TM 10: Water Quality Assessment & Monitoring

This technical memorandum (TM) discusses topics related to water quality. The following topics are addressed:

- DWSD water quality goals
- Water quality monitoring plans
- Water quality monitoring equipment and laboratory infrastructure
- Customer complaints handling
- Water quality data handling and documentation
- Water quality data interpretation
- Water quality recommendations
- Evaluation of potential for direct filtration treatment process at Lake Huron Water Treatment Plant (WTP)
- Recommendations regarding Lake Huron direct filtration

1.0 Background

Water quality data were requested from DWSD and reviewed for trends and current compliance. Data reviewed were:

- Monthly Operations Reports (MORs) for each WTP FOR 2011, 2012 and January to June 2013
- Total coliform and *E. coli* data for DWSD and all wholesale systems that are monitored by DWSD for 2011 and 2012
- Lead and copper data for DWSD and all wholesale systems that are monitored by DWSD (most recent data from 2011)
- TOC data for 2010, 2011, 2012 and January to June 2013
- Mineral analyses for 2011 and 2012
- TTHM and HAA compliance data for 2011 and 2012
- Hexavalent chromium study from 2011
- Partial chemistry for 2012 and 2013
- UCMR1, UCMR2 and first set of UMCR3
- Bromide and Bromate data for Water Works Park WTP for 2011 and 2012

- EDC and PPCP data for Southwest WTP from 2007 and for the intakes at Southwest and Water Works Park from 2009 (Water Research Foundation Study 3071 PPCPs and EDCs – Occurrence in the Detroit River and Their Removal by Ozonation)
- General plant information questionnaires from 2013 Water Master Plan Update project

1.1 Water Quality Goals

DWSD established water quality goals as part of the Comprehensive Water Master Plan completed in 2004. These goals are shown in **Table 1-1** along with recommended modifications or new goals.

Table 1-1: DWSD Water Quality Goals Current and Recommended[1]

Water Quality Parameter	SDWA Requirement	DWSD Goal	Comments
All Regulated parameters (VOCs, SOCs, IOCs, radiologicals, SWTRs, D/DBPs and others)	Comply with all applicable primary drinking water regulations	Comply with all applicable primary drinking water regulations	Consider setting higher standards of compliance
Filtered Water Turbidity (ESWTR)	<0.3 NTU in 95% of combined filter effluent samples taken monthly, measurements at 4 hours intervals	<0.1 NTU in 95% of combined filter effluent samples taken each month	
	Maximum 1 NTU in combined filter effluent	Maximum 1 NTU in combined filter effluent	
	<0.5 NTU in individual filters after 4 hours of continuous operation (based on 2 consecutive measurements taken 15 minutes apart)	<0.3 NTU in individual filters after 4 hours of continuous operations	
	<1 NTU in individual filters at any time based on 2 consecutive measurements taken 15 minutes apart	<1 NTU in individual filters at any time	
Filtered water particle counts	Not required	Minimize particles	
		Maintain particle counts at baseline level	
Microbials (Interim and Long Term SWTR)	3-log *Giardia* removal/inactivation	Zero *Giardia*, virus and *Cryptosporidium* in finished water	
	4-log virus removal/inactivation		
	2-log *Cryptosporidium* removal		

[1] New and modified recommendations are shown in red

Table 1-1: DWSD Water Quality Goals Current and Recommended[1]

Water Quality Parameter	SDWA Requirement	DWSD Goal	Comments
	by filtration		
	0 to 0.25 log additional *Cryptosporidium* inactivation based on source water occurrence		
Primary disinfection (SWTRs)	≥0.5 log *Giardia* inactivation (conventional)	≥1.5 inactivation ratio for *Giardia* inactivation	
	≥ 1.0-log *Giardia* inactivation (direct filtration)	≥3.0 log virus inactivation (direct filtration)	
	≥2.0 log virus inactivation	≥ 1-log additional inactivation of *Cryptosporidium*	Obtaining individual filters effluent of <0.15 NTU 95% of the time per month will provide 0.5 log additional credit. A goal of 1 log drives CIP to ozone and/or UV at all WTPs. Consider it this goal is reasonable.
	>1.0 inactivation ratio		Ratio is the achieved CT versus the required CT
Total coliform (TCR)	<5% monthly sample positive	<5% monthly samples positive	
	No E. coli positive repeat sample or an E. coli positive routine sample followed by a total coliform positive sample	No E. coli samples positive	
Chlorine residual at entry to system (Stage 1 D/DBPR)	<4.0 mg/L	<4.0 mg/L	
	>0.2 mg/L	>0.2 mg/L at ends of DWSD distribution system	
Chlorine residual within distribution system (SWTR)	Detectable in 95% of monthly samples	>0.1 mg/L in 100% of monthly samples	
Chlorine residual at entry points to wholesale customers		>0.5 mg/L	
Disinfection Byproducts (Stage 1 & Stage 2 D/DBPR)	TTHM ≤ 80 ppb	TTHM ≤40 ppb	
	HAA5 ≤60 ppb	HAA5 ≤30 ppb	
	Bromate ≤10 ppb	Bromate ≤10 ppb	

Table 1-1: DWSD Water Quality Goals Current and Recommended[1]

Water Quality Parameter	SDWA Requirement	DWSD Goal	Comments
Disinfection Byproducts at entry to wholesale customer systems		TTHM ≤40 ppb	
		HAA5 ≤30 ppb	
TOC (Stage 1 D/DBPR)	<2.0 in source water to avoid enhanced coagulation	<2.0 mg/L	
Color (NSDWR)	<15 true color units	<5 true color units	Color is not currently measured
Taste and Odor (NSDWR)	<3 TON	<1 TON	
		No objectionable odor in finished water and in distribution system	
Lead (LCR)	<0.0015 mg/L in 90th percentile	<0.0015 mg/L in 90th percentile	
Copper (LCR)	<1.3 mg/L in 90th percentile	<1.3 mg/L in 90th percentile	
Orthophosphate (None)	None, but must meet lead action levels at the tap	>1 mg/L as PO4	Established by MDEQ per LCR. Consider future impact on wastewater discharge quality
pH (NSDWR)	6.5 to 8.5	7.0 to 7.9	Recommend tighter control of pH, assess distribution system corrosion
Aluminum (NSDWR)	0.05 to 0.2 mg/L	<0.2 mg/L in finished water	
Iron (NSDWR)	<0.3 mg/L	<0.1 mg/L in finished water and in distribution system	

The original set of goals did not address specific water quality associated with some regulations, such as the VOC, SOCs, IOCs, radiologicals, corrosivity, and other secondary regulated parameters like iron. It is assumed that DWSD's water quality goals are to maintain "regulatory compliance" unless otherwise specified in **Table 1-1**. In addition, there were no goals for the distribution system such as water age, tank turnover and other operational/water quality potential distribution issues. Therefore this table was updated and expanded to include comprehensive regulatory compliance as well as some goals that go beyond basic compliance.

DWSD participated in the Partnership for Safe Water and the water plants were accredited. Participation was discontinued in 2012 for unknown reasons. Some plants still prepared the Partnership data. As of January 2014, participation in the Partnership for Safe Water has been re-established. It may be beneficial to consider participation in other benchmarking programs such as

Qualserve and Distribution System Optimization Program. However, AWWA is no longer funding the Qualserve program and the only activity occurring is data collection. Nonetheless there may be value in assessing and following the best practices developed under this program.

2.0 Current Monitoring Plans

This section discusses the existing water quality monitoring, water quality data, and the staff organization involved in water quality assessment. It concludes with recommendations for future water quality testing.

2.1 Water Quality Monitoring

DWSD tests source waters, finished waters and the distribution system for a wide variety of parameters (**Table 2-1**). In addition, special studies are conducted through Water Research Foundation participation, consultants, the DWSD Water Quality Group and regulatory requirements such as the Unregulated Contaminant Monitoring Rule.

In addition to testing DWSD source and finished waters, DWSD tests the City of Detroit distribution system. DWSD collects and analyzes samples for retail customers. DWSD also provides total coliform sample collection and testing for 84 of the 127 communities. Total coliform and *E. coli* are analyzed. Depending on the type of complaint, metals analysis is sometimes performed. Costs for this are reportedly built into the customer rate. DWSD provides analytical services for lead and copper for 91 communities but the sampling responsibility resides with the community. No other analytical work is provided to the communities. DWSD could potentially offer additional water quality services to their communities and develop an appropriate pricing structure.

A complete description of the water quality monitoring program is shown in Table 2-1. This table also includes recommendations for the future program.

The MDEQ required monitoring schedule is attached in **Appendix A**.

In January 2014 DWSD began finish water mineral sampling at Northeast and Springwells. Currently only the plant taps at Water Works Park, Lake Huron and Southwest are monitored for some of the basic mineral parameters. Since water treatment processes vary, an ongoing assessment of finished water quality should be monitored on all finished waters.

Additional recommendations for the future monitoring include:

- Assess the value of plankton monitoring in the plant influents for Northeast and Springwells. These plants share the same source water as Water Works Park, but the water is chlorinated and then transported to the WTPs, thus probably destroying much of the algae prior to treatment. It is important to note that destruction of cyanobacteria can release microcystin and that this will not be assessed using an algal count on a chlorinated source.
- Consider assessing total chlorine on some frequency to check for potential reactions with ammonia (monthly or when ammonia detected, in all finished water).
- Cyanide testing is scheduled for 2014. DWSD will plan for this sample collection and analysis.

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Table 2-1: Current Water Quality Monitoring Program and Recommendations for Future

Parameter	Current Practice				Recommended Practice				Comments
	Source[2]	Finished[3]	Distribution	Special Study	Source	Finished[4]	Distribution	Special Study	
	Frequency				Frequency				
Aluminum	MO FI, DR, LHI	MO All plants		Yes at SP	MO All sources	MO All plants		At other plants if needed	Aluminum precipitation issues and dosing control
Ammonia	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Bi-Carbonate Alkalinity	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Calcium	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Carbonate Alkalinity	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Chloride	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Chlorine (total)			Per TCR			Online or grab All plants			MDEQ requires only free chlorine, not total Good idea to check total on some frequency
Chlorine (free)	DA all plants at multiple treatment points	Online All plants			DA or online at all plants at multiple treatment points	Online All plants	Per RTCR Online at storage		Samples also at pre-CL2, post CL2, applied, filtered, tap
COD	MO FI, DR, LHI	MO All plants			MO FI, DR, LHI	MO All plants			
Conductivity	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Copper	MO FI, DR, LHI	MO All plants	50/3 yr Per LCR		MO All sources	MO All plants	50/3 yr Per LCR		Reduced monitoring – consecutive system
Cyanide						With phase V		Study in distribution system if detected in finished water	Waiver is being rescinded by MDEQ
Dissolved Oxygen	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants		Study in distribution system	
Fluoride	MO & DA FI, DR, LHI	MO All plants DA all plants	Weekly		DA All sources	DA All plants	Weekly		MDEQ recommends some routine testing in distribution system
Free CO2	MO FI, DR, LHI	MO All plants			MO FI, DR, LHI	MO All plants			
Iron	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Magnesium	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			

[2] Fi – Fighting Island, DR = Detroit River at Belle Isle, LHI – Lake Huron Intake

[3] Most parameters measured at WWP (Water Works Park), LH (Lake Huron) and SW (Southwest) only, not at SP (Springwells) or NE (northeast), when done on a monthly frequency

[4] Recommendations are for all plants in service

Table 2-1: Current Water Quality Monitoring Program and Recommendations for Future

Parameter	Current Practice				Recommended Practice				Comments
	Source[2]	Finished[3]	Distribution	Special Study	Source	Finished[4]	Distribution	Special Study	
	Frequency				Frequency				
Manganese	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Nitrate	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Nitrite	MO FI, DR, LHI	MO All plants			DMO All sources	MO All plants			
Non-Carbonate Hardness	MO & DA FI, DR, LHI	MO All plants DA all plants			MO All sources	MO All plants			
Ozone residual		DA in contactors WWP							Assume done online
Total Organic Nitrogen	MO FI, DR, LHI	MO All plants			No	No			Delete this analysis
pH	MO FI, DR, LHI DA all influent	MO All plants DA SW, LH, SP, NE	2/yr. LCR		DA All sources	DA All plants	10 at 2/yr LCR		
Phosphorus	MO FI, DR, LHI	MO All plants DA all plants applied & tap DA at NE in distribution	10 at 2/yr LCR		MO All sources	DA All plants	10 at 2/yr LCR		
Potassium	MO FI, DR, LHI	MO All plants				YR All plants			
Silica	MO FI, DR, LHI	MO All plants			YR All sources	YR All plants			
Sodium	MO FI, DR, LHI	MO All plants			YR All sources	YR All plants			
Sulfate	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Temperature	DA All sources	DA All plants			DA All sources	DA All plants			
Total Alkalinity	MO & DA FI, DR, LHI	MO All plants DA all plants			DA All sources	DA All plants			
Total Dissolved Solids	MO FI, DR, LHI	MO All plants			MO All sources	MO All plants			
Total Hardness	MO & MO FI, DR, LHI	MO All plants DA all plants			DA All sources	DA All plants			
Total Solids	MO FI, DR, LHI	MO All plants			No	No			Delete this analysis
Turbidity	See separate table (2-1a)								
UV254 (SUVA calc)					MO All sources	MO All plants			
UV transmittance								Study if UV treatment	12 months prior to UV installation

Table 2-1: Current Water Quality Monitoring Program and Recommendations for Future

Parameter	Current Practice				Recommended Practice				Comments
	Source[2]	Finished[3]	Distribution	Special Study	Source	Finished[4]	Distribution	Special Study	
	Frequency				Frequency				
								planned	
Zinc	MO FI, DR, LHI	MO WWP, SW, LH			MO All sources	MO All plants			
Bromide		MO WWP			MO WWP	MO WWP			Important to monitor is ozone planned at any additional WTPS
Bromate		MO WWP				MO WWP			Important to monitor is ozone planned at any additional WTPS
VOCs	2 per yr FI, DR, LHI	Quart All plants			Online for spill detection All plants	Quart All plants			Delete VOC on sources
SOCs		2 per 36 mo, done in 2nd and 3rd quarters All plants				2 per 36 mo, done in 2nd and 3rd quarters All plants			
Partial Chem		YR All plants				YR All plants			
Radiologicals		9 yrs All plants				9 yrs All plants			
Metals		9 yrs All plants				9 yrs All plants			
TOC	Quart All sources	Quart All plants			MO All sources	MO All plants		Fractionation study at WWP	
DOC					MO All sources	MO All plants			
TTHM & HAA	2 per yr TTHM FI, DR, LHI		3 per quart + customers			Quart All plants	3 per quart + customers		Reduced monitoring for compliance, consecutive system Delete source water TTHM
WQP (LCR)			10 at 2/yr in Detroit; 70 per year in suburban communities				10 at 2/yr in Detroit; 70 per year in suburban communities		Reduced monitoring
Lead			50 per 3 yr		1 per 3 yrs All sources	1 per 3 yrs All plants	50 per 3 yrs		Reduced monitoring, consecutive system
Total coliform	See separate table (2-1b)								
Chromium hexavalent				2011 All plants				UCMR3 All plants	Will monitor in UCMR3
EDCs & PPCPs				WaterRF				Future	
Algae (plankton)	2/wk FI, DR, LHI & influent to SP & NE				2/wk FI, DR, LH				All plants, could decrease freq in winter

Table 2-1: Current Water Quality Monitoring Program and Recommendations for Future

Parameter	Current Practice				Recommended Practice				Comments
	Source[2]	Finished[3]	Distribution	Special Study	Source	Finished[4]	Distribution	Special Study	
	Frequency				Frequency				
Asbestos									Waived
Chlorophyll					WK in summer All sources				
Color					DA All sources	DA All plants			
Cryptosporidium				LT2 Round 1 All sources				LT2 round 2 All sources	Future routine monitoring
Giardia	ICR							Repeat at some frequency (3 years?)	
HPC	DA FI, DR, LHI	DA WWP, SP, LH	Low Cl2<0.1 ppm		DA All sources	DA all plants	With TCR samples		
MTBE	2 per yr FI, DR, LHI	Quart All plants		All ND					Monitor if regulated
Nitrosamines				All ND					Monitor if regulated
Perchlorate				All ND					Monitor if regulated
Strontium									With UCMR3
Radon									Rule has been withdrawn
Odor	DA FI, DR, LHI	DA SP, LH, SW	As needed		DA All sources	DA All plants	As needed		Water Works Park discontinued
ATP								Evaluate for security/contamination events/regrowth	
Microtox	DA DR	DA WWP	DA 1 per system					Evaluate alternatives	Use TCR sites Used to do on chemical deliveries WWP uses
Deltatox	DA FI, LHI	DA NE, SW	DA 1 per system					Evaluate alternatives	

WWP = Water Works Park WTP
NE = Northeast WTP
SW = Southwest WTP
SP = Springwells WTP
LH = Lake Huron WTP
FI – Fighting Island intake for Southwest plan
LHI = Lake Huron Intake
DR = Detroit River or Belle Isle intake for Water Works Park, Springwells & Northeast plants
DA=daily
MO=monthly
YR=yearly
Note: For Water Quality Parameters (WQP) (Lead & Copper Rule - LCR) SOCWA, Flint and Genesee County do their own monitoring

Table 2-1a: Turbidity Measurements Reported in Monthly Operation Reports from DWSD Treatment Plants

Sample Location	Lake Huron WTP	Northeast WTP	Springwells WTP	Water Works Park WTP	Southwest WTP	Regulatory Requirements	Master Plan Recommendations
Raw water	8 hrs	2 hrs	hourly	4 hrs	hourly	Recommended	Online All plants
Settled water	none	none	None	15 min	none	Recommended	Daily All plants
Applied (filter influent)	Daily	30 min	hourly	Not reported	hourly		Set consistent frequency for all plants, online
Individual filters	10 min	hourly	Not reported	Not reported	Nor reported	15 min	15 min report, online All filters all plants
Filter confluence	4 hrs	4 hrs	Not reported	4 hrs	Not reported	4 hrs	4 hrs report, online All plants
Plant tap	Daily	Not reported	Not reported	Not reported	Not reported	recommended	Daily report, online All plants

Table 2-1b: Total Coliform Sampling Performed by DWSD Treatment Plants and Associated Water Sources and Distribution Systems*

Sample Location	Lake Huron WTP	Northeast WTP	Springwells WTP	Water Works Park WTP	Southwest WTP	Regulatory Requirements	Master Plan Recommendations
Raw water	8 hrs	none	none	Daily	Daily	Daily	Daily All plants
Plant tap	8 hrs	2 hrs	2 hrs	8 hrs	4 hrs	Per MDEQ	Per MDEQ
Distribution System	56 per month + customers					Consecutive system per MDEQ	56 per month + customers

* Total coliform and E. coli are run simultaneously

- Total Organic Nitrogen is seldom used in drinking water and is typically low or not- detectable. This analysis could be eliminated.
- Total solids analysis could be eliminated.
- VOC analysis on source waters should be limited to spills assessment. Routine testing (quarterly) is essential to maintaining lab certification and analytical capability during a spill event.
- Frequency of algae monitoring could be decreased in the winter (as needed). Samples are usually reported as zero and therefore the analysis provides limited benefit.
- Odor analysis is recommended on all finished waters daily.
- Color should be tracked for raw and finished water, especially for the Lake Huron WTP if direct filtration is to be considered.

2.1.1 Online analyzers

DWSD uses a variety of online water quality analyzers for process control and regulatory compliance. These online monitors and their plant locations were reported as:

- Turbidity (all WTPs)
- Free chlorine (all WTPs, note Northeast needs for filters, combined filter effluent (CFE)and settled water, Springwells needs on raw and settled waters)
- Particle counters (Springwells and Water Works Park have on individual filters; Springwells, Water Works Park and Southwest have on raw, settled and CFE; Northeast has in their budget for raw, settled and CFE)
- Phosphate (Water Works Park, Southwest, Northeast)
- Fluoride (Water Works Park)
- Streaming current (Southwest, Water Works Park, Northeast)
- UV254 (Water Works Park – just purchased, not yet in use)

The online analyzers recommendations will be developed further in phase 2 of this project. TM- 13 Water Treatment Plant Needs Assessment provides estimated costs for the online chlorine analyzers at Northeast and the replacement of turbidimeters and particle counters at Water Works Park.

Online water quality monitoring on the Detroit River and Lake St. Clair is discussed in TM-8 Watershed Management and Protection.

2.1.2 Water Quality Monitoring Equipment

The Water Master Plan Needs Assessment Site Survey (see TM-13 Water Treatment Plant Needs Assessment Appendices) included a question on the types of laboratory equipment present at each water plant and at the water quality group lab. The results of that survey are shown in **Table 2-2**. This table incudes only bench equipment and not online instrumentation. It is expected that additional equipment exists at different locations but was not reported in the survey as the question was open ended rather than list based.

Most respondents did not include laboratory equipment replacement needs. Laboratory equipment is usually purchased under the operations and maintenance budget. Therefore it was not assessed for the master plan capital projects. However, it is important to plan for replacement as lab equipment lifetime is typically in the 5 to 20 year range. In addition, it was suggested that investing in dedicated distribution system sampling stations may be valuable. The difficulty in establishing satisfactory manual sample points in the distribution system is an ongoing challenge for many utilities. As an alternative, sampling stations may be installed in the distribution system. However, such installation should not proceed until any changes to the distribution system that could impact water age have been completed. These sampling stations can also be a challenge to operate and maintain during winter and therefore are recommended where acceptable indoor sites cannot be identified.

Table 2-2: Laboratory Equipment Reported in Survey

Equipment	Water Works Park	Lake Huron	Southwest	Springwells	Northeast	Water Quality Group
Atomic adsorption spectrometer						x
Autoclave		x	x		x	
Balance	X	x	x	x		x
Conductivity meter		x	x	X	x	x
Digestion unit						x
Dissolved oxygen meter						x
Drying oven		x	x			x
Fluoride (ISE) meter	X		x	X		x
Freezer						x
Glass still/distillation/DI water	x	x				x
IDEXX sealer		x	x			x
Incubator	X	x	x	X		x
Microscope		x		X		
Moisture analyzer	X					
Muffle furnace						x
pH meter	X	X	x	X	x	x
Refrigerator		x	x			x
Spectrophotometer	x	x	X	X	x	x
Titration assembly			x	X		
Turbidimeter	X	X	X	X	x	x
Water bath		x	x			

2.2 Lab infrastructure

The need for laboratory infrastructure upgrades was discussed in a meeting with WTP staff on October 8, 2013. Staff recommended the following:

- Lake Huron lab improvements in 20 year CIP
- NE lab improvements in 5 year CIP
- Springwells lab improvements in 5 year CIP

- Water Works Park improvements not needed
- SW partial update (cabinets, hoods) in 5 year CIP
- Water quality lab improvements not needed

2.3 Customer Complaints Handling

In addition, DWSD tracks customer complaints. See **Appendix B** for the Detroit Customer Complaint form. The form documents complaints of rusty/discolored, odor, taste, cloudy/milky, sick/ill/itchy skin, particle/sand and dirty. A range of 20 different taste and odor descriptors are included. Historically, DWSD has experienced musty –MIB type odors more than earthy-Geosmin. In the event of a taste and odor event at either the water treatment plant or the distribution system, DWSD will use Flavor Profile Analysis. The FPA panel will determine the type and level of taste and odor, and PAC feed at the water plant initiated. DWSD provides sample collection and analysis for a basic suite of parameters. Analyses provided are total coliform, phenolphthalein alkalinity, total alkalinity, total hardness, color, odor, chlorine residual, fluoride and turbidity. DWSD, similar to most utilities, does not charge customers for water quality complaint investigations. Either DWSD or the customer may collect the sample. Onsite investigation is conducted as needed by water quality personnel.

DWSD receives customer inquiries on topics such as rusty water, lead, odor, and others. DWSD collects samples for their retail customers. Wholesale customers collect samples for their retail customers. Total coliform and E. coli are analyzed. Depending on the type of complaint, metals analysis is sometimes performed. In the past, odor has been a frequency complaint related to algal blooms and zebra mussels, but the frequency has declined in recent years. Rusty water complaints occur in areas with high water age and old unlined cast iron pipe. Other complaints are infrequent. All data are captured in a database. Complaints such a chlorine are tracked by location.

Hydrant flushing is the primary approach employed to improve customer concerns. Onsite investigation and sampling are conducted when deemed appropriate.

2.4 Water Quality Data Handling and Documentation

Water quality documentation consists primarily of SOPs (Standard Operating Procedures) and sampling plans. The Water Quality Group reported that SOPs existed for all analyses, but they were not reviewed as part of this project. Written sampling plans were provided for TCR and DBP requirements (see **Appendix C**). The TCR and DBP sample plans were updated in July, 2013. Both plans follow the MDEQ template. Sample plans are documented, reviewed, and update if required on a continual basis. The date changes were made should be incorporated in all plans. Only the DBP sample site plan was reviewed as part of this project. The WTP and Water Quality labs are certified by the MDEQ for a variety of parameters.

The Water Quality Group has a web based system for capturing data. This system has been in place since 1998 and thus provides an opportunity for historical water quality investigations. This system could be used to share data more widely such as with the WTPs and wholesale systems. DWSD generates an extensive and complete set of water quality data. It is recommended that additional time be allocated to trending and interpreting these data. Investigation of any issues identified through this evaluation should be conducted.

2.4.1 LIMS

In 2013, DWSD developed a short list of vendors to provide a LIMS (Laboratory Information Management System). DWSD developed a list of requirements for LIMS performance and a process

diagram. These documents (**Appendix D**) were sent to ChemWater, Perkin Elmer and StarLims. One of these vendors, ChemWare, provided their quotation (Appendix D) which offered a price of $572,652 in March, 2013.

Given the complexity of the DWSD monitoring performed at both the water treatment plants and in the distribution system communities, a LIMS is recommended. Given that DWSD has already developed the specification and acquired cost information, proceeding to purchase a LIMS should be pursued. The main consideration is that implementation of a LIMS requires staff time for training and set up. Regular utilization of a LIMS requires dedicated staff time that will need to be incorporated into overall staffing levels (0.5 to 1 FTE).

3.0 Data Interpretation

Water quality data were reviewed and assessed to determine which parameters were of potential interest and future challenge for DWSD regulatory compliance and customer aesthetic satisfaction.

3.1 Current Water Quality Assessment

Regulatory compliance is assessed in TM-9: Drinking Water Regulations Present and Future. Additional analysis is included herein as well as analysis of some non-regulated parameters. Specifically this section addresses:

- Microbial occurrence
- Distribution system chlorine residuals
- DBPs & TOC
- pH
- Alkalinity
- Hardness
- Corrosion indices
- Plankton and algae
- Aluminum, iron and manganese
- Taste and odor

3.1.2 Microbial Occurrence

Heterotrophic plate count (HPC) is a common method used to assess distribution system bacterial regrowth. DWSD measures HPC daily on the finished waters from Water Works Park, Southwest and Lake Huron using R2A agar method. HPC in the distribution system is reported to be measured only when the chlorine residual is less than 0.1 mg/L. HPC data were not reviewed. It is recommended that DWSD develop a distribution system HPC routine monitoring plan to track regrowth, at least in areas of high water age. Other methods, such as ATP, exist for assessing regrowth but these are more complicated and time intensive but may be considered in the future.

Review of the CCR data in tandem with DWSD recorded data for total coliforms indicated discrepancies between the data sets. A review of all bacterial analysis data gathered by DWSD was conducted for dates sampled in the distribution system for 2011 and 2012. Upon review of the DWSD

data, **Table 3-1**, **Figure 3-1,** and **Figure 3-2** were compiled to show the positive total coliform counts that were reported along with the corresponding chlorine residual for the distribution system data and WTP effluent data. No positive *E. coli* readings were reported.

Table 3-1: Summary of Positive Total Coliform Counts

Township/City	Date	Corresponding Chlorine Residual (mg/L)	Positive for *E. coli*
Bloomfield Twp	6/8/2012	1.03	NO
	7/23/2011	0.66	NR[1]
Dearborn Heights	12/7/2012	0.62	NO
Farmington	8/27/2012	0.75	NO
Garden City	6/20/2012	0.11	NO
	1/13/2011	0.60	NR
Lake Orion	6/28/2012	0.71	NO
Oak Park	10/2/2012	0.37	NO
West Bloomfield Twp	4/19/2012	0.93	NO
Brownstown Twp	1/14/2011	1.19	NR
	8/11/2011	1.08	NR
	9/28/2011	1.11	NR
Dearborn	7/8/2011	0.89	NR
Hamtramck	6/7/2011	0.40	NR
Livonia	12/6/2011	0.73	NR
Pittsfield Twp	11/28/2011	0.25	NR
Riverview	8/29/2011	1.01	NR
Taylor	1/7/2011	0.93	NR
	1/24/2011	0.86	NR
Westland	11/9/2011	0.88	NR
Detroit	1/7/2011	0.36	NR
	6/14/2011	0.80	NR
	8/16/2011	0.77	NR
	8/18/2011	0.86	NR
Water Works Park WTP	7/8/2011	0.99	NR
	3/31/2012	1.15	NR

[1]NR: Not Reported

For 2011, all positive total coliform counts were re-tested as negative indicating there was no need for further action; these re-check data were not provided for 2012.

3.1.3 Distribution System Chlorine Residuals

Further investigation into the potential relationship between free chlorine residual and total coliform occurrence was conducted. During 2011 and 2012 some communities reported very low annual average chlorine residuals (<0.3 mg/L) which are listed in **Table 3-2**.

Table 3-2: Summary of Low Average Chlorine Residual Communities

Township/City	2011 Average Free Chlorine mg/L	# Positive Total Coliform Samples in 2011 #/100 mL	2012 Average Free Chlorine mg/L	# Positive Total Coliform Samples in 2012 #/100 mL
Flat Rock	0.16	0	0.23	0
Grosse Ile	0.26	0	0.29	0
Grosse Point Shores	0.22	0	0.26	0

For the distribution system data, the free chlorine residual for all total coliform positive sample events in 2011 and 2012 ranged from 0.1 to 1.2 mg/L. **Figure 3-1** shows the average free chlorine residual versus the number of positive total coliform samples for each community. **Figure 3-2** shows the individual sample results for free chlorine residual with positive total coliform samples for communities where total coliform were detected. Despite some positive counts that had chlorine residuals below the minimum recommended residual of 0.20 mg/L, in general there was minimal correlation between chlorine residual and positive total coliform counts as shown from the data in the above tables and attached figures.

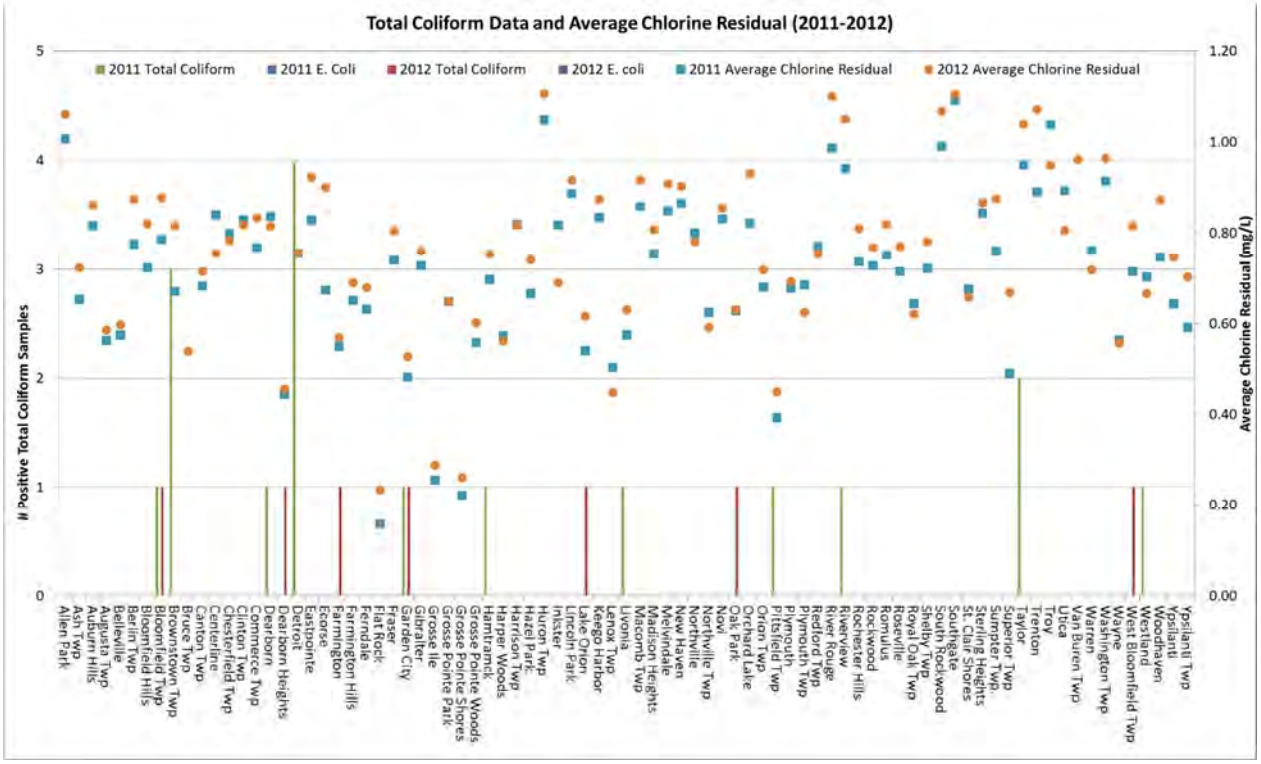


Figure 3-1: Distribution System Total Coliform Positive, Samples and Average Chlorine Residual, 2011-2012

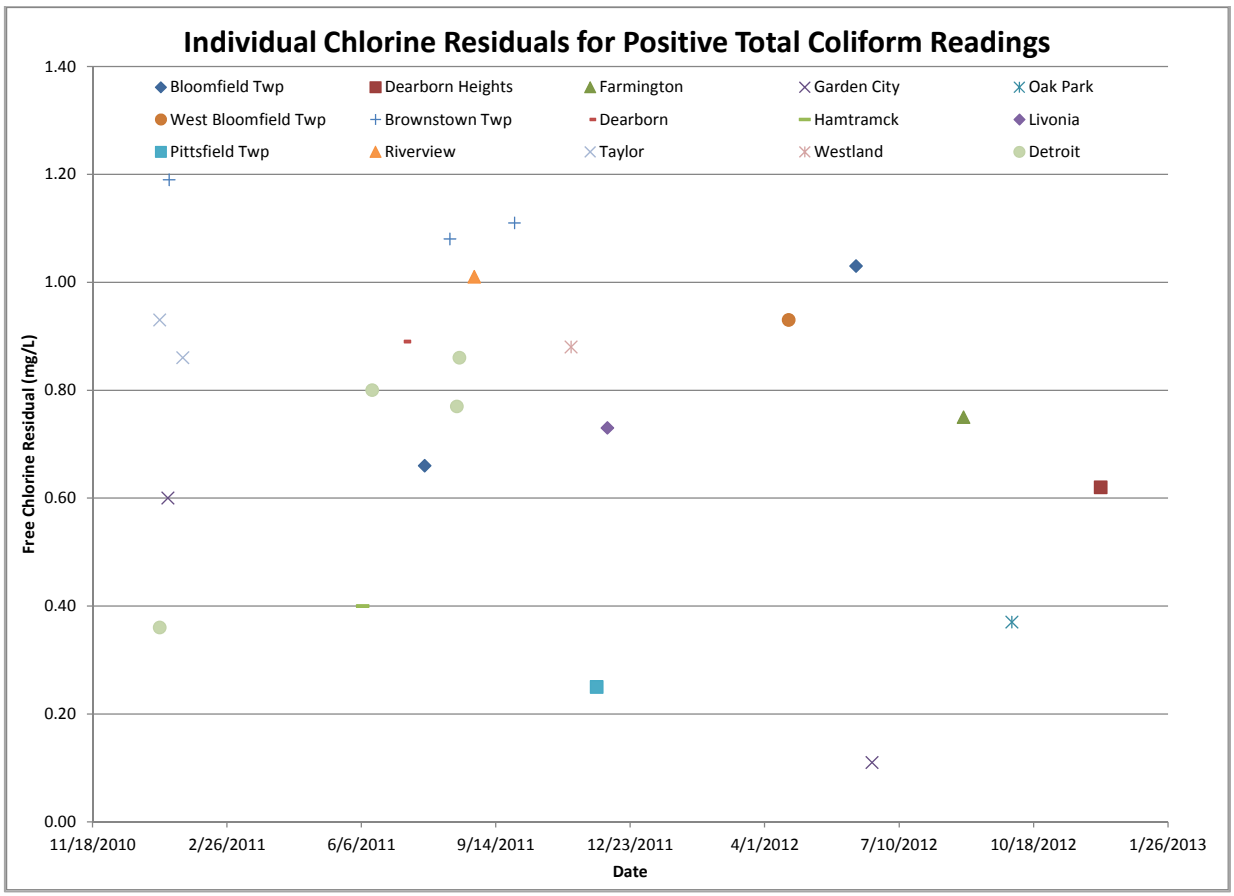


Figure 3-2: Relationship of Individual Samples for Chlorine Residual and Positive Total Coliform Results

3.1.4 DBPs & TOC

Current regulatory compliance is discussed in TM-9 Drinking Water Regulation Present and Future. Additional analysis is offered in this TM. **Figure 3-3** and **Figure 3-4** show the locational running annual average (LRAA) for the 1st quarter 2012 (May, September and December of 2011 and February of 2012) for select locations where the LRAA could be calculated for TTHM and HAA, respectively. Due to sample site changes implemented between 2011 and 2012, only a limited set of locations had sufficient data for this calculation. LRAAs for TTHMs and HAAs are well below the regulatory limits of 80 µg/L and 60 µg/L, respectively. The LRAA levels were calculated to predict future compliance with the Stage 2 D/DBP rule. DWSD is expected to comply with this new regulation as DBPs are below the MCLs.

The speciation of both TTHMs and HAAs was assessed (Figures 3-1, 3-2, 3-3 and 3-4). The principal THM species across all locations is chloroform (CCl_4) followed by dichlorobromomethane ($CHBrCl_2$) and dibromochloromethane ($CHBr_2Cl$). No incidences of bromoform (CBr_4) were recorded in 2011 or 2012. In both 2011 and 2012, the HAA speciation is mostly an even split between trichloroacetic acid (Cl3AA) and dichloroacetic acid (Cl2AA). No other HAA species were recorded.

The formation of TTHMs and HAAs within the treatment plants and the distribution system was examined and demonstrated that both locations create DBPs. In general, TTHM concentrations increase between the effluent of the water treatment plant and the distribution system locations. To illustrate this effect, the greatest increase can be seen at the Meijer's Gas sampling location in Pittsfield Township which recorded a TTHM annual average of 44.2 µg/L and 20.7 µg/L for 2011 and 2012,

respectively (**Figures 3-5 and 3-6**). It is important to note that the values in these Figures are the annual averages at each location and that not all locations have four samples taken in a given year. Pittsfield Township is located on the periphery of DWSDs system and receives water from Springwells and Southwest. The WTP effluent averages of the two WTPs that provide water to this location was approximately 15 µg/L in 2011 and approximately 12 µg/L in 2012. The increase in TTHM levels observed in 2011 and to a lesser extent in 2012 is likely a result of the long water ages to traverse DWSDs system between the effluent of the Springwells and Southwest plants. This increase is likely exacerbated if water is supplied only from the plant with the longer water age. However, as the LRAA is well below the MCL, DWSD and its wholesale systems are currently in compliance. The spatial variation in HAA levels cannot be completely ascertained as there are no data available for the WTP effluents. However, some of the locations which recorded high annual averages for TTHMs also recorded high annual averages for HAAs such as the Meijer Gas sampling location in Pittsfield Township indicating the potential for a spatial increase in HAAs within the distribution system attributable to longer water ages. **Figures 3-7and 3-8** shows the combined running annual average for each HAA species for the distribution locations.

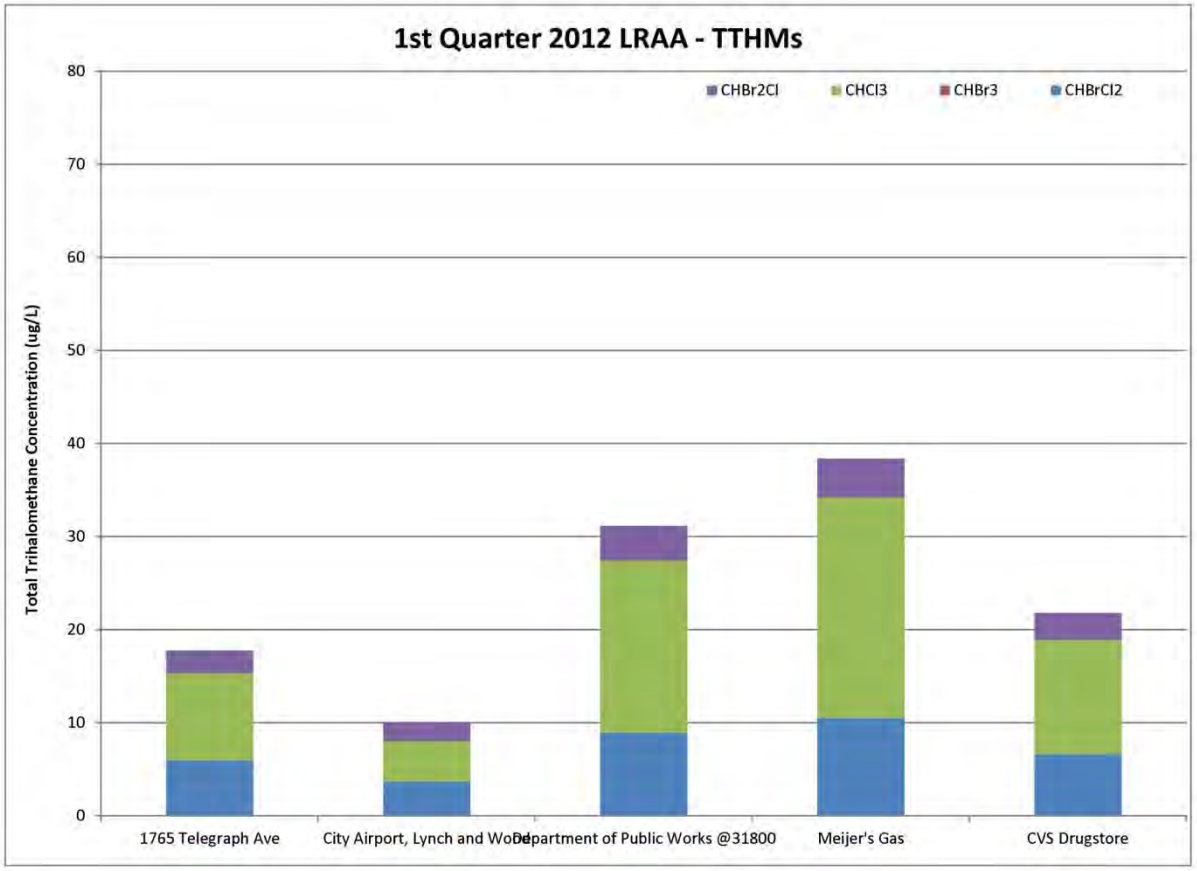


Figure 3-3: TTHM LRAA for First Quarter 2012

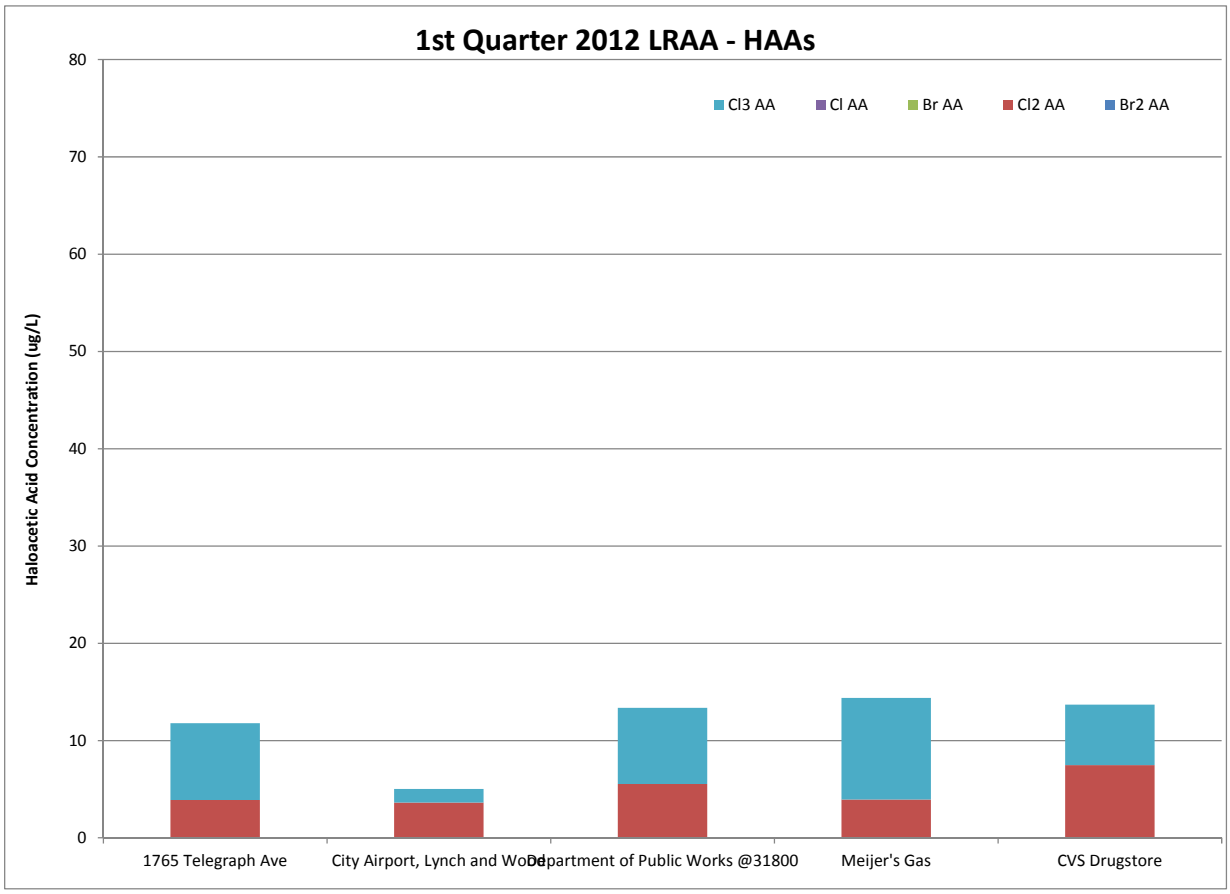


Figure 3-4: HAA LRAA for First Quarter 2012

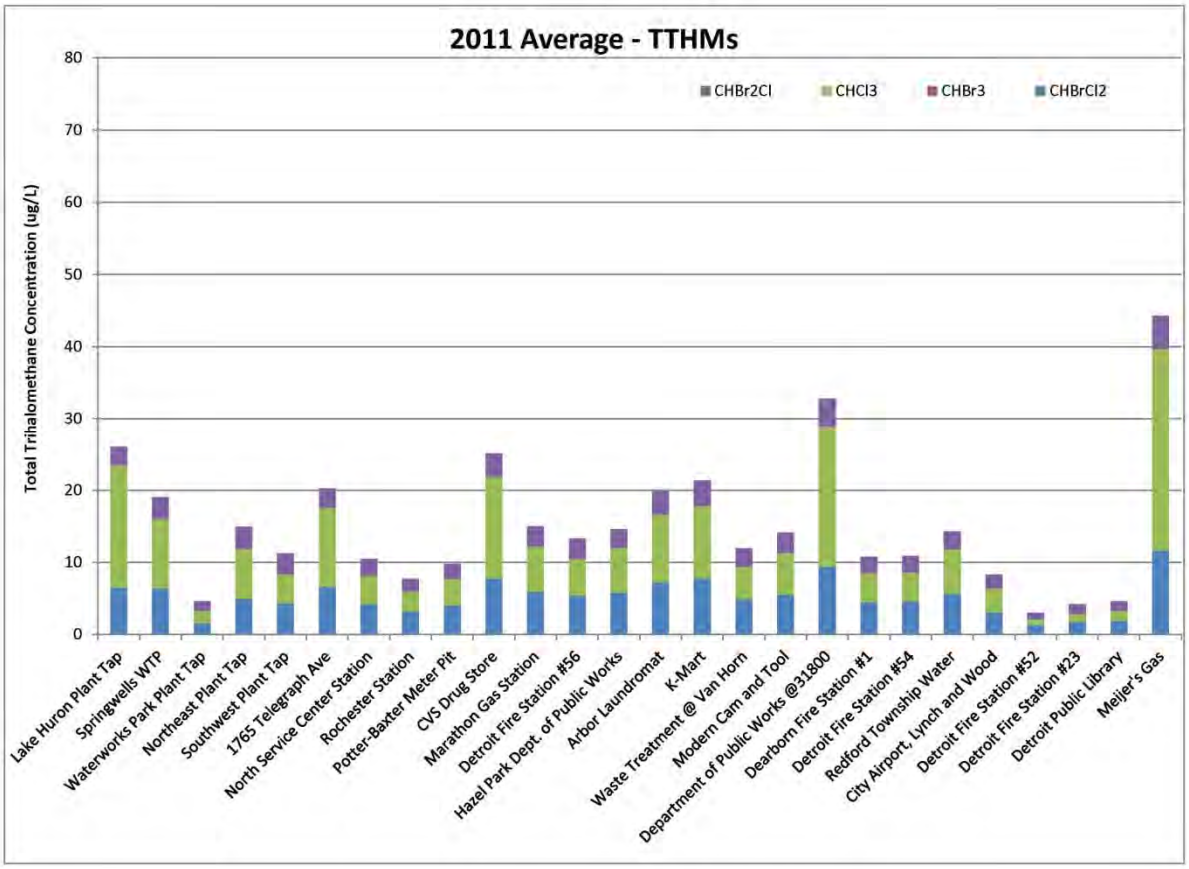


Figure 3-5: Yearly Average TTHMs at Distribution System Locations in 2011

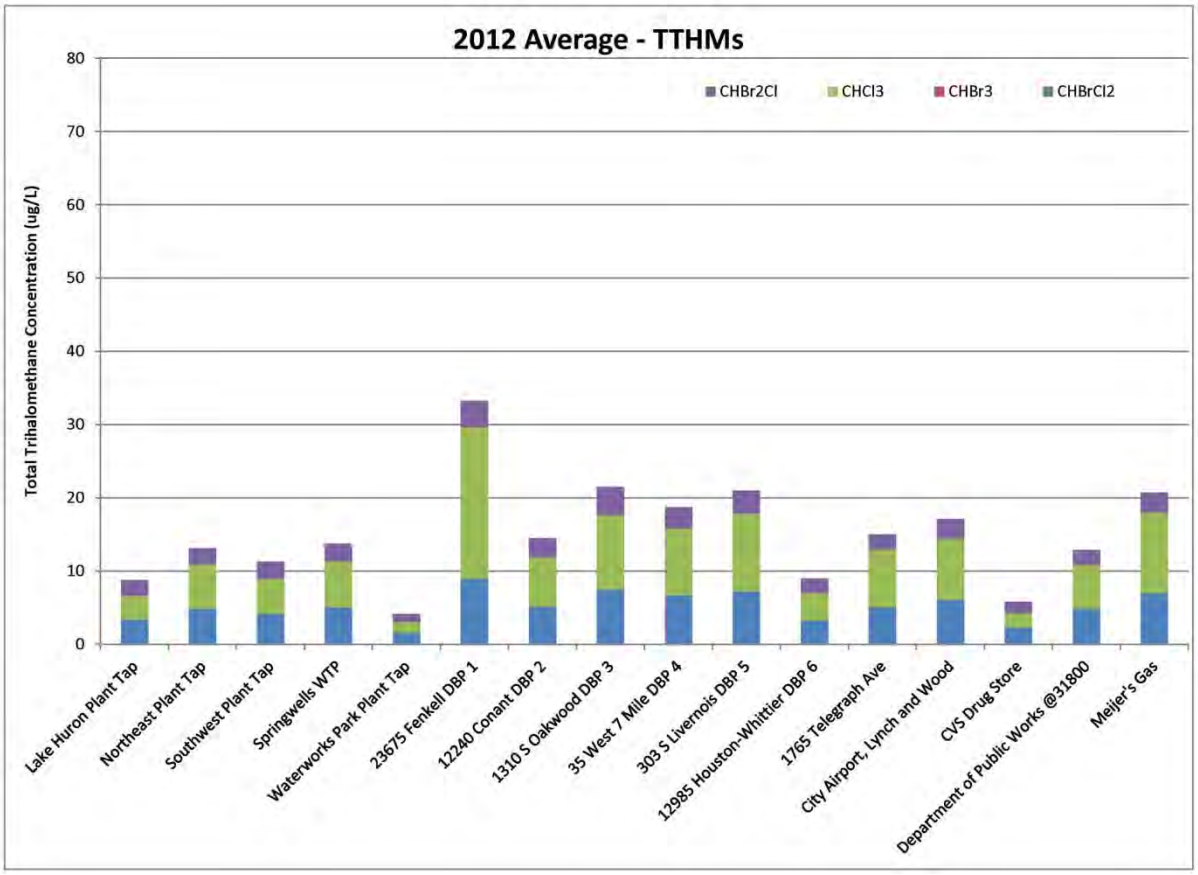


Figure 3-6: Yearly Average TTHMs at Distribution System Locations in 2012

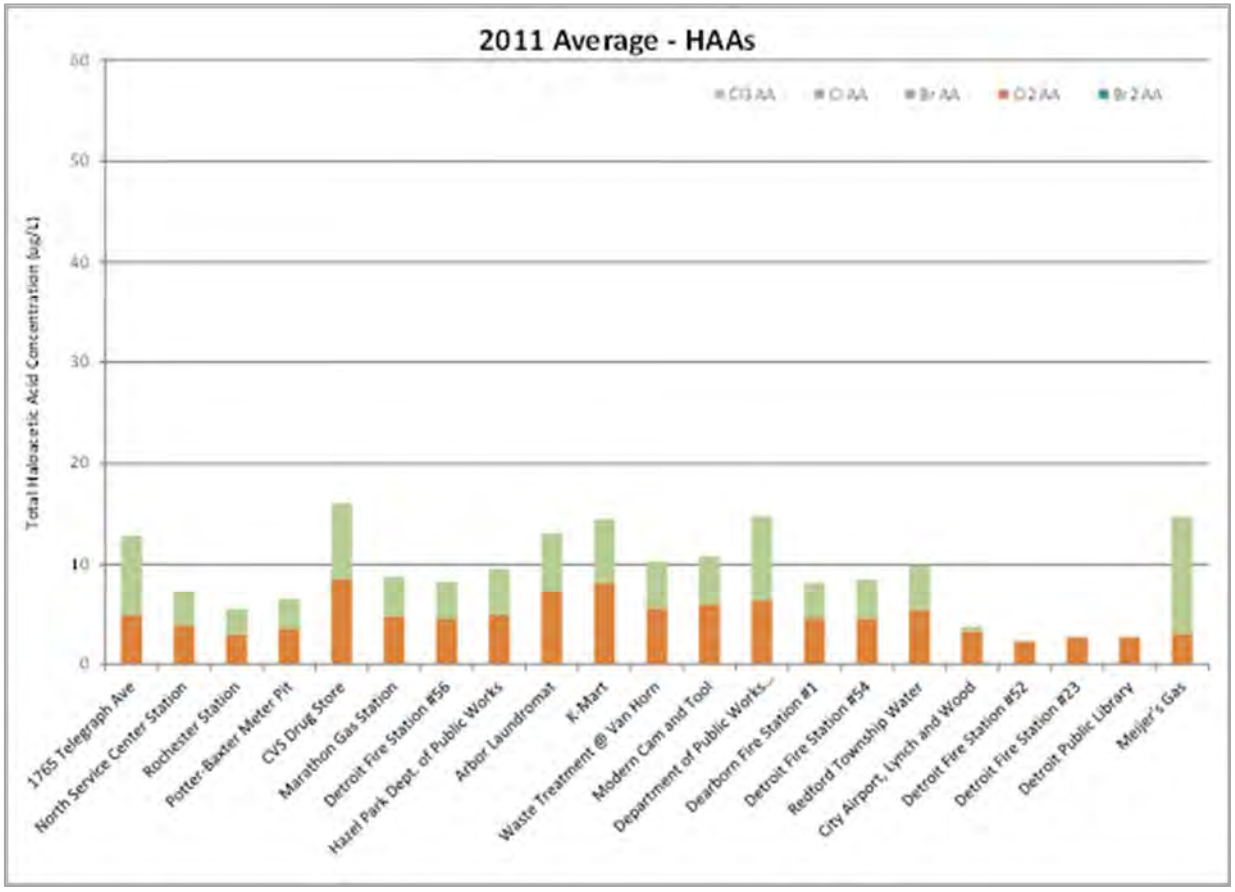


Figure 3-7: Yearly Average HAAs at Distribution System Locations in 2011

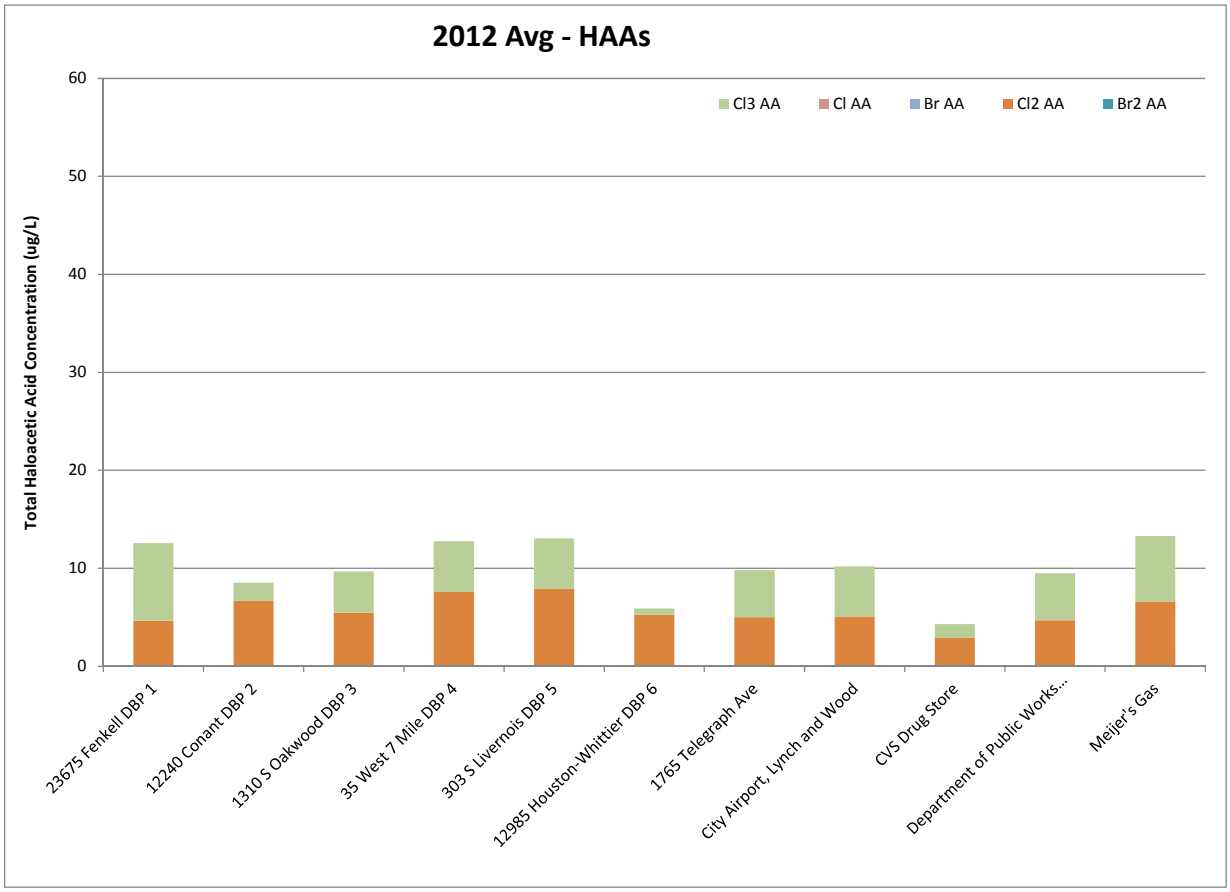


Figure 3-8: Yearly Average HAAs at Distribution System Locations in 2012

Bromide and bromate levels were analyzed for the Water Works Park WTP for 2012. As Water Works Park uses ozone the potential for bromate formation exists due to reactions between the raw water bromide and ozone. As shown in **Figure 3-9**, formation of bromate is below the MCL of 10 µg/L. Formation of bromate appears to be highly temperature dependent as bromate levels increase during the warmer water summer months. During cold water months between October and April, non-detect values were recorded.

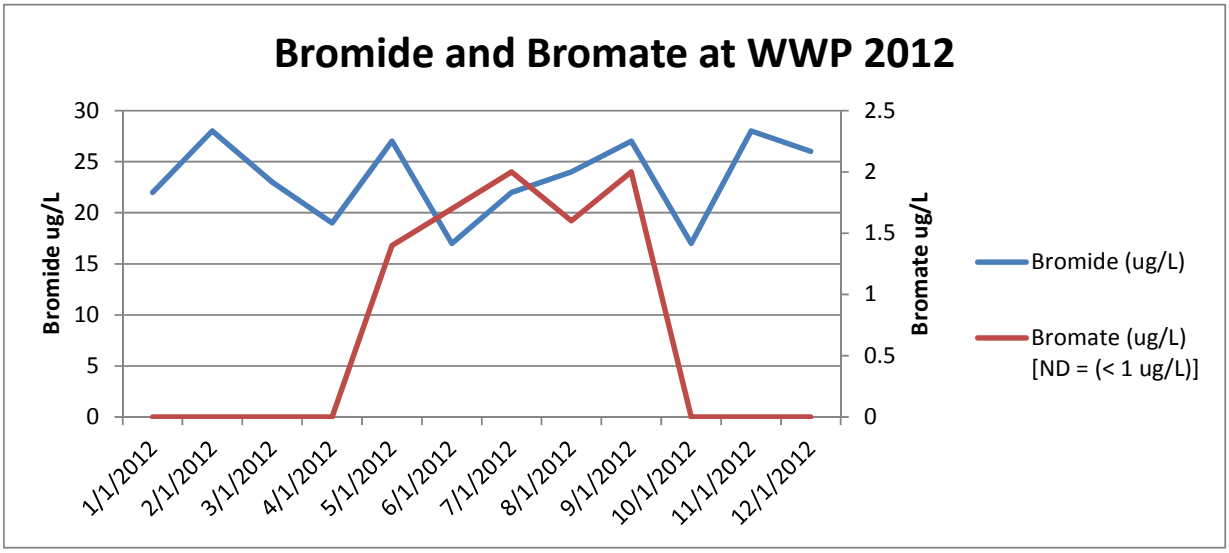


Figure 3-9: Monthly Bromide and Bromate at Water Works Park Finished Water in 2012

3.1.5 DBP Precursors

Total organic carbon DBP precursors are low in DWSDs source water. **Figures 3-10** and **3-11** depict the monthly TOC values in the raw water and treated water of each of DWSDs plants for 2010 - 2013. The raw water TOC values for the Belle Isle (serves Water Works Park, Springwells, and Northeast) on a four-year average basis is 1.82 mg/L. For the Fighting Island intake (serves Southwest), the four-year average TOC value between 2010 and 2013 is 1.95 mg/L and for the Lake Huron intake the four-year average is 1.55 mg/L. On a four-year average basis the five WTPs removed 24%, 22%, 23%, 22%, and 11% of influent TOC for the Water Works Park, Springwells, Northeast, Southwest, and Lake Huron WTPs, respectively. The Fighting Island intake had TOC greater than 2 mg/L as a monthly average in February with a maximum value of 3.2 mg/L.

The Stage 1 Disinfectants and Disinfection By-Products Rule (Stage 1 Rule) does not require a TOC removal in treatment processes if the source water running annual average TOC is below 2.0 mg/L. Despite the single 2013 high reading at the Southwest WTP, DWSD is not required to remove TOC during their treatment processes. Continued monitoring of TOC is recommended to track if TOC levels in the source water are changing over time as this will significantly impact the treatment requirements. Under the Stage 1 Rule 25% TOC removal is required for plants with raw water TOC between 2.0 and 4.0 mg/L and a raw water alkalinity between 60 and 120 mg/L as $CaCO_3$, the range for DWSDs source water alkalinity.

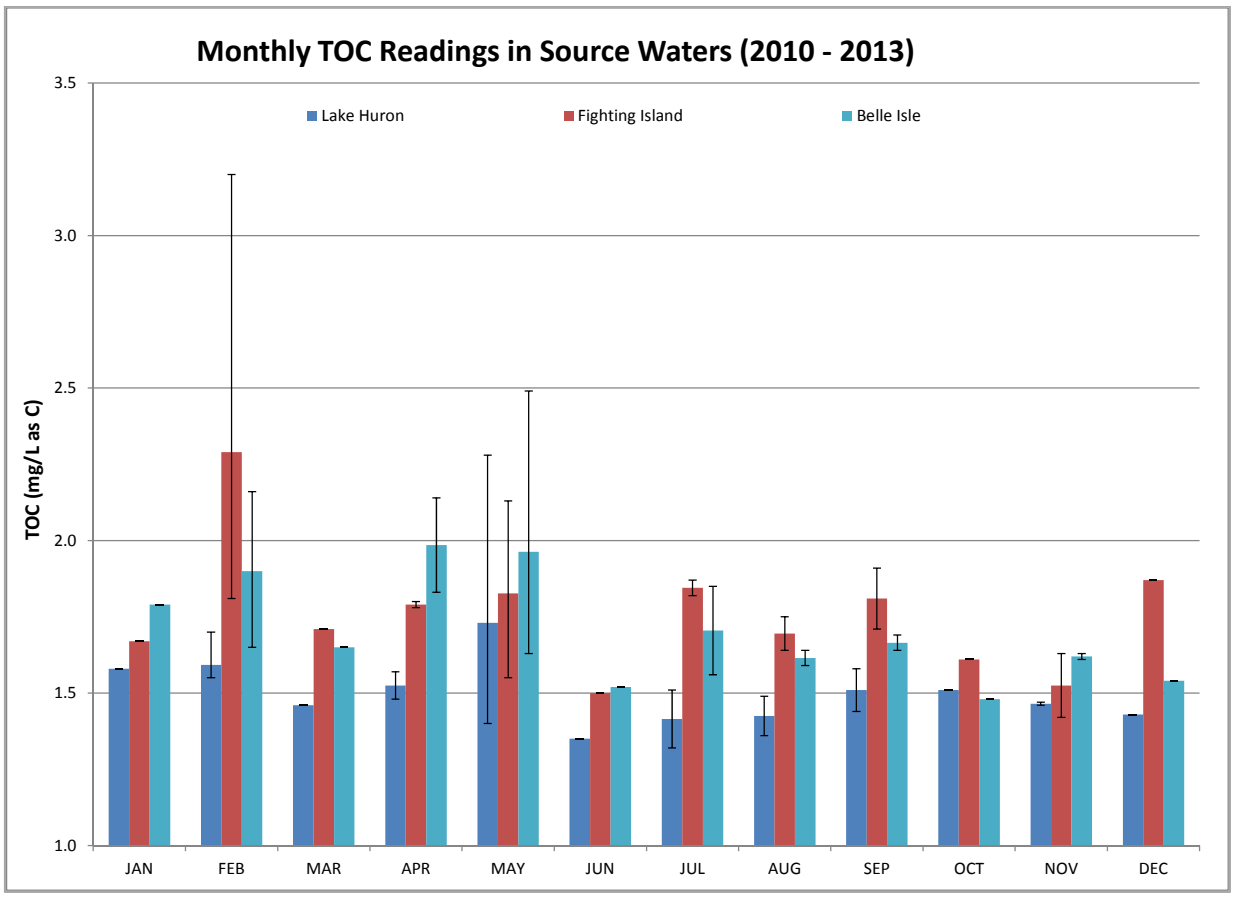


Figure 3-10: Monthly TOC Concentrations in DWSD Source Waters, Average of 2010 to 2013 with Maximum and Minimum Values

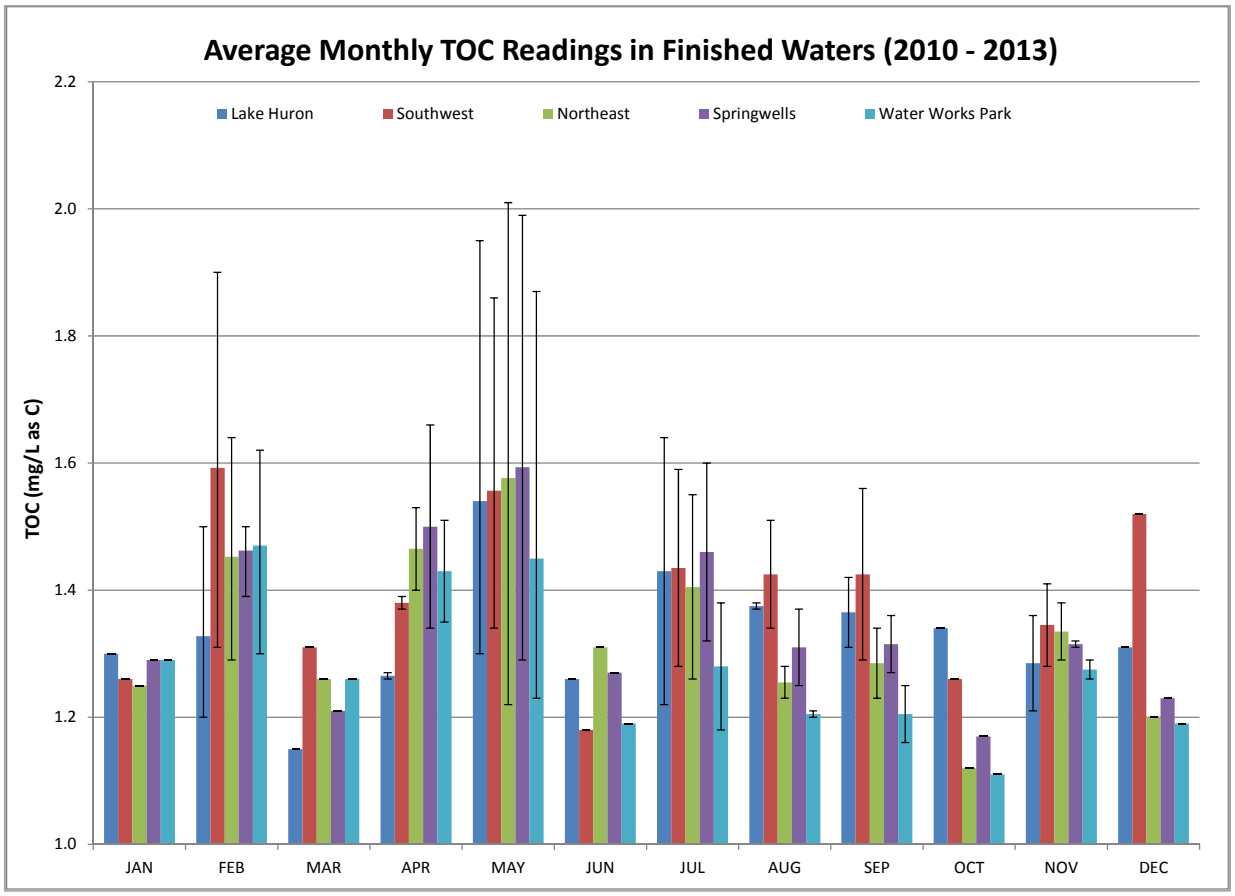


Figure 3-11: Monthly TOC Concentrations in DWSD Finished Waters, Average of 2010 to 2013 with Maximum and Minimum Values

3.1.6 pH

pH data are collected monthly on source and some finished waters as part of the mineral suite of analyses (**Figures 3-12 and 3-12**). Additional data are generated daily at each water treatment plant and reported in the Monthly Operations Report (MOR) to the MDEQ. The high pH value observed in the monthly data from April 2011 data at Lake Huron is not confirmed by the daily data. The MOR indicates a pH range of 8.1 to 8.2 for that month. The low pH value observed in the monthly data from August 2012 at Belle Isle is also not confirmed by the daily data. Per that data set, the pH is reported as ranging from 8.0 to 8.5. Therefore, these values from either the monthly or daily data are suspect.

In the finished water, only three of the five water treatment plants are currently analyzed for pH per the monthly data set. The monthly data range from 7.2 to 8.2. This variability is observed to a lesser extent in the daily data from the MORs where pH is monitored in the finished water. Improving the consistency of the finished water quality in terms of pH has the potential to improve distribution system corrosion, chlorine speciation and residual stability, DBP formation and other factors. Further evaluation of pH variability and stabilization of finished water quality is recommended.

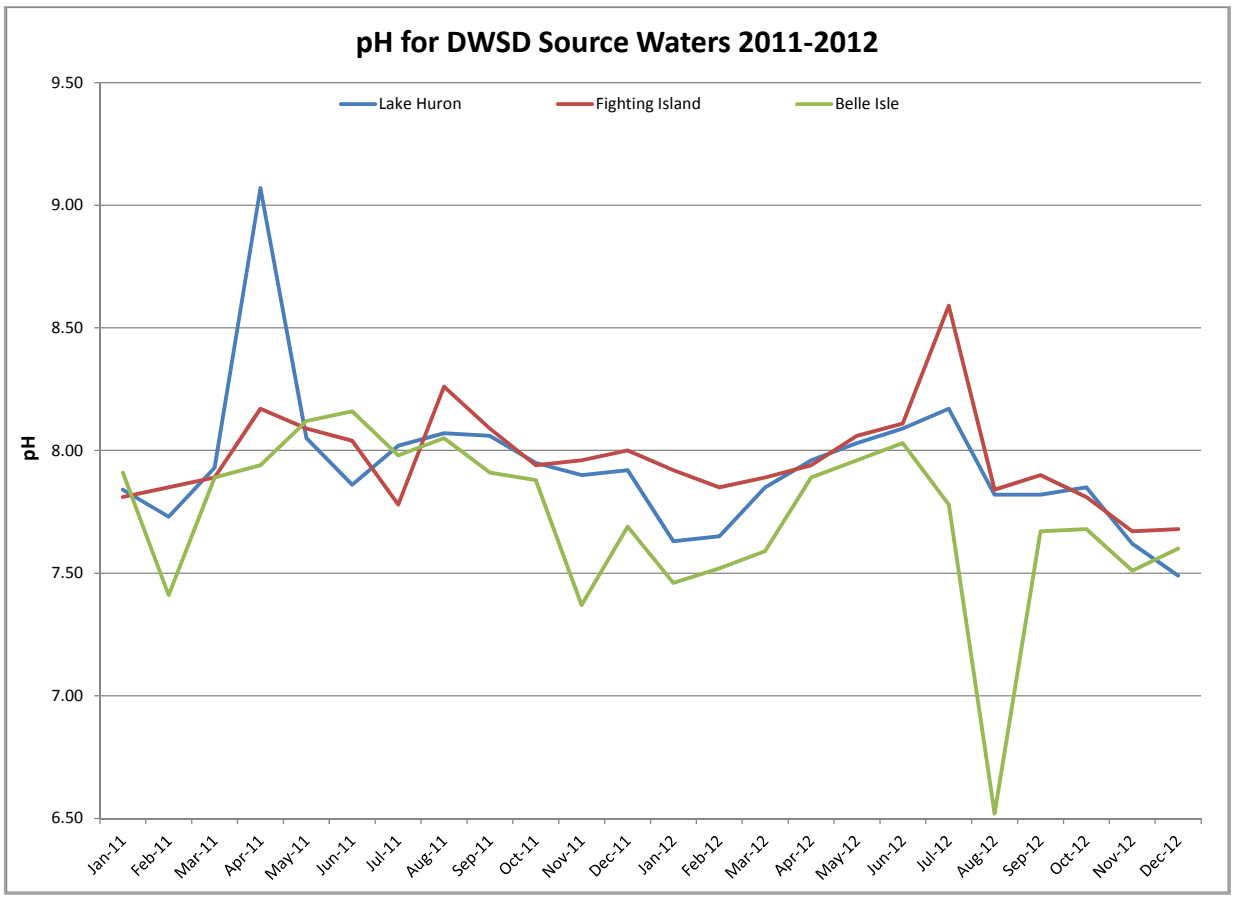


Figure 3-12: Monthly pH in DWSD Source Waters

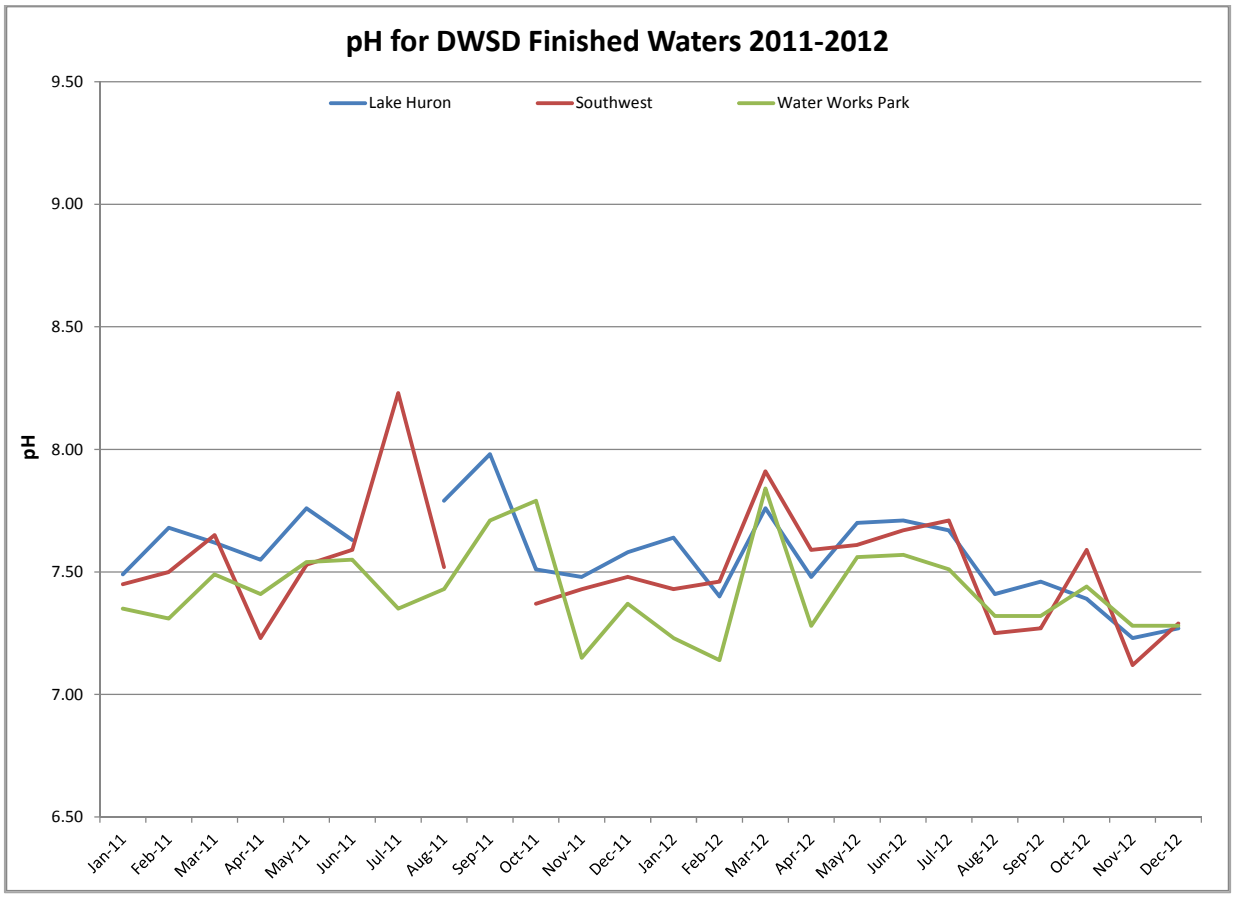


Figure 3-13: Monthly pH Concentrations in DWSD Finished Waters

3.1.7 Alkalinity

Alkalinity is measured monthly as part of the set of mineral analyzes in both the source and some finished waters (**Figures 3-14 and 3-15**). It is also measured as part of the LCR water quality parameter monitoring, when TOC is collected and sometimes during customer complaint investigations. Alkalinity in the source water varies from 80 to 100 mg/L. Similar to pH, the high value of over 120 mg/L alkalinity observed in January, 2012 is not confirmed by the daily data. In the finished waters, alkalinity varies from 70 to 105 mg/L. The mineral analysis sets are only monitored at three of the WTPS. Alkalinity is also measured daily at the individual treatment plants.

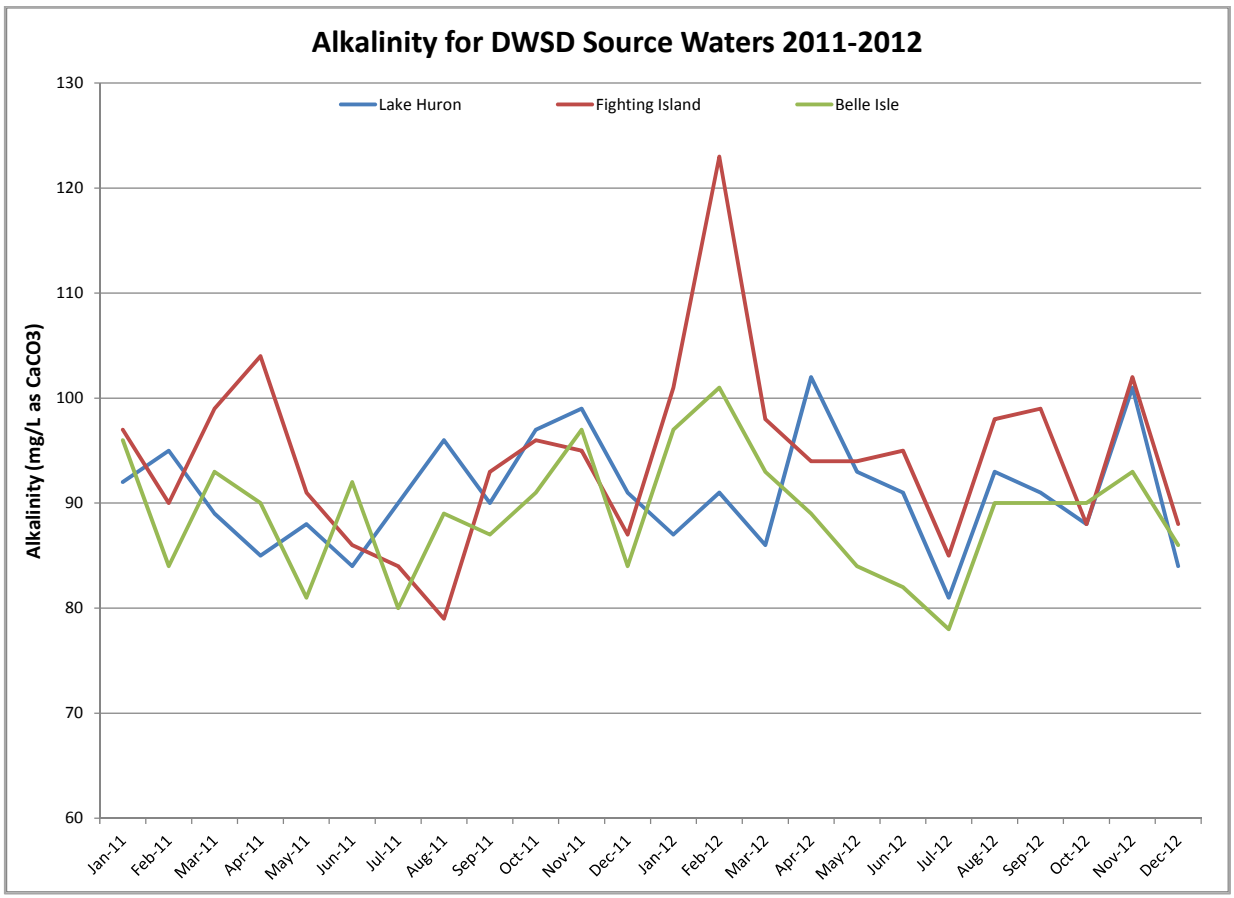


Figure 3-14: Monthly Alkalinity Concentrations in DWSD Source Waters

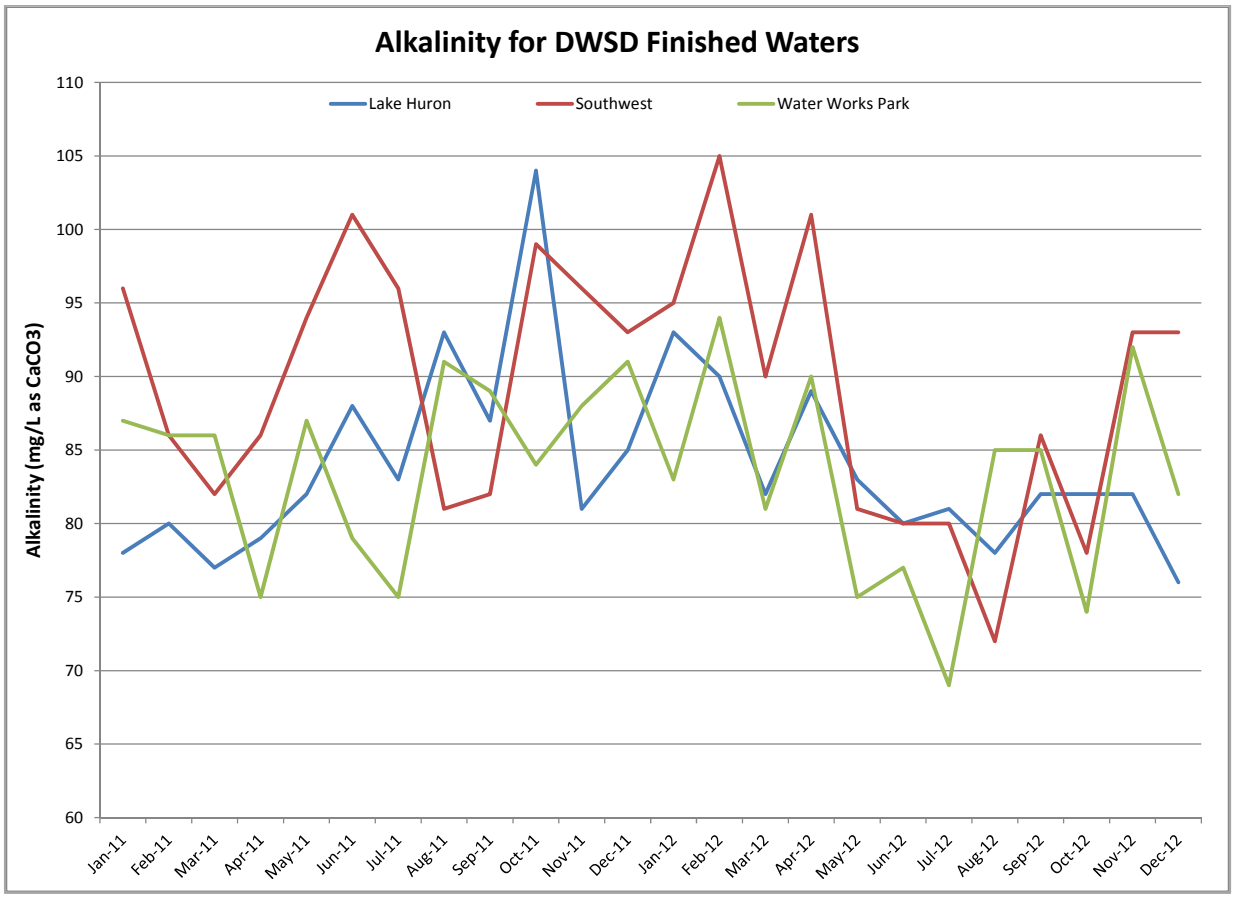


Figure 3-15: Monthly Alkalinity Concentrations in DWSD Finished Waters

3.1.8 Hardness

Total hardness is measured monthly as part of the set of mineral analyzes in both the source and some finished waters (**Figures 3-16 and 3-17**). Hardness, both total and non-carbonate, is also measured daily at the individual treatment plants. Hardness in the source water varies from 100 to 120 mg/L. Similar to pH and alkalinity, the high value of over 130 mg/L hardness observed in January, 2012 is not confirmed by the daily data. However, it is noted that these parameters were all high in the same sample suggesting that either this sample captured a unique set of water quality or that the sample procedure was compromised. In the finished waters, hardness varies from 100 to 115 mg/L. The Southwest water treatment plant shows high excursions of 130 to over 160 mg/L. These high values do not reflect the source water data. Either there is an additional source of hardness being contributed by the treatment process or the data are suspect.

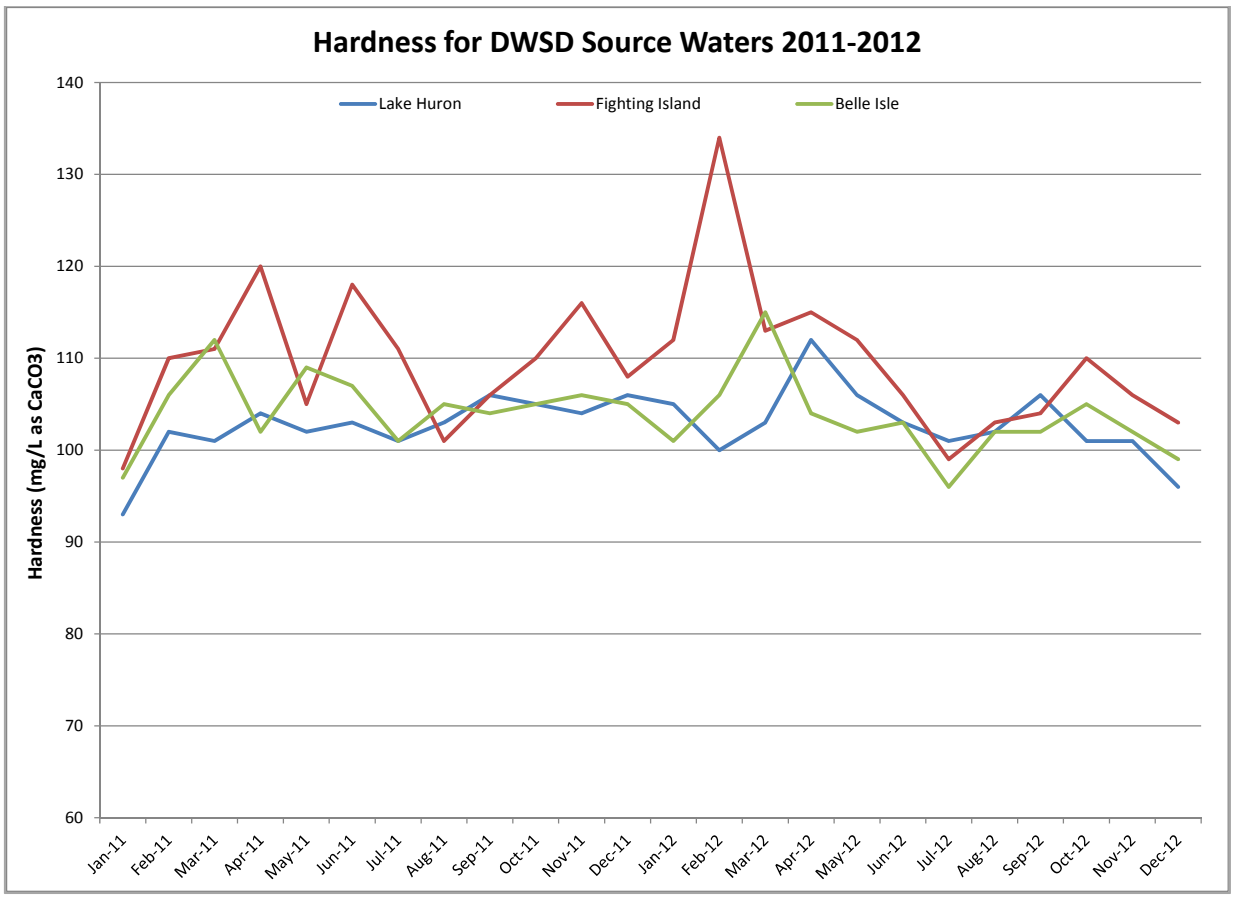


Figure 3-16: Monthly Hardness Concentrations in DWSD Source Waters

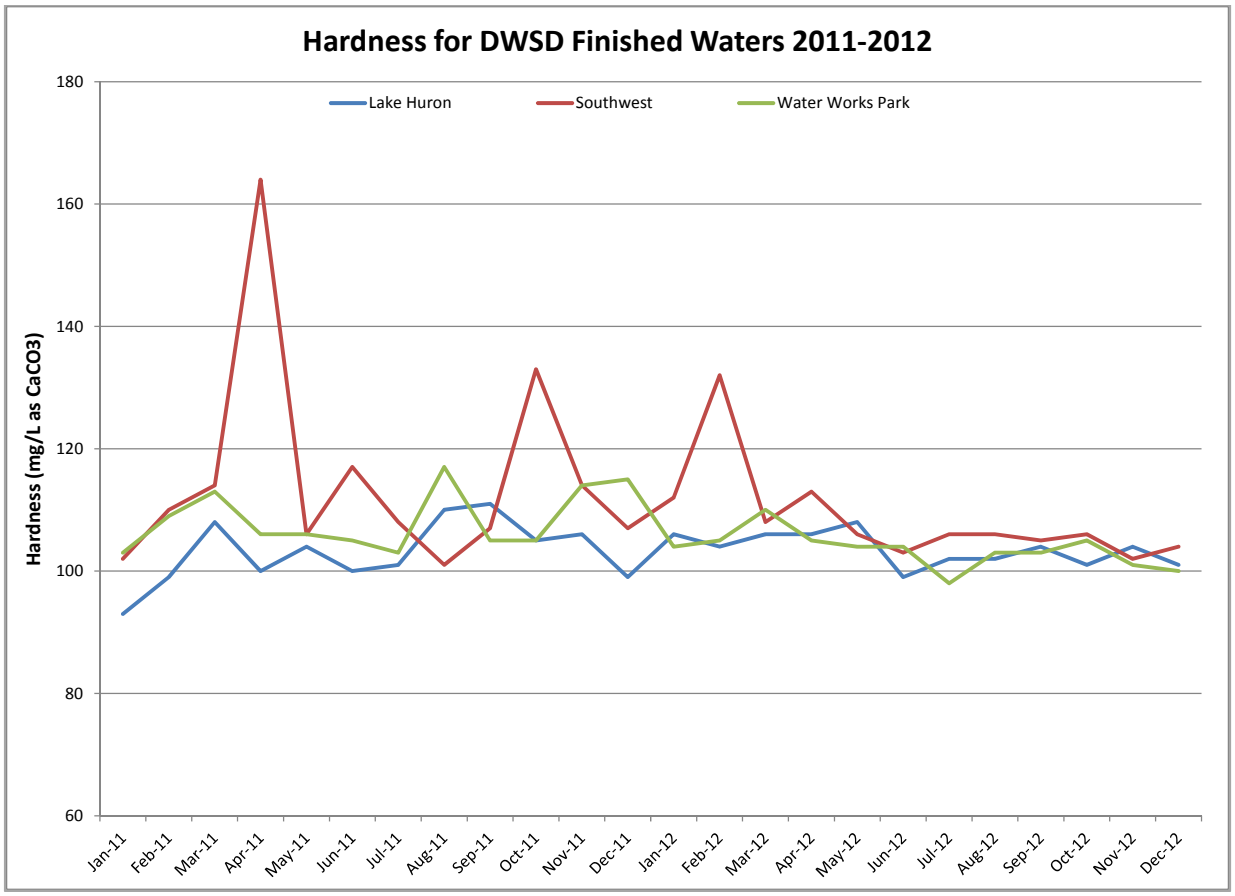


Figure 3-17: Monthly Hardness Concentrations in DWSD Finished Waters

3.1.9 Corrosion Indices

Lead and Copper Rule data and compliance is discussed in TM-9 Drinking Water Regulations Present and Future. Detroit has had challenges with lead levels in the past. Because the exact nature of the piping materials in the various DWSD customer communities is not known, a complete picture of the origins of the lead readings is difficult to ascertain. However, a limited assessment can be made based on the nature of the finished water quality received by each community. Thirty-nine total communities reported lead data other than zero. Of those 39 communities 15 received water from Southwest, 6 from Springwells, 7 from Northeast, 6 from Lake Huron, 2 from both Lake Huron and Northeast, 2 from both Springwells and Southwest, and 1 from Water Works Park, Springwells, and Northeast (Detroit).

An analysis of water corrosivity was conducted using the WTPs' finished water qualities for 2011 and 2012 using the monthly mineral analyzes. Average data for both years for the Lake Huron, Southwest, and Water Works Park WTPs was calculated. No mineral data are reported for the Northeast and Springwells WTPs. A commercial software package, WaterPRO, was utilized to calculate several industry accepted standards for analysis of water corrosivity. WaterPRO uses total dissolved solids (TDS, mg/L), calcium (mg/L), total alkalinity (mg/L as $CaCO_3$), pH, water temperature, chloride (mg/L), sulfate (mg/L), and magnesium (mg/L) as inputs. With these inputs WaterPRO can calculate the following corrosion indices:

- Langelier Saturation Index (LSI): Recommended values between 0.2 and 0.3, values above this may cause excess precipitation of calcium carbonate and values below are potentially corrosive.

- Calcium Carbonate Precipitation Potential (CCPP): Recommended values between 4 and 10 mg/L as $CaCO_3$. This parameter indicates the degree to which calcium carbonate will precipitate, values below zero will tend to dissolve calcium carbonate and can be considered corrosive, while values above zero will deposit varying degrees of calcium carbonate film, generally considered to yield resistance to corrosion.

- Larson's Ratio: The Larson's Ratio is the ratio of alkalinity to the sum of the chloride and sulfate concentrations. The Larson Ratio is used when assessing the corrosiveness of water to iron and potentially lead. Depending on the source, a Larson's Ratio of above 2.0 is targeted as an optimal range (Imran et al., 2005). Values below 2.0 are considered corrosive whereas above 2.0 the waters are considered non-corrosive in the absence of other parameters which may render the water corrosive.

Tables 3-3, 3-4 and 3-5 show the input data entered into WaterPRO to assess the corrosivity of the DWSD finished water.

Table 3-3: Summary of Input Data for WaterPRO for Water Works Park WTP

Parameter	Units	Spring	Summer	Fall	Winter
TDS	mg/L	144	157	139	134
Calcium	mg/L	28	26	26	26
Total Alkalinity	mg/L as $CaCO_3$	82	79	85	87
pH	--	7.52	7.46	7.45	7.28
Temperature	^oC	11.5	23.2	17.8	9.5
Chloride	mg/L	8.5	9.1	9.1	10.2
Sulfate	mg/L	31.2	31.2	31.2	31.2
Magnesium	mg/L	8.2	7.7	7.6	8.1

Table 3-4: Summary of Input Data for WaterPRO for Lake Huron WTP

Parameter	Units	Spring	Summer	Fall	Winter
TDS	mg/L	123	140	123	118
Calcium	mg/L	26	27	25	25
Total Alkalinity	mg/L as $CaCO_3$	82	84	86	84
pH	--	7.65	7.64	7.51	7.51
Temperature	^oC	13.6	22.4	19.9	13.7
Chloride	mg/L	6.7	8.8	8.7	8.7
Sulfate	mg/L	25.4	21.8	32.6	44.5
Magnesium	mg/L	7.6	7.7	7.5	7.6

Table 3-5: Summary of Input Data for WaterPRO for Southwest WTP

Parameter	Units	Spring	Summer	Fall	Winter
TDS	mg/L	152	146	136	133
Calcium	mg/L	30	26	26	27
Total Alkalinity	mg/L as $CaCO_3$	89	85	89	95
pH	--	7.59	7.66	7.36	7.44
Temperature	^oC	9.4	22.9	16.4	4.70
Chloride	mg/L	9.8	9.8	10.4	11.0
Sulfate	mg/L	39.1	26.7	32.8	36.6
Magnesium	mg/L	8.7	8.2	7.7	8.2

Based on the corrosion indices calculated for the input data listed in **Tables 3-3, 3-4 and 3-5**, the output results in **Tables 3-6, 3-7 and 3-8** show that the effluent for the DWSD water plants is in the range of indices that could be considered corrosive as they are below 0.2 for LSI and below 4.0 mg/L as $CaCO_3$ for CCPP. The Larson's Ratio for the Lake Huron WTP is acceptable during the spring and summer; the Southwest WTP also shows acceptable Larson's Ratio values during the summer. However, for the rest of the year for the Southwest and Lake Huron and for all seasons investigated at Water Works Park, the Larson's Ratio is below the optimum value of 2.0. These results are consistent with intermittent reports of rusty water in the distribution system. Unlined cast iron pipe and areas of high water age are the most prone to rusty water. In addition, high water age can alter the water quality and thus impact the corrosion indices. Distribution system water quality was not available to perform corrosion analyses and to compare to finished water. For all plants the indices decrease substantially under colder water conditions.

Despite the greater incidence of lead readings at the Southwest plant based on the 90^{th} percentile data, water from the Southwest WTP is not more corrosive than the other WTP finished water, based on analysis of the corrosion indices alone. As a result, there may not be correlation between the lead levels and finished water quality when only analyzing those two parameters alone. Other factors may play a greater role. It is recommended that the use of phosphate as a corrosion inhibitor to control lead is appropriate.

Table 3-6 Summary of Output Data for WaterPRO for Water Works Park WTP

Parameter	Units	Reference Value	Spring	Summer	Fall	Winter
pH	--	--	7.52	7.46	7.45	7.28
LSI	--	0.2 – 0.3	-0.63	-0.58	-0.62	-0.91
CCPP	mg/L as $CaCO_3$	4.0 – 10.0	-9.42	-8.12	-9.93	-19.7
Larson's Ratio	NA	> 2.0	1.8	1.7	1.9	1.9

Table 3-7: Summary of Output Data for WaterPRO for Lake Huron WTP

Parameter	Units	Reference Value	Spring	Summer	Fall	Winter
pH	--	--	7.65	7.64	7.51	7.51
LSI	--	0.2 – 0.3	-0.49	-0.36	-0.54	-0.64
CCPP	mg/L as $CaCO_3$	4.0 – 10.0	-6.14	-4.46	-7.97	-9.56
Larson's Ratio	NA	> 2.0	2.3	2.4	1.9	1.4

Table 3-8: Summary of Output Data for WaterPRO for Southwest WTP

Parameter	Units	Reference Value	Spring	Summer	Fall	Winter
pH	--	--	7.59	7.66	7.36	7.44
LSI	--	0.2 – 0.3	-0.54	-0.34	-0.71	-0.77
CCPP	mg/L as $CaCO_3$	4.0 – 10.0	-8.34	-4.23	-13.5	-16
Larson's Ratio	NA	> 2.0	1.6	2.0	1.8	1.8

Examination of the figures in Section 3 illustrates the variability in some of the water quality parameters that impact corrosion indices. Assuming all other water quality parameters remain the same an increase in hardness results in an increase in the LSI and CCPP with no effect on the Larson's Ratio. Increasing alkalinity causes the LSI to increase, the CCPP to decrease, and the Larson's Ratio to increase. Increasing pH leads to an increase in both the LSI and CCPP with no change in the Larson's Ratio. The fluctuations observed throughout the year in the finished and raw water may thus impact the corrosivity of the water, however additional data on corrosion observations is required to confirm or disprove this observation.

While monthly mineral data were not available for Springwells and Northeast, the finished water for those plants has a slightly lower alkalinity than Water Works Park. As discussed previously, for a decrease in alkalinity and assuming all other water quality parameters are the same as Water Works Park, the LSI is slightly lowered, however the CCPP increases slightly.

3.1.10 Plankton and Algae

DWSD has indicated their concern with *Cyanobacteria* (blue-green algae) in the raw water of their WTPs, specifically at Fighting Island intake to the Southwest WTP. Plankton data, including blue-green algae counts, is analyzed on a twice per week basis in the WTPs' raw waters. Since two of these WTPs receive water with a significant chlorine contact time (Northeast and Springwells), those results would be expected to be low due to degradation of the algal cells. **Figure 3-17 and Figure 3-18** show the monthly average Cyanobacteria concentrations for the Lake Huron, Belle Isle (Water Works Park) and Fighting Island (Southwest). Data recorded between 2005 and 2013 were analyzed. Lake Huron data are discussed in Section 6.

Cyanobacteria counts are typically low. At the Fighting Island intake, cyanobacteria average in single digits with peak values of up to 100/mL. However, verbal reports from staff at Southwest indicated that up to 60% of the total algae are Cyanobacteria during the summer months. *Actinomycetes* has

also been reported to be present and to cause taste and odor, but no data were available. At the Belle Isle intake, cyanobacteria are not usually in seven months of the year on average. They are detected in February, March, April, May and September with average counts below 20 per mL. The peak result reported was 300 per mL in March.

There is no EPA primary or secondary standard for Cyanobacteria, however to minimize the impact on water quality Cyanobacteria counts are recommended to be below 1,000 counts/mL (Kawamura, 2000). Over the eight years of investigation, DWSD is consistently below this recommendation. Blooms of this algae have been reported on the Canadian side of the Detroit River but have not yet reached the DWSD intakes according to DWSD's data. Vigilance in monitoring this organism is recommended.

DWSD has also reported large clumps of filamentous algae on the flocculation paddles at Springwells in the past. These algae were bleached indicating that they had been damaged by the chlorine contact time. The algae were identified as *Cladaphora*, *Spirogyra* and *Lynbia*.

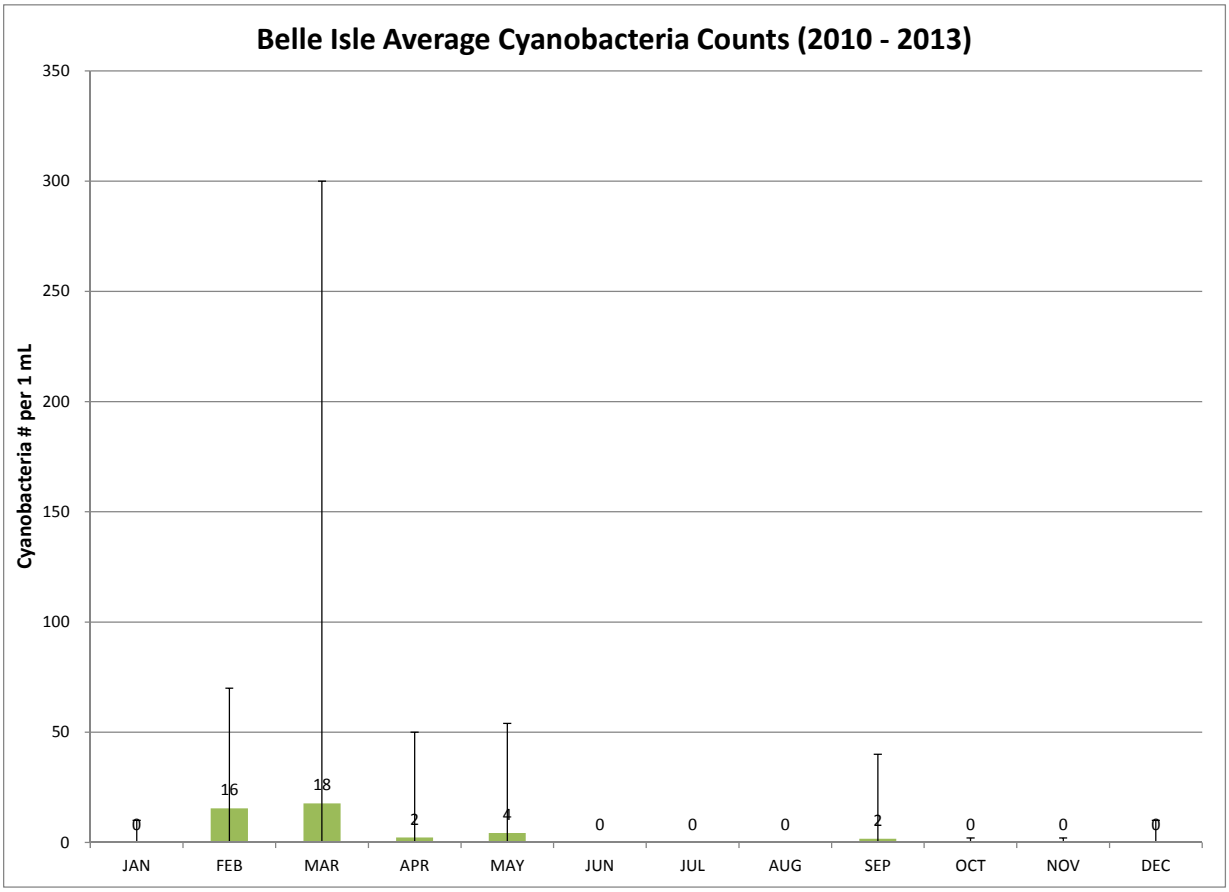


Figure 3-17: Monthly Cyanobacteria Concentrations in Belle Isle Intake Water

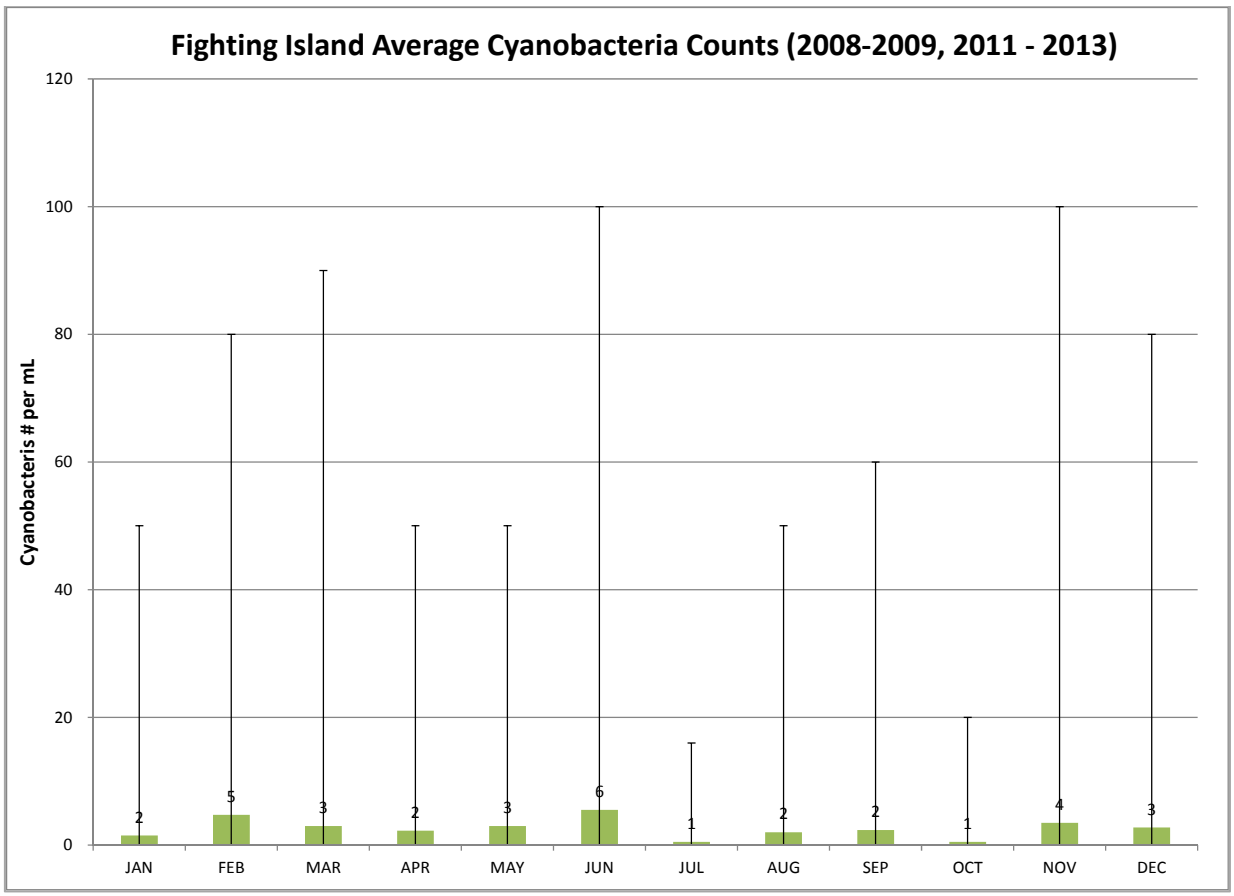


Figure 3-18: Monthly Cyanobacteria Concentrations in Fighting Island Intake Water

3.1.11 Aluminum

Aluminum is regulated under the EPA secondary standards (see TM-9 Drinking Water Regulations Present and Future). Aluminum is monitored monthly in both the source waters and the finished waters at three of the WTPs as part of the "mineral" set of analyses. Aluminum is also important to evaluate as DWSD uses alum for coagulation. Excess aluminum from either the source water or coagulation can create precipitation issues such as observed in the past at Springwells WTP. The source water aluminum concentrations vary over time and can be significant (**Figure 3-19**). Aluminum in the finished waters is lower but does sometimes exceed the secondary standard of 0.2 mg/L (**Figure 3-20**).

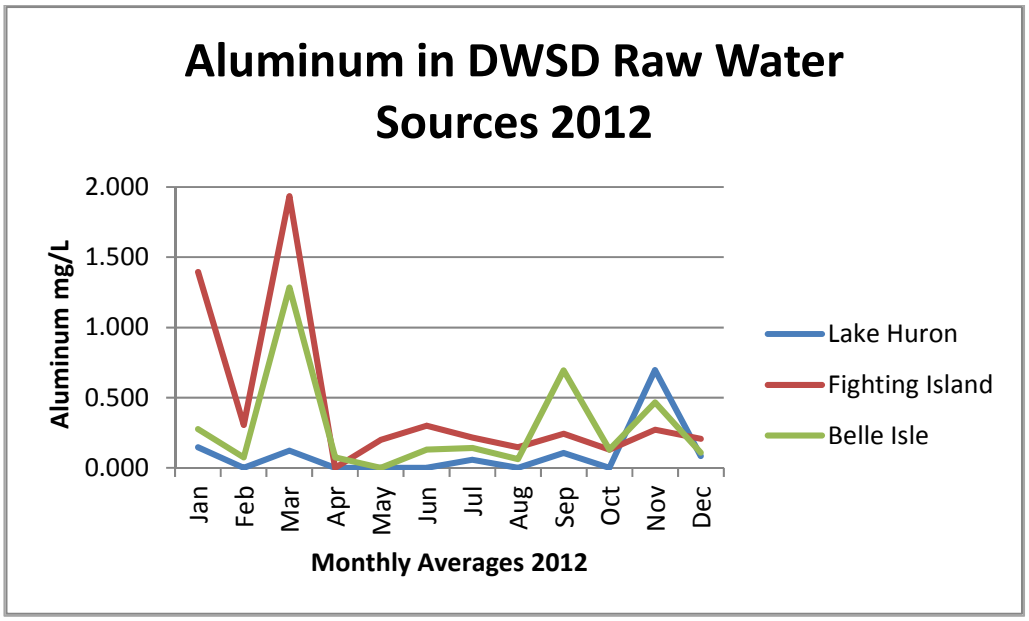


Figure 3-19: Monthly Aluminum Concentrations in Source Waters

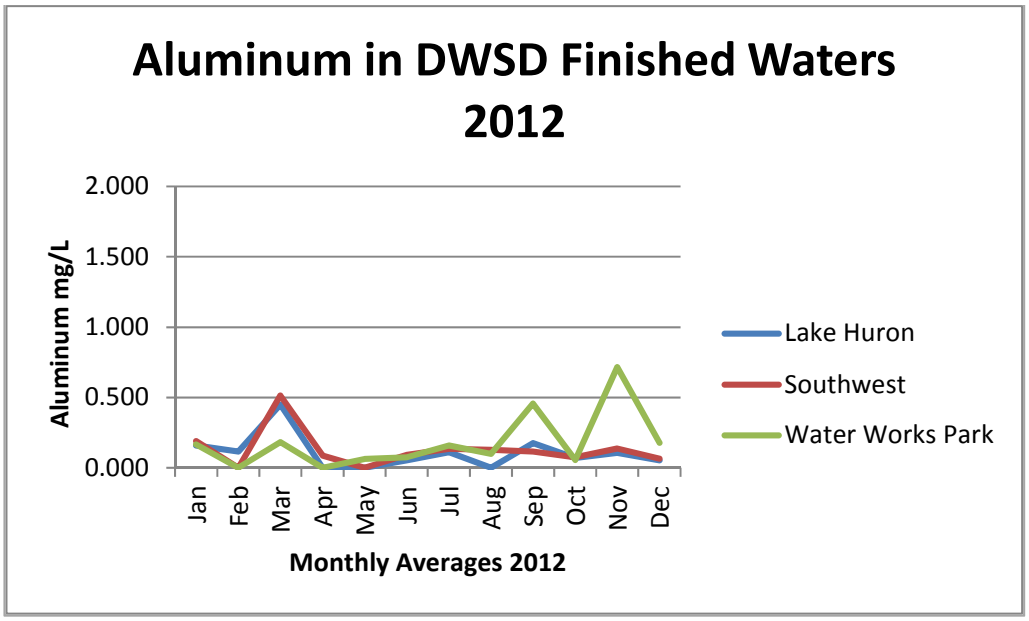


Figure 3-20: Monthly aluminum Concentrations in DWSD Finished Waters

3.1.12 Iron

Iron samples are collected monthly from the source waters and three of the water treatment plants as part of the mineral analysis set. Iron is regulated under the EPA secondary standards (see TM-9 Drinking Water Regulations Present and Future). Iron is important as an aesthetic issue as customers will notice discolored water if the concentration is above the recommended limit of 0.2 mg/L. In DWSD's source waters, iron varies up to 1.1 mg/L (**Figure 3-21**). In the finished waters, iron is often below 0.2 mg/L but does have some higher excursions at both Lake Huron and Water Works Park **(Figure 3-22)**.

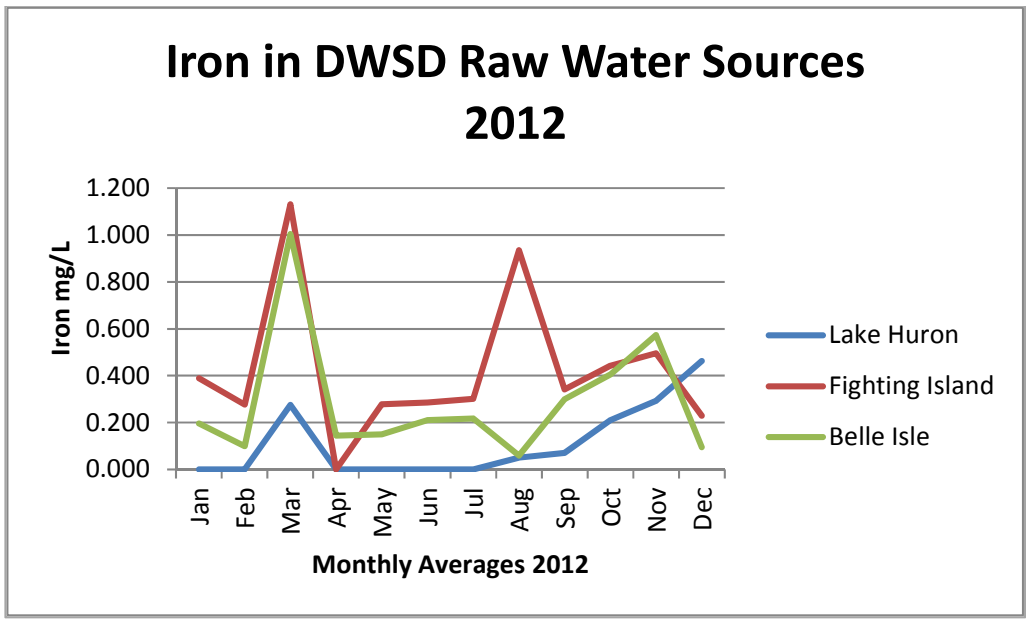


Figure 3-21: Monthly Iron Concentrations in Source Waters

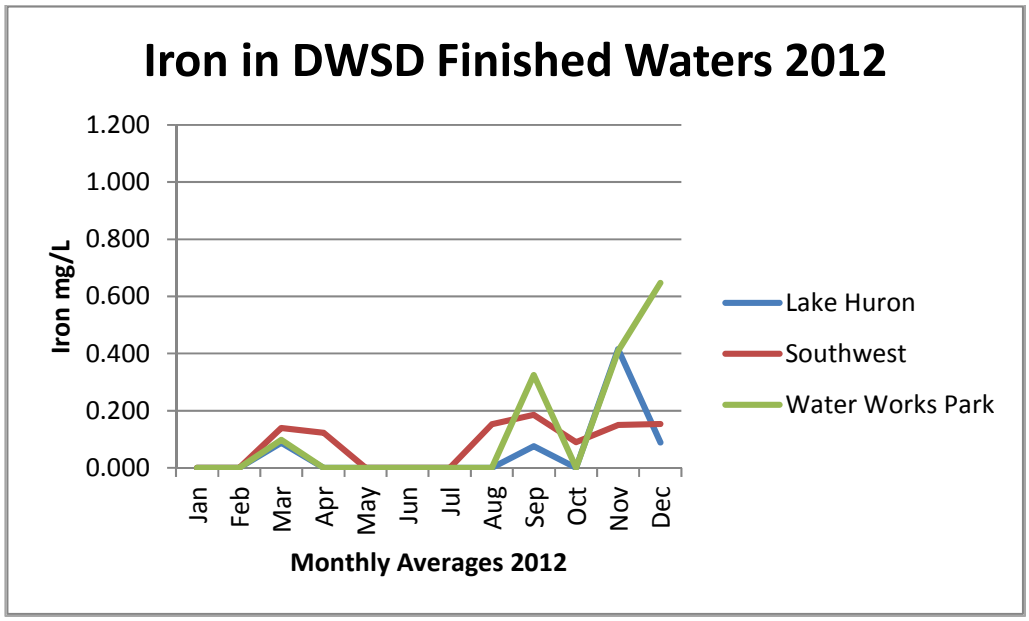


Figure 3-22: Monthly Iron Concentrations in DWSD Finished Waters

3.1.13 Manganese

Manganese samples are collected monthly from the source waters and three of the water treatment plants as part of the mineral analysis set. Manganese is regulated under the EPA secondary standards (see TM-9 Drinking Water Regulations Present and Future). Manganese is important as an aesthetic issue as customers will notice discolored water if the concentration is above the recommended limit of 0.05 mg/L. In DWSD's source waters, manganese varies up to 0.012 mg/L (**Figure 3-23**). In the finished waters, manganese is less than 0.003 mg/L (**Figure 3-24**). Manganese does not appear to be issue for DWSD's source and finished waters.

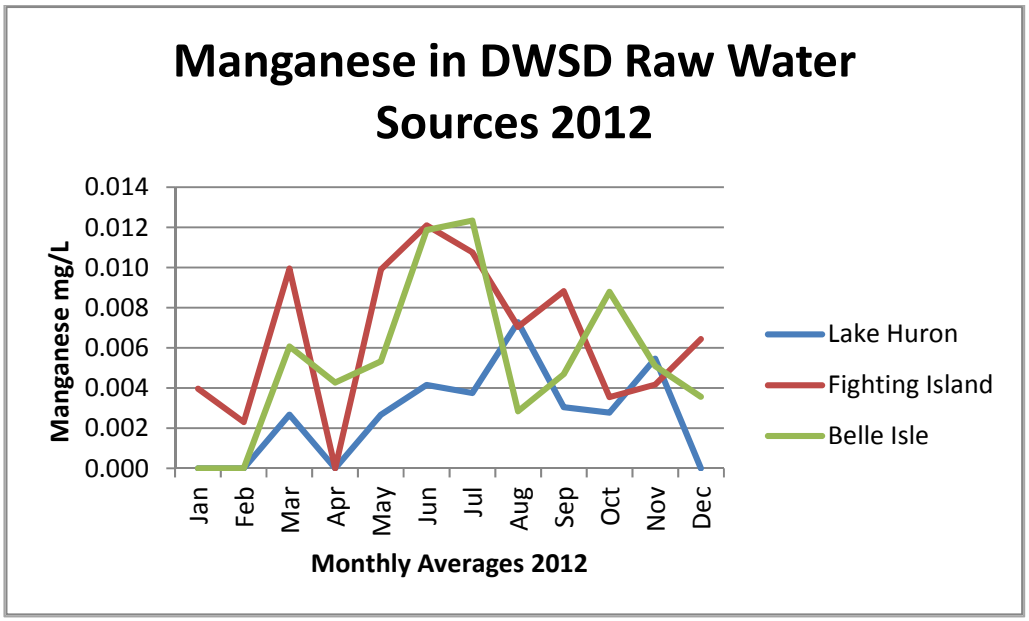


Figure 3-23: Monthly Manganese Concentrations in Source Waters

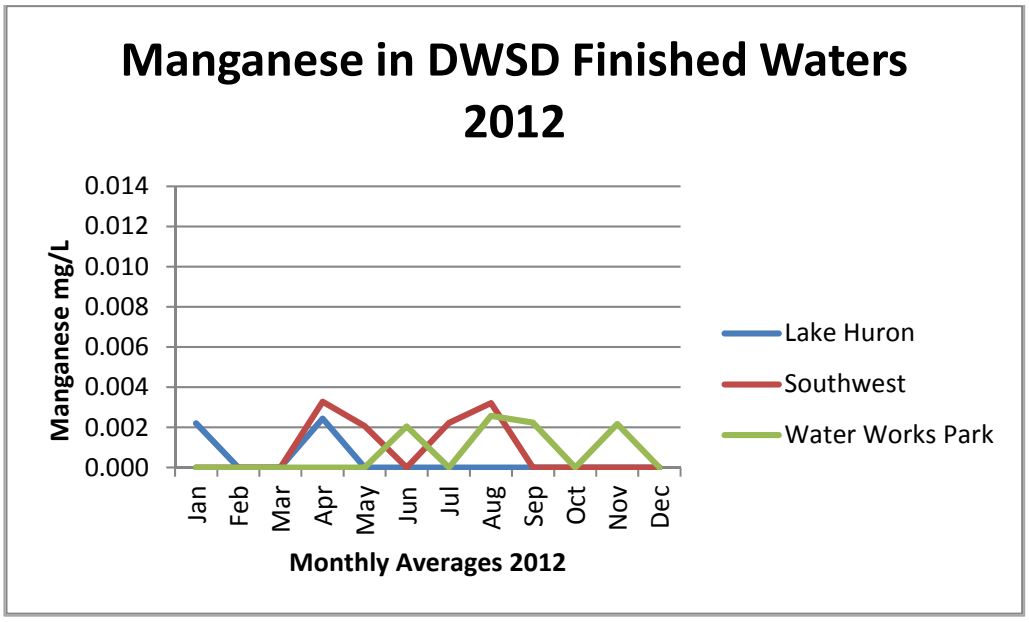


Figure 3-24: Monthly Manganese Concentrations in DWSD Finished Waters

3.1.14 Taste and Odor

In 1990, DWSD received over 400 customer calls of taste and odor in one day. The odor was determined to be related to the invasion of zebra mussels and their resulting impact on algal populations. Both geosmin and MIB (2-methylisoborneol) were detected in the drinking water. These odors are typically associated with *Actinomycetes* and Cyanobacteria blooms. While this odor issue resolved itself after a couple of years, the potential for a reoccurrence remains a concern. Taste and odor are not a current issue, but it is recommended that continued assessment and vigilance be conducted.

4.0 Staff Organization

Water quality monitoring is performed by the water quality group and by staff at each WTP. The Water Master Plans Needs Assessment Survey (2013) requested a description of staff at each facility. Per the results of this survey, the following positions were identified as performing water quality analyses and their approximate percent of time performing water quality is listed:

- Water Quality Division Manager II (one – 100%)
- Principal Analytical Chemist (one – 100%)
- Senior Analytical Chemist (one – 100%)
- Microbiologist (one – 100%)
- Senior Water Distribution System Investigator (one – 100%)
- Water System Investigator (two _ 100%)
- Assistant Water System Investigator (one – 100%)
- Senior Chemist (four per each water plant, 80% at Lake Huron WTP and 65% at other WTPs)

This organization creates a total staff of 21.6 FTE (full time equivalent) water quality personnel when adjusted for percent of time spent on water quality. Remaining time is spent on plant operations and maintenance.

In a study conducted by CDM Smith in 2012, a comparison of population served versus number of water quality staff was evaluated. A significant correlation was observed between these parameters based on the seven utilities surveyed (**Figure 4-1**). This correlation is based on the size of the population served. DWSD serves approximately 3.6 million people. DWSD performs all water quality analyses for the WTPs but only for a portion of the distribution system. Therefore, the population was adjusted downwards to 80 to 90 percent of the total population served to allow for the portions of the distribution system which are monitored by the wholesale communities rather than DWSD. Using this correlation, it is estimated that 30 to 34 FTE's would be an appropriate staffing level for DWSD water quality personnel. This survey did note that two of the utilities were planning on a staff increase in the near future. Comparing the current FTE's to the predicted FTE's, it is observed that DWSD staff may be low by 8 to 12 FTE's.

It is also recommended that a team of water quality personnel form the water quality group and all WTPs be established to facilitate discussion and coordination of activities. Wholesale community representatives could also be included when relevant topics are addressed.

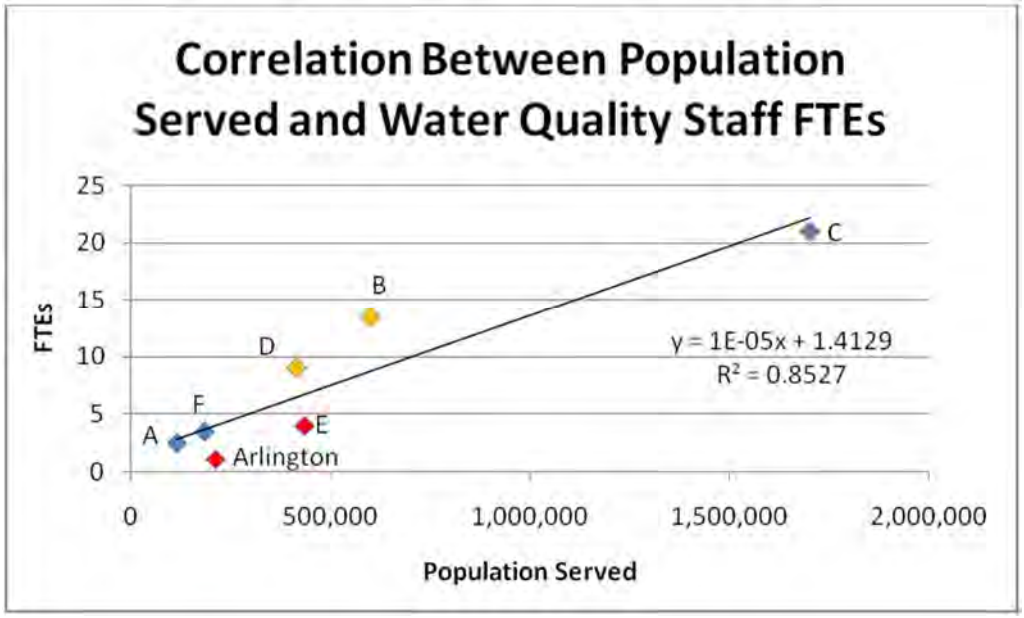


Figure 4-1: FTE versus Population for Surveyed Utilities

5.0 Recommendations on Water Quality Monitoring and Assessment

The following recommendations and projects are offered relating to water quality monitoring and assessment. These recommendations are not necessarily in order of priority. Capital projects are listed in **Table 5-1**. It is recommended that DWSD:

- Review water quality goals and update to be more comprehensive of regulations and aesthetics. Consider more global approach that includes wholesale systems or water quality at the points of entry.
- Implement the monitoring recommendations provided in **Table 2-1**.
- Develop and implement a plan to review and trend data routinely. Establish and utilize control limits for key parameters.
- Document all sampling plans and update annually
- Review current sampling plans per recommendations.
- Complete special studies on
  - Zebra mussel impact on water quality
  - Aluminum occurrence and minimization
  - Occurrence of microcystin
  - UV254 absorbance and UV transmittance prior to any UV disinfection installation
- Develop a coordinated team that includes representatives from each plant and the water quality group. Consider representatives from wholesale communities.

- Develop a program and costs for providing lab services to wholesale customers.
- Consider participation in Qualserve and in the Distribution System Optimization programs offered by AWWA.
- Rehab the labs at Springwells, Northeast and Southwest. This assumes that the lab rehab at Springwells is currently in process. Longer term improvements may be required at Lake Huron.
- Acquire and implement a LIMS or other electronic means of routinely capturing all data and facilitating data sharing among DWSD facilities and wholesale communities.
- Add online instruments to plants as needed (this will be further developed in phase 2 of the project).
- Monitor microcystin, MIB and geosmin when algae blooms
- Re-evaluate the potential for using installed distribution system sampling stations at select locations in the distribution system

Table 5-1: Potential Water Quality Capital Projects

Project	Study Cost	Capital Cost	FTEs	Schedule Short or Long Term
Rehab lab at Southwest (partial)	$0	$300,000		Short
Rehab lab at Lake Huron	$0	$500,000		Long
Rehab lab at Springwells	$0	$400,000		Short
Rehab lab at Northeast	$0	$500,000		Short
Install distribution system dedicated sampling stations	$0	$500,000		Long
Implement LIMS	$0	$500,000	1 FTE	Long
Implement monitoring and study recommendations	$0	$0	1 FTE	Short
Add online instrumentation as recommended	$0	TBD phase 2	0.25 FTE	Short

6.0 Evaluation of Potential for Direct Filtration at Lake Huron WTP

In order to more efficiently operate the Lake Huron WTP and create potential cost savings, DWSD is interested in converting this treatment plant from modified direct filtration to direct filtration. Direct filtration is defined by 10-States Standards and adopted by the MDEQ as "a series of processes, including coagulation and filtration, but excluding sedimentation, resulting in substantial particulate removal". The Lake Huron WTP currently operates as a "modified" direct filtration facility. The WTP feeds alum coagulant and a coagulant aid polymer upstream of settling basins. However, these settling basins do not provide sufficient detention time or routine sludge removal. Filter aid polymer is then added immediately upstream of the filters as needed. While not a true direct filtration process,

the WTP does not operate as a true pre-treatment facility either. Further discussion of the existing Lake Huron treatment process is provided in TM-13 Water Treatment Plant Needs Assessment.

6.1 Introduction

This memorandum summarizes a review of water quality data from the Lake Huron WTP as a first step in assessing the feasibility of direct filtration. Data which impact direct filtration, and which were reviewed where feasible, include:

- Turbidity
- Plankton counts (algae)
- Total organic carbon (TOC)
- Microbials (Total coliform, *E. coli* and HPC)
- Temperature
- Total Solids
- Color
- Chemical dosages: alum, coagulant aid polymer, and filter aid polymer

These parameters are based on MDEQ and 10-States Standards recommended data. Color data were not available for review as DWSD does not monitor color at any of their WTPs or sources. The above data were compiled for the Lake Huron source water and the WTP treated water to compare with industry benchmarks for water quality requirements for direct filtration. Additional water quality data are presented in Section 3.

This memorandum does not include a review of Lake Huron WTP operating parameters for assessment of direct filtration feasibility. The memorandum concludes with recommendations and next steps required to pursue direct filtration further.

6.2 Review of Water Quality Data

Direct filtration is generally feasible for source waters with minimal raw water turbidities such that the additional solids loading on the filters will not impact filter operations. Other WTPs using Lake Huron source water currently operate as direct filtration facilities such as the Lake Huron WTP for the City of London, Ontario. At that WTP, diatoms were reported as a parameter impacting the direct filtration processes at that plant (Foley, 1981). The following illustrate relevant data for the Lake Huron WTP:

Figure 6-1 shows the maximum daily turbidity values for the Lake Huron source water on a monthly basis for the period of 2005 and 2013.

Figure 6-2 shows the daily turbidity readings for the Lake Huron source water averaged on a monthly basis between 2005 and 2013

Figure 6-3 shows a frequency plot of all maximum daily turbidity readings for the Lake Huron source water between 2005 and 2013.

Figure 6-4 presents all monthly TOC data for Lake Huron source water and treated water between 2010 and 2013

Figure 6-5 shows a frequency plot of all monthly TOC data for the Lake Huron source water and treated water

Figure 6-6 illustrates the monthly average blue-green algae and diatom counts for the Lake Huron source water for the period of 2005 to 2013. Maximum values are also shown on the chart.

Figure 6-7 presents a frequency plot of all blue-green algae counts and diatom counts for the period of 2005 through 2013.

Figure 6-8 presents the total coliform data

Figure 6-9 presents the HPC data

Figure 6-10 and Figure 6-11 show alum and coagulant aid polymer dosages, respectively.

The results of **Figures 6-1** to **6-11** plus some additional data are summarized in **Table 6-1**.

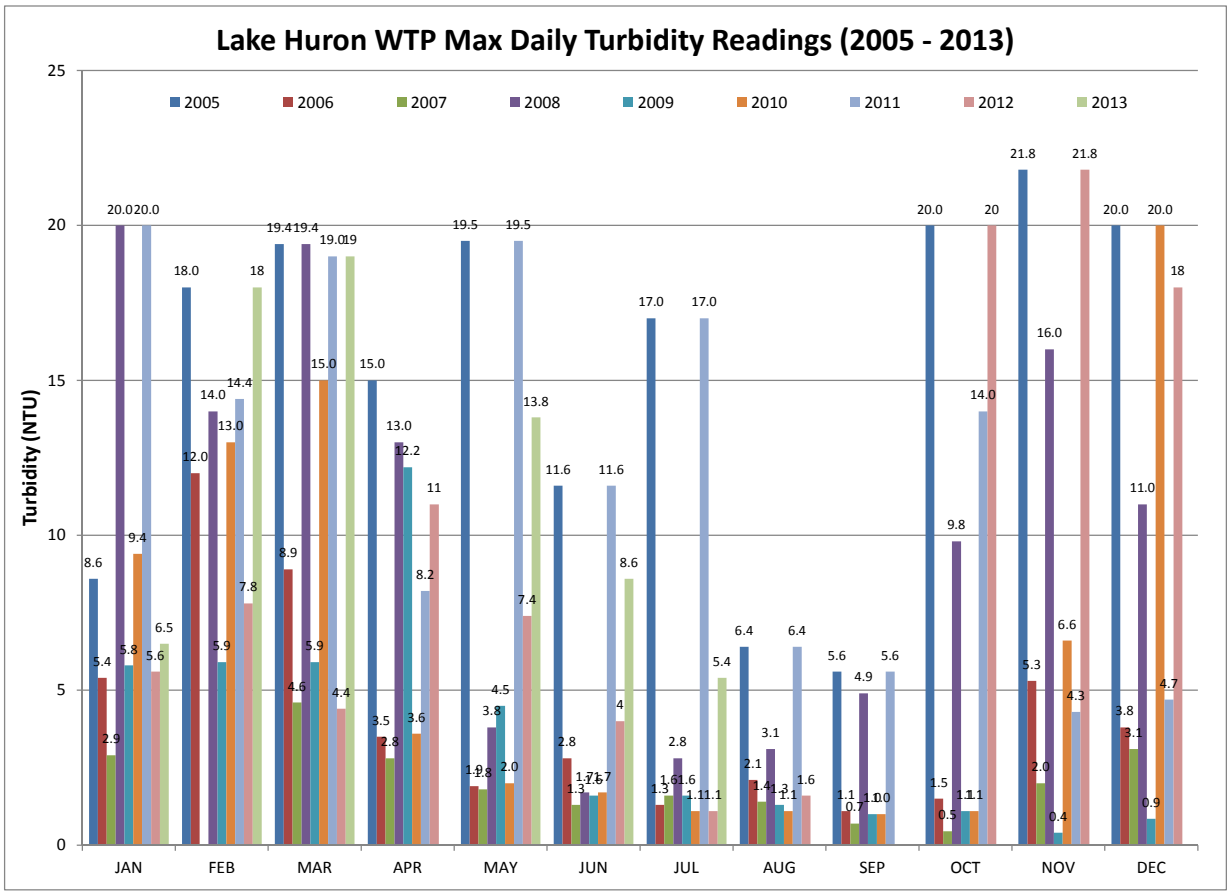


Figure 6-1: Maximum Daily Turbidity Values - Lake Huron Source Water 2005 to 2013

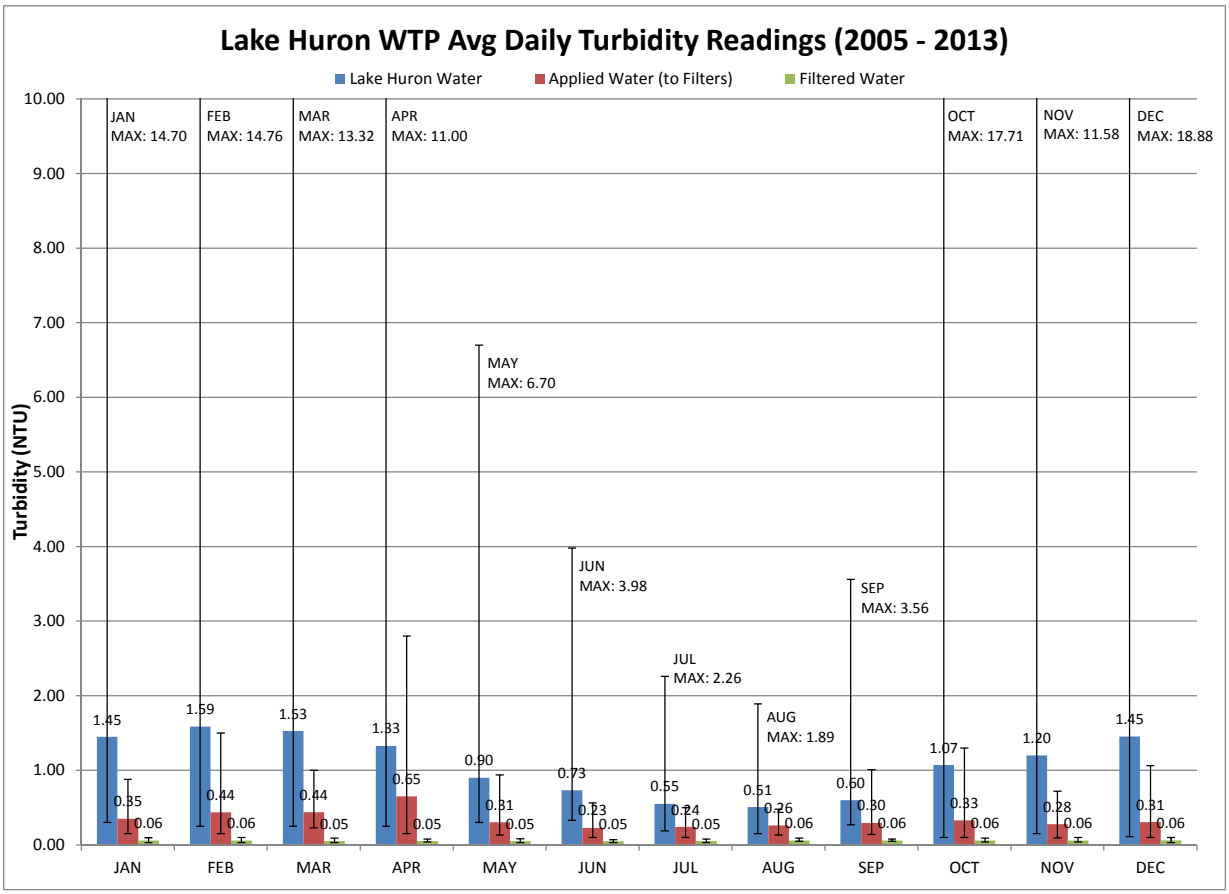


Figure 6-2: Daily Turbidity Readings for the Lake Huron Source Water, Averaged on a Monthly Basis between 2005 and 2013

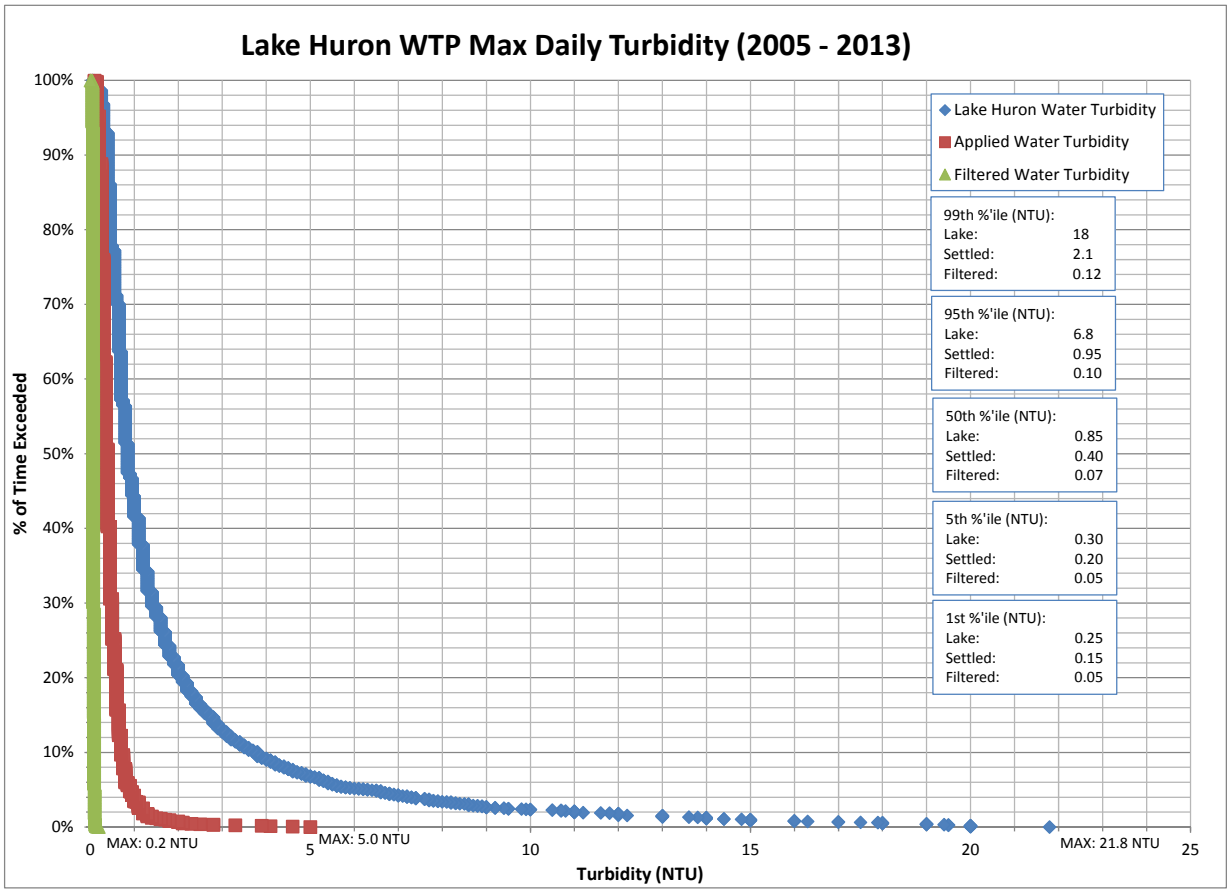


Figure 6-3: Frequency Plot of all Maximum Daily Turbidity Readings - Lake Huron Source Water, 2005 to 2013

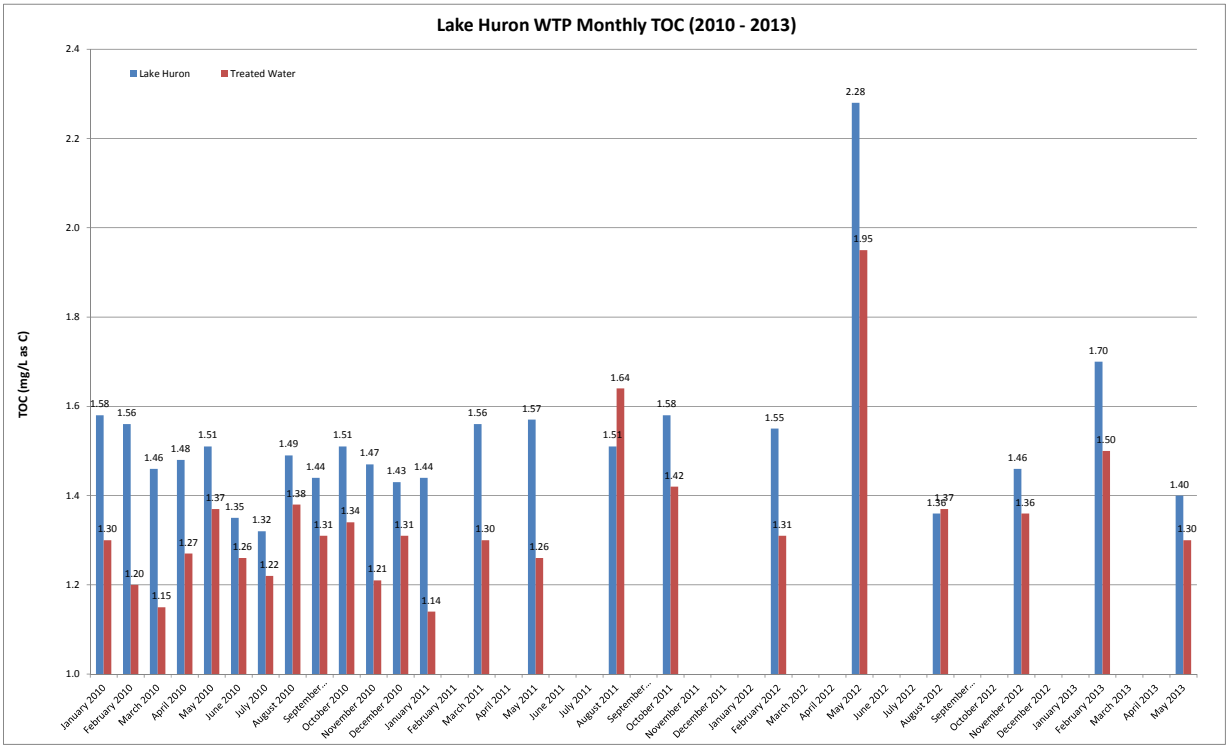


Figure 6-4: Monthly TOC Data - Lake Huron Source Water and Treated Water 2010 to 2013

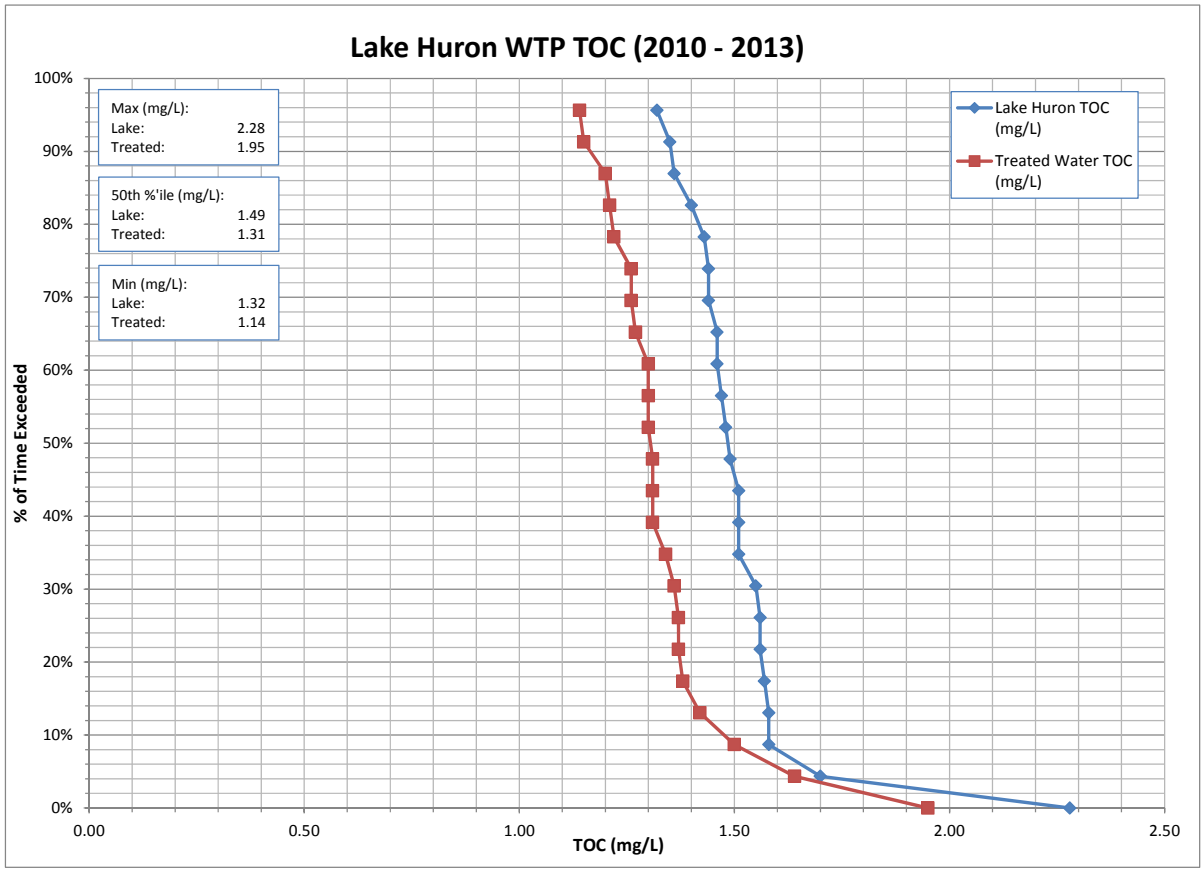


Figure 6-5: Frequency Plot of all Monthly TOC Data - Lake Huron Source Water and Treated Water, 2010 to 2013

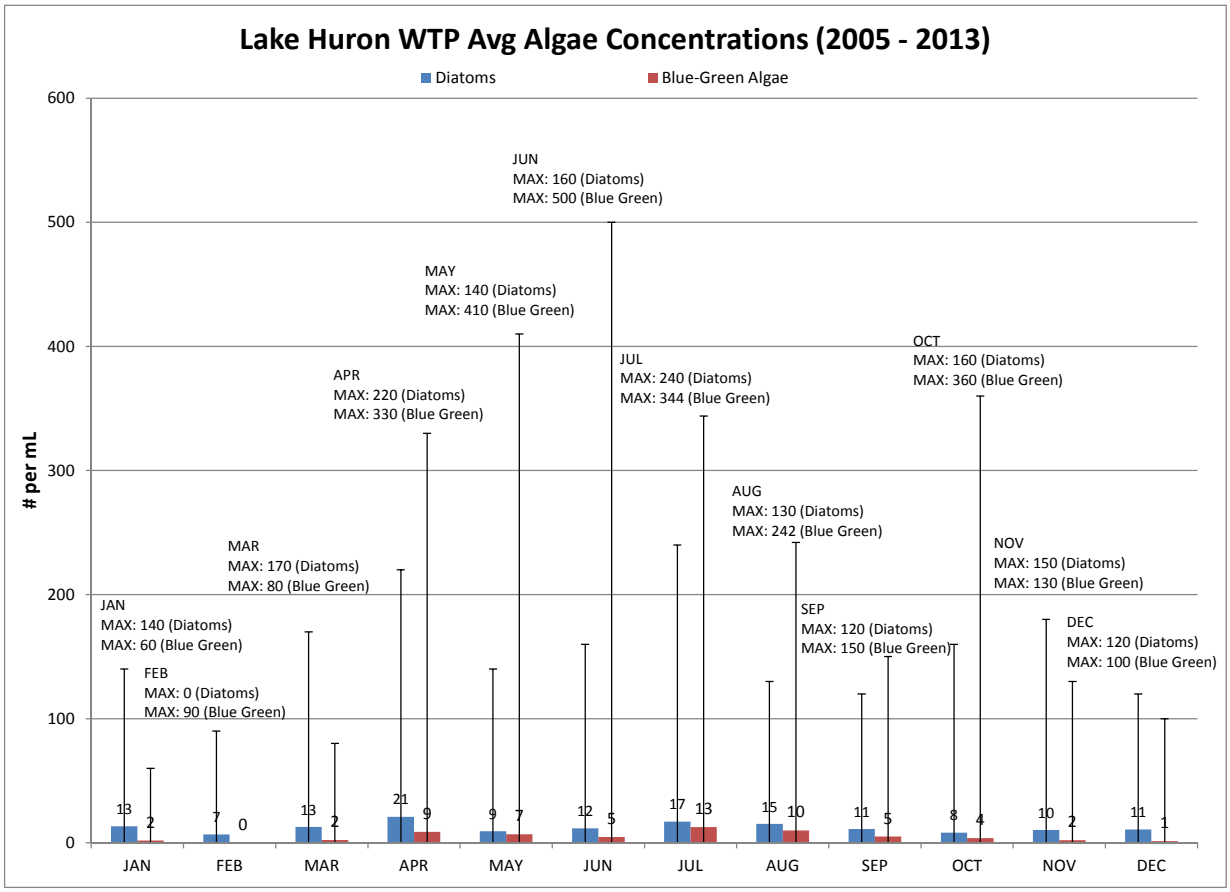


Figure 6-6: Monthly Average Cyanobacteria (blue-green algae) and Diatom Counts - Lake Huron Source Water, 2005 to 2013 (Maximum Values are also Shown on the Chart)

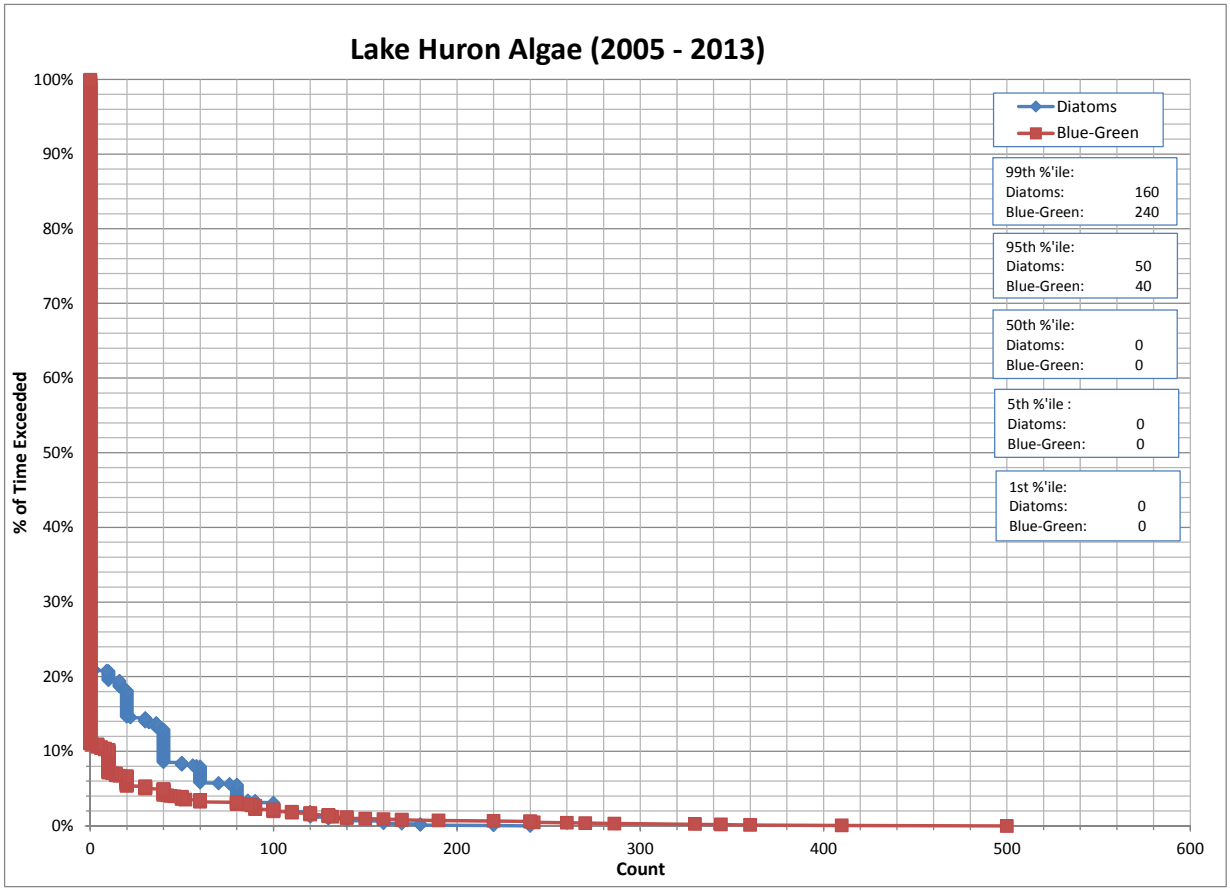


Figure 6-7: Frequency Plot of all Cyanobacteria (blue-green algae) Counts and Diatom Counts Lake Huron Source Water, 2005 to 2013

Figure 6-8 presents the microbial data for total coliform and **Figure 6-9** presents frequency data for HPC. Total coliform and HPC samples are analyzed daily on the source water. The total coliform results are low and often non-detectable during the winter and early spring. The total coliform concentrations peak during August through October reaching a daily maximum of 345 cfu/100 mL. *E. coli* is not monitored and so could not be assessed. HPC data reach a maximum value of approximately 300 per mL with a single outlier of 785 per mL. As discussed in TM-8, DWSD has not detected *Giardia* or *Cryptosporidium* in the Lake Huron water source. The source water is of high quality in terms of microbial contaminants.

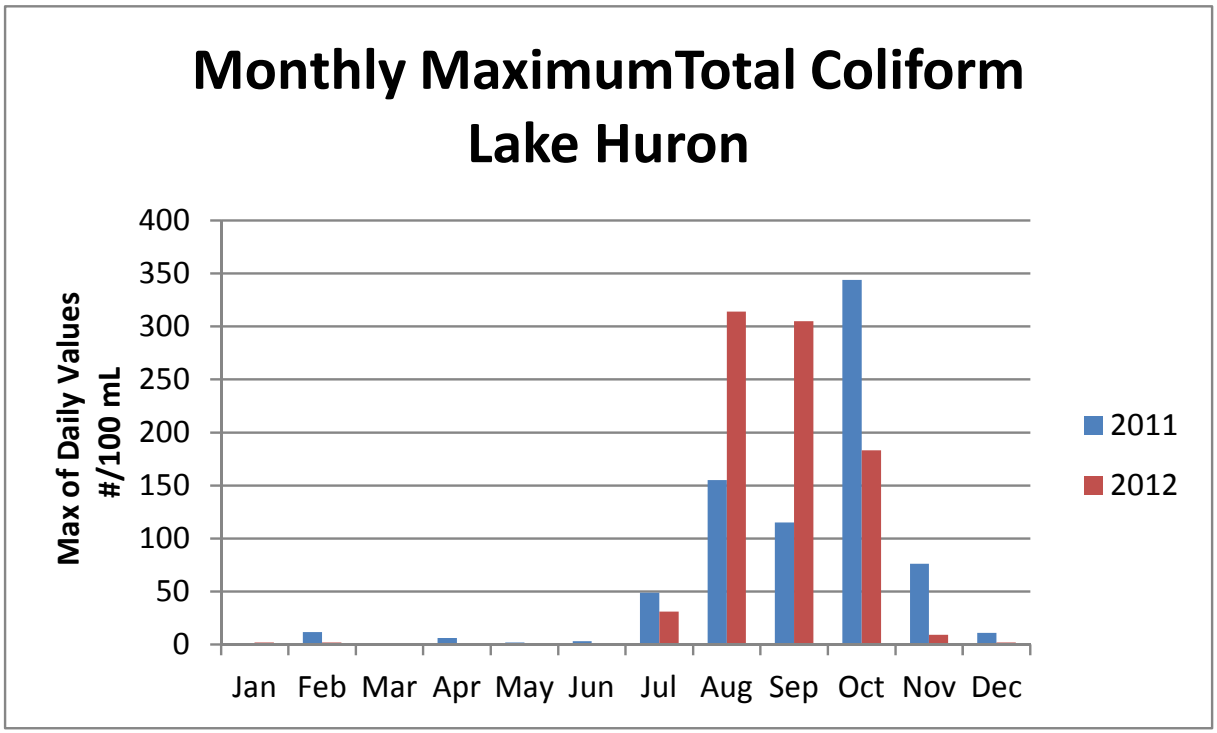


Figure 6-8: Monthly Maximum Total Coliform - Lake Huron, 2011 to 2012

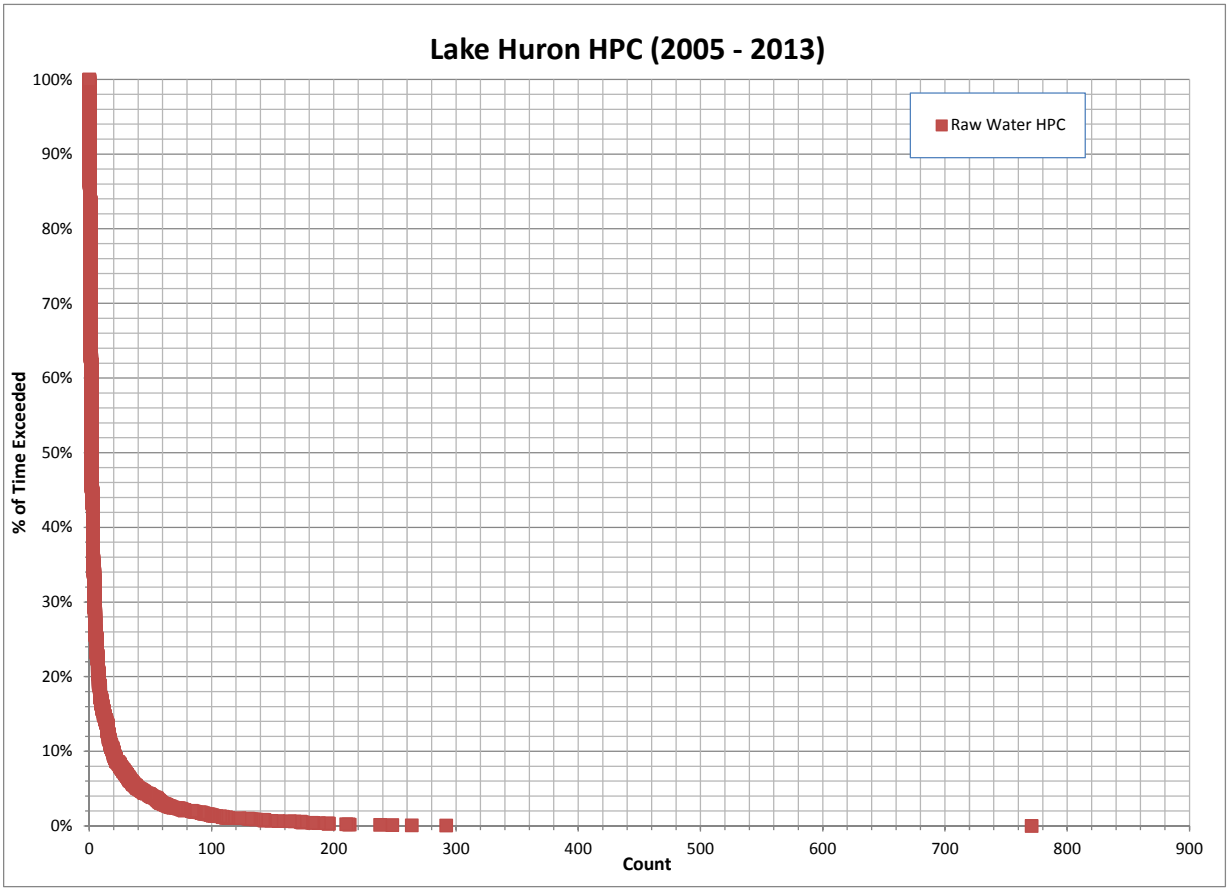


Figure 6-9: Monthly Maximum Total Coliform - Lake Huron, 2011 to 2012

Figure 6-10 shows the temperature frequency plot. As is typical in a northern climate there is variation in temperature from 0.5 to 26 degrees C.

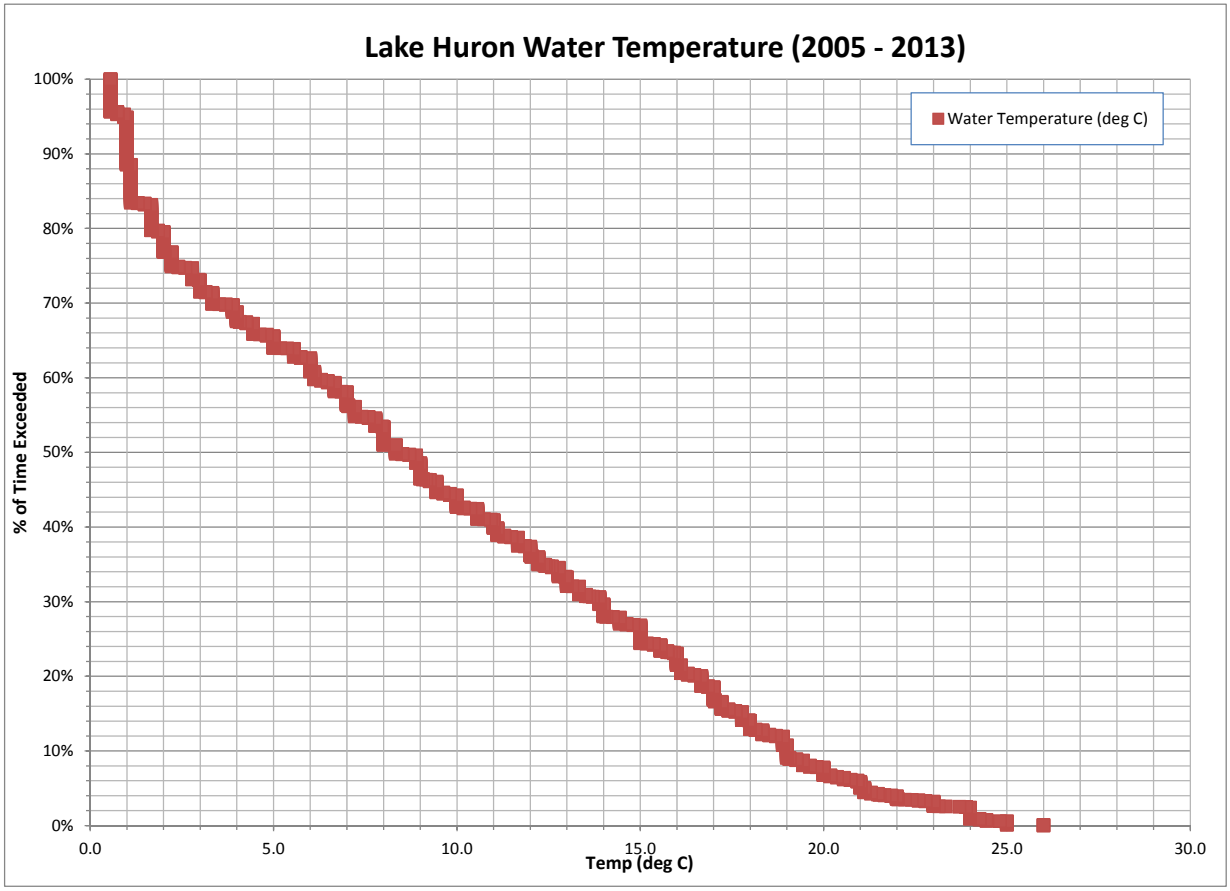


Figure 6-10: Frequency Plot of Temperature - Lake Huron, 2005 to 2013

Figures 6-11 and Figure 6-12 show alum and coagulant aid polymer dosages, respectively. Alum use is higher in the winter. Coagulant aid dosages are relatively constant. A frequency plot is shown in **Figure 6-13**.

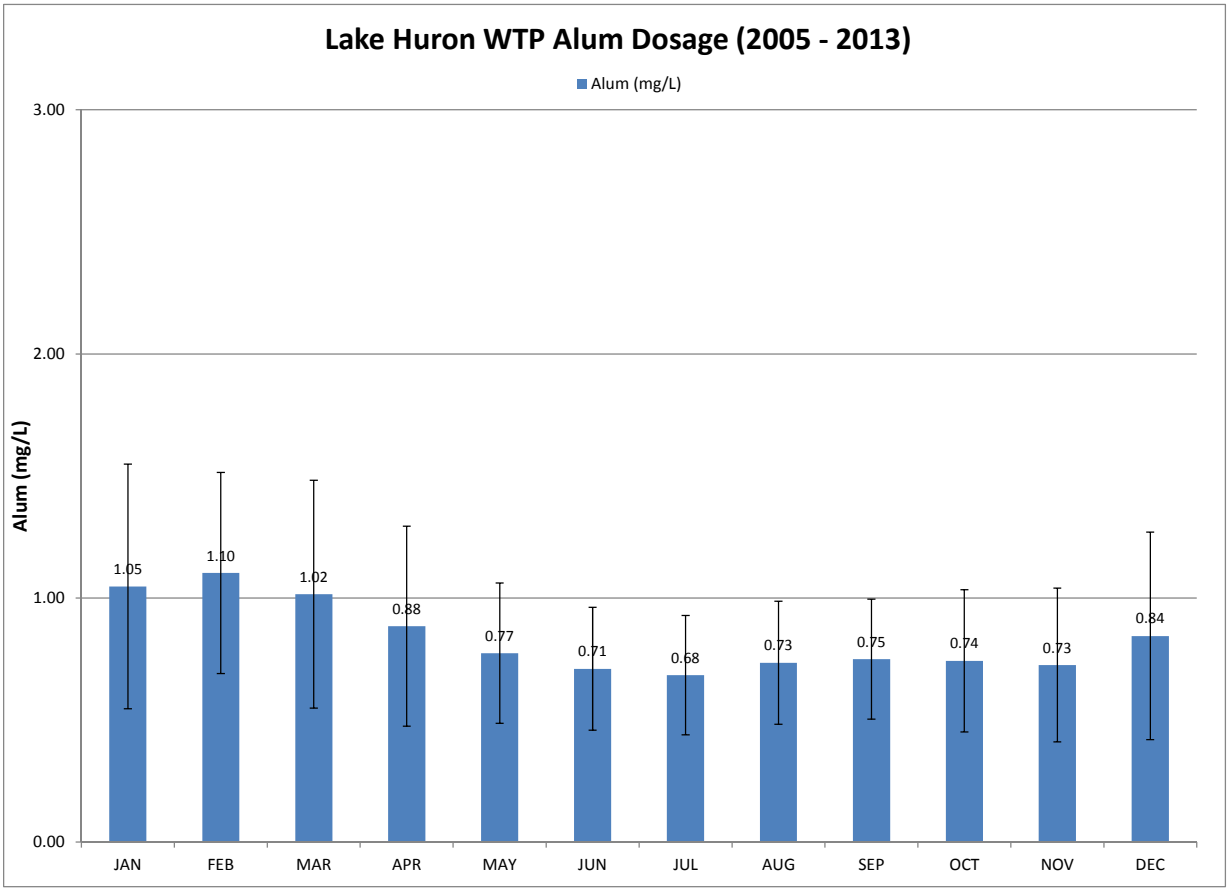


Figure 6-11: Monthly Average Alum Dosages - Lake Huron, 2005 to 2013 (Data Include 2 Standard Deviations)

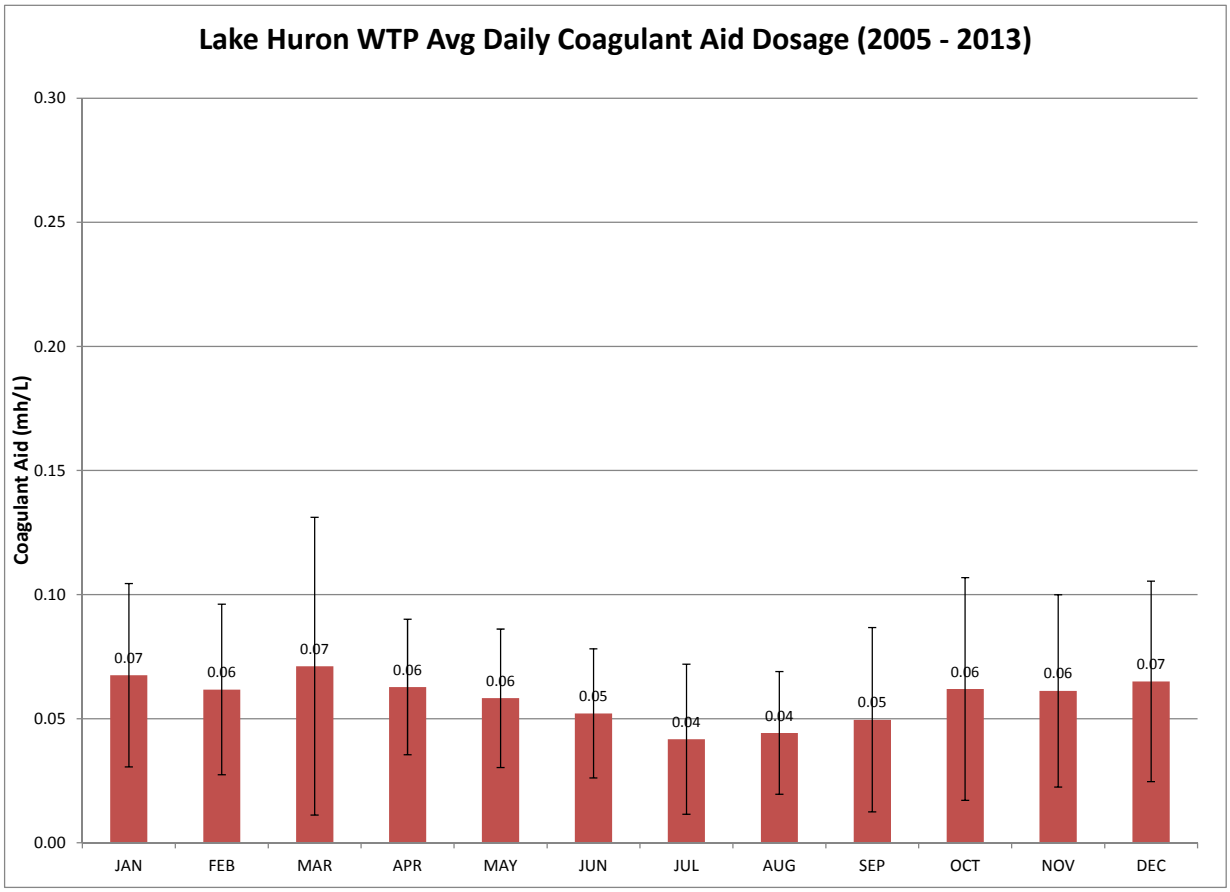


Figure 6-12: Monthly Average Coagulant Aid Dosages - Lake Huron, 2005 to 2013 (Data include 2 Standard Deviations)

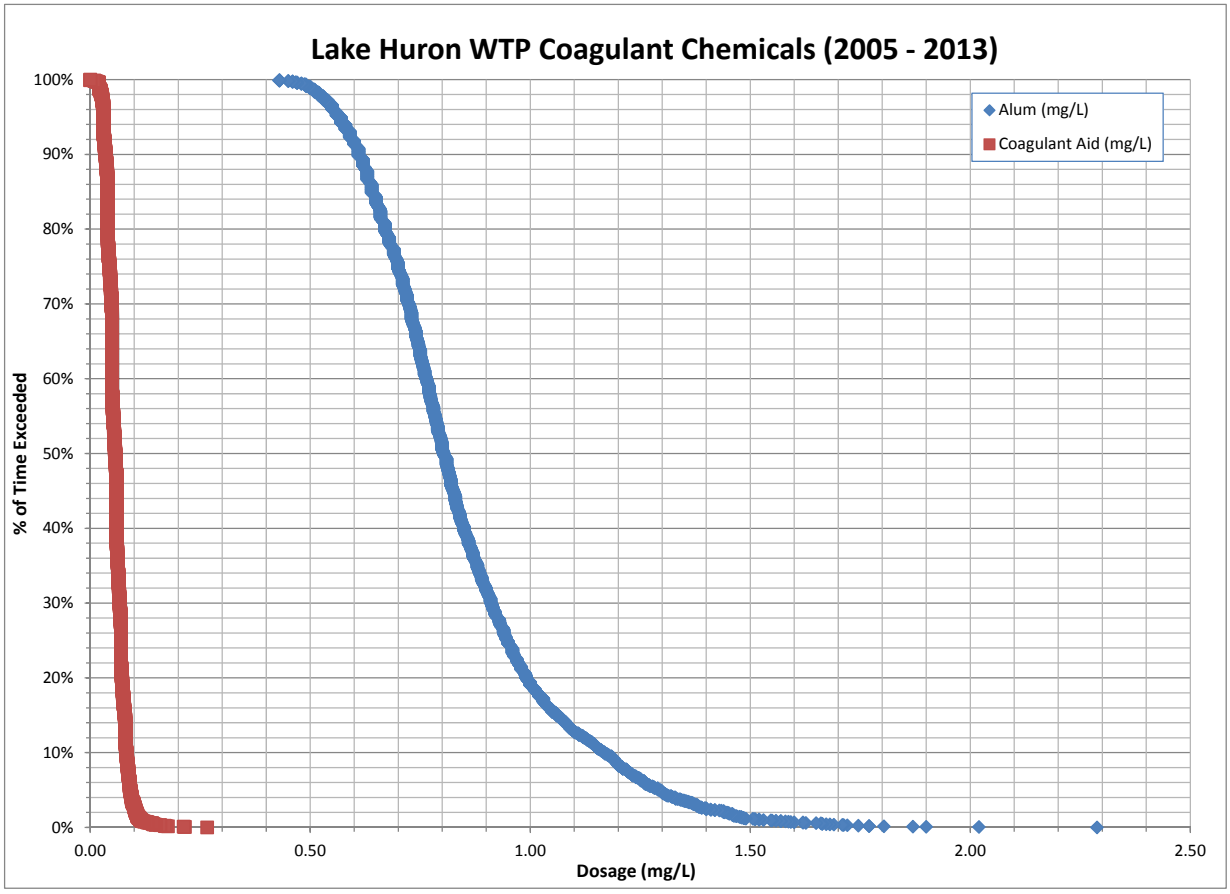


Figure 6-13: Frequency Plot of Alum and Coagulant Dosages - Lake Huron, 2005 to 2013

In terms of diatom and cyanobacteria (blue-green algae) counts, maximum values are also important. The maximum value for diatom counts of 240 per mL occurs in July and the maximum blue-green algae count of 500 per mL occurs in June.

Table 6-1 shows the benchmark values for each parameter based on Kawamura, 2000. Based on the benchmarks, the raw water quality of Lake Huron is suitable for direct filtration year-round based on an assessment of water quality only. Additional parameters such as color and algal biomass are also cited as key parameters for direct filtration analysis. Further study is recommended to confirm the values of these parameters in Lake Huron WTP water.

Table 6-1: Summary of Relevant Water Quality Data and Direct Filtration Recommended Benchmarks

Parameter	50th Percentile	95th Percentile	99th Percentile	Kawamura (2000) Benchmark Value
Lake Huron Turbidity (NTU)	0.85	6.8	18.0	Maximum < 20.0
Lake Huron TOC (mg/L as C)	1.49	1.70	2.28 (max)	Maximum < 2.50
Diatom Counts (#/mL)	0	50	140	Maximum < 1,000
Cyanobacteria (Blue-Green Algae) Counts (#/mL)	0	40	260	Maximum < 1,000

6.3 Water Quality Correlations

From **Figure 6-14**, alum dosage trends with raw water turbidities to produce relatively consistent settled water turbidity. The coagulation and settling process removed approximately 60-75% of raw water turbidity prior to filtration. This is low compared to conventional treatment processes and is likely due to the lack of adequate settling time and sludge removal at Lake Huron. However, during the month of April, there is a slight upset in the settled water turbidity. During these spring events, DWSD uses a filter aid polymer to improve filtration performance.

Diatoms are known to be particularly difficult to settle, even after coagulation or oxidation. However, despite the perceived minimal effect of coagulation on diatom removal, coagulation and flocculation are still required to produce a filterable floc for diatom and algae removal by the filters in a direct filtration mode. Further, filter aid polymer is currently not fed year-round; currently it is only fed from November through May. Filter aid polymers are typically used at direct filtration facilities and conversion of the filters to direct filtration may require this change in operations. Addition of filter aid polymer during the months of June through October should be investigated. Further, alternative coagulants such as poly-aluminum chloride, ferric sulfate, or ferric chloride should be evaluated in jar tests and at full-scale to produce a filterable floc by DF at lower dosages to extend filter runs and lower filtered water turbidity.

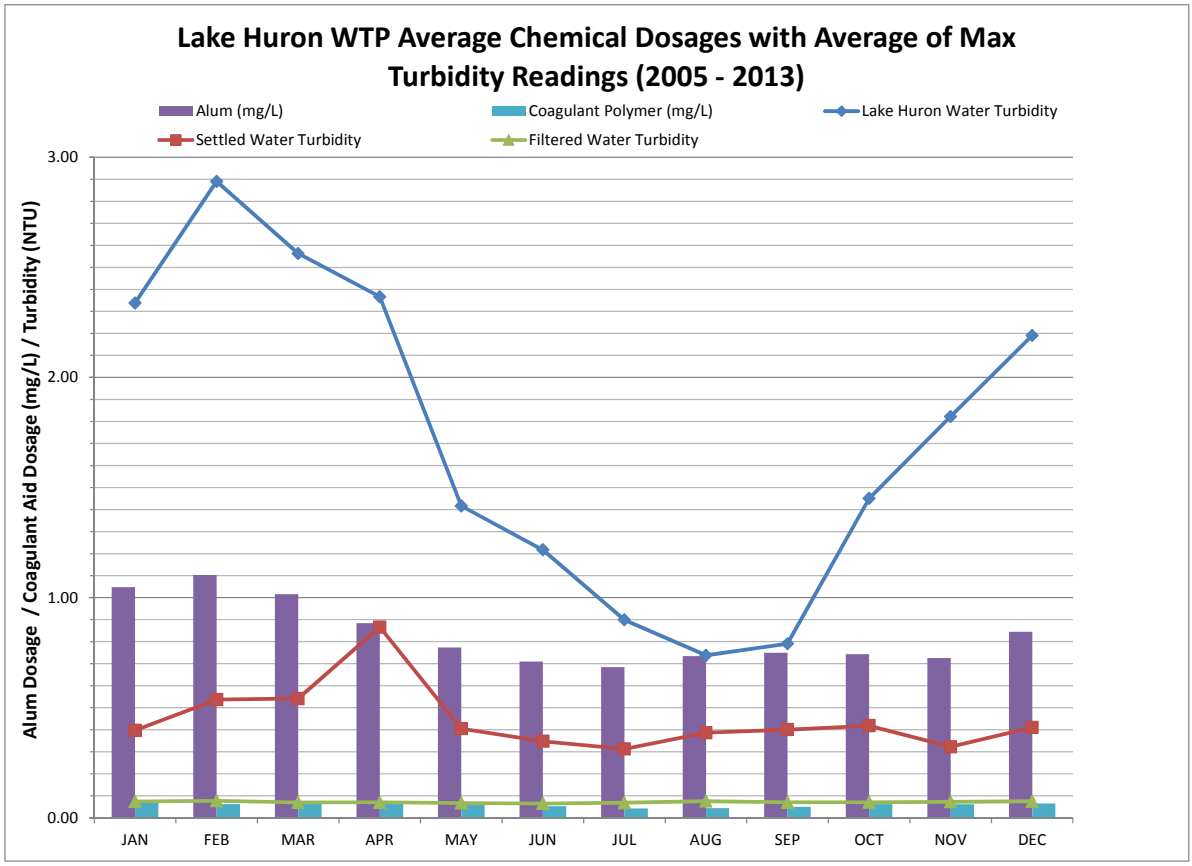


Figure 6-14: Comparison of Source Water Turbidity with Chemical Dosages - Lake Huron, 2005 to 2013

Figure 6-15 shows the relationship between chemical addition and TOC removal. The coagulation and settling process removed only 5-20% of raw TOC likely due to the lack of adequate settling time and sludge removal experienced in a typical conventional treatment plant. Because DWSDs raw water TOC is less than 2.0 mg/L, no removal of TOC is required by coagulation. For direct filtration, it may be possible to remove 10-15% of raw TOC, plus algal-derived taste and odor removal by operating filters in biological mode.

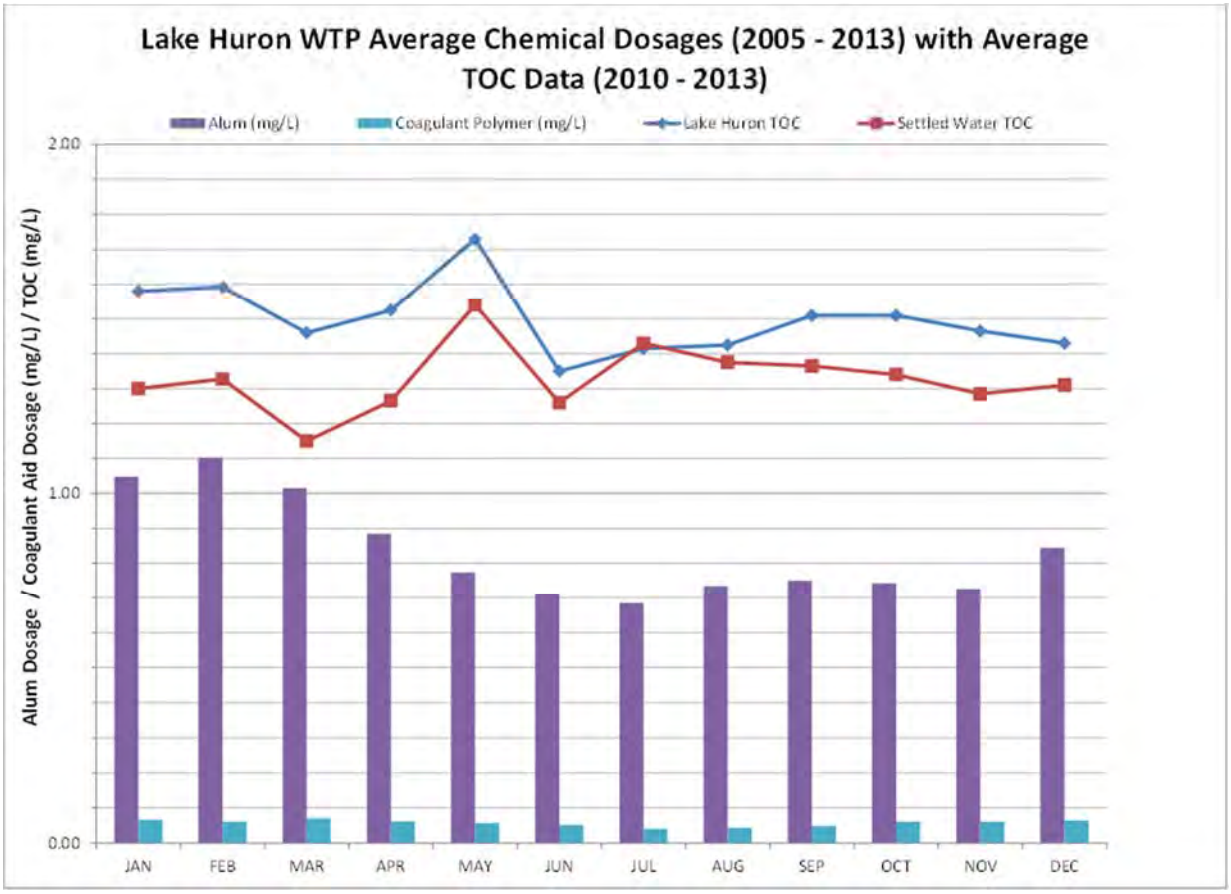


Figure 6-15: Comparison of TOC and Chemical Dosages - Lake Huron, 2005 to 2013

6.4 Plant Capacity

The Lake Huron Water Treatment Plant is currently allowed an operating capacity of 400 MGD. However, the MDEQ has indicated that this is based on performance and not on the traditional definition of rated capacity. If the plant capacity were to be rated as typically done, the capacity would be limited to 300 MGD. Higher plant production rates would require daily CT calculations. MDEQ will likely re-rate the plant at the lower capacity if DWSD decides to pursue converting the plant to direct filtration (personal communication, December 2013). Therefore any future expansion of the Lake Huron WTP would need to incorporate the revised capacity and any increase would need to include the 100 MGD reduction. Potentially a demonstration study to establish plant functionally at a higher treatment rate could be conducted if MDEQ concurred with that potential approach.

7.0 Recommendations on Direct Filtration

This memorandum has reviewed direct filtration feasibility at the Lake Huron WTP based on water quality alone. Water quality appears to be currently acceptable for use in a direct filtration treatment process. The next steps to pursue this option are to review the following parameters:

1. Meet with the MDEQ to review any pilot or demonstration work requirements and collect any additional data required. While new water treatment plants are required to conduct pilot studies per 10-States, converting an existing treatment plant to direct filtration may only require in-plant demonstration studies.

2. Review existing treatment processes relative to typical direct filtration design parameters. These include:

    a. Filter design parameters: media type, media configuration, filter loading rate, maximum available filtering head and historical filter treatment performance when operated in conventional and direct filtration modes including filter loading rate, filter run time, unit filter run volumes, backwash frequency, and head loss accumulation rates. Review of these parameters will be important to determine what upgrades will be required, if any, to convert to year-round direct filtration. .

    b. Design and operational information as mentioned above can be compared against industry best practices for direct filtration. For example, experience has shown that a deep-bed coarse mono media filter should have greater capacity to cope with algal and diatom blooms with reasonable filter runs than traditional dual-media beds with 1.0 mm effective size anthracite.

    c. Conduct pilot and/or full-scale evaluations if required to validate year-round direct filtration process at Lake Huron. Bench-scale tests should also be performed to screen alternative coagulants and polymers for cold water coagulation to produce a filterable floc. Polyaluminum chloride (PACL) may be a promising coagulant for cold water direct filtration application. Filter aids should also be considered for year-round application at low doses.

    d. Complete survey of other direct filtration plants treating Lake Huron water such as the Lake Huron plant referenced in Foley, 1981.

    e. Based on the outcomes of the above steps, prepare process design criteria and cost estimates for direct filtration upgrades for Lake Huron WTP.

8.0 References

Foley, P.D. 1981, Experience with Direct Filtration at Ontario's Lake Huron Treatment Plant, Journal AWWA.

Kawamura, Susumu. *Integrated Design of Water Treatment Facilities*. John Wiley and Sons, New York; 2nd Ed, 2000.

Recommended Standards for Water Works (10-States), 2012.

WaterPRO, Copyright 1996 – 2011 Schott Software. Published by ChemSW, Inc.

Appendix A

DWSD Monitoring Schedule

2013 Monitoring Schedule

DETROIT CITY OF **WSSN: 01800**

Collect samples early in the monitoring period. This schedule reflects your expected routine monitoring and is subject to change. To receive credit for monitoring, include the **WSSN, Site Code**, and **County** on your request for analysis form. Collect Bacteriological and Automated Partial Chemistry samples close to the shipping time and send overnight delivery. Send all sample results to your Department of Environmental Quality (DEQ) district office unless you use the DEQ laboratory. Test codes, sample units, and costs are listed to help you complete the DEQ laboratory form. Prices are subject to change without notice. The DEQ laboratory is closed on state holidays.

Location: Detroit - Northeast Plant

Collect these samples at the entry point to the distribution system (after treatment, if applicable.)

Sample Type	# Samples/ Frequency	Collect Before	Site Code	Fee	Unit Number	Test Code
Automated Partial Chemistry	This DEQ lab scan includes nitrate, nitrite, fluoride, and sodium whose monitoring frequency requirements differ from one another. Before requesting analyses from a laboratory other than the DEQ laboratory, check with your DEQ district staff for the specific monitoring requirements.					
	1/12 months	**09/30/2013**	TP101	$18.00	32	R
Volatile Organic Compounds	1/3 months	**Quarterly**	TP101	$100.00	36VO	CXVO
Complete Metals	1/108 months	09/30/2017	TP101	$102.00	36ME	CMET2
SOC – Pesticides	2/36 months	Between 4/1 and 06/30/2014 AND Between 7/1 and 9/30/2014	TP101	$125.00	36PT	CXPT
SOC – Herbicides	2/36 months		TP101	$120.00	36HB	CXHB
SOC – Carbamates	2/36 months		TP101	$120.00	36LP	CXLP
Gross Alpha (Radiological)	1/108 months	09/30/2014	TP101	Not performed at the DEQ Laboratory. A list of certified labs is at www.michigan.gov/DEQ. Select Water, Drinking Water, Community Water Supply, then Certified Labs under Programs and Activities.		
Radium 226 & Radium 228	1/108 months	09/30/2014	TP101			
Total Organic Carbon (TOC)	Pair/Quarterly	**Quarterly**	TP101	$35.00	36TO	CTOC
	Monitor for TOC in the source water before any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as "paired samples." Collect the treated water sample not later than the point of combined filter effluent turbidity monitoring and representative of treated water.					

Location: Detroit - Lake Huron Plant

Collect these samples at the entry point to the distribution system (after treatment, if applicable.)

Sample Type	# Samples/ Frequency	Collect Before	Site Code	Fee	Unit Number	Test Code
Automated Partial Chemistry	This DEQ lab scan includes nitrate, nitrite, fluoride, and sodium whose monitoring frequency requirements differ from one another. Before requesting analyses from a laboratory other than the DEQ laboratory, check with your DEQ district staff for the specific monitoring requirements.					
	1/12 months	**09/30/2013**	TP104	$18.00	32	R
Volatile Organic Compounds	1/3 months	**Quarterly**	TP104	$100.00	36VO	CXVO
Complete Metals	1/108 months	09/30/2017	TP104	$102.00	36ME	CMET2
SOC – Pesticides	1/36 months	06/30/2014	TP104	$125.00	36PT	CXPT
SOC – Herbicides	1/36 months	06/30/2014	TP104	$120.00	36HB	CXHB
SOC – Carbamates	1/36 months	06/30/2014	TP104	$120.00	36LP	CXLP
Gross Alpha (Radiological)	1/108 months	09/30/2020	TP104	Not performed at the DEQ Laboratory. A list of certified labs is at www.michigan.gov/DEQ. Select Water, Drinking Water, Community Water Supply, then Certified Labs under Programs and Activities.		
Radium 226 & Radium 228	1/108 months	09/30/2014	TP104			
Total Organic Carbon (TOC)	Pair/Quarterly	**Quarterly**	TP104	$35.00	36TO	CTOC
	Monitor for TOC in the source water before any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as "paired samples." Collect the treated water sample not later than the point of combined filter effluent turbidity monitoring and representative of treated water.					

WAYNE 3/25/2013

2013 Monitoring Schedule

DETROIT CITY OF **WSSN: 01800**

Collect samples early in the monitoring period. This schedule reflects your expected routine monitoring and is subject to change. To receive credit for monitoring, include the **WSSN, Site Code**, and **County** on your request for analysis form. Collect Bacteriological and Automated Partial Chemistry samples close to the shipping time and send overnight delivery. Send all sample results to your Department of Environmental Quality (DEQ) district office unless you use the DEQ laboratory. Test codes, sample units, and costs are listed to help you complete the DEQ laboratory form. Prices are subject to change without notice. The DEQ laboratory is closed on state holidays.

Location: Detroit - Southwest Plant

Collect these samples at the entry point to the distribution system (after treatment, if applicable.)

Sample Type	# Samples/ Frequency	Collect Before	Site Code	Fee	Unit Number	Test Code
Automated Partial Chemistry	This DEQ lab scan includes nitrate, nitrite, fluoride, and sodium whose monitoring frequency requirements differ from one another. Before requesting analyses from a laboratory other than the DEQ laboratory, check with your DEQ district staff for the specific monitoring requirements.					
	1/12 months	**09/30/2013**	TP102	$18.00	32	R
Volatile Organic Compounds	1/3 months	**Quarterly**	TP102	$100.00	36VO	CXVO
Complete Metals	1/108 months	09/30/2017	TP102	$102.00	36ME	CMET2
SOC – Pesticides	2/36 months	Between 4/1 and 06/30/2014 AND Between 7/1 and 9/30/2014	TP102	$125.00	36PT	CXPT
SOC – Herbicides	2/36 months		TP102	$120.00	36HB	CXHB
SOC – Carbamates	2/36 months		TP102	$120.00	36LP	CXLP
Gross Alpha (Radiological)	1/108 months	09/30/2014	TP102	Not performed at the DEQ Laboratory. A list of certified labs is at www.michigan.gov/DEQ. Select Water, Drinking Water, Community Water Supply, then Certified Labs under Programs and Activities.		
Radium 226 & Radium 228	1/108 months	09/30/2014	TP102			
Total Organic Carbon (TOC)	Pair/Quarterly	**Quarterly**	TP102	$35.00	36TO	CTOC
	Monitor for TOC in the source water before any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as "paired samples." Collect the treated water sample not later than the point of combined filter effluent turbidity monitoring and representative of treated water.					

Location: Detroit - Springwells Plant

Collect these samples at the entry point to the distribution system (after treatment, if applicable.)

Sample Type	# Samples/ Frequency	Collect Before	Site Code	Fee	Unit Number	Test Code
Automated Partial Chemistry	This DEQ lab scan includes nitrate, nitrite, fluoride, and sodium whose monitoring frequency requirements differ from one another. Before requesting analyses from a laboratory other than the DEQ laboratory, check with your DEQ district staff for the specific monitoring requirements.					
	1/12 months	**09/30/2013**	TP100	$18.00	32	R
Volatile Organic Compounds	1/3 months	**Quarterly**	TP100	$100.00	36VO	CXVO
Complete Metals	1/108 months	09/30/2017	TP100	$102.00	36ME	CMET2
SOC – Pesticides	2/36 months	Between 4/1 and 06/30/2014 AND Between 7/1 and 9/30/2014	TP100	$125.00	36PT	CXPT
SOC – Herbicides	2/36 months		TP100	$120.00	36HB	CXHB
SOC – Carbamates	2/36 months		TP100	$120.00	36LP	CXLP
Gross Alpha (Radiological)	1/108 months	09/30/2014	TP100	Not performed at the DEQ Laboratory. A list of certified labs is at www.michigan.gov/DEQ. Select Water, Drinking Water, Community Water Supply, then Certified Labs under Programs and Activities.		
Radium 226 & Radium 228	1/108 months	09/30/2014	TP100			
Total Organic Carbon (TOC)	Pair/Quarterly	**Quarterly**	TP100	$35.00	36TO	CTOC
	Monitor for TOC in the source water before any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as "paired samples." Collect the treated water sample not later than the point of combined filter effluent turbidity monitoring and representative of treated water.					

WAYNE 3/25/2013

2013 Monitoring Schedule

DETROIT CITY OF **WSSN: 01800**

Collect samples early in the monitoring period. This schedule reflects your expected routine monitoring and is subject to change. To receive credit for monitoring, include the **WSSN, Site Code**, and **County** on your request for analysis form. Collect Bacteriological and Automated Partial Chemistry samples close to the shipping time and send overnight delivery. Send all sample results to your Department of Environmental Quality (DEQ) district office unless you use the DEQ laboratory. Test codes, sample units, and costs are listed to help you complete the DEQ laboratory form. Prices are subject to change without notice. The DEQ laboratory is closed on state holidays.

Location: Detroit - Waterworks Park

Collect these samples at the entry point to the distribution system (after treatment, if applicable.)

Sample Type	# Samples/ Frequency	Collect Before	Site Code	Fee	Unit Number	Test Code
Automated Partial Chemistry	This DEQ lab scan includes nitrate, nitrite, fluoride, and sodium whose monitoring frequency requirements differ from one another. Before requesting analyses from a laboratory other than the DEQ laboratory, check with your DEQ district staff for the specific monitoring requirements.					
	1/12 months	**09/30/2013**	TP103	$18.00	32	R
Volatile Organic Compounds	1/3 months	**Quarterly**	TP103	$100.00	36VO	CXVO
Complete Metals	1/108 months	09/30/2017	TP103	$102.00	36ME	CMET2
SOC – Pesticides	2/36 months	Between 4/1 and 06/30/2014 AND Between 7/1 and 9/30/2014	TP103	$125.00	36PT	CXPT
SOC – Herbicides	2/36 months		TP103	$120.00	36HB	CXHB
SOC – Carbamates	2/36 months		TP103	$120.00	36LP	CXLP
Bromate	1/3 months	**Quarterly**	TP103	Not performed at the DEQ Laboratory. A list of certified labs is at www.michigan.gov/DEQ. Select Water, Drinking Water, Community Water Supply, then Certified Labs under Programs and Activities.		
Gross Alpha (Radiological)	1/108 months	09/30/2014	TP103			
Radium 226 & Radium 228	1/108 months	09/30/2014	TP103			
Total Organic Carbon (TOC)	Pair/Quarterly	**Quarterly**	TP103	$35.00	36TO	CTOC
	Monitor for TOC in the source water before any treatment at the same time as monitoring for TOC in the treated water. These samples (source water and treated water) are referred to as "paired samples." Collect the treated water sample not later than the point of combined filter effluent turbidity monitoring and representative of treated water.					

Location: Distribution System

Sample Type	Collect Samples According to the ...	# Samples/ Frequency	Collect	Site Code	Fee	Unit Number	Test Code
Bacteriological – coliforms	TCR Sampling Site Plan	54/Monthly	**Monthly**	DIST	$16.00	30	BPTC
Chlorine Residual	DBP Monitoring Plan	Measure the residual disinfectant level at the same point and at the same time as the bacteriological sample and report the average to the DEQ.					
Lead Copper for corrosion control	Lead and Copper Sampling Pool	50/36 months	Between 06/01 and 09/30/2014	DIST	$26.00	36CC	CCUB
Water Quality Parameters	Representative Sites	10 Detroit Service Area/twice/year 70 Detroit Suburbs/twice/year	**12/31/2013**	DIST	Various	Various	Various
Total Trihalomethanes	DBP Monitoring Plan	3/3 months	**During February, May, August and November**	See DBP monitoring Plan	$65.00	36VO	
Haloacetic Acids		3/3 months	**During February, May, August and November**	See DBP monitoring Plan	$130.00		

ST CLAIR

Appendix B

Detroit Customer Complaint Form

Detroit Customer Complaint

DATE TO COMPUTER: _____

DATE OF LETTER: _____

DATE: _____ TIME: _____

REPORTED BY: _____ OF: _____

RECEIVED BY: _____ WORK ORDER: _____

NAME: _____ **TELEPHONE NO:** _____

ADDRESS: _____ ***ZIP CODE*: 482**

CROSS STREETS: _____

Nature of the Complaint: (Rusty / Discolored)----(*Odor)----(*Taste)----(Cloudy / Milky)----(Oily)----(Sick / Ill / Itchy-Skin)----(Particles / Sand)----(Dirty)
(Other) Explain:

*TASTE & ODOR DESCRIPTORS (CIRCLE ALL THAT APPLY):

SWEET	BITTER	EARTHY	CHLORINOUS	PLASTIC	METALLIC	GRASSY	ROTTEN EGGS	SEPTIC	STALE
SALTY	SOUR	MUSTY	MEDICINAL	CHEMICAL	RUBBER HOSE	FISHY	RANCID OIL	SOAPY	ASTRINGENT

During telephone inquiry note which taps are affected (HOT/COLD), length of problem, construction or fires in the area, and if the neighbors are affected.

TELEPHONE INQUIRY: (1st Called: Date:_____ Time: _____) _____

_____

_____

_____

ADVICE GIVEN: _____

_____

_____

☐ **Satisfied** ☐ **Will Call Back If The Problem Persists** ☐ **Will Investigate** ☐ **Cannot Contact**

REFERRAL DATE: _____ APPOINTMENT DATE: _____ TIME: _____

INVESTIGATORS' NAMES: _____

Investigator's Observations: (Water Filter: YES / NO) (COLOR:) (TASTE:) (ODOR:)

_____

_____

_____

_____ **SAMPLES DELIVERED TO LABORATORY AT:** _____ **BY:** _____

◊ 24 hour Colilert ◊ 18 hour Colilert (Waterbath – In: _____ out: _____ at _____ °C) ◊ Colisure (*24 to 48 hour*)

Date Sample was Taken	Planted Date: _____ Time: _____ Init: _____ Read Date: _____ Time: _____ Init: _____ **Sampling Point** (Kitchen tap, bathroom tap, etc. . . .)	Sample #	Bacti (+ / -)	P. Alkalinity	T. Alkalinity	Hardness	Color	Odor	Cl_2 Residual	Fluoride	Turbidity

ANALYST'S COMMENTS: _____

_____

_____

Appendix C

Sample Siting Plan

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
RESOURCE MANAGEMENT DIVISION

SAMPLE SITING PLAN - BACTERIOLOGICAL

Issued under authority of 1976 PA 399 and Administrative Rules, as amended.

Failure to develop a plan is a violation of the Act and may subject the water supply to enforcement penalties. Administrative Rule R 325.10705 requires a water supply to monitor for total coliform bacteria according to a written sample siting plan subject to department review and revision. This form is provided as a convenience to the water supply to develop the plan.

Water Supply Information

Detroit Water and Sewerage Department Supply Name	1800 WSSN
735 Randolph Address	
Detroit, Michigan 48226 City, State, Zip	Wayne County

Water Supply Monitoring Contacts

Mary Lynn Semegen, Manager II, Water Quality Division Name & Title	313-926-8102 Telephone
Cheryl Porter, Assistant Director, Water Supply Operations Name & Title	313-926-8135 Telephone

Sampling Information

713,000 Population Served	5 *minutes* Minimum flushing time required before sampling
54 *per month* Number of Routine Distribution Samples Required Per Month	0.1 *mg/L* Minimum chlorine residual required prior to sampling

Contacts

Carolyn Bergstrom DEQ Drinking Water Environmental Quality Analyst Name	586-753-3755 Telephone
Kristina Donaldson DEQ Drinking Water District Engineer Name	586-753-3759 Telephone
Vacant DEQ Name & Title	586-753-3793 Telephone
Pollution Emergency Alerting System Information (PEAS) Call PEAS number if unable to contact DEQ staff.	1-800-292-4706 Telephone
Susan McCormick, Director Detroit Water and Sewerage Department Local Official	313-224-4701 Telephone
Darryl Latimer, Deputy Director Detroit Water and Sewerage Department Local Official	313 224-4784 Telephone
Wayne County Health Department 734-727-7107 Health Department	734-727-7106 Telephone
DWSD Water Quality Laboratory-Water Works ParkTreatment Plant Laboratory - Used Primarily	313-926-8128 Telephone
DWSD WWP/SPW/NE/SW/LH Operations Laboratories Laboratory – Alternate	313-926-8135 Telephone

Public Notification

Newspaper/Radio/TV
Means of Public Notification

Detroit Free Press Newspaper Name & City	313 222-6400 Telephone	localnews@freepress.com Email
WJR-AM Radio/ WDIV/TV4 Radio / Television Name & Address or City	313-873-9836 Telephone	www.wdiv.com Email

EQP 5950 (Rev. 03/2011)

City of Detroit
Water & Sewerage Department
Water Quality Division

DISTRIBUTION AND BRACKETING - BRACKETING POINTS FOR A TOWN

07/31/2013

Town: DETROIT

Pt.	Location	Address
3	**Fire Department Engine Co. 6 - kitchen tap**	**3080 Russell**
A	FSC Eastern Market Division	2934 Russell
D	Fire House # 5go around to back of building to 2nd floor	3400 Russel
E	tap	3405 Russell
F	tap	2937 Russell
G	tap	2939 Russell
4	**Fire Department Engine Co. 7 - Restroom**	**3737 E. Lafayette**
A	Panel Control Corporation	1000 Mt. Elliott
B	City Sport Ice Arena	3401 LaFayette
C	Modern Stool Company	6320 LaFayette
9	**Fire Department Engine Co. 32 - Utility**	**11740 E. Jefferson**
A	Chrysler Jefferson Plant	12200 E. Jefferson
C	Grosse Pointe Moving and Storage bathroom tap	11850 E. Jefferson
D	tap	11250 E. Jefferson Avenue
14	**Fire Department Engine Co. 44 - Restroom sink**	**35 W. 7 Mile Rd.**
C	Pointe One Auto Center	40 W. 7 Mile
D	Imperial Coney Island	5 W. Seven Mile Rd.
F	tap	111 W. 7 Mile Road
17	**Fire Department Engine Co. 47 - Kitchen**	**17475 Mt. Elliott**
A	Wa/Kay Industries	17403 Mt. Elliott
B	Apex Auto Body	17491 Mt. Elliott
C	tap	18054 Mt. Elliot
D	tap	17644 Mt. Elliott
18	**Fire Department Engine Co. 50 - Kitchen sink**	**12985 Houston-Whittier**

City of Detroit
Water & Sewerage Department
Water Quality Division

DISTRIBUTION AND BRACKETING - BRACKETING POINTS FOR A TOWN

07/31/2013

Town: DETROIT

Pt.	Location	Address
18	**Fire Department Engine Co. 50 - Kitchen sink**	**12985 Houston-Whittier**
A	Bright Market	13000 Houston-Whittier
B	May's Unisex Hair Salon	12900 Gratiot
20	**Fire Department Engine Co. 56 - utility sink**	**18601 Ryan**
A	Al Duncan Real Estate	18559 Ryan
C	Modern Way Cleaners bathroom tap	18549 Ryan
D	Pershing High School Engineering Department drinking fountain always running	18375 Ryan
28	**Fire Department Engine Co. 21 - restroom sink**	**10325 Linwood**
C	Community Market	11331 Linwood
D	Fish Delight	10315 Linwood
30	**Fire Department Engine Co. 29 - Kitchen sink**	**7600 W. Jefferson**
F	Lockmans Hardware bathroom tap	7630 W. Jefferson
H	Kovac's Bar - kitchen tap	6986 W. Jefferson Avenue
34	**Fire Department Engine Co. 40 - Kitchen**	**13939 Dexter**
B	Ryan's Market	13940 Dexter
C	Vandenbergh Food Company	14401 Dexter
36	**Fire Department Engine Co. 48 - kitchen middle sink**	**2300 S. Fort**
A	Detroit Recreation Center	2260 S. Fort
C	The Fish Station restroom tap	2640 S. Fort
D	tap	1941 S. Fort
38	**Fire Department Engine Co. 51 - restroom sink**	**18326 Livernois**
A	Rivers Investment	18222 Livernois
D	Livernois Family Medical Services	18254 Livernois

City of Detroit
Water & Sewerage Department
Water Quality Division

DISTRIBUTION AND BRACKETING - BRACKETING POINTS FOR A TOWN

07/31/2013

Town: DETROIT

Pt.	Location	Address
40	**Fire Department Engine Co. 54 - Kitchen**	**16825 Trinity**
A	State Farm Agency	20934 Grand River
B	Money Strategy	20966 Grand River
C	Sykes Barber Shop	20962 Grand River
D	Redford Branch Library	21200 Grand River
E	Detriot Police 8th Precinct	21400 Grand River
H	WTI, kitchen	20954 Grand River
42	**Fire Department Engine Co. 57 - Kitchen sink**	**13960 Burt Rd.**
D	BC Towing	20840 Schoolcraft
E	Cathedral of Faith DriversTraining	13925 Burt Road
45	**Burger King restroom**	**20240 Plymouth**
A	First Federal Bank restroom sink	20220 Plymouth Rd.
B	CKT Afrikan and Carribean Market utility sink	20400 Plymouth
46	**Considine Recreation Center**	**8904 Woodward Avenue**
A	Home Federal Bank - downstream	9108 Woodward Avenue
B	Detroit Public Schools Bldg. - downstream	9001 Woodward Avenue
C	Little Rock B.C. - downstream	9000 Woodward Avenue
D	The Family Place - upstream	8726 Woodward Avenue
E	Check Cashing - upstream	8642 woodward Avenue
F	Car Wash - upstream	8641 Woodward Avenue
G	Neighborhood Service Organization - upstream	8600 Woodward Avenue
47	**Best-N-Detroit Laundromat (313) 831-5360**	**3415 Woodward Avenue**
A	Michigan State University Bldg. - upstream	3408 Woodward Avenue
B	Coney Island - downstream	3433 Woodward Avenue
C	PharMor Pharmacy - upstream	3153 Woodward Avenue

City of Detroit
Water & Sewerage Department
Water Quality Division

DISTRIBUTION AND BRACKETING - BRACKETING POINTS FOR A TOWN

07/31/2013

Town: DETROIT

Pt.	Location	Address
47	**Best-N-Detroit Laundromat (313) 831-5360**	**3415 Woodward Avenue**
D	People Record Store - upstream	3159 Woodward Avenue
E	Check Cashing Store - upstream	3401 Woodward Avenue
49	**Burger King (313) 965-5464**	**1425 W Lafayette Boulevard**
A	Leather Unlimited - downstream	1601 W Lafayette Boulevard
B	Steak Hut - downstream	1551 W Lafayette Boulevard
C	Sawicki & Sons - downstream	1521 W Lafayette Boulevard
50	**Westside Service Center**	**15600 Grand River Avenue**
A	Walgreen's - upstream	15516 Grand River Avenue
B	Check Cashing - downstream	15631 Grand River Avenue
C	Family Dollar - downstream	15800 Grand River Avenue
D	Elm Restoration - downstream	15738 Grand River Avenue

Total number of distribution Point numbers 19

Total number of Bracket Point numbers : 63

Water Quality Division, Distribution and Bracketing-Bracketing Points for a Town Page 4 of 4

Distribution System Sample Sites All supplies must complete the table. Add additional sheets if needed. Examples provided on next page.

Option for groundwater supplies that collect only one routine sample per month: When the routine sample is positive for total coliform or *E. coli* the supply must sample four repeat sites in the distribution system, including the routine site, and all sources (wells). Supplies may use the source samples as the 4th repeat sample with prior approval from the Department of Environmental Quality via this Sample Siting Plan. Check **ONLY ONE** box below to commit to only one option:

☐ I will collect four repeat samples from the distribution system, including the routine site, and sample all sources. Compliance with the total coliform MCL is based on all distribution system site results. See Example 1 on next page.

☐ I will collect three repeat samples from the distribution system, including the routine site, and sample all sources. I will use all source samples as my 4th repeat sample. Compliance with the MCL is based on all distribution system and all source sample site results. See Example 2 on next page.

Dist. Site #	Routine Site Address (1st Repeat Sample)	# of samples/mo	Upstream Site Address (2nd Repeat Sample)	Downstream Site Address (3rd Repeat Sample)	4th Site Address (Not required if take more than 1 routine sample)	Site Code of All Sources That Serve The Routine Site * (Not required for surface water supplies)
1	See Attachment	56				
2						
3						
4						
5						
6						
7						
8						

* When a routine sample is positive for total coliform or *E.coli*, water supplies must collect samples from repeat sites in the distribution system. Groundwater supplies must also sample all raw water sources (wells) for each positive routine sample result. With department approval, source water collection may be limited to those wells that were in use at anytime within the 72-hour period prior to the collection of the routine positive sample. Supplies that purchase their source water must notify their supplier of water within 24 hours of a positive routine sample result. Surface water supplies are not required to sample their source water.

Source Sample Sites Raw Water, Common Header, Entry Point (Plant Tap), and Other Non-Distribution System Sample Sites

Site Code	Well # or Entry Point Designation	Location or Address

All sources **MUST** be sampled if a routine distribution sample is positive for total coliform or *E. coli*.

Sample Siting Plan Completed By

Mary Lynn Semegen, Manager II, Water Quality Division
Name and Title

313 926-8102
Telephone

Signature

08/29/2012
Date

EQP 5950 (Rev. 03/2011)

Examples for Distribution System Sample Sites

Example 1 (Ex. 1): A groundwater supply collects only one routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect four repeat samples in the distribution system, including the routine site and all sources. Compliance with the MCL is based on all distribution system site results.

Ex. 2: A groundwater supply collects only one routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect four repeat samples in the distribution system, including the routine site and all sources. The supply will collect three repeat samples in the distribution system and use all source sample results as the 4th repeat site, as allowed in regulation. Compliance with the MCL is based on all distribution system and all source sample site results. In other words, if any source sample is positive for total coliform or *E. coli*, the supply will incur an MCL violation.

Ex. 3: A groundwater supply collects more than one routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect three repeat samples in the distribution system, including the routine site and all sources. Compliance with the MCL is based on all distribution system site results.

Ex. 4: A water supply that purchases its source water collects only one routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect four repeat samples in the distribution system, including the routine site. The supply must notify the seller of water within 24 hours that the routine site detected total coliform or *E. coli*.

Ex. 5: A water supply that purchases its source water collects more than 1 routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect three repeat samples in the distribution system, including the routine site. The supply must notify the seller of water within 24 hours that the routine site detected total coliform or *E. coli*.

Ex. 6: A surface water supply collects only one routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect four repeat samples in the distribution system, including the routine site. No source water monitoring is required. Compliance with the MCL is based on all distribution system site results.

Ex. 7: A surface water supply collects more than one routine sample per month. When the routine is positive for total coliform or *E. coli* the supply must collect three repeat samples in the distribution system, including the routine site. No source water monitoring is required. Compliance with the MCL is based on all distribution system site results.

Dist. Site #	Routine Site Address (1st Repeat Sample)	# of samples/mo	Upstream Site Address (2nd Repeat Sample)	Downstream Site Address (3rd Repeat Sample)	4th Site Address (Not required if take more than 1 routine sample)	Site Code of All Sources That Serve The Routine Site * (Not required for surface water supplies)
Ex. 1	120 Park Place	1	135 Park Place	98 Park Place	1500 Virginia Ave.	WL001, WL002, WL003
Ex. 2	120 Park Place	1	135 Park Place	98 Park Place	Use source samples	WL001, WL002, WL003
Ex. 3	120 Park Place	2	135 Park Place	98 Park Place	Not required	WL001, WL002, WL003
Ex. 4	120 Park Place	1	135 Park Place	98 Park Place	1500 Virginia Ave.	Notify supplier of water of positive routine sample result
Ex. 5	120 Park Place	2	135 Park Place	98 Park Place	Not required	Notify supplier of water of positive routine sample result
Ex. 6	120 Park Place	1	135 Park Place	98 Park Place	1500 Virginia Ave.	Not required for surface water supplies
Ex. 7	120 Park Place	2	135 Park Place	98 Park Place	Not required	Not required for surface water supplies

* When a routine sample is positive for total coliform or *E.coli*, water supplies must collect samples from repeat sites in the distribution system. Groundwater supplies must also sample all raw water sources (wells) for each positive routine sample result. With department approval, source water collection may be limited to those wells that were in use at anytime within the 72-hour period prior to the collection of the routine positive sample. Supplies that purchase their source water must notify their supplier of water within 24 hours of a positive routine sample result. Surface water supplies are not required to sample their source water.

Instructions to Develop Sample Siting Plan

1. Choose distribution system sample sites that are representative of water throughout the distribution system. If possible, choose sites where a smooth nonthreaded sampling tap is available or can be installed. A map of all sites listed in the Distribution System Sample Site chart can show that sites are representative of water throughout the distribution system. It is recommended that the Distribution System Sample Sites chart include a few extra sites that can be used as a repeat sample in the event that a routine site is positive for total coliform. Choose these sites using the same criteria used to select routine sites.
2. Update the Sample Siting Plan when population changes or when existing sample sites are no longer representative of water throughout the distribution system.
3. Submit the Sample Siting Plan to the Department of Environmental Quality (DEQ) field office for review and possible revision. For field office addresses, visit www.michigan.gov/deq and click on Contacts.
4. Keep a copy easily accessible to the water operator and available for inspection by the DEQ staff.

Procedure When Sample Result Is POSITIVE

1. If a distribution system sample result is positive for total coliform bacteria or *E.coli*, then collect repeat samples within 24 hours of learning of the positive result from all of the following sites:
   A. The site of the positive sample result (1st repeat sample); and
   B. An upstream site within five service connections of the original positive site (2nd repeat sample); and
   C. A downstream site within five service connections of the original positive site (3rd repeat sample); and
   D. A 4th site in the distribution system (4th repeat sample) if the supply collects only one routine sample per month. A groundwater supply that collects one routine sample each month may use a source sample to meet this 4th repeat sample requirement. The groundwater supply shall indicate its decision on the 4th repeat sample by checking the appropriate box above the Distribution System Sample Site table. This option does not apply to surface water supplies or supplies that purchase all source water.
   E. Every raw water source (well). With department approval source water collection may be limited to those wells that were in use at anytime within the 72-hour period prior to the collection of the original positive sample. A supply that purchases groundwater must notify the supplier of water within 24 hours of a positive total coliform or *E. coli* routine sample result. This paragraph E does not apply to surface water supplies or supplies that purchase surface water.
2. Notify the DEQ field office within 24 hours if more than one distribution system sample result is positive for total coliform bacteria. Supplies that collect more than 40 samples each month must notify the DEQ when greater than 5.0 percent of the sample results are positive for total coliform.
3. Notify the DEQ field office within 24 hours if any sample result is positive for *E.coli*.
4. Collect a minimum of five samples during the next month. All five must be in the distribution system. Supplies that routinely collect more than five samples are not required to increase frequency, unless directed by the DEQ.

Sample Instructions

1. Remove the aerator, if present.
2. Flush sample tap for a minimum of two minutes.
3. Disinfect sample tap by either using chlorine bleach, or flaming the tap with a torch.
4. Flush sample tap again.
5. Reduce water stream to a modest, nonsplashing flow.
6. If you use a chemical disinfectant you must measure chlorine residual according to your Disinfection Byproduct Rule Monitoring Plan that you submitted to the DEQ. Ensure a chlorine residual is detectable before collecting the bacteriological sample.
7. Remove cap from bottle and hold cap with the inner surface facing downward. Do not set cap down. Dust-like particles in the bottle are a preservative; do not empty out or rinse out this preservative.
8. Fill the bottle. Avoid contact with sample tap or other surfaces. Do not overfill.
9. Recap the sample bottle before turning off the water.
10. Complete the laboratory sample request form and attach it to the sample bottle.
11. Mail or deliver the sample to a laboratory certified by the state to perform bacteriological analyses. Samples must be analyzed within 30 hours of collection. Note that some laboratories are not available to accept samples on Fridays, weekends, holidays, etc.

Monthly Monitoring

1. Collect samples at regular time intervals throughout the month. Water supplies that serve fewer than 4,901 persons may collect all samples on a single day if the samples are from different sites.
2. It is recommended that raw water samples be collected each month. The DEQ may require monitoring of raw water (wells) or from the entry point (plant tap). Raw water samples must be collected within 24 hours of notification of a distribution system total coliform positive result.
3. Failure to collect samples on time or failure to collect the required number of samples will result in a monitoring violation. Two or more monitoring violations within a 12-month period will result in a fine. Notify the DEQ if monitoring was not performed as required.

EQP 5950 (Rev. 03/2011)

RICK SNYDER
GOVERNOR

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
SOUTHEAST MICHIGAN DISTRICT OFFICE

DAN WYANT
DIRECTOR

March 22, 2013

Ms. Mary Lynn Semegen
Detroit Water And Sewerage
10100 East Jefferson
Detroit, MI 48214

WSSN: 01800
Detroit City of

Dear Ms. Semegen:

SUBJECT: Drinking Water Monitoring Schedule – 2013
Updated Stage 2 DDBP Monitoring Plan
Annual Reports

Enclosed is your Drinking Water Monitoring Schedule for calendar year 2013 outlining the minimum requirements for your public water supply. Please note that Stage 2 Disinfectants and Disinfection Byproduct (DDBP) requirements are included in the schedule.

After receiving four quarters of results from your Stage 2 DDBP monitoring, we have determined that your water supply qualifies for reduced monitoring. Your reduced monitoring requirements are summarized below.

Monitor quarterly (during May, August, November, and February) at the following location(s):

Sample For...	Site Code	Address of Sample Site
☒ TTHM ☒ HAA5	DBP 1	**23675 Fenkell**
☒ TTHM ☒ HAA5	DBP 2	**12240 Conant**
☒ TTHM ☒ HAA5	DBP 3	**1310 South Oakwood**

For all monitoring, collect samples early in the monitoring period of the year indicated on the schedule. If you use a private laboratory, you are required to report the results to us within the first ten days of the month following the month that you received the results. To receive credit for monitoring, the **"WSSN"** (water supply serial number), the **"Site Code,"** and **"County"** must appear on the sample result. Bottles will NOT be mailed automatically. To order bottles, call the Department of Environmental Quality (DEQ) Laboratory at 517-335-8184. Be certain of the Environmental Protection Agency sampling and analysis method requirements for hold times.

The Michigan Safe Drinking Water Act requires certain reports to be submitted to this office each year. Please remember that cross connection reports and annual pumpage reports are due by March 31, and the **Consumer Confidence Report** is due by July 1.

27700 DONALD COURT • WARREN, MICHIGAN 48092-2793
www.michigan.gov/deq • (586) 753-3700

Also enclosed is the document "2013 Monitoring and Reporting Requirements." This provides additional details about monitoring and reporting requirements. If you have any questions, please contact me by e-mail at bergstromc@michigan.gov, by phone at 586-753-3755, or by mail at the address above.

Sincerely,

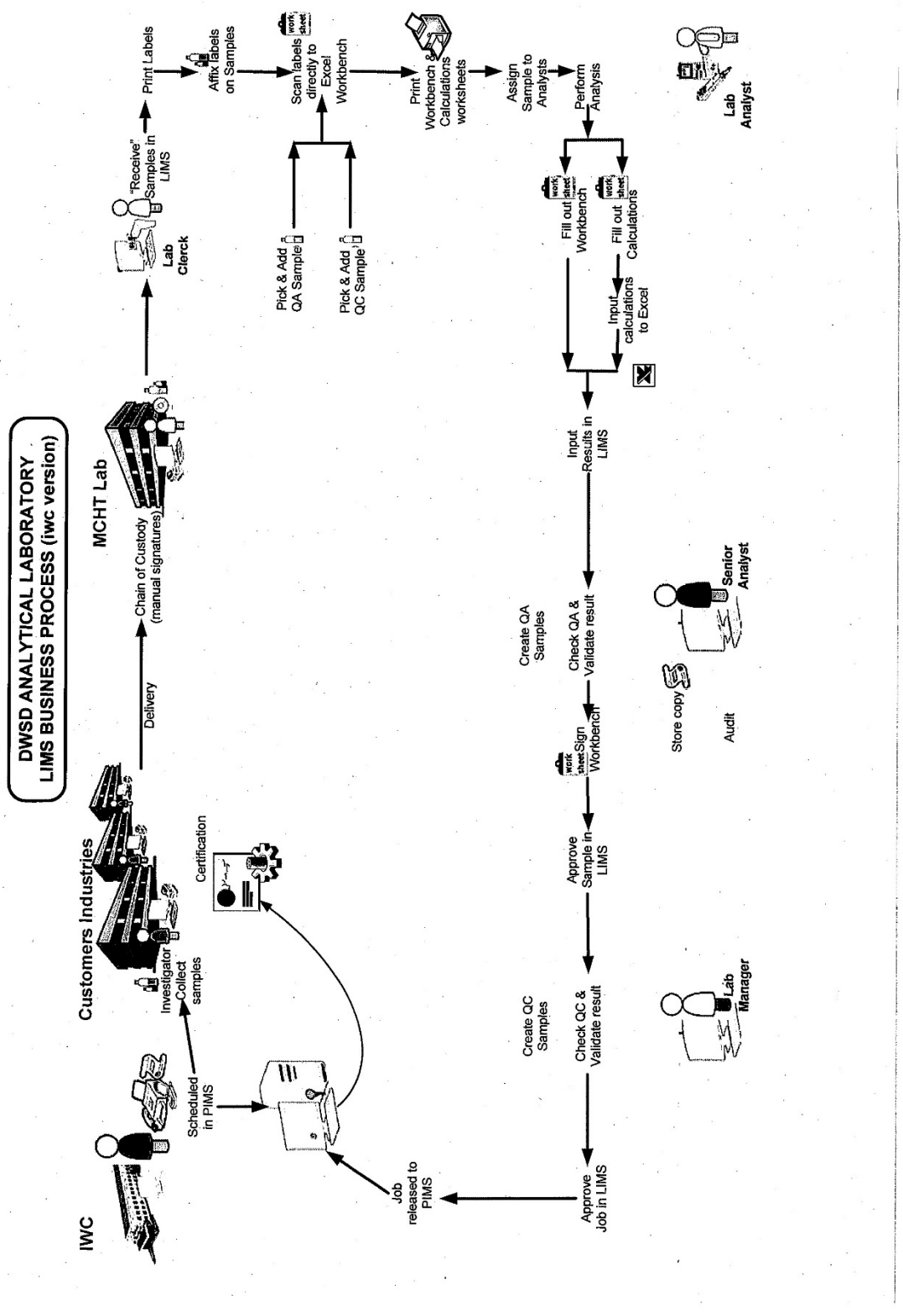
Carolyn Bergstrom
Environmental Quality Analyst
Southeast Michigan District Office
Office of Drinking Water
and Municipal Assistance

Enclosure
cc/enc: DWSD Water Treatment Plant Superintendents
Mr. Darryl Latimer, Deputy Director
cc: Ms. Kris Donaldson, DEQ

Appendix D

DWSD LIMS General Requirements

DWSD LIMS General Requirements	
Sample Login	
Job Based	
Scheduled	
Non-Scheduled (walk-in, emergency)	
ICP Equipments (Perkin Elmer Optima 3000 & 4300)	
Cyanide Equipment (OI analytical FS 3000 Cyanide Ana, Model #A00952)	
Metals (Cetac Mercury Analyzer M6100)	
Manual and/or with instrument interfacing	
Numeric, text or alpha-numeric entry	
Define and update significant Figures (decimal places) by test	
User Configurable Tests, Parameters, Limits	
Sample Analysis (many tests = one analysis)	
Ability to create, modify and force workflows based on sample type	
Quality Assurance (QA) functionality	
Quality Control (QC) functionality	
Batching	
Event Driven Alerts (time sensitive tests)	
User configurable calculations	
User configurable calculations based on results from other calculations	
Chain of Custody	
Configurable Security	
Role based access to functions and modules	
Password policies - length, alpha-numeric, expiration	
User configurable	
Record Username (electronic signature), item changed, date and time changed, old and new value, reason/comment	
Create, save ,share and export ad-hoc reports and queries	
Create charts for any queried data - pie, line, column, distribution, etc.	
Print barcode labels to industry standard label printers	
Create and modify barcode labels	
Export data to Microsoft Excel	
User configurable fields, screens, objects	
Support for industry standard - NELAC, 21CFR11,GALP, Section 508, ISO17025	
Version control of tests, parameters, limits, reports, configuration changes, software upgrades, etc.	
APIs to integrate with 3rd party applications	
Ability to attach/store documents- SOPs, pictures, quick reference guides, etc	
Wastewater/Freshwater specific LIMS	


DWSD ANALYTICAL LABORATORY
LIMS BUSINESS PROCESS (iwc version)
IWC
Customers Industries
Investigator
Collect samples
Scheduled in PIMS
Certification
Delivery
MCHT Lab
Chain of Custody (manual signatures)
"Receive" Samples in LIMS
Lab Clerck
Print Labels
Affix labels on Samples
Pick & Add QA Sample
Pick & Add QC Sample
Scan labels directly to Excel Workbench
Print Workbench & Calculations worksheets
Assign Sample to Analysts
Perform Analysis
Lab Analyst
Fill out Workbench
Fill out Calculations
Input calculations to Excel
Input Results in LIMS
Create QA Samples
Check QA & Validate result
Senior Analyst
Store copy
Audit
Sign Workbench
Approve Sample in LIMS
Create QC Samples
Check QC & Validate result
Lab Manager
Approve Job in LIMS
Job released to PIMS

CHEMWARE
LABORATORY INFORMATION MANAGEMENT

quotation

HORIZON® LABORATORY INFORMATION MANAGEMENT SYSTEMS

201302025-CC
March 6, 2013

customer contact information		chemware contact information	
Customer:	Detroit Water & Sewerage Department	Acct Mgr:	Chris Couch
Contact:		Phone:	919.855.8716 x298
Address:	2727 Second Avenue	Email:	ccouch@chemware.com
City, ST Zip:	Detroit, Michigan 48201	Project Mgr:	
Phone:		Phone:	
Email:		Email:	

Domestic USD

required	optional	item	software: laboratory information management system (LIMS)		qty	units	total
☒	☐	HC-001	HORIZON Central	LIMS License	40	named users	196,520
						subtotal core LIMS software	$ 196,520

required	optional	item	software: enterprise reporting and business intelligence (BI)		qty	units	total
☒	☐	HO-106	HORIZON Report Manager	Report Writer, Dev Tools	75	named users	36,870
☒	☐	HO-107	LabOnline	Web Portal	1	site	16,500
						subtotal BI software	$ 53,370

required	optional	item	software: data capture and integration		qty	units	total
☒	☐	HO-114	HORIZON Data Exchange (HDX)*	Instrument Data Parsing Tool	15	inst. connections	27,690
☐	☒	HO-117	HORIZON Field Data Capture Automation	PDA/PreLogin Integration	~~1~~	~~server~~	~~30,674~~
☐	☒	HO-120	SimpleIndex Barcode OCR Software Server Edition	Scanned Document Capture	~~1~~	~~workstation~~	~~1,651~~
						subtotal data capture software	$ 27,690

required	optional	item	software: database and tools		qty	units	total
☒	☐	OR-302	Oracle Database, ASFU Standard Edition	Processor-Based (Unlim Users)	1	processor	19,305
☒	☐	OR-303	Oracle Forms Services	Web-Based LIMS Deployment	40	named users	20,298
						subtotal database software	$ 39,603

included	optional	item	Eramosa & Sigma: project deliverables		qty	units	rate	total
☒	☐	IM-401	Laboratory Assessment	Eramosa	96	hours	168	16,128
☒	☐	IM-402	Project Management	Eramosa	144	hours	168	24,192
☒	☐	IM-403	Project Oversight and QA/QC	Sigma	280	hours	168	47,040
☒	☐	IM-404	On-site Training Coordination	Sigma	160	hours	168	26,880
☒	☐	IM-405	Document Management and Testing Plans	Sigma	160	hours	168	26,880
						subtotal project deliverables		141,120

included	optional	item	ChemWare: project management and implementation		qty	units	rate	total
☒	☐	IM-411	Laboratory Assessment	Onsite Operations Analysis	24	hours	168	4,032
☒	☐	IM-412	Standard Project Services	Services with Specification	120	hours	168	20,160
☒	☐	IM-413	Advanced Project Services	Services with Specification	80	hours	225	18,000
☒	☐	IM-414	Project Management	Project Reporting & Oversight	80	hours	168	13,440
☒	☐	IM-416	Systems Integration	Services with Specification	120	hours	168	20,160
☒	☐	IM-417	Report Delivery	Services with Specification	80	hours	168	13,440
						subtotal services hours		1,344
						subtotal project management and implementation		$ 89,232

included	optional	item	services: training		qty	units	rate	total
☒	☐	TR-502	System Administrator I Training, Onsite	At Client Site	3	days	1,992	5,976
☒	☐	TR-503	Advanced System Administrator Training	Advanced Training Topics	32	hours	168	5,376
☒	☐	TR-505	Advanced Report Writer Training	2x2 Days Online, 3 Days at CW	1	course	6,285	6,285
☒	☐	TR-506	End-User Training, Onsite	At Client Site, Unlimited Students	5	days	1,496	7,480
						subtotal training		$ 25,117

included	optional	item	quotation summary	qty	units	total
☒	☐	HC	HORIZON LIMS	40	named users	196,520
☒	☐	HO	Advanced Enterprise Solutions	-	various	81,060
☒	☐	OR	Database and Tools	-	various	39,603
☒	☐	IM	Project Management and Implementation	1344	hours	230,352
☒	☐	TR	Training	-	various	25,117
					estimated labor hours	1519
					optional items total	~~32,326~~
					required/selected items total	$ 572,652
					quotation total	$ 572,652

Footnotes:
* HDX includes a library of instrument parsing templates and up to 4 hours of configuration services per instrument.