

To: Kirby Templin, PE, City of Shakopee  
Micah Heckman, PE, City of Shakopee

From: Jack Ammerman, PE, Stantec  
Brendan Barth, EIT, Stantec

File: 227705401

Date: May 16, 2023

## Reference: Quality Forklift Stormwater Management Plan

## INTRODUCTION

Swervo Development Corporation hired Stantec Consulting Services, Inc. (Stantec) to prepare stormwater calculations and site design drawings for the proposed Quality Forklift project. This memorandum highlights relevant City of Shakopee (City) rules and how the proposed stormwater management system addresses each rule. The City of Shakopee is an approved LGU by Lower Minnesota River Watershed District and therefore submittal to the watershed is not required.

## EXISTING CONDITIONS

- The Quality Forklift site being developed is currently occupied by two buildings with associated bituminous drive lanes and parking areas
- Pervious areas on-site consist of grass with some trees
- The site is located southeast of the intersection of Valley Industrial Blvd N and Citation Dr
- Runoff from the site generally flows north where it is collected by an existing depression before being piped west under Citation Dr to an existing drainage swale
- The geotechnical evaluation completed by Braun Intertec indicates soils on site are consistent with Hydrologic Soil Group (HSG) B
- Bedrock elevation varies across the site but was encountered between elevations 725.1 and 726.3
- Runoff from the site is calculated separately for pervious and impervious areas
- Time of concentration was calculated using direct entry method with time of six (6) minutes
- See Figure-01 in Appendix A for the existing drainage map
- See Appendix B for Existing HydroCAD model output

Table 1: Existing Conditions Curve Numbers

| Drainage Area | Total Area (sf) | Area (sf)        |                       |
|---------------|-----------------|------------------|-----------------------|
|               |                 | Grass<br>CN = 69 | Impervious<br>CN = 98 |
| E-01          | 156,080         | 86,972           | 69,108                |

## PROPOSED CONDITIONS

- The proposed project will consist of mass grading, construction of a gravel storage yard, and stormwater management improvements
- Stormwater will be managed on-site using a combination of surface infiltration and underground storage
  - The stormwater management system will utilize the existing depression along the north portion of the site, but proposes to retrofit the depression with an external weir with rectangular notch

**Reference:** Quality Forklift Stormwater Management Plan

- Additionally, the existing berm along the north side of the depression will be increased in height and a stabilized overflow will be constructed
- The depression alone does not provide adequate volume to meet City volume reduction requirements; therefore, 24-inch dual wall HDPE is proposed to provide the remaining volume to meet the requirement
- Stormwater calculations use MSE3 rainfall distribution and Atlas 14 rainfall depth
- Runoff for the site was calculated separately for pervious and impervious areas
- Time of concentration was calculated using direct entry method with time of six (6) minutes
- See Figure-02 in Appendix A for the proposed drainage map
- See Appendix B for Proposed HydroCAD model output

**Table 2: Proposed Conditions Curve Numbers**

| Drainage Area | Total Area (sf) | Area (sf)        |                   |                       |
|---------------|-----------------|------------------|-------------------|-----------------------|
|               |                 | Grass<br>CN = 69 | Gravel<br>CN = 96 | Impervious<br>CN = 98 |
| P-01          | 156,080         | 44,819           | 58,238            | 55,023                |

## CITY OF SHAKOPEE RELEVANT RULES

**Design Criteria Sect. 4.3.P.2.a.ii. – For redevelopment projects, stormwater runoff volumes will be controlled, and the post-construction runoff volume shall be retained on-site for 1.0-inches of runoff from new impervious surfaces created by the project.**

**Table 3: Impervious Area Summary**

| Existing Impervious Area (sf) | New Impervious Area (sf) | Total Proposed Impervious Area <sup>1</sup> (sf) | Increase from Existing (sf) |
|-------------------------------|--------------------------|--------------------------------------------------|-----------------------------|
| 69,108                        | 42,962                   | 111,261                                          | 42,153                      |

Note: Gravel surface considered new impervious

**Table 4: Volume Reduction Summary**

| New Impervious Area (sf) | 1.0-Inch Runoff Volume (cf) | Volume Below Outlet <sup>1</sup> (cf) |
|--------------------------|-----------------------------|---------------------------------------|
| 42,962                   | 3,580                       | 3,741                                 |

<sup>1</sup> Volume reported is combination of surface storage and underground pipe storage

*The existing depression will be retrofitted with an external weir with rectangular notch. Additionally, 24-inch dual wall HDPE pipe is proposed to provide storage for volume reduction. Table 4 indicates that the combined system provides greater than 1.0-inches of runoff from new impervious surfaces. The volume control standard is considered satisfied.*

Reference: Quality Forklift Stormwater Management Plan

**Design Criteria Sect. 4.3.P.2.b. – There shall be a net reduction from the pre-project conditions on an average annual basis of stormwater discharge Volume, Total Suspended Solids (TSS), and Total Phosphorus (TP). For new development and redevelopment, the water quality control standard shall be considered satisfied if the volume control standard has been satisfied.**

*As presented in Table 4 above, the volume control standard has been met; therefore, the water quality control standard is considered satisfied.*

**Design Criteria Sect. 4.3.P.2.c. – Post-construction peak runoff rates for the 2-, 10-, 100-year 24-hour events shall be reduced to less than or equal to pre-project conditions.**

**Table 5: Peak Runoff Rate Summary**

| Storm Event | Existing (cfs) | Proposed (cfs) |
|-------------|----------------|----------------|
| 2-Year      | 5.4            | 3.4            |
| 10-Year     | 7.5            | 7.5            |
| 100-Year    | 27.7           | 26.2           |

*The proposed stormwater management retrofit provides rate control for the 2-, 10-, and 100-year 24-hour events compared to pre-project conditions as presented in Table 5 above.*

**Comprehensive Water Resource Management Plan Sect. 4.A.6. – Any new development or redevelopment will maintain a minimum building opening elevation three feet above the anticipated 100-year high water elevation.**

**Table 6: High Water Level Summary**

| Device Name | 2-Year 24-Hour HWL | 10-Year 24-Hour HWL | 100-Year 24-Hour HWL | 100-Year 10-Day HWL |
|-------------|--------------------|---------------------|----------------------|---------------------|
| E_IB-01     | 731.0              | 731.5               | 732.0                | 730.8               |
| P_IB-01     | 731.8              | 732.3               | 732.7                | 731.9               |

**Table 7: Freeboard Summary**

| Exposure          | Relevant Stormwater Feature | 100-Year 24-Hour HWL | Low Opening | Low Opening Freeboard (ft) |
|-------------------|-----------------------------|----------------------|-------------|----------------------------|
| Existing Building | P_IB-01                     | 732.7                | 735.7       | 3.0                        |

*The proposed design results in an anticipated 100-year high water elevation three feet below the minimum building opening as presented in Table 7 above.*

Reference: Quality Forklift Stormwater Management Plan

**Table 8: Sanitary Structure Rim Elevation and HWL Summary**

| Structure | Relevant Stormwater Feature | 100-Year 24-Hour HWL | MH Rim Elevation | Separation (ft) |
|-----------|-----------------------------|----------------------|------------------|-----------------|
| West MH   | P_IB-01                     | 732.7                | 733.1            | 0.4             |
| East MH   | P_IB-01                     | 732.7                | 732.8            | 0.1             |

*In addition to providing three feet of separation between the anticipated 100-year high water elevation and low opening, the proposed high water elevation never exceeds the rim elevations of the nearby sanitary sewer manhole structures as presented in Table 8 above.*

## SUMMARY

The proposed stormwater management system for the Quality Forklift project:

- provides volume reduction greater than one-inch of runoff over new impervious surfaces,
- reduces TSS and TP loading on an average annual basis from existing conditions,
- provides rate control for the 2-, 10-, and 100-year 24-hour storm events from existing conditions, and
- maintains a minimum building opening of three feet above the anticipated 100-year HWL.

**Stantec Consulting Services Inc.**



**Jack Ammerman, PE**

Associate | Civil Engineer | Project Manager

Cell: (810) 252-1431

[Jack.Ammerman@stantec.com](mailto:Jack.Ammerman@stantec.com)

Appendices:

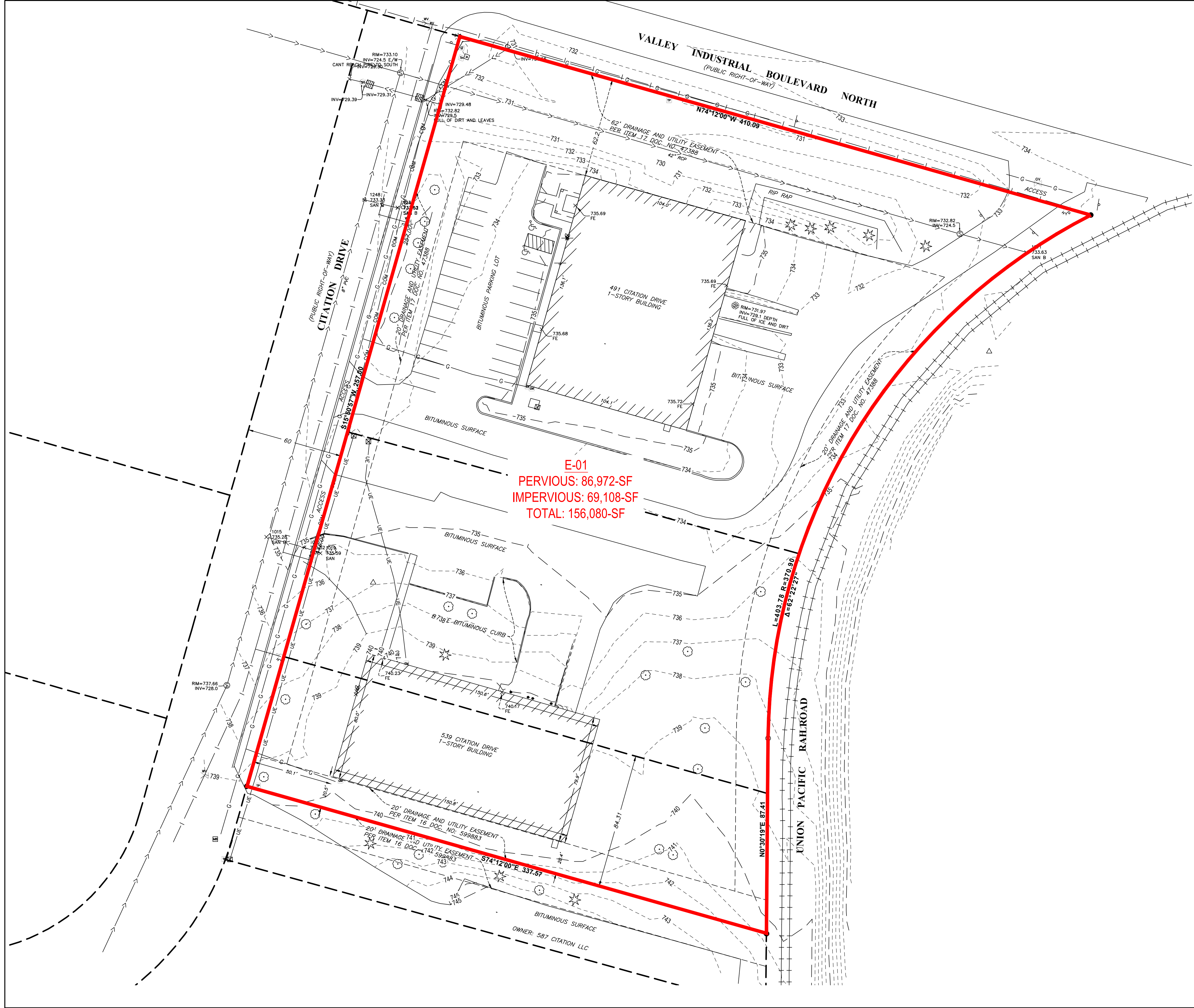
- Appendix A: Existing and Proposed Drainage Maps
- Appendix B: Existing and Proposed HydroCAD Model Outputs
- Appendix C: Geotechnical Report

## **APPENDIX A**

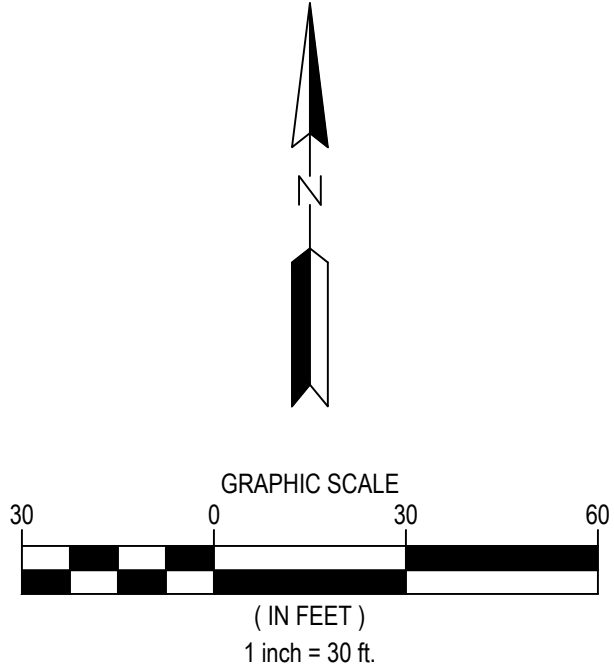
### **Existing and Proposed Conditions Drainage Maps**

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U:\22770541\QUALITY FORKLIFT CRANE SITES DESIGN\2\_DRAINAGE\CD\1\_HYDROLOGY\FIG-01 EXISTING HYDROLOGY.dwg



E-01  
PERVIOUS: 86,972-SF  
IMPERVIOUS: 69,108-SF  
TOTAL: 156,080-SF



LEGEND

- EXISTING DRAINAGE BOUNDARY
- EASEMENT LINE
- 901 EXISTING MINOR CONTOUR
- 900 EXISTING MAJOR CONTOUR
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER MANHOLE
- EXISTING STORM SEWER INLET
- EXISTING STORM SEWER INLET
- EXISTING FLARED END SECTION

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CLIENT:  
**SWERVO**  
Development Corporation

**QUALITY FORKLIFT  
IMPROVEMENTS**  
CITY OF SHAKOPEE  
SCOTT COUNTY, MINNESOTA

| DATE:      | DESCRIPTION:     | ISSUE NO.: | PROJECT TITLE: |
|------------|------------------|------------|----------------|
| 10/13/2023 | CLIENT SUBMITTAL | 1          |                |
| 11/09/2023 | CLIENT SUBMITTAL | 2          |                |
| 11/09/2023 | CLIENT SUBMITTAL | 3          |                |
| 05/16/2023 | CITY SUBMITTAL   | 4          |                |
|            |                  |            |                |
|            |                  |            |                |
|            |                  |            |                |

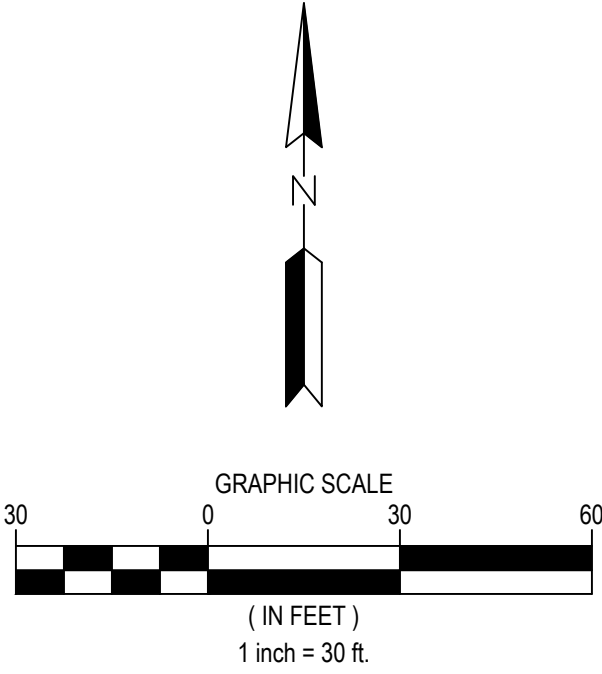
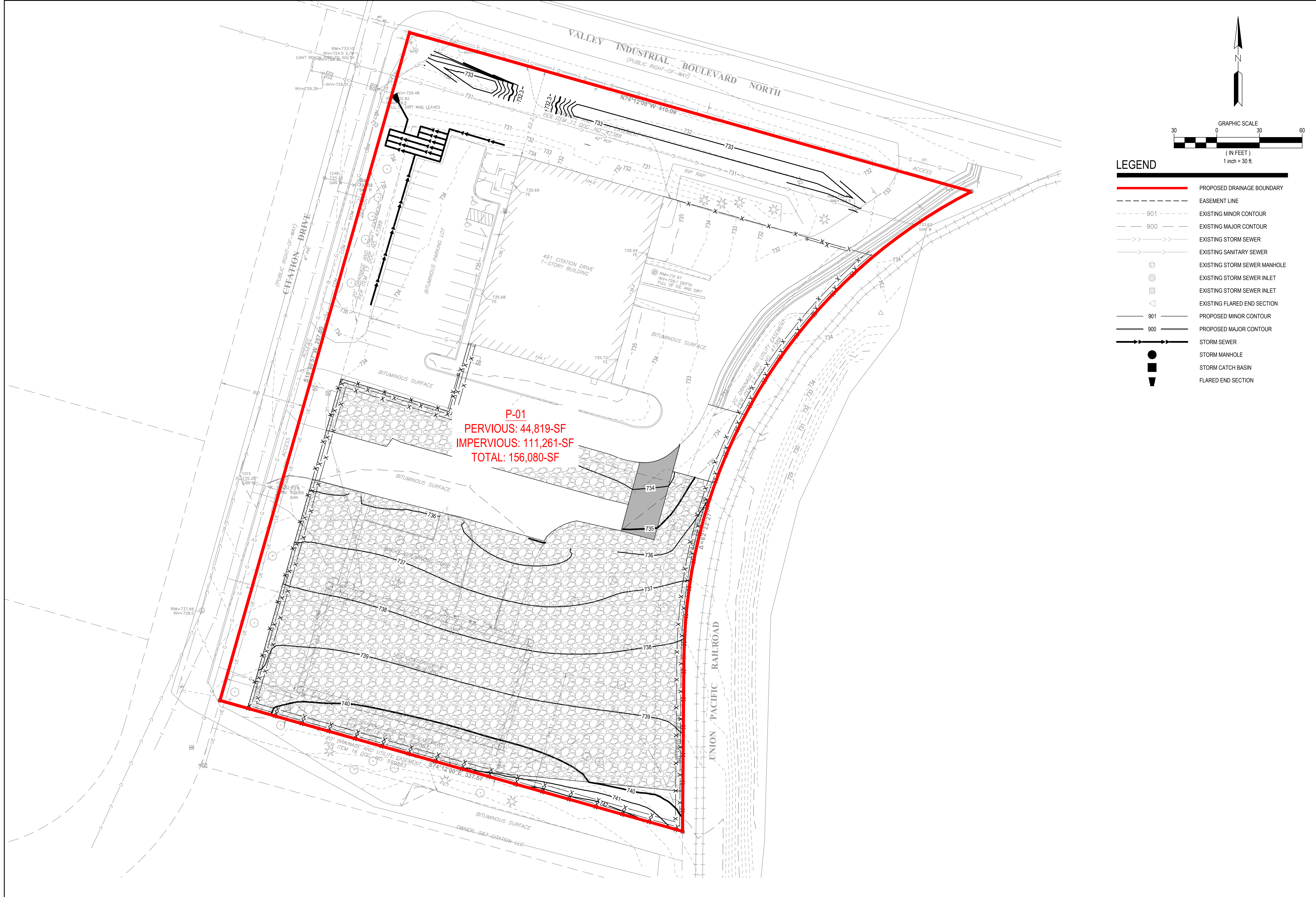
CERTIFICATION:

**NOT FOR CONSTRUCTION**

|                    |           |            |  |
|--------------------|-----------|------------|--|
| PROJECT NO.:       |           | 227705401  |  |
| DWN BY:            | CHK'D BY: | APP'D BY:  |  |
| YMK                | BMB       | JRA        |  |
| ISSUE DATE:        |           | 05/16/2023 |  |
| ISSUE NO.:         |           | 4          |  |
| SHEET TITLE:       |           |            |  |
| EXISTING HYDROLOGY |           |            |  |
| SHEET NO.:         |           |            |  |
| FIG-01             |           |            |  |

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U:\27705401\QUALITY FORKLIFT CRANE SITES DESIGN\2\_DRAINAGE\CD\1\_HYDROLOGY\FIG-02 PROPOSED HYDROLOGY.dwg



LEGEND

- PROPOSED DRAINAGE BOUNDARY
- EASEMENT LINE
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING STORM SEWER
- EXISTING SANITARY SEWER
- EXISTING STORM SEWER MANHOLE
- EXISTING STORM SEWER INLET
- EXISTING FLARED END SECTION
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- STORM SEWER
- STORM MANHOLE
- STORM CATCH BASIN
- FLARED END SECTION

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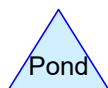
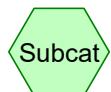
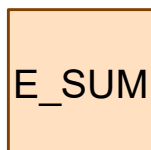
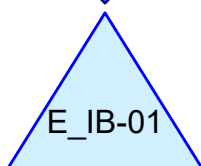
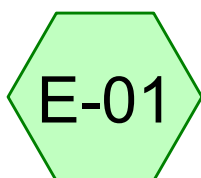
**QUALITY FORKLIFT  
IMPROVEMENTS**  
CITY OF SHAKOPEE  
SCOTT COUNTY, MINNESOTA

| PROJECT TITLE          |                  |
|------------------------|------------------|
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| DESCRIPTION:           | CLIENT SUBMITTAL |
| DATE:                  | 10/13/2023       |
|                        | 11/09/2023       |
|                        | 11/09/2023       |
|                        | 05/16/2023       |
| CERTIFICATION:         |                  |
| NOT FOR CONSTRUCTION   |                  |
|                        |                  |
|                        |                  |
|                        |                  |
| PROJECT NO.: 227705401 |                  |
| DWN BY: YMK            | CHK'D BY: BMB    |
| ISSUE DATE:            | 05/16/2023       |
| ISSUE NO.:             | 4                |
| SHEET TITLE:           |                  |
| PROPOSED HYDROLOGY     |                  |
| SHEET NO.:             |                  |
| FIG-02                 |                  |

## **APPENDIX B**

### **Existing and Proposed HydroCAD Model Output**

# EXISTING



**2023-0516 EX HCAD\_227705401**

Prepared by Stantec Consulting Services

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Page 2

**Rainfall Events Listing**

| Event# | Event<br>Name | Storm Type | Curve | Mode    | Duration<br>(hours) | B/B | Depth<br>(inches) | AMC |
|--------|---------------|------------|-------|---------|---------------------|-----|-------------------|-----|
| 1      | 2-Year        | MSE 24-hr  | 3     | Default | 24.00               | 1   | 2.85              | 2   |
| 2      | 10-Year       | MSE 24-hr  | 3     | Default | 24.00               | 1   | 4.22              | 2   |
| 3      | 100-Year      | MSE 24-hr  | 3     | Default | 24.00               | 1   | 7.29              | 2   |

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-01:**

Runoff Area=156,080 sf 44.28% Impervious Runoff Depth=1.49"  
Tc=6.0 min CN=69/98 Runoff=8.62 cfs 0.445 af

**Reach E\_SUM:**

Inflow=5.37 cfs 0.436 af  
Outflow=5.37 cfs 0.436 af

**Pond E\_IB-01:**

Peak Elev=730.95' Storage=2,605 cf Inflow=8.62 cfs 0.445 af  
Discarded=0.05 cfs 0.009 af Primary=5.37 cfs 0.436 af Secondary=0.00 cfs 0.000 af Outflow=5.41 cfs 0.445 af

**Summary for Subcatchment E-01:**

Runoff = 8.62 cfs @ 12.13 hrs, Volume= 0.445 af, Depth= 1.49"  
 Routed to Pond E\_IB-01 :

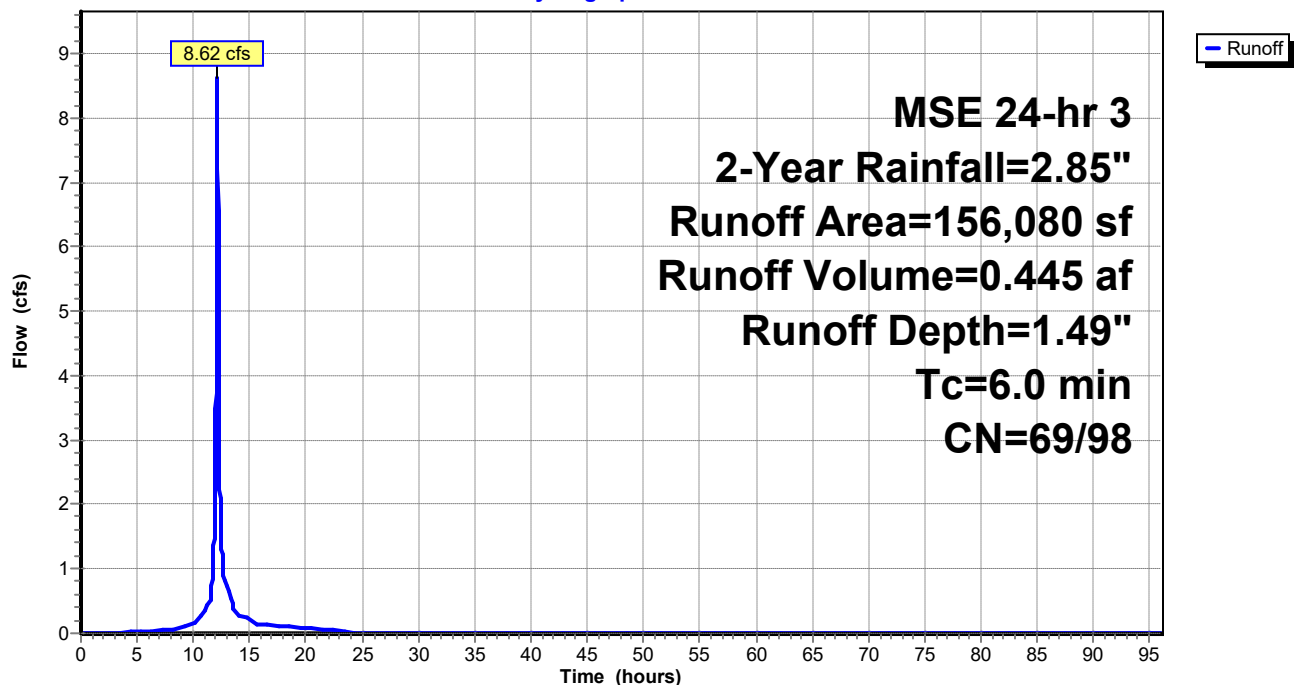
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 2-Year Rainfall=2.85"

| Area (sf) | CN | Description                     |
|-----------|----|---------------------------------|
| 86,972    | 69 | 50-75% Grass cover, Fair, HSG B |
| * 69,108  | 98 | Impervious, HSG B               |
| 156,080   | 82 | Weighted Average                |
| 86,972    | 69 | 55.72% Pervious Area            |
| 69,108    | 98 | 44.28% Impervious Area          |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

**Subcatchment E-01:**

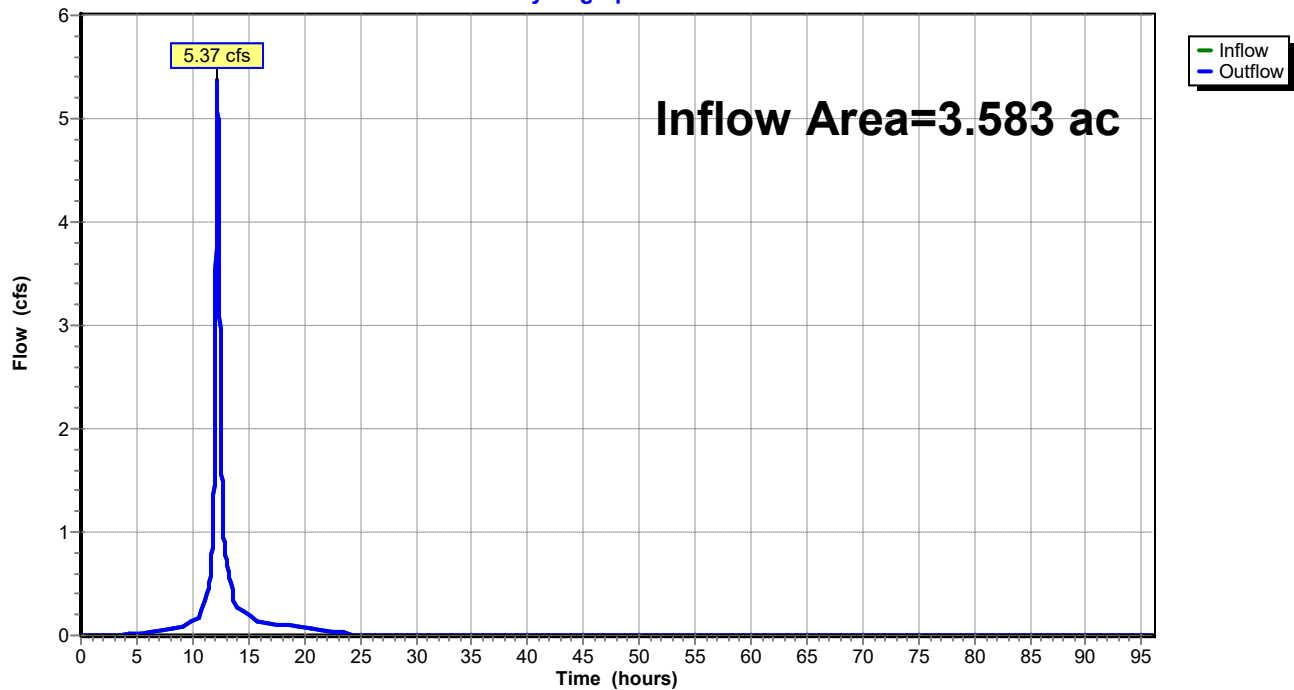
Hydrograph



**Summary for Reach E\_SUM:**

Inflow Area = 3.583 ac, 44.28% Impervious, Inflow Depth = 1.46" for 2-Year event  
Inflow = 5.37 cfs @ 12.20 hrs, Volume= 0.436 af  
Outflow = 5.37 cfs @ 12.20 hrs, Volume= 0.436 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

**Reach E\_SUM:****Hydrograph**

**Summary for Pond E\_IB-01:**

Inflow Area = 3.583 ac, 44.28% Impervious, Inflow Depth = 1.49" for 2-Year event  
 Inflow = 8.62 cfs @ 12.13 hrs, Volume= 0.445 af  
 Outflow = 5.41 cfs @ 12.20 hrs, Volume= 0.445 af, Atten= 37%, Lag= 3.9 min  
 Discarded = 0.05 cfs @ 12.20 hrs, Volume= 0.009 af  
 Primary = 5.37 cfs @ 12.20 hrs, Volume= 0.436 af  
 Routed to Reach E\_SUM :  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to Reach E\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 Peak Elev= 730.95' @ 12.20 hrs Surf.Area= 4,367 sf Storage= 2,605 cf

Plug-Flow detention time= 6.3 min calculated for 0.445 af (100% of inflow)  
 Center-of-Mass det. time= 6.3 min ( 781.2 - 774.8 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 729.50' | 32,507 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 33,534               | 22,067                    | 32,507                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                     |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Culvert</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                  |
| #2     | Secondary | 731.80' | <b>80.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |
| #3     | Discarded | 729.50' | <b>0.450 in/hr Exfiltration over Surface area</b>                                                                                                                                  |

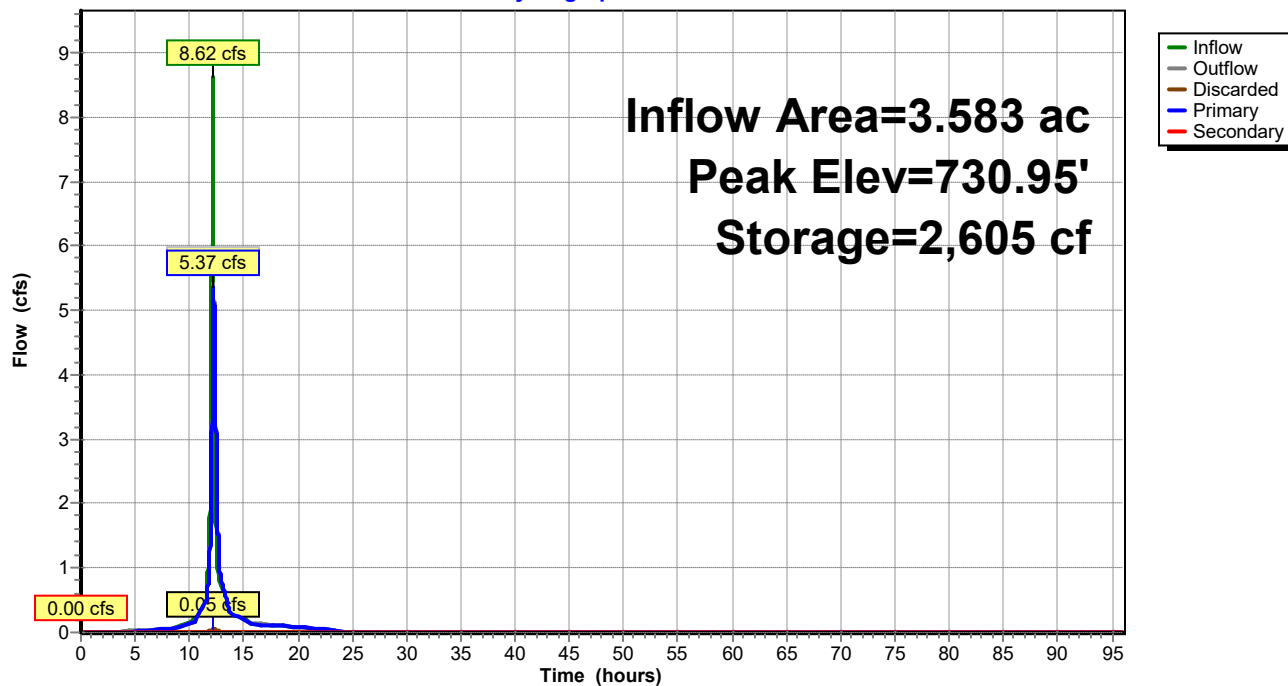
**Discarded OutFlow** Max=0.05 cfs @ 12.20 hrs HW=730.95' (Free Discharge)  
 ↑ **3=Exfiltration** (Exfiltration Controls 0.05 cfs)

**Primary OutFlow** Max=5.36 cfs @ 12.20 hrs HW=730.95' TW=0.00' (Dynamic Tailwater)  
 ↑ **1=Culvert** (Barrel Controls 5.36 cfs @ 3.91 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=729.50' TW=0.00' (Dynamic Tailwater)  
 ↑ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond E\_IB-01:

## Hydrograph



Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-01:**

Runoff Area=156,080 sf 44.28% Impervious Runoff Depth=2.55"  
Tc=6.0 min CN=69/98 Runoff=15.12 cfs 0.762 af

**Reach E\_SUM:**

Inflow=7.45 cfs 0.749 af  
Outflow=7.45 cfs 0.749 af

**Pond E\_IB-01:**

Peak Elev=731.45' Storage=5,510 cf Inflow=15.12 cfs 0.762 af  
Discarded=0.08 cfs 0.013 af Primary=7.45 cfs 0.749 af Secondary=0.00 cfs 0.000 af Outflow=7.52 cfs 0.762 af

**Summary for Subcatchment E-01:**

Runoff = 15.12 cfs @ 12.13 hrs, Volume= 0.762 af, Depth= 2.55"  
 Routed to Pond E\_IB-01 :

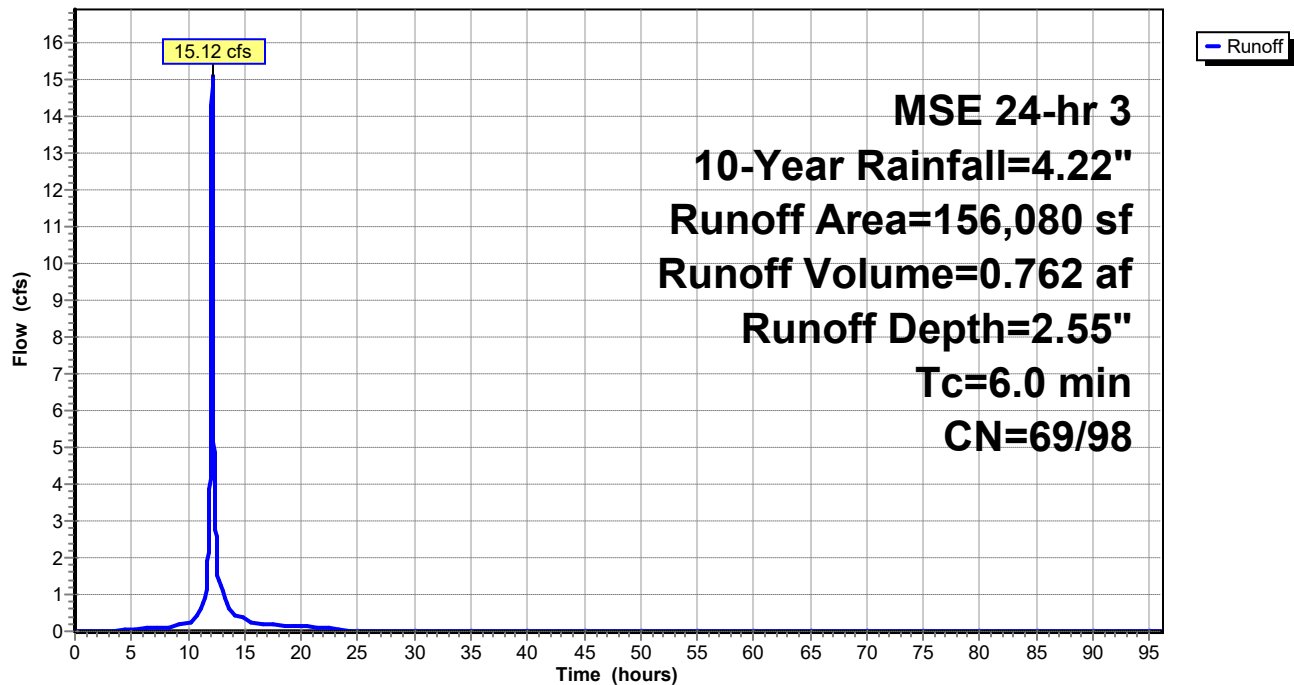
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 10-Year Rainfall=4.22"

| Area (sf) | CN | Description                     |
|-----------|----|---------------------------------|
| 86,972    | 69 | 50-75% Grass cover, Fair, HSG B |
| * 69,108  | 98 | Impervious, HSG B               |
| 156,080   | 82 | Weighted Average                |
| 86,972    | 69 | 55.72% Pervious Area            |
| 69,108    | 98 | 44.28% Impervious Area          |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

**Subcatchment E-01:**

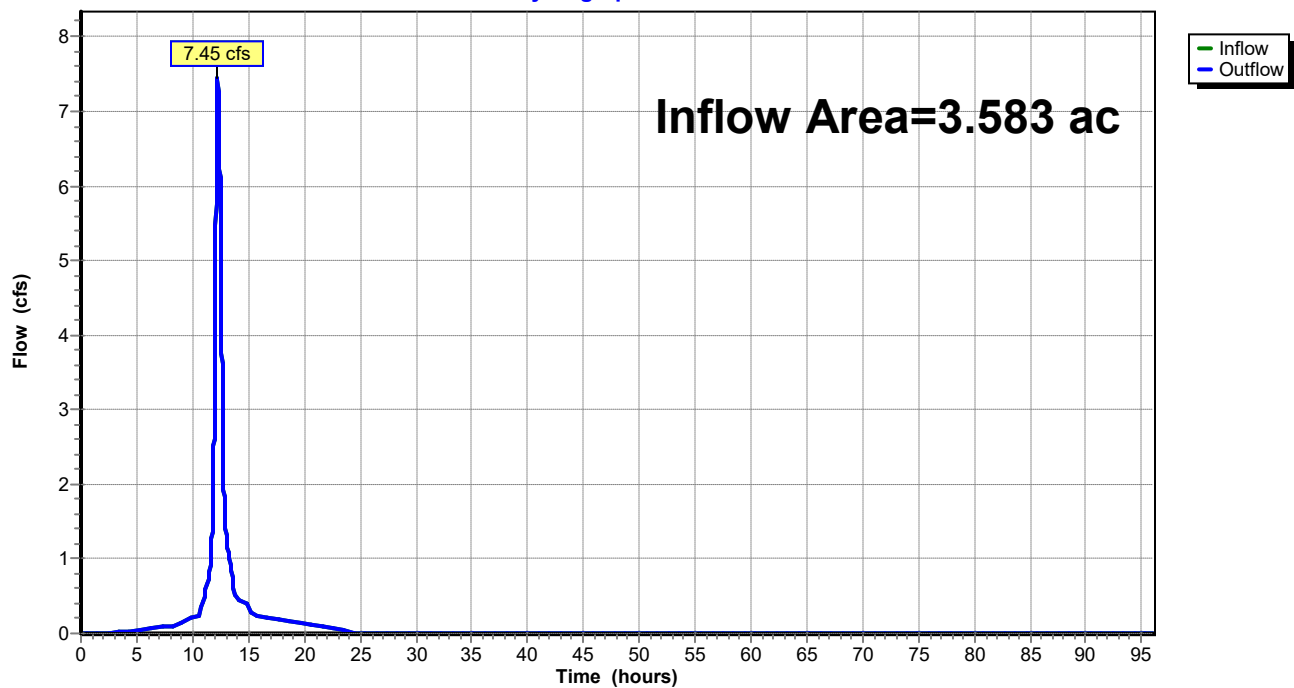
Hydrograph



**Summary for Reach E\_SUM:**

Inflow Area = 3.583 ac, 44.28% Impervious, Inflow Depth = 2.51" for 10-Year event  
Inflow = 7.45 cfs @ 12.22 hrs, Volume= 0.749 af  
Outflow = 7.45 cfs @ 12.22 hrs, Volume= 0.749 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

**Reach E\_SUM:****Hydrograph**

**Summary for Pond E\_IB-01:**

Inflow Area = 3.583 ac, 44.28% Impervious, Inflow Depth = 2.55" for 10-Year event  
 Inflow = 15.12 cfs @ 12.13 hrs, Volume= 0.762 af  
 Outflow = 7.52 cfs @ 12.22 hrs, Volume= 0.762 af, Atten= 50%, Lag= 5.4 min  
 Discarded = 0.08 cfs @ 12.22 hrs, Volume= 0.013 af  
 Primary = 7.45 cfs @ 12.22 hrs, Volume= 0.749 af  
 Routed to Reach E\_SUM :  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to Reach E\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 Peak Elev= 731.45' @ 12.22 hrs Surf.Area= 7,301 sf Storage= 5,510 cf

Plug-Flow detention time= 7.5 min calculated for 0.762 af (100% of inflow)  
 Center-of-Mass det. time= 7.5 min ( 779.5 - 772.0 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 729.50' | 32,507 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

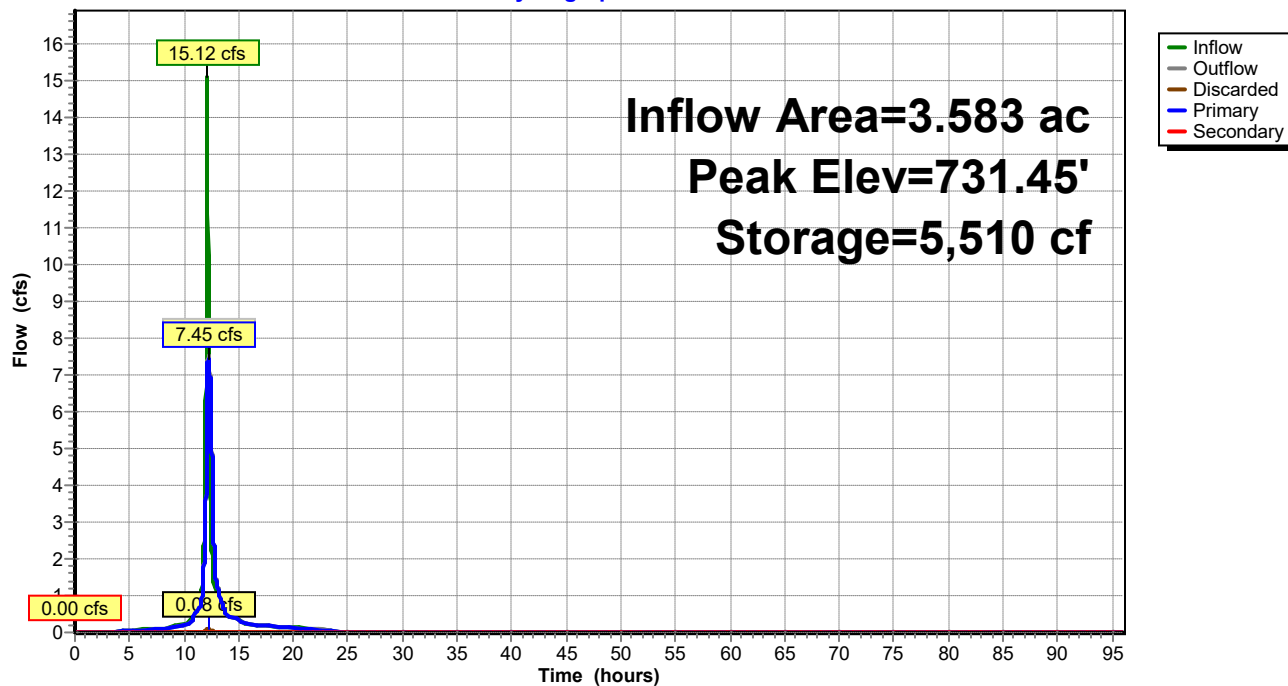
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 33,534               | 22,067                    | 32,507                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                     |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Culvert</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                  |
| #2     | Secondary | 731.80' | <b>80.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |
| #3     | Discarded | 729.50' | <b>0.450 in/hr Exfiltration over Surface area</b>                                                                                                                                  |

**Discarded OutFlow** Max=0.08 cfs @ 12.22 hrs HW=731.45' (Free Discharge)  
 ↑ **3=Exfiltration** (Exfiltration Controls 0.08 cfs)

**Primary OutFlow** Max=7.45 cfs @ 12.22 hrs HW=731.45' TW=0.00' (Dynamic Tailwater)  
 ↑ **1=Culvert** (Barrel Controls 7.45 cfs @ 4.24 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=729.50' TW=0.00' (Dynamic Tailwater)  
 ↑ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

**Pond E\_IB-01:****Hydrograph**

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-01:**

Runoff Area=156,080 sf 44.28% Impervious Runoff Depth=5.21"  
Tc=6.0 min CN=69/98 Runoff=31.18 cfs 1.557 af

**Reach E\_SUM:**

Inflow=27.67 cfs 1.537 af  
Outflow=27.67 cfs 1.537 af

**Pond E\_IB-01:**

Peak Elev=732.00' Storage=10,456 cf Inflow=31.18 cfs 1.557 af  
Discarded=0.11 cfs 0.020 af Primary=9.65 cfs 1.368 af Secondary=18.03 cfs 0.169 af Outflow=27.78 cfs 1.557 af

**Summary for Subcatchment E-01:**

Runoff = 31.18 cfs @ 12.13 hrs, Volume= 1.557 af, Depth= 5.21"  
 Routed to Pond E\_IB-01 :

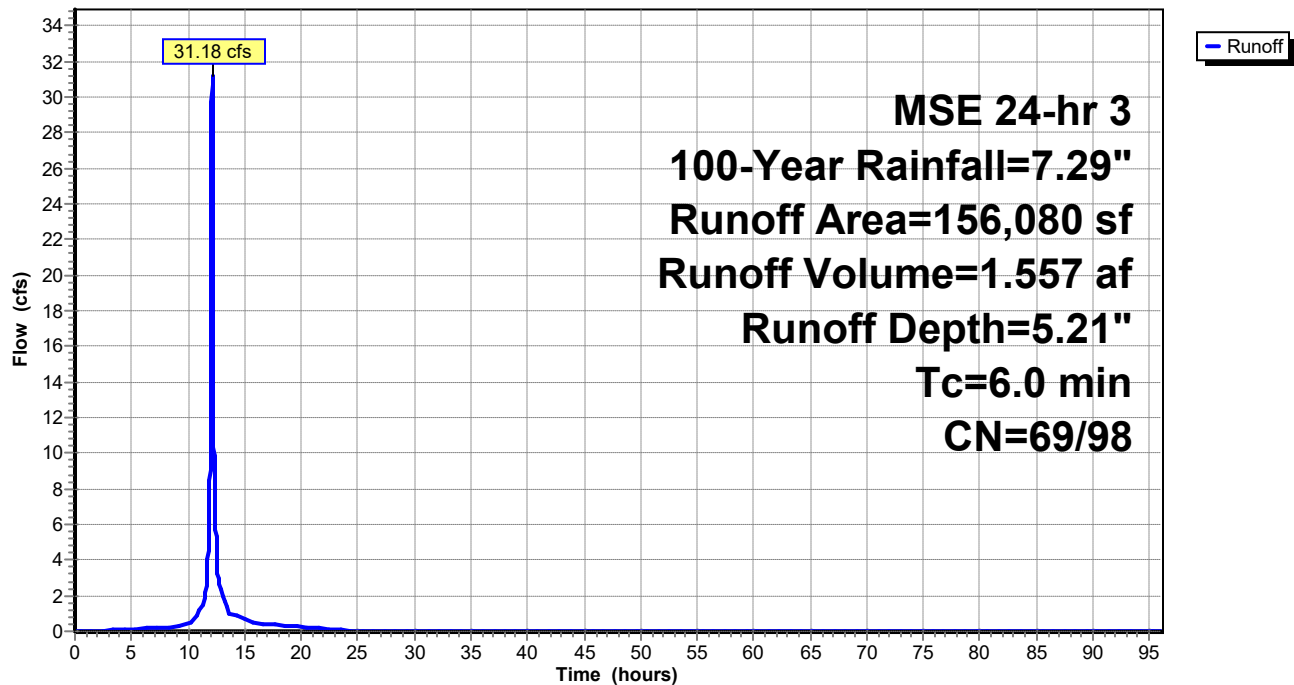
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 100-Year Rainfall=7.29"

| Area (sf) | CN | Description                     |
|-----------|----|---------------------------------|
| 86,972    | 69 | 50-75% Grass cover, Fair, HSG B |
| * 69,108  | 98 | Impervious, HSG B               |
| 156,080   | 82 | Weighted Average                |
| 86,972    | 69 | 55.72% Pervious Area            |
| 69,108    | 98 | 44.28% Impervious Area          |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, |

**Subcatchment E-01:**

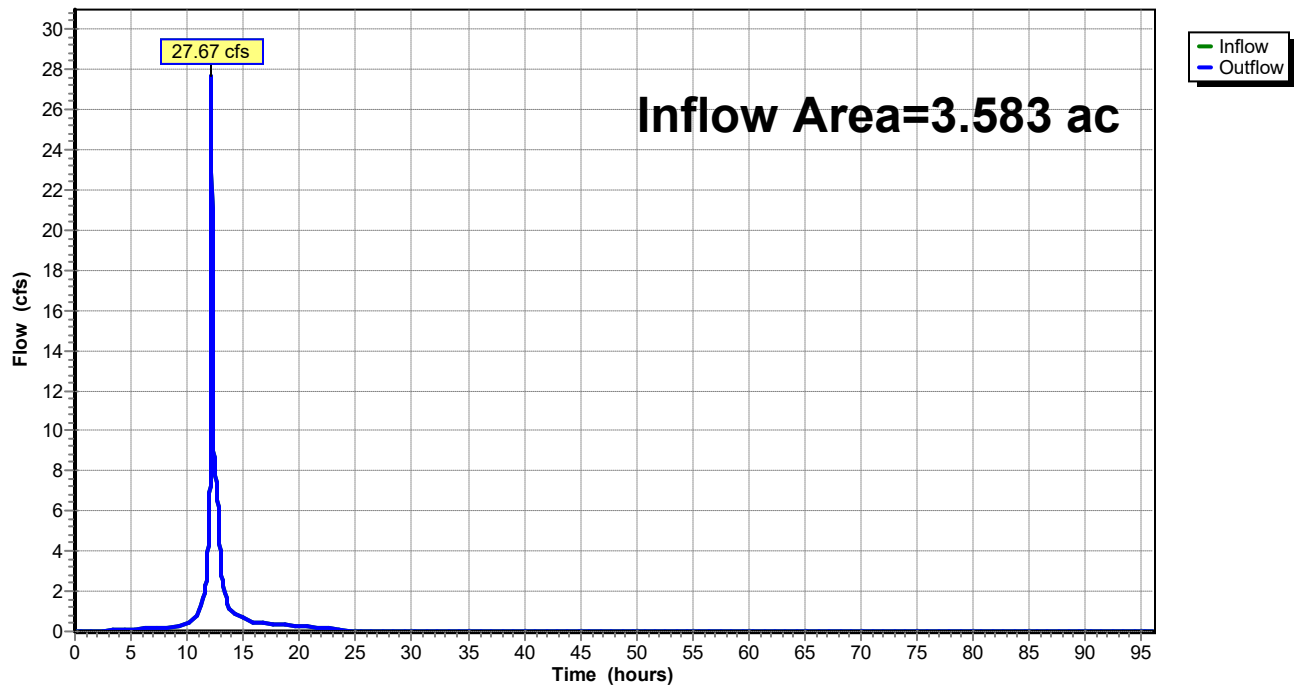
Hydrograph



**Summary for Reach E\_SUM:**

Inflow Area = 3.583 ac, 44.28% Impervious, Inflow Depth = 5.15" for 100-Year event  
Inflow = 27.67 cfs @ 12.16 hrs, Volume= 1.537 af  
Outflow = 27.67 cfs @ 12.16 hrs, Volume= 1.537 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

**Reach E\_SUM:****Hydrograph**

**Summary for Pond E\_IB-01:**

Inflow Area = 3.583 ac, 44.28% Impervious, Inflow Depth = 5.21" for 100-Year event  
 Inflow = 31.18 cfs @ 12.13 hrs, Volume= 1.557 af  
 Outflow = 27.78 cfs @ 12.16 hrs, Volume= 1.557 af, Atten= 11%, Lag= 1.8 min  
 Discarded = 0.11 cfs @ 12.16 hrs, Volume= 0.020 af  
 Primary = 9.65 cfs @ 12.16 hrs, Volume= 1.368 af  
 Routed to Reach E\_SUM :  
 Secondary = 18.03 cfs @ 12.16 hrs, Volume= 0.169 af  
 Routed to Reach E\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 Peak Elev= 732.00' @ 12.16 hrs Surf.Area= 10,636 sf Storage= 10,456 cf

Plug-Flow detention time= 8.3 min calculated for 1.556 af (100% of inflow)  
 Center-of-Mass det. time= 8.3 min ( 775.2 - 766.9 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 729.50' | 32,507 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

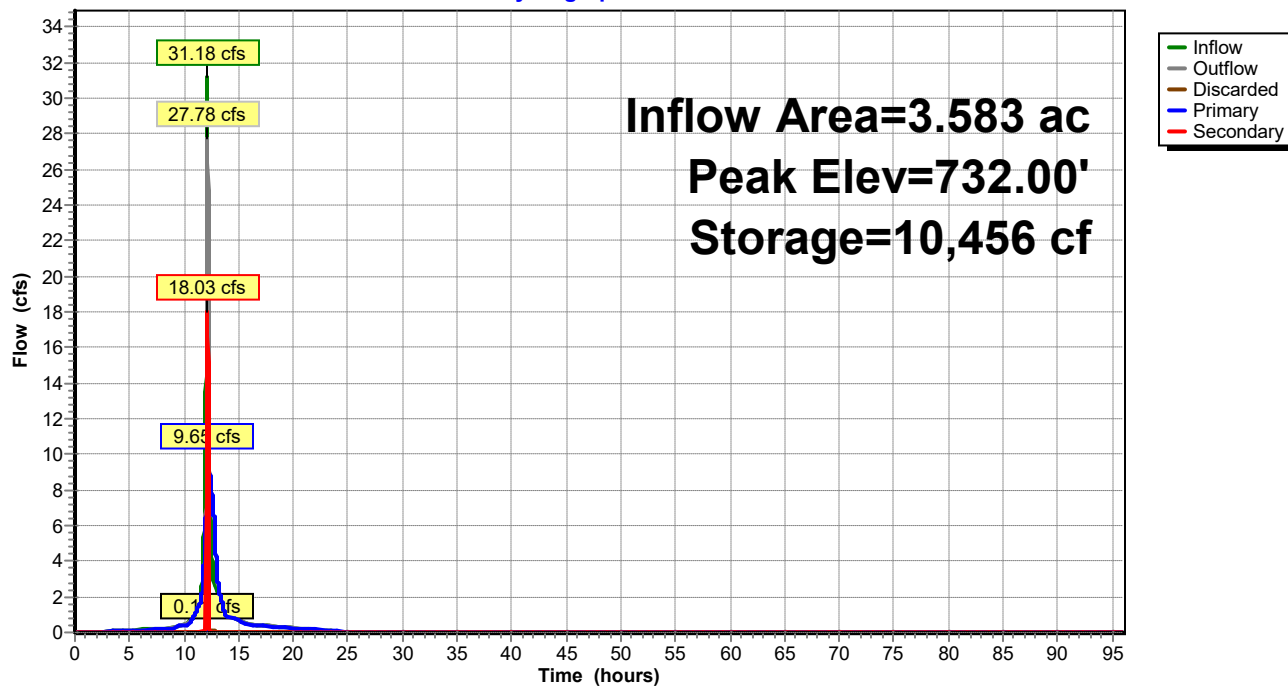
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 33,534               | 22,067                    | 32,507                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                     |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Culvert</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                  |
| #2     | Secondary | 731.80' | <b>80.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |
| #3     | Discarded | 729.50' | <b>0.450 in/hr Exfiltration over Surface area</b>                                                                                                                                  |

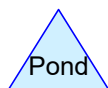
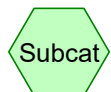
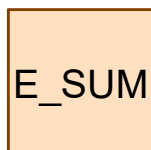
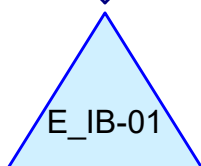
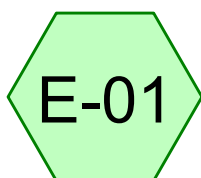
**Discarded OutFlow** Max=0.11 cfs @ 12.16 hrs HW=732.00' (Free Discharge)  
 ↑ **3=Exfiltration** (Exfiltration Controls 0.11 cfs)

**Primary OutFlow** Max=9.64 cfs @ 12.16 hrs HW=732.00' TW=0.00' (Dynamic Tailwater)  
 ↑ **1=Culvert** (Barrel Controls 9.64 cfs @ 5.46 fps)

**Secondary OutFlow** Max=17.95 cfs @ 12.16 hrs HW=732.00' TW=0.00' (Dynamic Tailwater)  
 ↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 17.95 cfs @ 1.12 fps)

**Pond E\_IB-01:****Hydrograph**

# EXISTING SNOWMELT



**2023-0516 EX SNOWMELT\_227705401**

Prepared by Stantec Consulting Services

Printed 5/16/2023

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**Rainfall Events Listing**

| Event# | Event<br>Name   | Storm Type | Curve | Mode  | Duration<br>(hours) | B/B | Depth<br>(inches) | AMC |
|--------|-----------------|------------|-------|-------|---------------------|-----|-------------------|-----|
| 1      | 100-Year 10-Day | MSE 24-hr  | 3     | Scale | 240.00              | 1   | 7.20              | 4   |

Time span=0.00-300.00 hrs, dt=0.01 hrs, 30001 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment E-01:** Runoff Area=156,080 sf 100.00% Impervious Runoff Depth=7.20"  
Tc=6.0 min CN=98/100 Runoff=4.28 cfs 2.150 af

**Reach E\_SUM:** Inflow=4.28 cfs 2.150 af  
Outflow=4.28 cfs 2.150 af

**Pond E\_IB-01:** Peak Elev=730.75' Storage=1,827 cf Inflow=4.28 cfs 2.150 af  
Primary=4.28 cfs 2.150 af Secondary=0.00 cfs 0.000 af Outflow=4.28 cfs 2.150 af

### Summary for Subcatchment E-01:

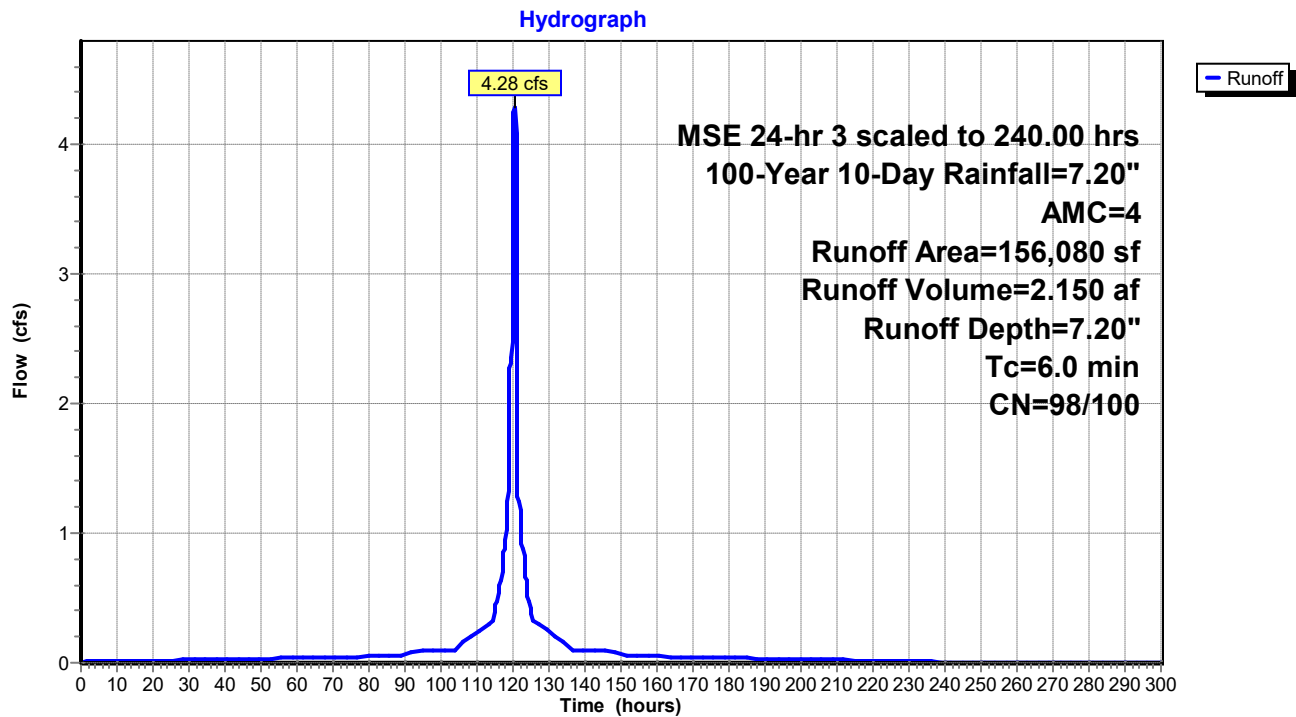
Runoff = 4.28 cfs @ 120.50 hrs, Volume= 2.150 af, Depth= 7.20"  
 Routed to Pond E\_IB-01 :

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 scaled to 240.00 hrs 100-Year 10-Day Rainfall=7.20", AMC=4

|   | Area (sf) | CN  | Description                     |
|---|-----------|-----|---------------------------------|
| * | 86,972    | 100 | 50-75% Grass cover, Fair, HSG B |
| * | 69,108    | 100 | Impervious, HSG B               |
|   | 156,080   | 100 | Weighted Average                |
|   | 156,080   | 100 | 100.00% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, |

### Subcatchment E-01:

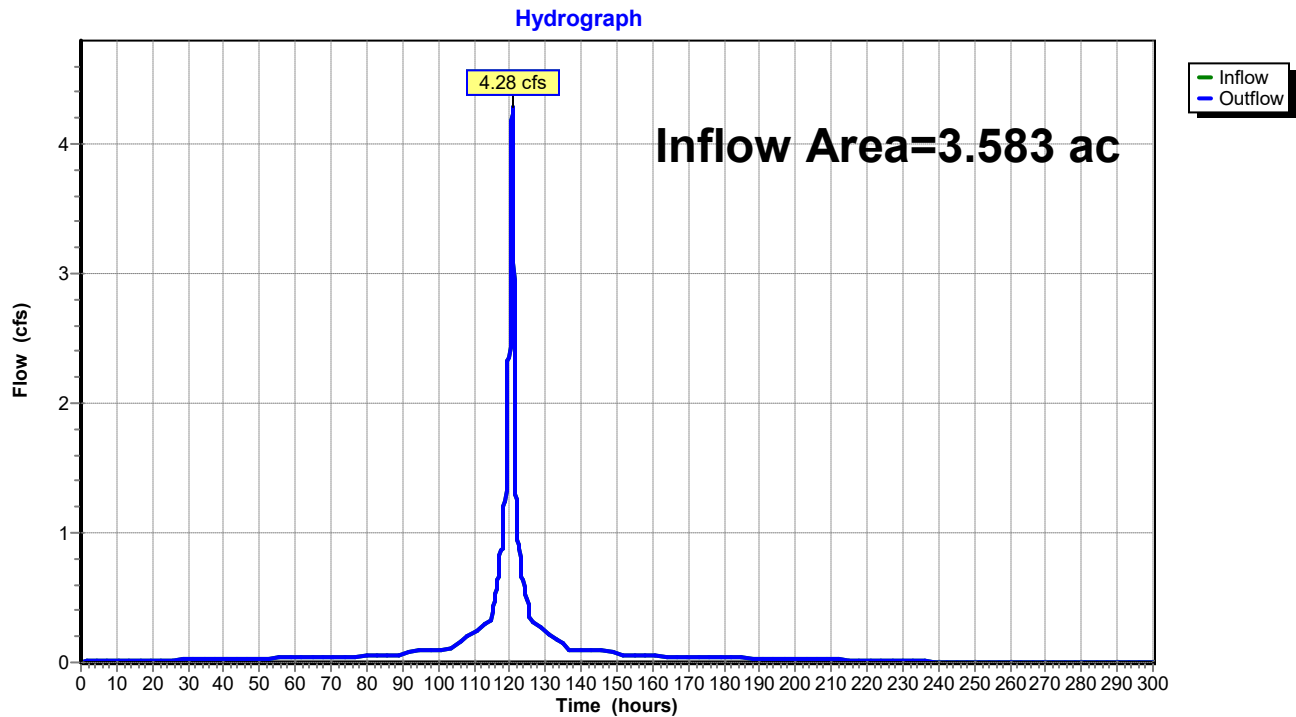


### Summary for Reach E\_SUM:

Inflow Area = 3.583 ac, 100.00% Impervious, Inflow Depth = 7.20" for 100-Year 10-Day event  
Inflow = 4.28 cfs @ 121.01 hrs, Volume= 2.150 af  
Outflow = 4.28 cfs @ 121.01 hrs, Volume= 2.150 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.01 hrs

### Reach E\_SUM:



### Summary for Pond E\_IB-01:

Inflow Area = 3.583 ac, 100.00% Impervious, Inflow Depth = 7.20" for 100-Year 10-Day event  
 Inflow = 4.28 cfs @ 120.50 hrs, Volume= 2.150 af  
 Outflow = 4.28 cfs @ 121.01 hrs, Volume= 2.150 af, Atten= 0%, Lag= 30.8 min  
 Primary = 4.28 cfs @ 121.01 hrs, Volume= 2.150 af  
 Routed to Reach E\_SUM :  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to Reach E\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.01 hrs  
 Peak Elev= 730.75' @ 121.01 hrs Surf.Area= 3,418 sf Storage= 1,827 cf

Plug-Flow detention time= 6.3 min calculated for 2.150 af (100% of inflow)  
 Center-of-Mass det. time= 6.3 min ( 7,214.1 - 7,207.8 )

| Volume | Invert  | Avail.Storage | Storage Description                                        |
|--------|---------|---------------|------------------------------------------------------------|
| #1     | 729.50' | 32,507 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

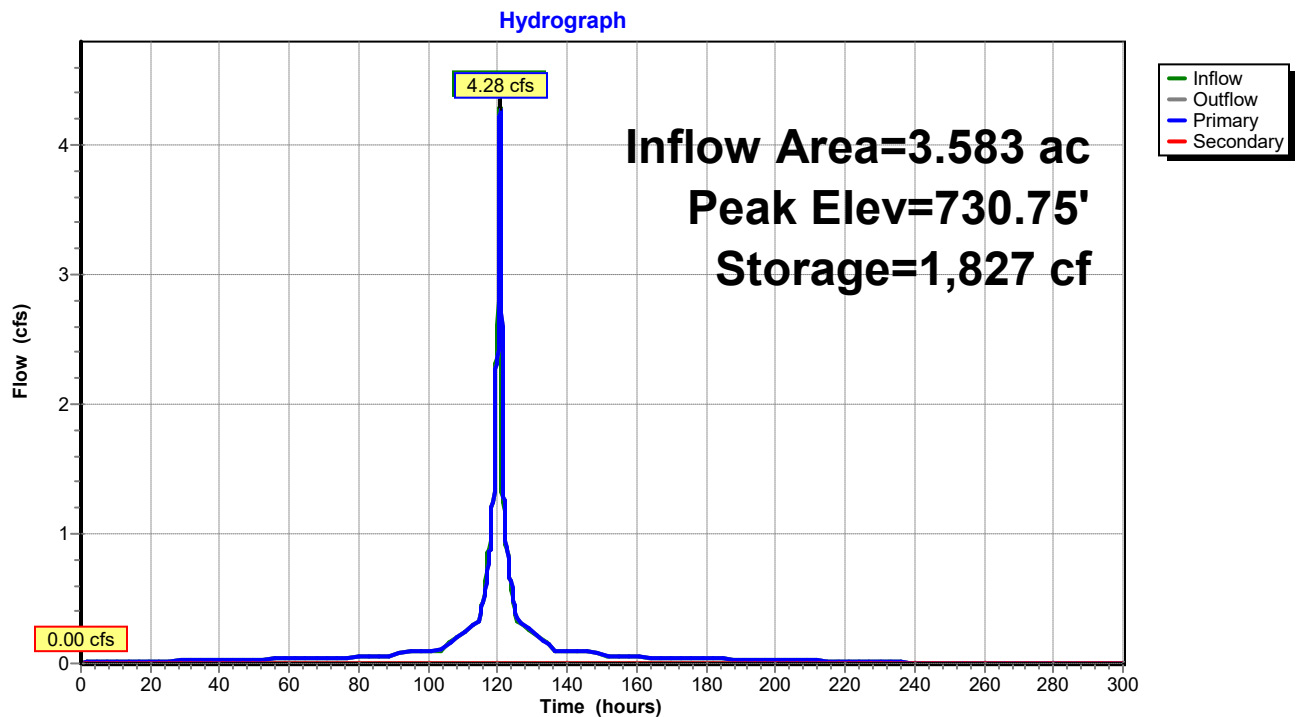
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 33,534               | 22,067                    | 32,507                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                     |
|--------|-----------|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Culvert</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                  |
| #2     | Secondary | 731.80' | <b>80.0' long x 10.0' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |

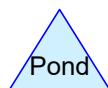
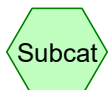
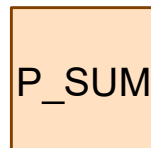
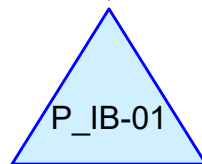
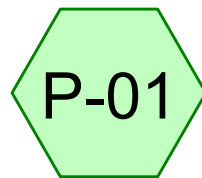
**Primary OutFlow** Max=4.28 cfs @ 121.01 hrs HW=730.75' TW=0.00' (Dynamic Tailwater)  
 ↑1=Culvert (Barrel Controls 4.28 cfs @ 3.68 fps)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=729.50' TW=0.00' (Dynamic Tailwater)  
 ↑2=Broad-Crested Rectangular Weir ( Controls 0.00 cfs)

**Pond E\_IB-01:**



# PROPOSED



**2023-0516 PR HCAD\_227705401**

Prepared by Stantec Consulting Services

Printed 5/16/2023

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**Rainfall Events Listing**

| Event# | Event<br>Name | Storm Type | Curve | Mode    | Duration<br>(hours) | B/B | Depth<br>(inches) | AMC |
|--------|---------------|------------|-------|---------|---------------------|-----|-------------------|-----|
| 1      | 2-Year        | MSE 24-hr  | 3     | Default | 24.00               | 1   | 2.85              | 2   |
| 2      | 10-Year       | MSE 24-hr  | 3     | Default | 24.00               | 1   | 4.22              | 2   |
| 3      | 100-Year      | MSE 24-hr  | 3     | Default | 24.00               | 1   | 7.29              | 2   |

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P-01:**

Runoff Area=156,080 sf 33.97% Impervious Runoff Depth=1.81"  
Tc=6.0 min CN=84/98 Runoff=11.25 cfs 0.540 af

**Reach P\_SUM:**

Inflow=3.42 cfs 0.379 af  
Outflow=3.42 cfs 0.379 af

**Pond P\_IB-01:**

Peak Elev=731.84' Storage=10,011 cf Inflow=11.25 cfs 0.540 af  
Discarded=0.10 cfs 0.161 af Primary=3.42 cfs 0.379 af Secondary=0.00 cfs 0.000 af Outflow=3.52 cfs 0.540 af

**Summary for Subcatchment P-01:**

Runoff = 11.25 cfs @ 12.13 hrs, Volume= 0.540 af, Depth= 1.81"  
 Routed to Pond P\_IB-01 :

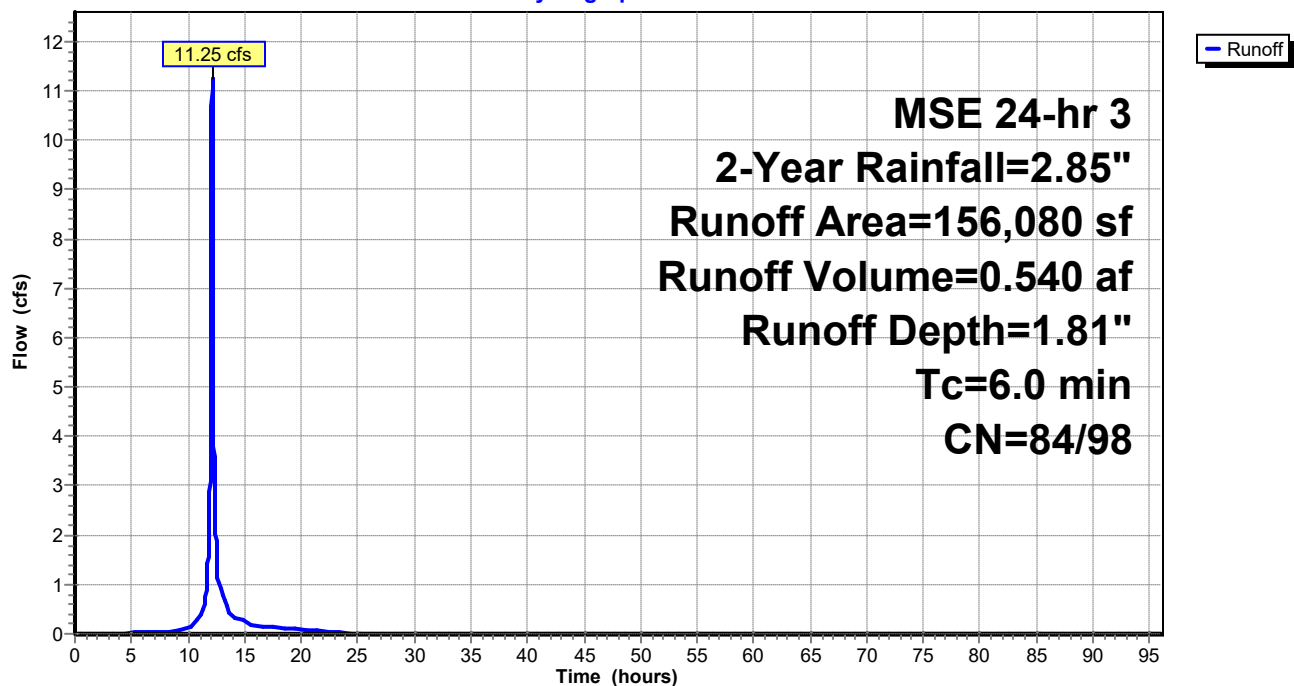
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 2-Year Rainfall=2.85"

|   | Area (sf) | CN | Description                     |
|---|-----------|----|---------------------------------|
|   | 44,819    | 69 | 50-75% Grass cover, Fair, HSG B |
| * | 53,023    | 98 | Impervious, HSG B               |
| * | 58,238    | 96 | Gravel Surface, HSG B           |
|   | 156,080   | 89 | Weighted Average                |
|   | 103,057   | 84 | 66.03% Pervious Area            |
|   | 53,023    | 98 | 33.97% Impervious Area          |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, |

**Subcatchment P-01:**

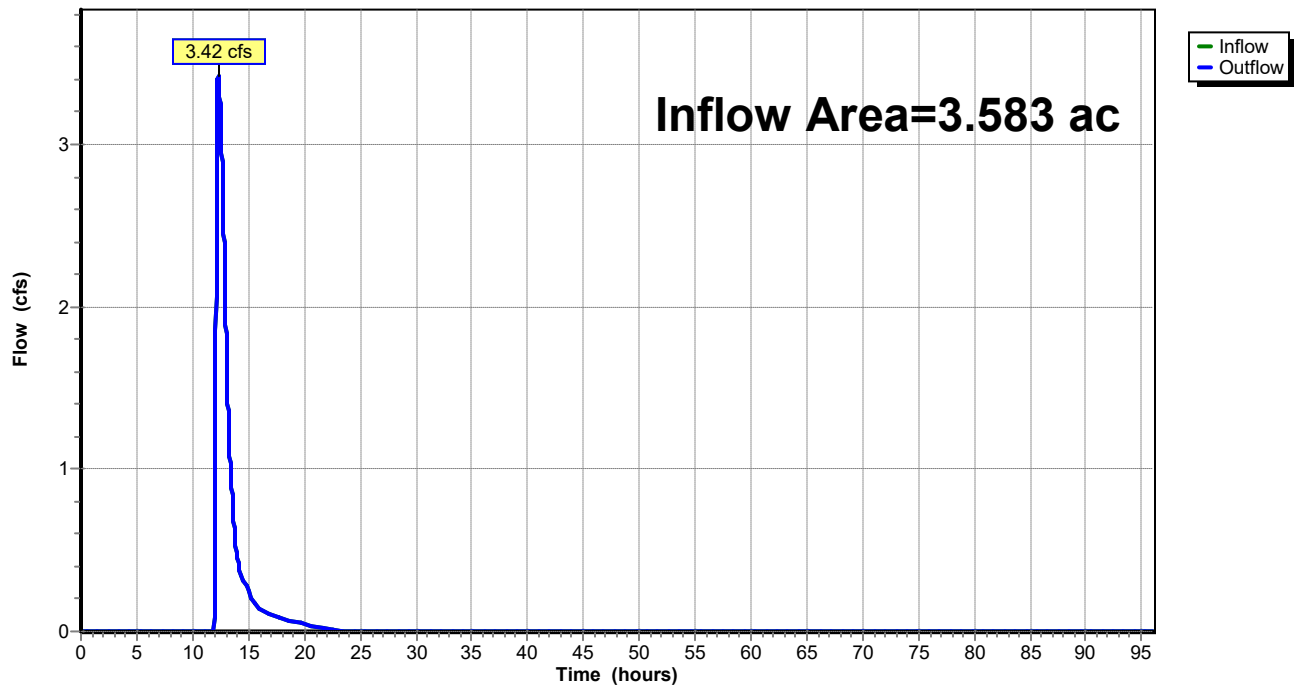
Hydrograph



**Summary for Reach P\_SUM:**

Inflow Area = 3.583 ac, 33.97% Impervious, Inflow Depth = 1.27" for 2-Year event  
Inflow = 3.42 cfs @ 12.29 hrs, Volume= 0.379 af  
Outflow = 3.42 cfs @ 12.29 hrs, Volume= 0.379 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

**Reach P\_SUM:****Hydrograph**

**Summary for Pond P\_IB-01:**

Inflow Area = 3.583 ac, 33.97% Impervious, Inflow Depth = 1.81" for 2-Year event  
 Inflow = 11.25 cfs @ 12.13 hrs, Volume= 0.540 af  
 Outflow = 3.52 cfs @ 12.29 hrs, Volume= 0.540 af, Atten= 69%, Lag= 9.7 min  
 Discarded = 0.10 cfs @ 12.29 hrs, Volume= 0.161 af  
 Primary = 3.42 cfs @ 12.29 hrs, Volume= 0.379 af  
 Routed to Reach P\_SUM :  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to Reach P\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 Peak Elev= 731.84' @ 12.29 hrs Surf.Area= 10,067 sf Storage= 10,011 cf

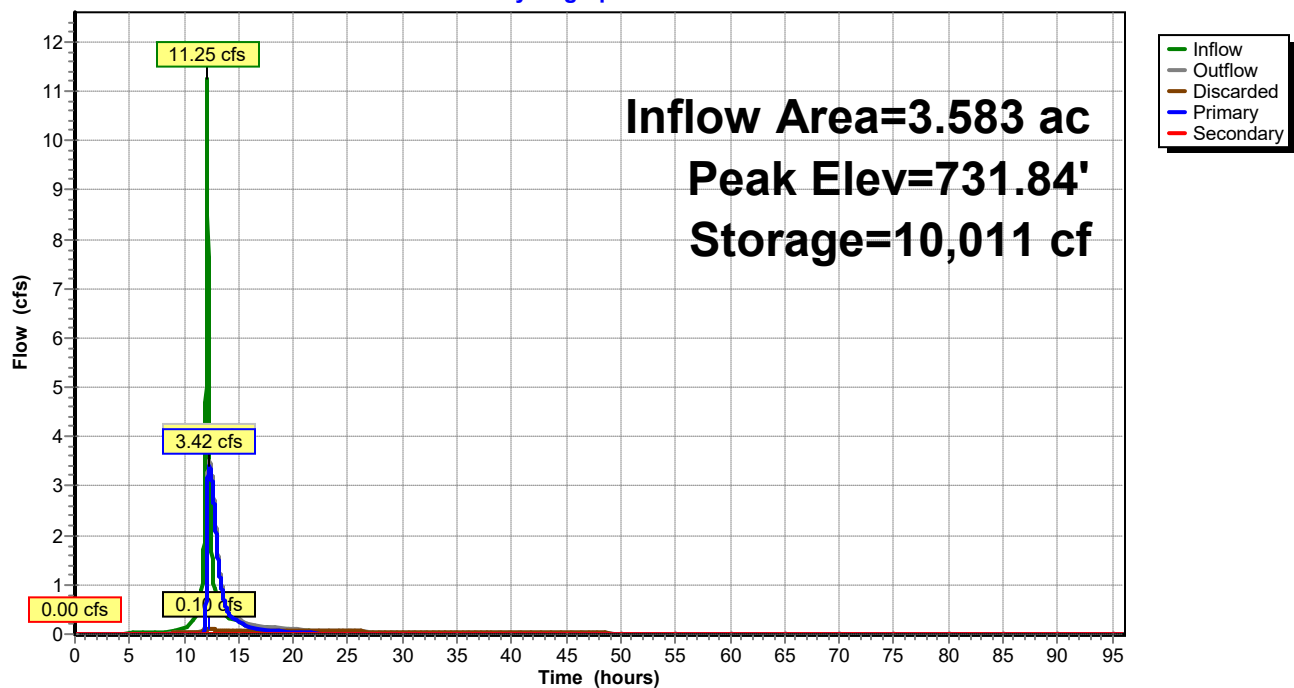
Plug-Flow detention time= 266.5 min calculated for 0.540 af (100% of inflow)  
 Center-of-Mass det. time= 266.7 min ( 1,048.4 - 781.8 )

| Volume    | Invert  | Avail.Storage | Storage Description                                                                                        |
|-----------|---------|---------------|------------------------------------------------------------------------------------------------------------|
| #1        | 729.50' | 24,808 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)<br><b>24.0" Round Pipe Storage</b><br>L= 400.0' |
| #2        | 730.00' | 1,257 cf      |                                                                                                            |
| 26,064 cf |         |               | Total Available Storage                                                                                    |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 18,136               | 14,368                    | 24,808                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                                                                                                                                   |
|--------|-----------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Existing Pipe</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                                                                                                                          |
| #2     | Device 1  | 732.00' | <b>6.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32                                                                                                                                               |
| #3     | Device 1  | 731.05' | <b>27.0" W x 5.0" H Vert. Orifice</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                                                                                              |
| #4     | Discarded | 729.50' | <b>0.450 in/hr Infiltration over Surface area</b>                                                                                                                                                                                                                                                |
| #5     | Secondary | 732.30' | <b>20.0' long x 5.0' breadth Stabilized Overflow to Valley Industrial Blvd</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65<br>2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88 |
| #6     | Device 1  | 732.32' | <b>Inlet Capacity</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50<br>Disch. (cfs) 0.000 0.410 1.170 2.150 3.100 3.710                                                                                                                                                                           |
| #7     | Device 6  | 732.60' | <b>5.0' long x 15.0' breadth To Citation Drive</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60                                                                                                                                                                                        |

Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Discarded OutFlow** Max=0.10 cfs @ 12.29 hrs HW=731.84' (Free Discharge)↑**4=Infiltration** (Exfiltration Controls 0.10 cfs)**Primary OutFlow** Max=3.42 cfs @ 12.29 hrs HW=731.84' TW=0.00' (Dynamic Tailwater)↑**1=Existing Pipe** (Passes 3.42 cfs of 8.97 cfs potential flow)↑**2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)↑**3=Orifice** (Orifice Controls 3.42 cfs @ 3.65 fps)↑**6=Inlet Capacity** ( Controls 0.00 cfs)↑**7=To Citation Drive** ( Controls 0.00 cfs)**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=729.50' TW=0.00' (Dynamic Tailwater)↑**5=Stabilized Overflow to Valley Industrial Blvd** ( Controls 0.00 cfs)**Pond P\_IB-01:****Hydrograph**

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P-01:**

Runoff Area=156,080 sf 33.97% Impervious Runoff Depth=3.05"  
Tc=6.0 min CN=84/98 Runoff=18.76 cfs 0.910 af

**Reach P\_SUM:**

Inflow=7.49 cfs 0.736 af  
Outflow=7.49 cfs 0.736 af

**Pond P\_IB-01:**

Peak Elev=732.30' Storage=15,262 cf Inflow=18.76 cfs 0.910 af  
Discarded=0.13 cfs 0.174 af Primary=7.48 cfs 0.736 af Secondary=0.01 cfs 0.000 af Outflow=7.63 cfs 0.910 af

**Summary for Subcatchment P-01:**

Runoff = 18.76 cfs @ 12.13 hrs, Volume= 0.910 af, Depth= 3.05"  
 Routed to Pond P\_IB-01 :

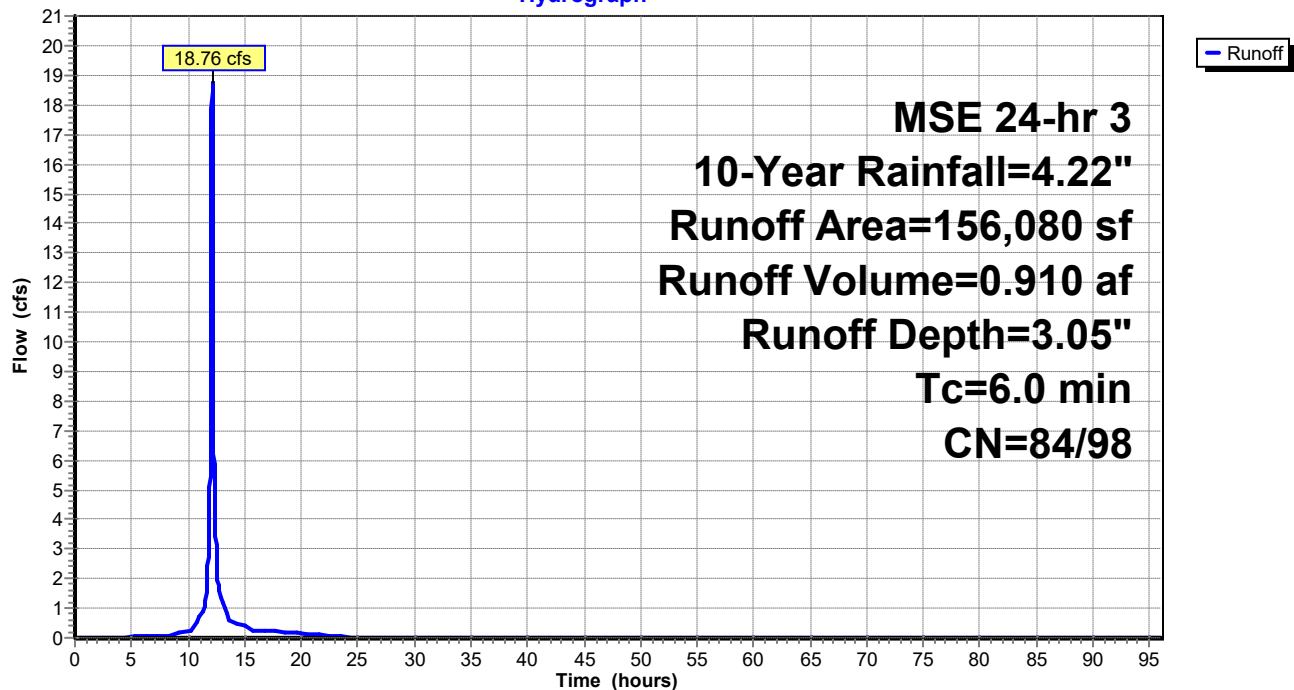
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 10-Year Rainfall=4.22"

|   | Area (sf) | CN | Description                     |
|---|-----------|----|---------------------------------|
|   | 44,819    | 69 | 50-75% Grass cover, Fair, HSG B |
| * | 53,023    | 98 | Impervious, HSG B               |
| * | 58,238    | 96 | Gravel Surface, HSG B           |
|   | 156,080   | 89 | Weighted Average                |
|   | 103,057   | 84 | 66.03% Pervious Area            |
|   | 53,023    | 98 | 33.97% Impervious Area          |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, |

**Subcatchment P-01:**

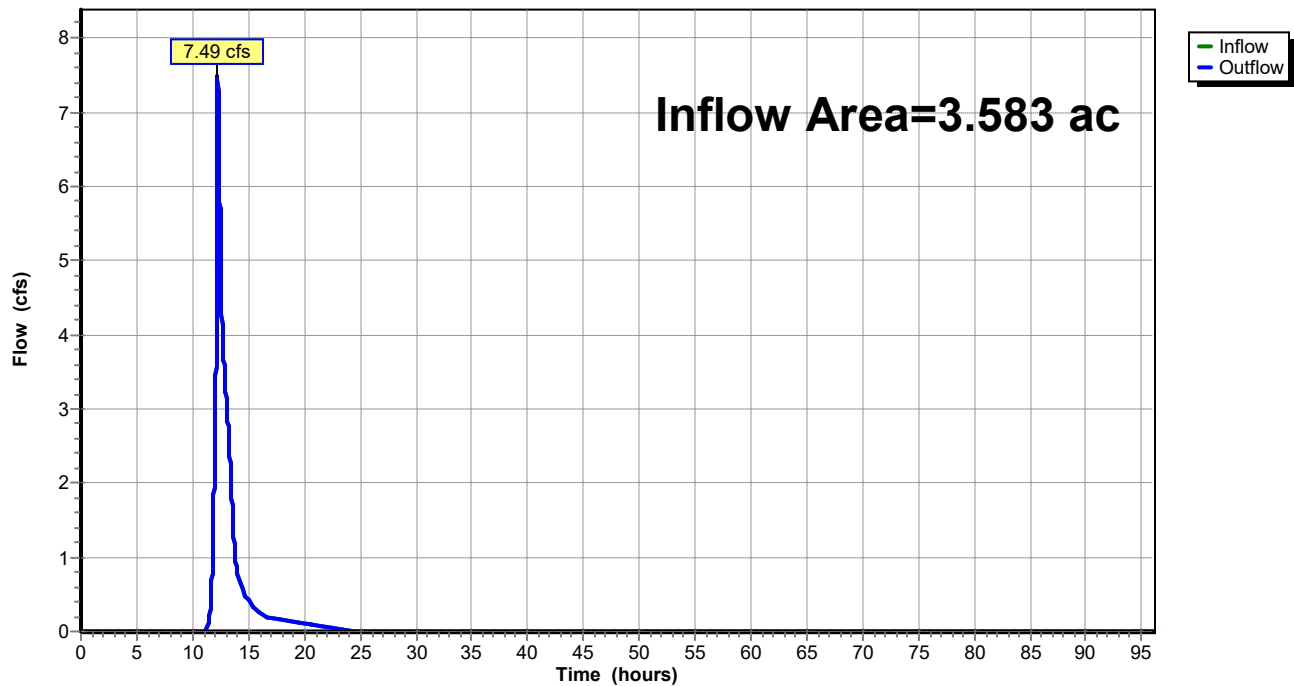
Hydrograph



**Summary for Reach P\_SUM:**

Inflow Area = 3.583 ac, 33.97% Impervious, Inflow Depth = 2.46" for 10-Year event  
Inflow = 7.49 cfs @ 12.25 hrs, Volume= 0.736 af  
Outflow = 7.49 cfs @ 12.25 hrs, Volume= 0.736 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

**Reach P\_SUM:****Hydrograph**

**Summary for Pond P\_IB-01:**

Inflow Area = 3.583 ac, 33.97% Impervious, Inflow Depth = 3.05" for 10-Year event  
 Inflow = 18.76 cfs @ 12.13 hrs, Volume= 0.910 af  
 Outflow = 7.63 cfs @ 12.25 hrs, Volume= 0.910 af, Atten= 59%, Lag= 7.1 min  
 Discarded = 0.13 cfs @ 12.25 hrs, Volume= 0.174 af  
 Primary = 7.48 cfs @ 12.25 hrs, Volume= 0.736 af  
 Routed to Reach P\_SUM :  
 Secondary = 0.01 cfs @ 12.25 hrs, Volume= 0.000 af  
 Routed to Reach P\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 Peak Elev= 732.30' @ 12.25 hrs Surf.Area= 12,888 sf Storage= 15,262 cf

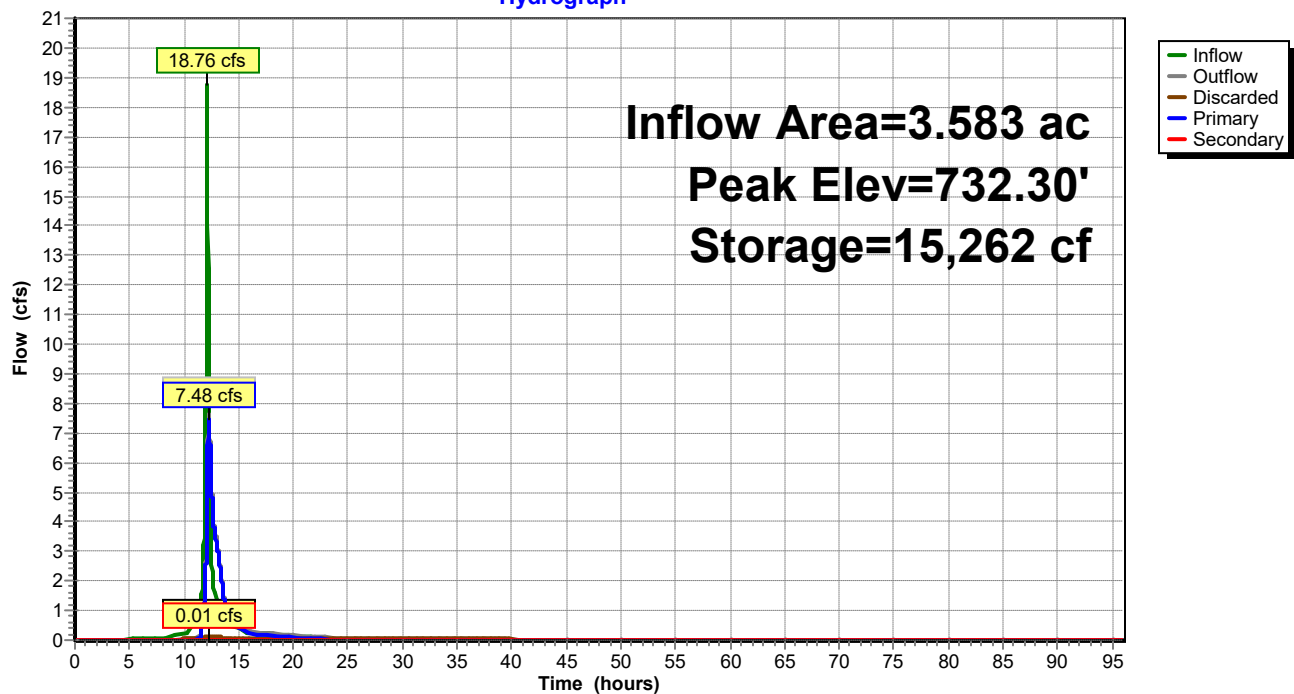
Plug-Flow detention time= 179.0 min calculated for 0.910 af (100% of inflow)  
 Center-of-Mass det. time= 179.2 min ( 954.0 - 774.7 )

| Volume    | Invert  | Avail.Storage | Storage Description                                                                                        |
|-----------|---------|---------------|------------------------------------------------------------------------------------------------------------|
| #1        | 729.50' | 24,808 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)<br><b>24.0" Round Pipe Storage</b><br>L= 400.0' |
| #2        | 730.00' | 1,257 cf      |                                                                                                            |
| 26,064 cf |         |               | Total Available Storage                                                                                    |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 18,136               | 14,368                    | 24,808                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                                                                                                                                   |
|--------|-----------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Existing Pipe</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                                                                                                                          |
| #2     | Device 1  | 732.00' | <b>6.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32                                                                                                                                               |
| #3     | Device 1  | 731.05' | <b>27.0" W x 5.0" H Vert. Orifice</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                                                                                              |
| #4     | Discarded | 729.50' | <b>0.450 in/hr Infiltration over Surface area</b>                                                                                                                                                                                                                                                |
| #5     | Secondary | 732.30' | <b>20.0' long x 5.0' breadth Stabilized Overflow to Valley Industrial Blvd</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65<br>2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88 |
| #6     | Device 1  | 732.32' | <b>Inlet Capacity</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50<br>Disch. (cfs) 0.000 0.410 1.170 2.150 3.100 3.710                                                                                                                                                                           |
| #7     | Device 6  | 732.60' | <b>5.0' long x 15.0' breadth To Citation Drive</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60                                                                                                                                                                                        |

Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Discarded OutFlow** Max=0.13 cfs @ 12.25 hrs HW=732.30' (Free Discharge)↑ **4=Infiltration** (Exfiltration Controls 0.13 cfs)**Primary OutFlow** Max=7.48 cfs @ 12.25 hrs HW=732.30' TW=0.00' (Dynamic Tailwater)↑ **1=Existing Pipe** (Passes 7.48 cfs of 10.79 cfs potential flow)↑ **2=Broad-Crested Rectangular Weir** (Weir Controls 2.87 cfs @ 1.58 fps)↑ **3=Orifice** (Orifice Controls 4.61 cfs @ 4.91 fps)↑ **6=Inlet Capacity** ( Controls 0.00 cfs)↑ **7=To Citation Drive** ( Controls 0.00 cfs)**Secondary OutFlow** Max=0.01 cfs @ 12.25 hrs HW=732.30' TW=0.00' (Dynamic Tailwater)↑ **5=Stabilized Overflow to Valley Industrial Blvd** (Weir Controls 0.01 cfs @ 0.14 fps)**Pond P\_IB-01:****Hydrograph**

Time span=0.00-96.00 hrs, dt=0.01 hrs, 9601 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P-01:**

Runoff Area=156,080 sf 33.97% Impervious Runoff Depth=5.97"  
Tc=6.0 min CN=84/98 Runoff=35.84 cfs 1.783 af

**Reach P\_SUM:**

Inflow=26.15 cfs 1.590 af  
Outflow=26.15 cfs 1.590 af

**Pond P\_IB-01:**

Peak Elev=732.72' Storage=21,349 cf Inflow=35.84 cfs 1.783 af  
Discarded=0.17 cfs 0.193 af Primary=12.21 cfs 1.375 af Secondary=13.95 cfs 0.214 af Outflow=26.32 cfs 1.783 af

**Summary for Subcatchment P-01:**

Runoff = 35.84 cfs @ 12.13 hrs, Volume= 1.783 af, Depth= 5.97"  
 Routed to Pond P\_IB-01 :

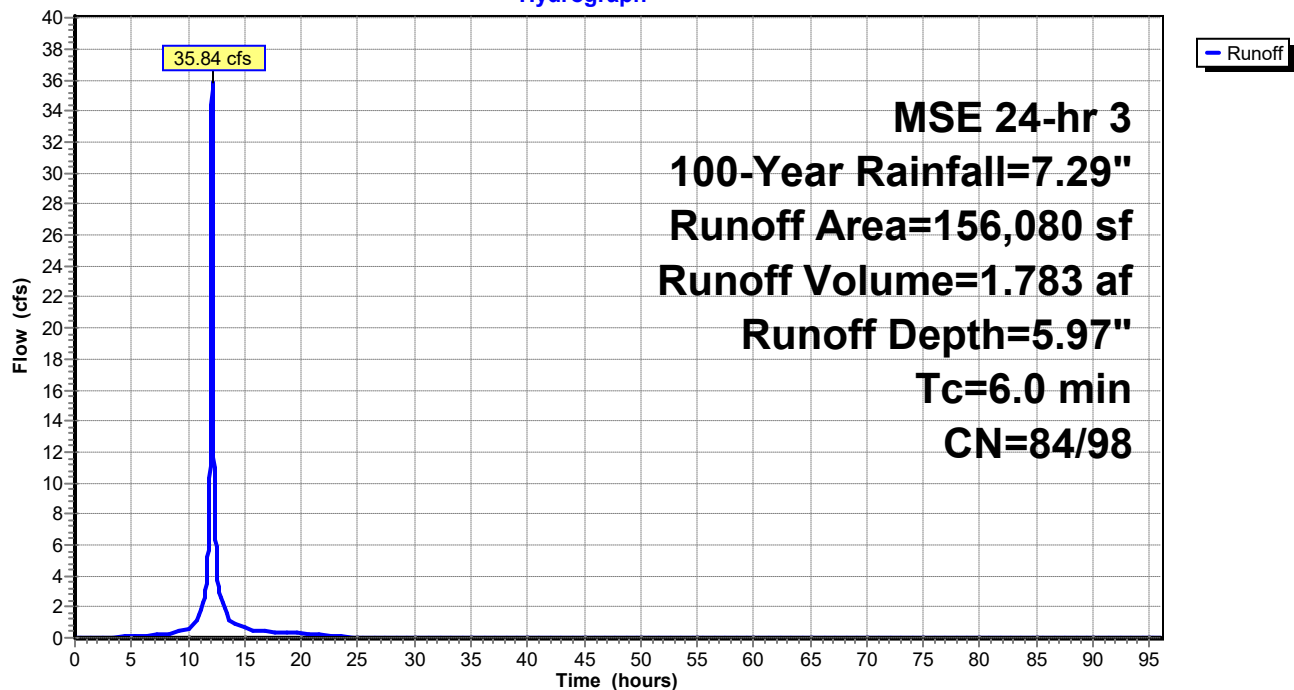
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 100-Year Rainfall=7.29"

| Area (sf) | CN | Description                     |
|-----------|----|---------------------------------|
| 44,819    | 69 | 50-75% Grass cover, Fair, HSG B |
| * 53,023  | 98 | Impervious, HSG B               |
| * 58,238  | 96 | Gravel Surface, HSG B           |
| 156,080   | 89 | Weighted Average                |
| 103,057   | 84 | 66.03% Pervious Area            |
| 53,023    | 98 | 33.97% Impervious Area          |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description   |
|----------|---------------|---------------|-------------------|----------------|---------------|
| 6.0      |               |               |                   |                | Direct Entry, |

**Subcatchment P-01:**

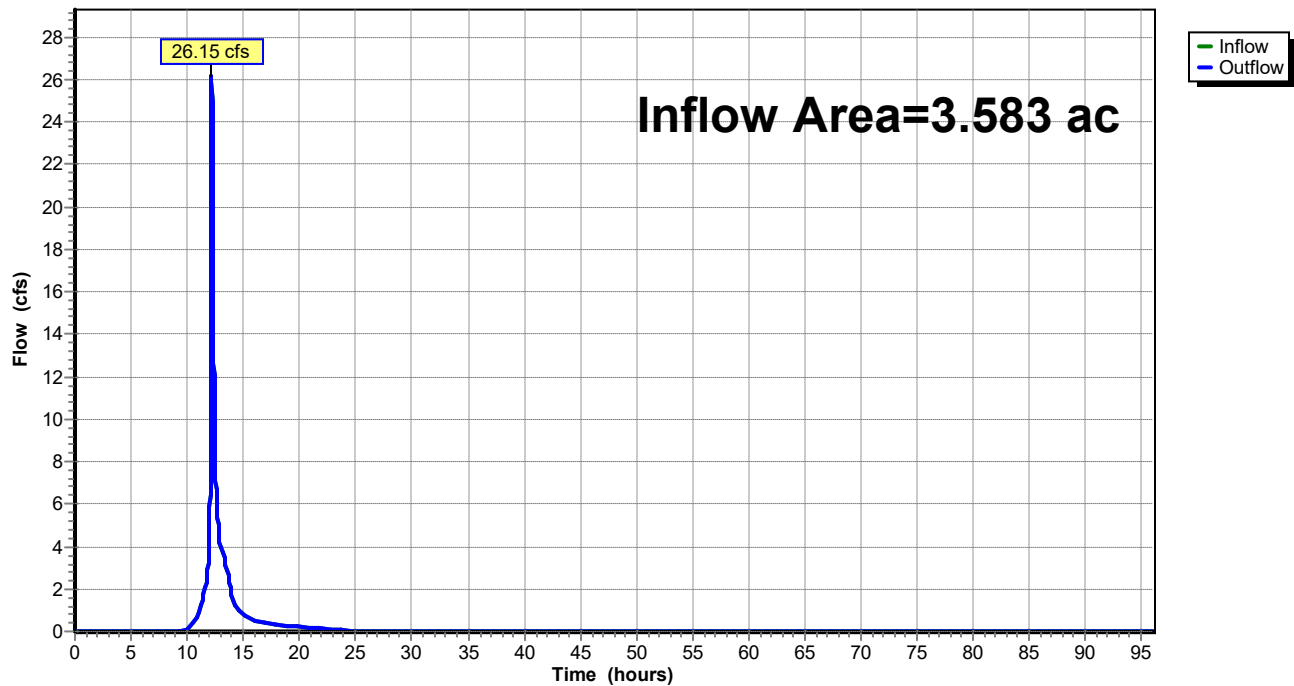
Hydrograph



**Summary for Reach P\_SUM:**

Inflow Area = 3.583 ac, 33.97% Impervious, Inflow Depth = 5.32" for 100-Year event  
Inflow = 26.15 cfs @ 12.18 hrs, Volume= 1.590 af  
Outflow = 26.15 cfs @ 12.18 hrs, Volume= 1.590 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs

**Reach P\_SUM:****Hydrograph**

**Summary for Pond P\_IB-01:**

Inflow Area = 3.583 ac, 33.97% Impervious, Inflow Depth = 5.97" for 100-Year event  
 Inflow = 35.84 cfs @ 12.13 hrs, Volume= 1.783 af  
 Outflow = 26.32 cfs @ 12.18 hrs, Volume= 1.783 af, Atten= 27%, Lag= 3.1 min  
 Discarded = 0.17 cfs @ 12.18 hrs, Volume= 0.193 af  
 Primary = 12.21 cfs @ 12.18 hrs, Volume= 1.375 af  
 Routed to Reach P\_SUM :  
 Secondary = 13.95 cfs @ 12.18 hrs, Volume= 0.214 af  
 Routed to Reach P\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.01 hrs  
 Peak Elev= 732.72' @ 12.18 hrs Surf.Area= 16,058 sf Storage= 21,349 cf

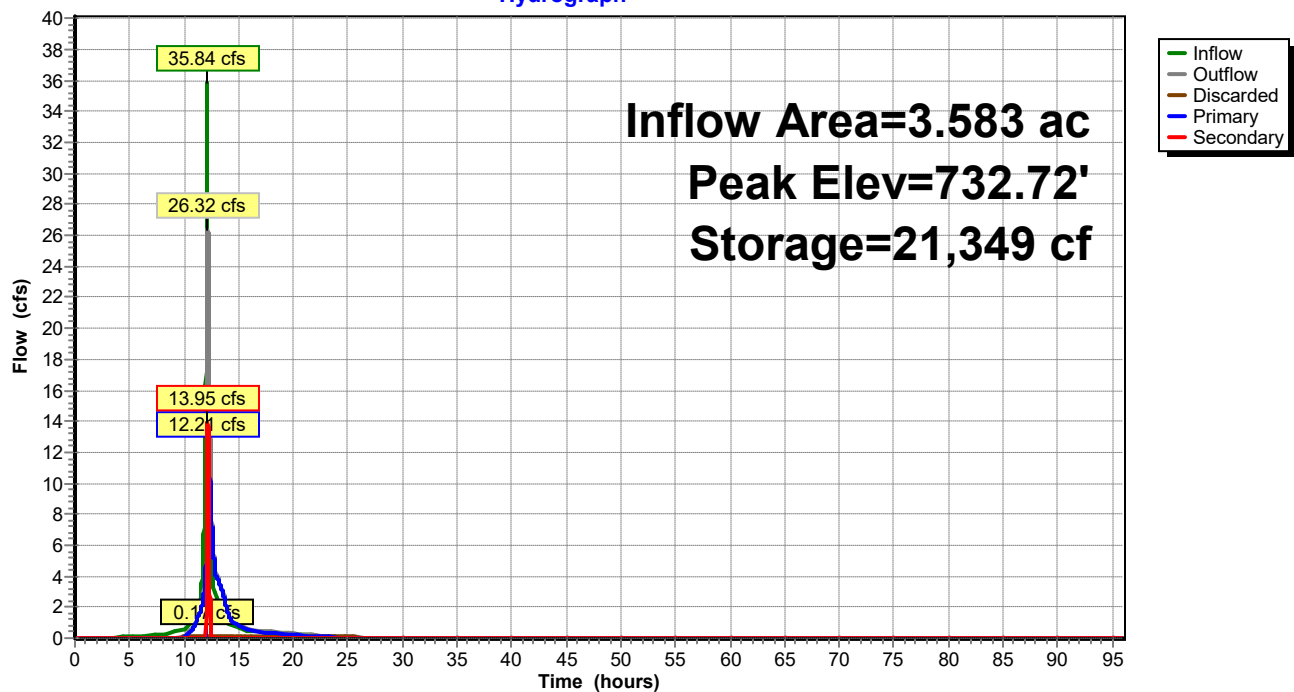
Plug-Flow detention time= 107.6 min calculated for 1.783 af (100% of inflow)  
 Center-of-Mass det. time= 107.8 min ( 873.0 - 765.1 )

| Volume    | Invert  | Avail.Storage | Storage Description                                                                                        |
|-----------|---------|---------------|------------------------------------------------------------------------------------------------------------|
| #1        | 729.50' | 24,808 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)<br><b>24.0" Round Pipe Storage</b><br>L= 400.0' |
| #2        | 730.00' | 1,257 cf      |                                                                                                            |
| 26,064 cf |         |               | Total Available Storage                                                                                    |

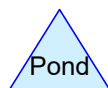
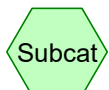
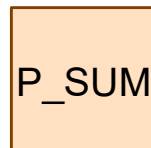
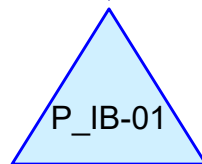
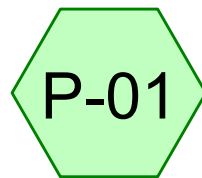
| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 18,136               | 14,368                    | 24,808                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                                                                                                                                   |
|--------|-----------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Existing Pipe</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                                                                                                                          |
| #2     | Device 1  | 732.00' | <b>6.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32                                                                                                                                               |
| #3     | Device 1  | 731.05' | <b>27.0" W x 5.0" H Vert. Orifice</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                                                                                              |
| #4     | Discarded | 729.50' | <b>0.450 in/hr Infiltration over Surface area</b>                                                                                                                                                                                                                                                |
| #5     | Secondary | 732.30' | <b>20.0' long x 5.0' breadth Stabilized Overflow to Valley Industrial Blvd</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65<br>2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88 |
| #6     | Device 1  | 732.32' | <b>Inlet Capacity</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50<br>Disch. (cfs) 0.000 0.410 1.170 2.150 3.100 3.710                                                                                                                                                                           |
| #7     | Device 6  | 732.60' | <b>5.0' long x 15.0' breadth To Citation Drive</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60                                                                                                                                                                                        |

Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

**Discarded OutFlow** Max=0.17 cfs @ 12.18 hrs HW=732.72' (Free Discharge)↑ **4=Infiltration** (Exfiltration Controls 0.17 cfs)**Primary OutFlow** Max=12.21 cfs @ 12.18 hrs HW=732.72' TW=0.00' (Dynamic Tailwater)↑ **1=Existing Pipe** (Barrel Controls 12.21 cfs @ 6.91 fps)↑ **2=Broad-Crested Rectangular Weir** (Passes < 11.89 cfs potential flow)↑ **3=Orifice** (Passes < 5.46 cfs potential flow)↑ **6=Inlet Capacity** (Passes < 3.12 cfs potential flow)↑ **7=To Citation Drive** (Passes < 0.58 cfs potential flow)**Secondary OutFlow** Max=13.93 cfs @ 12.18 hrs HW=732.72' TW=0.00' (Dynamic Tailwater)↑ **5=Stabilized Overflow to Valley Industrial Blvd** (Weir Controls 13.93 cfs @ 1.64 fps)**Pond P\_IB-01:****Hydrograph**

# PROPOSED SNOWMELT



**2023-0516 PR SNOWMELT\_227705401**

Prepared by Stantec Consulting Services

Printed 5/16/2023

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Page 2

**Rainfall Events Listing**

| Event# | Event<br>Name   | Storm Type | Curve | Mode  | Duration<br>(hours) | B/B | Depth<br>(inches) | AMC |
|--------|-----------------|------------|-------|-------|---------------------|-----|-------------------|-----|
| 1      | 100-Year 10-Day | MSE 24-hr  | 3     | Scale | 240.00              | 1   | 7.20              | 4   |

Time span=0.00-300.00 hrs, dt=0.01 hrs, 30001 points  
Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.  
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P-01:** Runoff Area=156,080 sf 100.00% Impervious Runoff Depth=7.20"  
Tc=6.0 min CN=98/100 Runoff=4.28 cfs 2.150 af

**Reach P\_SUM:** Inflow=3.67 cfs 2.064 af  
Outflow=3.67 cfs 2.064 af

**Pond P\_IB-01:** Peak Elev=731.92' Storage=10,883 cf Inflow=4.28 cfs 2.150 af  
Primary=3.67 cfs 2.064 af Secondary=0.00 cfs 0.000 af Outflow=3.67 cfs 2.064 af

### Summary for Subcatchment P-01:

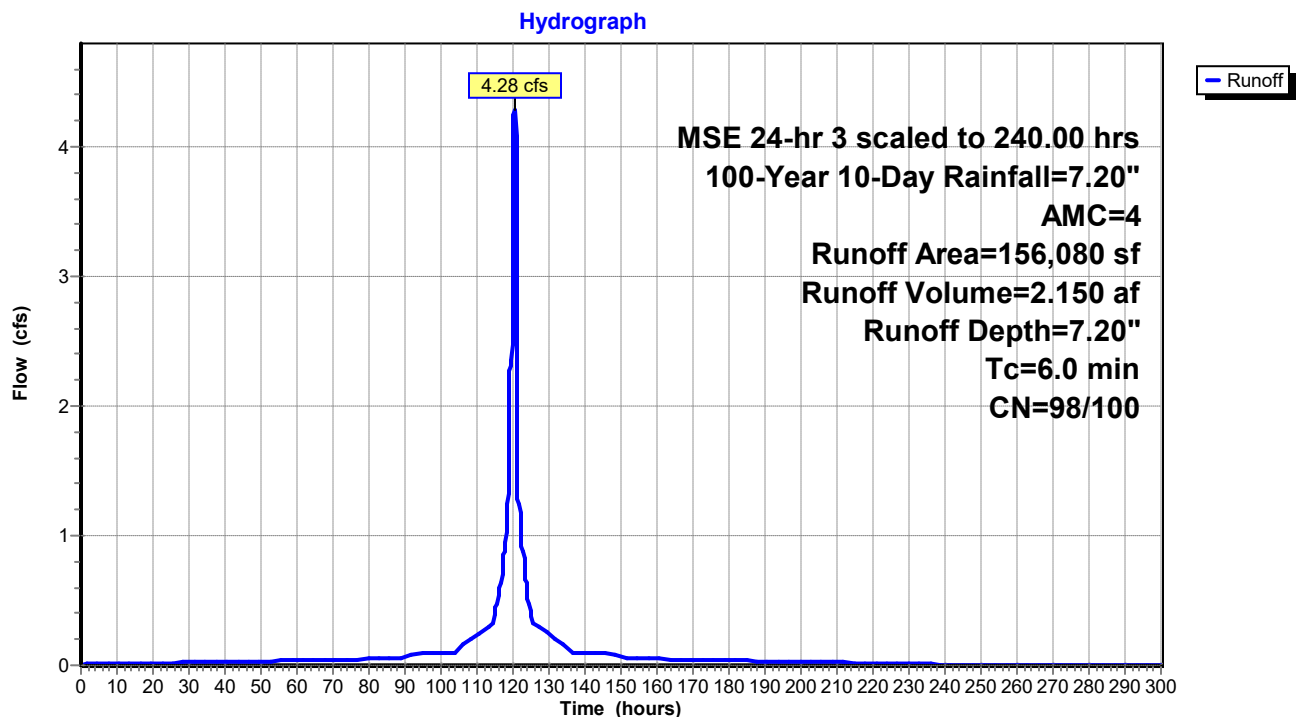
Runoff = 4.28 cfs @ 120.50 hrs, Volume= 2.150 af, Depth= 7.20"  
 Routed to Pond P\_IB-01 :

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-300.00 hrs, dt= 0.01 hrs  
 MSE 24-hr 3 scaled to 240.00 hrs    100-Year 10-Day Rainfall=7.20", AMC=4

|   | Area (sf) | CN  | Description                     |
|---|-----------|-----|---------------------------------|
| * | 44,819    | 100 | 50-75% Grass cover, Fair, HSG B |
| * | 53,023    | 100 | Impervious, HSG B               |
| * | 58,238    | 100 | Gravel Surface, HSG B           |
|   | 156,080   | 100 | Weighted Average                |
|   | 156,080   | 100 | 100.00% Impervious Area         |

| Tc<br>(min) | Length<br>(feet) | Slope<br>(ft/ft) | Velocity<br>(ft/sec) | Capacity<br>(cfs) | Description   |
|-------------|------------------|------------------|----------------------|-------------------|---------------|
| 6.0         |                  |                  |                      |                   | Direct Entry, |

### Subcatchment P-01:

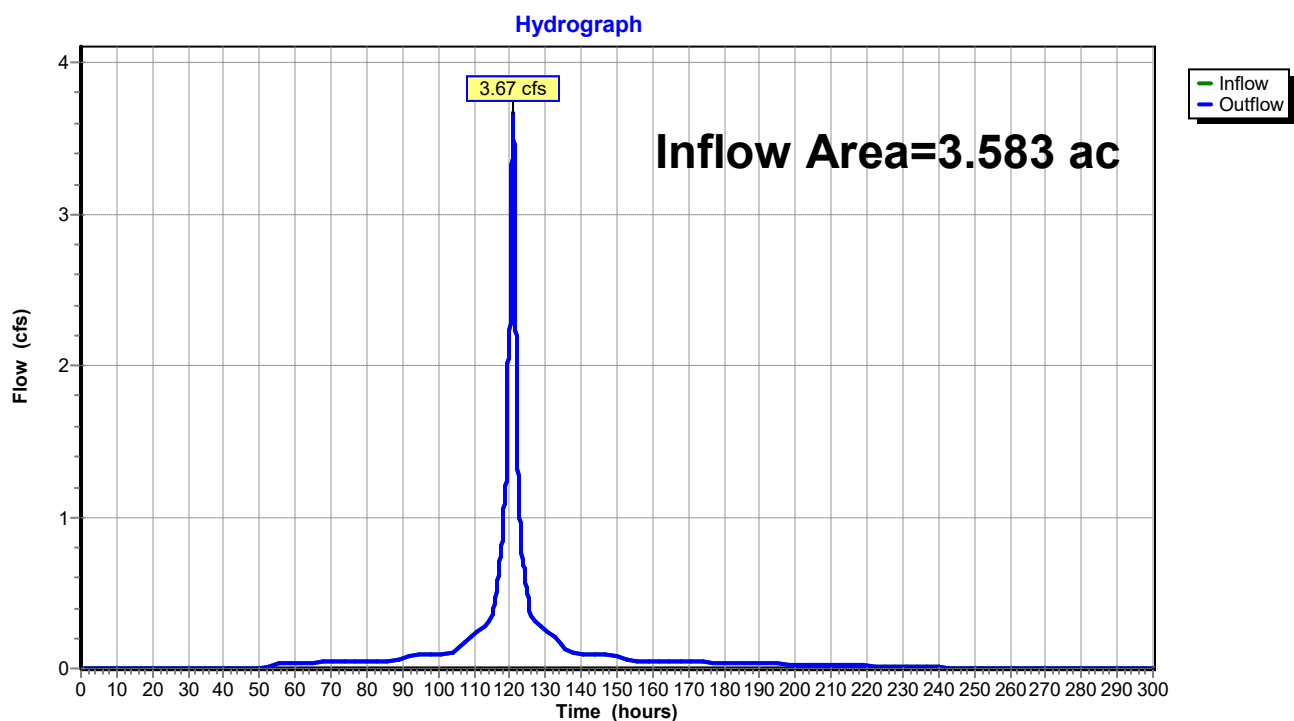


### Summary for Reach P\_SUM:

Inflow Area = 3.583 ac, 100.00% Impervious, Inflow Depth = 6.91" for 100-Year 10-Day event  
Inflow = 3.67 cfs @ 121.06 hrs, Volume= 2.064 af  
Outflow = 3.67 cfs @ 121.06 hrs, Volume= 2.064 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.01 hrs

### Reach P\_SUM:



### Summary for Pond P\_IB-01:

Inflow Area = 3.583 ac, 100.00% Impervious, Inflow Depth = 7.20" for 100-Year 10-Day event  
 Inflow = 4.28 cfs @ 120.50 hrs, Volume= 2.150 af  
 Outflow = 3.67 cfs @ 121.06 hrs, Volume= 2.064 af, Atten= 14%, Lag= 33.4 min  
 Primary = 3.67 cfs @ 121.06 hrs, Volume= 2.064 af  
 Routed to Reach P\_SUM :  
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Routed to Reach P\_SUM :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-300.00 hrs, dt= 0.01 hrs  
 Peak Elev= 731.92' @ 121.06 hrs Surf.Area= 10,447 sf Storage= 10,883 cf

Plug-Flow detention time= 484.3 min calculated for 2.064 af (96% of inflow)  
 Center-of-Mass det. time= 264.0 min ( 7,471.8 - 7,207.8 )

| Volume    | Invert  | Avail.Storage | Storage Description                                                                                        |
|-----------|---------|---------------|------------------------------------------------------------------------------------------------------------|
| #1        | 729.50' | 24,808 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)<br><b>24.0" Round Pipe Storage</b><br>L= 400.0' |
| #2        | 730.00' | 1,257 cf      |                                                                                                            |
| 26,064 cf |         |               | Total Available Storage                                                                                    |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 729.50              | 10                   | 0                         | 0                         |
| 730.50              | 2,236                | 1,123                     | 1,123                     |
| 731.00              | 4,610                | 1,712                     | 2,835                     |
| 732.00              | 10,600               | 7,605                     | 10,440                    |
| 733.00              | 18,136               | 14,368                    | 24,808                    |

| Device | Routing   | Invert  | Outlet Devices                                                                                                                                                                                                                                                                                   |
|--------|-----------|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary   | 729.50' | <b>18.0" Round Existing Pipe</b> L= 60.0' Ke= 0.500<br>Inlet / Outlet Invert= 729.50' / 729.30' S= 0.0033 '/' Cc= 0.900<br>n= 0.013, Flow Area= 1.77 sf                                                                                                                                          |
| #2     | Device 1  | 732.00' | <b>6.0' long x 0.5' breadth Broad-Crested Rectangular Weir</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32                                                                                                                                               |
| #3     | Device 1  | 731.05' | <b>27.0" W x 5.0" H Vert. Orifice</b> C= 0.600<br>Limited to weir flow at low heads                                                                                                                                                                                                              |
| #4     | Secondary | 732.30' | <b>20.0' long x 5.0' breadth Stabilized Overflow to Valley Industrial Blvd</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00<br>2.50 3.00 3.50 4.00 4.50 5.00 5.50<br>Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65<br>2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88 |
| #5     | Device 1  | 732.32' | <b>Inlet Capacity</b><br>Head (feet) 0.00 0.10 0.20 0.30 0.40 0.50<br>Disch. (cfs) 0.000 0.410 1.170 2.150 3.100 3.710                                                                                                                                                                           |
| #6     | Device 5  | 732.60' | <b>5.0' long x 15.0' breadth To Citation Drive</b><br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63                                                                                                                             |

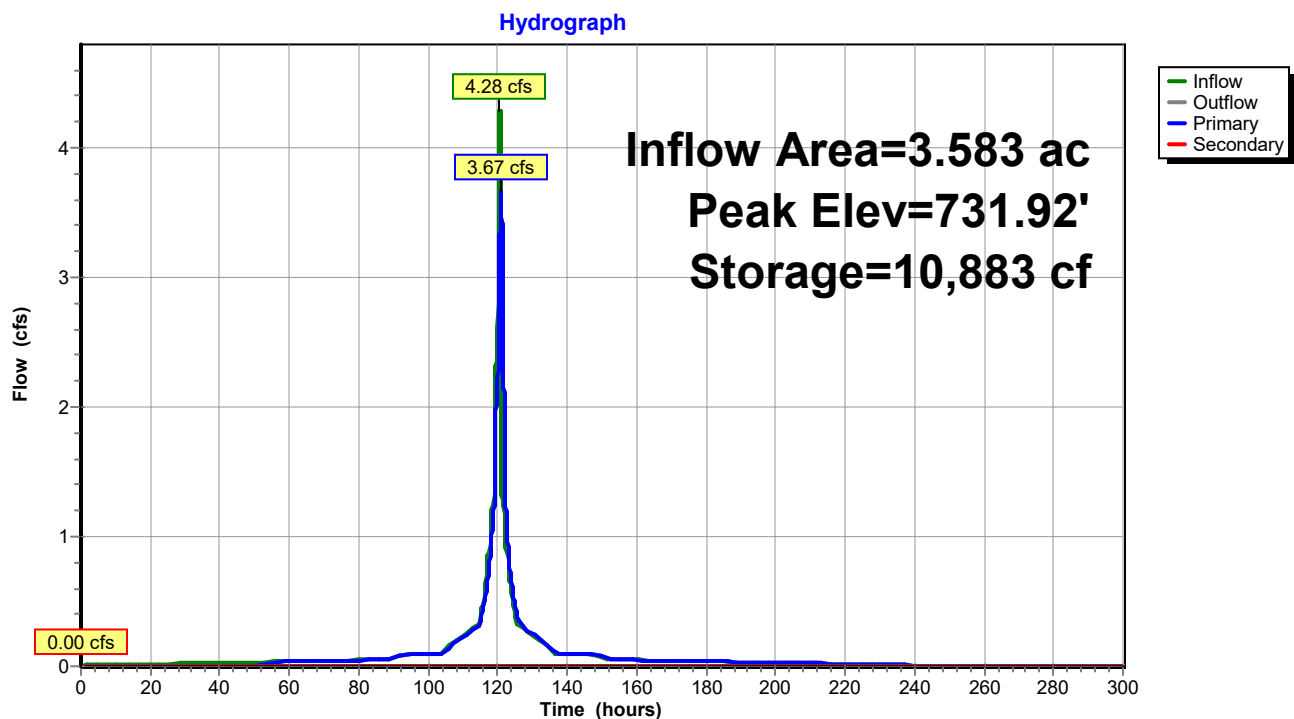
**Primary OutFlow** Max=3.66 cfs @ 121.06 hrs HW=731.92' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Existing Pipe** (Passes 3.66 cfs of 9.33 cfs potential flow)
- ↑ **2=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)
- ↑ **3=Orifice** (Orifice Controls 3.66 cfs @ 3.91 fps)
- ↑ **5=Inlet Capacity** ( Controls 0.00 cfs)
- ↑ **6=To Citation Drive** ( Controls 0.00 cfs)

**Secondary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=729.50' TW=0.00' (Dynamic Tailwater)

- ↑ **4=Stabilized Overflow to Valley Industrial Blvd** ( Controls 0.00 cfs)

### Pond P\_IB-01:



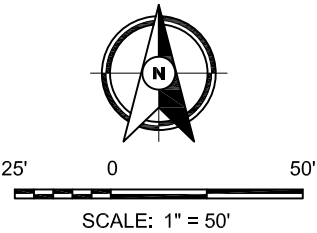
## **APPENDIX C**

### **Geotechnical Report**

F:\2023\B2300982\CAD\B2300982.dwg, Geo, 2/14/2023 7:56:20 PM



**DENOTES APPROXIMATE LOCATION OF  
STANDARD PENETRATION TEST BORING**



**BRAUN  
INTERTEC**  
The Science You Build On.

11001 Hampshire Avenue S  
Minneapolis, MN 55438  
952.995.2000  
braunintertec.com

**DRAFT**  
Subject to change

| Drawing Information |          |
|---------------------|----------|
| Project No:         | B2300982 |
| Drawing No:         | B2300982 |
| Drawn By:           | BJB      |
| Date Drawn:         | 2/1/23   |
| Checked By:         | BJA      |
| Last Modified:      | 2/4/23   |

| Project Information              |  |
|----------------------------------|--|
| Quality Forklift<br>Improvements |  |

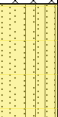
491 Citation Drive

Shakopee, Minnesota

**Soil Boring  
Location Sketch**

|                                                                                                                                                                     |  |                        |                    |                      |                                             |                 |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------|--------------------|----------------------|---------------------------------------------|-----------------|--|
| <b>Project Number B2300982</b><br><b>Geotechnical Evaluation</b><br><b>Quality Forklift Improvements</b><br><b>491 Citation Drive</b><br><b>Shakopee, Minnesota</b> |  |                        |                    |                      | BORING: <b>ST-1</b>                         |                 |  |
|                                                                                                                                                                     |  |                        |                    |                      | LOCATION: See attached sketch               |                 |  |
|                                                                                                                                                                     |  |                        |                    |                      | DATUM: NAD 1983 HARN Adj MN Scott (US Feet) |                 |  |
|                                                                                                                                                                     |  |                        |                    |                      | NORTHING: 218095                            | EASTING: 464503 |  |
| DRILLER: B. Kammermeier                                                                                                                                             |  | LOGGED BY: B. Albrecht |                    | START DATE: 02/10/23 | END DATE: 02/10/23                          |                 |  |
| SURFACE ELEVATION: 730.6 ft                                                                                                                                         |  | RIG: 7506              | METHOD: 3 1/4" HSA | SURFACING: Soil      | WEATHER: Clear                              |                 |  |

| Elev./Depth ft | Water Level | Description of Materials<br>(Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)                                                                                                                                                                       | Sample | Blows<br>(N-Value)<br>Recovery | q <sub>p</sub><br>tsf | MC<br>% | Tests or Remarks                   |
|----------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------|-----------------------|---------|------------------------------------|
| 730.0          |             |  SILTY SAND (SM), fine to medium-grained, trace fibers, dark brown, moist (TOPSOIL FILL)<br>FILL: SILTY SAND (SM), fine to medium-grained, trace Gravel, brown, moist |        |                                |                       |         |                                    |
| 0.6            |             |                                                                                                                                                                                                                                                        |        |                                |                       |         |                                    |
| 727.6          |             |  POORLY GRADED SAND with SILT (SP-SM), fine to coarse-grained, with Gravel, brown, wet, medium dense to loose (GLACIAL OUTWASH)                                       |        | 3-6-7<br>(13)<br>14"           |                       |         |                                    |
| 3.0            |             |                                                                                                                                                                                                                                                        |        |                                |                       |         |                                    |
| 725.1          |             |  SHAKOPEE FORMATION, LIMESTONE, tan, moist, highly weathered, very dense<br>END OF BORING<br><br>Boring immediately backfilled                                       | 5      | 3-2-18<br>(20)<br>8"           |                       |         |                                    |
| 5.5            |             |                                                                                                                                                                                                                                                        |        |                                |                       |         |                                    |
| 724.6          |             |                                                                                                                                                                                                                                                        |        | 50/0"<br>(REF)<br>0"           |                       |         | Auger met refusal at 6 feet        |
| 6.0            |             |                                                                                                                                                                                                                                                        |        |                                |                       |         | Water not observed while drilling. |
|                |             |                                                                                                                                                                                                                                                        | 10     |                                |                       |         |                                    |
|                |             |                                                                                                                                                                                                                                                        | 15     |                                |                       |         |                                    |

[illegible]

See Descriptive Terminology sheet for explanation of abbreviations

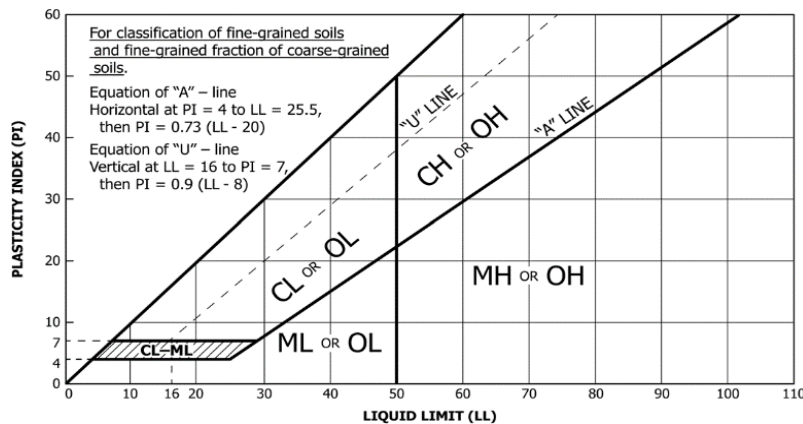
|                                                                                                                                                                     |  |                        |                    |                      |                                             |                 |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------|--------------------|----------------------|---------------------------------------------|-----------------|--|
| <b>Project Number B2300982</b><br><b>Geotechnical Evaluation</b><br><b>Quality Forklift Improvements</b><br><b>491 Citation Drive</b><br><b>Shakopee, Minnesota</b> |  |                        |                    |                      | BORING: <b>ST-3</b>                         |                 |  |
|                                                                                                                                                                     |  |                        |                    |                      | LOCATION: See attached sketch               |                 |  |
|                                                                                                                                                                     |  |                        |                    |                      | DATUM: NAD 1983 HARN Adj MN Scott (US Feet) |                 |  |
|                                                                                                                                                                     |  |                        |                    |                      | NORTHING: 217809                            | EASTING: 464619 |  |
| DRILLER: B. Kammermeier                                                                                                                                             |  | LOGGED BY: B. Albrecht |                    | START DATE: 02/10/23 | END DATE: 02/10/23                          |                 |  |
| SURFACE ELEVATION: 735.3 ft                                                                                                                                         |  | RIG: 7506              | METHOD: 3 1/4" HSA | SURFACING: Soil      | WEATHER: Clear                              |                 |  |

| Elev./<br>Depth<br>ft | Water<br>Level | Description of Materials<br>(Soil-ASTM D2488 or 2487; Rock-USACE EM<br>1110-1-2908)                                                                        | Sample | Blows<br>(N-Value)<br>Recovery | q <sub>p</sub><br>tsf | MC<br>% | Tests or Remarks                      |
|-----------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------|-----------------------|---------|---------------------------------------|
| 734.5<br>0.8          |                | SILTY SAND (SM), fine to coarse-grained, with Gravel, dark brown, moist (TOPSOIL FILL)<br>FILL: SILTY SAND (SM), fine to medium-grained, dark brown, moist |        | 4-10-8<br>(18)<br>12"          |                       |         |                                       |
| 731.3<br>4.0          |                | POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, trace Gravel, brown, moist, loose (GLACIAL OUTWASH)                                          | 5      | 3-3-5<br>(8)<br>11"            |                       |         |                                       |
| 728.3<br>7.0          |                | POORLY GRADED SAND (SP), fine to medium-grained, light brown, wet, medium dense (GLACIAL OUTWASH)                                                          |        | 5-7-7<br>(14)<br>14"           |                       |         |                                       |
| 726.3<br>9.0          |                | SHAKOPEE FORMATION, LIMESTONE, moist, highly weathered, hard, very dense                                                                                   |        | 18-50/3"<br>(REF)<br>4"        |                       |         |                                       |
| 725.0<br>10.3         |                | END OF BORING                                                                                                                                              | 10     |                                |                       |         | Auger met refusal at 10 feet 3 inches |
|                       |                | Boring immediately backfilled                                                                                                                              |        |                                |                       |         | Water not observed while drilling.    |
|                       |                |                                                                                                                                                            | 15     |                                |                       |         |                                       |

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup> |                                                                       |                                                           |                                                             | Group Symbol | Soil Classification                                          |
|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------|--------------|--------------------------------------------------------------|
|                                                                                          |                                                                       |                                                           |                                                             |              | Group Name <sup>B</sup>                                      |
| Coarse-grained Soils<br>(more than 50% retained on No. 200 sieve)                        | Gravels<br>(More than 50% of coarse fraction retained on No. 4 sieve) | Clean Gravels<br>(Less than 5% fines <sup>C</sup> )       | $C_u \geq 4$ and $1 \leq C_c \leq 3^D$                      | GW           | Well-graded gravel <sup>E</sup>                              |
|                                                                                          |                                                                       |                                                           | $C_u < 4$ and/or ( $C_c < 1$ or $C_c > 3$ ) <sup>D</sup>    | GP           | Poorly graded gravel <sup>E</sup>                            |
|                                                                                          |                                                                       | Gravels with Fines<br>(More than 12% fines <sup>C</sup> ) | Fines classify as ML or MH                                  | GM           | Silty gravel <sup>EFG</sup>                                  |
|                                                                                          |                                                                       |                                                           | Fines Classify as CL or CH                                  | GC           | Clayey gravel <sup>EFG</sup>                                 |
|                                                                                          | Sands<br>(50% or more coarse fraction passes No. 4 sieve)             | Clean Sands<br>(Less than 5% fines <sup>H</sup> )         | $C_u \geq 6$ and $1 \leq C_c \leq 3^D$                      | SW           | Well-graded sand <sup>I</sup>                                |
|                                                                                          |                                                                       |                                                           | $C_u < 6$ and/or ( $C_c < 1$ or $C_c > 3$ ) <sup>D</sup>    | SP           | Poorly graded sand <sup>I</sup>                              |
|                                                                                          |                                                                       | Sands with Fines<br>(More than 12% fines <sup>H</sup> )   | Fines classify as ML or MH                                  | SM           | Silty sand <sup>FGI</sup>                                    |
|                                                                                          |                                                                       |                                                           | Fines classify as CL or CH                                  | SC           | Clayey sand <sup>FGI</sup>                                   |
| Fine-grained Soils<br>(50% or more passes the No. 200 sieve)                             | Silts and Clays<br>(Liquid limit less than 50)                        | Inorganic                                                 | PI > 7 and plots on or above "A" line <sup>J</sup>          | CL           | Lean clay <sup>KLM</sup>                                     |
|                                                                                          |                                                                       |                                                           | PI < 4 or plots below "A" line <sup>J</sup>                 | ML           | Silt <sup>KLM</sup>                                          |
|                                                                                          |                                                                       | Organic                                                   | Liquid Limit – oven dried<br>Liquid Limit – not dried <0.75 | OL           | Organic clay <sup>KLMN</sup><br>Organic silt <sup>KLMQ</sup> |
|                                                                                          |                                                                       |                                                           | PI plots on or above "A" line                               | CH           | Fat clay <sup>KLM</sup>                                      |
|                                                                                          | Silts and Clays<br>(Liquid limit 50 or more)                          | Inorganic                                                 | PI plots below "A" line                                     | MH           | Elastic silt <sup>KLM</sup>                                  |
|                                                                                          |                                                                       |                                                           | Liquid Limit – oven dried<br>Liquid Limit – not dried <0.75 | OH           | Organic clay <sup>KLMP</sup><br>Organic silt <sup>KLMQ</sup> |
|                                                                                          |                                                                       | Organic                                                   | Liquid Limit – oven dried<br>Liquid Limit – not dried <0.75 | OL           | Organic clay <sup>KLMP</sup><br>Organic silt <sup>KLMQ</sup> |
|                                                                                          |                                                                       |                                                           |                                                             |              |                                                              |
| Highly Organic Soils                                                                     |                                                                       | Primarily organic matter, dark in color, and organic odor |                                                             | PT           | Peat                                                         |

- A. Based on the material passing the 3-inch (75-mm) sieve.  
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.  
C. Gravels with 5 to 12% fines require dual symbols:  
GW-GM well-graded gravel with silt  
GW-GC well-graded gravel with clay  
GP-GM poorly graded gravel with silt  
GP-GC poorly graded gravel with clay  
D.  $C_u = D_{60} / D_{10}$   $C_c = (D_{30})^2 / (D_{10} \times D_{60})$   
E. If soil contains  $\geq 15\%$  sand, add "with sand" to group name.  
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.  
G. If fines are organic, add "with organic fines" to group name.  
H. Sands with 5 to 12% fines require dual symbols:  
SW-SM well-graded sand with silt  
SW-SC well-graded sand with clay  
SP-SM poorly graded sand with silt  
SP-SC poorly graded sand with clay  
I. If soil contains  $\geq 15\%$  gravel, add "with gravel" to group name.  
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.  
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.  
L. If soil contains  $\geq 30\%$  plus No. 200, predominantly sand, add "sandy" to group name.  
M. If soil contains  $\geq 30\%$  plus No. 200 predominantly gravel, add "gravelly" to group name.  
N. PI  $\geq 4$  and plots on or above "A" line.  
O. PI < 4 or plots below "A" line.  
P. PI plots on or above "A" line.  
Q. PI plots below "A" line.



DD Dry density, pcf  
WD Wet density, pcf  
P200 % Passing #200 sieve  
MC Moisture content, %  
OC Organic content, %

#### Laboratory Tests

$q_p$  Pocket penetrometer strength, tsf  
 $q_u$  Unconfined compression test, tsf  
LL Liquid limit  
PL Plastic limit  
PI Plasticity index

#### Particle Size Identification

Boulders..... over 12"  
Cobbles..... 3" to 12"  
Gravel  
Coarse..... 3/4" to 3" (19.00 mm to 75.00 mm)  
Fine..... No. 4 to 3/4" (4.75 mm to 19.00 mm)  
Sand  
Coarse..... No. 10 to No. 4 (2.00 mm to 4.75 mm)  
Medium..... No. 40 to No. 10 (0.425 mm to 2.00 mm)  
Fine..... No. 200 to No. 40 (0.075 mm to 0.425 mm)  
Silt..... No. 200 (0.075 mm) to .005 mm  
Clay..... < .005 mm

#### Relative Proportions<sup>L M</sup>

trace..... 0 to 5%  
little..... 6 to 14%  
with.....  $\geq 15\%$

#### Inclusion Thicknesses

lens..... 0 to 1/8"  
seam..... 1/8" to 1"  
layer..... over 1"

#### Apparent Relative Density of Cohesionless Soils

Very loose ..... 0 to 4 BPF  
Loose ..... 5 to 10 BPF  
Medium dense..... 11 to 30 BPF  
Dense..... 31 to 50 BPF  
Very dense..... over 50 BPF

#### Consistency of Cohesive Soils

Very soft..... 0 to 1 BPF..... < 0.25 tsf  
Soft..... 2 to 4 BPF..... 0.25 to 0.5 tsf  
Medium..... 5 to 8 BPF..... 0.5 to 1 tsf  
Stiff..... 9 to 15 BPF..... 1 to 2 tsf  
Very Stiff..... 16 to 30 BPF..... 2 to 4 tsf  
Hard..... over 30 BPF..... > 4 tsf

#### Moisture Content:

**Dry:** Absence of moisture, dusty, dry to the touch.  
**Moist:** Damp but no visible water.  
**Wet:** Visible free water, usually soil is below water table.

#### Drilling Notes:

**Blows/N-value:** Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

**Partial Penetration:** If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

**Recovery:** Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

**WOH:** Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

**WOR:** Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

**Water Level:** Indicates the water level measured by the drillers either while drilling ( , at the end of drilling ( , or at some time after drilling ( ).

#### Sample Symbols

 Standard Penetration Test  
 Modified California (MC)  
 Auger  
 Grab Sample  
 Rock Core  
 Thinwall (TW)/Shelby Tube (SH)  
 Texas Cone Penetrometer  
 Dynamic Cone Penetrometer