ANDERSON ENGINEERING
EMPLOYEE OWNED

STORMWATER DRAINAGE STUDY

FOR

Cobey Creek – 2nd Plat

Lee's Summit, Missouri

Prepared For:
Clayton Properties Group
120 SE 30th Street
Lee's Summit, MO 64082

Prepared By:
Anderson Engineering, Inc.
941 W. 141st Terrace, Suite A
Kansas City, MO 64145

May 6, 2022

Rev 1: July 28, 2022

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1.0 - Introduction

This Micro drainage study has been prepared for Clayton Properties Group DBA Summit Homes KC, to support the construction of Cobey Creek 2nd Plat, a mixed-use commercial and residential subdivision located in Lee's Summit, Missouri. The proposed construction activities consist of mass grading, roadway construction, utility installation, and a wet detention basin. The total disturbed area for all four phases of the project is 97.3-acres, with Cobey Creek 2nd Plat (Phase 2) consisting of 61.0-acres.

The location of the Project Site can further be described as the southeast quarter of Section 29, Township 47 North, Range 31 West in the City of Lee's Summit, Jackson County, Missouri. The Cobey Creek 2nd Plat Project Site map can be seen in **Figure 1** and **Figure 2** below. The land is zoned Planned Mixed Use (PMIX). Adjacent properties to the north and west of the development are zoned Agricultural (AG). The adjacent property to the east is zoned Agricultural (A) and is located within the City limits of Greenwood, Missouri. The adjacent property to the south is located on the opposite side of US Highway 150 and is zoned Agricultural (AG) and Planned Community Commercial (CP-2).

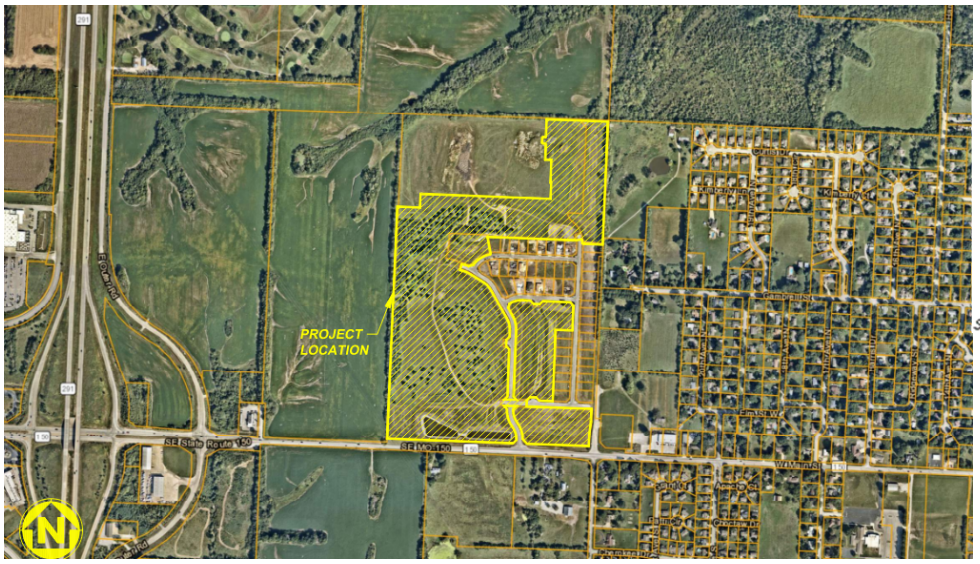


Figure 1: Project Location

Figure 2: Vicinity Map

2.0 – Master Drainage Study

2.1 Existing Conditions

2.1.1 General

Cobey Creek 2nd Plat is the second of four phases for the mixed-use development plan. A Macro stormwater report for the entire development plan was completed by Hg Consultants, Inc. in October of 2020, with a fourth and final addendum dated April 23, 2021 (together to be referred to hereon as the "Master Drainage Study"). Refer to **Appendix F** for the Master Drainage Study.

Figure 1: Existing Site Condition (Nov. 05, 2021)

Phase 1 of Cobey Creek has been constructed and contains one dry detention basin in the northeast corner of the property and two of the three wet detentions basins that were originally approved at the south end. The wet detention basins are intended to function as a treatment train, acting in series as the upper basin(s) spill over into the lowest basin. The two existing wet detention basins from Phase 1 can be seen in **Figure 3**. A third wet detention basin (referred to as "Pond 1" in the Master Drainage Study and Phase 1 Wet Detention Basin As-Builts) was proposed for the Master Drainage Study that was not constructed in Phase 1. After a change in ownership of the property in 2021, Anderson Engineering Inc. was hired to finalize the design of the remaining phases of construction. After further investigation, it is assumed that the remaining wet detention basin was not constructed in Phase 1 due to a conflict with an existing 20" KCMO water main and easement that cuts across the southwest corner of the property. Upon this assessment, Anderson Engineering Inc. has re-designed the basin to avoid the existing water main conflict, while maintaining the functionality and intent of the originally approved wet detention basin.

Cobey Creek 2nd Plat (Phase 2) predominantly drains to the existing dry detention basin located at the northeast corner of the development, as intended in the Master Drainage Study and preliminary development plan. The Master Drainage Study indicates this basin was designed to

serve as the primary measure of reducing stormwater discharge from the fully developed condition of the property using the Comprehensive Control Strategy defined in KCAPWA Section 5600 and also provide 40-hour release of the 90 percent mean annual rainfall event for water quality. Refer to **Appendix A** for the proposed drainage area map and Master Drainage Study drainage area map.

2.1.2 Watershed

The mixed-use development plan resides within an unnamed tributary of Big Creek Watershed. Stormwater leaves the project site in two locations. The majority of the development area drains northeast to an existing (Phase 1) dry detention basin which outflows to an unnamed tributary to Big Creek. A smaller portion of the site drains south to the two existing wet detention basins in series, which outfalls south of US Highway 150 to an unnamed tributary of Lake Winnebego.

3.0 - Objective

This Micro drainage study summarizes the hydrologic and hydraulic analyses of the third proposed wet detention basin, which is the fourth and final detention basin planned for the development, performed by Anderson Engineering Inc. The fourth detention basin proposed in the Master Drainage Study was not constructed in Phase 1 and therefore will be constructed in Phase 2. The design and outfall conditions for the proposed basin will meet or exceed those of the previously completed Master Drainage Study. The objective of this report is to demonstrate that the proposed uppermost wet detention basin will not cause any negative impacts on the two existing wet basins below, and that the lowermost basin will continue to meet the comprehensive control and water quality discharge requirements of the City of Lee's Summit, Missouri, as designed and outlined in the original Master Drainage Study.

4.0 – Mapping

The Project Site was surveyed by Anderson Engineering Inc. and is the source of the topographic mapping data that was utilized in this drainage analysis. This topographic information was also used in the civil engineering design of the proposed site improvements, performed by Anderson Engineering Inc. To view topographic contours of the pre-developed and post-developed site, refer to **Appendix A** of this report.

5.0 – Site Description

5.1 Existing Conditions

5.1.1 General

The existing Project Site consists of an undeveloped, open grassed space. The turf is in good condition and generally drains southeast to the proposed wet detention basin, which outfalls to the two existing wet detention basins in series. The final basin in the wet detention series (existing) outfalls south of US Highway 150 to an unnamed tributary to Lake Winnebego. The Project Site is located within an area of minimal flood hazard (Zone X) as shown of FEMA flood hazard map 29095C0551G effective 1/20/2017. Refer to Map in **Appendix C** for more information.

Based on the Soil Survey of Jackson County by the USDA Natural Resource Conservation Service, the Project Site soil type is Arisburg Silt Loam (1 to 5 percent slopes, Hydrologic Soil Group C). For more information on the existing soil conditions, refer to the Soil Report included in **Appendix B** of this report.

5.1.2 Existing Drainage

The drainage area collected by the existing wet detention basins is approximately 16.73 acres, in which 3.71 acres originates from offsite and flows onto the property from the west. This drainage flows to the southeast via sheet flow and shallow concentrated flow, where it is collected by the series of two existing wet detention basins. For more information on the existing drainage conditions of the site, refer to the Drainage Map located in **Appendix A** of this report.

5.2 Proposed Development

The proposed wet detention basin volume and outfall conditions are designed to meet or exceed those of the design and capacity of the original Master Drainage Study. The series of wet detention basin have been collectively designed for the 2-yr, 10-yr, and 100-yr design storm, per City of Lee's Summit, Missouri requirements. The location of the basin has been shifted slightly from its original location defined in the Master Drainage Study and Phase 1 plans, due to an existing water main and easement conflict that was identified to the southwest of the proposed basin.

The proposed drainage area collected by the third wet detention basin is 2.80-acres in size and follows the drainage pattern of existing conditions, since the majority of flow is from off-site. The stormwater runoff from the west will drain eastward to the proposed wet detention basin and be collected before it reaches the existing wet detention basins. This will provide an additional measure of water quality due to siltation, limit the peak runoff flowing from offsite, and provide a culvert for water flow under the proposed entry drive of SE Sunset Ridge. The proposed basin will outfall into the existing Phase 1 wet detention basins in series, as planned in the Master Drainage Study. Refer to **Appendix G** for the Phase 1 wet detention basin as-built plans. Stormwater flowing out of the proposed wet detention basin will be controlled by a 24-inch flared end section as shown in **Figure 4**. The full plan and profile of the proposed wet detention basin can be found in **Appendix A.** Additional storage was added to the bottom of the wet detention basin to allow additional volume for silt accumulation, acting as a water quality pool to enhance sedimentation and pollutant removal of dissolved nutrients and urban pollutants. For more information on the proposed development drainage patterns, refer to the Drainage Map in **Appendix A**.

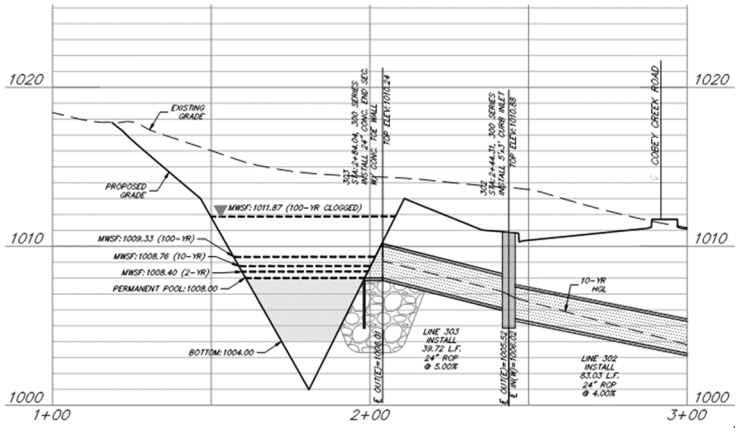


Figure 2: Detention Basin Outlet Control Structure Visual

6.0 – Hydrologic Analysis

6.1 Methodology

The original drainage study submitted and approved with Phase 1 of Cobey Creek utilized Section 5600 – Storm Drainage Systems & Facilities, City of Lee's Summit, Missouri, Design Criteria and the Kansas City Metropolitan Chapter of the American Public Works Association, Section 5600

(February 2011) as its guideline. This section of KCAPWA defines the "Comprehensive Control Strategy", which includes a 40-hour extended detention for the 90 percent mean annual rain event. The Macro drainage areas defined as "EX1" and "P1" in the originally approved drainage study contain an outlet control structure, which was designed and installed in the lowest of the existing wet detention basins to meet all KCAPWA requirements, as it is the ultimate release point for all three of the wet detention basins. Since no changes are being made to the existing outlet control structure of the lowest wet detention basin, the methodology of this report is to prove that the Micro drainage area captured by the third wet basin in the series will not produce any surcharging or negative impacts to the functionality of the lower two existing wet basins. This Micro drainage analysis is contained within the Macro drainage areas of "EX1" and "P1" from the original drainage study. Since the Macro drainage study has already considered this area in comprehensive control calculations, a Pre vs. Post analysis was utilized for the third and final wet detention basin. To complete this investigation, the SCS TR-55 method was used to calculate runoff curve numbers and Hydraflow Hydragraphs software extension for AutoDesk Civil 3D was used to evaluate storm drainage and storage requirements, as well as aid in the design/sizing of the outlet works of the proposed wet basin. A Type II 24-hour rainfall distribution was used to determine all stormwater hydrographs. The 2-year, 10-year, and 100-year, 24-hour rainfall depths used within the model were determined from NOAA Atlas 14, Volume 8, Version 2. To view the NOAA data, refer to **Appendix D** of this report. The following rainfall depths were used for this study:

P_2 = 3.68 in.

P_{10} = 5.61 in.

P_{100} = 9.17 in.

6.2 Curve Number Calculations

Table 1 of this report summarizes the weighted curve number calculations that were used in this drainage analysis. The surface cover type determined at the Project Site is open grassed space, good condition (CN=74). As the drainage area is primarily offsite and not being developed, the pre-development and post-development curve numbers are the same.

Table 1: SCS Curve Number Calculations

SCS CURVE NUMBER CALCUATIONS				
EXISTING & PROPOSED SUB-BASINS				
Drainage Sub-Basin	**Hydrologic Soil Group**	**Total Area (acres)**	**Grass CN = 74**	**Composite CN**
EXISTING	C	2.80	74	**74**
PROPOSED	C	2.80	74	**74**

6.3 Time of Concentration

The SCS TR-55 method was used to calculate the time of concentration for the existing and proposed drainage assessments. The Hydraflow Hydrographs extension for AutoDesk Civil 3D automatically calculates the time of concentration for sheet flow and shallow concentrated flow. **Table 2** of this report summarizes the time of concentration results that were generated in Hydraflow. Similar to the curve number, there is no change in time of concentration between existing and proposed conditions, due to offsite flow. For more information on the time of concentration calculations, refer to the Hydraflow report located in **Appendix E**.

Table 2: Time of Concentration

TIME OF CONCENTRATION		
EXISTING SUB-BASINS		
Drainage Sub-Basin	**TC (Min)**	**Manning's n (Sheet Flow)**
EXISTING	33.5	0.24
PROPOSED	33.5	0.24

6.4 Detention Basin Performance

The wet detention basin has a capacity of 2.86 acre-feet of storage and is designed to control the 100-year design storm with greater than 1.0-foot of freeboard. **Table 3** shows the performance of the detention basin for a 2-year, 10-year, and 100-year design storm. As shown in **Figure 4**, the 24-inch outfall limits the flow of water leaving the basin, which causes water to be temporarily stored and released at a controlled rate. The permanent pool elevation of the wet detention basin is 1008.00, which is the same elevation as the outlet pipe flowline. Additional storage was added to the bottom of the wet detention basin to allow for silt accumulation, acting as a water quality pool. The additional storage allows for at least 5-years of sediment accumulation at the bottom of the basin without impact to the intended functionality of the wet

detention basin. The size of proposed wet detention basin is 1.85 acre-feet for the 100-year design storm and a maximum storage capacity of 2.86 acre-feet. For more information about the proposed wet detention basin, refer to the Hydraflow report located in **Appendix E** of this report.

Table 3: Proposed Detention Basin Performance

PROPOSED DETENTION BASIN					
BASIN PERFORMANCE					
DESIGN STORM	**Flow In (CFS)**	**Flow Out (CFS)**	**Peak Storage (AC-FT)**	**Peak Stage Over Permanent Pool (FT)**	**Peak Elevation (FT)**
2-YEAR	3.12	0.97	1.54	0.40	1008.40
10-YEAR	6.77	3.29	1.66	0.76	1008.76
100-YEAR	14.23	8.71	1.85	1.33	1009.33

6.5 Peak Flow Rates

This Micro drainage analysis is intended to prove that the area flowing into the third proposed wet detention basin will not have any negative downstream impacts on Macro drainage areas "EX1" and "P1" when compared to the originally approved drainage report. To do this, pre-development and post-development peak flow rates will be compared for the contributing area flowing into the middle wet detention basin as it exists today (most upstream basin without basin three) and when the proposed wet basin is installed. **Table 4** of this report summarizes the pre-development and post-development flow rates for a 2, 10, and 100-year design storm.

Table 4: Peak Flow Rates

PRE-DEVELOPMENT vs. POST-DEVELOPMENT	
2-YEAR PEAK FLOW RATE	
Existing (CFS)	**Proposed (CFS)**
3.12	0.97
10-YEAR PEAK FLOW RATE	
Existing (CFS)	**Proposed (CFS)**
6.77	3.29
100-YEAR PEAK FLOW RATE	
Existing (CFS)	**Proposed (CFS)**
14.23	8.71

7.0 – Downstream Impacts

Using the Hydraflow Hydrographs extension for AutoDesk Civil 3D, Anderson Engineering Inc. developed a drainage model that was able to assess the peak runoff and detention release rates of the third, uppermost wet detention basin for a 2-yr, 10-yr, and 100-yr design storm. The results of this analysis conclude that the proposed wet detention basin will reduce peak flow rates of the contributing Micro drainage area such that it will not have any negative downstream impacts on the two existing wet detention basins, and that the existing outlet control structure contained in the lowest of the three basins will continue functioning as designed in the originally approved Master Drainage Study, meeting all KCAPWA and City of Lee's Summit stormwater discharge requirements. For more information on the drainage model, refer to the full Hydraflow report in **Appendix E**.

8.0 – Conclusion

Cobey Creek 2nd Plat is the second of four phases for the mixed-use development plan. A Macro Master Drainage Study was completed by HG Consultants and was approved with Cobey Creek 1st Plat (Phase 1). The Macro drainage study designed for a majority of the drainage for the four-phase development to be conveyed to a dry detention basin, which was constructed in the northeast corner of the property during Phase 1. The study also accounted for drainage on the south side of the development using a series of three wet detention basins. Two of the three wet detention basins were constructed with Phase 1, leaving the third and uppermost wet detention basin to be constructed in Phase 2. The configuration and outlet conditions for the existing lowermost wet detention basin was designed to release runoff from all three wet detention basin drainage areas and utilized the Comprehensive Control Strategy defined by KCAPWA, including the 40-hour extended release of the 90 percent mean annual stormwater volume. This Micro drainage study has analyzed the drainage area contributing to the uppermost wet detention basin and concludes using the Pre vs. Post methodology, that the construction of the third wet detention basin will not negatively impact the existing wet detention basins, and that the existing outlet control structure will continue to function as designed to meet the Comprehensive Control Strategy and Water Quality volume release that the City of Lee's Summit requires.

The proposed wet detention basin holds approximately 1.85 acre-feet of storage volume for the 100-year design storm and a has a maximum storage capacity of 2.86 acre-feet. The stormwater collected in the uppermost wet basin will be released in a controlled manner, such that flow rates out of the uppermost wet basin and into the middle wet basin are less than those prior to construction of the remaining phases of the development. The design of the proposed uppermost wet detention basin meets the intent and functionality of the originally approved basin design from Cobey Creek 1st Plat Street and Storm Plans, the Master Drainage Study, and the Design and Construction Manual of the City of Lee's Summit, Missouri.

9.0 – References

AutoDesk, Civil 3D, 2020

AutoDesk, Hydraflow Hydrographs Extension for AutoCAD Civil 3D, 2020

AutoDesk, Hydraflow Express Extension for AntoCAD Civil 3D, 2020

City of Lee's Summit, Section 5600 - Storm Drainage Systems & Facilities, Design Criteria, 2020

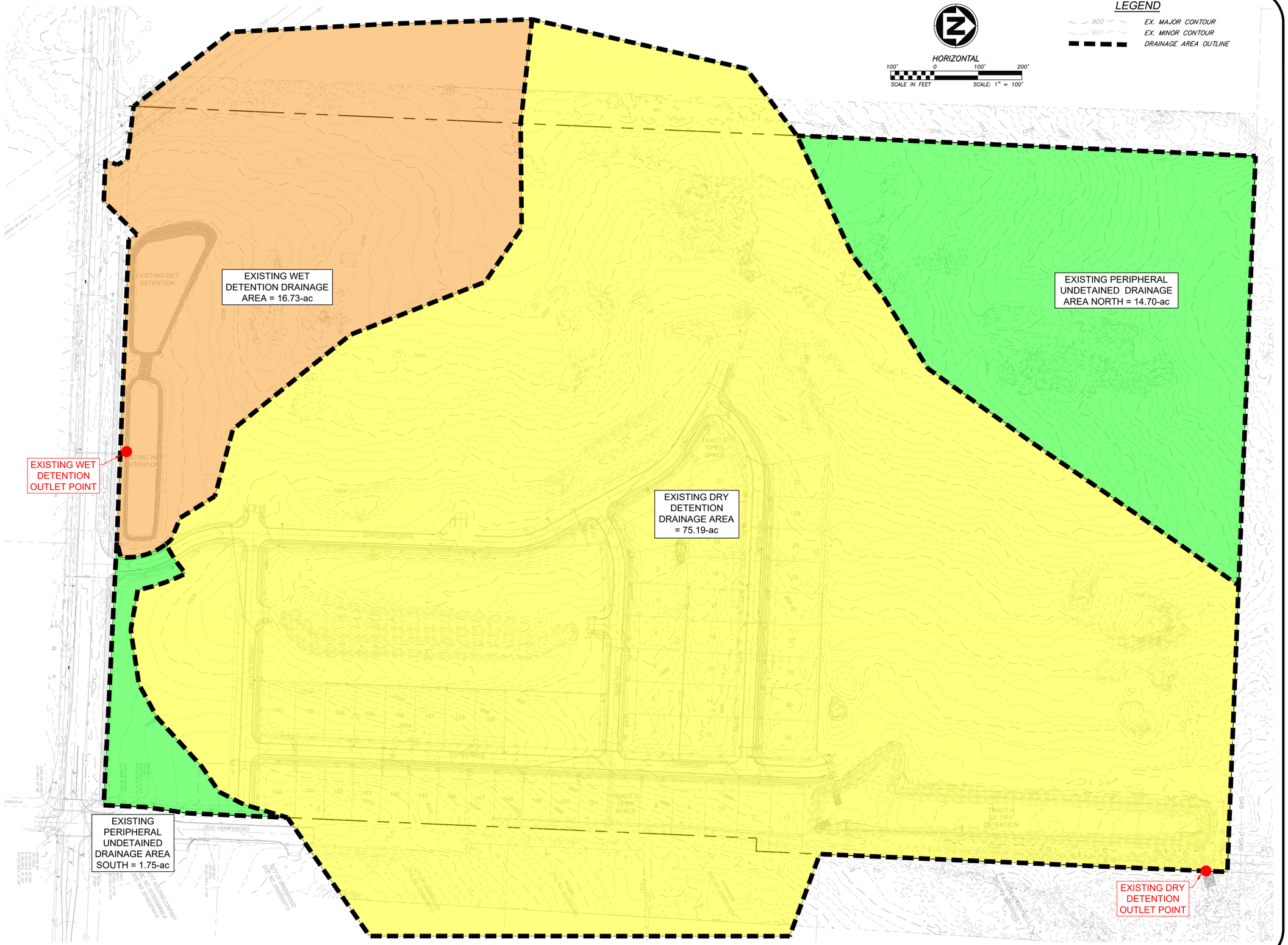
APWA, Section 5600 - Storm Drainage Systems & Facilities, 2011

Google Earth, Geographic Information System, 2022

NOAA, Atlas 14, Volume 8, Version 2, 2022

USDA, Web Soil Survey, 2022

Appendix A



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				JOB NUMBER: 21KC10060

CLAYTON PROPERTIES GROUP
COBEY CREEK - 2ND PLAT - STREET, STORM, & EROSION

EXISTING DRAINAGE AREAS (BEFORE PHASE 2)

S29, T47N, R31W
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

EXHIBIT
A

PROPOSED WET DETENTION DRAINAGE
AREA = 2.80-ac
CN = 74
T_C = 33.5 min.

PROPOSED WET DETENTION BASIN

EXISTING WET DETENTION DRAINAGE
AREA = 6.98-ac

EXISTING WET DETENTION OUTLET POINT

PROPOSED PERIPHERAL UNDETAINED DRAINAGE AREA NORTH = 4.19-ac

EXISTING DRY DETENTION
AREA = 93.34-ac

PROPOSED PERIPHERAL UNDETAINED DRAINAGE AREA SOUTH = 1.12-ac

EXISTING DRY DETENTION OUTLET POINT

LEGEND

- 900 — PROP. MAJOR CONTOUR
- 901 — PROP. MINOR CONTOUR
- 900 — EX. MAJOR CONTOUR
- 901 — EX. MINOR CONTOUR
- DRAINAGE AREA OUTLINE

HORIZONTAL
100' 0 100' 200'
SCALE IN FEET
SCALE: 1" = 100'

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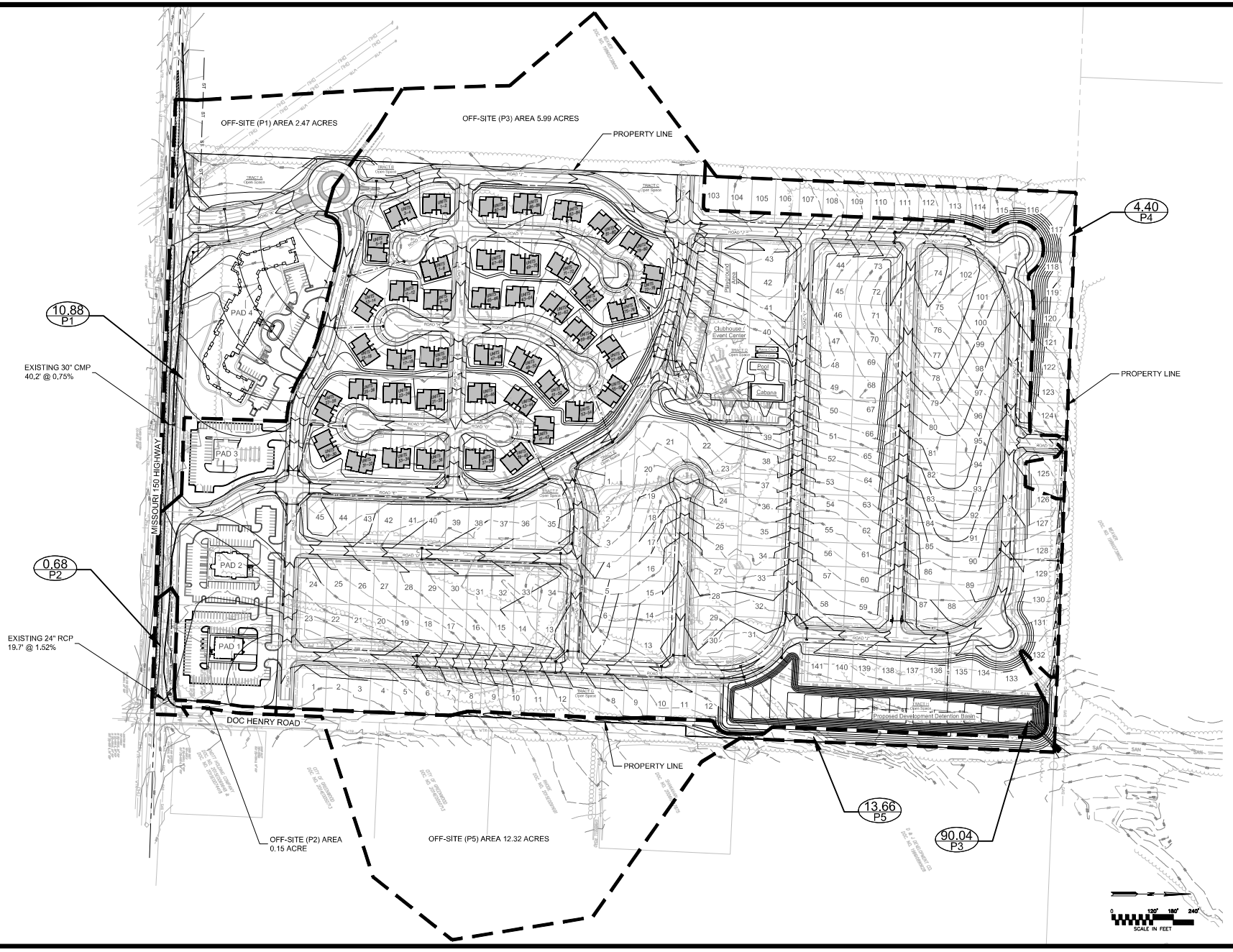
CLAYTON PROPERTIES GROUP
COBEY CREEK - 2ND PLAT - STREET, STORM, & EROSION

PROPOSED DRAINAGE AREAS (FULLY DEVELOPED)

S29, T47N, R31W
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

EXHIBIT
B

Jul 27, 2022 – 4:59pm Plotted By: gcote G:\Shared drives\KC10 – Land Development\Projects\2021\21KC10060 Cobey Creek Residential\01 CIVIL\03–DWG\Sheet\Exhibits\2022.07.26 – DRAINAGE MAP.dwg Layout: PROPOSED MASTER DRAINAGE PLAN



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R. KEVIN STERRETT, KS E-21889 MO E-26440
Jul 11, 2017

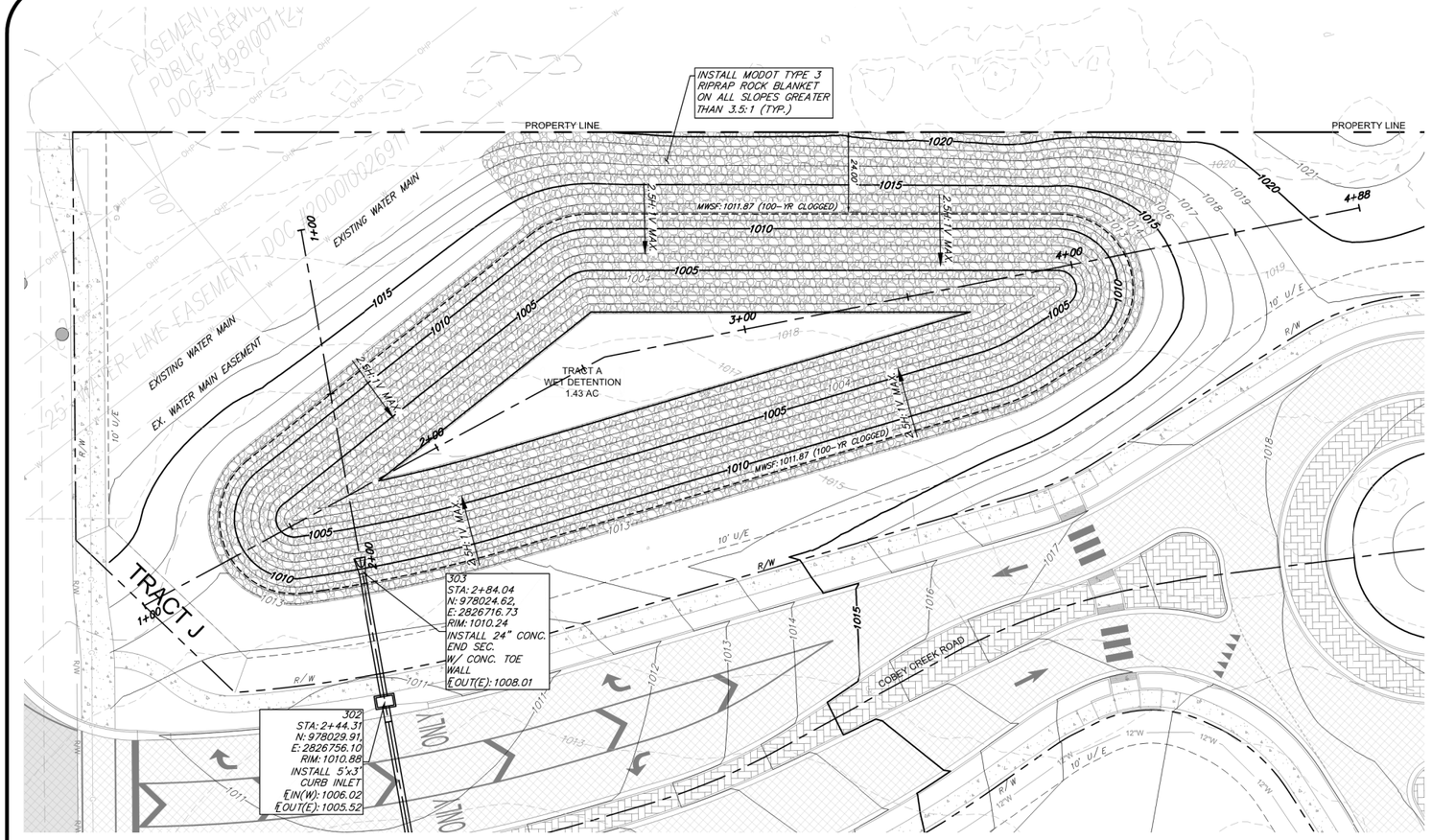
Consult Inc engineers planners
11010 Haskell Street, Suite 210, Kansas City, Kansas 66109
CORPORATE LICENSE No. E2010057 (MO) / E-2796 (KS)

STORM DRAINAGE REPORT
DEVELOPED CONDITIONS

COBEY CREEK

CITY OF LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

X-REF NO.	16-059 BASE
DRAWING NO.	16-059 PDPs
DATE	May 8, 2018
JOB NO.	16-059
SHEET	2 OF 2



WATER SURFACE ELEVATIONS:

PERM. POOL	– 1008.00
2-YR	– 1008.40
10-YR	– 1008.76
100-YR	– 1009.33
100-YR CLOGGED	– 1011.87

OUTLET DISCHARGE RATES:

2-YR	– 0.97 CFS
10-YR	– 3.29 CFS
100-YR	– 8.71 CFS
100-YR CLOGGED	– 0.00 CFS

LEGEND

- 900 — PROPOSED MAJOR CONTOUR
- 901 — PROPOSED MINOR CONTOUR
- 900 — EXISTING MAJOR CONTOUR
- 901 — EXISTING MINOR CONTOUR
- RIPRAP STABILIZATION
- RIGHT-OF-WAY
- ROAD CENTERLINE

WET DETENTION BASIN GENERAL NOTES:

1. CONTRACTOR TO CONSTRUCT STORMWATER MANAGEMENT FACILITIES, SPECIFICALLY THOSE FEATURES RELATED TO DETENTION, PRIOR TO ANY LAND DISTURBANCE OF THE SITE AND PRIOR TO THE CONSTRUCTION OF ANY OTHER SITE DEVELOPMENT WORK AS NOT TO EFFECT DOWNSTREAM NEIGHBORS WITH UNDETAINED STORMWATER DISCHARGE.
2. AN AS-GRADED AND AS-BUILT DRAWING SHALL BE SUBMITTED TO AND REVIEWED BY THE CITY FOR THE DETENTION BASIN. THIS SHALL BE REQUIRED PRIOR TO ISSUANCE OF A CERTIFICATE OF SUBSTANTIAL COMPLETION. ALL PRECAUTIONS SHOULD BE TAKEN TO ENSURE DETENTION POND AND OUTLET STRUCTURE ARE CONSTRUCTED ACCORDING TO THE APPROVED PLANS; VOLUMES AND ELEVATIONS ARE CRITICAL FOR AS-BUILT APPROVAL. THE CITY SHALL BE PROVIDED WITH AN AS-BUILT SURVEY OF THE DETENTION BASIN, OUTLET STRUCTURE INCLUDING ALL WEIR ELEVATIONS AND STORM SYSTEM INCLUDING ALL THE INVERTS, STAMPED BY A MISSOURI LICENSED ENGINEER.
3. ALL SIDEWALK ADJACENT TO TRACTS SHALL BE CONSTRUCTED WITH PUBLIC IMPROVEMENTS, ALONG WITH ALL ADA ACCESSIBLE SIDEWALK RAMPS.
4. ALL SEDIMENT ACCUMULATED THROUGHOUT THE DURATION OF CONSTRUCTION SHALL BE DREDGED OR SKIMMED FROM BOTTOM OF WET POND PRIOR TO FINAL ACCEPTANCE. CONTRACTOR SHALL MAKE GREATEST EFFORT TO PREVENT SEDIMENT BUILDUP AND USE DEWATERING PRACTICES OUTLINED IN THE SWPPP UNTIL CONSTRUCTION IS COMPLETED.

EMERGENCY SPILLWAY NOTES:

24" OUTLET PIPE SHALL FUNCTION AS EMERGENCY SPILLWAY.

STORAGE VOLUME:

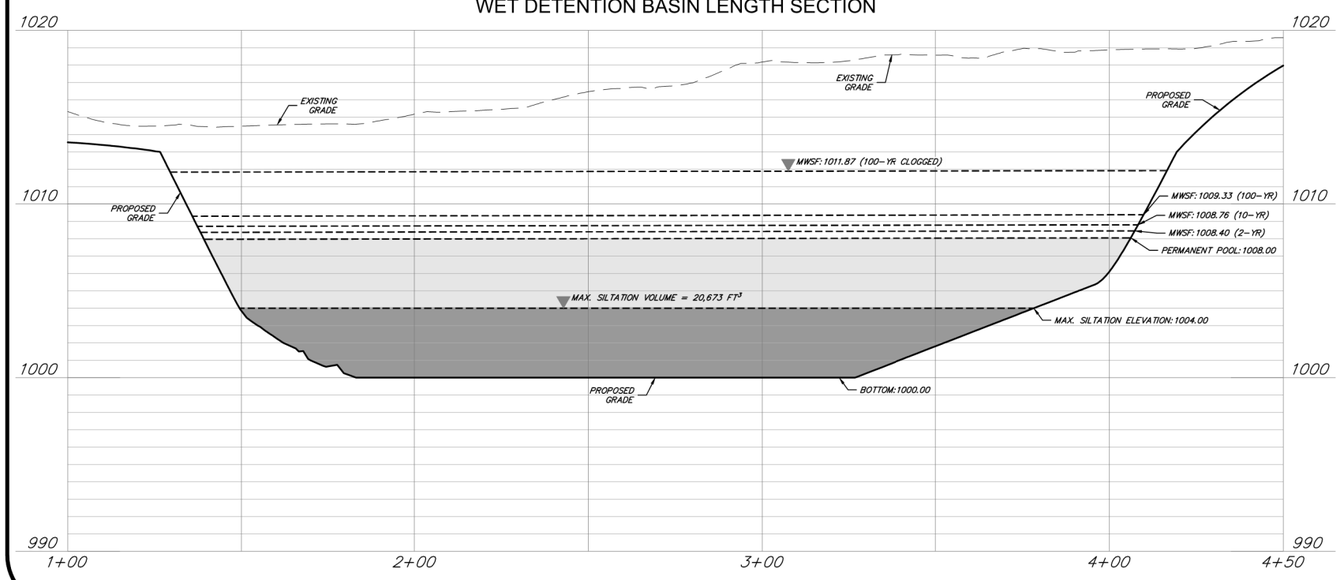
REQUIRED: 107,330 FT³

DESIGN: 125,623 FT³

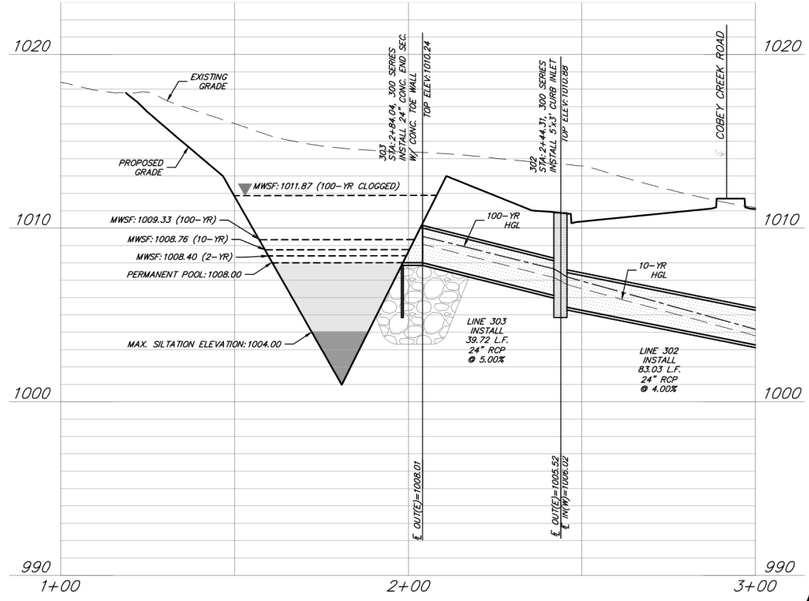
NOTE: REFER TO STORM PLAN & PROFILE SHEET (C508) FOR STORM LINE 300 SERIES

HORIZ.: 1"=20'
VERT.: 1"=4'

WET DETENTION BASIN LENGTH SECTION



WET DETENTION BASIN WIDTH SECTION



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CLAYTON PROPERTIES GROUP
COBEY CREEK - 2ND PLAT - STREET, STORM, & EROSION

WET DETENTION BASIN PLAN & PROFILE

S29, T47N, R31W
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

SHEET NUMBER
C503
57 OF 87

May 05, 2022 – 9:04pm Plotted By: cotsa Q:\Shared drives\KC10 – Land Development\Projects\2021\21KC10060 Cobey Creek Residential\01 CIVIL\03-SWO\Sheet\STREET STORM EROSION\21KC10060 – SHTS – DETENTION BASIN.dwg Layout: WET DETENTION BASIN PLAN & PROFILE

Appendix B

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Jackson County, Missouri

May 5, 2022

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 23, Sep 1, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	6.9	100.0%
Totals for Area of Interest		**6.9**	**100.0%**

Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

Jackson County, Missouri

10000—Arisburg silt loam, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w22b
Elevation: 610 to 1,130 feet
Mean annual precipitation: 39 to 43 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 87 percent
Minor components: 13 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
Bt - 13 to 19 inches: silty clay loam
Btg - 19 to 56 inches: silty clay loam
BCg - 56 to 79 inches: silty clay loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107BY007MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sharpsburg

Percent of map unit: 5 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Greenton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Haig

Percent of map unit: 3 percent
Landform: Flats
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R109XY001MO - Claypan Summit Prairie
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

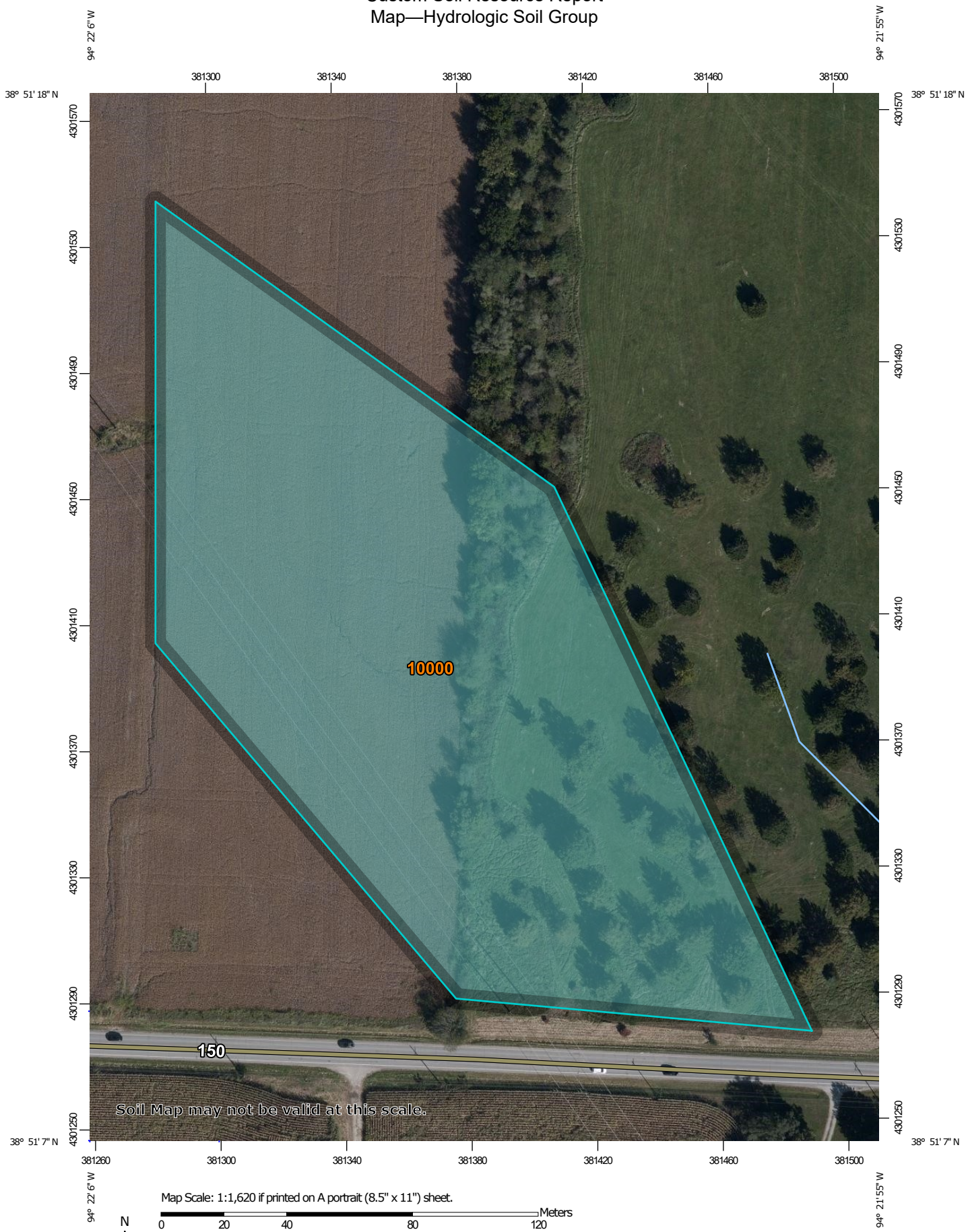
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.



Map Scale: 1:1,620 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

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Survey Area Data: Version 23, Sep 1, 2021

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Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	6.9	100.0%
Totals for Area of Interest			**6.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix C

National Flood Hazard Layer FIRMette

FEMA

94°22'12"W 38°51'35"N

94°21'35"W 38°51'7"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 5/3/2022 at 8:46 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix D

NOAA Atlas 14, Volume 8, Version 2
Location name: Lees Summit, Missouri, USA*
Latitude: 38.8534°, Longitude: -94.3651°
Elevation: 1013.58 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.412** (0.326-0.522)	**0.483** (0.381-0.612)	**0.600** (0.472-0.762)	**0.698** (0.546-0.889)	**0.834** (0.632-1.09)	**0.940** (0.697-1.25)	**1.05** (0.752-1.42)	**1.16** (0.798-1.60)	**1.30** (0.867-1.85)	**1.42** (0.919-2.03)
10-min	**0.604** (0.477-0.765)	**0.708** (0.558-0.897)	**0.879** (0.691-1.12)	**1.02** (0.799-1.30)	**1.22** (0.925-1.60)	**1.38** (1.02-1.82)	**1.53** (1.10-2.07)	**1.69** (1.17-2.34)	**1.91** (1.27-2.70)	**2.07** (1.35-2.97)
15-min	**0.736** (0.581-0.933)	**0.863** (0.681-1.09)	**1.07** (0.842-1.36)	**1.25** (0.975-1.59)	**1.49** (1.13-1.95)	**1.68** (1.24-2.22)	**1.87** (1.34-2.53)	**2.07** (1.43-2.86)	**2.33** (1.55-3.29)	**2.53** (1.64-3.63)
30-min	**1.02** (0.805-1.29)	**1.20** (0.947-1.52)	**1.50** (1.18-1.90)	**1.75** (1.37-2.23)	**2.09** (1.59-2.74)	**2.36** (1.75-3.13)	**2.63** (1.89-3.56)	**2.91** (2.01-4.02)	**3.28** (2.18-4.64)	**3.55** (2.31-5.10)
60-min	**1.34** (1.06-1.69)	**1.57** (1.24-1.99)	**1.96** (1.54-2.49)	**2.29** (1.79-2.92)	**2.75** (2.09-3.61)	**3.12** (2.31-4.14)	**3.49** (2.51-4.73)	**3.88** (2.68-5.37)	**4.40** (2.93-6.24)	**4.80** (3.12-6.90)
2-hr	**1.65** (1.32-2.08)	**1.94** (1.54-2.44)	**2.42** (1.92-3.04)	**2.83** (2.23-3.57)	**3.41** (2.61-4.45)	**3.88** (2.90-5.11)	**4.35** (3.15-5.86)	**4.85** (3.38-6.68)	**5.53** (3.71-7.79)	**6.06** (3.97-8.63)
3-hr	**1.87** (1.49-2.34)	**2.19** (1.75-2.74)	**2.73** (2.17-3.43)	**3.21** (2.54-4.03)	**3.88** (2.99-5.05)	**4.43** (3.33-5.82)	**5.00** (3.64-6.71)	**5.60** (3.92-7.69)	**6.42** (4.34-9.02)	**7.07** (4.65-10.0)
6-hr	**2.25** (1.81-2.79)	**2.65** (2.13-3.28)	**3.33** (2.67-4.14)	**3.94** (3.14-4.91)	**4.81** (3.74-6.23)	**5.53** (4.20-7.23)	**6.28** (4.62-8.38)	**7.08** (5.00-9.67)	**8.19** (5.58-11.4)	**9.07** (6.01-12.8)
12-hr	**2.65** (2.15-3.25)	**3.15** (2.55-3.87)	**4.01** (3.24-4.94)	**4.77** (3.84-5.90)	**5.89** (4.62-7.57)	**6.80** (5.21-8.83)	**7.76** (5.75-10.3)	**8.78** (6.26-11.9)	**10.2** (7.01-14.2)	**11.3** (7.58-15.9)
24-hr	**3.09** (2.53-3.77)	**3.68** (3.01-4.49)	**4.70** (3.83-5.75)	**5.61** (4.54-6.88)	**6.94** (5.48-8.85)	**8.02** (6.19-10.3)	**9.17** (6.85-12.1)	**10.4** (7.47-14.0)	**12.1** (8.38-16.7)	**13.5** (9.07-18.7)
2-day	**3.65** (3.01-4.41)	**4.28** (3.52-5.16)	**5.37** (4.41-6.50)	**6.34** (5.18-7.71)	**7.78** (6.21-9.85)	**8.97** (6.98-11.5)	**10.2** (7.71-13.4)	**11.6** (8.39-15.5)	**13.5** (9.41-18.5)	**15.0** (10.2-20.7)
3-day	**4.04** (3.35-4.86)	**4.68** (3.87-5.62)	**5.78** (4.77-6.97)	**6.77** (5.55-8.19)	**8.23** (6.59-10.4)	**9.43** (7.38-12.0)	**10.7** (8.11-13.9)	**12.1** (8.80-16.1)	**14.0** (9.82-19.1)	**15.5** (10.6-21.4)
4-day	**4.37** (3.63-5.23)	**5.01** (4.16-6.00)	**6.12** (5.06-7.35)	**7.11** (5.85-8.57)	**8.57** (6.88-10.7)	**9.77** (7.66-12.4)	**11.0** (8.38-14.3)	**12.4** (9.06-16.5)	**14.3** (10.1-19.4)	**15.8** (10.8-21.7)
7-day	**5.17** (4.32-6.14)	**5.85** (4.89-6.96)	**7.02** (5.85-8.37)	**8.03** (6.65-9.61)	**9.49** (7.65-11.8)	**10.7** (8.41-13.4)	**11.9** (9.08-15.3)	**13.2** (9.69-17.4)	**15.0** (10.6-20.2)	**16.4** (11.3-22.4)
10-day	**5.86** (4.92-6.94)	**6.62** (5.55-7.83)	**7.87** (6.58-9.34)	**8.94** (7.44-10.6)	**10.4** (8.44-12.8)	**11.6** (9.20-14.5)	**12.9** (9.85-16.4)	**14.1** (10.4-18.5)	**15.8** (11.3-21.3)	**17.2** (11.9-23.4)
20-day	**7.83** (6.63-9.18)	**8.84** (7.47-10.4)	**10.5** (8.81-12.3)	**11.8** (9.88-13.9)	**13.6** (11.0-16.4)	**14.9** (11.9-18.4)	**16.3** (12.5-20.5)	**17.6** (13.1-22.8)	**19.3** (13.8-25.7)	**20.6** (14.4-27.9)
30-day	**9.48** (8.07-11.1)	**10.7** (9.09-12.5)	**12.6** (10.7-14.8)	**14.2** (12.0-16.7)	**16.2** (13.2-19.5)	**17.8** (14.2-21.7)	**19.2** (14.9-24.0)	**20.7** (15.4-26.5)	**22.4** (16.1-29.6)	**23.7** (16.7-32.0)
45-day	**11.6** (9.90-13.4)	**13.1** (11.2-15.2)	**15.4** (13.1-17.9)	**17.2** (14.6-20.1)	**19.6** (16.0-23.3)	**21.3** (17.0-25.8)	**22.9** (17.7-28.4)	**24.4** (18.2-31.1)	**26.2** (18.9-34.4)	**27.5** (19.4-36.9)
60-day	**13.4** (11.5-15.5)	**15.1** (12.9-17.4)	**17.7** (15.1-20.5)	**19.8** (16.8-23.0)	**22.4** (18.3-26.5)	**24.2** (19.4-29.2)	**25.9** (20.1-32.0)	**27.4** (20.5-34.8)	**29.3** (21.2-38.3)	**30.5** (21.6-40.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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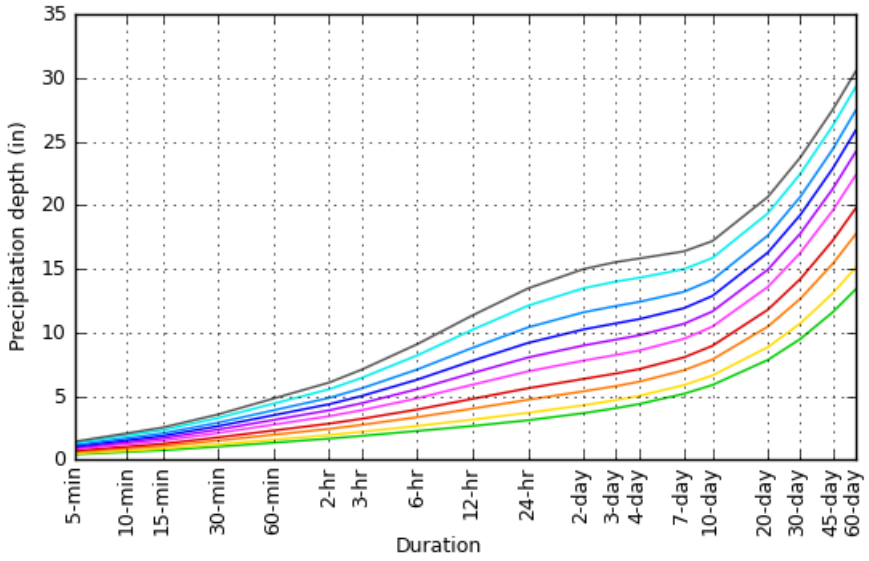
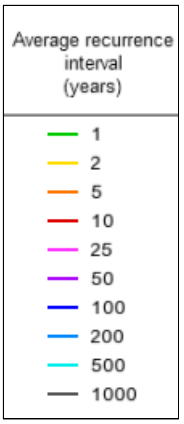
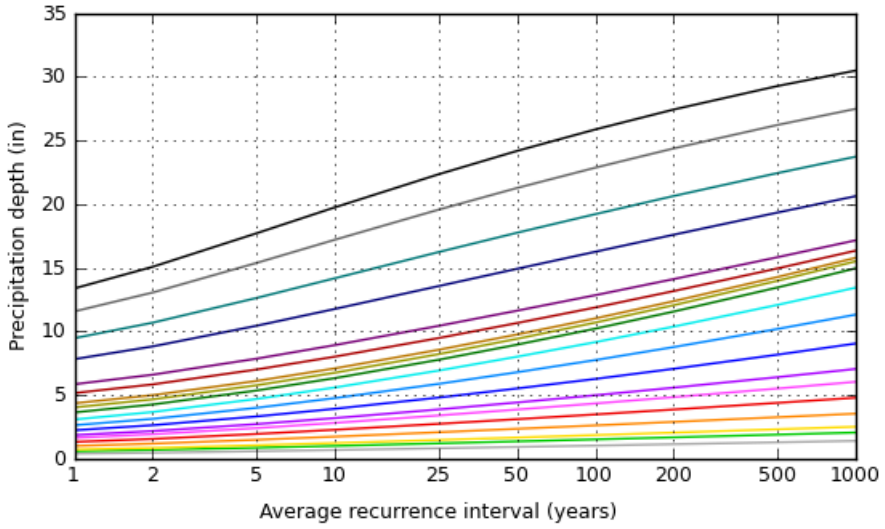
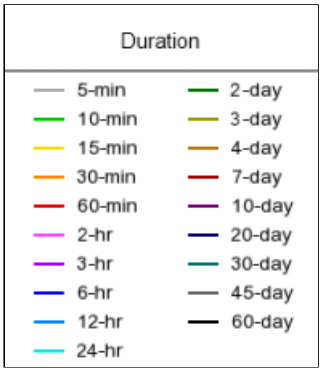
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 38.8534°, Longitude: -94.3651°









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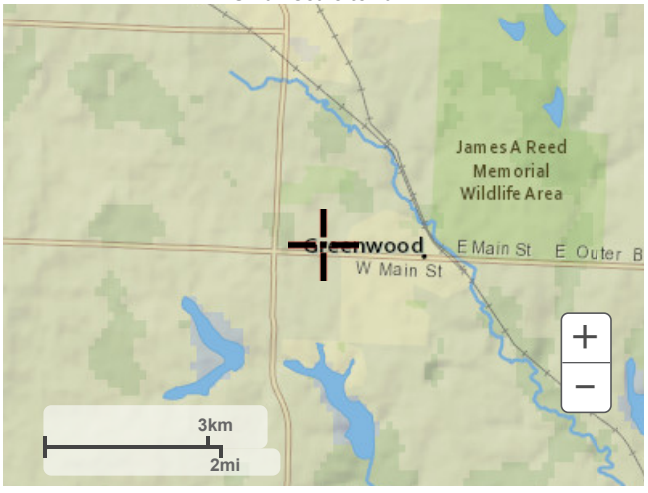
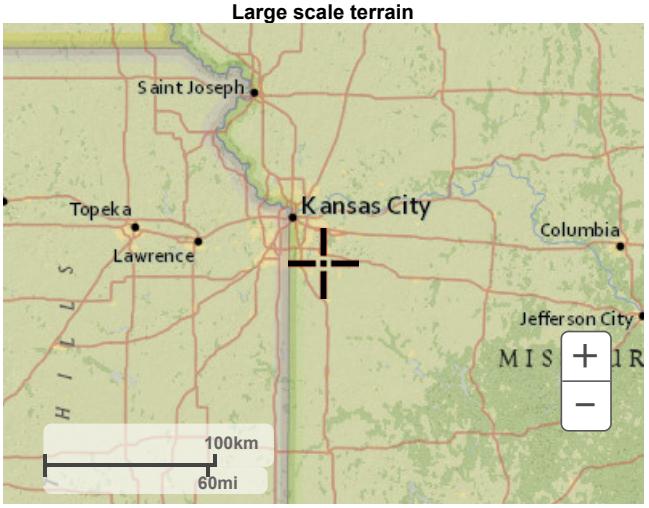
Maps & aerials

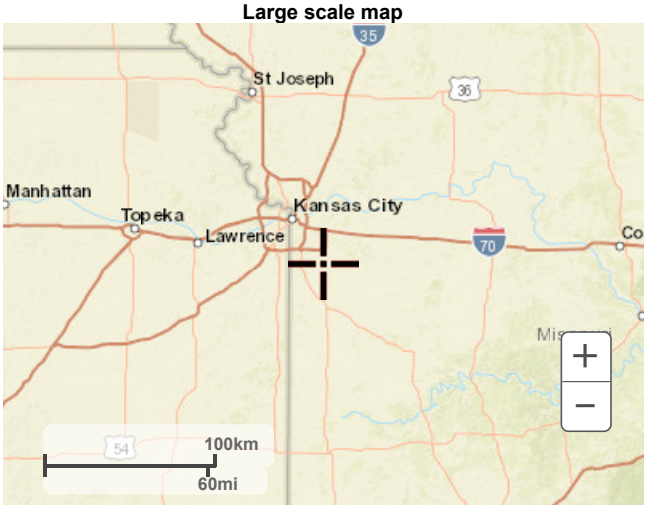
Small scale terrain



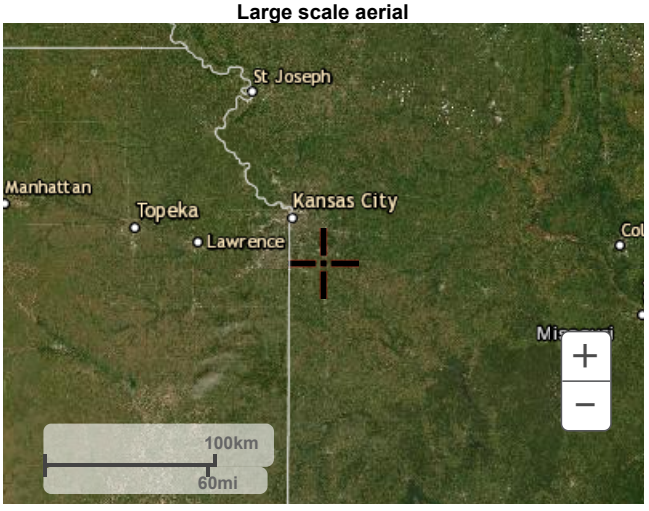
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Appendix E

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020 Thursday, 05 / 5 / 2022

Pond No. 1 - SW Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1000.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1000.00	2,995	0	0
1.00	1001.00	4,003	3,486	3,486
2.00	1002.00	5,112	4,546	8,032
3.00	1003.00	6,317	5,703	13,736
4.00	1004.00	7,579	6,938	20,673
5.00	1005.00	8,879	8,220	28,893
6.00	1006.00	10,220	9,541	38,434
7.00	1007.00	11,599	10,901	49,335
8.00	1008.00	13,019	12,301	61,636
9.00	1009.00	14,477	13,740	75,376
10.00	1010.00	15,975	15,218	90,594
11.00	1011.00	17,512	16,736	107,330
12.00	1012.00	19,088	18,293	125,623
13.00	1013.00	20,703	19,888	145,511

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 1008.00	0.00	0.00	0.00
Length (ft)	= 39.72	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

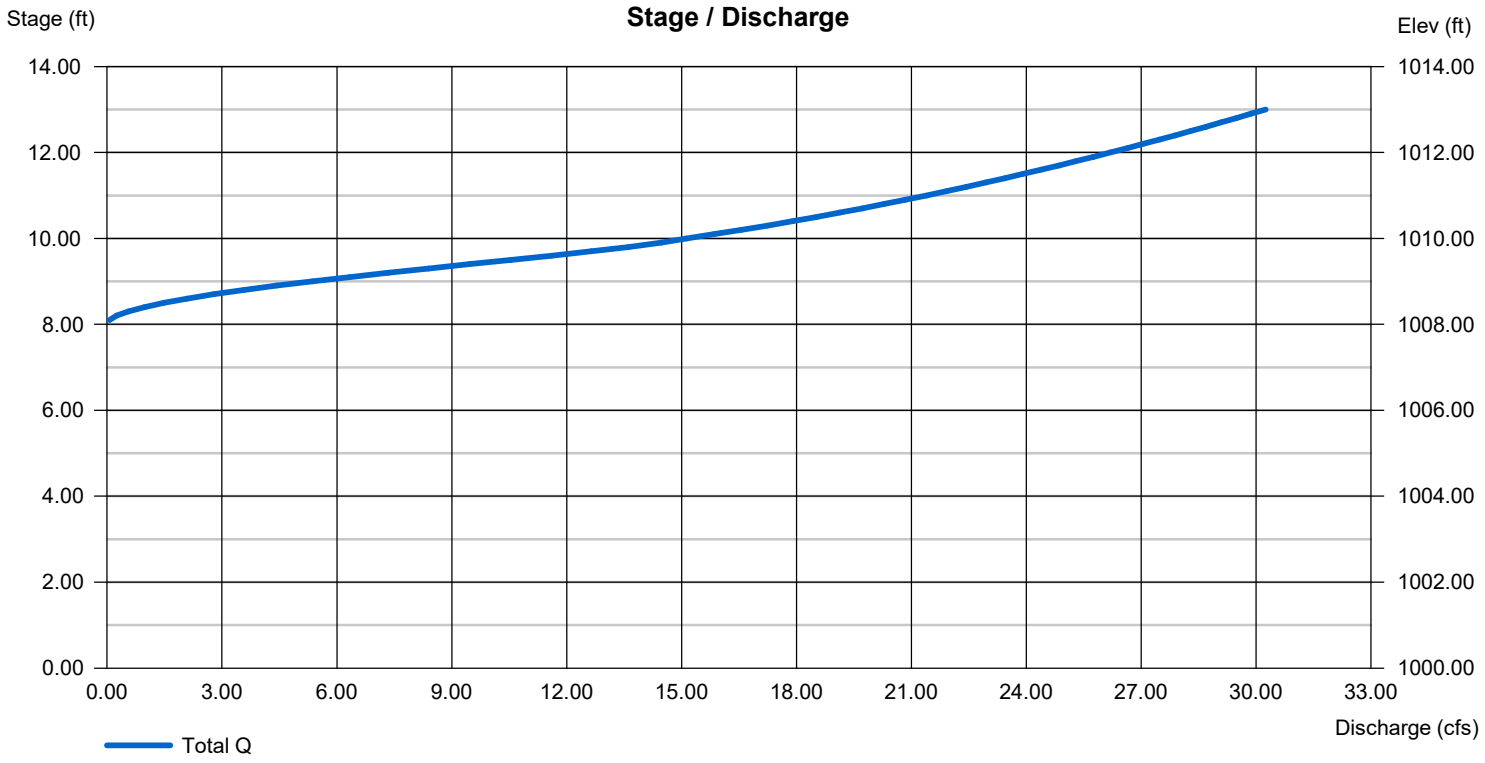
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

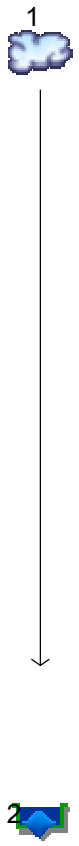
Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Detention
2	Reservoir	Detention Routing

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	2.127	3.120	-------	-------	6.771	-------	-------	14.23	Detention
2	Reservoir	1	0.514	0.969	-------	-------	3.287	-------	-------	8.706	Detention Routing

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

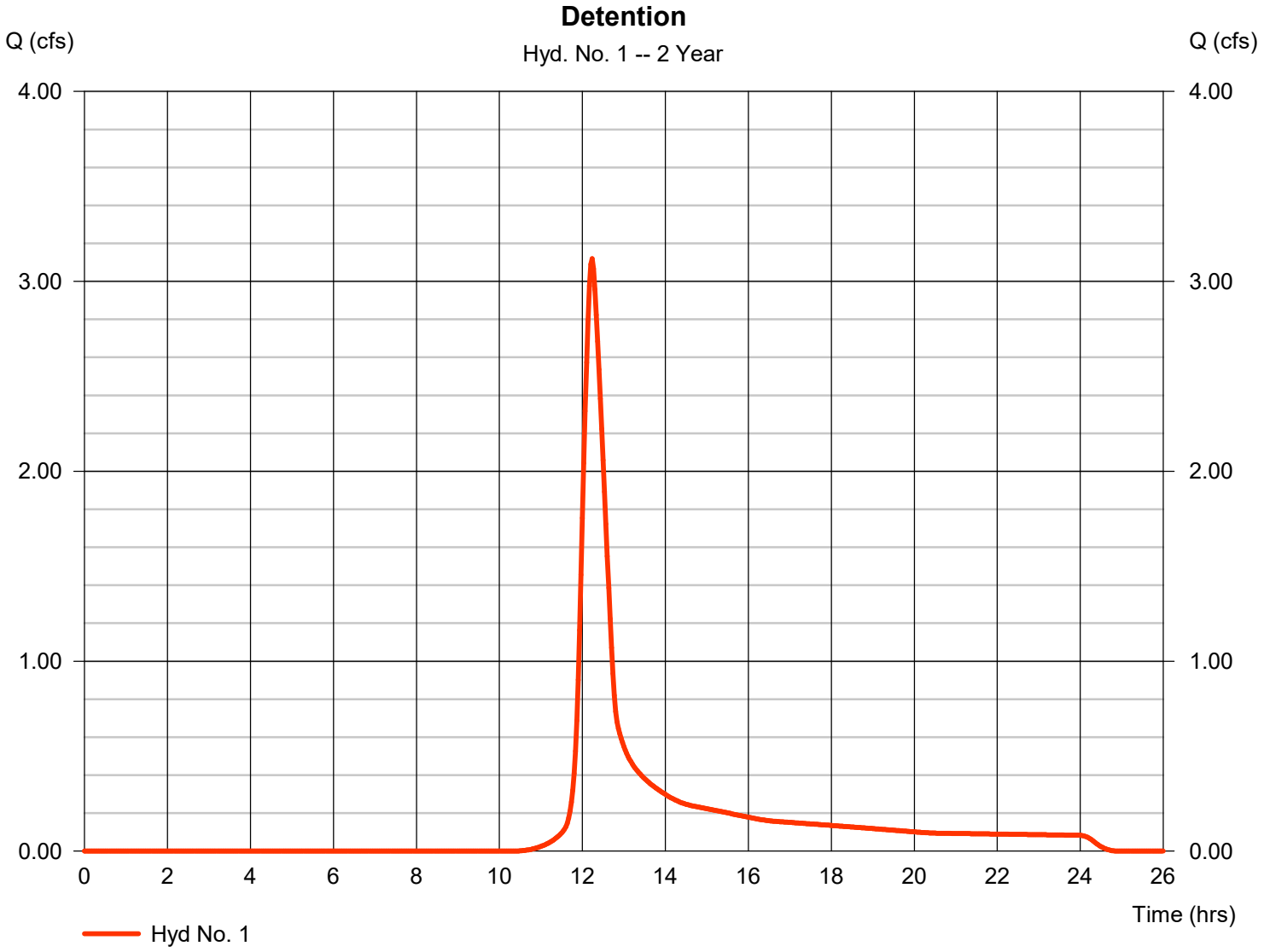
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.120	2	734	14,054	------	------	------	Detention
2	Reservoir	0.969	2	764	14,033	1	1008.40	67,139	Detention Routing

Hydrograph Report

Hyd. No. 1

Detention

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.120 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.23 hrs
Time interval	=	2 min	Hyd. volume	=	14,054 cuft
Drainage area	=	2.800 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	33.50 min
Total precip.	=	3.68 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



TR55 Tc Worksheet

Hyd. No. 1

Detention

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.87		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.25**	**+**	**0.00**	**+**	**0.00**	**=**	**31.25**
Shallow Concentrated Flow							
Flow length (ft)	= 310.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 2.26**	**+**	**0.00**	**+**	**0.00**	**=**	**2.26**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 33.50 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

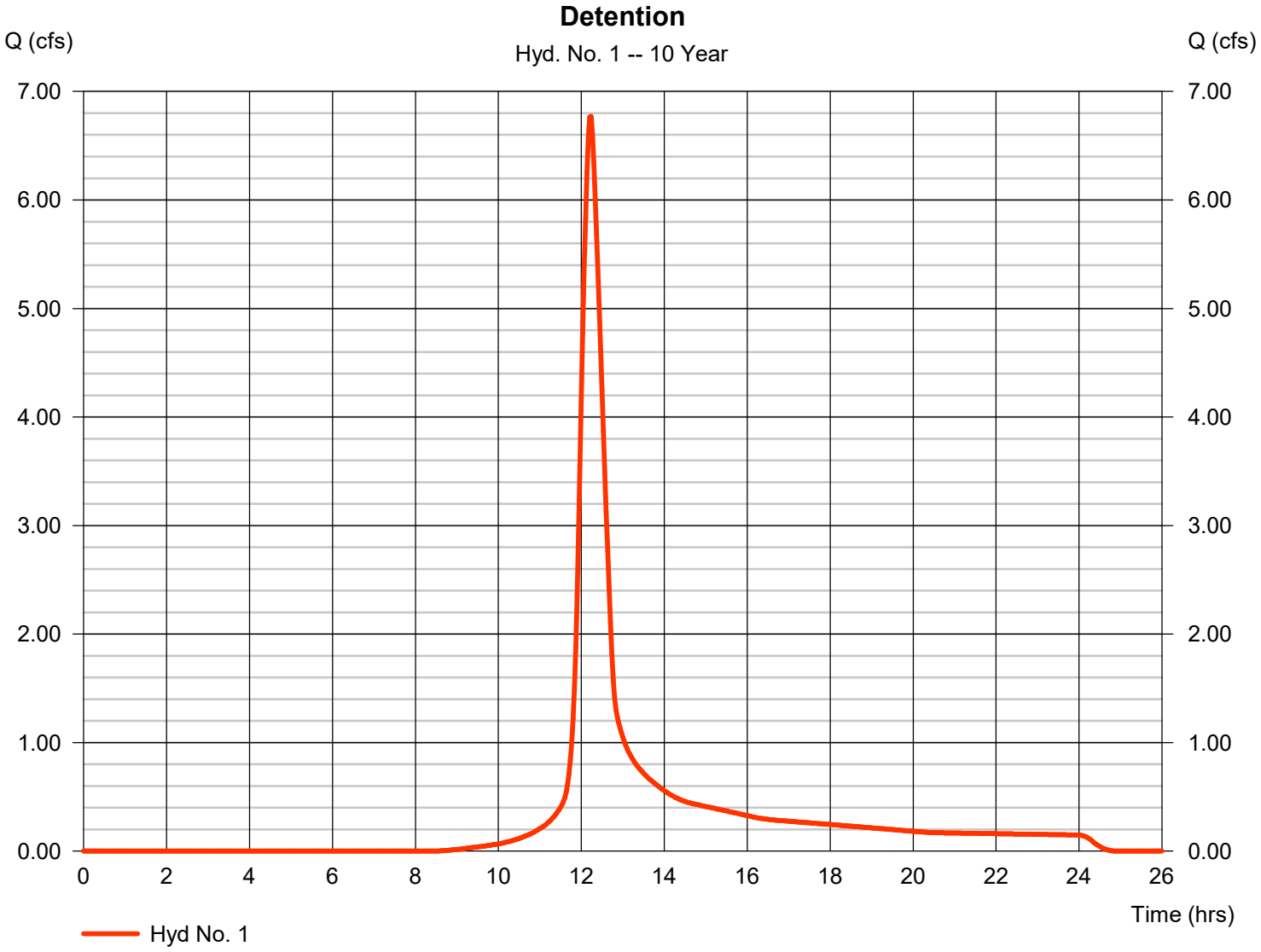
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.771	2	734	29,430	------	------	------	Detention
2	Reservoir	3.287	2	756	29,408	1	1008.76	72,124	Detention Routing

Hydrograph Report

Hyd. No. 1

Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 6.771 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 29,430 cuft
Drainage area	= 2.800 ac	Curve number	= 74
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 33.50 min
Total precip.	= 5.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

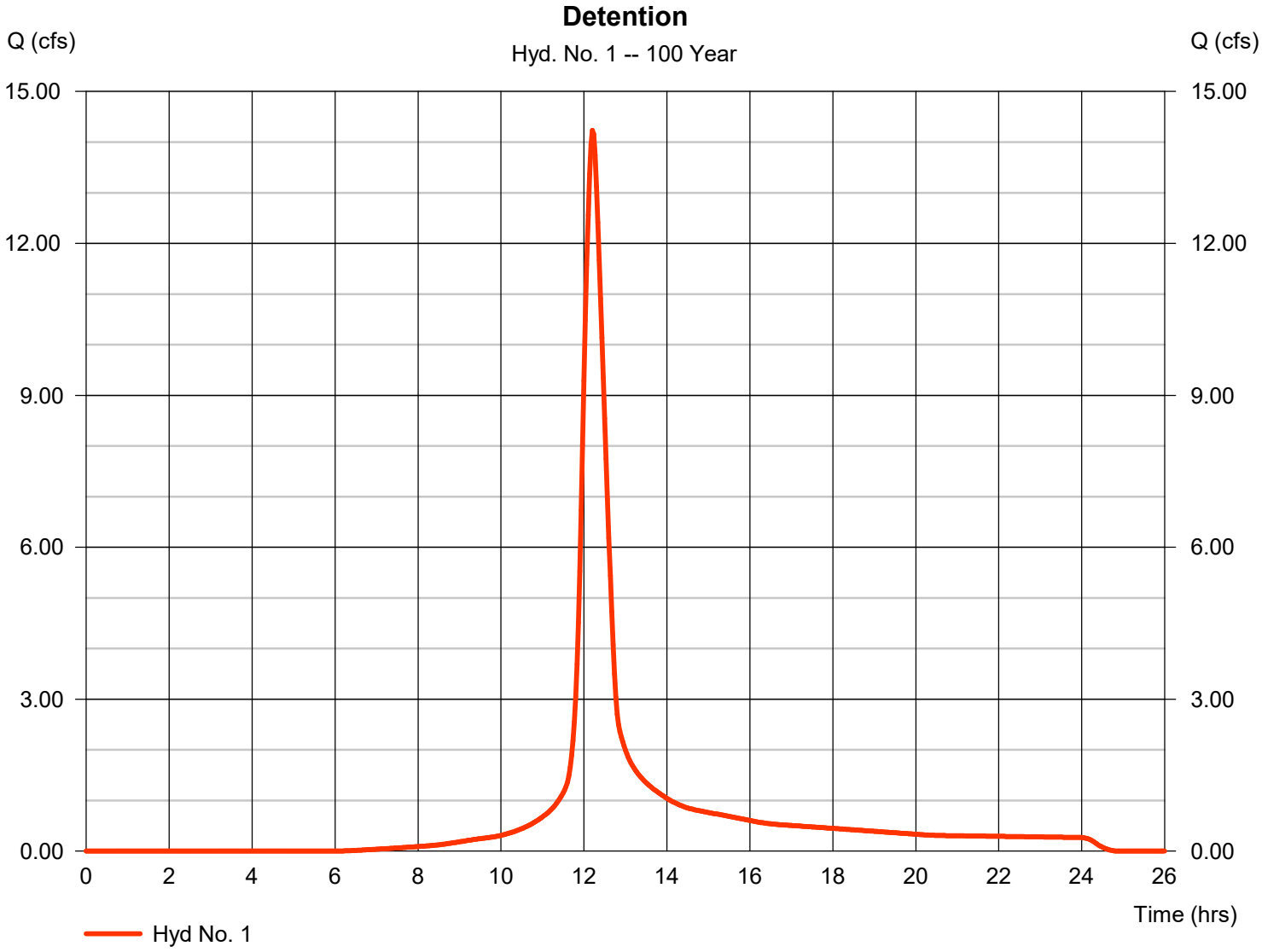
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	14.23	2	732	61,583	------	------	------	Detention
2	Reservoir	8.706	2	750	61,562	1	1009.33	80,388	Detention Routing

Hydrograph Report

Hyd. No. 1

Detention

Hydrograph type	=	SCS Runoff	Peak discharge	=	14.23 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.20 hrs
Time interval	=	2 min	Hyd. volume	=	61,583 cuft
Drainage area	=	2.800 ac	Curve number	=	74
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	33.50 min
Total precip.	=	9.17 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: Springfield_IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

96 W Farm Road 168 - Residential Subdivision\01 CIVIL\02-R&D\Drainage\Rainfall Data\Springfield MO 1Hr (2008).pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	3.09	3.68	0.00	0.00	5.61	0.00	0.00	9.17
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydraflow Table of Contents

Appendix F

STORM WATER REPORT

Cobey Creek

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

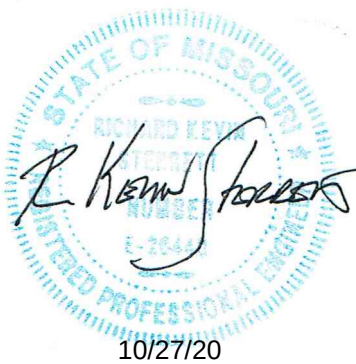
JCM DEVELOPMENT,LLC

PREPARED BY

Hg Consult, Inc

Condensed Version

October, 2020



10/27/20

Content

Report Summary

As requested by the City of Lee's Summit, this condensed report has been prepared to chronicle the changes to the storm system during construction of the first phase of the project and since the storm report was approved. As provided on the content page, 3 addendums have been prepared, based on the 3 changes to the plans. A summary of those addendums and changes are as follows:

Addendum 1

This addendum was prepared prior to construction to address City comments in regard to the north pond design. The addendum addressed the usage of the skimmer and the 40 hour release from the pond , effective height of the pond and the need to design the pond to TR-60 requirements and the energy dissipation design at the out of the discharge ping from the pond.

Addendum 2

This addendum addressed the change of the geometric shape of the south detention pond outlet structure after construction began. The approved design called for a circular structure. It was found that the circular manhole could not be cast, based on the size and a square structure was to take its place. Calculations confirmed that the geometric shape change did not impact the hydraulic design or flow of the pond.

Addendum 3

This addendum addressed the change of the geometric shape of the outlet structure for the north pond after construction began. For the same reason on the change for the south pond, circular manholes couldn't be cast and a

rectangular structure was substituted for 2 side by side manholes, with again, no impact on the pond flow or hydraulic function.

STORM WATER DRAINAGE REPORT

Cobey Creek

Mixed Use Development

Lee's Summit, MO

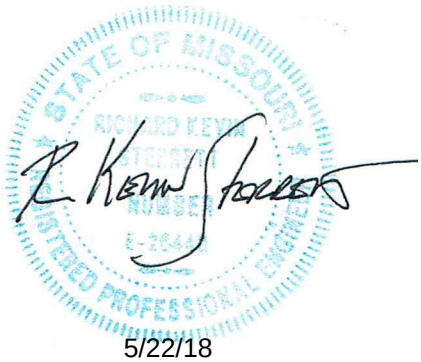
PREPARED FOR

JCM DEVELOPMENT, LLC

PREPARED BY HG

CONSULT, INC.

May 22, 2018



5/22/18

1. Project Overview

The proposed project is a mixed use development. The project will contain 12.7 acres of commercial development and 84.6 acres of mixed residential development and open space. The site is current undeveloped with a lone residential dwelling.

The topography of the site is a gentle slope south to the north, specifically to the north east corner to a creek. Some area along the highway frontage slopes to the south and drains through a culvert pipe under M-150 Highway.

2. Drainage Assessment of the Project Site

Storm drainage for the site will include a full underground system, designed for the 10-year storm event and overland routing of the higher storm events. The majority of the post development site drainage will be regulated at the north east corner of the site with a detention facility, sized for the 2-year, 10-year, and 100-year storm events with the 40-hour extended detention included.

3. Temporary Erosion and Sediment Control

During construction and prior to paving, it will be necessary to control erosion and sediment from the site during storms with in the construction timeframe. To insure that sediment does not enter the existing storm system or runs off to the existing street or creek, perimeter containment, silt fence, inlet protection, rock ditch checks will be used. The detention pond will utilized as a temporary sediment basin during construction of the early phases of the development. This will be fully addressed in the E, S&C plans with the Phase 1 construction plans. To keep construction traffic from tracking mud onto the adjacent citystreet, a stabilized rock construction entrance will need to be installed.

These erosion control devices, and their maintenance throughout the construction timeframe, are required by ordinance and the details for them are referenced by APWA 5600.

Post-development water quality will be addressed through the use a release structure sized for the 2-year, 10-year, and 100-year storm events with the 40-hour extended detention included. The owner will need to have a routine maintenance policy for the cleaning, repair and replacement of the detention release structure.

4. Soil Classifications

NRCS Web Soil Survey categorizes the soils on the Cobey Creek site below.

Table 4.1 – Soil Classification

Symbol	Name	Slopes	HSG
10000	Arisburg silt loam	1-5%	C
10082	Sampsel silty clay loam	2-5%	C/D
10117	Sampsel silty clay loam	5-9%	C/D

For this analysis, Soil group C was considered for the Cobey Creek site. Curve Numbers were used in accordance with the APWA 5600.

5. Methodology

The method for evaluating Cobey Creek was the use of a PondPack Model. Both Pre-Development and Post-Development conditions were considered:

PondPack V8i

- TR-55 Unit Hydrograph Method
  - 2-year, 10-year and 100-year Return Frequency storms
  - AMC II Soil Moisture conditions
  - 24-Hour SCS Type II Rainfall Distribution
  - SCS Runoff Curve Numbers per APWA 5600 (Table 5602-3)
  - Time of Concentration developed per TR-55

6. Pre-Development Conditions

This section of the drainage study has been prepared to evaluate the Pre-Development Conditions related to stormwater runoff. The following tables summarize the Pre-Development Conditions Analysis. Refer to the Design Calculations for details regarding the analysis.

Table 6.1 – Pre-Development Watershed Data

Name	Area (acres)	Composite CN	Tc (hrs)
EX1	17.64	75	0.217
EX2	2.43	74	0.145
EX3	89.68	75	0.419
EX4	14.70	74	0.182

Table 6.1 – Pre-Development Discharges

Name	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
EX1	29.07	61.09	107.36
EX2	4.29	9.17	16.32
EX3	105.54	226.85	403.16
EX4	23.98	51.33	91.04

Per APWA Section 5608.4 and City of Lee's Summit criteria, the post-development discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

APWA allowable releases were calculated for the various points of discharge. Off-site flows were allowed to bypass detention. Off-site flows were calculated using a separate PondPack model. The off-site time of concentrations used the same existing time of concentrations located in Table 6.1 and the areas can be found in Table 6.3. Where detention was not possible, areas of the site were drained to the detention in P3 to reduce the outflow from EX1, EX2, and EX4. Release rates per APWA were added to the off-site discharges to produce the allowable rates.

Table 6.3 – Pre-Development Off-site Watershed Data

Name	Total Area (acres)	On-site Area (acres)	Off-site Area (acres)
EX1	17.82	13.42	4.38
EX2	2.43	2.24	0.19
EX3	89.68	68.35	21.33
EX4	14.70	14.7	0

Table 6.4 – Off-site flow rates

Name	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
EX1	8.30	16.50	28.11
EX2	0.33	0.70	1.24
EX3	32.55	63.46	106.65
EX4	0	0	0

Table 6.5 – Allowable Peak Flow Rates

Name	Allowable Q2 (cfs)	Allowable Q10 (cfs)	Allowable Q100 (cfs)
EX1	15.01	43.34	68.37
EX2	1.49	5.32	8.17
EX3	66.73	200.16	311.70
EX4	7.35	29.40	44.10

7. Post-Development Conditions

This section of the drainage study has been prepared to evaluate the Post-Development Conditions related to stormwater runoff. The following tables summarize the Post-Development Conditions Analysis. Refer to the Design Calculations for details regarding the analysis.

Table 7.1 – Post-Development Watershed Data

Name	Area (acres)	Composite CN	Tc (hrs)
P1	10.88	84	0.153
P2	0.68	81	0.112
P3	90.04	83	0.364
P4	4.40	82	0.165

Table 7.2 – Post-Development Discharges

Name	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
P1	29.29	58.87	84.76
P2	1.73	3.27	5.40
P3	56.27	194.07	282.73
P4	10.77	20.01	32.66

All storm events for Areas P2, P3, and P4 will see a decrease in the maximum release rates from Pre-Development Conditions to Post-Development Conditions. Area P1 is does not meet the release requirements. This area will be a separate development that will require detention. The developer will be required to size this separate detention to meeting the allowable release rates located in Table 6.4.

P2 and P4 are fringe areas that do not contain any detention. The 2-year flows for P2 and P4 do not meet the allowable release rates located in Table 6.4. A waiver to the Design and Construction manual will be submitted to the City of Lee's Summit.

P5 on the proposed drainage map is a small fringe area on the backside of the detention pond. This area will be routed to a diversion ditch along the east side of the property and converge with the outlet of the detention pond at the Northeast corner of the property.

APWA 5608.4 also requires a 40-hour extended release of the water quality storm event (1.37"/24-hour rainfall) per Section 8.10 of the BMP Manual. The detention facility will release the water quality event over a 40-hour period. The Time vs. Volume graph is located in the Design Calculations Section.

8. Post-Development 100-year Spillway

APWA 5600 also requires a spillway in the detention pond sized for the 100-year event, assuming 100% clogging of the primary outlet works and zero available storage in the detention pond. The 100-year water surface elevation is 976.0. The spillway was set at an elevation of 976.5 and was sized to provide 1-foot of freeboard. The spillway will be 475-feet in length and riprap will be sized and placed throughout the spillway.

9. Future Conditions

The Cobey Creek site does not have any future developments planned.

10. Conclusions

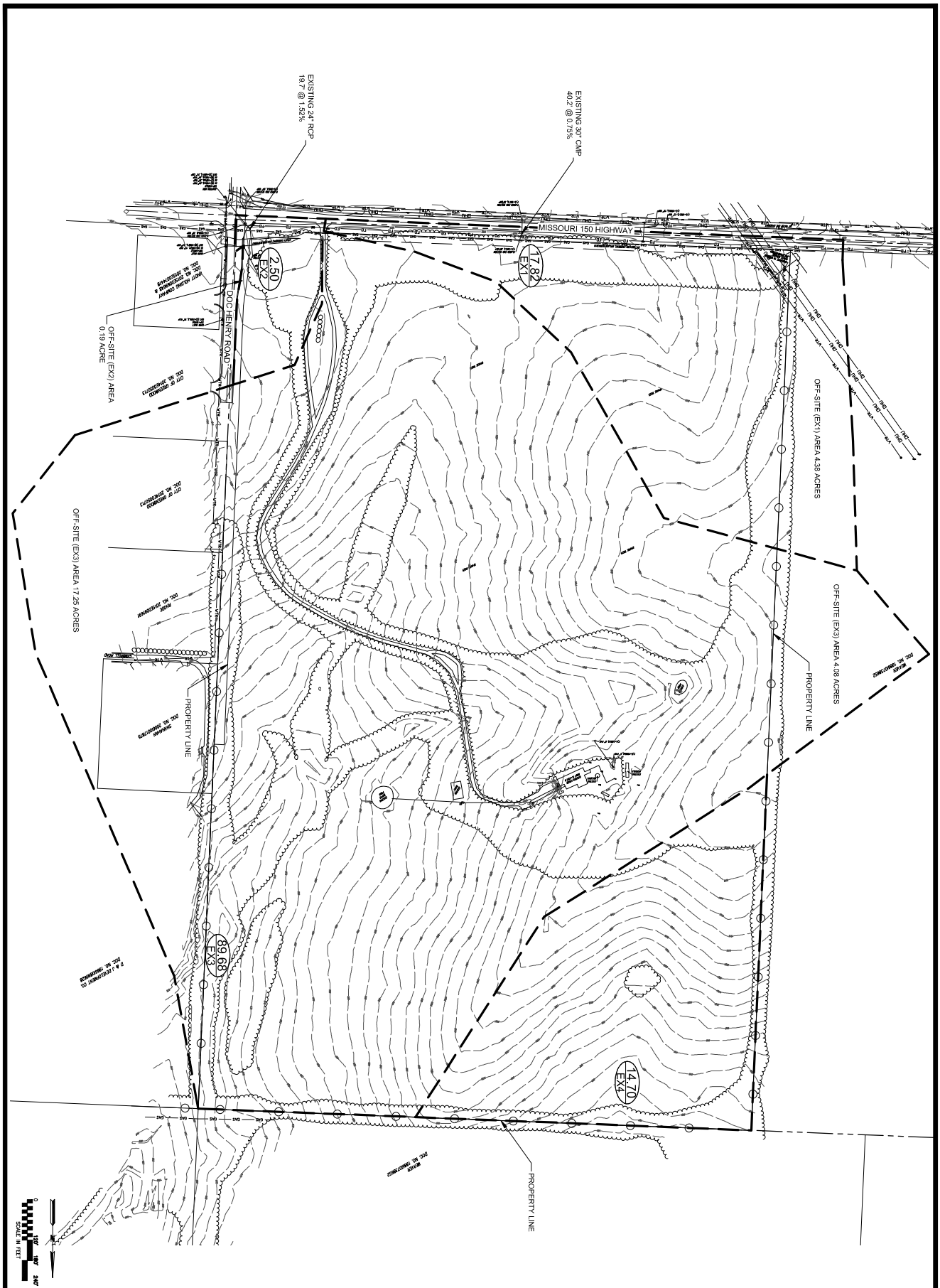
The Cobey Creek project is a mixed use development 186 single family lots, 44 multi-family lots, and 4 commercial lots. The project will contain 12.7 acres of commercial development and 84.6 acres of mixed residential development and open space. The report has been prepared to evaluate the stormwater discharge at the site to ensure the requirements of APWA 5600 are met. The detention pond and release structure was designed to not increase peak discharges from existing conditions as well as meeting the maximum releases from APWA 5600. It is not anticipated that the Cobey Creek Development will have any downstream impacts.

The 2-year flows for P2 and P4 do not meet the allowable release rates located in Table 6.4. A waiver to the Design and Construction manual will be submitted to the City of Lee's Summit.

11. Design Calculations

See the attached for drainage area maps and stormwater calculations.

DRAINAGE AREA MAPS



STORM DRAINAGE REPORT
EXISTING CONDITIONS

COBEY CREEK

CITY OF LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

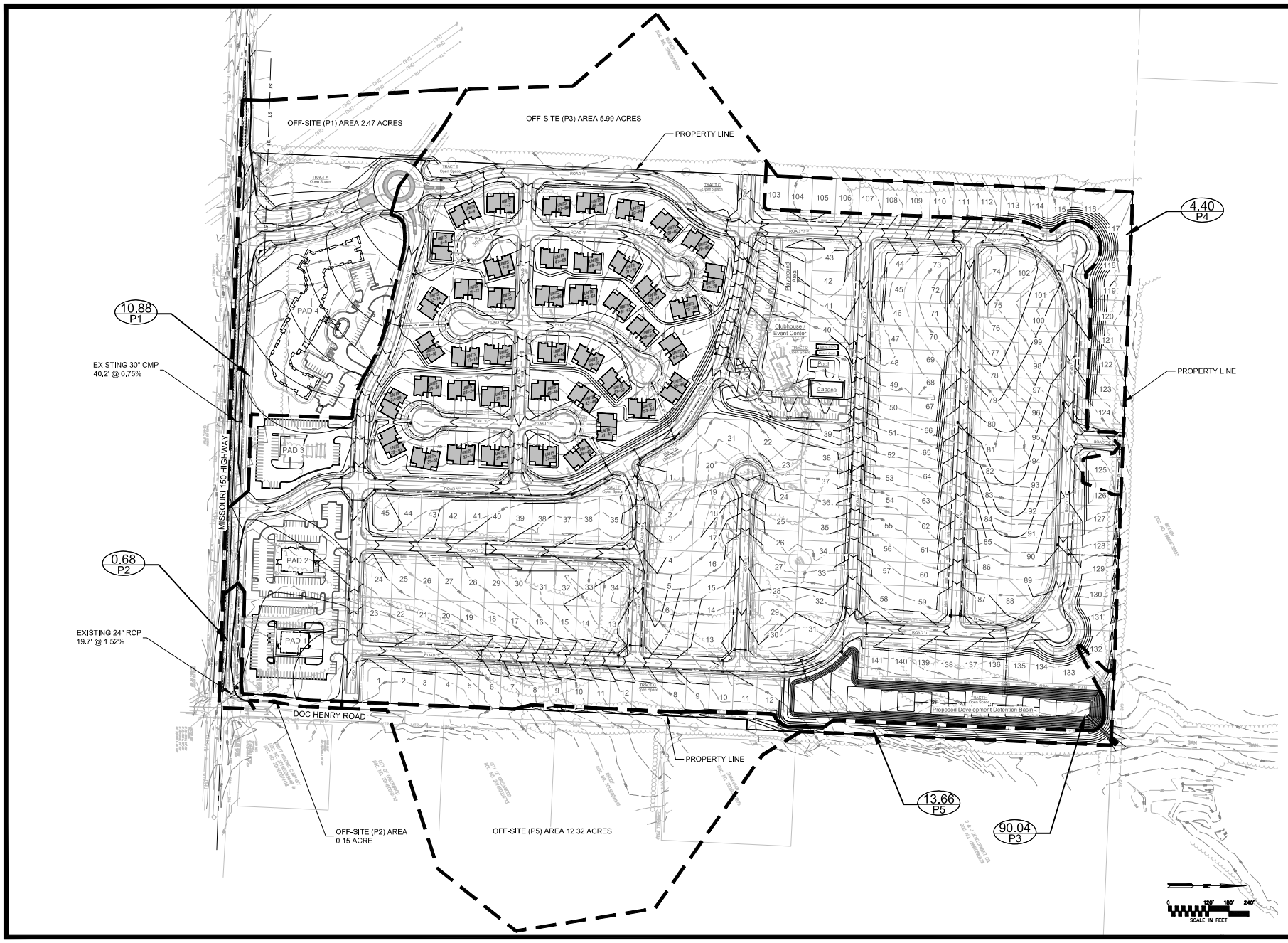
Consult Inc engineers planners
11010 Haskell Street, Suite 210, Kansas City, Kansas 66109
CORPORATE LICENSE No. E20100573 (MO.) / E-1736 (KS.)

R. KEVIN STERRETT, KS E-21889
MO E-26440
Jul 11, 2017

DATE	REVISION	NO.	BY	CK/APP

SHEET NO.	SHEET TITLE
1	16-009 BASE
2	16-009 EXISTING EXHIBIT

DATE: May 5, 2016
PROJECT NO.: 16-009



NO.	BY	DRAWN
DATE	REVISION	

IF THIS IS NOT A BLUE INK SEAL AND THE SIGNATURE IN BLUE INK, THE PLAN IS A COPY AND MAY CONTAIN UNAUTHORIZED ALTERATIONS. THE CERTIFICATION CONTAINED ON THIS DOCUMENT SHALL NOT APPLY TO ANY COPIES.

R. KEVIN STERRETT - KS E-21889 MO E-26440
Jul 11, 2017

Consult Inc engineers planners
11010 Haskell Street, Suite 210, Kansas City, Kansas 66109
CORPORATE LICENSE No. E2010095T3 (MO) / E-2796 (KS)

STORM DRAINAGE REPORT
DEVELOPED CONDITIONS

COBEY CREEK

CITY OF LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

X-REF NO.	16-059 BASE
DRAWING NO.	16-059 PDPs
DATE	May 8, 2018
JOB NO.	16-059
SHEET OF	2 OF 2

SOIL CLASSIFICATIONS

Hydrologic Soil Group—Jackson County, Missouri

Map Scale: 1:4,680 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 18, Sep 16, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 14, 2014—Oct 10, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10000	Arisburg silt loam, 1 to 5 percent slopes	C	60.8	66.3%
10116	Sampsel silty clay loam, 2 to 5 percent slopes	C/D	9.0	9.8%
10117	Sampsel silty clay loam, 5 to 9 percent slopes	C/D	21.9	23.8%
Totals for Area of Interest			**91.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

TIME OF CONCENTRATION CALCULATIONS

EX1

	Area	CN	Composite CN
Row Crop	4.4	78	19
Undeveloped	13.4	74	56
Total	**17.8**		**75**

P1

	Area	CN	Composite CN
Row Crop	2.5	78	18
Undeveloped	1.0	74	7
Mixed Use	7.4	88	60
Total	**10.9**		**84**

EX2

	Area	CN	Composite CN
Undeveloped	0.2	74	6
Undeveloped	2.3	74	68
Total	**2.5**		**74**

P2

	Area	CN	Composite CN
Undeveloped	0.2	74	16
Undeveloped	0.2	74	23
Mixed Use	0.3	88	41
Total	**0.7**		**81**

EX3

	Area	CN	Composite CN
Row Crop	4.1	78	4
Residential/Undeveloped	17.3	80	15
Undeveloped	68.4	74	56
Total	**89.7**		**75**

P3

	Area	CN	Composite CN
Row Crop	6.0	78	5
Undeveloped	3.3	74	3
Multi Family	25.8	88	25
Residential	55.0	82	50
Total	**90.0**		**83**

EX4

	Area	CN	Composite CN
Undeveloped	14.7	74	**74**
Total	**14.7**		

P4

	Area	CN	Composite CN
Residential	4.4	82	**82**
Total	**4.4**		

Cobey Creek
Existing
Jackson County, Missouri

Sub-Area Time of Concentration Details

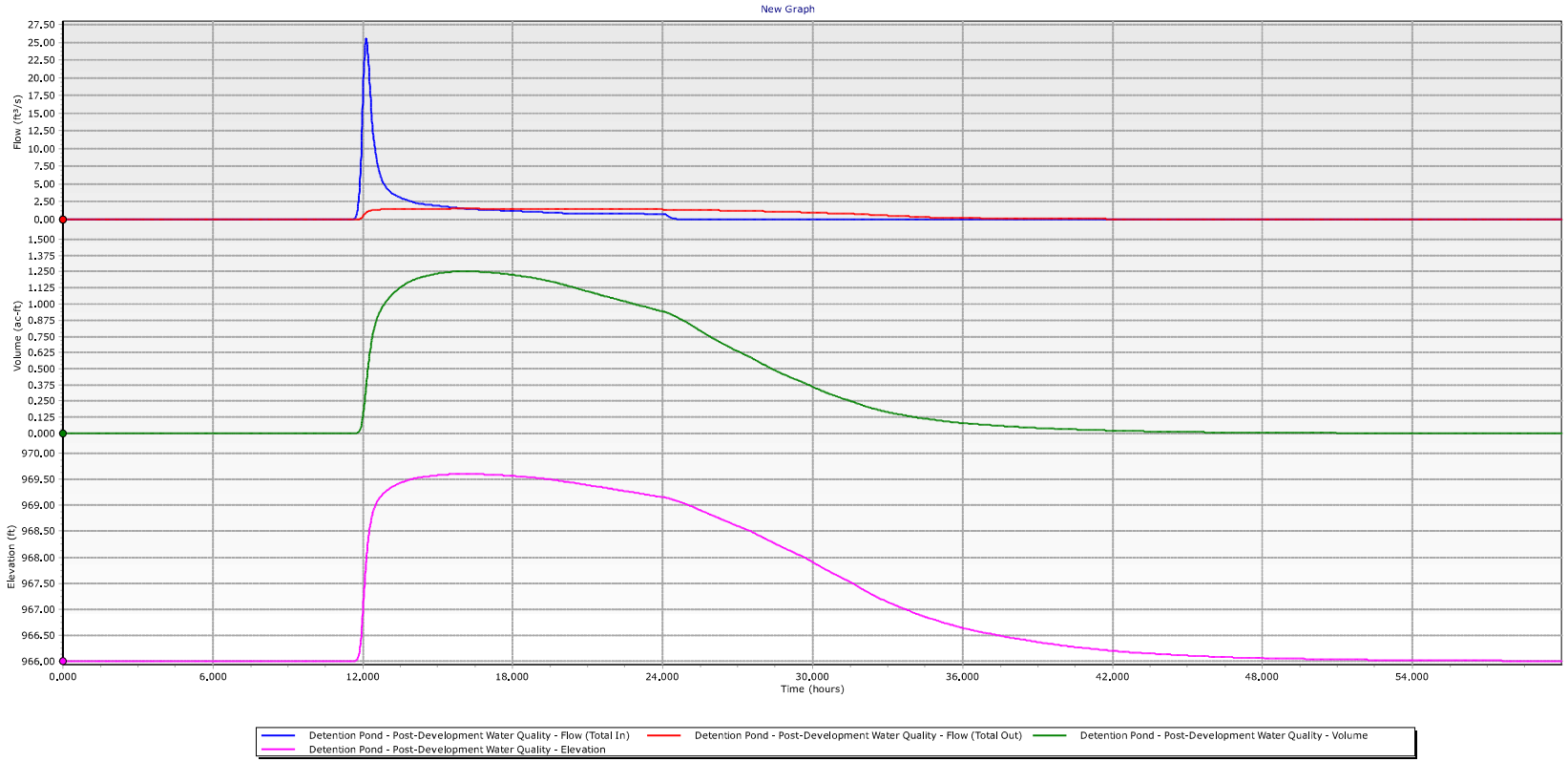
Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
EX3							
SHEET	100	0.0100	0.170				0.228
SHALLOW	1400	0.0330	0.050				0.133
CHANNEL	1520	0.0160	0.030	22.00	17.60	7.280	0.058
					Time of Concentration		.419
EX1							
SHEET	50	0.0140	0.170				0.114
SHALLOW	500	0.0200	0.050				0.061
CHANNEL	910	0.0200	0.030	8.00	10.00	6.019	0.042
					Time of Concentration		.217
EX2							
SHEET	50	0.0150	0.150				0.101
SHALLOW	100	0.0220	0.050				0.012
CHANNEL	350	0.0220	0.050	4.50	8.00	3.038	0.032
					Time of Concentration		.145
EX4							
SHEET	50	0.0120	0.150				0.110
SHALLOW	340	0.0300	0.050				0.034
CHANNEL	730	0.0300	0.050	16.00	15.00	5.336	0.038
					Time of Concentration		.182

Cobey Creek
Proposed
Jackson County, Missouri

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
P3							
SHEET	100	0.0100	0.170				0.228
SHALLOW	600	0.0160	0.050				0.082
CHANNEL	2950	0.0175	0.013	12.60	12.60	15.175	0.054
					Time of Concentration		.364
P1							
SHEET	50	0.0140	0.170				0.114
SHALLOW	200	0.0200	0.025				0.019
CHANNEL	1000	0.0200	0.013	8.00	10.00	13.889	0.020
					Time of Concentration		.153
P2							
SHEET	50	0.0150	0.150				0.101
SHALLOW	50	0.0220	0.025				0.005
CHANNEL	250	0.0220	0.013	4.50	8.00	11.574	0.006
					Time of Concentration		.112
P4							
SHEET	50	0.0120	0.150				0.110
SHALLOW	100	0.0300	0.050				0.010
CHANNEL	1460	0.0300	0.030	16.00	15.00	9.012	0.045
					Time of Concentration		.165

WATER QUALITY EVENT EXTENDED RELEASE


New Graph
Flow (ft³/s)
27.50
25.00
22.50
20.00
17.50
15.00
12.50
10.00
7.50
5.00
2.50
0.00
Volume (ac-ft)
1.500
1.375
1.250
1.125
1.000
0.875
0.750
0.625
0.500
0.375
0.250
0.125
0.000
Elevation (ft)
970.00
969.50
969.00
968.50
968.00
967.50
967.00
966.50
966.00
0.000
6.000
12.000
18.000
24.000
30.000
36.000
42.000
48.000
54.000
Time (hours)
Detention Pond - Post-Development Water Quality - Flow (Total In)
Detention Pond - Post-Development Water Quality - Flow (Total Out)
Detention Pond - Post-Development Water Quality - Volume
Detention Pond - Post-Development Water Quality - Elevation

PONDPACK OUTPUT

COBEY CREEK

Project Summary	
Title	COBEY CREEK
Engineer	Kellen Huffman
Company	Hg Consult, Inc
Date	5/22/2018

Notes

COBEY CREEK

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
P3	Pre-Development Water Quality	1	0.988	12.240	5.37
P3	Post-Development Water Quality	1	2.422	12.130	25.54
P3	Pre-Development 2 year	2	9.729	12.130	105.54
P3	Post-Development 2 year	2	13.945	12.090	169.63
P3	Pre-Development 10 year	10	20.139	12.130	226.85
P3	Post-Development 10 year	10	25.862	12.090	314.25
P3	Pre-Development 100 year	100	35.662	12.120	403.16
P3	Post-Development 100 year	100	42.704	12.090	511.44
P1	Pre-Development Water Quality	1	0.196	12.090	1.62
P1	Post-Development Water Quality	1	0.322	12.010	5.06
P1	Pre-Development 2 year	2	1.933	12.040	29.07
P1	Post-Development 2 year	2	1.756	11.980	29.29
P1	Pre-Development 10 year	10	4.002	12.030	61.09
P1	Post-Development 10 year	10	3.215	11.970	52.87
P1	Pre-Development 100 year	100	7.086	12.010	107.36
P1	Post-Development 100 year	100	5.265	11.970	84.76
P2	Pre-Development Water Quality	1	0.024	12.050	0.21
P2	Post-Development Water Quality	1	0.015	12.010	0.23
P2	Pre-Development 2 year	2	0.258	11.990	4.29
P2	Post-Development 2 year	2	0.097	11.950	1.73
P2	Pre-Development 10 year	10	0.543	11.970	9.17
P2	Post-Development 10 year	10	0.184	11.940	3.27
P2	Pre-Development 100 year	100	0.970	11.970	16.32

COBEY CREEK

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
P2	Post-Development 100 year	100	0.309	11.940	5.40
P4	Pre-Development Water Quality	1	0.141	12.080	1.11
P4	Post-Development Water Quality	1	0.107	12.030	1.58
P4	Pre-Development 2 year	2	1.519	12.010	23.98
P4	Post-Development 2 year	2	0.654	11.990	10.77
P4	Pre-Development 10 year	10	3.192	12.010	51.33
P4	Post-Development 10 year	10	1.228	11.990	20.01
P4	Pre-Development 100 year	100	5.706	11.990	91.04
P4	Post-Development 100 year	100	2.044	11.970	32.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
O-3	Pre-Development Water Quality	1	0.988	12.240	5.37
O-3	Post-Development Water Quality	1	2.421	16.040	1.53
O-3	Pre-Development 2 year	2	9.729	12.130	105.54
O-3	Post-Development 2 year	2	13.944	12.470	56.27
O-3	Pre-Development 10 year	10	20.139	12.130	226.85
O-3	Post-Development 10 year	10	25.861	12.290	194.07
O-3	Pre-Development 100 year	100	35.662	12.120	403.16
O-3	Post-Development 100 year	100	42.703	12.310	282.73
O-1	Pre-Development Water Quality	1	0.196	12.090	1.62
O-1	Post-Development Water Quality	1	0.322	12.010	5.06
O-1	Pre-Development 2 year	2	1.933	12.040	29.07

COBEY CREEK

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
O-1	Post-Development 2 year	2	1.756	11.980	29.29
O-1	Pre-Development 10 year	10	4.002	12.030	61.09
O-1	Post-Development 10 year	10	3.215	11.970	52.87
O-1	Pre-Development 100 year	100	7.086	12.010	107.36
O-1	Post-Development 100 year	100	5.265	11.970	84.76
O-2	Pre-Development Water Quality	1	0.024	12.050	0.21
O-2	Post-Development Water Quality	1	0.015	12.010	0.23
O-2	Pre-Development 2 year	2	0.258	11.990	4.29
O-2	Post-Development 2 year	2	0.097	11.950	1.73
O-2	Pre-Development 10 year	10	0.543	11.970	9.17
O-2	Post-Development 10 year	10	0.184	11.940	3.27
O-2	Pre-Development 100 year	100	0.970	11.970	16.32
O-2	Post-Development 100 year	100	0.309	11.940	5.40
O-4	Pre-Development Water Quality	1	0.141	12.080	1.11
O-4	Post-Development Water Quality	1	0.107	12.030	1.58
O-4	Pre-Development 2 year	2	1.519	12.010	23.98
O-4	Post-Development 2 year	2	0.654	11.990	10.77
O-4	Pre-Development 10 year	10	3.192	12.010	51.33
O-4	Post-Development 10 year	10	1.228	11.990	20.01
O-4	Pre-Development 100 year	100	5.706	11.990	91.04
O-4	Post-Development 100 year	100	2.044	11.970	32.66

Pond Summary

COBEY CREEK

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development Water Quality	1	2.422	12.130	25.54	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development Water Quality	1	2.421	16.040	1.53	969.60	1.254
Detention Pond (IN)	Post-Development 2 year	2	13.945	12.090	169.63	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 2 year	2	13.944	12.470	56.27	972.74	5.248
Detention Pond (IN)	Post-Development 10 year	10	25.862	12.090	314.25	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 10 year	10	25.861	12.290	194.07	974.17	7.988
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	42.703	12.310	282.73	976.00	12.018

PONDPACK SPILLWAY OUTPUT

COBEY CREEK-SPILLWAY

Project Summary	
Title	COBEY CREEK-SPILLWAY
Engineer	Kellen Huffman
Company	Hg Consult, Inc
Date	5/22/2018

Notes

COBEY CREEK-SPILLWAY

Subsection: Master Network Summary

Catchments Summary

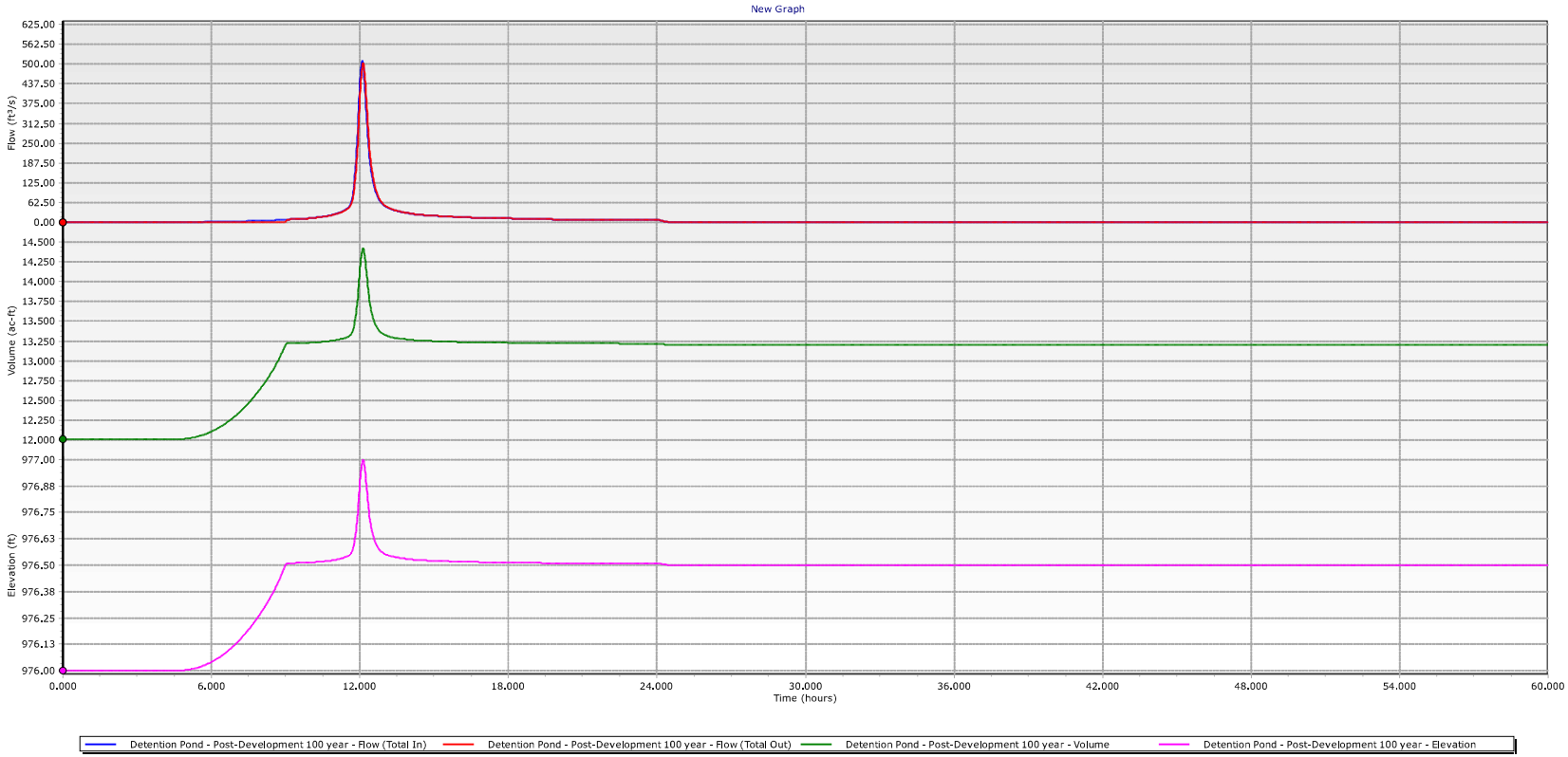
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
P3	Post-Development 100 year	100	42.704	12.090	511.44

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
O-3	Post-Development 100 year	100	41.518	12.130	502.73

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	41.518	12.130	502.73	977.00	14.420


New Graph
Flow (ft³/s)
625.00
562.50
500.00
437.50
375.00
312.50
250.00
187.50
125.00
62.50
0.00
Volume (ac-ft)
14.500
14.250
14.000
13.750
13.500
13.250
13.000
12.750
12.500
12.250
12.000
Elevation (ft)
977.00
976.88
976.75
976.63
976.50
976.38
976.25
976.13
976.00
0.000
6.000
12.000
18.000
24.000
30.000
36.000
42.000
48.000
54.000
60.000
Time (hours)
Detention Pond - Post-Development 100 year - Flow (Total In)
Detention Pond - Post-Development 100 year - Flow (Total Out)
Detention Pond - Post-Development 100 year - Volume
Detention Pond - Post-Development 100 year - Elevation

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Element Details			
Label	Composite Outlet Structure - 1	Notes	

Headwater Range			
Headwater Type	Use Pond for Headwater Range	Maximum (Headwater)	979.00 ft
Pond	Detention Pond	Increment (Headwater)	0.50 ft
Minimum (Headwater)	964.70 ft		

SpotElevation (ft)

Tailwater Setup	
Tailwater Type	Free Outfall

Tailwater Tolerances			
Maximum Iterations	30	Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft	Flow Tolerance (Minimum)	0.001 ft³/s
Headwater Tolerance (Maximum)	0.50 ft	Flow Tolerance (Maximum)	10.000 ft³/s
Tailwater Tolerance (Minimum)	0.01 ft		

Outlet Structure			
Outlet Structure Type	Culvert	Culvert Type	Circular

Outlet Structure (IDs and Direction)			
Outlet ID	Culvert - 1	Downstream ID	Tailwater
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

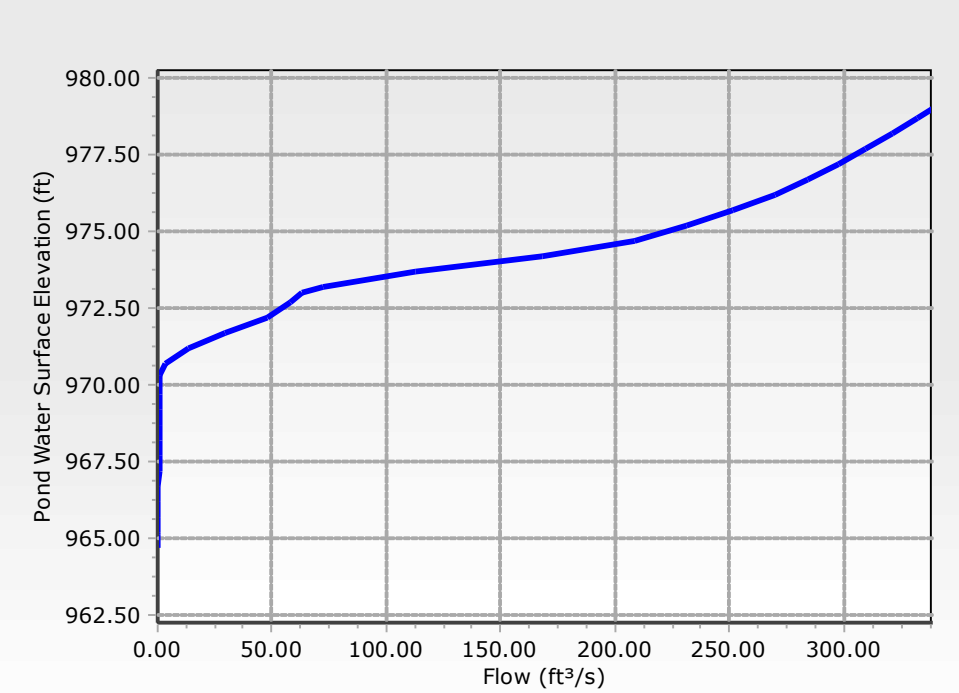
Culvert Data			
Number of Barrels	2	Downstream Invert	964.20 ft
Length	102.32 ft	Diameter	48.0 in
Upstream Invert	964.70 ft		

Unsubmerged->Submerged			
Specify Transitions	False	Compute Inlet Control Only	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Culvert Coefficients			
Inlet Description	Concrete - Groove end projecting	C	0.0317
Chart	Chart 1	Y	0.6900
Nomograph	Nomograph 3	Manning's n	0.011
Equation Form	Form 1	Ke	0.200
K	0.0045	Kr	0.000
M	2.0000	Slope Correction Factor	-0.500

Culvert (Advanced)			
Convergence Tolerance	0.00 ft	Specify Number of Backwater Sections	False



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s
Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s
Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	Free Outfall
965.10	0.12	964.80	Free Outfall	Free Outfall
965.20	0.16	964.81	Free Outfall	Free Outfall
965.70	0.30	964.85	Free Outfall	Free Outfall
966.20	0.35	964.87	Free Outfall	Free Outfall
966.70	0.41	964.88	Free Outfall	Free Outfall
967.20	0.49	964.90	Free Outfall	Free Outfall
967.70	0.52	964.90	Free Outfall	Free Outfall
968.20	0.56	964.92	Free Outfall	Free Outfall
968.70	0.62	964.92	Free Outfall	Free Outfall
969.20	0.66	964.93	Free Outfall	Free Outfall
969.70	0.68	964.93	Free Outfall	Free Outfall
970.20	0.72	964.94	Free Outfall	Free Outfall
970.30	0.72	964.94	Free Outfall	Free Outfall
970.70	3.53	965.24	Free Outfall	Free Outfall
971.20	13.78	965.78	Free Outfall	Free Outfall
971.70	29.56	966.31	Free Outfall	Free Outfall
972.20	47.61	966.78	Free Outfall	Free Outfall
972.70	57.94	967.01	Free Outfall	Free Outfall
973.00	63.26	967.13	Free Outfall	Free Outfall
973.20	72.53	967.32	Free Outfall	Free Outfall
973.70	112.93	968.07	Free Outfall	Free Outfall
974.20	167.95	969.00	Free Outfall	Free Outfall
974.70	208.39	969.66	Free Outfall	Free Outfall
975.20	230.98	970.13	Free Outfall	Free Outfall
975.70	251.77	970.63	Free Outfall	Free Outfall
976.20	270.41	971.12	Free Outfall	Free Outfall
976.70	284.48	971.51	Free Outfall	Free Outfall
977.20	297.36	971.89	Free Outfall	Free Outfall
977.70	309.66	972.26	Free Outfall	Free Outfall
978.20	321.29	972.63	Free Outfall	Free Outfall
978.70	332.45	973.00	Free Outfall	Free Outfall
979.00	338.98	973.22	Free Outfall	Free Outfall

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s
Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2
Downstream ID = Tailwater (Pond Outfall)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.06	(N/A)	0.00
0.00	0.04	(N/A)	0.00
0.00	0.02	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
CRIT.DEPTH CONTROL Vh= .023ft Dcr= .068ft H.JUMP IN PIPE Hev= .00ft
CRIT.DEPTH CONTROL Vh= .026ft Dcr= .079ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s
Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2
Downstream ID = Tailwater (Pond Outfall)

Message
CRIT.DEPTH CONTROL Vh= .037ft Dcr= .109ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .040ft Dcr= .119ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .044ft Dcr= .130ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .051ft Dcr= .151ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .058ft Dcr= .172ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .530ft Dcr= 1.440ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .597ft Dcr= 1.595ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .630ft Dcr= 1.670ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 127.65 ft³/s
Upstream ID = Orifice - 3, Riser - 2, Orifice - 1, Riser - 1, Orifice - 2
Downstream ID = Tailwater (Pond Outfall)

Message
CRIT.DEPTH CONTROL Vh= .686ft Dcr= 1.793ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .924ft Dcr= 2.261ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= 1.264ft Dcr= 2.778ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= 1.554ft Dcr= 3.091ft CRIT.DEPTH Hev= .00ft
INLET CONTROL... Submerged: HW =5.43
INLET CONTROL... Submerged: HW =5.93
INLET CONTROL... Submerged: HW =6.42
INLET CONTROL... Submerged: HW =6.81
INLET CONTROL... Submerged: HW =7.19
INLET CONTROL... Submerged: HW =7.56
INLET CONTROL... Submerged: HW =7.93
INLET CONTROL... Submerged: HW =8.30
INLET CONTROL... Submerged: HW =8.52

Outlet Structure	
Outlet Structure Type	Orifice

Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

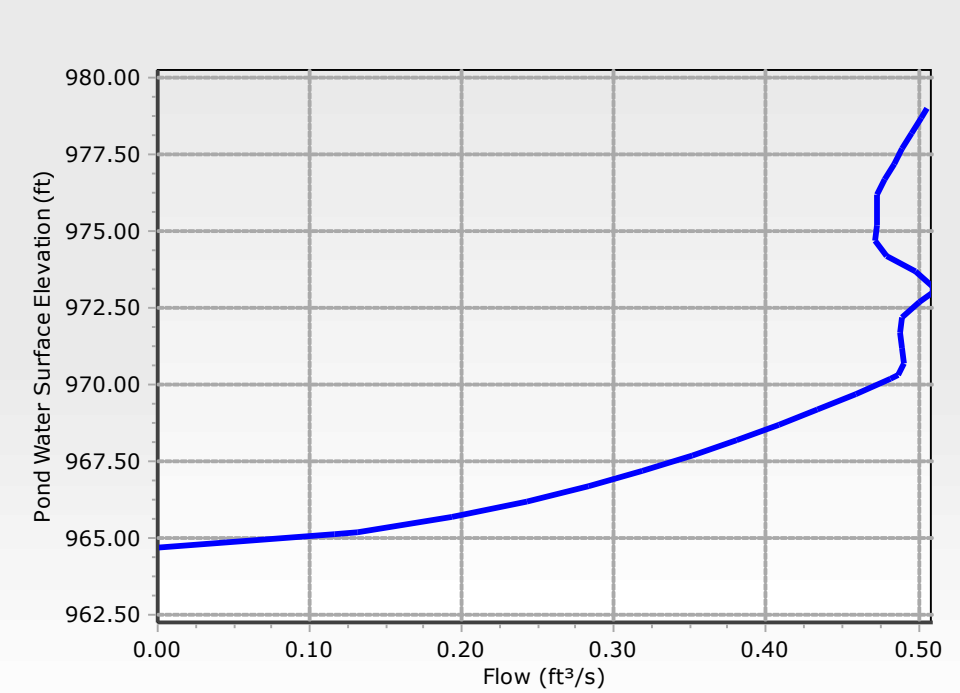
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Orifice)			
Number of Openings	2	Orifice Diameter	2.0 in

Outlet Structure (Common)	
Elevation	964.70 ft



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.12	965.10	964.80	964.80
965.20	0.13	965.20	964.81	964.81
965.70	0.19	965.70	964.85	964.85
966.20	0.24	966.20	964.87	964.87
966.70	0.28	966.70	964.88	964.88
967.20	0.32	967.20	964.90	964.90
967.70	0.35	967.70	964.90	964.90
968.20	0.38	968.20	964.91	964.92

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft^3/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
968.70	0.41	968.70	964.92	964.92
969.20	0.43	969.20	964.93	964.93
969.70	0.46	969.70	964.93	964.93
970.20	0.48	970.20	964.94	964.94
970.30	0.49	970.30	964.94	964.94
970.70	0.49	970.70	965.24	965.24
971.20	0.49	971.20	965.78	965.78
971.70	0.49	971.70	966.31	966.31
972.20	0.49	972.20	966.78	966.78
972.70	0.50	972.70	967.01	967.01
973.00	0.51	973.00	967.13	967.13
973.20	0.51	973.20	967.32	967.32
973.70	0.50	973.70	968.07	968.07
974.20	0.48	974.20	968.99	969.00
974.70	0.47	974.70	969.66	969.66
975.20	0.47	975.20	970.13	970.13
975.70	0.47	975.70	970.63	970.63
976.20	0.47	976.20	971.12	971.12
976.70	0.48	976.70	971.51	971.51
977.20	0.48	977.20	971.89	971.89
977.70	0.49	977.70	972.26	972.26
978.20	0.50	978.20	972.63	972.63
978.70	0.50	978.70	973.00	973.00
979.00	0.51	979.00	973.22	973.22

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
H =.30
H =.39
H =.85
H =1.33
H =1.82
H =2.30
H =2.80
H =3.29
H =3.78
H =4.27
H =4.77
H =5.26
H =5.36
H =5.46
H =5.42
H =5.39

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =5.42
H =5.69
H =5.87
H =5.88
H =5.63
H =5.21
H =5.04
H =5.07
H =5.07
H =5.08
H =5.19
H =5.31
H =5.44
H =5.57
H =5.70
H =5.78

Outlet Structure	
Outlet Structure Type	Riser

Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

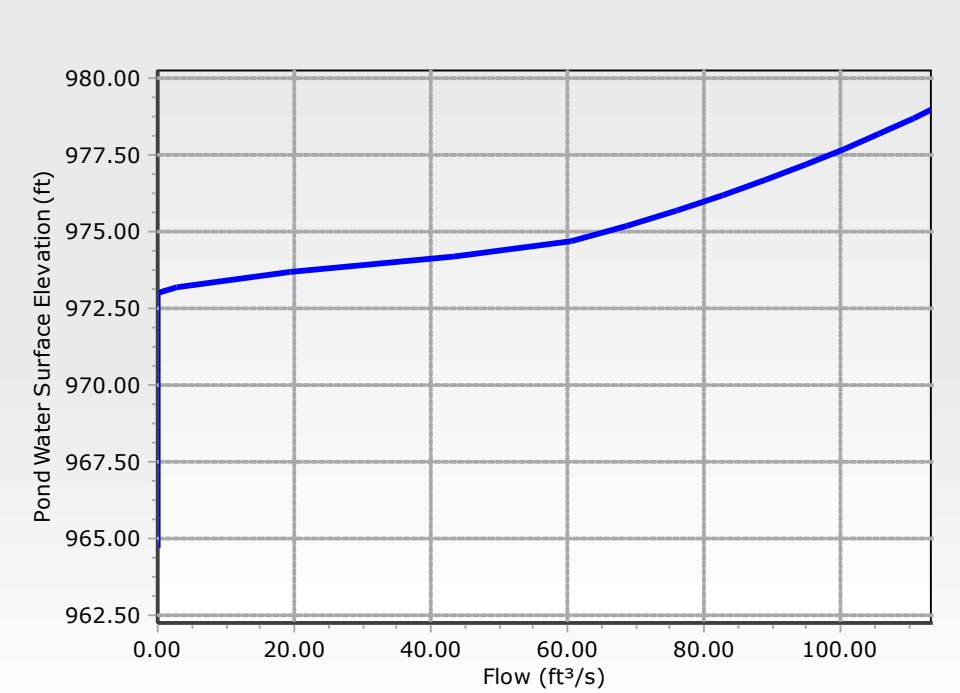
Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		

Outlet Structure (Common)	
Elevation	973.00 ft

Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Riser, Advanced)



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.00	0.00	0.00	964.81
965.70	0.00	0.00	0.00	964.85
966.20	0.00	0.00	0.00	964.87
966.70	0.00	0.00	0.00	964.88
967.20	0.00	0.00	0.00	964.90
967.70	0.00	0.00	0.00	964.90
968.20	0.00	0.00	0.00	964.92
968.70	0.00	0.00	0.00	964.92
969.20	0.00	0.00	0.00	964.93
969.70	0.00	0.00	0.00	964.93
970.20	0.00	0.00	0.00	964.94

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
970.30	0.00	0.00	0.00	964.94
970.70	0.00	0.00	0.00	965.24
971.20	0.00	0.00	0.00	965.78
971.70	0.00	0.00	0.00	966.31
972.20	0.00	0.00	0.00	966.78
972.70	0.00	0.00	0.00	967.01
973.00	0.00	0.00	0.00	967.13
973.20	2.95	973.20	Free Outfall	967.32
973.70	19.32	973.70	Free Outfall	968.07
974.20	43.36	974.20	Free Outfall	969.00
974.70	60.38	974.70	Free Outfall	969.66
975.20	68.68	975.20	Free Outfall	970.13
975.70	76.09	975.70	Free Outfall	970.63
976.20	82.84	976.20	Free Outfall	971.12
976.70	89.07	976.70	Free Outfall	971.51
977.20	94.90	977.20	Free Outfall	971.89
977.70	100.39	977.70	Free Outfall	972.26
978.20	105.60	978.20	Free Outfall	972.63
978.70	110.56	978.70	Free Outfall	973.00
979.00	113.43	979.00	973.22	973.22

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	Message
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	Weir: H =0.2ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
Weir: H =0.7ft
Weir: H =1.2ft
Orifice: H =1.70; Riser orifice equation controlling.
Orifice: H =2.20; Riser orifice equation controlling.
Orifice: H =2.70; Riser orifice equation controlling.
Orifice: H =3.20; Riser orifice equation controlling.
Orifice: H =3.70; Riser orifice equation controlling.
Orifice: H =4.20; Riser orifice equation controlling.
Orifice: H =4.70; Riser orifice equation controlling.
Orifice: H =5.20; Riser orifice equation controlling.
Orifice: H =5.70; Riser orifice equation controlling.
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=6.00

Outlet Structure	
Outlet Structure Type	Riser

Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

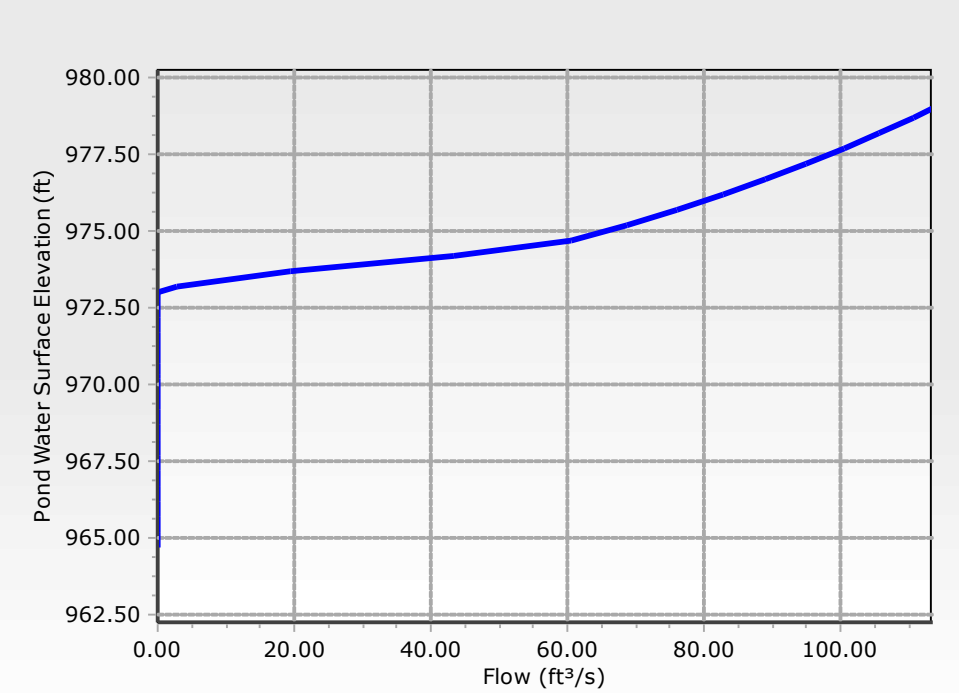
Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		

Outlet Structure (Common)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Common)			
Elevation	973.00 ft		

Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.00	0.00	0.00	964.81
965.70	0.00	0.00	0.00	964.85
966.20	0.00	0.00	0.00	964.87
966.70	0.00	0.00	0.00	964.88
967.20	0.00	0.00	0.00	964.90
967.70	0.00	0.00	0.00	964.90

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
968.20	0.00	0.00	0.00	964.92
968.70	0.00	0.00	0.00	964.92
969.20	0.00	0.00	0.00	964.93
969.70	0.00	0.00	0.00	964.93
970.20	0.00	0.00	0.00	964.94
970.30	0.00	0.00	0.00	964.94
970.70	0.00	0.00	0.00	965.24
971.20	0.00	0.00	0.00	965.78
971.70	0.00	0.00	0.00	966.31
972.20	0.00	0.00	0.00	966.78
972.70	0.00	0.00	0.00	967.01
973.00	0.00	0.00	0.00	967.13
973.20	2.95	973.20	Free Outfall	967.32
973.70	19.32	973.70	Free Outfall	968.07
974.20	43.36	974.20	Free Outfall	969.00
974.70	60.38	974.70	Free Outfall	969.66
975.20	68.68	975.20	Free Outfall	970.13
975.70	76.09	975.70	Free Outfall	970.63
976.20	82.84	976.20	Free Outfall	971.12
976.70	89.07	976.70	Free Outfall	971.51
977.20	94.90	977.20	Free Outfall	971.89
977.70	100.39	977.70	Free Outfall	972.26
978.20	105.60	978.20	Free Outfall	972.63
978.70	110.56	978.70	Free Outfall	973.00
979.00	113.43	979.00	973.22	973.22

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
Weir: H =0.2ft
Weir: H =0.7ft
Weir: H =1.2ft
Orifice: H =1.70; Riser orifice equation controlling.
Orifice: H =2.20; Riser orifice equation controlling.
Orifice: H =2.70; Riser orifice equation controlling.
Orifice: H =3.20; Riser orifice equation controlling.
Orifice: H =3.70; Riser orifice equation controlling.
Orifice: H =4.20; Riser orifice equation controlling.
Orifice: H =4.70; Riser orifice equation controlling.
Orifice: H =5.20; Riser orifice equation controlling.
Orifice: H =5.70; Riser orifice equation controlling.
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=6.00

Outlet Structure	
Outlet Structure Type	Orifice

Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 3	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

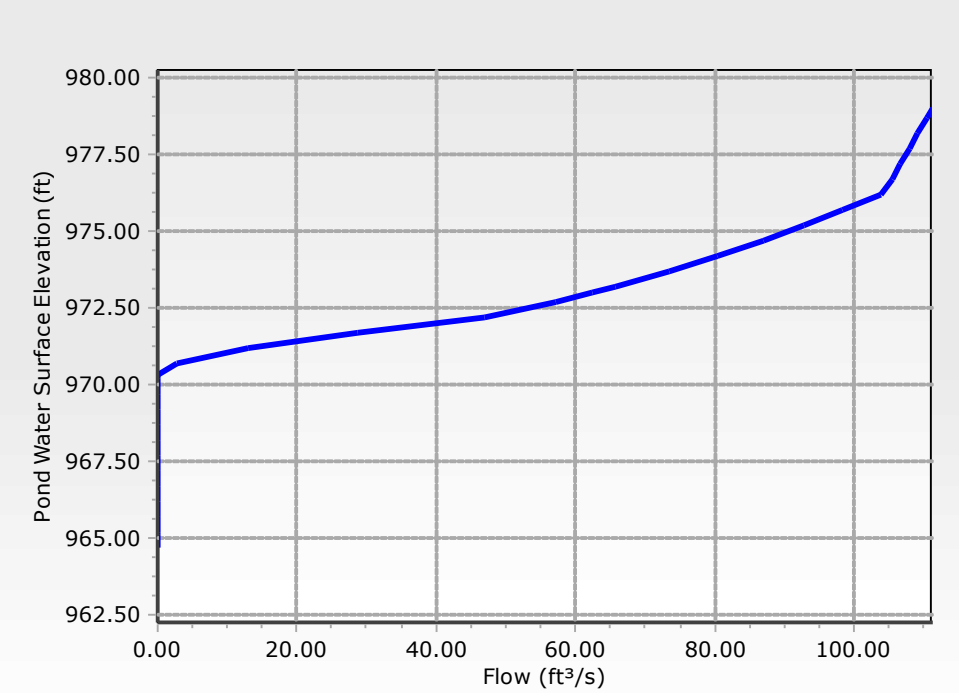
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Orifice)			
Number of Openings	4	Orifice Diameter	21.0 in

Outlet Structure (Common)	
Elevation	970.30 ft



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.00	0.00	0.00	964.81
965.70	0.00	0.00	0.00	964.85
966.20	0.00	0.00	0.00	964.87
966.70	0.00	0.00	0.00	964.88
967.20	0.00	0.00	0.00	964.90
967.70	0.00	0.00	0.00	964.90
968.20	0.00	0.00	0.00	964.92

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
968.70	0.00	0.00	0.00	964.92
969.20	0.00	0.00	0.00	964.93
969.70	0.00	0.00	0.00	964.93
970.20	0.00	0.00	0.00	964.94
970.30	0.00	0.00	0.00	964.94
970.70	2.79	970.70	Free Outfall	965.24
971.20	13.03	971.20	Free Outfall	965.78
971.70	28.85	971.70	Free Outfall	966.31
972.20	46.88	972.20	Free Outfall	966.78
972.70	57.18	972.70	Free Outfall	967.01
973.00	62.56	973.00	Free Outfall	967.13
973.20	65.90	973.20	Free Outfall	967.32
973.70	73.58	973.70	Free Outfall	968.07
974.20	80.54	974.20	Free Outfall	969.00
974.70	86.94	974.70	Free Outfall	969.66
975.20	92.90	975.20	Free Outfall	970.13
975.70	98.50	975.70	970.63	970.63
976.20	103.80	976.20	971.12	971.12
976.70	105.48	976.70	971.51	971.51
977.20	106.72	977.20	971.89	971.89
977.70	107.99	977.70	972.26	972.26
978.20	109.27	978.20	972.63	972.63
978.70	110.59	978.70	973.00	973.00
979.00	111.36	979.00	973.22	973.22

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
CRIT.DEPTH CONTROL Vh= .103ft
Dcr= .297ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 3 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
CRIT.DEPTH CONTROL Vh= .243ft Dcr= .656ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .407ft Dcr= .994ft CRIT.DEPTH Hev= .00ft
H =1.03
H =1.53
H =1.83
H =2.03
H =2.53
H =3.03
H =3.53
H =4.03
H =4.53
H =5.03
H =5.19
H =5.31
H =5.44
H =5.57
H =5.70
H =5.78

Outlet Structure			
Outlet Structure Type	Orifice		

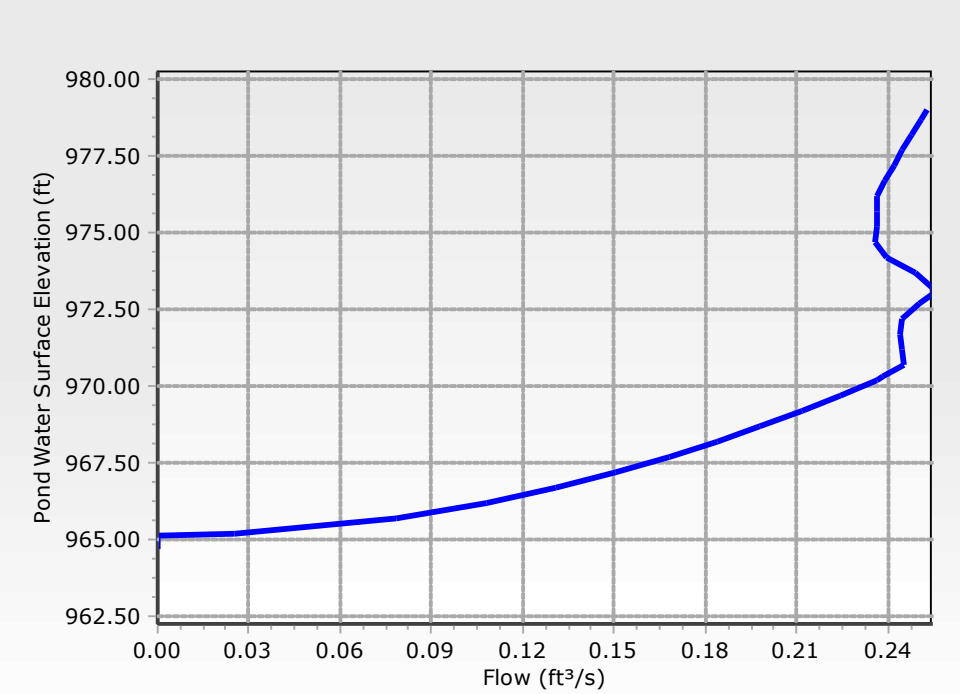
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	4	Orifice Diameter	1.0 in

Outlet Structure (Common)	
Elevation	965.10 ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
964.70	0.00	0.00	0.00	0.00
965.10	0.00	0.00	0.00	964.80
965.20	0.03	965.20	Free Outfall	964.81
965.70	0.08	965.70	Free Outfall	964.85
966.20	0.11	966.20	Free Outfall	964.87
966.70	0.13	966.70	Free Outfall	964.88
967.20	0.15	967.20	Free Outfall	964.90
967.70	0.17	967.70	Free Outfall	964.90
968.20	0.18	968.20	Free Outfall	964.92
968.70	0.20	968.70	Free Outfall	964.92
969.20	0.21	969.20	Free Outfall	964.93
969.70	0.22	969.70	Free Outfall	964.93
970.20	0.24	970.20	Free Outfall	964.94
970.30	0.24	970.30	Free Outfall	964.94
970.70	0.25	970.70	965.24	965.24
971.20	0.24	971.20	965.78	965.78

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
971.70	0.24	971.70	966.31	966.31
972.20	0.24	972.20	966.78	966.78
972.70	0.25	972.70	967.01	967.01
973.00	0.25	973.00	967.13	967.13
973.20	0.25	973.20	967.32	967.32
973.70	0.25	973.70	968.07	968.07
974.20	0.24	974.20	968.99	969.00
974.70	0.24	974.70	969.66	969.66
975.20	0.24	975.20	970.13	970.13
975.70	0.24	975.70	970.63	970.63
976.20	0.24	976.20	971.12	971.12
976.70	0.24	976.70	971.51	971.51
977.20	0.24	977.20	971.89	971.89
977.70	0.24	977.70	972.26	972.26
978.20	0.25	978.20	972.63	972.63
978.70	0.25	978.70	973.00	973.00
979.00	0.25	979.00	973.22	973.22

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)	Message
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	WS below an invert; no flow.
0.00	0.00	(N/A)	0.00	H =.06
0.00	0.00	(N/A)	0.00	H =.56
0.00	0.00	(N/A)	0.00	H =1.06
0.00	0.00	(N/A)	0.00	H =1.56
0.00	0.00	(N/A)	0.00	H =2.06
0.00	0.00	(N/A)	0.00	H =2.56
0.00	0.00	(N/A)	0.00	H =3.06
0.00	0.00	(N/A)	0.00	H =3.56
0.00	0.00	(N/A)	0.00	H =4.06
0.00	0.00	(N/A)	0.00	H =4.56
0.00	0.00	(N/A)	0.00	H =5.06
0.00	0.00	(N/A)	0.00	H =5.16
0.00	0.00	(N/A)	0.00	H =5.46
0.00	0.00	(N/A)	0.00	H =5.42
0.00	0.00	(N/A)	0.00	H =5.39
0.00	0.00	(N/A)	0.00	H =5.42
0.00	0.00	(N/A)	0.00	H =5.69
0.00	0.00	(N/A)	0.00	H =5.87
0.00	0.00	(N/A)	0.00	H =5.88
0.00	0.00	(N/A)	0.00	H =5.63
0.00	0.00	(N/A)	0.00	H =5.21
0.00	0.00	(N/A)	0.00	H =5.04

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =5.07
H =5.07
H =5.08
H =5.19
H =5.31
H =5.44
H =5.57
H =5.70
H =5.78

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
964.70	0.00	(N/A)	0.00
965.10	0.12	(N/A)	0.00
965.20	0.16	(N/A)	0.00
965.70	0.27	(N/A)	0.00
966.20	0.35	(N/A)	0.00
966.70	0.41	(N/A)	0.00
967.20	0.47	(N/A)	0.00
967.70	0.52	(N/A)	0.00
968.20	0.56	(N/A)	0.00
968.70	0.61	(N/A)	0.00
969.20	0.65	(N/A)	0.00
969.70	0.68	(N/A)	0.00
970.20	0.72	(N/A)	0.00
970.30	0.72	(N/A)	0.00
970.70	3.53	(N/A)	0.00
971.20	13.76	(N/A)	0.00
971.70	29.58	(N/A)	0.00
972.20	47.61	(N/A)	0.00
972.70	57.94	(N/A)	0.00
973.00	63.26	(N/A)	0.00
973.20	72.53	(N/A)	0.00
973.70	112.95	(N/A)	0.00
974.20	167.97	(N/A)	0.00
974.70	208.40	(N/A)	0.00
975.20	230.98	(N/A)	0.00
975.70	251.39	(N/A)	0.00
976.20	270.19	(N/A)	0.00
976.70	284.34	(N/A)	0.00
977.20	297.25	(N/A)	0.00
977.70	309.51	(N/A)	0.00
978.20	321.21	(N/A)	0.00
978.70	332.45	(N/A)	0.00
979.00	338.97	(N/A)	0.00

Contributing Structures
(no Q: Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1,Orifice - 2)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Orifice - 3,Riser - 2,Riser - 1)
Orifice - 3,Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 3,Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Riser - 2,Riser - 1)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

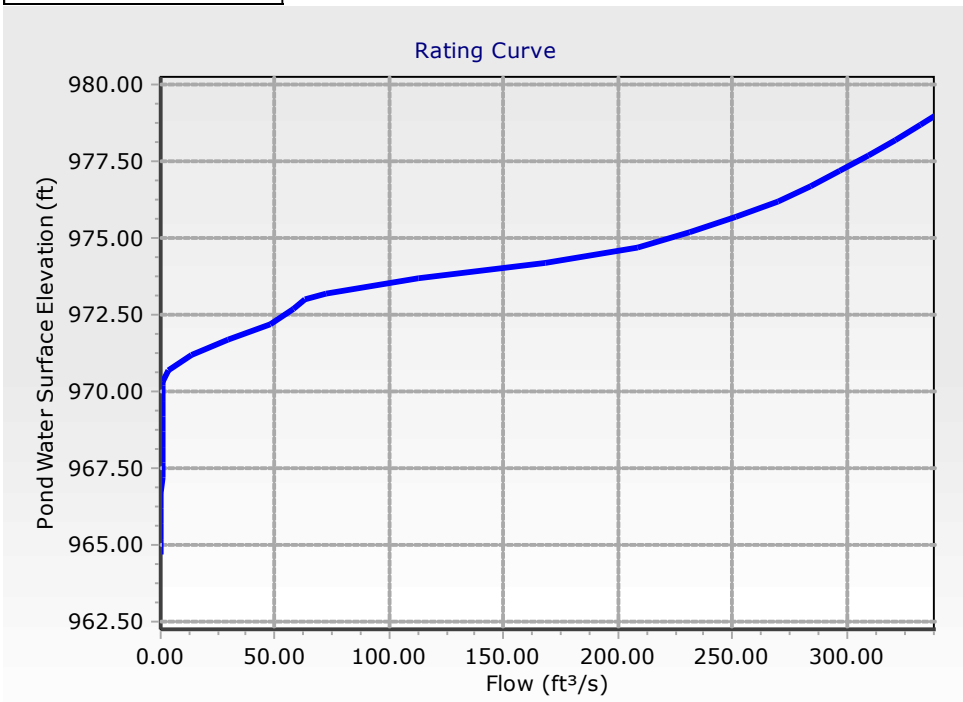
Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 3,Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 3,Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 3,Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 3,Orifice - 1,Orifice - 2,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 3,Riser - 2,Orifice - 1,Riser - 1,Orifice - 2,Culvert - 1



FINAL STORM REPORT

ADDENDUM 1

Cobey Creek, Phase 1

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

JCM DEVELOPMENT, LLC

PREPARED BY

HG CONSULT, INC.

July 1, 2019

7/1/19

Contents

This addendum to the final storm report for Cobey Creek, Phase 1, is prepared to address comments from the City of Lee's Summit staff from a letter dated May 25th, 2019 in regard to specific stormwater issues. The three sections are intended to provide additional information to the first three comments of said letter.

1. 40 Hour Extended Detention

The 8" skimmer used for erosion control will be permanent and the coupling will be capped. After final construction, if it is determined the North Detention Pond does not drain in 48 hours; the cap will be removed to drain the detention pond.

2. Effective Height

TR-60 states the following for the effective height of the dam.

"Effective height of dam. The difference in elevation in feet between the lowest open channel auxiliary spillway crest and the lowest point in the original cross section on the centerline of the dam. If there is no open channel auxiliary spillway, the top of the dam becomes the upper limit."

The top of the auxiliary spillway is at El. 977.0. The lowest point in the original cross section on the centerline of the dam is El. 968.0. Therefore, TR-60 does not apply to this detention pond.

3. Energy Dissipation

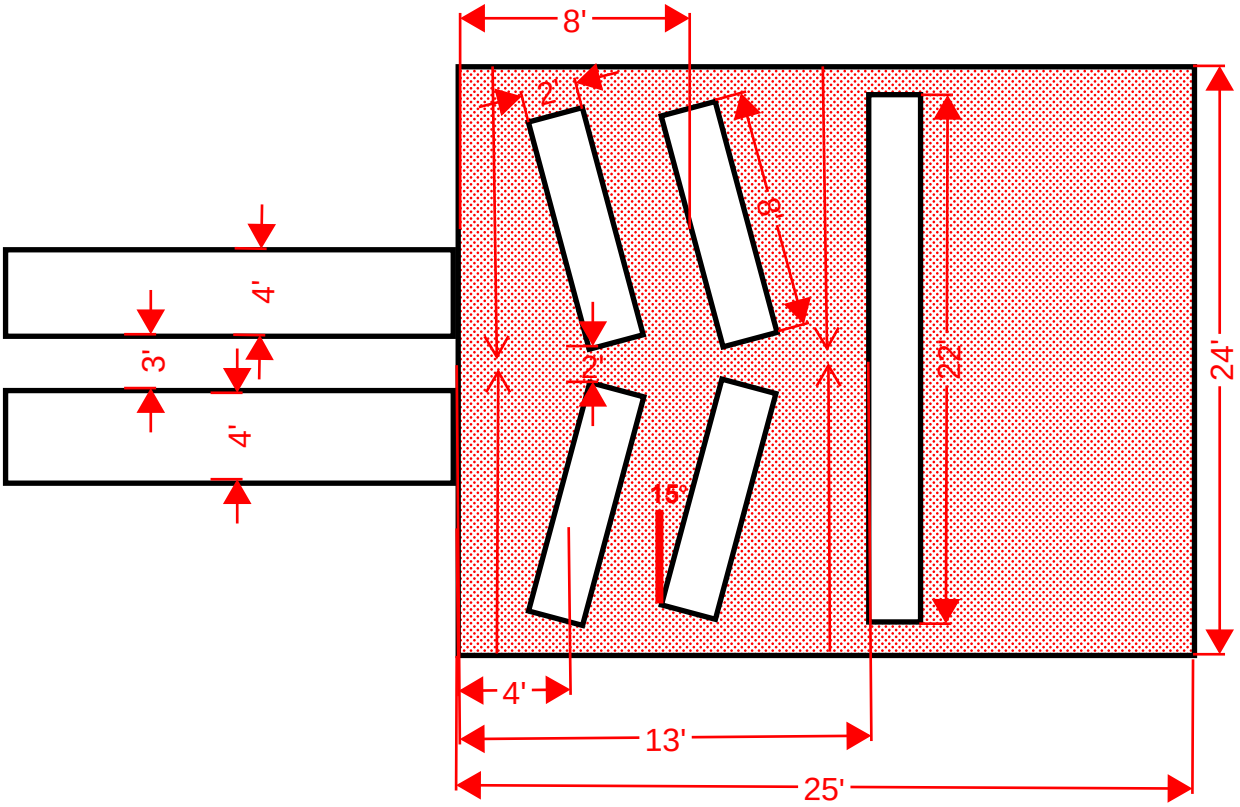
Additional energy dissipation has been added to the outlet structure at the request of the City of Lee's Summit. The outlet rip rap pad is fitted with a Contra Costa Design from HEC 14. The design details are included in the plans. The original 100-year outlet velocity is ~12.0 ft/s and the proposed 100-year outlet velocity is expected to be ~8.7 ft/s. Calculations are included in this Addendum.

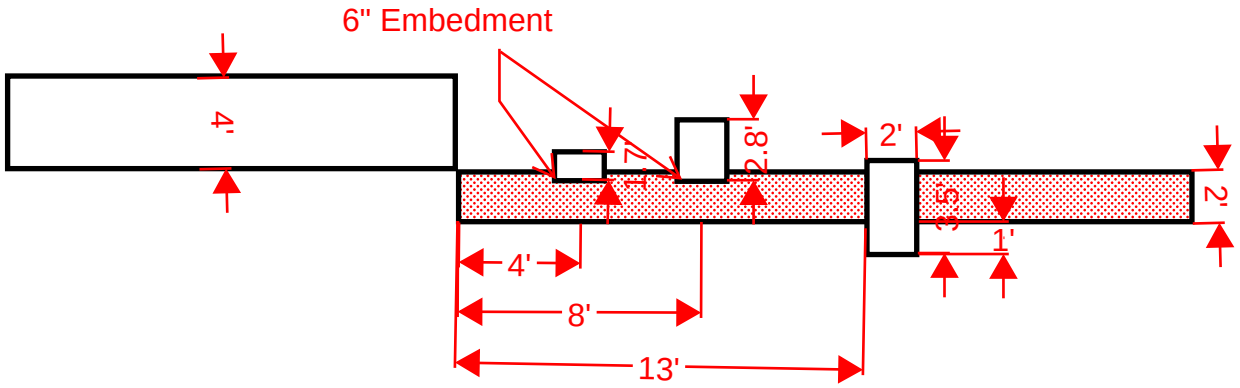
HY-8 Energy Dissipation Report

External Energy Dissipator

Parameter	Value	Units
Select Culvert and Flow		
Crossing	Crossing 1	
Culvert	Culvert 1	
Flow	280.00	cfs
Culvert Data		
Culvert Width (including multiple barrels)	8.0	ft
Culvert Height	4.0	ft
Outlet Depth	3.51	ft
Outlet Velocity	11.98	ft/s
Froude Number	1.13	
Tailwater Depth	0.00	ft
Tailwater Velocity	0.00	ft/s
Tailwater Slope (SO)	0.0049	
External Dissipator Data		
External Dissipator Category	Streambed Level Structures	
External Dissipator Type	Contra Costa	
Restrictions		
Froude Number	<3	
TailWater	<.5D	
Input Data		
Baffle Block Height Ratio		
Note:	2.5 < Baffle Block Height Ratio < 7	
Note:	Optimum Baffle Block Height Ratio = 3.5	
Ratio of Baffle Block Height to Block Distance from the Culvert	3.500	
End Sill Height to Maximum Depth Ratio		
Note:	Maximum Depth in the Dissipator is 4.794 feet	
Note:	0.06 < End Sill Height to Max Depth Ratio < 0.1	
Note:	0.1 is Recommended for End Sill Height to Max Depth Ratio	
Ratio to Determine End Sill Height from Maximum Depth	0.100	
Basin Width		
Note:	Channel Width is 8.000 feet	ft
Note:	4.000 < Basin Width < 12.000	ft
Note:	Channel Width is Recommended for Basin Width	
Basin Width	8.000	ft
Results		
Basin Depth (Y2)	4.794	ft
Basin Length (LB)	21.373	ft
Basin Width (WB)	8.000	ft
Exit Width (W3)	8.000	ft
Exit Depth (YC)	2.954	ft

Exit Velocity (VB=VC)	8.653	ft/s
First Baffle		
Height (H1)	1.174	ft
Width (WB)	8.000	ft
Space (L1)	4.111	ft
Second Baffle		
Height (H2)	2.349	ft
Width (WB)	8.000	ft
Space (L2)	8.221	ft
End Sill		
Height (H3)	0.479	ft
Top Width (W3)	8.000	ft
Location (L3)	13.152	ft


8'
2'
8'
4'
3'
4'
2'
15°
22'
24'
4'
13'
25'


6" Embedment
4'
1'
2.8'
2'
1.5'
2'
1'
4'
8'
13'

STORM WATER REPORT

Addendum 2

Cobey Creek

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

JCM DEVELOPMENT,LLC

PREPARED BY

Hg Consult, Inc

August 3, 2020

This addendum to the final storm report for Cobey Creek, Phase 1, is prepared to address the updating of the Pond Pack information for the south pond outlet structure. The attached Pondpack print out addresses the flow characteristics associated with six- 12inch diameter holes shown on the new square outlet structure detail, also attached.

The structure was changed to square from a circular manhole due to the unavailability of the manhole in a 6 foot diameter, as designed and approved in the original plans. The Pond pack information is provided as confirmation that original release orifices (12” holes) on the circuler manhole when placed on the square version, shows no changes to the hydraulic function of the outlet structure within the pond.

STORM WATER REPORT

Addendum 3

Cobey Creek

Mixed Use Development

Lee's Summit, MO

PREPARED FOR

JCM DEVELOPMENT,LLC

PREPARED BY

Hg Consult, Inc

October 8, 2020

This addendum to the Final Storm Report for Cobey Creek, Phase 1 is prepared for addressing the change to the geometric shape of the outlet structure in the north pond from circular to rectangular, due to the unavailability of a six foot diameter manhole.

This change is the same as the change at the south pond, except that the north pond design called for 2 circular manholes side by side. The shape of the outlet structure has been redesigned to incorporate the 2 manholes into one larger and rectangular structure. All orifices that were shown for the manholes have been incorporated into the rectangular structure at the same elevations to provide the same hydraulic flows at the various storm events as originally designed. Details of the new and approved structure are attached.

AS-BUILTS STORM REPORT

ADDENDUM 4

Cobey Creek, Phase 1

Mixed Use Development Lee's

Summit, MO

PREPARED FOR

JCM DEVELOPMENT, LLC

PREPARED BY

HG CONSULT, INC.

April 23, 2021

4/23/21

This addendum to the final storm report for Cobey Creek, Phase 1, is prepared for the North Detention Pond for the as-built conditions.

Proposed orifices/risers were designed to handle the WQ, 2, 10, and 100 year events. The table below summarizes the proposed vs. the as-built orifice elevations.

Table 1– Design Water Surface Elevations

Name	Design Elevation	As-Built Elevation
2 – 48" Pipes	964.70	965.40
2 – 2" Orifices (WQ)	964.70	965.35
4 – 1" Orifices (WQ)	965.10	965.75
4 – 21" Orifices (2-Year and 10-Year)	970.30	970.45
2 – 42" Risers (10-Year and 100-Year)	973.00	972.90
165' Emergency Spillway	977.00	977.05

The North Detention Pond was designed with adequate storage volume to discharge the design storm events. The as-built storage volumes closely match the design storage volumes and are summarized below.

Table 2– North Detention Pond Volumes

Elevation	Design Volume (CF)	As-Built Volume (CF)
964.70	0.00	---
965.00	91.14	---
965.66	1078.69	0.00
966.00	1587.43	96.91
967.00	5221.71	2224.13
968.00	11887.61	7480.39
969.00	16284.71	11378.48
970.00	22239.80	17002.99
971.00	34243.52	27237.46
972.00	67231.45	57187.14
973.00	138511.05	124762.26
974.00	218096.48	201239.95
975.00	304146.11	285267.17
976.00	396454.77	376940.76
977.00	495081.75	476368.06
978.00	600087.34	583653.32
979.00	711528.98	698910.02
979.07	---	707297.84

APWA 5608.4 requires a 40-hour extended release of the water quality storm event (1.37"/24-hour rainfall) per Section 8.10 of the BMP Manual. The detention facility was designed with the 1" and 2" orifices to release the water quality event over a 40-hour period. Because the 1" and 2" orifices were constructed 0.65' higher the water quality event was slightly impacted. Below is a summary of those results.

Table 3 – Water Quality

Name	Max WSE (ft)	Max Pond Storage (ac-ft)	Peak Flow (cf/s)	Release Duration (hr)
Design	970.40	1.431	1.42	40.96
As-Built	970.74	1.114	2.72	34.24

As indicated in table the water quality event will discharge through the 21" orifices at a maximum depth of 0.29' (3.5") therefore slightly increasing the discharge for a short amount of time and thus reducing the maximum pond storage and the release duration. Although there is a slight impact the detention pond is able to release the water quality event for 34.24 hours. See water quality hydrographs in Appendix.

Per APWA Section 5608.4 and City of Lee's Summit criteria, the post-development discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

The table below summarizes the allowable, designed, and as-built discharge rates for the North Detention Pond.

Table 4 – North Detention Release Rates

Name	2-Year	10-Year	100-Year
Allowable Discharge (cfs)	66.73	200.16	311.70
Design Discharge (cfs)	65.08	194.74	278.44
As-Built Discharge 9cfs)	85.52	204.93	277.47

The highlighted items above indicate were the allowable flow rates were exceeded in the as-built conditions. The 2-year had a significant increase because the 2-Year WSE = 973.33 and therefore is discharging into the 42" risers. In order to get the 2-Year closer to the allowable we propose adding 0.6' risers to the 42" domes therefore raising the 42" domes to an elevation of 973.50. The additional riser lengths keep the 2-Year below the 42" risers and therefore discharging through 21" orifices. This proposed change has the following flow rates:

Table 5: Proposed North Detention Discharge Values

Name	2-Year	10-Year	100-Year
Allowable Discharge (cfs)	66.73	200.16	311.70
Proposed Discharge (cfs)	68.55	194.57	272.78

By making the aforementioned revision to the risers we exceed the allowable 2-Year by 3% and meet the 10 and 100-Year.

The proposed change increases the proposed 100-Year WSE from 976.50 to 976.82. The new WSE would be within 0.23' of the Spillway. In order to accommodate the 0.5' of freeboard the spillway would need to be raised an additional 4" which appears to be in a very limited section of the spillway based on the as-built information. The subsequent 100-Year WSE with the aforementioned changes is 978.31. The as-built top of dam elevation is very close to 979.00.

Table 6: Subsequent 100 Year Spillway Discharge Values and Elevations

Name	100-Year WSE	Subsequent 100-Year WSE	Spillway Elevation	Top of Dam Elevation
Designed	976.50	977.99	977.00	979.00
Proposed	976.82	978.31	977.32	978.99

In summary we propose adding a 7" extension to the 42" domes (ELEV = 973.50). Additionally we proposed raising the spillway elevation by 0.32' (ELEV = 977.32). By doing so the WQ, 2, 10, 100, and subsequent 100-Year events are within a close tolerance to the allowable. The PondPack results are contained within.

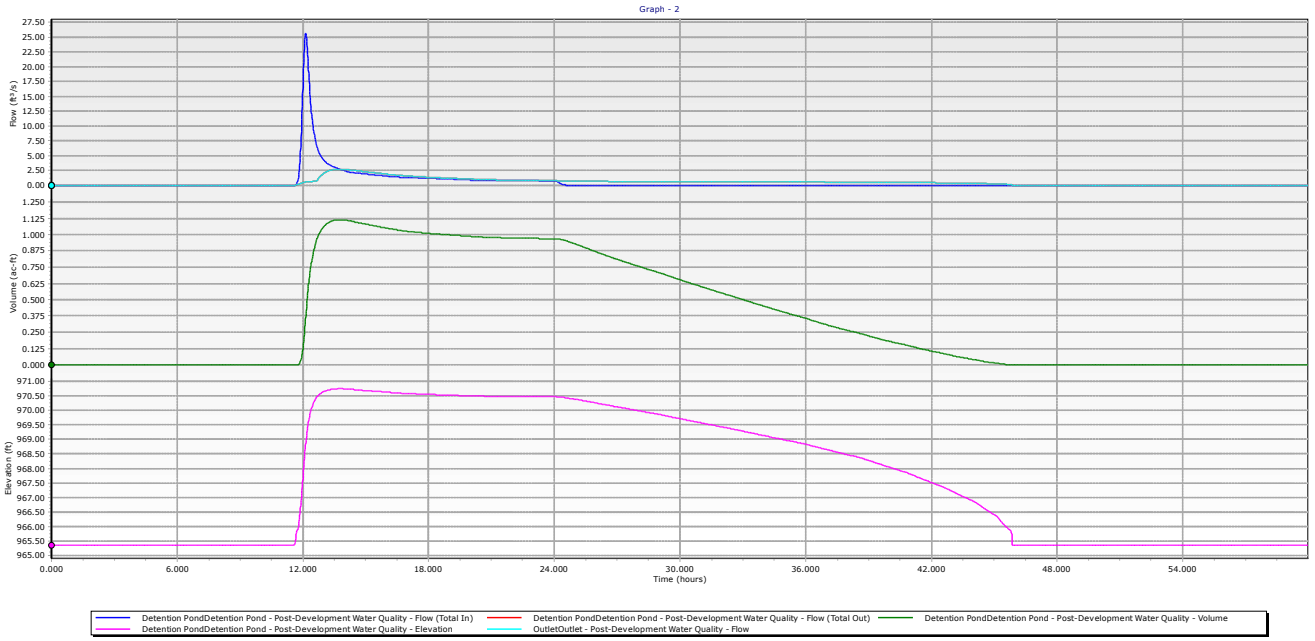
Table 7: Summary of Changes

Name	42" Risers Elevation	Spillway Elevation
As-Built	972.90	977.00
Proposed	973.50	977.32

The upstream pipes were analyzed to determine if the increased 10-Year WSE had an effect on the HGL in pipe systems 1 and 12. The 10-Year WSE elevation was used as the tailwater condition. The tailwater increased from 974.53 to 974.91 for the 10-Year event. Pipe system 1 has an invert into north pond of 973.12. Because the tailwater is only 1.79 deep inside the 60" diameter pipe (pipe HGL is above tailwater) the pipe system remains inlet controlled and therefore the HGL is not affected. The invert elevation into the pond for pipe system 12 is 971.10 therefore has a tailwater depth of 3.81. Because the tailwater depth is higher than the HGL in a free outfall condition the system is outlet controlled. Therefore the HGL changes by 0.38' at the outfall (12-A) and dissipates to "no-change" three structures upstream (structure 12-D – 245' upstream). In summary the increased 10-Year WSE had no-effect on system 1 and had minimal effect on system 12. System 12 continues to contain the HGL within the pipe.

Appendix

WATER QUALITY EVENT EXTENDED RELEASE


Graph - 2
Flow (ft^3/s)
Volume (ac-ft)
Elevation (ft)
Time (hours)
0.000
6.000
12.000
18.000
24.000
30.000
36.000
42.000
48.000
54.000
Detention PondDetention Pond - Post-Development Water Quality - Flow (Total In)
Detention PondDetention Pond - Post-Development Water Quality - Elevation
Detention PondDetention Pond - Post-Development Water Quality - Flow (Total Out)
OutletOutlet - Post-Development Water Quality - Flow
Detention PondDetention Pond - Post-Development Water Quality - Volume

PONDPACK OUTPUT

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Project Summary	
Title	COBEY CREEK
Engineer	Matthew Castor
Company	Hg Consult, Inc
Date	4/6/2021

Notes

Table of Contents

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
P3	Post-Development 2 year	2	13.945	12.090	169.63
P3	Post-Development 10 year	10	25.862	12.090	314.25
P3	Post-Development 100 year	100	42.704	12.090	511.44
P1	Post-Development 2 year	2	1.756	11.980	29.29
P1	Post-Development 10 year	10	3.215	11.970	52.87
P1	Post-Development 100 year	100	5.265	11.970	84.76
P2	Post-Development 2 year	2	0.097	11.950	1.73
P2	Post-Development 10 year	10	0.184	11.940	3.27
P2	Post-Development 100 year	100	0.309	11.940	5.40
P4	Post-Development 2 year	2	0.654	11.990	10.77
P4	Post-Development 10 year	10	1.228	11.990	20.01
P4	Post-Development 100 year	100	2.044	11.970	32.66

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
O-3	Post-Development 2 year	2	13.945	12.410	68.55
O-3	Post-Development 10 year	10	25.862	12.290	194.57
O-3	Post-Development 100 year	100	42.704	12.320	272.78
O-1	Post-Development 2 year	2	1.756	11.980	29.29
O-1	Post-Development 10 year	10	3.215	11.970	52.87
O-1	Post-Development 100 year	100	5.265	11.970	84.76
O-2	Post-Development 2 year	2	0.097	11.950	1.73
O-2	Post-Development 10 year	10	0.184	11.940	3.27

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Subsection: Master Network Summary

Node Summary

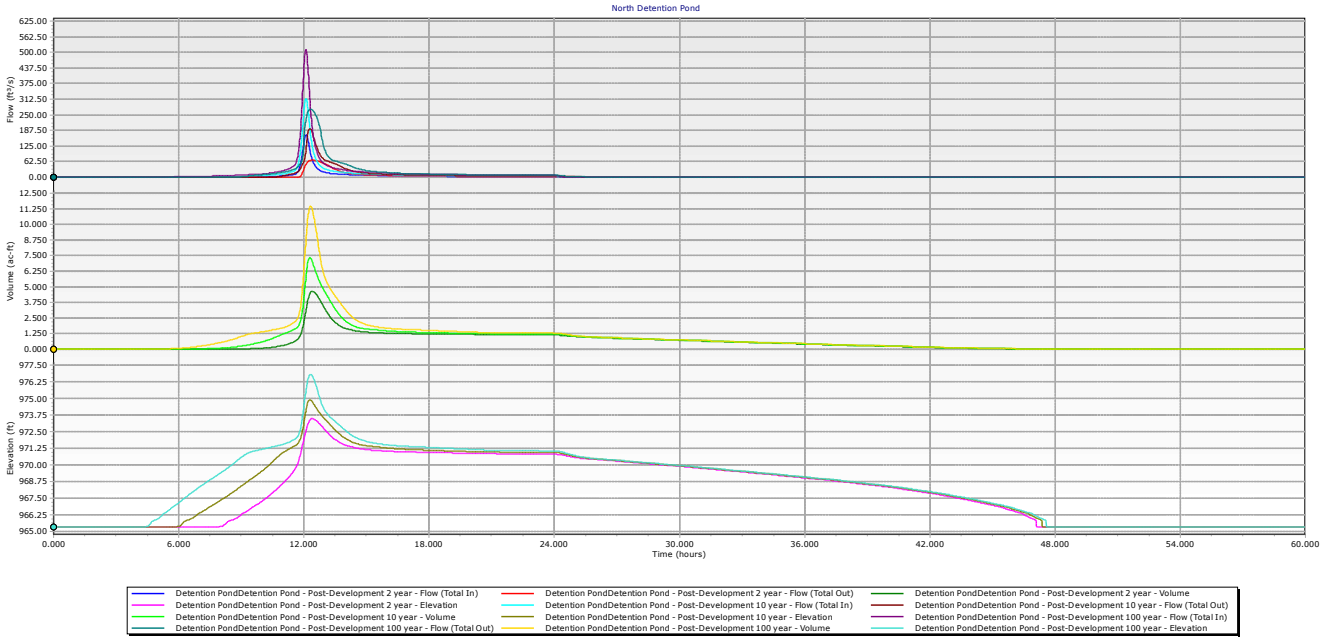
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
O-2	Post-Development 100 year	100	0.309	11.940	5.40
O-4	Post-Development 2 year	2	0.654	11.990	10.77
O-4	Post-Development 10 year	10	1.228	11.990	20.01
O-4	Post-Development 100 year	100	2.044	11.970	32.66

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development 2 year	2	13.945	12.090	169.63	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 2 year	2	13.945	12.410	68.55	973.47	4.636
Detention Pond (IN)	Post-Development 10 year	10	25.862	12.090	314.25	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 10 year	10	25.862	12.290	194.57	974.91	7.336
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	42.704	12.320	272.78	976.82	11.475

COBEY CREEK - 2, 10, 100 YEAR (AS-BUILTS)

Index


North Detention Pond
Flow (ft³/s)
625.00
562.50
500.00
437.50
375.00
312.50
250.00
187.50
125.00
62.50
0.00
Volume (ac-ft)
12.500
11.250
10.000
8.750
7.500
6.250
5.000
3.750
2.500
1.250
0.000
Elevation (ft)
977.50
976.25
975.00
973.75
972.50
971.25
970.00
968.75
967.50
966.25
965.00
0.000
6.000
12.000
18.000
24.000
30.000
36.000
42.000
48.000
54.000
60.000
Time (hours)
Detention PondDetention Pond - Post-Development 2 year - Flow (Total In)
Detention PondDetention Pond - Post-Development 2 year - Elevation
Detention PondDetention Pond - Post-Development 10 year - Volume
Detention PondDetention Pond - Post-Development 100 year - Flow (Total Out)
Detention PondDetention Pond - Post-Development 2 year - Flow (Total Out)
Detention PondDetention Pond - Post-Development 10 year - Flow (Total In)
Detention PondDetention Pond - Post-Development 10 year - Elevation
Detention PondDetention Pond - Post-Development 100 year - Volume
Detention PondDetention Pond - Post-Development 2 year - Volume
Detention PondDetention Pond - Post-Development 10 year - Flow (Total Out)
Detention PondDetention Pond - Post-Development 100 year - Flow (Total In)
Detention PondDetention Pond - Post-Development 100 year - Elevation

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Element Details			
Label	Composite Outlet Structure - 1	Notes	

Headwater Range			
Headwater Type	Use Pond for Headwater Range	Maximum (Headwater)	979.07 ft
Pond	Detention Pond	Increment (Headwater)	0.50 ft
Minimum (Headwater)	965.35 ft		

SpotElevation (ft)

Tailwater Setup	
Tailwater Type	Free Outfall

Tailwater Tolerances			
Maximum Iterations	30	Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft	Flow Tolerance (Minimum)	0.001 ft³/s
Headwater Tolerance (Maximum)	0.50 ft	Flow Tolerance (Maximum)	10.000 ft³/s
Tailwater Tolerance (Minimum)	0.01 ft		

Outlet Structure			
Outlet Structure Type	Culvert	Culvert Type	Circular

Outlet Structure (IDs and Direction)			
Outlet ID	Culvert - 1	Downstream ID	Tailwater
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

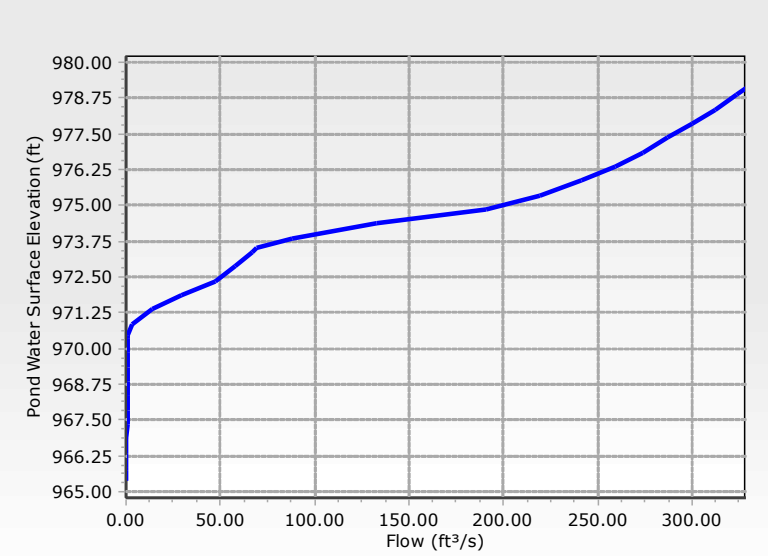
Culvert Data			
Number of Barrels	2	Downstream Invert	964.80 ft
Length	102.32 ft	Diameter	48.0 in
Upstream Invert	965.35 ft		

Unsubmerged->Submerged			
Specify Transitions	False	Compute Inlet Control Only	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Culvert Coefficients			
Inlet Description	Concrete - Groove end projecting	C	0.0317
Chart	Chart 1	Y	0.6900
Nomograph	Nomograph 3	Manning's n	0.011
Equation Form	Form 1	Ke	0.200
K	0.0045	Kr	0.000
M	2.0000	Slope Correction Factor	-0.500

Culvert (Advanced)			
Convergence Tolerance	0.00 ft	Specify Number of Backwater Sections	False



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s
Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s
Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	Free Outfall
965.75	0.12	965.45	Free Outfall	Free Outfall
965.85	0.16	965.46	Free Outfall	Free Outfall
966.35	0.30	965.50	Free Outfall	Free Outfall
966.85	0.37	965.52	Free Outfall	Free Outfall
967.35	0.42	965.53	Free Outfall	Free Outfall
967.85	0.48	965.55	Free Outfall	Free Outfall
968.35	0.52	965.55	Free Outfall	Free Outfall
968.85	0.58	965.57	Free Outfall	Free Outfall
969.35	0.62	965.57	Free Outfall	Free Outfall
969.85	0.65	965.58	Free Outfall	Free Outfall
970.35	0.68	965.59	Free Outfall	Free Outfall
970.45	0.69	965.59	Free Outfall	Free Outfall
970.85	3.49	965.89	Free Outfall	Free Outfall
971.35	13.73	966.43	Free Outfall	Free Outfall
971.85	29.54	966.96	Free Outfall	Free Outfall
972.35	47.56	967.43	Free Outfall	Free Outfall
972.85	57.90	967.66	Free Outfall	Free Outfall
973.35	66.57	967.84	Free Outfall	Free Outfall
973.50	69.03	967.90	Free Outfall	Free Outfall
973.85	87.98	968.27	Free Outfall	Free Outfall
974.35	133.02	969.06	Free Outfall	Free Outfall
974.85	191.12	970.02	Free Outfall	Free Outfall
975.35	219.54	970.52	Free Outfall	Free Outfall
975.85	241.18	971.02	Free Outfall	Free Outfall
976.35	259.30	971.47	Free Outfall	Free Outfall
976.85	273.70	971.86	Free Outfall	Free Outfall
977.35	287.15	972.24	Free Outfall	Free Outfall
977.85	299.93	972.61	Free Outfall	Free Outfall
978.35	312.04	972.99	Free Outfall	Free Outfall
978.85	323.63	973.36	Free Outfall	Free Outfall
979.07	328.45	973.51	Free Outfall	Free Outfall

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s
Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.02	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.06	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.01	(N/A)	0.00

Message
WS below an invert; no flow.
CRIT.DEPTH CONTROL Vh= .023ft Dcr= .068ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .026ft Dcr= .079ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .037ft Dcr= .109ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s
Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Message
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .056ft Dcr= .167ft CRIT.DEPTH Hev= .00ft
FLOW PRECEDENCE SET TO UPSTREAM CONTROLLING STRUCTURE
CRIT.DEPTH CONTROL Vh= .129ft Dcr= .379ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .265ft Dcr= .760ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .403ft Dcr= 1.125ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .530ft Dcr= 1.440ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .597ft Dcr= 1.595ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .650ft Dcr= 1.715ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .665ft Dcr= 1.748ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .777ft Dcr= 1.984ft CRIT.DEPTH Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 133.88 ft³/s
Upstream ID = Orifice - 2, Riser - 2, Orifice - 1, Riser - 1, Copy of Orifice - 1
Downstream ID = Tailwater (Pond Outfall)

Message
CRIT.DEPTH CONTROL Vh= 1.043ft Dcr= 2.463ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= 1.424ft Dcr= 2.964ft CRIT.DEPTH Hev= .00ft
INLET CONTROL... Submerged: HW =5.17
INLET CONTROL... Submerged: HW =5.67
INLET CONTROL... Submerged: HW =6.12
INLET CONTROL... Submerged: HW =6.51
INLET CONTROL... Submerged: HW =6.89
INLET CONTROL... Submerged: HW =7.26
INLET CONTROL... Submerged: HW =7.64
INLET CONTROL... Submerged: HW =8.01
INLET CONTROL... Submerged: HW =8.16

Outlet Structure	
Outlet Structure Type	Orifice

Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

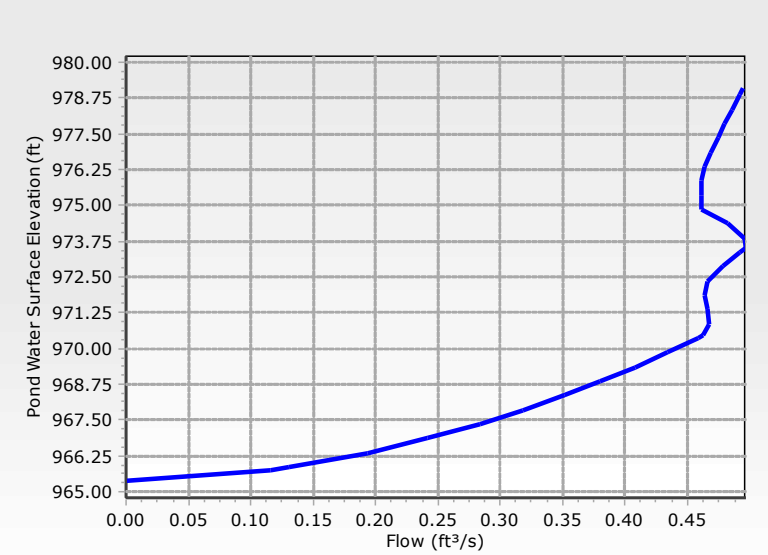
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	2	Orifice Diameter	2.0 in

Outlet Structure (Common)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Outlet Structure (Common)	
Elevation	965.35 ft



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.12	965.75	965.45	965.45
965.85	0.13	965.85	965.46	965.46
966.35	0.19	966.35	965.50	965.50
966.85	0.24	966.85	965.52	965.52
967.35	0.28	967.35	965.53	965.53
967.85	0.32	967.85	965.55	965.55
968.35	0.35	968.35	965.55	965.55
968.85	0.38	968.85	965.57	965.57
969.35	0.41	969.35	965.57	965.57
969.85	0.43	969.85	965.58	965.58
970.35	0.46	970.35	965.58	965.59

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
970.45	0.46	970.45	965.59	965.59
970.85	0.47	970.85	965.88	965.89
971.35	0.47	971.35	966.43	966.43
971.85	0.46	971.85	966.96	966.96
972.35	0.47	972.35	967.43	967.43
972.85	0.48	972.85	967.66	967.66
973.35	0.49	973.35	967.84	967.84
973.50	0.50	973.50	967.90	967.90
973.85	0.50	973.85	968.27	968.27
974.35	0.48	974.35	969.06	969.06
974.85	0.46	974.85	970.02	970.02
975.35	0.46	975.35	970.52	970.52
975.85	0.46	975.85	971.02	971.02
976.35	0.46	976.35	971.47	971.47
976.85	0.47	976.85	971.86	971.86
977.35	0.47	977.35	972.24	972.24
977.85	0.48	977.85	972.61	972.61
978.35	0.49	978.35	972.99	972.99
978.85	0.49	978.85	973.36	973.36
979.07	0.50	979.07	973.51	973.51

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
H =.30
H =.39
H =.85
H =1.33
H =1.82
H =2.30
H =2.80
H =3.28
H =3.78
H =4.27
H =4.77
H =4.86
H =4.97
H =4.92
H =4.89
H =4.92
H =5.19
H =5.51
H =5.60
H =5.58
H =5.29

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =4.83
H =4.83
H =4.83
H =4.88
H =4.99
H =5.11
H =5.24
H =5.36
H =5.49
H =5.56

Outlet Structure	
Outlet Structure Type	Riser

Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

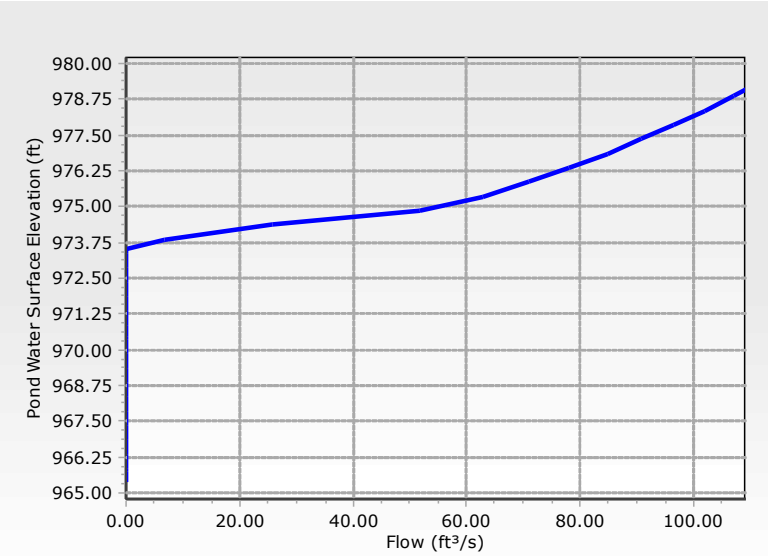
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		

Outlet Structure (Common)	
Elevation	973.50 ft

Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.00	0.00	0.00	965.46
966.35	0.00	0.00	0.00	965.50
966.85	0.00	0.00	0.00	965.52
967.35	0.00	0.00	0.00	965.53
967.85	0.00	0.00	0.00	965.55
968.35	0.00	0.00	0.00	965.55
968.85	0.00	0.00	0.00	965.57
969.35	0.00	0.00	0.00	965.57
969.85	0.00	0.00	0.00	965.58
970.35	0.00	0.00	0.00	965.59
970.45	0.00	0.00	0.00	965.59
970.85	0.00	0.00	0.00	965.89
971.35	0.00	0.00	0.00	966.43
971.85	0.00	0.00	0.00	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
972.35	0.00	0.00	0.00	967.43
972.85	0.00	0.00	0.00	967.66
973.35	0.00	0.00	0.00	967.84
973.50	0.00	0.00	0.00	967.90
973.85	6.83	973.85	Free Outfall	968.27
974.35	25.85	974.35	Free Outfall	969.06
974.85	51.74	974.85	Free Outfall	970.02
975.35	62.98	975.35	Free Outfall	970.52
975.85	70.99	975.85	Free Outfall	971.02
976.35	78.17	976.35	Free Outfall	971.47
976.85	84.76	976.85	Free Outfall	971.86
977.35	90.86	977.35	Free Outfall	972.24
977.85	96.58	977.85	Free Outfall	972.61
978.35	101.98	978.35	Free Outfall	972.99
978.85	107.11	978.85	Free Outfall	973.36
979.07	109.29	979.07	973.51	973.51

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
Weir: H =0.35ft
Weir: H =0.85ft
Weir: H =1.35ft
Orifice: H =1.85; Riser orifice equation controlling.

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 1 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
Orifice: H =2.35; Riser orifice equation controlling.
Orifice: H =2.85; Riser orifice equation controlling.
Orifice: H =3.35; Riser orifice equation controlling.
Orifice: H =3.85; Riser orifice equation controlling.
Orifice: H =4.35; Riser orifice equation controlling.
Orifice: H =4.85; Riser orifice equation controlling.
Orifice: H =5.35; Riser orifice equation controlling.
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=5.57

Outlet Structure	
Outlet Structure Type	Riser

Outlet Structure (IDs and Direction)			
Outlet ID	Riser - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

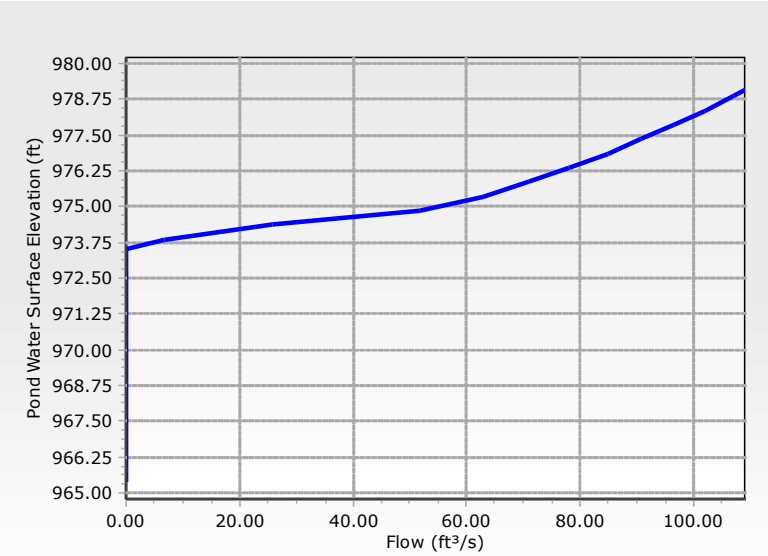
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Riser)			
Riser	Stand Pipe	Transition Elevation	0.00 ft
Diameter	42.0 in	Transition Height	0.00 ft
Weir Coefficient	3.00 (ft^0.5)/s	K Reverse	1.000
Orifice Coefficient	0.600		

Outlet Structure (Common)	
Elevation	973.50 ft

Outlet Structure (Riser, Advanced)			
Use Orifice Depth to Crest?	True	Use Submerged Weir Equation?	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.00	0.00	0.00	965.46
966.35	0.00	0.00	0.00	965.50
966.85	0.00	0.00	0.00	965.52
967.35	0.00	0.00	0.00	965.53
967.85	0.00	0.00	0.00	965.55
968.35	0.00	0.00	0.00	965.55
968.85	0.00	0.00	0.00	965.57
969.35	0.00	0.00	0.00	965.57
969.85	0.00	0.00	0.00	965.58
970.35	0.00	0.00	0.00	965.59
970.45	0.00	0.00	0.00	965.59
970.85	0.00	0.00	0.00	965.89
971.35	0.00	0.00	0.00	966.43
971.85	0.00	0.00	0.00	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
972.35	0.00	0.00	0.00	967.43
972.85	0.00	0.00	0.00	967.66
973.35	0.00	0.00	0.00	967.84
973.50	0.00	0.00	0.00	967.90
973.85	6.83	973.85	Free Outfall	968.27
974.35	25.85	974.35	Free Outfall	969.06
974.85	51.74	974.85	Free Outfall	970.02
975.35	62.98	975.35	Free Outfall	970.52
975.85	70.99	975.85	Free Outfall	971.02
976.35	78.17	976.35	Free Outfall	971.47
976.85	84.76	976.85	Free Outfall	971.86
977.35	90.86	977.35	Free Outfall	972.24
977.85	96.58	977.85	Free Outfall	972.61
978.35	101.98	978.35	Free Outfall	972.99
978.85	107.11	978.85	Free Outfall	973.36
979.07	109.29	979.07	973.51	973.51

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
Weir: H =0.35ft
Weir: H =0.85ft
Weir: H =1.35ft
Orifice: H =1.85; Riser orifice equation controlling.

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Riser - 2 (Stand Pipe)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
Orifice: H =2.35; Riser orifice equation controlling.
Orifice: H =2.85; Riser orifice equation controlling.
Orifice: H =3.35; Riser orifice equation controlling.
Orifice: H =3.85; Riser orifice equation controlling.
Orifice: H =4.35; Riser orifice equation controlling.
Orifice: H =4.85; Riser orifice equation controlling.
Orifice: H =5.35; Riser orifice equation controlling.
FULLY CHARGED RISER: Orifice Equation Control to Crest; H=5.57

Outlet Structure	
Outlet Structure Type	Orifice

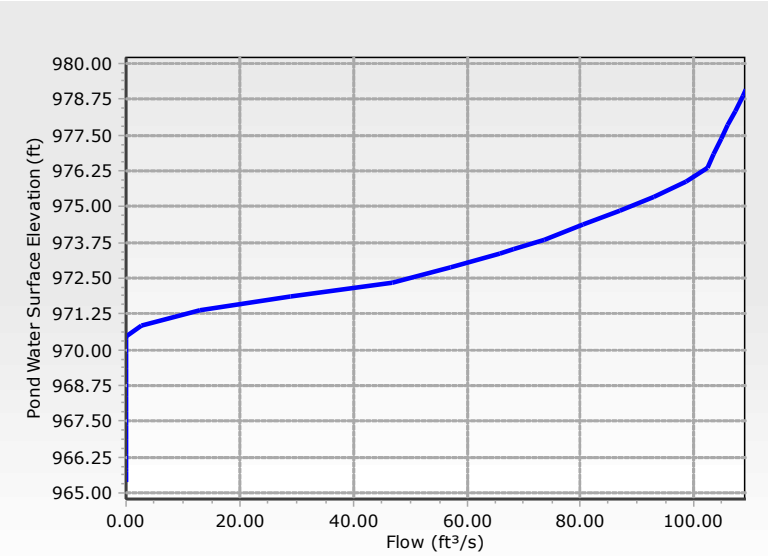
Outlet Structure (IDs and Direction)			
Outlet ID	Orifice - 2	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	4	Orifice Diameter	21.0 in

Outlet Structure (Common)	
Elevation	970.45 ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.00	0.00	0.00	965.46
966.35	0.00	0.00	0.00	965.50
966.85	0.00	0.00	0.00	965.52
967.35	0.00	0.00	0.00	965.53
967.85	0.00	0.00	0.00	965.55
968.35	0.00	0.00	0.00	965.55
968.85	0.00	0.00	0.00	965.57
969.35	0.00	0.00	0.00	965.57
969.85	0.00	0.00	0.00	965.58
970.35	0.00	0.00	0.00	965.59
970.45	0.00	0.00	0.00	965.59
970.85	2.79	970.85	Free Outfall	965.89
971.35	13.03	971.35	Free Outfall	966.43
971.85	28.85	971.85	Free Outfall	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
972.35	46.88	972.35	Free Outfall	967.43
972.85	57.18	972.85	Free Outfall	967.66
973.35	65.90	973.35	Free Outfall	967.84
973.50	68.29	973.50	Free Outfall	967.90
973.85	73.58	973.85	Free Outfall	968.27
974.35	80.54	974.35	Free Outfall	969.06
974.85	86.94	974.85	Free Outfall	970.02
975.35	92.90	975.35	970.52	970.52
975.85	98.50	975.85	971.02	971.02
976.35	102.26	976.35	971.47	971.47
976.85	103.46	976.85	971.86	971.86
977.35	104.71	977.35	972.24	972.24
977.85	105.95	977.85	972.61	972.61
978.35	107.25	978.35	972.99	972.99
978.85	108.55	978.85	973.36	973.36
979.07	109.15	979.07	973.51	973.51

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
WS below an invert; no flow.
CRIT.DEPTH CONTROL Vh= .103ft Dcr= .297ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .243ft Dcr= .656ft CRIT.DEPTH Hev= .00ft
CRIT.DEPTH CONTROL Vh= .407ft Dcr= .994ft CRIT.DEPTH Hev= .00ft
H =1.03
H =1.53
H =2.03
H =2.18
H =2.53
H =3.03
H =3.53

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Orifice - 2 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =4.03
H =4.53
H =4.88
H =4.99
H =5.11
H =5.24
H =5.36
H =5.49
H =5.56

Outlet Structure	
Outlet Structure Type	Orifice

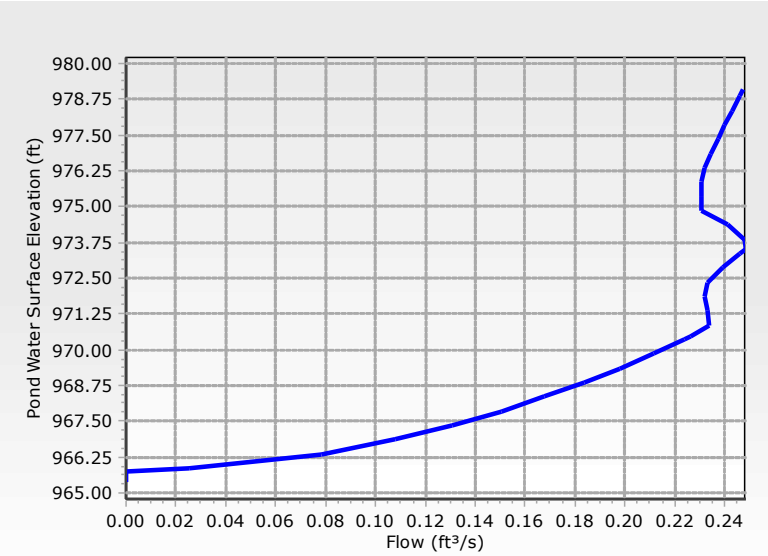
Outlet Structure (IDs and Direction)			
Outlet ID	Copy of Orifice - 1	Downstream ID	Culvert - 1
Flow Direction	Forward Flow Only	Notes	

Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft

Outlet Structure (Orifice)			
Orifice	Circular Orifice	Orifice Coefficient	0.600
Number of Openings	4	Orifice Diameter	1.0 in

Outlet Structure (Common)	
Elevation	965.75 ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1



RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
965.35	0.00	0.00	0.00	0.00
965.75	0.00	0.00	0.00	965.45
965.85	0.03	965.85	Free Outfall	965.46
966.35	0.08	966.35	Free Outfall	965.50
966.85	0.11	966.85	Free Outfall	965.52
967.35	0.13	967.35	Free Outfall	965.53
967.85	0.15	967.85	Free Outfall	965.55
968.35	0.17	968.35	Free Outfall	965.55
968.85	0.18	968.85	Free Outfall	965.57
969.35	0.20	969.35	Free Outfall	965.57
969.85	0.21	969.85	Free Outfall	965.58
970.35	0.22	970.35	Free Outfall	965.59
970.45	0.23	970.45	Free Outfall	965.59
970.85	0.23	970.85	965.88	965.89
971.35	0.23	971.35	966.43	966.43
971.85	0.23	971.85	966.96	966.96

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Water Surface Elevation (ft)	Device Flow (ft³/s)	(into) Headwater Hydraulic Grade Line (ft)	Converge Downstream Hydraulic Grade Line (ft)	Next Downstream Hydraulic Grade Line (ft)
972.35	0.23	972.35	967.43	967.43
972.85	0.24	972.85	967.66	967.66
973.35	0.25	973.35	967.84	967.84
973.50	0.25	973.50	967.90	967.90
973.85	0.25	973.85	968.27	968.27
974.35	0.24	974.35	969.06	969.06
974.85	0.23	974.85	970.02	970.02
975.35	0.23	975.35	970.52	970.52
975.85	0.23	975.85	971.02	971.02
976.35	0.23	976.35	971.47	971.47
976.85	0.23	976.85	971.86	971.86
977.35	0.24	977.35	972.24	972.24
977.85	0.24	977.85	972.61	972.61
978.35	0.24	978.35	972.99	972.99
978.85	0.25	978.85	973.36	973.36
979.07	0.25	979.07	973.51	973.51

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft³/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Downstream Hydraulic Grade Line Error (ft)	Convergence Error (ft^3/s)	Downstream Channel Tailwater (ft)	Tailwater Error (ft)
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00
0.00	0.00	(N/A)	0.00

Message
WS below an invert; no flow.
WS below an invert; no flow.
H =.06
H =.56
H =1.06
H =1.56
H =2.06
H =2.56
H =3.06
H =3.56
H =4.06
H =4.56
H =4.66
H =4.97
H =4.92
H =4.89
H =4.92
H =5.19
H =5.51
H =5.60
H =5.58
H =5.29
H =4.83
H =4.83
H =4.83
H =4.88

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

RATING TABLE FOR ONE OUTLET TYPE
Structure ID = Copy of Orifice - 1 (Orifice-Circular)

Upstream ID = (Pond Water Surface)
Downstream ID = Culvert - 1 (Culvert-Circular)

Message
H =4.99
H =5.11
H =5.24
H =5.36
H =5.49
H =5.56

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
965.35	0.00	(N/A)	0.00
965.75	0.12	(N/A)	0.00
965.85	0.16	(N/A)	0.00
966.35	0.27	(N/A)	0.00
966.85	0.35	(N/A)	0.00
967.35	0.41	(N/A)	0.00
967.85	0.47	(N/A)	0.00
968.35	0.52	(N/A)	0.00
968.85	0.56	(N/A)	0.00
969.35	0.61	(N/A)	0.00
969.85	0.65	(N/A)	0.00
970.35	0.68	(N/A)	0.00
970.45	0.69	(N/A)	0.00
970.85	3.49	(N/A)	0.00
971.35	13.73	(N/A)	0.00
971.85	29.54	(N/A)	0.00
972.35	47.56	(N/A)	0.00
972.85	57.90	(N/A)	0.00
973.35	66.57	(N/A)	0.00
973.50	69.03	(N/A)	0.00
973.85	87.98	(N/A)	0.00
974.35	132.96	(N/A)	0.00
974.85	191.12	(N/A)	0.00
975.35	219.55	(N/A)	0.00
975.85	241.17	(N/A)	0.00
976.35	259.30	(N/A)	0.00
976.85	273.68	(N/A)	0.00
977.35	287.14	(N/A)	0.00
977.85	299.84	(N/A)	0.00
978.35	311.94	(N/A)	0.00
978.85	323.50	(N/A)	0.00
979.07	328.46	(N/A)	0.00

Contributing Structures
(no Q: Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1,Copy of Orifice - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Orifice - 2,Riser - 2,Riser - 1)
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

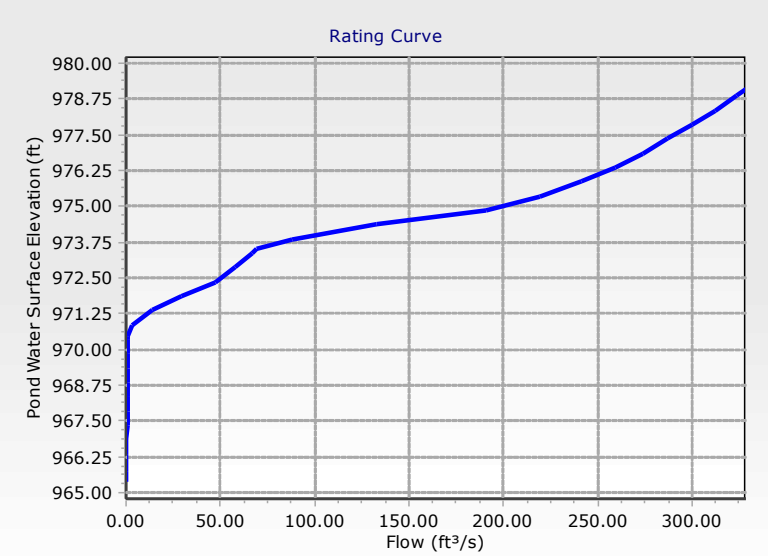
Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 2,Orifice - 1,Copy of Orifice - 1,Culvert - 1 (no Q: Riser - 2,Riser - 1)
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1

Composite Outlet Structure Detailed Report: Composite Outlet Structure - 1

Composite Rating Table
Tailwater Elevation = Free Outfall (Composite Outlet Structure - 1)

Contributing Structures
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1
Orifice - 2,Riser - 2,Orifice - 1,Riser - 1,Copy of Orifice - 1,Culvert - 1



PONDPACK SPILLWAY OUTPUT

COBEY CREEK - SPILLWAY (AS-BUILTS)

Project Summary	
Title	COBEY CREEK
Engineer	Matthew Castor
Company	Hg Consult, Inc
Date	4/6/2021

Notes

Table of Contents

COBEY CREEK - SPILLWAY (AS-BUILTS)

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
P1	Post-Development 100 year	100	5.265	11.970	84.76
P2	Post-Development 100 year	100	0.309	11.940	5.40
P3	Post-Development 100 year	100	42.704	12.090	511.44
P4	Post-Development 100 year	100	2.044	11.970	32.66

Node Summary

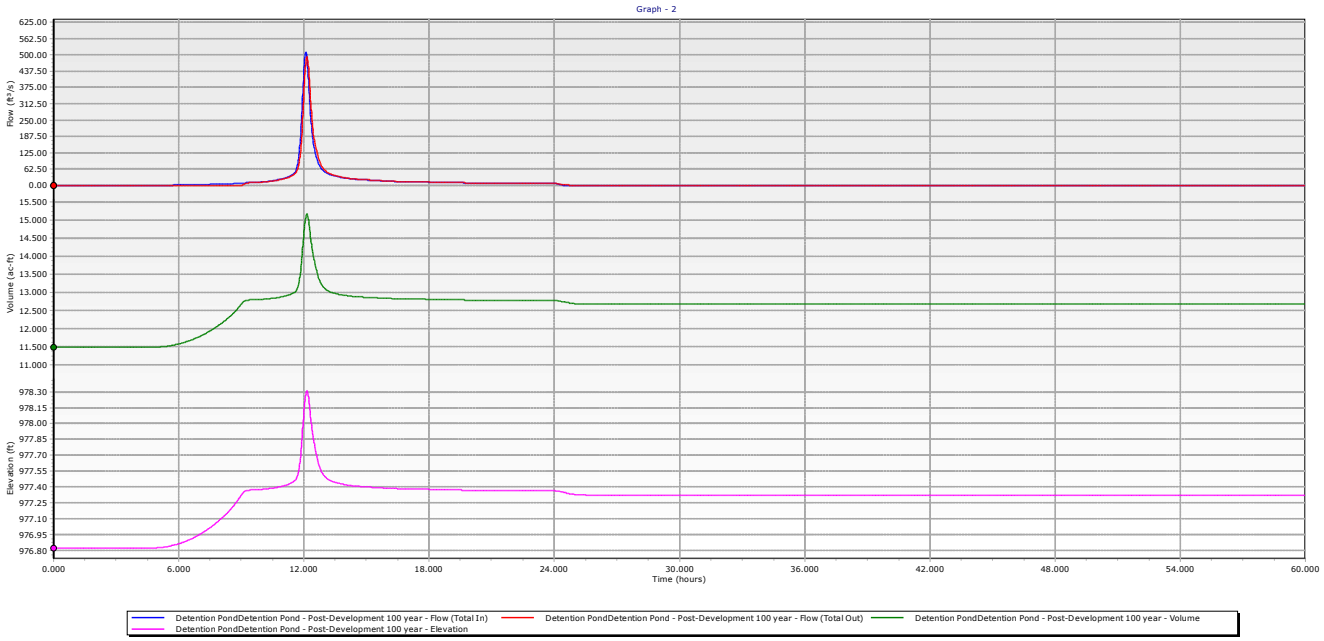
Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
O-1	Post-Development 100 year	100	5.265	11.970	84.76
O-2	Post-Development 100 year	100	0.309	11.940	5.40
O-3	Post-Development 100 year	100	41.512	12.140	493.13
O-4	Post-Development 100 year	100	2.044	11.970	32.66

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Detention Pond (IN)	Post-Development 100 year	100	42.704	12.090	511.44	(N/A)	(N/A)
Detention Pond (OUT)	Post-Development 100 year	100	41.512	12.140	493.13	978.31	15.173

COBEY CREEK - SPILLWAY (AS-BUILTS)

Index


Graph - 2
Flow (ft^3/s)
625.00
562.50
500.00
437.50
375.00
312.50
250.00
187.50
125.00
62.50
0.00
Volume (ac-ft)
15.500
15.000
14.500
14.000
13.500
13.000
12.500
12.000
11.500
11.000
Elevation (ft)
978.30
978.15
978.00
977.85
977.70
977.55
977.40
977.25
977.10
976.95
976.80
0.000
6.000
12.000
18.000
24.000
30.000
36.000
42.000
48.000
54.000
60.000
Time (hours)
Detention PondDetention Pond - Post-Development 100 year - Flow (Total In)
Detention PondDetention Pond - Post-Development 100 year - Flow (Total Out)
Detention PondDetention Pond - Post-Development 100 year - Volume
Detention PondDetention Pond - Post-Development 100 year - Elevation

Appendix G

POND #1 100 YEAR WATER SURFACE ELEVATION = 1007.21

POND #2 100 YEAR WATER SURFACE ELEVATION = 1002.77

POND #3 100 YEAR WATER SURFACE ELEVATION = 999.60

PROPOSED CONTOURS PER SURVEY

POND #1
TOP OF DAM ELEV. = 1009.00
WATER SURFACE ELEV. = 1005.00
BOTTOM OF POND ELEV. = 1001.00
EMERGENCY SPILLWAY = RISER PIPE
SERVES AS EMERGENCY SPILLWAY.

NOTE:
THE POND #1 100 YEAR WATER SURFACE ELEVATION WITH CLOGGED OUTLET STRUCTURE = 1008.28

POND #2
TOP OF DAM ELEV. = 1005.00
WATER SURFACE ELEV. = 1001.00
BOTTOM OF POND ELEV. = 997.00
SPILLWAY = 1.5' WIDE WEIR WITH 3:1 SIDE SLOPES @ ELEV. 1001.00
EMERGENCY SPILLWAY = 15' WIDE WEIR WITH 3:1 SIDE SLOPES @ 1003.27

POND #3
TOP OF DAM ELEV. = 1001.00
WATER SURFACE ELEV. = 998.00
BOTTOM OF POND ELEV. = 994.00
EMERGENCY SPILLWAY = OUTLET STRUCTURE SERVES AS EMERGENCY SPILLWAY

POND #1 POND #2 POND #3

MISSOURI 150 HIGHWAY

TEMPORARY 18" PVC RISER DET4B
SEE SHEET 42 FOR RISER DETAIL.
N. 978011.13 E. 2826721.74

TEMPORARY 18" HDPE END SECTION DET4A
N. 978026.79 E. 2826878.79

6'x 6' CONCRETE OUTLET STRUCTURE 1D
SEE SHEET 43B FOR STRUCTURE DETAIL.
N. 977941.91 E. 2827378.75

PROPOSED CONTOURS PER PLAN

NOTE:
THE POND #2 100 YEAR WATER SURFACE ELEVATION WITH CLOGGED OUTLET STRUCTURE = 1004.04

NOTE:
THE POND #3 100 YEAR WATER SURFACE ELEVATION WITH CLOGGED OUTLET STRUCTURE = 1004.46

SCALE: 1"=50'

1"=10'

Know what's below. Call before you dig. 811

"POND 1" NOT CONSTRUCTED IN PHASE 1
(THIS COMMENT IS FROM ANDERSON ENGINEERING, INC. THIS MARKUP IS NOT A PART OF THE AS-BUILT PLANS.)

STA. 1+57.89 TEMPORARY STORM LINE 4
TEMPORARY 18" PVC RISER DET4B
FL IN (W) = 1005.00

STA. 0+00.00 TEMPORARY STORM LINE 4
18" HDPE END SECTION DET4A
FL OUT (E) = 1001.00

POND #1
POND #2
POND #3
PROPOSED GRADE
EXISTING GRADE
SPILLWAY (FUTURE WATER FEATURE)
100 YEAR WATER SURFACE ELEVATION = 1007.21
100 YEAR WATER SURFACE ELEVATION = 1002.77
100 YEAR WATER SURFACE ELEVATION = 999.60
POND WATER SURFACE ELEV. 1005.00
POND WATER SURFACE ELEV. 1001.00
POND WATER SURFACE ELEV. 998.00

157.89 L.F
TEMPORARY
18" HDPE
@ 2.53%

STA. 1+13.12, LINE 1
RISER STRUCTURE 1D
M150 HWY. STA. 25+28.35, 92.37' LT.
6'x 6' CONCRETE OUTLET STRUCTURE
TOP ELEV. = ~~1002.07~~ 1002.37
FL IN (N) = ~~998.07~~ 998.24

STA. 0+82.62, LINE 1
M150 HWY WIDENING PLANS
4'x 4' JUNCTION BOX 1C
M150 HWY. STA. 25+28.43, 70.87' LT.
TOP = ~~1003.30~~ 1003.40
FL IN (N) = ~~998.04~~ 998.10
FL OUT (S) = ~~997.88~~ 998.00

30.50 L.F
FROM M150 HWY. WIDENING PLANS
30" HDPE
@ ~~0.10%~~ 0.33%

AS-BUILT
02/19/21

TEMPORARY STORM LINE 4

STORM LINE 1 FROM M150 WIDENING

NO.	DATE	REVISION	BY	CK/APP
	02/19/21	AS-BUILTS	SPW	RKS
8	06/24/20	REVISED NORTH OUTLET STRUCTURE PER ORIGINAL STORM REPORT	SPW	RKS
7	07/31/20	PER CITY'S COMMENTS	SPW	RKS
	10/31/18	SUBMITTAL TO CITY OF LEES SUMMIT	SPW	RKS

IF THIS IS NOT A BLUE INK SEAL AND THE SIGNATURE IN BLUE INK, THE PLAN IS A COPY AND MAY CONTAIN UNAUTHORIZED ALTERATIONS. THE CERTIFICATION CONTAINED ON THIS DOCUMENT SHALL NOT APPLY TO ANY COPIES.

STATE OF MISSOURI — REGISTERED PROFESSIONAL ENGINEER

R. KEVIN STERRETT | NO E-26440
August 24, 2020

Consult Inc engineers planners
11010 Haskell Street, Suite 210, Kansas City, Kansas 66109
CORPORATE LICENSE No. E2010005573 (MO.) / E-1736 (KS.)

STREET AND STORM SEWER PLANS
SOUTH DETENTION BASINS, TEMPORARY STORM LINE AND OUTLET STRUCTURE
COBEY CREEK FIRST PLAT
PHASE I
CITY OF LEES SUMMIT, JACKSON COUNTY, MISSOURI

X-REF NO. 16-059 Base Phase I
DRAWING NO. 16-059 Phase I Street Plans
DATE August 24, 2020
JOB NO. 16-059