TM-13: Water Treatment Plant Needs Assessment

1.0 Purpose of Memorandum

This memorandum served as the basis for developing capital needs plans for the Detroit Water and Sewerage Department's five water treatment plants (WTP) for the Comprehensive Water Master Plan. The development of the capital needs for each facility is based on a review of the following documents and data:

- April 2002 Northeast WTP Needs Assessment Report prepared by Malcolm Pirnie/TYJT Joint Venture
- November 2002 Springwells WTP Needs Assessment Report prepared by Hazen and Sawyer
- May 2003 Southwest WTP Needs Assessment Report performed by Hazen and Sawyer
- June 2004 Task D Water Quality Management Plan Final Report for the Comprehensive Water Master Plan prepared by C2MHill and TYJT in association with CDM
- July 2005 to July 2013 WTP Monthly Operating Report Data
- October 2013 Site Assessment Questionnaires and Interviews completed by DWSD WTP staff

The review did not include an independent assessment of each facility. The scope and costs for the capital improvements are based on the documents and data sources listed above.

During Phase 2 of the Water Master Plan Update, additional input was received from DWSD regarding capital project needs at each plant. In addition, investigations by the master planning team identified new capital needs for potential future regulatory requirements and process technology improvements. The new capital needs identified in Phase 2 are listed directly in TM-17. The original source data in TM-13 remain unchanged. TM-17 presents updated capital cost estimates for certain projects originally identified in TM-13. TM-17 does not include projects from TM-13 that are not proposed for implementation during the planning period.

2.0 Acronyms and Technology

The definitions and acronyms provided below apply to terms used throughout this memorandum:

- Detroit Water and Sewerage Department (DWSD)
- Water Treatment Plant (WTP)
- Northeast (NE)
- Springwells (SP)
- Southwest (SW)
- Lake Huron (LH)

- Water Works Park (WWP)
- Capital Improvement Program (CIP)
- Comprehensive Water Master Plan (CWMP)
- Needs Assessment (NA)
- Safe Drinking Water Act (SDWA)
- Ten States Standards (TSS)
- Partnership for Safe Water (PSW)
- Million Gallons per Day (MGD)
- Rated Capacity - The maximum allowable treatment capacity of the plant as permitted by the MDEQ
- Firm Capacity - The capacity of a unit process with the largest unit out of service.

3.0 Existing Water Treatment Facilities

The Detroit Water and Sewerage Department owns and operates five water treatment facilities which provide water to nearly 3 million customers in Southeastern Michigan. The Northeast, Springwells, Southwest, Lake Huron, and Water Works Park Water Treatment Plants have a maximum rated treatment capacity of 1,720 million gallons per day and firm high service pumping capacity of 2,400 million gallons per day. The high service pumping capacity exceeds the rated treatment capacity to assist in meeting peak hourly demands from finished water storage. Applicable treatment and pumping capacities and other data for each plant are shown in **Table 3-1**. System storage and high service pumping are not accounted for in **Table 3-1**.

Table 3-1: Treatment and Pumping Capacities and Other Data for Each Plant

Facility	Year Placed in Service	Rated Treatment Capacity (MGD)	Firm High Service Pumping Capacity (MGD)	Finished Water Storage Volume (MG)	Areas Served
Northeast WTP	1956	300	400	30	Northeast Detroit/Wayne County, Southern Macomb County, Southeast Oakland County
Springwells WTP	1930 First Train; 1958 Second Train	540(1)	260 Intermediate Pressure District 450 High Pressure District	60	Detroit and Northern Wayne County, Eastern Washtenaw County, Oakland County, Southeastern Macomb County

Table 3-1: Treatment and Pumping Capacities and Other Data for Each Plant

Facility	Year Placed in Service	Rated Treatment Capacity (MGD)	Firm High Service Pumping Capacity (MGD)	Finished Water Storage Volume (MG)	Areas Served
Southwest WTP	1963	240	310	30	Southern Wayne County, Northern Monroe County, Eastern Washtenaw County
Lake Huron WTP	1974	400	420	44	Genessee County, Lapeer County, St. Clair County, Monroe County, Oakland County
Water Works Park WTP	2003	240	560	28	East Detroit/Wayne County
System Totals:		1,720	2,400	192	

1 - Filter upgrades at Springwells limit plant capacity to 350 MGD until construction is complete.

Four of the five plants (NE, SP, SW, and WWP) are conventional treatment facilities with the following process trains: rapid mix, coagulation, flocculation, sedimentation, granular media filtration, and disinfection. Lake Huron is the only facility which is operated as a "modified direct filtration" plant, which means the sedimentation basins are used as contact basins and do not require a minimum detention time of 4 hours. In addition, Water Works Park is the only plant which employs intermediate ozonation for primary disinfection control. All five plants use the same chemical systems including alum for coagulation, chlorine for preoxidation and primary disinfection (excluding Water Works Park), powdered activated carbon (PAC) for taste and odor (T&O) control, phosphoric acid for corrosion control, and fluoride for dental health protection. Polymers are also added at several facilities to enhance coagulation and filtration as well as for thickening and dewatering of alum residuals as shown in **Table 3-2**.

Table 3-2: Polymer Use at WTPs

Polymer Use	Facilities
Coagulant Aid	SP, LH, WWP
Filter Aid	LH, WWP
Residuals Thickening	LH, WWP, SW
Residuals Dewatering	WWP, SW

Two of the five plants, Southwest and Water Works Park, employ automated residuals removal from the sedimentations basins. The residuals are thickened and dewatered on site along with backwash wastewater, and disposed of at landfills. Lake Huron's basins are cleaned manually on an annual basis and the sludge is discharged to the sludge drying lagoons. The lagoons also receive thickened solids from the waste washwater treatment facility which processes filter backwash wastewater. The Springwells and Northeast plants do not have automated alum residuals collection in the sedimentation basins or a thickening treatment process on site for alum residuals or backwash wastewater. At both facilities, the basins are manually cleaned on an annual or bi-annual basis and the solids are discharged to the sewer; backwash wastewater is also discharged to the sewer. However, a pilot is currently underway at Northeast in which the mud valves in the sedimentation basins will be

opened daily to discharge sedimentation basin solids to the sewer. This process will be adopted at Springwells if the pilot test at Northeast is successful. A summary of the unit processes at each facility is provided in **Table 3-3**.

Table 3-3: Summary of Unit Processes at Each Facility

Facility	Northeast	Springwells	Southwest	Lake Huron	Water Works Park
Treatment Capacity (MGD)	300	540[1]	240	400	240
Intake	Belle Isle	Belle Isle	Fighting Island	Lake Huron	Belle Isle
Process					
Rapid Mix	Mechanical mixing w/ vertical turbine impellers	1930 Train: Hydraulic mixing 1958 Train: Mechanical mixing w/vertical turbine impellers	Mechanical mixing w/vertical turbine impellers	Mechanical mixing w/vertical turbine impellers	In-line pumped mixing system
Flocculation	Horizontal-shaft paddle reel flocculators, 7 parallel channels per basin with 4 stages of flocculation	1930 Train: Hydraulic mixing 1958 Train: Horizontal-shaft paddle reel flocculators, 5 stages of flocculation	Walking beam flocculators, 4 stages of flocculation	Vertical turbine flocculators, with 4 chambers and 3 stages of flocculation	Vertical turbine flocculators, with 3 stages of flocculation
Sedimentation	Horizontal-flow rectangular basins, manually cleaned to remove sludge	Horizontal-flow rectangular basins, manually cleaned to remove sludge	Horizontal flow; continuous automated sludge removal with chain and flight collectors	Horizontal-flow rectangular basins, manually cleaned to remove sludge[2]	Inclined plate settling with continuous sludge removal with chain and flight collectors

Table 3-3: Summary of Unit Processes at Each Facility

Facility	Northeast	Springwells	Southwest	Lake Huron	Water Works Park
Treatment Capacity (MGD)	300	540[(1)]	240	400	240
Intake	Belle Isle	Belle Isle	Fighting Island	Lake Huron	Belle Isle
Process					
Filtration	Dual-media declining rate filters, 7" anthracite and 19" sand, pumped backwash with rotating surface wash	Constant rate filters; Original 1930 Train was 20" sand over 18" gravel and original 1958 Train was 8" anthracite and 20" sand [(2)], pumped backwash and rotating surface wash	Dual-media declining rate filters, 7" anthracite and 22" sand, pumped backwash with rotating surface wash	Operated in declining rate mode, filters are dual-media #1-20 are 7"sand and 18" anthracite and #21-30 are 12" sand and 12" anthracite, pumped backwash and rotating surface wash	Mono-media constant rate filters, 48" anthracite, pumped backwash and air scour system
Disinfection	Chlorination with feed points in raw water tunnel (WWP) and filter effluent	Chlorination with feed points at raw water tunnel (WWP) and filter effluent. Chlorine can also be fed at mixing chamber, rapid mix, and prior to filtration.	Chlorination with feed points at raw water tunnel and filter effluent. Chlorine can also be fed at settled water conduits, reservoir return, and rapid mix.	Chlorination with feed points in raw water conduits and filter effluent	Chlorination feed points at raw water tunnel (pre-chlorination) and filter effluent, intermediate ozonation for primary disinfection and taste and odor control

Table 3-3: Summary of Unit Processes at Each Facility

Facility	Northeast	Springwells	Southwest	Lake Huron	Water Works Park
Treatment Capacity (MGD)	300	540(1)	240	400	240
Intake	Belle Isle	Belle Isle	Fighting Island	Lake Huron	Belle Isle
Process					
Residuals Handling	No separate processing facilities. Discharged to sewer during manual basin cleaning.	No separate processing facilities. Discharged to sewer during manual basin cleaning.	Backwash waste water and alum sludge are equalized, thickened, and dewatered. Thickening via gravity thickeners with inclined plate settlers and dewatering via centrifuge. Cake is hauled off site to a landfill.	Backwash waste water is equalized and thickened, then dewatered at the lagoons. Contact basin sludge is also manually discharged to lagoons.	Backwash waste water and alum sludge are equalized, thickened, and dewatered. Thickening via gravity thickeners with inclined plate settlers and dewatering via centrifuge. Cake is hauled off site to a landfill.
Chemical Systems	Alum, chlorine, fluoride, PAC, phosphoric acid Note: coagulant and filter aid polymers on-hold under CS-1494	Alum, chlorine, fluoride, PAC, phosphoric acid, coagulant aid polymer system	Alum, chlorine, fluoride, PAC, phosphoric acid, thickening/dewatering polymer for sludge conditioning	Alum, chlorine, fluoride, PAC, phosphoric acid, coagulant aid polymer, filter aid polymer, thickening polymer for sludge conditioning	Alum, chlorine, fluoride, PAC, phosphoric acid, ozone, sulfuric acid, sodium bisulfite, sodium hydroxide, filter aid polymer, thickening/dewatering polymer for sludge conditioning

1- Filter upgrades at Springwells limit plant capacity to 350 MGD until construction is complete.

2- 1930 Filters upgraded in SP-549 and SP-558; 1958 Filters are currently under construction for upgrades

3- Lake Huron is a "modified" direct filtration facility. Sedimentation Basins are operated as contact basins.

4.0 Needs Assessment Review

Needs Assessments were conducted for the Northeast, Springwells and Southwest WTP's in 2002. At that time, major upgrades were under construction at Lake Huron, and Water Works Park was in the final phases of being reconstructed. Each NA team performed detailed investigations of each plant's process mechanical, architectural, structural, HVAC, electrical, and instrumentation and control equipment and systems. The reports provided recommendations for the capital investments needed over the next 10 years to ensure each plant met DWSD Water Quality Goals and industry accepted capacity guidance provided by Ten States Standards and the Partnership for Safe Water.

In 2004 the CWMP team identified projects that would be necessary at Lake Huron to increase its treatment capacity to 800 MGD as well as projects at both Lake Huron and Water Works Park to ensure each plant would meet future regulatory and operational requirements. A summary of the findings for each facility as reported in the NAs and 2004 CWMP follows.

4.1 Northeast Water Treatment Plant

The Northeast Water Treatment Plant was constructed in 1956 to serve growing suburban populations east and north of Detroit. The source of raw water is the Belle Isle intake, located in the Detroit River, which also serves Springwells and Water Works Park. The raw water is chlorinated, fluoridated, and screened at WWP before it flows to Northeast by gravity. Low lift pumps lift the raw water to the process trains, which operate in parallel. With a maximum rated capacity of 300 MGD, the plant process trains consist of rapid mix, flocculation, sedimentation, and dual-media gravity filtration.

In April 2002 a Needs Assessment prepared by Malcolm Pirnie/TYJT was conducted to identify process mechanical, electrical, instrumentation, HVAC, structural and architectural deficiencies and develop a 10-year capital improvement program to address these needs. The needs assessment team realized that due to the length of service of much of the plant's equipment and the frequency of preventive and corrective maintenance activities, most of the process equipment was in need of replacement. However, most of the projects recommended have not been constructed and several design projects for recommended improvements are now on hold. Of the projects listed below, only the Critical Pumping Improvements and some of the Urgent I&C Improvements have been completed. The table below summarizes the scope of work for the recommended projects, cost, and current status of each project. For most uncompleted projects, the estimated cost is from the 2002 Needs Assessment. For the flocculation and sedimentation upgrades/residuals handling project, the estimated cost is as reported in the 2011 CS-1475 Final Design Report. The actual cost is used for completed projects, as reported in the DWSD CIP.

Table 4-1: Northeast 2002 Needs Assessment Project Status

Project Title	Description	Cost	Status
Service Water System Improvements	Provide alternate service water supply; Inspect and replace 12-inch service water main and gate valves; Install isolation gate valves on 12-inch service water main	$1,590,400 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. CS-1430; Construction Project No. NE-378
Filter System, Pipes, Valves, I&C and Backwash Improvements	Clean and paint filter piping, replace filter valves and instruments; Improve backwash systems; Replace filter monitoring and control system; replace filter local control panels; Replace instrumentation; Lower, North and South Filter Gallery electrical improvements; replacement of dehumidifiers and ductwork	$25,200,800 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. CS-1430; Construction Project No. NE-378

Table 4-1: Northeast 2002 Needs Assessment Project Status

Project Title	Description	Cost	Status
Critical Improvements to Major Pumping Equipment	Replacement of High Lift Pump Station pumps, vault valves, pipes and fittings in high service header pipe, four Low Lift Pump Station discharge valves, and other related work	$20,950,000 (Actual)	Project Pending Close-Out per the January 2013 CIP Update
Flocculation and Sedimentation Basin Upgrades	Replace flocculation equipment and increase length of flocculation zone; Add intermediate and end baffle walls to flocculation; Create manways in existing training walls; Add inclined plate settlers to sedimentation basins, Add mechanical sludge collection equipment; Improvements to instrumentation and controls	$84,742,000 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. is CS-1475. Final Design Report completed in 2011. Additional items added to the original needs assessment scope included design of a residuals handling facility. Cost estimate shown is from the 2011 Final Design Report.
Chemical Building/Process Mechanical Systems	Replacement of rapid mixers; Repairs/upgrades to alum, PAC, phosphoric acid feed systems; Replacement of pre/post chlorination system; New coagulant aid and filter aid polymer system; New temperature, pH, turbidity, and level instruments, New outdoor storage shed	$3,621,000 (Estimate)	On-Hold Per January 2013 CIP Update; Design Project No. CS-1494; Preliminary Engineering Study completed March 2011
Major Pumping Equipment Improvements	Upgrades to Low and High Lift Pumps; Replace suction gate valves; Refurbish supply fans and steam coils, replace filters in Low and High Lift Pump Stations; Replace ductwork and heaters; Provide motor floor exhaust; and Install oil water separator for High Lift Building	$17,542,700 (Estimate)	On Hold Per January 2013 CIP Update
Intermediate Structural and Architectural Repairs	Replacement of windows, floor hatches, steel gratings; Repair of cracks and water leaks; Masonry repairs and tuckpointing; Elevator rehabilitation and asbestos abatement throughout various buildings.	$2,897,100 (Estimate)	Project does not appear in January 2013 CIP Update.
Urgent Instrumentation and Control Upgrades	PC-713 Control System Expansion in Low Lift PS	$932,900 (Estimate)	Work was never completed.
Urgent Electrical Improvements	Miscellaneous electrical improvements	$600,600 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. CS-1430
Filter Media Replacement and Related In-box Improvements	Filter media replacement and related filter box rehabilitation	$17,311,000 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. is CS-1494; Preliminary Engineering Study completed March 2011

Table 4-1: Northeast 2002 Needs Assessment Project Status

Project Title	Description	Cost	Status
Administration Building Improvements	Improvements for ADA Compliance; Install new HVAC system for office and lab; Miscellaneous improvements	$562,800 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. is CS-1494; Preliminary Engineering Study completed March 2011
Intermediate Electrical/Mechanical System Improvements	Switchgear, wash water, Chemical, Administration Building electrical improvements; Replace drive gallery exhaust fans and rapid mixer motor floor ventilation; Replace unit heaters, coils and wall duct in Chemical/Floc Building	$14,334,900 (Estimate)	On-Hold per January 2013 CIP Update; Design Project No. is CS-1494; Preliminary Engineering Study completed March 2011
Long Range Site Improvements	Landscaping; inspect/replace belt drain/underdrain systems; Replace venturi meters and air valves; Replace emergency reservoir fill valves; Inspect and recondition discharge header gate valves, reline high-service yard piping	$2,869,500 (Estimate)	Project does not appear on the CIP. Was scheduled to begin between 2004 and 2008.
Integrated Ozone/UV System	Integrated ozone/UV light system	$47,611,200 (Estimate)	Project does not appear on the CIP. Was scheduled to begin in the years from 2008-2012.
Totals		$134,101,000 (2002 Estimated Costs , with Ozone/UV Disinfection) $86,489,800 (2002 Estimated Costs, w/o Ozone/UV Disinfection) $84,742,000 (2011 Estimated Costs for Floc/Sed/Residuals Project) $21,882,900 (Completed Projects Cost)	

4.2 Springwells Water Treatment Plant

The Springwells WTP is the oldest of the DWSD water treatment facilities. The first train was constructed in 1930 and has a maximum rated capacity of 340 MGD and the second train constructed in 1958 has a maximum rated capacity of 200 MGD. Like Northeast, the Springwells plant receives its raw water from the Belle Isle Intake. The raw water influent is screened, chlorinated and fluoridated at Water Works Park before it is conveyed to Springwells. The low lift pumps lift the raw water for treatment through the process trains, which operate independently. The 1930 train provides hydraulic mixing through a baffled chamber for rapid mixing while the 1958 train has mechanical rapid mixers. Both trains have flocculation, sedimentation and filtration treatment units.

The Needs Assessment for Springwells was prepared by Hazen and Sawyer in November of 2002. This report identified process, mechanical, electrical, instrumentation, HVAC, structural and architectural system deficiencies. All of these deficiencies were grouped into projects and a 10-year capital improvement plan was developed to address the necessary improvements. Unlike Northeast, some of the major process improvements identified were completed or are under construction at Springwells. The table below summarizes the scope of work for the recommended projects, cost and

current status of each project. The estimated costs are from the 2002 Needs Assessment and the actual costs were obtained from the DWSD CIP for projects that were completed.

Table 4-2: Springwells 2002 Needs Assessment Project Status

Emergency High Lift Header Stabilization and Sump Pumps	Provide high lift header support replacements, welding and thrust restraint repairs at various locations; Replace sump pumps at several locations throughout the plant	$3,750,000 (Actual)	Completed in 2008
Chemical Feed and Mixing Improvements Project	Demolish existing chemical systems (alum and PAC) and rehabilitate existing chemical building; Provide coagulant aid polymer system; related work includes structural, HVAC, site/civil, electrical and I&C	$15,212,000 (Actual)	Completed in 2007
Miscellaneous Mechanical, Electrical and Architectural	Conversion of hoists, cranes, trolleys and elevators to AC power for modernization; Eliminate DC power supply; HVAC improvements in the Service Building and Administration Building; Miscellaneous plumbing and controls modifications; and service water and 12" fire line piping replacement	$10,250,000 (Estimated)	(Waiting on Information on Status from DWSD)
High/Low Lift Pumps and High Lift Header Replacement, Instrumentation and Control	Replacement of pumps, motors, and valves in both the Low Lift and High Lift Pump Stations; replace electrical switchgear; vacuum priming system improvements; structural, architectural, plumbing and HVAC repairs for both pump stations, Switch, Turbine and Boiler Houses; Relocation of phosphoric acid system and dosing points;	$98,400,000 (Construction Estimate) $7,440,400 (Design Estimate)	Design in progress/on-going per the January 2013 CIP Update. Additional scope was added to the original needs assessment scope which includes installing a main control system and remote control stations linked to PLC's through the plant, providing VFDs for several pumps at both stations, and replacing dewatering pumping units and valves.
1958 Filter Rehabilitation, Heat/Dehumidify 1930 Filter Area	Replacement of media, underdrains, controls, and valves in the 1958 Filter train; New filter aid polymer system (1930 and 1958 filters); Dehumidification of 1930 Filter Building and other HVAC, plumbing, structural, and architectural repairs on the 1930 and 1958 Filter Buildings	$83,000,000 (Construction Estimate) $8,580,000 (Design Estimate)	Design and construction administration services are in progress; Construction services are under procurement. Additional scope was added to include oversight services for the 1930 plant failed filters project.
Pretreatment Improvements, Demolish Facilities	Demolish 1930 pre-treatment train and sanitary sewer lift station; Modify 1958 Basins to accommodate 540 MGD; New Chemical and Rapid mix facilities; Demolish boilers, Coal Shed and restoration of area; Local instrumentation and controls for the new systems.	$140,000,000 (Construction Estimate) $25,000,000 (Design Estimate)	On-Hold per the January 2013 CIP Update; no monies allocated in the budget. Cost estimate is from 2011 CIP.

Table 4-2: Springwells 2002 Needs Assessment Project Status

Emergency High Lift Header Stabilization and Sump Pumps	**Provide high lift header support replacements, welding and thrust restraint repairs at various locations; Replace sump pumps at several locations throughout the plant**	**$3,750,000 (Actual)**	**Completed in 2008**
Instrumentation and Control Upgrades	Distributed Control System and Miscellaneous Conduit and Wire	$6,300,000 (Estimate)	Completed
Ozone Disinfection System	New ozonation facilities for disinfection	$45,000,000 (Estimate)	Per Needs Assessment, DWSD was to decide between ozone alone or ozone and UV for future disinfection needs
Ozone and UV Disinfection System	New Ozone and UV Disinfection facilities	$80,000,000 (Estimate)	Per Needs Assessment, DWSD was to decide between ozone alone or ozone and UV for future disinfection needs
Totals		$458,970,400 (Estimated Costs, including Ozone/UV Disinfection) $423,970,400 (Estimated Costs, including Ozone Disinfection) $378,970,400 (Estimated Costs with no Ozone or Ozone/UV Disinfection) $18,962,000 (Completed Projects Cost)	

4.3 Southwest Water Treatment Plant

The Southwest Water Treatment Plant was constructed in 1963 at which time it was owned and operated by Wayne County. DWSD purchased this plant several years later in an effort to consolidate water services in Southeast Michigan. Raw water for Southwest flows by gravity from the Detroit River through an intake at Fighting Island. The plant has a rated capacity of 240 MGD. The original plant was designed with the ability to be upgraded to 320 MGD via equipment replacement. There are also spare raw water conduits which can accommodate an expansion up to 480 MGD. The low lift pumps lift the raw water for treatment through the process trains which operate in parallel.

Hazen and Sawyer submitted the Needs Assessment report for the Southwest Water Treatment Plant in May of 2003. This report identified process, mechanical, electrical, instrumentation, HVAC, structural and architectural system deficiencies. All of these deficiencies were grouped into projects and a 10-year capital improvement plan was developed to address the necessary improvements. Several of the projects have been completed as shown in the table below, which summarizes the scope of work for the recommended projects, cost and current status of each project. The estimated costs for pending projects are from the 2002 Needs Assessment; actual costs for completed projects are from the DWSD CIP.

Table 4-3: Southwest 2002 Needs Assessment Project Status

Project Title	Description	Cost	Status
Chemical Tanks and Loading Dock Structural Rehabilitation	Drain, inspect, and rehabilitate alum tanks; Rehabilitate Chemical Dock Area	$7,245,000* (Actual)	Complete. DWSD Construction Contract No. SW-550. Work was combined with HVAC and plumbing improvements project shown below. Cost shown is the total cost for both projects.
Heating, Ventilation, and Dehumidification Improvements; Plumbing and Auxiliary Services; Miscellaneous Mechanical	Replace ventilation, heating and controls in Flocculation Building; Modernization of (3) kathabar dehumidification units; Filter Building Ventilation and Steam Heating Rehabilitation; Service air improvements; Sampling system reconfiguration/modernization; Hydraulic oil system and air operated controls rehabilitation; Low Lift Pump LL-3 suction cage and Miscellaneous Piping and Mechanical	See Chemical Tanks and Loading Dock Structural Rehabilitation Project	See Chemical Tanks and Loading Dock Structural Rehabilitation Project. Scope also included a new service water supply booster station.
Flocculation and Sedimentation Basin Rehabilitation; Plant Safety and Miscellaneous Improvements	Replace flushing water piping, appurtenances and pumps in dry well; Repair/Replace effluent butterfly valves and operators; Crack repair; Replace expansion joint sealant; Basin Access, Exterior, Site and Drainage Improvements	$8,300,000 (Estimate from NA, but does not reflect work completed)	The following items were completed as part of the SW-548 Waste Wash Water and Sludge Treatment Facility Project: Replacement of flushing pumps, piping and appurtenances. Replacement of influent and effluent butterfly valves and operators Re-graded ground cover on top of sedimentation basins and redirected flocculation building roof drainage The following work still needs to be completed: Basin Access, Crack Repair and expansion joint replacement

Table 4-3: Southwest 2002 Needs Assessment Project Status

Project Title	Description	Cost	Status
High/Low Lift Pump Station and Administration Building Improvements	New 30 MGD Low Lift Pump, motor and controls; New traveling water screen and controls with update of controls for existing screens; Flushing system for traveling screens; Motorized sluice gates for EQ chamber/High Lift Building flume isolation; New stop logs/gates for High Lift Pump Suction Isolation; Architectural and structural rehabilitation at Administration, High and Low Lift Buildings; ADA Compliance for public areas; Reservoir isolation valve and operator rehabilitation; Bridge crane modernization	$8,855,000 (Estimate)	On-Hold per the January 2013 CIP Update. The project is also listed as including the Chemical Systems and Building Improvements project shown in the next row but the scope shown in the CIP did not reflect that work.
Chemical Systems and Chemical Building Improvements	Demolish existing abandoned chemical systems; Improvements/repairs to the alum, PAC, chlorine, and fluoride systems; Relocate phosphoric acid feed points; Install new coagulant aid polymer system; Scrubber and HVAC improvements; Architectural and structural rehabilitation of Chemical Building; Laboratory equipment and facilities modernization, plumbing upgrades and drain replacement; Electrical and Instrumentation and Controls Upgrades throughout.	$6,095,000 (Estimate)	On-Hold per January 2013 CIP Update. The project title was included in the work for the High/Low Lift and Administration Building Improvement Project, but the scope described did not include this work.
Filtration Improvements	Replace media, inspect and clean underdrains; Retrofit rate control valves, operators, and controls; Replace surface wash system; Provide new filter controls and consoles; New filter aid polymer system; New loss of head instrumentation; Repair/Replace air release valves/piping on wash water supply headers; New transfer pumps, motors, VFDs, and controls; Rehab/replace transfer pump discharge piping, fittings, and venturi meters and transmitters; Filter Building architectural repairs	$28,750,000 (Estimate)	On-Hold per January 2013 CIP Update; no money allocated in CIP.
Electrical and Instrumentation and Controls	Low voltage system upgrade; Medium voltage vacuum circuit breakers; High and Low Lift surge protection capacitors; and New distributed control system	$12,435,000 (Estimate)	On-Hold per January 2013 CIP Update; no money allocated in CIP.
Ozone Disinfection System	New ozonation facilities for disinfection	$37,000,000 (Estimate)	Per Needs Assessment DWSD was to decide between ozone alone or ozone and UV for future disinfection needs

Table 4-3: Southwest 2002 Needs Assessment Project Status

Project Title	Description	Cost	Status
Ozone and UV Disinfection System	New Ozone and UV Disinfection facilities	$51,000,000 (Estimate)	Per Needs Assessment DWSD was to decide between ozone alone or ozone and UV for future disinfection needs
Totals		$115,345,500 (2002 Estimated Cost w/ Ozone/UV Disinfection) $101,345,500 (2002 Estimated Cost w/ Ozone Disinfection) $64,35,500 (2002 Estimated Costs w/o Ozone or Ozone/UV Disinfection) $7,245,000 (Completed Projects Cost)	

4.4 Lake Huron Water Treatment Plant

Lake Huron was constructed in 1974, initially designed as a conventional water treatment facility. In 2004, after completion of a pilot study along with various upgrades to the process trains, the MDEQ rated the maximum capacity of Lake Huron at 400 MGD. Lake Huron is the only DWSD facility which is operated in "modified" direct filtration mode. In this mode of operation, the sedimentation basins are operated as contact basins. The raw water source for the plant is Lake Huron. The raw water tunnel is designed for a maximum capacity of 1200 MGD and 800 MGD during cold weather. The plant was constructed with provisions to increase the capacity by adding additional process trains and pumping units to obtain the maximum production capacity of 1200 MGD.

In the early 2000's a variety of process treatment improvements were constructed at the Lake Huron WTP. These improvements included new high lift and backwash water pumps (including discharge piping and valves), rehabilitation of two clear wells and the high service suction well, filtration capacity improvements, pretreatment improvements and filter control modification, and a new treatment facility for filter backwash wastewater. When the CWMP was produced in 2004, several projects were identified to increase the treatment capacity of Lake Huron to match future demand projections of the DWSD water distribution system in the northern and northwestern suburbs. Given decreasing water demands in the interim, none of these projects have been implemented; most are no longer part of the CIP, while others need re-evaluation in light of the projected lesser capacity. There are also additional needs that have been identified, which are part of the current CIP. The table on the following pages provides the project description, estimated cost, the suggested time interval for implementation and status of the project.

Table 4-4: Lake Huron Proposed Projects from 2004 Comprehensive Water Master Plan and 2008 CIP

Project Description	Cost	Time Interval for Implementation	Status
Low Lift Building Pump Upgrade	$5,500,500	0-5 year interval	Per the January 2013 Update to the 2013-2018 CIP this project is described as: "designing and replacing the existing pumping unit for low lift pump No. 4 and equipping it with a variable frequency drive with a bypass starter. Work will also include verifying the HVAC for displacement of heat being generated from proposed VFD and integration with ovation system."
Increase Low Lift Pump Capacity, Installation of Low Lift Discharge Conduit and Conduit/Screens	$5,000,000	0-10 years	Not relevant due to decreased demand
Expand Chlorination Building, Increase Pre and Post Chlorination Capacity, Increase Chlorine Storage Capacity	$1,500,000	0-10 years	Not relevant due to decreased demand
Upgrade Hydroflourosilic Acid, Alum and Powdered Activated Carbon Feed Systems	$10,000,000	0-10 years	Re-evaluate for current needs
Upgrade coagulant aid and filter aid polymer feed systems	$1,000,000	0-10 years	Re-evaluate for current needs
Increase phosphoric acid feed capacity	$1,000,000	0-10 years	Not relevant due to decreased demand
Finish 10 filters including underdrain, media, piping and controls	$20,000,000	0-10 year interval	Not relevant due to decreased demand
Increase high lift pump capacity	$8,400,000	0-10 year interval	Not relevant due to decreased demand
Increase flocculation/contact basin capacity	$30,000,000	21-30 year interval	Not relevant due to decreased demand
Increase Low Lift Pump Capacity	$1,200,000	21-30 year interval	Not relevant due to decreased demand
Increase High Lift Pump Capacity	$4,200,000	21-30 year interval	Not relevant due to decreased demand
Filter Building Expansion	$42,000,000	21-30 year interval	Not relevant due to decreased demand
Add 5th backwash water treatment train	$5,600,000	21-30 year interval	Not relevant due to decreased demand
Pre-Ozone Facility	$40,000,000	21-30 year interval	Re-evaluate for current needs
UV Disinfection Facility	$40,000,000	21-30 year interval	Re-evaluate for current needs
Total	$209,900,000 (2004 CWMP Estimated Cost) $5,500,000 (2013 CIP Estimated Cost)		

4.5 Water Works Park Water Treatment Plant

Water Works Park II began operating in 2003 as a conventional surface water treatment plant. The original facility was demolished and a new facility was constructed on the same site. However, the original high lift facility and pumps were rehabilitated and have a maximum capacity equivalent to the original design capacity of 600 MGD. The raw water source for the plant is the Belle Isle intake on the Detroit River. The plant has a maximum rated capacity of 240 MGD and is DWSD's first facility with ozone disinfection facilities as well as a Residuals Handling Facility to treat filter backwash wastewater and alum sludge residuals. The plant was designed to use independent process trains - a minimum of two process units are provided for each treatment process. In addition, all conveyance facilities such as pipelines, junction chambers, channels, and wet wells are configured to provide a minimum of two treatment pathways.

Since the WWP facility was new, the only project recommended by the Comprehensive Water Master Plan Team was the construction of a new UV disinfection system. The cost for this system was estimated at $16,000,000 based on the Southwest WTP Needs Assessment estimate of a similar sized facility. In addition, a yard piping improvements project for WWP has been included in DWSD's Capital Improvement Plan for the last 10 years but has not been completed. The table below provides the project description, estimated cost, suggested time interval for implementation and status of these projects.

Table 4-5: Water Works Park Proposed Projects from 2004 Comprehensive Water Master Plan and 2008 CIP

Project Description	Cost	Time Interval for Implementation	Status
UV Disinfection System	$16,000,000	21-30 year interval	Re-evaluate for current needs
Increase Low Lift Pump Capacity, Installation of Low Lift Discharge Conduit and Conduit/Screens	$27,400,000	0-10 years	Per January 2013 Update to 2013-2018 CIP the project is described as: "replacement of yard piping from 24 inch to 72 inch diameter, pressure reducing valves, 48 inch HLPS suction gate valves, discharge header isolation valves and refurbish valve manholes and other miscellaneous improvements."
Totals	$16,000,000 (2004 Comprehensive Water Master Plan) $27,400,000 (2008 CIP)		

5.0 Regulatory Review Analysis

A review of regulatory criteria and recommended unit process criteria for water treatment plants was conducted to assess each plant's current performance and capacity. The Safe Drinking Water Act (SDWA) and the associated regulations determine a plant's ability to meet required treatment objectives for filtered water effluent turbidity, disinfection, disinfection byproducts and other categories. The plant's ability to meet permit requirements of the SDWA governs its capacity and production capabilities. However, when evaluating a unit process such as flocculation, sedimentation or filtration, Ten States Standards and Partnership for Safe Water criteria provide industry accepted

guidance to determine capacity. It should be noted that TSS design criteria are typically more stringent than the PSW. The following paragraphs discuss the TSS, PSW, and SDWA criteria and the performance of DWSD's WTPs with respect to these criteria and regulations.

5.1 Ten States Standards Recommended Criteria

Ten States Standards are recommended standards to guide the design and preparation of plans and specifications for public water supply systems. The standards are developed by the Water Supply Committee of the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. The committee has a representative from Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Ontario (Canadian Province), Pennsylvania and Wisconsin. Ten States Standards recommendations, though widely accepted, may require adjustments or variations depending upon statutory requirements and the legal authority of the state in which the public water supply is located. The table below provides a summary of the recommended standard for each process and indicates (with a Y for Yes or N for No) whether the existing process at each plant meets the standard at the plant's rated capacity. The evaluation was based on data provided in the NA and CWMP reports.

Table 5-1: Ten States Standards Evaluation of WTPs Unit Processes

Process	Ten States Standard Recommendation	Northeast 300 MGD	Springwells[1] 540 MGD	Southwest 240 MGD	Lake Huron 400 MGD	Water Works Park 240 MGD
Rapid Mix	Detention time of 30 seconds or less	N	1930 Train: N 1958 Train: Y	Y @ 240 MGD or less	Y	Y
	Minimum Velocity Gradient of 750 fps/ft	N	1930 Train: N 1958 Train: N	Y	Y	Y
Flocculation	Minimum detention time of 30 minutes	N	1930 Train: N 1958 Train: Y	Y	Y @ 300 MGD or less	Y
Sedimentation	Minimum detention time of 4 hours [2]	N	1930 Train: N 1958 Train: N	N	N/A[3]	N /A
	Surface overflow rate of 0.5 gpm/sf or less	N	1930 Train: N 1958 Train: N	Y		Y
Filtration	Filtration rate from 2 to 4 gpm/sf	Y	1930 Train: Y 1958 Train: Y	N/A- declining rate filter from 5 gpm/sf to 1.6 gpm/sf	Y	N/A- max rate is 8 gpm/sf (deep bed mono media filters)

Rapid Mix and Flocculation are one process in the 1930 Train.

If the sedimentation basin meets the surface overflow rate criteria it does not need to meet the minimum detention time recommendation

Lake Huron is a modified direct filtration facility with contact basins instead of sedimentation basins

Each plant's unit processes were evaluated for both firm and total capacity with respect to TSS design criteria for minimum flocculation detention time, sedimentation surface overflow rate, and filtration rates as shown in **Table 5-2** below.

Table 5-2: Ten States Standards Evaluation of WTPs Firm and Total Capacity

Process	Rated Capacity	Northeast 300 MGD		Springwells[1] 540 MGD		Southwest 240 MGD		Lake Huron 400 MGD		Water Works Park 240 MGD	
	Ten States Standard Recommendation	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)
Flocculation	Minimum detention time of 30 minutes	259	192	1958 Train 234	1958 Train 178	230	173	298	149	250	168
Sedimentation[2]	Surface overflow rate of 0.5 gpm/sf or less	136	102	1930 Train 134 1958 Train 140	1930 Train 100 1958 Train 105	230	172	N/A	N/A	240	160
Filtration[3]	Filtration rate from 2 to 4 gpm/sf	289	276	1930 Train 363 1958 Train 250	1930 Train 341 1958 Train 237	250	238	400	400	269	246

Springwells only has flocculation in the 1958 Train.

Lake Huron is operated in modified direct filtration mode; sedimentation basins are used as contact basins. Water Works Park sedimentation basins have inclined plate settlers which reduce the overflow rate to 0.3 gpm/sf

Filtration calculations assume one filter out for total capacity and two out for firm capacity. Springwells 1958 Train will be rated at 6 gpm/sf at the completion of the construction project; current calculation is based on 4 gpm/sf. Water Works Park has deep bed filters with maximum filtration rate of 8 gpm/sf.

The Northeast and Springwells WTPs do not meet most of the recommended design criteria of the Ten States Standards. For both plants, sedimentation is the limiting process which ultimately reduces treatment capacity. It is very likely that there is some solids carry over to the filters when these plants are operated closer to their rated capacity. Many of the projects identified in the Needs Assessments for Northeast and Springwells were intended to bring them into compliance with the recommended standards; however, many of those projects have been placed on hold as DWSD evaluates system demand, capacity, and capabilities. An exception has been the filters at Springwells, which are currently being rehabilitated. It should be noted that treatment effectiveness has not been compromised by the inability of these plants to meet Ten States Standards recommended design criteria, as both plants meet Safe Drinking Water Act regulations as discussed in more detail in the following pages.

5.2 Partnership for Safe Water

The Partnership for Safe Water (PSW) is a voluntary national program for water suppliers formed and administered by representatives of the American Water Works Association (AWWA), the American Water Works Association Research Foundation (AWWARF), the United States Environmental Protection Agency (USEPA), the Association of Metropolitan Water Authorities (AMWA), the National Association of Water Companies (NAWC), and the Association of State Drinking Water Administrators (ASDWA). The policies and procedures of the partnership were developed jointly and approved by the aforementioned National Partners.

There are four phases of participation by Water Supply Partners in the PSW Program. Completion of each phase indicates increasingly higher levels of commitment and accomplishment. The phases are:

- Phase I- Partner: Signs partnership agreement and commits to completion of Phase III.
- Phase II- Data Collection and Analysis: Collect plant turbidity and performance for the previous year using the PSW Program and submits it to national AWWA. This data is the baseline on which performance improvements will be measured.
- Phase III- Self-assessment and Correction: Completes "Partnership for Safe Water Self-Assessment Manual" and prepares completion report.
- Phase IV- Excellence in Water Treatment- Water Supply Partner has achieved the highest levels of turbidity performance. Phase IV is achieved with the completion of application and onsite performance assessment.

The primary purpose of the PSW is to encourage water suppliers to assess their facilities, treatment processes, operating and maintenance procedures, and management practices to "identify areas that will enhance the water system's potential to prevent entry of *Cryptosporidium, Giardia,* and other microbial contaminants to treated water and to voluntarily implement those actions that are appropriate for the system". DWSD joined the PSW in February 1997 and completed assessments for Lake Huron (1998), Southwest (1998), and Northeast (1999) WTPs. Presently, DWSD no longer participates as a member of the PSW but still uses the Phase II and Phase III processes to monitor performance. **Table 5-3** provides the major unit process evaluation criteria used for the PSW assessments at DWSD facilities.

Table 5-3: Partnership for Safe Water Unit Process Evaluation Criteria

	Category/Type	Detention Time
Flocculation	Base	20 mins
	Single Stage	30 mins @Temp <0.5°C 25 mins @Temp >0.5°C
	Multiple Stage	30 mins @Temp <0.5°C 25 mins @Temp >0.5°C
Sedimentation	Type	Surface Overflow Rate
	Rectangular/Turbidity Mode	0.7 gpm/sf @ Basin Depth >14ft 0.5-0.6 gpm/sf @ Basin Depth 10-12 ft
Filtration	Type	Loading Rate
	Dual/Mixed Media	4.0 gpm/sf
	Deep Bed	6.0 gpm/sf

In 2004, the CWMP team summarized the results of the PSW Self-Assessments performed at Northeast, Southwest and Lake Huron. At that time the team also rated the Springwells facility based on the PSW criteria without conducting a self-assessment; Water Works Park was not included in the evaluation because it was being commissioned. However, a review of the WWP major unit process design criteria indicates that it meets the PSW major unit process evaluation criteria at peak flow of 240 MGD. A comparison of the design criteria for the other facilities with the PSW criteria shows that there are processes which would have a lower rated capacity according to PSW criteria. The analysis in **Table 5-4** is based on all process trains in service and extracted from the Comprehensive Water Master Plan Task D Water Quality Management Plan Report; however the firm capacity values were calculated for this report.

Table 5-4: Partnership for Safe Water Rated Capacity for DWSD WTP's

Process	Rated Capacity	Northeast 300 MGD		Springwells[1] 540 MGD		Southwest 240 MGD		Lake Huron 400 MGD		Water Works Park 240 MGD	
	Partnership for Safe Water Criteria	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)	Total (MGD)	Firm (MGD)
Flocculation	Minimum detention time of 20 minutes	384	288	1958 Train 307	1958 Train 266	320	259	439	223	394	252
Sedimentation[2]	Surface overflow rate of 0.7 gpm/sf or 0.3 gpm/sf for basins with inclined plate settlers	191	143	398	287	268	200	N/A	N/A	240	160
Filtration[3]	Filtration rate from 2 to 4 gpm/sf; 6 gpm/sf for deep bed	289	276	549[4]	578	220	226	400	400	269	246

Springwells only has flocculation in the 1958 Train.

Lake Huron is operated in modified direct filtration mode; sedimentation basins are used as contact basins. Water Works Park sedimentation basins have inclined plate settlers which reduce the overflow rate to 0.3 gpm/sf

Filtration calculations assume one filter out for total capacity and two out for firm capacity. Springwells 1958 Train will be rated at 6 gpm/sf at the completion of the construction project; current calculation is based on 4 gpm/sf. Water Works Park has deep bed filters with maximum filtration rate of 8 gpm/sf.

Previous CWMP used a value of 3.5 gpm/sf for all filters at Springwells.

A review of **Table 5-4** shows that Northeast and Springwells do not meet PSW criteria. For instance at Northeast, the sedimentation basins only meet the PSW criteria of 0.7 gpm/sf at 191 MGD, which is only two-thirds of its rated capacity. Likewise at Springwells the sedimentation basins are also the limiting process; based on PSW criteria the capacity is 80% of the rated capacity. As noted in the Needs Assessment discussion previously, the projects identified at Northeast and Springwells would address these potential capacity limiting issues when designed and constructed, but the projects have not been completed.

5.3 Plant Capacity Rating

Ten State Standards and Partnership for Safe Water are recommended guidelines for the design and performance of water treatment facilities. In the previous section, each unit process at the plant was evaluated to determine if it met the guidance criteria. The MDEQ rated capacity of each plant (**Table 3-1**) was previously established and closely follows Ten States Standards guidelines. **Table 5-5** below combines the data presented for the firm treatment capacity by unit process presented in the discussion on the TSS and PSW criteria. The following evaluation allows determination of which process at the plant limits its rated treatment capacity. For the analysis, the firm capacity of each process was evaluated (largest unit out of service) in accordance with MDEQ criteria.

Table 5-5: Firm Unit Process Capacity Ratings of Existing DWSD Water Treatment Plants

	Northeast (MGD)		Springwells (MGD)[1]		Southwest (MGD)		Lake Huron (MGD)[2]		Water Works Park (MGD)[3]		Totals	
Unit Process	TSS	PSW	TSS	PSW	TSS	PSW	TSS	PSW	TSS	PSW		
Flocculation	192	288	178	266	173	259	149	223	168	252		
Sedimentation	102	143	205	287	172	241	N/A	N/A	240	240		
Filtration	289	289	719	719	238	238	400	400	246	246		
Process Limiting Capacity	102	143	178	266	172	238	149	223	168	240	TSS 769	PSW 1,110
Plant Rated Capacity	300		540		240		400		240		1,720	
Max Day Flow	270		390		160		280		140		1,240	

Springwells flocculation capacity is calculated for the 1958 Train only; the 1930 train does not have flocculation.
Sedimentation and filtration include both the 1930 and 1958 Trains. The 1930 Train filters are rated at 3.5 gpm/sf and the 1958 train is rated at 6 gpm/sf.
Lake Huron's sedimentation basins are operated as contact basins and TSS/PSW guidelines for loading rates are not applicable.
Water Works Parks filters are rated at 8 gpm/sf as approved by MDEQ.

Based on the table above, the total capacity of DWSD water treatment facilities with respect to compliance with Ten States Standards is 769 MGD, the less conservative Partnership for Safe Water guidelines provides a total capacity of 1,110 MGD, and the total rated capacity of the facilities is 1,720 MGD. As shown in the table, the maximum day flow at each facility has been less than its rated capacity based on data from January 2005 through July of 2013. The maximum day flow at each facility did not occur on the same day in the evaluation period.

5.4 Safe Drinking Water Act Regulations

The Safe Drinking Water Act is comprised of several enforceable regulations designed to protect public health. Detailed descriptions of each of the following key regulations can be found in Attachment A of this memo:

- Surface Water Treatment Rule (SWTR)
- Enhanced Surface Water treatment Rule (ESWTR)
- Interim Enhanced Surface Water Treatment Rule (IESWTR)

- Long Term 1 Enhanced Surface Water Treatment Rule (LT1 ESWTR)
- Long Term 2 Enhanced Surface Water Treatment Rule (LT2 ESWTR)
- Stage 1 Disinfectants/Disinfection By-Products Rule (D/DBPR)
- Stage 2 Disinfectants/Disinfection By-Products Rule (D/DBPR)
- Total Coliform Rule
- Filter Backwash Recycle Rule
- Ground Water Rule
- Radionuclides
- Lead and Copper Rule
- Volatile Organic, Synthetic Organic, and Inorganic Chemicals Rule

A review of the 2004 Comprehensive Water Master Plan recommendations regarding DWSD's ability to comply with the current SDWA regulations and those in process of being promulgated are shown in **Table 5-6**.

Table 5-6: Safe Drinking Water Act Rules and DWSD Compliance Status

SDWA Rule	CWMP Recommendations	Current DWSD Compliance Status
Interim Enhanced SWTR	Improve particle removal to be achieved by PSW efforts and improvements to coagulation, flocculation, settling and filtration facilities	Complies - DWSD has improved process trains at some but not all facilities. There have been no instances of violation of the IESWTR
Long Term 1 and 2 ESWTR	If higher levels of *Cryptosporidium* are detected in the source waters: Continue enhanced filtration operations to achieve 0.1 NTU level; install UV disinfection technology in all plants for *Cryptosporidium* inactivation (plus ozone for T&O control); advance to Phase IV of PSW.	Complies - DWSD has not had to implement additional methods for inactivation of *Cryptosporidium* as source water levels have remained low or non-detect
Filter Backwash Rule	Treatment of filter backwash wastewater prior to recycle or discharge to the DWSD Sewer	Complies - Lake Huron, Water Works Park and Southwest treat filter waste backwash water. Recycle occurs at WWP and SW and LH discharges to surface water. SP and NE discharge to the sewer.
Stage 1 D/DBP Rule	Current and future bromate regulations may impact use of ozone	Complies - Ozone is only used at WWP. Bromate regulations have not changed since the 2004 plan
Stage 2 D/DBP Rule	Implement compliance monitoring and control DBP's in the distribution system	Complies - monitoring began April 1, 2012.

While DWSD is currently compliant with LT2ESWTR, a second round of source water Cryptosporidium monitoring will be required by April 1, 2015. The EPA will be changing the method of detection for Cryptosporidium. So even though DWSD did not detect Cryptosporidium in the first round, it does not mean it will be non-detect in the second round. Depending on the level of Cryptosporidium detected in the second round, DWSD could be required to provide ozone and UV disinfection systems to achieve compliance. A more detailed analysis of the SDWA and future regulations is presented in a separate Technical Memorandum.

5.5 Current Water Production and Demand

A review of DWSD's monthly operating data from July 2005 through July 2013 shows that overall demand has trended downward (See **Figures 1 through 4** which follow). Demand for water has decreased for a variety of reasons, with the primary factor being population loss in Southeast Michigan, both residential and industrial. However, as recently as July 2011, a maximum day flow of 1.04 billion gallons of water occurred. The average flow for the system over the last eight years has been 620 MGD, which is a little more than a third of the systems total treatment capacity. As shown on the graphs on the following pages, Springwells produces the most water, followed by Lake Huron, Northeast, Water Works Park and Southwest. **Table 5-7** provides the average and maximum day flows for each WTP based on data from July 2005 through July of 2013 as well as rated, maximum, and firm pumping capacity.

Table 5-7: Average and Maximum Day WTP Flows (2005 – 2013)

Production (MGD)			Northeast	Springwells	Southwest	Lake Huron	Water Works Park	System Wide
Average day			140	220	84	160	100	620
Maximum day			270	390	160	280	140	1,040
Rated Capacity			300	540	240	400	240	1,720
Firm Pumping Capacity	400	260 (Intermediate Pressure District) 450 (High Pressure District)	310	420	560	2,360		

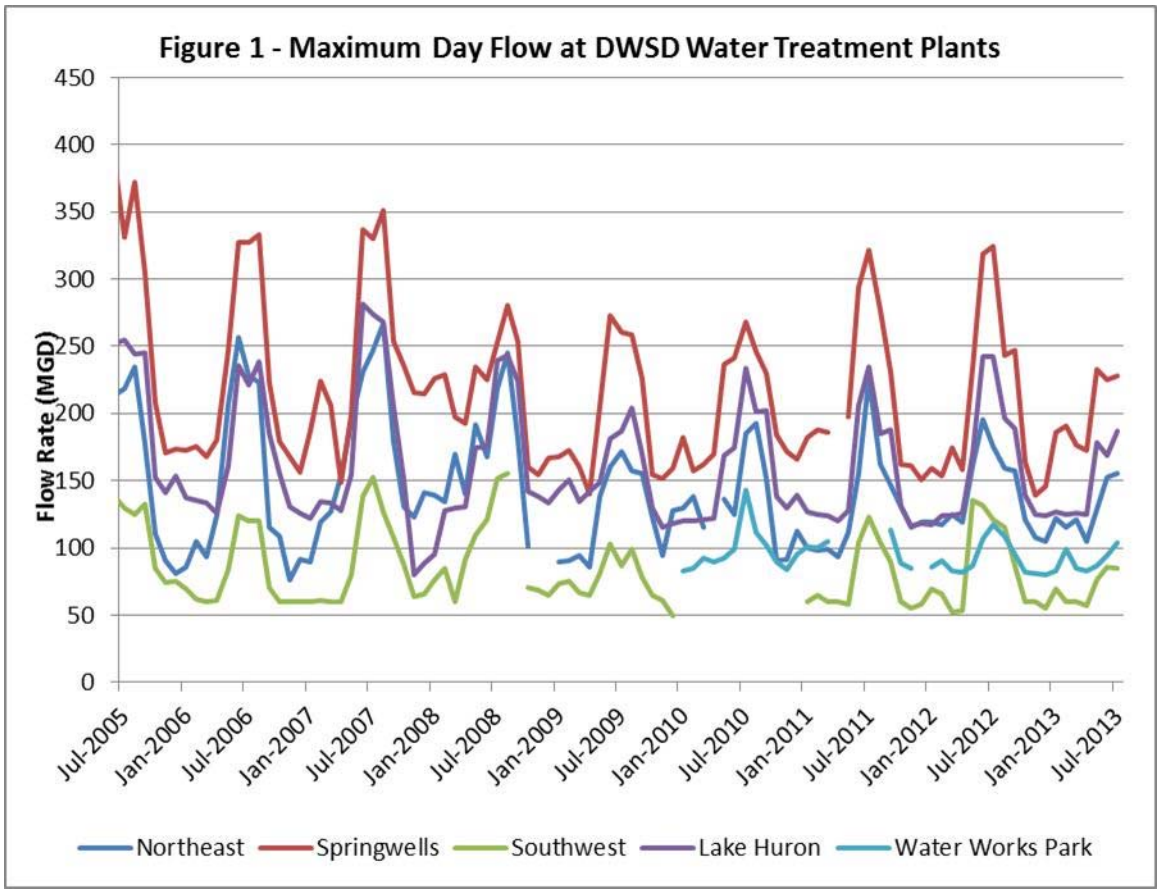
Figure 1 - Maximum Day Flow at DWSD Water Treatment Plants
Flow Rate (MGD)
450
400
350
300
250
200
150
100
50
0
Jul-2005
Jan-2006
Jul-2006
Jan-2007
Jul-2007
Jan-2008
Jul-2008
Jan-2009
Jul-2009
Jan-2010
Jul-2010
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Northeast
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Southwest
Lake Huron
Water Works Park

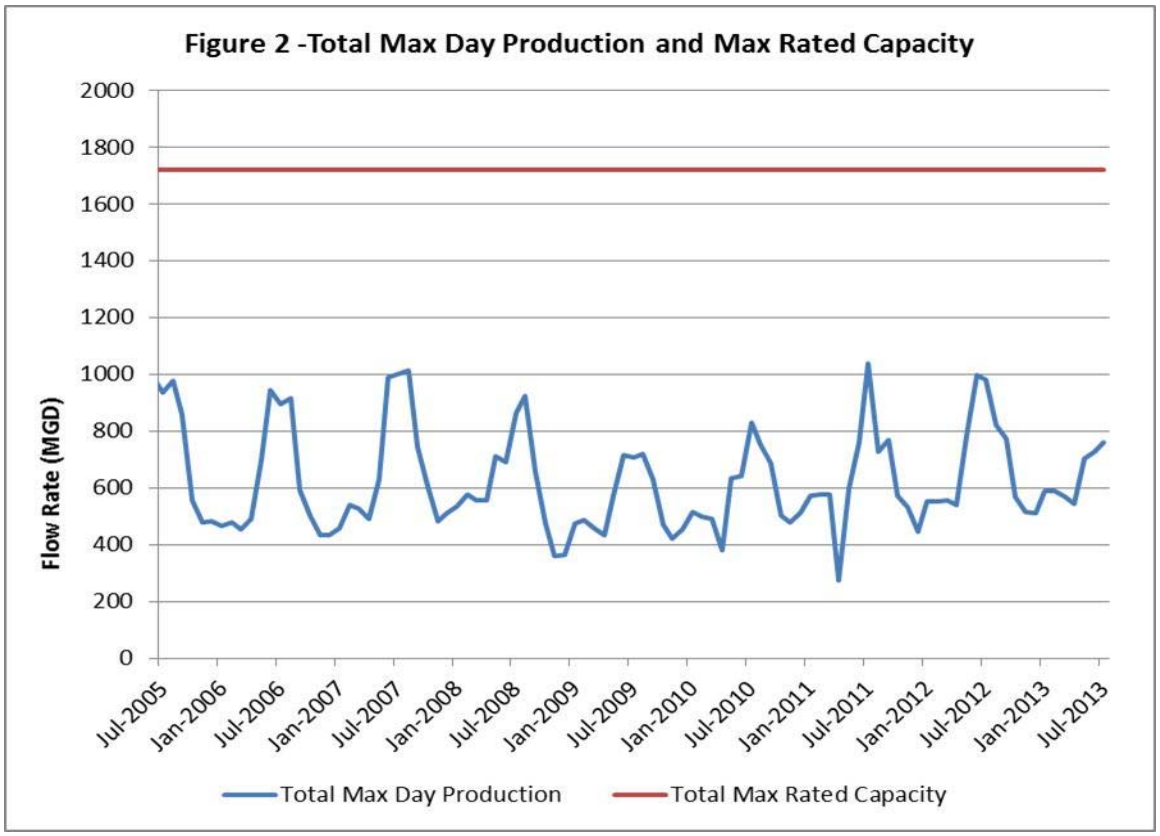
Figure 2 -Total Max Day Production and Max Rated Capacity
Flow Rate (MGD)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jul-2005
Jan-2006
Jul-2006
Jan-2007
Jul-2007
Jan-2008
Jul-2008
Jan-2009
Jul-2009
Jan-2010
Jul-2010
Jan-2011
Jul-2011
Jan-2012
Jul-2012
Jan-2013
Jul-2013
Total Max Day Production
Total Max Rated Capacity

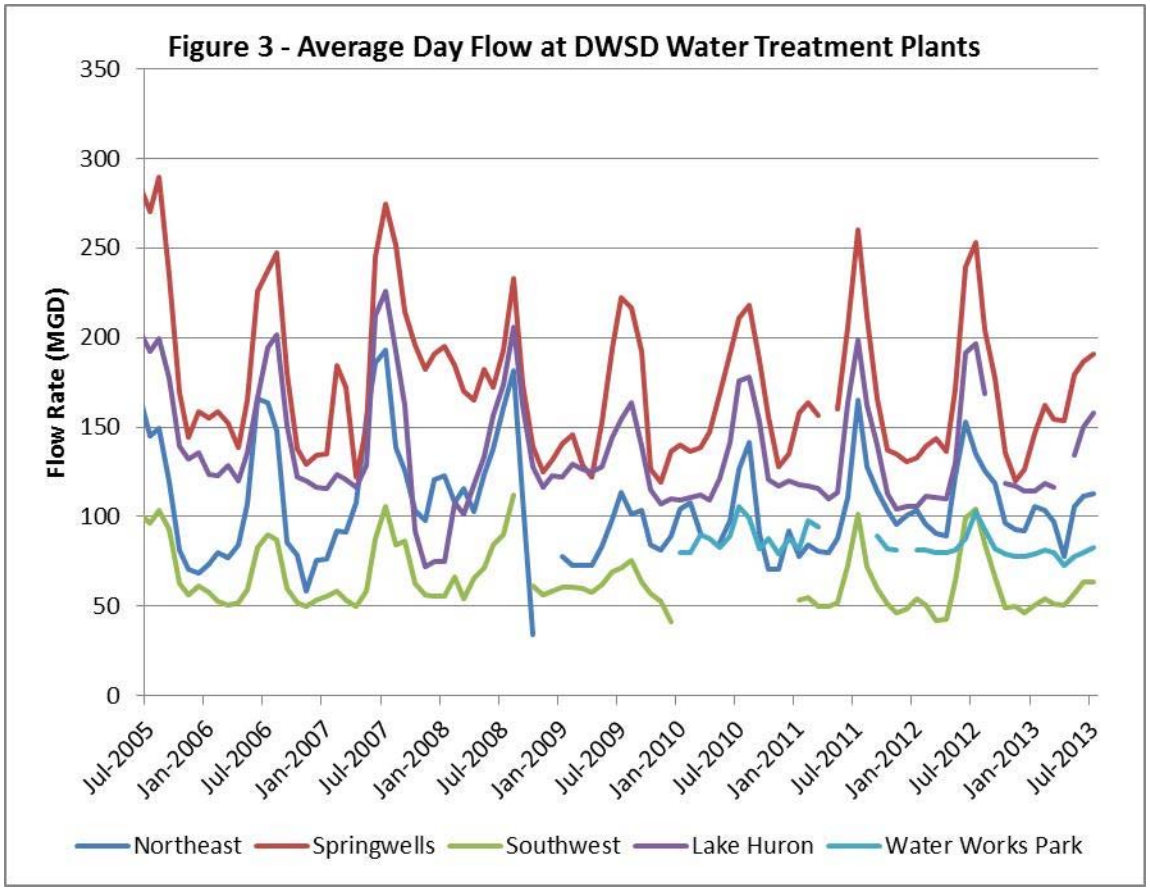
Figure 3 - Average Day Flow at DWSD Water Treatment Plants
Flow Rate (MGD)
350
300
250
200
150
100
50
0
Jul-2005
Jan-2006
Jul-2006
Jan-2007
Jul-2007
Jan-2008
Jul-2008
Jan-2009
Jul-2009
Jan-2010
Jul-2010
Jan-2011
Jul-2011
Jan-2012
Jul-2012
Jan-2013
Jul-2013
Northeast
Springwells
Southwest
Lake Huron
Water Works Park

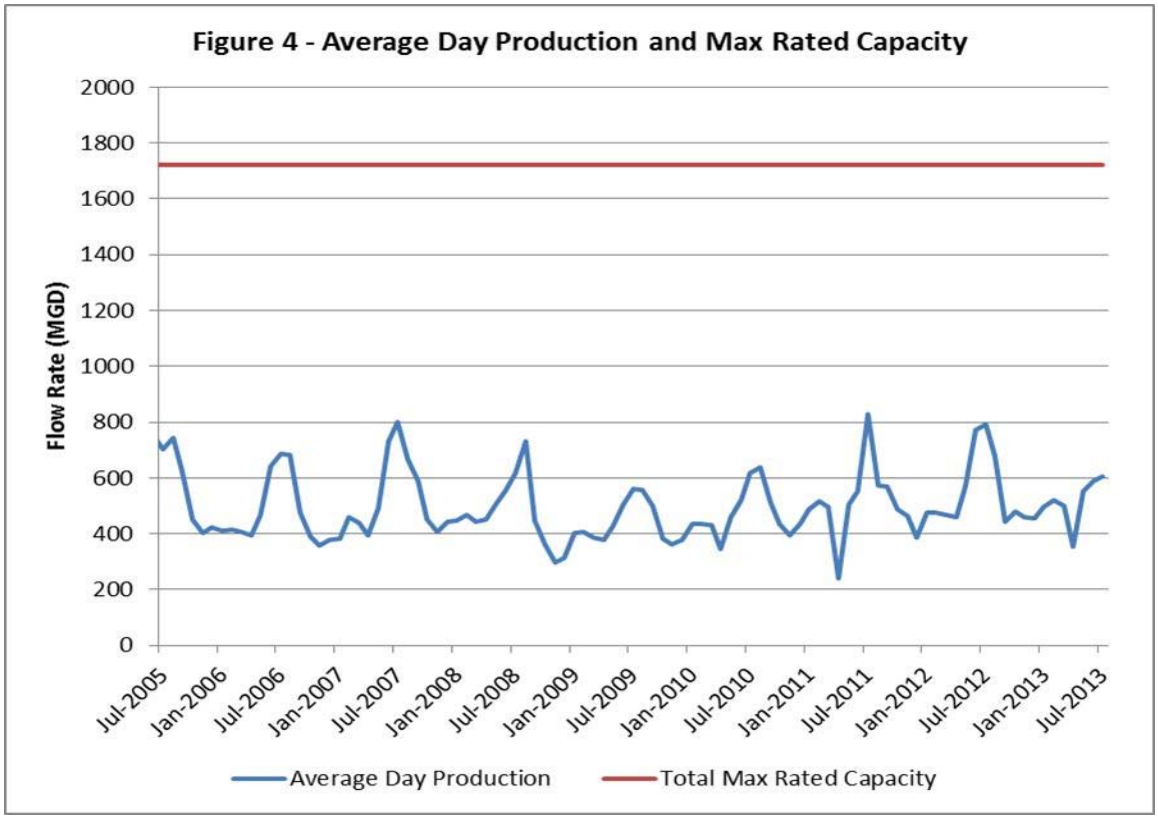
Figure 4 - Average Day Production and Max Rated Capacity
Flow Rate (MGD)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
Jul-2005
Jan-2006
Jul-2006
Jan-2007
Jul-2007
Jan-2008
Jul-2008
Jan-2009
Jul-2009
Jan-2010
Jul-2010
Jan-2011
Jul-2011
Jan-2012
Jul-2012
Jan-2013
Jul-2013
Average Day Production
Total Max Rated Capacity

Tetra Tech staff interviewed DWSD Operations and Maintenance staff at each facility and was briefed on how each process currently performs and the needs at each facility to remain operable and reliable. A general plant and unit process questionnaire was provided to each plant manager in advance of these meetings. The questionnaires and DWSD responses are provided in Attachment A. Plant managers were asked to identify short term (next 5 years) and long term (next 20 years) improvements necessary to keep the plant operable. Their recommendations are described below. There is also a general need for painting of most of the equipment, crack repair for many structures, architectural improvements such as windows and lighting, as well as heating, ventilation, and air conditioning upgrades. The detailed memo for each site visit is included in Attachment B. A brief discussion of the team's findings for each facility is provided below along with a table of the proposed improvements and the cost of these improvements. It should be noted that the improvement projects suggested for each plant represent the opinion of the plant staff; Tetra Tech did not perform independent assessments. Some of the projects suggested by plant staff are operations and maintenance based projects and should not be considered as "capital improvements". The cost estimates are based on the previous needs assessments, projects that were completed with similar scope from the CIP, or vendor quotes where applicable. Based on the year in which the original cost was estimated, the Engineering News Record Construction Cost Index was applied to present the cost in 2013 dollars.

6.0 Northeast

Of all the facilities assessed, Northeast requires the most capital investment to bring it into a reliable operating state based on discussions with plant staff and the visual inspection of the facilities. Because of the age of the equipment, DWSD maintenance personnel often have to fabricate replacement parts because manufacturer parts are no longer available. While Northeast is currently able to meet DWSD water quality goals and SDWA regulations, its ability to meet these goals in the future is questionable without rehabilitation and upgrades of the plant. The plant did not identify any long term projects and indicated that all of the improvements need to occur in the next five years as shown in **Table 6-1**.

Table 6-1: Northeast WTP Proposed Improvements

Project Description	Priority
Upgrade plant instrument air, include new piping	5 years
Provide new dehumidification/ventilation system in the filter, wash water and high lift buildings	5 years
Replace Steam Generation System, including piping	5 years
Provide new online chlorine analyzers	5 years
Replace suction lines for all sample pumps	5 years
Upgrade alum feed injector/ejector system with magmeters, audible alarms when feed interrupted, and particle counters for raw, settled, filtered water samples	5 years
Upgrade/replace phosphoric acid feed system day	5 years

Table 6-1: Northeast WTP Proposed Improvements

Project Description	Priority
tank	
Upgrade filters: media, local panels, controls, gauges, flow meters, surface wash system etc. Audible alarms for filter turbidity monitoring software	5 years
Repair/upgrade Rodney Hunt actuators/operators on low and high lift pump discharge valves	5 years
Replace/upgrade rapid mix and flocculation systems	5 years
Upgrade electrical systems	5 years
Upgrade Instrumentation and controls	5 years
Upgrade entire laboratory facility	5 years

7.0 Springwells

Springwells has the largest treatment capacity of all DWSD facilities and produces the most water. A project to provide major improvements to the filters is currently under construction. Due to the construction, the current treatment capacity of the plant is limited to 350 MGD. Many of the projects identified for Springwells are necessary for continued, reliable operation of the plant. All of the equipment at Springwells has to be controlled manually and can only be monitored from the Ovation system. Similar to Northeast, due to the age of the equipment, replacement parts are no longer available making it difficult to repair broken equipment. Proposed improvements recommended by plant staff for the Springwells WTP are shown in **Table 7-1**.

Table 7-1: Springwells WTP Proposed Improvements

Project Description	Priority
Replace Low Lift and High Lift Pumps	5 Years
Upgrade Control System to automate plant operations	5 Years
Upgrade entire electrical system	5 Years
Replace Rail guides at the North Gate house at the 1930 plant	5 Years
Replace steam, condensate return, and	5 Years

Table 7-1: Springwells WTP Proposed Improvements

Project Description	Priority
instrument/service air piping	
Replace beams and cranes in the North gate house (Basins 1 and 2)	5 Years
Replace yard piping and valves	5 Years
Replace all sample pumps and piping/tubing	5 Years
Modify/Upgrade 1930 Plant Pretreatment	20 Years
Replace/Renovate High Lift Header	20 years

8.0 Southwest

The Southwest WTP is in fairly good condition, but a variety of improvements are necessary to keep the plant operational. Of the improvements recommended by plant staff, the most critical appear to be replacement of the flocculation equipment and upgrades to the filters. Proposed improvements recommended by plant staff for the Southwest WTP are shown in the **Table 8-1**.

Table 8-1: Southwest WTP Proposed Improvements

Project Description	Priority
Upgrade of the filters, including wash water transfer pump controls	5 Years
Upgrade the phosphoric acid feed system and the chlorination system	5 Years
Upgrade flocculator equipment	5 Years
Install deaerator tank	5 Years
Rehabilitate or replace the hydraulic oil system for the high lift	5 Years
Upgrade cabinets and hoods in laboratory	5 Years
Accumulate lead free fittings, fixtures, and valves per PL 111-380 ,	20 Years
Provide new steam generators	20 Years
Replace steam unit heaters	20 Years
Upgrade Low Lift, High Lift, Wash Water and Transfer Pump Stations	20 Years

9.0 Lake Huron

Lake Huron underwent its last series of major capital improvements in the late 90's and early 2000's. The plant is in good condition but still requires some upgrades and rehabilitation of equipment to remain reliable and produce high quality water. Of the improvements listed below, one of the most critical based on visual observation is the dredging of the lagoons and the structural reinforcement of the retention basin and wash water clarifier. The proposed improvements identified by Lake Huron staff are provided in **Table 9-1.**

Table 9-1: Lake Huron WTP Proposed Improvements

Project Description	Priority
Refurbish Low Lift and High Lift Pumps motor exciters	5 Years
Replace Low Lift Pump No. 1 VFD	5 Years
Replace hot water heating boilers, chillers, and provide new dehumidification systems	5 Years
Rehabilitate drainage system for outside of long passageway and improve drainage system for high lift pump floor	5 Years
Rehabilitate retention basin and clarifiers	5 Years
Rehabilitate/replace low and high lift flow measurement devices	5 Years
Replace hydropneumatic tanks	5 Years
Replace all filter controls including limit switches	5 Years
Replace North Wash water Rate control valve in filter gallery area	5 Years
Replace 13.8 kV switchgear and upgrade/replace fence around the transformers	5 Years
Dredge Lagoons 1 through 4	5 Years
Upgrade/rehabilitate decant pumps and pit	5 Years
Refurbish/upgrade the filters	20 Years
Replace/Renovate high lift header	20 Years
Replace all sludge pumps in the wash water treatment facility	20 Years

10.0 Water Works Park

Water Works Park is the newest of the five water treatment plants. Even though most of the equipment and systems were installed about ten years ago, some equipment is near the end of its useful life. The high lift pumps were only refurbished during the reconstruction of WWP and are due for replacement in the long term. Proposed improvements recommended by plant staff to keep WWP operating reliably are provided in **Table 10-1**.

Table 10-1: Water Works Park WTP Proposed Improvements

Project Description	Priority
Replace flocculator motors	5 Years
Upgrades to the DCS/Ovation control system (equipment/hardware/software	5 Years
Replace chlorinators and evaporators	5 Years
Provide new chemical feed pumps for all chemical systems	5 Years
Provide controllers and torque analyzers on screening equipment	5 Years
Replace steam generators	5 Years
Upgrade/replace ozone system nitrogen feed compressors	5 Years
Repair cracks throughout the facility	5 Years
Provide new gas unit heaters throughout the plant	5 Years
Provide new trolley/hoist in the chlorine room	5 Years
Replace uninterruptible power supply systems (UPS)	5 Years
Replace HVAC system at the administration building	5 Years
Replace 14 of 28 chains on sedimentation basin	5 Years
Replace turbidimeters and particle counters	5 Years
Repair the venturi meters	5 Years
Provide new gates, cranes on the A and B shaft	5 Years
Replace ozone generator	20 Years
Provide new VFD's for the low lift pumps, wash water pumps and flocculators	20 Years
Replace all Rotork actuators on all equipment	20 Years

Table 10-1: Water Works Park WTP Proposed Improvements

Project Description	Priority
Replace all process feed pumps (sludge, centrifuge, eq, etc.) at Residuals Facility	20 Years
Replace all high lift pumps and motors	20 Years
Automate the screen house and high lift pump station equipment	20 Years
Upgrade/replace yard piping	20 Years

In addition to capital costs, each plant has operational costs associated with daily operations and maintenance. As part of the site assessment process, the plants identified each of the costs shown in **Table 10-2**. The total annual operating cost for these facilities is $51,213,463.

Table 10-2: Operational Costs for DWSD Water Treatment Plants

Annual Cost Category	Northeast	Lake Huron	Southwest	Springwells	Water Works Park
Employee Wages and Salaries (Base)[1]	$1,299,353	$924,576	$846,800	$1,782,253	$1,774,786
Contract Employees	$0	$416,000	$0	$0	$0
Employee Benefits (87.69% of Pay)	$1,139,403	$810,761	$742,559	$1,562,858	$1,556,310
Overtime Cost (15% of Pay Plus Fringes)	$365,813	$260,301	$238,404	$501,767	$499,664
Electricity	$4,200,000	$8,268,978	$2,038,070	$6,200,000	$2,707,160
Natural Gas	$90,350	$213,371	$141,790	$300,000	$341,402
Water	$0	$39,026	$0	$0	$0
Chemicals	$1,573,060	$1,456,383	$1,010,000	$2,343,720	$1,767,047
Maintenance (Equipment/Facilities)	$300,000	$325,000	$250,000	$376,500	$145,000
Residuals Handling Cost[2]	$700,000	$200,000	$450,000	$700,000	$355,000
Total Per Plant	$9,667,979	$12,914,395	$5,717,623	$13,767,097	$9,146,369
Total for All Water Plants	$51,213,463				

1-Water Works Park wages include Water Quality Division Staff

2-Residuals Cost and Northeast and Springwells assumed equal as both are manual processes. Lake Huron does not include lagoons dredging or landfill disposal costs. Southwest and Water Works Park have residuals handling facilities and cost shown include landfill, electrical, and chemicals.

11.0 Conclusion

A review of water production and lab data indicates that DWSD is currently meeting or exceeding its water quality goals and Safe Drinking Water Act requirements at the water treatment plants. Even though each plant is capable of meeting the permitted requirements at current demands, these plants may not be able to perform reliably at their maximum rated capacities for a sustained period. With respect to system demand and capacity requirements, a review of the data shows that the system produces approximately 700 MGD for average flows and up to a billion gallons per day to meet maximum day demands. **Tables 11-1** to **11-5** show a compilation of needs for each of DWSD's water treatment plants over the next 20 years. Chapter 6 of the report describes the use of these cost estimates in the life cycle evaluation of system-wide treatment plant capacity requirements.

Table 11-1: Northeast WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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	Cannot find drawings of the pumps. Don't know what type of valves. Assume Cone Valves	Replacement of these valves should be included in the scope for the Major Pumping System Improvements project listed below; however the scope did not call for replacement of all of these operators. **(1)** Low lift pump discharge piping is 36" in diameter. Six pumps total, three rated at 62MGD and three rated at 53 MGD;
Low Lift Pumps	NE - LLP - 2	Repair Leaking Caisson	5 Years	2013 10-Year CIP	$2,000,000	$1,481,481	$1,481,481		
Rapid Mix / Floc	NE - RMF - 1	Replace/upgrade rapid mix and flocculation systems	5 years	2013 Plant Staff Assessment	$6,354,000	$4,887,692	$5,152,007	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)	
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, I&C and Backwash Improvements" and "Filter Media Replacement and Related In-box Improvements" Projects. Scope for those projects encompass items listed here.	
Filters	NE - FIL - 2	Filter System Pipes, Valves, I&C, and Backwash Improvements	5 years	2002 Needs Assessment	$25,200,800	$16,154,359	$23,797,096	2002 Needs Assessment (2002 Dollars)	
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)	
Chemical Feed	NE - CHF - 1	Upgrade/replace phosphoric acid feed system day 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.	
Chemical Feed	NE - CHF - 2	Chemical Building/Process Mechanical Improvements	5 years	2002 Needs Assessment	$3,621,000	$2,321,154	$3,419,308	2002 Needs Assessment (2002 Dollars)	

Table 11-1: Northeast WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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.	
Residuals	NE - RSD - 2	Residuals Processing Facility	TBD	CS - 1475 Final Design Report Sept 2011	$78,388,000	$60,298,462	$63,559,259	Cost is based on data provided in 2011 CS-1475 Final Design Report. Includes Sed Basin Improvements, Sludge collection and processing facility. Floc Improvements incl. above.	Major cost; need final decision on whether it is included or not.
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.	Replacement of these valves should be included in the scope for the Major Pumping System Improvements project listed below; however the scope did not call for replacement of all of these operators. **(1)** High lift pump discharge piping is either 24" or 30" in diameter depending on pump size. There are 12 pumps total. Five pumps rated at 50 MGD @ 200ft, two pumps rated at 52 MGD @ 200ft, three pumps rated at 52 MGD @240ft, and two pumps at 49MGD @200ft
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.	
UV / Ozone	NE - UVO - 1	Integrated Ozone/UV System	TBD	2002 Needs Assessment	$47,611,200	$30,520,000	$44,959,220	2002 Needs Assessment. Project is no longer on the CIP but based on DWSD's voluntary water quality goals may be necessary. Has been included here as a placeholder. (2002 Dollars)	Major cost; need final decision on whether it is included or not.
Electrical / I & C	NE - EIC - 1	Urgent Electrical Improvements	5 years	2002 Needs Assessment	$600,600	$385,000	$567,146	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)	

Table 11-1: Northeast WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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)	
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.	1988 System O&M Manual: Max power demand at the plant was 8830 kw and min was 5300 kw; Motors 1/2hp and larger but less than 200 hp operate at 460 V; Two unit substation step power down to 480 volt; stepdown transformers provide 120 v power to motors less than ½ hp and lighting panels;
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.	Because this plant basically needs all new mechanical equipment, the assumption for this cost should assume that new equipment provided will be capable of being monitored and controlled via a SCADA system.
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 RSMeans +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	1988 System O&M Manual- Three instrument air compressors. Rotary, electrically, motor drive by AC squirrel cage induction motors, directly connected by a flexible coupling. **(1)** Instrument Air Compressor No. 3F- 3300rpm at 70 psig; 37 cfm capacity, Manufactured by Nash Engineering Co.; Motor 15 hp 220/440V manufactured by Continental Electric Company; **(2)** Instrument Air Compressors No. 4F and 5F- 3545 rpm at 70 psig; 56 cfm capacity, Manufactured by Nash Engineering Co.; Motor 20 hp 230/460V Manufactured by GE; **(3)** Instrument Air Receiver Tank: 30"x84"; 330 gals, 125 psig; **(4)** Instrument Air Dryer: Dessicant, regenerative, electric heater, 56 scfm, Manufactured by Air Drying System, Inc.

Table 11-1: Northeast WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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.	1988 System O&M Manual: Plant has two dehumidification systems known as kathabar humidity systems. **(1)** System located in Washwater Building- 25,000 cfm air flow, two conditioners rated at 12,500 cfm each, air regenerators remove 200 lb moisture/hour each, inlet air is 55oF with 40 grains moisture, exit air is 60oF with 15 grains moisture; **(2)** System located in High Lift Building Header Vault- 17,500 cfm air flow, air regenerator removes 430 lb of moisture/hour, inlet air 55oF with 40 grains moisture, exit air is 60oF with 15 grains moisture
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 RSMeans +50% costing for (3) Boilers, (2) Feed pumps, (3) chemical feed pump/system, Deareretor, Condensate return tank, Duplex condensate Return system, and steam and condensate piping. [$750,000 for Equipment $500,000 for Piping (3000LF) $50,000 for Demo]	Two of the three steam generators were updated in December 2000. Source of info is an updated insert to the 1988 System O&M Manual: **(1)** Steam Generators No. 1 and 2- Clayton Model EB-254-1, single pass units with design capacity of 8645 lb/hr at 100 psig, Normal Boiler HP is 250; Natural Gas Only; **(2)** Steam Generator No. 3- Clayton, mono tube package type; 1725 lb/hr at 100 psig capacity, Normal Boiler HP is 60; Duel Fuel; **(3)** Steam Generator Feed Pumps No. 34F and 36F-Centrifugal, 85gpm 31ft head, 1750 rpm Aurora Pump, 10 hp 220/440V 1750 rpm Fairbanks Morse Motor; **(4)** Steam Generator Chemical Feed Pumps (3)- Microprocess controlled solenoid driven (positive displacement) Diaphragm type, 120 strokes per minute, Manufactured by Pro-Minent-Gamma Fluid Controls, Pumps 1 and 2 are Model #1201 0.45gph at 17 psig back pressure; Pump 3 is Model #1002 Type 4b 0.61gph at 145 psig back pressure; **(5)** Deaerator- 15,000 lb/hr, 300 gals, Clever-Brooks Model SM-15; **(6)** Condensate Return Tank- 390 gals, ceramic lining, 100 psig working pressure, Manufactured by Patterson-Kelly Co.; **(7)** Water Softener Tanks (2)- 140 gals, Manufactured by Clayton; **(8)** Brine Tank (1)- 148 gals; **(9)** Chemical Feed Tanks (3)- 50 gals, Manufactured by Clayton; **(10)** Condensate Return Pumps (2)- Centrifugal duplex, 5.4 cgm air and 22.5 gpm condensate at 40 psig discharge pressure.

Table 11-1: Northeast WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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)	
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	Total of 9 samples pumps. Pumps are new but they are still issues with samples thus it is believed new suctions lines are necessary.
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	New piping, supply and drain required. Cost similar to replacing the 3 chlorine analyzers below
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.	Three chlorine analyzers- one for raw water sample, reservoir sample and the tap sample. Per Peterson and Matz W&T Cl2 anaylzer is $6k
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)	Assumed to be similar to 2013 10-Year CIP Review project for Roof and Building Improvements. OPC = $2.5M
Site Improvements	NE - SIT - 1	Water Production Metering Improvements	5 years	2013 10-Year CIP	$2,500,000	$1,851,852	$1,851,852	Rehab or replace Venturi meters in Yard Piping	
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 of pipe and cone valves and gate.	
		Total Estimated Cost			**$264,330,000**	**$192,353,806**	**$230,199,482**		

Table 11-2: Springwells WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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 flume isolation roller gates (CS - 1425) and low lift caisson leak repair	$10,000,000 added for Suction flume roller gates; $4,000000 added for caisson leak repair.
Rapid Mix / Floc	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.	
Rapid Mix / Floc	SPW - RMF - 2	Flocculator drive repair / replacement	5 Years	2013 Plant Staff Assessment	$1,000,000	$1,000,000	$1,000,000	Comparison to similar work elsewhere	
Rapid Mix / Floc	SPW - RMF - 3	1930 Plant Pretreatment modifications/upgrade	20 Years	2013 Plant Staff Assessment	$142,800,000	$91,538,462	$134,845,931	2002 Needs Assessment (2002 Dollars)	This project was recommended in the NA, but no longer seems to be the plan for the SPW WTP. Need clarification on whether the project should be included or not.
Sedimentation	SPW - SED - 1	Replace North Gate house rail guards in 30's plant	5 Years	2013 Plant Staff Assessment	$150,000	$150,000	$150,000	Scope definition not clear. Cost estimated based on general knowledge.	
Sedimentation	SPW - SED - 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 16-ton crane and that some building modifications required to accommodate new equipment	
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 $54M	Note full bid amount is included; project under construction. Some or all of this contract maybe should be not considered in analysis.
Filters	SPW - FIL - 2	1930 Filter and related building roof repairs	5 Years	2013 10-Year CIP	$1,500,000	$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.	
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.	
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	

Table 11-2: Springwells WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
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	
UV / Ozone	SPW - UVO - 1	Ozone Disinfection System	TBD	2002 Needs Assessment	$45,000,000	$28,750,000	$42,352,000	2002 Needs Assessment. Project is no longer on the CIP but based on DWSD's voluntary water quality goals, may be necessary. Has been included here as a placeholder. DWSD needed to decide between ozone alone or ozone/UV for future disinfection. (2002 Dollars)	COSTS FOR RECORD PURPOSES ONLY. NOT INCLUDED IN COST TOTALS.
UV / Ozone	SPW - UVO - 2	Ozone and UV Disinfection System	TBD	2002 Needs Assessment	$80,000,000	$56,153,846	$82,720,613	2002 Needs Assessment. Project is no longer on the CIP but based on DWSD's voluntary water quality goals may be necessary. Has been included here as a placeholder. DWSD needed to decide between ozone alone or ozone/UV for future disinfection. (2002 Dollars)	Higher cost alternative is included in cost totals. CRJ revised up due to SPW capacity relative to LH
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 an 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.	

Table 11-2: Springwells WTP Proposed Capital Improvements

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	Additional Information to Prepare Cost Estimates
Electrical / I & C	SPW - EIC - 2	Complete electrical upgrades	5 Years	2013 Plant Staff Assessment	$15,000,000	$15,000,000	$15,000,000	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 misc. improvements in all other electical components. Includes panelboards, disconnects, VFDs. Conduit remains, some wire replaced, but not all.	
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,M. However, this included extensive yard piping work, which is included in SPW - SIT - 1. Assume 2013 Dollars.	There is a project listed in the January 2013 Update to the 2013-2018 CIP it is described as "Replacement of steam lines, condensate return lines and pumps, compressed air lines, gates, valves, and yard piping at the Springwells WTP. " Cost is $21,000,000 according to CIP.
Laboratory / Admin	SPW - LAD - 1	Replace all sample pumps and piping/tubing	5 Years	2013 Plant Staff Assessment	$500,000	$500,000	$500,000	Some rehab of sampling system is included in SP 563. This project assumes some additional needs.	
Building	SPW - BLD - 1	Miscellaneous Mechanical, Electrical, and Architectural Improvements	5 years	2002 Needs Assessment	$0	$0	$0	2002 Needs Assessment (2002 Dollars) All work in this project is part of completed or ongoiing construction projects.	
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 estiamted at 33M. CDM indicates that SPW is less complex and includes about 20 gate valves; assume $25M.	
Site Improvements	NE - SIT - 1	Water Production Metering Improvements	5 years	2013 10-Year CIP	$2,500,000	$1,851,852	$1,851,852	Rehab or replace Venturi meters in Yard Piping	
		Total Estimated Cost			**$548,600,000**	**$419,369,565**	**$489,243,802**		

Table 11-3: Southwest WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
Low Lift Pumps	SW - LLP - 1	Low Lift Pump Station Upgrades	20 Years	2013 Plant Staff Assessment	$10,000,000	$10,000,000	$10,000,000	Assume this includes a relatively minor amount of high-lift piping replacement in addition to the pumps	Kerr Pump and Fairbanks provide equipment estimate which is stored under the job file
Rapid Mix / Floc	SW - RMF - 1	Flocculator equipment upgrades	5 Years	2013 Plant Staff Assessment	$5,000,000	$5,000,000	$5,000,000	Recevied Jim Meyer and Sons, Inc quote for new walking beam flocculator equipment.	Walking beam type flocculators- there is no information in the 1988 system O&M on the flocculators installed. In the system O&M they are referred to as turbine impeller flocculators which is incorrect. We know the plants is rated at 240 MGD, and there are 4 flocculation basins with 5 chambers each. Each chamber is 16-ft long by 135 ft wide by 24 ft deep.
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	Mechanical work reported to be completed. Basin repairs and crack repair and Misc. improvements included here.
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.	Upgrade of the filters, including new media, rate controllers, surface wash, new wash water and transfer pumps, motors and controls; filter building arch and structural rehab; new polymer system.
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 mechnical equipment and updating the controls, monitoring and controls imporvements along with minor building improvements	There are 9 chlorinators and 3 evaporators. Use same price for this equipment as Water Works Park. Cannot find any information about phosphoric acid feed system.
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)	
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	Kerr Pump and Fairbanks provide equipment estimate which is stored under the job file
High Lift Pumps	SW - HLP - 2	High/Low Lift Pump Station and Administration Building	5 Years	2002 Needs Assessment	$1,946,490	$1,247,750	$1,838,069	2002 Needs Assessment (2002 Dollars)	NA Scope includes one new 30 mgd LL pump. Cost is deleted from this scope as assumed to be included in SW - LLP -1 above.

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Table 11-3: Southwest WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
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.	See backup under P:\IER\12675\123P0515020T\ProjMgmt\50-Construction\Changes_RFP 09-High Service Valve Operators.
UV / Ozone	SW - UVO - 1	Ozone or Ozone plus UV Disinfection System	TBD	2002 Needs Assessment	$51,000,000	$32,692,308	$48,159,261	2002 Needs Assessment (2002 Dollars)	Decision needed as to which if any UV / Ozone System is recommended for future disinfection needs. UV + Ozone is assumed in this cost estimate.
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)	
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	Plant has a new deaerator tank but if needs to be installed. New piping required; it cannot be replaced in kind. Plant cannot do in house and the cost may be more than allotted for O&M costs.
HVAC Mechanical	SW - HVM - 2	New steam generators	20 Years	2013 Plant Staff Assessment	$1,500,000	$1,500,000	$1,500,000	Based on RSMeans +50% costing for (3) Boilers, (2) Feed pumps, (3) pump chemical feed system, Deareator, Condensate return tank, Duplex condensate Return system, and steam and condensate piping	This project is probably closer than 20 years off. There is no information on the size of the steam generation system/equipment. But it is probably safe to assume that its capacity is similar to that of the Northeast Plant.
HVAC Mechanical	SW - HVM - 3	Replacement of steam unit heaters	20 Years	2013 Plant Staff Assessment	$250,000	$250,000	$250,000	Based on RSMeans +50% costing + 5% per year - for (16) SUH, 250MBH units each	Half of the Steam Unit Heaters were replaced under project SW-550 and the remaining half need to be replaced. Under SW-550 16 horizontal type steam unit heaters that were corrosion resistant and had the following characteristics: 4,200 cfm at 70 deg F, entering temp 55 def, exiting temp 121 deg F and the capacity rating in BTU/hr were determined by the contractor.
Site Improvements	SW - SIT - 1	Water Production Metering	5 years	2013 10-Year CIP	$2,500,000	$1,851,852	$1,851,852	Rehab or replace Venturi meters in Yard Piping	
		Total Estimated Cost			**$136,122,250**	**$100,053,494**	**$130,525,591**		

Table 11-4: Lake Huron WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
Low Lift Pumps	LH - LLP - 1	Low Lift Pumps refurbish all motor exciters	5 Years	2013 Plant Staff Assessment	$8,000,000	$8,000,000	$8,000,000		Kerr Pump and Fairbanks provided equipment estimate (on record).
Low Lift Pumps	LH - LLP - 2	Replace Low Lift Pump No. 1 VFD	5 Years	2013 Plant Staff Assessment / 2013 10-Year CIP	$5,400,000	$4,000,000	$4,000,000	2013 10-Year CIP project includes replacing pump and motor and new VFD. Used CIP cost.	See info above regarding pumps. Note there is a project that was shown in the January 2013 Update to the 2013-2018 CIP that is described as: "Designing and replacing the existing pumping unit for Low Lift Pump No. 4 and equipping it with a Variable Frequency Drive with a bypass starter. Work will also include verifying the HVAC for displacement of heat being generated from proposed VFD, and integration with the ovation system." Estimated Cost is $5,400,000.
Rapid Mix / Floc	LH - RMF - 1	Replace floc Drives, bearings and paddle	5 Years	2013 10-Year CIP	$6,000,000	$4,444,444	$4,444,444		
Filters	LH - FIL - 1	Replace all filter controls including limit switches	5 Years	2013 Plant Staff Assessment	$4,800,000	$4,800,000	$7,070,913		This project assumed to rate contollers only. Larger rehab deferred to LH - FIL - 3. Raw cost increased by 50% for electrical, mech, and OH & P. Costs from 2002.
Filters	LH - FIL - 2	Replace North Wash water Rate control valve in filter gallery area	5 Years	2013 Plant Staff Assessment	$400,000	$400,000	$400,000	See sheet P-3 of 1970 filtration plant drawings. This is a rate controller valve but might have been replaced with something different over past 45 years. Assume cost is similar to a motorized 36" vee ball control valve	
Filters	LH - FIL - 3	Complete refurbishment/upgrades of the filters	20 Years	2013 Plant Staff Assessment	$100,000,000	$100,000,000	$100,000,000	Southwest $29M estimated in 2002 today cost is $43M or $750/sf. Northeast $36M estimated in 2002 Today cost is $54M or $1000/sf	Southwest has 24 filters @ 54' x 45.33' Approx 2445 sf or 58,680 sf total. Northeast has 48 filters @ 43.66 x 27' Approx 1175 sf ea or 56,400 sf total . Lake Huron has 40 filters @ 60' x 46.5' = 2790 sf ea or 111,600 total. ENR in 2002 = 6500 and today = 9668
Residuals	LH - RSD - 1	Rehabilitate retention basin and clarifiers	5 Years	2013 Plant Staff Assessment	$2,400,000	$2,400,000	$2,400,000	Request more information. Don't have infor for these basins. Assume retention baisn is 80' x 80' x 15' deep = 1.4 MG. Assume no mechanisms in the basis return pumps to be replaced and handrial and other misc. improvements needed. Assume retention baisn is 80' x 80' x 15' deep = 0.7 MG. Assume clarifiers have circular collection mechanisms in them. Assume new clarifier mechanism, sluice gates and	

Table 11-4: Lake Huron WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
								return pumps are required.	
Residuals	LH - RSD - 2	Dredging of Lagoons 1-4	5 Years	2013 Plant Staff Assessment	$3,000,000	$3,000,000	$3,000,000	Based on contract LH-391 the lagoons A-F in contract LH-380 are actually lagoons 1-6. Assume 3' of material needs to be removed froom each lagoon. Look up Southwest sed basin cost. Call Land fill?	Maximum usable depth 33"
Residuals	LH - RSD - 3	Upgrade/rehab decant pumps and pit	5 Years	2013 Plant Staff Assessment	$150,000	$150,000	$150,000	Assume this is a typical duplex submersible pump station approximately 300 gpm capacity	
Residuals	LH - RSD - 4	Replace all sludge pumps in the wash water treatment facility	20 Years	2013 Plant Staff Assessment	$250,000	$250,000	$250,000		Six recessed impeller pumps with assumed capacity of approx 200 gpm.
High Lift Pumps	LH - HLP - 1	High Lift Pumps refurbish all motor exciters	5 Years	2013 Plant Staff Assessment	$15,000,000	$15,000,000	$15,000,000		Kerr Pump and Fairbanks provided equipment estimate (on record).
High Lift Pumps	LH - HLP - 2	High Lift Header Replacement/Renovation	20 Years	2013 Plant Staff Assessment	$6,000,000	$6,000,000	$6,000,000	Assume some of the underground piping will be replaced in addition to all interior piping	Springwells $150M in todays dollars to replace high and low lift pumps and high lift piping. Assum 1/3 or 50M of this is related to high lift piping
UV / Ozone	LH - UVO - 1	Pre-Ozone Facility	TBD	2004 Comprehensive Water Master Plan	$40,000,000	$23,134,760	$34,079,972	2004 Comprehensive Water Master Plan. Project is no longer on the CIP but based on DWSD's voluntary water quality goals may be necessary. Has been included here as a placeholder. Assume costs are based in 2002.	Major cost item related to UV / Ozone. Both projects included in costs. Decision needed to include or not. CRJ Revised down relative to SPW
UV / Ozone	LH - UVO - 2	UV Disinfection Facility	TBD	2004 Comprehensive Water Master Plan	$40,000,000	$23,134,760	$34,079,972	2004 Comprehensive Water Master Plan. Project is no longer on the CIP but based on DWSD's voluntary water quality goals may be necessary. Has been included here as a placeholder. Assume costs are based in 2002.	Major cost item related to UV / Ozone. Both projects included in costs. Decision needed to include or not. CRJ revised down relative to SPW
Electrical / I & C	LH - EIC - 3	Replace 13.8 kV switchgear and upgrade/replace fence around the transformers	5 Years	2013 Plant Staff Assessment	$3,000,000	$3,000,000	$3,000,000	Assumes $2.5 million for switchgear, 300k for removal of existing gear and construction sequencing issues to keep the plant operational, and 200k for fencing.	

Table 11-4: Lake Huron WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
Electrical / I & C	LH - EIC - 1	Rehabilitate/replace low and high lift flow measurement	5 Years	2013 Plant Staff Assessment	$260,000	$260,000	$260,000		Assume $20,000 per pump x 13
HVAC Mechanical	LH - HVM - 1	Replace hydropneumatic tanks	5 Years	2013 Plant Staff Assessment	$100,000	$100,000	$100,000	$35,000 Diaphragm tank (500gal) EA	
HVAC Mechanical	LH - HVM - 2	Replacement of hot water heating boilers, chillers, new dehumidification systems	5 Years	2013 Plant Staff Assessment	$1,000,000	$1,000,000	$1,000,000	Based on RSMeans +50% costing for (3) boilers, feed pumps, circulating pumps, expansion tanks. (1) chiller/air handler, circulating pumps, condenser. (2) dehumidification dry desiccant type [$400,000 for Boiler Equipment; $200,000 for Chiller/Air handler; $300,000 for Dehumid $40,000 for Demo Use $1,000,000	1989 System O&M Manual ***Boiler System*** **:** Three boilers, 2 scotch marine, fire tube type rated at 6.176 MBtu each, 179 hp, 15 psig water pressure, manufactured by Rite Eng. Corp.; 1 CB, packaged boiler rated at 3.348 MBtu, 100 hp, 30 psig water pressure, manufactured by Cleaver Brooks. System consists of feed pumps, hot water circulating pump, expansion tanks and not water tanks. ***Air Conditioning System*** **:** Unit is free standing cabinet, electric motor driven, centrifugal blower type rated at 105,000 Btu/hr, with 23,732 cfm of airflow. System includes refrigeration compressor, condenser, chilled water circulating pump, condenser water pump, and chilled water pump ***Dehumidification System*** **:** Two 13,500 cfm air conditioners, inlet air condition is 80 deg F dry bulbs with 40 grains of moisture and exit air condition is 60 deg F dry bulb with 15 grains of moisture, manufactured by Ross Engineering Corp. Regenerator is kathene solution type designed to remove 200 lbs of moisture per hour. Note All new DWSD Dehumidification systems are dry dessicant type.
HVAC Mechanical	LH - HVM - 3	Rehabilitate drainage system for outside of long passageway and improve drainage system for high lift pump floor.	5 Years	2013 Plant Staff Assessment	$105,000	$105,000	$105,000	Based on RSMeans +50% costing; $105/LF for CI piping/Fitting Assume 1000LF of pipe	
Site Improvements	NLH- SIT - 1	Water Production Metering Improvements	5 years	2013 10-Year CIP	$2,500,000	$1,851,852	$1,851,852	Rehab or replace Venturi meters in Yard Piping	
		Total Estimated Cost			**$238,365,000**	**$201,030,816**	**$225,192,154**		

Table 11-5: Waterworks Park WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
Intake	WWP - INT - 1	Controllers and torque analyzers on screening equipment	5 Years	2013 Plant Staff Assessment	$300,000	$300,000	$300,000	Recevied quote for replacing the exising controls from Evoqua Water Tech. (formerly Siemens). The quote did not include torque analyzers.	
Intake	WWP - INT - 2	New gates, cranes on the A and B shaft	5 Years	2013 Plant Staff Assessment	$750,000	$750,000	$750,000		Assumed to be gates that go into the shafts so that the RWBPS can be used to boost flow to NE-WTP and SP-WTP. They are 12'Wx14'H gates that are dropped into shafts that are about 72' deep. Probably need new guides to be installed by divers, and a new lifting mechanism and storage rack(s). Dives will be deep, so divers in the shaft will be limited to a few hours/shift.
Rapid Mix / Floc	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	Three process trains with three stage flocculation with 5 vertical turbine flocculaotrs per stage. Total of 45 flocculators. Stage 1 70 $sec^{-1,}$ and Stages 2 and 3 are 50 sec^{-1}. Volume per train is 871,800 gallons.
Sedimentation	WWP - SED - 1	Replace 14 of 28 chains on sedimentation basin	5 Years	2013 Plant Staff Assessment	$500,000	$500,000	$500,001		Chain is plastic. Longitudinal Collectors are 64′ x 26.17′ and Cross collectors are 107′x 4′. There are four longitudinal collectors and one cross collector per sedimentation basin. There are six sedimentation basins. Siemens quote is $55K for chain material.
Filters	WWP - FIL - 1	Replace turbidimeters and particle counters	5 Years	2013 Plant Staff Assessment	$400,000	$400,000	$400,000	Assume 1 unit of each type per filter	Cost per W&T per unit is approximately $6K
Chemical Feed	WWP - CHF - 1	Replacement of chlorinators and evaporators	5 Years	2013 Plant Staff Assessment	$550,000	$550,000	$550,000		Chlorinator $15,000; evaparator $35,000
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	Alum Feed System: Four metering pump with 4 to 216 gph feed capacity; Sulfufic Acid Feed System: Four metering pumps with 1.5 to 69 gph feed capacity; Coagulant Aid Polymer: Four metering pumps with 1.8 to 16.3 gph feed capacity; 3 sets of Milton Roy Feed pums $114K.
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.	
Residuals	WWP - RSD - 1	Residuals facility rehabilitation	20 Years	2013 Plant Staff Assessment	$525,000	$525,000	$525,000	Major process feed pumps (sludge, centrifuge, eq, etc.) included only.	Equalization Pumps: Three self-priming centrifugal pumps with 2600 gph rated at 30 ft TDH and VFD's; Centrifuge Feed Pumps: Four progressing cavity pumps with 200 gpm rated at 50 psi and VFD's.

Table 11-5: Waterworks Park WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
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.	High Lift Pumps are from a 1960's installation. There are 3 pumps rated at 80 mgd, 4 rated at 60 mgd, and 4 rated at 40 mgd. No information on discharge head. Based on Southwest WTP Fairbanks equipment cost of one high lift pump = 1.2M. Assume cost at WWP is similar
UV / Ozone	WWP - UVO - 1	Ozone Generator replacement	20 Years	2013 Plant Staff Assessment	$4,360,000	$4,360,000	$6,422,746	Ozone contactor plus piping and controls for Northeast Needs Assessment (2002) was 4.36M. Inc. OH &P. Assume similar for WWP replacement	
UV / Ozone	WWP - UVO -2	UV Disinfection Facility	TBD	2004 Comprehensive Water Master Plan	$16,000,000	$16,000,000	$16,000,000	2004 Comprehensive Water Master Plan. Project is no longer on the CIP but based on DWSD's voluntary water quality goals may be necessary. Has been included here as a placeholder.	Major cost item related to UV. Decision needed to include or not.
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 replacment of 9 DCS rack/panels, update to latest software packages, new operator interfaces. Interconnecting fiber network shall remain as is.	
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.	
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 5 LLP VFDs, 3 Floc VFDs, 4 WW VFDs only. No updates to HVAC, structure, or controls.	
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		Need more information to know which equipment has Rotork operators. From looking through the P&ID diagrams it apprears there are roughly 300 valves and gates with motor opertors. So cost is based on replacing 300.
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.	
HVAC Mechanical	WWP - HVM - 1	Replace steam generators	5 Years	2013 Plant Staff Assessment	$500,000	$500,000	$500,000	Need more information	Reported cost at Southwest was $250,000 for half of unit heaters. Assume double.

Table 11-5: Waterworks Park WTP Proposed Capital Improvements

Plant Process / System	Project ID	Project Description	Priority	Source	Reported Source Cost	Adjust to Constr. Only	Adjust to Dec 2013 Cost	Basis for Cost	Additional Information for Cost Estimates
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	
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 RSMeans +50% costing (40) GUH unit to be replaced at a cost of $7,500/each	
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	
Site Improvemer	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.	Project included in the January 2013 Update to the 2013-2018 CIP and is described as: "replacement of yard piping from 24 inch to 72 inch diameter, pressure reducing valves, 48 inch HLPS suction gate valves, discharge header isolation valves, refurbish valve manholes, and other miscellaneous improvements." Estimated cost is $27,400,000 which was found in the 2008 CIP. No cost was in the 2013 CIP. **Price listed in 2008 dollars was $29M.** ENR 2008 + 8310; ENR today = 9668
		Total Estimated Cost			**$96,910,000**	**$87,317,407**	**$89,380,154**		