Basis of Design Report Harbor Brook CSO 018 Constructed Wetlands Pilot Treatment System

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Save the Rain

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SECTION 1

Introduction

1.1 Background

Onondaga County entered into an Amended Consent Judgment (ACJ) with the State of New York, New York State Department of Environmental Conservation (NYSDEC), and Atlantic States Legal Foundation (ASLF) on January 20, 1998 pertaining to pollutant loadings from the Metropolitan Syracuse Wastewater Treatment Plant ("METRO") and the combined sewer overflows (CSOs) that discharge into Onondaga Lake. The combined sewer service area is entirely within the City of Syracuse limits and drains to the southeastern end of Onondaga Lake. Figure 1 is a location map of the project area.

On November 16, 2009, the Fourth Stipulation and Order to the 1998 ACJ was adopted, which revised the ACJ to include provisions for the addition of green infrastructure projects into the previously approved grey infrastructure program. The County has proposed to implement a green infrastructure program to reduce the volume of rainwater that presently enters the combined sewer system in an effort to reduce the frequency and volume of CSO discharges to the receiving waters tributary to Onondaga Lake.

CSO discharges to Harbor Brook are a health concern and represent a nutrient loading that contributes to the degradation of water quality in Onondaga Lake. CSO 018, located near the intersection of Velasko Road and West Onondaga Street (see Figure 2), is one of these overflows that discharges combined sewage (i.e., sewage combined with stormwater) into Harbor Brook during severe wet-weather events. Since there is a significant amount of open space available in close proximity to this overflow, Onondaga County has expressed an interest in pursuing construction of a passive, sustainable natural treatment system (constructed treatment wetland) to treat the combined sewage overflow at this location before discharge into Harbor Brook. Figure 3 is a property ownership map which shows the extent of County owned property within the project area.

To accommodate this goal, the CH2M HILL and CHA team is completing the design of a full scale constructed wetland pilot treatment system at CSO 018. This Basis of Design Report is the second phase of design, intended to provide design drawings and information to a 50 percent level of completion for County, community, and regulatory review. Prior to this, the first phase of design confirmed the technical, regulatory, and economic feasibility of constructing a full-scale wetland pilot treatment facility and included a 10 percent design concept and cost opinion. Documents from the first phase included:

1. Engineering Report (dated December, 2010), submitted with the Green Innovation Grant Program 2010 application to the New York State Environmental Facilities Corporation (NYSEFC).
2. Project Definition Report (dated January 2011), provided documentation of concept design including theoretical removal efficiencies for the available footprint of land.

1.2 Purpose and Objective

The long term goal is to use the data generated from the full scale pilot system to design a permanent wetland treatment system at CSO 018 (with potential expansion to include CSO 078 or the application of treatment wetlands technology at other CSOs). This project will be part of a larger scale project to restore the site (from west of Velasko Road where Harbor Brook crosses under Grand Avenue to about Holden Street or some portion of this area) and to improve the water quality of the entire Harbor Brook flow. A community park and educational resource is envisioned to complement the long-term wetland treatment system. These concepts will be discussed and developed concurrently with the CSO 018 wetland pilot project development and during the approximately 2-year monitoring program in cooperation with the County.

This Basis of Design Report builds upon the two (2) previously prepared reports and progresses the concept of constructing a full-scale constructed wetlands pilot treatment system at CSO 018 into the final design phase. This report specifically includes the following:

- Project description.
- Layout of proposed facilities on the selected project site.
- Stormwater Management Model (SWMM) results for the 1 year, 2 hour storm event conveyed through the grit and floatables removal unit, conveyance pipes, and constructed wetlands pilot treatment facilities.
- Floatables and grit removal facilities design criteria, including an evaluation of several alternatives.
- Sizing criteria for the constructed wetland cells.
- Cut sheets of selected equipment.
- Geotechnical investigation memo.
- Evaluation of compensatory storage requirements for the Velasko Road Detention Basin (see approximate outline of the basin in Figure 2) and incorporation of required storage into the project site design.
- Flow monitoring at the relocated CSO 018 outfall to identify CSO discharge events to Harbor Brook.
- Preparation of 50 percent complete design drawings.
- Confirmation of permitting requirements.
- Operation, maintenance and monitoring requirements.
- Project schedule.
- Updated Engineer’s Opinion of Probable Construction Costs.

SECTION 2

Project Site Conditions

2.1 Existing Project Site

The existing project site at CSO 018 (Figures 1 and 2), located in Onondaga County within the City of Syracuse, is bordered generally by West Onondaga Street to the south, Harbor Brook to the north, and Velasko Road to the west. The drainage area tributary to CSO 018 is approximately 145 acres in size (Figure 4).

2.1.1 Current CSO and HBIS Operations

An existing 48-inch reinforced concrete pipe (RCP) conveys combined sewage from West Onondaga Street in a northerly direction towards CSO 018, located along Harbor Brook (see Progress Print D-3001). Flow is conveyed through an existing CSO regulator which splits the flow into an interceptor flow component and an overflow component. Dry weather flows are currently conveyed through a 10-inch vitrified clay pipe (VCP) interceptor-connect pipe, through a grit removal chamber discharging into the 21-inch Harbor Brook Interceptor Sewer (HBIS), which is tributary to the METRO wastewater treatment plant. Flow over the capacity of the 10-inch interceptor-connect pipe is conveyed through the CSO 018 outfall pipe and discharged to Harbor Brook.

2.1.2 Newly Constructed HBIS Modifications

The Onondaga County Department of Water Environment Protection (OCDWEP) has recently constructed a new HBIS along the Rowland Street extension (D&S Service Access) which consists of an 18-inch & 21-inch polyvinyl chloride (PVC) pipe through the CSO 018 project site. Combined sewage flowing down the existing 48-inch RCP from West Onondaga Street will be conveyed through a new flow diversion manhole which will split the flow into an interceptor flow component and an overflow component. Dry weather flows will be conveyed through a new 12-inch interceptor–connect pipe that discharges into the new 21-inch HBIS, which is tributary to the METRO wastewater treatment plant. Flows over the capacity of the 12-inch interceptor-connect pipe will be conveyed through a new 30-inch HDPE overflow pipe to CSO 018 and will be discharged into Harbor Brook. The existing grit removal facility will be abandoned. This work is scheduled to be completed by June of 2011.

Since the old 21-inch HBIS is located within the area proposed for construction of the wetland treatment cells, it is required that the old HBIS be abandoned and the new HBIS be commissioned and made active before construction of the wetland treatment cells commences.

2.1.3 Other Considerations

2.1.3.1 Potential Combining and Treatment of CSO 078 with CSO 018

The CSO 078 drainage basin is located immediately to the west of the CSO 018 drainage basin (see Figure 4). Recognizing the usual cost-effective advantage of combining CSO flows for treatment, preliminary consideration was given to combining the flow from CSO 078 with the flow from CSO 018 and treating this combined flow in a constructed wetlands treatment facility located in the vicinity of CSO 018.

While the potential advantages were recognized, there are no definite plans by OCDWEP to combine these CSOs into one CSO treatment facility in the near future. Due to the potential advantages of combining flows in the future after construction of the pilot facility to treat the CSO 018 flows, this option remains viable and has been given consideration. While a grit and floatables removal facility is proposed at the present time just for CSO 018, an area immediately adjacent to this facility is available for construction of a similar grit and floatables removal facility to treat the flows from CSO 078, if the OCDWEP decides to pursue this option in the future. Therefore, the option of having two (2) adjacent grit and floatables removal units constructed immediately north of West Onondaga Street with conveyance of flows to a constructed wetlands treatment facility sized to treat both CSO 018 and CSO 078 flows remains a future possibility and has not been precluded. The current wetland treatment facility could be expanded to the south into the adjacent wetland created as part of the 1998 expansion of the stormwater management area.

The results of the pilot study will define the design criteria for the development of future wetland treatment facilities within Onondaga County and beyond, and will be the basis for determining how a potential wetland treatment facility to include CSO 078 flow could be constructed within the lands available adjacent to Harbor Brook.

2.1.3.2 Bellevue Country Club Stormwater Pond Discharge

There are two (2) stormwater detention ponds located on the Bellevue Country Club property that are believed to contribute a significant amount of snowmelt and stormwater to CSO 018 during the early spring months (shown on Figure 4). Stormwater flows are discharged over a weir structure located at the outlet of the most downstream (west) pond and into a drop manhole located at the intersection of Sunhill Terrace and Glenwood Avenue. From here, the flow is conveyed through the combined sewers in a northerly direction along Sunhill Terrace and then in an easterly direction along Bellevue Avenue to the intersection of Bellevue Avenue and Velasko Road. At this location, the regulated flow is conveyed through a 15″ combined sewer along Bellevue Avenue to the intersection of Bellevue Avenue and Upland Road (with the overflow being conveyed through the 27″ sewer along Velasko Road which flows in a northerly direction to Harbor Brook), then through a 24″ sewer in a northerly direction toward W. Onondaga Street, and finally tributary to the 48″ Rowland Trunk Sewer at W. Onondaga Street.

The estimated combined sewage discharge from CSO 018 to Harbor Brook (derived from SWMM modeling of the combined sewer system by other OCDWEP engineering consultants) includes the stormwater contribution from the Country Club ponds. Therefore, the potential future elimination of this flow contribution from CSO 018 may result in a reduction of the existing 1 year, 2 hour storm event CSO flows. However, this reduction is not believed to be significant enough (in volume or nutrient loading) to substantially impact the current sizing of the constructed wetlands facilities.

2.1.3.3 Geotechnical Investigation

A subsurface investigation was completed on the site in February 2011. A technical memorandum of our findings is included in Appendix A. The investigation revealed a varying layer of peat across the site that will impact construction of the proposed facilities. See Section 3.3.5.4 for design considerations.

2.1.3.4 Impact of Flood Levels

The Velasko Road Detention Basin has historically experienced regular flooding prior to 1980, due to lack of attenuation of stormwater flows. In 1980, a dam and a flood control structure were constructed just upstream of Holden Street which formed the Velasko Road Detention Basin (see approximate outline of the basin in Figure 4). These facilities addressed flooding issues up to a 25-year storm, with a maximum design outflow rate of 300 cubic feet per second (cfs). To provide sufficient stormwater storage within the detention basin, three (3) houses that existed along the south side of Rowland Street between Velasko Road and Holden Street were demolished. This section of Rowland Street was removed, with the exception of a gravel access driveway to the current grit removal system.

As the community grew and storm flows increased, there was a need to increase the discharge rate from the control structure to continue to protect the area from flooding up to the 25-year storm event. In about 1998, the dam was modified to include an orifice (approximately 2 ft x 2 ft in size) that allows additional flow to exit the detention pond to a design rate of about 480 cfs. Flow was directed to the orifice by excavating a channel adjacent to the Avio flood control gate. The increased flow required that the Holden, Hoeffler, and Lydell Street (east of Hoeffler Street) culverts be replaced with larger culverts and the channel from Hoeffler Street upstream to the control gate be modified. About 93,000 cubic yards of soil were excavated from the floodplain to provide additional storage capacity (about 41 acre-ft).

The highest 15 minute interval flow recorded at the structure since 1999 is 331 cfs which occurred on January 23, 2007. The highest recorded daily average flow is 177 cfs which occurred on January 19, 1996. These high flows suggest that the existing capacity of the basin has not yet been reached. The preliminary FEMA flood study dated June 2008 indicates that the 100 year storm event would result in a water elevation of +/- 402.00 (NAVD 88).

Construction of the wetland treatment system within the Velasko Road Detention Basin will require mitigation by creating compensatory storage. This is discussed further in Section 3.3.4.

2.1.3.5 Phase 1 Environmental Site Assessment

A Phase I Environmental Site Assessment is being completed for the Velasko Road Detention Basin. The preliminary findings and recommendations are not considered unusual for the current and historical uses of the area within the City of Syracuse. The preliminary results indicate that a site soil management plan should be developed for staging and disposal of site soils during construction activities. Additionally, recommendations may include a subsurface investigation to obtain a more complete understanding of adjacent or site subsurface materials identified as recognized or historic recognized environmental concerns. This will be further discussed with the County. The final Phase I Environmental Site Assessment will be provided to the County under separate cover.

2.2 Existing CSO 018 Flow Characteristics

Flow attributes of CSO 018, based on Stormwater Management Modeling (SWMM), are provided in Table 2-1 below. Brown and Caldwell created the SWMM combined sewer model, prepared under a separate contract with Onondaga County, that models combined sanitary and storm flows for the entire county. The B&C model results which incorporated the new Harbor Brook Interceptor Sewer establish the design flows for this project. A copy of the hydrograph for the 1 year, 2 hour storm event developed from this model and the associated technical memo is included in Appendix B.

TABLE 2-1

CSO 018 Attributes (Based on 2011 Stormwater Management Modeling (SWMM) Results)

Parameter	Value
Basin (Catchment) Area	145 acres
Annual CSO Flow	13.6 million gallons/year
Number of Overflow Events/Year	42
CSO Volume for 1 year, 2 hour storm event	0.70 million gallons
CSO Peak Flow Rate for1 year, 2 hour storm event	40 cfs

SECTION 3

Basis of Design

3.1 Proposed Pilot Treatment System Overview

The use of wetlands for treatment of stormwater and wastewater is an accepted practice worldwide, supported by more than fifty years of design and operational experience. Virtually all types of water have been treated with wetlands, including many applications for domestic wastewater. Constructed treatment wetland systems are typically designed based on the performance of a pilot wetland system.

The proposed pilot treatment system has been sized to treat the combined sewage flow generated at CSO 018 during the 1 year, 2 hour storm event, which is presently discharged to Harbor Brook without treatment. The system will consist of grit and floatables removal followed by constructed wetlands treatment.

Grit and floatables removal is required upstream of the wetlands treatment system to protect the constructed wetland treatment system from an influx of inorganic materials. Grit removal is required to prevent filling in of the wetland treatment cells with inert solids, thereby reducing the treatment capacity of the constructed wetlands system. Floatables removal is required to prevent clogging of the wetland cell media, prevent danger to wildlife attracted to the facility, and ensure an aesthetically pleasing and attractive area is maintained.

The constructed treatment wetlands system will provide reduction of bacteria, nutrients (nitrogen and phosphorus), total suspended solids (TSS), and 5-day biochemical oxygen demand (BOD_5).

The proposed pilot treatment system will operate as follows:

1. When a rain event occurs, the existing 48-inch combined sewer (labeled as sanitary on provided base mapping) at West Onondaga Street will begin to surcharge within the proposed grit and floatables facility.
2. The grit and floatables facility will remove the majority of grit and floatables before overflowing through an automatic siphon, where flow will be conveyed to the constructed wetlands treatment system.
3. The constructed wetlands treatment system will consist of three (3) separate and distinct cells of different types of wetlands (i.e., floating wetland island, vertical downflow wetland, and surface flow wetland), which can be operated in either series or parallel flow patterns. The variety of flow patterns will allow for flexibility to monitor the removal efficiency of key contaminants in each wetland cell.
4. Once the storm event flows have passed through the constructed wetlands, the flow will be discharged through one outfall to Harbor Brook.

Storm event flows in excess of the 40 cfs peak design flow from a 1 year, 2 hour storm will discharge from the grit and floatables facility through an overflow weir, back to the 48”

Rowland Trunk Sewer for conveyance into the new HBIS (if excess capacity exists) or routed around the treatment wetland facility for direct discharge to Harbor Brook via the facility outlet pipe. The following sections provide greater detail on the grit and floatables facility and the constructed wetlands pilot treatment system.

3.2 Grit and Floatables Facility

For the purposes of providing a design prototype, several grit and floatables systems were reviewed for this application. The proposed grit and floatables prototype system was chosen based on a technical feasibility evaluation of several types of grit and floatables removal systems. Each of the removal alternatives were evaluated based on the following criteria (listed in no particular order):

- Operational reliability
- Electrical power requirements
- Solids handling requirements
- Required maintenance
- Grit and floatables removal efficiency
- Equipment lead time
- Construction cost
- Operation and maintenance costs
- Maximizing flow diverted to wetland treatment system

Based on results of the evaluation, the Storm King with Swirl Cleanse screen was recommended as the design prototype. A copy of the technical memorandum prepared for the feasibility evaluation of alternatives has been included as Appendix C.

3.2.1 Removal Efficiencies, Sizing and System Operation

3.2.1.1 Optimizing Unit Sizing and Removal Efficiencies

Based on the design flow of 40 cfs, two (2) 28 foot diameter Storm King units would be required to remove 95 percent of all grit, sand and sediment with specific gravity of 2.65, greater than or equal to 106 microns.

Recognizing that grit concentrations are higher during wet weather events and that the grit gradation has a tendency to migrate to the coarser part of the grading curve during significant wet weather flows, a smaller unit may also be considered. Based on this assumption the unit can be alternatively sized to remove 95 percent of all grit particles that are 106 microns for smaller more frequent storm events, but target coarser material at the peak wet weather flows.

This unit would be a single 26-foot diameter structure, designed to achieve 95 percent removal of all grit, sand and sediment with specific gravity of 2.65 greater than or equal to 300 microns at the design flow of 40 cfs. The volume of the vessel would be reduced to 33,700 gallons (from 82,260 gallons in the design above) with an underflow rate (flow back to the HBIS) of 4 cfs.

This separator size will maximize flow to the wetland, provide the wetlands with appropriate preliminary treatment, while also emphasizing the treatment capabilities of the constructed wetlands. The estimated construction cost is also considerably lower than the 2 unit option and is consistent with the alternatives considered in Appendix C.

3.2.1.2 Inline/Offline Operation Options

Two alternative operation scenarios were evaluated. The alternatives include an “offline” option and “inline”option. Based on conversations with the County and modeling data received from Brown and Caldwell, 1991 is considered an average year for rainfall events and as such was used as the basis of the evaluation.

The offline option allows dry weather flow (+/- 4 cfs) to continue through the existing Rowland Street Trunk sewer and diverts wet weather flows through the grit and floatables unit to the constructed wetlands. In addition to the dry weather flow, the grit and floatables unit discharges +/- 1.33 cfs of underflow returned to the HBIS. Therefore, under this option a total of +/- 5.33 cfs would be returned to the HBIS. With offline operation, 68 percent of CSO volume and 55 percent of CSO events are diverted to the wetland.

Under the inline option, all flows (including dry weather flows) would pass through the grit and floatables unit. As such, flows returning to the HBIS will be reduced to +/- 4 cfs. With inline operation, 91.0 percent of CSO volume and 78.5 percent of CSO events are diverted to the wetland. The disadvantage of this option is that it may result in increased life-cycle costs due to increased operations and maintenance (floatables may not be flushed out of unit between CSO events due to dry weather flow configuration).

Figure 5 shows the volume of overflows that will reach the constructed wetlands under each operation scenario described above. Based on this data, the inline option will allow approximately 10 more storm events and 3.08 million gallons more CSO water to the constructed wetlands for the average year when compared to the offline option. The inline option is shown in the 50 percent design drawings as the design prototype.

3.2.1.3 Proposed System Description

Based on the evaluations described in Appendix C, and further refined as described above, the proposed grit and floatables removal system is sized to treat flow rates up to 40 cfs, as produced by the 1 year, 2 hour storm event at CSO 018, and remove 95 percent of grit, 300 microns and greater in size. The design prototype as shown in the 50 percent drawings, a Storm King with Swirl Cleanse in an “in line” configuration, is a stainless steel unit that will be installed within a 26 foot diameter cast-in place concrete chamber. A copy of the equipment cut sheets is included in Appendix D.

The design prototype uses vortex separation technology, and consists of a circular vortex chamber, with an automatic discharge siphon, and sanitary sewer return piping. When the flow in the sanitary sewer system reaches the designed level, the water will overflow to the circular vortex chamber. Floatables and water will be collected on a conical screen and returned to the sanitary system through the return piping; grit will be removed through a separate return pipe off the bottom of the vortex chamber. (Based on discussions with the County at completion of 50 percent design, final design will include the collection of grit rather than conveying it to the HBIS.) As the water level continues to rise within the chamber, the treated water will be discharged through the automatic siphon to the constructed wetlands.

The system will be equipped with an emergency overflow weir that will function and discharge any flows in excess of the 40 cfs design flow rate back into the existing 48” Rowland Trunk Sewer for conveyance into the new HBIS (if excess capacity exists) or routed around the treatment wetland facility for direct discharge to Harbor Brook via the facility outlet pipe.

3.2.2 Hydraulic Modeling

To assess the potential impacts the grit and floatables facility and associated diversion structures would have on the capacity of the upstream sewer system under high flows, CHA developed two EPA SWMM models (version 5.0) for impacted parts of the system. Both models extended from the manhole at the intersection of Bellevue Avenue and Upland Road to the existing interceptor sewer and the proposed treatment wetlands. The first model was an existing conditions model which was used to determine the depth of flow in the sewer system under the existing condition with the newly constructed HBIS. The second model was a proposed conditions model which includes the design prototype unit and associated diversion structures.

Figure 6 shows the system hydraulic gradeline in the existing sewer system from the 1 year, 2 hour storm event. The 48-inch pipe is flowing approximately half full and the upstream 24-inch pipe, between Bellevue Avenue and West Onondaga Street, is flowing full but the system is not surcharged.

Figure 6 also shows the system hydraulic gradeline for the 1 year, 2 hour storm event with the inline design prototype. The results indicated the 48″ pipe is surcharged to Elevation 411.3 (NAVD 88) at the West Onondaga Street manhole which is above the 2 existing service laterals. Therefore, it is recommended that these two services be converted to grinder pumps to protect the buildings from surcharging. This is based on a limited SWMM model completed for the Basis of Design report. Brown & Caldwell will run the full CSO 018 model with the addition of the inline Storm King unit to verify these hydraulic gradeline elevations during final design.

3.3 Constructed Wetlands Pilot Treatment System

3.3.1 General Wetlands Description

3.3.1.1 Target Flows

The intent of the constructed pilot treatment wetland is to capture and treat the CSO 018 discharge resulting from up to the 1-year, 2-hour storm event. Flows in excess of the 40 cfs peak flow associated with the design storm will discharge from the grit and floatables facility through an overflow weir, back to the 48″ Rowland Trunk Sewer for conveyance into the new HBIS (if excess capacity exists) or routed around the treatment wetland facility for direct discharge to Harbor Brook via the facility outlet pipe.

Due to the nature of the open wetland system, CSO volumes (from longer duration storms) in excess of the design storm volume can be accepted; however, treatment performance will be variable from event to event, with higher removal efficiencies during shorter duration storm events, and lower efficiencies during longer duration storm events due to greater dilution from rainfall. During extreme storm events, manually operated valves will allow flexibility in directing flows. The options that will be considered are allowing excess flow to travel through the wetland or bypassing flow around the wetland if required to maintain the integrity of the wetland plantings and berms.

3.3.1.2 Wetland Performance Objectives

As stated previously, the goal of the constructed treatment wetland is to sufficiently reduce contaminant levels in the CSO 018 flow resulting from the 1 year, 2 hour storm event. Since flows will be episodic with higher and lower flows over a 24 hr period, the discharge quality will be somewhat variable but on average will achieve the goal of improving the CSO water quality. The pilot testing program will define the actual treatment efficiency of the wetland system and will help determine modifications required, if any, to improve the performance.

As previously presented in the Project Definition Report, a summary of average annual contaminant reductions that are expected for the wetland treatment system and the reduced load to Harbor Brook is presented in Table 3-1. These data do not incorporate the addition of the grit and floatables removal system. The removal of grit and floatables prior to the constructed treatment wetlands will contribute to optimal performance and lead to better overall water quality discharged to Harbor Brook, and it will minimize the maintenance required for the treatment wetlands to achieve removal efficiencies as shown in Table 3-1.

TABLE 3-1
Potential Contaminant Reductions to Harbor Brook from the Proposed CSO 018 Treatment Wetland

Constituent	Inflow Concentration (mg/L)[1]	Annual Average Reduction Range (%)[2]	Annual Average Outflow Concentration Range (mg/L)	Annual Load Reduction (Tons/yr)[3]
BOD_5	30.38	50 – 80	6 – 15	1.1 – 1.7
TSS	100.25	50 – 90	10 – 50	3.5 – 6.3
TKN[4]	4.14	20 – 40[5]	2.5 – 3.3	0.06 – 0.11
P	0.78	20 – 40[5]	0.5 – 0.6	0.013 – 0.020
Fecal Coliform	430,000	3 orders of magnitude	430	
Total Load Reduction				4.7 – 9.1[6]

Notes:

[1] Based on SUNY ESF report “Creating Stormwater Treatment Wetlands for Harbor Brook, Syracuse, New York: An Urban Ecosystem Educational Partnership – Part II of the CNY Watershed Project, Smardon and Wu

[2] Annual average concentration reductions are based on literature including the North American Wetland database, USEPA (1996), Treatment Wetland – Second Edition, Kadlec and Wallace (2009), and experience by CH2M HILL treatment wetland technologists.

[3] Based on 18.6 MG/yr CSO 018 discharge flow

[4] TKN = Total Kjeldahl Nitrogen

[5] Higher reductions may be achieved during warmer temperatures (i.e., summer season) of up to 90% depending on flow rate and concentration

[6] Sum of BOD_5, TSS, TKN, and P loading values

3.3.2 Seasonal Effectiveness

Seasonal effectiveness of constructed wetland systems is well documented in Kadlec and Wallace (for reference, see footnote 2 of Table 3-1). Each constituent has a rate constant (theta) value assigned to it that indicates the degree to which the fluctuation in water temperature will affect the removal efficiency. For example, total suspended solids, BOD_5 and total phosphorus reduction are temperature independent and have theta values of 1. In other words, performance in summer and winter is expected to remain unchanged on an average seasonal basis. Nitrogen reduction is very dependent on temperature with a theta value of 1.04, and as the temperature falls, nitrogen reduction becomes less efficient. When the water temperature falls below about 40^{O}F, nitrification and denitrification are reduced to close to zero.

Wetlands for water quality improvement of wastewater flows have been documented in North America since the early 1900s. Examples of northern wetlands with starting dates include: Lexington, Massachusetts (1912), Brillion Marsh, Wisconsin (1923), and Cootes Paradise, Hamilton, Ontario (1919). Wetlands for treating leachate and wastewater have been reported on in Alaska, Yukon, and Northwest Territories from the mid-1960s on. CSO flows have been treated in Europe since the mid 1980s.

3.3.3 Proposed Types of Constructed Wetland Cells

Three (3) types of wetland cells have been selected for inclusion in this full scale pilot project to determine the optimal CSO treatment potential and configuration (in series, in parallel, and in series/parallel). These include:

- Floating Wetland Island (FWI)
- Vertical Down Flow (VDF)
- Surface Flow (SF) wetlands

Flow control structures will be configured to allow discharge from CSO 018 to enter each wetland cell directly and then be discharged directly to Harbor Brook (parallel operation). In addition, the wetlands will be able to operate in series, flowing from the FWI to the VDF and then finally to the SF cell or in a combination of parallel and series with flow discharge from the FWI being split between the VDF and the SF wetlands before combining and discharging to Harbor Brook. A summary describing each wetland component is presented in the Table 3-2. A brief description of each wetland type follows.

TABLE 3-2
Wetland Treatment Components

Component	FWI	VDF	SF
Area (ft^2)	12,217	10,562	11,012
Normal Depth (NWL) (ft)	1	0	0.5
Max Event Depth (EWL) (ft)	4.0	1.5	1.5
Side slopes	3:1	3:1	3:1

3.3.3.1 Floating Wetland Island

The Floating Wetland Island (FWI) is a man-made floating island of wetland vegetation with roots that extend down into the water column below the island mat. The use of FWI for domestic wastewater treatment is a relatively recent application of a process that has been used in the mining industry for many years. It is somewhat similar to the floating aquatic vegetation type of wetland technology that typically used duckweed or water hyacinth plants, which naturally have the leaves floating on the water surface, to vegetate the wetland. While these latter plants needed to be harvested to remove the contaminants, the FWI vegetation does not need to be removed in order to provide water quality improvement. Native species will be used for FWI vegetation.

This cell will be drained to a low water elevation of about 1 foot of water depth between CSO events and will fill to about 5 feet of water depth before overtopping to the next cell. This expected changing water level is another good reason for using this type of wetland for this application; the cell can provide a high storage volume for storm flows, but plants will not become flooded for long periods of time as they would if planted into the wetland bottom soils.

The FWI cell will have greater diversity of vegetation, since the depth of water over the root portion of the plants will be consistently low, with the roots themselves always submerged. The combination of open water and diverse plant species will provide pleasing aesthetics and high habitat value but low mosquito productivity when compared with a natural wetland, since mosquito predators will be maintained in this environment.

3.3.3.2 Vertical Down Flow Wetland

The Vertical Down Flow (VDF) wetland cell will have water entering either directly from CSO 018 or from the FWI cell. CSO water will be dosed into Cell 2 from Cell 1 using an automated control valve to the top of the wetland through riser pipes onto splash pads that distribute the flow across the wetland surface. When flow is added directly to Cell 2 from the grit/floatables removal system in the parallel flow mode, the flow will be added continuously to the gravel bed. The water will percolate down through the wetland sand and gravel bed, where the water will be collected in a perforated header piping system and then directed to either the Surface Flow Wetland or Harbor Brook. The VDF wetland will be dosed at a rate of +/- 55,000 gallons per dose. Once the initial dose has run through the gravel and discharged through the under drain, the cell will be dosed again. This process will continue until the water volume in the FWI (Cell 1) returns to its normal water level (NWL) of 396.50 (NAVD 88).

The VDF wetland cell is expected to have a more robust range of vegetation, since this cell will be flooded and drained regularly. Native species such as cattail and bulrush are the most likely candidate species for planting.

Benefits of VDF cells are that there is no open water and therefore no mosquito productivity, and there is limited CSO water exposure potential to the public.

3.3.3.3 Surface Flow Wetland

The Surface Flow (SF) wetland most closely resembles a natural wetland, and is also generally the lowest cost per unit area to build and maintain. It will have a vegetated shelf that will be about one-half to one foot deep under dry-weather water level conditions and three feet deep water areas (deep zones) that will help with redistributing flow to reduce the potential for short-circuiting. They will provide re-aeration, as well as a refuge for wildlife. The SF cell will have the potential for increased water depth for greater CSO water storage and treatment prior to overflowing to Harbor Brook. The SF wetland outfall is a 30-inch pipe with an invert of 392.5 (NAVD 88). Stop logs in the outlet structure will set the discharge elevation at 393.00 (NAVD 88) allowing 6 inches of standing water within the wetland.

The SF wetland with constant standing water and regular flooding will also require a robust plant, but will likely be most favorable for native species such as cattail and bulrush. Volunteer

Phragmites from seeds carried in by wind and water will tend to have a more difficult time germinating and becoming established in standing water.

As with the FWI, the combination of open water and plantings will provide high habitat value but low mosquito productivity when compared with a natural wetland, since mosquito predators will be maintained in this environment.

Benefits of SF wetlands are that it provides high storage volume to contain CSO storm flows, it is aesthetically pleasing with open water and wetland vegetation, it has low mosquito productivity due to high predator populations, and the relative cost compared to the other wetlands is low.

3.3.4 Wetlands Hydraulic Modeling

To assess the hydraulic capacity and performance of the treatment wetlands system for the 1 year, 2 hour storm event, a SWMM (EPA SWMM version 5.0) model was developed of the wetlands and the associated hydraulic control structures. The wetlands SWMM extends from the outlet of the grit and floatables removal system and through the treatment wetlands where it discharges into the relocated stream at the east end of the wetlands. The model includes all of the wetland treatment cells (floating wetlands, vertical down-flow, and surface flow), culverts, manholes, gates, valves, diversion structures, and valve control rules required to operate the treatment wetlands. Using the SWMM, three hydraulic operational flow scenarios were modeled; these include the Series, Series-Parallel and Parallel Flow scenarios.

Due to EPA SWMM limitations, the infiltration/underdrain flow response resulting from the dosing of Cell 2 was modeled in a separate model using the Low Impact Development functionality built into EPA SWMM. This modeled response was then replicated in the wetlands model using a custom drainage rating curve. A hydraulic conductivity of 10 in/hr was used for this part of the analysis. While the actual hydraulic conductivity is expected to be slightly higher, this rate is conservative from a capacity perspective and allows for some loss of conductivity over the life of the wetland.

The following sections provide a brief summary of how the treatment wetlands are expected to function under each scenario.

3.3.4.1 Series Flow Scenario

Under the Series Flow scenario the model shows that Cell 1 can contain the entire 700,000 gallon (93,600 ft^3) 1 year, 2 hour storm event from the CSO without overtopping the Cell 1 embankments. Under this scenario, the 1 year, 2 hour storm event is held in Cell 1 and dosed by gravity into Cell 2 using a dose volume of 55,000 gallons/dose (7,350 ft^3/dose) which is equivalent to a depth of 6 inches over the surface area of Cell 2. After Cell 2 is dosed, the water is allowed to infiltrate and drain completely before the cell is dosed again. It takes about 6 hours for the water to infiltrate into the Cell 2 media and pass though Cell 3 and for Cell 3 to return back to the normal water level of 393.0 feet (NAVD 88). This dosing and infiltrating cycle occurs 12 times following the 1 year, 2 hour storm event. Under this scenario it takes about 88 hours for the design storm to pass though the treatment wetlands and for the wetlands to return to the initial condition water levels. The volume hydrographs in each of the cells under this scenario are included in Figure 7.

3.3.4.2 Series-Parallel Flow Scenario

Under the Series-Parallel Flow Scenario the entire 1 year, 2 hour storm event is sent directly into Cell 1 and contained. The “top half” of the Cell 1 storage is sent to Cell 3 and allowed to drain into Harbor Brook before the dosing of Cell 2 is started. In order for the Cell 2 infiltration to function as designed, Cell 3 needs to be at or below elevation 393.1 feet (NAVD 88) before Cell 2 is dosed. Cell 2 is dosed at a rate of 55,000 gallons/dose. The parallel portions of this treatment scenario are run one after the other so that the water going from Cell 1 to Cell 3 does not prevent Cell 2 from functioning properly. Under this scenario it takes about 58 hours for the design storm to pass though the treatment wetlands and for the wetlands to return to the initial condition water levels. The volume hydrographs in each of the cells under this scenario are included in Figure 8.

3.3.4.3 Parallel Flow Scenario

Under the Parallel Flow Scenario, one third of the 700,000 gallon (93,600 ft^3) 1 year, 2 hour storm event is sent directly to each of the wetlands cells. The flow is split in flow diversion structures #6 and #8. The volume sent to each cell ranges from 180,000 to 248,000 gallons (24,000 to 33,400 ft^3). Discharges from each wetland cell are directed via flow control structures to a common structure to a single pipe discharge to Harbor Brook. Under this scenario it takes about 14 hours for the design storm to pass though the treatment wetlands and for the wetlands to return to the initial condition water levels. The volume hydrographs in each of the cells under this scenario are included in Figure 9.

3.3.4.4 Potential Impacts of High Water Levels in Harbor Brook

The impact of high water levels in Harbor Brook was considered while modeling the hydraulics and operations of the treatment wetlands, but not explicitly modeled. Under each of the operational scenarios modeled, the primary factor that controls how long it takes the wetlands to return back to the initial condition water levels is the water level in Cell 3. When water levels are below 393.0 feet (NAVD 88) in Harbor Brook they have little or no effect on the time it takes for flows to pass though the treatment wetlands. When water levels in Harbor Brook (and as a result in Cell 3) are above 393.0 feet (NAVD 88), the dosing system does not activate. This means that under the Series and Series-Parallel scenarios the dosing portion of the treatment doesn’t begin until the water levels in Harbor Brook have receded to below 393.0 feet (NAVD 88). Under the Parallel scenario regardless of the water levels in Harbor Brook the wetland inflows are allowed to flow freely; the water levels in Cells 2 and 3 will recede at approximately the same rate as the water levels in Harbor Brook.

A rising Harbor Brook will be isolated from the constructed wetlands by an inline check valve on the wetland discharge pipe. As water levels in the Velasko Road Detention Basin rise above the wetland controlled berm spillways, stormwater flows will enter and flood the wetland facility.

3.3.5 Other Considerations

3.3.5.1 Water Table Elevation

As part of the geotechnical investigation, six piezometers were installed across the site to monitor the water table elevation during the pilot study monitoring period (see Figure 1 of Appendix A “well locations”and Plan Sheet C-1001). Table 3-2 shows the recorded water table elevations for measurements taken to date. It is expected that the level will fluctuate depending on season, rainfall, frost, etc.

TABLE 3-3
Groundwater monitoring data

Date	Well #	Boring #	Ground Elevation	Surface to Groundwater (ft)	Ground water Elevation
1.20.2011	1	B-15*	396.0	5.31’	390.2
	2	B-9	395.5	3.50’	392.8
	3	B-11	396.3	3.15’	392.7
	4	B-5	396.8	3.81’	391.7
	5	B-2	395.8	1.30’	394.7
	6	B-10	395.5	1.49’	395.3
4.8.2011	1	B-15	396.0	1.38’	394.12
	2	B-9	395.5	2.07’	394.23
	3	B-11	396.3	1.84’	393.96
	4	B-5	396.8	2.74’	392.76
	5	B-2	395.8	1.21’	394.79
	6	B-10	395.5	1.16’	395.64
4.29.2011	1	B-15	396.0	0.46’	395.04
	2	B-9	395.5	1.1’	395.20
	3	B-11	396.3	0.45’	395.35
	4	B-5	396.8	0.65’	394.85
	5	B-2	395.8	0.02’	395.98
	6	B-10	395.5	0.55’	397.35

* Refers to the boring/well locations indicated on Boring Location Plan.

3.3.5.2 Discharge Location to Harbor Brook

In order to maintain good flow through the wetland system without pumping, a reasonable grade is required. The proposed discharge location is to an existing drainage ditch that discharges to Harbor Brook just up-gradient of the flow control structure of the Velasko Road Detention Basin. Note that the water level of Harbor Brook under base flow conditions has averaged about 392.3 NGVD 29 (approximately 391.7 NAVD 88) feet based on flow and level measurements recorded by US Geological Survey since about 1998 when modifications were made to the outlet structure. This establishes the surface flow wetland bottom elevation.

The normal water elevation in the surface flow (Cell 3) wetland will be 393.0 NAVD 88 and the outfall to Harbor Brook will be set at this elevation. As noted above, water levels in Harbor Brook will impact the discharge rate from the constructed wetland facility. However, since the proposed wetlands will accommodate the CSO volume from the design storm, treatment will be delayed until the storm runoff in Harbor Brook recedes below 393.0 (NAVD 88).

Discharge to Harbor Brook will be through 36-inch HDPE piping combined from the discharge from Cells 1, 2, and 3 and the bypass piping north of the proposed wetlands. The flow rate will be metered by a pressure transducer or radar flow meter and pass through an inline check valve prior to being discharged through an outfall structure to Harbor Brook.

3.3.5.3 Berms and Maximum Water Depths

In order to accommodate the CSO volume associated with the 1 year, 2 hour storm event, and provide 1 foot of freeboard, the berm height required around Cell 1 – Floating Wetland Island is Elev. 402.00 (NAVD 88). Berm heights associated with the Cell 2 - Vertical Down Flow Wetland and Cell 3 – Surface Wetland are dictated by the desire to isolate the treatment wetlands from the stormwater within the Velasko Road Detention Basin area. Based on the preliminary FEMA flood study dated June 2008 (which provides information related to a maximum 100-year storm event), the 10 year storm event would result in a water elevation of +/-399.5 (NAVD 88). As such, the lower wetland cells would be protected for storm events smaller than the 10 year storm. The berms have been designed with emergency spillways to allow w the free flow of flood waters into and out of the wetland cells. During storm events where the water storage required in the Velasko Road Detention Basin exceeds the spillway elevation of the lower wetland cells (Elev. 396.00 NAVD 88), the wetland cells will be flooded with stormwater. As the storage volume recedes, storm water will be released through the emergency spillway until it reaches the spillway elevation. Water in the cells below the spillway elevation will be stored until the Velasko Road Detention Basin recedes to an elevation which allows the remaining water in the cells to flow through the wetlands to the Harbor Book outfall.

3.3.5.4 Geotechnical Recommendations

The technical memo in Appendix A recommends that, for larger structures and loadings, the layer of peat be removed from below the structures and replaced with structural fill. It also recommends that depending on the bury depth of various pipes, restrained joints be considered to provide additional protection from joint separation.

The wetland cell berms should be constructed with silty clay and clayey silt soils, classified as MH or CL in the Unified Soil Classification System, with no sizes larger than 3 inches and at least 75 percent by dry weight of fines passing the No. 200 standard sieve size. The plasticity index of the soil should be at least 15. The coefficient of permeability of the soil should be less than 1×10^{-5} centimeters per second when compacted to a minimum of 90 percent of standard Proctor maximum dry density at a moisture content wet of optimum. Note that these soils are not available on-site and will need to be imported. There is also peat at the location of the wetlands and it is recommended that a stabilization fabric (Mirafi 600x, or equal) be installed on top of the native soil. Removal of the peat at the location of the berms will not be required.

3.3.5.5 Cell Lining

Cells 1 and 2 will have HDPE liners as they will be required for these types of systems, and since these cells will not benefit from groundwater to keep plants viable during drought conditions. If Cell 3 remains unlined, it will benefit from shallow groundwater as a source of water for the deep zones. This will provide shallow groundwater for Cell 3 and will be used for watering Cells 1 and 2 to keep all plants viable during drought conditions. As is typical for wetland systems that are unlined, the bottom of the wetland will self seal over time due to sedimentation that blinds the bottom pores. Negative impact to groundwater from CSO flows is expected to be minimal; during most flow conditions, Cell 3 receives pretreated water from either Cell 1 or 2. Monitoring wells around the unlined Cell 3 will be a part of the experimental program to determine if groundwater becomes impacted by infiltration from Cell 3.

3.3.5.6 Compensatory Storage – Velasko Road Detention Basin

Since the proposed project is located within the Velasko Road Detention Basin, construction of the wetland treatment system will reduce the storage volume available in the basin. As such it will be necessary to make up that storage volume lost to the wetlands by constructing compensatory storage within the existing basin. In order to account for potential back to back storm events, compensatory storage will be required for the berm volumes plus the storage volume in the wetland cells. Based on the proposed wetland grading plan, the berm volume is 2.07 Acre-Feet (AF) and the cell volumes are 2.55 AF (Cell 1), 1.63 AF (Cell 2), and 0.63 AF (Cell 3). The total required compensatory storage is 6.88 AF.

Figure 10 shows areas within the basin where the required compensatory storage will be provided. The current plan is to stay within County owned property and not impact existing wetlands on site. A topographic survey of the area was underway during the preparation of this report. Based on the County LiDAR mapping the areas identified are estimated to provide up to 7.95 Acre Feet for storage.

3.3.5.7 Wetland Level Control

Flow control through the constructed wetlands will consist of a series of flow diversion structures (FDS) combined with pressure transducers located in each wetland cell. Please refer to the Basis-of-Design drawings for the locations of the diversion structures within the constructed wetlands system.

The constructed wetland treatment system will operate as follows: When the system is operating in series, the pressure transducer in FDS #11 will activate (open) a 12-inch butterfly valve when the desired elevation is reached such that wetland Cell 2 will be dosed approximately 55,000 gallons of water (6 inch depth equivalent over the area of Cell 2). The valve will close based on a predetermined duration of discharge. A second pressure transducer in FDS #13 will determine when wetland Cell 3 can accept additional flow and will not allow the valve to open until the predetermined water level has been reached. The dosing process will continue until the water level within Cell 1 drops below the valve-off elevation indicated by the pressure transducer. A copy of the equipment cut sheets for the pressure transducer and butterfly valve have been included as Appendix E.

3.3.5.8 Site Security

The grit and floatables removal facility and the constructed pilot wetlands area will each be secured by a fence to prevent trespass and access to the control valves and monitoring equipment. Gates will be provided at appropriate locations to allow access for operation and maintenance of the facility. A chain link fence is assumed for the Basis of Design, but the final fence selection will occur during final design.

SECTION 4

Permitting

Investigations for State and federally regulated environmental resources were conducted at the project site, identifying that the project area contains federally regulated wetlands and a state and federally regulated stream (Harbor Brook). A copy of Wetland Delineation Report is included as Appendix F. It was also determined that the project site is within a stormwater management basin used to protect downstream residents from flooding up to the 25-year storm event. The pilot project will result in the relocation of the existing CSO 18 outfall to Harbor Brook, allowing the majority of the flow from this CSO to enter the pilot wetlands for treatment before discharging to Harbor Brook. Construction of the wetland pilot treatment system will also require the relocation of a ditch with wetland vegetation. As a result, the following permits and approvals will be required:

- State Pollutant Discharge Elimination System (SPDES) permit modification from NYS Department of Environmental Conservation (NYSDEC) for CSO 18 to address relocation and treatment.
- State Environmental Quality Review (SEQR). The project will require review under the State Environmental Quality Review Act (SEQR). It has been identified as a Type 1 action and is undergoing coordinated review with the involved agencies. Onondaga County intends to serve as Lead Agency. A full environmental assessment form (FEAF) has been prepared and will provide the basis for a determination of significance. Since the project is intended to improve water quality from CSO 18 and the project impacts are occurring on previously disturbed lands, it is anticipated that a Negative Declaration will be issued.
- U.S. Army Corps of Engineers (USACE) Nationwide Permit (NWP) No. 43 – Stormwater Management Facilities to relocate the outfall and impacts to the wetland ditch that will be relocated to facilitate treatment facility design.
- Article 15 Protection of Waters permit modification from NYSDEC for impacts to Harbor Brook (Class B waters) associated with the relocated outfall. It is assumed that the existing permit for the interceptor sewer project associated with the Harbor Brook watershed can be modified.
- Section 401 Water Quality Certification from NYSDEC, required in conjunction with the authorization of the NWPs and the Article 15 permit. This certification addresses the placement of clean fill and proper erosion and sedimentation controls.
- SPDES General Construction Permit for land disturbance in excess of one acre. A Stormwater Pollution Prevention Plan will be prepared and a Notice of Intent submitted to NYSDEC. Depending on how much land is disturbed at any one time, a 5-acre waiver may be required.
- Coordination with the NYS Natural Heritage Program, U.S. Fish and Wildlife Service, and NYS Office of Parks, Recreation and Historic Preservation to ensure no impacts to protected

species and cultural resources. This coordination is required as part of the general permit conditions for the Nationwide Permits, Water Quality Certification, and the Article 15 Permit.

- The placement of fill within the stormwater management basin associated with Harbor Brook will require compensatory storage. Approval for the fill and associated compensatory storage will be required from Onondaga County Department of Water Environment Protection.
- City of Syracuse curb cut permit for access road to grit and floatables facility

A Joint Application for Permit will be prepared and submitted to NYSDEC and USACE to obtain the permits identified above. Wetland impacts will include approximately 0.20 acre of wetland ditch that will be mitigated by replacement in kind.

SECTION 5

Operations, Maintenance, and Monitoring

5.1 Operations and Maintenance

The constructed wetlands pilot treatment system has been designed to minimize the operations and maintenance required to run the system. The grit and floatables system does not have any moving parts or require power. The only electrical components of the system are the pressure transducers and actuated butterfly valves located within the constructed wetland cells as well as the level sensing devices for flow measurement and automatic sampling equipment. A summary of the specific operations and maintenance required for each system is outlined below.

5.1.1 Grit and Floatables Removal System

Since there are no moving parts associated with the design prototype, operations and maintenance of the system will be relatively simple. After the unit is used to treat a wet-weather event, the equipment should be checked to make sure all residual floatables have been removed from the top screen. This can be accomplished by spraying down the screen with a high pressure hose. Floatables not removed from the screen following a rain event should be manually removed to prevent odors from building up in and around the system and maintaining an aesthetically pleasing environment.

5.1.2 Wetlands Treatment System

5.1.2.1 Operations

Design of the wetland treatment area includes a number of flow control structures with weirs and gates to direct and control flows under various flow scenarios. Gates and weirs in these structures will require adjustments as different treatment alternatives are evaluated. Gates in the flow diversion structures and manholes will be operated from the surface by a pull chain during dry weather when not in operation. The gates in manhole 5 are the only gates that may require operation under flow conditions; as such these gates will have manual gate operators and floor stands mounted on the top of the structure. Table 5-1 below identifies the various gate positions to achieve the three flow scenarios; Series, Parallel, and Series + Parallel. A summary of the various flow scenarios is included in Appendix G.

TABLE 5-1
Wetland System Diversion Gate Configurations

Gate	Series	Parallel	Series & Parallel
5A	Open	Open	Open
5B	Closed	Closed	Closed
6A	Closed	Open	Closed
7A	Closed	Closed	Open

TABLE 5-1
Wetland System Diversion Gate Configurations

Gate	Series	Parallel	Series & Parallel
8B	Closed	Open	Closed
11A	Closed	Open	Open
12 Dosing Valve	Open	Closed	Closed
13A	Open	Closed	Closed
13B	Closed	Open	Open

5.1.2.2 Make-up Flow to Wetland (Low Flow Conditions)

During prolonged periods between storm events it may be necessary to provide supplemental water to the wetlands Cells 1 and 2 to keep plants viable. Groundwater levels are anticipated to be sufficient to provide this required moisture for Cell 3 since it is expected to be unlined. The current design includes a wet well (MH # 19) which is supplied with water from the Cell 3 deep zone. During low CSO flows to the wetlands, a temporary pump will be set up to pump water into the wetland Cell 1 and Cell 2 from the Cell 3 deep zone, via MH #19. As groundwater data is collected through this spring and through the pilot study, the design will be modified accordingly. As a secondary source of water, the temporary pump could be set up to draw water from Harbor Brook or from the stormwater box culvert adjacent to Velasko Road. Water that is pumped into the constructed wetlands will flow through the system back to Harbor Brook.

5.1.2.3 Vector Control

Natural wetlands are subject to wide variations in water level as flood waters inundate a wetland area and recede, and this variation allows mosquito populations to expand rapidly as the fast-growing mosquitoes mature before populations of predator species are established. In contrast, Cells 1 and 3 will be designed to maintain a minimum water level, so that the populations of aquatic predators which feed upon mosquito larvae (including minnows and aquatic insects) are sustained. Cell 2 will not produce mosquitoes since there will be no standing water. Thus, mosquito populations are not expected to increase as a result of the project, but if necessary, additional measures such as erecting bat roosting boxes and bird nesting boxes (particularly for swallows) will also help to keep the mosquito population lower. Mosquito specific larvacides can be used for mosquito control if required. This addresses the problem before they emerge.

5.1.2.4 Nuisance Wildlife Control

While one intention of creating wetlands is to encourage wildlife use, overuse of the wetland by certain species can cause damage that can be costly to repair or take a long time to naturally regenerate. During the start-up of wetland systems, the young wetland plants are vulnerable to grazing by waterfowl. Controls, which may include overhead filament wires and bird scare tape and perimeter snow fencing, may be required. Once the vegetation is established, concern is shifted to nuisance wildlife such as muskrats that can completely eat out wetlands if they do not have natural predators to keep their populations under control. They can also negatively impact the integrity of the berms. Construction of a nuisance wildlife exclusion fence around the perimeter of the wetland at the start of the project is the best way to keep nuisance wildlife from migrating into the wetland.

5.1.2.5 Odor Control

Constructed treatment wetlands, once fully vegetated, are designed to minimize odor potential. Odors will be addressed by maintaining an appropriate water level in the wetlands and keeping the cells flooded with 6″ to 1′ of water above the anoxic wetland soils that are a critical component for retaining bound metals and phosphorous and for reducing the nitrite and nitrate concentrations through denitrification. Wetland systems with odorous conditions are rare, and these are typically systems that are not properly operated or are poorly designed. With proper operation, odor problems from the grit and floatables and wetland are not anticipated. If there are fugitive odors, the intent of the pilot program will be to determine the source and solution.

5.2 Monitoring

The State University of New York, College of Environmental Science and Forestry (SUNY ESF) under the guidance of CH2M HILL will be responsible for monitoring the system during the pilot phase. The monitoring will include sampling of stormwater quality into and out of the grit and floatables systems as well as each wetland cell during at least three CSO events per season over a two year period (i.e., 24 sampling events). The data will be compiled and evaluated and then reports prepared summarizing the data and the system performance. SUNY ESF will also visually monitor the berms to determine if there are obvious integrity issues, record vegetation health and density, inventory wildlife seen on the site, measure water levels in each cell, and other activities. They will be on the site at least once per week for the duration of the monitoring program.

Wetland sampling and flow metering points will be located throughout the constructed wetland cells as well as the bypass manholes such that a complete mass balance can be performed on the system. Table 5-2 identifies flow metering and sampling locations to monitor the three flow scenarios; Series, Parallel, and Series + Parallel.

Grab samples will be collected by SUNY ESF in addition to samples taken by automatic sampling units. The locations of the automatic sampling units will be shown on the final design drawings. Automatic sampling protocols will be determined as part of the final design. Flow metering will be accomplished by in-pipe flow meters that will be capable of being transferred to different locations within the constructed wetlands based on the flow scenario operation.

TABLE 5-2
Sampling and Flow Metering Locations

Locations	Series	Parallel	Series & Parallel
Sampling (structures)	MH’s: 5, 11, 13, 18	MH’s: 5, 11, 13, 18, 19	MH’s: 5, 11, 13, 18, 19
Flow Metering	MH’s: 5, 18	MH’s: 5, 6, 8, 10, 18	MH’s: 5, 7, 8, 11, 18

In addition, as required in the County's Proposed Modifications to the Ambient Monitoring Program Work Plan (AMP) dated May 14, 2010, a water level sensor will be installed in the outlet pipe discharge to Harbor Brook. This sensor will measure water level and CSO activation duration resulting from the combined flows discharged from the constructed treatment wetland facility and flows routed from the existing CSO 018 structure.

SECTION 6

Project Schedule

The following schedule in Table 6-1 was set for the project in order to begin the pilot program as quickly as possible. Several work items such as permit review and pre-ordering equipment and plants could delay or accelerate this schedule. In addition, phasing of work to allow for earlier construction start dates is under consideration.

TABLE 6-1
Proposed Project Schedule

Work Item	Start	Completion
Basis of Design Report (30 - 50%)	February 2011	May 2011
Final Design (50 - 90%)	May 2011	June 2011
Permit Submittal and Review	July 2011	August 2011
NYSDEC Public Notice and Permit Issue	August 2011	September 2011
Construction Tender Documents	July 2011	July 2011
Procurement (Bidding)	August 2011	September 2011
Construction	September 2011	November 2011
Planting	Spring 2012	Spring 2012
Evaluation	2012	2015

SECTION 7

Project Cost Opinion

A conceptual planning-level construction cost opinion was prepared for the full scale constructed wetland pilot treatment system for preliminary budget planning and is presented in Table 7-1.

TABLE 7-1
Construction Cost Opinion

Item	Cost Basis	Totals
Grit and Floatables Removal System		$1,786,000
Grit & Floatables and Wetlands Electrical		$89,000
Wetland Cells		
Cell 1 FWI		$540,000
Cell 2 VDF		$417,000
Cell 3 SF		$205,000
Subtotal		$3,037,000
Contractor Overhead (10%)	$3,037,000	$304,000
		$3,341,000
Profit (5%)	$3,341,000	$168,000
		$3,509,000
Mobilization/Bonds/Insurances (5%)	$3,509,000	$176,000
		$3,685,000
Contingency (20%)	$3,685,000	$737,000
		$4,422,000
Escalation (to mid-point of construction) (7.9%)	$4,422,000	$350,000
		$4,772,000
Local Adjustment Factor (96.5%)	$4,772,000	$4,605,000
Market Adjustment Factor (5%)	$4,605,000	$4,836,000
Total Construction Cost Opinion		**$4,836,000**
Engineering, Legal and Administrative Costs		
Permitting (1%)	$4,836,000	$49,000
Engineering (20%)	$4,836,000	$968,000

TABLE 7-1
Construction Cost Opinion

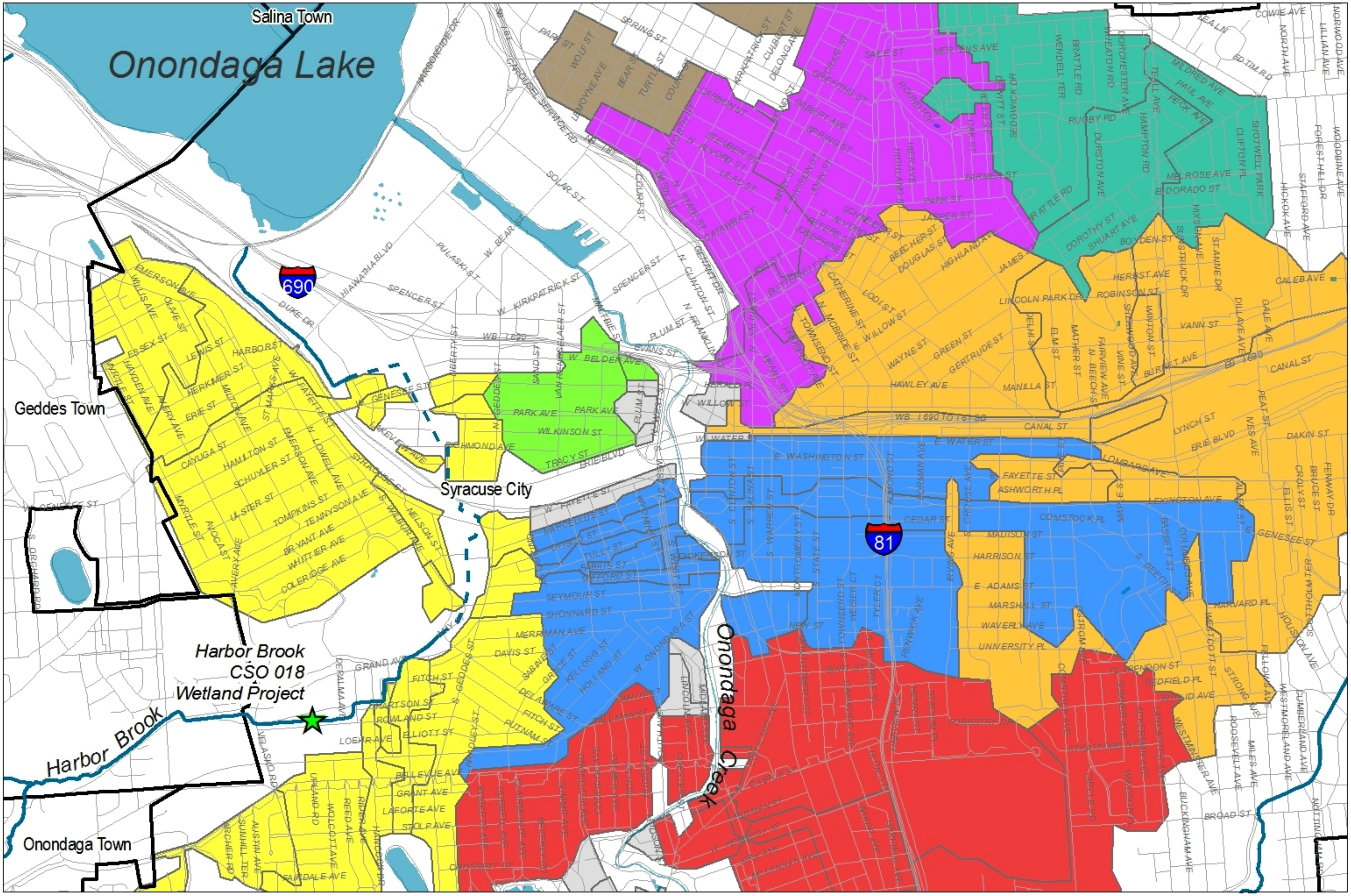
Item	Cost Basis	Totals
Services During Construction (4%)	$4,836,000	$194,000
Startup Services (1%)	$4,836,000	$49,000
Legal and Admin (5%)	$4,836,000	$242,000
Subtotal		$1,502,000
Total Project Cost Opinion		**$6,338,000**

The cost estimates presented in this engineering report are "order-of-magnitude" (Level 3) estimates, as defined by the American National Standards Institute (ANSI) and The Association for the Advancement of Cost Engineering International (AACE International) as "approximate estimates made without detailed engineering data. It is normally expected that estimates of this type will be accurate within plus 30 percent or minus 20 percent." This range implies that there is a high probability that the final project cost will fall within the range.

A 20% contingency has been included in these cost estimates as a provision for unforeseeable, additional costs within the general bounds of the project scope; particularly where previous experience has shown that unforeseeable events that will increase costs are likely to occur. The contingency in these estimates consists of two components: 1) Bid Contingency covers the unknown costs associated with constructing a given project scope, such as adverse weather conditions, strikes by material suppliers, geotechnical unknowns, and unfavorable market conditions for a particular project scope; and 2) Scope Contingency covers scope changes that may occur during final design and implementation.

The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time of the estimates. The final cost for the project will depend on such criteria as actual labor and material costs, competitive market conditions, actual site conditions, final project scope, and other variables. As a result, the final project cost will vary from this estimate. The proximity to actual costs will depend on how close the assumptions of this estimate match final project conditions. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help assure proper project evaluation and adequate funding.

Figures

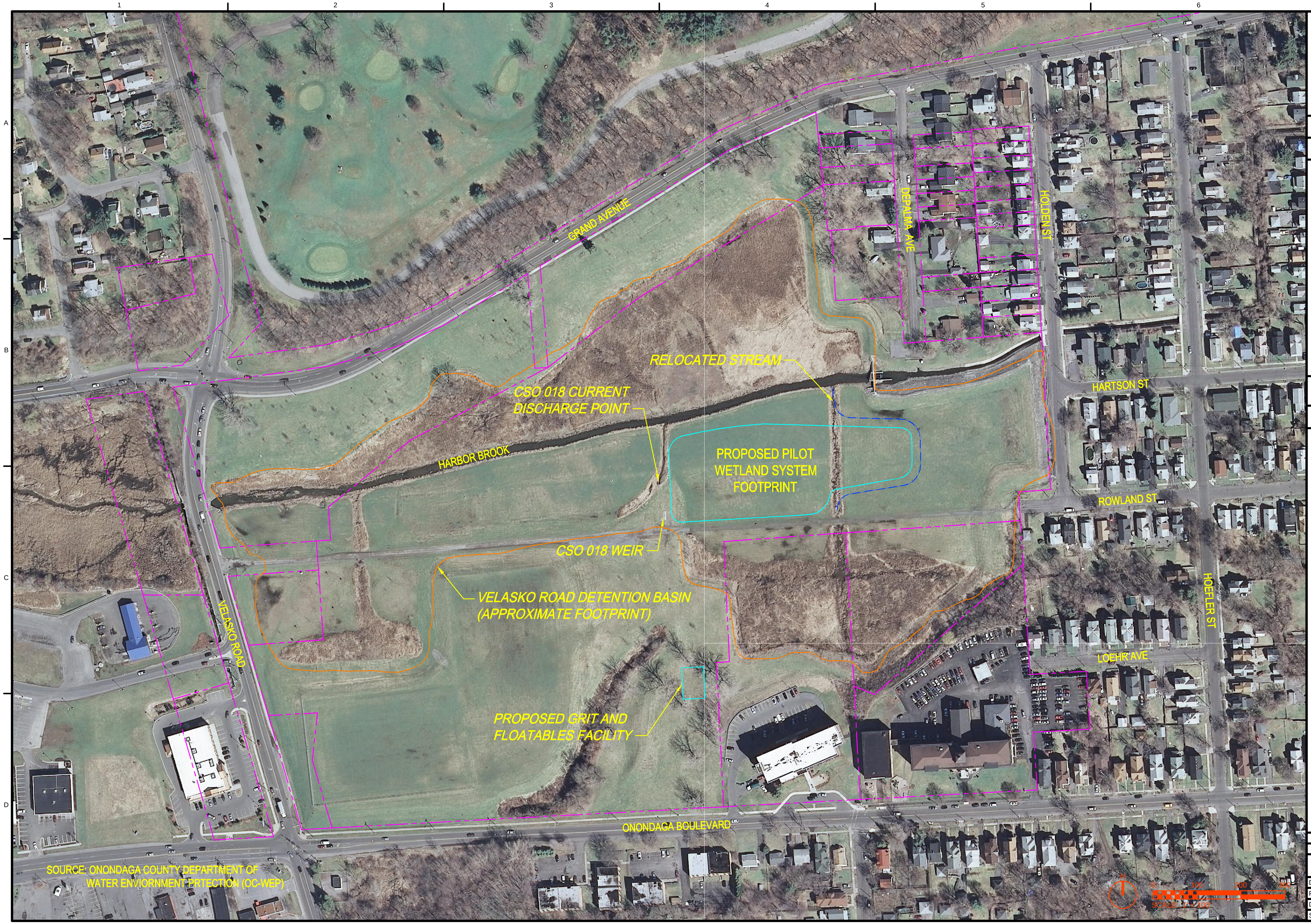


Notes:
1. Shaded areas represent CSO drainage basins
2. Data Source: Onondaga County Department of Water Environment Protection

FIGURE 1

Harbor Brook CSO Wetland Project Location

CH2MHILL



SOURCE: ONONDAGA COUNTY DEPARTMENT OF WATER ENVIORNMENT PRTECTION (OC-WEP)

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HARBOR BROOK CSO #018
CONSTRUCTED WETLANDS
CITY OF SYRACUSE
ONONDAGA COUNTY, NEW YORK

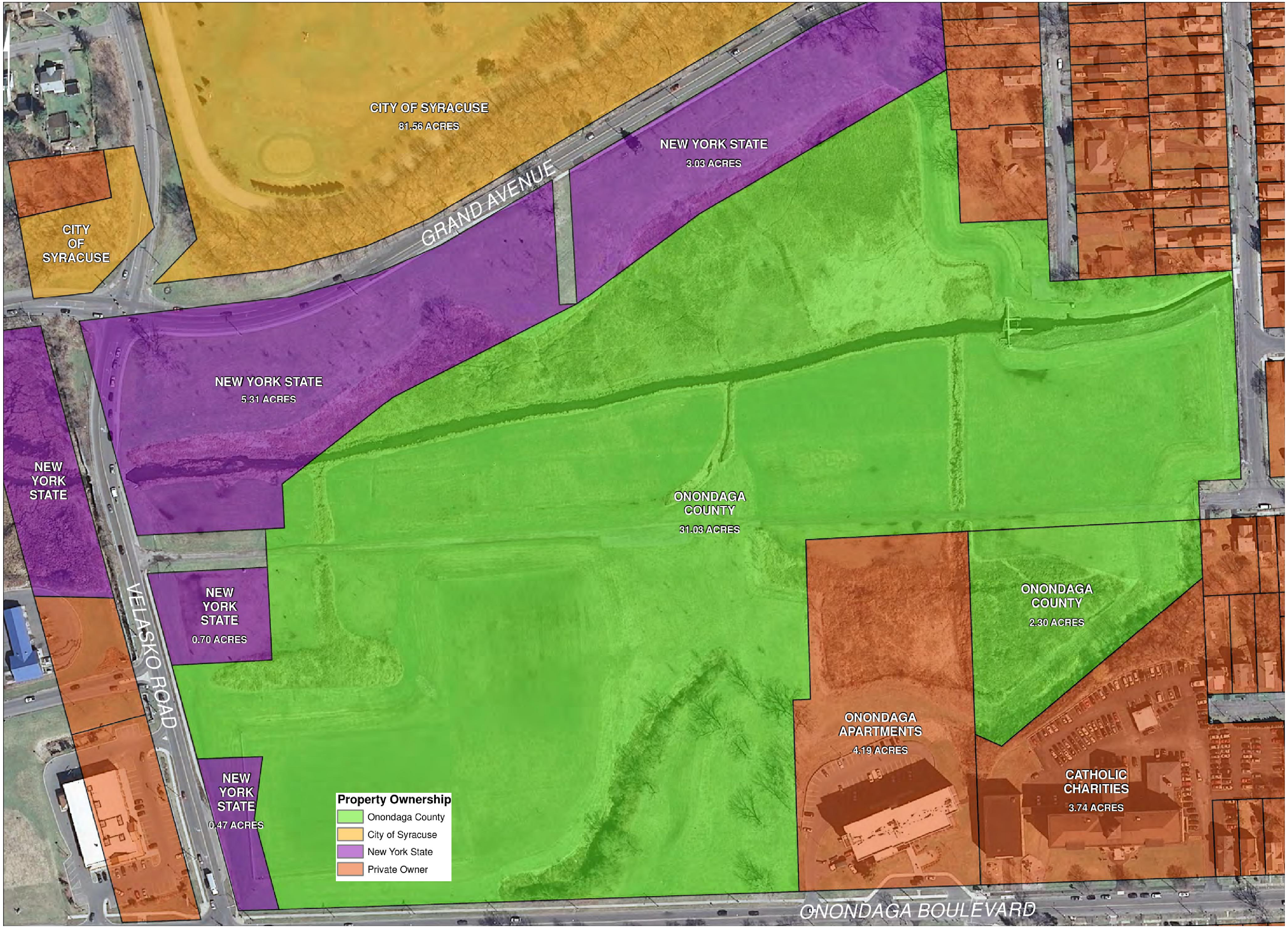
FIGURE 2
PROPOSED LOCATION OF CONSTRUCTED WETLANDS TREATMENT FACILITIES SITE

1" = 100'
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	MAY 02, 2011
PROJ	19217
DWG	FIGURE 2
SHEET	FIGURE 2

PRELIMINARY

FILENAME: FIGURE 2.dwg PLOT DATE: 5/2/2011 PLOT TIME: 2:46:59 PM



NO.	DATE	REVISION	BY	APVD
1	05/02/2011	50% SUBMISSION	KH	MEH

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CONSTRUCTED WETLANDS
CITY OF SYRACUSE
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FIGURE 3
PROPERTY OWNERSHIP

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
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DATE	MAY 02, 2011
PROJ	19217
DWG	FIGURE 3
SHEET	FIGURE 3

PRELIMINARY

FILENAME: FIGURE 3.dwg PLOT DATE: 5/2/2011 PLOT TIME: 2:47:13 PM

Both Harbor Brook and CSO 018 discharge is just off this aerial to the north.

Source:
Onondaga County Department of Water Environment Protection (OC-WEP)

FIGURE 4

Location and Boundaries of Drainage Area Tributary to CSO 018

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Storm Volume to Wetlands
For Average Year (1991)

Overflow #	Date	Storm Duration (min)	Peak Flow Rate (cfs)	Average Flow Rate (cfs)	Total Overflow Volume (gal)	26' Dia. Storm King Inline Volume to Wetlands (gal)	26' Dia. Storm King Offline Volume to Wetlands (gal)
1	1/11/1991	70.2	7.58	2.95	93,051	59,351	17,442
2	1/16/1991	375	3.70	0.52	87,516	53,816	0
3	3/2/1991	45	6.64	2.38	48,066	14,366	0
4	3/3/1991	780	7.34	1.11	390,007	356,307	0
5	3/23/1991	90	17.79	7.38	298,003	264,303	210,573
6	3/27/1991	570	10.50	0.83	212,731	179,031	0
7	4/8/1991	55.2	5.89	2.37	58,740	25,040	0
8	4/10/1991	70.2	11.74	4.25	133,967	100,267	58,357
9	4/15/1991	85.2	16.82	6.28	240,033	206,333	155,469
10	4/21/1991	334.8	9.33	3.42	513,352	479,652	279,777
11	5/6/1991	70.2	3.76	1.47	46,204	12,504	0
12	5/10/1991	105	2.94	1.42	66,766	33,066	0
13	5/17/1991	150	21.37	8.53	574,389	540,689	451,139
14	5/25/1991	85.2	13.22	5.45	208,318	174,618	123,754
15	5/26/1991	375	23.30	8.36	1,406,988	1,373,288	1,149,413
16	5/30/1991	55.2	11.41	4.12	102,027	68,327	35,373
17	6/11/1991	90	25.98	9.72	392,625	358,925	305,195
18	6/12/1991	94.8	28.75	10.86	462,189	428,489	371,894
19	6/30/1991	100.2	13.86	5.51	247,738	214,038	154,218
20	7/5/1991	124.8	40.00	14.09	789,140	755,440	680,934
21	7/7/1991	55.2	1.69	0.72	17,720	0	0
22	7/13/1991	49.8	2.20	0.96	21,483	0	0
23	7/22/1991	100.2	40.00	17.46	785,400	751,700	691,881
24	7/23/1991	25.2	2.65	0.99	11,168	0	0
25	8/3/1991	94.8	14.96	5.65	240,332	206,632	150,037
26	8/9/1991	514.8	21.94	7.79	1,801,184	1,767,484	1,460,148
27	8/20/1991	115.2	19.53	6.38	329,868	296,168	227,394
28	8/31/1991	124.8	30.73	10.81	605,506	571,806	497,300
29	9/4/1991	34.8	1.20	0.46	7,235	0	0
30	9/10/1991	75	17.11	5.88	197,996	164,296	119,521
31	9/15/1991	214.8	22.40	11.50	1,108,536	1,074,836	946,600
32	9/18/1991	90	25.55	10.00	403,995	370,295	316,565
33	9/19/1991	165	5.35	1.17	86,618	52,918	0
34	9/23/1991	10.2	0.11	0.04	172	0	0
35	9/24/1991	250.2	15.04	5.79	649,788	616,088	466,718
36	10/4/1991	19.8	2.89	1.03	9,111	0	0
37	10/5/1991	40.2	5.03	1.49	26,898	0	0
38	10/10/1991	60	0.66	0.15	4,127	0	0
39	10/15/1991	370.2	9.52	4.00	664,748	631,048	410,038
40	11/28/1991	70.2	6.27	2.39	75,249	41,549	0
41	12/3/1991	240	3.12	1.35	145,785	112,085	0
42	12/29/1991	30	0.43	0.13	1,758	0	0
				Total Volume (gal.)	**13,566,527**	**12,354,757**	**9,279,740**

Key:

🟥 Storm events that will not reach the wetlands.

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CONSTRUCTED WETLANDS
CITY OF SYRACUSE
ONONDAGA COUNTY, NEW YORK

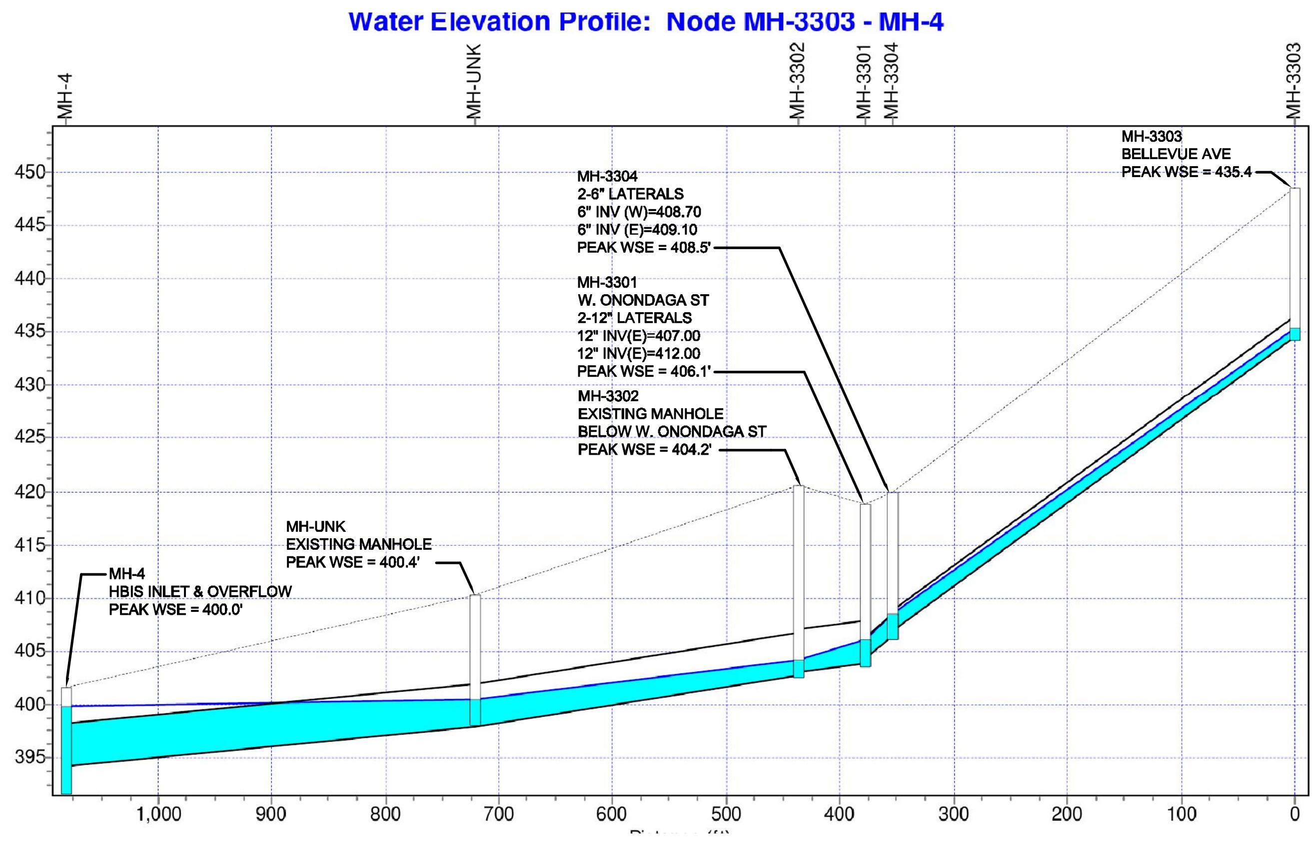
FIGURE 5
STORM VOLUME TO WETLANDS
FOR AVERAGE YEAR (1991)

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

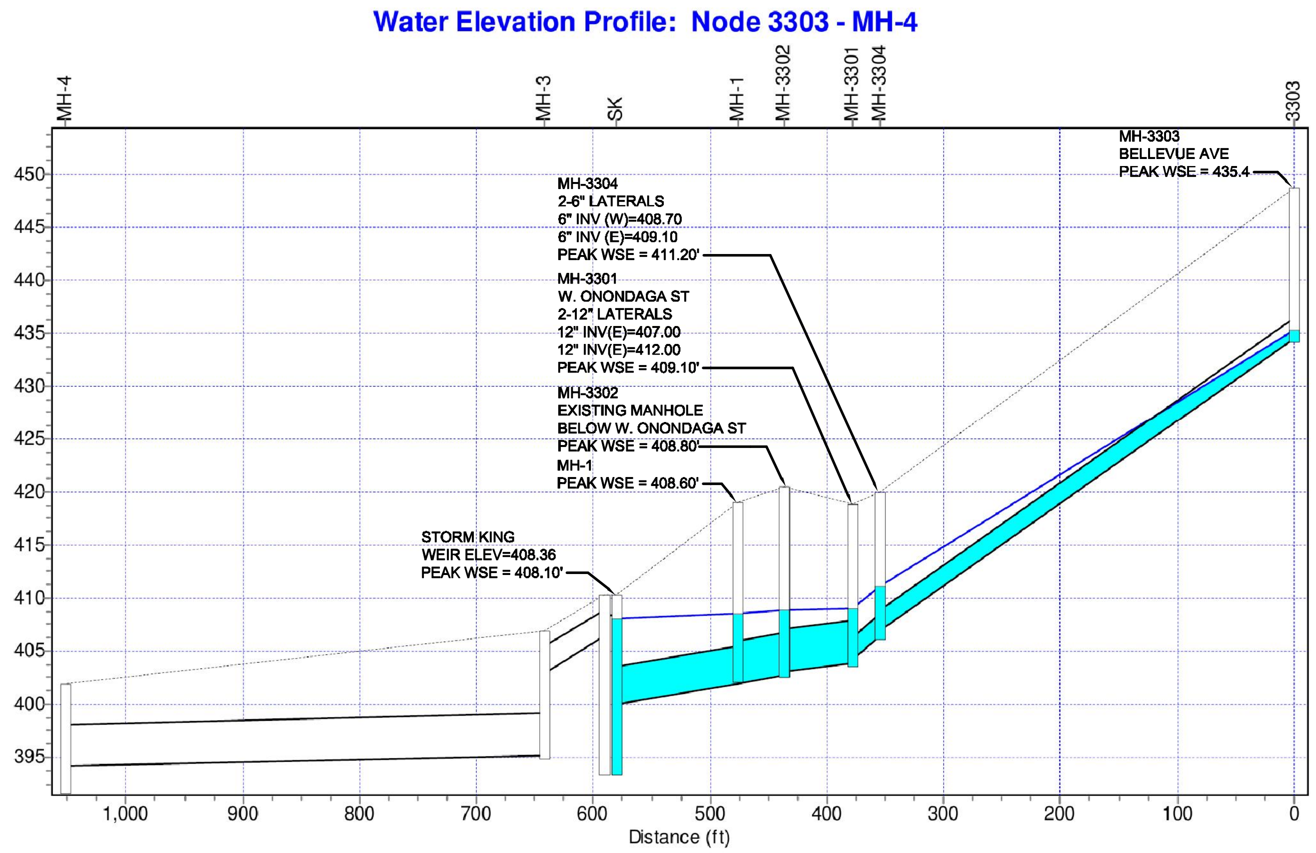
DATE	MAY 02, 2011
PROJ	19217
DWG	FIGURE 5
SHEET	FIGURE 5

PRELIMINARY

FILENAME: FIGURE 5.dwg PLOT DATE: 5/25/2011 PLOT TIME: 8:57:12 AM



EXISTING CONDITION WATER SURFACE PROFILE
(1 YEAR – 2 HOUR DESIGN STORM)



PROPOSED CONDITION WATER SURFACE PROFILE
(1 YEAR – 2 HOUR DESIGN STORM)

NO.	DATE	REVISION	BY	APVD
1	05/02/2011	50% SUBMISSION	KH	MEH

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DR DRAWN-BY
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FIGURE 6
EXISTING AND PROPOSED CONDITIONS SYSTEM HYDRAULIC GRADELINES

VERIFY SCALE
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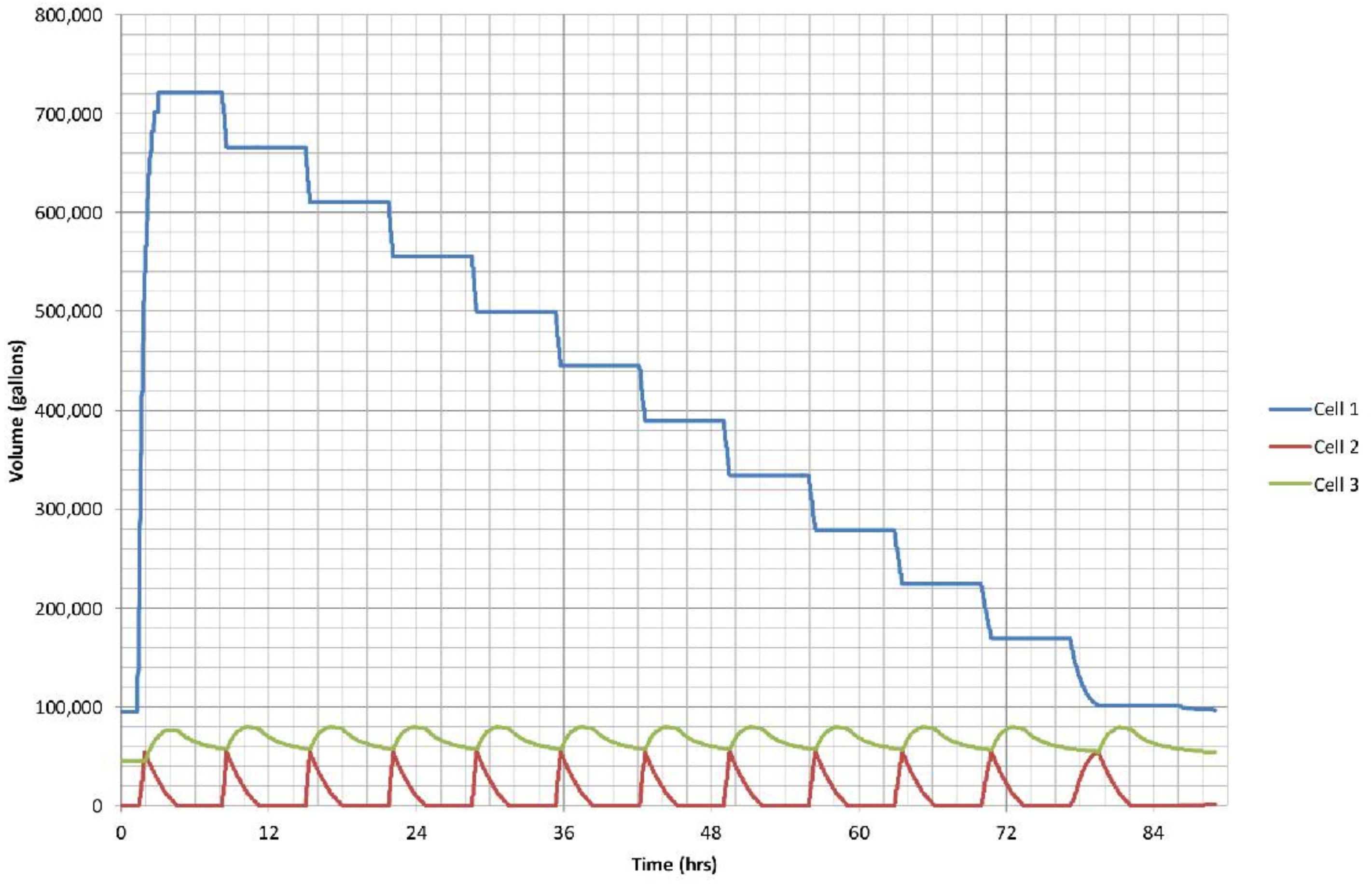
0 1"

DATE	MAY 02, 2011
PROJ	19217
DWG	FIGURE 6
SHEET	FIGURE 6

PRELIMINARY

FILENAME: FIGURE 6.dwg PLOT DATE: 5/2/2011 PLOT TIME: 3:45:48 PM

Figure 7 - Cell Volume Hydrographs: Series Flow Scenario



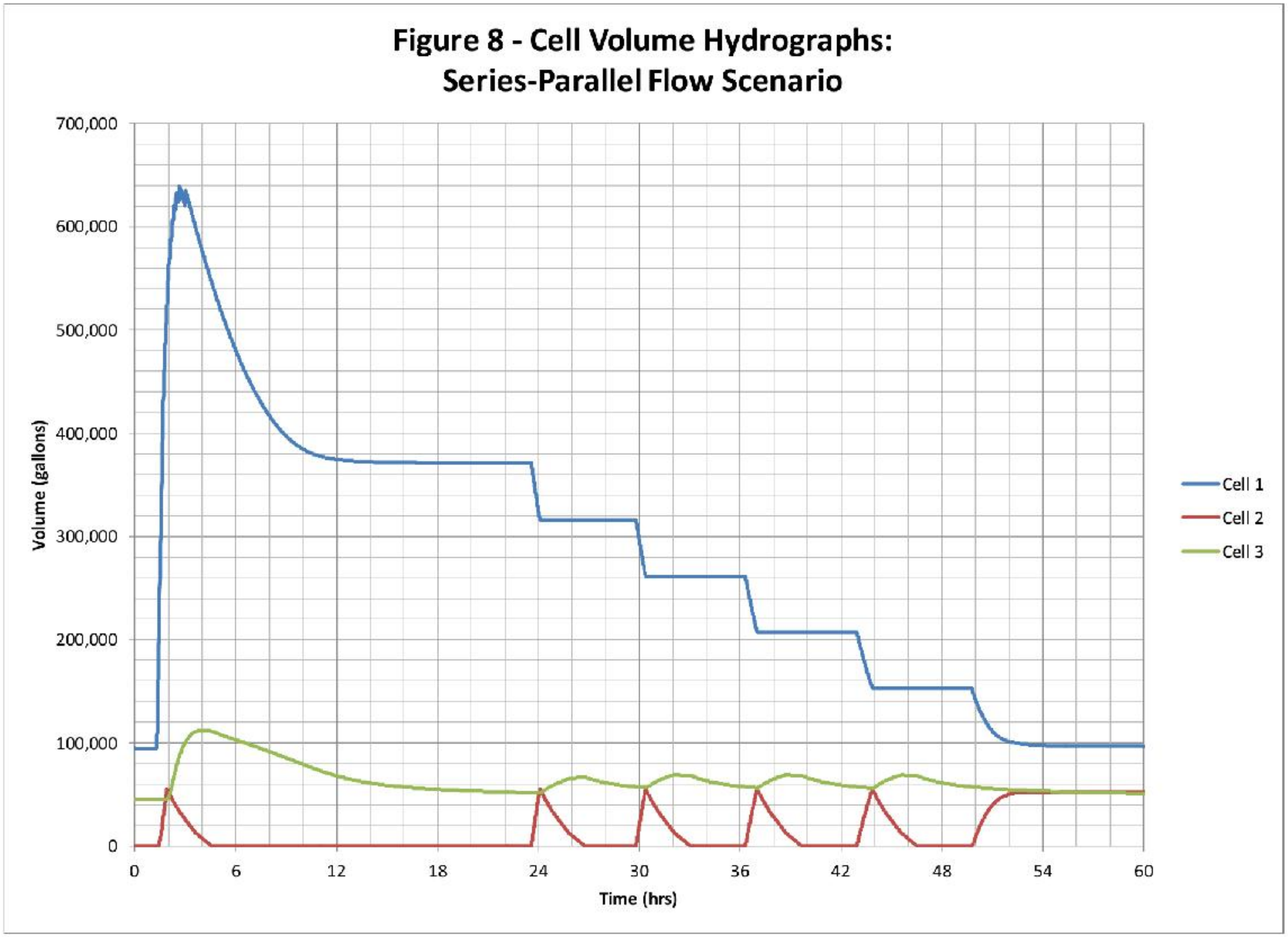
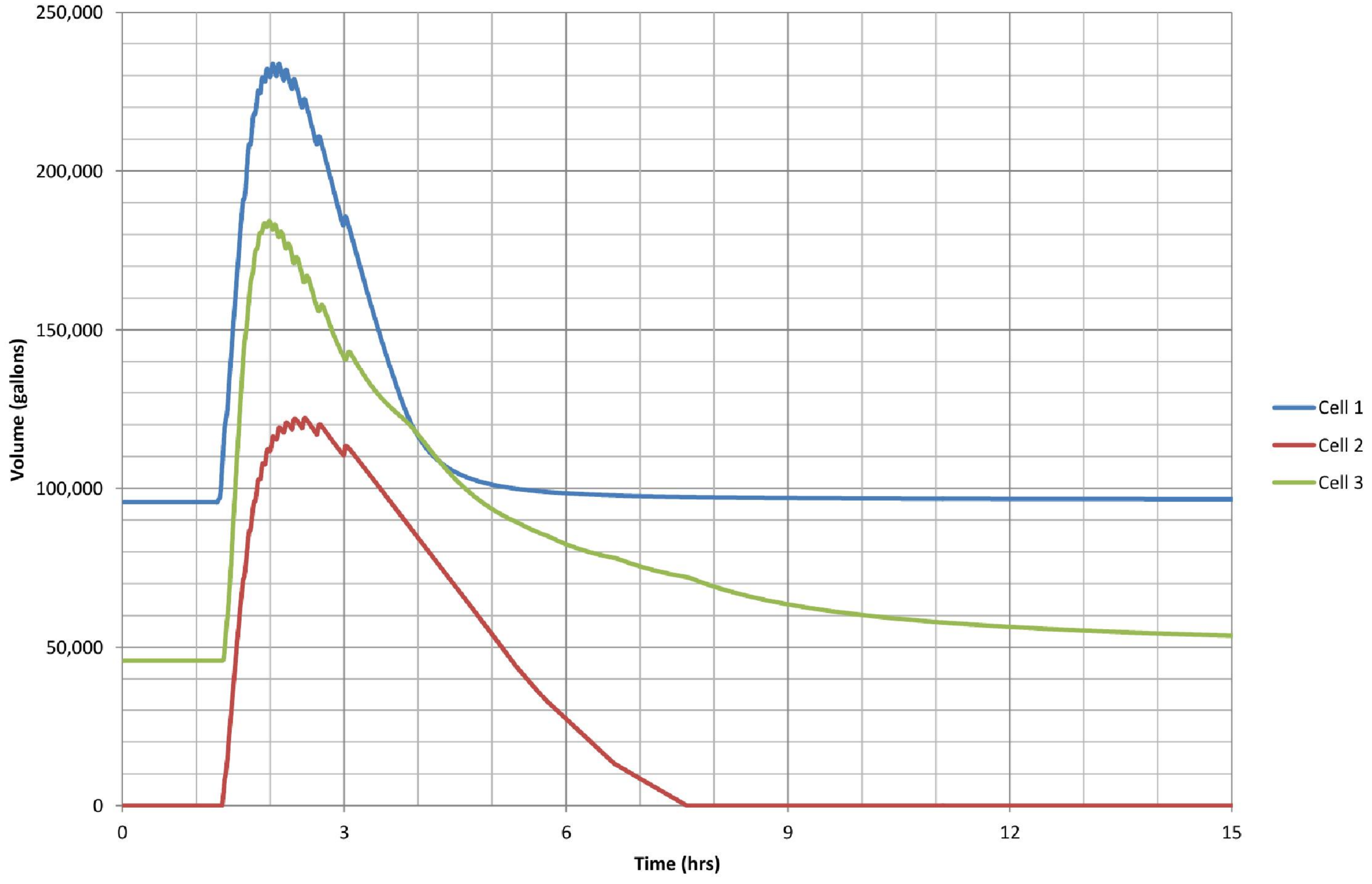
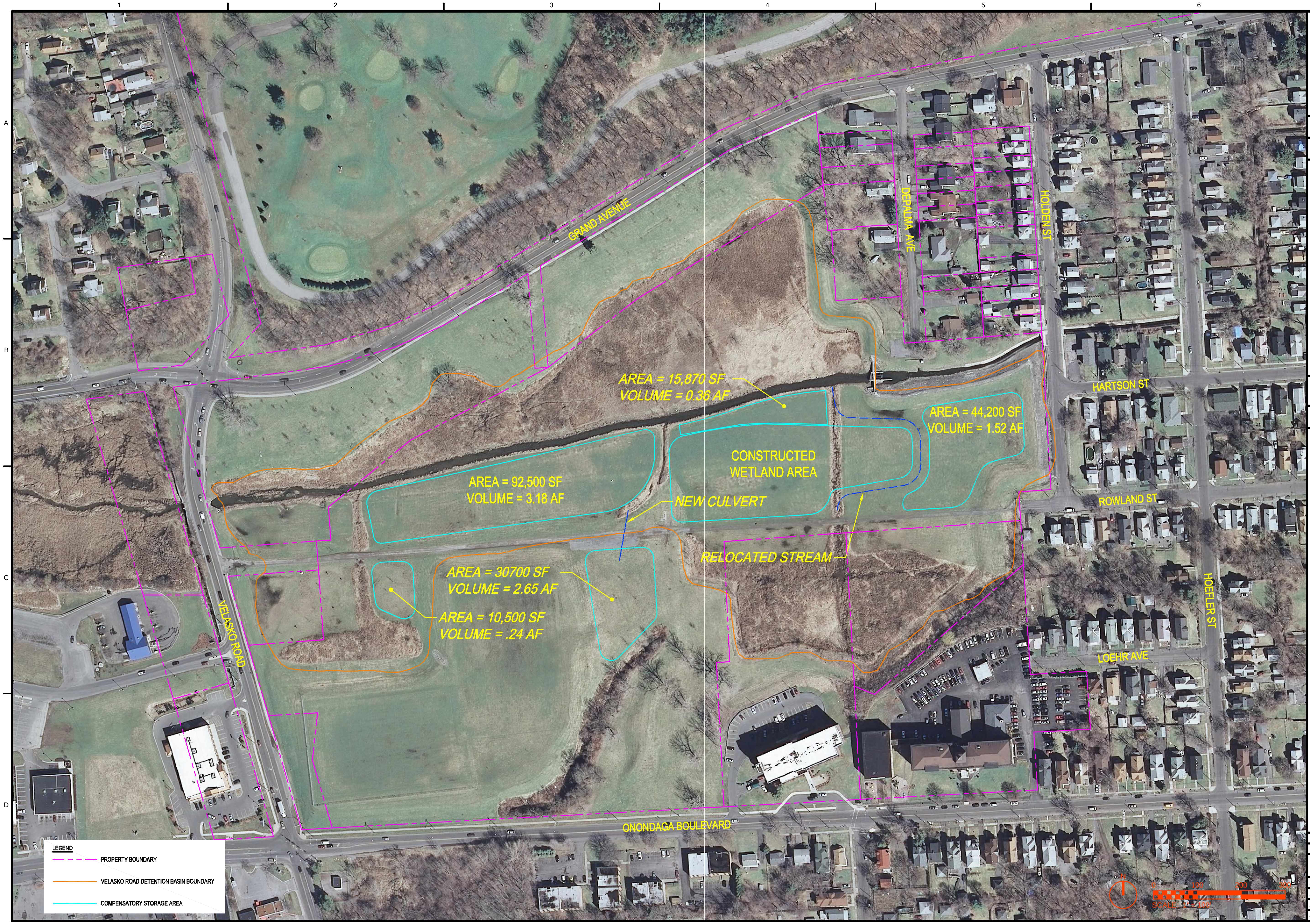


Figure 8 - Cell Volume Hydrographs:
Series-Parallel Flow Scenario

Figure 9 - Cell Volume Hydrographs:
Parallel Flow Scenario





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DSGN	DR	CHK	APVD
ENGINEER	DRAWN-BY	CHECKED-BY	APPROVED-BY

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FIGURE 10
COMPENSATORY STORAGE EXHIBIT

1" = 100'

VERIFY SCALE

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0 1"

DATE	MAY 02, 2011
PROJ	19217
DWG	FIGURE 10
SHEET	FIGURE 10

PRELIMINARY

FILENAME: FIGURE 10.dwg PLOT DATE: 5/2/2011 PLOT TIME: 3:06:07 PM

Appendix A

Geotechnical Investigation

CHA

Interoffice Memorandum

To: **Mike Hollowood, Chris Jedrich**

From: **Kelly Owens**

Date: **March 9, 2011, Revised March 16, 2011**

Re: **Subsurface Investigation for the Onondaga County Sewer CSO**
Syracuse, New York
CHA Project No.: 19217.8005.32000

This memorandum summarizes the results of the geotechnical investigation performed for the combined sewer overflow (CSO) proposed in Harbour Brook Field located in Syracuse, New York. The project includes the installation of a Hydro International Storm King Overflow structure and construction of the associated outflow pipes.

The objectives of this investigation were to identify subsurface conditions in the area of the CSO and outflow pipes and develop geotechnical recommendations for the design and construction of the proposed project.

PROJECT AND SITE DESCRIPTION

We understand that Onondaga County is planning to construct a CSO in Harbour Brook field, in the City of Syracuse, New York. The CSO will include a Hydro International Storm King Overflow with Swirl Cleanse tank and associated outfall pipes.

In addition to the CSO construction, the County is planning a constructed wetland area in the northern portion of the site adjacent to Harbour Brook. This will include the construction of a number of soil containment berms with an approximate average height of six feet.

The site is located off of West Onondaga Street, near the intersection with Velasko Road. The site is an open field with few large trees that slopes towards Harbour Brook and has existing subsurface sewer lines, evident by manholes at the ground surface. The site is bordered by Velasko Road to the west, apartment buildings to the east, West Onondaga Street to the south and Harbour Brook to the north.

Existing monitoring wells were observed at the site during this investigation. CHA completed 16 borings and installed 8 monitoring wells for a wetland mitigation investigation on January 4 through January 5, 2011 in the areas bordering the north and south banks of Harbour Brook. The nearest of these borings (B-7) to the approximate proposed CSO structure location is about 150 feet to the north. Logs of these borings were submitted to the Environmental/Planning group on January 24, 2011 and are included herein for reference. The locations of these borings and monitoring wells are shown on the attached boring location plan.

SUBSURFACE INVESTIGATION

Eight borings were advanced and one piezometer was installed for this geotechnical investigation between February 16 and February 18, 2011 designated as B-17 through B-23 and B-19A. Borings B-17, B-18, B-19 and B-19A were advanced in the area of the proposed outfall pipe alignment. Borings B-20 through B-22 were advanced in the originally proposed area for the CSO unit, and boring B-23 was advanced on the slope north of Harbour Brook. Note that the proposed location for the CSO unit was revised after completion of the borings. The revised location is in the vicinity of B-18.

The borings were located in the field by CHA during the subsurface investigation by measuring from existing features. Boring elevations were estimated from topographic survey mapping of the project site completed by CHA. The locations and elevations of the borings should be considered accurate only to the degree implied by the method used to determine them. The approximate boring locations are shown on the attached Boring Location Plan (Figure 1).

The borings were advanced by Nature's Way Environmental Construction & Consultants, Inc. of Crittenden, New York. A geotechnical engineer observed the field investigation to ensure proper drilling and sampling methods were used for this investigation, to classify soil samples, and to prepare field logs documenting subsurface conditions.

The borings were advanced with a rubber-track mounted drill rig using 2¼" hollow stem augers (HSA). Split-spoon sampling and standard penetration tests were generally conducted in the borings continuously to depths varying from 6 to 12 feet and at standard 5-foot intervals to boring termination. In borings B-20 through B-22, continuous sampling was resumed at the anticipated bearing depth of the CSO tank. The split-spoon sampler was driven with a 140(±) pound hammer free falling 30(±) inches, in general accordance with ASTM International guidelines (ASTM D1586). "Blow counts" are recorded on the boring logs and indicate the penetration resistance for a six-inch advancement of the split-spoon sampler. Initially, the sampler is driven six inches to seat the sampler in undisturbed material. The number of blows required to drive the sampler the next twelve inches is taken as the standard penetration resistance or "N" value. This value is indicative of the soil's in-place density or consistency. The final six-inch increment that the spoon is driven is not included in the determination of "N". Refusal is defined as a resistance of greater than 50 blows per six inches of penetration.

A temporary piezometer was installed in boring B-21 to provide a more accurate observation of the static groundwater level compared to water tables observed during drilling operations.

SUBSURFACE CONDITIONS

According to the *Surficial Geologic Map of New York, Finger Lakes Sheet* (Muller, E.H., et al., 1986) the site deposition consists of lacustrine silt and clay that is generally calcareous with potential land instability and variable thickness.

According to the *Geologic Map of New York, Finger Lakes Sheet* (Rickard, L.V., Fisher, D.W., 1986) the bedrock is of the Syracuse Formation that consists of dolostone, shale, gypsum and salt.

Subsurface conditions encountered in the borings for this investigation are detailed and described on the attached boring logs. General subsurface conditions are described below in order of increasing depth. It should be noted that subsurface conditions documented on the boring logs for the previous (January 4 through January 5, 2011) investigation at the site indicate similar soil types and layering exist in the northern portion of the site.

Topsoil – Topsoil was encountered at ground surface in all borings to depths varying from 0.1 to 0.3 feet.

Fill – Fill was encountered beneath the topsoil in all borings to depths varying from 8 to 17.5 feet and to termination in boring B-19. The fill generally consisted of varying amounts of fine to coarse sand and clayey silt, and trace amounts of fine to coarse gravel. The fill also contained trace amounts of organics, brick, rubber fragments, concrete rubble, coal, glass, and asphalt. The fill was generally brown and visually classified as moist to wet. Based on SPT resistance penetration the fill was very loose to compact.

Silt – Silt was encountered below the fill in borings B-17, B-18 and B-19A to depths ranging from 12.5 to 16.5 feet. The silt contained varying amounts of clay, fine to coarse sand, and fine gravel. The silt was gray/black; and the moisture content was observed to be moist to wet. Based on SPT resistance, the silt was soft to medium stiff.

Sand – Fine to coarse sand was encountered beneath the fill in borings B-21 and B-22 to depths ranging from 22.5 to 25.5 feet. The sand contained of varying amounts of silt and clay with trace amounts of fine gravel. The sand was brown and the moisture content was visually classified as moist to wet. Based on SPT resistance, penetration the sand was very loose to medium compact.

Peat – Peat was encountered beneath the silt, sand, or fill to depths varying from 28 to 33.3 feet in borings B-20 through B-22, and to termination in borings B-17, B-18, B-19, and B-23. The peat was brown and the moisture content was visually classified as moist to wet. Based on SPT resistance, the peat was soft to stiff.

Silty Clay – Silty clay was encountered beneath the peat in borings B-20 through B-22 to termination. The silty clay was gray and the moisture content was visually classified as moist to wet. Based on SPT resistance penetration, the silty clay was very soft to soft.

GROUNDWATER

Groundwater level observations were made in the boreholes during drilling operations and within the piezometer that was installed in B-21 to determine static groundwater level. Groundwater levels are listed in Table 1 below.

Table 1 – Estimated Depth of Groundwater

Boring	Estimated Depth to Groundwater (ft)	Estimated Elevation (ft)
B-18	8.7	397.8
B-19A	9.7	400.0
B-20	15.0	397.2
B-21	14.3*	401.7*
B-22	14.5	400.5
B-23	15.4	389.6

*Static groundwater level measured approximately 6 days after piezometer installation.

Boreholes were only open for a short period of time. Due to the fine grained nature of the soil encountered at the site, water levels observed during drilling may not represent static groundwater level conditions. In addition, factors such as temperature and precipitation also affect groundwater levels. For these reasons, long-term groundwater levels may differ from those described herein at any given time. We recommend that a groundwater elevation of 402 feet be used for the design of the CSO structure.

RECOMMENDATIONS

General

Final design information for the CSO structure and outlet pipe construction, including structure depth, diameter, and location, as well as finished site grade, were not available at the time this memo was prepared. The recommendations provided in this report are based on preliminary design information and the understanding that no significant changes in site grade will be completed.

Based on preliminary design information provided, we understand that the CSO will consist of a cast in place concrete structure with a tank depth of about 14 feet and an inside diameter of about 30 feet. The tank wall thickness is estimated to be 1.5 feet; and the base slab will be approximately 2 feet thick. The base slab will also extend about 2.5 foot from the outside tank wall face. The weight of the CSO structure and internal equipment is estimated to be approximately 923 kips. Based on a preliminary detail provided for the CSO structure, we understand that the top of the tank will be approximately at grade.

CSO Structure

Based on the preliminary design information and the subsurface information from borings B-18 through B-22, it is estimated that the base of the CSO structure will bear in the peat material, approximately 8 feet above the underlying silty clay surface. Note that B-18, which is the nearest boring to the proposed CSO location, did not fully penetrate the peat material. However, a bottom elevation of 384 feet for the peat at the proposed CSO location was interpolated from the information obtained from B-20 through B-22 since the bottom of this material appears to be relatively consistent at the locations investigated in this portion of the site.

The peat material is not considered adequate for support of the CSO due to its high organic content and potential to decompose over time, therefore, it is recommended that the peat be removed below the CSO to the silty clay and replaced with structural fill as described in the *Structural Fill Section* and as shown on the attached Limits of Structural Fill Detail to create an acceptable bearing surface.

The bearing surface shall be prepared in accordance with the *Site Preparation Section* included herein. Note that the site soils are considered moisture sensitive and may become unstable if exposed to precipitation; therefore, the structural fill shall be placed as soon as possible after excavation to protect these soils from excessive moisture.

Based on this recommendation, the preliminary design information for the CSO, and subsurface conditions, we recommend that the CSO structure (full of liquid) be designed to a maximum un-factored contact pressure of 1.8 ksf on the prepared structural fill subgrade. Subsequently, the net increase in stress at the surface of the underlying very soft silty clay will be negligible with respect to existing conditions. This will eliminate the potential for appreciable settlement of the CSO structure.

The walls of the CSO structure will retain earth and will be restrained against lateral movement; therefore they should be designed to resist “at rest” earth pressures. Given the groundwater conditions at the site, the CSO walls should also be designed to resist hydrostatic pressure behind the walls.

Backfill around the structure should consist of structural fill that extends a distance from the structure walls at least half the structure wall height. The structure walls can then be designed based on the engineering properties of the structural fill as follows:

- Total unit weight: 125 pcf
- Buoyant unit weight: 65 pcf
- Angle of internal friction: 32 degrees
- Coefficient of at-rest earth pressure (Ko): 0.47

CSO Pipes

Several pipes to carry flow to and from the CSO structure will be installed at the project site. These include a 30-inch diameter HDPE inlet pipe, an 8-inch diameter HDPE underflow pipe, a 6-inch diameter HDPE overspill pipe, and a 42-inch diameter HDPE overflow (outfall) pipe. Pipes sections will be connected using water-tight bell and spigot joints. The pipes will enter/exit the CSO structure at various elevations and from various directions; and will therefore be installed within the various soil types encountered in the borings.

We recommend that soils encountered along pipe alignments be over-excavated by one half of the pipe diameter or a minimum of one foot and replaced with NYSDOT No. 2 crushed stone in order to provide a firm bedding surface for uniform pipe support. It is also recommended that a 6 oz./s.y. non-woven geotextile such as Mirafi 160N or equal be placed on the exposed soil surface prior to placing the crushed stone.

Note that there is the potential for some differential vertical deflection of the CSO pipes over time due to the varying soil types (including peat) that will comprise the subgrade for pipes. The HDPE pipe material should accommodate potential differential vertical movement; however consideration should be given to pipe joint selection to minimize the risk for potential joint separation due to horizontal displacement of pipe sections that could result from differential vertical deflection of pipes. It is anticipated that the proposed water-tight bell and spigot pipe joints should provide adequate resistance to potential separation, however, the use of joint restraints should be considered to minimize the risk. To eliminate all risk of pipe joint separation, butt fused joints should be considered.

Site Preparation

The areas within the footprint of the proposed construction should be stripped of any vegetation and topsoil. Excavations, including undercuts, for the CSO structure and pipes shall be completed to the levels described in the *CSO Structure and CSO Pipes Sections*. Subsequent to stripping and excavating to proposed grades, the exposed subgrade should be proof rolled using a smooth drum roller with a gross weight of at least 10 tons. The roller should operate in its vibratory mode, and complete at least six passes over the subgrade at a speed not exceeding 3 feet per second (fps). Any areas which pump or weave during proof rolling should be undercut by a minimum of 12 inches and stabilized. If the vibratory roller tends to “bring up” moisture, the subgrade should be proof rolled with the roller operating in the static mode. A smaller roller or hand-operated compaction equipment shall be used in smaller, tight access areas as required.

Excavations should then be brought to proposed bearing grades using compacted NYSDOT No. 2 crushed stone or structural fill as previously described herein. Structural fill should meet the gradation requirements and be compacted as indicated in the *Structural Fill Section.*

Structural Fill

Structural fill shall be used for backfilling the excavations and undercuts. Material suitable for structural fill should consist of sound, durable, sand and gravel, free of stumps, roots, other organics and any frozen or deleterious materials conforming to the following gradation:

Sieve Size	**Percent Passing by Weight**
4 inch	100
No. 40	0 to 70
No. 200	0 to 10

Based upon visual classification of the soils encountered in the borings; the on-site soils do not meet the requirements for structural fill.

Structural fill should be placed in loose lifts not exceeding 8 inches in thickness and should be compacted to at least 95 percent of the maximum laboratory dry density as determined by the modified Proctor test (ASTM D-1557). Actual lift thickness shall depend upon the type of compaction equipment used during construction.

Constructed Wetland Berms

The constructed wetland berms will function to separate high flows of storm water runoff from entering the wetland area, and contain a relatively consistent level of water within the wetland area. Therefore, the soil used for the construction of the berms will need to have a relatively low permeability, and ideally be relatively resistant to erosion over the short term until vegetation is established.

We therefore recommend that the berms be constructed with silty clay and clayey silt soils, classified as MH or CL in the Unified Soil Classification System, with no sizes larger than 3 inches and at least 75 percent by dry weight of fines passing the No. 200 standard sieve size. The plasticity index of the soil should be at least 15. The coefficient of permeability of the soil should be less than 1×10^{-5} centimeters per second when compacted to a minimum of 90 percent of standard Proctor maximum dry density at a moisture content wet of optimum.

Excavations

All excavations should be performed in accordance with the Occupational Safety and Health Administration (OSHA) standards and applicable state and local codes. In areas where sufficient sloping of excavation cuts is not possible, the excavation should be shored, sheeted and braced as required.

Control of Water

Based on conditions observed during the subsurface investigation, it is likely that groundwater will be encountered during construction of the CSO structure and associated piping. Project specifications should require that groundwater be maintained at a minimum depth of two feet below excavation bottoms at all times to maintain stable conditions. It should be the responsibility of the contractor to maintain dry conditions for completion of construction. Dewatering methods suitable for this site include the use of well points, sumps and pumps, diversion and drainage ditches, and other similar methods. Pumps should be of sufficient capacity to control the groundwater, and operated in a manner which will limit the withdrawal of fines from the soil. It is recommended that pumps be installed in sumps lined with a filter fabric and crushed stone. The crushed stone should be an open graded, free draining crushed aggregate such as NYSDOT No. 2 or No. 3 stone. The geotextile should be a 6 ounce per square yard or heavier, non-woven filter fabric with an apparent opening size (AOS) equal to or smaller than the U.S. Standard sieve size of 70, such as Mirafi 160N or a geotextile of similar qualities.

Surface runoff should be diverted away from excavations during construction.

OBSERVATION DURING CONSTRUCTION

A qualified geotechnical engineer should carefully inspect the final excavation and bearing surfaces to ascertain that the subgrade has been properly prepared and is consistent with the design recommendations. The inspection of subgrade and structural fill should include probing at select locations.

Materials used as fill, including those used below structures, should be tested by a qualified soils laboratory to verify they meet the specified gradations and to determine their maximum dry density for compaction. In-place density tests should be performed to verify that compaction methods and equipment achieve the required densities.

CONCLUSION

The general geotechnical recommendations presented in this memo are based, in part, on project and subsurface information available at the time this report was prepared and in accordance with generally accepted foundation engineering practices. If changes are made to the locations of the proposed structures, a geotechnical engineer should confirm recommendations made herein.

Additionally, some variation of subsurface conditions may occur from the locations explored that may not become evident until construction. Depending on the nature and extent of the variations, it may be necessary to re-evaluate the recommendations presented herein.

Attachments

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FIGURES

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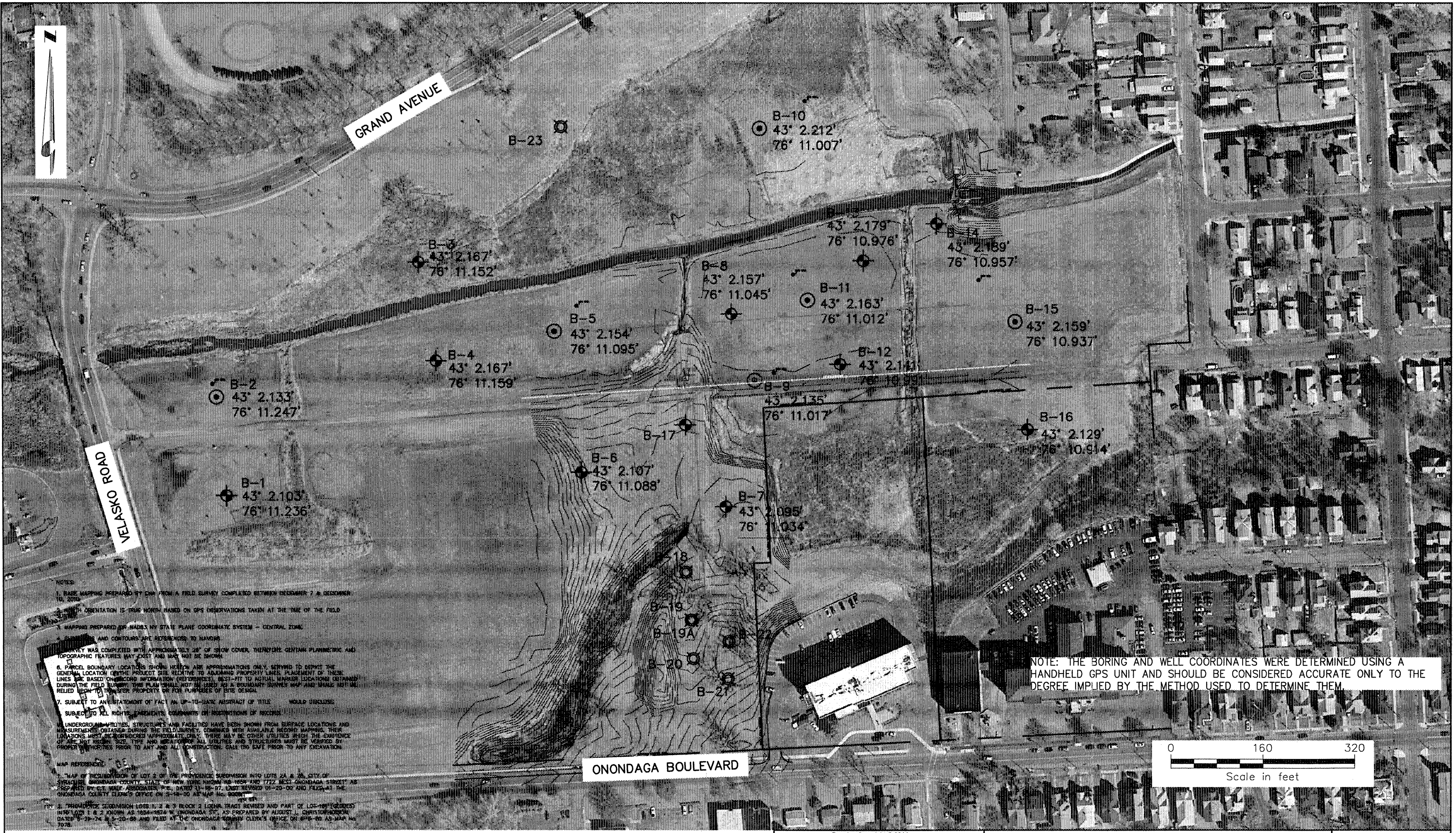

NOTES:

1. BASE MAPPING PREPARED BY CHA FROM A FIELD SURVEY COMPLETED BETWEEN DECEMBER 7 & DECEMBER 10, 2010.

2. NORTH ORIENTATION IS TRUE NORTH BASED ON GPS OBSERVATIONS TAKEN AT THE TIME OF THE FIELD SURVEY.

3. MAPPING PREPARED ON NAD83 NY STATE PLANE COORDINATE SYSTEM – CENTRAL ZONE.

4. ELEVATIONS AND CONTOURS ARE REFERENCED TO NAVD88.

5. SURVEY WAS COMPLETED WITH APPROXIMATELY 38" OF SNOW COVER, THEREFORE CERTAIN PLANIMETRIC AND TOPOGRAPHIC FEATURES MAY EXIST AND MAY NOT BE SHOWN.

6. PARCEL BOUNDARY LOCATIONS SHOWN HEREON ARE APPROXIMATIONS ONLY, SERVING TO DEPICT THE GENERAL LOCATION OF THE PROJECT SITE RELATIVE TO ADJOINING PROPERTY LINES. PLACEMENT OF THESE LINES ARE BASED ON RECORD INFORMATION (REFERENCES), BEST-FIT TO ACTUAL MARKER LOCATIONS OBTAINED DURING THE FIELD SURVEY. THIS PLAN SHALL NOT BE USED AS A BOUNDARY SURVEY MAP AND SHALL NOT BE RELIED UPON TO TRANSFER PROPERTY OR FOR PURPOSES OF SITE DESIGN.

7. SUBJECT TO ANY STATEMENT OF FACT AN UP-TO-DATE ABSTRACT OF TITLE WOULD DISCLOSE.

8. SUBJECT TO ALL RIGHTS, EASEMENTS, COVENANTS OR RESTRICTIONS OF RECORD.

9. UNDERGROUND UTILITIES, STRUCTURES AND FACILITIES HAVE BEEN SHOWN FROM SURFACE LOCATIONS AND MEASUREMENTS OBTAINED DURING THE FIELD SURVEY, COMBINED WITH AVAILABLE RECORD MAPPING. THEIR LOCATIONS MUST BE CONSIDERED APPROXIMATE ONLY. THERE MAY BE OTHER UTILITIES WHICH THE EXISTENCE OF ARE NOT KNOWN. SIZE, TYPE AND LOCATION OF ALL UTILITIES AND STRUCTURES MUST BE VERIFIED BY PROPER AUTHORITIES PRIOR TO ANY AND ALL CONSTRUCTION. CALL DIG SAFE PRIOR TO ANY EXCAVATION.

MAP REFERENCES:

1. "MAP OF RESUBDIVISION OF LOT 2 OF THE PROVIDENCE SUBDIVISION INTO LOTS 2A & 2B, CITY OF SYRACUSE, ONONDAGA COUNTY, STATE OF NEW YORK KNOWN AS 1654 AND 1772 WEST ONONDAGA STREET" AS PREPARED BY C.T. MALE ASSOCIATES, P.C., DATED 11-18-97, LAST REVISED 01-20-00 AND FILED AT THE ONONDAGA COUNTY CLERK'S OFFICE ON 3-18-00 AS MAP No. [illegible]

2. "PROVIDENCE SUBDIVISION LOTS 1, 2 & 3 BLOCK 2 LOEHR TRACT REVISED AND PART OF LOT-[illegible] ([illegible]) INTO LOTS 1 & 2 KNOWN AS 1654-1674 W. ONONDAGA ST." AS PREPARED BY AUGUST L. CHRISTOPHERSON, DATED 5-29-74 & 5-20-86 AND FILED AT THE ONONDAGA COUNTY CLERK'S OFFICE ON 6-18-86 AS MAP No. 7078.

NOTE: THE BORING AND WELL COORDINATES WERE DETERMINED USING A HANDHELD GPS UNIT AND SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED TO DETERMINE THEM.

B-1 ⌖	APPROXIMATE BORING LOCATION (01/2011)
B-2 ◉	APPROXIMATE WELL LOCATION (01/2011)
B-18 ⌖	APPROXIMATE BORING LOCATION (02/2011)

Drawing Copyright © 2011

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BORING LOCATION PLAN

HARBOUR BROOK FIELD CSO SITE
CITY OF SYRACUSE, NEW YORK

PROJECT NO.
19217

DATE: 03/2011

FIGURE 1

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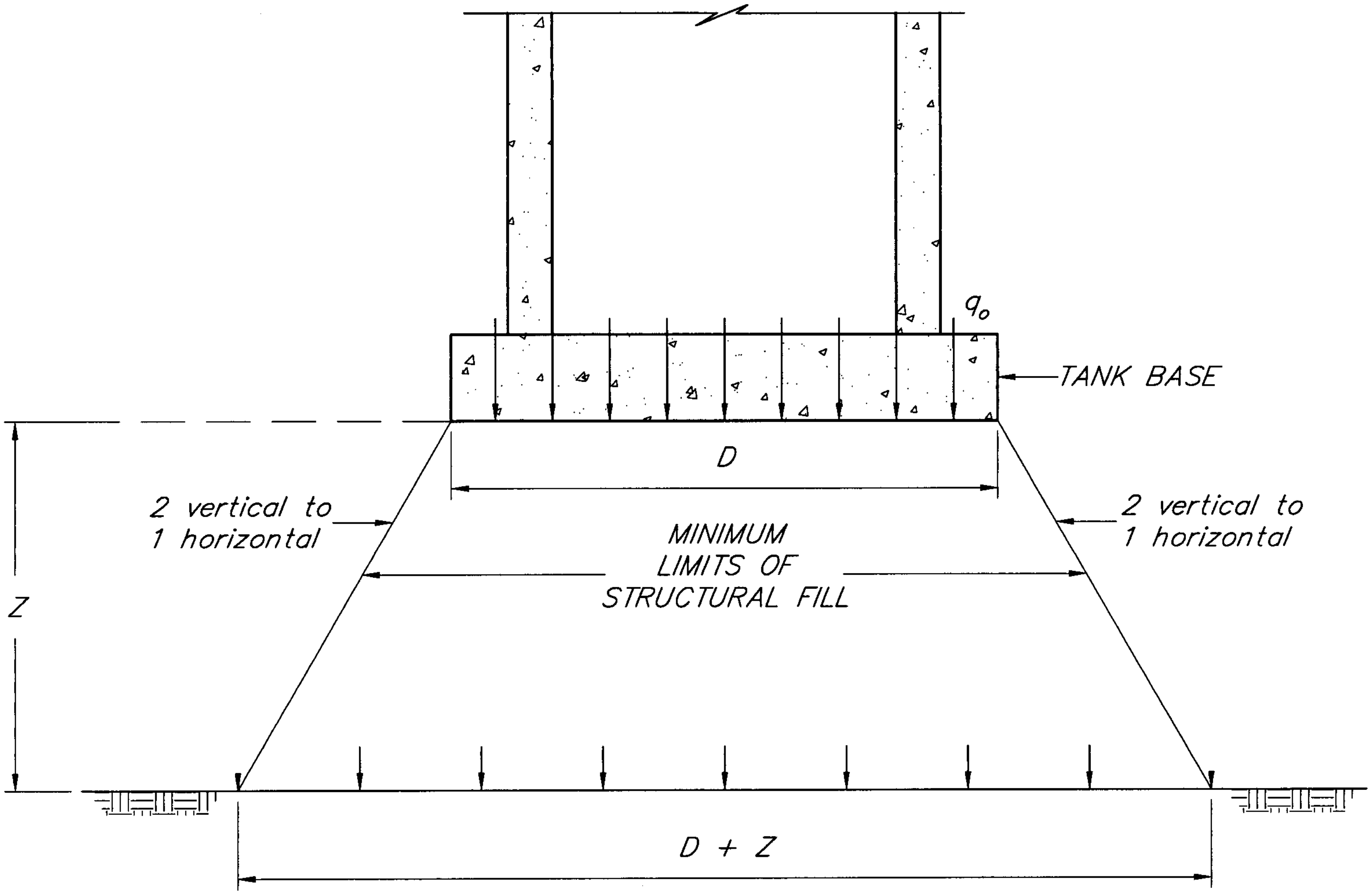

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LIMITS OF STRUCTURAL FILL DETAIL

HARBOUR BROOK FIELD CSO SITE
CITY OF SYRACUSE, NEW YORK

PROJECT NO.
19217

DATE: 03/2011

FIGURE 2

BORING LOGS

February 16-18, 2011 Subsurface Investigation

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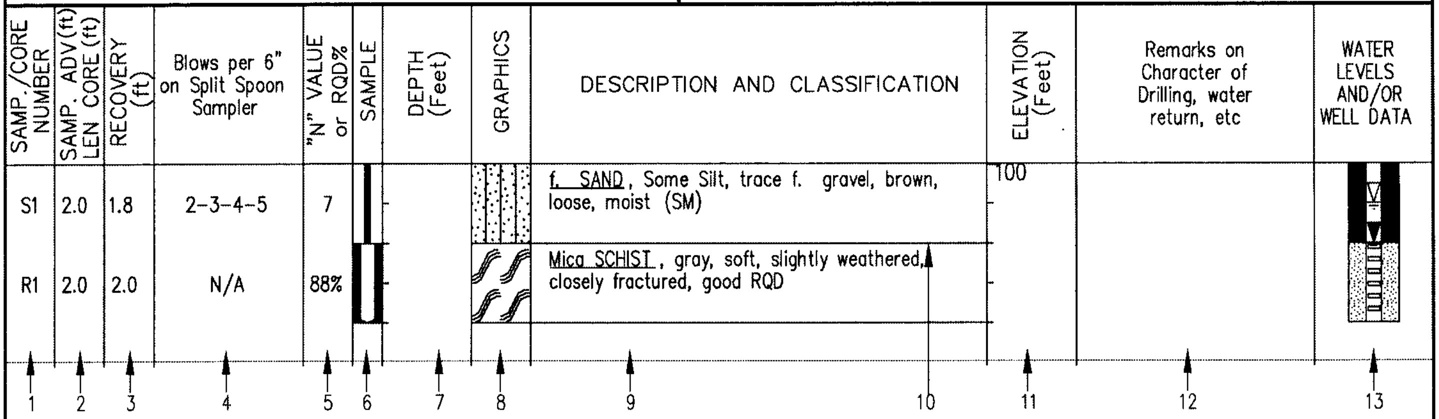
LEGEND TO SUBSURFACE LOGS



SAMP./CORE NUMBER	SAMP. ADV(ft) LEN CORE(ft)	RECOVERY (ft)	Blows per 6" on Split Spoon Sampler	"N" VALUE or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, water return, etc	WATER LEVELS AND/OR WELL DATA
S1	2.0	1.8	2-3-4-5	7				f. SAND, Some Silt, trace f. gravel, brown, loose, moist (SM)	100		
R1	2.0	2.0	N/A	88%				Mica SCHIST, gray, soft, slightly weathered, closely fractured, good RQD			

Subsurface Logs present material classifications, test data, and observations from subsurface investigations at the subject site as reported by the inspecting geologist or engineer. In some cases, the classifications may be made based on laboratory test data when available. It should be noted that the investigation procedures only recover a small portion of the subsurface materials at the site. Therefore, actual conditions between borings and sampled intervals may differ from those presented on the Subsurface Logs. The information presented on the logs provide a basis for an evaluation of the subsurface conditions and may indicate the need for additional exploration. Any evaluation of the conditions reported on the logs must be performed by Professional Engineers or Geologists.

1. SAMP./CORE NUMBER – Samples are numbered for identification on containers, laboratory reports or in text reports.

2. SAMP.ADV/LEN.CORE – Length of sampler advance or length of coring run measured in feet.

3. RECOVERY – Amount of sample actually recovered after withdrawing sampler or core barrel from bore hole measured in feet.

4. SAMPLE BLOWS/6" – Unless otherwise noted, blow counts represent values obtained by driving a 2.0" (O.D.), 1-3/8" (I.D.) split spoon sampler into the subsurface strata with a 140 pound weight falling 30" as per ASTM D 1586. After an initial penetration of 6" to seat the sampler into undisturbed material, the sampler is then driven an additional 2 or 3 six inch increments.

5. "N" Value or RQD % – "N" VALUE – The sum of the second and third sample blow increments is generally termed the Standard Penetration Test (SPT) "N" value. CORE RQD – Core Rock Quality Designation, RQD, is defined as the summed length of all pieces of core equal to or longer than 4 inches divided by the total length of the coring run. Fresh, irregular breaks distinguishable as being caused by drilling or recovery operations are ignored and the pieces are counted as intact lengths. RQD values are valid only for cores obtained with NX size core barrels.

6. SAMPLE – Graphical presentation of sample type and advance or core run length. See Table 1.

7. DEPTH – Depth as measured from the ground surface in feet.

8. GRAPHICS – Graphical presentation of subsurface materials. See Table 4. Dual soil classification and rock graphics may vary and are not shown on Table 4.

9. DESCRIPTION AND CLASSIFICATION – SOIL – Recovered samples are visually classified in the field by the supervising geologist or engineer unless otherwise noted. Particle size and plasticity classification is based on field observations, and using the Unified Soil Classification System (USCS). See Table 4. USCS symbols are presented in parentheses following the soil description. Where necessary, dual symbols may be used for combinations of soil types. Relative proportions, by weight and/or plasticity, are described in general accordance with "Suggested Methods of Test for Identification of Soils" by D.M. Burmister, ASTM Special Publication 479, 6-1970. See Table 2. Soil density or consistency description is based on the penetration resistance. See Table 3. Soil moisture description is based on the observed wetness of the soil recovered being dry, moist, wet, or saturated. Water introduced into the boring during drilling may affect the moisture content of the materials. Other geologic terms may also be used to further describe the subsurface materials. ROCK – Rock core descriptions are based on the inspector's observations and may be examined and described in greater detail by the project engineer or geologist. Terms used in the description of rock core are presented in Table 5.

10. DIVISION LINES – Division lines between deposits are based on field observations and changes in recovered material. Solid lines depict contacts between two deposits of different geologic depositional environment of known elevation. Dashed lines represent estimated elevation of contacts between two deposits of different geologic depositional environment. Dotted lines depict transitions of deposits within the same depositional environment, such as grain size or density.

11. ELEVATION – Elevation of strata changes in feet.

12. REMARKS – Miscellaneous observations.

13. WATER LEVELS & WELL DATA – Hollow water level symbol, if present, represents level at which first saturated sample or water level was encountered. Solid water level symbol, if present, depicts the most probable static water elevation at the time of drilling or as measured in an installed observation well at a later date. Subsurface water conditions are influenced by factors such as precipitation, stratigraphic composition, and drilling/coring methods. Conditions at other times may differ from those described on the logs. For graphical presentation of observation/monitoring well construction, see Table 6. Elevations of changes in construction are noted at the bottom of each section.

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LEGEND TO SUBSURFACE LOGS

TABLE 1
TYPICAL SAMPLE TYPES

- SPLIT SPOON (1 3/8" I.D.)
- NX SIZE ROCK CORE
- SHELBY TUBE "UNDISTURBED"
- AUGER SAMPLE

TABLE 2
SAMPLE MATERIAL PROPORTIONS

ADJECTIVE	PERCENTAGE OF SAMPLE
"and"	35% – 50%
"some"	20% – 35%
"little"	10% – 20%
"trace"	< 10%

Standard split spoon samples may not recover particles with any dimension larger than 1 3/8". Therefore, reported gravel percentages may not reflect actual conditions.

TABLE 3
DENSITY/CONSISTENCY

GRANULAR SOILS		COHESIVE SOILS	
Blows/ft.	Density	Blows/ft.	Consistency
< 5	Very Loose	< 2	Very Soft
5–10	Loose	2–4	Soft
11–30	Med. Compact	5–8	Med. Stiff
31–50	Compact	9–15	Stiff
> 50	Very Compact	16–30	Very Stiff
		> 30	Hard

TABLE 4
USCS CLASSIFICATION, PARTICLE SIZE, & GRAPHICS

MAJOR PARTICLE SIZE DIVISION		USCS SYMBOL	GRAPHIC SYMBOL	GENERAL DESCRIPTION
COARSE GRAINED SOILS	GRAVEL Coarse: 3"–3/4" Fine: 3/4"–#4 Classification based on > 50% being gravel	GW	●	Well graded gravels, gravel & sand mix.
		GP	○	Poorly graded gravels, gravel & sand mix.
		GM	○	Gravel, sand and silt mix.
		GC	▨	Gravel, sand and clay mix.
	SAND Coarse: #4–#10 Med.: #10–#40 Fine: #40–#200 Classification based on > 50% being sand	SW	▩	Well graded sand, sand & gravel mix.
		SP	░	Poorly graded sand, sand & gravel mix.
		SM	▥	Sand and silt mix.
		SC	▨	Sand and clay mix.
FINE GRAINED SOILS	SILT & CLAY Classification based on > 50% passing #200 sieve.	ML	▥	Inorganic silt, low plasticity.
		CL	▨	Inorganic clay, low plasticity.
		OL	▤	Organic silt/clay, low plasticity.
		MH	▥	Inorganic silt, high plasticity.
		CH	▨	Inorganic clay, high plasticity.
		OH	▤	Organic silt/clay, high plasticity.
ORGANIC SOILS		Pt	▦	Peat and other highly organic soils.
FILL		Fill	▩	Miscellaneous fill materials.

TABLE 5
ROCK CLASSIFICATION TERMS

HARDNESS:

Very Soft	Carves
Soft	Grooves with knife
Med. Hard	Scratched easily with knife
Hard	Scatched with difficulty
Very Hard	Cannot be scratched with knife

WEATHERING:

Fresh	Slight or no staining of fractures, little or no discoloration, few fractures.
Slightly	Fractures stained, discoloration may extend into rock 1", some soil in fractures.
Moderately	Significant portions of rock stained and discolored, soil in fractures, loss of strength.
Highly	Entire rock discolored and dull except quartz grains, severe loss of strength.
Complete	Weathered to a residual soil.

BEDDING:		FRACTURE SPACING:		RQD:	
Massive	> 40"	Massive/V. Wide	> 6'	Excellent	> 90%
Thick	12' – 40"	Thick/Wide	2' – 6'	Good	76% – 90%
Medium	4" – 12"	Med./Med.	8" – 24"	Fair	51% – 75%
Thin	< 4"	Thin/Close	2 1/2" – 8"	Poor	25% – 50%
		V. Thin/V. Close	< 2 1/2"	V. Poor	< 25%

TABLE 6
WELL CONSTRUCTION

- SOLID PVC PIPE
- SCREENED PVC PIPE
- STAINLESS STEEL SCREENED PIPE
- FINE GRAINED WASHED SAND
- WASHED SAND
- BENTONITE PLUG
- AIR ENTRAINED CEMENT
- NATURAL SOIL/ ROCK FILL
- BENTONITE/ CEMENT GROUT

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-17

Page 1 of 1

PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York	DRILL FLUID: None
CLIENT: CH2M Hill, Inc.	DRILLING METHOD: 2.25" HSA
CONTRACTOR: Nature's Way	
DRILLER: S. Gingrich	INSPECTOR: K. Owens
START DATE and TIME: 2/17/2011 3:00:00 PM	
FINISH DATE and TIME: 2/17/2011 4:00:00 PM	
SURFACE ELEV: 403.50 (ft; Estimated)	CHECKED BY: K. Adnams

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	2-17-11	2:45 PM	Casing Pulled	17.5	N/A	20

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	1.1	4-5-7-6	12				**TOPSOIL** **f.m.c. SAND**, little clayey silt, trace f. gravel, trace organics/brick/asphalt, brown, medium compact, moist **(FILL)**	402	Groundwater observations made during drilling may not represent static conditions.	
S-2	2	1.3	12-6-8-10	14		2		**Clayey SILT**, little f.m.c. sand, trace f.c. gravel, trace organics/brick/concrete, gray, stiff, moist **(FILL)**	400		
S-3	2	0.7	5-5-2-8	7		4		becomes medium stiff **(FILL)**	398		
S-4	2	0.1	3-3-3-3	6		6		**Similar Soil (FILL)**	396	Shoe of spoon S-4 blocked by piece of plywood.	
S-5	2	0.5	1-1-2-2	3		8		**Clayey SILT**, trace f.m.c. sand, gray, soft, moist **(ML)**	394		
S-6	2	0.3	2-2-3-3	5		10		becomes dark brown, wet **(ML)**	392		
						12		**Silty CLAY**, trace organics, gray, soft, moist **(CL)**	390		
S-7	2	0.6	1-2-3	4		14			388		
						16			386		∇
S-8	2	1.8	1-1-2-2	3		18		**PEAT**, brown/light brown, soft, moist **(PEAT)**	384		

End of Boring at 20 ft

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-18

Page 1 of 1

LOCATION: Syracuse, New York
CLIENT: CH2M Hill, Inc.
CONTRACTOR: Nature's Way
DRILLER: S. Gingrich
INSPECTOR: K. Owens
START DATE and TIME: 2/17/2011 1:40:00 PM
FINISH DATE and TIME: 2/17/2011 3:00:00 PM
SURFACE ELEV: 406.50 (ft; Estimated)
CHECKED BY: K. Adnams

DRILL FLUID: None
DRILLING METHOD: 2.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	2-17-11	2:15 PM	During Drilling	10	8	12
	2-17-11	2:45 PM	Casing Pulled	8.7	N/A	17.5

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	0.8	7-7-4-7	11				**Silty CLAY**, trace f.m.c. sand, trace f. gravel, trace organics/concrete, brown, stiff, moist **(FILL)**	406		
S-2	2	1	8-9-13-12	22		2		**Clayey SILT**, little f.m.c. sand, trace f. gravel, trace organics, brown, very stiff, moist **(FILL)**	404		
S-3	2	1.2	5-6-11-17	17		4		grades to trace coal, becomes dark gray **(FILL)** **Silty CLAY**, gray, very stiff, moist **(FILL)**	402		
S-4	2	0.3	7-6-5-4	11		6		**Clayey SILT**, little f.m.c. sand, trace brick, gray, stiff, moist **(FILL)**	400		
S-5	2	1.1	2-2-4-3	6		8		**Clayey SILT**, little f.m.c. sand, trace f. gravel, trace concrete, dark gray/light brown, medium stiff, moist **(FILL)**	398	Groundwater levels observed during drilling may not represent static conditions.	∇
						10		grades to trace glass **(FILL)**	396	Organic odor noted in sample S-6.	
S-6	2	1.2	2-3-5-3	8				**Clayey SILT**, little f.m.c. sand, trace f. gravel, trace organics, black, medium stiff, wet **(ML)**			
						12			394		
S-7	2	1.1	2-3-4-4	7		14		**PEAT**, dark brown, medium stiff, moist **(PEAT)**	392	Organic odor noted in sample S-7.	
						16			390		
S-8	2	1.7	1-2-3-4	5		18		becomes light brown **(PEAT)**	388	Organic odor noted in sample S-8.	

End of Boring at 20 ft

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-19

Page 1 of 1

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: Nature's Way

DRILLER: S. Gingrich INSPECTOR: K. Owens

START DATE and TIME: 2/17/2011 11:00:00 AM

FINISH DATE and TIME: 2/17/2011 11:30:00 AM

SURFACE ELEV: 409.70 (ft; Estimated) CHECKED BY: K. Adnams

DRILL FLUID: None

DRILLING METHOD: 2.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	2-17-11	11:30 AM	Casing Pulled	None	N/A	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL		Groundwater conditions observed during drilling may not represent static conditions.	
S-1	2	1.1	2-2-2-10	4				**Clayey SILT**, little f.m.c. sand, trace f. gravel, trace organics/brick, gray, soft, moist **(FILL)**			
						2		No recovery	408		
S-2	2	0	20-18-11-12	29							
						4		**Clayey SILT**, little f.m.c. sand, trace organics/brick, brown, stiff, moist **(FILL)**	406		
S-3	2	0.1	6-6-7-6	13							
						6		No recovery	404		
S-4	2	0	11-9-8-9	17							
						8		End of Boring at 8 ft	402	Boring B-19 terminated due to lack of recovery in samples. It is believe a small cobble or gravel fragment was blocking recovery. B-19 moved approximately 1' east to B-19A.	
						10			400		
						12			398		
						14			396		
						16			394		
						18			392		
									390		

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-19A

Page 1 of 1

PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: Nature's Way

DRILLER: S. Gingrich INSPECTOR: K. Owens

START DATE and TIME: 2/17/2011 11:30:00 AM

FINISH DATE and TIME: 2/17/2011 12:15:00 PM

SURFACE ELEV: 409.70 (ft; Estimated) CHECKED BY: K. Adnams

DRILL FLUID: None

DRILLING METHOD: 2.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	2-17-11	11:55 AM	During Drilling	10	8	12
	2-17-11	1:15 PM	Casing Pulled	9.7	13	20

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
									408	Advance B-19A approximately 1' east of B-19 and auger to 2'.	
S-1	2	0.5	12-20-12-11	32		2		**Clayey SILT**, little f.m.c. sand, trace f. gravel, hard, moist **(FILL)**	406	Driller notes harder drilling 2'-4'.	
S-2	2	1	5-2-5-5	7		4		**Clayey SILT**, little f.m.c. sand, trace f.c. gravel, trace brick, light brown/brown/black, medium stiff, moist **(FILL)**	404		
S-3	2	0	9-11-5-2	16		6		No recovery	402		
S-4	2	0.7	2-3-2-2	5		8		grades to trace glass **(FILL)**	400		▽
S-5	2	0.5	1-2-2-2	4		10		grades to trace organics **(FILL)**	398	Groundwater conditions observed during drilling may not represent static conditions. Spoon of sample S-5 was wet.	
						12					
S-6	2	1	1-1-1-5	2		14		**SILT**, trace f.m.c. sand, black, soft, wet **(ML)**	396	Organic odor noted in sample S-6.	
						16			394		
S-7	2	1.4	2-1-2-3	3		18		**PEAT**, light/dark brown, soft, moist **(PEAT)**	392 390		

End of Boring at 20 ft

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-20

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: Nature's Way

DRILLER: S. Gingrich

INSPECTOR: K. Owens

START DATE and TIME: 2/16/2011 1:30:00 PM

FINISH DATE and TIME: 2/16/2011 4:00:00 PM

SURFACE ELEV: 412.20 (ft; Estimated)

CHECKED BY: K. Adnams

DRILL FLUID: None

DRILLING METHOD: 2.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	2-16-11	2:05 PM	During Drilling	15	15	17

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL	412		
S-1	2	0.6	1-5-6-6	11				**SILT**, little f.m.c. sand, trace c. gravel, trace organics, dark brown, medium compact, moist **(FILL)**			
						2		No recovery	410	Coarse gravel fragement stuck in shoe of sample S-2.	
S-2	2	0	10-6-6-20	12							
						4		**SILT**, little f.m.c. sand, trace organics, dark brown, very loose, moist **(FILL)**	408	Sample S-3 was mottled in color.	
S-3	2	0.4	1-1-2-2	3							
						6			406		
						8		**f.m.c. SAND**, little silt, trace f.c. gravel, mottled brown, loose, moist **(FILL)**	404		
S-4	2	0.3	4-3-4-7	7							
						10			402		
						12			400		
								Similar Soil (FILL)			
S-5	2	0.1	2-3-3-3	6		14			398		
								PEAT, brown, medium stiff, wet **(PEAT)**		Groundwater observations made during drilling may not represent static conditions.	▽
S-6	2	0.2	2-1-4-4	5		16			396		
								No recovery		Coarse gravel and wood fragment stuck in shoe of sample S-7.	
S-7	2	0	7-2-1-5	3		18			394		
								PEAT, dark brown, stiff, wet **(PEAT)**		Organic odor noted in sample S-8.	

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field

SUBSURFACE LOG

HOLE NUMBER B-20

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-8	2	1	4-9-2-4	11				**PEAT**, dark brown, stiff, wet **(PEAT)** *(continued)*	392		
								PEAT, light/dark brown, stiff, moist **(PEAT)**		Organic odor noted in sample S-9.	
S-9	2	1.5	5-5-6-6	11		22			390		
						24			388		
						26			386		
						28			384	Organic odor noted in peat.	
S-10	2	2	2-2-2-2	4							
						30		**Silty CLAY**, gray, soft, moist **(CL)**	382		
						32			380		
								Similar Soil (CL)			
S-11	2	2	WH-WH-WH -WH	0		34			378		
						36			376		
						38		**Similar Soil (CL)**	374		
S-12	2	2	WH-WH-WH -WH	0							
						40			372		
						42			370		
								Similar Soil (CL)			
S-13	2	1.7	WH-WH-WH -WH	0		44					

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-20

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
					▮		▨	**<u>Similar Soil</u> (CL)** *(continued)*			
								End of Boring at 45 ft		Hole collapsed to 5' when augers were pulled so water reading not taken.	
						46			366		
						48			364		
						50			362		
						52			360		
						54			358		
						56			356		
						58			354		
						60			352		
						62			350		
						64			348		
						66			346		
						68			344		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-21

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: Nature's Way

DRILLER: S. Gingrich

INSPECTOR: K. Owens

START DATE and TIME: 2/16/2011 10:00:00 AM

FINISH DATE and TIME: 2/16/2011 12:45:00 PM

SURFACE ELEV: 416.00 (ft; Estimated)

CHECKED BY: K. Adnams

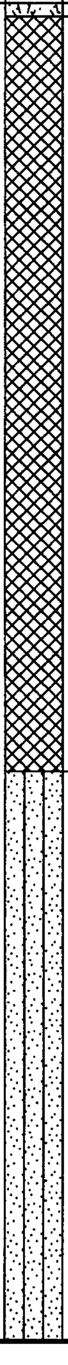
DRILL FLUID: None

DRILLING METHOD: 2.25" HSA

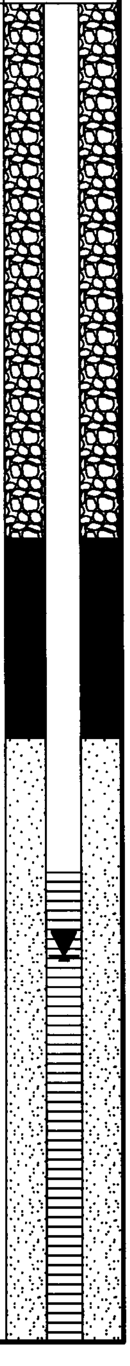
	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	2-16-11	10:45 AM	During Drilling	18	18	20
	2-17-11	8:00 AM	Start of Day	14.9	40	40
	2-22-11	2:00 PM	Static	14.2	40	40

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	DEPTH (Feet)	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.
						TOPSOIL		Groundwater measurements made during drilling may not represent static conditions.
S-1	2	0.6	1-4-4-3	8		**Clayey SILT**, Some f.m.c. Sand, trace organics/brick, dark brown/red, medium stiff, moist **(FILL)**		
					2	**Clayey SILT**, Some f.m.c. Sand, trace organics/brick, dark brown, medium stiff, moist **(FILL)**	414	
S-2	2	0.5	2-4-3-3	7				
					4	**Similar Soil (FILL)**	412	
S-3	2	0.3	2-3-3-2	6				
					6	**f. SAND**, little silt, trace organics, light brown, medium compact, moist **(FILL)**	410	
S-4	2	0.7	4-7-6-6	13				
					8	**f.m.c. SAND**, little silt, trace organics/coal/glass, brown, medium compact, moist **(FILL)**	408	
S-5	2	0.5	8-7-8-14	15				
					10		406	
					12		404	Driller notes easier drilling at 11.5.
						f.m.c. SAND, little clayey silt, trace f. gravel, mottled, very loose, moist **(SM)**		
S-6	2	0.2	2-2-2-2	4	14		402	
					16		400	
					18	**f.m.c. SAND**, little silt, trace f. gravel, light brown, very loose, wet **(SM)**	398	
S-7	2	0.4	2-2-2-1	4				

GRAPHICS



WATER LEVELS AND/OR WELL DATA



PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-21

Page 2 of 2

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	DEPTH (Feet)	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.
						f.m.c. SAND, trace silt, light brown, loose, wet **(SM)**		
S-8	2	0.1	2-4-5-4	9				
					22		394	
						PEAT, red/brown, medium stiff, moist **(PEAT)**		Organic odor noted in peat.
S-9	2	0.6	4-3-5-5	8	24		392	
						PEAT, light brown, soft, wet **(PEAT)**		
S-10	2	0.8	1-1-2-2	3	26		390	
						PEAT, light brown, medium stiff, moist **(PEAT)**		
S-11	2	1.3	2-3-3-6	6	28		388	
						Similar Soil (PEAT)		
S-12	2	1.1	3-3-5-5	8	30		386	
					32		384	
						Silty CLAY, gray, soft, wet **(CL)**		
S-13	2	2	WH-2-2-1	4	34		382	
					36		380	
					38	**Similar Soil (CL)**	378	
S-14	2	2	WH-2-1-3	3				
					40	End of Boring at 40 ft	376	
					42		374	
					44		372	

WATER LEVELS AND/OR WELL DATA

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-22

Page 1 of 2

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: Nature's Way

DRILLER: S. Gingrich

INSPECTOR: K. Owens

START DATE and TIME: 2/17/2011 8:15:00 AM

FINISH DATE and TIME: 2/17/2011 10:45:00 AM

SURFACE ELEV: 415.00 (ft; Estimated)

CHECKED BY: K. Adnams

DRILL FLUID: None

DRILLING METHOD: 2.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	2-17-11	9:20 AM	During Drilling	18	18	20
	2-17-11	10:40 AM	Casing Pulled	14.5	15	31

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	0.4	3-4-5-4	9				Clayey SILT, Some f.m.c. Sand, trace f. gravel, trace organics, brown, stiff, moist **(FILL)**	414		
						2		f.m.c. SAND, little clayey silt, trace f. gravel, trace organics, dark brown, loose, moist **(FILL)**			
S-2	2	0.4	3-3-2-1	5					412		
						4		grades to trace brick **(FILL)**			
S-3	2	0.3	2-2-5-3	7					410		
						6					
									408		
						8		No recovery		Plywood fragment blocking shoe of spoon S-4.	
S-4	2	0	7-4-3-5	7					406		
						10					
									404		
						12					
								f.m.c. SAND, little silt, trace f. gravel, trace rubber/concrete/brick, dark gray, compact, moist **(FILL)**	402	Driller notes harder drilling 13' to 15'.	
S-5	2	0.8	15-17-19-9	36		14					∇
									400	Groundwater observations made during drilling may not represent static conditions.	
						16					
									398	Driller notes harder drilling 17.5' to 22'.	
						18		No recovery			
S-6	2	0	11-9-5-6	14					396		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-22

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								f.m.c. SAND, Some Silt, black, trace organics, medium compact, wet **(SM)**		Organic odor noted in sample S-7.	
S-7	2	0.8	3-4-8-8	12					394		
						22		**Similar Soil (SM)**			
S-8	2	0.9	5-5-6-8	11					392		
						24		**Similar Soil (SM)**			
S-9	2	0.6	6-4-5-7	9					390		
						26		**PEAT**, light/dark brown, medium stiff, moist/wet **(PEAT)**		Organic odor noted in peat samples.	
S-10	2	1.2	5-3-3-3	6					388		
						28					
									386		
						30					
									384		
						32					
								Similar Soil (PEAT)	382		
								Silty CLAY, gray, soft, wet **(CL)**			
S-11	2	2	2-1-2-2	3		34					
									380		
						36					
									378		
						38		**Silty CLAY**, gray, very soft, moist/wet **(CL)**			
S-12	2	2	WR-WR-WH-2	0					376		
						40		End of Boring at 40 ft			
									374		
						42					
									372		
						44					

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field

SUBSURFACE LOG

HOLE NUMBER B-23

Page 1 of 1

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: Nature's Way

DRILLER: S. Gingrich

INSPECTOR: K. Owens

START DATE and TIME: 2/18/2011 8:00:00 AM

FINISH DATE and TIME: 2/18/2011 9:15:00 AM

SURFACE ELEV: 405.00 (ft; Estimated)

CHECKED BY: K. Adnams

DRILL FLUID: None

DRILLING METHOD: 2.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	2-18-11	8:45 AM	During Drilling	15	13	15
	2-18-11	9:00 AM	Casing Pulled	15.4	18	20

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	1	1-3-3-7	6				**Clayey SILT**, little f.m.c. sand, trace f. gravel, trace organics/brick/asphalt, brown, stiff, moist **(FILL)**	404	Cobbles and boulders visibile up the slope from the borehole site.	
						2					
S-2	2	0.4	5-10-12-12	22				**Clayey SILT**, little f.m.c. sand, little c. gravel, trace organics/asphalt, brown, very stiff, moist **(FILL)**	402	Driller notes possible cobbles/boulders while drilling.	
						4		**Similar Soil (FILL)**		Cobble fragment stuck in shoe of sample S-3.	
S-3	2	0.8	5-10-9-13	19				**f.m. SAND**, trace silt, light brown, medium compact, moist **(FILL)**	400		
						6		**Similar Soil (FILL)**			
S-4	2	0.6	10-11-5-5	16				**Clayey SILT**, little f.m.c. sand, trace f. gravel, brown, very stiff, moist **(FILL)**	398		
						8		**Clayey SILT**, trace f.m.c. sand, trace f. gravel, red/brown, medium stiff, moist **(FILL)**			
S-5	2	0.5	3-2-3-2	5					396		
						10		grades to little f.m.c. sand, becomes very stiff **(FILL)**			
S-6	2	0.7	4-16-15-12	31					394		
						12					
								Clayey SILT, little f.m.c. sand, trace f. gravel, trace asphalt, light brown/black, very stiff, moist/wet **(FILL)**	392		
S-7	2	1.3	4-9-11-9	20		14					
									390	Groundwater observations made during drilling may not represent static conditions.	▽
						16					
									388		
						18		**PEAT**, light brown, medium stiff, wet **(PEAT)**			
S-8	2	0.9	2-2-5-4	7					386		

End of Boring at 20 ft

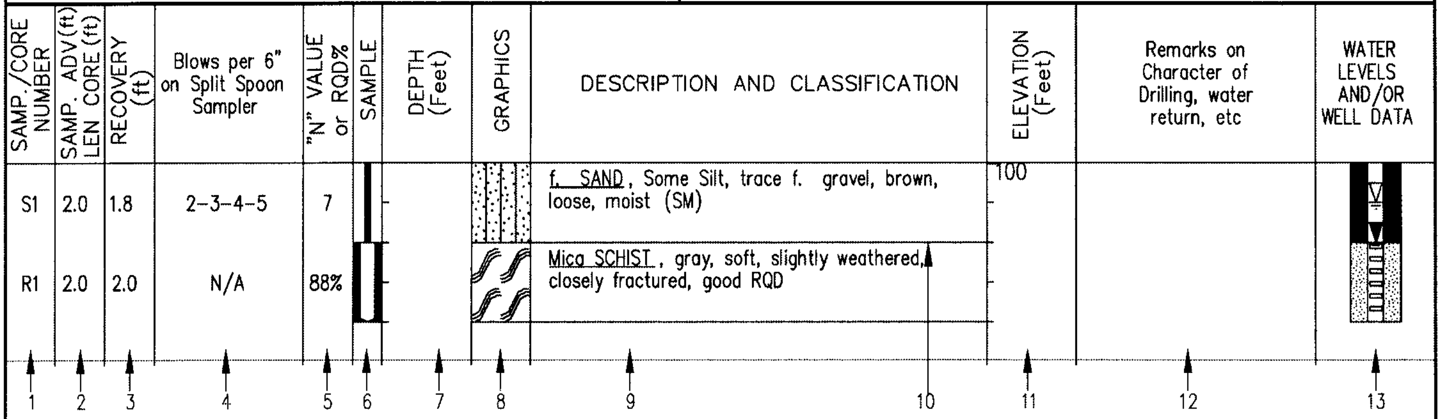
BORING LOGS

January 4-5, 2011 Subsurface Investigation

CHA

LEGEND TO SUBSURFACE LOGS

Page 1of 2



Subsurface Logs present material classifications, test data, and observations from subsurface investigations at the subject site as reported by the inspecting geologist or engineer. In some cases, the classifications may be made based on laboratory test data when available. It should be noted that the investigation procedures only recover a small portion of the subsurface materials at the site. Therefore, actual conditions between borings and sampled intervals may differ from those presented on the Subsurface Logs. The information presented on the logs provide a basis for an evaluation of the subsurface conditions and may indicate the need for additional exploration. Any evaluation of the conditions reported on the logs must be performed by Professional Engineers or Geologists.

1. SAMP./CORE NUMBER – Samples are numbered for identification on containers, laboratory reports or in text reports.

2. SAMP.ADV/LEN.CORE – Length of sampler advance or length of coring run measured in feet.

3. RECOVERY – Amount of sample actually recovered after withdrawing sampler or core barrel from bore hole measured in feet.

4. SAMPLE BLOWS/6" – Unless otherwise noted, blow counts represent values obtained by driving a 2.0" (O.D.), 1-3/8" (I.D.) split spoon sampler into the subsurface strata with a 140 pound weight falling 30" as per ASTM D 1586. After an initial penetration of 6" to seat the sampler into undisturbed material, the sampler is then driven an additional 2 or 3 six inch increments.

5. "N" Value or RQD % – "N" VALUE – The sum of the second and third sample blow increments is generally termed the Standard Penetration Test (SPT) "N" value. CORE RQD – Core Rock Quality Designation, RQD, is defined as the summed length of all pieces of core equal to or longer than 4 inches divided by the total length of the coring run. Fresh, irregular breaks distinguishable as being caused by drilling or recovery operations are ignored and the pieces are counted as intact lengths. RQD values are valid only for cores obtained with NX size core barrels.

6. SAMPLE – Graphical presentation of sample type and advance or core run length. See Table 1.

7. DEPTH – Depth as measured from the ground surface in feet.

8. GRAPHICS – Graphical presentation of subsurface materials. See Table 4. Dual soil classification and rock graphics may vary and are not shown on Table 4.

9. DESCRIPTION AND CLASSIFICATION – SOIL – Recovered samples are visually classified in the field by the supervising geologist or engineer unless otherwise noted. Particle size and plasticity classification is based on field observations, and using the Unified Soil Classification System (USCS). See Table 4. USCS symbols are presented in parentheses following the soil description. Where necessary, dual symbols may be used for combinations of soil types. Relative proportions, by weight and/or plasticity, are described in general accordance with "Suggested Methods of Test for Identification of Soils" by D.M. Burmister, ASTM Special Publication 479, 6-1970. See Table 2. Soil density or consistency description is based on the penetration resistance. See Table 3. Soil moisture description is based on the observed wetness of the soil recovered being dry, moist, wet, or saturated. Water introduced into the boring during drilling may affect the moisture content of the materials. Other geologic terms may also be used to further describe the subsurface materials. ROCK – Rock core descriptions are based on the inspector's observations and may be examined and described in greater detail by the project engineer or geologist. Terms used in the description of rock core are presented in Table 5.

10. DIVISION LINES – Division lines between deposits are based on field observations and changes in recovered material. Solid lines depict contacts between two deposits of different geologic depositional environment of known elevation. Dashed lines represent estimated elevation of contacts between two deposits of different geologic depositional environment. Dotted lines depict transitions of deposits within the same depositional environment, such as grain size or density.

11. ELEVATION – Elevation of strata changes in feet.

12. REMARKS – Miscellaneous observations.

13. WATER LEVELS & WELL DATA – Hollow water level symbol, if present, represents level at which first saturated sample or water level was encountered. Solid water level symbol, if present, depicts the most probable static water elevation at the time of drilling or as measured in an installed observation well at a later date. Subsurface water conditions are influenced by factors such as precipitation, stratigraphic composition, and drilling/coring methods. Conditions at other times may differ from those described on the logs. For graphical presentation of observation/monitoring well construction, see Table 6. Elevations of changes in construction are noted at the bottom of each section.

PROJECT NUMBER: 19217.8005.32000	**Onondaga County Sewer - Harbour Brook Field** SUBSURFACE LOG HOLE NUMBER B-01 Page 1 of 1

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt INSPECTOR: N. Bennett

START DATE and TIME: 1/4/2011 12:40:00 PM

FINISH DATE and TIME: 1/4/2011 1:36:00 PM

SURFACE ELEV: CHECKED BY: C. Symmes

DRILL FLUID: None DRILLING METHOD: 4.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-4-11	1:20 PM	During Drilling	5	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								SILT, trace f. sand, trace organics, gray, v. loose, moist **(ML)**			
S-1	2	1.1	WH-1-1-1	2							
						2		**Similar Soil (ML)**			
S-2	2	2	WH-WH-WH-1	0							
						4		**Similar Soil (ML)**			
S-3	2	1.6	WH-WH-WH-WH	0				becomes wet		Groundwater levels observed during drilling may not represent static conditions.	∇
						6		**Similar Soil (ML)**			
S-4	2	1.5	WH-WH-WH-WH	0							
						8		End of Boring at 8 ft			
						10					

PROJECT NUMBER: 19217.8005.32000

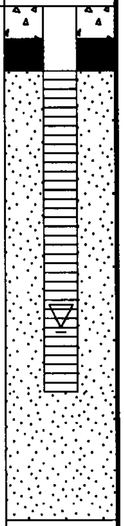
Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-02

Page 1 of 1

LOCATION: Syracuse, New York
CLIENT: CH2M Hill, Inc.
CONTRACTOR: TransTech Drilling Services
DRILLER: J. Leonhardt INSPECTOR: N. Bennett
START DATE and TIME: 1/4/2011 11:14:00 AM
FINISH DATE and TIME: 1/4/2011 12:00:00 PM
SURFACE ELEV: CHECKED BY: C. Symmes

DRILL FLUID: None DRILLING METHOD: 4.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-4-11	11:50 AM	During Drilling	5	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	1.3	1-2-2-1	4				**SILT**, Some f.m.c. Sand, little f.c. gravel, dark gray, v. loose, moist **(ML)**			
						2		**SILT**, trace f.c. gravel, dark gray, loose, moist **(ML)**			
S-2	2	1.4	2-3-2-2	5							
						4		becomes v. loose, wet **(ML)**			
S-3	2	1.4	1-WH-WH-1	0						Groundwater levels observed during drilling may not represent static conditions.	
						6		**SILT**, trace f. sand, gray, v. loose, wet **(ML)**			
S-4	2	1.1	1-WH-WH-WH	0							
						8		End of Boring at 8 ft		Piezometer installed at completion of boring.	
						10					
						12					
						14					
						16					
						18					

CHA

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-03

Page 1 of 1

PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt

INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 12:40:00 PM

FINISH DATE and TIME: 1/5/2011 1:00:00 PM

SURFACE ELEV:

CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-5-11	12:42 PM	During Drilling	0.1	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	0	WH-WH-WH-WH	0				No Recovery		Groundwater levels observed during drilling may not represent static conditions.	∇
S-2	2	0	WH-WH-WH-WH	0		2		No Recovery		Soil from surface to a depth of 4 feet interpreted to be peat based on auger cuttings.	
S-3	2	1.1	WH-WH-WH-1	0		4		**SILT**, little wood, trace f. sand, trace organics, lt. brown, v. loose, wet **(ML)**			
S-4	2	1.4	1-0-1-WH	1		6		**PEAT**, dark brown, v. soft, wet **(Pt)** **Clayey SILT**, trace f. sand, trace organics, gray, v. soft, wet **(ML)**			
						8		End of Boring at 8 ft			
						10					
						12					
						14					
						16					
						18					

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-04

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PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt INSPECTOR: N. Bennett

START DATE and TIME: 1/4/2011 10:45:00 AM

FINISH DATE and TIME: 1/4/2011 11:14:00 AM

SURFACE ELEV: 396.00 (ft; Estimated) CHECKED BY: C. Symmes

DRILL FLUID: None DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-4-11	11:05 AM	During Drilling	4.2	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	0.1	WH-1-2-1	3				TOPSOIL PEAT, mottled brown/lt. brown, soft, moist **(Pt)**			
						2			394		
S-2	2	0.4	1-2-1-1	3				Clayey SILT, little organics, trace f. sand, lt. brown, soft, moist **(ML)** becomes mottled brown/lt. brown **(ML)**			
						4		Clayey SILT, trace f. sand, trace organics, lt. brown, v. soft, wet **(ML)**	392	Groundwater levels observed during drilling may not represent static conditions.	▽
S-3	2	1.7	WH-WH-WH-WH	0				becomes dark brown **(ML)**			
						6		Similar Soil **(ML)** becomes gray **(ML)**	390		
S-4	2	1.1	WH-WH-WH-WH	0				Clayey SILT, trace f. sand, lt. brown, v. soft, wet **(ML)** PEAT, dark brown, v. soft **(Pt)**			
						8		End of Boring at 8 ft	388		
						10			386		
						12			384		
						14			382		
						16			380		
						18			378		

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-05

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PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt INSPECTOR: N. Bennett

START DATE and TIME: 1/4/2011 9:30:00 AM

FINISH DATE and TIME: 1/4/2011 10:45:00 AM

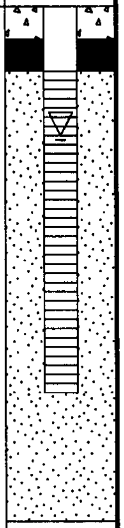
SURFACE ELEV: 396.00 (ft; Estimated) CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-4-11	9:40 AM	During Drilling	2	6	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	1	2-3-2-2	5				**CLAY**, trace c. gravel, trace organics, lt. brown, med. stiff, moist **(CL)**			
						2		**CLAY**, trace f. gravel, trace organics, lt. brown, v. soft, wet **(CL)**	394	Groundwater levels observed during drilling may not represent static conditions.	
S-2	2	1.1	1-WH-WH-1	0				**PEAT**, dark brown, v. soft, wet **(Pt)**			
						4		No Recovery	392		
S-3	2	0	WH-WH-WH-WH	0							
						6		**Clayey SILT**, trace organics, dark brown, v. soft, wet **(ML)**	390		
S-4	2	1.8	1-0-1-1	1				**PEAT**, brown, v. soft, wet **(Pt)**			
						8		End of Boring at 8 ft	388	Piezometer installed at completion of boring.	
						10			386		
						12			384		
						14			382		
						16			380		
						18			378		



Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-06

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PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt INSPECTOR: N. Bennett

START DATE and TIME: 1/4/2011 1:20:00 PM

FINISH DATE and TIME: 1/4/2011 1:37:00 PM

SURFACE ELEV: 406.00 (ft; Estimated) CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-4-11	1:37 PM	Completion	None	10	12

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	1.5	4-5-8-6	13				**SILT**, trace f. sand, trace c. gravel, gray, m. compact, moist **(FILL)**		Groundwater levels observed during drilling may not represent static conditions.	
S-2	2	1.1	5-4-5-6	9		2		**SILT**, trace f. sand, trace f. gravel, gray, loose, moist **(FILL)**	404		
S-3	2	1.6	2-1-2-3	3		4		**SILT**, trace f. sand, trace glass/brick, gray, v. loose, moist **(FILL)**	402		
S-4	2	0.1	5-5-4-3	9		6		**SILT**, trace f. sand, trace f. gravel, gray, loose, moist **(FILL)**	400		
S-5	2	0	3-2-4-3	6		8		No Recovery **(FILL)**	398	Glass shard blocking shoe in Sample S-5.	
						10		**Similar Soil (FILL)**	396		
S-6	2	1.2	4-1-4-3	5				**PEAT**, dark brown, soft, moist **(Pt)**			
						12		End of Boring at 12 ft	394		
						14			392		
						16			390		
						18			388		

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field

SUBSURFACE LOG

HOLE NUMBER B-07

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LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt   INSPECTOR: N. Bennett

START DATE and TIME: 1/4/2011 1:40:00 PM

FINISH DATE and TIME: 1/4/2011 2:06:00 PM

SURFACE ELEV: 406.80 (ft; Estimated)   CHECKED BY: C. Symmes

DRILL FLUID: None   DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-4-11	2:06 PM	Completion	None	10	12

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	1.6	2-3-5-4	8	▮		▨	**SILT**, trace f. sand, trace f. gravel, trace wood, dark gray, loose, moist **(FILL)**	406	Groundwater levels observed during drilling may not represent static conditions.	
S-2	2	0.4	9-4-5-3	9	▮	2	▨	**f.m.c. SAND**, little f.c. gravel, trace silt, trace asphalt, mottled brown/white, loose, moist **(FILL)**	404		
S-3	2	0.2	2-1-2-4	3	▮	4	▨	becomes v. loose **(FILL)**	402	Poor recovery Sample S-3, blockage in shoe.	
S-4	2	1	4-2-2-1	4	▮	6	▨	**f.m. SAND**, little f. gravel, trace silt, brown, v. loose, moist **(FILL)**	400		
S-5	2	0.3	1-2-2-1	4	▮	8	▨	**Similar Soil** **(FILL)**	398	Poor recovery Sample S-5, blockage in shoe.	
S-6	2	0.3	1-0-1-2	1	▮	10	▨	**Similar Soil** **(FILL)**	396	Poor recovery Sample S-6, rotting wood blocking shoe.	
						12		End of Boring at 12 ft	394		
						14			392		
						16			390		
						18			388		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-08

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LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt | INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 7:40:00 AM

FINISH DATE and TIME: 1/5/2011 8:10:00 AM

SURFACE ELEV: 396.00 (ft; Estimated) | CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-5-11	8:00 AM	During Drilling	5	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	0.8	WH-2-1-2	3				**SILT**, trace f. sand, trace organics, dark brown, v. loose, moist **(ML)**			
						2		**SILT**, little wood, dark brown, v. loose, moist **(ML)**	394		
S-2	2	0.5	1-2-2-1	4							
						4		No Recovery	392	No soil recovery Sample S-3, wood plugged spoon and shoe. Groundwater levels observed during drilling may not represent static conditions.	
S-3	2	0.1	WH-WH-WH-WH	0							∇
						6		**PEAT**, dark brown, v. soft, wet **(Pt)**	390		
S-4	2	0.9	WH-WH-WH-WH	0							
						8		End of Boring at 8 ft	388		
						10			386		
						12			384		
						14			382		
						16			380		
						18			378		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-09

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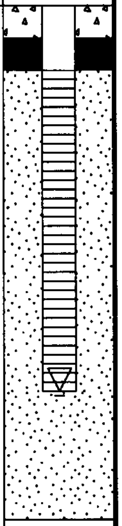
LOCATION: Syracuse, New York
CLIENT: CH2M Hill, Inc.
CONTRACTOR: TransTech Drilling Services
DRILLER: J. Leonhardt INSPECTOR: N. Bennett
START DATE and TIME: 1/4/2011 2:19:00 PM
FINISH DATE and TIME: 1/4/2011 2:55:00 PM
SURFACE ELEV: 396.40 (ft; Estimated) CHECKED BY: C. Symmes

DRILL FLUID: None
DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-4-11	2:30 PM	During Drilling	6	6	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	0.7	2-2-2-2	4				**f.m. SAND**, trace f.c. gravel, trace concrete block, trace glass, dark gray/white, v. loose, moist **(FILL)**	396		
S-2	2	1.7	1-2-3-2	5		2		**SILT**, trace f. sand, dark gray/brown, loose, moist **(ML)**	394		
S-3	2	0.4	2-2-2-1	4		4		**SILT**, Some Wood, dark brown, v. loose, moist **(ML)**	392		
S-4	2	1.9	1-2-2-2	4		6		**Clayey SILT**, trace wood, gray, soft, wet **(ML)**	390	Groundwater levels observed during drilling may not represent static conditions.	
						8		End of Boring at 8 ft	388	Piezometer installed at completion of boring.	
						10			386		
						12			384		
						14			382		
						16			380		
						18			378		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-10

Page 1 of 1

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 12:10:00 PM

FINISH DATE and TIME: 1/5/2011 12:40:00 PM

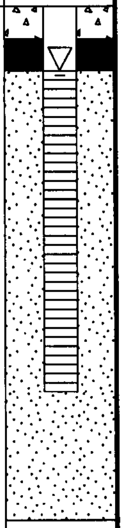
SURFACE ELEV:

CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-5-11	12:42 PM	During Drilling	1	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								No Recovery			
S-1	2	0	WH-WH-WH-WH	0						Groundwater levels observed during drilling may not represent static conditions.	
						2		**SILT**, trace f. sand, trace organics, dark brown, v. soft, wet **(ML)**			
S-2	2	0.4	WH-0-1-1	1							
						4		No Recovery			
S-3	2	0	WH-WH-WH-WH	0							
						6		No Recovery		Soil from a depth of 6 to 8 feet interpreted to be Peat based on auger cuttings.	
S-4	2	0	WH-WH-WH-WH	0							
						8		End of Boring at 8 ft		Piezometer installed at completion of boring.	
						10					
						12					
						14					
						16					
						18					

CHA

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-11

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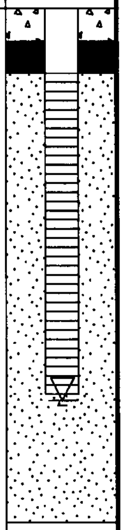
PROJECT NUMBER: 19217.8005.32000	
LOCATION: Syracuse, New York	DRILL FLUID: None
CLIENT: CH2M Hill, Inc.	DRILLING METHOD: 4.25" HSA
CONTRACTOR: TransTech Drilling Services	
DRILLER: J. Leonhardt	INSPECTOR: N. Bennett
START DATE and TIME: 1/4/2011 3:00:00 PM	
FINISH DATE and TIME: 1/4/2011 3:30:00 PM	
SURFACE ELEV: 396.00 (ft; Estimated)	CHECKED BY: C. Symmes

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-5-11	3:25 PM	During Drilling	6.1	6	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								Clayey SILT, trace organics, dark brown, soft, moist **(ML)**			
S-1	2	0.4	WH-1-2-2	3							
						2		**Similar Soil** **(ML)** **SILT**, trace f. sand, brown, loose, moist **(ML)**	394		
S-2	2	0.8	3-3-3-3	6							
						4		**Similar Soil** **(ML)**	392	Poor recovery Sample S-3.	
S-3	2	0.1	WH-0-1-WH	1							
						6		**Clayey SILT**, trace organics, trace wood, gray, v. soft, wet **(ML)**	390	Groundwater levels observed during drilling may not represent static conditions. Organic odor noted in sample S-4.	
S-4	2	0.8	WH-1-0-WH	1				**PEAT**, dark brown, v. soft, wet **(ML)**			
						8		End of Boring at 8 ft	388	Piezometer installed at completion of boring.	
						10			386		
						12			384		
						14			382		
						16			380		
						18			378		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-12

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LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt   INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 8:40:00 AM

FINISH DATE and TIME: 1/5/2011 9:00:00 AM

SURFACE ELEV: 396.20 (ft; Estimated)   CHECKED BY: C. Symmes

DRILL FLUID: None   DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-5-11	9:00 AM	Completion	None	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								SILT, trace f. sand, trace organics, dark brown, v. loose, moist **(ML)**	396		
S-1	2	0.7	WH-2-1-2	3							
						2		becomes loose **(ML)**	394		
S-2	2	0.9	2-3-7-7	10							
						4		**Silty CLAY**, trace organics, gray, v. soft, moist **(CL)**	392	Wood blocking shoe in Sample S-2.	
S-3	2	1.2	1-WH-WH-WH	0							
						6		becomes soft **(CL)**	390		
S-4	2	1.7	WH-0-3-2	3							
						8		End of Boring at 8 ft	388	Groundwater levels observed during drilling may not represent static conditions.	
						10			386		
						12			384		
						14			382		
						16			380		
						18			378		

PROJECT NUMBER: 19217.8005.32000	**Onondaga County Sewer - Harbour Brook Field** SUBSURFACE LOG HOLE NUMBER B-13 Page 1 of 1

LOCATION: Syracuse, New York		DRILL FLUID: None	DRILLING METHOD: 4.25" HSA
CLIENT: CH2M Hill, Inc.			
CONTRACTOR: TransTech Drilling Services			
DRILLER: J. Leonhardt	INSPECTOR: N. Bennett		
START DATE and TIME: 1/5/2011 8:12:00 AM			
FINISH DATE and TIME: 1/5/2011 8:32:00 AM			
SURFACE ELEV: 395.50 (ft; Estimated)	CHECKED BY: C. Symmes		

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-5-11	8:20 AM	During Drilling	4	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	0.8	WH-1-2-2	3				Clayey SILT, trace f. sand, trace organics, dark brown, soft, moist **(ML)**	394		
						2		SILT, little wood, trace f. sand, dark brown, loose, moist **(ML)**			
S-2	2	1.2	2-3-2-3	5					392		∇
						4		Clayey SILT, trace f. sand, trace organics, dark brown, v. soft, wet **(ML)**		Groundwater levels observed during drilling may not represent static conditions.	
S-3	2	1.5	WH-WH-WH-WH	0					390		
						6					
S-4	2	0.7	WH-1-0-1	1				PEAT, dark brown, v. soft, wet **(Pt)**	388		
						8		End of Boring at 8 ft			
									386		
						10					
									384		
						12					
									382		
						14					
									380		
						16					
									378		
						18					
									376		

CHA

PROJECT NUMBER: 19217.8005.32000

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-14

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LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 11:15:00 AM

FINISH DATE and TIME: 1/5/2011 11:35:00 AM

SURFACE ELEV: 394.50 (ft; Estimated) CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
WATER LEVEL OBSERVATIONS	1-5-11	11:15 AM	During Drilling	2	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								SILT, trace f. sand, trace organics, dark brown, loose, moist **(ML)**	394		
S-1	2	0.8	1-2-3-4	5							
						2		becomes wet **(ML)**		Groundwater levels observed during drilling may not represent static conditions.	∇
								PEAT, dark brown, med. stiff, wet **(Pt)**	392		
S-2	2	0.9	4-4-4-4	8							
						4		**Clayey SILT**, trace organics, dark brown, v. soft, wet **(ML)**			
									390		
S-3	2	0.1	WH-WH-WH-1	0							
						6		**Similar Soil (ML)**			
								PEAT, dark brown, v. soft, wet **(Pt)**	388		
S-4	2	0.4	WH-0-1-WH	1							
						8		End of Boring at 8 ft			
									386		
						10					
									384		
						12					
									382		
						14					
									380		
						16					
									378		
						18					
									376		

Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-15

Page 1 of 1

PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt   INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 10:20:00 AM

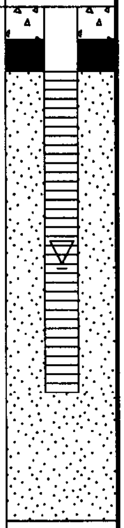
FINISH DATE and TIME: 1/5/2011 11:00:00 AM

SURFACE ELEV: CHECKED BY: C. Symmes

DRILL FLUID: None   DRILLING METHOD: 4.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-5-11	10:45 AM	During Drilling	4	6	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
								TOPSOIL			
S-1	2	1	WH-2-5-6	7				**SILT**, trace f. sand, trace organics, dark brown, loose, moist **(ML)**			
						2		becomes m. compact **(ML)**			
S-2	2	0.9	3-5-6-6	11							
						4		**Clayey SILT**, trace organics, dark brown, v. soft, wet **(ML)**		Poor recovery Sample S-3, wood in shoe. Groundwater levels observed during drilling may not represent static conditions.	
S-3	2	0.3	WH-WH-WH-1	0							
						6		**Similar Soil (ML)**			
S-4	2	1.9	WH-0-1-1	1							
						8		**PEAT**, dark brown, v. soft, wet **(Pt)** End of Boring at 8 ft		Piezometer installed at completion of boring.	
						10					
						12					
						14					
						16					
						18					



Onondaga County Sewer - Harbour Brook Field
SUBSURFACE LOG
HOLE NUMBER B-16

Page 1 of 1

PROJECT NUMBER: 19217.8005.32000

LOCATION: Syracuse, New York

CLIENT: CH2M Hill, Inc.

CONTRACTOR: TransTech Drilling Services

DRILLER: J. Leonhardt | INSPECTOR: N. Bennett

START DATE and TIME: 1/5/2011 8:52:00 AM

FINISH DATE and TIME: 1/5/2011 9:20:00 AM

SURFACE ELEV: | CHECKED BY: C. Symmes

DRILL FLUID: None

DRILLING METHOD: 4.25" HSA

WATER LEVEL OBSERVATIONS	DATE	TIME	READING TYPE	WATER DEPTH (ft)	CASING BOTTOM (ft)	HOLE BOTTOM (ft)
	1-5-11	9:07 AM	During Drilling	4	4	8

SAMP./CORE NUMBER	SAMP. ADV. (ft) LEN. CORE (ft)	RECOVERY (ft)	Blows Per 6" on Split Spoon Sampler	"N" Value or RQD%	SAMPLE	DEPTH (Feet)	GRAPHICS	DESCRIPTION AND CLASSIFICATION	ELEVATION (Feet)	Remarks on Character of Drilling, Water Return, etc.	WATER LEVELS AND/OR WELL DATA
S-1	2	0.7	1-6-6-5	12				**SILT**, trace f. sand, trace organics, dark brown, m. compact, moist **(ML)**			
						2		becomes v. loose **(ML)**			
S-2	2	0.9	3-2-2-3	4				**PEAT**, dark brown, soft, moist **(Pt)**		Organic odor noted in Sample S-2.	
						4		becomes v. soft, wet **(Pt)**		Groundwater levels observed during drilling may not represent static conditions.	∇
S-3	2	1.2	WH-WH-WH-1	0							
						6					
S-4	2	1.1	WH-WH-WH-1	0				**Clayey SILT**, trace f. sand, trace organics, dark brown, v. soft, wet **(ML)** becomes tan **(ML)**			
						8		End of Boring at 8 ft			
						10					
						12					
						14					
						16					
						18					

Appendix B

Brown and Caldwell SWMM Model Technical Memorandum

Technical Memorandum

290 Elwood Davis Road, Suite 290
Liverpool, NY 13088
Phone: 315-449-3010

Technical Memorandum

Subject: Harbor Brook CSO 018 Model Results

Date: May 24, 2011

To: Rita Fordiani, P.E. (CH2M)

Copy: Robert Kukenberger, P.E. (CDM)
Richard DeGuida, P.E. (CHA)

From: Daniel Gilbert, P.E.
Daniel Davis, P.E.

1. INTRODUCTION

This technical memorandum summarizes the model flows and volumes for CSO 018 in the Harbor Brook watershed. The model results are provided to assist others currently designing a wetland treatment system for the CSO 018 discharge.

Both single-event and continuous simulations were used to project the peak flows and volumes to the proposed treatment system. The design storms included the one-year and 10-year return frequencies, two-hour duration, 15-minute intervals. The continuous simulation approach included the typical year (1991) which is based on historical hourly rainfall data.

2. ASSUMPTIONS AND MODEL MODIFICATIONS

For this evaluation, two model scenarios were simulated for future conditions. The first model scenario was the Future Baseline Condition which includes all the planned “gray” projects in the Harbor Brook basin. The second model scenario was the Future Alternative Condition which includes the Future Baseline plus the addition of the planned grit facility and wetland at CSO 018.

2.1 Future Baseline Condition (No Wetland at CSO 018)

The SWMM model of the Harbor Brook basin has been recently modified to include the following future conditions:

- Lower Harbor Brook Storage Facility: New 4.9 MG tank to store flows from CSOs 003, 004, and 063.
- HBIS Replacement: New Harbor Brook Interceptor Sewer from CSO 078 to CSO 009. The new HBIS removes the existing interceptor defect, and includes new regulator structures at the CSO locations.
- New regulator size (12-inch) has been incorporated into the CSO 018 regulator
- Sewer Separation: CSOs areas 013 and 016 are separated and closed.

The proposed wetland treatment system for CSO 018 is a full-scale pilot and is part of the system-wide CSO abatement program for Onondaga County. Based upon more detailed review of the local sewers tributary to CSO 018 it was determined that the model should be modified to incorporate additional details to be more consistent with the wetland project in the design phase. The previous model evaluations for this area were conducted for planning purposes. The following modifications were made to the Harbor Brook SWMM model to better represent the CSO 018 sewers and tributary area.

- Minor losses were added to the new regulator structure at CSO 018.
- The CSO 018 area was reviewed in detail and updated in the GIS. Based on minor differences in the boundary of the drainage areas, the current area was reduced by approximately 15%.
- The modeled sewers in the CSO 018 vicinity were reviewed and compared to the sewers shown on the Mile Square maps. In the model, all the flow from CSO 018 area was previously conveyed through a single pipe (18-inch sewer) along Bellevue Avenue. Detailed review of the drainage area shows that approximately 84% of the area should be conveyed through that single pipe and the remaining 16% of the area is conveyed through two additional pipes. This additional piping was added to the model. In addition, the CSO018 area was split from one large area into three areas to allow runoff to enter the system at the three different points.

- Following these changes noted above, the monitoring data from CSO 018 collected in 2004 was re-evaluated and the model calibration for this local area was updated. A separate memo will be developed to document the updated calibration of CSO 018 which will be part of the next annual SWMM update.

It is worth noting that the CSO 018 regulator has historically been subjected to increased inflows from the CSO 078 area. During springtime periods these increased flows get regulated down to the 018 regulator. The planned regulator improvements at CSO 018, as part of the HBIS replacement, will serve to improve the frequency of overflows that currently exist at this location.

Additionally, collection system staff indicated that the City may have had some historical basement backup along the Rowland Trunk Sewer in the vicinity of Onondaga St. and/or Bellevue Avenue. This is consistent with the high HGL during peak wet-weather in the model at this location. Any modifications that may impact the hydraulic grade line in this portion of the City's collection system should be reviewed and evaluated so as not to worsen hydraulic conditions in this part of the collection system.

2.2 Future Alternative Condition (With Wetland at CSO 018)

The future condition Harbor Brook SWMM model, described above, was modified to include the planned grit facility and wetland at CSO 018. The modifications include the following:

- Flow is intercepted at the upstream end of the 48" Rowland Trunk Sewer and diverted to a new grit facility. The grit facility is a vortex unit with an approximate volume of 0.0337 MG.
- There are three discharge locations from the grit facility. One discharge is the underflow to the new HBIS which is controlled to by a valve. Another discharge is the overflow to the wetlands, and the final discharge is an emergency bypass that is directed back to the 48" Rowland Truck Sewer and is conveyed to the baseline CSO 018 regulator/weir structure.

3. MODEL RESULTS

3.1 Future Baseline Condition (No Wetland at CSO 018)

The baseline condition model was run with design storm and typical year rainfall. Table 1 summarizes the future baseline CSO 018 flows for the 1-year and 10-year design storms, as well as the typical year. The 1-year design storm peak overflow rate and volume is 40 cfs and 0. 7 MG, respectively. The peak regulated flow ranges from about 5 to 8 cfs during overflow, as illustrated in Figure 1. The regulated flow can vary depending on the dynamic conditions within the trunk sewer and HBIS that occur during wet-weather conditions.

The expected maximum flow in the Rowland trunk sewer is approximately 49 cfs (10-year design storm). In addition, based on the model results for the typical year condition, the overflow is expected to activate approximately 42 times per year with an annual overflow volume of 13.6 MG, and a peak event volume of 1.8 MG.

A frequency distribution chart was created for typical year event volumes discharged from CSO 018 overflow, and is provided in Figure 2. In the typical year a total of 42 events are expected to discharge from the CSO 018 overflow. Approximately 37 of the events are expected to have a volume of 0.7 MG or less.

Table 1. CSO 018 Future Baseline Flows and Volumes.

Location	1-yr Design Storm		10-yr Design Storm		1991 Typical Year		
	Peak Flow, cfs	Future Overflow Volume, MG	Peak Flow, cfs	Future Overflow Volume, MG	*Overflow Frequency, times/ year	Annual Overflow Volume, MG	*Peak Event Overflow Volume, MG
CSO 018 Total Flow	44	NA	49	NA	NA	NA	NA
CSO 018 Regulated Flow	5-8	NA	5-8	NA	NA	NA	NA
CSO 018 Overflow	40	0.7	45	1.4	42	13.6	1.8

**Inter event duration of 6 hours.*

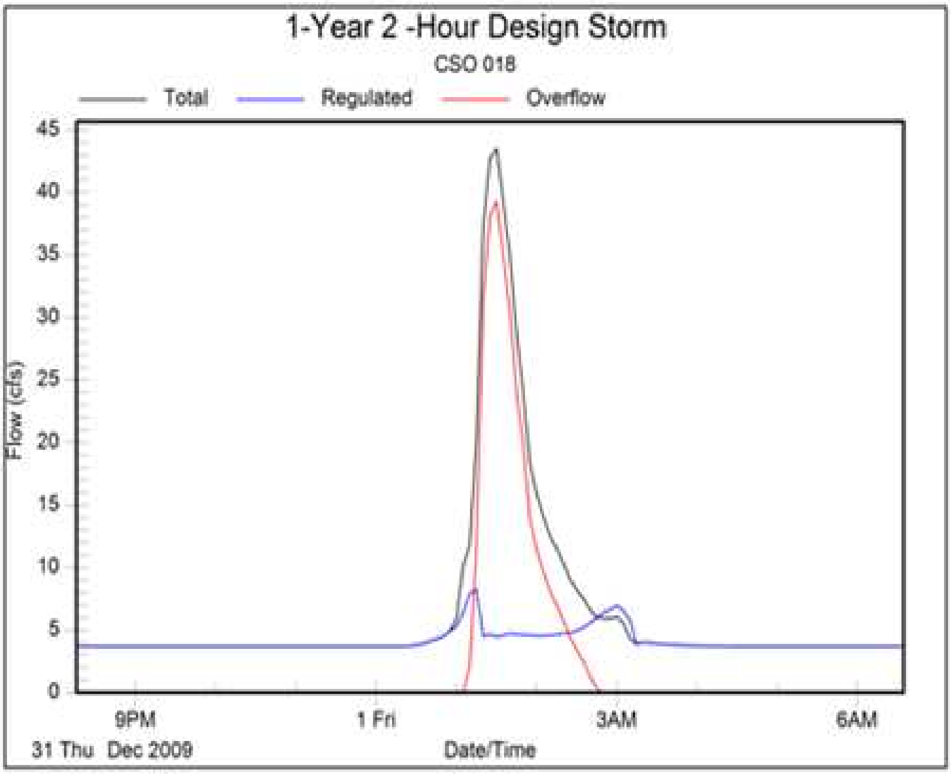


Figure 1. Future Baseline CSO 018 Flows, 1-Year Design Storm.

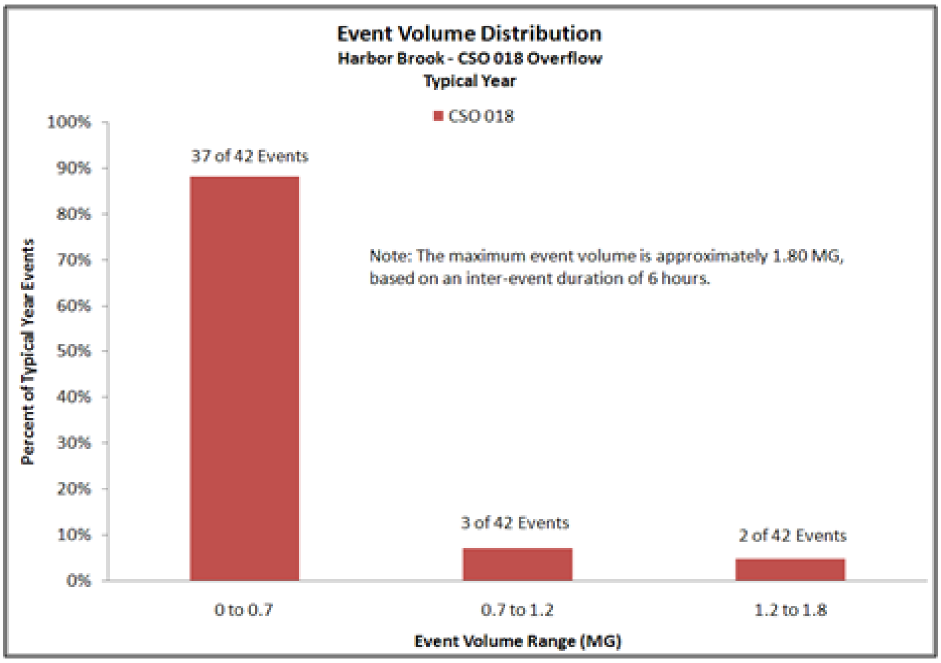


Figure 2. Future Baseline CSO 018 Event Volume Frequency Distribution, 1991 Typical Year.

3.2 Future Alternative Condition (With Wetland at CSO 018)

The alternative condition model was run with design storm and typical year rainfall. The hydraulics of the alternative condition are different from the hydraulics of the baseline condition. As illustrated in Figure 3, in the alternative condition the flow is intercepted at the upstream end of the Rowland Trunk Sewer and diverted to the new grit facility. The flow is then regulated to the HBIS, and overflow is conveyed to the new wetlands. For extreme events, excess flow can be diverted back to the Rowland Trunk Sewer and then the baseline regulator structure. The underflow (or regulated flow) from the grit facility will have a fixed maximum capacity controlled by a valve. The baseline regulator does not have the same restriction and is more significantly influenced by the hydraulics of the HBIS.

Due to the new hydraulics and regulated flow in the alternative condition, it was important to test the alternative condition for various maximum regulator flows to see which best reflects baseline conditions. The alternative condition model was simulated with four different maximum capacities for the underflow (regulated flow) from the grit facility. The underflows tested were 5, 6, 7 and 8 cfs which is the range of regulated flow found in the baseline condition. Table 2 summarizes the results of the alternative model runs and provides the baseline results for comparison.

The results show that the alternative condition with 6 cfs underflow compares most favorable to baseline conditions with respect to typical year frequency and overflow volume. However, for this scenario, the baseline CSO 018 weir does active at the 1-year design storm and in the typical year. The HBIS is being relieved by the baseline weir during peak wet-weather conditions. The baseline weir would need to be raised by approximately 0.25-0.5 ft to mitigate this activation. Any weir raise performed should be done in a way to provide flexibility for future adjustment if needed. Another option to mitigate the baseline weir activation would be to modify the new regulating valve. These and any other available options should be evaluated during final design. Table 3 provides the typical year event flows and volumes from the grit overflow for the 6 cfs regulator scenario.

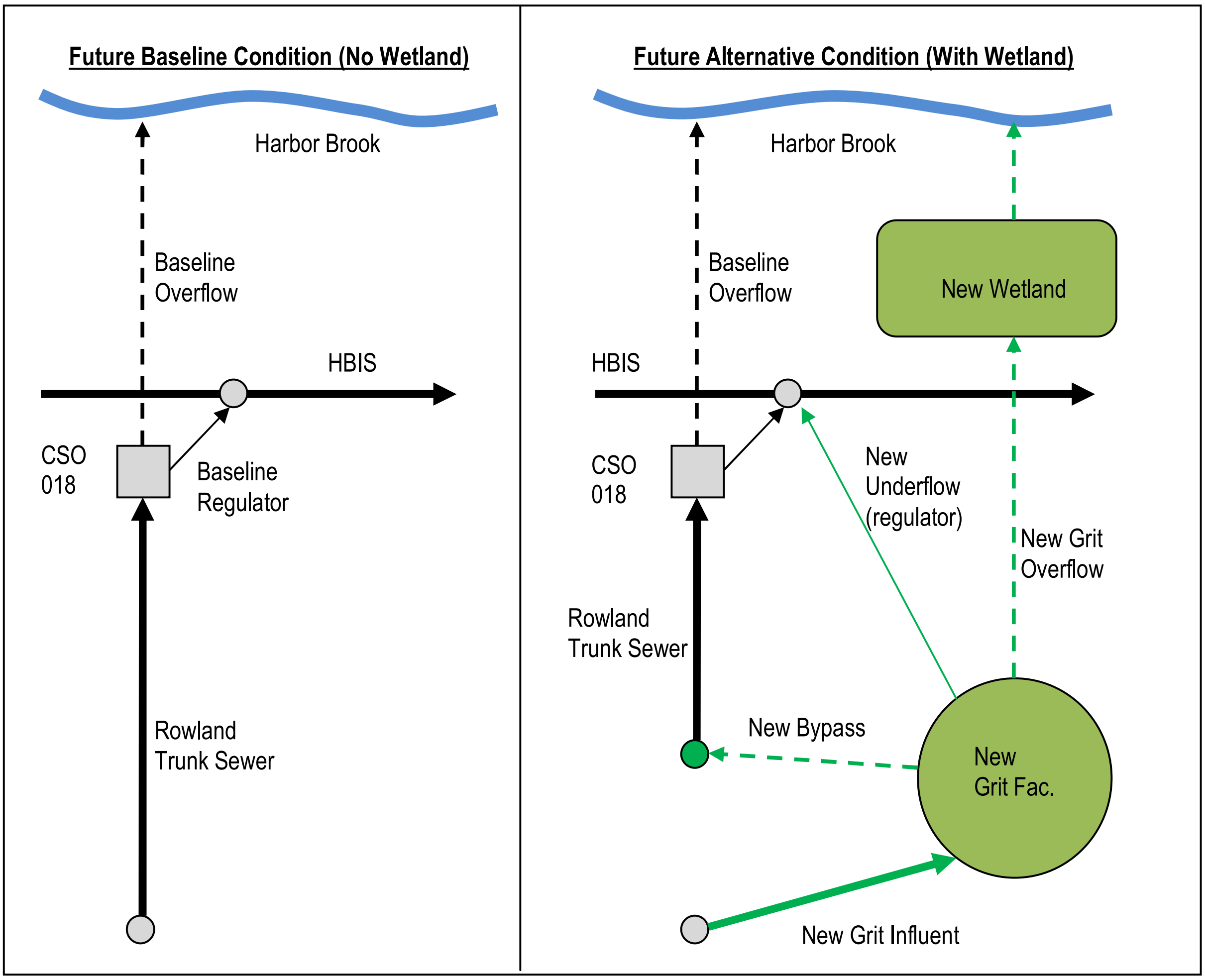


Figure 3. Schematic of Future Baseline and Alternative Conditions.

Table 2. CSO 018 Baseline and Alternative Flows and Volumes.

Model Scenario	Max. Regulated Flow, cfs	1-yr Design Storm			1991 Typical Year			
		Peak Overflow, cfs	Overflow Volume, MG	Baseline 018 Weir Active?	*Overflow Frequency, times/ year	Total Overflow Volume, MG	*Peak Event Overflow Volume, MG	Baseline 018 Weir Active?
Baseline Cond.	5-8	40	0.7	NA	42	13.6	1.8	NA
Alternative Cond.	5	39	0.65	No	47	18.2	1.9	No
	6	38	0.60	Yes	41	13.4	1.6	Yes
	7	37	0.55	Yes	33	10.2	1.4	Yes
	8	36	0.50	Yes	31	8.0	1.2	Yes

**Inter event duration of 6 hours.*

Table 3. Typical Year Event Flows and Volumes – Grit Overflow (6 cfs regulator capacity).

Event #	Event Date	Peak Overflow, cfs	Overflow Volume, MG	Event #	Event Date	Peak Overflow, cfs	Overflow Volume, MG
1	1/11/1991	8	0.13	23	7/22/1991	40	0.71
2	1/16/1991	5	0.23	24	7/23/1991	0	0.001
3	3/2/1991	10	0.04	25	8/3/1991	13	0.20
4	3/3/1991	8	0.63	26	8/9/1991	20	1.64
5	3/23/1991	16	0.25	27	8/20/1991	18	0.27
6	3/27/1991	10	0.27	28	8/31/1991	29	0.53
7	4/8/1991	8	0.06	29	9/4/1991	4	0.01
8	4/10/1991	11	0.11	30	9/10/1991	15	0.15
9	4/15/1991	15	0.19	31	9/15/1991	20	0.96
10	4/21/1991	9	0.59	32	9/18/1991	24	0.34
11	5/6/1991	5	0.07	33	9/19/1991	7	0.16
12	5/10/1991	6	0.11	34	9/24/1991	13	0.63
13	5/17/1991	19	0.47	35	10/5/1991	6	0.07
14	5/25/1991	12	0.18	36	10/10/1991	3	0.03
15	5/26/1991	21	1.27	37	10/15/1991	9	0.74
16	5/30/1991	12	0.08	38	11/24/1991	2	0.06
17	6/11/1991	24	0.32	39	11/28/1991	8	0.08
18	6/12/1991	27	0.39	40	12/3/1991	5	0.30
19	6/30/1991	12	0.22	41	12/29/1991	3	0.10
20	7/5/1991	40	0.71	TYPICAL YEAR TOTAL		NA	13.4
21	7/7/1991	4	0.03	EVENT PEAK		38	1.64
22	7/13/1991	5	0.04				

Appendix C

Technical Memorandum – Grit & Floatables Removal Alternative

Technical Memorandum

To: CH2M Hill

From: CHA

Date: March 3, 2011 (Revised 4/21/11)

Re: **Harbor Brook CSO #018 Constructed Wetlands Pilot Treatment System Evaluation of Grit and Floatables Removal System Alternatives**

I. Introduction

As part of the Onondaga County "Save the Rain" Green Infrastructure Program, a constructed wetlands pilot treatment system will be constructed as a pilot treatment facility for combined sewer overflow (CSO) #018. An integral and important component of this treatment facility will be grit and floatables removal facilities. Grit and floatables removal are required upstream of the wetland treatment system to protect these natural treatment systems from an influx of inorganic materials. Grit removal is required to prevent filling in of the wetland treatment cells with inert solids, thereby reducing the treatment capacity of the constructed wetlands system. In addition, floatables removal is required to prevent clogging of the wetland cell media, prevent danger to wildlife attracted to the facility, and ensure an aesthetically pleasing and attractive area is maintained.

Several grit and floatables removal systems have already been considered by the Onondaga County Department of Water Environment Protection (OCDWEP) for implementation at CSO #018. The *Floatable Control Facility Plan*, prepared by ARCADIS (dated November 16, 2010), considered the following technologies that have been used across the USA for CSO floatables control:

1. Mechanically Raked CSO Bar Screens
2. Mechanically Cleaned Conventional Screens
3. Horizontal Band Screens
4. Low Profile Overflow Screens
5. Rotary Drum Sieve Screens
6. Pump Action Screens
7. Brush Screens
8. Oscillating Static Screens
9. Static Screens
10. Drum Screens
11. Continuous Deflection Separation

A cost-effectiveness evaluation of these floatables control technologies in the report led to a recommended floatables control technology for CSO #018, which consists of a mechanically cleaned CSO bar screen (sized for 27 cfs).

In addition, a full-scale Storm King with Swirl Cleanse screen unit (as manufactured by Hydro International) for both grit and floatables removal was pilot tested at the Metropolitan Syracuse Wastewater Treatment Plant by Brown and Caldwell in 2005.

Recognizing that, a significant effort has already been expended by the OCDWEP in evaluating various grit and floatables removal facilities that are applicable to CSO #018, a streamlined and focused mini-evaluation of several technologies was completed to confirm the appropriate technology to install upstream of the wetlands treatment facility. The intent of this evaluation was not to duplicate effort that has already been performed by the OCDWEP, but to build upon information that has been obtained from these past efforts and their recommendations.

The purpose of this memo is to summarize the results of a technical feasibility evaluation of several types of grit and floatables removal systems that have been previously considered by OCDWEP. Since some of these systems just remove floatables and other systems just remove grit, these alternatives have been paired to provide combined systems that achieve both the required floatables and grit removal to protect the constructed wetlands treatment cells. The following specific alternatives have been evaluated:

1. Mechanically Cleaned CSO Bar Screen (manufactured by Duperon), combined with the Pista Grit Removal System (manufactured by Smith and Loveless).

2. Mechanically Cleaned CSO Bar Screen (manufactured by Duperon), combined with a gravity grit channel.

3. Hydro-Jet Screen (manufactured by Hydro International) combined with a gravity grit channel.

4. Storm King with Swirl Cleanse Screen (manufactured by Hydro International).

Each of these four (4) grit and floatables removal alternatives has been evaluated based on the following criteria:

a. Operational Reliability
b. Electrical Power Requirements
c. Solids Handling Requirements
d. Required Maintenance
e. Grit and Floatables Removal Efficiency
f. Equipment Lead Time
g. Construction Cost
h. Operation and Maintenance Cost
i. Maximizing Flow Diverted to Wetland Treatment System

II. Description of Grit and Floatable Removal Systems

1. Mechanically Raked Bar Screen with Pista Grit Removal System

The first alternative considered consists of floatables removal using a mechanically raked bar screen and grit removal using a Pista Grit vortex system.

Mechanically raked bar screens are fine screens that are mechanically cleaned and can be arranged in either a vertical or horizontal position. The Duperon FlexRake is a vertical type system that utilizes a full penetration scraper to remove debris from the fine screen and discharges the debris to a hopper located adjacent to the equipment. The screens are custom tear-shaped bars with quarter-inch openings. As floatables build up on the screen, the scraper is activated. While the screens are mechanically cleaned, the system may require a high-pressure hose wash to remove any materials that the scraper does not remove.

The Pista Grit system is a type of vortex separation technology used to remove grit. The system consists of an inlet channel, vortex chamber, outlet channel, and grit pump. The inlet channel controls velocity of the influent and draws grit to the chamber floor. Influent then flows to a circular chamber with baffles that control water flow and create a vortex forcing grit to settle into a hopper below the chamber. Water leaves the chamber through the outlet channel located opposite of the inlet channel. The grit that collects in the hopper is then pumped to a storage hopper for disposal. The published grit removal efficiency of the Pista Grit system is 95%.

The equipment lead time, upon approval of shop drawings, is approximately 8 to 12 weeks for the bar screen and 14 to16 weeks for the Pista Grit system. A copy of the cut sheets for this equipment is included in Appendix A and Appendix B.

One advantage of this alternative is that both mechanical systems are proven technologies that have been successfully used in the wastewater industry for many years. Disadvantages of this alternative are that both pieces of mechanical equipment require electrical power and that disposal of grit and floatables is required after the system is used.

2. Mechanically Raked Bar Screen with Gravity Grit Channel

The second alternative considered consists of floatables removal using a mechanically raked bar screen and grit removal using a simple gravity grit channel.

A gravity (un-aerated) grit channel system is the simplest type of grit removal systems available for wastewater treatment. This type of removal system consists of an enlarged concrete channel that reduces the flow velocity below 1 fps, where grit settles out due to low velocities through the chamber. Periodically, grit that builds up in the channel will need to be cleaned out (using a backhoe and vacuum truck) and disposed of. This type of system will not remove floatables from the waste stream; however in combination with the mechanically raked bar screen, this option will remove both grit and floatables. Cut sheets for the gravity grit channel have not been included, as this system will consist of an enlarged cast-in-place concrete channel, sized based on the peak flow rate through the system. The bar screen equipment lead time, upon approval of shop drawings, is approximately 8 to 12 weeks.

Advantages of this alternative are that the gravity grit channel is the simplest to operate and there is no mechanical equipment involved. Disadvantages of this system are that the channel will need to be cleaned periodically and grit removal efficiency will vary depending on the actual flow velocities achieved through the channel. Low flow velocities through the gravity grit chamber could result in organics settling out with the grit, resulting in the potential for odor generation problems.

3. Hydro Jet Screen with Gravity Grit Channel

The third alternative considered consists of floatables removal using the Hydro-Jet Screen, manufactured by Hydro International, and grit removal using a simple gravity grit channel.
Please refer to alternative two for a description of the gravity grit channel. The Hydro-Jet screen system consists of a rectangular tank with a self-cleansing screen on either side of a dry weather flow channel. As flow rises during a storm event, the CSO water overflows the dry weather channel and flows through the screen which catches the floatables. As the water continues to

rise, treated effluent is discharged through an automatic siphon to the downstream grit channel. To remove the floatables, the screen is set on an incline with a channel at the bottom to convey the floatables and excess water back to the sanitary sewer.

Advantages of this alternative are that the gravity grit channel is the simplest to operate and there is no mechanical equipment involved. Another advantage of this system is that the floatables captured by the Hydro Jet Screen are returned to the sanitary sewer system; therefore routine maintenance to remove floatables from the screens is minimal. Capital construction costs will also be low compared to other options. Flow diverted to the wetlands is maximized. Disadvantages of this system are that the gravity grit channel will need to be cleaned periodically and grit removal efficiency will vary depending on the actual flow velocities achieved through the channel. Another disadvantage of this system is that there is a potential for odor generation within the gravity grit chamber due to settling of that occurs within the chamber. A copy of the cut sheets for this equipment is included in Appendix C.

4. Storm King with Swirl Cleanse Removal System

The Storm King is the fourth alternative and another type of vortex separation technology. The system consists of a circular vortex chamber with a discharge siphon and sanitary sewer return piping. When the flow in the sanitary sewer system reaches the designed level, the water overflows to the circular vortex chamber. Floatables and water are collected on a conical screen and are returned to the sanitary system through the return piping; grit is removed through a separate return pipe off the bottom of the vortex chamber. As the water level continues to rise within the chamber, the treated water is discharged through the siphon to a desired location. While the flow within the chamber removes most of the solids from the screen, as the water level decreases, solids may build up on the screen and may require a high-pressure hose to wash and remove the solids.

The published removal efficiency of the Storm King system has been documented by the manufacturer (Hydro International) to remove up to 99% of grit and floatables. The pilot testing demonstrated the Storm King’s ability to remove solids and floatables from wet-weather/ combined sewage flows, and the advantages of this system were observed first-hand by the OCDWEP staff. During the pilot study performed at the METRO Syracuse Wastewater Treatment Plant, the pilot unit averaged 70% removal of all solids (consisting of floatables, grit, and Total Suspended Solids (TSS), as published in the report (Brown and Caldwell, Hydro International Storm King with Swirl Cleanse Pilot Testing, September 2005). Because the Harbor Brook constructed treatment wetlands will provide TSS removal, the Storm King would be sized to provide grit and floatables removal only. Hydro International has indicated that removal efficiency is not lower during the early stages of increasing flow rates (i.e., when flows are just beginning to be conveyed through the outlet spillway of the unit until the point where additional high flows are reached that result in flows going out the emergency overflow weir). The equipment lead time is approximately 12 to 16 weeks after approval of shop drawings. A copy of the cut sheets for this equipment is included in Appendix D.

Advantages of this alternative include that it does not require electrical power, as the device uses hydraulic head to power a self-cleaning mechanism; there is no mechanical equipment; and the solids are returned to the sanitary sewer system after passing through the chamber and a holding tank for solids is not required. Odor generation is therefore not a concern and maintenance is drastically reduced. Disadvantages of this system is that it is not as well proven as the other systems considered, has a higher capital cost, and does not divert as much flow to the wetland as other alternatives.

Please note that as part of this evaluation, variations of the Storm King alternative were considered and will be finalized through the design process:

- Locating the Storm King System on the proposed project site so that the system does not cause backwatering impacts upstream in the combined sewer system and that the grit and floatables can flow by gravity into the Harbor Brook Interceptor Sewer (HBIS). If this is not possible due to the hydraulic conditions of the proposed project site, the use of grinder pumps for low elevation connections or pumping of the grit and floatables into the HBIS may become necessary.
- Sizing the Storm King system to optimize flow diverted to the wetland, providing grit and floatables protection, and optimizing the treatment potential of the wetland.

Additionally, manufacturers of grit and floatables removal equipment were also contacted to determine if "or equal" equipment exists to the Storm King in the wastewater treatment market. The following vendors have been contacted:

1. Process Wastewater Technologies LLC – manufacturers of the SanSep passive screening device that has no moving parts.
2. John Meunier – manufacturers of the HYDROVEX FluidSep vortex separator which removes both grit and floatables.
3. Gabriel Novac & Assoc., Inc. – manufacturers of the HYDROCLEAN brush screen.
4. Grande Water Management Systems manufacturers of the ACU-SCREEN which is a fine perforated CSO screen.

Based on preliminary information received to date, it appears that the Process Wastewater Technologies LLC's SanSep unit can be considered an "or equal".

III. Evaluation Results

The following table summarizes the results of an evaluation of the four (4) grit and floatable removal alternatives described above. The ranking system is based on "1" being the best score and "4" being the worst score. The lowest overall score identifies the best grit and floatables removal alternative.

Table 1: Equipment Evaluation

Evaluation Criteria	Mechanically Raked Bar Screen w/ Pista Grit	Mechanically Raked Bar Screen w/ Gravity Grit Channel	Hydro Jet Screen w/ Gravity Grit Channel	Storm King with Swirl Cleanse
Operational Reliability	4	3	2	1
Electric Power Required	4	3	1	1
Solids Handling	2	4	3	1
Equipment Maintenance	4	3	2	1
Removal Efficiency	2	4	3	1
Equipment Lead Time	2	1	2	2
Construction Cost	3	2	1	4
O&M Cost	3	4	2	1
Flow Diversion	1	1	1	4
Total	**25**	**25**	**17**	**16**

IV. Recommendations

Recommendations for the grit and floatables removal system are based on the key criteria established for this evaluation. Based on the information reviewed for each system and the ranking above, it is our recommendation that the Storm King with Swirl Cleanse screen be installed for effective grit and floatables control upstream of the pilot wetlands treatment system at the Harbor Brook CSO #018. This alternative will provide a high level of protection for the wetland treatment cells from discharges of floatables and grit, will not require electric power to operate, will return the removed grit and floatables to the sanitary sewer system, and will require only minimal routine maintenance. The potential for odor generation within this system should also be minimal because the grit and floatables are returned to the sanitary sewer rather than being stored within the system.

Based on this recommendation, the Storm King was included as a design prototype for the Basis of Design Report and 50% design drawings. The disadvantages cited will be addressed in final design – particularly as they relate to optimizing flow and treatment potential for the constructed wetland treatment system.

Reference List

ARCADIS. November 2010. *Floatable Control Facility Plan, Onondaga County Department of Water Environment Protection*.

Brown and Caldwell. September 2005. *Hydro International Storm King with Swirl-Cleanse Pilot Testing, Onondaga County Department of Water Environment Protection.*

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Appendix A

The Preferred Technology in Wastewater

DUPERON®
corporation

The Duperon® FlexRake®

SIMPLE. TOUGH. PROVEN.

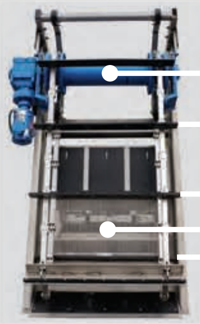
The Duperon® FlexRake®

DUPERON®
corporation

SIMPLE. TOUGH. PROVEN.

The Preferred Technology in Wastewater

The Duperon® FlexRake®



...is simple, consisting of three basic components:

1. A powerful drive head
2. A durable raking device
3. A rugged bar screen

Design simplicity solves many headaches at the head works of the plant.

THE CONCEPT OF SIMPLE

The achievement of mechanical simplicity requires the design of one part doing more. The simplicity of the Duperon FlexRake is possible through the multi-functioning action of one part: the FlexLink™. This clever patented design allows the link to function as a frame, lower sprocket, and connection point for scrapers, and be driven by a single sprocket. The rugged bar screen has a frame which guides the chain and relocates it in the screen. Bottom line: simplicity works when it achieves a simple cleaning mechanism with trouble-free longevity.

The design of the FlexRake solves many of the headaches of head works machines: complex gear mechanisms and controls; high maintenance components subject to regular lubrication, wear or fouling; confined space entries; reversal of mass in systems that must travel in one direction and then auto-reverse; carryover; shutdown due to unexpected debris volumes or conditions; inability to remove accumulation at the bottom of the channel…

How the FlexRake works...

1.

The FlexLink articulates to a 90 degree angle, closing on the drive pin. Once closed, the sprocket drives the link system forward.

2.

As it leaves the drive sprocket, the FlexLink locks into a solid bar, forming its own frame. (It works similarly to a knee or elbow.)

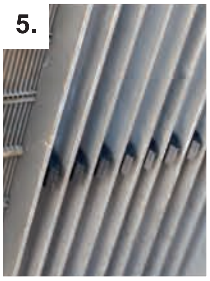
3.

As the FlexLink chain and attached scrapers reach the bottom of the screen, the FlexLink forms its own lower sprocket.

4.

Once the links turn to travel up the screen, they are engineered to allow clearance around the pin and water lubrication, allowing stainless on stainless movement without gouging or wear.

5.



Industry-exclusive full-penetration technology features scrapers designed to clean 3 sides of the bar, as well as horizontal cross members.

6.

Multiple scrapers placed every 21 inches continuously rake the barscreen. With screen head loss minimized, some sites report a 3x greater capture rate than with their previous machines.

FlexRake®

SIMPLE. TOUGH. PROVEN.

The Duperon® FlexRake®

SIMPLY CLEANED

The FlexRake wastewater product line offers industry-exclusive FULL PENETRATION TECHNOLOGY with a scraper designed to clean 3 sides of the bar – as well as cross support members – so debris simply cannot accumulate. Assembly/disassembly is simple… just 4 bolts, from the deck. This Duperon technology leaves nothing to chance.

SIMPLY DRIVEN

Duperon's patented FlexLink™ system is a clever solution to complex gear sprocket mechanisms - simple 90 degree articulation around the square sprocket drives the unit. No tight clearances to bind or jam; no close tolerances to foul due to corrosion or wear.

SIMPLE ENGAGEMENT

As the FlexRake flexes and pivots around large debris, rigid side fabrications are angled to guide the scrapers to return engagement. This simple method for positive location, along with the scraper's lateral containment by that same rigid frame, assures the continuous engagement of each successive scraper.

- **ENERGY EFFICIENT**
- **LONG PRODUCT LIFE**

SIMPLE OPERATION

Multiple scrapers on the screen operating at a speed of 0.5 rpm discharge debris once per minute. The slow operating speed provides long product life. Multiple scrapers minimize debris accumulation, resulting in reduced headloss and slot velocity, as well as greater capture rates.

SIMPLY CONTROLLED

Start it up… let it run. In their simplest form, controls are designed for continuous operation. Duperon Corporation offers pre-engineered packages that range from the most basic (continuous operation) to more complex (level control with complete SCADA integration).

SIMPLE

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The Preferred Technology in Wastewater

TOUGH MOVES

The exclusive flex/pivot action of the FlexRake® allows all types of debris to be removed, all at the same screen – regardless of coarse or fine screen openings. With the rugged durability of Duperon® equipment, prescreening is no longer a necessity. The patented design of the FlexRake eliminates the need for a lower sprocket and the common problems that come with it. No lower sprocket means no drive shaft, drive sprockets, or bearings requiring in-channel lubrications. No tracks, gaskets, seals or other close tolerances prone to wear due to grit. Most importantly: NO confined space entries.

TOUGH LINKS

THE PATENTED LINK SYSTEM:
The FlexLink™ design utilizes a 4.5 lb stainless steel cast link system to create a frame, lower sprocket, and scraper connection point. With 33,000 lb yield and 60,000 lb break point, it forms a chain that is stronger and more hard-wearing than any other in the industry. That's strength where it's needed most!

DUPERON'S SOLUTION TO

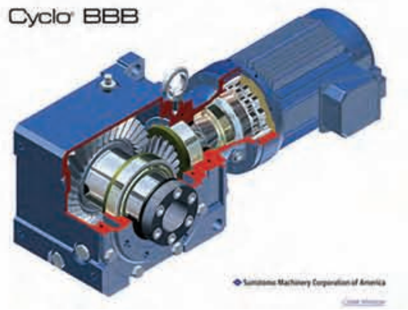
- ***LOWER SPROCKETS***
- ***BEARINGS***
- ***SHAFTS***
- ***LUBRICATION POINTS***
- ***CONFINED SPACE ENTRIES***
- ***TRACKS...***

TOUGH MATERIALS

State-of-the-art materials such as UHMW and stainless steel are used for all wetted parts, eliminating corrosion in the harsh wastewater environment. Such materials ensure the highest duty of performance, designed such that the pressures and velocities exerted by the equipment and environment will assure a long life cycle.

TOUGH GEARMOTOR

Powerful drive lifts up to 1,000 lbs. Duperon's use of premium efficiency Sumitomo Cyclo gear motors eliminates abrasive sliding contact. Unique rolling contact, low operating speeds and the grease-filled non-vented gearbox allow for 5 year maintenance schedules.



TOUGH WARRANTY

More than 20 years in the industry and over 400 machines worldwide… Duperon Corporation has the experience to assure excellence with the industry's first Five-Year Warranty. Duperon technology leaves nothing to chance… we guarantee it.

TOUGH

SIMPLE. TOUGH. PROVEN.

The Duperon® FlexRake®

PROVEN EASE OF INSTALLATION

The FlexRake ships fully assembled to sites without space or handling constraints, creating installation as simple as pick, place, anchor, wire and run.

When site constraints such as limited access doors, multiple floors, and handling constraints exist, the FlexRake ships fully factory-tested to be disassembled on site. Duperon's simplicity of design makes reassembly a snap, with sites often accomplishing reassembly and installation in one day – sometimes using an on-site maintenance crew.

PROVEN LOW MAINTENANCE

Maintainance Schedule and Estimated Labor Costs	
Daily	None
Monthly	None
Quarterly	Check drive and bearings for any apparent leakage or damage.
Annually	Check drive and bearings for any apparent leakage or damage. Verify unit condition.
	Change grease in gearbox.

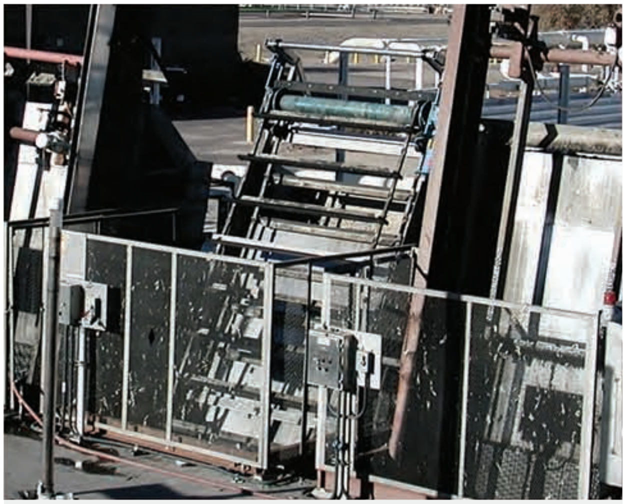
Maintenance is reduced by the simple design of the Duperon FlexLink™, which is engineered for water lubrication. Slow operating speeds of 0.5 rpm allow for lubrication of the gear motor to occur every 5 years or 20,000 hours.

PROVEN LOW COST OF OWNERSHIP

Maintainance Schedule and Estimated Labor Costs				
		1 year	5 year	20 years
Daily	None	0.0	0.0	0.0
Monthly	None	0.0	0.0	0.0
Quarterly	Visual inspection of bearing and seals.	0.5	2.5	10.0
Annually	Visual inspection for general mechanical condition.	0.5	2.5	10.0
	Check/change Grease in Gearbox.	0.5	2.5	10.0
	Visual inspection of snap rings.	2.0	10.0	40.0
	Total Labor Hours	3.5	17.5	70.0

1. Picking units with use of spreader bar
2. Placing unit at installation angle
3. Use of lifting brackets

PROVEN: LOW PROFILE = LOW CONSTRUCTION COSTS



The tougher functionality of the FlexRake, proven through repeated grease attacks and high I & I, was just one benefit of the equipment's installation in Phoenix, Arizona. During plant upgrades, the low profile of the Duperon FlexRake saved over $1M in construction costs when compared to previous equipment.

PROVEN

SIMPLE. TOUGH. PROVEN.

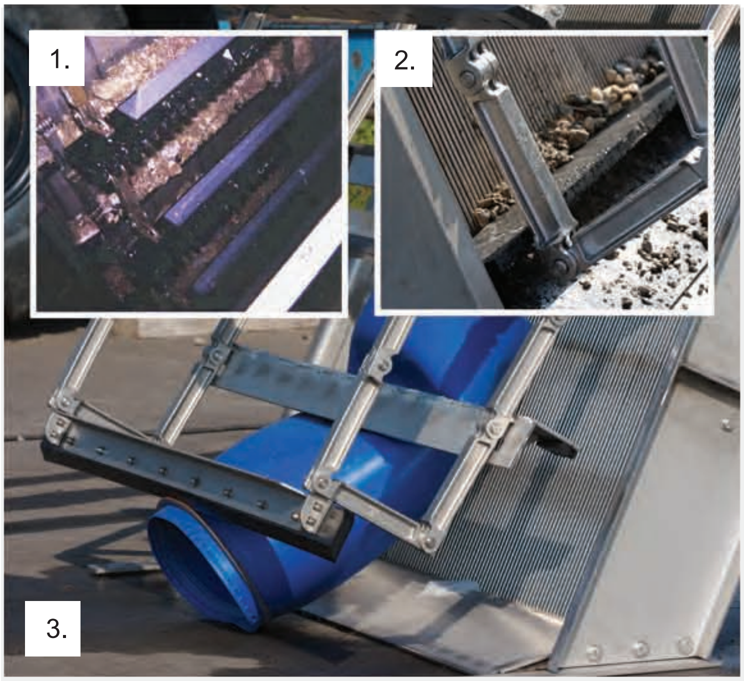
PROVEN EFFECTIVENESS

GREASE AND GRIT

In 2004, the City of Monroe, Michigan participated in a “cleaning project” initiated for the purpose of raising awareness of the grease problem within commercial business concerns such as car washes (wax) and restaurants (grease). Prior to the project, influent sewer lines were chemically treated to break down the accumulation of grease, wax and similar solids in successive stages. As was typical, one FlexRake® in the City’s 6 ft. channel was in operation for the project.

Unexpectedly, grease, wax and other solids hit the plant nearly at once, creating a “grease attack” at the head works. This “attack” overwhelmed the conveyor, but the FlexRake continued as normal, removing several inches of grease and debris with each pass at the screen. The FlexRake maintained head works operations; when the crew returned the following morning, they found plant processes continuing uninterrupted.

> **“Ingenious...screenings are 50% drier than what I was seeing before...”**
> -Michigan



1. City of Monroe grease attack
2. Stones/grit easily lifted
3. FlexRake flexing around a barrel

PROVEN STANDARD OF EXCELLENCE

In 2006, Duperon® Corporation was the first to offer a Five-Year Warranty in wastewater-the industry's toughest standard for equipment excellence.

New Mexico

> **2/3 reduction in disposal volume!**
> -Pennsylvania

PROVEN RESULTS

An installation in Pennsylvania has reported satisfaction exceeding expectations. Historically, the Authority had disposed of a 3 cubic yard dumpster each week. The dumpster contained extremely wet organic screening waste. The combined installation of a Duperon FlexRake and Washer Compactor has reduced this disposal to one 2 cubic yard dumpster every two weeks. With no standing water, there has been significant reduction of weight thereby reducing trucking and disposal costs. Odor has been considerably reduced, and the dryness of the compacted screenings has improved appearance on disposal. The combined efforts of the FlexRake and the Washer Compactor have also had a very favorable impact on maintenance processes downstream.

PROVEN

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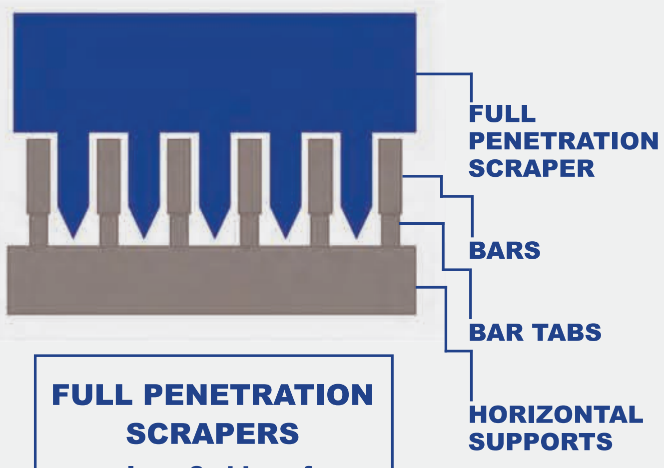
The Duperon® FlexRake®



FULL PENETRATION SCRAPERS
clean 3 sides of bar and horizontal cross members - leaving nothing to chance!

FULL PENETRATION MODEL FINE SCREEN, 1/2 IN BAR OPENING

The Full Penetration (FP) model FlexRake is typically used in wastewater or other applications where debris can accumulate or wrap around the bars. The scraper is designed to clean 3 sides of the bar. The Full Penetration model is available in bar spacings greater than .5 – 6 inches. If the site allows, this model ships fully assembled. All components are serviceable above the deck, eliminating confined space entries. The patented FlexLink™ system flexes and pivots around large debris and removes it. Virtually maintenance free!

FlexRake® OUTMANEUVERS DEBRIS

The FlexRake handles grease and grit without difficulty, as well as large or unusual debris conditions ranging from sewer plugs to 2' x 4's. Varied flow and influx of debris are no longer an issue. The FlexRake is designed to continue running through all conditions – assuring that the plant will continue to function without shutdown.

Grease attack - no problem!

Factory demonstration of 4x4 entering screen at bottom of channel.

WIDTH-LENGTH	2 feet - 10 feet wide -up to 100 ft long.
SINGLE-STRAND WIDTH	Also available for channels 18 inches - 24 inches.
ANGLE OF INSTALLATION	Ideal 30 degrees from vertical. Range from vertical to horizontal dependent on site.
MATERIAL OF CONSTRUCTION	Standard: 304 SSTL. Alternative: 316 SSTL.
BAR OPENING	Greater than .5 inch - 6 inches.
SCRAPER CONFIGURATION	Spacing: Every 2nd link. UHMW Full Penetration scrapers.
TYPICAL MOTOR/ SPEED	1/3 HP, explosion proof - operating speed .5 rpm.

FP MODEL

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The Preferred Technology in Wastewater

FULL PENETRATION MODEL FINE SCREEN, 1/4-1/2 IN BAR OPENING

The smaller the slot opening, the more critical it becomes to keep the barscreen open. The Full Penetration, Fine Screen (FPFS) model FlexRake® combines the rugged reliability of the Full Penetration model FlexRake with fine screen openings. Utilizing staging scrapers that clean the face of the bar screen and stainless steel teeth that fully penetrate the bar, the Full Penetration, Fine Screen model offers precision technology with the ability to adapt to large debris. Duperon® has eliminated the need for pre-screening… the powerful combination of stainless steel and UHMW scrapers allows for the best in redundancy and unit performance.

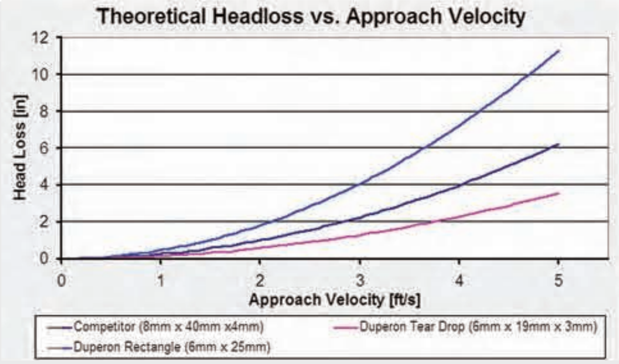
THE BEST SCREENING EFFICIENCY IN THE MARKET

Duperon's bar screen utilizes custom tear-shaped bars with a 50% screening efficiency for .25 inch bar openings, resulting in more favorable flow characteristics and less headloss. The unique tear drop shape keeps large debris on the surface of the screen for removal by scrapers. Small debris flows right through, and full penetration scrapers assure that no debris can accumulate, even on horizontal cross members.

Bar Type	
Sharp-edged rectangular	2.42
Rectangular with semicircular face	1.83
Circular	1.79
Rectangular with semicircular upstream and downstream face	1.67
Tear shape	**0.76**

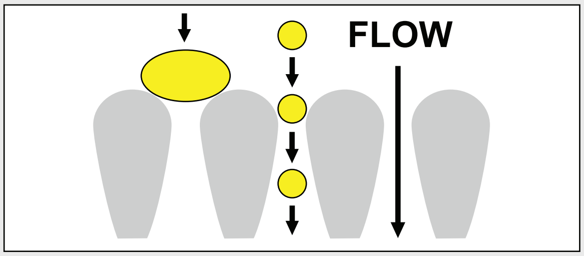
Lin, Shundar. Water and Wastewater Calculations Manual.
New York, New York. McGraw-Hill, 2001.

MOST EFFICIENT



EXCLUSIVE ABILITY TO CLEAN THE BOTTOM OF THE CHANNEL

Due to the "square" sprocket action of the FlexLink™, the FlexRake has the unique ability to hit the base plate of the frame with a scraping, shoveling action that moves debris up the screen eliminating accumulation at the bottom of the channel.

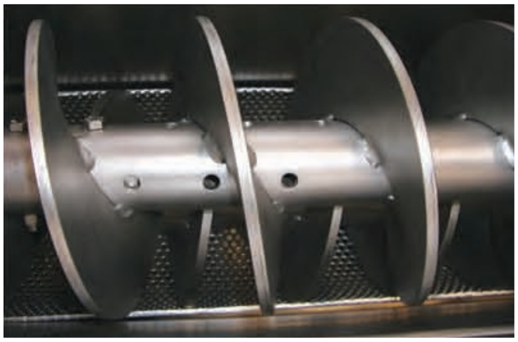


TEAR DROP BARS ARE THE MOST EFFICIENT BARS IN THE INDUSTRY

WIDTH-LENGTH	2 feet - 10 feet wide-up to 100 ft long
SINGLE-STRAND WIDTH	Also available for channels 18 inches - 24 inches.
ANGLE OF INSTALLATION	Ideal 30 degrees from vertical. Range from 10 degrees from vertical to horizontal (dependent on site conditions)
MATERIAL OF CONSTRUCTION	304 SSTL. Alternative: 316 SSTL
BAR OPENING	.25 inch - .5 inch
SCRAPER CONFIGURATION	Spacing: Every 2nd link. UHMW staging scraper/stainless steel full penetration teeth positioned every 21 inches.
TYPICAL MOTOR/ SPEED	1/2 HP, explosion proof, inverter duty-operating speed .5-2 rpm

FPFS MODEL

SIMPLE. TOUGH. PROVEN.



DUPERON WASHER COMPACTOR

Continuing the tradition of simple, efficient, effective products... Exclusive patent-pending positive displacement technology eliminates clogging, bridging and jamming. Unique dual-auger design eliminates the need for additional agitation. Flood washing saturates screenings, eliminating clogging issues inherent in fine spray nozzles. Resulting compacted debris is light grey in color, with volume reduction of up to 82%.

DUPERON AUGER CONVEYOR

Duperon's Auger Conveyor is flexible and scalable to site constraints, with modular components that make assembly – and additions – simple. Constructed of abrasion-resistant UHMW and built to uphold Duperon's tradition of tough durability; powered by the energy-efficient Sumitomo Hyponic drive. A multitude of accessories are available, such as splicing kits, legs, standard mounting holes, and more.

ENCLOSURES

For added convenience and cleanliness, Duperon enclosures are built to site specifications. Each is available in rugged 304 or 316 stainless steel, with the option of full or partial enclosure. Access/viewing doors are placed according to customer preference.

CONTROLS

For best economies, Duperon Corporation offers standard controls packages, from the most basic on/off/overload capability to enhanced VFD packages with differential level control. Custom packages are also

OTHER PRODUCTS

SIMPLE. TOUGH. PROVEN.

The Preferred Technology in Wastewater


Arizona

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The Duperon® FlexRake®

SIMPLE. TOUGH. PROVEN.

PISTA®

GRIT REMOVAL SYSTEM

COMPLETE GRIT HANDLING, WASHING, & DEWATERING

UNPARALLELED RESEARCH & DEVELOPMENT

HIGHEST GRIT REMOVAL EFFICIENCIES

BY SMITH & LOVELESS INC.

PISTA®

GRIT REMOVAL SYSTEM

Smith & Loveless' commitment to market leadership in grit removal kindles on-going research and development, which leads to continued system innovations. Since the introduction of the original vortex **PISTA**® Grit Chamber in the early 1970s, S&L has developed numerous patented and exclusive components to further enhance the capability for complete grit removal, handling, and dewatering. This innovation and experience makes the unparalleled **PISTA**® the industry's most specified grit removal system today.

Exclusive & Patented Features

- *Flat Bottom **PISTA**® Grit Chamber*
- ***PISTA**® Grit Flow Control Baffle*
- ***PISTA**® 360-degree In-Line Design*
- *Low Energy-Use **PISTA**® Propeller*
- *S&L **PISTA**® Coanda Ramp Design*
- ***PISTA**® Grit Fluidizer Vane*
- ***PISTA**® Turbo Grit Pumps with **SonicStart**™*
- ***PISTA**® Grit Handling System*

C. Lancaster

PISTA® GRIT REMOVAL SYSTEM *Unparalleled Vortex Grit Removal*

Removing grit reduces accumulation in downstream basins, channels and piping, thus preventing excess wear and abrasion on mechanical equipment and reduction of basin volumes and detention times.

The **PISTA**® Grit Removal System maintains the highest proven grit removal effciencies on the market over a wide range of daily flows. In fact, Smith & Loveless—backed by the experience *and* evidence of more than 2,000 system installations—publishes its removal efficiencies for a range of grit sizes, including fine grit. The **PISTA**® efficiencies are based on actual WWTP performance—not hypothetical testing or theorizing.

High removal efficiencies originate from the **PISTA**®'s unparalleled hydraulic design, including its flat grit chamber floor, engineered baffle arrangements and low-energy axial-flow propeller. The combination creates a true vortex which effectively separates grit from organics and the waste stream. Forced vortex action distinguishes the **PISTA**® because it does not rely *only* on less efficient particle settling or gravity.

Grit Characteristics & Removal

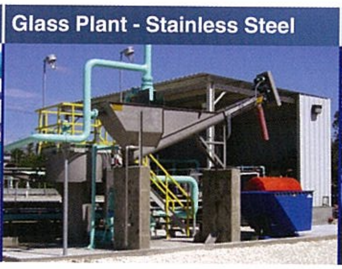
Grit consists of a variety of particles including sand, gravel and other heavy, discrete inorganic materials. A large majority of grit found in typical domestic sewage–in upwards of 90% and more–are coarser particles 50 mesh size grit and larger (300 µm). The remainder composition of smaller grit particles mostly ranges between 50 and 100 mesh (150 µm). Grit particles can reach 200 mesh (100 µm) in size—like silt—but turbulence in the flow prevents them from settling anywhere in the treatment scheme (not posing problems like typical grit). S&L's published removal efficiencies demonstrate percentage removal at various particulate sizes and total removal. Our field tests consistently prove that the **PISTA**® meets or exceeds 95 percent removal efficiency for all grit in a waste stream.

PISTA® Design & Application

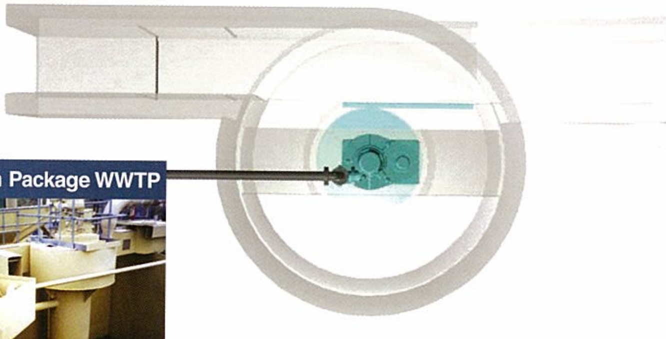
GRIT REMOVAL SYSTEM

500+ MGD Municipal Headworks

Glass Plant - Stainless Steel



Integral PISTA® in Package WWTP



The patented 360-degree in-line design (Model A Series) allows for easy installation to existing headworks.

PISTA® offers flexible application for true grit removal, whether from domestic sewage in a municipal WWTP headworks, distribution network pump stations or industrial process streams in a commercial production facility. The grit chamber can be installed above-grade or below ground with either concrete, carbon steel, or stainless steel tankage.

Individual units can handle waste streams less than 0.5 MGD all the way to 100 MGD. In large treatment works, multiple units arrange to efficiently remove grit from hundreds of millions of gallons of flow a day.

PISTA® Model Number	Max. Flow	Metric
0.5 / 0.5A	0.5 MGD	1,892 CMD
1.0 / 1.0A	1.0 MGD	3,785 CMD
2.5 / 2.5A	2.5 MGD	9,465 CMD
4.0 / 4.0A	4.0 MGD	15,140 CMD
7.0 / 7.0A	7.0 MGD	26,495 CMD
12.0 / 12.0A	12.0 MGD	45,420 CMD
20.0 / 20.0A	20.0 MGD	75,700 CMD
30.0 / 30.0A	30.0 MGD	113,550 CMD
50.0 / 50.0A	50.0 MGD	189,250 CMD
70.0 / 70.0A	70.0 MGD	265,000 CMD
100 / 100.0A	100.0 MGD	378,500 CMD

PISTA® New Flow Control Baffle Provides Engineering Benefits

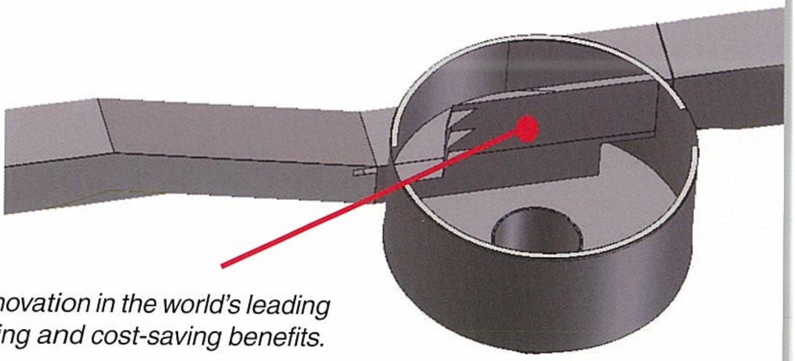
GRIT REMOVAL SYSTEM

The patented **PISTA**® Grit Flow Control Baffle provides many engineering benefits and cost-saving considerations. By increasing chamber velocity during low flow periods, the baffle extends the grit extraction path within the vortexing grit chamber. This is key because a longer grit path within in the flow pattern increases the likelihood of grit being captured on the chamber's flat-floor.

Beyond this, the **PISTA**® Grit Flow Control Baffle also permits design flexibility so that water elevations can be controlled. Controlling the water level is important because it upholds the proper velocities approaching the grit chamber. Previously, the most common way to accomplish this was to back up the flow with a downstream submerged weir. The **PISTA**® Flow Control Baffle with its preset inlet and outlet openings supplants the need for the submerged weir. By integrating the water elevation settings with the baffle, the overall outlet footprint requirements decrease as much as half the typical distance. This also affords the design engineer the flexibility to allow an outlet channel to make sharp turns immediately after leaving the circular portion of the grit chamber. The resulting smaller footprint provides significant construction cost savings.

Flow Control Baffle Benefits

- *Increases grit chamber velocity during low-flow periods and removal efficiency by lengthening grit extraction path.*
- *Controls flow velocity and eliminates need for downstream level control devices.*
- *Decreases overall grit system footprint requirements.*



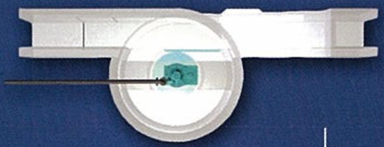
*The **PISTA®** Grit Chamber Flow Control Baffle is the latest design innovation in the world's leading grit removal system. The baffle development offers many engineering and cost-saving benefits.*

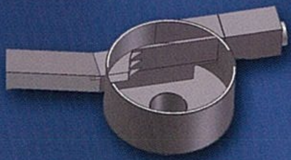
PISTA®

GRIT REMOVAL SYSTEM

C. Lancaster

UNPARALLELED INNOVATION FOR 30+ YEARS.

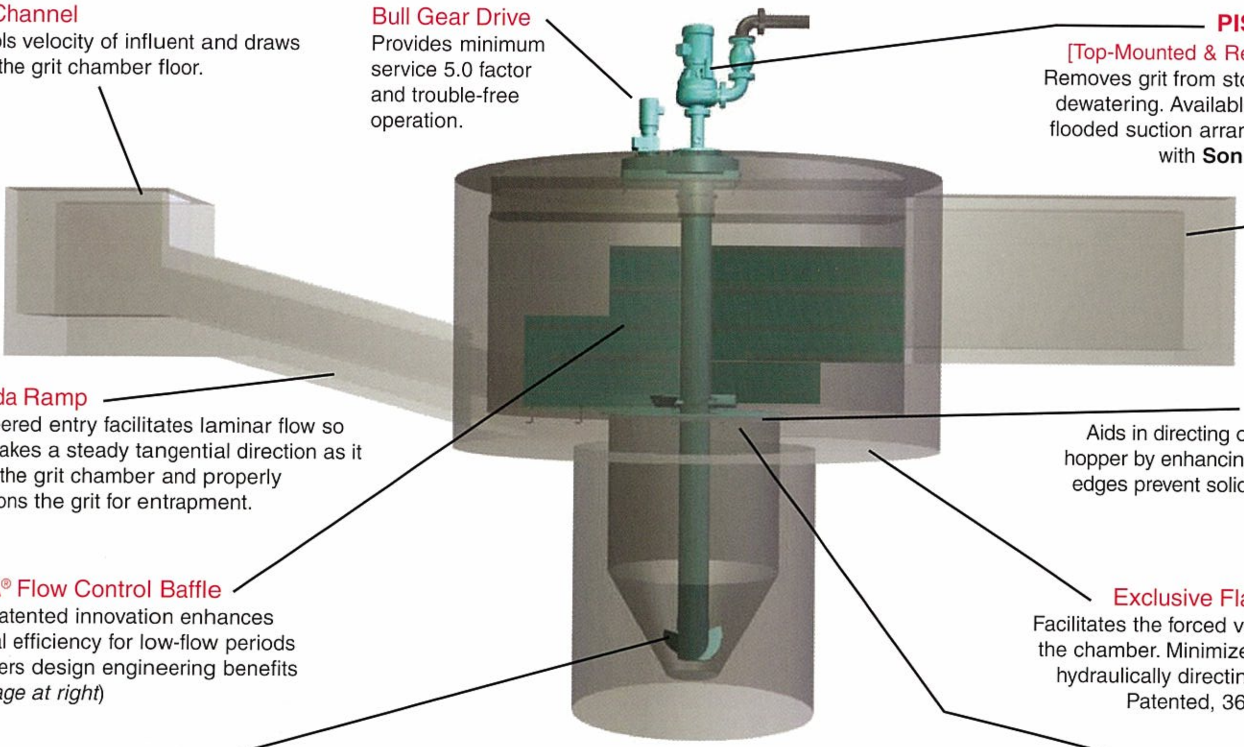




- **1973 - PISTA® Grit Removal System (270°)**
- **1974 - PISTA® Grit Screw Conveyor**
- **1978 - Air Lift Vents**
- **1981 - 50 MGD PISTA® Grit Chamber**
- **1982 - 175 GPM PISTA® Grit Concentrator**
- **1982 - 4" PISTA® Turbo Grit Pump**
- **1984 - 70 MGD PISTA® Grit Chamber**
- **1988 - 360° PISTA® In-Line Design**
- **1988 - 250 GPM PISTA® Grit Concentrator**
- **1989 - Parallel (Lamella) Plate Screw Conveyor**
- **1992 - PISTA® Grit Fluidizer**
- **1998 - 6" PISTA® Turbo Grit Pump**
- **1998 - 500 GPM PISTA® Grit Concentrator (Ni-Hard)**
- **1999 - 100 MGD PISTA® Grit Chamber**
- **2004 - PISTA® Flow Control Baffle**
- **2004 - PISTA® Turbo Grit Pump with SonicStart™**

PISTA® Grit Chamber Features and Benefits

GRIT REMOVAL SYSTEM



Inlet Channel
Controls velocity of influent and draws grit to the grit chamber floor.

Coanda Ramp
Engineered entry facilitates laminar flow so that it takes a steady tangential direction as it enters the grit chamber and properly conditions the grit for entrapment.

PISTA® Flow Control Baffle
New, patented innovation enhances removal efficiency for low-flow periods and offers design engineering benefits (*see page at right*)

PISTA® Grit Fluidizer
Patented blade exclusive to S&L design. Loosens collected grit, preventing compacting.

Bull Gear Drive
Provides minimum service 5.0 factor and trouble-free operation.

Storage Hopper
Stores removed grit prior to dewatering.

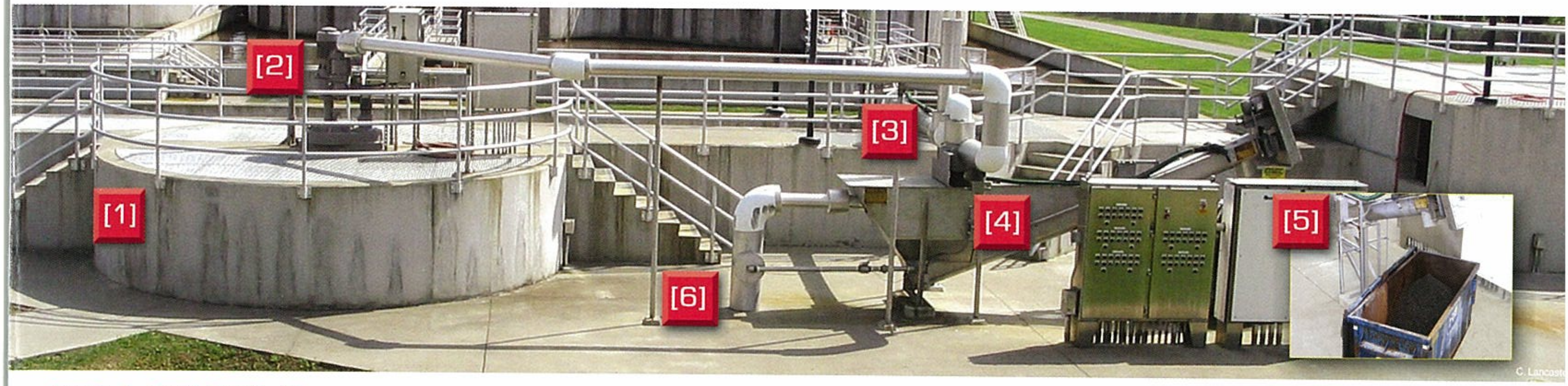
PISTA® Turbo Grit Pump
[Top-Mounted & Remote-Mounted Options]
Removes grit from storage hopper to washing dewatering. Available in vacuum-primed and flooded suction arrangements. Now available with **SonicStart**™ prime sensing.

Outlet Channel
S&L can assist with design information for optimal performance.

Axial-Flow Propeller
Aids in directing organic-free grit into lower hopper by enhancing flow patterns. Rounded edges prevent solids build-up, thus ensuring high efficiency.

Exclusive Flat-Bottom Basin Floor
Facilitates the forced vortex flow pattern inside the chamber. Minimizes organic capture while hydraulically directing grit into lower hopper. Patented, 360-degree in-line design.

Hopper Cover Plate
Stationary and recessed, it removes for quick access to storage hopper.



PISTA® Complete Grit Removal, Handling & Dewatering System Flow Scheme

GRIT REMOVAL SYSTEM

[1] ***PISTA® Grit Chamber*** — Influent enters flat-floor grit chamber hydraulically guided by coanda ramp, internal baffles and central, low-speed propeller. Forced vortex drives grit particles to center chamber floor and into lower grit hopper while organics and flow continue to plant.

[2] ***PISTA® Turbo Grit Pump*** — Top-mounted or remote mounted unit pumps collected grit slurry (kept fluid by the **PISTA®** Grit Fluidizer) to the **PISTA®**'s second-stage grit washing and dewatering system while also providing proper head.

[3] ***PISTA® Grit Concentrator*** — Specifically engineered for the **PISTA®** system, this abrasion-resistant Ni-Hard unit washes grit further. It positions on the grit discharge line.

[4] ***PISTA® Grit Screw Conveyor*** — Grit from the concentrator deposits into the parallel (lamella) plate section of the S&L dewatering screw conveyor, which aids in retaining finer grit and reducing the stream's turbulence and overflow rate.

[5] ***Dewatered Grit Discharges*** from the top of the inclined screw conveyor into a container for disposal.

[6] ***The Flow and any Residual Organics are Returned*** to the inlet channel prior to the grit chamber, typically 93% of flow and 95% of organics.

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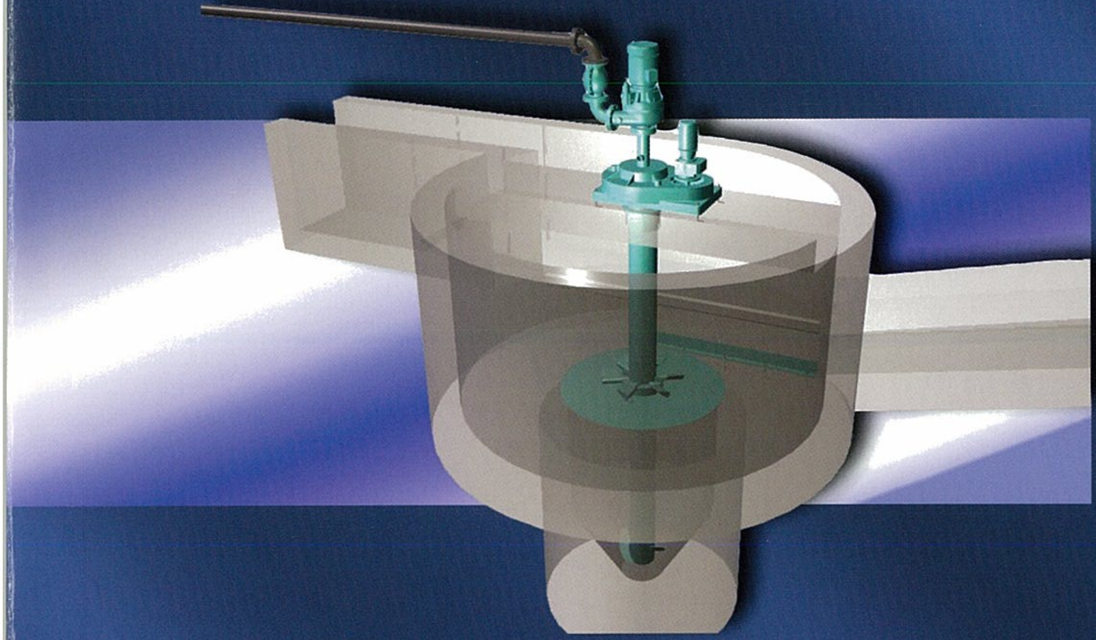
UNPARALLELED GRIT REMOVAL.



Smith & Loveless Inc. knows grit removal. Our experience flows from more than three decades of thorough R&D and 2000+ PISTA® installations throughout North America and the world. Along the way, we've continued to enhance the complete system with innovations that deliver unparalleled results. With the PISTA® Grit Removal System you receive the finest in system performance backed by the value-added experience and support of Smith & Loveless.

PISTA®

GRIT REMOVAL SYSTEM

BY SMITH & LOVELESS INC.

Bulletin #950 • P: 913.888.5201 • F: 913.888.2173 • web: smithandloveless.com

Appendix B

The Preferred Technology in Wastewater

DUPERON® corporation

The Duperon® FlexRake®

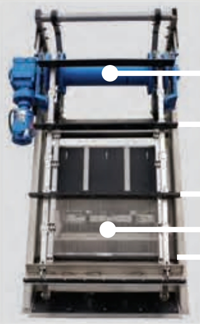
SIMPLE. TOUGH. PROVEN.

The Duperon® FlexRake®

DUPERON®
corporation

SIMPLE. TOUGH. PROVEN.

The Duperon® FlexRake®



...is simple, consisting of three basic components:

1. A powerful drive head
2. A durable raking device
3. A rugged bar screen

Design simplicity solves many headaches at the head works of the plant.

THE CONCEPT OF SIMPLE

The achievement of mechanical simplicity requires the design of one part doing more. The simplicity of the Duperon FlexRake is possible through the multi-functioning action of one part: the FlexLink™. This clever patented design allows the link to function as a frame, lower sprocket, and connection point for scrapers, and be driven by a single sprocket. The rugged bar screen has a frame which guides the chain and relocates it in the screen. Bottom line: simplicity works when it achieves a simple cleaning mechanism with trouble-free longevity.

The design of the FlexRake solves many of the headaches of head works machines: complex gear mechanisms and controls; high maintenance components subject to regular lubrication, wear or fouling; confined space entries; reversal of mass in systems that must travel in one direction and then auto-reverse; carryover; shutdown due to unexpected debris volumes or conditions; inability to remove accumulation at the bottom of the channel…

How the FlexRake works...

1.

The FlexLink articulates to a 90 degree angle, closing on the drive pin. Once closed, the sprocket drives the link system forward.

2.

As it leaves the drive sprocket, the FlexLink locks into a solid bar, forming its own frame. (It works similarly to a knee or elbow.)

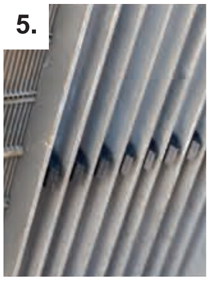
3.

As the FlexLink chain and attached scrapers reach the bottom of the screen, the FlexLink forms its own lower sprocket.

4.

Once the links turn to travel up the screen, they are engineered to allow clearance around the pin and water lubrication, allowing stainless on stainless movement without gouging or wear.

5.



Industry-exclusive full-penetration technology features scrapers designed to clean 3 sides of the bar, as well as horizontal cross members.

6.

Multiple scrapers placed every 21 inches continuously rake the barscreen. With screen head loss minimized, some sites report a 3x greater capture rate than with their previous machines.

FlexRake®

SIMPLE. TOUGH. PROVEN.

The Duperon® FlexRake®

SIMPLY CLEANED

The FlexRake wastewater product line offers industry-exclusive FULL PENETRATION TECHNOLOGY with a scraper designed to clean 3 sides of the bar – as well as cross support members – so debris simply cannot accumulate. Assembly/disassembly is simple… just 4 bolts, from the deck. This Duperon technology leaves nothing to chance.

SIMPLY DRIVEN

Duperon's patented FlexLink™ system is a clever solution to complex gear sprocket mechanisms - simple 90 degree articulation around the square sprocket drives the unit. No tight clearances to bind or jam; no close tolerances to foul due to corrosion or wear.

SIMPLE ENGAGEMENT

As the FlexRake flexes and pivots around large debris, rigid side fabrications are angled to guide the scrapers to return engagement. This simple method for positive location, along with the scraper's lateral containment by that same rigid frame, assures the continuous engagement of each successive scraper.

- **ENERGY EFFICIENT**
- **LONG PRODUCT LIFE**

SIMPLE OPERATION

Multiple scrapers on the screen operating at a speed of 0.5 rpm discharge debris once per minute. The slow operating speed provides long product life. Multiple scrapers minimize debris accumulation, resulting in reduced headloss and slot velocity, as well as greater capture rates.

SIMPLY CONTROLLED

Start it up… let it run. In their simplest form, controls are designed for continuous operation. Duperon Corporation offers pre-engineered packages that range from the most basic (continuous operation) to more complex (level control with complete SCADA integration).

SIMPLE

SIMPLE. TOUGH. PROVEN.

The Preferred Technology in Wastewater

TOUGH MOVES

The exclusive flex/pivot action of the FlexRake® allows all types of debris to be removed, all at the same screen – regardless of coarse or fine screen openings. With the rugged durability of Duperon® equipment, prescreening is no longer a necessity. The patented design of the FlexRake eliminates the need for a lower sprocket and the common problems that come with it. No lower sprocket means no drive shaft, drive sprockets, or bearings requiring in-channel lubrications. No tracks, gaskets, seals or other close tolerances prone to wear due to grit. Most importantly: NO confined space entries.

TOUGH LINKS

DUPERON'S SOLUTION TO

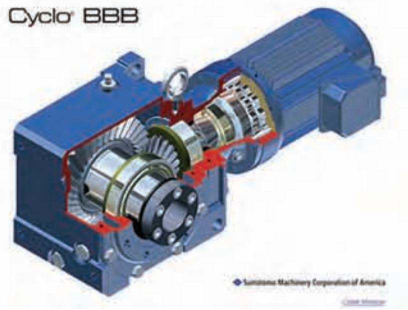
- *LOWER SPROCKETS*
- *BEARINGS*
- *SHAFTS*
- *LUBRICATION POINTS*
- *CONFINED SPACE ENTRIES*
- *TRACKS...*

THE PATENTED LINK SYSTEM: The FlexLink™ design utilizes a 4.5 lb stainless steel cast link system to create a frame, lower sprocket, and scraper connection point. With 33,000 lb yield and 60,000 lb break point, it forms a chain that is stronger and more hard-wearing than any other in the industry. That's strength where it's needed most!

TOUGH MATERIALS

State-of-the-art materials such as UHMW and stainless steel are used for all wetted parts, eliminating corrosion in the harsh wastewater environment. Such materials ensure the highest duty of performance, designed such that the pressures and velocities exerted by the equipment and environment will assure a long life cycle.

TOUGH GEARMOTOR



Powerful drive lifts up to 1,000 lbs. Duperon's use of premium efficiency Sumitomo Cyclo gear motors eliminates abrasive sliding contact. Unique rolling contact, low operating speeds and the grease-filled non-vented gearbox allow for 5 year maintenance schedules.

TOUGH WARRANTY

More than 20 years in the industry and over 400 machines worldwide… Duperon Corporation has the experience to assure excellence with the industry's first Five-Year Warranty. Duperon technology leaves nothing to chance… we guarantee it.

TOUGH

SIMPLE. TOUGH. PROVEN.

The Duperon® FlexRake®

PROVEN EASE OF INSTALLATION

The FlexRake ships fully assembled to sites without space or handling constraints, creating installation as simple as pick, place, anchor, wire and run.

When site constraints such as limited access doors, multiple floors, and handling constraints exist, the FlexRake ships fully factory-tested to be disassembled on site. Duperon's simplicity of design makes reassembly a snap, with sites often accomplishing reassembly and installation in one day – sometimes using an on-site maintenance crew.

PROVEN LOW MAINTENANCE

Maintainance Schedule and Estimated Labor Costs	
Daily	None
Monthly	None
Quarterly	Check drive and bearings for any apparent leakage or damage.
Annually	Check drive and bearings for any apparent leakage or damage. Verify unit condition.
	Change grease in gearbox.

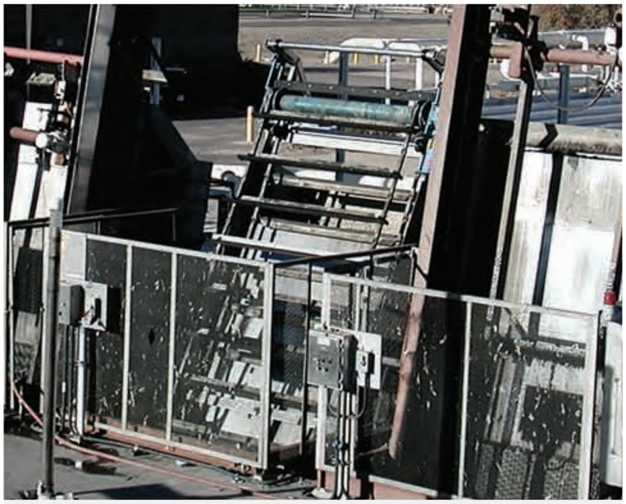
Maintenance is reduced by the simple design of the Duperon FlexLink™, which is engineered for water lubrication. Slow operating speeds of 0.5 rpm allow for lubrication of the gear motor to occur every 5 years or 20,000 hours.

PROVEN LOW COST OF OWNERSHIP

Maintainance Schedule and Estimated Labor Costs				
		1 year	5 year	20 years
Daily	None	0.0	0.0	0.0
Monthly	None	0.0	0.0	0.0
Quarterly	Visual inspection of bearing and seals.	0.5	2.5	10.0
Annually	Visual inspection for general mechanical condition.	0.5	2.5	10.0
	Check/change Grease in Gearbox.	0.5	2.5	10.0
	Visual inspection of snap rings.	2.0	10.0	40.0
	Total Labor Hours	3.5	17.5	70.0

1. Picking units with use of spreader bar
2. Placing unit at installation angle
3. Use of lifting brackets

PROVEN: LOW PROFILE = LOW CONSTRUCTION COSTS



The tougher functionality of the FlexRake, proven through repeated grease attacks and high I & I, was just one benefit of the equipment's installation in Phoenix, Arizona. During plant upgrades, the low profile of the Duperon FlexRake saved over $1M in construction costs when compared to previous equipment.

PROVEN

SIMPLE. TOUGH. PROVEN.

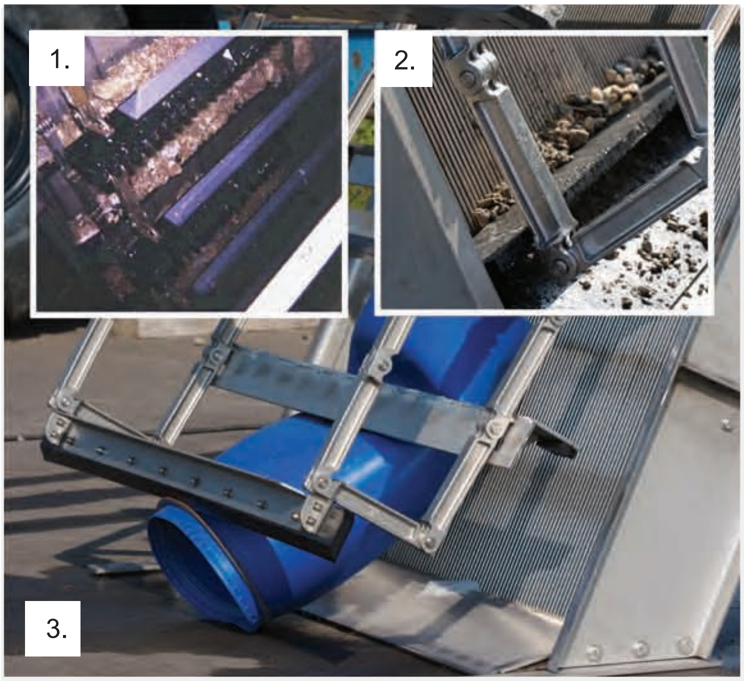
PROVEN EFFECTIVENESS

GREASE AND GRIT

In 2004, the City of Monroe, Michigan participated in a “cleaning project” initiated for the purpose of raising awareness of the grease problem within commercial business concerns such as car washes (wax) and restaurants (grease). Prior to the project, influent sewer lines were chemically treated to break down the accumulation of grease, wax and similar solids in successive stages. As was typical, one FlexRake® in the City’s 6 ft. channel was in operation for the project.

Unexpectedly, grease, wax and other solids hit the plant nearly at once, creating a “grease attack” at the head works. This “attack” overwhelmed the conveyor, but the FlexRake continued as normal, removing several inches of grease and debris with each pass at the screen. The FlexRake maintained head works operations; when the crew returned the following morning, they found plant processes continuing uninterrupted.

> **“Ingenious...screenings are 50% drier than what I was seeing before...”**
> -Michigan



1. City of Monroe grease attack
2. Stones/grit easily lifted
3. FlexRake flexing around a barrel

PROVEN STANDARD OF EXCELLENCE

In 2006, Duperon® Corporation was the first to offer a Five-Year Warranty in wastewater-the industry's toughest standard for equipment excellence.

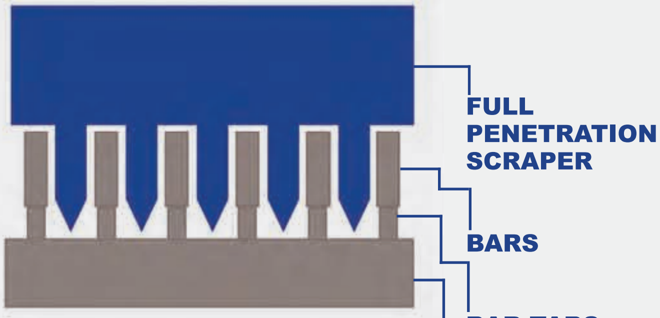
New Mexico

> **2/3 reduction in disposal volume!**
> -Pennsylvania

PROVEN RESULTS

An installation in Pennsylvania has reported satisfaction exceeding expectations. Historically, the Authority had disposed of a 3 cubic yard dumpster each week. The dumpster contained extremely wet organic screening waste. The combined installation of a Duperon FlexRake and Washer Compactor has reduced this disposal to one 2 cubic yard dumpster every two weeks. With no standing water, there has been significant reduction of weight thereby reducing trucking and disposal costs. Odor has been considerably reduced, and the dryness of the compacted screenings has improved appearance on disposal. The combined efforts of the FlexRake and the Washer Compactor have also had a very favorable impact on maintenance processes downstream.

The Duperon® FlexRake®



FULL PENETRATION SCRAPERS
clean 3 sides of bar and horizontal cross members - leaving nothing to chance!

FULL PENETRATION MODEL
FINE SCREEN, 1/2 IN BAR OPENING

The Full Penetration (FP) model FlexRake is typically used in wastewater or other applications where debris can accumulate or wrap around the bars. The scraper is designed to clean 3 sides of the bar. The Full Penetration model is available in bar spacings greater than .5 – 6 inches. If the site allows, this model ships fully assembled. All components are serviceable above the deck, eliminating confined space entries. The patented FlexLink™ system flexes and pivots around large debris and removes it. Virtually maintenance free!

FlexRake® OUTMANEUVERS DEBRIS

The FlexRake handles grease and grit without difficulty, as well as large or unusual debris conditions ranging from sewer plugs to 2' x 4's. Varied flow and influx of debris are no longer an issue. The FlexRake is designed to continue running through all conditions – assuring that the plant will continue to function without shutdown.

Grease attack - no problem!

Factory demonstration of 4x4 entering screen at bottom of channel.

WIDTH-LENGTH	2 feet - 10 feet wide -up to 100 ft long.
SINGLE-STRAND WIDTH	Also available for channels 18 inches - 24 inches.
ANGLE OF INSTALLATION	Ideal 30 degrees from vertical. Range from vertical to horizontal dependent on site.
MATERIAL OF CONSTRUCTION	Standard: 304 SSTL. Alternative: 316 SSTL.
BAR OPENING	Greater than .5 inch - 6 inches.
SCRAPER CONFIGURATION	Spacing: Every 2nd link. UHMW Full Penetration scrapers.
TYPICAL MOTOR/ SPEED	1/3 HP, explosion proof - operating speed .5 rpm.

FP MODEL

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FULL PENETRATION MODEL FINE SCREEN, 1/4-1/2 IN BAR OPENING

The smaller the slot opening, the more critical it becomes to keep the barscreen open. The Full Penetration, Fine Screen (FPFS) model FlexRake® combines the rugged reliability of the Full Penetration model FlexRake with fine screen openings. Utilizing staging scrapers that clean the face of the bar screen and stainless steel teeth that fully penetrate the bar, the Full Penetration, Fine Screen model offers precision technology with the ability to adapt to large debris. Duperon® has eliminated the need for pre-screening… the powerful combination of stainless steel and UHMW scrapers allows for the best in redundancy and unit performance.

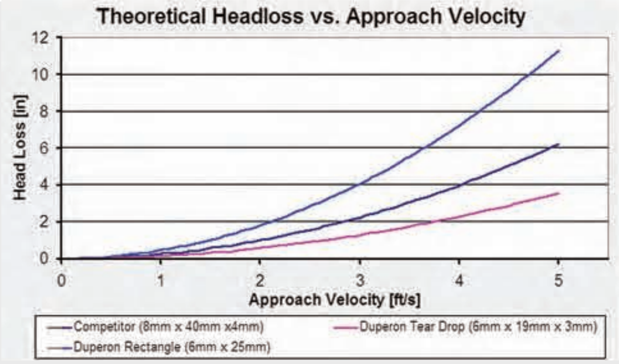
THE BEST SCREENING EFFICIENCY IN THE MARKET

Duperon's bar screen utilizes custom tear-shaped bars with a 50% screening efficiency for .25 inch bar openings, resulting in more favorable flow characteristics and less headloss. The unique tear drop shape keeps large debris on the surface of the screen for removal by scrapers. Small debris flows right through, and full penetration scrapers assure that no debris can accumulate, even on horizontal cross members.

Bar Type	
Sharp-edged rectangular	2.42
Rectangular with semicircular face	1.83
Circular	1.79
Rectangular with semicircular upstream and downstream face	1.67
Tear shape	**0.76**

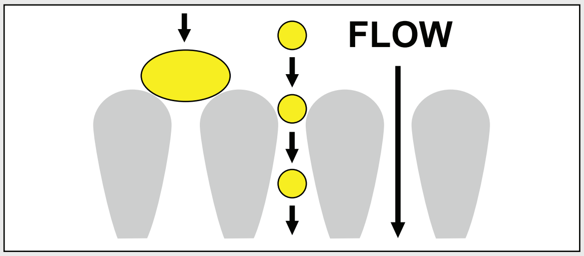
Lin, Shundar. Water and Wastewater Calculations Manual.
New York, New York. McGraw-Hill, 2001.

MOST EFFICIENT



EXCLUSIVE ABILITY TO CLEAN THE BOTTOM OF THE CHANNEL

Due to the "square" sprocket action of the FlexLink™, the FlexRake has the unique ability to hit the base plate of the frame with a scraping, shoveling action that moves debris up the screen eliminating accumulation at the bottom of the channel.

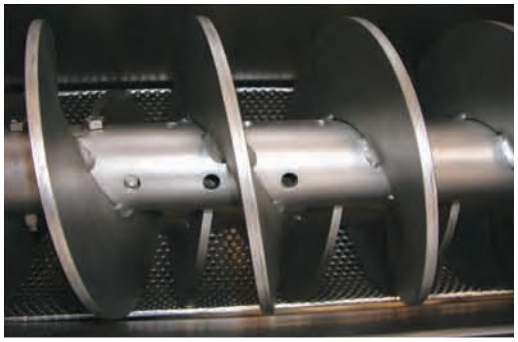


TEAR DROP BARS ARE THE MOST EFFICIENT BARS IN THE INDUSTRY

WIDTH-LENGTH	2 feet - 10 feet wide-up to 100 ft long
SINGLE-STRAND WIDTH	Also available for channels 18 inches - 24 inches.
ANGLE OF INSTALLATION	Ideal 30 degrees from vertical. Range from 10 degrees from vertical to horizontal (dependent on site conditions)
MATERIAL OF CONSTRUCTION	304 SSTL. Alternative: 316 SSTL
BAR OPENING	.25 inch - .5 inch
SCRAPER CONFIGURATION	Spacing: Every 2nd link. UHMW staging scraper/stainless steel full penetration teeth positioned every 21 inches.
TYPICAL MOTOR/ SPEED	1/2 HP, explosion proof, inverter duty-operating speed .5-2 rpm

FPFS MODEL

SIMPLE. TOUGH. PROVEN.



DUPERON WASHER COMPACTOR

Continuing the tradition of simple, efficient, effective products... Exclusive patent-pending positive displacement technology eliminates clogging, bridging and jamming. Unique dual-auger design eliminates the need for additional agitation. Flood washing saturates screenings, eliminating clogging issues inherent in fine spray nozzles. Resulting compacted debris is light grey in color, with volume reduction of up to 82%.

DUPERON AUGER CONVEYOR

Duperon's Auger Conveyor is flexible and scalable to site constraints, with modular components that make assembly – and additions – simple. Constructed of abrasion-resistant UHMW and built to uphold Duperon's tradition of tough durability; powered by the energy-efficient Sumitomo Hyponic drive. A multitude of accessories are available, such as splicing kits, legs, standard mounting holes, and more.

ENCLOSURES

For added convenience and cleanliness, Duperon enclosures are built to site specifications. Each is available in rugged 304 or 316 stainless steel, with the option of full or partial enclosure. Access/viewing doors are placed according to customer preference.

CONTROLS

For best economies, Duperon Corporation offers standard controls packages, from the most basic on/off/overload capability to enhanced VFD packages with differential level control. Custom packages are also

OTHER PRODUCTS

SIMPLE. TOUGH. PROVEN.

DUPERON®
corporation

515 N. Washington Ave.
Saginaw, MI 48607

800.383.8479

duperon.com

The Duperon® FlexRake®

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Appendix C

Hydro International

Storm King® Overflow with Swirl Cleanse™ - Design Summary

Project Information

Project No: 11-3026
Client: Clough, Harbor & Associates
Site: Onondaga County CSO 18

Design History

Design Created By: mbodwell
Date Created: 2/8/2011

Unit Diameter

Unit Diameter: 24.0 ft

Design Flows

Design Inflow Rate: 17.0 MGD US
Design Underflow Rate: 0.85 MGD US

Design Details

This unit was sized Manually

Removal Efficiency (Grading)

The removal efficiency for this unit for the specified grading is 99.30%
For details of the grading used see the Grading Details Section.

Loading Rate

The loading rate for this unit under these flow conditions is 26.094 gal/min/ft²

Inlet and Underflow Pipe Details

Pipe Material: Steel

Inlet Pipe:

Inlet Pipe Diameter: 30.0 in
Pipe Wall Thickness: 0.25 in

Underflow Pipe:

Underflow Pipe Diameter: 6.0 in

Hydro International

Storm King® Overflow with Swirl Cleanse™ - Design Summary

Additional Unit Details

Headloss Across Unit: 0.892ft

Angle of Base Benching: 15°

Screen Component Details

Flows

Spillflow: 15.69MGD US
Overspill: 0.46MGD US

Levels

Screen Chamber Invert Level: 15.256ft
Screen Chamber Depth: 2.597ft
Weir Level: 17.853ft
Maximum TWL: 18.214ft

Pipe Sizes

Overflow Pipe Diameter: 3.5ft

Syphon Details

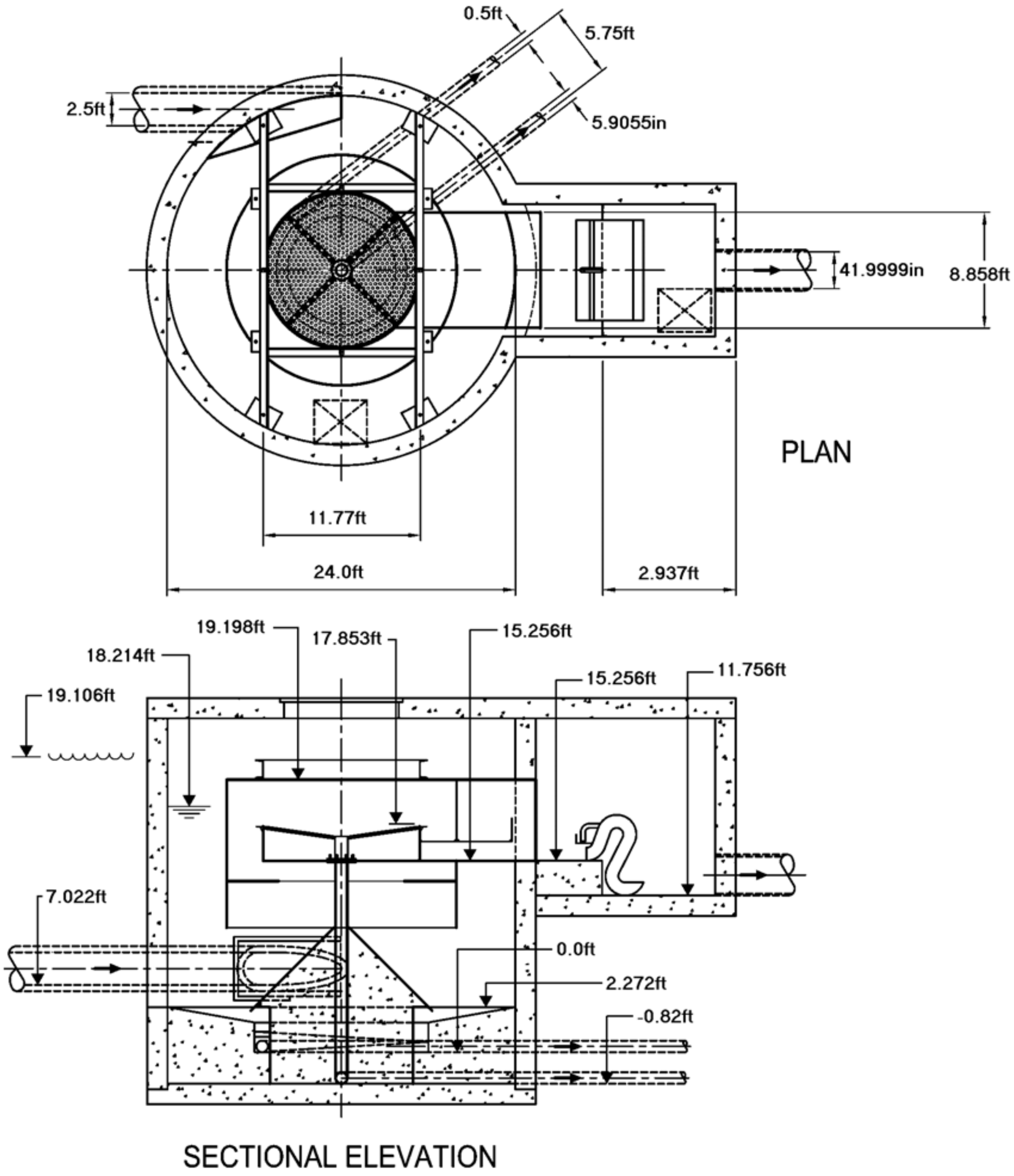
Syphon Type: Straight (Vertical)
Number of Syphons: 2
Syphon Design Flow: 10.2MGD US
Syphon Driving Head: 0.82ft
Syphon Width: 4.429ft
Syphon Depth: 0.82ft

Hydro International

Storm King® Overflow with Swirl Cleanse™ - Summary Diagram

Project Information

Project No: 11-3026
Client: Clough, Harbor & Associates
Site: Onondaga County CSO 18

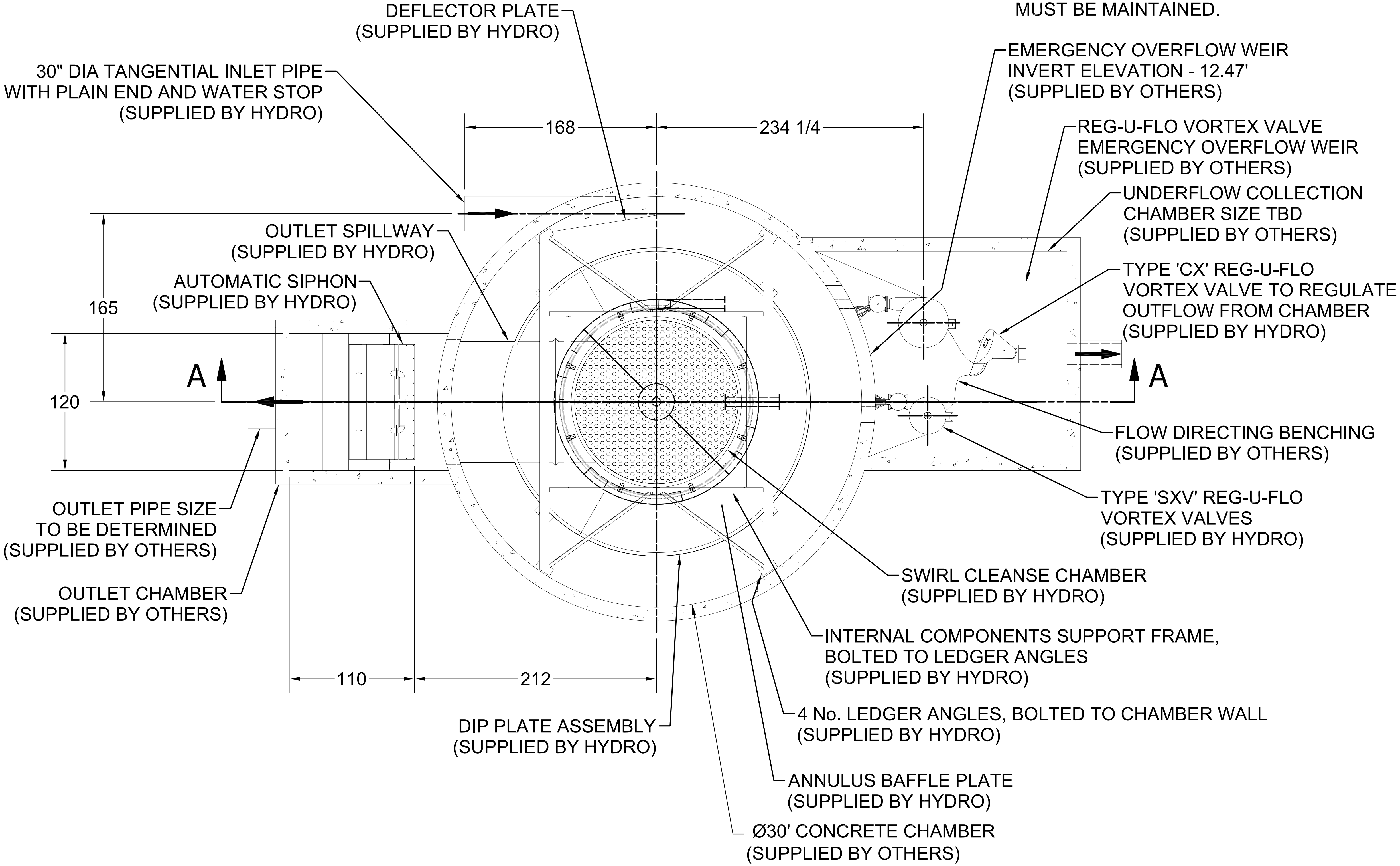


mbodwell February 8, 2011 16:58 Version 2. 1. 4

Appendix D

Storm King – Grit & Floatables Removal Equipment

NOTE
- THE INLET PIPE AND OVERFLOW CHANNEL MAY BE ROTATED 360° ABOUT THE UNIT'S CENTRAL AXIS BUT THE INLET PIPE AND UNDERFLOW OUTLET PIPE ORIENTATION MUST BE MAINTAINED.



PROJECTION

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT GENERAL ARRANGEMENT AND DETAIL DRAWINGS.

REV	BY	DATE	DESCRIPTION
-	MB	3/4/11	FIRST RELEASE

REVISION HISTORY

Date 3/4/2011
Scale 1/8"=1'
Drawn By MB
Checked By -
Approved By NDR

Title
30' STORM KING

ONONDAGA CSO 18
ONONDAGA CO., NY

GENERAL ARRANGEMENT

Hydro International wetweather

94 Hutchins Drive
Portland, ME 04102
Tel: (207) 756-6200
Fax: (207) 756-6212
email: hiltech@hil-tech.com

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERENCES ARE:

FRACTIONS ± 1/16
DECIMALS ± .06
ANGLES ± 1˚

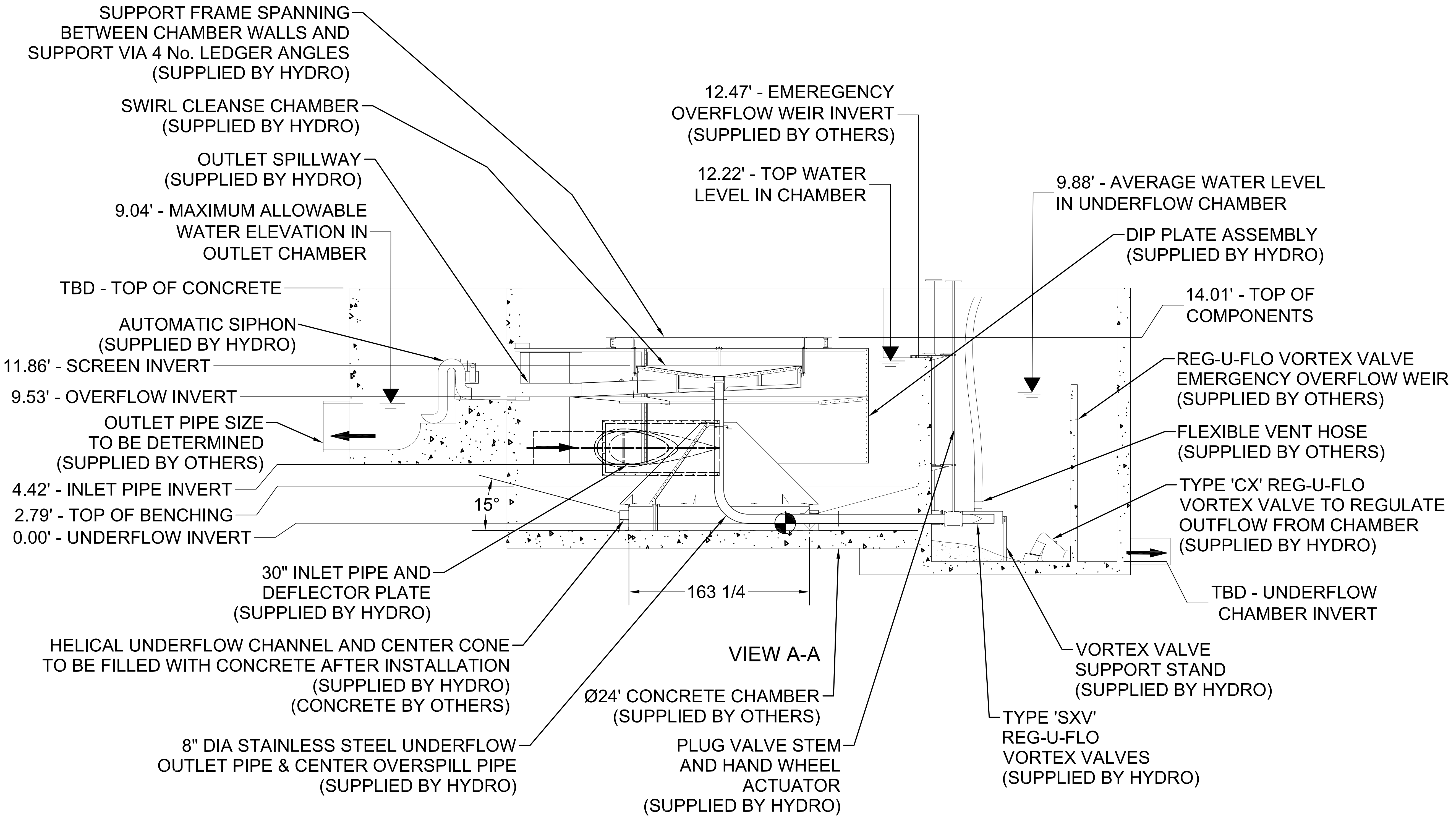
Approximate Weight: 23,000 lbs.
Finish: -
Treatment: -
Sheet Size: B
Sheet: 1OF1
Next Assembly: N/A
Ref. No. 11-3026
Drawing No. GA2
Rev -

EXAMPLE ONLY - NOT FOR CONSTRUCTION

PROJECTION

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT GENERAL ARRANGEMENT AND DETAIL DRAWINGS.



VIEW A-A

REV	BY	DATE	DESCRIPTION
-	MB	3/4/11	FIRST RELEASE

REVISION HISTORY

Date 3/4/2011 | Scale 1/8"=1'

Drawn By MB | Checked By - | Approved By NDR

Title

30' STORM KING

ONONDAGA CSO 18
ONONDAGA CO., NY

ELEVATION VIEW

Hydro International
wetweather

94 Hutchins Drive
Portland, ME 04102
Tel: (207) 756-6200
Fax: (207) 756-6212
email: hiltech@hil-tech.com

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERENCES ARE:

FRACTIONS ± 1/16
DECIMALS ± .06
ANGLES ± 1˚

Approximate Weight: 23,000 lbs.
Finish: -
Treatment: -
Sheet Size: B
Sheet: 1OF1

Next Assembly: N/A
Ref. No. 11-3026
Drawing No. EL2
Rev -

EXAMPLE ONLY - NOT FOR CONSTRUCTION

BUDGETARY QUOTATION

To:	Clough, Harbor & Associates
Project:	Onondaga County CSO 18
Location:	Onondaga County, NY
Hydro Ref:	11-3026
Date:	Monday, March 07, 2011

TO SUPPLY:

QUANTITY	DESCRIPTION: Design Flow Rate – 17 mgd; Treatment Objectives – Grit Removal and Screening (0.2 Aspect Ratio)	PRICE
1 No.	30-foot diameter in situ Storm King® with Swirl Cleanse, manufactured in type 304 stainless steel. Support structure manufactured in galvanized carbon steel.	
1 No.	8.125-inch Type CX Reg-U-Flo® Vortex Valve with pivoting bypass door (US Patent #4,889,166 and Canadian patent #1,284,611) manufactured in 304 stainless steel	
	TOTAL:	**$384,500**

Price includes design costs, fabrication, installation details and drawings, and delivery to site. Unloading, storage and installation by others. Price does not include taxes or duties of any kind.

Hydro International pursues a policy of continuous product development and reserves the right to change their technical specification without prior notice.

The descriptions contained in this quotation are our interpretation of the specifications. Should amendments to this proposal be necessary, we reserve the right to vary the price accordingly.

Validity:	30 Days.
Delivery:	Submittals, 6 to 8 weeks from receipt of purchase order. Storm King, 20 to 24 weeks from receipt of approved submittals.
Terms:	To be determined.

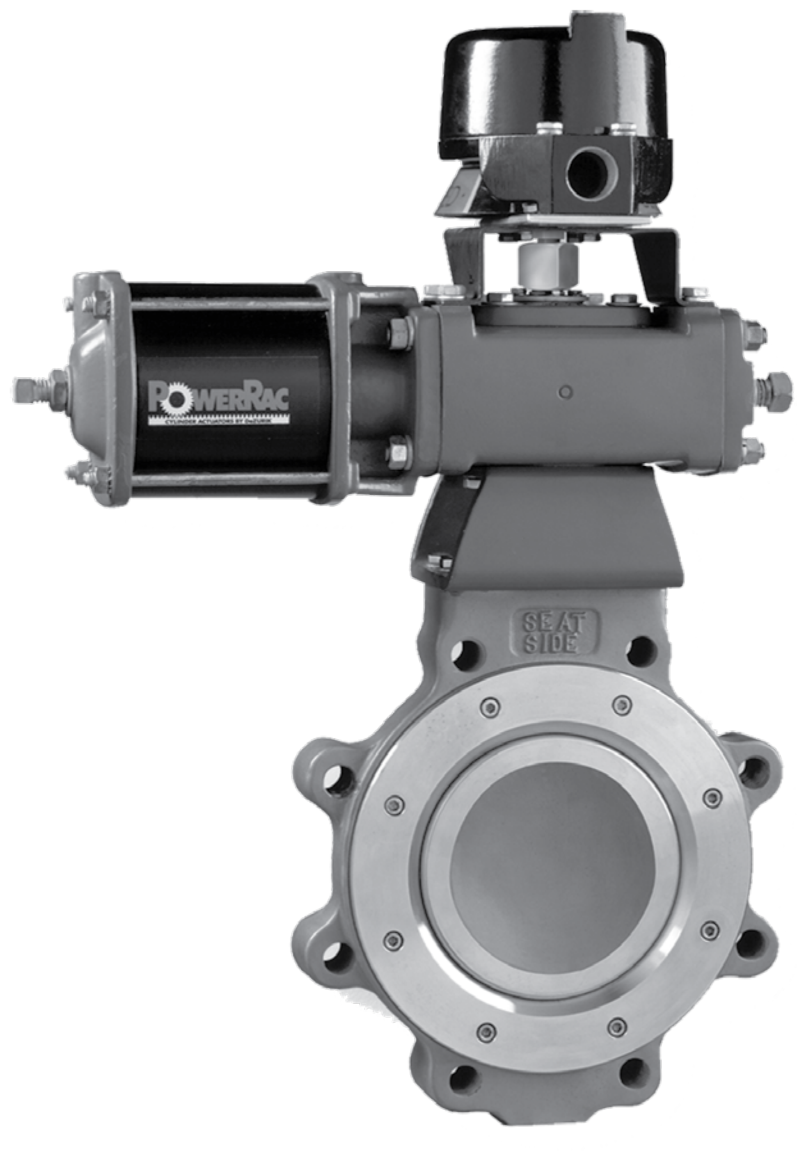
Appendix E

Control Equipment

BULLETIN 45.00-2
FEBRUARY 2009

DeZURIK

BHP HIGH PERFORMANCE BUTTERFLY VALVES TECHNICAL SPECIFICATIONS



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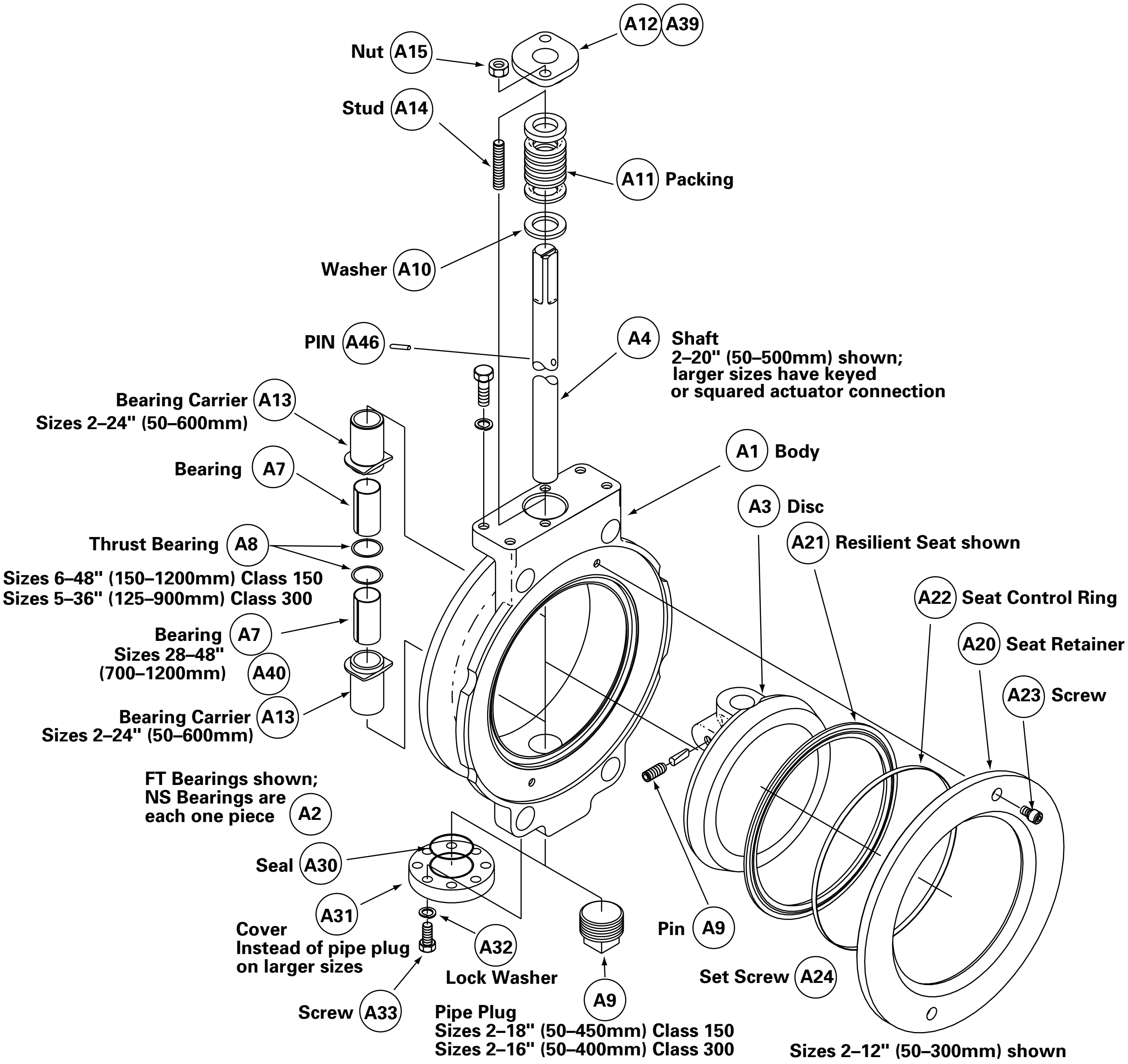
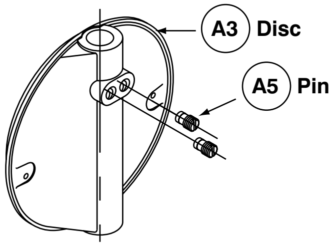
Materials of Construction





Disc Pinning
14" & larger (350mm & larger)

Item	Description	Characteristic/Material
A1	Body	CS, 2–8" (50–175mm), Class 150, 2–8" (50–175mm), Class 300; Carbon Steel, ASTM A 516, Grade 70, Pressure Vessel Plate
		CS, 10–48" (250–1200mm), Class 150, 10–36" (250–900mm), Class 300; Carbon Steel, ASTM A 216, Grade WCB
		S2, 2–48" (50–1200mm), Class ANSI 150, 2–36" (50–900mm), Class ANSI 300, 316 Stainless Steel, ASTM A 351, Grade CF8M
		S3, 2–12" (50–300mm), Class 150 Lugged, 317 Stainless Steel, ASTM A 351, Grade CG-3M except with .03% max. carbon
A2	Locator Bearing	NS, 2–48" (50–1200mm), Non-galling Nickel Alloy
A3	Disc	S2, 2-48" (50-1200mm), 316 Stainless Steel, ASTM A 351, Grade CF8M
		S2NH, 2-48" (50-1200mm), 316 Stainless Steel, Nickel Overlay, Heat Treated, ASTM A 351, Grade CF8M
		S3, 3-12" (80-300mm) Except 5" (125mm), Class150 Lugged, 317 Stainless Steel, ASTM A 351, Grade CF8M
A4	Shaft	S2, 2-48" (50-1200mm), 316 Stainless Steel, ASTM A 479
		S3, 3-12" (80-300mm) Except 5" (125mm), Class150 Lugged, 317 Stainless Steel, ASTM A 276
		S5, 2-48" (50-1200mm), 17-4PH Stainless Steel, ASTM A 564, Type 630, Condition H1150, per NACE MR-01-75
A5	Disc Pin	2–12" (50–300mm), Nitronic 50, ASTM A 479, Type XM-19, Condition "A", per NACE MR-01-75
		14–48" (350–1200mm), 316 Stainless Steel, ASTM A 276
A6	Gasket Seat	TT, RT, TI and RI, 5–10" (125–250mm), Virgin Teflon
A7 & A40	Bearing Liner	FT, 2–48" (50–1200mm), PTFE/317 Stainless Steel
A8	Thrust Washer	FT, 6–48" (150–1200mm), Class 150, 5–48" (125–1200mm), Class 300, PTFE/317 Stainless Steel
A9	Pipe Plug	CS, 2–18" (50–450mm), Class 150, 2–16" (50–400mm), Class 300 Carbon Steel, ASTM A 216, Grade WCB
		S2, 2–18" (50–450mm), Class 150, 2–16" (50–400mm), Class 300, 316 Stainless Steel, ASTM A 351, Grade CF8M
		S3, 3–12" (80–300mm) Except 5" (125 mm), Class 150 Lugged, 317 Stainless Steel, ASTM A 240
A10	Washer, Packing	CS, S2, 2–16" (50–400mm) Class 150, 2–12" (50–300mm) and 16" (400mm) Class 300, ASTM A 240, Type 316
		CS, S2, 18" (450mm) and 20" (500mm) Class 150, 14" (350mm) and 18" (450mm) Class 300, ASTM A 276, Type 316, Condition A
		CS, S2, 24–48" (600–1200mm) Class 150, 20-36" (500–900mm) Class 300, ASTM A 511, Type 316
		S3, 3-4" (75–100mm) and 6–12" (150–300mm) Class 150 Lugged, ASTM A 167, Type 317
A11 & A26	Packing	TC, 2–48" (50–1200mm), V-Flex Virgin PTFE
		G1, 2–48" (50–1200mm), Graphoil Ring, Carbon Filament Rings
		G2, 2–36" (50–900mm), Graphoil, Inconel-Graphite Core
		TMD Primary, 2–36" (50–900mm), V327, Top Ring: 10% Polyester-Filled PTFE; Other Rings: 5% Glass-Filled PTFE; Bottom Ring includes Elgiloy Spring
		TMD Secondary Packing, 2–36" (50–900mm), Virgin Teflon
A12	Gland	2-36" (50–900mm) Class 150, 2–24" (50–600mm) Class 300, 317 Stainless Steel, ASTM A 351, Type 317
		30" (750mm) and 36" (900mm) Class 150, 42" (1050mm) and 48" (1200mm) Class 300, 316 Stainless Steel, ASTM A 511, Grade MT 316
A13	Bearing Carrier	FT, 2–12" (50–300mm), Class 150 CS and S2 Bodies, 316 Stainless Steel, ASTM A 276
		FT, 2–24" (50–600mm), Class 150 S3 Body and 2–12" (50–300mm),
A14	Gland Stud	Class 300 C2, S2 and S3 Body, 317 Stainless Steel, ASTM A 351, Grade CG3M
		CS, S2 and S3, 2–48" (50–1200mm), 316 Stainless Steel
A15	Gland Nut	CS, S2 and S3, 2–48" (50–1200mm), 316 Stainless Steel
A20	Seat Retainer	CS, Carbon Steel, ASTM A 516, Grade 70
		S2, 316 Stainless Steel, ASTM A 240, Type 316
		S3, 3–12" (80–300mm), Class 150 Lugged, 317 Stainless Steel, ASTM A 240
A21	Seat	PTFE (TT, TI, TTS2, TIS2) Virgin PTFE
		RTFE (RT, RI, RTS2, RIS2) Reinforced PTFE
A22	Control Ring	RT, TT, RTS2, TTS2, Titanium, ASTM B 265, Grade 3
		RI, TI, TIS2, RIS2, Inconel 625
A23	Seat Retainer Screw	CS, S2, 2–48" (50–1200mm), 316 Stainless Steel
		S3, 3–12" (50–300mm), Except 5" (125mm), Class 150 Lugged, 317 Stainless Steel
A24	Disc Pin Set Screws	2–12" (50–300mm), CS and S2 Disc, 316 Stainless Steel
		2–12" (50–300mm), Except 5" (125mm), S3 Disc, 317 Stainless Steel, ASTM A 167
A27	Gasket, Seat	TIS2, RIS2, RTS2, TTS2, and S2, Graphoil, Commercial Grade GTB
A28	Seat, Metal (Not Shown)	TIS2, RIS2, RTS2, TTS2, 2–48" (50–1200mm), 316 Stainless Steel, ASTM A 240
		S2, 2–48" (50–1200mm), 316 Stainless Steel, Nickel Overlay, Heat Treated, ASTM A 240, Type 316
A30	Bottom Cover Seal	S2 Shaft, 20–48" (500–1200mm) Class 150, 18–36" (450–900mm) Class 300, PTFE
		S4 Shaft, 24–48" (600–1200mm), PTFE
		S5 Shaft, 20–24" (500–600mm) Class 150, 18–36" (450–900mm) Class 300, Graphoil, Commercial Grade GTB
A31	Bottom Cover	CS, 20–48" (500–1200mm), Class 150, Carbon Steel, ASTM A 516, Grade 70
		S2, 18–36" (450–900mm), Class 300, 316 Stainless Steel, ASTM A 240 Condition A
A32	Bottom Cover Lockwasher	20–36" (500–900mm), Class 150, 18 (450mm) and 20" (500mm), Class 300, 410 Stainless Steel
		42 (1050mm) and 48" (1200mm), Class 150, 24–36" (600–900mm), Class 300, 316 Stainless Steel
A33	Bottom Cover Screw	20–48" (500–1200mm), Class 150, 18–36" (450–900mm), Class 300, Stainless Steel, ASTM A 193, Grade B8M, Class 1 or 2
A39	Gland Plate	S2, 30" (750mm) and 36" (900mm) Class 150, 42" (1050mm) and 48" (1200mm) Class 300, 316 Stainless Steel, ASTM A 240, Type 316
A46	Pin	300 Series Stainless Steel

Material Selections for use with Seat Options

Item	Material	Seat Options			
		PTFE/Titanium (RT and TT)	PTFE/Inconel (TI and RI)	Fyre-Block® (TIS2, TTS2, RTS2 and RIS2)	Metal (S2 and S2L)
Body (A1)	Carbon Steel (CS)	Recommended	Recommended	Recommended	Recommended
	316 Stainless Steel (S2)	Recommended	Recommended	Recommended	Recommended
	317 Stainless Steel (S3)*	Recommended	Recommended	Not Allowed	Not Allowed
Packing (A11)	PTFE (TC, TMD) 2-36" (50-900mm)	Recommended	Recommended	Allowed if Fire Safety Not Concern	Allowed to 450°F (232°C)
	Carbon Graphite (G1) 2-24" (50-600mm)	Allowed	Allowed	Recommended	Recommended
	Graphoil (G2, G2L, G2DL) 2-36" (50-900mm)	Recommended	Recommended	Recommended	Recommended
Disc (A3)	316 Stainless Steel (S2)	Recommended	Recommended	Not Allowed	Not Allowed
	316 Stainless Steel, Plated & Heat Treated (S2NH)	Allowed	Allowed	Recommended	Recommended
	317 Stainless Steel (S3)*	Recommended	Allowed	Not Allowed	Not Allowed
Shaft (A4)	316 Stainless Steel (S2) 2" (50mm) & Larger	Recommended	Recommended	Not Allowed	Not Allowed
	317 Stainless Steel (S3)*	Recommended	Recommended	Not Allowed	Not Allowed
	17-4 PH Stainless Steel (S5)	Allowed	Allowed	Recommended	Recommended
Bearing (A2), (A7)	PTFE/317 (FT)	Recommended	Recommended	Recommended	Allowed to 450°F (232°C)
	Nickel Stainless Steel (NS)	Allowed	Allowed	Allowed	Recommended

* 317 Stainless Steel Body, Disc, and Shaft on 3–4" (80–100mm), 6–12" (150–300mm), Class 150 Lugged

Applicable Standards

DeZURIK BHP Butterfly Valves are designed and/or tested to meet the following standards:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings. Class 150 valves are designed to mate with Class 125 pipe flanges, and Class 300 valves are designed to mate with Class 250 pipe flanges.
ANSI B16.5	Pipe Flanges and Flanged Fittings. 2–24" (80–300mm) valves are designed to mate with Class 150 or 300 flanges.
ANSI B16.34	Valves-Threaded and Welded End. All BHP Butterfly Valves comply with requirements of this standard.
ANSI/FCI 70-2	Control Valve Seat Leakage. The high temperature valve (metal seated) meets ANSI Class IV or V shutoff requirements. All valves are tested to Class IV. (If Class V is required, it must be specified as an option to allow for test differences.) PTFE and RTFE seats meet Class VI requirements.
ANSI B16.20	Metallic Gaskets for Piping, Double-Jacket Corrugated and Single Spiral Wound, 5th Edition. Standard construction provides effective sealing with API 601 gaskets. Optional undrilled seat retainer (UR) construction available to provide full seal area contact with API 601 gaskets.
ANSI B16.47	Pipe Flanges and Flanged Fittings. 28" (700mm) and larger are designed to mate with Class 150 or 300 flanges.
API 598	Resilient Seated and Fyre Block® Valves meet the leak rate requirements of this standard.
API 607	Fire Test for Soft Seated, Quarter-Tum Valves, 3rd and 4th Editions. Fyre-Block® style BHP Butterfly Valves only.
BS 5146	Inspection and Test of Steel Valves for the Petroleum, Petrochemical and Allied Industries. Fyre-Block® style BHP Butterfly Valves only with fire portion of standard.
BS 6755	Part 1 Seat & Shell Test. Resilient Seated, and Fyre-Block® Valves meet the leak rate requirements of this standard.
BS 6755	Part 2 Fire Test. Fyre-Block® Valves comply with this standard.
BS 4504	Conforms to flange bolt guide and pressure ratings.
JIS B2212	Conforms to flange bolt guide and pressure ratings.
MSS-SP-61	Pressure Testing of Steel Valves.
MSS-SP-25	Standard Marking System for Valves, Fittings, Flanges, and Unions. All valves comply with requirements of this standard.
DIN 3230	Leak Rate 1 Requirement. Resilient Seated and Fyre-Block® Valves meet the leak rate requirements of this standard.
DIN 2632-	Conforms to flange bolt guides and pressure 2635 ratings.
EN 29001	DeZURIK manufacturing processes comply with this quality standard.
ISA D79.01	Level 2 Leak Rates Cryogenic Tests ISA A75.02 Standard Control Valve Capacity Test Procedure.
ISO 7005	Conforms to flange bolt guide and pressure ratings.
ISO 5208	Conforms to pressure testing requirements of this standard.
ISO 5211	Conforms to flange bolt guide and pressure ratings.
ISO 5752	All valves designed to comply with face-to-face dimensions.
ISO 9001	DeZURIK manufacturing processes certified to this quality standard.
MSS-SP-68	High Pressure-Offset Seat Butterfly Valves. All valves comply with the requirements of SP68.
NACE	Sulfide Stress Cracking Resistant Metallic MR-01-75 Material for Oil Field Equipment. NACE trim is standard with PTFE/Titanium, PTFE/Inconel and Fyre-Block® seats. This construction available as an option with metal seated valves.

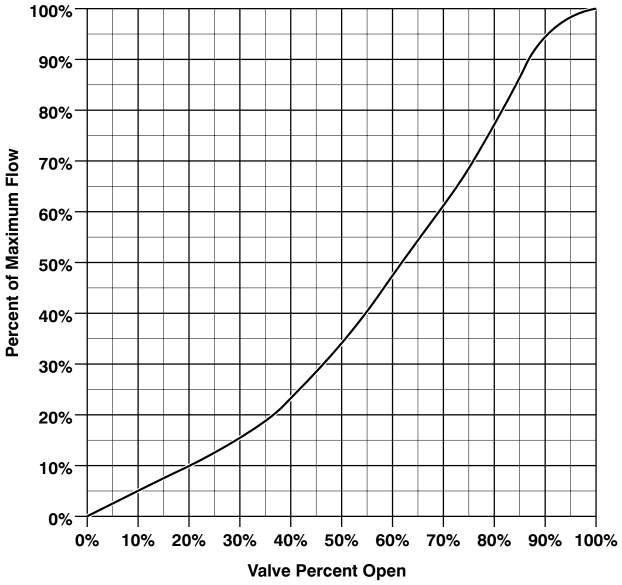
Valve Selection

Flow Coefficients

Cv Values (Flow in GPM of water at 1 psi pressure drop)
Kv Values (Flow in m^3/hr. of water at 100 kPa pressure drop)
BHP Cv/Kv & K Factor

Valve Size	ANSI Class 150		ANSI Class 300	
	Cv Kv 100% Open	K Factor	Cv Kv 100% Open	K Factor
2" 50mm	85 74	2.25	85 74	1.74
2.5" 65mm	180 156	1.02	180 156	1.01
3" 80mm	275 238	1.04	260 225	0.93
4" 100mm	520 450	0.87	475 411	0.85
5" 125mm	860 744	0.78	770 666	0.81
6" 150mm	1360 1180	0.65	1130 977	0.77
8" 200mm	2260 1960	0.71	2110 1830	0.68
10" 250mm	3550 3070	0.71	3350 2900	0.66
12" 300mm	5000 4330	0.72	4800 4150	0.65
14" 350mm	6800 5880	0.57	6390 5530	0.53
16" 400mm	9000 7790	0.56	8460 7320	0.52
18" 450mm	11800 10200	0.52	11100 9600	0.49
20" 500mm	14400 12500	0.54	13500 11700	0.51
24" 600mm	20000 17300	0.58	17700 15300	0.61
28" 700mm	27000 17300	0.67	–	–
30" 750mm	33300 28800	0.53	180 156	0.74
36" 900mm	56500 48900	0.40	180 156	0.51
42" 1050mm	67000 58000	0.53	–	–
48" 1200mm	10300 89100	0.39	–	–

Flow Characteristic



Shutoff Class
(Per FCI 70-2/ANSI B16.104-DIN 3230 Leak Rate1)

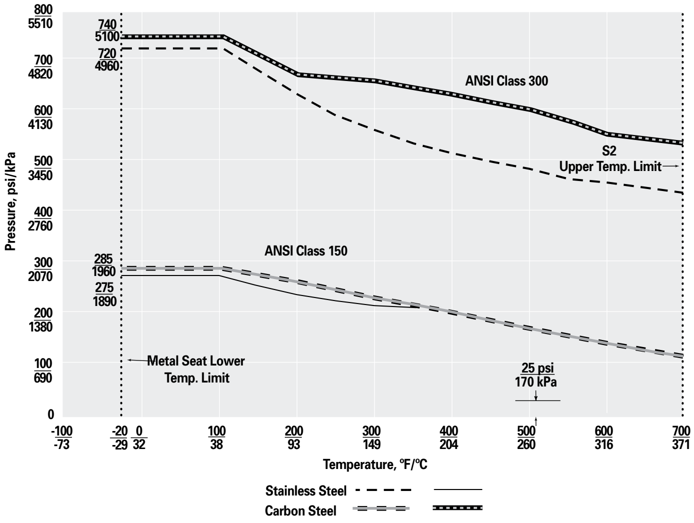
PTFE and RTFE Seated	(Bubble tight) with pressure on either side of the disc.
Fyre-Block® Seated	Class VI - DIN 1 (Bubble tight)
Metal Seated	ANSI Class 150 & 300-Class IV, Uni-Directional on seat side ANSI Class 150 & 300-Class V (opt), Uni-Directional on seat side

Pressure Ratings (Ambient Temperature)

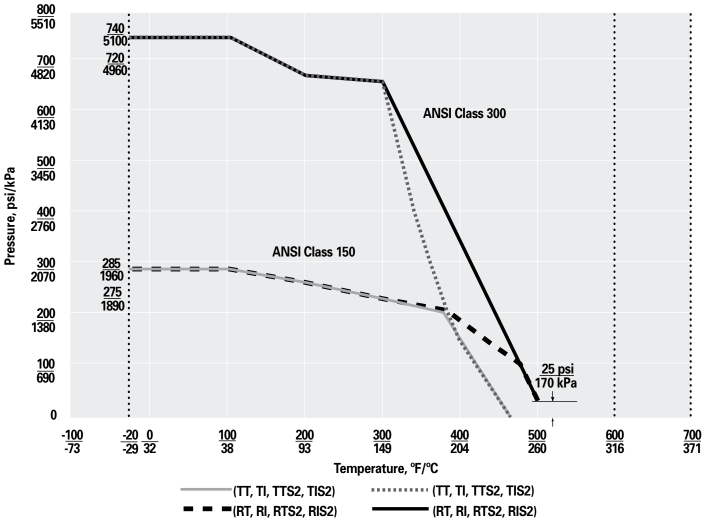
Carbon Steel, Class 150 = 285 psi (1960 kPa)
Carbon Steel, Class 300 = 740 psi (5100 kPa)
Stainless Steel, Class 150 = 275 psi (1890 kPa)
Stainless Steel, Class 300 = 720 psi (4960 kPa)

Pressure/Temperature Ratings:

Metal Seat



Soft Seats



Valve Weights

Valve Weights, Class 150

BHP Cv/Kv & K Factor

Valve Size	Wafer Body		Lugged Body	
	Stainless Steel Lbs/Kg	Carbon Steel Lbs/Kg	Stainless Steel Lbs/Kg	Carbon Steel Lbs/Kg
2” 50mm	3 1	7 3	7 3	7 3
2.5” 65mm	4 2	10 5	9 4	10 5
3” 80mm	10 5	15 7	11 5	20 9
4” 100mm	11 5	17 8	19 9	32 15
5” 125mm	18 8	27 12	26 12	42 19
6” 150mm	22 10	38 17	45 21	50 23
8” 200mm	36 16	65 29	46 21	10 5
10” 250mm	61 28	86 39	67 31	140 64
12” 300mm	100 46	100 46	145 66	145 66
14” 350mm	142 65	142 65	188 86	188 86
16” 400mm	192 87	192 87	243 111	243 111
18” 450mm	314 143	314 143	363 165	363 165
20” 500mm	411 187	411 187	335 152	335 152
24” 600mm	665 302	665 302	800 363	800 363
28” 700mm	Contact DeZURIK			
30” 750mm	975 442	975 442	1175 553	1175 553
36” 900mm	1560 708	1560 708	1900 862	1900 862
42” 1050mm	Contact DeZURIK		4507 2045	4507 2045
48” 1200mm	4015 1821	4015 1821	4545 2062	4545 2062

Valve Weights, Class 300

BHP Cv/Kv & K Factor

Valve Size	Wafer Body		Lugged Body	
	Stainless Steel Lbs/Kg	Carbon Steel Lbs/Kg	Stainless Steel Lbs/Kg	Carbon Steel Lbs/Kg
2” 50mm	4 2	8 4	11 5	14 6
2.5” 65mm	6 3	8 4	18 8	18 8
3” 80mm	8 4	19 9	21 10	25 11
4” 100mm	14 6	21 10	35 16	36 16
5” 125mm	25 11	36 17	49 22	57 26
6” 150mm	28 13	85 39	64 29	98 45
8” 200mm	49 22	75 34	110 50	111 50
10” 250mm	79 36	96 44	175 80	185 84
12” 300mm	124 57	124 57	230 105	230 105
14” 350mm	182 83	182 83	232 105	232 105
16” 400mm	246 112	246 112	312 106	312 106
18” 450mm	402 182	402 182	465 211	465 211
20” 500mm	525 238	525 238	613 278	613 278
24” 600mm	736 334	736 334	1025 465	1025 465
30” 750mm	Contact DeZURIK		3006 1365	3006 1365
36” 900mm	Contact DeZURIK		4350 1975	4350 1975

Ordering

To order, simply complete the valve order code from the information shown. An ordering example is shown for your reference.

Valve Style

Give valve style code as follows:

BHP = High Performance Butterfly Valve

Valve Size

Give valve size code as follows:

2 = 2" (50mm)
2.5 = 2.5" (65mm)
3 = 3" (80mm)
4 = 4" (100mm)
5 = 5" (125mm)
6 = 6" (150mm)
8 = 8" (200mm)
10 = 10" (250mm)
12 = 12" (300mm)
14 = 14" (350mm)
16 = 16" (400mm)
18 = 18" (450mm)
20 = 20" (500mm)
24 = 24" (600mm)
28 = 28" (700mm)
30 = 30" (750mm)
36 = 36" (900mm)
42 = 42" (1050mm)
48 = 48" (1200mm)

End Connection/Face-To-Face

Give end connection and face-to-face code as follows:

Class 150 Wafer

W1 = ANSI
W110 = DIN 10 or BS4504/10 Drilling
W116 = DIN 16 or BS4504/16 Drilling
W1D = B.S. Table D Drilling
W1E = B.S. Table E Drilling
W1J1 = JIS 10 Drilling

Class 150 Lugged

L1 = ANSI
L110 = DIN 10 or BS4504/10 Drilling
L116 = DIN 16 or BS4504/16 Drilling
L1D = B.S. Table D Drilling
L1E = B.S. Table E Drilling
L1J1 = JIS 10 Drilling

Class 300 Wafer

W2 = ANSI
W225 = DIN 25 or BS4505/25 Drilling
W240 = DIN 40 or BS4505/40 Drilling
W2F = B.S. Table F Drilling
W2H = B.S. Table H Drilling
W2J = B.S. Table J Drilling
W2J2 = JIS 20 Drilling

Class 300 Lugged

L2 = ANSI
L225 = DIN 25 or BS4505/25 Drilling
L240 = DIN 40 or BS4505/40 Drilling
L2F = B.S. Table F Drilling
L2H = B.S. Table H Drilling
L2J = B.S. Table J Drilling
L2J2 = JIS 20 Drilling

Note: Standard flange bolt threads on 18" (450mm) and larger Class 150 valves and 12" (300mm) and larger Class 300 valves are 8 U.N.; conforming to MSS-SP-68, MSS-SP-67, API 609 and ASTM F704-81. Contact the factory for non-standard flange bolt threads, i.e. 7 UNC.

Body Material

Give body material code as follows:

CS = Carbon Steel
S2 = 316 Stainless Steel
S3 = 317 Stainless Steel-Available Class 150 Lugged Only 3-12" (80-300mm)

Packing Material

Give packing material code as follows:

TC = PTFE V-Flex, to 500°F (260°C)
G1 = Carbon Graphite to 700°F (371°C)
G2 = Graphoil to 1000°F (538°C)
TCD = PTFE V-Flex, Dual Seat, Low Cycle to 5001 ptF (260°C).
TCDL = PTFE V-Flex, Dual Seat, Live Loaded, Low Cycle to 500°F (260°C).
TCL = PTFE V-Flex, Live Loaded, Low Cycle to 500°F (260°C).
TMD = PTFE with Mechanical Spring, Dual Seat, High Cycle to 500°F (260°C).
G2D = Graphoil, Dual Seal, High Cycle to 1000°F (538°C).
G2L = Graphoil, Live Loaded, High Cycle to 1000°F (538°C).
G2DL = Graphoil, Dual Seal, Live Loaded, High Cycle to 1000°F (538°C).

*Note: The limiting factor in valve selection is the lowest temperature of the packing or seat.
Note: G1 and G2 packing on Fyre-Block® valves have been tested to API607, 4th Edition.

Trim Combination

Give disc, shaft, bearing and seat codes as follows:

Disc Material

S2 = 316 Stainless Steel - Note 2
S2NH = 316 Stainless Steel Nickel Overlay Heat Treated -Note 1
S3 = 317 Stainless Steel - Note 3

Shaft Material

S2 = 316 Stainless Steel
S3 = 317L Stainless Steel
S5 = 17-4 PH Stainless Steel

Bearing Material

FT = Fabric PTFE/317 Stainless Steel to 500°F (260°C)
NS = Nickel Stainless Steel - Used with S2 Seats to 700°F (230°C)

Seat Material*

Give seat material code as follows:

TT = PTFE/Titanium (Contact DeZURIK if application is for oxygen service) to 450°F (232°C).
TI = PTFE/Inconel to 450°F (232°C).
TIS2 = PTFE with Inconel and 316 Stainless Steel, to 450°F (230°C).
TTS2 = PTFE/Titanium and 316 Stainless Steel-must use G1 packing, to 450°F (232°C).
S2 = 316 Stainless Steel, to 700°F (371°C).
RT = Reinforced PTFE/Titanium, to 500°F (260°C).
RI = Reinforced PTFE/Inconel, to 500°F (260°C).
RIS2 = Reinforced PTFE with Inconel and 316 Stainless Steel, to 500°F (260°C).
RTS2 = Reinforced PTFE/Titanium and 316 Stainless Steel, to 500°F (260°C).

Notes:

1. Heat Treated Discs are for use with S5 Shafts, and TTS2, TIS2, RIS2, RTS2 or S2 Seats.
2. 316 Stainless Steel Disc with 316 Stainless Steel Shaft must use FT Bearings.
3. With 317 Stainless Steel Disc use 317 Stainless Steel Shaft with FT Bearing and either TT or TI Seat. 317 Stainless Steel available in sizes 3–12" (80–300mm) Class 150 only.

Options

Give options code as follows:

UR = Undrilled Seat Retainer - Available on 2–12" (50–300mm) only. Lugged style not available for dead end service.
NT = NACE Trim - Required on metal seated valves only. (Standard on valves with RT, RI, TT, TI, TIS2, RIS2 and TTS2 seats.)
C5 = Class 5 Seat Test - For use with S2 metal seated valves.
15 = 150 psi Disc - 36" (900mm) & Larger.
PED = Pressure Equipment Directive (CE Mark) Category I Assessment Module A.
PEDL = Pressure Equipment Directive (Lloyd’s CE Mark) Category II and III Assessment Module H.
API = Conformance to API-609. Not available on 2.5" and 5" for CL150 and CL300. Valves with (S2) metal seats do not meet the required leak rates for PI 598. (S2) metal seats meet the Class V (optional C5) ANSI B16.104/FCI 70.2 requirements.

Ordering Example:

BHP,3,L1,S2,TC,S2-S2-FT-TT,UR*

Lever Actuators

10-Position Levers

A 10-position dial provides positive latching in open, closed and eight intermediate positions. A pointer indicates position of disc plus a notch in the handle allows use of a padlock to prevent unauthorized valve operation. An optional adjustable memory stop is available to allow the valve to be closed and reopened to the same position.

Mounting

Lever actuators can be mounted at standard and 180° clockwise from standard. Specify mounting positions other than standard below the valve and actuator identification.

Ordering Levers

To order, add lever code “LT” to basic valve identification. Lever actuators available on 2–8" (50–200mm) Class 150 and Class 300 valve sizes only. Handwheel actuators are recommended for valve sizes over 6" (150mm) and where water hammer may occur due to a sudden valve closure. Maximum pipeline velocity for lever operated valve is 20 feet (6 meters) per second.

Memory Stop

An adjustable memory stop is available which allows return of the valve to preset open position after shutoff. Order the memory stop as part of a complete valve, by adding “ST” after the actuator code.

Ordering Example:
BHP,3,L1,S2,TC,S2-S2-FT-TT*LT,ST

Lever Actuator Sizing

Class 150

Valve Size	Order Code	psi/kPa		
		TT/TI RT/RI	TTS2/TIS2 RTS2/RIS2	S2
2-6” 50-150mm	LT	285 1960	285 1960	285 1960
8” 200mm	LT	285 1960	285 1960	50 340

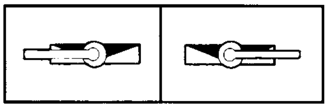
Note: Stainless Steel valves are rated to 275 psi (1890 kPa).

Class 300

Valve Size	Order Code	psi/kPa		
		TT/TI RT/RI	TTS2/TIS2 RTS2/RIS2	S2
2&4” 50&100mm	LT	740 5100	740 5100	740 5100
6” 150mm	LT	740 5100	650 4480	300 2070
8” 200mm	LT	740 5100	450 3100	50 340

Ordering Example:
BHP,3,L1,S2,TC,S2-S2-FT-TT*LT

Lever Mounting Positions



Standard Mounting

180° Clockwise

Note: 90º, 180° and 270º Lever Mounting Position provided if requested on order.

Rotary Manual Actuators

Rotary manual actuators feature a cast iron housing with bearings on each end of the input shaft for durability and performance. The ductile iron gear provides strength for robust applications and a long service life without maintenance. Rotary manual actuators are available with handwheel, chainwheel, or a 2" (50mm) square nut input option. Actuators feature external position indication and are available with safety lockout devices.

PowerRac® Cylinder Actuators

PowerRac double-acting and spring-return actuators feature a proven rack-and-pinion design. PowerRac® provides high torque output throughout the full stroke for accurate control.

Spring-Diaphragm Actuators

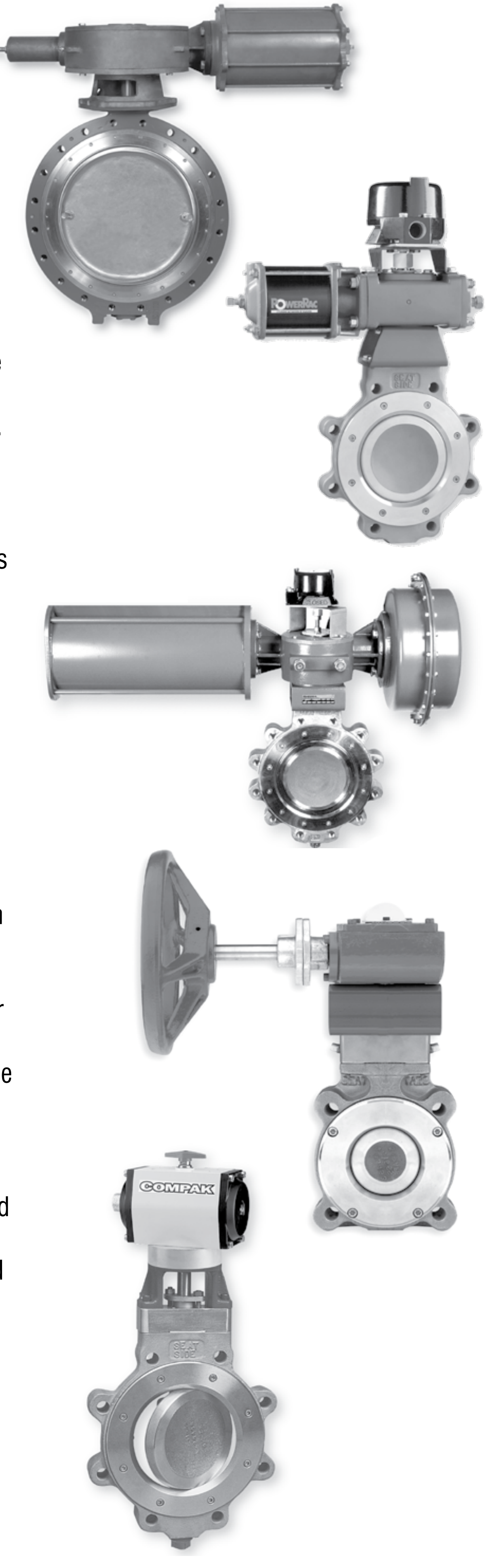
DeZURIK spring-diaphragm actuators feature all steel, cast iron and stainless steel construction with no aluminum parts to corrode in caustic environments. The output shaft is supported at the top and bottom with bronze bearings that absorb side thrust and ensure smooth, efficient throttling control. Diaphragm actuators provide on-off or modulating control with either spring-to-spring or spring-to-close operation. All diaphragm actuators feature external position indication and are available with safety lockout devices.

Handwheel and Chainwheel Actuators

Manual gear actuator housings are constructed of high strength metal and feature sintered bronze bearings on each end of the input shaft for durability and performance. The high strength gear provides strength for robust applications and a long service life without maintenance. All manual gear actuators feature external position indication and are available with safety lockout devices. Actuators for buried service are available as an option.

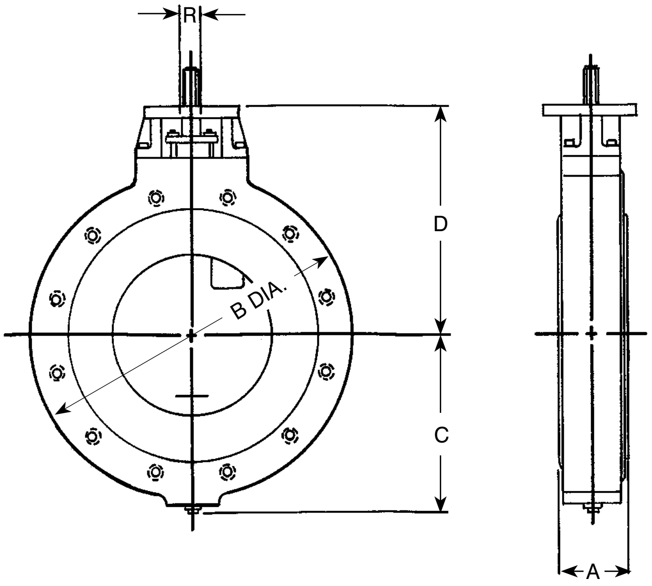
Compak™ Cylinder Actuators

Compak actuators are a versatile rack-and-pinion design and are available as double-acting or spring-return units. The compact, modular design allows the actuator to be mounted for a low profile assembly. Compak actuators are matched to each valve's torque requirements to ensure that the most economical valve and actuator package is specified.



Dimensions

Basic Valve



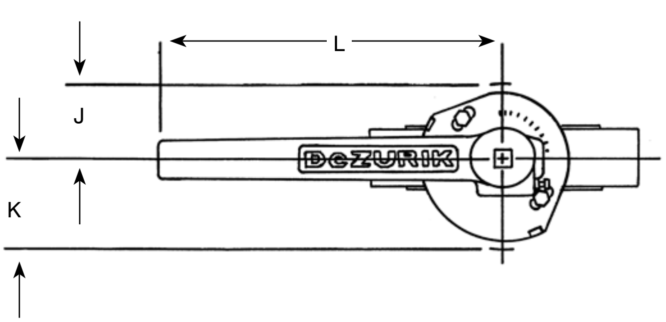
Valve Size	Dimensions											
	A		B				C		D		R (Dia.)	
	Class 150	Class 300	Class 150		Class 300		Class 150	Class 300	Class 150	Class 300	Class 150	Class 300
			Wafer	Lugged	Wafer	Lugged						
2” 50mm	1.75 44	1.75 44	4.31 110	6.06 154	4.31 110	6.44 164	3.31 84	3.50 89	5.50 140	5.50 140	0.371 9	0.371 9
2.5” 65mm	1.88 48	1.88 48	5.00 127	7.00 178	5.00 127	7.44 189	3.44 87	4.00 102	5.75 146	6.00 152	0.371 9	0.434 11
3” 80mm	1.88 48	1.88 48	5.66 144	7.62 194	5.66 144	8.19 208	3.97 101	4.38 102	6.00 152	6.38 162	0.434 11	0.496 13
4” 100mm	2.12 54	2.12 54	6.78 172	9.00 229	6.78 172	9.75 248	4.75 121	5.06 129	6.75 171	7.75 197	0.496 13	0.621 16
5” 125mm	2.31 59	2.31 59	7.69 195	10.00 254	7.75 197	10.94 278	5.50 140	5.94 151	7.75 197	8.25 210	0.621 16	0.746 19
6” 150mm	2.31 59	2.44 62	8.88 226	11.00 279	9.00 229	12.44 316	6.50 165	7.16 182	8.25 210	9.00 229	0.746 19	0.995 25
8” 200mm	2.50 64	2.88 73	11.00 279	13.50 343	11.12 282	14.88 378	7.59 193	8.47 215	9.50 241	10.75 273	0.995 25	1.245 32
10” 250mm	2.93 74	3.36 85	13.75 349	16.12 409	13.25 337	17.50 445	8.78 223	10.06 256	11.19 284	12.62 321	1.245 32	1.495 38
12” 300mm	3.28 83	3.72 95	15.50 394	19.12 486	15.50 394	20.38 518	10.19 259	11.38 289	12.75 324	13.75 349	1.495 38	1.745 44
14” 350mm	3.61 92	4.64 118	16.50 419	21.00 533	16.62 422	22.25 565	11.81 300	12.84 326	14.00 356	16.88 429	1.495 38	1.870 48
16” 400mm	3.99 101	5.26 134	18.75 476	23.50 597	18.69 475	24.50 622	12.94 329	13.81 351	15.75 400	14.25 362	1.620 41	1.995 51
18” 450mm	4.43 113	5.89 150	21.25 540	25.00 635	21.38 543	27.00 686	14.31 329	16.00 406	18.62 473	15.50 394	1.870 48	2.245 57
20” 500mm	4.92 125	6.26 159	23.25 591	27.75 705	23.50 597	29.25 743	15.81 402	16.81 427	20.56 522	16.75 425	2.245 57	2.449 63
24” 600mm	6.12 155	7.22 183	27.25 692	32.00 813	27.50 699	34.50 876	17.31 440	20.06 510	17.75 451	19.69 500	2.499 63	3.624 92
28” 700mm	6.50 165	—	—	36.50 927	—	—	19.88 505	—	20.00 508	—	2.998 76	—
30” 750mm	6.50 165	9.88 251	33.75 857	38.75 984	34.12 867	43.00 1092	21.06 535	25.84 656	21.12 536	25.00 635	2.999 76	4.499 114
36” 900mm	7.88 83	10.88 276	40.25 1022	46.00 1168	40.88 1038	50.00 1270	25.38 645	28.75 730	25.00 635	28.50 724	3.624 92	5.000 127
42” 1050mm	9.88 251	—	53.00 1346	47.25 1200	—	—	28.94 735	—	30.00 762	—	4.499 114	—
48” 1200mm	10.88 276	—	59.50 1511	53.81 1367	—	—	32.50 826	—	31.68 805	—	5.000 127	—

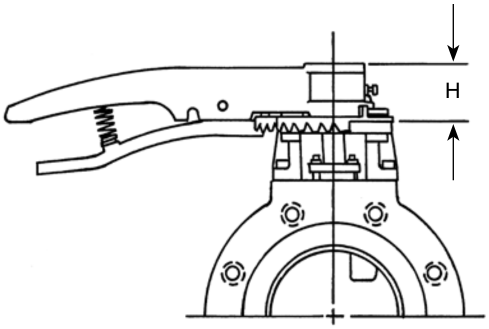
Inch
Millimeter

Note: All dimensions are subject to change without notice. For piping layouts, request certified drawings.

Dimensions

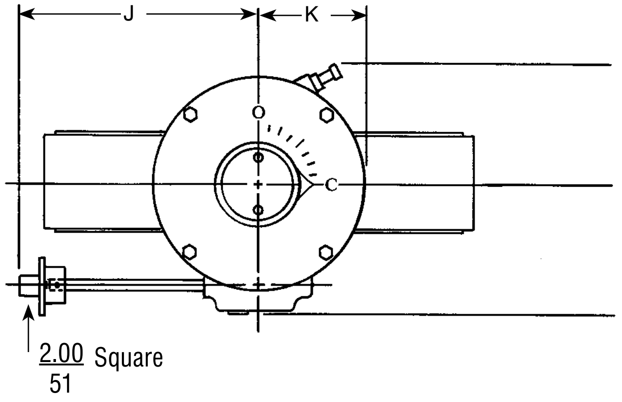
Lever

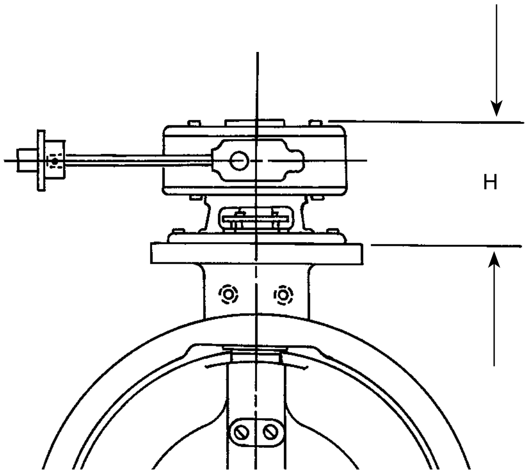




Valve Size	Dimensions										
	H	J		K		L					
		Class 150	Class 300	Class 150	Class 300	PTFE Seats (RT, RI, TT & TI)		Fyre-Block® (TTS2, TIS2, RTS2 & RIS2)		Metal Seat (S2)	
						Class 150	Class 300	Class 150	Class 300	Class 150	Class 300
2” 50mm	2.00 51	2.00 51	2.00 51	2.44 62	2.44 62	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
2.5” 65mm	2.00 51	2.00 51	2.00 51	2.44 62	2.44 62	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
3” 80mm	2.00 51	2.00 51	2.00 51	2.44 62	2.44 62	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
4” 100mm	2.00 51	2.00 51	3.00 72	2.44 62	3.56 90	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254	10.00 254
5” 125mm	2.00 51	2.00 51	3.00 72	2.44 62	3.56 90	10.00 254	14.00 356	—	—	—	—
6” 150mm	2.25 57	3.00 72	3.00 72	3.56 90	3.56 90	14.00 356	22.00 559	14.00 356	22.00 559	22.00 559	22.00 559
8” 200mm	2.25 57	3.00 72	3.00 72	3.56 90	3.56 90	22.00 559	22.00 559	22.00 559	22.00 559	22.00 559	22.00 559

2" (50mm) Square Nut, G-Series Actuator





Actuator Code	Dimensions				
	H	J	K	L	M
GS-12-N	10.37 263	16.38 416	7.88 200	9.25 235	9.50 241
GS-16-N	10.94 278	27.69 703	22.00 559	11.00 279	13.50 343

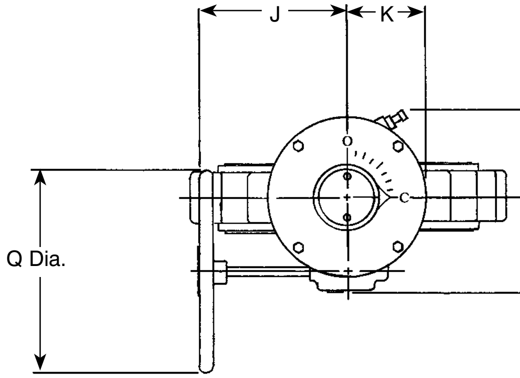
Inch
Millimeter

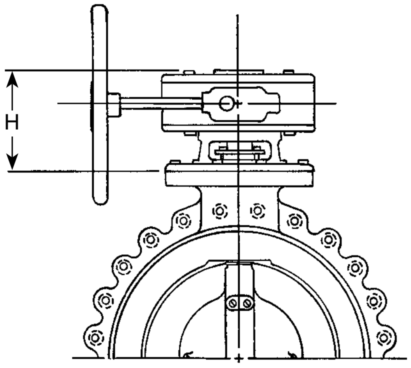
Note: H dimension on 14" (350mm) valve with GS-12-N is 11.25
286

Note: All dimensions are subject to change without notice. For piping layouts, request certified drawings.

Dimensions

Handwheel, G-Series Actuator

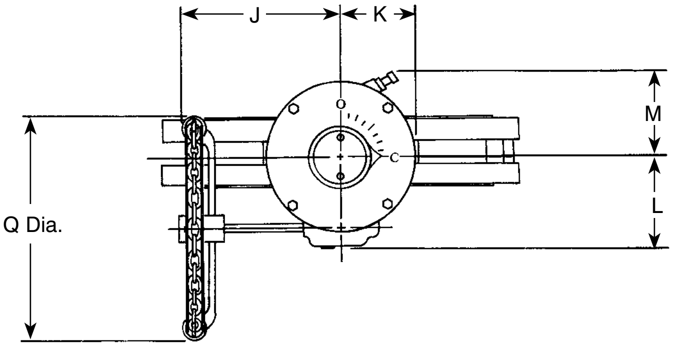


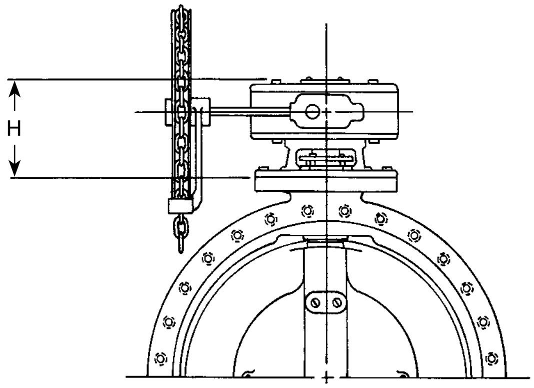


Actuator Code	Dimensions					
	H	J	K	L	M	Q
GS-12-HD16	10.37 263	13.50 343	7.88 200	9.25 235	9.50 241	16.00 406
GS-12-HD24	10.37 263	17.50 445	7.88 200	9.25 235	9.50 241	24.00 610
GS-12-HD30	10.37 263	17.50 445	7.88 200	9.25 235	9.50 241	30.00 762
GS-16-HD20	10.94 278	24.88 632	22.00 559	11.00 279	13.50 343	20.00 508
GS-16-HD24	10.94 278	28.25 718	22.00 559	11.00 279	13.50 343	24.00 610
GS-16-HD30	10.94 278	28.38 721	22.00 559	11.00 279	13.50 343	30.00 762

Note: H dimension on 14" (350mm)
valve with GS-12-HD24 is 11.25
286

Chainwheel, G-Series Actuator





Actuator Code	Dimensions					
	H	J	K	L	M	Q
GS-12-CW20	10.37 263	13.50 343	7.88 200	9.25 235	9.50 241	16.00 406
GS-12-CW30	10.37 263	17.50 445	7.88 200	9.25 235	9.50 241	24.00 610
GS-16-CW20	10.94 278	24.88 632	22.00 559	11.00 279	13.50 343	20.00 508

Note: H dimension on 14" (350mm)
valve with GS-12-CW20 is 11.25
286

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DeZURIK

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Printed in the U.S.A.

ASHCROFT®

Type KS Thin Film Pressure Transducer/Transmitter For Sanitary Applications

APPLICATIONS:

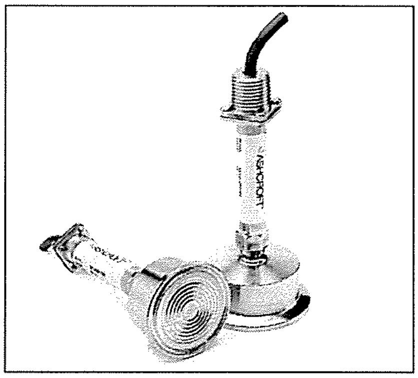
Dairy, food, pharmaceutical and any 3A sanitary application

BENEFITS & FEATURES:

- ***316L stainless steel electropolished (1½″-2″) Tri-Clamp® style diaphragm***
- ***Vac.-1000 psi pressure range***
- ***Stainless steel NEMA 4X enclosure***
- ***Superior long-term stability and repeatability***
- ***Current/voltage/millivolt output***
- ***Wide range of electrical connections available***
- ***All-welded construction***

Ashcroft® combines the proven polysilicon thin film technology with its longtime know-how of diaphragm seals to create the KS sanitary pressure transmitter. The all-welded stainless steel construction meets the 3A Sanitary Standard 74-02.

The KS Sanitary Pressure Transmitter features the benefits of polysilicon thin film performance at an affordable price. Modern chemical vapor disposition methods provide simple, stable, molecular bonds between a proven metal diaphragm and polysilicon strain gage bridge. There are no epoxies or bonding agents to contribute to signal instability or drift.



The integral metal diaphragm and polysilicon bridge are virtually unaffected by shock, vibration or mounting position.

PERFORMANCE SPECIFICATIONS

Accuracy Class (Span):

Includes non-linearity, (Terminal Point Method), hysteresis, non-repeatability, zero offset and span setting errors)	1%
Best fit straight line (BFSL)	±0.75%

ENVIRONMENTAL SPECIFICATIONS

Temperature

Storage	–65/+250°F	(–54 to +120°C)
Operating	–20/+180°F	(–28 to +82°C)
Compensated	+30/+130°F	(0 to +50°C)

Thermal Coefficients: (68°F (20°C) ref.) % Span/°F

Standard:

ZERO	±0.04%
SPAN	±0.04%

Humidity:
No performance effect at 95% relative humidity – noncondensing

FUNCTIONAL SPECIFICATIONS

Standard Ranges (psi)

0/30*†
0/60*†
0/100†
0/150†
0/200†
0/300†
0/500
0/750
0/1000
vac./30*†
vac./60*†
vac./100†

Consult factory for nonstandard ranges.

*T/C multiply by 1.5 times.
†NEMA 4X only with F2 and C1 electrical connections.

Overpressure: (F.S.)

Proof	200%
Burst	800%

Vibration Sweep:
Less than ±0.1%F.S. effect for 0-2000 Hz at 20 g's in any axis

Shock:
Less than ±0.05%F.S. effect for 100 g's, 20ms shock in any axis

Position Effect: Less than 0.01% F.S.

ELECTRICAL SPECIFICATIONS

Transmitter Output Signal:
4-20mA (2 wire)
1-5 Vdc (3 wire)
1-6 Vdc (3 wire)

Supply Current:
Less than 3mA for voltage output

Power Requirements:
10-36 Vdc unregulated
Reverse polarity protected

Transducer Output Signal:
2m V/V ratiometric
3m V/V ratiometric
10m V/V ratiometric
20m V/V ratiometric

Power Requirements: 5-10 Vdc regulated

Circuit to Case Insulation Resistance:
100 M ohms @ 50 Vdc

PHYSICAL SPECIFICATIONS

Enclosure: NEMA 4X

Weight:
13.5 oz (approx. without cable)

MATERIALS

Case: 300 series stainless steel

Cable:
No. 24 AWG, 36″ PVC, shielded, vented, UL approved

Diaphragm: 316L stainless steel

Standard Process Connections:
316L stainless steel electropolished Tri-Clamp® style 1½″, 2″

Fill: USP grade 99.5% glycerin fill, contact factory for other fill fluids

Consult factory for pricing, availability and required minimums for nonstandard products.

WARNING! Sensitive Diaphragm!

TO ORDER THIS TYPE KS TRANSDUCER/TRANSMITTER:

Select: KS 7 ☐☐☐ ☐☐ ☐☐ ☐☐☐☐☐☐

1. Type Configuration (KS)

2. Accuracy/TC
(7) 1.0%, ±0.040%/°F

3. Sanitary Seal
(S15) 1½ inch Sanitary Connection **(S20)** 2 inch Sanitary Connection

4. Output Signal
(42) 4-20mA **(16)** 1/6 Vdc **(15)** 1/5 Vdc **(02)** 2mV/V
(03) 3mV/V **(10)** 10mV/V **(20)** 20mV/V

5. Electrical Termination
(F2) 36″ cable, shielded, PVC sheathing **(B4)** Bendix 4-pin # PT02A-8-4P*
(B6) Bendix 6-pin # PT02A-10-6P* **(B8)** WP Bendix 4-pin # PT02E-8-4P*
(B9) WP Bendix 6-pin # PT02E-10-6P* **(C1)** 1/2 NPT-M Conduit w/36″ cable **(HM)** Hirschman miniature

6. Pressure Range
(Vac./30) vac./30 through **(1000)** 1000 psi (see standard ranges).

*Mating connector available as necessary

Consult factory for guidance in product selection
Phone (203) 385-0217, Fax (203) 385-0602 or
visit our web site at www.ashcroft.com

Appendix F

Wetland Delineation Report

Harbor Brook
CSO 018 Treatment Wetland

Wetland Delineation Report

City of Syracuse
Onondaga Co., New York

CHA Project Number: 19217.8001.31000

Prepared for:

Onondaga County Department of Water
Environment Protection
650 Hiawatha Boulevard West
Syracuse, NY 13204

Prepared by:

441 South Salina Street
Syracuse, New York 13202
(315) 471-3920

February 2011

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FIGURES

ATTACHMENTS

1.0 INTRODUCTION

This report describes the wetlands and streams that occur within the potential impact areas of the proposed Harbor Brook CSO 018 Treatment Wetland Project in the City of Syracuse, Onondaga County, New York. The area reviewed (the JD Boundary) is 42.85 acres in size. The site is on the west side of the City of Syracuse and is roughly bounded by Velasko Rd., Grand Ave., W. Onondaga St., and Holden St. (Figure 1 – Project Location Map located in Attachment 1). The purpose of this report is to document the wetland boundaries and, if needed, to supplement a wetlands permit application to the USACE and NYSDEC. The report includes a general description of the project site, its ecology, wetland descriptions and is complemented by field data sheets and photographs, which are presented in the attachments.

1.1 Project Overview

As part of Onondaga County's ongoing green infrastructure program, an approximate 2 acre full scale pilot treatment wetland system will be constructed on the south-central portion of the site. The wetland system will serve multiple purposes of (1) treating CSO 018 overflows currently discharged into Harbor Brook, (2) acting as a demonstration project to test the effectiveness of three types of constructed treatment wetland systems and (3) creating wildlife habitat for public enjoyment. The treatment wetlands to be constructed for pilot testing are: floating wetland island (FWI), vertical downflow (VDF), and surface flow (SF) wetlands. Data collected from this pilot system will allow the project team to assess the performance of each wetland type individually and in series to determine the optimum treatment potential within the larger watershed.

1.2 Project Area Description

The site consists of a graded, vegetated drainage basin in the vicinity of Harbor Brook with elevated athletic fields in its southwest corner. No above ground structures are located on the site with the exception of the stormwater control structure located on the downstream end of the site. Most of the project site is used for stormwater management but also includes an access road and residents informally use the area for recreation. Harbor Brook flows through the center of the project site from west to east.

CHA, Inc. was retained to delineate and describe the wetlands of the project site that are regulated by the United States Army Corps of Engineers (USACE) under Section 404 of the

Clean Water Act and the New York State Department of Environmental Conservation (NYSDEC) under Article 24 of the New York State Environmental Conservation Law. The wetland delineation was conducted on November 29, 2010.

2.0 METHODOLOGY

In accordance with the procedures provided in the 1987 Corps of Engineers Wetland Delineation Manual and the *Interim Regional Supplement to the Corps of Engineers Wetland Manual: Northcentral and Northeast Region* (October 2009)[1], and based on the characteristics of the project, the "Routine Wetland Determination" method was used to delineate wetlands.

The wetland boundaries were determined in the field based on the three parameter approach, whereby an area is a wetland if it exhibits vegetation adapted to wet conditions (hydrophytes), hydric soils, and the presence or evidence of water at or near the soil surface during the growing season (hydrology).

Coded surveyor's ribbons (e.g. flag code A-1, A-2, etc.) were placed along the wetland boundaries based on observations of vegetation, soils and hydrologic conditions. Flagged boundaries were survey-located using a Trimble GeoXT2 handheld unit from the Geo Explorer 2008 series. This unit has a post-processed and real-time accuracy of ≤ 1m, and was used with a 6' Trimble Hurricane antenna to increase accuracy.

Data points were recorded along the wetland boundaries at various locations. At each location a wetland data point and an upland data point were recorded to show the difference between the wetland and upland habitats. Data sheets corresponding to each point can be found in Attachment 2.

Vegetative communities are described according to *Ecological Communities of New York State, Second Edition* (Edinger 2002)[2] and *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin 1979)[3].

---

[1] U.S. Army Corps of Engineers. 2009. *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region,* ed. J. S. Wakley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-09-19. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

[2] Edinger, G.J., D.J. Evans, S. Gebauer, T.G. Howard, D.M. Hunt, and A.M. Olivero (editors), 2002. Ecological *Communities of New York State. Second Edition. A revised and expanded edition of Carol Reschke's Ecological*

Representative photographs of the wetlands and upland portions of the project site are provided in Attachment 3.

3.0 INVESTIGATION RESULTS

3.1 Resource Review

Prior to visiting the project site, various maps and other sources of background information were reviewed. These figures are included in Attachment 1 and included the:

- United States Geological Survey (USGS) 7.5 minute topographic map (Syracuse West USGS Quadrangle, Figure 1),
- New York State Department of Environmental Conservation (NYSDEC) New York State Freshwater Wetlands Map (Syracuse West Quadrangle, illustrated on Figure 2),
- United States Department of the Interior, Fish and Wildlife Service (USFWS), National Wetlands Inventory (NWI) map (Syracuse West Quadrangle, illustrated on Figure 2),
- U. S. Department of Agriculture, Natural Resources Conservation Service Soil Survey of Onondaga County, New York (USDA-NRCS Soil Data Mart dated February 18, 2010) (Figure 3). Soils descriptions were taken from NRCS Web Soil Survey Version 5, dated Feb 18, 2010, and the
- Sanborn Fire Insurance Maps obtained from Environmental First Search Sanborn Maps Dated 1953, 1951, and 1911, Volume 2, Sheet No. 245 (Figure 4).

3.1.1 USGS Topographic Map

According to the Syracuse West USGS Quadrangle map, the project site is in a relatively flat area bound by steep slopes just outside of the project site boundary. The site elevation is approximately 395 ASL.

Communities of New York State. (*Draft for review*). New York Natural Heritage Program, New York State Department of Environmental Conservation. Albany, NY.

[3] Cowardin, L. M., V. Carter, F. C. Golet, E. T. LaRoe, 1979. *Classification of wetlands and deepwater habitats of the United States*. U. S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.

3.1.2 NYSDEC Freshwater Wetlands Map

The NYSDEC Freshwater Wetlands map (Figure 2) illustrates that no mapped NYS-regulated wetlands occur within or in close proximity to the project site. The project site does not occur within the regulated 100-foot Adjacent Area of any NYS-regulated wetlands.

3.1.3 NWI Wetland Map

The NWI map (Figure 2) illustrates one NWI wetland (PFO1C) within the project site. No other mapped wetlands are shown within the vicinity of the project site. Currently, the mapped PFO1C NWI wetland does not exist as indicated on the NWI map. As is noted later in this report, the mapped NWI wetland is a different community type than noted on the map.

3.1.4 Soil Survey Map

Soils data for the project site was obtained from the U.S. Department of Agriculture, Natural Resources Conservation Service Soil Survey of Onondaga County, New York (USDA-NRCS Soil Data Mart dated February 18, 2010) (Figure 3). Soils descriptions were taken from NRCS Web Soil Survey Version 5, dated Feb 18, 2010. This information was used in conjunction with on-site soil sampling to determine the presence of hydric soils. The following soils are mapped as occurring within the site:

- **Cut and fill land (CFL)** – This soil is somewhat excessively drained. Available water capacity is low. Depth to restrictive feature is more than 80 inches and depth to water table is about 36 to 72 inches.
- **Palmyra gravelly loam, 3 to 8% slopes (PgB)** - This well drained soil occurs on deltas, outwash plains and terraces. The parent material is loamy over sandy and gravelly glaciofluvial deposits, derived mainly from limestone and other sedimentary rocks. Depth to water table is more than 80 inches. Depth to restrictive feature is more than 80 inches. Flooding and ponding do not occur. Available water capacity is low.
- **Teel silt loam (Te)** – this moderately well drained soil occurs on flood plains. Parent material is silty alluvium. Depth to water table is about 18 to 24 inches. Flooding occurs occasionally. Available water capacity is high and depth to restrictive feature is more than 80 inches.
- **Wayland silt loam (Wn)** – this poorly drained soil occurs on flood plains. Parent material is silty and clayey alluvium washed from uplands that contain some

calcareous drift. Available water capacity is high. Depth to water table is about 0 inches. Flooding and ponding occur frequently. Depth to restrictive feature is more than 80 inches.

3.1.5 Hydrology

Hydrology of the wetlands and streams within the project site is provided by a combination of runoff from surrounding lands, direct precipitation, and in most areas groundwater input. The hydrology of each delineated feature is described in detail in the next section.

The project site occurs within the Seneca Drainage Basin (HUC 04140201). The entire project site drains to Harbor Brook, which flows east, then north approximately 2.5 miles to where it flows into Onondaga Lake. Onondaga Lake flows into the Seneca River, then into the Oswego River and ultimately Lake Ontario. The distance water travels from the project site to Lake Ontario is approximately 32 river miles or 28 aerial (linear) miles.

Water quality of surface waters in New York State is classified by the NYSDEC as “A,” “B,” “C,” or “D,” with special classifications for water supply sources. A “T” used with the classification indicates the stream supports, or may support, a trout population. Water quality standards are also provided. All surface waters with a Classification and/or a Standard of C(T) or better are regulated by the State.

Within the project site Harbor Brook is classified by the NYSDEC as a Class B, Standard B stream. The unnamed/unclassified ditch/artificial intermittent stream portion of Wetland A has not yet been classified by the NYSDEC.

3.1.6 Sanborn Fire Insurance Maps

Sanborn Fire Insurance maps (Figure 4) were reviewed to determine historical disturbances to the area. Maps from 1911 indicate that Harbor Brook was once located within the existing path of Rowland road. Sometime between 1911 and 1951, the stream channel was diverted to the north, straightened, a portion paved, and the existing floodplain was created.

3.2 Field Investigation

3.2.1 Vegetative Communities

Five vegetative community types were identified within the project site. The vegetative communities identified on-site include: mowed lawn, unpaved road/path, reedgrass/purple loosestrife marsh (PEM1), ditch/artificial intermittent stream (R4UB1) and marsh headwater stream (R2UB1).

Terrestrial (Upland) Communities

Mowed Lawn

Edinger describes this community as residential, recreational, or commercial land, or unpaved airport runways in which the groundcover is dominated by clipped grasses and there is less than 30% cover of trees. Ornamental and/or native shrubs may be present, usually with less than 50% cover. The groundcover is maintained by mowing.

Most of the non-wetland habitats of the project site resemble mowed lawn-like habitats. Based on signs that are present, to promote environmental responsibility, these areas are not mowed. Various grasses and forbs dominate this community. Species commonly observed include timothy (*Phleum pratense*), goldenrod (*Solidago sp.*), Queen Anne’s lace (*Daucus carota*), English plantain (*Plantago lanceolata*) and common selfheal (*Prunella vulgaris*). A very low number of boxelder (*Acer negundo*) and white ash (*Fraxinus americana*) saplings and trees occur randomly.

Unpaved Road/Path

Edinger describes this community as a sparsely vegetated road or pathway of gravel, bare soil, or bedrock outcrop. These roads or pathways are maintained by regular trampling or scraping of the land surface. The substrate consists of the soil or parent material at the site, which may be modified by the addition of local organic material (woodchips, logs, etc.) or sand and gravel.

Rowland Street (D&S Service Access), which is present in the center of the site and runs east/west, is an unpaved road/path. This sparsely vegetated bare soil roadway resembles Edinger’s description. Vegetation is present in the center of the roadway where it escapes trampling from vehicle tires. Vegetative species observed include species common to the mowed lawn community.

Palustrine (Wetland) Communities

Reedgrass/Purple Loosestrife Marsh (PEM1)

Edinger describes this community as a marsh that has been disturbed by draining, filling, road salts, etc. in which reedgrass (*Phragmites australis*) or purple loosestrife (*Lythrum salicaria*) has become dominant. This community is common along highways and railroads.

All of the wetlands of the project site are reedgrass/purple loosestrife marshes. These wetlands are dominated by common reed. Purple loosestrife is present and abundant in some areas. The exotic and invasive reed canarygrass (*Phalaris arundinacea*) is also present in some areas. Other species such as climbing nightshade (*Solanum dulcamara*), buttercup (*Ranunculus sp.*), poverty rush (*Juncus tenuis*), asters (*Aster spp.*) and sedges (*Juncus spp.*) were also present but usually not dominant. Boxelder, green ash (*Fraxinus pennsylvanica*) and white willow (*Salix alba*) saplings and shrubs occur randomly in low numbers.

Riverine (stream) Communities

Ditch/Artificial Intermittent Stream (R4UB1)

Edinger describes this community as the aquatic community of an artificial waterway constructed for drainage or irrigation of adjacent lands. Water levels either fluctuate in response to variations in precipitation and groundwater levels, or water levels are artificially controlled. The sides of ditches are often vegetated, with grasses and sedges usually dominant.

One ditch/artificial intermittent stream occurs on site. This small excavated stream channel originates at a culvert outlet at wetland flag A-92 and extends to wetland flag A-95 where it flows into Harbor Brook. This narrow stream channel has a cobble/gravel substrate and slightly defined bed and banks. It appears that this stream receives hydrology from delineated Wetland C (culvert connection between them) as well as CSO 018 discharge flow. This stream may be dry during the summer months.

Marsh Headwater Stream (R2UB1)

Edinger describes this community as the aquatic community of a small, marshy perennial brook with a very low flow gradient, slow flow rate, and cool to warm water that flows through a marsh, fen, or swamp where a stream system originates. These streams usually have clearly distinguished meanders and are in unconfined landscapes.

Of all of Edinger's stream descriptions, Harbor Brook appears to fit best into the marsh headwater stream classification. Harbor Brook enters the western edge of the site through a culvert outlet. It flows east through the middle of the site through emergent wetland. It continues east, out of the site within a concrete canal.

3.2.2 Wetlands and Streams

Based on the methodology discussed in Section 2 of this report, three wetland systems (Wetlands A, B and C) were identified and delineated within the project site. Two streams (Harbor Brook and Stream A) were also identified. The approximate coordinates of these features are:

- Wetland A center-point coordinates: 43.03627, -76.18468.
- Stream A: Beginning 43.03576, -76.18428, Ending 43.03614, -76.18421.
- Harbor Brook: Beginning 43.03565, -76.18811, Ending 43.03667, -76.18102.
- Wetland B center-point coordinates: 43.03508, -76.18762.
- Wetland C center-point coordinates: 43.03424, -76.18482.

Surveyed wetland boundaries are provided on the Wetland Delineation Map provided as Attachment 4.

The following table provides the community types and dominant species of the delineated wetland areas and streams that occur within the project site.

Table 1

Vegetative Communities and Species Compositions

Wetland ID	Stream ID	Community Type	Dominant Vegetation & Characteristics	Wetland Area & Stream Length w/in JD Boundary
A	--	Reedgrass/Purple Loosestrife Marsh (PEM1)	Common reed and purple loosestrife are dominant and constitute greater than 90% of the vegetative cover of this wetland.	9.2 acres
	Harbor Brook	Marsh Headwater Stream (R2UB1)	Bankfull width (BFW) = ~20'; bankfull depth (BFD) = 18"; muddy gravel substrate; swift water flow (~12" deep) at time of survey; perennial; 100% run; perennial; aquatic plants within stream channel; minnows and macroinvertebrates likely; receives some seasonal shading from surrounding tall herbaceous vegetation; occurs within an	1622 linear feet

Wetland ID	Stream ID	Community Type	Dominant Vegetation & Characteristics	Wetland Area & Stream Length w/in JD Boundary
			unconfined landscape so floodplain is broad.	
	A	Ditch/Artificial Intermittent Stream (R4UB1)	BFW = 2.5'; BFD = 8"; cobble gravel substrate; gentle water flow (~ 2" deep) at time of survey; probably intermittent; 25% riffle/75% run; aquatic vegetation within stream in lower half of this stream near Harbor Brook but not in the upper half of this stream; small minnows may be present seasonally; macroinvertebrates likely; receives some seasonal shading from surrounding tall herbaceous vegetation; occurs within an unconfined landscape so its floodplain is broad.	140 linear feet
B	--	Reedgrass/Purple Loosestrife Marsh (PEM1)	Poverty rush, common reed and redtop grass (*Agrostis alba*) are dominant. This area appears to be maintained by mowing.	0.09 acre
C	--	Reedgrass/Purple Loosestrife Marsh (PEM1)	Common reed dominates some portions of this wetland and Japanese knotweed dominates other portions. The center line of this linear wetland has standing water. The standing water area had iron-stained algae and garbage within it.	0.37 acre

Wetland/Stream A is the largest wetland/stream system of the project site and is composed of reedgrass/purple loosestrife marsh, a small segment of ditch/artificial intermittent stream and Harbor Brook. This entire wetland/stream system occurs within an engineered floodplain created for the protection of neighborhoods downstream. The communities of this wetland/stream system are described as follows:

> ***Wetland A*** consists of reedgrass/purple loosestrife marsh (PEM1) and ditch/artificial intermittent stream (R4UB1). Harbor Brook (R2UB1) flows through the main portion of this wetland. This thickly-vegetated wetland had saturated soils when it was delineated. Harbor Brook and the ditch/artificial intermittent stream both had flowing water when the site was delineated.
>
> Common reed has become well established and is the dominant vegetative cover; forming monotypic stands in most areas. Purple loosestrife is also abundant mostly occurring

along the outer edges of the wetland. Dryer portions of this wetland appear to have been mowed, which has suppressed the common reed and purple loosestrife in these areas allowing poverty rush and redtop grass to be dominant with lesser occurrences of sedges, asters (*Symphyotrichum sp.*) and goldenrods (*Solidago sp.*).

This wetland appears to receive semi permanent hydrology from groundwater near the soil surface. Rainfall, runoff and seasonal flooding by Harbor Brook are likely secondary hydrology sources. Hydrology indicators observed include soil saturation (A3) within 12 inches of the soil surface, a high water table (A2), oxidized rhizospheres on living roots (C3) and sediment deposits (B2) in some areas.

The soils of this wetland were disturbed during the straightening and paving of Harbor Brook and the creation of the floodplain. Hydric soil indicators include a low chroma (1) soil matrix with distinct and prominent mottles within the upper 12 inches of the soil surface.

Stream A is a small ditch/artificial intermittent stream. This stream begins at a culvert outlet and flows a short distance to where it flows into Harbor Brook. This narrow, mostly unvegetated channel has cobble gravel substrate and 2-3 inches of flowing water under normal flow conditions. The lower portion of this stream contains some aquatic vegetation. It appears that this stream receives water from delineated Wetland C. Water flows from Wetland C through a culvert and the culvert outlet is the beginning of Stream A.

Harbor Bro**ok** is a mapped perennial stream which flows east through the central portion of the site. According to Sanborn Maps this stream was straightened sometime between 1911 and 1951 (Attachment 1, Figure 4). This would explain why the stream does not occur in the same location as mapped on the USGS map. Harbor Brook enters the project site through a large concrete culvert. It flows east through the site within a natural bottomed (muddy gravel substrate) channel. This bed of the channel contains aquatic vegetation and has +/- 12 inches of flowing water under normal flow conditions. Near the eastern extent of the site Harbor Brook flows through a concrete control structure and is then contained within a concrete canal.

Wetland B is a small isolated patch of reedgrass/purple loosestrife marsh (PEM1) that occurs in a slight topographic depression near the western boundary of the project site. This wetland does not have a surface water connection to the nearby wetlands or streams. This wetland is either a remnant portion of wetland or a wetland that formed from soil compaction associated with the area's manipulated history. Its soils were saturated at the time of the delineation. Common reed dominates some portions of this wetland. Other areas that are dominated by sphagnum moss and poverty rush appear to have been mowed in the past.

Wetland B receives hydrology from groundwater, precipitation and runoff from surrounding lands. Hydrology indicators include soil saturation (A3) within the upper 12 inches, a high water table (A2) and oxidized rhizospheres on living roots (C3).

Hydric soil indicators of Wetland B include a low chroma soil matrix with distinct mottles within the upper 16 inches of the soil surface.

Wetland C is a linear wetland ditch composed of reedgrass/purple loosestrife marsh. This wetland is linear and the center ditch line was inundated with approximately 6 to 12 inches of water. The “banks" had saturated soils and were dominated by common reed (*Phragmites australis*) and Japanese knotweed (*Polygonum cuspidatum*). Open water with algae occurs in the lower, center portion of the wetland. This wetland occurs within a topographic depression and has a culverted inlet and a culverted outlet. Boxelder trees are present along the edges of the wetland.

This wetland receives hydrology from groundwater, precipitation and runoff. Hydrology indicators include surface water (A1), a high water table (A2) and soil saturation (A3) within the upper 12 inches of the soil surface.

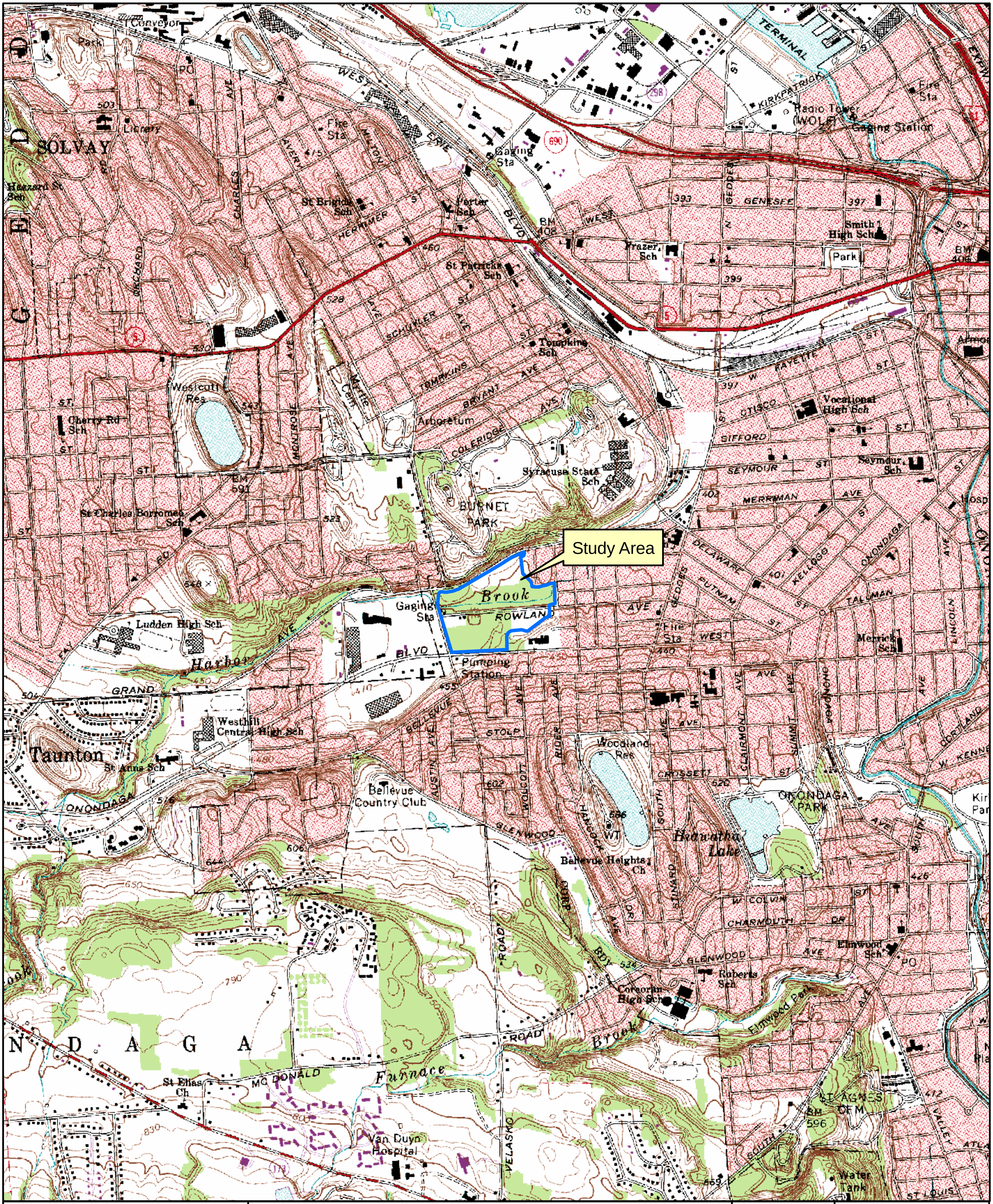
Hydric soil indicators include a low chroma (2) soil matrix with prominent mottling.

4.0 SUMMARY

Wetland A, Stream A and Wetland C have a surface water connection to Waters of the United States and are therefore considered federally jurisdictional. Wetland B does not have a surface water connection to Waters of the United States and is therefore likely be considered not federally jurisdictional.

Attachment 1

Figures



CHA

III Winners Circle, P.O. Box 5269 • Albany, NY 12205-0269
Main: (518)453-4500 • www.cloughharbour.com

Project Location Map

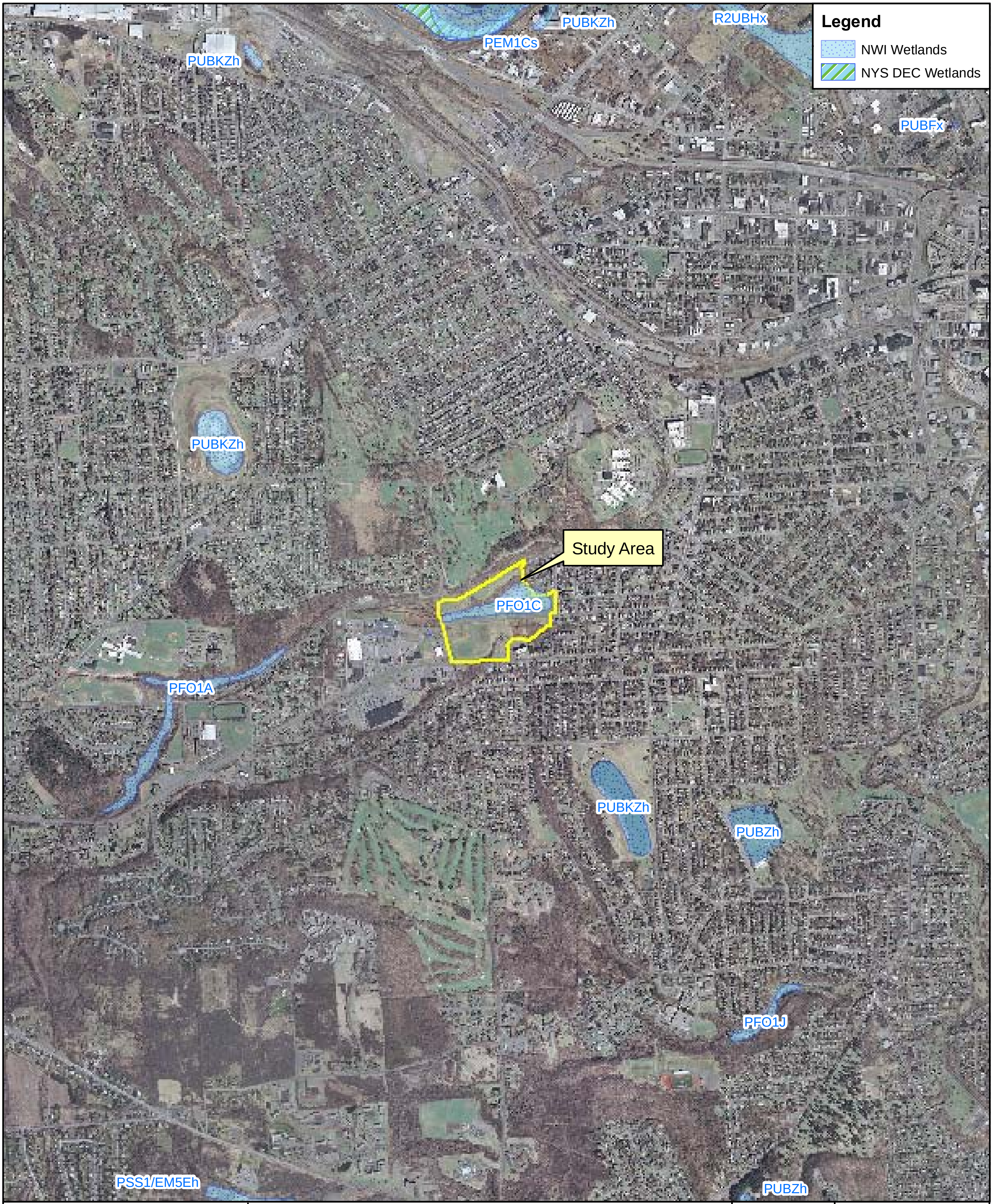
Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga County, NY

N
W E
S
1 inch = 2,000 feet

Project No.: 19217

Date: January 2011

Figure 1



CHA

III Winners Circle, P.O. Box 5269 • Albany, NY 12205-0269
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Wetlands Map

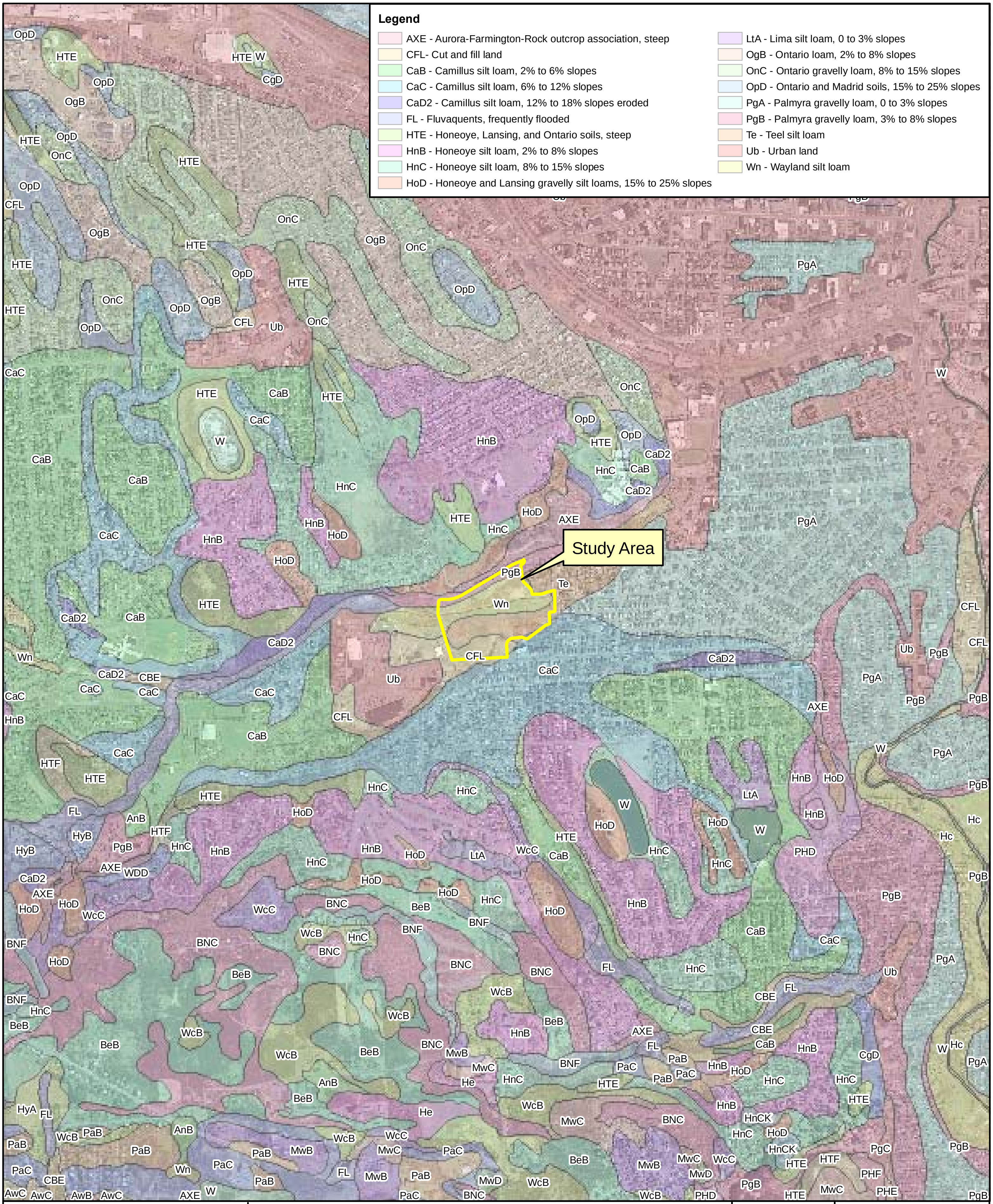
Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga County, NY

N
W E
S
1 inch = 2,000 feet

Project No.: 19217

Date: January 2011

Figure 2



Soils Map

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga County, NY

N
W E
S
1 inch = 2,000 feet

Project No.: 19217

Date: January 2011

Figure 3

CHA
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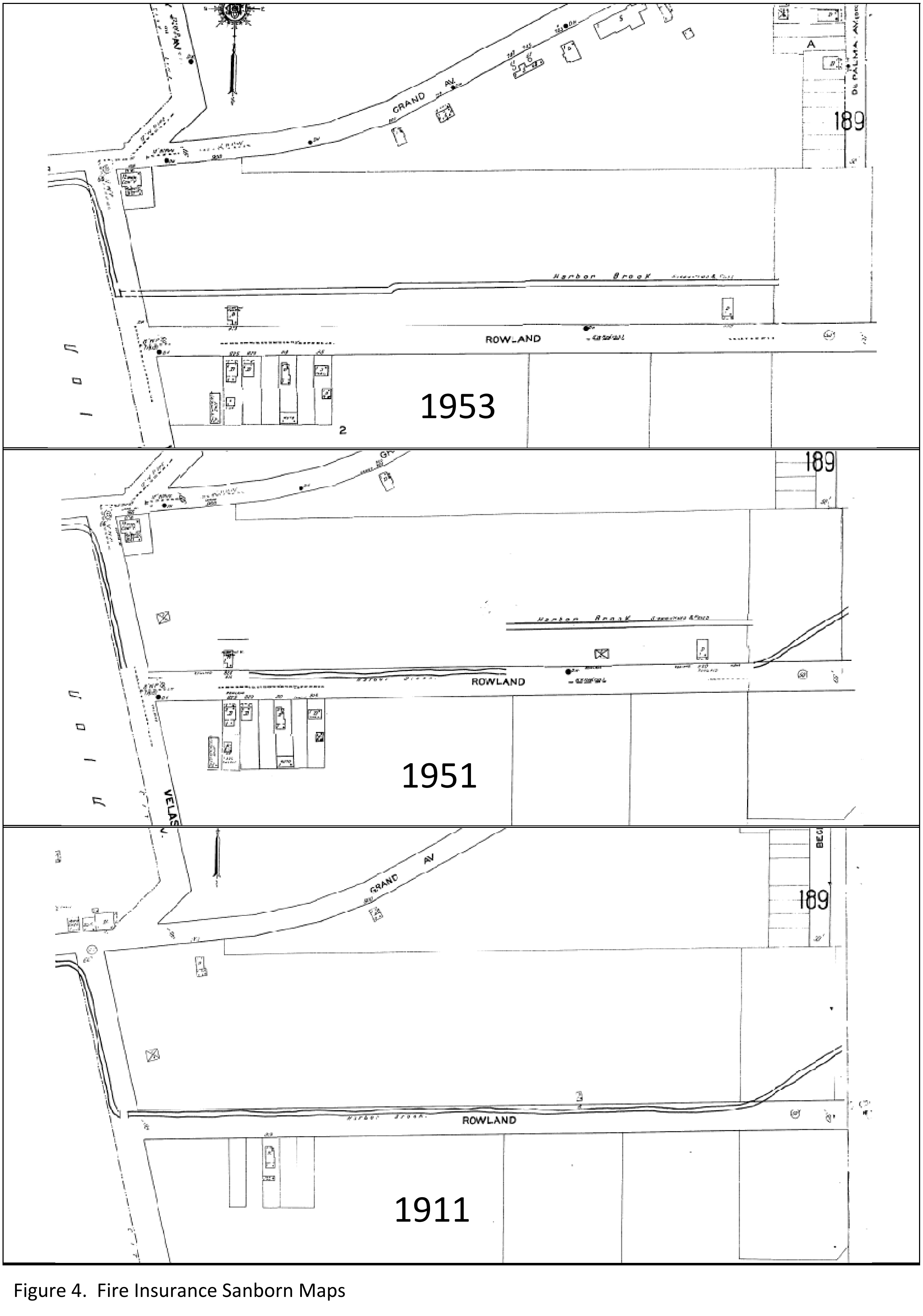

Figure 4. Fire Insurance Sanborn Maps

Attachment 2

Field Data Sheets

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10

Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Wet A near UPL A-13

Investigator(s): Greaves & Frazer Section, Township, Range: ______

Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): flat

Slope (%): 0 Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Wn- Wayland Silt loam NWI classification: PEM1

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x	No ______	**Is the Sampled Area within a Wetland?** **Yes** x **No** ______ If yes, optional Wetland Site ID: ______
Hydric Soil Present?	Yes x	No ______	
Wetland Hydrology Present?	Yes x	No ______	

Remarks: (Explain alternative procedures here or in a separate report.)
Probably disturbed in the past.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______
Water Table Present? Yes ______ No x Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes x No ______ Depth (inches): 10

Wetland Hydrology Present? Yes x **No** ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: WET A near UPL A-13

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Phragmites australis	60	Y	FACW
2. Phalaris arundinacea	40	Y	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

x Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ______

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wet A near UPL A-13

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-8	10YR 2/2	98	10YR 3/6	2			loam	
9+	10YR 2/1	90	10YR 3/4	10			loam with wood chunks	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
_x_ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes x **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10

Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Upl A near UPL A-1

Investigator(s): Greaves & Frazer Section, Township, Range: ______

Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): flat

Slope (%): 0 Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Wn- Wayland Silt Loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes x No ______

Hydric Soil Present? Yes ______ No x

Wetland Hydrology Present? Yes ______ No x

Is the Sampled Area within a Wetland? Yes ______ No x

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______

Water Table Present? Yes x No ______ Depth (inches): ~18

Saturation Present? (includes capillary fringe) Yes x No ______ Depth (inches): ~16

Wetland Hydrology Present? Yes ______ No x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Soils saturated deeper.

VEGETATION – Use scientific names of plants.

Sampling Point: Upl A near UPL A-1

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0	= Total Cover	

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0	= Total Cover	

Herb Stratum (Plot size: 5')			
1. Dispacus follonum	10	N	NI/FAC
2. Phalaris arundinacea	90	Y	FACW
3. Solidago canadensis	10	N	FACU
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	110	= Total Cover	

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0	= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

x Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ______

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Upl A near UPL A-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-16	10YR 3/2	98	10YR 3/6	2			loam	
17+	10YR 2/1	99	10YR 5/3	1			loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ______ **No** x

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10

Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Wetland A near A-56

Investigator(s): Greaves & Frazer Section, Township, Range: ______

Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): concave

Slope (%): 0 Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Te- Teel silt loam NWI classification: PEM1

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes x	No ______
Hydric Soil Present?	Yes x	No ______
Wetland Hydrology Present?	Yes x	No ______

Is the Sampled Area within a Wetland? **Yes** x **No** ______

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- x Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ______	No x	Depth (inches): ______
Water Table Present?	Yes x	No ______	Depth (inches): 8
Saturation Present? (includes capillary fringe)	Yes x	No ______	Depth (inches): surface

Wetland Hydrology Present? Yes x **No** ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wet A near A-56

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Phragmites australis	80	Y	FACW
2. Lythrum salicaria	20	N	FACW
3. Juncus tenuis	5	N	FAC
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	105 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- x Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ______

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wet A near A-56

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 2/2	100					loamy sand	
6+	2.5Y 3/1	80	2.5Y 5/6	10			loamy clay	rocks
			2.5Y 6/1	10				

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)

___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
x Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes x **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10

Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Wet A near A-77

Investigator(s): Greaves & Frazer Section, Township, Range: ______

Landform (hillslope, terrace, etc.): stream w/ wetland fringe Local relief (concave, convex, none): flat

Slope (%): 0 Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Wn-Wayland Silt Loam NWI classification: PEM1

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes x No ______

Hydric Soil Present? Yes x No ______

Wetland Hydrology Present? Yes x No ______

Is the Sampled Area within a Wetland? Yes x **No** ______

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

Common reed wetland fringe to stream,

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
x High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
x Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
x Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______

Water Table Present? Yes x No ______ Depth (inches): 2

Saturation Present? (includes capillary fringe) Yes x No ______ Depth (inches): surface

Wetland Hydrology Present? Yes x **No** ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wet A near A-77

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Phragmites australis	95	Y	FACW
2. Ranunculus sp.	5	N/A	N/A
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	95 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ____

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- x Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ____

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wet A near A-77

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-10	10YR 2/1						loam	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- x Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes x **No** ______

Remarks:

Can't get past 10" due to rock.

Redox concentrations (oxidized rhizospheres)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10

Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Upl A near A-77

Investigator(s): Greaves & Frazer Section, Township, Range: ______

Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): flat

Slope (%): ______ Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Wn- Wayland Silt Loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ______ No x (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes ______ No x

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ______ No x

Hydric Soil Present? Yes ______ No x

Wetland Hydrology Present? Yes ______ No x

Is the Sampled Area within a Wetland? Yes ______ No x

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______

Water Table Present? Yes ______ No x Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ______ No x Depth (inches): ______

Wetland Hydrology Present? Yes ______ No x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upl A near A-77

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Phleum pratense	95	Y	FACU
2. Plantago lanceolata	5	N	UPL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30)			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A = ______

Hydrophytic Vegetation Indicators:

- ___ Rapid Test for Hydrophytic Vegetation
- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ______ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Upl A near A-77

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/2	100					loam	
6+	2.5Y 5/4	100					rocky fill	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________________
Depth (inches): ______________________

Hydric Soil Present? Yes ______ No x

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10
Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Wet B near B-3
Investigator(s): Greaves & Frazer Section, Township, Range: ______
Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): concave
Slope (%): 0 Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: Wn- Wayland Silt Loam NWI classification: PEM2
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)
Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______
Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes x No ______
Hydric Soil Present? Yes x No ______
Wetland Hydrology Present? Yes x No ______

Is the Sampled Area within a Wetland? Yes x No ______

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- x Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______
Water Table Present? Yes x No ______ Depth (inches): 10
Saturation Present? (includes capillary fringe) Yes x No ______ Depth (inches): surface

Wetland Hydrology Present? Yes x No ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wet B near B-3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Juncus tenuis	40	Y	FACW
2. Phragmites australis	20	Y	FACW
3. Aster sp.	5	N/A	N/A
4. Sedge sp.	5	N/A	N/A
5. Sphagnum moss	20	N/A	N/A
6. Agrostis alba (red top)	20	Y	FACW
7.			
8.			
9.			
10.			
11.			
12.			
	80 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation
x Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ______

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wet B near B-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-3	10YR 3/1	100					loamy sand	
4-6+	2.5Y 3/1	85	10YR 3/3	15			loam	

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)

___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
x Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
___ Polyvalue Below Surface (S8) (**LRR K, L**)
___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes x **No** ______

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10

Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Upl B near B-3

Investigator(s): Greaves & Frazer Section, Township, Range: ______

Landform (hillslope, terrace, etc.): slight hill Local relief (concave, convex, none): concave

Slope (%): 2 Lat: ______ Long: ______ Datum: ______

Soil Map Unit Name: Te- Teel Silt Loam NWI classification: N/A

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ______ No x

Hydric Soil Present? Yes ______ No x

Wetland Hydrology Present? Yes ______ No x

Is the Sampled Area within a Wetland? Yes ______ No x

If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

Field/meadow

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ Marl Deposits (B15)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______

Water Table Present? Yes ______ No x Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ______ No x Depth (inches): ______

Wetland Hydrology Present? Yes ______ No x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upl B near B-3

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Plantago lanceolata	30	Y	UPL
2. Aster sp.	2	N/A	N/A
3. Sedge sp.	3	N/A	N/A
4. Phleum pratense (timothy)	60	Y	FACU
5. Prunella vulgaris	5	N	FACU
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	95 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? Yes ______ No x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Upl B near B-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-20+	10YR 3/2	100						rocks

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ **No** x

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10
Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Wet C near C-19
Investigator(s): Greaves & Frazer Section, Township, Range: ___
Landform (hillslope, terrace, etc.): hillslope/ stream channel Local relief (concave, convex, none): concave
Slope (%): ~5 Lat: ___ Long: ___ Datum: ___
Soil Map Unit Name: CFL- Cut and Fill Land NWI classification: PEM1
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes x No ___
Hydric Soil Present? Yes x No ___
Wetland Hydrology Present? Yes x No ___

Is the Sampled Area within a Wetland? **Yes** x **No** ___
If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)
Common reed wetland fringe to stream.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
x High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:
Surface Water Present? Yes ___ No x Depth (inches): ___
Water Table Present? Yes x No ___ Depth (inches): 10
Saturation Present? Yes x No ___ Depth (inches): surface
(includes capillary fringe)

Wetland Hydrology Present? Yes x **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Wet C near C-19

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Phragmites australis	100	Y	FACW
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1. Solanum dulcamara	5	Y	FAC
2.			
3.			
4.			
	5 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

☐ Rapid Test for Hydrophytic Vegetation
☒ Dominance Test is >50%
☐ Prevalence Index is ≤3.0[1]
☐ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** x **No** ______

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Wet C near C-19

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 2/2	90	10YR 3/6	10			loam	
9+	7.5YR 3/4	100						iron stained soils, gravelly

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) (**LRR R, MLRA 149B**)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- _x_ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
- ___ Coast Prairie Redox (A16) (**LRR K, L, R**)
- ___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
- ___ Dark Surface (S7) (**LRR K, L**)
- ___ Polyvalue Below Surface (S8) (**LRR K, L**)
- ___ Thin Dark Surface (S9) (**LRR K, L**)
- ___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
- ___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
- ___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes _x_ **No** ___

Remarks:

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Harbor Brook City/County: Syracuse/Onondaga Sampling Date: 11/29/10
Applicant/Owner: Onondaga County Department of Water State: NY Sampling Point: Upl C near C-19
Investigator(s): Greaves & Frazer Section, Township, Range: ______
Landform (hillslope, terrace, etc.): hillslope Local relief (concave, convex, none): concave
Slope (%): ~5 Lat: ______ Long: ______ Datum: ______
Soil Map Unit Name: CFL- Cut and Fill Land NWI classification: N/A
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ______ (If no, explain in Remarks.)
Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? No Are "Normal Circumstances" present? Yes x No ______
Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? No (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ______ No x
Hydric Soil Present? Yes ______ No x
Wetland Hydrology Present? Yes ______ No x

Is the Sampled Area within a Wetland? **Yes** ______ **No** x
If yes, optional Wetland Site ID: ______

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)

___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No x Depth (inches): ______
Water Table Present? Yes ______ No x Depth (inches): ______
Saturation Present? Yes ______ No x Depth (inches): ______
(includes capillary fringe)

Wetland Hydrology Present? Yes ______ **No** x

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: Upl C near C-19

Tree Stratum (Plot size: 30')	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Sapling/Shrub Stratum (Plot size: 15')			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
	0 = Total Cover		

Herb Stratum (Plot size: 5')			
1. Plantago lanceolata	5	N	UPL
2. Poa pratensis	95	Y	FACU
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	100 = Total Cover		

Woody Vine Stratum (Plot size: 30')			
1.			
2.			
3.			
4.			
	0 = Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

___ Rapid Test for Hydrophytic Vegetation
___ Dominance Test is >50%
___ Prevalence Index is ≤3.0[1]
___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb – All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft tall.

Woody vines – All woody vines greater than 3.28 ft in height.

Hydrophytic Vegetation Present? **Yes** ______ **No** x

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: Upl C near C-19

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-20+	10YR 3/2						silt loam w/ stones, fill material	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7) (**LRR R, MLRA 149B**)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ Loamy Mucky Mineral (F1) (**LRR K, L**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
___ Coast Prairie Redox (A16) (**LRR K, L, R**)
___ 5 cm Mucky Peat or Peat (S3) (**LRR K, L, R**)
___ Dark Surface (S7) (**LRR K, L**)
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___ Thin Dark Surface (S9) (**LRR K, L**)
___ Iron-Manganese Masses (F12) (**LRR K, L, R**)
___ Piedmont Floodplain Soils (F19) (**MLRA 149B**)
___ Mesic Spodic (TA6) (**MLRA 144A, 145, 149B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ______ No x

Remarks:

Attachment 3
Site Photographs

Photo 1 – Wetland A near flag A-7, looking south

Photo 2 – Wetland A near flag A-7, looking west

Sheet 1	**CHA # 19217**

SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

Photo 3 – Wetland A near flag A-27, looking southwest

Photo 4 – Wetland A near flag A-27, looking south toward the elevated athletic fields

SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

Sheet 2

CHA # 19217

Photo 5 – Wetland A and Harbor Brook, looking east from flag A-34

Photo 6 – Culvert where Harbor Brook enters the project site at flags A-34 and A-35

	SITE PHOTOGRAPHS
Sheet 3	CHA # 19217

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

Photo 7 – Upland area adjacent to Wetland A/Harbor Brook, looking southeast from flag A-34

Photo 8 – Wetland A, looking toward flag A-69 from flag A-72

SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

CHA # 19217

Photo 9 – Stream A, looking north from flag A-92 toward the stream's confluence with Harbor Brook

Photo 10 – Looking at the confluence of Stream A with Harbor Brook

CHA	SITE PHOTOGRAPHS
Sheet 5 / CHA # 19217	Harbor Brook CSO 018 Treatment Wetland City of Syracuse, Onondaga Co., NY

Photo 11 – Harbor Brook, looking east from flag A-95

Photo 12 – Harbor Brook, looking west from flag A-95

SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

Sheet 6	CHA # 19217

Photo 13 – Concrete canal portion of Harbor Brook, looking east from flag A-4

Photo 14 – Wetland A, looking southeast from flag A-104.
The greener grass in the immediate foreground is mowed upland.

SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

Photo 15 – Wetland B, looking west toward flag B-1

Photo 16 – Wetland C, looking east from flag C-7

SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

Sheet 8 | **CHA # 19217**

Photo 17 – Closeup view of Wetland C

Photo 18 – Overall view of Wetland C, looking northeast from flag C-3

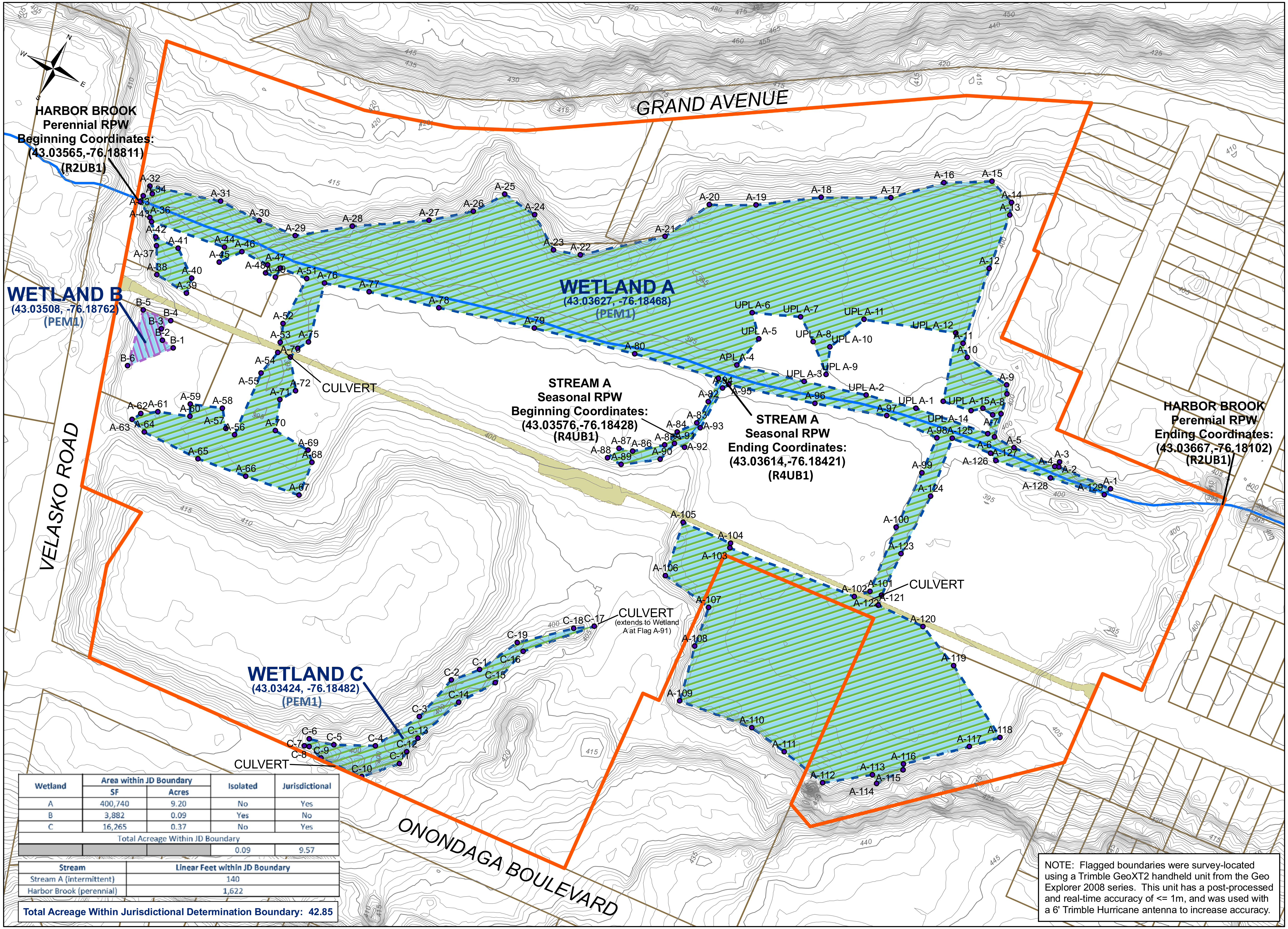
SITE PHOTOGRAPHS

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga Co., NY

CHA # 19217

Attachment 4

Wetland Location Map



Wetland	Area within JD Boundary		Isolated	Jurisdictional
	SF	Acres		
A	400,740	9.20	No	Yes
B	3,882	0.09	Yes	No
C	16,265	0.37	No	Yes
Total Acreage Within JD Boundary				
			0.09	9.57

Stream	Linear Feet within JD Boundary
Stream A (intermittent)	140
Harbor Brook (perennial)	1,622

Total Acreage Within Jurisdictional Determination Boundary: 42.85

NOTE: Flagged boundaries were survey-located using a Trimble GeoXT2 handheld unit from the Geo Explorer 2008 series. This unit has a post-processed and real-time accuracy of <= 1m, and was used with a 6' Trimble Hurricane antenna to increase accuracy.

CHA

February 2011

WETLAND DELINEATION MAP

Harbor Brook CSO 018 Treatment Wetland
City of Syracuse, Onondaga County, NY

🟥	Jurisdictional Determination Boundary
▨	Jurisdictional Wetland
▨	Isolated Wetland
●	Wetland Flags
—	Harbor Brook
—	Stream A
▭	Existing Dirt Roadway
▭	Parcel Bounds (2008)

Scale: 1 inch = 150 feet
(at 11"x17")

Appendix G

Wetland Flow Scenarios Summary

Harbor Brook CSO 018 Treatment Wetland Flow Narrative

Flow	Event	Rising Limb	Peak	Falling Limb
Series	Design (1 yr/2 hr)	• Flow enters Cell 1. • Water level rises. • Flows to Cells 2 & 3 if dosed via actuated valve.	• Flow continues entering Cell 1. • Water level peaks. • Flows to Cells 2 & 3 via dosing through actuated valve. • Discharge from Cell 3 to Harbor Brook.	• Flow continues entering Cell 1. • Water level begins to fall. • Flows to Cells 2 & 3 continue via dosing through actuated valve. • Discharge from Cell 3 to Harbor Brook. • All cells revert to NWL conditions. • If Harbor Brook water level exceeds the outfall elevation, water level will drop in the cells after Harbor Brook level recedes.
	Low	• Same as design flow.	• Same as design flow.	• Same as design flow.
	Extreme	• Same as design flow.	• Same as design flow except Cell 1 over flows through spillway creating continuous flows to Cells 2 & 3. • All cells are flooded and discharging through the spillway to Harbor Brook. • Harbor Brook could overflow into one or more wetland cells through stabilized overflows.	• As flood level recedes, flows discharge from the wetland area down to the spillway elevation of each Cell. • The stormwater remaining in the wetland Cells will be retained until the water elevation in Harbor Brook drops back to 397.00. At this point flows from Cell 3 and Cell 2 will discharge through the wetland system. • Once Cell 2 completely discharges the flood waters, dosing via from Cell 1 will resume and continue until Cell 1 reaches its normal water level (NWL)
Parallel	Design (1 yr/2 hr)	• Flow continuously enters Cells 1, 2 and 3 independently. No dosing of Cell 2 under this scenario. • Water level rises. • Combined discharge occurs from all three Cells to Harbor Brook via common discharge point.	• Flow continues entering Cells 1, 2 and 3. • Water level peaks. • Discharge continues from all three cells to Harbor Brook.	• Flow continues entering Cells 1, 2 and 3. • Water levels begin to fall in all cells. • Discharge continues from all three cells to Harbor Brook. • All cells revert to Normal water level (NWL) conditions. • If Harbor Brook water level exceeds the outfall elevation, water level will drop in the cells after Harbor Brook level recedes.
	Low	• Same as design flow.	• Same as design flow.	• Same as design flow.
	Extreme	• Same as design flow.	• Same as design flow except as water levels rise, stormwater will flow through the Cell spillways and discharge to Harbor Brook. • Harbor Brook could overflow into one or more wetland cells.	• As flood level recedes, flows discharge from the wetland area down to the spillway elevation of each Cell. • The stormwater remaining in the wetland Cells will be retained until the water elevation in Harbor Brook drops back to an elevation which allows flows to discharge from all three cells. • All three cell levels drop to normal water level (NWL)
Series + Parallel	Design (1 yr/2 hr)	• Flow enters Cell 1. There will be an initial dose released to Cell 2. Water continues to rise to elevation 399.00, overtops the weir, and starts discharging to Cell 3. • Discharge from Cell 2 & 3 directly to Harbor Brook via common discharge point.	• Flow continues entering Cell 1 and discharges to Cell 3 • Water level peaks at 401.00 and begins to recede. • Discharge continues to Harbor Brook from Cell 3.	• As water levels fall below 399.00 in Cell 1 and water level in Cell 3 drains to the normal water level (NWL) 393.00; the actuated control valve is activated and dosing of Cell 2 begins. Discharge from Cell 2 is directed to Harbor Brook. • Dosing of Cell 2 continues until the water level in Cell 1 is back to the normal water level.
	Low	• Same as design flow.	• Same as design flow except if storm volume does not exceed elevation 399.00 in Cell 1, series treatment will only occur through Cell 2.	Same as design flow except if storm volume does not exceed elevation 399.00 in Cell 1, series treatment will only occur through Cell 2.
	Extreme	• Same as design flow.	• Same as design flow except as water levels continue to rise; stormwater will flow through the Cell 1 & 2 spillways and discharge to Harbor Brook through Cell 3 spillway. • Harbor Brook could overflow into one or more wetland cells.	• As flood levels recede, flows discharge from the wetland area down to the spillway elevation of each Cell. • The stormwater remaining in the wetland Cells will be retained until the water elevation in Harbor Brook drops back to an elevation that allows flows to discharge from Cells 2 & 3. Once Cell 3 drains down to the normal water level (NWL), Cell 1 will resume dosing of Cell 2 which will discharge directly to Harbor Brook. The dosing of Cell 2 will continue until Cell 1 volume is back down to normal water level(NWL) .