

TM-6: Life Cycle Cost Analysis of Water Treatment Plant Alternatives

1.0 Introduction

This technical memorandum presents the life cycle cost analysis of alternatives for water treatment plant consolidation and repurposing. The key factors in this evaluation include:

1. Capital costs for future water treatment plant upgrades;
2. Capital costs for new water transmission mains, or rehabilitation of existing mains, required to maintain redundant supply options in an emergency disruption of service;
3. Operating costs for water treatment plant;
4. Energy costs for additional pumping associated with supplying water from treatment plants more distant than the water treatment plant being repurposed; and
5. The economic present worth of capital costs and annual costs for each alternative, including a range of economic factors representing high and low future cost inflation.

The life cycle cost evaluation was performed in conjunction with a series of reviews, meetings, and workshops with wholesale and retail customers and DWSD. These reviews and workshops allowed for progressive input on the evaluation, the addition of alternatives and decision criteria, and the subsequent short-listing of selected alternatives. The series of reviews and workshops included:

- March 2013: Phase 1 Report with the initial life cycle cost evaluation
- March and April: Master Plan Steering Team and Retail Customer Steering Committee meetings to discuss treatment plan consolidation and repurposing
- May 2014: Board of Water Commissioners Workshop
- May 2014: DWSD Management Team Workshop
- June 2014: Wholesale Customer and Customers' Engineers Workshop
- July 2014: Master Plan Steering Team discussion of update of life cycle cost for selected alternatives
- August 2014: Wholesale Customers, Analytical Work Group and DWSD Workshop.

The life cycle cost calculations for all alternatives are included in Attachment 1 to this TM. The list of alternatives prior to short-listing included the following:

1. Maintain all five plants at the current MDEQ rated capacity of 1,720 MGD

2. Repurpose the Northeast plant, and upgrade remaining plants to their current MDEQ rated capacity.
3. Repurpose the Southwest plant, and upgrade remaining plants to their current MDEQ rated capacity.
4. Repurpose the Northeast and Southwest plant, and upgrade remaining plants to their current MDEQ rated capacity.
5. Repurpose the Springwells plant, and upgrade remaining plants to their current MDEQ rated capacity.
6. Reduce the capacity of all plants so that the sum of all capacities matches projected future water demands in the planning period.
7. Expand the capacity of Lake Huron and maintain the current capacity of Water Works Park
8. Repurpose the Lake Huron plant, and upgrade remaining plants to their current MDEQ rated capacity.

Four alternatives were selected for further evaluation during the workshops in May and June:

1. Baseline—Maintain all five plants, but reduce the rated capacity to 1,000 MGD
2. Alternative 1—Repurpose Northeast and reduce other plants for a total of 1,000 MGD
3. Alternative 2—Repurpose Northeast and Southwest, total capacity of 1,000 MGD
4. Alternative 3—Repurpose Springwells, reduce other plants to a total of 1,000 MGD

2.0 Guiding Principles

Discussions at the workshops in May and June and at other steering committee meetings resulted in a series of insights, observations and conclusions about plant consolidation and repurposing. These are captured below in a list of “guiding principles” that set the context for the identification of alternatives and the scope of the life cycle cost calculations:

1. The Water Works Park plant is the most modern plant, and it is strategically located to provide pre-treatment for two other plants. Recommended yard piping improvements will allow this plant to operate at design capacity.
2. The Lake Huron plant is a relatively new plant, and its location provides abundant high quality water directly from Lake Huron. The plant is in good condition with low capital needs. Recommended operating changes will reduce the cost of producing and pumping water from this facility in the future.

3. Three intakes should be preserved in order to provide flexibility for future supply needs, maintenance of intake structures, and response to temporary source water situations that may require an emergency response.
4. Consolidating plants should reduce DWSD's fixed costs for water treatment.
5. Decisions on consolidation should be based on asset management principles; make maximum use of viable existing infrastructure, and abandon or repurpose marginal assets to renew the asset life for a new objective.
6. Recognizing that consolidation and repurposing will require several years, the implementation should be done in a progressive, step-wise approach that provides benefits with each step.
7. Consolidation and repurposing should support innovative proposals that may emerge from other initiatives for the Blue Economy and Green Infrastructure.
8. The national and regional trend is declining per capita water demand, and there are ambitious regional goals for reduction in non-revenue water. The consolidation and repurposing plan should be reviewed at 5-year intervals to re-project the treatment capacity requirements, which could be lower in the future.

3.0 Life Cycle Cost Analysis

The life cycle cost analysis required the consideration of capital costs, operating costs, and the staging of when construction would occur. The different alternatives for water plant closures have significantly different operating and capital costs. In order to compare all alternatives on a consistent economic basis, the life cycle cost analysis considers the full time series of new capital, replacement, salvage, and annual operating costs over the 20-year planning period. All costs in the time series are then represented by one number, called the Present Worth.

The alternative with the lowest Present Worth cost is the most cost-effective in consideration of expenditures and benefits. In developing the different alternatives, it is important that all meet the same threshold of level of service for drinking water quality, wholesale customer contract pressure and volume and redundancy.

Not all factors in the plant closure evaluation can be equated into annual costs and capital costs. There are non-monetary factors, such as potential future scenarios for regulations and growth, and certain risks that are best understood as additional decision criteria outside of the life cycle cost evaluation. These non-monetary factors are discussed in Chapter 6 of this report.

The life cycle cost evaluation was performed in accordance with the United States Office of Management and Budget Circular A-94, revised, titled: "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs." These guidelines are generally used in programs when federal funding is provided for water and transportation projects.

In the context of the OMB Circular A-94 guidelines, the discount rate is an important economic factor.

This factor is used to translate future expenditures and benefits over time to the single Present Worth value described above. In order to compute Present Worth, it is necessary to discount future benefits and costs. The OMB guidance on the use of discount rates is presented below:

“This discounting reflects the time value of money. Benefits and costs are worth more if they are experienced sooner. All future benefits and costs, including non-monetized benefits and costs, should be discounted. The higher the discount rate, the lower is the present value of future cash flows. For typical investments, with costs concentrated in early periods and benefits following in later periods, raising the discount rate tends to reduce the net present value.”

The alternatives are structured so that benefits are consistent for all alternatives, as measured by the level of service goals. The largest uncertainty for DWSD and its customers is how costs could rise in the future, in order to achieve the level of service benefits. Future costs include construction, financing, and energy, chemical, labor and benefits.

In order to address the uncertainty around future costs, the life cycle evaluation was performed twice, once with a lower discount rate, then again with a higher discount rate. The low discount rate was 4 percent per year, and the high rate was 7 percent per year.

This range of rates is typical of the range of values currently used in the United States for cost-benefit studies performed in accordance with Circular A-94. The higher discount rate reflects a scenario of costs increasing at a higher rate than has been the case over the last 5 years. The lower discount rate reflects a scenario of costs increasing at approximately the same rate as over the last 5 years.

Tables A and B in Attachment 1 present the calculations for the life cycle costs for all alternatives. Table A presents the calculations for the 8 original alternatives and Table B presents the calculations for the 4 selected alternatives. Both tables use the same basic calculation methodology. However, the calculations for the selected alternatives include several new considerations that were requested during the workshops. The sections below discuss these new considerations.

3.1 Labor Costs

There were several questions at the June 2014 wholesale customer workshop regarding the basis of labor, overtime, and benefits costs. The original calculations used actual FY2013 costs for all of these categories. Actual costs for FY2014 were recently obtained. A comparison of FY2013 actual costs, FY2014 budget costs, and FY2014 actual costs is shown below in **Table 3-1**.

Table 3-1: Labor Cost Comparisons Related to Water Production

	FY2013 Actual	FY2014 Budget	FY2014 Actual
Water Production	\$12,504,000	\$18,427,000	\$13,340,000

As of 2014, salary and wages, overtime and contract costs remained in flux due to operational optimization efforts that are underway by the DWSD. The benefits structure was also fluid due to financial scenarios driven by the ongoing bankruptcy proceedings.

Given this dynamic situation, the sensitivity of the life cycle cost analysis was examined relative to the actual and budget costs shown above. Results for each alternative are presented below in **Table 3-2**.

Table 3-2: Present Worth Summary at 4% Discount Rate for Various Annual Labor Costs

Alternative	FY2013 Actual	FY2014 Actual	FY2014 Budget
	\$ billions	\$ billions	\$ billions
Baseline	1.497	1.509	1.582
Alternative 1	1.391	1.397	1.455
Alternative 2	1.398	1.402	1.446
Alternative 3	1.488	1.499	1.558

3.2 Energy Costs

During the workshops, it was noted that the energy calculations were based on the assumption that all flows from repurposed plants would need to be re-pumped. This is a conservative assumption, because a portion of the water pumped from one plant would reach the service area of the former plant without double pumping. The current life cycle cost analysis with the conservative assumption on second pumping showed increases of 7, 10, and 16 percent for energy costs compared to the base line.

At this time, the use of the 2035 hydraulic model has not progressed far enough to calculate the average annual changes in energy costs for each alternative. Therefore, the current version of the analysis leaves the energy costs the same as in the original analysis, and a sensitivity analysis was performed, and is shown in the **Table 3-3** below.

Table 3-3: Present Worth Summary at 4% and 7% Discount Rates for Various Annual Energy Costs (in \$billions)

Alternative	FY2013 Actual		25% Less Double Pumping		50% Less Double Pumping	
	4%	7%	4%	7%	4%	7%
Baseline	1.497	1.161	1.497	1.161	1.497	1.161
Alternative 1	1.391	1.079	1.380	1.070	1.367	1.060
Alternative 2	1.398	1.098	1.382	1.089	1.366	1.074
Alternative 3	1.488	1.179	1.469	1.164	1.449	1.148

For all scenarios, the lowest cost alternatives remain Alternatives 1 and 2.

3.3 Chemicals

There is no change in cost for chemicals from the earlier analysis. It is expected that chemical costs will be reduced for the Lake Huron plant in the future, if this plant is converted to a direct filtration process for a maximum day capacity of approximately 320 MGD. Such a change would reduce operating costs, but it would not impact the relative ranking of the alternatives in the life cycle cost analysis.

3.4 Maintenance and Other

There is no change in these costs from earlier analysis. They continue to be based on the fiscal year 2013 costs for residuals handling and O&M related repair and replacement costs at each plant.

3.5 Plants

Since the original presentation of water treatment plant upgrade costs in March 2014, the master planning team and DWSD have further evaluated and refined the needs assessment for each plant. Tables B-12 to B-16 present a worksheet for each plant showing the results of the needs assessment, the source of the information, and how each type of cost was handled in the life cycle cost analysis.

The needs assessment numbers are based on restoring the full capacity of each plant. However, with the exception of the Water Works Park plant, all alternatives are based on a future capacity that is lower than the current design capacity. Therefore, the needs assessment estimates are pro-rated down based on the estimated future capacity. There are three types of pro-rating situations:

1. Costs that are fixed regardless of the range of plant capacity being considered.
2. Costs are generally proportional to plant capacity. Note that a factor of 10% was added when reducing the estimated cost for reduced capacity at each plant, to allow for a diseconomy of smaller scale.
3. Costs that are not included in the life cycle cost analysis because these are for high lift pumping or other improvements that will be needed regardless of plant consolidation. (Note that the current contract for filter rehabilitation at the Springwells plant has been included in this category.)

The hydraulic model is used in each of these alternatives to determine the probable capacity required at each plant, based on a total maximum day demand of 1,000 MGD. These capacities are shown on **Table 3-4**. These capacities were then used to reduce the plant rehabilitation cost by prorating the original costs for restoring the plants to their current rated capacities. In doing this proration calculation, an estimate was made for fixed costs that would not change with incremental changes in capacity, such as electrical and HVAC systems, vs costs that are proportional to capacity.

Table 3-4: Model Simulated Water Treatment Plant Capacities for Selected Alternatives

Water Treatment Plant	Baseline – Reduced WTP Capacities (all plants operating)	Alternative 1 – Northeast WTP Repurposed and others reduced	Alternative 2 – Northeast WTP & Southwest WTP Repurposed and others reduced	Alternative 1 – Springwells WTP Repurposed and others reduced
Lake Huron	285	314	319	322
Northeast	145	60 ⁽¹⁾	60 ⁽¹⁾	300
Southwest	152	123	70 ⁽¹⁾	140
Springwells	186	341	444	262 ⁽¹⁾
Waterworks	232	222	237	238
Total	1000	1000	1000	1000

⁽¹⁾ Flow rate from plant that is proposed to be used as a pumping station. Treatment processes to be closed.

3.6 Regulatory Compliance & Inventory

At the workshop in May, DWSD requested that the cost of regulatory compliance and the cost of equipment and supply inventory for each plant be included in the cost analysis. The project team researched these costs, and the following approach was used:

- Capital costs for potential future regulations were approximated by including estimates to install UV, ozone and chlorine gas conversion at each plant (except for Water Works Park which has ozone disinfection). These costs were added and incorporate a 50% probability that these investments would be mandated during the planning period.
- Compliance reporting: Water Quality Group staff costs and lab costs were included in the previous analysis. The latest analysis adds the cost of labor for 1.0 full time equivalent (FTE) for headquarters staff per plant per year to handle compliance related issues.
- All supplies and spare parts are stored at the plants, so there is no storage cost.
- The Materials Management Group in the Finance Division included 38 staff. Based on discussion with DWSD it was agreed that the effort to manage inventory for each plant can be estimated by allowing for 1.0 FTE per plant per year for staff in the Materials Management Group.

3.7 Transmission Mains

An updated set of maps has been prepared to show the new inter-plant water transmission mains. These maps are provided in Attachment C. New mains were identified where the hydraulic model showed that velocity exceeded 10 feet per second or head loss exceeds 3 feet per 1,000 feet.

The cost of the Garland Main Replacement (\$68 million) has been added, to the two alternatives that include repurposing the Northeast water treatment plant. Also, consistent with earlier analysis of the original 8 alternatives, the cost of the Water Works Park (WWP) Yard Piping and Metering Project (\$38 million) is included as a transmission cost for all alternatives, because this project will allow the WWP plant to convey the full plant capacity into the transmission system.

The cost for a new, dedicated raw water transmission main from Southwest to Springwells has been included, in order to preserve the intake at Fighting Island. This is a substantial new cost for the alternative of repurposing the Southwest plant while preserving the intake. (The previous analysis of alternatives in Table A proposed to handle the raw water transmission from Southwest to Springwells as an emergency procedure with valve operations on existing mains, rather than dedicating a new transmission main.)

3.8 Life Cycle Cost Factors – Salvage Value

One comment from the workshops was that salvage value should be shown more clearly. Salvage values are now shown on the worksheet title “LCA Factors”. Salvage value calculation is based on a service life of 100 years for pipelines and buildings, and a service life of 20 years for electrical and mechanical equipment. The salvage values were calculated as if new water main construction is completed in 2020 and water treatment plant upgrades are completed in 2025. The salvage value is

calculated for the fraction of remaining service life at the end of the planning period, 2035. These calculations are shown in Table B-9.

Additional analysis was performed, based on a request at the AWG workshop, to compare the life cycle cost analysis with and without accounting for salvage values. The results of this comparison are shown below in **Table 3-5**. Note that the ranking of two alternatives switches when salvage value is not included. These two alternatives also switch ranking for certain other sensitivity analyses. Due to this sensitivity, it is recommended that re-purposing be done in two phases. In the first phase, complete the repurposing of Northeast by 2020; in the second phase then re-examine at the economics of repurposing the Southwest plant between 2020 and 2025.

Table 3-5: Present Worth Summary at 4% and 7% Discount Rates with and without Salvage Value

Alternative	Present Worth at 4% Discount Rate (\$ Millions)	
	With Salvage Value	Without Salvage Value
Baseline: Reduce All Plants to total of 1,000 MGD	\$1,530	\$1,705
Repurpose Northeast WTP; total capacity of all plants = 1,000 MGD	\$1,443	\$1,615
Repurpose Northeast and Southwest WTPs total capacity of all plants = 1,000 MGD	\$1,439	\$1,646
Repurpose Springwells WTP total capacity of all plants = 1,000 MGD	\$1,489	\$1,691

4.0 Decommission and Re-commission Cost Example

A question was received at the August 2014 workshop regarding the cost to bring a plant back on-line after decommissioning it. The master plan team evaluated this question by developing the costs to decommission 80 MGD of filtration capacity at either the Lake Huron or Springwells WTP and then re-commission that capacity after a period of 20 years. The planning team also evaluated the cost to maintain treatment operations for 80 MGD over the same period. The cost estimates and details are provided in Tables B-18 to B-20.

Results of this cost analysis show that the present worth cost estimate to operate 80 MGD of conventional filtration basins for 20 years is approximately \$3.8 to \$4.7 million dollars depending on interest rate applied (7% v. 4% respectively). The decommissioning and re-commissioning present worth cost estimates totaled \$1.4 to \$2.5 million dollars. Thus the cost to decommission, then re-commission in the future, if necessary, is approximately half the cost of operating the filters in anticipation of having the capacity available, if needed in 20 years. The cost estimates are detailed in Tables B-18 to B-20 in Attachment 1.

5.0 Updated Cost of Original Alternative to Maintain All 5 Plants at MDEQ Rated Capacity

Table 6-6 in Chapter 6 provides an overall summary of the life cycle cost analysis plus non-monetary factors. The first alternative titled “Maintain All 5 Plants at Current MDEQ Rated Capacity” is the original first alternative that was evaluated in the March 2014 life cycle cost analysis. The present

worth cost of this alternative shown in Table A-1 is \$1,628 million and its annual cost is \$48.57 million.

The evaluation of the selected alternatives included additional costs for regulatory compliance and materials inventory that were not considered in the original screening of alternatives. **Table 5-1** below shows these additional costs:

Table 5-1: Adjusted Cost for Maintaining All 5 Plants at Current MDEQ Rated Capacity (\$1,000s)

	Present Worth Cost (4% discount rate)	Total Annual Cost
Original Total shown in Table A-1.	\$1,628,000	\$48,570
Additional Cost for Regulatory Compliance	\$398,000	6,100
Additional Cost for Materials Inventory	3,000	200
New Total shown in Table 6-6	\$2,029,000	\$54,870

Attachment A

Table A-1. Summary of Water Treatment Plant Life Cycle Cost Analysis at 4% Discount Rate FY 2015 to FY 2034

Alternative	Annual WTP O&M Costs (\$ thousands)					Capital Needs through FY 2034 (\$ thousands)		Present Worth (\$ thousands)
	Labor	Energy	Chemical	Other	Total	WTP	Mains	March 2014
1. Maintain current rated capacity at all plants	\$ 12,500	\$ 23,200	\$ 8,230	\$ 4,640	\$ 48,570	\$ 980,800	\$ 38,000	\$ 1,628,000
2. Repurpose Northeast	\$ 10,590	\$ 24,850	\$ 8,230	\$ 3,520	\$ 47,190	\$ 770,900	\$ 70,100	\$ 1,447,000
3. Repurpose Southwest	\$ 10,640	\$ 23,960	\$ 8,230	\$ 2,770	\$ 45,600	\$ 900,600	\$ 58,600	\$ 1,531,000
4. Repurpose Northeast and Southwest	\$ 8,730	\$ 25,600	\$ 8,230	\$ 1,650	\$ 44,210	\$ 690,600	\$ 83,200	\$ 1,343,000
5. Repurpose Springwells	\$ 10,390	\$ 26,880	\$ 8,230	\$ 3,920	\$ 49,420	\$ 536,400	\$ 328,800	\$ 1,508,000
6. Expand Lake Huron plus use Waterworks Park	\$ 8,120	\$ 33,330	\$ 5,720	\$ 3,500	\$ 50,670	\$ 321,100	\$ 1,532,700	\$ 2,456,000
7. Reduce rated capacity across all plants	\$ 11,860	\$ 24,690	\$ 8,230	\$ 4,640	\$ 49,420	\$ 784,800	\$ 140,500	\$ 1,558,000
8. Repurpose Lake Huron	\$ 10,920	\$ 13,460	\$ 8,230	\$ 4,140	\$ 36,750	\$ 805,300	\$ 320,500	\$ 1,562,000

See Table J 2 for analysis at 7 percent discount rate.

See Tables J-3 to J-10 for supporting documentation and explanatory notes.

Table A-2. Summary of Water Treatment Plant Life Cycle Cost Analysis at 7% Discount Rate FY 2015 to FY 2034

Alternative	Annual WTP O&M Costs (\$ thousands)					Capital Needs through FY 2034 (\$ thousands)		Present Worth (\$ thousands)
	Labor	Energy	Chemical	Other	Total	WTP	Mains	March 2014
1. Maintain current rated capacity at all plants	\$ 12,500	\$ 23,200	\$ 8,230	\$ 4,640	\$ 48,570	\$ 980,800	\$ 38,000	\$ 1,217,000
2. Repurpose Northeast	\$ 10,590	\$ 24,850	\$ 8,230	\$ 3,520	\$ 47,190	\$ 770,900	\$ 70,100	\$ 1,089,000
3. Repurpose Southwest	\$ 10,640	\$ 23,960	\$ 8,230	\$ 2,770	\$ 45,600	\$ 900,600	\$ 58,600	\$ 1,147,000
4. Repurpose Northeast and Southwest	\$ 8,730	\$ 25,600	\$ 8,230	\$ 1,650	\$ 44,210	\$ 690,600	\$ 83,200	\$ 1,013,000
5. Repurpose Springwells	\$ 10,390	\$ 26,880	\$ 8,230	\$ 3,920	\$ 49,420	\$ 536,400	\$ 328,800	\$ 1,157,000
6. Expand Lake Huron plus use Waterworks Park	\$ 8,120	\$ 33,330	\$ 5,720	\$ 3,500	\$ 50,670	\$ 321,100	\$ 1,532,700	\$ 1,949,000
7. Reduce rated capacity across all plants	\$ 11,860	\$ 24,690	\$ 8,230	\$ 4,640	\$ 49,420	\$ 784,800	\$ 140,500	\$ 1,176,000
8. Repurpose Lake Huron	\$ 10,920	\$ 13,460	\$ 8,230	\$ 4,140	\$ 36,750	\$ 805,300	\$ 320,500	\$ 1,185,000

See Table J-1 for analysis at 4 percent discount rate.

See Tables J 3 to J 10 for supporting documentation and explanatory notes.

Table A-3 Labor Cost Estimates

Baseline FY 2013 Costs

PLANTS	SALARY / WAGES	OVERTIME	BENEFITS	TOTAL SALARY & BENEFITS	CONTRACT LABOR	TOTAL ALL LABOR
LAKE HURON (LH)	\$929,102	\$294,846	\$576,091	\$1,800,039	\$166,188	\$1,966,227
NORTHEAST (NE)	\$1,230,407	\$432,035	\$597,014	\$2,259,457	\$46,000	\$2,305,457
SOUTHWEST (SW)	\$1,184,084	\$366,352	\$785,399	\$2,335,835	\$46,000	\$2,381,835
SPRINGWELLS (SPW)	\$1,288,409	\$541,517	\$699,440	\$2,529,367	\$46,000	\$2,575,367
WATERWORKS PARK	\$1,774,102	\$699,840	\$755,393	\$3,229,336	\$46,000	\$3,275,336
TOTAL	\$6,406,104	\$2,334,591	\$3,413,338	\$12,154,033	\$350,188	\$12,504,221

Alternatives	Labor Estimate	Explanation of Estimate
1 Maintain current rated capacity at all plants	\$ 12,504,221	Same as Base Line
2 Repurpose Northeast	\$ 10,592,794	Subtract NE total labor from Base Line, retain labor legacy cost
3 Repurpose Southwest	\$ 10,640,749	Subtract SW total labor from Base Line, retain labor legacy cost
4 Repurpose Northeast and Southwest	\$ 8,729,322	Subtract NE and SW total labor from Base Line, retain labor legacy cost
5 Repurpose Springwells	\$ 10,390,485	Subtract SPW total labor from Base Line, retain labor legacy cost
6 Expand Lake Huron plus Waterworks Park	\$ 8,120,779	Estimated to double operations and maintenance positions at LH; subtract labor for NE, SW and SPW; retain labor legacy cost
7 Reduce rated capacity across all plants	\$ 11,863,508	Estimated to allow reduction of 8 positions in operations staff, retain labor legacy cost. See J-10 Notes.
8 Repurpose Lake Huron	\$ 10,918,215	Subtract LH total labor from Base Line, retain labor legacy cost

Table A-4 Energy Cost Estimates

Baseline FY 2013 Costs

LOCATION	DTE Bill	Estimate for Natural Gas and Diesel	Estimated Energy Cost
LAKE HURON (LH)	\$7,379,969	\$ 295,199	\$ 7,675,168
NORTHEAST (NE)	\$4,728,583	\$ 189,143	\$ 4,917,727
SOUTHWEST (SW)	\$2,037,826	\$ 81,513	\$ 2,119,339
SPRINGWELLS (SPW)	\$5,473,759	\$ 218,950	\$ 5,692,709
WATERWORKS PARK	\$2,690,296	\$ 107,612	\$ 2,797,908
Totals:	\$22,310,433	\$ 892,417	\$ 23,202,850

Alternatives	Treat and Pump	Second Pumping ¹	Total Energy	Explanation of Estimates
1 Maintain current rated capacity at all plants	\$23,202,850	\$ -	\$ 23,202,850	Same as Baseline Total Energy
2 Repurpose Northeast	\$21,530,823	\$ 3,317,100	\$ 24,847,923	Treat & pump costs are based on (baseline total energy cost - total energy at NE + high lift % at NE).
3 Repurpose Southwest	\$22,884,949	\$ 1,073,100	\$ 23,958,049	Treat & pump costs are based on (baseline total energy cost - total energy at SW + high lift % at SW).
4 Repurpose Northeast and Southwest	\$21,212,922	\$ 4,390,200	\$ 25,603,122	Treat & pump costs are based on (baseline total energy cost - total energy at NE - total energy at SW + high lift % at NE + high lift % at SW).
5 Repurpose Springwells	\$21,324,256	\$ 5,558,500	\$ 26,882,756	Treat & pump costs are based on (baseline total energy cost - total energy at SPW + high lift % at SPW).
6 Expand Lake Huron plus Waterworks Park	\$16,835,214	\$ 16,490,580	\$ 33,325,794	See note below
7 Reduce rated capacity across all plants	\$23,202,850	\$ 1,490,250	\$ 24,693,100	Same as Baseline Total Energy plus Second Pumping (see Table A-11)
8 Repurpose Lake Huron	\$15,527,682	\$ (2,063,000)	\$ 13,464,682	See note below

¹ Second Pumping Costs - See Additional Calculations (Table A-11)

Alternative 6 Treat and Pump costs assume 87,600 MG/yr from WWP + 113,942 MG/yr from LH, cost to pump from WWP=\$40/MG, cost to pump from LH = \$117/MG (Avg of \$75/MG 6 months and \$159/MG 6 months). \$117*113,942+\$40*87,600

Table A-5 Chemical Cost Estimates

Baseline FY 2013 Costs

LOCATION	FAAR Report
LAKE HURON (LH)	\$1,785,772
NORTHEAST (NE)	\$1,189,496
SOUTHWEST (SW)	\$861,895
SPRINGWELLS (SPW)	\$1,883,181
WATERWORKS PARK	\$2,513,933
Totals:	\$8,234,276

Alternatives	Estimated Chemical Cost	Explanation of Estimate
1 Maintain current rated capacity at all plants	\$8,234,276	Same as Base Line
2 Repurpose Northeast	\$8,234,276	See Note
3 Repurpose Southwest	\$8,234,276	See Note
4 Repurpose Northeast and Southwest	\$8,234,276	See Note
5 Repurpose Springwells	\$8,234,276	See Note
6 Expand Lake Huron plus Waterworks Park	\$5,715,000	Based on current chemical dosage at Lake Huron, pending pilot testing
7 Reduce rated capacity across all plants	\$8,234,276	Same as Base Line
8 Repurpose Lake Huron	\$8,234,276	Same as Base Line

Note: Alternatives 2-5 Same as Base Line, because chemical purchase costs are similar among plants and total annual volume of treated water is the same for all alternatives.

Table A-6 Other O&M Cost Estimates

Baseline FY 2013 Costs

LOCATION	Residuals	O&M Related Repair and Replacement	Total
LAKE HURON (LH)		\$ 504,000	\$ 504,000
NORTHEAST (NE)		\$ 1,118,000	\$ 1,118,000
SOUTHWEST (SW)	\$96,000	\$ 1,774,000	\$ 1,870,000
SPRINGWELLS (SPW)		\$ 718,000	\$ 718,000
WATERWORKS PARK	\$35,000	\$ 395,000	\$ 430,000
Totals:	\$131,000	\$4,509,000	\$ 4,640,000

Alternatives	Estimated Other Cost	Explanation of Estimate
1 Maintain current rated capacity at all plants	\$4,640,000	Same as Base Line
2 Repurpose Northeast	\$3,522,000	Subtract NE Total from Base Line
3 Repurpose Southwest	\$2,770,000	Subtract SW Total from Base Line
4 Repurpose Northeast and Southwest	\$1,652,000	Subtract NE + SW Total from Base Line
5 Repurpose Springwells	\$3,922,000	Subtract SPW Total from Base Line
6 Expand Lake Huron plus Waterworks Park	\$3,500,000	Estimated to be \$3,500,000 based on new size of Lake Huron plant
7 Reduce rated capacity across all plants	\$4,640,000	Same as Base Line
8 Repurpose Lake Huron	\$4,136,000	Subtract LH Total from Base Line

Table A-7 Water Treatment Plant Upgrade Cost Estimates

Alternatives	Estimated Construction Cost	Estimated Decommissioning Cost	Engineering, Legal, Admin and Contingency ²	Estimated Capital Cost	Reference
1 Maintain current rated capacity at all plants	\$ 754,482,093	\$ -	\$ 226,344,628	\$ 980,826,721	Phase 1 Interim Report
2 Repurpose Northeast	\$ 591,964,053	\$ 1,000,000	\$ 177,889,216	\$ 770,853,269	Phase 1 Interim Report
3 Repurpose Southwest	\$ 691,773,832	\$ 1,000,000	\$ 207,832,150	\$ 900,605,982	Phase 1 Interim Report
4 Repurpose Northeast and Southwest	\$ 529,255,792	\$ 2,000,000	\$ 159,376,738	\$ 690,632,530	Phase 1 Interim Report
5 Repurpose Springwells	\$ 410,638,665	\$ 2,000,000	\$ 123,791,600	\$ 536,430,265	Phase 1 Interim Report
6 Expand Lake Huron plus Waterworks Park	\$ 244,000,000	\$ 3,000,000	\$ 74,100,000	\$ 321,100,000	See below ¹
7 Reduce rated capacity across all plants	\$ 602,700,000	\$ 1,000,000	\$ 181,110,000	\$ 784,810,000	TM 13 estimates scaled down for lower capacity.
8 Repurpose Lake Huron	\$ 618,449,883	\$ 1,000,000	\$ 185,834,965	\$ 805,284,848	Phase 1 Interim Report

¹Concept estimate for direct filtration and increase to 800 MGD; \$ 6 million low lift pumping, \$ 30 million high lift pumping and new treatment facilities at \$0.52 per gallon. Total construction cost estimate is \$244,000,000

²Engineering, Legal, Admin and Contingency estimated at 30% of construction & decommissioning costs

Table A-8 Inter-Plant Water Transmission Capital Cost Estimates

Alternatives	Estimated Construction Cost	Engineering, Legal, Administration and Contingency	Estimated Capital Cost	Explanation
1 Maintain current rated capacity at all plants	\$ 35,000,000	\$ 3,000,000	\$ 38,000,000	This project has been designed and bid.
2 Repurpose Northeast	\$ 53,900,000	\$ 16,170,000	\$ 70,070,000	See Phase 1 Interim Report
3 Repurpose Southwest	\$ 45,100,000	\$ 13,530,000	\$ 58,630,000	See Phase 1 Interim Report
4 Repurpose Northeast and Southwest	\$ 64,000,000	\$ 19,200,000	\$ 83,200,000	See Phase 1 Interim Report
5 Repurpose Springwells	\$ 252,900,000	\$ 75,870,000	\$ 328,770,000	See below
6 Expand Lake Huron plus Waterworks Park	\$ 1,179,000,000	\$ 353,700,000	\$ 1,532,700,000	See below
7 Reduce rated capacity across all plants	\$ 108,113,000	\$ 32,433,900	\$ 140,546,900	See below
8 Repurpose Lake Huron	\$ 246,576,000	\$ 73,972,800	\$ 320,548,800	See below

Mains for Alternative 5
Mains for Alternative 6

150,000 feet of new transmission to interconnect plants = \$217,900,000
Second feed from Lake Huron, add new Chesterfield PS, increase capacity at NSC
new pipeline Chesterfield to Edison Corridor, and new inter-plant mains proposed for
Alternative 5 = \$ 1,144,000,000

Mains for Alternative 7
Mains for Alternative 8

43,000 feet of new 72" main = \$73,113,000 (See Table in Chapter 5-Phase 1 Interim Report)
50 miles of 84" main parrallel to existing main from NE WTP to Imlay City

Table A-9 Life Cycle Cost Analysis Factors

1 Planning Period

July 1, 2015, to June 30, 2034.

Therefore, the FY2013 Base Line costs were escalated 2 years using a rate of 3 percent per year.

2 Discount Rate

Two different discount rates were used, 4 percent and 7 percent, the results are shown on Tables J-1 and J-2, respectively.

3 Cost Escalation

A 3 percent annual rate of inflation was used, based on recent cost trends in construction cost and operating costs.

4 Phasing of Construction Costs

A detailed scheduling of construction for proposed water treatment plant upgrades will be performed in Phase 2. For the purpose of the Phase 1 life cycle cost analysis, it was assumed that construction would be scheduled over the full 20-year period following approximately the schedule shown below:

<u>Period</u>	<u>Type of Upgrade Activity</u>	<u>Percent of Total Construction Cost</u>
2015-2019	Safety, Water Quality	10
2020-2024	Efficiency, Water Quality	25
2025-2029	Efficiency, Water Quality	30
2030-2034	Service Life Renewal	35
2015-2019	New inter-plant transmission mains	100

5 Service Life, Salvage Value and Stranded Costs

Water mains and structures were assigned a 100 year service life for salvage value calculations. Mechanical equipment was assigned a 20-year service life.

Table A-9 Life Cycle Cost Analysis Factors (Continued)

In alternatives that consider closing Springwells and Southwest, there are significant recent capital costs or ongoing construction and these costs can not be used for customers, but are already being financed through revenue bonds. These "stranded costs" are handled outside of the life cycle cost calculation, along with other subjective factors.

6 Economic Present Worth Factors

	%	Period	Mid Point	Years of Escalation from 2013	3%/yr Escalation Factor	Present Worth Factor 4%	Present Worth Factor 7%	4% Aggregate Factor	7% Aggregate Factor
Water Treatment Plants	10	2015-2019	2017	4	1.12	0.89	0.82	0.909	0.654
	25	2020-2024	2022	9	1.30	0.73	0.58		
	30	2025-2029	2027	14	1.51	0.60	0.42		
	35	2030-2034	2032	19	1.75	0.49	0.30		
Inter Plant Transmission	100	2015-2024	2020	7	1.23	0.76	0.62	0.935	0.763
Annual Costs Present Worth Factor for 20 Years								13.6	10.6

Water Treatment Plant and Inter Plant Transmission Costs Present Worth Factors based on number of years from 2014 to Mid Point of cost assignment period.

Aggregate present worth factors for WTPs based on % of projects completed in each 5-yr window from 2015 to 2034.

Table A-10 Notes to Accompany Life Cycle Cost Tables

1. Annual Volume of Water Production

All operating costs are based on treating 201,542 million gallons per year, which was the measured production in FY2013.

Plant	FY2013 (Million Gallons)
Waterworks Park	30,379
Lake Huron	49,809
Northeast	38,512
Springwells	60,906
Southwest	21,936
Total	201,542

2. Staffing Profile	Budgeted Positions	Actual Positions on 6/30/13	Actual					Total Staff
			Admin	Chemist	Operators	Maint.	Contract	
LAKE HURON	28	23	2	4	9	5	3	23
NORTHEAST	28	25	3	4	9	9	0	25
SOUTHWEST	26	20	1	4	7	8	0	20
SPRINGWELLS	42	32	2	8	14	8	0	32
WW PARK	37	28	2	7	12	7	0	28
TOTAL	161	128	10	27	51	37	3	128

3. Assumptions on Future Staffing

1. High lift pumps at treatment plants that are closed will continue to operate and will be automated like other booster stations
2. Alternative 7 of reduced capacity at all plants, assume that operations staff for NE, SPW, LH reduced by one fourth. No reduction in and maintenance staff.
3. Labor legacy cost tentatively estimated to be 66% of benefits, based on communications with DWSD
4. Lake Huron direct filtration at 800 MGD estimated at 14 new positions

Table A-11 Supplemental Calculations to Accompany Life Cycle Cost Tables

1. Energy cost for high lift pumping is based on CS-1272 Energy Audit recently updated for WWP

Percent of annual electric power required for high lift pumping:

	Low	High	Backwash	Other	Total
Lake Huron	10	80		10	100
Northeast	28	66	1	5	100
Southwest	9	85	0	6	100
Springwells	29	65	1	5	100
Waterworks	13	75	2	10	100

Reduced Capacity Scenario as Follows (MGD)			Upgrade Cost for Rated Capacity	Costs Associated with Capacity	Costs for Support Systems*	Cost for Reduced Capacity
Lake Huron	300	400	\$ 136,032,210	\$ 45,300,000	\$ 90,732,210	\$ 128,104,710
Northeast	150	300	\$ 162,518,040	\$ 107,400,000	\$ 55,118,040	\$ 119,558,040
Southwest	180	240	\$ 62,708,261	\$ 34,900,000	\$ 27,808,261	\$ 56,600,761
Springwells	200	540	\$ 343,843,428	\$ 170,600,000	\$ 173,243,428	\$ 249,065,650
Waterworks	<u>240</u>	240	\$ 49,380,154			\$ 49,380,154
Total	1070					\$ 602,709,315

*For Springwells, "Systems" includes ongoing 1958 Filter Rehabilitation Project

-----Second Pumping Estimated Annual Volume (Million Gallons)-----

Pumping Facility	Lake Huron/Imlay City	Northeast	Springwells	Water Works Park	Southwest	Second Pumping Annual Volume (MG)	Estimated Second Pumping Cost
Unit Cost (\$/MG)	\$ 159.10	\$ 54.20	\$ 49.00	\$ 39.60	\$ 36.90		
Alternative 2	15,000	-	-	23,500	-	38,500	\$ 3,317,100
Alternative 3	-	-	21,900	-	-	21,900	\$ 1,073,100
Alternative 4	15,000	-	21,900	23,500	-	60,400	\$ 4,390,200
Alternative 5	25,000	12,000	-	23,500	-	60,900	\$ 5,558,500
Alternative 6	97,800	-	-	23,500	-	121,300	\$ 16,490,580
Alternative 7	7,500	-	-	7,500	-	15,000	\$ 1,490,250
Alternative 8	(30,000)	50,000	-	-	-		\$ (2,063,000)

Attachment B

Table B-1. Summary of Water Treatment Plant Life Cycle Cost Analysis at 4% Discount Rate FY 2015 to FY 2034

Alternative	Annual WTP O&M Costs (\$ thousands)					Capital Needs through FY 2034 (\$ thousands)		Present Worth (\$ thousands)
	Labor	Energy	Chemical	Other	Total	WTP	Mains	March 2014
Baseline - Maintain Five Plants	\$ 12,500	\$ 23,200	\$ 8,230	\$ 4,640	\$ 48,570	\$ 997,000	\$ 104,900	\$ 1,530,000
1. Repurpose Northeast; Maintain Four Plants	\$ 10,590	\$ 24,850	\$ 8,230	\$ 3,520	\$ 47,190	\$ 884,500	\$ 139,200	\$ 1,443,000
2. Repurpose Northeast and Southwest; Maintain Three Plants	\$ 8,730	\$ 25,600	\$ 8,230	\$ 1,650	\$ 44,210	\$ 840,800	\$ 260,800	\$ 1,439,000
3. Repurpose Springwells; Maintain Four Plants	\$ 10,390	\$ 26,880	\$ 8,230	\$ 3,920	\$ 49,420	\$ 763,200	\$ 303,700	\$ 1,489,000

Table B-2. Summary of Water Treatment Plant Life Cycle Cost Analysis at 7% Discount Rate FY 2015 to FY 2034

Alternative	Annual WTP O&M Costs (\$ thousands)					Capital Needs through FY 2034 (\$ thousands)		Present Worth (\$ thousands)
	Labor	Energy	Chemical	Other	Total	WTP	Mains	March 2014
Baseline - Maintain Five Plants	\$ 12,500	\$ 23,200	\$ 8,230	\$ 4,640	\$ 48,580	\$ 997,000	\$ 104,900	\$ 1,178,000
1. Repurpose Northeast; Maintain Four Plants	\$ 10,590	\$ 24,850	\$ 8,230	\$ 3,520	\$ 47,200	\$ 884,500	\$ 139,200	\$ 1,117,000
2. Repurpose Northeast and Southwest; Maintain Three Plants	\$ 8,730	\$ 25,600	\$ 8,230	\$ 1,650	\$ 44,220	\$ 840,800	\$ 260,800	\$ 1,127,000
3. Repurpose Springwells; Maintain Four Plants	\$ 10,390	\$ 26,880	\$ 8,230	\$ 3,920	\$ 49,430	\$ 763,200	\$ 303,700	\$ 1,170,000

All alternatives provide a total rated capacity of 1,000 MGD.
See Tables B-3 to B-10 for supporting documentation and explanatory notes.

Table B-3 Labor Cost Estimates

Baseline FY 2013 Costs

PLANTS	SALARY / WAGES	OVERTIME	BENEFITS	TOTAL SALARY & BENEFITS	CONTRACT LABOR	TOTAL ALL LABOR
LAKE HURON (LH)	\$929,102	\$294,846	\$576,091	\$1,800,039	\$166,188	\$1,966,227
NORTHEAST (NE)	\$1,230,407	\$432,035	\$597,014	\$2,259,457	\$46,000	\$2,305,457
SOUTHWEST (SW)	\$1,184,084	\$366,352	\$785,399	\$2,335,835	\$46,000	\$2,381,835
SPRINGWELLS (SPW)	\$1,288,409	\$541,517	\$699,440	\$2,529,367	\$46,000	\$2,575,367
WATERWORKS PARK	\$1,774,102	\$699,840	\$755,393	\$3,229,336	\$46,000	\$3,275,336
TOTAL	\$6,406,104	\$2,334,591	\$3,413,338	\$12,154,033	\$350,188	\$12,504,221

Alternatives	Labor Estimate	Explanation of Estimate
Baseline - Maintain Five Plants	\$ 12,504,221	Maintained same labor as for current rated capacity, because most of labor cost is for average daily production.
1 Repurpose Northeast; Maintain Four Plants	\$ 10,592,794	Subtract NE total labor from Base Line, retain labor legacy cost
2 Repurpose Northeast and Southwest; Maintain Three Plants	\$ 8,729,322	Subtract NE and SW total labor from Base Line, retain labor legacy cost
3 Repurpose Springwells; Maintain Four Plants	\$ 10,390,485	Subtract SPW total labor from Base Line, retain labor legacy cost

Table B-4 Energy Cost Estimates

Baseline FY 2013 Costs

LOCATION	DTE Bill	Estimate for Natural Gas and Diesel	Estimated Energy Cost
LAKE HURON (LH)	\$7,379,969	\$ 295,199	\$ 7,675,168
NORTHEAST (NE)	\$4,728,583	\$ 189,143	\$ 4,917,727
SOUTHWEST (SW)	\$2,037,826	\$ 81,513	\$ 2,119,339
SPRINGWELLS (SPW)	\$5,473,759	\$ 218,950	\$ 5,692,709
WATERWORKS PARK	\$2,690,296	\$ 107,612	\$ 2,797,908
Totals:	\$22,310,433	\$ 892,417	\$ 23,202,850

Alternatives	Treat and Pump	Second Pumping ¹	Total Energy	Explanation of Estimates
Baseline - Maintain Five Plants	\$23,202,850	\$ -	\$ 23,202,850	Same as Baseline Total Energy
¹ Repurpose Northeast; Maintain Four Plants	\$21,530,823	\$ 3,317,100	\$ 24,847,923	Treat & pump costs are based on (baseline total energy cost - total energy at NE + high lift % at NE).
² Repurpose Northeast and Southwest; Maintain Three Plants	\$21,212,922	\$ 4,390,200	\$ 25,603,122	Treat & pump costs are based on (baseline total energy cost - total energy at NE - total energy at SW + high lift % at NE + high lift % at SW).
³ Repurpose Springwells; Maintain Four Plants	\$21,324,256	\$ 5,558,500	\$ 26,882,756	Treat & pump costs are based on (baseline total energy cost - total energy at SPW + high lift % at SPW).

¹ Second Pumping Costs - See Additional Calculations (Table B-11)

Table B-5 Chemical Cost Estimates

Baseline FY 2013 Costs

LOCATION	FAAR Report
LAKE HURON (LH)	\$1,785,772
NORTHEAST (NE)	\$1,189,496
SOUTHWEST (SW)	\$861,895
SPRINGWELLS (SPW)	\$1,883,181
WATERWORKS PARK	\$2,513,933
Totals:	\$8,234,276

Alternatives	Estimated Chemical Cost	Explanation of Estimate
Baseline - Maintain Five Plants	\$8,234,276	Same as Base Line
1 Repurpose Northeast; Maintain Four Plants	\$8,234,276	See Note
2 Repurpose Northeast and Southwest; Maintain Three Plants	\$8,234,276	See Note
3 Repurpose Springwells; Maintain Four Plants	\$8,234,276	See Note

Note: Alternatives 2-5 Same as Base Line, because chemical purchase costs are similar among plants and total annual volume of treated water is the same for all alternatives.

Table B-6 Other O&M Cost Estimates

Baseline FY 2013 Costs

LOCATION	Residuals	O&M Related Repair and Replacement	Total
LAKE HURON (LH)		\$ 504,000	\$ 504,000
NORTHEAST (NE)		\$ 1,118,000	\$ 1,118,000
SOUTHWEST (SW)	\$96,000	\$ 1,774,000	\$ 1,870,000
SPRINGWELLS (SPW)		\$ 718,000	\$ 718,000
WATERWORKS PARK	\$35,000	\$ 395,000	\$ 430,000
Totals:	\$131,000	\$4,509,000	\$ 4,640,000

Alternatives	Estimated Other Cost	Explanation of Estimate
Baseline - Maintain Five Plants	\$4,640,000	Same as Baseline FY2013 Costs
1 Repurpose Northeast; Maintain Four Plants	\$3,522,000	Subtract NE Total from Baseline
2 Repurpose Northeast and Southwest; Maintain Three Plants	\$1,652,000	Subtract NE + SW Total from Baseline
3 Repurpose Springwells; Maintain Four Plants	\$3,922,000	Subtract SPW Total from Baseline

Table B-7 Water Treatment Plant Upgrade Cost Estimates

Alternatives	Estimated Construction Cost ¹	Estimated Regulatory Compliance and Inventory ²	Estimated Decommissioning Cost	Engineering, Legal, Admin and Contingency ³	Estimated Capital Cost
Baseline - Maintain Five Plants	\$ 550,754,814	\$ 216,200,000	\$ -	\$ 230,086,444	\$ 997,041,259
1 Repurpose Northeast; Maintain Four Plants	\$ 499,999,299	\$ 175,400,000	\$ 5,000,000	\$ 204,119,790	\$ 884,519,089
2 Repurpose Northeast and Southwest; Maintain Three Plants	\$ 498,746,101	\$ 138,000,000	\$ 10,000,000	\$ 194,023,830	\$ 840,769,931
3 Repurpose Springwells; Maintain Four Plants	\$ 431,554,668	\$ 150,500,000	\$ 5,000,000	\$ 176,116,400	\$ 763,171,068

¹See work sheets B-13 to B-17

²Regulatory compliance = UV+Ozone–Chlorine Conversion before 2035 50% chance; plus central WQ Staff labor plus central administration labor PW (see below).

³Engineering, Legal, Admin and Contingency estimated at 30% of construction & decommissioning costs

Plant	Total for Regulatory Compliance and Inventory Management	UV/Ozone	CL2	PW Compliance Lbr	PW Inventory Labor
Northeast	\$ 40,800,000	\$ 45,000,000	\$ 30,000,000	\$ 1,800,000	\$ 1,500,000
Southwest	\$ 37,400,000	\$ 48,200,000	\$ 20,000,000	\$ 1,800,000	\$ 1,500,000
Springwells	\$ 65,700,000	\$ 83,000,000	\$ 40,000,000	\$ 2,200,000	\$ 2,000,000
Lake Huron	\$ 54,800,000	\$ 68,000,000	\$ 35,000,000	\$ 1,800,000	\$ 1,500,000
Waterworks Park	\$ 17,500,000	\$ 8,400,000	\$ 20,000,000	\$ 1,800,000	\$ 1,500,000
Total	\$ 216,200,000				

Baseline Capacity Scenario as Follows (MGD)	Cost for Baseline	Cost for Alternative 1	Cost for Alternative 2	Cost for Alternative 3
Lake Huron	285	\$ 132,580,088	\$ 140,830,088	\$ 142,205,088
Northeast	145	\$ 110,636,418	\$ -	\$ 159,621,225
Southwest	152	\$ 49,529,049	\$ 45,982,170	\$ 47,755,609
Springwells	186	\$ 230,036,514	\$ 285,214,296	\$ 54,000,000
Waterworks	232	\$ 27,972,746	\$ 27,972,746	\$ 27,972,746
Total	1000	\$ 550,754,814	\$ 499,999,299	\$ 431,554,668

Table B-8 Inter-Plant Water Transmission Capital Cost Estimates

Alternatives	Estimated Construction Cost	Engineering, Legal, Administration and Contingency	Estimated Capital Cost
Baseline - Maintain Five Plants	\$ 80,679,000	\$ 24,203,700	\$ 104,882,700
1 Repurpose Northeast; Maintain Four Plants	\$ 107,092,400	\$ 32,127,720	\$ 139,220,120
2 Repurpose Northeast and Southwest; Maintain Three Plants	\$ 200,617,400	\$ 60,185,220	\$ 260,802,620
3 Repurpose Springwells; Maintain Four Plants	\$ 233,596,000	\$ 70,078,800	\$ 303,674,800

Estimated Construction Cost

	Total	Inter-plant Mains	Raw Water Main	Garland Main	Water Works Park Yard Piping
B	\$ 80,679,000	\$ 45,679,000		\$ -	\$ 35,000,000
1	\$ 107,092,400	\$ 18,870,000		\$ 53,222,400	\$ 35,000,000
2	\$ 200,617,400	\$ 28,987,000	\$ 83,408,000	\$ 53,222,400	\$ 35,000,000
3	\$ 233,596,000	\$ 198,596,000		\$ -	\$ 35,000,000

Table B-9 Life Cycle Cost Analysis Factors

1 Planning Period

July 1, 2015, to June 30, 2034.

Therefore, the FY2013 Base Line costs were escalated 2 years using a rate of 3 percent per year.

2 Discount Rate

Two different discount rates were used, 4 percent and 7 percent, the results are shown on Tables J-1 and J-2, respectively.

3 Cost Escalation

A 3 percent annual rate of inflation was used, based on recent cost trends in construction cost and operating costs.

4 Phasing of Construction Costs

A detailed scheduling of construction for proposed water treatment plant upgrades will be performed in Phase 2. For the purpose of the Phase 1 life cycle cost analysis, it was assumed that construction would be scheduled over the full 20 year period following approximately the schedule shown below:

Period	Type of Upgrade Activity	Percent of Total Construction Cost
2015-2019	Safety, Water Quality	10
2020-2024	Efficiency, Water Quality	25
2025-2029	Efficiency, Water Quality	30
2030-2034	Service Life Renewal	35
2015-2019	New inter-plant transmission mains	100

5 Service Life, Salvage Value and Stranded Costs

Water mains and structures were assigned a 100 year service life for salvage value calculations. Mechanical and electrical equipment was assigned a 20 year service life.

6 Economic Present Worth Factors

	% of total	Period	Mid Point	Years of	3%/yr	Present	Present	4%	7%
				Escalation	Escalation	Worth	Worth	Aggregate	Aggregate
				from 2013	Factor	Factor 4%	Factor 7%	Factor	Factor
Water Treatment Plants	10	2015-2019	2017	4	1.12	0.89	0.82	0.909	0.654
	25	2020-2024	2022	9	1.30	0.73	0.58		
	30	2025-2029	2027	14	1.51	0.60	0.42		
	35	2030-2034	2032	19	1.75	0.49	0.30		
Inter Plant Transmission	100	2015-2024	2020	7	1.23	0.76	0.62	0.935	0.763
Annual Costs Present Worth Factor for 20 Years								13.6	10.6

Water Treatment Plant and Inter Plant Transmission Costs Present Worth Factors based on number of years from 2014

to Mid Point of cost assignment period.

Aggregate present worth factors for WTPs based on % of projects completed in each 5-yr window from 2015 to 2034.

7 Salvage Value

Salvage Values are based on a service life of 100 years for pipelines and buildings, and a service life of 20 years for electrical and mechanical equipment.

Straight line values are fraction of remaining service life in 2035 times the initial cost.

PW Factors: 0.45 0.26

Assumed 20% of the overall plant upgrade costs are Structural upgrades (equipment is other 80%).

	New Mains 2015-2020	Straight Line Value in 2035	Plant Upgrades Complete mid 2025	Structure	Equipment	Straight Line Value in 2035	Total Salvage Value 2035	4% PW in 2014	7% PW in 2014
8 Maintain Five Plants	\$ 80,679,000	\$ 68,577,150	\$ 550,754,814	\$ 110,150,963	\$ 440,603,851	\$ 319,437,792	\$ 388,014,942	\$ 174,606,724	\$ 100,883,885
1 Repurpose NE	\$ 107,092,400	\$ 91,028,540	\$ 499,999,299	\$ 99,999,860	\$ 399,999,439	\$ 289,999,593	\$ 381,028,133	\$ 171,462,660	\$ 99,067,315
2 Repurpose NE and SW	\$ 200,617,400	\$ 170,524,790	\$ 498,746,101	\$ 99,749,220	\$ 398,996,881	\$ 289,272,738	\$ 459,797,528	\$ 206,908,888	\$ 119,547,357
3 Repurpose SPW	\$ 233,596,000	\$ 198,536,600	\$ 431,554,668	\$ 86,310,934	\$ 345,243,734	\$ 250,301,707	\$ 448,858,307	\$ 201,986,238	\$ 116,703,160

Table B-10 Notes to Accompany Life Cycle Cost Tables

1. Annual Volume of Water Production

All operating costs are based on treating 201,542 million gallons per year, which was the measured production in FY2013.

Plant	FY2013 (Million Gallons)
Waterworks Park	30,379
Lake Huron	49,809
Northeast	38,512
Springwells	60,906
Southwest	21,936
Total	201,542

2. Staffing Profile	Budgeted Positions	Actual Positions on 6/30/13	Admin	Chemist	Operators	Maint.	Contract	Total Staff
LAKE HURON	28	23	2	4	9	5	3	23
NORTHEAST	28	25	3	4	9	9	0	25
SOUTHWEST	26	20	1	4	7	8	0	20
SPRINGWELLS	42	32	2	8	14	8	0	32
WW PARK	37	28	2	7	12	7	0	28
TOTAL	161	128	10	27	51	37	3	128

3. Assumptions on Future Staffing

1. High lift pumps at treatment plants that are closed will continue to operate and will be automated like other booster stations
2. Alternative 7 of reduced capacity at all plants, assume that operations staff for NE, SPW, LH reduced by one fourth. No reduction in and maintenance staff.
3. Labor legacy cost tentatively estimated to be 66% of benefits, based on communications with DWSD
4. Lake Huron direct filtration at 800 MGD estimated at 14 new positions

Table B-11 Supplemental Calculations to Accompany Life Cycle Cost Tables

1. Energy cost for high lift pumping is based on CS-1272 Energy Audit recently updated for WWP

Percent of annual electric power required for high lift pumping:

	Low	High	Backwash	Other	Total
Lake Huron	10	80		10	100
Northeast	28	66	1	5	100
Southwest	9	85	0	6	100
Springwells	29	65	1	5	100
Waterworks	13	75	2	10	100

-----Second Pumping Estimated Annual Volume (Million Gallons)-----

Pumping Facility	Lake Huron/Imlay City	Northeast	Springwells	Water Works Park	Southwest	Second Pumping Annual Volume (MG)	Estimated Second Pumping Cost
Unit Cost (\$/MG)	\$ 159.10	\$ 54.20	\$ 49.00	\$ 39.60	\$ 36.90		
Close NE	15,000	-	-	23,500	-	38,500	\$ 3,317,100
Close SW	-	-	21,900	-	-	21,900	\$ 1,073,100
Close NE&SW	15,000	-	21,900	23,500	-	60,400	\$ 4,390,200
Close SPW	25,000	12,000	-	23,500	-	60,500	\$ 5,558,500

TABLE B-13 - NORTHEAST WTP PROPOSED CAPITAL IMPROVEMENTS

(Northeast is a 300 MGD conventional water treatment plant with low lift, rapid mix/flocculation/sedimentation, filtration, high lift pumping and filtered water storage; no alum disposal residuals treatment capabilities on site.)

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost and Comments	Estimated Cost for Reduced Capacity Alternatives				
									Type	Baseline	Alt. 1	Alt. 2	Alt. 3
Low Lift Pumps	NE - LLP - 1	Replace low lift Rodney Hunt valve operators	5 years	2013 Plant Staff Assessment	\$300,000	\$300,000	\$300,000	Can not find drawings of the pumps. Don't know what type of valves. Assume Cone Valves	1	150	0	0	300
Low Lift Pumps	NE - LLP - 2	Repair Leaking Orison	5 Years	2013 10-Year CIP	\$2,000,000	\$1,481,481	\$1,980,963	Updated cost estimate presented below	1	\$300,000	\$0	\$0	\$300,000
Rapid Mix / Flocc	NE - RMF - 1	Replace/upgrade rapid mix and flocculation systems	5 years	2013 Plant Staff Assessment	\$6,354,000	\$4,887,692	\$5,352,007	Cost is based on data provided in 2011 CS-1475 Final Design Report for replacement of flocculators and necessary structural improvements to the flocculation zone only. Replacement of rapid mixers included in the "Chemical Building/Process Mechanical Systems" Project. (2011 Dollars)	2	\$1,980,963	\$0	\$0	\$1,980,963
Filters	NE - FIL - 1	Upgrade filters: media, local panels, controls, gauges, flow meters, surface wash system etc. Audible alarms for filter turbidity monitoring software	5 years	2013 Plant Staff Assessment	N/A	N/A	N/A	See "Filter System Piping Valves, R/C and Backwash Improvements" and "Filter Media Replacement and Related In box Improvements" Projects. Scope for those projects encompasses items listed here.	1	2,833,604	\$ -	\$ -	\$ 5,152,007
Filters	NE - FIL - 2	Filter System Pines, Valves, R/C, and Backwash Improvements	5 years	2002 Needs Assessment	\$25,200,800	\$16,154,359	\$23,797,096	2002 Needs Assessment (2002 Dollars)	2	N/A	N/A	N/A	N/A
Filters	NE - FIL - 3	Filter Media Replacement and In box Improvements	5 years	2002 Needs Assessment	\$17,311,000	\$11,096,795	\$16,346,764	2002 Needs Assessment (2002 Dollars)	2	\$ 13,088,403	\$ -	\$ -	\$ 23,797,096
Chemical Feed	NE - CHF - 1	Upgrade/replace phosphoric acid feed system dry tank	5 years	2013 Plant Staff Assessment	N/A	N/A	N/A	See "Chemical Building/Process Mechanical Systems" Project which includes the upgrades to the phosphoric acid feed system in the scope of work.	1	\$ 8,990,720	\$ -	\$ -	\$ 16,346,764
Chemical Feed	NE - CHF - 2	Chemical Building/Process Mechanical Improvements	5 years	2002 Needs Assessment	\$3,621,000	\$2,821,154	\$3,419,308	2002 Needs Assessment (2002 Dollars)	1	N/A	\$0	\$0	N/A
Residuals	NE - RSD - 1	Short Term Residuals Handling	5 Years	2013 10-Year CIP	\$5,000,000	\$3,703,704	\$3,703,704	Short Term Cost for Pilot Work and modifications with operation of mud valves as permanent solution.	1	\$3,419,308	\$0	\$0	\$3,419,308
Residuals	NE - RSD - 2	Residuals Processing Facility	1BD	CS - 14/5 Final Design Report Sept 2011	\$78,388,000	\$60,296,462	\$63,269,269	Cost is based on data provided in 2011 CS-14/5 Final Design Report. Includes Sed Basin Improvements, Sludge collection and processing facility. Hoc Improvements incl. above.	2	\$3,703,704	\$0	\$0	\$3,703,704
High Lift Pumps	NE - HLP - 1	Replace high lift Rodney Hunt valve operators	5 years	2013 Plant Staff Assessment	\$500,000	\$500,000	\$500,000	Costs included for actuators only for Cone Valves replaced in NE - HLP - 2	3	\$ 34,957,593	\$ -	\$ -	\$ 63,559,259
High Lift Pumps	NE - HLP - 2	Major Pumping Equipment Improvements	5 years	2013 10-Year CIP	\$30,000,000	\$22,222,222	\$22,222,222	Project included in 2002 Needs Assessment. Construction Cost from 2013 10-Year CIP Update used here.	3	\$ -	\$ -	\$ -	\$ -
Electrical / I & C	NE - EIC - 1	Urgent Electrical Improvements	5 years	2002 Needs Assessment	\$600,600	\$382,000	\$467,146	2002 Needs Assessment. Project includes development of as built drawings for electrical system, load and short circuit study, upgrade of phone and auto call systems, new emergency light fixtures, installation of UPS system. (2002 Dollars)	1	\$ -	\$0	\$0	\$ -
Electrical / I & C	NE - EIC - 2	Intermediate Electrical/Mechanical System Improvements	5 years	2002 Needs Assessment	\$14,334,900	\$9,189,038	\$13,536,435	2002 Needs Assessment (2002 Dollars)	1	\$567,146	\$0	\$0	\$567,146
Electrical / I & C	NE - EIC - 3	Upgrade electrical systems	5 years	2013 Plant Staff Assessment	\$12,750,000	\$12,750,000	\$12,750,000	Scope of Work for 2002 Needs Assessment encompasses switchgear work, but all other electrical upgrades to MCC's, VFD's etc. would be done under this project. Assumes complete replacement of MCCs, panelboards, disconnects, VFDs. Conduit remains, some wire replaced, but not all.	1	\$13,536,435	\$0	\$0	\$13,536,435

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost and Comments	1	150	0	0	300			
Electrical / I & C	NE - EIC - 4	Upgrade instrumentation and controls	5 years	2013 Plant Staff Assessment	\$1,750,000	\$1,750,000	\$1,750,000	Project would provide monitoring and control of all plant equipment and systems via an instrumentation and controls system. Assumes only replacing panels. Not replacing field instruments, conduit or wire.	1	\$1,750,000	\$0	\$0	\$1,750,000			
HVAC Mechanical	NE - HVM - 1	Plant Instrument Air upgrade including new compressed air system and replacement of piping	5 years	2013 Plant Staff Assessment	\$525,000	\$525,000	\$525,000	Based on RSMMeans +50% costing for (3) 15HP oil-less compressors, air dryer, and air receiver tank, and piping \$250,000 for Equipment \$250,000 for Piping (3,000LF) \$25,000 for Demo	1	\$525,000	\$0	\$0	\$525,000			
HVAC Mechanical	NE - HVM - 2	New dehumidification/ventilation system in the filter, wash water and high lift buildings	5 years	2013 Plant Staff Assessment	\$3,000,000	\$3,000,000	\$3,000,000	2002 Needs Assessment called for replacement in-kind. DWSD no longer uses a kathabar system but prefers a dry dessicant type dehumidification system. This estimate based on similar work at SPW WTP.	1	\$3,000,000	\$0	\$0	\$3,000,000			
HVAC Mechanical	NE - HVM - 3	Steam Generation System needs to be completely replaced, including piping	5 years	2013 Plant Staff Assessment	\$1,300,000	\$1,300,000	\$1,300,000	Based on RSMMeans +50% costing for (3) Boilers, (2) Feed pumps, (3) chemical feed pump/system, Deaerator, Condensate return tank, Duplex condensate Return system, and steam and condensate piping. (\$750,000 for Equipment \$500,000 for Piping (3000LF) \$250,000 for Demo]	1	\$1,300,000	\$0	\$0	\$1,300,000			
HVAC Mechanical	NE - HVM - 4	Service Water System Improvements	5 years	2002 Needs Assessment	\$1,590,400	\$1,019,487	\$1,501,814	2002 Needs Assessment (2002 Dollars)	1	\$1,501,814	\$0	\$0	\$1,501,814			
HVAC Mechanical	NE - HVM - 5	Replace suction piping for 9 sample pumps	5 years	2013 Plant Staff Assessment	\$46,000	\$46,000	\$46,000	Each sample line is 100' long 3" diameter	1	\$46,000	\$0	\$0	\$46,000			
Lab / Administrative	NE - LAD - 1	Provide 3 particle counters	5 years	2013 Plant Staff Assessment	\$375,000	\$375,000	\$375,000	Assume cost per counter is \$10k	1	\$375,000	\$0	\$0	\$375,000			
Lab / Administrative	NE - LAD - 2	Three (3) new online chlorine analyzers	5 years	2013 Plant Staff Assessment	\$375,000	\$375,000	\$375,000	New piping and sample pumps required for raw water and reservoir. Assume pipe tap for finished water.	1	\$375,000	\$0	\$0	\$375,000			
Buildings	NE - BLD - 1	Intermediate Structural/Architectural Repairs	5 years	2002 Needs Assessment	\$2,897,100	\$1,857,115	\$2,735,729	2002 Needs Assessment (2002 Dollars)	1	\$2,735,729	\$0	\$0	\$2,735,729			
Site Improvements	NE - SIT - 1	Water Production Metering Improvements	5 years	2016 CIP Estimate	\$2,500,000	\$1,851,852	\$2,900,000	from DWSD	1	\$2,900,000	\$0	\$0	\$2,900,000			
High Lift Pumps: condition assessment, pump rehabilitation and related building mechanical	New 2014						\$6,250,000		3	\$ -	\$ -	\$ -	\$ -			
Construction of Yard Piping Modifications at Northeast Water Treatment Plant	New 2014						\$795,766		3	\$ -	\$ -	\$ -	\$ -			
Site Improvements	NE - SIT - 2	State Fair Main and Valve Improvements	5 years	2013 10 Year CIP	\$6,000,000	\$4,444,444	\$4,444,444	Retrofit piping & valve in State Fair Park grounds to provide control for reservoir filling. includes 1 to 2 miles of pipe and cone valves and gate.	3	\$ -	\$ -	\$ -	\$ -			
Total Estimated Cost										\$193,833,658			\$110,636,418	\$0	\$0	\$159,621,225

Plant Process/ System Codes:				Costs to Present Day (Dec 2013)		
				Yr of Est.	ENR Index	Adjustment
Intake	INT	High Lift Pumps	HLP	2002	6563	1.473
Low Lift Pumps	LLP	UV / Ozone	UVO	2011	9172	1.054
Rapid Mix / Flocc	RMF	Electrical / I & C	EIC	2013	9668	1.000
Sedimentation	SED	HVAC Mechanical	HVM			
Filters	FIL	Lab / Administrative	LAD			
Chemical Feed	CHF	Buildings	BLD			
Residuals	RSD	Site Improvements	SIT			
Reservoirs	RES					

Reduced Capacity Upgrade Type

- 1 - Cost included in full, not proportional to capacity
- 2 - Cost included, but proportional to capacity
- 3 - Cost not included, does not vary among alternatives

TABLE B-14 - SPRINGWELLS WTP PROPOSED CAPITAL IMPROVEMENTS

(Facility is rated at 540 MGD and is a conventional water treatment facility. 1930 train is 340 MGD has hydraulic pretreatment (rapid mix/flocculation), sedimentation basins and filtration. 1958 Train is 200 MGD with rapid mix, flocculation, sedimentation and filtration. Low and High Lift pumping operates for both trains. No residuals handling on site for sedimentation basin sludge.)

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost and Comments	Estimated Cost for Reduced Capacity Alternatives				
									Type	Baseline 200	Alt. 1 340	Alt. 2 450	Alt. 3 0
Low Lift Pumps	SPW - LLP - 1	Low Lift and High Lift Pumps complete replacement - Low Lift Portion	5 Years	CS - 1474 Final Design OPC	\$66,000,000	\$47,430,830	\$47,430,830	CS - 1474 Final Design OPC Low Lift Portion only plus replacement of LL Suction Turbine solution for or gates (CS - 1473) and low lift basin leak repair	2	\$ 19,323,671	\$ 32,850,242	\$ 43,478,261	\$ -
Rapid Mix / Flocc	SPW - RMF - 1	Mixer replacement in 1930 and 1958 Rapid Mix	5 Years	2013 Plant Staff Assessment	\$7,500,000	\$7,500,000	\$7,500,000	\$5M for 1930 plant improvements; \$2.5M for 1958 improvements.	2	\$ 3,055,556	\$ 5,194,444	\$ 6,875,000	\$ -
Rapid Mix / Flocc	SPW - RMF - 2	Flocculator drive motor / replacement	5 Years	2013 Plant Staff Assessment	\$1,000,000	\$1,000,000	\$1,000,000	Comparison to similar work elsewhere	1	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ -
Rapid Mix / Flocc	SPW - RMF - 3	1930 Plant Pretreatment Modifications	20 Years	2013 Plant Staff Assessment	\$142,900,000	\$91,538,500	\$134,846,000	2002 Needs Assessment	2	\$ 54,937,259	\$ 93,393,341	\$ 123,608,833	\$ -
Sedimentation	SPW - SCD - 1	Replace North Gate house rail guards in 300's plant	5 Years	2013 Plant Staff Assessment	\$150,000	\$150,000	\$150,000	Scope definition not clear. Cost estimated based on general knowledge.	1	\$ 150,000	\$ 150,000	\$ 150,000	\$ -
Sedimentation	SPW - SCD - 2	Replacement of beams and cranes in the North gate house (Basins 1 and 2)	5 Years	2013 Plant Staff Assessment	\$400,000	\$400,000	\$400,000	Assume 30-ton crane and that some building modifications required to accommodate new equipment	1	\$ 400,000	\$ 400,000	\$ 400,000	\$ -
Filters	SPW - FIL - 1	1958 Filter Rehabilitation SP - 563	5 Years	Contract Bid	\$71,000,000	\$71,000,000	\$71,000,000	Total Bid Amount. Remaining cost after June 2014 is about \$34M	1	\$ 54,000,000	\$ 54,000,000	\$ 54,000,000	\$ 54,000,000
Filters	SPW - FIL - 2	1930 Filter and related building roof repairs	5 Years	2013 10-Year CIP	\$1,000,000	\$1,111,111	\$1,111,111	10-Year CIP costs adjusted to include only 1930 Filter and related building roof repairs; other work has been completed in recent projects.	1	\$ 1,111,111	\$ 1,111,111	\$ 1,111,111	\$ -
Residuals	SPW - RSD - 1	Short Term Residuals Handling	5 Years	2013 10-Year CIP	\$5,000,000	\$3,703,704	\$3,703,704	Short Term Cost for Pilot Work and modifications with operation of mud valves as permanent solution.	2	\$ 1,508,916	\$ 2,565,158	\$ 3,395,062	\$ -
High Lift Pumps	SPW - HLP - 1	High Lift Header Replacement/Renovation SP 567	20 years	2013 10-Year CIP	\$50,000,000	\$37,037,037	\$37,037,037	Costs from 2013 10-Year CIP reported as Sept. 2013. Not adjusted to December 2013	3	\$ -	\$ -	\$ -	\$ -
High Lift Pumps	SPW - HLP - 2	Low Lift and High Lift Pumps complete replacement - High Lift Portion	5 Years	CS - 1474 Final Design OPC	\$72,000,000	\$51,742,724	\$51,742,724	CS - 1474 Final Design OPC High Lift Portion only	3	\$ -	\$ -	\$ -	\$ -
Electrical / I & C	SPW - EIC - 1	Control system upgrades to automate plant operations	5 Years	2013 Plant Staff Assessment	\$3,250,000	\$3,250,000	\$3,250,000	Project would provide monitoring and control of all plant equipment and systems via instrumentation and controls system. Assumes only replacing panels. Not replacing field instruments, conduit or wire. Automation of the 1958 filters, high and low lift pumps, and chem feed systems has been provided by recent construction projects. This estimate includes remaining plant operations.	1	\$ 3,250,000	\$ 3,250,000	\$ 3,250,000	\$ -
Electrical / I & C	SPW - EIC - 2	Complete electrical upgrades	5 Years	2013 Plant Staff Assessment	\$15,000,000	\$15,000,000	\$0	Assumes replacement of Switchgear & MCCs is included in HL & LL Pump replacement projects. Also electrical rehab for the Admin Bldg, Chemical Bldg, and 1958 Filter Bldg is included in the SP - 560 & SP - 563 Contracts. This project assumed to be miscellaneous improvements in other electrical components. Includes panelboards, disconnects, VFDs, Conduit, terminals, some wire replaced, but not all. See DWSD estimate below.	1	\$ -	\$ -	\$ -	\$ -
HVAC Mechanical	SPW - HVM - 1	Steam, condensate return, and instrument/service air piping needs replacement	5 Years	2013 Plant Staff Assessment	\$5,000,000	\$5,000,000	\$5,000,000	Scope is similar to project in CIP, which was \$21.5M. However, this included extensive yard piping work, which is included in SPW - SIT - 1. Assume 2013 Dollars.	1	\$ 5,000,000	\$ 5,000,000	\$ 5,000,000	\$ -
Laboratory / Admin	SPW - LAD - 1	Replace all sample pumps and piping/laboring	5 Years	2013 Plant Staff Assessment	\$500,000	\$500,000	\$500,000	Same rehab of sampling system is included in SP 563. This project assumes some additional needs.	1	\$ 500,000	\$ 500,000	\$ 500,000	\$ -
Building	SPW - BLD - 1	Miscellaneous Mechanical, Electrical, and Architectural Improvements	5 years	2002 Needs Assessment	\$0	\$0	\$0	2002 Needs Assessment (2002 Dollars) A work in this project is part of some closed or ongoing construction projects.	1	\$ -	\$ -	\$ -	\$ -

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost and Comments		200	340	450	0
Site Improvements	SPW - SIT - 1	Yard piping and valves replacement	5 Years	2013 Plant Staff Assessment	\$25,000,000	\$25,000,000	\$25,000,000	WW Park was estimated at 33M. CDM indicates that SPW is less complex and includes about 20 gate valves; DWSD estimate shown below.	1	\$ 25,000,000	\$ 25,000,000	\$ 25,000,000	\$ -
		Construct Improvements to the 1930 Sedimentation Basin Water Control Gates, Lifting Devices and Miscellaneous Improvements to these Facilities					\$7,500,000		1	\$ 7,500,000	\$ 7,500,000	\$ 7,500,000	\$ -
		Electrical Gear Relocation and Miscellaneous Architectural, Structural, HVAC and Plumbing Improvements to the Administration Building at Springwells Water Treatment Plant					\$2,000,000		1	\$ 2,000,000	\$ 2,000,000	\$ 2,000,000	\$ -
		Replacement of Rapid Mix Units at Springwells Water Treatment Plant 1958 Process Train					\$1,000,000		1	\$ 1,000,000	\$ 1,000,000	\$ 1,000,000	\$ -
		Miscellaneous Concrete Improvements at the Springwells Water Treatment Plant					\$2,100,000		1	\$ 2,100,000	\$ 2,100,000	\$ 2,100,000	\$ -
		Powdered Activated Carbon System Improvements at Springwells WTP					\$3,100,000		1	\$ 3,100,000	\$ 3,100,000	\$ 3,100,000	\$ -
		Condition Assessment and Design of High Lift Header					\$4,000,000		3	\$ -	\$ -	\$ -	\$ -
		Redesign Motor Control and Electrical System for Low Lift and High Lift Pumps; Condition Assessment, Motor Rewinding, New Electrical					\$42,000,000		1	\$ 42,000,000	\$ 42,000,000	\$ 42,000,000	\$ -
Site Improvements	NE - SIT - 1	Water Production Metering Improvements	5 years	2013 10-Year CIP	\$2,500,000	\$1,851,852	\$3,100,000	New estimate from DWSD	1	\$ 3,100,000	\$ 3,100,000	\$ 3,100,000	\$ -
Total Estimated Cost					\$468,600,000	\$363,216,757	\$454,471,406			\$230,036,614	\$285,214,296	\$328,568,267	\$54,000,000

Plant Process / System Codes:				Costs to Present Day (Dec 2013)		
				Yr of Est.	ENR Index	Adjustment
Intake	INT	High Lift Pumps	HLP	2002	6563	1.473
Low Lift Pumps	LLP	UV / Ozone	UVO	2011	9172	1.054
Rapid Mix / Floc	RMF	Electrical / I & C	EIC	2013	9668	1.000
Sedimentation	SED	HVAC Mechanical	HVM			
Filters	FIL	Lab / Administrative	LAD			
Chemical Feed	CHF	Buildings	BLD			
Residuals	RSD	Site Improvements	SIT			
Reservoirs	RES					

Reduced Capacity Upgrade Type

- 1 -Cost included in full, not proportional to capacity
- 2 -Cost included, but proportional to capacity
- 3 -Cost not included, does not vary among alternatives

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Type	285	315	320	320	
Replacement of Low Lift Pump # VFD, 13,800 volt Switchgear, Exciters for High-Lift Pump Motors at the Lake Huron Water Treatment Plant							\$6,000,000		1	\$ 6,000,000	\$ 6,000,000	\$ 6,000,000	\$ 6,000,000	
Electrical Tunnel Rehabilitation							\$5,600,000		1	\$ 5,600,000	\$ 5,600,000	\$ 5,600,000	\$ 5,600,000	
Replacement of Filter Controls and Rehabilitation of Raw Water Conduit Venturi Flow Metering at the Lake Huron Water Treatment Plant							\$10,800,000		1	\$ 10,800,000	\$ 10,800,000	\$ 10,800,000	\$ 10,800,000	
Total Estimated Cost											\$132,580,088	\$140,830,088	\$142,205,088	\$142,205,088

Plant Process/ System Codes:				Costs to Present Day (Dec 2013)		
				Yr of Est.	ENR Index	Adjustment
Intake	INT	High Lift Pumps	HLP	2002	6563	1.473
Low Lift Pumps	LLP	UV / Ozone	UV0	2011	9172	1.054
Rapid Mix / Flocc	RMF	Electrical / I & C	EIC	2013	9668	1.000
Sedimentation	SED	HVAC Mechanical	HVM			
Filters	FIL	Lab / Administrative	LAD			
Chemical Feed	CHF	Buildings	BLD			
Residuals	RSD	Site Improvements	SIT			
Reservoirs	RES					

Reduced Capacity Upgrade Type

- 1 - Cost included in full, not proportional to capacity
- 2 - Cost included, but proportional to capacity
- 3 - Cost not included, does not vary among alternatives

Rehabilitate retention basin and clarifiers

TABLE B-16 - WATER WORKS PARK WTP PROPOSED CAPITAL IMPROVEMENTS

(Facility is 240 MGD conventional water treatment facility, with ozone for predisinfection and a residuals handling facility for alum sludge and filter backwash wastewater).

Estimated Cost: for Reduced Capacity Alternatives

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust. to Constr. Only	Adjust. to Dec 2013 Cost	Basis for Cost	Type	Estimated Cost: for Reduced Capacity Alternatives			
										Baseline	Alt. 1	Alt. 2	Alt. 3.
Intake	WWP-INT-1	Controllers and torque analyzers on screening equipment	5 Years	2013 Plant Staff Assessment	\$300,000	\$300,000	\$300,000	Received quote for replacing the existing controls from Evouca Water Tech. (formerly Siemens). The quote did not include torque analyzers.	1	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000
Intake	WWP-INT-2	Controllers and torque analyzers on screening equipment and new gates, cranes on A and B shaft of intake	5 Years	2013 Plant Staff Assessment	\$750,000	\$750,000	\$1,100,000	See new cost for updated 2016 CIP project below.	1	\$ 1,100,000	\$ 1,100,000	\$ 1,100,000	\$ 1,100,000
Rapid Mix / Flocc	WWP-RMF-1	Replace flocculator motors	5 Years	2013 Plant Staff Assessment	\$1,100,000	\$1,100,000	\$1,100,000	Assume gear boxes and VFD's need to be replaced; also in 2016 CIP	2	\$ 1,100,000	\$ 1,100,000	\$ 1,100,000	\$ 1,100,000
Sedimentation	WWP-SED-1	Replace 14 of 28 chains on sedimentation basin	5 Years	2013 Plant Staff Assessment	\$500,000	\$500,000	\$500,000	Also in 2016 CIP	2	\$ 500,000	\$ 500,000	\$ 500,000	\$ 500,000
Filters	WWP-FIL-1	Replace turbidimeters, particle counters, chlorinators, evaporators, chemical feed pumps, and trolley hoist	5 Years	2013 Plant Staff Assessment			\$1,600,000	Assume 1 unit of each type per filter; see updated cost from 2016 CIP below.	2	\$ 1,600,000	\$ 1,600,000	\$ 1,600,000	\$ 1,600,000
Chemical Feed	WWP-CHF-1	Replacement of chlorinators and evaporators	5 Years	2013 Plant Staff Assessment	\$550,000	\$550,000	\$550,000		2	\$ 550,000	\$ 550,000	\$ 550,000	\$ 550,000
Chemical Feed	WWP-CHF-2	New chemical feed pumps for all chemical systems	5 Years	2013 Plant Staff Assessment	\$500,000	\$500,000	\$500,000	Assume extra cost for different kind of pumps	2	\$ 500,000	\$ 500,000	\$ 500,000	\$ 500,000
Chemical Feed	WWP-CHF-3	Trolley/Hoist in the Chlorine room	5 Years	2013 Plant Staff Assessment	\$75,000	\$75,000	\$75,000	Assume 5-ton hoist only.	2	\$ 75,000	\$ 75,000	\$ 75,000	\$ 75,000
High Lift Pumps	WWP-HLP-1	Replacement of all high lift pumps and motors	20 Years	2013 Plant Staff Assessment	\$24,000,000	\$24,000,000	\$24,000,000	Includes current CIP project for automation of HL Pumps	3	\$ -	\$ -	\$ -	\$ -
UV / Ozone	WWP-UVO-1	Ozone Generator replacement	20 Years	2013 Plant Staff Assessment	\$4,380,000	\$4,380,000	\$6,422,746	Ozone contactor plus piping and controls for Northeast Needs Assessment (2002) was 4.38M. Inc. OH & P. Assume similar for WWP replacement	2	\$ 6,422,746	\$ 6,422,746	\$ 6,422,746	\$ 6,422,746
Electrical / I & C	WWP-EIC-1	Upgrades to the DCS/Ovation control system (equipment/hardware/software)	5 Years	2013 Plant Staff Assessment	\$1,500,000	\$1,500,000	\$1,500,000	Assumes replacement of 9 DCS rack/panels, update to latest software packages, new operator interfaces. Interconnecting fiber network shall remain as is.	1	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000	\$ 1,500,000
Electrical I & C	WWP-EIC-2	Replace uninterruptible power supply systems (UPS)	5 Years	2013 Plant Staff Assessment	\$130,000	\$130,000	\$130,000	Replace 15 kva UPSs used on panelboards in each building. Assumed 8 units.	1	\$ 130,000	\$ 130,000	\$ 130,000	\$ 130,000
Electrical / I & C	WWP-EIC-3	VFD's for the low lift pumps, wash water pumps and flocculators	20 Years	2013 Plant Staff Assessment	\$3,750,000	\$3,750,000	\$3,750,000	Replace 6 LLP VFDs, 3 Flocc VFDs, 4 WW VFDs only. No updates to HVAC, structure, or controls.	1	\$ 3,750,000	\$ 3,750,000	\$ 3,750,000	\$ 3,750,000
Electrical / I & C	WWP-EIC-4	Replacement of all Rotork actuators on all equipment	20 Years	2013 Plant Staff Assessment	\$4,000,000	\$4,000,000	\$4,000,000		1	\$ 4,000,000	\$ 4,000,000	\$ 4,000,000	\$ 4,000,000
Electrical / I & C	WWP-EIC-5	Automation/control of the screen house and high lift pump station equipment	20 Years	2013 Plant Staff Assessment	\$300,000	\$300,000	\$300,000	Part of this cost is include in item 9 above also. Assumes new control panel/rack and SCADA software programming/commissioning.	1	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000
HVAC Mechanical	WWP-HVM-1	Replace steam generators	5 Years	2013 Plant Staff Assessment	\$500,000	\$500,000	\$500,000	Need more information	1	\$ 500,000	\$ 500,000	\$ 500,000	\$ 500,000
HVAC Mechanical	WWP-HVM-2	Ozone system nitrogen feed compressors	5 Years	2013 Plant Staff Assessment	\$120,000	\$120,000	\$120,000	(3) 10HP rotary screw air compressors w/ 120 gallon tank and air dryer, 10CFM@150PSI (\$30,000/EA) + (100LF of piping, valves, controls) + misc	1	\$ 120,000	\$ 120,000	\$ 120,000	\$ 120,000
HVAC Mechanical	WWP-HVM-3	Gas unit heaters throughout the plant	5 Years	2013 Plant Staff Assessment	\$300,000	\$300,000	\$300,000	Based on RSMears +50% costing (40) GUH unit to be replaced at a cost of \$7,500/each	1	\$ 300,000	\$ 300,000	\$ 300,000	\$ 300,000
Buildings	WWP-BLD-1	Structural/crack repair through the facility	5 Years	2013 Plant Staff Assessment	\$250,000	\$250,000	\$250,000	Not enough information available. Assume 1250 LF @ \$250/ft	1	\$ 250,000	\$ 250,000	\$ 250,000	\$ 250,000
Site Improvements	WWP-SIT-1	Yard piping upgrades	5 Years	2013 10-Year CIP	\$37,000,000	\$27,407,407	\$27,407,407	Used 2013 10-Year CIP Review cost.	3	\$ -	\$ -	\$ -	\$ -
Electrical/ISC		Various Small Cap projects for DCS/Ovation controls, electrical power UPS, steam generators and nitrogen feed compressors					\$ 2,200,000	2016 CIP	1	\$ 2,200,000	\$ 2,200,000	\$ 2,200,000	\$ 2,200,000
Site Improvements		Miscellaneous Concrete and Road Improvements at the Waterworks Park Water Treatment Plant					\$2,200,000	2016 CIP	1	\$ 2,200,000	\$ 2,200,000	\$ 2,200,000	\$ 2,200,000
All		Facilities Condition Assessment at the Waterworks Park Treatment Plant					\$575,000	2016 CIP	1	\$ 575,000	\$ 575,000	\$ 575,000	\$ 575,000
Total Estimated Cost										\$27,972,746	\$27,972,746	\$27,972,746	\$27,972,746

Plant Process/ System Codes:			Costs to Present Day (Dec 2013)			
			Yr of Est.	ENR Index	Adjustment	
Intake	INT	High Lift Pumps	HLP	2002	6563	1.473
Low Lift Pumps	LLP	UV / Ozone	UVO	2008	8310	1.163
Rapid Mix / Flocc	RMF	Electrical / I & C	EIC	2011	9172	1.054
Sedimentation	SED	HVAC Mechanical	HVM	2013	9668	1.000
Filters	FIL	Lab / Administrative	LAD			
Chemical Feed	CHF	Buildings	BLD			
Residuals	RSD	Site Improvements	SIT			
Reservoirs	RES					

Reduced Capacity Upgrade Type

- 1 - Cost included in full, not proportional to capacity
- 2 - Cost included, but proportional to capacity
- 3 - Cost not included, does not vary among alternatives

TABLE K-17 - SOUTHWEST WTP PROPOSED CAPITAL IMPROVEMENTS

(Facility is rated at 240 MGD. Conventional treatment with low lift, rapid mix, flocculation, sedimentation, filtration, high lift pumps, and filtered water storage reservoirs. Sed basins have chain and flight mechanisms for removing alum residuals for treatment at the residuals handling facility which processes alum sludge and filter backwash wastewater)

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Type	Estimated Cost for Reduced Capacity Alternatives				
										Baseline	Alt. 1	Alt. 2	Alt. 3	
Rapid Mix / Floc	SW - RMF - 1	Flocculator equipment upgrades	5 Years	2013 Plant Staff Assessment	\$5,000,000	\$5,000,000	\$5,000,000	Received Jim Meyer and Sons, Inc quote for new walking beam flocculator equipment.	2	\$ 3,125,000	\$ 2,708,333	\$ -	\$ 2,916,667	
Sedimentation	SW - SED - 1	Floc / Sed Basin Rehab	5 Years	2002 Needs Assessment	\$6,350,760	\$4,071,000	\$5,997,018	2002 Needs Assessment - Immediate Priority Floc / Sed Basin Rehab & Misc. Improvements	2	\$ 3,748,136	\$ 3,248,385	\$ -	\$ 3,498,260	
Filters	SW - FIL - 1	Intermediate Filtration System Improvements	5 Years	2013 Plant Staff Assessment	\$25,480,000	\$16,333,333	\$24,060,745	2002 Needs Assessment "Filtration Improvements" Project.	2	\$ 15,037,965	\$ 13,032,903	\$ -	\$ 14,035,434	
Chemical Feed	SW - CHF - 1	Upgrades and Rehabilitation of the phosphoric acid feed system and the chlorination system	5 Years	2013 Plant Staff Assessment	\$1,000,000	\$1,000,000	\$1,000,000	Assume "upgrade" means replacement of mechanical equipment and updating the controls, monitoring and controls improvements along with minor building improvements	1	\$1,000,000	\$1,000,000	\$0	\$1,000,000	
Chemical Feed	SW - CHF - 2	Chemical Systems and Chemical Building Improvements	5 Years	2002 Needs Assessment	\$5,300,000	\$3,397,436	\$5,004,786	2002 Needs Assessment (2002 Dollars)	2	\$ 3,127,991	\$ 2,710,926	\$ -	\$ 2,919,458	
High Lift Pumps	SW - HLP - 1	High Lift Pump Station Upgrades	5 Years	2013 Plant Staff Assessment	\$13,000,000	\$13,000,000	\$13,000,000	Assume this includes a relatively minor amount of high lift piping replacement in addition to the pumps	3					
High Lift Pumps	SW - HLP - 2	High/Low Lift Pump Station and Administration Building Improvements	5 Years	2002 Needs Assessment	\$1,946,490	\$1,247,750	\$1,838,069	2002 Needs Assessment (2002 Dollars)	1	\$1,838,069	\$1,838,069	\$0	\$1,838,069	
High Lift Pumps	SW - HLP - 3	Resolution of the hydraulic oil system leaks in the high lift	5 Years	CS - 1475 Evaluation	\$4,820,000	\$4,820,000	\$4,820,000	Maximum cost of 6 alternatives for resolution listed here. Reviewed during construction of residuals facility but not implemented.	1	\$4,820,000	\$4,820,000	\$0	\$4,820,000	
Electrical / I & C	SW - EIC - 1	Electrical and Instrumentation and Controls	5 Years	2002 Needs Assessment	\$10,400,000	\$6,666,667	\$9,820,712	2002 Needs Assessment (2002 Dollars)	1	\$9,820,712	\$9,820,712	\$0	\$9,820,712	
HVAC Mechanical	SW - HVM - 1	Installation of deaerator tank	5 Years	2013 Plant Staff Assessment	\$75,000	\$75,000	\$75,000	Install existing deaerator tank	1	\$75,000	\$75,000	\$0	\$75,000	
		Replace High-Lift Pump Discharge Valve Actuators with New Valve Actuation System					\$1,960,465		3					
		High-Lift Pump Suction Sluice Gate and Replacement of Rapid Mix Isolation Butterfly Valves		Master Planning Team Estimate			\$2,500,000		2	\$ 1,562,500	\$ 1,354,167	\$ -	\$ 1,458,333	
		Residuals Decant Recycle Modifications					\$1,773,675		1	\$1,773,675	\$1,773,675	\$0	\$1,773,675	
	SW-SIT-1	Construction of Water Production Flow Metering Modifications and Improvements to Southwest	5 Years	2016 CIP			\$2,800,000		1	\$2,800,000	\$2,800,000	\$0	\$2,800,000	
		Design/Construction Assistance Engineering Services for Upgrades to the Southwest Water Treatment Plant Laboratory					\$800,000		1	\$800,000	\$800,000	\$0	\$800,000	
Total Estimated Cost							\$80,450,469				\$49,529,049	\$45,982,170	\$0	\$47,755,609

Plant Process / System Codes:				Costs to Present Day (Dec 2013)		
				Yr of Est.	ENR Index	Adjustment
Intake	INT	High Lift Pumps	HLP	2002	6563	1.473
Low Lift Pumps	LLP	UV / Ozone	UVO	2011	9172	1.054
Rapid Mix / Floc	RMF	Electrical / I & C	EIC	2013	9668	1.000
Sedimentation	SED	HVAC Mechanical	HVM			
Filters	FIL	Lab / Administrative	LAD			
Chemical Feed	CHF	Buildings	BLD			
Residuals	RSD	Site Improvements	SIT			
Reservoirs	RES					

Reduced Capacity Upgrade Type

- 1 -Cost included in full, not proportional to capacity
- 2 -Cost included, but proportional to capacity
- 3 -Cost not included, does not vary among alternatives
- 4- Cost for potential regulatory compliance included at 50% probability

Table B-18 Cost Estimate to Decommissioned & Re-commission 80 MGD Filter Capacity At Lake Huron WTP

Item	Basis of Estimate	unit cost (\$)	Units	Number of units	Costs	Year cost Incurred	2014 PW 4%	2014 PW 7%
Valve-off 6 filters and sedimentation basins disconnect control systems	Labor for 1 day (1/2 day for valves, 1/2 day control system disconnect)	\$45	hr	8	\$360	2016	\$ 351	\$ 332
Remove filter media	SPW-563 (CDM Smith CCI cost estimate for removal=\$2.25/cf; Roughly estimated +\$2.25/cf for trucking and disposal)	\$4.50	cf	45240	\$203,580	2016	\$ 198,700	\$ 187,901
Install Protective Covers	See below plus 'details & notes'							
Materials for 6 filters w/ dimensions of 19'-4" W x 60'-0" L	3/4-inch plywood, 4'x8'	\$45	ea	240	\$10,800	2016	\$ 10,541	\$ 9,968
Materials for 6 filters w/ dimensions of 19'-4" W x 60'-0" L	2inx12inx8ft lumber (16" on center plus exterior frame)	\$12	ea	924	\$10,986	2016	\$ 10,723	\$ 10,140
Labor	2 carpenters for two days per filter	\$60	hr	192	\$11,520	2016	\$ 11,244	\$ 10,633
Remove Protective Covers	See below plus 'details & notes'							
Remove Protective Covers- Waste hauling	Lumber calculated for covers	\$75	ton	31	\$2,330	2036	\$ 1,875	\$ 1,027
Remove Protective Covers--Labor	2 laborers for one day per filter	\$45	hr	96	\$4,320	2036	\$ 3,477	\$ 1,904
Install New Filter Media	SPW-563 (CDM Smith CCI cost estimate for media=\$25/cf)	\$25	cf	45240	\$1,131,000	2036	\$ 910,187	\$ 498,436
Test and replace piping & valves as needed	SPW-563 (assumed replacement of all valves and adjoining piping; plus replacement of surface sweeps)	\$500,000	dual filter	3	\$1,500,000	2036	\$ 1,207,145	\$ 661,056
Install new control system	SPW-563	\$50,000	dual filter	3	\$150,000	2036	\$ 120,715	\$ 66,106
Decommission & Re-commission total					\$ 3,024,897		\$ 2,474,958	\$ 1,447,502

Table B-19 Cost Estimate to Operate Decommissioned Filter Capacity for 20 years

Item	Basis of Estimate	unit cost (\$)	Units	Number of units	Annual Operation cost or Capital cost at specified year	2014 PW 4%	2014 PW 7%
Electrical cost for backwashing for 20 years	Scaled current cost (See details and notes)				\$14,760	\$ 200,735	\$ 156,455
Filter media replacement in year 1 (2016)	SPW-563; (CDM Smith CCI cost estimate for media=\$25/cf)	\$25	cf	45240	\$1,131,000	\$ 1,103,888	\$ 1,018,870
Filter media supplement annually	SPW-563; (CDM Smith CCI cost estimate for media=\$25/cf) 1" per year anthracite loss and replacement	\$25	cf	1160	\$29,000	\$ 394,400	\$ 307,400
Preventive maintenance for 20 years	25% of Operation Labor				\$ 32,058	\$ 435,989	\$ 339,815
Sedimentation sludge removal and disposal for 20 years	DWS-898 (Assume per plant cost based on 300 mgd/plant, scaled by 80/300 mgd.)				\$ 50,000	\$ 680,000	\$ 530,000
Upgrade Control System (at year 15=2030)	SPW -563	\$50,000	dual filter	3	\$150,000	\$ 130,869	\$ 84,130
Operation Labor Cost for 20 years	Current Operating Cost for 1.5 FTEs				\$ 128,232	\$ 1,743,958	\$ 1,359,261
Total Operate 20 years					\$1,535,050	\$4,689,839	\$3,795,931

Table B-20 Lake Huron WTP Information and Decommission, Re-commission Cost Details

LH WTP capacity 400 mgd.

30 filters in operation.

Therefore 6 filters =80 mgd of capacity.

Filter area	2320 sf each	13920 sf (decommission example)
Filter loading rate	4 gpm/sf	
Filter dimensions		
Length	60 ft	
Width	19.33 ft	
6.5 ft gullet between filter cells		
Media depth	39 inches	

LH Filter PM - Annual inspection. Surface sweep nozzles and wash arms are inspected and cleaned.
 Sizeable mud balls and mud accumulations, if any, are removed by power washing. Filter media levels are checked.
 Every 5 years perform complete filter study, filter inspections. (Recommended PM per Sanitary Survey document)

1 Calculation of filter cover materials

A. Assume plywood dimensions 4' x 8'

sheets in width direction:	5
Sheets in length direction:	8
Plywood Sheets per filter:	40

B. Assume stud framing with 2"x12"x8' lumber 16" on center across length of filter

Stud every 16" plus two ends down length	46
Number of studs end to end for width	3
number of studs end to end for outside of length	8
total number of studs required	<u>154</u>

C. Plywood weight; 2.34 lbs/sf 3/4" plywood

Weight	2.34 lbs/sf
Sq ft	2320
total	32573 lbs
	16.3 tons

D. Stud framing weight

weight	32 lbs/(2"x12"x8' board)
boards	924
total	29568 lbs
	14.8 tons

2 Energy costs

FY2013 DTE bill	\$7,379,969
% of power costs for backwash	1% based on table A-11 (at other plants, not detailed for LH)
FY2013 Estimated backwash	\$73,800
FY2013 LH WTP production	49809 MG
Annual production of 80 mgd	29200 MG
% decommissioned of 2013 production	59%
Electrical cost of decommissioned capacity	\$43,264 per year
Instead	
Considered 80 mgd as % of 400 mgd	20%
Electrical cost of decommissioned capacity	\$14,760 per year

3 Operation Labor costs

total 2013	
labor cost at LH 2013 FTE	
LH (Table B-3) (Table B-10*)	\$/FTE
\$1,966,227	23 \$ 85,488
1.5 FTEs =	\$ 128,232
25% of 1.5 FTEs for PM=	\$ 32,058.04
* including contract employees	

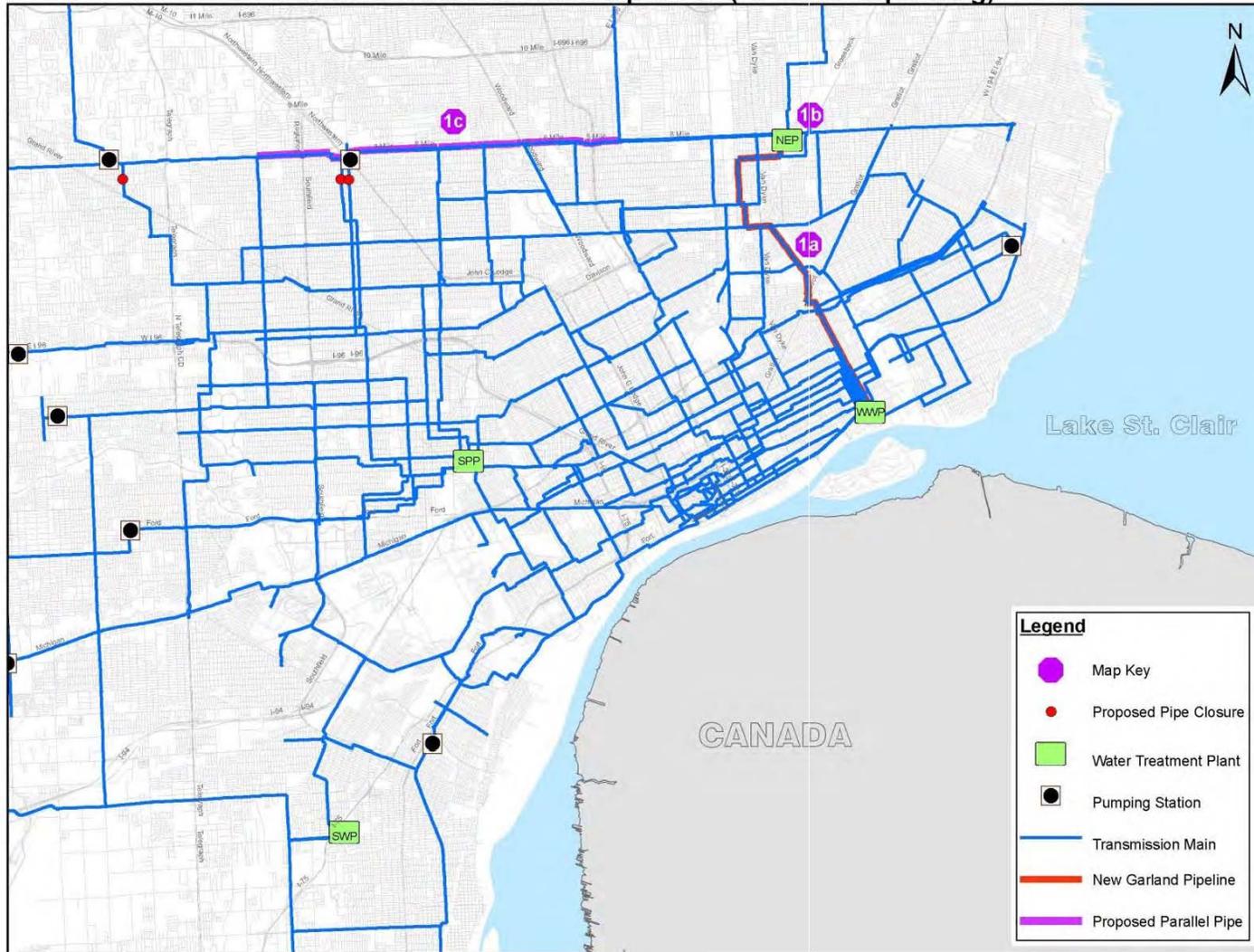
4 Economic Present Worth Factors

	Period	Mid Point	Years of Escalation from 2014	3%/yr Escalation Factor	Present Worth Factor 4%	Present Worth Factor 7%	4% Aggregate Factor	7% Aggregate Factor
Decommission and Re-commission filtration capacity	2015-2017	2016	2	1.06	0.92	0.87	0.976	0.923
	2035-2037	2036	22	1.92	0.42	0.23	0.805	0.441
Annual Costs Present Worth Factor for 20 Years							13.6	10.6
Upgrades	2030	2030	15	1.56	0.56	0.36	0.872	0.561

Water Treatment process decommission & re-commission Costs Present Worth Factors based on number of years from 2014 to Mid Point of cost assignment period.

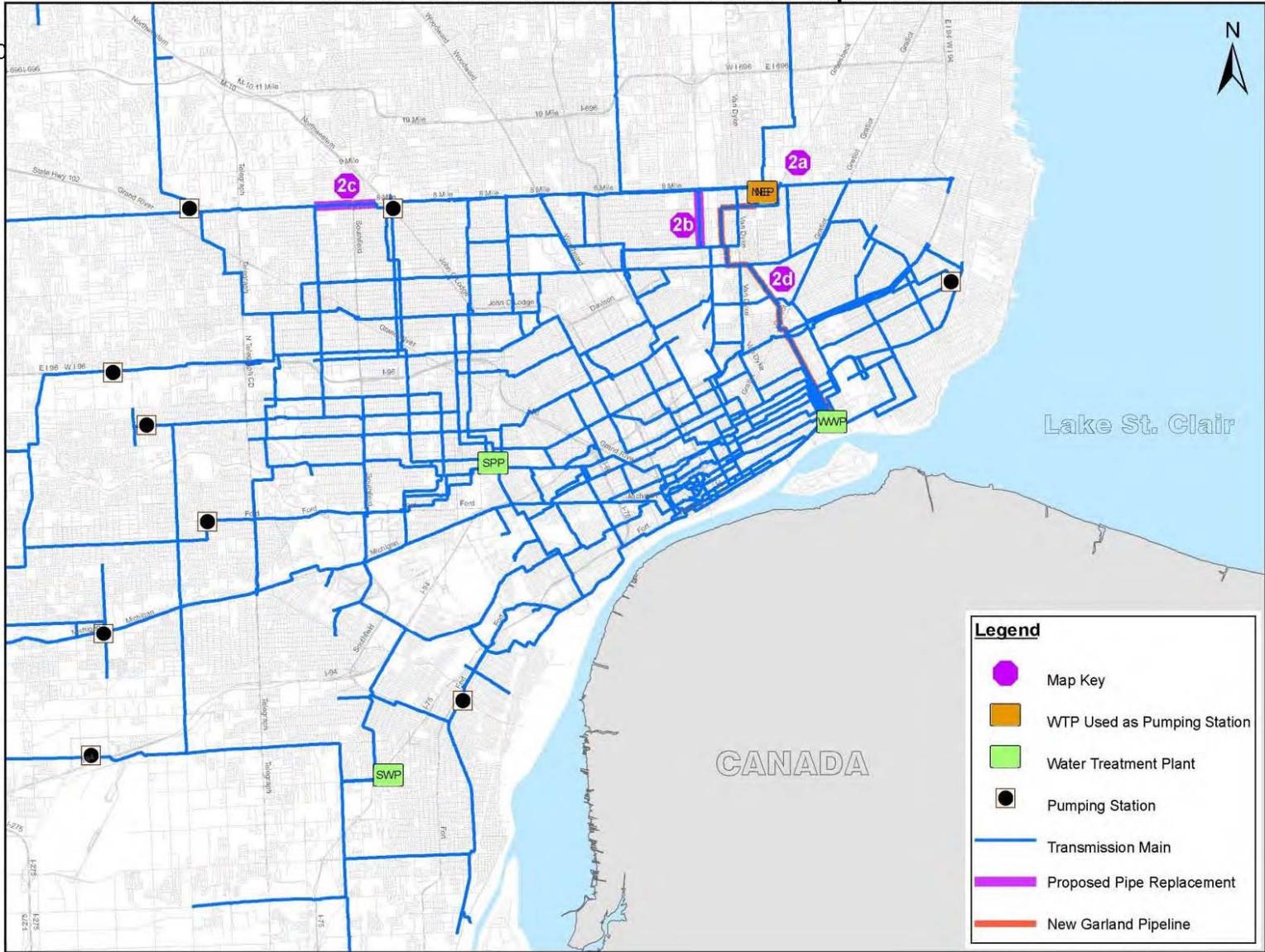
Attachment C

DWSD Water Treatment Plants Consolidation Analysis Baseline - Reduced WTP Capacities (All Plants Operating)*



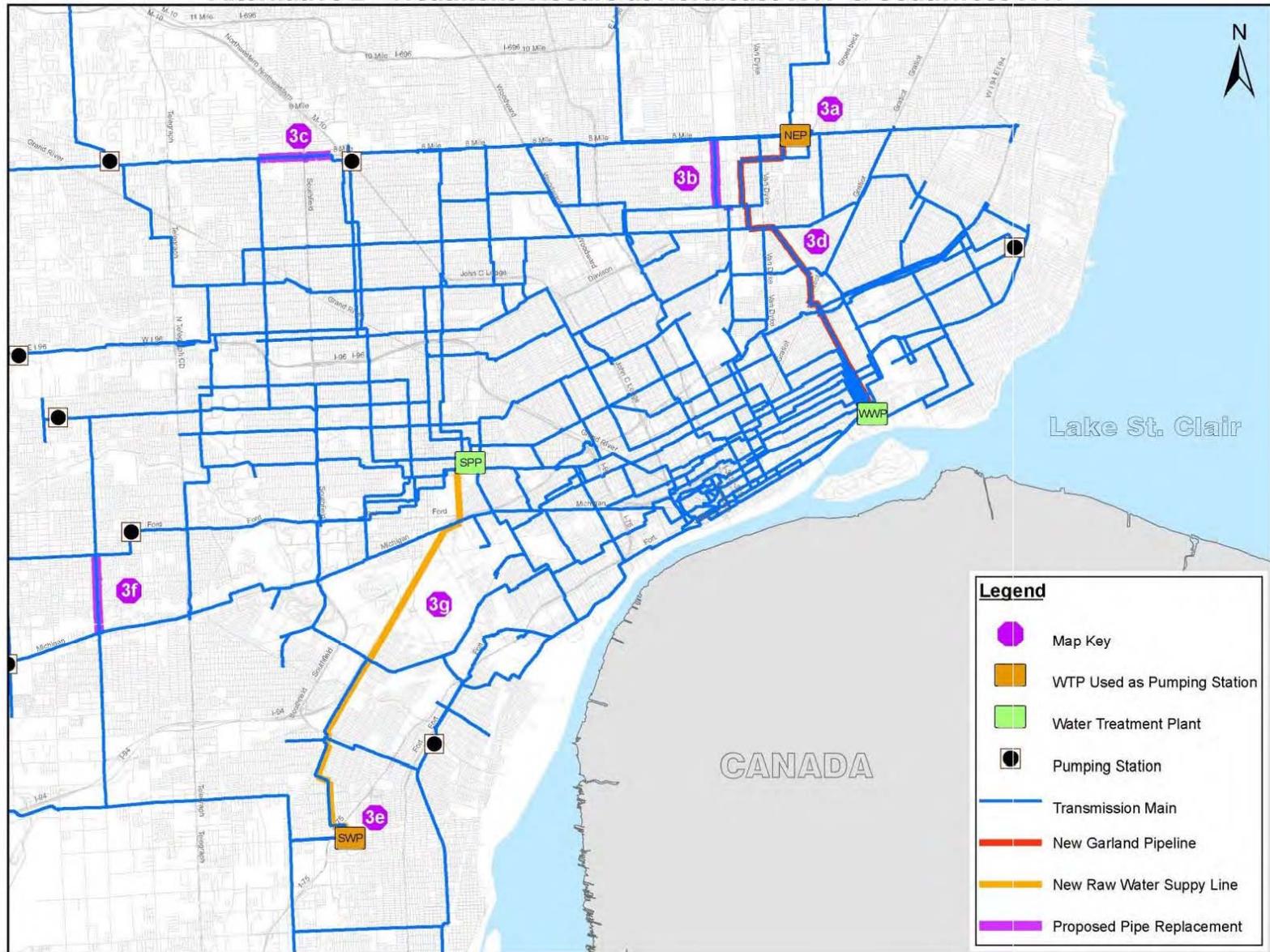
* The analysis was based on the 2011 Maximum Day Demand Model

DWSD Water Treatment Production Change Alternative 1 - Northeast WTP Shut-down & Reduced Capacities at Other Plants*



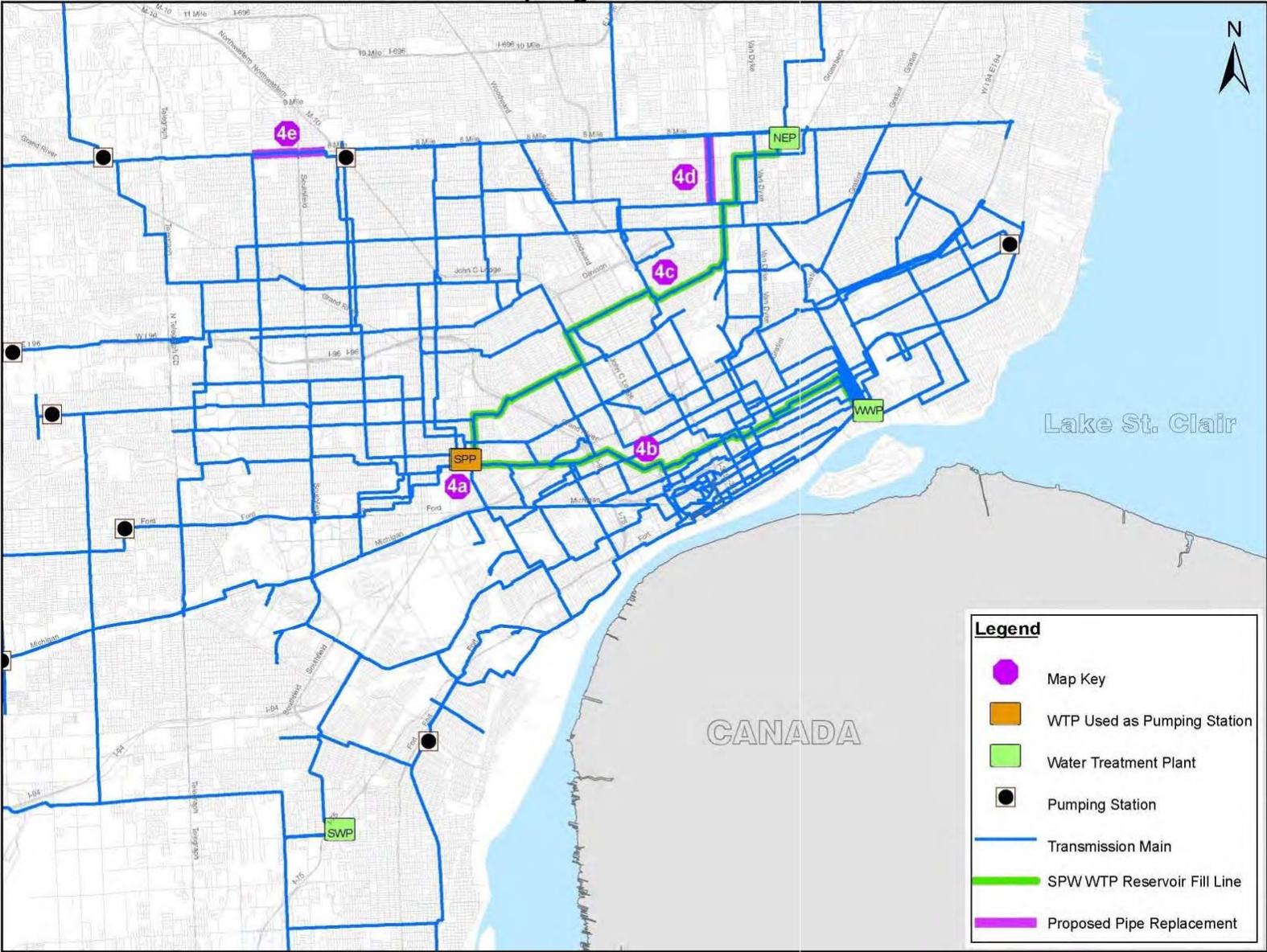
* The analysis was based on the 2011 Maximum Day Demand Model

DWSD Water Treatment Production Change Alternative 2 - Treatment Closure at Northeast WTP & Southwest WTP*



* The analysis was based on the 2011 Maximum Day Demand Model

DWSD Water Treatment Production Change Alternative 3 - Springwells WTP Treatment Closed*



* The analysis was based on the 2011 Maximum Day Demand Model

Table 2

DWSD Contract No. CS 1528 - Comprehensive Water Master Plan Update

Cost Estimate for Capital Improvements of Water Treatment Plant Consolidation⁽¹⁾

Alternative	Required Capital Improvement*	Unit	Quantity	Unit Cost	Route Location	Location Factor	Cost
No. 1 - Reducing Water Treatment Plant Capacities ⁽²⁾	1a - New 60" Garland Pipeline	LF	43,200	\$ 616	Urban	2.0	\$ 53,222,400
	1b - New State Fair Valve and Flow Meter at Northeast WTP Yard	LS	1	\$ 615,000			\$ 615,000
	1c - New 48" Parallel Pipeline along 8 Mile Rd. between Dequindre Rd. and Evergreen Rd.	LF	43,000	\$ 524	Urban	2.0	\$ 45,064,000
	Total						\$ 98,901,400
No.2 - Closing Treatment at Northeast WTP & Reducing Capacities at the Other Plants ⁽³⁾	2a - NEWTP Yard Piping Improvement						
	2aa - New State Fair Valve and Flow Meter	LS	1	\$ 615,000			\$ 615,000
	2ab - New Bulkhead	LF	20	\$ 245			\$ 4,900
	2ac - New Bulkhead	LF	20	\$ 245			\$ 4,900
	2b - New 48" Pipeline along Mound Rd. between Nevada Rd. and 8 Mile Rd. to Replace Exist. 24" Pipeline	LF	7,850	\$ 524	Urban	2.0	\$ 8,226,800
	2c - New 54" Pipeline along 8 Mile Rd. between Evergreen Rd. and St. Marys Rd. to Replace Exist. 48" Pipeline	LF	8,850	\$ 566	Urban	2.0	\$ 10,018,200
	2d - New 60" Garland Pipeline	LF	43,200	\$ 616	Urban	2.0	\$ 53,222,400
Total						\$ 72,092,200	
No.3 - Closing Treatment at Both Northeast and Southwest WTPs	3a - NEWTP Yard Piping Improvement						
	3aa - New State Fair Valve and Flow Meter	LS	1	\$ 615,000			\$ 615,000
	3ab - New Bulkhead	LF	20	\$ 245			\$ 4,900
	3ac - New Bulkhead	LF	20	\$ 245			\$ 4,900
	3b - New 48" Pipeline along Mound Rd. between Nevada Rd. and 8 Mile Rd. to Replace Exist. 24" Pipeline	LF	7,850	\$ 524	Urban	2.0	\$ 8,226,800
	3c - New 54" Pipeline along 8 Mile Rd. between Evergreen Rd. and St. Marys Rd. to Replace Exist. 48" Pipeline	LF	8,850	\$ 566	Urban	2.0	\$ 10,018,200
	3d - New 60" Garland Pipeline	LF	43,200	\$ 616	Urban	2.0	\$ 53,222,400
	3e - SWWTP Yard Piping Improvement						
	3da - New 54" Reservoir Fill Pipe at SW WTP	LF	100	\$ 750			\$ 75,000
	3db - New 36" Cone Valve at SW WTP Yard	EA	1	\$ 500,000			\$ 500,000
	3dc - New Bulkhead	LF	20	\$ 245			\$ 4,900
3f - New 48" Pipeline along Inkster Rd. between Marquette Rd. and Michigan Ave. to Replace Exist. 36" Pipeline	LF	9,100	\$ 524	Urban	2.0	\$ 9,536,800	
3g - New 66" Raw Water Supply Pipeline from Southwest WTP to Springwells WTP	LF	52,000	\$ 802	Urban	2.0	\$ 83,408,000	
Total						\$ 165,616,900	
No. 4 - Closing Treatment at Springwells WTP	4a - SPWWTP Yard Piping Improvement						
	4aa - New 96" Steel Pipe at SPW WTP Yard	LF	400	\$ 1,550			\$ 620,000
	4ab - New 36" Cone Valve at SPW WTP Yard	EA	2	\$ 500,000			\$ 1,000,000
	4b - New 60" Reservoir Fill Pipeline from WWP WTP	LF	54,000	\$ 616	Urban	2.0	\$ 66,528,000
	4c - New 72" Reservoir Fill Pipeline from NE WTP	LF	66,550	\$ 843	Urban	2.0	\$ 112,203,300
	4d - New 48" Pipeline along Mound Rd. between Nevada Rd. and 8 Mile Rd. to Replace Exist. 24" Pipeline	LF	7,850	\$ 524	Urban	2.0	\$ 8,226,800
	4e - New 54" Pipeline along 8 Mile Rd. between Evergreen Rd. and St. Marys Rd. to Replace Exist. 48" Pipeline	LF	8,850	\$ 566	Urban	2.0	\$ 10,018,200
Total						\$ 198,596,300	

(1) Capital Improvements were assessed based on the following hydraulic criteria:

- (a) flow velocity should not be larger than 10 fps; and
- (b) unit headloss in transmission pipes should not larger than 3 ft per 1,000 ft.

(2) The reduced capacities are LHP = 300, NEP=150, SPP=200, SWP=180 and WWP=240 MGD.

(3) The reduced capacities are NEP = 0 (closed), LHP = 300, SPP=350, SWP=180 and WWP=240 MGD.