#### MIDWEST WASH GROUP Northeast Corner of Rte 291 and Se Thompson Drive Lee's Summit, Mo 64081

#### PRELIMINARY STORMWATER DRAINAGE STUDY

Prepared for:

Midwest Wash Group 1362 NE Windsor Dr. Lee's Summit, MO 64086



Olsson Project No. 022-04040 May 2023 (Revised June 2023)

# olsson

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### **1. GENERAL INFORMATION**

The Midwest Wash Group's project (the project) is approximately 1.23 acres of proposed planned industrial. This project is located northeast of the intersection of HWY 291 and SE Thompson Drive in Lee's Summit, Missouri. Stormwater from the project is conveyed into the Big Creek Watershed. Figure 1 shows the location and boundary of the project.



Figure 1. Location Map.

### **1.1 FEMA Floodplain Classifications**

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Panel Number 29095C0438G classifies the project to be within the Zone X.

Zone X – Areas that are determined to be moderate flood hazards areas and can be any
of the following: areas of the 500-year (0.2-percent-annual-chance) flood; areas of
average depths of less than one foot or with drainage areas less than one square mile;
areas protected by levees from the 1% annual chance flood.

### **1.2 Soil Classifications**

Soil maps published on the Natural Resources Conservation Service's (NRCS) Web Soil Survey categorize soils within the project boundary as shown in Table 1. See Exhibit 2 in Appendix A for a map of soils on the property.

Table 1. Soil Classifications.

| Symbol | Name  | Slopes | Hydrologic Soil Group |
|--------|---|--------|-----------------------|
| 10116  | Sampsel silty clay loam (9.7%)              | 2-5 %  | C/D                   |
| 10180  | Udarents-Urban land-Sampsel complex (90.3%) | 2-5 %  | С                     |

## 2. METHODOLOGY

This drainage study has been prepared to evaluate the hydrologic impact generated by the project. The base data for the models prepared for this report has been obtained from available online maps and aerial imagery. Stormwater management is based upon methods and objectives defined in the Kansas City Metropolitan Chapter of the American Public Works Association's (KC-APWA) 2011 design guidance document called "Section 5600 Storm Drainage Systems & Facilities". Stormwater runoff models were created for the 2-, 10-, and 100-year design storm events.

### **3. EXISTING CONDITIONS**

The existing site consist of open green space currently. Existing drainage patterns sheet flow from the west public storm system (open flared end section) into our proposed site and then is captured by an existing swale (north of property), and then captured into another public storms system (flared end section). The total estimated area modeled within this drainage area is approximately 12.0 acres in existing conditions, which includes portions of on-site and off-site drainage area.

### **3.1 Hydrologic Analysis (Existing Conditions)**

To provide a direct comparison between the existing and proposed conditions models, the points of interest have been kept consistent throughout the analysis.

Curve numbers were determined based on the soil classifications outlined in Section 1.2 and existing land use. Land use was determined from recent aerial imagery. Curve numbers were assumed as shown in Table 2.

#### Table 2. Curve Numbers.

| Land Use                                    | HSG | CN |
|---|-----|----|
| Sampsel silty clay loam (9.7%)              | C/D | 74 |
| Udarents-Urban land-Sampsel complex (90.3%) | D   | 80 |

\*HSG = hydrologic soil group, \*CN = curve number

#### Table 3. Existing Conditions Drainage Area Data.

| Drainage<br>Area | On-site Area<br>(acres) | Off-site Area<br>(acres) | Total Area<br>(acres) |                             |                        |
|------------------|-------------------------|--------------------------|-----------------------|-----------------------------|------------------------|
| А                | 1.29                    | 0                        |                       |                             |                        |
| В                | 0                       | 12.0                     |                       |                             |                        |
| Total<br>Area:   |                         |                          | 13.29                 |                             |                        |
| Drainage<br>Area | Storm Event             | K Value                  | Intensity<br>(in/Hr)  | Runoff Q<br>(cfs)(Rational) | Runoff Q<br>(cfs)(SCS) |
| A (On-           | 10-YR                   | 1.0                      | 7.35                  | 2.85                        | 7.225                  |
| site)            | 100-YR                  | 1.25                     | 10.32                 | 4.99                        | 13.81                  |
| B (Off-          | 10-YR                   | 1.0                      | 7 35                  | 26.46                       | 67.21                  |
| aita)            | 10 11                   | 1.0                      | 1.00                  |                             |                        |

### **3.2 Detention Requirements**

Per APWA Section 5608.4 and the City of Lee's Summit criteria, the performance criteria for comprehensive control is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

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

Both Rational and SCS methods of analysis have been utilized for the given site and both flows can be seen below. The site layout governs the allowable detention basin sizing and the basin sizing accommodates the 100-year storm event for both analysis methods. The comprehensive control requirements have been satisfied utilizing the rational method and the SCS method resulted in a post development flow rate that is lower than the pre-development flow rate while still containing the 100-year storm event within the basin.

### **4. PROPOSED CONDITIONS**

The proposed conditions sections of this analysis assume completion the project. The project will consist of a proposed car wash facility. With this, the impervious area has been calculated to show the impervious area has increased to roughly 59%.

#### 4.1 Effects of Development

The modeled drainage areas and points of interest are similar to the existing conditions model. However, throughout the site, some shifting of ridgelines will occur, accommodating proposed detention facility and anticipated grading activities, which will change the relative areas draining to each point of interest. The following is a summary of the proposed conditions drainage areas.

**Drainage Area A (on-site)** in proposed conditions is approximately 1.12 acres overall. Proposed grading activities and construction of buildings on-site will alter ridgelines from existing conditions, shifting areas very slightly. Please note, there is a difference between Existing Drainage Area A and Existing Drainage Area A due to site specifics, however, with this the small difference (0.17 acres) will sheet flow into Decker Street (Eastern Street) and into the public setback curb inlet. This inlet was already anticipated to capture this runoff, but gutter spread calcs were completed and proves this additional runoff can be handled.

**Drainage Area B (off-site)** in proposed conditions is approximately 12.0 acres overall. The only proposed grading activity that will occur within this Drainage Area is a modified swale in order to keep this runoff on the outskirts of the property site. This area was calculated via GIS, but it is assumed existing conditions currently take this water through a swale and into the public system. As discussed above, only a slight modification will need to occur in order to keep water from in its existing route/etc.

### 4.2 Hydrologic Analysis (Proposed Conditions)

The analysis provided in Section 3 established existing conditions of the development's drainage areas. The analysis in Section 4 will provide guidance for configuring the detention basin to meet the objectives established in Section 3. Proposed curve numbers for the on-site drainage areas were calculated based off impervious areas for the developed site.

The following tables summarize the results of the existing vs. proposed conditions analysis. Table 4 summarizes the proposed conditions drainage area data. Tables 5 compares the flow rates without detention along with Table 6 that shows the rates when detention is provided. These rates demonstrate the effects of development for each drainage area.

 Table 4. Proposed Conditions Drainage Area Data.

\*Note: Difference between Existing Drainage Area A and Proposed Drainage Area A of 0.17 acres. This water will sheet flow to Decker Street and be captured into existing public storm system (which was already calculated to handle this runoff)

| Drainage<br>Area           | On-site Area<br>(acres)  | Off-site Area<br>(acres) | Total Area<br>(acres) |                             |                         |
|----------------------------|--------------------------|--------------------------|-----------------------|-----------------------------|-------------------------|
| А                          | *1.12                    | 0                        |                       |                             |                         |
| В                          | 0                        | 12.0                     |                       |                             |                         |
| Total<br>Area:             |                          |                          | 13.29                 |                             |                         |
| Drainage<br>Area           | Storm Event              | K Value                  | Intensity<br>(in/Hr)  | Runoff Q<br>(cfs)(Rational) | Runoff Q<br>(cfs)(SCS)  |
|                            |                          |                          |                       |                             |                         |
| A (On-                     | 10-YR                    | 1.0                      | 7.35                  | 5.43                        | 7.052                   |
| A (On-<br>site)            | 10-YR<br>100-YR          | 1.0<br>1.25              | 7.35<br>10.32         | 5.43<br>9.53                | 7.052<br>10.66          |
| A (On-<br>site)<br>B (Off- | 10-YR<br>100-YR<br>10-YR | 1.0<br>1.25<br>1.0       | 7.35<br>10.32<br>7.35 | 5.43<br>9.53<br>26.46       | 7.052<br>10.66<br>67.21 |

Table 5 shows post-development peak discharge values points of interest assuming no detention is provided. Proposed conditions peak flow rates without detention are higher than allowable release rates for the 10-year storm and 100-year storm. Section 4.4 will analyze the effects of detention on proposed conditions peak flow rates and provide a comparison to peak flow rates without detention to determine if detention is beneficial for this project.

| Drainage<br>Area   | Storm<br>Event | Runoff Q<br>(cfs)<br>(Rational) | Runoff Q (cfs)<br>(SCS) |                                       |                               |
|--------------------|----------------|---------------------------------|-------------------------|---------------------------------------|-------------------------------|
| Existing<br>A (On- | 10-<br>YR      | 2.85                            | 7.225                   |                                       |                               |
| site)              | 100-<br>YR     | 4.99                            | 13.81                   | <b>Difference (cfs)</b><br>(Rational) | Difference (cfs)<br>(SCS)     |
| Proposed<br>A (On- | 10-<br>YR      | 5.85                            | 7.879                   | 2.85 – 5.85 <b>= -3</b>               | 7.225 – 7.879 <b>= -0.554</b> |
| site)              | 100-<br>YR     | 10.25                           | 13.48                   | 4.99 – 9.53 <b>= -4.54</b>            | 13.81 – 13.48 <b>= 0.330</b>  |

 Table 5. Proposed (No Detention) Conditions Peak Flow Comparison

### 4.3 **Proposed Detention Facilities**

To mitigate the increases in peak flows (shown in the previous table) and, where possible, to decrease further to the allowable release rates established in Section 3, detention will be provided for each of the on-site drainage areas. This detention facility will be constructed as part of the

project. The detention facility is designed to capture most of the site runoff and to mitigate increases in peak discharge from the site.

The detention facility will contain a 15" outlet pipe with an orifice plate containing a 10" orifice set at the bottom of the detention basin and an additional 10" orifice set 6" higher than the top of the bottom orifice. Additional information will be provided for the outlet design with the final stormwater drainage study.

It should be noted that this detention basin/structure will consist of a (4) sided 6' tall retaining wall with (1) opening on the northern side to allow for ease of maintenance and an overflow path. Due to site constraints with existing utilities/etc. this was the only available location to fit a sufficient basin.

Tables 6 includes hydrologic summaries of the proposed detention facilities for the 10- and 100year storm events, respectively.

**Table 6. Proposed Conditions Detention Flow** 

| Drainage Area | Storm Event | Runoff Q (cfs) (Rational) | Runoff Q (cfs) (SCS) |
|---------------|-------------|---------------------------|----------------------|
| Proposed A    | 10-YR       | 2.728                     | 7.052                |
| (On-site)     | 100-YR      | 5.665                     | 10.66                |

### 4.4 Effects of Proposed Detention

The tables above compare the results of the proposed conditions analysis with the detention described above to the existing conditions from Section 3 at the points of interest.

As shown in Table 6, with the addition of detention facility, peak discharges at Drainage Area A will be at or below the allowable release rates for the 10-year and 100-year storm.

### **5. SUMMARY**

This stormwater drainage study was prepared to evaluate the hydrologic impact generated by the Car Wash project and to provide recommendations for a comprehensive stormwater management plan. The project is a proposed car wash on approximately 1.29 acres.

### **6. CONCLUSIONS AND RECOMMENDATIONS**

This proposed stormwater management plan was designed to achieve compliance with current design criteria in effect for the City of Lee's Summit, Missouri.

The results of the analysis demonstrate that the future stormwater management plan for the project will achieve compliance with design criteria. We therefore request approval of this Preliminary Stormwater Drainage Study. This approval is conditional and should be substantiated with each plat of the project.

### 7. REFERENCES

- Best Management Products, Inc. (2021). "Frequently Asked Questions" <a href="https://www.bmpinc.com/faq/>">https://www.bmpinc.com/faq/></a>
- City of Lee's Summit. (2020). "Section 5600 Storm Drainage Systems & Facilities, City of Lee's Summit, Missouri, Design Criteria"
- FEMA (Federal Emergency Management Agency). (2021). "FEMA Flood Map Service Center". <a href="https://msc.fema.gov/portal/home>">https://msc.fema.gov/portal/home></a> (March 23, 2023).
- KC-APWA (American Public Works Association, Kansas City Metropolitan Chapter). (2011). "Division V Section 5600 Storm Drainage Systems & Facilities".

### **APPENDIX A**

Site Maps









|      |        | LEGE       |
|------|--------|------------|
| SS   |        | — ss — — — |
| SD — |        | — SD ———   |
|      | - P-UG |            |
| W    |        | — W ——     |
|      | — G —  |            |
| SS — |        | — SS ———   |
| SD — |        | — SD ———   |
| UGE— |        | — UGE———   |
| W    |        | — W ——     |
|      | — G —  |            |
| FP — |        | — FP ——    |

![](_page_14_Figure_4.jpeg)

05.13.23

SHEET 1 (C503)

### NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services NOAA, N/NGS12 National Geodetic Survey SSMC-3, #9202 1315 East-West Highway Silver Spring, Maryland 20910-3282 (301) 713-3242

To obtain current elevation, description, and/or location information for bench marks shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713- 3242, or visit its website at http://www.ngs.noaa.gov.

**Base map** information shown on this FIRM was derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date stream channel configurations and floodplain delineations than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed Map Index for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the Map Service Center (MSC) website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

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995000 FT

38° 52' 30" 94° 22' 30"

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JOINS PANEL 0551

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|--|---|---|---|---|---------|
| The 1% annual a 1% chance of the area                                | l chance flood (<br>f being equaled   | 100-year flood), a  | also known as the<br>any given year. Th   | base flood, is the flood that ha<br>e Special Flood Hazard Area is  | 5       |
| include Zones A<br>elevation of the                                  | A, AE, AH, AO, A<br>1% annual ch  | AR, A99, V, and V<br>ance flood.  | E. The Base Flood   | Elevation is the water-surface  |         |
| ZONE A   | No Base F   | lood Elevations d   | etermined.  |   |         |
| ZONE AE<br>ZONE AH   | Base Flood  | a Elevations deter  | mined.<br>(usually areas of n   | onding); Base Flood Elevations  |         |
| ZONE AO  | determine<br>Flood den  | d.<br>ths of 1 to 3 feet  | (usually sheet flow   | on sloping terrain); average  |         |
|  | depths de   | termined. For are   | as of alluvial fan flo  | boding, velocities also determine   | ed.     |
| ZONE AR  | Special Flo<br>flood by a<br>AR indicat<br>protection   | ood Hazard Areas<br>flood control systems<br>that the forme<br>from the 1% and  | formerly protected<br>tem that was subse<br>r flood control syst<br>nual chance or grea   | from the 1% annual chance<br>equently decertified. Zone<br>em is being restored to provide<br>ater flood.   |         |
| ZONE A99   | Area to be<br>protection  | system under co   | L% annual chance<br>nstruction; no Base   | flood by a Federal flood<br>e Flood Elevations determined.  |         |
| ZONE V   | Coastal flo<br>determine  | ood zone with velo<br>d.  | ocity hazard (wave  | action); no Base Flood Elevatio   | ns      |
| ZONE VE  | Coastal flo<br>determine  | ood zone with velo<br>d.  | ocity hazard (wave  | action); Base Flood Elevations  |         |
|  | FLOODWAY  | Y AREAS IN ZO   | ONE AE  |   |         |
| The floodway is<br>encroachment s<br>flood heights.                  | s the channel of<br>so that the 1%  | f a stream plus ar<br>annual chance flo   | ny adjacent floodpla<br>bod can be carried  | ain areas that must be kept free<br>without substantial increases ir  | of<br>I |
| ZONE X   | Areas of 0.2%<br>average depth<br>mile: and area  | annual chance f<br>s of less than 1 f   | lood; areas of 1%<br>oot or with drainag<br>yees from 1% ann  | annual chance flood with<br>e areas less than 1 square<br>ual chance flood.   |         |
|  | OTHER ARI   | EAS   |   |   |         |
| ZONE X<br>ZONE D   | Areas determi<br>Areas in which   | ined to be outside<br>h flood hazards ar  | e the 0.2% annual<br>re undetermined, b   | chance floodplain.<br>ut possible.  |         |
|  |   |   |   | M (CBRS) AREAS  |         |
|  | CUASTALE  | ARRIER RESU   | JURCES STSTEI   | (CDRS) AREAS  |         |
|  | OTHERWIS  | E PROTECTED   | ) AREAS (OPAs   | )   |         |
| CBRS areas and   | d OPAs are norr   | mally located with<br>1% Annual Chan  | ın or adjacent to S<br>Ice Floodplain Bour  | pecial Flood Hazard Areas.<br>Idary   |         |
|  |   | 0.2% Annual Ch  | ance Floodplain Bo  | undary  |         |
|  |   | Zone D boundary   | aiy<br>1  |   |         |
|  |   | CBRS and OPA b  | oundary   |   |         |
|  |   | Boundary dividin<br>dividing Special I  | g Special Flood Ha<br>Flood Hazard Areas  | zard Area Zones and boundary<br>of different Base Flood Elevation   | ons,    |
| ~~ 513~  | ~   | riood depths, or<br>Base Flood Eleva  | riood velocities.<br>ition line and value   | ; elevation in feet*  |         |
| (EL 987)   |   | Base Flood Eleva<br>feet*   | tion value where u  | niform within zone; elevation in  | ۱       |
| *Referenced to   | the North Ame   | rican Vertical Dat  | um of 1988  |   |         |
| A  |   | Cross section line  | 9   |   |         |
| 23   | 23  | Transect line   |   |   |         |
| <u> </u>   |   | Culvert<br>Bridge   |   |   |         |
| 45° 02' 08", 9   | 03° 02' 12"   | Geographic coor   | dinates referenced  | to the North American Datum c   | f       |
| 3100000 I  | FT  | 1983 (NAD 83) V<br>5000-foot ticks:   | vestern Hemispher<br>Missouri State Plan  | e<br>e West Zone  |         |
| DX5510   |   | (FIPS Zone 2403   | ) Transverse Merc   | ator projection   |         |
|  | ×   | Bench mark (see   | e explanation in Not  | tes to Users section of this FIRM   | 1       |
| •<br>M1.5  | ×   | Bench mark (see<br>panel)<br>River Mile   | e explanation in Not  | tes to Users section of this FIRM   | 1       |
| • M1.5   | ×   | Bench mark (see<br>panel)<br>River Mile   | explanation in No   | tes to Users section of this FIRN   | 1       |
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LEGEND

![](_page_16_Figure_0.jpeg)

USDA Natural Resources

Conservation Service

| MAF   | P LEGEND                              | MAP INFORMATION   |  |
|---|---------------------------------------|---|--|
| Area of Interest (AOI) Area of Interest (AOI)             | Spoil Area                            | The soil surveys that comprise your AOI were mapped at 1:24,000.  |  |
| Soils Soil Map Unit Polygo                                | Nery Stony Spot                       | Warning: Soil Map may not be valid at this scale.<br>Enlargement of maps beyond the scale of mapping can ca   |  |
| Soil Map Unit Lines Soil Map Unit Points                  | of Conter Other Special Line Features | misunderstanding of the detail of mapping and accuracy of<br>line placement. The maps do not show the small areas of<br>contrasting soils that could have been shown at a more de |  |
| Special Point Features Blowout                            | Water Features                        | scale.<br>Please rely on the bar scale on each map sheet for map  |  |
| Borrow Pit<br>Clay Spot                                   | Transportation<br>HII Rails           | measurements.<br>Source of Map: Natural Resources Conservation Service  |  |
| <ul> <li>Closed Depression</li> <li>Gravel Pit</li> </ul> | US Routes                             | Web Soll Survey UKL:<br>Coordinate System: Web Mercator (EPSG:3857)<br>Maps from the Web Soil Survey are based on the Web Me  |  |
| Gravelly Spot   | Major Roads                           | projection, which preserves direction and shape but distort<br>distance and area. A projection that preserves area, such a  |  |
| Lava Flow   | Background<br>Aerial Photography      | accurate calculations of distance or area are required.<br>This product is generated from the USDA-NRCS certified of  |  |
| Mine or Quarry  | , onder notography                    | of the version date(s) listed below.<br>Soil Survey Area: Jackson County, Missouri  |  |
| Viscenaneous Water     Perennial Water                    |                                       | Survey Area Data: Version 24, Aug 31, 2022<br>Soil map units are labeled (as space allows) for map scale<br>1:50.000 or larger.   |  |
| <ul> <li>Rock Outcrop</li> <li>Saline Spot</li> </ul>     |                                       | Date(s) aerial images were photographed: Aug 30, 2022<br>8, 2022  |  |
| Sandy Spot  | t .                                   | The orthophoto or other base map on which the soil lines or compiled and digitized probably differs from the backgroun  |  |
| <ul><li>Sinkhole</li><li>Slide or Slip</li></ul>          |                                       | shifting of map unit boundaries may be evident.   |  |
| ø Sodic Spot  |                                       |   |  |

![](_page_17_Figure_2.jpeg)

### Map Unit Legend

| Man Unit Symbol             | Man Linit Nama   |               | Demonst of AOI |
|-----------------------------|--|---------------|----------------|
| Map Onit Symbol             | Map Unit Name  | Acres III AOI | Percent of AOI |
| 10116                       | Sampsel silty clay loam, 2 to 5 percent slopes                   | 0.2           | 9.7%           |
| 10180                       | Udarents-Urban land-Sampsel<br>complex, 2 to 5 percent<br>slopes | 1.9           | 90.3%          |
| Totals for Area of Interest |  | 2.1           | 100.0%         |

![](_page_18_Picture_3.jpeg)

### **APPENDIX B**

Existing Condition Hydrographs

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Hyd. No. 1

**Existing Conditions** 

| Hydrograph type | = Rational             | Peak discharge    | = 2.844 cfs |
|-----------------|------------------------|-------------------|-------------|
| Storm frequency | = 10 yrs               | Time to peak      | = 5 min     |
| Time interval   | = 1 min                | Hyd. volume       | = 853 cuft  |
| Drainage area   | = 1.290 ac             | Runoff coeff.     | = 0.3       |
| Intensity       | = 7.348 in/hr          | Tc by User        | = 5.00 min  |
| IDF Curve       | = APWA 5-15 Min Tc.IDF | Asc/Rec limb fact | = 1/1       |

![](_page_20_Figure_5.jpeg)

Monday, 05 / 1 / 2023

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Hyd. No. 1

**Existing Conditions** 

| Hydrograph type | = Rational             | Peak discharge    | = 4.988 cfs  |
|-----------------|------------------------|-------------------|--------------|
| Storm frequency | = 100 yrs              | Time to peak      | = 5 min      |
| Time interval   | = 1 min                | Hyd. volume       | = 1,497 cuft |
| Drainage area   | = 1.290 ac             | Runoff coeff.     | = 0.3        |
| Intensity       | = 12.890 in/hr         | Tc by User        | = 5.00 min   |
| IDF Curve       | = APWA 5-15 Min Tc.IDF | Asc/Rec limb fact | = 1/1        |
|                 |                        |                   |              |

![](_page_21_Figure_5.jpeg)

Monday, 05 / 1 / 2023

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Hyd. No. 4

SCS Existing

| Hydrograph type | = SCS Runoff | Peak discharge     | = 7.225 cfs   |
|-----------------|--------------|--------------------|---------------|
| Storm frequency | = 10 yrs     | Time to peak       | = 11.97 hrs   |
| Time interval   | = 1 min      | Hyd. volume        | = 15,461 cuft |
| Drainage area   | = 1.290 ac   | Curve number       | = 79*         |
| Basin Slope     | = 2.3 %      | Hydraulic length   | = 285 ft      |
| Tc method       | = LAG        | Time of conc. (Tc) | = 8.00 min    |
| Total precip.   | = 5.67 in    | Distribution       | = Type II     |
| Storm duration  | = 24 hrs     | Shape factor       | = 484         |

\* Composite (Area/CN) = [(1.160 x 80) + (0.130 x 74)] / 1.290

![](_page_22_Figure_6.jpeg)

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Hyd. No. 4

SCS Existing

| Hydrograph type | = SCS Runoff | Peak discharge     | = 13.81 cfs   |
|-----------------|--------------|--------------------|---------------|
| Storm frequency | = 100 yrs    | Time to peak       | = 11.97 hrs   |
| Time interval   | = 1 min      | Hyd. volume        | = 30,504 cuft |
| Drainage area   | = 1.290 ac   | Curve number       | = 79*         |
| Basin Slope     | = 2.3 %      | Hydraulic length   | = 285 ft      |
| Tc method       | = LAG        | Time of conc. (Tc) | = 8.00 min    |
| Total precip.   | = 9.25 in    | Distribution       | = Type II     |
| Storm duration  | = 24 hrs     | Shape factor       | = 484         |

\* Composite (Area/CN) = [(1.160 x 80) + (0.130 x 74)] / 1.290

![](_page_23_Figure_6.jpeg)

Monday, 06 / 19 / 2023

### APPENDIX C

Proposed Condition Hydrographs with Detention Storage

### **Pond Report**

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Pond No. 1 - EDD

#### Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 988.75 ft

#### Stage / Storage Table

| Stage (ft) | Elevation (ft) | Contour area (sqft) | Incr. Storage (cuft) | Total storage (cuft) |
|------------|----------------|---------------------|----------------------|----------------------|
| 0.00       | 988.75         | 282                 | 0                    | 0                    |
| 1.00       | 989.75         | 473                 | 373                  | 373                  |
| 2.00       | 990.75         | 525                 | 499                  | 872                  |
| 3.00       | 991.75         | 570                 | 547                  | 1,419                |
| 4.00       | 992.75         | 608                 | 589                  | 2,008                |
| 5.00       | 993.75         | 642                 | 625                  | 2,633                |
| 6.00       | 994.75         | 713                 | 677                  | 3,310                |
| 6.50       | 995.25         | 760                 | 368                  | 3,678                |

#### **Culvert / Orifice Structures**

#### [PrfRsr] [B] [C] [A] [B] [C] [D] [A] = 10.00 10.00 Inactive Inactive Inactive Inactive 0.00 Rise (in) Inactive Crest Len (ft) Span (in) = 10.00 10.00 0.00 0.00 Crest El. (ft) = 991.75 0.00 0.00 0.00 No. Barrels = 1 1 0 0 Weir Coeff. = 3.33 3.33 3.33 3.33 Invert El. (ft) = 989.75 991.25 0.00 0.00 Weir Type = Rect Rect \_\_\_\_ ----Length (ft) = 2.00 2.00 0.00 0.00 Multi-Stage = No No No No Slope (%) = 1.00 1.00 0.00 n/a N-Value = .013 .013 .013 n/a = 0.60 0.60 0.60 0.60 = 0.000 (by Contour) Orifice Coeff. Exfil.(in/hr) Multi-Stage = n/a No No No TW Elev. (ft) = 0.00

**Weir Structures** 

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

![](_page_25_Figure_11.jpeg)

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Monday, 06 / 19 / 2023

#### Hyd. No. 2

Rational Proposed Condition - Proposed EDD1

| Hydrograph type | = Rational             | Peak discharge    | = 5.844 cfs  |
|-----------------|------------------------|-------------------|--------------|
| Storm frequency | = 10 yrs               | Time to peak      | = 5 min      |
| Time interval   | = 1 min                | Hyd. volume       | = 1,753 cuft |
| Drainage area   | = 1.120 ac             | Runoff coeff.     | = 0.71*      |
| Intensity       | = 7.348 in/hr          | Tc by User        | = 5.00 min   |
| IDF Curve       | = APWA 5-15 Min Tc.IDF | Asc/Rec limb fact | = 1/1        |

\* Composite (Area/C) = [(0.760 x 0.90) + (0.360 x 0.30)] / 1.120

![](_page_26_Figure_7.jpeg)

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

Monday, 06 / 19 / 2023

#### Hyd. No. 2

Rational Proposed Condition - Proposed EDD1

| Hydrograph type | = Rational             | Peak discharge    | = 10.25 cfs  |
|-----------------|------------------------|-------------------|--------------|
| Storm frequency | = 100 yrs              | Time to peak      | = 5 min      |
| Time interval   | = 1 min                | Hyd. volume       | = 3,075 cuft |
| Drainage area   | = 1.120 ac             | Runoff coeff.     | = 0.71*      |
| Intensity       | = 12.890 in/hr         | Tc by User        | = 5.00 min   |
| IDF Curve       | = APWA 5-15 Min Tc.IDF | Asc/Rec limb fact | = 1/1        |

\* Composite (Area/C) = [(0.760 x 0.90) + (0.360 x 0.30)] / 1.120

![](_page_27_Figure_7.jpeg)

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Hyd. No. 5

SCS Proposed to Basin

| Hydrograph type | = SCS Runoff | Peak discharge     | = 7.879 cfs   |
|-----------------|--------------|--------------------|---------------|
| Storm frequency | = 10 yrs     | Time to peak       | = 11.97 hrs   |
| Time interval   | = 1 min      | Hyd. volume        | = 17,937 cuft |
| Drainage area   | = 1.120 ac   | Curve number       | = 90*         |
| Basin Slope     | = 1.3 %      | Hydraulic length   | = 275 ft      |
| Tc method       | = LAG        | Time of conc. (Tc) | = 7.12 min    |
| Total precip.   | = 5.67 in    | Distribution       | = Type II     |
| Storm duration  | = 24 hrs     | Shape factor       | = 484         |

\* Composite (Area/CN) = [(0.760 x 98) + (0.360 x 74)] / 1.120

![](_page_28_Figure_6.jpeg)

Monday, 06 / 19 / 2023

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Hyd. No. 5

SCS Proposed to Basin

| Hydrograph type | = SCS Runoff | Peak discharge     | = 13.48 cfs   |
|-----------------|--------------|--------------------|---------------|
| Storm frequency | = 100 yrs    | Time to peak       | = 11.97 hrs   |
| Time interval   | = 1 min      | Hyd. volume        | = 31,864 cuft |
| Drainage area   | = 1.120 ac   | Curve number       | = 90*         |
| Basin Slope     | = 1.3 %      | Hydraulic length   | = 275 ft      |
| Tc method       | = LAG        | Time of conc. (Tc) | = 7.12 min    |
| Total precip.   | = 9.25 in    | Distribution       | = Type II     |
| Storm duration  | = 24 hrs     | Shape factor       | = 484         |

\* Composite (Area/CN) = [(0.760 x 98) + (0.360 x 74)] / 1.120

![](_page_29_Figure_6.jpeg)

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Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2022

#### Monday, 06 / 19 / 2023

#### Hyd. No. 3

Rational Out of EDD1

| Hydrograph type | = Reservoir                       | Peak discharge        | = 2.728 cfs  |
|-----------------|-----------------------------------|-----------------------|--------------|
| Storm frequency | = 10 yrs                          | Time to peak          | = 8 min      |
| Time interval   | = 1 min                           | Hyd. volume           | = 1,378 cuft |
| Inflow hyd. No. | = 2 - Rational Proposed Condition | oMaxPn6peoveetionEDD1 | = 991.25 ft  |
| Reservoir name  | = EDD                             | Max. Storage          | = 1,144 cuft |

![](_page_30_Figure_7.jpeg)

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#### Monday, 06 / 19 / 2023

#### Hyd. No. 3

Rational Out of EDD1

| Hydrograph type | = Reservoir                       | Peak discharge         | = 5.665 cfs  |
|-----------------|-----------------------------------|------------------------|--------------|
| Storm frequency | = 100 yrs                         | Time to peak           | = 7 min      |
| Time interval   | = 1 min                           | Hyd. volume            | = 2,700 cuft |
| Inflow hyd. No. | = 2 - Rational Proposed Condition | oMaxPn6peoveetiobnEDD1 | = 992.33 ft  |
| Reservoir name  | = EDD                             | Max. Storage           | = 1,762 cuft |

![](_page_31_Figure_7.jpeg)

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Monday, 06 / 19 / 2023

#### Hyd. No. 6

SCS Out of Pond

| Hydrograph type | = Reservoir                 | Peak discharge | = 7.052 cfs   |
|-----------------|-----------------------------|----------------|---------------|
| Storm frequency | = 10 yrs                    | Time to peak   | = 12.00 hrs   |
| Time interval   | = 1 min                     | Hyd. volume    | = 17,562 cuft |
| Inflow hyd. No. | = 5 - SCS Proposed to Basin | Max. Elevation | = 992.80 ft   |
| Reservoir name  | = EDD                       | Max. Storage   | = 2,038 cuft  |

![](_page_32_Figure_7.jpeg)

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Monday, 06 / 19 / 2023

#### Hyd. No. 6

SCS Out of Pond

| Hydrograph type | = Reservoir                 | Peak discharge | = 10.66 cfs   |
|-----------------|-----------------------------|----------------|---------------|
| Storm frequency | = 100 yrs                   | Time to peak   | = 12.02 hrs   |
| Time interval   | = 1 min                     | Hyd. volume    | = 31,489 cuft |
| Inflow hyd. No. | = 5 - SCS Proposed to Basin | Max. Elevation | = 995.07 ft   |
| Reservoir name  | = EDD                       | Max. Storage   | = 3,544 cuft  |

![](_page_33_Figure_7.jpeg)