

Woosley, Rosemary (DEQ)

From: Wurfel, Brad (DEQ)
Sent: Monday, October 05, 2015 8:48 PM
To: Vorce, Susan (DEQ)
Subject: Fwd: FOIA request

0090-16
 EXEC - RMD
 Lansing
 Due: 10-27-15

10 DAY EXT
 RW

Sent from my iPhone

Begin forwarded message:

From: "Kaffer, Nancy" <nkaffer@freepress.com>
Date: October 5, 2015 at 2:57:07 PM EDT
To: "WurfelB@michigan.gov" <WurfelB@michigan.gov>
Subject: FOIA request

Brad, if you're not the DEQ's FOIA officer, please forward or advise.

Best,

Nancy

Nancy Kaffer
 Detroit Free Press
 160 W. Fort St.
 Detroit, MI 4226

Oct. 5, 2015

Brad Wurfel
 Michigan Department of Environmental Quality

To Whom It May Concern:

Under the Michigan Freedom of Information Act § 15.231 et seq., I am requesting an opportunity to inspect or obtain copies of electronic, written or audio files, material or documentation -- including but not limited to communications, emails, letters, memos, reports and meeting records -- related to a 2011 report titled "Analysis of the Flint River as a Permanent Water Supply for the City of Flint" and a supplementary document, "Analysis of the Flint River as a Permanent Water Supply for the City of Flint Appendices 1 to 8."

If there are any fees for searching or copying these records, please inform me if the cost will exceed \$10. However, I would also like to request a waiver of all fees in that the disclosure of the requested information is in the public interest and will contribute significantly to the public's understanding of the Flint water situation. This information is not being sought for commercial purposes.

The Michigan Freedom of Information Act requires a response to this request within five days. If access to the records I am requesting will take longer than this amount of time, please contact me with information about when I might expect copies or the ability to inspect the requested records. If you deny any or all of this request, please cite each specific exemption you feel justifies the refusal to release the information and notify me of the appeal procedures available to me under the law.

Thank you for considering my request.

Sincerely,

Nancy Kaffer
313-222-6585

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Rennaker, Joanne (DEQ)

From: Busch, Stephen (DEQ)
Sent: Friday, October 16, 2015 8:25 AM
To: Rennaker, Joanne (DEQ)
Subject: FOIA 215-16
Attachments: FW: Flint River as a Source

JoAnne,

The report requested for this FOIA is in the attached email. You may want to include the email as it shows the date Mike received the report (3/27/2013).

Stephen Busch, P.E.
MDEQ Lansing District Coordinator
Office of Drinking Water and Municipal Assistance
Lansing and Jackson District Supervisor
517-643-2314
buschs@michigan.gov

Rennaker, Joanne (DEQ)

From: Prysby, Mike (DEQ)
Sent: Wednesday, March 27, 2013 3:12 PM
To: Busch, Stephen (DEQ)
Subject: FW: Flint River as a Source
Attachments: Flint WTP Report Revised August 29, 2011.pdf

Here's the Flint WTP 2011 report – all 91 pages of it....I am going through it looking for the high points

Michael Prysby, P.E.
District Engineer
Office of Drinking Water and Municipal Assistance
517 335-6122

From: Brent Wright [<mailto:bwright@cityofflint.com>]
Sent: Wednesday, March 27, 2013 3:01 PM
To: Prysby, Mike (DEQ)
Subject: Flint River as a Source

Hope this works...Brent

July 2011

Analysis of the Flint River as a Permanent Water Supply for the City of Flint

Prepared for:

City of Flint

1101 S. Saginaw Street

Flint, MI 48502

(810) 766-7346

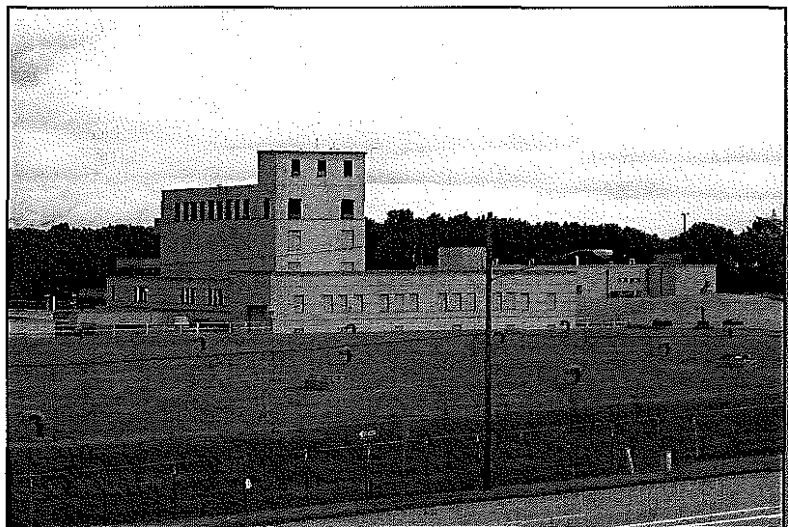
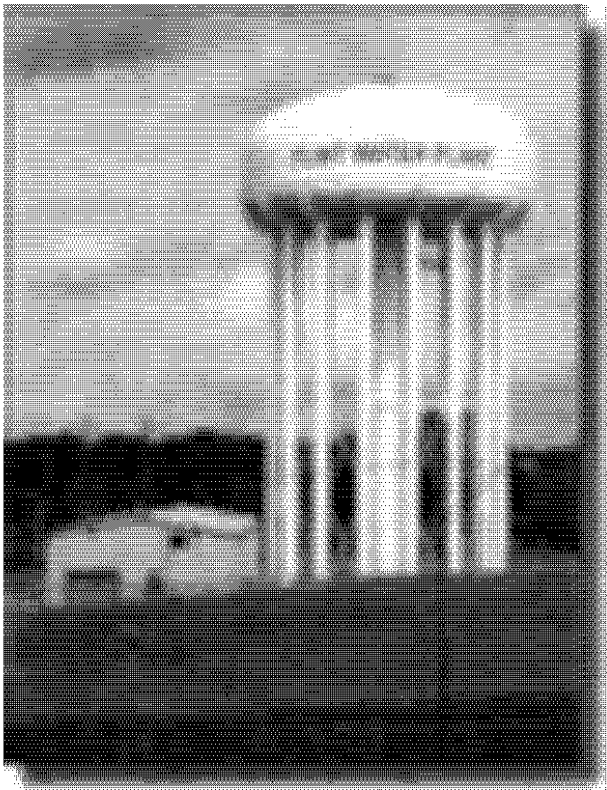


Table of Contents

I.	Purpose.....	1
II.	History.....	1
III.	Regulatory Requirements for Quantity of Source Water.....	1
IV.	Demands	2
V.	Drought Flows	2
VI.	Reservoir Losses	2
A.	Evaporation	3
B.	Sedimentation	3
C.	Seepage	3
VII.	Other Water Uses	3
VIII.	Analysis of Adequacy of Flint River	4
IX.	Dams	5
A.	Holloway Dam	6
B.	Mott Dam	6
C.	Utah Dam	6
D.	Hamilton Dam.....	6
E.	Kearsley Dam.....	7
F.	Thread Lake Dam	7
X.	Source Water Quality.....	7
XI.	Water Treatment	8
A.	Lime Sludge Disposal	8
B.	Soda Ash Feed System.....	8
C.	Chemical Storage	8
D.	Electrical and SCADA	9
E.	Post Chlorination and Zebra Mussel Control.....	9
F.	Security Issues	9
G.	Pumping System Improvements (Low and High Service Pumps in PS No. 4).....	9
H.	Filter Transfer Station to Dort Reservoir and UV Inactivation.....	9
I.	Emergency Interconnect	9
XII.	Cost Summary.....	10
XIII.	Implementation	12
XIV.	Intangibles.....	12
XV.	Summary	12

List of Tables

Table 1: City Customer Demand Summary	2
Table 2: Source Water Requirements	2
Table 3: Storage Requirements	4
Table 4: Summary of Dams	5
Table 5: Project Costs	10

List of Figures

Figure 1: Cost of Water Using Flint River as Source	11
Figure 2: Comparison of Alternatives.....	11

Appendices

1. Holloway Reservoir Management Plan
2. Excerpt of Flint WWTP NPDES permit
3. Analysis of Adequacy of Flint River as a Water Supply
4. Holloway Dam Drawings
5. 2008 Holloway Dam Safety Report
6. 2008 Utah Dam Safety Report
7. 2008 Hamilton Dam Safety Report
8. Cost of Service Study – Flint Water Treatment Plant

I. Purpose

This study evaluates the feasibility of utilizing the City of Flint's Water Treatment Plant (WTP) and Flint River as the primary water supply for the City of Flint. The study evaluates whether the Flint River is an adequate source of water for the City of Flint and identifies upgrades needed to reliably supply water on a continuous basis.

II. History

The City of Flint's WTP was constructed in 1917 and supplied water to city customers for drinking and industrial uses. Records indicate that Flint supplied approximately 16 mgd in 1940 and that by the mid-1950s water use had increased to about 45 mgd. This significant increase coincided with increases in automobile production and population in the area. The Holloway Reservoir was constructed in 1954 to increase water supply capacity to meet the growing demand. Because of continued concerns regarding the adequacy of the Flint River for meeting the future water supply needs of the area, the city evaluated alternatives for a new water supply and ultimately contracted with the City of Detroit in 1967 for water supply. Detroit continues to supply water to Flint and its customers today. Detroit supplies finished water to the city via a single transmission pipeline. For reliability, the city's WTP has been maintained as a backup water supply in the event of a disruption to the single supply pipeline.

Because of recent concerns with the cost and reliability of the existing water supplies, the City of Flint, Genesee County, Lapeer County, the City of Lapeer, and Sanilac County are evaluating alternatives for their long-term water supply. The most recent study (Preliminary Engineering Report, Lake Huron Supply, Karegnondi Water Authority; September 2009) focused on two primary alternatives: Alternative 1 – continued supply by Detroit, and Alternative 2 – development of a new Lake Huron water supply. This study evaluates a third alternative. Alternative 3 provides for utilizing the existing City of Flint WTP to treat water from the Flint River. Alternative 3 assumes that water will be supplied only to customers within the city.

To evaluate the feasibility of Alternative 3, the river and WTP will be examined to determine their ability to supply water in sufficient quantity meeting current and anticipated regulations. There have been many new rules and regulations for treatment of surface water since 1967 when Flint's WTP was last used as a primary water supply.

III. Regulatory Requirements for Quantity of Source Water

Regulations require that the quantity of water at the source shall:

- Be adequate to meet the maximum projected water demand of the service area as shown by calculations based on a one in fifty year drought or the extreme drought of record, and should include consideration of multiple year droughts. Requirements for flows downstream of the intake shall comply with requirements of the appropriate reviewing authority.
- Provide reasonable surplus for anticipated growth.
- Be adequate to compensate for all losses such as silting, evaporation, seepage, etc.
- Be adequate to provide ample water for other legal users of the source.

IV. Demands

The alternative of utilizing the city's WTP and Flint River as a water supply will be evaluated on the basis of supplying water to Flint's direct customers only. Although Flint currently supplies water to GCDC-WWS, for this analysis it is assumed that GCDC-WWS receives its primary water supply by another source. Table 1 summarizes the city's current and projected demands for direct customers of the city. Projections have been provided by city representatives.

Table 1: City Customer Demand Summary

	2010	2035
Average Day Demand (ADD)	14.0 mgd	15.0 mgd
Maximum Day Demand (MDD)	17.5 mgd	18.0 mgd

Actual water requirements will be greater than the amount of water provided to customers. About ten percent additional water must be added for treatment processes and system operation. Water for fire-fighting is not included in customer demands and must be added to the quantity of water needed.

Surface water sources must be adequate to supply water through a drought period. Although the MDD is projected to be 18 mgd, the sustained maximum demand over a longer period will be less than the MDD. Analysis of records of water use indicates that the 30-day sustained maximum demand is about 80% of the MDD. Table 2 summarizes the source water requirements to supply the city's future needs.

Table 2: Source Water Requirements

Future Maximum Day Demand (Customers)	18.0 mgd
Future Maximum Day Demand (WTP Backwash / Process Water)	2.0 mgd
Subtotal (Future Maximum Day Demand)	20.0 mgd
Sustained (30 day) Future Maximum Day Demand	(80% of MDD) 16.0 mgd
Replenish Water from Fire Fighting	0.7 mgd
Future Maximum Day Demand (Source Water)	16.7 mgd

V. Drought Flows

USGS records indicate that the most severe drought in Michigan occurred between 1930 and 1937, and that the low stream flows experienced during this period have a recurrence interval of 50 to 70 years. River flow records which include the drought of the 1930s will be used to evaluate the adequacy of the river as a permanent water source.

VI. Reservoir Losses

Both the Holloway Dam and Mott Dam were constructed since the drought period of the 1930s. If used to simulate the "design drought conditions", the records of flow on the Flint River from the 1930's should be adjusted for potential impact from the addition of these two dams and resulting reservoirs.

A. Evaporation

If the two reservoirs had existed during the drought period, the flows in the river would have been a little less because of the volume of water which would have been lost to evaporation from these two bodies of water.

B. Sedimentation

The July 2001 Flint River Assessment completed by the MDNR indicates that sedimentation occurs in the Holloway Reservoir at an accelerated rate, but does not provide specific volumes. Sedimentation reduces the storage volume of reservoirs. No investigation to determine the amount of sedimentation has been completed in the Holloway Reservoir since its construction, but the storage volume of the reservoir has certainly decreased since its construction.

Mott Dam maintains a fixed water level, so storage for water supply is not available. Therefore, sedimentation in Mott Lake is not a concern with respect to water supply.

C. Seepage

The land adjacent to both the Holloway Reservoir and Mott Lake has a relatively high groundwater table. Any loss of water by seepage from the bottom of the reservoirs seems likely to flow back to the river downstream of the respective dams, resulting in little or no impact to the quantity of water available for water supply or flow augmentation. Loss from the reservoirs by seepage is not considered a significant factor.

VII. Other Water Uses

Since 1967 when Detroit began supplying water to Flint, the Holloway Reservoir has been utilized as a backup water source, source of flow augmentation for the river, and for recreational purposes. Although the city maintains control over the dam and water levels; the city has leased their surrounding lands to the Genesee County Parks and Recreation Commission (GCPRC) for park, recreational, and conservation purposes. In 1987, the city and GCPRC adopted the Holloway Reservoir Management Plan (HRMP) which defined how water levels in the reservoir were to be maintained to achieve the goals above. The HRMP establishes a summer water level of 755 and a winter level of 751. Discharge from the reservoir is to be maintained above 65 cfs except when the level is less than 751; outflow from the reservoir is not to exceed inflow to the reservoir. A copy of the HRMP is included in Appendix 1.

Flow augmentation for the city's WWTP discharge is another consideration. The city's NPDES permit for their WWTP indicates that a Flint River drought flow of 85 cfs was used to determine the permitted limits for WWTP effluent. It appears that the HRMP requirement to maintain a 65 cfs minimum at the Holloway Reservoir was established to provide adequate flow in the river at the city's WWTP outfall. An excerpt of the city's WWTP NPDES permit is included Appendix 2.

The existing water supply contract between the city and Genesee County Drain Commissioner Division of Water and Waste Services (GCDC-WWS) provides that both the city and GCDC-WWS supply the other up to 8 mgd of finished water in the event of an emergency or supply disruption. For this analysis, it is assumed that the Flint WTP and river must be able to supply 8 mgd to GCDC-

WWS in the event of an emergency in addition to the quantity consumed by the city's water customers. The need to provide backup to GCDC-WWS is assumed to be limited to a period of two weeks. Over a 14 day period, 125 million gallons of water should be reserved to meet the commitment for an emergency supply.

VIII. Analysis of Adequacy of Flint River

A detailed analysis of the adequacy of the Flint River as a water supply source is included in Appendix 3. This section provides an overview.

In 1977 when the HRMP was executed, water was not withdrawn from the Flint River for water supply. In 1977 without any withdrawal for water supply, the HRMP provided for a minimum discharge of 65 cfs from the Holloway Reservoir, to provide for a river flow of 85 cfs at the city's WWTP. If water is withdrawn from the river for water supply, the minimum flow from the reservoir must be increased by the rate of WTP withdrawal if the 85 cfs base flow is to be maintained at the city's WWTP. With Flint's future sustained demand estimated to be 16.7 mgd (26 cfs), a minimum flow of 91 cfs (65 cfs + 26 cfs) will be needed from the Holloway Reservoir to maintain the 85 cfs base flow at the WWTP.

The United States Geological Survey (USGS) in a 1963 report Water Resources of the Flint Area Michigan examined the Flint River as a water supply for Flint. Using river flow records between 1930 and 1952, the USGS report includes a Draft-Storage curve for the Holloway Reservoir. If a minimum discharge of 91 cfs is to be maintained during a drought period, 6.2 billion gallons water would need to be withdrawn from the reservoir to supplement natural river flow.

In addition to the 6.2 billion gallons of storage to maintain the existing rates of flow in the river plus water supply, additional storage is required to provide GCDC-WWS an emergency supply and to make up for reservoir losses. The following table summarizes the total storage needed.

Table 3: Storage Requirements

Storage to meet sustained demand and WWTP flow	6.20 billion gallons
Storage to provide backup supply to GCDC-WWS	0.11 billion gallons
Storage to make up loss by evaporation	0.90 billion gallons
Storage lost by siltation	0.64 billion gallons (assumed)
Storage to provide loss by seepage	0.00 billion gallons
Storage Needed to Supplement River Flow	7.85 billion gallons

To provide 7.85 billion gallons of storage, the Holloway Reservoir operating level must be raised by at least three feet to 758 feet. Although possible, there are many challenges associated with operating the Holloway Reservoir at the 758 feet level.

- The existing drum gates used to control reservoir level are designed for adjustment over a four feet range (751 feet to 755 feet). The design of the dam is such that the existing gates cannot simply be replaced with larger ones to increase the upper level to 758 feet. The dam spillway will likely need to be reworked to accommodate the larger drum gates. Drawings showing the details of the dam are included in Appendix 4.

- Although operation at the 758 water level provides five feet of freeboard to the top of the dam, the watershed contributing to the reservoir is quite large and has resulted in quick increases in the reservoir level during extreme rain events. The reduction in freeboard will result in a reduced safety factor for managing flood events.
- Seepage through the earthen dam embankment will increase as a result of the increased hydraulic pressure with the higher water level. Increased seepage through the dam's embankment will reduce the strength and integrity of the embankment and is likely to increase maintenance needs.
- The 758 feet water level is based on an assumption regarding the loss of the reservoir volume by siltation. The depth of siltation should be measured to better determine the quantity of siltation and its impact on storage and reservoir level.
- Recreational activities, the fishery, and adjacent properties will be impacted by use of the reservoir for water supply. Normal water levels will be increased by three feet and during dry periods, the water levels may vary by several feet. During an extreme drought period, water levels may be as much as 11 feet below normal levels.
- If the 85 cfs drought flow at the city's WWTP cannot be achieved, a new NPDES permit with stricter discharge limits may issued by the MDEQ. This could result in higher WWTP costs for the city.

Analysis shows that without modification, the Holloway Reservoir can support a sustained maximum day demand of 11.6 mgd for water supply through a drought period.

IX. Dams

If the Flint River is to be used as water supply, existing dams will continue to be critical for management of the flows in the river and water supply. Following is a summary of the dams on and adjacent to the river.

Table 4: Summary of Dams

Facility	Construction Completed	Catchment Area (sq. mi.)	Surface Area (Acres)	Storage (Acre-Feet)	Ownership	Hazard Classification	Condition
Holloway Dam	1954	523	1,973	17,678	Flint	High	Good
Mott Dam	1972	612	684	0	GCPRC		Good
Kearsley Dam	1929	115	175	2,000	Flint	Significant	Satisfactory
Utah Dam	1928	729		0	Flint	Low	Poor
Hamilton Dam		748	17		Flint	High	Poor
Thread Creek Dam	1973	63	80	320	Flint	Significant	Poor

A. Holloway Dam

The Holloway Dam was last inspected in 2008 and was reported to be in good condition. A copy of the 2008 Dam Safety Report is included in Appendix 5. Other than routine maintenance, the following upgrades / modifications are recommended to provide a water supply of up to 11.6 mgd:

- Replacement of drum gate bearings
- Installation of river flow gage on North Branch of Flint River
- Improved instrumentation to measure and monitor gate positions and water surface level

If the river is to be used as a water supply of greater capacity than 11.6 mgd, additional modifications are required at the Holloway Dam to allow for operation at an increased water level. These improvements will include replacement of gates with larger ones and reworking of the dam spillway to accommodate the larger gates. The existing embankment should be armored to strengthen the dam's embankment and protect against erosion from wave action. A budget of \$2.57 million is established for the upgrades to the Holloway Dam to provide adequate capacity for the projected future demands.

B. Mott Dam

The Mott Dam is under the jurisdiction of the GCPRC. The reservoir level is maintained by a fixed weir so the reservoir volume is not available for storage. The dam has been reported to be in good condition.

C. Utah Dam

Utah Dam is inoperable and in poor condition. A copy of the 2008 Dam Safety Report is included in Appendix 6. Recent studies and evaluations conclude that the dam is of little benefit and should be removed. The 2010 Hamilton Dam Modifications and Riverfront Restoration PER provides a budget of \$1.9 M for removal of the Utah Dam, including replacement with a pedestrian bridge, construction of a boat launch, and local storm sewer upgrades.

D. Hamilton Dam

The Hamilton Dam is in poor condition and considered unstable. A copy of the 2008 Dam Safety Report is provided in Appendix 7. The dam has been the subject of extensive study and recommended for removal and replacement. The 2010 Hamilton Dam Modifications and Riverfront Restoration PER provides a budget of \$7.1 M for the removal and replacement of the dam, including ancillary upgrades to adjacent portions of the river.

The new Hamilton Dam is proposed at a lower elevation than the existing dam to reduce potential for flooding. A reduced water level upstream of the dam will reduce the water pool depth at the WTP intake, unless the Utah Dam is replaced or another dam is added. Testing of pumps at the WTP was completed to determine the impact of a reduced water depth at the WTP intake. Allowing for two feet of loss through the WTP intake screens after operation, reduction of the height of the Hamilton Dam by 1.5 feet or more will impact WTP's ability to draw water from the river.

E. Kearsley Dam

The Kearsley Dam is reported in satisfactory condition. Although the dam is located downstream of the city's WTP, water from the dam and Kearsley Lake supplements the river flow in advance of the Hamilton Dam, therefore contributing to the impoundment from which the WTP draws water. Water from the Kearsley Creek also serves to augment river flow at the city's WWTP located further downstream.

The storage volume of Kearsley Lake is relatively minor in relation to the storage deficit from Section VIII. Supplemental flows to the river from the Kearsley Creek are included in the USGS records included in this analysis

The dam is an important component of the city's water supply system because of its potential contribution to the WTP intake. Although currently in satisfactory condition, there will be ongoing maintenance needs to be addressed.

F. Thread Lake Dam

The Thread Lake Dam is reported to be in poor condition. Flow from the Thread Creek supplements the river flow prior to the city's WWTP. The storage provided by Thread Lake is negligible and flow from Thread Creek is included in the USGS records of river flow used for this analysis.

The Thread Lake Dam remains a facility of the city which because of its poor condition needs to be addressed. However, since the dam appears to be of little benefit to the water supply considered in this analysis, a budget for upgrades or removal has not been included in the costs for water supply.

X. Source Water Quality

Since the Flint WTP is the backup water supply in the event of a disruption to the supply from Detroit, raw water at the WTP intake is regularly sampled and analyzed. Available records provide a good understanding of the characteristics of the raw water and ranges of variances, and will be helpful to design water treatment processes and estimate operating costs.

Preliminary analysis indicates that water from the river can be treated to meet current regulations; however, additional treatment will be required than for Lake Huron water. This results in higher operating costs than the alternative of a new Lake Huron supply.

Although water from the river can be treated to meet regulatory requirements, aesthetics of the finished water will be different than that from Lake Huron. As an example, the temperature of water supplied to customers during the summer will be warmer than the present Lake Huron supply, because of the increased summer temperature in the relatively shallow river.

A detailed investigation of potential sources of contamination has not been completed. The MDEQ has reported that the Richfield Landfill is considering an application for an NPDES permit to allow

for discharge of stormwater and/or treated leachate to the Holloway Reservoir. If an NPDES permit is issued, there may be an impact on the quality of source water.

If used for water supply, a source water protection management plan should be developed to study the watershed, identify potential sources of contamination, and enact safeguards to prevent or control future threats.

XI. Water Treatment

For comparison with other alternatives, it is assumed that the Flint WTP will treat water from the river to provide a finished water of similar quality to the other alternatives being considered (continued Detroit supply and new Lake Huron supply).

A review of the city's WTP has been completed (Technical Memorandum, Cost of Service Study, Flint Water Treatment Plant prepared by Lockwood, Andrews, and Newnam (LAN), dated June 2011) to evaluate its ability to treat water from the river on a continuous basis to meet current and anticipated regulations and produce high quality finished water. Details regarding this review and analysis are provided in Appendix 8.

Although the WTP has been maintained and operated as a backup water supply, there have been numerous changes in regulations and standards since the WTP last supplied water on a continuous basis. Although equipment and systems at the WTP have been used sparingly, some existing equipment and systems require replacement from deterioration or obsolescence to provide reliability for continuous operation.

Following is a summary of upgrades needed.

A. Lime Sludge Disposal

Prior to supply of water by DWSD, the city's WTP disposed of lime sludge from water treatment operations at the Bray Road disposal site. The city is working with the MDEQ to address concerns at the Bray Road site; for this study it has been assumed that new sludge handling and disposal provisions will be utilized. Lime residual handling and disposal facilities have an estimated project cost of \$15.1 million. No costs have been included for remediation of the Bray Road site.

B. Soda Ash Feed System

Records of analyses of the source water indicate non-carbonate hardness. To remove the non-carbonate hardness and provide softening, soda ash should be added during treatment. The addition of a soda ash feed system has an estimated project budget of \$0.5 million.

C. Chemical Storage

Bulk chemical storage of at least 30 days is needed if the plant operates on a continuous basis. New storage tanks for liquid carbon dioxide, liquid oxygen, and liquid nitrogen will be needed. The project budget for chemical storage is \$2.1 million.

D. Electrical and SCADA

The power requirements of equipment at the WTP exceed the capacity of the substation which supplies the plant. Backup power generators at the WTP are not currently operable. Upgrades are recommended to power feeders for several of the existing systems. New SCADA is recommended to provide control and monitoring of operations at the WTP. The project budget for these upgrades is \$8.1 million.

E. Post Chlorination and Zebra Mussel Control

Zebra mussels are an invasive shell fish which have been introduced to the Great Lakes basin, including the Flint River. Zebra mussels can obstruct pipes and water intake screens. A sodium permanganate feed system is proposed for zebra mussel control. The project budget is \$0.3 million.

F. Security Issues

Additional security measures to guard against malevolent threats or terrorism which target the new water source will be required. A project budget for this is \$0.3 million.

G. Pumping System Improvements (Low and High Service Pumps in PS No. 4)

The pumps are in poor condition and their capacity is not consistent with the projected demands of the city. The pumps should be replaced with new, more efficient pumps. The project budget for these is \$7.8 million.

H. Filter Transfer Station to Dort Reservoir and UV Inactivation

Recent USEPA regulations require additional treatment or enhancement of existing treatment processes for microbial contaminants such as giardia, cryptosporidium, viruses, and bacteria. It is anticipated that enhanced contact time and ultraviolet light deactivation will be required to comply with these new standards. A project budget of \$7.0 million is established for compliance with the new surface water treatment rules.

I. Emergency Interconnect

The GCDC-WWS and City of Flint have a mutual aid agreement providing for each to provide the other up to 8 mgd of water as a back-up supply in the event of an emergency with either system's supply. A pumping station and piping interconnect is needed to effectively complete this exchange. The project budget for these upgrades is \$8.6 million.

The total of all WTP upgrades above is \$49.9 million.

In addition to upgrades to the treatment plant, there will be increased operating costs associated with the continuous operation of the WTP. For comparison with other alternatives for a long-term water supply, only the additional operational costs have been determined.

- Labor – Full scale operation of the WTP and dams on a continuous basis will require additional staffing. It is estimated that labor costs will increase by \$2,034,000 per year.
- Chemicals – The cost of chemicals used for water treatment are estimated at \$423 per million gallons of water produced.
- Residual Disposal – Disposal costs for lime sludge is estimated to be \$453,000 annually.

- Power – Increased power costs are estimated to be \$104 per million gallons of water produced.
- Ozone – Ozone treatment will be needed to meet new treatment standards. A budget of \$208,000 is assumed.
- Maintenance – Maintenance costs are assumed to be 20% of the O&M budget. Maintenance costs of the WTP and other facilities are expected to be relatively high because of the age of the facilities.

XII. Cost Summary

Upgrades to dams and the WTP will be needed for the Flint River to reliably supply drinking water on a continuous basis to Flint's customers. The cost of these upgrades is presented in the following table. Costs have been adjusted to an ENR Construction Cost Index of 8688 to allow for comparison with the 2009 Study. It has been assumed that design/construction commenced in 2010, to allow for comparison with the alternatives in the 2009 study.

Table 5: Project Costs

WTP Upgrades	\$49,888,000
Hamilton Dam Replacement	\$7,100,000
Holloway Dam /Reservoir Upgrades	\$2,570,000
Utah Dam Removal	\$1,900,000
Total Capital Cost	\$61,458,000

Costs shown are based on upgrades to existing facilities to supply the projected future maximum day demand of 18.0 mgd. These upgrades are based on the assumption that the HRMP is modified to allow for operation over a greater range of water levels. Other options for supplying the projected maximum day demand will result in higher costs.

Operating costs in the initial year of operation are estimated to increase \$7 million above current operating costs. Operating costs are projected to increase annually because of inflation and projected growth in demand over the study period.

Figure 1 shows the cost of water for Alternative 3, utilizing the existing WTP and Flint River for water supply. The cost of water is comprised of three components: continued purchase of water from Detroit during construction, debt for construction of facility upgrades, and ongoing operating costs.

Figure 1: Cost of Water Using Flint River as Source

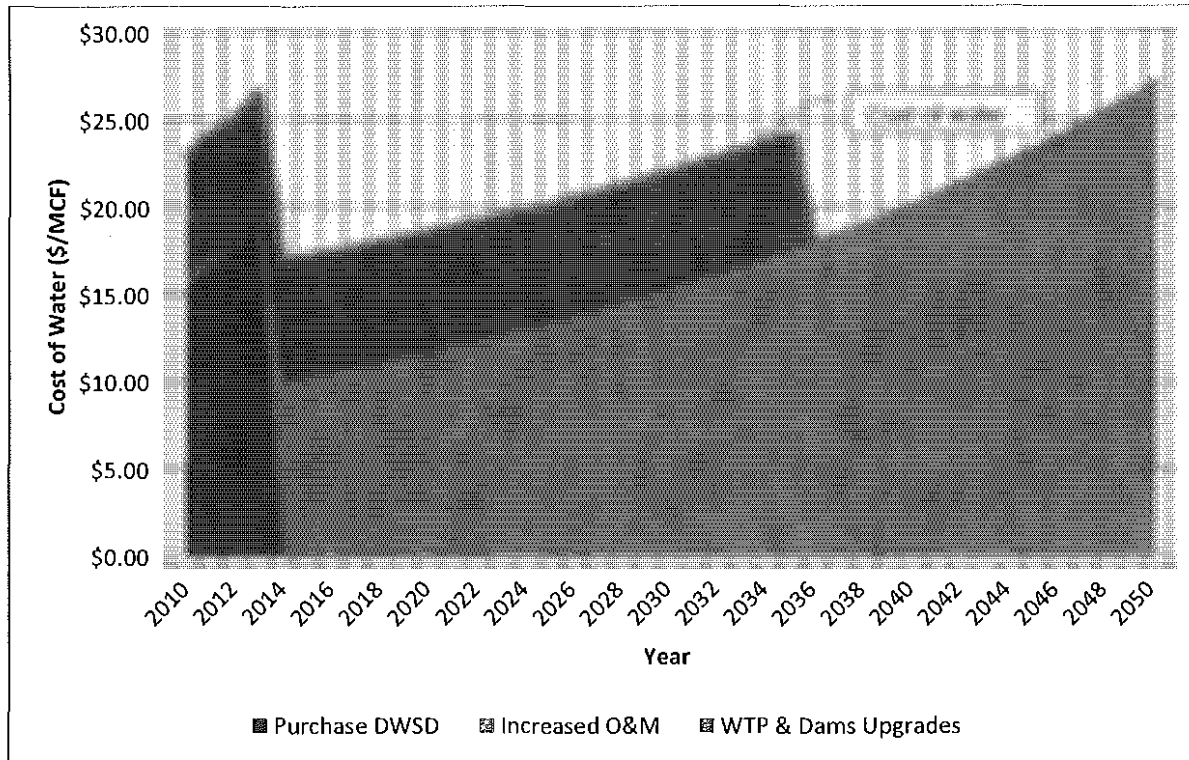
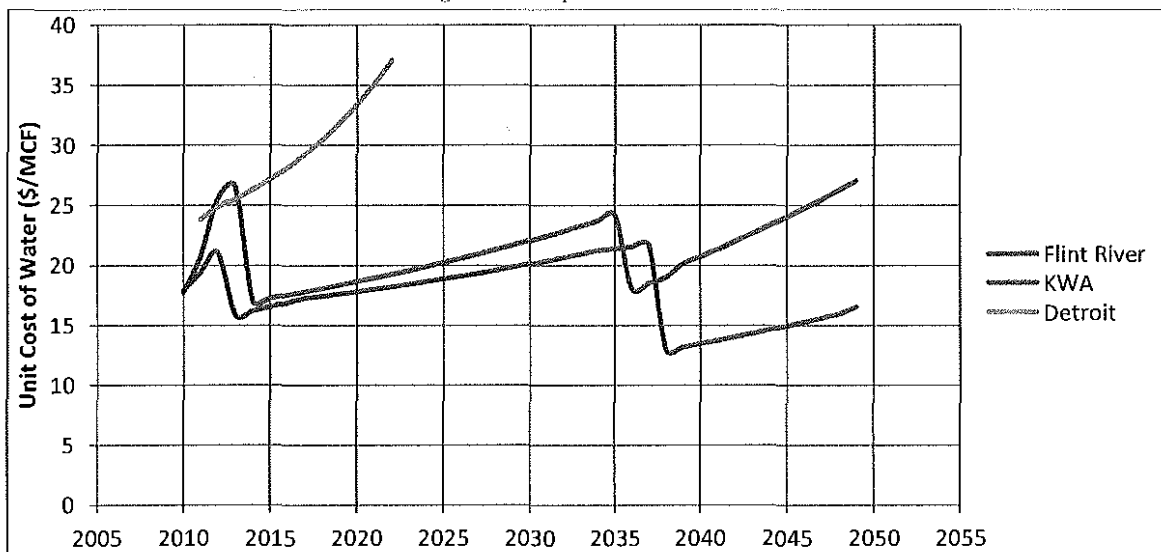


Figure 2 compares the cost of water for all three alternatives. Continued Supply by the City of Detroit results in a higher cost for water supply than the other two alternatives. The city's costs for The KWA-New Lake Huron Supply have been based upon the terms of the current KWA Raw Water Supply Contract, and the assumption that the city purchases 18 mgd capacity in the KWA system. The KWA alternative is projected to result in the lowest cost for water.

Figure 2: Comparison of Alternatives



XIII. Implementation

Planning, design, construction, and start-up will require 52 to 60 months for completion. Additional time may be required to address ancillary issues such as modifications to agreements, permits, and “non-construction related” environmental issues.

XIV. Intangibles

In addition to the upgrades identified for the dams and WTP, other issues will potentially need to be addressed if the Flint River is to be used as a water supply. Examples of these include:

- Environmental impact of work on dams or removal of sediment from the river or reservoirs
- Impact of construction and reservoir operation on the fishery
- Impact to recreational users and land owners adjacent to the Holloway Reservoir
- Potential upgrades to the city’s WWTP if river flows are reduced and stricter effluent limits are included in future NPDES permits
- Impacts of the replacement of the Hamilton Dam at a lower level for improved flood control may impact the ability for the WTP to draw water from the river
- Results of a Source Water Protection Plan which may identify potential threats of contamination or other impacts to the water supply

XV. Summary

Analysis indicates that the cost of supplying water from the Flint River on a continuous basis will be greater than the proposed KWA Raw Water Supply Contract, but less than continued supplied from Detroit. Additionally, if the Flint River is to be used for a water supply for city customers, there will need to be some modifications to existing facilities, operating agreements, and permits. Upgrades will be required at the city’s dams and the water treatment plant to reliably supply water to the city on a continuous basis. To meet the future maximum day demand of 18 mgd projected by city staff, one or more of the following will be required.

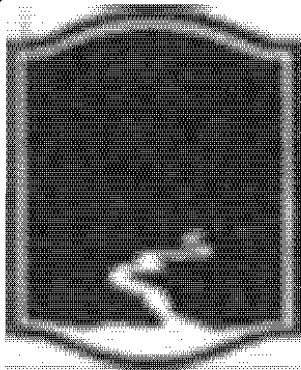
- Modify the Holloway Dam and Reservoir to provide additional storage
- Modify the HRMP to provide for more variance in water levels and/or modify limits on minimum discharge
- Modify the WWTP NPDES permit based on reduced flows in the river and provide resulting upgrades to WWTP for higher treatment
- Provide other raw water storage reservoirs

Addressing the preceding items is likely to require a great deal of time and effort because of the impacts on many other parties. Without making the modifications above, the river is limited to supplying a maximum day demand of about 11.6 mgd.

Appendices

1. Holloway Reservoir Management Plan
2. Excerpt of Flint WWTP NPDES permit
3. Analysis of Adequacy of Flint River as a Water Supply
4. Holloway Dam Drawings
5. 2008 Holloway Dam Safety Report
6. 2008 Utah Dam Safety Report
7. 2008 Hamilton Dam Safety Report
8. Cost of Service Study – Flint Water Treatment Plant

Appendix 1 - Holloway Reservoir Management Plan



March 13, 1987

TO: Members of the Ad Hoc Committee to Work With
City of Flint Officials on Management of the
Holloway Reservoir

FROM: Kenneth J. Smithee, Director
Genesee County Parks & Recreation Commission

CITIZEN REPRESENTATIVES: SUBJECT: Action of the Parks & Recreation Commission

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PRESIDENT

ARCHIE HALFORD, JR.
VICE PRESIDENT

CHARLES E. OLIVER, JR.
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ANTHONY RAGNONE
GENESEE COUNTY
DRAIN COMMISSIONER

KENNETH J. SMITHEE
DIRECTOR

Please be advised that the recommendations as outlined on Attachment A were approved by the Genesee County Parks & Recreation Commission meeting in formal session on March 12, 1987.

On behalf of the Commission, I would like to extend our personal thanks to each of you for the assistance which you rendered which led to the agreement between the Parks & Recreation Commission and the City of Flint and will provide protection for recreational users of the Holloway Reservoir, adjacent property owners and also help protect the fish and other aquatic life.

Thanks again.

Sincerely,

Kenneth J. Smithee
Director

KJS:jp
Attachment

R-22
AGENDA ITEM: (5). i.

PRESENTED: 3/9/87

ADOPTED: 3/9/87

By the Mayor:

WHEREAS, the City of Flint in adopting ordinance 2208 granted to the Genesee County Parks and Recreation Commission the right to establish and operate park and recreational facilities and conservations programs on property owned by the City of Flint in the Holloway Reservoir area; reserving unto itself the power to control and regulate the dams and water levels of the Holloway Reservoir, and

WHEREAS, it is in the interests of the City and the Genesee County Parks and Recreation Commission to establish a Management Plan which optimizes the summer recreational programs available to the public while preserving downstream usages of the Flint River, and which will assist the City in implementing the provisions of ordinance 2208.

NOW, THEREFORE, BE IT RESOLVED, that the City of Flint adopts the attached Holloway Reservoir Management Plan.

APPROVED AS TO FORM:

[Signature]

Chief Legal Officer

R990

COUNCIL MARCH 9, 1987

HOLLOWAY RESERVOIR MANAGEMENT PLAN

GENERAL OBJECTIVE:

To operate Holloway Dam in a manner that optimizes summer recreation on the Holloway Reservoir while preserving downstream usages of the waters of the Flint River and assuring availability of a back-up water supply for Flint.

GENERAL OPERATING PROCEDURE:

Spring Fill - The City of Flint shall operate the dam with the intention of capturing a sufficient quantity of spring run-off to maintain the reservoir at a minimum elevation of 755 feet no later than May 1 of each year.

Summer Operation - The City of Flint shall maintain a minimum outflow of 65 cfs until the level of the reservoir falls to an elevation of 752.7 feet.

At any time that the level reaches elevation 752.7 feet the city shall operate the dam such that the outflow does not exceed inflow, on any given day, provided, however, that the city shall not be obligated to make more than one adjustment to flow during any given day.

Winter Drawdown - The City of Flint shall operate the dam to gradually drawdown the reservoir during the first two weeks of November to an elevation of 751 feet in order to prevent structural damage to the dam from freezing.

Notification - The City of Flint shall provide prior notification to the Genesee County Parks and Recreation Commission before making a change in dam operations which result in significant drawdown.

Maintenance and Construction - Routine maintenance shall be scheduled to avoid conflicts with major events and peak usage periods on the reservoir. A minimum of 30 days notification shall precede all maintenance and construction involving significant drawdown. The Genesee County Parks and Recreation Commission shall promptly receive copies of all dam maintenance permit applications made by the City of Flint to the Michigan Department of Natural Resources.

Gauging of Water Flow into Reservoir - The City of Flint shall be a cooperator with the U.S.G.S. and State of Michigan to establish a stream gauge on the north branch of the Flint River upstream of the Holloway Reservoir and be a cooperator on the annual maintenance and operation of the existing gauge on the south branch of the Flint River and the new gauge on the north branch of the Flint River.

EMERGENCIES:

In emergency situations affecting public health, safety and welfare the City of Flint shall operate the Holloway dam in a manner to protect the public health, safety and welfare. This shall be done even though recreational users and others may be temporarily inconvenienced. Situations which shall be identified as emergencies shall include but not be limited to the following: flood conditions, interruption of the City of Flint's public water supply, and event(s) which threatens the structural integrity of the dam, and acts of God. However, low flow augmentation for sewage treatment shall not be considered as an emergency.

MONITORING:

The City of Flint in cooperation with the Genesee County Parks and Recreation Commission will assure conformance with the Holloway Reservoir Management Guidelines. A standing oversight committee shall be created to provide monitoring of the reservoir management and facilitate exchange of timely information regarding the Holloway dam and reservoir. The committee shall be composed of two members from both the City of Flint and the Genesee County Parks and Recreation Commission and shall meet in April and November of each year. The Genesee County Parks and Recreation Commission shall provide the City of Flint with a schedule for summer events on Holloway Reservoir at the April meeting of the Oversight Committee.

PERIOD AND EXECUTION OF AGREEMENT:

The Holloway Reservoir Management Plan shall be in full force and effect when officially adopted by the Flint City Council and the Genesee County Parks and Recreation Commission and shall remain so until altered by mutual agreement.

MANAGEMENT PLAN STATUS:

This management plan establishes targets for optimal operation of the Holloway Dam and Reservoir but does not replace the terms and conditions of Flint City Ordinance No. 2208.

p:DAM(a)

Appendix 2 - Excerpt of Flint WWTP NPDES permit

PART I

Section A. Limitations and Monitoring Requirements

1. Final Effluent Limitations, Monitoring Point 001A

During the period beginning on the effective date of this permit and lasting until the expiration date of this permit, the permittee is authorized to discharge treated municipal wastewater from Monitoring Point 001A through Outfall 001.

Outfall 001 discharges to the Flint River. Such discharge shall be limited and monitored by the permittee as specified below.

Parameter	Maximum Limits for Quantity or Loading				Maximum Limits for Quality or Concentration				Frequency of Analysis	Sample Type
	Monthly	7-Day	Daily	Units	Monthly	7-Day	Daily	Units		
Flow	(report)	---	(report)	MGD	---	---	---	---	Daily	Report Total Daily Flow
Carbonaceous Biochemical Oxygen Demand (CBOD ₅)										
4/1-4/30	6,672	10,000	---	lbs/day	16	---	24	mg/l	Daily	24-Hr Composite
5/1-10/31	2,920	3,750	---	lbs/day	7	---	9	mg/l	Daily	24-Hr Composite
11/1-11/30	4,590	6,672	---	lbs/day	11	---	16	mg/l	Daily	24-Hr Composite
12/1-3/31	5,420	8,340	---	lbs/day	13	---	20	mg/l	Daily	24-Hr Composite
Total Suspended Solids										
5/1-10/31	8,340	12,500	---	lbs/day	20	30	---	mg/l	Daily	24-Hr Composite
11/1-4/30	12,500	18,800	---	lbs/day	30	45	---	mg/l	Daily	24-Hr Composite
Ammonia Nitrogen (as N)										
4/1-4/30	2,920	4,170	---	lbs/day	7.0	---	10.0	mg/l	Daily	24-Hr Composite
5/1-10/31	667	1,460	---	lbs/day	1.6	---	3.5	mg/l	Daily	24-Hr Composite
11/1-11/30	2,080	2,920	---	lbs/day	5.0	---	7.0	mg/l	Daily	24-Hr Composite
12/1-3/31	2,500	3,128	---	lbs/day	6.0	---	7.5	mg/l	Daily	24-Hr Composite
Total Phosphorus (as P)	417	---	---	lbs/day	1.0	---	---	mg/l	Daily	24-Hr Composite
Fecal Coliform Bacteria	---	---	---	---	200	400	---	cts/100 ml	Daily	Grab
Total Residual Chlorine	---	---	---	---	---	---	0.038	mg/l	Daily	Grab
Total Mercury										
Through 12/31/2008	---	---	---	lbs/day	(report)	---	---	ng/l	Quarterly	Grab
Beginning 1/1/2009	0.0042	---	---	lbs/day	10	---	---	ng/l	Quarterly	Grab
Acute Toxicity										
Through 12/31/2008	---	---	---	---	---	---	(report)	TU _A	Quarterly	24-Hr Composite
Beginning 1/1/2009	---	---	---	---	---	---	1.0	TU _A	Quarterly	24-Hr Composite
Chronic Toxicity										
Through 12/31/2008	---	---	---	---	(report)	---	---	TU _C	Quarterly	24-Hr Composite
Beginning 1/1/2009	---	---	---	---	1.5	---	---	TU _C	Quarterly	24-Hr Composite
pH										
	---	---	---	---	Minimum Daily	---	Maximum Daily	S.U.	Daily	Grab

The following design flow was used in determining the above limitations, but is not to be considered a limitation or actual capacity: A rated design capacity of 50 MGD and the 1988 Water Resources Commission directive to use a 95 percent exceedance (Flint River drought) flow of 85 cfs (Holloway Reservoir Management Plan) for limit calculations.

Appendix 3 - Analysis of Adequacy of Flint River as a Water Supply

Technical Memorandum
Analysis of Adequacy of Flint River as Water Supply

1.0 Quantity of Water Required

Recommended Standards for Water Works, 2003 Edition indicates that the quantity of surface water at the source shall:

- Be adequate to meet the maximum projected water demand of the service area as shown by calculations based on a one in fifty year drought or the extreme drought of record, and should include consideration of multiple year droughts. Requirements for flows downstream of the intake shall comply with requirements of the appropriate reviewing authority.
- Provide reasonable surplus for anticipated growth
- Be adequate to compensate for all losses such as silting, evaporation, seepage, etc.
- Be adequate to provide ample water for other legal users of the source.

2.0 Demand Summary

City staff has indicated the future maximum day demand of the city is 18 mgd.

In addition to the water used by customers, some water will be required for water treatment processes and filter backwash. An allowance for WTP Backwash and Process water of 2 mgd is assumed.

Water used for fire-fighting is not included in customer demand or sales. An allowance 0.7mgd for replenishing water used for fire-fighting is assumed.

The maximum day demand represents the quantity of water which must be supplied on the particular day that the highest use (demand) occurs. Treatment and pumping must be designed to deliver the maximum day demand. During peak periods, storage from the Holloway Reservoir can be utilized to supplement the natural river flow. For analysis of the river as a source, the maximum month will be used as the demand.

A review of the city's water demands and precipitation records suggest that maximum month demand is about 80% of the maximum day demand.

The maximum sustained demand to be withdrawn from the river is computed in the following table:



Table 1: City of Flint Design Demand Summary

Future Maximum Day Demand (Customers)		18.0 mgd
Future Maximum Day Demand (WTP Backwash / Process Water)		2.0 mgd
Subtotal (Future Maximum Day Demand)		20.0 mgd
Sustained (30 day) Future Maximum Day Demand	(80% of MDD)	16.0 mgd
Replenish Water from Fire Fighting		0.7 mgd
Future Maximum Day Demand (Source Water)		16.7 mgd

3.0 Additional Demands and Requirements

In addition to the demands from Section 2, the following demands must be accounted for:

3.1 Mutual Aid

The City and GCDC-WWS have a mutual aid agreement to supply each other water in the event of a disruption in supply or other emergency. The agreement provides that the city will supply GCDC-WWS up to 8 mgd.

For this analysis, it is assumed that an emergency will be corrected within 14 days. The volume of water that may be required is therefore: 14 days * 8,000,000 gal/day = 112,000,000 gal. This volume will be reserved from the reservoir volume.

3.2 Evaporation

Both the Holloway and Mott dams have been constructed since the drought period of the 1930's, which is being used as the base river flow for analysis. Evaporation from the Holloway Reservoir and Mott Lake will reduce the amount of available from the river. The NWS publishes an atlas which shows evaporation rates. Evaporation is primarily a factor during the "growing season"; the atlas shows that about 24" of water is lost via evaporation from open water surfaces in Genesee County over the May through October period. Loss by evaporation will be offset by the addition of rainfall directly upon the water surface. Since the analysis is based upon drought conditions, the low rainfall having a recurrence rate of 100 years will be used. During the May through October period, 11.5 inches of rain is estimated during the 1 in 100 dry year. The net loss by evaporation is therefore 12.5 inches.

The following table summarizes the loss by evaporation, over the six month period from May through October.



Table 2: Reservoir Evaporation Loss

Reservoir	Surface Area (Acres)	Evaporation (inches)	Precipitation (inches)	Net Loss by Evaporation (Gallons)
Holloway Reservoir	1,973	24	11.5	669,646,065
Mott Lake	684	24	11.5	232,153,020
Total				901,799,085

3.3 Siltation

The July 2001 Flint River Assessment completed by the MDNR indicates that sedimentation occurs in the Holloway Reservoir at an accelerated rate, but does not provide quantities. Measurements of the silt accumulation in the reservoir have not been completed. Accumulations of several feet have occurred in other reservoirs. Sedimentation of an average of 1 foot across the Holloway Reservoir will result in the loss of 643,000,000 gallons of storage, or about ten percent of the total volume available.

Mott Lake is not used as a water storage reservoir. Its level is controlled by a fixed weir. Although siltation likely occurs in Mott Lake too, it has no impact on storage for water supply.

3.4 Seepage

Seepage is not believed to have a significant impact on the availability of water at the WTP. Seepage through the embankments of either the Holloway or Mott dams or through the bottom of the reservoirs seems likely to migrate back to the Flint River, although perhaps downstream of the reservoirs, prior to the WTP.

3.5 Flint WWTP

The City's WWTP discharges treated wastewater to the Flint River. The NPDES permit issued to the WWTP has established limits for the treated effluent, based on a drought flow in the river of at least 85 cfs.

3.6 Holloway Reservoir Management Plan

In 1977 the City and Genesee County executed the Holloway Reservoir Management Plan (HRMP) which established parameters for the operation of the dam and reservoir. In 1977, water was no longer withdrawn from the river for water supply and the HRMP appears to have been developed to address four primary issues:

- Availability to utilize the reservoir for water supply as a backup or alternative supply
- Provide for physical maintenance of the dam
- Provide for the recreational use of the reservoir
- Provide flow augmentation to Flint WWTP

The HRMP establishes a summer operating level of 755 and a winter level 751. The summer level maximizes the volume of water available during the dry period in the event that the river is to be used as a water supply. The higher level also supports recreational activities on the reservoir. The 751 winter level provides protection against damage from freezing during the winter. The HRMP establishes a minimum discharge of 65 cfs from the dam, presumably to provide a minimum flow of 85 cfs in the river at the WWTP.

4.0 Analysis

It is assumed that the demands and other requirements identified above are to be maintained in the event that water is withdrawn from the Flint River for water supply. In 1963, USGS published Water Resources Flint Area Michigan, which includes an analysis of the river as a water supply. This publication includes design information regarding the Holloway Reservoir and its operation for water supply.

In 1977 when the HRMP was executed, water was not withdrawn from the river for water supply. If the HRMP required a minimum discharge of 65 cfs at the Holloway Dam to provide for adequate flow in the river at the WWTP, the minimum discharge from the Holloway Dam should be increased by the amount of water withdrawn for water supply if the current river flow at the WWTP is to be maintained.

$$65 \text{ cfs} + 16.7 \text{ mgd (25.8 cfs)} = 90.8 \text{ cfs (58.7 mgd)}$$

Figure 1 shows the sustained discharge which can be maintained from the Holloway Reservoir during a drought period. This graph is based on USGS records of flow in the river between 1930 and 1952. This period includes the drought period of 1930 to 1937, which is USGS considers the most severe drought in Michigan history, having a recurrence period of 1 every 50 to 70 years. This period was prior to the construction of Holloway Dam, so river records reflect the natural flow of the river without impact by dam operations.

Figure 1: Draft-Storage Curve, Flint River near Otisville (excerpt from USGS Water Resources Flint Area Michigan)

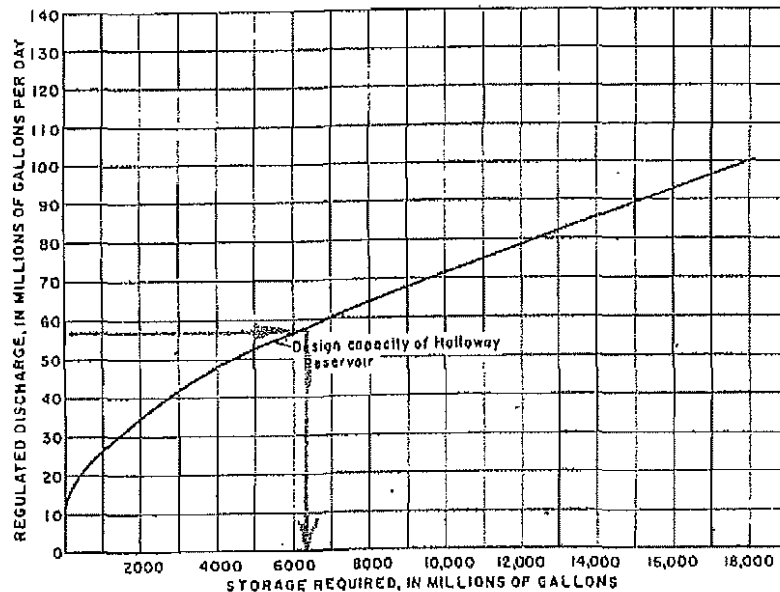


Figure 1 indicates that about 6.2 billion gallons of storage is needed to maintain a sustained discharge of 58.6 mgd from the reservoir to provide the minimum river flow of 85 cfs at the WWTP.

In addition to the 6.2 billion gallons of storage, additional storage is required to provide GCDC-WWS an emergency supply and to make up for reservoir loss by evaporation.

Table 3: Storage Requirements to Maintain Current Conditions plus Water Supply

Storage to meet sustained demand and WWTP flow:	6.20 billion gallons
Storage to provide backup supply to GCDC-WWS:	0.11 billion gallons
Storage to make up loss by evaporation:	0.90 billion gallons
Storage lost by siltation:	0.64 billion gallons (assumed)
Storage to provide loss by seepage:	0.00 billion gallons (assumed)
Storage Needed to Supplement River Flow:	7.85 billion gallons

For this analysis, it is assumed that storage is available from the Holloway Reservoir to supplement the natural river flow.

- The Holloway Reservoir was designed to provide storage for water supply in the 1950's
- The Mott Dam is a fixed weir, so storage is not available. The dam is owned by the Genesee county Parks Department and provides recreational benefit.
- The Hamilton Dam impoundment is limited to the river channel; storage volume is negligible.
- The Utah Dam is inoperable.



- The Kearsley Dam is not directly located on the Flint River, but on the Kearsley Creek just prior to its confluence with the Flint River. The Kearsley Creek discharges to the Flint River downstream of the City's WTP so storage from the river is not available for water supply; however, discharge from the Kearsley dam can be used to supplement downstream river flows, including the flow in the river at the WWTP. The Kearsley Reservoir can provide a maximum of 650 million gallons of storage.
- The Thread Lake Dam is not located on the Flint River, but the Thread Creek discharges into the Swartz Creek which discharges into the Flint River just west of the downtown area. The Thread Lake dam provides a maximum storage volume of 100 million gallons of storage. Discharge from the Thread Lake dam could be used to supplement downstream river flows, but not for water supply.
- For this analysis, storage from neither the Kearsley Reservoir nor Thread Lake is included. Both dams were constructed prior the Holloway Reservoir and discharges from the Kearsley Dam and Thread Lake Dam are assumed to be included in the analysis presented in the USGS publication.

Following is a capacity curve for the Holloway Reservoir, from the USGS Water Resources Flint Area.

Figure 2: Holloway Reservoir Storage Capacity (excerpt from USGS Water Resources Flint Area Michigan)

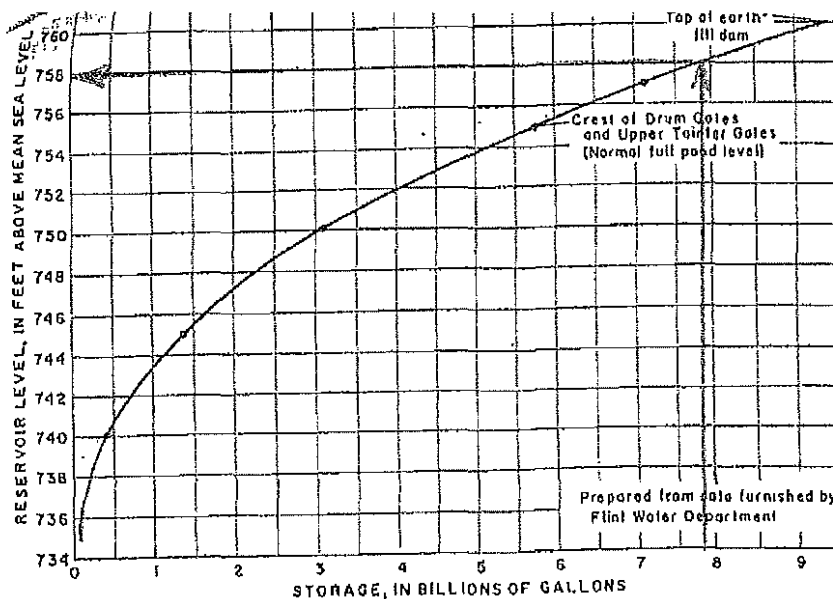


Figure 2 indicates that a Holloway Reservoir level of 758.0 feet provides storage of 7.85 billion gallons.

Review of design drawings of the Holloway Dam indicates that the dam was designed to use drum gates to maintain the normal water level(s) of the reservoir. The drum gates can rotate to allow for reservoir levels ranging from a low level of 751 feet to a high level of 755 feet. If the reservoir is to be maintained



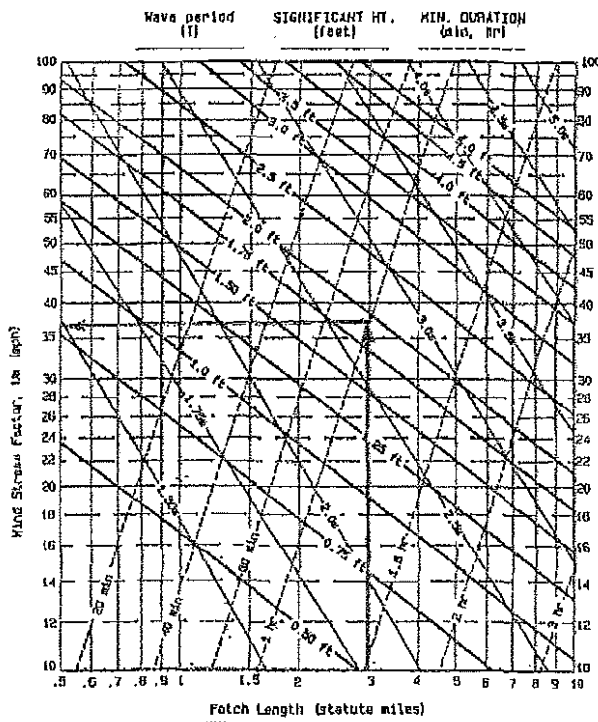
at a higher level than the current summer level of 755 feet, modifications will be required to the drum gates.

According to the original dam design drawings, the dam embankment was constructed to elevation 763 feet (however, the USGS reports shows the top elevation as 760 feet). If the reservoir level is raised to 758 feet, only about five feet of freeboard will be provided to guard against overtopping. There are three concerns regarding increasing the reservoir level from 755 to 758 feet.

The increased hydraulic pressure resulting from the higher water level on one side of the dam will result in increased seepage through the embankment, and a reduction in its integrity.

The reservoir has a fetch of about three miles east from the dam. Figure 3 shows that a 37 mph wind sustained for one hour duration from the east can result in waves capable of two feet. The original design drawings show rip-rap armoring on the reservoir side of the dam embankment to an elevation of 757 feet. Rip-rap armoring should be extended to at least two feet higher than the 758 feet level to protect against wave action.

Figure 3: Predicted Wave Action – Holloway Reservoir



The reservoir is tributary to a large watershed. There have been rapid increases in river flow (and reservoir level) soon after intense rain events in the watershed. A rain storm in June 1996 resulted in a 1.62 foot increase in the water level of the reservoir resulting in the opening of dam gates and discharge of 7,740 cfs. Reducing the freeboard also reduces the volume available for flood management.

5.0 Quantity of Water Supply Available

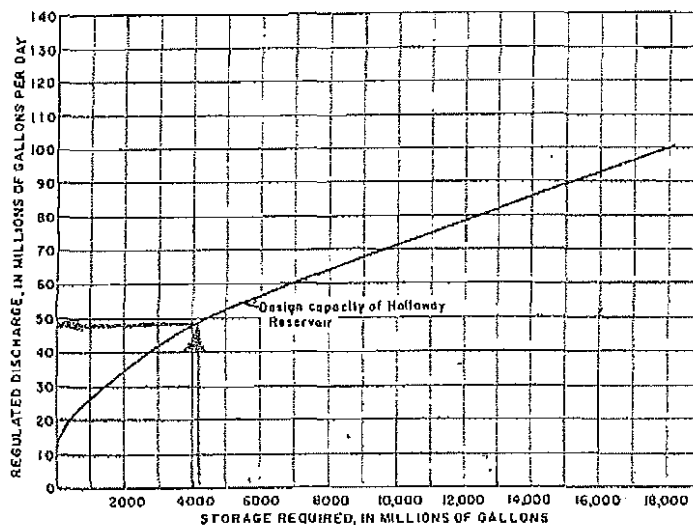
Analysis has shown that without modifications to facilities and/or permits and agreements, the river cannot supply the future maximum demand of the city.

Table 4: Storage Available for Water Supply

Original Storage Volume of Holloway Reservoir (elevation 755')	5.76 billion gallons
Storage lost by Sedimentation (assumed)	0.64 billion gallons
Storage to make up for Evaporation	0.9 billion gallons
Storage to provide backup supply for GCDC-WWS	0.11 billion gallons
Storage available to supplement river flow	4.11 billion gallons

The following figure shows that 4.11 billion gallons of storage can sustain a supplemental flow of 48 mgd.

Figure 4 – Sustained Discharge Available from Holloway Reservoir



A minimum discharge of 48 cfs from the Holloway Reservoir can support a sustained water withdrawal of about 11 mgd and maintain 85 cfs at the WWTP, as shown in the following table.



Table 5 – Maximum Sustained WTP Withdrawal Available

	1978 - Holloway Reservoir Management Plan	Future
Minimum Reservoir Discharge	65 cfs	48 cfs
River Inflow	20 cfs	20 cfs
WTP Withdrawal	0 cfs	17 cfs (10.99 Mgd)
River Flow at WWTP	85 cfs	85 cfs

A sustained water withdrawal of 11 mgd will support a maximum day demand of 11.6 mgd, as shown in the following table.

Table 6 – Available WTP Maximum Day Demand

Sustained Withdrawal Available		11.0 mgd
Water to replenish fire fighting		0.7 mgd
Sustained (30 day) Future Maximum Day Demand Available		10.3 mgd
Future Maximum Day Demand Available	(Multiply by 125%)	12.9 mgd
Water available for WTP Backwash/Process		1.3 mgd
Water available for customer Max Day Demand		11.6 mgd



Appendix 4 - Holloway Dam Drawings

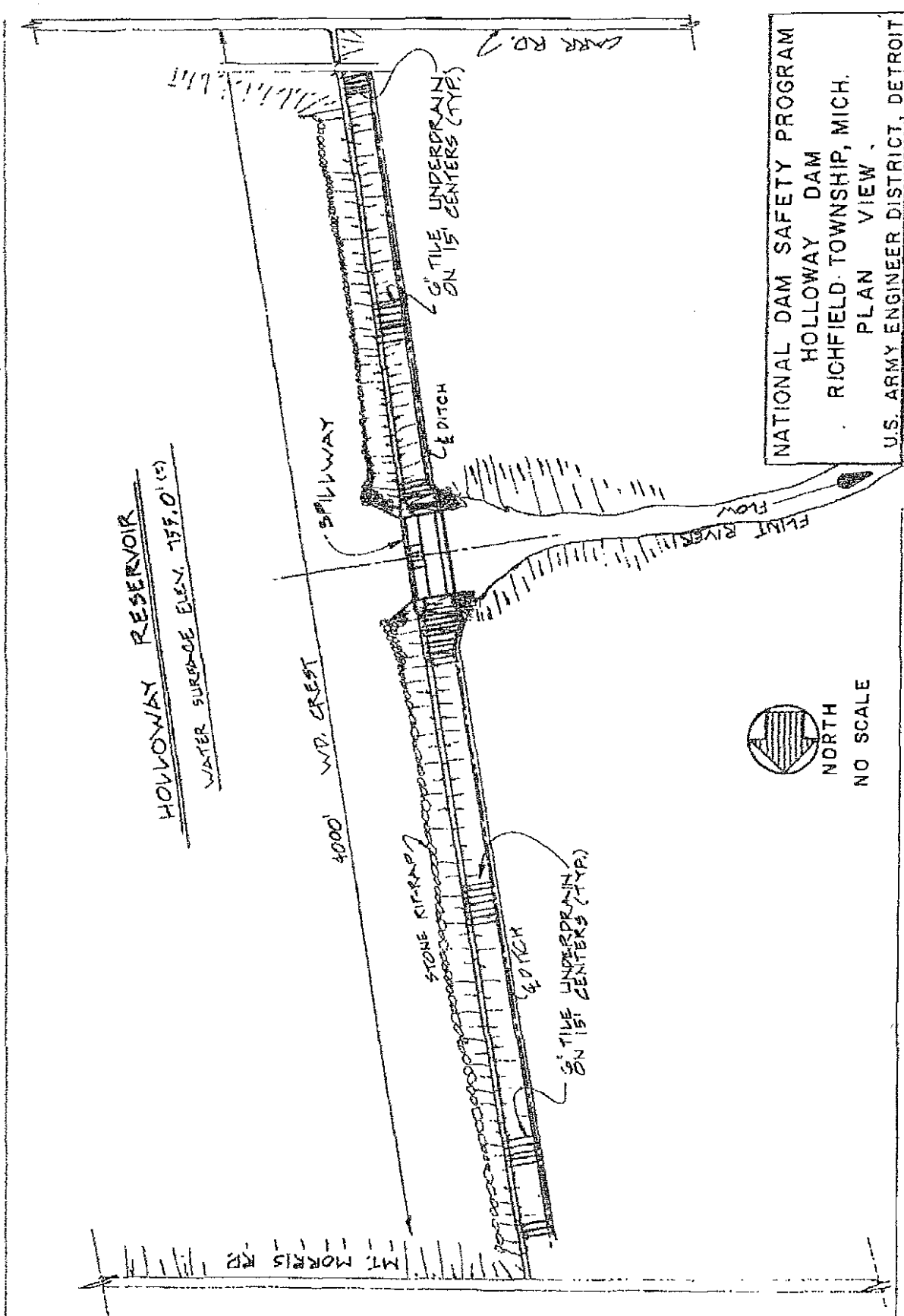


FIGURE No. 5

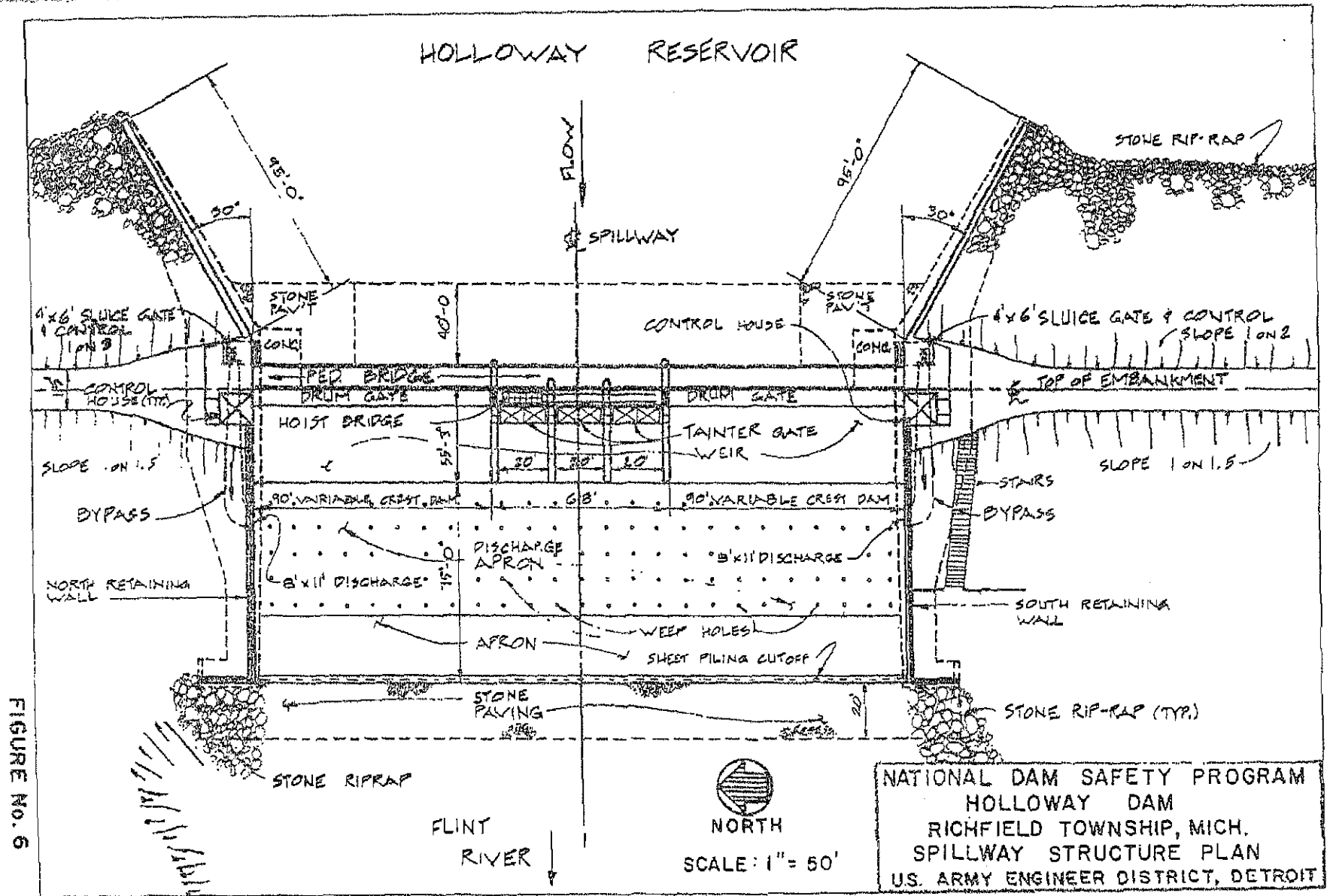
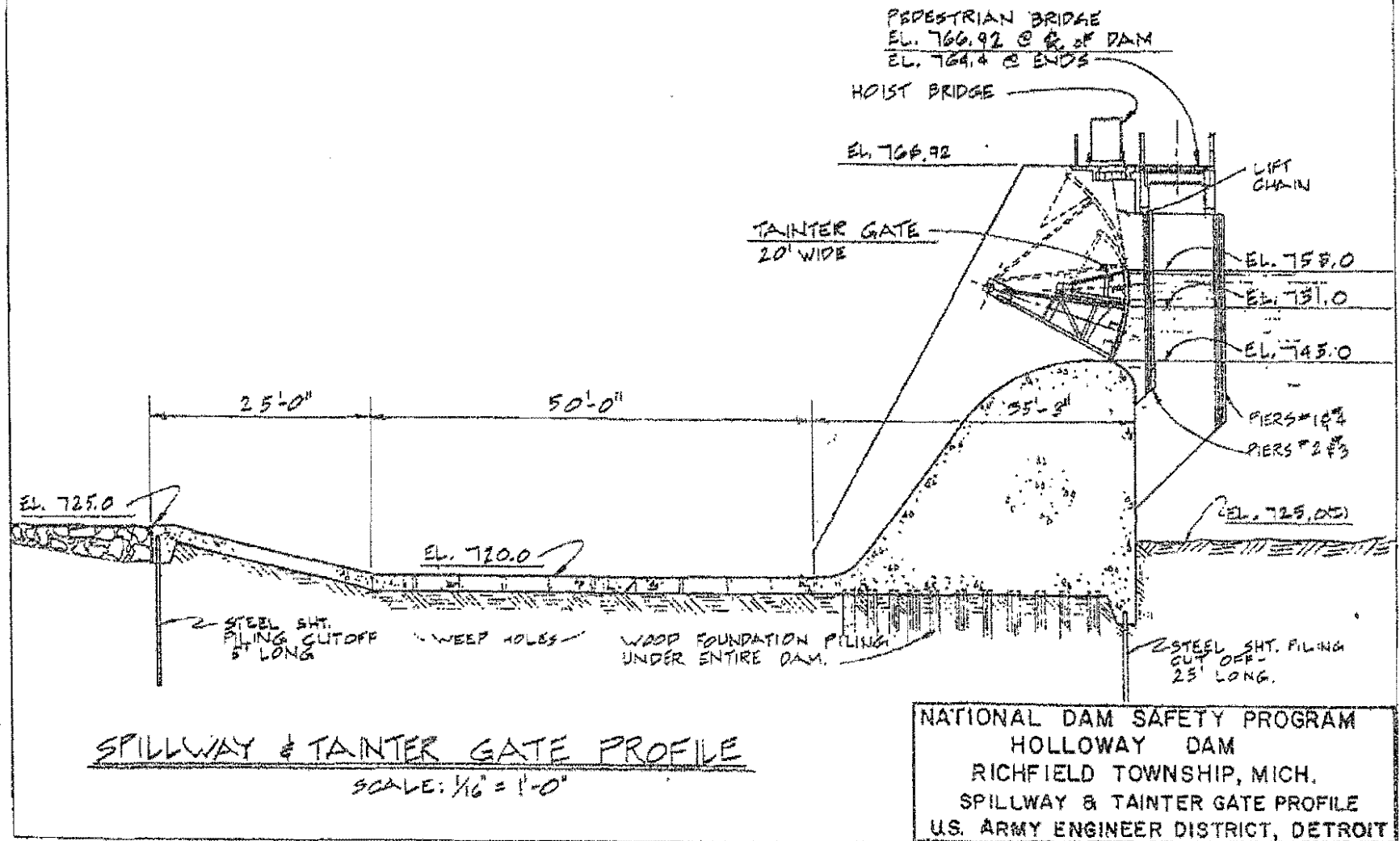
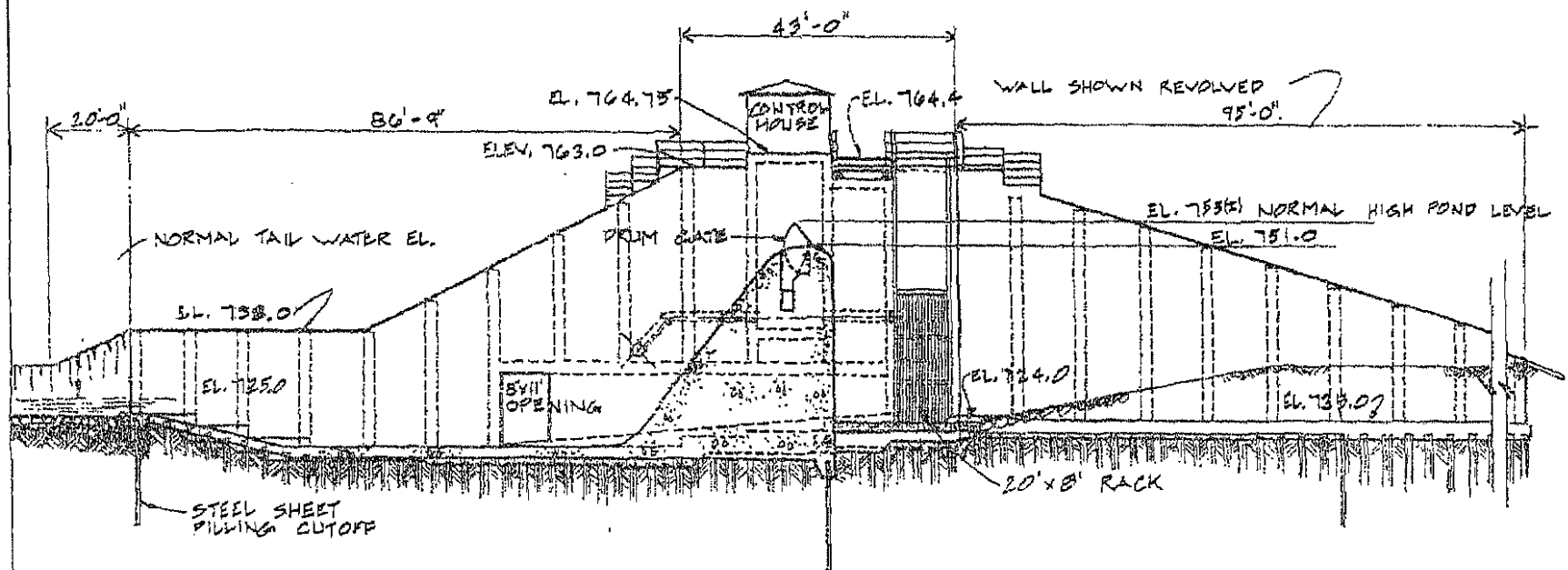


FIGURE NO. 7



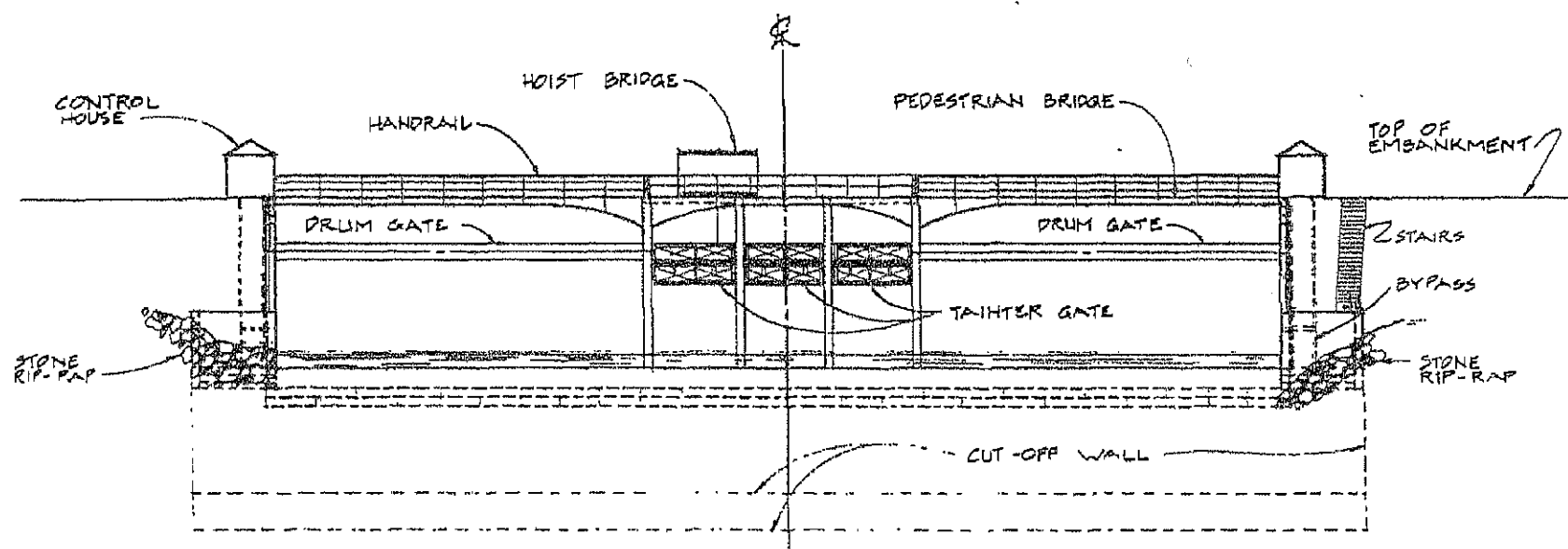


SPILLWAY AND DRUM GATE PROFILE

NO SCALE

NATIONAL DAM SAFETY PROGRAM
 HOLLOWAY DAM
 RICHFIELD TOWNSHIP, MICH.
 SPILLWAY & DRUM GATE PROFILE
 U.S. ARMY ENGINEER DISTRICT, DETROIT

FIGURE NO. 8

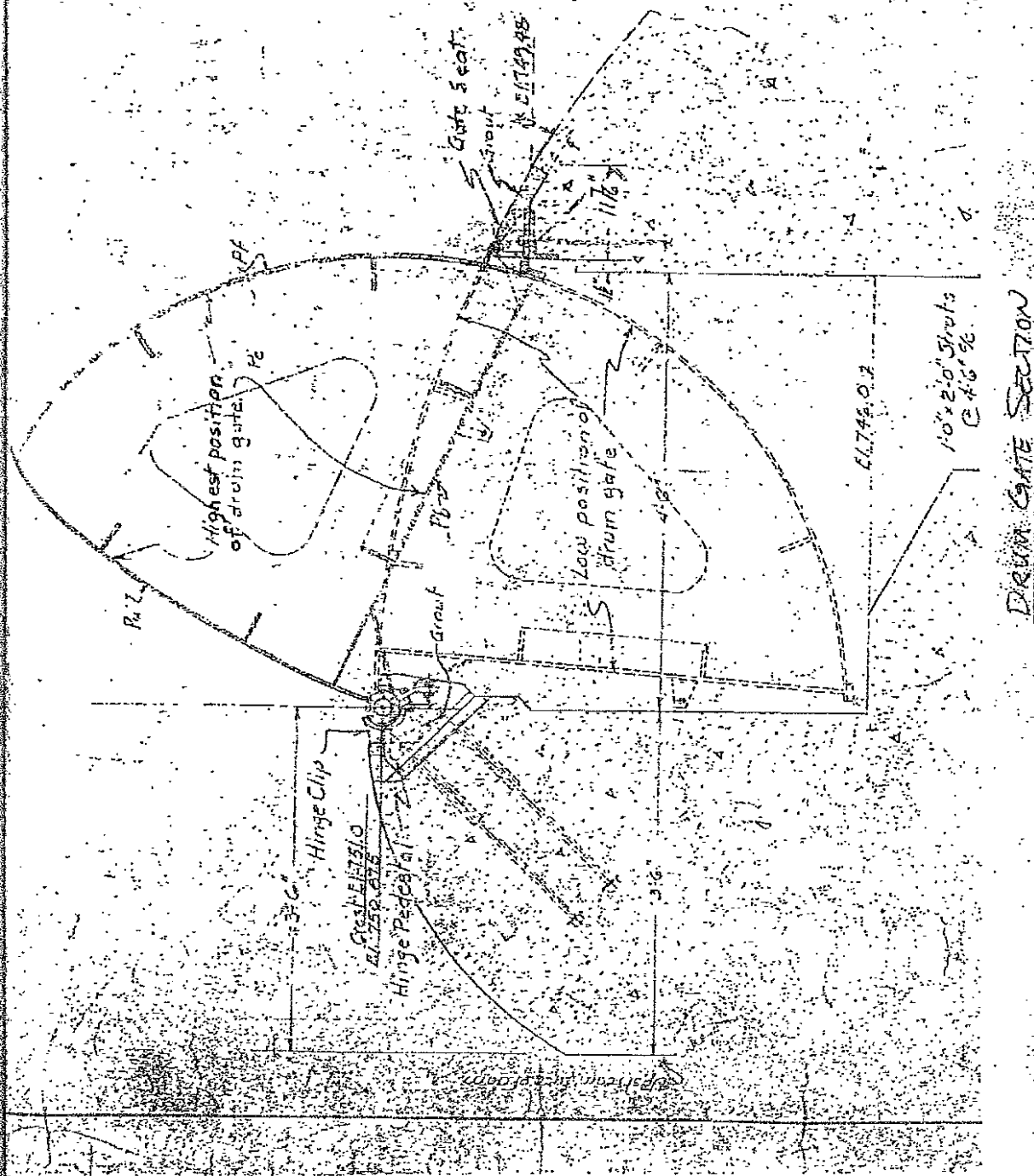


SPILLWAY ELEVATION VIEW

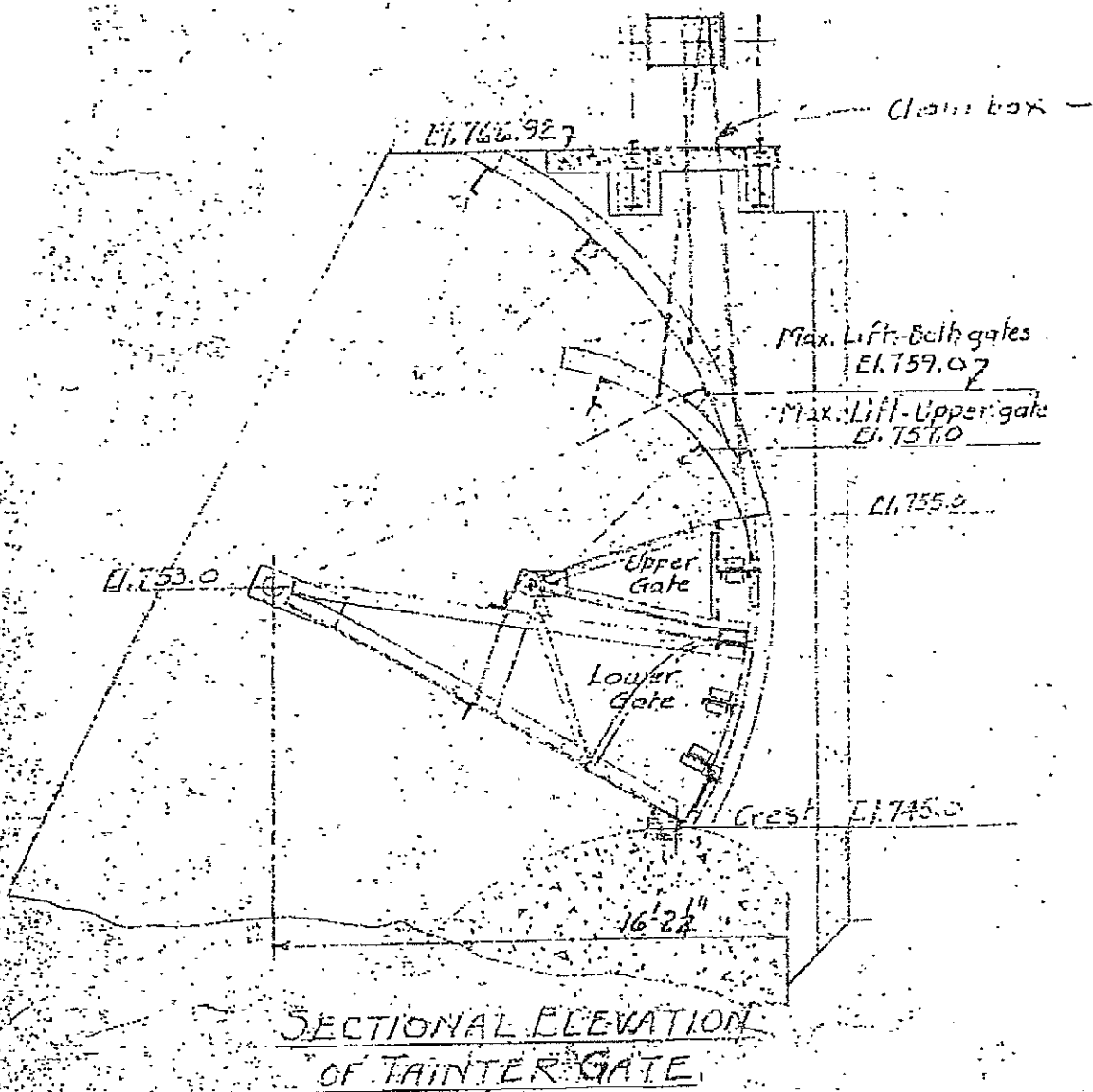
SCALE: 1" = 40'

FIGURE No. 10

NATIONAL DAM SAFETY PROGRAM
 HOLLOWAY DAM
 RICHFIELD TOWNSHIP, MICH.
 SPILLWAY ELEVATION VIEW
 U.S. ARMY ENGINEER DISTRICT, DETROIT



DRUM GATE SECTION



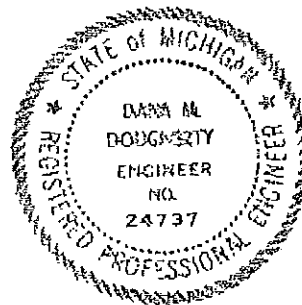
Appendix 5 - 2008 Holloway Dam Safety Report

MICHIGAN PUBLIC ACT 451, PART 315
INSPECTION REPORT
HOLLOWAY DAM
GENESEE COUNTY, MICHIGAN
INVENTORY NUMBER 064 - HIGH HAZARD

FOR

CITY OF FLINT
WATER TREATMENT PLANT
4500 N. DORT HIGHWAY
FLINT, MICHIGAN 48505
ATTN: MR BRENT WRIGHT
(810) 787-6537

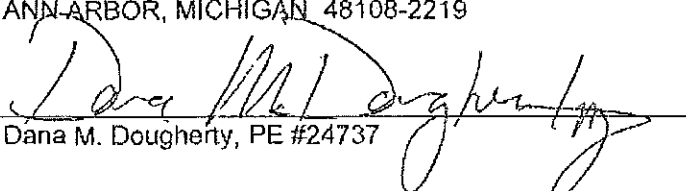
BY
Stantec Consulting Michigan Inc.
Engineers - Planners - Surveyors
3959 Research Park Drive
Ann Arbor, Michigan 48108-2219
(734) 761-1010



INSPECTOR(S): Dana M. Dougherty - Stantec Consulting Michigan Inc.

DATE OF INSPECTION: October 19, 2008

PROFESSIONAL ENGINEER: Dana M. Dougherty, PE
STANTEC CONSULTING MICHIGAN INC.
3959 RESEARCH PARK DRIVE
ANN ARBOR, MICHIGAN 48108-2219


Dana M. Dougherty, PE #24737

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

Table of Contents

1.0 PURPOSE AND AUTHORITY	1.1
2.0 CONCLUSIONS AND RECOMMENDATIONS	2.1
3.0 PROJECT INFORMATION	3.1
3.1 PERTINENT DATA	3.1
4.0 FIELD INSPECTION	4.1
4.1 SPILLWAY	4.1
4.2 RIGHT EMBANKMENT	4.1
4.3 LEFT EMBANKMENT	4.2
5.0 STRUCTURAL STABILITY	5.1
6.0 HYDROLOGY AND HYDRAULICS	6.1
7.0 OPERATION AND MAINTENANCE	7.1

LIST OF APPENDICES

APPENDIX A – BACKGROUND INFORMATION

1. Location Map
2. Project Information (1978 USACE Report)
3. Project Drawings

APPENDIX B – HYDROLOGY/HYDRAULICS

1. MDEQ Flood Discharge Data
2. Hydraulic Calculations

APPENDIX C – PHOTOGRAPHS

APPENDIX D – EMERGENCY ACTION PLAN NOTIFICATION LIST

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

1.0 Purpose and Authority

The purpose of the report is to present a summary of findings for the field inspection of the Holloway Dam completed by Stantec Consulting Michigan Inc. (Stantec) on October 19, 2008 pursuant to the requirements of Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, Section 31518.

This dam inspection Report and associated inspection activities were commissioned by the City of Flint, Michigan, the dam owner. The Holloway Dam is registered with the Michigan Department of Environmental Quality (MDEQ) as Dam Number 064.

References in the report to "left" and "right" are based on the observer facing downstream.

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

2.0 Conclusions and Recommendations

The Holloway Dam was inspected on October 19, 2008 in accordance with Michigan P.A. 451, Part 315 criteria. The dam, including spillway and embankments was found to be in good condition. A summary of comments/recommendations is as follows:

1. The City of Flint should continue their operation and maintenance procedures as outlined in the "Holloway Reservoir Operation and Maintenance Plan".
2. The Emergency Action Plan should be exercised annually and Notification List concurrently updated.
3. Small brush should be removed from the left and right embankments.
4. Minor spalls and cracks in the spillway concrete should be monitored. These do not require immediate correction, but should be planned and budgeted in the City's long term Capital Improvement Plan (CIP).
5. The seepage monitoring weirs should be placed back into operation by repairing the eroded channel. Periodic observations of seepage rates and observed fines deposition should be performed and logged for long term data comparison.
6. Warning signs on the concrete abutments should be re-painted.
7. The security fence in the downstream right embankment should be repaired.
8. Monitor the sloughed area in the downstream right embankment and repair as needed.
9. Further inspections should be performed in accordance with P.A. 451, Part 315 regulations.

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

3.0 Project Information

The Holloway Dam is located on the Flint River in Richfield Township, Genesee County, Michigan (Section 11, T8N, R5E). The dam and lower one fourth of the reservoir are in Genesee County while the upper three fourths of the reservoir are in Lapeer County. The dam was built in 1954 to maintain a base flow in the Flint River for water supply and sewage dilution requirements. The Holloway Dam was previously referred to as the Richfield Storage Dam. Presently the reservoir's uses are primarily, base water flow implementation, sewage dilution and recreation. The dam consists of earth embankments and a 248 ft long gated concrete spillway structure. The total length of the dam is approximately 3,350 ft between the natural moraine banks. The top of the embankment serves as a gravel road for maintenance purposes. A steel framed walkway spans the top of the spillway structure for operation and maintenance of the gates. The embankment side slopes are 3 horizontal to 1 vertical on the upstream face and 2 horizontal to 1 vertical on the downstream face.

3.1 PERTINENT DATA

The embankment is comprised of two zones: an upstream section and key trench of compacted impervious clay; and a larger downstream section of essentially granular material, predominantly sand with some gravel.

The plans show a sheet pile cutoff wall along the full length of the dam near the upstream toe, extending 23 ft below the base of the embankment and two feet into the embankment. A subdrain system, originating just downstream of the centerline of the crest and transverse to the dam axis, is also shown. The plans indicate that this subdrain system is formed by tile drain pipes with a center-to-center drain spacing of 15 ft. Plan details indicate a graded filter surrounding the tile drain pipes. The pipes empty into a collection ditch at the toe of the downstream slope. The right embankment has been modified by installation of fill at the toe with a bench located mid point on the slope. Weep drains were extended with 6" PVC pipe.

The outlet works of the dam consist of a reinforced concrete spillway controlled by seven gates. There is a control house on each end of the spillway. A telemark water level recording gage is in the left control house.

The following is a tabulation of principal data obtained from the construction drawings.

Hazard Classification – High (per 1978 USACE report).

Length of Dam – Overall length of the dam including the concrete spillway structure and the right and left embankments is approximately 3,350 ft.

Stantec
HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN
Project Information
December 2008

Height of Dam – The total height of the dam, defined in P.A. 451, Part 315 as the difference in elevation between the natural stream bed and the design flood elevation, is approximately 30 ft. the crest of the dam is at El. 763.0 ft.

Crest Width of Embankments – Approximately 15 ft.

Side Slopes – The earth embankments have 3.0 H to 1.0 V slopes on the upstream face and 2.0 H to 1.0 V slopes on the downstream face. The right embankment downstream slope has been modified with fill at the toe and a bench at midpoint.

Spillway: 248 ft long concrete spillway structure with:

- a) two 90 ft long drum gates
- b) three 20 ft long taintor gates
- c) two 4 ft by 6 ft sluice gates perpendicular to the dam axis
- d) 75 ft by 248 ft wide discharge apron

Cutoff: 25 ft deep steel sheet pile cutoff wall at the upstream toe of the full length of the dam, and 15 ft deep steel sheet pile cutoff wall along the downstream side of the spillway structure.

Embankments: Upstream section and key trench of compacted impervious clay and a larger downstream section of granular material, predominantly sand with some gravel.

Further details of the spillway structure and embankments are shown in **Appendix A**. These figures have been taken from the 1978 Phase I Inspection Report.

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

4.0 Field Inspection

An inspection of the facilities was performed by Dana M. Dougherty, PE (Stantec) on October 19, 2008. The weather on the date of inspection was clear with temperature at approximately 55°F. The impoundment elevation was near normal (summer) i.e. 755. Flow was passing over the drum gates as well as through the left (looking downstream) sluiceway.

The following items were noted: (Referenced photographs can be found in Appendix C.)

4.1 SPILLWAY

Overall the spillway appeared to be in excellent condition. Recent preventative maintenance work includes painting of miscellaneous metals including handrails, gates, and support beams, installation of new galvanized steel grating on the gate operator platform and patching concrete at the upper downstream end of the taintor gate piers.

Some minor items were noted with regard to concrete condition including:

1. There was spalled concrete on the top of the upstream right wingwall. The face of the wall exhibited cracking and efflorescence at this location (Ref. Photos #3 and #4).
2. There was a small crack in the right abutment immediately above the drum gate. There is no evidence of movement or displacement at this crack (Ref. Photo #6). This should be monitored.
3. Minor alligator cracking was noted in the taintor gate piers (Ref. Photos #7 and #8). These do not pose any immediate concern but should be monitored.
4. There were cracks in the left abutment and left downstream retaining walls. No displacement was noted. These cracks should be monitored for future movement (Ref. Photos #9 and #10).
5. The upper portion of the downstream end of the left downstream retaining wall has alligator cracking and efflorescence. This should be monitored (Ref. Photo #12).
6. The warning signs that are painted on the upstream abutment/wingwall faces are faded and difficult to read. These should be repainted.

4.2 RIGHT EMBANKMENT

Overall the condition of the right embankment appears to be good with no significant erosion, seepage, settlement, sloughing or animal burrows noted. The following specific items were noted:

Stantec
HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN
Field Inspection
December 2008

1. There was a minor amount of erosion beneath the riprap on the upstream embankment face immediately adjacent to the spillway.
2. Some brush has begun to grow on the upstream slope. This should be selectively removed (Ref Photos #14 and #16). Small natural growth such as wildflowers and grasses should remain.
3. Considerable brush was observed on the downstream embankment face and within the toe-of-slope drain. This should be removed (Ref. Photos #17 and #20).
4. For the most part weep tiles are dry. There is one section midway in the embankment where the weep tiles are active. Some sloughing of the slope was observed in this area. It appeared that this has been addressed through addition of a blanket drain with geotextile fabric. This should be monitored for further displacement.
5. A short section of the security fence was in disrepair. This should be corrected (Ref. Photo #23).
6. The seepage monitoring weir is not functioning. Flow was passing around the weir through an eroded section. This should be corrected (Ref. Photo #24).

4.3 LEFT EMBANKMENT

The observed condition of the left embankment was good to excellent. There was no evidence of significant erosion, seepage, settlement, sloughing or animal burrows. The following specific items were noted:

1. A minor amount of small brush should be removed from the downstream slope (Ref. Photo #28).
2. There was no evidence of seepage from the weep drains, however the toe-of-slope drain was flowing, in particular the final 100 ft (Ref. Photo #29).
3. The seepage monitoring weir is not functioning similar to the right side. Flow was passing around the weir through an eroded section. This should be corrected (Ref. Photo #30).

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

5.0 Structural Stability

The assessment of stability is based on visual observations made during our field inspection (10/19/08).

No deficiencies were noted that would impact the structural integrity of the dam; however minor items were noted that should be proactively addressed to mitigate potential future deficiencies. Over all the condition of the facility remains good.

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

6.0 Hydrology and Hydraulics

The MDEQ has estimated the required spillway capacity at the Holloway Dam to be 9900 cfs (reference Appendix B). This equates to the 200 year frequency flood which is mandated by statute – P.A. 451, Part 315, Section 324.31516.

Headwater rating curves previously produced by the USACE (1978) and Acres International (1993) indicate that this discharge capacity can be met at an impoundment elevation of approximately 755. This would allow for approximately 8 feet of freeboard. Thus, the spillway discharge capacity is sufficient to meet P.A. 451, Part 315 requirements. Furthermore, the spillway capacity at overtopping (El. 763) is approximately 40,000 cfs or $\frac{1}{2}$ PMF.

The spillway capacity has also been determined with the assumption that the drum gates fail to operate and are locked in the up position (reference Ayres, Lewis, Norris & May, Inc. (ALNM) Report – 1996). The resultant 200 year impoundment elevation is computed to be approximately 761 or two feet of freeboard. Therefore, the required spillway design capacity can be met through operation of the taintor gates only.

HOLLOWAY DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

7.0 Operation and Maintenance

The dam is operated and maintained by staff from the City of Flint Water Treatment Plant. Routine operation and maintenance is performed in accordance with the Holloway Reservoir Operation and Maintenance Plan which is on file at the City of Flint WTP.

Impoundment elevation is continuously monitored via an on-site level transducer. Instantaneous level information is available remotely to assist operations personnel in maintenance of the impoundment elevation.

During summer months, the drum gates are in a raised position and taintor gates closed. The impoundment elevation is maintained between 755.0 and 755.75 by operating the drum and/or taintor gates as needed.

The impoundment elevation is lowered in the winter to approximately elevation 751.0. The drum gates are lowered during this period.

Emergency backup power is available to operate the taintor gates in case of a power loss. An Auxiliary Generator Power System Report is available at the WTP.

The City has performed routine maintenance of the facilities on an "as needed" basis. The most recent work consisted of painting exposed steel components including the taintor gates and access platform support steel.

In addition to routine surveillance by operations staff, supervisor staff also performs an annual inspection of the facilities. Noted deficiencies are scheduled for correction the following year.

Appendix 6 - 2008 Utah Dam Safety Report

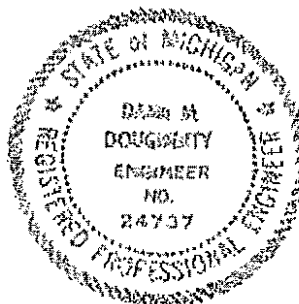
MICHIGAN PUBLIC ACT 451, PART 315
INSPECTION REPORT
UTAH DAM
GENESEE COUNTY, MICHIGAN
INVENTORY NUMBER 1275 - LOW HAZARD

FOR

CITY OF FLINT
WATER TREATMENT PLANT
4500 N. DORT HIGHWAY
FLINT, MICHIGAN 48505
ATTN: MR BRENT WRIGHT
(810) 787-6537

BY

Stantec Consulting Michigan Inc.
Engineers - Planners - Surveyors
3959 Research Park Drive
Ann Arbor, Michigan 48108-2219
(734) 761-1010



INSPECTOR(S):

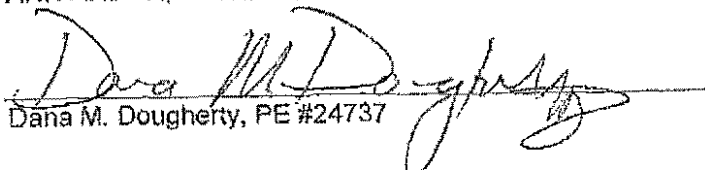
Dana M. Dougherty - Stantec Consulting Michigan Inc.

DATE OF INSPECTION:

October 19, 2008

PROFESSIONAL ENGINEER:

Dana M. Dougherty, PE
STANTEC CONSULTING MICHIGAN INC.
3959 RESEARCH PARK DRIVE
ANN ARBOR, MICHIGAN 48108-2219


Dana M. Dougherty, PE #24737

Stantec
INSPECTION REPORT
UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

Table of Contents

1.0 PURPOSE AND AUTHORITY.....	1.1
2.0 CONCLUSIONS AND RECOMMENDATIONS.....	2.1
3.0 PROJECT INFORMATION.....	3.1
4.0 FIELD INSPECTION.....	4.1
5.0 STRUCTURAL STABILITY.....	5.1
6.0 HYDROLOGY AND HYDRAULICS.....	6.1
7.0 OPERATION AND MAINTENANCE.....	7.1

LIST OF APPENDICES

APPENDIX A – BACKGROUND INFORMATION

1. Location Map
2. Project Drawings

APPENDIX B – HYDROLOGY/HYDRAULICS

1. MDEQ Flood Discharge Data
2. FEMA Flood Insurance Map
3. 1993 Acres Report (Excerpts)

APPENDIX C – PHOTOGRAPHS

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

1.0 Purpose and Authority

The purpose of the report is to present a summary of findings for the field inspection of the Utah Dam completed by Stantec Consulting Michigan Inc. (Stantec) on October 19, 2008 pursuant to the requirements of Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, Section 31518.

This dam inspection Report and associated inspection activities were commissioned by the City of Flint, Michigan, the dam owner. The Utah Dam is registered with the Michigan Department of Environmental Quality (MDEQ) as Dam Number 11275.

References in the report to "left" and "right" are based on the observer facing downstream.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

2.0 Conclusions and Recommendations

The Utah Dam was inspected on October 19, 2008 in accordance with Michigan P.A. 451, Part 315 criteria. The dam was found to be in fair to poor condition. A summary of comments/recommendations is as follows:

1. The stability of the exposed portion of the structure is poor and is no longer capable of serving its intended purpose.
2. The operating components of the facility (floodgates) have been decommissioned for sometime and are no longer functional.
3. The purpose of the dam (impound water for the upstream water treatment plant) is no longer needed as the Hamilton Dam, which is located downstream, provides this capability.
4. The Hamilton Dam is currently being evaluated for potential reconstruction and should the decision be made to proceed with that project the Utah Dam will serve no useful future function.
5. The spillway hydraulic capacity is deficient with regard to P.A. 451, Part 315, Section 324.31516 rules. This is further exacerbated by the fact that the partially open gates impede high flows resulting in an increased backwater.
6. The City should consider full or partial removal of the dam. It is possible that the foundation and submerged portion of the piers may be reused to support a new pedestrian crossing bridge. The minimum removal effort would consist of removing the gates from the dam. Due to the aforementioned deficiencies and related public safety liabilities the City should take immediate action perhaps concurrent with the proposed Hamilton Dam reconstruction.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

3.0 Project Information

Utah Dam is located on the Flint River in the City of Flint, Genesee County, Michigan (T08N, R07E, Section 32) at the south end of Whaley Park. The site location map is shown in Appendix A.

Utah Dam is owned by the City of Flint and plans for the dam are on file with the City. It was designed by the Ambursen Dam Company of New York and San Francisco and built around 1928. The dam was constructed to maintain a reservoir at El. 711 to provide sufficient head on the City's water treatment plant intake pipe. The pool created by the dam was limited to the main channel of the Flint River. The dam was built between the two banks of the river and has a total length of 240 ft. It consists of a concrete gravity structure with six spillway bays and 4 ft wide piers. Each bay has a 12 ft high by 25 ft long vertical lift gate.

There are two bridge decks on the structure. The upper deck is approximately 11 ft wide and it is used to move the gate hoist along the length of the dam. The gate hoist travels the length of the dam on two No. 40 rails, each of which is supported by 15 inch "I" beams. The beams are supported by the piers.

The lower bridge deck is separated by the vertical lift gates. The downstream side of the deck is 7 ft wide and it serves as a pedestrian walkway. The upstream side of the deck is 5 ft wide and it is used by the operator to gain access to the upper deck via a steel ladder.

Presently, the dam serves as a walkway over the Flint River and as a backup for Hamilton dam for providing a head on the water intake pipe. The gates of Utah Dam are currently locked open above the normal backwater elevation created by Hamilton Dam, which is 2.2 miles downstream. Elevations given in this report are referenced to National Geodetic Vertical Datum.

Six spillway bays and vertical lift gates are contained within the structure. Pertinent data about Utah Dam is give below.

Height of Dam – The total height of the dam, defined in P.A. 451, Part 315 as the difference in elevation between the natural stream bed (El. 696.8 ft) and the design flood elevation (El. 717.2 ft) is approximately 20.4 ft.

Crest Width of Structure – 30 ft as measured along the lower deck.

Sill of Vertical Lift Gates – El. 697.3 ft.

Sketches of the dam are included in Appendix A.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

4.0 Field Inspection

An inspection of the facilities was performed by Dana M. Dougherty, P.E. (Stantec) on October 19, 2008. The weather on the date of inspection was clear with temperature at approximately 55°F. The impoundment elevation was approximately 1.9 ft below normal elevation. The City was in the process of lowering the Hamilton Dam impoundment per directive from the MDEQ. This directive requires that the Hamilton Dam impoundment be lowered 3.25 ft.

The following items were noted (Reference photographs can be found in Appendix C):

1. The concrete condition on the downstream face of the dam is fair to poor. The right downstream retaining wall shows significant spalling in its top and outside corner. The left downstream retaining wall has significant spalling and cracking. The pier noses (three of five) are spalled. The access platform or walkway on the dam, concrete is in fair to poor condition. There is effervescence and cracking in the access platform support beams. There is no displacement. (Ref. Photos #1 and #5.)
2. The concrete condition of the upstream dam face is fair to poor. The noses of all piers show effervescence and some alligator cracking. This is also true for the right and left upstream retaining walls. There does not appear to be any substantial structural cracking in any of these members or displacement. There is spalling of concrete at the top of the piers as well as at the top of the abutment walls where the access platform rests. There is also some indication of spalling in the access platform beams and in some cases at the bottom of the beams themselves (Ref. Photos #2 and #6).
3. The gates are randomly open. The left gate, Bay No. 1, is 2 feet above the water level on this date. Bay No. 2 and No. 3 from the left, are 4 feet above water level on this date and Bay No. 4, 5, and 6 are 6.5 feet above water level. All dimensions reference water level to the bottom of the gate.
4. The superstructure appears to be in very poor condition. Concrete is in fair to poor condition. The operating platform, which housed a single moveable gantry crane for all six gates, has spalling in the beams as well as the piers. Protective railings are all intact, but in poor condition and require painting (Ref. Photos #7 and #8).
5. The top of the right embankment has a paved walkway with chain link fence on either side of the walkway. This is also true for the left embankment. There is also lighting at the site, utility poles in each embankment with a light fixture (Ref. Photos #3 and #4).
6. The embankments have some tree growth which should be removed.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN
Field Inspection
December 2008

7. On the date of the inspection, the water level is about 10.6 feet below the operating/walkway platform (El. 706.6 NGVD).
8. There is a 4 foot wide opening in the fence on the left downstream face of the dam, next to the utility pole, which allows access and is a safety issue. Also, the safety fencing that was installed on the upstream side of the dam, between the walkway and the gates, has been removed and is a safety issue.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

5.0 Structural Stability

The assessment of stability is based on visual observations made during our field inspection (10/10/08).

The overall structural condition of the Utah Dam is categorized to be fair to poor. Substantial deteriorated concrete is evident with numerous spalls, cracks, and some exposed reinforcing steel. The superstructure concrete is in the poorest condition with the gate lift support structure no longer capable of supporting its intended function i.e. gate operation.

The condition of the access platforms and exposed portions of the piers is somewhat better than the superstructure but still would be categorized as poor. The submerged portion of the piers and foundation were not inspected as part of this report, however experience with similar structures would imply that their condition would be better than the exposed components.

In conclusion, the Utah Dam structural stability will no longer support gate operation. Furthermore, continued use of the access platforms for pedestrian crossing will be dependent on future evaluation, repair and/or modification of those components.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

6.0 Hydrology and Hydraulics

The MDEQ has established the required spillway capacity at the Utah Dam to be 11,800 cfs (reference Appendix B). This equates to the 100 year frequency flood which is mandated by statute, P.A. 451, Part 315, Section 324.31516, for dams classified as low hazard such as the Utah Dam.

The hydraulic capacity of the Utah Dam is greatly impacted by the downstream Hamilton Dam. The normal impoundment elevation of the Hamilton Dam impoundment is approximately El. 708.0 (NGVD) while the gate sill elevation of the Utah Dam is 697.3. Thus, the Utah Dam is partially submerged under normal conditions.

Overtopping of the right embankment occurs at or near El. 714.0. The 1993 Acres Report (Appendix B) indicates that overtopping of this embankment will be experienced at flows over 7,830 cfs. The FEMA Flood Insurance Study (Appendix B) shows the 100 year flood elevation at the Utah Dam to be approximately El. 716.0. Thus the right embankment is overtopped under high flow conditions due to backwater impacts from the Hamilton Dam. It should be noted that the FEMA Flood Insurance Study assumes that all six gates are operable at Hamilton Dam. Since 1991 only three gates have been operable thus the backwater impact would be greater than shown on the FEMA maps.

The Utah Dam's hydraulic capacity is further diminished by the fact that the floodgates are currently locked in a partially open position. The bottom of gate elevation for each bay (numbered left to right locking downstream) is approximately:

Bay No. 1	708.5
Bays No. 2 and 3	710.5
Bays No. 4 through 6	713.0

Under high flows (100 year El. 716.0) the gates will impede flow thereby further exacerbating flood conditions.

For the above described reasons, it is concluded that the Utah Dam does not meet spillway capacity requirements as required by statute.

UTAH DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

7.0 Operation and Maintenance

The Utah Dam is operated and maintained by staff from the City of Flint Water Treatment Plant. The floodgates are currently non-functional and are locked in a partially open position. Power has been disconnected from the gate operators. The impoundment elevation is maintained by the downstream Hamilton Dam thereby negating the usefulness of the Utah Dam.

The City staff therefore maintains a minimal surveillance effort at the dam. Minimal preventative maintenance has been performed in the recent past. It is the City's intent to remove all or a portion of the structure as funds become available. Until that time maintenance will be limited to those items necessary to insure public safety with regard to the pedestrian bridge crossing.

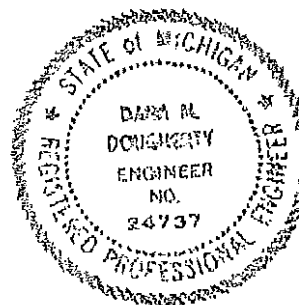
Appendix 7 - 2008 Hamilton Dam Safety Report

MICHIGAN PUBLIC ACT 451, PART 315
INSPECTION REPORT
HAMILTON DAM
GENESEE COUNTY, MICHIGAN
INVENTORY NUMBER 060 – HIGH HAZARD

FOR

CITY OF FLINT
WATER TREATMENT PLANT
4500 N. DORT HIGHWAY
FLINT, MICHIGAN 48505
ATTN: MR BRENT WRIGHT
(810) 787-6537

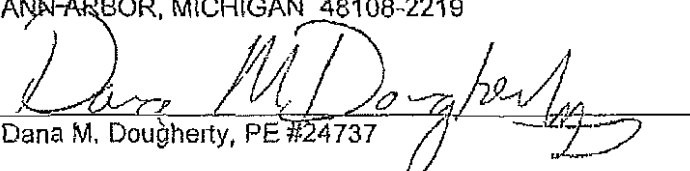
BY
Stantec Consulting Michigan Inc.
Engineers – Planners – Surveyors
3959 Research Park Drive
Ann Arbor, Michigan 48108-2219
(734) 761-1010



INSPECTOR(S): Dana M. Dougherty – Stantec Consulting Michigan Inc.

DATE OF INSPECTION: October 19, 2008

PROFESSIONAL ENGINEER: Dana M. Dougherty, PE
STANTEC CONSULTING MICHIGAN INC.
3959 RESEARCH PARK DRIVE
ANN-ARBOR, MICHIGAN 48108-2219


Dana M. Dougherty, PE #24737

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

Table of Contents

1.0 PURPOSE AND AUTHORITY	1.1
2.0 CONCLUSIONS AND RECOMMENDATIONS	2.1
3.0 PROJECT INFORMATION	3.1
4.0 FIELD INSPECTION	4.1
5.0 STRUCTURAL STABILITY	5.1
6.0 HYDROLOGY AND HYDRAULICS	6.1
7.0 OPERATION AND MAINTENANCE	7.1

LIST OF APPENDICES

Appendix A – Background Information

1. Location Map
2. Project Information (1978 USACE Report)
3. Project Drawings

Appendix B – Hydrology/Hydraulics

1. MDEQ Flood Discharge Data
2. FEMA – FIS Information
3. Acres International (1993) Headwater Rating Curve
4. USACE (1981) Spillway Rating Curves
5. Stantec (2008) Headwater Curve Computations

Appendix C – Photographs

Appendix D – Emergency Action Plan Notification List

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

1.0 PURPOSE AND AUTHORITY

The purpose of this report is to present a summary of findings for the field inspection of the Hamilton Dam completed by Stantec Consulting Michigan Inc. on October 19, 2008 pursuant to the requirements of Part 315, Dam Safety, of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, Section 31518.

This Dam Inspection Report and associated inspection activities were commissioned by the City of Flint, the dam owner. The Hamilton Dam is registered with the Michigan Department of Environmental Quality (MDEQ) as Dam Number 060.

References in this report to "left" and "right" are based on the observer facing downstream.

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

2.0 CONCLUSIONS AND RECOMMENDATIONS

The Hamilton Dam was inspected on October 19, 2008 in accordance with the Michigan P.A. 415, Part 315 criteria. The dam was found to be in poor condition which supports the conclusion found in previous dam safety reports. Specific comments/recommendations are as follows:

1. The stability of the exposed structural components including gate piers, access and operating platforms, and abutments is poor. These components are no longer capable of serving their intended purpose.
2. Three of the floodgates have been decommissioned while the reliability of the remaining gates is suspect. With three gates operating inadequate freeboard exists at the right embankment (looking downstream). In addition upstream flood elevations will be greater than those included in the FMEA Flood Insurance maps.
3. The MDEQ mandated drawdown should be adhered to until the dam is reconstructed.
4. The City should proceed immediately to implement the preferred option from the 2008 Reconstruction Feasibility Study.
5. In the interim, the City should exercise the Emergency Action Plan (EAP) annually to insure an efficient implementation when and if needed.

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

3.0 PROJECT INFORMATION

Hamilton Dam is located on the Flint River in downtown Flint, Michigan near the Flint Branch of the University of Michigan campus, and approximately 800 ft. upstream from the Saginaw Street Bridge.

Plans for the current dam are on file with the City of Flint, but original design data is not available. The dam was designed by Fargo Engineering Company of Jackson, Michigan, and was constructed about 1920 by Price Brothers Company of Lansing, Michigan on the site of a previous mill dam. The dam was constructed to sustain a head for the upstream water treatment plant intake.

The existing structure is a reinforced concrete gravity dam with six gated spillway bays. Each bay has a tainter gate on the fixed crest of a concrete spillway. The six bays, each 33 ft. long, and the five piers, each four feet thick, make a total length of 218 ft. There is an end sill below the spillway and an 18 ft. concrete apron beyond the end sill. The gates are operated during flood flows.

The original 1920 dam had seven bays with tainter gates. In 1964, the southern (left) most gate, its spillway and headrace were removed.

A fish ladder was constructed through the right abutment sidewalls in 1978. Also in 1978, the right concrete abutment was modified to install an Archimedean screw pump.

Repairs to Hamilton Dam were carried out in the summer of 1992. Steel sheet piling was placed just upstream of the gates for Bays 1, 2 and 6 because of the deteriorated condition of the gates. The sheet piles were to maintain the headpond in case of gate failure. The top elevation of the sheet piles was placed near the top of the tainter gates (Elev. 707.8 ft.) in a closed position. Gate repairs were completed in Bays 3, 4, and 5. These repairs included the complete removal of the existing gates and replacement with new gates, repair of buttress and sill concrete, repair of gate trunnions, replacement of lift chains, and painting of all exposed gate steel.

The top deck of the structure is divided lengthwise into a pedestrian walkway and the gate hoist rails for the two gate hoists. The hoist rails consist of two "I" beams (18 inch and 15 inch) that are supported by the piers. The two hoists for raising the spillway tainter gates are driven by attached electric motors.

A U.S. Army Corps of Engineer's bronze disk is set flush with the bridge deck in the walkway at the second pier from the right end. Unless otherwise noted, data given in this report is based on the assumption that the E1 715.06 ft. elevation given for this benchmark is on National Geodetic Vertical Datum (NGVD).

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN
PROJECT INFORMATION
December 2008

The terrain near the dam and reservoir is urban and gently rolling. Five borings from the original plans show sand with an occasional pocket of clay or gravel in the soils overlying a soft sandstone which is 40 or 50 ft. below ground surface.

Six spillway bays and tainter gates make up the structure. Only Gates 3, 4 and 5 are currently operable. Sketches and pertinent data about Hamilton Dam are shown in **Appendix A**.

Hamilton Dam was classified by the U.S. Army Corp of Engineers as High Hazard in the 1980 Phase I Inspection Report. This classification remains in effect to date.

Plans for the original Dam construction in 1920 and plans for repairs performed in 1992 are on file with the City of Flint. Past inspection reports on file include the following:

- 1980 USACE, Phase I, National Dam Safety Program Report
- 1986 Ayres, Lewis, Norris & May, Inc. (ALNM) and Sublakes Diving Inspection Report
- 1988 MDNR Inspection Report
- 1989 Ayres, Lewis, Norris & May, Inc. (ALNM) Structural Evaluation and Reconstruction of Hamilton Dam Report
- 1993 Acres International Corp., Dam Inspection Report
- 1996 Ayres, Lewis, Norris & May, Inc. (ALNM) Inspection Report
- 1999 Paul C. Rizzo Associates, Inc. Dam Inspection Report
- 2000 USACE Hamilton Dam Condition Survey
- 2005 Soil & Materials Engineers, Inc. Dam Inspection Report
- 2008 Stantec Feasibility Study for Reconstruction

These reports have been consistent in their recommendations to undertake corrective action to address structural deficiencies within the facility. The 1989 Ayres, Lewis, Norris & May, Inc. (ALNM) and 2000 USACE Reports included estimated costs of \$3,830,000 and \$5,588,000 respectively to make the necessary improvements to insure dam safety and integrity. The 2008 Stantec Report estimated the reconstruction cost to be \$4,901,000.

On March 14, 2008, acting under the authority of Part 315, Dam Safety of the Natural Resources and Environmental Protection Act, 1994 P.A. 451 as amended, the Michigan

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN
PROJECT INFORMATION
December 2008

Department of Environmental Quality issued an order to the City of Flint to drawdown the Hamilton impoundment 3.25 ft. to an elevation not greater than 705.25 NGVD for the purpose of public health, welfare and safety protection. The depth of necessary drawdown was computed by the MDEQ to eliminate the danger of loss of life downstream in the event of a sudden dam failure.

A permit under Part 301, Inland Lakes and Streams was issued for this activity on September 30, 2008. The City of Flint has subsequently abided by the conditions of this permit and has lowered the normal impoundment elevation to the prescribed elevation. It should also be noted that the MDEQ permit requires permanent deflation of the Obermeyer (Inflatable) Dam.

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

4.0 FIELD INSPECTION

An inspection of the facilities was performed on October 19, 2008 by Dana M. Dougherty, PE. The weather on the date of the inspection was clear with temperatures at approximately 55°F. The impoundment elevation was below normal by approximately 1.5 ft. The City was in the process of lowering the impoundment per directive from the MDEQ. This directive requires that the impoundment be lowered 3.25 ft. The floodgate in Bay #3 has been opened to accomplish this task.

The following items were noted during the field inspection (referenced photographs can be found in Appendix C):

1. The condition of the exposed concrete including piers, slabs, abutments is poor with numerous spalls, cracks and exposed reinforcing steel (Ref. Photos #1 through #4, #7, #8, #10).
2. The floodgates in Bays 1, 2 and 6 have been decommissioned by placement of steel sheeting across the face of these bays (Ref. Photos #2 and #8).
3. The City reports that the remaining floodgates (Bays 3 through 5) are operative, however, Bays 4 and 5 have not been operated with any frequency and thus their reliability is suspect.
4. The access walkway/platform remains closed to the public due to safety concerns (Ref. Photos #3 and #4).
5. Overall the condition of the dam continues to worsen with the structural integrity of numerous components compromised.

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

5.0 STRUCTURAL STABILITY

The assessment of stability is based on a visual observation made during our field inspection (10/19/08) and visual observations made during preparation of the 2008 Reconstruction Feasibility Study, as well as the 1989 condition survey (concrete corings).

The overall structural condition of the Hamilton Dam is poor. Exposed surfaces including gate piers, access and operating platforms and abutments all exhibit conditions that indicate these components have exceeded their useful life. Numerous spalls, cracks and exposed reinforcing steel exist.

In conclusion, the Hamilton Dam structural stability is deficient and thus this facility represents a potential liability with regard to public health, welfare and safety.

Stantec
INSPECTION REPORT
HAMILTON DAM
 CITY OF FLINT
 GENESEE COUNTY, MICHIGAN

6.0 HYDROLOGY AND HYDRAULICS

The dam is regulated under State of Michigan P.A. 451 Part 315 statute. Guidelines that accompany this statute require high hazard potential dams with heights less than 40 ft. to be capable of passing a 200-year flood or the flood of record whichever is greater. For the Hamilton Dam, the 200-year flood controls and has been computed by the Michigan Department of Environmental Quality to be 13,000 cfs (reference Appendix B).

The computed maximum impoundment elevation for the 200-year flood event varies dependent on assumptions made with regard to the number of floodgates that are operative. In 1981, calculations were performed by the United States Geologic Survey and form the basis for the FEMA Flood Insurance mapping that is used to this day. The USGS assumed that all six floodgates were operational. The USACE also computed the maximum impoundment elevation in their 1981 National Dam Safety Inspection Report. They assumed that just two gates were operational due to the fact that the gates could not be locked in an open position and only two operators existed. In 1993 after decommissioning of Gates 1, 2 and 6, Acres International Corporation computed the maximum headwater elevation assuming that gates were operational in Bays 3, 4 and 5.

The results of these various studies is as follows (refer to Appendix B for more information):

Source	Estimated 200-year Impoundment Elevation NGVD Datum
1981 F.I.S. (U.S.G.S.)	709.05*
1981 Dam Safety Inspection Report (USACE)	711.6
1993 Dam Safety Inspection Report (ACRES)	712.8

** USGS added 0.95' to the computed impoundment elevation for the purpose of floodplain mapping. Therefore the floodplain mapping indicates a 200-year flood elevation of approximately 710.0 NGVD.*

It should be noted that there is uncertainty as to whether or not adequate freeboard exists at this site. The Acres report indicates that freeboard is sufficient based on the fact that the upstream right streambank area was raised in the mid 1980's. However, a recent survey conducted as part of the 2008 Reconstruction Feasibility Study indicates the elevation of this area to be similar to that shown in the 1981 USACE report i.e. ± 711.5 NGVD. Thus, it would appear that inadequate freeboard currently exists.

Stantec
INSPECTION REPORT
HAMILTON DAM
CITY OF FLINT
GENESEE COUNTY, MICHIGAN

7.0 OPERATION AND MAINTENANCE

The Hamilton Dam is operated and maintained by staff from the City of Flint Water Treatment Plant. Floodgates in Bays 1, 2 and 6 are currently non-functional. Floodgates in the remaining bays can be operated, however their reliability is diminished due to the deteriorated condition of the operating slab.

City staff maintains the impoundment elevation by operating the gates on an as needed basis. The impoundment is currently being maintained at the MDEQ mandated level of 705.25 NGVD i.e. 3.25 ft below normal.

The City has performed minimal maintenance to the structure in anticipation of reconstruction.

Appendix 8 - Cost of Service Study – Flint Water Treatment Plant

DRAFT

**Technical Memorandum
Cost of Service Study
Flint Water Treatment Plant**

I. Introduction

This Technical Memorandum describes the proposed improvements needed at the Flint Water Plant to treat Flint River water on a continuous basis. The primary foundations for this evaluation were the "Water Treatment Plant Rehabilitation – Phase II" report dated December 2003 and the "Preliminary Engineering Report, Lake Huron Water Supply, Karegnondi Water Authority" dated September 2009. The findings, as presented in the following sections, address the improvements required for the water plant to produce finished water in conformance with the current federal and state drinking water regulations. In addition, operation and maintenance costs for continuous operation have been evaluated and included in order to determine the total cost associated with using the Flint River as a source of water.

Improvements, as proposed in this evaluation, along with those previously made during the Phase I improvements program, will produce a finished water quality equal to the current water quality as received from the DWSD. The design parameters are as follows:

- 1) Minimum Day Demand – 10-mgd
Average Day Demand – 15-mgd (14-mgd in 2010 increasing to 15-mgd in 2050)
Maximum Day Demand – 28-mgd
- 2) Turbidity – 0.20 NTU
- 3) Hardness – 80 to 100 mg/l as CaCO_3
- 4) Cryptosporidium – 3-Log Inactivation
- 5) Giardia – >3-Log Inactivation
- 6) Viruses – >4-Log Inactivation
- 7) Taste and Odor – Eliminated with pre-ozonation
- 8) Trihalomethanes – Less than 80 $\mu\text{g/l}$
- 9) HAA5 – Less than 60 $\mu\text{g/l}$

As part of this investigation, an inspection of the Flint Water Plant was performed on May 3, 2011. The purpose of this inspection was to determine if the recommendations in the Phase II report, as referenced above, needed to be revised due to changed conditions or water supply needs. Based on findings from this meeting, the major adjustment to be made is the reduction of average day demand from 20-mgd to 14-mgd and maximum day demand being reduced from 36-mgd to 28-mgd. Required improvements as recommended in this study have taken these new demands into account. The conceptual design of these new facilities would allow cost effective expansion to 36-mgd, as needed, to meet future demands.

II. Required Capital Improvements

The following describes the required improvements as required for the Flint Water Plant to operate on a continual basis using the Flint River as a water source. Most of these improvements are more fully described in the Phase II report and are not repeated to avoid duplicative effort.



A. Lime Sludge Disposal

Lime sludge is proposed to be pumped from the east and west softening basins to two new 42-ft diameter thickeners (25-ft SWD) located adjacent to the plate settling building. Decant from the thickener will flow by gravity to the primary clarifier influent channel. Thickened sludge (12% solids) will be pumped to a new plate-and-frame filter press located at the north end of the WTP 1 primary settling basin. A new two-story building would be constructed at that location to house the pumping facilities and presses. Each press, located on the second floor, will have a 225-cf per hour capacity and will drop the dewatered sludge into a first floor bunker area. The dewatered cake will be transferred to a lime storage concrete bunker located approximately 60 feet north of the sludge press building. The storage bunker (100-ft x 192-ft) will have the capacity to store three to four months of dewatered lime sludge cake. About every three months, contract haulers will remove the lime sludge and place on agricultural lands that are permitted for final disposal.

The capacities of these facilities are based on average day flow of 15-mgd, maximum day demand of 28-mgd and water quality softening requirements. Based on raw water quality data provided by the City of Flint, a lime dosage of 209 mg/l, soda ash dosage of 47 mg/l and carbon dioxide dosage of 37 mg/l were used to estimate lime sludge quantities and flows.

Opinion of Probable Cost:

Site and Access:

Site Demolition	\$	129,000
Roadway Improvements	\$	385,000
Partial Settling Basin Demolition	\$	129,000
On-site Truck Scale	\$	257,000
Subtotal Construction:	\$	900,000
Construction Contingencies (15%):	\$	135,000
Design Contingencies (5%):	\$	45,000
Engineering, Legal, Bonds & Administration (17%):	\$	153,000

Opinion of Probable Cost: \$ 1,233,000

Thickener Basins - 42 ft Diameter:

Two Thickener Mechanisms	\$	310,000
Two Concrete Basins (25 ft SWD)	\$	513,000
Two Geodesic Dome Covers	\$	180,000
Install Equipment	\$	257,000
Site Work	\$	97,000
Utilities, Piping and Process	\$	193,000
Subtotal Construction:	\$	1,550,000
Construction Contingencies (15%):	\$	232,500
Design Contingencies (5%):	\$	77,500
Engineering, Legal, Bonds & Administration (17%):	\$	263,500

Opinion of Probable Cost: \$ 2,124,000



Filter Presses and Building:

Two-225 cf Plate & Frame Press	\$	1,650,000
Building (70 ft x 60 ft)	\$	3,331,000
MEP	\$	1,089,000
Site Utilities	\$	129,000
Subtotal Construction:	\$	6,199,000
Construction Contingencies (15%):	\$	929,850
Design Contingencies (5%):	\$	309,950
Engineering, Legal, Bonds & Administration (17%):	\$	1,053,830

Opinion of Probable Cost: \$ 8,493,000

Lime Storage Bunker and Site Work:

12 ft Concrete Walls and Slab	\$	833,000
Frame and Fabric Building Cover	\$	325,000
Site Improvements	\$	385,000
Front End Loader (5 cyd)	\$	308,000
Site Utilities	\$	513,000
Subtotal Construction:	\$	2,364,000
Construction Contingencies (15%):	\$	354,600
Design Contingencies (5%):	\$	118,200
Engineering, Legal, Bonds & Administration (17%):	\$	401,880

Opinion of Probable Cost: \$ 3,239,000

Total for Lime Disposal : \$ 15,089,000

B. Soda Ash Feed System

In order to remove the non-carbonate hardness, soda ash will be needed to meet the finished water hardness concentrations. Two new 800 #/hour feeders will be needed to meet the dosage requirements. Each of these feeders will be connected to the existing silos.

Opinion of Probable Cost:

Demolition of Existing Feeders	\$	20,000
Two 800 #/hr Feeders	\$	112,000
MEP	\$	109,000
Chemical	\$	77,000
New Pneumatic Fill System	\$	58,000
Subtotal Construction:	\$	376,000
Construction Contingencies (15%):	\$	56,400
Design Contingencies (5%):	\$	18,800
Engineering, Legal, Bonds & Administration (17%):	\$	63,920

Opinion of Probable Cost: \$ 516,000



C. Additional Chemical Storage

During the Phase I improvements, the MDEQ did not mandate 30-day chemical bulk storage requirements since the plant was a redundant water supply to the DWSD. However, if the facility becomes a continuously operated treatment plant, then additional chemical storage must be added to meet the minimum storage volume requirements. To comply with the regulations, new oxygen, nitrogen and carbon dioxide storage facilities must be provided as follows.

Liquid Carbon Dioxide:

Capacity – 34 tons
 Vaporizer – 750 #/hour @ 300 psig
 Piping – Schedule 80 Carbon Steel and Schedule 40 - 304L Stainless Steel

Liquid Oxygen

Capacity – 9000 gallons
 Operating pressure – 75 psi
 Feed Rate – 175 scfm
 Piping – Type K Copper

Liquid Nitrogen

Capacity – 540 gallons
 Operating pressure – 100 psi
 Feed Rate – 1 scfm
 Piping – Type K Copper

Opinion of Probable Cost:

Carbon Dioxide Storage Facilities	\$	328,000	
MEP	\$	103,000	
Oxygen & Nitrogen Storage Facilities	\$	961,000	
MEP	\$	109,000	
		Subtotal Construction:	\$ 1,501,000
		Construction Contingencies (15%):	\$ 225,150
		Design Contingencies (5%):	\$ 75,050
		Engineering, Legal, Bonds & Administration (17%):	\$ 255,170
		Opinion of Probable Cost:	\$ 2,057,000

D. Electrical and SCADA Improvements

Section 9, relating to power and controls, of the Phase II study was prepared by Dmytryka Jacobs Engineers (DJE). The scope of the Phase II work did not include detailed investigations of the water plant site-wide power distribution nor the secondary power distribution within each of the facility structures. However, a number of observations and basic recommendations were presented in Section 9 by DJE.

The Flint Water Plant currently uses 2400V as primary power throughout the facility. All of the power feeders in the plant site are 5kV rated and it appears the existing switchgear is also rated at 5kV. Most of the major electrical improvements installed during Phase I were dual voltage (2400/4160) equipment in anticipation of the plant power being changed to 4160V in the near future. This change would allow the existing network of power feeders to handle approximately twice the power and would eliminate running new feeders to various portions of the plant.



The current sub-station has two 2.5MVA transformers running in parallel for a total capacity 5 MVA. These old transformers are not equipped with cooling fans. The full connected load to these transformers is estimated to be 6.97 MVA while the estimated power load at 36 MGD is 4.22MVA. Based on these estimates there is sufficient power for the plant with both sub-station transformers in service. Even though the transformers are owned by Consumers Energy, it could take weeks to replace one of these main transformers in the event of a unit failure, which will result in reduced treatment and pumping capacity. The sub-station switchgear was installed in 1960 and is antiquated and difficult to maintain.

The two existing Fairbanks Morse generators are currently inoperable and would cost approximately \$1M to rehabilitate. The DJE team recommended installing two new emergency generators in lieu of rebuilding the existing units.

Section 9 of the Phase II report provides sufficient detail for the purposes of this report, but a detailed electric system evaluation of the entire plant should be performed prior to any major improvements to this facility.

While LAN did not perform a detailed review of the WTP electrical system during our site visit, it appears that all of the DJE findings are still pertinent. We, therefore, concur with the improvements as recommended by DJE in the Phase I report.

Opinion of Probable Cost:

Substation Upgrade	\$	961,000
Standby Power Generation	\$	2,242,000
Pump Station No. 4 Upgrade	\$	1,365,000
Filter Press Building Feeder	\$	87,000
WTP SCADA, Equipment & Programming	\$	720,000
Telemetry System Equipment & Programming	\$	103,000
Computers, Software & Training	\$	155,000
Filter Transfer PS Power Feeders	\$	135,000
Emergency PS Power Feeders	\$	145,000
Subtotal Construction:	\$	5,913,000
Construction Contingencies (15%):	\$	886,950
Design Contingencies (5%):	\$	295,650
Engineering, Legal, Bonds & Administration (17%):	\$	1,005,210

Opinion of Probable Cost: \$ 8,101,000

E. Post-Chlorination and Zebra Mussel Control

The previous report recommended changing the disinfection system from gaseous chlorine to sodium hypochlorite due to the potential for hazardous gas release and the requirements imposed by new federal regulations. Previous treatability studies have not addressed the potential impact of re-growth in the system due to ozonation by-products. These impacts should be addressed prior to proceeding with final plans for using river water.

The Flint River is known to be infested with Zebra mussels and mitigation measures will have to be implemented if the plant is placed into continuous operation. A sodium permanganate feed system is proposed to address these concerns.

Opinion of Probable Cost:

Demolition of Existing Equipment	\$	39,000	
Storage Tanks	\$	9,000	
Metering Pumps and Tables	\$	11,000	
Piping, Valves & Tables	\$	9,000	
Containment	\$	59,000	
Installation	\$	108,000	
Subtotal Construction:	\$	235,000	
Construction Contingencies (15%):	\$	35,250	
Design Contingencies (5%):	\$	11,750	
Engineering, Legal, Bonds & Administration (17%):	\$	39,950	
Opinion of Probable Cost:	\$	322,000	

F. Security Issues

For water plant security issues, please refer to City of Flint Vulnerability Assessment. Details are omitted in this report due to confidentiality.

Not available at the time of the previous report, a source water monitoring system is included in the study due to recent advancements in technology. The proposed system design is based on Hach Model SC1000, equipped with UVAS, NH4D, pH, ORP, turbidity and DO probes.

Opinion of Probable Cost:

Security Improvements	\$	145,000	
Source Water Monitoring System	\$	95,000	
Subtotal Construction:	\$	240,000	
Construction Contingencies (15%):	\$	36,000	
Design Contingencies (5%):	\$	12,000	
Engineering, Legal, Bonds & Administration (17%):	\$	40,800	
Opinion of Probable Cost:	\$	329,000	

G. PS No. 4 - Low and High Service Pumps

Section 7 of the Phase II report included recommendations to replace two of the low lift pumps and two of the high lift pumps along with various other improvements. During the site visit, it was apparent the condition of this facility has continued to deteriorate. Furthermore, with the reduction in water system demands, the various pump capacities are no longer properly sized to efficiently meet the new plant flow ranges. The pumps and motors are oversized and are operating outside their best efficiency ranges and should be replaced due to age, condition and cost to operate.

Additionally, some of these pumps cannot be operated due to excessive vibrations in the shaft and steady bearings. Existing vibration monitors are functioning as designed and are shutting the power off to the motors to avoid damage.

For low lift service, it is proposed to install two 10-mgd and two 15-mgd (nominal ratings) vertically mounted pumps equipped with low voltage inverter duty motors. The motors would be powered by low



voltage variable frequency drives. This will provide a firm rated capacity of approximately 35-mgd in low lift capacity.

For high lift service, it is proposed to install one 10-mgd, two 15-mgd and one 20-mgd (nominal ratings) pumps equipped with medium voltage inverter duty motors. These motors will be power by medium voltage variable frequency drives. This combination of pumps will provide a firm rated capacity of 40-mgd.

Opinion of Probable Cost:

Demolition of Existing Equipment	\$	135,000
Install Two (2) 10 MGD @ 40 ft of TDH Vertically Mounted Pumps with 125 HP, 480 V Inverter Duty Motor with 20 ft of Shaft & Steady Bearings	\$	473,000
Install Two (2) 15 MGD @ 40 ft of TDH Vertically Mounted Pumps with 150 HP, 480 V Inverter Duty Motor with 20 ft of Shaft & Steady Bearings	\$	495,000
Install One (1) 10 MGD @ 190 ft of TDH Vertically Mounted Pump with 450 HP, 4160 V Inverter Duty Motor with 20 ft of Shaft & Steady Bearings	\$	245,000
Install Two (2) 15 MGD @ 190 ft of TDH Vertically Mounted Pumps with 700 HP, 4160 V Inverter Duty Motor with 20 ft of Shaft & Steady Bearings	\$	520,000
Install One (1) 20 MGD @ 190 ft of TDH Vertically Mounted Pump with 800 HP, 4160 V Inverter Duty Motor with 20 ft of Shaft & Steady Bearings	\$	285,000
Piping, Valves, Supports & Bearings	\$	480,000
Intermediate Platforms, Ladders & Stairs	\$	360,000
Ventilation & Boiler Systems	\$	340,000
Install Three (3) Low Voltage VFD Units	\$	85,000
Install Four (4) Medium Voltage VFD Units	\$	2,250,000
Subtotal Construction:	\$	5,668,000
Construction Contingencies (15%):	\$	850,200
Design Contingencies (5%):	\$	283,400
Engineering, Legal, Bonds & Administration (17%):	\$	963,560
Opinion of Probable Cost:	\$	7,766,000

H. Filter Transfer Station to Dort Reservoir and UV Inactivation

Under the requirements as outlined in the USEPA drinking water regulations addressing potential microbial contaminants, additional treatment technologies and enhancement of existing processes must be implemented to comply with these regulations.

As required under the enhanced surface water treatment rules, it is essential for water utilities to address giardia, cryptosporidium, viruses and bacteria in finished water. The level of treatment is dependent on



the source water classification. The City of Flint will need to perform a two-year source water study to determine the bin placement for the Flint River. For the purposes of this report, a Bin 4 placement was selected due to the nature of the watershed and, therefore, it is assumed enhanced Ct and UV inactivation will be required.

Reservoir No. 3 does not provide sufficient Ct to meet the current regulations, therefore, Dort Reservoir will need to be placed into the process train. Since Dort Reservoir does not match the hydraulic profile of the plant, an intermediate pump station will be required. This new facility will also include a UV inactivation system to comply with the enhanced water quality regulations.

This proposed facility, located west of the filters and south of Dort Reservoir, will house three 14-mgd (nominal rating) variable speed pumps with inverter duty, low voltage motors for a firm rated capacity of 28-mgd. Housed in a separate part of this same structure will be the UV system that will be equipped with three 12" medium pressure units with a rated capacity of 28-mgd.

Opinion of Probable Cost:

Site Work & Utilities	\$	77,000
Building (80 ft x 60 ft)	\$	1,440,000
Three (3) 14 MGD @ 40 ft of TDH, Vertically Mounted Pumps with 150 HP, 480 V Inverter Duty Motor	\$	535,000
MEP	\$	940,000
Valves and Controls	\$	205,000
Install Three (3) 12" MP UV Units	\$	590,000
UV Piping & Controls	\$	368,000
Ventilation & Boiler Systems	\$	165,000
Install Three (3) Low Voltage VFD Units	\$	85,000
Piping Connections	\$	125,000
200 ft of 30" Water Main	\$	200,000
600 ft of 36" Water Main	\$	420,000
Subtotal Construction:	\$	5,150,000
Construction Contingencies (15%):	\$	772,500
Design Contingencies (5%):	\$	257,500
Engineering, Legal, Bonds & Administration (17%):	\$	875,500

Opinion of Probable Cost: \$ 7,056,000

I. Emergency Interconnect Pumping Station

The City of Flint and Genesee County DWWS have entered into an agreement to provide 8-mgd of back-up service to each other under emergency conditions. There are several alternatives for pumping station locations and configurations to accomplish this interconnect. For the purposes of this report, a station located west of the filter building was selected as the most practical from and operational cost perspective. While the opinions of cost presented below indicate that these pumps will be housed in their own structure, it is feasible to house the pumps in the filter transfer station for potential savings.

Preliminary design for this pumping station include two constant speed 8-mgd pumps equipped with soft starts and medium voltage motors. A reverse flow control station will be included within the same structure to allow for flow from the DWWS to assist the City of Flint. Approximately three miles of 24-inch pipeline will be needed to connect the two systems.

Opinion of Probable Cost:



Site Work & Utilities	\$	90,000
Building (32 ft x 24 ft)	\$	245,000
Install Two (2) 8 MGD @ 290 ft of TDH, Vertically Mounted Pumps with 600 HP, 4160V Motor	\$	380,000
MEP	\$	335,000
Valves and Controls	\$	128,000
Reverse Flow Control Station	\$	110,000
Ventilation Systems	\$	35,000
16000 ft of 24" Water Main	\$	4,992,000
Subtotal Construction:	\$	6,315,000
Construction Contingencies (15%):	\$	947,250
Design Contingencies (5%):	\$	315,750
Engineering, Legal, Bonds & Administration (17%):	\$	1,073,550
Opinion of Probable Cost:	\$	8,652,000

The opinions of capital cost presented in the preceding sections are tied to an ENR Index of 8688 to match the September 2009 Lake Huron Water Supply Report. Furthermore, the contingency percentages included with each opinion of cost are the same as in the September 2009 report. The total opinion of probable project cost of these proposed improvements is as follows:

Lime Sludge Disposal	\$	15,089,000
Soda Ash Feed System	\$	516,000
Additional Chemical Storage	\$	2,057,000
Electrical and SCADA Improvements	\$	8,101,000
Post-Chlorination and Zebra Mussel Control	\$	322,000
Security Issues	\$	329,000
PS No. 4 - Low & High Service Pumps	\$	7,766,000
Filter Transfer Pumping Station & UV	\$	7,056,000
Emergency Interconnect Pumping Station	\$	8,652,000
Total Opinion of Probable Project Cost:	\$	49,888,000

III. Cost of Additional Operation

The City of Flint currently operates the water treatment plant periodically during the year to maintain the systems and to meet regulatory requirements. The water treatment plant is staffed with various classifications of employees to operate and maintain the facility for these minimal operations.

As part of this work, and to develop all costs of providing water service from the Flint River, it is necessary to determine the probable cost for operating and maintaining this facility for continuous operation. Water quality differences between the Flint River and Lake Huron are significant and require different treatment chemicals and dosages. Most noticeable is the fact that Lake Huron water does not require softening which negates the need for softening process and the associated lime sludge disposal.

The primary cost parameters that are included in this difference are labor, chemicals, residual disposal and electrical power. Each will be discussed in the following sections. These costs were projected through the year 2050.



A. Labor

Additional staffing was discussed and developed with representatives from the City of Flint to provide full time coverage on a 24/7/365 schedule, plus provide staff for residual management and operations of the various dams. Hourly rates and fringe benefits were based on current budget figures and inflated at a rate of 3% for future costs. The following table outlines the proposed staffing a cost for this operational element.

Classification	Number	Cost/Hr	Hrs/Year	Total	Fringe (%)	Total
Operators	12	\$ 20.00	2080	\$ 499,200	90.40%	\$ 950,477
Maintenance	4	\$ 25.00	2080	\$ 208,000	90.40%	\$ 396,032
Laboratory QA/QC	2	\$ 24.00	2080	\$ 99,840	90.40%	\$ 190,095
Laboratory SDWA	2	\$ 20.00	2080	\$ 83,200	90.40%	\$ 158,413
Planned Overtime	NA	MIXED	8320	\$ 178,048	90.40%	\$ 339,003

This estimate represents approximately \$2,034,000 per year of additional labor.

B. Chemicals

Chemical costs are based on the projected average day water demand of 14-mgd and the average dose for each of the chemicals based on the raw water quality information and other operational records. Further, data from the previous treatability work performed during the Phase I improvements was also incorporated into these estimates. Chemical suppliers and other water utilities were contacted to obtain current chemical purchase costs which were adjusted by the ENR ratio back to an index of 8688. Where necessary, transportation costs to the Flint, MI area were included. The following summarizes the chemical costs associated with treating the Flint River water.

Chemical	Dose(mg/l)	Cost/#	Cost/ MGD
Ferric	44.50	\$0.24	\$89.07
Lime	209.00	\$0.10	\$174.31
Soda Ash	47.00	\$0.29	\$113.67
CO ₂	37.00	\$0.10	\$30.86
Cl ₂	3.00	\$0.34	\$8.51
Fluoride	1.00	\$0.33	\$2.75
Phosphate*	1.00	\$0.51	\$4.25
		Cost per MGD	\$423.42

*Costs range from \$0.51 to \$0.96 per pound

In addition to the above, the cost of ozone will need to be added which is approximately \$20.08 per million gallons per day per mg/l dose. This cost includes oxygen, nitrogen and power costs.

C. Residual Disposal

This category is divided into two groups: clarifier sludge collected in the plate settling basins and lime sludge from the softening process. The clarifier sludge is pumped from the clarifier basins by zone (six zones per train, three trains, total of 18 zones) to the plant main drain. As part of the Phase I work, the main drain was connected to a new wastewater pumping station located south of the filter gallery building. This pump station discharges the collected residuals to the city's sanitary sewer system. Nearly all of the filter wash water is recirculated back to the head of the ozone facility for re-use.

The cost to treat clarified sludge discharged into the sanitary sewer system is calculated as follows:



Plate Clarifier Sludge

Flow (MGD)	14
SS (mg/l)	75
Primary Sludge (#/d)	13,435
% Solids	2%
Sludge (gals/day)	80,500
Sludge (cf/day)	10,762

Based on the City of Flint's current wastewater charges of \$1.00 per 100 cf, the annual cost would be \$39,200 per year.

Lime/Soda Ash softening generates large quantities of residual wastes that have high disposal costs. The treatment proposed in this study involves pumping the sludge, at about 4% concentration, from the softening basins to two gravity thickeners, where it will concentrate to about 12% solids. After thickening, sludge will be pumped to the filter presses to be dewatered to approximately 55% solids. The filter presses will drop the cake into a lower bunker where it will be removed by an end loader to the main storage bunker. About every three months, the sludge will be loaded onto trucks and applied to agricultural land.

The volume of sludge is estimated as follows:

Sludge Production from Clarifier

Reaction	meq/l	meq/l as CaCO_3	meq/l as $\text{Mg}(\text{OH})_2$
CO_2	0.25	0.25	0
$\text{Ca}(\text{HCO}_3)_2$	4.65	9.30	0
$\text{Mg}(\text{HCO}_3)_2$	0.30	0.60	0.30
MgSO_4	0.89	0.89	0.89
Excess Lime	1.25	1.25	0
Total meq/l		12.28	1.19
Less Practical Limits meq/l		0.60	0.20
Precipitate Produced meq/l		11.68	0.99
Precipitate Produced mg/l		584	49
Precipitate Produced #/MG		4872	412
Total #/MG		5284	
WTP Flow (MGD)	14	27	
Dry Sludge Production in #/day	73,983	142,681	
@ 4% Solids (gals/day)	221,771	427,701	
@ 12% Solids (gals/day)	73,924	142,567	
@ 12% Solids (gals/week)	517,466	997,970	
Dry Sludge Production (tons/week)	259		SG CaCO_3 2.71
Number of Hours per Week to Press	48		SG $\text{Mg}(\text{OH})_2$ 2.36
Dry Sludge Processed (#/hr)	10,789		SG solids 2.68
@ 55% Solids Sludge Processed (#/hr)	19,617		
55% Solids Sludge (#/cy)	2571	Sludge Solids =	55% as CaCO_3
@ 55% Solids Sludge Processed (cf/hr)	206	Sludge Unit Wt. =	95.22 pcf



Based on the preceding, 471 tons of softening sludge at 55% solids will be handled each week based on average flow and chemical dosage. Several Michigan water facilities were contacted to obtain lime sludge hauling and disposal costs. From this data a rate of \$18.50 per wet ton was selected as a reasonable rate for disposal cost. This rate will result in an annual cost of \$453,000.

D. Power

Practically all of the additional power costs are associated with low lift, intermediate transfer and high service pumping. Additional power costs will be used for process and handling of the softening sludge. The City of Flint is currently paying \$0.07 per kwhr for service at the water plant. Power costs are calculated as follows:

TDH (ft) - High	190
TDH (ft) - Filter Transfer	40
TDH (ft) - Low	40
TDH Total (ft)	270
Pump Eff. (W to W)	80.00%
\$/kwhr	\$0.070
Pumping Cost Per MGD	\$99.51
Solids Handling per MGD	\$4.98
Total Power Cost per MGD	\$104.49

Annual costs associated with the operation and maintenance of the Flint Water Plant are summarized in the attached tables following this section.

IV. Project Implementation Schedule

There are a number of issues that will impact the implementation schedule for this work. The source water studies to define bin number associated with cryptosporidium and giardia will take approximately two years. Part of these studies can be performed concurrently with design, but sufficient work will need to be performed to avoid impacting design schedule or work. A planning period of one year should be allowed for preliminary water quality and regulatory evaluations prior to initiating design work. Design of this project will require 10 to 12 months, with an additional three months required for permitting. After permits are received, allow three months for bidding and contract execution. Major equipment procurement and construction will take from 24 to 30 months. Plant commissioning will take about 2 months.

Total time required from notice to proceed to project completion 52 months to 60 months. This time frame does not include financing issues.

Proposed Scope of Upgrades to Flint WTP

1. Introduction

The City of Flint plans to utilize their existing WTP to provide water on a continuous basis. The city plans to treat water from the Flint River until construction of the proposed KWA supply is complete and the WTP can then be used to treat water from Lake Huron. An evaluation of the WTP to provide treatment of water from both sources is in process to define the scope of upgrades needed to provide reliable service. In addition to the different treatment requirements of each source, the WTP has not been operated on a continuous basis for 40+ years so facilities are also being evaluated to identify equipment which should be replaced because of its age, condition, or obsolescence.

2. Preliminary Scope of Work

Based on the WTP evaluation, the following scope of proposed upgrades has been developed. This summary is preliminary, provided for review and comment by interested parties. Comments received will be used to finalize the scope of work to be implemented at the Flint WTP.

The proposed upgrades have been categorized into two phases. Phase 1 is work that will be completed as soon as practical so that the WTP can be utilized to treat water from the river in 2014. Phase 2 work is needed to provide long-term service with the proposed KWA Lake Huron water source. Phase 2 work will be completed in 2015 to 2016.

Work is proposed to be contracted except where noted "by city" the work is planned to be completed by City staff.

Item 1 – Chemical Systems / Ozone

Additional storage of nitrogen and oxygen will be provided for redundancy and 30 day capacity.

Existing ozone units will be serviced to prepare for continuous operation.

New alternative coagulant chemical feed system will be added for treatment of raw water from Lake Huron.

Phase 1	Phase 2
Oxygen and nitrogen storage	New coagulant feed system
Service existing ozone system (by city)	

Need Feed system OR New Coag?

Thought → Upgrade one trans
 \$ \$ For 54-0V gen.
 = Repl one gen. to provide gen.
 Aug 03 Datours
 - 2 Feeds didn't help

Item 2 – Electrical

The WTP presently uses 2400V as primary power. Power feeders and switchgear are rated at 5kV. Upgrading the primary power to 4160V will enable existing power feeders to provide twice the power and eliminate the need to install new feeder circuits throughout the WTP.

The current substation has two 2.5 MVA transformers running in parallel for a total capacity of 5 MVA. The transformers are obsolete. It is planned that the transformers and conductors to the WTP will be replaced to provide two independent power sources for redundancy. The existing on-site backup power generators are obsolete and inoperable. Since two independent power sources will be provided to the WTP, replacement of the generators is not proposed.

* Electrical switch gear and equipment at Pump Station 4 will be replaced. *

* If filter presses (or other equipment) are utilized for dewatering of softening sludge, a new power feed will be required to the equipment. — Rental option?

Electrical switch gear and equipment at Plant 2 will be replaced.

Phase 1	Phase 2
Upgrade existing substation and power supply	Upgrade power system at Plant 2
Upgrade facilities at Pump Station 4	
Power to filter presses? TBD	

Item 3 – Mid-Point Chlorination

Mid-point chlorination facilities are proposed, including the following principal components:

- Feeders, scales, monitors
- Piping, valves, and controls
- Scrubber
- Ton Containers
-

} Pipe to bottom

Phase 1	Phase 2
Mid-point chlorination	

Foundation?
↑

Ours Gen Co.
want to pay
for any type of
interconnect?

Item 4 – Security Measures

Add three additional security cameras to monitor the following areas:

- Chlorine storage area
- Oxygen and Nitrogen storage area
- East side of WTP property

Phase 1	Phase 2
Additional security cameras (by City)	

Item 5 – Low and High Service Pump Station No. 4

As a result of decreased demands, pumps at Pump Station No. 4 are "over-sized" and do not efficiently operate. Some of the pumps experience vibrations in the shafts and steady bearings. The existing pump station will be rehabilitated to replace "over-sized" pumps and obsolete equipment and provide needed maintenance. Proposed work includes:

- 25 mgd Low Service Pump No. 4 – upgrade motor to inverter duty, rehabilitate pump and piping, install new valve, and install new VFD
- 15 mgd Low Service Pump No. 6 – rehabilitate pump shaft and bearings
- Install two new High Service Pumps (15 mgd @190 feet TH, vertically mounted pumps with 800 HP 2400/4160 V inverter duty motors, with 20 feet of shaft and steady bearings)
- Replacement of existing piping, valves, supports, and bearings
- New intermediate platforms, ladders, & stairs
- New ventilation (for exhausting heat from VFD's)
- Install two medium voltage VFD units
- Demolition of existing equipment to accommodate new equipment

Rehabilitation of Pump Station No. 4 is planned to be completed in two phases. A new high service pump and a new low lift pump will be installed initially to provide efficient service during the period when water from the Flint River is treated. Additional high service and low lift pumps will be installed later to provide long-term reliable, efficient service.

Phase 1	Phase 2
Rehabilitate Pump 6 shaft and bearings (by City)	Rehabilitate 25 mgd Low Service Pump No. 4, new motor, new valve, new VFD
New High Service Pump No. 1	New High Service Pump No. 2
Install VFD for Pump No. 1	Install VFD for Pump No. 2
Provide ventilation for Pump No. 1	Provide ventilation for Pump No. 2
Demolition of existing equipment	Demolition of existing equipment

appeared adequate in survey?
Double check

Item 6 – Filter Transfer Station

Recent changes in regulations, enhanced CT is required. Additional CT can be provided by including the volume of the Dort Reservoir in the process train. However, because of its elevation with respect to other treatment processes, pumping will be required to utilize the reservoir. The proposed pumping facility will provide for the following:

- Three 12 mgd @ 40 ft TH vertical turbine pumps with 150 HP, 480 V inverter duty motors are planned.
- Valves and Controls
- Ventilation and boiler system
- Three low voltage VFD's
- Power feeders
- MEP
- Piping connections
- 200 feet of 30" water main
- 600 feet of 36" water main
- Site work, paving, & utilities

Gen Co. → start Mon.
2015 the
L. Huron River
tail lining also here to Monitor
River or we could work

Phase 1	Phase 2
Filter Transfer Pump Station	

Item 7 – SCADA

As new pumps, chemical systems, and controls are installed; instrumentation and monitoring should be provided. It is proposed that the SCADA network is upgraded to current technology and software and training provided in the initial phase.

Phase 1	Phase 2
SCADA Network Upgrade	SCADA Hardware (Phase 2)
Software and Training	
SCADA Hardware (Phase 1)	

Can this be part
of Gen. contr.'s back-up

Item 8 – Raw Water Piping Connection

The proposed KWA raw water pipeline will connect to the existing 72" PCCP finished water supply line near Center and Pierson Roads. (East of this connection, the 72" PCCP will be utilized by GCDC-WWS for distribution of finished water in the GCDC-WWS service area.) Raw water from Lake Huron will be conveyed to the WTP site via the 72" PCCP pipeline. On the WTP site, the 72" pipeline will be tapped for a 42" pipe and for a 36" pipe to convey raw water for treatment. The following work is proposed:

- Piping connections
- 900 feet of 42" water main
- 100 feet of 36" water main
- Roadway and site restoration
- Storm sewer relocation
- Control valve rehabilitation and replacement

Phase 1	Phase 2
	Raw water piping connections

3. Other Items to Address to Finalize Scope of Work

In addition to the upgrades proposed above, the following issues/questions need to be addressed before finalizing the scope of proposed upgrades to the WTP:

- a) Options for handling / disposal of lime sludge from softening operations (during period Flint River is water source)
- b) Requirements for CT and enhanced treatment
- c) Impacts of using river as continuous supply (quantity, quality monitoring & control, reservoir operating levels)
- d) Chemical storage options

FLINT WTP Meeting

8/27/13

MDER Regs to WTP op.

2 Phases — Get WTP ready for op.
via FLINT RIVER water till KWA
built
2 1/2 — 3 yrs

Phase I — what to do now — heading for FLINT
— start design l.p. (if not used for KWA)
Phase II — Lake water

Item

1 O₂/NOX tank — no 30 day sto.

Providing 1cl tank for O₂/NOX
headrooming to 30-day sto.

* 30 day supply is state guideline
— who is supplier? how quick? 25-30 days
only 2 hrs run till KWA could be OK

* Could not maintain O₂ conc. for study
based on O₃ study, but ↓ Cl₂ demand
destroyed Algae, back kill — sign
2.0 mg/L O₃ → 2-1 Log from E. coli
get rid of Organics, ↓ THM

Full WTP old load is; a 3.6 MVA

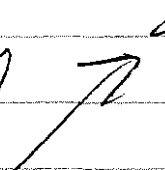
Another 1 transformer will not run ^{entire} WTP
issue

1 GEN or 2 GEN for Avg. DAY costs
& 1 sub. station

Item 3 - out (assoc. w. DORT)

Item 5

PH1 Now 15 MED H.S. w. VED/Ventilation
PH2 2nd 15 MED H.S.

Item 6 - Not doing  EXPANSION of
SCADA to all PLCs
& top. of distributed
PLCs

Item 7 - SCADA

Item 8 - RAW WATER connection

- planning for hard block on incoming
line

Now could use

Sledge - Biny Road out

- Old settling BASINS in WTP 1
- Rehab. Plate Presses (temp. structure) ^{n. end of} settling BASINS
or conveyor system
- Pump in / Pump out supernat. $\rightarrow$ Long term?

Filter re-cycle milk if re-cycle
line decant water

Size

may be more cost-effective to build temp
pressur & truck out

Dray Road - not option

- Primary need to form a better solid for
disposal

pot UV units - Pharo II wtl upgrade 2003
report

II or series?

- old filter tank station to
DORT - p.p. not installed
as we permitted

UV can be in II

at crypto credit - validated units $\rightarrow$ # lamps
dosage, etc

For
city

$\rightarrow$ All Approvals via EM/Treas. & how this
works out - will this get approved?

Recap - Pharo

& into DORT out

Look @ O₂/N₂ str

Elec. item - energy power VS pot. vol

and CL₂ out

Security - in

Send et
values

P.S. improvement - ok

Item 6 - out

SCADA -

Optans Lime Sledge

M.D.H. Ch in WTP to repl. & det. factor

- Item 8 - saved in piping connection

Move O&RT (int. P.S. transfer sta.) to Phase 2

(~~*~~ - Get refresh out for Review) -

Rennaker, Joanne (DEQ)

From: Brent Wright <bwright@cityofflint.com>
Sent: Tuesday, June 25, 2013 7:58 AM
To: Ashford, Stephen (DEQ); Busch, Stephen (DEQ); Prysby, Mike (DEQ); Daugherty Johnson; Dave Jansen; Howard Croft; John O'Malia; John O'Brien; Hansen, Jeff; Green, Warren; Michael Glasgow; Samir Matta
Subject: Flint Water Plant Meeting Reminder
Attachments: Flint WTP Mtg Agenda 6-26-13.doc

Gentlemen just a reminder of the scheduled 9 am meeting tomorrow at the Flint Water. A meeting agenda is attached. Have a great day.

Thank You,
Brent Wright

FLINT WTP FACILITY MEETING AGENDA

June 26, 2013

9:00 am

Discussion Topics

- I. Introductions
- II. Progress Update
 - A. Regulatory Needs for Interim & Long Term Operation
 - B. Scheduled Plant Run
 - C. Timing
 - D. Softening/Sludge Disposal
- III. Existing WTP Facility Anticipated Improvements
 - A. Plant Capacity/Hydraulics
 - B. Short Term Goal-Flint River
 - C. Long Term Goal-KWA
 - D. Project Costs/Budgets
 - 1. City
 - a) Test Run Mode
 - b) Flint River
 - c) KWA
 - 2. County
 - a) Test Run Mode
 - b) Flint River
 - c) KWA
- IV. Operational Considerations
 - A. Job Duties
 - B. Work Sharing
 - C. Operational/Product/Utility Costs
- V. Other Issues
- VI. Meeting Schedule

Rennaker, Joanne (DEQ)

From: Shekter Smith, Liane (DEQ)
Sent: Friday, March 22, 2013 8:41 AM
To: Donaldson, Kristina (DEQ); Prysby, Mike (DEQ)
Cc: Bloemker, Jon (DEQ); Benzie, Richard (DEQ); Busch, Stephen (DEQ); Butler, Sonya (DEQ); Willard, Veronica (DEQ)
Subject: FW: Flint Scenarios
Attachments: Flint Scenarios FY 2013-14.pdf; Recent DWSD Flint Supply Cost Options.pdf; TYJT Recommendation DWSD vs Flint.pdf; flint water supply assessment final report 2-6-13.pdf

Importance: High

Kris and Mike –

Note the assignment below, due next Wednesday morning at the latest.

I'll need a point person to coordinate this. Any volunteers – Steve? Richard?

Sonya – I cc'd you as an FYI (thought you'd find the assessment interesting).

Liane J. Shekter Smith, P.E., Chief
 Office of Drinking Water and Municipal Assistance
 Michigan Department of Environmental Quality
 517-373-9523

From: Sygo, Jim (DEQ)
Sent: Thursday, March 21, 2013 6:07 PM
To: Shekter Smith, Liane (DEQ); Creal, William (DEQ)
Cc: Willard, Veronica (DEQ); Smith, Laura (DEQ)
Subject: FW: Flint Scenarios
Importance: High

Bill and Liane,

Please have the attached documents reviewed and comments provided relative to the City of Flint water supply needs and relative to the impacts that are possible to the Detroit System.

Treasury needs an assessment as to the need for the alternative water supply and it's impacts so they can provide input to the financial managers.

We need comments by next week and will likely meet with the Director on Thursday.

Bring in whatever staff you need for the review and please try to have your assessments by Wednesday morning.

Sorry for the tight time frame but this one is out of my hands. I will also be looking at the report.

From: Wyant, Dan (DEQ)
Sent: Thursday, March 21, 2013 5:10 PM

To: Sygo, Jim (DEQ)
Cc: Shaler, Karen (DEQ); Thelen, Mary Beth (DEQ); Wyant, Dan (DEQ)
Subject: FW: Flint Scenarios
Importance: High

Jim,

Director asked that you reivew and coordinate this with with Liane Shekter Smith and/or Bill Creal and their appropirate staff. Director also asked that I schedule an internal meeting with you and staff on this for next week. After your review, please let me know who you want in the meeting. It needs to happen on Tuesday, Wednesday or Thursday of next week.

Thank you.

Mlary Beth

From: Stibitz, Brom (Treasury)
Sent: Thursday, March 21, 2013 5:00 PM
To: Wyant, Dan (DEQ)
Cc: Dillon, Andy (Treasury)
Subject: FW: Flint Scenarios

Andy asked that I pass this information along to you.

Summary of FY 2013-14 DWSD Cost Allocations to Flint Under Various Scenarios
Flint Only

	Revenue Requirement	Rates and Charges		
		Fixed	Commodity	Avg Unit Cost
1 Status Quo (<i>Flint Portion</i>)	12,574,900	379,304	13.01	20.39
2 Suggested Cct (<i>Flint Portion</i>)	11,281,100	351,661	12.06	19.27
3 Change	(1,293,800)	(27,643)	(0.95)	(1.12)
4 % Change	-10.3%	-7.3%	-7.3%	-5.5%
5 Max Day Only	9,904,300	294,542	10.87	16.91
6 Change	(1,376,800)	(57,119)	(1.19)	(2.36)
7 % Change	-13.9%	-19.4%	-10.9%	-14.0%
8 Add CTA Line to BP	10,093,100	310,271	10.87	17.23
9 Change	188,800	15,729	0.00	0.32
10 % Change	1.9%	5.1%	0.0%	1.9%
11 CTA to BP / Flint only to FWTP	12,446,300	506,371	10.87	21.25
12 Change	2,353,200	196,100	0.00	4.02
13 % Change	18.9%	38.7%	0.0%	18.9%
14 Add CTA Line to FWTP	10,191,200	318,450	10.87	17.40
15 Change	(2,255,100)	(187,921)	0.00	(3.85)
16 % Change	-22.1%	-59.0%	0.0%	-22.1%
17 CTA to FWTP / Buy existing 72	10,009,600	303,315	10.87	17.08
18 Change	(181,600)	(15,135)	0.00	(0.32)
19 % Change	-1.8%	-5.0%	0.0%	-1.9%
20 Cumulative Change	(2,565,300)	(75,989)	(2.14)	(3.31)
21 Cumulative % Change	-20.4%	-20.0%	-16.4%	-16.2%

	Assumptions				
	Avg Day mgd	Max Day mgd	Peak Hour mgd	DWSD Investment	
				CTA \$	Flint Only \$
1 Status Quo	24.6	45.6	47.7	0	0
2 Suggested Contract	23.4	40.6	42.4	0	0
3 Max Day Only	12.0	18.0	18.0	0	0
4 Add CTA Line to BP	12.0	18.0	18.0	62,290,800	0
5 CTA to BP / Flint only to FWTP	12.0	18.0	18.0	62,290,800	32,391,300
6 Add CTA Line to FWTP	12.0	18.0	18.0	94,682,100	0
7 CTA to FWTP / Buy existing 72	12.0	18.0	18.0	94,682,100	(2,500,000)

TFG

DWSD Worksheet : 18 MGD Maximum Day Customer with Model Contract Twinning Line and Owning both to the Flint WTP

Capacity

Flint ADD: 0.00 MGD - MCF/Day
 DWSD ADD: 12 MGD 1,604 MCF/Day

Annual Volume

Flint: - MCF
 DWSD: 585,561 MCF

2013 Cost of Supply

Flint WTP O&M: - /MCF \$ - /Yr
 DWSD: \$ 17.08 /MCF \$ 10,001,390 /Yr

Escalation/Inflation Rate

Flint: 4.51% /Yr
 DWSD: 4.7% /Yr

Capital Expenditure

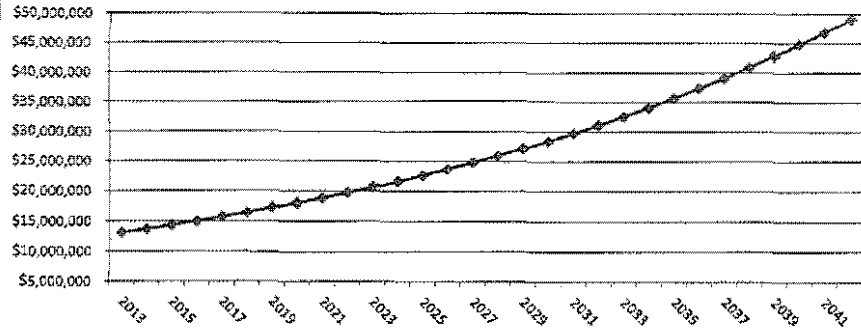
Amount: \$ -
 Reserve: \$ - 0% Reserve Rate: 0.00%
 Amount plus Reserve: \$ -
 Revenue Bond Rate: 5%
 Number of Years: 25
 Annual Cost: \$0

Year	Flint WTP O&M	Water Purchase	Revenue Bond Payment	Interest on Reserve	TOTAL
1 2013	\$ -	10,001,390	-	-	\$ 10,001,390
2 2014	\$ -	10,471,456	-	-	\$ 10,471,456
3 2015	\$ -	10,963,614	-	-	\$ 10,963,614
4 2016	\$ -	11,478,904	-	-	\$ 11,478,904
5 2017	\$ -	12,018,412	-	-	\$ 12,018,412
6 2018	\$ -	12,583,278	-	-	\$ 12,583,278
7 2019	\$ -	13,174,592	-	-	\$ 13,174,592
8 2020	\$ -	13,793,902	-	-	\$ 13,793,902
9 2021	\$ -	14,442,216	-	-	\$ 14,442,216
10 2022	\$ -	15,121,000	-	-	\$ 15,121,000
11 2023	\$ -	15,831,687	-	-	\$ 15,831,687
12 2024	\$ -	16,575,776	-	-	\$ 16,575,776
13 2025	\$ -	17,354,838	-	-	\$ 17,354,838
14 2026	\$ -	18,170,515	-	-	\$ 18,170,515
15 2027	\$ -	19,024,529	-	-	\$ 19,024,529
16 2028	\$ -	19,918,682	-	-	\$ 19,918,682
17 2029	\$ -	20,854,860	-	-	\$ 20,854,860
18 2030	\$ -	21,835,039	-	-	\$ 21,835,039
19 2031	\$ -	22,861,286	-	-	\$ 22,861,286
20 2032	\$ -	23,935,766	-	-	\$ 23,935,766
21 2033	\$ -	25,060,747	-	-	\$ 25,060,747
22 2034	\$ -	26,238,602	-	-	\$ 26,238,602
23 2035	\$ -	27,471,816	-	-	\$ 27,471,816
24 2036	\$ -	28,762,992	-	-	\$ 28,762,992
25 2037	\$ -	30,114,852	-	-	\$ 30,114,852
2038	\$ -	31,530,250	-	-	\$ 31,530,250
2039	\$ -	33,012,172	-	-	\$ 33,012,172
2040	\$ -	34,563,744	-	-	\$ 34,563,744
2041	\$ -	36,188,240	-	-	\$ 36,188,240
2042	\$ -	37,889,088	-	-	\$ 37,889,088

25 Yrs Cumulative
 \$ 458,060,853

30 Yrs Cumulative
 \$ 631,244,349

**DWSD 18 MGD Maximum Day Customer Twinning Option DWSD
Owns Both Lines**



DWSD Worksheet : 18 MGD Maximum Day Customer with Model Contract Twinning Line and Owning Only New Line to the Flint WTP

Capacity

Flint ADD: 0.00 MGD - MCF/Day
 DWSD ADD: 12 MGD 1,604 MCF/Day

Annual Volume

Flint: - MCF
 DWSD: 585,561 MCF

2013 Cost of Supply

Flint WTP O&M: - /MCF \$ - /Yr
 DWSD: \$ 17.40 /MCF \$ 10,188,770 /Yr

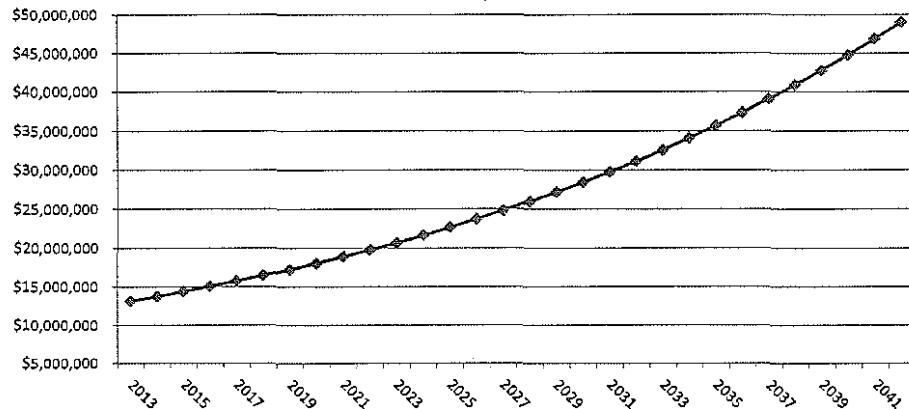
Escalation/Inflation Rate

Flint: 4.51% /Yr
 DWSD: 4.7% /Yr

Capital Expenditure

Amount: \$ -
 Reserve: \$ - 0% Reserve Rate: 0.00%
 Amount plus Reserve: \$ -
 Revenue Bond Rate: 5%
 Number of Years: 25
 Annual Cost: \$0

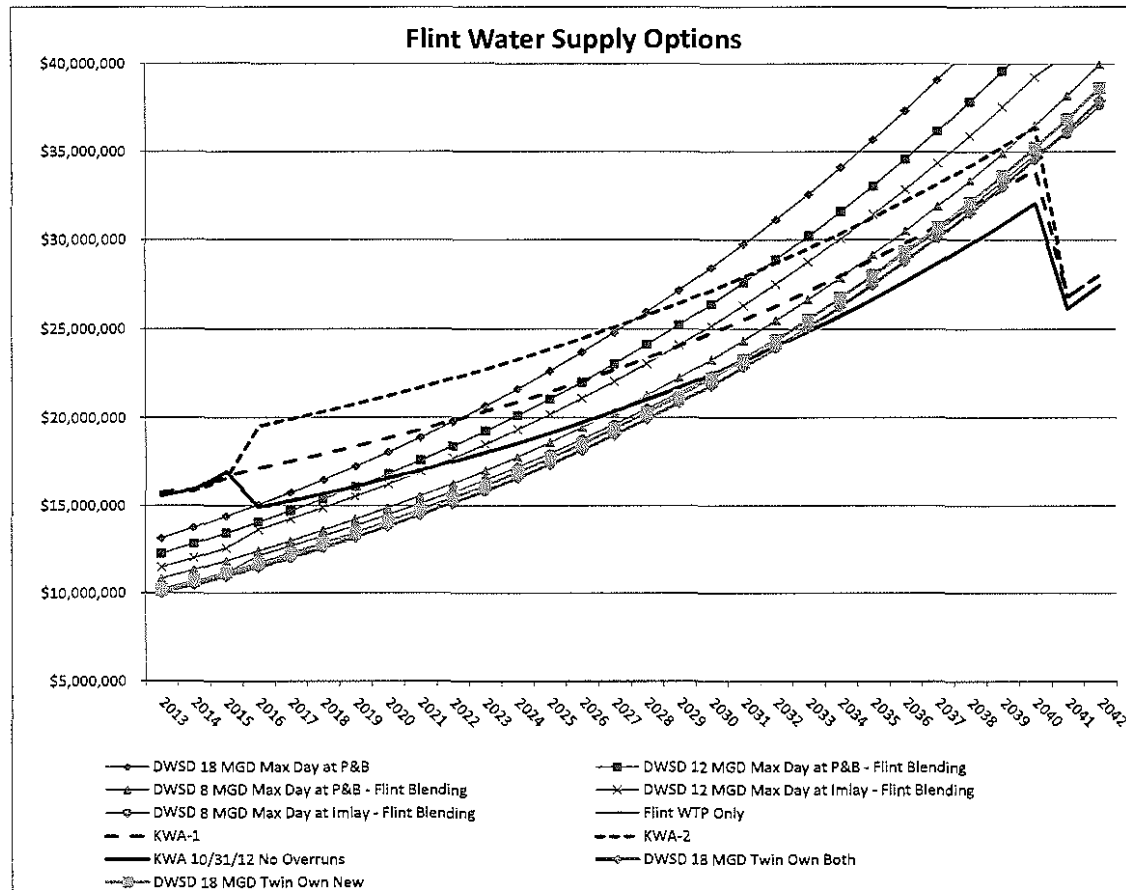
DWSD 18 MGD Maximum Day Customer Twinning Option DWSD Owns New Line



				Water	Revenue	Interest	
	Year	Flint WTP	O&M	Purchase	Bond	on	TOTAL
					Payment	Reserve	
1	2013	\$	-	10,188,770		-	\$ 10,188,770
2	2014	\$	-	10,667,642		-	\$ 10,667,642
3	2015	\$	-	11,169,021		-	\$ 11,169,021
4	2016	\$	-	11,693,965	-	-	\$ 11,693,965
5	2017	\$	-	12,243,582	-	-	\$ 12,243,582
6	2018	\$	-	12,819,030	-	-	\$ 12,819,030
7	2019	\$	-	13,421,525	-	-	\$ 13,421,525
8	2020	\$	-	14,052,336	-	-	\$ 14,052,336
9	2021	\$	-	14,712,796	-	-	\$ 14,712,796
10	2022	\$	-	15,404,297	-	-	\$ 15,404,297
11	2023	\$	-	16,128,299	-	-	\$ 16,128,299
12	2024	\$	-	16,886,330	-	-	\$ 16,886,330
13	2025	\$	-	17,679,987	-	-	\$ 17,679,987
14	2026	\$	-	18,510,946	-	-	\$ 18,510,946
15	2027	\$	-	19,380,961	-	-	\$ 19,380,961
16	2028	\$	-	20,291,866	-	-	\$ 20,291,866
17	2029	\$	-	21,245,584	-	-	\$ 21,245,584
18	2030	\$	-	22,244,126	-	-	\$ 22,244,126
19	2031	\$	-	23,289,600	-	-	\$ 23,289,600
20	2032	\$	-	24,384,211	-	-	\$ 24,384,211
21	2033	\$	-	25,530,269	-	-	\$ 25,530,269
22	2034	\$	-	26,730,192	-	-	\$ 26,730,192
23	2035	\$	-	27,986,511	-	-	\$ 27,986,511
24	2036	\$	-	29,301,877	-	-	\$ 29,301,877
25	2037	\$	-	30,679,065	-	-	\$ 30,679,065
	2038	\$	-	32,120,981	-	-	\$ 32,120,981
	2039	\$	-	33,630,667	-	-	\$ 33,630,667
	2040	\$	-	35,211,309	-	-	\$ 35,211,309
	2041	\$	-	36,866,240	-	-	\$ 36,866,240
	2042	\$	-	38,598,953	-	-	\$ 38,598,953

25 Yrs Cumulative
 \$ 466,642,790

30 Yrs Cumulative
 \$ 643,070,941



Option	Costs through 2042	Ranking
Flint WTP Only	\$ 590,441,893	1
DWSD 8 MGD Max Day at Imlay	\$ 634,795,488	2
KWA 10/31/12 Update	\$ 649,775,166	3
DWSD 8 MGD Max Day at P&B	\$ 672,671,705	4
KWA-1	\$ 707,279,715	5
DWSD 12 MGD Max Day at Imlay	\$ 725,576,803	6
DWSD 12 MGD Max Day at P&B	\$ 762,110,308	7
KWA-2	\$ 766,784,313	8
DWSD 18 MGD Max Day at P&B	\$ 821,226,268	9
DWSD 18 MGD Max Twin Own Both	\$ 631,244,349	
DWSD 18 MGD Max Own New Line	\$ 643,070,941	



STATE OF MICHIGAN CONTRACT NO. 271N3200089

CITY OF FLINT WATER SUPPLY ASSESSMENT

At the request of the Treasurer, Tucker, Young, Jackson, Tull, Inc. (TYJT) makes the following recommendation to the Department of Treasury concerning Flint's water supply alternatives. Based on the financial analysis performed of the various options presented by DWSD to continue treated water service to Flint compared to Flint being supplied by the new KWA untreated water system, TYJT believes that several of the options presented by DWSD are lower in cost currently and over the long run than the one offered by KWA. TYJT also believes that DWSD's most recent offer (subsequent to the submittal of our report) to build a smaller parallel water main from Imlay to Flint, funded by the entire DWSD base of customers, is the best solution offering the least cost alternative and the required redundancy by MDEQ.

Furthermore, since a majority of the KWA system has not been designed and none of the system has been constructed, there is an additional risk that the cost of the KWA system may actually be higher than estimated due to potential construction delays and unforeseen conditions. This risk to Flint could be substantial since the city is responsible for 30 percent of the KWA design and construction costs while still having to purchase water from DWSD during the construction period.

Finally, there are other issues that were identified in our report that may result in risks to Flint if it were to join KWA that should be considered by the Treasury in determining how Flint's potable water should be supplied. These issues are related to redundancy and reliability, other items affecting cost, and Flint's desire to control its own destiny related to its water supply. These are described further below.

- DWSD's supply to Flint is via a 72-inch water main from Imlay City. This main also supplies Imlay City, Mayfield and the Greater Lapeer County Utilities Authority (GLCUA). The volume of water contained within the 72-inch main is approximately 30 million gallons. If Genesee and Flint move to KWA then the three remaining communities' consumption would most likely not be large enough to maintain fresh water in DWSD's pipeline (due to loss of chlorine residual). DWSD may consider shutting down the 72-inch line completely due to the water quality concerns, which would then create an additional burden for Imlay, Mayfield and GLCUA to finance treated water supplies.
- The KWA supply option is counter to the Treasury's Competitive Grant Assistance Program (Formerly EVIP Grant). This program has been put in place to allow for communities to consolidate their services and save money. Two existing customers of DWSD (Flint and Genesee County) along with the potential of others customers (GLCUA, Mayfield, Imlay City) separating from another water system is in contradiction to the program.
- There is a concern over the ability of smaller systems (KWA) over larger systems (DWSD) to pay for future unfunded mandates and regulations. Obviously, identifying regulation requirements over 30 years is hard to determine. However, it is widely accepted that a large system has greater ability to respond to unfunded mandates because the cost can be distributed over a large customer base.
- Although Flint will be responsible for 30 percent of the construction cost, they will only have a minority vote on the KWA board. Furthermore, there are other communities (Lapeer County, the City of Lapeer, and Sanilac County) that sit on the board and vote. However, they are not purchasing water nor contributing to the construction costs. Their position on the KWA Board will not provide them an ability to "control their own destiny," as they have stated to the Treasury.

STATE OF MICHIGAN CONTRACT NO. 271N3200089

CITY OF FLINT WATER SUPPLY ASSESSMENT
February 2013

For Submittal to:
State of Michigan, Department of Treasury



Submitted by:

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Table of Contents

Table of Contents	i
Figures	ii
Tables	ii
Appendices	ii
1. Introduction	1
Report Organization	1
2. Flint Water Supply Options	2
Karegnondi Water Authority (KWA) Lake Huron Water Supply	2
DWSD Water System	3
3. Data Collection	6
4. Cost of Service	8
DWSD Water Supply	8
KWA Water Supply	10
Flint WTP	11
5. Capital Requirements	12
KWA Supply System	12
Lake Intake	12
Pumping Stations	13
Transmission Main	13
Other KWA Costs	14
Summary	14
Flint WTP Improvements	15
DWSD Inlay Station Supply Options	15
Financing	15
6. Findings	17
7. Other Considerations	19
Redundancy/Reliability	19
Additional Cost Considerations	20
Flint's Autonomy	20

Figures

Figure 2-1: KWA Raw Water System	5
Figure 2-2: DWSD Water System	4
Figure 6-1: Flint Water Supply Options through 2042	18

Tables

Table 2-1: DWSD Supply Options	5
Table 4-1: Cost of DWSD Supply Options	8
Table 4-2: Recent DWSD Water Rates	9
Table 4-3: O&M Inflation Rates of Other Large Water Systems	10
Table 4-4: O&M Inflation Rates of Other Comparable Systems to KWA	11
Table 4-5: FY 13 O&M Costs for Year-round Operations	11
Table 5-1: KWA Intake Cost Estimate	12
Table 5-2: Pumping Stations Cost Estimate	13
Table 5-3: Transmission Pipeline Cost Estimate	14
Table 5-4: Other Costs	14
Table 5-5: Total Cost Comparison	15
Table 6-1: Total Cost of Options through 2042	17

Appendices

Appendices A – Meeting Minutes

Appendix B – Cost Worksheets

1. INTRODUCTION

Tucker, Young, Jackson, Tull, Inc. (TYJT), at the request of the State Treasurer performed an analysis of the water supply options being considered by the City of Flint. The City of Flint is presently supplied potable water from the Detroit Water and Sewerage Department (DWSD). This supply is from a single 72-inch water main that terminates at a master meter located at Potter and Baxter. Additionally, downstream of the DWSD master meter, Flint supplies its customer Genesee County. The City of Flint also operates a water treatment plant that uses the Flint River as its source of supply to provide back up and redundancy to the DWSD supply as required by MDEQ.

The Karegnondi Water Authority (KWA) is planning on constructing a raw water supply system that could provide Lake Huron water to the Flint Water Treatment Plant. Flint's existing plant would be upgraded to treat the new raw water source.

The State Treasurer has appointed an emergency financial manager for the City of Flint. As such the Treasurer has requested TYJT to provide an analysis of the water supply options to assist the Treasurer in determining any potential risk and the best course going forward for supplying potable water to the City of Flint.

Report Organization

The following sections of this report are described below:

Section 2 – The basis of the analysis is described in this section. The options include the KWA option and several options offered by DWSD.

Section 3 – A significant amount of information and data was collected including memorandums, reports, drawings, financial reports, and other documents. This section summarizes the information used in the analysis.

Section 4 – This section describes the evaluation of the cost of supply for the Flint options. The costs are comprised of the initial cost of operations plus the annual rate of escalation/inflation.

Section 5 – The evaluation process used to analyze the construction costs associated with the KWA supply system is described in this section. Additionally, the cost of financing the capital requirements is described.

Section 6 – This section presents the financial review of the options considered to supply potable water to Flint. A summary of these options is also provided.

Section 7 – In addition to the financial analysis other considerations were identified that should be considered in understanding the risks and determining the best option to supply Flint. They include items related to cost, redundancy and reliability, and Flint's ability to control their future cost of water supply.

2. FLINT WATER SUPPLY OPTIONS

Two water purveyor options were evaluated; the KWA water supply system and continued supply from DWSD. Both suppliers would provide water from Lake Huron as the source. The KWA system is a raw water supply, which means that the water would have to be treated by Flint before distributing the potable water to its customers. The DWSD supply is potable or "finished" water and would not need additional treatment.

Additionally, an option for the Flint WTP to supply the City of Flint without being supplied from either DWSD or KWA was initially considered. The preliminary investigation evaluated the cost associated with the required improvements to the plant and to the Flint River dam system. Although it appeared that this was a viable option, Flint in a meeting on December 20, 2012 with the Treasury, stated that the City did not want to pursue the option and it is no longer being considered.

Karegnondi Water Authority (KWA) Lake Huron Water Supply

The KWA water supply system schematic is shown in Figure 2-1. The system is comprised of an intake in Lake Huron that supplies water to the Lake Huron Pump Station (LHPS). The LHPS lifts the water and pumps it through an approximately 22 mile long 60-inch pipeline. The pipeline terminates at a 5 MG reservoir and is then pumped from the Intermediate Pump Station (IPS) through approximately 26 miles of 60-inch and 18 miles of 30-inch pipeline to the existing Flint WTP. Downstream of the IPS, approximately half way to the Flint WTP, the 60-inch line would also supply a new Genesee County WTP.

The raw water transmission system has a 60 MGD capacity and is sized to deliver a maximum of 18 MGD to the Flint WTP with an average day supply of 12 MGD. Improvements at the Flint WTP would also be required to treat the lake water as the plant is currently designed to treat the Flint River water.

The term of the KWA contract for Flint is 40 years.

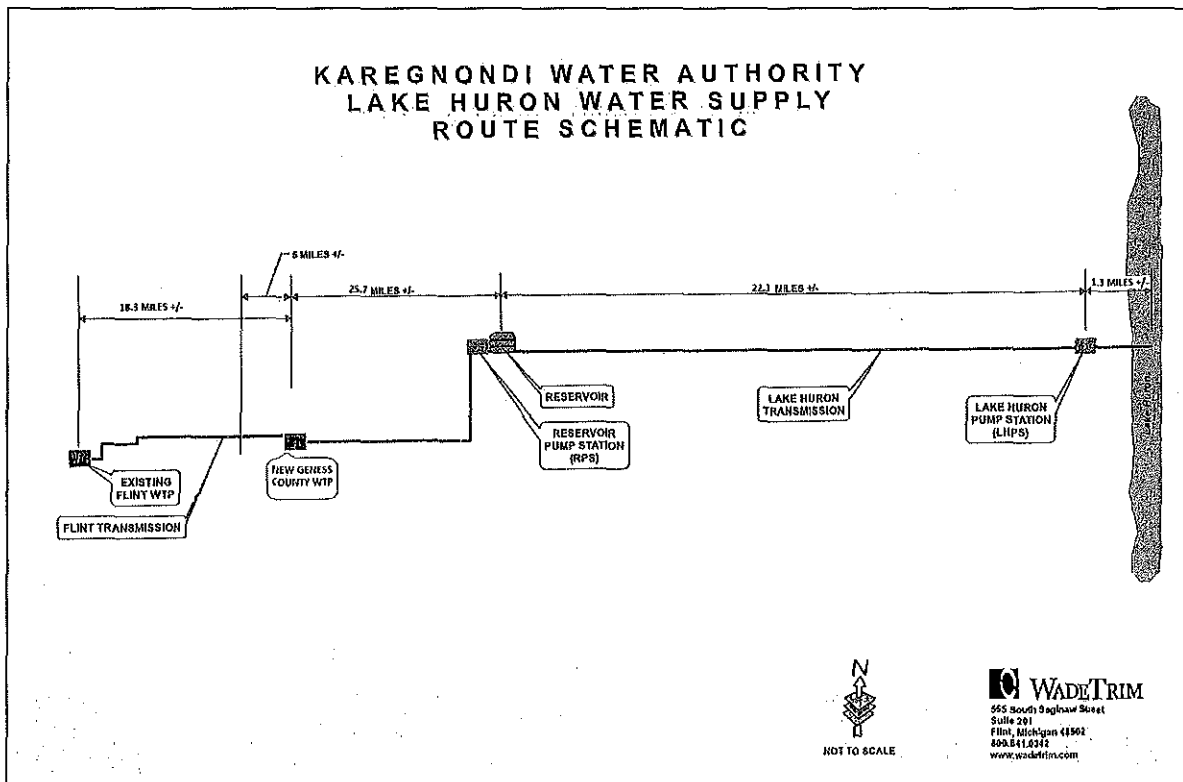


Figure 2-1: KWA Raw Water System

DWSD Water System

The DWSD system schematic is shown in Figure 2-2. Flint is currently supplied by DWSD at Master Meter FL-1, located at Potter and Baxter. Flint typically gets its water from the Lake Huron WTP, located in Fort Gratiot, Michigan; near the Lake Huron shoreline. Water is treated and pumped at the Lake Huron WTP and supplied through a 120-inch pipeline to an intermediate pump station called the Imlay Pump Station. The Imlay Pump Station has 20 MG of reservoir capacity. Depending on the time of year and the DWSD system demand, water is either bypassed directly to Flint or it is re-pumped at Imlay. It should be noted that the DWSD supply to Flint is part of a very large water system and during emergencies or outages water can be supplied from the south up to Flint in lieu of the Lake Huron facility.

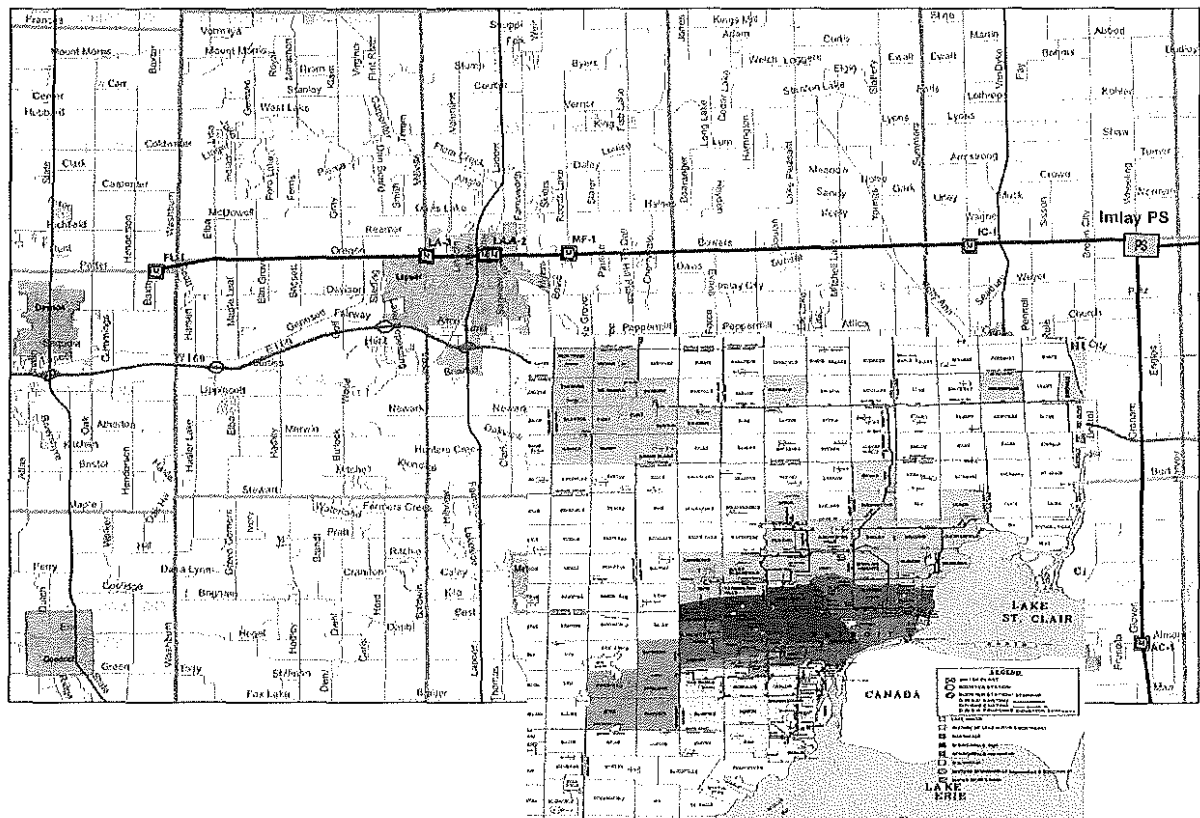


Figure 2-2: DWSD Water System

The pipeline from Imlay to FL-1 is a 72-inch pipeline. It has been estimated that the 72-inch line serving Flint has a capacity in excess of 90 MGD.

DWSD has presented several contractual options to Flint and all of them are based on Flint signing a new 30 year contract. The options shown in Table 2-1 are based on two different supply points; one at the current master meter location FL-1 at Potter and Baxter (P&B) and the other at the location of the Imlay Pump Station. The reason for the varying options is to provide a lower water rate at the Imlay Station, since the DWSD rate formula is based on distance and elevation factors related to the supply location.

The rates are also dependent on the maximum amount of water DWSD supplies. As example, if DWSD supplies a maximum day demand of 18 MGD that would equal the entire amount of water required by Flint.

For the options less than the maximum of 18 MGD means that the Flint WTP would supplement the difference by supplying water treated from the Flint River. These options are known as “blending” and would allow for Flint to blend two sources of water to supply its customers; the Flint River using the Flint WTP and Lake Huron from DWSD system.

Description	Average Day Demand
18 MGD Maximum Day Customer – FL-1	12 MGD
12 MGD Maximum Day Customer – FL-1	8 MGD
8 MGD Maximum Day Customer – FL-1	8 MGD
12 MGD Maximum Day Customer - Imlay	12 MGD
8 MGD Maximum Day Customer - Imlay	12 MGD

Table 2-1: DWSD Supply Options

3. DATA COLLECTION

During the course of the investigation several documents were used to perform the analysis. The names of the documents are listed below for reference.

KWA and Flint

- Preliminary Engineering Report, Lake Huron Water Supply Karegnondi Water Authority, September 2009;
- Analysis of the Flint River as a Permanent Water Supply for the City of Flint, July 2011;
- Cost Comparison, KWA vs. DWSD, Letter to Mr. Kurtz, October 31, 2012;
- Lake Huron Supply Study, KWA, Appendix 20, October 2012 Preliminary Report Update, Final Report (DRAFT), October 4, 2012;
- Articles of Incorporation of Karegnondi Water Authority, endorsed in 2010;
- Karegnondi Water Authority Bylaws, October 26, 2010;
- KWA Raw Water Supply Contract;
- Flint WTP Statement of Revenues and Expenditures 09' – 12';
- GCDC Division of Water and Waste Services Financial Statements 03' – 11'; and
- Assorted emails with further clarification of questions and documentation.

DWSD

- Historical Rates and Charges to Flint 04' – 13';
- Historical Rates and Charges to Flint with Hypothetical Model Contract 10' – 13';
- 2013 Rates and Charges for the following options:
 - 18 MGD Maximum Day Customer at FL-1;
 - 12 MGD Maximum Day Customer at FL-1 (Flint blending*);
 - 8 MGD Maximum Day Customer at FL-1 (Flint blending*);
 - 12 MGD Maximum Day Customer at Imlay (Flint blending*);
 - 8 MGD Maximum Day Customer at Imlay (Flint blending*); and
- Assorted emails with further clarification of questions and documentation.

- * Flint blending based on DWSD supplying two-thirds and Flint one-third of 12 MGD average day demand.

Two meetings were also held; one with DWSD and one with Flint and Genesee County representing KWA. The meetings were held on November 19, 2012 and November 20, 2012, respectively. Minutes from these meetings are included in Appendix A.

4. COST OF SERVICE

Information provided by DWSD, Flint, and representatives of the KWA were used in the cost of service evaluation. To evaluate the annual escalation/inflation rate over the planning period, the rate adjustment for DWSD was estimated based on the recent rate adjustment history. For the KWA system both the estimated cost of operations when the system begins supplying water and the annual rate adjustment or inflation was evaluated. The existing cost of operations and escalation for the Flint WTP was based on actual costs provided and then adjusted depending on the scenario considered. This section describes the evaluation process and the rates used in the analysis.

DWSD Water Supply

The City of Flint has been a customer of DWSD since 1967. The Flint WTP has been maintained as a backup to the DWSD system. As indicated previously, several options were provided by DWSD depending on the type of service Flint was to select. The unit cost of water for each of these options is shown in Table 4-1. These rates are based on DWSD's FY13, which are current until July 2013.

Service Option	Volume (MGD)	Unit Cost (\$/MGD)
18 MGD Maximum Day Customer – FL-1	12	16.37
12 MGD Maximum Day Customer – FL-1	8	16.31
8 MGD Maximum Day Customer – FL-1	8	12.68
12 MGD Maximum Day Customer - Imlay	12	14.38
8 MGD Maximum Day Customer - Imlay	12	11.11

Table 4-1: Cost of DWSD Supply Options

To determine annual escalation rate, DWSD's last 10 years of history was used along with other large urban water systems in Michigan. The water systems used for benchmarking comparison were: Lansing, Grand Rapids, and Saginaw.

Table 4-2 identifies the annual and average rate of increase to Flint based on supplying water either to the current FL-1 at Potter and Baxter or Imlay. Note the last three years of the rates (FY 2011 through FY 2013) assumes that Flint's cost would be based on the new 30 year contract; FY 2011 being the first year that the new contract was available.

Fiscal Year	Average Unit Cost (\$/MCF)	Annual Change (%)
2004	11.06	
2005	10.24	-7.4
2006	10.56	3.1
2007	11.09	5.0
2008	11.35	2.3
2009	13.07	15.2
2010	11.73	-10.3
2011	13.89	18.4
2012	15.08	8.6
2013	16.24	7.7
Average		4.4%

From FL-1

Fiscal Year	Average Unit Cost (\$/MCF)	Annual Change (%)
2004	11.06	
2005	10.24	-7.4
2006	10.56	3.1
2007	11.09	5.0
2008	11.35	2.3
2009	13.07	15.2
2010	11.16	-14.6
2011	12.23	9.6
2012	13.28	8.6
2013	14.32	7.8
Average		2.9%

From Imlay

Table 4-2: Recent DWSD Water Rates

Audited financial reports were used to determine the rate of inflation associated with other three large municipal systems. The results are shown in Table 4-3.

Water Systems	Years Evaluated	Average Rate (%)
Lansing	05'-12'	4.6
Grand Rapids	04'-11'	1.6
Saginaw	04'-11'	7.0

Table 4-3: O&M Inflation Rates of Other Large Water Systems

Based on the information analyzed from DWSD and the other communities, it was determined that a fair annual rate of inflation for operations and maintenance cost for the analysis should be 4.4%. The 4.4% has historical significance from Flint's current water supplier and falls within the range of the other communities.

KWA Water Supply

The initial projected O&M cost for the KWA supply would be comprised of KWA's O&M costs as well as Flint's O&M costs. Because there was limited information provided, the initial estimated rate of \$1.50/MCF was used. This rate is based on information from the cost comparison analysis attached to the letter to Mr. Kurtz, dated October 31, 2012.

The KWA cost evaluation used an annual O&M inflation rate of 5%. To validate this rate a similar analysis to DWSD's operations and maintenance annual rate of inflation was used. First, in discussions with Flint and the Genesee County Drain Commission (GCDC), they believed that the annual rate of inflation for the new KWA system would be similar to the GCDC Water & Waste Services (WWS). Additionally, two large transmission systems were used to benchmark the inflation rates: the Southeastern Oakland County Water Authority (SOCWA) and the Ypsilanti Utility Community Authority (YUCA). Although both of these systems transmit finished water opposed to raw water, they were considered similar enough for comparison as they are comprised of only large water mains, pumping facilities and storage.

Once again audited financial statements were used to calculate the inflation rates. A summary of the findings are shown in Table 4-4. Based on the fact that the information analyzed showed a large difference between the two systems, it was determined that the KWA assumption of 5% was a good rate of inflation to use in the financial analysis. This rate is almost equally between the GCDC rate and the other two transmission systems.

Systems	Years Evaluated	Average Rate (%)
GCDC WWS	03' – 11'	10.5
SOCWA	04'-12'	--
YUCA	04'-12'	0.7

Table 4-4: O&M Inflation Rates of Other Comparable Systems to KWA

Flint WTP

The Flint WTP currently serves as a backup supply to the DWSD service to Flint. To maintain backup operations, the City of Flint operates the plant approximately 20 days each year. Flint indicated that the average production rate when they operate is 11 MGD.

For the blending options and the KWA supply considered, Flint would be required to operate its plant all year around. Therefore, their operating and maintenance costs were evaluated and adjusted to determine an annual cost associated with year-round operations.

The Flint WTP provided three years of operating costs for the assessment. Additionally, reports listed in Section 3 were also used as reference to determine both operating costs for the plant processing Flint River water (blending options) and Lake Huron raw water (KWA option).

Major cost centers were analyzed to estimate annual operation and maintenance. They included: labor, utilities, chemicals and residual management. In general, as recommended by the Flint plant staff, labor and overhead were increased from the current costs by two-thirds. Additionally, variable costs for power, chemicals and residual cost were increased to estimate full time treatment at the Flint WTP. Data from the KWA Preliminary Report and annual operating data for the Flint WTP (provided separately) were analyzed to make these forecasts.

The annual operating and maintenance costs developed for Flint WTP used are shown in Table 4-5.

Source of Supply	Average Daily Production (MGD)	Estimated Annual O&M Cost
Flint River (Blending with DWSD)	4	\$5,895,097
Lake Huron (Supplied by KWA)	12	\$7,913,118

Table 4-5: FY 13 O&M Costs for Year-round Operations

It was determined that a fair annual rate of inflation for operations and maintenance cost for the Flint WTP plant should be 4.51%. The 4.51% is an average of Lansing, Grand Rapids and Saginaw facilities.

5. CAPITAL REQUIREMENTS

Large capital investments would be required by Flint and GCDC to construct the KWA supply system. Furthermore, some of the options presented by DWSD (supply point from Imlay) would require the purchase by Flint of DWSD's 72-inch water main. Performing the financial analysis; therefore, required an analysis of the KWA construction cost estimate for the transmission system and Flint WTP improvements.

Revenue bonds were also identified as the source of financing the new supply system and associated improvements. This section describes the assumptions made and the interest used for financing the improvements.

KWA Supply System

The most current cost estimate of the KWA system was presented in the document titled; Lake Huron Supply Study, KWA, Appendix 20, October 2012 Preliminary Report Update, Final Report (DRAFT), October 4, 2012. The cost of construction is estimated at \$272,421,558. Flint's portion would be 30% or \$81,726,467.

Due to the significance of this expenditure, a detailed review of the cost was performed and is presented in this section. The analysis was performed based on the main elements of the supply system: the lake intake, the two pumping stations, and the transmission pipeline. Additionally, an analysis was performed related to construction contingencies and other costs such as engineering, legal, and administration.

Lake Intake

KWA representatives indicated in a meeting in November that the design documents for the intake were at 90% and that it was planned for advertisement in January 2013. A summary of the estimate is shown in Table 5-1.

Description	Estimate
Intake and Crib	\$22,076,850
ELAC at 25%	5,519,213
Property	2,300,000
Total	\$29,896,063

Table 5-1: KWA Intake Cost Estimate

Based on the evaluation, it appeared that the cost estimate was reasonable. Given that the design was nearly complete, the engineering, legal, administration, and construction contingencies (ELAC) at 25% were also found to be appropriate.

Pumping Stations

KWA representatives indicated that the pump stations were estimated at a level of design less than 15%. Therefore, in addition to an evaluation of their cost estimate, other water pumping station costs were used for comparison. Additionally, contractors were also contacted for costs. Table 5-2 summarizes the KWA cost estimate compared to our cost estimate performed for the Treasury.

Description	KWA	Estimate	TY/T	Estimate
Pumping Stations		\$24,618,080		\$54,573,314
Land for Intermediate Pump Station and Reservoir		--		75,000
Subtotal		\$24,618,080		\$54,648,314
ELAC for Construction	25%	6,154,520	30%	16,394,494
Total		\$30,772,600		\$71,042,808

Table 5-2: Pumping Stations Cost Estimate

Two things to note regarding the difference in the cost estimates; firstly, there is a large difference in the cost estimates of the pumping stations. The estimate developed for the Treasury used several other pumping stations construction costs from Southeastern Michigan and discussions with contractors. These costs were then computed on a \$/MG's for comparison.

Secondly, our estimate for the Treasury is based on an ELAC of 30% instead of KWA's 25%. Although 25% was acceptable for the intake, it is believed to be too low for the pumping station estimate given that the engineering effort is less than 15%.

Transmission Main

Although the specific route for the transmission main was not provided, an estimate was calculated based on the general information provided. Once again, the KWA estimate was based on a level of design less than 15%. The estimate performed for the Treasury used the line items provided by KWA for the pipeline and also consulted with contractors to evaluate the cost of construction. The comparison is shown in Table 5-3.

Although the cost of construction of the pipeline is similar, a value of 30% was used for ELAC due to the level of design. Additionally, KWA did not believe there would be any additional costs for easements; however, this did not seem practical. Therefore an estimate for acquiring the easements was added to the Treasury estimate and is based on the 277 easements identified by KWA. The cost shown includes surveying, legal, engineering, administration, etc.

Description	KWA	Estimate	TYJT	Estimate
Transmission Mains		\$166,202,316		\$167,419,530
ELAC for Construction	25%	41,550,579	30%	50,225,859
Subtotal		\$207,752,895		\$217,645,389
Easements		--		1,166,170
Total		\$207,752,895		\$218,811,559

Table 5-3: Transmission Pipeline Cost Estimate

Other KWA Costs

In prior estimates of the construction cost, KWA used an ELAC of 37%. In this case it could be considered that the engineering effort associated with the design would have been included. However, it is believed that KWA's reduced ELAC of 25%, does not include the design effort. Additionally, it would be prudent to assume that the owner would want a construction manager during construction of this large project. A summary of these costs are shown in Table 5-4.

Description	Estimate
Design Engineering for Pumping Stations and the Transmission Pipeline	\$16,939,581
Construction Management at 5% of Project Cost Estimate of \$217,645,389	14,434,609
Administration	349,440
Legal, Easements, Contract Documents	831,000
Total	\$32,554,630

Table 5-4: Other Costs

Summary Comparison

A summary of the two cost estimates are shown in Table 5-5. Based on the comparison, the estimate performed by TYJT shows a higher cost to Flint by approximately \$25,000,000.

Note that there are two other costs shown in the summary that were not previously addressed; power and backup power. Regarding the cost of providing power to the pumping facilities, the cost of \$4,000,000 appears reasonable.

The KWA has repeatedly indicated that backup power is not needed. Backup power is a standard practice in the water industry. Furthermore, a loss of power at either pumping facility will prevent the supply of water to both Flint and Genesee County. For these reasons, the cost of providing backup power was included in our estimate for the Treasury.

Intake/Crib	\$ 27,596,063	\$ 27,596,063
Pump Stations	30,772,600	71,042,808
Transmission Mains	207,752,895	217,645,389
Power	4,000,000	4,000,000
Redundant Power for PS		1,273,200
Land for Lake Huron Pumping Station	2,300,000	2,300,000
Design Engineering/PS and Transmission		16,939,581
Construction Management		14,434,410
Administration		349,440
Legal/Easement/Contract Documents		831,000
Easements		1,166,170
Total	\$ 272,421,558	\$ 357,578,060
Flint Share at 30%	\$81,726,467	\$107,273,418

Table 5-5: Total Cost Comparison

Flint WTP Improvements

The KWA analysis identified capital costs required to convert the existing WTP from river water treatment to treating lake water. The cost estimate was identified as \$7,100,000 in the 2009 report. This number was used in the our analysis, since additional information was not provided. For the purpose of the financial analysis; however, the \$7,100,000 was increased by 3% each year for three years to account for inflation.

DWSD Imlay Station Supply Options

The options identified by DWSD to supply service to Flint at the Imlay Pump Station would require Flint to purchase the 72-inch water main from Imlay to Master Meter, FL-1. The pipeline is approximately 25 miles long. The estimated cost provided by DWSD for estimating purposes is \$4,700,000.

Financing

The cost of financing the revenue bonds for the capital work was investigated. Based on conversations with local financial advisors knowledgeable in bond financing, an interest rate of 5% for the 25 year

period was considered acceptable. This is based on a Standard and Poor's bond rating of A without insurance.

Additional costs associated with the bond include the reserve and bond issuance fee. The bond holders will require a reserve of approximately 10% of the loan to be held for the 25 year payment period. The cost associated with the bond issuance has been estimated at 2.25% of the principal borrowed for the KWA project and 3% for the smaller loan associated with the Flint WTP improvements or the purchase of the 72-inch main.

Furthermore, since no revenue will be generated to pay on the bonds for the first three years that the system is being constructed, the cost associated with capitalizing the interest was also included.

Finally, interest on the reserve will be provided back to KWA and Flint. Although the interest is currently less than 1%, it was determined that a 3% rate would be more prudent long-term.

6. FINDINGS

Using the information described in the previous sections, a cost evaluation was conducted for the KWA supply and the DWSD options. Individual worksheets for each option are provided in Appendix B. For the purpose of comparison a 30 year period was used. This period includes the 3 year construction period, the 25 loan period and an additional two years to get a sense of the cost of operation after the loans have been paid.

There were three separate cost sheets prepared for the KWA option. The first cost sheet (KWA) is based on the cost estimate provided by KWA. The costs provided assumed no overruns or delay in construction. With KWA's own assumptions of an overrun in construction of 15% and a one year delay in operations, the KWA estimated cost becomes \$686,375,920 through Year 2042.

Since this cost estimate did not appear to include the financing of revenue bonds, another cost sheet (KWA-1) was developed that included KWA's cost estimate without overruns with the additional finance costs associated with the revenue bonds. A final cost sheet (KWA-2) includes the cost associated with the revenue bonds based on the estimate provided by TYJT for the Treasury.

A summary of the cost sheets provided in Appendix B are shown in Table 6-1. Figure 6-1 shows the cumulative annual costs associated with each option.

DWSD 8 MGD Maximum Day at Imlay Station	634,795,488	1
KWA (10/31/12 No Overruns, As Provided)*	649,775,166	2
DWSD 8 MGD Maximum Day at FL-1	672,671,705	3
KWA-1 (10/31/12 No Overruns with Cost of Financing)	707,279,715	4
DWSD 12 MGD Maximum Day at Imlay Station	725,576,803	5
DWSD 12 MGD Maximum Day at FL-1	762,110,308	6
KWA-2 (Treasury Estimate)	766,784,313	7
DWSD 18 MGD Maximum Day at FL-1	821,226,268	8

* \$686,375,920 with 15% overrun in construction and a one year delay in operations

Table 6-1: Total Cost of Options through 2042

Based on the analysis, it is prudent to assume the KWA water supply option costs would be somewhere between the KWA-1 and KWA-2 options. Therefore, the analysis indicates that the two DWSD options of supplying 8 MGD on a maximum day and up to 8 MGD on average are the least cost options for Flint. These options allow Flint to maximize the use of existing assets; the City of Flint's (the Flint WTP) and DWSD's (the existing 72-inch main).

Additionally, in recent conversations with the Treasury another option was discussed that could potentially be the most cost-effective solution. Currently the Flint WTP serves as a backup if service is

lost through either the DWSD or KWA pipeline. If the a twin pipe paralleling the DWSD 72-inch water main were constructed with interconnects with the 72-inch line, then the new water main could serve as the backup to Flint and the Flint WTP could be abandoned or potentially sold to Genesee County for their use.

The construction of the parallel pipeline would be considered in the DWSD capital expenditure as a Common to All (CTA) cost. This means that the capital cost of the pipeline would be shared by all DWSD customers and not just by Flint. Preliminary analysis of this option appears to be the most cost-effective of all the options discussed. However, a more thorough cost analysis is warranted and this approach would require an agreement between Flint and DWSD.

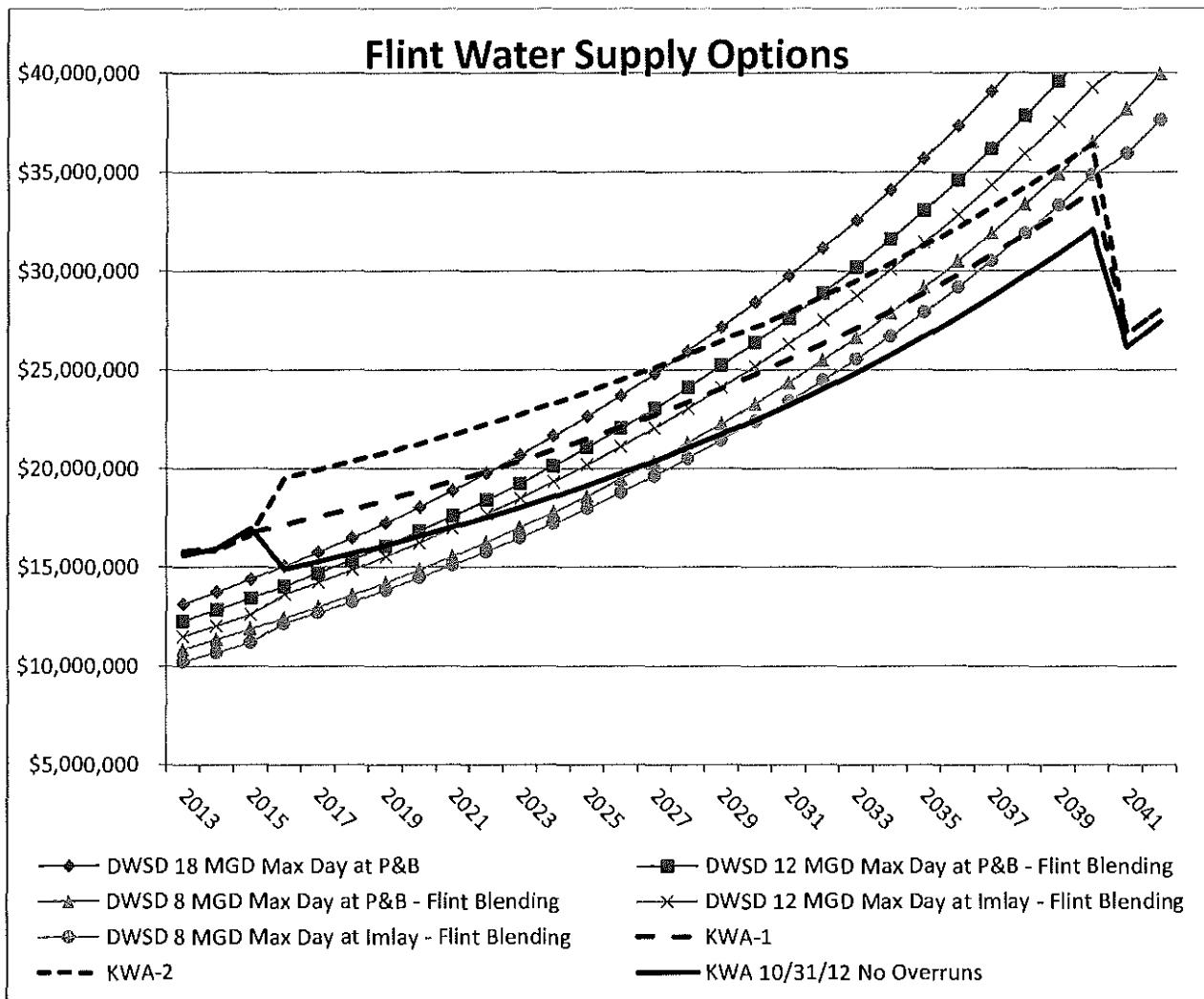


Figure 6-1: Flint Water Supply Options through 2042

7. OTHER CONSIDERATIONS

As part of the investigation other issues were identified that may result in risks to Flint that should be considered by the Treasury in determining how Flint's potable water should be supplied. These issues are related to redundancy and reliability, other items affecting cost, and Flint's desire to control its own destiny related to its water supply. These are described further below.

Redundancy/Reliability

In one of the first meetings related to this task assessment, which was held on November 1, 2012, the Genesee County Drain Commissioner, Mr. Jeff Wright, stated that one of the main reasons for pursuing the KWA supply option related to the lack of reliability of the DWSD system. He pointed to the Northeast blackout of 2003; a widespread power outage that occurred throughout parts of the Northeastern and Midwestern United States and Ontario, Canada, on Thursday, August 14, 2003. He stated that Flint and Genesee County were out of water for several days.

It is worth noting that this was a power outage of historic proportions that affected millions of Americans. However, DWSD did begin supplying water again relatively quickly in comparison to other major cities impacted by the same power outage.

Furthermore, the KWA supply system offers less redundancy to Flint than the current DWSD system. Under both options, Flint is supplied by a single pipeline; however, DWSD has backup power at all of its major facilities supplying Flint. The KWA system will not have a redundant power at its pumping facilities. This would be a major risk.

Currently, backup to the DWSD system for Flint is Flint's WTP using the Flint River as the source of supply. KWA has stated that the Flint River source would also be used as backup to Flint if the KWA supply through its pipeline was lost. However, since the Flint WTP would be upgraded to treat Lake Huron water under the KWA option, using the Flint River as a backup source would require the Flint WTP to maintain two process treatment streams.

In addition to Flint and Genesee County, the DWSD's 72-inch main supplies Imlay City, Mayfield and the Greater Lapeer County Utilities Authority (GLCUA). The volume of water contained within the 72-inch main is approximately 30 MG. Only supplying these three remaining communities would cause the water age to increase dramatically; somewhere in excess of three weeks old, before reaching the customers' master meters. Since the half-life of chlorine in the DWSD system is approximately 5 days, the chlorine would most probably be near zero requiring re-chlorination of the finished water upstream of the master meters.

Re-chlorinating is a costly and risky process due to the instability of chlorine gas. It is unknown whether DWSD would pursue this improvement or possibly abandoned the 72-inch pipeline.

If Flint is supplied by the KWA system, then DWSD supplying their other customers along the 72-inch water main may be reconsidered. Since the KWA system is a raw water supply, the communities would

either have to build a treatment facility to treat the water from KWA or find another water source for their communities.

Additional Cost and Risk Considerations

The design of the KWA supply and the construction of the system have not been completed; therefore, final costs and time to complete are unknown. Cost overruns and delays in completion will both negatively impact Flint's final cost. As example, if the project is not completed within the three year period, payment on the bonds will be due, but the revenue source needed from the sale of water could not be provided.

Furthermore, there is always a risk with large water system construction; especially those including an intake in the Great Lakes, pumping stations and rehabilitation of older water treatment plants. These risks include the potential of explosive gases in tunneling below Lake Huron, changing site conditions associated with the large number of miles of pipe installation and rehabilitating an older WTP, and the startup and debugging of the entire pumping system.

Flint has indicated that they have a high water loss. Not addressing this issue prior to sizing the Flint supply pipeline from KWA could cause the water main to be oversized along with its incremental cost in construction.

Also, the KWA supply option appears to run counter to the Treasury's Competitive Grant Assistance Program (Formerly EVIP Grant). This program has been put in place to allow for communities to consolidate their services and save money. Two existing customers of DWSD (Flint and Genesee County) along with the potential of others customers (GLCUA, Mayfield, Imlay City) separating to from another water system is in contradiction to the program.

Finally, there is a concern over the ability of smaller systems (KWA) over larger systems (DWSD) to pay for future unfunded mandates and regulations. Obviously, identifying regulation requirements over 30 years is hard to determine. However, it is widely accepted that a large system has greater ability to respond to unfunded mandates because the cost can be distributed over a large customer base.

Flint's Autonomy

Flint has indicated that a major point of consideration is that they have no control over the rate increases issued to Flint by DWSD. All other counties supplied by DWSD have representatives on the Board of Water Commissioners (BOWC). The BOWC is one of the governing bodies that approve the water rates. Since Flint and Genesee County do not have a representative on the BOWC, Flint believes they are held "hostage" to DWSD's rates and cost of service.

This issue was stated in Flint's handout at the November 1, 2012 meeting. The handout is titled, "Flint Water Supply Future." However, it is worth noting in the same handout, Flint also identifies similar concerns with the governing board of the KWA system. Notably, that although Flint and Genesee County will be the only customers and Flint will be responsible for 30 percent of the construction cost,

they will have a minority vote on the KWA board. Furthermore, there are other communities (Lapeer County, the City of Lapeer, and Sanilac County) that sit on the board and vote. However, they are not purchasing water nor contributing to the construction costs.

STATE OF MICHIGAN CONTRACT NO. 271N3200089

CITY OF FLINT WATER SUPPLY ASSESSMENT

State of Michigan, Department of Treasury

Appendix A: Meeting Minutes

MEETING MINUTES

IN ATTENDANCE: Sue McCormick, DWSD Director
Darryl Latimer, DWSD Deputy Director
George Karmo, TYJT
Awni Qaqish, TYJT
Dave Guastella, TYJT

DATE: November 24, 2012

PURPOSE OF MEETING: Meeting with DWSD for the Indefinite-scope, Indefinite-delivery Contract Number 00383, 2012 Professional General Architectural/Engineering Services – City of Flint Water Supply Assessment

PREPARED BY: Dave Guastella

A meeting was held at the DWSD Main Office Building on November 19, 2012 to discuss the water supply options being presented by DWSD to the City of Flint. The main items discussed generally followed the attached DWSD Discussion/Questions that were provided to the Department prior to the meeting. A summary of the key points discussed are provided below.

DISCUSSION ITEMS

1. Question/Discussion Item: Verify that the four options presented at the November 1, 2012 meeting are still available for consideration:
 - a. Supplied from Potter & Baxter using the new model contract (assume a Maximum Day Customer),
 - b. Supplied from Imlay Station,
 - c. Finished un-pumped supply from Lake Huron WTP, and
 - d. Raw un-pumped supply from Lake Huron WTP.

DWSD prefers to focus on the first two supply point listed; from the current location at Potter & Baxter and at the Imlay Pump Station as these apply specifically to Flint.

DWSD provided the attached summary regarding the current costs to Flint based on the various options that DWSD is offering. The savings associated with each option is provided as well. As example, if Flint were to purchase water from the supply point located at Imlay Station, the current cost to Flint would be \$5,661,000 and it would be a savings of nearly 50%

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compared to Flint's current rate.

2. Question/Discussion Item: What additional capital improvements will be required for each option?

If Imlay Pump Station is selected as the supply point then Flint would need to purchase the 72-inch water main and an agreement to supply Lapeer would need to be worked out. DWSD believes that this could be worked out through a "wheeling" charge over the 72-inch main or possibly moving the supply point downstream of the Lapeer connection.. DWSD estimates the value of the water main at \$4.7M. Flint could bond for this amount or DWSD could include the cost into Flint's rate.

3. Question/Discussion Item: Are there other options being presented that should be considered (e.g., blending)?

Only the two options indicated above are currently being considered and both would include blending; DWSD providing 2/3 of the supply and the Flint WTP providing the other 1/3.

4. Question/Discussion Item: To evaluate each option over the 25 year planning period, provide:

- a. Annual water rate for Flint for 2002 through 2012, and the
- b. Projected annual rate adjustment for each option. What are the proposed measures to keep the rate adjustments down in the future?

DWSD provided the attached historical rates from 2002 through 2012 for the existing water contract with Flint. The attachment also includes what the rates would have been if Flint had signed the new model contract or had taken service from Imlay. These rates were provided back to 2010.

DWSD believes that 5% would be a good estimation to assume for their annual escalation in rates over the 25 year planning period.

5. Question/Discussion Item: Flint stated a 10% increase in the capacity charge. What number did DWSD provide Flint?

It was unclear to DWSD where the 10% increase in capacity charge stated by Flint came from. DWSD's information provided shows an average of 6.3%. DWSD offered a meeting with TYJT to discuss how the fixed and commodity charges are allocated.

6. Question/Discussion Item: Flint financial comparison is based on the initial Cost of \$14,413,858, which includes \$2,725,538 for Flint WTP operating cost; i.e, DWSD charge is \$11,688,320. How good is this number?

DWSD indicated that the charge of \$11,638,320 is good through 6/30/13.based on their existing contract with DWSD.

7. Question/Discussion Item: KWA's initial charge to Flint is based on 12 MGD. Is DWSD charge

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based on 12 MGD?

Yes, 12 MGD from DWSD would be a maximum with Flint supplying 6 MGD for a total of 18 MGD (2/3 vs. 1/3).

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**Indefinite-scope, Indefinite-delivery Contract Number 00383
2012 Professional General Architectural/Engineering Services**

CITY OF FLINT WATER SUPPLY ASSESSMENT

DWSD Discussion/Questions for the November 19, 2012 Meeting

1. Verify that the four options presented at the November 1, 2012 meeting are still available for consideration:
 - c. Supplied from Potter & Baxter using the new model contract (assume a Maximum Day Customer),
 - d. Supplied from Imlay Station,
 - e. Finished un-pumped supply from Lake Huron WTP, and
 - f. Raw un-pumped supply from Lake Huron WTP.
2. What additional capital improvements will be required for each option?
3. Are there other options being presented that should be considered (e.g., blending)?
4. To evaluate each option over the 25 year planning period, provide:
 - g. Annual water rate for Flint for 2002 through 2012, and the
 - h. Projected annual rate adjustment for each option. What are the proposed measures to keep the rate adjustments down in the future?
5. Flint stated a 10% increase in the capacity charge. What number did DWSD provide Flint?
6. Flint financial comparison is based on the initial Cost of \$14,413,858, which includes \$2,725,538 for Flint WTP operating cost, i.e DWSD charge is \$11,688,320. How good is this number?
7. KWA's initial charge to Flint is based on 12 MGD. Is DWSD charge based on 12 MGD?

Comments: Meeting minutes were recorded based on the understanding of the author. Please contact the author within three days if you have any different understanding of the meeting. These minutes will be considered approved unless comments are provided within three days.

Summary of DWSD Cost Allocations to Flint Under Various Scenarios
Flint Only

	Revenue	Rates and Charges		
	<u>Requirement</u>	<u>Fixed</u>	<u>Commodity</u>	<u>Avg Unit Cost</u>
1 Status Quo	11,461,700	357,271	12.46	19.91
2 Model Contract	9,732,100	275,517	11.16	16.90
3 Change	(1,729,600)	(81,754)	(1.30)	(3.00)
4 % Change	-15.1%	-22.9%	-10.4%	-15.1%
5 Max Day Only	9,424,700	271,010	10.72	16.37
6 Change	(307,400)	(4,507)	(0.44)	(0.53)
7 % Change	-3.3%	-1.7%	-4.1%	-3.3%
8 Allow Blending	6,302,800	182,369	10.72	16.42
9 Change	(3,121,900)	(88,641)	0.00	0.05
10 % Change	-49.5%	-48.6%	0.0%	0.3%
11 Imlay City Connections	5,800,700	170,912	9.77	15.11
12 Change	(502,100)	(11,457)	(0.95)	(1.31)
13 % Change	-8.7%	-6.7%	-9.7%	-8.7%
14 Cumulative Change	(5,661,000)	(186,359)	(2.69)	(4.80)
15 Cumulative %Change	-49.4%	-52.2%	-21.6%	-24.1%

	Assumptions					
	Avg Day	Max Day	Peak Hour	Distance	Elevation	Sales
	<i>mgd</i>	<i>mgd</i>	<i>mgd</i>	<i>miles</i>	<i>feet</i>	<i>mgd</i>
1 Status Quo	11.8	21.6	22.6	52.0	866	11.8
2 Model Contract	11.8	17.9	18.8	52.0	866	11.8
3 Max Day Only	11.8	17.9	17.9	52.0	866	11.8
4 Allow Blending	7.9	11.9	11.9	52.0	866	7.9
5 Imlay City Connections	7.9	11.9	11.9	45.2	866	7.9

tFg

Recent DWSD Water Rates to Flint

FY	Rates and Charges			Annual Change			Average
	Fixed \$/mo	Commodity \$/Mcf	Avg Unit Cost \$/Mcf	Fixed \$/mo	Commodity \$/Mcf	Avg Unit Cost \$/Mcf	Annual Change
<i>As Charged</i>							
2004		11.06	11.06				
2005		10.24	10.24			-7.4%	
2006		10.56	10.56			3.1%	
2007		11.09	11.09			5.0%	
2008		11.35	11.35			2.3%	
2009		13.07	13.07			15.2%	
2010		14.32	14.32			9.6%	
2011	182,301	14.29	16.01		-0.2%	11.8%	
2012	443,096	13.36	17.53	143.1%	-6.5%	9.5%	
2013	707,000	12.46	19.12	59.6%	-6.7%	9.1%	6.3%
<i>Hypothetical Model Contract</i>							
2004		11.06	11.06				
2005		10.24	10.24			-7.4%	
2006		10.56	10.56			3.1%	
2007		11.09	11.09			5.0%	
2008		11.35	11.35			2.3%	
2009		13.07	13.07			15.2%	
2010		13.96	13.96			6.8%	
2011	145,918	13.74	15.28		-1.6%	9.5%	
2012	378,968	12.58	16.57	159.7%	-8.4%	8.4%	
2013	597,323	11.63	17.93	57.6%	-7.6%	8.2%	5.5%

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PRELIMINARY

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11/20/12

Recent DWSD Water Rates to Flint

FY	Rates and Charges			Annual Change			Average
	Fixed \$/mo	Commodity \$/Mcf	Avg Unit Cost \$/Mcf	Fixed \$/mo	Commodity \$/Mcf	Avg Unit Cost \$/Mcf	Annual Change
<i>As Charged</i>							
2004		11.06	11.06				
2005		10.24	10.24			-7.4%	
2006		10.56	10.56			3.1%	
2007		11.09	11.09			5.0%	
2008		11.35	11.35			2.3%	
2009		13.07	13.07			15.2%	
2010		14.32	14.32			9.6%	
2011	182,301	14.29	16.01		-0.2%	11.8%	
2012	443,096	13.36	17.53	143.1%	-6.5%	9.5%	
2013	707,000	12.46	19.12	59.6%	-6.7%	9.1%	6.3%
<i>Hypothetical Model Contract - Flint Only</i>							
2004		11.06	11.06				
2005		10.24	10.24			-7.4%	
2006		10.56	10.56			3.1%	
2007		11.09	11.09			5.0%	
2008		11.35	11.35			2.3%	
2009		13.07	13.07			15.2%	
2010		11.73	11.73			-10.3%	
2011	70,060	12.45	13.89		6.1%	18.4%	
2012	175,882	11.47	15.08	151.0%	-7.9%	8.6%	
2013	272,923	10.65	16.24	55.2%	-7.1%	7.7%	4.4%

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11/20/12

Recent DWSD Water Rates to Flint

FY	Rates and Charges			Annual Change			Average
	Fixed \$/mo	Commodity \$/Mcf	Avg Unit Cost \$/Mcf	Fixed \$/mo	Commodity \$/Mcf	Avg Unit Cost \$/Mcf	Annual Change
<i>As Charged</i>							
2004		11.06	11.06				
2005		10.24	10.24			-7.4%	
2006		10.56	10.56			3.1%	
2007		11.09	11.09			5.0%	
2008		11.35	11.35			2.3%	
2009		13.07	13.07			15.2%	
2010		14.32	14.32			9.6%	
2011	182,301	14.29	16.01		-0.2%	11.8%	
2012	443,096	13.36	17.53	143.1%	-6.5%	9.5%	
2013	707,000	12.46	19.12	59.6%	-6.7%	9.1%	6.3%
<i>Hypothetical Model Contract - Flint Only @ Imlay</i>							
2004		11.06	11.06				
2005		10.24	10.24			-7.4%	
2006		10.56	10.56			3.1%	
2007		11.09	11.09			5.0%	
2008		11.35	11.35			2.3%	
2009		13.07	13.07			15.2%	
2010		11.16	11.16			-14.6%	
2011	65,919	10.88	12.23		-2.5%	9.6%	
2012	165,275	9.89	13.28	150.7%	-9.1%	8.6%	
2013	255,580	9.09	14.32	54.6%	-8.1%	7.8%	2.9%

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PRELIMINARY

THE FOSTER GROUP

11/20/12

MEETING MINUTES

IN ATTENDANCE: Ed Kurtz; Flint Emergency Financial Manager, City of Flint
Dayne Walling; Mayor, City of Flint
Mike Brown, City of Flint
John O'Brien, Genesee County
Howard Croft, City of Flint
Dwayne "Duffy" Johnson, City of Flint
Brent Wright, City of Flint
Awni Qaqish, TYJT
Dave Guastella, TYJT

DATE: November 24, 2012

PURPOSE OF MEETING: Meeting with the City of Flint for the Indefinite-scope, Indefinite-delivery Contract Number 00383, 2012 Professional General Architectural/Engineering Services – City of Flint Water Supply Assessment

PREPARED BY: Dave Guastella

A meeting was held at the City of Flint Municipal Center on November 20, 2012 to discuss the water supply option being presented by the Karegnondi Water Authority (KWA) to the City of Flint. The main items discussed generally followed the attached KWA Discussion/Questions that were provided to City prior to the meeting. A summary of the key points discussed are provided below.

The questions submitted are repeated in the Discussion Items for easy reference. A summary of the action items generated from the meeting follow the Discussion Items.

DISCUSSION ITEMS

1. Question/Discussion Item: Is the maximum day demand of 18 MGD for Flint the maximum day demand (MDD) throughout the 25 year planning period? If not, what is the 25 year projected MDD?

KWA would supply up to 18 MGD. 18 MGD has been assumed as the maximum day demand and 12 MGD is assumed as the average day demand throughout the 25 year planning period.

2. Question/Discussion Item: Copy of the intake contract documents and engineer's estimate.

The intake contract documents are approximately 90% complete and are not available for distribution. However, the updated Appendix 20, dated October 4, 2012 includes the most recent cost estimate of the intake based on the current design in process.

Comments: Meeting minutes were recorded based on the understanding of the author. Please contact the author within three days if you have any different understanding of the meeting. These minutes will be considered approved unless comments are provided within three days.

-
3. Question/Discussion Item: Documentation of the Flint WTP improvements required and cost estimate.

The costs are approximately \$7M as presented in the September 2009 Preliminary Engineering Report. However, this estimate has been updated. Some processes have been eliminated. John O'Brien will provide the updated costs and the description of the planned improvements to the plant.

4. Question/Discussion Item: Confirm Flint's allocated percentage of the KWA capital improvements (30%?).

Yes, the allocation is based on 18 MGD/60 MGD total capacity.

5. Question/Discussion Item: Copy of the proposed KWA operating agreement for Flint.

John O'Brien will provide the operating agreement as well as the Capacity Contract and Articles of Incorporation.

6. Question/Discussion Item: What is the annual operating agreement adjustment projected for the 25 year planning period?

This information is provided in Appendix 14, Table 14.2 of the September 2009 Preliminary Engineering Report. Operating cost based on Table 1. Used 12 MGD as average day demand (ADD). Assumed 5% as the annual increase in operating costs. John O'Brien indicated that these operating costs were based on Genesee County's operating costs. John O'Brien will provide the last 10 years of audited financial statements for the water fund.

To assess operating and maintenance costs for the Flint WTP, Duffy will provide multiple years of financial statements for the water fund. Duffy did not believe they had 10 years, but they will provide what they have.

Regarding operation and maintenance costs, Flint believes that these costs will increase by 2/3 of what they are now.

7. Question/Discussion Item: Need the route of the pipelines and the locations of the facilities proposed. Purpose is to identify constraints that impact costs (i.e., utilities, environmental (e.g. wetlands), easements, etc.).

KWA will not release the route due to concerns regarding speculation of land and easements. John O'Brien did indicate that the Lake Huron pump station would be at Fisher and M-25. The intermediate pump station site is near a location of the Lapeer/Sanilac/St. Clair border; where all three meet.

8. Question/Discussion Item: KWA's initial charge to Flint is based on a 12 MGD average day demand. What is the basis of this number? Are there population projections and water use figures available that were used to determine the Flint demand for the 25 year planning period?

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This was answered in Question No. 1 above.

9. Question/Discussion Item: Is there a transition plan and cost during construction of the KWA system identified?

Flint is looking for an agreement with DWSD for back-up supply from the 72-inch main at the Genesee border.

10. Question/Discussion Item: The October 4, 2012 Preliminary Engineering Report Update states: "no backup power is planned for the pumps" (LHPS) and "No backup power is planned for pumping" (IPS). In case of power loss, how would Flint supply its customers?

Flint indicated that they have adequate storage to supply the system for 6 to 7 days. Flint has 55 MG of storage and Genesee County has 65 MG for 2.5 days.

11. Question/Discussion Item: The latest plan shows only a 5 million gallon ground reservoir is planned for balancing between LHPS and IPS. How is redundancy maintained?

In cases of emergency, Flint indicated that the back-up for the KWA system will be the same as it is now with DWSD; they will use the Flint River as the source water. Flint currently operates their plant four times a year.

When questioned as to whether the WTP will be able to treat both lake water from the KWA system and river water Flint indicated that once the improvements identified in the September 2009 Preliminary Engineering Report are completed they will be able to accomplish both treatment processes. Flint will provide a schematic of the treatment trains at the WTP and a copy of the Flint transmission system.

Genesee County indicated that additional redundancy would also be provided from the new Genesee County WTP.

Regarding hydraulic transients; Genesee County indicated that a model analysis has not been included, but capital costs for mitigating transients have been included.

12. Question/Discussion Item: Related to the construction cost:

- a. Does it include an additional traffic lane since the construction will occupy half the right of way? *Not required, all roads are county roads; however, there are a few State road crossings.*
- b. Does it include costs/fees for permit requirements such as inspection cost by the jurisdictional authorities? As a point of reference, the permit fee costs for the Flint Transmission System came out to be \$5.8 million. *Not required; all of the counties have waived any fees.*
- c. Does the cost of the steel pipe segments include corrosion protection measures such as

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anode stations and related O&M? Yes; however, the KWA has not settled on using steel pipe. PCCP pipe may be used. Steel shown in estimate because it is highest in cost and therefore the pricing is conservative.

- d. SCADA monitoring stations require power. Is the cost of bring power to the SCADA stations included? Again, as a point of reference for the Flint Transmission System we estimated \$800,000 for power to SCADA and valve operators. Yes, Genesee County did emphasize that the SCADA system will be simple and straightforward because a lot of controls are not required.
- e. Other items discussed at the meeting included:
 - The 2009 plant improvement cost is still good; however, there will be some reduction, such as a sulfuric chloride feed system that was eliminated. Plant capacity now is 36MGD, but will be 18 MGD.
 - The KWA Lake Huron Pumping Station (LHPS) is now only high lift pump station.
 - Genesee County will provide the distance of the intake pipe from the crib to the LHPS.
 - The intake project is almost ready to bid; waiting for the COE permit.
 - Genesee County is estimating the construction for the pipe lines and pump stations will begin July 2013.
 - The route has been flown for survey.
 - Genesee County is estimating construction will be complete and the project will be placed in service by Jan 2016.
 - Genesee County to provide a list of assumptions that the \$272 million cost estimate is based on since the route is now known.

13. The Flint River is identified as a backup: At what capacity? MDD or emergency supply?

The Flint River would serve as a back up supply.

14. Where did the 40 years come from (Flint hostage to Detroit)? DWSD's new contracts are 30 years with openers to revise terms of supply (volume and pressure) after the first two years, then three years, and then in five year increments thereafter.

The 40 years was stated in error. The reference was to DWSD's requirement to sign a 30 year contract.

After 40 years Flint will own 30% of the project and can sell their share of ownership if they want. Conversely, with DWSD, they continue to pay for the capital projects but have no ownership. Flint believes they will know what they will be charged for the next 25 years versus DWSD that can't commit to a fixed escalation.

Action Items for Follow-up		
Items:	Assigned To:	Date to Complete
1. Updated Costs for the Flint WTP Improvements and a description of the improvements.	John O'Brien	11/21/12
2. KWA Operating Agreement, Capacity Contract and Articles of Incorporation.	John O'Brien	11/20/12
3. Provide the last 10 years of audited financial statements for the Genesee water fund.	John O'Brien	11/20/12
4. Provide multiple years of financial statements for the City of Flint water fund.	Duffy Johnson	11/26/12
5. Provide schematic of the Flint WTP and a map of the Flint transmission system.	Brent Wright	11/26/12
6. Provide the length of the intake pipe from the crib to the pump station.	John O'Brien	11/20/12
7. Provide a list of assumptions that the \$272 million cost estimate is based on since the route is now known.	John O'Brien	11/26/12

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**Indefinite-scope, Indefinite-delivery Contract Number 00383
2012 Professional General Architectural/Engineering Services**

CITY OF FLINT WATER SUPPLY ASSESSMENT

KWA Discussion/Questions for the November 20, 2012 Meeting

1. Is the maximum day demand of 18 MGD for Flint the maximum day demand (MDD) throughout the 25 year planning period? If not, what is the 25 year projected MDD?
2. Copy of the intake contract documents and engineer's estimate.
3. Documentation of the Flint WTP improvements required and cost estimate.
4. Confirm Flint's allocated percentage of the KWA capital improvements (30%?).
5. Copy of the proposed KWA operating agreement for Flint.
6. What is the annual operating agreement adjustment projected for the 25 year planning period?
7. Need the route of the pipelines and the locations of the facilities proposed. Purpose is to identify constraints that impact costs (i.e., utilities, environmental (e.g. wetlands), easements, etc.).
8. KWA's initial charge to Flint is based on a 12 MGD maximum day demand. What is the basis of this number? Are there population projections and water use figures available that were used to determine the Flint demand for the 25 year planning period?
9. Is there a transition plan and cost during construction of the KWA system identified?
10. The October 4, 2012 Preliminary Engineering Report Update states: "no backup power is planned for the pumps" (LHPS) and "No backup power is planned for pumping" (IPS). In case of power loss, how would Flint supply its customers?
11. The latest plan shows only a 5 million gallon ground reservoir is planned for balancing between LHPS and IPS. How is redundancy maintained?
12. Related to the construction cost:
 - a. Does it include an additional traffic lane since the construction will occupy half the right of way?
 - b. Does it include costs/fees for permit requirements such as inspection cost by the jurisdictional authorities? As a point of reference, the permit fee costs for the Flint Transmission System came out to be \$5.8 million.

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-
- c. Does the cost of the steel pipe segments include corrosion protection measures such as anode stations and related O&M?
 - d. SCADA monitoring stations require power. Is the cost of bring power to the SCADA stations included? Again, as a point of reference the for the Flint Transmission System we estimated \$800,000 for power to SCADA and valve operators.
13. The Flint River is identified as a backup: At what capacity? MDD or emergency supply?
14. Where did the 40 years come from (Flint hostage to Detroit)? DWSD's new contracts are 30 years with openers to revise terms of supply (volume and pressure) after the first two years, then three years, and then in five year increments thereafter.

STATE OF MICHIGAN CONTRACT NO. 271N3200089

CITY OF FLINT WATER SUPPLY ASSESSMENT

State of Michigan, Department of Treasury

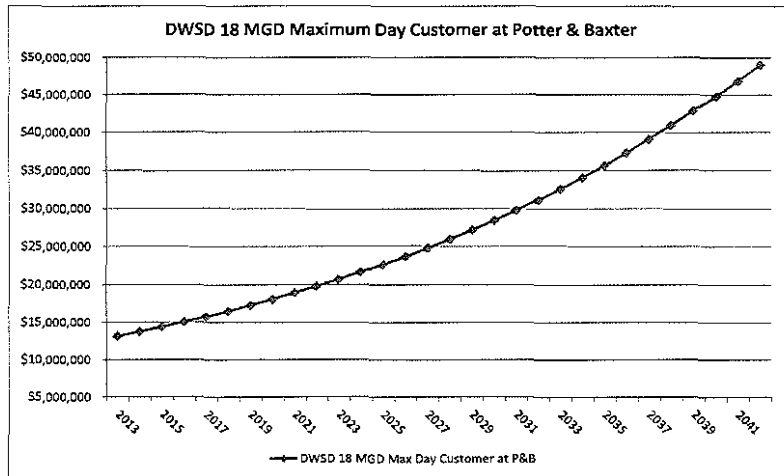
Appendix B: Cost Worksheets

DWSD Worksheet : 18 MGD Maximum Day Customer with Model Contract at Potter & Baxter

Capacity	Flint ADD:	0.60 MGD	81 MCF/Day	1	2013	Flint WTP O&M	Water Purchase	Revenue Bond Payment	Interest on Reserve	TOTAL
	DWSD ADD:	12 MGD	1,604 MCF/Day	2	2014	\$ 3,538,214	9,585,642	-	-	\$ 13,123,856
				3	2015	\$ 3,697,788	10,036,167	-	-	\$ 13,733,955
				4	2016	\$ 3,864,558	10,507,867	-	-	\$ 14,372,425
Annual Volume	Flint:	29,412 MCF		5	2017	\$ 4,038,850	11,001,736	-	-	\$ 15,040,586
	DWSD:	585,561 MCF		6	2018	\$ 4,221,002	11,518,818	-	-	\$ 15,739,820
2013 Cost of Supply				7	2019	\$ 4,411,369	12,060,203	-	-	\$ 16,471,571
	Flint WTP O&M:	120.30 /MCF	\$ 3,538,214 /Yr	8	2020	\$ 4,610,322	12,627,032	-	-	\$ 17,237,354
	DWSD:	16.37 /MCF	\$ 9,585,542 /Yr	9	2021	\$ 4,818,247	13,220,503	-	-	\$ 18,038,750
Escalation/Inflation Rate				10	2022	\$ 5,035,550	13,841,866	-	-	\$ 18,877,416
	Flint:	4.51% /Yr		11	2023	\$ 5,262,653	14,492,434	-	-	\$ 19,755,087
	DWSD:	4.7% /Yr		12	2024	\$ 5,499,999	15,173,578	-	-	\$ 20,673,577
Capital Expenditure				13	2025	\$ 5,748,049	15,886,736	-	-	\$ 21,634,785
	Amount:	\$ -		14	2026	\$ 6,007,286	16,633,413	-	-	\$ 22,640,699
	Reserve:	\$ -	0% Reserve Rate: 0.00%	15	2027	\$ 6,278,215	17,415,183	-	-	\$ 23,693,398
	Amount plus Reserve:	\$ -		16	2028	\$ 6,561,362	18,233,697	-	-	\$ 24,795,059
	Revenue Bond Rate:	5%		17	2029	\$ 6,857,279	19,090,681	-	-	\$ 25,947,960
	Number of Years:	25		18	2030	\$ 7,166,543	19,987,943	-	-	\$ 27,154,486
	Annual Cost:	\$0		19	2031	\$ 7,489,754	20,927,376	-	-	\$ 28,417,130
				20	2032	\$ 7,827,542	21,910,963	-	-	\$ 29,738,505
				21	2033	\$ 8,180,564	22,940,778	-	-	\$ 31,121,342
				22	2034	\$ 8,549,507	24,018,995	-	-	\$ 32,568,502
				23	2035	\$ 8,935,090	25,147,887	-	-	\$ 34,082,977
				24	2036	\$ 9,338,063	26,329,838	-	-	\$ 35,667,901
				25	2037	\$ 9,759,209	27,567,341	-	-	\$ 37,326,550
					2038	\$ 10,199,350	28,863,006	-	-	\$ 39,062,355
					2039	\$ 10,659,340	30,219,567	-	-	\$ 40,878,907
					2040	\$ 11,140,076	31,639,886	-	-	\$ 42,779,963
					2041	\$ 11,642,494	33,126,961	-	-	\$ 44,769,455
					2042	\$ 12,167,570	34,683,928	-	-	\$ 46,851,499
						\$ 12,716,328	36,314,073	-	-	\$ 49,030,401
						\$ 216,222,171				

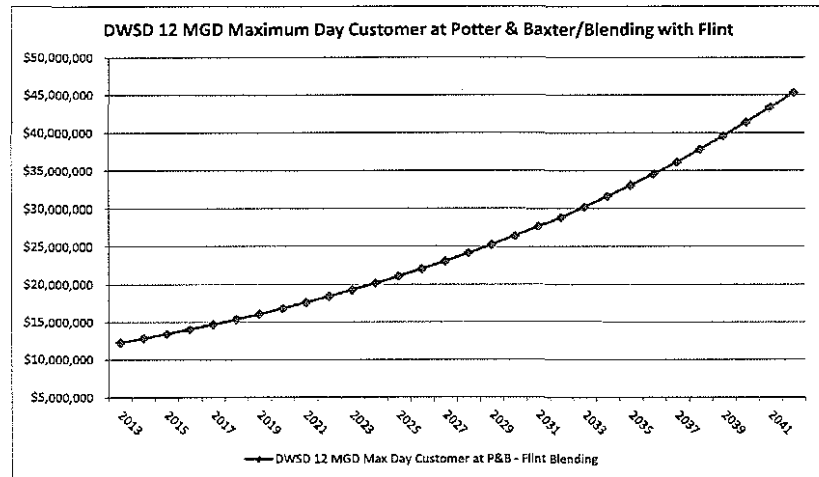
25 Yrs Cumulative
\$ 596,916,044

30 Yrs Cumulative
\$ 821,226,268



DWSD Worksheet : 12 MGD Maximum Day Customer with Model Contract at Potter & Baxter/Blending with Flint

Capacity	Flint ADD:	4 MGD	535 MCF/Day	1	Year	Flint WTP O&M	Water Purchase	Revenue Bond Payment	Interest on Reserve	TOTAL
	DWSD ADD:	8 MGD	1,070 MCF/Day	2	2013	\$ 5,895,097	6,367,005	-	-	\$ 12,262,103
				3	2014	\$ 6,160,966	6,666,255	-	-	\$ 12,827,221
				4	2015	\$ 6,438,626	6,979,569	-	-	\$ 13,418,395
Annual Volume	Flint:	195,187 MCF	195187.1658	5	2016	\$ 6,729,217	7,307,608	-	-	\$ 14,036,825
	DWSD:	390,374 MCF		6	2017	\$ 7,032,705	7,651,066	-	-	\$ 14,683,771
				7	2018	\$ 7,349,880	8,010,666	-	-	\$ 15,360,546
			5895097.471	8	2019	\$ 7,681,359	8,387,167	-	-	\$ 16,068,527
2013 Cost of Supply				9	2020	\$ 8,027,789	8,781,364	-	-	\$ 16,809,153
	Flint WTP O&M:	\$ 30.20 /MCF	\$ 5,895,097 /Yr	10	2021	\$ 8,389,842	9,194,088	-	-	\$ 17,583,930
	DWSD:	\$ 16.31 /MCF	\$ 6,367,005 /Yr	11	2022	\$ 8,768,224	9,626,210	-	-	\$ 18,394,434
				12	2023	\$ 9,163,671	10,078,642	-	-	\$ 19,242,313
Escalation/Inflation Rate				13	2024	\$ 9,576,952	10,552,338	-	-	\$ 20,129,291
	Flint:	4.51% /Yr		14	2025	\$ 10,008,873	11,048,298	-	-	\$ 21,057,171
	DWSD:	4.7% /Yr		15	2026	\$ 10,460,273	11,567,568	-	-	\$ 22,027,841
				16	2027	\$ 10,932,031	12,111,244	-	-	\$ 23,043,275
Capital Expenditure				17	2028	\$ 11,425,066	12,680,473	-	-	\$ 24,105,538
	Amount:	\$ -		18	2029	\$ 11,940,336	13,276,455	-	-	\$ 25,216,791
	Reserve:	\$ -	0% Reserve Rate: 0.00%	19	2030	\$ 12,478,845	13,900,448	-	-	\$ 26,379,294
	Amount plus Reserve:	\$ -		20	2031	\$ 13,041,641	14,553,769	-	-	\$ 27,595,410
	Revenue Bond Rate:	5%		21	2032	\$ 13,629,819	15,237,796	-	-	\$ 28,867,616
	Number of Years:	25		22	2033	\$ 14,244,524	15,953,973	-	-	\$ 30,198,497
	Annual Cost:	\$0		23	2034	\$ 14,886,952	16,703,810	-	-	\$ 31,590,762
				24	2035	\$ 15,558,354	17,488,889	-	-	\$ 33,047,242
				25	2036	\$ 16,260,035	18,310,866	-	-	\$ 34,570,902
					2037	\$ 16,993,363	19,171,477	-	-	\$ 36,164,840
					2038	\$ 17,759,764	20,072,537	-	-	\$ 37,832,300
					2039	\$ 18,560,729	21,015,946	-	-	\$ 39,576,675
					2040	\$ 19,397,818	22,003,695	-	-	\$ 41,401,513
					2041	\$ 20,272,660	23,037,869	-	-	\$ 43,310,528
					2042	\$ 21,186,956	24,120,649	-	-	\$ 45,307,605

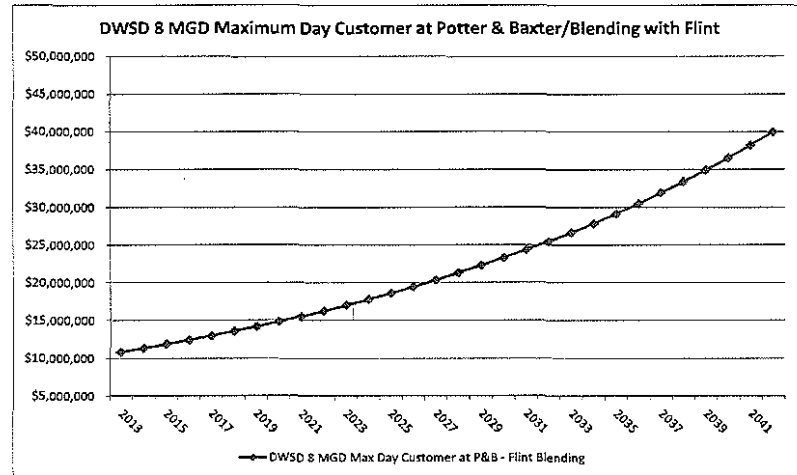


25 Yrs Cumulative
\$ 554,681,686

30 Yrs Cumulative
\$ 762,110,308

DWSD Worksheet : 8 MGD Maximum Day Customer with Model Contract at Potter & Baxter/Blending with Flint

Capacity	Flint ADD:	4 MGD	535 MCF/Day	1	Year	Flint WTP O&M	Water Purchase	Revenue Bond Payment	Interest on Reserve	TOTAL
	DWSD ADD:	8 MGD	1,070 MCF/Day	2	2013	\$ 5,895,097	4,949,947	-	-	\$ 10,845,044
				3	2014	\$ 6,160,966	5,182,594	-	-	\$ 11,343,560
				4	2015	\$ 6,438,826	5,426,176	-	-	\$ 11,865,002
Annual Volume	Flint:	195,187 MCF		5	2016	\$ 6,729,217	5,681,206	-	-	\$ 12,410,423
	DWSD:	390,374 MCF		6	2017	\$ 7,032,705	5,948,223	-	-	\$ 12,980,928
				7	2018	\$ 7,343,880	6,227,789	-	-	\$ 13,577,669
2013 Cost of Supply				8	2019	\$ 7,681,359	6,520,495	-	-	\$ 14,201,855
	Flint WTP O&M:	\$ 30.20 /MCF	\$ 5,895,097 /Yr	9	2020	\$ 8,027,789	6,826,359	-	-	\$ 14,854,747
	DWSD:	\$ 12.68 /MCF	\$ 4,949,947 /Yr	10	2021	\$ 8,389,842	7,147,826	-	-	\$ 15,537,668
				11	2022	\$ 8,768,224	7,483,774	-	-	\$ 16,251,997
Escalation/Inflation Rate				12	2023	\$ 9,163,671	7,835,511	-	-	\$ 16,999,182
	Flint:	4.51% /Yr		13	2024	\$ 9,576,952	8,203,780	-	-	\$ 17,780,732
	DWSD:	4.7% /Yr		14	2025	\$ 10,008,873	8,589,358	-	-	\$ 18,598,230
				15	2026	\$ 10,460,273	8,993,057	-	-	\$ 19,453,330
Capital Expenditure				16	2027	\$ 10,932,031	9,415,731	-	-	\$ 20,347,762
	Amount:	\$ -		17	2028	\$ 11,425,066	9,858,271	-	-	\$ 21,283,336
	Reserve:	\$ -	0% Reserve Rate: 0.00%	18	2029	\$ 11,940,336	10,321,609	-	-	\$ 22,261,945
	Amount plus Reserve:	\$ -		19	2030	\$ 12,478,845	10,806,725	-	-	\$ 23,285,570
	Revenue Bond Rate:	5%		20	2031	\$ 13,041,641	11,314,641	-	-	\$ 24,356,282
	Number of Years:	25		21	2032	\$ 13,629,819	11,846,429	-	-	\$ 25,476,248
	Annual Cost:	\$0		22	2033	\$ 14,244,524	12,403,211	-	-	\$ 26,647,735
				23	2034	\$ 14,886,952	12,986,162	-	-	\$ 27,873,114
				24	2035	\$ 15,558,354	13,596,512	-	-	\$ 29,154,866
				25	2036	\$ 16,260,035	14,235,548	-	-	\$ 30,495,583
					2037	\$ 16,993,363	14,904,619	-	-	\$ 31,897,982
					2038	\$ 17,759,764	15,605,136	-	-	\$ 33,364,899
					2039	\$ 18,560,729	16,338,577	-	-	\$ 34,899,306
					2040	\$ 19,397,818	17,106,490	-	-	\$ 36,504,308
					2041	\$ 20,272,660	17,910,495	-	-	\$ 38,183,155
					2042	\$ 21,186,956	18,752,288	-	-	\$ 39,939,245

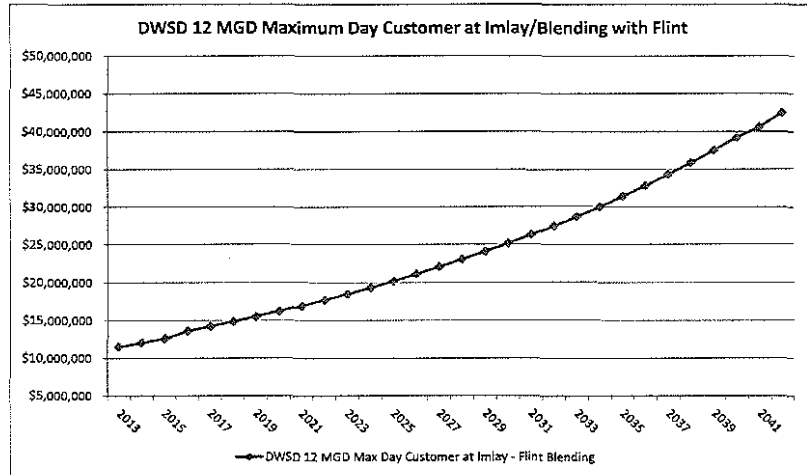


25 Yrs Cumulative
\$ 489,780,792

30 Yrs Cumulative
\$ 672,671,705

DWSD Worksheet : 12 MGD Maximum Day Customer with Model Contract at Imlay/Blending with Flint

<u>Capacity</u>				Year	Flint WTP O&M	Water Purchase	Revenue Bond Payment	Interest on Reserve	TOTAL
Flint ADD:	4 MGD	535 MCF/Day		1	2013	\$ 5,895,097		19,500	\$ 11,489,180
DWSD ADD:	8 MGD	1,070 MCF/Day		2	2014	\$ 6,160,966		19,500	\$ 12,018,888
				3	2015	\$ 6,438,826		19,500	\$ 12,572,986
<u>Annual Volume</u>				4	2016	\$ 6,729,217	462,610	19,500	\$ 13,615,209
Flint:	195,187 MCF			5	2017	\$ 7,032,705	462,610	19,500	\$ 14,221,512
DWSD:	390,374 MCF			6	2018	\$ 7,349,880	462,610	19,500	\$ 14,855,735
<u>2013 Cost of Supply</u>				7	2019	\$ 7,681,359	462,610	19,500	\$ 15,519,164
Flint WTP O&M:	\$ 30.20 /MCF	\$ 5,895,097 /Yr		8	2020	\$ 8,027,789	462,610	19,500	\$ 16,213,144
DWSD:	\$ 14.38 /MCF	\$ 5,613,583 /Yr		9	2021	\$ 8,389,842	462,610	19,500	\$ 16,939,082
<u>Escalation/Inflation Rate</u>				10	2022	\$ 8,768,224	462,610	19,500	\$ 17,698,452
Flint:	4.51% /Yr			11	2023	\$ 9,163,671	462,610	19,500	\$ 18,492,794
DWSD:	4.7% /Yr			12	2024	\$ 9,576,952	462,610	19,500	\$ 19,323,718
<u>Capital Expenditure</u>				13	2025	\$ 10,008,873	462,610	19,500	\$ 20,192,910
Capital:	\$ 4,700,000			14	2026	\$ 10,460,273	462,610	19,500	\$ 21,102,134
Bond Issuance (3% of Total):	195,000	Check:	3.0%	15	2027	\$ 10,932,031	462,610	19,500	\$ 22,053,234
3 Years of Capitalized Interest:	975,000	Check:	5.0% /Yr (Bond Interest on Total)	16	2028	\$ 11,425,066	462,610	19,500	\$ 23,048,139
Reserve (10% of Total):	650,000	Check:	10.0%	17	2029	\$ 11,940,336	462,610	19,500	\$ 24,088,867
Total:	\$ 6,520,000			18	2030	\$ 12,478,845	462,610	19,500	\$ 25,177,531
Revenue Bond Rate:	5%			19	2031	\$ 13,041,641	462,610	19,500	\$ 26,316,339
Number of Years:	25			20	2032	\$ 13,629,819	462,610	19,500	\$ 27,507,602
Annual Cost:	\$462,610			21	2033	\$ 14,244,524	462,610	19,500	\$ 28,753,736
Interest on Reserve:	3%			22	2034	\$ 14,886,952	462,610	19,500	\$ 30,057,271
				23	2035	\$ 15,558,354	462,610	19,500	\$ 31,420,852
				24	2036	\$ 16,260,035	462,610	19,500	\$ 32,847,245
				25	2037	\$ 16,993,363	462,610	19,500	\$ 34,339,345
				2038	\$ 17,759,764	17,697,307	462,610	19,500	\$ 35,900,181
				2039	\$ 18,560,729	18,529,080	462,610	19,500	\$ 37,532,919
				2040	\$ 19,397,818	19,399,947	462,610	19,500	\$ 39,240,875
				2041	\$ 20,272,660	20,311,745			\$ 40,584,404
				2042	\$ 21,186,956	21,266,397			\$ 42,453,353

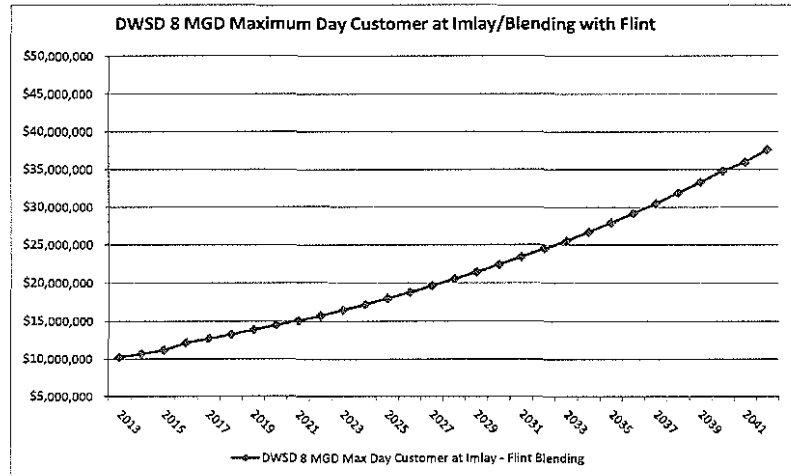


25 Yrs Cumulative
\$ 529,865,071

30 Yrs Cumulative
\$ 725,576,803

DWSD Worksheet : 8 MGD Maximum Day Customer with Model Contract at Imlay/Blending with Flint

				Flint WTP		Water	Revenue	Interest on	TOTAL
Capacity				Year	O&M	Purchase	Bond Payment	Reserve	
Flint ADD:	4	MGD	535 MCF/Day	1	2013	\$ 5,895,097	4,337,059	19,500	\$ 10,212,656
DWSD ADD:	8	MGD	1,070 MCF/Day	2	2014	\$ 6,160,966	4,540,901	19,500	\$ 10,682,367
				3	2015	\$ 6,438,826	4,754,323	19,500	\$ 11,173,649
Annual Volume				4	2016	\$ 6,729,217	4,977,776	462,610	\$ 12,150,103
Flint:	195,187	MCF		5	2017	\$ 7,092,705	5,211,732	462,610	\$ 12,687,546
DWSD:	390,374	MCF		6	2018	\$ 7,349,880	5,456,683	462,610	\$ 13,249,673
2013 Cost of Supply				7	2019	\$ 7,681,359	5,713,147	462,610	\$ 13,837,616
Flint WTP O&M:	\$ 30.20	/MCF	\$ 5,895,097 /Yr	8	2020	\$ 8,027,789	5,981,665	462,610	\$ 14,452,564
DWSD:	\$ 11.11	/MCF	\$ 4,337,059 /Yr	9	2021	\$ 8,389,842	6,262,803	462,610	\$ 15,095,755
				10	2022	\$ 8,768,224	6,557,155	462,610	\$ 15,768,489
Escalation/Inflation Rate				11	2023	\$ 9,163,671	6,865,341	462,610	\$ 16,472,122
Flint:	4.51%	/Yr		12	2024	\$ 9,576,952	7,188,012	462,610	\$ 17,208,074
DWSD:	4.7%	/Yr		13	2025	\$ 10,008,873	7,525,849	462,610	\$ 17,977,832
Capital Expenditure				14	2026	\$ 10,460,273	7,879,564	462,610	\$ 18,782,947
Capital:	\$ 4,700,000			15	2027	\$ 10,932,031	8,249,903	462,610	\$ 19,625,044
Bond Issuance (3% of Total):	195,000	Check:	3.0%	16	2028	\$ 11,425,066	8,637,649	462,610	\$ 20,505,824
3 Years of Capitalized Interest:	975,000	Check:	5.0% /Yr (Bond Interest on Total)	17	2029	\$ 11,940,336	9,043,618	462,610	\$ 21,427,064
Reserve (10% of Total):	650,000	Check:	10.0%	18	2030	\$ 12,478,845	9,468,668	462,610	\$ 22,390,624
Total:	\$ 6,520,000			19	2031	\$ 13,041,641	9,913,696	462,610	\$ 23,398,447
Revenue Bond Rate:	5%			20	2032	\$ 13,629,819	10,379,639	462,610	\$ 24,452,569
Number of Years:	25			21	2033	\$ 14,244,524	10,867,482	462,610	\$ 25,556,117
Annual Cost:	\$462,610			22	2034	\$ 14,886,952	11,378,254	462,610	\$ 26,708,316
Interest on Reserve:	3%			23	2035	\$ 15,558,354	11,913,032	462,610	\$ 27,914,496
				24	2036	\$ 16,260,035	12,472,945	462,610	\$ 29,176,090
				25	2037	\$ 16,993,363	13,059,173	462,610	\$ 30,495,646
					2038	\$ 17,759,764	13,672,954	462,610	\$ 31,875,828
					2039	\$ 18,560,729	14,315,583	462,610	\$ 33,319,422
					2040	\$ 19,397,818	14,988,415	462,610	\$ 34,829,343
					2041	\$ 20,272,660	15,692,871		\$ 35,965,530
					2042	\$ 21,186,956	16,430,436		\$ 37,617,392



25 Yrs Cumulative
\$ 493,063,801

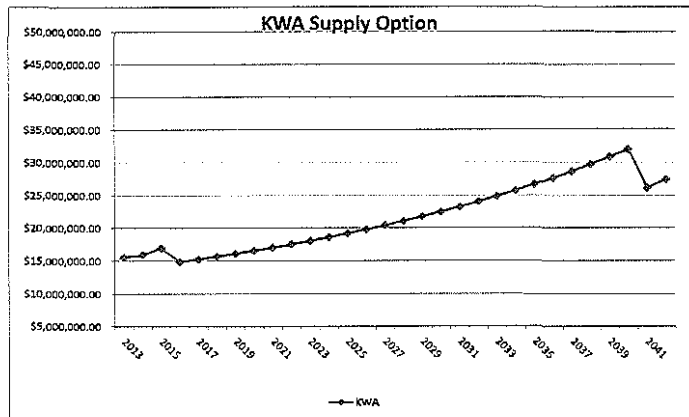
30 Yrs Cumulative
\$ 634,795,488

KWA Supply Option Worksheet
KWA 10/31/12 No Overruns

	Year	DWSD & Flint WTP Costs	KWA Entry Fee	KWA Debt service	Flint WTP Debt Service	KWA Operation s	Flint WTP Operations with KWA	TOTAL
1	2013	\$ 14,413,858	1,162,800					\$ 15,576,658
2	2014	\$ 15,355,135	581,400					\$ 15,936,535
3	2015	\$ 16,365,534	581,400					\$ 16,946,934
4	2016			6,593,155	572,781	878,869	6,843,344	\$ 14,888,149
5	2017			6,593,155	572,781	922,812	7,185,511	\$ 15,274,260
6	2018			6,593,155	572,781	968,953	7,544,787	\$ 15,679,676
7	2019			6,593,155	572,781	1,017,401	7,922,026	\$ 16,105,363
8	2020			6,593,155	572,781	1,068,271	8,318,127	\$ 16,552,334
9	2021			6,593,155	572,781	1,121,684	8,734,034	\$ 17,021,654
10	2022			6,593,155	572,781	1,177,769	9,170,735	\$ 17,514,440
11	2023			6,593,155	572,781	1,236,657	9,629,272	\$ 18,031,865
12	2024			6,593,155	572,781	1,298,490	10,110,736	\$ 18,575,162
13	2025			6,593,155	572,781	1,363,414	10,616,273	\$ 19,145,623
14	2026			6,593,155	572,781	1,431,585	11,147,086	\$ 19,744,607
15	2027			6,593,155	572,781	1,503,164	11,704,441	\$ 20,373,541
16	2028			6,593,155	572,781	1,578,322	12,289,663	\$ 21,033,521
17	2029			6,593,155	572,781	1,657,239	12,904,146	\$ 21,727,320
18	2030			6,593,155	572,781	1,740,101	13,549,353	\$ 22,455,390
19	2031			6,593,155	572,781	1,827,106	14,226,821	\$ 23,219,862
20	2032			6,593,155	572,781	1,918,461	14,938,162	\$ 24,022,559
21	2033			6,593,155	572,781	2,014,384	15,685,070	\$ 24,865,390
22	2034			6,593,155	572,781	2,115,103	16,469,323	\$ 25,750,362
23	2035			6,593,155	572,781	2,220,858	17,292,789	\$ 26,679,584
24	2036			6,593,155	572,781	2,331,901	18,157,429	\$ 27,655,266
25	2037			6,593,155	572,781	2,448,496	19,065,300	\$ 28,679,733
	2038			6,593,155	572,781	2,570,921	20,018,565	\$ 29,755,422
	2039			6,593,155	572,781	2,699,467	21,019,494	\$ 30,884,697
	2040			6,593,155	572,781	2,834,440	22,070,468	\$ 32,070,845
	2041					2,976,162	23,173,992	\$ 26,150,154
	2042					3,124,970	24,332,691	\$ 27,457,662

25 Yrs Cumulative
\$ 503,456,186

30 Yrs Cumulative
\$ 649,775,164



Net/Grd. Bond Rate	5%	Bond Guarantee: Increased by 3%/Yr to 2013 &c	
Number of Years	25		
Annual Cost	\$7,986,562		
Interest on Reserve	3%		
Capital	\$	7,759,342	
Bond Issuance (% of Total)		2.60%	Credit
3 Years of Capitalized Interest		1,463,000	Credit
Reserve (10% of Total)		1,070,000	Credit
Total	\$	10,669,342	
Percentage Bond Rate			
Number of Years	25		
Annual Cost		\$765,946	
Interest on Reserve	3%	3%	

KWA Supply Option Worksheet		KWA-1	
Capacity			
Flint AOB:	12 MGD	1,064 MCF/Day	
KWA AOB:	12 MGD	1,064 MCF/Day	
Annual Volume			
Flint:	565,561 MCF		
KWA:	565,561 MCF		
2016 Cost of Supply			
Flint WTP Cost:	13.51 /MCF	\$ 7,832,118 /Yr	
KWA:	1.90 /MCF	\$ 878,869 /Yr	
Escalation/Inflation Rate			
Flint:	4.51% /Yr		
KWA:	5.08% /Yr		
Capital Expenditure			
Capitol:	272,421,558		
Bond Insurance (1.25% of Total):	8,460,000		
3 Years of Capitalized Interest:	56,000,000		
Reserve (10% of Total):	37,240,000		
Total:	374,861,558		
Flint's Share (50%):	212,900,847		
Overall Estimate:			
Reserve and Insurance Bond Insurance and			
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5	28 Yrs Cumulative 559,734,153
5	30 Yrs Cumulative 787,239,715

[illegible]

Year	DCM	Water Purchase	Free-Bond	First Payable	Interest on	TOTAL
2005	\$ 5,936,314	\$11,462,700	\$1,562,800	\$551,400	\$65,600	\$15,793,111
2006	\$ 5,607,758	\$12,044,775	\$1,400,000	\$511,000	\$66,600	\$15,644,371
2007	\$ 3,664,558	\$12,664,235	\$1,400,000	\$511,000	\$66,600	\$15,712,488
2008	\$ 3,720,000	\$779,869	\$766,562	\$755,946	\$65,600	\$15,744,727
2009	\$ 4,812,977	\$68,953	\$7,968,562	\$756,946	\$65,600	\$15,746,983
2010	\$ 9,032,375	\$1,017,402	\$7,968,562	\$756,946	\$65,600	\$15,806,084
2011	\$ 9,456,358	\$1,068,271	\$7,968,562	\$756,946	\$65,600	\$15,866,133
2012	\$10,030,857	\$1,121,684	\$7,968,562	\$756,946	\$65,600	\$15,934,407
2013	\$10,725,755	\$1,137,679	\$7,968,562	\$756,946	\$65,600	\$15,944,551
2014	\$10,755,586	\$1,136,677	\$7,968,562	\$756,946	\$65,600	\$15,946,355
2015	\$11,160,739	\$1,348,489	\$7,968,562	\$756,946	\$65,600	\$16,484,121
2016	\$11,588,596	\$1,431,585	\$7,968,562	\$756,946	\$65,600	\$16,800,000
2017	\$12,683,325	\$1,504,344	\$7,968,562	\$756,946	\$65,600	\$17,174,435
2018	\$13,028,123	\$1,594,322	\$7,968,562	\$756,946	\$65,600	\$17,559,555
2019	\$14,674,355	\$1,697,235	\$7,968,562	\$756,946	\$65,600	\$18,297,313
2020	\$14,674,355	\$1,740,203	\$7,968,562	\$756,946	\$65,600	\$18,297,313
2021	\$15,838,716	\$1,877,206	\$7,968,562	\$756,946	\$65,600	\$19,590,430
2022	\$16,027,775	\$1,816,461	\$7,968,562	\$756,946	\$65,600	\$19,690,744
2023	\$17,566,067	\$2,014,344	\$7,968,562	\$756,946	\$65,600	\$21,365,923
2024	\$17,566,067	\$2,115,103	\$7,968,562	\$756,946	\$65,600	\$21,777,679
2025	\$18,220,858	\$2,203,858	\$7,968,562	\$756,946	\$65,600	\$22,603,134
2026	\$19,730,731	\$2,351,502	\$7,968,562	\$756,946	\$65,600	\$24,906,842

Financing water from 2005 to 2016 at three percent interest rate. The interest rate is based on the year during DCIM construction at 3.0 percent. The interest rate is based on the current rate (the interest rate was 2.0 percent until 2016).

WVA Revenue
 Payment
 Free-Bond
 First Payable
 Interest on
 TOTAL

Other Deductions
 Estimated present is Three's Entry Fee to WVA

End Certificate

KWA Supply Option Worksheet
KWA2

Capacity

Flint ADD:	12 MGD	1,604 MCF/Day
KWA ADD:	12 MGD	1,604 MCF/Day

Annual Volume

Flint	585,561 MCF
KWA	585,561 MCF

2016 Cost of Supply

Flint-WTP O&M:	\$ 13.51 /MCF	\$ 7,813,118 /Yr
KWA:	\$ 1.50 /MCF	\$ 878,468 /Yr

Escalation/Inflation Rate

Flint:	4.51% /Yr
KWA:	5.0% /Yr

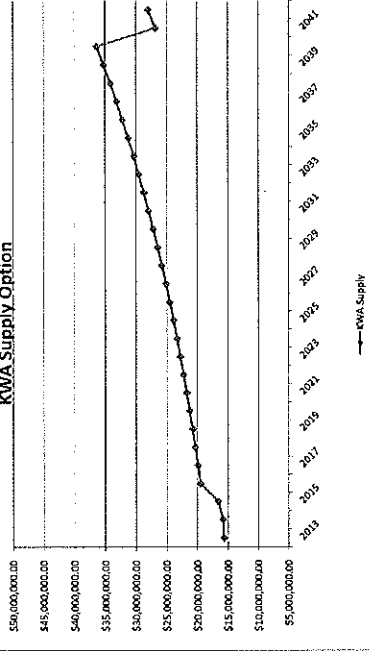
Capital Expenditures

Capital:	\$ 357,578,060
Bond Issuance (2.25% of Total):	11,050,000
3 Years of Capitalized Interest:	74,000,000
Reserve (1.0% of Total):	49,000,000
Total:	\$ 491,628,060
Flint's Share (30%):	\$ 147,488,418

Revenue Bond Rate:	5%
Number of Years:	25
Annual Cost:	\$10,464,666
Interest on Reserve:	3%

Capital:	\$ 7,753,362
Bond Issuance (3% of Total):	240,000
3 Years of Capitalized Interest:	1,000,000
Reserve (1.0% of Total):	1,070,000
Total:	\$ 10,668,362
Revenue Bond Rate:	5%
Number of Years:	25
Annual Cost:	\$756,946
Interest on Reserve:	3%

KWA Supply Option



Year	Flint WTP O&M	Water Purchase	Flint Revenue Pre-Bond Entry Fee & Bond Payment	Flint Revenue Bond Payment	Interest on Reserve	TOTAL
2013	\$ 3,182,214	\$ 17,461,700	\$ 1,182,000		\$ 473,100	\$ 15,688,614
2014	\$ 3,497,788	\$ 17,694,785	\$ 1,182,000		\$ 473,100	\$ 16,460,673
2015	\$ 3,864,558	\$ 17,932,869	\$ 1,182,000		\$ 473,100	\$ 16,869,542
2016	\$ 4,284,118	\$ 18,176,953	\$ 1,182,000		\$ 473,100	\$ 17,316,169
2017	\$ 4,757,977	\$ 18,427,041	\$ 1,182,000		\$ 473,100	\$ 17,800,118
2018	\$ 5,290,000	\$ 18,683,132	\$ 1,182,000		\$ 473,100	\$ 18,321,232
2019	\$ 5,877,775	\$ 18,945,229	\$ 1,182,000		\$ 473,100	\$ 18,880,104
2020	\$ 6,527,775	\$ 19,213,332	\$ 1,182,000		\$ 473,100	\$ 19,466,187
2021	\$ 7,249,904	\$ 19,487,441	\$ 1,182,000		\$ 473,100	\$ 20,079,425
2022	\$ 8,048,857	\$ 19,767,556	\$ 1,182,000		\$ 473,100	\$ 20,720,313
2023	\$ 8,931,476	\$ 20,053,686	\$ 1,182,000		\$ 473,100	\$ 21,388,262
2024	\$ 9,904,139	\$ 20,345,801	\$ 1,182,000		\$ 473,100	\$ 22,082,941
2025	\$ 10,973,779	\$ 20,644,001	\$ 1,182,000		\$ 473,100	\$ 22,803,881
2026	\$ 12,146,596	\$ 20,948,286	\$ 1,182,000		\$ 473,100	\$ 23,550,182
2027	\$ 13,429,712	\$ 21,258,656	\$ 1,182,000		\$ 473,100	\$ 24,323,566
2028	\$ 14,831,329	\$ 21,574,111	\$ 1,182,000		\$ 473,100	\$ 25,124,530
2029	\$ 16,361,053	\$ 21,894,661	\$ 1,182,000		\$ 473,100	\$ 25,953,815
2030	\$ 18,029,305	\$ 22,220,306	\$ 1,182,000		\$ 473,100	\$ 26,812,611
2031	\$ 19,847,475	\$ 22,551,046	\$ 1,182,000		\$ 473,100	\$ 27,702,067
2032	\$ 21,827,775	\$ 22,886,881	\$ 1,182,000		\$ 473,100	\$ 28,623,536
2033	\$ 23,984,627	\$ 23,227,711	\$ 1,182,000		\$ 473,100	\$ 29,577,939
2034	\$ 26,334,680	\$ 23,573,536	\$ 1,182,000		\$ 473,100	\$ 30,566,852
2035	\$ 28,894,605	\$ 23,924,356	\$ 1,182,000		\$ 473,100	\$ 31,591,916
2036	\$ 31,681,787	\$ 24,280,171	\$ 1,182,000		\$ 473,100	\$ 32,654,958
2037	\$ 34,714,042	\$ 24,641,081	\$ 1,182,000		\$ 473,100	\$ 33,758,204
2038	\$ 38,009,319	\$ 25,007,086	\$ 1,182,000		\$ 473,100	\$ 34,902,804
2039	\$ 41,584,201	\$ 25,378,186	\$ 1,182,000		\$ 473,100	\$ 36,089,573
2040	\$ 45,466,566	\$ 25,753,291	\$ 1,182,000		\$ 473,100	\$ 37,321,416
2041	\$ 49,683,370	\$ 26,132,401	\$ 1,182,000		\$ 473,100	\$ 38,609,162
2042	\$ 54,274,473	\$ 26,515,516	\$ 1,182,000		\$ 473,100	\$ 40,053,565

\$ 25 Yrs Cumulative 686,057,940

\$ 30 Yrs Cumulative 786,764,515