Great Lakes Water Supply Program





6-300 D3 - Stormwater Management Plan: Booster Pumping Station and Water Tower, Waukesha, WI







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EXECUTIVE SUMMARY

The Waukesha Water Utility (WWU) provides water treatment and distribution services to the City of Waukesha (Waukesha), portions of the Town of Waukesha, and the City of Pewaukee. The St. Peter Sandstone aquifer that serves as Waukesha's primary source of drinking water is being simultaneously depleted and subjected to increases in the concentrations of radium and other contaminants. WWU commissioned the Great Water Alliance (Program) to transition Waukesha's water supply from groundwater to Lake Michigan water. The purpose of the Program is to plan, design, construct, and commission infrastructure with a 100-year useful life necessary to transition Waukesha's water supply.

The Program was broken down into seven contract packages. The purpose of this Stormwater Management Plan (Report) is to illustrate the stormwater management and erosion control best management practices (BMPs) that will be implemented at the site of Contract Package 3, the Booster Pumping Station (BPS), and Contract Package 3A, the Water Tower, to comply with all applicable stormwater regulations. **Section 1** of this Report meets all the requirements for a stormwater management plan, as described in Wisconsin Administrative Code Chapter NR 216.47, by illustrating how the design of the site meets the following standards.

- **Performance Standards:** The site design meets the post-construction performance standards for both new development and redevelopment in WAC Chapter NR 151.121 and City of Waukesha Municipal Code Chapter 32.
- **Practices During Construction:** The erosion control plan that meets all the requirements of NR 216.46 and construction site performance standards set forth in NR 151.11. and City of Waukesha Municipal Code Chapter 32.
- **Groundwater Limitations:** The seasonal high groundwater elevation at the site is greater than 5 feet from the bottom of the permanent stormwater infiltration system.
- Long-Term Maintenance: Provisions have been made for long-term maintenance for all permanent structures. A copy of the long-term maintenance agreement between the WWU and the City of Waukesha (Waukesha) is included in the Appendix F.
- **Management Practices:** The BMPs control impacts from stormwater runoff on the receiving surface water or groundwater. An explanation of the technical basis used to select the BMPs is included in the Report.

The 1-year, 24-hour and the 2-year, 24-hour post-construction peak runoff discharge rates will be reduced to the 1-year, 24-hour and the 2-year, 24-hour pre-development peak runoff discharge rates respectively by the BMPs onsite. This meets the standards set forth in NR 151.123.

The BMPs have been designed to control total suspended solids (TSS) carried in runoff from the post-construction site. The retention basin will reduce the expected TSS concentration in the stormwater runoff from the site by 40-percent for the redevelopment and 80-percent for the new development. In doing so, the design complies with City of Waukesha and Wisconsin Department of Natural Resources (WDNR) performance standards under NR 151.122.

The runoff discharged from the site ultimately drains east to two culverts under Springdale Road. In general, the runoff peak discharge rates are shown by this plan to be reduced from the site and, hence, any hydraulic conditions at the downstream culverts crossings can thereby be presumed improved.

The City of Waukesha's Municipal Code (Section 32.10(d)(3)).and the (WDNR) NR 151.124 Infiltration Performance Standards require moderate impervious development to infiltrate sufficient runoff volume such that the post-







development infiltration volume shall be at least 75% of the pre-development infiltration volume, based on the average annual rainfall. No more than 2% of the post-construction site is required as an effective infiltration area. Subsurface investigation shows a brown gravelly sand substrata is present 3 to 5 feet below ground surface in the area of the proposed infiltration basin, which a design infiltration rate of 3.6 inches/hour was applied (see Geotechnical Report, **Appendix B**).

A 50-foot buffer (City of Waukesha Municipal Code Chapter 32.10H(A) around the wetland adjacent to the site is designated a protective area. The site has been designed such that there will be no impervious surfaces located within the protective area. Wherever land disturbing construction activity takes place in the protective area, a self-sustaining vegetative cover shall be established to provide for bank stability and filtering of pollutants from upslope overland flow areas under sheet flow conditions. This practice meets the standards set forth in NR 151.125.

The Report meets all the requirements for an erosion control plan, as described in NR 216.46, by describing how the construction practices meet the following standards.

- **Performance Standards:** The construction practices meet the erosion control performance standards for new development in NR 151.11.
- Required Information: Descriptions of the construction site, the nature of the land disturbing activities, and the intended sequence of major land disturbing construction activities are included in the Report. It also includes estimates of the total area of the construction site and the area impacted by land disturbing construction activities. Available data describing the surface soils and subsoils, the depth to the seasonal high groundwater elevation, and the name of the immediate receiving water are provided in the Report as well.
- Site Map: Site maps are provided in Appendix A that include all features described in NR 216.46(5).
- Erosion and Sediment Control Best Management Practices: Descriptions of the erosion and sediment control BMPs that meets the requirements of NR 216.46(6).
- Material: No solid materials will be discharged from the site.
- Non-Erosive Flow: Descriptions of any velocity dissipation devices placed at discharge locations to provide non-erosive flow are be included in the Report.
- **Inspections:** The Report provides plans for inspections of the erosion and sediment control BMPs weekly and within 24 hours following a rainfall of 0.5 in or greater. The method for the required documentation of the inspections are provided as well.

For the reasons discussed in the paragraphs above, this Report meets the Wisconsin Department of Natural Resources (WDNR) requirements for a Stormwater Management Plan and Erosion and Sediment Control Plan (NR 151.121-151.128 and NR 151.11).

The Report demonstrates that the BPS and Water Tower site meets City of Waukesha and WDNR requirements for erosion and sediment control during construction and post-construction stormwater management.





SECTION 1 Project Description

1.1 Introduction

The Waukesha Water Utility (WWU) provides water treatment and distribution services to the City of Waukesha (Waukesha), portions of the Town of Waukesha, and the City of Pewaukee. The St. Peter Sandstone aquifer that serves as Waukesha's primary source of drinking water is being simultaneously depleted and subjected to increases in the concentrations of radium and other contaminants. WWU commissioned the Great Water Alliance (Program) to transition Waukesha's water supply from groundwater to Lake Michigan water. The purpose of the Program is to plan, design, construct, and commission infrastructure with a 100-year useful life necessary to transition Waukesha's water supply.

After a lengthy study and public engagement, the WDNR, Department of Justice, and Great Lakes-St. Lawrence River Basin Water Resources Council unanimously approved Waukesha's Application for Lake Michigan Diversion with Return Flow to source water from Lake Michigan and return the required amount of flow to the Great Lakes-St. Lawrence River Basin via the Root River. WWU is implementing The Program to transition Waukesha's water supply from groundwater to Lake Michigan water, now known as the Great Water Alliance. The purpose of the Program is to plan, design, construct, and commission infrastructure with a 100-year useful life necessary to transition Waukesha's water supply.

The Program is the first for a community in a county straddling the Great Lakes-St. Lawrence River Basin to access Great Lakes water through the Great Lakes-St. Lawrence River Basin Water Resources Compact (Compact). Successful implementation of the Program will set industry precedents for solving water quality and water scarcity challenges for at-risk water supplies in other Great Lakes Communities eligible to receive Great Lakes water through the Compact.

In its Final Decision, dated June 21, 2016, the Compact Council unanimously approved Waukesha's Application to source water from Lake Michigan as Waukesha's only reasonable water supply alternative. As part of the Program, a transmission main with pumping facilities, storage and chemical treatment will deliver potable water to Waukesha from a connection to a water system supplied by Lake Michigan. A pressure main with pumping facilities located at Waukesha's Clean Water Plant are required per the Final Decision to achieve a net zero water balance in the Lake Michigan basin by discharging highly treated effluent to the Root River.

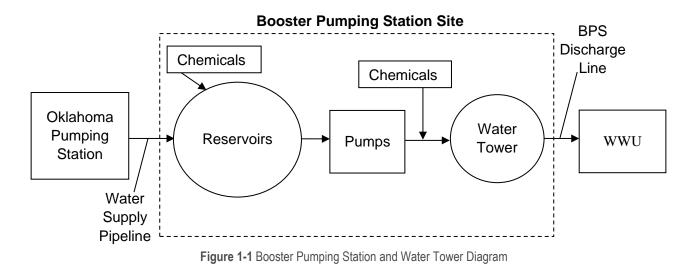
The purpose of the Booster Pumping Station (BPS) and Water Tower is to store, treat, and pump potable water received from the water supplier via the Water Supply Pipeline and convey that water to the WWU distribution system. To perform these functions, the BPS has been designed to meet the full range of anticipated demands from Waukesha. The on-site reservoirs provide a delineation between the Milwaukee Water Works (MWW) and WWU systems and provide emergency storage. Chemicals will be added to the water in the reservoirs and/or after the pumps in order to maintain potable water quality standards. **Figure 1-1** shows a simplified diagram of the BPS and Water Tower in reference to other facilities along the supply line.

The BPS site consists of the following four elements:

- The Reservoirs
- Chemical Feed System

- Pumping System
- Water Tower





1.2 Purpose

The purpose of this Report is to determine the existing and proposed hydrologic and hydraulic site conditions, stormwater management system requirements, and the erosion and sediment control BMPs in accordance with the Wisconsin Department of Natural Resources (WDNR) Administrative Code, the Waukesha County Stormwater Management and Erosion Control Ordinance, and the City of Waukesha's Stormwater Management and Erosion Control Ordinance the following sections:

- Project Description
- Regulatory Conditions and Permit Overview
- Methodology and Assumptions
- Existing Conditions
- Construction Practices
- Proposed Conditions

- Wetland Watershed Analysis
- Water Quality
- Post Construction Stormwater Management
- Summary of Results
- Exhibits
- Appendices

This Report summarizes the proposed design and construction practices, and acts as a tool for coordinating between various engineering disciplines and the regulatory entities. This Report is also a convenient milestone to confirm with the regulatory entities that the site concepts align with their requirements.





SECTION 2 Regulatory Conditions and Permit Overview

This section discusses the applicable regulatory entities and conditions for stormwater management; and provides an overview of the required permits at the State, County, and Municipal levels.

2.1 Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources (WDNR) has jurisdiction over all construction in the state of Wisconsin. The WDNR has the authority to approve or deny the Program's Water Resources Application for Project Permits (WRAPP) which includes the Construction Site Storm Water Runoff General Permit No. WI-S067831-5. Coordination will be required with the WDNR to obtain approval of these certifications that will cover the construction activities on the BPS site. The WRAPP will act as a Notice of Intent that describes how the site design of the BPS meets the WDNR's erosion control plan requirements (NR 216.46), construction site performance standards (NR 151.11), storm water management plan requirements (NR 216.47), post-construction performance standards (NR 151.121-128), and reporting and monitoring requirements (NR 216.48). A notice of termination will be prepared and submitted at the end of construction and once the site has undergone final stabilization (NR 216.55). Coordination will be held with the WDNR to obtain approval of the Construction Site Storm Water Runoff General Permit in conjunction with the WRAPP prior to construction. The WRAPP will be the last stormwater and erosion control approval that the Program pursues. The post-construction performance standards include the following quantitative requirements:

- 40% TSS reduction in runoff for the redevelopment and 80% TSS reduction in runoff for the new development, as compared to no BMPs and based on average annual rainfall (NR 151.122). The resulting composite goal is 70% TSS reduction for this site.
- Reduce the 1-year, 24-hour post-construction peak runoff discharge rate to the 1-year, 24-hour predevelopment peak runoff discharge rate (NR 151.123)
- Reduce the 2-year, 24-hour post-construction peak runoff discharge rate to the 2-year, 24-hour predevelopment peak runoff discharge rate (NR 151.123)
- Infiltrate sufficient runoff volume for moderate impervious developments such that the post-development infiltration volume shall be at least 75% of the pre-development infiltration volume, based on the average annual rainfall. No more than 2% of the post-construction site is required as an effective infiltration area (NR 151.124)

During construction, the site cannot discharge sediments more than 5 tons per acre per year from initial grading to final stabilization per NR 151.11. The requirements of this permit do not preempt more stringent erosion and sediment control requirements that may be imposed by any other regulatory agency with jurisdiction.

2.2 City of Waukesha

The City of Waukesha has jurisdiction over all land within the City limits. Within their jurisdiction, the City has the authority to enforce Municipal Code Chapter 32 Stormwater Management and Erosion Control. Chapter 32 outlines the City's requirements for post-construction stormwater management and construction site erosion control. The City of Waukesha's Code is followed to design a site with BMPs that control the quality and quantity of runoff from the site and minimize erosion and sediment on and off the site. The Program will coordinate with the City of Waukesha to obtain a Storm Water Permit, based on the post-construction stormwater management, and the Grading and Erosion Control Permit, based on the erosion and sediment control BMPs. The Program will pursue the approval of the Storm Water Management Plan before any of the other stormwater permits and approvals.





The post construction performance standards include the following quantitative requirements:

- 40% TSS reduction in runoff for the redevelopment and 80% TSS reduction in runoff for the new development, as compared to no BMPs and based on average annual rainfall ((32.10(d)(2)). The resulting composite goal is 70% TSS reduction for this site.
- Post-development peak discharge shall be equal to or less than existing condition flows for the 1, 2, 10, and 100-year, 24-hour design storms ((32.10(d)(1)).
- Infiltrate sufficient runoff volume for moderate impervious developments such that the post-development infiltration volume shall be at least 75% of the pre-development infiltration volume, based on the average annual rainfall. No more than 2% of the post-construction site is required as an effective infiltration area ((32.10(d)(3)).

The requirements of this permit do not preempt more stringent erosion and sediment control requirements that may be imposed by any other regulatory agency with jurisdiction.







SECTION 3 Methodology and Assumptions

This section discusses the methods and assumptions used for evaluating the existing and proposed hydrologic and hydraulic site conditions.

3.1 Hydrologic Analysis Methods

HydroCAD version 10.00 was used to model the existing and proposed conditions. HydroCAD is a proprietary software which uses Natural Resources Conservation Service (NRCS) TR-20/55 methodologies. Travel paths and times of concentration (TOC) computations are indicated on the existing and proposed conditions exhibits in **Appendix A**. Calculations and summaries for the TOC and Curve Number (CN) values are included in **Appendix C** for existing conditions and **Appendix D** for proposed conditions.

The 1, 2, 10, and 100-year, 24-hour storms were modeled for the existing and proposed conditions using MSE3 rainfall distribution developed by NRCS for use in Wisconsin where MSE is titled for Midwest and Southeast US.

Rainfall values for the hydrologic analysis were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2. Point Precipitation Frequency are shown in **Table 3-1**.

Table 3-1 Design Rainfall Values			
Storm Recurrence Interval	24-hour Rainfall Volume		
1 year	2.42 inches		
2-year	2.72 inches		
10-year	3.83 inches		
100-year	6.18 inches		

Peak runoff flow and volume are determined using HydroCAD using parameters for rainfall presented above and presented in **Appendices C** and **D**.

3.2 Hydraulic Analysis Methods

Hydrographs generated in the HydroCAD model were routed through the various hydraulic elements in the HydroCAD models. These include storm sewer, wet detention basins, dry infiltration basin, culverts, and areas where runoff can be impounded under large storm events (e.g. upstream of culverts and/or topographic depressions). Hydrographs were routed through these structures using the HydroCAD model. Proposed storm sewer systems were sized using Rational Method (submitted separately to the appropriate local and state plumbing review).

3.3 Assumptions

Several assumptions were made in the hydrologic and hydraulic (H/H) modeling.

CNs were developed based on a review of land cover / use and soils (Natural Resources Conservation Service (NRCS) Web Soil Survey). The proposed site is located within the city limits of Waukesha. Waukesha has defined maximum pre-development CNs that apply to woodlands, grasslands, and croplands per Waukesha Municipal Code Chapter 32 Stormwater Management and Erosion Control. Where conventional CNs exceed those defined by Waukesha, the Waukesha maximum CN is used. According to NR 151.12(5)(b)1., pre-development conditions shall be land cover in "good" hydrologic condition as defined by TR-55.

Waukesha Water Utility





SECTION 4 Existing Conditions

This section discusses the existing conditions at the site and the results from the hydrologic and hydraulic study.

4.1 Existing Tributary Area

For the purposes of this Report, the project area studied is broken down into two components:

- Building Site: Area within the property lines of the proposed site.
- Planting Site: Areas outside the grading limits of the proposed project but that is proposed to be stripped of existing vegetation and planted with a prairie seed mixes for meadow conditions.

The existing land cover, drainage subarea boundaries, and flow paths are shown in Exhibit SW1 presented in **Appendix A**. Surface drainage of the site is generally south to southeast to the adjacent wetlands. The site ultimately discharges into Poplar Creek. The project area is about 13.5 acres for the building site and 3.5 acres for the revegetation (planting) area. Across the site, there is relief ranging roughly from elevation 935 to elevation 860 and a maximum slope of about 10% off the north slope and towards the off-site adjacent wetland.

4.1.1 Existing Land Cover and Use

Exhibit SW1 is provided to show the existing land cover of the on-site and off-site area in exhibits presented in **Appendix A.** A broad and flat wet ditch wetland with some depressional storage borders the site to the southeast. East Broadway borders the south side of the site. Wooded area borders the site to the west, north and east. The existing area of the site is mostly sparsely wooded brush area with some remnant structures and pavement from past development. The site was previously used as a missile testing facility in the 1970s and 1980s.

4.1.2 Soil Conditions

The Soils Map (**Appendix B**) shows the primary hydrologic soil groups on-site. The soil survey shows the soils at the site to be predominantly loam to silt loam, all of which range from hydrological soil group B to D soils. Based on the soil boring logs in the Geotechnical report, the soils encountered at the site were mostly silt and sand that extended down to the depth explored. Shallow groundwater was generally observed at least 10 feet below existing grade. Based on the soil borings performed, the appropriate hydrologic soil groups were chosen as the soil type to represent the project site and adjacent tributary areas. Geotechnical report is in **Appendix B**.

4.1.3 Wetlands

A Wetland Delineation Report was issued by TRC Solutions in April 2020 for the Alternate Rempe-Nike BPS site in the City of Waukesha. This Report was submitted to the WDNR and the United States Army Corps of Engineers (USACE).

The wetland limits and the surrounding protective area are shown on the wetland mapping in **Appendix A**. The entirety of the site lies within the wetland's tributary area, as displayed in the exhibit. The wetland lies in a broad and flat depressional area which ultimately discharges east toward other low-lying areas just west of Springdale Road.



4.1.4 Regulatory Floodplain

There is no regulatory floodplain present on or adjacent to the site. This is supported by the Flood Insurance Rate Map (FIRM) 55133C0214G, effective November 5, 2014 (Appendix A).

4.2 Existing Hydrologic and Hydraulic Conditions

The existing hydrologic and hydraulic conditions are crucial for evaluating the impacts of development on the site and the surrounding area. Modeling the discharge rate of the pre-developed site is required by NR 151.123 and NR 151.124 in the Wisconsin Administrative Code.

4.2.1 Catchment Area Description

The **Existing Conditions Exhibit SW1** in **Appendix A** shows the existing drainage patterns on-site and within the tributary area. The site drainage areas were determined using 1-foot topographic mapping generated from a field survey. The land cover was determined using the topographic mapping and aerial photography.

Table 4-1						
Existing Drainage Areas Summary						
Description	Sub-Basins	Drainage Area (ac)	Impervious Area (ac)			
Building Site	1S	13.53	0.71			
Planting Area	Planting Area 2S 3.44 0.00					
Total Existing		16.97	0.71			

Each of the areas is described and delineated into sub-basins as presented in Table 4-1.

Minimal off-site area conveys flow to the low point of the total tributary area, which is the wetland. The sub-basins are delineated separately to define the on-site peak flows to meet the WDNR and City requirements.

4.2.2 Existing Conditions Model Results

HydroCAD was used to model the existing conditions for the 1-year, 2-year, 10-year and 100-year return period for 24-hour duration. The HydroCAD model reports are provided in **Appendix C**. The on-site release rates are summarized in the **Table 4-2**.

	Table 4-2 Existing Conditions Results Summary							
Subarea or		Area	Time of		Peak Flow Rate (cfs)			
Junction	Description	(ac)	CN	Conc. (min)	1-year	2-year	10- year	100-year
1S	EX Building Site	13.53	68	49.9	2.30	3.44	8.91	24.21
2S	2S EX Planting Area 3.44 66 39.6 0.52 0.81 2.31 6.58							6.58
3L	Total Existing	16.97	68	-	2.79	4.20	11.10	30.33





SECTION 5 Construction Practices

This section discusses the construction practices undertaken at the site. The proposed construction activities are anticipated to take place from April 2021 to July 2023. The following is an anticipated sequence of construction activities:

- Mobilization and erosion control installation
- Site preparation
- Earthwork, site grading, excavation, and soil stockpiling
- Reservoir and facility construction
 - Building Foundation
 - Booster Pumping Station Building
 - Reservoirs
 - Utility Connections
- Water Tower Construction
 - Water Tower Foundation
 - Water Tower Structure
- Pavement and stormwater ponds construction
- Site restoration, erosion mat
- Erosion control removal, silt fence and inlet protection following vegetation establishment
- Final Stabilization
- Demobilization

5.1 Erosion and Sediment Control Best Management Practices

Construction sediment control will be provided by the following practices:

- Silt Fence Silt fence will be placed to reduce slope length of the disturbed area and to intercept and
 retain sediments from disturbed area. Silt fence will be installed in horseshoe fashion around the soil
 stockpiles.
- Stone Tracking Pad Entrance Two Stone Tracking Pad Entrances will be provided on East Broadway to prevent, reduce or mitigate tracking out of sediment.
- Ditch Check and Silt Trap Erosion Bale Ditch checks will be provided to reduce flow velocity and to promote settling of sediments. One Silt Trap will be used to detain sediment-laden runoff to allow the majority of the sediment to settle out.
- Temporary Sediment Basin One sediment basin will be built on the south part of the site to intercept sediment-laden runoff and retain the sediment.
- Inlet protection Filter Fabric will be installed beneath inlet covers to trap sediments.
- Erosion Matting Sidewalls of the stormwater ponds and slope along the south and east end of the site will have erosion matting. It will help to protect the soil surface from erosive effect of rainfall and prevent erosion during establishment of grass and to reduce the soil moisture loss due to evaporation.
- Soil Stockpiles and Slopes Exceeding 4:1 will maintain compliance with construction site erosion control
 requirements through prescriptive compliance. Soil stockpiles will have silt fence on the down slope side.
 Stockpiles will be stabilized with mulch, temporary vegetation, or tarps if remaining for more than 30 days.
 Slopes exceeding 4:1 will be covered in erosion mat.



SECTION 6 Proposed Conditions

This section discusses the proposed conditions at the site and the results from the hydrologic and hydraulic study.

6.1 Proposed Conditions

The construction on the BPS site will be completed in a single phase. The proposed construction was modeled in HydroCAD 10.00 to show how the runoff changes from pre-development to post-development. A storm sewer system, wet detention basin, and infiltration basin will be constructed at the site and will be designed to store and treat stormwater runoff in accordance with Waukesha's and WDNR stormwater criteria. The site will be graded to direct runoff away from the building and reservoirs towards vegetated areas and the storm sewer.

6.1.1 Proposed Land Cover and Use

The proposed land cover, grading, drainage subarea boundaries, flow paths, and proposed site and stormwater management improvements are shown in **Exhibit SW2** presented in **Appendix A**. Surface drainage of the site is maintained generally south to southeast to the adjacent wetlands. The site ultimately discharges into Poplar Creek. The proposed project area is approximately 13.5 acres of grading and improvements, and another 3.5 will be stripping existing vegetation and planting with a prairie seed mix for meadow conditions. Across the site, there is relief ranging roughly from elevation 935 to elevation 860 and a maximum slope of about 10% off the north slope and towards the off-site adjacent wetland.

The proposed building site is currently spare woodland with light underbrush, which will be converted for the construction of the BPS site. The grades will be raised approximately 3-7 ft above existing grade to accommodate the access drives, tanks, Water Tower and pump station building. **Table 6-1** summarizes the proposed drainage areas, which include both building site and revegetation areas, both captured by the pond drainage and undetained direct runoff drainage.

Table 6-1 Proposed Drainage Areas Summary						
Description	Sub-Basins	Drainage Area (ac)	Impervious Area (ac)			
Building Site – To Pond	2S	9.54	3.32			
Planting Area – To Pond	3S	3.44	0.00			
Building Site – Uncaptured4S3.990.20						
Total Proposed Area		16.97	3.52			

6.2 Proposed Hydrologic and Hydraulic Conditions

The Proposed Conditions **Exhibit SW2** in **Appendix A** shows the proposed development. The proposed development consists of approximately 17 acres of developed land, delineated into two sub-basins. One wet detention basin, one infiltration basin and vegetated area are proposed to reduce the rate of runoff and enhance the quality of runoff flowing from the site. The proposed development will disturb approximately 13.5 acres and will result in a net increase in impervious area of approximately 2.81 acres.





6.2.1 Catchment Area Description

Proposed conditions catchments are illustrated on **Exhibit SW2** in the **Appendix A**. The proposed conditions are divided into the Sub-basin 2S, Sub-basin 3S, and Sub-basin 4S (Undetained Area). The Sub-basin 2S Area contains most of the proposed conditions site including: a majority of the impervious area, the proposed wet detention basin (1P), and infiltration basin (2P). The Sub-basin 4S (Undetained Area) contains some pavement area in the southwest corner, mostly pervious area along the fringe areas of the building site. The Undetained Area is the undetained portion of the building site being graded and that flows directly offsite to the wetland, bypassing the proposed control practices.

6.2.2 Time of Concentration and Curve Numbers

The proposed conditions TOC and CN were calculated using the TR-55 methodology. Travel paths for the TOC computations are indicated on the **Exhibit SW2** in **Appendix A**.

6.2.3 Best Management Practices

The following are descriptions of the proposed infrastructure and BMPs that are designed to manage stormwater on the site.

6.2.3.1 Stormwater Conveyance

Proposed storm sewers and overland flow will convey stormwater on-site. The proposed storm sewer, manholes and catch basins are illustrated in **Exhibit SW2** in **Appendix A**.

Storm sewers were sized using the rational method, and inlet capacity and spacing evaluated (assuming 35% clogging). Majority of the site was graded so that runoff will be collected through the storm sewer system that is directed to the proposed wet detention basin. Sub-basin 2S area has the highest percentage of impervious surface on the site due to the pavement, Water Tower, building and the two reservoirs. The limited space and the proximity to the two structures necessitates the storm sewer to convey flow from Sub-basin 2S area to the Wet Detention Basin (1P). The Sub-basin 3S is mostly pervious and also drains to the Wet Detention Basin. The storm inlets collect the stormwater from Sub-basin 3S north of the site. There is a perimeter wall from the north of the building site that runs west to east. These walls will assist in containing most of the stormwater on the site and routing to the ponds. The inlets can be seen on the Proposed Conditions **Exhibit SW2** in **Appendix A**. Under extreme storm events, surcharged runoff will flow to the ponds via overland flow paths.

6.2.3.2 Stormwater Detention and Infiltration

A wet detention basin and a dry infiltration basin will be constructed on-site to control stormwater. The Wet Detention Basin is connected to the Infiltration Basin with 36-inch diameter round culvert. The Infiltration Basin drains into an Overflow Basin and then to the wetland through the outlet. The outlet functions as a multi-stage outlet, with a 4-inch diameter low-flow orifice outlet, and a 24-inch diameter high-flow orifice. As runoff enters the pond, it is held back (detained) and slowly released through the control orifices. If needed, the emergency overflow of these ponds will pass the stormwater to the adjacent roadside ditch on the south side, which ultimately flows to the wetland. Peak elevations for both ponds are designed to be below the emergency spillways in the 100-year rainfall event.

The Wet Detention Basin is in the Sub-Pond 1 Area and collects flow from the site via storm sewer and overland flows. The Wet Detention Basin will be lined with an approximately 2-foot clay liner to impede infiltration into the





subsurface and create a permanent pond. The clay liner specifications will meet WDNR Technical Standard 1001 for Type "B" Clay liner. The Wet Detention Basin will reduce the Total Suspended Solid (TSS) concentration in runoff. It will also dissipate chlorine from clear water discharges.

6.2.4 Proposed Conditions Model Results

HydroCAD was used to model the proposed conditions for the 1- year, 2-year, 10-year and 100-year return period for 24-hour duration similar to the existing conditions model. The HydroCAD modeling reports are located in **Appendix D**. The proposed runoff release rates <u>with and without controls</u> for the 1-year, 2-year, 10-year and 100-year return period are summarized in **Table 6-2**.

	TABLE 6-2 Proposed Conditions Results Summary							
Subarea or	Description	Area	CN	Тс		Peak Flow	Rate (cfs)	
Junction	Description	(ac)	(min)		1-year	2-year	10-year	100-year
2S	Building Site - To Pond	9.54	82	14.0	11.85	14.78	26.35	52.44
3S	Planting Area - To Pond	3.44	68	35.5	0.72	1.09	2.83	7.63
4S	Building Site - Uncaptured	3.99	74	16.0	2.50	3.40	7.24	16.71
	Total PROPOSED (no controls)	16.97	77		14.37	18.30	34.30	72.26
5L	Total PROPOSED (with controls)	16.97	77		2.50	3.40	7.31	17.19

As stated, the total proposed runoff discharge from the site is shown with and without controls in Table 6.2. Table 6-3 below shows the flow reduction and associated storage volume and maximum water surface for each control practice during the design storm events.

	TABLE 6-3 Detention System Routing Analysis Summary					
	Normal Water Level	Overflow Elevation	1-Year Discharge	2-Year Discharge	10-Year Discharge	100-Year Discharge
Wet Detention Basin	874.00	878.00				
Peak Inflow (cfs)	-	-	11.97	15.01	27.32	55.82
Peak Outflow (cfs)	-	-	1.40	2.04	4.91	9.85
Max Water Surface Elev. (ft)	-	-	874.71	874.91	875.76	876.84
Max Storage Volume (ac-ft)	-	3.07	0.49	0.64	1.26	2.11
Infiltration Basin	874.00	878.00				
Peak Inflow (cfs)	-	-	1.40	2.04	4.91	9.85
Peak Outflow (cfs)	-	-	0.61	0.69	0.94	9.80
Max Water Surface Elev. (ft)	-	-	874.69	874.91	875.76	876.76
Max Storage Volume (ac-ft)	-	0.36	0.05	0.07	0.13	0.23





6.3 Springdale Road Culverts Impacts

The runoff discharged from the site ultimately drains east to two culverts under Springdale Road as shown by **Exhibit SW3** in **Appendix A**. The City has indicated that these existing culverts may not have adequate capacity to convey the entire tributary drainage under Springdale Road without ponding or overtopping. In general, the runoff peak discharge rates are shown by this plan to be reduced from the site and, hence, any hydraulic conditions at the downstream culverts crossings can thereby be presumed improved.







SECTION 7 Water Quality

Water quality for the site will be achieved through the Wet Detention Basin and Infiltration Basin located on the south side of the site.

In accordance with NR 151.122, 40 percent of total suspended solids (TSS) from stormwater runoff from the redevelopment area (25%) and 80 percent of the TSS from the new development area (75%), which is resulting composite goal of 70 percent removal of TSS is required at the site. WinSLAMM (Source Loading and Management Model for Windows) version 10.4 was used to develop a model to calculate the TSS reduction. The Wet Detention Basin, along with the Infiltration Basin, are proposed to achieve the required pollutant removal. **Table 7-1** describes the sediment removal. The overall results of the WinSLAMM analysis indicate that approximately <u>75.20 percent</u> of TSS will be removed from stormwater leaving the site, based on an average annual rainfall. The water quality treatment exceeds the required 70% TSS reduction from the site in accordance with the WDNR NR 151.122 Total Suspended Solids Performance Standards. The input and output files of the WinSLAMM modeling are located in **Appendix E**.

Table 7-1 Water Quality Reductions Summary					
Yield,Yield,PercentageParameterno controlswith controlsreduction					
Runoff Volume	424,790 cu ft	174,782 cu ft	58.85%		
TSS	2072 lb	513.8 lb	75.20%		
TP	8.707 lb	3.108 lb	64.30%		

The soil boring logs indicate soils within the area of the infiltration basin to be generally sand with cobble 3 to 5 feet below grade at the proposed infiltration basin location. Groundwater was encountered (> 10 feet) within the borings performed near the proposed infiltration basin and accounted for by the analysis and design, maintaining 5 feet separation. Refer to **Appendix B** for a copy of the soil boring logs.

Based on the WDNR Conservation Practice Standard 1002, a design infiltration rate of 3.6 inches per hour is recommended for sand soil textures.

Infiltration was analyzed using WinSLAMM software. The results of the WinSLAMM analysis indicate a predevelopment infiltration volume of 40.23 acre feet. The City and WDNR require moderate impervious developments to infiltrate at least 75 percent of the pre-development infiltration volume, which would be a minimum of 30.17 acre feet.

The results of the post-development WinSLAMM analysis indicate approximately 37.03 acre feet of runoff will infiltrate as a result of the open areas and proposed infiltration basin. This is approximately <u>92.0 percent</u> of the pre-development infiltration volume which is in accordance with the City and WDNR infiltration requirements. Refer to **Appendix E** (WinSLAMM Summary) for details of the infiltration analysis.





SECTION 8 Post Construction Stormwater Management

8.1 Stormwater Facility Maintenance Practices and Procedures

As with any stormwater BMP device, routine maintenance is critical to proper performance. The owner will enter into an agreement with Waukesha for stormwater facility maintenance. A draft of the agreement is presented in **Appendix F**. The following practices will be implemented:

- Erosion: All grassed areas, embankments and flow control devices should be inspected frequently and particularly during high flow events (major rain storms and spring snow melt) for rills, scour and short-circuiting. Areas showing signs of erosion shall be repaired, reinforced and revegetated immediately.
- Sedimentation: Accumulated sediment should be removed, and bare areas regraded, seeded or otherwise revegetated. Sediment material, free of trash and debris, may be used to fill and restore small depressions or shallow water pockets and then seeded.
- **Transport:** Silt, sod, stone, and any other material transported as a result of high water volumes, velocities or scour shall be removed, replaced, and reinforced immediately to its proper condition and location occupied prior to the storm event. Trash and other deleterious debris shall be properly disposed of.
- **Storm Sewers and Structures:** Storm sewers and structures should be inspected on an annual basis, cleaned when necessary and repaired immediately upon discovery of any structural defects.
- Wet Detention Basin: The wet detention basin is designed to reduce peak flows and reduce runoff total
 suspended solids (TSS) from the site. It shall be maintained regularly to function correctly. It is required to
 remove sediment and trash from the pond inlets, outlets, and trash tracks. The embankments and outlet shall
 be inspected for settlement or signs of slope erosion. Regular inspection is necessary to inspect for animal
 burrows, sinkholes, wet areas, etc. Non-routine maintenance includes sediment removal from the permanent
 pool as required.
- Infiltration Basin: The infiltration basin is designed to reduce runoff volumes. Regular inspection is necessary
 to ensure the proper function. Any accumulated sediment or debris shall be removed and properly disposed
 as needed. The embankments and outlet shall be inspected for settlement or signs of slope erosion. The
 vegetation shall be visually inspected to ensure healthy growth. Regular mowing of the upper embankment
 is necessary to control woody vegetation. Excessive ponding duration (greater than 72 hours) shall be address
 per the maintenance provisions of Appendix F.
- Overflow Relief Dry Basin: The overflow relief dry basin is designed to handle additional volume of water in
 the case of an emergency tank overflow. The basin will collect additional overland flow and allows large flows
 to pass through the pond and outlet pipe to prevent flooding to the southern residents. When the pond
 overflows it will go through the discharge pipe and be discharged to the wetland. The inlet endwall shall be
 kept clear of vegetation, trash or any other obstructions. Further, the integrity of the pipe and outlet endwall
 shall be inspected annually for structural deficiencies or obstructions.
- **Outlet structures**: The outlet structures should be inspected on an annual basis, cleaned when necessary and repaired immediately upon discovery of any structural defects.







SECTION 9 Summary of Results

Table 9.1 Comparison of Peak Discharge Rates for Existing and Proposed Conditions					
Conditions	1-year 24-hour	2-year 24-hour	10-year 24-hour	100-year 24-hour	
EXISTING	2.79	4.20	11.10	30.33	
PROPOSED	2.50	3.40	7.31	17.19	

The proposed 1-year, 24-hour and the 2-year, 24-hour runoff rate are no greater than the 1-year, 24-hour and the 2-year, 24-hour existing runoff rates.

The results for peak discharge rates satisfy quantitative requirements according the post construction performance standards.

The TSS reduction for the site is 75.20%. The water quality treatment exceeds the required 70% TSS reduction from the site in accordance with the WDNR NR 151.122 Total Suspended Solids Performance Standards. The site with control practices will achieve over 75% of the predevelopment infiltration volume.

The effects on the hydrologic conditions of the wetland area located downstream of the site was evaluated as part of the plan. A hydraulic analysis of the wetland depressional area adjacent to Springdale Road was reviewed and no significant impacts are anticipated. In general, the runoff peak discharge rates are shown by this plan to be reduced from the site and, hence, any hydraulic conditions at the downstream culverts crossings at Springdale Road can thereby be presumed improved. The total tributary watershed of the wetland area (from the project site) is shown by the exhibit provided in Appendix A.

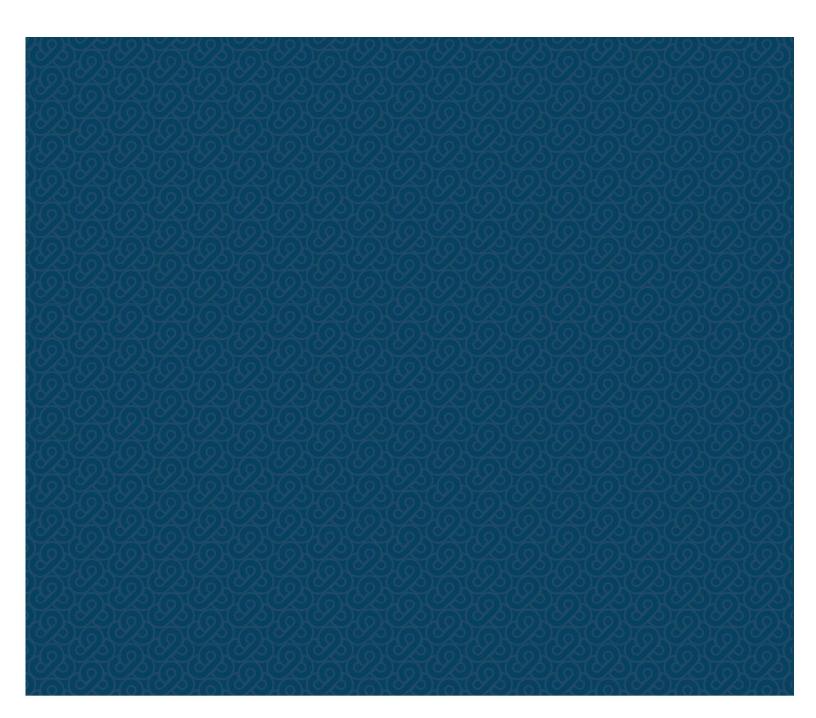
The proposed development will maintain compliance with the City of Waukesha and the WDNR requirements for stormwater management. We request your approval of this Stormwater Management Plan to allow for the construction of the BPS and Water Tower projects.

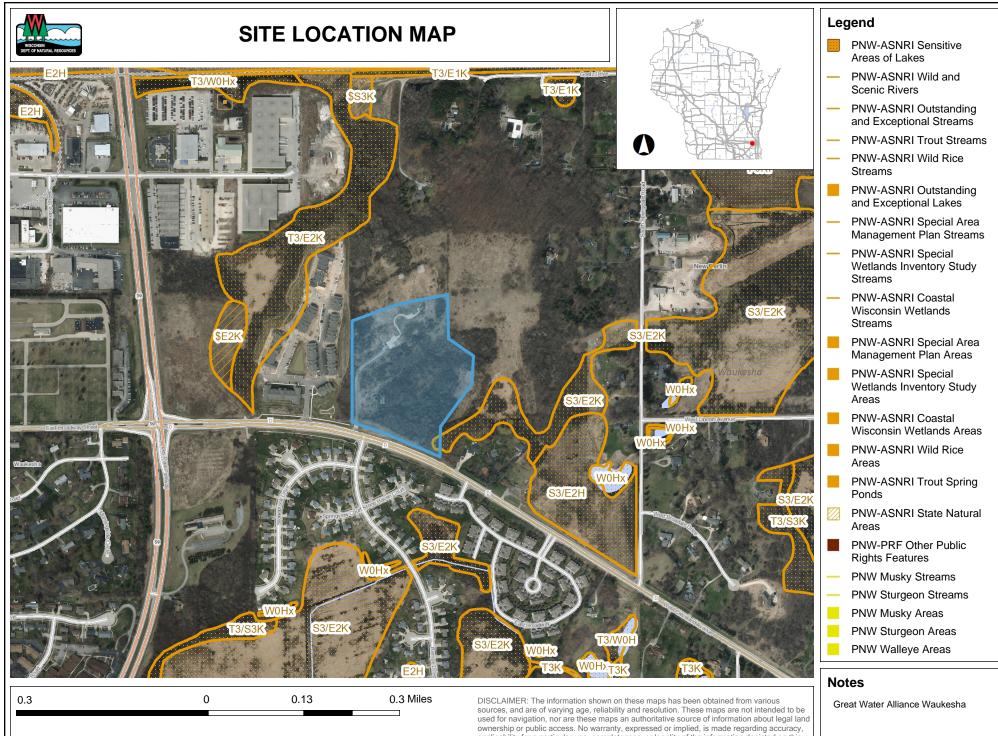






Appendix A – Existing and Proposed Conditions Exhibits





NAD_1983_HARN_Wisconsin_TM

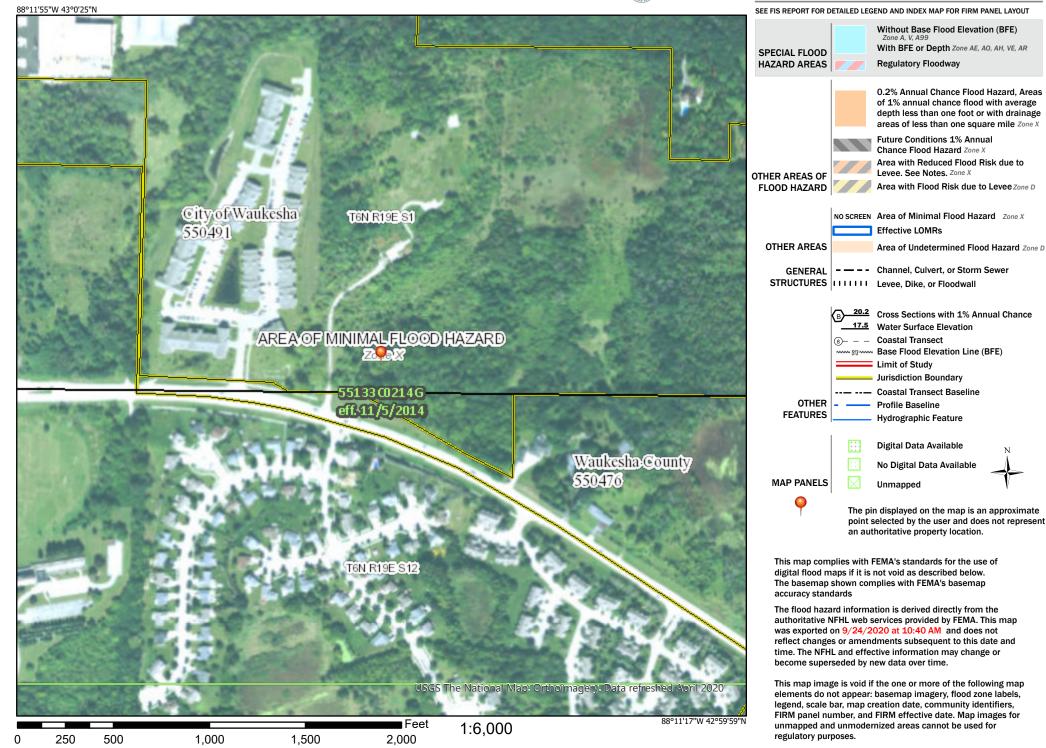
1:7,920

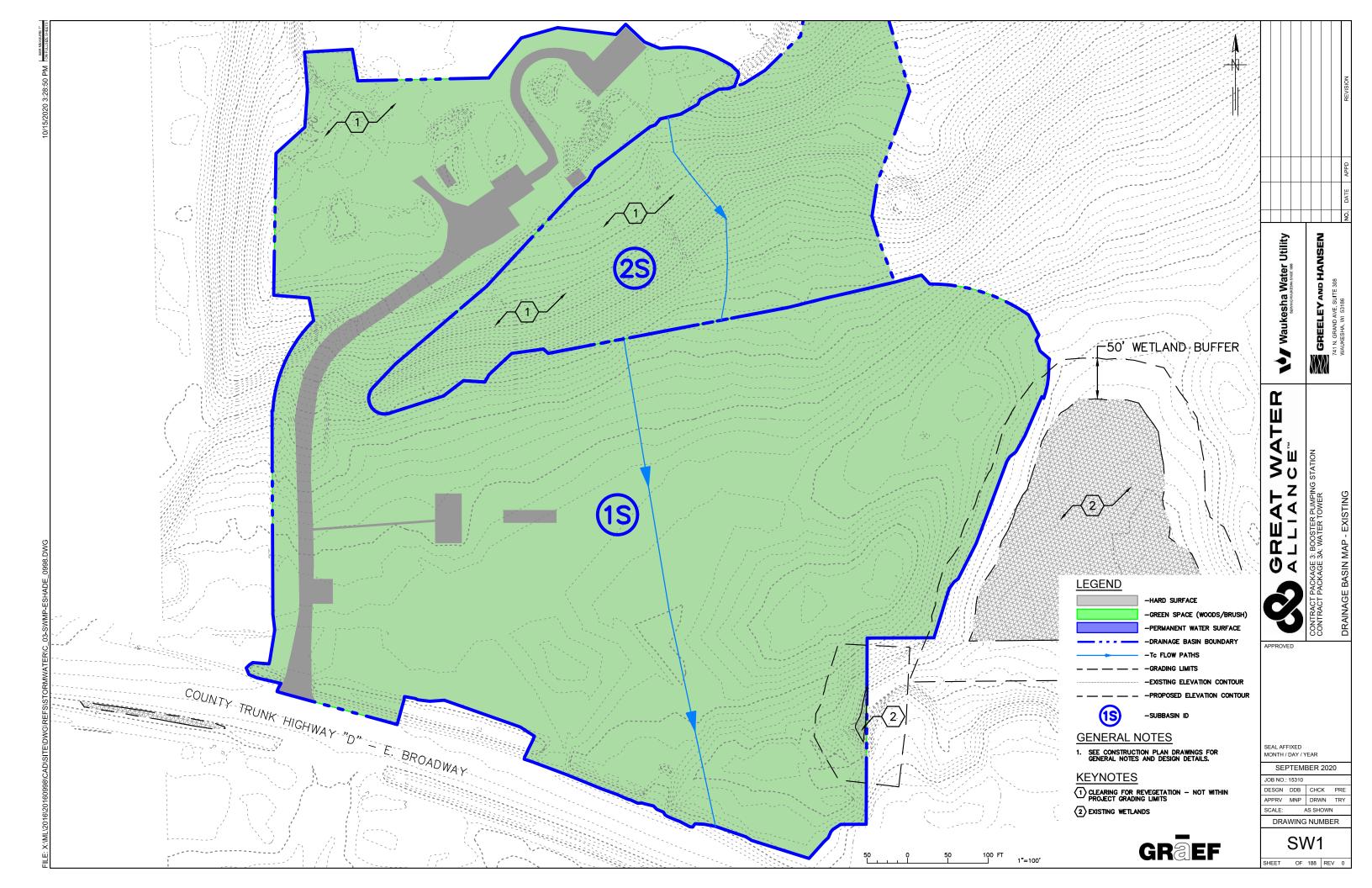
applicability for a particular use, completeness, or legality of the information depicted on this map. For more information, see the DNR Legal Notices web page: http://dnr.wi.gov/legal/

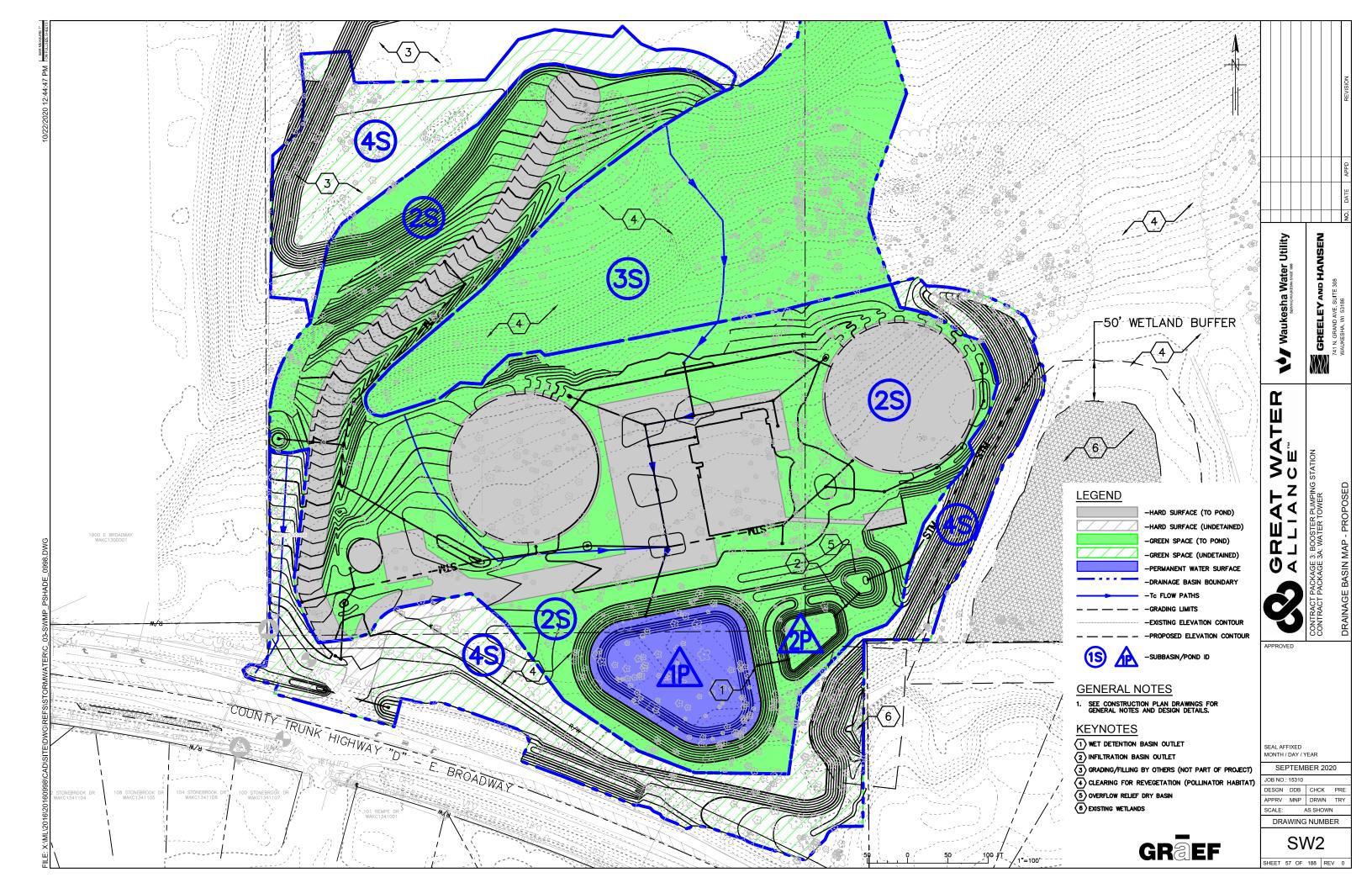
National Flood Hazard Layer FIRMette



Legend









			REVISION
			APPD
			NO. DATE /
			ġ
	Maukesha Water Utility	GREELEY AND HANSEN	741 N. GRAND AVE, SUITE 308 WAUKESHA, WI 53186
d) INED)) ED) :ACE ARY TOUR INTOUR	GREAT WATER	CONTRACT PACKAGE 3: BOOSTER PUMPING STATION CONTRACT PACKAGE 34: WATER TOWER	OFFSITE DRAINAGE PATTERN MAP
ROJECT) HABITAT)	DRAWING	BER 20 CHCK DRWN AS SHOW	PRE TRY /N
	SHEET 57 OF	188 RI	EV 0

LEGEND -HARD SURFACE (TO POND) -HARD SURFACE (UNDETAIN -GREEN SPACE (TO POND) -GREEN SPACE (UNDETAINE -PERMANENT WATER SURFA -DRAINAGE BASIN BOUNDAR -Tc FLOW PATHS - - - - - - - - - GRADING LIMITS -EXISTING ELEVATION CONT SUBBASIN/POND ID

GENERAL NOTES

1. SEE CONSTRUCTION PLAN DRAWINGS FOR GENERAL NOTES AND DESIGN DETAILS.

KEYNOTES

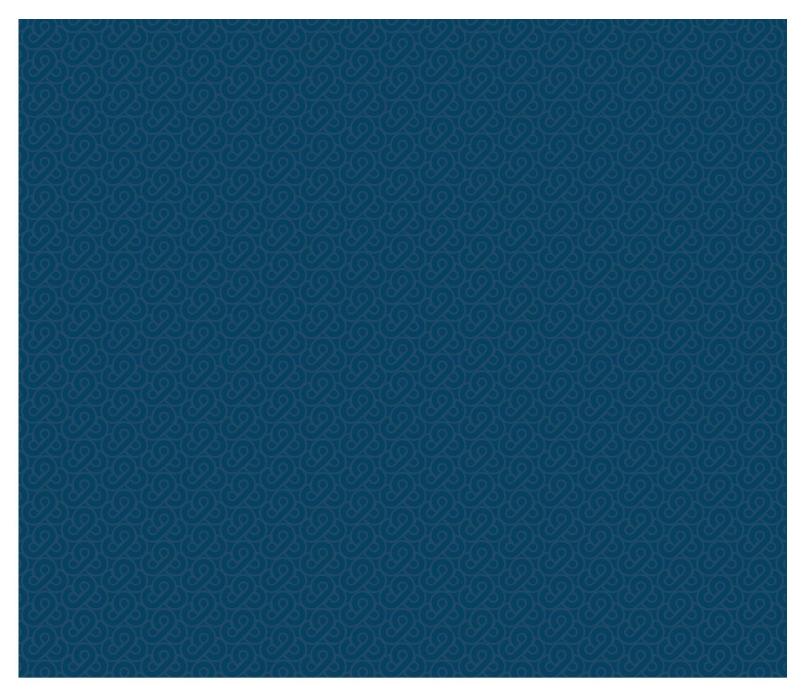
- (1) WET DETENTION BASIN OUTLET
- $\overline{\langle 2 \rangle}$ INFILTRATION BASIN OUTLET
- 3 GRADING/FILLING BY OTHERS (NOT PART OF PR
- (4) CLEARING FOR REVEGETATION (POLLINATOR HA
- 5 OVERFLOW RELIEF DRY BASIN
- 6 EXISTING WETLANDS





Appendix B – Geotechnical Report

and Soil Map





United States Department of Agriculture

Natural Resources Conservation Service A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Milwaukee and Waukesha Counties, Wisconsin

Great Water Alliance



Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/? cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



	MAP L	EGEND)	MAP INFORMATION
Area of Int	erest (AOI)	8	Spoil Area	The soil surveys that comprise your AOI were mapped at
	Area of Interest (AOI)	٥	Stony Spot	1:15,800.
Soils		۵	Very Stony Spot	Warning: Soil Map may not be valid at this scale.
	Soil Map Unit Polygons	\$	Wet Spot	
~	Soil Map Unit Lines	Δ	Other	Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil
	Soil Map Unit Points		Special Line Features	line placement. The maps do not show the small areas of
•	Point Features	Water Fea	·	contrasting soils that could have been shown at a more detailed scale.
്	Blowout	~	Streams and Canals	State.
\boxtimes	Borrow Pit	Transpor	tation	Please rely on the bar scale on each map sheet for map
Ж	Clay Spot	+++	Rails	measurements.
\diamond	Closed Depression	~	Interstate Highways	Source of Map: Natural Resources Conservation Service
X	Gravel Pit	~	US Routes	Web Soil Survey URL:
00	Gravelly Spot	~	Major Roads	Coordinate System: Web Mercator (EPSG:3857)
0	Landfill	~	Local Roads	Maps from the Web Soil Survey are based on the Web Mercator
٨.	Lava Flow	Backgrou	Ind	projection, which preserves direction and shape but distorts
عليہ	Marsh or swamp		Aerial Photography	distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more
衆	Mine or Quarry			accurate calculations of distance or area are required.
0	Miscellaneous Water			This product is generated from the USDA-NRCS certified data as
õ	Perennial Water			of the version date(s) listed below.
Ň	Rock Outcrop			Soil Survey Area: Milwaukee and Waukesha Counties,
÷	Saline Spot			Wisconsin
÷.	Sandy Spot			Survey Area Data: Version 15, Sep 16, 2019
 e	Severely Eroded Spot			Soil map units are labeled (as space allows) for map scales
_	Sinkhole			1:50,000 or larger.
Ŷ				Date(s) aerial images were photographed: Aug 1, 2019—Oct 20,
	Slide or Slip			2019
ø	Sodic Spot			The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CeD2	Casco loam, 12 to 20 percent slopes, eroded	3.1	23.8%
FoB	Fox loam, 2 to 6 percent slopes	0.0	0.2%
FoC2	Fox loam, 6 to 12 percent slopes, eroded	0.9	6.6%
HmB2	Hochheim loam, 2 to 6 percent slopes, eroded	1.8	13.9%
HmC2	Hochheim loam, 6 to 12 percent slopes, eroded	1.2	9.1%
HoC3	Hochheim soils, 6 to 12 percent slopes, severely eroded	3.7	28.0%
HtA	Houghton muck, 0 to 2 percent slopes	0.0	0.0%
LmB	Lamartine silt loam, 0 to 3 percent slopes	2.4	18.5%
Totals for Area of Interest		13.2	100.0%

Map Unit Legend

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a

given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Milwaukee and Waukesha Counties, Wisconsin

CeD2—Casco loam, 12 to 20 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2tjwd Elevation: 640 to 1,150 feet Mean annual precipitation: 31 to 37 inches Mean annual air temperature: 45 to 48 degrees F Frost-free period: 134 to 193 days Farmland classification: Not prime farmland

Map Unit Composition

Casco, eroded, and similar soils: 85 percent Minor components: 15 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Casco, Eroded

Setting

Landform: Moraines Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Loamy alluvium over calcareous, stratified sandy and gravelly outwash

Typical profile

Ap - 0 to 5 inches: loam Bt - 5 to 15 inches: clay loam 2C - 15 to 79 inches: stratified sand to gravel

Properties and qualities

Slope: 12 to 20 percent

Depth to restrictive feature: 10 to 20 inches to strongly contrasting textural stratification

Natural drainage class: Somewhat excessively drained

Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum in profile: 25 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 6e Hydrologic Soil Group: B Forage suitability group: Low AWC, adequately drained with limitations (G095BY003WI) Hydric soil rating: No

Minor Components

Fox

Percent of map unit: 8 percent Landform: Moraines Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Concave Hydric soil rating: No

Rodman

Percent of map unit: 7 percent Landform: Moraines Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Concave Hydric soil rating: No

FoB—Fox loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2szgj Elevation: 740 to 1,140 feet Mean annual precipitation: 31 to 35 inches Mean annual air temperature: 45 to 48 degrees F Frost-free period: 124 to 190 days Farmland classification: All areas are prime farmland

Map Unit Composition

Fox and similar soils: 93 percent *Minor components:* 7 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Fox

Setting

Landform: Outwash plains Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Crest Down-slope shape: Convex Across-slope shape: Linear Parent material: Fine-loamy glaciofluvial deposits over sandy and gravelly outwash

Typical profile

Ap - 0 to 7 inches: loam Bt1 - 7 to 22 inches: clay loam 2Bt2 - 22 to 36 inches: gravelly loam 2C - 36 to 79 inches: stratified sand to gravel

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 26 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 2e Hydrologic Soil Group: C Forage suitability group: Mod AWC, adequately drained (G095BY005WI) Hydric soil rating: No

Minor Components

Casco

Percent of map unit: 4 percent Landform: Outwash plains Landform position (three-dimensional): Riser Down-slope shape: Linear Across-slope shape: Linear Hydric soil rating: No

Fox

Percent of map unit: 3 percent Landform: Outwash plains Landform position (two-dimensional): Shoulder Landform position (three-dimensional): Crest Down-slope shape: Convex Across-slope shape: Linear Hydric soil rating: No

FoC2—Fox loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2szgk Elevation: 830 to 1,090 feet Mean annual precipitation: 31 to 35 inches Mean annual air temperature: 43 to 48 degrees F Frost-free period: 130 to 190 days Farmland classification: Farmland of statewide importance

Map Unit Composition

Fox, eroded, and similar soils: 92 percent *Minor components:* 8 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Fox, Eroded

Setting

Landform: Outwash plains Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Fine-loamy glaciofluvial deposits over sandy and gravelly outwash

Typical profile

Ap - 0 to 5 inches: loam Bt1 - 5 to 21 inches: clay loam 2Bt2 - 21 to 33 inches: sandy clay loam 2C - 33 to 79 inches: stratified sand to gravel

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 26 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 25 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 2.0
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 3e Hydrologic Soil Group: C Forage suitability group: Mod AWC, adequately drained (G095BY005WI) Hydric soil rating: No

Minor Components

Casco, eroded

Percent of map unit: 5 percent Landform: Moraines Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Linear Across-slope shape: Concave Hydric soil rating: No

Boyer

Percent of map unit: 3 percent Landform: Outwash plains Landform position (three-dimensional): Rise Down-slope shape: Linear Across-slope shape: Convex Hydric soil rating: No

HmB2—Hochheim loam, 2 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t03w Elevation: 820 to 1,330 feet Mean annual precipitation: 29 to 36 inches Mean annual air temperature: 43 to 46 degrees F Frost-free period: 135 to 175 days Farmland classification: All areas are prime farmland

Map Unit Composition

Hochheim, eroded, and similar soils: 85 percent Minor components: 15 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hochheim, Eroded

Setting

Landform: Drumlins Landform position (two-dimensional): Summit, shoulder Landform position (three-dimensional): Crest, side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 7 inches: loam Bt - 7 to 16 inches: loam C - 16 to 33 inches: gravelly sandy loam Cd - 33 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: More than 80 inches Frequency of flooding: None Frequency of ponding: None Calcium carbonate, maximum in profile: 60 percent Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm) Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 2e Hydrologic Soil Group: D Forage suitability group: Mod AWC, adequately drained (G095BY005WI) Hydric soil rating: No

Minor Components

Theresa, eroded

Percent of map unit: 10 percent Landform: Till plains Landform position (two-dimensional): Summit, backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Hydric soil rating: No

Lamartine

Percent of map unit: 5 percent Landform: Drumlins Landform position (two-dimensional): Footslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Linear Hydric soil rating: No

HmC2—Hochheim loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t03r Elevation: 900 to 1,340 feet Mean annual precipitation: 31 to 33 inches Mean annual air temperature: 43 to 46 degrees F Frost-free period: 135 to 175 days Farmland classification: Farmland of statewide importance

Map Unit Composition

Hochheim, eroded, and similar soils: 90 percent Minor components: 10 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hochheim, Eroded

Setting

Landform: Drumlins Landform position (two-dimensional): Shoulder, summit Landform position (three-dimensional): Crest, side slope Down-slope shape: Convex Across-slope shape: Linear Parent material: Loamy till and/or calcareous, dense loamy till

Typical profile

Ap - 0 to 7 inches: loam Bt - 7 to 16 inches: clay loam C - 16 to 33 inches: gravelly sandy loam Cd - 33 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 20 to 40 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 4e Hydrologic Soil Group: D Forage suitability group: Mod AWC, adequately drained (G095BY005WI) Hydric soil rating: No

Minor Components

Theresa

Percent of map unit: 5 percent Landform: Drumlins Landform position (two-dimensional): Summit Landform position (three-dimensional): Crest Down-slope shape: Convex Across-slope shape: Convex Hydric soil rating: No

Hochheim

Percent of map unit: 5 percent Landform: Drumlins Landform position (two-dimensional): Backslope, shoulder Landform position (three-dimensional): Side slope, head slope Down-slope shape: Convex Across-slope shape: Linear Hydric soil rating: No

HoC3—Hochheim soils, 6 to 12 percent slopes, severely eroded

Map Unit Setting

National map unit symbol: g948 Elevation: 670 to 1,100 feet Mean annual precipitation: 28 to 36 inches Mean annual air temperature: 37 to 55 degrees F Frost-free period: 135 to 170 days Farmland classification: Farmland of statewide importance

Map Unit Composition

Hochheim and similar soils: 100 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hochheim

Setting

Landform: Ground moraines, drumlins Landform position (two-dimensional): Backslope Landform position (three-dimensional): Side slope Down-slope shape: Convex Across-slope shape: Convex Parent material: Calcareous, dense loamy till

Typical profile

A,E - 0 to 6 inches: clay loam Bt1,Bt2,BC - 6 to 17 inches: clay loam C - 17 to 60 inches: gravelly loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 60 percent
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 4e Hydrologic Soil Group: B Forage suitability group: Mod AWC, adequately drained (G095BY005WI) Hydric soil rating: No

HtA—Houghton muck, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2szff Elevation: 600 to 1,090 feet Mean annual precipitation: 31 to 35 inches Mean annual air temperature: 43 to 48 degrees F Frost-free period: 124 to 192 days Farmland classification: Farmland of statewide importance

Map Unit Composition

Houghton, muck, and similar soils: 90 percent Minor components: 10 percent Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Houghton, Muck

Setting

Landform: Depressions Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Parent material: Herbaceous organic material

Typical profile

Oap - 0 to 6 inches: muck *Oa - 6 to 79 inches:* muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 5.95 in/hr)
Depth to water table: About 0 to 4 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 3w Hydrologic Soil Group: A/D Hydric soil rating: Yes

Minor Components

Houghton, ponded Percent of map unit: 4 percent Landform: Depressions Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Hydric soil rating: Yes

Palms

Percent of map unit: 2 percent Landform: Lakebeds (relict) Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Concave Hydric soil rating: Yes

Adrian

Percent of map unit: 2 percent Landform: Lakebeds (relict) Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Concave Hydric soil rating: Yes

Willette, muck

Percent of map unit: 1 percent Landform: Depressions Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Linear Hydric soil rating: Yes

Edwards

Percent of map unit: 1 percent Landform: Depressions Landform position (three-dimensional): Dip Down-slope shape: Concave Across-slope shape: Concave Hydric soil rating: Yes

LmB—Lamartine silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t043 Elevation: 590 to 1,140 feet Mean annual precipitation: 29 to 35 inches Mean annual air temperature: 37 to 46 degrees F Frost-free period: 135 to 170 days Farmland classification: Prime farmland if drained

Map Unit Composition

Lamartine and similar soils: 85 percent *Minor components:* 15 percent *Estimates are based on observations, descriptions, and transects of the mapunit.*

Description of Lamartine

Setting

Landform: Interdrumlins Landform position (two-dimensional): Footslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Linear Parent material: Loess over loamy till

Typical profile

Ap - 0 to 8 inches: silt loam Bt1 - 8 to 20 inches: silty clay loam 2Bt2 - 20 to 28 inches: clay loam 2C - 28 to 79 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified Land capability classification (nonirrigated): 2w Hydrologic Soil Group: B/D Forage suitability group: High AWC, high water table (G095BY007WI) Hydric soil rating: No

Minor Components

Pella

Percent of map unit: 8 percent Landform: Drainageways Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Concave Hydric soil rating: Yes

Ossian

Percent of map unit: 7 percent

Custom Soil Resource Report

Landform: Depressions Landform position (two-dimensional): Toeslope Landform position (three-dimensional): Base slope Down-slope shape: Concave Across-slope shape: Concave Hydric soil rating: Yes

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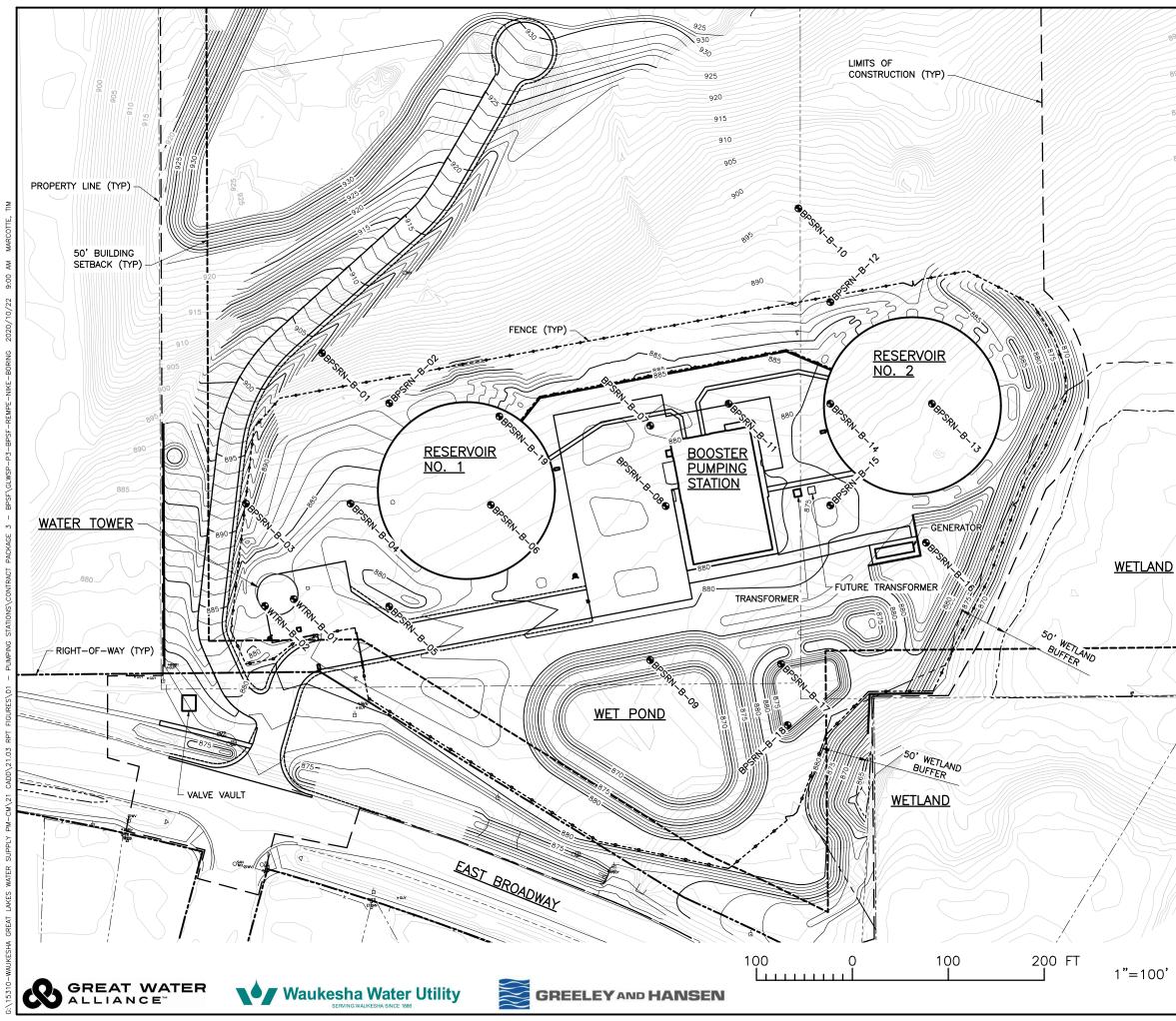
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SOIL	BORING	S
BORING NO.	NORTHING	EASTING
BPSRN-B-01	371151.9425	2483192.0895
BPSRN-B-02	371099.6530	2483262.1531
BPSRN-B-03	370995.0298	2483112.7680
BPSRN-B-04	370995.0298	2483221.8065
BPSRN-B-05	370887.6530	2483262.1531
BPSRN-B-06	370993.6530	2483368.1531
BPSRN-B-07	371076.2842	2483534.3312
BPSRN-B-08	370992.4853	2483550.3691
BPSRN-B-09	370831.8566	2483534.2634
BPSRN-B-10	371302.7290	2483688.8222
BPSRN-B-11	371099.1234	2483616.0238
BPSRN-B-12	371205.1234	2483722.0238
BPSRN-B-13	371099.1234	2483828.0238
BPSRN-B-14	371099.1234	2483722.0238
BPSRN-B-15	370993.1234	2483722.0238
BPSRN-B-16	370954.2191	2483821.8126
BPSRN-B-17	370827.8645	2483670.7059
BPSRN-B-18	370763.9971	2483677.6177
BPSRN-B-19	371085.8900	2483377.0000
WTRN-B-01	370895.4021	2483162.6322
WTRN-B-02	370888.2701	2483132.6300

* BORING COORDINATES LISTED ARE ACTUAL FIELD LOCATIONS. ASTERISK DENOTES BORINGS THAT SHIFTED FROM DESIGNED COORDINATES.

WAUKESHA, WISCONSIN GREAT LAKES WATER SUPPLY PROGRAM **BOOSTER PUMPING STATION REMPE-NIKE PRELIMINARY SOIL BORING PLAN - DRAFT** 2020-10-22

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			ATE -								CAVE-IN						-) (
										8.5tt.												
									N/A											Recor	ded	
VATER ENCOUNTERED DURING DRILLING: 38.5ft. Image: Cave Depth at completion: 22ft. Image: Cave Depth after 0 hours: N/A V WATER LEVEL AT COMPLETION: NE Image: Cave Depth after 0 hours: N/A Image: Cave Depth after 0 hours: N/A	WATER ENCOUNTERED DURING DRILLING: 38.5ft. 超 CAVE DEPTH AT COMPLETION: 22ft. D WATER LEVEL AT COMPLETION: NE D CAVE DEPTH AFTER 0 HOURS: N/A D	-			es betv							1										

ROJECT No	WA	Alte	rnati		PS Site 2 0521741		WATER	BORIN	G LO	C	Inte	rtek	P	Si	PAGE		NG	-No BPSRN-B
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RILLING CONTR	RACTOR		GI	eeley			CTOR PROJECT No		DATE COM	PLETED					LATIT	UDE		
REW CHIEF					PSI	DRILLING RIG			BORING OF	FSET			3/3	31/20		BITUDE		
IELD LOG BY					P. Rotaru	DRILLING METHOD		O ATV #419	ROADWAY	NAME					NORT	HING		
OG QC BY				F	R. Sayles	HAMMER TYPE	EFFICIEN	ICY	STATION			FFSET			EAST			
						TOWNSHIP	RANGE	SECTION		1/4 SECTIO			ECTION				EVATION	
						TOWNSHIP	RANGE	SECTION		1/4 SECTIO		1/4 51			SURF.			
Sample No / Type	Sample Recovery (In)		N - Value	Depth (ft)	Elevation (ft)	and	vil / Rock Deso I Geological O Major Unit / C	rigin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength $Q_{\rm p}$ (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1		3	_			opsoil (15"± Thi loist	ick), Dark Brow	n Silty Clay, V	/ery	OL							32	
ss	<u> </u>	3	6	-					1.1								8	
2	4 '	4	8	_	B	rown Sandy Silt	With Gravel, V	ery Moist		ML								
SS		4			B	rown Medium S	and and Grave	I Moist to We	5.5 t								9	
3 SS 1		23	29			Possible Perche		., 110131 10 110	•								5	
4	1	2	35	-														
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9 1	5_ <u></u> 50	/5" +	R															
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				-	-		Trans On 1	Marta 1	37		77777							
10 1		2		-	B	rown Lean Clay	, Trace Gravel,	IVIOIST										
101 1	2	20 🖵	49	40									4.5	7.63			12	
		29																
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	EKLE	VEL	ALC	UNIP	ETION:	NE				DEPTH	AFIER	UHU	UKS:	N//	4			W D

Depth (ff)	00521741 ley-Hansen PSI P. Rotaru R. Sayles	CONSULTANT PROJE DRILLING CONTRAC DRILLING RIG DRILLING METHOD / HAMMER TYPE TOWNSHIP	TOR PROJECT №	ATV #419	DATE STAR DATE COMP BORING OF ROADWAY I STATION	PLETED			3/:	31/20 31/20	LATITU LONGI NORTH EASTI	JDE TUDE HING		2 of
	PSI P. Rotaru R. Sayles	DRILLING RIG DRILLING METHOD / HAMMER TYPE TOWNSHIP	HD A	(BORING OF ROADWAY I STATION	FSET		1/4 SE	3/:	31/20	LONGI NORTH EASTI	TUDE HING NG		
N - Value Deoth (ft)	P. Rotaru R. Sayles	DRILLING METHOD / HAMMER TYPE TOWNSHIP	HOLE SIZE	(ROADWAY I	NAME		1/4 SE	CTION		NORTH	HING NG	WATION	
N - Value Deoth (ft)	R. Sayles	HAMMER TYPE	HOLE SIZE	(STATION			1/4 SE			EASTI	NG	WATION	
N - Value Deoth (ft)		TOWNSHIP				1/4 SECTIO		1/4 SE						
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N - Value Depth (ft)	tion (ft)	Soi							4	Ļ				
	Eleva	and	I / Rock Descri Geological Orig Major Unit / Co	gin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
3	Bi	rown Lean Clay,	Trace Gravel, M	loist					4.5	2.23			12	
	-													
3 [13] 9	60								4.5	6.39			11	
									3.75	3.79			13	
	-								-	-				
1	70								4.5	4.95			12	
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1									4.5	6.39			12	
	_					CL								
	80								4.5	8.24			11	
2"/ <u>R</u> /									45	5.98			12	
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4" <u>, R</u> , 9	90								4.5	5.56			13	
<u>2"/ R /</u>	-								4.5					
2"/_R/ 10	00		o the West due t		100				4.5				10	
	3 7 73 7 73 5 6 60 64 1 52 8 3 70 9 4 88 0 2" 4 88 0 2" 2" R 2" R	$ \frac{3}{7} $ $ 7 $ $ 73 $ $ 60 $ $ 5 $ $ - $ $ 60 $ $ 6 $ $ 60 $ $ - $ $ - $ $ 60 $ $ - $ $ - $ $ 60 $ $ - $	$ \frac{3}{7} $ $ 73 $ $ 60 $ $ 6 $ $ 6 $ $ 6 $ $ 6 $ $ 6 $ $ 6 $ $ 6 $ $ - $ $ 7 $ $ 73 $ $ 60 $ $ - $ $ 6 $ $ 6 $ $ - $ $ - $ $ 7 $	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \frac{3}{7} 73 60 \\ \frac{5}{60} 60 \\ \frac{6}{60} -4 \\ \frac{1}{4} 52 70 \\ \frac{1}{8} -4 \\ \frac{1}{4} 52 70 \\ \frac{1}{9} -4 \\ \frac{1}{8} 88 \\ \frac{80}{90} -4 \\ \frac{1}{2^{n} \ R} 90 \\ \frac{1}{2^{n} \ R} -4 \\ \frac{1}{8} 81 \\ \frac{1}{8} \\ \frac{1}{8} 81 \\ \frac{1}{8} \\ 1$	$ \frac{3}{7} $ $ \frac{7}{73} $ $ \frac{60}{60} $ $ \frac{60}{64} $ $ \frac{1}{4} $ $ \frac{1}{52} $ $ \frac{70}{8} $ $ \frac{3}{70} $ $ \frac{1}{4} $ $ \frac{52}{8} $ $ \frac{70}{9} $ $ \frac{3}{70} $ $ \frac{1}{9} $ $ \frac{4}{8} $ $ \frac{80}{90} $ $ \frac{2^{7}}{R} $ $ \frac{90}{1} $ $ \frac{1}{7} $ $ \frac{1}{7} $ $ \frac{90}{1} $ $ \frac{1}{7} $	3 - 7 73 60 5 - 6 60 - - 4 - 1 52 70 - 3 70 - - 4 - 3 70 - - 4 - - - </td <td>3 - 7 73 60 5 - 6 60 - - 4 52 70 - - - 4 52 70 - - - <!--</td--><td>3 - 7 73 60 6 60 - 6 60 - 4 52 70 8 70 - 4 52 70 8 80 - - - - 4 52 70 8 80 - - - - 4 88 80 0 - - 4 88 80 0 - - 4* 89 - 2* R - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -</td><td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td><td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td><td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td><td>$\frac{3}{8} 73 60 \\ \frac{7}{8} 73 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 70 \\ \frac{1}{8}$</td><td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td></td>	3 - 7 73 60 5 - 6 60 - - 4 52 70 - - - 4 52 70 - - - </td <td>3 - 7 73 60 6 60 - 6 60 - 4 52 70 8 70 - 4 52 70 8 80 - - - - 4 52 70 8 80 - - - - 4 88 80 0 - - 4 88 80 0 - - 4* 89 - 2* R - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -</td> <td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td> <td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td> <td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td> <td>$\frac{3}{8} 73 60 \\ \frac{7}{8} 73 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 70 \\ \frac{1}{8}$</td> <td>$\begin{array}{c ccccccccccccccccccccccccccccccccccc$</td>	3 - 7 73 60 6 60 - 6 60 - 4 52 70 8 70 - 4 52 70 8 80 - - - - 4 52 70 8 80 - - - - 4 88 80 0 - - 4 88 80 0 - - 4* 89 - 2* R - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$ \frac{3}{8} 73 60 \\ \frac{7}{8} 73 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 60 \\ \frac{1}{8} 70 \\ \frac{1}{8} $	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$

$\overline{\Delta}$	WATER ENCOUNTERED DURING DRILLING: 12ft.	鬣	CAVE DEPTH AT COMPLETION: N/A]
V	WATER LEVEL AT COMPLETION: NE	ļ	CAVE DEPTH AFTER 0 HOURS: N/A]
Ţ	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	
IOT	E: Stratification lines between soil types represent the approximate boundary; gradua	al trans	sition between in-situ soil layers should be expected.	
				_

PROJECT No		. ,	ornati		PS Site 2 0521741	ALLIAN	CE"	BORIN	IG LO	JG	Inte	rtek	lP	S	PAGE			-No BPSRN-B
CONSULTANT			Gr	eelev	-Hansen	CONSULTANT PROJE	CT No		DATE STAF	RTED			3/	30/20	HORIZ	ZONTAL	DATUM	VERTICAL DATUM
RILLING CO	NTRACT	OR			PSI	DRILLING CONTRACT	FOR PROJECT	No	DATE COM	PLETED				30/20	LATIT	UDE		I
CREW CHIEF				F	P. Rotaru	DRILLING RIG		HD ATV #419	BORING OF	FSET			•		LONG	ITUDE		
IELD LOG B	Y				R. Sayles	DRILLING METHOD /			ROADWAY	NAME					NORT	HING		
OG QC BY				r	. Sayles	HAMMER TYPE	EFFIC	IENCY	STATION		0	FFSET			EAST	ING		
COUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	DN N	1/4 S	ECTION		SURF	ACE ELI	VATION	
													£	£	-			
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and Each N	/lajor Ūnit /	Origin for / Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1	_	3				opsoil (12"± Thic loist	k), Dark Bro	own Silty Clay, V	/ery	OL							17	
s	7	2	6	-					0.99				4.0				21	
2 SS	11	6	11	_	B	rown Lean Clay,	very Moist	to inidist		CL			2.0				17	
3		5		_	В	rown Sand and G	Gravel, Mois	t to Wet (Possi	5.5 ble				2.0				17	
SS	6	4	15		P	erched Water 12	'-17')										5	
4 SS	7	9 43 27	45	10													2	
		27 18			Ž					SP							2	
				-	<u>×</u>													
5 SS	5	24 12	18	-													15	
		6		-					17								-	
				_	В	rown Medium Sa	nd, Wet (Pe	ossible Perchec										
6 SS	6	15 18	46	20						SP							17	
		28							22									
						rown Sand and G Vater)	Gravel, Wet	(Possible Percl	ned									
7 SS	<u>4</u>	\ <u>50/4</u> "/		-						SW								
				-					27									
		- 04		_	B	rown Lean Clay,	Moist to Ve	ry Moist										
8 	4	21 27	50	30									4.5				10	
		23																
0		1/																
9 SS	12	14 26 32	58										4.5				11	
		52		-														
10	40	16		-														
SS	13	21	52	<u>40</u>									4.5	6.18			12	
				-						CL								
11	10	15	56															
SS		23 33											4.5	8.24			11	
12	10	19 25	60	E0										,				
SS		25 35		50									4.5+	7.42			10	
				-														
13	11		66	-														
-											1111							
													TIO: /					14
					DURING I	DRILLING: 12 NE	π.			DEPTH DEPTH								W D W D
-					HOURS:	N/A			-					easure		Recon	ded	D

PROJECT No	GW/	A - Alt	ernat		PS Site 2		WATER	BORIN	IG LO	COG	Inte	rtek		Si	PAGE		NG	No BPSRN-B-0 2 of
CONSULTANT	Г		6-		<u>052174</u> -Hansei	CONSULTANT PROJ	IECT No		DATE STAR	TED			2/	30/20	HORI	ZONTAL	DATUM	VERTICAL DATUM
DRILLING CO	NTRACT	FOR	Gi	eeley	PS	DRILLING CONTRAC	CTOR PROJECT N	lo	DATE COM	PLETED				<u>30/20</u>	LATIT	UDE		
CREW CHIEF				F	P. Rotari	DRILLING RIG	ŀ	HD ATV #419	BORING OF	FSET			5/	55,20		BITUDE		
FIELD LOG B	Υ				R. Sayle	DRILLING METHOD		<u>12 / (1 / # 110</u>	ROADWAY	NAME					NORT	HING		
LOG QC BY				_		HAMMER TYPE	EFFICI	ENCY	STATION		0	FFSET			EAST	ING		
COUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	DN	1/4 S	ECTION		SURF	ACE ELI	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	So and Each	il / Rock De Geological Major Unit /	scription Origin for Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS	S	11 30				Brown Lean Clay,	, Moist to Ver	y Moist						u 4.53		_	≥ 11	
		36																
14 SS ,	13	15 24	70	60									4.0				12	
		46																
15 	11	13 24	55										4.0	3.71			13	
		31																
16	40	13	E4	-														
SS ,	13	20 31	51	<u>70</u>									3.5	2.47			13	
				-														
17	12	12	62										45	2.00			40	
SS,		27 35											4.5	3.96			12	
										CL								
18 SS ,	14	15 24	61	80									3.0	2.89			13	
		37																
19 SS	<u>5</u>	50/5"											3.5	2.14			22	
20 1	4 1	50/4"	<u>R</u>	-										1 50				
20 SS				90									4.5+	4.53			18	
21	4.5	50/5"	R											5.36				
SS													4.5+				21	
22 SS		28 28 38	66	100					100				4 5+	9.07			17	
		38			I	En	d of Boring at	t 100.0 ft.		•			<u></u>	<u>~~</u> /			<u>`</u> '''	

ROJECT No		A - Alto	ernati		PS Site 2 0521741		WATER	BORIN	G LO	C	Inte	rtek	P	Si	PAGE		NG	-No BPSRN-B
ONSULTANT	Г		6-		/-Hansen	CONSULTANT PROJ	ECT No		DATE STAR	TED			A1	07/20	HORIZ	ZONTAL	DATUM	VERTICAL DATUM
RILLING CO	NTRACT	OR	Gr	eeley		DRILLING CONTRAC	TOR PROJECT No		DATE COM	PLETED					LATIT	UDE		
REW CHIEF					PSI	DRILLING RIG			BORING OF	FSET			4/	07/20		ITUDE		
IELD LOG B	Y			F	P. Rotaru	DRILLING METHOD		D ATV #419	ROADWAY	NAME					NORT	HING		
OG QC BY				D. E	Buchman	HAMMER TYPE	EFFICIEN		STATION			FFSET			EAST		_	
									STATION									
OUNTY	1			1		TOWNSHIP	RANGE	SECTION		1/4 SECTIO		1/4 S	ECTION		SURF.	ACE ELI	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	il / Rock Deso Geological O Major Unit / C	rigin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
		0			T	opsoil (11"± Thio	ck), Dark Brow	n Silt, Very M		OL							25	
1 SS	10	6	8	-	P	ossible Fill, Brov	vn and Dark B	rown Lean Cla	0.9/ av,				1.25				22	
2	10	4	11		T	race Sand and G	Gravel, Very Mo	oist to Moist	-									
		6 5							5.5				2				15	
3 SS	8	8	70		B	rown Sand and (iravel, Damp		•	SP							5	
,		39 31		-	В	rown Fine to Me	dium Sand, Mo	oist to Wet	8								ĭ	
4 SS	12	9	26	10			-,										9	
		14																
					∇					SP								
5 SS	10	26	35	-	-												21	
		19							17								-	
					В	rown Sand With	Gravel, Possi	ble Cobbles, V										
6	14	23	30															
		10 20	50	20													12	
-																		
7 SS ,	12	20 17	46														14	
		29		-														
										SP								
8 SS	14	23	81	30													19	
		50															19	
				-														
9 SS ,	10	23	90															
SS		40 50																
						rown Loon Ola	Troop Orean	Moist	37									
10		12		-	В	rown Lean Clay,	rrace Gravel,	, WOIST										
SS,	8	26	58	40									4.25	4.53			12	
		32																
11 SS ,	8	17 26	66	-									4.5	9.48			11	
/		40								CL								
12	14	20	62	50									45	7 60			10	
_SS		24 38											4.5	7.63			10	
				-														
13	18		51															
	١ð		51															
			I			WA	TER & CAV	/E-IN OBS	ERVAT	ON D	ATA		1				<u> </u>	
	ATER	ENCC	UNTE	ERED	DURING [3.5ft.	驖				MPLE	TION	NE	<u> </u>			W D
_					LETION:	NE		_		DEPTH								W D
🗶 WA					HOURS:	N/A present the appro				ot Encou							ded	

CONSULTANT DRILLING CONTRACTO CREW CHIEF FIELD LOG BY LOG QC BY COUNTY	OR	Gr	eeley F	05217 -Hans F 2. Rota	CONSULTANT PROJECT NO DRILLING CONTRACTOR PROJECT NO DRILLING RIG DRILLING RIG	DATE STAF	TED			A/		HORIZ	ZONTAL	DATUM	VERTICAL DATUM
CREW CHIEF FIELD LOG BY LOG QC BY COUNTY	OR		P	F	DRILLING CONTRACTOR PROJECT №	DATE COM				<u> </u>	07/20				
FIELD LOG BY					DRILLING RIG		PLETED				07/20	LATIT	TUDE		
LOG QC BY COUNTY				. 1\Uld		BORING OF	FSET			-4/	51720		GITUDE		
COUNTY				luchm	DRILLING METHOD / HOLE SIZE	ROADWAY	NAME					NORT	THING		
			0.0	oucrim	HAMMER TYPE EFFICIENCY	STATION		OF	FSET			EAST	ING		
(in)					TOWNSHIP RANGE SECTION	N	1/4 SECTIO	N	1/4 S	ECTION		SURF	ACE EL	EVATION	
(in)									I	£	£				
Sample No / Type Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	i	USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS/	22 26 25		-		Brown Lean Clay, Trace Gravel, Moist					4.0				12	
14 SS 18	19 24 36	60	60							4.5	6.18			12	
15			-												
15 SS 18	18 21 32	53	-							4.5				12	
16 18 SS 18	16 25 38	63	<u>70</u>							4.5				12	
17 10 SS 10	15 25 32	57	_							4.5	4.74			12	
18 12 SS 12	14 28 40	68	<u>80</u>				CL			4.5	4.53			14	
19 12 SS 12	26 31 33	64	-							4.5	10.3+			10	
20 18 SS 18	23 29 32	61	90							4.5+				12	
21 SS 18	25 31 34	65	-							4.5	9.07			9	
22 <u>5</u> SS	<u>,50/5"</u> ,	R	100		End of Boring at 100.0 ft.	100				4.0	4.12				

CONSULTANT DRILLING CONT CREW CHIEF FIELD LOG BY LOG QC BY COUNTY ON ad L ON A COUNTY	Sample Recovery (in)		Gr	F	-Hanse P: P. Rotar	DRILLING CONTRAC		0	DATE STAR				4/	08/20			DATUM	VERTICAL DATUM
CREW CHIEF FIELD LOG BY LOG QC BY COUNTY						SI	FOR PROJECT No	0	DATE COM									
FIELD LOG BY LOG QC BY COUNTY	Recovery (in)	<u>6</u>			P. Rotar	DRILLING RIG							4/	08/20	LATIT			
LOG QC BY	Recovery (in)	<u>s</u>				u	н	ID ATV #419	BORING OF	FSET					LONG	ITUDE		
COUNTY	Recovery (in)	<u>s</u>			Buchma	DRILLING METHOD /	HOLE SIZE		ROADWAY	NAME					NORT	HING		
	Recovery (in)	<u>y</u>				HAMMER TYPE	EFFICIE	ENCY	STATION		0	FFSET			EASTI	NG		
Sample No / Type	Recovery (in)	<u>s</u>				TOWNSHIP	RANGE	SECTION	-	1/4 SECTIO	N	1/4 S	ECTION		SURF	ACE ELI	VATION	
Sample No / Type	Recovery (in)	s											£	£				
	Sample	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	/ Rock Des Geological (/lajor Unit /	Origin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q ₍ (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1		3			<u> </u>	Topsoil (12"± Thic Moist	k), Dark Brov	wn Silty Clay, V	/ery	OL								
s	8	3	6	-	Ľ	\			0.99								11	
2 SS	10	4	10	-	\	Brown Lean Clay,			3								10	
		5 5		_		Brown Silty Sand \	With Gravel,	Moist		SM							10	
3 	8	6 5	11						8								11	
4	14	6 5	19	10		Brown Silt, Moist											10	
		7 12		10					10	ML							10	
				-	¥	<u>Brown Sandy With</u>	Gravel, We	t (Possible Pe	12 rched									
5	12	3 5	18	_		Water)		·										
		5 13	-														12	
										SP								
6	12	9	63	-														
	12	28 35	03	20													12	
				_		Desure Lagar Class	T 0		22		·////							
7	0	11	40			Brown Lean Clay,	Trace Grave	, MOIST										
ss	8	22 20	42										3.75	4.53			12	
		20		-														
				-														
8 	18	9 17	41	30									3.5	2.64			14	
		24																
9 SS	15	9 16 ,	39	-									4.5	4.04			12	
		23		-														
				_														
10 SS	18	11 14	35	40						CL			3.75	3.63			12	
		21																
				4														
11 SS	18	10 15	41	-									4 25	4.33			13	
		26		_									.20	1.00				
12 SS	18	8 17	44	50									A =	5.20			10	
		17 27		50									4.5	5.36			12	
				-														
13	18		42	4														
+											<i>V////</i>							
					I	WAT	ER & CA	VE-IN OBS	ERVAT	ION D	ATA		·				I	
						G DRILLING: 12	ft.	<u>ال</u>	-	DEPTH								W
-					LETION:				-	DEPTH								W D

	- Alte	ernati		PS Site			NCE	BOF	RIN	G L(CO	Inte	rtek		Si	PAGE		NG	No BPSRN-B-(
		C		05217	0	CONSULTANT PRO	DJECT No			DATE STAR	TED			A /	00/00	HORI	ZONTAL	DATUM	VERTICAL DATUM
ITRACTO	R	Gr	eeley	-Hanse	1	DRILLING CONTRA	ACTOR PROJE	CT No		DATE COM	PLETED				08/20	LATI	TUDE		
			_		-	DRILLING RIG			#440	BORING OF	FSET			4/	00/20		GITUDE		
					1	DRILLING METHOD	D / HOLE SIZE	HDAIV	#419	ROADWAY	NAME					NOR	THING		
			D. B	sucnma		HAMMER TYPE	EF	FICIENCY		STATION		0	FFSET			EAST	ING	_	
						TOWNSHIP	RANGE	SEC	CTION		1/4 SECTIO	DN NC	1/4 S	ECTION		SURF	ACE ELI	EVATION	
														£	£				
(in)											2			trengt	trengt	(9	(%)	(%)	
over	unts	lue	(Ħ)	n (ft)		S	oil / Rock	Description			ASH	. <u>e</u>	gram	np. S	np. S	nit (%	dex	ntent	
Rec	Ŭ ≽	- Va	bepth	vatio		and Each	d Geologic	cal Origin fo	or		A/	sraph	l Dia	0 C C C C C	d Cor	d Lin	ity Ir	ပိ	Notes
mple	Blo	z	Ц	Ele		Lach	i major Off		4113		ISCS		Wel	nfine	nfine	Liqui	astic	istur	
Sar														Unco	Uncol	_		Mo	
	10 18		_	\rightarrow	Bro	wn Lean Clay	y, Trace Gr	ravel, Moist										12	
18	11	45	60												6 00				
			50											4.5	o.39			12	
			-																
14	10	38	-												4 50				
	16 22		_											4.5	4.03				
	12 14	38	70											4 5+	5 15			12	
	24		-												0.10			¹	
			-								_								
	14 38	63	-								CL			4.5				6	
			_																
12	16 42	80	80											4.5				14	
	38																		
			-																
10	39	75	-											4.5				9	
L	36		-																
			_																
10	14 36	73	90											4.5				5	
L	37									92									
			1	Ĺ	Bro	wn Clayey Sa	and and Gr	avel, Wet											
3_15	<u>50/3"</u>	<u>R</u>	-															5	
			-								SC								
	0/0"		-																
2/\5	50/2"J	<u>R</u>	100				ad at D	g at 100.0 ft.		100								19	
	Cample Recovery (in)	Image: Construction of the second	Image: series of the series	Image: Participant of the second state of t	P. Rota D. Buchma D. Buchma D. Buchma (ii) A 20 A 10 A 10 A 10 A 10 A 10 A 10 A 20 A 10 A 10 A 10 A 10 A 10 A 10 A 10 A 1	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	P. Rotaru DRILING RIG D. Buchman DRILLING METHOL UMMER TYPE TOWNSHIP (ii) Åison and Åison and 10 and 11 45 20 and 18 11 10 38 22 and 14 10 22 and 18 11 14 16 25 and 14 16 25 and 18 14 18 18 18 18 18 18 18 18 18 18 19 90 18 14 18 18 18 18 18 14 18 14 19 90 18 14 18 14 36 - 18 14 14 14<	P. Rotaru DRILLING RIG D. Buchman DRILLING METHOD / HOLE SIZE HAMMER TYPE EF 10 10 11 11 12 10 18 11 19 26 18 11 19 45 20 10 22 10 18 11 14 16 25 10 14 14 18 12 18 12 18 12 18 13 14 16 38 - 18 14 138 - 14 14 18 13 19 - 10 38 - - 14 14 18 13 19 - 18 14 18 73	PSI DPILLING RIG HD ATV D. Buchman PRATE DRILING METHOD / HOLE SIZE 1000000000000000000000000000000000000	PSI PRULING RIG HD ATV #419 PRULING METHOD / HOLE SIZE PRULING METHOD / HOLE SIZE PRULING METHOD / HOLE SIZE Image: state sta	PSI DRLING RIG HD ATV #419 BORNO OF D. Buchman PRAMMER TYPE EFFCIENCY STATION Image: Station of the state o	PSI PRiLING RIG HD ATV #419 ORNING OFFSET D. Buchman PRILING METHOD / HOLE SIZE ROADWAY NAME TOWNSHIP RANGE SECTION 14 45 0 0 0 10 Soil / Rock Description and Geological Origin for Each Major Unit / Comments 0 18 11 45 60 - - - 14 16 38 - - - - - 12 16 80 - - - - - - 18 18 75 - - - - - - - 18 18 75 -<	P. Rotari PD ATV #419 DORNA OFFSET OPELLING REFLOD / FOLD STO / #10 DORNA OFFSET D. Buchman PRULING REFLOD / FOLD STO / #10 Station 0	P. Rotaru P. Rotaru <t< td=""><td>P. Rotaru DelLING RG DD ATU #419 DORUG OFFSET DORUG OFFSET DORUG OFFSET DORUG OFFSET DORUG OFFSET ROUNNANT NAME DORUG OFFSET DORUG OFFSET ROUNNANT NAME <</td><td>PROTO PROTO <th< td=""><td>PR02 PR02 <th< td=""><td>VIC VIC VID VID</td></th<><td>PSI DEMUND REF T DEMUND REF T OWNER TYPE DEMUND REF T OWNER TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE</td></td></th<></td></t<>	P. Rotaru DelLING RG DD ATU #419 DORUG OFFSET DORUG OFFSET DORUG OFFSET DORUG OFFSET DORUG OFFSET ROUNNANT NAME DORUG OFFSET DORUG OFFSET ROUNNANT NAME <	PROTO PROTO <th< td=""><td>PR02 PR02 <th< td=""><td>VIC VIC VID VID</td></th<><td>PSI DEMUND REF T DEMUND REF T OWNER TYPE DEMUND REF T OWNER TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE</td></td></th<>	PR02 PR02 <th< td=""><td>VIC VIC VID VID</td></th<> <td>PSI DEMUND REF T DEMUND REF T OWNER TYPE DEMUND REF T OWNER TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE</td>	VIC VIC VID VID	PSI DEMUND REF T DEMUND REF T OWNER TYPE DEMUND REF T OWNER TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE DEMUND REF TYPE TYPE TYPE TYPE TYPE TYPE TYPE TYPE

PROJECT NAM	GWA	- Alt	ernat	ive Bl	PS Site		IG LO	DG	Inte	rtek	P	Si]	B		NG	No BPSRN-B-0
CONSULTANT					052174	CONSULTANT PROJECT No	DATE STAR								DATUM	1 of
DRILLING CO		00	Gr	eeley	-Hanse	DRILLING CONTRACTOR PROJECT №	DATE COM				4/1	0/20	LATIT		BATOM	VERTICAL BATOM
	-	UR			PS	SI					4/1	0/20				
CREW CHIEF				F	P. Rotar								LONG	SITUDE		
FIELD LOG BY	Y			D. E	Buchma	DRILLING METHOD / HOLE SIZE	ROADWAY	NAME					NORT	HING		
LOG QC BY						HAMMER TYPE EFFICIENCY	STATION		0	FFSET			EAST	ING		
COUNTY						TOWNSHIP RANGE SECTION		1/4 SECTI	ON	1/4 S	ECTION		SURF	ACE ELI	EVATION	N
											÷	÷				
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength \mathbf{Q}_{p} (tsf)	Unconfined Comp. Strength Q ₍ (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1		3				Topsoil (12"± Thick), Dark Brown Silty Clay, \ Moist	/ery	OL							50	
s	8	4	9	-	1		0.99				4.0				21	
2	8	5	18	-		Brown Lean Clay, Very Moist		CL								
		6 12			_	Brown Sand With Gravel, Moist to Wet (Poss	5.5								22	
3 SS	8	10	50			Perched Water 12'-22')	ibic								3	
4	11	29 9	35													
SS		15 20		<u>10</u>											4	
				_	¥											
5	10	5	45					SP								
ss	10	7	15												14	
		8		-												
				_												
6 SS	10	16 17	35	20											7	
		18					22									
				-		Brown Lean Clay, Moist										
7 SS	8	10	25	-				CL							13	
		15					27									
						Brown Coarse Sand and Gravel, Wet (Possib	27 le									
8	14	5	31	30		Perched Water)		SP								
SS		12 19		30				J							16	
				-		Brown Lean Clay, Trace Gravel, Moist	32		-							
9	15	8	32			Brown Lean Oldy, These Gravel, Moist										
9 SS	15	13 19	32								4.5	7.83			12	
				-												
10		10		-												
SS	15	10 15	37	40							4.5	7.01			12	
		22														
								CL								
11 SS ,	12	16 21	49	-							4.5	5.77			12	
/		28		-												
12 SS	14	18	51	50							4.5	5.15			13	
		30										5.10				
				-												
13	14		51													
						WATER & CAVE-IN OBS	ERVAT	ON D	ATA							
						DRILLING: 12ft. 뗥	-									WD
					LETION:		U					N/A		D .	ala 1	W Di
-					HOURS:	N/A epresent the approximate boundary; gradual trar	NE = No								ded	

PROJECT No	GWA	- Alt	ernati		PS Site 2		AT WA	TER	BORIN	IG LO	CG	Inte	ertek		S	PAGE		UNG	No BPSRN-B-0 2 of
CONSULTANT			Gr		-Hansen	CONSULTANT F	PROJECT N	D		DATE STAR	TED			4	10/20	HORI	ZONTAL	DATUM	VERTICAL DATUM
ORILLING CON	ITRACTO	DR	0.	cerey		DRILLING CON	TRACTOR P	ROJECT No		DATE COM	PLETED					LATIT	FUDE		
CREW CHIEF					PSI Determ	DRILLING RIG			> AT\/#440	BORING OF	FSET			4/	10/20		GITUDE		
FIELD LOG BY					P. Rotaru	DRILLING MET	HOD / HOLE		D ATV #419	ROADWAY	NAME					NOR	THING		
OG QC BY				D. E	Buchman	HAMMER TYPE		EFFICIEN	ICY	STATION		0	OFFSET			EAST	ING		
COUNTY						TOWNSHIP	RA	NGE	SECTION		1/4 SECTIO		1/4 5	SECTION	1	SURF	ACE FL	EVATION	1
1									020mon		1	1			-	0014			•
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	a	and Geo	ock Deso logical O r Unit / C	cription Irigin for Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _o (tsf)	Unconfined Comp. Strength Q _r (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		16 20			Br	rown Lean C	Clay, Trac	ce Gravel,	Moist					4.5				11	
		31																	
14	12	15	56	-															
	14	22 34		60								\///	1	4.5	6.6			11	
	ľ	<u> </u>										\///							
15	_	17										\///							
15 SS	10	17 27	66											4.5	5.98			13	
	ľ	39		-							CL	\///	1						
												\///							
16 SS	12	18 27	70	70										4.5	6.6			13	
	Ţ	43										////							
				-								\///							
17	12	18	69									\///		4.5	7.04				
SS		30 39										\///		4.5	7.21			14	
	ľ]	G	rayish Browr	n Siltv Sa	and. Verv	Moist	77			1						
18	8	16	37				2	,,											
SS	0	18 19	3/	80														16	
	ľ																		
10	_	17																	
19 SS	6	17 16	31								SM		!					16	
	1	15		-															
20 SS	0.5	50/1"	R	90															
-										92									
	1					nd of Boring ossible Cobb	oles, Bou				1	<u>_r.t.l.</u>	1		1	1	1	<u> </u>	
						w	VATER	R & CAV	/E-IN OBS	ERVAT		ATA							
∑ wa	TER	ENCC	UNTE	RED	DURING D		12ft.				DEPTH		OMPLE	TION	: NE	Ξ			WE
					LETION:	NE					DEPTH								WE DF
_	TERI	_EVEI							1 - -					01.00	• • • • •				Dh

⊥ <u></u>	WATER LEVEL AT COMPLETION:	NE	.	CAVE DEPTH AFTER 0 HOURS: N/A
Ţ	WATER LEVEL AFTER 0 HOURS:	N/A		NE = Not Encountered; NMR = No Measurement Recorded
NOTE	: Stratification lines between soil types re	present the approximate boundary; gradua	al trans	ition between in-situ soil layers should be expected.

N - Value Depth (ft)		CONSULTANT PROJECT No CONSULTANT PROJECT No DRILLING CONTRACTOR PROJECT No DRILLING RIG DRILLING METHOD / HOLE SIZE DRILLING METHOD / HOLE SIZE TOWNSHIP RANGE SOII / ROCK DESCRIPTION and Geological Origin for Each Major Unit / Comments	ROADWAY N	LETED		Well Diagram	Unconfined Comp. Strength Q, (tst) Unconfined Comp. Strength Unconfined Comp. Strength	20 LATI 20 LON NOR EAS SURI	FACE ELI	EVATION	VERTICAL DATUM
N - Value Depth (ft)	PSI V. Jones V. Canning	DRILLING CONTRACTOR PROJECT No DRILLING RIG Marooka #39 DRILLING METHOD / HOLE SIZE HAMMER TYPE EFFICIENCY TOWNSHIP RANGE SECTION Soil / Rock Description and Geological Origin for Each Major Unit / Comments	BORING OFF ROADWAY N STATION	SET AME /4 SECTIO		1/4 SE	4/27/2	LATI LON NOR EAS SURI	GITUDE THING TING FACE ELI		
N - Value Depth (ft)	V. Jones J. Canning Elevation (t)	BRILLING RIG Marooka #39 DRILLING METHOD / HOLE SIZE DRILLING METHOD / HOLE SIZE HAMMER TYPE EFFICIENCY TOWNSHIP RANGE Soil / Rock Description and Geological Origin for Each Major Unit / Comments	ROADWAY N STATION	AME /4 SECTIO		1/4 SE	CTION	LON NOR EAS SURI	THING TING FACE ELI		
N - Value Depth (ft)	I. Canning Elevation (ft)	DRILLING METHOD / HOLE SIZE HAMMER TYPE EFFICIENCY TOWNSHIP RANGE SECTION Soil / Rock Description and Geological Origin for Each Major Unit / Comments	ROADWAY N	/4 SECTIO		1/4 SE		EAS SURI	TING FACE ELI		
N - Value Depth (ft)	Elevation (ft)	HAMMER TYPE EFFICIENCY TOWNSHIP RANGE SECTION Soil / Rock Description and Geological Origin for Each Major Unit / Comments				1/4 SE		SURI	FACE ELI		
<u> </u>	 , т	Township Range Section Soil / Rock Description and Geological Origin for Each Major Unit / Comments				1/4 SE		SURI	FACE ELI		
<u> </u>	 , т	Soil / Rock Description and Geological Origin for Each Major Unit / Comments	·					(%)			
<u> </u>	 , т	and Geological Origin for Each Major Unit / Comments		USCS / AASHTO	Graphic	II Diagram	d Comp. Strength D _p (tsf) d Comp. Strength	Limit (%)	ndex (%)	ntent (%)	
						We	Unconfined Comp. Q _p (tsf) Unconfined Comp.	Liquid	Plasticity Index (%)	Moisture Content (%)	Notes
		Topsoil (3"± Thick), Dark Brown Silty Clay V Matter, Very Moist	With Root	OL						22	
	+ 1	Brown Sand With Gravel and Silt Seams, N	0.3							5	
21			IOISL	SP						7	
	-										
40			8							12	
22 1		Brown Silty Sand, Moist		014						16	
	hest		12	SIVI							
		Brown Sand and Gravel, Moist to Wet	12								
37	-									3	
	-										
18 2										10	
	1										
	-			SW							
62	-										
										Ø	
59 3											
		Gray Silty Sand and Gravel. Wet	32								
29		,,		014							
				SM						8	
		Grav Sandy Lean Clay With Gravel Wet	37								
43			40	CL							
<u> </u>	0	End of Boring at 40.0 ft.	40		V////					8	
	37 18 2 62 59 3 29		22 10 Brown Silty Sand, Moist 37 37 18 20 62 - 59 30 Gray Silty Sand and Gravel, Wet	22 10 Brown Silty Sand, Moist 37 - 37 - 18 20 62 - - - 59 30 - - 62 - - - 59 30 - - - 32 Gray Silty Sand and Gravel, Wet 32 - 37 - - - 37 - - <td>22 10 Brown Silty Sand, Moist SM 37 12 Brown Sand and Gravel, Moist to Wet 12 37 - - - 18 20 ✓ SW 62 - - SW 59 30 - - 59 30 - - 62 - - - 62 - - - 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<!--</td--><td>22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - - SW 37 - - SW 18 20 - - 59 30 SW SW 62 - - SW 62 - - SW 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - - - - - - - - - - - - - - - - - - - - - 29 - - - <td< td=""><td>22 10 Brown Silty Sand, Moist SM 37 12 SM 37 Brown Sand and Gravel, Moist to Wet SW 18 20 SW 62 SW SW 59 30 SW 59 30 Gray Silty Sand and Gravel, Wet SM 29 Gray Sandy Lean Clay With Gravel, Wet CL</td><td>22 10 Brown Silty Sand, Moist SM 12 SM 37 12 Brown Sand and Gravel, Moist to Wet SW 18 20 59 30 59 30 Gray Silty Sand and Gravel, Wet SM 29 SM Gray Sandy Lean Clay With Gravel, Wet CL</td><td>22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - Brown Sand and Gravel, Moist to Wet SM 18 20 - SW 62 - - SW 62 - - SW 59 30 - - 59 30 - - 62 - - - 62 - - - 59 30 - - 7 - - - 62 - - - 62 - - - 7 - - - 30 - - - 7 - - - 62 - - - 9 - - - 10 - - - 11 - - - 129 - - - 137</td><td>22 10 22 10 Brown Silty Sand, Moist 37 37 37 18 20 62 59 30 59 30 Gray Silty Sand and Gravel, Wet 32 33 62 62 62 62 62 62 62 63 64 7</td><td>22 10 Brown Silty Sand, Moist SM 16 22 10 SM 16 16 37 12 10 31 31 37 12 10 10 31 18 20 20 10 10 62 10 59 30 6 59 30 32 6 62 10 32 6 7 32 6 7 62 30 32 6 63 7 32 8 64 37 6 8 63 37 6 8</td></td<></td></td>	22 10 Brown Silty Sand, Moist SM 37 12 Brown Sand and Gravel, Moist to Wet 12 37 - - - 18 20 ✓ SW 62 - - SW 59 30 - - 59 30 - - 62 - - - 62 - - - 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - </td <td>22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - - SW 37 - - SW 18 20 - - 59 30 SW SW 62 - - SW 62 - - SW 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - - - - - - - - - - - - - - - - - - - - - 29 - - - <td< td=""><td>22 10 Brown Silty Sand, Moist SM 37 12 SM 37 Brown Sand and Gravel, Moist to Wet SW 18 20 SW 62 SW SW 59 30 SW 59 30 Gray Silty Sand and Gravel, Wet SM 29 Gray Sandy Lean Clay With Gravel, Wet CL</td><td>22 10 Brown Silty Sand, Moist SM 12 SM 37 12 Brown Sand and Gravel, Moist to Wet SW 18 20 59 30 59 30 Gray Silty Sand and Gravel, Wet SM 29 SM Gray Sandy Lean Clay With Gravel, Wet CL</td><td>22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - Brown Sand and Gravel, Moist to Wet SM 18 20 - SW 62 - - SW 62 - - SW 59 30 - - 59 30 - - 62 - - - 62 - - - 59 30 - - 7 - - - 62 - - - 62 - - - 7 - - - 30 - - - 7 - - - 62 - - - 9 - - - 10 - - - 11 - - - 129 - - - 137</td><td>22 10 22 10 Brown Silty Sand, Moist 37 37 37 18 20 62 59 30 59 30 Gray Silty Sand and Gravel, Wet 32 33 62 62 62 62 62 62 62 63 64 7</td><td>22 10 Brown Silty Sand, Moist SM 16 22 10 SM 16 16 37 12 10 31 31 37 12 10 10 31 18 20 20 10 10 62 10 59 30 6 59 30 32 6 62 10 32 6 7 32 6 7 62 30 32 6 63 7 32 8 64 37 6 8 63 37 6 8</td></td<></td>	22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - - SW 37 - - SW 18 20 - - 59 30 SW SW 62 - - SW 62 - - SW 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - 59 30 - - 62 - - - - - - - - - - - - - - - - - - - - - - - - - - - 29 - - - <td< td=""><td>22 10 Brown Silty Sand, Moist SM 37 12 SM 37 Brown Sand and Gravel, Moist to Wet SW 18 20 SW 62 SW SW 59 30 SW 59 30 Gray Silty Sand and Gravel, Wet SM 29 Gray Sandy Lean Clay With Gravel, Wet CL</td><td>22 10 Brown Silty Sand, Moist SM 12 SM 37 12 Brown Sand and Gravel, Moist to Wet SW 18 20 59 30 59 30 Gray Silty Sand and Gravel, Wet SM 29 SM Gray Sandy Lean Clay With Gravel, Wet CL</td><td>22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - Brown Sand and Gravel, Moist to Wet SM 18 20 - SW 62 - - SW 62 - - SW 59 30 - - 59 30 - - 62 - - - 62 - - - 59 30 - - 7 - - - 62 - - - 62 - - - 7 - - - 30 - - - 7 - - - 62 - - - 9 - - - 10 - - - 11 - - - 129 - - - 137</td><td>22 10 22 10 Brown Silty Sand, Moist 37 37 37 18 20 62 59 30 59 30 Gray Silty Sand and Gravel, Wet 32 33 62 62 62 62 62 62 62 63 64 7</td><td>22 10 Brown Silty Sand, Moist SM 16 22 10 SM 16 16 37 12 10 31 31 37 12 10 10 31 18 20 20 10 10 62 10 59 30 6 59 30 32 6 62 10 32 6 7 32 6 7 62 30 32 6 63 7 32 8 64 37 6 8 63 37 6 8</td></td<>	22 10 Brown Silty Sand, Moist SM 37 12 SM 37 Brown Sand and Gravel, Moist to Wet SW 18 20 SW 62 SW SW 59 30 SW 59 30 Gray Silty Sand and Gravel, Wet SM 29 Gray Sandy Lean Clay With Gravel, Wet CL	22 10 Brown Silty Sand, Moist SM 12 SM 37 12 Brown Sand and Gravel, Moist to Wet SW 18 20 59 30 59 30 Gray Silty Sand and Gravel, Wet SM 29 SM Gray Sandy Lean Clay With Gravel, Wet CL	22 10 Brown Silty Sand, Moist SM 37 - 12 SM 37 - Brown Sand and Gravel, Moist to Wet SM 18 20 - SW 62 - - SW 62 - - SW 59 30 - - 59 30 - - 62 - - - 62 - - - 59 30 - - 7 - - - 62 - - - 62 - - - 7 - - - 30 - - - 7 - - - 62 - - - 9 - - - 10 - - - 11 - - - 129 - - - 137	22 10 22 10 Brown Silty Sand, Moist 37 37 37 18 20 62 59 30 59 30 Gray Silty Sand and Gravel, Wet 32 33 62 62 62 62 62 62 62 63 64 7	22 10 Brown Silty Sand, Moist SM 16 22 10 SM 16 16 37 12 10 31 31 37 12 10 10 31 18 20 20 10 10 62 10 59 30 6 59 30 32 6 62 10 32 6 7 32 6 7 62 30 32 6 63 7 32 8 64 37 6 8 63 37 6 8

CONSULTANT DRILLING CONTRA CREW CHIEF FIELD LOG BY COG QC BY COUNTY			~		e 2		ANCE	TER	BO	RIN	G LO	COG	Inte	rtek	Ē	Si	PAGE		NG	No BPSRN-B-
CREW CHIEF FIELD LOG BY		~		05217		CONSULTANT PF	ROJECT N	lo			DATE STAF	TED			4	22/00	HORI	ZONTAL	DATUM	VERTICAL DATUM
FIELD LOG BY	CTOR	Gr	reeley	-Hans		DRILLING CONTR	RACTOR	PROJECT N	lo		DATE COM	PLETED				23/20	LATIT	TUDE		
OG QC BY					PSI	DRILLING RIG		_	-		BORING OF	FSET			4/	23/20		GITUDE		
				V. Jon		DRILLING METHO	DD / HOLE		arook	a #395	ROADWAY	NAME					NORT	THING		
OUNTY			D. E	luchm	an	HAMMER TYPE		EFFICIE	ENCY		STATION		0	FFSET			EAST	ING		
						TOWNSHIP	R4	ANGE	Is	SECTION		1/4 SECTIO		1/4 5	ECTION		SURF	ACE EL	EVATION	N
		1										1				6		-	-	
Sample No / Type Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)		s ar Eac	Soil / R nd Geo h Majo	Rock Des blogical or Unit /	scriptio Origin Comm	on for nents		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _o (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1 6	3					psoil (8"± Th	ick), D	ark Brow	vn Silty	Clay, Ve	ry Moist 0.6/	OL	-						18	
66	3	6	-		Br	own Lean Cla	ay, Very	y Moist			0.0/				2.0				21	
2 8	3	9										CL							04	
SS	4														3.0				24	
3 SS 12	3	6									8				3.0	3.05			26	
4 12 SS	3 2 3 3 9	12	10	c	_	own Silty Sar	nd, Very	y Moist			12	SM							14	
					Br	own Sand an	d Grav	el, Wet			12	1								
5 10 SS 10) 16	30	-																8	
	16																		ð	
												SP								
6 13	3 4	19	20																	
SS13	, 8 11		20																9	
				ŀ	Rr	own Medium	Sand	Wet			22									
7 15	. 8	11			וט		Janu,	W GL												
/ 15 		11																	16	
		'																		
	7	-	-																	
8 9 SS 9	10	22	30																22	
	12	/										SP								
			1																	
9 SS 12	15	37																	16	
	22		-																	
10 SS 10	9 16	43	40								40								20	
	27	[End of	Boring a	t 40.0 f	t.					•		•	•	~	

		terna		PS Site		GREA	AT WA	TER	BORIN	IG LO	OG	Inte	rtek	P	Si	B PAGE		NG	No BPSRN-B-
CONSULTANT				0052174	CON	SULTANT PF	ROJECT NO)		DATE STAF	RTED						ZONTAL	DATUM	VERTICAL DATUM
DRILLING CONTRA	CTOR	C	Greeley	/-Hanse	DRIL	LING CONTR	RACTOR P	ROJECT No		DATE COM	PLETED				23/20	LATIT	UDE		
CREW CHIEF						LING RIG				BORING OI	FSET			4/:	23/20	LONG	ITUDE		
FIELD LOG BY				V. Jon	DRIL	LING METH	DD / HOLE		rooka #395	ROADWAY	NAME					NORT	HING		
LOG QC BY			D. E	Buchma		MER TYPE		EFFICIEN	CY	STATION		0	FFSET			EAST	ING	_	
COUNTY						/NSHIP	RA	NGE	SECTION		1/4 SECTIO			ECTION				EVATION	1
			1			-		-							, ,		-		
Sample No / Type Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)		ar Eac	nd Geo h Majo		rigin for omments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1 6	3				Topso ∖Moist	il (10"± T	hick), D	ark Browr	n Silty Clay, V	/ery	OL							28	
SS 6	19 8	27								0.8								5	
2 6 SS 6	9	17			Brown	Sand w	Ith Grav	/el, Moist t	to vvet									3	
	9																		
	31	31																6	
4 10 SS 10	<u>16</u> 33	65	10								SP							3	
	43 22				न														
			-	l lig	<u> </u>														
5 14 SS 14	19	20																9	
	9] _							17								Ŭ	
				l F	Gray	Sandy Silf	t With G	Gravel, We	et										
6 8 SS 8	3	11	20								ML							9	
	8									22								Ŭ	
			-		Brown	Silty Sar	nd, Wet												
7 8	13	24] -								SM							18	
	13		-							27									
			_		Brown	Sand an	d Grave	el, Wet											
8 10 SS 10	12 21	42	30							30	SW							7	
	21	<u></u>					End of I	Boring at 3	30.0 ft.									~	
SS	11			_		Sand an	d Grave		30.0 ft.		SM SW							18	

ONSULTANT CONSULTANT PROJECT № DATE STARTED 4/27/20 HORIZONTAL DATUM VERTICAL DATUM RILLING CONTRACTOR PSI PRILLING CONTRACTOR PROJECT № DATE COMPLETED 4/27/20 LATITUDE REW CHIEF V. Jones PRILLING RIG Marooka #395 BORING OFFSET LONGITUDE ELD LOG BY N. Canning PRILLING METHOD / HOLE SIZE ROADWAY NAME NORTHING OG QC BY HAMMER TYPE EFFICIENCY STATION OFFSET EASTING	PROJECT NA	GWA	- Alt	ernati		PS Site		æ	GRE	AT W		ER	B	OR	IN	GL	0	G	Inte	ertek)S i	B PAG		ING	No BPSRN-	
Number Construction Part of Contracting Data contra	CONSULTANT			<u> </u>				CONSU	LTANT P	ROJEC	T No					DATE ST	ARTED					10710	n HOR	IZONTA	L DATUN		1 of
Description U. Joint IVE Inclusion Bills Marcoka #309 (RULAD BIRT POINT / DUE SITE DOUTTINE DOUTINE DOUTINE DO	DRILLING CO	NTRACT	OR	Gr	eeiey			DRILLIN	IG CONT	RACTO	R PRO	JECT N	lo			DATE CO	MPLE	ED					LATI	TUDE		I	
DELIDIO ** N. Camp PRUCKIN METRO/*/NEE S22 ROUWNY MVE ************************************	CREW CHIEF							DRILLIN	ig rig				lanc		0-	BORING	OFFSE	т			4	12/12		GITUDE			
OLD OF W IMAGE TYPE IPPOIDEY INTERVIEW IPPOIDEY INTERVIEW OPPOID Restrict DAMY TOWNERP Vesc SECTION 14 SECTION 14 SECTION 14 SECTION SUBJECT ELEMATION Section Section Vesc SECTION 14 SECTION 14 SECTION SUBJECT ELEMATION Section Section Section Vesc Section Section SUBJECT ELEMATION Section Section <td>FIELD LOG B</td> <td>Y</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>DRILLIN</td> <td>IG METH</td> <td>HOD / HO</td> <td>OLE SIZ</td> <td></td> <td>aroc</td> <td>ока #3</td> <td></td> <td>ROADWA</td> <td>Y NAM</td> <td>E</td> <td></td> <td></td> <td></td> <td></td> <td>NOR</td> <td>THING</td> <td></td> <td></td> <td></td>	FIELD LOG B	Y						DRILLIN	IG METH	HOD / HO	OLE SIZ		aroc	ока #3		ROADWA	Y NAM	E					NOR	THING			
a a a b a b a b a b a b a b a b a b a b a b a b a b a b a b a b a b a b a	LOG QC BY				N.	Cannir		HAMME	R TYPE			EFFICIE	ENCY			STATION			C	FFSET			EAS	TING			
Sol S	COUNTY						-	TOWNS	HIP		RANG	E		SECTIO	DN		1/4	SECTIO	N	1/4	SECTIO	N	SUR	FACE EL	EVATIO	DN	
Sol S																					£	£					
1 7 3 8 -	Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)			a Ead	Soil / Ind G ch Ma	' Roc eolog ajor L	k Des gical (Jnit /	scrip Origi Corr	tion in for iments	5			USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Streng O. (tsf)	Unconfined Comp. Streng Q. (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	1	7	3			-			(10"± 7	Thick)), Dar	rk Bro	wn S	ilty Cla	y, Ve	ery		OL	7/1/						30		
3 9 10 4 6 5.5 2.0 2.0 3 9 17 37 37 10 37 5 5 4 11 13 21 10 5 7 5 7 5 13 9 22 10 10 12 10 8 5 12 12 26 12 26 12 26 14 8 12 21 9 12 14 14 14 8 12 21 91 30 30 30 30 30 30 30 30 30 30 32 30 32 30 32 30		1	4	8	-		\				laiat					0.8		CI			3.5				23		
3 9 17 37 3S 9 18 37 4 11 13 21 4 11 13 21 9 12 10 5S 13 9 22 5S 12 26 6 12 26 7 15 16 5S 12 21 8 22 9 12 8 22 14 14 8 22 9 13 13 16 6 29 33 13 13 16 62 33 13 16 9 13 13 16 13 13 9 13 13 13	2 SS	10	4	6	-		DIC			idy, ivi	10151					5 5		OL			20						
SS 0 18 57 4 11 13 21 10 5 13 0 22 10 5 13 0 22 10 5 12 12 10 8 6 12 12 10 8 6 12 12 10 8 7 35 15 16 53 35 12 12 14 14 8 22 11 11 8 22 11 11 9 13 16 62 13 9 13 16 62 13 9 13 16 62 13 9 13 16 62 13 9 13 16 62 13 9 13 16 62 13 9 13 16 62 8	/		3	07		╞	Bro	wn S	and ar	nd Gra	avel,	Moist	t			0.0	+										
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	SS ,	э	18	31																				1	5		
9 12 12 5 13 9 22 6 12 12 61 20 20 5 7 15 16 53 30 - - 9 13 12 - 9 13 12 61 9 13 16 53 9 13 16 62 9 13 12 61 9 13 12 61 9 13 16 62 9 13 16 62 9 13 16 62 9 13 16 62 9 13 16 62 9 13 16 62 9 13 16 62 9 13 16 62 10 10 10 10 10 10 10 10 11 10 10 10 <td< td=""><td></td><td>11</td><td>13</td><td>21</td><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>SP</td><td></td><td></td><td></td><td></td><td></td><td></td><td>7</td><td></td><td></td></td<>		11	13	21	10													SP							7		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	/															12	:										
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$					1	F	Bro	wn S	ilty Sa	nd W	ith G	ravel,	Mois	st													
⁶ / _{SS} ¹² ¹² / ₂₆ ¹² / ₂₆ ¹³ / ₃₅ ¹⁵ / ₁₆ ¹⁵ / ₅₃ ¹⁵ / ₁₆ ¹⁵ / ₅₃ ¹⁵ / ₁₆ ¹⁵ / ₅₃ ¹⁵ / ₁₆ ¹⁵ / ₁₆ ¹⁵ / ₁₆ ¹⁶ / ₁₇ ¹⁷ / ₁₇ ¹⁶ / ₁₇	5 SS ,	13	10	22	-																			1	8		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			12		-													SM						1			
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7 15 16 53 30 - - 8 12 21 91 50 - - 9 13 16 62 33 - - - 9 33 - - 13 16 62 -		12	26	61	20																			1	14		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			35			1										22								1			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			10			ſ	Brc	wn S	ilt, Moi	ist							T							1			
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		15	23	53																				1	11		
8 12 21 91 30 50 - - - - 9 13 16 62 - 33 - - - - 9 13 16 62 - 33 - - - -			30		-													ML						1			
9 13 16 62 33 - 33 - 8	Q		21		-																			1			
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9 13 16 62 - SS 33 - 			50							.0					A1 - *	32	:		ЩĻ					1			
SS 10 29 02 33 - SP SP S	0		16			Ī	ZBrc	ownisl	n Gray	/ Coar	rse Sa	and a	ind G	ravel, V	/Vet									1			
	ss,	13	29	62	1																			1	8		
10 16 20 65 40 40 SS 16 28 37 50 40 7			- 33															SP						1			
SS 10 28 65 40 7 37 End of Boring at 40.0 ft. 7	10	10	20	07	-																			1			
	SS	16	28	65	40					Fnd	of Ro	rina a	at 40 (D ft		40				1				1	<u> </u>		
	10 	16		65	40					End	of Bo	ring a	at 40.0	D ft.		40		SP									
									W	/ATE	ER 8	& CA	VE-	IN OI	BSE	RVA	TIO	N DA	ATA								
WATER & CAVE-IN OBSERVATION DATA								RILLI												MPL	ETION						WE DF
☑ WATER ENCOUNTERED DURING DRILLING: 33.5ft. 🛛 📓 CAVE DEPTH AT COMPLETION: 22ft. 🖞	V w	ATER															DE	этн /	AFTER	ROH	OURS	: N					WE DF
☑ WATER ENCOUNTERED DURING DRILLING: 33.5ft. ☑ CAVE DEPTH AT COMPLETION: 22ft. ☑ ☑ WATER LEVEL AT COMPLETION: NE ☑ CAVE DEPTH AFTER 0 HOURS: N/A ☑																											

ROJECT No				0	052174 [,]	2 GREAT 1 CONSULTANT PRO		BORIN							PAGE	ZONTAL		VERTICAL DATUM
			Gr	eeley	-Hanser	1			DATE COM				5/	01/20			DATUM	VERTICAL DATON
REW CHIEF					PS				BORING OF				5/	01/20		SITUDE		
					V. Jones	S		rooka #395										
ELD LOG BY	ŕ			N.	Canning				ROADWAY	NAME					NORT			
OG QC BY						HAMMER TYPE	EFFICIEN		STATION			OFFSET			EAST			
OUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	ON	1/4	SECTION		SURF	ACE ELI	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	bil / Rock Desc I Geological Oi Major Unit / C	rigin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _o (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1	0	8	01		<u></u> ر	Topsoil (3"± Thic Matter and Grave	ck), Dark Brown el. Very Moist	Silty With Ro	ot (OL							21	
SS	9	10	21	-		Brown Silty Sand		loiot	0.3								10	
2 SS	10	8	28	-		BIOWIT SIILY Sanu	i vvitili Glavel, iv	IOIST									5	
3		15										-						
ss	14	41 50	91														10	
4 SS	13	18	81	10													4	
		54 47								SM								
				-														
5 SS	15	18 27	67	-									3.5				5	
		40											3.5				5	
6	12	29	88	20														
SS		38 50		20													6	
				-		Brown Sandy Silt	and Gravel. Ve	erv Moist to W	22 /et									
7	14	22	60															
		28 32	00														7	
					¥													
8	<u>ر 6 م</u>	50 /		-														
SS				30													10	
										ML								
9	<u>6</u>	50 /																
SS	<u> </u>																9	
10 m	<u>م</u> 5 آ	50/5"/	R /	-														
SS				<u>40</u>														
							L \M/of		42	<u> </u>		ļ						
11	5	50/5"	R /			Brown Silty Sand	i, vvet					1						
SS	<u> </u>	33,0								SM							15	
							NUL C INT		47			-						
12	5	50/5"/	R /	-		Gray Sandy Silt V	with Gravel, We	et										
SS	<u> </u>	0010		50									4.5+	6.6			7	
										ML								
10	1 1	50/4"																
13		50/1"		1														
						\٨/ Δ	TER & CAV		FRVAT									
	TER	ENCC	UNTE	RED	DURING		27ft.			DEPTH		OMPLE	ETION	: NE	Ξ			V
-					ETION:					DEPTH								V L
V WA		LEVEL	AFT	ER 0 H	IOURS:	N/A			NF = Nc	ot Encou	ntered:	NMR	= No M	leasure	ement	Recor	ded	

		- All	ernat				S S			ER B	BORIN	IG L	OG	Inte	rtek	P	Si	PAGE		NG		PSRN	
CONSULTANT					05217		CONSULT	ANT PROJE	ECT No			DATE STA	RTED					HORIZ	ZONTAL	DATUM	1 VE	RTICAL DATU	2 of
RILLING CON	VTRACTO	OR	Gi	reeley	-Hans		DRILLING	CONTRAC	TOR PRO	DJECT No		DATE CON	IPLETED				01/20	LATIT	UDE				
REW CHIEF						PSI	DRILLING	RIG				BORING O	FFSET			5/	01/20	LONG	ITUDE				
IELD LOG BY	/				V. Jon		DRILLING	METHOD /	HOLE SI		ooka #395	ROADWAY	NAME					NORT	HING				
DG QC BY				N.	Canni		HAMMER	TYPE		EFFICIENCY	Y	STATION		0	FFSET			EASTI	ING				
OUNTY						_	TOWNSHI	Þ	RANG	Æ	SECTION		1/4 SECTIO	N I	1/4 S	ECTION		SURF	ACE ELE	EVATIO	N		
																£	£						
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)			Soi and Each N	I / Roc Geolo Vlajor I	ck Descri gical Ori Unit / Co	iption gin for mments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)		Notes	
SS				-		Gr	ay Sand	ly Silt W	/ith Gra	avel, Wet		57	ML			4.5+				8			
					-	Bro	wnish (Gray Sa	ind and	d Gravel, V	Wet	01											
14 SS 15 SS		\ <u>50/4"</u> /		<u>60</u> _									SP							11			
				-								67.5											
	TER	ENCC				<u>G D</u>				& CAVE	E-IN OBS					TION							
-					DURIN		RILLING			& CAVE	E-IN OBS	CAVE	TON DA DEPTH A DEPTH A	AT CO									WDD

ROJECT No				0	0521741			BORIN				TUCK	12		PAGE			1 0
ONSULTANT			Gr	eeley	-Hansen	CONSULTANT PROJE			DATE STAP				4/	29/20			DATUM	VERTICAL DATUM
RILLING CO		OR			PSI	DRILLING CONTRAC	FOR PROJECT No	0	DATE COM				4/	29/20				
REW CHIEF				,	V. Jones	DRILLING RIG	Ma	arooka #395	BORING OI	FSET					LONG	BITUDE		
IELD LOG B	Y				Canning	DRILLING METHOD /	HOLE SIZE		ROADWAY	NAME					NORT	HING		
OG QC BY					j	HAMMER TYPE	EFFICIE	ENCY	STATION		0	FFSET			EAST	ING		
OUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	ON	1/4 S	ECTION		SURF	ACE ELI	EVATION	
													£	£				
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	/ Rock Des Geological (/lajor Unit / /	Origin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_{p} (tsf)	Unconfined Comp. Strength Q_{ℓ} (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1		2				opsoil (9"± Thick), Dark Brow	n Silty Clay, Ve	ery Moist 0.8/	OL	7/10						26	
1 	15	3	6	-	B	rown Lean Clay,	Very Moist		0.0/				2	2.14			23	
2	15	3	7	_						CL								
		3				rown Sandy Silt \	With Group	Very Moiet	5.5		K		2.5				19	
3 SS	9	4	14		B	Town Sandy Slit \	wiur Gravel,	very MOIS	8	ML							11	
4		9		-	В	rown Medium Sa	nd With Grav	vel, Moist	0									
Ś	10	10 14	28	<u>10</u>													4	
		14																
_										SP								
5 SS	13	18 35	69	-													3	
		34		-					17									
				_	В	rown Silty Sand \	With Gravel,	Moist										
6 SS	14	13 18	37	20													13	
		19																
				-						SM								
7	_ 6 ,	50		_													_	
SS																	7	
					B	rown Medium Sa	nd Wet		27									
8	10	20	37	_	¥Σ													
	10	18 19	51	30						SP							19	
				_		Matin	-1		32									
0		17			G	Fray Medium San	u, vvet											
9 	12	17 20	40							SP							19	
		20		-					37									
					G	Fray Silt, Wet					T							
10 SS ,	15	16 20	45	40						ML			3.0				22	
		25							42									
					В	rown Lean Clay,	Trace Grave	el, Moist			1							
11 SS	13	23	62	-									4.5	5.77			13	
		23 39												0.11				
12	18	17	54	50						CL			0-	0.10				
SS		20 34		50									3.5	6.18			13	
				-														
13	15		59															
+	13										<i>V</i> ///							
					1	WAT	ER & CA	VE-IN OBS	ERVAT	ION D	ATA		1			1	<u> </u>	
	ATER	ENCC	UNTE	RED	DURING		.5ft.	题		DEPTH		MPLE	TION	: NE				W D
					_ETION:	NE		Ļ		DEPTH								W D
💆 WA					HOURS:	N/A present the approx				ot Encou							ded	

	GW/	a - Alt	ernati		PS Site 052174		WATER	BORIN	IG LO	C	Inte	ertek		Si	PAGE		UN	No BPSRN-B-1 2 of
CONSULTANT			Gr		-Hanse	CONSULTANT PRO	JECT No		DATE STAR	TED			/۸	29/20	HORI	ZONTAL	DATUM	VERTICAL DATUM
DRILLING CON	NTRACT	OR	0	celey		DRILLING CONTRA	CTOR PROJECT N	ło	DATE COM	PLETED				29/20	LATIT	UDE		
CREW CHIEF					V. Jone	DRILLING RIG		laraaka #205	BORING OF	FSET			4/	29/20		GITUDE		
FIELD LOG BY	(DRILLING METHOD		larooka #395	ROADWAY	NAME					NORT	HING		
OG QC BY				N.	Cannir	HAMMER TYPE	EFFICI	ENCY	STATION		0	FFSET			EAST	ING		
COUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	DN NC	1/4 5	ECTION		SURF	ACE EL	EVATION	l
													£	ţ				
ype	Sample Recovery (in)	6								0		_	Unconfined Comp. Strength Q_p (tsf)	Strength	(%	Plasticity Index (%)	Moisture Content (%)	
Sample No / Type	Ievoc	Blow Counts	- Value	Depth (ft)	Elevation (ft)	Sc	il / Rock De	scription		USCS / AASHTO	hic	Well Diagram	sf). (js	mp. (Liquid Limit (%)	ndex	onter	
le N	Rec	O ≩	- <8	Deptl	vatio	and Fach	Geological Major Unit /	Origin for Comments		S/A	Graphic	Dia	ပ္ခရီ	d Co	id Lii	ity I	Ö Ö	Notes
amp	nple	B	z		Ē	Luon		Commonto		ISC:		Wel	nfine	nfine	Liqu	astic	istur	
S	Sar												Uncol	Unconfined Comp. Q, (tsf)		đ	Mo	
ss		19 23				Brown Lean Clay	, Trace Grave	el, Moist					-	3.46			13	
		36									\///							
14 SS	5	50/5"	R								\///			5.56				
SS				60									4.5				12	
15	6,	50												0 00				
SS	<u> </u>													9.89			11	
16	F	50/C"		-						CL	\///							
16 SS	<u> </u>	\ <u>50/5</u> "		70							\///			4.95			10	
_											\///							
				1														
17 SS	5	50/5"											4.5+	7.63			12	
				-														
											\///							
18 SS		50/4"	R	80							\///		4.5+	10.31			11	
									82		\///							
					╞	Brown Clayey Sa	nd With Grav	el, Very Moist	02									
19 SS	5	29 39	88							SC							10	
		39 49								00							12	
					┝	Brown Lean Clay	, Moist		87									
20 SS	4 /	\50/4"				<u>_</u>					\///							
SS		′		90													11	
											<i>\///</i>							
21	3 /	\50/3"	<u>R</u>							CL				8.24				
SS	ت	<u> </u>]									4.5	8.24			10	
<u></u>	1 1	150/4		-							\///			10.00				
SS .		1 <u>50/1</u>		100		F -	d of Dorigenet	t 100 0 0	100		V////		4.5+	10.31				
22 SS	1	\50/1"	R	100		En	d of Boring at	t 100.0 ft.	100				4.5+	10.31			<u>11</u>	

ROJECT No				0	0521741			BORIN				-tek	12		PAGE		DATIT	
ONSULTANT			Gr	reeley	-Hansen	CONSULTANT PROJ			DATE STAF				4/	17/20			DATUM	VERTICAL DATUM
RILLING CO	-	OR			PSI	DRILLING CONTRAC	CTOR PROJECT No)	DATE COM				4/	17/20				
REW CHIEF				,	V. Jones	DRILLING RIG		arooka #395							LONG	GITUDE		
ELD LOG B	Y			F	R. Sayles	DRILLING METHOD	/ HOLE SIZE		ROADWAY	NAME					NORT	THING		
OG QC BY						HAMMER TYPE	EFFICIE	NCY	STATION		0	FFSET			EAST	ING		
OUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	ON	1/4 S	ECTION		SURF	ACE EL	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	il / Rock Des Geological (Major Unit / (Drigin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						opsoil (11"± Thio	ck), Dark Brov	wn Silty Clay, \	/ery	OL			-				32	
1 SS ,	7	3	7	_	\M	oist			0.9	'			3.0				23	
2	10	4	6	_	B	rown Lean Clay,	, Very Moist			CL								
		3 3					Onevel Maint		5.5								20	
3 SS ,	6	5	21			rown Silt, Trace	Graver, MOISt	L									12	
4	11	10	22	-						ML								
SS,		10 12		<u>10</u>													11	
				-		rown Sand and (Gravel Wet		12		·							
5	7	6	13	_														
SS ,		6 7									•••••						3	
6	7	6	16	-							•••••							
SS ,		8 8	10	20						SW							7	
				_														
7	0	14	07								•••••							
SS	8	13 14	27														12	
				-		en e			27		····							
8	9	10	40	_	Ы	rown Sandy Lea	in Clay with G	sravel, very ivic	DIST									
8 SS ,	9	16 30	46	30													10	
				_						CL								
9	40	6																
9 SS ,	10	15 6	21														7	
							Nith Crossel 1	(on Maint	37									
10	-	8	05	-		rown Silt Sand V	wiui Glavel, V	TELY IVIOISE										
SS ,	5	16 19	35	<u>40</u>						SM							13	
						rown Loop Class	Trace Crowel	L Moint	42									
11 ,	6,	50				rown Lean Clay,	, made Gravel	I, IVIOISL										
SS		<u> </u>											4.0				9	
12	44	9		-						CL								
ŚŚ.,	14	12 26	38	50									4.0	3.13			12	
13	40		00															
	18		39															
					<u> </u>	WA	TER & CA	VE-IN OBS	ERVAT		ATA		1					
	ATER	ENCC	UNTE	RED	DURING [2ft.	<u> </u> ₩	1	DEPTH		MPLE	TION	: 75	ft.			W
					ETION:	NE		Ļ		DEPTH								W D
⊈ W#					HOURS:	N/A present the appro				ot Encou							ded	

ROJECT No DNSULTANT RILLING CO REW CHIEF							T WAT	TER	BORIN	IG L	OG	Inte	ertek		Si	B		NGr	No BPSRN-B-13
RILLING CO	Greeley-Han					CONSULTANT PRO				DATE STAF								DATUM	2 of 2
		OR	Gr	eeley	/-Hanser	DRILLING CONTR				DATE STA				4/	17/20			DATOW	VERTICAL DATOW
		UK			PS	DRILLING RIG	ACTOR F	ROJECT NO	,	BORING O				4/	17/20		GITUDE		
ELD LOG B					V. Jones	DRILLING METHO			arooka #395								THING		
DG QC BY	51			F	R. Sayles	HAMMER TYPE	DI HOLE	EFFICIE		STATION			OFFSET			EAST			
						TOWNSHIP	DAN		SECTION	STATION	1/4 SECTIO			ECTION				EVATION	
JUNIY	1					TOWNSHIP	RAN	NGE	SECTION		1/4 SECTIO		1/4 8			SURF	ACE EL	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	an	d Geol	ogical C	scription Drigin for Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS	/	11 14		_		Brown Lean Cla	y, Trace	e Gravel	l, Moist					3.5	3.71			14	
14 SS	16	25 19 32 48	80	<u>60</u>										3.5	4.74			14	
15 SS	18	22 38 47	85	_										3.5	4.33			13	
16 SS	6,	<u>50</u>		70										4.5	7.01			10	
17 SS	4_	\ <u>50/4"</u> j	<u>R</u>	_	题						CL							16	
18 SS	5,	\ <u>50/5</u> "/	<u>R</u>	80 -										3.5	3.87			2	
19 SS	_2_	\50/2"∫	<u>r</u>	_														17	
20 SS	1	\50/1"]	<u>R</u>	90										3.0				15	
21 SS	3	\ <u>50/3</u> "ʃ	<u>R</u>	-										3.5	3.63			15	
22		\50/1"ʃ	<u>r</u>	100						100				4 5				10	
SS	y				<u> </u>	E	nd of B	oring at	100.0 ft.				<u>a</u>	<u> </u>	, <u> </u>			L <u>12</u> ,⊥_	
7								& CA	VE-IN OBS							<u>.</u>			1.8 m
⊈ w#							12ft.			-									WET DRY WET
	A1 FR	LEVEL			LETION: HOURS:	NE N/A					DEPTH ot Encou						Recor	ded	DRY

00 - GW GEOTECH GWA - Alternative BPS Site 2 6/1/20

§ 0	Ţ	WATER LEVEL AFTER 0 HOURS:	N/A		NE = Not Encountered; NMR = No Measurement Recorded
ģ	NOT	E: Stratification lines between soil types re	present the approximate boundary; gradu	al tran	sition between in-situ soil layers should be expected.

Greedby-Hamen Marcal Control A28273 Marcal Control A28273 Marcal Control A28273 Marcal Control Marcal Contro Marcal Contro Ma	1 of	RIZONTAL	HORI			_				DATE STAF	GREAT WATER BORIN	521741				7	CONSULTAN
CHEAN DATE Marcake #309 CONSIDIEFT CONTRACT	DE	TITUDE	LATIT						LETED	DATE COM	NG CONTRACTOR PROJECT No		eeley	Gr	OR	NTRACT	DRILLING C
PIELID DIFT N. Cambing Solution Writery /ref. BIZ SOLUMARY MARE	UDE	NGITUDE		28/20	4/2				FSET	BORING OF	NG RIG						CREW CHIE
COLD OF W N. Canning Parameter Mr PERCIPACY Station OPPET PARING DODARY TOWNERP PARKE BECTON VERSION OPPET PARING DEMONIT OULDAY TOWNERP PARKE BECTON VERSION OPPET DEMONIT	NG	RTHING	NOR						VAME	ROADWAY						Y	FIELD LOG I
COUNT TOWERP Device DECIDION V4 BECTION						r	FFSET	0		STATION	ER TYPE EFFICIENCY	anning	N. (OG QC BY
a.f. (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)																	
Image: constraint of the second sec				c		-											
1 9 3 12 -	Plasticity Index (%) Moisture Content (%) sapov	Plasticity Index (%)	Liquid Limit (%)	Unconfined Comp. Strengtt Q, (tsf)	Unconfined Comp. Strengtt Q _p (tsf)		Well Diagram	Graphic	USCS / AASHTO		and Geological Origin for	Elevation (ft)	Depth (ft)	N - Value	Blow Counts	Sample Recovery (in)	Sample No / Type
SS 9 3 12 0.8/ SP 2 8 5 25 1 1 5 7 22 4 1	33								OL	ery	(10"± Thick), Dark Brown Silty Clay, V				2		
2 8 5 25 - 5 5 3 12 9 13 10 1.75 11 3 12 9 13 10 12 11 12 14 3 12 3 10 12 12 14 12 14 14 14 5 7 22 47 12 12 14										0.8			-	12	5	9	
3 12 3 12 5									SP		Sand and Gravel, Moist	Br	_	25	5	8	2
3S 12 9 13 1 4 11 4 18 10 1.75 11 4 11 4 18 10 1.75 11 5S 7 23 47 - 1.75 11 5S 7 23 47 - - 50 10 1.75 9 9 6 5 12 4 10 0 - - - - 9 9 - - - 9 9 - - - 9 9 - - - 9 9 - - 9 9 - - - 9 - - - 9 - - - 9 - - - 9 - - - 9 - - - - 9 - - - 9 - - - 9 - - - - - - - - - - <td< td=""><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>5.5</td><td>Sandy Silt With Gravel Moist</td><td>B</td><td></td><td>-</td><td>17</td><td></td><td></td></td<>	5									5.5	Sandy Silt With Gravel Moist	B		-	17		
4 11 4 18 10 10 12 14 55 7 22 47 12 12 14 9 6 12 3 10 20 5% 12 4 10 9 6 12 3 10 20 5% 12 4 10 9 7 0 6 13 7 20 6 13 10 12 5% 10 12 14 9 9 7 0 6 13 7 20 6 13 10 12 14 14 9 9 9 15 15 16 16 15 15 16 10 10 10 10 10 10 10 10 10 10 12<	11				1.75									13	9	12	3 SS
SS 9 10 12 12 12 5 7 22 47 12 12 13 10 12 10 12 10 12 13 13 10 12 13 14 14 14 14 14 14 14 14 14 14 14 14 15 15 15 15 15 15 15 15 16 1									ML					18	8 /	11	
5 7 22 47 5 7 22 47 6 12 3 10 20 7 6 13 - - 7 6 13 - - 8 10 12 30 - - 8 10 12 36 30 - 7 8 10 12 36 30 - 8 10 12 36 30 - - 7 9 18 49 - - - 9 12 36 - - - - 10 12 36 - - - - - 9 9 18 49 - </td <td>14</td> <td></td> <td></td> <td></td> <td>2.5</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>10</td> <td>10</td> <td>9</td> <td>•••</td> <td>SS</td>	14				2.5								10	10	9	•••	SS
5 7 22 47 - 6 12 3 10 20 SM SM 9 6 12 3 10 20 SM 9 9 7 6 13 - - - - - - 9 10										12	Silty Sand With Gravel Very Moist	Bi	-				
SS 1 23 1 10 10 10 10 10 10 15 1 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>47</td><td>22</td><td>7</td><td>5</td></t<>														47	22	7	5
6 12 3 10 20 6 12 3 10 20 7 0 6 13 1 7 0 6 13 1 7 0 6 13 15 8 10 12 36 30 30 9 12 34 49 30 30 9 12 34 49 30 30 9 11 16 34 49 30 10 10 10 10 10 10 12 11 16 34 40 10 10 13 16 65 6 12 12 12 13 16 65 14 12 12 12	9													4/	23	'	
SS 12 4 10 20 SS 12 4 10 20 7 0 6 13 13 10 12 36 9 9 18 49 30 32 32 32 9 9 18 49 32 32 32 32 10 11 14 34 40 37 SW 37 31 10 11 14 34 40 40 37 SP 37 31 18 11 5 50/5° R - - 47 - 12<									SM				1		<u> </u>		
SS 12 4 10 20 SS 12 4 10 20 7 0 6 13 13 10 12 36 9 9 18 49 30 32 32 32 9 9 18 49 32 32 32 32 10 11 14 34 40 37 SW 37 31 10 11 14 34 40 40 37 SP 37 31 18 11 5 50/5° R - - 47 - 12<													-		3		6
7 0 6 13 - Brown Medium Sand, Wet (Possible Perched Water) sp 7 0 6 13 - - - - - - - 15 8 10 12 36 30 - - - - - - 15 9 9 123 49 - - - - - - - 10 - - 10 - 10 - 10 - - - - - - - - - - - 10 -	9												20	10	4	12	
7 0 6 13 -															6		
SS 0 6 13 16 65 10 17 10 12 36 30 32 15 15 9 9 18 49 - 32 10 17 16 65 - 10 11 14 34 40 37 37 37 10 10 10 11 16 65 - 10 11 14 34 40 37 37 10 11 16 65 - 10 11 16 65 - 10 12 11 16 65 - 10 11 16 65 - 10										Water)	Medium Sand, Wet (Possible Perched	Br					-
8 10 12 36 30 9 9 18 49 9 9 18 40 10 11 14 34 40 11 55 50/5" R 50 11 14 34 40 10 12 14 21 61 50 12 14 21 61 50 13 16 65 65														13	6	0	
8 10 12 36 30 30 30 32									00				-		_7_]		
SS 17 17 17 16 17 17 16 17 17 18 15 15 16 17 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 17 16 16 17 17 17 17 17 17 17 18 18 18 18 18 18 18 18 18 18 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 12 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>55</td><td></td><td></td><td></td><td>-</td><td></td><td></td><td></td><td></td></td<>									55				-				
9 18 49 9 26 - 10 26 - 10 11 14 34 10 11 14 34 11 16 50 12 14 21 61 31 16 65	15												30	36	12 17	10	
9 9 18 49 26 - - 10 26 - 11 14 34 10 11 14 11 14 34 18 - 11 5 50/5" 12 14 21 61 31 - - 13 16 65										32							
9 9 123 49 - 10 37 37 37 10 1								•••••			parse Sand and Gravel, Wet (Possible	G	-				
10 11 14 34 40 10 11 14 34 40 11 16 65 61 50 12 14 21 61 50 13 16 65 65 65	10								SW		i water)	P	-	49	18 23	9	9
10 11 14 34 40 10 11 14 34 40 18 18 18 18 18 11 5 50/5" R - 12 5 50/5" R - 12 14 21 61 50 13 16 65 - -										37			_		26		00
SS 11 16 34 40 18 11 5 50/5" R - 50/5" 12 12 12 14 21 61 50 - - - 12 13 16 65 - - - - - 12										57	Medium Sand, Very Moist	Ві					
00 13 - - - - - - - - 12 - - 12 - - 12 - - - 12 - - - 12 - - 12 - - 12 - - - 12 - - - 12 - 12 - 12 - 12 - - - - - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 12	10												40	34		11	
11 5 50/5" R - - 12 12 14 21 61 50 - - - 12 13 16 65 - - - - - 12 12 12																	33
SS - - - - 12 - 47 - 12 - 12 - - - 12 12 1									SP				-				
12 14 21 61 50 13 16 65													-	R/	50/5"	5,	
I2 I4 21 61 31 50 13 16 65	12																55
12 14 21 61 50 31 31 50 13 16 65											ean Clay, Trace Gravel. Moist to Verv	Br					
SS 30 - 30 - 30 - 12 - 12 - 12 - 12 - 12 - 12 - 12 - 1											,,,,,,,,,,,,,,,,,			61	21	14	
	12			4.12	3.75	:			0				50			• *	SS
													-				
														65		16	13
								/////						00		0	-
WATER & GAVE-IN UDJERVATION DATA			1					TA		RVAT	WATER & CAVE-IN OBSI		I			1	
∑ WATER ENCOUNTERED DURING DRILLING: 22ft. 🛛 🙀 CAVE DEPTH AT COMPLETION: NE	W D		Ξ	NE	ION:	ET	MPLI					URING [RED [UNTE	ENCO	ATER	
VATER LEVEL AT COMPLETION: NE Image: CAVE DEPTH AFTER 0 HOURS: N/A VATER LEVEL AFTER 0 HOURS: N/A NE = Not Encountered; NMR = No Measurement Recorded	W D										, i i i i i i i i i i i i i i i i i i i						

ROJECT NA	GWA	A - Alte	ernati	ve Bl	PS Site 2		WATER	BORIN	IG L	OG	Inte	ertek		Sil	B		NGN	No BPSRN-B-14
				0	0521741	CONSULTANT PROJE		_ • • • • •	DATE STAF								DATUM	2 of 2
RILLING CC		OR	Gr	eeley	/-Hansen	DRILLING CONTRACT		. No	DATE COM				4/	28/20	LATIT		DATOW	VERTICAL DATOW
REW CHIEF		UK			PSI		OK PROJECT	NO	BORING OI				4/	28/20		BITUDE		
					V. Jones			Marooka #395										
IELD LOG B	3 Y			N.	Canning	DRILLING METHOD / I		0.51.01.0	ROADWAY	NAME					NORT			
OG QC BY						HAMMER TYPE		CIENCY	STATION			FFSET			EAST			
OUNTY	1					TOWNSHIP	RANGE	SECTION		1/4 SECTIO	N	1/4 S	ECTION		SURF	ACE ELI	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and (Geologica	escription I Origin for / Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS	/	22 31		-	В	rown Lean Clay,	Frace Gra	vel, Moist to Ver	y Moist				3.75	7.42			11	
14 SS _	18	21 30 41	71	 60 									4.75	6.18			11	
15 SS _	18	26 33 39	72	-									4.25	3.30			10	
16 SS _	13	19 39 50	89	<u>70</u>									4.5+	9.48			10	
17 SS	5,	<u>ر50/5"</u> ر	<u>R</u>	_						CL			3.5	4.95			12	
18 SS	5_	<u>ر50/5"</u> ر	<u>R</u>	<u>80</u>									3.75				15	
19 SS	6_	<u>50</u> ,		_									4.0	4.95			15	
20 SS	4_1	\ <u>50/4"</u> /	<u>r</u>	90									4.5	3.71			24	
21 SS	5,	<u>ر 50/5"</u>	<u>R</u>	-													16	
22 SS		\50/1"]	R	100					100				4.0	4.12			15	
	,			~		End	of Boring	at 100.0 ft.					<u>,</u>	·			<u>, ,,</u> ,⊢	
∠ w/	ATER	ENCO	UNTF	RED	DURING	WAT DRILLING: 221		AVE-IN OBS		ION D/		MPLF	TION					WET
					LETION:	NE NE			_	DEPTH								DRY WET DRY
_					HOURS:	N/A				ot Encou						Recor	ded	DKI

00 - GW GEOTECH GWA - Alternative BPS Site 2 6/1/20

	-			
GW	Ī	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded
ė	NOT	E: Stratification lines between soil types represent the approximate boundary; gradu	al tran	sition between in-situ soil layers should be expected.

ROJECT NA	GWA	A - Alt	ernat		PS Site 2		WATER	BORIN	G L	CO	Inte	rtek		Si	PAGE		NG	No BPSRN-B-
ONSULTANT	г		<u> </u>			CONSULTANT PROJ	IECT No		DATE STAP	TED			A /	4 5/20	HORE	ZONTAL	DATUM	VERTICAL DATUM
RILLING CO	NTRACT	OR	Gr	reeley	-Hansen	DRILLING CONTRAC	CTOR PROJECT No		DATE COM	PLETED				15/20	LATIT	TUDE		
REW CHIEF					PSI	DRILLING RIG			BORING OI	FSFT			4/	15/20		GITUDE		
					V. Jones			rooka #395										
ELD LOG B	Υ			N.	Canning				ROADWAY	NAME						THING		
OG QC BY						HAMMER TYPE	EFFICIEN	ICY	STATION		0	FFSET			EAST	ING		
OUNTY						TOWNSHIP	RANGE	SECTION	1	1/4 SECTIO	NC	1/4 S	ECTION		SURF	ACE EL	EVATION	
													ţ	£				
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	il / Rock Desc Geological O Major Unit / C	rigin for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q ₍ (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
					Т	opsoil (14"± Thio	ck), Dark Brow	n Silt, Very M	oist	OL								
1	8	3	6						1.1/								30	
		3 3			В	rown Lean Clay,	, Very Moist			CL			2.0				22	
2 SS	13	3	8	-					5.5	-			3.5				23	
/	6	5				rown Medium to		and Gravel, N		+								
3 SS	_6_/	4 11			N	/et (Possible Pe	rched Water)										5	
4	4	15/0" 14	31															
SS ,	-	17		<u>10</u>						1							5	
		14			Ţ					1								
											•••••							
5 SS ,	8	14 14	24	-													8	
		10								SW								
										SW								
6	3,	0		-														
6 SS	\sim	9 7	R,	20														
		8/0"																
				-														
7	7	7	9															
	<u> </u>	5 4															17	
		<u> </u>							27									
				-		rown Silty Fine S /ater)	Sand, Wet (Po	ssible Perche	d									
8 SS		13 12		30													20	
		14/0"																
				-						SM								
9 1	10 /	16	R /															
ŠŠ		19 18/0"															22	
		10/0		-					37									
						rownish Gray Sa loist	andy Clay With	Gravel, Very	Moist to									
10 SS	6	6 9		40		0.01											15	
00		9 6/0"								1								
				-														
11 r	13 /	4	R /															
SS	<u> </u>	6											1.25				11	
		5/0"		-						CL								
12 SS	8,	6 5		50									1.0				10	
55		5 5/0"								1			1.0					
				-														
13 [12 [1	R/															
13																		
						14/ 4-												
7		ENOC					TER & CAV						TION					W
-							2ft.	¥										
					LETION: HOURS:	NE N/A			-	DEPTH ot Encou						Recor	hed	W D
-						present the appro	vimate hered										acu	

PROJECT No	GW	A - Alt	ernat		PS Site 2	- ALLIAN	WATER	BORIN	IG LO	COG	Inte	ertek		S	PAGE		NG	No BPSRN-B-1
CONSULTANT	т		<u> </u>		0521741	CONSULTANT PROJ	JECT No		DATE STAR	TED			A /	16/20	HORE	ZONTAL	DATUM	VERTICAL DATUM
DRILLING CO	ONTRACT	FOR	G	eeley	-Hanser	DRILLING CONTRAC	CTOR PROJECT No)	DATE COM	PLETED				15/20	LATIT	UDE		
CREW CHIEF	:				PS	DRILLING RIG	84	arooka #005	BORING OF	FSET			4/	15/20		GITUDE		
FIELD LOG B	BY				V. Jones	DRILLING METHOD		arooka #395	ROADWAY	NAME					NORT	HING		
LOG QC BY				IN.	Canning	HAMMER TYPE	EFFICIE	NCY	STATION		0	FFSET			EAST	ING		
COUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	NC	1/4 S	ECTION	I	SURF	ACE ELI	EVATION	
	_												lth	ţ	1			
ype	Sample Recovery (in)	<i>"</i>								D		_	Unconfined Comp. Strength Q _o (tsf)	. Strength	(%	(%)	Moisture Content (%)	
0/T	over	Blow Counts	- Value	Depth (ft)	Elevation (ft)	So	il / Rock Des	scription		ASH	hic	Well Diagram	sf). (j	mp. (Liquid Limit (%)	ndex	onter	
ole N	Rec	N N N	> - N	Dept	evatio	and Each	Geological (Major Unit /	Drigin for Comments		S/A	Graphic		ပ္သိုင္ရ	Q Co	id Li	city I	ы С	Notes
Sample No / Type	mple	B			Ш		- ,			USCS / AASHTO		Ne Ne	onfine	Unconfined Comp. Q, (tsf)	Liqu	Plasticity Index (%)	oistu	
.,	Sa												Uncc	Uncc			ž	
SS		9 15		-		Brownish Gray Sa Vloist	andy Clay Wit	h Gravel, Very	Moist to	CL			3.0				10	
		18/0"			h	Brown Lean Clay,	Trace Grave	I. Moist	57/									
14 SS	18 /	20	<u>R</u>	60			,	.,					4.0				14	
		37/0"]														
15 SS ,	13	14 24	59										4.5				16	
-		35		-														
16		10		-														
16 SS _	18	18 22	42	70									4.5				4	
		20																
17		20																
	16	26	48										4.5				13	
l		_22_																
18		24		-						CL								
SS	14	30 28	58	80									4.5				13	
ĺ																		
19 (<u> </u>	50/2"	/ R /															
19 SS													4.5				13	
l				1														
20 i	<u>мз</u>	\50/3"	<u>R</u>															
20 SS				90									4.5				15	
l				-														
21	4 /	50/4"																
SS													4.5				14	
22		\50/1"	R	100					100				4 -					
SS	μ	I		100	I	En	d of Boring at	100.0 ft.		1	<u>x/////</u>		4.5	<u>ل</u> ــــــــــــــــــــــــــــــــــــ		I	ı	

Greeley-Hansen Marcola #395 Date court Welter V. Jones PRLING CONTRACTOR PROJECT No. Date court Worker V. Jones PRLING CONTRACTOR PROJECT No. Date court OC DUG BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DUG BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DI CO BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DI CO BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DI CO BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DI CO BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DI CO BY A. Salinas PRLING METHOD / HOLE SIZE ROADWAY N OC DI CO BY Marco A #395 Soli / Rock Description and Geological Origin for Each Major Unit / Comments Solid / Rock Description (PS Thick), Dark Brown Silty Clay, Very Moist SS 9 3 6 - - SS 10 10 32 - - SS 14 11 24 <	SET		FSET 1/4 SEC i i i i i i i i i i i i i i i i i i i	Strength Strength	20		DE G ELEVATION	
WOHEF V. Jones Marcoka #355 BORING OFF DIGG BY A. Salinas PRILING METHOD / HOLE SIZE RRADAVX N OC BY A. Salinas PRILING METHOD / HOLE SIZE RRADAVX N NTY TOWESHP RAKCE SECTION I add (i) iii generation Soil / Rock Description and Geological Origin for Each Major Unit / Comments Soil / Rock Description and Geological Origin for Each Major Unit / Comments 1 9 3 6 - - 5 12 22 10 - - 5 12 12 17 - - 6 3 14 5 20 - 7 16 7 19 - - 5 12 12 17 - - 6 3 14 15 20 - - 7 16 7 19 - - - 5 12 10 - <th>AME 44 SECTION 14 SECTION 1</th> <th>N</th> <th>1/4 SEC</th> <th>CTION</th> <th></th> <th>ORTHING ASTING URFACE</th> <th>G</th> <th>N</th>	AME 44 SECTION 14 SECTION 1	N	1/4 SEC	CTION		ORTHING ASTING URFACE	G	N
V. Jones Marcoka #395 Rodowerv	AME 44 SECTION 14 SECTION 1	N	1/4 SEC			ORTHING ASTING URFACE	G	N
A. Salinas HAMMER TYPE EFFICIENCY STATION NY TOWNENIP RANCIE SECTION 1 9 (i) 0 0 0 0 1 9 (i) 0 0 0 0 0 0 1 9 3 6 0	A SECTION A SECTION NSCS / AASHTO USCS / AASHTO OL	N	1/4 SEC		E SI	ASTING	ELEVATION	N
NTY TOWNEHP RANCE SECTION 1 add for the section of the sectin of the section of the section of the section of the sect	P USCS / AASHTO	N	1/4 SEC		5	URFACE		IN
ad for the second sec	P USCS / AASHTO		<u> </u>		(%)			N
1 9 3 6 1 9 3 6 2 7 8 19 3 10 3 10 3 14 8 29 5 12 10 10 3 14 15 10 5 12 10 10 22 10 10 10 5 12 10 10 5 12 10 10 7 16 7 19 7 16 7 19 10 10 - - 8 14 11 24 9 12 10 - 9 12 10 - 13 - - - 9 12 10 - 13 - - - 15 10 - - 15 10 - - 15 10 - - </td <td>OL</td> <td>Graphic</td> <td>Well Diagram</td> <td>Comp. Strength 2_p (tsf) Comp. Strength</td> <td>(%) +</td> <td>(%)</td> <td></td> <td></td>	OL	Graphic	Well Diagram	Comp. Strength 2 _p (tsf) Comp. Strength	(%) +	(%)		
1 9 3 6 2 7 8 19 2 7 8 19 3 10 20 3 3 14 8 29 4 10 8 32 10 5 12 22 10 10 5 12 22 17 - 6 3 14 15 20 5 12 22 17 - 7 16 7 19 - 10 14 15 20 - 7 16 7 19 - 10 - - - - 8 14 11 24 30 - 10 - - - - - 9 12 10 - - - 13 - - - - - 15 10 7 23 - -			:	Unconfined Unconfined	Q, (tsf)	Plasticity Index (%)	Moisture Content (%)	Notes
SS 3 3 0 - 2 7 8 19 - 3 10 - - - 3S 14 8 29 - 4 10 8 32 10 3S 14 15 29 - 4 10 8 32 10 5S 12 10 - - 5S 12 17 - - 7 10 - - - 6 3 14 15 20 9 9 - - - 7 16 7 19 - 10 - - - - 8 14 11 24 30 - 9 12 10 - - - 9 12 13 - - - 10 15 11 25 40 - 11 10 <	CL					-	29	
2 7 8 19 - 3 14 8 29 - 3 14 8 29 - 4 10 8 32 10 5 12 22 - - 5 12 22 - - 6 3 14 15 20 7 7 - - - 6 3 14 15 20 9 9 - - - 7 16 9 19 - 7 16 9 10 - 8 14 11 24 30 9 12 8 23 - 10 - - - - 11 10 - - - 11 10 7 23 -				1.25			22	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							5	
$\frac{SS}{4} 10 15 23 10 10 10 10 10 10 10 1$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							5	
SS 10 10 5 12 22 7 10 6 3 14 7 10 10 8 14 11 24 9 12 8 23 10 10 10 8 14 11 24 9 12 8 23 13 10 13 10 10 13 10 11 10 15 11 25 40 11 10 7 23 40							_	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							5	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	SP							
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$							3	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								
7 16 7 19 - SS 16 7 19 - 8 14 11 24 30 9 12 8 23 - 10 13 - - - 10 13 - - - 10 15 11 25 40 11 10 7 23 - 11 10 7 23 -								
7 16 7 19 SS 16 7 19 9 12 8 23 10 13 - 9 12 8 23 13 - - 10 15 11 25 40 15 15 - 11 10 7 23 11 10 7 23								
SS 9 8 14 11 24 30 8 14 11 24 30 9 12 8 23 - 9 12 8 23 - 10 15 11 25 40 10 15 11 25 40 11 10 7 23 - 11 10 7 23 -								
SS 14 11 24 30 9 12 8 23 9 12 8 23 10 15 11 10 15 11 15 40 11 10 7 23 -							19	
SS 14 11 24 30 9 12 8 23 9 12 8 23 10 15 11 10 15 11 15 40 11 10 7 23 -								
SS 11 30 9 12 8 23 13 - - 10 15 11 25 40 10 15 10 - - 10 15 10 - - 11 10 7 23 -								
9 9 12 8 23 - - - - - - - - - - - - -							17	
SS 12 10 23 10 13 - 10 15 11 25 40 15 - 15 - 15 - 15 - 15 - 15 - 15 - 11 10 7 23	SP							
SS 12 10 23 10 13 - 10 15 11 25 40 15 - 15 - 15 - 15 - 15 - 15 - 15 - 11 10 7 23								
10 15 11 25 40 15 15 15 40 15 15 15 15 15 15 10 15 10 11 10 7 23							20	
SS 10 23 40 15 - - - 42 Brown Lean Clay, Trace Gravel, Moist 42								
SS 10 23 40 15 - - - 42 Brown Lean Clay, Trace Gravel, Moist 42								
42 Brown Lean Clay, Trace Gravel, Moist							15	
11 10 7 23 - SS 10 9 23 -								
SS 10 9 23								
				3.0			7	
	CL							
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$				3.5			13	
13 14 45								
WATER & CAVE-IN OBSERVATIO	1							<u> </u>
/ WATER ENCOUNTERED DURING DRILLING: 22ft. LAVE D)N DA		MPLET	ION:	NE			W
WATER LEVEL AT COMPLETION: NE Image: CAVE D WATER LEVEL AFTER 0 HOURS: N/A NE = Not		FTER	0 HOU	IRS:	N/A			W

PROJECT N	GW/	A - Alto	ernati	ive Bl	PS Site 2		WATE	■R B	ORIN	GIO	CG	Inte	ertek		Si	B		NG I	No BPSRN-B-16
				0	0521741	CONSULTANT PROJ			•••••	DATE STAF								DATUM	2 of 2
DRILLING CO			Gr	reeley	/-Hansen	DRILLING CONTRAC				DATE STAP				4/	16/20	LATI		DATOM	VERTICAL DATOW
		UK			PSI	DRILLING CONTRAC		JECTINO		BORING OF				4/	16/20		GITUDE		
FIELD LOG I					V. Jones	DRILLING METHOD			oka #395	ROADWAY							THING		
OG QC BY	51			Α	. Salinas	HAMMER TYPE		EFFICIENCY	,	STATION			FFSET			EAST			
						TOWNSHIP	RANG		SECTION		1/4 SECTIO			ECTION				EVATION	
	1							,	GEORION				"+0			0014			
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and Each I	Geolog Major I	ck Descri gical Oriç Unit / Col	gin for mments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_{p} (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS]	15 23		_	B	brown Lean Clay,	Trace	Gravel, N	loist					4	4.12			12	
14 SS	18	22 18 20 27	47	<u>60</u>										4.5				12	
15 SS	10	28 41 49	90	-										4.5	6.18			12	
16 SS	12	36 44 50	94	<u>70</u>										4.5	6.18			11	
17 SS	9	30 36 50	86	-							CL			4.5	4.95			12	
18 SS	<u>, 11</u>	<u>ر 50/5</u> "،	<u>R</u>	80										4.5	6.39			12	
19 SS	7	29 39 50	89	-										4.0	3.71			13	
20 SS	4	\ <u>50/4"</u> /	<u>R</u>	90										3.75	3.71			12	
21 SS	4	<u>ر 50/4"</u>	<u>R</u>	_										4.5				12	
22	5	ر "50/5		100						100				_					
SS	<u> </u>					Enc	I of Bor	ring at 100	0.0 ft.				<u>a</u>	<u> </u>	,			·	
						WA	FER 8	& CAVE	-IN OBSI	ERVAT	ION D/	ATA							
						DRILLING: 22			1		DEPTH		MPLE	TION					WET DRY
					LETION:	NE			Ē		DEPTH								WET DRY
_					HOURS:	N/A					ot Encou	,						ded	

00 - GW GEOTECH GWA - Alternative BPS Site 2 6/1/20

2	<u> </u>	WATER LEVEL AT COMPLETION.			CAVE DEL THAI TER O HOORS. NA
2	Ţ	WATER LEVEL AFTER 0 HOURS:	N/A		NE = Not Encountered; NMR = No Measurement Recorded
'n	NOT	E: Stratification lines between soil types re	present the approximate boundary; graduation	al trans	sition between in-situ soil layers should be expected.

ROJECT No					PS Site 2 0521741			BORIN			Inte	rtek		51	PAGE			1 0
ONSULTANT			Gr	eeley	-Hansen	CONSULTANT PROJ	IECT No		DATE STAF	RTED			5/	26/20	HORIZ	ZONTAL	DATUM	VERTICAL DATUM
RILLING CON	NTRACT	OR			PS	DRILLING CONTRAC	CTOR PROJECT	No	DATE COM	PLETED			5/	26/20	LATIT	UDE		
REW CHIEF				6	P. Rotaru	DRILLING RIG		HD ATV #419	BORING OI	FSET					LONG	ITUDE		
IELD LOG BY	Y				. Salinas	DRILLING METHOD			ROADWAY	NAME					NORT	HING		
OG QC BY				A	Jaimas	HAMMER TYPE	EFFIC	CIENCY	STATION		0	FFSET			EAST	ING		
OUNTY						TOWNSHIP	RANGE	SECTION		1/4 SECTIO	DN NC	1/4 \$	ECTION		SURF	ACE ELI	EVATION	
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and	il / Rock De Geological Major Unit	escription Origin for / Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength $Q_{\rm b}$ (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
1		F				Fopsoil, Dark Bro	wn Silty Cla	y, Very Moist (1	2"±	OL							35	
1 	9	5	8	-		Fhick)			0.99	CL							23	
2	9	4 50		_	[\e	Brown Lean Clay,	Very Moist		3	SP								
SS						Brown Medium Sa	and With Gr	avel, Damp	/								4	
3 SS	14	10 8	18	_		Brown Sandy Silt	With Grave	I, Moist	5.5/								8	
4	7	10	21															
SS/	,	9 12		<u>10</u>													8	
				_						ML								
5		15																
ss	12	18	43														6	
		25		-					17									
				_	Ľ	Brown Medium Sa	and, Wet											
6 SS	16	20	45	20													19	
		23																
				-						SP								
7 SS	14	27	60	_													21	
		25 35		_													21	
					E	Brown Silty Fine S	Sand, Wet		27									
8	13	25	52				,											
SS	10	29 23	02	30						SM							20	
				_		Brown Lean Clay,	Maiat to V/a	m / Maiat	32									
0		10				Slowin Learn Clay,		i y worst										
9 SS _	14	19 29	76										2.5	2.23			12	
		47		-														
				_														
10 SS	15	11 21	46	40									3.5	6.60			12	
		25																
11 SS	18	11	48	-						CL			3.0	7.21			11	
		27											0.0					
12	18	12 25	62	50														
SS		25 37		50										4.12			12	
				-														
13	14		54															
-	14		54								<i>\////</i>							
						WA	TER & CA	AVE-IN OBS	ERVAT	ION D	ATA		1				<u> </u>	
	ATER	ENCC	UNTE	RED	DURING		B.5ft.			DEPTH		MPLE	TION	: NE				W
					ETION:	NE		Ē	CAVE	DEPTH	AFTEF	R 0 HC	URS:	N/A	4			W D
👤 WA					HOURS:	N/A present the appro				ot Encou							ded	

PROJECT No		- Alt	ernati		PS Site 2		WATER	BORIN	IG LO	CO	Inte	ertek		S	PAGE		ING	No BPSRN-B-1
CONSULTANT	r		_		0521741	CONSULTANT PROJE	CT No		DATE STAF	TED				00/00	HORI	ZONTAL	DATUM	2 of
DRILLING CO	NTRACT	OR	Gr	eeley	-Hansen	DRILLING CONTRACT	FOR PROJECT	No	DATE COM	PLETED				26/20	LATIT	UDE		
CREW CHIEF					PSI	DRILLING RIG			BORING OF	FSET			5/	26/20		GITUDE		
FIELD LOG B					P. Rotaru	DRILLING METHOD /		HD ATV #419	ROADWAY							HING		
LOG QC BY				Α.	Salinas	HAMMER TYPE		IENCY	STATION			OFFSET			EAST			
COUNTY						TOWNSHIP	RANGE	SECTION	<u> </u>	1/4 SECTIO			SECTION				EVATION	
														-				
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	and (/ Rock De Geological Iajor Unit /	escription Origin for / Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q ₆ (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
SS		15 18		_	B	own Lean Clay,	Moist to Ve	ry Moist					3.0	3.71			13	
		36																
14 SS ,	18	13 15	44	60									4.0	5.77			12	
		29		-										0.11			, <u>'</u>	
				-														
15 SS ,	16	18 29	66	-									3.5	3.22			15	
		37									V///							
16 SS ,	18	20 23	57	70									2.25	3.22			15	
		34																
				-						CL								
17 SS ,	18	14 19	65	-									3.25	4.04			16	
		46		-														
18 	18	20 25 42	67	80									4.5	5.77			11	
		42																
19 	17	25 26	69	-									4.5	5.15			12	
		43		-														
				-														
20 SS ,	18	19 24	62	90									3.75	3.91			17	
		38							92									
					G	ray Sandy Silt, Ve	ery Moist											
21 SS ,	18	22 23	62														13	
		39								ML								
		26		-														
22 SS	18	26 30 41	71	100		F	of Boring a	xt 100 0 0	100								13	

<u>¥</u>	WATER ENCOUNTERED DURING DRIELING. 18.51	मुख्य	CAVE DEFINIAT COMFLETION. NE	DRY
Ā	WATER LEVEL AT COMPLETION: NE	Ē	CAVE DEPTH AFTER 0 HOURS: N/A	WET DRY
Ţ	WATER LEVEL AFTER 0 HOURS: N/A		NE = Not Encountered; NMR = No Measurement Recorded	
IOTE	E: Stratification lines between soil types represent the approximate boundary; gradu	al trans	sition between in-situ soil layers should be expected.	

PROJECT NAM	GWA	A - Alte	ernat		PS Site 2		RIN	G LC	COG	Inte	rtek	p	Si]	BC		NG	No WTRN-B-0
CONSULTANT					0521741	CONSULTANT PROJECT No.		DATE STAR								DATUM	VERTICAL DATUM
DRILLING CON		OR	Gr	eeley	-Hanser	DRILLING CONTRACTOR PROJECT No		DATE COMP				5/0	6/20	LATIT			
CREW CHIEF					PS			BORING OF				5/0	6/20		ITUDE		
					T. Eber	ASV AT	V #420										
FIELD LOG BY	(0	D. Turley			ROADWAY	NAME					NORT			
LOG QC BY						HAMMER TYPE EFFICIENCY		STATION		OI	FSET			EASTI	NG		
COUNTY						TOWNSHIP RANGE	SECTION		1/4 SECTIO	NC	1/4 SI	ECTION		SURF	ACE ELI	EVATION	1
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Descriptic and Geological Origin Each Major Unit / Comn	for		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
						opsoil, Dark Brown Silty Clay, Very I	Moist (12	"±	OL							17	
1 SS	18	4	8	-		Thick)		0.99				2.0	2.14			22	
2	6	4	27		Ĩ	Brown Lean Clay, Very Moist			CL								
ss	0	13 14	21					5.5				1.5				24	
3 SS	14	16	42			Brown Medium Sand With Gravel, Da	amp									5	
/	_	21 21		-					SP							5	
4 SS	<u> </u>	50/5"		10					55								
								12									
					Ē	Brown Coarse Sand and Gravel, Wet	t										
5 SS	12	18	54	-					SP							12	
		34						47								12	
						Brown Lean Clay, Trace Gravel, Mois	st to Verv	17 Moist		111							
6	14	17	52	-		,,,,,,,,											
ss	14	25 28	53	20								3.5	4.12			13	
		_ 20]															
7 SS	16	20 24	58	-								4.0				12	
		34		_													
8	14	10	39	30												10	
		15 24		30								2.25	2.06			13	
0		11															
9 SS ,	12	11 15	39									3.0	2.72			12	
		24		-					CL								
10 SS	14	10 15	38	40								0.5	2 31			16	
		23										0.0	01			10	
11	14	12	45														
SS/	14	18 27	+5									4.25	4.53			12	
10		10		-													
12 SS_,	16	10 15	39	50								3.5	3.54			13	
		24															
13	14		52	-													
						WATER & CAVE-IN		RVATI	ON D	ATA							
						DRILLING: 12ft.	驖	CAVE					NE				W Di
					LETION:	NE		CAVE					N/A				W D!
-					HOURS:	N/A present the approximate boundary; gra		NE = No								ded	

CONSULTANT DRILLING CONTRACTOR CREW CHIEF FIELD LOG BY LOG QC BY COUNTY COUNTY BIOM Contractor COUNTY		reeley	0521741 -Hansen PSI T. Ebert D. Turley	DRILLING CONTRACT	OR PROJECT No	ATV #420	DATE STAR DATE COMI BORING OF ROADWAY STATION	PLETED	OF	FSET		06/20 06/20	HORIZ LATITU LONGI NORTH	TUDE	DATUM	VERTICAL DATUM
CREW CHIEF FIELD LOG BY LOG QC BY COUNTY			PSI T. Ebert	DRILLING CONTRACT DRILLING RIG DRILLING METHOD / I HAMMER TYPE	ASV A	(BORING OF	FSET	OF	FSET			LONGI	TUDE		
FIELD LOG BY	e		T. Ebert	DRILLING RIG DRILLING METHOD / I HAMMER TYPE	HOLE SIZE	(ROADWAY		OF	FSET						
LOG QC BY COUNTY	e e			DRILLING METHOD / I	HOLE SIZE	(NAME	OF	FSET			NORTH	HING		
COUNTY	e			HAMMER TYPE			STATION		OF	FSET						
	Ð			TOWNSHIP	RANGE	SECTION							EASTI	NG		
sample No / Type mple Recovery (in) Blow Counts	<u> </u>							1/4 SECTIC	N	1/4 SE	ECTION		SURFA	ACE ELE	VATION	
Sa	N - Value	Depth (ft)	Elevation (ft)	Soil and (Each M	/ Rock Descri Geological Oriq Iajor Unit / Co	iption gin for mments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q _p (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
<u>SS</u> 12 20 32		-	B	rown Lean Clay, ⁻	Trace Gravel, M	Noist to Very	Moist					4.53			12	
14 SS 10 28 41		60									1.0				17	
15 12 12 SS 12 28		-									2.0	2.06			14	
16 14 11 SS 28		 70									4.5+	4.74			12	
17 12 12 SS 12 30		-									4.25	4.33			12	
18 12 14 SS 28		 80						CL			4.25	4.12			12	
19 SS 12 28 29		-									4.5	4.95			12	
20 12 15 SS 12 28		90									4.5+				7	
21 10 18 SS 30 38		-									4.0	3.13			12	
22 SS 12 29 40	69	100		End	of Boring at 10	0.0 ft.	100				4.5+	7.42				

PROJECT NAM	e GWA	- Alte	ernati		PS Site		IG LO	DG	Inte	ertek	P	Si	B		NG	No WTRN-B-0
CONSULTANT					052174		DATE STAR						HORI	ZONTAL	DATUM	VERTICAL DATUM
DRILLING CON	ITRACTO)R	Gr	eeley	-Hanse	DRILLING CONTRACTOR PROJECT №	DATE COM	9 FTFD			5/*	11/20	LATIT	UDF		
CREW CHIEF					PS	DRILLING RIG	BORING OF				5/*	11/20				
				[). Turle	y ASV ATV #420										
FIELD LOG BY				A	Salina		ROADWAY	NAME					NORT		_	
OG QC BY						HAMMER TYPE EFFICIENCY	STATION		0	FFSET			EAST	ING		
COUNTY						TOWNSHIP RANGE SECTION		1/4 SECTI	ION	1/4 S	ECTION		SURF	ACE ELI	EVATION	1
Sample No / Type	Sample Recovery (in)	Blow Counts	N - Value	Depth (ft)	Elevation (ft)	Soil / Rock Description and Geological Origin for Each Major Unit / Comments		USCS / AASHTO	Graphic	Well Diagram	Unconfined Comp. Strength Q_{p} (tsf)	Unconfined Comp. Strength Q, (tsf)	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Notes
Sa	Sam					Topsoil, Dark Brown Silt, Very Moist (10"± Th	ick)) OL	<u> </u>		Uncon	Uncon		Pla		
1 SS	5	4	8	_	\		0.8	CL			2.75				33 20	
2		4				Brown Lean Clay, Moist	3/				2.75				20	
Ś	10	4 8	16			Brown Medium to Coarse Sand With Gravel, Wet	Moist to								10	
3	12	8 21	43	-												
SS		21 22		4	¥										4	
4 SS	16	25 8 11	19	<u>10</u>				0.00							11	
5	44	15	04					SP								
ss	14	11,	24												12	
	ľ	13		-												
				-												
6 SS	12	14 11 ,	41	20											14	
		30					22									
				-	F	Brown Lean Clay, Trace Gravel, Moist to Ver			1////							
7	13	8	37	-							4.5+				11	
SS		16 21		_							4.5+				11	
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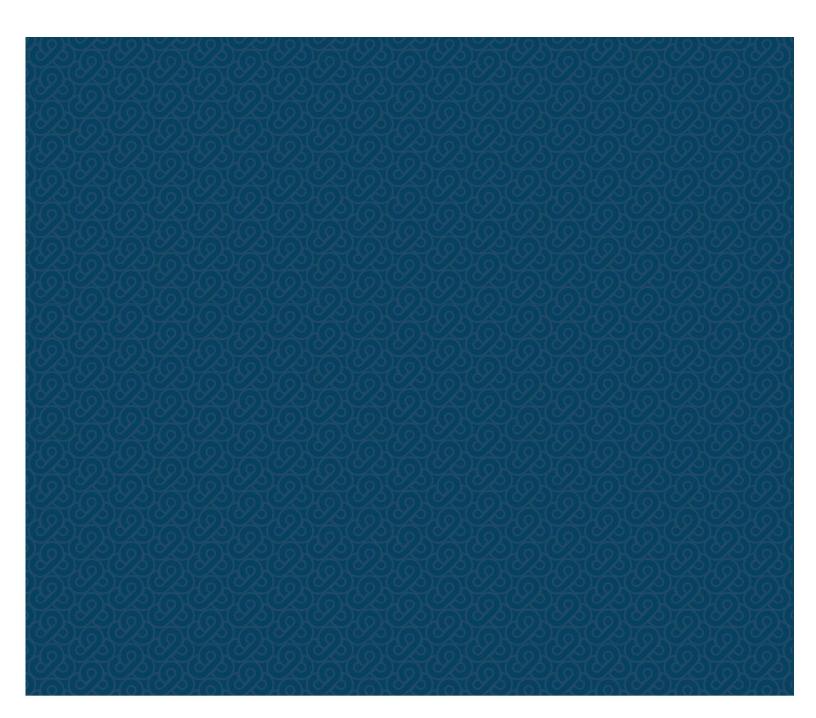
The stratification lines represent approximate boundaries. The sensition may be gradual.

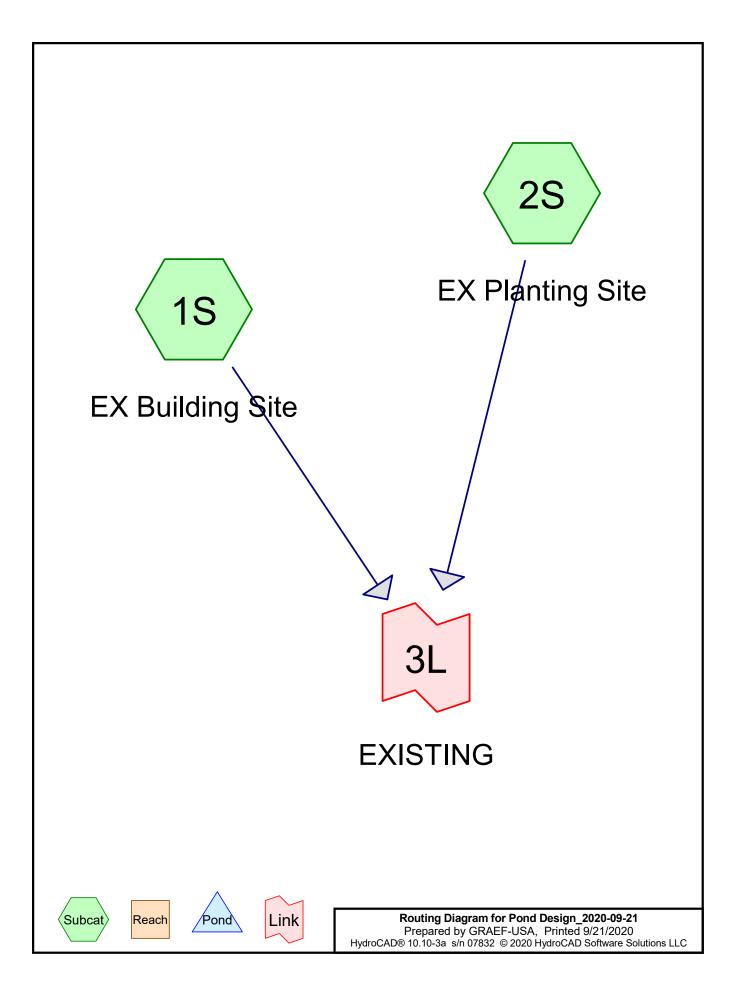
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	- 0 -		¢	1	16	Topsoil, Dark Brown Silty Clay, Thick)	, Very Moist (16"±				0	Qu	× 2.0	Qp 4.0	
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	- 12 -					End of Pit at 12'									
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The stratification lines represent approximate boundaries. The sensition may be gradual.



Appendix C – Existing Conditions HydroCAD Modeling





0.399 af, Depth= 0.35"

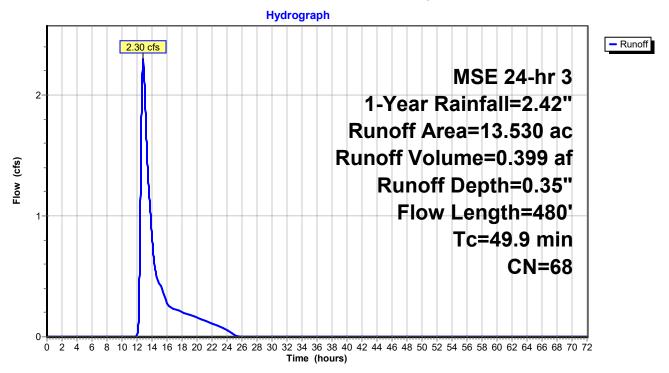
Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area **Deteriorated Asphalt assumed Gravel**

Runoff =	2.30 cfs @	12.81 hrs,	Volume=	
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Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 1-Year Rainfall=2.42"

	Area	(ac)	CN	Desc	cription		
*	0.	710	96	Grav	el surface	, HSG A	
	5.	128	77	Woo	ds, Good,	HSG D	
	2.	564	70	Woo	ds, Good,	HSG C	
_	5.	128	55	Woo	ds, Good,	HSG B	
	13.	530	68	Weig	ghted Aver	age	
	13.	530		100.	00% Pervi	ous Area	
	Тс	Lengt	h	Slope	Velocity	Capacity	Description
_	(min)	(feet	t)	(ft/ft)	(ft/sec)	(cfs)	
	45.9	30	0 0	0.0330	0.11		Sheet Flow,
							Woods: Light underbrush n= 0.400 P2= 2.72"
	4.0	18	0 (0.0222	0.74		Shallow Concentrated Flow,
_							Woodland Kv= 5.0 fps
	49.9	48	0 -	Total			

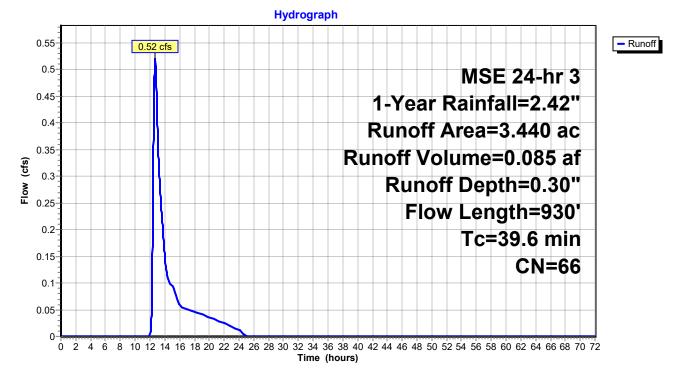


Runoff = 0.52 cfs @ 12.71 hrs, Volume= 0.085 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 1-Year Rainfall=2.42"

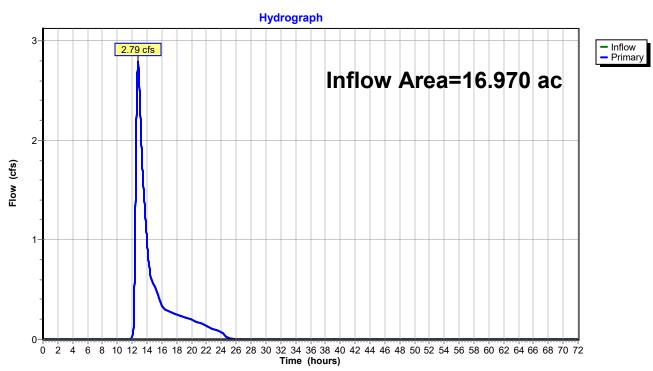
_	Area	(ac) C	N Des	cription		
*	1.	720	77 Soil	D Woodla	nd	
*	1.	720	55 Soil	B Woodla	nd	
_	3.	440 (6 Wei	ghted Ave	rage	
	3.	440	100.	00% Pervi	ous Area	
	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
	30.3	300	0.0933	0.17		Sheet Flow,
	1.4	150	0.1200	1.73		Woods: Light underbrush n= 0.400 P2= 2.72" Shallow Concentrated Flow,
	3.9	300	0.0330	1.27		Woodland Kv= 5.0 fps Shallow Concentrated Flow,
	4.0	180	0.0222	0.74		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, Woodland Kv= 5.0 fps
			- · ·			1

39.6 930 Total



Inflow Area =	16.970 ac,	0.00% Impervious, Infl	ow Depth = 0.34"	for 1-Year event
Inflow =	2.79 cfs @	12.81 hrs, Volume=	0.483 af	
Primary =	2.79 cfs @	12.81 hrs, Volume=	0.483 af, Atte	en= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area **Deteriorated Asphalt assumed Gravel**

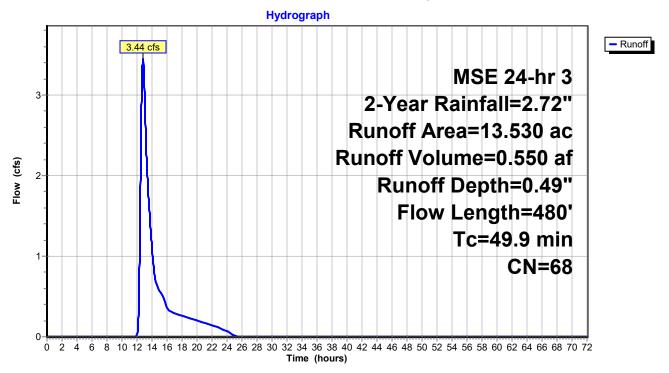
Runoff =	3.44 cfs @	12.81 hrs,	Volume=
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0.550 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 2-Year Rainfall=2.72"

	Area	(ac)	C١	Deso	cription		
*	0.	710	96	6 Grav	/el surface	, HSG A	
	5.	128	77	7 Woo	ds, Good,	HSG D	
	2.	564	70) Woo	ods, Good,	HSG C	
_	5.	128	55	5 Woo	ods, Good,	HSG B	
	13.	530	68	3 Weig	ghted Aver	age	
	13.	530		100.	00% Pervi	ous Area	
	Тс	Lengt	h	Slope	Velocity	Capacity	Description
	(min)	(fee	t)	(ft/ft)	(ft/sec)	(cfs)	
	45.9	30	0	0.0330	0.11		Sheet Flow,
							Woods: Light underbrush n= 0.400 P2= 2.72"
	4.0	18	0	0.0222	0.74		Shallow Concentrated Flow,
							Woodland Kv= 5.0 fps
	49.9	48	0	Total			

480 Total

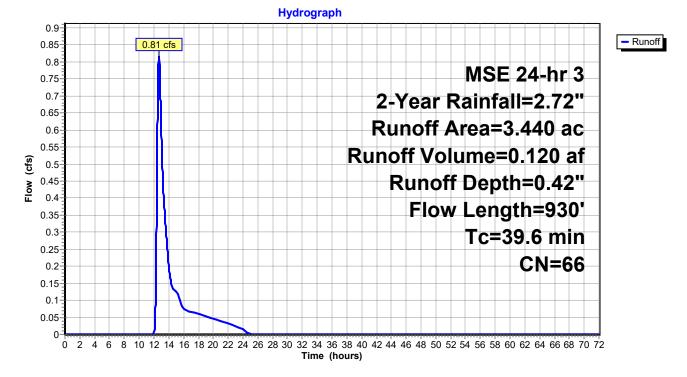


Runoff 0.81 cfs @ 12.67 hrs, Volume= 0.120 af, Depth= 0.42" =

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 2-Year Rainfall=2.72"

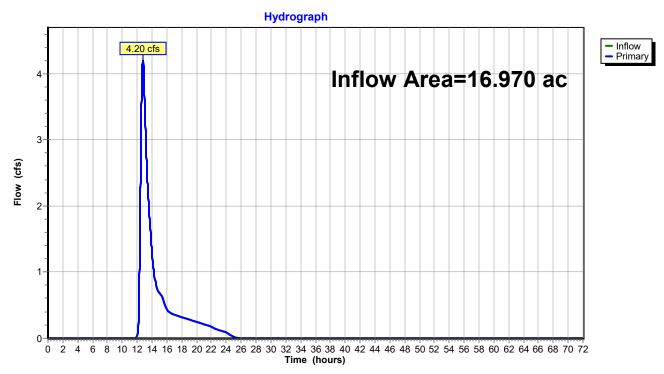
	Area	(ac) C	N Des	cription		
*	1.	720	77 Soil	D Woodla	nd	
*	1.	720 క	55 Soil	B Woodla	nd	
	3.	440 6	6 Wei	ghted Aver	rage	
	3.	440	100.	00% Pervi	ous Area	
	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
	30.3	300	0.0933	0.17		Sheet Flow,
						Woods: Light underbrush n= 0.400 P2= 2.72"
	1.4	150	0.1200	1.73		Shallow Concentrated Flow,
						Woodland Kv= 5.0 fps
	3.9	300	0.0330	1.27		Shallow Concentrated Flow,
	4.0	400	0 0000	0.74		Short Grass Pasture Kv= 7.0 fps
	4.0	180	0.0222	0.74		Shallow Concentrated Flow,
			T ()			Woodland Kv= 5.0 fps

39.6 930 Total



Inflow Area =	16.970 ac,	0.00% Impervious, Inflow E	Depth = 0.47"	for 2-Year event
Inflow =	4.20 cfs @	12.80 hrs, Volume=	0.670 af	
Primary =	4.20 cfs @	12.80 hrs, Volume=	0.670 af, Atte	en= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Summary for Subcatchment 1S: EX Building Site

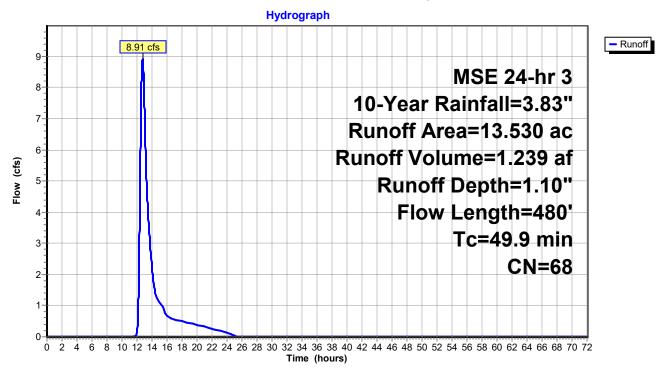
Existing conditions - disturbed area Deteriorated Asphalt assumed Gravel

Runoff	=	8.91 cfs @	12.75 hrs,	Volume=	1.239 af,	Depth= 1.10"
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Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 10-Year Rainfall=3.83"

	Area	(ac)	CN	Desc	cription		
*	0.	710	96	Grav	el surface	, HSG A	
	5.	128	77	Woo	ds, Good,	HSG D	
	2.	564	70	Woo	ds, Good,	HSG C	
	5.	128	55	Woo	ds, Good,	HSG B	
	13.	530	68	Weig	ghted Aver	age	
	13.	530		100.	00% Pervi	ous Area	
	Tc	Lengt		Slope	Velocity	Capacity	Description
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	45.9	30	0.	0330	0.11		Sheet Flow,
							Woods: Light underbrush n= 0.400 P2= 2.72"
	4.0	18) 0.	0222	0.74		Shallow Concentrated Flow,
							Woodland Kv= 5.0 fps
	40.0	40	у т				

49.9 480 Total

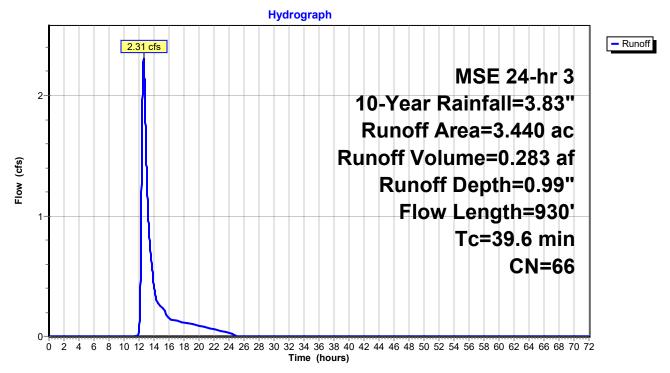


Runoff = 2.31 cfs @ 12.63 hrs, Volume= 0.283 af, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 10-Year Rainfall=3.83"

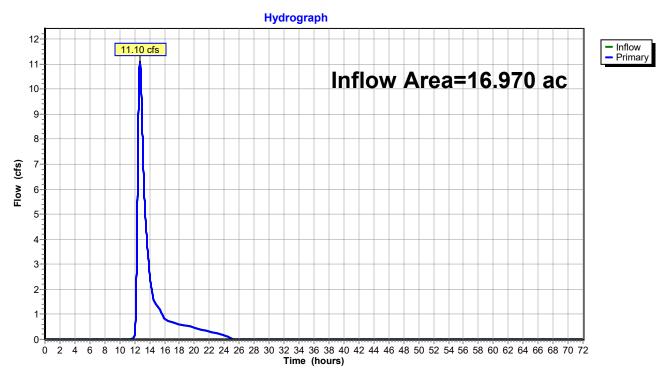
	Area	(ac) C	N Dese	cription		
*	1.	720 7	7 Soil	D Woodla	nd	
*	1.	720 5	55 Soil	B Woodla	nd	
_	3.	440 6	6 Weig	ghted Aver	age	
	3.	440		00% Pervi		
	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
_	30.3	300	0.0933	0.17		Sheet Flow,
						Woods: Light underbrush n= 0.400 P2= 2.72"
	1.4	150	0.1200	1.73		Shallow Concentrated Flow,
						Woodland Kv= 5.0 fps
	3.9	300	0.0330	1.27		Shallow Concentrated Flow,
						Short Grass Pasture Kv= 7.0 fps
	4.0	180	0.0222	0.74		Shallow Concentrated Flow,
			.			Woodland Kv= 5.0 fps

39.6 930 Total



Inflow Are	a =	16.970 ac,	0.00% Impervious,	Inflow Depth = 1.08"	for 10-Year event
Inflow	=	11.10 cfs @	12.70 hrs, Volume	= 1.522 af	
Primary	=	11.10 cfs @	12.70 hrs, Volume	= 1.522 af, Att	ten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Summary for Subcatchment 1S: EX Building Site

Existing conditions - disturbed area Deteriorated Asphalt assumed Gravel

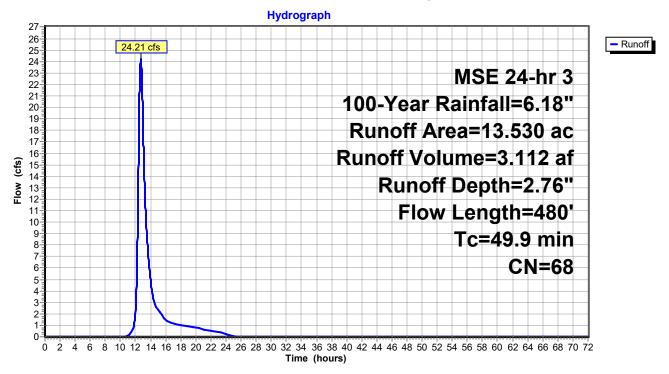
Runoff	=	24.21 cfs @	12.70 hrs,	Volume=	
--------	---	-------------	------------	---------	--

3.112 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 100-Year Rainfall=6.18"

	Area	(ac)	CN	Desc	cription			
*	0.	710	96	Gravel surface, HSG A				
	5.	.128 77 Woods, Good,				HSG D		
	2.564 70 Woods, Good, HSG C							
	5.	128	55	Woo	ds, Good,	HSG B		
	13.530 68 Weighted Average							
	13.530			100.00% Pervious Area				
	Тс	Lengt	n S	lope	Velocity	Capacity	Description	
	(min)	(feet		(ft/ft)	(ft/sec)	(cfs)	Decemption	
	45.9	300) 0.0)330	0.11		Sheet Flow,	
							Woods: Light underbrush n= 0.400 P2= 2.72"	
	4.0	180	0.0)222	0.74		Shallow Concentrated Flow,	
							Woodland Kv= 5.0 fps	
	40.0	400	<u>, т</u> .	4.1				

49.9 480 Total

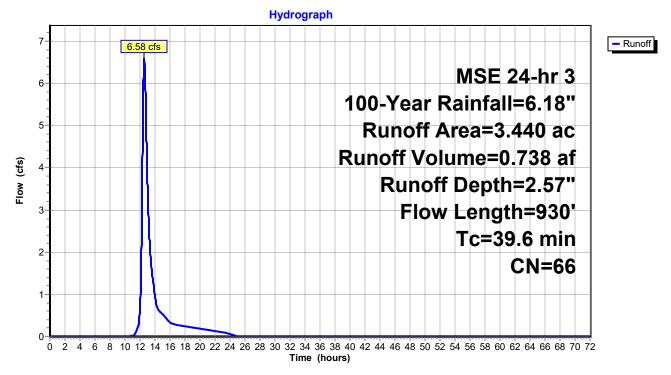


Runoff = 6.58 cfs @ 12.58 hrs, Volume= 0.738 af, Depth= 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 100-Year Rainfall=6.18"

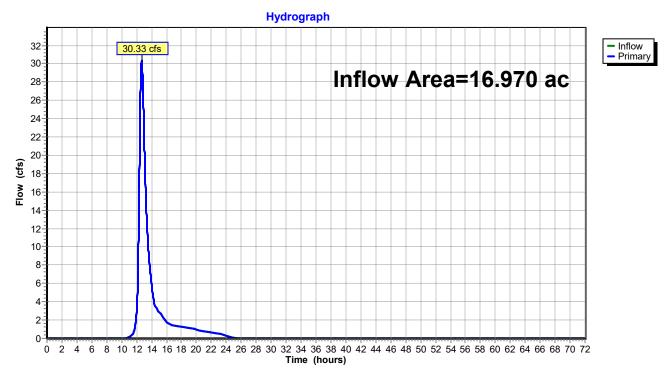
	Area	(ac) C	N Des	cription		
*	1.720 7		7 Soil	D Woodla	nd	
*	1.	720 5	55 Soil	B Woodla	nd	
_	3.	440 6	6 Wei	ghted Aver	age	
	3.	440	100.	00% Pervi	ous Area	
	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
	30.3	300	0.0933	0.17		Sheet Flow,
	1.4	150	0.1200	1.73		Woods: Light underbrush n= 0.400 P2= 2.72" Shallow Concentrated Flow, Woodland Kv= 5.0 fps
	3.9	300	0.0330	1.27		Short Grass Pasture Kv= 7.0 fps
	4.0	180	0.0222	0.74		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
	~ ~ ~					

39.6 930 Total



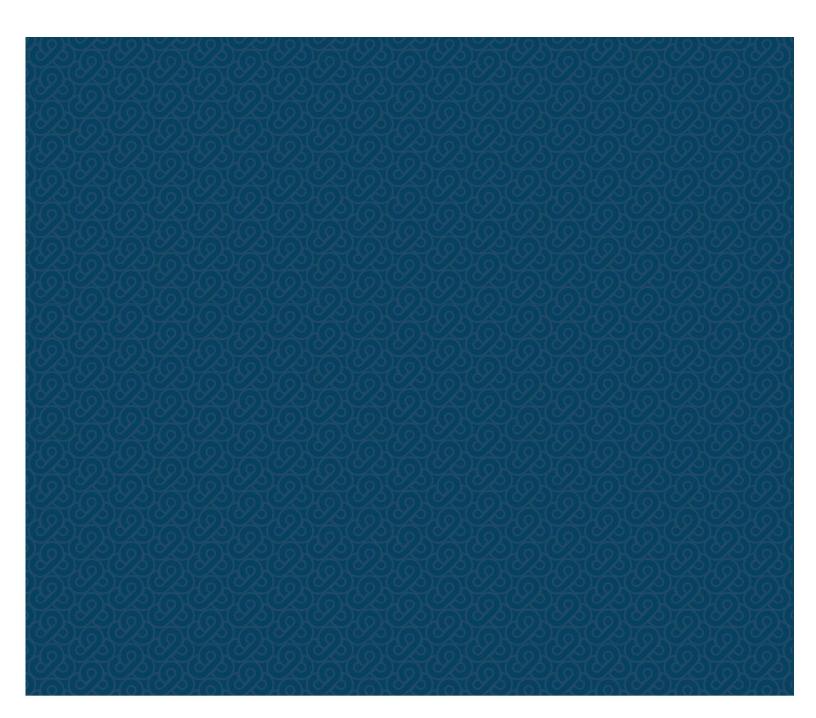
Inflow Are	a =	16.970 ac,	0.00% Impervious,	Inflow Depth =	2.72"	for 100-Year event
Inflow	=	30.33 cfs @	12.69 hrs, Volume	= 3.850	af	
Primary	=	30.33 cfs @	12.69 hrs, Volume	= 3.850	af, Atte	en= 0%, Lag= 0.0 min

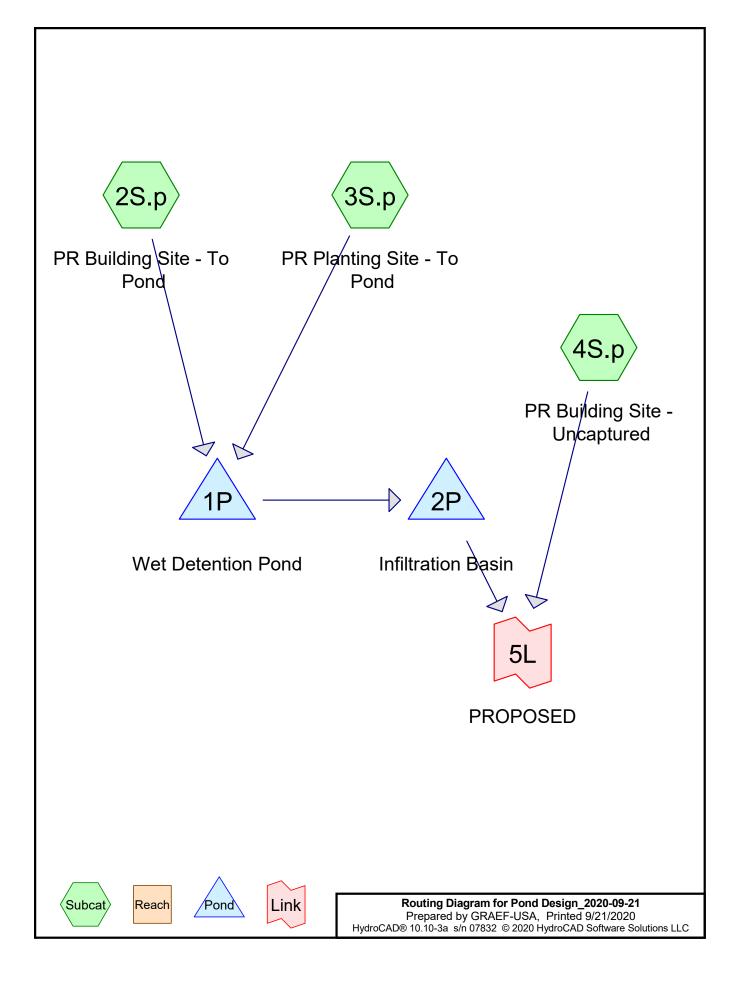
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs





Appendix D – Proposed Conditions HydroCAD Modeling





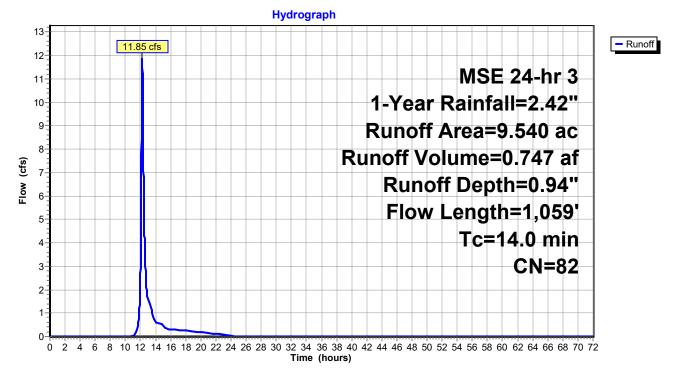
Summary for Subcatchment 2S.p: PR Building Site - To Pond

Runoff = 11.85 cfs @ 12.23 hrs, Volume= 0.747 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 1-Year Rainfall=2.42"

	Area	(ac)	CN	Description						
*	1.	660	98	Roof						
*	1.660 98			Pave	Paved parking					
	2.236 80			>75%	>75% Grass cover, Good, HSG D					
	1.118 74		>75%	>75% Grass cover, Good, HSG C						
	2.236 61		>75%	>75% Grass cover, Good, HSG B						
*	0.	0.630 98		Wate	Water Surface, 0% imp					
	9.	9.540 82		Weig	Weighted Average					
	6.	220			65.20% Pervious Area					
	3.	320		34.8	34.80% Impervious Area					
	Тс	Lengt	n S	Slope	Velocity	Capacity	Description			
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
	12.0	15	0.	0333	0.21		Sheet Flow,			
							Grass: Short n= 0.150 P2= 2.72"			
	1.4	32	50.	0654	3.84		Shallow Concentrated Flow,			
							Grassed Waterway Kv= 15.0 fps			
	0.3	26	40.	0400	15.46	27.31	Pipe Channel,			
							18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'			
							n= 0.010 Concrete pipe, straight & clean			
	0.3	32	0.	0300	16.21	50.94	Pipe Channel,			
							24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'			
							n= 0.010 Concrete pipe, straight & clean			
	110	1 05	ъ т.	1-1-						

14.0 1,059 Total



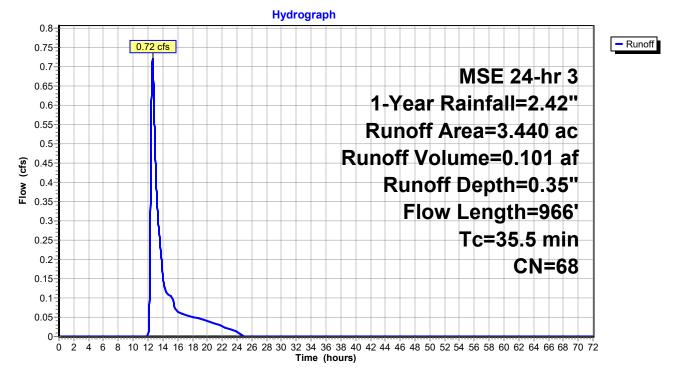
Subcatchment 2S.p: PR Building Site - To Pond

Summary for Subcatchment 3S.p: PR Planting Site - To Pond

Runoff = 0.72 cfs @ 12.62 hrs, Volume= 0.101 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 1-Year Rainfall=2.42"

Area	(ac) C	N Dese	cription		
1.	720 7	'8 Mea	dow, non-g	grazed, HS	G D
1.	720 5	58 Mea	dow, non-o	grazed, HS	G B
3.	440 6	8 Weig	ghted Aver	age	
3.	440	100.	00% Pervi	ous Area	
_					
Tc	Length	Slope		• •	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
30.3	300	0.0933	0.17		Sheet Flow,
					Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		Shallow Concentrated Flow,
					Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.100
1.2	150	0.0400	2.17	10.66	Pipe Channel,
					30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'
					n= 0.100
0.6	90	0.0400	2.45	17.34	Pipe Channel,
					36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'
					n= 0.100
35.5	966	Total			



Subcatchment 3S.p: PR Planting Site - To Pond

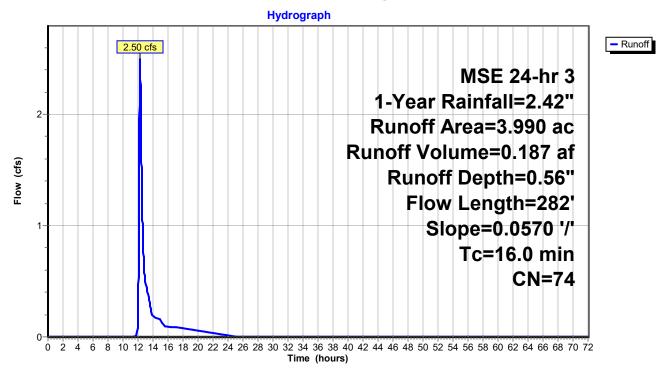
Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

Runoff = 2.50 cfs @ 12.28 hrs, Volume= 0.187 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 1-Year Rainfall=2.42"

	Area	(ac)	CN	l Desc	cription				
*	0.	200	98	B Pave	ed parking				
	1.	896	80) >75%	% Grass co	over, Good	, HSG D		
	1.	263	61	>75%	% Grass co	over, Good	, HSG B		
	0.	631	74	>75%	% Grass co	over, Good	, HSG C		
	3.	990	74	Weig	ghted Aver	age			
	3.	790		94.9	9% Pervio	us Area			
	0.	200		5.01	% Impervi	ous Area			
	_								
	Tc	Leng		Slope	Velocity	Capacity	Description		
	(min)	(fee	et)	(ft/ft)	(ft/sec)	(cfs)			
	16.0	28	32	0.0570	0.29		Sheet Flow,	0.450	
							Grass: Short	n= 0.150	P2= 2.72"

Subcatchment 4S.p: PR Building Site - Uncaptured



Summary for Pond 1P: Wet Detention Pond

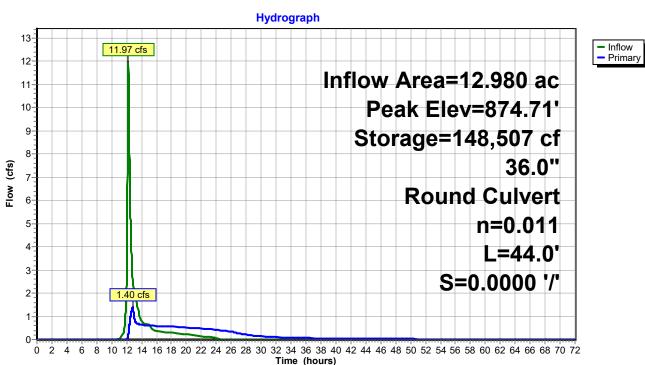
Inflow Area =	12.980 ac, 25.58% Impervious, Inflow Depth = 0.78" for 1-Year event	
Inflow =	11.97 cfs @ 12.23 hrs, Volume= 0.848 af	
Outflow =	1.40 cfs @ 12.85 hrs, Volume= 0.801 af, Atten= 88%, Lag= 36.9 n	nin
Primary =	1.40 cfs @ 12.85 hrs, Volume= 0.801 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf Peak Elev= 874.71' @ 15.10 hrs Surf.Area= 30,844 sf Storage= 148,507 cf (21,463 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= 491.9 min (1,327.2 - 835.4)

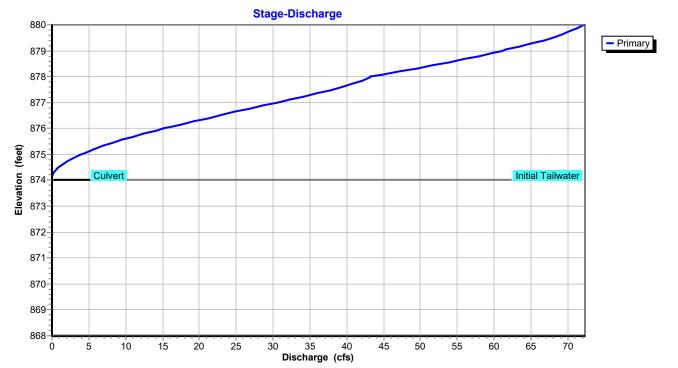
Volume	Inv	vert Avail.Sto	orage Storage	Description		
#1	868.	00' 357,2	60 cf Custom	Stage Data (Conic	c) Listed below (Recal	c)
Elevatio (fee		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
868.0	00	15,446	0	0	15,446	
869.0	00	16,921	16,178	16,178	16,988	
870.0	00	18,453	17,681	33,859	18,591	
871.0	00	20,041	19,242	53,101	20,254	
872.0	00	21,685	20,858	73,959	21,975	
873.0	00	27,575	24,571	98,530	27,892	
874.0	00	29,464	28,514	127,044	29,873	
875.0	00	31,411	30,432	157,476	31,916	
876.0	00	33,413	32,407	189,883	34,017	
877.0	00	35,472	34,437	224,320	36,179	
878.0	00	37,588	36,525	260,845	38,401	
879.0	00	50,492	43,882	304,727	51,326	
880.0	00	54,601	52,533	357,260	55,514	
Device	Routing	Invert	Outlet Device	S		
#1	Primary		36.0" Round			
				P, square edge hea		
					4.00' S= 0.0000 '/' (
			n= 0.011 Cor	ncrete pipe, straigh	t & clean, Flow Area=	÷ /.U/ st

Primary OutFlow Max=1.40 cfs @ 12.85 hrs HW=874.61' TW=874.45' (Dynamic Tailwater) -1=Culvert (Barrel Controls 1.40 cfs @ 2.05 fps) Pond Design_2020-09-21



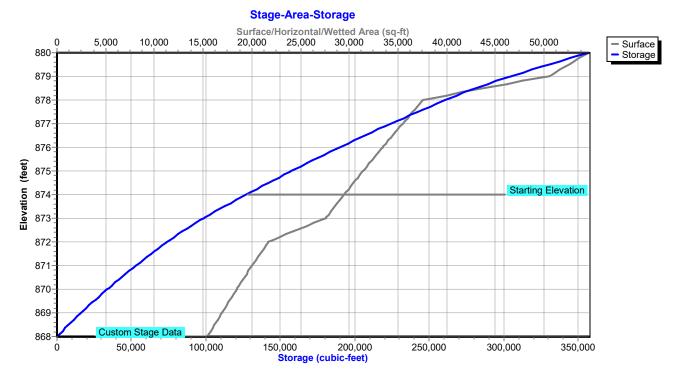
Pond 1P: Wet Detention Pond





Pond Design_2020-09-21

Prepared by GRAEF-USA HydroCAD® 10.10-3a s/n 07832 © 2020 HydroCAD Software Solutions LLC



Pond 1P: Wet Detention Pond

Summary for Pond 2P: Infiltration Basin

Inflow Area =	12.980 ac, 25.58% Impervious, Inflow De	epth > 0.74" for 1-Year event
Inflow =	1.40 cfs @ 12.85 hrs, Volume=	0.801 af
Outflow =	0.61 cfs @ 15.13 hrs, Volume=	0.801 af, Atten= 56%, Lag= 137.0 min
Discarded =	0.31 cfs @ 15.13 hrs, Volume=	0.513 af
Primary =	0.31 cfs @ 15.13 hrs, Volume=	0.288 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Peak Elev= 874.69' @ 15.13 hrs Surf.Area= 3,238 sf Storage= 2,140 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow) Center-of-Mass det. time= 39.7 min (1,366.9 - 1,327.2)

Volume	Invert	Avail.Stor	age Storage	Description		
#1	874.00'	15,47	0 cf Custom	n Stage Data (Pr	ismatic) Listed below (Recalc)	
Elevatio (fee 874.0	et)	rf.Area (sq-ft) 2,927	Inc.Store (cubic-feet) 0	Cum.Store (cubic-feet) 0		
875.0		3,375	3,151	3,151		
876.0		3,849	3,612	6,763		
877.0		4,347	4,098	10,861		
878.0	00	4,871	4,609	15,470		
Device	Routing	Invert	Outlet Device	es		
#1	Discarded	874.00'		filtration over S		
#2	Primary	874.00'	Conductivity to Groundwater Elevation = 869.00' 24.0" Round Culvert L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 873.95' S= 0.0022 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf			
#3	Device 2	874.00'	4.0" Vert. Ori	fice C= 0.600	Limited to weir flow at low heads	
#4	Device 2	876.00'	4.0' long x 4.	00' rise Sharp-C	Crested Weir Cv= 2.62 (C= 3.28)	
Discourd		Max-0.21 af	@ 15 10 hrs			

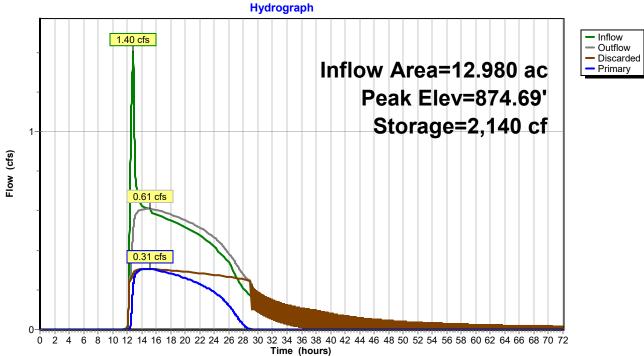
Discarded OutFlow Max=0.31 cfs @ 15.13 hrs HW=874.69' (Free Discharge) **1=Infiltration** (Controls 0.31 cfs)

Primary OutFlow Max=0.31 cfs @ 15.13 hrs HW=874.69' TW=0.00' (Dynamic Tailwater)

2=Culvert (Passes 0.31 cfs of 1.76 cfs potential flow)

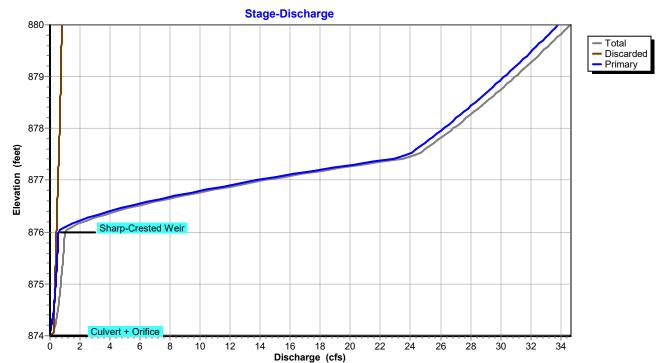
-3=Orifice (Orifice Controls 0.31 cfs @ 3.50 fps)

-4=Sharp-Crested Weir (Controls 0.00 cfs)



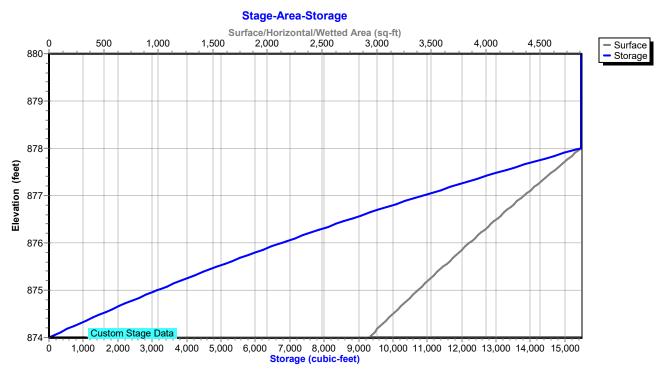
Pond 2P: Infiltration Basin





Pond Design_2020-09-21 Prepared by GRAEF-USA

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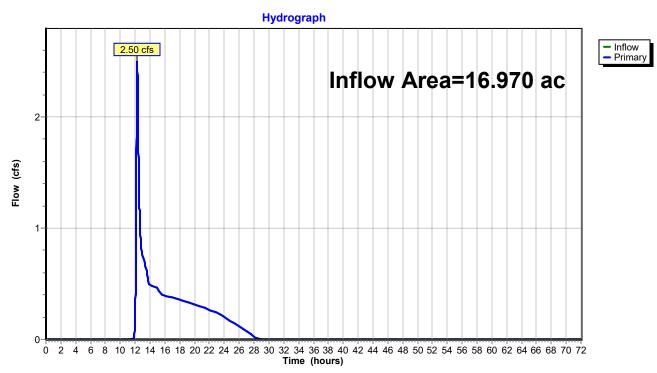
Pond 2P: Infiltration Basin

	Great Water Alliance Waukesha PROPOSED
Pond Design_2020-09-21	MSE 24-hr 3 1-Year Rainfall=2.42"
Prepared by GRAEF-USA	Printed 9/21/2020
HydroCAD® 10.10-3a s/n 07832 © 2020 HydroCAD Soft	ware Solutions LLC Page 13

Summary for Link 5L: PROPOSED

Inflow Area =	16.970 ac, 20.74% Impervious,	Inflow Depth = 0.34" for 1-Year event
Inflow =	2.50 cfs @ 12.28 hrs, Volume	e= 0.476 af
Primary =	2.50 cfs @ 12.28 hrs, Volume	e= 0.476 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Link 5L: PROPOSED

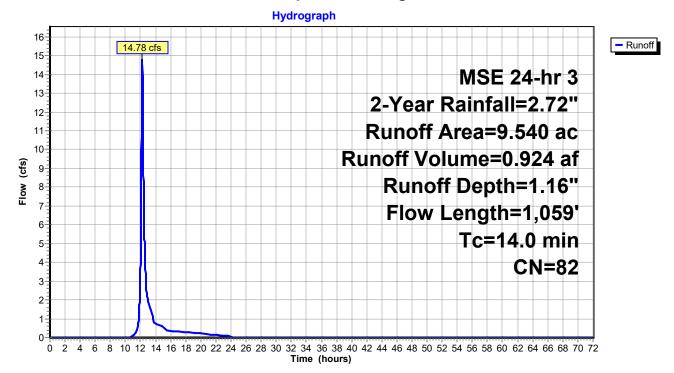
Summary for Subcatchment 2S.p: PR Building Site - To Pond

Runoff = 14.78 cfs @ 12.23 hrs, Volume= 0.924 af, Depth= 1.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 2-Year Rainfall=2.72"

	Area	(ac)	CN	Desc	cription					
*	1.	660	98	Roof	Roofs					
*	1.	660								
	2.	236	80	>75%	% Grass co	over, Good	, HSG D			
	1.	118	74	>75%	% Grass co	over, Good	, HSG C			
	2.	236	61	>75%	% Grass co	over, Good	, HSG B			
*	0.	630	98	Wate	er Surface	, 0% imp				
	9.	540	82	Weig	ghted Aver	age				
	6.	220			0% Pervio					
	3.	320		34.8	0% Imperv	vious Area				
	Тс	Lengt	n S	Slope	Velocity	Capacity	Description			
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
	12.0	15	0.	0333	0.21		Sheet Flow,			
							Grass: Short n= 0.150 P2= 2.72"			
	1.4	32	50.	0654 3.84			Shallow Concentrated Flow,			
							Grassed Waterway Kv= 15.0 fps			
	0.3 264 0.		4 0.	0.0400 15.46 27.31		27.31	Pipe Channel,			
							18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'			
							n= 0.010 Concrete pipe, straight & clean			
	0.3	32	0.	0300	16.21	50.94	Pipe Channel,			
							24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'			
							n= 0.010 Concrete pipe, straight & clean			
	110	1 05	ъ т.	1-1-						

14.0 1,059 Total



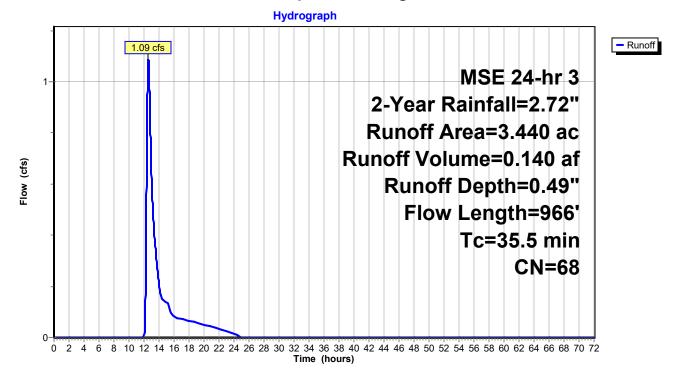
Subcatchment 2S.p: PR Building Site - To Pond

Summary for Subcatchment 3S.p: PR Planting Site - To Pond

Runoff = 1.09 cfs @ 12.59 hrs, Volume= 0.140 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 2-Year Rainfall=2.72"

Area	(ac) C	N Dese	cription		
1.	720 7	'8 Mea	dow, non-g	grazed, HS	G D
1.	720 5	58 Mea	dow, non-o	grazed, HS	G B
3.	440 6	8 Weig	ghted Aver	age	
3.	440	100.	00% Pervi	ous Area	
_					
Tc	Length	Slope		• •	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
30.3	300	0.0933	0.17		Sheet Flow,
					Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		Shallow Concentrated Flow,
					Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.100
1.2	150	0.0400	2.17	10.66	Pipe Channel,
					30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'
					n= 0.100
0.6	90	0.0400	2.45	17.34	Pipe Channel,
					36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'
					n= 0.100
35.5	966	Total			



Subcatchment 3S.p: PR Planting Site - To Pond

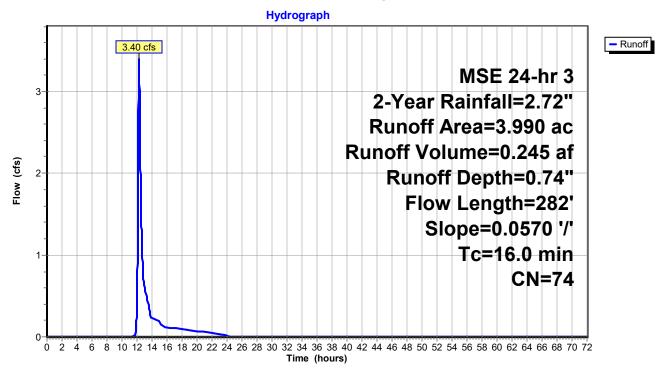
Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

Runoff = 3.40 cfs @ 12.27 hrs, Volume= 0.245 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 2-Year Rainfall=2.72"

_	Area	(ac)	CN	Desc	cription				
*	0.	200	98	B Pave	ed parking				
	1.	896	80) >759	% Grass co	over, Good	, HSG D		
	1.	263	61	l >759	% Grass co	over, Good	, HSG B		
	0.	631	74	<mark>ا >75</mark>	% Grass co	over, Good	, HSG C		
	3.	990	74	l Weig	ghted Aver	age			
	3.	790		94.9	9% Pervio	us Area			
	0.	200		5.01	% Impervi	ous Area			
	Tc	Leng		Slope	Velocity	Capacity	Description		
	(min)	(fee	et)	(ft/ft)	(ft/sec)	(cfs)			
	16.0	28	32	0.0570	0.29		Sheet Flow,		
							Grass: Short	n= 0.150	P2= 2.72"

Subcatchment 4S.p: PR Building Site - Uncaptured



Summary for Pond 1P: Wet Detention Pond

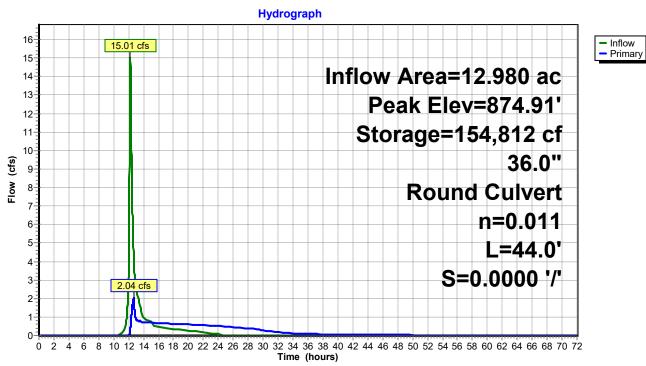
Inflow Area	a =	12.980 ac, 25.58% Impervious, Inflow Depth = 0.98" for 2-Year event
Inflow	=	15.01 cfs @ 12.23 hrs, Volume= 1.064 af
Outflow	=	2.04 cfs @ 12.68 hrs, Volume= 1.015 af, Atten= 86%, Lag= 26.9 min
Primary	=	2.04 cfs @ 12.68 hrs, Volume= 1.015 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf Peak Elev= 874.91' @ 15.15 hrs Surf.Area= 31,243 sf Storage= 154,812 cf (27,768 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= 532.1 min (1,362.9 - 830.9)

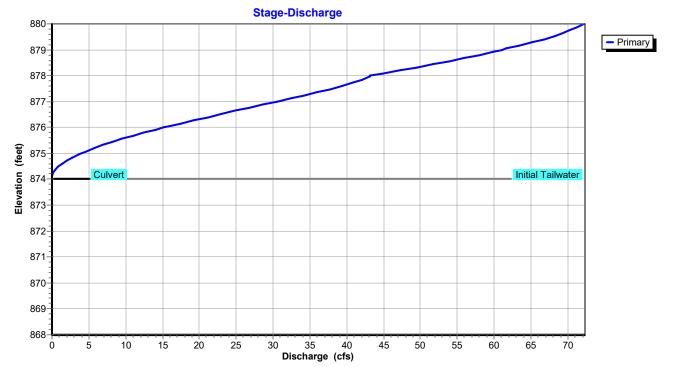
Volume	Inve	rt Avail.Sto	rage Storage I	Description				
#1	868.0	0' 357,20	60 cf Custom	Stage Data (Conic	c) Listed below (Reca	lc)		
						·		
Elevatior	า เ	Surf.Area	Inc.Store	Cum.Store	Wet.Area			
(feet)	(sq-ft)	(cubic-feet)	(cubic-feet)	(sq-ft)			
868.00)	15,446	0	0	15,446			
869.00)	16,921	16,178	16,178	16,988			
870.00)	18,453	17,681	33,859	18,591			
871.00)	20,041	19,242	53,101	20,254			
872.00)	21,685	20,858	73,959	21,975			
873.00)	27,575	24,571	98,530	27,892			
874.00)	29,464	28,514	127,044	29,873			
875.00)	31,411	30,432	157,476	31,916			
876.00)	33,413	32,407	189,883	34,017			
877.00)	35,472	34,437	224,320	36,179			
878.00)	37,588	36,525	260,845	38,401			
879.00)	50,492	43,882	304,727	51,326			
880.00)	54,601	52,533	357,260	55,514			
Device	Routing	Invert	Outlet Devices	6				
#1	Primary	874.00'	36.0" Round	Culvert				
			L= 44.0' RCP, square edge headwall, Ke= 0.500					
			Inlet / Outlet Invert= 874.00' / 874.00' S= 0.0000 '/' Cc= 0.900					
			n= 0.011 Con	crete pipe, straigh	t & clean, Flow Area	= 7.07 sf		

Primary OutFlow Max=2.03 cfs @ 12.68 hrs HW=874.73' TW=874.54' (Dynamic Tailwater) -1=Culvert (Barrel Controls 2.03 cfs @ 2.32 fps) Pond Design_2020-09-21 Prepared by GRAEF-USA

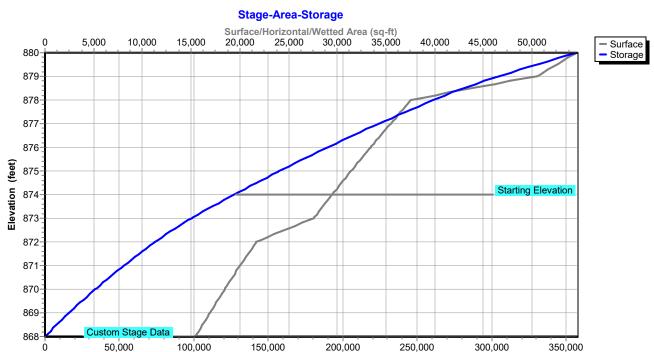


Pond 1P: Wet Detention Pond





Pond Design_2020-09-21 Prepared by GRAEF-USA



Storage (cubic-feet)

Pond 1P: Wet Detention Pond

Summary for Pond 2P: Infiltration Basin

Inflow Area =	12.980 ac, 25.58% Impervious, Inflow D	epth > 0.94" for 2-Year event
Inflow =	2.04 cfs @ 12.68 hrs, Volume=	1.015 af
Outflow =	0.69 cfs @ 15.17 hrs, Volume=	1.015 af, Atten= 66%, Lag= 149.7 min
Discarded =	0.32 cfs @ 15.17 hrs, Volume=	0.605 af
Primary =	0.36 cfs @ 15.17 hrs, Volume=	0.410 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Peak Elev= 874.91' @ 15.17 hrs Surf.Area= 3,332 sf Storage= 2,832 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow) Center-of-Mass det. time= 48.1 min (1,411.0 - 1,362.9)

Volume	Invert	Avail.Stor	age Storage	Description		
#1	874.00'	15,47	0 cf Custom	n Stage Data (Pri	i smatic) Listed below (Recalc)	
Elevatio (fee		rf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)		
874.0	1	2,927	0	0		
875.0		3,375	3,151	3,151		
876.0		3,849	3,612	6,763		
877.0		4,347	4,098	10,861		
878.0	00	4,871	4,609	15,470		
Device	Routing	Invert	Outlet Device	es		
#1	Discarded	874.00'	3.600 in/hr Ir	filtration over S	urface area	
#0	Drimon	974 00'			Elevation = 869.00'	
#2	Primary	874.00'	24.0" Round		neadwall, Ke= 0.500	
					873.95' S= 0.0022 '/' Cc= 0.900	
					hed, Flow Area= 3.14 sf	
#3	Device 2	874.00'	4.0" Vert. Orifice C= 0.600 Limited to weir flow at low heads			
#4	Device 2	876.00'	4.0' long x 4.00' rise Sharp-Crested Weir Cv= 2.62 (C= 3.28)			
Bissended OutFlow, May-0.20 afs @ 45.47 km LIM/-074.04L (Ence Discharge)						

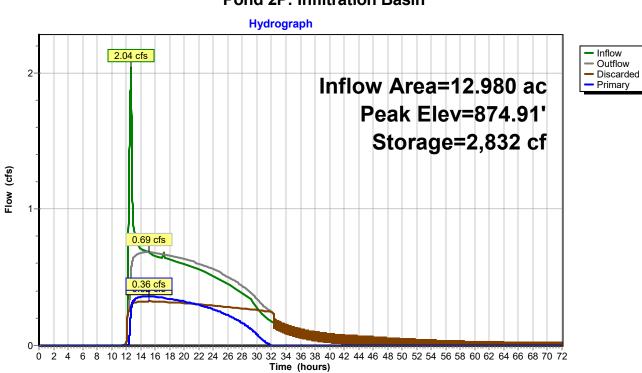
Discarded OutFlow Max=0.32 cfs @ 15.17 hrs HW=874.91' (Free Discharge) **1=Infiltration** (Controls 0.32 cfs)

Primary OutFlow Max=0.36 cfs @ 15.17 hrs HW=874.91' TW=0.00' (Dynamic Tailwater)

2=Culvert (Passes 0.36 cfs of 2.91 cfs potential flow)

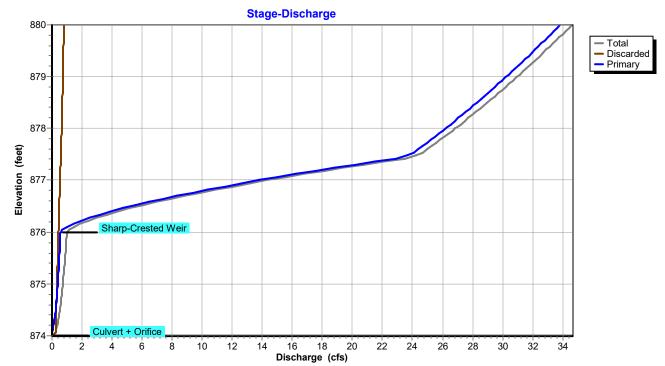
3=Orifice (Orifice Controls 0.36 cfs @ 4.14 fps)

-4=Sharp-Crested Weir (Controls 0.00 cfs)



Pond 2P: Infiltration Basin

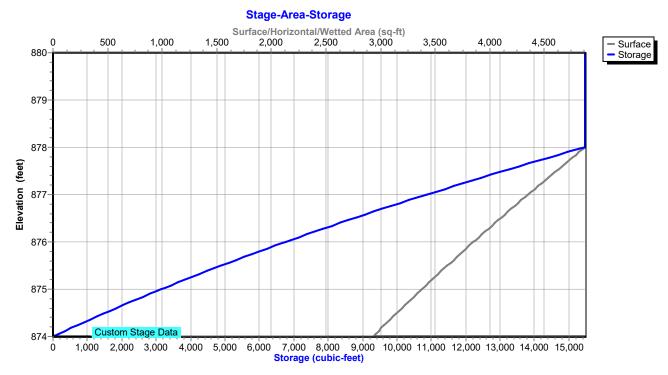




Pond Design_2020-09-21 Prepared by GRAEF-USA

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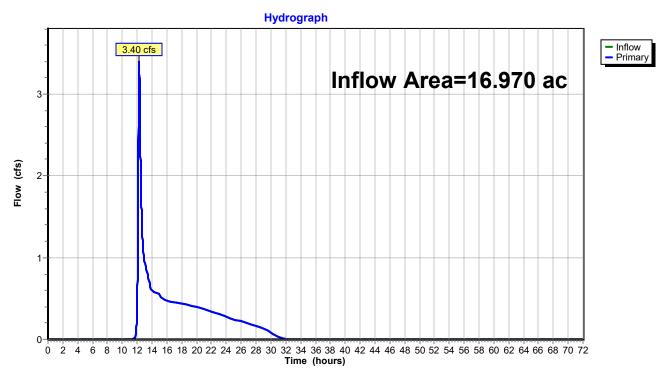
Pond 2P: Infiltration Basin

	Great Water Alliance Waukesha PROPOSED
Pond Design_2020-09-21	MSE 24-hr 3 2-Year Rainfall=2.72"
Prepared by GRAEF-USA	Printed 9/21/2020
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Summary for Link 5L: PROPOSED

Inflow Area =	16.970 ac, 20.74% Impervious, Inflow I	Depth = 0.46"	for 2-Year event
Inflow =	3.40 cfs @ 12.27 hrs, Volume=	0.655 af	
Primary =	3.40 cfs @ 12.27 hrs, Volume=	0.655 af, Atte	en= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



Link 5L: PROPOSED

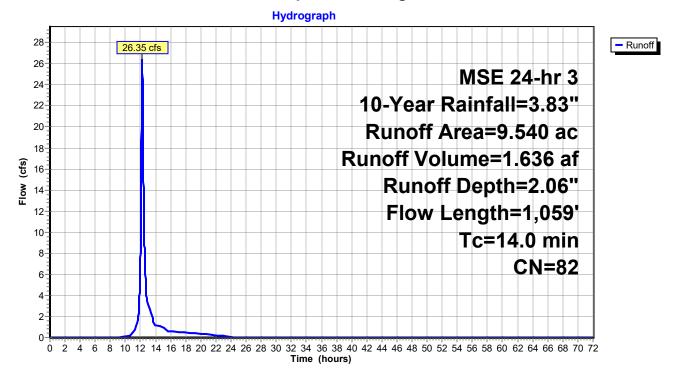
Summary for Subcatchment 2S.p: PR Building Site - To Pond

Runoff = 26.35 cfs @ 12.22 hrs, Volume= 1.636 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 10-Year Rainfall=3.83"

	Area	(ac)	CN	Desc	cription					
*	1.	660	98	Root	ſs					
*	1.	660	98	Pave	Paved parking					
	2.	236	80	>759	% Ġrass co	over, Good	, HSG D			
	1.	118	74	>759	% Grass co	over, Good	, HSG C			
	2.	236	61	>759	% Grass co	over, Good	, HSG B			
*	0.	630	98	Wate	er Surface	, 0% imp				
	9.	540	82	Weig	ghted Aver	age				
	6.	220		65.2	0% Pervio	us Area				
	3.	320		34.8	0% Imperv	vious Area				
					•					
	Tc	Lengtl	n S	Slope	Velocity	Capacity	Description			
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)				
	12.0	150	0.	0333	0.21		Sheet Flow,			
							Grass: Short n= 0.150 P2= 2.72"			
	1.4	32	5 0.	0654	3.84		Shallow Concentrated Flow,			
							Grassed Waterway Kv= 15.0 fps			
	0.3	264	4 0.	0400	15.46	27.31	Pipe Channel,			
							18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'			
							n= 0.010 Concrete pipe, straight & clean			
	0.3	320	0.	0300	16.21	50.94	Pipe Channel,			
							24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'			
							n= 0.010 Concrete pipe, straight & clean			
	440	4 0 5	ς т.	1-1-1						

14.0 1,059 Total



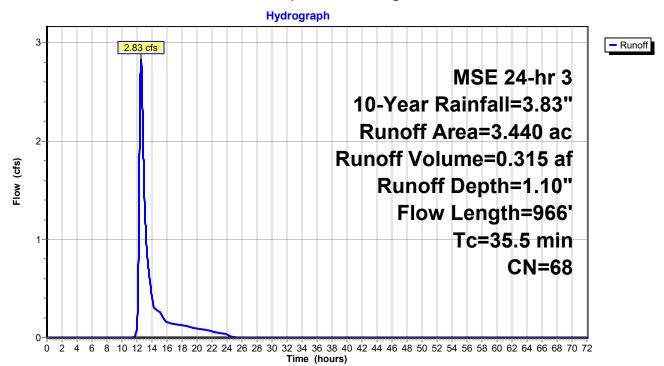
Subcatchment 2S.p: PR Building Site - To Pond

Summary for Subcatchment 3S.p: PR Planting Site - To Pond

Runoff = 2.83 cfs @ 12.54 hrs, Volume= 0.315 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 10-Year Rainfall=3.83"

Area	(ac) C	N Dese	cription		
1.	720 7	'8 Mea	dow, non-g	grazed, HS	GD
1.	720 5	58 Mea	dow, non-g	grazed, HS	G B
3.	440 6	8 Wei	ghted Aver	rage	
3.	440	100.	00% Pervi	ous Area	
Тс	Length	Slope		Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
30.3	300	0.0933	0.17		Sheet Flow,
					Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		Shallow Concentrated Flow,
					Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
				10.00	n= 0.100
1.2	150	0.0400	2.17	10.66	Pipe Channel,
					30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'
	~~~		o / =	47.04	n= 0.100
0.6	90	0.0400	2.45	17.34	
					36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'
					n= 0.100
35.5	966	Total			



## Subcatchment 3S.p: PR Planting Site - To Pond

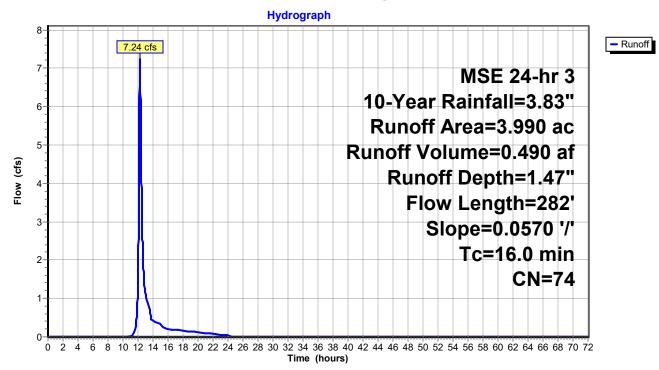
#### Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

Runoff = 7.24 cfs @ 12.25 hrs, Volume= 0.490 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 10-Year Rainfall=3.83"

	Area	(ac)	CN	l Desc	cription				
*	0.	200	98	8 Pave	ed parking				
	1.	896	80	) >759	% Grass co	over, Good	, HSG D		
	1.	263	61	>759	% Grass co	over, Good	, HSG B		
	0.	631	74	>759	% Grass co	over, Good	, HSG C		
	3.	990	74	- Weig	ghted Aver	age			
	3.	790		94.9	9% Pervio	us Area			
	0.	200		5.01	% Impervi	ous Area			
	Тс	Leng		Slope	Velocity	Capacity	Description		
	(min)	(fee	et)	(ft/ft)	(ft/sec)	(cfs)			
	16.0	28	32	0.0570	0.29		Sheet Flow,		
							Grass: Short	n= 0.150	P2= 2.72"

### Subcatchment 4S.p: PR Building Site - Uncaptured



### Summary for Pond 1P: Wet Detention Pond

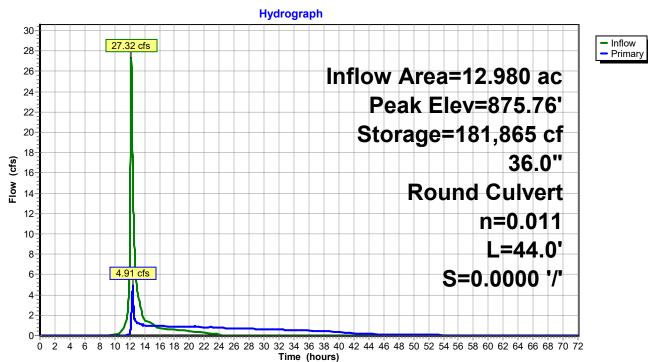
Inflow Are	ea =	12.980 ac, 25.58% Impervious, Inflow Depth = 1.80" for 10-Year event
Inflow	=	27.32 cfs @ 12.23 hrs, Volume= 1.951 af
Outflow	=	4.91 cfs @ 12.42 hrs, Volume= 1.893 af, Atten= 82%, Lag= 11.8 min
Primary	=	4.91 cfs @ 12.42 hrs, Volume= 1.893 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf Peak Elev= 875.76' @ 15.27 hrs Surf.Area= 32,923 sf Storage= 181,865 cf (54,821 cf above start)

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= 707.6 min (1,526.9 - 819.3)

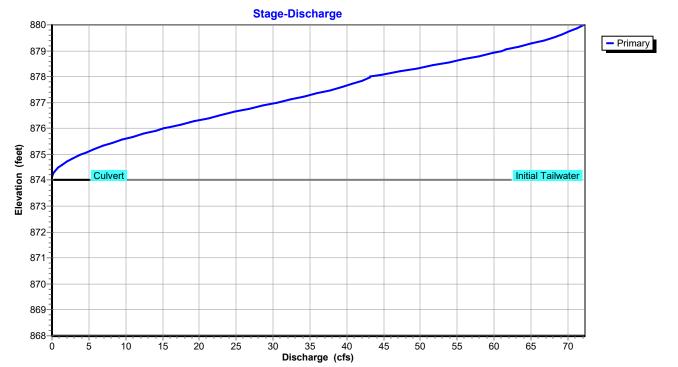
Volume	Inve	ert Avail.Sto	rage Storage I	Description				
#1	868.0	0' 357,2	60 cf Custom	Stage Data (Conic	c) Listed below (Reca	lc)		
				•	,	,		
Elevatio		Surf.Area	Inc.Store	Cum.Store	Wet.Area			
(fee	t)	(sq-ft)	(cubic-feet)	(cubic-feet)	(sq-ft)			
868.0	0	15,446	0	0	15,446			
869.0	0	16,921	16,178	16,178	16,988			
870.0	0	18,453	17,681	33,859	18,591			
871.0	0	20,041	19,242	53,101	20,254			
872.0	0	21,685	20,858	73,959	21,975			
873.0	0	27,575	24,571	98,530	27,892			
874.0		29,464	28,514	127,044	29,873			
875.0		31,411	30,432	157,476	31,916			
876.0		33,413	32,407	189,883	34,017			
877.0		35,472	34,437	224,320	36,179			
878.0		37,588	36,525	260,845	38,401			
879.0		50,492	43,882	304,727	51,326			
880.0	0	54,601	52,533	357,260	55,514			
Device	Deutine	lunicant	Outlet Devices					
Device	Routing	Invert	Outlet Devices					
#1	Primary	874.00'	36.0" Round					
			L= 44.0' RCP, square edge headwall, Ke= 0.500					
						Cc= 0.900		
			n= 0.011 Con	crete pipe, straigh	t & clean, Flow Area=	= /.U/ st		

Primary OutFlow Max=4.93 cfs @ 12.42 hrs HW=875.11' TW=874.83' (Dynamic Tailwater) -1=Culvert (Barrel Controls 4.93 cfs @ 3.06 fps) Pond Design_2020-09-21 Prepared by GRAEF-USA



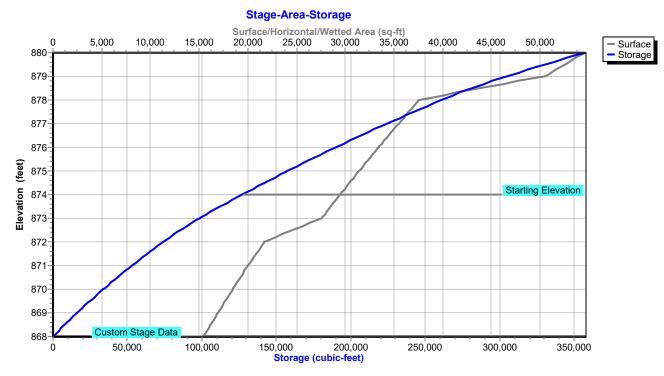
## Pond 1P: Wet Detention Pond





Pond Design_2020-09-21 Prepared by GRAEF-USA

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### Pond 1P: Wet Detention Pond

### Summary for Pond 2P: Infiltration Basin

Inflow Area =	12.980 ac, 25.58% Impervious, Inflow D	epth > 1.75" for 10-Year event
Inflow =	4.91 cfs @ 12.42 hrs, Volume=	1.893 af
Outflow =	0.94 cfs @ 15.27 hrs, Volume=	1.893 af, Atten= 81%, Lag= 171.0 min
Discarded =	0.41 cfs @ 15.27 hrs, Volume=	0.975 af
Primary =	0.53 cfs $\overline{@}$ 15.27 hrs, Volume=	0.918 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Peak Elev= 875.76' @ 15.27 hrs Surf.Area= 3,733 sf Storage= 5,836 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow) Center-of-Mass det. time= 74.3 min (1,601.2 - 1,526.9)

Volume	Invert	Avail.Stor	rage Storage	Description			
#1	874.00'	15,47	'0 cf Custom	n Stage Data (Pr	ismatic) Listed below (Recalc)		
Elevatio (fee 874.0 875.0	et) )0	rf.Area (sq-ft) 2,927 3,375	Inc.Store (cubic-feet) 0 3,151	Cum.Store (cubic-feet) 0 3,151			
876.0 877.0		3,849 4,347	3,612 4,098	6,763 10,861			
878.0	00	4,871	4,609	15,470			
Device	Routing	Invert	Outlet Device	es			
#1	Discarded	874.00'		filtration over S			
#2	Primary	874.00'	Conductivity to Groundwater Elevation = 869.00' <b>24.0" Round Culvert</b> L= 23.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 874.00' / 873.95' S= 0.0022 '/' Cc= 0.900				
#3 #4	Device 2 Device 2	874.00' 876.00'	n= 0.012 Concrete pipe, finished, Flow Area= 3.14 sf <b>4.0" Vert. Orifice</b> C= 0.600 Limited to weir flow at low heads <b>4.0' long x 4.00' rise Sharp-Crested Weir</b> Cv= 2.62 (C= 3.28)				

**Discarded OutFlow** Max=0.41 cfs @ 15.27 hrs HW=875.76' (Free Discharge) **1=Infiltration** (Controls 0.41 cfs)

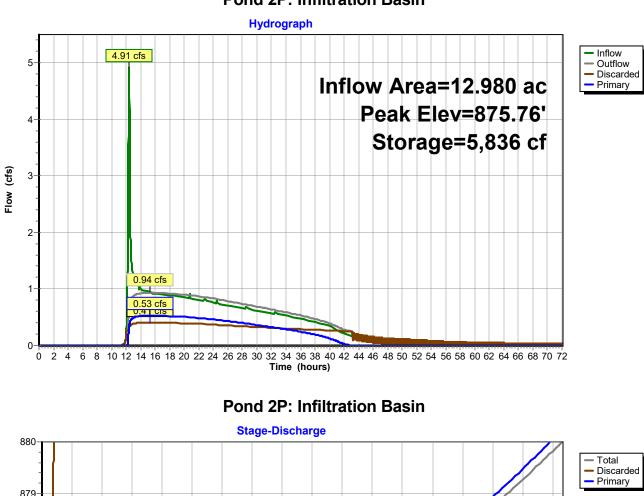
**Primary OutFlow** Max=0.53 cfs @ 15.27 hrs HW=875.76' TW=0.00' (Dynamic Tailwater)

**2=Culvert** (Passes 0.53 cfs of 9.44 cfs potential flow)

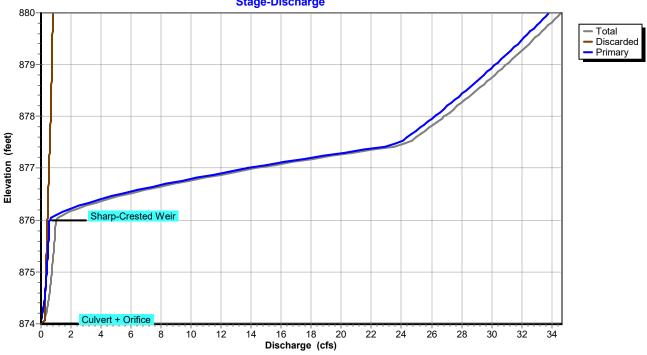
-3=Orifice (Orifice Controls 0.53 cfs @ 6.07 fps)

-4=Sharp-Crested Weir (Controls 0.00 cfs)

Pond Design_2020-09-21

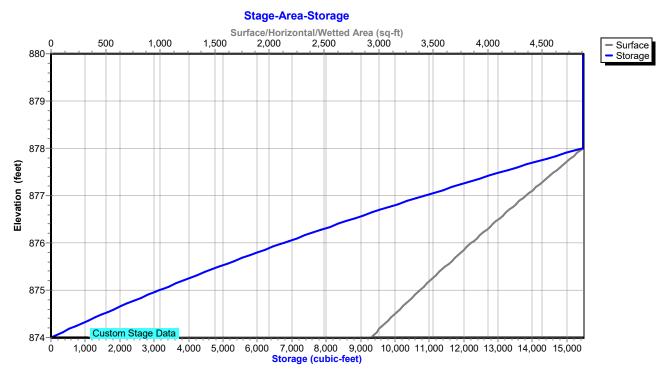


## Pond 2P: Infiltration Basin



Pond Design_2020-09-21 Prepared by GRAEF-USA

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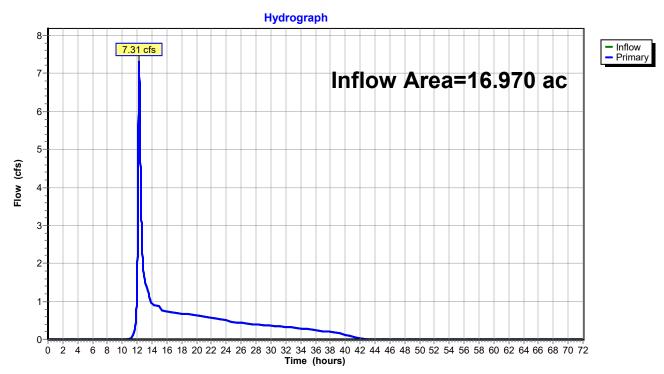
### **Pond 2P: Infiltration Basin**

	Great Water Alliance Waukesha PROPOSED
Pond Design_2020-09-21	MSE 24-hr 3 10-Year Rainfall=3.83"
Prepared by GRAEF-USA	Printed 9/21/2020
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## Summary for Link 5L: PROPOSED

Inflow Area	a =	16.970 ac, 20.74% Impervious, Inflow Depth = 1.00" for 10-Year event
Inflow	=	7.31 cfs @ 12.26 hrs, Volume= 1.408 af
Primary	=	7.31 cfs @ 12.26 hrs, Volume= 1.408 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



### Link 5L: PROPOSED

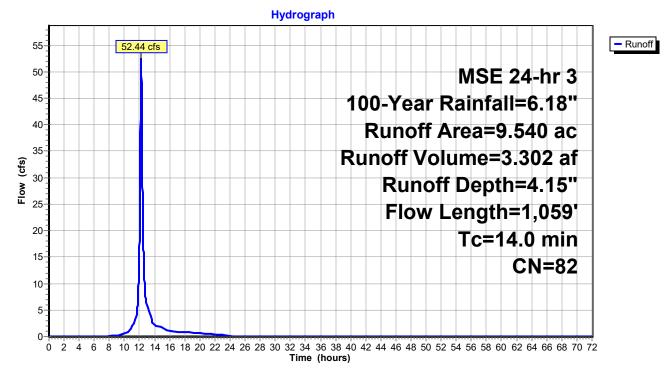
### Summary for Subcatchment 2S.p: PR Building Site - To Pond

Runoff = 52.44 cfs @ 12.22 hrs, Volume= 3.302 af, Depth= 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 100-Year Rainfall=6.18"

	Area	(ac)	CN	Description			
*	1.	660	98	Root	ſs		
*	1.	660	98	Pave	Paved parking		
	2.236 80		>759	>75% Grass cover, Good, HSG D			
	1.118 74		>759	>75% Grass cover, Good, HSG C			
	2.236 61 >75% Grass c				% Grass co	over, Good	, HSG B
*	* 0.630 98		Wate	er Surface	, 0% imp		
	9.540 82		Weig	ghted Aver	age		
					0% Pervio	us Area	
	3.	320		34.8	0% Imperv	vious Area	
					•		
	Tc	Lengtl	n S	Slope	Velocity	Capacity	Description
	(min)	(feet	)	(ft/ft)	(ft/sec)	(cfs)	
	12.0	150	0.	0333	0.21		Sheet Flow,
							Grass: Short n= 0.150 P2= 2.72"
	1.4	32	5 0.	0654	3.84		Shallow Concentrated Flow,
							Grassed Waterway Kv= 15.0 fps
	0.3	264	4 0.	0400	15.46	27.31	Pipe Channel,
							18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'
							n= 0.010 Concrete pipe, straight & clean
	0.3	320	0.	0300	16.21	50.94	Pipe Channel,
							24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'
							n= 0.010 Concrete pipe, straight & clean
	440	4 0 5	ς т.	1-1-1			

14.0 1,059 Total



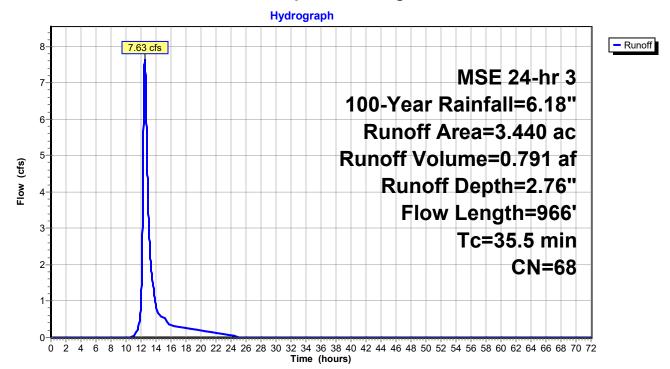
#### Subcatchment 2S.p: PR Building Site - To Pond

#### Summary for Subcatchment 3S.p: PR Planting Site - To Pond

Runoff = 7.63 cfs @ 12.51 hrs, Volume= 0.791 af, Depth= 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 100-Year Rainfall=6.18"

Area	(ac) C	N Dese	cription		
1.	720 7	'8 Mea	dow, non-g	grazed, HS	G D
1.	720 5	58 Mea	dow, non-o	grazed, HS	G B
3.	440 6	8 Weig	ghted Aver	age	
3.	440	100.	00% Pervi	ous Area	
_					
Tc	Length	Slope		• •	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
30.3	300	0.0933	0.17		Sheet Flow,
					Woods: Light underbrush n= 0.400 P2= 2.72"
1.4	150	0.1200	1.73		Shallow Concentrated Flow,
					Woodland Kv= 5.0 fps
0.2	126	0.0400	13.69	16.80	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.010 Concrete pipe, straight & clean
1.8	150	0.0400	1.37	1.68	Pipe Channel,
					15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'
					n= 0.100
1.2	150	0.0400	2.17	10.66	Pipe Channel,
					30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'
					n= 0.100
0.6	90	0.0400	2.45	17.34	Pipe Channel,
					36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'
					n= 0.100
35.5	966	Total			



#### Subcatchment 3S.p: PR Planting Site - To Pond

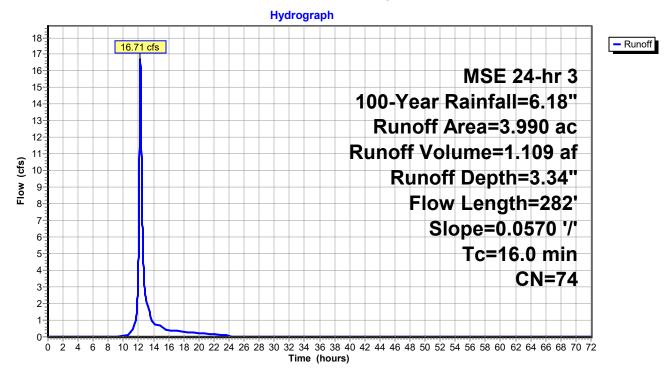
#### Summary for Subcatchment 4S.p: PR Building Site - Uncaptured

Runoff = 16.71 cfs @ 12.25 hrs, Volume= 1.109 af, Depth= 3.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs MSE 24-hr 3 100-Year Rainfall=6.18"

	Area	(ac)	CN	Desc	cription					
*	0.	200	98	Pave	ed parking					
	1.	896	80	>759	% Grass co	over, Good	, HSG D			
	1.	263	61	>759	% Grass co	over, Good	, HSG B			
	0.	631	74	>759	% Grass co	over, Good	, HSG C			
	3.	990	74	Weig	ghted Aver	age				
	3.	790		94.9	9% Pervio	us Area				
	0.	200		5.01	% Impervi	ous Area				
	_									
	Tc	Leng		Slope	Velocity	Capacity	Description			
	(min)	(fee	et)	(ft/ft)	(ft/sec)	(cfs)				
	16.0	28	32 (	0.0570	0.29		Sheet Flow,			
							Grass: Short	n= 0.150	P2= 2.72"	

#### Subcatchment 4S.p: PR Building Site - Uncaptured



#### Summary for Pond 1P: Wet Detention Pond

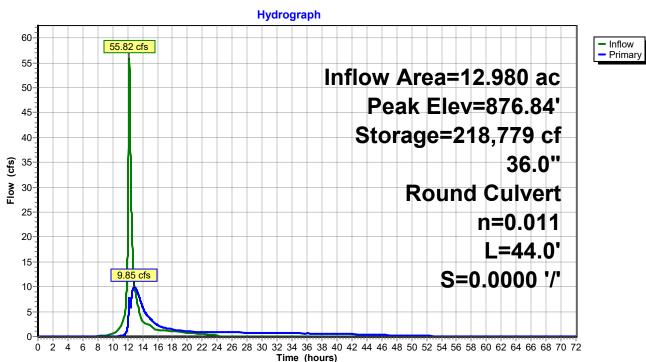
Inflow Are	a =	12.980 ac, 25.58% Impervious, Inflow Depth = 3.78" for 100-Year event
Inflow	=	55.82 cfs @ 12.22 hrs, Volume=
Outflow	=	9.85 cfs @ 12.88 hrs, Volume= 4.028 af, Atten= 82%, Lag= 39.4 min
Primary	=	9.85 cfs @ 12.88 hrs, Volume= 4.028 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Starting Elev= 874.00' Surf.Area= 29,464 sf Storage= 127,044 cf Peak Elev= 876.84' @ 12.95 hrs Surf.Area= 35,145 sf Storage= 218,779 cf (91,735 cf above start)

Plug-Flow detention time= 1,527.4 min calculated for 1.111 af (27% of inflow) Center-of-Mass det. time= 497.2 min (1,302.7 - 805.5)

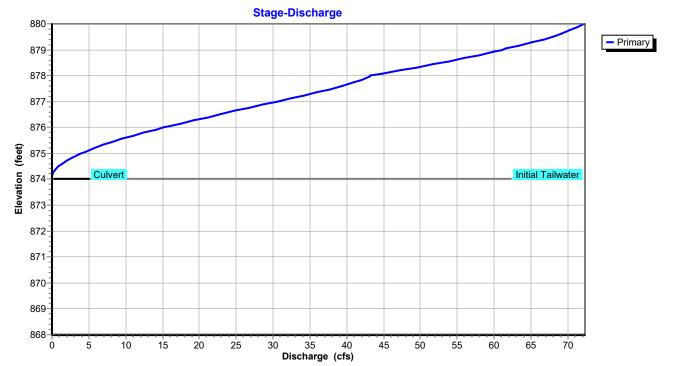
Volume	Inv	ert Avail.Sto	orage Storage	Description		
#1	868.0				c) Listed below (Recalc)	
		,				
Elevatio	n	Surf.Area	Inc.Store	Cum.Store	Wet.Area	
(fee	t)	(sq-ft)	(cubic-feet)	(cubic-feet)	<u>(sq-ft)</u>	
868.0	0	15,446	0	0	15,446	
869.0	0	16,921	16,178	16,178	16,988	
870.0	0	18,453	17,681	33,859	18,591	
871.0	0	20,041	19,242	53,101	20,254	
872.0	0	21,685	20,858	73,959	21,975	
873.0	0	27,575	24,571	98,530	27,892	
874.0	0	29,464	28,514	127,044	29,873	
875.0	0	31,411	30,432	157,476	31,916	
876.0	0	33,413	32,407	189,883	34,017	
877.0	0	35,472	34,437	224,320	36,179	
878.0	0	37,588	36,525	260,845	38,401	
879.0	0	50,492	43,882	304,727	51,326	
880.0	0	54,601	52,533	357,260	55,514	
Device	Routing	Invert	Outlet Devices	6		
#1	Primary	874.00'	36.0" Round	Culvert		
			L= 44.0' RCF	P, square edge hea	adwall, Ke= 0.500	
			Inlet / Outlet Ir	nvert= 874.00' / 87	4.00' S= 0.0000 '/' Cc	= 0.900
			n= 0.011 Con	crete pipe, straigh	t & clean, Flow Area= 7	.07 sf

Primary OutFlow Max=9.85 cfs @ 12.88 hrs HW=876.84' TW=876.75' (Dynamic Tailwater) -1=Culvert (Outlet Controls 9.85 cfs @ 1.83 fps) Pond Design_2020-09-21 Prepared by GRAEF-USA



#### Pond 1P: Wet Detention Pond





Pond Design_2020-09-21 Prepared by GRAEF-USA

Stage-Area-Storage Surface/Horizontal/Wetted Area (sq-ft) 20,000 25,000 30,000 35,000 - Surface 5,000 10,000 40,000 15,000 45,000 50,000 0 880-Storage 879 878 877 876 Elevation (feet) 875-Starting Elevation 874 873 872 871 870 869 **Custom Stage Data** 868 50,000 100,000 150,000 200,000 250,000 300,000 350,000 0

Storage (cubic-feet)

#### Pond 1P: Wet Detention Pond

#### Summary for Pond 2P: Infiltration Basin

Inflow Area =	12.980 ac, 25.58% Impervious, Inflow D	Depth > 3.72" for 100-Year event
Inflow =	9.85 cfs @ 12.88 hrs, Volume=	4.028 af
Outflow =	9.80 cfs @ 12.96 hrs, Volume=	4.028 af, Atten= 1%, Lag= 5.0 min
Discarded =	0.51 cfs @ 12.96 hrs, Volume=	1.217 af
Primary =	9.29 cfs @ 12.96 hrs, Volume=	2.811 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 3 Peak Elev= 876.76' @ 12.96 hrs Surf.Area= 4,226 sf Storage= 9,815 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow) Center-of-Mass det. time= 53.7 min (1,356.5 - 1,302.7)

Volume	Invert	Avail.Stor	age Storage	Description					
#1	874.00'	15,47	0 cf Custom	Custom Stage Data (Prismatic) Listed below (Recalc)					
Elevatio		Irf.Area	Inc.Store	Cum.Store					
(fee	1		(cubic-feet)	(cubic-feet)					
874.0	)0	2,927	0	0					
875.0	00	3,375	3,151	3,151					
876.0	00	3,849	3,612	6,763					
877.0	)0	4,347	4,098	10,861					
878.0	00	4,871	4,609	15,470					
		,							
Device	Routing	Invert	Outlet Device	s					
#1	Discarded	874.00'	3.600 in/hr In	filtration over S	Surface area				
			Conductivity (	to Groundwater	Elevation = 869.00'				
#2	Primary	874.00'	24.0" Round						
	,		L= 23.0' RC	P. square edge	headwall, Ke= 0.500				
				, I O	873.95' S= 0.0022 '/' Cc= 0.900				
					hed, Flow Area= 3.14 sf				
#3	Device 2	874.00'			Limited to weir flow at low heads				
#0 #4	Device 2	876.00'			Crested Weir $Cv= 2.62$ (C= 3.28)				
<del>#4</del>	Device Z	070.00	4.0 10119 X 4.	ou nee sharp-c	(C = 2.02 (C = 3.20))				
Discard		Max-0.51 cfs	@ 12.06 hrs	HW/=876 76' (	Free Discharge)				

**Discarded OutFlow** Max=0.51 cfs @ 12.96 hrs HW=876.76' (Free Discharge) **1=Infiltration** (Controls 0.51 cfs)

**Primary OutFlow** Max=9.29 cfs @ 12.96 hrs HW=876.76' TW=0.00' (Dynamic Tailwater)

**-2=Culvert** (Passes 9.29 cfs of 17.14 cfs potential flow)

-3=Orifice (Orifice Controls 0.68 cfs @ 7.75 fps)

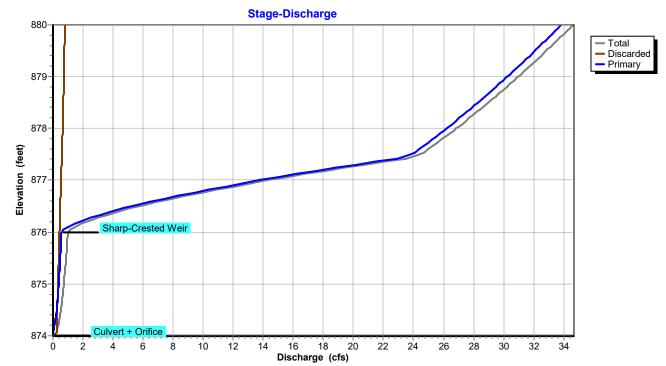
-4=Sharp-Crested Weir (Weir Controls 8.61 cfs @ 2.85 fps)

Pond Design_2020-09-21 Prepared by GRAEF-USA

Hydrograph 11-- Inflow 9.80 cfs - Outflow 10-9.29 cfs Discarded Inflow Area=12.980 ac Primary 9-Peak Elev=876.76' 8-Storage=9,815 cf 7-Flow (cfs) 6-5-4 3-2-1 0.5<mark>1 cfs</mark> 0-0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 Time (hours)

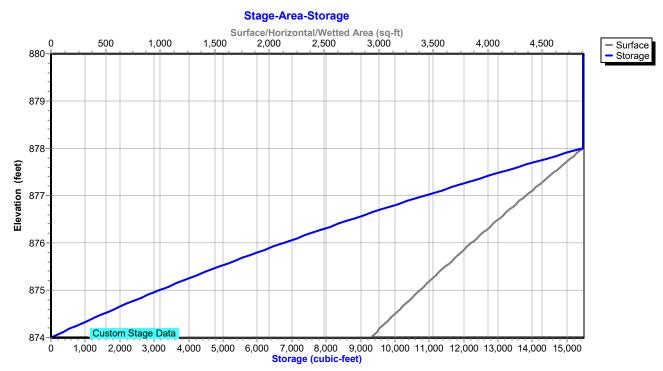






Pond Design_2020-09-21 Prepared by GRAEF-USA

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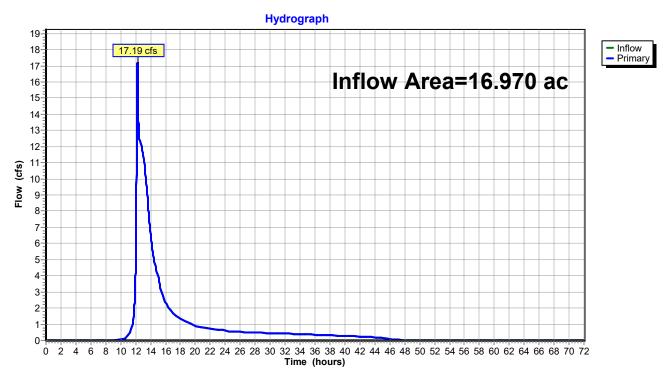
#### **Pond 2P: Infiltration Basin**

Pond Design_2020-09-21	Great Water Alliance Waukesha PROPOSED MSE 24-hr 3 100-Year Rainfall=6.18"
Prepared by GRAEF-USA	Printed 9/21/2020
HydroCAD® 10.10-3a s/n 07832 © 2020 F	HydroCAD Software Solutions LLC Page 49

#### Summary for Link 5L: PROPOSED

Inflow Are	a =	16.970 ac, 20.74% Impervious, Inflow Depth = 2.77" for 100-Year event
Inflow	=	17.19 cfs @ 12.25 hrs, Volume= 3.921 af
Primary	=	17.19 cfs $\overline{@}$ 12.25 hrs, Volume= 3.921 af, Atten= 0%, Lag= 0.0 min

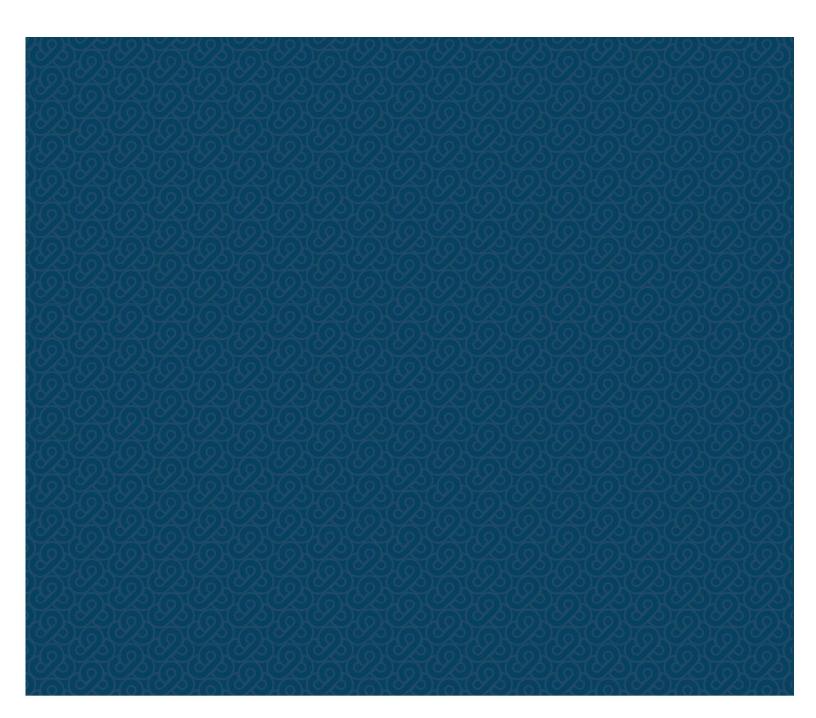
Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

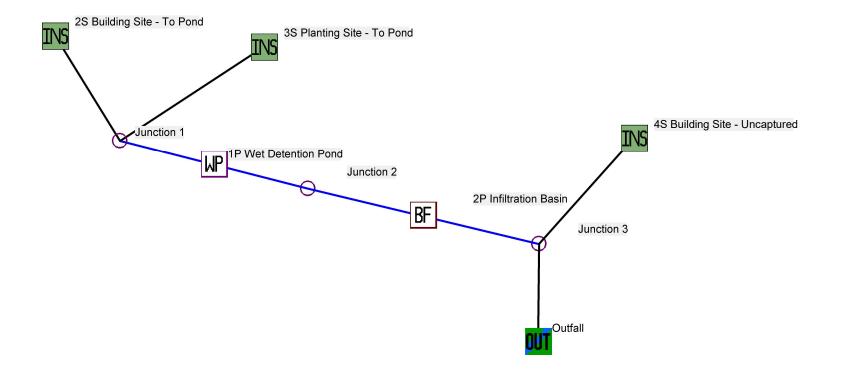


#### Link 5L: PROPOSED



# **Appendix E – WinSLAMM Modeling**





Data file name: C:\Users\1987\Documents\ PROJECTS\20200998.02 Great Water Alliance Waukesha\WinSLAMM\2020-0998.02 GWA Waukesha 2020-09-21.mdb WinSLAMM Version 10.4.1 Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI AVG01.pscx Runoff Coefficient file name: C:\WinSLAMM Files\WI SL06 Dec06.rsvx Residential Street Delivery file name: C:\WinSLAMM Files\WI Res and Other Urban Dec06.std Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std Industrial Street Delivery file name: C:\WinSLAMM Files\WI Com Inst Indust Dec06.std Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI GEO03.ppdx Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv Cost Data file name: Seed for random number generator: -42 Study period starting date: 01/05/69 Study period ending date: 12/31/69 End of Winter Season: 03/28 Start of Winter Season: 12/06 Date: 09-22-2020 Time: 19:59:39 Site information: Great Water Alliance - Booster Pump Station Waukesha, WI LU# 1 - Institutional: 2S Building Site - To Pond Total area (ac): 9.540 1 - Roofs 1: 1.660 ac. Pitched Connected PSD File: C:\WinSLAMM Files\NURP.cpz 13 - Paved Parking 1: 1.660 ac. Connected PSD File: C:\WinSLAMM Files\NURP.cpz 45 - Large Landscaped Areas 1: 2.236 ac. Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz 46 - Large Landscaped Areas 2: 1.118 ac. Normal Silty PSD File: C:\WinSLAMM Files\NURP.cpz 47 - Large Landscaped Areas 3: 2.236 ac. Normal Sandy PSD File: C:\WinSLAMM Files\NURP.cpz 70 - Water Body Areas: 0.630 ac. PSD File: LU# 2 - Institutional: 4S Building Site - Uncaptured Total area (ac): 3.990 PSD File: C:\WinSLAMM Files\NURP.cpz 13 - Paved Parking 1: 0.200 ac. Connected 45 - Large Landscaped Areas 1: 1.896 ac. Normal Sandy PSD File: C:\WinSLAMM Files\NURP.cpz 46 - Large Landscaped Areas 2: 0.631 ac. Normal Silty PSD File: C:\WinSLAMM Files\NURP.cpz Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz 47 - Large Landscaped Areas 3: 1.263 ac. LU# 3 - Institutional: 3S Planting Site - To Pond Total area (ac): 3.440 Normal Sandy PSD File: C:\WinSLAMM Files\NURP.cpz 57 - Undeveloped Areas 1: 1.720 ac. 58 - Undeveloped Areas 2: 1.720 ac. Normal Clayey Low Density PSD File: C:\WinSLAMM Files\NURP.cpz Control Practice 1: Wet Detention Pond CP# 1 (DS) - 1P Wet Detention Pond Particle Size Distribution file name: Not needed - calculated by program Initial stage elevation (ft): 6 Peak to Average Flow Ratio: 3.8 Maximum flow allowed into pond (cfs): No maximum value entered **Outlet Characteristics:** Outlet type: Orifice 1 1. Orifice diameter (ft): 3 2. Number of orifices: 1 3. Invert elevation above datum (ft): 6 Outlet type: Broad Crested Weir 1. Weir crest length (ft): 10 2. Weir crest width (ft): 10 3. Height from datum to bottom of weir opening: 10 Pond stage and surface area Entry Stage Pond Area Natural Seepage Other Outflow Number (ft) (acres) (in/hr) (cfs) 0.ÒÓ 0.00Ó0 Ò.00 0.00 0 1 0.01 0.3550 0.00 0.00 2 1.00 0.3880 0.00 0.00 3 2.00 0.4240 0.00 0.00 4 3.00 0.4600 0.00 0.00 5 4.00 0.4980 0.00 0.00 6 5.00 0.6330 0.00 0.00 7 6.00 0.6760 0.00 0.00 8 7.00 0.00 0.00 0.7210 9 8.00 0.7670 0.00 0.00 9.00 10 0.8140 0.00 0.00 10.00 0.8630 11 0.00 0.00 12 11.00 1.1590 0.00 0.00 12.00 1.2530 0.00 0.00 13

Control Practice 2: Biofilter CP# 1 (DS) - 2P Infiltration Basin

1. Top area (square feet) = 4871

- 2. Bottom aea (square feet) = 2927
- 3. Depth (ft): 4
- 4. Biofilter width (ft) for Cost Purposes Only: 10
- 5. Infiltration rate (in/hr) = 3.6
- 6. Random infiltration rate generation? No
- Infiltration rate fraction (side): 1 7.
- 8. Infiltration rate fraction (bottom): 1
- 9. Depth of biofilter that is rock filled (ft) 0
- 10. Porosity of rock filled volume = 0
- 11. Engineered soil infiltration rate: 0
- 12. Engineered soil depth (ft) = 0
- 13. Engineered soil porosity = 0
- 14. Percent solids reduction due to flow through engineered soil = 0
- 15. Biofilter peak to average flow ratio = 3.8
- 16. Number of biofiltration control devices = 1
- 17. Particle size distribution file: Not needed calculated by program
- 18. Initial water surface elevation (ft):0Soil DataSoil Type Fraction in Eng. Soil
- Biofilter Outlet/Discharge Characteristics:
  - Outlet type: Sharp Crested Weir 1. Weir length (ft): 4

    - 2. Invert elevation above datum (ft): 2
  - Outlet type: Broad Crested Weir
    - 1. Weir crest length (ft): 10
    - 2. Weir crest width (ft): 10
    - 3. Height of datum to bottom of weir opening: 3.99
  - Outlet type: Surface Discharge Pipe
    - 1. Surface discharge pipe outlet diameter (ft): 0.33
    - 2. Pipe invert elevation above datum (ft): 0
    - 3. Number of surface pipe outlets: 1

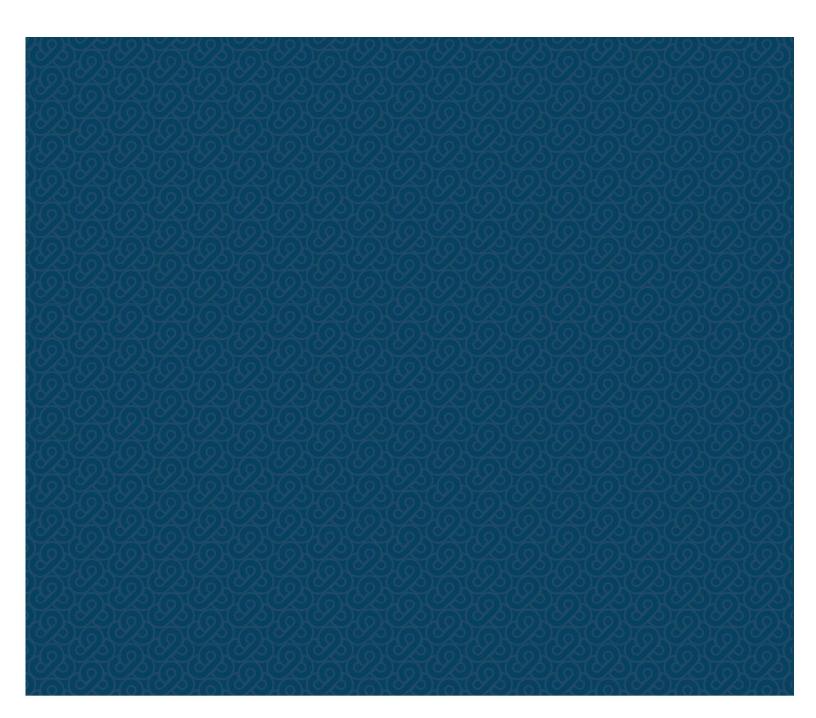
Data file name: C:\Users\1987\Documents_PROJECTS\20200998.02 Great Water Alliance Waukesha\WinSLAMM\2020-0998.02 GWA Waukesha 2020-09-21.mdb WinSLAMM Version 10.4.1

Rain file name: C:\WinSLAMM Files\Rain Files\WisReg - Milwaukee WI 1969.RAN Particulate Solids Concentration file name: C:\WinSLAMM Files\v10.1 WI_AVG01.pscx Runoff Coefficient file name: C:\WinSLAMM Files\WI_SL06 Dec06.rsvx Pollutant Relative Concentration file name: C:\WinSLAMM Files\WI GEO03.ppdx Residential Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std Institutional Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std Commercial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std Industrial Street Delivery file name: C:\WinSLAMM Files\WI_Com Inst Indust Dec06.std Other Urban Street Delivery file name: C:\WinSLAMM Files\WI_Res and Other Urban Dec06.std Freeway Street Delivery file name: C:\WinSLAMM Files\Freeway Dec06.std Apply Street Delivery Files to Adjust the After Event Load Street Dirt Mass Balance: False Source Area PSD and Peak to Average Flow Ratio File: C:\WinSLAMM Files\NURP Source Area PSD Files.csv Cost Data file name: Seed for random number generator: -42 Study period starting date: 01/05/69 Study period ending date: 12/31/69 Start of Winter Season: 12/06 End of Winter Season: 03/28 Model Run Start Date: 01/05/69 Model Run End Date: 12/31/69 Date of run: 09-22-2020 Time of run: 19:59:01 Total Area Modeled (acres): 16.970 Years in Model Run: 0.99 Runoff Percent Particulate Particulate Percent

		Volume (cu ft)	Runo Volun Redu	ne Conc.	Solids Yield (lbs)	Particula Solids Reductio	
Total of all Land Uses w Outfall Total with Contro Annualized Total After C	ls:	424790 174782 177209	- 58.8	78.12 85% 47.09	2072 513.8 520.9	75.20%	6
Pollutant Particulate Solids Total Phosphorus	Conc. No Controls 78.12 0.3283	Conc. With Controls 47.09 0.2848	Conc. Units mg/L mg/l	Pollutant Yield No Controls 2072 8 707	Pollutant Yield With Controls 513.8 3 108	Pol. Yield Units Ibs	Percent Reduction 75.20 % 64.30 %
Annualized Total After C Pollutant	Outfall Controls: Conc. No Controls	177209 Conc. With Controls	Conc. Units	Pollutant Yield No Controls	520.9 Pollutant Yield With Controls	Pol. Yield Units	P R



# Appendix F – WWU and Waukesha Long Term Maintenance Agreement



Waukesha Water Utility, as "Owner" of the property described below, in accordance with Chapter 32 City of Waukesha Storm Water Management and Erosion Control, agrees to install and maintain storm water management practice(s) on the subject property in accordance with approved plans and Storm Water Management Plan conditions. The owner further agrees to the terms stated in this document to ensure that the storm water management practice(s) continues serving the intended functions in perpetuity. This Agreement includes the following exhibits:

Exhibit A: Legal Description of the real estate for which this Agreement applies ("Property").
Exhibit B: Location Map(s) – shows an accurate location of each storm water management practice affected by this Agreement.
Exhibit C: Maintenance Plan – prescribes those activities that must be carried out to maintain compliance with this Agreement.

<u>Note</u>: After construction verification has been accepted by the City of Waukesha, for all planned storm water management practices, an <u>addendum(s)</u> to this agreement shall be recorded by the Owner showing design and construction details. The addendum(s) may contain several additional exhibits, including certification by City of Waukesha of Storm Water and Erosion Control Permit termination, as described below.

Through this Agreement, the Owner hereby subjects the Property to the following covenants, conditions and restrictions:

- 1. The Owner shall be responsible for the routine and extraordinary maintenance and repair of the storm water management practice(s) and drainage easements identified in Exhibit B until Storm Water and Erosion Control Permit termination by the City of Waukesha in accordance with Chapter 32 of the City Code of Ordinances.
- 2. After Storm Water and Erosion Control Permit termination under 1., the current Owner(s) shall be solely responsible for maintenance and repair of the storm water management practices and drainage easements in accordance with the maintenance plan contained in Exhibit C.
- 3. The Owner(s) shall, at their own cost, complete inspections of the storm water management practices at the time intervals listed in Exhibit C, and conduct the inspections by a qualified professional, file the reports with the City of Waukesha after each inspection and complete any maintenance or repair work recommended in the report. The Owner(s) shall be liable for the failure to undertake any maintenance or repairs. After the work is completed by the Contractor, the qualified professional shall verify that the work was properly completed and submit the follow-up report to the City within 30 days.
- 4. In addition, and independent of the requirements under paragraph 3 above, the City of Waukesha, or its designee, is authorized to access the property as necessary to conduct inspections of the storm water management practices or drainage easements to ascertain compliance with the intent of this Agreement and the activities prescribed in Exhibit C. The City of Waukesha may require work to be done which differs from the report described in paragraph 3 above, if the City of Waukesha reasonably concludes that such work is necessary and consistent with the intent of this agreement. Upon notification by the City of Waukesha of required maintenance or repairs, the Owner(s) shall complete the specified maintenance or repairs within a reasonable time frame determined by the City of Waukesha.
- 5. If the Owner(s) do not complete an inspection under 3. above or required maintenance or repairs under 4. above within the specified time period, the City of Waukesha is authorized, but not required, to perform the specified inspections, maintenance or repairs. In the case of an emergency situation, as determined by the City of Waukesha, no notice shall be required prior to the City of Waukesha performing emergency maintenance or repairs. The City of Waukesha may levy the costs and expenses of such inspections, maintenance or repair related actions as a special charge against the Property and collected as such in accordance with the procedures under s. 66.0627 Wis. Stats. or subch. VII of ch. 66 Wis. Stats.

Name and Return Address

City of Waukesha 130 Delafield Street Waukesha, WI 53188

Parcel Identification Number(s) -_

6. This Agreement shall run with the Property and be binding upon all heirs, successors and assigns. After the Owner records the addendum noted above, the City of Waukesha shall have the sole authority to modify this agreement upon a 30-day notice to the current Owner(s).

Dated this ____ day of _____, 2021.

**Owner:** 

(Owners Signature)

(Owners Typed Name)

#### Acknowledgements

State of Wisconsin: County of Waukesha

This document was drafted by:

Milwaukee, Wisconsin 53203

Graef-USA, Inc.

(414) 259-1500

Personally came before me this _____ day of ______, 2021, the above named ______ to me known to be the person who executed the foregoing instrument and acknowledged the same.

> (Name) Notary Public, Waukesha County, WI My commission expires: ______.

275 W Wisconsin Avenue, Suite 300 Ear Contification Stamm

#### City of Waukesha Common Council Approval

Dated this ____ day of _____, 202_.

Shawn N. Reilly, Mayor

Gina Kozlik, City Clerk

#### Acknowledgements

State of Wisconsin: County of Waukesha

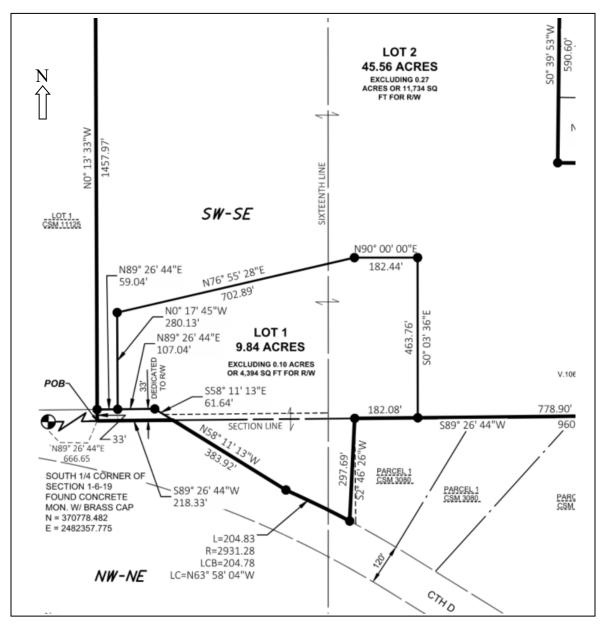
Personally came before me this _____ day of ______, 2021, the above named ______ to me known to be the person who executed the foregoing instrument and acknowledged the same.

(Name) Notary Public, Waukesha County, WI My commission expires: ______.

#### **Exhibit A – Legal Description**

The following description and reduced copy map identify the land parcel(s) affected by this Agreement. For a larger scale view of the referenced document, contact the Waukesha County Register of Deeds office.

Site Name: Date of Recording:	GWA Booster Pumping Station and Water Tower	Acres: 17.0
Map Produced By:	Benjamin Larson, N17 W24222 Riverwood Dr, Suite 31	0, Waukesha WI 53188
Legal Description:	Lot 1 of CSM, located in the southwest 1/4 of	the southeast 1/4, and the southeast
	1/4 of the southeast 1/4 of section 1, the northwest 1/4 of	the northeast 1/4 and the
	northeast 1/4 of the northeast 1/4 of section 12 township	6 north, range 19 east, in the City
	of Waukesha, Waukesha County, Wisconsin.	

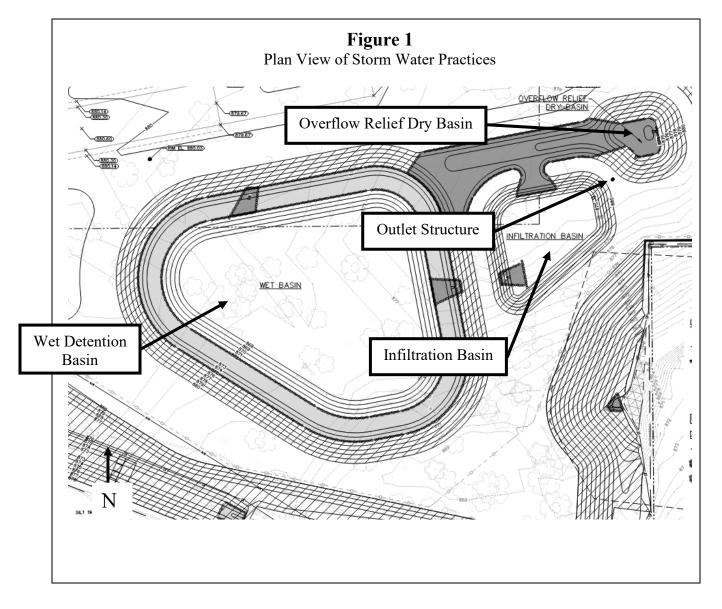


<u>Site notes</u>: See Exhibit C for specific maintenance requirements for storm water management practices within this area.

#### **Exhibit B - Location Map** Storm Water Management Practices Covered by this Agreement

The storm water management practices covered by this Agreement are depicted in the reduced copy of a portion of the construction plans, as shown below. The practices include one wet detention basin, one infiltration basin, one overflow relief dry basin and all associated pipes, earthen berms, rock chutes and other components of these practices.

Site Name:GWA Booster Pumping Station and Water TowerStorm water Practices:Wet Detention Basin, Infiltration Basin, Overflow Relief Dry BasinLocation of Practices:South end of site (See Figure 1)Owners:Waukesha Water Utility



#### Exhibit C Storm Water Practice Maintenance Plan

This exhibit explains the basic function of each of the storm water practices listed in Exhibit B and prescribes the minimum maintenance requirements to remain compliant with this Agreement. The maintenance activities listed below are aimed to ensure these practices continue serving their intended functions in perpetuity. The list of activities is not all inclusive, but rather indicates the minimum type of maintenance that can be expected for this particular site. Any failure of a storm water practice that is caused by a lack of maintenance will subject the Owner(s) to enforcement of the provisions listed on page 1 of this Agreement by the City of Waukesha.

#### System Description:

A wet detention basin and a dry infiltration basin will be constructed on-site to control stormwater by reducing the rate of runoff and enhancing the quality of runoff flowing from the site. The Wet Detention Basin is connected to the Infiltration Basin with a 36-inch diameter round culvert. The Infiltration Basin drains into an Overflow Basin and then to the wetland through the outlet. The outlet functions as a multi-stage outlet, with a 4-inch diameter low-flow orifice outlet, and a 24-inch diameter high-flow orifice.

The proposed development consists of approximately 17 acres of developed land, delineated into two sub-basins. The proposed development will disturb approximately 13.5 acres and will result in a net increase in impervious area of approximately 2.81 acres. The Wet Detention Basin is in the Sub-Pond 1 Area and collects flow from the site via storm sewer and overland flows. As runoff enters the pond, it is held back (detained) and slowly released through the control orifices. The Wet Detention Basin, along with the Infiltration Basin, will reduce the Total Suspended Solid (TSS) concentration in runoff by 75% (the TSS resulting composite goal) and will also dissipate chlorine from clear water discharges.

For the system to operate properly, the pond size, water level and outlet structures must be maintained as specified in this Agreement (see Figures 1, 2 and 3). "As-built" construction drawings of the basin, showing actual dimensions, elevations, outlet structures, etc. will be recorded as an addendum(s) to this agreement within 60 days after City of Waukesha accepts verification of construction from the project engineer.

#### Minimum Maintenance Requirements for the Wet Detention Basin:

To ensure the proper long-term function of the storm water management practices described above, the following activities must be completed:

- 1. All outlet pipes must be checked monthly to ensure there is no blockage from floating debris or ice, especially the washed stone in front of the 3-inch orifice and the trash rack on the riser in the main basin. Any blockage must be removed immediately. The washed stone must be replaced when it becomes clogged.
- 2. Inlets and outlets must be checked after heavy rains (minimum of annually) for signs of erosion. Any eroding areas must be repaired immediately to prevent premature sediment build-up in the downstream forebays or basin. Erosion matting is recommended for repairing grassed areas.
- 3. NO trees are to be planted or allowed to grow on the earthen berms. Tree root systems can reduce soil compaction and cause berm failure. The berms must be inspected annually, and any woody vegetation removed.
- 4. Invasive plant and animal species shall be managed in compliance with Wisconsin Administrative Code Chapter NR 40. This may require eradication of invasive species in some cases.
- 5. If the permanent pool falls below the safety shelf, a review shall be performed to determine whether the cause is liner leakage or an insufficient water budget. If the cause is leakage, the liner shall be repaired. Leakage due to muskrat burrows may require removal of the animals. If the permanent pool cannot be sustained at the design elevation, benching of the safety shelf may be necessary.
- 6. If floating algae or weed growth becomes a nuisance (decay odors, etc.), it must be removed from the basin or the forebay and deposited where it cannot drain back into the basin. Removal of the vegetation from the water reduces regrowth the following season (by harvesting the nutrients). Wetland vegetation must be maintained along the waters edge for safety and pollutant removal purposes.
- 7. When sediment in the infiltration basin and wet detention basin has accumulated to an elevation of three feet below the outlet elevation, it must be removed (see Exhibit D). All removed sediment must be placed in an appropriate upland disposal site and stabilized (grass cover) to prevent sediment from washing back

into the basin. The forebays will likely need sediment removal first. Failure to remove sediment from the forebays will cause resuspension of previously trapped sediments and increase downstream deposition.

- 8. No grading or filling of the basins or berm other than for sediment removal is allowed, unless otherwise approved by the City of Waukesha.
- 9. Periodic mowing of the grass swales will encourage vigorous grass cover and allow better inspections for erosion. Waiting until after August 1 will avoid disturbing nesting wildlife. Mowing around the basin or the forebays may attract nuisance populations of geese to the property and is not necessary or recommended.
- 10. Any other repair or maintenance needed to ensure the continued function of the storm water practices or as ordered by the City of Waukesha under the provisions listed on page 1 of this Agreement.
- 11. The titleholder(s) or their designee must document all inspections as specified above. Documentation shall include as a minimum: (a) Inspectors Name, Address and Telephone Number, (b) Date of Inspections, (c) Condition Report of the Storm Water Management Practice, (d) Corrective Actions to be Taken and Time Frame for Completion, (e) Follow-up Documentation after Completion of the Maintenance Activities. All documentation is to be delivered to the attention of the City Engineer at the City of Waukesha Engineering Department on January 10th and July 10th each year.

#### Minimum Maintenance Requirements for Infiltration Basin:

To ensure the proper function of storm water infiltration basin, the following list of maintenance activities are recommended:

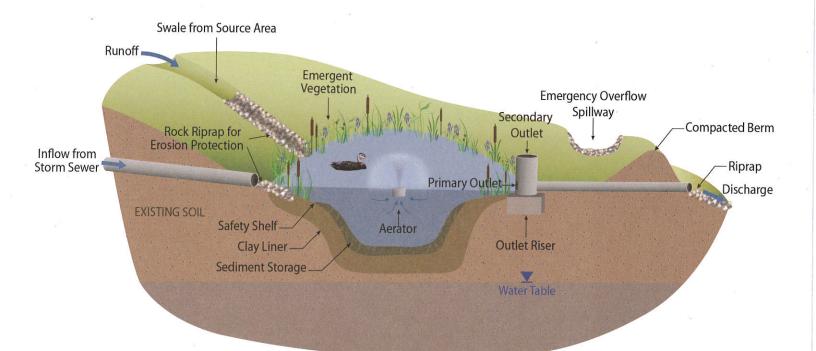
- 1. A minimum of 70% soil cover made up of native grasses must be maintained on the basin bottom to ensure infiltration rates. Periodic burning or mowing is recommended to enhance establishment of the prairie grasses (which may take 2-3 years) and maintain the minimum native cover. To reduce competition from cool season grasses (bluegrass, fescues, quack, etc.) and other weeds:
  - For the first year, cut to a 6" height three times once each in June, July and early August. To prevent damage to the native grasses, do not mow below a 6" height. Remove excessive accumulation of clippings to avoid smothering next year's seedlings.
  - After the first year, mowing may only be needed in early June each year to help control the spread of cool season plants. The mowing should also be raised to 10-12" to avoid damage to the warm season plants.
  - Burning may also be used to manage weeds in 2-5 years intervals. Late spring burns (mid-late May) provide maximum stimulus to warm season grasses and work well to control cool season grasses. Burn when the cool season grasses are growing, and the warm season plants are just barely starting to grow to get maximum control of cool season species.
  - Any major bare areas or areas taken over by nonnative species must be reseeded. To clear area of weeds and cool season grasses, treat with an herbicide that contains glysophosphate in accordance with manufacturer's instructions. Ensure a firm seedbed is prepared to a depth of 3 inches (a roller is recommended). Seeding should occur in early-mid June. Seed with Big Bluestem, Indian Grass, Little Blue Stem or Switchgrass (preferably an equal mix of all four types). A companion crop of oats is recommended. Seed must be placed at a depth of 1/4 1/2" and a minimum rate of 1/4 pound per 100 square feet. If broadcast seeding by hand, drag leaf rake over soil surface after seeding. Then roll it again and cover with a light layer of mulch and staked erosion control netting to hold it in place until germination. For other planting details, see NRCS standard 342 (Critical Area Planting).
- 2. Invasive plant and animal species shall be managed in compliance with Wisconsin Administrative Code Chapter NR 40. This may require eradication of invasive species in some cases.
- 3. The basin and all components (inlets, outlets, etc.) should be inspected after each heavy rain, but at a minimum of once per year. If the basin is not draining properly (within 72 hours), further inspection may be required by persons with expertise in storm water management and/or soils.
  - If soil testing shows that the soil surface has become crusted, sealed or compacted, some deep tillage should be performed. Deep tillage will cut through the underlying soils at a 2-3 foot depth, loosening the soil and improving infiltration rates, with minimal disturbance of the surface vegetation. Types of tillage equipment that can be used include a subsoiler or straight, narrow-shanked chisel plow.
  - If sedimentation is determined to be causing the failure, the accumulated sediment must be removed, and the area reseeded in accordance with the notes above.
  - If inspection of the monitoring well shows that groundwater is regularly near the surface, additional design features may need to be considered, such as subsurface drainage or conversion to a wetland treatment system.

- If the washed stone trench has become clogged, the stone and possibly the soil immediately around the stone must be replaced.
- 4. All outlet pipes, stone trenches and other flow control devices must be kept free of debris. Any blockage must be removed immediately.
- 5. Any eroding areas must be repaired immediately to prevent premature sediment build-up in the system. Erosion matting is recommended for repairing grassed areas.
- 6. Heavy equipment and vehicles must be kept off of the bottom and side slopes of infiltration basins to prevent soil compaction. Soil compaction will reduce infiltration rates and may cause failure of the basin, resulting in ponding and possible growth of wetland plants.
- 7. No trees are to be planted or allowed to grow on the earthen berms of the bottom of the basin. On the berms, tree root systems can reduce soil compaction and cause berm failure. On the basin bottom, trees may shade out the native grasses. The basin must be inspected annually, and any woody vegetation removed.
- 8. Grass swales leading to the basin shall be preserved to allow free flowing of surface runoff in accordance with approved grading plans. No buildings or other structures are allowed in these areas. No grading or filling is allowed that may interrupt flows in any way.
- 9. If floating algae or weed growth becomes a nuisance in the forebay (decay odors, etc.), it must be removed and deposited where it cannot drain back into the basin or forebay. Removal of the vegetation from the water reduces regrowth the following season (by harvesting the nutrients). Wetland vegetation must be maintained along the waters edge for safety and pollutant removal purposes.
- 10. When sediment in the forebay has accumulated to an elevation of three feet below the outlet elevation, it must be removed (refer to figure). All removed sediment must be placed in an appropriate upland disposal site and stabilized (grass cover) to prevent sediment from washing back into the basin. Failure to remove sediment from the forebays will cause resuspension of previously trapped sediments and increase deposition in the infiltration basin.
- 11. No grading or filling of the basin or berms other than for sediment removal is allowed.
- 12. Periodic mowing of the grass swales will encourage rigorous grass cover and allow better inspections for erosion. Waiting until after August 1 will avoid disturbing nesting wildlife. Mowing around forebay may attract nuisance populations of geese to the property and is not necessary or recommended.
- 13. Any other repair or maintenance needed to ensure the continued function of the infiltration basin as ordered by the City of Waukesha under the provisions listed on page 1 of this Agreement.
- 14. The titleholder(s) or their designee must document all inspections as specified above. Documentation shall include as a minimum: (a) Inspectors Name, Address and Telephone Number, (b) Date of Inspections, (c) Condition Report of the Storm Water Management Practice, (d) Corrective Actions to be Taken and Time Frame for Completion, (e) Follow-up Documentation after Completion of the Maintenance Activities. All documentation is to be delivered to the attention of the City Engineer at the City of Waukesha Engineering Department on January 10th and July 10th each year.

# STORMWATER PONDS Guidelines for Maintenance

A stormwater pond is a best management practice (BMP) that collects and holds storm runoff to remove pollutants carried by the water before they enter our rivers and lakes. Water reaches the stormwater pond through a combination of underground pipes, ditches and overland flow. Once the runoff enters the stormwater pond, sediment and other pollutants settle to the bottom. The water that entered as polluted runoff leaves the pond gradually, resulting in cleaner water draining into our lakes and streams and reduced flooding problems downstream.

Stormwater ponds are carefully designed to hold and treat runoff. Over time, the pond fills in with sediments and begins to lose its ability to remove pollutants. A smaller "forebay" may be present, which may fill up with sediment first. Maintenance is needed for the pond to continue to function the way it was designed, to protect our lakes and streams. Maintenance is also required by an agreement on file with the municipality.



# **ANNUAL MAINTENANCE FOR STORMWATER PONDS**

#### **DO-IT-YOURSELF**

There are some maintenance jobs that can—and should—be regularly attended to by the owner of the stormwater pond. This includes:

- Remove vegetation/debris obstructions around the outlet pipes and trash rack. Outlets come in a variety of shapes and designs and may look different from the drawing on page 1.
- Check the sediment depth—most easily done through hole in ice when frozen. Many ponds will have a forebay where the runoff flows in, intended to trap the bulk of the sediment and which will fill up first.(See page 3.)
- Record water levels including depth along the safety shelf. This is best done by reading a depth gauge that is permanently mounted in the pond.
- Visually assess water quality and estimate percent weed/algae cover in early and late summer.
- Remove trash, litter and invasive plants. Cattails or reeds around the edge of the pond (safety shelf) help deter children and geese from entering the water and should be left uncut.

#### **ENLIST A PROFESSIONAL**

Besides the maintenance that owners can do, a qualified inspector should be hired to annually inspect the pond and check for the following:

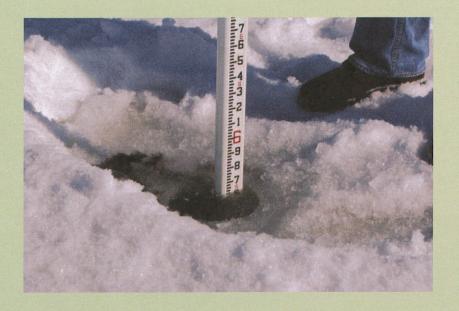
- The condition of the pipes, swales or structures where water flows into and out of the basin.
- Erosion of sideslopes, embankments, inlet/outlet, and emergency spillway, including the condition of rock riprap and underlying fabric.
- The condition of the pond liner (if present). Patch holes and remove burrowing animals, if necessary.

- Remove trees sprouting along the embankments. Left to grow, tree roots threaten the structural integrity of the embankments.
- Be sure to check the engineering design before doing any digging. Ponds often have a clay or synthetic lining that could be punctured or damaged resulting in a pond that no longer holds water.
- Inspect any fencing or signage for damage.
- Replace spent mosquito control devices.
- Invite bats to the area by installing bat houses to provide natural mosquito control.
- Aeration is sometimes added for algae control. While it helps with the aesthetics of a pond, it detracts from the sediment trapping abilities. Turn off aerators during rain or snow melt periods to allow settling of sediment.

- The presence of invasive species. Develop a plan for their removal if necessary.
- The permanent pool elevation and sediment depth by surveying and referencing to a vertical benchmark (known elevation).
- Soft spots or settling that may have occurred in the embankment.

For a sample inspection report, visit the Waukesha County website at www.waukeshacounty.gov/cleanwater.

# **CHECKING SEDIMENT DEPTH**



Simply use an ice auger to drill a hole and insert a measuring pole or rod into the hole to get the total depth. If distance from water surface to top of sediment is less than 3 feet, refer to a professional for advice on possible sediment removal. A reference to as-built surveys and design water levels is necessary. You may have less than 3 feet if water levels are low, so record water from the depth gauge levels at the same time. (See page 2.)

## MANAGING THE WATERSHED: WHAT HOMEOWNERS CAN DO

Many stormwater ponds are owned by a group of landowners and maintained through a homeowner association within a subdivision. In addition to maintaining the ponds, there are actions that each homeowner can take to manage the land that drains to the ponds. The following will help extend the life of the ponds and reduce water pollution at the same time:

- Regularly sweep litter and grass clippings off sidewalks, driveways, streets and parking lots.
- Test the soil in landscaped areas, and follow recommended application rates for fertilizers and pesticides.
- Pick up after pets. This also helps keep excess nutrients and bacteria out of the pond.
- Minimize salt application to impervious areas. Salt generally passes through the pond soils, damaging the plants and polluting the receiving surface and groundwater resources.
- Prevent sediment from leaving construction sites. The more sediment that enters the pond, the sooner it will require expensive soil restoration or replanting.

Ponds that fill up with sediment over time will have to be cleaned out, requiring expensive maintenance like dredging. Proper care and maintenance of your pond will extend its life.





## **Enforcement of Stormwater Pond Maintenance**

Maintenance responsibilities for stormwater ponds are usually documented as a deed restriction or a maintenance agreement that was recorded on the property when the pond was built. Maintenance can also be required through a local ordinance to meet clean water laws. The local municipality or stormwater utility district is the likely regulatory agency for maintenance. Either way, the regulatory agency can require the owner(s) of a stormwater pond to perform and report inspections and to complete repairs and maintenance activities as needed. If the owner(s) fails to comply, the regulatory agency may resort to citations or other enforcement measures, or may perform the maintenance activities itself and recover the costs through special charges on the property tax bill.

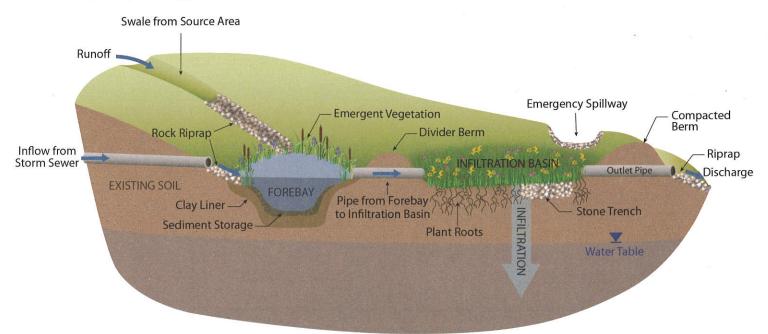
Developed by Waukesha County Department of Parks & Land Use with funding from the Wisconsin Department of Natural Resources (2015).

# **INFILTRATION BASINS** Guidelines for Maintenance

A n infiltration basin is a storm water best management practice (BMP) designed to capture runoff and let it soak into the ground—a process called infiltration. The basin is carefully engineered to infiltrate runoff volumes from the specific land area, or watershed that drains to the basin. Runoff will enter the infiltration basin through a combination of underground pipes, ditches and overland flow. A small pond, or forebay, is usually constructed at the inflow area to trap sediment and attached pollutants before entering the infiltration basin. This can help prevent plugging the soils in the infiltration basin.

The bottom of the infiltration basin is flat, wide and planted with vegetation specifically designed to encourage infiltration (see page 2). There may be a stone-filled trench constructed within the basin bottom or near the perimeter to further enhance infiltration, especially during frozen ground periods. The basin will usually have an overflow pipe and an emergency spillway to handle runoff events that exceed the design capacity. The infiltration basin is generally designed not to pond runoff in the basin for more than a few days at a time.

An infiltration basin may act like a leaky pond, but they are very effective at protecting local lakes, rivers and downstream properties from water pollution and flooding caused by urban runoff. Infiltrating runoff also helps replenish the groundwater, the source of drinking water for 80% of Wisconsin residents. Groundwater also supports water levels in local lakes and base flows in streams, especially during periods of dry weather.



Note: Rain gardens are essentially small infiltration basins. They are designed to capture and infiltrate runoff from small watersheds such as a rooftop, driveway or small parking lot. Some roadside or backyard swales are also designed as small infiltration practices.

# THE NATIVE LANDSCAPE

# Root Systems of Prairie Plants

Before our landscape was developed, very little rainfall actually ran off the ground. Most of it soaked into the soil, where it was either used by plants or became part of the groundwater system. Native plants are used in infiltration basins to help replicate some of these conditions. Native plants have very deep root systems with as much as twothirds of the plant being underground. This massive root system improves the soil, creating more pathways for infiltration, and making the basin more effective at soaking up runoff and filtering pollutants. By comparison, turf grass (pictured at far left in the illustration) only has a few inches of root mass. Other benefits of using native plants include:

- Creating habitat and food sources for birds, butterflies, bees and other wildlife.
- Absorbing more nutrients in runoff like phosphorous and nitrogen, which cause algae blooms and excessive weed growth in lakes and streams.
- Improving aesthetics of the infiltration basin, providing year round interest and color with a mix of wildflowers and grasses.
- Reducing maintenance needs (once established), such as mowing, watering (plants are drought resistant), or use of fertilizer or pesticide.

# MANAGING THE WATERSHED: WHAT HOMEOWNERS CAN DO

Many infiltration basins are owned by a group of landowners and maintained through a homeowner association within a subdivision. In addition to maintaining the basin, there are actions that each homeowner can take to manage the land that drains to the basin. The following will help extend the life of the basin and reduce water pollution at the same time:

- Regularly sweep litter and grass clippings off sidewalks, driveways, streets and parking lots.
- Test the soil in landscaped areas, and follow recommended application rates for fertilizers and pesticides.

- Pick up after pets. This also helps keep excess nutrients and bacteria out of the basin.
- Minimize salt application to impervious areas. Salt generally passes through the basin soils, damaging the plants and polluting the receiving surface and groundwater resources.
- Prevent sediment from leaving construction sites. The more sediment that enters the basin, the sooner it will require expensive soil restoration or replanting.

# **MAINTENANCE FOR INFILTRATION BASINS**

#### **DO-IT-YOURSELF**

There are some maintenance jobs that can—and should—be regularly attended to by the owner of the infiltration basin. This includes:

- Inspect and remove debris in the forebay, or near the inflow or outlet pipes, stone trench and spillway.
- Remove weeds by carefully spotapplying herbicide rather than by pulling. This is because pulling weeds disturbs the soil and provides an opening for invasive species to grow.

#### **ENLIST A PROFESSIONAL**

Besides the maintenance that an owner can do, a qualified inspector should be hired annually to inspect and repair the following, as needed:

- The condition of the forebay, including the amount of sediment build-up or liner damage. Take soil cores if needed to evaluate liner. Patch holes and remove burrowing animals, if necessary.
- The condition of the pipes, swales or structures where water flows into and out of the basin.
- Erosion of side slopes, embankments, inlet/outlet, and emergency spillway, including the condition of rock riprap and underlying filter fabric.
- Detect the presence of invasive species.
   Develop a plan for their removal if necessary.
- Soft spots or settling that may have occurred in the embankment.

- Remove excessive dead plant material in the early spring.
- Replant with different species if an original plant dies out. The original plant may have been unsuitable for the soil type or degree of wetness.
- Water native plants during establishment only. Once established, watering won't be necessary.

- Diagnose any reported prolonged ponding (more than three days). Evaluate the condition of the soils, taking core samples and testing infiltration rates, if needed.
- Burn every-other-year in April where feasible. Otherwise, mow in late spring or very early summer to a height of 4 to 6 inches. The purpose is to cut the weeds before they can go to seed, and do it before the native plants start to really shoot up. This cutting height generally requires a brush hog or similar device. A normal lawn mower will cut it too short.
- Remove any large trees growing in the embankment and re-compact the soil as needed.
  - Develop plans to repair damaged structures, plantings or forebay liners, to remove sediment or enhance soil infiltration rates (aeration, tillage, etc.), if necessary.

For a sample inspection report, visit: www.waukeshacounty.gov/cleanwater.

## **Enforcement of Infiltration Basin Maintenance**

Maintenance responsibilities for infiltration basins are usually documented as a deed restriction or a maintenance agreement that was recorded on the property when the basin was built. Maintenance can also be required through a local ordinance to meet clean water laws. The local municipality or storm water utility district is the likely regulatory agency for maintenance. Either way, the regulatory agency can require the owner(s) of an infiltration basin to perform and report inspections and to complete repairs and maintenance activities as needed. If the owner(s) fails to comply, the regulatory agency may resort to citations or other enforcement measures, or may perform the maintenance activities itself and recover the costs through special charges on the property tax bill.

Developed by Waukesha County Department of Parks & Land Use with funding from the Wisconsin Department of Natural Resources (2015).

Send Inspection Reports to:



**City of Waukesha** ATTN: Velvet Weier 130 Delafield Street Waukesha, WI 53188

### **BMP Inspection Report**

(Rev 11/12/18)

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ITEM		Okay	,	Modify		N,	N/A				ſ	NOTES	I	
1) Access - 3' wide Inspection														
2) Access - 12' wide Equipment														
3) Slopes - Fully vegetated, no bare soil/erosion														
4) Trees - None present in basin or on slopes														
5) Safety Shelf														
6) Emergency Spillway														
7) Inlet(s) - No obstruction/no erosion														
8) Inlet(s) - Quantity inspected														
9) Outlet(s) - No obstruction/no erosion														
10) Outlet(s) - Quantity inspected														
11) Control Structure - Functional and secure														
12) All Rip Rap - Clear of debris and vegetation														
13) Sedimentation - No major accumulation														
14) Permanent Pool Level - Per plan/weir														
<b>15)</b> Evidence of <b>pollutant</b> (e.g. oily sheen, trash)														
16) Evidence of invasive species														
17) Evidence of burrowing animals														 
18) * Permanent Pool Level - Elevation						_								 
<b>19)</b> * Depth from sediment to water surface														

INSPECTION SUMMARY/ADDITIONAL NOTES
PHOTOS
Include at least 3 photos with descriptions
include at least 5 photos with descriptions
1) Overall BMP condition
2) Condition of Control Structure

3) Condition of Inlet, Outlet, Spillway(s)

**Other:** Items requiring significant maintenance, hazards, questionable findings

RESOLUTION OF MODIFICATIONS					
	ACTION # KEY: (1) Monitor Condition (2) Routine Maintenance (3) Urgent Modification Requ		ed		
ITEM #	DESCRIPTION OF WORK REQUIRED			ACTION #	
COMPANY SCHEDULED TO PERFORM REQUIRED MODIFICATIONS					
Name:					
Company:					
Contact:					



# GREELEY AND HANSEN

741 N. Grand Ave., Suite 308 Waukesha, WI 53186