

July 14, 2016

Onondaga County Water Environment Protection
650 Hiawatha Blvd. West
Syracuse, New York 13204

RE: Groundwater Monitoring – June 2016 Semi-Annual Groundwater Monitoring report
Harbor Brook CSO 018 Pilot Constructed Wetlands Treatment Facility
SPDES Permit Number: NY 002 7081

The State University of New York College of Environmental Science and Forestry (SUNY ESF) and the Onondaga County Department of Water Environment Protection (OCDWEP) completed the 2016 first and second quarter groundwater monitoring for the Harbor Brook CSO 018 Pilot Constructed Wetlands Treatment Facility, located in the City of Syracuse, Onondaga County, New York on March 16 and June 9, 2016, respectively. This letter provides a summary of the groundwater monitoring performed and the associated results.

Monitoring Wells

SUNY ESF and OCDWEP performed the groundwater sampling on March 16 and June 9, 2016. Groundwater samples were collected from five monitoring wells (MWs). The MWs are designated as MW-A, MW-B, MW-C, MW-D and MW-5. Likewise, SUNY ESF from January through June performed a monthly groundwater level monitoring for each of the wells. Attachments A and B contain measured monthly groundwater elevation and groundwater contour maps showing the location of the MWs.

Groundwater Sampling and Water Level Monitoring

Groundwater sampling and water level monitoring was completed in accordance with the New York State Department of Environmental Conservation (NYSDEC) Quality Assurance Project Plan to Evaluate the Ground Water Resources of NYS and the Facility Groundwater Monitoring Work Plan. Prior to collecting a groundwater sample from each well, SUNY ESF and OCDWEP measured the depth to water in the wells to calculate the necessary purge volumes. Each well was purged using separate stainless steel hand bailers during the first quarter sampling and peristaltic pump during the second quarter sampling. The switch to peristaltic pump was as a result of MW-A and MW-B being damaged by freeze conditions during winter of 2015/2016 (See OCDWEP letter to NYSDEC dated April 15, 2016). SUNY ESF and OCDWEP purged approximately three well volumes from each well in an effort to reduce sample turbidity and stabilize water quality parameters prior to sampling. The purged water was discharged onto the adjacent ground surfaces.

After purging, the redox potential, specific conductance (SC), pH, temperature, and dissolved oxygen of the groundwater was measured using an YSI 650 MDS water quality meter. While wearing disposable latex gloves, SUNY ESF and OCDWEP personnel collected all water samples. Samples were preserved in accordance with OCDWEP's NYSDEC approved Environmental Lab Field Preservation Guide. After the samples were collected and put on ice, OCDWEP transported

them, under appropriate chain of custody procedures, to the OCDWEP Laboratory at 7120 Henry Clay Boulevard in Liverpool, NY. In accordance with the SPDES Permit and the approved Groundwater Monitoring Work Plan for the facility, the samples were analyzed for ammonia (NH₃), ammonium (NH₄⁺), total dissolved solids (TDS), sulfate (SO₄²⁻), turbidity (TURB), hardness (as CaCO₃), chloride (Cl⁻), nitrite (NO₂⁻), nitrate (NO₃⁻), fecal coliforms (FCs), and total coliforms (TCs). The parameters were analyzed according to 6 NYCRR Part 703 – NYS Groundwater Standards.

Per SPDES Permit NY 002 7081, previous baseline monitoring of the following metals occurred. Since not required during quarterly monitoring, these metals were not sampled for during this period: Aluminum (Al), chromium (Cr), arsenic (As), cadmium (Cd), copper (Cu), iron (Fe), lead (Pb), manganese (Mn), mercury (Hg), nickel (Ni), selenium (Se), and zinc (Zn).

Sample Results

Table 1 and Table 2 summarize the sample results for MW-A through MW-D and MW-5. As required by the SPDES Permit, the groundwater results were compared to NYSDEC Part 703 Groundwater Standards. Highlighted cells indicate occurrences where the Part 703 Groundwater Standards were exceeded. The complete laboratory data packages are included in Attachment C.

Table 1: 2016 First Quarter Groundwater Monitoring for SPDES Parameters – March 16, 2016.

Sample Name				MW-A	MW-B	MW-C	MW-D	MW-5
Sampling Date				3/16/16	3/16/16	3/16/16	3/16/16	3/16/16
Parameter	CAS RN	NYSDEC Part 703 Class GA Water Quality Standards	Unit					
Water Elevation	NA	-	ft. a.s.l.	394.85	392.91	394.06	395.91	397.36
Total Dissolved Solids	TDS	500	mg/L	929	533	713	291	1,076 ^Φ
Sulfate	14808-79-8	250,000	µg/L	217,000	78,000	141,000	23,300	208,500 ^Φ
pH	pH	6.5-8.5	pH units	6.97	6.95	7.31	7.27	7.12
Hardness (as CaCO ₃)	18785-72-3	-	mg/L CaCO ₃	634	494	735	934	4,195 ^Φ
Specific Conductance	SC	-	µmhos/cm	1,486	909	1,159	506	1,715
Turbidity	TURB	5	NTU	46	18	1,010	1,850	7,860 ^Φ
Ammonia and Ammonium as N	-	2000	µg/L	2,350	547	487	680	311 ^Φ
Chloride	16887-00-6	250,000	µg/L	172,000	13,800	163,000	7,330	263,500 ^Φ
Nitrite as N	14797-65-0-N	1000	µg/L	< 25 ^U	< 25 ^U	< 28.7	< 25 ^U	< 25 ^{ΦU}
Nitrate as N	14797-65-0-N	10,000	µg/L	< 10 ^U	465	2,500	116	< 25 ^{ΦU}
Sum of Nitrate and Nitrite	NA	10,000	µg/L	< 25	465	2500	116	< 25 ^Φ
Fecal Coliform	NA	-	CFU/100 ml	< 10 ^U	36	440	< 10 ^U	< 10 ^U
Total Coliform	NA	50	CFU/100 ml	6,640	440	454	< 10 ^U	454

Note: Laboratory data was converted to match part 703 Standard units. Highlighted boxes show concentrations exceeding NYSDEC Part 703 Water Quality Standard; U – Reported value is below the Method Reporting Limit (MRL); Φ – The average values of duplicate samples.

Table 2: 2016 Second Quarter Groundwater Monitoring for SPDES Parameters – June 9, 2016.

Sample Name				MW-A	MW-B	MW-C	MW-D	MW-5
Sampling Date				6/9/2016	6/9/2016	6/9/2016	6/9/2016	6/9/2016
Parameter	CAS RN	NYSDEC Part 703 Class GA Water Quality Standards	Unit					
Water Elevation	NA	-	ft. a.s.l.	394.10	392.11	392.66	394.91	396.86
Total Dissolved Solids	TDS	500	mg/L	1,443	653	726	403	938.5 ^Φ
Sulfate	14808-79-8	250,000	µg/L	419,000	133,000	141,000	<10,000 ^U	139,500 ^Φ
pH	pH	6.5-8.5	pH units	6.83	7.04	7.01	7.27	7.32
Hardness (as CaCO ₃)	18785-72-3	-	mg/L CaCO ₃	897	537	529	392	426 ^Φ
Specific Conductance	SC	-	µmhos/cm	2083	955	1203	733	1548
Turbidity	TURB	5	NTU	97	44.6	34.5	125	49.6 ^Φ
Ammonia and Ammonium as N	-	2000	µg/L	4,650	1,200	825	1,520	114.85 ^Φ
Chloride	16887-00-6	250,000	µg/L	312,000	18,900	138,000	10,900	286,000
Nitrite as N	14797-65-0-N	1000	µg/L	<25 ^U	<25 ^U	<25 ^U	<25 ^U	<25 ^{UΦ}
Nitrate as N	14797-65-0-N	10000	µg/L	<25 ^U	<25 ^U	<25 ^U	50.4	<25 ^{UΦ}
Sum of Nitrate and Nitrite	NA	10000	µg/L	<25	<25	<25	50.4	<25
Fecal Coliform	NA	-	CFU/100 ml	<10 ^U	<10 ^U	9	<10 ^U	45
Total Coliform	NA	50	CFU/100 ml	<10 ^U	<10 ^U	9	<10 ^U	45

Note: Laboratory data was converted to match part 703 Standard units. Highlighted boxes show concentrations exceeding NYSDEC Part 703 Water Quality Standard; U – Reported value is below the Method Reporting Limit (MRL); Φ – The average values of duplicate samples.

Figures 1 through 12 (Attachment D) summarize the long term trends in parameter values for each monitoring well over the sampling period from pre-construction (November 2011) to the second quarter of 2016. The legends represent monitoring wells and the horizontal axis the sampling dates. Sampling dates correspond to the following:

- 11/16/2011 – Pre-construction sampling
- 12/19/2013 – Pre-operational sampling from 9/19/2013 and 12/19/2013
- 3/12/2015 – Operational baseline sampling
- 6/10/2015 – 2015 Second quarter sampling
- 9/26/2015 – 2015 Third quarter sampling
- 10/20/2015 – 2015 Fourth quarter sampling
- 3/16/2016 – 2016 First quarter sampling
- 6/9/2016 – 2016 Second quarter sampling

The baseline operational groundwater monitoring data of March 12, 2015 serves as the baseline to assess the impacts of the constructed wetland treatment system on local groundwater quality. Table 3 and Table 4 indicate the percent changes in monitored contaminants above the operational baseline values for the 2016 first and second quarter groundwater sampling.

An increase in water quality parameter concentration when compared to the baseline values is seen for some parameters in the first and second quarters. Hardness, pH, Nitrite, Fecal coliform and Total coliform concentrations (Figures 3, 4, 9, 11 and 12) exceeded the baseline sampling results for each well during the first quarter sampling except for Hardness in MW-A, Chloride & pH in MW-B, and Total coliform in MW-D. All parameters measured for monitoring wells MW-C and MW-5 increased from the baseline except for Total dissolved solids (TDS) and Total ammonia nitrogen in MW-C and Chloride in MW-5 (Table 1). Similarly, during the second quarter sampling Nitrite (Figure 9) and Fecal Coliform (Figure 11) exceeded the baseline sampling result in all the monitoring wells except for Nitrite in MW-B. Only Total Coliform (MW-A), Nitrate (MW-5), Hardness (MW-B), Chloride and Specific Conductance (MW-B & MW-C), and Total Dissolved Solids (MW-B & MW-5) exceeded the baseline sampling result for all MWs in the second quarter sampling. Unlike the first quarter sampling, fewer of the parameters had values above the baseline in the second quarter sampling results.

Comparing the long term sampling results (Figures 1-12), Total dissolved solids, Sulfate, Specific Conductance, and Total Coliforms decreased in the first and second quarter when compared to previous sampling. Turbidity (Figure 6) during the second quarter sampling, decreased greatly when compared to prior sampling results for all MWs and the baseline sampling results (Table 2). This is likely attributed to the use of peristaltic pump for purging and sample collection. pH (Fig. 3), Hardness (Fig. 4), Chloride (Fig. 8), Nitrite (Fig. 9) and Nitrate (Fig. 10) remained fairly the same over the long term sampling.

Table 3: Percent increase from baseline monitoring (2016 First Quarter Monitoring)

Sample Name	MW-A	MW-B	MW-C	MW-D	MW-5
Sample Date	3/16/2016	3/16/2016	3/16/2016	3/16/2016	3/16/2016
Parameter	Percent Change from Operational Baseline (%)				
Total Dissolved Solids	-	8.8%	-	-	15.7%
Sulfate	-	33.8%	6.0%	-	46.8%
pH	5.1%	-	4.0%	3.1%	1.7%
Hardness (as CaCO ₃)	-	33.2%	3.7%	117.7%	165.5%
Specific Conductance	-	28.2%	324.5%	-	6.5%
Turbidity	-	-	361.2%	667.6%	114.8%
Ammonia and Ammonium as N	-	40.3%	-	-	38.8%
Chloride	-	-	77.9%	-	-
Nitrite as N	<127.3%	-	<187.0%	<150.0%	<150.0%
Nitrate as N	-	-	<608.2%	-	<150.0%
Fecal Coliform	<100.0%	>620.0%	>8700.0%	<100.0%	<100.0%
Total Coliform	>132,700.0%	57.1%	>2,170%	-	>354.0%

Table 4: Percent increase from baseline monitoring (2016 Second Quarter Monitoring).

Sample Name	MW-A	MW-B	MW-C	MW-D	MW-5
Sample Date	6/9/2016	6/9/2016	6/9/2016	6/9/2016	6/9/2016
Parameter	Percent Change in Concentration from Operational Baseline (%)				
Total Dissolved Solids	-	33.3%	-	-	0.9%
Sulfate	-	128.1%	6.0%	-	-
pH	3.0%	-	-	3.1%	4.6%
Hardness (as CaCO ₃)	-	44.7%	-	-	-
Specific Conductance	-	34.7%	340.7%	-	-
Turbidity	-	-	-	-	-
Ammonia and Ammonium as N	59.2%	207.7%	-	61.9%	-
Chloride	-	26.8%	50.7%	-	-
Nitrite as N	<127.3%	-	<150.0%	<150.0%	<150.0%
Nitrate as N	-	-	-	-	<150.0%
Fecal Coliform	<100.0%	<100.0%	>80.0%	<100.0%	>800.0%
Total Coliform	<100.0%	-	-	-	-

Summary of Results

Several parameters were noted at concentrations exceeding the applicable NYSDEC standards.

In the first quarter monitoring (Table 1), these include:

- Total dissolved solids (MW-A, MW-B, MW-C, MW-5),
- Turbidity in all MWs,
- Ammonia (MW-A),
- Chloride (MW-5), and
- Total coliforms (MW-A, MW-B, MW-C & MW-5)

In the second quarter monitoring (Table 2), these include:

- Total dissolved solids (MW-A, MW-B, MW-C, & MW-5),
- Sulfate and Ammonia (MW-A),
- Turbidity in all MWs, and
- Chloride (MW-A & MW-5)

Elevated turbidity could be attributed to the fact that monitoring wells were installed as piezometers, and not formally developed as a traditional groundwater monitoring well would be.

When analyzing long term trends in the water quality parameters over the duration of the monitoring period to date, no apparent continuous trend (increasing or decreasing) is evident. In order to conclusively determine the impact of the wetland treatment system on the local groundwater quality, additional quarterly monitoring will continue in accordance with the Facility Groundwater Monitoring Work Plan. Long-term trends will continue to be analyzed, and detailed inferences on the effects of the wetland treatment system will be discussed in future semi-annual reports.

Attachment A: Monthly groundwater elevation from January through June 2016

Months	Water Elevation				
	MW-A	MW-B	MW-C	MW-D	MW-5
January 2016	394.3	392.91	392.78	394.91	396.96
February 2016	394.45	393.81	393.21	395.51	396.96
March 2016	394.85	392.91	394.06	395.91	397.36
April 2016	394.2	392.76	393.01	395.06	396.86
May 2016	394.07	392.31	392.76	394.81	396.82
June 2016	394.1	392.11	392.66	394.91	396.86



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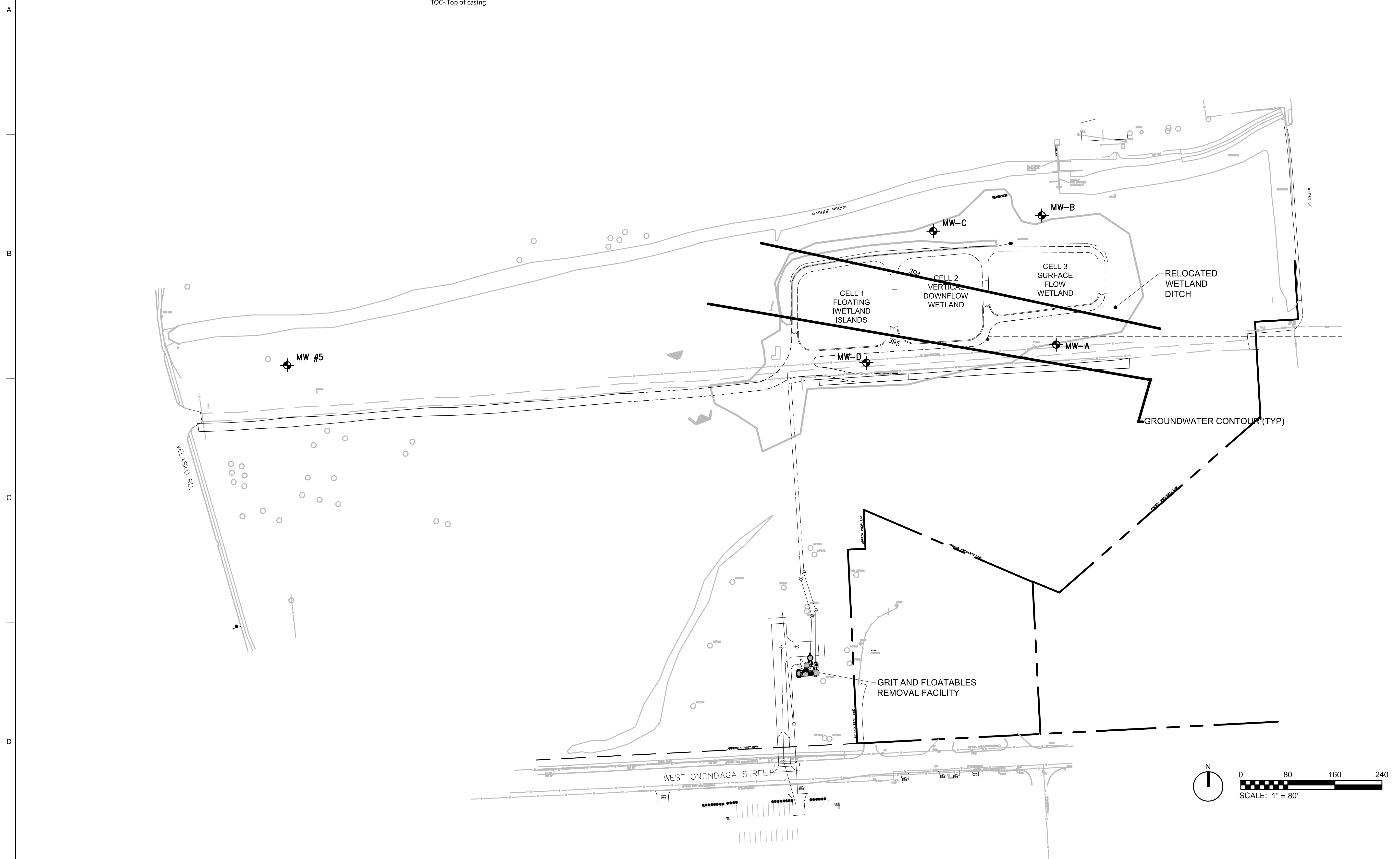


Attachment B: Monthly Groundwater Contour Maps

GROUND WATER SUMMARY TABLE

Date	MW-A				MW-B				MW-C				MW-D				MW-5			
	DTW (TOC) feet	Well Depth (TOC)	Casing Elevation	Water Elevation	DTW (TOC) feet	Well Depth (TOC)	Casing Elevation	Water Elevation	DTW (TOC) feet	Well Depth (TOC)	Casing Elevation	Water Elevation	DTW (TOC) feet	Well Depth (TOC)	Casing Elevation	Water Elevation	DTW (TOC) feet	Well Depth (TOC)	Casing Elevation	Water Elevation
2/22/2016	5.10	11.52	399.55	394.55	4.60	11.45	398.41	393.81	5.55	10.87	398.76	393.21	7.80	11.77	403.31	395.51	3.40	8.80	400.36	396.96

DTW- Depth to Water
TOC- Top of casing



CH2MHILL	ESF	430 E. GENESEE STREET, SUITE 400 SYRACUSE, NY 13202-4511-7270 PH (315) 345-1400 - FAX (315) 451-7270 EB 0000072 AA 001992
GROUNDWATER CONTOUR MAP February 22, 2016		HARBOR BROOK CSO 018 PILOT CONSTRUCTED WETLANDS TREATMENT FACILITY CITY OF SYRACUSE ONONDAGA COUNTY, NEW YORK
1" = 80' VERIFY SCALE BAR IS ONE INCH ON ORIGINAL DRAWING.		
DATE	February 2016	
PROJ	381098	
DWG		
SHEET		

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Attachment C: Laboratory Data Packages

Attachment D: Long term groundwater sampling results of 11/16/2011 through 6/9/2016

Attachment D: Figures 1-12, Long-Term Groundwater Monitoring for SPDES Parameters

11/16/2011 = Pre-Construction Sampling
 12/19/2013 = Pre-Operational Sampling (9/19/2013 and 12/19/2013)
 3/12/2015 = Operational Baseline Sampling
 6/10/2015 = 2015 2nd Quarter Sampling
 8/26/2015 = 2015 3rd Quarter Sampling
 10/20/2015 = 2015 4th Quarter Sampling
 3/16/2016 = 2016 1st Quarter Sampling
 6/6/2016 = 2016 2nd Quarter Sampling

