ernest Jones, Secretary

Witnesses:

Arnold B. Whitney

Vivian Kimball

GREATER LAPEER COUNTY UTILITIES AUTHORITY

By: Fred Hocksema, Chairman

By: Hilton Burgess, Secretary

APPROVED AS TO FORM AND EXECUTION
BY [illegible]

Acting Corporation Counsel

APPROVED AND [illegible] BY
THE COMMON COUNCIL APR 15 1969

DEPUTY CITY CLERK

16.5.4. Contract Between City of Flint and the County of Genesee Relative to Water Supply

CONTRACT BETWEEN THE CITY OF FLINT AND THE COUNTY OF GENESEE RELATIVE TO WATER SUPPLY

This Agreement, made this 28th day of June, 1973, by and between the CITY OF FLINT, a Michigan Home Rule City Corporation (hereinafter referred to as the City) and the COUNTY OF GENESEE, a Michigan County Corporation (hereinafter referred to as the County) acting by and through the Genesee County Drain Commissioner (hereinafter referred to as the County Agent), having been designated as such by appropriate legislation in compliance with Act 342 of the Public Acts of 1939, and any subsequently named Agent for the County of Genesee, this agreement limited, however, to the geographic area of the County of Genesee.

1. SALE, DELIVERY AND PURCHASE.

That, subject to the conditions hereinafter provided, the City agrees to exclusively sell and deliver water to the County Agent, and subject to the conditions hereinafter provided, the County Agent agrees to purchase exclusively all water he sells from the City of Flint for all Genesee County with the exception of Fenton and Argentine Townships and the City of Flint, it being specifically understood that water purchased from the Flint system shall not be used to supply any governmental units or private persons outside Genesee County.

2. RECEIVING, STORAGE AND WATER QUALITY.

A. That the City shall provide, and the County Agent on behalf fo the County shall receive water at approximately 20 psi, at such point or points as may from time to time be mutually agreed upon by the parties hereto.

B. That the County Agent shall provide and utilize sufficient controlled storage and re-pumping facilities to meet the demands of the users of said system without drawing from the water system of the City at any rate in excess of that rate which, if maintained constantly through each 24 hour day, would provide the total quantity of water necessary to supply the requirements of the county users during the same 24 hour day. Provided further that no new storage and re-pumping facilities shall be required unless it has been determined by the City that its storage facilities and/or pumping facilities are inadequate to supply sufficient water to the City and County customers at that location at periods of peak demand. Such above water use shall be temporary in nature and at the option of the City.

C. That the County Agent shall accept water as delivered from the water system of the City provided said water meets all requirements of the various State regulatory agencies.

D. That the County Agent shall at no time during the life of this contract, grant the right to any person, firm, unit of government, corporation or business association whatever other than the City, to sell water within the limits of the County. It is agreed that this provision goes to the essence of this contract and breach thereof will be sufficient reason, at the option of the City, to immediately suspend delivery of water to the County water system.

E. That there shall be no physical connection between the water system of the City and the water system of the County without the approval of the City.

3. <u>CONSTRUCTION, EXTENSIONS, RECORDS AND SERVICE AREA.</u>

A. That no construction, operation, extensions or addition of water mains or pipes shall be made and no pumping, water storage or other water facilities shall be installed in the areas where the County had established a water system without clear and complete plans and specifications for such work being submitted to and approved by the Director of Public Works of the City prior to such work being done. Such approval or disapproval shall be made within 30 calendar days after said plans and specifications are submitted, or approval may be assumed. It is mutually agreed that the City may inspect County water facilities under construction and County water system operations at its option at all reasonable times and places.

B. That suitable records shall be created and maintained by the County Agent of the number and sizes of service connections and the daily and hourly rates of consumption of city water through the County water facilities.

Said records shall be available to the City at all reasonable times and places.

Further, the County Agent shall furnish to the City without cost, a large wall map of the County water supply system. Said map shall be at least the scale of 1" equals 600 ft. Further, "as built" plans of the new mains and appurtenances, excluding individual service connections, shall be provided to the City within 6 months after substantial completion of construction. Said map shall be kept reasonably current by periodic revision, without cost to the City.

Any existing water system within the County shall not be supplemented with water purchased from the City except with the written approval of the City.

4. METERING, RATES AND FINANCIAL ARRANGEMENTS.

A. That all water supplied to the County system by the City shall be measured by a meter or meters installed at a mutually agreed point or points of delivery. The meter or meters shall be furnished and installed at the expense of the County Agent under the supervision and inspection of the City or its authorized agents. All meters shall be housed in an appropriate structure. Said meter or meters shall be of a size and make satisfactory to the City, and subject to its inspection at all times. All necessary valves, appurtenances and flow control devices shall be included in the installation as required. The City shall maintain or have maintained said meter or meters at the expense of the County Agent and promptly make such repairs and/or adjustments as may from time to time be necessary. The County Agent shall accept the City"s estimates of quantitites of water supplied during all periods in which there is a reasonable basis for believing that the meter or meters failed to accurately measure all water delivered to the County system. Such estimates are to be based upon prior use and/or engineering calculations from available data and/or records. The timely maintenance of meter pits and/or meter locations shall be the responsibility of the County Agent. Any faulty and/or non-repairable meters shall be replaced by the County Agent at his expense and in accordance with the provisions cited above.

B. The County Agent shall pay for all water delivered to the County system. Delivery shall be complete at such time as the water use is recorded on the meter or meters as provided in paragraph 4-A herein.

C. That the rate of payment by the County Agent to the City for all water delivered directly off the 72" City transmission main shall be 1.3587 times the rate the City pays the Detroit Water Board for water supplied. The 72" transmission line is that line completed in 1967 from about Baxter and Potter Roads westerly to the city limits at Branch and Pierson Roads. The rate of payment by the County Agent to the City for all other water delivered at points of connection to the City's distribution system shall be at the rate of 1.50 times the rate established by ordinance for in-city water users. Minimum monthly bills for given water meter sizes, and water quantities shall be those provided for in the ordinances of the City of Flint.

All quantities of water delivered from the 72" pipeline, as defined above, shall be charged in one billing however many points of delivery may be installed. There shall be no minimum billing charged.

D. That bills for ter delivered shall be rendere nonthly to the County Agent. They shall be payable on or before the due date shown thereon which shall be approximately 15 days from the date of mailing. There shall be a further charge of ten percent (10%) of the amount of the bills if the bills are not paid on or before the due dates. Water service to the County system may be discontinued if the bills are not paid within 30 days, and the County Agent and his surety agree to save the City harmless from all damage claims resulting from discontinuance of service occasioned by the failure to pay said water bills. The Flint water supply system is subject to the provisions of the Revenue Bond Act which prohibits free water supply and in the event water supplied to the County Agent is not paid for the City must discontinue supplying water to the County system.

The City agrees to extend at the option of the County Agent the due date of the first monthly billing, rendered as described above, for an additional 60 days and second monthly bill so rendered an additional 30 days, without the 10% additional charge.

5. TERM OF CONTRACT AND TERMINATION.

A. That the City shall supply and sell water exclusively to the County Agent and the County Agent shall receive and purchase exclusively said water in accordance with the terms of this agreement for a period of 40 years from date hereof. This contract may be terminated by either party after expiration of said 40 year period, upon one year's written notice served upon the opposite party by delivering the same to the Clerk of the City or to the County Agent as the case may be, or may be terminated at any time by mutual consent of the parties. Provided however, that the terms of the contract hereinafter referred to existing between the City of Flint and the City of Detroit by its Board of Water Commissioners and any possible renewal thereof may prevent the City from complying with the maximum term herein provided and in that event such term of 40 years shall be modified by the provisions of the herein described contract.

B. That no failure or delay in the performance of this agreement by either party shall be deemed to be a breach thereof when such failure or delay is occasioned by or due to any act of God, strikes, lockouts, wars, riots, epidemics, explosions, sabotage, breakage or accident to machinery or lines or pipes; the binding order of any court or governmental authority any other cause, whether of the kind herein enumerated or otherwise, not within the control of either party provided, however, that no cause or contingency shall relieve the County Agent of his obligation to make payment for water delivered by the City.

6. CONSTRUCTION, OWNERSHIP AND USE OF FACILITIES.

A. That all facilities in existence, constructed with City of Flint funds, or constructed subsequent to the date of this agreement with City funds which may be used by the City to deliver water within the jurisdiction of the County Agent shall remain the property of the City.

B. It is mutually understood and agreed that the County water system mains may be connected to the mains serving other areas for flow in either direction to provide an adequate water supply from the City system to the County's system and to other areas and/or units of government and to provide for efficient operation of the entire water supply system. The City agrees that any connections made will be in accordance with accepted water system distribution practice, and that no connection will be made that will at any time adversely affect the water system of the County. The City will provide the County agent plans and specifications 30 calendar days or more prior to making changes as indicated above.

C. The supply of water may be temporarily discontinued to the County system and/or regulated whenever it is necessary to do so to insure proper operation of the water system of the City, except that under emergency conditions, the Flint Department of Public Works may take immediate steps to regulate or discontinue flows to the County system. No claims for damages for such discontinuance or decreases in flow may be made by the County Agent or his customers against the City. Any restrictions upon water use imposed on the users in the City shall also be imposed on the users of the County system. The County Agent and his surety shall hold the City harmless from any and all claims, actions and causes of action which arise with reference to such regulations, limitation or discontinuance.

D. The City shall provide water to the County system at such points as may be mutually agreed upon and in amounts generally sufficient to supply the County's system use. The County Agent shall construct, maintain and operate such water meter pits, storage facilities, control facilities, pumping facilities, appurtenances and connecting lines as may be required. The maximum demand at any point of supply shall not exceed that amount determined in writing by the City to be available at that point.

7. CONTRACT PROVISIONS IMPOSED ON THE CITY OF FLINT.

That the City purchases the water to be delivered under the provisions of this contract from the C / of Detroit pursuant to the t is of a certain contract dated the 20th day of December, 1965. That contract provides the terms and conditions under which the City purchases water and it is specifically understood between the parties hereto that the terms and conditions of this contract must be and are subordinate to the provisions of the contract between the City of Flint and the City of Detroit. That the obligations and rights of the parties herein provided are modified, restricted, terminated and changed as the ability of the City to comply with this contract is affected by the requirements and provisions of the contract between the City of Flint and the City of Detroit.

8. MISCELLANEOUS.

A. That this agreement shall take effect upon its adoption and execution by the respective parties hereto.

B. That this agreement shall inure to the benefit of and be binding upon the respective parties hereto.

C. It is hereby agreed that the County Agent shall in no way, in whole or in part, transfer, assign or in any way allienate his interests, rights or obligations under this contract without the expressed approval in writing of the City.

D. The County Agent and his surety hereby agree to protect and hold harmless the City from any and all liability arising out of the construction, operation and maintenance of the facilities constructed pursuant to this agreement by the County Agent or his agents excepting causes arising out of the negligent acts or omissions of the City.

E. The County Agent is to furnish the City copies of all pertinent resolutions and/or other data showing whereby the County Agent became or becomes the agent for the various governmental agencies and governmental units receiving water under the terms of this agreement.

9. REVIEW PROCEDURE.

It is further provided that any and all decisions of the County Agent relative to the furnishing of water to individual customers or areas, and all priorities and schedules with reference to same within the area set forth in this contract shall be subject to review, upon proper application, by the Public Works Committee of the Genesee County Board of Commissioners, or any duly designated successor to that Committee, or by any board, commission or body duly designated to perform the functions currently carried on by said Committee. Applications shall be made in a manner to be prescri d by the Genesee County Board Commissioners and procedures relative thereto shall be prescribed by said Board.

If the Public Works Committee of the Genesee County Board of Commissioners, in its discretion, finds that the decision of the County Agent is arbitrary, or is such as to improperly and unreasonably discriminate against customers or areas similarly situated or is such as to create unnecessary hardships, it shall issue a report to that effect which shall also contain a course of recommended action. Upon receipt of such report the County Agent shall be required to revise his plans and such revision shall be similarly subject to review. This provision shall not relieve the County Agent of his obligation to comply with the provisions of paragraph 3-A hereof.

10. SPECIAL PROVISIONS.

A. The parties hereto make this agreement with the knowledge that Act 342 now provides that other agencies than the County Drain Commissioner may be designated as County Agent. It is the intent of all parties that this agreement shall be binding and effective between the County and the City notwithstanding any change in designation of the County Agent.

This contract supercedes all other existing contracts between the City and County Agent for the supply of water for limited areas within the County of Genesee and these previous contracts are hereby terminated by mutual agreement of the parties, except for those particulars noted in paragraphs 10-B and 10-C below.

B. The water meter and water mains in the City of Burton in the East Court Street area near Center Road shall be turned over without cost to the County Agent for operation and maintenance under the terms of this contract within 30 days after signing.

The transfer of ownership and possession of the mains and/or facilities herein provided shall take place upon revocation by the appropriate governmental units, of any and all franchises by virtue of which the City has furnished services through such facilities and the installation of approved master meters. The change of water suppliers to the said mains and/or customers shall be at a mutually agreeable time and place and in an agreed upon manner.

The transfer of the City's right, title and interest in said mains is subject to the following terms and conditions: The County Agent agrees to accept such mains and/or facilities in their existing condition and there shall be no warranties expressed or implied as to the condition, serviceability, adequacy, quality, etc such mains and/or fac ities. The County Agent furth agrees to assume all obligations and duties of the City with reference to such mains and/or facilities, and the County Agent waives any and all rights, actions or causes of action, that he might have against the City with reference to the transfer of said mains and/or facilities. The County Agent further agrees to assume any and all obligations heretofore assumed by the City with reference to said mains and/or facilities. The City has no current knowledge of any such obligations.

C. The City owns and operates certain transmission lines and water mains and other facilities within the geographic limits of the County of Genesee and outside the City of Flint. It is mutually agreed that such ownership and use of such facilities is hereby retained by the City and ownership and use will only hereafter be transferred by mutual agreement of the parties hereto.

It is the intention of the parties hereto that the County Agent will purchase water in large quantities from the City water system and that he will distribute water to the individual users from a water distribution system constructed by the County Agent for that purpose and that individual customers of the County Agent will not be serviced from the Flint system and that such individual users now located in the County serviced from the City system shall remain the customers of the City system until such time as water mains are located within the County so that such individual users may secure water service from the County system.

The County Agent has acquired all of the City's right, title and interest in certain water facilities in the public right-of-way serving the Flint Sewage Plant on Beecher Road and the Flint Park Board property on Linden Road. The County Agent has acquired and/or operates the 12" water main on Bristol Road that currently supplies water to Bishop Airport. The aforedescribed sewage treatment plant, park board property and Bishop Airport shall continue, however, to receive water through such facilities. The quantity of water delivered to such properties owned by the City shall be deducted from billings to the County Agent. The deduction shall be made from the water supplied through the Donaldson Street meter as long as the amount supplied equals or exceeds the amount used by the City. All water used by the City in excess of that supplied through the Donaldson Street meter shall be deducted from the water supplied through the 72" transmission main. It is mutually agreed that a capacity of 600 GPM shall be allocated for use by said City properties. The service now being rendered by such water facilities is sufficient for the City's purposes and it is agreed that no assessment shall be made against said properties for other water facilities. That all water supplied by the County Agent to the Flint Sewage Plant, Flint Park Board property on Linden Board and Bishop Airport shall be measured by meters approved by the County Agent and furnished and installed by the City under the inspection of the County Agent. The meters shall be subject to the inspection of the County Agent at all reasonable times.

The rights above enumerated, which are retained by the City by virtue of this agreement, shall be permanent in nature and shall continue indefinitely at the option of the City and the retention of these rights shall not be construed, in any way as creating any liabilities on the part of the City with reference to said facilities.

It is understood and agreed that water supplied to the Flint Sewage Plant, the Flint Park Board property and Bishop Airport, shall be in accordance with this section only as long as said water is used for facilities on the properties owned by the City.

It is agreed that limitations of flows and points of connection to the City water system now in effect, pursuant to prior contracts shall remain in use and effect unless discontinued by mutual consent. Those transfers of water mains and facilities that occurred under previous contracts shall continue and be observed by both parties to this contract.

WITNESS:	CITY OF FLINT
Linda [illegible]	By Francis E. Limmer
[illegible] Johnson	By Lloyd B. Hendon
	COUNTY OF GENESEE
Brenda G. Walsh	By [illegible]
[illegible]	By [illegible]
	COUNTY AGENT
[illegible]	By Anthony [illegible]
Stanley [illegible]	

Approved as to form:

[illegible]

City Attorney

16.5.5. Supplemental Agreement and Amendment to City/County Water Agreement

TI

SUPPLEMENTAL AGREEMENT AND AMENDMENT

TO CITY/COUNTY WATER AGREEMENT

This agreement is made this 31st day of March, 1988 by and between the City of Flint, a Michigan municipal corporation, with principal offices at 1101 South Saginaw Street, Flint, Michigan 48502 (hereinafter the "City"), the County of Genesee, a political subdivision of the state, with principal offices at 1101 South Beach Street, Flint, Michigan 48502 (hereinafter the "County") and the Genesee County Drain Commissioner, the County agency designated as such pursuant to Act 342 of the Public Acts of 1939, as amended, with principal offices at 932 Beach Street, Flint, Michigan 48502 (hereinafter the "County Agency").

WHEREAS, the City, the County and the County Agency entered into an agreement dated June 28, 1973 which provided, generally, for the sale of water by the City to the County Agency as exclusive agency for communities within Genesee County (hereinafter the "Water Agreement"); and

WHEREAS, the Water Agreement further recognized the City as the sole agent for purchasing water from the City of Detroit either for distribution within its own system or for sale to the County Agency; and

WHEREAS, on or about March 5, 1981, the City, the County and the County Agency executed an amendment to the Water Agreement which modified the rates charged to the County Agency with the first rate (being 1.3587 times the Detroit rate) being for water taken directly off the seventy-two inch (72") East/West line connecting the City's water system to the Detroit water system, and the second rate (2.0 times the Detroit rate) being for water taken off the City's distribution system; and

Bob Carelyn

WHEREAS, the County Agency desires to construct certain improvements to its water system, said improvements being commonly referred to as the Genesee County "water loop", which improvements would enable the County Agency to take most of its water off the seventy-two inch (72") East/West line; and

WHEREAS, before such construction may begin, the County Agency must have the approval of the City; and

WHEREAS, the development of the water loop as proposed by the County Agency will enhance the economic development and the creation of jobs throughout Genesee County; and

WHEREAS, it is the desire of the City to cooperate with the County and the County Agency on a project that will benefit citizens throughout the County; and

WHEREAS, the City and the County Agency have reached certain proposed agreements in connection with the City's approval of the water loop and other related matters, which proposed agreements are set forth in a letter of understanding dated March 7, 1988, a copy of which is attached hereto as Exhibit A.

NOW THEREFORE, in consideration of the mutual rights, duties, responsibilities, promises and undertakings of the parties hereto as set forth herein, IT IS HEREBY AGREED AS FOLLOWS:

1. Approval of Water Loop Design.

The City does hereby approve the County Agency's proposed water loop design as it presently exists, subject to minor changes previously discussed by the parties. The City will, upon execution of this agreement by all parties, communicate its approval of the proposed water loop design the Michigan State Health Department in the manner requested by the

ntv Agency.

-. East/West Water Line.

The parties acknowledge that the City intends to build an East/West ter line to connect the City's water system to a new North/South Detroit ne to be constructed by the City of Detroit. It is proposed that the new rth/South Detroit line will run north approximately along M-15 into the ty of Davison area, that the City's East/West line will connect with said ne in the Davison area and that the City's East/West line will run west pproximately along Davison Road into the City. This East/West line would e built at the City's sole cost and expense.

Upon completion of its design for the East/West water line referred to bove, the City will notify the County Agency of the easements it will equire for said line, and the County Agency will exercise its best efforts o quire, within one (1) year from the date of such notice, easements for said East/West water line in the name of the City and on forms prepared by the City in public rights-of-way from the various governmental agencies naving jurisdiction over same. The County Agency will provide the same service to the City of Detroit with respect to the new North/South Detroit line, if requested by the City of Detroit to do so. Such efforts will be provided by the County Agency at no cost to the City or to the City of Detroit for the services of the County Agency's agents and employees who perform those services. The County Agency will cooperate but will not be required: to acquire any easements that may be necessary from private landowners; to institute or pursue any legal action to acquire any easements; to pay any consideration for the purchase of any easement; or to incur any other expenses, fees, costs or attorneys' fees in connection therewith.

3. City Connections to North/South Detroit Water Line.

Section 6 of the Water Agreement dated June 28, 1973, as amended on or about March 5, 1981, is hereby further amended to add a new subsection "e" to read as follows:

> The City will exercise its best efforts to obtain from the City of Detroit a maximum of three (3) connections to the new North/South Detroit water line at such points as shall be selected by the County Agency. In that regard, the City hereby represents that it has discussed such matter with the City of Detroit and has been advised that such three connections will be permitted. The County Agency will, at its sole expense, construct such connections and, upon construction of each such connection, the County Agency will deed to the City all of the rights, title and interest in the meter, meter pit and water line attached to such connection, including any easement in which such structures are located, from the physical connection to the new North/South Detroit water line to a point two hundred feet (200') from the right-of-way line in which said North/South Detroit line is located, but not more than three hundred feet (300') from the center line of the new North/South Detroit line. Upon such conveyance, said structures shall be deemed a part of the City's water system.

4. Amendment to Section 4(C) of the Water Agreement.

This first paragraph of section 4(C) of the Water Agreement dated June 28, 1973, as amended on or about March 5, 1981, is hereby further amended to read as follows:

> The rate of payment by the County Agency to the City for all water delivered directly off the seventy-two inch (72") water line in Potter Road shall be 1.3587 times the rate the City pays the Detroit Water Board for water supplied. The rate of payment by the County Agency to the City for all water delivered directly off any of the City's connections to the new North/South Detroit water line shall be 1.3587 times the rate the City pays to the Detroit Water Board for water supplied. The rate of payment by the County Agency for all water delivered at points of direct connection of individual properties to the City's distribution system shall be at the City's ordinance rates for out-city customers. The rate of payment by the County Agency to the City for all other water delivered from connections to the City's

distribution system shall be 2.0 times the rate the City pays the Detroit Water Board for water supplied.

5. Minimum Usage.

Section 6 of the Water Agreement dated June 28, 1973, as amended on or about March 5, 1981, is hereby further amended to add a new subsection "f" to read as follows:

Until its actual water usage exceeds 10 million gallons per day on an annual average, the County will take, at a minimum, all of its water off the City's East/West seventy-two inch (72") line and/or any other connections to the City's water distribution system other than the County Agency's connections to any of the two northerly most of the City's three lines connected to the new North/South Detroit water line. After the County Agency's actual water usage exceeds 10 million gallons per day on an annual average, it will take a minimum of 10 million gallons per day on an annual average off of the City's East/West seventy-two inch (72") line and/or any other existing connection to the City's water distribution system other than the connections to any of the two northerly most of the City's three lines connected to the new North/South Detroit water line.

If, in any year, the County Agency takes less than the minimum set forth above, it will only pay for the water actually delivered and no water shall be taken from the new North/South water line except the one most southerly until the usage again exceeds 10 million gallons per day on an annual average. The County Agency will take no water off of the two (2) northernmost of the City's connections to the new North/South Detroit water line, except the one most southerly, unless and until its lines through which it takes such water are connected to the Water Loop so that the water taken from the City's East/West seventy-two inch (72") line can be used to serve such lines.

6. Utility Basis of Rate Making.

The Water Agreement dated June 28, 1973, as amended on or about March 5, 1981, is hereby further amended to add a new Section 11 to read as follows:

The City and the County Agency recognize and acknowledge that section 123.141 of the Michigan Compiled Laws requires that water rates be determined on the basis of the actual cost of service as determined under the utility basis of rate making. The City and the County Agency further recognize and acknowledge that, if rates were determined on such basis each year, the rate obtain for the County Agency the exclusive right to sell water obtained from Detroit through the City to areas outside of Genesee County.

9. Easements.

The City will grant the County an easement it requires for watermain purposes in the northerly 33' of that parcel of land described as:

> The WLY 3/4 of NW 1/4 of NE 1/4 of SEC 3, T6N R6E; also ELY 1/2 of NW 1/4 of said SEC; also NW 1/4 of NW 1/4 of said section EXC WLY 231 FT.

Further, the parties hereto agree to grant each other such easements in or over lands they may own as each shall reasonably require from time to time for their public purposes.

10. Land Application of Sludge.

The County Agency will provide reasonable consultation and assistance to the City to enable the City to start its own program for the land application of sludge. The City and the County Agency will cooperate and a st each other in the continued operation and improvement of each other's program.

IN WITNESS HEREOF the parties hereto have executed this agreement as of the date first above written.

WITNESSED:

Ed Murphy

Diane Montgomery

CITY OF FLINT

Matthew S. Collier, Mayor

Louis A. Hawkins

Louis Hawkins, Clerk

APPROVED AS TO FORM

City Attorney

of Water Supply & Pollution Control

Matthew S. Collier
MAYOR

William C. Ewing, P.E.
SUPERINTENDENT

exhibit A

March 7, 1988

Mr. Anthony Ragnone
Genesee County Drain Commissioner
932 Beach Street
Flint, Michigan 48502

Dear Mr. Ragnone:

Re: Genesee County Water Loop and Amendments to City/County Water Agreement

The purpose of this letter is to set forth our mutual understanding of our agreements relative to the proposed Genesee County water loop, the City's approval of the design thereof and other related matters. After execution of this letter of understanding, our respective counsel will prepare appropriate contract and other documents implementing those agreements.

We agree as follows:

1. The City will approve the County's water loop design as it presently exists, subject to minor changes as previously discussed. The City will communicate this approval to the State Health Department at the time the final documents implementing these agreements are executed and delivered and in the manner requested by the County.

2. The City intends to build an East/West water line to connect the City's water system to a new North/South Detroit line to be constructed by the City of Detroit. The Detroit line will run north approximately along M-15 into the City of Davison area and the City's East/West line will connect with said line in the Davison area and will run west approximately along Davison Road into the City. This line will be built at the City's sole cost and expense.

3. Upon completion of its design for the East/West water line referred to above, the City will notify the County of the easements it will require for said line and the County will exercise its best efforts to acquire, within one (1) year from the date of such notice, easements for said East/West line in the name of the City and on forms prepared by the City in public rights of way from the various governmental agencies having jurisdiction over same. The County will provide the same service to the City of Detroit, if requested by the City of Detroit to do

3. Cont'd.

so. Such efforts will be provided by the County at no cost to the City or to the City of Detroit for the services of the County's agents and employees who perform those services. The County will cooperate but will not, however, be required: to acquire any easements that may be necessary from private landowners; to institute or pursue any legal action to acquire any easements; pay any consideration for the purchase of any easement; or incur any other expenses, fees, costs or attorneys' fees in connection therewith.

4. The County will have a maximum of three connections to the Detroit line at such points as shall be selected by the County. Upon construction of each such connection, the County will deed to the City all of its rights, title and interest in the meter, meter pit and water line connected to such connection, including any easement in which such structures are located, from the physical connection to the Detroit line to a point two hundred feet (200') from the right of way line in which said Detroit line is located, but not more than three hundred feet (300') from the center line of the new north/south Detroit line. Upon such conveyance, said structures shall be deemed a part of the City's water system.

5. For any water taken by the County off of the structures deeded to the City as described in 4, above, the County will pay for at one and three thousand five hundred eighty-seven ten thousandths (1.3587) times the rate charged the City by the City of Detroit. For any water taken by the County off of the 72" line presently in existence, the County will continue to pay for at the rate of one and three thousand five hundred eighty-seven ten thousandths (1.3587) times the rate charged the City by the City of Detroit. For any water taken off of any other point in the City's water distribution system, the County will continue to pay the rate of two (2.0) times the rate charged the City by the City of Detroit.

6. Until its actual water usage exceeds 10 million gallons per day on an annual average, the County will take, at a minimum, all of its water off the City's existing seventy-two inch (72") east/west line and/or any existing connection to the City's water distribution system other than the County's connections to any of the City's three lines connected to the new north/south Detroit line. After the County's actual water usage exceeds 10 million gallons per day on an annual average, it will take a minimum of 10 million gallons per day on an annual average off of the City's existing seventy-two inch (72") east/west line and/or any existing connection to the City's water distribution system other than the City's connections to any of the City's three lines connected to the new north/south Detroit line.

6. Cont'd.

If, in any year, the County takes less than the minimum set forth above, it will only pay for the water actually used and no water shall be taken from the new north/south Detroit line until the usage again exceeds ten (10) million gallons per day. The County will take no water off the*City's connections to the new north/south Detroit line unless and until its lines through which it takes such water are connected to the County water loop so that water taken from the City's seventy-two inch (72") east/west line could be used to serve such lines.

7. The existing City/County water agreement will be amended to include language, satisfactory to counsel for the City and the County, which will:

   a. recognize the requirement that rates be determined on the the basis of the actual cost of service as determined under the utility basis of rate making as referred to in MCLA Sect. 123.141;

   b. recognize that, if rates were determined on such basis each year, the rate formulas would fluctuate each year, would vary for different parts of the combined water systems, would from time to time unfairly benefit one party over the other and would impede economic growth and development within the County;

   c. recognize the need for stability and foreseeability in the setting of water rates so as to enhance economic growth and development in the County;

   d. recognize that the rates agreed to and the other agreements made by the City and the County in their contract will, over all, equate with rates determined in accordance with the above referenced statutory cost of service basis over the length of the contract.

8. The City/County water agreement will be extended to the earlier of the following, a) the year 2020, or b) the year the final payments are due on the bonds issued by the City to fund the East/West line and the demolition of its water plant.

9. The City will bargain in good faith with the City of Detroit to obtain for the County the exclusive right to sell water obtained from Detroit through the City to areas outside of Genesee County, particularly Saginaw and Shiawassee counties.

* two Northerly-most of the

10. The City will grant the County an easement for watermain purposes in the northerly 33' of that parcel of land described as: the WLY 3/4 of NW 1/4 of NE 1/4 of SEC 3, T6N R6E; also ELY 1/2 of NW 1/4 of said SEC; also NW 1/4 of NW 1/4 of said section EXC WLY 231 FT.

Further, the City and the County agree to grant each other such easements in or over lands they may own as each shall reasonably require from time to time for their public purposes.

11. The County will provide reasonable consultation and assistance to the City to enable the City to start its own program for the land application of sludge and both parties will cooperate with and assist each other in the continued operation and improvement of each party's program.

12. Any agreements made herein which are not merged in subsequent documents executed to implement the terms hereof shall continue in effect and be binding on the parties hereto.

By execution hereof, the undersigned acknowledges agreement to the foregoing and will submit same to the Flint City Council for discussion at its March 9 committee meeting and for formal approval at its regularly scheduled meeting on March 14. If you likewise agree to the foregoing, please execute the acknowledgement of same in the signature space set forth below.

Thank you for your courtesies and cooperation.

Yours very truly,

William C. Ewing, Acting Director
Department of Public Works

I have read the foregoing statement of agreements and understanding between the City and the County and acknowledge same as being accurate and acceptable.

Anthony Ragnone
Genesee County Drain Commissioner, as
County Agency pursuant to Act 342 of
Public Act 1939, as amended.

By: ______________
Anthony Ragnone

Dated: 3-9-88

11 County Access Ro[illegible] water

	5/99 CCF BILLED	@ 0.836	Pipeline @ 0.5679366	TOTAL
6050-7280-007 W. CARPENTER RD.	0	$0.00		$0.00
6050-7350-003 G-3000 FLUSHING RD.	0	$0.00		$0.00
6050-7370-006 G-3348 FLUSHING RD.	5,400	$4,514.40		$4,514.40
6050-7591-007 G-3167 W. PIERSON	0	$0.00		$0.00
6050-7640-015 G-3376 N. GENESEE	41,737		$23,703.97	$23,703.97
6050-7650-011 S. GENESEE RD.	299,544		$170,122.00	$170,122.00
6050-7680-009 POTTER & BELSAY	79,000		$44,866.99	$44,866.99
6050-7700-003 POTTER & IRISH RDS.	75,400		$42,822.42	$42,822.42
6050-7800-010 OAK & POTTER	29,370		$16,680.30	$16,680.30
6050-8830-002 VANSLYKE & BRISTOL	0	$0.00		0
6050-8840-010 MIS & POTTER	5,110		$2,902.16	$2,902.16
TOTALS	535,561	$4,514.40	$301,097.84	$305,612.24

16.5.6. Agreement (a.k.a. Second Amendment)

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AGREEMENT

THIS AGREEMENT made and entered into as of this 20th day of February, 2001, by and between the CITY OF FLINT, a Michigan municipal corporation, ("Flint"), and the GENESEE COUNTY DRAIN COMMISSIONER, a designated County Agency ("County Agency"),

WITNESSETH:

WHEREAS, Flint and the County Agency are parties to a certain Agreement dated June 28, 1973, as amended by certain Amendments date March, 1981 and by a Supplemental Agreement and Amendment dated March 31, 1988 (collectively, "Water Supply Agreement"), under which Flint has agreed to sell to the County Agency, and the County Agency has agreed to purchase, a water supply: and

WHEREAS, certain billing and rate claims and disputes have arisen between Flint and the County Agency under the Water Supply Agreement, including a claim by Flint that allegedly understated its billings to the County Agency commencing in approximately 1991 ("underbilling claim") and a claim by the County Agency that Flint allegedly has charged excessive rates ("overbilling claim"); and

WHEREAS, Flint and the County Agency are desirous of discussing, negotiating, and attempting to resolve these disputes; and

WHEREAS, to facilitate such discussions, negotiations and settlement attempts, the County Agency is willing to make a conditional partial payment toward Flint's underbilling claim, under the terms and conditions set forth herein.

NOW, THEREFORE, for an in consideration of the mutual covenants hereinafter contained, and for other good and valuable consideration, the receipt of which hereby is acknowledged, the parties hereto agree as follows:

1.**Recitals**. The foregoing recitals are accurate and are incorporated as part of this Agreement.

2.**Discussions**. Flint and the County Agency, through their respective designated representatives, agree to discuss, negotiate and attempt to resolve, diligently, in good faith and using best effort, all of the billing, rate and other contractual claims and disputes pending between them under their Water Supply Agreement, including Flint's underbilling claim and the Count's overbilling claim. The parties further agree that face to face discussions shall commence on February 20, 2001 at a mutually agreed time and location. The time period for discussions shall terminate May 31, 2001.

3.**Payment**. At the commencement of discussions on February 20, 2001, the County Agency agrees to pay to Flint the sum of two million dollars ($2,000,000), as a conditional partial payment toward the principal amount of Flint's underbilling claim. This payment is not an admission by the County Agency that Flint's underbilling claim is valid or has any merit. Nor is it an admission that any other claim that Flint has asserted or may asset under the Water Supply Agreement is valid or has merit. Nor is it a waiver of any defense that the County Agency has or may have to any claim that Flint may assert. Nor is it a waiver of the County Agency's overbilling claim. The County Agency specifically reserves all defenses to Flint's underbilling claim, including its position that Flint's underbilling claim has no merit and that the County Agency owes no money to Flint. The County Agency also specifically reserves its overbilling claim and any other claim it may have against Flint. This payment is made solely to induce and facilitate the discussions between the parties.

4.**Acknowledgment of Partial Payment**. If all pending claims and disputes between the parties are resolved fully by a written, mutually executed settlement agreement, Flint shall retain the payment described in Paragraph 3 as a credit to the account of the County agency, and any further payments shall be made by the County in accordance with said settlement agreement. If no such settlement agreement is mutually executed on or before May 31, 2001, the parties shall continue their negotiations in good faith, and it shall be acknowledged by Flint and understood between the parties that a payment towards the amount in dispute has been received and that said payment shall be retained by Flint as a credit to the account of the County Agency for water usage for May, June, July, and August of 2001, and/or any other periods of time for which amounts may be due the City.

5. **Notices**. All notices in connection with this agreement shall be given when mailed by certified mail, postage prepaid, on Flint to Mayor, City of Flint, 1101 S. Saginaw Street, Flint, Michigan 48502; and on the County Agency to Genesee County Drain Commission, G-4610 Beecher Road, Flint, Michigan 48532-2617.

6. **Assignment and Applicable Law**. This Agreement shall inure to the benefit of and be binding upon the successors, transferees and assigns of Flint and upon the successors, transferees and assigns of the County Agency and each of them. However, neither party shall assign or transfer this Agreement without the prior written approval of the other. This Agreement shall be deemed to be a Michigan contract and any matter concerning it shall be determined by Michigan law.

7. **Invalidity**. If any term or provision of this Agreement or the application thereof to any person or person shall to any extent be invalid or unenforceable as finally determined by any count of competent jurisdiction, this Agreement may, at the option of either party, be canceled and terminated, and all obligations, undertakings, and liabilities of the parties hereto shall thereupon automatically be terminated, released, and discharged.

8. **Failure to Enforce**. The failure of any party hereto to enforce any of the provisions of this Agreement, or the waiver thereof in any instance, shall not be construed as a general waiver or relinquishment on its part of any such provision, but the same shall, nevertheless, be and remain in full force and effect.

9. **Causes Beyond Control**. Neither party to this Agreement shall be liable to another for failure, default, or delay in performing any of its obligations hereunder, other than for the payment of money obligations specified herein, in case such failure, default, or delay in performing any of its obligations specified herein is caused by strikes or other labor problems; by forces of nature; unavoidable accident; fire; acts of the public enemy; interference by civil authorities; passage of laws; orders of the court; adoption of rules; ordinances; acts; failure to act; decisions, order, or regulations of any government or military body or agency, office, or

commission; delays in receipt of material; or any other cause, whether of similar nature, not within the control of the party affected and which, by the excise of due diligence, such party is unable to prevent or overcome. Should any of the foregoing occur, the parties hereto agree to proceed with diligence to do what is reasonable and necessary so that each party may perform its obligations under this Agreement.

10. **Complete Agreement**. This Agreement sets forth the complete understanding between Flint and the County Agency, as to matters addressed herein, and any amendment hereto to be effective must be in writing.

IN WITNESS WHEREOF, the parties hereto have caused this agreement to be executed in their respective corporate names by their respective officers thereunto duly authorized and their respective corporate seals to be hereunto affixed and attested by their respective officers having custody thereof the day and year first above written.

CITY OF FLINT, MICHIGAN

By Woodrow Stanley

Mayor

ATTEST:

Marlene J. Ragland

COUNTY AGENCY

By J. Wright

Genesee County Drain Commissioner

16.5.7. Third Amendment to 1973 City/County Water Supply Agreement

3^{RD} AMENDMENT TO
1973 CITY/COUNTY WATER SUPPLY AGREEMENT

THIS AGREEMENT is made this 21st day of October, 2003, by and between the City of Flint, a Michigan municipal corporation, with principal offices at 1101 South Saginaw Street, Flint, Michigan 48502 (hereinafter the "City"), the County of Genesee, a political subdivision of the State of Michigan with principal offices at 1101 South Beach Street, Flint, Michigan 48502 (hereinafter the "County") and the Genesee County Drain Commissioner, the County Agency designated by the Genesee County Board of Commissioners pursuant to Act 342 of the Public Acts of 1939, as amended, with principal offices at 4608 Beecher Road, Flint, Michigan 48532 (hereinafter the "County Agency"). Collectively the City, County and County Agency shall be referred to herein as "the Parties."

WHEREAS, the Parties entered into an exclusive water sale/purchase agreement, dated June 28, 1973, which provided, generally, for the sale of water by the City to the County Agency for the purpose of supplying water to the communities of Genesee County outside the City (hereinafter the "Water Agreement").

WHEREAS, the water which the City sells to the County Agency is purchased by the City from the City of Detroit, acting by and through its Board of Water Commissioners, (hereinafter the "Board"); and

WHEREAS, the water rate structure established by paragraph 4C of the Water Agreement provided that the County Agency would pay 1.3587 times the rate charged the City by the Board for water delivered to the City, (which rate charged to the City is hereinafter referred to as "the base rate,") and then delivered to the County Agency (which rate charged the County Agency by the City is hereinafter referred to as "the base plus rate") through a connection to the City's 72" transmission main in Potter Road (hereinafter the "Main") and 1.5 times the rate established by ordinance for in-city users for water delivered to the County Agency at any other points of connection to the City's water supply system (hereinafter the "System"); and

WHEREAS, the First Amendment to the Water Agreement, made on or about March 5, 1981, continued the base plus rate, established a new and separate rate payable by the County Agency for direct connections to the system of individual properties outside the territorial limits of the City, which rate is based on the City ordinance for out-city users and increased the rate payable by the County Agency to 2.0 times the base rate for all other connections to the System (the latter two rates hereinafter are collectively referred to as "the other rates"); and

WHEREAS, in 1981 the Legislature amended Section 1 of Act 34 of the Public Acts of 1917, (hereinafter the "Water Sale Act") requiring certain municipalities which sell water outside its territorial limits to charge a rate which is "based on the actual cost of service as determined under the utility basis of rate making . . . "; and

WHEREAS, the Second Amendment to the Water Agreement, made March 31, 1988, acknowledged the above amendment to the Water Sale Act and stipulated to continuing the base plus rate and other rates as being consistent with the 1981 amendment to the Water Sale Act; and

WHEREAS, under the Water Agreement, as last amended, the City under-billed the County Agency for water supplied from August 1991 through September 2000, in the principal amount of $8,622,133.14.

WHEREAS, the County Agency, in year 2001, began paying off said principal and, on December 16, 2001, made its sixth and final payment for a total amount paid to the City of $8,622,133.14.

WHEREAS, the City of Flint has made claims of interest due on said principal going back to August, 1991.

WHEREAS, the County Agency has made claims against the City of excessive water rate charges going back to March, 1981.

WHEREAS, the Parties wish to settle all outstanding claims with regards to over/under billing of water charges, according to the terms and conditions set forth below.

NOW THEREFORE, for the consideration and purposes set forth above,

IT IS HEREBY AGREED BY THE PARTIES AS FOLLOWS:

I. ACKNOWLEDGEMENT OF PAYMENT BY COUNTY

The City acknowledges receipt of the payment of $8,622,133.14 by the County Agency for claimed under billings of water through September, 2000. It is further acknowledged by the City that its water rate charges to the County for the period of October 1, 2000 to May 31, 2002 have been paid in full.

II. WATER RATE; NEW WATER RATE

Effective June 1, 2002 through December, 2003, the water rate chargeable by the City to the County Agency for water delivered and to be delivered from the City's 72" transmission main to the County's water supply system shall be the base rate (i.e. the amount charged the City by the Detroit Board of Water Commissioners or its successor agency, if any) plus an additional flat rate of $125,000.00 per month. Beginning January 1, 2004, the water rate chargeable by the City to the County Agency for water to be delivered from said 72" transmission main to the County's water supply system shall be the base rate plus an additional flat rate of $102,917.00 per month. Beginning January 1, 2005 and each calendar year thereafter through August, 2008, the latter flat rate shall be adjusted for inflation in the amount of any annual average percentage increase in the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) for the preceding calendar year. For the period of June 1, 2002 through August, 2008, all water delivered by the City to the County through the water distribution system of the City at any point other than said 72" transmission main shall be chargeable at the rate established by Table 24b of the "Cost of Service and Water and Sewer Rate Study" commissioned by the City from Alvord, Burdick and Howson, LLC, consulting engineers.

For the period beginning September 1, 2008 through December 31, 2013, the new water rate shall be determined as hereinafter provided. It is intended that the new rate be based on the results of a new water rate study to be commissioned by the City and County. In 2007, the City and the County will jointly select a consultant to prepare the new rate study and the County will share in the cost of that part of the study related to the cost of service to the County. The balance of the cost of said study shall be borne solely by the City. The study shall be completed not later than January 1, 2008. In the event that the Parties are unable to agree on a new water rate before March 1, 2008, the matter will be submitted to binding arbitration. Each Party will select an arbitrator of its choosing prior to April 1, 2008, and the two arbitrators so chosen will select a third. At least two of the three arbitrators must agree on the new water rate. The water rate determined by the Arbitrators will be effective, unless otherwise agreed by the Parties, through the balance of this Agreement. Each Party is responsible for the fees of the arbitrator selected by it. The fees for the third arbitrator shall be shared equally by the Parties. Any other costs of arbitration shall be shared equally by the Parties.

III. ADDITIONAL AMOUNT OWED BY COUNTY AGENCY

The County Agency will pay the City accrued interest on the water charges under billed the County for the period of August 1, 1991 through September, 2000, which interest equals $487,795.15. The County Agency shall pay said accrued interest charges within 30 days of the effective date of this Agreement.

IV. SALE OF WATER BY CITY; EXCLUSIVE WATER PURCHASE BY COUNTY AGENCY

The City agrees to sell water to the County Agency in such quantities as will meet the demands of the County Agency's customers subject, however, to those terms and conditions regarding quantities as are set forth in the 1973 Water Agreement and modified by the Consent Judgment entered March 9, 1981, through the term of this Agreement or the date it may be earlier terminated as herein provided.

Notwithstanding any prior agreement or amendment to such agreement between the Parties to the contrary, the County Agency agrees to purchase water exclusively from the City through the term of this Agreement or the date it may be earlier terminated as herein provided.

V. TERMINATION BY CITY

This Agreement may be earlier terminated by the City for non-payment when due of the amount agreed upon above. Notice of an intent to terminate must be sent to the County Agency ninety (90) days prior to such termination. The County Agency may cure such breach by paying the amount due, in full, within the ninety (90) day period.

The City may terminate this Agreement between September 1, 2010 and December 31, 2013 by written notice to the County Agency one (1) year prior to the effective date of said termination.

VI. TERMINATION BY COUNTY

The County Agency may terminate this Agreement between September 1, 2010 and December 31, 2013 by written notice to the City one (1) year prior to the effective date of said termination.

VII. EXPIRATION OF AGREEMENT; AUTOMATIC RENEWAL; EFFECT OF EXPIRATION OR TERMINATION OF AGREEMENT

Unless earlier terminated as provided herein, this Agreement will otherwise expire at Midnight, December 31, 2013.

Upon termination or expiration of this Agreement, no other agreement or amendment to an agreement with respect to the provision of water by the City to the County Agency will be of any force or effect unless agreed upon by the Parties, in writing, subsequent to the date hereof.

VIII. STIPULATION OF COMPLIANCE WITH WATER SALE ACT; NEW WATER RATE STUDY

The Parties recognize and acknowledge that Section 1 of PA 34 of 1917, as amended, sometimes referred to as the "Water Sale Act", being MCLA 123.141, requires that the price charged by the City for water to its customers shall be at a rate which is based on the actual cost of service as determined under the utility basis of rate-making. The Parties stipulate that the water rates established by this and prior Water Agreements are in compliance with PA 34.

The water rates established by this Agreement for the period of October 1, 2000 through December 31, 2003, are in compromise of disputed claims. For the period of January 1, 2004 through August, 2008, the water rate established by this Agreement is based upon certain economic assumptions from the "Cost of Service and Water and Sewer Rate Study" commissioned by the City from Alvord, Burdick and Howson, LLC, consulting engineers. The results of that study are incorporated by reference herein and made a part hereof.

IX. <u>WAIVER OF CLAIMS BY CITY</u>

The City hereby waives claim to any and all amounts for under-billings, including principal and interest, not otherwise provided for in this Agreement, which are, or could otherwise in the future be, claimed by the City to be owed by the County and/or the County Agency under the Water Agreement, as amended, through the date of this Agreement.

X. <u>WAIVER OF CLAIMS BY COUNTY AND COUNTY AGENCY</u>

The County and County Agency hereby waive any and all claims for reimbursement of overpayments which are, or could otherwise in the future be, claimed by the County or County Agency under the Water Agreement, as amended, through the date hereof.

XI. <u>FULL SETTLEMENT OF ISSUES</u>

This Agreement constitutes a full and final settlement of any and all issues pertaining to claims of underpayments and/or overpayments by the Parties, respectively, through the date hereof and each releases and discharges the other from any liability for said claims.

XII. <u>CONTINUED APPLICABILITY OF OTHER AGREEMENTS</u>

All other terms and conditions of the 1973 City/County Water Supply Agreement and its amendments, not otherwise inconsistent with the provisions of this Agreement, shall remain in full force and effect.

XIII. <u>NOTICES</u>

All notices in connection with this Agreement shall be given when mailed by certified mail, postage prepaid to the City addressed to the Mayor, City of Flint, 1101 South Saginaw Street, Flint, Michigan 48502, the County of Genesee, addressed to the Chairperson, Genesee County Board of Commissioners, 1101 South Beach Street, Flint, Michigan 48502 and the County Agency addressed to the Genesee County Drain Commissioner, G-4610 Beecher Road, Flint, Michigan 48532-2617.

XIV. COMPLETE AGREEMENT

This Agreement sets forth the complete understanding between the Parties as to the matters addressed herein and no other understandings or agreements than those expressed herein shall apply.

IN WITNESS HEREOF, the Parties hereto have executed this Agreement as of the date first above written.

APPROVED AS TO FORM

Karen Folks
Chief Legal Officer
City of Flint

CITY OF FLINT

James Rutherford
Mayor of the City of Flint

Edward Kurtz
Financial Manager

Inez Brown
Clerk, City of Flint

APPROVED AS TO FORM

Ward Chapman

Ward Chapman, Corporation Counsel
Genesee County

COUNTY OF GENESEE

Richard E. Hammel, Chairperson
Genesee County Board of Commissioners

Michael J. Carr, Clerk

COUNTY AGENCY

Jeffrey Wright, Genesee County Drain Commissioner

PREPARED BY:

Raymond J. Branch
Legal Counsel to County Agency
BRANCH, FOLTS & PERKINS, PLC
G-5161 E. Court Street, North
Burton, Michigan 48509
(810) 743-8945
rjb/73.water.agmt.2138

16.5.8. 4th Amendment to 1973 City/County Water Supply Agreement; Emergency Water Supply Mutual Aid Agreement

PRELIMINARY

4TH AMENDMENT TO 1973 CITY/COUNTY WATER SUPPLY AGREEMENT:

EMERGENCY WATER SUPPLY MUTUAL AID AGREEMENT

THIS AGREEMENT, entered into as of ________________, 2007, by and among the COUNTY OF GENESEE, a Michigan municipal corporation, with principal offices at 1101 South Beach Street, Flint, Michigan 48502 (hereinafter the "County"), and the Genesee County Drain Commissioner, in his capacity as the duly appointed and acting "COUNTY AGENCY", with principal offices at 4610 Beecher Road, Flint, Michigan 48532, and the CITY OF FLINT a Michigan home-rule City located within the County of Genesee (hereinafter referred to as the "City"). (The COUNTY, COUNTY AGENCY and the CITY sometimes hereafter are collectively referred to as "the Parties".)

<u>WITNESSETH</u>

WHEREAS, Act 35 of the Public Acts of 1951, as amended, being MCLA 124.1 <u>et seq</u> (hereinafter referred to as "Act 35") specifically Section 2 of Act 35 (being MCLA 124.2), allows a "municipal corporation" to join with any other "municipal corporation(s)" by contract for the ownership, operation or performance jointly, or by any one on behalf of all, of any property, facility or service which each would have the power to own, operate or perform separately; and

WHEREAS, Section 1 of Act 35 defines "city", "county" and a "local agency with power to enter into contractual undertakings" as "municipal corporation(s)" for the purpose of entering into intergovernmental contracts between municipal corporations; and

WHEREAS, Act 342 of the Public Acts of 1939, as amended, being MCLA 46.171 <u>et seq</u> (hereinafter referred to as "Act 342") provides, inter alia, that a county board of commissioners of a county may authorize and direct the establishment of a system of water improvements and services between cities, villages, townships, charter townships or any duly authorized and established combinations thereof, within or without the county; and

WHEREAS, the County, by resolution of its Board of Supervisors, pursuant to the powers granted it under Act 342, authorized and directed the establishment of the Genesee County Water Supply System (hereinafter referred to as "the System") consisting of water transmission mains and all other facilities necessary to supply water to the Genesee County Water Supply District (hereinafter referred to as "the District"); and

WHEREAS, the Drain Commissioner has been designated by the County Board of Commissioners under Act 342 as the COUNTY AGENCY for the supervision and control of the management and operation of all improvements, facilities and services established pursuant to Act 342, including those of the System; and

WHEREAS, Act 342 authorizes the County Agency to enter into agreements with units of government to make and execute proposed alterations, changes and extensions of the improvements, facilities and services established under said Act; and

WHEREAS, Act 279 of the Public Acts of 1909, as amended, being MCLA 117.1 et seq and commonly known as the "home rule city act", specifically Section 4-b (2), allows each city organized under its provisions to provide in its charter for, inter alia, the installation and connection of waterworks on and to property within the city; and

WHEREAS, Section 7-309 of the Charter of the City of Flint authorizes the City to provide for the installation and connection of waterworks on and to property within the City; and

WHEREAS, Chapter 46 of Flint City Code provides for a water supply system to serve consumers of the City; and

WHEREAS, the City and the County entered into an exclusive water sale/purchase agreement on June 28, 1973 (hereinafter the "Base Agreement"), which agreement provides that the County shall exclusively purchase from the City all the water the County intends to supply to the communities of Genesee County outside the City of Flint; and

WHEREAS, the Base Agreement further provides that, under emergency conditions, the City may decrease or discontinue water flows to the County System; and

WHEREAS, neither the Base Agreement nor subsequent amendments thereto, waive the exclusive purchase requirements of said agreement in the event the City reduces or eliminates water supply to the County in the event of an emergency; and

WHEREAS, this Agreement permits the County to seek alternate sources of safe and sanitary water for its customers should the City reduce its available supply of water to the County due to an emergency situation, such as a loss of pressure due to a main break, power loss, rationing of supply or sabotage, act or threatened act of terrorism, contamination of the water supply or other reason; and

WHEREAS, the second purpose of this Agreement is for the City to obtain from the County a supply of safe and sanitary water for City users in the event of an emergency situation such as described above.

NOW THEREFORE, for the consideration and purposes set forth above,

IT IS HEREBY AGREED BY THE PARTIES AS FOLLOWS:

I. **<u>COUNTY WATERMAIN; CONNECT TO CITY SYSTEM</u>**

The COUNTY, through the COUNTY AGENCY, without cost to the CITY, shall construct, operate and maintain a 24" watermain from a point of beginning near the intersection of E. Frances Road and Dort Highway thence South to a metering pit/pump station to be located approximately 2,000 feet North of the intersection of Coldwater Road and Dort Highway (hereinafter referred to as the "Dort Pit"). The "Dort Pit" shall also be constructed, operated and maintained without cost to the CITY by the COUNTY AGENCY. This watermain system will be constructed according to the standards and specifications required by the COUNTY for connection to its System.

CITY

II. IV REVERSE FLOW OF WATER

The connection point of the COUNTY'S 24" main to the CITY system shall have reverse flow capability in the event that the COUNTY is requested to supply water to the CITY during an emergency.

III. COMMODITY CHARGE IV CITY WATER RATE

The COUNTY, through the COUNTY AGENCY, shall pay the CITY the same rate for water supplied to the County System by the City during a declared Level One Emergency as is established by Section II of the 3rd AMENDMENT TO 1973 CITY/COUNTY WATER SUPPLY AGREEMENT, entered into by the Parties on October 21, 2003.

IV. READINESS CHARGE V

The COUNTY AGENCY shall pay the CITY a "readiness to serve" charge of _______ per month for "emergency" access to the CITY system. [This is based on the current readiness to serve charge by the City of Flint for a ____" meter and will fluctuate with their rate. Payment by the County Agency is contingent on the implementation of the Treatment Plant Operating Agreement between the City and County Agency.] NEW

V. DEFINITIONS

A "Level One Emergency" as used in this Agreement shall mean a situation in which there is a lack of a potable supply or a sufficient capacity of water from the primary supply of the CITY due to a loss of pressure following a main break, power loss, rationing of supply or sabotage, an act or threatened act of terrorism, contamination or some other unforeseen and unexpected event or occurrence causing or necessitating a reduction or elimination of the primary water supply.

"Primary Water Supply" as used in this Agreement shall mean the supply of water provided through the 72" water main from Detroit.

"Secondary Source of Water" as used in this Agreement shall mean the supply of water processed and treated at the Water Filtration Plant of the City of Flint.

A "Level Two Emergency" shall mean a situation in which there is a lack of a safe and/or sufficient supply of water in both sources of water from the CITY due to a loss of pressure from a main break, power loss, rationing of supply, or sabotage, an act or threatened act of terrorism, contamination or some other unforeseen and unexpected event or occurrence causing or necessitating a reduction or elimination of both primary and secondary water supplies.

VI. EMERGENCY WATER SUPPLY TO COUNTY

Except as otherwise provided, the CITY shall supply a minimum of 12 mgd of water from its "Secondary Source of Water" to the COUNTY AGENCY system as measured at the "Dort Pit" and the Donaldson Avenue metering pit during a "Level One Emergency". If the CITY lacks sufficient water capacity to supply 12 mgd to both the CITY and COUNTY systems, respectively, the CITY shall provide ½ of its total capacity to the COUNTY AGENCY'S system.

VII. LACK OF POTABLE WATER; RELEASE OF CITY

In the event of a lack of potable water in both sources of CITY water supply, the CITY is relieved of its obligation under this Agreement to provide a supply of water to the COUNTY until such time as the condition causing the emergency can be reasonably removed or corrected.

VIII. EMERGENCY WATER SUPPLY TO CITY

Except as otherwise provided, the COUNTY AGENCY shall provide to the CITY a minimum of 12 mgd of water through the "Dort Pit" in the event of a Level One and Two Emergency. If the COUNTY system lacks sufficient water capacity to provide 12 mgd of water to both the COUNTY system and the CITY system, the COUNTY AGENCY shall provide ½ of its systems' total capacity of potable water to the CITY system.

IX. COUNTY WATER RATE

The CITY shall pay to the COUNTY AGENCY, for water supplied by the COUNTY AGENCY to the CITY, under the terms of this Agreement, the same rate for water charged by the COUNTY to its other customers. [No readiness to serve charge will be applied.]

X. LACK OF POTABLE WATER; RELEASE OF COUNTY

The COUNTY AGENCY and the COUNTY are relieved of any obligation to provide a supply of water to the CITY system in the event of a Level One and Two Emergency, if the COUNTY AGENCY'S system lacks potable water.

XI. NOTIFICATION OF COUNTY; EMERGENCY

The CITY shall immediately notify the COUNTY AGENCY of a Level One and/or Two Emergency to permit the COUNTY to appropriately respond.

XII. NOTIFICATION OF CITY; EMERGENCY

The COUNTY AGENCY shall immediately notify the CITY if the COUNTY AGENCY lacks potable water in the event of a Level One and/or Two Emergency.

XIII. WAIVER OF EXCLUSIVE PURCHASE OF WATER

The provisions of the Base Agreement and subsequent amendments and modifications thereto, which provide that the COUNTY and/or the COUNTY AGENCY shall purchase its water supply exclusively from the CITY, are waived during a Level One or Level Two Emergency.

XIV. TERM OF AGREEMENT

This Agreement shall become effective after approval by the governing body of the CITY and COUNTY, respectively, and execution of the authorized officials of the Parties. It shall continue in effect for such time that the "3rd Amendment to 1973 CITY/COUNTY WATER SUPPLY AGREEMENT" shall remain in force and effect.

XV. SEVERABLE PROVISIONS

In the event that any one or more of the provisions of this Contract shall for any reason be held to be invalid, illegal or unenforceable in any respect, such invalidity, illegality or unenforceability shall not effect any other provisions hereof, but this Contract shall be construed as if such invalid, illegal or unenforceable provisions had never been contained herein.

XVI. NONDISCRIMINATION

The Parties, as required by law, shall not discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions or privileges of employment, or matters directly or indirectly related to employment because of race, color, religion, national origin, age, sex, disability that is unrelated to the individuals' ability to perform the duties of a particular job or position, height, weight, or marital status. Breach of this covenant may be regarded as material breach of this Contract. A contract awarded to a contractor and his/her subcontractors by the County Agency shall contain a covenant not to discriminate in a form substantially the same as set forth in this section.

XVII. DISREGARDING TITLES

The titles of the sections set forth in this Contract are inserted for the convenience of reference only and shall be disregarded when construing or interpreting any of the provisions of this Contract.

XVIII. COMPLETE AGREEMENT

This Contract, and any additional or supplementary documents incorporated herein by specific reference, contains all the terms and conditions agreed upon by the parties hereto and no other agreements, oral or otherwise, regarding the subject matter of this Contract or any part thereof shall have any validity or bind any of the parties hereto.

XIX. NON-BENEFICIARY CONTRACT

This Contract is not intended to be a third party beneficiary contract and confers no rights on anyone other than the parties hereto.

XX. CERTIFICATION OF AUTHORITY TO SIGN CONTRACT

The persons signing on behalf of each of the Parties hereto certify by their signatures that they are authorized to sign this Contract on behalf of such Party and that this Contract has been authorized by such Party.

IN WITNESS WHEREOF, the parties hereto have caused this Contract to be executed and delivered, by their respective duly authorized officers, all as of the day and year first above written.

APPROVED AS TO FORM

____

Trachelle Young
Chief Legal Officer
City of Flint

CITY OF FLINT

____

Donald J. Williamson
Mayor of the City of Flint

____

Inez Brown
Clerk, City of Flint

APPROVED AS TO FORM

____

Ward Chapman, Corporation Counsel

COUNTY OF GENESEE

____

Richard E. Hammel, Chairperson
Genesee County Board of Commissioners

____

Michael J. Carr, Clerk

PRELIMINARY

COUNTY AGENCY

____

Jeffrey Wright, Genesee County Drain Commissioner

PREPARED BY:

____

Raymond J. Branch (P-31154)
Legal Counsel for County Agency
BRANCH, FOLTS & PERKINS, PLC
G-5161 E. Court Street, North
Burton, Michigan 48509
(810) 743-8945

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RWM 3 April, 0[illegible]

Lake Huron Water Supply Study

Karegnondi Water Authority

- **City of Flint**
- **Genesee County**
- **Lapeer County**
- **Sanilac County**

Appendix 17
Service to Genesee County

February 23, 2009

17.1 Introduction

Genesee County, through the Genesee County Drain Commissioner Division of Water and Waste Services (GCDC-WWS) supplies water to 19 communities in Genesee County. The GCDC-WWS purchases finished water from the City of Flint; Flint purchases finished water for the City of Detroit Water and Sewerage Department (DWSD).

GCDC-WWS operates pumping, transmission, storage, and distribution facilities for the delivery of water to its customers. The new Lake Huron Water Supply being studied will replace the current finished water supply with raw water. A new water supply for the GCDC-WWS will require the modification of some existing facilities and the addition of new facilities. Appendix 8 of this study considered the addition of treatment prior to distribution to Genesee County. This Appendix considers other improvements or modifications needed if the new Lake Huron Water Supply is utilized.

17.2 Henderson Road Pumping Station Modifications

The Henderson Road Pumping Station (HRPS) was constructed in 2004 in conjunction with GCDC-WWS's North Loop. Together, the North Loop and the HRPS provide for the transmission of water around the east and north side of Genesee County. Water is supplied to the HRPS through a connection to Flint's 72" transmission main. The 72" main supplies finished water to Flint and Genesee County from DWSD.

A 48 inch pipeline conveys water to the HRPS from the 72 inch Flint pipeline. Water from the 48 inch pipeline is routed through one of two existing 10 million gallon ground storage tanks. Pumps at the HRPS draw water from the storage tanks and pump into the North Loop transmission main. There are presently three pumps at the HRPS, two with a capacity of 8 mgd and one with a capacity of 12 mgd. These provide a firm capacity of 16 mgd and a total capacity of 30 mgd. The HRPS was designed to allow expansion to a total capacity of 56.2 mgd.

With the new Lake Huron Water Supply, the HRPS will serve as the high service pump for the Genesee County WTP. All water normally supplied to Genesee County will be pumped through the HRPS. GCDC-WWS criteria provide that distribution system storage provide sufficient capacity to meet peak demands and that maximum day demands are met by adequate supply capacity. The following table summarizes the required pump upgrades.

Table 17-1 HRPS Pumping Capacity

	Existing (mgd)	Initial (2014) (mgd)	25 Year (2039) (mgd)
MDD		25	32
Pumps			
1	8	8	8
2	8	8	8
3	14	14	14
4		8	8
5			8
Total	30	38	46
Firm	16	24	32

The addition of two 8 mgd pumps is necessary to provide sufficient capacity for the projected 25 year MDD. The addition of a single pump should provide sufficient capacity initially.

The HRPS building will need to be expanded to accommodate any additional pumps.

The existing generator has sufficient capacity for operation of three pumps and can provide backup power for the initial MDD.

A budget of $1,000,000 is planned for the initial upgrades.

17.3 Flint's 72 inch Pipeline

Flint is supplied finished water from DWSD by a 72" transmission main. Flint supplies water to GCDC-WWS through eight connections from the 72" main.

With the new Lake Huron water supply being considered to replace the existing DWSD supply, the 72" main will no longer be required to supply water to Flint, other than, perhaps as a backup source. Although there are eight connections from the 72" main to the GCDC-WWS distribution system, there are no direct connections from the 72" main to the city's distribution system. Abandonment of the 72" main will result in some reduction in the level of service of the GCDC-WWS distribution system unless other provisions for supplying water to the GCDC-WWS distribution are provided.

Transfer of the 72 inch pipeline to GCDC-WWS will maintain service to their distribution system at or better than current levels. The pipeline can be separated by existing valves located at the city's water treatment plant, yet provide for a mutual aid emergency interconnection between the two systems.

The city's 72 inch main runs a distance of about 11 miles, between the DWSD meter and the city's WTP. Based upon the estimated 1963 construction cost of the main and the depreciation criteria established for this study, the 2009 depreciated value of the main is estimated at $1.3 million. Table 17.2 summarizes this computation.

Table 17-2 Depreciated Value of 72" Transmission Main

Length of Main	58,000 feet
2009 Unit Cost of 72" Main (this study)	$574
Construction Cost (2009 $)	$33,292,000
2009 ENR Index	8688
1963 ENR Index	901
Adjusted Construction Cost (1963 $)	$3,452,589
Service Life	75 Years
Remaining Value	**$1,335,001**

17.4 Existing Henderson Road 48" Pipeline Modifications

The HRPS presently draws water from Flint's 72 inch pipeline to supply the GCDC-WWS north loop. A 48 inch pipeline along Henderson Road supplies the HRPS. A meter is provided at the connection to record water sales between Flint and GCDC-WWS.

With the new Lake Huron Water Supply being studied, the pipeline along Henderson Road will no longer supply the HRPS.

Piping at the HRPS should be reconfigured, reversing the flow in the 48” main along Henderson Road, to supply the 72 inch Flint pipeline. In conjunction with the transfer of the 72” main from Flint to GCDC-WWS, this modification will provide for distribution of water to the southern part of Genesee County.

Flow reversal from the HRPS can be accomplished by repositioning of existing valves. The meter and check valve located at the connection to the 72” main should be removed and replaced with a control valve to allow flow into the 72” main.

A budget of $500,000 is established for replacing the meter with a control valve.

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 18
Continued Supply from DWSD

April 28, 2009
Revised September 24, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

18.1 Introduction

The City of Flint (Flint) and the Greater Lapeer County Utility Authority (GLCUA) have water supply contracts with the City of Detroit Water and Sewerage Department (DWSD). The Genesee County Drain Commissioner-Division of Water and Waste Services (GCDC-WWS) has a contract with Flint for supply of water. Sanilac County, the other study participant, is not currently a customer of DWSD. The Sanilac County community of Worth Township is supplied water by the Village of Lexington. Neither Sanilac County nor Worth Township is considered in this discussion regarding service by DWSD. Continuing their existing service will be discussed later.

One of the alternatives for long term water supply for Flint, GCDC-WWS, and GLCUA is continuing to purchase finished water from DWSD. Representatives of the study group have met with DWSD officials to discuss options for continued supply by DWSD. Although the specific details for any of the options discussed have not been worked out, several different concepts have been discussed. This appendix provides a review and analysis of some of the options for continued supply by DWSD.

18.2 DWSD Rate Model

DWSD has established a uniform rate structure to establish water rates for all of its suburban wholesale customers. The rate structure includes the following variables which are defined for each individual suburban wholesale customer:

- Annual average day demand
- Maximum day demand
- Peak hour demand
- Distance from geographical center of all DWSD WTP's
- Elevation difference from geographical center of all DWSD WTP's
- Meter Size
- Combinations of some of these factors

DWSD determines its cost to operate, maintain, and expand the system on an annual basis. Individual costs are categorized according to their impact from the preceding variables. The cost of water for each customer is computed annually using the cost factors and the variables established for each community.

Because of their location away from the Detroit metropolitan area; the cost of water for Flint, GCDC-WWS, and GLCUA is heavily dependent upon the distance and elevation variables of the DWSD rate model. As an example, the 2009 water rate for Flint is $13.07 per 1,000 cubic feet (MCF). Table 18-1 shows that 69% of the cost of water is attributed to distance and elevation factors incorporated in the DWSD rate model.

Table 18-1 Example of Cost Components of Flint Rate

Component of Rate	Cost of Water ($/MCF)	Portion of Rate Attributed to Distance & Elevation
Commodity	$3.95	
Distance	$2.21	17%
Distance / Elevation	$6.84	52%
Other	$0.07	
Total	**$13.07**	**69%**

18.3 Planned DWSD Transmission Facilities Upgrades

DWSD is planning significant upgrades to their transmission facilities. The cost of upgrades to DWSD's facilities are divided amongst customers and incorporated into the water rates. The cost of transmission facilities are considered "common to all" and are distributed on the basis of distance and elevation. Future rates for Flint, GCDC-WWS, and GLCUA are expected to increase significantly to provide for the investment in the new transmission facilities because of their high distance and elevation factors.

Table 18-2 summarizes upgrades planned by DWSD to their transmission facilities.

Table 18-2 Planned DWSD Transmission Facility Upgrades

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb (includes the following)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

Source: DWSD Capital Improvement Program-September 25, 2008 Presentation

DWSD has let contracts for management of many recent projects. A construction management fee of 7% will be added to the project costs, shown in table 18-2, to allow for construction management.

18.4 Continued Supply by DWSD

DWSD has developed a new master agreement for wholesale water sales to suburban communities. A copy of the master agreement is included in Section 18.6. The agreement requires a thirty year commitment for water supply and that customers purchase a minimum volume annually. The agreement also allows suburban communities to establish the demands and pressures to be supplied. Water rates will be established based upon the demands established by the customer. DWSD is not required to deliver rates greater than the demands required by the contract and DWSD may increase a community's rate when the contracted amount is exceeded.

Existing suburban customers are not required to execute the new master agreement for continued supply by DWSD. Existing customers can continue to purchase water using the existing contract. Water rates will be established using historical demands plus a 20% proxy.

Some of the concepts for continued service which have been discussed with DWSD will be compared on the basis of the projected cost of water. Rates for the concepts studies have been computed using the format presented by DWSD and the Foster Group in September 2008 to document the computation of the 2009-2010 rates.

DWSD officials have indicated that the cost of water to wholesale suburban customers is anticipated to increase at an average rate of 7% annually through 2014 and 5% annually thereafter. These increases represent the average for all suburban customers. A review of historical rates indicates that annual increases to Flint have averaged 1% higher than the average of all customers. For this analysis, it is assumed that rate increases are 1% higher than the averages anticipated by DWSD.

Table 18-2 identified several upgrades to the transmission facilities planned by DWSD. DWSD rate methodology incorporates the recovery of capital investment in new facilities into the rate. In developing rates for the options considered here, the following assumptions have been made.

- The group of suburban wholesale customers remains unchanged
- Water loss is constant

Four options have been studied for Flint, GCDC-WWS, and GLCUA to continue as DWSD customers.

18.4.1 Option 1- Annual Contract

This scenario assumes that Flint and GLCUA continue to purchase finished water from DWSD based on their existing contracts. GCDC-WWS is assumed to continue to purchase water from Flint. This option represents no change from the present arrangement.

Without executing the new master agreement, rates will be established based on historical demands plus a 20% proxy.

The 2009-2010 rate was determined by DWSD and presented in September 2008. For this analysis, it is assumed that the rate increases at an annual rate of 8% through 2014 and 6% later. Table 18-3 shows the 2009-10 rates, key variables used in the DWSD rate model, and the required rate of capital recovery used to determine the cost of water for this option.

Table 18-3 Factors Used to Determine Cost of Water for Option 1

	2009-10 Rate ($/MCF)	Distance Factor	Distance-Elevation Factor	% Peak Hour Distance	Capital Recovery Requirement ($ / $100M)	Projected 2036 Rate ($ / MCF)
Flint & GCDC-WWS	$14.32	52.0	76.2	8.52%	$570,000	$60.55
GLCUA	$16.11	47.3	70.1	0.82%	$55,000	$65.57

Table 18-4 shows the projected cost of water if Flint and GCDC-WWS continue to purchase water utilizing the existing water supply contract. Table 18-5 shows the projected cost of water for GLCUA from DWSD with their original contract.

18.4.2 Option 2- Master Agreement (Current Demands Plus 5%)

This option is based on the assumption that Flint, GCDC-WWS, and GLCUA execute the new master agreement for water supply with DWSD. It is assumed that the agreement limits demands to 5% more than historical demands for purposes of establishing rates.

Table 18-6 shows the 2009-10 rates, key variables used in the DWSD rate model, and the required rate of capital recovery used to determine the cost of water for this option.

Table 18-6 Factors Used to Determine Cost of Water for Option 2

	2009-10 Rate ($/MCF)	Distance Factor	Distance-Elevation Factor	% Peak Hour Distance	Capital Recovery Requirement ($ / $100M)	Projected 2036 Rate ($ / MCF)
Flint & GCDC-WWS	$12.71	52.0	76.2	7.69%	$516,000	$53.80
GLCUA	$14.16	47.3	70.1	0.73%	$49,000	$57.65

Table 18-7 shows the projected cost of water for Flint and GCDC-WWS and Table 18-8 shows the projected cost of water for GLCUA.

Table 18-4 Option 1 - Flint & GCDC-WWS; No Change

Option 1 - Flint & GCDC-WWS: No Change

Assumptions:

DWSD Capital Projects: (from DWSD September 25, 2008)

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb (includes the following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

Const. Management Fee (assumed)	7.0%

DWSD Commodity Rates:

Flint & GCDC-WWS Commodity Rate (2008-09)	$13.07	$/MCF
Flint & GCDC-WWS Commodity Rate (2009-10)	$14.32	$/MCF

Capital Cost Recovery:

Flint & GCDC share of Capital Cost Recovery	8.52%	
Revenue Requirement (Initial Year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System						
					Suburban Wholesale Customers					Flint-GCDC
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009		$13.07	1,461,952	$874,618,000	$743,425,300	$11,107,649	$47,579,219	$58,686,868	$6.71	$5,000,121
2010		$14.32	1,461,952	$863,510,351	$733,983,799	$11,107,649	$46,974,963	$58,082,612	$6.64	$4,948,639
2011	8.0%	$15.47	1,471,711	$852,402,703	$724,542,297	$11,107,649	$46,370,707	$57,478,356	$6.57	$4,897,156
2012	8.0%	$16.70	1,480,983	$841,295,054	$715,100,796	$11,107,649	$45,766,451	$56,874,100	$6.50	$4,845,673
2013	8.0%	$18.04	1,490,254	$830,187,406	$705,659,295	$11,107,649	$45,162,195	$56,269,843	$6.43	$4,794,191
2014	8.0%	$19.48	1,499,525	$819,079,757	$696,217,793	$11,107,649	$44,557,939	$55,665,587	$6.36	$4,742,708
2015	5.0%	$20.46	1,508,836	$807,972,108	$686,776,292	$11,107,649	$43,953,683	$55,061,331	$6.30	$4,691,225
2016	5.0%	$21.48	1,518,146	$796,864,460	$677,334,791	$11,107,649	$43,349,427	$54,457,075	$6.23	$4,639,743
2017	5.0%	$22.55	1,527,457	$785,756,811	$667,893,290	$11,107,649	$42,745,171	$53,852,819	$6.16	$4,588,260
2018	5.0%	$23.68	1,536,767	$774,649,163	$658,451,788	$11,107,649	$42,140,914	$53,248,563	$6.09	$4,536,778
2019	5.0%	$24.86	1,546,078	$763,541,514	$649,010,287	$11,107,649	$41,536,658	$52,644,307	$6.02	$4,485,295
2020	5.0%	$26.11	1,555,388	$752,433,865	$639,568,786	$11,107,649	$40,932,402	$52,040,051	$5.95	$4,433,812
2021	5.0%	$27.41	1,564,698	$741,326,217	$630,127,284	$11,107,649	$40,328,146	$51,435,795	$5.88	$4,382,330
2022	5.0%	$28.78	1,574,009	$730,218,568	$620,685,783	$11,107,649	$39,723,890	$50,831,539	$5.81	$4,330,847
2023	5.0%	$30.22	1,583,319	$719,110,920	$611,244,282	$11,107,649	$39,119,634	$50,227,283	$5.74	$4,279,364
2024	5.0%	$31.73	1,592,630	$708,003,271	$601,802,780	$11,107,649	$38,515,378	$49,623,027	$5.67	$4,227,882
2025	5.0%	$33.32	1,601,940	$696,895,622	$592,361,279	$11,107,649	$37,911,122	$49,018,770	$5.60	$4,176,399
2026	5.0%	$34.99	1,611,251	$685,787,974	$582,919,778	$11,107,649	$37,306,866	$48,414,514	$5.54	$4,124,917
2027	5.0%	$36.74	1,620,561	$674,680,325	$573,478,276	$11,107,649	$36,702,610	$47,810,258	$5.47	$4,073,434
2028	5.0%	$38.57	1,629,871	$663,572,677	$564,036,775	$11,107,649	$36,098,354	$47,206,002	$5.40	$4,021,951
2029	5.0%	$40.50	1,639,182	$652,465,028	$554,595,274	$11,107,649	$35,494,098	$46,601,746	$5.33	$3,970,469
2030	5.0%	$42.53	1,648,492	$641,357,379	$545,153,772	$11,107,649	$34,889,841	$45,997,490	$5.26	$3,918,986
2031	5.0%	$44.65	1,657,803	$630,249,731	$535,712,271	$11,107,649	$34,285,585	$45,393,234	$5.19	$3,867,504
2032	5.0%	$46.89	1,667,113	$619,142,082	$526,270,770	$11,107,649	$33,681,329	$44,788,978	$5.12	$3,816,021
2033	5.0%	$49.23	1,676,424	$608,034,434	$516,829,269	$11,107,649	$33,077,073	$44,184,722	$5.05	$3,764,538
2034	5.0%	$51.69	1,685,734	$596,926,785	$507,387,767	$11,107,649	$32,472,817	$43,580,466	$4.98	$3,713,056
2035	5.0%	$54.28	1,695,044	$585,819,136	$497,946,266	$11,107,649	$31,868,561	$42,976,210	$4.91	$3,661,573
2036	5.0%	$56.99	1,704,355	$574,711,488	$488,504,765	$11,107,649	$31,264,305	$42,371,954	$4.84	$3,610,090

	Macomb Loop										
		Suburban Wholesale Customers					Flint-GCDC	Flint-GCDC		Cost of Water	
	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Total Capital Recovery		($/MCF)	($)
2009								$5,000,121	$3.42	$16.49	$24,107,832
2010								$4,948,639	$3.38	$17.70	$25,883,789
2011								$4,897,156	$3.33	$18.79	$27,658,053
2012								$4,845,673	$3.27	$19.97	$29,582,301
2013								$4,794,191	$3.22	$21.26	$31,676,996
2014								$4,742,708	$3.16	$22.65	$33,956,765
2015								$4,691,225	$3.11	$23.57	$35,556,442
2016								$4,639,743	$3.06	$24.54	$37,248,200
2017								$4,588,260	$3.00	$25.56	$39,037,119
2018								$4,536,778	$2.95	$26.63	$40,928,557
2019								$4,485,295	$2.90	$27.77	$42,928,165
2020								$4,433,812	$2.85	$28.96	$45,041,903
2021								$4,382,330	$2.80	$30.21	$47,276,055
2022								$4,330,847	$2.75	$31.54	$49,637,251
2023	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$2,843,230	$7,122,595	$4.50	$34.72	$54,975,711
2024	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$2,813,955	$7,041,837	$4.42	$36.16	$57,583,071
2025	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$2,784,681	$6,961,080	$4.35	$37.67	$60,339,609
2026	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$2,755,406	$6,880,323	$4.27	$39.26	$63,253,525
2027	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$2,726,131	$6,799,565	$4.20	$40.93	$66,333,461
2028	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$2,696,857	$6,718,808	$4.12	$42.70	$69,588,534
2029	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$2,667,582	$6,638,051	$4.05	$44.55	$73,028,354
2030	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$2,638,307	$6,557,294	$3.98	$46.50	$76,663,059
2031	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$2,609,033	$6,476,536	$3.91	$48.56	$80,503,333
2032	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$2,579,758	$6,395,779	$3.84	$50.72	$84,560,447
2033	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$2,550,483	$6,315,022	$3.77	$53.00	$88,846,281
2034	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$2,521,209	$6,234,264	$3.70	$55.39	$93,373,362
2035	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$2,491,934	$6,153,507	$3.63	$57.91	$98,154,898
2036	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$2,462,659	$6,072,750	$3.56	$60.55	$103,204,817

Table 18-5 Option 1 GLCUA: No Change

Option 1 - GLCUA: No Change

Assumptions:

DWSD Capital Projects: (DWSD September 25, 2008)

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb (includes the following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

Const. Management Fee (assumed)		7.0%

DWSD Commodity Rates:

GLCUA Commodity Rate (2008-09)	$14.84	$/MCF
GLCUA Commodity Rate (2009-10)	$16.11	$/MCF

Capital Cost Recovery:

GLCUA share of Capital Cost Recovery	0.82%	
Revenue Requirement (initial year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System							Macomb Loop							GLCUA		Cost of Water	
					Suburban Wholesale Customers					GLCUA		Suburban Wholesale Customers					Flint-GCDC				
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Total Capital Recovery		($/MCF)	($)
2009		$14.84	73,195	$874,618,000	$743,425,300	$11,107,649	$47,579,219	$58,686,868	$6.71	$481,232								$481,232	$6.57	$21.41	$1,567,449
2010		$16.11	73,195	$863,510,351	$733,983,799	$11,107,649	$46,974,963	$58,082,612	$6.64	$476,277								$476,277	$6.51	$22.62	$1,655,452
2011	8.0%	$17.40	85,882	$852,402,703	$724,542,297	$11,107,649	$46,370,707	$57,478,356	$6.57	$471,323								$471,323	$5.49	$22.89	$1,965,572
2012	8.0%	$18.79	98,570	$841,295,054	$715,100,796	$11,107,649	$45,766,451	$56,874,100	$6.50	$466,368								$466,368	$4.73	$23.52	$2,318,558
2013	8.0%	$20.29	111,257	$830,187,406	$705,659,295	$11,107,649	$45,162,195	$56,269,843	$6.43	$461,413								$461,413	$4.15	$24.44	$2,719,251
2014	8.0%	$21.92	123,944	$819,079,757	$696,217,793	$11,107,649	$44,557,939	$55,665,587	$6.36	$456,458								$456,458	$3.68	$25.60	$3,172,994
2015	5.0%	$23.01	136,572	$807,972,108	$686,776,292	$11,107,649	$43,953,683	$55,061,331	$6.30	$451,503								$451,503	$3.31	$26.32	$3,594,493
2016	5.0%	$24.16	149,201	$796,864,460	$677,334,791	$11,107,649	$43,349,427	$54,457,075	$6.23	$446,548								$446,548	$2.99	$27.16	$4,051,845
2017	5.0%	$25.37	161,830	$785,756,811	$667,893,290	$11,107,649	$42,745,171	$53,852,819	$6.16	$441,593								$441,593	$2.73	$28.10	$4,547,571
2018	5.0%	$26.64	174,458	$774,649,163	$658,451,788	$11,107,649	$42,140,914	$53,248,563	$6.09	$436,638								$436,638	$2.50	$29.14	$5,084,352
2019	5.0%	$27.97	187,087	$763,541,514	$649,010,287	$11,107,649	$41,536,658	$52,644,307	$6.02	$431,683								$431,683	$2.31	$30.28	$5,665,041
2020	5.0%	$29.37	199,716	$752,433,865	$639,568,786	$11,107,649	$40,932,402	$52,040,051	$5.95	$426,728								$426,728	$2.14	$31.51	$6,292,676
2021	5.0%	$30.84	212,344	$741,326,217	$630,127,284	$11,107,649	$40,328,146	$51,435,795	$5.88	$421,774								$421,774	$1.99	$32.83	$6,970,486
2022	5.0%	$32.38	224,973	$730,218,568	$620,685,783	$11,107,649	$39,723,890	$50,831,539	$5.81	$416,819								$416,819	$1.85	$34.23	$7,701,907
2023	5.0%	$34.00	237,601	$719,110,920	$611,244,282	$11,107,649	$39,119,634	$50,227,283	$5.74	$411,864	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$273,644	$685,508	$2.89	$36.89	$8,764,239
2024	5.0%	$35.70	250,230	$708,003,271	$601,802,780	$11,107,649	$38,515,378	$49,623,027	$5.67	$406,909	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$270,827	$677,736	$2.71	$38.41	$9,611,260
2025	5.0%	$37.49	262,859	$696,895,622	$592,361,279	$11,107,649	$37,911,122	$49,018,770	$5.60	$401,954	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$268,009	$669,963	$2.55	$40.04	$10,523,564
2026	5.0%	$39.36	275,487	$685,787,974	$582,919,778	$11,107,649	$37,306,866	$48,414,514	$5.54	$396,999	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$265,192	$662,191	$2.40	$41.76	$11,505,542
2027	5.0%	$41.33	288,116	$674,680,325	$573,478,276	$11,107,649	$36,702,610	$47,810,258	$5.47	$392,044	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$262,374	$654,418	$2.27	$43.60	$12,561,861
2028	5.0%	$43.40	300,744	$663,572,677	$564,036,775	$11,107,649	$36,098,354	$47,206,002	$5.40	$387,089	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$259,557	$646,646	$2.15	$45.55	$13,697,480
2029	5.0%	$45.56	313,373	$652,465,028	$554,595,274	$11,107,649	$35,494,098	$46,601,746	$5.33	$382,134	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$256,739	$638,873	$2.04	$47.60	$14,917,670
2030	5.0%	$47.84	326,002	$641,357,379	$545,153,772	$11,107,649	$34,889,841	$45,997,490	$5.26	$377,179	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$253,922	$631,101	$1.94	$49.78	$16,228,030
2031	5.0%	$50.24	338,630	$630,249,731	$535,712,271	$11,107,649	$34,285,585	$45,393,234	$5.19	$372,225	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$251,104	$623,329	$1.84	$52.08	$17,634,505
2032	5.0%	$52.75	351,259	$619,142,082	$526,270,770	$11,107,649	$33,681,329	$44,788,978	$5.12	$367,270	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$248,287	$615,556	$1.75	$54.50	$19,143,413
2033	5.0%	$55.38	363,887	$608,034,434	$516,829,269	$11,107,649	$33,077,073	$44,184,722	$5.05	$362,315	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$245,469	$607,784	$1.67	$57.05	$20,761,461
2034	5.0%	$58.15	376,516	$596,926,785	$507,387,767	$11,107,649	$32,472,817	$43,580,466	$4.98	$357,360	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$242,652	$600,011	$1.59	$59.75	$22,495,772
2035	5.0%	$61.06	389,145	$585,819,136	$497,946,266	$11,107,649	$31,868,561	$42,976,210	$4.91	$352,405	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$239,834	$592,239	$1.52	$62.58	$24,353,906
2036	5.0%	$64.11	401,773	$574,711,488	$488,504,765	$11,107,649	$31,264,305	$42,371,954	$4.84	$347,450	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$237,017	$584,467	$1.45	$65.57	$26,343,892

Table 18-6 Option 2 - Flint & GCDC-WWS: 30 Year Contract, Rates Based on 5% Growth Over 2008

Option 2 - Flint & GCDC-WWS: 30 Year Contract, Rates Based on 5% Growth Over 2008

Assumptions:

DWSD Capital Projects: (DWSD September 25, 2008)

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb (includes the following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

Const. Management Fee (assumed)	7.0%

DWSD Commodity Rates:

Flint & GCDC-WWS Commodity Rate (2008-09)	$13.07	$/MCF
Flint & GCDC-WWS Commodity Rate (2009-10)	$12.71	$/MCF

Capital Cost Recovery:

Flint & GCDC share of Capital Cost Recovery	7.69%	
Revenue Requirement (Initial Year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System						
					Suburban Wholesale Customers					Flint-GCDC
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009		$13.07	1,461,952	$874,618,000	$743,425,300	$11,107,649	$47,579,219	$58,686,868	$6.71	$4,513,020
2010		$12.71	1,461,952	$863,510,351	$733,983,799	$11,107,649	$46,974,963	$58,082,612	$6.64	$4,466,553
2011	8.0%	$13.73	1,471,711	$852,402,703	$724,542,297	$11,107,649	$46,370,707	$57,478,356	$6.57	$4,420,086
2012	8.0%	$14.82	1,480,983	$841,295,054	$715,100,796	$11,107,649	$45,766,451	$56,874,100	$6.50	$4,373,618
2013	8.0%	$16.01	1,490,254	$830,187,406	$705,659,295	$11,107,649	$45,162,195	$56,269,843	$6.43	$4,327,151
2014	8.0%	$17.29	1,499,525	$819,079,757	$696,217,793	$11,107,649	$44,557,939	$55,665,587	$6.36	$4,280,684
2015	5.0%	$18.16	1,508,836	$807,972,108	$686,776,292	$11,107,649	$43,953,683	$55,061,331	$6.30	$4,234,216
2016	5.0%	$19.06	1,518,146	$796,864,460	$677,334,791	$11,107,649	$43,349,427	$54,457,075	$6.23	$4,187,749
2017	5.0%	$20.02	1,527,457	$785,756,811	$667,893,290	$11,107,649	$42,745,171	$53,852,819	$6.16	$4,141,282
2018	5.0%	$21.02	1,536,767	$774,649,163	$658,451,788	$11,107,649	$42,140,914	$53,248,563	$6.09	$4,094,814
2019	5.0%	$22.07	1,546,078	$763,541,514	$649,010,287	$11,107,649	$41,536,658	$52,644,307	$6.02	$4,048,347
2020	5.0%	$23.17	1,555,388	$752,433,865	$639,568,786	$11,107,649	$40,932,402	$52,040,051	$5.95	$4,001,880
2021	5.0%	$24.33	1,564,698	$741,326,217	$630,127,284	$11,107,649	$40,328,146	$51,435,795	$5.88	$3,955,413
2022	5.0%	$25.55	1,574,009	$730,218,568	$620,685,783	$11,107,649	$39,723,890	$50,831,539	$5.81	$3,908,945
2023	5.0%	$26.83	1,583,319	$719,110,920	$611,244,282	$11,107,649	$39,119,634	$50,227,283	$5.74	$3,862,478
2024	5.0%	$28.17	1,592,630	$708,003,271	$601,802,780	$11,107,649	$38,515,378	$49,623,027	$5.67	$3,816,011
2025	5.0%	$29.57	1,601,940	$696,895,622	$592,361,279	$11,107,649	$37,911,122	$49,018,770	$5.60	$3,769,543
2026	5.0%	$31.05	1,611,251	$685,787,974	$582,919,778	$11,107,649	$37,306,866	$48,414,514	$5.54	$3,723,076
2027	5.0%	$32.61	1,620,561	$674,680,325	$573,478,276	$11,107,649	$36,702,610	$47,810,258	$5.47	$3,676,609
2028	5.0%	$34.24	1,629,871	$663,572,677	$564,036,775	$11,107,649	$36,098,354	$47,206,002	$5.40	$3,630,142
2029	5.0%	$35.95	1,639,182	$652,465,028	$554,595,274	$11,107,649	$35,494,098	$46,601,746	$5.33	$3,583,674
2030	5.0%	$37.75	1,648,492	$641,357,379	$545,153,772	$11,107,649	$34,889,841	$45,997,490	$5.26	$3,537,207
2031	5.0%	$39.63	1,657,803	$630,249,731	$535,712,271	$11,107,649	$34,285,585	$45,393,234	$5.19	$3,490,740
2032	5.0%	$41.61	1,667,113	$619,142,082	$526,270,770	$11,107,649	$33,681,329	$44,788,978	$5.12	$3,444,272
2033	5.0%	$43.70	1,676,424	$608,034,434	$516,829,269	$11,107,649	$33,077,073	$44,184,722	$5.05	$3,397,805
2034	5.0%	$45.88	1,685,734	$596,926,785	$507,387,767	$11,107,649	$32,472,817	$43,580,466	$4.98	$3,351,338
2035	5.0%	$48.17	1,695,044	$585,819,136	$497,946,266	$11,107,649	$31,868,561	$42,976,210	$4.91	$3,304,871
2036	5.0%	$50.58	1,704,355	$574,711,488	$488,504,765	$11,107,649	$31,264,305	$42,371,954	$4.84	$3,258,403

	Macomb Loop							Flint-GCDC		Cost of Water	
		Suburban Wholesale Customers					Flint-GCDC				
	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Total Capital Recovery		($/MCF)	($)
2009								$4,513,020	$3.09	$16.16	$23,620,731
2010								$4,466,553	$3.06	$15.77	$23,047,961
2011								$4,420,086	$3.00	$16.73	$24,621,971
2012								$4,373,618	$2.95	$17.78	$26,329,103
2013								$4,327,151	$2.90	$18.91	$28,187,518
2014								$4,280,684	$2.85	$20.15	$30,210,199
2015								$4,234,216	$2.81	$20.96	$31,629,251
2016								$4,187,749	$2.76	$21.82	$33,130,032
2017								$4,141,282	$2.71	$22.73	$34,717,050
2018								$4,094,814	$2.66	$23.68	$36,395,060
2019								$4,048,347	$2.62	$24.69	$38,169,079
2020								$4,001,880	$2.57	$25.75	$40,044,396
2021								$3,955,413	$2.53	$26.86	$42,026,590
2022								$3,908,945	$2.48	$28.03	$44,121,543
2023	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$2,566,249	$6,428,727	$4.06	$30.89	$48,901,709
2024	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$2,539,826	$6,355,837	$3.99	$32.16	$51,214,711
2025	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$2,513,403	$6,282,947	$3.92	$33.50	$53,660,119
2026	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$2,486,980	$6,210,057	$3.85	$34.91	$56,245,210
2027	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$2,460,558	$6,137,166	$3.79	$36.39	$58,977,656
2028	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$2,434,135	$6,064,276	$3.72	$37.96	$61,865,548
2029	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$2,407,712	$5,991,386	$3.66	$39.60	$64,917,417
2030	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$2,381,289	$5,918,496	$3.59	$41.34	$68,142,258
2031	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$2,354,866	$5,845,606	$3.53	$43.16	$71,549,558
2032	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$2,328,444	$5,772,716	$3.46	$45.08	$75,149,317
2033	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$2,302,021	$5,699,826	$3.40	$47.10	$78,952,082
2034	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$2,275,598	$5,626,936	$3.34	$49.22	$82,968,970
2035	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$2,249,175	$5,554,046	$3.28	$51.45	$87,211,705
2036	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$2,222,752	$5,481,156	$3.22	$53.80	$91,692,648

Table 18-7 Option 2 - GLCUA: 30 Year Contract Based on 5% Growth Over 2008

Option 2 - GLCUA: 30 Year Contract Based on 5% Growth Over 2008

Assumptions:

DWSD Capital Projects: (DWSD September 25, 2008)

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

Const. Management Fee (assumed)	7.0%

DWSD Commodity Rates:

GLCUA Commodity Rate (2008-09)	$14.84	$/MCF
GLCUA Commodity Rate (2009-10)	$14.16	$/MCF

Capital Cost Recovery:

GLCUA share of Capital Cost Recovery	0.73%	
Revenue Requirement (initial year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System						
					Suburban Wholesale Customers					GLCUA
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009		$14.84	73,195	$874,618,000	$743,425,300	$11,107,649	$47,579,219	$58,686,868	$6.71	$428,414
2010		$14.16	73,195	$863,510,351	$733,983,799	$11,107,649	$46,974,963	$58,082,612	$6.64	$424,003
2011	8.0%	$15.29	85,882	$852,402,703	$724,542,297	$11,107,649	$46,370,707	$57,478,356	$6.57	$419,592
2012	8.0%	$16.52	98,570	$841,295,054	$715,100,796	$11,107,649	$45,766,451	$56,874,100	$6.50	$415,181
2013	8.0%	$17.84	111,257	$830,187,406	$705,659,295	$11,107,649	$45,162,195	$56,269,843	$6.43	$410,770
2014	8.0%	$19.26	123,944	$819,079,757	$696,217,793	$11,107,649	$44,557,939	$55,665,587	$6.36	$406,359
2015	5.0%	$20.23	136,572	$807,972,108	$686,776,292	$11,107,649	$43,953,683	$55,061,331	$6.30	$401,948
2016	5.0%	$21.24	149,201	$796,864,460	$677,334,791	$11,107,649	$43,349,427	$54,457,075	$6.23	$397,537
2017	5.0%	$22.30	161,830	$785,756,811	$667,893,290	$11,107,649	$42,745,171	$53,852,819	$6.16	$393,126
2018	5.0%	$23.42	174,458	$774,649,163	$658,451,788	$11,107,649	$42,140,914	$53,248,563	$6.09	$388,715
2019	5.0%	$24.59	187,087	$763,541,514	$649,010,287	$11,107,649	$41,536,658	$52,644,307	$6.02	$384,303
2020	5.0%	$25.82	199,716	$752,433,865	$639,568,786	$11,107,649	$40,932,402	$52,040,051	$5.95	$379,892
2021	5.0%	$27.11	212,344	$741,326,217	$630,127,284	$11,107,649	$40,328,146	$51,435,795	$5.88	$375,481
2022	5.0%	$28.46	224,973	$730,218,568	$620,685,783	$11,107,649	$39,723,890	$50,831,539	$5.81	$371,070
2023	5.0%	$29.89	237,601	$719,110,920	$611,244,282	$11,107,649	$39,119,634	$50,227,283	$5.74	$366,659
2024	5.0%	$31.38	250,230	$708,003,271	$601,802,780	$11,107,649	$38,515,378	$49,623,027	$5.67	$362,248
2025	5.0%	$32.95	262,859	$696,895,622	$592,361,279	$11,107,649	$37,911,122	$49,018,770	$5.60	$357,837
2026	5.0%	$34.60	275,487	$685,787,974	$582,919,778	$11,107,649	$37,306,866	$48,414,514	$5.54	$353,426
2027	5.0%	$36.33	288,116	$674,680,325	$573,478,276	$11,107,649	$36,702,610	$47,810,258	$5.47	$349,015
2028	5.0%	$38.14	300,744	$663,572,677	$564,036,775	$11,107,649	$36,098,354	$47,206,002	$5.40	$344,604
2029	5.0%	$40.05	313,373	$652,465,028	$554,595,274	$11,107,649	$35,494,098	$46,601,746	$5.33	$340,193
2030	5.0%	$42.05	326,002	$641,357,379	$545,153,772	$11,107,649	$34,889,841	$45,997,490	$5.26	$335,782
2031	5.0%	$44.15	338,630	$630,249,731	$535,712,271	$11,107,649	$34,285,585	$45,393,234	$5.19	$331,371
2032	5.0%	$46.36	351,259	$619,142,082	$526,270,770	$11,107,649	$33,681,329	$44,788,978	$5.12	$326,960
2033	5.0%	$48.68	363,887	$608,034,434	$516,829,269	$11,107,649	$33,077,073	$44,184,722	$5.05	$322,548
2034	5.0%	$51.11	376,516	$596,926,785	$507,387,767	$11,107,649	$32,472,817	$43,580,466	$4.98	$318,137
2035	5.0%	$53.67	389,145	$585,819,136	$497,946,266	$11,107,649	$31,868,561	$42,976,210	$4.91	$313,726
2036	5.0%	$56.35	401,773	$574,711,488	$488,504,765	$11,107,649	$31,264,305	$42,371,954	$4.84	$309,315

	Macomb Loop							GLCUA		Cost of Water	
		Suburban Wholesale Customers					Flint-GCDC				
	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Total Capital Recovery		($/MCF)	($)
2009								$428,414	$5.85	$20.69	$1,514,631
2010								$424,003	$5.79	$19.95	$1,460,447
2011								$419,592	$4.89	$20.18	$1,732,974
2012								$415,181	$4.21	$20.73	$2,043,177
2013								$410,770	$3.69	$21.53	$2,395,313
2014								$406,359	$3.28	$22.54	$2,794,078
2015								$401,948	$2.94	$23.17	$3,164,501
2016								$397,537	$2.66	$23.90	$3,566,439
2017								$393,126	$2.43	$24.73	$4,002,105
2018								$388,715	$2.23	$25.64	$4,473,856
2019								$384,303	$2.05	$26.64	$4,984,201
2020								$379,892	$1.90	$27.72	$5,535,809
2021								$375,481	$1.77	$28.88	$6,131,519
2022								$371,070	$1.65	$30.11	$6,774,351
2023	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$243,610	$610,269	$2.57	$32.45	$7,711,128
2024	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$241,102	$603,350	$2.41	$33.79	$8,455,535
2025	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$238,594	$596,431	$2.27	$35.22	$9,257,324
2026	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$236,085	$589,511	$2.14	$36.74	$10,120,352
2027	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$233,577	$582,592	$2.02	$38.35	$11,048,724
2028	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$231,069	$575,673	$1.91	$40.06	$12,046,797
2029	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$228,560	$568,753	$1.81	$41.86	$13,119,204
2030	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$226,052	$561,834	$1.72	$43.78	$14,270,866
2031	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$223,544	$554,914	$1.64	$45.79	$15,507,010
2032	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$221,036	$547,995	$1.56	$47.92	$16,833,188
2033	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$218,527	$541,076	$1.49	$50.17	$18,255,295
2034	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$216,019	$534,156	$1.42	$52.53	$19,779,592
2035	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$213,511	$527,237	$1.35	$55.03	$21,412,725
2036	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$211,003	$520,318	$1.30	$57.65	$23,161,749

18.4.3 Option 3 – Master Agreement (Future Demands)

This scenario is based on the assumption that Flint, GCDC-WWS, and GLCUA execute the new master agreement with DWSD for water supply. It is assumed that the agreement establishes the future demands from Appendix 1 for establishing water rates.

Table 18-9 shows the 2009-10 rates, key variables used in the DWSD rate model, and the required rate of capital recovery used to determine the cost of water for this option.

Table 18-8 Factors Used to Determine Cost of Water for Option 3

	2009-10 Rate ($/MCF)	Distance Factor	Distance-Elevation Factor	% Peak Hour Distance	Capital Recovery Requirement ($ / $100M)	Projected 2036 Rate ($ / MCF)
Flint & GCDC-WWS	$14.13	52.0	76.2	9.91%	$665,000	$60.38
GLCUA	$14.50	47.3	70.1	2.58%	$173,118	$62.28

Table 18-10 shows the projected cost of water for Flint and GCDC-WWS and Table 18-11 shows the projected cost of water for GLCUA.

18.4.4 Option 4 – Master Agreement (Capital Contribution)

DWSD officials have indicated that Flint, GCDC-WWS, and GLCUA could realize reduced rates through a partnering arrangement. In this scenario, Flint, GCDC-WWS, and GLCUA would execute the new master agreement and would be responsible for the construction and operation of a portion of the transmission facilities upgrades planned by DWSD. Under this option, the distance and elevation factors used for establishing rates can be reduced. However, the cost for constructing and operating a portion of the proposed DWSD facilities must be added to the purchase price of water to determine the total cost of water.

Specific details of such a partnering arrangement have not be discussed in detail or agreed upon. To evaluate this option, it is assumed that Flint, GCDC-WWS, and GLCUA construct and operate that portion of the planned Flint Loop Transmission System (FTS) which are located in Genesee County. Table 18-12 summarizes the FTS facilities planned for Genesee County.

Table 18-12 Flint Loop Transmission System Facilities Planned Within Genesee County

Facilities	Cost
North Transmission CM-2018	$266,000,000*
30 Inch Main CM-2019	$9,500,000*
Grand Blanc Pumping Station	$48,000,000*
Subtotal	$323,500,000
Construction Management (7%)	$22,645,000
Total Project Cost	$346,145,000

*Source: December 2008 DWSD Summary of Construction Cost, Flint Transmission System CS-1486

The proposed facilities to be constructed by Flint, GCDC-WWS, and GLCUA include the Grand Blanc Pumping Station. It is assumed that Flint, GCDC-WWS, and GLCUA will be responsible for the ongoing operation and maintenance of the pumping station. For this analysis, an average pumping rate of 25 mgd is assumed throughout the study period.

Table 18-9 Option 3 - Flint & GCDC-WWS: 30 Year Contract Based on KWA Demands

Option 3 - Flint & GCDC-WWS: 30 Year Contract Based on KWA Demands

Assumptions:

DWSD Capital Projects: (DWSD September 25, 2008)

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb (includes the following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

Const. Management Fee (assumed)	7.0%	

DWSD Commodity Rates:

Flint & GCDC-WWS Commodity Rate (2008-09)	$13.07	$/MCF
Flint & GCDC-WWS Commodity Rate (2009-10)	$14.13	$/MCF

Capital Cost Recovery:

Flint & GCDC share of Capital Cost Recovery	9.91%	
Revenue Requirement (initial year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System							Macomb Loop							Flint-GCDC		Cost of Water	
					Suburban Wholesale Customers					Flint-GCDC		Suburban Wholesale Customers					Flint-GCDC				
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Total Capital Recovery		($/MCF)	($)
2009		$13.07	1,461,952	$874,618,000	$743,425,300	$11,107,649	$47,579,219	$58,686,868	$6.71	$5,815,869								$5,815,869	$3.98	$17.05	$24,923,580
2010		$14.13	1,461,952	$863,510,351	$733,983,799	$11,107,649	$46,974,963	$58,082,612	$6.64	$5,755,987								$5,755,987	$3.94	$18.07	$26,413,367
2011	8.0%	$15.26	1,471,711	$852,402,703	$724,542,297	$11,107,649	$46,370,707	$57,478,356	$6.57	$5,696,105								$5,696,105	$3.87	$19.13	$28,155,007
2012	8.0%	$16.48	1,480,983	$841,295,054	$715,100,796	$11,107,649	$45,766,451	$56,874,100	$6.50	$5,636,223								$5,636,223	$3.81	$20.29	$30,044,641
2013	8.0%	$17.80	1,490,254	$830,187,406	$705,659,295	$11,107,649	$45,162,195	$56,269,843	$6.43	$5,576,341								$5,576,341	$3.74	$21.54	$32,102,461
2014	8.0%	$19.22	1,499,525	$819,079,757	$696,217,793	$11,107,649	$44,557,939	$55,665,587	$6.36	$5,516,460								$5,516,460	$3.68	$22.90	$34,342,900
2015	5.0%	$20.18	1,508,836	$807,972,108	$686,776,292	$11,107,649	$43,953,683	$55,061,331	$6.30	$5,456,578								$5,456,578	$3.62	$23.80	$35,912,270
2016	5.0%	$21.19	1,518,146	$796,864,460	$677,334,791	$11,107,649	$43,349,427	$54,457,075	$6.23	$5,396,696								$5,396,696	$3.55	$24.75	$37,572,499
2017	5.0%	$22.25	1,527,457	$785,756,811	$667,893,290	$11,107,649	$42,745,171	$53,852,819	$6.16	$5,336,814								$5,336,814	$3.49	$25.75	$39,328,600
2018	5.0%	$23.37	1,536,767	$774,649,163	$658,451,788	$11,107,649	$42,140,914	$53,248,563	$6.09	$5,276,933								$5,276,933	$3.43	$26.80	$41,185,860
2019	5.0%	$24.53	1,546,078	$763,541,514	$649,010,287	$11,107,649	$41,536,658	$52,644,307	$6.02	$5,217,051								$5,217,051	$3.37	$27.91	$43,149,855
2020	5.0%	$25.76	1,555,388	$752,433,865	$639,568,786	$11,107,649	$40,932,402	$52,040,051	$5.95	$5,157,169								$5,157,169	$3.32	$29.08	$45,226,465
2021	5.0%	$27.05	1,564,698	$741,326,217	$630,127,284	$11,107,649	$40,328,146	$51,435,795	$5.88	$5,097,287								$5,097,287	$3.26	$30.31	$47,421,892
2022	5.0%	$28.40	1,574,009	$730,218,568	$620,685,783	$11,107,649	$39,723,890	$50,831,539	$5.81	$5,037,405								$5,037,405	$3.20	$31.60	$49,742,677
2023	5.0%	$29.82	1,583,319	$719,110,920	$611,244,282	$11,107,649	$39,119,634	$50,227,283	$5.74	$4,977,524	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$3,307,090	$8,284,614	$5.23	$35.05	$55,502,808
2024	5.0%	$31.31	1,592,630	$708,003,271	$601,802,780	$11,107,649	$38,515,378	$49,623,027	$5.67	$4,917,642	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$3,273,040	$8,190,682	$5.14	$36.46	$58,061,326
2025	5.0%	$32.88	1,601,940	$696,895,622	$592,361,279	$11,107,649	$37,911,122	$49,018,770	$5.60	$4,857,760	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$3,238,989	$8,096,749	$5.05	$37.93	$60,767,044
2026	5.0%	$34.52	1,611,251	$685,787,974	$582,919,778	$11,107,649	$37,306,866	$48,414,514	$5.54	$4,797,878	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$3,204,938	$8,002,817	$4.97	$39.49	$63,628,050
2027	5.0%	$36.25	1,620,561	$674,680,325	$573,478,276	$11,107,649	$36,702,610	$47,810,258	$5.47	$4,737,997	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$3,170,888	$7,908,884	$4.88	$41.13	$66,652,875
2028	5.0%	$38.06	1,629,871	$663,572,677	$564,036,775	$11,107,649	$36,098,354	$47,206,002	$5.40	$4,678,115	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$3,136,837	$7,814,952	$4.79	$42.86	$69,850,512
2029	5.0%	$39.96	1,639,182	$652,465,028	$554,595,274	$11,107,649	$35,494,098	$46,601,746	$5.33	$4,618,233	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$3,102,786	$7,721,019	$4.71	$44.67	$73,230,446
2030	5.0%	$41.96	1,648,492	$641,357,379	$545,153,772	$11,107,649	$34,889,841	$45,997,490	$5.26	$4,558,351	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$3,068,735	$7,627,087	$4.63	$46.59	$76,802,678
2031	5.0%	$44.06	1,657,803	$630,249,731	$535,712,271	$11,107,649	$34,285,585	$45,393,234	$5.19	$4,498,469	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$3,034,685	$7,533,154	$4.54	$48.61	$80,577,752
2032	5.0%	$46.26	1,667,113	$619,142,082	$526,270,770	$11,107,649	$33,681,329	$44,788,978	$5.12	$4,438,588	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$3,000,634	$7,439,222	$4.46	$50.73	$84,566,789
2033	5.0%	$48.58	1,676,424	$608,034,434	$516,829,269	$11,107,649	$33,077,073	$44,184,722	$5.05	$4,378,706	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$2,966,583	$7,345,289	$4.38	$52.96	$88,781,511
2034	5.0%	$51.01	1,685,734	$596,926,785	$507,387,767	$11,107,649	$32,472,817	$43,580,466	$4.98	$4,318,824	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$2,932,533	$7,251,357	$4.30	$55.31	$93,234,279
2035	5.0%	$53.56	1,695,044	$585,819,136	$497,946,266	$11,107,649	$31,868,561	$42,976,210	$4.91	$4,258,942	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$2,898,482	$7,157,424	$4.22	$57.78	$97,938,127
2036	5.0%	$56.23	1,704,355	$574,711,488	$488,504,765	$11,107,649	$31,264,305	$42,371,954	$4.84	$4,199,061	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$2,864,431	$7,063,492	$4.14	$60.38	$102,906,795

Table 18-10 Option 3 - GLCUA: 30 Year Contract, Rates Based on KWA Demands

Option 3 - GLCUA: 30 Year Contract, Rates Based on KWA Demands

Assumptions:

DWSD Capital Projects: (DWSD September 25, 2008)

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$572,200,000	2009
NOTS	$245,200,000	2009
Macomb (includes the following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	
Const. Management Fee (assumed)		7.0%

DWSD Commodity Rates:

GLCUA Commodity Rate (2008-09)	$14.84	$/MCF
GLCUA Commodity Rate (2009-10)	$14.50	$/MCF

Capital Cost Recovery:

GLCUA share of Capital Cost Recovery	2.58%	
Revenue Requirement (initial year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System						
					Suburban Wholesale Customers					GLCUA
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009		$14.84	73,195	$874,618,000	$743,425,300	$11,107,649	$47,579,219	$58,686,868	$6.71	$1,514,121
2010		$14.50	73,195	$863,510,351	$733,983,799	$11,107,649	$46,974,963	$58,082,612	$6.64	$1,498,531
2011	8.0%	$15.66	85,882	$852,402,703	$724,542,297	$11,107,649	$46,370,707	$57,478,356	$6.57	$1,482,942
2012	8.0%	$16.91	98,570	$841,295,054	$715,100,796	$11,107,649	$45,766,451	$56,874,100	$6.50	$1,467,352
2013	8.0%	$18.27	111,257	$830,187,406	$705,659,295	$11,107,649	$45,162,195	$56,269,843	$6.43	$1,451,762
2014	8.0%	$19.73	123,944	$819,079,757	$696,217,793	$11,107,649	$44,557,939	$55,665,587	$6.36	$1,436,172
2015	5.0%	$20.71	136,572	$807,972,108	$686,776,292	$11,107,649	$43,953,683	$55,061,331	$6.30	$1,420,582
2016	5.0%	$21.75	149,201	$796,864,460	$677,334,791	$11,107,649	$43,349,427	$54,457,075	$6.23	$1,404,993
2017	5.0%	$22.84	161,830	$785,756,811	$667,893,290	$11,107,649	$42,745,171	$53,852,819	$6.16	$1,389,403
2018	5.0%	$23.98	174,458	$774,649,163	$658,451,788	$11,107,649	$42,140,914	$53,248,563	$6.09	$1,373,813
2019	5.0%	$25.18	187,087	$763,541,514	$649,010,287	$11,107,649	$41,536,658	$52,644,307	$6.02	$1,358,223
2020	5.0%	$26.44	199,716	$752,433,865	$639,568,786	$11,107,649	$40,932,402	$52,040,051	$5.95	$1,342,633
2021	5.0%	$27.76	212,344	$741,326,217	$630,127,284	$11,107,649	$40,328,146	$51,435,795	$5.88	$1,327,044
2022	5.0%	$29.15	224,973	$730,218,568	$620,685,783	$11,107,649	$39,723,890	$50,831,539	$5.81	$1,311,454
2023	5.0%	$30.60	237,601	$719,110,920	$611,244,282	$11,107,649	$39,119,634	$50,227,283	$5.74	$1,295,864
2024	5.0%	$32.13	250,230	$708,003,271	$601,802,780	$11,107,649	$38,515,378	$49,623,027	$5.67	$1,280,274
2025	5.0%	$33.74	262,859	$696,895,622	$592,361,279	$11,107,649	$37,911,122	$49,018,770	$5.60	$1,264,684
2026	5.0%	$35.43	275,487	$685,787,974	$582,919,778	$11,107,649	$37,306,866	$48,414,514	$5.54	$1,249,094
2027	5.0%	$37.20	288,116	$674,680,325	$573,478,276	$11,107,649	$36,702,610	$47,810,258	$5.47	$1,233,505
2028	5.0%	$39.06	300,744	$663,572,677	$564,036,775	$11,107,649	$36,098,354	$47,206,002	$5.40	$1,217,915
2029	5.0%	$41.01	313,373	$652,465,028	$554,595,274	$11,107,649	$35,494,098	$46,601,746	$5.33	$1,202,325
2030	5.0%	$43.06	326,002	$641,357,379	$545,153,772	$11,107,649	$34,889,841	$45,997,490	$5.26	$1,186,735
2031	5.0%	$45.21	338,630	$630,249,731	$535,712,271	$11,107,649	$34,285,585	$45,393,234	$5.19	$1,171,145
2032	5.0%	$47.48	351,259	$619,142,082	$526,270,770	$11,107,649	$33,681,329	$44,788,978	$5.12	$1,155,556
2033	5.0%	$49.85	363,887	$608,034,434	$516,829,269	$11,107,649	$33,077,073	$44,184,722	$5.05	$1,139,966
2034	5.0%	$52.34	376,516	$596,926,785	$507,387,767	$11,107,649	$32,472,817	$43,580,466	$4.98	$1,124,376
2035	5.0%	$54.96	389,145	$585,819,136	$497,946,266	$11,107,649	$31,868,561	$42,976,210	$4.91	$1,108,786
2036	5.0%	$57.71	401,773	$574,711,488	$488,504,765	$11,107,649	$31,264,305	$42,371,954	$4.84	$1,093,196

	Macomb Loop										
		Suburban Wholesale Customers					Flint-GCDC	GLCUA		Cost of Water	
	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement	Total Capital Recovery		($/MCF)	($)
2009								$1,514,121	$20.69	$35.53	$2,600,338
2010								$1,498,531	$20.47	$34.97	$2,559,862
2011								$1,482,942	$17.27	$32.93	$2,827,859
2012								$1,467,352	$14.89	$31.80	$3,134,438
2013								$1,451,762	$13.05	$31.31	$3,483,957
2014								$1,436,172	$11.59	$31.31	$3,881,224
2015								$1,420,582	$10.40	$31.12	$4,249,468
2016								$1,404,993	$9.42	$31.17	$4,649,984
2017								$1,389,403	$8.59	$31.42	$5,085,038
2018								$1,373,813	$7.87	$31.85	$5,557,044
2019								$1,358,223	$7.26	$32.44	$6,068,570
2020								$1,342,633	$6.72	$33.16	$6,622,350
2021								$1,327,044	$6.25	$34.01	$7,221,291
2022								$1,311,454	$5.83	$34.98	$7,868,485
2023	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$860,978	$2,156,842	$9.08	$39.68	$9,428,201
2024	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$852,113	$2,132,387	$8.52	$40.66	$10,173,114
2025	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$843,248	$2,107,933	$8.02	$41.76	$10,976,785
2026	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$834,384	$2,083,478	$7.56	$42.99	$11,843,167
2027	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$825,519	$2,059,023	$7.15	$44.34	$12,776,461
2028	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$816,654	$2,034,569	$6.77	$45.82	$13,781,130
2029	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$807,789	$2,010,114	$6.41	$47.43	$14,861,918
2030	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$798,924	$1,985,659	$6.09	$49.15	$16,023,863
2031	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$790,059	$1,961,205	$5.79	$51.01	$17,272,319
2032	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$781,194	$1,936,750	$5.51	$52.99	$18,612,971
2033	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$772,329	$1,912,295	$5.26	$55.10	$20,051,856
2034	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$763,465	$1,887,841	$5.01	$57.36	$21,595,384
2035	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$754,600	$1,863,386	$4.79	$59.75	$23,250,361
2036	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$745,735	$1,838,931	$4.58	$62.28	$25,024,013

Table 18-13 shows the 2009-10 rates, key variables used in the DWSD rate model, and the required rate of capital recovery used to determine the cost of water for this option.

Table 18-11 Factors Used to Determine Cost of Water for Option 4

	2009-10 Rate ($/MCF)	Distance Factor	Distance-Elevation Factor	% Peak Hour Distance	Capital Recovery Requirement ($ / $100M)	Projected 2036 Rate ($ / MCF)
Flint & GCDC-WWS	$8.06	22.8	31.1	4.45%	$299,000	$44.67
GLCUA	$8.61	22.8	31.1	1.29%	$87,000	$46.02

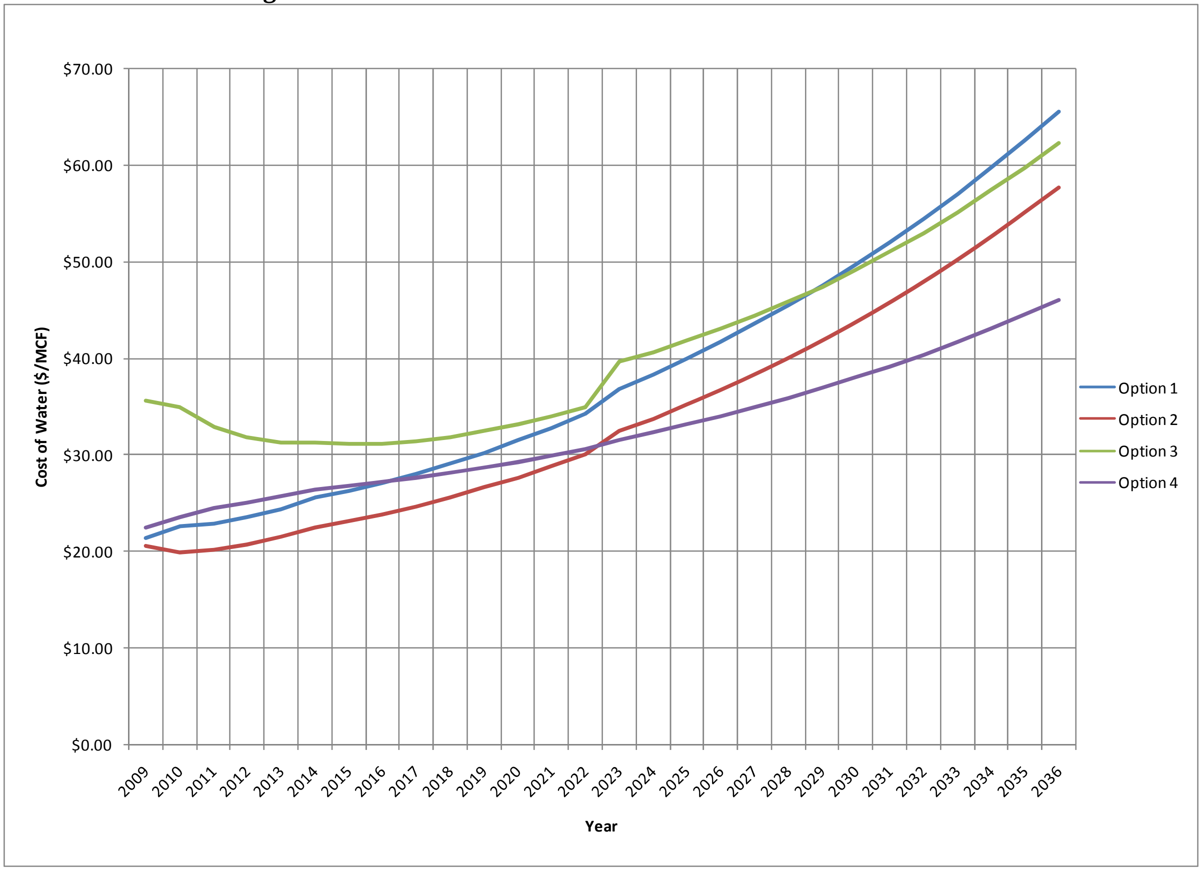
Table 18-14 shows the projected cost of water for Flint and GCDC-WWS and Table 18-15 shows the projected cost of water for GLCUA.

18.5 Summary

The cost of water for the four options considered is shown graphically in Figures 18-1 and 18-2.

Figure 18-1: Flint & GCDC-WWS Remain DWSD Customers-Cost of Water

Figure 18-2: GLCUA Remain DWSD Customers-Cost of Water



18.6 Comparison of Options

The four options considered are variations of concepts for DWSD continuing to supply water to Flint, GCDC-WWS, and GLCUA. The specific details of any particular option for continuing the DWSD supply have not been worked out; the analyses completed are based on certain assumptions to provide a general understanding of the likely cost of water from DWSD. Volatility of assumptions regarding utility costs, construction costs, inflation, and other economic variables will occur and cannot be predicted with accuracy. However, costs for all options considered (including the alternative of a new Lake Huron water supply) should be affected similarly. Although costs may vary, it is expected that the relative difference between the options and alternatives studied will be consistent.

In comparing the four options for continuing supply by DWSD, Option 2 and Option 3 appear to establish the range of the future cost of water. Option 2 results in the lower rate since it is based on the assumption that there is only a 5% increase in demands over the next 25 years. Option 3 is based on the assumption that demands increase about 16% over the next 25 years.

Over the 25 year planning period, the cost of water for Option 4 will almost be equal to that of Option 2, when averaged over the period. Initially, Option 4 will have a higher cost. Beyond the 25 year planning period, greater savings will be realized with Option 4 than the Options 1 through 3.

Because Option 4 has a slightly less cost than other options over the 25 year planning period and beyond, it will be compared with the alternative of constructing a new Lake Huron water supply in Section 8 of the Preliminary Engineering Report.

Table 18-12 Option 4 - Flint & GCDC-WWS Build and Operate FTS

Option 4 - Flint & GCDC-WWS, Build and Operate FTS

Assumptions:

Flint-GCDC Capital Projects

Flint Loop Transmission System

Facilities	Cost[1]
North Transmsission CM-2018	$266,000,000
30 Inch Main CM-2019	$9,500,000
Grand Blanc Pumping Station	$48,000,000
Subtotal	$323,500,000
Construction Management	$22,645,000
Total Project Cost	$346,145,000
Term	30
Interest Rate	5.00%
Debt Service	$22,517,229

[1]DWSD costs from following sources:
FTS - DWSD December 2008
NOTS & Macomb - DWSD September 25, 2008

Operating & Maintenance Costs of Grand Blanc Pumping Station

	Flow (mgd)	TDH (feet)
2010 Normal Delivery Rate	25	280

assumed efficiency	0.70
assumed $/kWh	$0.063
assumed rate of inflation	3.00%
kWh/1,000gal	1.26
kWh/yr	11,497,500
annual pumping cost	$724,343

Const. Management Fee (assumed)	7.0%

Other DWSD Capital Projects:

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$278,000,000	2009
NOTS	$245,200,000	2009
Macomb (including the following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

DWSD Commodity Rates:

Flint & GCDC-WWS Commodity Rate (2008-09)	$13.07	$/MCF
Flint & GCDC-WWS Commodity Rate (2009-10)	$8.06	$/MCF

Capital Cost Recovery:

Flint & GCDC share of Capital Cost Recovery	4.45%	
Revenue Requirement (initial year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System						
					Suburban Wholesale Customers					Flint-GCDC
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009		$13.07	1,461,952	$559,824,000	$475,850,400	$7,109,765	$30,454,426	$37,564,190	$6.71	$1,671,606
2010		$8.06	1,461,952	$552,714,235	$469,807,100	$7,109,765	$30,067,654	$37,177,419	$6.64	$1,654,395
2011	8.0%	$8.70	1,471,711	$545,604,470	$463,763,800	$7,109,765	$29,680,883	$36,790,648	$6.57	$1,637,184
2012	8.0%	$9.40	1,480,983	$538,494,706	$457,720,500	$7,109,765	$29,294,112	$36,403,877	$6.50	$1,619,973
2013	8.0%	$10.15	1,490,254	$531,384,941	$451,677,200	$7,109,765	$28,907,341	$36,017,106	$6.43	$1,602,761
2014	8.0%	$10.97	1,499,525	$524,275,176	$445,633,900	$7,109,765	$28,520,570	$35,630,334	$6.36	$1,585,550
2015	5.0%	$11.51	1,508,836	$517,165,411	$439,590,600	$7,109,765	$28,133,798	$35,243,563	$6.30	$1,568,339
2016	5.0%	$12.09	1,518,146	$510,055,646	$433,547,299	$7,109,765	$27,747,027	$34,856,792	$6.23	$1,551,127
2017	5.0%	$12.69	1,527,457	$502,945,882	$427,503,999	$7,109,765	$27,360,256	$34,470,021	$6.16	$1,533,916
2018	5.0%	$13.33	1,536,767	$495,836,117	$421,460,699	$7,109,765	$26,973,485	$34,083,250	$6.09	$1,516,705
2019	5.0%	$14.00	1,546,078	$488,726,352	$415,417,399	$7,109,765	$26,586,714	$33,696,478	$6.02	$1,499,493
2020	5.0%	$14.69	1,555,388	$481,616,587	$409,374,099	$7,109,765	$26,199,942	$33,309,707	$5.95	$1,482,282
2021	5.0%	$15.43	1,564,698	$474,506,822	$403,330,799	$7,109,765	$25,813,171	$32,922,936	$5.88	$1,465,071
2022	5.0%	$16.20	1,574,009	$467,397,058	$397,287,499	$7,109,765	$25,426,400	$32,536,165	$5.81	$1,447,859
2023	5.0%	$17.01	1,583,319	$460,287,293	$391,244,199	$7,109,765	$25,039,629	$32,149,394	$5.74	$1,430,648
2024	5.0%	$17.86	1,592,630	$453,177,528	$385,200,899	$7,109,765	$24,652,858	$31,762,622	$5.67	$1,413,437
2025	5.0%	$18.75	1,601,940	$446,067,763	$379,157,599	$7,109,765	$24,266,086	$31,375,851	$5.60	$1,396,225
2026	5.0%	$19.69	1,611,251	$438,957,998	$373,114,299	$7,109,765	$23,879,315	$30,989,080	$5.54	$1,379,014
2027	5.0%	$20.68	1,620,561	$431,848,234	$367,070,999	$7,109,765	$23,492,544	$30,602,309	$5.47	$1,361,803
2028	5.0%	$21.71	1,629,871	$424,738,469	$361,027,698	$7,109,765	$23,105,773	$30,215,538	$5.40	$1,344,591
2029	5.0%	$22.80	1,639,182	$417,628,704	$354,984,398	$7,109,765	$22,719,001	$29,828,766	$5.33	$1,327,380
2030	5.0%	$23.94	1,648,492	$410,518,939	$348,941,098	$7,109,765	$22,332,230	$29,441,995	$5.26	$1,310,169
2031	5.0%	$25.13	1,657,803	$403,409,174	$342,897,798	$7,109,765	$21,945,459	$29,055,224	$5.19	$1,292,957
2032	5.0%	$26.39	1,667,113	$396,299,410	$336,854,498	$7,109,765	$21,558,688	$28,668,453	$5.12	$1,275,746
2033	5.0%	$27.71	1,676,424	$389,189,645	$330,811,198	$7,109,765	$21,171,917	$28,281,681	$5.05	$1,258,535
2034	5.0%	$29.09	1,685,734	$382,079,880	$324,767,898	$7,109,765	$20,785,145	$27,894,910	$4.98	$1,241,324
2035	5.0%	$30.55	1,695,044	$374,970,115	$318,724,598	$7,109,765	$20,398,374	$27,508,139	$4.91	$1,224,112
2036	5.0%	$32.08	1,704,355	$367,860,350	$312,681,298	$7,109,765	$20,011,603	$27,121,368	$4.84	$1,206,901
2037	5.0%	$33.68	1,713,665	$360,750,586	$306,637,998	$7,109,765	$19,624,832	$26,734,597	$4.78	$1,189,690

	Macomb Loop						
		Suburban Wholesale Customers					Flint-GCDC
	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009							
2010							
2011							
2012							
2013							
2014							
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
2023	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$1,485,020
2024	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$1,469,730
2025	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$1,454,440
2026	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$1,439,150
2027	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$1,423,860
2028	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$1,408,570
2029	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$1,393,279
2030	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$1,377,989
2031	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$1,362,699
2032	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$1,347,409
2033	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$1,332,119
2034	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$1,316,828
2035	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$1,301,538
2036	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$1,286,248
2037	$408,909,659	$347,573,210	$6,316,167	$22,244,685	$28,560,853	$5.74	$1,270,958

	Flint-GCDC						Flint-GCDC / GLCUA O&M				Cost of Water	
	Flint Transmission	Share of DWSD	Capital Recovery	Flint-GCDC Share			Grand Blanc PS O&M	Flint-GCDC Share			($/MCF)	($)
2009	$11,258,614	$1,671,606	$12,930,221	95.2%	$12,313,713	$8.42		95.2%	$0	$0.00	$21.49	$31,421,424
2010	$22,517,229	$1,654,395	$24,171,624	95.2%	$23,019,131	$15.75		95.2%	$0	$0.00	$23.81	$34,802,463
2011	$22,517,229	$1,637,184	$24,154,413	94.5%	$22,822,591	$15.51	$724,343	94.5%	$684,404	$0.47	$24.68	$36,317,946
2012	$22,517,229	$1,619,973	$24,137,202	93.8%	$22,630,957	$15.28	$746,073	93.8%	$699,515	$0.47	$25.15	$37,253,462
2013	$22,517,229	$1,602,761	$24,119,990	93.1%	$22,444,378	$15.06	$768,455	93.1%	$715,071	$0.48	$25.69	$38,290,413
2014	$22,517,229	$1,585,550	$24,102,779	92.4%	$22,262,651	$14.85	$791,509	92.4%	$731,081	$0.49	$26.30	$39,436,839
2015	$22,517,229	$1,568,339	$24,085,568	91.7%	$22,086,413	$14.64	$815,254	91.7%	$747,586	$0.50	$26.65	$40,206,460
2016	$22,517,229	$1,551,127	$24,068,356	91.1%	$21,914,621	$14.44	$839,711	91.1%	$764,571	$0.50	$27.03	$41,032,835
2017	$22,517,229	$1,533,916	$24,051,145	90.4%	$21,747,102	$14.24	$864,903	90.4%	$782,047	$0.51	$27.44	$41,918,660
2018	$22,517,229	$1,516,705	$24,033,934	89.8%	$21,583,690	$14.04	$890,850	89.8%	$800,028	$0.52	$27.89	$42,866,801
2019	$22,517,229	$1,499,493	$24,016,722	89.2%	$21,424,231	$13.86	$917,575	89.2%	$818,527	$0.53	$28.38	$43,880,296
2020	$22,517,229	$1,482,282	$23,999,511	88.6%	$21,268,575	$13.67	$945,103	88.6%	$837,558	$0.54	$28.91	$44,962,363
2021	$22,517,229	$1,465,071	$23,982,300	88.1%	$21,116,583	$13.50	$973,456	88.1%	$857,135	$0.55	$29.47	$46,116,415
2022	$22,517,229	$1,447,859	$23,965,088	87.5%	$20,968,120	$13.32	$1,002,659	87.5%	$877,271	$0.56	$30.08	$47,346,063
2023	$22,517,229	$2,915,668	$25,432,897	87.0%	$22,114,307	$13.97	$1,032,739	87.0%	$897,983	$0.57	$31.55	$49,946,376
2024	$22,517,229	$2,883,167	$25,400,396	86.4%	$21,951,441	$13.78	$1,063,721	86.4%	$919,286	$0.58	$32.22	$51,317,817
2025	$22,517,229	$2,850,665	$25,367,894	85.9%	$21,792,083	$13.60	$1,095,633	85.9%	$941,195	$0.59	$32.95	$52,777,338
2026	$22,517,229	$2,818,164	$25,335,393	85.4%	$21,636,111	$13.43	$1,128,502	85.4%	$963,727	$0.60	$33.72	$54,329,447
2027	$22,517,229	$2,785,662	$25,302,891	84.9%	$21,483,406	$13.26	$1,162,357	84.9%	$986,899	$0.61	$34.54	$55,978,908
2028	$22,517,229	$2,753,161	$25,270,390	84.4%	$21,333,859	$13.09	$1,197,228	84.4%	$1,010,728	$0.62	$35.42	$57,730,760
2029	$22,517,229	$2,720,659	$25,237,888	84.0%	$21,187,363	$12.93	$1,233,145	84.0%	$1,035,233	$0.63	$36.35	$59,590,322
2030	$22,517,229	$2,688,158	$25,205,387	83.5%	$21,043,816	$12.77	$1,270,139	83.5%	$1,060,431	$0.64	$37.35	$61,563,218
2031	$22,517,229	$2,655,656	$25,172,885	83.0%	$20,903,120	$12.61	$1,308,243	83.0%	$1,086,342	$0.66	$38.40	$63,655,383
2032	$22,517,229	$2,623,155	$25,140,384	82.6%	$20,765,184	$12.46	$1,347,490	82.6%	$1,112,986	$0.67	$39.51	$65,873,087
2033	$22,517,229	$2,590,653	$25,107,882	82.2%	$20,629,917	$12.31	$1,387,915	82.2%	$1,140,382	$0.68	$40.70	$68,222,948
2034	$22,517,229	$2,558,152	$25,075,381	81.7%	$20,497,234	$12.16	$1,429,553	81.7%	$1,168,552	$0.69	$41.95	$70,711,954
2035	$22,517,229	$2,525,650	$25,042,879	81.3%	$20,367,055	$12.02	$1,472,439	81.3%	$1,197,516	$0.71	$43.27	$73,347,477
2036	$22,517,229	$2,493,149	$25,010,378	80.9%	$20,239,300	$11.88	$1,516,612	80.9%	$1,227,297	$0.72	$44.67	$76,137,300
2037	$22,517,229	$2,460,647	$24,977,876	80.5%	$20,113,895	$11.74	$1,562,111	80.5%	$1,257,918	$0.73	$46.15	$79,089,635

Table 18-13 Option 4 - GLCUA; 30 Year Contract; Flint, GCDC & GLCUA Construct and Operate FTS

Option 4 - GLCUA; 30 Year Contract; Flint, GCDC, & GLCUA Construct and Operate FTS

Assumptions:

Flint-GCDC / GLCUA Capital Projects

Flint Loop Transmission System

Facilities	Cost[1]
North Transmsission CM-2018	$266,000,000
30 Inch Main CM-2019	$9,500,000
Grand Blanc Pumping Station	$48,000,000
Subtotal	$323,500,000
Construction Management	$22,645,000
Total Project Cost	$346,145,000
Term	30
Interest Rate	5.00%
Debt Service	$22,517,229

[1]Source of DWSD costs:
FTS - DWSD December 2008
NOTS & Macomb - DWSD September 25, 2008

Operating & Maintenance Costs of Grand Blanc Pumping Station

	Flow (mgd)	TDH (feet)
2010 Normal Delivery Rate	25	280

assumed efficiency	0.70
assumed $/kWh	$0.063
assumed rate of inflation	3.00%
kWh/1,000gal	1.26
kWh/yr	11,497,500
annual pumping cost	$724,343

Const. Management Fee (assumed)	7.0%

Other DWSD Capital Projects:

Project	Estimated Cost	Construction Start
Flint Loop Transmission System	$278,000,000	2009
NOTS	$245,200,000	2009
Macomb (includes following:)	$464,800,000	2023
Chesterfield Booster Pump Station	$15,150,000	
24 Mile Road Parallel Main	$38,000,000	
Lake Huron WTP HS Pump Upgr.	$23,450,000	
Second Feed - PH to Chesterfield	$388,200,000	

DWSD Commodity Rates:

GLCUA Commodity Rate (2008-09)	$14.84	$/MCF
GLCUA Commodity Rate (2009-10)	$8.61	$/MCF

Capital Cost Recovery:

GLCUA share of Capital Cost Recovery	1.29%	
Revenue Requirement (initial year)	$6.71	per $100
Depreciation Period	66.67	years
Annual Depreciation Expense (Suburban Wholesale)	$1.27	per $100
Rate of Return	6.40%	
Suburban Wholesale Customers Allocation Base	85%	

Cost of Water:

				Flint Loop Transmission System and North Oakland Transmission System						
					Suburban Wholesale Customers					GLCUA
	Assumed Annual Rate Increase	DWSD Commodity ($/MCF)	Annual Consumption (MCF)	Capital Value of DWSD Investment (plus const mgt)	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009		$15	73,195	$559,824,000	$475,850,400	$7,109,765	$30,454,426	$37,564,190	$6.71	$484,578
2010		$8.61	73,195	$552,714,235	$469,807,100	$7,109,765	$30,067,654	$37,177,419	$6.64	$479,589
2011	8.0%	$9.30	85,882	$545,604,470	$463,763,800	$7,109,765	$29,680,883	$36,790,648	$6.57	$474,599
2012	8.0%	$10.04	98,570	$538,494,706	$457,720,500	$7,109,765	$29,294,112	$36,403,877	$6.50	$469,610
2013	8.0%	$10.85	111,257	$531,384,941	$451,677,200	$7,109,765	$28,907,341	$36,017,106	$6.43	$464,621
2014	8.0%	$11.71	123,944	$524,275,176	$445,633,900	$7,109,765	$28,520,570	$35,630,334	$6.36	$459,631
2015	5.0%	$12.30	136,572	$517,165,411	$439,590,600	$7,109,765	$28,133,798	$35,243,563	$6.30	$454,642
2016	5.0%	$12.91	149,201	$510,055,646	$433,547,299	$7,109,765	$27,747,027	$34,856,792	$6.23	$449,653
2017	5.0%	$13.56	161,830	$502,945,882	$427,503,999	$7,109,765	$27,360,256	$34,470,021	$6.16	$444,663
2018	5.0%	$14.24	174,458	$495,836,117	$421,460,699	$7,109,765	$26,973,485	$34,083,250	$6.09	$439,674
2019	5.0%	$14.95	187,087	$488,726,352	$415,417,399	$7,109,765	$26,586,714	$33,696,478	$6.02	$434,685
2020	5.0%	$15.70	199,716	$481,616,587	$409,374,099	$7,109,765	$26,199,942	$33,309,707	$5.95	$429,695
2021	5.0%	$16.48	212,344	$474,506,822	$403,330,799	$7,109,765	$25,813,171	$32,922,936	$5.88	$424,706
2022	5.0%	$17.31	224,973	$467,397,058	$397,287,499	$7,109,765	$25,426,400	$32,536,165	$5.81	$419,717
2023	5.0%	$18.17	237,601	$460,287,293	$391,244,199	$7,109,765	$25,039,629	$32,149,394	$5.74	$414,727
2024	5.0%	$19.08	250,230	$453,177,528	$385,200,899	$7,109,765	$24,652,858	$31,762,622	$5.67	$409,738
2025	5.0%	$20.03	262,859	$446,067,763	$379,157,599	$7,109,765	$24,266,086	$31,375,851	$5.60	$404,748
2026	5.0%	$21.04	275,487	$438,957,998	$373,114,299	$7,109,765	$23,879,315	$30,989,080	$5.54	$399,759
2027	5.0%	$22.09	288,116	$431,848,234	$367,070,999	$7,109,765	$23,492,544	$30,602,309	$5.47	$394,770
2028	5.0%	$23.19	300,744	$424,738,469	$361,027,698	$7,109,765	$23,105,773	$30,215,538	$5.40	$389,780
2029	5.0%	$24.35	313,373	$417,628,704	$354,984,398	$7,109,765	$22,719,001	$29,828,766	$5.33	$384,791
2030	5.0%	$25.57	326,002	$410,518,939	$348,941,098	$7,109,765	$22,332,230	$29,441,995	$5.26	$379,802
2031	5.0%	$26.85	338,630	$403,409,174	$342,897,798	$7,109,765	$21,945,459	$29,055,224	$5.19	$374,812
2032	5.0%	$28.19	351,259	$396,299,410	$336,854,498	$7,109,765	$21,558,688	$28,668,453	$5.12	$369,823
2033	5.0%	$29.60	363,887	$389,189,645	$330,811,198	$7,109,765	$21,171,917	$28,281,681	$5.05	$364,834
2034	5.0%	$31.08	376,516	$382,079,880	$324,767,898	$7,109,765	$20,785,145	$27,894,910	$4.98	$359,844
2035	5.0%	$32.63	389,145	$374,970,115	$318,724,598	$7,109,765	$20,398,374	$27,508,139	$4.91	$354,855
2036	5.0%	$34.27	401,773	$367,860,350	$312,681,298	$7,109,765	$20,011,603	$27,121,368	$4.84	$349,866

	Macomb Loop						
		Suburban Wholesale Customers					Flint-GCDC
	Capital Value of DWSD Investment	Allocation of DWSD Investment	Annual Depreciation Expense	Return on Rate Base	Annual Revenue Requirement	Revenue Required per $100 Investment	Annual Requirement
2009							
2010							
2011							
2012							
2013							
2014							
2015							
2016							
2017							
2018							
2019							
2020							
2021							
2022							
2023	$497,336,000	$422,735,600	$6,316,167	$27,055,078	$33,371,246	$6.71	$430,489
2024	$491,019,833	$417,366,858	$6,316,167	$26,711,479	$33,027,646	$6.64	$426,057
2025	$484,703,666	$411,998,116	$6,316,167	$26,367,879	$32,684,047	$6.57	$421,624
2026	$478,387,498	$406,629,374	$6,316,167	$26,024,280	$32,340,447	$6.50	$417,192
2027	$472,071,331	$401,260,632	$6,316,167	$25,680,680	$31,996,848	$6.43	$412,759
2028	$465,755,164	$395,891,889	$6,316,167	$25,337,081	$31,653,248	$6.36	$408,327
2029	$459,438,997	$390,523,147	$6,316,167	$24,993,481	$31,309,649	$6.30	$403,894
2030	$453,122,830	$385,154,405	$6,316,167	$24,649,882	$30,966,049	$6.23	$399,462
2031	$446,806,662	$379,785,663	$6,316,167	$24,306,282	$30,622,450	$6.16	$395,030
2032	$440,490,495	$374,416,921	$6,316,167	$23,962,683	$30,278,850	$6.09	$390,597
2033	$434,174,328	$369,048,179	$6,316,167	$23,619,083	$29,935,251	$6.02	$386,165
2034	$427,858,161	$363,679,437	$6,316,167	$23,275,484	$29,591,651	$5.95	$381,732
2035	$421,541,994	$358,310,695	$6,316,167	$22,931,884	$29,248,052	$5.88	$377,300
2036	$415,225,826	$352,941,952	$6,316,167	$22,588,285	$28,904,452	$5.81	$372,867

	Flint-GCDC / GLCUA Capital						Flint GCDC / GLCUA O&M				Cost of Water	
	Flint Transmission	Share of DWSD	Capital Recovery	GLCUA Share			Grand Blanc PS O&M	GLCUA Share			($/MCF)	($)
2009	$11,258,614	$484,578	$11,743,193	4.8%	$559,911	$7.65		4.8%	$0	$0.00	$22.49	$1,646,127
2010	$22,517,229	$479,589	$22,996,818	4.8%	$1,096,479	$14.98		4.8%	$0	$0.00	$23.59	$1,726,689
2011	$22,517,229	$474,599	$22,991,828	5.5%	$1,267,720	$14.76	$724,343	5.5%	$39,939	$0.47	$24.52	$2,106,261
2012	$22,517,229	$469,610	$22,986,839	6.2%	$1,434,458	$14.55	$746,073	6.2%	$46,558	$0.47	$25.07	$2,470,920
2013	$22,517,229	$464,621	$22,981,850	6.9%	$1,596,545	$14.35	$768,455	6.9%	$53,384	$0.48	$25.68	$2,856,633
2014	$22,517,229	$459,631	$22,976,860	7.6%	$1,754,170	$14.15	$791,509	7.6%	$60,428	$0.49	$26.35	$3,266,452
2015	$22,517,229	$454,642	$22,971,871	8.3%	$1,906,715	$13.96	$815,254	8.3%	$67,668	$0.50	$26.76	$3,654,156
2016	$22,517,229	$449,653	$22,966,882	8.9%	$2,055,171	$13.77	$839,711	8.9%	$75,141	$0.50	$27.19	$4,057,165
2017	$22,517,229	$444,663	$22,961,892	9.6%	$2,199,696	$13.59	$864,903	9.6%	$82,856	$0.51	$27.66	$4,476,994
2018	$22,517,229	$439,674	$22,956,903	10.2%	$2,340,441	$13.42	$890,850	10.2%	$90,822	$0.52	$28.17	$4,915,236
2019	$22,517,229	$434,685	$22,951,914	10.8%	$2,477,550	$13.24	$917,575	10.8%	$99,048	$0.53	$28.72	$5,373,570
2020	$22,517,229	$429,695	$22,946,924	11.4%	$2,611,160	$13.07	$945,103	11.4%	$107,544	$0.54	$29.31	$5,853,764
2021	$22,517,229	$424,706	$22,941,935	11.9%	$2,741,400	$12.91	$973,456	11.9%	$116,321	$0.55	$29.94	$6,357,685
2022	$22,517,229	$419,717	$22,936,946	12.5%	$2,868,394	$12.75	$1,002,659	12.5%	$125,388	$0.56	$30.61	$6,887,302
2023	$22,517,229	$845,216	$23,362,445	13.0%	$3,048,430	$12.83	$1,032,739	13.0%	$134,756	$0.57	$31.57	$7,500,869
2024	$22,517,229	$835,794	$23,353,023	13.6%	$3,170,955	$12.67	$1,063,721	13.6%	$144,436	$0.58	$32.33	$8,089,919
2025	$22,517,229	$826,373	$23,343,602	14.1%	$3,290,471	$12.52	$1,095,633	14.1%	$154,438	$0.59	$33.14	$8,711,173
2026	$22,517,229	$816,951	$23,334,180	14.6%	$3,407,080	$12.37	$1,128,502	14.6%	$164,775	$0.60	$34.00	$9,367,092
2027	$22,517,229	$807,529	$23,324,758	15.1%	$3,520,885	$12.22	$1,162,357	15.1%	$175,458	$0.61	$34.92	$10,060,283
2028	$22,517,229	$798,107	$23,315,336	15.6%	$3,631,979	$12.08	$1,197,228	15.6%	$186,500	$0.62	$35.89	$10,793,506
2029	$22,517,229	$788,686	$23,305,915	16.0%	$3,740,455	$11.94	$1,233,145	16.0%	$197,912	$0.63	$36.92	$11,569,680
2030	$22,517,229	$779,264	$23,296,493	16.5%	$3,846,400	$11.80	$1,270,139	16.5%	$209,708	$0.64	$38.01	$12,391,897
2031	$22,517,229	$769,842	$23,287,071	17.0%	$3,949,898	$11.66	$1,308,243	17.0%	$221,901	$0.66	$39.17	$13,263,433
2032	$22,517,229	$760,420	$23,277,649	17.4%	$4,051,027	$11.53	$1,347,490	17.4%	$234,505	$0.67	$40.39	$14,187,757
2033	$22,517,229	$750,998	$23,268,227	17.8%	$4,149,865	$11.40	$1,387,915	17.8%	$247,533	$0.68	$41.68	$15,168,545
2034	$22,517,229	$741,577	$23,258,806	18.3%	$4,246,485	$11.28	$1,429,553	18.3%	$261,001	$0.69	$43.05	$16,209,689
2035	$22,517,229	$732,155	$23,249,384	18.7%	$4,340,956	$11.16	$1,472,439	18.7%	$274,923	$0.71	$44.50	$17,315,318
2036	$22,517,229	$722,733	$23,239,962	19.1%	$4,433,346	$11.03	$1,516,612	19.1%	$289,315	$0.72	$46.02	$18,489,803

18.7 Master Agreement

A copy of the master agreement developed by DWSD follows.

WATER SERVICE CONTRACT

BETWEEN

CITY OF DETROIT

AND

____

04/08/08 Version

TABLE OF CONTENTS

WATER SERVICE CONTRACT
BETWEEN
CITY OF DETROIT
AND

____

This Water Service Contract ("Contract") is made between the City of Detroit, a municipal corporation, by its Water and Sewerage Department and Board of Water Commissioners (the "Board"), and ______________________________, a municipal corporation ("Customer"). The Board and Customer may be referred to individually as "Party" or collectively as the "Parties."

Whereas, the City of Detroit owns a public water supply system ("System") operated by the Board; and

Whereas, the Board supplies water service to numerous governmental entities in the Board's water service area; and

Whereas, Customer desires to obtain water service from the Board; and

Whereas, the purpose of this Contract is to provide for the long-term service of potable water to Customer; and

Whereas, the Board implemented a voluntary partnering effort with its wholesale water customers, of which the Technical Advisory Committee is a central part, and which is intended to assist the Board in data gathering, alternative evaluations and recommendations, achieving full disclosure of rates, identifying true cost of service principles to guide revenue collection, and to provide assistance with a cohesive planning effort for the Board's water service area;

ACCORDINGLY, THE PARTIES AGREE AS FOLLOWS:

Article 1.
Definitions

1.01 The following words and expressions, or pronouns used in their stead, shall be construed as follows:

"Adjusted Prevailing Water Rate" shall have the meaning ascribed in Article 3 herein.

"Annual Volume" shall mean the actual volume of water used by Customer for the period of July 1st to June 30th as measured on bills issued from August 1st through July 31st.

"Board" shall mean the City of Detroit Board of Water Commissioners.

"**City**" shall mean the City of Detroit, a municipal corporation, acting through its Board of Water Commissioners.

"**Contract**" shall mean each of the various provisions and parts of this document, including all attached Exhibits and any amendments thereto, as may be executed and approved by Customer's governing body, the Board of Water Commissioners, and the Detroit City Council.

"**Contract Term**" shall have the meaning ascribed in Article 2 herein.

"**Customer**" shall mean the Party that enters into a contract with the City of Detroit by way of this Contract, whether an authority, city, township, village or other municipal corporation recognized by the State of Michigan.

"**Customer Maximum Day Demand**" shall mean the Customer's recorded water usage on the DWSD Maximum Day. Customer Maximum Day Demand shall, in conjunction with Customer Peak Hour Demand, be a component of its Maximum Flow Rate.

"**Customer Peak Hour Demand**" shall mean the Customer's recorded water usage during the DWSD Peak Hour. Customer Peak Hour Demand, in conjunction with Customer Maximum Day Demand, shall be a component of its Maximum Flow Rate.

"**DWSD**" shall mean the City of Detroit Water and Sewerage Department.

"**DWSD Maximum Day**" shall mean the maximum reported water production day for the System during any twenty-four hour period as measured from 12:00 a.m. Eastern Standard Time in any given calendar year, as determined by DWSD in reviewing water production and storage reports.

"**DWSD Peak Hour**" shall mean the hour during the DWSD Maximum Day in which the most water is delivered to the System, measured from top-of-the-hour to top-of-the-hour (e.g. 7:00 a.m. to 8:00 a.m.), and as determined by DWSD in reviewing water production and pumping reports. In calculating the DWSD Peak Hour, the time period from 11:00 PM to 5:00 AM Eastern Standard Time (EST) shall not be considered provided, however, that if Customer has an approved Filling Schedule, the time period specified in the Filling Schedule shall supersede the time period of 11:00 PM to 5:00 AM EST.

"**Early Termination Costs**" shall have the meaning ascribed in Article 3 herein.

"**Filling Schedule**" shall have the meaning ascribed in Article 22 herein.

"**Maximum Flow Rate**" shall mean the aggregate amount of water usage that Customer commits not to exceed, as determined by the Customer Maximum Day Demand and the Customer Peak Hour Demand, collectively.

"**Meter Facilities**" shall mean a location in which a water meter is housed including, without limitation, meter pits and meter vaults.

"Minimum Annual Volume" shall mean fifty percent of Customer's Projected Annual Volume.

"Notices" shall mean all notices, consents, approvals, requests and other communications required to be given under the terms of this Contract.

"Pressure Problem" shall have the meaning ascribed in Article 5 herein.

"Pressure Range" shall have the meaning ascribed in Article 5 herein.

"Projected Annual Volume" shall mean the projected annual water sales to Customer as set forth in Exhibit B.

"Service Area" shall mean the mutually agreed upon area where Customer is permitted to distribute water received from the Board under the terms of this Contract which (a) may be entirely within the corporate limits of Customer or may exceed the corporate limits of Customer and (b) which may or may not include the entire geographical area within the Customer's corporate limits.

"System" shall mean the public water works system owned and operated by the City of Detroit, acting through its Board of Water Commissioners and its Water and Sewerage Department.

"Technical Advisory Committee" shall mean the committee consisting of representatives of the Detroit Water and Sewerage Department, wholesale water customers of the Detroit Water and Sewerage Department and their respective representatives, and shall include its successor or replacement if altered or discontinued. The Technical Advisory Committee or its successor shall remain in existence for a minimum term of January 1, 2008 until December 31, 2038 unless the committee determines otherwise.

"Water Distribution Points" shall have the meaning ascribed in Article 4 herein.

Article 2.
Contract Term

2.01 Term. The Board shall sell and supply water to Customer from the System in accordance with the terms of this Contract for a period of thirty years from the effective date of this Contract and any ten-year renewal terms (collectively the "Contract Term"), subject to Article 3 herein. The effective date of this Contract shall be the date that this Contract is approved by the Detroit City Council or Customer's governing body whichever is later. This Contract replaces and supersedes any prior water service contracts between the Parties.

2.02 Renewal. This Contract shall automatically renew at the conclusion of the thirty-year term for an additional ten-year term, unless a Party provides written notification to the other Party in accordance with Article 16 on or before the conclusion of the twenty-fifth year of the thirty-year term stating its intent not to renew this Contract. Thereafter, this Contract shall automatically renew every ten years for an additional ten-year term, unless a Party provides written notification to the other Party in accordance with Article 16 on or before the conclusion of the fifth year of the then current ten-year term stating its intent not to renew this Contract. The automatic renewals of this Contract shall not preclude a review of its terms and the Parties are encouraged to reaffirm or amend its terms as necessary. The Parties may, in writing, mutually agree upon a longer renewal term.

2.03 Notification of Renewal. The Board shall notify Customer of its first Contract renewal option during the twenty-fifth year of the thirty-year term; provided, however, that the Board's failure to so notify Customer shall not obviate Customer's obligations as set forth in Section 2.02.

Article 3. Early Termination Costs

3.01 Early Termination Costs. In addition to any other remedies provided for by law or by the terms of this Contract, Customer shall be liable to the Board for the payment of any costs incurred by the Board related to providing water to Customer in the event Customer terminates this Contract before the conclusion of a Contract Term ("Early Termination Costs"); provided, however, that payment of such Early Termination Costs by Customer shall not entitle Customer to receive water service from the Board.

3.02 Calculation of Costs. Payment of Early Termination Costs will be calculated by applying the Adjusted Prevailing Water Rate to the Minimum Annual Volume requirements for the remainder of the Contract Term. The Adjusted Prevailing Water Rate shall be the rate charged by the Board to Customer as of Customer's effective termination date, adjusted annually to reflect projected inflationary increases utilizing a locally based wholesale price index. The Parties may agree upon another standardized price index. The Board may seek a recommendation from the Technical Advisory Committee on the amount of the Early Termination Costs.

3.03 Specifically Constructed Facilities. If the Board has constructed facilities specifically for the benefit of Customer, additional costs may be included in the calculation of the Early Termination Costs, provided that any such facilities shall be identified in a written agreement between the Board and Customer at or near the time of construction.

3.04 Formation of Water Authority. Customer may join with another authority, city, township, village or other municipal corporation recognized by the State of Michigan to form a water authority for the sole purpose of collectively contracting for water service from the Board. The exercise of this right shall not be construed as an early termination of this Contract and this Contract shall be voided upon the approval of a new water service contract by Customer's governing body, the Board and the Detroit City Council.

Article 4.
Service Area

4.01 Delivery Location. Water shall be delivered by the Board to Customer at the location(s) identified in Exhibit A (collectively, the "Water Distribution Points"), and at other locations as may be mutually agreed upon in writing by the Board and Customer.

4.02 Limit of Responsibility. The Board shall have no responsibility for distributing, operating, repairing, replacing and maintaining any portions of the Customer's water supply system downstream of the Water Distribution Points shown in Exhibit A, provided, however, that this Section 4.02 does not prevent the application of the provisions of Section 11.02 herein.

4.03 Board Responsibility. The Board owns and is responsible for operating and maintaining all parts of its System upstream from Customer's Water Distribution Points. Should the Board fail to maintain its Meter Facilities and/or any Board owned and maintained equipment within the Meter Facilities, Customer shall provide written notice to the Board which describes the objectionable condition of the Meter Facility and/or the equipment within, and its intent to take reasonable steps to maintain the condition and charge the reasonable cost of doing so to the Board. Upon receipt of the notice and subject to Section 11.01, the Board shall have thirty calendar days to repair the condition specified in the notice, unless a force majeure event prevents the repair within the thirty-day period. If the Board has not repaired the condition at the conclusion of the thirty-day period and has not provided a written explanation to Customer explaining the reason for the delay (e.g. necessary parts are on order or occurrence of a force majeure event specified in Section 11.01), then Customer may take reasonable steps to maintain the specified condition and charge the reasonable cost of doing so to the Board.

4.04 Extension of Service Area. Customer's distribution of water supplied by the Board shall be limited to the Service Area stated in Exhibit A. The Parties agree that situations may arise in which Customer desires to extend its Service Area, either temporarily or permanently, beyond its corporate limits. Should such a situation arise, Customer shall provide written notice to the Board explaining the nature, duration and extent of the requested Service Area extension. The Board shall have the option, which it may exercise at any time, of requiring a written amendment to this Contract to accommodate the change in Service Area. Should the Board determine that an immediate amendment is required, the Parties shall, within thirty calendar days of Customer's request, meet to negotiate mutually agreeable terms for the extension of the Service Area. The Board shall not unreasonably deny a request to extend the Service Area.

4.05 Change or Addition of Water Distribution Points. Water Distribution Points may be added or changed only by the express written agreement of the Board and Customer and shall be embodied in a written amendment to this Contract.

4.06 Sole Supplier. Except as provided in Article 17 herein, the Board shall be the sole supplier of public potable water to Customer's Service Area.

Article 5.
Pressure; Maximum Flow Rate; Minimum Annual Volume

5.01 Pressure Range. The Board shall use its best efforts to deliver water at the Water Distribution Points at a pressure range ("Pressure Range") adequate to meet the reasonable requirements of Customer. For purposes of evaluating this effort, water pressure shall be determined by reviewing the average hourly pressure measured from top-of-the-hour to top-of-the-hour (e.g. 7:00 a.m. to 8:00 a.m.). The Pressure Range to be provided by the Board to Customer's Water Distribution Points is specified in Exhibit B. The location at which the water pressure will be measured shall be specified in Exhibit A and identified as point "P". A Pressure Range will not be established for water meters that are not located on a DWSD transmission main.

5.02 Remedy for Non-Compliance with Pressure Range. If the water pressure at Customer's Water Distribution Points is above or below the Pressure Range, the Parties shall meet to discuss the reasons for the non-compliance and, if agreed, develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the pressure event, or as otherwise agreed. The corrective action plan shall include a timetable for resolution of the non-compliance issue(s).

A. If it is determined that another customer's exceedence of the rates of flow established by that customer's Maximum Flow Rate caused or contributed to the Board's inability to meet its Pressure Range agreement with Customer, then the corrective action plan shall provide for the resolution of the issue.

B. If Customer is exceeding the rates of flow established by its Maximum Flow Rate on a day other than the DWSD Maximum Day at the time Customer experiences a variation from the Pressure Range, then the Board shall be relieved from its obligation to provide water to Customer within the Pressure Range for that period of time during which Customer is exceeding the rates of flow established by its Maximum Flow Rate.

5.03 Maximum Flow Rate. Customer's Maximum Flow Rate is specified in Exhibit B. Customer shall not exceed the Maximum Flow Rate specified in Exhibit B, as measured in million gallons on the DWSD Maximum Day and during the DWSD Peak Hour.

5.04 Remedy for Non-Compliance with Maximum Flow Rate. The Board has no obligation to supply to Customer more than the Maximum Flow Rate. If Customer exceeds its Maximum Flow Rate on the DWSD Maximum Day or during the DWSD Peak Hour, the Board and Customer may, as needed, take one or more of the following steps:

A. The Board may require that Customer take all reasonable steps to reduce its consumption to the Maximum Flow Rate. Such steps may include water conservation measures, outdoor water use restrictions, water loss studies and remediation, and an internal system operation evaluation.

B. The Parties may meet to negotiate a new Maximum Flow Rate. If so negotiated, Customer shall pay the rate associated with the new Maximum Flow Rate in the subsequent rate year.

C. The Board may recalculate Customer's rate for the Board's current fiscal year utilizing a revised cost allocation formula as follows:

i. For cost allocation purposes only, a new Maximum Flow Rate will be established from the first exceedence date forward. The new Maximum Flow Rate will be at least equal to the flow rate demonstrated by Customer on the DWSD Maximum Day, and may be higher than the actual flow rate demonstrated by Customer. Pursuant to subsection (ii) below, the Board will seek a recommendation from the Technical Advisory Committee's Analytical Work Group (as defined in Section 6.07 herein) on the establishment of the new Maximum Flow Rate. If the Board receives a recommendation and the recommendation is higher than twice the amount by which the demonstrated flow rate exceeded the original Maximum Flow Rate, then the Board shall be limited to establishing a new Maximum Flow Rate that is at least equal to the flow rate demonstrated by Customer on the DWSD Maximum Day and no higher than the recommendation provided by the Analytical Work Group. If no recommendation is received by the Board, or if the Board receives a recommendation and the recommendation is less than twice the amount by which the demonstrated flow rate exceeded the original Maximum Flow Rate, then the Board shall be limited to establishing a new Maximum Flow Rate that is at least equal to the flow rate demonstrated by Customer on the DWSD Maximum Day and no higher than twice the amount by which the demonstrated flow rate exceeded the original Maximum Flow Rate. In any event, Customer's exceedence of its Maximum Flow Rate will continue to affect each subsequent year's rate calculation until renegotiated. If a rate has been approved for the next fiscal year (July 1st to June 30th) but the rate has not yet been applied, the Board may modify Customer's rate to account for an exceedence of its Maximum Flow Rate. If the Board has built capital facilities based upon Customer's negotiated Maximum Flow Rate and Customer consistently exceeds its Maximum Flow Rate, then the Board may re-calculate the amount of Customer's percentage of the capital cost of such facilities.

ii. The Board will seek a recommendation from the Technical Advisory Committee's Analytical Work Group, or its successor, whenever it intends to invoke subsection 5.04(C)(i). Any recommendation from the Analytical Work Group shall be received by the Board within sixty calendar days after the Board's request for a recommendation.

5.05 Procedure for Non-Compliance with Maximum Flow Rate. If Customer has failed in its obligations under Section 5.03, the Parties shall meet to discuss the reasons for the non-compliance and develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the non-compliance event, or as otherwise agreed. If the Parties determine that a corrective action plan is not required and a subsequent incident of non-compliance occurs, the Parties shall meet to develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the subsequent incident of non-compliance, or as otherwise agreed. Any corrective action plan required under this Section 5.05 shall include a timetable for resolution of the non-compliance issue(s). In the event the reason for Customer's non-compliance under Section 5.03 is due to a Customer water main break, fire or meter calibration performed by DWSD, these events will be taken into consideration in determining (1) whether a corrective action plan is warranted and (2) the extent to which, if any, the steps specified in Section 5.04 should apply.

5.06 Minimum Annual Volume. Customer shall purchase from the Board not less than the Minimum Annual Volume of water specified in Exhibit B. If Customer's Annual Volume is less than the Minimum Annual Volume, Customer shall pay to the Board an amount computed by applying the current rate to the Minimum Annual Volume less any amounts already billed to the Customer by the Board.

5.07 Periodic Review. For Customer and System planning purposes and, with regard to the Minimum Annual Volume, enforcement of the provisions of Article 3, a Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume shall be established by mutual agreement for the Contract Term. A contractually binding Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume shall be established by mutual agreement for first two years of the Contract Term. Not later than the second year of the Contract Term, the Board and Customer shall negotiate a contractually binding Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume for the succeeding three years of the Contract Term. Not later than the fifth year of the Contract Term, and every five years thereafter, the Board and Customer shall negotiate a contractually binding Maximum Flow Rate, Pressure Range, Projected Annual Volume and Minimum Annual Volume for the succeeding five years of the Contract Term. If the Parties do not negotiate new or revised Maximum Flow Rates, Pressure Ranges, Projected Annual Volumes and Minimum Annual Volumes according to the aforementioned schedule, then the figures established for planning purposes (as shown in italicized type in Exhibit B) shall become contractually binding for the then-current three or five year term.

5.08 Remedy for Excessive Rate(s) of Flow Causing Pressure Problem(s). Customer acknowledges that Customer's rates of flow may cause and/or contribute to the Board's inability to meet its Pressure Range agreements with Customer and/or the Board's other customers (hereinafter, "Pressure Problem"). The Board may review or monitor Customer's daily rates of flow if a Pressure Problem occurs and the Board's Pressure Range agreement with Customer and/or another customer of the Board is alleged to have been breached. The approximate rate of flow by individual meter location used to establish the Pressure Range and Maximum Flow Rate is specified in Exhibit B. If a Pressure Problem occurs, the Parties shall meet to discuss the reasons for the Pressure

Problem and develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the Pressure Problem, or as otherwise agreed. The corrective action plan may require one or both of the following steps:

A. The Board may require that Customer take all reasonable steps to reduce its consumption to the rate of flow established by the Maximum Flow Rate. Such steps may include water conservation measures, outdoor water use restrictions, water loss studies and remediation, and an internal system operation evaluation. In addition, the Board may require that Customer adjust its rate of flow at individual meters, including the establishment of a not-to-exceed flow rate for individual meters.

B. The Parties may meet to negotiate a new Maximum Flow Rate. If so negotiated, Customer shall pay the rate associated with the new Maximum Flow Rate in the subsequent rate year.

If the Parties determine that a corrective action plan is not required and a subsequent Pressure Problem occurs, the Parties shall meet to develop and implement a mutually agreeable written corrective action plan within sixty calendar days of the subsequent Pressure Problem, or as otherwise agreed. Any corrective action plan required under this Section 5.08 shall include a timetable for resolution of the Pressure Problem. In the event the reason for the Pressure Problem is due to a Customer water main break, fire or meter calibration performed by DWSD, these events will be taken into consideration in determining (1) whether a corrective action plan is warranted and (2) the extent to which, if any, the steps specified above in this Section 5.08 should apply.

5.09 Board Costs for Corrective Action Plan. If at any time the Board is required under the terms of this Article 5 to develop and implement a corrective action plan and the plan involves incurring capital costs, the Board will determine whether the costs will be charged as a System cost or whether the cost will be borne by a specific customer or customers. If the Board determines that all or part of the costs should be borne by a specific customer or customers, the Board will seek a recommendation from the Technical Advisory Committee on the assessment of the costs.

5.10 Customer Costs for Corrective Action Plan. If at any time Customer is required under the terms of this Article 5 to develop and implement a corrective action plan, Customer will pay all costs related thereto.

Article 6.
Technical Advisory Committee

6.01 Establishment. The Technical Advisory Committee is formed to facilitate a cooperative working partnership between the Board and its wholesale water customers by facilitating the development of recommendations regarding System planning and supply to DWSD management and the Board. The Technical Advisory Committee shall maintain bylaws that govern the way it conducts its business. In the event of a conflict between the terms of the bylaws adopted by the Technical Advisory Committee and the terms of this Contract, the terms of this Contract shall control.

6.02 General Responsibilities. The Technical Advisory Committee shall periodically review and evaluate the rates, rate methodology, and performance of the System. The Technical Advisory Committee shall review and evaluate flow rates, pressures and Annual Volumes for the System at a minimum of every five years to assist the Board in its System planning effort. The Technical Advisory Committee shall have the opportunity each year to review the Capital Improvement Program as prepared by DWSD, prior to its adoption by the Board. The Technical Advisory Committee may consider Customer proposals for improving the operation of Customer's water system and/or the System. The Board will supply the Technical Advisory Committee with information the Board deems reasonably necessary to accomplish the general responsibilities defined in this Section 6.02.

6.03 Annual Report by Board. The Board will present an annual report to the Technical Advisory Committee which shall consist of (1) all instances of non-compliance with the Parties' obligations contained in Article 5 herein, including Customer and Board responses thereto; (2) a general report on System operation and maintenance; and (3) a report that lists those contracts, if any, that have been entered into by the Board and another customer(s) where the terms of the contract(s) invoke the application of Article 14 herein.

6.04 Notification of Rates. The Board shall provide Customer and the Technical Advisory Committee with notice of the proposed rates for each fiscal year as early as possible before the implementation of the rates.

6.05 Disclosure of Rate Information by Board. Each year, the Board will disclose to Customer and the Technical Advisory Committee information related to wholesale rates.

6.06 Disclosure of Rate Information by Customer. Each year, Customer will disclose to its customers information related to its retail rates and other charges, and information regarding what portion of those costs is related to charges from DWSD and/or other major service providers.

6.07 Work Groups. The Technical Advisory Committee may create work groups to address specific issues facing the System. The work groups in existence as of January 1, 2008 are the Analytical Work Group, the Best Practices Work Group, the Contract Work Group, the Customer Service Work Group, the Emergency Preparedness Work Group, and the Rates Work Group. Any reference to a particular work group in this Contract shall include its successor or replacement if altered or discontinued.

Article 7.
Rates

7.01 Rates. Customer agrees to pay for all water supplied by the Board at such rates as the Board may establish. Rates shall be reasonable in relation to the costs incurred by the Board for the supply of water and shall conform to Public Act 34 of 1917, Michigan Compiled Laws, Sec. 123.141, et seq., as amended. The Board shall give written notice of any changes in the rates. Notice shall be made in accordance with Section 5e of Public Act 279 of 1909, Michigan Compiled Laws, Sec. 117.5e, as amended, ("Act 279").

7.02 Notification of Rates. As soon as possible in the ratemaking process, the Board shall provide information on proposed rates and the draft data and information used in the calculation of proposed rates in a format that will enable Customer to assist in the ratemaking process. Not less than thirty calendar days prior to the hearing required by Act 279, the Board shall provide Customer with written notice of a proposed rate and the underlying data used to calculate the rate. The Board shall meet with Customer to review the rate and the data.

7.03 Estimate of Usage. In the event meters fail to correctly measure the quantity of water supplied to Customer for any period of time, the Board shall provide a reasonable estimate of the quantity of water supplied to Customer for such period provided that there is a reasonable basis for the estimate. Customer and the Board shall, either through their respective technical representatives and/or the Technical Advisory Committee, seek agreement upon a method to estimate such quantities. In the event the Parties are unable to agree upon a method to estimate such quantities, the Board's determination of a method shall be conclusive and the Customer agrees to accept the estimate established by the Board.

7.04 Rate Methodology. The Board agrees to provide to Customer a description of the current methodology for rate making in the form of the "Rates 101" document produced by the Technical Advisory Committee, as may be periodically updated. The "Rates 101" document, entitled *DWSD Rates: Understanding DWSD Wholesale Water Rates*, and any updates thereto shall be provided to Customer via posting on the DWSD website.

Article 8.
Meters and Meter Facilities

8.01 Metering Requirement. All water furnished by the Board to Customer shall be measured by water meters installed in Meter Facilities at Customer's Water Distribution Points unless, in the Board's determination, it is not feasible to install water meters due to the configuration of Customer's water system.

8.02 Existing Distribution Points. As of the effective date of this Contract, the Board shall own, operate and maintain all water meters and Meter Facilities for all existing Water Distribution Points, unless specifically indicated otherwise in Exhibit A.

8.03 Customer Maintenance Responsibilities. Customer shall be responsible for maintaining at its Water Distribution Points any and all appurtenances as may be designated as Customer's responsibility in Exhibit A. Should Customer fail to maintain the appurtenances shown in Exhibit A, the Board may take reasonable steps to maintain the appurtenances and charge the reasonable cost of doing so to Customer. Prior to the Board taking action to maintain the appurtenances, the Board shall give Customer thirty days written notice to complete the required maintenance. Notice to the Customer shall not be required if, in the Board's determination, there exists an emergency condition affecting the operation of the System or if the health, safety and welfare of the general public may be jeopardized.

8.04 New Distribution Points. For any new Water Distribution Points that may be constructed or installed after the effective date of this Contract, Customer shall furnish at Customer's expense, a water meter and Meter Facility that meets the Board's specifications. Thereafter, the Board shall furnish any replacement water meters for new Water Distribution Points and the expense shall be recovered through the Board's rates as a System cost. The Board shall own, operate and maintain all water meters and Meter Facilities after construction, installation or replacement, unless specifically indicated otherwise in Exhibit A.

8.05 Meter Repair and Replacement. If the Board initiates a meter repair or meter replacement, the cost shall be recovered through the Board's rates as a System cost. If Customer requests a meter replacement for reasons other than malfunction or disrepair, Customer shall pay the cost of the replacement.

8.06 Pressure Regulating Facilities. After the effective date of this Contract, all newly installed Customer-owned pressure regulating facilities shall be installed in a facility that is separate from the Board's Meter Facility.

Article 9.
Dispute Resolution

9.01 Any and all claims alleging a breach of this Contract may first be submitted to an alternative dispute resolution process. An alternative dispute resolution process may include, but is not limited to, facilitation, binding arbitration, or non-binding arbitration. Each Party shall be responsible for its own costs and fees (including expert witness fees and attorney fees), unless otherwise agreed to in writing. The Parties shall agree upon the form and procedures for the agreed upon alternative dispute resolution process. This Article 9 shall not prohibit a Party from seeking relief directly from a court of competent jurisdiction at any time.

Article 10.
Default Provisions

10.01 In the event either Party commits a material breach of this Contract, the Party alleging the breach shall give written notice of the breach to the other Party within a reasonable time of discovering the breach. The Party in breach shall be given a reasonable time to cure the breach. If the Party in breach fails to cure the breach, the non-breaching Party may declare this Contract in default and pursue all available legal remedies, including termination of this Contract for cause. In the event that the Party in breach is showing reasonable progress toward curing the breach, the Party alleging the breach may extend the time for curing the breach.

Article 11.
Force Majeure and Other Events

11.01 Force Majeure. No failure or delay in performance of this Contract, by either Party, shall be deemed to be a breach thereof when such failure or delay is caused by a force majeure event including, but not limited to, any Act of God, strikes, lockouts, wars, acts of terrorism, riots, epidemics, explosions, sabotage, breakage or accident to machinery or lines of pipe, the binding order of any court or governmental authority, or any other cause, whether of the kind herein enumerated or otherwise, not within the control of a Party, except that no cause or contingency shall relieve Customer of its obligation to make payment for water delivered by the Board.

11.02 Board Liability. Except to the extent that the Board is the proximate cause, the Board shall not be held liable or accountable for any bursting, leakage, breakage, damage or accident of any kind that may occur to Customer's water works system, or any damages of any kind or nature, including, but not limited to, injury to persons or damage to property, resulting from such bursting, leakage, breakage, damage or accident that may occur to water mains or pipes located downstream of the Water Distribution Points specified herein, or located within Customer's distribution system.

11.03 Discontinuance of Service. In the event the public health, safety and welfare requires the Board to discontinue temporarily all or part of the supply of water to Customer, no claims for damages of any kind or nature for such discontinuance shall be made by Customer against the Board. The Board will provide notice to Customer of any temporary discontinuance of the water supply.

Article 12.
Timely Payment

12.01 Bills for water service shall be rendered to Customer on a monthly basis. All such bills shall be due and payable within forty-five calendar days from the date shown on the bill. Any portion of the charges that are not paid by the due date shall be subject to a finance charge at a rate of 1.5% per month for each month that they remain unpaid. Any portion of the total bill, plus any finance charges applied to the bill which are not paid by the next billing date, shall be shown on the next bill as arrears. The Board may disconnect water service if bills are overdue ninety calendar days from the billing date. The Board shall not terminate water service if there is a good faith dispute concerning the accuracy of billings. If the accuracy of a bill is in dispute, Customer shall place the disputed amount in an escrow account pending resolution of the dispute. Accrued interest on the escrow account shall belong to the Party that prevails in the resolution of the dispute.

Article 13.
Assignment

13.01 This Contract shall not be assigned, in whole or in part, by either Party without the prior written consent of the other Party. Consent to an assignment by either Party shall not be unreasonably withheld.

Article 14.
Ensuring Equality of Contract Terms

14.01 If the Board enters into any contract, and any amendments thereto, with a water service customer other than Customer, and the material terms of such other contract are more favorable than the material terms of Customer's Contract, Customer may elect to adopt all of such other material terms. However, if Customer exercises the option provided for in this Article 14, Customer must accept all material terms of the other contract in their entirety and may not select among various terms contained in multiple other contracts by, for example, selecting the Contract Term from one contract and the Early Termination Costs provision of another contract. The terms and conditions of Exhibit B of this Contract are specifically excluded from the application of this Article 14.

Article 15.
Amendment

15.01 The Parties may periodically consider it in their best interests to change, modify or extend a term, condition or covenant of this Contract for reasons which may include, but are not limited to, the creation, expansion or closing of industry or other business. Any change, addition, deletion, extension or modification that is mutually agreed upon by the Board and Customer shall be incorporated in a written amendment to this Contract. Such amendments shall not invalidate this Contract nor relieve or release either Party of any of its respective obligations under this Contract unless so stated in the amendment.

15.02 No amendment to this Contract shall be effective and binding upon the Parties unless it expressly makes reference to this Contract, is in writing, is signed and acknowledged by duly authorized representatives of both Parties, is approved by Customer's governing body, and is approved by the Board and the Detroit City Council.

Article 16.
Notices

16.01 Except as otherwise specified herein, all notices, consents, approvals, requests and other communications (collectively, "Notices") required or permitted under this Contract shall be given in writing and mailed by first class mail to the Parties and at the addresses identified in Exhibit B.

16.02 All Notices shall be deemed given on the day of post-marked mailing. Any Notice given by a Party hereunder must be signed by an authorized representative of such Party.

16.03 Notwithstanding the requirement above as to the use of first-class mail, change of address notices, termination notices, and other Notices of a legal nature, shall be sent by certified first-class mail, postage prepaid, return receipt requested.

Article 17.
Water Quality

17.01 Contamination. For the protection of the health of all consumers supplied with water from the System, Customer agrees to guard carefully against all forms of contamination. Should contamination occur, the area or areas affected shall immediately be shut off and isolated, and shall remain so until such conditions shall have been abated, and the water declared safe and fit for human consumption by the properly constituted governmental health agencies having jurisdiction of the area affected. Customer shall immediately notify the Board, and the Board shall immediately notify Customer, of any emergency or condition that may affect the quality of water in either Party's system.

17.02 Co-mingling of Water Sources. Except in cases of emergency, Customer will not permit water from any other source of supply to be mixed or mingled with water from the System without prior written approval from the Board. In cases of emergency, only such water from sources other than the Board shall be used as shall meet the requirements of the Michigan Department of Environmental Quality, and then only in such quantities as shall be necessary to relieve the emergency.

17.03 Emergency Connections. During emergencies, Customer's water facilities may be used and connected, at the discretion of the Board, to water facilities serving other communities for flow in either direction to provide an adequate water supply from the System to Customer and to other areas and other units of government. Customer shall be permitted to immediately make an emergency connection when the connection point to be used has been previously approved for emergency use by the Board in writing, provided that Customer shall, after making the connection, promptly notify the Board of such event. When the emergency has been abated, the emergency connection must be severed as soon as practicable. The Board, or its designee, must approve, in writing, the continuation of any emergency connection that is required for longer than seven calendar days. If an approved emergency connection continues for more than seven calendar days, Customer must provide the Board with weekly updates on the emergency and a schedule for abatement of the emergency that must be approved by the Board in writing.

17.04 Water Quality. The Board shall endeavor to remain in compliance with all applicable Michigan and Federal laws, rules and regulations regarding drinking water quality.

Article 18.
Rights-of-Way

18.01 Use of Rights-of-Way. The Customer shall assist the Board to obtain permission to use streets, highways, alleys, and/or easements in the local governmental units within the Customer's jurisdiction for the purpose of constructing, maintaining, and operating water facilities to adequately service the Customer's jurisdiction and other areas. This assistance shall include obtaining the consent of the local governmental units, as provided in Article 7, Section 29, Michigan Constitution of 1963. In the event of such construction, the Board shall request the Customer and local governmental units within the Customer's jurisdiction to execute such separate instruments granting rights-of-way in its streets, highways, and alleys as may be reasonably required by the Board. The

Board shall give the Customer notice of any construction work in the Customer's jurisdiction. The Board shall comply with any of Customer's ordinances that apply to the construction. Customer shall inform the Board of the applicable ordinances. The Board and Customer shall meet to review the construction and its impact on their respective operations. The Board shall restore all existing structures and/or improvements laying in the right-of-way of construction to as good a condition as before the construction took place. Any such facilities constructed, maintained and operated under this section shall remain the property of the Board and shall not be operated or maintained by any entity other than the Board or its authorized representatives.

18.02 Relocation of Facilities. Should future construction by any federal, state or county agency require relocation of a water transmission main, Meter Facility or other Board facility, the cost incurred by the Board for such relocation, if not reimbursed by the agency requiring the relocation, will be charged in future rates as a common-to-all cost to all System users. Otherwise, the cost incurred by the Board for construction requiring the relocation of a water transmission main, Meter Facility or other Board facility that is proposed, required, undertaken, conducted or facilitated by Customer will be charged to Customer.

18.03 Easements. Subject to the provisions of Section 18.01 herein and to the extent that Customer has jurisdiction, the Board shall be granted temporary and permanent easements, and shall be permitted to use the streets, alleys and highways within Customer's legal jurisdiction for the purpose of constructing, operating and maintaining the System. This consent by Customer is given in compliance with Article 7, Sec. 29 of the Michigan Constitution of 1963, provided that the Board shall provide Customer with a written explanation of the type of easement required and the duration thereof.

Article 19.
Access to Towers and Antennas

19.01 Where possible, each Party shall give to the other Party access to towers and antennas under its respective jurisdiction for the purpose of transmitting information recorded in the Meter Facilities. Access shall not be unreasonably denied by either Party.

Article 20.
Relationship to Wastewater Services

20.01 Customer and the Board acknowledge that future growth in the System may place additional burdens on their respective wastewater systems. Customer, if it is also a wastewater disposal services customer of the Board, understands that any increase in the volume of water it receives from the System is not a guarantee of increased capacity in the Board's wastewater disposal system.

Article 21.
Construction Standards

21.01 The Board shall have the right to review and approve Customer's construction plans for Meter Facilities at new Water Distribution Points, water mains sized twenty-four inches and larger, pump stations, reservoirs and water towers. The Board's approval of construction plans shall be timely and shall not be unreasonably withheld.

Article 22.
Operation of Storage

22.01 Prior to Customer's operation of any new or existing water storage facility, Customer shall seek the Board's written approval of the filling schedule ("Filling Schedule") of the storage facility. The Board may periodically require Customer to change or adjust a previously approved Filling Schedule. The Parties shall collaborate on devising a mutually beneficial Filling Schedule. If the Parties are unable to agree upon a Filling Schedule, the Board's determination of a Filling Schedule shall be final. All Filling Schedules shall be for a period of six consecutive hours. Customer shall at all times abide by the then-current Board approved Filling Schedule. The Board shall act promptly in approving Filling Schedule requests. Nothing in this Article 22 shall prevent Customer from operating its storage facility at any time, provided that any storage operation that falls outside of the approved Filling Schedule shall not be exempt from the terms of Sections 5.03 and 5.04 herein.

Article 23.
Miscellaneous

23.01 If any provision of this Contract or its application to any person or circumstance shall to any extent be invalid or unenforceable, the remainder of this Contract shall not be affected and shall remain valid and enforceable to the fullest extent permitted by law.

23.02 This Contract contains the entire agreement between the Parties and all prior negotiations and agreements are merged into this Contract. Neither Party has made any representations except those expressly set forth in this Contract, and no rights or remedies are, or shall be, acquired by either Party by implication or otherwise unless expressly set forth in this Contract.

23.03 Unless the context otherwise expressly requires, the words "herein," "hereof," and "hereunder," and other words of similar import, refer to this Contract as a whole and not to any particular section or subdivision.

23.04 The headings of the sections of this Contract are for convenience only and shall not be used to construe or interpret the scope or intent of this Contract or in any way affect the same.

23.05 The rights and remedies set forth in this Contract are not exclusive and are in addition to any of the rights or remedies provided by law or equity. This Contract and all actions arising under it shall be governed by, subject to, and construed according to the law of the State of Michigan. Each Party agrees, consents and submits to the exclusive personal jurisdiction of any state or federal court of competent jurisdiction in Wayne County, Michigan, for any action arising out of this Contract. Each Party also agrees that it shall not commence any action against the other Party because of any matter whatsoever arising out of or relating to the validity, construction, interpretation and enforcement of this Contract in any state or federal court of competent jurisdiction other than one in Wayne County, Michigan.

23.06 There are no third party beneficiaries to this Contract and this Contract shall not be construed to benefit any persons other than the Board and Customer.

23.07 This Contract may be executed in any number of originals, any one of which shall be deemed an accurate representation of this Contract. Promptly after the execution of this Contract, the Board shall provide a copy to the Customer.

23.08 The rights and benefits under this Contract shall inure to the benefit of and be binding upon the respective Parties hereto, their agents, successors, and assigns.

23.09 Any and all documents, memoranda, reports, exhibits or other written material referred to in this Contract are and shall be incorporated by reference herein.

23.10 This Contract shall be deemed to be mutually drafted.

(Signatures appear on next page)

In Witness Whereof, the City and Customer, by and through their duly authorized officers and representatives, have executed this Contract.

Witnesses:	**City of ____________________:**
1. ____________________ (signature)	By: ____________________ (signature)
	____________________ (print name)
2. ____________________ (signature)	Its: ____________________ (title)

Witnesses:	**City of Detroit:**
1. ____________________ (signature)	By: ____________________ Kwame M. Kilpatrick
2. ____________________ (signature)	Its: Mayor

APPROVED BY
CUSTOMER'S GOVERNING BODY ON:

____
Date

APPROVED BY
BOARD OF WATER COMMISSIONERS ON:

____
Date

APPROVED BY
DETROIT CITY COUNCIL ON:

____
Date

EXHIBIT A

Customer's Water Distribution Points

This Exhibit contains the following information:

1. The corporate limits of Customer;

2. The agreed upon water Service Area of Customer which (a) may or may not be entirely within the corporate limits of Customer and (b) which may or may not include the entire area within the Customer's corporate limits;

3. The specific location of the Water Distribution Points, including any Board approved emergency connections;

4. The designation of appurtenances to be maintained by Customer and those to be maintained by the Board; and

5. A list of any closed meter locations.

EXHIBIT B

Projected Annual Volume and Minimum Annual Volume (Table 1)
Pressure Range and Maximum Flow Rate (Table 2)
Flow Split Assumptions (Table 3)
Addresses for Notice (Table 4)

Table 1 and Table 2 set forth the agreed upon Projected Annual Volumes, Minimum Annual Volumes, Pressure Ranges and Maximum Flow Rates for the term of this Contract provided that figures in bold type face are immediately enforceable pursuant to the terms of Section 5.07 and italicized figures are contained for planning purposes only but will become effective absent the negotiated replacements anticipated in Section 5.07.

The approximate rate of flow by individual meter set forth in Table 3 is the assumption upon which the Pressure Range commitments established in Table 2 have been devised. Should Customer deviate from these assumptions at any meter(s), the Board may be unable to meet the stated Pressure Range commitments in this Contract or in the contract of another customer of the Board and Section 5.08 of this Contract may be invoked.

EXHIBIT B

Table 1
Projected Annual Volume and Minimum Annual Volume

Fiscal Year Ending June 30	Projected Annual Volume (mcf)	Minimum Annual Volume (mcf)
2009	**400,000**	**200,000**
2010	**404,000**	**202,000**
2011	*408,000*	*204,000*
2012	*412,100*	*206,050*
2013	*416,200*	*208,100*
2014	*420,400*	*210,200*
2015	*424,600*	*212,300*
2016	*428,800*	*214,400*
2017	*433,100*	*216,550*
2018	*437,400*	*218,700*
2019	*441,800*	*220,900*
2020	*446,200*	*223,100*
2021	*450,700*	*225,350*
2022	*455,200*	*227,600*
2023	*459,800*	*229,900*
2024	*464,400*	*232,200*
2025	*469,000*	*234,500*
2026	*473,700*	*236,850*
2027	*478,400*	*239,200*
2028	*483,200*	*241,600*
2029	*488,000*	*244,000*
2030	*492,900*	*246,450*
2031	*497,800*	*248,900*
2032	*502,800*	*251,400*
2033	*507,800*	*253,900*
2034	*512,900*	*256,450*
2035	*518,000*	*259,000*
2036	*523,200*	*261,600*
2037	*528,400*	*264,200*
2038	*533,700*	*266,850*

EXHIBIT B

Table 2
Pressure Range and Maximum Flow Rate

Calendar Year	Pressure Range (psi) Meter 1		Pressure Range (psi) Meter 2		Pressure Range (psi) Meter 3		Maximum Flow Rate (mgd)	
	Min	Max	Min	Max	Min	Max	Max Day	Peak Hour
2008	**110**	**145**	**115**	**145**	**110**	**145**	**20.0**	**35.0**
2009	**110**	**145**	**115**	**145**	**110**	**145**	**20.2**	**35.4**
2010	*110*	*145*	*115*	*145*	*110*	*145*	*20.4*	*35.8*
2011	*110*	*145*	*115*	*145*	*110*	*145*	*20.6*	*36.2*
2012	*110*	*145*	*115*	*145*	*110*	*145*	*20.8*	*36.6*
2013	*110*	*145*	*115*	*145*	*110*	*145*	*21.0*	*37.0*
2014	*110*	*145*	*115*	*145*	*110*	*145*	*21.2*	*37.4*
2015	*110*	*145*	*115*	*145*	*110*	*145*	*21.4*	*37.8*
2016	*110*	*145*	*115*	*145*	*110*	*145*	*21.6*	*38.2*
2017	*110*	*145*	*115*	*145*	*110*	*145*	*21.8*	*38.6*
2018	*112*	*145*	*117*	*145*	*112*	*145*	*22.0*	*39.0*
2019	*112*	*145*	*117*	*145*	*112*	*145*	*22.2*	*39.4*
2020	*112*	*145*	*117*	*145*	*112*	*145*	*22.4*	*39.8*
2021	*112*	*145*	*117*	*145*	*112*	*145*	*22.6*	*40.2*
2022	*112*	*145*	*117*	*145*	*112*	*145*	*22.8*	*40.6*
2023	*112*	*145*	*117*	*145*	*112*	*145*	*23.0*	*41.0*
2024	*112*	*145*	*117*	*145*	*112*	*145*	*23.2*	*41.4*
2025	*112*	*145*	*117*	*145*	*112*	*145*	*23.4*	*41.8*
2026	*112*	*145*	*117*	*145*	*112*	*145*	*23.6*	*42.2*
2027	*112*	*145*	*117*	*145*	*112*	*145*	*23.8*	*42.6*
2028	*115*	*150*	*120*	*150*	*115*	*150*	*24.0*	*43.0*
2029	*115*	*150*	*120*	*150*	*115*	*150*	*24.2*	*43.4*
2030	*115*	*150*	*120*	*150*	*115*	*150*	*24.4*	*43.8*
2031	*115*	*150*	*120*	*150*	*115*	*150*	*24.6*	*44.2*
2032	*115*	*150*	*120*	*150*	*115*	*150*	*24.8*	*44.6*
2033	*115*	*150*	*120*	*150*	*115*	*150*	*25.0*	*45.0*
2034	*115*	*150*	*120*	*150*	*115*	*150*	*25.3*	*45.5*
2035	*115*	*150*	*120*	*150*	*115*	*150*	*25.6*	*46.0*
2036	*115*	*150*	*120*	*150*	*115*	*150*	*25.9*	*46.5*
2037	*115*	*150*	*120*	*150*	*115*	*150*	*26.2*	*47.0*

EXHIBIT B

Table 3
Flow Split Assumptions

Meter	Assumed Flow Split (2008-2009)
1	50%
2	30%
3	50%

Table 4
Addresses for Notice

If to the Board:	If to Customer:
Director Detroit Water and Sewerage Department 735 Randolph Detroit, Michigan 48226	Title Address City, Michigan, Zip Code

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 19
Schedule

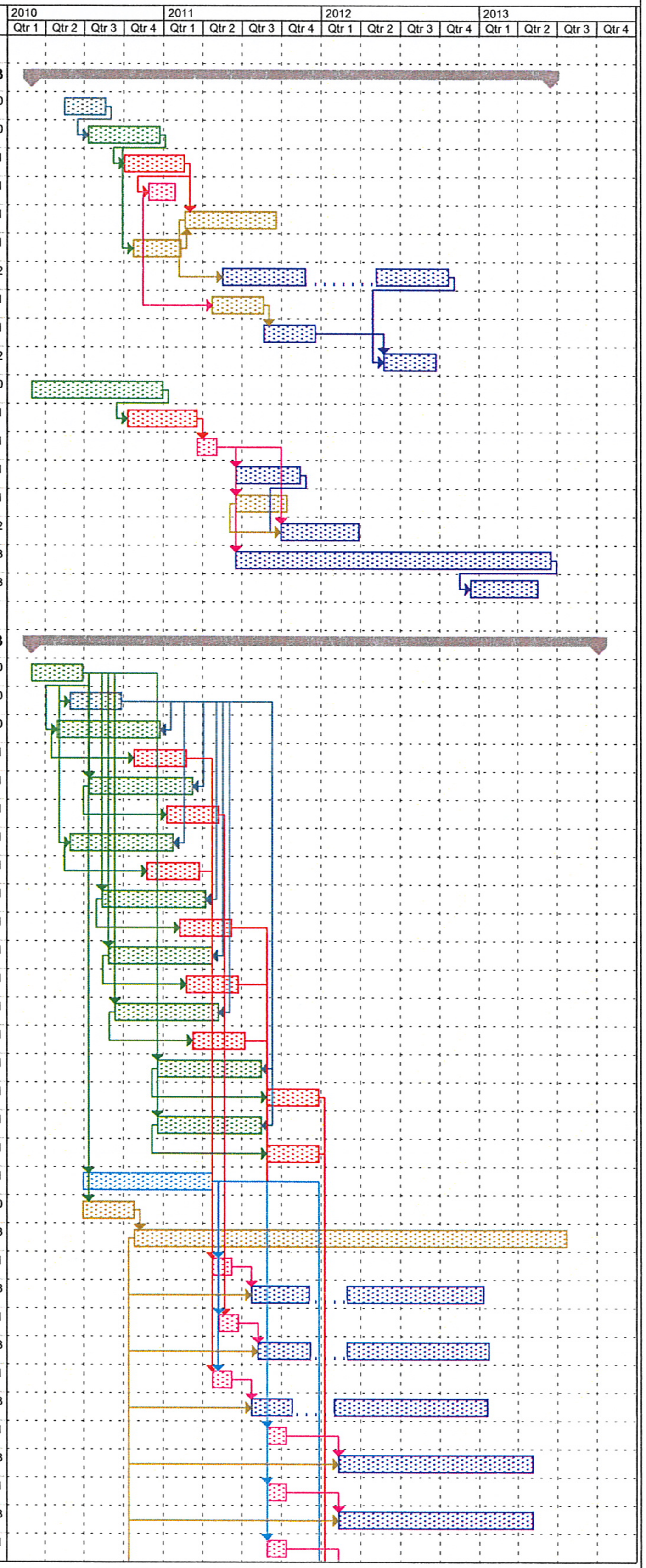
March 3, 2009

19.1 Introduction

A schedule for implementation follows.

Project Schedule
Lake Huron Water Supply

ID	Task Name	Duration	Start	Finish
1				
2	**Intake & LHPS**	**1090 days**	**Mon 3/1/10**	**Sun 6/16/13**
1	Lake Borings	70 days	Mon 5/17/10	Fri 8/20/10
2	Intake Design	120 days	Mon 7/12/10	Fri 12/24/10
3	Intake Permitting	100 days	Mon 10/4/10	Fri 2/18/11
4	Bidding	45 days	Mon 11/29/10	Fri 1/28/11
5	Pipe Manufacture	210 days	Mon 2/21/11	Tue 9/20/11
6	Pipe Procurement	80 days	Mon 10/25/10	Fri 2/11/11
7	Pipe Installation	360 days	Thu 5/19/11	Mon 10/22/12
8	Crib Timber Supply	120 days	Sun 4/24/11	Sun 8/21/11
9	Crib Construction	120 days	Mon 8/22/11	Mon 12/19/11
10	Crib Installation	120 days	Sat 5/26/12	Sat 9/22/12
11	LHPS Design	220 days	Mon 3/1/10	Fri 12/31/10
12	LHPS Permitting	120 days	Mon 10/11/10	Sat 3/19/11
13	Bidding	45 days	Sun 3/20/11	Tue 5/3/11
14	Shorewell Construction	150 days	Sat 6/18/11	Mon 11/14/11
15	Pipe Manufacture	120 days	Sat 6/18/11	Sat 10/15/11
16	Pipe Installation	180 days	Sat 10/1/11	Wed 3/28/12
17	Pump Station Construction	720 days	Sat 6/18/11	Sun 6/16/13
18	Reservoir Construction	150 days	Thu 12/13/12	Fri 5/17/13
3				
4	**Pipelines**	**1314 days**	**Mon 3/1/10**	**Sat 10/5/13**
1	Finalize Pipeline Size & Route	120 days	Mon 3/1/10	Mon 6/28/10
2	Soil Borings	120 days	Sun 5/30/10	Sun 9/26/10
3	Pipeline Design - Contract 1	240 days	Fri 4/30/10	Sat 12/25/10
4	Pipeline Permitting (PA 399) - Contract 1	120 days	Wed 10/27/10	Wed 2/23/11
5	Pipeline Design - Contract 2	240 days	Wed 7/14/10	Thu 3/10/11
6	Pipeline Permitting (PA 399) - Contract 2	120 days	Mon 1/10/11	Mon 5/9/11
7	Pipeline Design - Contract 3	240 days	Sun 5/30/10	Mon 1/24/11
8	Pipeline Permitting (PA 399) - Contract 3	120 days	Fri 11/26/10	Fri 3/25/11
9	Pipeline Design - Contract 4	240 days	Fri 8/13/10	Sat 4/9/11
10	Pipeline Permitting (PA 399) - Contract 4	120 days	Wed 2/9/11	Wed 6/8/11
11	Pipeline Design - Contract 5	240 days	Sat 8/28/10	Sun 4/24/11
12	Pipeline Permitting (PA 399) - Contract 5	120 days	Thu 2/24/11	Thu 6/23/11
13	Pipeline Design - Contract 6	240 days	Sun 9/12/10	Mon 5/9/11
14	Pipeline Permitting (PA 399) - Contract 6	120 days	Fri 3/11/11	Fri 7/8/11
15	Pipeline Design - Contract 7	240 days	Mon 12/20/10	Tue 8/16/11
16	Pipeline Permitting (PA 399) - Contract 7	120 days	Mon 8/29/11	Mon 12/26/11
17	Pipeline Design - Contract 8	240 days	Mon 12/20/10	Tue 8/16/11
18	Pipeline Permitting (PA 399) - Contract 8	120 days	Mon 8/29/11	Mon 12/26/11
19	Pipeline R.O.W.	300 days	Tue 6/29/10	Sun 4/24/11
20	Pipe Procurement & Mat'l Selection	120 days	Tue 6/29/10	Tue 10/26/10
21	Pipe Production	1000 days	Wed 10/27/10	Mon 7/22/13
22	Pipe Bidding - Contact 1	45 days	Mon 4/25/11	Wed 6/8/11
23	Pipe Construction - Contract 1	450 days	Sun 7/24/11	Thu 1/10/13
24	Pipe Bidding - Contact 2	45 days	Tue 5/10/11	Thu 6/23/11
25	Pipe Construction - Contract 2	450 days	Mon 8/8/11	Tue 1/22/13
26	Pipe Bidding - Contact 3	45 days	Mon 4/25/11	Wed 6/8/11
27	Pipe Construction - Contract 3	450 days	Sun 7/24/11	Sat 1/19/13
28	Pipe Bidding - Contact 4	45 days	Mon 8/29/11	Wed 10/12/11
29	Pipe Construction - Contract 4	450 days	Fri 2/10/12	Sat 5/4/13
30	Pipe Bidding - Contact 5	45 days	Mon 8/29/11	Wed 10/12/11
31	Pipe Construction - Contract 5	450 days	Fri 2/10/12	Sat 5/4/13
32	Pipe Bidding - Contact 6	45 days	Mon 8/29/11	Wed 10/12/11

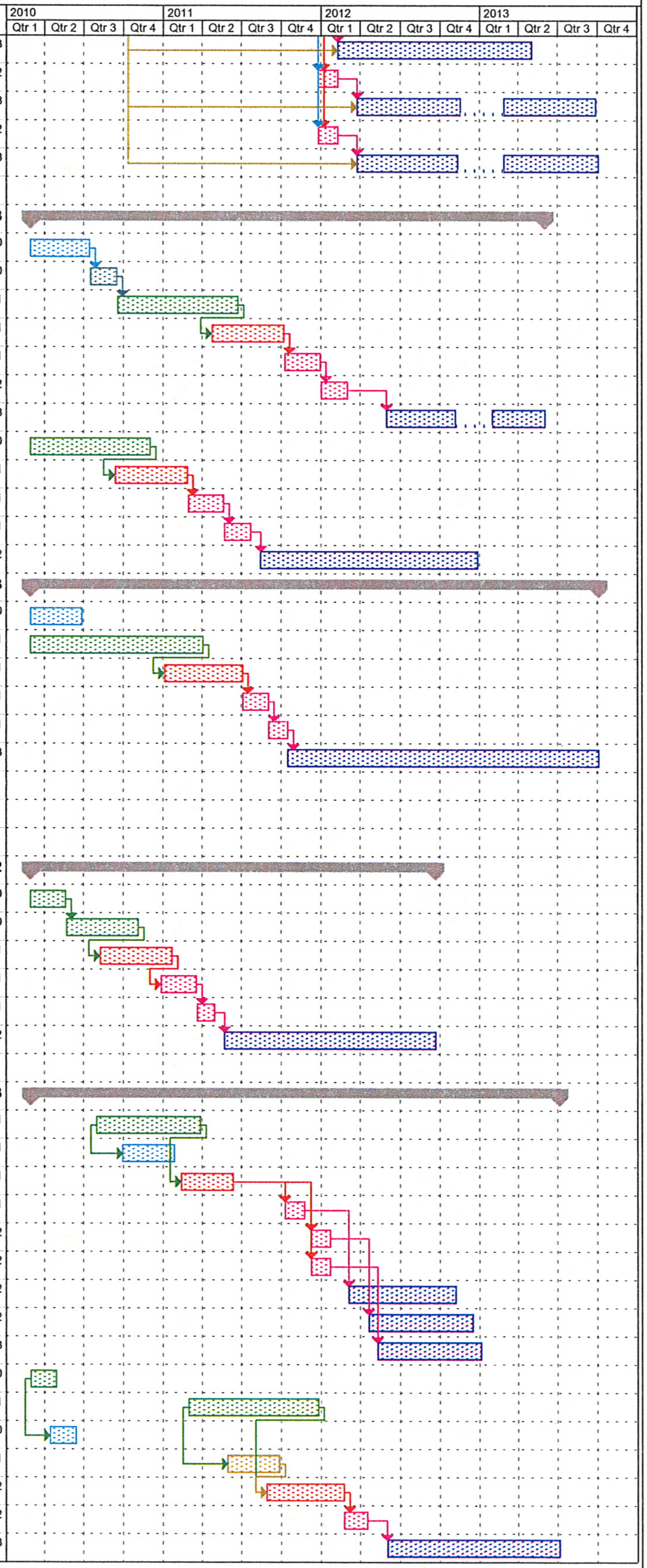


Project: Project Schedule
Date: Tue 10/6/09

Task		Milestone		Rolled Up Split		External Tasks	
Split		Summary		Rolled Up Milestone		Project Summary	
Progress		Rolled Up Task		Rolled Up Progress			

Project Schedule
Lake Huron Water Supply

ID		Task Name	Duration	Start	Finish
33		Pipe Construction - Contract 6	450 days	Fri 2/10/12	Sat 5/4/13
34		Pipe Bidding - Contact 7	45 days	Tue 12/27/11	Thu 2/9/12
35		Pipe Construction - Contract 7	450 days	Mon 3/26/12	Sun 9/29/13
36		Pipe Bidding - Contact 8	45 days	Tue 12/27/11	Thu 2/9/12
37		Pipe Construction - Contract 8	450 days	Mon 3/26/12	Sat 10/5/13
5					
6		**Reservoir and RPS**	**851 days**	**Mon 3/1/10**	**Mon 6/3/13**
1		Land Acquistion	100 days	Mon 3/1/10	Fri 7/16/10
2		Soil Borings	45 days	Mon 7/19/10	Fri 9/17/10
3		Reservoir Design	200 days	Mon 9/20/10	Fri 6/24/11
4		Reservoir Permitting	120 days	Mon 4/25/11	Fri 10/7/11
5		Reservoir Bidding	60 days	Mon 10/10/11	Fri 12/30/11
6		Reservoir Award	45 days	Mon 1/2/12	Fri 3/2/12
7		Reservoir Construction	200 days	Fri 6/1/12	Mon 6/3/13
8		RPS Design	200 days	Mon 3/1/10	Fri 12/3/10
9		RPS Permitting	120 days	Mon 9/13/10	Fri 2/25/11
10		RPS Bidding	60 days	Mon 2/28/11	Fri 5/20/11
11		RPS Award	45 days	Mon 5/23/11	Fri 7/22/11
12		RPS Construction	360 days	Mon 8/15/11	Fri 12/28/12
7		**Genesee Co. WTP**	**1315 days**	**Mon 3/1/10**	**Sat 10/5/13**
1		Land Acquisition	120 days	Mon 3/1/10	Mon 6/28/10
2		Design	400 days	Mon 3/1/10	Mon 4/4/11
3		Permitting	180 days	Wed 1/5/11	Sun 7/3/11
4		Bidding	60 days	Mon 7/4/11	Thu 9/1/11
5		Award	45 days	Fri 9/2/11	Sun 10/16/11
6		Construction	720 days	Mon 10/17/11	Sat 10/5/13
8					
9					
10					
11		**Flint WTP**	**670 days**	**Mon 3/1/10**	**Fri 9/21/12**
1		Finalize Design Concept	60 days	Mon 3/1/10	Fri 5/21/10
2		Design Engineering	120 days	Mon 5/24/10	Fri 11/5/10
3		Permitting	120 days	Mon 8/9/10	Fri 1/21/11
4		Bidding	60 days	Mon 12/27/10	Fri 3/18/11
5		Award	30 days	Mon 3/21/11	Fri 4/29/11
6		Construction	350 days	Mon 5/23/11	Fri 9/21/12
12					
13		**Lapeer County**	**1215 days**	**Mon 3/1/10**	**Sat 7/6/13**
1		Pipeline Design	240 days	Sun 8/1/10	Mon 3/28/11
2		ROW Procurement	120 days	Thu 9/30/10	Thu 1/27/11
3		Pipeline Permitting	120 days	Sat 2/12/11	Sat 6/11/11
4		Pipeline Contract 1 Bidding	45 days	Mon 10/10/11	Wed 11/23/11
5		Pipeline Contract 2 Bidding	45 days	Fri 12/9/11	Sun 1/22/12
6		Pipeline Contract 3 Bidding	45 days	Fri 12/9/11	Sun 1/22/12
7		Pipeline Contract 1 Construction	240 days	Mon 3/5/12	Tue 11/6/12
8		Pipeline Contract 2 Construction	240 days	Sat 4/21/12	Sun 12/16/12
9		Pipeline Contract 3 Construction	240 days	Fri 5/11/12	Sat 1/5/13
10		Finalize WTP Concept	60 days	Mon 3/1/10	Thu 4/29/10
11		WTP Design	300 days	Tue 3/1/11	Sun 12/25/11
12		WTP Land Procurement	60 days	Thu 4/15/10	Sun 6/13/10
13		WTP Equipment Procurement	120 days	Mon 5/30/11	Mon 9/26/11
14		WTP Permitting	180 days	Sun 8/28/11	Thu 2/23/12
15		WTP Bidding	45 days	Fri 2/24/12	Tue 4/17/12
16		WTP Construction	400 days	Sat 6/2/12	Sat 7/6/13



Project: Project Schedule
Date: Tue 10/6/09

Task	Milestone	Rolled Up Split	External Tasks
Split	Summary	Rolled Up Milestone	Project Summary
Progress	Rolled Up Task	Rolled Up Progress	

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 2
Planning Criteria

February 23, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

2.1 General

The Karegnondi Water Authority (KWA) is studying the feasibility of a new regional drinking water supply. The alternative studied will provide raw Lake Huron water to central Michigan communities. This memorandum summarizes the criteria used to develop the concept and resulting costs for the alternative considered.

2.2 Design Criteria

2.2.1 Service Area

It is assumed that the following communities are supplied water by the KWA, and are considered the customers of the KWA.

City of Flint
Genesee County
Lapeer County (Greater Lapeer County Utility Authority, GLCUA)
Sanilac County (Worth Township)

All proposed KWA customers are currently supplied finished water from other utilities. The City of Flint and the GLCUA are direct customers of the Detroit Water and Sewerage Department (DWSD). Genesee County is supplied water from the City of Flint and is therefore considered a second-tier customer of DWSD. Worth Township is supplied by the Lexington-Worth Townships Utility Authority (LWTUA); LWTUA is supplied by the Village of Lexington. Copies of existing water supply contracts for the communities in the service area are included in Appendix 16.

KWA customers may expand water service to other areas within their jurisdiction, in the future.

2.2.2 Study Period

The study period is 25 years.

The proposed alternative will be developed to meet the projected 25 year maximum day demands (MDD) of the Service Area, with consideration for future expansion as demands increase beyond the projected 25 year MDD.

2.2.3 Demands

Appendix 1 summarizes the demands used for this study.

2.2.4 Capacity

The new water supply alternative is planned to provide adequate capacity to deliver raw water to meet the maximum day demands of KWA customers. Peak hourly demands are assumed to be met by local storage provided by individual KWA customers.

2.2.5 Proposed Alternative

Figure 2.1 is a schematic of the proposed water supply. The capacity required for the projected 25 year MDD of the service are shown on the schematic.

Fig 2.1 – Water Supply Schematic

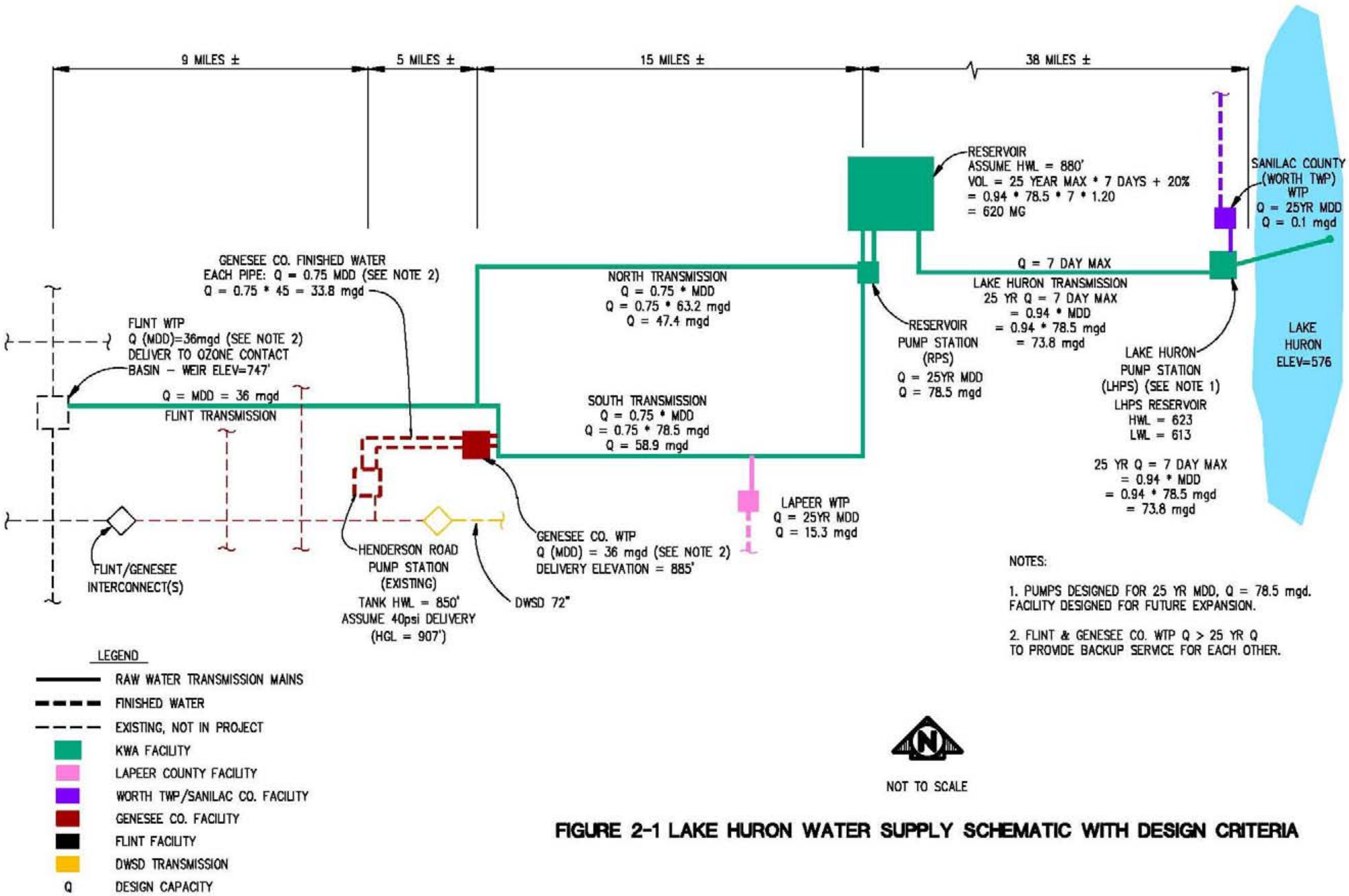


FIGURE 2-1 LAKE HURON WATER SUPPLY SCHEMATIC WITH DESIGN CRITERIA

2.2.6 Design Criteria

The proposed water supply alternative is planned to meet the criteria established by Michigan Department of Environmental Quality and other regulatory agencies with jurisdiction.

2.3 Economic Criteria

2.3.1 Opinions of Probable Cost

Estimates of construction cost are developed based on an assumed Engineering News-Record Construction Cost Index of 8688.

Estimates of construction cost are increased by 37% to determine the proposed project budget. The additional 37% accounts for the following project related costs.

Design Contingencies:	5%
Construction Contingencies:	15%
Engineering, Bonds, Legal, and Administration:	17%
Total	37%

2.3.2 Land

Proposed land procurement costs for the project are assumed as follows:

Easements: $0.15 per square foot
Land (purchase): $6,000 per acre (rural)

Genesee County purchased 230 acres of land in Worth Township, Sanilac County in 2002. The land was purchased for the potential use as a water supply facility. The land was purchased for $2.3 million. Because a portion of the property abuts Lake Huron, it is unique and was purchased at a premium above the typical cost of property in the project area.

2.3.3 Capitalized Interest

Capitalized interest is not included during the construction period.

2.3.4 Commencement of Operations

It is assumed that the proposed facilities will become operational in January 2014.

2.3.5 Operating, Maintenance, and Administrative Costs

It is assumed that operating, maintenance, and administrative costs increase at an annual rate of 3%.

Administrative costs of $200,000 during the initial year of the project, 2010. The administrative cost has been assumed to increase at an annual 3% rate of inflation.

Electrical power rates are assumed to be $0.063 per kWh in 2014. Electrical power rates are assumed to increase at an annual rate of 3%.

Labor rates for operation and maintenance personnel in 2014 have been assumed as follows:
WTP Superintendent - $35 per hour
Supervisor - $30 per hour
Operators - $20 per hour
Maintenance Mechanics - $25 per hour
Mechanics Helpers - $20 per hour
Instrument Technicians - $25 per hour

It is assumed that fringe benefits add 62% to the above labor rates. It is assumed that labor rates increase by 3% annually.

2.3.6 Depreciation

The lives of key components of the water supply have been assumed as follows:
Pipe – 75 years
Mechanical Equipment – 20 years
Physical Plant – 75 years

Depreciation expense is computed on a straight line basis, using the original installed cost of the facilities. Depreciation expense is considered constant throughout the study period, based upon the assumption that the price inflation will be offset by the rate-of-return on funds set aside for depreciation. Depreciation expenses are presented but are not included in annual operating and maintenance expenses.

2.3.7 Financing and Rate of Return

It is assumed that project financing will be at a rate of 6% over a period of 25 years.

2.4 Cost Distribution

The KWA will supply raw water to its customers and the costs thereof will be distributed amongst the KWA customers. Project costs associated with the construction of facilities for supply of raw water are divided proportionally on the basis of each customer's maximum day demand to the total design capacity of the facilities. Operating costs associated with the delivery of raw water are developed on a unit price basis ($ per MCF); operating costs for each KWA customer are determined based on the unit cost and each customer's average annual demand.

Each KWA customer will be individually responsible for the cost of construction and operation of the local facilities necessary to provide treatment other provisions necessary for local distribution. To provide for a complete evaluation, the concept studied also considers the needs for local treatment and supply to existing local distribution systems. Construction and operating costs associated with specific customer communities are assigned to the specific community and combined with their share of the KWA costs to determine the projected costs for each community.

Costs presented represent the additional costs which will be incurred by KWA customers if the proposed alternative replaces their existing water supply. Operating and maintenance expenses of existing facilities are not included in costs presented for the studied alternative.

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 3
Reliability Provisions

February 23, 2009

3.1 General

System reliability is one of primary criteria by which alternatives for long term water supply will be evaluated. For purposes of this study, reliability is considered the ability to continuously supply a safe water supply of sufficient quantity to meet the customer's needs, including fire protection.

Reliability of a water utility can be affected by any aspect of the utility, ranging from physical equipment to staff and operations. Reliability can be provided through redundancy of equipment or processes utilized for pumping and treating water, including ancillary systems such as power supply and control systems. Reliability can also be provided by an independent, redundant water supply which could be provided by water supply contracts with other utilities or by utilization of wells. Storage of a sufficient quantity of water can also provide reliability.

This memorandum reviews and establishes the criteria for reliability of the physical facilities included with the concept considered for a long term water supply for Karegnondi Water Authority (KWA) customers.

3.2 Proposed KWA Water Supply

The proposed KWA Lake Huron Water Supply will supply water to its customers, including Sanilac County, Lapeer County, GCDC-WWS, and the City of Flint. The proposed KWA supply will deliver raw water to customers for local treatment and distribution.

Figure 3.1 is a schematic showing the key components of the proposed KWA Lake Huron Water Supply.

3.3 Demands

It is assumed that the KWA will supply raw water to customers sufficient to meet the maximum day demands of the customers. It is assumed that water will be treated locally, with sufficient capacity to meet local maximum day demands. It is assumed that KWA customers will be responsible to provide sufficient local storage to meet peak hour demands.

The proposed raw water reservoir and facilities before the reservoir will be designed for the maximum demand over a consecutive seven day period. The reservoir will provide seven days of water storage to allow up to a week for repairs or maintenance of either the proposed single intake or single Lake Huron Transmission pipeline. A review of records indicates that the maximum demand over a consecutive seven day period is about 94% of the maximum day demand. For this study, the maximum consecutive seven day demand is termed the 7 day maximum demand.

Where twin pipelines are planned for redundancy, each will be designed so that together the pipelines have sufficient capacity to deliver the maximum day demand. However, each pipeline will be designed to provide "emergency demands" in the event that one of the pipelines must be removed from service for repairs or maintenance. For this study, emergency demands are assumed to be equal to 75% of the maximum day demand. Past experience indicates that maximum day demands can be reduced to this level through the use of outdoor water use restrictions.

Figure 3.1: Lake Huron Water Supply

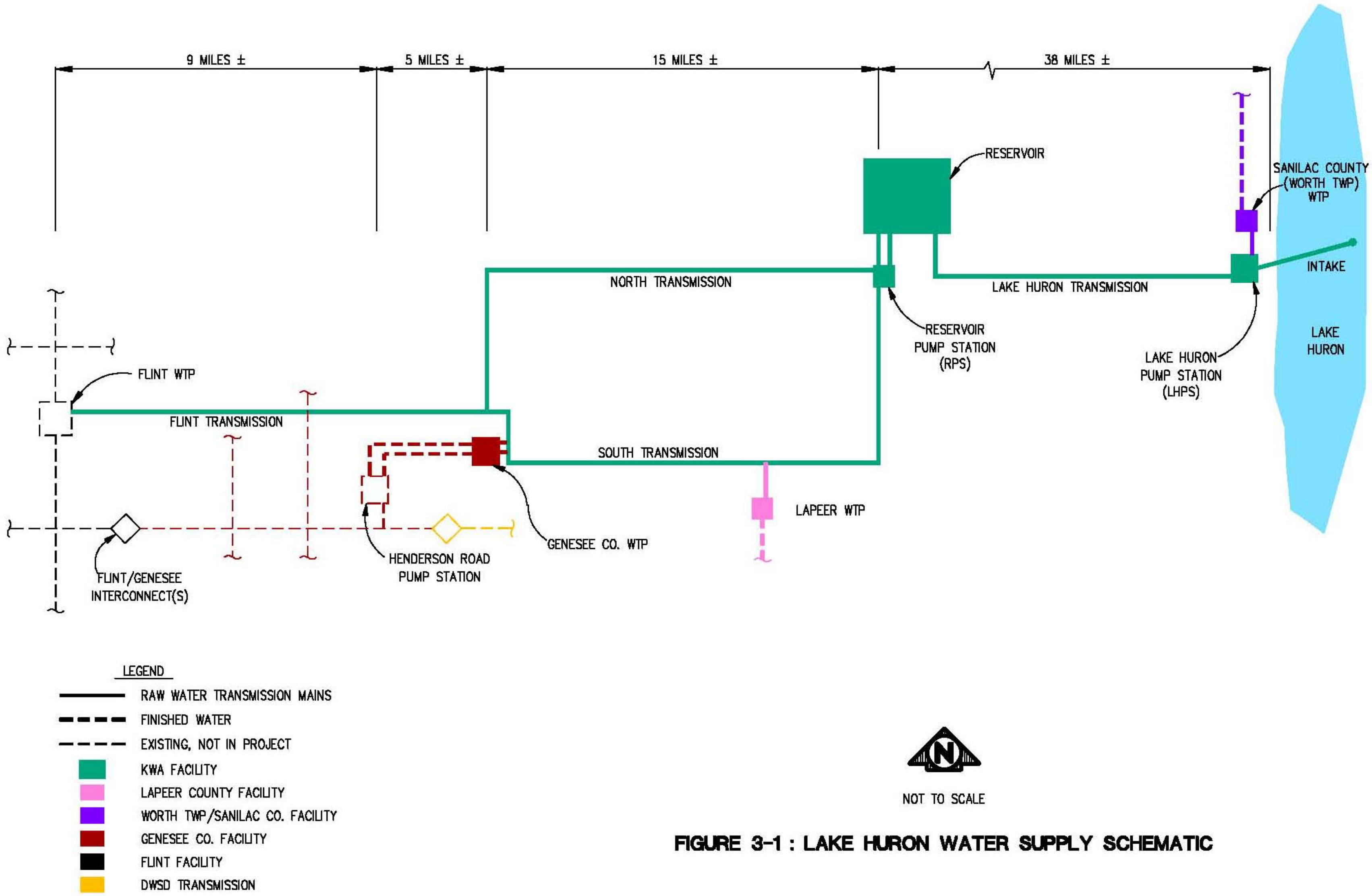


FIGURE 3-1 : LAKE HURON WATER SUPPLY SCHEMATIC

3.4 Specific Reliability Provisions

Key components of the proposed water supply studied are identified below, along with reliability provisions established for each.

3.4.1 Intake

A single intake is proposed. The intake will be designed to withstand the forces of wind, waves, water, ice, erosion, and shipping traffic. Provisions are to be provided to maintain reliable service throughout the range of conditions that might be encountered, such as frazil ice and zebra mussels.

The intake design shall limit any required repairs or maintenance to be completed within a one week period. Upstream reservoir storage of at least seven days demand will be provided to allow for this.

3.4.2 Lake Huron Pumping Station

The Lake Huron Pumping Station (LHPS) will be designed with sufficient firm capacity to meet the 7-Day Maximum Demand.

The LHPS will be designed to include raw water storage sufficient to meet the 7-Day Maximum Demand of Worth Township.

Backup power for pumping is not provided since water can be supplied from the reservoir for periods of at least seven days, in the event of a power failure. Backup power will provided to maintain lighting, security, HVAC, control, and monitoring in the event of a local power failure.

Primary pumping control will be via local PLC controller.

3.4.3 Reservoir

The reservoir will be designed to provide storage of raw water to meet the 7-Day Maximum Demand.

3.4.4 Reservoir Pumping Station

The Reservoir Pumping Station (RPS) will be designed to provide firm capacity to meet the maximum day demand of KWA customers, below the pumping station.

Backup power sufficient for pumping the 25 year maximum day demand (MDD) and to maintain lighting, security, HVAC, control, and monitoring will be provided for the RPS in the event of a local power failure.

Primary pumping control will be via local PLC controller.

3.4.5 North and South Transmission Mains

Twin transmission pipelines will convey raw water from the RPS to the Genesee County WTP and to the Flint transmission main. Each pipeline (the North Transmission Main and the South Transmission Main) will be designed with capacity to deliver the emergency demand; together both pipelines have been planned with capacity for the 25 year MDD.

3.4.6 Flint Transmission Main

The Flint Transmission Main has been planned with capacity for the 50 year MDD.

Redundancy for the Flint Transmission Main will be provided by one or more of the following:

- Flint's water system includes 57 million gallons of finished water storage.
- The Flint WTP can draw raw water from the Flint River, in the event that the Flint Transmission Main is out of service.
- The Genesee County and Flint finished water distribution systems will be interconnected, enabling treated water from Genesee County's WTP to be supplied to Flint water customers.

3.4.7 Genesee County WTP

Water treatment processes and facilities will be designed with sufficient firm capacity to continuously treat water to the established water quality at the maximum day demand. Firm capacity may be provided either through redundancy of specific units of equipment or processes or by providing a redundant group or train of all of the unit processes and equipment required to treat the water to the desired quality.

Backup power sufficient for treating and pumping the maximum day demand and to maintain lighting, security, HVAC, control, and monitoring will be provided for the Genesee County WTP in the event of a local power failure.

3.4.8 Flint WTP

Water treatment processes and facilities will be designed with sufficient firm capacity to continuously treat water to the established water quality at the maximum day demand. Firm capacity may be provided either through redundancy of specific units of equipment or processes or by providing a redundant group or train of all of the unit processes and equipment required to treat the water to the desired quality.

A second power supply from the electric utility provides backup power to operate all equipment, processes, and facilities at the city's WTP.

3.4.9 Lapeer County Communities

The cities of Lapeer and Imlay City, the Village of Almont, and Mayfield Township are presently supplied water from the Detroit Water and Sewerage Department (DWSD). Each community maintains one or more backup wells which are available to supply water in the event of a loss of supply from DWSD. For this study, it is assumed that each community will continue to rely upon their backup wells for reliability.

3.4.10 Sanilac County (Worth Township)

Pumping and water treatment equipment and processes will be designed to provide firm capacity to supply the maximum day demand.

The LHPS will provide storage in excess of for the 7 day MDD of Worth Township, in the event the intake is out of service for repairs or maintenance.

Backup power sufficient for treating and pumping the maximum day demand and to maintain lighting, security, HVAC, control, and monitoring will be provided for the Worth Township WTP in the event of a local power failure.

3.5 Other Alternatives for Reliability

The concept studied is assumed to be independent from the DWSD supply which presently supplies water to many of the communities in the study area. Although the concept studied has been developed to provide suitable provisions for maintaining a reliable water supply, the existing DWSD facilities represent another alternative for reliability. The DWSD system is an independent supply with the ability to deliver the quantities of finished water necessary to provide backup of most components of the new Lake Huron supply being studied.

To provide additional reliability for the new Lake Huron supply, the existing supply points from DWSD should be maintained and it will be necessary to negotiate a suitable contract with DWSD for backup supply.

If a contract for mutual aid can be negotiated, the project cost for the new Lake Huron Water Supply can be reduced through the elimination of redundant facilities, provided for reliability. Potential cost reductions are presented in Appendix 15.

APPENDIX 4

Lake Huron Water Supply Study

Technical Memorandum

Lake Huron Pumping Station and Intake

Karegnondi Water Authority
Genesee County
City of Flint
Lapeer County
Sanilac County

February 18, 2009

Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY
One Oakbrook Terrace
Suite 207
Oakbrook Terrace, IL 60181

Appendix 4 – Lake Huron Pumping Station and Intake

4.1 - Intake

Purpose

This Technical Memorandum outlines the general design components of a raw water intake system for the proposed Lake Huron Water Supply for the Karegnondi Water Authority. The intake system maximum day design capacity is 200 MGD and 83 MGD for minimum day demand, based on the ratios for the projected 50 year water system demands. The projected 50 year maximum day demand is 103.8 MGD to be supplied from Lake Huron to the raw water storage reservoir. It is common practice to increase the capacity of intake facilities because of cost, difficult construction, and to allow for potential growth. Therefore the crib, intake pipeline and pump station shorewell have been planned with two times the 50 year projected demand.

4.1.1 - Structure Location

4.1.1.1 - Sounding and Subsurface Investigation

Soundings from the shore line to the easterly limits of the shipping lanes, about 21,000 feet east of the Lake Huron shore, were performed by Hennessey Engineers, Inc., to establish lake bottom elevations (contours) along the proposed intake conduit route. Generally, the lake bottom, along the proposed conduit route, has a mild bottom slope of approximately 1.63 feet per 1000 feet.

At this time, geotechnical studies of the lake bottom along the proposed route have not been performed for this conceptual design. Two shore borings were performed in 2005 and the results of these soil borings were included in a geotechnical report titled "Genesee County Raw Water Intake - Lake Shore Pumping Station - Phase 1 Subphase A" as prepared by Hanson Engineering, P.C., dated May 13, 2005. Soil boring data from 1962 have also been reviewed as part of this work.

Based on the existing geotechnical information, it appears the intake conduit from the lakeshore to the crib can be constructed by the open cut method using conventional excavation means. The soil materials at the open-cut elevations consist of primarily stiff gray clay with some fine sand. Discussions with excavating contractors from southeastern Michigan indicated this work could be performed using long-stick backhoe or dredge line if large boulders are anticipated.

However, prior to making a final decision on whether the intake conduit can be installed by open-cut or if tunneling is required, additional geotechnical investigations must be performed along the offshore alignment. The findings of the offshore subsurface geotechnical investigation must take into account the following:

1) The soils are acceptable for open-cut construction.

2) The levels of pollutant parameters are acceptable and are believed to be of no environmental concern with regard to open water dredging activity.

3) The necessary soil/rock properties that would be required to design the tunnel if open cut method is not feasible.

4.1.1.2 - Potential Ice Formation

The most frequent operational problem experienced with intakes in the Great Lakes is associated with the formation of ice, which reduces the hydraulic capacity of the facilities. Temporary shut down of the intake facility has been known to transpire as a direct result of ice formation on and/or inside the intake system.

Great Lakes experience indicates that location and design features of submerged intakes can alleviate intake-icing problems. However, the problems may occur despite all precautions. It is common knowledge that the major ice formations of interest are characterized as sheet ice and frazil ice. Sheet ice, which forms on the lake surface, will act as a shield to heat transfer and protect the water intake. Sheet ice is not expected to be a problem at the proposed intake site due to the water depth that is available.

Frazil ice formation is a common phenomenon adversely affecting water intakes on the Great Lakes. Frazil ice crystals are known to form when the lake water is cooled below 32^{o}F. The phenomenon requires conditions of turbulence within the super cool water mass created either by currents, wind action or from withdrawing water at rates, which create critical velocities. Formation conditions are characterized by winds at approximately 10 miles per hour, clear skies contributing to high heat transfer rates for the water mass, air temperature below 19^{o}F, water temperatures less than 32^{o}F, and heat loss gradient of approximately 0.01^{o}F per hour. In the active state of formation the crystals agglomerate into spongy masses, or slush ice, which have the capacity to adhere to surfaces. The formation and accretion processes are accelerated in the presence of materials of high thermal conductivity, such as steel, which will act to absorb the latent heat released during the ice formation process.

Frazil ice and the resulting anchor ice formations on an intake structure are closely related to heat conduction, convection, and radiation of intake structure materials and entrance velocity. For that reason, the intake structure should be constructed of a material with low thermal conductivity such as wood, concrete, plastics or plastic covered steel in preference to plain steel to prevent the water from becoming super cooled and forming frazil ice. Water passages/openings should be designed so that the entrance velocity does not exceed 0.25 foot per second during the winter conditions.

4.1.1.3 - Lake Currents

The United States Department of Commerce's National Oceanic and Atmospheric Administration and Ontario Department of Lands and Forests have conducted several investigations on water currents in Lake Huron in conjunction with the University of

Michigan. From these reports, it is apparent there is a constant supply of changing water to the vicinity of the proposed intake structure from Lake Michigan and Lake Superior. The dominant surface water flow patterns by-pass Saginaw Bay and the peninsula.

4.1.1.4 - Shipping Channel and Freighter Drafts

During the previous evaluations of the proposed intake conduit route crib location, two items were discovered that warranted further investigation. These items were: 1) location of the easterly limit of the up bound shipping lane would put the intake crib in a shipping lane route and 2) if the intake is located in the shipping lane, then the ship's draft must be taken into account.

In an effort to evaluate these concerns, a meeting was held with the following individuals to ascertain what information may be available on these issues. The record information on this meeting is provided as follows.

> *"After researching and conversations with the Port Huron Lake Pilots Association, Mr. Bob Lafean (retired U.S.C.G. and former commander of the Port Huron facility) and Mr. Rick Harkins (Vice President-Operations, Lake Carrier's Association), the following information was obtained about the above referenced subjects:*
>
> *The Upbound and Downbound courses as shown on the N.O.A.A. National Charts for lower Lake Huron are the recommended courses by both the U.S. and Canadian Lake Carrier's Association. Although most freighters attempt to stay on the course lines, there is nothing "cast in stone" which would mandate staying even within a reasonable distance each side of the shown courses. Obviously, wind and weather conditions sometimes will dictate routes upbound and downbound. It was also noted that some of the older and more experienced Great Lakes Captains navigate based on their experience more so than trusting their navigation equipment. Both Mr. Lafean and Mr. Harkins pointed out that regardless of where we were (except in the coastal shallow waters), there is not an area or zone where we could locate which would not have potential of a freighter over top of the intake. Our planned intake area is not a normal zone for anchoring. However, should a ship be in distress, anchorage could occur.*
>
> *The Lake Carrier's Association states that the freighters on the Great Lakes draft between 26 and 28 feet below existing water level, which is consistent from Mr. Lafean and the Lake Pilots Association. U.S. flagged freighters on the Great Lakes range in length from 383 to 1,013.5 feet and there is not a correlation between length and draft depth. The primary cargo within the Great Lakes system is iron ore, stone and coal as well as smaller volumes of cement, salt, sand, grain and liquid-bulk products.*

Based on the preceding and for purposes for this technical memorandum, the following parameters were used for locating the intake:

1) Depth - Minimum of 30 feet from lake surface to top of crib to account for ship draft.

2) Distance from shore - Less than four miles since the shipping lanes are recommended and not mandatory.

4.1.1.5 - Quality of Lake Huron Water Supply

Water quality sampling was conducted on September 15, 2004, November 9, 2004 and May 19, 2005, at two and three-mile locations from the shore, to determine the quality of Lake Huron water for the proposed raw water intake structure. Both sites were sampled three times in order to represent seasonal variations in the lake. At each site, the water was sampled at approximately eight feet from the bottom and eight feet below the surface. NAD83 Geographic coordinates of the sites are provided in Table 4 -1.

Table 4 - 1

Location	**Latitude**	**Longitude**	**State Plane (N)**	**State Plane (E)**
Site 1 - Two Miles	43^{o} 10' 24.2062"	82^{o} 27' 53.5531"	615,654.02	13,630,615.18
Site 2 - Three Miles	43^{o} 10' 27.2213"	82^{o} 26' 32.6820"	616,005.33	13,636,598.93

The water quality data obtained from the sampling program indicated the following:

1) small seasonal variability in the measured physical/chemical parameters

2) small physical/chemical variability between the two sites

3) small physical/chemical variability with water depth

4) no measured contaminants exceeding the USEPA SDWA MCLs

5) no physical/chemical characteristics which would indicate water that is especially difficult to treat

6) quality is consistent with historical records from DWSD, Lexington and Saginaw-Midland Municipal Water Supply Corporation

7) excellent water quality source

In conclusion, no observed physical/chemical characteristics at either site, at either depth, or over any season, would require any special attention in the treatment design process.

4.1.2 - Type of Intake Structure

At this time a single inlet structure is proposed to be located so as to minimize lake bottom sand ingested and ice formation. Experience has shown to reduce the potential of ice formation on an intake structure is to minimize the transport of ice into the intake by strong inlet velocity near the inlet. Therefore, an inlet structure with as large port openings will be designed to provide inlet velocities 0.25 foot per second or less, under anticipated winter water demand, to minimize potential interference from anchor ice formation due to frazil ice.

The inlet structure is proposed to be constructed of wood, to discourage the formation of ice on its surface. Timber is the most common construction material as the low thermal conductivity of wood is a valuable characteristic in avoiding ice formations, which may interfere with intake capacity.

Several lake intakes along the west shore of Lake Michigan do not utilize timber intake structures. The cities of Racine, Wisconsin; Green Bay, Wisconsin and Evanston, Illinois, Gary, Indiana, Sheboygan, Wisconsin for example, have hydraulically balanced lake intakes cones. They consist of inlet cones, equally spaced connected to a cross at the inlet end of the intake conduit. Each inlet is equidistant from the terminating cross and, therefore, provides equal head loss and equal entry velocity, thereby eliminating an unbalance in inlet conditions. These types of inlets require grating to protect the inlets from debris. Icing problems have been experienced probably due to high winter water demand relative to the maximum design quantities and/or because they are located in relatively shallow waters. Lake bottom sediments, such as sand accumulation have been recorded at the bottom of the vertical intake pipe, probably due to significant movement of sand and silt near the intake ports.

The type of intake structure design proven to be the most successful for continuous day-to-day operation in the Great Lakes is the wood crib type structure. These types of inlet structures have peripheral multi-inlet ports, which allow the water to enter the structure at low velocities and accelerate slowly towards a central inlet connected to the intake shaft. The proposed inlet structure will most likely be an eight-sided shaped structure for economy in construction. The inlet ports will be located approximately 10 feet above lake bottom to minimize the entrance of sediments. The size of these inlet ports will be controlled so the inlet velocity will be 0.25 fps for winter flows and 0.5 fps for summer flows. The largest area required to meet both conditions will determine the inlet port size. A crib designed for 200 MGD maximum flow and for 83 MGD minimum flow will be 80 feet by 80 feet in size.

The proposed inlet structure would be built on shore of mainly 12" by 12", No. 1 Structural, RC, Heavy, Douglas Fir timbers, bolted together and designed to be floated to the site before setting over the intake shaft. Its design should be that it would have slight buoyancy; the freeboard above the water should desirably be small so as to facilitate towing to position with a minimum of wind and wave interference.

Once at the site, the intake structure would be lowered to its final position weighted, with concrete and crushed rock, and firmly bedded on a crushed stone mat on the lake bottom and directly above the intake shaft. Blocks of concrete or rock of varying sizes will surround the intake structure. The structure would surround a bell-mouth pipe, which is connected to the intake conduit.

There is little practical data on the impact of waves relative to the generation of forces, such as lakebed shear and frictional dissipation, on submerged structures. However the data does indicate that the crib would be subjected to hydrodynamic forces created by wave influence and currents estimated at between 0.2 to 0.5 feet per second. Based on experience with intake structures, as proposed herewith, it is not anticipated that these forces would be significant in relation to the mass of a wooden intake structure with concrete and stone ballast and surrounded by concrete blocks and armor rock. The crib should be designed for a wave of 25 to 30 feet with a return period of 100 years. The maximum horizontal velocities of the oscillating motion just above the lake bottom will be between five and six feet per second during this design wave. According to tests conducted at the U.S. Waterways Experiment Station on rubble mound breakers, stones placed on a 2 to 1 slope will need to weigh only about ten pounds to resist these velocities. It is proposed to use rubble containing a variety of sizes to avoid large interstitial spaces and thus prevent high velocities from penetrating the mound to the structure. If the stones were of a nearly uniform size, sand would leach out from under the crib. Horizontal forces on the walls, projecting five feet above the lake bottom, will primarily be the drag type. The magnitude of the force will be about 500 pounds per foot of length. This value represents the most extreme assumptions as to a drag coefficient. The proposed intake structure would have a dead weight and protective ballast of approximately 1800 tons.

4.1.3 - Capacity of the Intake Conduit

Intake conduit capacity should be provided for the maximum demand for the design selected period and this capacity should be available at the recorded lowest lake water level of 576.05 IGLD 85 (Mar. 1964).

The capacity of the intake is determined by its allowable draw-down which will occur at the shore shaft or pump suction well. General practice is to design intakes with an allowable draw-down in the range of 15 to 20 feet. This maximum draw-down allows for the construction of a shore shaft or pump suction well without an excessively deep excavation. The depth of the shore shaft or pump suction well must be deep enough to provide for the intake draw-down and the proper submergence on the pumping equipment. The usual required submergence is in the range of at least 10 feet over pumping equipment suction in order to avoid cavitation.

Standard practice of design for water transmission conduits is to use a design friction factor of ‘C’ of approximately 120. While it is specifically understood that commercially manufactured pipe will have an effective ‘C’ value of approximately 140 or better, prudent design and regulatory requirements generally recommend a lower value to allow for reduction to deposits on the pipe wall. Frequent testing on a number of intakes located on the Great Lakes have shown effective ‘C’ values of 125 to 136 after 50+ years of service. Based on this information, a design ‘C’ value of 120 is recommended for this project. One issue that has a direct effect on the hydraulic capacity of the pipeline is the infestation of zebra mussels.

4.1.4 - Zebra Mussels

4.1.4.1 - General

Since their initial invasion around 1986, zebra mussels have caused havoc for water intakes on the Great Lakes. Many water utilities spent hundreds of thousands of dollars in the early 1990's to retrofit their intake facilities to prevent their colonization by these small mollusks.

A zebra mussel infestation affects flow through an intake in two ways. First, the presence of the zebra mussels creates a rougher interior pipe surface, increasing the hydraulic friction. Secondly, the growth of the zebra mussel layer reduces the flow area of the conduit. Even if the zebra mussels are dead, their shells generally remain firmly attached to the substrate for many years.

The apparent Hazen-Williams “C” factors have been back-calculated from testing performed on existing intakes. As would be expected, the initial “C” factors for the intake pipelines are approximately 140. This equates to an average surface rougosity of 0.0005 feet. As calculated, this apparent “C” value drops to approximately 90 over the first two years of infestation. This represents a reduction in intake capacity to approximately 70% of the initial capacity. Over a period in excess of ten years the intake pipeline “C” value would be expected to stabilize at a value of approximately 60. This would represent a capacity of less than 40% of the initial capacity.

4.1.4.2 - Preventive Zebra Mussel Control Systems

An alternative to accepting zebra mussel infestation and suffering the consequent degradation in flow capacity is the installation of some type of zebra mussel control/discouragement system. To date, no universally accepted Zebra Mussel control method has been identified. Although numerous control methods have been installed, tested, and proven effective, many are limited in applicability by the physical arrangement of potable water intake systems. The methods that are physically adaptable, also must not impart any toxic or aesthetic effects that are not easily reversible by the normal water treatment process.

Application of chemicals at the intake has been the most popular zebra mussel control technique among potable water utilities. Numerous chemicals have been tested for this purpose, although only a few have been utilized in actual practice. Generally the chemical is applied through a solution pipe installed within or adjacent to the intake pipeline, which connects the onshore chemical feed facilities with diffusers installed at the lake bottom intake structure. The diffusers are normally situated so that all applied chemical is drawn into the intake with the inflowing water, and none escapes into the lake. The following paragraphs describe a number of chemicals that have proven beneficial for zebra mussel control.

Chlorination has been found to be an effective control technique. One advantage of chlorine is that it is a standard waterworks chemical, its use is widespread and one of the most acceptable of the available chemicals. Further, at some point in the treatment process, chlorination will be performed. Chlorination has the additional advantage that a blanket USEPA/Corps of Engineers permit exists for its use to control zebra mussels. Use of any other chemical would require an individual permit review. Also, chlorine will assist in the control of algae in the lake conduit and help maintain the “C” values.

Permanganate has been found to be effective in controlling zebra mussels. Early testing suggested that unacceptably high doses of permanganate were required to kill zebra mussels. However, field trials have shown that dosages of 0.25 to 0.35 mg/l prevent infestation. It is assumed that even though these dosages do not kill the mussels, they make the environment sufficiently disagreeable that the mussels choose not to settle. Permanganate does not produce regulated disinfection byproducts. This chemical is more expensive compared to either chlorine or sodium hypochlorite, but the lower dosage requirement partially compensates for that cost difference. A disadvantage in choosing potassium permanganate is that it is both a hazardous chemical and a fire hazard. Problems arise with the disposal of the empty drums and also extreme care is needed in the handling and transporting of this chemical. However, these problems have, to a large extent, been eliminated by the production of liquid sodium permanganate. And like chlorine, sodium permanganate will control algae and maintain pipeline “C” factors.

4.1.4.3 - Recommended Zebra Mussel Control System

Taking into account chemical costs, system maintenance and handling issues, the most viable and cost-effective option is a zebra mussel control system utilizing chemical application of sodium permanganate.

Chemical solution would be conveyed to the intake structure through polyethylene pipes installed within the proposed intake conduit. The installed pipelines would consist of two polyethylene pipelines; one chemical line would be used to convey chemical solution while the other would serve as a spare.

At the intake structure, diffusers of the multiple orifice type would be installed along the inner and outer lips of the peripheral intake ports. Applied chemical solution would be continuously drawn down into the intake bell mouth and spillage of chemical solution into the waters surrounding the intake exterior should not occur. In the event the Lake Huron Pumping Station discontinues pumping, the chemical feed pumps would automatically stop pumping, therefore the selected chemical would not be introduced into the surrounding waters.

4.1.5 - Proposed Intake Structure

4.1.5.1 - General

Numerous factors must be considered in the selection of the proposed location as well as design and configuration of the lake intake structure. Of these the most significant are: 1) capital expenditures, 2) water quality, and 3) operation and maintenance.

The lake intake structure should be placed in as deep of water as economically justifiable. This is based on the principle that the main source of lake pollution is normally from the shore. A deep-water intake far away from the shore will provide water with higher quality, thus is less expensive to treat. In addition, at such a location, the depth of sand and silt deposit would be less and therefore less likely to have significant impact on the intake structure or interfere with the operation of the intake. Furthermore, such an area has the potential for lowest concentration of frazil ice.

Previous studies on existing intakes in the Great Lakes area reported that the dividing line between frequent and infrequent ice stoppages in the Great Lakes, particularly in Lakes Michigan and Huron, appears to be at submergence between 30 and 40 feet. In all cases, where the surface water was frozen, intakes were free from ice problems. In most cases where the water depth to the top of the crib inlets was less than thirty (30) feet, frazil and/or anchor ice had created operating difficulties during some seasons under certain extreme weather conditions. In all cases where the depth equaled or exceeded forty (40) feet, cribs were operated without ice stoppages.

Based on the considerations of the factors discussed above, the most desirable location for the proposed intake structure would be in the deepest available section of the lake bottom at elevation 530 (IGLD 85) in 46 feet of water and still be outside the designated shipping lane. However, due to the significant increase in capital expenditures that would be required, it is recommended to select a location closer to shore.

The recommended location for the intake structure would be approximately 17,000 feet from shore in a section of the lake with a relatively flat bottom at approximate elevation 536 (IGLD 85) in 40 feet of water.

A single submerged intake structure with multi-inlets and peripheral ports would be set at about ten (10) feet above lake bottom to avoid possible poorer quality water and to reduce the prospect of drawing water affected by re-suspension of lake sediments by wave action. The expected water depth over the intake structure would be approximately thirty (30) feet. At this depth, interference with pleasure boats or commercial ships that may stray from the designated shipping lanes should not be a problem. However, potential frazil ice problems should be anticipated.

Several methods have been known to be successful in mitigating ice formations at various intakes in the Great Lakes. For example:

1) Stop pumping or at least reduce the withdrawal rate until ice melts, or

2) Send divers to brake-up the ice formation, or

3) Back flush the intake system from a designated water storage facility.

All of these are viable solutions. If the intake structure cannot be located with at least 40 feet of water over the crib, a back-up plan should be in place in the event of ice problems. Back flushing of the intake system by pumping or use of water stored in elevated tanks or reservoirs is a frequently used procedure, however, it is not consistently successful and it wastes water. It has sometimes been possible to clear partially clogged intake ports by a method termed “control drawdown”, which involves throttling the intake-well pumps and maintaining reduced intake flow. Under some conditions this flow may be sufficient to erode ice bridges at the ports and restore intake capacity.

4.1.5.2 - Intake Conduit

As previously discussed, there are two methods available for installing an intake conduit, open cut or tunneling. For this project, three alternatives are available, including, 1) open cut, 2) soft ground tunnel and 3) rock tunnel. In order to make a final determination on the most cost effective method of installation, geotechnical borings must be made into the lake bottom at several locations along the proposed route to obtain samples for laboratory testing and analysis. Engineering properties of the materials encountered will then used to analyze the various options. As previously discussed, the preliminary geotechnical investigation of the soil conditions encountered in the 2005 shore borings and the 1962 data, indicate that open cut construction is feasible. However, this assumes that the soil conditions of the lake bottom are consistent with the existing information.

4.1.5.2.1 - Open Cut Method

Assuming the lake bottom is favorable for open cut construction, from the shoreline to the shore shaft the ground is approximately twenty feet above lake level. Open trench construction would be very deep and would destroy a substantial area of highly desirable lakefront property. It is proposed, as an alternative to open cut construction, to construct the intake conduit in a tunnel from the shoreline to the shore shaft, thereby, avoiding damaging the existing surface.

The intake conduit, which extends from the lake intake crib to the shore, is proposed to be built on a grade following the natural slope of the lake bottom but avoid constructing any high points in the conduit. Because of the dissolved gases in the lake water, if there is a high point in the line it could possibly cause a partial blockage and thereby reduce the capacity of the intake conduit.

For open cut installation, the general practice is to construct the intake conduit in a trench along the lake bottom and to provide approximately four feet of cover over the pipeline. Soil permitting, it is proposed to install the pipe in open trench with a minimum cover of four feet. The total volume of trench excavation will be influenced by the geotechnical investigative results. Depending on trench conditions, foundation blocking with timber sills and chocks may be required for the installation to set the grade of the conduit. Granular material, such as pea gravel, will be used for bedding and backfilling along the pipeline from the trench bottom to one foot above the top of the conduit. Suitable excavated material would be used to fill the remaining portions of the trench up to the existing lake bottom level and for protection the trench is then covered with approximately two feet of rock.

As previously indicated, the erosive forces beyond the breaker zone (lakeward) will only be those resulting from velocities between five and six feet per second. Stones weighing a minimum of about ten pounds will be placed in this area to resist these velocities. Much more severe conditions will occur in the breaker zone. In this zone, water velocities become very large and the turbulence created by the breaking waves is exceedingly violent. Waves break at depths equal to or somewhat greater than the height of the breakers. If it is assumed that breakers as high as 14 feet will occur, then the breaker zone may extend out to a depth of 20 feet. In the region of water depths varying from 0 feet to 20 feet, the stone ditch cover may then have to be made up of stones weighing from 1000 to 1500 pounds each.

4.1.5.2.2 - Tunnel Method

If the soil conditions are such the intake conduit cannot be constructed using an open cut method, then the intake conduit will be constructed as a tunnel. Additional information will be presented on the installation by tunneling once the geotechnical testing is performed.

4.1.5.2.2.1 - Soft Ground Tunnel

For the soft ground tunnel option there are a number of technical issues that must be addressed in order to construct the tunnel. To maintain an adequate depth below the lake bottom, the tunnel elevation must be below elevation 520. The soils encountered at this depth in the shore borings consist of glacial till which contains silty clays, silty sands, fine to medium sands, gravel and sand mixtures and boulders. Due to the granular nature of these materials, groundwater control must be provided. While all of these issues can be addressed, the mitigation methods are expensive and the potential for problems and failures during the tunneling operations are high. These issues are discussed in more detail in the Hanson report. Based on these findings and unless different geotechnical conditions are encountered during the lake borings, it is recommended that the soft ground tunnel option be eliminated from further consideration.

4.1.5.2.2.2 - Rock Tunnel

If tunneling is required, based on the findings from the geotechnical investigations from the shore borings, then tunnel construction in the shale is recommended. The elevation of the rock tunnel would be located approximately 170 feet below boring grade. At this elevation, a sufficient thickness of rock will be present to mitigate poor rock quality and potential groundwater issues. As discussed in more detail in the Hanson report, the strength and hardness of the shale indicated the rock is favorable for typical tunnel construction and no adverse impacts to the tunnel construction are expected.

It is a known fact this shale contains differing levels of methane gas and that during the construction of the DWSD Port Huron intake a deadly explosion occurred. Based on discussions with a tunneling contractor from southeast Michigan, the use of modern closed faced tunnel boring machines, equipped with a gas monitoring system and automatic shutdowns devices, greatly improves safety during the tunnel operations. In addition, it is recommended that a single pass, segmented concrete liner be installed as the tunnel construction progresses to mitigate gas permeation from the exposed rock face. However, cost impacts associated with gaseous conditions increase as the levels of gas increase. Based on the preceding, the rock tunnel option should only be considered if the soil conditions preclude the open cut method.

4.1.5.3 - Available Pipe Materials

For the open cut construction, the two most suitable materials for the large diameter pipeline, as anticipated for this project, would be prestressed concrete cylinder pressure pipe and steel pipe.

The joints for the two pipe materials considered would be subaqueous joints consisting of steel spigot and bell ring and a rubber gasket with a joint assembly harness system. A rubber gasket would seal the joints so that the joint will remain tight under all conditions of service, including slight movement due to expansion, contraction and normal settlement.

Each length of pipe would be provided with bell and spigot ends formed by steel joint rings securely fastened in the pipe wall. Portions of the joints rings, which are exposed after the pipe is manufactured, will be protected from corrosion by an epoxy coating.

Prestressed concrete cylinder pressure pipe is a composite structure that consists of the following principal elements: concrete core, steel cylinder and joint rings, high tensile wire and cements mortar lining. The concrete and steel cylinder core is prestressed by helically wrapping a high strength steel wire under tension. This wire is then covered with a cement mortar coating. The current AWWA standards for prestressed concrete cylinder pipe are C301 and C304 and Manual M9 for design.

For prestressed concrete cylinder pressure pipe mortar coating provides a practical method of physical and chemical protection for the steel reinforcement and the prestressing wire. Additional protective, including epoxy paints and PVC sheet, are available but these measures are not considered necessary for the proposed project.

Steel pipe is produced by forming a steel cylinder either spirally from coils or circumferentially from plates. The current AWWA standard for steel water pipe is C200 and Manual M11 for design.

There are several coating and lining options for steel pipe installed in a sub-aqueous environment. It is recommended use an AWWA C222 polyurethane coating for the pipe with an abrasion resistant ceramic epoxy lining complying with AWWA C210 and NSF 61.

4.1.5.4 - Intake Conduit Size

Based on the preceding with a flow of 200 MGD and limiting the headloss to 15 feet at a design “C” value of 120, the intake pipeline diameter will be 102". If 20 feet of headloss is allowed then the intake pipe size can be reduced to 96". The savings in pipeline cost will more than offset the additional excavation and caisson costs for the shore well, see Figure 4-1. Access manholes should be provided at approximately 1,500 feet intervals along the length of the conduit to facilitate inspection and maintenance of the intake system.

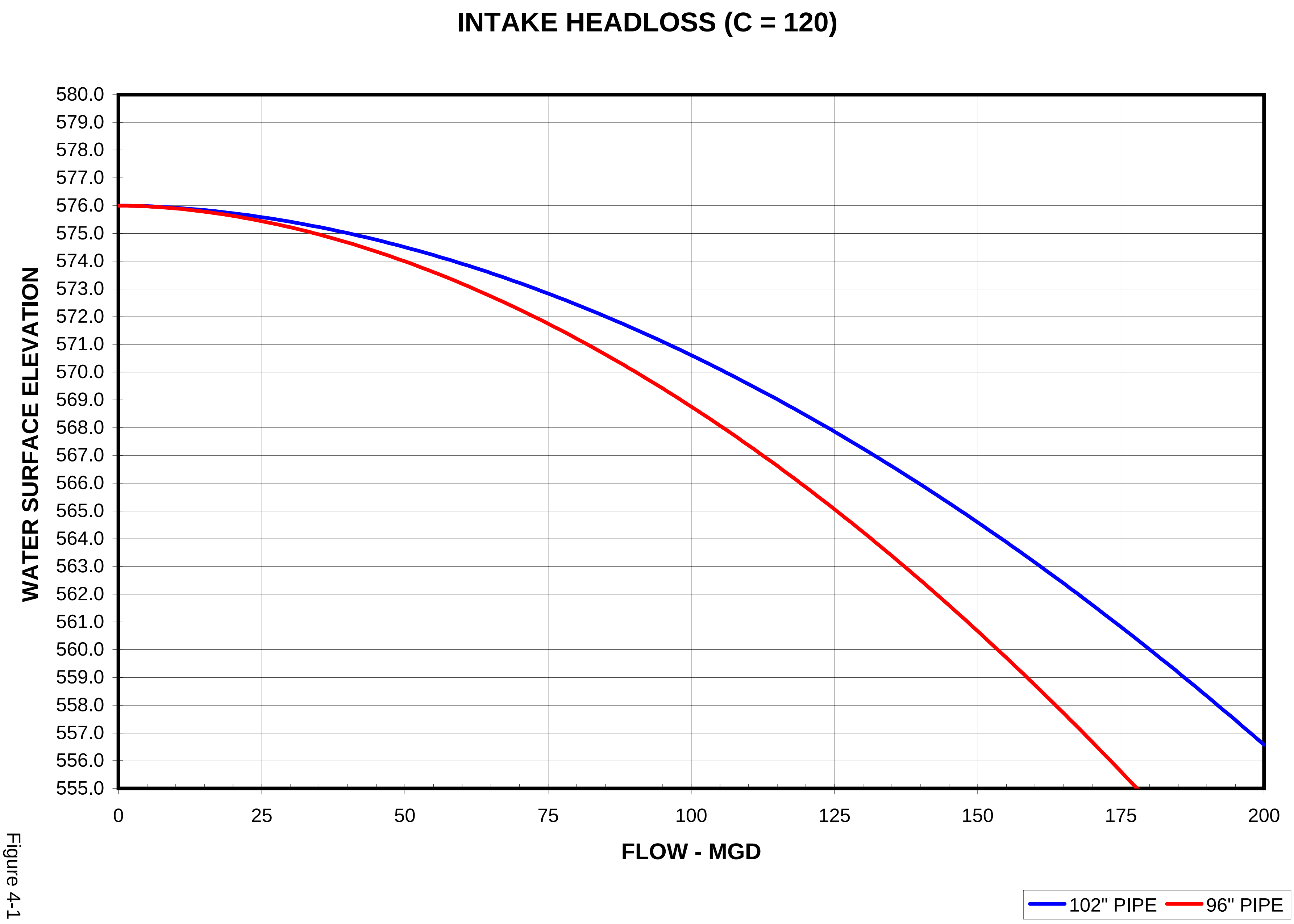
4.1.6 – Intake Conclusions and Recommendations

Based on the proceeding, the following conclusions and recommendations are presented for your consideration:

1) Water quality testing results indicate that the proposed location for the crib will provide an excellent source of water that can be treated economically.

2) The preliminary geotechnical studies show that open cut installation is feasible.

3) For a 200 MGD required flow the recommended nominal pipeline diameter inches is 96 inches.


INTAKE HEADLOSS (C = 120)
WATER SURFACE ELEVATION
580.0
579.0
578.0
577.0
576.0
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572.0
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562.0
561.0
560.0
559.0
558.0
557.0
556.0
555.0
0
25
50
75
100
125
150
175
200
FLOW - MGD
102" PIPE
96" PIPE

Figure 4-1

4) A timber crib is recommended with an approximate size of 80 feet by 80 feet.

5) The crib should be located at pipeline station 170+00 in about 40 feet of water depth.

6) Zebra Mussel control system piping should be installed during initial construction even if the chemical feed systems is not required/installed during initial construction.

7) A back flushing frazil ice mitigation system should be included.

8) Geotechnical evaluations of the lake sediments should be performed to finalize the pipeline installation method.

9) Sufficient time should be allotted for the necessary permitting process and construction details will have to be coordinated with the various agencies.

4.2 – Lake Huron Pumping Station

4.2.1 - General

The purpose of this section is to provide conclusions and recommendations for the layout and configuration of the Lake Huron Pumping Station. For the preparation of this Technical Memorandum, certain assumptions have been made in conjunction with staff and data supplied by other consultants. These assumptions include:

1) Design shorewell and structure foundations for capacity of 200 MGD.

2) Super structures and water storage reservoirs are sized for 104 MGD.

3) Installed pumping equipment will provide a firm rated capacity of 74 MGD

4) Discharge pipeline diameter of 72 inches and approximately 37 miles in length.

5) Pipeline will discharge into a raw water storage reservoir with a fixed discharge head elevation of 880 feet.

6) Minimum water surface elevation of 576 feet for Lake Huron.

7) Constant speed pumps would be used and only if necessary evaluate variable frequency drives (VFDs).

4.2.2 - Evaluation of Pump Station Location

GCDC-DWWS purchased approximately 230+ acres of property located west of Lake Shore Drive and north of Fisher Road in Sanilac County, Michigan for the purposes of locating a raw water delivery system. The DWWS also owns property to the east of Lake Shore Drive that extends from the east right-of-way of Lake Shore Drive to the shore of Lake Huron. This parcel of property, with a width of about 337 feet, provides access to the lake for the intake conduit. The centerline of the proposed intake conduit is located in the center of the east parcel which is approximately 1,300 feet north of the intersection of Lake Shore Drive and north of Fisher Road.

In general, the east property gently slopes from west to east from the road right-of-way at an elevation of 605 feet for approximately 480 feet to an elevation of 594 feet. At this point the grade drops rapidly to the shore of Lake Huron with a water surface elevation of about 578± feet. It is our understanding that the intended purpose for this piece of property is strictly limited to the installation of the intake pipeline and that no above ground structures/facilities will be located east of Lake Shore Drive.

The west parcel is located north of Fisher Road and east of Lake Shore Drive extending west to St. Clair Road. A creek passes through the eastern section of the property approximately 600 feet west of Lake Shore Drive along the proposed intake conduit centerline.

Generally, the eastern portion of the west parcel (Site) slopes gently east to west over an approximate distance of 600 feet from Lake Shore Drive at an elevation of 605 feet to the creek bank at an elevation of about 595 feet. The Site has sufficient area to locate the pumping station; however one limiting concern is the potential for flooding along the creek. Numerous attempts were made to obtain flood elevations for this section of the creek, but none of the attempts were successful. While the pump station floor elevation can been set above the Fisher Road elevation at the creek to avoid potential flooding issues, there may be potential regulatory impact if the flood plain is impacted due to fill requirements.

The Site offers several advantages, primarily its close proximity to Lake Shore Drive, which reduces access cost and the short distance for the intake conduit connection. However, there are several distinct disadvantages, other than the potential flood issue, to locating the pumping station on this Site. Due to the existing topography, the site will not yield sufficient material to balance the cut and fill, therefore requiring a significant quantity of select backfill delivered to the site. A non-technical issue that the KWA staff may wish to consider is the aesthetics of locating the pumping station along Lake Shore Drive. The height of the structures will be an imposing view which may result in a negative public reaction. While decorative landscaping and architectural treatments will mitigate the appearance issues, the structure height cannot be addressed by these approaches.

4.2.2 - Pump Station Design Concept

4.2.2.1 - General Concepts

The design of the pumping station is largely based on the type of pumping equipment that is selected. For this type of pumping station there are two types of pumps that can be used, specifically vertical turbine and split case centrifugal pumps. As would be anticipated, there are trade-offs in the design based on the selected pumps. These trades-offs included capital costs, operation and maintenance costs and system reliability. The decision on which type of pump to use should focus on the owner's preference and the staff's ability to operate and maintain the equipment. Regardless of the type of equipment selected, the final design and selection of the pumping equipment must include a detailed evaluation of the total life cycle cost. The operation of pumps is sensitive to the cost of electrical power, therefore, minor differences in the "wire to water" efficiencies of competing manufacturers becomes large differential cost when evaluated over the long useful life of this equipment.

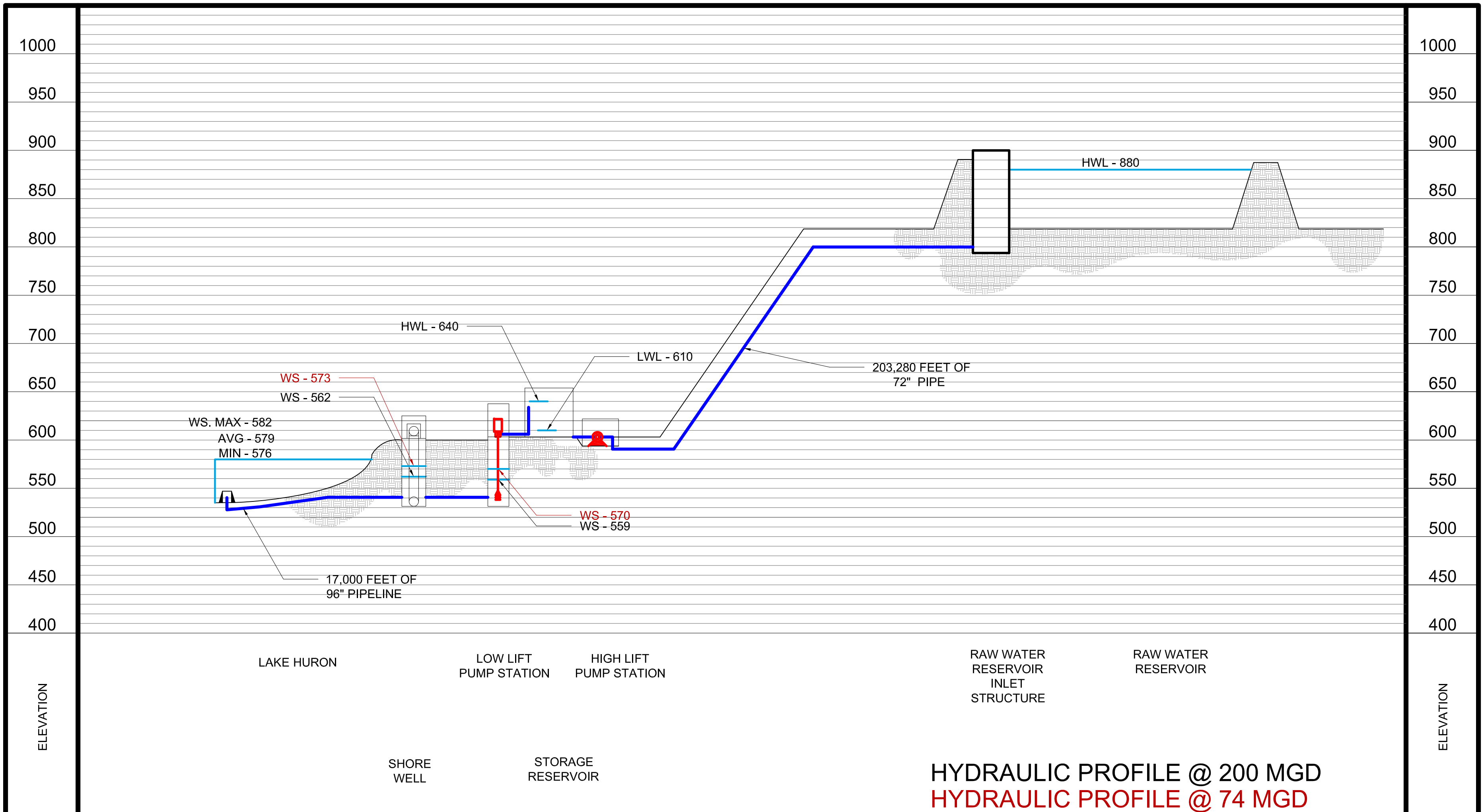
Obviously, the design of a pumping station involves many other issues other than the selection of the pumping equipment. These issues include locating the pump suction with sufficient submergence below operating water level surface, redundancy of operation to allow for planned or emergency maintenance, suction piping and sump design in accordance with the Hydraulic Institute standards, transient mitigation and control, the hydraulics of the discharge piping, and control system.

During the course of the 2005 study, numerous pump station configurations with vertical turbine, horizontal split-case centrifugal and vertically mounted split-case centrifugal pumps were developed and discussed. These discussions resulted in a conceptual design that included the use of a shorewell as a low lift pump wetwell, vertical turbine low lift pumps discharging into two raw water reservoirs and horizontal split-case centrifugal pumps for high service pumping. Figure 4-2 shows the hydraulic profile of the proposed pumping station. The following sections will further describe the conceptual design.

4.2.2.2 - Shorewell and Low Lift Pumps

As part of the construction of the intake conduit tunnel, from the pumping station site toward the lake, a shaft will be required to initiate the boring operation with the tunnel boring machine. In lieu of constructing a temporary shaft, it is recommended to construct a permanent shaft that will serve as a shorewell and be incorporated into the pumping station design. While the diameter of this permanent shaft will be larger than that necessary for the tunneling operation, the resulting cost savings should be considered.

This shorewell will serve other purposes besides as a suction well for the low lift pumps. The structure will house the traveling screens to protect the system from debris and fish. Also, the valve to isolate the intake conduit and crib would also be housed at this



Lockwood, Andrews & Newnam, Inc.
A LEO A DALY COMPANY
PLANNING
ENGINEERING
PROGRAM MANAGEMENT

GENESEE COUNTY DRAIN COMMISSIONER
DIVISION OF WATER & WASTE SERVICES

LAKE HURON
PUMP STATION
HYDRAULIC PROFILE

FIGURE 4 - 2

location. This structure will be divided into two parallel trains to allow for periodic maintenance and will also contain the piping and valves for backflushing the intake.

An additional feature is this shorewell must be designed to dissipate surges which can occur in the intake conduit if the flow of water is suddenly stopped. This may happen during a power loss or when the low lift pumps are shut-down. The shorewell or pump suction well will require an attached retention basin which will allow the surge to dissipate into the retention basin and then returned back into the shorewell by gravity.

As covered in the intake section of this report, the depth of this structure must account for the low lake level, the headloss in the intake conduit and also provide sufficient submergence on the pumps to prevent cavitation and/or vortexing. Using a low lake level of elevation 576 with 20 feet of allowable headloss in the intake piping, and three feet of headloss across the traveling screens results in a operational water surface elevation of 553 feet. Allowing for 10 feet of submergence over the pumps bowls, pump length and appropriate distance from the pump suction bell to the floor will establish a base slab elevation of approximately 535 feet. Using a ground floor slab elevation of 602, the depth of this structure is approximately 67 feet. This depth may be modified depending on final design and equipment selection.

In order to provide sufficient room for the pumps, traveling screens, backflushing system, surge protection and the intake isolation valve, the inside diameter of the shorewell will be approximately 76 feet. It is proposed to construct the shaft as a concrete caisson. Obviously, there is insufficient geotechnical information to complete the design of this structure. However, based on current information, it is estimated that the structure walls will be about four feet in thickness.

The low lift pump station would be constructed on top of the shorewell at 602 feet. This station would house three vertical turbine pumps, each with a nominal capacity of 37 MGD @ 85 feet TDH, for a combined rated capacity of 74 MGD with one unit out of service and space for the installation of three additional pumps of various sizes for future expansion. Each pump will discharge through header pipes to the onsite storage reservoirs. Each reservoir will have a rise well to maintain a constant discharge head on the pumps. The fixed discharge condition will minimize the fluctuation in the TDH, thereby allowing the use of constant speed vertical turbine pumps. Each of the pumps would be equipped with isolation valves, a control valve, and an air release valve as well as appropriate monitoring sensors.

The pump room floor layout has sufficient clearances and “lay down” room for pump/motor maintenance. An overhead gantry crane is provided for pump/motor removal. The pump discharge column shall be specified with segment lengths that will allow removal by the overhead crane. This feature eliminates the need for roof openings and crane rental for pump maintenance. It is recommended that the pump room be sound proofed.

4.2.2.3 - Raw Water Reservoirs

Two 3.0 MG raw water reservoirs are proposed for the initial phase of this project with area provided for an additional 6.0 MG for future expansion. These reservoirs will receive the discharge from the low head vertical turbine pumps and will provide a suction head for the high service split case centrifugal pumps. The proposed reservoirs will have 40 feet of SWD, with a high water level elevation of 640 and a low water operating level of 610. These reservoirs are not designed to provide for long term supply but to provide sufficient storage for more even pump operation. In addition, these reservoirs will provide sufficient water for backflushing the intake and back-up storage for the proposed Sanilac County water treatment plant.

4.2.2.4 - High Service Pump Analysis

The preliminary analysis of the high service pumps required more assumptions associated with the discharge parameters than those associated with the low lift pumps. High service pump selection involves the development of system head curves in order to make even a preliminary pump selection for layout. In an effort to maintain consistency within the team, the same discharge pipeline diameter and length were used as well as the anticipated static head difference

Standard practice of design for water transmission mains is to use a Hazen-Williams friction factor "C" value in the range of 100 to 120. For many years, standard of practice as recommended by numerous design references indicated a "C" value of 100 should be used to allow for degradation of the pipe "smoothness" due to deposits on the pipe wall. However, due to improvements in controlling water quality factors and based on numerous in-situ test results have shown that a "C" factor of 100 is no longer a reasonable assumption, especially in large diameter, over 24 inches, pipe.

As previously indicated, most design professionals and regulatory agencies use or require the use of a "C" in the range of 100 to 120 for cement mortar lined pipe. Some regulatory agencies allow the use of higher values, up to 140, for plastic or plastic lined pipe. Regardless of the "C" value selected for design, it must be remembered that commercially available, large diameter, centrifugally spun, cement mortar lined pipe will have an effective "C" of 140 or higher. If this fact is ignored and a more typical value of 100 to 120 is selected for the design and pump selection, the pumps will cavitate when initially placed into service due to the "flatter" system head curve. This problem will continue until the effective "C" value is reduced to the design level.

To illustrate this point, please refer to Figure 4-3. As shown, three system head curves were developed using the hydraulic profile as previously referred to as Figure 4-2. The following outlines the parameters use for each head curve:

1) High Reservoir Level - Static head of 240 feet, "C" of 140, pipe length of 203,280 feet and a pipe diameter 72 inches.

2) Average Reservoir Level - Static head of 255 feet, “C” of 120, pipe length of 203,280 feet and a pipe diameter 72 inches.

3) Low Reservoir Level - Static head of 270 feet, “C” of 100, pipe length of 203,280 feet and a pipe diameter 72 inches.

As indicated on Figure 4-3, the flow and resulting head results are shown in the following table.

Table 4 - 4

Flow (MGD)	System Head Curve (ft)		
	High Res.	Avg. Res.	Low Res.
74	348	404	471

As outlined in the above table, the large differences in the resulting pump heads, makes the selection of a split case centrifugal pump difficult since these types of pumps generally have a flatter curve. For the purposes of this presentation, a Flow-Serve Model 600-LNN-1200 at 895 rpm pump was evaluated, since it was the best selection presented by four manufacturers. This pump would have a nominal capacity of 37 MGD at the resulting TDH of 399 feet. This pump model can be equipped with impellers ranging in size from 40 to 47.25 inches in diameter. In order to meet the design point of 74 MGD @ TDH of 399 feet, the impeller diameter for this pump would be 40.16 inches.

Selection of pumping equipment is directly related to the discharge boundary conditions that determine the total dynamic head for the pumping system. The choice of discharge pipe diameter, with all other conditions being equal, has a direct impact on the total dynamic head. A pipe size selected based on flow velocity may be appropriate for the hydraulic conditions for conveying water, but may not represent the most cost effective selection for the total pumping system design. This design approach becomes more important as the length of the discharge line increases. Furthermore, the cost of electrical power must be factored into the design to account for the cost sensitivity of future power generation costs.

For illustrative purposes, two pipe size alternatives were investigated in addition to the original 72" option. Increasing the pipe diameter, with all other factors being equal, “flattens” the system head curve. This “flattening” reduces the large differentials in the head requirements. The results are outlined in the following table with the results for the 72" option shown for comparison.

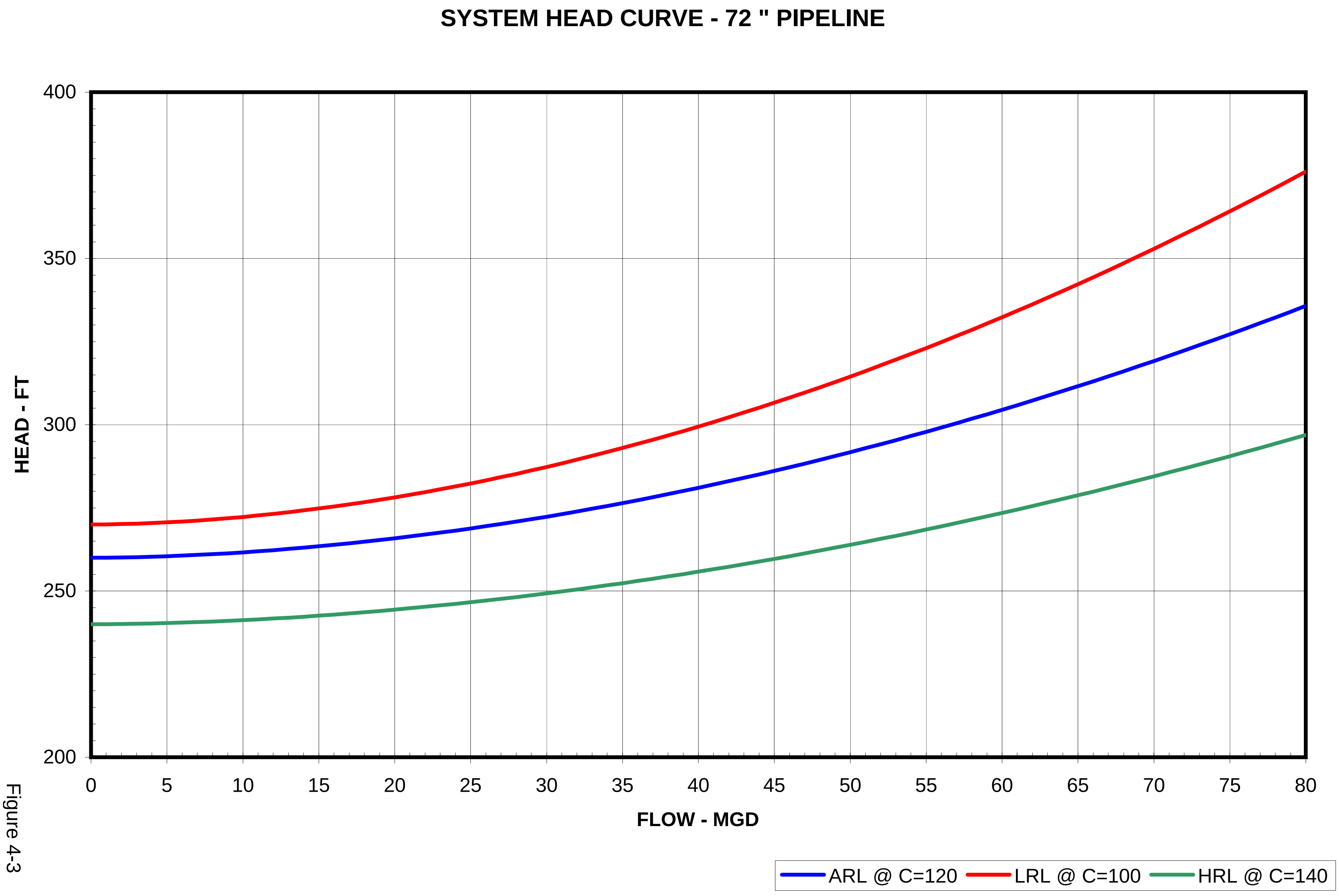

SYSTEM HEAD CURVE - 72 " PIPELINE
HEAD - FT
400
350
300
250
200
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
FLOW - MGD
ARL @ C=120
LRL @ C=100
HRL @ C=140

Figure 4-3

Table 4-5

Flow (MGD)	System Head Curve (ft)								
	72" Option			78" Option			84" Option		
	C=140 High Res	C=120 Avg. Res.	C=100 Low Res.	C=140 High Res	C=120 Avg. Res.	C=100 Low Res.	C=140 High Res	C=120 Avg. Res.	C=100 Low Res.
74	348	404	471	313	357	406	291	327	365

As indicated by the above data, the "flattening" of the system head curves allows the use of larger diameter impellers in the pumps without the use of VFDs or attempting to accurately forecast future water demands. The Flow-Serve pump as referenced above will operate outside of its curve for the 72" and 84" options and will operate well within the curve for the 78" option. However, pumps equipped with variable frequency drives can easily operate within the head ranges of the 72" pipeline option.

4.2.2.5 - High Service Pump Selection

For the purposes of this Technical Memorandum, the final selection of the pumps is not critical. The conceptual design basis indicates the construction of the raw water pumping station can be modified to meet the required changes to incorporate any of the design approaches as outlined in the preceding. The challenges as described can be addressed and cost effectively compared during the final design.

The high lift pump station would be constructed to the west and adjacent to the low lift pump room. This facility would house up to three split case horizontal pumps, each with a nominal capacity of 37 MGD @ 399 feet TDH, for a combined rated capacity of 74 MGD with one unit out of service and space for the installation of three additional pumps of various sizes for expansion. Each of the pump suctions will be connected to header pipes from the onsite storage reservoirs to maintain a positive suction head for NPSH requirements. Each of the pumps would be equipped with isolation valves, a control valve, and an air release valve as well as appropriate monitoring sensors.

As with the low lift pump room, the high service pump room floor layout has sufficient clearances and "lay down" room for pump/motor maintenance. An overhead gantry crane is provided for pump/motor removal. It is recommended that the pump room be sound proofed.

The discharge piping is designed with dual headers with cross connections and appropriate valving to allow for isolation of either side for redundancy. Each side of the header piping is protected by surge relief valves that will discharge back into the reservoir during transient conditions. The room will also be protected from flooding, in the case of a piping failure, by drains that will discharge to the outside.

For this Technical Memorandum, the following ancillary facilities have been included: one office, control room and restrooms. The non-personnel areas including electrical, mechanical, chemical and maintenance rooms are required for the functioning of the station. One recommendation that is strongly suggested is that two electrical rooms and dual motor control centers (MCC) be provided. In keeping with the redundancy requirements, separate electrical and control centers will keep the station in service if an electrical fire occurs in one of the areas. In stations where only one electrical room/MCC is provided, the redundancy is basically eliminated. Due to the critical nature of this facility, the final design should include a detailed review of system back-ups and the ability to take each critical function out of service for maintenance and repair. A detailed security evaluation should also be performed.

4.2.3 - Pump Station Summary and Conclusions

Based on the proceeding, the following conclusions and recommendations are presented for your consideration:

1) The shorewell used for the intake conduit construction should be incorporated into the pump station design as a sump for screening, surge relief and low lift pumping.

2) The design utilizes vertical turbine pumps for low lift service and horizontal split case centrifugal pumps for high lift service.

3) Raw water reservoirs are provided for low lift pump discharge and to provide flooded suction for the high lift pumps. Water supply pumps for the proposed Sanilac County Water treatment plant will also take suction from these same reservoirs.

4) Detailed hydraulic analyses should be performed to determine the most cost effective combination of high service pumps and discharge pipeline options.

5) Due to the critical nature of this facility, the final design should include a detailed review of system back-ups and the ability to take each critical function out of service for maintenance and repair

6) A detailed security evaluation and design should also be performed prior to final design. At a minimum the facility should be doubled fenced with automatic gates that will limit ingress to the area between the fence lines. Outer perimeter gates and fencing should be able to withstand a vehicular crash without compromising security. The property should also be equipped with motion detectors, smoke and fire alarms, video surveillance cameras and recorders. Emergency panic stations should be located throughout the facility for operator use.

7) Process safety management assessment must be performed to evaluate treatment chemical selection.

4.3 - Opinions of Cost

4.3.1 - General

The following opinions of cost have been prepared based on the conceptual designs as outlined in the previous sections of this report and compared with past costs from projects that are similar in scope and complexity. Historical costs were trended to present costs using the *Engineering News Record* construction cost indices. All of the following costs are based on a projected *Engineering News Record* cost index of 8688.

4.3.2 - Intake

The estimated costs for the intake are based on a design flow of 200 MGD, one 80' x 80' timber intake crib, 17,000 feet of 96" diameter pipeline, and zebra mussel system chemical piping for sodium permanganate.

Table 4-6

Item Description	Estimated Cost
Timber Crib (228,000 BF)	$1,336,000.00
17,000 LF of 96" Intake Pipeline Open Cut Installation (from shore to crib)	$36,720,000.00
Zebra Mussel Control System Piping	$1,650,000.00
Sub Total	$39,706,000.00
15% Construction Contingency	$5,956,000.00
5% Design Contingency	$1,985,000.00
17% Engineering, Legal, Bond & Administrative	$6,750,000.00
Construction Total	**$54,397,000.00**

4.3.3 - Shorewell and Tunnel

The proposed concrete caisson shorewell that will serve as the low lift pump suction wetwell would be constructed as part of the intake project. This structure will serve as the construction shaft for the tunnel portion of the intake conduit from the pump station location to the shore of Lake Huron. The estimated costs for the tunnel work associated with this item include the 96" carrier pipe, 120" diameter tunnel liner and the temporary receiving shaft located on the lakeshore.

Table 4-7

Item Description	Estimated Cost
Concrete Caisson Including Excavation and Internal Walls and Baffling	$4,529,000.00
96" Carrier Pipe in Tunnel (700 LF)	$2,100,000.00
Sub Total	$6,629,000.00
15% Construction Contingency	$995,000.00
5% Design Contingency	$332,000.00
17% Engineering, Legal, Bond & Administrative	$1,126,900.00
Construction Total	**$9,082,900.00**

4.3.4 – Lake Huron Pumping Station

Costs for the pump station construction include the low and high lift pumping stations, two 3.0 million gallon reservoirs, the control building, chemical building and site improvements for a 74 MGD firm rated pumping capacity. Additive costs for VFDs are also provided.

Table 4-8

Item Description	Estimated Cost
Lake Huron Pumping Station	$29,100,000.00
15% Construction Contingency	$4,365,000.00
5% Design Contingency	$1,455,000.00
17% Engineering, Legal, Bond & Administrative	$4,947,000.00
Construction Total	**$39,867,000.00**
Add Three VFDs for Horizontal Pumps	$1,400,000.00
Add (See Figure 4-4) for Architectural Tank Options	$160,000 to $1,000,000

4.3.5 – Operation and Maintenance Costs

Projected operation and maintenance expenses are outlined in Table 4-9 below.

Table 4-9

Projected Annual O&M Expenses (2014)	
Maintenance	$313,500
Labor	203,840
Chemicals	$57,260
Power	$1,141,000
Residuals	$36,000
Depreciation	$1,007,000

4.4 – Construction Time

The pump station and intake projects are time of year dependent and are interrelated. The off shore construction is time dependent and generally can be performed from May to October of each year, but allowances must be provided for lake and weather conditions. If bids can be taken during the winter and the contract awarded in early spring, then time will be available for pipe manufacturing and delivery to the site for summer construction. However, if pipe cannot be delivered for summer construction, then a season is lost for construction. Based on the preceding the following construction time frames are presented for planning purposes.

4.4.1 – Lake Huron Pump Station

Shorewell, Temporary Receiving Shaft, Tunnel and 96" Pipe – 8 months
Pumping Station, Storage Tanks, and Site Work – 24 months

4.4.2 – Intake and Crib

17,000 LF of 96" Pipe Submittals, Fabrication and Delivery – 6 months
228,000 BF of Timber Delivery and Crib Construction – 7 months
Crib Towing and Installation – 3 months (season and weather dependent)
Pipe Installation from Shore to Crib – 12 to 15 months (season and weather dependent)

Fluted Precast Pilasters

Beecher, IL

$80,000

Insulation Finish System

Pleasant Prairie, WI

$130,000

Insulation Finish System

Edinburg, TX

$500,000

Figure 4-4

APPENDIX 5

Lake Huron Water Supply Study

Technical Memorandum

Transmission Main Route Considerations

Karegnondi Water Authority
City of Flint
Genesee County
Lapeer County
Sanilac County

February 16, 2009

WADETRIM

555 South Saginaw Street
Suite 201
Flint, Michigan 48502

Appendix 5 - Transmission Main Route Considerations

5.1 - General Route Information

The general route of the transmission main, beginning at a parcel on Lake Huron, will proceed westerly to Genesee County and the City of Flint. Although a final route has yet to be determined for the transmission main, it will generally pass through St. Clair County and/or Sanilac County, Lapeer County, and finally Genesee County.

The majority of the land along the proposed route from Lake Huron to Genesee County is rural in nature. St. Clair, Sanilac, and Lapeer Counties primarily consist of farmland with gently rolling hills. Genesee County has relatively flat terrain that is mostly wooded with some urban development in closer proximity to the City of Flint. The elevation between Lake Huron and Genesee County varies from a low of approximately 590 feet to a high of approximately 975 feet. There are several high points between Lake Huron and Genesee County with the highest overall topography occurring in western Lapeer County.

The anticipated water transmission system includes five (5) sections. These sections are generally described as the following. A schematic of the route is included at the end of this Technical Memorandum.

1. Lake Huron Transmission Section – Proceeding from Lake Huron westerly to the proposed reservoir, which is anticipated to be located in Lapeer County.

2. North and South Transmission Sections – Proceeding from the proposed reservoir via a northern route and via a southern route to the Genesee County Water Treatment Plant (WTP). It is anticipated that the North Transmission will primarily provide raw water to the City of Flint's Water Treatment Plant and the South Transmission will primarily provide raw water to the Genesee County's WTP. However, these two transmission routes will be interconnected to provide reliability to both facilities.

3. Flint Transmission Section – Proceeding with transmission of raw water from the Genesee County WTP location to the existing Flint WTP.

4. Genesee County Finished Water (FW) Transmission – Proceeding from the Genesee County WTP with treated water to the existing Genesee County Henderson Road Pump Station.

Table 5.1 - Estimated Length of Transmission Route

Name of Transmission Route	Estimated Route Length (miles)
Lake Huron Transmission	38.5
North Transmission	14.7
South Transmission	13.9
Flint Transmission	14.1
Genesee County Finished Water (FW) Transmission	5.4

5.2 - Route Considerations

Although a specific route for the proposed pipeline(s) has not been chosen, sections will be constructed along both paved and gravel road rights-of-way, as well as within cross country easement areas between Lake Huron and Genesee County. Due to the rural nature of the terrain, few underground utilities other than telephone and gas will be encountered for the majority of the route. It is assumed that the existing road right-of-way can accommodate the proposed transmission pipeline in most areas; however, due to the large diameter of the pipe, construction will impact a large portion of rights-of-way under the jurisdiction of the Sanilac, St. Clair, Lapeer, and Genesee County Road Commissions, as well as the Michigan Department of Transportation (MDOT). Specific permitting requirements for the project were not explored as part of this study, but will need to be addressed as the route is identified. Any route is expected to cross power transmission lines, up to four railroad lines, and transmission pipelines which traverse the area. Coordination with the appropriate owners will need to be addressed when the route has been identified as well.

An environmental review has not been conducted as part of this study. However, it is anticipated that roughly 85 wetlands, and multiple floodplains, endangered species, and archaeological and historical sites may be impacted by the pipeline construction. In addition, the proposed route will traverse the Black River, Flint River, South Branch of the Flint River, and approximately fifty (50) creeks, streams, and drains during construction. Specific permitting requirements from the Sanilac, St. Clair, Lapeer, and Genesee County Drain Commissioner's offices, as well as the Michigan Department of Environmental Quality (MDEQ) will need to be addressed as the route is identified.

5.3 - Geotechnical Considerations

Available soil boring information was obtained from Division C of the circa 1960's plans for the Lake Huron Water Supply Project prepared by Consoer, Townsend & Associates. Wade Trim has completed a cursory review of these soil boring logs for the proposed raw water transmission line to be installed from the Lake Huron shoreline westward toward the proposed treatment plant. The purpose of this geotechnical review was to evaluate suitability of excavated soils along the proposed transmission main alignment for potential reuse as trench backfill material within existing roadway rights-of-way.

A total of approximately 250 soil boring logs were reviewed. These soil borings were generally located along Fisher, Clear Lake, Snoblin, and Norway Lake Roads between Lake Huron and the intersection of Norway Lake and Flint River Roads. General information obtained from these logs has been tabulated in spreadsheet form for ease of accessibility.

The geotechnical evaluation summary is predicated upon the following key points:

- The available soil boring information for the proposed raw water transmission line alignment, as described above, is over 40 years old. While this information is still very helpful in identifying soil conditions at the respective soil boring locations, groundwater information and other subsurface conditions may vary due to cyclical fluctuations in long term groundwater levels and other human activities.

- Most of the available soil boring logs indicate borings depths to be on the order of approximately 13 feet, with a few being extended to depths of up to 20 to 25 feet. Comments made herein are specific to the depths within the vertical reaches of the available soil borings. Where excavations deeper than these borings are planned, the comments provided herein may not apply for the deeper reaches of excavation.

- Due to the size and/or quality of the drawings we reviewed, the text was either unreadable or missing in a few places and no judgment could be made as to the suitability of existing soils for reuse as trench backfill material within the existing roadway rights-of-way in these areas.

In light of the foregoing, the following summary comments regarding suitability of excavated soils for reuse as trench backfill within the roadway rights-of-way are offered.

Areas where excavated soils are judged to be primarily granular in nature and good to very good for backfill within the influence of existing roadways are as follows:

1. US-25 from the potential Lake Huron Pump Station south approximately 1,000 feet to Fisher Road

2. Fisher Road from US-25 west approximately two miles to Babcock Road

3. Fisher Road from about 1,000 feet to about 3,500 west of Fargo Road

4. Clear Lake Road from about 2,000 feet west of Cedar Creek Road west about 3/4 mile to Lake Pleasant Road

5. Snoblin Road from about 3,000 feet to about 6,000 feet west of Jefferson Road

6. Snoblin Road from 400 feet east of Jones Road to about 2,000 feet west of Jones Road

7. Norway Lake Road from about 200 feet west of Lapeer Road west approximately 1 mile to about 200 feet west of Valentine Road (extended)

8. Norway Lake Road from about 3,600 feet west of Valentine Road (extended) west approximately 1.2 miles to Flint River Road

Areas where excavated soils are judged to be primarily cohesive and/or organic in nature and poor to very poor for backfill within the influence of existing roadways are as follows:

1. Fisher Road from Babcock Road west approximately six miles to Fargo Road

2. Fisher Road from about 3,500 feet west of Fargo Road west approximately 3-1/4 miles to Bricker Road

3. Fisher Road from about 1,500 feet west of Cork Road west approximately 3 miles to about 1,500 feet west of Jordan Road

4. Fisher Road from Melvin/Owens Road west approximately two miles to Mason Road

5. Fisher Road from Bailey Road west approximately one mile to Maple Valley Road

6. Clear Lake Road from Cade Road west about 4,000 feet

7. Clear Lake Road from Bentley Road west approximately 1-1/2 miles to Churchill Road

8. Clear Lake Road from about 1,000 feet west of Van Dyke Road (M-53) west approximately 1 mile to about 1,000 feet west of Blacks Corners Road

Areas where roadways have not been developed and existing excavated soils, excluding organic soils, could be used for backfill are as follows:

1. Fisher Road right-of-way from approximately 3/4 mile west of Jordan Road west approximately 1-1/4 miles to Melvin/Owens Road

2. Fisher Road right-of-way from Mason Road west approximately three miles to Bailey Road

3. Fisher Road right-of-way from Maple Valley Road west approximately one mile to Cade Road

4. Snoblin Road right-of-way from Five Lakes Road west approximately 3/4 mile to Fish Lake Road

Most remaining areas for which soil boring information has been reviewed have somewhat variable soil profiles, with existing soil types ranging from very good to very poor in terms of suitability for reuse as backfill. For these areas, it is preliminarily estimated that about 25 to 50% of the material excavated would be suitable for reuse as trench backfill material.

Additionally, the available soil boring information should be reviewed during the preliminary design phase to address other geotechnical construction considerations that could impact project costs. Among these are:

- Temporary construction dewatering;

- Special considerations for supporting utility trench walls and temporary construction loadings (i.e. equipment, material stockpiles, etc.) in areas of peat, muck, and/or organic soils;

- Potential for bedrock and/or boulder excavation;
- Special considerations for tunneling or boring major roadway, railroad, river, and drainage crossings;
- Considerations for special pipe coatings or treatments (i.e. cathodic protection) in areas of highly organic soils; and,
- Considerations for deep foundation systems to support the proposed water transmission main and utility trench backfill materials in areas of peat, organic, or otherwise unstable soils.

5.4 - Route Selection Criteria and Restoration Alternatives

As discussed above, the alternatives for the transmission main are along mainly rural gravel road rights-of-way, rural paved road rights-of-way, or within easement areas. The easement areas would likely be along section lines or quarter lines in areas where a route along an existing road right-of-way would not be feasible.

Typical cross sections for these four (4) alternatives are included in this Appendix. These typical sections assume a 66-foot right-of-way. Utilizing these typical cross sections, restoration costs estimates were generated for the four (4) alternatives. Restoration costs would include, but are not limited to, clearing and grubbing, construction access approaches, site grading, ditching, drive culvert replacement, drive restoration, aggregate base / surface course, HMA paving, aggregate shoulders, topsoil, seed, mulch, permanent traffic signs, and temporary traffic control devices.

Through Genesee County, Lapeer County, and Sanilac or St. Clair County, it is anticipated that the four (4) alternatives will be utilized when the final route is determined during the design phase.

Based on a preliminary route analysis, the following is an approximated number of miles of each restoration alternative by county and by each transmission route. This preliminary analysis was completed for cost estimating purposes.

Table 5.2 - Anticipated Restoration Activities by County

BY COUNTY	Genesee (miles)	Lapeer (miles)	Sanilac / St. Clair (miles)	Total
Gravel Road	6.5	12.7	12.7	31.9
Paved Road	2.2	0	0	2.2
Easement (Cross-County)	3.9	6.8	6.3	17.0
Easement (Adjacent to Right-of-Way)	4.7	23.8	6.0	34.5
Tunneled	0.1	0.8	0.1	1.0
Estimated Total Route Length (miles):	**17.4**	**44.1**	**25.1**	**86.6**

Table 5.3 - Anticipated Restoration Activities by Transmission Route

By Transmission Main Route	Open Cut, Paved Roadway (miles)		Open Cut, Gravel Roadway (miles)					
Location	Native Material Backfill	Sand Backfill	Native Material Backfill	Sand Backfill	Open Cut, Adjacent to ROW (miles)	Open Cut, Cross Country (miles)	Tunneled (miles)	**Total (miles)**
Lake Huron Transmission	0	0	0.8	17.4	12.9	7.3	0.1	**38.5**
North Transmission	0	0	1.1	4.2	8.3	1.0	0.1	**14.7**
South Transmission	0	0	0	1.8	8.6	2.8	0.7	**13.9**
Flint Transmission	0	2.2	0	3.4	2.7	5.7	0.1	**14.1**
Genesee County FW Transmission	0	0	0	3.2	2.0	0.2	0	**5.4**
Total (Miles)	**0**	**2.2**	**1.9**	**30.0**	**34.5**	**17.0**	**1.0**	**86.6**

The backfill cost estimates include either native or sand backfill material from one (1') foot above the proposed transmission main to the bottom of the subbase material. The restoration costs include subbase, base and surface restoration, as well as topsoil, seed, fertilizer and mulch. Land acquisition is not included in the following unit costs, however, were addressed as a separate line item in the overall cost estimate, see Section 5.6.

The following backfill and restoration unit costs were established based on a projected *Engineering News Record* cost index value of 8688. See worksheets for divisions of costs.

Table 5.4 – Backfill and Restoration Unit Cost Estimates

Transmission Route	**Backfill and Restoration Unit Costs Per Foot**
Lake Huron Transmission	$ 46.65
North Transmission	$ 46.50
South Transmission	$ 45.05
Flint Transmission	$ 52.60
Genesee County Finish Water Transmission	$ 48.50

5.5 - Raw Water Reservoir and Water Treatment Plant Site Considerations

The layout of the proposed transmission line would connect to the proposed Genesee County WTP, as well as the proposed raw water reservoir. The treatment plant and reservoir would need to be located such that the land area would meet the size and storage volume requirements.

Similar to the transmission main, the selected locations for the treatment plant and the reservoir would need to be reviewed for wetland, floodplains, and other governing agencies requirements. All permitting requirements will need to be addressed as the location for the treatment plant is identified and selected.

It is anticipated that the land required for these sites would need to be purchased at fair market value.

5.6 - Easement Acquisition

In areas where easements will be acquired, the land shall be purchased. For cost estimating purposes, easement acquisition was estimated at approximately $6,000 per acre. Where the easement will be cross county, this easement width was estimated at 100 feet in width.
When the easement will be adjacent to an existing road right-of-way, the width is anticipated to be less than or equal to 24 feet in width.

The number of easements anticipated, for cost estimating purposes only are as shown in the following table.

Table 5.5 - Estimated Easements

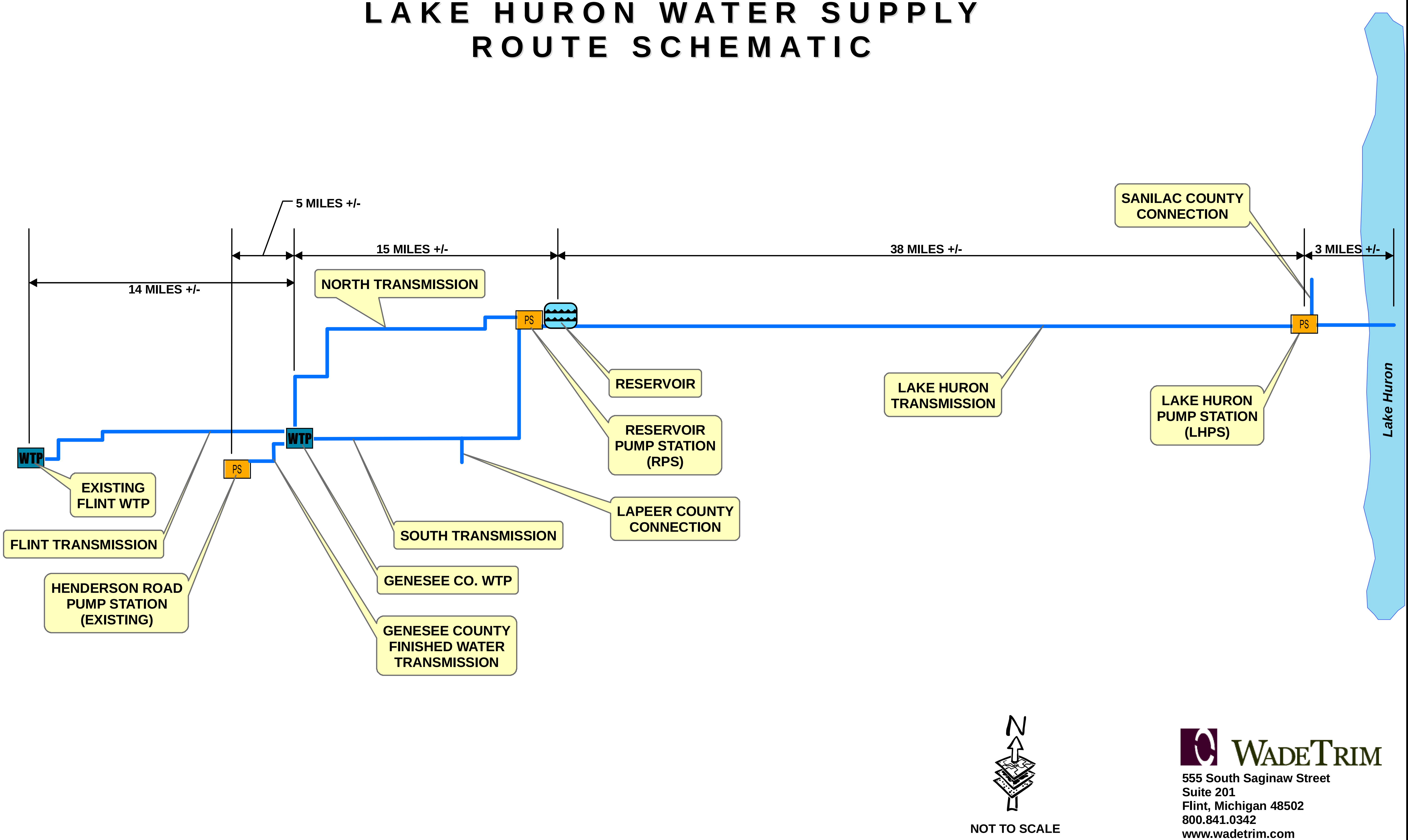
Transmission Main Route	Estimated Easements
Lake Huron Transmission	139
North Transmission	96
South Transmission	92
Flint Transmission	42
Genesee County Finished Water Transmission	25
Total Estimated Easements:	**394**

5.7 - Attachments to Appendix 5

The following are included as attachments to this Technical Memorandum and can be found on the following pages:

1. Lake Huron Water Supply Route Schematic
2. Typical Restoration Cross Sections (4)
3. Summary of Geotechnical Data
4. Worksheets – Summary of Costs

KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY
ROUTE SCHEMATIC



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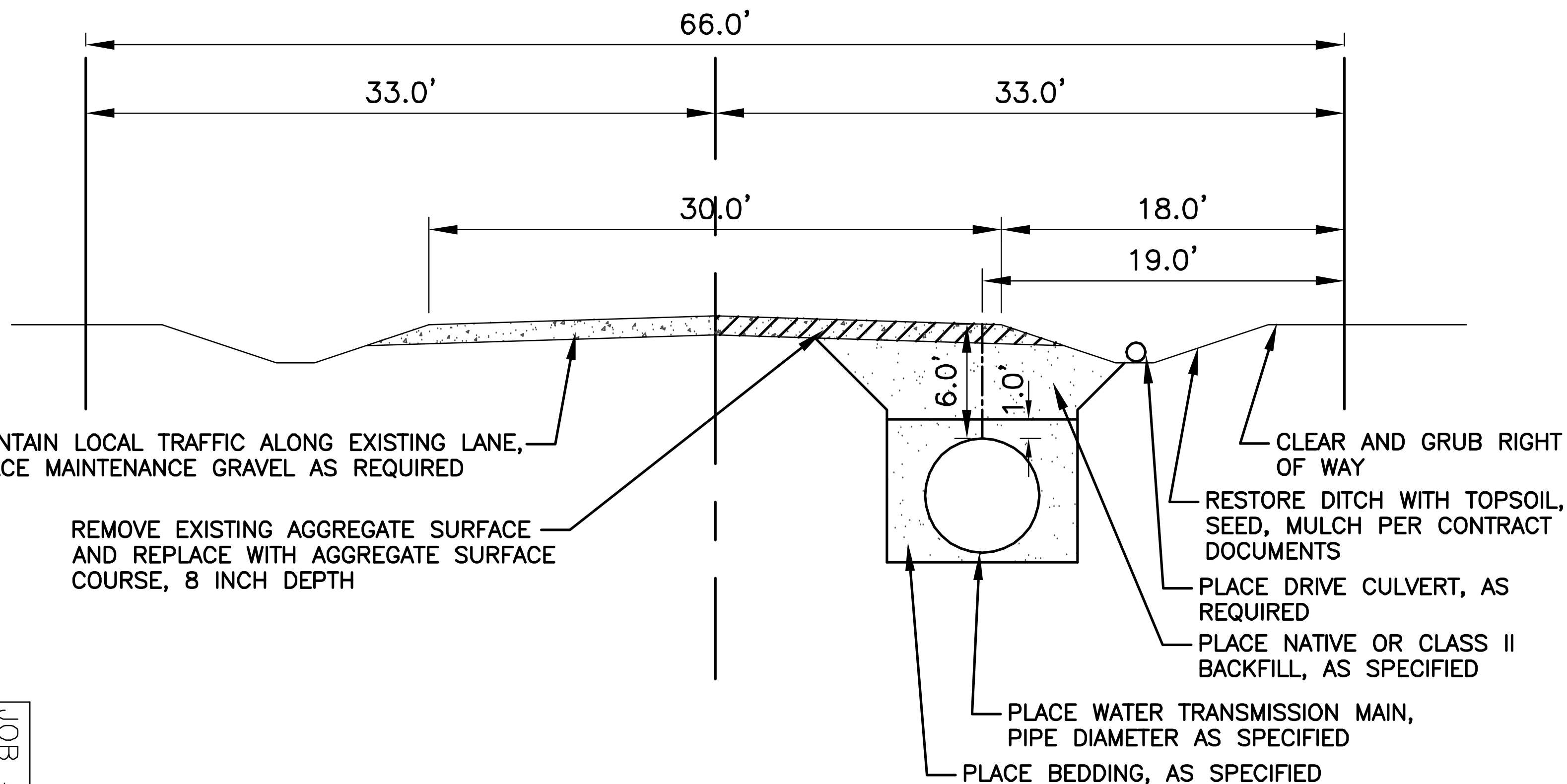
KAREGNONDI WATER AUTHORITY

TYPICAL RESTORATION CROSS SECTION
GRAVEL ROADWAY



RURAL GRAVEL

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SHEET: 1 OF 4

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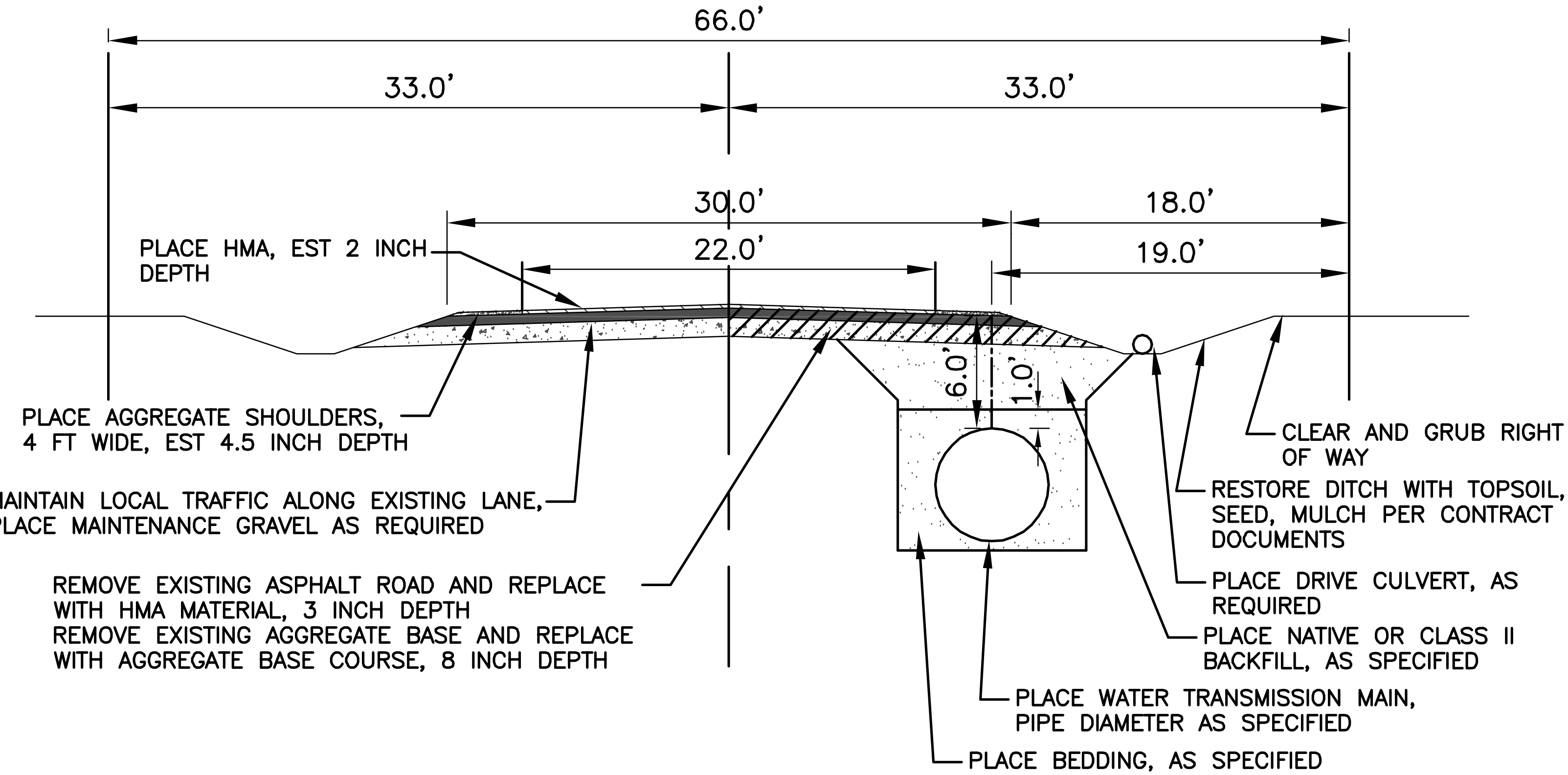
TYPICAL RESTORATION CROSS SECTION
PAVED ROADWAY

KAREGNONDI WATER AUTHORITY



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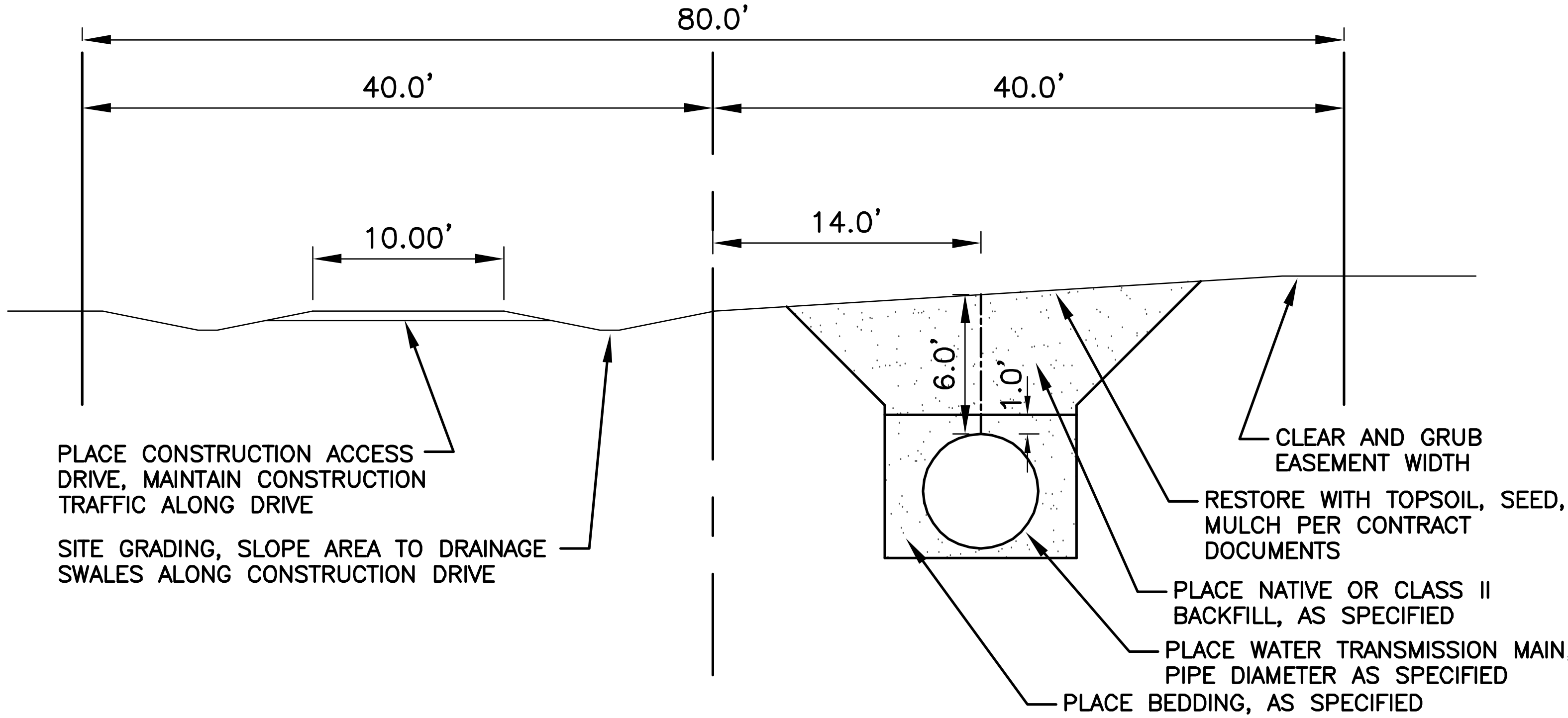

CROSS COUNTRY

TYPICAL RESTORATION CROSS SECTION
CROSS COUNTRY – EASEMENT AREA

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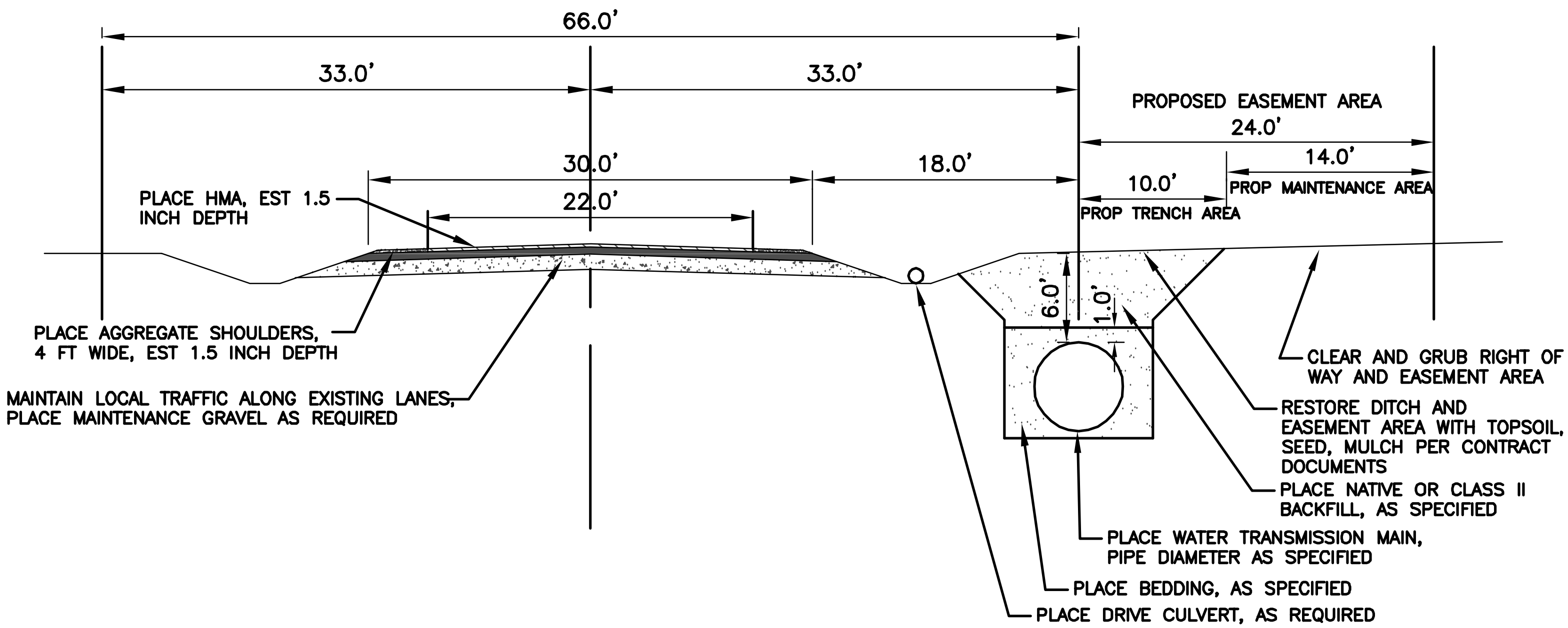
TYPICAL RESTORATION CROSS SECTION ADJACENT TO ROAD RIGHT OF WAY

KAREGNONDI WATER AUTHORITY



ADJACENT TO RIGHT OF WAY

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SHEET: 4 OF 4

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WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

Open Cut, Rural Paved Road Restoration

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$15,000.00	$15,000.00
2	Clearing & Grubbing	Ft	5280	$2.50	$13,200.00
3	Ditching	Ft	5280	$4.50	$23,760.00
4	Culvert, 12 inch	Ft	150	$22.00	$3,300.00
5	Aggregate Base, 22A (15' Wide, 8" Deep)	Ton	3880	$22.00	$85,360.00
6	HMA, 3C (11' Wide, 3" Deep)	Ton	1120	$70.00	$78,400.00
7	HMA, 4C (24' Wide, 1.5" Deep)	Ton	1220	$72.00	$87,840.00
8	Shoulder, Aggregate (4' Wide, 4.5" Deep)	Ton	1160	$24.00	$27,840.00
9	Drive Restoration	Each	5	$650.00	$3,250.00
10	Restoration	Acre	2.2	$3,500.00	$7,700.00
11	Permanent Traffic Signs (Including posts)	Each	5	$350.00	$1,750.00
12	Plastic Drums	Each	55	$20.00	$1,100.00
13	Signs, Temp	Sft	500	$5.00	$2,500.00

Total Restoration Costs Per Mile	**$351,000.00**
Total Restoration Costs Per Foot	**$66.50**

Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

WADETRIM

Open Cut, Gravel Road Restoration

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$8,000.00	$8,000.00
2	Clearing & Grubbing	Ft	5280	$2.50	$13,200.00
3	Ditching	Ft	5280	$4.50	$23,760.00
4	Culvert, 12 inch	Ft	150	$22.00	$3,300.00
5	Agg Surface, Maintenance Side (15' Wide, 2" Deep)	Ton	970	$22.00	$21,340.00
6	Agg Surface, Reconst Side (15' Wide, 8" Deep)	Ton	3880	$22.00	$85,360.00
7	Drive Restoration	Each	5	$650.00	$3,250.00
8	Restoration	Acre	2.2	$3,500.00	$7,700.00
9	Permanent Traffic Signs (Including posts)	Each	5	$350.00	$1,750.00
10	Plastic Drums	Each	55	$20.00	$1,100.00
11	Signs, Temp	Sft	500	$5.00	$2,500.00

Total Restoration Costs Per Mile	**$171,260.00**

Total Restoration Costs Per Foot	**$32.50**

Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

WadeTrim

Open Cut, Adjacent to Road Right of Way Restoration

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$9,000.00	$9,000.00
2	Clearing & Grubbing	Ft	5280	$6.50	$34,320.00
3	Ditching	Ft	5280	$4.50	$23,760.00
4	Culvert, 12 inch	Ft	150	$22.00	$3,300.00
5	HMA, 4C (24' Wide, 1.5" Deep)	Ton	1220	$72.00	$87,840.00
6	Shoulder, Aggregate (4' Wide, 1.5" Deep)	Ton	400	$24.00	$9,600.00
7	Drive Restoration	Each	5	$650.00	$3,250.00
8	Restoration	Acre	2.2	$3,500.00	$7,700.00
9	Permanent Traffic Signs (Including posts)	Each	5	$350.00	$1,750.00
10	Plastic Drums	Each	55	$20.00	$1,100.00
11	Signs, Temp	Sft	500	$5.00	$2,500.00

Total Restoration Costs Per Mile	**$184,120.00**
Total Restoration Costs Per Foot	**$34.90**

Land Acquisition

1	Land Acquisition (24' Wide) ($6,000/acre or $0.15/sft)	Acre	3	$6,000.00	$18,000.00

Total Land Acquisition Per Foot	**$3.50**

Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

Open Cut, Cross Country Restoration

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$8,000.00	$8,000.00
2	Clearing & Grubbing	Ft	5280	$6.50	$34,320.00
3	Construction Access Approach	Each	2	$1,100.00	$2,200.00
4	Construction Access Drive (10' Wide, 3x1 Stone)	Cyd	500	$27.00	$13,500.00
5	Agg Surface Lane (10' Wide, 6" 23A Agg)	Ton	1940	$22.00	$42,680.00
6	Site Grading	Ft	5280	$1.50	$7,920.00
7	Restoration	Acre	12.2	$2,500.00	$30,500.00
8	Plastic Drums	Each	10	$20.00	$200.00
9	Signs, Temp	Sft	80	$5.00	$400.00

Total Restoration Costs Per Mile	**$139,720.00**
Total Restoration Costs Per Foot	**$26.50**

Land Acquisition

1	Land Acquisition (80' Wide) ($6,000/acre or $0.15/sft)	Acre	10	$6,000.00	$60,000.00

Total Land Acquisition Per Foot	**$11.40**

Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

WADETRIM

Paved Road Crossing Restoration

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$1,280.00	$1,280.00
2	Culvert, 18 inch	Ft	60	$32.00	$1,920.00
3	Cold Mill HMA Surface	Syd	110	$12.00	$1,320.00
4	Aggregate Base, 22A (8" Deep)	Ton	90	$22.00	$1,980.00
5	HMA, 3C (3" Deep)	Ton	30	$70.00	$2,100.00
6	HMA, 4C (1.5" Deep)	Ton	25	$72.00	$1,800.00
7	Curb and Gutter, Det B2	Lft	100	$16.00	$1,600.00
8	Restoration	Syd	100	$13.00	$1,300.00
9	Plastic Drums	Each	10	$20.00	$200.00
10	Signs, Temp (Detour)	Sft	500	$5.00	$2,500.00
	Total Restoration Costs per Each				**$16,000.00**

Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

WADETRIM

Drain Crossing Restoration

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$1,490.00	$1,490.00
2	By-Pass Pumping	Lsum	1	$3,000.00	$3,000.00
3	Check Dam, Stone	Cyd	25	$30.00	$750.00
4	Mulch Blanket	Syd	80	$2.00	$160.00
5	Restoration	Syd	80	$10.00	$800.00
6	Rip Rap, Plain	Syd	80	$35.00	$2,800.00

Total Restoration Costs per Each	**$9,000.00**

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Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

WORKSHEET

Transmission Pipeline Preliminary
Restoration Construction Costs

Utility Relocations

Item #	Item Description	Unit	Quantity	Unit Cost	Total
1	Mobilization (5%)	Lsum	1	$10,000.00	$10,000.00
2	Water Leads, Remove and Replace Short Side (Not Including New Curb Stop)	Each	100	$700.00	$70,000.00
3	Extra Backfill for Lower WM in Sanitary Sewer Areas	Cyd	17600	$7.50	$132,000.00
4	Sanitary Leads, Remove and Replace, (Est. 20 Feet Each)	Each	300	$350.00	$105,000.00

Total Estimated Utility Relocation	**$317,000.00**

Please Note: The above costs are based on a projected *Engineering News Record* cost index value of 8688.

Worksheet

Transmission Pipeline Summary
of Restoration and Backfill Costs

LAKE HURON TRANSMISSION RESTORATION COSTS

Restoration Type	Quantity	Unit Cost	Total
Open Cut, Paved Roadway Restoration	0	$66.50	$0.00
Open Cut, Gravel Roadway Restoration	96,260	$32.50	$3,128,450.00
Open Cut, Adjacent to ROW Restoration	68,440	$34.90	$2,388,560.00
Open Cut, Cross Country Restoration	38,280	$26.50	$1,014,420.00
Paved Road Crossing Restoration	7	$16,000	$112,000.00
Drain Crossing Restoration	35	$9,000	$315,000.00
Trench Backfill, Hauled Sand	91,990	$19.40	$1,784,610.00
Trench Backfill, Native Materials	110,990	$6.65	$738,080.00
Total Restoration Cost			**$9,481,120.00**

Restoration Cost Per Foot of Transmission Pipe **$46.65**

Land Acquisition	Quantity	Unit Cost	Total
Adjacent to ROW Route	68,440	$3.50	$239,540.00
Cross Country Route	33,000	$11.40	$376,200.00
Total for Land Acquisition			**$615,740.00**

Total Restoration Plus Land Acquisition Costs	**$10,096,860.00**

Please Note: The above costs are based on a projected Engineering News Record cost index value of 8688.

Worksheet

Transmission Pipeline Summary
of Restoration and Backfill Costs

WADETRIM

NORTH TRANSMISSION RESTORATION COSTS

Restoration Type	Quantity	Unit Cost	Total
Open Cut, Paved Roadway Restoration	0	$66.50	$0.00
Open Cut, Gravel Roadway Restoration	28,250	$32.50	$918,130.00
Open Cut, Adjacent to ROW Restoration	44,030	$34.90	$1,536,650.00
Open Cut, Cross Country Restoration	5,280	$26.50	$139,920.00
Paved Road Crossing Restoration	8	$16,000	$128,000.00
Drain Crossing Restoration	10	$9,000	$90,000.00
Trench Backfill, Hauled Sand	22,440	$19.40	$435,340.00
Trench Backfill, Native Materials	55,120	$6.65	$366,550.00
Total Restoration Cost			**$3,614,590.00**

Restoration Cost Per Foot of Transmission Pipe **$46.50**

Land Acquisition	Quantity	Unit Cost	Total
Adjacent to ROW Route	44,030	$3.50	$154,110.00
Cross Country Route	5,280	$11.40	$60,190.00
Total for Land Acquisition			**$214,300.00**

Total Restoration Plus Land Acquisition Costs	**$3,828,890.00**

Please Note: The above costs are based on a projected Engineering News Record cost index value of 8688.

Worksheet

Transmission Pipeline Summary
of Restoration and Backfill Costs

SOUTH TRANSMISSION RESTORATION COSTS

Restoration Type	Quantity	Unit Cost	Total
Open Cut, Paved Roadway Restoration	0	$66.50	$0.00
Open Cut, Gravel Roadway Restoration	9,520	$32.50	$309,400.00
Open Cut, Adjacent to ROW Restoration	45,230	$34.90	$1,578,530.00
Open Cut, Cross Country Restoration	14,540	$26.50	$385,310.00
Paved Road Crossing Restoration	21	$16,000	$336,000.00
Drain Crossing Restoration	13	$9,000	$117,000.00
Trench Backfill, Hauled Sand	9,520	$19.40	$184,690.00
Trench Backfill, Native Materials	59,770	$6.65	$397,470.00
Total Restoration Cost			**$3,308,400.00**

Restoration Cost Per Foot of Transmission Pipe **$45.05**

Land Acquisition	Quantity	Unit Cost	Total
Adjacent to ROW Route	45,230	$3.50	$158,310.00
Cross Country Route	14,540	$11.40	$165,760.00
Total for Land Acquisition			**$324,070.00**

Total Restoration Plus Land Acquisition Costs	**$3,632,470.00**

Please Note: The above costs are based on a projected Engineering News Record cost index value of 8688.

Worksheet

Transmission Pipeline Summary
of Restoration and Backfill Costs

FLINT TRANSMISSION RESTORATION COSTS

Restoration Type	Quantity	Unit Cost	Total
Open Cut, Paved Roadway Restoration	11,800	$66.50	$784,700.00
Open Cut, Gravel Roadway Restoration	17,840	$32.50	$579,800.00
Open Cut, Adjacent to ROW Restoration	14,510	$34.90	$506,400.00
Open Cut, Cross Country Restoration	33,910	$26.50	$898,620.00
Paved Road Crossing Restoration	6	$16,000	$96,000.00
Drain Crossing Restoration	4	$9,000	$36,000.00
Trench Backfill, Hauled Sand	29,640	$19.40	$575,020.00
Trench Backfill, Native Materials	48,420	$6.65	$321,990.00
Utility Relocations	1	$317,000	$317,000.00
Total Restoration Cost			**$4,115,530.00**

Restoration Cost Per Foot of Transmission Pipe **$52.60**

Land Acquisition	Quantity	Unit Cost	Total
Adjacent to ROW Route	14,510	$3.50	$50,790.00
Cross Country Route	25,030	$11.40	$285,340.00
Total for Land Acquisition			**$336,130.00**

Total Restoration Plus Land Acquisition Costs	**$4,451,660.00**

Please Note: The above costs are based on a projected Engineering News Record cost index value of 8688.

Worksheet

Transmission Pipeline Summary
of Restoration and Backfill Costs

WADETRIM

GENESEE CO. FINISHED WATER TRANSMISSION RESTORATION COSTS

Restoration Type	Quantity	Unit Cost	Total
Open Cut, Paved Roadway Restoration	0	$66.50	$0.00
Open Cut, Gravel Roadway Restoration	16,660	$32.50	$541,450.00
Open Cut, Adjacent to ROW Restoration	10,560	$34.90	$368,540.00
Open Cut, Cross Country Restoration	1,200	$26.50	$31,800.00
Paved Road Crossing Restoration	1	$16,000	$16,000.00
Drain Crossing Restoration	2	$9,000	$18,000.00
Trench Backfill, Hauled Sand	16,660	$19.40	$323,200.00
Trench Backfill, Native Materials	11,760	$6.65	$78,200.00
Total Restoration Cost			**$1,377,190.00**

Restoration Cost Per Foot of Transmission Pipe **$48.50**

Land Acquisition	Quantity	Unit Cost	Total
Adjacent to ROW Route	10,560	$3.50	$36,960.00
Cross Country Route	0	$11.40	$0.00
Total for Land Acquisition			**$36,960.00**

Total Restoration Plus Land Acquisition Costs	**$1,414,150.00**

Please Note: The above costs are based on a projected Engineering News Record cost index value of 8688.

Transmission Main Route Considerations
Soils Information

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B2	C/4	0 - 50	US 25 ~1100' N. of Fisher Rd. (W. Side)	606	Sand to ~13'	None	>13'	Very Good	Minor	US Highway Crossing
B3	C/4	11 + 05	US 25 @ Fisher Rd. (NW Quad)	604	Sand to ~10'; then Clayey Sand to ~13'	593	~11'	Good	Moderate	
B3A	C/4	11 + 15	US 25 @ Fisher Rd. (NW Quad)	595	Sand to ~7'; then Clay to ~8'; then Sand to ~13'	595	0	Very Good	Moderate	
B3B	C/4	17 + 40	Fisher Rd. @ Birch Crk. (NE Quad)	596	Sand to ~13'	588	~8'	Very Good	Moderate	River Crossing
B4	C/4	19 + 90	Fisher Rd. ~200' W. of Birch Crk.	599	Sand to ~13'	590	~9'	Very Good	Moderate	
B5	C/5	30 + 20	Fisher Rd. ~1,960' W. of US 25	608	Clay to ~7'; then Sand to ~10'; then Clay to ~13'	None	>13'	Fair to Poor	Minor	
B6	C/5	41 + 45	Fisher Rd. ~3,085' W. of US 25	620	Sand to ~9'; then Clay to ~14'	618	~2'	Good	Severe	
B7	C/6	50 + 80	Fisher Rd. ~4,020' W. of US 25	626	Sand to ~13'	623	~3'	Good	Severe	
B8	C/6	63 + 20	Fisher Rd. @ Campbell / St. Clair Rd. (NW Quad)	631	Sand to ~14'	629	~2'	Good	Severe	
B9	C/7	73 + 15	Fisher Rd. ~1,035' W. of Campbell Rd.	635	Sand to ~6'; then Clay to ~8'; then Clayey Sand to ~13'	633	~2'	Fair	Severe	
B10	C/7	82 + 65	Fisher Rd. ~1,985' W. of Campbell Rd.	643	Sand to ~9'; then Clay to ~14'	641	~2'	Good	Severe	
B11	C/7	93 + 25	Fisher Rd. ~3,045' W. of Campbell Rd.	653	Sand to ~3'; then Clay to ~14'	None	>14'	Poor	Minor	
B12	C/8	103 + 25	Fisher Rd. ~4,045' W. of Campbell Rd.	655	Clay to ~6'; then Sand to ~13'	649	~6'	Fair	Severe	
B13	C/8	115 + 95	Fisher Rd. @ Babcock Rd.	665	Clay to ~11'; then Sand to ~13'	656	~9'	Poor	Moderate	
B14	C/9	124 + 90	Fisher Rd. ~870' W. of Babcock Rd.	671	Clay to ~9'; then Sand to ~13'	None	>13'	Poor	Minor	
B15	C/9	134 + 65	Fisher Rd. ~1,845' W. of Babcock Rd.	679	Sand to ~1'; then Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Minor	

Soils information was obtained from Division C of the circa 1960's plans for the Lake Huron Water Supply Project prepared by Consoer, Townsend Associates.

Transmission Main Route Considerations
Soils Information

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B16	C/10	143 +80	Fisher Rd. ~2,760' W. of Babcock Rd.	685	Sand to ~3'; then Clay to ~13'	None	>13'	Poor	Minor	
B17	C/10	153 +55	Fisher Rd. ~3,735' W. of Babcock Rd.	691	Sand to ~2'; then Clay to ~13'	None	>13'	Poor	Minor	
B18	C/11	168 + 75	Fisher Rd. @ Vincent Rd. (NE Quad)	698	Clay to ~13'	None	>13'	Poor	Slight	
B19	C/11	173 + 30	Fisher Rd. ~430' W. of Vincent Rd.	700	Clay to ~13'	None	>13'	Poor	Slight	
B20	C/11	183 + 55	Fisher Rd. ~1,455' W. of Vincent Rd.	710	Sand to ~3'; then Clay to ~13'	None	>13'	Poor	Minor	
B21	C/12	205 + 65	Fisher Rd. ~3,665' W. of Vincent Rd.	705	Clay to ~13'	None	>13'	Poor	Minor	
B22	C/12	211 + 30	Fisher Rd. ~4,230' W. of Vincent Rd.	716	Clay to ~13'	None	>13'	Poor	Slight	
B23	C/13	221 + 85	Fisher Rd. @ Wildcat Rd. (NW Quad)	724	Sand to ~3'; then Clay to ~13'	None	>13'	Poor	Slight	
B24	C/13	233 + 80	Fisher Rd. ~1,220' W. of Wildcat Rd.	736	Clay to ~13'	725	~11'	Poor	Minor	
B25	C/14	246 + 80	Fisher Rd. ~2,520' W. of Wildcat Rd.	753	Clay to ~13'	None	>13'	Poor	Slight	
B26	C/14	255 + 20	Fisher Rd. ~3,360' W. of Wildcat Rd.	763	Clay to ~13'	None	>13'	Poor	Slight	
B27	C/15	266 + 20	Fisher Rd. ~4,460' W. of Wildcat Rd.	781	Clay to ~13'	None	>13'	Poor	Slight	
B28	C/15	274 + 30	Fisher Rd. @ Croswell Rd. (NW Quad)	780	Clay to ~13'	None	>13'	Poor	Slight	
B29	C/15	285 + 60	Fisher Rd. ~1,145' W. of Croswell Rd.	779	Clay to ~13'	None	>13'	Poor	Slight	
B30	C/16	295 + 65	Fisher Rd. ~2,150' W. of Croswell Rd.	766	Clay to ~13'	None	>13'	Poor	Slight	
B31	C/16	305 + 25	Fisher Rd. ~3,110' W. of Croswell Rd.	744	Clay to ~13'	None	>13'	Poor	Slight	
B32	C/17	314 + 95	Fisher Rd. ~4,080' W. of Croswell Rd.	711	Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Slight	
B33/B33A	C/17	323 + 15	Fisher Rd. ~4,900' W. of Croswell Rd. (Black River Crossing)	684	Clay to ~17'; then Sand & Gravel to ~25'	670	~14'	Poor (to ~17')	Minor (to ~17')	River Crossing
B34	C/18	336 + 70	Fisher Rd. ~6,255' W. of Croswell Rd.	728	Clay to ~13'	None	>13'	Poor	Slight	
B35	C/18	346 + 35	Fisher Rd. ~7,220' W. of Croswell Rd.	725	Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Minor	
B36	C/18	356 + 05	Fisher Rd. ~8,190' W. of Croswell Rd.	732	Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Minor	

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Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B37	C/19	365 + 35	Fisher Rd. ~9,120' W. of Croswell Rd.	734	Clay to ~13'	None	>13'	Poor	Slight	
B38	C/19	379 + 20	Fisher Rd. @ Cribbins Rd. (NW Quad)	732	Clay to ~10'; then Clayey Sand to ~13'	None	>13'	Poor	Minor	
B39	C/20	392 + 05	Fisher Rd. ~1,305' W. of Cribbins Rd.	738	Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Minor	
B40	C/20	402 + 35	Fisher Rd. ~2,335' W. of Cribbins Rd.	738	Clay to ~9'; then Sand to ~13'	728	~10'	Poor	Moderate	
B41	C/21	412 + 70	Fisher Rd. ~3,370' W. of Cribbins Rd.	741	Clay to ~8'; then Silty Sand to ~13'	None	>13'	Poor	Minor	
B42	C/21	421 + 05	Fisher Rd. ~4,205' W. of Cribbins Rd.	742	Clay to ~10'; then Silty Sand to ~13'	None	>13'	Poor	Minor	
B43	C/22	431 + 75	Fisher Rd. @ Fargo Rd. (NW Quad)	744	Clay to ~13'	None	>13'	Poor	Slight	
B44	C/22	443 + 40	Fisher Rd. ~1,190' W. of Fargo Rd.	746	Clay to 3'; then Sand to ~13'	743	~3'	Good	Severe	
B45	C/22	453 + 50	Fisher Rd. ~2,200' W. of Fargo Rd.	748	Sand to ~13'	744	~4'	Very Good	Severe	
B46	C/23	463 + 25	Fisher Rd. ~3,175' W. of Fargo Rd.	754	Clay to ~3'; then Sand to ~13'	745	~9'	Good	Moderate	
B47	C/23	472 + 80	Fisher Rd. ~4,130' W. of Fargo Rd.	759	Clay to ~12'; then Clayey Sand to ~13'	None	>13'	Poor	Minor	
B48	C/24	484 + 55	Fisher Rd. @ Duce/Todd Rd. (NW Quad)	754	Clay to ~13'	None	>13'	Poor	Slight	
B49	C/24	497 + 50	Fisher Rd. ~1,330' W. of Todd Rd.	752	Clay to ~13'	None	>13'	Poor	Slight	
B50	C/25	505 + 70	Fisher Rd. ~2,150' W. of Todd Rd.	754	Clay to ~13'	None	>13'	Poor	Slight	
B51	C/25	514 + 55	Fisher Rd. ~3,035' W. of Todd Rd.	754	Clay to ~13'	None	>13'	Poor	Slight	
B52	C/25	524 + 60	Fisher Rd. ~4,040' W. of Todd Rd.	753	Clay to ~13'	740	~13'	Poor	Minor	
B53	C/26	537 + 45	Fisher Rd. @ Kilgore Rd. (NW Quad)	758	Clay to ~13'	None	>13'	Poor	Slight	
B54	C/26	548 + 45	Fisher Rd. ~1,145' W. of Kilgore Rd.	755	Clay to ~13'	None	>13'	Poor	Slight	
B54A	C/27	552 + 40	Fisher Rd. ~1,540' W. of Kilgore Rd.	751	Clay to ~20'	None	>20'	Poor	Slight	
B55	C/27	559 + 30	Fisher Rd. ~2,230' W. of Kilgore Rd.	751	Clay to ~13'	None	>13'	Poor	Slight	
B56	C/27	568 + 05	Fisher Rd. ~3,105' W. of Kilgore Rd.	749	Clay to ~13'	None	>13'	Poor	Slight	

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Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B57	C/28	578 + 70	Fisher Rd. ~4,170' W. of Kilgore Rd.	751	Clay to ~13'	None	>13'	Poor	Slight	
B58	C/28	590 + 00	Fisher Rd. @ Brown Rd. (NW Quad)	753	Clay to ~13'	None	>13'	Poor	Slight	
B59	C/29	601 + 05	Fisher Rd. ~1,155' W. of Brown Rd.	756	Clay to ~13'	None	>13'	Poor	Slight	
B60	C/29	610+90	Fisher Rd. ~2,150' W. of Brown Rd.	761	Clay to ~10'; then Silty Sand to ~13'	None	>13'	Poor	Minor	
B61	C/29	621 + 10	Fisher Rd. ~3,160' W. of Brown Rd.	759	Clay to ~13'	None	>13'	Poor	Slight	
B62	C/30	630 + 85	Fisher Rd. ~4,135' W. of Brown Rd.	768	Clayey Sand to ~4'; then Clay to ~10'; then Sand to ~13'	759	~9'	Fair to Poor	Moderate	
B63	C/30	642 + 80	Fisher Rd. @ Bricker Rd. (NW Quad)	770	Clayey Sand to ~9'; then Clay to ~10'; then Sand to ~13'	None	>13'	Fair to Poor	Moderate	
B64	C/31	653 + 55	Fisher Rd. ~1,115' W. of Bricker Rd.	763	Clayey/Silty Sand to ~10'; then Sand to ~13'	760	~3'	Fair	Severe	
B65	C/31	663 + 05	Fisher Rd. ~2,065' W. of Bricker Rd.	764	Clayey Sand to ~9'; then Sand to ~13'	760	~4'	Fair	Severe	
B66	C/32	673 + 45	Fisher Rd. ~3,105' W. of Bricker Rd.	766	Clay to ~8'; then Sand to ~13'	755	~11'	Fair	Minor	
B67	C/32	683 + 00	Fisher Rd. ~4,060' W. of Bricker Rd.	772	Clay to ~13'	None	>13'	Poor	Slight	
B68	C/32	694 + 15	Fisher Rd. @ Cork Rd. (NW Quad)	770	Clay to ~7'; then Sand to ~9'; then Clay to ~13'	768	~2'	Poor	Moderate to Severe	
B69	C/33	706 + 75	Fisher Rd. ~1,285' W. of Cork Rd.	778	Clay to ~8'; then Sand to ~13'	774	~4'	Fair	Severe	
B70	C/33	716 + 30	Fisher Rd. ~2,240' W. of Cork Rd.	781	Clay to ~13'	None	>13'	Poor	Slight	
B71	C/34	724 + 60	Fisher Rd. ~3,070' W. of Cork Rd.	788	Clay to ~10'; then Clayey Sand to ~12'; then Clay to ~13'	780	~8'	Poor	Moderate	
B72	C/34	735 + 60	Fisher Rd. ~4,170' W. of Cork Rd.	798	Clay to ~8'; then Clayey Sand to ~12'; then Sand to ~13'	789	~9'	Poor	Moderate	
B73	C/35	746 + 75	Fisher Rd. @ Duquette Rd. (NW Quad)	805	Clay to ~13'	None	>13'	Poor	Slight	

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Transmission Main Route Considerations
Soils Information

WADETRIM

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B74	C/35	758 + 25	Fisher Rd. ~1,195' W. of Duquette Rd.	803	Clay to ~12'; then Sand to ~13'	793	~10'	Poor	Moderate	
B75	C/36	768 + 60	Fisher Rd. ~2,230' W. of Duquette Rd.	808	Clay to ~6'; then Sand and Gravel to ~10' (Refusal)	None	>10'	Fair to Poor	Moderate	Possible Rock Excavation
*B75A	C/36	768 + 65	Fisher Rd. ~2,235' W. of Duquette Rd.	809	Clay to ~6'; then Sand and Gravel to ~8' (Refusal)	None	>8'	Poor	Moderate	Possible Rock Excavation
B76	C/36	777 + 40	Fisher Rd. ~3,110' W. of Duquette Rd.	809	Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Moderate	
B76A	C/36	781 + 40	Fisher Rd. ~3,510' W. of Duquette Rd.	807	Clay to ~5'; then Peat to ~8'; then Marl to ~12'; then Clay to ~20'	802	~5'	Very Poor	Severe	Organic Soils Present
B77	C/36	787 + 20	Fisher Rd. ~4,090' W. of Duquette Rd.	809	Clay to ~8'; then Sand to ~12'; then Clayey Sand to ~13'	None	>13'	Fair to Poor	Moderate	
B78	C/37	799 + 65	Fisher Rd. @ Brockway Rd. (M19) (NW Quad)	807	Clay to ~13'	None	>13'	Poor	Slight	State Highway Crossing
B79	C/37	809 + 65	Fisher Rd. ~1,035' W. of Brockway Rd.	805	Clay to ~10'; then Clayey Sand to ~13'	796	~9'	Poor	Moderate	
B80	C/38	818 + 65	Fisher Rd. ~1,935' W. of Brockway Rd.	795	Clay to ~10'; then Clayey Sand to ~13'	789	~6'	Poor	Moderate	
B81	C/38	826 + 00	Fisher Rd. @ Parker Rd. (NW Quad)	800	Clay to ~13'	None	>13'	Poor	Slight	
B81A	C/38	831 + 55	Fisher Rd. ~575' W. of Parker Rd.	793	Sand to ~5'; then Clay to ~20'	776	17'	Fair to Poor	Moderate	
B82	C/39	838 + 50	Fisher Rd. ~1,270' W. of Parker Rd. @ C&O RR Crossing (NE Quad)	801	Clay to ~13'	None	>13'	Poor	Slight	Railroad Crossing
B83	C/39	853 + 45	Fisher Rd. ~160' W. of Jordan Rd.	841	Clay to ~13'	None	>13'	Poor	Slight	
B84	C/40	863 + 80	Fisher Rd. ~1,195' W. of Jordan Rd.	822	Clay to ~5'; then Clayey Sand to ~12'; then Clay to ~13'	None	>13'	Poor	Moderate	
B85	C/40	869 + 25	Fisher Rd. ~1,740' W. of Jordan Rd.	815	Clay to ~6'; then Sand to ~13'	805	~10'	Fair	Moderate	
B86	C/40	873 + 60	Fisher Rd. ~2,175' W. of Jordan Rd.	810	Clay to ~13'	None	>13'	Poor	Slight	

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B87	C/40	878 + 75	Fisher Rd. ~2,690' W. of Jordan Rd.	809	Clay to ~4'; then Sand to ~13'	None	>13'	Fair to Good	Moderate	
B88	C/41	890 + 85	Fisher Rd. ~3,900' W. of Jordan Rd.	815	Clay to ~13'	None	>13'	Poor	Slight	
B89	C/42	901 + 80	Fisher Rd. R-O-W ~4,995' W. of Jordan Rd.	839	Sand to ~13'	None	>13'	Very Good	Minor	Cross Country
B90	C/43	914 + 45	Fisher Rd. R-O-W ~6,260' W. of Jordan Rd.	815	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B91	C/43	931 + 80	Fisher Rd. R-O-W ~7,995' W. of Jordan Rd.	802	Sand to ~4'; then Clay to ~13'	None	>13'	Fair	Minor	Cross Country
B92	C/44	938 + 55	Fisher Rd. R-O-W ~8,670' W. of Jordan Rd.	802	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B93	C/44	957 + 90	Fisher Rd. @ Owens / Melvin Rd. (NW Quad)	799	Clay to ~13'	None	>13'	Poor	Slight	
B94	C/45	969 + 30	Fisher Rd. ~1,170' W. of Melvin Rd.	805	Clay to ~13'	None	>13'	Poor	Slight	
B95	C/45	979 + 20	Fisher Rd. ~2,160' W. of Melvin Rd.	801	Clay to ~13'	None	>13'	Poor	Slight	
B96	C/46	989 + 25	Fisher Rd. ~3,165' W. of Melvin Rd.	802	Clay to ~13'	None	>13'	Poor	Slight	
B97	C/46	997 + 15	Fisher Rd. ~3,955' W. of Melvin Rd.	800	Sand to ~3'; then Clay to ~13'	None	>13'	Poor	Minor	
B98	C/46	1004 + 15	Fisher Rd. @ Mowerson Rd.	802	Clay to ~10'; then Sand to ~12'; then Clay to ~13'	793	~9'	Poor	Moderate	
B99	C/47	1017 + 05	Fisher Rd. ~1,320' W. of Mowerson Rd.	803	Clay to ~11'; then Sand to ~13'	796	~7'	Poor	Moderate	
B100	C/47	1027 + 75	Fisher Rd. ~2,390' W. of Mowerson Rd.	805	Clay to ~11'; then Sand to ~13'	796	~9'	Poor	Moderate	
B101	C/48	1033 + 30	Fisher Rd. ~2,945' W. of Mowerson Rd.	804	Clay to ~9'; then Sand to ~13'	None	>13'	Poor	Moderate	
B102	C/48	1038 + 85	Fisher Rd. ~3,500' W. of Mowerson Rd.	803	Clay to ~13'	None	>13'	Poor	Slight	
B103	C/48	1045 + 70	Fisher Rd. ~4,185' W. of Mowerson Rd.	802	Peat to ~1'; then Clay to ~13'	798	~4'	Poor	Moderate	Organic Soils Present
B104	C/48	1050 + 45	Fisher Rd. ~4,660' W. of Mowerson Rd.	803	Peat and Clay to ~5'; then Clay to ~13'	None	>13'	Very Poor	Minor	Organic Soils Present

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B105	C/49	1055 + 80	Fisher Rd. @ Mason Rd. (NE Quad)	805	Peat to ~1'; then Peaty Clay to ~4'; then Clay to ~13'	None	>13'	Very Poor	Minor	Organic Soils Present
B106	C/49	1065 + 65	Fisher Rd. R-O-W ~965' W. of Mason Rd.	807	Topsoil to ~5'; then Clay to ~8'; then Clayey Sand to ~10'; Then Clay to ~13'	None	>13'	Poor	Minor	Cross Country
B107	C/49	1076 + 00	Fisher Rd. R-O-W ~2,000' W. of Mason Rd.	809	Topsoil to ~3'; then Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B108	C/50	1086 + 15	Fisher Rd. R-O-W ~3,015' W. of Mason Rd.	813	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B109	C/50	1098 + 05	Fisher Rd. R-O-W ~4,205' W. of Mason Rd.	811	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B110	C/51	1109 + 40	Fisher Rd. R-O-W @ Shephard St./ Winn Rd. (NW Quad)	819	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B111	C/51	1119 + 65	Fisher Rd. R-O-W ~1,065' W. of Shephard Rd.	819	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B112	C/52	1129 + 85	Fisher Rd. R-O-W ~2,085' W. of Shephard Rd.	815	Clay to ~9'; then Clayey Sand to ~13'	None	>13'	Poor	Minor	Cross Country
B113	C/52	1140 + 20	Fisher Rd. R-O-W ~3,120' W. of Shephard Rd.	810	Clay to ~7'; then Sand to ~10'; then Clay to ~13'	800	~10'	Poor	Minor	Cross Country
B114	C/52	1149 + 05	Fisher Rd. R-O-W ~4,005' W. of Shepard Rd.	806	Clay to ~7'; then Clayey Sand to ~10'' then Clay to ~13'	None	>13'	Poor	Minor	Cross Country
B115	C/53	1162 + 40	Fisher Rd. R-O-W ~5,340' W. of Shepard Rd. (W. of Capac Rd.)	808	Clay to ~13'	798	~10'	Poor	Minor	Cross Country
B116	C/53	1172 + 20	Fisher Rd. R-O-W ~6,320' W. of Shepard Rd.	807	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B117	C/54	1181 + 45	Fisher Rd. R-O-W ~7,245' W. of Shepard Rd.	807	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B118	C/54	1186 + 75	Fisher Rd. R-O-W ~7,775' W. of Shepard Rd.	810	Clay to ~13'	None	>13'	Poor	Slight	Cross Country
B119	C/55	1201 + 20	Fisher Rd. R-O-W ~9,220' W. of Shepard Rd.	806	Clay to ~13'	None	>13'	Poor	Slight	Cross Country

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B120	C/55	1215 + 20	Fisher Rd. @ Bailey Rd. (NW Quad)	805	Clay to ~13'	None	>13'	Poor	Slight	
B121	C/56	1226 + 40	Fisher Rd. ~1,190' W. of Bailey Road	808	Clay to ~13'	None	>13'	Poor	Slight	
B122	C/56	1237 + 60	Fisher Rd. ~2,310' W. of Bailey Road	813	Sand to ~8'; then Clayey Sand to ~13'	802	~11'	Fair	Moderate	
B123	C/57	1248 + 40	Fisher Rd. ~3,390' W. of Bailey Road	806	Clay to ~13'	795	~11'	Poor	Minor	
B124	C/57	1258 + 25	Fisher Rd. ~4,375' W. of Bailey Road	807	Clay to ~13'	None	>13'	Poor	Slight	
B125	C/57	1267 + 60	Fisher Rd. @ Maple Valley / Martin Rd. (NW Quad)	805	Clay to ~13'	None	>13'	Poor	Slight	
B126	C/58	1280 + 50	Fisher Rd. R-O-W ~1,310' W. of Maple Valley Rd.	802	Peat to ~8'; then Silty Sand to ~13'	800	~2'	Poor to Very Poor	Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B127	C/58	1290 + 55	Fisher Rd. R-O-W ~2,315' W. of Maple Valley Rd.	802	Peat to ~6'; then Silty Sand to ~7'; then Clay to ~13'	795	~7'	Very Poor	Moderate to Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B128	C/59	1300 + 65	Fisher Rd. R-O-W ~3,325' W. of Maple Valley Rd.	809	Clay to ~9'; then Sand to ~12'; then Clay to ~13'	797	~11'	Poor	Moderate	
B129	C/59	1310 + 50	Fisher Rd. R-O-W ~4,310' W. of Maple Valley Rd.	813	Clay to ~13'	802	~11'	Poor	Moderate	
B130	C/60	1322 + 40	Clear Lake Rd. @ Cade Rd. (NW Quad)	828	Clay to ~13'	None	>13'	Poor	Slight	
B131	C/60	1332 + 40	Clear Lake Rd. ~1,040' W. of Cade Rd.	846	Clay to ~13'	None	>13'	Poor	Slight	
B132	C/60	1340 + 85	Clear Lake Rd. ~1,885' W. of Cade Rd.	840	Clay to ~13'	None	>13'	Poor	Slight	
B133	C/61	1350 + 70	Clear Lake Rd ~2,870' W. of Cade Rd.	830	Clay to ~13'	None	>13'	Poor	Slight	
B134	C/61	1360 + 35	Clear Lake Rd ~3,835' W. of Cade Rd.	817	Clay to ~13'	811	~6'	Poor	Minor to Moderate	
B135	C/62	1376 + 00	Clear Lake Rd. @ N. Brown City Rd. (NW Quad)	818	Sand to ~5'; then Clayey Sand to ~8'; then Clay to ~10'; then Sand to ~14'	None	>14'	Fair	Minor	
B136	C/62	1383 + 75	Clear Lake Rd. ~875' W. of N. Brown City Rd.	823	Sand to ~2'; then Clay to ~13'	None	>13'	Poor	Minor	
B137	C/63	1393 + 60	Clear Lake Rd. ~1,860' W. of N. Brown City Rd.	818	Sand to ~4'; then Clay to 10'; then Sand to ~13'	None	>13'	Fair	Minor	

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B138	C/63	1404 + 70	Clear Lake Rd. ~2,970' W. of N. Brown City Rd.	830	Sand to ~5'; then Clay to ~9'; then Sand and Gravel to ~13'	821	~9'	Fair	Moderate	
B139	C/63	1414 + 35	Clear Lake Rd. @ Bentley Rd. (NW Quad)	832	Clayey Sand to ~2'; then Clay to ~8'; then Sand to ~10'; then Clay to ~13'	827	~5'	Poor	Moderate to Severe	
B140	C/64	1423 + 50	Clear Lake Rd. ~2,400' W. of Bentley Rd.	852	Clayey Sand to ~3'; then Clay to ~13'	None	>13'	Poor	Slight	
B141	C/64	1433 + 05	Clear Lake Rd. ~3,355' W. of Bentley Rd.	872	Clay to ~13'	None	>13'	Poor	Slight	
B142	C/65	1441 + 10	Clear Lake Rd. @ Dean Rd. (NW Quad)	881	Clay to ~13'	None	>13'	Poor	Slight	
B143	C/65	1453 + 90	Clear Lake Rd. ~1,320' W. of Dean Rd.	875	Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Minor	
B144	C/66	1462 + 85	Clear Lake Rd. ~2,215' W. of Dean Rd.	878	Clayey Sand to ~2'; then Clay to ~9'; then Clayey Sand to ~13'	None	>13'	Poor	Minor	
B145	C/66	1470 + 80	Clear Lake Rd. ~3,010' W. of Dean Rd.	867	Clay to 13'	None	>13'	Poor	Slight	
B146	C/66	1480 + 65	Clear Lake Rd. @ Churchill Rd. (NW Quad)	873	Clayey Sand to ~4'; then Clay to ~10'; then Sand to ~13'	None	>13'	Poor	Minor	
B146A	C/67	1489 + 10	Clear Lake Rd. ~880' W. of Churchill Rd. - Swale Area	839	Sand to ~2'; then Peat to ~4'; then Silty Sand to ~13'; then Sand to ~20'	835	~4'	Fair to Poor	Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B147	C/67	1490 + 5	Clear Lake Rd. ~975' W. of Churchill Rd. - Swale Area	840	Sand to ~13'	838	~2'	Very Good	Severe	Special Pipe Coating / Treatment Noted
B148	C/67	1501 + 20	Clear Lake Rd. ~2,090' W. of Churchill Rd.	837	Sand to ~2'; then Clay to ~13'	None	>13'	Poor	Slight	
B149	C/68	1512 + 30	Clear Lake Rd. ~3,200' W. of Churchill Rd.	820	Topsoil to ~4'; then Sand to ~13'	None	>13'	Good	Minor	
B150	C/68	1521 + 90	Clear Lake Rd. ~4,160' W. of Churchill Rd.	815	Peat to ~5'; then Sand to ~13'	815	0'	Fair	Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted

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Transmission Main Route Considerations
Soils Information

WADETRIM

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B151	C/68	1533 + 35	Clear Lake Rd. @ Van Dyke Rd. M53) (NW Quad)	824	Sand to ~13'	817	~7'	Very Good	Moderate to Severe	State Highway Crossing
B152	C/69	1543 + 20	Clear Lake Rd. ~1,030' W. of Van Dyke Rd.	821	Peat to ~6'; then Organic Sand to ~10'; then Marl to ~13'	815	~6'	Very Poor	Severe	Organic Soils Present
B152A	C/69	1543 + 80	Clear Lake Rd. ~1,090' W. of Van Dyke Rd.	820	Peat to ~4'; then Marl to ~9'; then Silty Sand to ~16'; then Clay to ~18'	815	~5'	Very Poor	Severe	Organic Soils Present
B153	C/69	1549 + 35	Clear Lake Rd. ~1,645' W. of Van Dyke Rd.	828	Sand to ~3'; then Clay to ~9'; then Clayey Sand to ~11'; then Sand to ~13'	823	~5'	Fair to Poor	Severe	
B154	C/70	1559 + 45	Clear Lake Rd. ~2,655' W. of Van Dyke Rd.	849	Clayey Sand to ~13'	None	>13'	Fair	Minor	
B155	C/70	1569 + 25	Clear Lake Rd. ~3,635' W. of Van Dyke Rd.	894	Sand to ~4'; then Clay to ~13'	None	>13'	Fair to Poor	Slight	
B156	C/70	1579 + 25	Clear Lake Rd. ~4,635' W. of Van Dyke Rd.	896	Clay to ~13'	None	>13'	Poor	Slight	
B157	C/71	1585 + 95	Clear Lake Rd. @ N. Blacks Corners Rd. (NW Quad)	887	Clay to ~11'; then Clayey Sand to ~13'	875	~12'	Poor	Minor	
B158	C/71	1595 + 45	Clear Lake Rd. ~985' W. of N. Blacks Corners Rd.	876	Clay to ~7'; then Sand to ~9'; then Clayey Sand to ~11'; then Clay to ~13'	867	~9'	Poor	Moderate	
B159	C/71	1604 + 95	Clear Lake Rd. ~1,935' W. of N. Blacks Corners Rd.	839	Clayey Sand to ~8'; then Clay to ~13'	839	0'	Fair to Poor	Severe	
B160	C/72	1615 + 85	Clear Lake Rd. ~3,025' W. of N. Blacks Corners Rd.	823	Silty Sand to ~2'; then Peat to ~5'; then Sand to ~13'	818	~5'	Fair	Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B161	C/72	1625 + 35	Clear Lake Rd. ~3,975' W. of N. Blacks Corners Rd.	825	Sand to ~13'	820	~5'	Very Good	Severe	Special Pipe Coating / Treatment Noted
B162	C/73	1637 + 75	Clear Lake Rd. @ Summers Rd. (NW Quad)	851	Clayey Sand to ~3'; then Clay to ~13'	None	>13'	Poor	Slight	
B163	C/73	1645 + 85	Clear Lake Rd. ~885' W. of Summers Rd.	856	Clayey Sand to ~4'; then Clay to ~11'; then Sand to ~13'	None	>13'	Poor	Minor	

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Transmission Main Route Considerations
Soils Information

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B164	C/74	1656 + 30	Clear Lake Rd. ~1,930' W. of Summers Rd.	862	Clay to ~9'; then Sand to ~13'	853	~9'	Fair to Poor	Moderate	
B165	C/74	1667 + 90	Clear Lake Rd. ~3,090' W. of Summers Rd.	873	Clayey Sand to ~7'; then Clay to ~13'	None	>13'	Fair to Poor	Minor	
B166	C/74	1678 + 50	Clear Lake Rd. ~4,150' W. of Summers Rd.	884	Sand to ~4'; then Clay to ~13'	None	>13'	Fair to Poor	Minor	
B167	C/75	1689 + 90	Clear Lake Rd. @ Slattery Rd. (NW Quad)	875	Sand to ~3'; then Clay to ~12'; then Sand to ~13'	None	>13'	Fair to Poor	Minor	Special Pipe Coatings / Treatment Noted to East and West
B168	C/75	1700 + 75	Clear Lake Rd. ~1,135' W. of Slattery Rd.	897	Sand to ~13'	None	>13'	Very Good	Minor	
B169	C/76	1713 + 65	Clear Lake Rd. ~2,425' W. of Slattery Rd.	922	Sand to ~13'	None	>13'	Very Good	Minor	
B170	C/76	1723 + 90	Clear Lake Rd. ~3,450' W. of Slattery Rd.	893	Sand to ~3'; then Clay to ~8'; then Sand to ~13'	None	>13'	Fair	Minor	
B171	C/77	1735 + 80	Clear Lake Rd. ~4,640 W. of Slattery Rd.	868	Sand to ~13'	858	~10'	Very Good	Moderate	
B172	C/77	1742 + 30	Clear Lake Rd. @ Cedar Creek Rd. (NW Quad)	865	Sand to ~5'; then Clayey Sand to ~12'; then Clay to ~13'	854	~11'	Fair to Poor	Moderate	
B173	C/78	1752 + 60	Clear Lake Rd. ~1,070' W. of Cedar Creek Rd.	863	Sand to ~4'; then Clay to ~9'; then Clayey Sand to ~11'; then Sand to ~13'	856	~7'	Fair to Poor	Moderate to Severe	
B174	C/78	1766 + 10	Clear Lake Rd. ~2,420' W. of Cedar Creek Rd.	881	Sand to ~13'	None	>13'	Very Good	Minor	
B175	C/79	1774 + 90	Clear Lake Rd. ~3,300' W. of Cedar Creek Rd.	895	Sand to ~13'	None	>13'	Very Good	Minor	
B176	C/79	1783 + 60	Clear Lake Rd. ~4,170' W. of Cedar Creek Rd.	858	Sand to ~12'; then Clay to ~13'	854	~4'	Very Good	Severe	
B177	C/79	1793 + 50	Clear Lake Rd. @ Lake Pleasant Rd. (NE Quad)	849	Sand to ~5'; then Clayey Sand to ~10'; then Clay to ~13'	None	>13'	Fair to Poor	Minor	
B178	C/80	1810 + 65	Lake Pleasant Rd. ~1,645' N. of Clear Lake Rd.	852	Sand to ~11'; then Clayey Sand to ~13'	847	~5'	Very Good	Severe	

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Transmission Main Route Considerations
Soils Information

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B179	C/80	1819 + 25	Lake Pleasant Rd. ~2,505' N. of Clear Lake Rd.	853	Unreable to ~11'; then Sand to ~13'	842	~9'	Unknown	Moderate	Unreadable Text
B180	C/80	1821 + 10	Lake Pleasant Rd. @ Snoblin Rd. (NW Quad)	851	Sand to ~13'	None	>13'	Very Good	Minor	
B181	C/81	1836 + 10	Snoblin Rd. ~1,550' W. of Lake Pleasant Just East of GTRR	841	Sand to ~5'; then Clayey Sand to ~11'; then Sand to ~13'	836	~5'	Fair	Severe	Railroad Crossing
B182	C/81	1844 + 25	Snoblin Rd. ~2,365' W. of Lake Pleasant Rd.	833	Peat to ~3'; then Clayey Sand to ~9'; then Sand to ~13'	828	~5'	Fair to Poor	Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B183	C/82	1854 + 10	Snoblin Rd. ~3,350' W. of Lake Pleasant Rd.	836	Sand to ~5'; then Clayey Sand to ~10'; then Sand to ~13'	None	>13'	Fair	Minor	
B184	C/82	1866 + 60	Snoblin Rd. ~4,600' W. of Lake Pleasant Rd.	832	Sand to ~3'; then Clay to ~9'; then Sand to ~13'	None	>13'	Fair	Minor	
B185	C/83	1873 + 70	Snoblin Rd. @ Jefferson Rd. (NW Quad)	833	Clay to ~9'; then Clayey Sand to ~11'; then Sand to ~13'	828	~5'	Poor	Severe	
B185A	C/83	1876 + 50	Snoblin Rd. ~325' W. of Jefferson Rd. @ Unnamed Crk. (NW Quad)	832	Sand to ~8'; then Clayey Sand to ~22'	824	~8'	Fair to Good	Moderate to Severe	Creek Crossing
B186	C/83	1884 + 20	Snoblin Rd. ~1,095' W. of Jefferson Rd.	840	Clayey Sand to ~13'	837	~3'	Fair	Severe	
B187	C/83	1894 + 20	Snoblin Rd. ~2,095' W. of Jefferson Rd.	836	Clayey Sand to ~12'; then Sand to ~13'	831	~5'	Fair	Severe	
B188	C/84	1906 + 25	Snoblin Rd. ~3,300' W. of Jefferson Rd.	838	Topsoil to ~2'; then Sand to ~13'	826	~12'	Very Good	Minor	
B189	C/84	1912 + 75	Snoblin Rd. ~3,950' W. of Jefferson Rd.	843	Sand to ~13'	None	>13'	Very Good	Minor	
B190	C/85	1926 + 00	Snoblin Rd. ~5,275' W. of Jefferson Rd.	843	Sand to ~13'	None	>13'	Very Good	Minor	
B191	C/85	1935 + 15	Snoblin Rd. ~6,190' W. of Jefferson Rd.	833	Peat to ~5'; then Peaty Sand to ~9'; then Sand to ~12'; then Clay to ~13'	832	~1'	Very Poor	Severe	Organic Soils Present
B192	C/86	1952 + 10	Snoblin Rd. @ Jones Rd. (NE Quad)	850	Sand to ~13'	None	>13'	Very Good	Minor	
B193	C/86	1964 + 80	Snoblin Rd. ~1,230' W. of Jones Rd.	849	Sand to ~13'	None	>13'	Very Good	Minor	

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Transmission Main Route Considerations
Soils Information

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B194	C/87	1972 + 30	Snoblin Rd. ~1,980' W. of Jones Rd.	837	Sand to ~13'	None	>13'	Very Good	Minor	
B195	C/87	1978 + 20	Snoblin Rd. @ Five Lakes Rd. (NE Quad)	837	Sand to ~4'; then Clay to ~13'	825	~12'	Fair to Poor	Minor	
B196	C/87	1989 + 05	Snoblin Rd. R-O-W ~1,045' W. of Five Lakes Rd.	843	Sand to ~13'	None	>13'	Very Good	Minor	Cross Country
B197	C/88	1998 + 00	Snoblin Rd. R-O-W ~1,940' W. of Five Lakes Rd. @ Unnamed Crk. (NE Quad)	825	Peat to ~4'; then Marl to 12'; then Clay to ~13'	823	~3'	Very Poor	Severe	Cross Country, Organic Soils Present, Special Pipe Coating / Treatment Noted
B198	C/88	2011 + 20	Snoblin Rd. R-O-W ~3,260' W. of Five Lakes Rd.	838	Sand to ~5'; then Clayey Sand to ~8'; then Sand to ~13'	831	~7'	Fair to Good	Moderate to Severe	Cross Country
B199	C/89	2022 + 40	Snoblin Rd. R-O-W ~4,380' W. of Five Lakes Rd.	838	Sand to ~13'	835	~3'	Very Good	Severe	Cross Country
B200	C/89	2031 + 50	Snoblin Rd. R-O-W (E.) and Scott Rd. (W.) @ Fish Lake Rd. (NW Quad)	858	Sand and Gravel to ~3'; then Organic Sand to ~11'; then Clayey Sand to ~13'	None	>13'	Poor	Minor	Organic Soils Present
B201	C/90	2040 + 90	Scott Rd. ~995' W. of Fish Lake Rd.	867	Sand to ~2'; then Clayey Sand to ~12'; then Clay to ~13'	None	>13'	Fair	Minor	
B202	C/90	2051 + 40	Scott Rd. ~2,045' W. of Fish Lake Rd.	860	Sand to ~3'; then Clayey Sand to ~9'; then Sand to ~13'	None	>13'	Fair	Minor	
B203	C/90	2061 + 95	Scott Rd. ~3,100' W. of Fish Lake Rd.	870	Sand to ~7' (Refusal on Boulder)	None	>7'	Very Good (to 7')	Minor (to 7')	Possible Boulders
B203A	C/90	2062 + 10	Scott Rd. ~3,115' W. of Fish Lake Rd.	870	Sand to ~7'; then Sand, Gravel & Cobbles to ~13'	None	>13'	Very Good	Minor	
B204	C/91	2072 + 60	Scott Rd. ~4,165' W. of Fish Lake Rd.	860	Sand to ~13'	None	>13'	Very Good	Minor	
B205	C/91	2083 + 65	Scott Rd. @ Scholtz Rd. (NE Quad)	857	Not Described	?	?	Unknown	Unknown	Text Missing
B206	C/92	2095 + 00	Scholtz Rd. ~1,095' S. of Scott Rd.	858	Clayey Sand to ~13'	None	>13'	Fair	Minor	
B207	C/92	2105 + 35	Scholtz Rd. ~2,130' S. of Scott Rd.	859	Clayey Sand to ~13'	None	>13'	Fair	Minor	
B208	C/93	2112 + 60	Norway Lake Rd. ~180' W. of Scholtz Rd.	864	Clayey Sand to ~13'	None	>13'	Fair	Minor	
B209	C/93	2120 + 80	Norway Lake Rd. ~1,000' W. of Scholtz Rd.	850	Clayey Sand to ~13'	None	>13'	Fair	Minor	

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Transmission Main Route Considerations
Soils Information

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B210	C/93	2130 + 40	Norway Lake Rd. ~1,960' W. of Scholtz Rd.	856	Sand to ~13'	None	>13'	Very Good	Minor	
B210A	C/94	2136 + 80	Norway Lake Rd. ~2,600' W. of Scholtz Rd.	833	Peat to ~3'; then Silty Sand to ~9'; then Clay to ~13'; then Sand to ~18'; then Clayey Sand to ~20'	830	~3'	Fair to Poor	Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B211	C/94	2140 + 60	Norway Lake Rd. ~2,980' W. of Scholtz Rd.	831	Peat to ~8'; then Marl to ~13'	None	>13'	Very Poor	Minor	Organic Soils Present, Special Pipe Coating / Treatment Noted
B212	C/94	2150 + 25	Norway Lake Rd. @ Millis Rd. (NW Quad)	836	Sand to ~5'; then Clay to 11'; then Sand to ~14'	828	~8'	Fair	Moderate to Severe	
B213	C/95	2163 + 40	Norway Lake Rd. @ Weir Rd. (NW Quad)	851	Sand to ~4'; then Clay to ~8'; then Sand to ~13'	None	>13'	Fair	Minor	
B214	C/95	2174 + 20	Norway Lake Rd. ~1,090' W. of Weir Rd.	839	Sand to ~9'; then Clay to ~12'; then Sand to ~13'	831	~8'	Good	Moderate to Severe	
B215	C/96	2183 + 00	Norway Lake Rd. ~1,970' W. of Weir Rd.	827	Peat to ~5'; then Marl to ~9'; then Clay to ~11'; then Sand to ~13'	816	~11'	Very Poor	Moderate	Organic Soils Present, Special Pipe Coating / Treatment Noted
B215A	C/96	2188 + 80	Norway Lake Rd. ~2,550' W. of Weir Rd.	830	Sand to ~3'; then Clay to ~6'; then Sand to 12'; then Clay to ~20'	820	~10'	Fair to Good (to ~13')	Moderate (to ~13')	Special Pipe Coating / Treatment Noted
B216	C/96	2194 + 40	Norway Lake Rd. ~3,110' W. of Weir Rd.	837	Clayey Sand to ~14'; then Sand to ~15'	824	~13'	Fair	Minor	
B217	C/96	2203 + 65	Norway Lake Rd. ~4,035' W. of Weir Rd.	830	Sand to ~13'	823	~7'	Very Good	Moderate to Severe	
B218	C/97	2216 + 20	Norway Lake Rd. @ Lapeer Rd. (NW Quad)	833	Peat to ~5'; then Marl to ~8'; then Clay to ~13'	None	>13'	Very Poor	Minor	State Highway Crossing Organic Soils Present, Special Pipe Coating / Treatment Noted
B219	C/97	2226 + 95	Norway Lake Rd. ~1,135' W. of Lapeer Rd.	855	Sand to ~13'	None	>13'	Very Good	Minor	
B220	C/98	2236 + 75	Norway Lake Rd. ~2,115' W. of Lapeer Rd.	855	Sand to ~13'	None	>13'	Very Good	Minor	
B221	C/98	2247 + 10	Norway Lake Rd. ~3,150' W. of Lapeer Rd.	846	Sand to ~13'	None	>13'	Very Good	Minor	
B222	C/99	2257 + 00	Norway Lake Rd. ~4,140' W. of Lapeer Rd.	843	Sand to ~13'	None	>13'	Very Good	Minor	

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Transmission Main Route Considerations
Soils Information

WADETRIM

Boring No.	Division / Sheet No.	STA	Location	Ground Surface Elev.	Description of Material	Ground Water Elev.	Depth to Ground Water	Soil Suitability for Backfill	Dewatering Concern	Comments
B223	C/99	2269 + 50	Norway Lake Rd. @ Valentine Rd. (NW Quad)	820	Sand to ~13'	None	>13'	Very Good	Minor	
B223A	C/99	2276 + 60	Norway Lake Rd. ~710' W. of Valentine Rd.	787	Sand to ~2'; then Peaty Sand to ~7'; then Clay to ~9'; then Clayey Sand to ~14'; then Clay to ~17'; then Clayey Sand to ~20'	780	~7'	Poor	Moderate to Severe	Organic Soils Present, Special Pipe Coating / Treatment Noted
B224	C/100	2283 +85	Norway Lake Rd. ~1,435' W. of Valentine Rd.	781	Sand to ~1'; then Peaty Clay to ~5'; then Peat to ~13'	None	>13'	Very Poor	Minor	Organic Soils Present, Special Pipe Coating / Treatment and Pile-Supported Pipe Cradle Noted
B225	C/100	2293 + 80	Norway Lake Rd. ~2,430' W. of Valentine Rd.	785	Loam to ~3'; then Sand to ~9'; then Clay to ~11'; then Sand to ~13'	779	~6'	Good	Severe	Special Pipe Coating / Treatment and Pile-Supported Pipe Cradle Noted
B225A	C/100	2301 + 20	Norway Lake Rd. ~3,170' W. of Valentine Rd.	779	Sand to ~3'; then Peaty Sand to ~6'; then Soft Clay to ~15'; then Sand to 20'	None	>20'	Poor	Minor to Moderate	Organic Soils Present, Special Pipe Coating / Treatment Noted
B226	C/101	2303 + 60	Norway Lake Rd. ~3,410' W. of Valentine Rd.	777	Fill to ~3'; then Silty Sand to ~5'; then Peat to ~13'	None	>20'	Poor	Minor to Moderate	Organic Soils Present, Special Pipe Coating / Treatment Noted
B227	C/101	2314 + 20	Norway Lake Rd. ~4,470' W. of Valentine Rd.	775	Sand to ~5'; then Silty Sand to ~13'	770	~5'	Good	Severe	Special Pipe Coating / Treatment Noted
B228	C/101	2321 + 30	Norway Lake Rd. ~5,180' W. of Valentine Rd.	782	Sand to ~13'	None	>13'	Very Good	Minor	Special Pipe Coating / Treatment Noted
B229A	C/102	2330 + 00	Norway Lake Rd. ~6,050' W. of Valentine Rd. @ Flint River (NW Quad)	780	Sand to ~25'	768	~12'	Very Good	Minor	River Crossing
B230	C/102	2333 + 30	Norway Lake Rd. ~6,380' W. of Valentine Rd.	783 (In Ditch Bottom)	Sand to ~13'	None	>13'	Very Good	Minor	
B231	C/102	2343 + 85	Norway Lake Rd. ~7,435' W. of Valentine Rd.	794 (In Ditch Bottom)	Sand to ~13'	None	>13'	Very Good	Minor	
B232	C/103	2357 + 70	Norway Lake Rd. ~8,820' W. of Valentine Rd.	816	Sand to ~13'	None	>13'	Very Good	Minor	
B233	C/103	2368 + 20	Norway Lake Rd. @ Flint River Rd.	818	Sand to ~13'	None	>13'	Very Good	Minor	

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Lake Huron Water Supply Study

Appendix 6

Technical Memorandum

Transmission Lines

Karegnondi Water Authority

- **City of Flint**
- **Genesee County**
- **Lapeer County**
- **Sanilac County**

February 16, 2009

Jones & Henry Engineers, Ltd.
2000 West Central Avenue
Toledo, Ohio 43606
419.473.9611
www.jheng.com

6.1 TRANSMISSION LINES

6.1.1 General

This technical memorandum describes the general design criteria for raw water transmission lines as components of the Lake Huron Water Supply Study.

6.1.2 Transmission Lines

The Project has five major transmission pipe lines. Four are raw water lines and one dual line is finished water.

The waterlines are sized to maintain a velocity of 5 feet per second or less under all operating conditions and have operating pressures less than 200 psi.

A detailed hydraulic analysis has not been performed as part of the planning study but it will be required as part of the detailed design of the system.

1. Lake Huron Transmission

   203,280 feet of 72-inch diameter steel pipe (cement mortar-lined) or pressure concrete cylinder pipe (PCCP). Both pipe materials have similar installed costs. The actual material should be selected based on costs and conditions at the time of construction. The breakdown of costs for PCCP will be used for the remainder of this technical memorandum.

   The Lake Huron Transmission pipeline conveys raw water from the Lake Huron Pump Station to the Raw Water Reservoir, approximately 38.5 miles west of the pump station.

2. North Transmission

   77,760 feet of 54-inch diameter ductile iron pipe (DIP). Costs are based on DIP Class 200 in this technical memorandum. The actual class of pipe must be determined during the design phase.

   The North Transmission pipeline is one of two lines to convey raw water from the Reservoir to the Genesee County WTP or serve as the first leg of the raw water supply to the Flint WTP. There will be valves near the Genesee WTP to allow either alternate to be implemented.

3. South Transmission

   44,265 feet of 60-inch DIP, and 29,186 feet of 54-inch diameter DIP. Costs are based on DIP Class 200 in this technical memorandum. The actual class must be determined during the design phase.

   The South Transmission pipeline is the other line that will convey raw water from the Reservoir to the Lapeer and Genesee County WTPs or serve as the first leg of the raw water supply to the Flint WTP with the north transmission serving as a backup. There will be valves near the Genesee WTP to allow either alternate to be implemented.

4. Flint Transmission

   74,560 feet of 48-inch diameter DIP. Costs are based on DIP Class 200 in this technical memorandum. Pipe class(es) need to be determined during the design phase.

The Flint Transmission pipeline conveys raw water from the North Transmission pipeline to the Flint WTP. The Flint Transmission pipeline can also be fed by the South Transmission pipeline passing through the Genesee WTP site as a backup to the North Transmission pipeline.

5. Genesee County Finished Water Transmission

28,420 feet of 42-inch DIP. Costs are based on DIP Class 200 in this technical memorandum. Pipe class(es) need to be determined during the design phase.

Finished water from the Genesee County Water Treatment plant will be conveyed to the existing Henderson Road Pump Station by two parallel 42-inch pipelines. The pipelines will be constructed in separate parallel trenches. The pipe length reflects total pipe length of the two pipelines.

See Appendix 5 for additional detail of routing, alignments, and surface conditions for each of the five Transmission Pipelines.

6.1.3 Pipe Installation

The following is a discussion of components that are included in transmission pipeline and used to develop the estimate of costs. They are presented in the order shown on the estimate forms. The estimate forms follow this discussion.

1. Pipe

The 72-inch pipe will be either cement mortar lined steel or pressure concrete cylinder pipe rated for 200 psi pressure. All other pipe for the project is DIP, with push-on joints with integral joint restraint as needed. Pressure Class 200 has been assumed here, but the actual class proposed needs to be determined during design.

Material prices for pipe are based on manufacturer's pricing December 2008.

The installation rates for the pipelines are based on production rates for similar pipe sizes and soil and site conditions. Information obtained through conversation with contractors.

72-inch pipe installed at a typical rate of 300 ft/day
60-inch pipe installed at a typical rate of 250 ft/day
48 and 54-inch pipe installed at a typical rate of 300 ft/day
48-inch pipe installed in developed areas (in Flint vicinity) at a rate of 200 ft/day.
42-inch pipe installed at a typical rate of 300 ft/day

DIP Pipe Encasement – Polyethylene Wrap "Polywrap" – 4 mil HDT

2. Labor

A standard pipeline crew for installation of the transmission pipelines consists of seven-man crew.

Assume $550/day/ man
Labor cost = $3,850/day

3. Equipment

Typical equipment for the transmission line installation:

375 Cat Excavator
950 Cat Loader
D-8 Dozer
(trucks included in hauled materials prices)

4. Fuel Costs

Fuel cost for the listed equipment is $973 per day.
This is based on 350 gallons per day consumption and diesel at $2.78 per gallon (December 2008).

5. Pipe Bedding

The pipe installation will use a Type 4 trench.

The bedding with this installation will be sand or gravel from 6 to 8-inches below bottom of the pipe to one foot above the top of pipe. Width of pipe trench at the bottom will be pipe diameter plus 12-inches either side.

Sand will be Class 2 at $5.50 per ton
Stone will be 6A at $18.00 per ton

Costs have been included to haul bedding materials to the site and haul out spoil materials associated with the bedding material displacement.

Typical cost for hauling materials to and from the job, including labor and equipment, is $5.00 per cubic yard.

The pipeline construction in the project area is likely to encounter wet conditions in some sections which will require dewatering. For the project estimates, 20 percent of the trench length is assumed to require dewatering (See Item 6 below). The trenches in dewatered areas will have 6A stone used for bedding from the trench bottom to the spring-line of the pipe instead of sand. The remainder of backfill around the pipe will be sand.

The two types of pipe bedding for the project are noted as wet-construction and dry-construction.

6. Dewatering

The pipe installation will require dewatering due to the location of the project and the native conditions. As noted, it is assumed that 20 percent of the pipe installation will require dewatering.

Typical cost for dewatering is $40 per foot.

Note: Additional support for the installed pipe due to poor soils such as peat or marl needs to be evaluated after detailed soils investigations are completed.

7. Specials & Appurtenances

The routes of the various pipe line and the installation location in-paved roads or gravel roads, adjacent to roads in easements, or cross-country in-easement are presented in Appendix 5. The routing and shifting alignments will require pipe fittings in most cases to achieve the deflections. For the transmission pipeline estimates, pipeline offsets are done using two 45-degree bends. Right-angle bends are also done using two 45-degree bends.

The costs represent material cost only. The installation cost is included in the pipe construction cost.

8. Air Release Valves

Air release valves will be installed along the pipe line as needed for proper operation. Previous initial designs for the Lake Huron transmission main were used to develop preliminary quantities. The air release valves will be installed in concrete chambers, 9 feet by 9 feet with adequate height for the air release valve.

9. Isolation Valves

Valves will be installed in the transmission main at approximately six (6) mile intervals to isolate the line for emergencies and routine inspections. The valves will be knife gate valves with electric actuators. The valves will be pressure rated for 200 psi where necessary.

The actuators will be either 480V 3-phase, or 240 V single-phase. The single phase power will allow power to be more readily supplied to the remote sites along the transmission lines.

The valve assemblies will be installed in reinforced concrete vaults with manhole access. The top slab of the vault will be removable.

The cost represents the complete installation including the valve, actuator, and concrete chamber.

10. Blow-Off Valves

Blow-off valves will be installed on the transmission line for flushing sections of lines. They will provide a flow adequate to suspend and transport sediment as needed.

The blow-off valve assembly will consist of a tee fitting with 18-inch side outlet on the transmission line with an 18-inch gate valve in a separate valve chamber and approximately 100 feet of 18-inch DIP to transport the blow-off flow to a discharge point.

The cost represents the complete installation including the fitting, valve, piping and chamber.

11. Flushing Hydrants

Flushing hydrants will be installed along the route for construction needs and routine access for the operation and maintenance of the transmission lines. These will be typical hydrant assemblies connected to the transmission line installed at 18,000 to 20,000 feet intervals.

12. Pipe in Tunnel

It will be necessary to install the pipe in tunnels at several locations. The tunnel construction is based on a steel liner plate tunnel approximately 12-inches larger than the outside diameter of the pipe bells. The transmission line will be installed after the tunnel is complete. Tunnel construction will be used to cross State Highways, active Railroads, and streams and rivers. The location of the pipe in tunnel installation is addressed in Technical Memorandum 5.

The price to construct the primary tunnel, without pipe costs, for the 48-inch through 72-inch pipe is $2,135 per foot.

6.1.4 Construction Schedule

The construction schedule for the transmission lines is based on several factors. The key factor is the daily production rate of pipe installation, estimated to be between 200 to 300-feet per day. Other factors are lead time to begin getting piping and equipment delivered to the site, time needed to construct the various chambers for the valves and other appurtenances, and the time to complete surface restorations which will be on-going throughout the project. Seasonal limitations must also be taken into account.

The transmission lines construction schedule is impacted by the number of construction contracts to be used for each of the five transmission line projects.

6.2 ANNUAL OPERATIONS AND MAINTENANCE COSTS

6.2.1 Annual Operating Costs

The following assumptions were made for operating costs:

1. Power cost based on $100 per month per valve for electrically-operated knife gate valves.

2. Direct Labor Cost of $25 per hour with a fringe benefit rate of 1.62.

This estimate assumes a two-man crew will inspect and exercise the valves and chambers along all routes six times per year at 30 hours per inspection.

6.2.2 Annual Maintenance Costs

Maintenance costs were assumed as follows:

1. Valves and Hydrants – 2-1/2 percent of original costs (40 years)

2. Pipelines – 1-1/3 percent of original cost (75 years)

Table 6-1
Annual Operations and Maintenance Costs

Operating Costs	
Labor	$14,580
Power	$22,800
Subtotal	$37,380
Maintenance Costs	
Valves & Hydrants 2-1/2%	$197,490
Piping 1-1/3%	$1,904,045
Subtotal	$2,101,535
Total O&M Costs	**$2,138,915**

6.3 COSTS ESTIMATES

6.3.1 Cost Estimates

Cost estimates for the five transmission lines are on the following pages.

LAKE HURON TRANSMISSION

Pipe Size	72 inches	
Total Length	203,280 feet	38.5 miles
Open Cut Length	202,640 feet	
Tunnel-Installed	640 feet	

MATERIAL (Open Cut)	Length (ft)		$ / LF	TOTAL
Cost of Pipe	202,640		$ 380.00	$ 77,003,200

LABOR	Days		(Cost/Day)	TOTAL
Labor	676		$ 3,850.00	$ 2,602,600

EQUIPMENT	Days		(Cost / day)	TOTAL
Equipment	676		$ 1,522.00	$ 1,028,872

FUEL	Days	Daily Usage (gl)	Cost (gl)	TOTAL
Fuel	676	350	$ 2.78	$ 657,748

PIPE BEDDING	Length (ft)	Volume (cy)	Unit Cost	TOTAL
Wet Construction				
Stone 6A	40,528	18,537	$ 18.00	$ 333,659
Sand Class 2	40,528	22,039	$ 5.50	$ 121,215
Hauling (Bedding Material)		40,576	$ 5.00	$ 202,878
Haul Away Spoils		70,048	$ 5.00	$ 350,242
Dry Construction				
Sand Class 2	162,112	162,302	$ 5.50	$ 892,663
Hauling (Bedding Material)		162,302	$ 5.00	$ 811,512
Haul Away Spoils		280,194	$ 5.00	$ 1,400,968
SUB TOTAL				**$ 4,113,136**

DEWATERING	Length (ft)		$ / LF	TOTAL
Dewatering	40,528		$ 40.00	$ 1,621,120

PIPE SUBTOTAL	**$ 87,026,676**
COST OF PIPE /ft	**$ 428.11**

SPECIALS		Unit Cost	TOTAL
Air Release Valve Units	46 units	$ 29,000	$ 1,334,000
Isolation Valve Units	7 units	$ 231,000	$ 1,617,000
Blow-off Valve Unit	11 units	$ 76,500	$ 841,500
Flushing / Hydrant	11 units	$ 2,000	$ 22,000
SUB TOTAL			**$ 3,814,500**

Tunnel Installed Sections			
Black River	300 ft	$ 2,515	$ 754,500
Hyway M-19	120 ft	$ 2,515	$ 301,800
Railroad Crossing	100 ft	$ 2,515	$ 251,500
Van Dyke Rd.	120 ft	$ 2,515	$ 301,800
SUB TOTAL	**640 ft**		**$ 1,609,600**

SUB TOTAL		**$ 92,450,776**
OVERHEAD & PROFIT	15%	**$ 13,867,616**
GRAND - TOTAL		**$ 106,318,393**

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NORTH TRANSMISSION

Pipe Size	54 inches	
Total Length	77,760 feet	14.73 miles
Open Cut Length	77,390 feet	
Tunnel-Installed	370 feet	

MATERIAL (Open Cut)	Length (ft)		$ / LF	TOTAL
Cost of Pipe	77,390		$ 285.00	$ 22,056,150

LABOR	Days		(Cost/Day)	TOTAL
Labor	258		$ 3,850.00	$ 993,300

EQUIPMENT	Days		(Cost / day)	TOTAL
Equipment	258		$ 1,522.00	$ 392,676

FUEL	Days	Daily Usage (gl)	Cost (gl)	TOTAL
Fuel	258	350	$ 2.78	$ 251,034

PIPE BEDDING	Length (ft)	Volume (cy)	Unit Cost	TOTAL
Wet Construction				
Stone 6A	15,478	5,570	$ 18.00	$ 100,265
Sand Class 2	15,478	6,717	$ 5.50	$ 36,942
Hauling (Bedding Material)		12,287	$ 5.00	$ 61,435
Haul Away Spoils		19,491	$ 5.00	$ 97,454
Dry Construction				
Sand Class 2	61,912	49,148	$ 5.50	$ 270,315
Hauling (Bedding Material)		49,148	$ 5.00	$ 245,741
Haul Away Spoils		77,963	$ 5.00	$ 389,816
SUB TOTAL				**$ 1,201,967**

DEWATERING	Length (ft)		$ / LF	TOTAL
Dewatering	15,478		$ 40.00	$ 619,120

P I P E S U B T O T A L	**$ 25,514,247**
COST OF PIPE /ft	**$ 328.12**

SPECIALS		Unit Cost	TOTAL
Bends	40 units	$ 11,014	$ 440,561
Air Release Valve Units	17 units	$ 25,000	$ 425,000
Isolation Valve Units	4 units	$ 153,000	$ 612,000
Blow-off Valve Unit	4 units	$ 69,025	$ 276,100
Flushing / Hydrant	4 units	$ 2,000	$ 8,000
SUB TOTAL			**$ 1,761,661**

Tunnel Installed Sections			
Lapeer Road	120 ft	$ 2,420	$ 290,400
Flint River	250 ft	$ 2,420	$ 605,000
SUB TOTAL	**370 ft**		**$ 895,400**

SUB TOTAL		**$ 28,171,309**
OVERHEAD & PROFIT	15%	**$ 4,225,696**
G R A N D - T O T A L		**$ 32,397,005**

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SOUTH TRANSMISSION

Pipe Size	60	inches		
Total Length	44,265	feet	8.38 miles	
Open Cut Length	43,995	feet		
Tunnel-Installed	270	feet		
Pipe Size	54	inches		
Total Length	29,186	feet	5.53 miles	
Open Cut Length	29,186	feet		
Tunnel-Installed	-	feet		
MATERIAL (Open Cut)	**Length (ft)**		**$ / LF**	**TOTAL**
Cost of Pipe 60 inches	43,995		$ 328.00	$ 14,430,262
Cost of Pipe 54 inches	29,186		$ 285.00	$ 8,317,872
LABOR	**Days**		**(Cost/Day)**	**TOTAL**
Labor	244		$ 3,850.00	$ 939,400

EQUIPMENT	Days		(Cost / day)	TOTAL
Equipment	244		$ 1,522.00	$ 371,368

FUEL	Days	Daily Usage (gl)	Cost (gl)	TOTAL
Fuel	244	350	$ 2.78	$ 237,412

PIPE BEDDING	Length (ft)	Volume (cy)	Unit Cost	TOTAL
Wet Construction				
Stone 6A	14,636	5,267	$ 18.00	$ 94,810
Sand Class 2	14,636	6,351	$ 5.50	$ 34,933
Hauling (Bedding Material)		11,619	$ 5.00	$ 58,093
Haul Away Spoils		18,431	$ 5.00	$ 92,153
Dry Construction				
Sand Class 2	58,544	46,475	$ 5.50	$ 255,610
Hauling (Bedding Material)		46,475	$ 5.00	$ 232,373
Haul Away Spoils		73,722	$ 5.00	$ 368,611
SUB TOTAL				**$ 1,136,584**

DEWATERING	Length (ft)		$ / LF	TOTAL
Dewatering	14,636		$ 40.00	$ 585,442

P I P E S U B T O T A L	**$ 26,018,340**
COST OF PIPE /ft	**$ 354.23**

SPECIALS		Unit Cost	TOTAL
Bends	24 units	$ 11,014	$ 264,337
Air Release Valve Units	17 units	$ 25,000	$ 425,000
Isolation Valve Units (60")	2 units	$ 184,000	$ 368,000
Isolation Valve Units (54")	2 units	$ 153,000	$ 306,000
Blow-off Valve Unit	2 units	$ 69,025	$ 138,050
Flushing / Hydrant	4 units	$ 2,000	$ 8,000
SUB TOTAL			**$ 1,509,387**

Tunnel Installed Sections			
Lapeer Road	120 ft	$ 2,463	$ 295,560
Flint River	150 ft	$ 2,420	$ 363,000
SUB TOTAL	**270 ft**		**$ 658,560**

SUB TOTAL		**$ 28,186,287**
OVERHEAD & PROFIT	15%	**$ 4,227,943**
G R A N D - T O T A L		**$ 32,414,230**

FLINT TRANSMISSION

Pipe Size	48 inches	
Total Length	74,560 feet	14.12 miles
Open Cut Length	74,140 feet	
Special Installation Sewer Area	26,400 feet	5.00 miles
Tunnel-Installed	420 feet	

MATERIAL (Open Cut)	Length (ft)		$ / LF	TOTAL
Cost of Pipe	74,140		$ 222.00	$ 16,459,080

LABOR	Days		(Cost/Day)	TOTAL
Labor (Normal Installation)	160		$ 3,850.00	$ 616,000
Labor (Sewer Area)	132		$ 3,850.00	$ 508,200
SUB TOTAL				**$ 1,124,200**

EQUIPMENT	Days		(Cost / day)	TOTAL
Equipment	292		$ 1,522.00	$ 444,424

FUEL	Days	Daily Usage (gl)	Cost / gl	TOTAL
Fuel	292	350	$ 2.78	$ 284,116

PIPE BEDDING	Length (ft)	Volume (cy)	Unit Cost	TOTAL
Wet Construction				
Stone 6A	14,828	5,336	$ 18.00	$ 96,054
Sand Class 2	14,828	6,435	$ 5.50	$ 35,391
Hauling (Bedding Material)		11,771	$ 5.00	$ 58,855
Haul Away Spoils		18,672	$ 5.00	$ 93,361
Dry Construction				
Sand Class 2	59,312	47,084	$ 5.50	$ 258,963
Hauling (Bedding Material)		47,084	$ 5.00	$ 235,421
Haul Away Spoils		74,689	$ 5.00	$ 373,446
SUB TOTAL				**$ 1,151,491**

DEWATERING	Length (ft)		$ / LF	TOTAL
Dewatering	14,828		$ 40.00	$ 593,120

PIPE SUBTOTAL	**$ 20,056,431**
COST OF PIPE /ft	**$ 269.00**

SPECIALS		Unit Cost	TOTAL
Bends	50 units	$ 19,793	$ 989,672
Air Release Valve Units	17 units	$ 29,000	$ 493,000
Isolation Valve Units	3 units	$ 84,000	$ 252,000
Blow-off Valve Unit	4 units	$ 76,500	$ 306,000
Flushing / Hydrant	4 units	$ 2,000	$ 8,000
SUB TOTAL			**$ 2,048,672**

Tunnel Installed Sections			
State Road	120 ft	$ 2,357	$ 282,840
Flint River	300 ft	$ 2,357	$ 707,100
SUB TOTAL	**420 ft**		**$ 989,940**

SUB TOTAL		**$ 23,095,042**
OVERHEAD & PROFIT	15%	**$ 3,464,256**
GRAND - TOTAL		**$ 26,559,299**

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GENESEE COUNTY FINISHED WATER LINE

Pipe Size	42 inches	
Total Length	28,420 feet	5.38 miles
Open Cut Length	28,420 feet	
Tunnel-Installed	0 feet	

MATERIAL	Length (ft)		$ / LF	TOTAL
Cost of Pipe	28,420		$ 171.00	$ 4,859,820

LABOR	Days		(Cost/Day)	TOTAL
Labor	95		$ 3,850.00	$ 365,750

EQUIPMENT	Days		(Cost / day)	TOTAL
Equipment	95		$ 1,522.00	$ 144,590

FUEL	Days	Daily Usage (gl)	Cost / gl	TOTAL
Fuel	95	350	$ 2.78	$ 92,435

PIPE BEDDING	Length (ft)	Volume (cy)	Unit Cost	TOTAL
Wet Construction				
Stone 6A	5,684	1,785	$ 18.00	$ 32,138
Sand Class 2	5,684	2,171	$ 5.50	$ 11,943
Hauling (Bedding Material)		3,957	$ 5.00	$ 19,784
Haul Away Spoils		5,982	$ 5.00	$ 29,911
Dry Construction				
Sand Class 2	22,736	15,827	$ 5.50	$ 87,050
Hauling (Bedding Material)		15,827	$ 5.00	$ 79,136
Haul Away Spoils		23,929	$ 5.00	$ 119,645
SUB TOTAL				**$ 379,606**

DEWATERING	Length (ft)		$ / LF	TOTAL
Dewatering	5,684		$ 40.00	$ 227,360

P I P E S U B T O T A L	**$ 6,069,561**
COST OF PIPE /ft	**$ 213.57**

SPECIALS		Unit Cost	TOTAL
Bends	16 units	$ 7,710	$ 123,360
Air Release Valve Units	6 units	$ 23,000	$ 138,000
Isolation Valve Units	2 units	$ 97,430	$ 194,860
Blow-off Valve Unit	2 units	$ 61,550	$ 123,100
Flushing / Hydrant	2 units	$ 2,000	$ 4,000
SUB TOTAL			**$ 583,320**

SUB TOTAL		**$ 6,652,881**
OVERHEAD & PROFIT	15%	**$ 997,932**
G R A N D - T O T A L		**$ 7,650,813**

COST SUMMARY

DESCRIPTION	LENGTH	COST/FT	COST
LAKE HURON TRANSMISSION	203,280	$523.01	$106,318,393
NORTH TRANSMISSION	77,760	$416.63	$32,397,005
SOUTH TRANSMISSION	73,450	$441.31	$32,414,230
FLINT TRANSMISSION	74,560	$356.21	$26,559,299
GENESEE COUNTY FINISHED WATER LINE	28,420	$269.21	$7,650,813
S U B - T O T A L S	**457,470**	**$448.86**	**$205,339,739**
15% CONSTRUCTION CONTINGENCY			$30,800,961
5% DESIGN CONTINGENCY			$10,266,987
17% ENGINEERING, LEGAL, BOND & ADMINISTRATIVE			$34,907,756
TOTAL CONSTRUCTION COST			**$281,315,443**

Lake Huron Water Supply Study

Appendix 7

Technical Memorandum

Reservoir and Reservoir Pump Station

Karegnondi Water Authority

- **City of Flint**
- **Genesee County**
- **Lapeer County**
- **Sanilac County**

January 16, 2009

Jones & Henry Engineers, Ltd.
2000 West Central Avenue
Toledo, Ohio 43606
419.473.9611
www.jheng.com

7.1 RESERVOIR

7.1.1 General

This technical memorandum describes the general design criteria for an upground reservoir and reservoir pump station as components of the Lake Huron Water Supply Study.

7.1.2 Reservoir Size

The raw water reservoir has been sized to hold 94 percent of the projected 25-year, maximum-day demand (MDD) or 78.5 mgd for a period of 7 days, plus an approximate 20 percent of additional working volume. This is considered a sufficient amount of time to make any emergency repairs to the pipeline, pumping station, or other. The additional working volume would be to maintain a minimum pool depth and possible water quality issues that comes with shallow water. The reservoir will turn over in terms of volume several times in the course of a year. The number of times is contingent on the volume of water used. Seasonally, the reservoir will turn over (temperature inversion) twice.

In terms of water loss due to evaporation, there should be an approximate balance from precipitation annually. At times, there will be some water loss from evaporation during hot dry weather, but the loss should be negligible percentage wise.

Seepage loss through the levee could be significant if it is not properly constructed with liners to reduce the loss. Bentonite clay liner of one-foot thick has been assumed in the cost estimate to reduce seepage. Final Design should include a blanket drain or toe drain at the base of the levee to accommodate seepage.

There is no ideal depth of water for a reservoir; generally, the deeper the better. A typical depth of 35 feet has been selected. Reservoirs with depths less than 20 feet will have seasonal excess blue-green or another algae growth with subsequent water quality problems.

The following is the recommended reservoir size for 2014 through 2039 and for a second cell to be constructed by the year 2039:

Required Volume = 7 days x 0.94 x 78.5 mgd = 516.5 mg + 20 % = 620 mg

Wetted Perimeter	Total 20	Total 2039
62 acres	100 acres	190 acres

The recommended size includes acreage to construct a reservoir pump station with access roads.

7.1.3 Reservoir Details

A single cell reservoir is recommended. A second cell should be constructed in the future as water usage increases. The second cell would be constructed to have a common levee between the two celled reservoir. A benefit of having a second cell would be to have a backup, should the levee fail on one of them. A bypass line is included for pumping directly to the suction side of the reservoir pump station and bypassing the reservoir. A rate control valve would be used to match pumping from the Lake Huron Pump Station to the pumps discharging from the reservoir pump station.

As an alternative to the rate control valve, a minimum three million gallon storage tank should be constructed on the bypass line to accommodate differences in pumping rates of the two pump stations (see Figure 1).

Maintenance will include vegetative control (mowing) as well as control of burrowing animals and maintenance and monitoring of drainage tiles.

A very preliminary study of the proposed property was conducted. Using well logs in the area and published geological information of that regional area. The conclusion was that it does appear that there may be significant quantities of clay bearing soil materials from which to construct dikes with liners.

A typical reservoir cross section is shown in Figure 2. Actual recommendations for type and thickness of liners can only be made after a thorough site investigation.

A single line entering near the top of the reservoir to prevent draining in the event of a pipe break is recommended with a sediment trap (Figure 3). The trap will provide sufficient time for heavier solids to settle out. The trap will have to be cleaned periodically.

A multi-port outlet structure will be provided (Figure 4). Sluice gates would be mounted at various heights. A single sluice gate would be opened in order to draw off the best quality water. The best water quality depth could change seasonally or for some other reason. The outlet structure could be accessed by a bridge from the top of the dike (vandal potential) or by boat (inconvenient). An overflow/reservoir drain structure would be provided (Figure 5). The discharge line would run to an appropriate point. No chemical feed provisions are contemplated. Hand broadcasting of copper sulfate via boat would likely be necessary at the onset of summer for curtailing blue-green algae.

An outfall structure will be provided to dissipate energy in the event of an accidental overflow.

7.1.4 Identification of Site

There are a number of potential sites in the area that may be suitable for an upground reservoir.

Sites in the area have significant changes in the topography and may be difficult if not impossible to achieve an earth balance. However, there will be more than sufficient backfill available from construction of the transmission lines if needed.

A thorough evaluation will be necessary including an environmental site assessment and a wetlands study.

7.1.5 Permitting

As previously mentioned, an environmental assessment must be conducted for the presence or absence of hazardous or toxic materials in the soil, subsurface, or ground water. The wetlands study would determine presence or absence of wetlands or protected species.

The design of the reservoir would be reviewed by the DEQ and DNR to evaluate its compliance with state requirements and the Federal Dam Safety Act of 1994. Local zoning/planning commission requirements must also be addressed.

7.1.6 Water Quality

As may be expected, the water quality will not be quite as good as directly from Lake Huron. However, because of its large size for any alternative and the multi-port outlet, it should not diminish by much. Seasonal application of copper sulfate will probably be a requirement. The small amount of copper sulfate applied has no effect on corrosion and negligible effect on lead/copper programs.

7.1.7 Security

An eight foot high chain link fence with barbed wire around the entire reservoir site is recommended. A separate eight foot high chain link fence with barbed wire is recommended for the reservoir pump station.

7.1.8 Ice

Withdrawing water at a low velocity and choosing the proper outlet to withdraw water should eliminate any problems of ice in the reservoir pump station. A means of back flushing the intake line utilizing the reservoir pumps could be considered.

7.1.9 Construction Cost

Table 7-1
Estimated Reservoir Construction Cost

Item	Unit Cost	Unit	Estimated Quantity	Estimated Cost
Mobilization	$100,000	Lump Sum	1	$100,000
Clearing	$6,500	Acre	100	$650,000
Embankment	$3.50	Cubic Yard	1,337,000	$4,679,500
12-inch Bentonite Liner	$13,000	Acre	80	$1,040,000
Rip-Rap Liner	$40	Cubic Yard	56,000	$2,240,000
Seeding	$2,500	Acre	35	$87,500
Blanket Drain	$30	Ton	36,200	$1,086,000
Structures	$100,000	Each	5	$500,000
Access Roads	$15	Ton	7,000	$105,000
Security Fence	$18	Lineal Feet	9,500	$171,000
Subtotal				$10,659,000
15% Construction Contingency				$1,598,850
5% Design Contingency				$532,950
17% Engineering, Legal, Bond, and Administrative				$1,812,030
Total Construction Cost				$14,602,830

The alternative three million gallon bypass storage tank would add an additional $2,800,000 to the subtotal or $13,459,000 and bring the total construction cost to $19,784,730.

7.1.10 Schedule

There is no anticipated long lead time for shop drawing approval and manufacturing of any item related to the reservoir. Depending on the specific location and the availability of excavated material from the transmission lines construction, the reservoir should be able to be constructed in 12 to 15 months.

7.2 RESERVOIR PUMP STATION

7.2.1 General

The pump station has been sized to provide the projected 25-year, maximum-day demand (MDD) for the proposed Genesee County Water Treatment Plant, Flint Water Treatment Plant, and Lapeer Treatment Plant. Additional space will be provided for two future pumps and upsizing the original pumps to meet projected 50-year demands.

The pump station can be considered two stations housed in a common building. The North Pump Station will have pumps which can be dedicated to pumping into the north transmission main and the South Pump Station will have pumps which can be dedicated to pumping into the south transmission main. One backup pump will be able to serve either the north or south pump stations. Under normal circumstances any or all of the pumps will pump through both lines.

7.2.2 Pumps and Piping

Five 20 mgd ± 400 Hp horizontal split case pumps will be provided, drawing water from the reservoir with a common intake header and discharging into a common discharge header. The headers will be valved so that two pumps can be dedicated to discharging through the north transmission route and two pumps can be dedicated to discharging through the south route. The fifth backup pump can be valved through the headers to serve either the north or south routes. In an emergency, any or all of the five pumps can pump to either route. (See schematic design drawing – Figure 6). Normal operation would be to have one or two pumps pumping through both routes to meet average-day demand. See Tables 7-4, 7-5, 7-6, and 7-7 for average, maximum, and emergency demands. Three pumps running can meet the north route emergency demands; however, emergency demands using the south route will require four pumps running.

The pumps will be provided with Variable Frequency Drives (VFDs) to control the rate of flow required at each treatment plant and to accommodate the differences in total dynamic head (TDH) between the north and south transmission lines routes.

7.2.3 Standby Power

An engine generator will provide one hundred percent backup power. The generator will be sized to be capable of running any four pumps.

7.2.4 Chemical Storage and Feed

Bulk chemical storage tanks will be provided for pretreatment of the raw water. Two complete sets of feed systems will be provided and dedicated to each of the north and south transmission mains routes. The separate feed systems will accommodate the differing pretreatment requirements of the water treatment plants.

7.2.5 Structure Location

The pump station will be located close to the reservoir to minimize suction line loss and provide convenience of a single location.

7.2.6 Construction Cost

Table 7-2
Estimated Reservoir Pump Station Construction Cost

Description	Estimated Cost
Structures	$3,400,000
Equipment	$2,300,000
Piping and Valves	$1,800,000
Electrical	$3,700,000
Subtotal	$11,200,000
15% Construction Contingency	$1,680,000
5% Design Contingency	$560,000
17% Engineering, Legal, Bond, and Administrative	$1,904,000
Total Construction Cost	$15,344,000

7.2.7 Schedule

Many of the equipment items for the pump station will require long lead times for shop drawing approval, manufacturing, delivery, and installation. The reservoir pump station could take 18 to 20 months to complete and place in service.

7.3 ANNUAL OPERATIONS AND MAINTENANCE (O&M) COSTS

7.3.1 General

Chemical costs for pretreatment at the reservoir pump station are unknown. An estimated allowance item has been added to the O&M costs.

7.3.2 Annual Operating Costs

The following assumptions were made for operating costs:

Power cost based on 6.3 cents per kilowatt hour.
Direct Labor Costs based on the following labor rates:

- $20 per hour for operators
- $25 per hour for maintenance mechanics
- $15 per hour for seasonal workers

For the reservoir pump station, one operator for four hours each work day has been assumed. For the reservoir, one seasonal worker full time for four months. The daily operator could assist the seasonal worker occasionally and care for the reservoir in addition to the reservoir pump station during the remaining months. All per hour costs are increased by a 1.62 multiplier for fringe benefits.

7.3.3 Annual Maintenance Costs

Maintenance costs were assumed as follows:

- Equipment – 5 % of original cost (20 years)
- Piping and Valves – 2-1/2 % of original cost (40 years)
- Structures – 1-1/3 % of original cost 75 years)

Table 7-3
Annual Operation and Maintenance Costs
Reservoir and Reservoir Pump Station

Operating Costs	
Labor	$39,886
Power * *	$168,626
Chemicals	$50,000
Subtotal	$258,512
Maintenance Costs	
Equipment 5 %	$272,500
Piping & Valves 2½ %	$40,000
Structures 1-1/3 %	$42,666
Subtotal	$355,166
Total O&M Costs	**$613,678**

** See Table 7-4 for Power Cost Calculations

Table 7- 4
CURRENT AVERAGE DAY DEMAND / TWO LINES
Friction Loss, Head, & HP Estimates

MAX DAY FLOW RATE	**23,799 gpm**	**34.27 mgd**
Usage by Genesee County	10,563 gpm	**15.21 mgd**
Usage by Flint	11,472 gpm	**16.52 mgd**
Usage by Lapeer	1,764 gpm	**2.54 mgd**

SOUTH ROUTE		
Flow Reservoir to Lapeer	- gpm	**mgd**
Pipe Diameter (D = inches)	**60 inches**	5 ft
Pipe Length (L = feet)	44,930 ft	8.51 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	- ft/s	
Friction head loss	0.00 ft	0.00 psi
Lapeer to Genesee County		
Design Flow Rate	- gpm	**- mgd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	28,520 ft	5.40 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	- ft/s	
Friction head loss	0.00 ft	0.00 psi
Total Headloss from Reserv. to Genesee Co.	**0.00 ft**	**0.00 psi**
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	-50.00 ft	
Additional Head to Clear Hills	84.50 ft	
Total Head Needed on Pumps: To Genesee Co.	**84.50 ft**	

NORTH ROUTE		
Complementary Flow North Route	23,799 gpm	**34.27 mgpd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	77,760 ft	14.73 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	3.33	
Friction head loss	53.78 ft	23.30 psi
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	3.78 ft	
Additional Head to Clear Hills	0.00 ft	
Total Head Needed on Pumps: To Genesee Co.	**25.00 ft**	

Genesee County to Flint		
Design Flow Rate	11,472 gpm	**16.52 mgd**
Pipe Diameter (D = inches)	**48 inches**	4 ft
Pipe Length (L = feet)	74,560 ft	14.12 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	2.03 ft/s	
Friction head loss	23.71 ft	10.27 psi
Total Head Needed on Pumps: To Genesee Co.	25.00 ft	10.83 psi
Additional Head to Clear Hills	26.49 ft	
Total Head Needed on Pumps: To Flint	**51.49** ft	

Power Requirements		
Assumed efficiency	85%	
Power Required	400 h.p	298.73 kw
Assumed number of pumps operating simultaneously	**3**	
Pumping Rate	7,933 gpm	11.42 mgd
Power Required (each pump)	133 hp	99.58 kw

Operational Cost		
Cost of Energy	**$ 0.0630** kwh	
Operation Cost Per Day	$ 451.68 assumes 24 hour pumping	
Operation Cost Per Year	$ 164,861.81 assumes 24/7 pumping	

Table 7- 5
25-YEAR AVERAGE DAY DEMAND / TWO LINES
Friction Loss, Head, & HP Estimates

MAX DAY FLOW RATE	**31,840 gpm**	**45.85 mgd**
Usage by Genesee County	12,215 gpm	**17.59 mgd**
Usage by Flint	13,368 gpm	**19.25 mgd**
Usage by Lapeer	6,257 gpm	**9.01 mgd**

SOUTH ROUTE		
Flow Reservoir to Lapeer	3,132 gpm	**4.51 mgd**
Pipe Diameter (D = inches)	**60 inches**	5 ft
Pipe Length (L = feet)	44,930 ft	8.51 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	0.36 ft/s	
Friction head loss	0.44 ft	0.19 psi
Lapeer to Genesee County		
Design Flow Rate	- gpm	**- mgd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	28,520 ft	5.40 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	- ft/s	
Friction head loss	0.00 ft	0.00 psi
Total Headloss from Reserv. to Genesee Co.	**0.44 ft**	**0.19 psi**
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	-49.56 ft	
Additional Head to Clear Hills	84.62 ft	
Total Head Needed on Pumps: To Genesee Co.	**84.62 ft**	

NORTH ROUTE		
Complementary Flow North Route	28,708 gpm	**41.34 mgpd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	77,760 ft	14.73 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	4.02	
Friction head loss	76.09 ft	32.96 psi
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	26.09 ft	
Additional Head to Clear Hills	10.46 ft	
Total Head Needed on Pumps: To Genesee Co.	**36.55 ft**	

Genesee County to Flint		
Design Flow Rate	13,368 gpm	**19.25 mgd**
Pipe Diameter (D = inches)	**48 inches**	4 ft
Pipe Length (L = feet)	74,560 ft	14.12 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	2.37 ft/s	
Friction head loss	31.47 ft	13.63 psi
Total Head Needed on Pumps: To Genesee Co.	36.55 ft	15.83 psi
Additional Head to Clear Hills	48.07 ft	
Total Head Needed on Pumps: To Flint	**84.62** ft	

Power Requirements		
Assumed efficiency	85%	
Power Required	880 h.p	656.85 kw
Assumed number of pumps operating simultaneously	**3**	
Pumping Rate	10,613 gpm	15.28 mgd
Power Required (each pump)	293 hp	218.95 kw

Table 7- 6
25-YEAR MAXIMUM DAY DEMAND / TWO LINES
Friction Loss, Head, & HP Estimates

MAX DAY FLOW RATE	**54,528 gpm**	**78.52 mgd**
Usage by Genesee County	24,160 gpm	**34.79 mgd**
Usage by Flint	20,056 gpm	**28.88 mgd**
Usage by Lapeer	10,313 gpm	**14.85 mgd**

SOUTH ROUTE		
Flow Reservoir to Lapeer	25,031 gpm	**36.05 mgd**
Pipe Diameter (D = inches)	**60 inches**	5 ft
Pipe Length (L = feet)	44,930 ft	8.51 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	2.84 ft/s	
Friction head loss	20.43 ft	8.85 psi
Lapeer to Genesee County		
Design Flow Rate	14,719 gpm	**21.20 mgd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	28,520 ft	5.40 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	2.06 ft/s	
Friction head loss	8.11 ft	3.51 psi
Total Headloss from Reserv. to Genesee Co.	**28.54 ft**	**12.36 psi**
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	-21.46 ft	
Additional Head to Clear Hills	89.89 ft	
Total Head Needed on Pumps: To Genesee Co.	**89.89 ft**	

NORTH ROUTE		
Complementary Flow North Route	29,497 gpm	**42.48 mgpd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	77,760 ft	14.73 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	4.13	
Friction head loss	80.00 ft	34.66 psi
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	30.00 ft	
Additional Head to Clear Hills	10.18 ft	
Total Head Needed on Pumps: To Genesee Co.	**40.17 ft**	

Genesee County to Flint		
Design Flow Rate	20,056 gpm	**28.88 mgd**
Pipe Diameter (D = inches)	**48 inches**	4 ft
Pipe Length (L = feet)	74,560 ft	14.12 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	3.56 ft/s	
Friction head loss	66.64 ft	28.87 psi
Total Head Needed on Pumps: To Genesee Co.	40.17 ft	17.40 psi
Additional Head to Clear Hills	49.71 ft	
Total Head Needed on Pumps: To Flint	**89.89** ft	

Power Requirements		
Assumed efficiency	85%	
Power Required	1602 h.p	1194.93 kw
Assumed number of pumps operating simultaneously	**4**	
Pumping Rate	13,632 gpm	19.63 mgd
Power Required (each pump)	400 hp	298.73 kw

Table 7-7
25 YEAR EMERGENCY CONDITIONS
75% of Maximum Day / South Route Only
Friction Loss, Head, & HP Estimates

SOUTH ROUTE				
Flow Reservoir to Lapeer	40,889	gpm	**58.88**	mgd
Lapeer to Genesee County	32,903	gpm	**47.38**	mgd
Genesee County to Flint	14,729	gpm	**21.21**	mgd
Flow Reservoir to Lapeer				
Design Flow Rate	40,889	gpm	**58.88**	mgd
Pipe Diameter (D = inches)	**60**	**inches**	5	ft
Pipe Length (L = feet)	44,930	ft	9.10	miles
Hazen & Williams Fric. Factor (C)	120			
Velocity	4.64	ft/s		
Friction head loss	50.65	ft	21.94	psi
Lapeer to Genesee County				
Design Flow Rate	32,903	gpm	**47.38**	mgd
Pipe Diameter (D = inches)	**54**	**inches**	4.5	ft
Pipe Length (L = feet)	28,520	ft	6.00	miles
Hazen & Williams Fric. Factor (C)	120			
Velocity	4.61	ft/s		
Friction head loss	35.91	ft	15.56	psi
Total Headloss from Reserv. to Genesee Co.	86.57			
Genesee County to Flint				
Design Flow Rate	14,729	gpm	**21.21**	mgd
Pipe Diameter (D = inches)	**48**	**inches**	4	ft
Pipe Length (L = feet)	74,560	ft	13.90	miles
Hazen & Williams Fric. Factor (C)	120			
Velocity	2.61	ft/s		
Friction head loss	37.65	ft	16.31	psi
Total Friction Head Loss	124.22	ft	53.81	psi
Total Head Needed on Pump	**97.86**		**42.39**	**psi**
Minor Loss & others (10%)	9.79		4.24	psi
Total Head	107.64	ft	46.63	psi
Power Requirements				
Assumed efficiency	85%			
Power Required	1438	h.p	1073.03	kw
Assumed number of pumps operating simultaneously	**4**			
Pumping Rate	10,222	gpm	14.72	mgd
Power Required (each pump)	360	hp	268.26	kw

Table 7- 8
25-YEAR EMERGENCY CONDITIONS
75% of Maximum Day / North Route Only
Friction Loss, Head, & HP Estimates

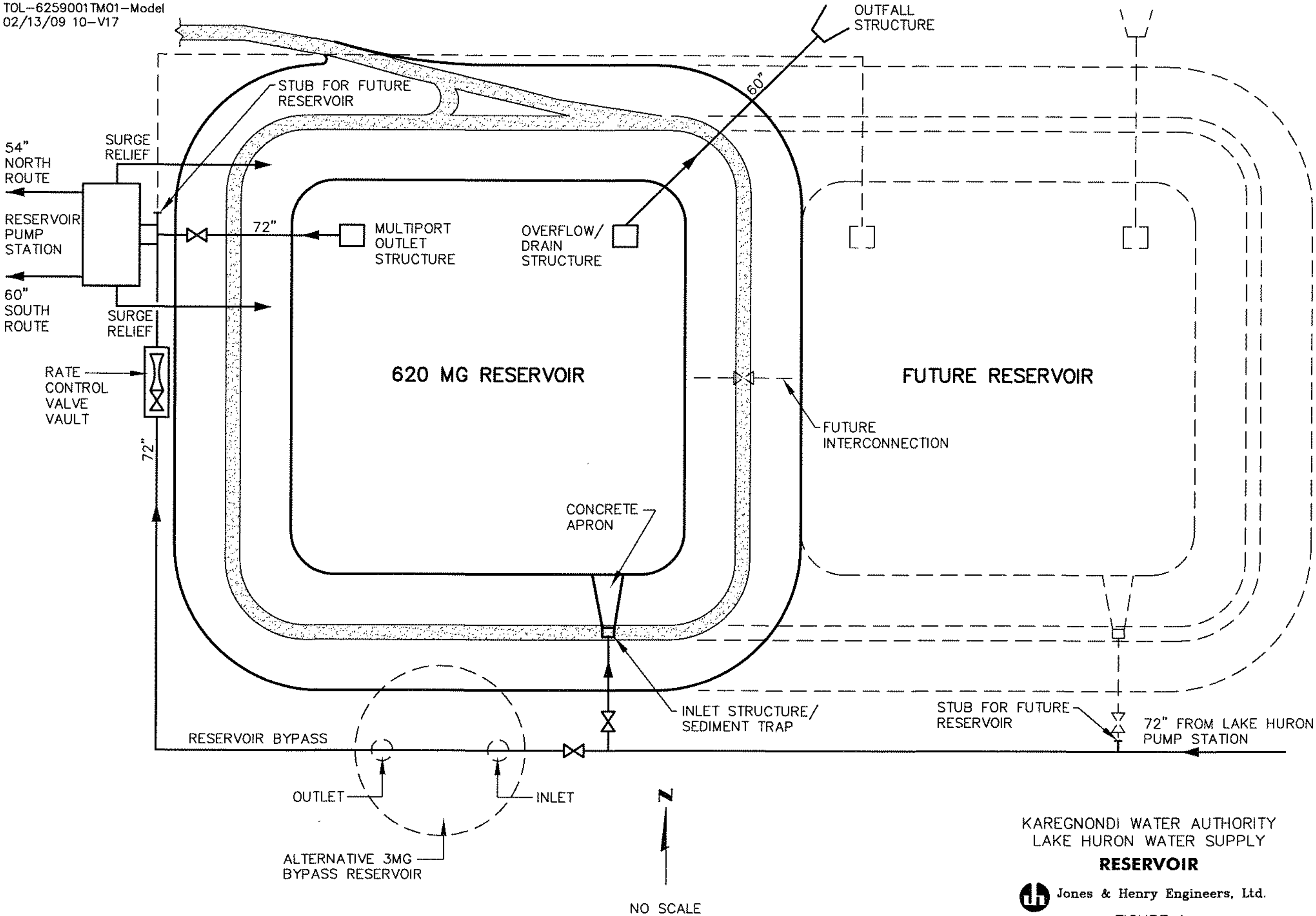
MAX DAY FLOW RATE	**33,161 gpm**	**47.75 mgd**
Usage by Genesee County	18,120 gpm	**26.09 mgd**
Usage by Flint	15,042 gpm	**21.66 mgd**
Usage by Lapeer	- gpm	**mgd**

NORTH ROUTE		
Flow North Route	33,161 gpm	**47.75 mgpd**
Pipe Diameter (D = inches)	**54 inches**	4.5 ft
Pipe Length (L = feet)	77,760 ft	14.73 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	4.65	
Friction head loss	99.35 ft	43.04 psi
Difference in Elevation	50.00 ft	
Head Needed on Pump For Friction Loss	49.35 ft	
Additional Head to Clear Hills	8.77 ft	
Total Head Needed on Pumps: To Genesee Co.	**58.12 ft**	

Genesee County to Flint		
Design Flow Rate	15,042 gpm	**21.66 mgd**
Pipe Diameter (D = inches)	**48 inches**	4 ft
Pipe Length (L = feet)	74,560 ft	14.12 miles
Hazen & Williams Fric. Factor (C)	120	
Velocity	2.67 ft/s	
Friction head loss	39.14 ft	16.96 psi
Total Head Needed on Pumps: To Genesee Co.	58.12 ft	25.18 psi
Additional Head to Clear Hills	48.43 ft	
Total Head Needed on Pumps: To Flint	**106.55** ft	

Power Requirements		
Assumed efficiency	85%	
Power Required	1155 h.p	861.39 kw
Assumed number of pumps operating simultaneously	**3**	
Pumping Rate	11,054 gpm	15.92 mgd
Power Required (each pump)	385 hp	287.13 kw

TOL–6259001TM01–Model
02/13/09 10–V17

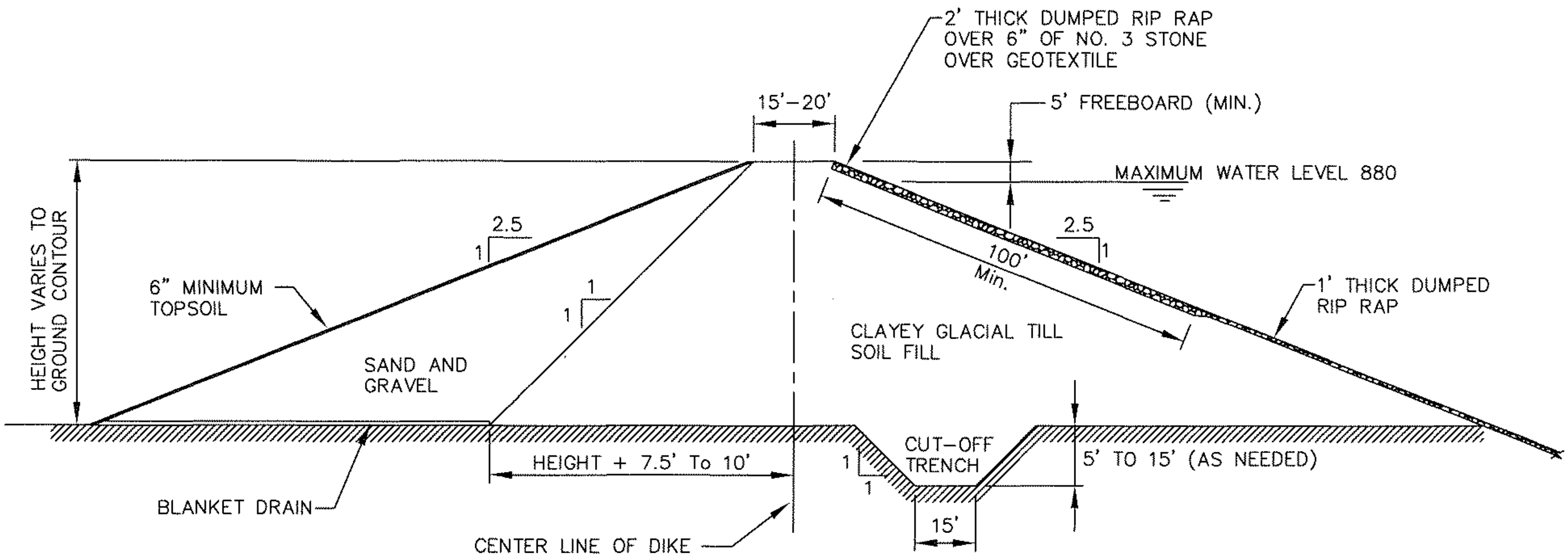


KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY
RESERVOIR

Jones & Henry Engineers, Ltd.

FIGURE 1

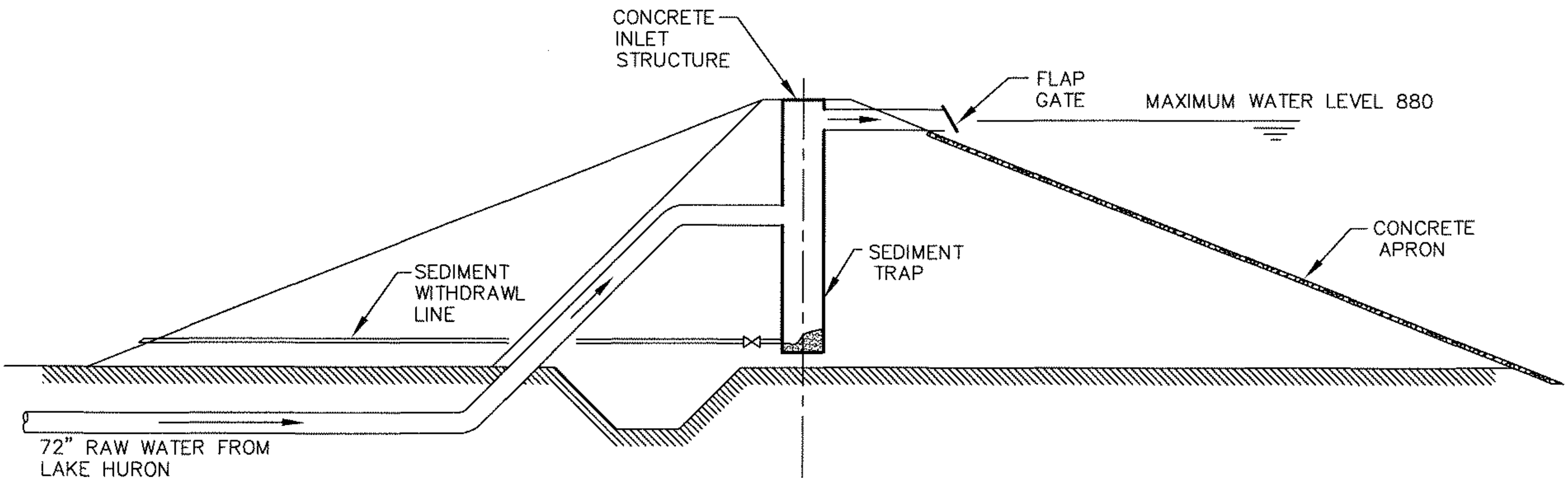
TOL-6259001TM02-Model
02/13/09 10-V17



NO SCALE

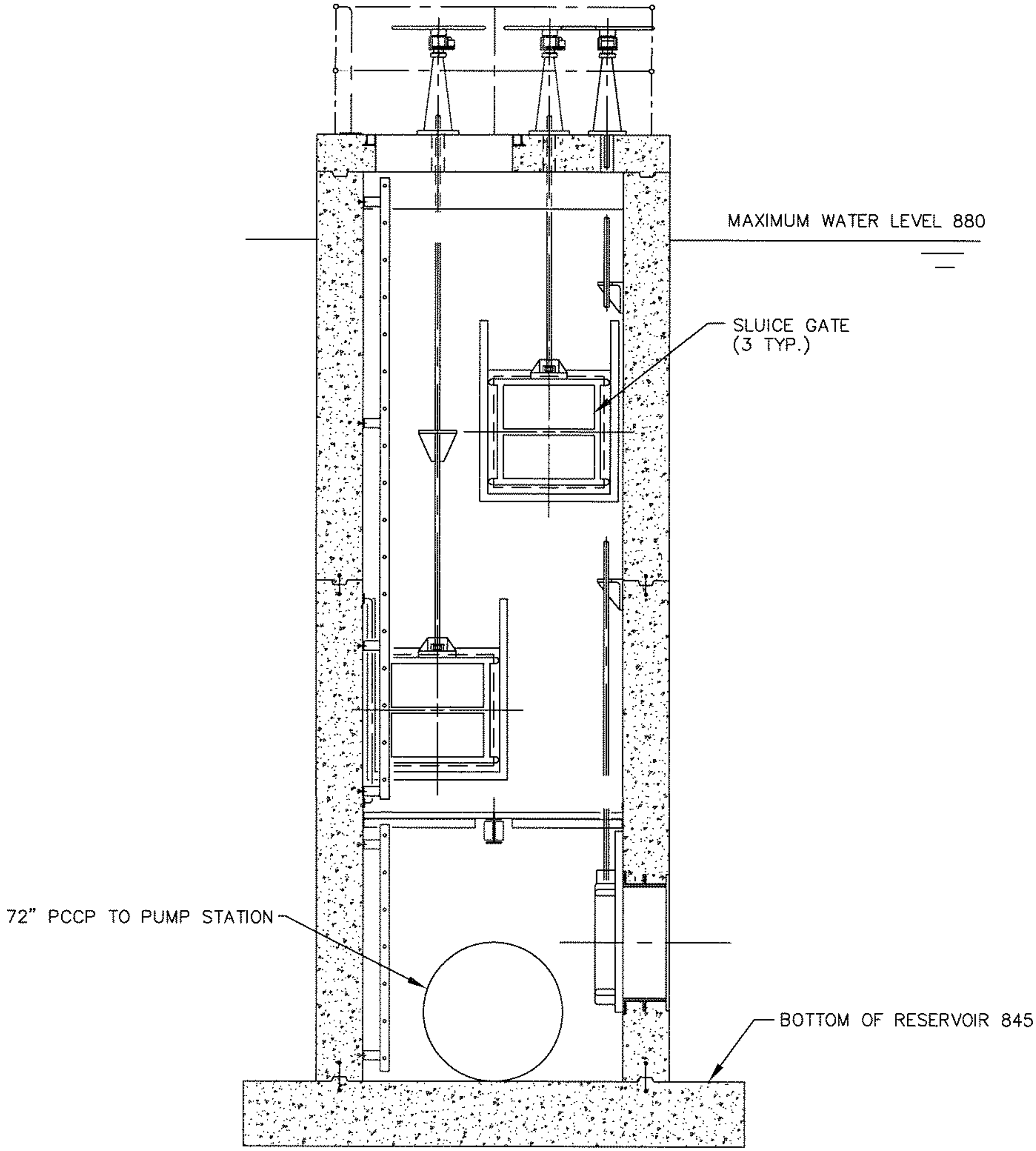
KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY
RESERVOIR CROSS SECTION
Jones & Henry Engineers, Ltd.
FIGURE 2

TOL-6259001TM03-Model
02/13/09 10-V17



NO SCALE

KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY
INLET STRUCTURE & SEDIMENT TRAP
Jones & Henry Engineers, Ltd.
FIGURE 3



NO SCALE

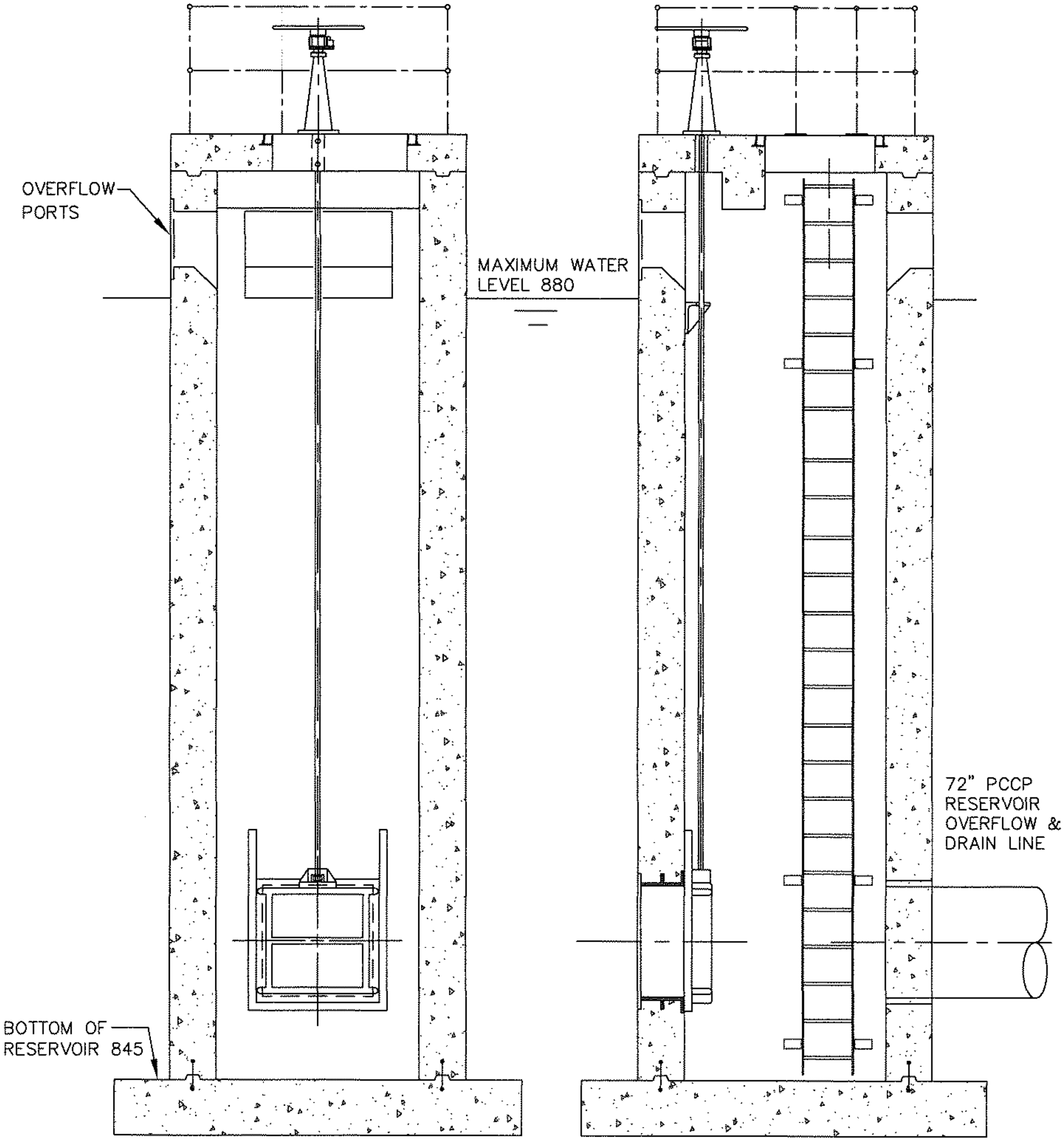
TOL-6259001TM04-Model
02/13/09 10-V17

KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY

MULTI-PORT OUTLET STRUCTURE

Jones & Henry Engineers, Ltd.

FIGURE 4



SECTION
NO SCALE

SECTION
NO SCALE

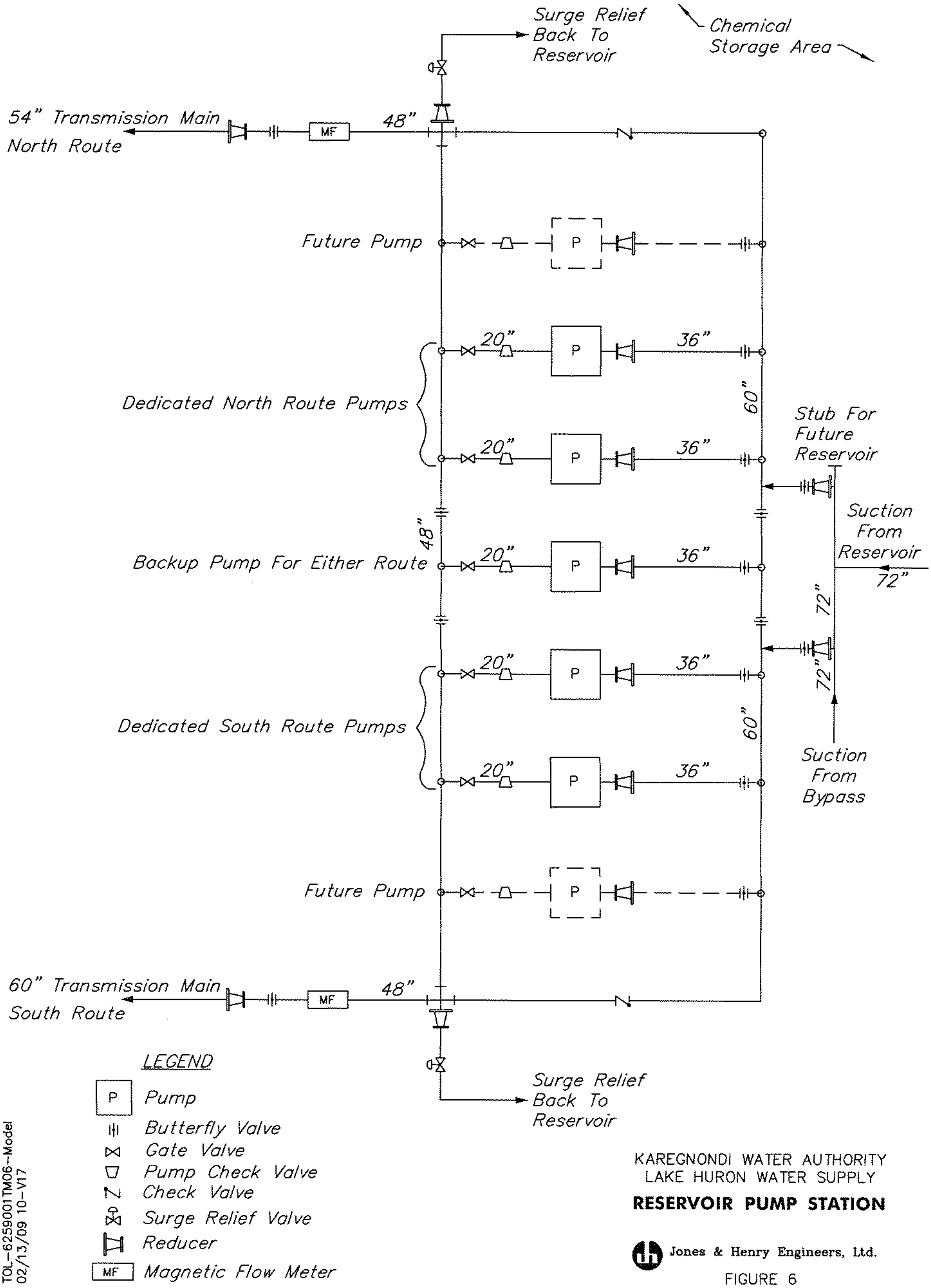
KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY

OVERFLOW/DRAIN STRUCTURE

Jones & Henry Engineers, Ltd.

FIGURE 5

TOL-6259001TM05-Model
02/13/09 10-V17



KAREGNONDI WATER AUTHORITY
LAKE HURON WATER SUPPLY
RESERVOIR PUMP STATION

Jones & Henry Engineers, Ltd.

FIGURE 6

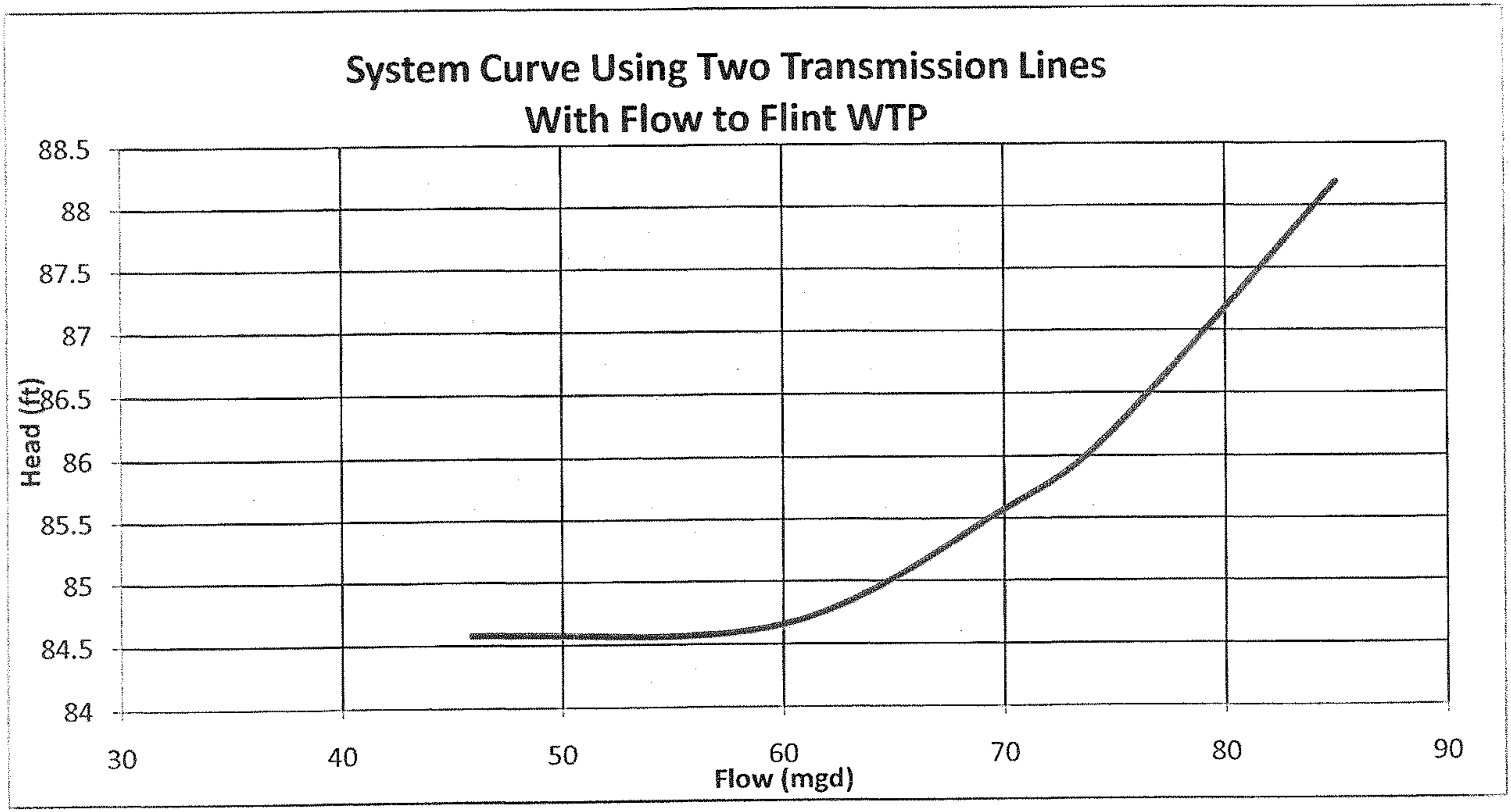

System Curve Using Two Transmission Lines
With Flow to Flint WTP
88.5
88
87.5
87
86.5
86
85.5
85
84.5
84
Head (ft)
30
40
50
60
70
80
90
Flow (mgd)

Figure 7

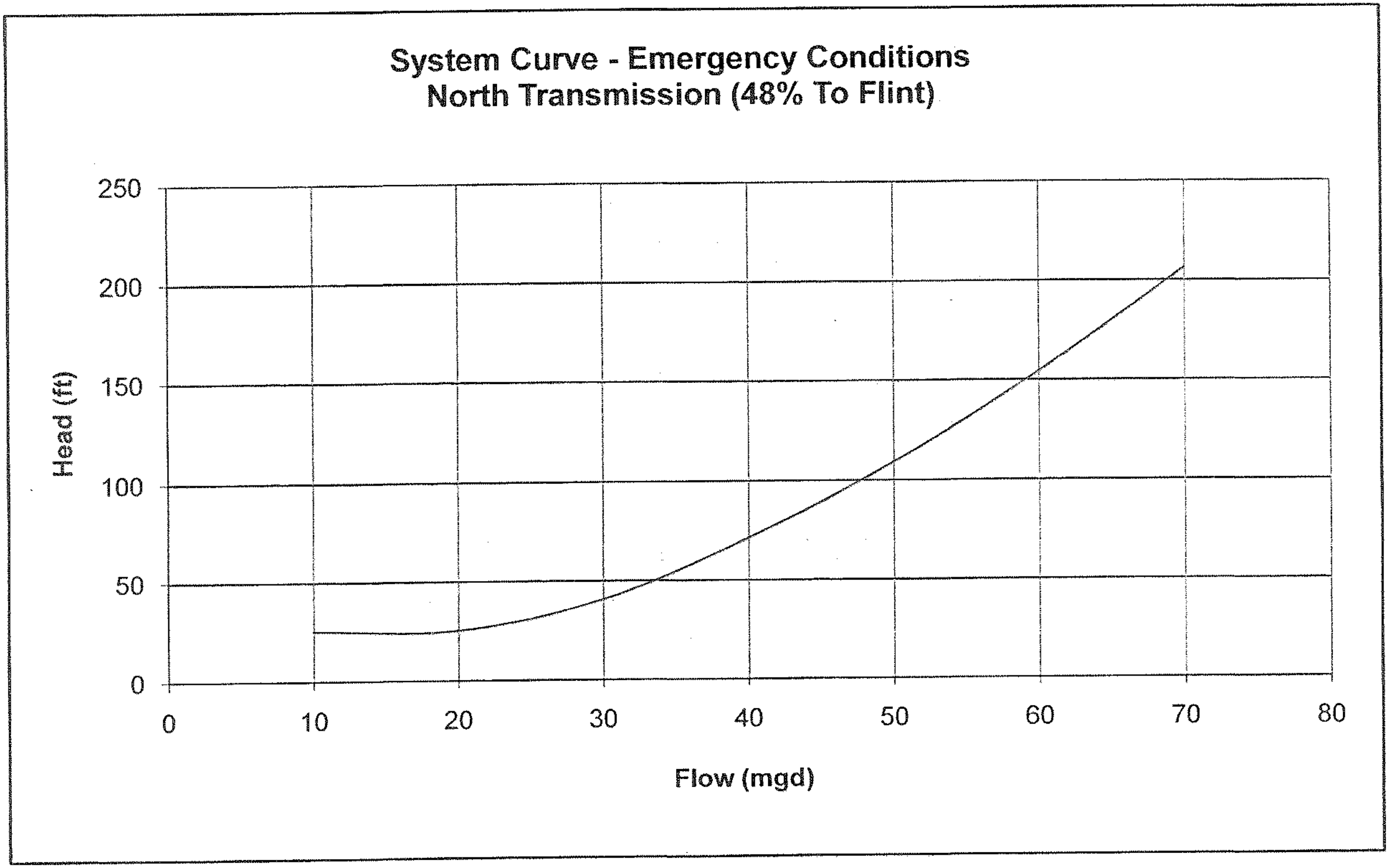

System Curve - Emergency Conditions
North Transmission (48% To Flint)
250
200
150
100
50
0
Head (ft)
0
10
20
30
40
50
60
70
80
Flow (mgd)

Figure 8

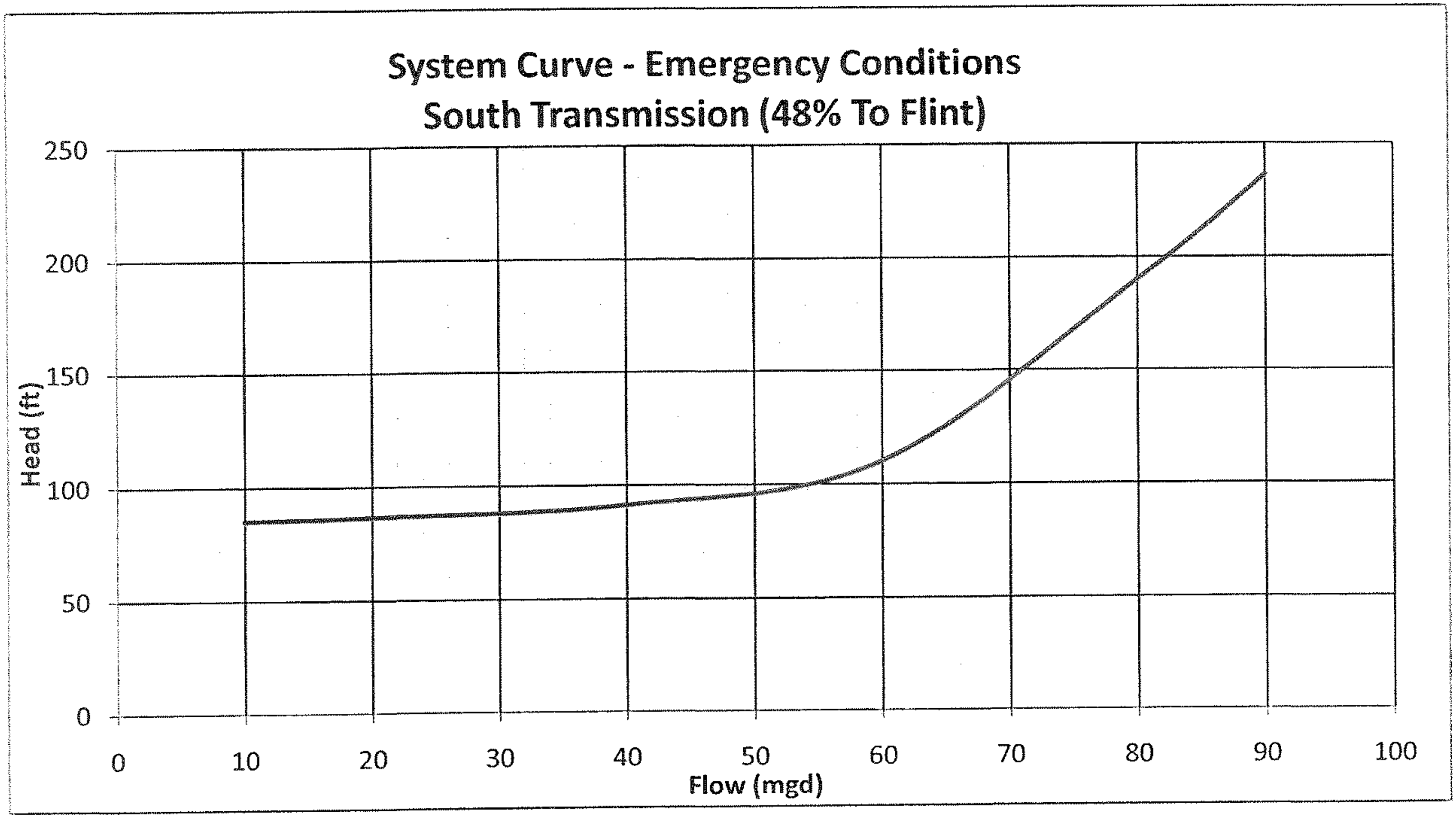
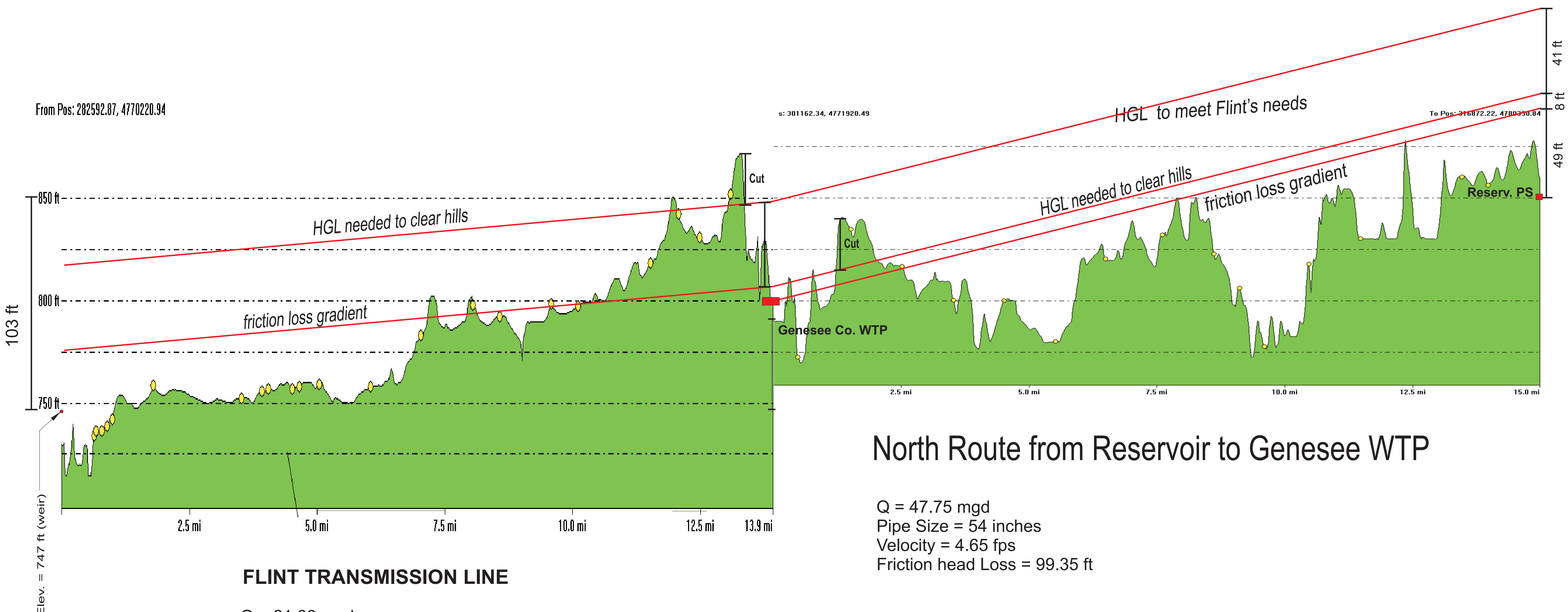

System Curve - Emergency Conditions
South Transmission (48% To Flint)
Head (ft)
250
200
150
100
50
0
0
10
20
30
40
50
60
70
80
90
100
Flow (mgd)

Figure 9

NORTH ROUTE PUMPING TO FLINT WTP
EMERGENCY CONDITIONS
75% OF MAXIMUM DAY DEMAND



North Route from Reservoir to Genesee WTP

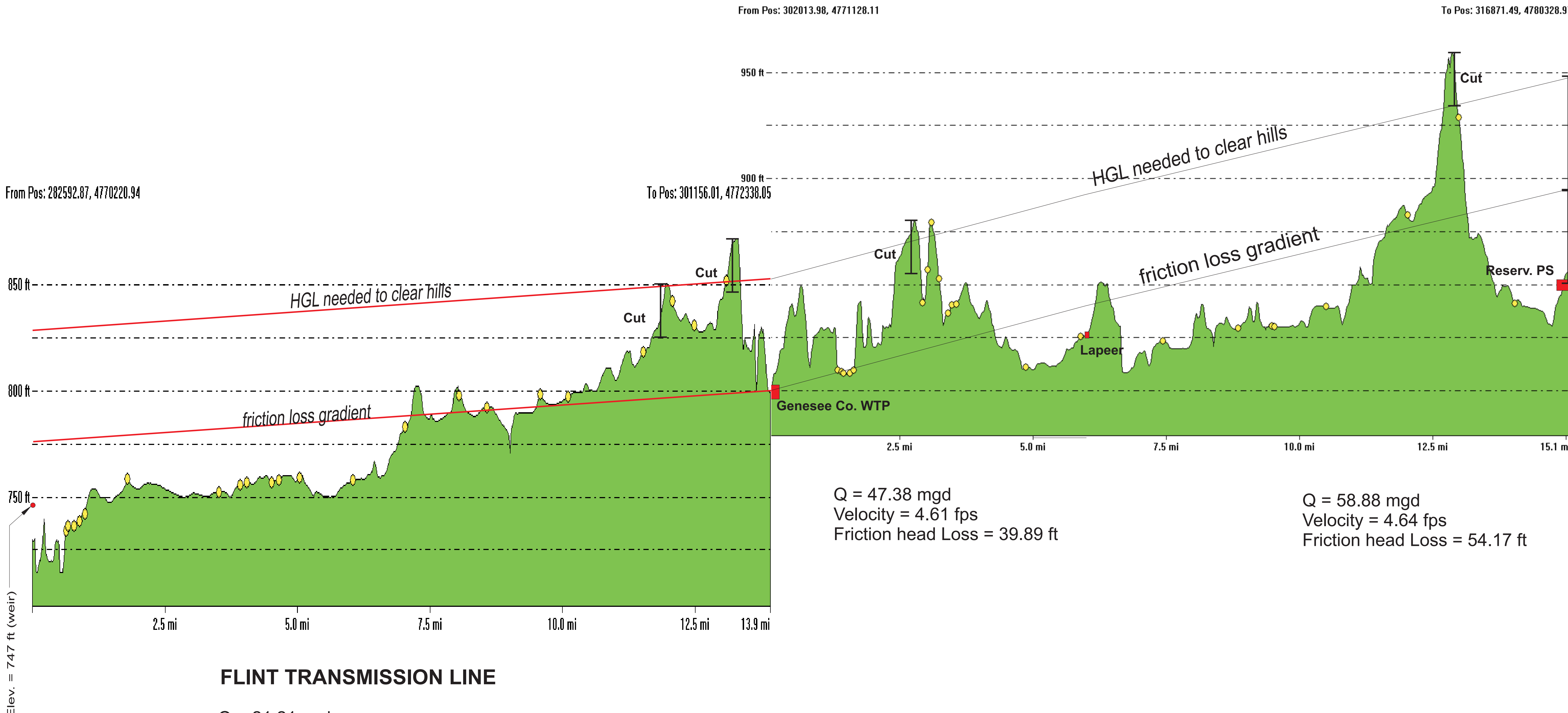
Q = 47.75 mgd
Pipe Size = 54 inches
Velocity = 4.65 fps
Friction head Loss = 99.35 ft

FLINT TRANSMISSION LINE

Q = 21.66 mgd
Pipe Size = 48 inches
Velocity = 2.67 fps
Friction head Loss = 39.14 ft

HGL Eval of North & South Route.cdr
Dec-11-2008

FIGURE 10



Q = 47.38 mgd
Velocity = 4.61 fps
Friction head Loss = 39.89 ft

Q = 58.88 mgd
Velocity = 4.64 fps
Friction head Loss = 54.17 ft

FLINT TRANSMISSION LINE

Q = 21.21mgd
Velocity = 2.61 fps
Friction head Loss = 24.26 ft

SOUTH ROUTE PUMPING TO FLINT WTP

Evaluation South Route Only.cdr
Jan-13-2009

Lake Huron Water Supply Study

Technical Memorandum 8
Genesee County Water Treatment Plant

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

January 15, 2009

Gannett Fleming, Inc.
P.O. Box 67100
Harrisburg, PA 17106

8.1 Introduction

8.1.1 Background

In 2004, the Office of the Genesee County Drain Commissioner (Genesee County) contracted Rowe Incorporated to assess options for development of a water supply system utilizing Lake Huron water for drinking water supply. Rowe Incorporated assembled a project team to perform that assessment. As part of that team, Gannett Fleming, Inc. (GFI) performed evaluations related to water treatment facilities. The initial phase of the study included screening available information and applicable treatment technologies as the basis for a workshop held with Genesee County on September 29, 2004 to identify treatment process concepts for further detailed analysis. As a result of that workshop, several treatment processes were compared in detail:

- High-rate plate settler clarification-filtration
- High-rate plate settler clarification-filtration followed by UV disinfection
- High-rate plate settler clarification-membrane filtration
- Direct membrane filtration
- Direct membrane filtration followed by UV disinfection

Considering regulatory, permitting, and additional factors, Genesee County ultimately selected a high-rate plate settler clarification-filtration process, with provisions to add UV disinfection and additional treatment processes in the future. The current study, which was authorized by the Karegnondi Water Authority, is being conducted to update the project concept and opinions of probable cost. The focus of this Appendix 8 is the Genesee County Water Treatment Plant (WTP), which would be provided Lake Huron raw water from the Karegnondi Water Authority for treatment and distribution to Genesee County customers.

8.1.2 Approach

This study was conducted to evaluate the technical and economic feasibility of the Lake Huron Water Supply Project. In support of that goal, the Genesee County WTP project was evaluated using the following approach:

- Develop design criteria for each treatment process.
- Develop WTP construction costs considering only WTP raw water equalization storage, process, chemical, finished water storage, finished water pumping, and wastewater facilities. Costs for the raw water intake, raw water pumping, reservoir, and transmission facilities were developed by other members of the project team. It is understood that finished water will be pumped from the Genesee County WTP to the existing Henderson Road Tanks.
- Obtain budgetary cost proposals from manufacturers for all major equipment.
- Develop a process schematic showing major process units.
- Estimate quantities of construction materials.
- Utilize the GFI construction and equipment cost database and 2008 R.S. Means Building Construction Cost Data for unit cost estimating. Unit costs for raw materials including steel, metals associated with electrical equipment, and cement have been fluctuating rapidly over the past few years. Therefore, it is critical that the unit costs for these and other materials continue to be updated regularly as the project proceeds, in accordance with emerging cost trends.
- Utilize percent of probable capital costs to estimate electrical (13%) and mechanical (7%) costs.
- Utilize percent of construction costs for estimating general contractor overhead and profit and general conditions (22%).
- Establish annual operating costs based on estimated quantities for chemicals, process power, residuals disposal, depreciation of mechanical equipment, and labor.
- Establish maintenance costs based on 5% of the value of mechanical equipment, 2.5% of the value of static materials, and 1% of the cost of concrete.

8.2.1 Water Treatment Plant Capacity

Genesee County projected demands, plant use, and treatment design capacity are summarized in Table 8.1. Demands represent the quantity of water that will be delivered to the system. Plant use, which includes chemical make-up water and process wastewater, is estimated to be approximately 6% of demand. Plant design capacity is the sum of system demand and plant use. The demands, as presented in Table 8.1 were provided by Genesee County.

The conceptual design and development of WTP probable costs were based on an initial facility capacity of 36 million gallons per day (mgd), as required to meet Genesee County projected 25-year maximum day demand and plant use. However, the plant was hydraulically designed for the anticipated 50-year maximum day demand and plant use (48 mgd). This study uses Genesee County's selected treatment process and a 36 mgd initial design capacity for establishing opinions of probable construction costs for the Genesee County WTP for use by the Karegnondi Water Authority in project planning and decision making.

Table 8.1: Production Requirements and Plant Design Capacity

Initial Average Day Demand (mgd)	Initial Maximum Day Demand (mgd)	25-year Average Day Demand (mgd)	25-year Maximum Day Demand (mgd)	25-year Maximum Day Plant Use (mgd)	Plant Design Capacity (mgd)	50-year Maximum Day Demand (mgd)	Future Expansion Design Capacity (mgd)
14.21	25.00	16.25	32.5	2.0	36	45	48

The required treatment capacity for the WTP is the sum of the WTP projected 25-year maximum day demand and plant use, which total 34.5 mgd. An initial plant design capacity of 36 mgd was selected for the conceptual design to facilitate planning for four (4) equally-sized pretreatment process trains at the ultimate plant capacity of 48 mgd. The preliminary plant layout was developed to allow individual basins or processes to be out of service without impacting operation of the remainder of the basins or processes. Because the projected 25-year average day demand is half of the projected maximum day demand, portions of the plant could also be taken out of service during extended periods of low production to reduce operating costs.

8.3.1 Raw Water Quality

Lake Huron raw water quality data were reviewed and reported in detail in Technical Memorandum No. 3 of the January 2006 report. A summary of those findings follows:

- The Lake Huron water source is high quality on average, with only occasional increases in turbidity and seasonal algae blooms. A deep water remote intake will provide more stable water quality than a near shore intake.
- Raw water pH and alkalinity are moderately high. If pretreatment is required, as with a conventional process, some pH adjustment may be necessary to optimize coagulation. Alternate coagulants, designed to perform over a broader pH range than conventional metal salts, may be effective. Multiple coagulants should be tested for effectiveness, along with coagulant aids.
- The water is moderately hard, but softening is not required because hardness is similar to current concentrations being supplied to Genesee County customers.
- Low water temperature is a concern for coagulation. Alternate coagulants that are more effective at low temperature should be considered.
- Oxidation may be needed upstream of filtration to remove the occasionally high levels of iron and manganese, if it is determined that the iron and manganese species present are soluble.
- Total organic carbon (TOC) concentrations are low, but more long term data are needed, especially during algae outbreaks.
- Genesee County has indicated that Lake Huron should be assumed to be classified as a Bin 1 source based on C*ryptosporidium* results collected by other water suppliers.
- Seasonal algae should be considered a potential problem and addressed in process and intake site selection. Seasonal algae blooms could result in treatment difficulty with hard-to-settle turbidity, increased pH, increased bacteria concentrations, and taste and odor episodes.
- The potential for algae growth and animal activity at the intermediate storage reservoir may impact raw water quality.

- Taste and odor episodes may occur infrequently, and treatment options designed for periodic application, such as powdered activated carbon, should be considered.

8.3.2 Regulatory Perspective

All surface waters must be treated in accordance with the Surface Water Treatment Rule (SWTR) and the Interim Enhanced Surface Water Treatment Rule (IESWTR). These rules require filtration as a treatment technique, in combination with chemical disinfection, to provide a dual barrier against pathogenic organisms. The effectiveness of filtration is established in the rules by requiring a combined filter effluent turbidity no greater than 0.3 NTU. The effectiveness of chemical disinfection is measured as a product of disinfection concentration multiplied by contact time, referred to generally as disinfection CT. As a minimum, the rules require that the post-filtration chemical disinfection CT be no less than that required to achieve 68.4% (0.5-Log) inactivation of *Giardia* and 99.99% (4-Log) inactivation of viruses.[1] The key to process selection is identifying a process that can cost effectively and reliably provide filtration to meet the required standard. The conventional filtration process being considered in this evaluation can effectively and reliably meet the filtration requirements of these rules.

The Long Term 2 Enhanced Surface Water Treatment Rule (LT2 ESWTR) was promulgated in January 2006. This rule will further strengthen disinfection requirements, but will do so by targeting source waters that are at risk for *Cryptosporidium*, a pathogen that is resistant to chlorination. This regulatory concept provides more stringent treatment requirements where they are required due to source water contamination, so that there is a more uniform level of protection across the country. For example, for equivalent finished water quality and reduced risk, a source water with 1 oocyst per liter would require a technology that is 99.99% (4-Log) effective to produce effluent with 0.0001 oocyst per liter to be equivalent to a 0.1 oocyst per liter source water being treated with a 99.9% (3-Log) technology that would also result in an effluent with 0.0001 oocyst per liter.

Source water monitoring is required to classify each source water according to risk of microbial contamination. Monitoring for systems serving more than 10,000 people consists of 24 months of monthly or bi-monthly monitoring of *Cryptosporidium*, E coli, and turbidity. The maximum running annual average concentration of *Cryptosporidium* oocysts is calculated and

[1] % Inactivation required = 100 – ($100/10^X$) where X = Log inactivation required.

used to classify a source water into one of four "bins". Each treatment facility is then required to achieve a certain log removal/inactivation of *Cryptosporidium* assigned to its source water bin through a combination of treatment techniques. Treatment requirements for each bin classification are listed in Table 8.2. This table also lists the log removal credit that is possible by a conventional filtration process meeting the filter effluent turbidity requirements. Treatment techniques that can be used to supplement a conventional process to attain target log removal/inactivation values are listed in Table 8.3.

Table 8.2: LT2 Source Water Bin Classification and Treatment Requirements

Bin Classification	*Cryptosporidium* Concentration	Total Log Removal/Inactivation Required	Presumptive Log Removal for Conventional Treatment	Additional Log Removal Required
	Cysts/L	Log	Log	Log
1	< 0.075	3.0	3.0	0.0
2	0.075 to <1.0	4.0	3.0	1.0
3	1.0 to < 3.0	5.0	3.0	2.0
4	3.0 and greater	5.5	3.0	2.5

Table 8.3: LT2 Treatment Techniques and *Cryptosporidium* Log Removal Values (LRV)

Treatment Technique	Proposed additional *Cryptosporidium* Log removal/inactivation credit
Conventional Filtration achieving filter effluent turbidity below IESWTR levels	0.5 log removal additional credit (ie. 3.5 LRV total) if combined filter effluent turbidity is less than 0.15 NTU in at least 95% of samples **or** 1.0 log removal additional credit (ie. 4.0 LRV total) if individual filter effluent turbidity is less than 0.15 NTU in at least 95% of the daily maximum turbidity measurements, and never greater than 0.3 NTU in two consecutive measurements 15 minutes apart.
UV	The maximum additional log removal credit that can be required for a Bin 4 source (2.5-Log) is achievable with UV. Log credit based on UV dose table.

It is reasonable to expect that the high quality, low turbidity Lake Huron source water from a remote intake, not susceptible to surface runoff, will be classified in Bin 1 and require no greater than a 3-Log removal value (LRV). However, there is the potential for algae growth and animal activity at the intermediate storage reservoir, which could impact raw water quality, so provisions have been made to provide additional treatment processes in the future to provide additional LRV in the event that the source water bin classification is higher than Bin 1 or Bin 2. A conventional filtration process can provide the required treatment up to Bin 2 classification if it is operated well and consistently low effluent turbidity is maintained. For Bin 3 or Bin 4 classifications, UV disinfection may also be required. For this study, costs include provisions for future installation of a UV disinfection system.

8.3.3 Process Concept

As directed by Genesee County, the treatment process used in this evaluation is conventional clarification/filtration, including: rapid mixing, flocculation, high-rate clarification with plate settlers, and granular media filtration. This treatment train is represented in Figure 8.1.

The process concept includes hydraulic and physical layout considerations for potential future processes. These processes may include carbon contact basins, intermediate ozonation in basins or with sidestream injection, post-ozonation, granular activated carbon (GAC) contactors, and/or UV disinfection. Pipe connections and structures with provisions for hydraulic head to accommodate future process steps are included in the estimated quantities.

8.3.4 Unit Process Design Criteria

The following sub-sections summarize the design criteria and proposed size of each unit process for the conceptual 36 mgd facility. Conservative design criteria, relative to the high quality source water, have been proposed for this study. All design criteria are in accordance with or exceed the Ten States Standards. Filters are conservatively designed with a surface loading rate of 2 gallons per minute per square foot (gpm/sf) at the initial maximum day demand and plant use (26.5 mgd), with the anticipation that, after the filters are in service, plant-scale trials will confirm that they can be permitted to operate at a higher surface loading rate (2.7 gpm/sf) to achieve the plant capacity of 36 mgd necessary to supply Genesee County's 25-year projected maximum day demand and plant use. The filters could ultimately be rated at 4.0 gpm/sf, if supported by plant-scale trial data, to achieve the 50-year projected maximum day demand and plant use. Because the rapid mix process is relatively small and the incremental cost to design and construct facilities sized for the future WTP capacity is minor, the rapid mixers are sized to be able to treat flows up to the 50-year projected demand and plant use (48 mgd).

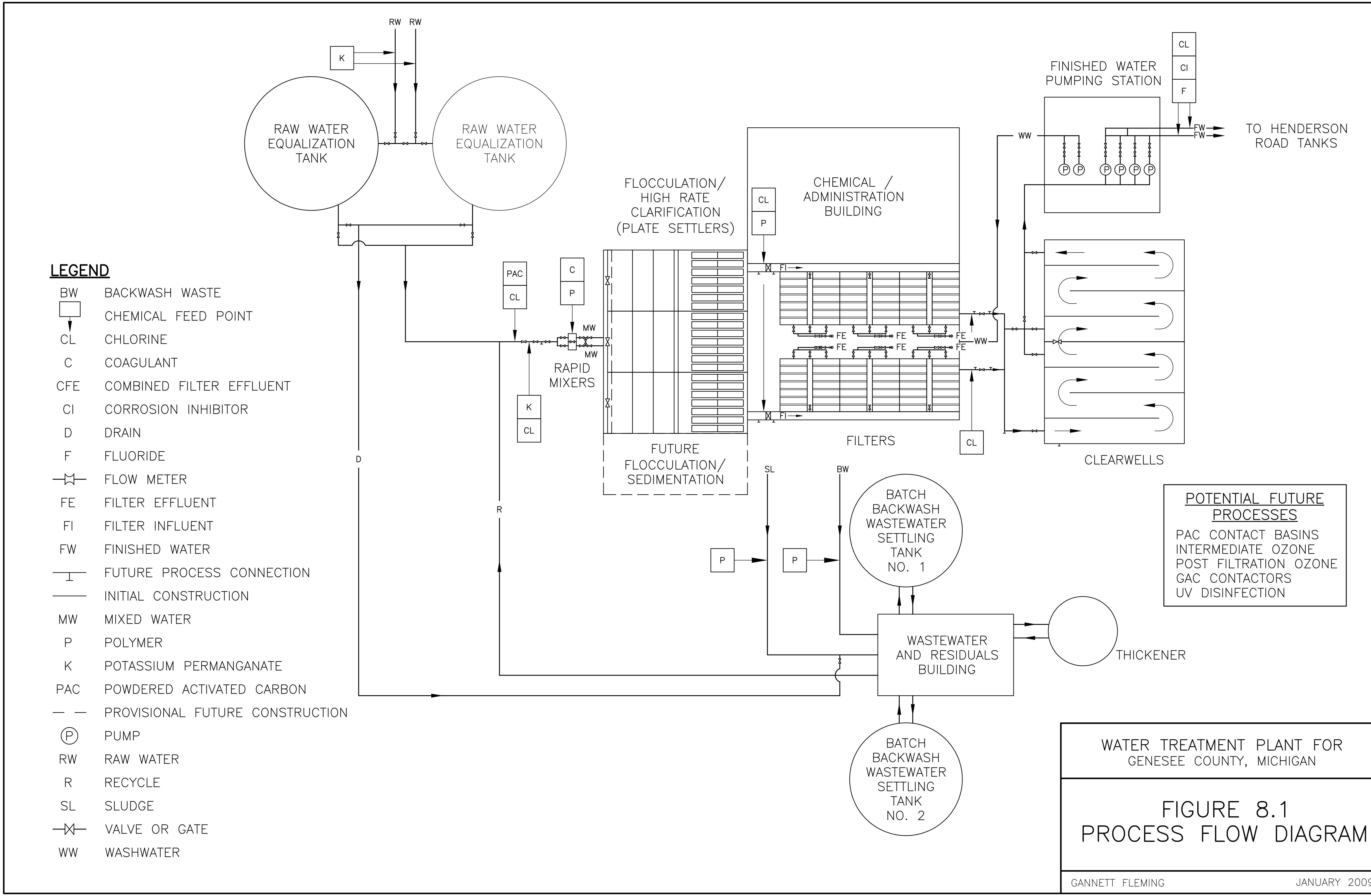


FIGURE 8.1
PROCESS FLOW DIAGRAM

8.3.4.1 Raw Water Equalization

A.	Type	Prestressed Concrete or Steel
B.	Number of tanks	2
C.	Volume per tank, Mgal	2
D.	Total volume, Mgal	4
E.	Total detention time, hr (at 50-year design capacity)	2
F.	Tanks can be operated individually or in parallel	
G.	Tanks provided with drain to wastewater handling system for removal of accumulated solids	
H.	Dimensions, ft.	
	1. Diameter	98.6
	2. Side Water Depth	35

Raw water equalization is provided at the WTP to dampen raw water pumping rate fluctuations. The need for and capacity of WTP raw water equalization should be evaluated during final design, as potential elimination of the raw water equalization tanks could provide significant cost savings.

8.3.4.2 Rapid Mixing

A.	Type	Concrete basins with vertical turbine mixers
B.	Number of basins	2
C.	Capacity per basin, mgd	24
D.	Total capacity, mgd	48
E.	Detention time, sec.	10
F.	Basins can be operated in series or in parallel	
G.	The length and width of the basin should be equal	
H.	Dimensions, ft.	
	1. Width	6
	2. Length	6
	3. Mixing Zone Depth	10.5
I.	Mixing volume per basin, gal.	2,800

8.3.4.3 Flocculation

A.	Type	Concrete basins with horizontal reel mixers
B.	Number of basins	3
C.	Capacity per basin, mgd	12
D.	Total capacity, mgd	36
E.	Number of flocculation stages per basin	3
F.	Flocculation detention time, min.	30
G.	Maximum horizontal velocity, ft/min	1.5
H.	Provide inlet and outlet stages for each basin	
I.	Dimensions, ft.	
	1. Width	45
	2. Length - each stage	14.67

	3.	Length - inlet stage	3
	4.	Length - outlet stage	3
	5.	Sidewater depth	17
J.	Volume per basin, gal.		
	1.	Flocculation	252,000
	2.	Total	283,000
K.	Baffle walls		Ported

8.3.4.4 High-Rate Clarification

A.	Type		Concrete basins with inclined plate settler
B.	Number of basins		3
C.	Capacity per basin, mgd		12
D.	Total capacity, mgd		36
E.	Size to match width of flocculation basins		
F.	Projected horizontal plate surface overflow rate, gpm/sf		0.3
G.	Plate length, ft.		10
H.	Plate width, ft.		4.5
I.	Plate angle, deg.		55
J.	Maximum velocity in effluent troughs, fps		2.0
K.	Provide space in front of plate packs for access to sludge collection equipment in basin		
L.	Number of plate rows per basin		7
M.	Number of plates per row		170
N.	Number of plate packs per row		2
O.	Basin dimensions, ft.		
	1.	Space in front of packs	10
	2.	Total length	51
	3.	Width	45
	4.	Sidewater depth	17
P.	Volume per basin, gal.		292,000
Q.	Sludge collection		
	1.	Type	Chain and Flight type with cross collectors and gravity blowdown to wastewater facilities
	2.	Number of units per basin	
		a. Longitudinal scrapers	2
		b. Cross collectors	1

8.3.4.5 Granular Media Filtration

A.	Type	Dual cell with center wastewater gullet and washwater/effluent flume below each cell
B.	Number of filters	6 filters (12 cells)
C.	Filtration rate, gpm/sf	2.0
D.	Capacity per filter at 2 gpm/sf, mgd	4.4
E.	Total capacity at 2 gpm/sf, mgd	26.5
F.	Surface loading rate at 36 mgd plant flow, gpm/sf	2.7

G. Length - each cell, ft. 39
H. Width - each cell, ft. 20
I. Area per filter, sf 780
J. Media Depth, inches
   1. Sand 12
   2. Anthracite 18
   3. Future deep bed depth, total 75
K. Support gravel, inches 12
L. Underdrain type Parallel lateral, air - water
M. Backwash Pumping
   1. Type Vertical turbine pumps
   2. Number 2
   3. Capacity, gpm at 20 gpm/sf 15,600
   4. Total dynamic head, feet 40 +/-
   5. Horsepower, hp 250
N. Note: Michigan regulations do not require plant rating with one filter out of service if plant design includes four (4) or more filters.

8.3.4.6 Finished Water Storage

A. Type Cast in place concrete with internal baffling
B. Number of clearwells 2
C. Length - each, ft. 103
D. Width - each, ft. 75
E. Sidewater Depth – each, ft. 20
F. Volume - each, Mgal. 1.1
G. Clearwell storage includes volume to provide washwater for two (2) filter backwashes, 10 minutes of equalization storage at 36 mgd, and 0.5-Log inactivation of *Giardia* with a chlorine residual of 1 mg/L at a finished water pH of 8.0 and temperature of 0.5 °C.
H. Clearwells will normally operate in series. They are arranged so either can be taken out of service with flow continuing through the remaining clearwell.
I. The clearwell size is based on providing the required disinfection CT at the 36 mgd initial design rate. Additional disinfection CT could be provided for expanded plant flows through provision for clearwell expansion, increasing the disinfectant level, or by taking CT credit for the finished water transmission mains between the finished water pump station and the Henderson Road Pumping Station. Genesee County could also consider utilizing the transmission mains between the finished water pump station and the Henderson Road Pumping Station to achieve CT initially, thereby reducing the required clearwell volume and reducing the initial capital cost.

8.3.4.7 Finished Water Pumping

A.	Type	vertical turbine pumps
B.	Number of units	4
C.	Capacity per unit, mgd,	12
D.	Total firm pumping capacity, mgd	36
E.	Total dynamic head, ft.	140
F.	Horsepower, hp	500
G.	Finished water pumping capacity based on construction of two (2) 42-inch diameter finished water mains to convey water to the Henderson Road Tanks.	

The initial finished water pumping capacity is sized to provide adequate reliable pumping capacity (with one pump out of service) to meet Genesee County's 25-year maximum day demands. The high service pump station conceptual design includes provisions for installation of an additional pump to increase the reliable high service pumping capacity to 48 mgd.

8.3.4.8 Process Wastewater and Residuals

A. Design Concept – Zero Discharge Facility

1. Provide clarification for filter backwash wastewater. Backwash wastewater will be batch-clarified in a fill and decant clarifier. After clarification, the supernatant will be directed to the head of the plant. The underflow solids will be discharged to the thickener.

2. Provide a thickener for sedimentation basin sludge blowdown and wastewater clarifier underflow solids. Discharge the thickener supernatant to the wastewater clarifiers.

3. Provide a residuals dewatering facility for all thickened sludge. Final disposal of sludge is assumed to be at an offsite landfill for developing anticipated operating costs. Discharge belt filter press filtrate to the thickener.

B. Batch Backwash Wastewater Settling Tank

1. Type — Circular clarifier with scraper mechanism
2. Number — 2
3. Design criteria
   a. Settling rate, ft./min. — 0.067
   b. Clarifier volume sized to contain filter backwash wastewater from one filter backwash and thickener supernatant flow
4. Diameter, ft. — 83

C. Thickener

1. Type — Circular thickener with scraper mechanism
2. Number — 1
3. Solids loading, lbs/day/sf — 5

	4.	Storage, days at maximum solids production	4
	5.	Diameter, ft.	51
	6.	Total Depth (including hopper), ft.	14.5
D.	Dewatering System		
	1.	Type	Belt filter press
	2.	Number	2
	3.	Capacity, lbs/day	8,000

A "Zero Discharge" concept is used in this conceptual design for the purpose of developing a conservative opinion of project costs for process wastewater handling, based on regulatory and permitting uncertainties related to other potential process wastewater treatment alternatives. Because of the significant costs associated with the wastewater processing facilities, Genesee County should further explore additional alternatives that may have significant cost advantages, such as construction of lagoons, during the preliminary and final design phases of the project. The use of a lagoon system could reduce capital cost by up to $5 million, as compared to the "Zero Discharge" approach. The technical feasibility as well as the permitting and regulatory aspects of each alternative should be considered along with the potential cost savings.

8.3.4.9 Security Provisions

The WTP Opinion of Probable Cost includes cost allowances for site security measures, including the cost of double fencing, as requested by Genesee County, in addition to allowances for security systems such as closed circuit cameras, an access control system, and a fence disturbance detection system.

8.4 Opinion of Probable Cost and Schedule

8.4.1 Capital Cost

The opinion of probable WTP capital cost is summarized in Table 8.4. The table includes a cost for each of the key process components included in this conceptual design. Electrical, mechanical, and contractor overhead and profit are included as a calculated percentage of construction costs.

Table 8.4: Opinion of Probable Capital Cost

Description	Conventional Filtration
Raw Water Equalization	$ 3,300,000
Site Work	$ 6,100,000
Pretreatment	$ 10,500,000
Filtration	$ 13,100,000
Chemical Facilities	$ 4,600,000
Administration	$ 3,000,000
Residual Handling	$ 7,400,000
Finished Water Storage	$ 3,600,000
High Service Pumping	$ 3,400,000
Subtotal	$ 55,000,000
Electrical (13%)	$ 7,200,000
Mechanical (7%)	$ 3,800,000
Subtotal	$ 66,000,000
Contractor Overhead and Profit (22%)	$ 14,500,000
Total – (ENR 8688)	$ 80,500,000

Potential cost savings associated with elimination of raw water equalization, elimination of wastewater handling equipment associated with the "zero discharge" concept in favor of lagoons, and reduction of the finished water clearwell size, as described in Section 8.3, could result in project cost savings of approximately $13 million to $14 million. Potential cost savings are discussed in Appendix 15.

As requested by the project team, project costs including design contingency, construction contingency, and engineering, bonds, legal, and administrative costs are <u>not</u> included in the WTP Opinion of Probable Capital Cost. These costs, which are assumed to be 37% of the construction costs, will be applied by the project team to the Summary of Project Costs.

8.4.2 Land Acquisition

Genesee County will need to acquire a minimum of 25 acres for construction of the WTP. Based on the land acquisition cost for rural acreage provided by Genesee County, WTP land acquisition cost of at least $150,000 should be anticipated.

8.4.3 Annual Cost

Annual costs were calculated for various WTP operational categories and are shown in Table 8.5.

Table 8.5: Annual Operating Costs

Projected Annual O&M Expenses (2014)	
Maintenance	$852,200
Labor	$859,248
Chemicals	$276,300
Power	$611,800
Residuals	$64,400
Depreciation	$1,250,000
Total O&M	**$3.913,948**

Annual costs were based on the following considerations:

- WTP labor costs computed as follows:

Table 8.6: WTP Labor Cost Summary

Staff				
Position	**Full-Time Employees**	**Hourly Rate**	**Fringe Benefits**	**Total**
Superintendent	1	$35.00	$21.70	$117,936
Supervisor	1	$30.00	$18.60	$101,088
Operators	5	$20.00	$12.40	$336,960
Mechanic	1	$25.00	$15.50	$84,240
Mechanic's Helper	2	$20.00	$12.40	$134,784
Instrument Technician	1	$25.00	$15.50	$84,240
Total Labor				**$859,248**

- Process power costs were based on $0.063 per kilowatt-hour (kwh) and included all significant pump and mixer loads at average flow for each year.
- Chemical costs were calculated based on average dosage used by the Detroit Lake Huron facility and average production for each year.

- Residuals dry solids quantities were calculated based on source water constituents, average day flow for each year, and average chemical dosages. Disposal costs were based on a 20% solids cake and $70 per ton disposal fee.
- Maintenance costs were estimated to be 5% of electrical/mechanical equipment initial capital cost per year, 3% of static equipment, and 1% of concrete. Maintenance labor was included with the labor cost.
- Depreciation costs were included for mechanical equipment only, depreciated over a 20-year useful life.

8.4.4 Schedule

The time required to design and construct the Genesee County WTP is approximately 46 to 52 months, as summarized in Table 8.7, based on a traditional design-bid-build project delivery approach. The following basic project schedule assumes a March 1, 2010 start date for design and permitting services.

Table 8.7: Project Schedule

PHASE	DURATION	START	COMPLETION
Design	18 months	3/1/10	9/1/11
Permitting	6 months	3/1/11	9/1/11
Bid	1.5 months	9/1/11	10/15/11
Award	2 months	10/15/11	12/15/11
Construction	24 months	12/15/11	12/15/13
Total(1)	**45.5 months**	**3/1/10**	**12/15/13**
Contingency(2)	6 months	12/15/13	6/15/14

(1) Considers overlap of Design and Permitting Phases.

(2) Schedule contingency for potential permitting and weather delays.

The WTP project schedule could be somewhat accelerated, if necessary, to coordinate with the overall water supply project schedule. Genesee County could also consider a design-build project delivery approach to more significantly reduce the project schedule.

Lake Huron Water Supply Study

Karegnondi Water Authority

- City of Flint
- Genesee County
- Lapeer County
- Sanilac County

Appendix 8A
Genesee County Water Treatment Plant Modifications

February 20, 2009

ROWE PROFESSIONAL SERVICES COMPANY
540 S. Saginaw Street Suite 200 P.O. Box 3748 Flint, MI 48502

8A.1 Introduction

The concept for a new Lake Huron Water Supply was developed consistent with the criteria established prior to beginning the study work. The following processes have been incorporated into the water treatment plant planned to serve GCDC-WWS customers. Although these processes provide greater treatment options, they are not required for a reliable, high quality water supply.

Raw water equalization: Equalization was originally included for balancing of incoming water supply with flow through treatment plant. A flow control valve can be substituted to control plant flow.

Residuals handling: One of the criteria originally established for the WTP was "zero waste discharge". Since the facility will likely be located in a rural area and public sewers will not be readily available, the proposed WTP has been planned with provisions for onsite processing and treatment of residuals resulting from the treatment of water. However, with the high quality source water, the residual quantity is expected to be suitable for lagoon treatment.

Finished Water Storage: Clearwell storage provided following disinfection has been designed to provide sufficient contact time for disinfection. The clearwell volume can be reduced since the finished water pipeline planned between the WTP and the Henderson Road Pump Station will provide the required disinfection contact time.

To finalize this study, the cost savings resulting from the three modifications above have been included in the project costs. Table 8-8 shows the adjusted construction cost for the GCDC-WWS WTP.

Table 8A-1 Adjusted Construction Cost for GCDC-WWS WTP

	Construction Cost From Table 8-4	Adjusted Construction Cost
Raw Water Equalization	$3,300,000	$0
Site Work	$6,100,000	$6,100,000
Pretreatment	$10,500,000	$10,500,000
Filtration	$13,100,000	$13,100,000
Chemical Facilities	$4,600,000	$4,600,000
Administration	$3,000,000	$3,000,000
Residual Handling	$7,400,000	$2,400,000
Finished Water Storage	$3,600,000	$1,900,000
High Service Pumping	$3,400,000	$3,400,000
Subtotal	$55,000,000	$45,000,000
Electrical (13%)	$7,200,000	$5,850,000
Mechanical (7%)	$3,800,000	$3,150,000
Subtotal	$66,000,000	$54,000,000
Contractor OH&P (22%)	$14,500,000	$11,880,000
Total	**$80,500,000**	**$65,880,000**

APPENDIX 9

Lake Huron Water Supply Study

Technical Memorandum

City of Flint Water Treatment Plant

Karegnondi Water Authority
City of Flint
Genesee County
Lapeer County
Sanilac County

February 20, 2009

WADETRIM

555 South Saginaw Street
Suite 201
Flint, Michigan 48502

Appendix 9 - City of Flint Water Treatment Plant

9.1 - Purpose

This Technical Memorandum outlines the general design components of upgrades to the City of Flint's Water Treatment Plant. The treatment facility's average day design capacity is 20 million gallons per day (mgd); maximum day design capacity is 36 mgd.

9.2 - Background

9.2.1 - Current Water Supply

The City of Flint has purchased treated water from the City of Detroit Water and Sewerage Department (DWSD) since December 1965. Presently, the City of Flint and Genesee County receive treated lake water through a single pipeline from the DWSD. While the City receives treated water from the DWSD, water is pumped by the DWSD to the Flint Water Treatment Plant (WTP) where the water is monitored daily and distributed throughout the City. Although this is the City's primary supply, the Flint WTP was designed to act as a standby backup source for potable water, which is obtained from the Flint River and treated at the plant.

Over the past decade the City of Flint has undertaken substantial multi-phased plant upgrades in order to increase overall treatment capacity and to provide adequate treatment for their emergency surface water supply in accordance with Michigan Department of Environmental Quality (MDEQ) standards. As a result, by the end of 2005, much of the WTP had been rehabilitated and upgraded, and is now capable of producing finished water of similar water quality to that of water received from the DWSD, by treating raw water from the Flint River. However, if the treatment plant were to accept raw water from Lake Huron as a result of the proposed regional water distribution system discussed within the Technical Memorandum, additional plant upgrades will be necessary.

9.2.2 - Current Plant Operation

As stated previously, the normal operation of the Flint WTP is to monitor the amount of water supplied by the DWSD and distribute it to consumers within the City of Flint. While this remains the City's primary source of treated drinking water, the treatment plant was originally designed and operated as a two-stage facility to treat Flint River water, prior to filtration. While the treatment plant has not been operated continuously since the City of Flint contracted with the DWSD for water, the City periodically operates the treatment plant to demonstrate that it can reliably treat Flint River water, should the supply of water from Detroit be interrupted.

Currently, when the WTP is operated as designed, and water from the Flint River is used as the raw water source, water enters the plant through trash racks at the river Intake Structure and then flows through a 72-inch pipe to Pump Station No. 4. At the pump station the flow is split and passes through one of the two traveling screens before flowing into the suction well at Pump Station No. 4.

Four (4) low-lift pumps, Pumps No. 3, 4, 5, and 6, pump the water into a pair of 48-inch force mains that combine into a single 48-inch force main. From there, water passes through a Venturi meter vault and into a 54-inch main that eventually empties into the Ozone Contactor facilities.

The Ozone Contactor facilities are comprised of a pre-sedimentation chamber followed by three (3) parallel contactor trains. Each train itself is composed of a diffusion basin divided into four (4) cells, followed by a contact chamber that is divided into nine compartments by baffle walls. Following ozonation, water flows by gravity through a 54-inch pipe to the two-stage, Lime Softening facilities.

The first stage (primary) treatment process consists of a Rapid Mix chamber, Primary Flocculation, and Primary Clarification facilities. Prior to entering the Rapid Mix chamber, water is dosed with ferric chloride, primary coagulant chemical. If necessary, the water is also dosed with a coagulant aid polymer. Once mixed, water flows to either one of the two, three-stage Primary Flocculation basins, then into Primary Clarification facilities. Primary clarification consists of three (3) parallel basins, each equipped with inclined plates to enhance solids removal. Effluent from the clarification process is conveyed by channel to second-stage (secondary) treatment to achieve softening through the addition of lime and polymer. Sludge currently generated during primary clarification is pumped to the Residuals Equalization Clarifier. Both solids and liquid flow by gravity into the sanitary sewer system of the City of Flint

The second-stage (secondary) treatment process consists of two parallel, solids-contact clarifiers. Lime is used as the coagulant chemical for softening. If necessary, the water is also dosed with a coagulant aid polymer. Secondary effluent from each solids-contact clarifier flows into a Recarbonation basin where carbon dioxide is added. Effluent from the two Recarbonation basins flows by open channel to the Filters. Lime sludge generated from the secondary treatment process is pumped to the lime lagoons.

Twelve (12) dual media filters operate in parallel, each with filter media consisting of 12 inches of sand and 30 inches of granular activated carbon (GAC) cap. Filter waste backwash water and filter-to-waste water is also pumped to the Residuals Equalization Clarifier basin. Filter effluent flows by gravity from the filters to Clearwell No. 3. The capability exists to add a filter aid polymer to the filter influent flow and sulfur dioxide can be added to the filter backwash water to eliminate any chlorine residual, thereby extending the life of the GAC cap.

From Clearwell No. 3 filtered water is then pumped to the Dort Reservoir for chlorination and blending with the Detroit water supply. Once blended, water flows by gravity from the Dort Reservoir to the high-service pumps at Pump Station No. 4. From there, water is pumped by one or more of the five high-service pumps, Pumps No. 1, 2, 7, 8, and 9, into the City's distribution system.

When treating raw water from Lake Huron, some of these processes and chemical additions become unnecessary and can be bypassed, or deleted, while other treatment processes and chemicals become necessary. Thus, if the plant were to treat raw water from Lake Huron on a continuous basis, portions of the plant would require modification or upgrades, as discussed in the following section.

9.3 - Unit Process Design for Treating Water from Lake Huron

Of the processes and infrastructure located within the Flint WTP, the following areas will require some form of modification or upgrade in order to treat raw water from Lake Huron:

1) Raw Water Feed to Ozone Contactor Basin;
2) Power Infrastructure;
3) Emergency Power;
4) Post-Filtration Disinfection System;
5) Aluminum Sulfate Feed System;
6) Phosphoric Acid Feed System for Corrosion Control and Sequestering;
7) Post-Filtration Pump Station;
8) Telemetry and SCADA Systems;
9) Security Measures; and
10) Secondary Emergency Connection to Genesee County.

For clarification purposes Figure 9.1 has been included and depicts a schematic of the upgrades presented herein.

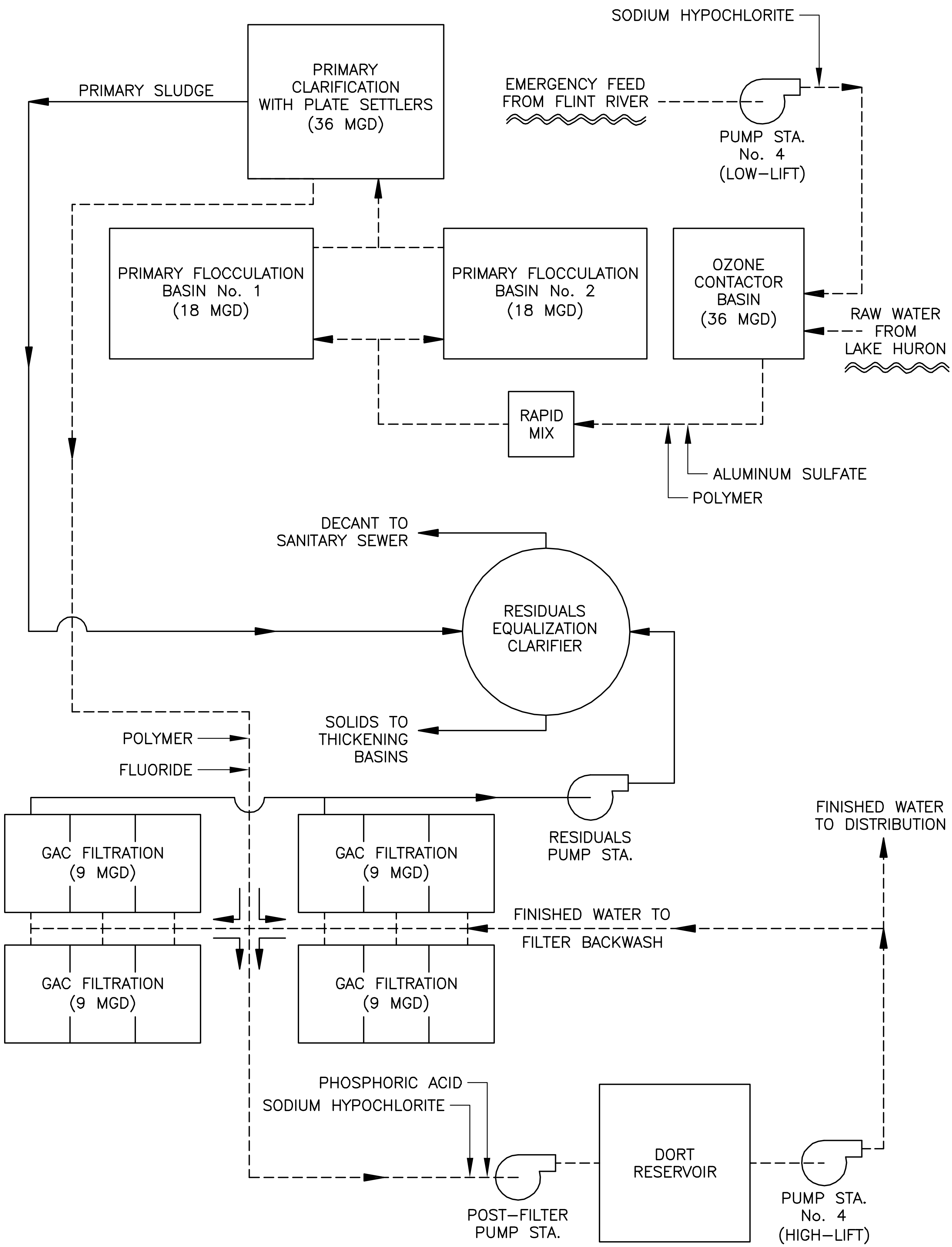
9.3.1 - Raw Water Feed

It is anticipated that raw water from Lake Huron will be fed to the WTP via a 48-inch diameter pipe, which will be piped directly to the Ozone Contactor Basin. In order to avoid re-pumping at the WTP, it will be necessary to maintain a hydraulic gradient of approximately 747 feet at the inlet to the Contactor Basin within the 48-inch transmission main. Furthermore, it is anticipated that several utilities will be crossed during the construction of the 48-inch raw feed line to the Contactor Basin including, but not limited to, several major water lines from Pump Station No. 4, including two 42-inch water mains and a 48-inch water main; a 6-inch sanitary sewer line; yard piping consisting of an 18-inch, a 24-inch, and a 36-inch water main; a 21-inch storm sewer; and miscellaneous telephone and electrical lines.

9.3.2 - WTP Power Infrastructure

Currently, the treatment facility utilizes 2,400 volts as facility-wide power to directly serve the 2,400-volt switchgear and motors currently located in Pump Station No. 4, as well as transformers throughout the facility. Based on the current state of the facility's power infrastructure, as well as a number of the proposed improvements discussed herein, there are a number of items that need to be addressed in regard to the overall power infrastructure:

- The plant's incoming power feed voltage needs to be raised from 2,400 volts to 4,160 volts. This would allow the plant to utilize the existing network of feeders to handle nominally twice the power-carrying capacity and eliminate the need to provide additional feeder capacity to Pump Station No. 4.



WADETRIM

PROPOSED PROCESS SCHEMATIC
FIGURE 9.1

CITY OF FLINT
WATER TREATMENT PLANT

- As a result of the voltage change, it would also require some modification of any existing 2,400 volt equipment and reconnections or replacement of all existing 2,400 volt transformers. For example, the southwest MCC room transformer – rated at 1,000 KVA – and the Ozone Contactor Basin transformer – rated at 750 KVA – should be field convertible to 4,160 volts. It is anticipated that a number of additional transformers will also need to be converted in the field, including:

    - Two (2) 225-KVA dry transformers in the Main Substation;
    - Two (2) 100-KVA dry transformers in the North Electrical Room; and,
    - Two (2) 300-KVA dry transformers in the South Electrical Room and one (1) in the southeast Office Area.

- Transformers located in the Electrical Maintenance Facility and Control Station No. 2 (located offsite) are not field convertible and will be replaced with units capable of operating at 4,160 volts.

9.3.3 - WTP Emergency and Backup Power

As a base-load facility capable of producing water at any time, the Flint WTP must have the ability to deal with power outages. Although the plant currently has a dual 46-KV primary feed system with automatic transfer entering the plant, these feeds come from the same switch yard.

While the plant is also equipped with two main substation transformers (operating in parallel) and dual 2.4-KV conductors to the majority of the plant, this setup does not address power issues that may occur with the generating utility or the transmission grid. For example, if the generating utility were to experience a failure at the switch yard, the possibility exists that the failure would cause the subsequent failure of both primary feeds to the treatment facility, which in turn would require the plant to operate using another power source or emergency power.

In the past, the plant has used two (2) Fairbanks Morse 1.8 MW diesel engine generators for emergency power. However, while these high-quality units were designed for full time power generation applications, they are antiquated equipment that had a history of significant maintenance issues. As a result, a series of three to four new generators, working in parallel, are proposed to replace these generators.

A likely location for a new bank of generators would be in the immediate vicinity of the existing sub-station. Based on emergency loading requirements of approximately 1.7 MW for the entire facility, and allowing for one unit to be out of service, a bank of three (3) 1-MW units or four (4) 0.75-MW units would be capable of providing adequate emergency power.

In addition to the generators, however, additional switchgear, fuel storage tanks, controls, and computer monitoring (e.g. SCADA) would be required to complete the proposed Emergency Power System.

9.3.4 - Post-Filtration Disinfection

Disinfection destroys bacteria and viruses, helping to protect ecosystems and prevent the spread of waterborne disease. The most commonly used disinfectant for both drinking water and wastewater treatment is chlorine. Its effectiveness against a wide spectrum of disease causing organisms, relatively low cost, and high reliability contribute to its popularity. Chlorine can be applied to water directly as a gas, mixed with water and applied as a solution, or through the use of chlorinating chemicals.

However, because chlorine production is energy intensive, and because energy costs have been increasing over the last decade, the price of chlorine has risen substantially in recent years. In addition, since the terrorist attacks on 9-11, water systems are giving greater attention to the security of their facilities and are conducting comprehensive “vulnerability assessments” and taking actions to protect against potential contamination of water supplies or disruption of service. As a result, many facilities are choosing to abandon gaseous chlorine and are turning to alternative methods of disinfection.

Of the alternatives available, liquid sodium hypochlorite is becoming the disinfection chemical of choice because it is inherently safer than gaseous chlorine. In solution, sodium hypochlorite (NaOCl) is commonly known as bleach and can be purchased and delivered in bulk, or it can be produced in a dilute concentration with onsite equipment. Both options for using sodium hypochlorite are technically feasible, although there is some uncertainty regarding the suitability of onsite sodium hypochlorite generation systems for the Flint WTP related to the reliability, system efficiency, and effectiveness.

It should be noted, however, that there are some advantages to onsite sodium hypochlorite generation. For example, the initial capital costs for onsite sodium hypochlorite generation systems are higher than bulk sodium hypochlorite systems, but the life cycle costs over a 20-year period were estimated to be lower. Additionally, an onsite NaOCl generation system would have the advantage of producing NaOCl on an as-needed basis, so degradation and large storage facilities would be immaterial.

Further discussion with plant and City personnel, however, indicated that storage and feed facilities for a bulk or semi-bulk hypochlorite system would be similar to systems already onsite, resulting in operating and maintenance issues that would be comparable. And, the lower capital investment associated with a bulk system is more attractive at this time.

For the use of bulk sodium hypochlorite, sodium hypochlorite is typically transported at 12 to 15% concentration. Upon delivery, the chemical can be diluted to the desired storage concentration. USEPA typically requires storage of a 30-day supply of treatment chemicals.

While storage of the chemical solution at higher concentrations allows for lower required volumes, higher concentrations accelerate the breakdown of sodium hypochlorite to undesired byproducts. Other factors that accelerate the breakdown of sodium hypochlorite include increasing temperature, increasing exposure to ultraviolet light, and deviation from the optimal pH range. Water treatment plants normally store sodium hypochlorite in bulk at concentrations from 65 to 12%, based on expected use.

It is anticipated that liquid sodium hypochlorite will be purchased and delivered to the Flint WTP where it will be diluted to a lower concentration and stored in corrosion-resistant bulk storage tanks. Ideally, the tankage should be installed in a dark and temperature-controlled environment maintained at about 60 to 70° Fahrenheit. If that i s not feasible, it should be in a shaded enclosure with good airflow to slow degradation. The tanks themselves should be double-walled and constructed of a NaOCl-compatible fiberglass resin with a resin-rich vinyl ester inner wall.

It is anticipated that the proposed NaOCl system will fit within the confines of the existing chlorine facilities. Based on an average daily plant flow of 20 MGD, a typical dosage rate for 6% concentrated solution would be 1 part per million (ppm) and the system would require approximately 10,000 gallons of storage to meet the monthly storage requirements recommended by the USEPA. Working within the space limitations of the facility, it is anticipated that two tanks of approximately 4,500 gallons each would be required, as well as a tank of approximately 2,100 gallons.

Typically, a 4,500-gallon bulk load of 12% solution concentration delivered to the site would then be split equally between the two proposed 4,500 gallon storage tanks. Both tanks would then be filled with dilution water to provide a total of 9,000 gallons of a 6% solution. As the chemical was used, and the stored volume decreased to approximately 2,000 gallons, the remaining chemical in the larger tanks would be transferred to the 2,100-gallon storage tank, which would provide approximately one week's worth of solution, based on average daily flow rates and dosages. With the two larger tanks empty, a subsequent full truck load of bulk chemical could be delivered to initiate the dilution process again.

Pumps will be provided to transfer chemical from the storage tanks to a day tank. From the day tank, the chemical will be delivered by the metering pumps to the injection points. A water flushing system will be provided to allow for flushing of the entire system during shutdown or intermittent-usage periods to minimize gasification and crystallization.

The feed system will be automatically controlled and take advantage of available control technology. Because of the degradation potential of NaOCl, chlorine-residual control is warranted. The residual sample point should be relatively close to the NaOCl application point on the downstream side to avoid "chasing" the residual set-point. As an added precaution, pH monitoring can be installed on the NaOCl storage tank or in the tank discharge line to monitor any drops in the pH of the neat solution that would indicate contamination problems.

Personnel who handle NaOCl will need to take the same precautions as they would for any other caustic material. Care should be taken to assure that the NaOCl does not come into contact with the skin; if it does, the skin should be immediately flushed with water. Emergency eyewash/showers will be provided as required within the chemical room and at the unloading station.

9.3.5 - Aluminum Sulfate Feed System

Aluminum sulfate (also called "alum") or a similar metal salt is used as a primary coagulant for removing turbidity, color, bacteria, algae, and other organic compounds from surface or groundwater.

For this application, it is proposed that alum be purchased as a liquid at a concentration of 48% in a water solution. It is anticipated that the solution will added to the incoming raw water at the rate of approximately 1-3 milligrams per liter (mg/L).

The three existing double-walled corrosion resistant fiberglass tanks currently used for bulk storage of ferric chloride, along with one additional new tank to match the existing, would be used to provide the required bulk storage volume. The three existing day tanks currently used for ferric chloride would be converted to alum feed day tanks.

Transfer pumps would be provided to transfer the alum from the storage tanks to the required day tank, per MDEQ requirements. Chemical metering pumps will draw from the day tanks and deliver chemical to the desired point of application.

9.3.6 - Corrosion Control and Sequestering Agent

Phosphate corrosion inhibitors and sequestering agents are among the few recognized chemicals that can be safely added to potable water to produce a significant improvement in distribution system corrosion, colored water, and scale control. Over 200 phosphate-based products are ANSI/NSF Standard 60 certified for potable water treatment for corrosion control and metal sequestering.

Phosphate products for potable water treatment can be broadly classified into three groups: phosphoric acid, orthophosphates, and condensed phosphates. Phosphoric acid, orthophosphates, and condensed phosphates encompass a wide variety of chemical compounds having potential for potable water treatment applications. The application of each phosphate product depends upon the specific properties or treatment desired.

For this application, it is proposed that phosphoric acid be purchased as a liquid at a concentration of 31% phosphate in a water solution. It is anticipated that the solution will be added to the filtered effluent water at the rate of approximately 1-2 milligrams per liter (mg/L). Based on an average daily plant flow rate and average dosage rates, approximately 1,125 gallons of storage would be required to meet the minimum 30-day storage requirements. A 6,000 gallon bulk storage tank would allow delivery of a full truckload of the chemical. A transfer pump would be provided to transfer the phosphoric acid from the storage tank to a 120 gallon day tank. Chemical metering pumps will draw from the day tanks and deliver chemical to the desired point of application.

9.3.7 - Post-Filtration Pump Station

A new transfer pump station, similar to Pump Station No. 4, will be constructed to serve two purposes: (1) to transfer treated water from the GAC filters to the Dort Reservoir; and (2) to back-feed Genesee County in case of emergencies. Without the pump station to transfer water to/from the treatment process, the WTP would be unable to use the reservoir due to hydraulic limitations.

The pump station itself will be constructed north of Plant No. 2 in the northeast corner of the WTP site. It will consist of a one million gallon clear well and a wet well, and will be equipped with three (3) low-lift pumps. The low-lift pumps, each equipped with a variable frequency drive, will be used when pumping to the Dort Reservoir. Space for the addition of a future pump will be provided, but the firm capacity of the three low-lift pumps will be 36 mgd without the future pump.

9.3.8 - Residuals Treatment and Solids Handling

As stated previously, ferric chloride sludge generated during primary clarification, as well as filter waste backwash water and filter-to-waste water, are currently pumped to the Residuals Equalization Clarifier basin. With the upgrade of the plant to treat raw water from Lake Huron, the filter waste backwash water and filter-to-waste water will continue to be pumped to the Residuals Equalization Clarifier basin, where both the solids and liquid will flow by gravity into the sanitary sewer system of the City of Flint. Because of the switch from treating water from the Flint River to water from Lake Huron, it will be necessary to switch the primary coagulation chemical from ferric chloride to aluminum sulfate (alum).

9.3.9 - Telemetry and SCADA System

The water treatment plant has a variety of equipment, provided by several different manufacturers, comprising the telemetry portion of the SCADA system. Currently, the telemetry system consists of a master telemetry unit (MTU) located in the plant’s Operations Center. The MTU is an Allen-Bradley CAB SLC5104 programmable controller (PLC) and serves as the plant’s main PLC or data concentrator. The MTU PLC communicates via Motorola UDS phone line modems to five remote stations – Oak, Irish, Belsay, South Genesee, and North Genesee – each of which has a complimentary Motorola UDS phone line modem and an AEI SLC5104 PLC. The communication protocol is proprietary to Allen-Bradley.

Four additional remote sites – Baxter/Potter, Cedar, West Side, and Torrey – communicate to the MTU via the use of hardwiring and YO repeaters. Each of these locations use Moore LCM YO repeater modules, communicating over Motorola UDS phone line modems to send status back to the plant and receive commands from the plant. At the plant the YO repeater units are hardwired to YO modules located in the MTU PLC rack. However, it is recommended to remove the existing repeaters and install PLC-based RTUs at all four locations consistent with the SCADA system currently used at the plant.

The plant SCADA system utilizes the Allen-Bradley SLC 5/04 PLC platform, which is both a viable and cost effective solution for PLC-based control systems. Using Allen-Bradley’s SLCs for additional plant SCADA also has the benefits of:

- Standardized components with minimal spare parts inventory.
- Maintenance staff is already trained to support this PLC platform.
- Additional programming software for a different platform PLC is not required.

The plant SCADA system currently uses AB DH+ communications. There are 21 PLCs and 3 operator stations on the DH+ network for a total of 24 nodes. DH+ networks typically begin to degrade, depending on traffic, when the number of nodes reaches 15 to 20. The number of operator stations is especially critical as these MMI stations are usually “bandwidth killers.” For example, as the SCADA system expands, the additional burden of more PLCs and operator stations begin to cause excessive delays in operator station command response times.

One option to preserve the investment currently made in the DH+ communications is to provide a means to breakup the existing single network into several smaller ones. Additionally, surge protection should be investigated for all networks, as well as incoming PLC power supply and communications.

All fiber lines in the plant currently being used for SCADA have six fibers. This relatively low number of spare fibers limits the ability to exploit any form of redundant ring self-healing communication technologies. Any future fiber lines should have a minimum of 12 fibers. Only the fibers that are used are terminated at the in-plant PLC panel locations. If for some reason a fiber goes bad, the DH+ network will be down until one of the spare fibers can be terminated and connected.

Due to previous rehabilitation projects, the majority of in-place plant equipment is ready to be placed onto the plant SCADA system with only the addition of PLCs, VO wiring, and programming required. Concentrations of signals due to the locations of MCCs, clusters of primary elements or treatment equipment, and remote geographic location lend themselves to future locations of PLCs. Possible future PLC locations include, but are not limited to:

- Primary Clarifiers
- Flocculation Basins (MCC Room)
- Chemical Feed Area(s)
- Residuals Handling Facility
- Main Substation
- Backup/Emergency Power Generation Facility

It should be noted that MCC rooms represent a concentration of signals that can be tied into the SCADA system with minimal wiring and conduit costs. Areas such as that of the Primary Clarifier will require a substantial amount of wiring and conduit to the field devices and control panels to obtain the required interface signals.

In addition to new PLCs, it is recommended that:

- The plant continues the use of the AB SLC 5/04 platform for any remaining expansion to its SCADA system.

- The existing DH+ network be split into four separate networks, using a DH+ gateway located at the Main PLC location to function as a switch and limit the traffic seen on each of the four networks.

- A separate Ethernet drop be provided from the gateway for the sole purpose of operator station communications. This will limit MMI traffic seen on each of the four DH+ networks.

- The existing AB 1784-KT cards in the operator station computers be replaced with dedicated NIC cards. This dedicated SCADANMI Ethernet network should have no other drops to it.

- DH+ surge arrestors be installed on every DH+ network, Ethernet network, PLC panel power circuit, RS232 serial communication network, and antenna coax.

- The use of an isolated grounding system be employed on new equipment or where not cost prohibitive on existing equipment.

- All spare fibers at all locations be terminated and tested. This will allow for a quick changeover in case of a fiber failure. Fiber patch panels should be installed at all locations where space permits for proper management and protection of the fiber communication backbone.

- All new installations employ higher count fiber cables (minimum 12 fibers). Where practical, replace existing cables with new to get more spare fibers.

- Make use of redundant fiber modules and adopt a self-healing ring topology for the fiber network. The fiber modules should have diagnostics capability that will allow the SCADA system the ability to monitor the health of the various links in the fiber network.

In addition to the recommended upgrades/modifications to the SCADA system, separate NIC cards should be installed in each of the operator stations, which should be dedicated solely for the plant SCADA and should not reside on any other network. By taking this step, the plant will achieve a firewall between the PLC network and the plant PC network. Should future intranet connectivity be desirable at the operator stations, a standalone web server could function as a resource to post real time SCADA information on web pages. This web server could be connected to the plant PC network to allow access to web page information via any in-plant web browser.

Please note, any connection to the internet should be made through the city-wide firewall administered by City Information Technology (IT) staff. At the proposed time of implementation of an intranet or internet connection at an operator station, an evaluation should be made as to the ability to secure this connection based on the current software and hardware technologies.

As stated previously, the water plant makes extensive use of dedicated, conditioned phone lines in its telemetry system. Phone line charges can represent a significant monthly cost, especially on large telemetry systems. Evaluation of radio as communication has shown that while installation costs are typically greater than that of phone lines, radio has no monthly usage fees.

Also, if there is a communication failure, repairing the radio system is a self determining effort rather than relying on a third party (the local telephone company) of which the plant has very little, if any, control over. This is a major concern for a utility in an area susceptible to major storms that may down utility poles or damage lines.

With radio there is usually concern about the propagation of the signal and the potential for interference. From observations of the service area's topography and foliage, radio communication may be successful as an infrastructure for the telemetry system. There are several avenues available to implement a radio-based telemetry system, including:

- The use of 2.4 GHz frequency and associated equipment that has a typical range of 2 to 3 miles. This wireless system would employ seamless Ethernet connectivity with typical data rates in the area of 1M to 3M baud. It should be noted that the range limitations of this system typically require additional access points to cover the required areas pertinent to the utility and the subsequent costs of additional access points can often be prohibitive.

- The use of unlicensed 900 MHz radio equipment and associated equipment that has a typical range of 7 to 9 miles. These radios have a much lower bandwidth than the 2.4 GHz equipment, with maximum data rates in the area of 0.5M baud and Ethernet connectivity. Due to the higher permissible radio output power of 1 watt, and the less line-of-sight characteristics of a lower frequency, the 900 MHz frequency is less susceptible to rain and fog than the 2.4 GHz frequency. Thus, using this lower frequency should allow coverage of the areas pertinent to the water plant with one MTU located at the water plant.

- Pursuing lower frequencies, such as the 450 MHz or 154MHz bands will allow a permissible increase in power (typically up to 5 watts) and have even less line-of-site requirements. A typical range of coverage in the area of 15 miles is not uncommon. Several key disadvantages of even lower frequencies are the requirement for FCC licensing and the fixed frequency does not permit the use of the frequency hopping technology used on the 900 MHz and 2.4 GHz ranges. The frequency hopping technology has the benefit of providing an inherently secure radio infrastructure and a resistance to interference.

It is therefore recommended that the water treatment plant switch from phone-based telemetry communication to radio-based telemetry. However, it will be necessary to conduct a detailed radio path propagation study utilizing a minimum fade margin of 20db at the 2.4 GHz, 900 MHz, and 450 MHz bands to determine the ideal frequency.

If possible, the plant should utilize frequency-hopping technology to provide security and minimize interference problems. Because of the migration of RTU and PLC equipment towards Ethernet connectivity, the plant should also utilize a radio manufacturer that supports Ethernet, serial, or both types of end devices to be connected to the radio infrastructure.

9.3.10 - Security Measures

A number of security measures have recently been implemented due to Homeland Security requirements at the Flint WTP in accordance with the City's Vulnerability Assessment. However, several items still have not been finalized and will therefore be completed as part of these proposed upgrades. Details of the items to be addressed are not provided within this Technical Memorandum as they are ***confidential***, but associated costs for the measures have been included.

9.3.11 - Secondary Emergency Connection to Genesee County

As a secondary emergency back-up to the Genesee County Water Treatment Plant, the City of Flint could back feed the County through Control Station No. 2. In order to accomplish this, Pump #4 (at Pump Station No. 4) would be replaced with a high service pump capable of pumping approximately 15 MGD at 250 feet of head. A VFD would also be installed along with the new pump, providing the capability of varying the flow to Control Station No. 2 by Flint WTP personnel so as not to interrupt or diminish flow to City customers.

Please note, costs associated with these changes have not been included in the final costs for the balance of the upgrades and modifications proposed in this Technical Memo.

9.4 - Treatment Performance Criteria and Basis of Design

The following is the design criteria by which the upgrades for the City of Flint's Water Treatment Plant have been based.

Firm Treatment Capacity:	36 mgd
Water Supply:	Lake Huron
Emergency Water Supply:	Flint River

The following Basis of Design illustrates the specifics of new and altered processes to allow the water treatment plant to treat raw water from Lake Huron at a quality similar to that received from DWSD. The average daily flow rate is estimated based on projected flow demands for the City of Flint for 2014.

9.4.1 - General

Maximum Day Flow Rate:	36 mgd
Average Day Flow Rate:	16.52 mgd
Minimum Day Flow Rate:	10 mgd

9.4.2 - Ozonation

Number of Contactor Trains:	3
Maximum Flow per Train:	12 mgd
Number of Compartments per Train:	2 diffusion basins, 9 contact chambers
Estimated Maximum Ozone Dosage:	4 mg/l

Diffusion Basins	
Type of Diffuser:	Fine-Bubble Ceramic Dome
Transfer Efficiency:	92%
Size of Each Diffusion Basin:	11' x 10' x 23' SWD
Hydraulic Retention Time at 16.52 mgd:	3.3 minutes
Contact Chambers	
Size of Each Contact Chamber:	8 @ 30' x 7' x 23' SWD
	1 @ 24' x 7' x 23' SWD
Hydraulic Retention Time at 16.52 mgd:	27.7 minutes
Ozone Residual Quenching	
Quenching Chemical:	sodium bisulfate
Required Dosage:	2.2 mg/l per mg/l ozone
Estimated Maximum Feed Rate:	150 lbs/day
Ozone Generator Capacity	
Number of Generators:	2
Number of Standby Generators:	1
Rated Capacity of Each Generator:	600 lbs/day
Estimated Maximum Feed Rate:	1,200 lbs/day

9.4.3 - Rapid Mixing

Number of Units:	2
Maximum Allowable Flow to Unit:	18 mgd
Size of Each Unit:	5'-7" x 6'-6" x 21' SWD
Volume of Each Unit:	762 ft^3
Hydraulic Retention Time:	30 seconds

9.4.4 - Primary Flocculation

Number of Units:	2
Size of Each Unit:	38' x 88' x 16' SWD
Volume per Unit:	53,504 ft^3
Maximum Allowable Flow to Each Unit:	18 mgd
Hydraulic Retention Time:	35 minutes
Outlet Conditions	
Number of Openings per Unit:	10
Size of Each Opening:	2' x 2'
Total Open Area per Unit:	40 ft^2

9.4.5 - Primary Clarification with Plate Settling

Number of Basins:	1
Number of Cells per Basin:	4
Size of Each Cell:	93' x 30' x 22' SWD

Volume of Each Cell:	61,380 ft^3
Area of Plates:	20,993 ft^2
Type of Weir:	v-notch
Number of Weir Troughs per Cell:	3

9.4.6 - Filtration

Type of Filter:	Granulated Activated Carbon
Number of Filters:	12
Size of Each Filter Unit:	25’ x 28’
Filter Area per Unit:	700 sf
Filtration Rate:	3 gpm/ft^2
Capacity of Each Filter:	3 mgd
Maximum Rated Capacity:	36 mgd
Filter Box Depth:	9.92 ft

9.4.7 - Disinfection

Chemical Form:	6% NaOCl solution
Average Dose:	1 mg/l @ 16.52 mgd
Maximum Dose:	2 mg/l @ 36 mgd
Estimated Contact Time:	25 minutes
Chemical Storage Capacity:	11,100 gallons
Day Tank Capacity:	1,000 gallons

9.4.8 - Post-Filter Pump Station

<u>Low-Lift Pumps to Dort Reservoir</u>

Number of Pumps:	3
Number of Standby Units:	1
Firm Pumping Capacity:	36 mgd
Rated Capacity of Each Pump:	Pump No. 1 - 15 mgd @ 35’ TDH Pump No. 2 - 20 mgd @ 35’ TDH Pump No. 3 - 20 mgd @ 35’ TDH

9.4.9 - Chemical Feed Systems

<u>Alum for Rapid Mix Clarification</u>

Chemical Form:	$Al_2(SO_4)^3$ solution
Average Dose:	1 mg/l @ 16.52 mgd
Maximum Dose:	2 mg/l @ 36 mgd
Chemical Storage Capacity:	20,000 gallons

<u>Phosphates for Corrosion Control</u>

Chemical Form:	31% PO_4 solution
Average Dose:	1.0 mg/l as PO_4 @ 16.52 mgd
Maximum Dose:	2.0 mg/l as PO_4 @36 mgd

Chemical Storage Capacity:	6,000 gallons
Day Tank Capacity:	120 gallons

<u>Hydrofluosilicic Acid for Fluoride Treatment</u>

Chemical Form:	30% H_2SiF_6 solution
Average Dose:	1.0 mg/l as F @ 16.52 mgd
Maximum Dose:	1.0 mg/l as F @ 36 mgd
Chemical Storage Capacity:	1,000 gallons
Day Tank Capacity:	200 gallons

9.5 - Engineer's Opinion of Construction Cost

A detailed breakdown of construction costs is summarized in Table 9.1 through Table 9.8 on the following pages. Construction costs are based on the conceptual designs as outlined in the previous sections of this report, and have been compared with past costs from projects that are similar in scope and complexity. Overall, the cost to update the Flint WTP in order for the plant to treat raw water from Lake Huron is estimated at approximately $7.1 million. Please note, historical costs were trended to present day costs using the *Engineering News Record* construction cost indices. All of the following costs are based on a projected *Engineering News Record* cost index value of 8688.

Table 9.1 - Raw Water Feed to Ozone Basing

Item Description	Estimated Cost	
48" Raw Water Line with Flow Meter (on WTP property)	$	450,000
Connection at Ozone Base	$	520,000
Piping, Valves, Structural Modifications to Ozone Basin	$	150,000
Subtotal:	**$**	**650,000**
15% Construction Contingency:	$	98,000
5% Design Contingency:	$	33,000
17% Engineering, Legal, Bond and Administrative:	$	101,000
Total:	**$**	**892,000**

Table 9.2 - Power Infrastructure, including Emergency/Backup Power

Item Description	Estimated Cost	
Substation Upgrade	$	980,000
Dewatering Building Feeders	$	90,000
Subtotal:	**$**	**1,070,000**
15% Construction Contingency:	$	161,000
5% Design Contingency:	$	154,000
17% Engineering, Legal, Bond and Administrative:	$	182,000
Total:	**$**	**1,467,000**

Table 9.3 - Post-Filtration Disinfection System

Item Description	**Estimated Cost**	
Demolition of Existing Equipment in Chlorine 1-Ton Storage Room	$	40,000
Bulk Storage Containers and Day Tank	$	50,000
Metering Pumps and Tables	$	12,000
Piping, Valves and Accessories	$	10,000
Containment	$	60,000
Installation	$	75,000
Subtotal:	**$**	**247,000**
15% Construction Contingency:	$	37,000
5% Design Contingency:	$	12,000
17% Engineering, Legal, Bond and Administrative:	$	42,000
Total:	**$**	**338,000**

Table 9.4 - Aluminum Sulfate Feed System

Item Description	**Estimated Cost**	
Conversion of Existing Ferric Chloride Feed System to Alum	$	25,000
Subtotal:	**$**	**25,000**
15% Construction Contingency:	$	4,000
5% Design Contingency:	$	1,000
17% Engineering, Legal, Bond and Administrative:	$	4,000
Total:	**$**	**34,000**

Table 9.5 - Phosphoric Acid Feed System for Corrosion Control and Sequestering

Item Description	**Estimated Cost**	
Bulk Storage Container and Day Tank	$	25,000
Metering Pumps and Tables	$	10,000
Piping, Valves and Accessories	$	10,000
Containment	$	35,000
Installation	$	30,000
Subtotal:	**$**	**110,000**
15% Construction Contingency:	$	17,000
5% Design Contingency:	$	6,000
17% Engineering, Legal, Bond and Administrative:	$	19,000
Total:	**$**	**152,000**

Table 9.6 - Post-Filtration Pump Station

Item Description	Estimated Cost	
Pump House Building	$	360,000
Furnish and Install One (1) 16-MGD @ 35 ft of TDH - Horizontally Mounted Pump	$	250,000
Furnish and Install Two (2) 20-MGD @ 35 ft of TDH - Horizontally Mounted Pump	$	600,000
Internal Piping, Valves, Supports and Steady Bearings	$	250,000
Intermediate Platforms, Ladders, Stairways, Ventilation and Boiler System	$	450,000
Subtotal:	**$**	**1,910,000**
15% Construction Contingency:	$	287,000
5% Design Contingency:	$	96,000
17% Engineering, Legal, Bond and Administrative:	$	325,000
Total:	**$**	**2,618,000**

Table 9.7 - Telemetry and SCADA Systems

Item Description	Estimated Cost	
Plant SCADA Panels, Installation and Programming	$	735,000
Telemetry System Panels, Installation and Programming	$	245,000
Additional Primary Elements	$	25,000
Computers, Software, and Training	$	160,000
Subtotal:	**$**	**1,165,000**
15% Construction Contingency:	$	175,000
5% Design Contingency:	$	58,000
17% Engineering, Legal, Bond and Administrative:	$	198,000
Total:	**$**	**1,596,000**

Table 9.8 - Security Measures

Item Description	Estimated Cost	
Implementation of Miscellaneous Security Measures	$	6,500
Subtotal:	**$**	**6,500**
15% Construction Contingency:	$	1,000
5% Design Contingency:	$	500
17% Engineering, Legal, Bond and Administrative:	$	1,000
Total:	**$**	**9,000**

9.6 - Schedule

Given a start date of March 2010, it is anticipated that the design of the proposed updates and modifications to the Flint Water Treatment Plant could be completed by September 2010. Once the design has been completed, permits would be sought and the bidding phase could take place.

Construction would begin April 2011, with final close-out as soon as June 2012, as shown in Table 9.9.

Table 9.9 - Estimated Design and Construction Schedule

Task	Approximate Date
Notice to Proceed with Design Engineering	March 2010
Preparation of Specifications	April – July 2010
Preparation of Plans	April – July 2010
Preparation of Engineer's Estimate of Construction Costs	June – July 2010
Preparation of Permit Application(s)	July 2010
Stakeholder Review and Preliminary Comments/Approval	August 2010
Finalization of Specifications	September 2010
Finalization of Plans	September 2010
Submit Plans & Specifications to Permitting Agency for Review/Approval	October – November 2010
Bidding Phase	December 2010
Contract Award	January 2011
Preconstruction Meeting	February 2011
Notice to Proceed	March 2011
Mobilization	April 2011
Construction	April 2011 – February 2012
Substantial Completion	March 2012
Restoration, Punch-List, and Final Clean-up	April 2012
Demobilization	May 2012
Project Closeout	June 2012

9.7 - Engineer’s Opinion of Operation and Maintenance Costs

Based on the proposed changes at the WTP identified herein, operation and maintenance (O&M) costs for an average flow rate of 16.52 MGD beginning in 2014 are estimated at $4.0 million. A detailed breakdown of the anticipated O&M budget for 2014 is shown in Table 9.10. Please note, the following costs are based on a projected *Engineering News Record* cost index value of 8688.

Maintenance costs have been estimated based not only the proposed equipment upgrades and changes outlined herein, but existing equipment maintenance as well. Furthermore, the depreciation costs shown in Table 9.10 reflect only the depreciation associated with the proposed plant upgrades and modifications outlined in this study. Depreciation for existing equipment already part of the plant’s existing treatment process have not been taken into account for the proposed 2014 O&M budget.

Table 9.10 - Projected Annual O&M Budget (2014)

Item Description	**Estimated Cost**	
Maintenance:	$	395,000
Labor:	$	1,635,000
Chemicals:	$	530,000
Power:	$	950,000
Residuals:	$	135,000
Depreciation:	$	355,000
Total:	**$**	**4,000,000**