

April 10, 2026

Rainbow Industrial Park

Stormwater Management Report

PREPARED FOR:

Modus Holdings



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Appendix A – Figures

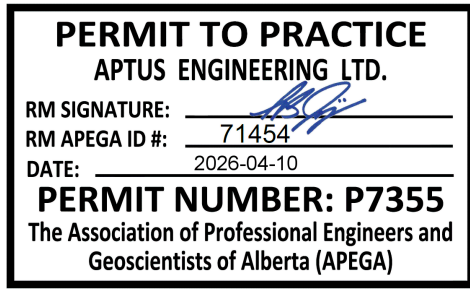
Appendix B – SWMF Results

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Corporate Authorization

This study entitled “Rainbow Industrial Park – Stormwater Management Report” was prepared by Aptus Engineering Ltd. for Modus Structures Inc.

The design and recommendations put forward reflect Aptus’ best professional judgment based on the information available at the time of preparing this report. Any use of this information in a manner not intended or with the knowledge that situations have changed shall not be the responsibility of Aptus Engineering Ltd.



Corporate Permit

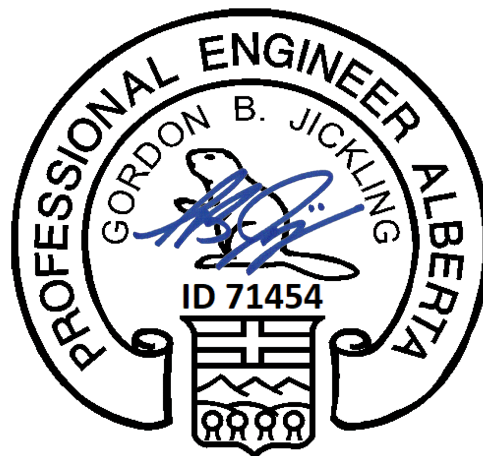
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1.0 Introduction & Study Area

Rainbow Industrial Park is located at NE23-29-1-W5, adjacent to the Dave Striker Industrial Subdivision, and forms part of the South Carstairs Area Structure Plan. The proposed development area was previously used as a driver training facility for Schlumberger Canada and is proposed to be redeveloped as an industrial subdivision.

Key characteristics of the proposed development include:

- Total development area of approximately 32.1 ha.
- Development consisting of 26 industrial lots constructed in two phases.
- Lot sizes ranging from approximately 1.0 ha to 1.3 ha.

The site is bounded by the following roadways:

- Highway 2A to the west
- Rainbow Road to the east
- Rainbow Drive to the south
- Township Road 294 to the north

Two existing stormwater management ponds serve the development. One pond is located in the northeast corner of the development, while the second pond is located south of Rainbow Drive. Runoff from the proposed development areas will ultimately be directed to these two ponds.

2.0 Background

2.1 EBA Engineering Consultants Report

In June 2000, EBA Engineering Consultants Ltd. prepared a broad-based stormwater management plan for the site in conjunction with the preparation of the South Carstairs Area Structure Plan. The study evaluated the entire 61.4 ha development area and established the sizing and flow requirements for two stormwater management ponds.

The original plan included the following stormwater management facilities:

Northeast Stormwater Pond

- Designed to capture runoff from part of the Schlumberger site as well as a portion of the proposed subdivision.
- Constructed during development of the Schlumberger facility; however, the pond was built west of the subdivision road rather than east, as originally shown in the plan.
- A survey completed by EBA determined the pond has a storage volume greater than 3,000 m³, compared to the 800 m³ required in the original report.

Rainbow Drive Stormwater Pond

- Designed to capture runoff from the remainder of the development area, including portions of the Schlumberger site and lands south of Rainbow Drive.
- The pond was also designed to maintain extra storage for firefighting purposes.
- A survey completed by EBA indicated the pond has an available stormwater storage capacity of approximately 2,800 m³, compared to the 1,600 m³ originally required.

2.2 Mountain Engineering Report

In December 2022 (revised July 2023), Mountain Engineering Ltd. prepared a Stormwater Management Report for the Dave Striker Industrial Subdivision. This report evaluated drainage for the surrounding area using the SWMHYMO hydrologic model, with hydrologic analysis based on the 1 in 100 year design storm from the City of Calgary Stormwater Management & Design Manual.

Key findings related to the Rainbow Industrial Park area include the following:

Northeast Pond Catchment

The northeast pond was identified as receiving runoff from approximately 14.9 ha of the Schlumberger site (Catchment 1). This entire drainage area will form part of the proposed Rainbow Industrial Park development. The Mountain Engineering report recommended installation of an additional 400 mm culvert outlet.

- Pre-development flow rate: 0.46 m³/s (30.87 L/s/ha)
- Recommended outlet: 400 mm culvert at 0.80% grade
- Controlled outflow rate: 0.26 m³/s
- Required storage volume: 1,722 m³

It is currently unknown whether the recommended outlet culvert was installed.

Rainbow Drive Pond Catchment

The remainder of the Schlumberger site (now the proposed Rainbow Industrial Park), approximately 16.4 ha, was identified as draining toward the storm pond south of Rainbow Drive as part of Catchment 4.

- Total catchment area: 29.5 ha
- Pre-development flow rate: 0.71 m³/s (24.06 L/s/ha)

In addition, originally Catchment 3 (5.7 ha) was planned to discharge into this pond, but was thought to be impractical and a separate pond was designed for that purpose.

The Mountain Engineering report recommended installation of an additional 400 mm culvert outlet in addition to the existing 450 mm outlet. With the additional culvert, the pond was determined to require:

- Storage volume: 2,607 m³
- Controlled outflow rate: 0.68 m³/s

It has been assumed that the recommended outlet modifications for the two stormwater management facilities have been implemented. This assumption should be verified prior to detailed design.

3.0 Proposed Development

The total Plan Area is approximately 32.1 hectares. 3.7 hectares of the site will be used for the road right of way, with the remaining 28.4 hectares being used as either commercial/industrial lots or municipal reserve for the stormwater management facilities.

The storm water management system for the development will consist of a system of roadway ditches and drainage swales that direct run-off from the industrial lots and roadways to the Northeast (14.9 ha) and Rainbow Drive (17.2ha) storm water management facilities (SWMF). The SWMFs will outlet at the restricted runoff rate to the Township Road 294 and Highway 2A ditches respectively.

The runoff from the remainder of Catchment 4 (12.3 ha) is currently directed to the Rainbow Drive SWMF.

3.1 Acceptable Outlet and Run-off Restrictions

The proposed development falls within the Stormwater Management Plan for the Dave Striker Industrial Subdivision (Mountain Engineering Ltd. July 2023). The Stormwater Management plan recommends the following post development outflows from stormwater management facilities for the 1:100 year Storm Event show below in [Table 1](#).

Table 1 – Dave Striker Industrial Subdivision Release Rates

| Catchment | Release Rate (L/s) | Unit Area Release Rate (L/s/ha) |
|-----------|--------------------|---------------------------------|
| 1 | 460 | 30.87 |
| 4 | 710 | 24.06 |

3.1.1 Catchment 1

As noted in Section 2.2, the existing catchment 1 outlets to the Township Road 294 ditch to the northeast via a 400mm culvert that was previously recommended. The runoff from this catchment eventually reaches the Highway 2 ditch.

3.1.2 Catchment 4

Section 2.2 notes that the existing catchment 4 discharges to a SWMF on the south side of Rainbow Drive. This catchment outlets into the Highway 2A ditch via a 400mm and 450mm culvert, which eventually reaches a wetland on the west side of Highway 2A.

3.2 Major-Minor Drainage Systems

Storm water management systems in Alberta are designed with a major-minor concept to avoid oversizing infrastructure for low frequency events. In a rural setting the minor system consists of ditches, swales, and culverts which convey smaller run off events to the SWMF, and the major system will use the same culverts and swales, but may also incorporate roads and other overland drainage routes to safely convey large run-off events to the SWMF. In rural settings the minor system is designed using the rational method to convey the 1:5YR statistical rainfall event, while the major system is designed to convey the 1:100YR statistical rainfall event in accordance with the velocity and depth requirements of the AEPA Stormwater Management guidelines.

3.3 Stormwater Management Facility Design

Minor and major drainage will be conveyed to the SWMFs via a system of ditches and culverts. The proposed SWMFs shall be designed with reference to Section 5.3.5.1 of the 2013 Stormwater Management Guidelines for the Province of Alberta (Alberta Environment & Parks), and the Red Deer Country Design Guidelines (2019). The final design of the storm water wetland will be of an extended detention type and incorporate the following features:

- ▲ A minimum 0.60m freeboard is provided above high water level
- ▲ Side-slopes in the active storage area and permanent pool are less than 5:1
- ▲ Permanent pool depth of 2.00-3.00m
- ▲ A flow control system to maintain the restricted release rate
- ▲ Length to width ratio of 2:1
- ▲ Maximum active storage depth of 1.50m from NWL to HWL.
- ▲ Permanent pool sized to store the volume of runoff from a 25mm storm event over the contributing area.
- ▲ Extended detention time exceeding 24hrs for the 25mm water quality event.
- ▲ Settlement forebays
- ▲ An emergency spillway (armored weir) constructed 0.30m above the pond high-water level elevation

The detailed design of the SWMFs will be completed as part of the detailed design for the development.

3.3.1 Water Quality

To meet Alberta Environment regulatory requirements for stormwater quality, which is currently a minimum removal rate of 85% of total suspended solids for particle sizes greater than, or equal to, 75 µm. the following features will be included in the final pond design:

- ▲ Permanent pool(s) sized to store the volume of runoff from a 25mm storm event over the contributing area.
- ▲ Detention time of 24 hours
- ▲ Settlement forebays to reduce the concentration of suspended solids and pollutants entering the storm water wetland.

4.0 Analysis Methodology & Data

A run-off model was developed using PCSWMM V7.7.3910 to evaluate the sizing of the storm water management facility. The minor system was not incorporated into the model as the primary purpose of this report is to evaluate the storage requirements of the SWMF at the restricted release rate.

4.1 PCSWMM Runoff Model

PCSWMM V7.7.3910 software by Computational Hydraulics International (CHI) was used to model the stormwater management system to conduct single event and continuous event analysis for this development. PCSWMM is a spatial decision support system for the US EPA SWMM5 program. The software is a dynamic rainfall-runoff-routing simulation model for single or continuous rainfall event analysis. Model runs were conducted using EPA SWMM version 5.2.4.

A diagram of the stormwater model and the PCSWMM model input and output files for the study area are provided in [Appendix C](#).

4.1.1 Single Event Design Storms

The design storm hyetographs developed for the single event model use a Chicago Distribution based on the Red Deer Regional Airport data from 1959-2012. Statistical run-off events including the 1:2 year, 1:5 year, 1:10 year, 1:25 year, 1:50 year, & 1:100 year were routed through the model to evaluate storage requirements, however only the results of the 1:100-year model run are appended. The outputs for the other storm events can be provided in digital format upon request.

Details of the design storm parameters are summarized in the [Table 2](#) below:

[Table 2 - Design Storm Parameters](#)

| Storm Event | 1:2 Year | 1:5 Year | 1:10 Year | 1:25 Year | 1:50 Year | 1:100 Year |
|-----------------------------|----------|----------|-----------|-----------|-----------|------------|
| Duration | 4 hours | 4 hours | 4 hours | 24 hours | 24 hours | 24 hours |
| Interval | 5 min | 5 min | 5 min | 5 min | 5 min | 5 min |
| Total Precipitation | 22.7mm | 32.9mm | 36.1mm | 82.8mm | 92.8mm | 102.7mm |
| Peak Intensity | 60mm/hr | 77mm/hr | 117mm/hr | 109mm/hr | 124mm/hr | 151mm/hr |
| Mean Intensity | 5.7mm/hr | 8.1mm/hr | 8.8mm/hr | 3.5mm/hr | 3.8mm/hr | 4.2mm/hr |
| <i>Peak Fraction = 0.33</i> | | | | | | |

4.1.2 Catchment Parameters

Catchments were defined for the single event model based on a previously identified catchment areas. Catchment naming has been taken from the previous Mountain Engineering Report. Catchment 2 represents an areas that will not contribute to either SWMF. The previous report identified the total imperviousness for each site as 50%. As 50% is the set imperviousness for gravel, 60% was chosen to account for the lots to have a gravel yard and a building. Catchment inputs for the single event model are listed below in [Table 2](#):

[Table 3 - Catchment Parameters](#)

| Drainage ID | Description | Catchment Area (Ha) | Slope (%) | Imperv. (%) | Width (m) |
|-------------|--------------------|---------------------|-----------|-------------|-----------|
| C01 | Northeast SWMF | 14.9 | 2 | 60 | 650 |
| C04a | New SWMF | 17.2 | 2 | 60 | 800 |
| C04b | Rainbow Drive SWMF | 12.3 | 2 | 60 | 200 |

4.1.3 Infiltration parameters

The infiltration method selected to compute the runoff from the development area was the Horton method. Parameters for the Horton Method and Manning 'n' values are referenced to the City of Calgary Storm Water Management & Design Manual (2011) as described below:

- ▲ Depression Storage, Impervious = 1.6mm
- ▲ Depression Storage, Pervious, Developed Areas = 3.2mm
- ▲ Depression Storage, Pervious, Berm Areas = 7.5mm
- ▲ Drying Time = 7 days
- ▲ Impervious Mannings' n = 0.015
- ▲ Pervious Manning' n = 0.15

4.1.4 Storage Curves

As no survey was completed for this report, the storage curve for the existing SWMFs were taken from the Mountain Engineering Report. A storage node for the northeast and Rainbow Drive SWMF was defined with a tabular storage curve summarized below:

Table 4 – Northeast SWMF

| Description | Contour Elevation (m) | Relative Depth (m) | Contour Area (m ²) | Cumulative Volume (m ³) |
|-------------|-----------------------|--------------------|--------------------------------|-------------------------------------|
| NWL | 945.40 | 0.000 | 1833 | 0 |
| HWL | 946.90 | 1.500 | 2756 | 3442 |

Table 5 – Rainbow Drive SWMF

| Description | Contour Elevation (m) | Relative Depth (m) | Contour Area (m ²) | Cumulative Volume (m ³) |
|-------------|-----------------------|--------------------|--------------------------------|-------------------------------------|
| NWL | 945.10 | 0.000 | 2245 | 0 |
| HWL | 946.20 | 1.100 | 3228 | 3010 |

4.2 Model Results and Stormwater Management Facilities

4.2.1 Existing Conditions

The existing conditions model assumes that the proposed development proceeds with the existing stormwater management facilities remaining in their current configuration. While previous analyses partially accounted for future development, this model applies updated assumptions to provide a consistent and conservative basis for evaluation. These include the use of the current design storm event and an increased imperviousness of 60% (compared to 50% in prior analyses).

The results of the modelling were as follows:

Table 6 – Existing Conditions Modelling Results

| Catchment | SWMF | Maximum Depth (m) | Maximum Volume (m ³) | Release Rate (m ³ /s) |
|-----------|--------------------|-------------------|----------------------------------|----------------------------------|
| C01 | Northeast SWMF | 1.84 | 4404 | 0.328 |
| C04 | Rainbow Drive SWMF | 2.04 | 6435 | 1.106 |

The northeast SWMF will outlet at a rate of 0.328 m³/s, lower than the 0.46m³/s from the previous report. However it will require 4,404 m³ of storage, over twice the amount indicated in the previous report of 1,722 m³. This would exceed the existing ponds HWL and may cause it to overflow. This pond would have to be expanded to accommodate the runoff from this catchment.

The Rainbow Drive SWMF will outlet at a rate of 1.106 m³/s, which exceeds the release rate from the of the previous report of 0.71 m³/s. Additionally, the maximum storage required would be 6,435 m³ which is more than the previous reports value of 2,607 m³.

4.2.1 Proposed Conditions

The development was then modelled using an alternative pond design for the Northeast SWMF, as well as a new SWMF being proposed on the north side of Rainbow Drive. The new pond would outlet into the existing Rainbow Drive pond through the existing 400mm culvert (assumed size) under Rainbow Drive. No Changes were proposed to the Rainbow Drive SWMF. The proposed pond dimensions are shown in the following tables:

Table 7 – Modified Northeast SWMF

| Description | Contour Elevation (m) | Relative Depth (m) | Contour Area (m ²) | Cumulative Volume (m ³) |
|-------------|-----------------------|--------------------|--------------------------------|-------------------------------------|
| NWL | 945.40 | 0.000 | 3089 | 0 |
| HWL | 946.90 | 1.500 | 5013 | 6076 |

Table 8 – Proposed New SWMF

| Description | Contour Elevation (m) | Relative Depth (m) | Contour Area (m ²) | Cumulative Volume (m ³) |
|-------------|-----------------------|--------------------|--------------------------------|-------------------------------------|
| NWL | 945.10 | 0.000 | 6537 | 0 |
| HWL | 946.20 | 1.100 | 9101 | 8601 |

The results of the modelling with the new pond design were as follows:

Table 9 – Proposed Conditions Modelling Results

| Catchment | SWMF | Maximum Depth (m) | Maximum Volume (m ³) | Release Rate (m ³ /s) | Unit Area Release Rate (L/s/ha) |
|-----------|-------------------------|-------------------|----------------------------------|----------------------------------|---------------------------------|
| C01 | Modified Northeast SWMF | 1.34 | 5273 | 0.289 | 19 |
| C04A | Proposed SWMF | 1.1 | 8601 | 0.200 | 12 |
| C04B | Rainbow Drive SWMF | 0.96 | 2565 | 0.676 | 23 |

The PCSWMM Single event model demonstrates that the SWMFs have adequate storage for the 1:100YR design storm event and provides a detention time of greater than 24 hours for the 25mm stormwater design event. All release rates were less than the maximum allowable release rates. Tables summarizing the results of all storm events for each pond are in Appendix B.

5.0 Conclusion

The Rainbow Industrial Park is proposed to be constructed within NE23-29-1-W5 as a redevelopment of the Schlumberger Driver Training facility. The development will include the remainder of Catchment 4 contributing to the existing Rainbow Drive SWMF and Catchment 1 contributing to the existing Northeast SWMF.

Runoff from the industrial lots will be collected by a ditch system and directed to the SWMFs. Culverts with capacity for 1:5-year storm events will convey the runoff across roadways. Rainfall events that exceed the capacity of the culverts will be conveyed overland to the SWMF. Overland drainage velocities and depths will conform to Alberta Environment guidelines.

The SWMF for Catchment 1 of the Rainbow Industrial Park will require an improvement of the existing Northeast SWMF. The improved SWMF will have a maximum active storage depth of 1.50m, an active storage of 5,273 m³ and a maximum permanent pool depth of 2.0-3.0m. The Northeast Pond discharges into the ditch along Township Road 294 via a 400mm outlet. Discharge from the pond will be controlled below the maximum discharge rate of 31 L/s/ha from the Dave Striker Industrial Subdivision SWMP.

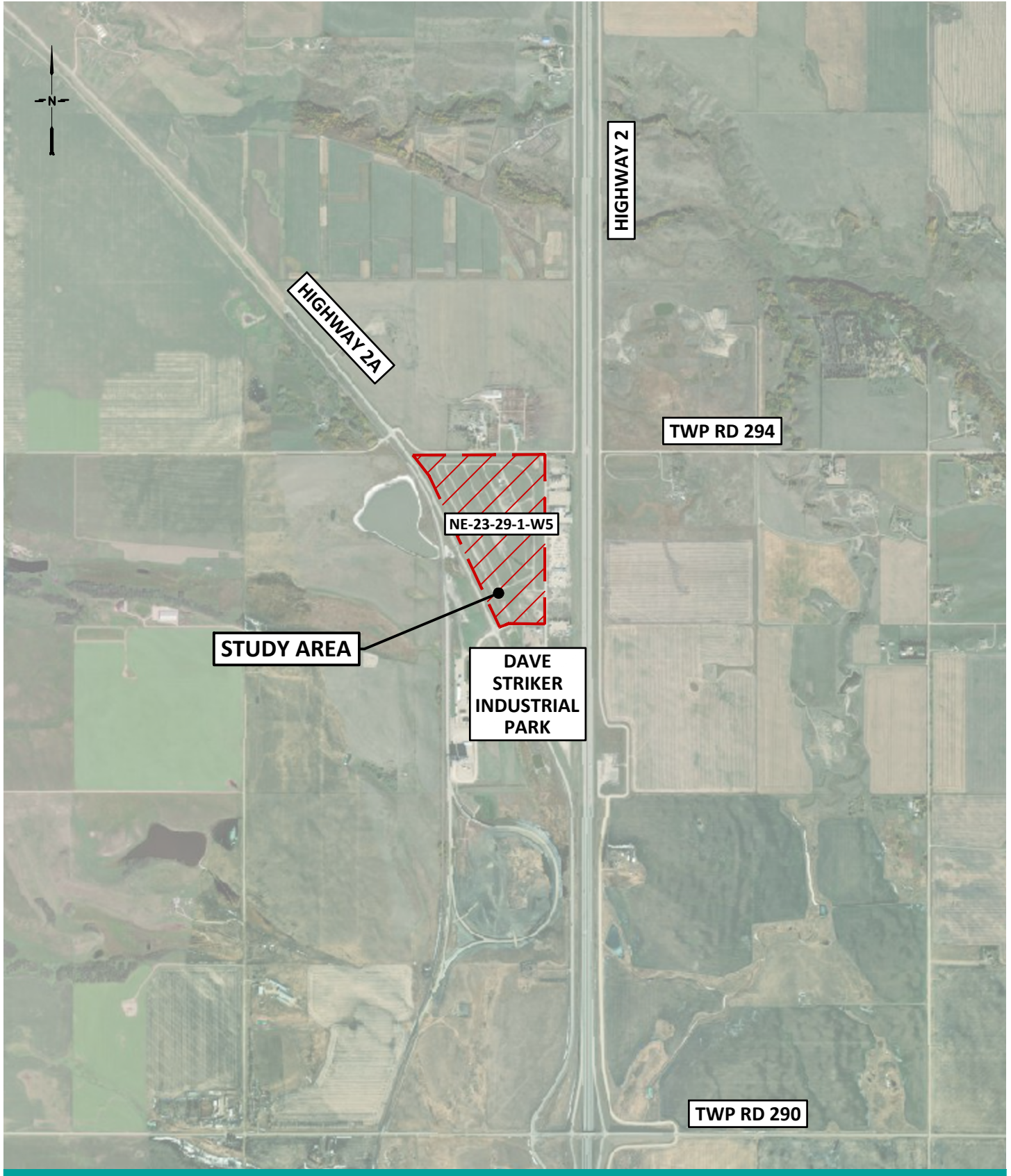
Catchment 4 will require an additional SWMF be constructed on the north side of Rainbow Drive. The SWMF will have a maximum active storage depth of 1.10m to match the existing Rainbow Drive pond, an active storage of 8,601 m³ and a maximum permanent pool depth of 2.0-3.0m. The new SWMF will outlet into the Rainbow Drive SWMF via an existing 400mm outlet under Rainbow Drive and be discharged into the Highway 2A ditch via the existing 400 and 450mm outlets. Discharge from the pond will be controlled below the maximum discharge rate of 24 L/s/ha from the Dave Striker Industrial Subdivision SWMP.

The PCSWMM Single event model demonstrates that the east catchment SWMF has adequate storage for the 1:100YR design storm event and provides a detention time of greater than 24 hours for the 25mm stormwater design event.

All existing culverts configurations and elevations should be confirmed prior to detailed design of the SWMFs.

Appendix A

Figures



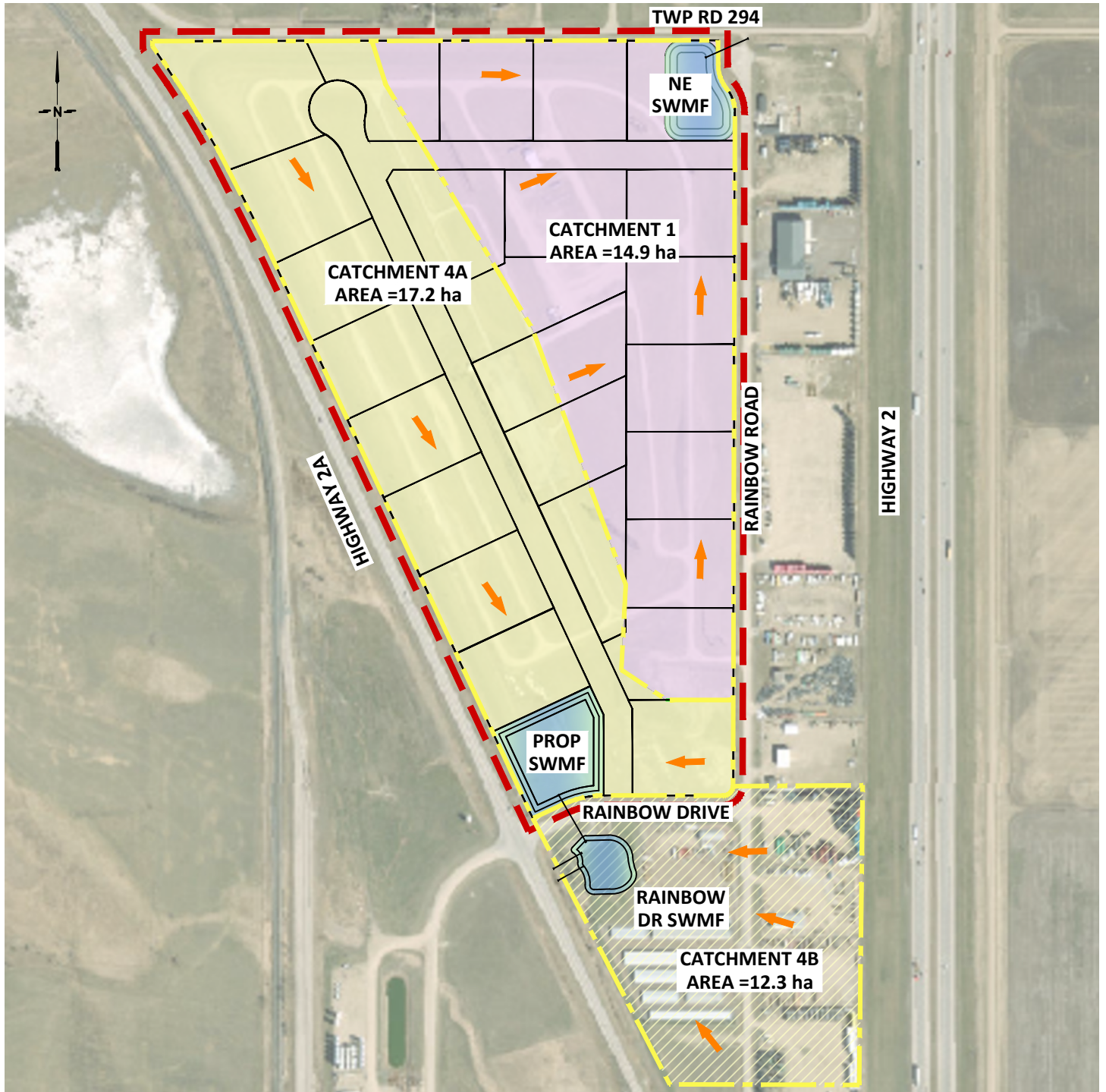
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RAINBOW INDUSTRIAL PARK

LOCATION PLAN
NE23-29-1-W5
MOUNTAIN VIEW COUNTY

F01

MODUS STRUCTURES INC.
5923



LEGEND

- PLAN BOUNDARY
- CATCHMENT BOUNDARY
- SWMF
- FLOW DIRECTION
- CULVERT



RAINBOW INDUSTRIAL PARK

CATCHMENT AREAS & PROPOSED DRAINAGE
 NE23-29-1-W5
 MOUNTAIN VIEW COUNTY

F02

Appendix B

SWMF Results

Modified Northeast SWMF

| Elevation | Active Storage Volume (m ³) | Peak Discharge (L/s) | Design Parameter |
|-----------|---|----------------------|--------------------|
| 945.40 | 0 | 0 | Normal Water Level |
| 945.85 | 1,527 | 204 | 1:5 Storm Event |
| 945.91 | 1,746 | 211 | 1:10 Storm Event |
| 946.52 | 4,248 | 271 | 1:25 Storm Event |
| 946.70 | 5,093 | 286 | 1:50 Storm Event |
| 946.74 | 5,273 | 289 | 1:100 Storm Event |
| 946.90 | - | - | Top of Freeboard |

Proposed SWMF

| Elevation | Active Storage Volume (m ³) | Peak Discharge (L/s) | Design Parameter |
|-----------|---|----------------------|--------------------|
| 945.10 | 0 | 0 | Normal Water Level |
| 945.50 | 2,759 | 81 | 1:5 Storm Event |
| 945.55 | 3,088 | 92 | 1:10 Storm Event |
| 946.03 | 6,850 | 175 | 1:25 Storm Event |
| 946.18 | 8,076 | 193 | 1:50 Storm Event |
| 946.24 | 8,601 | 200 | 1:100 Storm Event |
| 946.80 | - | - | Top of Freeboard |

Rainbow Drive SWMF

| Elevation | Active Storage Volume (m ³) | Peak Discharge (L/s) | Design Parameter |
|-----------|---|----------------------|--------------------|
| 945.10 | 0 | 0 | Normal Water Level |
| 945.45 | 838 | 327 | 1:5 Storm Event |
| 945.48 | 915 | 355 | 1:10 Storm Event |
| 945.90 | 2,086 | 600 | 1:25 Storm Event |
| 946.04 | 2,502 | 677 | 1:50 Storm Event |
| 946.06 | 2,565 | 676 | 1:100 Storm Event |
| 946.80 | - | - | Top of Freeboard |

Appendix C

PCSWMM Information

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

Element Count

Number of rain gages 2
 Number of subcatchments ... 3
 Number of nodes 8
 Number of links 7
 Number of pollutants 0
 Number of land uses 0

Raingage Summary

| Name | Data Source | Data Type | Recording Interval |
|-------------------|-------------------|-----------|--------------------|
| CoRD_2016_1-100YR | CoRD_2016_1-100YR | INTENSITY | 5 min. |
| CRD-100-YR-24HR | CRD-100-YR-24HR | INTENSITY | 5 min. |

Subcatchment Summary

| Name | Area | Width | %Imperv | %Slope | Rain Gage | Outlet |
|------|-------|--------|---------|--------|-----------------|--------------------|
| C01 | 14.90 | 650.00 | 60.00 | 2.0000 | CRD-100-YR-24HR | NE_SWMF |
| C04A | 17.20 | 800.00 | 60.00 | 1.0000 | CRD-100-YR-24HR | PROP_SWMF |
| C04B | 12.30 | 200.00 | 60.00 | 2.0000 | CRD-100-YR-24HR | Rainbow_Drive_SWMF |

Node Summary

| Name | Type | Invert Elev. | Max. Depth | Ponded Area | External Inflow |
|--------------------|----------|--------------|------------|-------------|-----------------|
| J-01 | JUNCTION | 945.10 | 4.90 | 0.0 | |
| OF-01 | JUNCTION | 944.98 | 1.02 | 0.0 | |
| OF-02 | JUNCTION | 944.98 | 1.02 | 0.0 | |
| OF-03 | OUTFALL | 944.90 | 1.00 | 0.0 | |
| OF1 | OUTFALL | 944.67 | 0.40 | 0.0 | |
| NE_SWMF | STORAGE | 945.40 | 4.60 | 0.0 | |
| PROP_SWMF | STORAGE | 945.10 | 5.00 | 0.0 | |
| Rainbow_Drive_SWMF | STORAGE | 945.10 | 5.00 | 0.0 | |

Link Summary

| Name | From Node | To Node | Type | Length | %Slope | Roughness |
|------|--------------------|--------------------|---------|--------|--------|-----------|
| C-01 | NE_SWMF | OF1 | CONDUIT | 91.2 | 0.8000 | 0.0130 |
| C-02 | Rainbow_Drive_SWMF | OF-01 | CONDUIT | 30.0 | 0.4000 | 0.0130 |
| C-03 | Rainbow_Drive_SWMF | OF-02 | CONDUIT | 30.0 | 0.4000 | 0.0130 |
| C-04 | J-01 | Rainbow_Drive_SWMF | CONDUIT | 75.5 | 0.0004 | 0.0130 |
| C-05 | PROP_SWMF | J-01 | CONDUIT | 8.7 | 0.0035 | 0.0130 |
| C-06 | OF-02 | OF-01 | CONDUIT | 16.0 | 0.0019 | 0.0130 |
| C-07 | OF-01 | OF-03 | CONDUIT | 78.5 | 0.1019 | 0.0130 |

Cross Section Summary

| Conduit | Shape | Full Depth | Full Area | Hyd. Rad. | Max. Width | No. of Barrels | Full Flow |
|---------|----------|------------|-----------|-----------|------------|----------------|-----------|
| C-01 | CIRCULAR | 0.40 | 0.13 | 0.10 | 0.40 | 1 | 0.19 |
| C-02 | CIRCULAR | 0.45 | 0.16 | 0.11 | 0.45 | 1 | 0.18 |
| C-03 | CIRCULAR | 0.40 | 0.13 | 0.10 | 0.40 | 1 | 0.13 |
| C-04 | CIRCULAR | 0.40 | 0.13 | 0.10 | 0.40 | 1 | 0.00 |
| C-05 | CIRCULAR | 0.40 | 0.13 | 0.10 | 0.40 | 1 | 0.01 |
| C-06 | CIRCULAR | 1.00 | 0.79 | 0.25 | 1.00 | 1 | 0.10 |
| C-07 | CIRCULAR | 1.00 | 0.79 | 0.25 | 1.00 | 1 | 0.77 |

Analysis Options

Flow Units CMS
Process Models:
 Rainfall/Runoff YES
 RDII NO
 Snowmelt NO
 Groundwater NO
 Flow Routing YES
 Ponding Allowed NO
 Water Quality NO
Infiltration Method HORTON
Flow Routing Method DYNWAVE
Surcharge Method EXTRAN
Starting Date 01/01/2016 00:00:00
Ending Date 01/05/2016 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00
Routing Time Step 5.00 sec
Variable Time Step YES
Maximum Trials 8
Number of Threads 1
Head Tolerance 0.001500 m

| ***** | Volume | Depth |
|----------------------------|-----------|---------|
| Runoff Quantity Continuity | hectare-m | mm |
| ***** | ----- | ----- |
| Total Precipitation | 4.560 | 102.697 |
| Evaporation Loss | 0.000 | 0.000 |
| Infiltration Loss | 1.328 | 29.915 |
| Surface Runoff | 3.211 | 72.330 |
| Final Storage | 0.032 | 0.721 |
| Continuity Error (%) | -0.262 | |

| ***** | Volume | Volume |
|----------------------------|-----------|----------|
| Flow Routing Continuity | hectare-m | 10^6 ltr |
| ***** | ----- | ----- |
| Dry Weather Inflow | 0.000 | 0.000 |
| Wet Weather Inflow | 3.213 | 32.130 |
| Groundwater Inflow | 0.000 | 0.000 |
| RDII Inflow | 0.000 | 0.000 |
| External Inflow | 0.000 | 0.000 |
| External Outflow | 3.164 | 31.641 |
| Flooding Loss | 0.000 | 0.000 |
| Evaporation Loss | 0.000 | 0.000 |
| Exfiltration Loss | 0.000 | 0.000 |
| Initial Stored Volume ... | 0.000 | 0.000 |
| Final Stored Volume | 0.049 | 0.489 |
| Continuity Error (%) | 0.001 | |

Time-Step Critical Elements

Link C-05 (24.01%)
Link C-06 (2.50%)

Highest Flow Instability Indexes

All links are stable.

Most Frequent Nonconverging Nodes

Convergence obtained at all time steps.

Routing Time Step Summary

Minimum Time Step : 0.50 sec
Average Time Step : 4.58 sec
Maximum Time Step : 5.00 sec
% of Time in Steady State : 0.00
Average Iterations per Step : 2.00

% of Steps Not Converging : 0.00
 Time Step Frequencies :
 5.000 - 3.155 sec : 90.48 %
 3.155 - 1.991 sec : 6.42 %
 1.991 - 1.256 sec : 1.55 %
 1.256 - 0.792 sec : 0.80 %
 0.792 - 0.500 sec : 0.75 %

 Subcatchment Runoff Summary

| Peak Runoff | Total Precip | Total Runon | Total Evap | Total Infil | Imperv Runoff | Perv Runoff | Total Runoff | Total Runoff |
|--------------|--------------|-------------|------------|-------------|---------------|-------------|--------------|--------------|
| Runoff Coeff | mm | mm | mm | mm | mm | mm | mm | 10^6 ltr |
| Subcatchment | | | | | | | | |
| CMS | | | | | | | | |
| C01 | 102.70 | 0.00 | 0.00 | 29.44 | 61.11 | 11.74 | 72.85 | 10.85 |
| 3.60 0.709 | | | | | | | | |
| C04A | 102.70 | 0.00 | 0.00 | 29.73 | 61.10 | 11.43 | 72.53 | 12.47 |
| 3.78 0.706 | | | | | | | | |
| C04B | 102.70 | 0.00 | 0.00 | 30.75 | 61.05 | 10.38 | 71.43 | 8.79 |
| 2.10 0.696 | | | | | | | | |

 Node Depth Summary

| Node | Type | Average Depth Meters | Maximum Depth Meters | Maximum HGL Meters | Time of Max Occurrence days hr:min | Reported Max Depth Meters |
|--------------------|----------|----------------------|----------------------|--------------------|------------------------------------|---------------------------|
| J-01 | JUNCTION | 0.26 | 1.09 | 946.19 | 0 09:51 | 1.09 |
| OF-01 | JUNCTION | 0.15 | 0.58 | 945.56 | 0 08:35 | 0.58 |
| OF-02 | JUNCTION | 0.15 | 0.58 | 945.56 | 0 08:35 | 0.58 |
| OF-03 | OUTFALL | 0.09 | 0.45 | 945.35 | 0 08:35 | 0.45 |
| OF1 | OUTFALL | 0.06 | 0.37 | 945.04 | 0 09:12 | 0.37 |
| NE_SWMF | STORAGE | 0.12 | 1.34 | 946.74 | 0 09:12 | 1.34 |
| PROP_SWMF | STORAGE | 0.27 | 1.14 | 946.24 | 0 10:15 | 1.14 |
| Rainbow_Drive_SWMF | STORAGE | 0.11 | 0.96 | 946.06 | 0 08:34 | 0.96 |

 Node Inflow Summary

| Node | Type | Maximum Lateral Inflow CMS | Maximum Total Inflow CMS | Time of Max Occurrence days hr:min | Lateral Inflow Volume 10^6 ltr | Total Inflow Volume 10^6 ltr | Flow Balance Error Percent |
|--------------------|----------|----------------------------|--------------------------|------------------------------------|--------------------------------|------------------------------|----------------------------|
| J-01 | JUNCTION | 0.000 | 0.200 | 0 12:17 | 0 | 12.2 | 0.002 |
| OF-01 | JUNCTION | 0.000 | 0.636 | 0 08:35 | 0 | 20.8 | 0.003 |
| OF-02 | JUNCTION | 0.000 | 0.268 | 0 08:35 | 0 | 9.27 | 0.002 |
| OF-03 | OUTFALL | 0.000 | 0.636 | 0 08:35 | 0 | 20.8 | 0.000 |
| OF1 | OUTFALL | 0.000 | 0.289 | 0 09:12 | 0 | 10.8 | 0.000 |
| NE_SWMF | STORAGE | 3.603 | 3.603 | 0 08:00 | 10.9 | 10.9 | 0.003 |
| PROP_SWMF | STORAGE | 3.783 | 3.783 | 0 08:00 | 12.5 | 12.6 | 0.002 |
| Rainbow_Drive_SWMF | STORAGE | 2.100 | 2.100 | 0 08:05 | 8.79 | 20.9 | 0.002 |

 Node Surge Summary

Surcharging occurs when water rises above the top of the highest conduit.

| Node | Type | Hours Surcharged | Max. Height Above Crown Meters | Min. Depth Below Rim Meters |
|------|----------|------------------|--------------------------------|-----------------------------|
| J-01 | JUNCTION | 18.65 | 0.695 | 3.805 |

Node Flooding Summary

No nodes were flooded.

Storage Volume Summary

| Storage Unit | Average Volume 1000 m ³ | Avg Pcmt Full | Evap Pcmt Loss | Exfil Pcmt Loss | Maximum Volume 1000 m ³ | Max Pcmt Full | Time of Max Occurrence days hr:min | Maximum Outflow CMS |
|--------------------|---------------------------------------|---------------|----------------|-----------------|---------------------------------------|---------------|---------------------------------------|------------------------|
| NE_SWMF | 0.423 | 1.5 | 0.0 | 0.0 | 5.273 | 18.4 | 0 09:12 | 0.289 |
| PROP_SWMF | 1.885 | 3.3 | 0.0 | 0.0 | 8.601 | 14.9 | 0 10:15 | 0.200 |
| Rainbow_Drive_SWMF | 0.267 | 1.2 | 0.0 | 0.0 | 2.565 | 11.5 | 0 08:34 | 0.676 |

Outfall Loading Summary

| Outfall Node | Flow Freq Pcmt | Avg Flow CMS | Max Flow CMS | Total Volume 10 ⁶ ltr |
|--------------|----------------|--------------|--------------|-------------------------------------|
| OF-03 | 98.81 | 0.064 | 0.636 | 20.800 |
| OF1 | 99.06 | 0.032 | 0.289 | 10.840 |
| System | 98.93 | 0.096 | 0.921 | 31.641 |

Link Flow Summary

| Link | Type | Maximum Flow CMS | Time of Max Occurrence days hr:min | Maximum Veloc m/sec | Max/ Full Flow | Max/ Full Depth |
|------|---------|--------------------|---------------------------------------|-----------------------|----------------|-----------------|
| C-01 | CONDUIT | 0.289 | 0 09:12 | 2.33 | 1.55 | 0.96 |
| C-02 | CONDUIT | 0.369 | 0 08:35 | 2.32 | 2.04 | 1.00 |
| C-03 | CONDUIT | 0.268 | 0 08:35 | 2.13 | 2.03 | 1.00 |
| C-04 | CONDUIT | 0.200 | 0 12:17 | 1.61 | 47.77 | 1.00 |
| C-05 | CONDUIT | 0.200 | 0 12:17 | 1.59 | 16.20 | 1.00 |
| C-06 | CONDUIT | 0.268 | 0 08:35 | 0.57 | 2.56 | 0.58 |
| C-07 | CONDUIT | 0.636 | 0 08:35 | 1.56 | 0.83 | 0.52 |

Flow Classification Summary

| Conduit | Adjusted /Actual Length | Fraction of Time in Flow Class | | | | | | | | | | |
|---------|-------------------------|--------------------------------|------|----------|------|----------|------|----------|------|---------|-----------|----------|
| | | Up Dry | | Down Dry | | Sub Crit | | Sup Crit | | Up Crit | Down Crit | Norm Ltd |
| C-01 | 1.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.90 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 |
| C-02 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.81 | 0.00 |
| C-03 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.80 | 0.00 |
| C-04 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C-05 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C-06 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| C-07 | 1.00 | 0.00 | 0.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

Conduit Surcharge Summary

| Hours Full | Hours Above Full | Hours Capacity |
|------------|------------------|----------------|
|------------|------------------|----------------|

| Conduit | Both Ends | Upstream | Dnstream | Normal Flow | Limited |
|---------|-----------|----------|----------|-------------|---------|
| C-01 | 0.01 | 8.15 | 0.01 | 8.67 | 0.01 |
| C-02 | 2.86 | 3.40 | 2.86 | 4.18 | 2.86 |
| C-03 | 3.97 | 3.97 | 4.49 | 3.73 | 3.73 |
| C-04 | 3.97 | 18.65 | 3.97 | 50.75 | 3.45 |
| C-05 | 18.65 | 19.01 | 18.65 | 33.71 | 18.10 |
| C-06 | 0.01 | 0.01 | 0.01 | 7.45 | 0.01 |

Analysis begun on: Sat Mar 28 15:29:53 2026
 Analysis ended on: Sat Mar 28 15:29:54 2026
 Total elapsed time: 00:00:01