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1.0 INTRODUCTION

This Run-on/Run-off Control System Plan (plan) was prepared for an existing coal combustion residuals (CCR) landfill located at the DTE Electric Company (DTE) Sibley Quarry Landfill (Landfill) in Trenton, Wayne County, Michigan.

This plan was prepared in accordance with 40 CFR Part 257 and specifically addresses the requirements under Subpart D, §257.81(c) of the U.S. Environmental Protection Agency (EPA) CCR Final Rule. The site is an existing landfill operating under a permit approved by the Michigan Department of Environment and Quality (MDEQ) on June 23, 2014, which is in accordance with regulatory standards generally equivalent to those included in the CCR Final Rule. Accordingly, run-on and run-off control system requirements for the disposal facility must meet or exceed those of the CCR Final Rule.

1.1 SITE LOCATION AND DESCRIPTION

The site consists of 207 acres located at 801 Fort Street in the City of Trenton, Wayne County, Michigan (Appendix A2: Figure 1). The Landfill is bounded by Sibley Road to the north, the former Detroit and Toledo Shore Line Railroad to the east (currently operated by CSX Corporation), and Fort Street to the west. The property is bounded on the south by the former Vulcan Mold & Iron Company (now owned by Danou Enterprises) and by the DTE Jefferson substation.

The site was operated as a limestone quarry since the mid 1800’s and was mined to a depth of approximately 300 feet below ground surface (“bgs”) in some areas. The site was acquired by DTE in 1951 and has been operated by DTE as a landfill since acquisition. The site is currently permitted as an existing Type III Industrial Waste Landfill under the provisions of Michigan Part 115, Solid Waste Management, of the Natural Resource and Environmental Protection Act (NREPA), 1994 Public Act (“PA”) 451.

1.2 DESCRIPTION OF CCR LANDFILL OPERATIONS

The current operating license designates 92.1 acres as areas authorized to receive waste, of which approximately 64.2 acres (Appendix A2: Figure 2) are areas of active landfilling occupied by CCR material. Approximately 90 acres, along the exterior perimeters of Landfill to the north, west, and south, are at final grade and have received final cover prior to September 2, 1999, and therefore are considered to be closed. Remaining portions of the site do not contain waste.

According to the January 2016 Annual Inspection Report, over the lifetime of the Landfill, it has received CCR (mainly fly ash with some bottom ash) from various DTE power plants. Currently, the Landfill receives CCR from the Trenton Power Plant (the main source), River Rouge Power Plant, and receives flue gas desulfurization material from the Monroe Power Plant. In addition, DTE reported that inert materials from various sites are disposed and used as CCR cover. On average, approximately 10,000 to 15,000 cubic yards of CCR are received on a monthly basis.
Currently, the Quarry is dewatered to approximately 300 feet bgs. Groundwater and stormwater are pumped from the quarry sump to an upper treatment pond located at the top of the quarry (referred to as “upper ponds”). Water from the upper ponds discharges into a conveyance channel which conveys the water approximately one-half mile to the lower ponds. A pump station at the southern end of the lower ponds discharges the water to the Detroit River. The water is discharged consistent with NPDES permit requirements. According to site personnel, the discharge rate averages approximately 1.5 million gallons per day (MGD), which maintains the water level in the quarry at its current elevation so that exposed CCR material are not in contact with the groundwater that interface at the bottom of the quarry.

1.3 CCR Final Rule Requirements

(40 CFR) 257.81(a) The owner or operator of an existing or new CCR landfill or any lateral expansion of a CCR landfill must maintain:

(1) A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm; and

(2) A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.

(b) Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under § 257.3–3.

The facility is an existing Landfill that has incorporated run-on and run-off controls systems, which during a 24-hour, 25-year storm, both prevents flow onto the site and collects and controls flow from the active portion of the unit. Run-off from the active portion of the CCR unit is collected and treated along with the groundwater pumped from the Quarry sump to maintain a consistent groundwater elevation. The treated water is discharged in accordance with the site’s existing NPDES permit.

1.4 Plan Content

(40 CFR) 257.81(c) Run-on and run-off control system plan—

(1) Content of the plan. The owner or operator must prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the timeframes specified in paragraphs (c)(3) and (4) of this section. These plans must document how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of this section. Each plan must be supported by appropriate engineering calculations. The owner or operator has completed the initial run-on and run-off control system plan when the plan has been placed in the facility’s operating record as required by § 257.105(g)(3).
This plan describes how the run-on and run-off control systems have been designed and constructed to meet the applicable requirements of the CCR Final Rule. A certification statement from a qualified professional engineer verifying that this initial Plan meets the requirements of this section § 257.81 is provided in Appendix A. Engineering calculations supporting this plan are provided in Appendix B. In accordance with § 257.81(c)(1), this Plan will be amended each time there is a change in conditions that substantially affect the written plan in effect.

1.5 DOCUMENTS REVIEWED

Background information, design basis information, and other data used in preparing this plan were provided to AECOM by DTE and other available public information sources. AECOM is not responsible for the accuracy of the documents reviewed, and has prepared this plan by practicing good engineering judgement based upon the best available information. The following documents were reviewed in the preparation of this plan:


Additional information on the references reviewed for this plan can be found in Section 4.0.
2.0 OVERVIEW OF RUN-ON/RUN-OFF CONTROL SYSTEMS

The Sibley Quarry Landfill is a unique landfill in that the active portion of the unit is self-contained below surrounding grade. Run-on and run-off peak flows resulting from a 24-hour, 25-year storm drain by gravity towards the low-point of the quarry, the quarry sump. The quarry sump is pumped to maintain a consistent water elevation, and is discharged to a series of treatment ponds/channels. These treatment ponds and channels ultimately discharge to the Detroit River in accordance with an existing NPDES permit.

One hydrologic and hydraulic (H&H) model was developed using HydroCAD (version 10.0) software to analyze the site in order to evaluate the run-on and run-off control systems’ abilities to control the design storm. The quarry sump and downstream conveyances were found to adequately contain the 24-hour, 25-year storm event without overtopping. The resulting output from this model can be found in Appendix B. The components that make up the run-on and run-off control systems are described in detail below.

2.1 RUN-ON CONTROLS

Run-on to the site is prevented by a ridge which surrounds the site, which has a minimum crest elevation of approximately 605 amsl. Topography surrounding the site outside the ridge generally slopes away from the site in all directions.

2.2 PERMANENT RUN-OFF MANAGEMENT FEATURES

Within the site/ridge limits that surround the active portions of the unit, runoff flows towards the quarry sump along varying slopes. These slopes include steep vertical drop-offs at the historic limits of the quarry mining development. Channelized conveyances and culverts are in place to direct flow towards to the quarry sump.

2.3 EROSION CONTROL

The majority of the site consists of either well-vegetated areas surrounding the active fill area, exposed rock, or CCR materials. Per the January 2016 annual inspection report: “Erosion gullies on the CCR slopes were observed. These gullies do not have to be maintained due to the incised nature of the Landfill.” Any potential erosion that may occur is contained within the quarry sump watershed, which conveys discharge through the site’s water treatment system and NPDES outfall.

2.4 COLLECTION AND HOLDING FACILITIES

The quarry sump water surface elevation (WSE) is maintained at approximately 300 amsl by pumping at an average rate of approximately 1.5 MGD. Using conservative modeling assumptions, the sump WSE rises to a peak level of approximately 336 amsl during the design storm, which is contained within the quarry well below surrounding grade.
(approximately 600 amsl). Following the design storm event, the temporary high water can be dewatered by pumping back down to normal operating levels.
3.0 FREQUENCY FOR REVISING THE PLAN

(40 CFR) 257.81(c)(4). The owner or operator of the CCR unit must prepare periodic run-on and runoff control system plans required by paragraph (c)(1) of this section every five years. The date of completing the initial plan is the basis for establishing the deadline to complete the first subsequent plan. The owner or operator may complete any required plan prior to the required deadline provided the owner or operator places the completed plan into the facility’s operating record within a reasonable amount of time. In all cases, the deadline for completing a subsequent plan is based on the date of completing the previous plan. For purposes of this paragraph (c)(4), the owner or operator has completed a periodic run-on and run-off control system plan when the plan has been placed in the facility’s operating record as required by § 257.105(g)(3).

DTE will update periodic run-on and runoff control system plans every five years and will place the plan in the facility’s operating record. DTE will obtain a certification from a qualified professional engineer stating that the run-on and run-off control system plan meet the requirements of this section.
4.0 REFERENCES

Digital Topographic Map of the Sibley Quarry Landfill Site (USGS NED n43w084 1/3 arc-second 2013 1 x 1 degree ArcGrid) courtesy of the U.S. Geological Survey. Obtained September 2016.


APPENDIX A1:
FINAL CCR RULE ENGINEER’S CERTIFICATION
Certification Statement 40 CFR § 257.81(c)(5) – Initial Run-on and Run-Off Control System Plan for an Existing CCR Landfill

CCR Unit: DTE Energy Sibley Quarry Landfill

I, Scott G. Hutsell, being a Registered Professional Engineer in good standing in the State of Michigan, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the information contained in the initial run-on and run-off control system plan dated October 17, 2016 meets the requirements of 40 CFR § 257.81.

Scott G. Hutsell  
Printed Name

10/17/16  
Date
APPENDIX A2: EXISTING SITE PLAN DRAWINGS
NOTES:
1. TOPOGRAPHIC INFORMATION GENERATED FROM AERIAL PHOTOGRAPHY DATED 27 APRIL 2013 BY KUCERA INTERNATIONAL, INC., WILLOUGHBY, OH.
2. APPROXIMATE BOUNDARY OF ACTIVE LANDFILLING OBTAINED FROM DTE DRAWING NO. 6SE 06200-021, DATED 31 OCTOBER 2013.
3. APPROXIMATE NO WASTE BOUNDARY OBTAINED FROM CORRESPONDENCES WITH DTE ON 18 FEBRUARY 2015.

LEGEND
- APPROXIMATE AREA OF WASTE REQUIRING FINAL COVER (64.2 AC)
- APPROXIMATE AREA OF NO WASTE
- APPROXIMATE BOUNDARY OF PERMITTED ACTIVE LANDFILLING AREA
- APPROXIMATE LANDFILL AREA THAT RECEIVED CLAY COVER

SCALE IN FEET

APPROXIMATE EXTENT OF WASTE AT SIBLEY QUARRY LANDFILL
APPENDIX B1:
NOAA RAINFALL DATA
# Point Precipitation Frequency Estimates

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

NOAA, National Weather Service, Silver Spring, Maryland

## PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)\(^1\)

<table>
<thead>
<tr>
<th>Duration</th>
<th>Average recurrence interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.32 (1.11-1.59)</td>
</tr>
<tr>
<td></td>
<td>1.55 (1.31-1.84)</td>
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<tr>
<td></td>
<td>1.80 (1.52-2.13)</td>
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<tr>
<td></td>
<td>2.22 (1.87-2.65)</td>
</tr>
<tr>
<td></td>
<td>2.61 (2.23-3.44)</td>
</tr>
<tr>
<td></td>
<td>3.17 (2.89-4.54)</td>
</tr>
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<td></td>
<td>3.64 (3.38-5.19)</td>
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<td></td>
<td>4.13 (3.83-5.77)</td>
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<td></td>
<td>4.63 (4.34-6.90)</td>
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<tr>
<td></td>
<td>5.40 (4.96-7.30)</td>
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<tr>
<td></td>
<td>6.29 (5.55-7.97)</td>
</tr>
<tr>
<td></td>
<td>7.28 (6.66-8.81)</td>
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<td></td>
<td>8.01 (7.43-9.61)</td>
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<td>9.01 (8.33-10.7)</td>
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<td>12.3 (11.75-13.8)</td>
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<td>13.4 (12.15-14.9)</td>
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<td>14.5 (13.45-16.1)</td>
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<td></td>
<td>15.6 (14.35-17.3)</td>
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<td></td>
<td>16.7 (15.15-18.6)</td>
</tr>
<tr>
<td></td>
<td>17.8 (16.35-19.9)</td>
</tr>
</tbody>
</table>

\(^1\) Precipitation frequency (PF) estimates in this table are based on 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.
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.1664°, Longitude: -83.1839°

Average recurrence interval (years)
- 1
- 2
- 5
- 10
- 25
- 50
- 100
- 200
- 500
- 1000

Duration
- 5-min
- 10-min
- 15-min
- 30-min
- 1-hr
- 2-hr
- 3-hr
- 4-hr
- 6-hr
- 8-hr
- 12-hr
- 24-hr

Precipitation depth (in)


Back to Top
Maps & aerials

Small scale terrain

Large scale terrain

Large scale map
APPENDIX B2:
HYDROCAD 25-YEAR/24-HOUR OUTPUT
### Area Listing (all nodes)

<table>
<thead>
<tr>
<th>Area (acres)</th>
<th>CN</th>
<th>Description</th>
<th>(subcatchment-numbers)</th>
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</thead>
<tbody>
<tr>
<td>124.490</td>
<td>98</td>
<td>(1S)</td>
<td></td>
</tr>
<tr>
<td>4.310</td>
<td>83</td>
<td>Brush, Poor, HSG D (3S)</td>
<td></td>
</tr>
<tr>
<td>37.700</td>
<td>71</td>
<td>Meadow, non-grazed, HSG C (1S)</td>
<td></td>
</tr>
<tr>
<td>1.480</td>
<td>98</td>
<td>Water Surface, 0% imp, HSG A (4S)</td>
<td></td>
</tr>
<tr>
<td><strong>167.980</strong></td>
<td><strong>92</strong></td>
<td><strong>TOTAL AREA</strong></td>
<td>**                        **</td>
</tr>
</tbody>
</table>
Summary for Subcatchment 1S: Quarry Contributing Area

Runoff = 602.86 cfs @ 12.08 hrs, Volume = 41.745 af, Depth = 3.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-72.00 hrs, dt = 0.01 hrs
Type II 24-hr 25-year Rainfall = 3.97"

<table>
<thead>
<tr>
<th>Area (ac)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 124.490</td>
<td>98</td>
<td>Meadow, non-grazed, HSG C</td>
</tr>
<tr>
<td>37.700</td>
<td>71</td>
<td></td>
</tr>
</tbody>
</table>

162.190 | 92  | Weighted Average
37.700    | 23.24% Pervious Area
124.490    | 76.76% Impervious Area

<table>
<thead>
<tr>
<th>Tc</th>
<th>Length</th>
<th>Slope</th>
<th>Velocity</th>
<th>Capacity</th>
<th>Description</th>
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</thead>
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<tr>
<td>11.6</td>
<td>100</td>
<td>0.0500</td>
<td>0.14</td>
<td></td>
<td>Sheet Flow, Grass: Dense n = 0.240 P2 = 2.34&quot;</td>
</tr>
<tr>
<td>4.5</td>
<td>1,800</td>
<td>0.1700</td>
<td>6.64</td>
<td></td>
<td>Shallow Concentrated Flow, Unpaved Kv = 16.1 fps</td>
</tr>
</tbody>
</table>

16.1 1,900 Total

Subcatchment 1S: Quarry Contributing Area

Type II 24-hr 25-year Rainfall = 3.97"
Runoff Area = 162.190 ac
Runoff Volume = 41.745 af
Runoff Depth = 3.09"
Flow Length = 1,900'
Tc = 16.1 min
CN = 92
Summary for Subcatchment 3S: Reach Contributing Area

Runoff = 21.00 cfs @ 11.90 hrs, Volume= 0.812 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type II 24-hr 25-year Rainfall=3.97"

<table>
<thead>
<tr>
<th>Area (ac)</th>
<th>CN</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.310</td>
<td>83</td>
<td>Brush, Poor, HSG D</td>
</tr>
<tr>
<td>4.310</td>
<td>100.00%</td>
<td>Pervious Area</td>
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</table>

Subcatchment 3S: Reach Contributing Area

Type II 24-hr 25-year Rainfall=3.97"
Runoff Area=4.310 ac
Runoff Volume=0.812 af
Runoff Depth=2.26"
Tc=0.0 min
CN=83
Summary for Subcatchment 4S: Pond Surfaces

Runoff = 9.92 cfs @ 11.90 hrs, Volume = 0.461 af, Depth = 3.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-72.00 hrs, dt = 0.01 hrs
Type II 24-hr 25-year Rainfall=3.97"

<table>
<thead>
<tr>
<th>Area (ac)</th>
<th>CN</th>
<th>Description</th>
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<tr>
<td>1.480</td>
<td>98</td>
<td>Water Surface, 0% imp, HSG A</td>
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<tr>
<td>1.480</td>
<td>100</td>
<td>100.00% Pervious Area</td>
</tr>
</tbody>
</table>

Subcatchment 4S: Pond Surfaces

Type II 24-hr
25-year Rainfall=3.97"
Runoff Area=1.480 ac
Runoff Volume=0.461 af
Runoff Depth=3.74"
Tc=0.0 min
CN=98
Summary for Reach 3R: Conveyance Channel

Channel dimensions based on topography.

**Inflow Area** = 167.980 ac, 74.11% Impervious, Inflow Depth > 1.11” for 25-year event

**Inflow** = 24.11 cfs @ 11.90 hrs, Volume = 15.491 af

**Outflow** = 11.35 cfs @ 11.97 hrs, Volume = 15.368 af, Atten = 53%, Lag = 4.4 min

Routing by Dyn-Stor-Ind method, Time Span = 0.00-72.00 hrs, dt = 0.01 hrs / 2

Max. Velocity = 2.26 fps, Min. Travel Time = 23.1 min

Avg. Velocity = 1.56 fps, Avg. Travel Time = 33.2 min

Peak Storage = 15,699 cf @ 11.97 hrs

Average Depth at Peak Storage = 2.24’

Bank-Full Depth = 4.00’ Flow Area = 16.0 sf, Capacity = 53.08 cfs

0.00’ x 4.00’ deep channel, n = 0.035 Earth, dense weeds

Side Slope Z-value = 1.0 ’/’ Top Width = 8.00’

Length = 3,120.0’ Slope = 0.0038 ’/’

Inlet Invert = 607.00’, Outlet Invert = 595.00’
Summary for Pond 1P: Upper Ponds

Assumed twin 24" culvert outlet.

Inflow Area = 163.670 ac, 76.06% Impervious, Inflow Depth > 1.12" for 25-year event
Inflow = 12.36 cfs @ 11.90 hrs, Volume= 15.212 af
Outflow = 5.29 cfs @ 11.98 hrs, Volume= 14.911 af, Atten= 57%, Lag= 5.0 min
Primary = 5.29 cfs @ 11.98 hrs, Volume= 14.911 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 614.96' @ 11.98 hrs Surf.Area= 0.527 ac Storage= 0.434 af

Plug-Flow detention time= 80.2 min calculated for 14.909 af (98% of inflow)
Center-of-Mass det. time= 39.9 min (2,324.9 - 2,285.0)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>614.00'</td>
<td>0.453 af</td>
<td>Custom Stage Data (Irregular) Listed below (Recalc)</td>
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</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</tr>
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<tbody>
<tr>
<td>(feet)</td>
<td>(acres)</td>
<td>(feet)</td>
<td>(acre-feet)</td>
<td>(acre-feet)</td>
<td>(acres)</td>
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<tr>
<td>614.00</td>
<td>0.378</td>
<td>570.0</td>
<td>0.000</td>
<td>0.000</td>
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<td>615.00</td>
<td>0.533</td>
<td>667.0</td>
<td>0.453</td>
<td>0.453</td>
<td>0.598</td>
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<table>
<thead>
<tr>
<th>Device</th>
<th>Routing</th>
<th>Invert</th>
<th>Outlet Devices</th>
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<tr>
<td>#1</td>
<td>Primary</td>
<td>614.00'</td>
<td>24.0&quot; Round Culvert X 2.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L= 25.0’ CPP, projecting, no headwall, Ke= 0.900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet / Outlet Invert= 614.00’ / 614.00’ S= 0.0000’ /” Cc= 0.900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf</td>
</tr>
</tbody>
</table>

Primary OutFlow Max= 5.29 cfs @ 11.98 hrs HW= 614.96’ TW= 614.61’ (Dynamic Tailwater)
↑↑↑1=Culvert (Barrel Controls 5.29 cfs @ 2.58 fps)
Pond 1P: Upper Ponds

Inflow Area=163.670 ac
Peak Elev=614.96'
Storage=0.434 af
24.0"
Round Culvert x 2.00
n=0.013
L=25.0'

Hydrograph
Summary for Pond 2P: S Upper Pond

Assumed twin 24" culvert outlet.

Inflow Area = 163.670 ac, 76.06% Impervious, Inflow Depth > 1.09" for 25-year event
Inflow    = 5.29 cfs @ 11.98 hrs, Volume= 14.911 af
Outflow   = 4.10 cfs @ 12.45 hrs, Volume= 14.679 af, Atten= 22%, Lag= 28.2 min
Primary   = 4.10 cfs @ 12.45 hrs, Volume= 14.679 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 614.68' @ 12.45 hrs Surf.Area= 0.494 ac Storage= 0.298 af

Plug-Flow detention time= 61.9 min calculated for 14.679 af (98% of inflow)
Center-of-Mass det. time= 30.8 min (2,355.7 - 2,324.9)

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<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
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<tr>
<td>#1</td>
<td>614.00'</td>
<td>0.467 af</td>
<td>Custom Stage Data (Irregular) Listed below (Recalc)</td>
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<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>(feet)</td>
<td>(acres)</td>
<td>(feet)</td>
<td>(acre-feet)</td>
<td>(acre-feet)</td>
<td>(acres)</td>
</tr>
<tr>
<td>614.00</td>
<td>0.390</td>
<td>578.0</td>
<td>0.000</td>
<td>0.000</td>
<td>0.390</td>
</tr>
<tr>
<td>615.00</td>
<td>0.548</td>
<td>655.0</td>
<td>0.467</td>
<td>0.467</td>
<td>0.564</td>
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<table>
<thead>
<tr>
<th>Device</th>
<th>Routing</th>
<th>Invert</th>
<th>Outlet Devices</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Primary</td>
<td>614.00'</td>
<td>24.0&quot; Round Culvert X 2.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L= 25.0’ CMP, projecting, no headwall, Ke= 0.900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Inlet / Outlet Invert= 614.00' / 613.75’ S= 0.0100 '/' Cc= 0.900</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf</td>
</tr>
</tbody>
</table>

Primary OutFlow Max=4.10 cfs @ 12.45 hrs HW=614.68' TW=608.88' (Dynamic Tailwater)
↑1=Culvert (Barrel Controls 4.10 cfs @ 3.27 fps)
Pond 2P: S Upper Pond

Inflow Area=163.670 ac
Peak Elev=614.68'
Storage=0.298 af
24.0”
Round Culvert x 2.00
L=25.0'
S=0.0100 '/'

Hydrograph
Summary for Pond SDF: Quarry

Assumed pump curve to achieve 1.5 MGD pump rate at pond elevation 310. Pond elevation of 310 selected instead of 300 (as reported in inspection report) because the surface model used as the basis reflects a minimum elevation of approximately 308 at the Quarry Sump. While this is inaccurate, it results in a more conservative model.

Inflow Area = 162.190 ac, 76.76% Impervious, Inflow Depth > 4.11” for 25-year event
Inflow = 605.18 cfs @ 12.08 hrs, Volume= 55.552 af, Incl. 2.32 cfs Base Flow
Outflow = 2.70 cfs @ 24.62 hrs, Volume= 14.752 af, Atten= 100%, Lag= 752.8 min
Primary = 2.70 cfs @ 24.62 hrs, Volume= 14.752 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Starting Elev= 310.00’ Surf.Area= 13,206 sf Storage= 13,206 cf
Peak Elev= 336.00’ @ 24.47 hrs Surf.Area= 234,199 sf Storage= 1,855,280 cf (1,842,074 cf above start)

Plug-Flow detention time= 1,770.1 min calculated for 14.446 af (26% of inflow)
Center-of-Mass det. time= 1,197.9 min (2,333.2 - 1,135.3)

<table>
<thead>
<tr>
<th>Volume</th>
<th>Invert</th>
<th>Avail.Storage</th>
<th>Storage Description</th>
</tr>
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<tbody>
<tr>
<td>#1</td>
<td>307.00’</td>
<td>6,639,962 cf</td>
<td>Custom Stage Data (Irregular) Listed below</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>307.00</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>310.00</td>
<td>13,206</td>
<td>502.0</td>
<td>13,206</td>
<td>13,206</td>
<td>20,068</td>
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<tr>
<td>315.00</td>
<td>30,905</td>
<td>829.0</td>
<td>107,189</td>
<td>120,395</td>
<td>54,863</td>
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<tr>
<td>320.00</td>
<td>44,005</td>
<td>926.0</td>
<td>186,313</td>
<td>306,708</td>
<td>69,102</td>
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<tr>
<td>325.00</td>
<td>51,544</td>
<td>1,041.0</td>
<td>238,624</td>
<td>545,332</td>
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<tr>
<td>330.00</td>
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<td>1,652.0</td>
<td>330,452</td>
<td>875,785</td>
<td>218,874</td>
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<tr>
<td>335.00</td>
<td>217,127</td>
<td>3,773.0</td>
<td>720,317</td>
<td>1,596,101</td>
<td>1,134,627</td>
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<tr>
<td>340.00</td>
<td>302,275</td>
<td>3,708.0</td>
<td>1,292,649</td>
<td>2,888,751</td>
<td>1,177,605</td>
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<tr>
<td>345.00</td>
<td>375,527</td>
<td>3,887.0</td>
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<td>4,579,947</td>
<td>1,287,445</td>
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<tr>
<td>350.00</td>
<td>449,589</td>
<td>4,434.0</td>
<td>2,060,014</td>
<td>6,639,962</td>
<td>1,650,245</td>
</tr>
</tbody>
</table>

Device Routing Invert Outlet Devices
#1 Primary 312.00’ Pump
Discharges@614.00’ Turns Off@308.00’
Flow (gpm) = 1,042.0 1,100.0 1,200.0 1,300.0 1,400.0
Head (feet) = 304.00 290.00 280.00 270.00 260.00

Primary OutFlow Max=2.70 cfs @ 24.62 hrs HW=336.00’ TW=614.71’ (Dynamic Tailwater)
1=Pump (Pump Controls 2.70 cfs)
Pond SDF: Quarry

Hydrograph

Inflow Area=162.190 ac
Peak Elev=336.00'
Storage=1,855,280 cf

Inflow Area=162.190 ac
Peak Elev=336.00'
Storage=1,855,280 cf