350 Ottawa NW, Unit 10
Grand Rapids MI 49503
Phone: 616-307-0261
Fax: 616-356-0298

WSSN: 04580

Office of Drinking Water and Municipal Assistance

Grand Rapids District Office

Water System Sanitary Survey

City of Muskegon Heights Water System

2015

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Sanitary Survey Review Summary

Water Supply: City of Muskegon Heights — WSSN: 04580
County: Muskegon — District: 61
Evaluators: Ernie Sarkipato, Luke Dehtiar — Date: May 2015

Category	Comment	N/A	NotEv	NoD/R	Rec	Def	SigDef
Source					X		
Construction & Maintenance	*Install second raw water meter to improve flexibility*				X		
Standby Power				X			
Isolation				X			
Source Water Protection	*Develop surface water intake protection plan*				X		
Capacity				X			
Treatment						**X**	
Disinfection	*Install manual startup/shutdown controls for all chems*				X		
Fluoride				X			
Phosphate Addition				X			
Softening		X					
Iron/Manganese Removal		X					
Arsenic Removal		X					
Pretreatment				X			
Filtration (gravity or membranes)	*Top off anthracite, develop filter maintenance program*				X		
C*T				X			
Other	*Additional drainage control measures near floc/sed*					**X**	
Distribution System						**X**	
Interconnections w/ Other WS				X			
Hydrants & Valves	*Must complete valve turning. Better records needed.*					**X**	
Service Lines & Metering	*Replace old service lines, conduct account audits.*				X		
General Plan	*Finalize the general plan & reliability study*				X		
Cross Connections	*Update written program, improve inspections & records*					**X**	
Construction & Maintenance				X			
Capacity	*Lost Water has been >30%, not acceptable*					**X**	
Finished Water Storage					X		
Construction & Maintenance	*Conduct 5-year inspection of Getty Tank*				X		
Controls	*Install a small permanent generator at Getty St.*				X		
Capacity				X			
Pumps (All Pumping Facilities)					X		
Construction & Maintenance	*Install VFD's and/or right-sized pumps for lower cost*				X		
Controls	*Install a small permanent generator at Sherman St.*				X		
Capacity	*Make modifications for new HSP's, exercise them*				X		
Monitoring & Reporting					X		
Bacteriological Monitoring	*Conduct 2nd round of crypto monitoring - Oct 2016*				X		
Chemical Monitoring				X			
MOR or Annual Pumpage Report				X			
Consumer Confidence Report				X			
Analytical Capabilities				X			
System Management & Operations					X		
Owner Responsibility	*Focus on internal analysis, planning, coordination*				X		
Capacity Development				X			
Reliability Study	*Work with engineers to complete study underway*				X		
Operations Oversight				X			
Permits				X			
Operator Compliance					X		
Operator Certification	*Hire foreman w/in six months of interim operation.*					**X**	
Technical Knowledge & Training	*Increase training program and reward certification.*				X		
Security						**X**	
Emergency Response Plan	*Update old Contingency Plan using new format*					**X**	
Site Security (Fences, Alarms...)	*Conduct tabletop exercises*				X		
Financial						**X**	
Rates	*Continually assess rates to fund improvements & staff*				X		
Budget & Capital Imp. Plan	*Update CIP to include budget, perform water audits*					**X**	
Other				X			

N/A - Not Applicable
NotEv - Not Evaluated
NoD/R - No Deficiencies/Recommendations Made
Rec - Recommendations Made
Def - Deficiencies Identified
SigDef - Significant Deficiencies Identified

SUMMARY OF FINDINGS - TREATMENT PLANT

The following is a list of items discussed in this report which should be addressed by the water system. This table is intended to be a concise summary of the more detailed discussions which are found in following sections of the report.

SC	Source	MO	System Management & Operations
TR	Treatment	OP	Operator Compliance
DS	Distribution System	SR	Security
ST	Finished Water Storage	FN	Financial
PU	Pumps (All Pumping Facilities)	OT	Other
MR	Monitoring & Reporting		

No.	Cat	Concern	Finding	Page
1	TR	Install additional drainage control for the building near the floc/sed basins	**DEF**	18
2	PU	Repair packing gland in LSP #3	REC	16
3	TR	Adjust/repair packing on rapid mix #1	REC	17
4	TR	Repair bearings on rapid mix #2	REC	17, 39
5	TR	Top-off anthracite in filters 1-8	REC	21
6	TR	Install manual startup controls for chemical feeds due to part-time plant operation	REC	40
7	SC	Install additional raw water meter to provide flexibility with rapid mix units	REC	17
8	TR	Establish a filter maintenance program and secure necessary tools	REC	21, 39
9	TR	Check bed expansion during backwash periodically	REC	21, 39
10	MR	Conduct crypto sampling for round 2 of LT2 starting in Oct. 2016	REC	10, 36
11	PU	Establish a comprehensive preventative maintenance program for all pumps	REC	38
12	SC	Develop surface water intake protection plan	REC	11, 37
13	TR	Adopt water quality goals for the WTP	REC	10, 21, 42
14	TR	Keep vegetation away form the sludge lagoons	REC	23, 40
15	OP	Develop training plans with each operator	REC	35
16	SR	Perform tabletop exercises to enhance security	REC	5
17	TR	Inspect chlorine intake line for plugs, perform periodic maintenance	REC	11

SUMMARY OF FINDINGS - DISTRIBUTION

The following is a list of items discussed in this report which should be addressed by the water system. This table is intended to be a concise summary of the more detailed discussions which are found in following sections of the report.

SC	Source	MO	System Management & Operations
TR	Treatment	OP	Operator Compliance
DS	Distribution System	SR	Security
ST	Finished Water Storage	FN	Financial
PU	Pumps (All Pumping Facilities)	OT	Other
MR	Monitoring & Reporting		

No.	Cat	Distribution Concerns	Finding	Page
1	FN	Develop administrative process for calculating lost water and audit of water accounts	**DEF**	55, 62
2	DS	Provide Lost Water for 2010 - 2014, outline plan for reducing if over 10%	**DEF**	4
3	DS	Review and update the Cross Connection Control Program & Ordinance	**DEF**	57
4	DS	Cross Connection: improve Inspections and record keeping, submit report for 2014.	**DEF**	57, 58, 61
5	DS	Turn the remaining distribution valves as outlined in the previously approved program	**DEF**	54, 61
6	FN	Complete a new Capital Improvements Plan for the next 5-year and 20-year periods	**DEF**	56, 61
7	SR	Submit an Emergency Response Plan	**DEF**	57
8	OP	Hire or contract with a full time permanent distribution operator in charge	**DEF**	44, 62
9	DS	Improve the records keeping system for distribution activities, i.e. hydrants & valves	REC	54, 61
10	DS	Formulate a unidirectional flushing program to increase scour velocity and clean valve seats	REC	54
11	DS	Undertake a service line replacement program	REC	52, 55, 61
12	DS	Continue the meter replacement program. At minimum, use a 15-year plan	REC	55
13	OP	Support staff to attend appropriate training, provide incentives for professional certification	REC	44, 61
14	MR	Update bacteriological sample site plan with new contact information	REC	60
15	ST	Perform 5-year inspection on Getty Tank	REC	45
17	DS	Consider installing radio read devices and/or reading meters monthly (ease of billing)	REC	56
18	ST	Install small permanent generator at Getty Tank to ensure communications	REC	45
19	PU	Conduct an efficiency study on the Sherman St. pumps, determine efficacy of this station	REC	48
20	MO	Complete the update to the reliability study for the distribution system	REC	59
21	DS	Continue to install hydrant auxiliary valves, and make sure these are tracked.	REC	54, 61
16	PU	Modify piping of "new" High Service Pumps to be used by the City, exercise the pumps	REC	47
22	MO	Improve communication/transparency on billing, metering, lost water, inactive accounts	REC	61, 62
23	DS	Conduct a water balance on the 30" gravity line to Sherman pump sta., inspect if needed.	REC	48

SANITARY SURVEY - TREATMENT PLANT

TREATMENT PLANT - BASIC DATA

Name of Supply: City of Muskegon Heights
WSSN: 4580
Review Dates: 7/22/14, 7/30/14
Reviewed By: Luke Dehtiar, Ernie Sarkipato

Mailing Address:
2724 Peck Street
Muskegon Heights, MI 49444

Plant Address
Water Filtration Plant
2323 Seminole Road
Muskegon Heights, MI 49444

City Officials		Phone	Email
Mayor:	Darrell L. Paige	(231) 733-8820	dpaige@cityofmuskegonheights.org
City Manager:	Lori Doody (interim)	(231) 733-8850	
Director Water Filtration Plant:	John Allen	(231) 780-3415	1939chris@gmail.com
F Operator-In-Charge:	John Allen	(231) 780-3415	1939chris@gmail.com
F Designated Backup Operator:	Eric Francik	(231) 780-3415	
Dir. of Infrastructure & Engin.	John Allen	(231) 780-3415	1939chris@gmail.com
S Operator-In-Charge:	John Allen	(231) 780-3415	1939chris@gmail.com
S Designated Backup Operator:	Kurt Miller		

Water Treatment Plant Operators:		Licenses	Operator ID	Expires
Director Water Filtration Plant:	John Allen	F-1, S-1	3226	1/15/2017
Chief Operator:	**Vacant**			
Shift Operator	Eric Francik	F-3	15671	1/15/2018
Shift Operator	Derrick Johnson	F-3	17258	7/15/2015
Shift Operator	Calvin Miles	F-3, S-4	4281	7/15/2016
Shift Operator	Steffan McGuffey	F-4	6888	10/15/2015
Maintenance Relief Operator	Dave Bonfoey	S-3	14397	7/15/2017
Maintenance Relief Operator	Deb Yordy	F-3	17657	7/15/2017
Maintenance Relief Operator	**Vacant**			
Maintenance Relief Operator	**Vacant**			

Comments:
2014 - John is the permanent OIC for the treatment plant, and the interim OIC for the distribution system. John also serves as the OIC at Grand Rapids, but is able to split his time in order to meet the operations oversight policy.

Retail Customers: (None)

Wholesale Customers: (None)

Total Population Served: 10,856

Percent Metered: 100%
Percent Unaccounted:

	% Lost	Metered	Sold	Unaccounted
WTP 2004	2%	2,273,429,000	2,228,765,000	44,664,000
WTP 2005	3%	2,714,355,000	2,629,971,000	84,384,000
WTP 2006	2%	2,456,281,000	2,418,177,000	38,104,000
WTP 2007	12%	2,478,152,000	2,190,335,600	287,816,400
WTP 2008	13%	2,294,822,000	2,002,689,900	292,132,100
WTP 2009	13%	2,135,448,000	1,858,246,000	277,202,000
WTP 2010				
WTP 2011				
WTP 2012				
WTP 2013				
WTP 2014				
Musk Hts Dist. 2004	36%	499,000,000	318,875,000	180,125,000
Musk Hts Dist. 2005	23%	700,673,000	536,997,000	163,676,000
Musk Hts Dist. 2006	26%	674,748,000	501,578,000	173,170,000
Musk Hts Dist. 2007	28%	655,880,000	469,159,600	186,720,400
Musk Hts Dist. 2008	31%	643,695,000	446,552,900	197,142,100
Musk Hts Dist. 2009	30%	529,744,000	369,119,000	160,625,000
Musk Hts Dist. 2010				
Musk Hts Dist. 2011				
Musk Hts Dist. 2012				
Musk Hts Dist. 2013				
Musk Hts Dist. 2014				

Comments:
2011: Unaccounted water levels need to be addressed in the Muskegon Heights Distribution System.
2015: Historic levels are well above the acceptable target of 10%. Attempts to calculate lost water for recent years are not reliable, with amounts ranging from 60% to -30%. The actual amount remains unknown for recent years, with the errors in calculation likely due to estimated billing practices by the City. The supply must refine their administrative and accounting practices to make the calculation of lost water practicable and reliable. Any amount of lost water above 10% must be investigated systematically in order to reduce the amount of lost revenue.

Water System Construction Features & Dates:

1907 - City water system installed; 15 wells; 48698 feet of 1" to 10" water main.
1917 - Water system improvements; 28,435 feet of 4" through 14" water main; (2) 750 gpm wells; 10 fire hydrants; 31 valves
1940 - 5.7 MGD plant designed by Shoecraft, Drury & McNamee (Tetra Tech MPS). Plant included: intake, 3 low service pumps, 1 rapid mix, 2 coagulation basins, 1 settling basin, 4 filters rated 2 gpm/ft2, 2 MG ground storage with 4 high service pumps at plant and 1.5 MG ground storage with 4 high service pumps at Sherman St.
1941 - Plant commenced operation on August 17.
1942 - Norton Township connects to city water supply.
1952 - Fluoridation initiated on January 22.
1957 - Low Service Pump No. 4 and Sherman St. high service pump No. 5 installed.
1965 - 5.7 MGD plant expansion designed by Ayres, Lewis, Norris and May included: low service pump No.5, second settling basin, 4 filters rated 2 gpm/ft2, 2 replacement high service pumps at plant, 1 replacement pump at Sherman St. station, 0.75 MG Getty St. elevated tank, instrumentation and transmission main.
1971 - 6 inches of anthracite added to each filter to allow 3 gpm/ft2 filtration rate.
1973 - 5.7 MGD expansion designed by Ayres, Lewis, Norris and May included; low service pump No.6, second rapid mix, 2 additional coagulation and settling basins, high service pump No.3 and additional 2 MG ground storage at plant.
1975 - Fruitport Township receives city water.
1984 - Replaced telemetering and instrumentation.
1985 - Installed 130 ft. of 30" main at low service pump station.
1992 - Restructured sludge lagoon into two cells.
2000 - 2003 - 8.4 MGD plant expansion designed by Fishbeck, Thompson, Carr & Huber. Plant included: 2nd intake, low service pumps No.1 and No.3 replacement, low service station generator, 2nd raw water transmission main, 2 inline rapid mix units, 2 additional flocculation basins, 2 additional rectangular sedimentation basins, 4 additional filters rated 3 gpm/ft2, filters 1-4 replacement of media and underdrain, filter to waste on all filters, 2 additional clearwells, 4 additional high service pumps at 5 MGD each for high pressure district, new Phos. Alum Cl F PAC chemical feed equipment, WTP backup generator, new SCADA controls.
2001 - Getty St. Booster Pump Station to service high pressure district.
2002 - Cathodic Protection for Getty St. elevated storage tank.
2006 - Sludge Removed from the north lagoon cell and replacement of the SCADA system.
2015 - Norton Shores and Fruitport Twp purchase water from the City of Muskegon, rather than Muskegon Heights.

Is Vulnerability Assessment Available for review?	Yes
Is Emergency Response Plan Available for review?	**No**

Plant Personnel and Security Comments:

Personnel - Operator in Charge is properly certified and backup operators with the proper certification are also available. Shift operators and maintenance relief operators should continue to be encouraged to pursue higher levels of certification. Vacancies should be filled to provide flexibility in work schedule coverage.

Construction - WTP plant upgrades were completed in 2004 but did not address existing equipment. In 2009-2010 the low service station, floc basins, sed basins, filter clearwells, and reservoirs were inspected and some rehabilitation work was completed. Additional rehabilitation work is listed in the City's 2010 Ten Year Capital Improvement Plan (see Appendix K).

Security - A mechanical front gate with limited access has been installed and used at the WTP. A mechanical gate may also be necessary at the entrance to the drive down to the low lift station. The City of Muskegon Heights' Vulnerability Assessment (VA) contains several recommended short term and long term improvements. The VA is from 2004 and should be updated. A Contingency Plan was completed in 2008. The 12/09 SDWA rule revisions changed the Contingency Plan into an Emergency Response Plan (ERP). The ERP is currently outdated and must be updated. Table Top Exercises should be performed to provide staff with emergency training.

WATER TREATMENT PLANT

Demand Data (Million Gallons): Total System Demands (Hts. + N. Shores + Fruitport)

Year	Max. Day	Avg. Day Max. Month	Avg. Day	Min. Day	Avg. Day / Capita (gpd)
2000	13.010	9.650	6.590	3.370	164.9
2001	14.460	11.940	6.850	2.680	171.4
2002	14.250	12.090	6.735	3.150	168.5
2003	15.980	10.528	6.832	3.550	171.0
2004	11.701	9.196	6.237	2.498	156.1
2005	15.651	12.901	7.811	3.815	189.8
2006	13.138	10.965	6.723	2.911	163.3
2007	15.201	11.290	6.789	2.957	164.9
2008	12.534	10.444	6.270	3.335	
2009	10.952	9.373	5.851	3.299	
2010	11.175		5.596	3.046	
2011	11.633		5.222	2.848	
2012	17.252		5.261	2.614	
2013	12.207		5.179		
2014	10.100		5.515		

			1 Yr.	3 Yr.	10 Yr.
		Avg. Day Demand (MGD)	5.515	5.318	6.022
		Avg./Rated Capacity	21.9%	21.1%	23.9%
Plant Design Capacity (MGD):	25.2	Max.. Day Demand (MGD)	10.100	**17.252**	**17.252**
State Rated Capacity (MGD):	25.2	Max./Rated Capacity	40.1%	**68.5%**	**68.5%**
Auxiliary Power Capacity (MGD):	10.0	Aux./Avg. Day Demand	181%	188%	166%

Plant Metering:

Location	Type	Line Size	Flow Range	Year Installed
Raw Water:	Mag	36 inch	0-35 MGD	2003
New Flocculator Influent	Strain Gage	36 inch	0-10 MGD	2003
Old Flocculator Influent	Venturi	16 inch	unknown	1940
Finished Water:	Mag	16 inch	1000-19500 gpm	2005
New Backwash Water:	Mag	24 inch	0-12,000 gpm	2003
Old Backwash Water:	Venturi	20 inch	unknown	1940
Individual Filter (1-12 each)	Mag	10 inch	0-2,000 gpm	2003
Hypochlorite	Mag	3 inch	0-200 gpm	2003
Hypochlorite	Mag	1.5 inch	0-50 gpm	2003
Hypochlorite	Mag	1.5 inch	0-50 gpm	2003
Hypochlorite	Mag	3 inch	0-100 gpm	2003
Plant Service Water:	Mag	4 inch	0-500 gpm	2003
High Pressure District:	Mag	24 inch	0-12000 gpm	2003
Gravity to Sherman:	Mag	30 inch	2500-27000 gpm	2005

Total Treated Water Storage:

		Tank	Capacity
Treatment Plant	Clearwell:	North Clearwell 1	0.0905 MG
		South Clearwell 1	0.0815 MG
		North Clearwell 2	0.0905 MG
		South Clearwell 2	0.0815 MG
		North Clearwell 3	0.1205 MG
		South Clearwell 3	0.038 MG
	Ground Storage:	East Reservoir	2.0 MG
		West Reservoir	2.0 MG
		Total	**4.50 MG**

Distribution System	Low Pressure District	
Elevated Storage:	Getty St.	0.75 MG
Ground Storage:	Sherman 1	1.0 MG
	Sherman 2	0.5 MG
Total (MG)		**2.25 MG**
Percent of Maximum Day:		13.0%

Demand/Capacity/Storage Comments:

2011 - Capacity of the WTP is adequate to handle maximum demands for the next several years. the generator at the WTP is capable of meeting the average day demands of the entire water system, but is not capable of meeting current maximum day demands.

2011 - The Strain Gage meter on the new flocculator influent line is a Niagara Model 1030F. It is not accurate due to the proximity to pipe bends up and down stream of the meter.

2011 - Storage at the WTP appears to be adequate. Distribution system storage is adequate for the City of Muskegon Heights in comparison to demands, but would only provide enough water to last about 10 hours based on the current average day demand of the entire system.

2014 - Moving forward from the loss of the wholesale customers in 2015, the demands will be much less than the system has experienced recently. Demand data will have to be re-assessed once the change-over occurs.

Muskegon Heights Process Unit Capacities

Subrule 3 of Rule 1006 of the Michigan Safe Drinking Water Act (Act 399) states:

The rated capacity of the complete treatment system is the smallest of the following rated capacities for each element or unit of the system:

(a) Intake-- The rated capacity of the intake is the lesser of the intake capacity at the 100-year drought elevation or the intake capacity at the time of the lowest recorded elevation of surface water at the point of intake.

(b) Raw water supply-- The rated capacity of the raw water supply is the firm capacity of raw water pumping units or the total flow from a system supplying raw water by gravity under minimum source water elevation conditions.

(c) Treatment processes-- The rated capacity of treatment processes including coagulation, precipitation, sedimentation, and filtration is the established maximum allowable treatment rate. Where less than 4 filters are provided, the rated capacity of the filters is the maximum allowable treatment rate with the largest filter removed from service.

(d) Finished water supply-- The rated capacity of the finished water supply to the distribution system or storage is the firm capacity of pumping systems or the total flow from a system supplying finished water by gravity under the limiting head condition.

The following are determinations of total and firm capacity for each unit process based on the "Recommended Standards for Water Works" a.k.a. "10 State Standards". Where applicable, the WTP's design capacity (25.2 MGD) has been used to determine compliance with these recommended design standards. A summary of the Rated Capacity for the WTP is provided at the end of this section.

Intake

criteria = headloss through the intake to the low service pump station

Old 30"	16.8	MGD
New 42"	34	MGD

Total Capacity	**50.8**	**MGD**
Rated Capacity	**50.8**	**MGD**

Low Service Pump Station

6 low service pumps in total. TDH = 128'

Total Capacity	**33.9**	**MGD**
Firm Capacity	**25.3**	**MGD**
Rated Capacity	**25.3**	**MGD**

The basis of design from the last WTP expansion included a hydraulic analysis of operating all 6 of the low service pumps simultaneously and determined that the total pumping capacity would be limited to 33.9 MGD. In addition, the firm pumping capacity with the largest low service pump out of service was determined to be 25.3 MGD. This is the basis for the capacities listed above.

Flocculation Basins

criteria = 10 States Standards
- Min. Flow Through Velocity = 0.5 feet/minute
- Max. Flow Through Velocity = 1.5 feet/minute
- Detention Time ≥ 30 minutes

At Design Capacity of 25.2 MGD

Detention Time	**45.3 Minutes**	**>30 Minutes**	**OK**
Flow Through Velocity	**0.82 Feet/Minute**	**>0.5 & < 1.5 Ft/min.**	**OK**

	Basin	Compartment		Capacity (MGD) @ Flow Through Velocity	
Basin	Volume	Width	Depth	0.5 fpm	1.5 fpm
1	0.126	43	13.83	3.20	9.61
2	0.126	43	13.83	3.20	9.61
3	0.135	43	13.83	3.20	9.61
4	0.135	43	13.83	3.20	9.61
5	0.135	16.7	13.83	1.24	3.73
6	0.135	16.7	13.83	1.24	3.73
			Total Capacity	15.30	45.90

Total Dt Capacity (All Basins)			Dt Capacity (Largest Out of Service)		
Dt	30	minutes	Dt	30	minutes
Volume	0.792	MG	Volume	0.657	MG
Capacity	38.02	MGD	Capacity	31.54	MGD

Individual Basins 30 minute Dt Capacity

1-2	0.126	MG	6.05	MGD
3-6	0.135	MG	6.48	MGD

Total Capacity	**38.02**	**MGD**
Rated Capacity	**38.02**	**MGD**

Sedimentation Basins

criteria = 10 States Standards
4 hours Minimum Settling Time
Max. Flow Through Velocity = 0.5 feet/minute
Outlet Weir Launder Loading Rate = 20,000 gpd/ft

Detention Time @ 25.2 MGD Design Capacity	**4.13 Hours**	**> 4 hours**	**OK**
Flow Through Velocity @ 25.2 MGD Design Capacity	**0.52 Feet/Min.**	**>0.5 Ft/m**	**Not Met**

Basin	Volume	Basin Width	Depth	Capacity @ Max. Velocity 0.5 fpm	Capacity @ Dt 4 hours
1	0.699	43	17.69	4.10	4.19
2	0.699	43	17.69	4.10	4.19
3	0.770	43	17.69	4.10	4.62
4	0.770	43	17.69	4.10	4.62
5	0.700	44	16.44	3.90	4.20
6	0.700	44	16.44	3.90	4.20

Total Capacity 24.18
Firm Capacity 20.08

Total Sett. Time Capacity (All Basins)
Time 4.0 hours
Volume 4.338 MG
Capacity 26.03 MGD

Sett. Time Capacity (Largest Out of Service)
Time 4.0 hours
Volume 3.568 MG
Capacity 21.41 MGD

Basins 5 & 6 have overflow weirs
4 weir troughs, 30 feet long per basin

Total Weir Length Each Basin 240 feet
Capacity of Each Basin 4.8 MGD

Total Capacity	**26.03 MGD**
Rated Capacity	**26.03 MGD**

Based on the 4 hour detention time requirement

Filters

criteria = 3.02 gal/minute/sq.ft. maximum filter loading rate as permitted

Loading Rate @ 25.2 MGD Design Capacity **3.02 gpm/sqft**

Filter	Area sq.ft.	Capacity
1	490	2.13 MGD
2	490	2.13 MGD
3	490	2.13 MGD
4	490	2.13 MGD
5	480	2.09 MGD
6	480	2.09 MGD
7	480	2.09 MGD
8	480	2.09 MGD
9	480	2.09 MGD
10	480	2.09 MGD
11	480	2.09 MGD
12	480	2.09 MGD

Total Capacity	**25.20 MGD**
Capacity (Largest Filter Out)	**23.07 MGD**
Capacity (N. Clearwell #1 Out)	**16.68 MGD**
Rated Capacity	**25.20 MGD**

High Service Pumps

	Total Capacity	Firm Capacity
WTP High Service Pumps (7 total)	32.53 MGD	26.48 MGD
Sherman Station Pumps (4 total)	15.2 MGD	9.2 MGD
Sherman Station Gravity Line	9 MGD	9 MGD

Total Capacity	**41.53 MGD**
Firm Capacity	**35.48 MGD**
Rated Capacity	**35.48 MGD**

Unit Capacity Summary

UNIT RATED CAPACITY		
Intake	50.8	MGD
Low Service Pumps	25.3	MGD
Floc Basins	38.02	MGD
Sed. Basins	26.03	MGD
Filters	25.20	MGD
High Service Pumps	35.48	MGD

The process schematic for the WTP show that it is comprised of six separate treatment trains consisting of flocculation, sedimentation, and under normal operation filtration with the numbered flocculation basins and sedimentation basins corresponding to each other (Floc 1 & Sed 1, Floc 2 & Sed 2, etc.) and every two basins corresponding with a set of 4 filters (Floc 1&2, Sed 1&2, Filters 1-4, etc.). Therefore, each treatment train may be limited by a different unit process and the rated capacity for each treatment train must be determined in order to develop an overall rated capacity.

TREATMENT TRAIN RATED CAPACITY

Treatment Train	Capacity		Limiting Factor
Floc & Sed Basins 1, Filters 1-4	4.19	MGD	Sed. Basin Min. Detention Time
Floc & Sed Basins 2, Filters 1-4	4.19	MGD	Sed. Basin Min. Detention Time
Floc & Sed Basins 3, Filters 5-8	4.18	MGD	Filter Loading Rate
Floc & Sed Basins 4, Filters 5-8	4.18	MGD	Filter Loading Rate
Floc & Sed Basins 5, Filters 9-12	4.18	MGD	Filter Loading Rate
Floc & Sed Basins 6, Filters 9-12	4.18	MGD	Filter Loading Rate

TOTAL TREATMENT TRAIN RATED CAPACITY	**25.10**	**MGD**
WTP DESIGN CAPACITY	**25.2**	**MGD**
OVERALL WTP RATED CAPACITY	**25.2**	**MGD**

COMMENTS:
While the minimum required detention time appears to control the rated capacity for the first two treatment trains, the WTP has the capability of splitting the flow across all 12 filters which would allow the Overall WTP Rated Capacity to be increased to the WTP Design Capacity. At the WTP Design Capacity, all recommended design criteria are met except for sedimentation basin flow through velocity which is only exceeded by 4% and does not appear to significantly impact the ability of the WTP to meet current treated water quality standards.

In the future, as system demands increase near the design capacity, the WTP should evaluate what impacts, if any, the higher flow through velocity may have on the effectiveness of the pretreatment process.

It should be noted that the north clearwells are critical for the operation of each set of filters and if one of these clearwells is taken out of service the entire set of filters will also be out of service. The worst case of this would be if north clearwell no. 1 was taken out of service the WTP capacity would be reduced to 16.7 MGD.

Water Quality:

2014 Data	Raw		Treated	
	Normal	Range	Normal	Range
Hardness, ppm	142	115-182	143	116-186
Turbidity, NTU	1.3	0.1-138	0.03	0.01-0.49
Color	8	0-385	0	0
Alkalinity, ppm	116	100-177	111	98-144
Total Col, cts/100 ml				
TOC, ppm	2.1	1.4-4.3	1.71	1.26-2.3
Nitrate, ppm				
Fluoride, ppm				
TTHM, ppb				
HAA5, ppb				
pH	8.25	5.13-11.56	7.71	6.4-8.9
HPC				

Monitoring Requirements: See Monitoring Schedule; Appendix B
Complete Chemical Analysis: See DEQ Chem File

Comments on water quality/monitoring requirements:
2011 - Muskegon Heights should consider adopting Water Quality Goals for its treatment plant. See Appendix C.
2011 - The City and their customer supplies separately completed Standard Monitoring and IDSE Reports to comply with the requirements of the Stage 2 DBPR. The reports showed elevated levels of DBP's but no single site is expected to exceed the LRAA MCL for either TTHM or HAA5. The City of Muskegon Heights' IDSE report was approved in 3/2010 and the City is ready for Stage 2 compliance monitoring.
2011 - The City completed LT2ESWTR crypto monitoring and has been classified into Bin 1, with the next round of monitoring scheduled to begin in 10/2016.
2011 - TTHM's and HAA5's appear to be the contaminants that pose the biggest threat to the system's water quality. Turbidity spikes have also occured at times, but have not exceeded treatment technique standards.
2011 - Raw water from Lake Michigan is generally of excellent quality. Taste and odor events, requiring the addition of activated carbon, have occurred seasonally.
2011 - Monitoring requirements of the MSDWA are being met with the exception of a TOC monitoring violation in the 1st Quarter of 2009. Operational monitoring parameters and frequencies at the WTP also appear to be adequate.
2015 - The City will be required to conduct the second round of crypto sampling under LT2ESWTR in Oct. 2016.

Intake Facility:

	Intake 1	Intake 2
Year:	1940	2000
Capacity:	16.8 MGD	34.0 MGD
Last Inspected:	Fall '14	Fall '14
Name of Source:	Lake Michigan	
Source Capacity:	unlimited	
Diameter of raw water intake pipe:	30"	42"
Total Length	4700'	4800'
Location (latitude/longitude):	available	available
Submergence:	2 Cribs	2 Cribs
Entrance Velocity:	5.35 fps @ 22.56' HL	5.66 fps @ 17.5' HL
Grating	2"x12"	2"x12"
Zebra Mussel Control:	Yes - Cl, PO4	Yes - Cl, PO4
Historic Low Water Elevation:	576.1 (1964)	
Historic Low Water Flow:	N/A	
Historic High Water Elevation	582.5 (1986)	
Standby (Emergency) Intake?	Yes, 1 Manhole	Yes, 1 Manhole
Size	Unknown	30" Diameter
Distance from Shore	3100'	3100'
Distance from Crib	1500'	1500'
Accessibility	Steel Cover	Blind Flange
Last Used	Unknown	Never
Is Source Water Assessment Plan available?	Yes	
Back flush provisions?	No	Yes

Comments of Intake: condition of intake, source protection, ownership, vulnerability to spills
- A Source Water Assessment was completed in 2004. Intakes are categorized as moderately sensitive to potential contaminants. The source water has moderately high susceptibility to potential contamination.
- Seasonal Chlorination is used to control zebra mussels.
- The sump pump from the Low Service Station currently discharges to Lake Michigan and requires an NPDES permit
- Chemical feed for Zebra Mussels is pumped from the WTP but the Low Service Station has the ability to setup chemical feed equipment if the line from the WTP breaks or is out of service. This includes fiber optics for controls and room for a 55 gallon chlorine container.
- Alternation of the Low Service Station Pumps is done by operator preference
- Potable water for the Low Service Station comes from the WTP.
- Each intake has a single emergency intake/access manhole. Detail of the manhole on the 1940 intake is not available, but it was videoed as part of the 2010 inspection. The pipe extends approximately 8 feet from the intake to approximately 2 feet above the lake bottom. The manhole on the 2000 intake extends 12 feet 3 inches from the intake to 3 feet above the lake bottom and is capped with a blind flange with eye hook for removal. Both manholes are protected with riprap.
- Inspections were conducted on both the intakes in 2006. 69 cubic yards of material in total was removed from the cribs and feed pipes. The old 30" intake showed many open joints with 1 inch gaps and a 30 foot section of pipe near the 3050 foot mark near an access manhole where the pipe was only 40% open. The new 42" intake showed heavy sedimentation from the cribs to the crib intersection with the pipes less than 50% open. The section of this intake near the access manhole was also found to have mussel growth and sediment buildup. Portions of the inspection reports are in the basic data folder.
- Inspections of both intakes were conducted on days in May, June, and July of 2010. Video recordings were made of the inspections. All 4 cribs structures had slat openings reduced to approximately 50%. All 4 intake pipe openings were over 90% plugged with material. Chlorine feed halos were found plugged. Material appears to be plugging most of the intake pipeline from the cribs to past the emergency manholes. Intake No. 1 emergency manhole had no cover and was actively pulling in water as the pipe section to the crib was plugged. As of November 2010 some of the material had been removed from Intake No. 1 (North) but a cover could not be placed on intake emergency manhole before weather prevented additional removal from being completed. Portions of both intakes remain plugged with material, which should be removed in Spring 2011 when conditions allow work to continue. Despite the presence of so much material in the intake, the WTP has been able to meet demands. It is uncertain whether the intake conditions are a factor in TOC treatment. The condition of the intakes may limit their capacity. At a reduced friction factor (C=50), capacity is limited to 8.75 and 18.3 MGD, respectively.
2014 - The intakes were inspection and cleaned in Fall 2014.
2014 - The City should consider implementing a surface water intake protection program (SWIPP). SWIPPs have been successfully completed and implemented by other supplies utilizing great lakes sources. Grand Haven may be a good example to reference, as they are relatively close and also utilize Lake Michigan as their source water.
2015 - Currently the intake chlorination has limited capacity. This issue should be addressed to ensure adequate chlorine to deter zebra/quagga mussels.

Pumps and Pump Locations:

Low Service:

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
LSP No. 1	Goulds	2000	7.4@128'	VTVS	H2O	Active	Yes	No
LSP No. 2	Layne	1988	4.6@120'	VTCS	H2O	Active	Yes	No
LSP No. 3	Goulds	2000	7.4@128'	VTVS	H2O	Active	Yes	No
LSP No. 4	Peerless	1957	4.9@120'	VTVS	oil	Active	Yes	No
LSP No. 5	Layne	1965	5.4@120'	VTCS	H2O	Active	Yes	No
LSP No. 6	Peerless	1974	8.8@130'	VTCS	H2O	Active	Yes	No

Firm 25.3 MGD @128' TDH	**Total** 33.9 MGD @128' TDH

(See Page 5 for basis of LSP capacities)

Low Service Station Aerial Photo

Low Service Station

Low Service Pump Nos. 1, 3, and 5

Low Service Pump Nos. 4, 6, and 2

Low Service Sub Level Piping (1, 3, 5)

Low Service Sub Level Piping (4, 6, 2)

High Service:

Low Pressure District: City of Muskegon Heights

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
WTP Old HSP No. 1	Layne	1965	4.46@162'	VTCS	H2O	Active	Yes	No
WTP Old HSP No. 2	Layne	1965	6.05@185'	VTCS	H2O	Active	Yes	No
WTP Old HSP No. 3	Peerless	1965	2.02@142'	VTCS	H2O	Active	Yes	No
Sherman No. 1	Am. Well	1941	3.0@155'	CentCS	H2O	Active	Yes	No
Sherman No. 2	Am. Well	1957	6.0@155'	CentCS	H2O	Active	Yes	No
Sherman No. 3	Am. Well	1941	2.2@152'	CentCS	H2O	Active	Yes	No
Sherman No. 4	DeLaval	1965	4.0@180'	CentCS	H2O	Active	Yes	No

WTP Old HSP No. 1 & No. 2

WTP Old HSP No. 3

Sherman Pump Station

Pump Nos. 1 & 3

Pump No. 5 (Not Connected)

Pump Nos. 4 & 2

High Pressure District: City of Norton Shores & Fruitport Township

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
WTP New HSP No. 4	Peerless	2000	5.0@210'	VTVS	H2O	Active	Yes	No
WTP New HSP No. 5	Peerless	2000	5.0@210'	VTVS	H2O	Active	Yes	No
WTP New HSP No. 6	Peerless	2000	5.0@210'	VTVS	H2O	Active	Yes	No
WTP New HSP No. 7	Peerless	2000	5.0@210'	VTVS	H2O	Active	Yes	No

No longer part of Muskegon Hts. system

Filtration Plant High Service Pumps No. 4, 5, 6 & 7

Firm	High Pressure	**22.77 MGD**
	Low Pressure	**15.48 MGD***
	System	**35.48 MGD***

Total	27.77 MGD
Total	21.53 MGD**
Total	41.53 MGD**

* Low Pressure & System based on FP#2 out and max. capacity of Sherman gravity feed = 9 MGD

** Total based on max. capacity of Sherman gravity feed = 9 MGD

NOTE: This section is outdate as a result of the loss of customers in 2015. Needs updating next survey cycle.

Filter Backwash:

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
Old HS BWP No. 1	DeLaval	1941	9750 gpm	CentCS	H2O	Active	Yes	No
Old HS BWP No. 2	DeLaval	1941	9750 gpm	CentCS	H2O	Out of Service	Yes	No
New HS BWP No. 3	Patterson	2000	9750 gpm	VTCS	H2O	Active	Yes	No

Firm Capacity:	**28.08 MGD**	**Total Capacity:**	**42.12 MGD**

Backwash Pump No. 1 & No. 2

Backwash Pump No. 3

Surface Wash Pump:

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
Old HS SWP No. 1	Unknown	2002	Unknown	CentCS	H2O	Active	Yes	No

Contaminant Containment Pumps:

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
Contam. Cont. No. 1	March	2002	12 gpm @ 30'	CentCS	Oil	Active	Yes	No
Contam. Cont. No. 2	March	2002	12 gpm @ 30'	CentCS	Oil	Active	Yes	No

Chemical Transfer Pumps:

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
Sodium Hypochlorite	March	2002	12 gpm @ 30'	CentCS	Oil	Active	Yes	Yes
Alum	March	2002	12 gpm @ 30'	CentCS	Oil	Active	Yes	Yes
Fluoride	Thompson	2006	47 gpm @ 30'	CentCS	Oil	Active	Yes	Yes

Chlorine Transfer

Alum Transfer

Fluoride Transfer

Sampling Pumps: (6)

Location/No.	Make	Year	Capacity	Type	Lubricant	Status	Preventive Maintenance	Flooding?
Various	Little Giant	2002	3 gpm @ 20'	CentCS	Oil	Active	Yes	No
Combined CFE	March	2006	3 gpm @ 28'	CentCS	Oil	Active	Yes	No

Comment on Pumps/Pump Maintenance:
- Pump maintenance is performed annually for each pump. No thermal or vibrational monitoring is employed, except on the Norton Shores HSP.

2014 - Low Service Pump #1 has a bearing issue within the pump. The bearing was repaired and the motor rebuilt.
- LSP#2 & #6 were pulled in 2005 to have the impeller replaced and pumps and motors rebuilt.
2014 - LSP #3 was leaking badly from the packing gland at the time of my visit.
- LSP #5 had its actuating valve rebuilt in 2006.
- LSP #4 is back in service. Prior vibration issues have been resolved and a VFD was installed.

- Sherman Pump #1 is operated using an electric actuator and had a new motor installed in 2007.
- Sherman Pumps #2 - #4 are all hydraulically actuated but the actuator for #3 is supplied by the pump station discharge line.
-Sherman Pump #2 has a bad actuator and is too large to function properly given the current hydraulic conditions.
- Sherman Pump #4 currently has broken valves that prevent its use. Repairs on this pump were completed in 2014.
- An extra pump motor is kept on hand at the Sherman Station
- A gravity transmission line runs from the WTP to the Sherman Reservoirs and has a maximum capacity of 9 MGD.

- High Service Pump #3 was rebuilt in 2005.
- High Service Pump #1 had the actuator rebuilt in 2006.

- Backwash Pump #2 is out of service and needs motor repairs. Capacity is still adequate as only 1 pump is used during a backwash. **(2015 update - this pump is now functional)**

- Sampling Pump Locations:
1. Raw
2. Rapid Mix (from both lines)
3. Settled (2 pumps in series)
4. Combined CFE
5. Plant Tap
- All Sample Pumps are Little Giant Model 4-MD except CFE Pump (March TE-5C-MD)

- Alum and NaHOCl transfer pumps are March Mfg. Model TE-7R-MD.
- Fluoride transfer pump is Finish Thompson Model KC8VTVN355C03.

- Contam. Contain. pumps are March Mfg. Model TE-7K-MD. These pumps discharge to the sludge lagoon.

TREATMENT FACILITIES

Rapid Mix:

Number of Units:	2 Inline Units		2 Basins (Not in Use)
Volume of each unit:	36 inch diameter x 4 feet =	211 gallons	0.01 MG 0.015 MG
Detention Time at rated capacity:	0.024 minutes		1.43 minutes
Mechanical or Static?	Mechanical		Mechanical
In-line or CSTR?	In-line		CSTR
Velocity Gradient (G)	2500 - 3400 sec^{-1} @ 32 to 70 °F		
Is mixing rate adjustable?	Yes		Yes
Condition of equipment	Active		Out of Service
Chemicals added (in order):	Sodium hypochlorite, carbon, alum		

Rapid Mix No. 1

Rapid Mix No. 2

Comment on Rapid Mix:
2011 - Paddles have been pulled from the old rapid mix basins and they are no longer operated. However, the paddles are still kept on hand in the WTP.
2011 - Rapid Mix No. 1 had a shear pin break and was rebuilt. There is no plan to inspect Rapid Mix No. 2 for possible rehab.

2014 - Rapid Mix #1 is leaking heavily. The packing should be adjusted to provide proper lubrication without excess leakage.

2014 - Rapid Mix #2 has an issue with its bearings, but should be repaired in fall of 2014.
2014 - The lack of a meter on each raw water line limits the flexibility of the rapid mix units.

The water supply plans on replacing one of the units, and rebuilding the other unit in fall of 2015.

Flocculation Basins:

Number of Units:	6	
Volume of each unit:	1&2 = 0.126 MG each; 3,4,5&6 = 0.135 MG each	
Detention time at rated capacity:	45 minutes	
Type of Units:	All Horizontal Shaft Paddle Flocculators	
Inlet design:	Baffle Wall	
Is mechanical flocculator used?	Yes	
Condition of equipment:	1, 2, 3, & 4	New paddle wheels, chains; baffles rehabbed
	5 & 6	Installed in 2004 and in good condition
Is C*T available?	See Appendix C	
Baffles:	On inlet and outlet	
Is Preventative Maintenance Performed?	Yes, Basin cleaned annually and drive greased monthly.	

← Floc Basin No. 1 ←

→ Floc Basin No. 2 →

← Floc Basin No. 3 ←

→ Floc Basin No. 4 →

→ Floc 2 - Stage 1 (typ.) →

← Floc 1 - Stage 2 (typ.) ←

↑ Floc Basin No. 5 ↓

↓ Floc Basin No. 6 ↑

Comment on Flocculation Basins:
- Basins 1-4 have 2 stages each, flow is perpendicular to paddle wheels. Basins 5&6 have 6 stages each, flow is parallel to paddle wheel shafts.
- Basins 1-4 have had paddle wheels and chains replaced with less corrosive materials. Concrete repairs and baffle repairs were also completed.
- Old Floc Basins have an angled inlet baffle wall to accommodate the splitter box. The area behind this inlet baffle collects surface scum which must be removed manually on a regular basis.
- The exterior building wall leaks by basin #2. A weep hole allows water to drain into the floc tank.
- Basins 1-4 were inspected for their structural condition and repaired in 2009.
- Floc drive motors are being rebuilt by WTP staff.
- Floc paddle wheel speeds are monitored through the SCADA system.
- 2014 Basins 3 & 4 are not operated in the winter due to icing issues.

Settling Basins:

Number of Units	6
Volume of Each Unit:	1&2 = 0.699 each; 3&4 = 0.770 each; 5&6 = 0.700 each
Detention Time at rated capacity:	248 minutes
Type of units:	Conventional rectangular below grade
Inlet Design:	1, 2, 3 & 4: Baffle Wall
	5&6: baffle wall w/ 105 3" openings
Baffles:	No intermediate baffling on any of the basins
Outlet Design:	1&2: No baffle wall, submerged ledge
	3&4: Baffle Wall
	5&6: Four 30' weir troughs
Baffling Factor (EPA Guidance Criteria):	1&2: 0.3 3&4: 0.5 5&6: 0.7
Overflow:	to plant drain
Drains:	Yes, to plant drain
Curbing:	N/A
Cleaning Procedure:	Manual; Drain, Open Valve to Lagoon, and Hose Down
Sludge Disposal:	Lagoon
Physical Condition:	1-4: 2009-10 inspected & rehabilitated ; 5&6: New
Is C*T available?	See Appendix A
Is preventative maintenance performed:	Yes - inspected and cleaned annually

Effluent turbidity, average/range: (05'-09')

	Avg.	Min.	Max.
2005	0.53	0.07	3.28
2006	0.55	0.10	2.61
2007	0.65	0.10	5.58
2008	1.00	0.10	5.13
2009	0.57	0.10	5.39
Overall	0.66	0.07	5.58

Comments on Settling Basins:
- The additional basins have spread the flow and reduced levels of accumulated sludge to allow for easier removal.
- Basins 1-4 were inspected by Dixon Engineering in 2009. Repairs to the basin interiors were made, but surface drainage must still be addressed to prevent ponding on the basin roof.
- 2014 - An additional drainage line should be added to prevent ponding against the building.
- Water from 3 separate settled water lines is run to a single turbidimeter to determine settled water turbidity.

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Filtration

Type of filter: Rapid Sand Filtration

	1-4	5-8	9-12
Number and Area of Filters:	490 ft^2 each	480 ft^2 each	480 ft^2 each
Design Filtration Rate, gpm/ft^2:	3	3	3
Approved Filtration Rate, gpm/ft^2:	3	3	3
Maximum Rate Experienced, gpm/ft^2:	4.31	4.31	4.31
Average filtration rate, gpm/ft^2: (2005-2010)	1.08	1.08	1.08
Is flow equalized through all filters?	Yes	Yes	Yes
Rate of flow device:	Effluent valve controlled by influent trough level		
Filter to waste available?	Yes	Yes	Yes

Filter hours:

	Filter Run Time			Individual Filter Runs (Hrs.)		
	Average	Max. Monthly Avg.	Min. Monthly Avg.	Monthly Avg. Run	Max. Run	%Wash H_2O
2004*	212.4	274.2	150.3	Not Determined	438	
2005*	201.2	286.6	116.6	Not Determined	266.5	2.18%
2006*	237.1	285.5	156.3	Not Determined	226.5	2.62%
2007*	260.0	287.2	231.9	Not Determined	221	2.95%
2008*	181.7	241.3	88.1	Not Determined	N/A	2.89%
2009	134.0	219.5	75.3	Not Determined	N/A	2.16%

* 2004 - 3/2008 MOR reported Hours of Filter Run Time per Day (Out of 288 possible) instead of filter run time

Filter Media - Filters No. 1-4 and 9-12

	Anthracite	Sand
Depth - inches	12	18
Effective size (mm):	0.95-1.05	0.45-0.55
Uniformity coefficient	≤ 1.7	≤ 1.6

Filter Media - Filters No. 5-8

	Anthracite	Sand	Torpedo	Gravel	Gravel	Gravel
Depth - inches	6	22	3	3	3	3
Effective size (mm):	0.8-1.0	0.45-0.55	#16-#8	#8-3/16"	3/16"-3/8"	5/8"-1"
Uniformity coefficient	1.75	≤ 1.6				

Date Last Rebuilt or Checked:	2002 - all filters
Underdrain Type:	1-4 and 9-12: Leopold porous plate and plastic block
	5-8: Wheeler Bottom Underdrains
Curbing:	Yes
Filter Overflow:	None - will drain in hallway floor drain
Surface Wash:	Leopold-Palmer rotating sweeps
Surface Wash source of water:	Plant finished water
Depth of Water Above Media:	8 feet, 4 inches
Filter Performance Records:	Hard copy records of Filter Confluence Points, but not individual filters (SCADA Only)

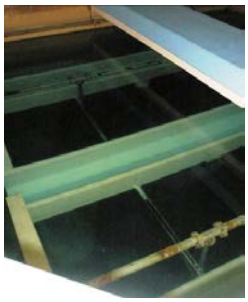
Turbidimeters

Is there continuous turbidimeter for each filter?	Yes	Calibration frequency:	monthly
Is there continuous turbidimeter for the applied?	Yes	Calibration frequency:	monthly
Is there continuous turbidimeter for confluence?	Yes	Calibration frequency:	monthly
Is there continuous turbidimeter for raw water?	Yes	Calibration frequency:	monthly
Is there continuous turbidimeter for plant tap?	Yes	Calibration frequency:	monthly
Turbidimeter used for combined compliance:	Yes	Calibration frequency:	monthly

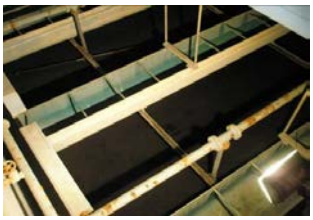
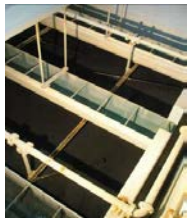
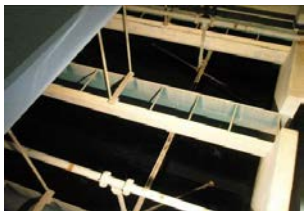
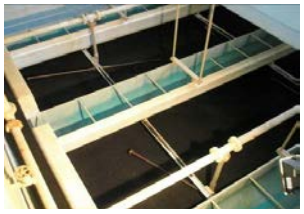
Filtration (continued)

Filter Nos. 1, 2, 3, and 4

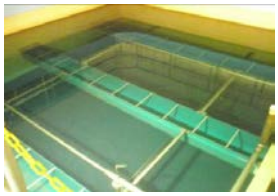
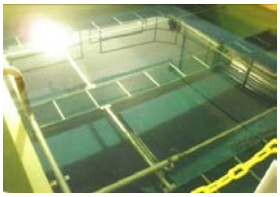
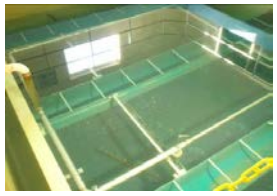
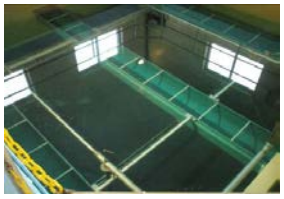





Filter Nos. 5, 6, 7, and 8

Filter Nos. 9, 10, 11, and 12

Comments on Filter Construction/Maintenance/Turbidity measurements:
- Turbidity is the determining factor in length of time for filter to waste cycle.
- The Plant Tap turbidimeter takes water from the finished water reservoir.
- Filters 1-8 have no indicators on their sweeps.
- Jar Tests are not currently performed to optimize treatment
- Most filters have mixing of sand & antrhacite rather than 2 distinct layers. The D_{90}/D_{10} ratio of anthracite to sand appears to be near 4, the ideal ratio is 3. When the ratio is this high too much mixing at the interface is typical.
- Media in Filters 5-8 is still original media from 1964 and may need to be replaced.
- Circular areas around the sweeps with more sand and less anthracite showing is caused by sweeps continuing to run due to the surface wash valve not closing properly.
- Current operation of filters is to place filters in service based on demand while still limiting the filtration rate, and to run filters for up to 200 hours prior to backwash based on turbidity levels. Limiting the number of filters in service has helped lower wash water use, compared to previous practice of having all available filters in continuous operation.
- Annual assessments should be performed on the filters. This should be feasible since lower demands during the winter allow sets of filters to be taken out of service.
- Filter operation should be optimized to maximize efficiency while maintaining performance to meet water quality goals.
- Turbidity data for individual filters is tracked through the SCADA system and stored on the computer, however the system is currently not capable of generating printable reports on individual filters.
- Laser Nephelometers were installed on each CFE point to help detect breakthrough at compliance sampling points. However, these units would be more useful detecting breakthrough if they were installed on each individual filter instead.
- Despite concerns about filter media (age, mixing), filters continue to meet turbidity treatment technique requirements.
- Clearwell inspections showed no evidence of filter underdrain failure.
- 2014 - The anthracite in filters 1-8 will be topped off this year.
- 2015 - The anthracite has not yet been added, planning on doing that this year.
- 2014 - All on-line turbidimeters will be switched to SWAN in the near future.
- 2015 - All filter effluent valve actuators were rebuilt or replaced and are functioning properly.
- 2014 - No filter profiling actions are conducted. Filter coring/probing, bed expansion during backwash, filter

Backwash:

Average run length time of filter:	158 (hours)	2008-2009		
Criteria for backwash:	200 Hours, 8 feet head loss, or 0.1 NTU turbidity			
Source of backwash water:	Plant Service Line - finished water from the high service suction wells			
Average duration of backwash:	30 minutes			
Maximum duration of backwash:	45 minutes			
Average backwash flow, gpm:	3333 gpm (100,000 gal / 30 minutes)			
Maximum backwash flow, gpm:	9750 gpm only 1 pump is used. (could increase if 2 pumps used)			
Average backwash rate - gpm/sq.ft:	1-4:	6.8 gpm/sq.ft	5-12:	6.9 gpm/sq.ft
Maximum backwash rate - gpm/sq.ft:	1-4:	19.9 gpm/sq.ft	5-12:	20.3 gpm/sq.ft
Rise Rate:	1-4:	2.66 ft/min	5-12:	2.72 ft/min
Backwash water disposal:	Filter to waste - discharges to lagoon			
Is bed expansion achieved?	Unknown			
Is there loss of media during backwash?	No			

Backwash disposal

Is backwash water recycled?	No
Location of recycled stream into plant flow:	N/A
Is treatment/equalization provided prior to recycling?	N/A

Associated problems with filters:

(Yes/No)

Air Binding -	No	Media Growth -	No
Cementing -	No	Media Attrition -	No?
Gravel Mounding -	No	Bacteria Growth -	No
Media Loss -	Yes?	Uniform Backwash -	Yes
Adequate Backwash Rate -	Yes	Mudballs -	No

Filter Operation comments:

- Filter backwash operation is automated but there is a Standard Operating Procedure in place for manually backwashing a filter if necessary.
- Backwash is run through an automated sequence. Operators are supposed to watch the backwash cycle but are not always able to.
- The filter backwash does not appear to maintain a rate > 15 gpm/sq.ft. for at least 15 min. as recommended by Ten State Standards
- Filters should be inspected to check filter bed expansion and the condition of the media.
- Filter run times have increased significantly since 2002. The additional filter capacity has allowed lower loading rates across the filters resulting in the longer run times.
- Particle counters or similar monitoring equipment should be used to evaluate individual filter performance and monitor for break through for filter runs exceeding 200 hours.
- The criteria for filter to waste is based on a set time after which filter to waste will continue if the turbidity has not yet fallen below the set point until it does.
- A filter maintenance program should be developed and the WTP should begin to collect baseline data.
- Surface Sweep pressure/air relief should discharge to drain to avoid splashing the filter
- Surface Sweeps should be cleaned routinely to prevent nozzles from becoming plugged.
- 2014 - Filter-to-waste is utilized for 20 minutes following each wash.
- 2014 - Operators are present during the entire wash, and have the option to manually extend the wash if necessary.

Sludge Handling:

Sludge Disposal options:
- On-Site Lagoons
- Sanitary Sewer (emergency)

Wastewater Sources:
- Filter backwash / Filter to waste
- Sedimentation Basin Drainage/Sludge
- Contaminant containment tank discharge
- Tank Drain/Overflow Lines (except finished water)

Number of lagoon cells: 2

	#1	#2	Total
Lagoon bottom area @ ele. 617.5 (sq.ft.):	30,926	31,125	62,051
Lagoon high water area @ ele. 621 (sq. ft.):	41,195	41,253	82,448
Lagoon Volume (MG)	0.944	0.947	1.891
Usable Depth (feet):	3.5	3.5	
Freeboard (feet)	1.5	1.5	
Berm Side Slopes	1:3	1:3	
3 Yr Average Day Demands (MGD):			5.318
Water Loss:			13%
Average Plant Flow (MGD):			6.113
Backwash/Waste %:			2.55%
Backwash/Waste Water Flow (MGD):			0.156
Average lagoon loading (gal/day/ft^2):	5.0	5.0	2.5
Free from flooding?	yes	yes	
Effluent sampling point?	N/A	N/A	
Adequate runoff diverting structures?	yes	yes	

Sludge Handling comments:
- Minimum usable depth and minimum freeboard are less than the recommended 5 feet and 2 feet, respectively from 10 States Standards.
- Each of the lagoon cells has an overflow structure with separate outlets on the adjacent property west of the lagoons, which is owned by the City.
- The entrance structure was modified using riprap along the center berm wall to prevent washout.
- The south lagoon was emptied in 2010, and the north is being emptied in 2015.
- Trees and brush are rooted in the lagoon berm walls and should be removed to prevent damage.

Plant Treated Water Storage/Clearwell:

CLEARWELLS	North Clearwells			South Clearwells		
	1	2	3	1	2	3
Location:	Filter 2,4	Filter 6,8	Filter 9,10,11	Filter 1,3	Filter 5,7	Filter 12
Size LxWxD (feet):	50x22x11	50x22x11	74x22x10	45x22x11	45x22x11	24x22x10
Volume (gal.):	90,500	90,500	120,500	81,500	81,500	38,000
Percent above grade:	0%	0%	0%	0%	0%	0%
Low water level:	7	7	7	7	7	7
Isolation capabilities:	Yes	Yes	Yes	Yes	Yes	Yes
Vents:	6" Vent	6" Vent	6" Vent (2)	6" Vent	6" Vent	6" Vent
Reservoir Baffling:	None	None	None	None	None	None
Drains:	None	None	None	None	None	None
Overflow:	None	None	None	None	None	None
Access Hatches:	2	2	2	2	2	2
Alarms:	High&Low	High & Low	High & Low	High & Low	High & Low	High & Low
Last Inspection:	2009	2009	2009	2009	2009	2009
C*T applied or applicability:	Yes	Yes	Yes	Yes	Yes	Yes

FINISHED WATER STORAGE Location:	East Reservoir	West Reservoir	Sherman #1	Sherman #2
Size LxW (feet):	122x144	122x144	81x108	24x108
Volume (MG)	2.0	2.0	1.0	0.5
Percent above grade:	0%	0%	0%	0%
Low water level:	7	7	7	7
Isolation capabilities:	Yes	Yes	Yes	Yes
Vents:	6" Vent (2)	6" Vent (2)	1	1
Reservoir Baffling:	Yes	Yes	None	None
Drains:	None	None	None	None
Overflow:	30" w/flap	30" to E. Res	12"	12"
Access Hatches:	2	2	1	1
Alarms:	High&Low	High & Low	High & Low	High & Low
Last Inspection:	2009	May-06	Nov-05	Nov-05
C*T applied or applicability:	Yes	Yes	No	No

WTP East and West Reservoirs

Sherman Blvd. Reservoirs

Comments on treated water storage/clearwell:
Clearwells
- Each clearwell pair has a crossover & valve between North & South sets. Crossovers: 1 & 2 are 24" and 3 is 30".
- If any north clearwell is taken out of service the set of 4 filters will be out of service.
- All six clearwells were inspected in 2009 by Dixon Engineering.

Finished Water Storage
- East & West Reservoirs are drained by high service pumps or drained to Sherman Tanks.

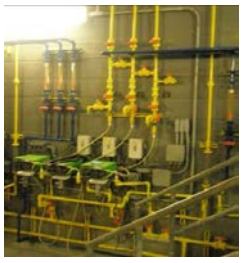
Reservoirs were inspected in 2006 by Dixon and found in good condition. East was inspected in 2009. Repairs are planned in early 2011 for E. Reservoir & Suction Well. Gravity line to Sherman will also be isolated with an opportunity to check for leakage. Inspection of the W. Reservoir is planned for 2011.
- Sherman reservoirs were inspected by Dixon in 2005. The report indicated the tanks were in good condition. Sherman overflows to a storm sewer in NW corner. Valve chamber hatch needs repairs to prevent entrance of surface water drainage. Vegetation in NE corner should be removed. The earthen cover adjacent to the east wall has been restored.
2015 - The Sherman hatches were replaced and vegetation removed.

CHEMICAL FEED

Chlorine

Chemical supplied:	Sodium Hypochlorite (15%)		
UL/NSF approved?	Yes		
Std 60 max dose:	84 mg/L at 12.5% Wt. Avail. Cl		
Avg. applied (05-10):	3.52 mg/L		
Max. applied (05-10):	6.7 mg/L		
Supplier:	Alexander Chemical	Manufacturer:	Alexander

Chlorine Feed Pumps
1,2,3 (Top); 4,5,6 (Right) ; 7,8,9 (Left)



		Injection Point	Feed Pumps	Status
Raw	1)	Rapid Mix 1	1, 2, or 3	Active
	2)	Rapid Mix 2	1, 2, or 3	Active
	3)	Intakes	3, 1, or 2	Active
Settled	4)	Filters 1-4 Influent	4, 5, or 6	Backup
	5)	Filters 5-8 Influent	5, 4, or 6	Backup
	6)	Filters 8-12 Influent	6, 4, or 5	Backup
Finished	7)	East Suction Well	7, 8, or 9	Backup
	12)	East Res. Valve Box	7, 8, or 9	Backup
	8)	West Suction Well	8, 7, or 9	Backup
	11)	West Res. Valve Box	8, 7, or 9	Backup
	9)	New High Service PS	9, 7, or 8	Backup
	10)	Clearwell 3 Outlet	9, 7, or 8	Backup

Chlorinators

Type of Feeders:	Pump #	Model #	Speed RPM	Tube #	Tube Bore	Flow Range ml/min
	1, 2, 3	Watson Marlow 604U	3.3 - 165	26	1/4"	50 - 2300
	4, 5, 6	Watson Marlow 504U	2 - 220	25	3/16"	8.1 - 890
	7, 8,	Watson Marlow 504U	2 - 220	25	3/16"	8.1 - 890
	9	Watson Marlow 504U	2 - 220	18	5/16"	20 - 2200

Chlorine Feed Dosage Determination: Flow Paced

Chlorine Room Description: Separate from other Chemicals, below grade, floor acts as secondary containment

	Type	Volume	Depth/Wt. Measure	Bypass
Storage Tank 1	FRP	7008 gallons	Level Transducer	N/A
Storage Tank 2	FRP	7008 gallons	Level Transducer	N/A
Day Tank	FRP	315 gallons	Level Transducer	Yes

minimum days of storage (05-10): 11

Chlorine Bulk Tanks

Chlorine Safety Features/Summary: (Y/N)

Air Pack -	None	Haz-Mat Team	County
Respirators -	Yes	Inside Access -	Yes
Chlorine Leak Alarm -	Yes	Outside Access	No
Doors Open Out -	Yes	Repair Kit -	N/A
Heater -	Yes	Ventilation -	Tank Vent
Window -	No	Air Supply -	HVAC
Scales -	No	Fan Switches -	None
Eyewash -	Yes	Transfer Pump	Yes (see pump listing)
		Piping Ident.	Yellow

Chlorine comments:

Chlorine Day Tank

- Only 1 storage tank is filled/used at a time to reduce loss of hypochlorite strength
- A March 3/4 HP transfer pump is used to supply the day tank if storage tank levels are too low to feed by gravity. This can be done automatically, but is generally performed manually.
- Both Storage and Day Tanks have low level alarms
- There is a sump alarm in the floor sump
- Eyewash is usually refilled annually
- Feed is flow paced however there is no redundant flow switch, but normal operational readings and samples provide additional overfeed protection.
- Pumps are not setup as intended as described above. Smaller pumps are being used during low demand periods.
- Phosphate has been modified to now feed into all carrier water not just the intake for corrosion control.
- The sump was full of fluid at the time of the inspection, but the sump has no pump to remove the

2015 - The intake has not been getting enough chlorine solution to get a detectable residual. This should be addressed to ensure adequate control of zebra/quagga mussels.

Coagulant

Chemical supplied:	Alum			
UL/NSF approved?	Yes			
Std 60 max dose:	150	mg/L		
Avg. applied (09-10):	22.4	mg/L		
Max. applied (09-10):	69.4	mg/L		
Supplier:	USALCO		Manufacturer:	USALCO

Chemical feed points:	Injection Point	Feed Pumps	Status
1)	Rapid Mix 1	1 or 2	Active
2)	Rapid Mix 2	1 or 2	Active

Chemical feeders:

	model	max feed rate	min feed rate
1	Watson Marlow 604U	3 L/min.	0.1 L/min.
2	Watson Marlow 604U	3 L/min.	0.1 L/min.

Chem feed dosage determination: Turbidity and Flow

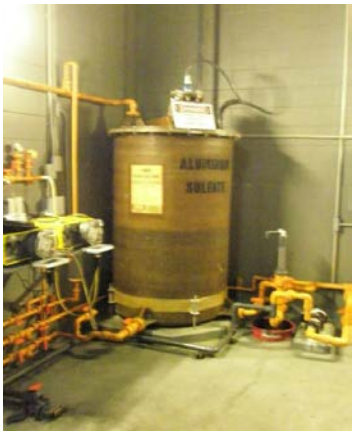
Coagulant Dosage Calculation:

ppm Al+3 = lbs Al+3 / M lbs H2O

Feeder calibration frequency:	N/A
Scale:	No (Level Transducer)
Chemical Storage:	Alum room
Bulk storage:	2 FRP tanks, 10,036 gallons each
Minimum Days of Storage:	17 (2005-2010)
Transfer pumps:	Yes (see pump listing)
Day tank:	FRP tank, 431 gallons
Spill protection:	Yes, room provides containment
piping identification:	Orange
Overfeed protection:	No

Alum Bulk Tanks

Alum Day Tank



Alum Feeds

Alum Comments:
- A March 3/4 HP transfer pump is used to supply the day tank if storage tank levels are too low to feed by gravity.
- Both Storage and Day Tanks have low level alarms
- There is a sump alarm in the floor sump
- Eyewash is usually refilled annually

Fluoride

Chemical supplied:	Hydrofluosilicic Acid (24%)		(19.8% F)
UL/NSF approved?	Yes		
Std 60 max dose:	6 mg/L		
Raw Avg. (04-09)	0.19 mg/L		
Avg. applied (2009):	1.10 mg/L		
Max. applied (2009):	1.32 mg/L		
Supplier:	Alexander Chemical	Manufacturer:	Alexander Chemical

Chemical feed point:	Injection Point	Feed Pumps	Status
	1) Filters 1-4 Influent	1 or 2	Active
	2) Filters 5-8 Influent	1 or 2	Active
	3) Filters 9-12 Influent	1 or 2	Active

Chemical feeders:

	model	max feed rate	min feed rate
1	Pulsatron LPK7MA-KTC3-500	8 gph	0.5 gph
2	Pulsatron LPK7MA-KTC3-500	8 gph	0.5 gph

Chemical feed dosage determination:	Flow
Fluoride dosage calculation:	ppm F x Flow (MGD) x 8.34 / (0.198 x 10.2 x 24) = gal/hour soln.
Feeder calibration frequency:	N/A
Scales?	Maximum scale wt. = 2000 lbs.
Chemical Storage:	Separate Fluoride Room
Bulk storage:	1 storage tank, 7008 gallons
Minimum Days of Storage:	Day Tank 3-5 days
Transfer pumps:	Yes (1, see pump listing)
Day tank:	1 FRP day tank 185 gal. capacity
Spill protection:	Secondary Containment provided
Piping identification:	Light Blue
Overfeed protection:	Flow pace via SCADA - residuals test every 2 hrs at onsite storage

Fluoride: Bulk Tank, Day Tank & Transfer Piping, Feed Pump, Feed Points




Fluoride Comments:
- A transfer pump has been added to allow the bulk tank to supply the day tank when the bulk tank level is lower than the day tank.
- Both Storage and Day Tanks have low level alarms
- There is a sump alarm in the floor sump
- Eyewash is usually refilled annually

2015 - The bulk tank was leaking at the outlet flange, and had been out of service for several months. The fluoride was working again as of May 2015.

Carbon:

Chemical supplied: Hydrodarco
UL/NSF approved? Yes
Std 60 max dose: 250 mg/L
Supplier: Van Waters & Rogers Manufacturer: Norit Americas, Inc.

Chemical feed point:	Injection Point	Feed Pumps	Status
	1) 36" Intake (1)	Volumetric Feeder	Standby
	2) 36" Intake (2)	Volumetric Feeder	Standby

Chemical feeders:	Model	Capacity	HP	Year	Type	Lubricant	Status
Volumetric Feeder Feed Pump	March	12gpm @ 30'	3/4 HP	2002	Cent CS	oil	Standby

Chem feed dosage determination: Flow
Carbon dosage calculation: lbs. Carbon / (8.34 * MG)
Feeder calibration frequency: Calibrated upon startup
Chemical Storage: Separate Room by Maintenance Shop
Bulk storage: 2 dozen bags of PAC (Room for 4 pallets)
Minimum Days of Storage: 1-2 days per bag
Spill protection: None
Piping identification: Medium Blue

Carbon Feeder

Carbon Feed Pump

Comments on Carbon:
- Carbon is used intermittenly for taste and odor control in summer months as needed.
- Carbon was temporarily being fed from a tank in the Alum room using one of the alum feed pumps. This equipment has now been removed from the Alum room. The carbon feeder had an oversized screw pump in the dry hopper, but a new screw of the appropriate size has been installed. The feeder is now available for use as necessary.
- Typically, carbon will be fed in early May at a low rate to capture the entire seasonal algal bloom.

Corrosion Control:

Chemical supplied: Sodium Hexametaphosphate — How is this product received, stored, and mixed?
UL/NSF approved? Yes
Std. 60 max dose: 12 mg/L
Supplier: Water Solutions Unlimited — Manufacturer: ICL Performance Products Limited

Chemical feed point:

Injection Point	Feed Pumps	Status
1) Intake Hypochlorite Pipe	1	Inactive
2) Cl Room Carrier Water	1	Active

Chemical feeders:

	model	max feed rate	min feed rate	
1	Watson Marlow 504 Du	24 mL/min	0.11 mL/min	{Changed to LMI?}
2	Watson Marlow 504 Du	24 mL/min	0.11 mL/min	

Chem feed dosage determination: Flow
Phosphate dosage calculation: dosage = lbs. chemical / (8.34 * MG)
Feeder calibration frequency: N/A
Scale: Yes, Force Flow Equipment 800 lb. Capacity
Chemical Storage: Area near contaminant containment tank
Bulk storage: Pallet of Bags
Minimum Days of Storage: 60 days (in day tank)
Transfer pumps: No
Day tank: 55 gallon container
Spill protection: Yes, floor in area is depressed
Piping identification: Mint Green

Comments on Phosphate:
- Used to prevent buildup in the chlorine feed lines.
- A new line was installed to feed phosphate at the chlorine room into the carrier water line to prevent corrosion in all chlorine feed lines not just the intake. This line feeds into the chlorine feed line upstream of the RPZ in the Cl feed room. There is another RPZ upstream of the entire Cl feed room out in the hallway near the rapid mixers.

PLANT PIPING AND MISCELLANEOUS

WTP Piping:

	pipe diameter	length
Old Intake pipe:	30"	
New Intake pipe:	42"	
Low service discharge:	30" & 36"	
Low service discharge:	30" & 36"	
Settled water effluent Tank 1&2:	36"	
Settled water effluent Tank 3&4:	36"	
Settled water effluent Tank 5&6:	36"	
From North Clearwell No. 1:	24"	
From North Clearwell No. 2:	24"	
From North Clearwell No. 3:	36"	
West Res to West Suction Well	30"	
East Res to East Suction Well	30"	
West Res to New Suction Well	48"	
East Res to New Suction Well	48"	
West Suction Well Header	18"	
East Suction Well Header	24"	
East Suction Well to Sherman	30" gravity	
Old High Service Discharge	30"	
New High Service Discharge	30"	
Backwash:	20"	
Surface wash:	4" - 6"	
Wash water drain:	20"	
Intake backflush line:	N/A	
Sludge drain:	20"	
Plant service line:	6"	

Pipe Color Coding:

Piping	Generic Color	Technical Color (per Tnemec)
Raw Water:	Dark Green	Malachite PL19
Settled Water:	Light Aqua	Aqua Sky GB36
Filtered Water:	Lightest Blue	Teardrop (blue) GB13
Potable Water:	Medium Blue	Clearsky (blue) EN17
Nonpotable Water:	Blue	Safety Blue SC06 w/ red bands?
Drain/Vent Lines:	Gray	Slate grey EN14
Backwash/Filter to Waste:	Brown	Amber Canyon EN10
Compressed Air:	Green	Safety Green SC07
Sodium Hypochlorite:	Yellow	Bright Yellow SC02
Fluoride:	Light Blue w/ Red Band	Teardrop (blue) GB13 w/ red bands
Alum	Orange	Safety Orange SC03
Poly Phosphate:	Mint Green	Frosted Mint GB48 w/ red bands?
Carbon Slurry:	Medium Blue	Fountainbleu GB04?
Natural Gas:	Red	Safety Red SC09
Diesel Fuel:	Yellow	Bright Yellow SC02 w/ red bands
No. 2 Diesel Fuel:		Green Charade GB50

Plant Cross Connections and Common Walls:

Filter gullets:	Air Gapped	Dehumidifier:	Raw Non Potable
Common walls:	None	Intake Cl Feed:	Raw Non Potable
Chlorine feed room:	RPZ	Raw Non Potable:	RPZ
Plant water RPZ:	RPZ	Carbon Slurry Line:	RPZ
Chemical feed areas:	RPZ	Fire Protect Carb Rm:	RPZ
Surface wash:	RPZ	Drains to Treat tanks:	None
Boiler:	RPZ	Irrigation Line:	RPZ

WTP RPZ Listing:

	Location	Model	Size	Serial No.	Last Tested
1	Basement Finished Water	Watts 909	2.5"	114551	2010
2	Chlorine Carrier Water Line	Watts 009 M2	1.5"	104382	2012
3	Chlorine Carrier Water - Raw Water	Watts 009 M3QT	3/4"	A96600	2010
4	Chlorine Carrier Water - Settled Water	Watts 009 M3QT	3/4"	A96762	2010
5	Basement Irrigation Line	Watts 909	4"	198369	2010
6	Fluoride Carrier Water	Watts 909 QT	1"	509350	2010
7	Boiler Feed Line	Watts 909 OT	3/4"	502582	2010
8	Boiler Fire Protection Line	Watts 909 MIOT	2"	384250	2010
9	Carbon Slurry Makeup Line	Watts 909 MIOT	2"	381342	2010
10	Carbon Fire Protection Line	Watts 909 MIOT	2"	383396	2010
11	Old Finished Water	Watts 909	2"	288310	2010
12	Surface Wash Supply - Catwalk	Watts 909	6"	259021	2010
13	New Floc Basin Wash Line	Watts 909 M1	2"	361337	2010
14	Paint Room Fire Line	Watts 909	4"	210732	2010
15	Mechanical Room	Watts 009 QT	1/2"	288310	2010
16	Old High Service Booster Pump	Febco 825	6"	87084	2010

Comment on Plant Piping Miscellaneous:
- Some Colors not in accordance with Ten States/AWWA
- Some Non-Potable water lines are mislabeled as potable water.
- Off of Surface wash line an unknown line runs off between filters 4 & 6 (possibly old irrigation line?) and there is a valved line that runs off to the low service station.
- Off the potable water line in the cat walk an unknown line runs off into the wall at filter #5
- The wall separating filters 1 & 3 from floc basins has been confirmed to be a double wall with a gap and drain line, not a common wall.
- The transition joint in the wall between filters 4 & 6 has a large crack with water flowing out of it if the west reservoir is filled above a certain level. The reservoir level is being kept below this point to prevent the leak. This will be further investigated and repaired when the reservoir is inspected in 2011. **This was repaired according to John Allen.**

PLANT METERING AND CONTROLS

Plant Domestic Metering: See Plant Metering on Page 3
Raw Water Metering: See Plant Metering on Page 3
High Service Metering: See Plant Metering on Page 3

Plant Controls:	Adjustment			
	SCADA	Manual	Monitored	Alarms
Low Service Pumps - Pumps 1-6	Yes	Yes	Flow	Yes
Rapid Mix	On/Off	Yes	No	Yes
Flocculator Paddle Wheel VFD	On/Off/Spd	Yes	Yes	Yes
Chemical Feed chlorine -	Yes	Yes	Dose/Lvl	Yes
alum -	Yes	Yes	Dose/Lvl	Yes
fluoride -	Yes	Yes	Dose/Lvl	Yes
phosphate -	Yes	Yes	Dose	Yes
chemical transfer pumps:	Yes	Yes	Level	Yes
Filters - Control Valves	Yes	Yes	Yes	Yes
Set of 4 Filters 1-4, 5-8, 9-12	Yes	Yes	Yes	Yes
Individual Filters 1-12 (not used)	Yes	Yes	Yes	Yes
Filter Backwash -	Yes	Yes	Yes	Yes
Storage Isolation Valves	Yes	Yes	Yes	Yes
Clearwells	Yes	Yes	Yes	Yes
Finished Water Reservoirs - East & West	Yes	Yes	Yes	Yes
Sherman	Yes	Yes	Yes	Yes
High Service Pumps - WTP Pumps 1-7	Yes	Yes	Yes	Yes
Sherman 1-4	Yes	Yes	Yes	Yes
Elevated Storage Getty St. Tank	Yes	Yes	Yes	Yes
Fruitport Tank	Yes	Yes	Yes	Yes
Getty St. Booster Pumps 1-3	Yes	Yes	Yes	Yes

Security:

Security Measure	Low Service	WTP	Sherman
Cameras:	X	X	
Security Door:		X	
Intrusion Alarms:	X	X	X
Fencing:	X	X	X
Locks:	X	X	X

Flexibility in Operation:

- If North Clearwells are out of service the entire set of 4 filters is out of service

Valve Operation:

Are critical valves exercised on a routine basis? All plant valves exercised at least annually
Formal program for WTP valve maintenance developed in 2009

Valve Location	Exercised	
Intake Valves	Annually	
Intake Backflush Valve	Annually	
High Service Isolation valves	Annually	
Clearwell Valves	Annually	
Influent/Effluent Pretreatment Basins Valving	Annually	
Effluent Flume Valve	Annually	
Low Service Pump Discharge Valving	Annually	
Chemical Feed Valving	Monthly	John will check if this is accurate

Standby Power:

	Type	Power Rating	Fuel Type /Source	Capacity	HP	Starting Frequency	Loading Frequency
Shorewell Low Service Pumping Station							
Dual Feed Overhead	1500 KVA	Consumers	Full	N/A	Primary Source		
Dual Feed Underground	1500 KVA	Consumers	Full	N/A	Only When Primary Fails		
Generator	505 kW	Diesel 24hr	10.0 MGD	765	Weekly	Annually	

Water Treatment Plant							
Dual Feed	2000 KVA	Consumers	Full	N/A	Primary Source		
Dual Feed	2000 KVA	Consumers	Full	N/A	Only When Primary Fails		
Generator	800 kW	Diesel 24hr	10.0 MGD	1350	Weekly	Annually	

Sherman High Service Station							
Dual Feed	Unknown	Consumers	Full	N/A	Primary Source		
Dual Feed	Unknown	Consumers	Full	N/A	Only When Primary Fails		

Interruptions in Operation:

- None in WTP operation
- 2005 Break in plant transmission main to Muskegon Heights caused loss of pressure throughout Muskegon Heights and rendered Sherman high service pumps inoperable.

Plant Alarms:

Comment on Plant Metering and Controls:
- Low Service Station Sump Pump Controls are located below grade.
- The Low Service Station generator is a Kohler 500 ROZD4 505kW/631KVA with 960 gallons of fuel storage.
- The Dual feed systems are locked out by Consumers Energy which must be contacted before a switch over can be performed.

LABORATORY

Parameter	*Method	Calibration	Sample Points	Sample Frequency
Alkalinity	Titration Method Std. Method 2320 B.	Chemical Indicator	Raw Plant Tap	Daily Daily
Chlorine	DPD Colorimetric Std Method 4500-Cl G Amperometric Titration Std Method 4500-Cl D	Daily Meter Calibration Annual	Distribution System Rapid Mix Applied Filtered	10+20+10/month req'd. every 1-2 hours every 1-2 hours every 1-2 hours
Fluoride	SPADNS Hach DR2800	Annual	Raw Plant Tap Distribution System	Daily Daily Weekly
Hardness	EDTA Titrimetric Std Method 2340 C.	Chemical Indicator	Raw Plant Tap	Daily Daily
pH	Electrometric Method Std Meth 4500-H^+ B. (pH Anode Meter)	Per Manufacturers Specifications	Raw Plant Tap	Daily Daily
Temp.	Thermometer (Certified)	Replaced Annually	Raw	Daily
HPC	Pore Plate Method Std Method 9215 B.	Internal QA/QC	Plant Tap	Daily
Turbidity	Turbidimeter Hach 2100N (Bench) Hach Model 1720 D Hach Filtertrak 660 Nephelometric Meth. Std Method 2130 B.	Monthly	Raw Applied Filtered CFE Filters 1-4 CFE Filters 5-8 CFE Filters 9-12 Plant Tap Individual Filters	Every 4 hours (min.) Every 4 hours (min.) Every 4 hours (min.) Every 4 hours (min.) Every 4 hours (min.) Every 4 hours (min.) Every 4 hours (min.) Every 4 hours (min.)
Coliform	Colilert Std Method 9223 B.	Method QA/QC	Filtered Plant Tap Distribution System	Daily Daily 10+20+10/month req'd.
HPC	Std Method 9215B	Method QA/QC	Raw Plant Tap Distribution System	 Daily
TOC (not-approved)	Hach Dir Meth 10129 0.3 - 20 ppm Hach DR2800 w/ DRB200 Incubator	Annual	Raw Plant Tap	Monthly Monthly

Laboratory Certification: Full Certification for:
Total Coliform and E. Coli (via Std. Methods, 19th Ed., Method 9223 B)
Hetertrophic Plate Count (via Std. Methods, 19th Ed., Method 9215B)

Laboratory Equipment:
Jar Tester - Phipps Bird
HACH 2100N Benchtop Turbidimeter
Thermo Orion model 162A Conductivity Meter
Fisher Accumet XL15 (pH, Temp, Conductivity)
Hach DR5000 Spectrophotometer (F^-, UV_{254}, Color)
Hach Pocket Colorimeter II
Marketforce Sterilmatic Sterilizer
Fisher Scientific Isotemp Oven
Fisher Scientific Incubator

Sampling Locations
Raw
Rapid Mix
Settled
CFE (3 total)
Plant Tap
Distribution (various)

Comments on laboratory:
- All lab equipment is calibrated every 6 months by a contractor.
- TOC is monitored for operational purposes. The Hach Method is not approved for compliance. TOC compliance samples are sent to a laboratory.

WATER PLANT - OBSERVATIONS, CONCLUSIONS, AND RECOMMENDATIONS

A summary of conclusions and recommendations contained in this section can be found at the end of the section.

Basic Data:
The City of Muskegon Heights water supply is a public utility currently providing service within the City only. Fruitport Township and the City of Norton Shores were previously customers of Muckegon Heights, but transitioned to utilizing water from the City of Muskegon in April 2015. Treated water from the plant currently meets or exceeds drinking water standards and treatment is performed in accordance with the requirements of the Safe Drinking Water Act. A treatment technique violation for Total Organic Carbon did occur for 1 monitoring period (1st quarter 2009), but has been in compliance since.

The City meets the minimum operator certification requirements for treatment (F-1, John Allen), distribution (F-1, John Allen), and shift operators (F-4). John is only serving as the distribution operator in charge (OIC) on an interim basis. The City is encouraged to obtain operators with higher levels of certification when filling vacancies, and to provide adequate training and incentives for staff to seek higher level certification, so the challenges of filling high level vacancies is minimized.

The water treatment plant was renovated and expanded in 2004 with available capacity to meet the anticipated future demands of the City and its customer supplies with a rated capacity of 25.2 MGD.

Water demands have decreased over the past few years with average demands of 6.7 MGD, and maximum daily demands slightly below 16 MGD. The rated capacity of 25.2 MGD should be adequate to meet the demands of the service area for the future. Demands will be much less in the near future, as a significant portion of the water use was attributed to Fruitport and Norton Shores. The population in the City of Muskegon Heights is expected to remain stagnant as the City is essentially built out within its municipal boundary.

The City has completed a Vulnerability Assessment and Emergency Response Plan in accordance with federal requirements. The City should continue to address security concerns, update its Vulnerability Assessment and Emergency Response Plan, and conduct table top exercises or other simulations regarding potential threats involving critical infrastructure, both treatment and distribution. The ERP should be updated to reflect changes in contact information and to re-evaluate the plan with the recent changes in the water service area and infrastructure.

Rules and Regulations:
As part of the 1986 amendments to the Federal Safe Drinking Water Act, the Surface Water Treatment Rule (SWTR) was promulgated and became effective June 29, 1993. As part of the 1996 amendments to the Federal Safe Drinking Water Act, the Interim Enhanced Surface Water Treatment Rule (IESWTR) was promulgated and became effective January 1, 2002.These rules and subsequent rules promulgated by the Department under the authority of the MSDWA, as amended, require the following of surface water treatment plants:

1. Maintain a disinfectant residual through the treatment process sufficient to inactivate Giardia and viruses. As currently operated, **the City of Muskegon Heights WTP complies with disinfectant residual contact time (C*T) requirements**. The C*T calculation was updated as part of this survey and is included in Appendix C.

2. Rule 325.10720 requires that a residual disinfectant concentration entering the distribution system be no less than 0.2 mg/L. Water suppliers must report to the MDEQ by the end of the next business day if the residual was below 0.2 mg/L. **The City of Muskegon Heights WTP has maintained plant tap free chlorine residuals of 0.2 mg/L or greater and meets these requirements.**

3. As further noted by Rule 325.10720, equipment must be provided to continuously monitor the chlorine residual leaving the plant. **The City of Muskegon Heights WTP has installed and maintains equipment to continuously monitor chlorine residual leaving the plant and meets this requirement**. Recent revisions to EPA method 334.0 now require continuous monitors to incorporate a quality control process. The City calibrates the chlorine analyzers omnthly, using the maufacturer's process and reagents. **John should verify this meets the quality control requirements of EPA Method 334.0.**

Rules and Regulations (continued):

4. Residual disinfectant in the distribution system measured as total chlorine shall not be undetectable in more than 5% of the samples each month, or HPC counts must be no more than 500. Distribution residuals must be measured and reported whenever coliform samples are collected. The City of Muskegon Heights measures free chlorine in at least 40 distribution system samples each month for the City's system as well as for its customer supply systems. If free chlorine is less than 0.05 ppm a total chlorine residual is taken. **The City has met this requirement as it has detected total chlorine residual in more than 95% of its samples each month.** The City also maintains the equipment to run HPC counts on the samples. For those samples which neither free nor total chlorine residual was detected HPC counts were obtained and were all determined to be less than 500.

5. Again, as noted by Rule 325.10720, turbidity determinations must be made at least once every 4 hours on samples representative of filtered water while the plant is in operation. A single monitoring point at a location containing effluent from all filters, but prior to storage is ideal for compliance purposes. All compliance points must be less than or equal to 0.3 NTU in 95% of samples each month, and at no time exceed 1 NTU. The compliance points are North Clearwell #1 tank for filters 1-4 CFE, the 36" effluent line from North Clearwell #2 for filters 5-8 CFE, and the 36" effluent line from North Clearwell #3 for filters 9-12 CFE. For compliance purposes, turbidity samples are collected from each CFE location once every 4 hours while the WTP is in operation. The filtered water has not been greater than 1 NTU for any sample and has been less than 0.3 NTU in more than 95% of the monthly samples. **Therefore, the Muskegon Heights WTP has met the requirements for this section.**

6. Finally, the MSDWA requires that individual filter turbidity be monitored and recorded every 15 minutes. This information must be recorded and maintained for 3 years to determine compliance with “triggers”. The Muskegon Heights WTP individual filter monitoring and tracking system is operating and performing satisfactorily and **the WTP meets these requirements.**

7. Stage 1 of the Disinfectants/Disinfection Byproducts Rule (DBPR) has now been phased out, as Stage 2 requirements are now fully implemented.

8. The Stage 2 DBPR was promulgated by EPA in January 2006 and requires MCL compliance at all TTHM and HAA5 sampling locations rather than averaging results across the system. **The City has established a monitoring plan and has been collecting samples in accordance with Stage 2 as required. The City has not had any problems complying with the new regulations.**

9. The Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) was promulgated by EPA in January 2006 and requires Cryptosporidium treatment for certain vulnerable plants. **The City has completed the required cryptosporidium monitoring and has been classified as Bin 1, which requires no additional treatment.** The City will complete a second round of monitoring starting in October 2016.

The Michigan Safe Drinking Water Act and Administrative Rules received major revisions which became effective December 3, 2009. The City of Muskegon Heights should be aware of any changes in their requirements caused by these revisions.

1. Source of Supply:
Lake Michigan provides the City of Muskegon Heights with an unlimited supply of excellent quality raw water. Wind conditions and seasonal temperature inversions, however, create problems which can be effectively addressed by experienced operators. The potential for occasional algae blooms present taste and odor problems which have been treatable in the past.

Raw water quality is generally very good, with average turbidity of just over 1 NTU. However, lake conditions can cause fluctuations in raw water quality that can exceed 100 NTU. While this raw water can be difficult to treat at times, the plant has produced a treated water averaging 0.03 NTU turbidity and 0.0 for color.

The Source Water Assessment completed in 2004 concluded that the Muskegon Heights intakes are moderately sensitive to potential contaminants and that the Muskegon Heights source water has moderately high susceptibility to potential contamination. The City of Muskegon Heights should use the information contained in the assessment to develop a more comprehensive Source Water Intake Protection Program (SWIPP). It may be desirable to coordinate these activities with the City of Muskegon and its customer supplies. Northwest Ottawa has established a SWIPP, which may be useful as a reference in developing a program for the City.

2. Intake Facility and Wet Well:
The water plant has two separate crib intake pipes, an old 30 inch intake with a capacity of 16.8 MGD and a new 42 inch intake with a capacity of 34 MGD for a total capacity of 50.8 MGD. Each intake pipe has the ability to feed chlorine for the removal and prevention of zebra mussels and has manholes that can be used as a standby emergency intake. Phosphate is also fed into the chlorine line to prevent them from clogging with buildup.

There are also two 30 inch discharge lines from the low service pump station to the water treatment plant which provide adequate reliability and capacity.

The sump pumps in the low service station still discharge back to Lake Michigan and require the WTP to maintain a NPDES discharge permit. The City may want to investigate alternative methods for the disposal of this wastewater which may be more cost effective as costs for obtaining and complying with a NPDES permit continue to rise.

The water plant applies chlorine on a seasonal basis for zebra mussel control to target its intake chlorination to specific times of the zebra mussel's life cycle while maintaining adequate CT. The City should continue to chlorinate its intakes on a seasonal basis unless additional contact time is desired.

The intakes were both inspected in 2010 after previous inspections in 2006. It is generally recommended that they be inspected once every 5 years as a minimum. The 2006 inspections indicated heavy sedimentation in portions of each intake and the 2010 inspection showed further sedimentation virtually plugging the intake lines. The accumulated zebra mussel debris has been removed, but an increased inspection or cleaning may be warranted.

3. Information and Control System:
A new SCADA system was installed during the plant expansion. However, after numerous communication problems since its installation, the system was replaced in 2007. The system allows for monitoring and control of the water treatment plant as well as remote sites of both the City's and its customer supplies from a operations room in the WTP.

4. Pumps and Pump Locations:
Proper functioning pumps are essential to the efficient operation of the plant. Pumps that fail to operate, or do not operate as designed, waste operator time, system resources, and the ability for the water utility to provide adequate and reliable service to its customers. It is important that the pumps be tested, serviced, and maintained. Detailed records should be kept of these activities. As a general recommendation for all systems, a preventative maintenance program should be established for each pump. As a minimum, the plan should include, but not be limited to, all of the following:

1) Basic pump information including the make, manufacturer, pump operating speed, design capacity including pump curves, horsepower of the motor, and pump and motor efficiencies.

2) Actual pump capacity, alone and in combination with other similar use pumps. This information should be recorded and maintained by plant staff so that system demands can be met using the most efficient combination of pumps. This information should be updated at least once per year.

3) A record of all work performed on the pump, including scheduled as well as unscheduled maintenance. The record should indicate the date the work was performed, the nature of the work, and the name of the individual performing the work.

4) An evaluation of the actual current draw for each motor and comparison with original installation or design conditions. Motor efficiencies should be verified at least once per year with appropriate records maintained.

Low service pumps No. 1 and No. 3 were replaced as part of the plant expansion giving the low service station total and firm capacities of 33.9 MGD and 25.3 MGD, respectively. As other low service pumps are considered for replacement, the City should evaluate the need for providing the low service station with additional firm capacity. Work on low service pumps No. 2 and No. 6 to replace their impellers and rebuild their motors was completed in 2005. Low service pump No. 4 was repaired in 2009 and had a VFD installed.

An additional high service pump station was also constructed as part of the plant expansion. This station contains 4 pumps each with a capacity of 5 MGD, which are dedicated to serving the City of Norton Shores and Fruitport Township high pressure district. A booster station at Getty Street constructed in 2002 near the City's elevated storage tank provides additional capacity to this high pressure district.

The old high service pump station at the water treatment plant containing 3 pumps and the Sherman Boulevard pumping station provide high service capacity to the City of Muskegon Heights low pressure district with total and firm capacities of 41.53 MGD and 35.48 MGD respectively.

A loss of pressure throughout the City's distribution system from a break on the City's high service transmission main between the WTP and the City in 2005 prevented the hydraulically actuated valves that operate the Sherman high service pumps from opening and rendered the entire station inoperable. Since then an electric actuator has been installed on pump No. 1 and the hydraulic actuator for pump No. 3 now uses the station discharge line as its source which should allow the actuators to operate during a loss of pressure or during a loss of power.

Sherman pump No. 4 is not currently in use except in an emergency due to a missing packing bolt that causes the pump to leak excessively when operated. Appropriate repairs should be completed to pump No. 4 to ensure that it will operate properly if needed.

High service pump No. 3 was rebuilt in 2005 and the actuator for pump No. 1 was rebuilt in 2006. Pump No. 2 is scheduled for service next but no work has been completed.

5. Pretreatment:
The water treatment plant uses 2 inline mixers with one located on each of the two 36 inch raw water lines to provide adequate mixing of its pretreatment chemicals. Paddles for the old rapid mix basins have been pulled and the basins are now just used for flow through to the floc basins. Some jar testing was done as part of the STEP 2 requirements for the TOC treatment technique. The results suggested that the raw water may not be amenable to enhanced coagulation treatment, but further testing was requested and mixing efficiencies should be further analyzed. **Rapid mix #1 was leaking badly from the packing gland and should be adjusted or repacked as necessary. Rapid mix #2 has a problem with the bearings and is expected to be repaired shortly. The lack of dual raw water meters limits the flexibility of operation with the rapid mixers.**

Two additional flocculation basins were constructed as part of the water plant expansion in 2002 for a total of six basins and a total volume of 0.792 MG. In 2009 the flocculator paddles for basins 1-4 had their paddle wheel and chains replaced. The basins were also structurally inspected and repaired.

Two additional 700,000 gallon settling basins were constructed as part of the water plant expansion in 2002. The plant now has 6 basins in all with a total volume of 4.338 MG. Basins 1-4 have limited baffling while the two new basins 5 & 6 each have an inlet baffle wall with 105 3-inch holes and 4 30-foot weir troughs on the basin outlet.

Flow through velocities in the settling basins at the design capacity were slightly above recommended standards, but are still considered adequate while flow through velocities for the flocculation basins and detention times for both flocculation and settling basins at design capacity are adequate and exceed the recommended standards.

6. Filtration:
The water plant installed 4 additional anthracite capped rapid sand filters as part of the 2002 expansion for a total of 12 filters overall. The 12 filters provide a combined capacity of 25.2 MGD at 3 gpm/sq.ft. The filters meet Ten State Standards requirements except that the design backwash rate does not appear to be maintained for a period of at least 15 minutes. Filter backwash cycles at the WTP are performed through an automated process and manual controls are provided on each filter to override or adjust the automation if necessary. Standard operating procedures for manually backwashing a filter are provided and staff are trained to follow the procedures.

The filter bed expansion should be tested during a backwash for each filter to determine whether an expansion of at least 50% is being maintained for at least 15 minutes. The backwash cycle should be adjusted as necessary to meet the minimum recommended standard.

The WTP staff do not currently conduct routine inspections and assessments of the filters to check for gravel mounding, mud balls, loss of media, etc. While the filter media was installed only a few years ago, these inspections and assessments should still be performed periodically to gather baseline data which can be used compare to results from future inspections and assessments.

During the survey some filters were observed to have mixing of the sand and anthracite media. This appears to be attributed to the gradation of the media. The D_{90}/D_{10} ratio of anthracite to sand appears to be close to 4 rather than the ideal ratio of 3. When the ratio is this high too much intermixing of the medias could occur, which could potentially result in poor-quality filtrate. Again, annual individual filter assessments would help to identify whether a potential problem exists and could be performed during periods of low demand in winter.

Media in filters 5-8 is still the original media installed in 1964 and may need to be scheduled for replacement.

Filter performance data appear to suggest that optimization of filters could potentially result in achievement of all of the following performance goals:
- Filter runs of up to 200 hours with
- Maximum loading rates on filters below the approved limit of 3 gpm/ft^2 while
- Maintaining continuous treated turbidity of 0.09 NTU or less and
- Minimizing the percentage of wash water use to less than 1.5% with a goal of less than 1%.

7. Sludge Handling:
The WTP has two onsite infiltration lagoons for the disposal of process wastewater. The discharge from these two lagoon cells qualifies for a groundwater permit exemption. Domestic sewage from the WTP is handled by the sanitary sewer. The sanitary sewer can also be used to dispose of process wastewater if necessary in an emergency.

However, neither of the lagoons have been constructed in accordance with Ten State Standards in regards to minimum usable depth and minimum freeboard. Trees and other brush have been allowed to grow around the lagoon cells without removal or proper maintenance. This growth may damage the berm structures.

The north lagoon cell had sludge removed in 2006 and the south lagoon cell is currently isolated to dry the sludge for removal.

8. Treated Water Storage:
2 finished water reservoirs with 2 MG of storage each located at the treatment plant along with 6 clearwells provide 4.5 MG of total storage at the plant. The Sherman reservoirs provide an additional 1.5 MG of finished water storage capacity for a total finished storage capacity of 6 MG.

The Sherman tanks were inspected in 2005 by Dixon Engineering and found to be in good condition. Recommendations for repair of the valve chamber hatch, removal of vegetation, and capping the exposed east wall still need to be completed. The tanks are scheduled to be inspected again in 2011.

The east and west reservoirs were inspected by Dixon Engineering in 2006 and also found to be in good condition. The east reservoir was inspected again in 2009 and repairs to the east reservoir and suction well are scheduled to be completed in 2011. At that time the gravity transmission line to the sherman reservoirs will be isolated and allow the line to be tested for leakage.

The transition joint in the wall between filters 4 & 6 has a large crack with water flowing out of it if the west reservoir is filled above a certain level. This leak has how been fixed according to John Allen.

The clearwells were inspected in 2009 and showed no indication of failures within the filter underdrains.

All tanks should be scheduled for recurring inspections at least once every five years.

9. Chlorine feed:
The water plant switched from chlorine gas to liquid sodium hypochlorite as part of the plant upgrades in 2002. Chlorine is stored in a single room separate from other chemicals. The water plant has 9 positive displacement chemical feed pumps available to feed the solution to 12 different injection points spread throughout the treatment process.

Phosphate is fed into all chlorine carrier water lines to control corrosion rather than just the intake.

Also see comments in section 2 above, for the Intakes regarding zebra mussel control using chlorine.

GENERALLY, the plant should install manual startup controls for each chemical due to part-time plant operation. Each chemical level should be read at the startup of the plant each day, as well as the shut-down each day.

10. Coagulant feed:
The water plant currently uses liquid Aluminum Sulfate as its primary coagulant. Alum is stored in a single room separate from other chemicals. The water plant has 2 peristaltic chemical feed pumps each of which have the ability to feed either rapid mix unit injection point.

The water plant previously fed Alumer, an alum and polymer blend to reduce sludge volumes, but the pin floc that was produced was not as effective in the pretreament process.

The raw water pH consistently exceeds the optimum pH range for alum of 5.5 to 7.8. Failure to operate within this pH range when using alum may result in wasted chemicals.

11. Fluoride feed:
The water plant uses liquid Hydrofluosilicic Acid to provide fluoride to its customers. The fluoride is stored in a single room separate from other chemicals. The plant has 2 positive displacement chemical feed pumps each of which have the ability to feed all 3 of the fluoride injection points and there is one injection point for each set of 4 filters.

Fluoride overfeed protection is currently provided by flow pacing the raw water meter and utilizing a second signal from a flow switch set at 3 MGD using the SCADA system. Plant tap fluoride residuals are tested every 2 hours.

A manually controlled transfer pump is present to allow Fluoride to be transferred from the bulk tank to the day tank when the bulk level is below the top of the day tank.

12. Phosphate feed:
The water plant feeds a Sodium Hexametaphosphate solution to prevent buildup on the chlorine feed lines that run throughout the plant and the intake pipes. The phosphate is delivered in dry bags and the solution is mixed in 55 gallon containers which are hooked up to the chemical feed pumps. The plant has 2 positive displacement chemical feed pumps available but only 1 pump is in service. The phosphate is fed into the chlorine carrier water line and can also be fed into the line that runs directly out to the intakes.

13. Carbon feed:
The water plant continues to maintain a carbon feed system which is only used to control taste and odor problems when necessary. The carbon is stored in 40 pound bags in the feeder room and approximately 2 dozen bags are kept on site. A volumetric feeder is used to put the carbon into a slurry and a small centrifugal pump is used to transport the solution. The carbon slurry is injected into each of the 2 raw water intake lines.

14. Plant Piping and Miscellaneous:
The plant has 2 raw water intakes and 2 raw water transmission lines from the low service station to the water plant which provide adequate reliability.

All of the piping was repainted as part of the last plant upgrade. However, some of the pipes are not color coded in accordance with the color schedule recommended by Ten States, but pipes are labeled to provide identification.

There are several backflow prevention devices located throughout the plant which have all been tested in accordance with the City's cross connection program. RPZ's in the plant, should be tested annually at minimum.

Some piping in the gallery under the filters could not be traced. This piping should be identified and labeled.

15. Plant Metering and Controls:
SCADA controls have been updated since the last plant expansion. All aspects of the treatment system have the ability to be operated remotely from the control room using the SCADA system and manual controls are also provided. Remote locations such as the low service station, Getty and Sherman booster stations, and the elevated and ground storage tanks can all be monitored and controlled from the water plant. Alarms provided at the WTP and remote locations are adequate.

A formal mainentance program for valves at the water treatment plant was developed in 2009. Each valve throughout the treatment plant should be exercised annually as a minimum to maintain adequate reliability. Records of these activities should also be developed to ensure that all valves have been identified and are being exercised and properly maintained.

The City of Muskegon Heights currently meets the requirements for providing standby power at the WTP and its remote sites. Both the shorewell low service lift station and the WTP each have their own dual feed services and backup generator. The generators at each of these locations are capable of providing 10 MGD of capacity at their respective facilities. The Sherman high service pump station is also provided with dual electrical feeds.

16. Laboratory:
The Water Treatment Plant Laboratory maintains DEQ certification for both Total Coliform and E.Coli, and Heterotrophic Plate Count testing.

The Water Treatment Plant has turbidimeters for each individual filter as well as for each of the combined filter effluent points and other locations throughout the entire treatment process.

All of the lab equipment is calibrated by a contractor.

17. Treatment Optimization:
It is important to optimize treatment practices to minimize the potential for contamination from microorganisms such as Cryptosporidium and Giardia or other unforeseen contaminants. Many of the optimization goals are currently met by the WTP. However, plant staff should continuously strive to produce the best water quality possible. A filter study should address many of these same issues. Appendix G contains a copy of "Recommended Practices for Treatment Optimization". This document prepared by this office in association with industry was provided to all water plants in May of 1995. It is recommended that these practices be studied to determine ways in which treatment may be further optimized. While the details of the document will not be reiterated here, certain practices have proven useful for other water plants. It is hoped that as many optimization practices as possible will be implemented. The City should begin to adopt internal water quality goals for the WTP to meet that are more restrictive than the current regulated standards. An example of this is found in Appendix C, an excerpt from AWWA's "Partnership for Safe Water Guidelines for Phase IV". Setting water quality goals that are below the regulatory requirements helps maintain compliance as well as achieve optimisation of treatment processes.

The recent upgrades to the WTP give the plant increased flexibility which could be used to perform plant scale trials, running separate treatment trains to compare treatment of the same raw water quality.

The following is a list of additional references to be used in the optimization of the water treatment plant:
-AWWA Self-Assessment for Treatment Plant Optimisation, 2001 Edition
- EPA 625/6-91/027 Optimizing Water Treatment Plant Performance Using The Composite Correction Program, 1998 Edition

18. Reliability:
The City's Vulnerability Assessment contained numerous recommendations for improving security and reliability of the treatment plant and distribution system. The remaining recommendations from the Vulnerability Assessment should be prioritized and a schedule for implementing them should be developed. In addition the Vulnerability Assessment should be updated.

A reliability study of the City's distribution system was completed in February 2009 and a reliability study of the City's water treatment plant was completed in November 2009. Recommended improvements from these studies have been incorporated into the City's 2010 10-year capital improvement plan.

December 2009 revisions to the Michigan Safe Drinking Water Act Administrative Rules expanded the required content of a water system reliability study and general plan which were not included in the City's 2009 studies.

19. Operators:
The City meets the minimum operator certification requirements for treatment (F-1, John Allen), and shift operators (F-4). Currently John Allen is acting as OIC for distribution on a short-term basis, while the City seeks a qualified candidate or promotes from within. **Previously, the change from a single operator in charge for both treatment and distribution to two separate operators in charge has helped the City to address previous deficiencies.** Currently, the respective operators in charge are the only staff certified at the appropriate levels (F-1 & S-2) to act as operator in charge. **The City is encouraged to obtain operators with higher levels of certification when filling vacancies, and to provide adequate training and incentives for staff to seek higher level certification. Some incentives have recently been established.**

These incentives may include pay raises or bonuses, job advancement opportunities, and public recognition which may encourage operators to pursue training and higher certification. The OIC should work with each operator to develop and approve a training plan that ensures appropriate training is taken.

2015 SANITARY SURVEY - DISTRIBUTION

Basic Information

WSSN:	04580	Supply:	City of Muskegon Heights	County:	Muskegon
Date:	April 2015	Reviewed by:	Ernie Sarkipato	District	61

Primary Contact:	John Allen	Copy To:	Lori Doody
SDWIS Role:	*Interim* Operator In Charge	SDWIS Role:	AC
Title:	Utility Director (contract operator)	Title:	Interim City Manager
Telephone:	231-780-3415	Telephone	231-733-8870
Cell Phone:	231-955-0050	Cell Phone:	
Pager:		Pager:	
Fax:		Fax:	231-733-8879
e-mail:	1939chris@gmail.com	e-mail:	
Address:	DPW Garage, 155 W. Sherman Rd.	Address:	City Hall, 2724 Peck Street
	Muskegon Heights MI 49444		Muskegon Heights MI 49444

Population:	10,856	Year:	2010	Basis:	2010 Census Estimate

Operator Certification

Distribution Classification:	S-2	Certification	Op. #	Exp. Date
Operator in Charge:	John Allen *(Interim)*	S-1	3226	1/15/2017
Backup Operator:	Matt Millis	None	14062	
Other Operators:	Kurt Miller	S-3	13268	7/15/2015
	Andre Evans (Meter Reading)	None	4580	
	Estus McGee (Meter Repair)	None	14171	
Maintenance Assistant -				
Maintenance Assistant -				
Maintenance Assistant -				

Do the operators receive adequate technical training?
If not, what and why?
Comments:

Staffing levels have decreased slightly over the years. The position of foremen is vacant, which puts additional strain on existing staff. The position is currently posted as the City continues to search for a qualified candidate. Operators with licensing have taken some classes to maintain licensure, but routine training has not been common practice. To increase the level of expertise amongst staff and to help retain licensed operators, the water supply may wish to create incentives to obtain licenses such as step increases in pay. **The City must obtain a full time permanent foreman who is adequately licensed (S-2) within the six month interim operation allowed.**

Ownership

Ownership:	City	(City, Village, Township, County, Authority, Association)
Consent Agreement:	Previous 2009 ACO now released	
Escrow Account:	N/A	
Annual Fee:	Active	(Paid, Unpaid, Exempt, Etc.)
Comments:		

STORAGE

Construction, Controls & Maintenance				
Location	Sherman Blvd. (West)	Sherman Blvd. (East)	Getty Street	WTP Storage
SDWIS Facility ID (Site Code)	ST200	ST200	ST300	ST100
Volume	0.5 MG	1.00 MG	0.75 MG	4.5 MG
Type	Ground	Ground	Multileg Elevated	Underground
Material				
O.F. Elevation			767	
Date Constructed	1940	1940	1964	1941, 1973
Date Inspected	2013	2013	**May-07**	
Date Painted Inside	N/A	N/A	**2000**	
Paint System	N/A	N/A	Pota Pox 20	
NSF Std 61 Compliant (Y/N)	N/A	N/A	Yes	
Date Painted Outside	N/A	N/A	2000	
Cathodic Protection	N/A	N/A	Yes	
Tank Isolation Valve	Yes	Yes	Yes	
Tank Drain (Hydrant)	Portable Pump	Portable Pump	Hydrant	
Altitude Valve	No	No	Yes, not used.	
Mud Valve	N/A	N/A	No	
High Alarm	37	37	766	
Low Alarm	27	27	731	
Alarms Received By	WTP	scada	system	
Total Head Range (Feet)	10	10	35	
Normal High Water Level	35	35	766	
Normal Low Water level	30	30	754	
Normal/Average Pressure				
Data Recording System				
Control Signal Type	radio	radio	radio	
Auxiliary Power for Controls?	No	No	No	
Control System Adequate?				
Vents Screened	Yes	Yes	Yes	
Overflow Screened	Yes	Yes	Iron Flapper	
Access Hatches Locked	Yes	Yes	Yes	
Expansion Collar Lubricated				
Mixing System				
Overflow Splash Pad	N/A	N/A	Yes - UPS	
Adequate Security?				
Operator Visit Frequency				

Comments:

Sherman resevoirs function as one but can be operated seperately. The Getty Street tank was inspected by Dixon Engineering in 2007. The report indicated the coatings were still in good condition and should be reinspected in 5 years. However, installation of a mud valve was recommended. The Sherman reservoirs were inspected by Dixon Engineering in 2005. The report indicated that tanks were in good condition and should be reinspected in 5 years. There is an overflow to a storm sewer in the NW corner. Shrubs and other deep rooted vegetation should be removed from around the tank perimeter. The sherman resevoirs were again inspected in 2013 (dive inspection). The minimum level for adequate pump suction head is unknown.

-**Getty Tank should be inspected again, approximately every five years. Supply should also perform more frequent inspections of hatches, screens, air intakes, overflow, etc.**

-**Getty St. Tank is current hub for SCADA communication to WTP, requiring a portable generator to maintain communications during longer periods of power failure. Currently it is equipped with a small UPS for short term operation.**

-Sherman St pump station does not have backup power for pumps, or for resevoir level indicator. The pumps would require a large generator, but a small UPS could be installed for just the resevoir transducer.

Capacity				
Usable Storage	0.5 MG	1.00 MG	0.75 MG	
Total Usable Storage (gal)	2,250,000	2.250	Mgal	
Total Usable Storage/Max Day		Given loss of customers, the Max Day/Avg. Day will need to be revisited after some amount of data are gathered.		
Total Usable Storage/Avg. Day				

Comments: Storage capacity is deemed sufficient at this time.

DISTRIBUTION

Pump Stations

	Location:	**Old High Service Pump Station**, Water Filtration Plant		
	Function:	Pump water from WTP to Muskegon Heights.		
	Adequate Security?	Yes		
Pump Number	1	2	3	
Year Installed	1965	1965	1965	
Type	Layne VTCS	Layne VTCS	Peerless VTCS	
Permit Capacity	4.46 MGD	6.05 MGD	2.02 MGD	
Permit TDH	162'	185'	142'	
Current Capacity	4.46 MGD	6.05 MGD	2.02 MGD	
Current TDH				
Basis	***2003 Test***	***2003 Test***	***2003 Test***	
HP	150	250	100	
Last Complete Inspection	2006	2003	2005	
Last Efficiency Test	2003	2003	2003	
Control Signal Type				
Controls Adequate?				
Operator Visit Frequency				

Comments:

AUXILIARY POWER

Power Type	Fixed Generator	Power Rating (kWh)	500 kW
Fuel Type	Diesel	Starting Frequency	Weekly
Capacity (gpm)		Load Testing Frequency	Monthly

Total Pump Capacity (gpm)	8701	12.53	mgd
Firm Pump Capacity (gpm)	4500	6.48	mgd
Auxiliary Power Capacity (gpm)	8701	12.53	mgd

Max Day Demand @ this location	5.42	mgd	
Peak Hour @ this location		gpm	(Hydropneumatic Stations)
Avg Day Demand @ this location	2.181	mgd	
Firm Pump Capacity/Max Day	83.6	%	
Peak Hour/Firm Pumping Capacity		%	(Hydropneumatic Stations)
Aux. Power Capacity/Avg Day	17.4	%	

Comments:

HSP 3 was rebuilt in 2005. HSP 1 had the actuator rebuilt in 2006. The WTP generator can only provide approximately 10 MGD of treatment, but the WTP also has dual electrical feeds which provide full capacity. However, Consumers Energy must be notified to unlock the feed transfer. **The Sherman Pump Station can supplement demands from the City of Muskegon Heights distribution system.**

DISTRIBUTION

Pump Stations

	Location:	New High Service Pump Station, Water Filtration Plant		
	Function:	*PREVIOUSLY* Pumped water from WTP to NS & FPT.		
	Adequate Security?			
Pump Number	4	5	6	7
Year Installed	2000	2000	2000	2000
Type	Peerless VTVS	Peerless VTVS	Peerless VTVS	Peerless VTVS
Permit Capacity	5.0 MGD	5.0 MGD	5.0 MGD	5.0 MGD
Permit TDH	210'	210'	210'	210'
Current Capacity	5.0 MGD	5.0 MGD	5.0 MGD	5.0 MGD
Current TDH				
Basis				
HP	250	250	250	250
Last Complete Inspection				
Last Efficiency Test				
Control Signal Type				
Controls Adequate?				
Operator Visit Frequency				

Comments:

VFDs installed for each pump. Currently not able to pump to Muskegon Heights distribution system. To minimize deterioration, periodic running of the pumps and motors is recommended.

AUXILIARY POWER

Power Type	Fixed Generator	Power Rating (kWh)	500 kW
Fuel Type	Diesel	Starting Frequency	Weekly
Capacity (gpm)		Load Testing Frequency	Monthly

Total Pump Capacity (gpm)	13889	20	mgd
Firm Pump Capacity (gpm)	10417	15	mgd
Auxiliary Power Capacity (gpm)	13889	20	mgd

Max Day Demand @ this location	10.56	mgd	
Peak Hour @ this location		gpm	(Hydropneumatic Stations)
Avg Day Demand @ this location	4.508	mgd	
Firm Pump Capacity/Max Day	70.4	%	
Peak Hour/Firm Pumping Capacity		%	(Hydropneumatic Stations)
Aux. Power Capacity/Avg Day	22.5	%	

Comments:

These pumps should be inspected for wear and efficiency as they represent the largest operating expense and electrical use. Additional room is provided for installation of future pumping needs (2 additional HSPs). The WTP generator can only provide approximately 10 MGD of treatment, but the WTP also has dual electrical feeds which provide full capacity. However, Consumers Energy must be notified to unlock the feed transfer.

These pumps were dedicated to Fruitport & Norton Shores previously, but are now owned and may be operated by Muskegon Heights. Pumping to the Muskegon Heights distibution system will result in a change in operating point, as they will not need to overcome as much TDH.

DISTRIBUTION

Pump Stations

Location:	Sherman Street Pump Station, Sherman and Jefferson			
Function:	Pumps water from Sherman reservoirs to Muskegon Heights.			
Adequate Security?				
Pump Number	1	2	3	4
Year Installed	1941	1957	1941	1965
Type	Am. Well CentCS	Am. Well CentCS	Am. Well CentCS	DeLaval CentCS
Permit Capacity	3.0 MGD	6.0 MGD	2.2 MGD	4.0 MGD
Permit TDH	155'	155'	152'	180'
Current Capacity	3.0 MGD	6.0 MGD	2.2 MGD	4.0 MGD
Current TDH				
Basis	2003 Test	2003 Test	2003 Test	2003 Test
HP	100	200	75	150
Last Complete Inspection	2007	2003	2003	2003
Last Efficiency Test	2003	2003	2003	2003
Control Signal Type				
Controls Adequate?				
Operator Visit Frequency				

Comments:

This pump station along with two ground storage resevoirs is fed by a 30" gravity line from the WTP. Indications are this line is in good shape, though no inspections have been done and a water balance has not been submitted.

Pump #2 has been out of service for an extended period of time (bad actuator). The supply has been relunctant to invest in it's repair due to low demand and large pump output. **Pump #4 also has limited use, due to large capacity and low demand, and is also currently out of service due to bad valves**.

To minimize energy use while maintaining this redundant feed of finished water to the distribution system, it is recommended the supply conduct efficiency testing on these pumps and consider installing variable frequency drives. The appropriate pumping rate can be selected based on needs of the system, and at a minimum cost.

AUXILIARY POWER

Power Type	Dual Feed	Power Rating (kWh)	N/A
Fuel Type	N/A	Starting Frequency	N/A
Capacity (gpm)		Load Testing Frequency	N/A

Total Pump Capacity (gpm)	10556	15.2	mgd	
Firm Pump Capacity (gpm)	6389	9.2	mgd	(Gravity feed capacity is only 9.0 MGD)
Auxiliary Power Capacity (gpm)	10556	15.2	mgd	(Dual feed, no generator)
Max Day Demand @ this location		5.42	mgd	
Peak Hour @ this location			gpm	(Hydropneumatic Stations)
Avg Day Demand @ this location		2.181	mgd	
Firm Pump Capacity/Max Day		58.9	%	
Peak Hour/Firm Pumping Capacity			%	(Hydropneumatic Stations)
Aux. Power Capacity/Avg Day		23.7	%	

Comments:

Pump 5 (0.86 MGD @ 150' TDH, 40 HP) is not installed. Pump motors and some electrical controls are below grade and subject to flooding. Pump 1 has an electrical actuator and the hydraulic actuator for Pump 3 is supplied by the station discharge line to allow valves to continue operating during a loss of system pressure such as the one that occurred in 2005. Pump 1 had a new motor installed in 2007. An extra pump motor is kept on hand at the Sherman Station. **A backup generator is recommended.**

DISTRIBUTION

Pump Stations

	Location:	Getty Street Booster Station, Getty Street and Norton Avenu		
	Function:	Pump water from Getty Street Tank to Norton Shores & Fruitport.		
	Adequate Security?			
Pump Number	1	2	3	
Year Installed	2002	2002	2002	
Type	ITT, Bell & Gossett	ITT, Bell & Gossett	ITT, Bell & Gossett	
Permit Capacity	2.59 MGD	2.59 MGD	2.59 MGD	
Permit TDH	48'	48'	48'	
Current Capacity	2.59 MGD	2.59 MGD	2.59 MGD	
Current TDH				
Basis				
HP	30	30	30	
Last Complete Inspection				
Last Efficiency Test				
Control Signal Type				
Controls Adequate?				
Operator Visit Frequency				

Comments:

2015: this pump station will be moved to Fruitport Township and connected to the City of Muskegon as part of the transition from the City of Muskegon Heights.

AUXILIARY POWER

Power Type	Fixed Generator	Power Rating (kWh)	80kW/100KVA
Fuel Type	Natural Gas	Starting Frequency	Weekly
Capacity (gpm)		Load Testing Frequency	Monthly

Total Pump Capacity (gpm)	5396	7.77	mgd
Firm Pump Capacity (gpm)	3597	5.18	mgd
Auxiliary Power Capacity (gpm)	5396	7.77	mgd

Max Day Demand @ this location	2.3	mgd	
Peak Hour @ this location		gpm	(Hydropneumatic Stations)
Avg Day Demand @ this location	0.3	mgd	
Firm Pump Capacity/Max Day	44.4	%	
Peak Hour/Firm Pumping Capacity		%	(Hydropneumatic Stations)
Aux. Power Capacity/Avg Day	3.9	%	

Comments:

Use of the station is limited to prevent double pumping but station is operated routinely to maintain pumps and chlorine residual in areas near the station where stagnation, water age and DBP formation could be a problem. Separate chlorine feed room, equipment appears decrepit.

2015: this pump station will be moved to Fruitport Township and connected to the City of Muskegon as part of the transition from the City of Muskegon Heights.

DISTRIBUTION

Interconnections with Other Supplies

Is water purchased from other supplies?	No
If yes, list WSSN number (s):	
No. of Emergency Connections:	30

Location	Main Size	Capacity	Metered?	Status (Regular/Emergency)	WSSN of Connection
DIRECT CONNECTIONS					
Water Treatment Plant	***30"***		***2002 Mag.***	***Emergency***	***04850***
Getty Street Booster Station	***12"***		***2002 Mag.***	***Emergency***	***04850***
Seminole and McCracken	30 x 12		8"	Emergency	04850
Seminole and Henry	24 x 12		8"	Emergency	04850
Getty and Norton	18 x 16		8"	Emergency	04850
Broadway and Getty	14 x 12		8"	Emergency	04850
Broadway and Glade (Seaway)	8 x 8		6"	Emergency	04850
Hoyt and Seaway	8 x 8		4"	Emergency	04850
Seminole and Lake Harbor	30 x 12		None	Emergency	04850
Glade (Seaway) and Cleveland	10 x 10		None	Emergency	04850
Hackley and Glade	10 x 6		None	Emergency	04570
Park and Keating	6 x 6		None	Emergency	04570
Keating and 5th Street Alley	36 x 12		None	Emergency	04570
Keating and McIlwraith	36 x 6		None	Emergency	04570
Delano and Getty	14 x 14		None	Emergency	04570
Barney and Getty	6 x 6		None	Emergency	04570
Oaklane and Sherman	12 x 12		None	Emergency	04570
Seminole and Henry	12"		None	Emergency	05800
INDIRECT CONNECTIONS (THROUGH NORTON SHORES AND FRUITPORT TOWNSHIP)					
Broadway and US 31	12 x 12	1244 gpm	1001 4" Mag.	Emergency	02507
Shettler and US 31	16 x 16	4980 gpm	2001 8" Mag.	Emergency	02507
Pontaluna and Harvey	16 x 16	2880 gpm	2001 6" Mag.	Emergency	02507
Sternberg and Harvey	16 x 16	2880 gpm	2001 6" Mag.	Emergency	02507
Wilson and Harvey	12 x 6	1244 gpm	2006 6" Mag.	Emergency	02507
Norton and Henry	6"		None	Emergency	05800
Summit and Henry	12"		None	Emergency	05800
Grand Haven Road and Wilson (Norton Shores)	12"		None	Emergency	06235
Black Lake Road (Norton Shores)	8"		None	Emergency	06235
Airline and Circle Drive (Fruitport)	10"		None	Emergency	06235
Judson and Clare (Fruitport)	8"		None	Emergency	06235
Third and Apple (Norton Shores)	10 x 10		None	Emergency	06235

Are valves exercised annually? No — Exercised routinely, but less than annually.

Flushed? Yes

Comments:

Only the Norton Shores and Fruitport Township pressure district can adequately maintain pressure in to Muskegon Heights (overflow elevation 767') in an emergency. However, the distribution system could be partially pressurized by "floating" on Muskegon's water system.

-Exercising of emergency valves is being integrated with the City's formal valve maintenance program. These activities are coordinated with the participating water supply.
-Meters at emergency connections are not used.

Water Supply	Tank Overflow Elevation
Musk Co. Northside	748 (Marshall St)
City of Muskegon	750.00
North Muskegon	752 (booster station)
Musk Co. Eastside	765
City of Muskegon Heights	***767.00***
Fruitport/Norton Shores	788.25

DISTRIBUTION

Distribution Piping

Mains by Material	
Cast Iron	49%
Ductile Iron	50%
PVC	
Asbestos-Cement	
HDPE	
Galvanized	
Concrete	1%

Note: The cast iron in the system is largely pre-1970

(From DEQ sanitary survey dating back to 2007, unsure of source)

Estimated percent of piping with coal tar lining _____ %

Mains by Size	
2"	0%
4"	10%
6"	61%
8"	3%
10"	10%
12"	4%
14"	4%
16"	1%
18"	3%
20"	2%
24"	2%
30"	1%
Total:	100%

Based on 2015 Reliability Study

Mains by Age				
1900	to	1930	years	88%
1931	to	1959	years	2%
1960	to	1979	years	5%
1980	to	1999	years	4%
2000	to	2014	years	1%
	to		years	
			Total:	100%

The age break-down is suspect, as Ductile Iron was not available from 1900-1930.

Comments:
Distribution system piping was first constructed in the early 1900s, though it is unknown whether any of this piping remains in service yet today. Substantial upgrades/expansions to the distribution system were made in 1939, 1964 and 1974. No other substantial watermain replacement work has been completed since that time. The system has been essentially built out within the City limits. Lack of road improvement funds has also contributed to the unwillingness to complete replacement projects.

Note on pipe condition: Recent calibration efforts of the distribution system hydraulic model lead to suspicions the system was being limited hydraulically by either severe tuberculation or closed valves. Pipe coupons from tapping operations indicate the pipe interiors have been in fair condition and show no signs of significant hydraulic loss.

DISTRIBUTION

Operational Concerns & Maintenance

Are there areas where water main breaks are frequent? **No**

If yes, identify locations:

Comments:

2005 - Major main break on 24" transmission line to the City of Muskegon Heights on Seminole Road. Heights distribution system lost pressure and precautionary boil required. See Correspondence file for full report.

2015 - large break on a 16" with small loss of pressure due to lack of adequate isolation. Limited boil notice issued. Generally speaking, only a few breaks a year is not bad for a larger distribution system.

Are there areas where aesthetic water quality complaints are frequent? **Yes**

If yes, identify locations: **Dead Ends - these are flushed 2x/yer**

Comments:

Aesthetic complaints are on dead ends on outside areas of the system usually occur after flushing. Random taste and odor complaints are received in the summer months.

Do you receive complaints alleging illness due to the water? No

If yes, identify locations:

Comments:

Are there areas where customers complain of low pressure? No

If yes, identify locations:

Comments:

Water complaints are taken at City Hall. If related to distribution (water service line, meter, etc) a work order is generated for DPW staff. Water quality related complaints are forwarded to WTP staff.

What is the procedure to respond to and track these complaints?

Comments:

2015 - The City has struggled in the last two winters with many frozen service lines. This is difficult during the winter, trying to provide water to those homes without water, but also in the spring when the lines begin thawing and leaking. The City does not typically make an effort to help customers thaw the lines.

DISTRIBUTION

Distribution System Capacity

Are there areas where peak flows (including fire flow) cannot be maintained?	Yes
If yes, identify locations: See 2015 Distribution System Reliability Study.	
Some hydrants have inadequate flow, but better flow can be found within a block	
Comments:	
Last ISO report date? 2004	Rating 5

Proposed distribution system improvements:

Location:	Estimated Completion Date
7100' 12", Glade Street & Glade Alley, Norton to Barney Avenue (Replace 6")	2013-2016*
4500' 12", Sherman Boulevard, Glade to Fifth & Jarman to Getty (Replace 6")	2013-2016*
1100' 12", Norton Avenue, Glade Alley to Park Street (Replace 6")	2013-2016*
2200' 12", Keating Avenue, Park to Fifth & South to Delano (Replace 4" & 6")	2013-2016*
1900' 8", Sixth/Seventh Alley, Barney to Keating (Replace 4")	2010-2012*
2700' 12", Ray/Getty Alley, Hume to Delano (Replace 6")	2017-2019*
2300' 8", Along Hoyt, Norton to Mona Lake Park (Replace 4")	2010-2012*
800' 12", Barney Avenue, Dyson to Getty (Replace 6")	2013-2016*
500' 12", Hume Avenue, Superior to Ray/Getty Alley (Replace 6"	2013-2016*
700' 8", Ray Street, Hume to Sherman (Replace 2")	2013-2016*
1100' 12", Getty Street, Broadway to Sherman (Replace 8")	2010-2012*
3200' 8" Cleveland Ave, Howden St to Wood St.	Newly recommended
Add hydrants: High School, Junior High, Waalkes & Maplewood, etc.	Newly recommended
Connect transmission main to distribution mains (due to customers leaving)	Newly recommended
3800' of 12" in Sanford St; Norton to Broadway (Replace 4" and 6")	Newly recommended
1100' of 8" in 7th & 5th St, Summit to Broadway (Replace 4")	Newly recommended
2000' of 8" Leahy St, Sherman to Barney (Replace 4")	Newly recommended
2300' of 8", Broadway, Seaway to 8th & Hoyt to Reynolds	Newly recommended

*these projects are not yet completed, and reiterated by the 2015 reliability study

Comments:

The distribution improvements listed above were originally recommended in the 2009 Distribution System Reliability Study. The completion dates are based on the City's February 2010 Capital Improvement Plan. The 2015 Reliability Study has added and re-prioritized several infrastructure projects to help increase flow and pressure, and replace old undersized watermain. **Due to the lack of these recommended infrastructure projects being completed, an updated capital improvements plan with a detailed funding description should be submitted.**

System Growth

Year	# of Construction Permits Issued	Permitted Amount of WM Feet
2005	0	0
2006	0	0
2007	0	0
2008	1	379
2009	1	177
2010	0	0
2011	0	0
2012	0	0
2013	1	472
2014	0	0

Comments:

The City's February 2010 10 Year Capital Improvement Program addresses water main replacement and follows the recommended improvements from the City's 2009 Reliability Study. **No street improvement projects are planned at this time, and the City has not historically funded replacement of watermain alone.**

DISTRIBUTION

Hydrants			
Number of Hydrants	318		
Number Without Auxiliary Shut-Off Valves	240	Note high number, referenced in 2008.	
Number that are Self-Draining	251		
Number of Inoperable Hydrants	2-3	(each is supplemented by adjacent hydrants)	
Frequency of Hydrant inspection:	5 years		
Inspection Staff:			
Are there areas where additional hydrants are needed?	No		
If yes, list locations:			
Hydrant location system	Hydrant Map	Accurate?	March 2009 - Yes
Are hydrants color coded for capacity?	Main Size	(not done yet)	
Has this information been provided to the fire department?	Fire Flow Contour Map		
Frequency and seasons of hydrant flushing	Fall, 5 areas, 1 done annually. Dead ends flushed annually.	per year	
Purpose of flushing	Clear Water Main		
Is the public notified prior to flushing?	Yes		
Does flushing follow a specific format?	Sherman Blvd outward, but isolation valves are not used.		
Is the volume of water used during flushing estimated?	Yes		
Do hydrants receive maintenance painting?			
Is a record maintained of hydrant activities?	Yes	***Card files now scanned (hard drive)***	

Hydrant records should include: Hydrant number, location of the hydrant, type of hydrant, size of barrel, size of bottom valve, size of lead, direction of turn, operable or inoperable, auxiliary valve type and size, weep holes plugged or unplugged, condition of hydrant (caps, chains, valve operation, operating nut, leakage & etc.), color coded capacity, flow data (gpm & psi) flushing dates, inspection dates.

Comments:

-A formal hydrant inspection and water main flushing program was developed in 2009. The City is broken down into 5 areas. One area is flushed and inspected each year in the fall. Dead ends are flushed more often to reduce complaints.

-Yearly inspections have resulted in a detailed record of the hydrant and its maintenance history. Record data is **not** being entered into a database.

-Although not required, yearly flushing of every hydrant with the added benefit from unidirectional flow using isolation valves would offer a better result in terms of pipe scour & sediment removal.

-Many hydrants are without auxillary shutoff valves. Hydrant shut-off valves are added any time they are isolated, though the number above is likely not 100% accurate as they are not formally tracked.

-Records management of hydrants could be improved by entering data into a J26database or spreadsheet and would allow entry of data on flushing records, auxillary valve installation, inpections, etc. In addition, the existing digital records should include a back-up in addition to being placed on a hard drive.

Valves			
Number of Valves	426		
Number of inoperable valves	1		
Are there areas where additional valves are needed?	No		
If yes, list locations:			
Valve location system	Valve Map	Accurate?	March 2009 - Yes
Valve Turning Frequencies	Primary:	1/5 Annually	
	Others:	1/5 Annually	
Records Maintained?	Yes	***Card files now stored digitally (hard drive)***	

Valve records should include: valve number, location of valve(with witness points), type of valve, size of valve, normal operating status (open or closed), condition of valve (operable or inoperable), direction of turn, number of turns, and dates of operation.

Comments:

A formal valve maintenance program was developed in 2009. The City is broken down into 5 areas, and the city crews turned all valves in a section each year for only two years. Inspection includes a detailed record of the valve and its installation/repair date. Data is NOT being entered into a database. **The supply must continue the approved valve turning plan, and is encouraged to maintain a digital record for each distribution valve. Recommend backing up the card files stored on local hard drive. City is considering contracting this service. The City was awarded a SAW grant for wastewater infrastructure inventorying, which will also be used to inventory the water assets.**

DISTRIBUTION

Customer Information

	Active	Inactive		
Total Services	3821	1304	Total No. of Services:	5124
Metered services	3820	1304	Percent Inactive:	25%
Non-Metered	1	0		

Percentage of service line materials:	
Copper	5% (new service lines)
PVC/PE/PB	
Galvanized	95%
Lead	

Ownership of Service (CWS/Customer)	
From Corp Stop to Curb Stop	CWS
From Curb Stop to Property Line	CWS
From Property Line to Meter	Customer
Meter	CWS

Percent of Usage by Customer Type	
% Residential	45%
% Commercial	11%
% Industrial	32%
% Other	22%

Large Users - % of Use
Mahle Engine Components-14.1%; Mona View Cemetary-2.5%; Wells Villa
Development-1.8%; Quality Plating-1.6%; Muskegon Heights. HS-1.4%; BRT
Recycling Svcs-1.2%; City Hall/Police-1.1%; Mona Lake MHP-1.0%;
Muskegon County Family (Govt)-0.7%; Consumers Energy-0.6%

Comments:
There are approximately 1304 inactive services in the City of Muskegon Heights. This is a large portion of the potential revenue in the City. It is also known that many of these inactive accounts could be illegally inhabited and using water without paying for it. The city billing and water departments work together with inspections to periodically check inactive accounts to ensure the structures are truly uninhabited. **The current checks and balances program is necessary to ensure revenue is not further lost to water theft, and the City should continuously audit the accounts to determine whether theft is occurring.**

The City has struggled with a large number of frozen services. Even with "let runs" in place, the last two winters have resulted in many (>100) frozen service lines. The problem due to freezing are not limited to the winter, but also in the spring when the city finds many leaks that were likely caused by winter freezing. **A service line replacement program is recommended to allow staff to function more efficiently and minimize the amount of time & money spent on frozen service lines.**

CUSTOMER METERS

Types of meters Used	Sensus 60% Touchpad	Rockwell 40% Manual/Remote
Number of Meters with Remote Reading Devices		
Residential Meter Sizes	5/8"	
Industrial/Commercial Meter Sizes	up to 6"	
Meter Testing/Maintenance Program	Yes, both and have meter tester at Sherman Street.	
Average Age of Meter in System	18 years	
Criteria for Changeout	Meter Failure	
Number or Percent Changeout per Year	400 (2010)	
Master Meter Locations	See Interconnection List	
Calibration of Master Meters	Annually	
Meter Reading Staff/Contract:	***Andre Evans***	

Comments:
The City has started a meter replacement program. New meters are all Sensus. **Continue with this program, as replacement of old meters may help reduce unaccounted water levels.** The City should also consider the use of radio read meters to allow coordinated billing instead of the current quarterly billing for 1/3 of customers each month. **Monthly billing would allow for more frequent auditing and analysis, as well as increase regularity of billing with customers.** The City is looking at partnering with DTE meter readers as well.

DISTRIBUTION

Water Rates

What is your current rate schedule?	Muskegon Heights	$ 3.18	/1000gals or $/qtr, $/cuM
	Wholesale	N/A	/1000gals or $/qtr, $/cuM
Are current rates adequate to support O&M and CIPS?		No	see below
When was last time rates were adjusted?		2014	
Has a water rate study been performed? When?		Dec-09	HRC, with a more recent internal
Is there a meter charge or ready to serve charge?		Yes	23.36/quarter for 5/8" meter
Is a copy of the water rate schedule and ordinance available?		Yes	

Comments:
Previous "distribution charge" has been incorporated into the overall water rate. The service charge per 1000 gallons has been increased by $0.40 for three years in a row.

Cooperation with billing to see which accounts are active but not being billed?

Billing Department discounting bills?

Capital Improvements: The previous plan has been has been analyzed and the City is far behind schedule in making needed improvements to the water system. The focus of improvements has been on water plant and storage facilities, with very little focus on pipes valves and hydrants in distribution. The City has completed approximately $1.3m worth of work, however the projects listed in the 2009 CIP total approximately $5.8m. An updated CIP must be completed with more detailed information regarding budget for the improvements.

Monthly billing cycle could potentially help customers with budgeting, and result in a more frequent accounting for water loss.

Lost Water should be a factor in discussions regarding rates and revenue. In 2008 and 2009 it was calculated to be approximately 30%.

The DEQ's Revolving Loan Section offers municipal assistsance in the fiscal planning and analysis areas, and staff are available to help upon request. Contact Bob Schneider at 517-388-6466.

Repair Parts Inventory

Extra Mains (Sections for Each Size in Service)	Yes
Repair Clamps (2 or more for each size)	Yes
Tees, Crosses & Elbows	Yes
Hydrants	Several
Valves	Several per size.
Services (Corp & Curb Stops, Clamps and Lines)	Yes
Other	

Comments:
All repair parts kept at Sherman Station. See appendix for copy of City inventory of repair parts.

Safety Programs

Confined Space Entry Program	
Trench Safety Program	

Comments:

PROGRAM COMPLIANCE

Cross Connection Programs			
Ordinance No.	Sec. 82, Div. 3	Date:	1905
Approved Program (Y/N)?	Yes	Date:	1973
Staff Assigned to Program, (No., Dept and/or who)			1-year term contract with Muskegon Township
Is Annual Cross Connection report required (Y/N)?			Yes
Was previous year's annual report received (Y/N)?			No - 2014 Date:
Was previous year's annual report acceptable (Y/N)?			No - not rec'd
Inspection Status:	Poor/Very poor		
Assembly Testing Frequency		High Hazard:	Low Hazard:
Assembly Testing Performance			
Recordkeeping:	Some records incomplete.		
Private Well Isolation/Abandonment Procedure:			

Comments:

2009 - Consent order included violations of Act 399 for failure to implement cross connection program.

2011 - Cross Connection Data per 2009 ACO submittal:

300	Total Accounts	309	Total Facilities
28	Vacant Accounts		
272	Active Accounts	12	Accounts in Compliance w/3 year Inspection (06-09)
18	Accounts w/no Testable Device	254	Accounts with Testable Devices or Unknown
137	Testable Devices	7	Devices Tested last 3 years (06-09)

2011 - Efforts were restarted in 2008, to conduct "initial" inspections of all accounts to verify device information and determine hazard. Doug Kadzban indicated that approximately 67% of these initial inspections are complete. Approximately 33% of those accounts that have been inspected are in compliance. The others still need to make corrections or have devices tested. The City is looking into a new software database system to track accounts, devices and due dates. New accounts have been added from the City's customer billing records. The City must comply with inspection and device testing frequencies.

2015 - There were no efforts towards inpsections or device testing in 2014, and no annual report submitted. The city entered into a 1-year term agreement with Muskegon Township (currently Jim Hoppas). The Agreement does not specify the number of inspections, devices to be tested, etc, and ends on November 1, 2015 with options for renewing.

-City has identified a difficulty in keeping track of accounts, which is due to the constantly changing nature of businesses and housing in the City.

-While the three year device testing appears to be keeping up with the total number of devices identified, the re-inspection of accounts is deficient.

-Records keeping system is needed to track accounts and make updates as ownership/occupancy changes. Recommend software that can be accessed by both City staff and contracted Township staff.

Annual Pumpage Reports	
Is Annual Pumpage Report required (Y/N)?	N/A - MONTHLY REPORTS

Monthly Operator Reports			
Are Monthly Operation Reports required (Y/N)?			Yes
Were all previous year's reports received (Y/N)?			Yes Timely?
Are previous year's reports acceptable (Y/N)?			
If no, describe problems:			

Comments:

MORs are submitted in a timely manner.

Consumer Confidence Reports			
Is the annual CCR required? (Y/N)			Yes
Was the previous year's report received? (Y/N)			Yes Date:
Was the previous year's acceptable? (Y/N)			Yes
Was the previous year's certification form received? (Y/N)			Yes Date:

Comments:

The CCR has been distributed in accordance with the rules. CCRs are mailed to customers.

Emergency Response Plan			
Date of ERP	Oct-08	Acceptable?	
Filed where?			

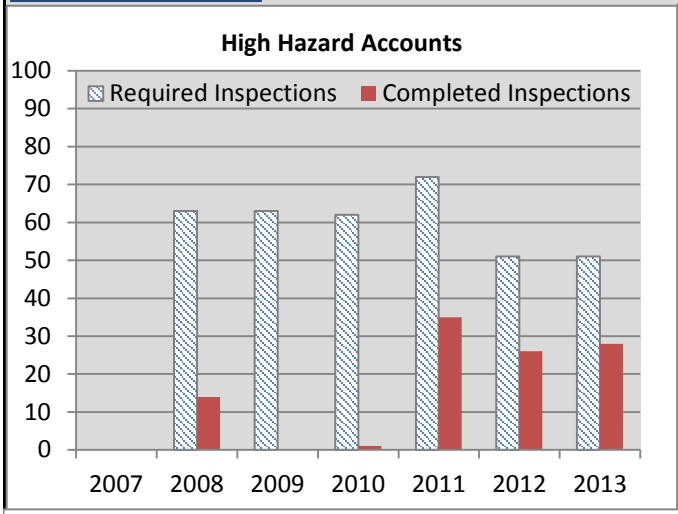
Comments:

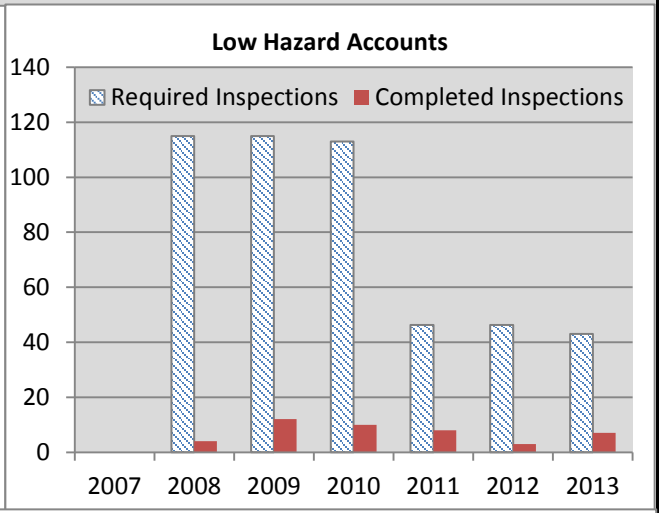
2010 - Per 12/2009 Michigan SDWA revisions, future ERPs shall include all of the above contents. The City's current ERP listed above is based on the previous Contingency Plan format. **The City must submit a new Emergency Response Plan at this time.**

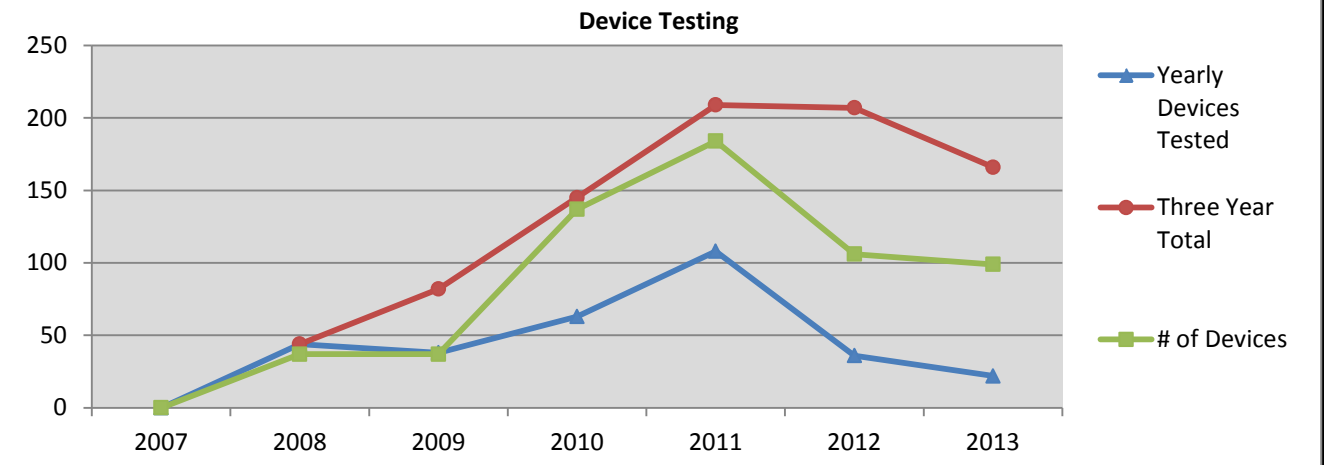
PROGRAM COMPLIANCE

Cross Connection Programs

	2007	2008	2009	2010	2011	2012	2013	2014
Total No. Accts								
High Hazard		63	63	62	72	51	51	
Low Hazard		345	345	339	139	139	129	
Years between inspections	report							report
High Hazard	not	1	1	1	1	1	1	not
Low Hazard	submitted	3	3	3	3	3	3	submitted
Inspection Required								
High Hazard	**-**	**63**	**63**	**62**	**72**	**51**	**51**	
Low Hazard	**-**	**115**	**115**	**113**	**46**	**46**	**43**	
Inspection Completed								
High Hazard	-	14	0	1	35	26	28	
Low Hazard	-	4	12	10	8	3	7	
Cross Connections Found	-	29	15	35	16	9	16	
Devices in System	-	37	37	137	184	106	99	
Devices Tested	-	44	38	63	108	36	22	
3-year Testing Total		**44**	**82**	**145**	**209**	**207**	**166**	







Comments:
The supply has been behind in inspections for several years. Records for the inspections completed are not adequate. Devices tested are adequate, meeting the minimum 3-year testing frequency. All accounts are non-residential - the supply must begin documenting residential hazards. 2014 report is missing.

PROGRAM COMPLIANCE

General Plan

Date of Most Recent Plan:	2009	
Filed Where?	Office File	Acceptable?
	General Layout	
	Facility locations & capacities	
	Water Main Inventory	
	Identification of Service Areas	
	Hydraulic Analysis	
	Capital Improvement Plan	

Comments:

2015 - The supply is currently due for an update to the General Plan, which is underway.

Reliability Study

Date of Most Recent Study:	2009	
Filed Where?	Basic Data	Acceptable?
Contents:	5 & 20 Year Demand Projections	
	Source Production Totals (Monthly)	
	Customer Supply Usage (Annual)	
	Res/Comm/Ind Usage (Annual)	
	Water Shortage Response Plan	
	Recommended Improvements	

Comments:

2015 - The supply is currently due for an update to the Reliability Study, which is underway. The city will need to cooperate with requests from the engineer to complete testing in the distribution to aid in model calibration.

Permits

Applies for and obtains permits prior to construction (Y/N):	Yes	
Reviews plans prior to submittal to DEQ (Y/N):	Yes	
Standard specifications on file at CWS (Y/N):	Yes	
If applicable, adheres to contract with supplier regarding plan submittal (Y/N):		Date:
Follows master plan for any construction (Y/N):	Yes	
Develops as-built plans (Y/N):	Yes	
Updates general plans (Y/N):	Yes	

Comments:

MONITORING

Bacteriological

Date of Approved Site Sampling Plan :	Sep-08		
Number of samples required each month:	10	Basis:	Population
Certified Lab Used:	Muskegon Heights WTP		
MCL, Monitoring or Reporting Violation(s) in past 3 years? (Y/N)	No	Date:	
Number & Type of Violations	None		
Public Notice Issued according to regulations? (Y/N)	N/A	Date:	

Comments:
SSP contact information should be updated. Muskegon Heights also analyzes TCR samples for its customer supplies.

Chemical

Date of Monitoring Schedule:	Jan-15		
Were nitrate, nitrite and fluoride (or partial chemical) samples collected? (Y/N)	Yes		
If nitrate detect, what is concentration?	0.7	Date:	2/25/2015
If nitrite detect, what is concentration?	ND	Date:	2/25/2015
Detects for metals > 50% of MCL? (Y/N)	No		
Metals (list) (2010 detections slightly above detection limit)	Barium and Chromium	Date:	
		Date:	
Detects for VOCs (Y/N) (except TTHMs & HAA5s)	No	Date:	
Detects for SOCs (Y/N)	No	Date:	
Date of Approved Disinfection Byproduct Monitoring Plan:	2014		

Comments:
2015: Sampling for DBP's is two samples quarterly. This reduced sampling is acceptable as long as LRAA's remain below 40/30 - routine sampling is four sites quarterly. Current LRAA's for DBP1 and DBP2 are acceptable for both HAAs and THMs.

Lead and Copper Monitoring

No. of Samples Required:	18		
Frequency (Semi Annual/Annual/Triennial)	Triennial		
Exceedance of lead or copper action level (Y/N)	No		
If yes, was public education issued? (Y/N)		Date:	
Next Monitoring Period:	6/1/2017 - 9/30/2017		
Corrosion Control Program Status, if applicable	N/A		
Lead service line replacement status, if applicable	N/A		

Comments:

Radiological Monitoring

Date of Monitoring Schedule			
Alpha, beta, radium, uranium	ND	Date:	
Radon	Not Required	Date:	
Tritium	Not Required	Date:	
Detects for Rads > 50% of MCL? (Y/N)	No		
If yes, list		Date:	

Comments:
Only Gross Alpha required.

DISTRIBUTION - SYSTEM COMMENTS & SUMMARY

Infrastructure:
The Muskegon Heights water distribution system is largely well serviced by sufficient transmission mains connected to smaller distribution mains. However it does contain some hydraulically deficient areas, and continues to age without major efforts to upgrade older watermain. The areas of limited fire flow can be attributed to old & undersized watermain, some limited connection between transmission and distribution mains, as well as areas of insufficient transmission capabilities. The latest reliability study addresses these issues with recommended improvements. **An updated Capital Improvements Plan for 5 and 20 year periods is needed, with budget analysis to show adequate funding.**

The focus in recent years in terms of maintenance has been on flushing and inspecting hydrants, yet valve operations and maintenance has been lacking. Without periodic operation, isolation valves in the system may become inneffective at minimizing sanitary hazards during times of emergency. **The supply must continue to excercise valves periodically.** In addition, recent attempts to calibrate computer models of the system to real-time fire flow data indicate the potential for either significantly tuberculated watermain, or closed valves in the system. Without a valve turning program, the latter can not be ruled out.

Perhaps due to age and poor construction practices, the city has also struggled with a multitude of frozen water services the past few winters. The impact on staff and public perception stretches beyond the winter months and into the spring, when leaking services continue to suface and require immediate attention. **A service line replacement program should be considered** to minimize the threats associated with service line freezing.

Lost water, or unaccounted for water, has been estimated to be above 30% in previous years, and recently calculations indicate extreme variability with lost water from -36% up to 60%. The supply has expressed some difficulty in calculating the exact amount due to poor billing practices. **The supply must formulate an administrative plan to accurately perform a water budget and calculate percent of water that is not generating revenue.** This requires accurate billing, metering, and accounting practices.

Operations & Maintenance:
The operators possess the skiills and tools required to complete routine tasks such as fixing leaks, turn on/shut off, and meter reading and replacement. There are programs which have proven more difficult to undertake such as cross connection inspections, and requiring of testable device results. The cross connection program was not addressed at all in 2014, leading to significant concerns over the ability of hte distribution operators to manage and implement this program. However in January 2015 the program was contracted to Muskegon Township, and according to discussions there will be significant headway with the program. Remaining concerns are in records management and record keeping, communication between City staff and the contract operations staff, and accountability for meeting stated goals of the program.

Staff are also encouraged to refine the record keeping systems at the garage, particularly in keeping digital records. This will be aided through activities funded by the City's SAW grant, which will include an inventory of hydrants and valves in the water distribution system. By maintaining digital records of hydrants, valves, service lines, meters, etc there will be increased awareness of the system and tracking of changes in the system will be more easily monitored.

DISTRIBUTION - SYSTEM COMMENTS & SUMMARY

Staffing:
The past several years have seen turnover in staffing in the distribution operators. Namely, the position of foreman has seen some turnover and is currently not filled with a full time permanent operator. **The water supply must either hire a full time properly certified operator for distribution, or arrange for contract operations of the distribution system.** Contract operations of the distribution system will alleviate the apparent lack of staffing. Even with the foreman position filled, the staffing levels are not at the level they used to be a few years ago. In addition, **the City should encourage certification of all operators and provide training and incentives** to gain professional certification up to the rating of the water system.

While crews are generally able to be responsive to complaints and immediate needs within the system, there are concerns over records management, operation of valves, hydrant flushing, meter reading and water accounting, and pump maintenance. **It is unclear whether there is adequate staffing at this time to coordinate and ensure proper oversight of all these distribution system related activities.**

Contracting services for cross connection activities has lessened the burden placed on distribution operators. However, at this time annual reports have not been filed and are now overdue for the 2014 calendar year. In a similar fashion, **the City may wish to consider contracting services for other items such as water audits, valve turning, pump maintenance, etc.**

Storage:
The total finished water storage volume is adequate to allow for emergency use during peak demands.

Program Compliance:
Often times, when staffing levels are not ideal, it is the programs such as Cross Connection, Valve Turning, flushing, and record keeping that fall to the back-burner and even off the plate entirely. Historically the Cross Connection Program has been neglected by the City and it was a central item in the compliance discussions and Administrative Consent Order (ACO) in 2009. The order and subsequent efforts to resolve it resulted in a renewed focus in these areas. However, each of these programs has again seen some amount of neglect. The Supply was not able to complete any inspections or require any device testing in 2014, essentially neglecting the cross connection program entirely. Recognizing this, the City entered a one-year term contract with Muskegon Township from November 1, 2014 to November 1, 2016. While the DEQ was not privy to this agreement until mid-2015, it seems the terms of this agreement are somewhat vague. The number of inspections and device testing are not specified, and management of records is not outlined. For valve turning, the Supply has neglected to turn any of the distribution valves since completing two sections immediately following the ACO.

Management & Accountability:
With ongoing changes in personnel at City Hall and in the water distribution crews, as well as changes in wholesale customers and residential/industrial accounts, the City must maintain a focus on transparency, accountability, and viability for the future. The water and the revenue should be accounted for on a regular basis, and accounts should be audited for theft and unauthorized use regularly. City Hall must interface with the Water Plant and the Distribution operators regularly as well as the DEQ district office to coordinate ongoing issues of water loss, theft, billing/metering inaccuracies, leaks, frozen pipes, estimated billing, etc.

To aid in the communication between City Hall, the Water Plant, and the Distribution crews, it is recommended the City install networking capabilities at each facility so that account records may be viewed and updated as changes occur. This would also increase the reliability and redundancy of records at the City.

Appendix A: C*T Calculations

C*t Determination

The C*t required for a water treatment plant is based on the effectiveness of giardia and virus inactivation of the treatment process. A 3-log removal is required for giardia and a 4-log removal is required for viruses. The conventional treatment process employed at the Muskegon Heights Water Treatment Plant has been awarded 2.5-log removal credit for giardia and 2-log removal credit for viruses. In order to meet the requirement, the plant must increase its capacity to remove or inactivate giardia by 0.5 logs, and viruses by 2 logs. The plant must make up the difference through disinfection. Muskegon Heights uses chlorine as its disinfectant, which is much more effective at the inactivation of viruses than giardia, so the required C*t is based on the 0.5-log inactivation requirement for giardia rather than the 2-log inactivation of viruses.

To perform the calculation of C*t, the plant's treatment is divided into each unit process. The processes identified in this calculation include: rapid mix, flocculation, sedimentation, filtration, clear well storage, and plant ground storage. Table C.1 shows the parameters used in the calculation as well as the minimum residual applied to each process.

Table C.1. C*t Parameters

Parameter	Value	Basis
Flow Rate	25.2 MGD	Rated Plant Capacity
Temperature	0.5 °C	Lake Michigan Standard Minimum
pH – Raw Water	11.56*	January 2004 - December 2009 Maximum
pH – Plant Tap	8.9	January 2004 – December 2009 Maximum
Cl Residual – Pretreatment - Rapid Mix - Flocculation Basins - Settling Basins	0.9 mg/L	January 2004 - October 2010 Minimum**
Cl Residual - Intermediate -Filters	0.88 mg/L	January 2004 - October 2010 Minimum
Cl Residual – Plant Tap - Clearwells - Finished Water Storage	0.77 mg/L	January 2004 - October 2010 Minimum

* Muskegon Hts. Raw max. pH value does not appear reasonable but will be used.
**Recent operation reports indicate higher average residuals, with minimum levels above 1.0

Baffling within a basin aids in keeping uniform flow through a process. Ideal plug flow corresponds to a perfect baffling condition. Baffling factors are established for each treatment process and used to adjust the C*t to account for short circuiting through the process. Table C.2 below shows the baffling factors used in the C*t calculations for Muskegon Heights.

Table C.2. Baffling Factors

Process	Baffling Factor	Basis
Rapid Mix	1.0	Pipeline Flow
Flocculation	0.5	Inlet and Outlet Baffles
Sedimentation	0.5	Inlet Baffles and Outlet Weir
Filtration	0.7	EPA Guidance*
Clear Wells	0.3	Unbaffled Inlet and Outlet
Plant Storage	0.4	Intra-Basin Baffles

* USEPA, *LT1ESWTR Disinfection Profiling and Benchmarking Technical Guidance Manual*, May 2003

The C*t value for the filters is calculated during a backwash cycle while the plant is operating at full capacity. Essentially, the full 25.2 MGD is distributed over 11 of the 12 filters. The filters generally have 8'4" of water above the media, and since the porosity of the media is unknown, only the water above the media will be accounted for.

Area of 11 filters = 490 sqft * 3 filters + 480 sqft * 8 filters = 5310 sqft

Volume of 11 filters = 5310 sqft * 8.333 ft (8'4") * 7.48 gal/cf = 331000 gal

Detention Time = 331000 gal / 17500 gpm (25.2 MGD) = 18.91 minutes

C*t for Filters = 0.88 mg/L * 18.91 min * 0.7 (baffling factor) = 11.65 min-mg/L

The clear wells are evaluated at the low water level for the high service station, which only leaves 3 feet of water in each clear well. The south clear wells must pass through the north clear wells in order to exit the plant, so the detention time for the clear wells is calculated by dividing the volume of a north clear well by the potential maximum flow through the set of clear wells (north and south). North Clear Well #1 and South Clear Well #1 provide the most conservative calculation, so those clear wells were used.

Volume of North CW #1 = 50 ft * 22 ft * 3 ft (LWL) * 7.48 gal/cf = 24684 gal

Flow through filters 1-4 = 3.015 gpm/sf (1 filter washing) * 490 sqft * 4 filters = 5910 gpm

Detention Time = 24684 gal / 5910 gpm = 4.18 min

C*t for Clear Wells = 0.77 mg/L * 4.18 min * 0.3 (baffling factor) = 0.96 min-mg/L

The plant site ground storage reservoirs are accounted for, but their volumes are limited by the low water level within the high service pumping station. The water levels within the east and west reservoirs are 7 and 3 feet, respectively. The high service pumping capacity exceeds the plant capacity, so the flow rate used in calculating the C*t for the ground storage reservoirs is greater than what is used for the other processes. The Sherman Station has a pumping capacity of 15.2 MGD, but the gravity line can only support 9 MGD, so the draw from the reservoirs is 9 MGD. The new and old high service pumps have capacities of 20 and 12.53 MGD, respectively. The total flow that can exit the plant reservoirs is 41.53 MGD.

The following table shows the C*t values attributed to each treatment stage and the total C*t for the plant.

Table C.3. C*t Provided

Process	C*t (min-mg/L)	Flowrate (gpm)	Volume (gal)	Baffling Factor	Cl Residual (mg/L)
Rapid Mix	0.02	17,500	423	1.0	0.9
Flocculation	20.37	17,500	792,000	0.5	0.9
Sedimentation	111.55	17,500	4,338,000	0.5	0.9
Filtration	11.65	17,500	331,000	0.7	0.88
Clearwells	0.96	5,910	24,684	0.3	0.77
Plant Storage	14.03	28,840	1,314,000	0.4	0.77
Total	**158.58**				

To re-iterate, the C*t required for a water treatment plant is based on the effectiveness of giardia and virus inactivation of the treatment process. After deducting the credits awarded for conventional treatment, the plant must inactivate giardia by 0.5 logs, and viruses by 2 logs. Using chlorine as a disinfectant, the limiting factor will be removal of giardia.

Table C.4 shows the C*t that would be required for the Muskegon Heights Water Treatment Plant at a temperature of 0.5°C and a pH of 9.0. At a minimum chlorine residual of 0.8 mg/L, the required C*t would be 70 min-mg/L. However as shown in table, the C*t required varies based on pH and chlorine residual for each process. Under the conditions identified above the required C*t for the Muskegon Heights Water Treatment Plant is approximately 89 min-mg/L.

Table C.4. C*t Requirement

Chlorine Concentration	pH>=9.0 & Temp<=0.5°C Log Inactivation		
(mg/L)	0.5	1.0	1.5
<=0.4	65	130	195
0.60	68	136	204
0.80	70	141	211
1.00	73	146	219
1.20	75	150	226
1.40	77	155	232
1.60	80	159	239

The Muskegon Heights Water Treatment Plant achieves a C*t of 158.58 min-mg/L (178% of the 89 min-mg/L required), or 0.89 log inactivation (0.5 required) under very conservative conditions. C*t was calculated at the plant's rated capacity, at the low water level within plant storage, backwashing a filter, at the minimum chlorine residual. The required C*t was also determined under conservative conditions. Since the C*t requirement is met under these conservative conditions, we are confident that it will be met consistently.

Most of the C*t credit is gained within the sedimentation stage, and while chlorine is being fed at the primary rapid mix unit, as long as a minimum applied free chlorine residual of 0.5 mg/L is maintained, the C*t requirement should be met.

A tracer study would better quantify the effective contact time in the basins or the reservoir, and would also be an indicator of any short circuiting. This study is recommended and could be done by using fluoride as a tracer. The findings of a tracer study may impact the C*t determination.

NOTES:

With recent reductions in customer base, the flow through the plant is expected to be drastically reduced and as such various treatment trains will likely be removed from operation on a regular basis. The flow through each treatment unit is not expected to vary drastically from the above assumptions. However, it is expected the plant will be undergoing drastic changes in operations which may have an effect on the parameters used above such as chlorine residuals and pH. **Given the changes, plant operators must bear in mind the impacts these operational changes may have on the achieved inactivation of viruses and giardia.** Future analyses of C*t will provide greater insight to the impact of operational changes on the C*t achieved at the plant.

	Rapid Mix	Floc	Settling	Filtration	Clearwell	Storage
Volume (gallons)	423	792,000	4,338,000	331,000	24,684	1,314,000
Flowrate (MGD)	25.2	25.2	25.2	25.2	8.51	41.53
Flowrate (gpm)	17500	17500	17500	17500	5910	28840
Flowrate (cfs)	38.99	38.99	38.99	38.99	13.17	64.26
Detention time (min)	0.02	45.26	247.89	18.91	4.18	45.56
Baffling Factor	1	0.5	0.5	0.7	0.3	0.4
Cl_2 Monitoring Location	Pretreatment	Pretreatment	Pretreatment	Intermediate	Plant Tap	Plant Tap
True Min Cl	0.9	0.9	0.9	0.88	0.77	0.77
Min Cl for CT Table	0.9	0.9	0.9	0.88	0.77	0.77
pH Monitoring Location	Raw	Raw	Raw	Raw	Tap	Tap
Max pH	11.56	11.56	11.56	11.56	8.9	8.9
C*T Attained	0.02	20.37	111.55	11.65	0.96	14.03
C*T Req (1 log rem)	184.3177778	184.3177778	184.3177778	183.6755556	134.83	134.83
Log inactivation attained	0.0001	0.1105	0.6052	0.0634	0.0072	0.1041
% of required attained	0.02	22.10	121.04	12.69	1.43	20.82

0.5
log inactivation required

0.890
log inactivation attained

178.1
% of required

City of Muskegon Heights WTP
Sanitary Survey 2015

Assumptions:
See Attached Explanation

	Rapid Mix	Floc	Settling	Filtration	Clearwell	Storage
Volume (gallons)	423	792,000	4,338,000	331,000	24,684	1,314,000
Flowrate (MGD)	25.2	25.2	25.2	25.2	8.51	41.53
Flowrate (gpm)	17500	17500	17500	17500	5910	28840
Flowrate (cfs)	38.99	38.99	38.99	38.99	13.17	64.26
Detention time (min)	0.02	45.26	247.89	18.91	4.18	45.56
Baffling Factor	1	0.5	0.5	0.7	0.3	0.4
Cl_2 Monitoring Location	Pretreatment	Pretreatment	Pretreatment	Intermediate	Plant Tap	Plant Tap
True Min Cl	0.46	0.46	0.46	0.46	0.46	0.46
Min Cl for CT Table	0.46	0.46	0.46	0.46	0.46	0.46
pH Monitoring Location	Raw	Raw	Raw	Raw	Tap	Tap
Max pH	11.56	11.56	11.56	11.56	8.9	8.9
C*T Attained	0.01	10.41	57.01	6.09	0.58	8.38
C*T Req (1 log rem)	169.2897778	169.2897778	169.2897778	169.2897778	127.68	127.68
Log inactivation attained	0.0001	0.0615	0.3368	0.0360	0.0045	0.0657
% of required attained	0.01	12.30	67.36	7.20	0.90	13.13

0.5
log inactivation required

0.504
log inactivation attained

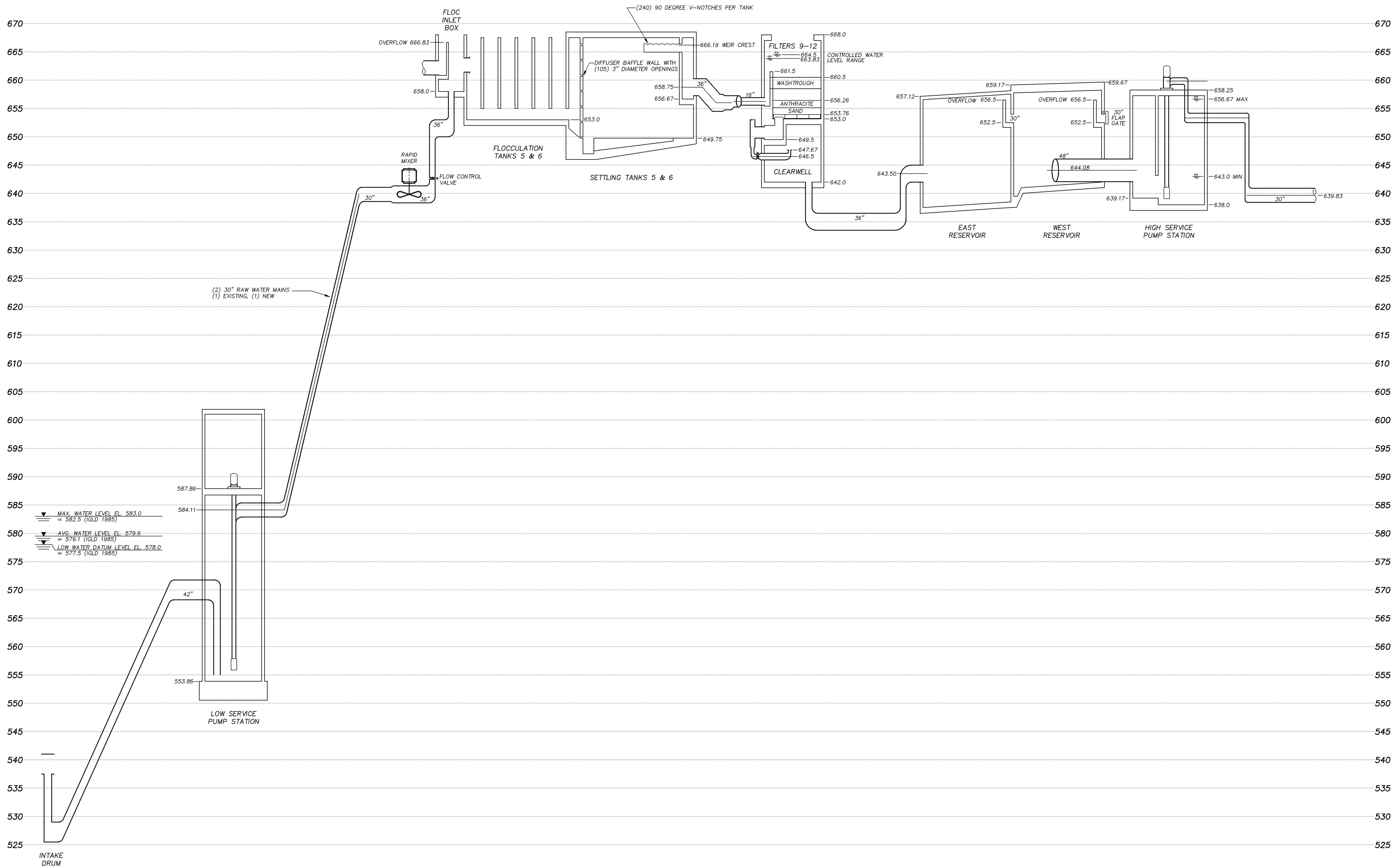
100.9
% of required

City of Muskegon Heights WTP
Sanitary Survey 2015

Assumptions:
See Attached Explanation

Minimum allowable chlorine residual to achieve required C*t
0.46 mg/L

Appendix B: Hydraulic Profile



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RECORD DRAWINGS

Constructed by: Triangle Associates, Inc.
Inspected by: FTC&H
Date: August 2004

HYDRAULIC PROFILE

Drawn By JLB
Designer TCG
Manager TDM

08/2004 ISSUED IN ACCORDANCE WITH CONSTRUCTION RECORDS

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FTC&H
Fishbeck, Thompson, Carr & Huber
Engineers • Scientists • Architects
Grand Rapids, Michigan (616) 575-3824

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City of Muskegon Heights
Norton Shores, Michigan

Water Filtration Plant Expansion

PROJECT NO.
98114BD.1

SHEET NO.
P101

Appendix C: Recommended Practices for Treatment Optimization

May 16, 1995

SUBJECT: Recommended Practices for Treatment Optimization

OVERVIEW

Increasing awareness of the potentially severe impact of cryptosporidium in drinking water has refocused attention on the importance of optimal water treatment. Because cryptosporidium is resistant to the disinfectants typically used in water treatment plants, it is essential that every effort be made to effect their removal through the pretreatment and filtration processes.

The department has utilized the input of a group of Michigan water treatment plant superintendents to develop recommended practices in four areas: treatment goals, monitoring protocols, treatment optimization, and emergency operating procedures. These treatment practices must be optimized if Michigan water supplies are to continue to avoid the cryptosporidiosis outbreaks experienced in other areas of the country.

TREATMENT GOALS

The goal of all water treatment plants should be to consistently produce finished water turbidities of 0.1 ntu or less.

The goal for each individual filter should be to consistently produce water with turbidities of 0.1 ntu or less.

The goal of plant operators should be to minimize the size and duration of turbidity increases above 0.1 ntu in individual filters after the following:

1) Restarting filters after backwash.
2) Restarting unwashed filters after routine plant shutdown.
3) Changes in filtration rates.
4) Changes in settled water quality.

MONITORING PROTOCOLS

Conformance with the treatment goals outlined above can only be determined if the necessary monitoring information is available. It is recommended that continuously recording turbidimeters be provided for:

1) Raw water.
2) Settled water.
3) Each individual filter.
4) Combined filter effluent.

Where it is not feasible to provide a turbidimeter for each filter, it is recommended that each group or bank of filters be provided with one turbidimeter and the necessary piping and valving to allow for monitoring of a specific filter or the entire group of filters.

It is recommended that particle counters be utilized to determine the effectiveness of optimized treatment. Particle counters have the potential to provide an earlier and more sensitive detection of water quality changes than turbidimeters. It is recommended that settled water and filtered water particle counts be monitored as another indicator of treatment efficiency and to provide a numerical measure of the removal of particles in the 2-5 micron cryptosporidium size range.

Because of the high cost and uncertain reliability of cryptosporidium and giardia testing, the State does not recommend routine testing for these parameters at this time. However, if improvements in methods and reductions in analytical costs occur, this type of monitoring will become useful in evaluating plant performance. Cryptosporidium and giardia testing is currently optional for water utilities and may be useful depending on specific conditions. Such testing may be required in the future by U.S. EPA regulation. The limitations of current laboratory methods can lead to uncertain or unreliable results. As such, utilities which pursue testing must carefully interpret these results. Careful selection of qualified laboratories is also an important factor when considering such testing.

TREATMENT OPTIMIZATION

There is an extensive amount of literature published on the subject of water treatment. A list of selected references pertaining to treatment optimization is attached. Based on a series of meetings with water treatment plant superintendents, a number of treatment practices were identified as being potentially important with regard to cryptosporidium removal, and in achieving the treatment goals listed above.

For coagulant feed control, the following practices should be examined:

1) Routine jar testing.
2) Use of streaming current detectors or other methods for controlling coagulant feed rates.
3) Optimization of the rapid mix and flocculation stages of treatment, including periods when backwash water is recycled.
4) Use of polymers.

The effectiveness of previous coagulant adjustments made in response to adverse changes in raw water quality caused by climatic and hydrologic events should be reviewed.

For filter operation, the following practices should be examined:

1) Filtering to waste following backwash.
2) Adding coagulant directly onto the filter influent following backwash, in the backwash water, or at the end of a backwash.
3) Allowing filters to set for a period of time following backwash before returning to service.
4) Ramping up the flow rate onto any filter being returned to service.
5) Minimizing sudden rate changes on the filters.

6) Comparing length of filter runs and head loss development with filter effluent turbidities.
7) Routine inspections for gravel mounding, mud balls, bed cracking, media growth, and media loss.
8) Checking for even flow distribution during backwash.

Many plants have been shown to operate more effectively from a water quality standpoint if the overall treatment rate is reduced. A reduction in the plant operating rate should be considered whenever monitoring shows degradation of treated water quality. Reductions in rates should also be considered during periods of adverse raw water quality or cold water conditions. It may be necessary to establish a lower overall plant rating than previously set in order to ensure meeting plant treatment goals at all times.

If reclaim of backwash water is part of routine plant operations, extreme care must be given to this practice to ensure against lowering plant effluent quality. Should there be any question about meeting treatment goals as the result of reclaim operations, discontinuing this practice permanently is encouraged.

EMERGENCY OPERATING PROCEDURES

All treatment plants occasionally experience changes in raw water quality that cause treatment goals to be exceeded. Experience has shown that brief periods of ineffective treatment can cause a cryptosporidiosis outbreak. Our discussions with water treatment plant superintendents emphasized the need to review in advance any procedures that may be effective in dealing with adverse changes in water quality. In particular, it was emphasized that information must be shared among operators in a treatment plant so that proper emergency procedures are implemented regardless of the operator on duty. It is recommended that each plant prepare a specific list of procedures for dealing with the various types of adverse treatment conditions that have previously been encountered. Plant staff are encouraged to review past operating history to evaluate the effectiveness of previous responses to these conditions so as to more quickly implement an effective treatment regime.

A number of emergency procedures were emphasized when treatment goals are being exceeded. They include:

1) Temporary plant shutdown.
2) Slowing treatment rates.
3) Stopping reclaim of backwash water.
4) Monitoring individual filter turbidities.
5) Filtering to waste.
6) Hand dosing of coagulant onto filters.
7) Use of anionic or non-ionic polymer filter aids.
8) Increasing disinfectant dose.
9) Increasing monitoring frequencies.

REFERENCES

The following recent articles and/or conferences focused on optimizing water treatment operations. It is strongly recommended that water plant officials review these article and conference outlines to help assess the overall performance of their plants and to better determine what areas of the overall operations and facilities need improvements or corrections.

1. "Assessing Treatment Plant Performance"; William D. Bellamy, John L. Cleasby, Gary S. Logsdon, and Martin J. Allen; Journal AWWA, Vol 85, December 1993, pp. 34-38.

2. "Preventing Waterborne Disease: How to Optimize Treatment", Participant Guide, AWWA Satellite Teleconference, September 9, 1994.

3. "Chicago, Bulls, and Cryptosporidium", AWWARF Technology Transfer Conference, Conference Outline, October 14, 1993.

P:\MPRL crypto

Table 1. Partnership for Safe Water Phase IV Performance Goals
General Data Monitoring Requirements ➢ Daily raw water turbidity ➢ Settled water turbidity at 4-hour time increments from each sedimentation basin ➢ On-line (continuous) turbidity from each filter ➢ One turbidity profile, that includes a backwash profile, from the filter run with the maximum turbidity value for each month (refer to Checklist item #5). ➢ Combined filter effluent at 4-hour time intervals
Individual Sedimentation Basin Performance Goals ➢ Settled water turbidity less than 1.0 NTU 95 percent of the time when the annual average raw water turbidity is less than or equal to 10 NTU ➢ Settled water turbidity less than 2.0 NTU 95 percent of the time when the annual average raw water turbidity is greater than 10 NTU
Individual Filter Performance Goals ➢ Filtered water turbidity less than 0.10 NTU 95 percent of the time based on values recorded at 15-minute time intervals ➢ 96^{th}, 97^{th}, 98^{th}, 99^{th} percentile values that indicate consistent filter performance ➢ Maximum filtered water turbidity equal to or less than 0.30 NTU ➢ The treatment plant has an individual filter effluent turbidity goal following a backwash of no more than 15 minutes of water production at a turbidity equal to or greater than 0.10 NTU
Combined Filter Performance Goal ➢ Combined filter effluent turbidity of less than 0.10 NTU 95 percent of the time.
Disinfection Performance Criteria ➢ CT values to achieve required log inactivation of *Giardia* and virus

Appendix D: 10-Year Capital Improvements Plan

Water System Capital Improvement Plan
10 Year
Year 1-3

Project		**Amount**
Inspect/Repair N.30" Intake	$	60,000
Inspect/Repair S. 42" Intake	$	60,000
LSPS Valve repair/replace	$	15,000
Reporting Program	$	50,000
On-line monitoring equipment	$	9,500
Carbon Feed modification	$	5,000
Resolve Hypochlorite plugging	$	3,000
Chemical Room Ventilation replacement	$	30,000
Resvr. Access Hatch replacement	$	3,000
Sed basins 3&4 deck sealing and drain install	$	300,000
Sed basin 1&2 drain install	$	50,000
Sludge removal	$	150,000
Sherman Stn Valve repair/replacement program	$	60,000
Sherman Resvr. East Retaining Wall replacement	$	65,000
Getty Elevated Tank Cleaning	$	7,000
WFP Valve repair/replacement Program	$	120,000
Filter Repairs	$	50,000
Relocate Lab AC units to ground level	$	16,000
Leak Repairs	$	360,000
Rotork valve operator replacement program	$	128,000
Pacscan removal and SCADA upgrade	$	200,000
WFP East Resvr. Retaining wall	$	115,000
Pipe Galley Catwalk replacement	$	45,000
Install monorail for HSP1&2	$	20,000
Billing and Pumpage Report program	$	120,000
Computer network upgrades	$	50,000
Telephone network upgrade	$	15,000
Utility Upgrade	$	300,000
Safety Signs, Cones & Barricades	$	3,100
Vehicle Replacement	$	35,000
Upgrade watermain - GETTY ST - Broadway to Sherman	$	110,000
Water Meters	$	57,000
Hydrant Replacement Program	$	90,000
Backhoe replacement	$	90,000
Metal Detector replacement (3)	$	2,400
Water Meter Reading Unit Upgrade (incl new software)	$	15,000
Upgrade watermain - Alley between 6th & 7th from Barney to Kea	$	171,000
Vehicle Replacement Meter reader	$	20,000
Reliability Study	$	15,000
Upgrade watermain - upgrade to serve Mona Lake Park	$	216,000
Vehicle Replacement Water Technician	$	20,000
Total for years 1-3	**$**	**3,251,000**
Average per year	**$**	**1,083,667**

Water System Capital Improvement Plan
10 Year
Year 4-7

Project		**Amount**
Inspect N. 30" Intake	$	60,000
Boiler and heating efficiencies	$	50,000
Sludge removal	$	300,000
Fluoride SCADA interlock w/ pumps	$	5,000
WFP Resevoir sealing	$	180,000
Sherman Station Valve repair/replacement program	$	60,000
Sherman Station Resevoir inspection	$	5,000
Sherman Station Resevoir repairs	$	150,000
Getty Booster Stn gas heater install	$	5,000
WFP valve repair/replacement program	$	120,000
Vehicle replacement	$	35,000
Replace surface wash pipeing for filters1-8	$	350,000
Replace underdrain and media for filters 1-4	$	300,000
Backwash meter replacement and connect w/ SCADA	$	8,000
Monorail over HSP1	$	12,000
Replace media and sealant for filters 5-8	$	250,000
North lagoon enlargement	$	200,000
Rotork valve operator replacement program	$	270,000
Install VFD for HS	$	60,000
Earthen Berm for Basins 3 & 4	$	250,000
Security Upgrade	$	140,000
Utility Upgrade	$	400,000
Safety Signs, Cones & Barricades	$	4,800
Hydrant Replacement Program	$	120,000
Water Meters	$	76,000
Metal Detector replacement (4/4)	$	800
Upgrade watermain - upgrade Keating	$	220,000
Upgrade watermain - upgrade in Glade Street	$	710,000
Upgrade watermain - upgrade in Sherman Blvd	$	450,000
Meter readers (2)	$	30,000
Upgrade watermain - upgrade in Norton Ave	$	110,000
Upgrade watermain - upgrade in Hume	$	50,000
Upgrade watermain - upgrade in Ray	$	110,000
Upgrade watermain - upgrade in Barney	$	80,000
Total for years 4-7	**$**	**5,171,600**
Average per year	**$**	**1,292,900**

Water System Capital Improvement Plan
10 Year
Year 8-10

Project		**Amount**
Inspect N. 30" Intake	$	60,000
Inspect S. 42" intake	$	60,000
Sludge removal	$	150,000
Sherman Stn. Valve repair/replacement program	$	60,000
Sherman low voltage circuit replacement	$	30,000
Getty elevated tank cleaning	$	7,000
WFP valve repair/replacement program	$	120,000
Vehicle replacement	$	35,000
Plant inspections	$	12,000
S. lagoon enlargement	$	200,000
Install VFD for SPS	$	65,000
Seal decking of Sherman Resevoir	$	150,000
Lightning suppression system	$	200,000
Sludge Lagoon structure and equipment	$	110,000
Replace Basin 3&4 effluent pipe	$	220,000
Corrosion control application system	$	80,000
Alternative Energy Systems	$	600,000
LS Dehumidification System	$	100,000
Utility Upgrade	$	300,000
Safety Signs, Cones & Barricades	$	3,600
Hydrant Replacement Program	$	90,000
Water Meters	$	60,000
Metal Detector replacements (3)	$	2,400
Upgrade watermain - upgrade in Alley between Ray & Getty	$	270,000
Reliability Study	$	15,000
Vibratory Compactor	$	3,000
Dewatering pump	$	3,000
Vehicle Replacement	$	62,000
Total for years 8-10	**$**	**3,068,000**
Average per year	**$**	**1,022,667**
Grand Total	$	11,490,600