APPENDIX D

STORMWATER MANAGEMENT PLAN

Proactive by Design

STORMWATER MANAGEMENT PLAN
Chippewa Sand Company LLC
Town of Cooks Valley, Wisconsin

April 25, 2018
File No. 20.0154893.10

PREPARED FOR:
Chippewa Sand Company LLC
New Auburn, Wisconsin

GZA GeoEnvironmental, Inc.
20900 Swenson Drive, Suite 150 | Waukesha, WI 53186
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Proactive by Design

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

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April 25, 2018
File No. 20.0154893.10

Ms. Michele Karlstad, General Manager
Chippewa Sand Company LLC
105 Highway Q
New Auburn, Wisconsin 54757

Re: Stormwater Management Plan
Chippewa Sand Company LLC
Town of Cooks Valley, Wisconsin

Dear Ms. Karlstad:

GZA GeoEnvironmental, Inc. (GZA) is pleased to present the attached Stormwater Management Plan ("Plan") to Chippewa Sand Company ("Client") for the industrial sand mine in the Town of Cooks Valley, Chippewa County, Wisconsin ("Site"). The Plan provides the design of a stormwater management system that GZA derived from the stormwater modeling and recommendations for managing stormwater within the mine during Phases I through V.

We appreciate the opportunity to provide services for this project. Please feel free to contact us with any questions.

Very truly yours,

GZA GeoEnvironmental, Inc.

Kara L. Koch, P.E.
Water Resources Engineer
Assistant Project Manager

Michael A. DeVasto, P.G.
Geologist
Assistant Project Manager

Mark J. Krumenacher, P.G.
Senior Principal
Senior Vice President

J:\154800to154899\154893 Chippewa Sand\10 SW Mngnt\Report\
FINAL 154893.10 Stormwater Mgmt Plan_Town of Cooks Valley WI 4-25-18.docx

Attachments

1.0 INTRODUCTION

The "Site" is comprised of a sand mining operation and wash plant located north of County Highway A, near the intersection of County Highway A and County Highway DD in the Town of Cooks Valley, Chippewa County, Wisconsin, as shown in Figure 1. Raw sand is screened, sorted, and washed at the wash plant. The washed sand is conveyed to a stockpile where it drains and is later transported to an off-Site facility. Wash water is pumped through a filter press to remove the solids and the water is recycled. Non-marketable material from the screening and washing process is dewatered at the wash plant. Removed solids are placed into the mine for reclamation. Figure 2 is a Site Plan for the facility and identifies the proposed mine Phases I through V.

1.1 EXISTING SITE CONDITIONS

The Site is permitted to drain internally so there are no stormwater outfalls. There are three stormwater ponds, one located in the northeast area of the processing plant (wet plant), one located at the south end of the current Phase V limits, and one on the west side of the current Phase V that are engineered to detain and infiltrate stormwater. The stormwater pond located near the processing plant we refer to as the "West Pond." The stormwater pond located on the west side of Phase V we refer to as the "East Pond." The West and East Ponds are currently being used to manage stormwater from the mine only.

The wet plant was designed to manage wash water through four settling ponds, one of which is the fresh water pond and the source of wash water. Stormwater from the wet plant was designed to enter the process water ponds or the freshwater pond via culverts and ditches.

1.2 PROPOSED STORMWATER MANAGEMENT

GZA evaluated the existing stormwater management system and the existing Site conditions to prepare this revised Stormwater Management Plan ("Plan") to meet the needs of Chippewa Sand Company. The proposed Plan includes a single pond located east of the wet plant, designed to retain the 100-year, 24-hour precipitation event ("South Pond") with an estimated retention volume of 25 acre-feet. GZA proposes a second pond to be built ("Infiltration Pond") designed to infiltrate the controlled discharge or to be used as a back up to the South Pond with an estimated retention volume of 1.2 acre-feet. The proposed Plan will have a single outfall at the south end of the Infiltration Pond. The proposed South Pond was designed to receive stormwater from the mining phases from gravity flow or pumping ponded stormwater in the active mine area.

The Site is designed to have zero discharge of wastewater. The wash plant is a closed loop system comprised of tanks, piping, and process water ponds isolated from the mine's proposed stormwater management system. The wet plant area is hydraulically isolated from the mining operations by grading and diversion ditches to the process water ponds or the freshwater pond, which have no outfalls. Stormwater from the wet plant area will be managed as it is now and have no connection to the proposed South Pond or Infiltration Pond. Stormwater from the mine area will still be directed to the West Pond or East Pond, which will be dedicated for managing stormwater from the mine areas prior to discharging into the South Pond. The south end of the current Phase V will still be managed in the stormwater pond located on the southern limit of that phase.

Stormwater will be managed internally within each phase by creating a sump area to facilitate collection and initial settling and pumping the ponded water to the South Pond if it cannot be conveyed by gravity. To the extent practicable, each mine phase will be strategically mined to maximize stormwater management through use of existing topography, berms, and swales to contain and divert stormwater.

Soil borings were drilled in the location of the proposed Infiltration Pond to evaluate the potential rate of infiltration and obtain an approximate groundwater elevation. The boring locations are identified on Figure 2. Boring logs and grain size distributions are provided in Appendix A. The soils within the location of the proposed Infiltration Pond, approximately 24 feet below ground surface, have characteristics of sand or loamy sand.

2.0 MODELING ANALYSIS

GZA modeled the 100-year precipitation event to evaluate the size of the retention pond needed (South Pond) and to meet the request of the Chippewa County Land Conservation and Forest Management Department.

2.1 HYDROLOGIC ANALYSIS

To evaluate the 100-year hydrograph for the South Pond, GZA performed a hydrologic simulation of the hypothetical 100-year flow into the South Pond utilizing HydroCAD. HydroCAD (Computer Aided Design to hydrology) is a stormwater model that evaluates hydrology and hydraulics of storm water runoff from source areas within each land use for specified rainfall events. HydroCAD utilizes hydrology, hydraulics, routing, time of concentration, rainfall data, and storage data to calculate pollutant load, including TSS loads. The HydroCAD report is provided in Appendix B.

To perform our analysis, GZA:

1. Delineated the watershed boundary for the South Pond during each mining phase;
2. Assigned a weighted Curve Number[1] (CN) based on surface soils and land cover during each mining phase;
3. Developed flow paths to calculate the time of concentration, T_c; and
4. Imported local rainfall precipitation frequency data.

The watershed area that discharges to the South Pond was evaluated using Client-provided topography in AutoCAD dated November 27, 2013. GZA defined the watershed of the South Pond into three major sub-basins. The East Basin flows to the East Pond and the West Basin flows to the West Pond; both are identified on Figure 2. The West Pond and East Pond will discharge into the proposed South Pond. The South Basin is comprised of the area that will directly discharge into the South Pond. Within the East Basin and West Basin, GZA divided those two areas into sub-basins based on mining phase, soil type, and land cover. As mining progresses through the phases, the basins increase in size to capture and convey stormwater to the South Pond.

The CN is used to determine the portion of the precipitation that will appear as runoff within the watershed. GZA downloaded the watershed's soil types[2] and, combined with the land type, assigned CN values to areas of interest. GZA calculated a weighted CN value for the watershed area. The weighted CN value changed during each phase as one phase became 'active' and the previous phase is reclaimed. The weighted CN values are described below.

The time of concentration (T_c) is required to evaluate the time required for runoff to travel from the most hydrologically distant point of the watershed to the point of collection. GZA followed the Sheet Flow Procedure and Shallow Concentration Flow Procedure in the HydroCAD Technical Reference[3] to evaluate the time of concentration. In the model, GZA conveyed stormwater to the South Pond, bypassing the potential to be stored within the active mine phase, to

[1] "Urban Hydrology for Small Watershed, TR-55", United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), Second Edition, June 1986.
[2] Web Soil Survey, version 14, Oct. 11, 2017 published by USDA NRCS.
[3] "Owner's Manual", HydroCAD Software Solutions, LLC. Version 10, July 27, 2011.

conservatively evaluate the size of the South Pond. A hypothetical time of concentration and travel path was used to calculate instantaneously the runoff volume. The time of concentration for each phase is listed below.

GZA assigned the model to use the Intensity Duration Frequency (IDF) curve, Type II Distribution, to create the design storm. GZA imported local Precipitation Frequency Data obtained from the National Oceanic and Atmospheric Administration (NOAA), which is recognized by HydroCAD as IDF file formats. GZA ran the model and exported the hydrograph results from the 100-year, 24-hour precipitation event (6.49 inches of rainfall).

Within the model, the hydrograph from the watersheds were diverted to the two existing stormwater ponds, identified on Figure 2. The overflow from those two existing ponds will discharge into the South Pond. The summary of the South Pond within the HydroCAD model identified a volume of runoff during each mining phase. GZA sized the South Pond to retain the total volume of runoff for each phase during the 100-year, 24-hour precipitation event.

2.1.1 Phase I (Current Mining)

Phase I stormwater will flow to the West Pond, South Pond, and East Pond by shallow concentrated flow, channeling, or pumping. In the stormwater calculations, GZA conservatively assumed the entire area of Phase I was sandstone or newly graded sand. Future phase areas discharging to the South Pond were identified as wooded or grass covered. GZA used a conservative CN number of 94 for sandstone, 86 for newly graded sand, 39 for grass-covered areas, and 30 for woods. Total watershed area draining to the South Pond was approximately 234.3 acres with a weighted CN value of 51. Note that the total watershed includes unmined areas where stormwater cannot be diverted away from the mine. The longest time of concentration was 111.0 minutes with an approximate runoff volume into South Pond of 23 acre-feet.

2.1.2 Phase II

Phase II stormwater will flow to the East Pond by shallow concentrated flow or to the South Pond by channeling or pumping excess ponded water. In the stormwater calculations, GZA conservatively assumed the entire area of Phase II will be sandstone and the area of Phase I will be reclaimed. Future phase areas discharging to the South Pond are identified as wooded or grass covered. GZA used a conservative CN number of 94 for sandstone, 39 for grass-covered areas, and 30 for woods. Total watershed area draining to the South Pond is approximately 251.1 acres with a weighted CN value of 43. The watershed area for Phase II expanded because the mining operations extend beyond the existing watershed boundary. The longest time of concentration was 119.2 minutes with an approximate runoff volume into the South Pond of 13 acre-feet.

2.1.3 Phase III

Phase III stormwater will flow to the West Pond by shallow concentrated flow or to the South Pond by channeling or pumping excess ponded water. In the stormwater calculations, GZA conservatively assumed the entire area of Phase III will be sandstone and the area of Phase II will be reclaimed. Future phase areas discharging to the South Pond are identified as wooded or grass covered. GZA used a conservative CN number of 94 for sandstone, 39 for grass-covered areas, and 30 for woods. Total watershed area draining to South Pond is approximately 286.4 acres with a weighted CN value of 45. The longest time of concentration was 119.7 minutes with an approximate runoff volume into South Pond of 21 acre-feet.

2.1.4 Phase IV

Phase IV stormwater will flow to the West Pond by shallow concentrated flow or to the South Pond by channeling or pumping excess ponded water. In the stormwater calculations, GZA conservatively assumed the entire area of Phase IV will be sandstone and the area of Phase III will be reclaimed. Future phase areas discharging to the South Pond are

identified as wooded or grass covered. GZA used a conservative CN number of 94 for sandstone, 39 for grass-covered areas, and 30 for woods. Total watershed area draining to the South Pond was approximately 309.4 acres with a weighted CN value of 46. The longest time of concentration was 119.7 minutes with an approximate runoff volume into South Pond of 25 acre-feet.

2.1.5 Phase V

Phase V stormwater will flow to the East Pond either by shallow concentrated flow or conveyed to the South Pond by channeling or pumping excess ponded water. In the stormwater calculations, GZA conservatively assumed the entire area of Phase V will be sandstone and the area of phase IV will be reclaimed. Other areas discharging to the South Pond are identified as wooded or grass covered. GZA used a conservative CN number of 94 for sandstone, 39 for grass-covered areas, and 30 for woods. Total watershed area draining to South Pond was approximately 318.8 acres with a weighted CN value of 44. The longest time of concentration was 119.7 minutes with an approximate runoff volume into South Pond of 19 acre-feet.

3.0 STORMWATER REGULATIONS AND DESIGN CRITERIA

3.1 TOTAL SUSPENDED SOLIDS

Sediment control best management practices (BMPs) on the Site will be designed, installed, and maintained to control TSS carried in runoff from the operation activities. According to the Wisconsin Department of Natural Resource (WDNR) General Permit to discharge under the Wisconsin Pollutant Discharge Elimination System (WPDES), Permit No. WI-B046515-6, for nonmetallic mining operations for industrial sand mining and processing, this Site will utilize BMPs in accordance with construction site performance standards in NR 151.11, Wis. Adm. Code, and in accordance with the WDNR's Construction Site Erosion and Sediment Control Technical Standards. This Site was classified as a construction site that consists of land disturbing construction activity of more than 1 acre and is subjected to comply with the reduction of 80%, or to the maximum extent practicable, of the sediment load carried in runoff, on an average annual basis.

A retention pond was selected for use as a stormwater BMP for the proposed development. Estimated TSS reduction is approximately 80% as compared to no treatment practices based on WDNR Conservation Practice Standard for Detention Ponds, dated October 2007. The proposed South Pond for the Site was designed to retain the 100-year, 24-hour precipitation event and be equipped to discharge manually. The pond will be discharged after the precipitation event at a time when TSS is reduced 80%, or to the maximum extent practicable.

3.2 PEAK DISCHARGE

By design, stormwater BMPs will be implemented to maintain or reduce the 2-year, 24-hour and 10-year, 24-hour storm events' post-construction peak discharge rates to the pre-construction peak discharge rates for the aforementioned storm events. Additionally, the 100-year, 24-hour peak flow rate must be safely conveyed by the system.

The retention pond consists of an approximate total volume of 25 acre-ft of available storage to retain the 100-year, 24-hour precipitation event. Overflow discharge of the retention pond will be routed over a riprap spillway or manually through a 12-inch diameter corrugated HDPE outlet pipe located on the south side of the pond and into the Infiltration Pond. The overflow discharge structure was designed at elevation 1,070 feet and lined with riprap to minimize erosion. The invert elevation of the pipe was designed at 1,064.5 feet and at a 2% slope with an open pipe discharging into the Infiltration Pond. The Infiltration Pond has a spillway discharge at elevation 1,064 feet and lined with riprap to minimize erosion.

3.3 INFILTRATION

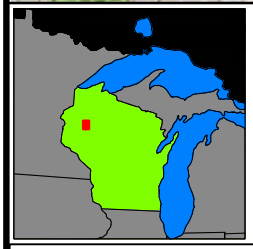
Infiltration within the South Pond may occur; however, GZA's design assumes sediment build-up with minimal infiltration. The Infiltration Pond was designed as a secondary treatment for Chippewa Sand Company and will not be considered a primary BMP. The Infiltration Pond is comprised of a single cell with a depth of 24 inches and native vegetation.

3.4 MAINTENANCE AND OPERATIONS PLAN

It is very important that the maintenance and operations plan be implemented in an effective manner, for the Plan to be successful and to prevent stormwater runoff from leaving the Site. The maintenance plan will include the inspection of ponds periodically and after rainfall events. When ponds become filled in with runoff water or sediment, remediation of the ponds will be necessary.

Ponds that have become filled in with wastewater or process water will be pumped out and the sediment-laden wastewater and processing water will be transported/piped to the process water settling ponds. Sediment that has accumulated at the bottom of the South Pond will be excavated and used in mine reclamation. The bottom of the retention pond will be scarified to ensure infiltration. Refer to WDNR Conservation Practice Technical Standard for Wet Detention Basin (1001) for operations and maintenance requirements. If clogging of the Infiltration Pond is observed, restoration procedures will be undertaken to unclog it by removing the top 2 to 3 inches and replant with prairie style vegetation using the soil preparation method recommended by the native nursery in the area. Refer to WDNR Conservation Practice Technical Standard for Infiltration Basin (1003) for operations and maintenance requirements.

FIGURES



SOURCE:

THE TOPOGRAPHIC AREA SHOWN ABOVE IS A PORTION OF THE COMO CREEK, WIS. USGS QUADRANGLE MAP.
DIGITAL TOPOGRAPHIC BASE MAP PROVIDED BY THE NATIONAL GEOGRAPHIC SOCIETY 2013(C) ESRI SERVICE LAYER.

CONTOUR ELEVATIONS REFERENCE NGVD 29,
CONTOURS ARE SHOWN IN FEET AT 10' INTERVALS

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0 1,000 2,000 4,000
APPROXIMATE SCALE IN FEET

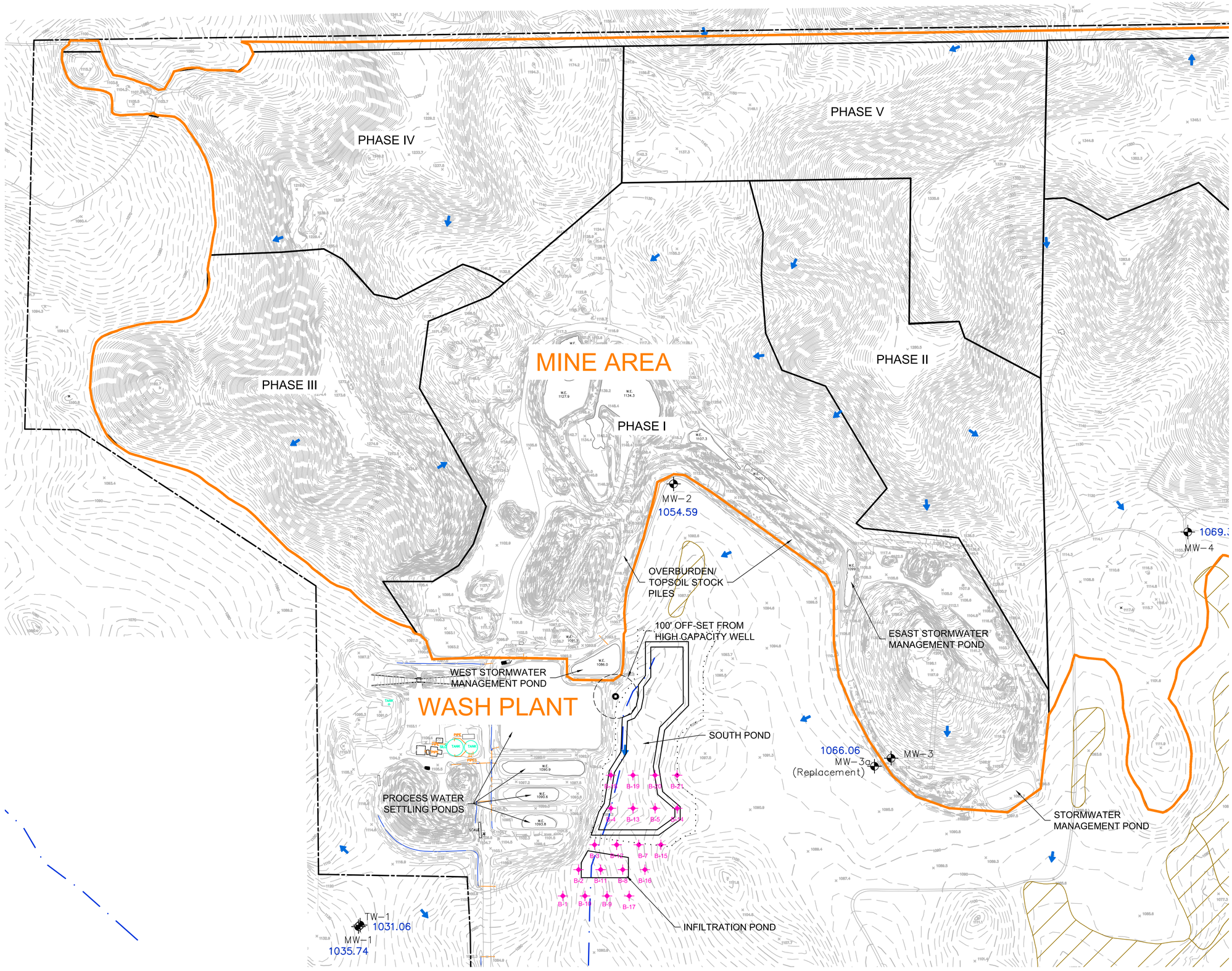
CHIPPEWA SAND COMPANY RECLAMATION PLAN
3182 COUNTY HIGHWAY A
BLOOMER, WISCONSIN

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:

SITE LOCATION MAP

PROJ MGR: MJK	REVIEWED BY: MAD	CHECKED BY: MAD	FIG 1
DESIGNED BY: KLK	DRAWN BY: LES	SCALE: 1 in = 2,000 ft	
DATE: 04/18/2018	PROJECT NO. 20.0154893.10	REVISION NO.	SHEET NO. OF



LEGEND

- APPROXIMATE SITE BOUNDARY
- EXISTING MAJOR CONTOURS (10' INTERVAL)
- EXISTING MINOR CONTOURS (2' INTERVAL)
- EXTENT OF MINING ACTIVITIES
- UNNAMED STREAMS INDICATED ON USGS TOPOGRAPHIC MAP
- MINING PHASES
- B-21 — SOIL BORING LOCATIONS
- WISCONSIN DEPARTMENT OF NATURAL RESOURCES IDENTIFIED WETLANDS
- SURFACE FLOW DIRECTION
- TW-1 — MONITORING WELL LOCATIONS
- 1031.06 — GROUNDWATER ELEVATION FROM ON SITE MONITORING WELLS (MARCH 27, 2017)
- HIGH CAPACITY WELL LOCATION

NOTES

1. BASE MAP DEVELOPED BY CONTINENTAL MAPPING CONSULTANTS.
2. LOCATION OF EXISTING MONITORING WELLS WERE OBTAINED FROM SEH'S MONITORING WELL LOCATIONS .DWG FILE.
3. LOCATION OF THE POND SOIL BORING EXPLORATIONS WERE PROVIDED BY GPS COORDINATES.

N
W E
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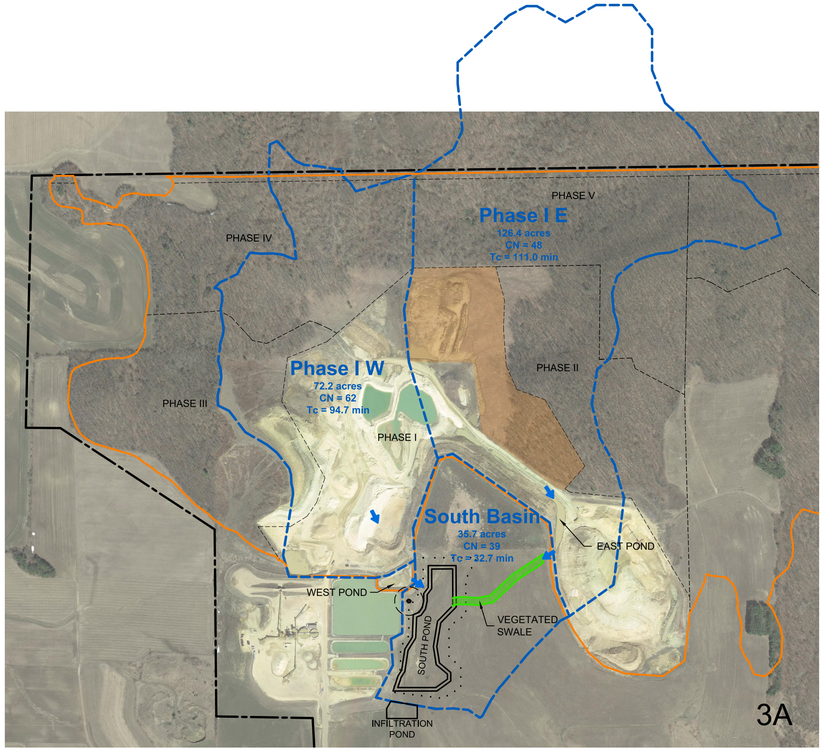
0 100' 200' 400' 600'
SCALE IN FEET 1" = 200'

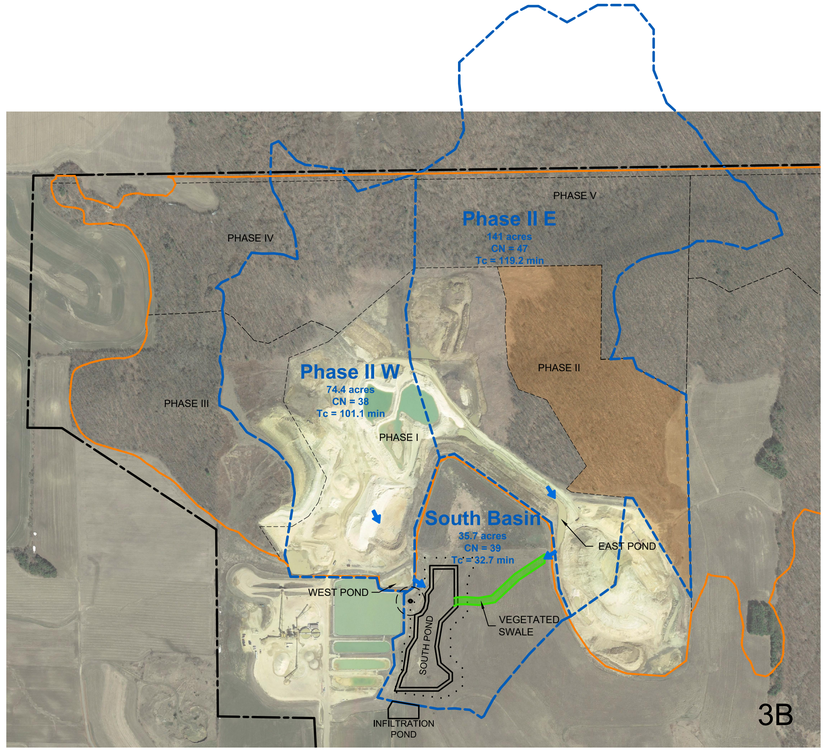
NO.	ISSUE/DESCRIPTION	BY	DATE

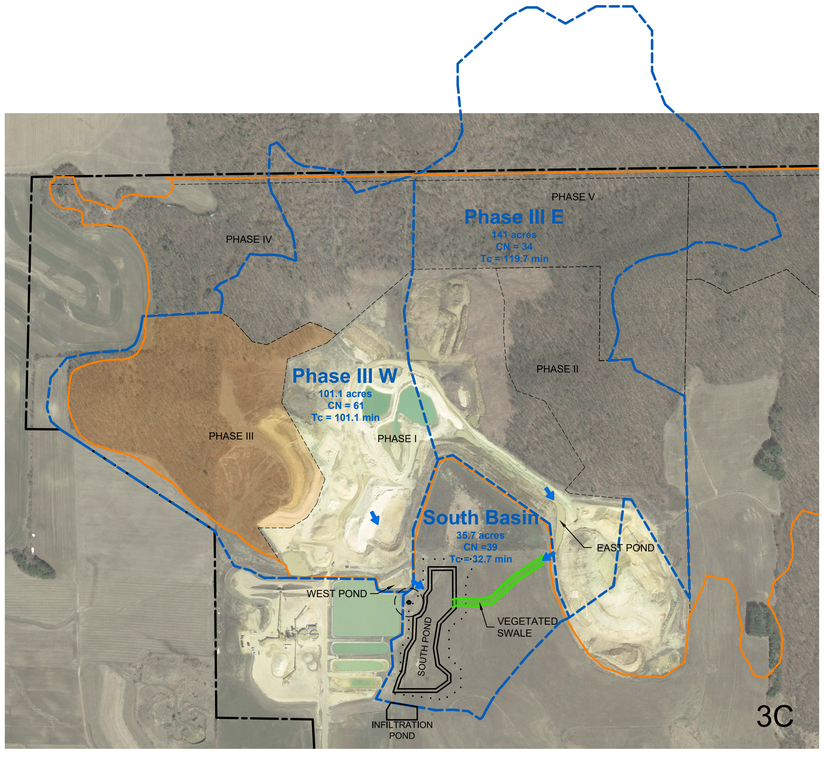
CHIPPEWA SAND COMPANY RECLAMATION PLAN
3182 COUNTY HWY A
BLOOMER, WI 54724

SITE PLAN

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		CHIPPEWA SAND COMPANY LLC	
PROJ MGR: MJK	REVIEWED BY: MAD	CHECKED BY: MAD	FIGURE 2
DESIGNED BY: KLK	DRAWN BY: KLK	SCALE: see above	
DATE: APRIL, 2018	PROJECT NO. 20.0154893.10	REVISION NO.	SHEET NO. 2 OF 7







LEGEND

- APPROXIMATE SITE BOUNDARY
- EXTENT OF MINING ACTIVITIES
- SOUTH POND AND INFILTRATION POND LOCATION
- MINING PHASES
- SOUTH POND WATERSHED AREAS
- SURFACE FLOW DIRECTION

PHASE I (FIGURE 3A)

1. Start Mining Phase 2
2. Construct Stormwater Management System
3. Divert Water to Eastern or Western Ponds
4. Pump Ponded Water to South Pond

PHASE II (FIGURE 3B)

5. Partial Reclamation Phase 1
6. Mining Phase 2
7. Divert Stormwater to Eastern Pond (Build Berms and Swales as Necessary)
8. Pump Ponded Water to South Pond

PHASE III (FIGURE 3C)

9. Partial Reclamation Phase 2
10. Mining Phase 3
11. Divert Stormwater to Western Pond (Build Berms and Swales as Necessary)
12. Pump Ponded Water to South Pond

N W E S

0 250' 500' 1000' 1500'

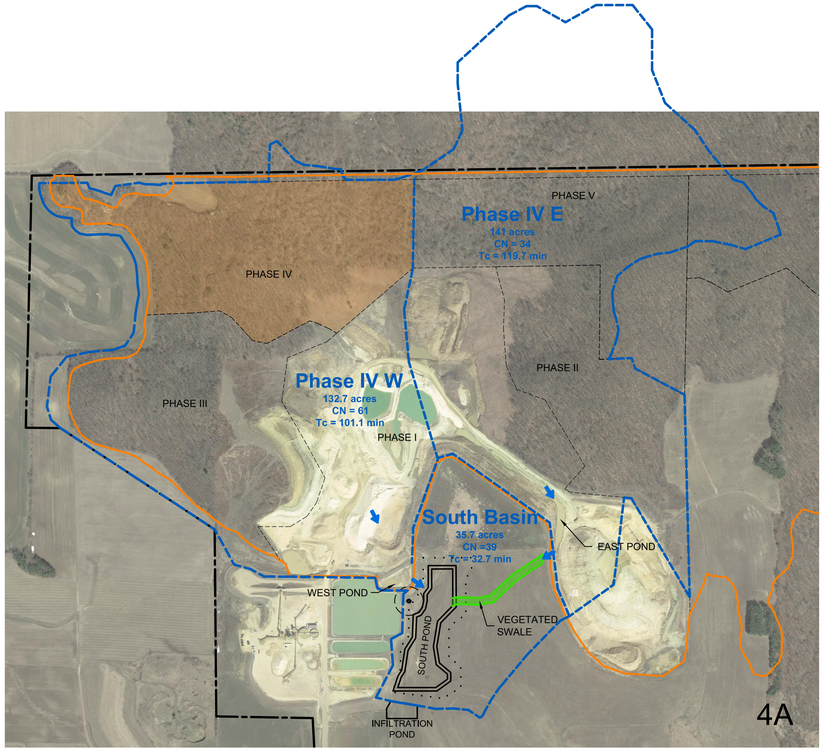
SCALE IN FEET 1" = 500'

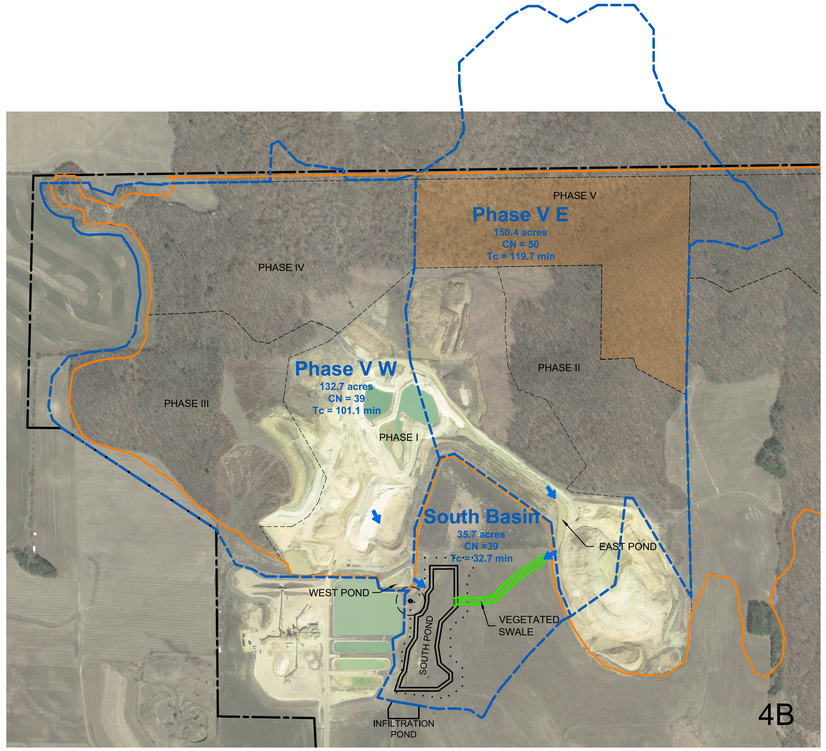
NO.	ISSUE/DESCRIPTION	BY	DATE

CHIPPEWA SAND COMPANY RECLAMATION PLAN
3182 COUNTY HWY A
BLOOMER, WI 54724

SOUTH POND WATERSHED MAP
PHASES 1-3

PREPARED BY:		PREPARED FOR:	
GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		CHIPPEWA SAND COMPANY LLC	
PROJ MGR: MJK	REVIEWED BY: MAD	CHECKED BY: MAD	FIGURE
DESIGNED BY: KLK	DRAWN BY: KLK	SCALE: see above	3
DATE: APRIL, 2018	PROJECT NO. 20.0154893.10	REVISION NO.	SHEET NO.





LEGEND

- APPROXIMATE SITE BOUNDARY
- EXTENT OF MINING ACTIVITIES
- SOUTH POND AND INFILTRATION POND LOCATION
- MINING PHASES
- SOUTH POND WATERSHED AREAS
- SURFACE FLOW DIRECTION

PHASE IV (FIGURE 4A)

1. Partial Reclamation Phase 3
2. Mining Phase 4
3. Divert Stormwater to Eastern Pond (Build Berms and Swales as Necessary)
4. Pump Ponded Water to South Pond

PHASE V (FIGURE 4B)

5. Partial Reclamation Phase 4
6. Mining Phase 5
7. Divert Stormwater to Western Pond (Build Berms and Swales as Necessary)
8. Pump Ponded Water to South Pond

N
W E
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0 250' 500' 1000' 1500'
SCALE IN FEET 1" = 500'

NO.	ISSUE/DESCRIPTION	BY	DATE

CHIPPEWA SAND COMPANY RECLAMATION PLAN
3182 COUNTY HWY A
BLOOMER, WI 54724

SOUTH POND WATERSHED MAP
PHASES 4-5

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: CHIPPEWA SAND COMPANY LLC	
PROJ MGR: MJK	REVIEWED BY: MAD	CHECKED BY: MAD	FIGURE 4
DESIGNED BY: KLK	DRAWN BY: KLK	SCALE: see above	
DATE: APRIL, 2018	PROJECT NO. 20.0154893.10	REVISION NO.	SHEET NO.

APPENDIX A

Soil Logs and Grain Size Distribution

GZA GeoEnvironmental, Inc.
20900 Swenson Drive #150
Waukesha, WI 53186
(262) 754-2560

BORING NUMBER B- 1

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		12		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 10": Silty, sandy TOPSOIL, dark brown Middle 9": Stiff, lean CLAY (CL), low plasticity; some Sand, fine; little Gravel, fine; brown, dry (USDA Soil Classification: Gravelly Sand) Lower 18" Poorly-graded SAND (SP), medium-grained; light orange to brown, moist		S-1 (0 - 5)		37	4.1
5		S-2: Poorly-graded SAND (SP), medium-grained; light orange to brown, moist		S-2 (5 - 10)		40	
10		S-3: Poorly-graded SAND (SP), orange to brown, moist to wet		S-3 (10 - 15)		48	
15		S-4: Poorly-graded SAND (SP), orange to brown, wet		S-4 (15 - 20)		54	
20		: End of Boring at 20 feet, BGS.					

REMARKS

GZA GeoEnvironmental, Inc.
20900 Swenson Drive #150
Waukesha, WI 53186
(262) 754-2560

BORING NUMBER B- 2

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		10		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 5": Silty sandy topsoil, dark brown Upper Middle 10": Stiff, sandy lean CLAY (CL), low plasticity; dark brown, dry Lower Middle 11": Stiff, sandy lean CLAY (CL), low plasticity; brown, moist Lower 22": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, moist		S-1 (0 - 5)		48	
5		S-2: Upper 22": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, moist Lower 18": Poorly-graded SAND (SP), medium-grained; light brown, moist		S-2 (5 - 10)		40	
10		S-3: Poorly-graded SAND (SP), medium-grained; little Gravel, fine; golden brown, wet		S-3 (10 - 15)		43	
15		S-4: Poorly-graded SAND (SP), medium-grained; little Gravel, fine; brown, wet		S-4 (15 - 20)		34	
20		: End of Boring at 20 feet, BGS					

REMARKS

GZA GeoEnvironmental, Inc.
20900 Swenson Drive #150
Waukesha, WI 53186
(262) 754-2560

BORING NUMBER B- 3

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		7		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 4": Silty sandy TOPSOIL, dark brown Middle 15": Poorly-graded SAND (SP), fine to medium-grained; little Silt; trace Gravel, fine; dark brown, dry Lower 19": Poorly-graded SAND (SP), medium-grained; orange to golden brown; dry		S-1 (0 - 5)		38	
5		S-2: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown; wet		S-2 (5 - 10)		40	
10		S-3: Poorly-graded SAND (SP), medium to coarse-grained; trace Gravel, fine; orange to golden brown; wet		S-3 (10 - 15)		60	
15		S-4: Poorly-graded SAND (SP), medium to coarse-grained; trace Gravel, fine; orange to golden brown, wet		S-4 (15 - 20)		57	
20		: End of Boring at 20 feet, BGS					

REMARKS

GZA GeoEnvironmental, Inc.
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Waukesha, WI 53186
(262) 754-2560

BORING NUMBER B- 4

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		5		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 4": Silty sandy TOPSOIL, dark brown Upper Middle 31": Medium stiff, sandy lean CLAY (CL), low plasticity; brown to dark brown, wet Middle 13": Clayey SAND (SC), fine to medium-grained; brown, wet (USDA Soil Classification: Sandy Loam) Lower Middle 5": Medium stiff, sandy lean CLAY (CL), low plasticity; grayish brown, moist Lower 4": Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist		S-1 (0 - 5)		57	
5		S- 2: Upper 9": Clayey SAND (SC), medium-grained; brown, wet (USDA Soil Classification: Sandy Loam) Lower 32": Poorly-graded SAND (SP), medium to coarse-grained; trace Gravel, fine; orange to golden brown, wet		S- 2 (5 - 10)		41	
10		S-3: Poorly-graded SAND (SP), medium to coarse-grained; little Gravel, fine; golden brown, wet	1	S-3 (10 - 15)		60	
15		S- 4: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, wet	2	S- 4 (15 - 20)		60	
20		S-5: Poorly-graded SAND (SP), fine-grained; golden brown (sample potentially weathered Sandstone)		S-5 (20 - 21)		12	

: Sampler refusal at 21 ft, BGS. Possible sandstone.

REMARKS

1. Gravel increases from 13' 10" to 14' 1" BGS
2. Gravel increases from 18' 10" to 19' 3"

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BORING NUMBER B- 5

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 2": Silty sandy TOPSOIL Upper Middle 23": Poorly-graded SAND (SP), fine to medium grained; little fines; dark brown transitioning to orange-brown, dry Lower Middle 6": Sandy lean CLAY (CL), low-plasticity; little Gravel, fine; brown, moist Lower 4": Poorly-graded SAND (SP), fine to medium-grained; trace Clay; orangish-brown, moist		S-1 (0 - 5)		35	
5		S- 2: Upper 11": Poorly-graded SAND (SP), fine to medium-grained; little Gravel, fine; golden brown, moist Middle 6": Poorly-graded SAND (SP), fine-grained; little Clay; little Gravel, fine; reddish-brown Lower 21": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown, moist (possible sandstone)		S- 2 (5 - 10)		38	
10		S- 3: Upper 25": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown, moist Lower 24": Poorly-graded SAND (SP), fine-grained; trace Clay; trace Gravel, golden brown (possible sandstone)		S- 3 (10 - 15)		49	
15		S-4: Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown with some reddish streaks, moist (possible sandstone)		S-4 (15 - 20)		40	
20		: End of Boring at 20 ft, BGS					

REMARKS

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BORING NUMBER B- 6

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		10		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 17": Poorly-graded SAND (SP), fine-grained; little Silt; dark brown, moist Lower 23": Poorly-graded SAND (SP), fine to medium-grained; golden brown, moist (USDA Soil Classification: Sand)		S-1 (0 - 5)		40	5.5
5		S-2: Poorly-graded SAND (SP), medium-grained; golden brown, moist		S-2 (5 - 10)		46	
10		S-3: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, wet	1	S-3 (10 - 15)		50	
15		S-4: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, wet		S-4 (15 - 20)		40	
20		: End of Boring at 20 ft, BGS					

REMARKS

1. Gravelly zone from 13' to 13' 6" BGS

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BORING NUMBER B- 7

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		8.5		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 13": Poorly-graded SAND (SP), fine-grained; little Clay; dark brown, dry Middle 12": Lean CLAY (CL), low plasticity; some Sand, fine; brown, moist Lower 29": Clayey SAND (SC), medium-grained; orange-brown, moist (USDA Soil Classification: Sandy Loam)		S-1 (0 - 5)		44	
5		S-2: Upper 10": Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist Middle 23": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, moist Lower 15": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, wet		S-2 (5 - 10)		48	
10		S-3: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, wet		S-3 (10 - 15)		50	
15		S- 4: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, wet		S- 4 (15 - 20)		47	
20		: End of Boring at 20 ft, BGS.					

REMARKS

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BORING NUMBER B- 8

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		11.5		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 6": Silty, sandy TOPSOIL, dark brown, dry Lower 30": Poorly-graded SAND (SP), medium-grained; little Gravel, fine; golden brown, moist (USDA Soil Classification: Sand)		S-1 (0 - 5)		36	
5		S-2: Poorly-graded SAND (SP), fine to medium-grained; golden brown, moist		S-2 (5 - 10)		38	7.3
10		S- 3: Upper 18": Poorly-graded SAND (SP), fine to medium-grained; golden brown, moist Lower 25": Poorly-graded SAND (SP), medium-grained; golden brown, moist to wet		S- 3 (10 - 15)		43	
15		S- 4: Poorly-graded SAND (SP), medium to coarse-grained; trace Gravel, fine; golden brown, wet		S- 4 (15 - 20)		37	
20		: End of Boring at 20 feet, BGS					

REMARKS

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BORING NUMBER B- 9

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		10		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 3": Silty, sandy TOPSOIL, dark brown Middle 41": Medium stiff to Stiff, sandy lean CLAY (CL), low plasticity; dark brown, moist (USDA Soil Classification: Loam) Lower 7": Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist		S-1 (0 - 5)		51	
5		S- 2: Upper 6": Poorly-graded SAND (SP), medium-grained; little Clay; brown, moist Lower 38": Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist		S- 2 (5 - 10)		44	
10		S- 3: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; wet		S- 3 (10 - 15)		59	
15		S- 4: Poorly-graded SAND (SP), medium to coarse-grained; trace Gravel, fine; wet		S- 4 (15 - 20)		57	
20		: End of Boring at 20 ft, BGS.					

REMARKS

ENVIRONMENTAL BH COLUMN W/ REMARKS - GINT STD US LAB.GDT - 4/16/18 14:19 - \\GZAWAUKESHA\JOBS\154800TO154899\154893 CHIPPEWA SAND\10 SW MNGNT\DRILLING\20.0154893.10 BORELOGS.GPJ

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BORING NUMBER B-10

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		10		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 24": Poorly-graded SAND (SP), fine-grained; little Silt; dark brown, dry (Potential Topsoil) (USDA Soil Classification: Loamy Sand) MIddle 11": Poorly-graded SAND (SP), fine to medium-grained; little Clay; trace Gravel, fine; brown, dry Lower 10": Poorly-graded SAND (SP), medium-grained; little Gravel, fine; orange to golden brown, moist		S-1 (0 - 5)		45	10.9
5		S- 2: Poorly-graded SAND (SP), medium-grained; golden brown, moist		S- 2 (5 - 10)		38	
10		S- 3: Poorly-graded SAND (SP), medium to coarse-grained; golden brown, wet		S- 3 (10 - 15)		53	
15		S- 4: Upper 40"; Poorly-graded SAND (SP), medium to coarse-grained; golden brown, wet Lower 20": Poorly-graded SAND (SP), medium to coarse-grained; some Gravel, fine; golden brown, wet		S- 4 (15 - 20)		60	
20		: End of Boring at 20 ft, BGS.					

REMARKS

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BORING NUMBER B-11

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		15		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S- 1: Upper 10": Silty, sandy TOPSOIL; little clay, dark brown Middle 15": Medium stiff, sandy lean CLAY (CL), low-plasticity; brown, moist (USDA Soil Classification: Loam) Lower 15": Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist		S- 1 (0 - 5)		40	
5		S- 2: Upper 32": Poorly-graded SAND (SP), medium to coarse-grained; light golden brown, moist Lower 12": Poorly-graded SAND (SP), medium-grained; trace Gravel, orange to golden-brown, moist		S- 2 (5 - 10)		44	
10		S - 3: Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist		S - 3 (10 - 15)		57	
15		S- 4: Poorly-graded SAND (SP), medium-grained; orange to golden brown, wet		S- 4 (15 - 20)		45	
20		: End of Boring at 20 feet, BGS					

REMARKS

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BORING NUMBER B-12

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		9		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 25": Poorly-graded SAND (SP), fine to medium-grained; little Silt; dark brown, moist Middle 13": Poorly-graded SAND (SP), fine to medium-grained; little Clay; trace Gravel, fine; brown, moist Lower 2": Poorly-graded SAND (SP), medium-grained; little Gravel, fine; orange to golden brown, moist		S-1 (0 - 5)		40	
5		S- 2: Poorly-graded SAND (SP), medium-grained; orange to golden brown, moist to wet		S- 2 (5 - 10)		29	
10		S- 3: Upper 45": Poorly-graded SAND (SP), medium to coarse-grained; orange to golden brown, wet Lower 15": Poorly-graded SAND (SP), fine to medium-grained; some Gravel, fine; golden brown, wet		S- 3 (10 - 15)		60	
15		S- 4: Poorly-graded SAND (SP), medium to coarse-grained; trace Gravel, fine; orange to golden brown, wet		S- 4 (15 - 20)		60	
20		: End of Boring at 20 feet, BGS					

REMARKS

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BORING NUMBER B-13

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		10		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 10": Silty, sandy TOPSOIL, dark brown, dry Middle 10": Poorly-graded SAND (SP), fine to medium-grained, little Clay, brown, dry Lower 20": Poorly-graded SAND (SP), medium-grained, some silt, golden brown, moist (USDA Soil Classification: Sand)		S-1 (0-5')		40	6.0
5		S-2: Upper 25": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, moist Lower 16": Poorly-graded SAND (SP), medium to coarse-grained; little gravel, fine; reddish-brown, moist		S-2 (5-10')		41	
10		S- 3: Upper 49": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; brown, wet Lower 11": Poorly-graded SAND (SP), fine to medium-grained; some Gravel, fine; little Clay; golden brown, wet		S- 3 (10-15')		60	
15		S-4: Upper 20": Poorly-graded SAND (SP), fine-grained; golden brown, wet Lower 40": Poorly-graded SAND (SP), fine to medium-grained; golden brown, wet		S-4 (15-20')		60	
20		: End of Boring at 20 feet, BGS					

REMARKS

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BORING NUMBER B-14

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 6": Silty, sandy TOPSOIL, dark brown, dry Middle 8": Loose, poorly-graded GRAVEL with SAND (GP), light tan, dry Lower 19": Poorly-graded SAND (SP), fine-grained; some Gravel, fine; trace Clay; golden brown, dry (USDA Soil Classification: Gravelly Loam)		S-1 (0-5')		33	
5		S-2: Poorly-graded SAND (SP), fine-grained; little Gravel, fine; trace Clay; golden brown, dry		S-2 (5-10')		17	10.3
10		S- 3: Upper 15": Poorly-graded SAND (SP), fine-grained; little Gravel, fine; trace Clay' golden brown, moist Lower 45": Poorly-graded SAND (SP), fine; light tan, dry		S- 3 (10-15')		60	
15		S-4: Poorly-graded SAND (SP), fine-grained; light tan, dry		S-4 (15-20')		50	
20		: End of Boring at 20 feet, BGS					

REMARKS

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BORING NUMBER B-15

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 10": Silty, sandy TOPSOIL, dark brown, dry Middle 13": Medium stiff, lean CLAY (CL), low plasticity; little Sand, fine; brown, moist Lower 22": Poorly-graded SAND (SP), fine to medium-grained; little Gravel, fine; trace Clay; orange to golden brown, moist		S-1 (0-5')		45	
5		S-2: Poorly-graded SAND (SP), fine-grained; little Gravel, fine; trace Clay; golden brown, moist		S-2 (5-10')		40	
10		S- 3: Poorly-graded SAND (SP), fine-grained; some Gravel, fine; trace Clay; golden brown, moist	1	S- 3 (10-15')		29	
15		S-4: Poorly-graded SAND (SP), fine-grained; some Gravel, fine; trace Clay; golden brown, moist (1" thick clay seam present at 17 to 18" in sample)		S-4 (15-20')		50	
20		: End of Boring at 20 feet, BGS					

REMARKS

1. Increasing gravel in bottom 3" of sample

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BORING NUMBER B-16

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		15		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 18": Silty, sandy TOPSOIL, dark brown, dry Middle 13": Medium stiff, lean CLAY (CL), low plasticity; some Sand, fine; brown, moist Lower 17": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, moist		S-1 (0-5')		48	
5		S-2: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, moist		S-2 (5-10')		44	
10		S- 3: Upper 16": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, moist Lower 35": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to brown, moist		S- 3 (10-15')		51	
15		S-4: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; orange to golden brown, wet		S-4 (15-20')		50	
20		: End of Boring at 20 feet, BGS					

REMARKS

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BORING NUMBER B-17

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		15		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 9": Silty, sandy TOPSOIL, dark brown, dry Middle 21": Medium stiff, lean CLAY (CL), low plasticity; little Sand, fine; brown, moist (USDA Soil Classification: Sandy Loam) Lower 17": Poorly-graded SAND (SP), fine to medium-grained; little Gravel, fine; golden brown, moist		S-1 (0-5')		47	
5		S-2: Upper 17": Poorly-graded SAND (SP), fine to medium-grained; little Gravel, fine; golden brown, moist Lower 26": Poorly-graded SAND (SP), medium to coarse-grained; little Gravel, fine; golden brown, moist		S-2 (5-10')		43	
10		S- 3: Poorly-graded SAND (SP), medium to coarse-grained; little Gravel, fine; golden brown, moist		S- 3 (10-15')		47	
15		S-4: Upper 33": Poorly-graded SAND (SP), medium to coarse-grained; little Gravel, fine; golden brown, wet Lower 11": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown, wet		S-4 (15-20')		54	
20		: End of Boring at 20 feet, BGS					

REMARKS

GZA GeoEnvironmental, Inc.
20900 Swenson Drive #150
Waukesha, WI 53186
(262) 754-2560

BORING NUMBER B-18

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB
ESTIMATE		15		

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 11": Silty, sandy TOPSOIL, dark brown, dry Middle 10": Poorly-graded SAND (SP), fine-grained; little Clay, brown, dry Lower 17": Poorly-graded SAND (SP), medium to coarse-grained; golden brown, dry (USDA Soil Classification: Sand)		S-1 (0-5')		41	8.3
5		S-2: Poorly-graded SAND (SP), medium-grained; orange to golden brown, dry		S-2 (5-10')		33	
10		S- 3: Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, dry		S- 3 (10-15')		60	
15		S-4: Upper 46": Poorly-graded SAND (SP), medium-grained; trace Gravel, fine; golden brown, wet Lower 14": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown, wet (possible bedrock)		S-4 (15-20')		60	
20		: End of Boring at 20 feet, BGS					

REMARKS

GZA GeoEnvironmental, Inc.
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(262) 754-2560

BORING NUMBER B-19

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 12": Silty, sandy TOPSOIL, dark brown, dry Middle 15": Poorly-graded SAND (SP), fine-grained; trace Clay; brown, dry Lower 20" Poorly-graded SAND (SP), fine to medium-grained; with Gravel, fine; golden brown, dry	1	S-1 (0 - 5)		47	
5		S-2: Upper 8": Poorly-graded SAND (SP), fine to medium-grained; with Gravel, fine; golden to reddish-brown, moist Middle 21": Well-graded SAND (SW), fine to coarse-grained; some Gravel, fine; little Clay; reddish brown, moist (USDA Soil Classification: Very Gravelly Loamy Sand) Lower 11": Poorly-graded SAND (SP), fine-grained; golden brown, moist		S-2 (5 - 10)		40	
10		S-3: Poorly-graded SAND (SP), fine-grained; golden brown, moist (Possible weathered bedrock)		S-3 (10 - 15)		48	
15		S-4: Poorly-graded SAND (SP), fine-grained; golden brown, moist (Possible weathered bedrock)		S-4 (15 - 20)		54	
20		: End of Boring at 20 feet, BGS.					

REMARKS

1. Pink angular gravel present in sample.

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BORING NUMBER B-20

CLIENT Chippewa Sand Company
PROJECT NAME Chippewa Sands
PROJECT NUMBER 20.0154893.10
PROJECT LOCATION 105 Highway Q
DATE STARTED 6/20/17 **COMPLETED** 6/20/17
GROUND ELEVATION _____ **HOLE SIZE** 2.38" inches
DRILLING CONTRACTOR On-Site Environmental
DRILLING METHOD Direct Push
LOGGED BY ESY **CHECKED BY** MJK
DRILL RIG Geo-Probe

GROUND WATER LEVELS (ft, bgs):

DATE	TIME	DEPTH	CASING	STAB

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	REMARKS	SAMPLE TYPE NUMBER (Depth Interval)	PID RESULTS	RECOVERY (inches)	MOISTURE CONTENT (%)
0		S-1: Upper 9": Silty, sandy TOPSOIL, dark brown Middle 9": Medium stiff, sandy lean CLAY (CL), low plasticity; brown, moist Lower 18": Poorly-graded SAND (SP), fine to medium-grained; trace Gravel, fine; golden brown, dry	1	S-1 (0 - 5)		36	
5		S-2: Upper 10": Poorly-graded SAND (SP), fine to medium-grained; little Gravel, fine; golden brown, dry Lower 30": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown with greenish streaks, moist		S-2 (5 - 10)		40	
10		S-3: Upper 5": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown with greenish streaks, moist Middle 21": Poorly-graded SAND (SP), medium to coarse-grained; orangish brown, moist Lower 18": Poorly-graded SAND (SP), fine-grained; trace Clay; golden brown, moist (Possible weathered bedrock)		S-3 (10 - 15)		44	
15		S-4: Poorly-graded SAND (SP), fine-grained; trace Clay; trace Gravel, fine; golden brown to brown, moist (Possible weathered bedrock)		S-4 (15 - 20)		55	
20		: End of Boring at 20 feet, BGS.					

REMARKS

1. 1-inch thick layer of black Sand present at 35" BGS.

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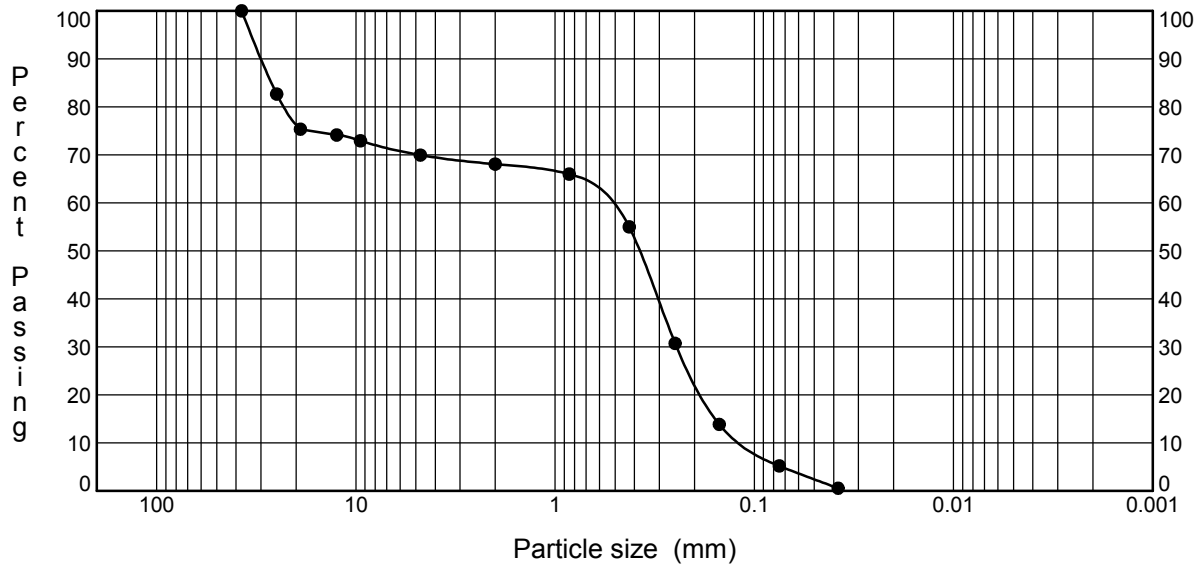
GRAIN SIZE DISTRIBUTION

CLIENT Chippewa Sand Company **PROJECT NAME** Chippewa Sands

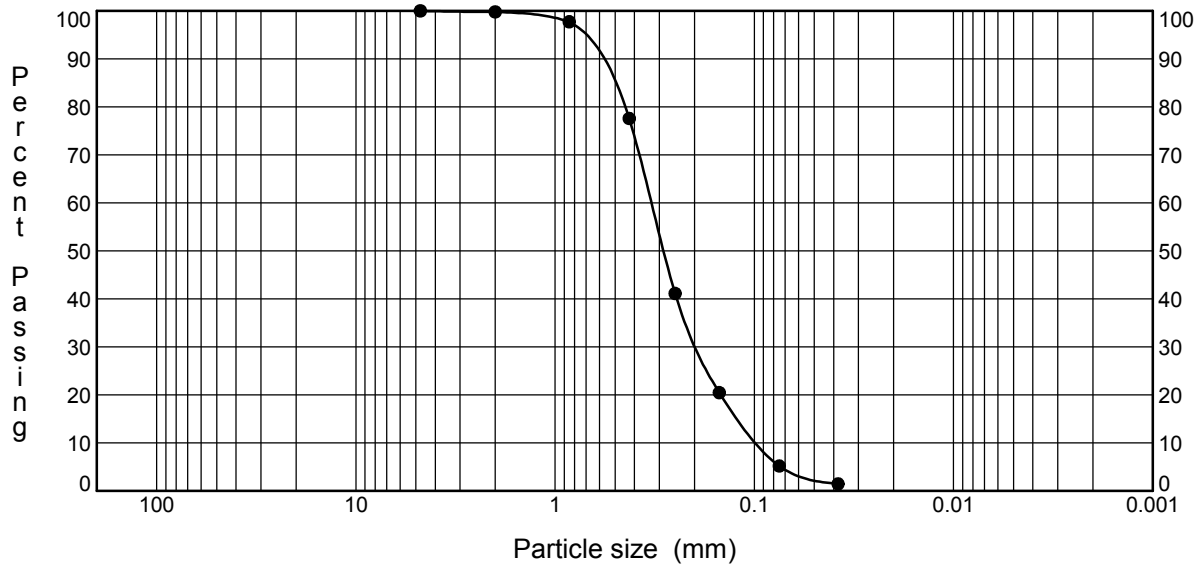
PROJECT NUMBER 20.0154893.10 **PROJECT LOCATION** 105 Highway Q

BOREHOLE No. **B- 1** DEPTH **2.0**



Cobbles	Gravel			Sand			Silt	Clay
	coarse	fine	coarse	medium	fine			

BOREHOLE No. **B- 6** DEPTH **2.0**



Cobbles	Gravel			Sand			Silt	Clay
	coarse	fine	coarse	medium	fine			

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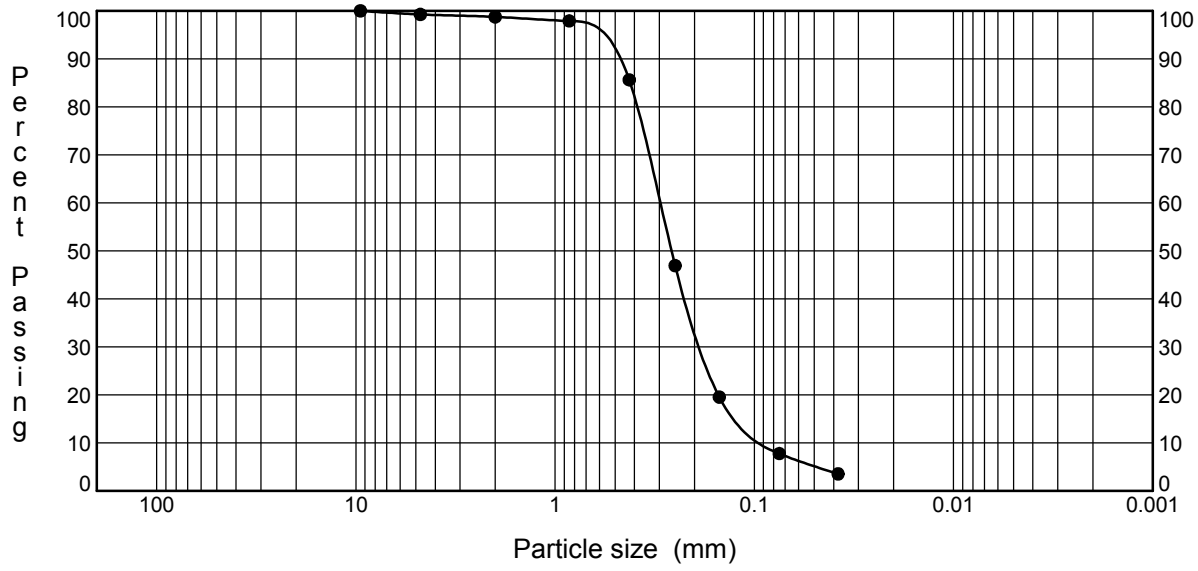
GRAIN SIZE DISTRIBUTION

CLIENT Chippewa Sand Company **PROJECT NAME** Chippewa Sands

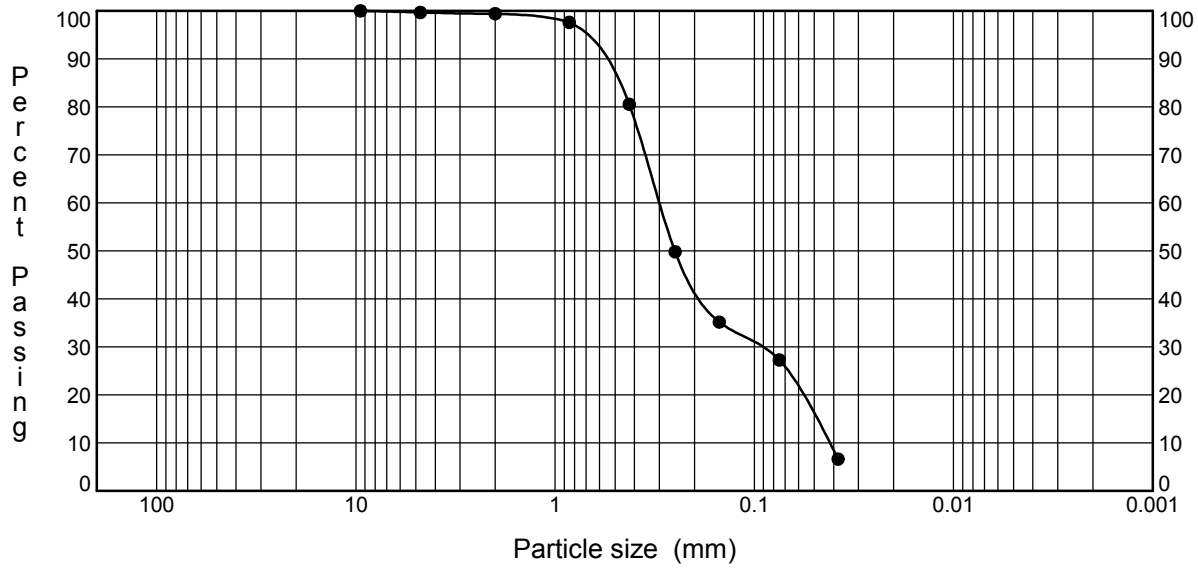
PROJECT NUMBER 20.0154893.10 **PROJECT LOCATION** 105 Highway Q

BOREHOLE No. **B- 8** DEPTH **4.0**



Cobbles	Gravel			Sand			Silt	Clay
	coarse	fine	coarse	medium	fine			

BOREHOLE No. **B-10** DEPTH **2.0**



Cobbles	Gravel			Sand			Silt	Clay
	coarse	fine	coarse	medium	fine			

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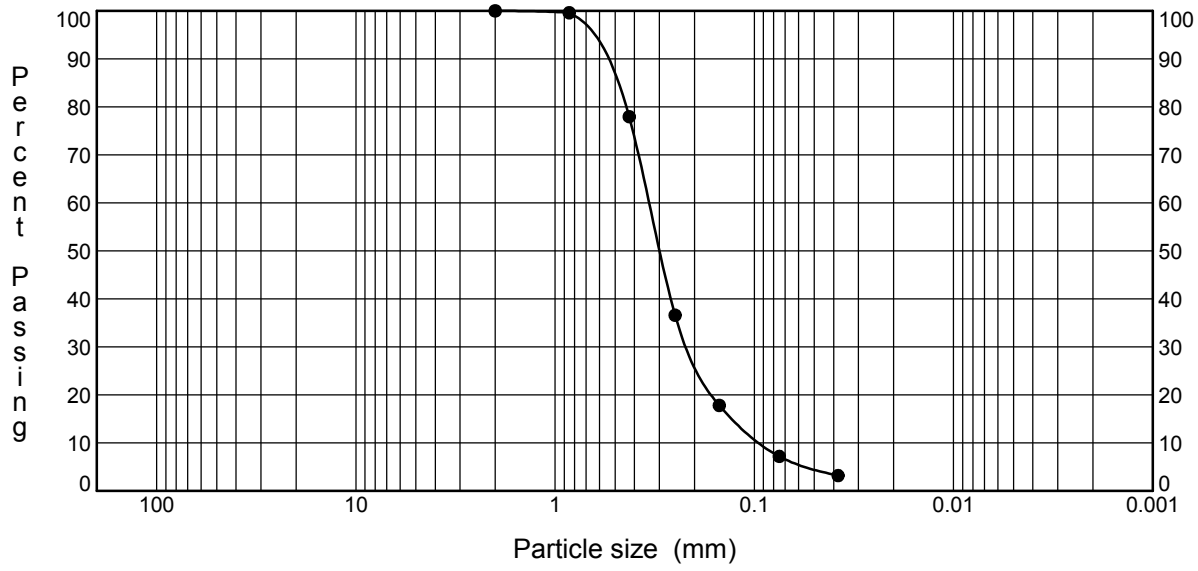
GRAIN SIZE DISTRIBUTION

CLIENT Chippewa Sand Company **PROJECT NAME** Chippewa Sands

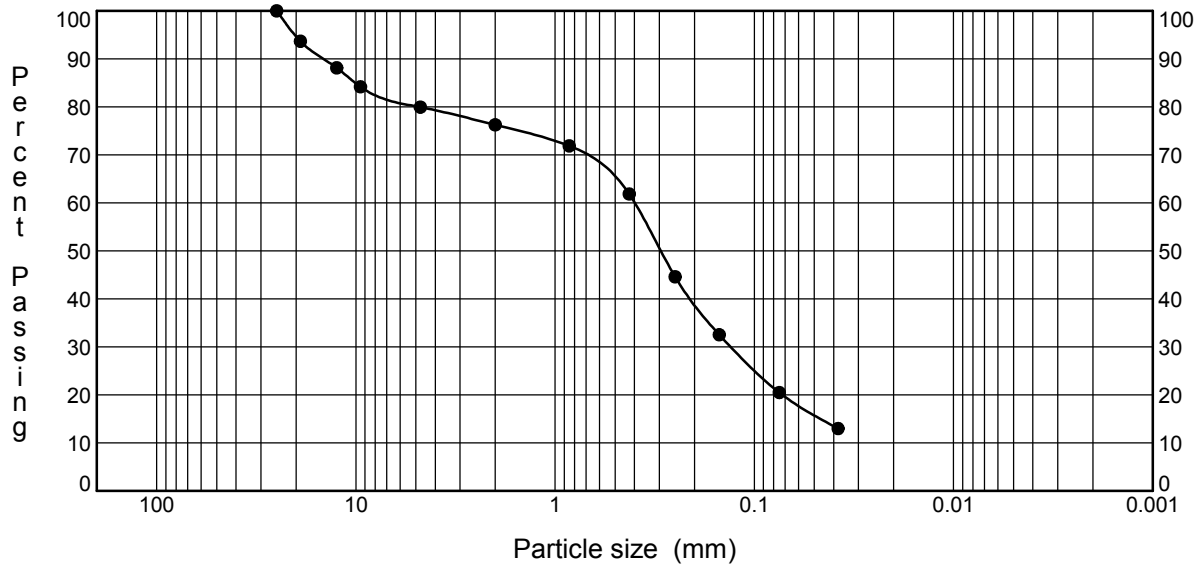
PROJECT NUMBER 20.0154893.10 **PROJECT LOCATION** 105 Highway Q

BOREHOLE No. **B-13** DEPTH **4.0**



Cobbles	Gravel		Sand			Silt	Clay
	coarse	fine	coarse	medium	fine		

BOREHOLE No. **B-14** DEPTH **4.0**



Cobbles	Gravel		Sand			Silt	Clay
	coarse	fine	coarse	medium	fine		

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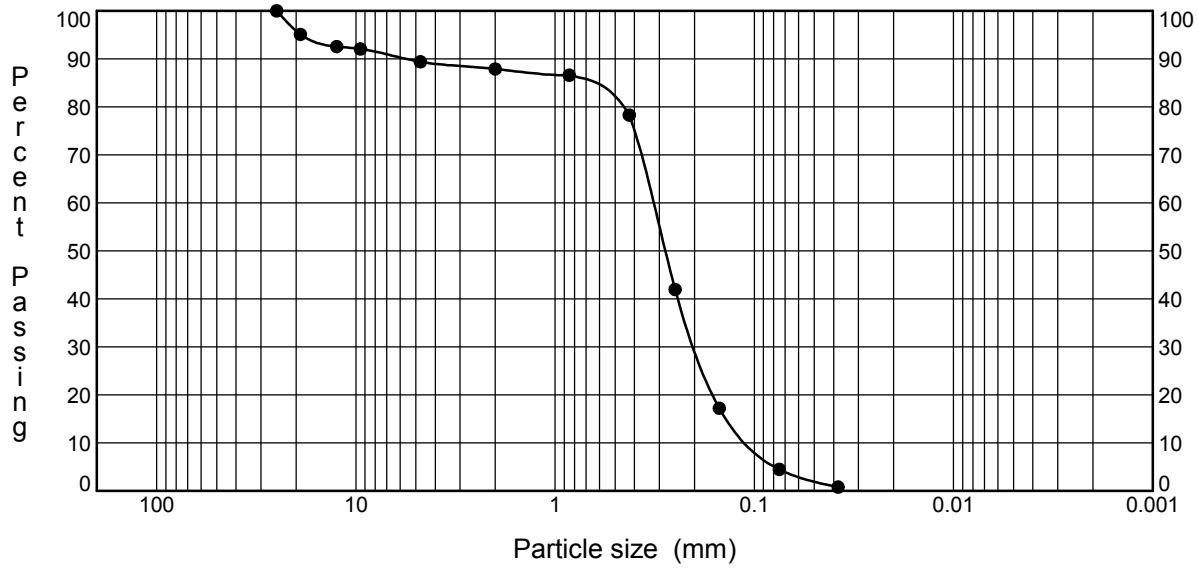
GRAIN SIZE DISTRIBUTION

CLIENT Chippewa Sand Company **PROJECT NAME** Chippewa Sands

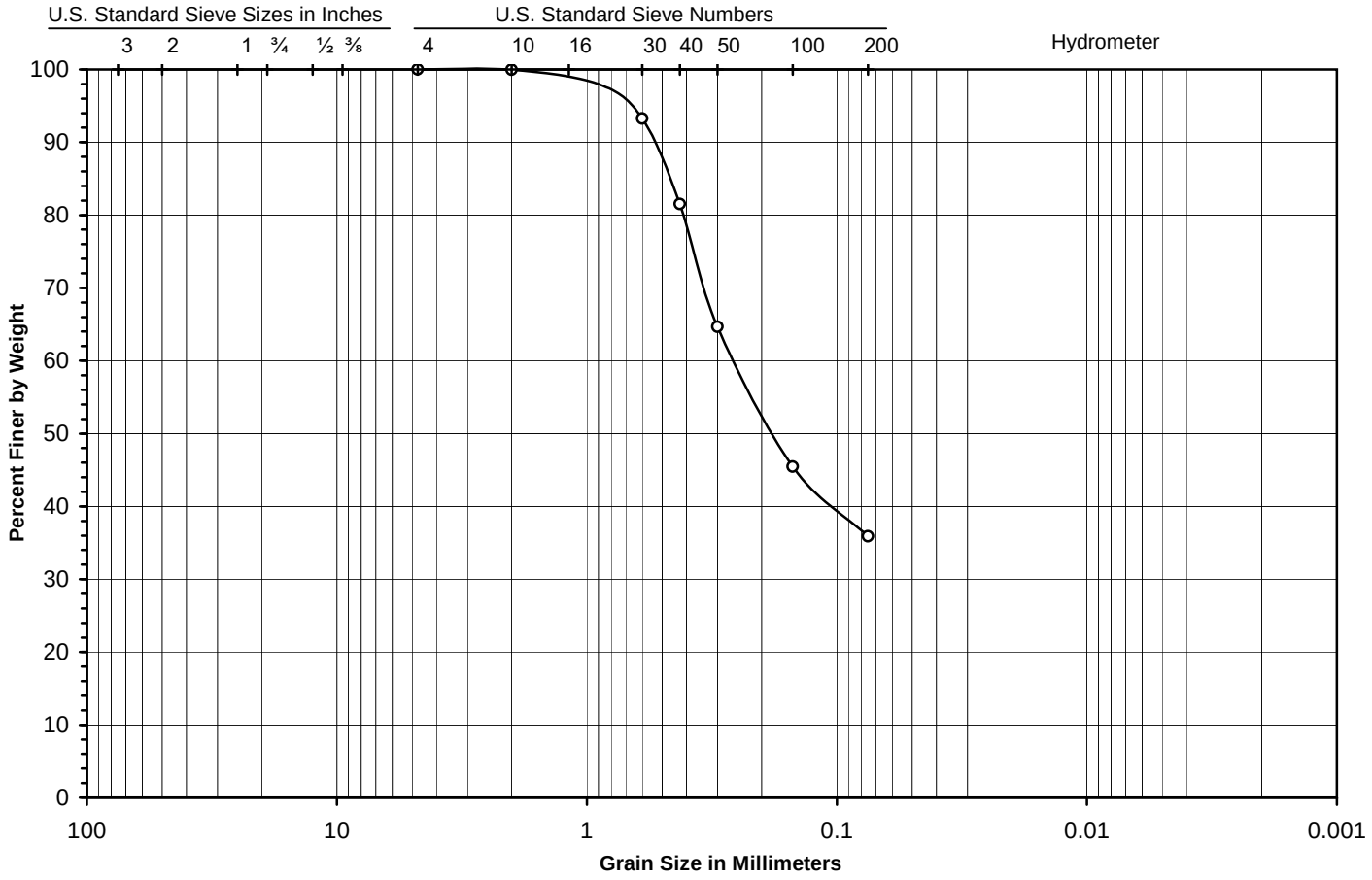
PROJECT NUMBER 20.0154893.10 **PROJECT LOCATION** 105 Highway Q

BOREHOLE No. **B-18** DEPTH **4.0**



Cobbles	Gravel		Sand			Silt	Clay
	coarse	fine	coarse	medium	fine		

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	-	-
19.0 mm (3/4")	-	-
12.5 mm (1/2")	-	-
9.5 mm (3/8")	-	-
4.75 mm (# 4)	100.0	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	100.0	-
1.18 mm (# 16)	-	-
600 µm (# 30)	93.3	-
425 µm (# 40)	81.5	-
300 µm (# 50)	64.7	-
180 µm (# 80)	-	-
150 µm (# 100)	45.5	-
75 µm (# 200)	35.9	-

SAMPLE ID: Pond #2, B-7, 2'-4'

Description/Classification

Silty/Clayey Sand (SM / SC-SM / SC)

Coefficients

D_{60} =	0.25	mm
D_{30} =	--	mm
D_{10} =	--	mm
C_u =	--	
C_c =	--	

Other Test Data

Moisture Content =	percent
Dry Unit Weight =	lbs./cu.ft.
Hydraulic Conductivity =	cm./sec.
Liquid Limit =	
Plastic Limit =	

Wisconsin Testing Laboratories LLC

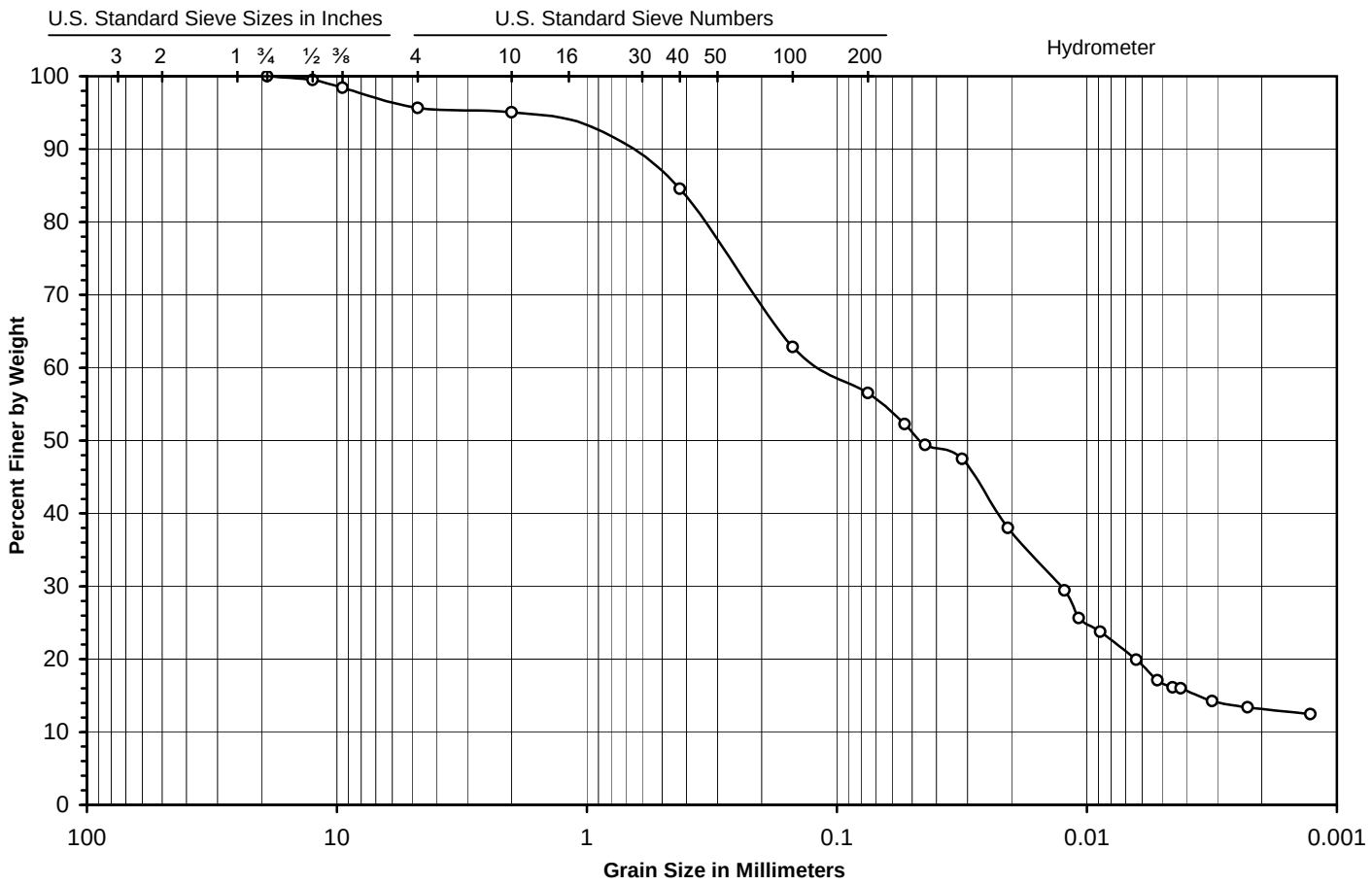
Job No. 0010-17-009

CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 3, 2017

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	-	-
19.0 mm (3/4")	100.0	-
12.5 mm (1/2")	99.5	-
9.5 mm (3/8")	98.4	-
4.75 mm (# 4)	95.6	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	95.0	-
1.18 mm (# 16)	-	-
600 µm (# 30)	-	-
425 µm (# 40)	84.6	-
300 µm (# 50)	-	-
180 µm (# 80)	-	-
150 µm (# 100)	62.8	-
75 µm (# 200)	56.5	-

SAMPLE ID: Pond #3, B-9, 2'-4'

Description/Classification

Sandy Silt/Clay (ML/MH/CL/CH/CL-ML)

Coefficients

D_{60} =	0.12	mm
D_{30} =	0.013	mm
D_{10} =	--	mm
C_u =	--	
C_c =	--	

Other Test Data

Moisture Content =	percent
Dry Unit Weight =	lbs./cu.ft.
Hydraulic Conductivity =	cm./sec.
Liquid Limit =	
Plastic Limit =	

Wisconsin Testing Laboratories LLC

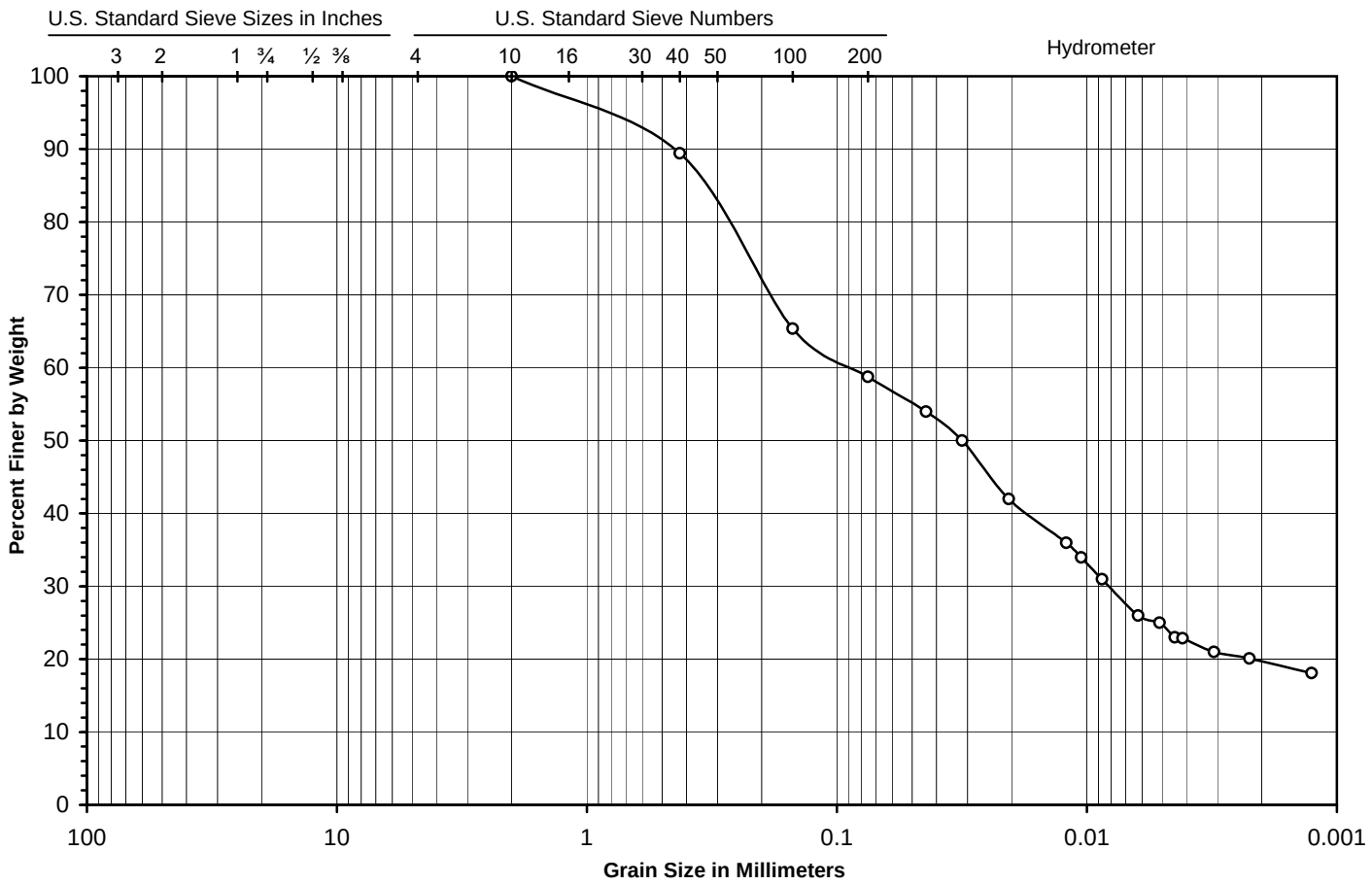
Job No. 0010-17-009

CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 10, 2017

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	-	-
19.0 mm (3/4")	-	-
12.5 mm (1/2")	-	-
9.5 mm (3/8")	-	-
4.75 mm (# 4)	-	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	100.0	-
1.18 mm (# 16)	-	-
600 µm (# 30)	-	-
425 µm (# 40)	89.4	-
300 µm (# 50)	-	-
180 µm (# 80)	-	-
150 µm (# 100)	65.4	-
75 µm (# 200)	58.8	-

SAMPLE ID: Pond #3, B-11, 2'-4'

Description/Classification

Sandy Silt/Clay (ML/MH/CL/CH/CL-ML)

Coefficients

D_{60} = 0.088 mm
D_{30} = 0.0080 mm
D_{10} = -- mm
C_u = --
C_c = --

Other Test Data

Moisture Content = percent
Dry Unit Weight = lbs./cu.ft.
Hydraulic Conductivity = cm./sec.
Liquid Limit =
Plastic Limit =

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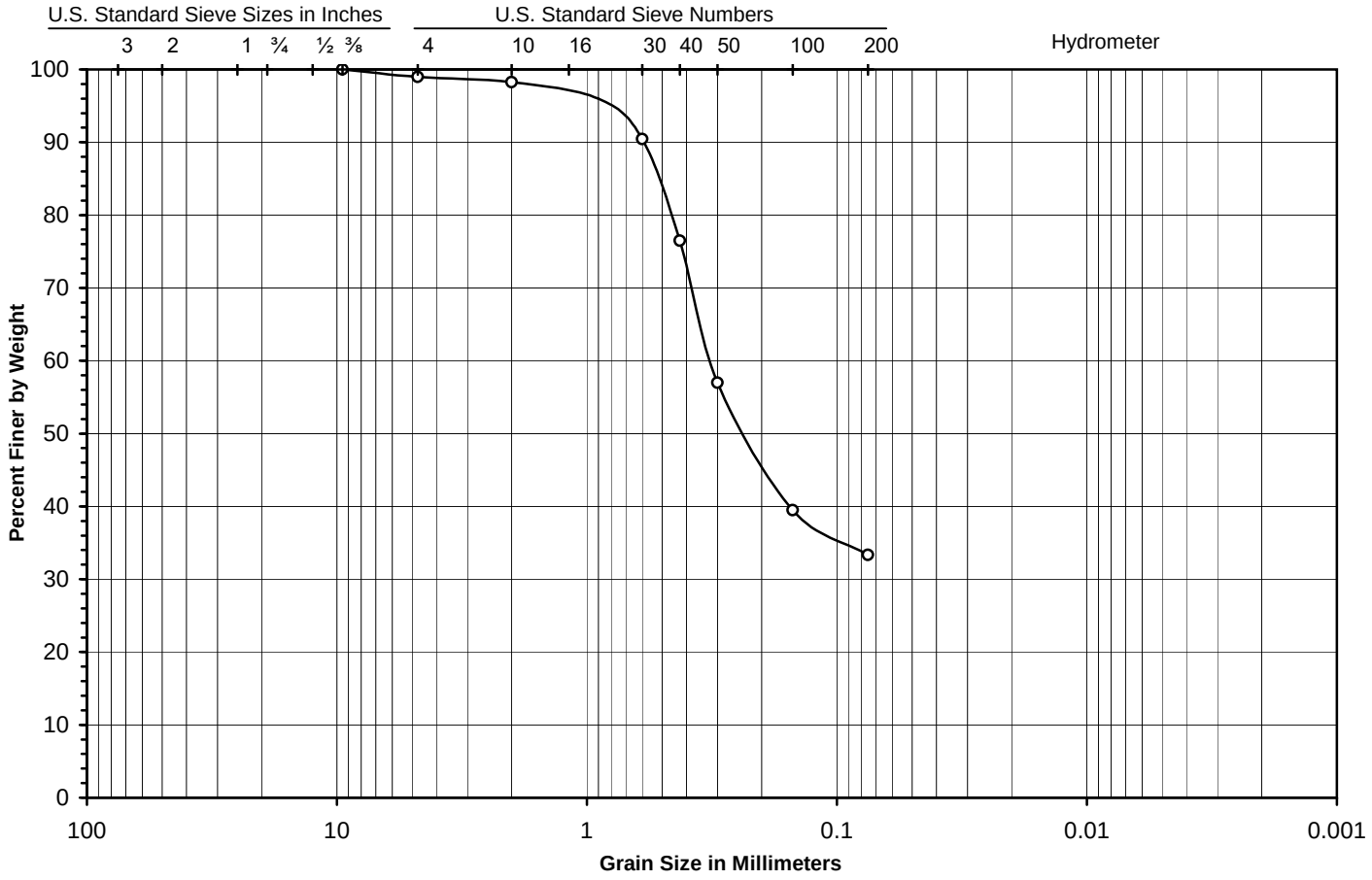
Job No. 0010-17-009

CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 10, 2017

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	-	-
19.0 mm (3/4")	-	-
12.5 mm (1/2")	-	-
9.5 mm (3/8")	100.0	-
4.75 mm (# 4)	99.0	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	98.2	-
1.18 mm (# 16)	-	-
600 µm (# 30)	90.4	-
425 µm (# 40)	76.5	-
300 µm (# 50)	57.0	-
180 µm (# 80)	-	-
150 µm (# 100)	39.5	-
75 µm (# 200)	33.4	-

SAMPLE ID: Pond #4, B-4, 2'-4'

Description/Classification

Silty/Clayey Sand (SM / SC-SM / SC)

Coefficients

D_{60} =	0.32	mm
D_{30} =	--	mm
D_{10} =	--	mm
C_u =	--	
C_c =	--	

Other Test Data

Moisture Content =	percent
Dry Unit Weight =	lbs./cu.ft.
Hydraulic Conductivity =	cm./sec.
Liquid Limit =	
Plastic Limit =	

Wisconsin Testing Laboratories LLC

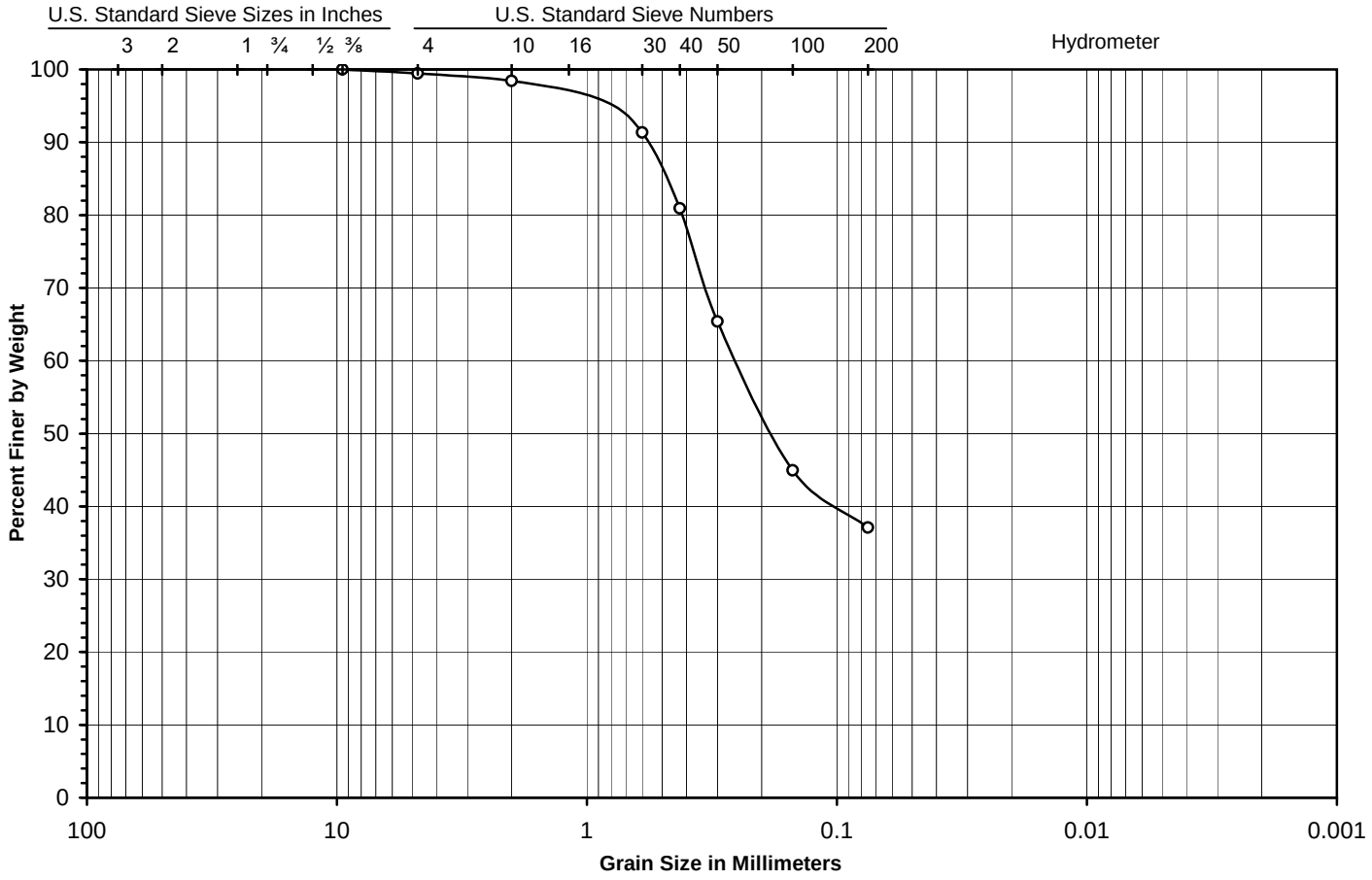
Job No. 0010-17-009

CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 3, 2017

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	-	-
19.0 mm (3/4")	-	-
12.5 mm (1/2")	-	-
9.5 mm (3/8")	100.0	-
4.75 mm (# 4)	99.4	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	98.4	-
1.18 mm (# 16)	-	-
600 µm (# 30)	91.3	-
425 µm (# 40)	80.9	-
300 µm (# 50)	65.4	-
180 µm (# 80)	-	-
150 µm (# 100)	44.9	-
75 µm (# 200)	37.1	-

SAMPLE ID: Pond #4, B-4, 4'-6'

Description/Classification

Silty/Clayey Sand (SM / SC-SM / SC)

Coefficients

D_{60} =	0.25	mm
D_{30} =	--	mm
D_{10} =	--	mm
C_u =	--	
C_c =	--	

Other Test Data

Moisture Content =	percent
Dry Unit Weight =	lbs./cu.ft.
Hydraulic Conductivity =	cm./sec.
Liquid Limit =	
Plastic Limit =	

Wisconsin Testing Laboratories LLC

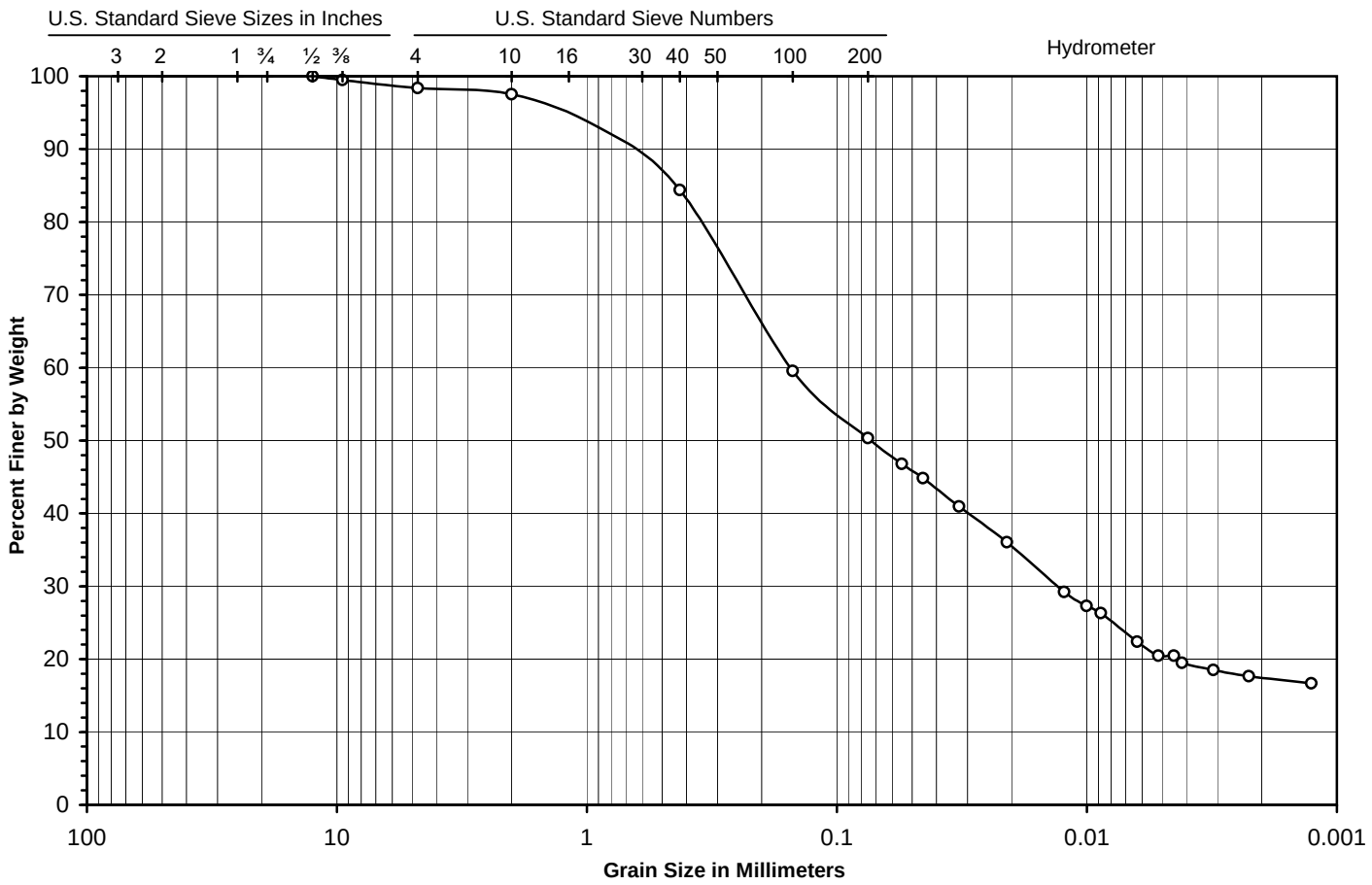
Job No. 0010-17-009

CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 3, 2017

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	-	-
19.0 mm (3/4")	-	-
12.5 mm (1/2")	100.0	-
9.5 mm (3/8")	99.5	-
4.75 mm (# 4)	98.4	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	97.5	-
1.18 mm (# 16)	-	-
600 µm (# 30)	-	-
425 µm (# 40)	84.4	-
300 µm (# 50)	-	-
180 µm (# 80)	-	-
150 µm (# 100)	59.5	-
75 µm (# 200)	50.4	-

SAMPLE ID: Pond #5, B-17, 2'-4'

Description/Classification

Sandy Silt/Clay (ML/MH/CL/CH/CL-ML)

Coefficients

D_{60} =	0.15	mm
D_{30} =	0.013	mm
D_{10} =	--	mm
C_u =	--	
C_c =	--	

Other Test Data

Moisture Content =	percent
Dry Unit Weight =	lbs./cu.ft.
Hydraulic Conductivity =	cm./sec.
Liquid Limit =	
Plastic Limit =	

Wisconsin Testing Laboratories LLC

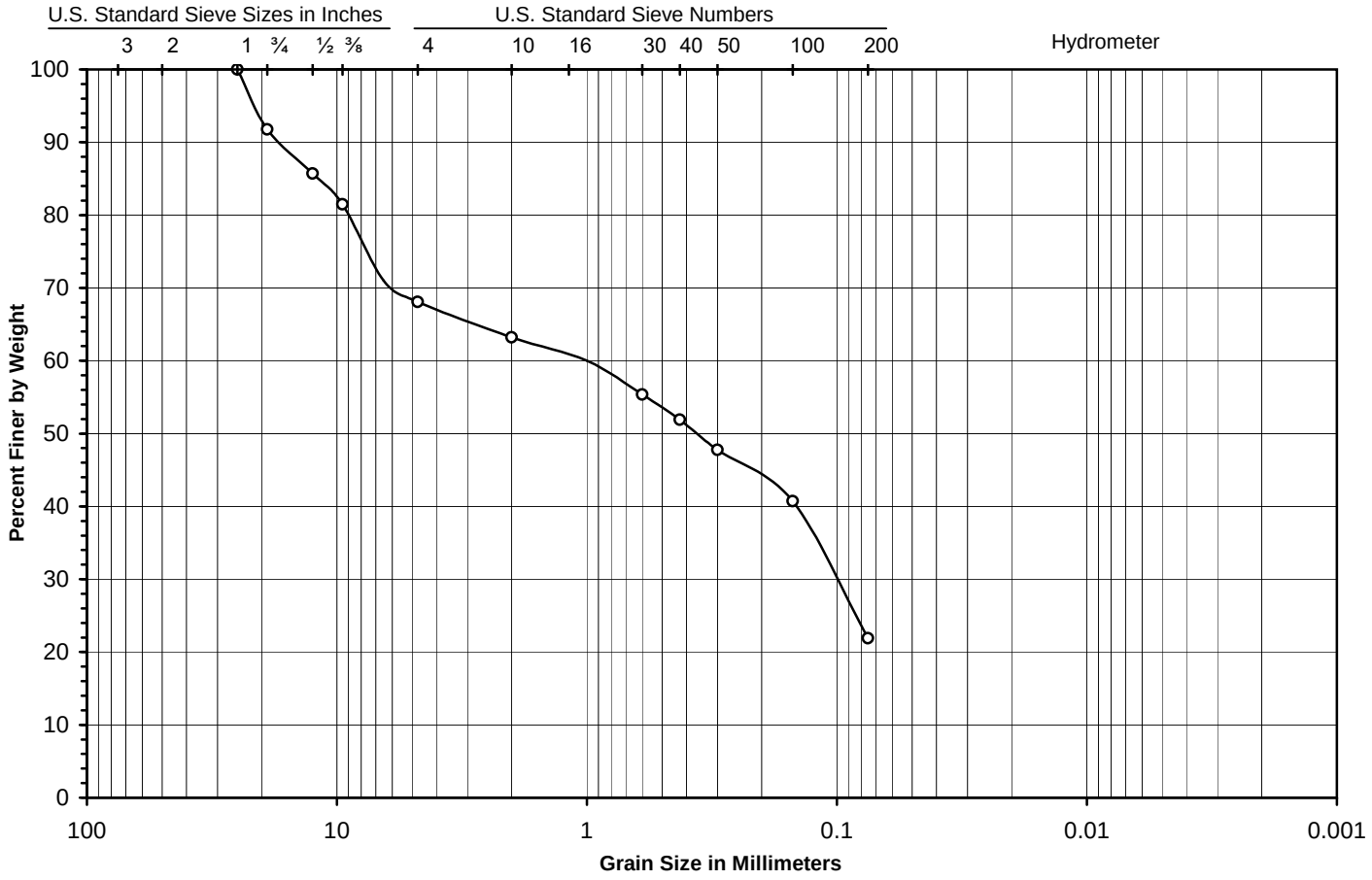
Job No. 0010-17-009

CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 10, 2017

GRAIN SIZE ANALYSIS TEST RESULTS



UNIFIED	GRAVEL	SAND	SILT AND CLAY
AASHTO	GRAVEL	SAND	SILT AND CLAY

SIEVE SIZE	PERCENT FINER	SPEC
125 mm (5")	-	-
100 mm (4")	-	-
90 mm (3½")	-	-
75 mm (3")	-	-
63 mm (2½")	-	-
50 mm (2")	-	-
37.5 mm (1½")	-	-
31.5 mm (1¼")	-	-
25.0 mm (1")	100.0	-
19.0 mm (3/4")	91.8	-
12.5 mm (1/2")	85.7	-
9.5 mm (3/8")	81.5	-
4.75 mm (# 4)	68.1	-
2.36 mm (# 8)	-	-
2.00 mm (# 10)	63.2	-
1.18 mm (# 16)	-	-
600 µm (# 30)	55.3	-
425 µm (# 40)	51.9	-
300 µm (# 50)	47.8	-
180 µm (# 80)	-	-
150 µm (# 100)	40.7	-
75 µm (# 200)	21.9	-

SAMPLE ID: Pond #5, B-19, 8'-10'

Description/Classification

Silty/Clayey Sand with gravel (SM / SC-SM / SC)

Coefficients

D_{60} =	1.0	mm
D_{30} =	0.10	mm
D_{10} =	--	mm
C_u =	--	
C_c =	--	

Other Test Data

Moisture Content =	percent
Dry Unit Weight =	lbs./cu.ft.
Hydraulic Conductivity =	cm./sec.
Liquid Limit =	
Plastic Limit =	

Wisconsin Testing Laboratories LLC

Job No. 0010-17-009

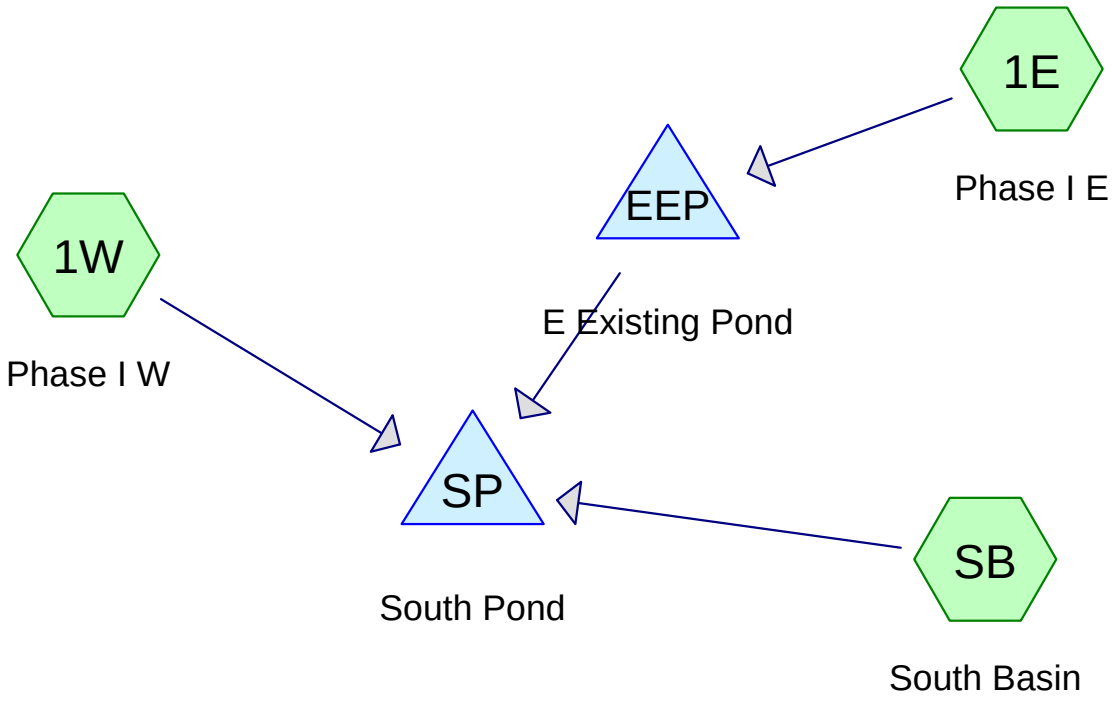
CHIPPEWA SANDS

For GZA GeoEnvironmental, Inc.

July 3, 2017

APPENDIX B

HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for Chippewa Phases 1-5
Prepared by GZA GeoEnvironmental, Inc., Printed 4/18/2018

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
35.700	39	(SB)
17.900	39	>75% Grass cover, Good, HSG A (1E)
44.400	86	Newly graded area, HSG B (1E, 1W)
30.100	94	Newly graded area, HSG D (1E, 1W)
106.200	30	Woods, Good, HSG A (1E, 1W)
234.300	**51**	**TOTAL AREA**

Time span=10.00-48.00 hrs, dt=0.05 hrs, 761 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1E: Phase I E Runoff Area=126.400 ac 0.00% Impervious Runoff Depth=1.18"
Flow Length=4,585' Tc=111.0 min CN=48 Runoff=38.45 cfs 12.427 af

Subcatchment 1W: Phase I W Runoff Area=72.200 ac 0.00% Impervious Runoff Depth=2.35"
Flow Length=3,837' Tc=94.7 min CN=62 Runoff=60.96 cfs 14.166 af

Subcatchment SB: South Basin Runoff Area=35.700 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=300' Slope=0.0266 '/' Tc=32.7 min CN=39 Runoff=7.10 cfs 1.665 af

Pond EEP: E Existing Pond Peak Elev=1,106.72' Storage=4.094 af Inflow=38.45 cfs 12.427 af
Outflow=25.86 cfs 8.917 af

Pond SP: South Pond Peak Elev=1,069.56' Storage=22.921 af Inflow=64.53 cfs 24.748 af
Outflow=1.52 cfs 4.375 af

Total Runoff Area = 234.300 ac Runoff Volume = 28.258 af Average Runoff Depth = 1.45"
100.00% Pervious = 234.300 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1E: Phase I E

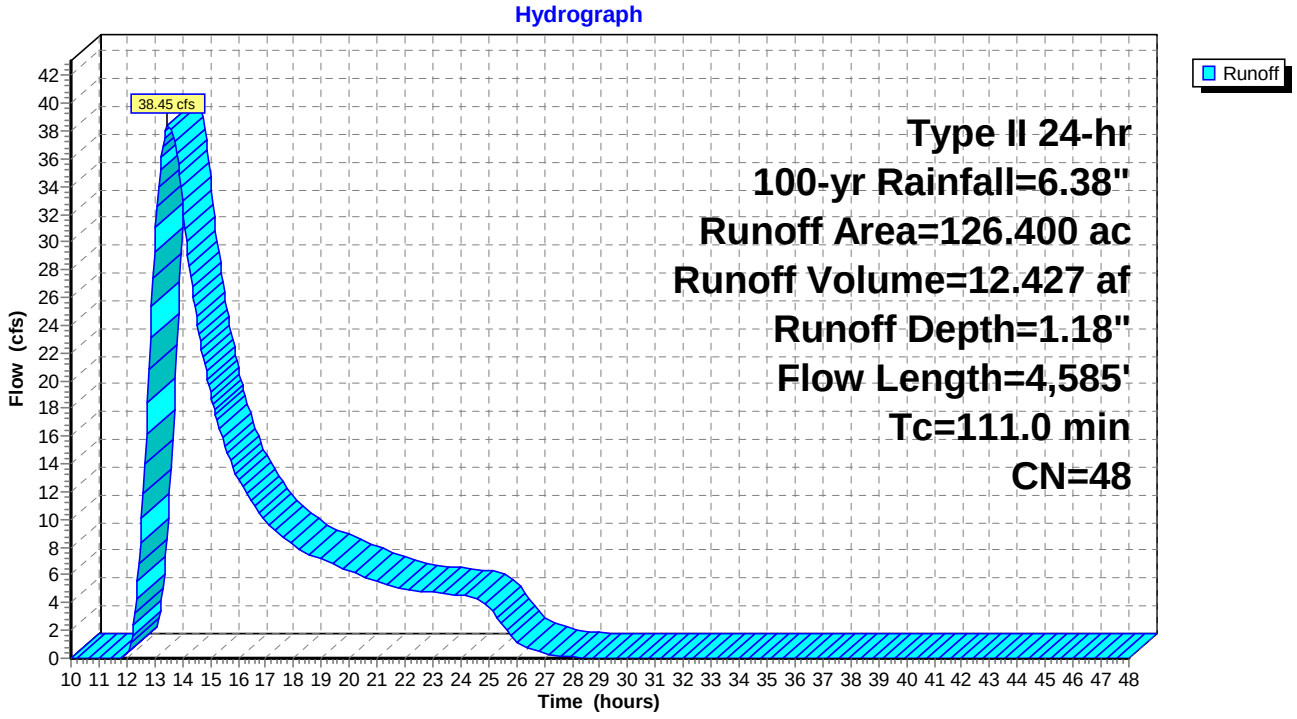
Runoff = 38.45 cfs @ 13.47 hrs, Volume= 12.427 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
73.500	30	Woods, Good, HSG A
17.900	39	>75% Grass cover, Good, HSG A
18.000	94	Newly graded area, HSG D
17.000	86	Newly graded area, HSG B
126.400	48	Weighted Average
126.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
34.8	2,335	0.0500	1.12		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
14.3	1,950	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
111.0	4,585	Total			

Subcatchment 1E: Phase I E



Summary for Subcatchment 1W: Phase I W

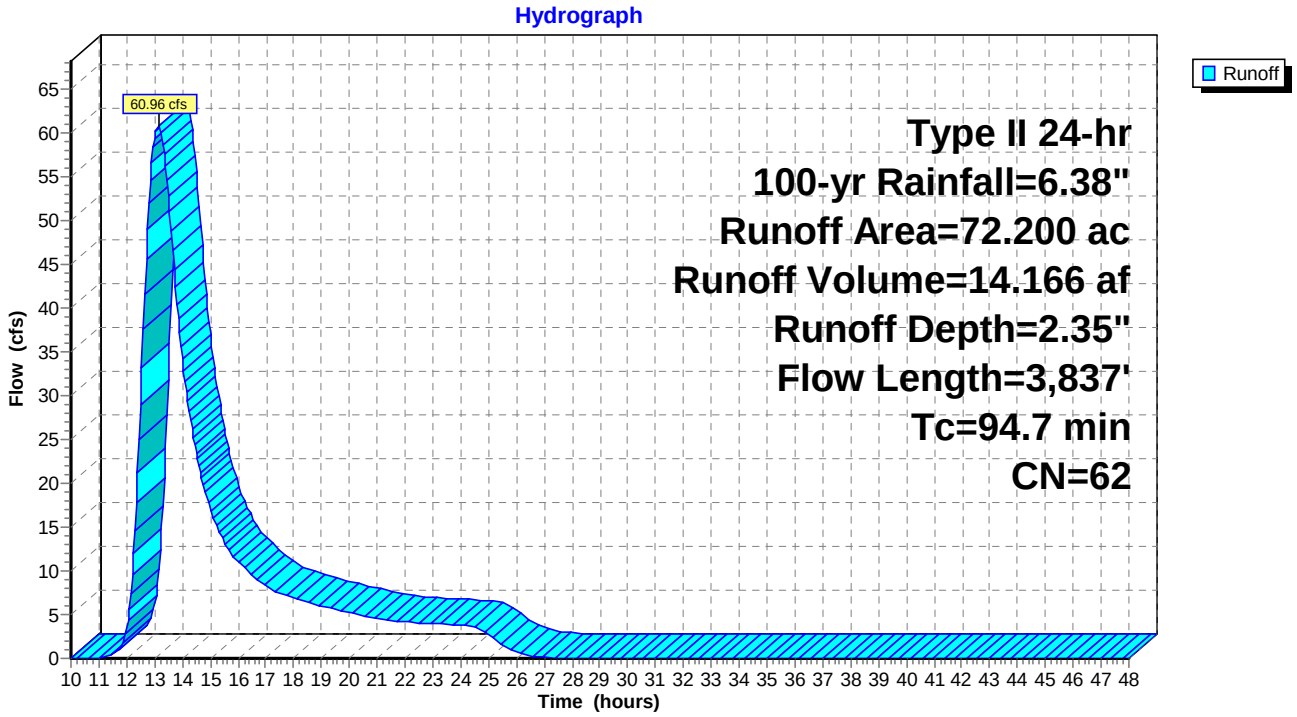
Runoff = 60.96 cfs @ 13.14 hrs, Volume= 14.166 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
4.100	94	Newly graded area, HSG D
7.300	30	Woods, Good, HSG A
25.400	30	Woods, Good, HSG A
8.000	94	Newly graded area, HSG D
27.400	86	Newly graded area, HSG B
72.200	62	Weighted Average
72.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
2.4	300	0.1700	2.06		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
13.5	924	0.0520	1.14		**Shallow Concentrated Flow, T2** Woodland Kv= 5.0 fps
16.9	2,313	0.0200	2.28		**Shallow Concentrated Flow, T3** Unpaved Kv= 16.1 fps
94.7	3,837	Total			

Subcatchment 1W: Phase I W



Summary for Subcatchment SB: South Basin

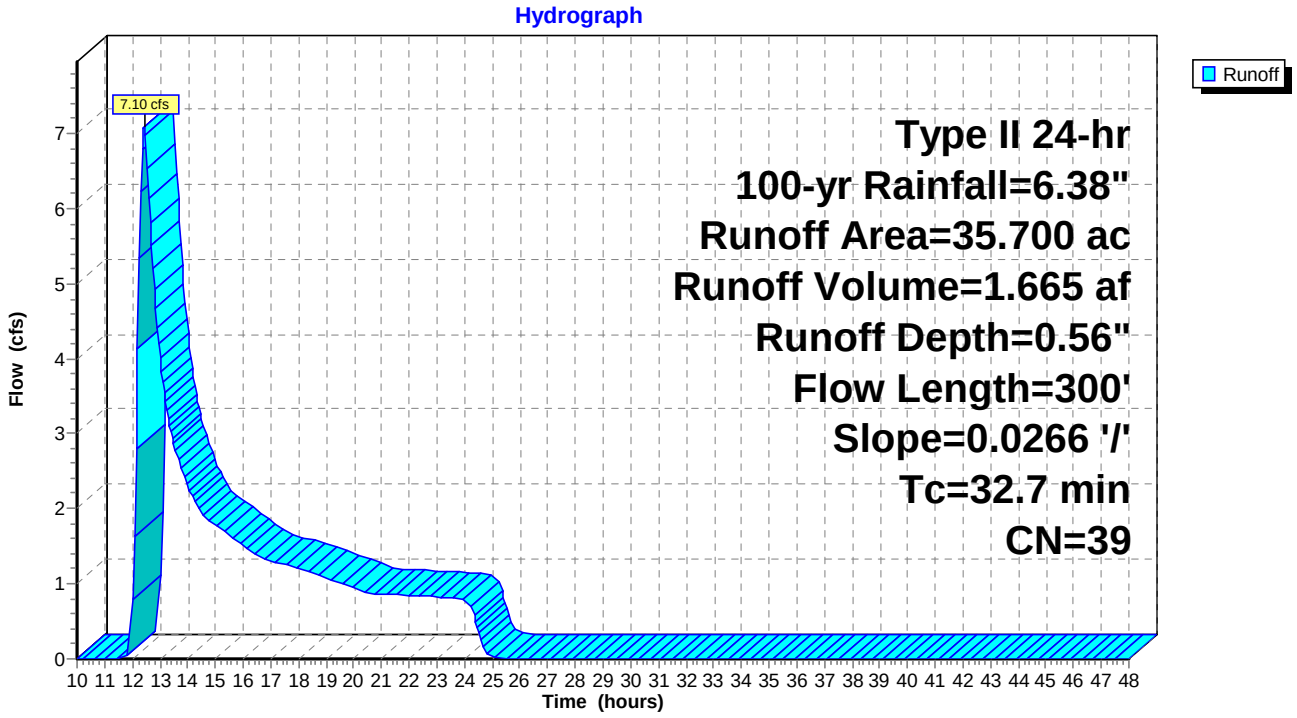
Runoff = 7.10 cfs @ 12.43 hrs, Volume= 1.665 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
*	35.700	39	
	35.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	300	0.0266	0.15		**Sheet Flow, Wetland Area** Grass: Dense n= 0.240 P2= 2.81"

Subcatchment SB: South Basin



Summary for Pond EEP: E Existing Pond

Inflow Area = 126.400 ac, 0.00% Impervious, Inflow Depth = 1.18" for 100-yr event
Inflow = 38.45 cfs @ 13.47 hrs, Volume= 12.427 af
Outflow = 25.86 cfs @ 14.42 hrs, Volume= 8.917 af, Atten= 33%, Lag= 56.6 min
Primary = 25.86 cfs @ 14.42 hrs, Volume= 8.917 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,106.72' @ 14.42 hrs Surf.Area= 0.819 ac Storage= 4.094 af

Plug-Flow detention time= 216.7 min calculated for 8.905 af (72% of inflow)
Center-of-Mass det. time= 100.4 min (1,092.0 - 991.7)

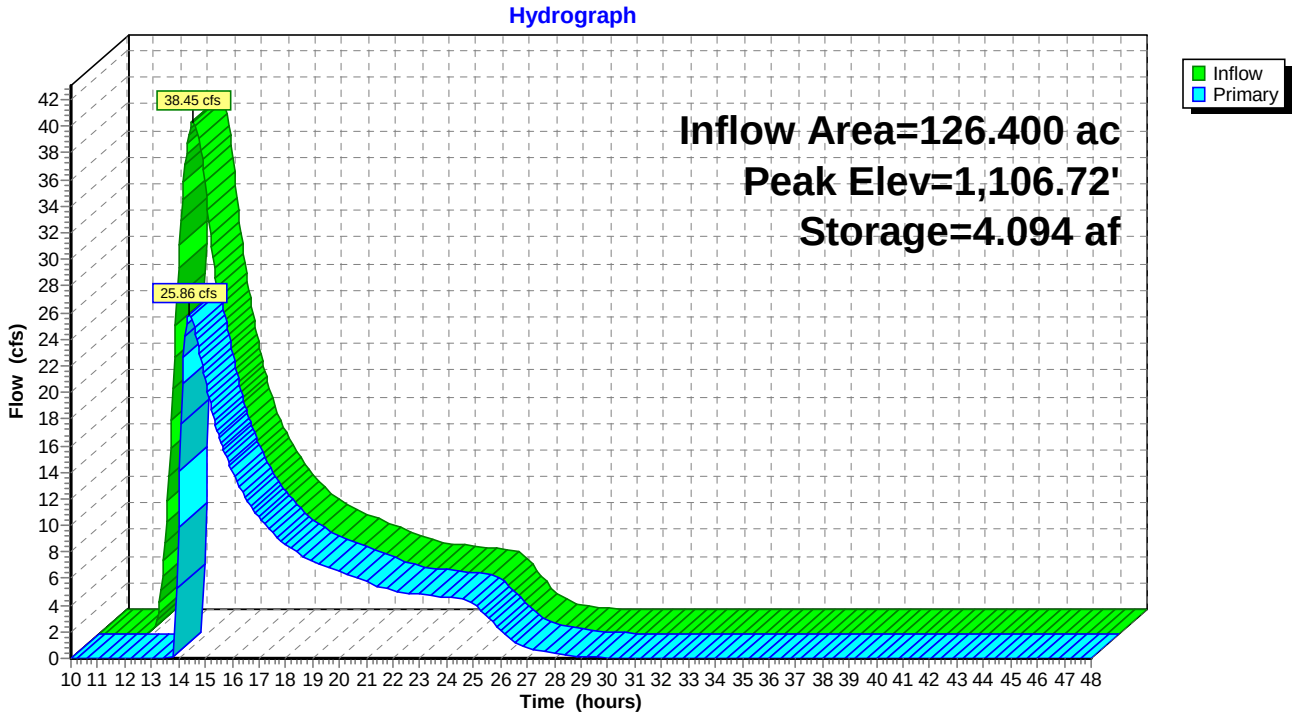
Volume	Invert	Avail.Storage	Storage Description
#1	1,096.00'	5.161 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,096.00	0.130	0.000	0.000
1,098.00	0.150	0.280	0.280
1,099.00	0.192	0.171	0.451
1,102.00	0.381	0.859	1.310
1,104.00	0.509	0.890	2.200
1,106.00	0.801	1.310	3.510
1,108.00	0.850	1.651	5.161

Device	Routing	Invert	Outlet Devices
#1	Primary	1,106.00'	**15.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=25.74 cfs @ 14.42 hrs HW=1,106.72' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 25.74 cfs @ 2.38 fps)

Pond EEP: E Existing Pond



Summary for Pond SP: South Pond

Inflow Area = 234.300 ac, 0.00% Impervious, Inflow Depth = 1.27" for 100-yr event
Inflow = 64.53 cfs @ 13.13 hrs, Volume= 24.748 af
Outflow = 1.52 cfs @ 26.53 hrs, Volume= 4.375 af, Atten= 98%, Lag= 803.7 min
Discarded = 1.52 cfs @ 26.53 hrs, Volume= 4.375 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,069.56' @ 26.53 hrs Surf.Area= 4.725 ac Storage= 22.921 af

Plug-Flow detention time= 1,053.1 min calculated for 4.369 af (18% of inflow)
Center-of-Mass det. time= 829.5 min (1,822.3 - 992.9)

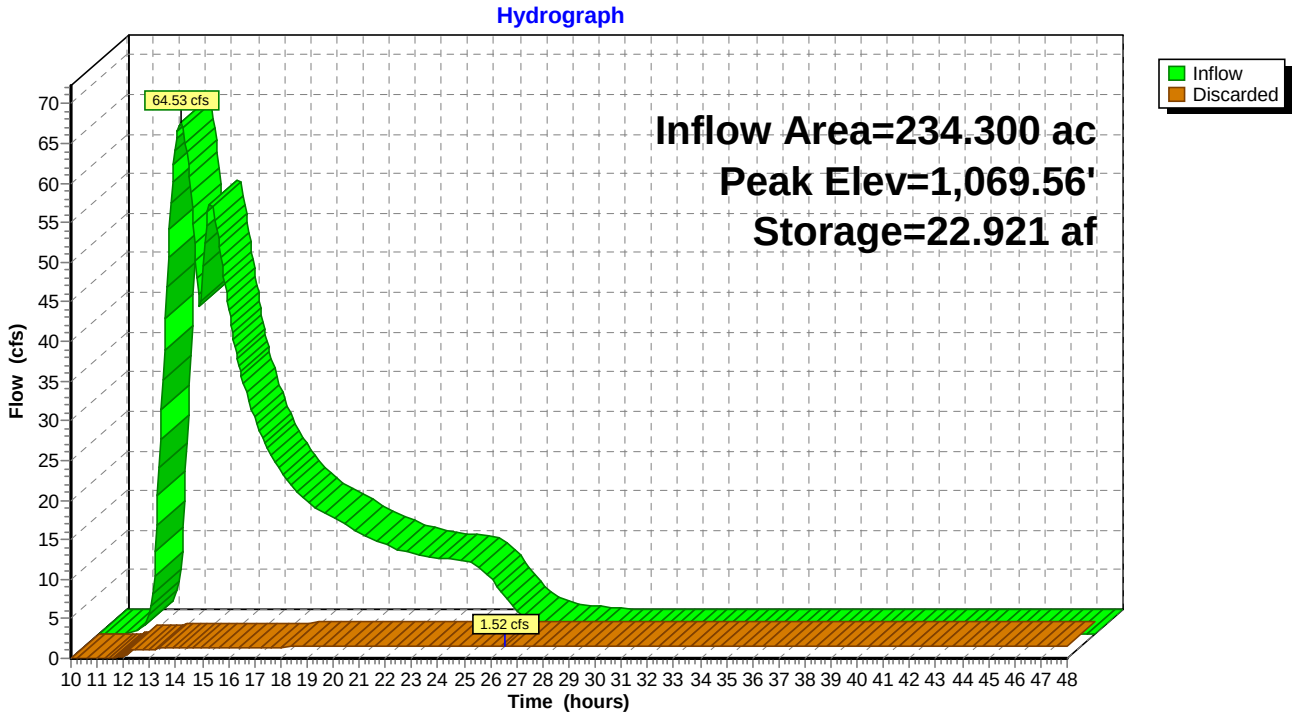
Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	25.038 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

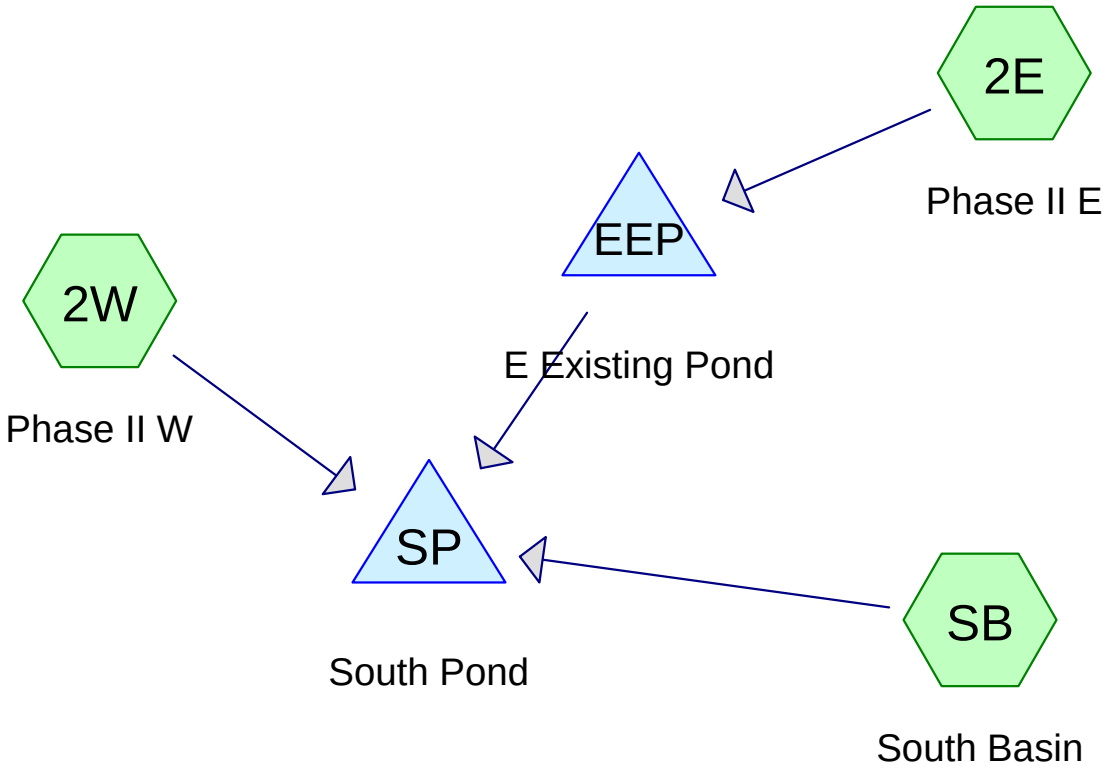
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,064.00	3.549	2,214.7	0.000	0.000	3.549
1,069.00	4.604	2,377.7	20.325	20.325	4.942
1,070.00	4.823	2,410.3	4.713	25.038	5.232

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,064.00'	**0.320 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.52 cfs @ 26.53 hrs HW=1,069.56' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.52 cfs)

Pond SP: South Pond





Subcat Reach Pond Link

Routing Diagram for Chippewa Phases 1-5
Prepared by GZA GeoEnvironmental, Inc., Printed 4/18/2018

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
35.700	39	(SB)
72.600	39	>75% Grass cover, Good, HSG A (2E, 2W)
36.600	94	Newly graded area, HSG D (2E, 2W)
106.200	30	Woods, Good, HSG A (2E, 2W)
251.100	**43**	**TOTAL AREA**

Time span=10.00-48.00 hrs, dt=0.05 hrs, 761 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 2E: Phase II E Runoff Area=141.000 ac 0.00% Impervious Runoff Depth=1.10"
Flow Length=4,545' Tc=119.2 min CN=47 Runoff=36.74 cfs 12.980 af

Subcatchment 2W: Phase II W Runoff Area=74.400 ac 0.00% Impervious Runoff Depth=0.50"
Flow Length=3,502' Tc=101.1 min CN=38 Runoff=6.73 cfs 3.099 af

Subcatchment SB: South Basin Runoff Area=35.700 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=300' Slope=0.0266 '/' Tc=32.7 min CN=39 Runoff=7.10 cfs 1.665 af

Pond EEP: E Existing Pond Peak Elev=1,106.73' Storage=4.099 af Inflow=36.74 cfs 12.980 af
Outflow=26.26 cfs 9.469 af

Pond SP: South Pond Peak Elev=1,067.24' Storage=12.582 af Inflow=33.59 cfs 14.234 af
Outflow=1.36 cfs 3.890 af

Total Runoff Area = 251.100 ac Runoff Volume = 17.744 af Average Runoff Depth = 0.85"
100.00% Pervious = 251.100 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2E: Phase II E

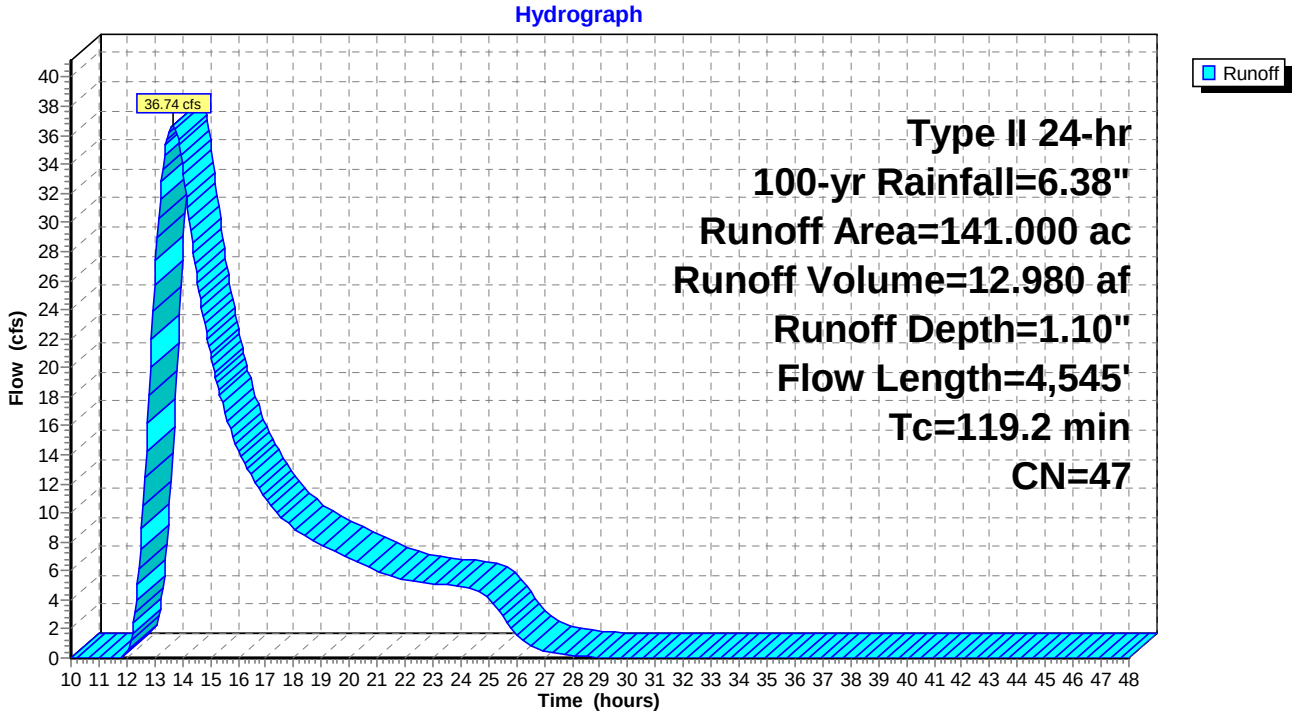
Runoff = 36.74 cfs @ 13.65 hrs, Volume= 12.980 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
73.500	30	Woods, Good, HSG A
32.500	94	Newly graded area, HSG D
35.000	39	>75% Grass cover, Good, HSG A
141.000	47	Weighted Average
141.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
34.8	2,335	0.0500	1.12		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
22.5	1,910	0.0200	1.41		**Shallow Concentrated Flow, T2** Nearly Bare & Untilled Kv= 10.0 fps
119.2	4,545	Total			

Subcatchment 2E: Phase II E



Summary for Subcatchment 2W: Phase II W

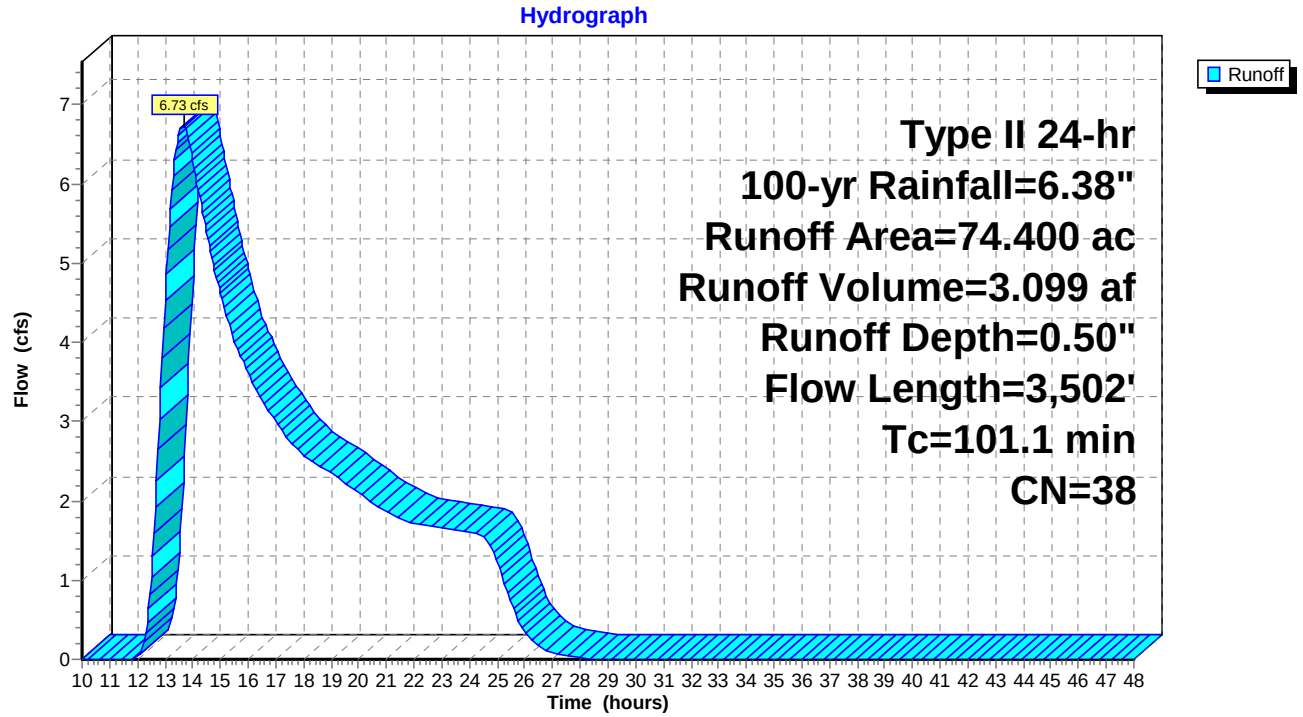
Runoff = 6.73 cfs @ 13.66 hrs, Volume= 3.099 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
4.100	94	Newly graded area, HSG D
7.300	30	Woods, Good, HSG A
25.400	30	Woods, Good, HSG A
37.600	39	>75% Grass cover, Good, HSG A
74.400	38	Weighted Average
74.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
2.4	300	0.1700	2.06		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
13.5	924	0.0520	1.14		**Shallow Concentrated Flow, T2** Woodland Kv= 5.0 fps
23.3	1,978	0.0200	1.41		**Shallow Concentrated Flow, T3** Nearly Bare & Untilled Kv= 10.0 fps
101.1	3,502	Total			

Subcatchment 2W: Phase II W



Summary for Subcatchment SB: South Basin

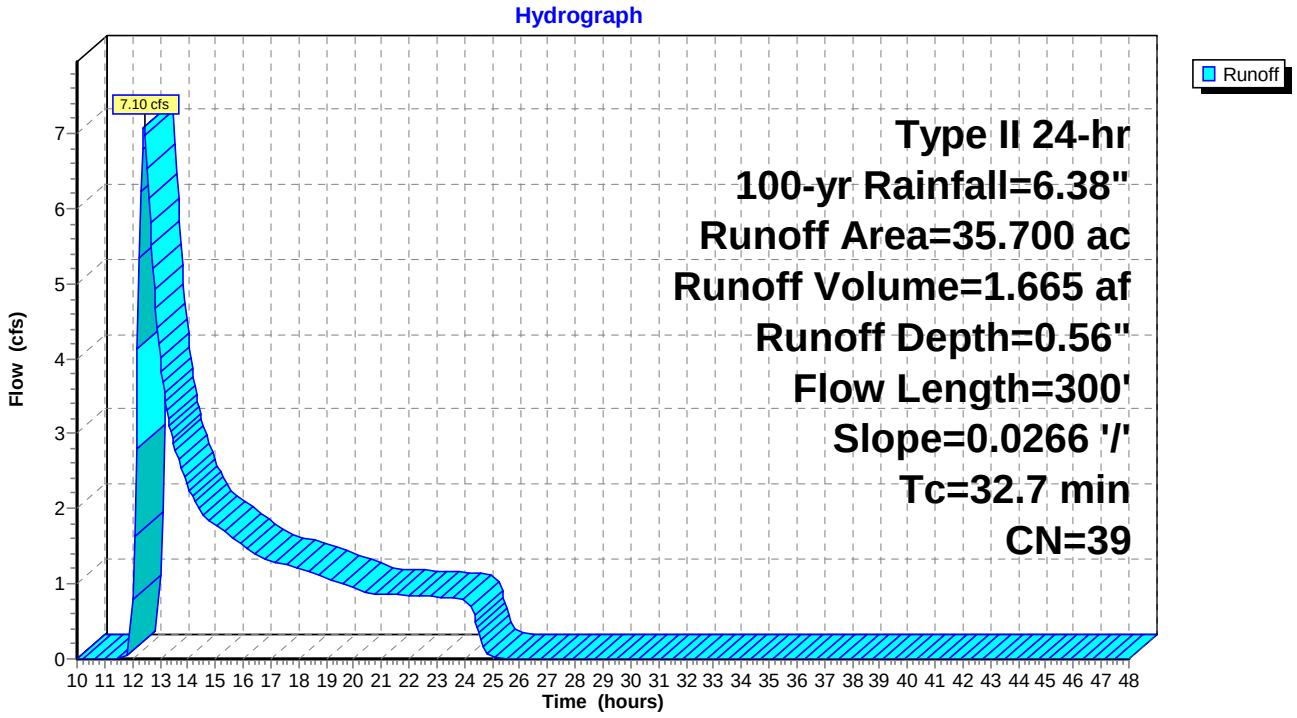
Runoff = 7.10 cfs @ 12.43 hrs, Volume= 1.665 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
*	35.700	39	
	35.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	300	0.0266	0.15		**Sheet Flow, Wetland Area** Grass: Dense n= 0.240 P2= 2.81"

Subcatchment SB: South Basin



Summary for Pond EEP: E Existing Pond

Inflow Area = 141.000 ac, 0.00% Impervious, Inflow Depth = 1.10" for 100-yr event
Inflow = 36.74 cfs @ 13.65 hrs, Volume= 12.980 af
Outflow = 26.26 cfs @ 14.52 hrs, Volume= 9.469 af, Atten= 29%, Lag= 52.6 min
Primary = 26.26 cfs @ 14.52 hrs, Volume= 9.469 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,106.73' @ 14.52 hrs Surf.Area= 0.819 ac Storage= 4.099 af

Plug-Flow detention time= 212.0 min calculated for 9.457 af (73% of inflow)
Center-of-Mass det. time= 98.3 min (1,101.3 - 1,003.0)

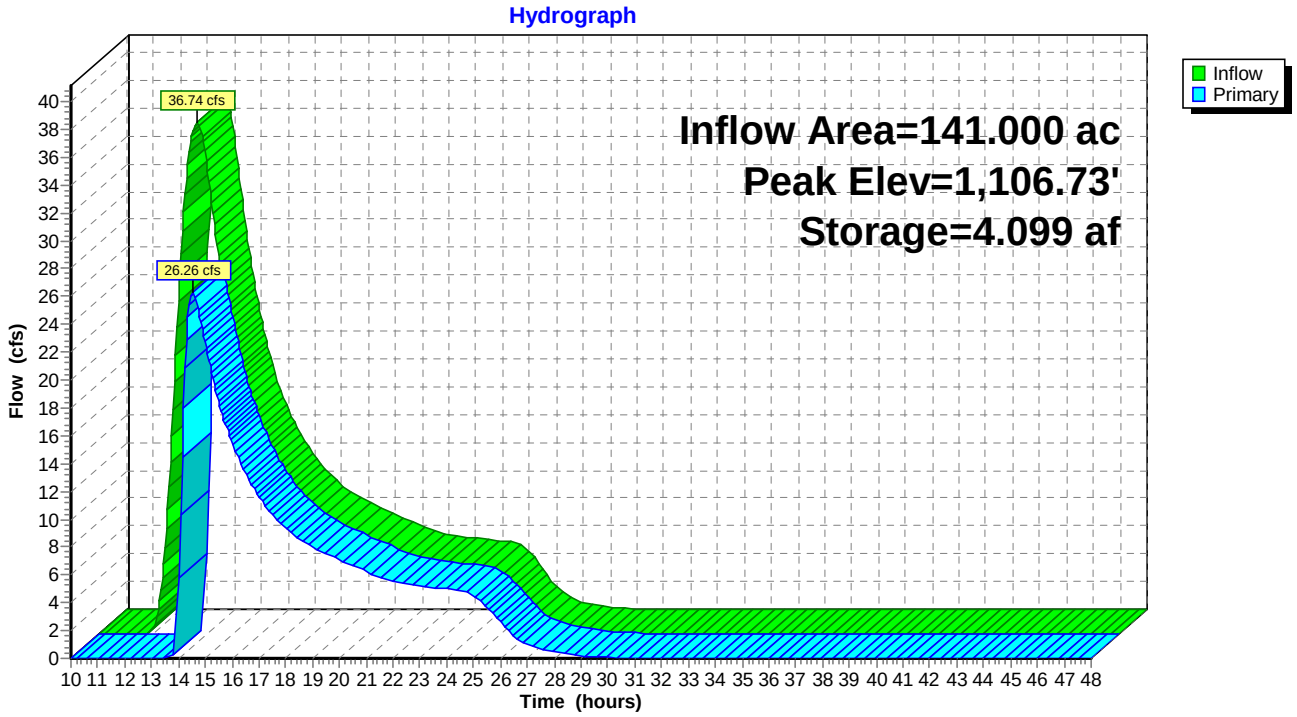
Volume	Invert	Avail.Storage	Storage Description
#1	1,096.00'	5.161 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,096.00	0.130	0.000	0.000
1,098.00	0.150	0.280	0.280
1,099.00	0.192	0.171	0.451
1,102.00	0.381	0.859	1.310
1,104.00	0.509	0.890	2.200
1,106.00	0.801	1.310	3.510
1,108.00	0.850	1.651	5.161

Device	Routing	Invert	Outlet Devices
#1	Primary	1,106.00'	**15.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=26.13 cfs @ 14.52 hrs HW=1,106.73' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 26.13 cfs @ 2.40 fps)

Pond EEP: E Existing Pond



Summary for Pond SP: South Pond

Inflow Area = 251.100 ac, 0.00% Impervious, Inflow Depth = 0.68" for 100-yr event
Inflow = 33.59 cfs @ 14.50 hrs, Volume= 14.234 af
Outflow = 1.36 cfs @ 26.74 hrs, Volume= 3.890 af, Atten= 96%, Lag= 734.2 min
Discarded = 1.36 cfs @ 26.74 hrs, Volume= 3.890 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,067.24' @ 26.74 hrs Surf.Area= 4.218 ac Storage= 12.582 af

Plug-Flow detention time= 980.1 min calculated for 3.890 af (27% of inflow)
Center-of-Mass det. time= 751.9 min (1,825.9 - 1,074.0)

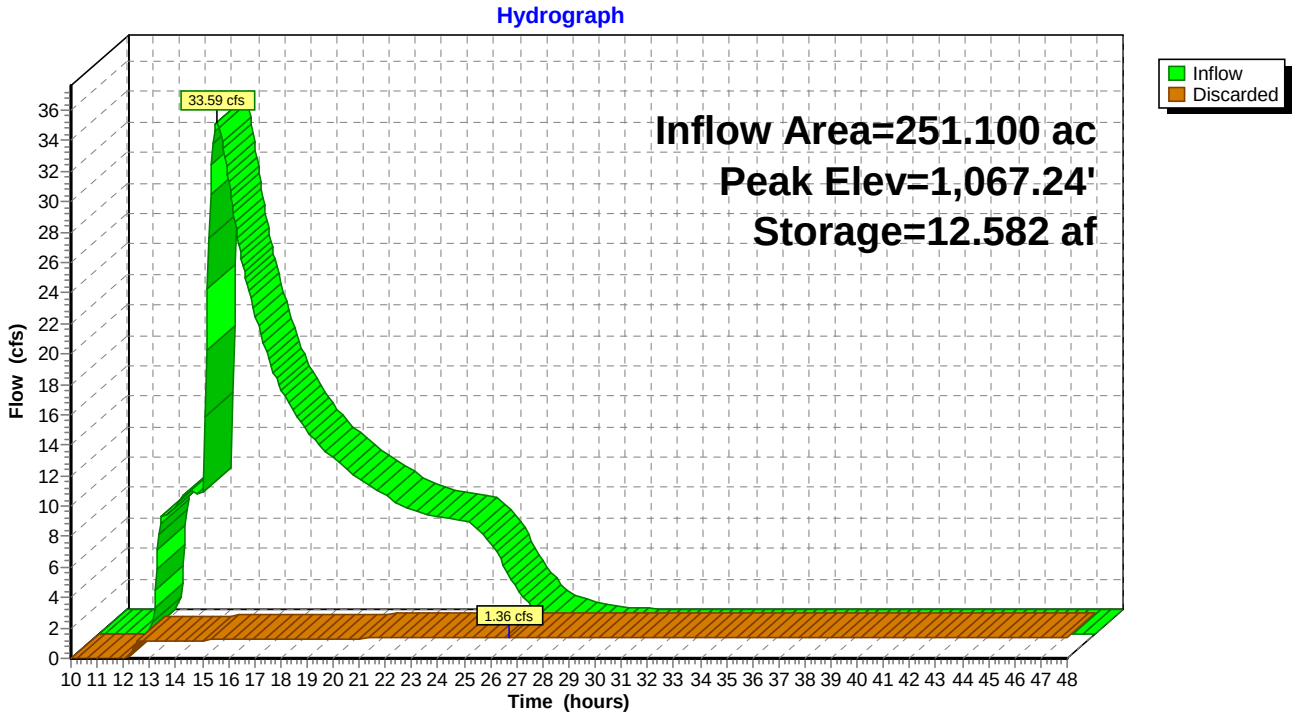
Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	25.038 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

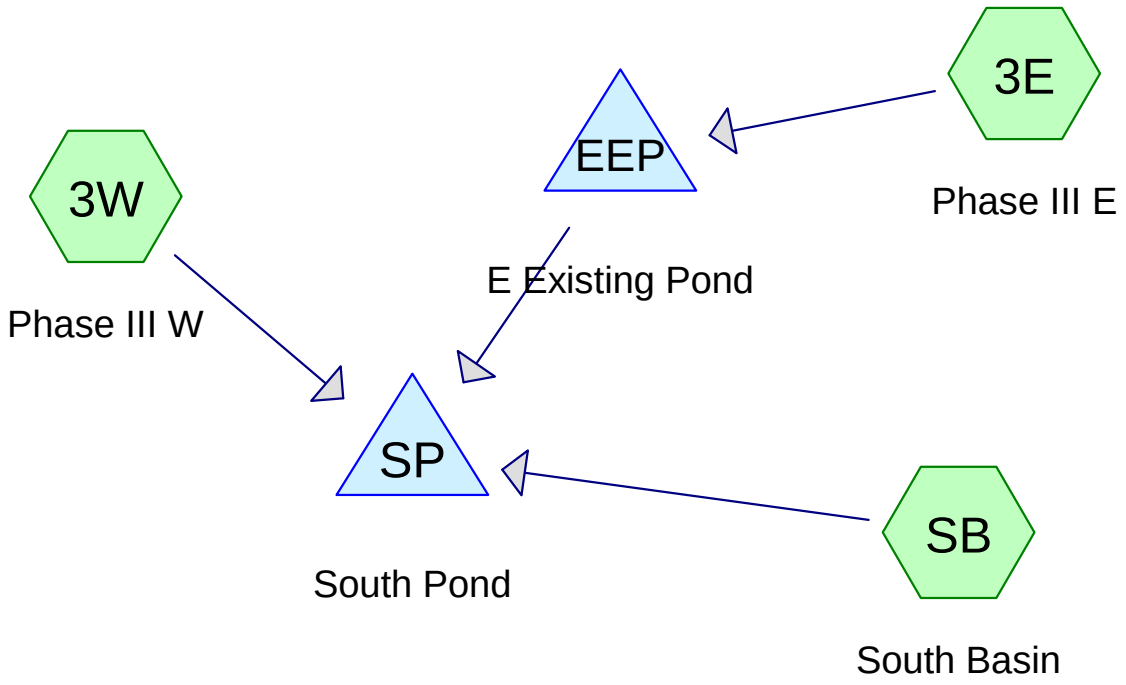
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,064.00	3.549	2,214.7	0.000	0.000	3.549
1,069.00	4.604	2,377.7	20.325	20.325	4.942
1,070.00	4.823	2,410.3	4.713	25.038	5.232

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,064.00'	**0.320 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.36 cfs @ 26.74 hrs HW=1,067.24' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.36 cfs)

Pond SP: South Pond





Subcat Reach Pond Link

Routing Diagram for Chippewa Phases 1-5
Prepared by GZA GeoEnvironmental, Inc., Printed 4/18/2018

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
35.700	39	(SB)
70.500	39	>75% Grass cover, Good, HSG A (3E, 3W)
32.500	39	Newly graded area, HSG D (3E)
42.200	94	Newly graded area, HSG D (3W)
98.900	30	Woods, Good, HSG A (3E, 3W)
279.800	**44**	**TOTAL AREA**

Time span=10.00-48.00 hrs, dt=0.05 hrs, 761 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3E: Phase III E Runoff Area=141.000 ac 0.00% Impervious Runoff Depth=0.28"
Flow Length=4,585' Tc=119.7 min CN=34 Runoff=4.91 cfs 3.346 af

Subcatchment 3W: Phase III W Runoff Area=103.100 ac 0.00% Impervious Runoff Depth=2.09"
Flow Length=3,502' Tc=101.1 min CN=59 Runoff=70.56 cfs 17.920 af

Subcatchment SB: South Basin Runoff Area=35.700 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=300' Slope=0.0266 '/' Tc=32.7 min CN=39 Runoff=7.10 cfs 1.665 af

Pond EEP: E Existing Pond Peak Elev=1,105.79' Storage=3.345 af Inflow=4.91 cfs 3.346 af
Outflow=0.00 cfs 0.000 af

Pond SP: South Pond Peak Elev=1,068.48' Storage=17.949 af Inflow=73.90 cfs 19.585 af
Outflow=1.45 cfs 4.178 af

Total Runoff Area = 279.800 ac Runoff Volume = 22.930 af Average Runoff Depth = 0.98"
100.00% Pervious = 279.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 3E: Phase III E

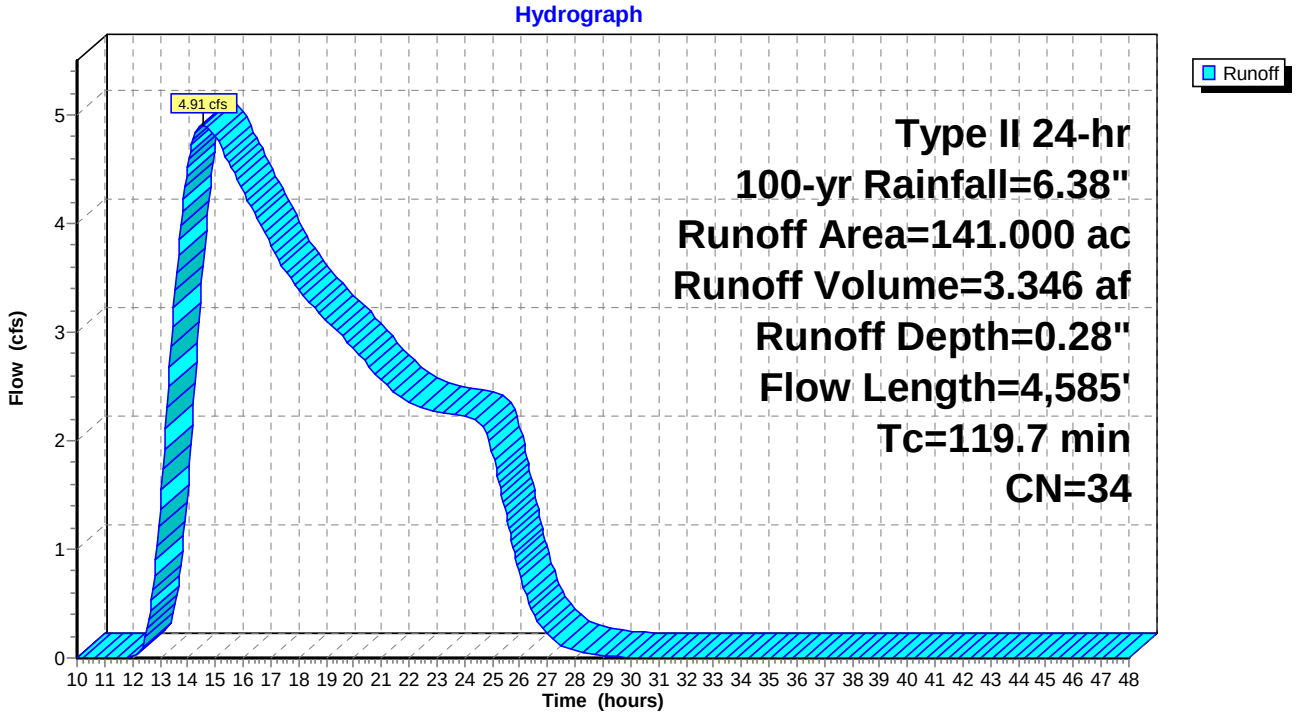
Runoff = 4.91 cfs @ 14.52 hrs, Volume= 3.346 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
	73.500	30	Woods, Good, HSG A
*	32.500	39	Newly graded area, HSG D
	35.000	39	>75% Grass cover, Good, HSG A
	141.000	34	Weighted Average
	141.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
34.8	2,335	0.0500	1.12		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
23.0	1,950	0.0200	1.41		**Shallow Concentrated Flow, T2** Nearly Bare & Untilled Kv= 10.0 fps
119.7	4,585	Total			

Subcatchment 3E: Phase III E



Summary for Subcatchment 3W: Phase III W

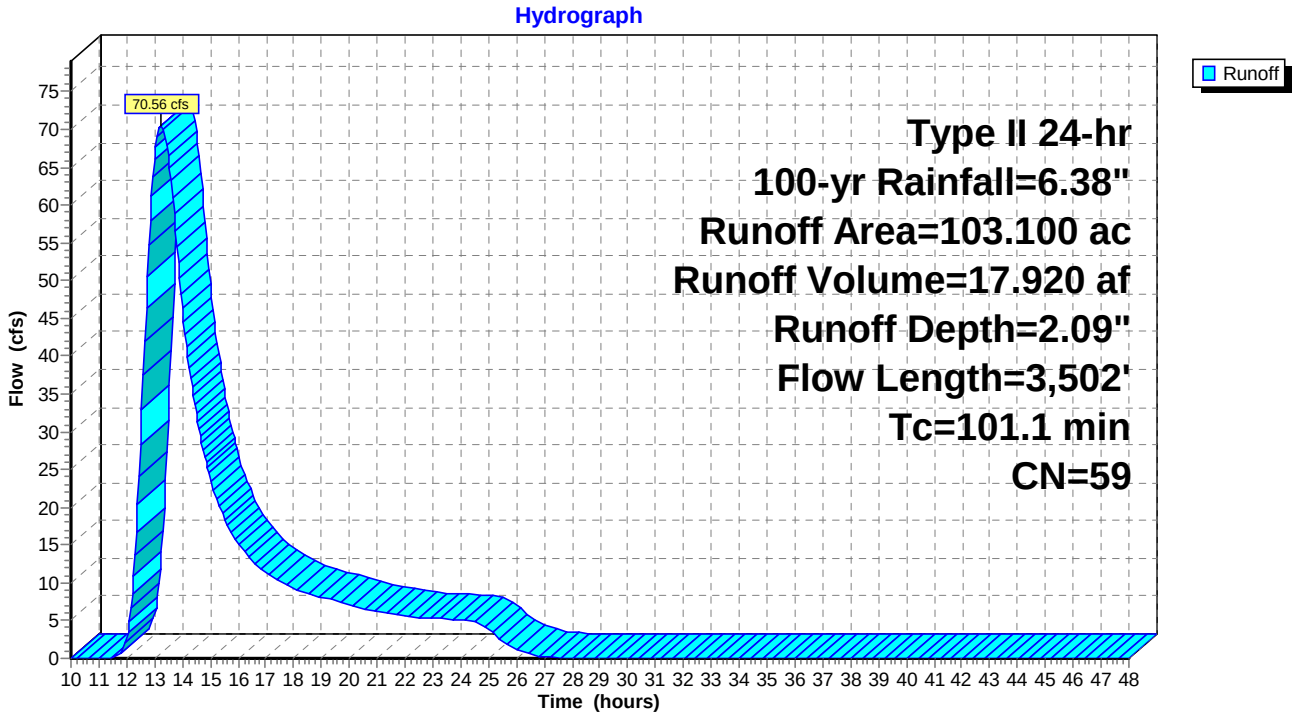
Runoff = 70.56 cfs @ 13.24 hrs, Volume= 17.920 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
11.400	94	Newly graded area, HSG D
12.800	94	Newly graded area, HSG D
25.400	30	Woods, Good, HSG A
35.500	39	>75% Grass cover, Good, HSG A
18.000	94	Newly graded area, HSG D
103.100	59	Weighted Average
103.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
2.4	300	0.1700	2.06		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
13.5	924	0.0520	1.14		**Shallow Concentrated Flow, T2** Woodland Kv= 5.0 fps
23.3	1,978	0.0200	1.41		**Shallow Concentrated Flow, T3** Nearly Bare & Untilled Kv= 10.0 fps
101.1	3,502	Total			

Subcatchment 3W: Phase III W



Summary for Subcatchment SB: South Basin

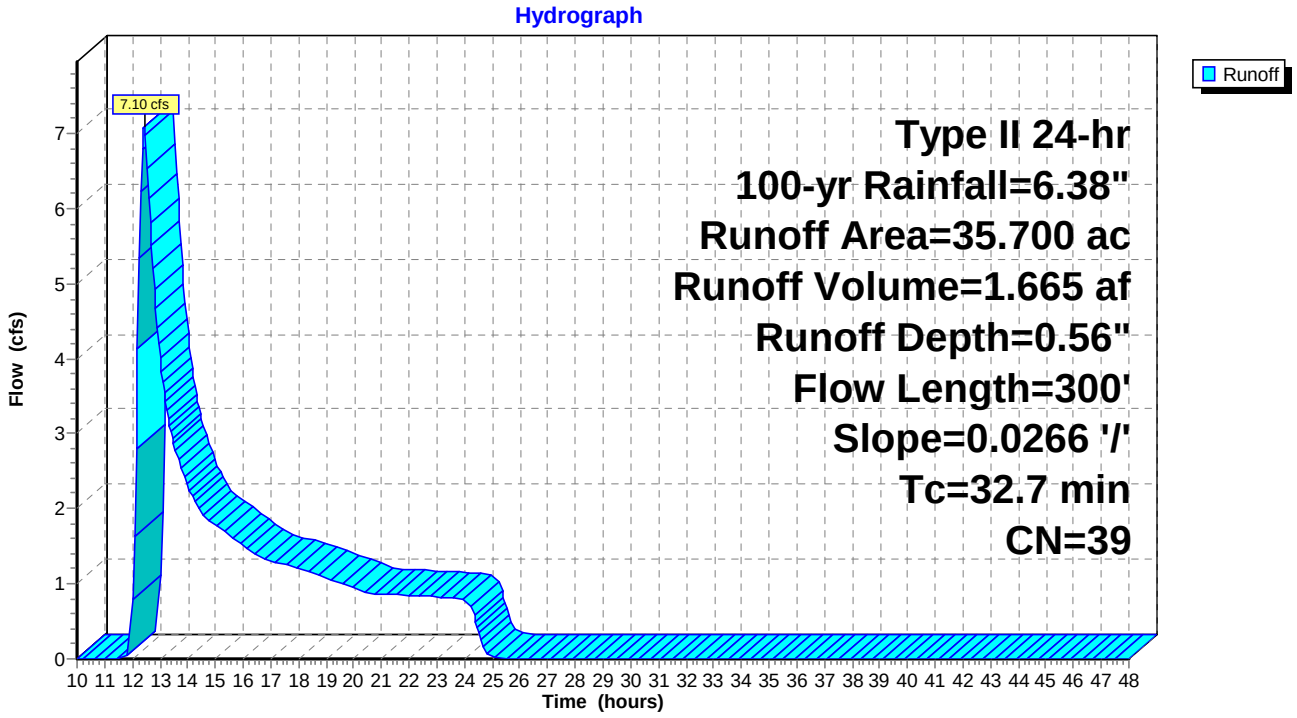
Runoff = 7.10 cfs @ 12.43 hrs, Volume= 1.665 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
*	35.700	39	
	35.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	300	0.0266	0.15		**Sheet Flow, Wetland Area** Grass: Dense n= 0.240 P2= 2.81"

Subcatchment SB: South Basin



Summary for Pond EEP: E Existing Pond

Inflow Area = 141.000 ac, 0.00% Impervious, Inflow Depth = 0.28" for 100-yr event
Inflow = 4.91 cfs @ 14.52 hrs, Volume= 3.346 af
Outflow = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,105.79' @ 30.90 hrs Surf.Area= 0.770 ac Storage= 3.345 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

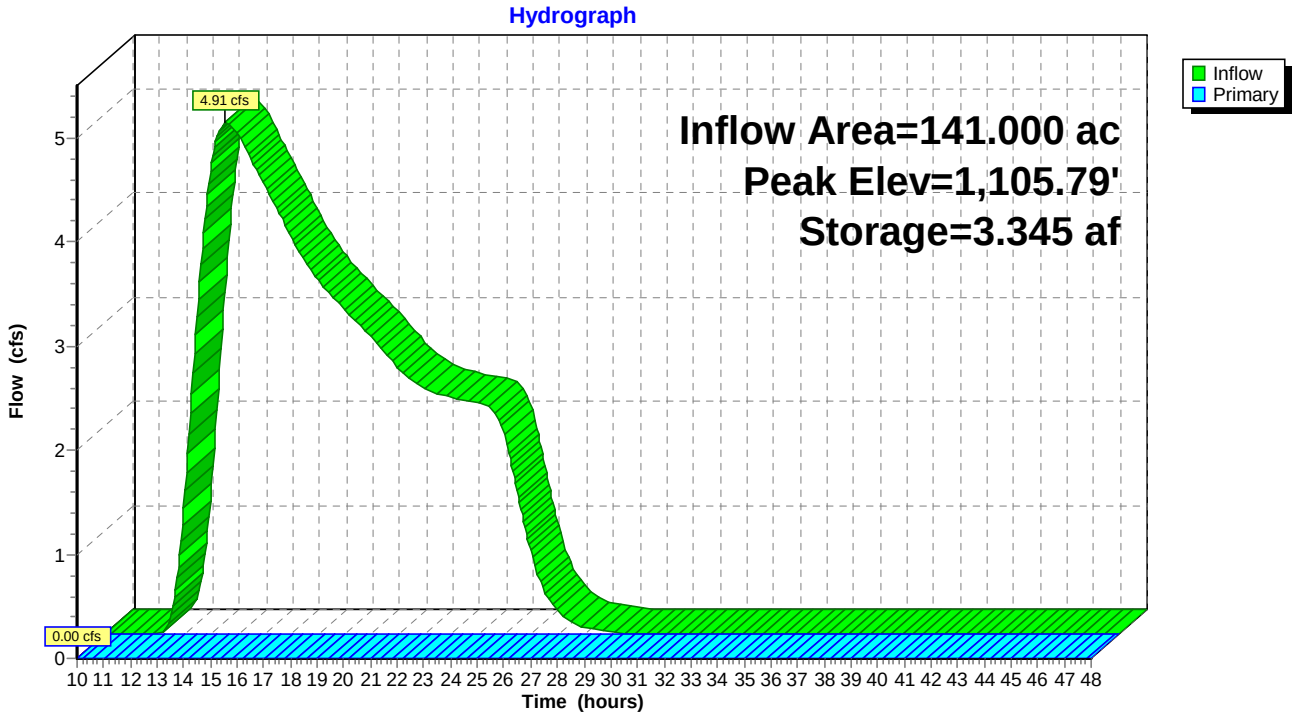
Volume	Invert	Avail.Storage	Storage Description
#1	1,096.00'	5.161 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,096.00	0.130	0.000	0.000
1,098.00	0.150	0.280	0.280
1,099.00	0.192	0.171	0.451
1,102.00	0.381	0.859	1.310
1,104.00	0.509	0.890	2.200
1,106.00	0.801	1.310	3.510
1,108.00	0.850	1.651	5.161

Device	Routing	Invert	Outlet Devices
#1	Primary	1,106.00'	**15.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 10.00 hrs HW=1,096.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond EEP: E Existing Pond



Summary for Pond SP: South Pond

Inflow Area = 279.800 ac, 0.00% Impervious, Inflow Depth = 0.84" for 100-yr event
Inflow = 73.90 cfs @ 13.21 hrs, Volume= 19.585 af
Outflow = 1.45 cfs @ 25.81 hrs, Volume= 4.178 af, Atten= 98%, Lag= 756.0 min
Discarded = 1.45 cfs @ 25.81 hrs, Volume= 4.178 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,068.48' @ 25.81 hrs Surf.Area= 4.487 ac Storage= 17.949 af

Plug-Flow detention time= 1,049.0 min calculated for 4.178 af (21% of inflow)
Center-of-Mass det. time= 867.7 min (1,816.3 - 948.5)

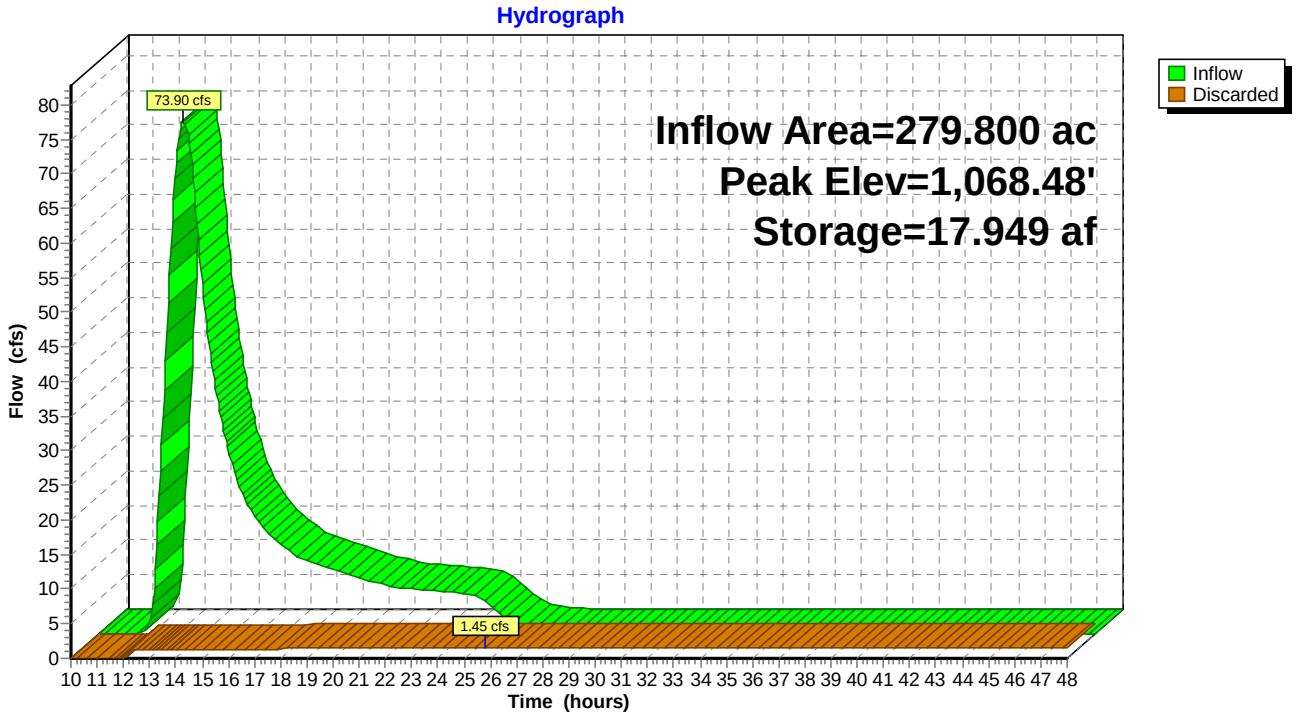
Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	25.038 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

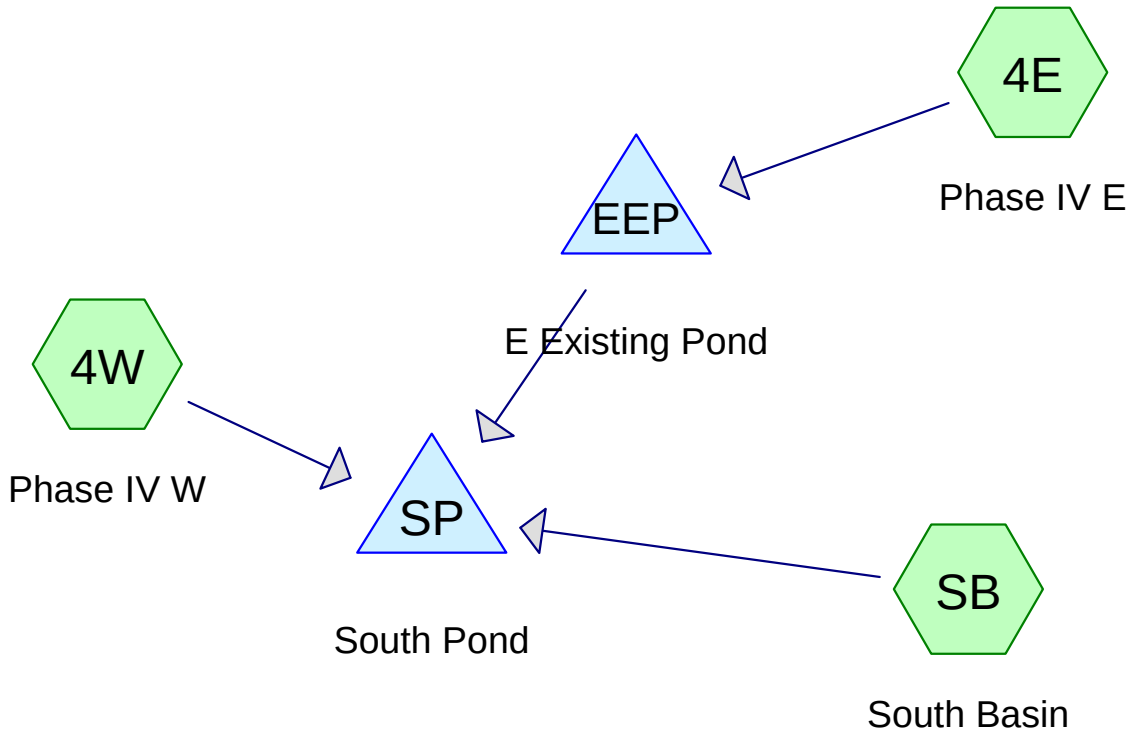
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,064.00	3.549	2,214.7	0.000	0.000	3.549
1,069.00	4.604	2,377.7	20.325	20.325	4.942
1,070.00	4.823	2,410.3	4.713	25.038	5.232

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,064.00'	**0.320 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.45 cfs @ 25.81 hrs HW=1,068.48' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.45 cfs)

Pond SP: South Pond





Subcat Reach Pond Link

Routing Diagram for Chippewa Phases 1-5
Prepared by GZA GeoEnvironmental, Inc., Printed 4/18/2018

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
35.700	39	(SB)
70.500	39	>75% Grass cover, Good, HSG A (4E, 4W)
32.500	39	Newly graded area, HSG D (4E)
44.400	94	Newly graded area, HSG D (4W)
42.200	39	Pasture/grassland/range, Good, HSG A (4W)
73.500	30	Woods, Good, HSG A (4E)
298.800	**45**	**TOTAL AREA**

Time span=10.00-48.00 hrs, dt=0.05 hrs, 761 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4E: Phase IV E Runoff Area=141.000 ac 0.00% Impervious Runoff Depth=0.28"
Flow Length=4,585' Tc=119.7 min CN=34 Runoff=4.91 cfs 3.346 af

Subcatchment 4W: Phase IV W Runoff Area=122.100 ac 0.00% Impervious Runoff Depth=2.09"
Flow Length=3,502' Tc=101.1 min CN=59 Runoff=83.56 cfs 21.222 af

Subcatchment SB: South Basin Runoff Area=35.700 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=300' Slope=0.0266 '/' Tc=32.7 min CN=39 Runoff=7.10 cfs 1.665 af

Pond EEP: E Existing Pond Peak Elev=1,105.79' Storage=3.345 af Inflow=4.91 cfs 3.346 af
Outflow=0.00 cfs 0.000 af

Pond SP: South Pond Peak Elev=1,069.19' Storage=21.192 af Inflow=86.89 cfs 22.887 af
Outflow=1.50 cfs 4.317 af

Total Runoff Area = 298.800 ac Runoff Volume = 26.233 af Average Runoff Depth = 1.05"
100.00% Pervious = 298.800 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 4E: Phase IV E

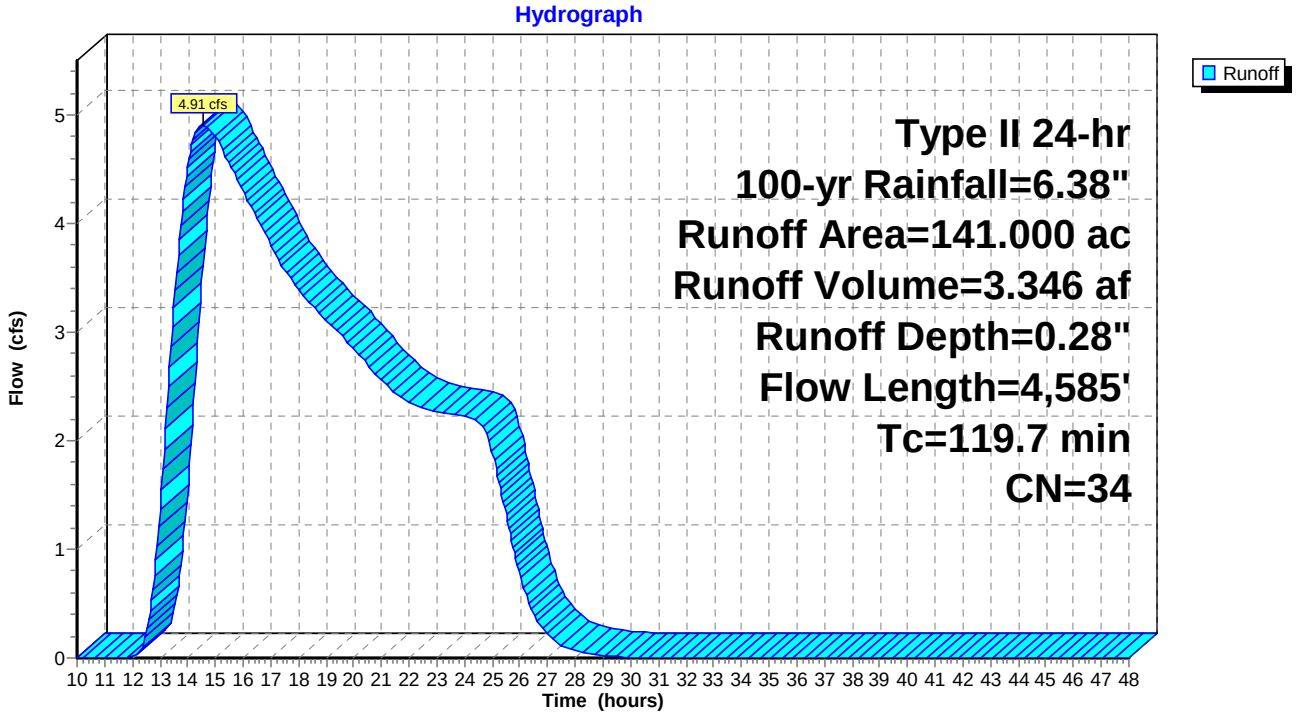
Runoff = 4.91 cfs @ 14.52 hrs, Volume= 3.346 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
	73.500	30	Woods, Good, HSG A
*	32.500	39	Newly graded area, HSG D
	35.000	39	>75% Grass cover, Good, HSG A
	141.000	34	Weighted Average
	141.000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
34.8	2,335	0.0500	1.12		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
23.0	1,950	0.0200	1.41		**Shallow Concentrated Flow, T2** Nearly Bare & Untilled Kv= 10.0 fps
119.7	4,585	Total			

Subcatchment 4E: Phase IV E



Summary for Subcatchment 4W: Phase IV W

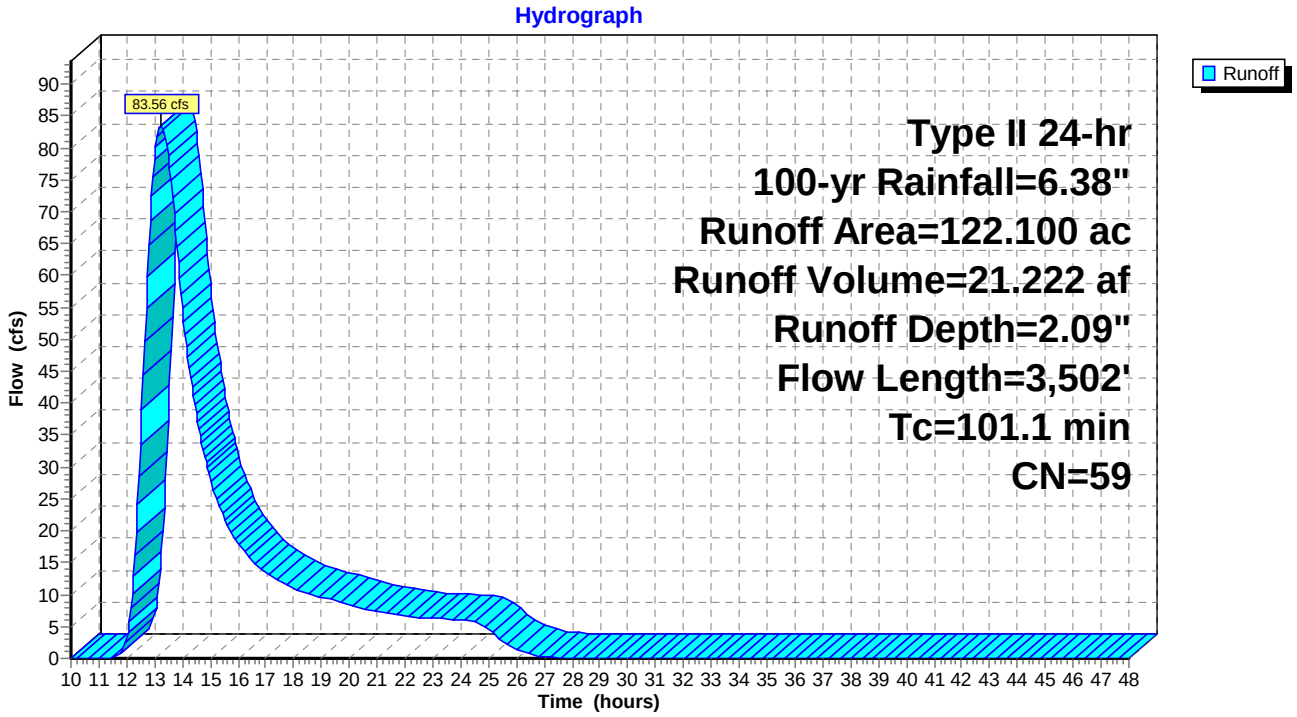
Runoff = 83.56 cfs @ 13.24 hrs, Volume= 21.222 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
11.400	39	Pasture/grassland/range, Good, HSG A
12.800	39	Pasture/grassland/range, Good, HSG A
25.400	94	Newly graded area, HSG D
35.500	39	>75% Grass cover, Good, HSG A
18.000	39	Pasture/grassland/range, Good, HSG A
19.000	94	Newly graded area, HSG D
122.100	59	Weighted Average
122.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
2.4	300	0.1700	2.06		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
13.5	924	0.0520	1.14		**Shallow Concentrated Flow, T2** Woodland Kv= 5.0 fps
23.3	1,978	0.0200	1.41		**Shallow Concentrated Flow, T3** Nearly Bare & Untilled Kv= 10.0 fps
101.1	3,502	Total			

Subcatchment 4W: Phase IV W



Summary for Subcatchment SB: South Basin

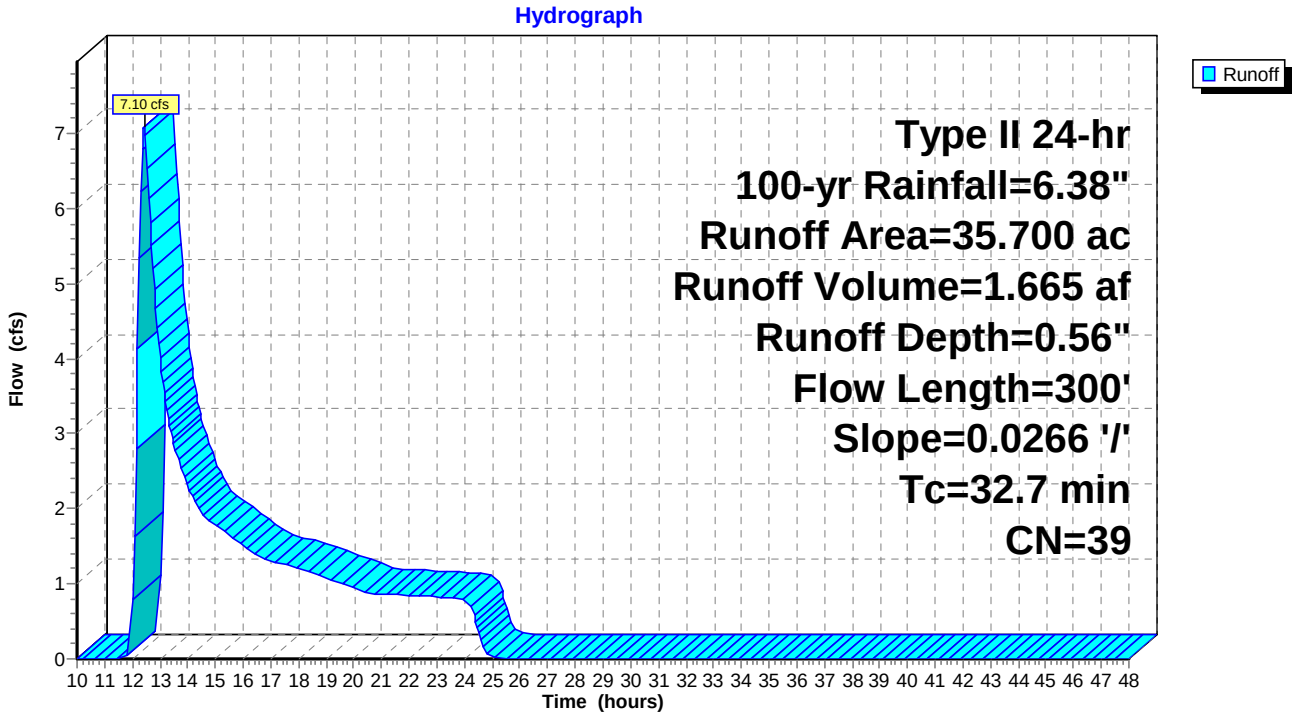
Runoff = 7.10 cfs @ 12.43 hrs, Volume= 1.665 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
*	35.700	39	
	35.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	300	0.0266	0.15		**Sheet Flow, Wetland Area** Grass: Dense n= 0.240 P2= 2.81"

Subcatchment SB: South Basin



Summary for Pond EEP: E Existing Pond

Inflow Area = 141.000 ac, 0.00% Impervious, Inflow Depth = 0.28" for 100-yr event
Inflow = 4.91 cfs @ 14.52 hrs, Volume= 3.346 af
Outflow = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 10.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,105.79' @ 30.90 hrs Surf.Area= 0.770 ac Storage= 3.345 af

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

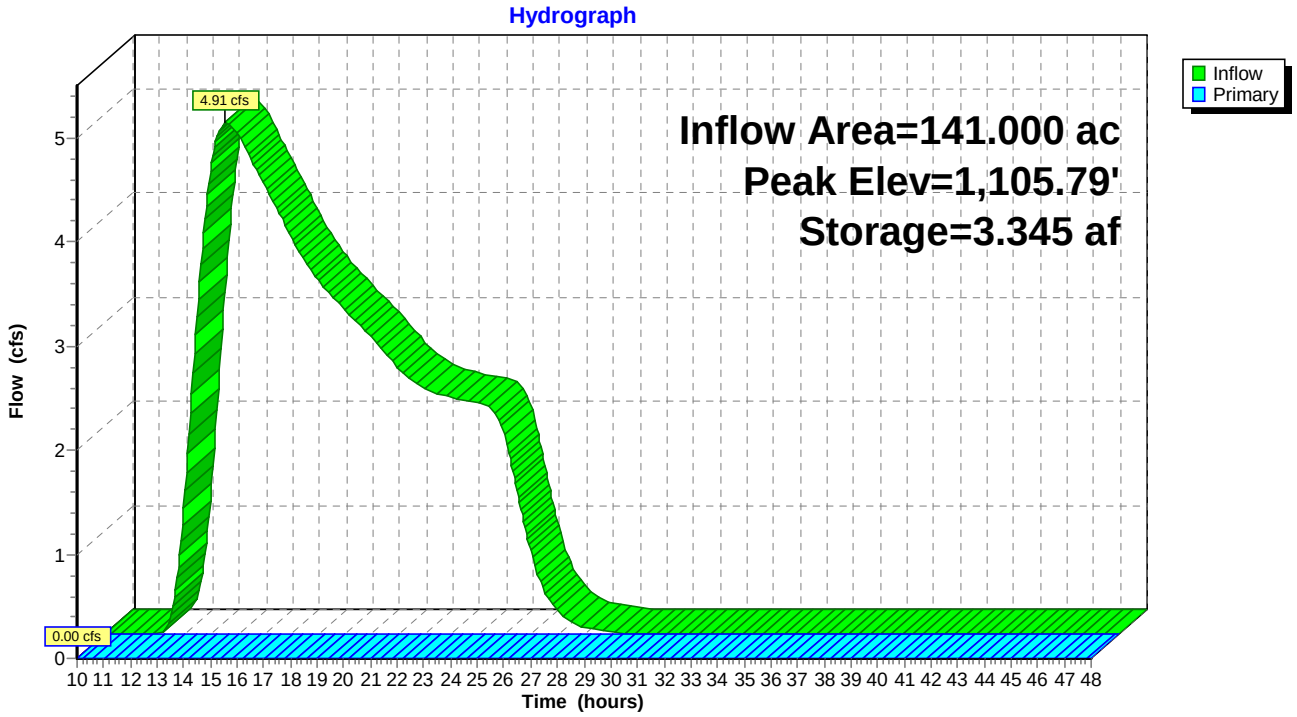
Volume	Invert	Avail.Storage	Storage Description
#1	1,096.00'	5.161 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,096.00	0.130	0.000	0.000
1,098.00	0.150	0.280	0.280
1,099.00	0.192	0.171	0.451
1,102.00	0.381	0.859	1.310
1,104.00	0.509	0.890	2.200
1,106.00	0.801	1.310	3.510
1,108.00	0.850	1.651	5.161

Device	Routing	Invert	Outlet Devices
#1	Primary	1,106.00'	**15.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=0.00 cfs @ 10.00 hrs HW=1,096.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond EEP: E Existing Pond



Summary for Pond SP: South Pond

Inflow Area = 298.800 ac, 0.00% Impervious, Inflow Depth = 0.92" for 100-yr event
Inflow = 86.89 cfs @ 13.22 hrs, Volume= 22.887 af
Outflow = 1.50 cfs @ 25.90 hrs, Volume= 4.317 af, Atten= 98%, Lag= 760.8 min
Discarded = 1.50 cfs @ 25.90 hrs, Volume= 4.317 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,069.19' @ 25.90 hrs Surf.Area= 4.645 ac Storage= 21.192 af

Plug-Flow detention time= 1,052.3 min calculated for 4.311 af (19% of inflow)
Center-of-Mass det. time= 870.0 min (1,818.2 - 948.2)

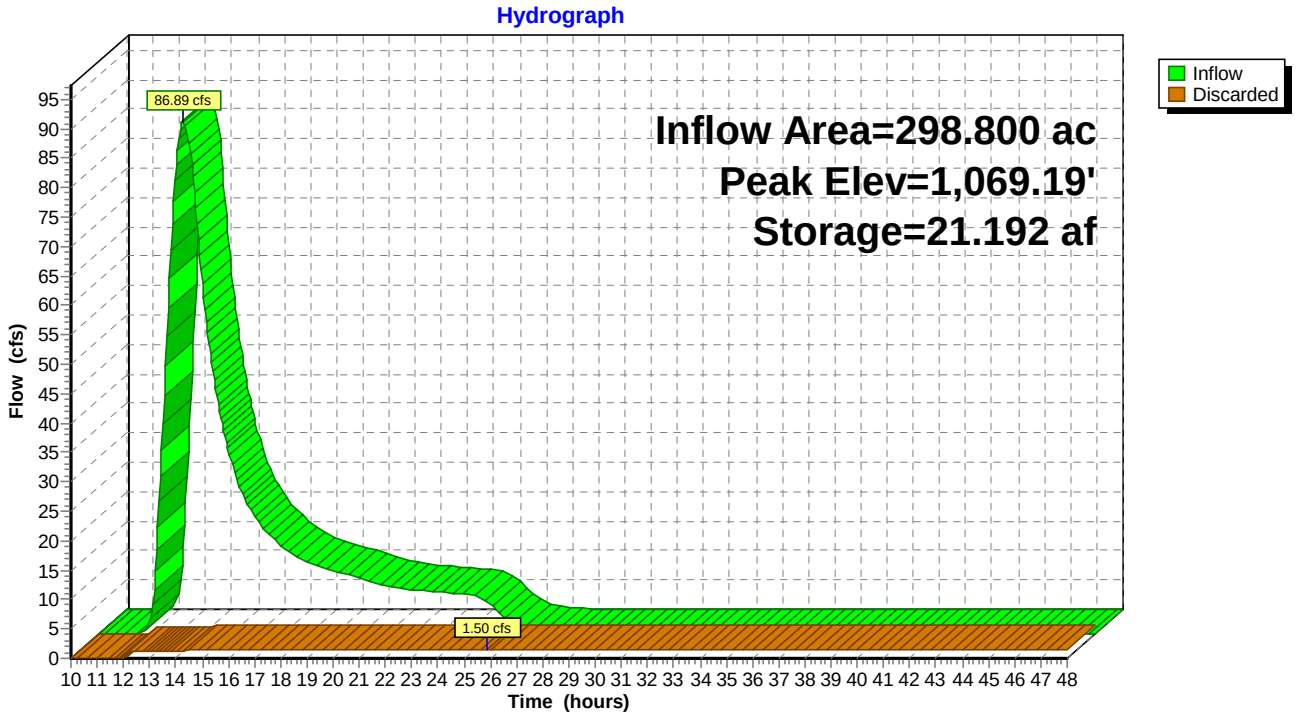
Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	25.038 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

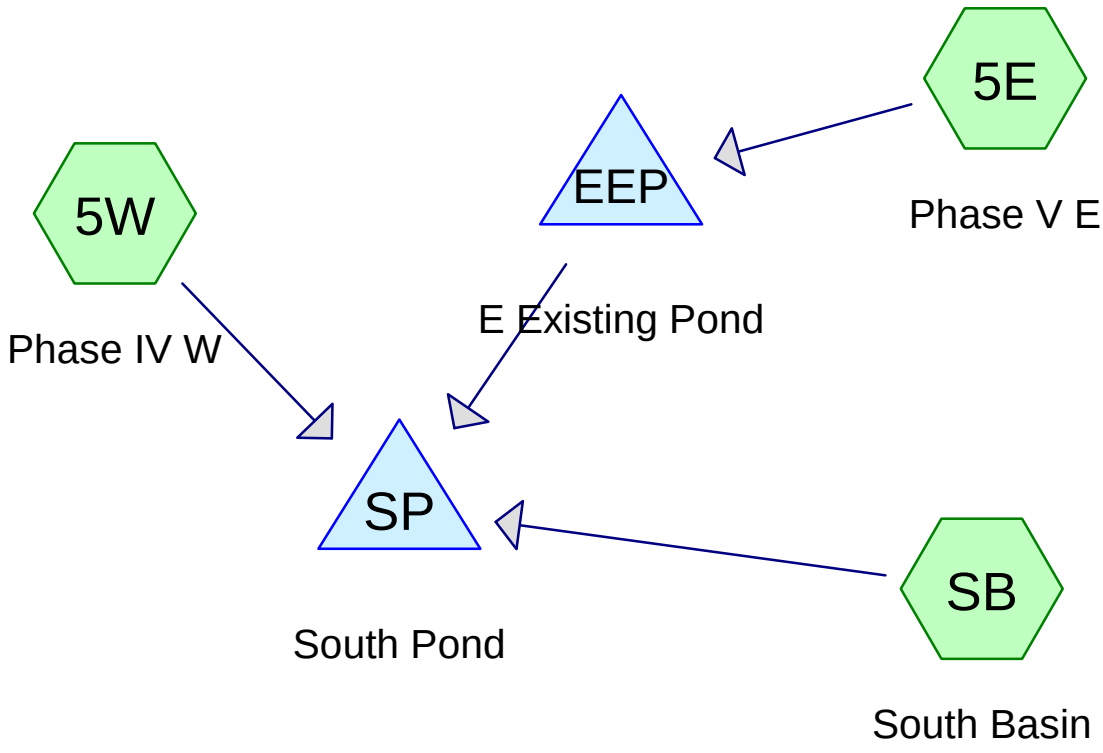
Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,064.00	3.549	2,214.7	0.000	0.000	3.549
1,069.00	4.604	2,377.7	20.325	20.325	4.942
1,070.00	4.823	2,410.3	4.713	25.038	5.232

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,064.00'	**0.320 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.50 cfs @ 25.90 hrs HW=1,069.19' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.50 cfs)

Pond SP: South Pond





Subcat Reach Pond Link

Routing Diagram for Chippewa Phases 1-5
Prepared by GZA GeoEnvironmental, Inc., Printed 4/18/2018

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
35.700	39	(SB)
70.500	39	>75% Grass cover, Good, HSG A (5E, 5W)
37.600	94	Newly graded area, HSG D (5E)
119.100	39	Pasture/grassland/range, Good, HSG A (5E, 5W)
45.300	30	Woods, Good, HSG A (5E)
308.200	**44**	**TOTAL AREA**

Time span=10.00-48.00 hrs, dt=0.05 hrs, 761 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 5E: Phase V E Runoff Area=150.400 ac 0.00% Impervious Runoff Depth=1.33"
Flow Length=4,585' Tc=119.7 min CN=50 Runoff=50.34 cfs 16.721 af

Subcatchment 5W: Phase IV W Runoff Area=122.100 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=3,502' Tc=101.1 min CN=39 Runoff=13.17 cfs 5.695 af

Subcatchment SB: South Basin Runoff Area=35.700 ac 0.00% Impervious Runoff Depth=0.56"
Flow Length=300' Slope=0.0266 '/' Tc=32.7 min CN=39 Runoff=7.10 cfs 1.665 af

Pond EEP: E Existing Pond Peak Elev=1,106.98' Storage=4.307 af Inflow=50.34 cfs 16.721 af
Outflow=43.23 cfs 13.210 af

Pond SP: South Pond Peak Elev=1,068.67' Storage=18.810 af Inflow=57.14 cfs 20.570 af
Outflow=1.46 cfs 4.155 af

Total Runoff Area = 308.200 ac Runoff Volume = 24.081 af Average Runoff Depth = 0.94"
100.00% Pervious = 308.200 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 5E: Phase V E

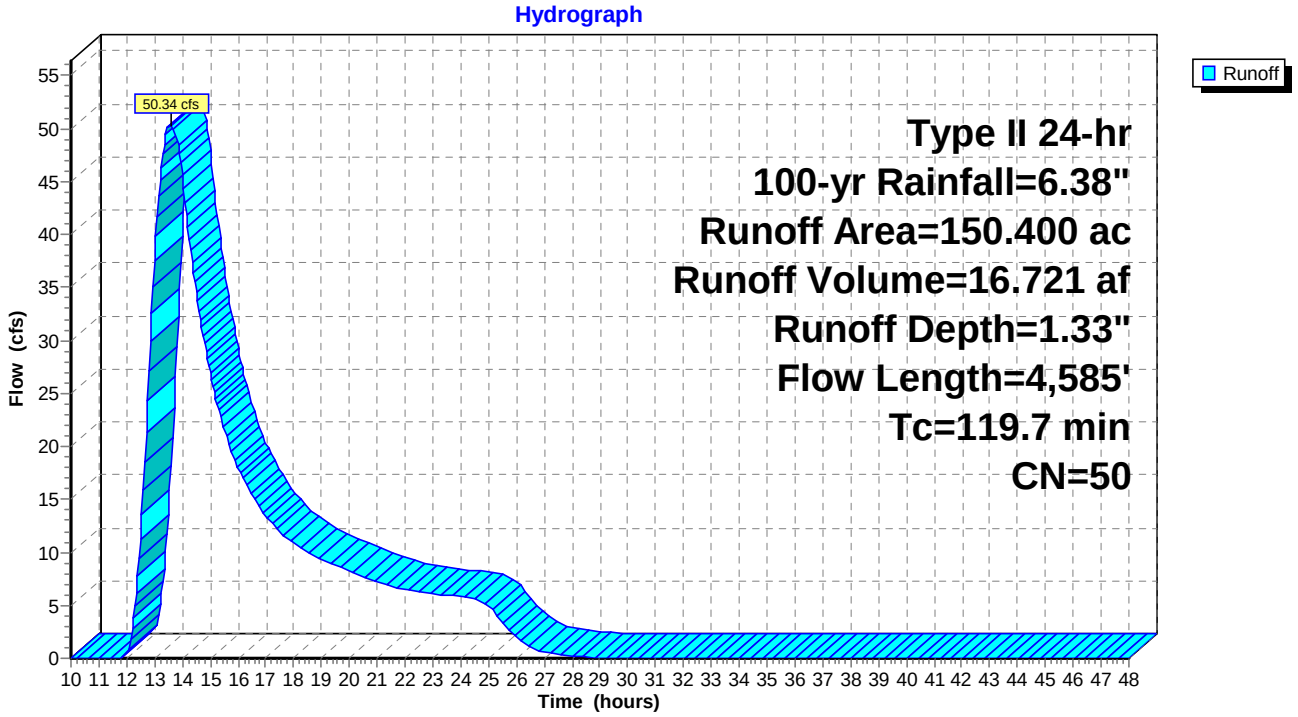
Runoff = 50.34 cfs @ 13.57 hrs, Volume= 16.721 af, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
45.300	30	Woods, Good, HSG A
32.500	39	Pasture/grassland/range, Good, HSG A
35.000	39	>75% Grass cover, Good, HSG A
37.600	94	Newly graded area, HSG D
150.400	50	Weighted Average
150.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
34.8	2,335	0.0500	1.12		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
23.0	1,950	0.0200	1.41		**Shallow Concentrated Flow, T2** Nearly Bare & Untilled Kv= 10.0 fps
119.7	4,585	Total			

Subcatchment 5E: Phase V E



Summary for Subcatchment 5W: Phase IV W

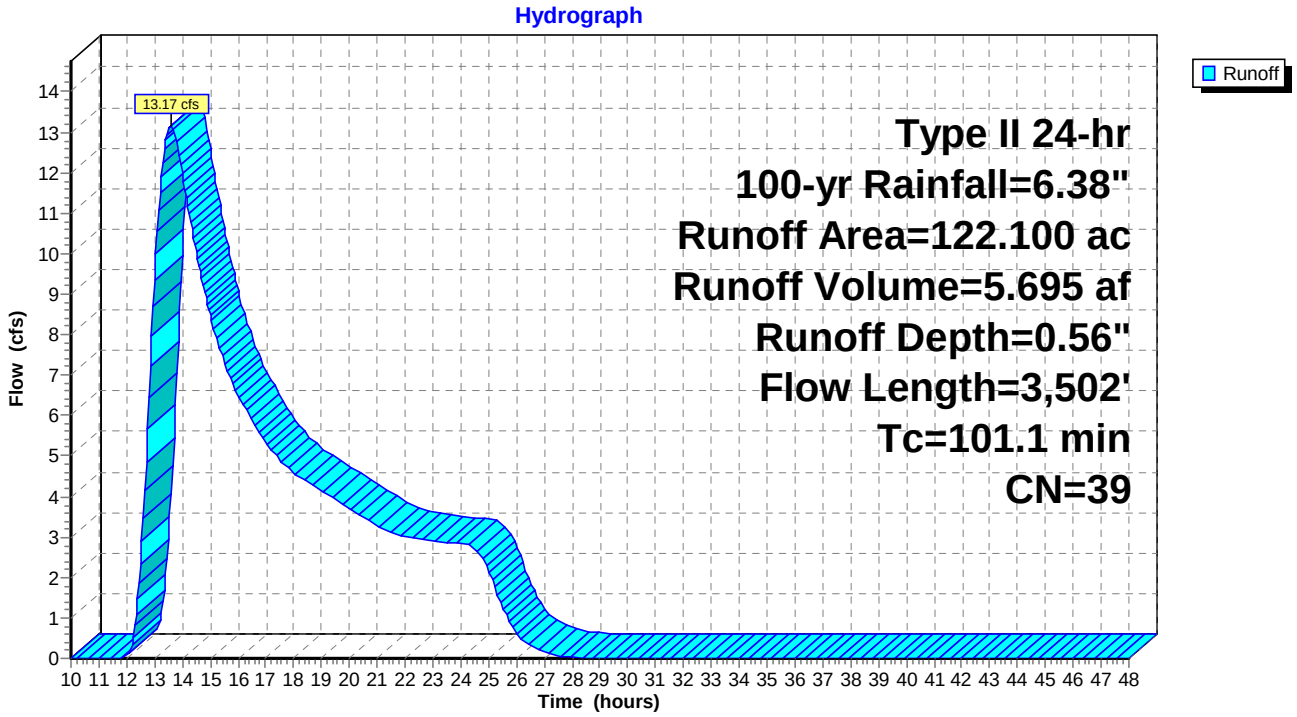
Runoff = 13.17 cfs @ 13.60 hrs, Volume= 5.695 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

Area (ac)	CN	Description
11.400	39	Pasture/grassland/range, Good, HSG A
12.800	39	Pasture/grassland/range, Good, HSG A
25.400	39	Pasture/grassland/range, Good, HSG A
35.500	39	>75% Grass cover, Good, HSG A
18.000	39	Pasture/grassland/range, Good, HSG A
19.000	39	Pasture/grassland/range, Good, HSG A
122.100	39	Weighted Average
122.100		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
61.9	300	0.0600	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 2.81"
2.4	300	0.1700	2.06		**Shallow Concentrated Flow, T1** Woodland Kv= 5.0 fps
13.5	924	0.0520	1.14		**Shallow Concentrated Flow, T2** Woodland Kv= 5.0 fps
23.3	1,978	0.0200	1.41		**Shallow Concentrated Flow, T3** Nearly Bare & Untilled Kv= 10.0 fps
101.1	3,502	Total			

Subcatchment 5W: Phase IV W



Summary for Subcatchment SB: South Basin

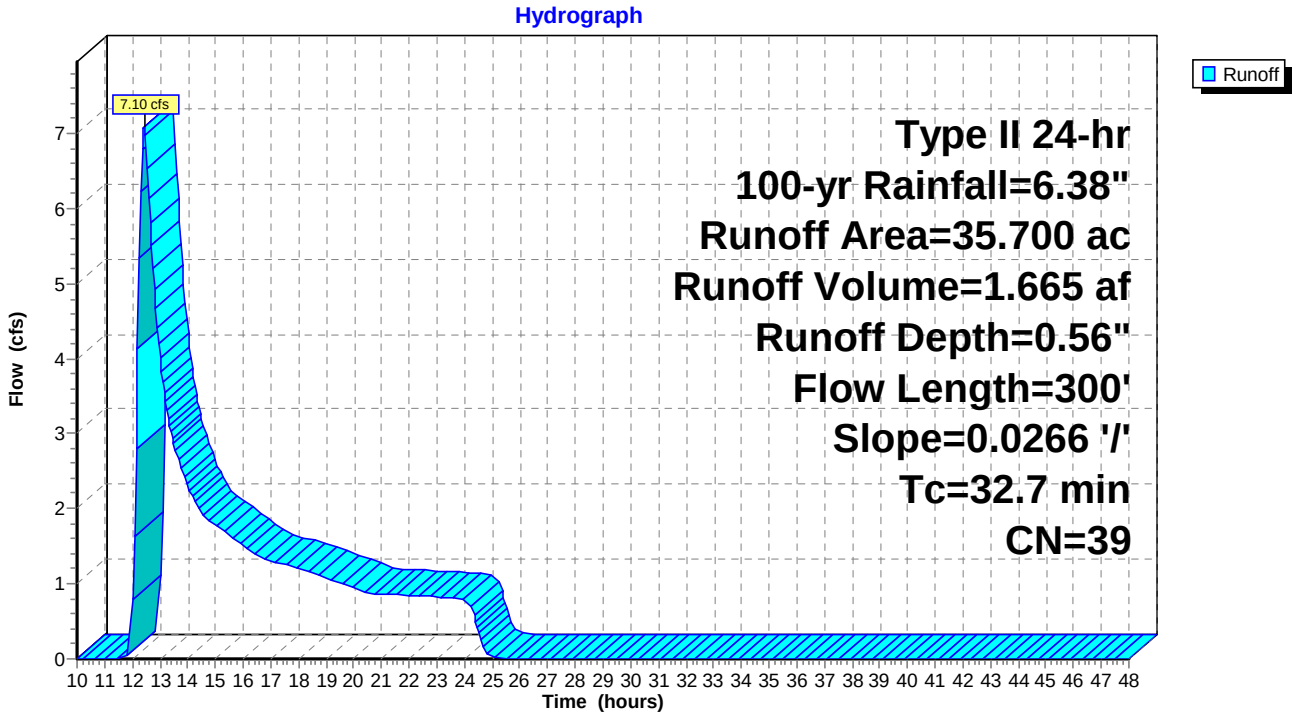
Runoff = 7.10 cfs @ 12.43 hrs, Volume= 1.665 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=6.38"

	Area (ac)	CN	Description
*	35.700	39	
	35.700		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	300	0.0266	0.15		**Sheet Flow, Wetland Area** Grass: Dense n= 0.240 P2= 2.81"

Subcatchment SB: South Basin



Summary for Pond EEP: E Existing Pond

Inflow Area = 150.400 ac, 0.00% Impervious, Inflow Depth = 1.33" for 100-yr event
Inflow = 50.34 cfs @ 13.57 hrs, Volume= 16.721 af
Outflow = 43.23 cfs @ 14.10 hrs, Volume= 13.210 af, Atten= 14%, Lag= 31.9 min
Primary = 43.23 cfs @ 14.10 hrs, Volume= 13.210 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,106.98' @ 14.10 hrs Surf.Area= 0.825 ac Storage= 4.307 af

Plug-Flow detention time= 168.1 min calculated for 13.193 af (79% of inflow)
Center-of-Mass det. time= 74.5 min (1,065.4 - 990.9)

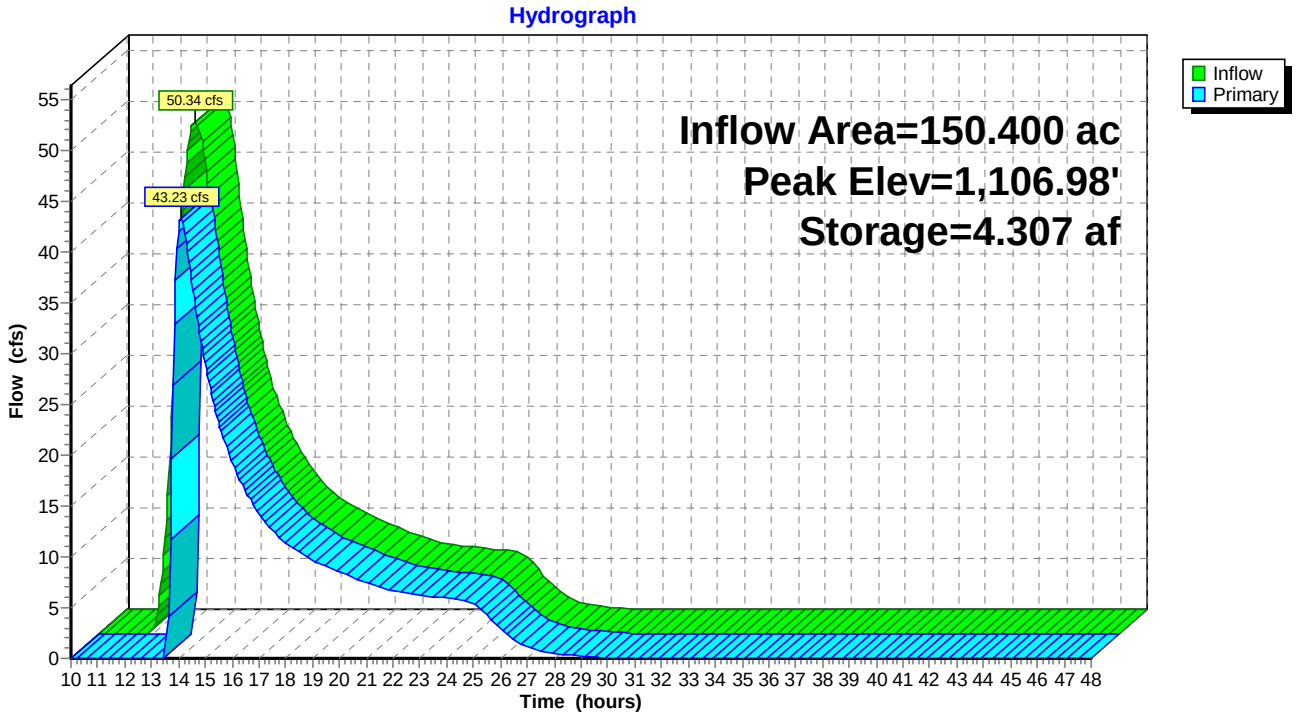
Volume	Invert	Avail.Storage	Storage Description
#1	1,096.00'	5.161 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,096.00	0.130	0.000	0.000
1,098.00	0.150	0.280	0.280
1,099.00	0.192	0.171	0.451
1,102.00	0.381	0.859	1.310
1,104.00	0.509	0.890	2.200
1,106.00	0.801	1.310	3.510
1,108.00	0.850	1.651	5.161

Device	Routing	Invert	Outlet Devices
#1	Primary	1,106.00'	**15.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=43.15 cfs @ 14.10 hrs HW=1,106.98' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 43.15 cfs @ 2.94 fps)

Pond EEP: E Existing Pond



Summary for Pond SP: South Pond

Inflow Area = 308.200 ac, 0.00% Impervious, Inflow Depth = 0.80" for 100-yr event
Inflow = 57.14 cfs @ 14.07 hrs, Volume= 20.570 af
Outflow = 1.46 cfs @ 26.86 hrs, Volume= 4.155 af, Atten= 97%, Lag= 767.4 min
Discarded = 1.46 cfs @ 26.86 hrs, Volume= 4.155 af

Routing by Stor-Ind method, Time Span= 10.00-48.00 hrs, dt= 0.05 hrs
Peak Elev= 1,068.67' @ 26.86 hrs Surf.Area= 4.530 ac Storage= 18.810 af

Plug-Flow detention time= 1,012.2 min calculated for 4.155 af (20% of inflow)
Center-of-Mass det. time= 781.6 min (1,831.3 - 1,049.7)

Volume	Invert	Avail.Storage	Storage Description
#1	1,064.00'	25.038 af	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Perim. (feet)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,064.00	3.549	2,214.7	0.000	0.000	3.549
1,069.00	4.604	2,377.7	20.325	20.325	4.942
1,070.00	4.823	2,410.3	4.713	25.038	5.232

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,064.00'	**0.320 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=1.46 cfs @ 26.86 hrs HW=1,068.67' (Free Discharge)
1=Exfiltration (Exfiltration Controls 1.46 cfs)

Pond SP: South Pond