

Phase III Drainage Report
for
PRAIRIE HAWK DRIVE ROADWAY IMPROVEMENTS PHASE 1
CASTLE ROCK, CO

Owner/Developer:

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March 15, 2023

APPROVAL BLOCKS**I. ENGINEER'S STATEMENT:**

I affirm that this report and plan for the Preliminary Drainage design of Prairie Hawk Drive Roadway Improvements Phase 1 was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.

Jeffrey Killingsworth, PE
Colorado Professional Engineer
License No. 41217

II. DEVELOPER'S STATEMENT:

CCD Miller's Landing LLC hereby certifies that the drainage facilities for Prairie Hawk Drive Roadway Improvements Phase 1 shall be constructed according to the design presented in this report. I understand that the Town of Castle Rock does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that the Town of Castle Rock reviews drainage plans pursuant to the Municipal Code; but cannot, on behalf of Prairie Hawk Drive Roadway Improvements Phase 1, guarantee that final drainage design review will absolve CCD Miller's Landing LLC and/or their successors and/or assigns of future liability for improper design.

Name of Developer

Authorized Signature

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II. GENERAL LOCATION AND DESCRIPTION

A. SITE LOCATION

The Prairie Hawk Drive Roadway Improvements Phase 1 project is located north of Plum Creek Parkway approximately 1,300 ft west of Interstate 25 (I-25) in Castle Rock, Colorado. The site is primarily within the Northeast Quarter (NE ¼) of Section 10 with a small portion in the Southeast Quarter (SE ¼) of Section 10 in Township 8 South, Range 67 West of the 6th P.M. in Douglas County, Colorado.

The project area is bounded to the north by an existing drainageway known as the Industrial Tributary. The Phillip S. Miller Park is located southwest of the project site and an existing industrial development is located to the north and northeast. Undeveloped land is located to the south of Plum Creek Parkway known as the Castle Meadow Planned Development. The specific project site is the entirety of Prairie Hawk Drive going north from Plum Creek Parkway to the Industrial Tributary and encompasses Phases 1 and 2 of the Prairie Hawk Dr Roadway Improvements Project. The construction plans for Phase 1 have both an interim and final design consideration that is dependent upon timing of the Plum Creek Parkway Improvements. Please refer to the CD Plans for further details. A vicinity map for the site can be found in Appendix A.

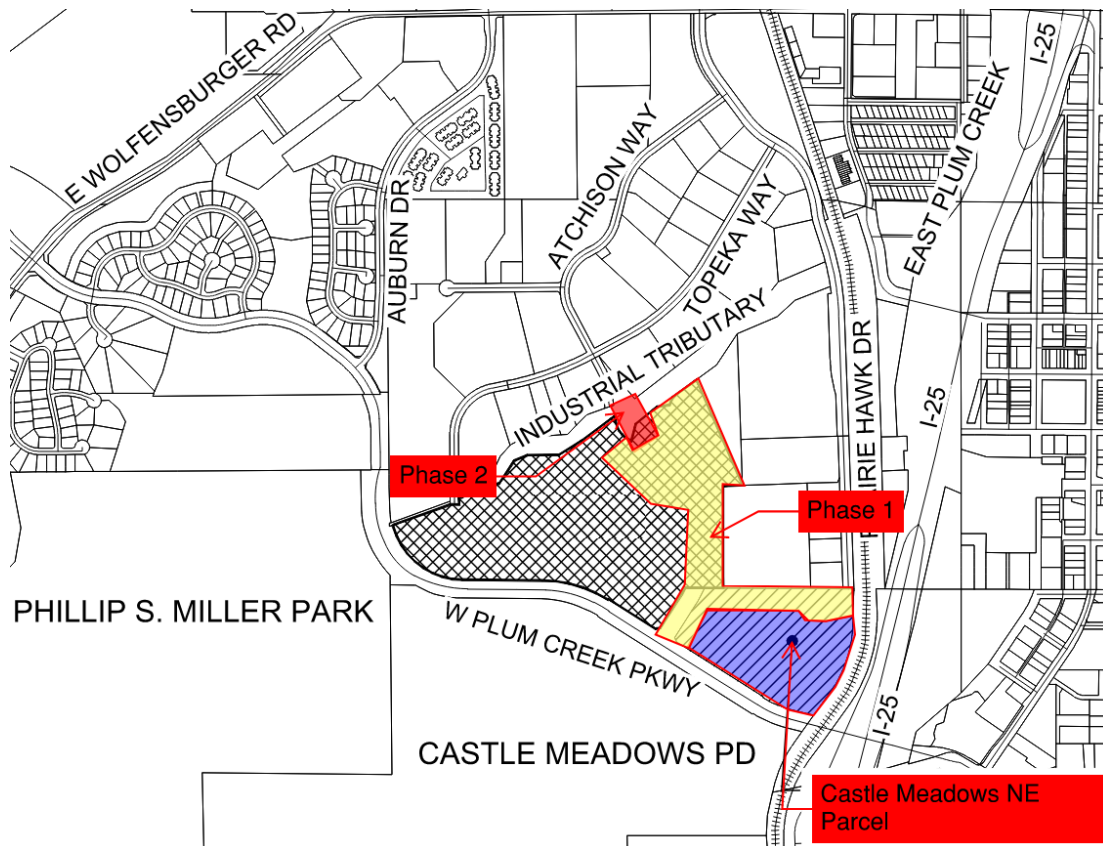


Figure 1: Vicinity Map (NTS)

B. DESCRIPTION OF PROPERTY AND LAND USE

The Prairie Hawk Drive Roadway Improvements Phase 1 project includes approximately 45 acres of the Miller's Landing and Castle Meadows development areas. The existing southern portion of the Phase 1 area (herein called Southern Prairie Hawk Area) consists of approximately 20 acres and drains stormwater to the southeast towards Plum Creek Parkway. A local storm sewer system collects runoff from Plum Creek Parkway and an offsite basin and outlets to the project site via a 36" RCP. This area is located in a Zone X, or Area of Minimal Flood Risk. Please refer to Appendix A for a copy of the FIRM Map Panel 08035C0301G. There are no major or minor drainageways, canals, nor irrigation ditches within the project area. There are no major geologic features onsite.

The northern portion of Phase 1 (herein called Northern Prairie Hawk Area) includes approximately 25 acres of the 66-acre Miller's Landing site. Portions of the site were previously disturbed due to a landfill remediation project. The area generally drains to the north and northeast toward the Industrial Tributary. A local storm sewer system collects runoff from Plum Creek Parkway and an offsite basin and outlets to the project site via a 36" RCP. A portion of the Industrial Tributary is identified as a Shaded Zone X Floodplain on FEMA FIRM Panels 08035C0282G and 08035C0301G dated March 16, 2016, and LOMR Letter of Map Revision (LOMR) Case No. 16-08-0265P Effective June 24, 2016, refer to Appendix A. All development in the Northern Prairie Hawk Area is located in a Zone X, or Area of Minimal Flood Risk.

The soils vary throughout the site and include Newlin gravelly sandy loam (NeE), Fondis clay loam (FoD) and Pits, clay (CP). The Newlin gravelly sandy loam is a part of the Type B hydrologic soil group, Fondis clay loam is part of the Type C hydrologic soil group and the Pits, clay soil type is assumed to be part of the Type D hydrologic soil group. For the project area, the predominant soil type is Class B, with C and D making up about 20% of the site. A soils map has been provided in Appendix A. Existing vegetation onsite is limited to native grasses and small brush – there are no large trees or other significant vegetation onsite.

The Southern Prairie Hawk Area slopes inward toward the middle of the project site at a 3:1 slope to where the proposed road will be constructed. The Southern Prairie Hawk Area generally slopes to the south to a low point near the intersection of the proposed Prairie Hawk Dr and Plum Creek Parkway. The Northern Prairie Hawk Area generally slopes north and east, towards the Industrial Tributary.

The entire Miller's Landing property is zoned IO, Interchange Overlay District, to support a Mixed-Use Development. The Castle Meadows area is zoned for Residential Mixed Use.

III. DRAINAGE BASINS AND SUB-BASINS

A. MAJOR DRAINAGE BASINS

The Southern Prairie Hawk Area lies within the Castle Meadows development area, near the southeast corner of the site. The Castle Meadows area sheetflows to the north and east to existing low points and swales that parallel the railroad and I-25 before eventually being captured in municipal storm sewer. The detention pond that serves the Southern Prairie Hawk Area (Pond F) will be built in the northeastern corner of the Castle Meadows area, but the pond will not serve the Castle Meadows NE Parcel area itself (14.92 acres), and will continue to allow flows from the Castle Meadows NE Parcel to run off to the northeast, undetained.

The Northern Prairie Hawk Area is located in a portion of the Industrial Watershed which outfalls to East Plum Creek. The Industrial Watershed area was studied as part of the Omni, Industrial and Westfield Watershed Master Plan report by CH2MHill in January 2011. In general, this area sheetflows runoff north and west to the Industrial Tributary. Due to this project, no additional channel improvements will be necessary for the Industrial Tributary. The property is zoned IO, Interchange Overlay District, to support a Mixed-Use Development and this site will be primarily used for a roadway, landscaping, and a sidewalk until fully developed.

Existing land use for these areas is open space and undeveloped land. No offsite flows reach this project onsite, and no flows leave the site without being detained in the proposed detention pond.

B. MINOR DRAINAGE BASINS

The entire project site is a portion of the overall Miller's Landing project site, which includes two detention ponds to serve the project area. The Southern Prairie Hawk Area of this project is tributary to proposed Detention Pond F, near the southeast corner of the full Miller's Landing development, and on the northeast corner of the Castle Meadows development area. The Northern Prairie Hawk Area is tributary to Detention Pond E, near the northern tip of the project site.

In the existing condition for the Southern Prairie Hawk Area of the site, water sheetflows across undeveloped land/open space, south into Plum Creek Parkway. In the proposed condition, runoff sheetflows south across landscape areas and roadway and is collected in curb and gutter before being captured in the proposed storm sewer that serves the Southern Prairie Hawk Area. These flows combine and are routed to proposed Pond F, which has only been sized to accept flows from the Southern Prairie Hawk Area.

In the existing condition, the Northern Prairie Hawk Area of this project sheetflows to the north and east before entering the Industrial Tributary. In the proposed

condition, runoff sheetflows off developed commercial areas into curb and gutter before being intercepted in storm sewer that transfers stormwater into proposed Pond E, which has been sized to accept flows from the Northern Prairie Hawk Area of this project. Pond E discharges at allowable rates to the northwest, where water will sheetflow into the Industrial Tributary.

There are no proposed or existing irrigation facilities on or near the project site. No offsite flows reach this project onsite, and no flows leave the site without being detained in one of the proposed detention ponds. Please refer to Appendix A for a Proposed Drainage Basin Map. Both the North and South Prairie Hawk Areas will follow the historic drainage patterns with some minor rerouting due to the proposed re-grading.

IV. DRAINAGE DESIGN CRITERIA

A. REGULATIONS

This drainage report was performed in accordance to the 2019 Town of Castle Rock Storm Drainage Design and Technical Criteria Manual as well as the Mile High Flood District Urban Storm Drainage Criteria Manual, here after known as Drainage Manual. These manuals were used as a basis of design for the site. This report analyzes the minor (5-year) and major (100-year) storm events.

B. DRAINAGE STUDIES, MASTER PLANS, AND SITE CONSTRAINTS

The Phase III Drainage Report for Coachline Road and Plum Creek Boulevard at I-25, by Felsburg Holt & Ullevig revised March 18, 2009 was reviewed and used to quantify offsite flows impacting the overall Miller's Landing project site, however there are no offsite flows reaching the Prairie Hawk Drive Phase 1 Roadway Improvements.

The Industrial Watershed was studied as part of the Omni, Industrial and Westfield Watershed Master Plan report by CH2MHill in January 2011, referred to as the Master Plan hereafter. Due to the Prairie Hawk Phase 1 Development, no additional channel improvements will be needed for the Industrial Tributary. The property is zoned IO, Interchange Overlay District, to support a Mixed-Use Development and this site will be mass graded for future development. Existing land use for this area was open space and undeveloped land. No offsite flows reach this project onsite, and no flows leave the site without being detained in one of the two proposed detention ponds. Runoff into these ponds will be released at allowable release rates in the direction and at the rates discussed in the MDP. The hydrology and hydraulic calculations shown in the appendices of this report analyze the minor and major events as set forth by the Town of Castle Rock (5 and 100-year events), using the rainfall parameters set forth in the manual and by using the UD-Detention and UD-Inlet workbooks provided by MHFD.

No adjacent developments' drainage will impact this site, and any runoff from this site will be released at allowable rates in historic directions. Please refer to Section V below for further details.

C. HYDROLOGY

On-site hydrology utilizes rainfall data provided by the Town of Castle Rock in a rational method workbook to obtain flows. One-hour rainfall depths (inches) for the 5-year (minor) and 100-year (major) storm events were taken from Table 6-1 in the 2012 Town of Castle Rock Storm Drainage Design and Technical Criteria Manual and are as follows.

Table 1 Town of Castle Rock 1-Hour Point Rainfall

2-YR	5-YR	10-YR	50-YR	100-YR
1.06	1.43	1.66	2.26	2.60

This information, along with slopes, lengths, and areas for all sub-basins (garnered from project topography) are provided in the standard forms located in Appendix A. C values and time of concentration calculations are broken down by basin as well and are shown in more detail in Appendix A. Imperviousness values were based on specific land use. Further details can be found in the Rational Calculations in Appendix B. The detention calculations were performed using the UD-Detention workbook from the Mile High Flood District. This determined detention volumes as well as release rates. Please refer to Section V below for further details.

D. HYDRAULICS

Hydraulic calculations for detention basin sizing were based on the MHFD design spreadsheets. Complete hydraulic calculations and detention basin sizing calculations for the proposed extended detention basin can be found in Appendix C. Extended detention basin outlet control design will be based on MHFD design spreadsheets.

Street and inlet capacity design is based on Chapter 8 of the Town's Drainage Criteria and design spreadsheets provided by MHFD are included in Appendix B. Hydraulic grade lines and storm pipe capacities were calculated using HydraFlow software.

E. STORAGE AND WATER QUALITY ENHANCEMENT

Water Quality measures have been included in the design of the proposed extended detention basins for the site. The pond that serves the Southern Prairie Hawk Area, known as Pond F, and the pond that serves the Northern Prairie Hawk Area, known as Pond E, were designed as extended detention basins which incorporate structures that release flows for the water quality capture volume (WQCV), excess urban runoff volume (EURV), and the 100-year storm event. The calculations for the design of the ponds can be found in Appendix C.

Detention Pond F was sized to only accept flows from the 'F' basins (Southern Prairie Hawk Area) described in section V below, and Pond E was sized to serve the 'E' basins (Northern Prairie Hawk). The ponds were sized to detain the 100-year event plus 0.5x the WQCV and to release at rates allowable by the Town of Castle Rock (WQCV at 40 hours, 5-year within 72 hours, and the 100-year at or less than 0.9x the historic inflow).

Pond F exists on the Castle Meadows NE Parcel property to the east of the Phase 1 area, but please note that Pond F is not designed to detain any flows from the Castle Meadows NE Parcel property. The Castle Meadows NE Parcel property will be required to provide its own detention for its development area. An emergency overflow weir will be provided on the northeast corner of the pond. The weir will be 1.5' deep, 10' wide, with 4:1 sides. This weir is designed to pass the undetained 100-year flow to the pond, 8.8 cfs, at a depth of 0.40', leaving 1.1' freeboard from the water surface to the top of the weir/berm top.

Pond E exists at the northernmost portion of the property and serves Basins E1-E5. An emergency overflow weir will be provided on the northeast corner of the pond. The weir will be 1.5' deep, 100' wide, with 4:1 sides. This weir is designed to pass the undetained 100-year flow to the pond, 88.5 cfs, at a depth of 0.45', leaving 1.05' freeboard from the water surface to the top of the weir/berm top.

Four-Step Process: This site adheres to the Four-Step Process, as seen in Figure 2 below. There are no streams onsite to be stabilized. Runoff has been reduced to the greatest extent possible by having runoff sheetflow over landscaped areas as much as feasible before being accepted into curb and gutter or storm sewer. The proposed full-spectrum detention pond provides WQCV treatment that releases over the course of ~43 hours. All water leaving the site passes through the full-spectrum detention pond before being released at a less-than historic rate.

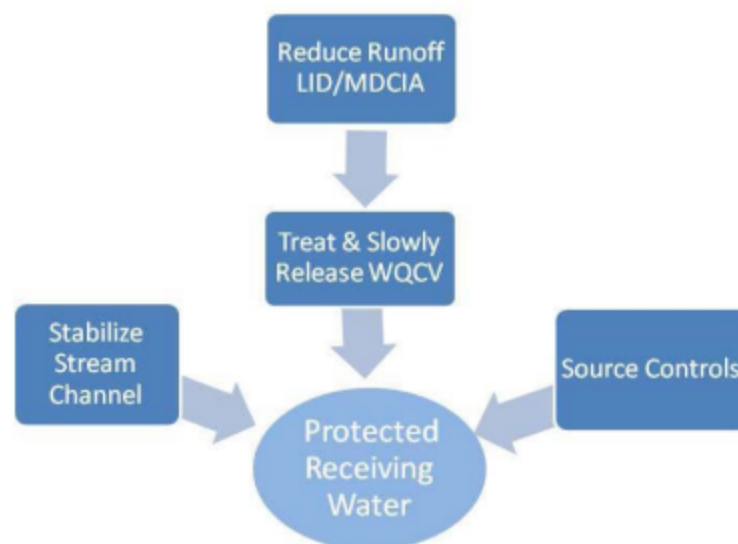


Figure 2: Four-Step Process

V. STORMWATER MANAGEMENT FACILITY DESIGN

A. STORMWATER CONVEYANCE FACILITIES

The general concept for the drainage design is to maintain the historic drainage patterns and match or decrease historic release rates for the site. Runoff from the Southern Area will drain via private storm sewer to Pond F near the southeast corner of the property, where detained water will be released to the east onto a riprap pad. Water will then be allowed to sheetflow to the northeast, as historic. The onsite storm sewer will outfall into Pond F into a 2' wide, 6" deep trickle channel that flows at 0.5% across the pond bottom to the outlet structure and micropool. Water will pond in Pond F and will be released as described in Section VB below (Please see Table 2 for full details). The pond will be maintained by the property owner, including mowing, sediment clearing, and debris removal within the pond. The pond has an emergency spillway on the northeast corner of the pond, and will release the 100-year event in case of full clogging of the pond. No offsite conveyance through this pond is necessary for this site.

No flow from Plum Creek Parkway will be accepted onto this site. There is a 10' Type R inlet proposed just to the north of this project site within Plum Creek Parkway that accepts road flows (swale flows in the interim construction for Plum Creek Parkway) with no bypass so that no offsite flows reach the Prairie Hawk site. Please refer to the Plum Creek Parkway CDs and Drainage Report for further details and calculations on this inlet.

Runoff from the Northern Area will drain via private storm sewer to Pond E near the northern boundary of the property, where detained water will be released to the northwest onto a riprap pad. Water will then be allowed to sheetflow to the northwest into the Industrial Tributary, as historic. The onsite storm sewer will outfall into Pond E into a 2' wide, 6" deep trickle channel that flows at 0.5% across the pond bottom to the outlet structure and micropool. Water will pond in Pond E and will be released as described in Section VB below (Please see Table 3 for full details). The pond will be maintained by the property owner, including mowing, sediment clearing, and debris removal within the pond. The pond has an emergency spillway on the northwest side of the pond and will release the 100-year event in case of full clogging of the pond. No offsite conveyance through this pond is necessary for this site.

There are two swales proposed for this site, both of which are temporary. Temporary Swale E1 and Temporary Swale E2 are both 3' bottom, 4:1 sides, 2% slope and 2.1' deep and convey undeveloped flows from Basins E1 and E2 to the flared end sections (FESs) at design points E1 and E2. These swales ensure that in the interim condition, before Basins E1 and E2 are fully developed, the undeveloped flows are still captured and transferred to the detention pond. These FESs will be removed when the basins are fully developed, and future site storm infrastructure will connect into the stubs at E1 and E2.

In the 5-year event, water will only be allowed to pond 10' into any onsite road, allowing one lane of traffic each direction; in the 100-year event, the inlets in sump will pond water up to the back of curb and 1" above the curb in the sump condition, but all flooding will be limited to the ROW.

PROPOSED BASINS

There are four basins in the Southern Prairie Hawk Area (F Basins) and 12 basins in the Norther Prairie Hawk Area (E Basins) as well as one offsite basin that is undisturbed and is released undetained. For full hydraulic calculations and HGL calculations, please refer to Appendix B. The proposed drainage basins onsite are as follows:

BASIN F1

Basin F1 is the western half of the Southern Area and includes the western half of Prairie Hawk Drive to the topographic high point and a grassed slope embankment. This 2.39-acre basin has an imperviousness of 49.9% and creates 3.55 and 10.58 cfs of runoff in the 5 and 100-year events, respectively. Runoff sheetflows from the embankment to the south and east before being captured in curb and gutter, where flow is then directed to a **dual** 10' Type R inlet and 18" RCP at Design Point F1 (DPF1, in sump). No flows bypass his inlet.

BASIN F2

Basin F2 is the eastern half of the Southern Area and includes the eastern half of Prairie Hawk Drive north to the topographic high point. This 1.97-acre basin has an imperviousness of 53.1% and creates 3.54 and 10.06 cfs of runoff in the 5 and 100-year events, respectively. Runoff sheetflows east from the median across the road and west down the landscaping embankment before being captured in curb and gutter, where flow is then directed to a **dual** 10' Type R inlet and 18" RCP at Design Point 2 (DP2, in sump). No flows bypass his inlet. Flows from DPF1 and DPF2 combine in a 5' diameter manhole and 24" RCP before flowing north up Prairie Hawk Dr.

Basin F3 and F4

Basin F3 is the detention pond and the sloped grassed areas tributary to the pond, not including the overlot grading for the Castle Meadows NE Parcel site to the south (Basin F4); any runoff from the Basin F4 to the south will pass through the pond, undetained. Detention for those flows are the responsibility of the Castle Meadows NE Parcel site to the south. Basin F3 is 0.83 acres, and with 31.9% imperviousness this basin creates 0.97 and 4.08 cfs in the 5 and 100-year events. Basin F4 is 14.92 acres, and with 2.0% imperviousness this basin creates 0.80 and 51.87 cfs in the 5 and 100-year events. These overlot graded-condition flows sheetflow into the pond.

Basin E1

Basin E1 consists of 11.83-acres of proposed commercial development that will drain southwest to northeast. Ultimately this basin will be conveyed via future storm sewer within the basin (from the proposed storm stub at DPE1) and drain into the proposed Pond E then conveyed downstream into Industrial Tributary. In this proposed condition, existing Basin E1 flows are conveyed via sheetflow to the Temporary E1 Swale (see appendix for full calculations) and into a 36" FES where flows are accepted into the proposed storm sewer onsite. All flows are then conveyed to Pond E. The future rate of flow used to size the storm sewer pipes has been calculated to be 33.18 cfs (5-yr) and 66.55 cfs (100-yr) due to a basin imperviousness of 90%. The proposed/interim flows for Basin E1, and the flows entering the FES, are 2.01 and 35.07 cfs in the 5 and 100-year events.

Basin E1.1

Basin E1.1 (0.97-acres at 100% imperviousness) is the road just east of Basin E1 and will accept all road flows from only E1.1. The inlet in E1.1 (INLET E1.1) is a 10' Type R inlet in sump at DPE1.1 that will accept 4.04 and 7.68 cfs in the 5 and 100-year events. All flows are then conveyed to Pond E via storm sewer.

Basin E2

Basin E2 consists of 2.99-acres of proposed commercial development that will drain northeast. Ultimately this basin will be conveyed via future storm sewer within the basin (from the proposed storm stub at DPE2) and drain into the proposed Pond E then conveyed downstream into Industrial Tributary. In this proposed condition, existing Basin E2 flows are conveyed via sheetflow to the Temporary E2 Swale (see appendix for full calculations) and into a 36" FES where flows are accepted into the proposed storm sewer onsite. All flows are then conveyed to Pond E. The future rate of flow used to size the storm sewer pipes has been calculated to be 7.26 cfs (5-yr) and 14.56 cfs (100-yr) due to a basin imperviousness of 90%. The proposed/interim flows for Basin E2, and the flows entering the FES, are 0.49 and 8.47 cfs in the 5 and 100-year events.

Basin E2.1

Basin E2.1 (100% imperviousness) is the road associated with Basin E2 and will accept all road flows from E2.1. The inlet in E2.1 (INLET E2.1) is a 10' Type R inlet at DPE2.1 that will accept 2.66 and 5.05 cfs in the 5 and 100-year events. All flows are then conveyed to Pond E via storm sewer.

Basin E3

Basin E3 consists of 2.32-acres of proposed commercial area that will ultimately drain to the north and will enter the proposed storm sewer via the proposed storm stub on the north side of the basin. When developed in the future, this basin will be conveyed via storm sewer north, and drain into the proposed Pond E before being conveyed downstream into Industrial

Tributary. This future rate of flow has been calculated to be 8.69 cfs (5-yr) and 17.44 cfs (100-yr) due to a basin imperviousness of 90%. In this proposed condition, pre-development flows from the 2.32-acres of 2% imperviousness from undeveloped land will create 0.45 and 7.77 cfs in the 5 and 100-year event. Pond E has been sized to detain the fully developed E3 flows, but until the basin is fully built out, the undeveloped flows will sheetflow offsite to the east.

Basins E3.1, E3.2, and E3.3

Basins E3.1, E3.2, and E3.3 (0.62, 0.45, and 0.25 acres respectively at 100% imperviousness) is the road north and west of Basin E3. Each basin collects runoff in curb and gutter before reaching a 10' Type R inlet at each of the three basin termination points. Design Point 3.1 accepts 2.59 and 4.92 cfs, Design Point 3.2 accepts 1.88 and 3.57 cfs, and Design Point 3.3 accepts 1.03 and 1.95 cfs in the 5 and 100-year events. All flow is then conveyed via storm sewer to Pond E.

Basins E4

Basin E4 is the northwestern most portion of the roundabout and northern roadway. This 0.29-acre, 100% impervious basin creates 1.21 and 2.31 cfs in the 5 and 100-year events. The runoff from this basin flows north in curb and gutter before being accepted in a 10' Type R inlet at Design Point E4 (DPE4), where flows are then directed to Detention Pond E.

Basin E4.1

Basin E4.1 is the northeastern most portion of the roundabout and northern roadway. This 0.24-acre, 100% impervious basin creates 0.99 and 1.88 cfs in the 5 and 100-year events. The runoff from this basin flows north in curb and gutter before being accepted in a 10' Type R inlet at Design Point E4.1 (DPE4.1), where flows are then directed to Detention Pond E.

Basin E-5

Basin E-5 consists of 2.82-acres of the proposed Pond E detention facility that drains out to the northeast. This basin will be conveyed downstream into Industrial Tributary.

Basin E6

Basin E6 is a portion of Phase 2 of the Prairie Hawk Roadway Improvements project that includes 1.62-acres of 100% impervious roadway north of the Industrial Tributary, north of Basins E4 and E4.1. Although this portion of the project is not being built with Phase 1, Pond E has been designed to overd detain for the flows from E6 (6.76 and 12.81 cfs in the 5 and 100-year events). Runoff from E6 will enter a proprietary water quality in-line unit, to be designed during Phase 2, and will be released into the Industrial Tributary.

Flows from E6 will not be detained, but Pond E has been sized to overdetail for these flows.

Basin OS1

Basin OS1 is a 0.92-acre basin of undisturbed land between Basins F1 and E3. This land will remain undisturbed and will not have flow detailed or treated. This basin is for area-reference only.

B. STORMWATER STORAGE FACILITIES – POND F

Pond F has been constructed as a full-spectrum detention basin and will incorporate structures which release flows for the excess urban runoff volume (EURV) and the 100-year storm event. Per the Town of Castle Rock's Criteria, the detention pond has been designed to provide an additional 0.5x the WQCV.

This pond is required to hold the 100-yr detention volume plus an additional 0.5*WQCV which equates to a total required volume of 1.02 ac-ft. This pond provides a detention volume of 1.23 ac-ft at the level of the emergency spillway (5.61' or elevation 6263.5). The 100-year ponding depth within the pond will be 3.16' when the outlet structure is operating as designed. Assuming the outlet structure is fully clogged, the major event will be allowed to pond up to 5.61' before reaching the spillway and exiting the pond. The designed 100-year release rate from the pond is 0.8x the historic inflow, meaning that a maximum of 8.85 cfs are allowed to be released, but only 4.0 cfs will leave the pond during the major event via the outlet structure. The WQCV will be released in 41 hours via an orifice plate, the EURV will be released in 66 hours through the same plate, and the 5-year event will be released in 67 hours. No offsite conveyance through this pond is necessary.

Table 2 - POND SUMMARY TABLE						
DESCRIPTION	STAGE (FT)	ELEVATION	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	ALLOWABLE RELEASE RATE	ACTUAL RELEASE RATE
MICROPOOL	0	6257.89	NA	NA	NA	NA
WQCV	1.05	6258.94	0.08	0.08	>40 HR	41 HR
EURV	1.97	6259.86	0.27	0.27	<72 HR	66 HR
100-YR+WQCV	3.16	6261.05	1.02	1.02	8.85 CFS*	4.0 CFS
OVERFLOW WEIR	5.61	6263.5	NA	1.23	100 YR INFLOW - 10.8 CFS	10.8 CFS @ 0.40' DEPTH
BERM TOP	7.11	6265	NA	1.81	NA	NA

*80% of Historic Inflow (11.06 cfs * 80% = 8.85 cfs)

The outlet structure itself is a 2.5' tall, 3.35'x2.25', 4:1 sloped grated box structure fronted by a 2.25'x7' micropool. On the front face of the structure is an orifice plate covered by a trash rack – the first hole at 0' is 0.40 sq inches and the second hole at

0.50' is 1.75 sq inches. There is an 18" RCP outlet pipe in the back of the structure with a restrictor plate at 6.0" above the invert of the pipe. This pipe eventually releases the pond outflow to a riprap pad northeast, as is the historic flow direction. Refer to Appendix C for additional storage information. The overflow route for Detention Pond F will be conveyed to the northeast through the emergency spillway towards the open land to the west of I-25. The spillway is a 1.5' deep, 10' wide (4:1 side slope) sharp-crested weir that passes the undetained 100-year inflow of 10.8 cfs at a depth of 0.40' through the weir. There is an additional 1.10' of freeboard above the 100-year WSEL going through the spillway. On the outfall side of the spillway is a riprap pad to dissipate energy.

C. STORMWATER STORAGE FACILITIES – POND E

Pond E has been constructed as a full-spectrum detention basin and will incorporate structures which release flows for the excess urban runoff volume (EURV) and the 100-year storm event. Per the Town of Castle Rock's Criteria, the detention pond has been designed to provide an additional 0.5x the WQCV. Note that Pond E overdetrains for Basin E6, which is a part of Phase 2 Prairie Hawk Roadway Improvements. The flows from E6 are undetained.

This pond is required to hold the 100-yr detention volume plus an additional 0.5*WQCV which equates to a total required volume of 3.92 ac-ft. This pond provides a detention volume of 5.35 ac-ft at the level of the emergency spillway (9.5' or elevation 6277.5). The 100-year ponding depth within the pond will be 4.2' when the outlet structure is operating as designed. Assuming the outlet structure is fully clogged, the major event will be allowed to pond up to 9.5' before reaching the spillway and exiting the pond. The designed 100-year release rate from the pond is 0.6x the historic inflow. A maximum of 29.49 cfs are allowed to be released, but only 24.3 cfs will leave the pond during the major event via the outlet structure. The WQCV will be released in 45 hours via an orifice plate, the EURV will be released in 46 hours through the same plate, and the 5-year event will be released in 45 hours. No offsite conveyance through this pond is necessary.

Table 3 - POND SUMMARY TABLE						
DESCRIPTION	STAGE (FT)	ELEVATION	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	ALLOWABLE RELEASE RATE	ACTUAL RELEASE RATE
MICROPOOL	0	6268	NA	NA	NA	NA
WQCV	3.83	6271.83	0.78	0.78	>40 HR	45 HR
EURV	5.20	6273.2	1.40	1.57	<72 HR	46 HR
100-YR+0.5*WQCV	7.47	6275.47	1.74	3.40	29.49 CFS*	24.3 CFS
OVERFLOW WEIR	9.5	6277.5	NA	5.36	100 YR INFLOW – 96.0 CFS	96.0 CFS @ 0.45' DEPTH
BERM TOP	11	6279	NA	6.97	NA	NA

*80% of Historic Inflow (36.86 cfs * 80% = 29.49 cfs)

The outlet structure itself is a 4.2' tall, 3.43'x2.29', 4:1 sloped grated box structure fronted by a 3.43'x9' micropool. On the front face of the structure is an orifice plate covered by a trash rack – the first hole at 0' is 0.83 sq inches and the second hole is at 1' and is 0.83 sq inches. At 2.36' above the bottom of the plate is a 6"Hx3"V orifice. There is a 24" RCP outlet pipe in the back of the structure with a restrictor plate 14.2" above the invert of the pipe. This pipe eventually releases the pond outflow to a riprap pad to the north and west of the pond, as is the historic flow direction. Refer to Appendix C for additional storage information.

The overflow route for Detention Pond E will be conveyed to the northeast through the emergency spillway towards the Industrial Tributary. The spillway is a 1.5' deep, 100' wide (4:1 side slope) sharp-crested weir that passes the undetained 100-year inflow of 96.0 cfs at a depth of 0.45' through the weir. There is an additional 1.05' of freeboard above the 100-year WSEL going through the spillway. On the outfall side of the spillway is a riprap pad to dissipate energy.

D. WATER QUALITY ENHANCEMENT BEST MANAGEMENT PRACTICES

Water quality measures have been included in the design of the proposed extended detention basins. The basins are designed to incorporate structures that release flows for the water quality capture volume (WQCV), excess urban runoff volume (EURV), and the 100-year storm event.

E. FLOODPLAIN MODIFICATION

This entire site is located in a Zone X, or Area of Minimal Flood Risk. Please refer to Appendix A for a copy of the FIRM Map Panel 08035C0301G. There are no modifications, disturbances, nor improvements planned within any floodplain on or near this project site.

F. GEOTECHNICAL INVESTIGATION AND SUB-SURFACE COLLECTION SYSTEM DESIGN

There are no subsurface investigations needed for this site, and there is no lot-to-lot drainage.

G. OPERATION AND MAINTENANCE

The owner of this property is responsible for the inspection and maintenance of Pond F. See below for anticipated maintenance intervals.

Routine Maintenance Activities

Mowing – Routine - A minimum of twice annually

Trash/Debris Removal – Routine - A minimum of twice annually and should be done after significant storm events. This activity must be performed prior to mowing operations.

Outlet Works Cleaning – Routine - A minimum of twice annually and as needed, after significant rain events.

Weed Control – Routine - As needed based on inspections.

Mosquito/Algae Treatment – As needed.

Major & Minor Maintenance Activities

Sediment Removal (Usually from the forebay, trickle channel, and/or micro-pool) – non-routine, as necessary based upon inspections. May be necessary as frequently as every 1-2 years.

Erosion Repair – Non-routine, as necessary.

Vegetation Removal/Tree Thinning – Non-routine, as necessary.

Drain Cleaning/Jet Vac – Non-routine, as necessary.

H. ADDITIONAL PERMITTING REQUIREMENTS

There are no additional permitting requirements for this submittal.

I. GENERAL

Hydrologic and hydraulic calculations can be found in the Appendix. Figure 1 is a vicinity map, and Figure 2 is a summary of the Four-Step Process. Table 1 within this report is a summary of the rainfall values used in the hydrologic calculations, and Tables 2 and 3 are the Pond Summary tables, which includes water surface elevations and release rates. Appendix A includes all reference maps and drainage maps. Appendix B includes all hydrologic and inlet calculations, as well as the hydraulic pipe calculations. Appendix C contains the detention calculations for the pond.

VI. CONCLUSIONS

A. COMPLIANCE WITH STANDARDS

The drainage design for Prairie Hawk Drive Phases 1 and 2 conforms to the Town of Castle Rock's Storm Drainage Design and Technical Criteria Manual, and the Urban Drainage and Flood Control Districts' Drainage Criteria Manual where applicable.

B. VARIANCES

No variances are being requested at this time.

C. DRAINAGE CONCEPT

The Rational Method was used to determine the developed runoff values for the minor drainage basins throughout the site. These basins were delineated based on the natural site topography and the developed site plan. Once the runoff values were identified, storm sewer pipes and other drainage conveyances were designed to capture and transport runoff towards one of the proposed extended detention basins, Pond E or Pond F. The storm sewer system has been designed to capture the minor (5-year) and major (100-year) storm events. The proposed extended detention basins will release water at the allowable rate in the historic direction of flow.

Runoff for the Northern Prairie Hawk Area will generally drain north and northeast towards the Industrial Tributary drainageway after being captured in the on-site drainage system or remain matching the historic drainage patterns.

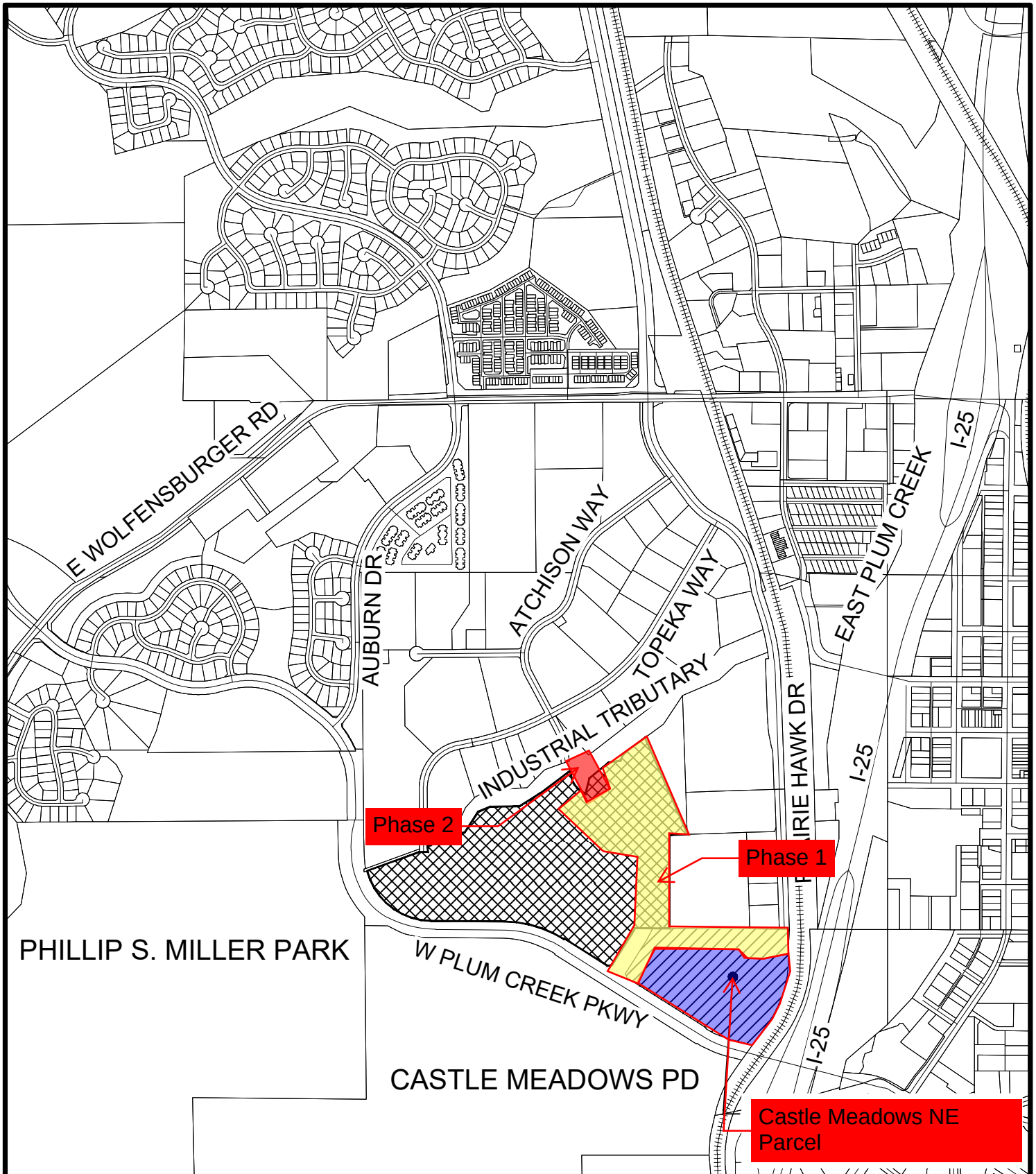
Runoff for the Southern Prairie Hawk Area will generally drain north and east and after being captured in the on-site drainage system, will be released at allowable rates in the historic direction (north).

VII. REFERENCES

- A. Drainage Criteria Manual, Volumes 1, 2, & 3, Mile High Flood District, Volumes 1&2 - June 2001, Volumes 1 & 2 - Revised March 2017, Volume 3 – Revised November 2015.
- B. Omni, Industrial and Westfield Watershed FHAD, CH2MHill, April 2013
- C. Omni, Industrial and Westfield Watershed Master Plan, CH2MHill, January 2011
- D. Phase III Drainage Report for Coachline Road and Plum Creek Boulevard at I-25, Felsburg Holt & Ullevig, January 2007, Revised March 2009.
- E. Town of Castle Rock Storm Drainage Design and Technical Criteria Manual, June 2019.

APPENDIX A – HYDROLOGIC CALCULATIONS

VICINITY MAP
FIRM MAP
DRAINAGE BASIN MAP
SCS SOILS MAP



APPROXIMATE SITE LOCATION

NOTES TO USERS

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

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The horizontal datum was NAD 83. GRS 1980 spheroid. Differences in feature alignment, projection or UTM zone used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

NGS Information Services
NGA, NIMS12
National Geodetic Survey
OSAC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

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

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

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

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

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

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

If you have questions about this map, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information K-Change (FMIX)** at 1-877-FEMA-MAP (1-877-369-5267), or visit the FEMA website at <http://www.fema.gov/businessinfo>.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHA) SUBJECT TO FLOODING BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, X, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevation determined.

ZONE AE Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); Average depths determined. For areas of annual or frequent flooding, velocities also determined.

ZONE AR Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR includes the area within the flood control system boundary existing to provide protection from the 1% annual chance or greater flood.

ZONE AV Areas in protection from the 1% annual chance flood by a flood control system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood stage.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 0.2% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPA)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

Base Flood Elevation line and value, elevation in feet

Base Flood Elevation value where uniform within zone, elevation in feet

Referenced to the North American Vertical Datum of 1988

Cross section line

Traverse line

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

100-meter Universal Transverse Mercator grid zone, zone 13

BM Bench mark (see explanation in Notes to Users section of this FIRM panel)

1:1.5 River Mile

MAP REPOSITORIES

Refer to Map Repositories list in Map Index

EFFECTIVE DATE OF COMMUNITY FLOOD INSURANCE RATE MAP

SEPTEMBER 30, 2009

EFFECTIVE DATES OF REVISIONS TO THIS MAP

MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add new areas to update map format, to add roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision.

For community map revision history prior to community mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-456-6622.

Notice to User: The **Map Number** shown below should be used when placing map orders. The **Community Number** shown above should be used on insurance applications for the subject community.

MAP SCALE 1" = 500'

250 0 250 500 1000 FEET METERS

150 0 150 300

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0301G
FIRM
FLOOD INSURANCE RATE MAP
DOUGLAS COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 301 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
COMMUNITY:
CASTLE ROCK, TOWN OF 080050
DOUGLAS COUNTY 080049

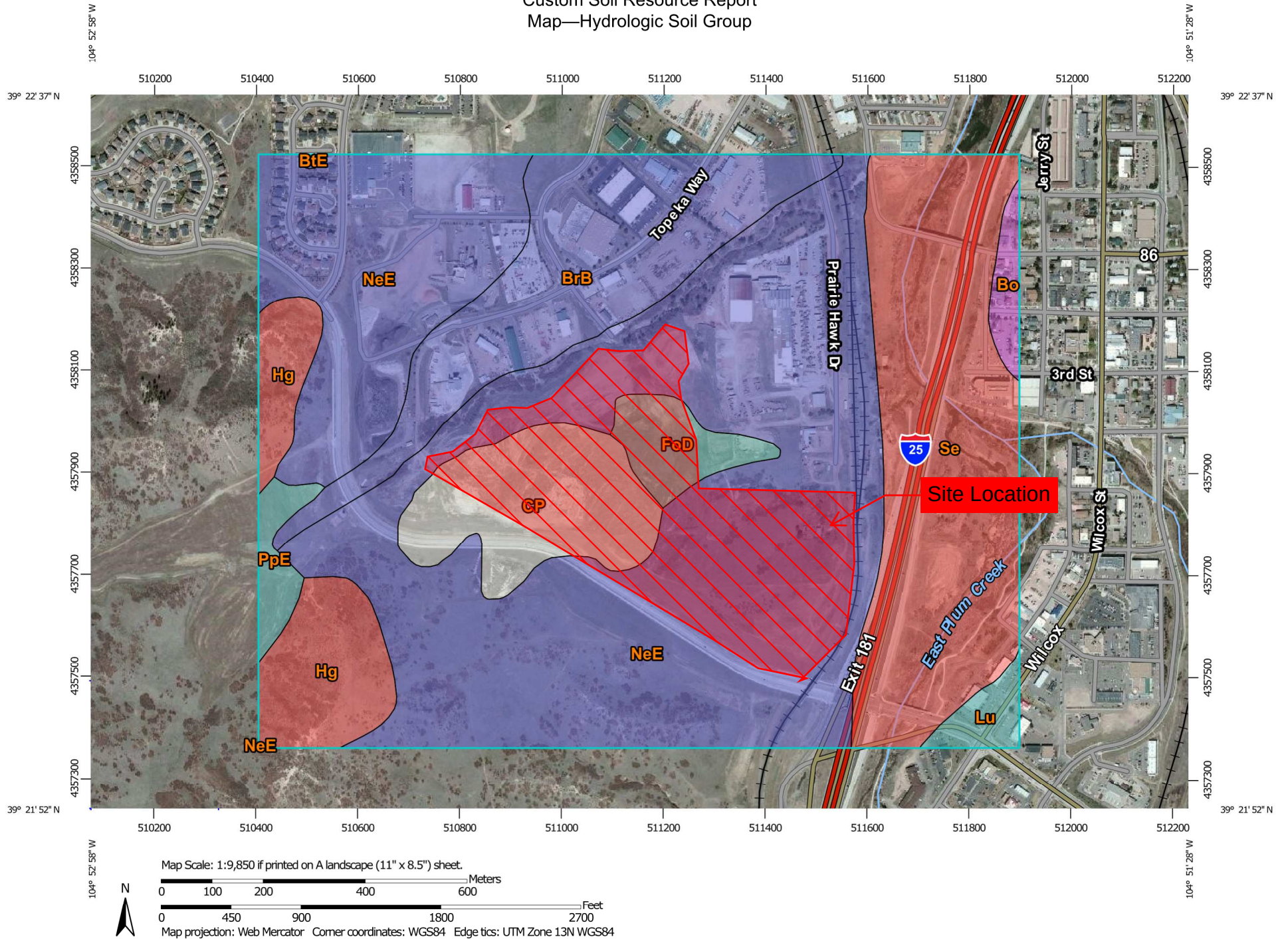
COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	0301	G
DOUGLAS COUNTY	080049	0301	G

Notice to User: The **Map Number** shown below should be used when placing map orders. The **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0301G
MAP REVISED
MARCH 16, 2016
Federal Emergency Management Agency

Custom Soil Resource Report

Map—Hydrologic Soil Group



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Castle Rock Area, Colorado
 Survey Area Data: Version 8, Sep 23, 2014

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

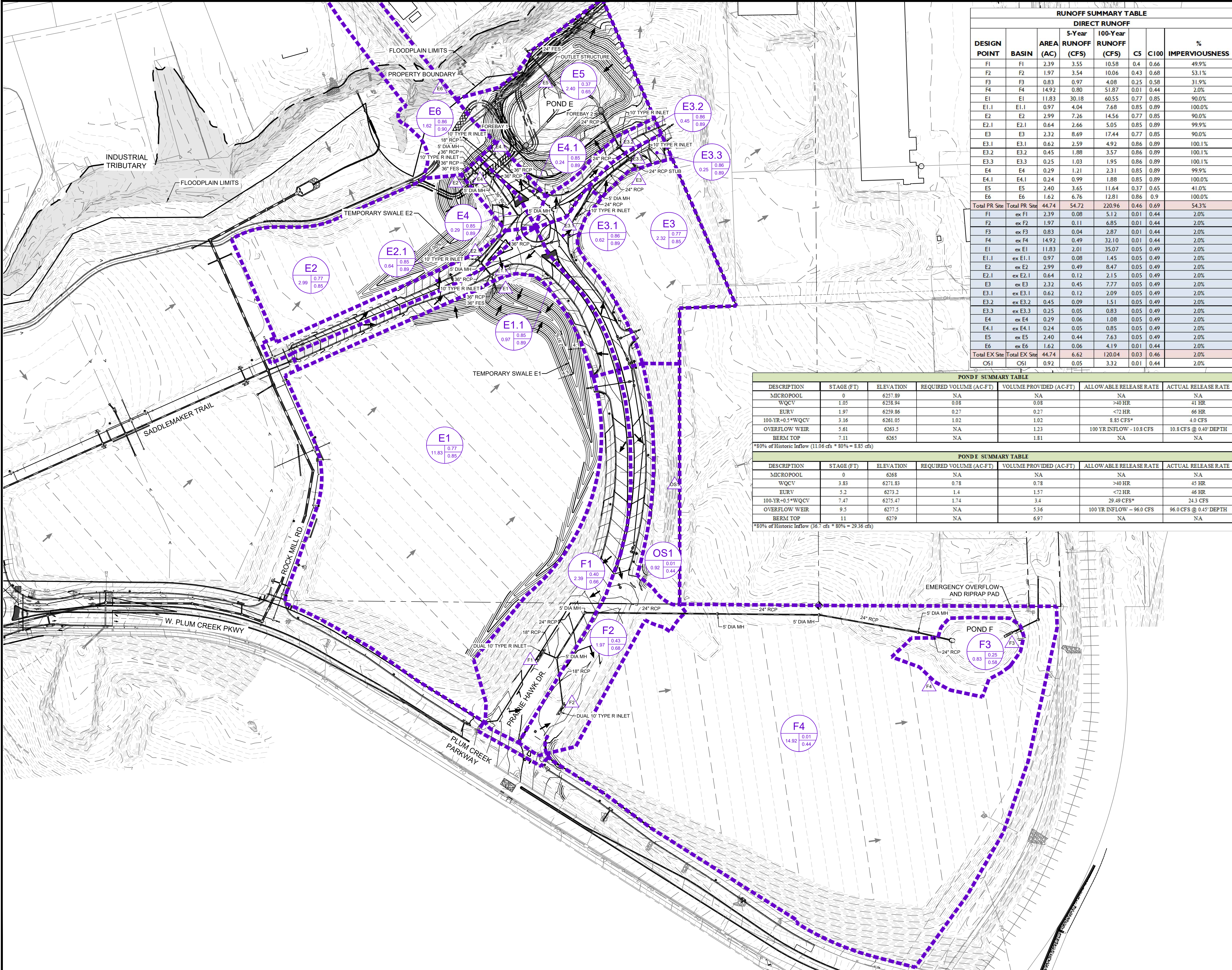
Date(s) aerial images were photographed: Mar 16, 2012—Apr 13, 2012

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

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Castle Rock Area, Colorado (CO622)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	4.0	0.9%
BrB	Bresser sandy loam, 1 to 3 percent slopes	B	51.6	12.0%
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	0.2	0.1%
CP	Pits, clay		28.2	6.5%
FoD	Fondis clay loam, 3 to 9 percent slopes	C	9.2	2.1%
Hg	Hilly gravelly land	D	25.2	5.8%
Lu	Loamy alluvial land, dark surface	C	4.5	1.0%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	226.8	52.7%
PpE	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes	C	5.3	1.2%
Se	Sandy wet alluvial land	D	75.7	17.6%
Totals for Area of Interest			430.8	100.0%

Rating Options—Hydrologic Soil Group*Aggregation Method:* Dominant Condition*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher



RUNOFF SUMMARY TABLE						
DIRECT RUNOFF						
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)	C5	C100
F1	F1	2.39	3.55	10.58	0.4	0.66
F2	F2	1.97	3.54	10.06	0.43	0.68
F3	F3	0.83	0.97	4.08	0.25	0.58
F4	F4	14.92	0.80	51.87	0.01	0.44
E1	E1	11.83	30.18	60.55	0.77	0.85
E1.1	E1.1	0.97	4.04	7.68	0.85	0.89
E2	E2	2.99	7.26	14.56	0.77	0.85
E2.1	E2.1	0.64	2.66	5.05	0.85	0.89
E3	E3	2.32	8.69	17.44	0.77	0.85
E3.1	E3.1	0.62	2.59	4.92	0.86	0.89
E3.2	E3.2	0.45	1.88	3.57	0.86	0.89
E3.3	E3.3	0.25	1.03	1.95	0.86	0.89
E4	E4	0.29	1.21	2.31	0.85	0.89
E4.1	E4.1	0.24	0.99	1.88	0.85	0.89
E5	E5	2.40	3.65	11.64	0.37	0.65
E6	E6	1.62	6.76	12.81	0.86	0.9
Total PR Site	Total PR Site	44.74	54.72	220.96	0.46	0.69
F1	ex F1	2.39	0.08	5.12	0.01	0.44
F2	ex F2	1.97	0.11	6.85	0.01	0.44
F3	ex F3	0.83	0.04	2.87	0.01	0.44
F4	ex F4	14.92	0.49	32.10	0.01	0.44
E1	ex E1	11.83	2.01	35.07	0.05	0.49
E1.1	ex E1.1	0.97	0.08	1.45	0.05	0.49
E2	ex E2	2.99	0.49	8.47	0.05	0.49
E2.1	ex E2.1	0.64	0.12	2.15	0.05	0.49
E3	ex E3	2.32	0.45	7.77	0.05	0.49
E3.1	ex E3.1	0.62	0.12	2.09	0.05	0.49
E3.2	ex E3.2	0.45	0.09	1.51	0.05	0.49
E3.3	ex E3.3	0.25	0.05	0.83	0.05	0.49
E4	ex E4	0.29	0.06	1.08	0.05	0.49
E4.1	ex E4.1	0.24	0.05	0.85	0.05	0.49
E5	ex E5	2.40	0.44	7.63	0.05	0.49
E6	ex E6	1.62	0.06	4.19	0.01	0.44
Total EX Site	Total EX Site	44.74	6.62	120.04	0.03	0.46
OS1	OS1	0.92	0.05	3.32	0.01	0.44

POND F SUMMARY TABLE						
DESCRIPTION	STAGE (FT)	ELEVATION	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	ALLOWABLE RELEASE RATE	ACTUAL RELEASE RATE
MICROPOOL	0	6257.89	NA	NA	NA	NA
WQCV	1.05	6258.94	0.08	0.08	>40 HR	41 HR
EURV	1.97	6259.86	0.27	0.27	<72 HR	66 HR
100-YR+0.5"WQCV	3.16	6261.05	1.02	1.02	8.85 CFS*	4.0 CFS
OVERFLOW WEIR	5.61	6263.5	NA	1.23	100 YR INFLOW - 10.8 CFS	10.8 CFS @ 0.40' DEPTH
BERM TOP	7.11	6265	NA	1.81	NA	NA
*80% of Historic Inflow (11.06 cfs * 80% = 8.85 cfs)						

POND E SUMMARY TABLE						
DESCRIPTION	STAGE (FT)	ELEVATION	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	ALLOWABLE RELEASE RATE	ACTUAL RELEASE RATE
MICROPOOL	0	6268	NA	NA	NA	NA
WQCV	3.83	6271.83	0.78	0.78	>40 HR	45 HR
EURV	5.2	6273.2	1.4	1.57	<72 HR	46 HR
100-YR+0.5"WQCV	7.47	6275.47	1.74	3.4	29.49 CFS*	24.3 CFS
OVERFLOW WEIR	9.5	6277.5	NA	5.36	100 YR INFLOW - 96.0 CFS	96.0 CFS @ 0.45' DEPTH
BERM TOP	11	6279	NA	6.97	NA	NA
*80% of Historic Inflow (36.7 cfs * 80% = 29.36 cfs)						

LEGEND

EXISTING PROPOSED

BASIN DESIGNATION

5 YEAR COEFFICIENTS

100 YEAR COEFFICIENTS

DESIGN POINT

DIRECTIONAL FLOW ARROW

EMERGENCY OVERFLOW ROUTE

PROPOSED DRAINAGE BASIN

EXISTING DRAINAGE BASIN

PROPOSED MAJOR CONTOUR

PROPOSED MINOR CONTOUR

EXISTING MAJOR CONTOUR

EXISTING MINOR CONTOUR

EASEMENT

RIGHT OF WAY (R.O.W.)

CENTERLINE

PROJECT BOUNDARY

PROPOSED STORM & STUB OUT

EXISTING STORM & STUB OUT

STORM MANHOLES

STORM INLETS

FES, FOREBAY, & TRICKLE CHANNEL

OUTLET STRUCTURE

RIPRAP

100 YEAR FLOODPLAIN

WETLAND

RETAINING WALL

DRAINAGE SWALE

0 100' 200'

1 inch = 100 ft.

LAND DEVELOPMENT

ENERGY

PUBLIC INFRASTRUCTURE

CORE CONSULTANTS, INC.

3472 S. BROADWAY

DENVER, CO 80113

303.703.4444

LIVEYOURCORE.COM

CORE

PROPOSED DRAINAGE MAP

PHASE 1 AND 2

PRAIRIE HAWK ROAD PHASE 1

DEVELOPMENT PROJECT

DATE: 10/3/22

CREATED BY: DG

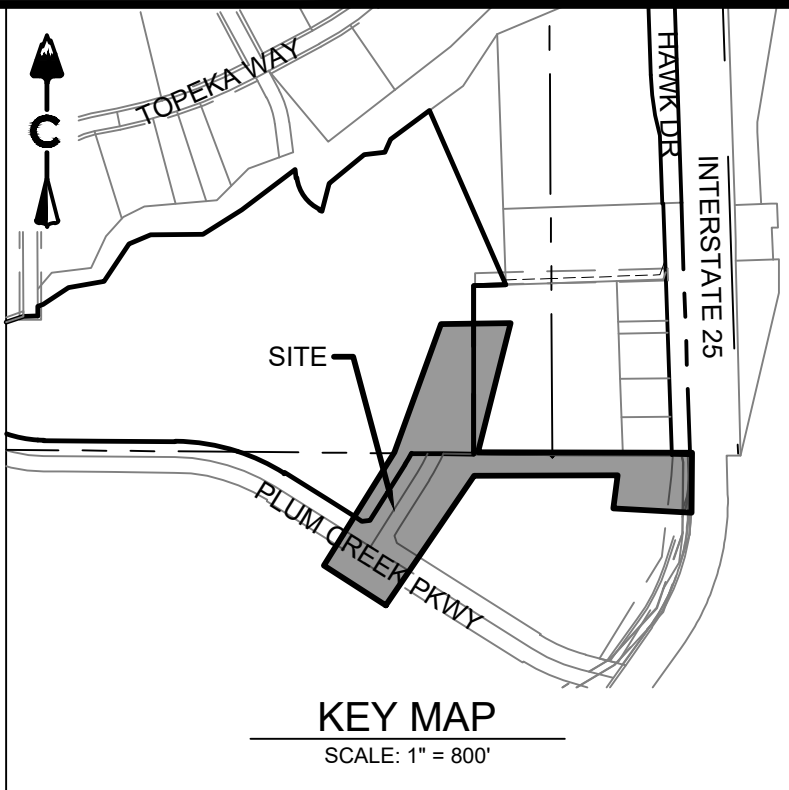
JOB NO. 17-069

SHEET 1

2021-09-11 (4:25 PM) Jess Korczel X:\17-069 Miller Landing\Cadd\Plan\Praire Hawk\Phase 2\Drainage PRDR-ERG2.dwg



RUNOFF SUMMARY TABLE							
DIRECT RUNOFF							
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)	C5	C100	% IMPERVIOUSNESS
F1	F1	2.39	3.55	10.58	0.4	0.66	49.9%
F2	F2	1.97	3.54	10.06	0.43	0.68	53.1%
F3	F3	0.83	0.97	4.08	0.25	0.58	31.9%
F4	F4	14.92	0.80	51.87	0.01	0.44	2.0%
E1	E1	11.83	30.18	60.55	0.77	0.85	90.0%
E1.1	E1.1	0.97	4.04	7.68	0.85	0.89	100.0%
E2	E2	2.99	7.26	14.56	0.77	0.85	90.0%
E2.1	E2.1	0.64	2.66	5.05	0.85	0.89	99.9%
E3	E3	2.32	8.69	17.44	0.77	0.85	90.0%
E3.1	E3.1	0.87	3.61	6.87	0.85	0.89	100.0%
E3.2	E3.2	0.45	1.88	3.57	0.86	0.89	100.1%
E4	E4	0.29	1.21	2.31	0.85	0.89	99.9%
E4.1	E4.1	0.24	0.99	1.88	0.85	0.89	100.0%
E5	E5	2.82	2.52	12.65	0.21	0.57	20.9%
PROPOSED SITE TOTAL		43.54	71.90	209.16	0.44	0.68	51.2%
F1	ex F1	2.39	0.07	4.64	0.01	0.44	2.0%
F2	ex F2	1.97	0.07	4.22	0.01	0.44	2.0%
F3	ex F3	0.83	0.04	2.87	0.01	0.44	2.0%
F4	ex F4	14.92	0.80	51.87	0.01	0.44	2.0%
E1	ex E1	11.83	1.67	29.03	0.05	0.49	2.0%
E1.1	ex E1.1	0.97	0.17	2.89	0.05	0.49	2.0%
E2	ex E2	2.99	0.25	4.44	0.05	0.49	2.0%
E2.1	ex E2.1	0.64	0.10	1.82	0.05	0.49	2.0%
E3	ex E3	2.32	0.45	7.77	0.05	0.49	2.0%
E3.1	ex E3.1	0.87	0.17	2.92	0.05	0.49	2.0%
E3.2	ex E3.2	0.45	0.09	1.51	0.05	0.49	2.0%
E4	ex E4	0.29	0.06	0.98	0.05	0.49	2.0%
E4.1	ex E4.1	0.24	0.05	0.88	0.05	0.49	2.0%
E5	ex E5	2.82	0.58	10.06	0.05	0.49	2.0%
EXISTING SITE TOTAL		43.54	4.56	125.91	0.03	0.47	2.0%
OS1	OS1	0.92	0.05	3.32	0.01	0.44	2.0%



LEGEND

EXISTING

PROPOSED

AREA XXXX

0.45

0.60

AREA XXXX

0.45

0.60

DIRECTIONAL FLOW ARROW

EMERGENCY OVERFLOW ROUTE

PROPOSED DRAINAGE BASIN

EXISTING DRAINAGE BASIN

PROPOSED MAJOR CONTOUR

PROPOSED MINOR CONTOUR

EXISTING MAJOR CONTOUR

EXISTING MINOR CONTOUR

EASEMENT

RIGHT OF WAY (R.O.W.)

CENTERLINE

PROJECT BOUNDARY

PROPOSED STORM & STUB OUT

EXISTING STORM & STUB OUT

STORM MANHOLES

STORM INLETS

FES, FOREBAY, & TRICKLE CHANNEL

OUTLET STRUCTURE

RIPRAP

100 YEAR FLOODPLAIN

WETLAND

RETAINING WALL

DRAINAGE SWALE

CORE CONSULTANTS, INC.
3472 S. BROADWAY
SUITE 200
303.703.4444
LIVEYOURCORE.COM

CORE

EXISTING DRAINAGE MAP
PHASE 1

PRAIRIE HAWK ROAD PHASE 1
DEVELOPMENT PROJECT

DATE: 10/3/22
CREATED BY: DG
JOB NO. 17-069
SHEET 1

APPENDIX B – HYDRAULIC CALCULATIONS

INLET CAPACITY
HGL CALCULATIONS
RATIONAL CALCULATIONS

Prairie Hawk Dr Roadway Improvements Phase 1

CORE Project #: 17-069

Prepared By: JNK

IMPERVIOUS CALCULATIONS-REFERENCE UDFCD Vol.1 RUNOFF Table 6-3

% Imperv.	Design Point	Residential & Commercial												Soil Type		
		Single Family			Multi-Family	Roof/ Concrete/ Commercial	Asphalt/ Ponded Water	Packed Gravel	Landscape Area		Historic			Soil Type A Area	Soil Type B Area	Soil Type C/D Area
		0.25 acres or less	0.25 - 0.75 acres	2.5 acres or larger	Attached				2-7% Slope	>7% Slope						
		45.00%	30.00%	12.00%	75.00%	90.00%	100.00%	40.00%	2.00%	2.00%	2.00%					
BASIN												Total	Percent			
		Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Impervious	Area (ac)	Area (ac)	Area (ac)
F1	F1	-	-	-	-	-	1.17	-	-	1.22	-	2.39	49.9%	-	2.39	-
F2	F2	-	-	-	-	-	1.03	-	-	0.94	-	1.97	53.1%	-	1.97	-
F3	F3	-	-	-	-	-	0.25	-	-	0.57	-	0.83	31.9%	-	0.83	-
F4	F4	-	-	-	-	-	-	-	-	14.92	-	14.92	2.0%	-	14.92	-
E1	E1	-	-	-	-	11.83	-	-	-	-	-	11.83	90.0%	-	-	11.83
E1.1	E1.1	-	-	-	-	-	0.97	-	-	-	-	0.97	100.0%	-	-	0.97
E2	E2	-	-	-	-	2.99	-	-	-	-	-	2.99	90.0%	-	-	2.99
E2.1	E2.1	-	-	-	-	-	0.64	-	-	-	-	0.64	99.9%	-	-	0.64
E3	E3	-	-	-	-	2.32	-	-	-	-	-	2.32	90.0%	-	-	2.32
E3.1	E3.1	-	-	-	-	-	0.62	-	-	-	-	0.62	100.1%	-	-	0.62
E3.2	E3.2	-	-	-	-	-	0.45	-	-	-	-	0.45	100.1%	-	-	0.45
E3.3	E3.3	-	-	-	-	-	0.25	-	-	-	-	0.25	100.1%	-	-	0.25
E4	E4	-	-	-	-	-	0.29	-	-	-	-	0.29	99.9%	-	-	0.29
E4.1	E4.1	-	-	-	-	-	0.24	-	-	-	-	0.24	100.0%	-	-	0.24
E5	E5	-	-	-	-	-	0.96	-	1.45	-	-	2.40	41.0%	-	-	2.40
E6	E6	-	-	-	-	-	1.62	-	-	-	-	1.62	100.0%	-	1.62	-

		Residential & Commercial												Soil Type			
		Single Family			Multi-Family									Soil Type A Area	Soil Type B Area	Soil Type C/D Area	
		0.25 acres or less	0.25 - 0.75 acres	2.5 acres or larger	Attached	Roof/ Concrete/ Commercial	Asphalt/ Pondered Water	Packed Gravel	2-7% Slope	>7% Slope	Historic						
		% Imperv.	Design Point	45.00%	30.00%	12.00%	75.00%	90.00%	100.00%	40.00%	2.00%			2.00%	2.00%	Total	Percent
	BASIN	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Impervious	Area (ac)	Area (ac)	Area (ac)
	Total PR Site	-	-	-	-	17.14	8.49	-	1.45	17.66	-	44.74	54.3%	-	21.73	23.01	
	ex F1	-	-	-	-	-	-	-	-	-	2.39	2.39	2.0%	-	2.39	-	
	ex F2	-	-	-	-	-	-	-	-	-	1.97	1.97	2.0%	-	1.97	-	
	ex F3	-	-	-	-	-	-	-	-	-	0.83	0.83	2.0%	-	0.83	-	
	ex F4	-	-	-	-	-	-	-	-	-	14.92	14.92	2.0%	-	14.92	-	
	ex E1	-	-	-	-	-	-	-	-	-	11.83	11.83	2.0%	-	-	11.83	
	ex E1.1	-	-	-	-	-	-	-	-	-	0.97	0.97	2.0%	-	-	0.97	
	ex E2	-	-	-	-	-	-	-	-	-	2.99	2.99	2.0%	-	-	2.99	
	ex E2.1	-	-	-	-	-	-	-	-	-	0.64	0.64	2.0%	-	-	0.64	
	ex E3	-	-	-	-	-	-	-	-	-	2.32	2.32	2.0%	-	-	2.32	
	ex E3.1	-	-	-	-	-	-	-	-	-	0.62	0.62	2.0%	-	-	0.62	
	ex E3.2	-	-	-	-	-	-	-	-	-	0.45	0.45	2.0%	-	-	0.45	
	ex E3.3	-	-	-	-	-	-	-	-	-	0.25	0.25	2.0%	-	-	0.25	
	ex E4	-	-	-	-	-	-	-	-	-	0.29	0.29	2.0%	-	-	0.29	
	ex E4.1	-	-	-	-	-	-	-	-	-	0.24	0.24	2.0%	-	-	0.24	
	ex E5	-	-	-	-	-	-	-	-	-	2.40	2.40	2.0%	-	-	2.40	
	ex E6	-	-	-	-	-	-	-	-	-	1.62	1.62	2.0%	-	1.62	-	
	Total EX Site	-	-	-	-	-	-	-	-	-	44.74	44.74	2.0%	-	21.73	23.01	
	OS1	-	-	-	-	-	-	-	-	-	0.92	0.92	2.0%	-	0.92	-	

Basin ID	% Imperv.	i	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
F1	49.9%	0.50	A	0.34	0.35	0.37	0.50	2.39	2.39	0.37	0.40	0.46	0.66
			B	0.37	0.40	0.46	0.66						
			C or D	0.38	0.44	0.50	0.69						
F2	53.1%	0.53	A	0.37	0.38	0.40	0.52	1.97	1.97	0.40	0.43	0.49	0.68
			B	0.40	0.43	0.49	0.68						
			C or D	0.41	0.47	0.52	0.70						
F3	31.9%	0.32	A	0.19	0.20	0.21	0.36	0.83	0.83	0.22	0.25	0.32	0.58
			B	0.22	0.25	0.32	0.58						
			C or D	0.23	0.30	0.37	0.61						
F4	2.0%	0.02	A	0.01	0.01	0.01	0.13	14.92	14.92	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
E1	90.0%	0.90	A	0.73	0.75	0.76	0.81	11.83	11.83	0.74	0.77	0.80	0.85
			B	0.74	0.77	0.79	0.85						
			C or D	0.74	0.77	0.80	0.85						
E1.1	100.0%	1.00	A	0.84	0.86	0.87	0.89	0.97	0.97	0.83	0.85	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.85	0.87	0.89						
E2	90.0%	0.90	A	0.73	0.75	0.76	0.81	2.99	2.99	0.74	0.77	0.80	0.85
			B	0.74	0.77	0.79	0.85						
			C or D	0.74	0.77	0.80	0.85						
E2.1	99.9%	1.00	A	0.84	0.86	0.87	0.89	0.64	0.64	0.83	0.85	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.85	0.87	0.89						
E3	90.0%	0.90	A	0.73	0.75	0.76	0.81	2.32	2.32	0.74	0.77	0.80	0.85
			B	0.74	0.77	0.79	0.85						
			C or D	0.74	0.77	0.80	0.85						
E3.1	100.1%	1.00	A	0.84	0.86	0.87	0.89	0.62	0.62	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89						
E3.2	100.1%	1.00	A	0.84	0.86	0.87	0.89	0.45	0.45	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89						
E3.3	100.1%	1.00	A	0.84	0.86	0.87	0.89	0.25	0.25	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89						
E4	99.9%	1.00	A	0.84	0.86	0.87	0.89	0.29	0.29	0.83	0.85	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.85	0.87	0.89						
E4.1	100.0%	1.00	A	0.84	0.86	0.87	0.89	0.24	0.24	0.83	0.85	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.85	0.87	0.89						
E5	41.0%	0.41	A	0.26	0.28	0.29	0.43	2.40	2.40	0.31	0.37	0.44	0.65
			B	0.30	0.33	0.39	0.62						
			C or D	0.31	0.37	0.44	0.65						
E6	100.0%	1.00	A	0.84	0.86	0.87	0.89	1.62	1.62	0.84	0.86	0.87	0.90
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89						
Total PR Site	54.3%	0.54	A	0.38	0.39	0.41	0.53	21.73 23.01	44.74	0.42	0.46	0.52	0.69
			B	0.41	0.44	0.50	0.68						
			C or D	0.42	0.48	0.53	0.71						

Basin ID	% Imperv.	i	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
ex F1	2.0%	0.02	A	0.01	0.01	0.01	0.13	2.39	2.39	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex F2	2.0%	0.02	A	0.01	0.01	0.01	0.13	1.97	1.97	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex F3	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.83	0.83	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex F4	2.0%	0.02	A	0.01	0.01	0.01	0.13	14.92	14.92	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E1	2.0%	0.02	A	0.01	0.01	0.01	0.13	11.83	11.83	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E1.1	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.97	0.97	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E2	2.0%	0.02	A	0.01	0.01	0.01	0.13	2.99	2.99	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E2.1	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.64	0.64	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E3	2.0%	0.02	A	0.01	0.01	0.01	0.13	2.32	2.32	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E3.1	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.62	0.62	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E3.2	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.45	0.45	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E3.3	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.25	0.25	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E4	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.29	0.29	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E4.1	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.24	0.24	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E5	2.0%	0.02	A	0.01	0.01	0.01	0.13	2.40	2.40	0.01	0.05	0.15	0.49
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
ex E6	2.0%	0.02	A	0.01	0.01	0.01	0.13	1.62	1.62	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
Total EX Site	2.0%	0.02	A	0.01	0.01	0.01	0.13	21.73 23.01	44.74	0.01	0.03	0.11	0.46
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						
OS1	2.0%	0.02	A	0.01	0.01	0.01	0.13	0.92	0.92	0.01	0.01	0.07	0.44
			B	0.01	0.01	0.07	0.44						
			C or D	0.01	0.05	0.15	0.49						

Prairie Hawk Dr Roadway Improvements Phase 1

CORE Project #: 17-069

Prepared By: JNK

TIME OF CONCENTRATION CALCULATIONS

-REFERENCE UDFCD Vol.1 Section 2.4

NRCS Conveyance factors, K -REFERENCE UDFCD Vol.1 RUNOFF Table 6-2

SF-2 Heavy Meadow 3 Short Grass Pasture & Lawns 7 Grassed Waterway 15
Tillage/field 5 Nearly Bare Ground 10 Paved Area & Shallow Gutter 20

SUB-BASIN DATA			INITIAL / OVERLAND TIME			CHANNEL / TRAVEL TIME T(t)						T(c) CHECK (URBANIZED BASINS)		FINAL T(c)
DRAIN BASIN	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	% IMPER-VIOUS	USDCM Eq . 6-5	min.
F1	2.39	0.40	160	33.0	5.0	820	1.2	20	2.2	6.2	11.3	0.50	25.3	11.3
F2	1.97	0.43	20	33.0	1.7	880	1.3	20	2.2	6.6	8.3	0.53	25.0	8.3
F3	0.83	0.25	120	33.0	5.3	50	25.0	7	3.5	0.2	5.6	0.32	20.7	5.6
F4	14.92	0.01	120	33.0	6.8	50	25.0	7	3.5	0.2	7.0	0.02	-	7.0
E1	11.83	0.77	50	3.0	2.9	850	3.0	7	1.2	11.7	14.6	0.90	14.5	14.5
E1.1	0.97	0.85	50	3.0	2.2	300	2.0	20	2.8	1.8	3.9	1.00	10.5	5.0
E2	2.99	0.77	300	2.0	8.1	950	1.0	20	2.0	7.9	16.1	0.90	18.0	16.1
E2.1	0.64	0.85	13	2.0	1.3	820	3.5	20	3.8	3.6	4.9	1.00	12.2	5.0
E3	2.32	0.77	50	6.0	2.3	250	3.0	20	3.5	1.2	3.5	0.90	11.8	5.0
E3.1	0.62	0.86	50	6.0	1.7	250	3.0	20	3.5	1.2	2.9	1.00	10.0	5.0
E3.2	0.45	0.86	50	6.0	1.7	250	3.0	20	3.5	1.2	2.9	1.00	10.0	5.0
E3.3	0.25	0.86	50	6.0	1.7	250	3.0	20	3.5	1.2	2.9	1.00	10.0	5.0
E4	0.29	0.85	50	6.0	1.7	80	3.0	20	3.5	0.4	2.1	1.00	9.3	5.0
E4.1	0.24	0.85	140	21.4	1.9	80	3.0	20	3.5	0.4	2.3	1.00	9.3	5.0
E5	2.40	0.37	100	4.0	8.3	80	4.0	20	4.0	0.3	8.7	0.41	19.5	8.7
E6	1.62	0.86	100	4.0	2.7	200	4.0	20	4.0	0.8	3.6	1.00	9.7	5.0
Total PR Site	44.74	0.46	160	33.0	4.6	820	1.2	7	0.8	17.8	22.4	0.54	-	22.4

SUB-BASIN DATA			INITIAL / OVERLAND TIME			CHANNEL / TRAVEL TIME T(t)						T(c) CHECK (URBANIZED BASINS)		FINAL T(c)
DRAIN BASIN	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	% IMPER- VIOUS	USDCM Eq . 6-5	min.
ex F1	2.39	0.01	20	33.0	2.8	880	1.3	7	0.8	18.7	21.5	0.02	-	21.5
ex F2	1.97	0.01	120	33.0	6.8	50	25.0	7	3.5	0.2	7.0	0.02	-	7.0
ex F3	0.83	0.01	120	33.0	6.8	50	25.0	7	3.5	0.2	7.0	0.02	-	7.0
ex F4	14.92	0.01	50	3.0	9.7	850	3.0	7	1.2	11.7	21.3	0.02	-	21.3
ex E1	11.83	0.05	50	3.0	9.3	300	2.0	7	1.0	5.1	14.4	0.02	-	14.4
ex E1.1	0.97	0.05	300	2.0	26.1	950	1.0	7	0.7	22.6	48.7	0.02	-	48.7
ex E2	2.99	0.05	13	2.0	5.4	820	3.5	7	1.3	10.4	15.8	0.02	-	15.8
ex E2.1	0.64	0.05	50	6.0	7.4	250	3.0	7	1.2	3.4	10.8	0.02	-	10.8
ex E3	2.32	0.05	50	6.0	7.4	250	3.0	7	1.2	3.4	10.8	0.02	-	10.8
ex E3.1	0.62	0.05	50	6.0	7.4	250	3.0	7	1.2	3.4	10.8	0.02	-	10.8
ex E3.2	0.45	0.05	50	6.0	7.4	250	3.0	7	1.2	3.4	10.8	0.02	-	10.8
ex E3.3	0.25	0.05	50	6.0	7.4	250	3.0	7	1.2	3.4	10.8	0.02	-	10.8
ex E4	0.29	0.05	50	6.0	7.4	80	3.0	7	1.2	1.1	8.5	0.02	-	8.5
ex E4.1	0.24	0.05	140	21.4	8.1	80	3.0	7	1.2	1.1	9.2	0.02	-	9.2
ex E5	2.40	0.05	100	4.0	12.0	80	4.0	20	4.0	0.3	12.3	0.02	-	12.3
ex E6	1.62	0.01	100	4.0	12.4	200	4.0	7	1.4	2.4	14.8	0.02	-	14.8
Total EX Site	44.74	0.03	50	25.0	4.7	150	6.0	7	1.7	1.5	6.2	0.02	-	6.2
OS1	0.92	0.01	50	25.0	4.8	150	6.0	7	1.7	1.5	6.3	0.02	-	6.3

Prairie Hawk Dr Roadway Improvements Phase 1

CORE Project #: 17-069

Prepared By: JNK

RATIONAL METHOD PEAK RUNOFF

5-Year STORM

Rainfall Depth-Duration-Frequency (1-hr) = 1.43

SF-3

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	5yr Runoff COEFF	T(c) min	C x A	I in/hr	Q cfs
F1	F1	2.39	0.40	11.3	0.96	3.69	3.55
F2	F2	1.97	0.43	8.3	0.85	4.16	3.54
F3	F3	0.83	0.25	5.6	0.21	4.71	0.97
F4	F4	14.92	0.01	7.0	0.18	4.39	0.80
E1	E1	11.83	0.77	14.5	9.15	3.30	30.18
E1.1	E1.1	0.97	0.85	5.0	0.83	4.85	4.04
E2	E2	2.99	0.77	16.1	2.31	3.14	7.26
E2.1	E2.1	0.64	0.85	5.0	0.55	4.85	2.66
E3	E3	2.32	0.77	5.0	1.79	4.85	8.69
E3.1	E3.1	0.62	0.86	5.0	0.53	4.85	2.59
E3.2	E3.2	0.45	0.86	5.0	0.39	4.85	1.88
E3.3	E3.3	0.25	0.86	5.0	0.21	4.85	1.03
E4	E4	0.29	0.85	5.0	0.25	4.85	1.21
E4.1	E4.1	0.24	0.85	5.0	0.20	4.85	0.99
E5	E5	2.40	0.37	8.7	0.89	4.09	3.65
E6	E6	1.62	0.86	5.0	1.39	4.85	6.76
Total PR Site	Total PR Site	44.74	0.46	22.4	20.67	2.65	54.72
F1	ex F1	2.39	0.01	21.5	0.03	2.71	0.08
F2	ex F2	1.97	0.01	7.0	0.02	4.39	0.11
F3	ex F3	0.83	0.01	7.0	0.01	4.39	0.04
F4	ex F4	14.92	0.01	21.3	0.18	2.72	0.49
E1	ex E1	11.83	0.05	14.4	0.61	3.31	2.01
E1.1	ex E1.1	0.97	0.05	48.7	0.05	1.66	0.08
E2	ex E2	2.99	0.05	15.8	0.15	3.17	0.49
E2.1	ex E2.1	0.64	0.05	10.8	0.03	3.74	0.12
E3	ex E3	2.32	0.05	10.8	0.12	3.74	0.45
E3.1	ex E3.1	0.62	0.05	10.8	0.03	3.74	0.12
E3.2	ex E3.2	0.45	0.05	10.8	0.02	3.74	0.09
E3.3	ex E3.3	0.25	0.05	10.8	0.01	3.74	0.05
E4	ex E4	0.29	0.05	8.5	0.02	4.11	0.06
E4.1	ex E4.1	0.24	0.05	9.2	0.01	3.99	0.05
E5	ex E5	2.40	0.05	12.3	0.12	3.55	0.44
E6	ex E6	1.62	0.01	14.8	0.02	3.27	0.06
Total EX Site	Total EX Site	44.74	0.03	6.2	1.45	4.57	6.62
OS1	OS1	0.92	0.01	6.3	0.01	4.55	0.05

Prairie Hawk Dr Roadway Improvements Phase 1

CORE Project #: 17-069

Prepared By: JNK

RATIONAL METHOD PEAK RUNOFF

100-YR STORM

SF-3

Rainfall Depth-Duration-Frequency (1-hr) = 2.60

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	100YR RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
F1	F1	2.39	0.66	11.3	1.58	6.71	10.58
F2	F2	1.97	0.68	8.3	1.33	7.56	10.06
F3	F3	0.83	0.58	5.6	0.48	8.57	4.08
F4	F4	14.92	0.44	7.0	6.50	7.98	51.87
E1	E1	11.83	0.85	14.5	10.09	6.00	60.55
E1.1	E1.1	0.97	0.89	5.0	0.87	8.82	7.68
E2	E2	2.99	0.85	16.1	2.55	5.71	14.56
E2.1	E2.1	0.64	0.89	5.0	0.57	8.82	5.05
E3	E3	2.32	0.85	5.0	1.98	8.82	17.44
E3.1	E3.1	0.62	0.89	5.0	0.56	8.82	4.92
E3.2	E3.2	0.45	0.89	5.0	0.40	8.82	3.57
E3.3	E3.3	0.25	0.89	5.0	0.22	8.82	1.95
E4	E4	0.29	0.89	5.0	0.26	8.82	2.31
E4.1	E4.1	0.24	0.89	5.0	0.21	8.82	1.88
E5	E5	2.40	0.65	8.7	1.57	7.43	11.64
E6	E6	1.62	0.90	5.0	1.45	8.82	12.81
Total PR Site	Total PR Site	44.74	0.69				220.96
F1	ex F1	2.39	0.44	21.5	1.04	4.92	5.12
F2	ex F2	1.97	0.44	7.0	0.86	7.98	6.85
F3	ex F3	0.83	0.44	7.0	0.36	7.98	2.87
F4	ex F4	14.92	0.44	21.3	6.50	4.94	32.10
E1	ex E1	11.83	0.49	14.4	5.82	6.02	35.07
E1.1	ex E1.1	0.97	0.49	48.7	0.48	3.02	1.45
E2	ex E2	2.99	0.49	15.8	1.47	5.76	8.47
E2.1	ex E2.1	0.64	0.49	10.8	0.32	6.81	2.15
E3	ex E3	2.32	0.49	10.8	1.14	6.81	7.77
E3.1	ex E3.1	0.62	0.49	10.8	0.31	6.81	2.09
E3.2	ex E3.2	0.45	0.49	10.8	0.22	6.81	1.51
E3.3	ex E3.3	0.25	0.49	10.8	0.12	6.81	0.83
E4	ex E4	0.29	0.49	8.5	0.14	7.48	1.08
E4.1	ex E4.1	0.24	0.49	9.2	0.12	7.25	0.85
E5	ex E5	2.40	0.49	12.3	1.18	6.45	7.63
E6	ex E6	1.62	0.44	14.8	0.71	5.94	4.19
Total EX Site	Total EX Site	44.74	0.46				120.04
OS1	OS1	0.92	0.44	6.3	0.40	8.28	3.32

RUNOFF SUMMARY TABLE

DIRECT RUNOFF

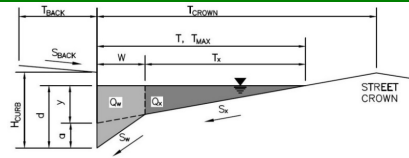
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)	C5	C100	% IMPERVIOUSNESS
F1	F1	2.39	3.55	10.58	0.4	0.66	49.9%
F2	F2	1.97	3.54	10.06	0.43	0.676	53.1%
F3	F3	0.83	0.97	4.08	0.25	0.576	31.9%
F4	F4	14.92	0.80	51.87	0.01	0.435	2.0%
E1	E1	11.83	30.18	60.55	0.77	0.853	90.0%
E1.1	E1.1	0.97	4.04	7.68	0.85	0.894	100.0%
E2	E2	2.99	7.26	14.56	0.77	0.853	90.0%
E2.1	E2.1	0.64	2.66	5.05	0.85	0.894	99.9%
E3	E3	2.32	8.69	17.44	0.77	0.853	90.0%
E3.1	E3.1	0.62	2.59	4.92	0.86	0.894	100.1%
E3.2	E3.2	0.45	1.88	3.57	0.86	0.894	100.1%
E3.3	E3.3	0.25	1.03	1.95	0.86	0.894	100.1%
E4	E4	0.29	1.21	2.31	0.85	0.894	99.9%
E4.1	E4.1	0.24	0.99	1.88	0.85	0.894	100.0%
E5	E5	2.40	3.65	11.64	0.37	0.652	41.0%
E6	E6	1.62	6.76	12.81	0.86	0.896	100.0%
Total PR Site	Total PR Site	44.74	54.72	220.96	0.46	0.694	54.3%
F1	ex F1	2.39	0.08	5.12	0.01	0.435	2.0%
F2	ex F2	1.97	0.11	6.85	0.01	0.435	2.0%
F3	ex F3	0.83	0.04	2.87	0.01	0.435	2.0%
F4	ex F4	14.92	0.49	32.10	0.01	0.435	2.0%
E1	ex E1	11.83	2.01	35.07	0.05	0.492	2.0%
E1.1	ex E1.1	0.97	0.08	1.45	0.05	0.492	2.0%
E2	ex E2	2.99	0.49	8.47	0.05	0.492	2.0%
E2.1	ex E2.1	0.64	0.12	2.15	0.05	0.492	2.0%
E3	ex E3	2.32	0.45	7.77	0.05	0.492	2.0%
E3.1	ex E3.1	0.62	0.12	2.09	0.05	0.492	2.0%
E3.2	ex E3.2	0.45	0.09	1.51	0.05	0.492	2.0%
E3.3	ex E3.3	0.25	0.05	0.83	0.05	0.492	2.0%
E4	ex E4	0.29	0.06	1.08	0.05	0.492	2.0%
E4.1	ex E4.1	0.24	0.05	0.85	0.05	0.492	2.0%
E5	ex E5	2.40	0.44	7.63	0.05	0.492	2.0%
E6	ex E6	1.62	0.06	4.19	0.01	0.435	2.0%
Total EX Site	Total EX Site	44.74	6.62	120.04	0.03	0.465	2.0%
OSI	OSI	0.92	0.05	3.32	0.01	0.435	2.0%

CONTRIBUTING AREAS TO POND E		
BASIN	AREA	% IMPERVIOUS
E1	515409	90.0%
E1.1	42427	100.0%
E2	130158	90.0%
E2.1	27905	100.0%
E3	101014	90.0%
E3.1	27200	100.0%
E3.2	19708	100.0%
E3.3	10767	100.0%
E4	12753	100.0%
E4.1	10407	100.0%
E5	104691	41.0%
E6	70617	100.0%
	TOTAL AREA	COMPOSITE % IMPERVIOUS
	1073056.4	87.3%
Acre Conversion	24.63	ac

CONTRIBUTING AREAS TO POND F		
BASIN	AREA	% IMPERVIOUS
F1	104062	49.9%
F2	85823	53.1%
F3	36012	31.9%
	TOTAL AREA	COMPOSITE % IMPERVIOUS
	225897	48.2%
Acre Conversion	5.19	ac

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET F1****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	27.0	ft
W	=	2.00	ft
S_X	=	0.020	ft/ft
S_W	=	0.083	ft/ft
S_O	=	0.000	ft/ft
n_{STREET}	=	0.018	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	17.0	27.0	ft
d_{MAX}	4.2	6.1	inches

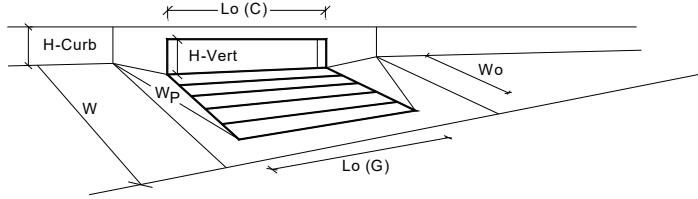
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow}	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

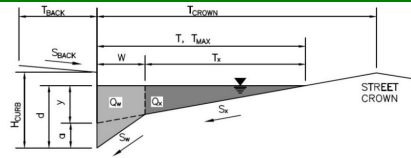
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type = CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		a _{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	4	4	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.2	6.1	inches
Grate Information		MINOR		MAJOR	
Length of a Unit Grate		L _o (G) =	N/A	N/A	feet
Width of a Unit Grate		W _o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A _{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C _f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C _w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C _o (G) =	N/A	N/A	
Curb Opening Information		MINOR		MAJOR	
Length of a Unit Curb Opening		L _o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H _{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H _{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W _p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C _f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C _w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C _o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR		MAJOR	
Depth for Grate Midwidth		d _{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d _{Curb} =	0.18	0.34	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF _{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF _{Curb} =	0.65	0.79	
Combination Inlet Performance Reduction Factor for Long Inlets		RF _{Combination} =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)		MINOR		MAJOR	
		Q _s =	3.6	11.1	cfs
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		Q _{PEAK REQUIRED} =	3.6	10.6	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET F2****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	27.0	ft
W	=	2.00	ft
S_X	=	0.020	ft/ft
S_W	=	0.083	ft/ft
S_O	=	0.000	ft/ft
n_{STREET}	=	0.018	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	=	17.0	27.0
d_{MAX}	=	4.0	6.0
		☐	☐

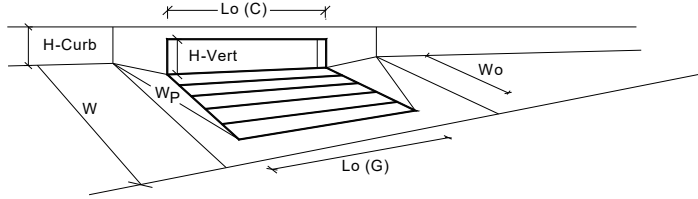
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow}	=	SUMP	SUMP
			cfs

INLET IN A SUMP OR SAG LOCATION

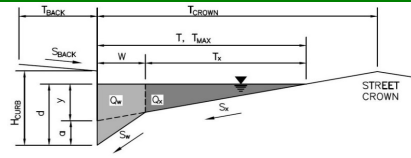
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type = CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	4	4	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.0	6.0	inches
Grate Information		MINOR		MAJOR	
Length of a Unit Grate		$L_o (G)$ =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		$C_f (G)$ =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		$C_w (G)$ =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		$C_o (G)$ =	N/A	N/A	
Curb Opening Information		MINOR		MAJOR	
Length of a Unit Curb Opening		$L_o (C)$ =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		$C_f (C)$ =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		$C_w (C)$ =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		$C_o (C)$ =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR		MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.17	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.64	0.79	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)		MINOR		MAJOR	
		Q_s =	3.0	10.6	cfs
WARNING: Inlet Capacity < Q Peak for Minor Storm		$Q_{PEAK REQUIRED}$ =	3.5	10.1	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E1.1****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} =$	5.0	ft
$S_{BACK} =$	0.020	ft/ft
$n_{BACK} =$	0.018	

$H_{CURB} =$	6.00	inches
$T_{CROWN} =$	20.0	ft
$W =$	2.00	ft
$S_x =$	0.030	ft/ft
$S_w =$	0.083	ft/ft
$S_o =$	0.000	ft/ft
$n_{STREET} =$	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
$T_{MAX} =$	10.0	20.0	ft
$d_{MAX} =$	5.0	6.0	inches
	☐	☐	

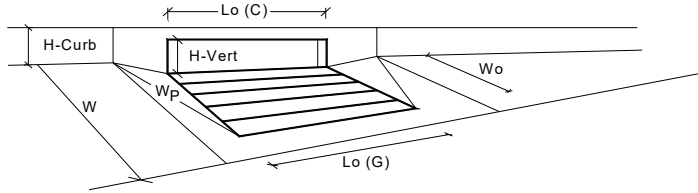
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
$Q_{allow} =$	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

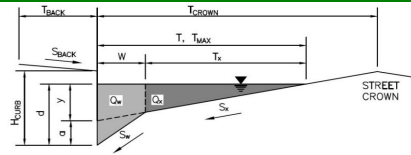
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a _{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.9	6.0	inches
Grate Information		MINOR		MAJOR	
Length of a Unit Grate		L _o (G) =	N/A	N/A	feet
Width of a Unit Grate		W _o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A _{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C _f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C _w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C _o (G) =	N/A	N/A	
Curb Opening Information		MINOR		MAJOR	
Length of a Unit Curb Opening		L _o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H _{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H _{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W _p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C _f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C _w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C _o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR		MAJOR	
Depth for Grate Midwidth		d _{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d _{Curb} =	0.24	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF _{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF _{Curb} =	0.86	0.93	
Combination Inlet Performance Reduction Factor for Long Inlets		RF _{Combination} =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)		MINOR		MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		Q _s =	4.6	8.3	cfs
		Q _{PEAK REQUIRED} =	4.0	7.7	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E2.1****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	20.0	ft
W	=	2.00	ft
S_x	=	0.030	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.000	ft/ft
n_{STREET}	=	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	10.0	20.0	ft
d_{MAX}	4.3	6.5	inches

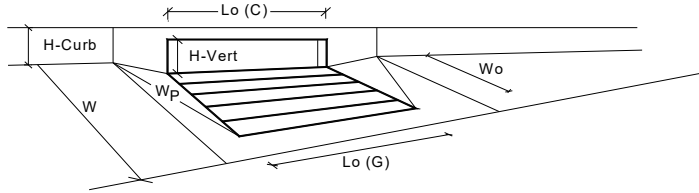
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow}	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

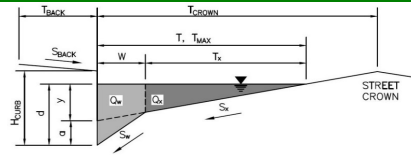
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a _{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.3	6.0	inches
Grate Information			MINOR	MAJOR	☒ Override Depths
Length of a Unit Grate		L _o (G) =	N/A	N/A	feet
Width of a Unit Grate		W _o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A _{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C _f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C _w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C _o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L _o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H _{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H _{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W _p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C _f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C _w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C _o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d _{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d _{Curb} =	0.19	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF _{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF _{Curb} =	0.81	0.93	
Combination Inlet Performance Reduction Factor for Long Inlets		RF _{Combination} =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		Q _s =	3.2	8.3	cfs
		Q _{PEAK REQUIRED} =	2.7	5.1	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E4****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	20.0	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.020	ft/ft
n_{STREET}	=	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	10.0	20.0	ft
d_{MAX}	4.5	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

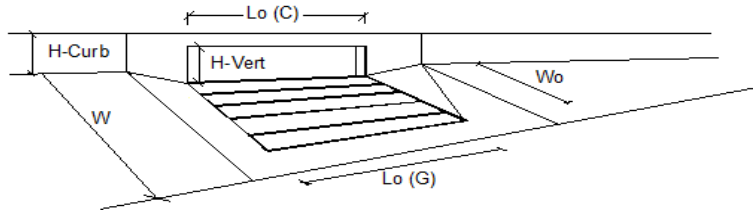
	Minor Storm	Major Storm	
Q_{allow}	4.4	16.2	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.21 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.31 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

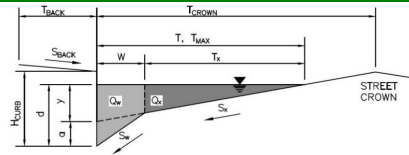
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		N_o =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$					
Total Inlet Interception Capacity		Q =	1.2	2.3	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_o =	0.0	0.0	cfs
Capture Percentage = Q_i/Q_o		$C\%$ =	100	100	%

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E4.1****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	20.0	ft
W	=	2.00	ft
S_X	=	0.020	ft/ft
S_W	=	0.083	ft/ft
S_O	=	0.030	ft/ft
n_{STREET}	=	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	10.0	20.0	ft
d_{MAX}	5.0	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

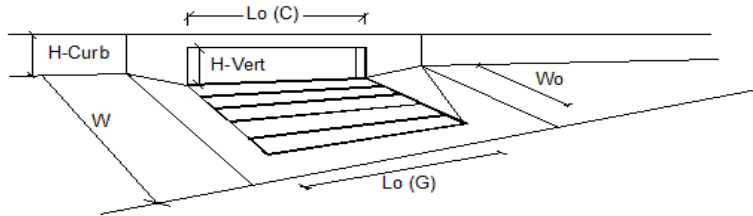
	Minor Storm	Major Storm	
Q_{allow}	5.4	14.4	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.99 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.88 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

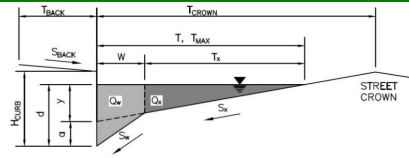
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		N_o =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		$C_f (G)$ =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_f (C)$ =	0.10	0.10	
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$					
Total Inlet Interception Capacity		Q =	1.0	1.9	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_s =	0.0	0.0	cfs
Capture Percentage = Q_i/Q_o		$C\%$ =	100	100	%

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E3.1****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	20.0	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.000	ft/ft
n_{STREET}	=	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Check boxes are not applicable in SUMP conditions

	Minor Storm	Major Storm	
T_{MAX}	10.0	20.0	ft
d_{MAX}	5.0	6.0	inches
	☐	☐	

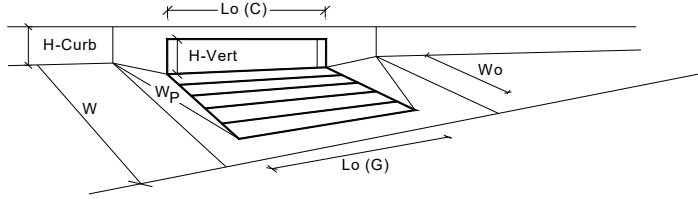
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow}	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

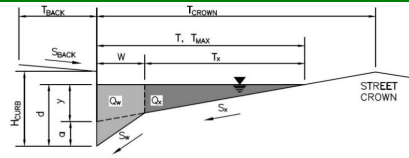
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a _{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.5	6.0	inches
Grate Information			MINOR	MAJOR	☒ Override Depths
Length of a Unit Grate		L _o (G) =	N/A	N/A	feet
Width of a Unit Grate		W _o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A _{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C _f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C _w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C _o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L _o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H _{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H _{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W _p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C _f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C _w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C _o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d _{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d _{Curb} =	0.21	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF _{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF _{Curb} =	0.83	0.93	
Combination Inlet Performance Reduction Factor for Long Inlets		RF _{Combination} =	N/A	N/A	
Total Inlet Interception Capacity (assumes clogged condition)			MINOR	MAJOR	
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		Q _s =	3.6	8.3	cfs
		Q _{PEAK REQUIRED} =	2.6	4.9	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E3.3****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	20.0	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_y	=	0.083	ft/ft
S_o	=	0.030	ft/ft
n_{STREET}	=	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	10.0	20.0	ft
d_{MAX}	5.0	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

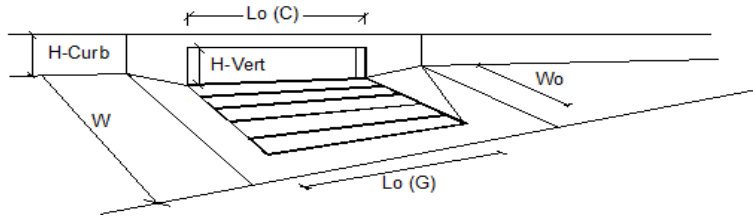
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow}	5.4	14.4	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.03 cfs on sheet 'Inlet Management'**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.95 cfs on sheet 'Inlet Management'**

INLET ON A CONTINUOUS GRADE

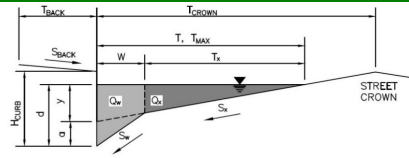
MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a _{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L _o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W _o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C _f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C _f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity					
Total Inlet Interception Capacity		Q =	1.0	2.0	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q _s =	0.0	0.0	cfs
Capture Percentage = Q _i /Q _a		C% =	100	100	%

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **PRAIRIE HAWK DR PHASE 1**Inlet ID: **INLET E3.2****Gutter Geometry:**

Maximum Allowable Width for Spread Behind Curb

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line

Distance from Curb Face to Street Crown

Gutter Width

Street Transverse Slope

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)

Street Longitudinal Slope - Enter 0 for sump condition

Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK}	=	5.0	ft
S_{BACK}	=	0.020	ft/ft
n_{BACK}	=	0.018	

H_{CURB}	=	6.00	inches
T_{CROWN}	=	20.0	ft
W	=	2.00	ft
S_x	=	0.020	ft/ft
S_w	=	0.083	ft/ft
S_o	=	0.030	ft/ft
n_{STREET}	=	0.016	

Max. Allowable Spread for Minor & Major Storm

Max. Allowable Depth at Gutter Flowline for Minor & Major Storm

Allow Flow Depth at Street Crown (check box for yes, leave blank for no)

	Minor Storm	Major Storm	
T_{MAX}	10.0	20.0	ft
d_{MAX}	5.0	6.0	inches
	☐	☐	

MINOR STORM Allowable Capacity is based on Spread Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

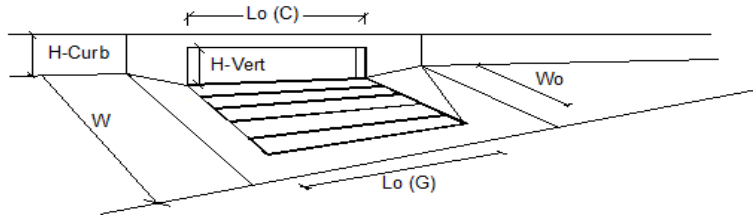
	Minor Storm	Major Storm	
Q_{allow}	5.4	14.4	cfs

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.88 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.57 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		N_o =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		$C_f (G)$ =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		$C_f (C)$ =	0.10	0.10	
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$					
Total Inlet Interception Capacity		Q =	1.9	3.6	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)		Q_o =	0.0	0.0	cfs
Capture Percentage = Q_o/Q_o		$C\%$ =	100	100	%

INLET MANAGEMENT

Worksheet Protected

INLET NAME	INLET F1	INLET F2	INLET E1.1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT**User-Defined Design Flows**

Minor Q_{Known} (cfs)	3.6	3.5	4.0
Major Q_{Known} (cfs)	10.6	10.1	7.7

Bypass (Carry-Over) Flow from Upstream [Inlets must be organized from upstream \(left\) to downstream \(right\) in order for bypass flows to be linked.](#)

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	3.6	3.5	4.0
Major Total Design Peak Flow, Q (cfs)	10.6	10.1	7.7
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

INLET MANAGEMENT

Worksheet Protected

INLET NAME	INLET E2.1	INLET E4	INLET E4.1
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT**User-Defined Design Flows**

Minor Q_{Known} (cfs)	2.7	1.2	1.0
Major Q_{Known} (cfs)	5.1	2.3	1.9

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	2.7	1.2	1.0
Major Total Design Peak Flow, Q (cfs)	5.1	2.3	1.9
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0

INLET MANAGEMENT

Worksheet Protected

INLET NAME	INLET E3.1	INLET E3.3	INLET E3.2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT**User-Defined Design Flows**

Minor Q_{Known} (cfs)	2.6	1.0	1.9
Major Q_{Known} (cfs)	4.9	2.0	3.6

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	2.6	1.0	1.9
Major Total Design Peak Flow, Q (cfs)	4.9	2.0	3.6
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0

Channel Report

E1 Temporary Swale

Trapezoidal

Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.10
Invert Elev (ft)	= 1.00
Slope (%)	= 2.00
N-Value	= 0.035

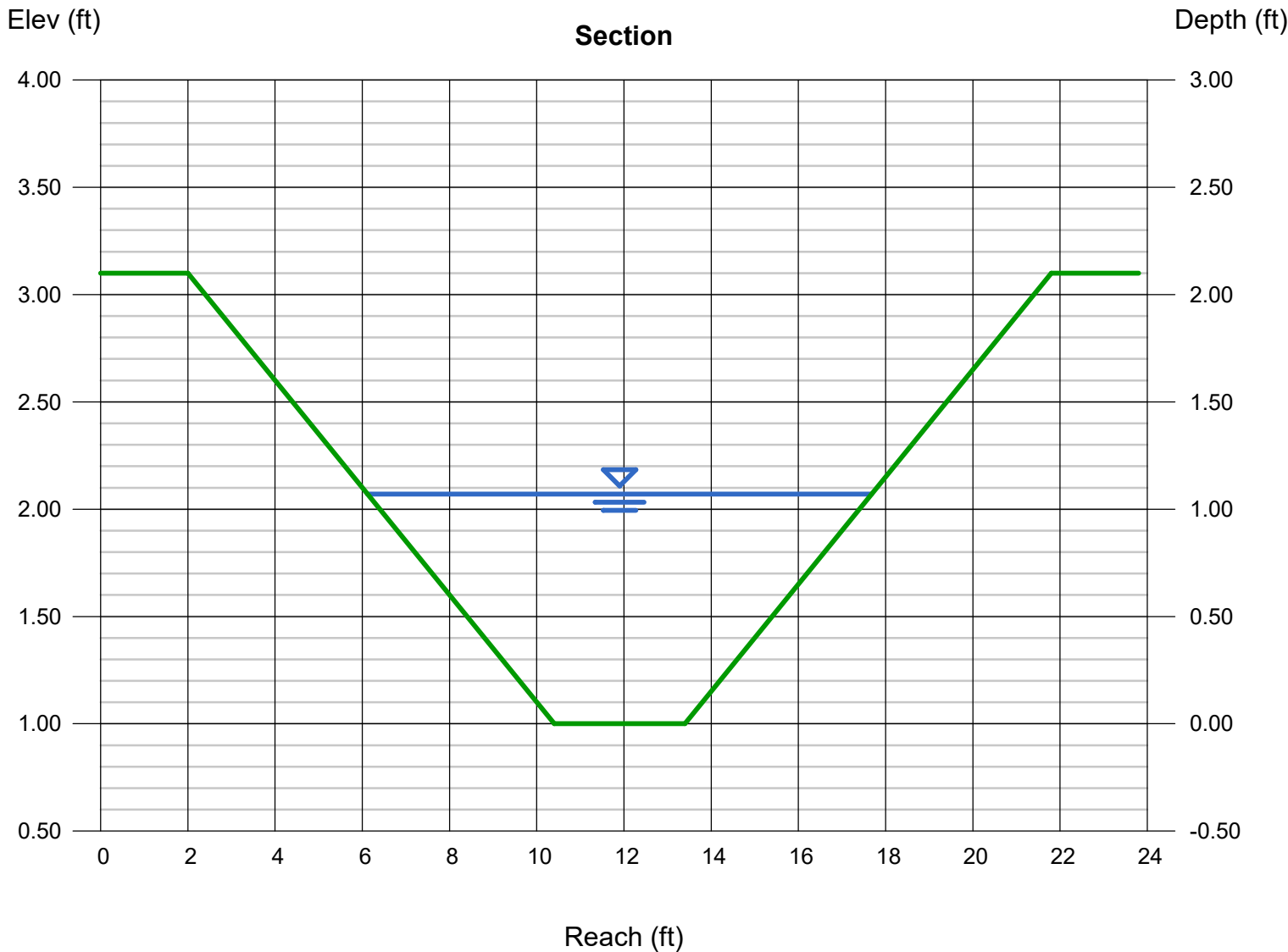
Highlighted

Depth (ft)	= 1.07
Q (cfs)	= 35.07
Area (sqft)	= 7.79
Velocity (ft/s)	= 4.50
Wetted Perim (ft)	= 11.82
Crit Depth, Yc (ft)	= 1.06
Top Width (ft)	= 11.56
EGL (ft)	= 1.39

Calculations

Compute by:	Known Q
Known Q (cfs)	= 35.07

This swale was sized for the existing condition (interim) flows. Proposed flows will be hard-piped into this system from the future development of Basin E1.



Channel Report

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

Tuesday, Mar 14 2023

E2 Temporary Swale

Trapezoidal

Bottom Width (ft) = 3.00
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 2.10
Invert Elev (ft) = 1.00
Slope (%) = 2.00
N-Value = 0.035

Highlighted

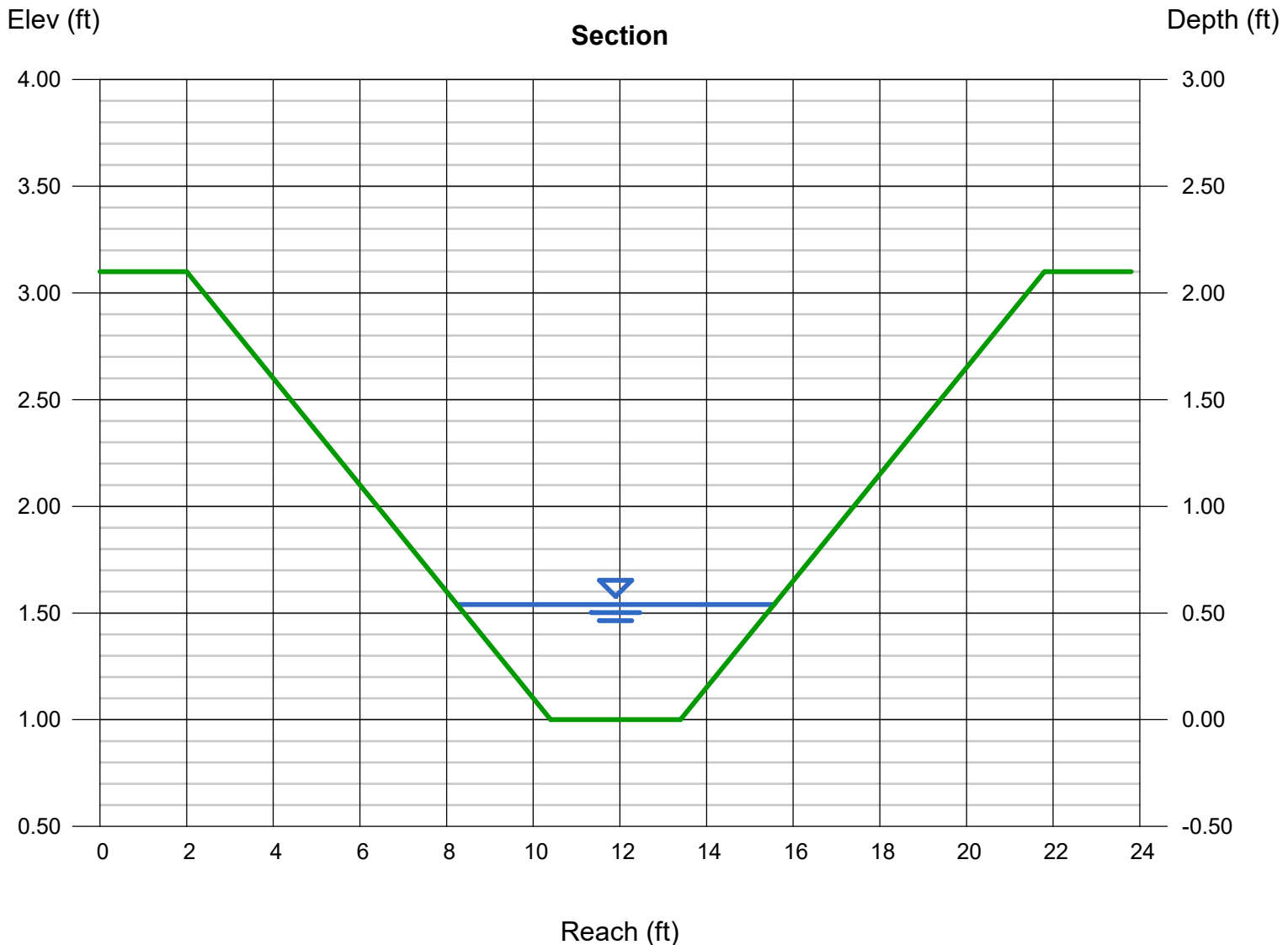
Depth (ft) = 0.54
Q (cfs) = 8.470
Area (sqft) = 2.79
Velocity (ft/s) = 3.04
Wetted Perim (ft) = 7.45
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 7.32
EGL (ft) = 0.68

Calculations

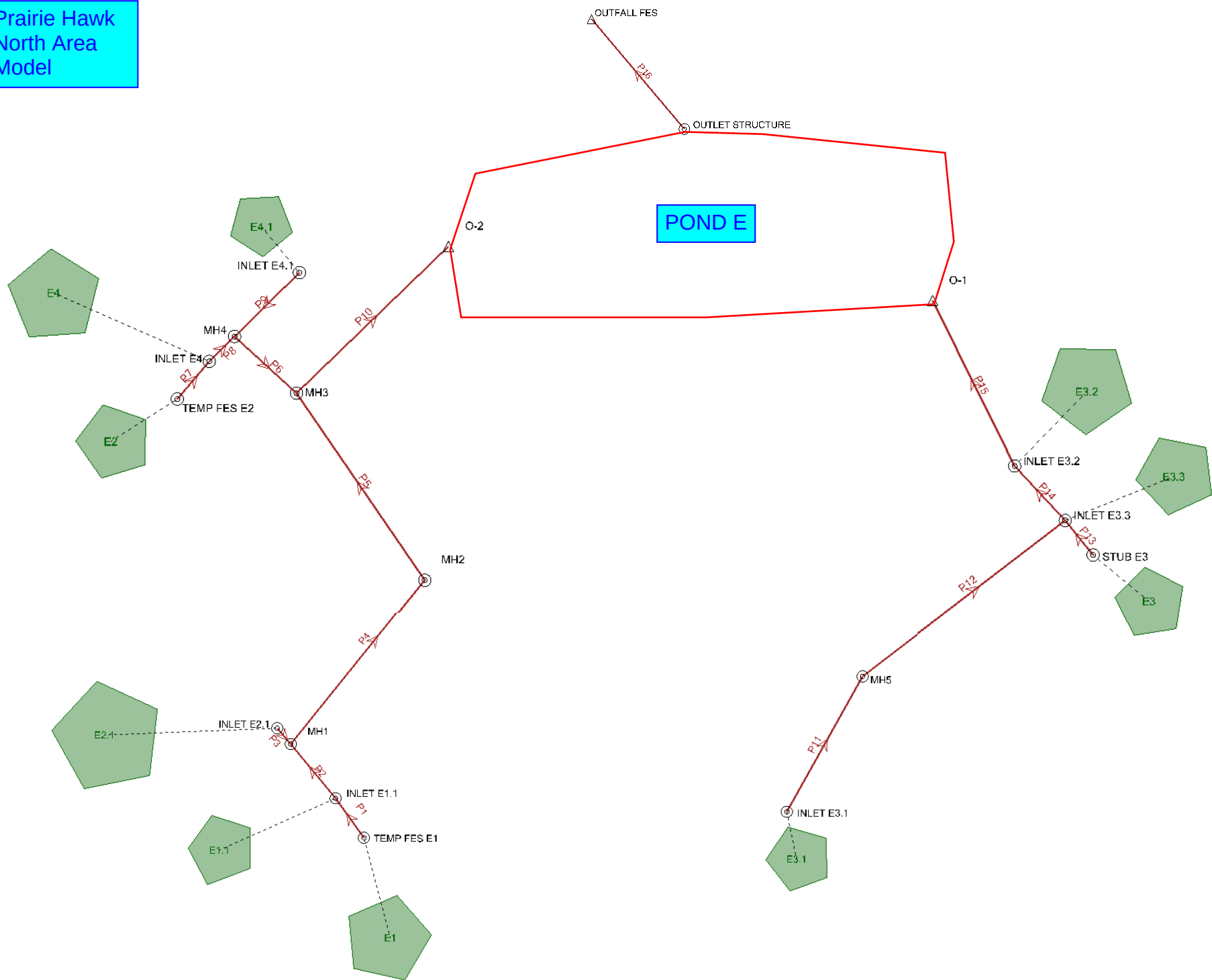
Compute by:
Known Q (cfs)

Known Q
= 8.47

This swale was sized for the existing condition (interim) flows. Proposed flows will be hard-piped into this system from the future development of Basin E2.



Prairie Hawk
North Area
Model



5-YEAR

Conduit Table - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P1	TEMP FES E1	6,286.65	INLET E1.1	6,286.21	35.1	0.013	36.0	0.013	30.29	10.02	6,288.43	6,288.22
P2	INLET E1.1	6,285.96	MH1	6,285.49	37.5	0.013	36.0	0.013	32.96	10.24	6,287.82	6,288.00
P3	MH1	6,285.01	INLET E2.1	6,285.19	11.1	-0.016	24.0	0.013	2.66	0.85	6,288.00	6,288.00
P4	MH1	6,284.76	MH2	6,280.85	142.0	0.028	36.0	0.013	34.70	13.85	6,286.68	6,283.84
P5	MH2	6,280.61	MH3	6,278.88	109.2	0.016	36.0	0.013	34.51	11.28	6,282.52	6,281.95
P6	MH4	6,280.07	MH3	6,278.88	40.4	0.029	36.0	0.013	8.68	9.54	6,281.93	6,281.95
P7	TEMP FES E2	6,281.99	INLET E4	6,281.57	32.6	0.013	36.0	0.013	7.28	6.77	6,283.62	6,283.64
P8	INLET E4	6,281.33	MH4	6,281.07	17.1	0.015	36.0	0.013	8.04	7.37	6,283.24	6,283.25
P9	MH4	6,281.57	INLET E4.1	6,282.26	43.8	-0.016	24.0	0.013	1.00	4.24	6,283.24	6,283.25
P10	MH3	6,278.53	O-2	6,271.53	102.0	0.069	36.0	0.013	41.62	20.27	6,280.63	6,275.00
P11	INLET E3.1	6,286.65	MH5	6,284.76	74.9	0.025	24.0	0.013	2.61	6.65	6,287.21	6,285.47
P12	MH5	6,284.51	INLET E3.3	6,281.40	103.4	0.030	24.0	0.013	2.58	7.06	6,285.07	6,284.72
P13	STUB E3	6,283.34	INLET E3.3	6,282.39	28.7	0.033	24.0	0.013	8.73	10.40	6,284.63	6,284.72
P14	INLET E3.3	6,282.15	INLET E3.2	6,281.15	36.0	0.028	24.0	0.013	12.12	10.70	6,283.40	6,282.00
P15	INLET E3.2	6,279.10	O-1	6,270.70	89.8	0.093	24.0	0.013	13.93	17.22	6,280.44	6,275.00
P16	OUTLET STRUCTURE	6,268.02	OUTFALL FES	6,265.28	81.3	0.034	24.0	0.013	21.00	13.26	6,269.66	6,266.33

5-YEAR

Manhole Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Absolute Headloss (ft)	Hydraulic Grade Line (In) (ft)	Elevation (Invert) (ft)
INLET E1.1	6,291.80	True	6,291.80	32.96	6,287.82	0.40	6,288.22	6,285.49
INLET E2.1	6,292.23	True	6,292.23	2.66	6,288.00	0.40	6,288.40	6,285.01
INLET E3.1	6,293.45	True	6,293.45	2.61	6,287.21	0.40	6,287.61	6,286.65
INLET E3.2	6,288.36	True	6,288.36	13.93	6,280.44	0.40	6,280.84	6,279.10
INLET E3.3	6,288.05	True	6,288.05	12.12	6,283.40	1.32	6,284.72	6,281.14
INLET E4	6,286.04	True	6,286.04	8.04	6,283.24	0.40	6,283.64	6,281.33
INLET E4.1	6,285.82	True	6,285.82	1.00	6,283.24	0.40	6,283.64	6,282.26
MH1	6,291.97	True	6,291.97	34.70	6,286.68	1.32	6,288.00	6,284.76
MH2	6,291.12	True	6,291.12	34.51	6,282.52	1.32	6,283.84	6,280.61
MH3	6,287.73	True	6,287.73	41.62	6,280.63	1.32	6,281.95	6,278.53
MH4	6,286.01	True	6,286.01	8.68	6,281.93	1.32	6,283.25	6,280.07
MH5	6,292.54	True	6,292.54	2.58	6,285.07	0.40	6,285.47	6,284.51
OUTLET STRUCTURE	6,270.44	True	6,270.44	21.00	6,269.66	0.40	6,270.06	6,268.02
STUB E3	6,286.00	True	6,286.00	8.73	6,284.63	0.40	6,285.03	6,283.34
TEMP FES E1	6,289.00	True	6,289.00	30.29	6,288.43	0.40	6,288.83	6,286.65
TEMP FES E2	6,285.00	True	6,285.00	7.28	6,283.62	0.40	6,284.02	6,281.99

5-YEAR

Catchment Table - Time: 0.00 hours

ID	Label	Outflow Element	Area (User Defined) (acres)	Runoff Coefficient (Rational)	Time of Concentration (min)	Flow (Total Out) (cfs)
85	E1	TEMP FES E1	11.830	0.770	14.500	30.29
86	E1.1	INLET E1.1	0.970	0.850	5.000	4.03
88	E2	TEMP FES E2	2.990	0.770	16.100	7.28
87	E2.1	INLET E2.1	0.640	0.850	5.000	2.66
92	E3	STUB E3	2.320	0.770	5.000	8.73
91	E3.1	INLET E3.1	0.620	0.860	5.000	2.61
94	E3.2	INLET E3.2	0.450	0.860	5.000	1.89
93	E3.3	INLET E3.3	0.250	0.860	5.000	1.05
89	E4	INLET E4	0.290	0.850	5.000	1.21
90	E4.1	INLET E4.1	0.240	0.850	5.000	1.00

Outfall Table - Time: 0.00 hours

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
49	OUTFALL FES	6,267.65	True	6,265.28	Free Outfall	<None>	0.00	6,266.33	21.00	24" FES
127	O-1	6,273.12	True	6,270.70	User Defined Tailwater	<None>	6,275.00	6,275.00	13.87	FOREBAY 2
128	O-2	6,273.95	True	6,271.53	User Defined Tailwater	<None>	6,275.00	6,275.00	41.51	FOREBAY 1

100-yr

Conduit Table - Time: 0.00 hours

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P1	TEMP FES E1	6,286.65	INLET E1.1	6,286.21	35.1	0.013	36.0	0.013	60.79	8.60	6,289.78	6,289.49
P2	INLET E1.1	6,285.96	MH1	6,285.49	37.5	0.013	36.0	0.013	65.86	9.32	6,289.09	6,288.73
P3	MH1	6,285.01	INLET E2.1	6,285.19	11.1	-0.016	24.0	0.013	5.06	1.61	6,288.73	6,288.73
P4	MH1	6,284.76	MH2	6,280.85	142.0	0.028	36.0	0.013	69.15	16.52	6,287.41	6,284.57
P5	MH2	6,280.61	MH3	6,278.88	109.2	0.016	36.0	0.013	68.83	13.25	6,283.25	6,281.02
P6	MH4	6,280.07	MH3	6,278.88	40.4	0.029	36.0	0.013	17.28	11.67	6,281.40	6,279.75
P7	TEMP FES E2	6,281.99	INLET E4	6,281.57	32.6	0.013	36.0	0.013	14.62	8.28	6,283.21	6,283.01
P8	INLET E4	6,281.33	MH4	6,281.07	17.1	0.015	36.0	0.013	16.07	9.02	6,282.61	6,282.72
P9	MH4	6,281.57	INLET E4.1	6,282.26	43.8	-0.016	24.0	0.013	1.90	5.14	6,282.74	6,282.72
P10	MH3	6,275.54	O-2	6,271.51	102.0	0.040	36.0	0.013	83.02	19.80	6,278.34	6,275.00
P11	INLET E3.1	6,286.65	MH5	6,284.76	74.9	0.025	24.0	0.013	4.91	8.01	6,287.43	6,285.69
P12	MH5	6,284.51	INLET E3.3	6,281.40	103.4	0.030	24.0	0.013	4.87	8.50	6,285.29	6,285.20
P13	STUB E3	6,283.34	INLET E3.3	6,282.39	28.7	0.033	24.0	0.013	17.53	5.58	6,285.38	6,285.20
P14	INLET E3.3	6,282.15	INLET E3.2	6,281.14	36.0	0.028	24.0	0.013	23.96	12.76	6,283.88	6,282.43
P15	INLET E3.2	6,279.10	O-1	6,270.70	89.8	0.094	24.0	0.013	27.39	20.74	6,280.92	6,275.00
P16	OUTLET STRUCTURE	6,268.02	OUTFALL FES	6,265.28	81.3	0.034	24.0	0.013	21.00	13.26	6,269.66	6,266.33

100-yr

Manhole Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Rim) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Absolute Headloss (ft)	Hydraulic Grade Line (In) (ft)	Elevation (Invert) (ft)
INLET E1.1	6,291.80	True	6,291.80	65.86	6,289.09	0.40	6,289.49	6,285.49
INLET E2.1	6,292.23	True	6,292.23	5.06	6,288.73	0.40	6,289.13	6,285.01
INLET E3.1	6,293.45	True	6,293.45	4.91	6,287.43	0.40	6,287.83	6,286.65
INLET E3.2	6,288.36	True	6,288.36	27.39	6,280.92	0.40	6,281.32	6,279.10
INLET E3.3	6,288.05	True	6,288.05	23.96	6,283.88	1.32	6,285.20	6,281.14
INLET E4	6,286.04	True	6,286.04	16.07	6,282.61	0.40	6,283.01	6,281.33
INLET E4.1	6,285.82	True	6,285.82	1.90	6,282.74	0.40	6,283.14	6,282.26
MH1	6,291.97	True	6,291.97	69.15	6,287.41	1.32	6,288.73	6,284.76
MH2	6,291.12	True	6,291.12	68.83	6,283.25	1.32	6,284.57	6,280.61
MH3	6,287.73	True	6,287.73	83.02	6,278.34	1.32	6,279.66	6,278.53
MH4	6,286.01	True	6,286.01	17.28	6,281.40	1.32	6,282.72	6,280.07
MH5	6,292.54	True	6,292.54	4.87	6,285.29	0.40	6,285.69	6,284.51
OUTLET STRUCTURE	6,270.44	True	6,270.44	21.00	6,269.66	0.40	6,270.06	6,268.02
STUB E3	6,286.00	True	6,286.00	17.53	6,285.38	0.40	6,285.78	6,283.34
TEMP FES E1	6,289.00	True	6,289.00	60.79	6,289.00	0.40	6,289.40	6,286.65
TEMP FES E2	6,285.00	True	6,285.00	14.62	6,283.21	0.40	6,283.61	6,281.99

100-yr

Catchment Table - Time: 0.00 hours

ID	Label	Outflow Element	Area (User Defined) (acres)	Runoff Coefficient (Rational)	Time of Concentration (min)	Flow (Total Out) (cfs)
85	E1	TEMP FES E1	11.830	0.850	14.500	60.79
86	E1.1	INLET E1.1	0.970	0.890	5.000	7.67
88	E2	TEMP FES E2	2.990	0.850	16.100	14.62
87	E2.1	INLET E2.1	0.640	0.890	5.000	5.06
92	E3	STUB E3	2.320	0.850	5.000	17.53
91	E3.1	INLET E3.1	0.620	0.890	5.000	4.91
94	E3.2	INLET E3.2	0.450	0.890	5.000	3.56
93	E3.3	INLET E3.3	0.250	0.890	5.000	1.98
89	E4	INLET E4	0.290	0.890	5.000	2.29
90	E4.1	INLET E4.1	0.240	0.890	5.000	1.90

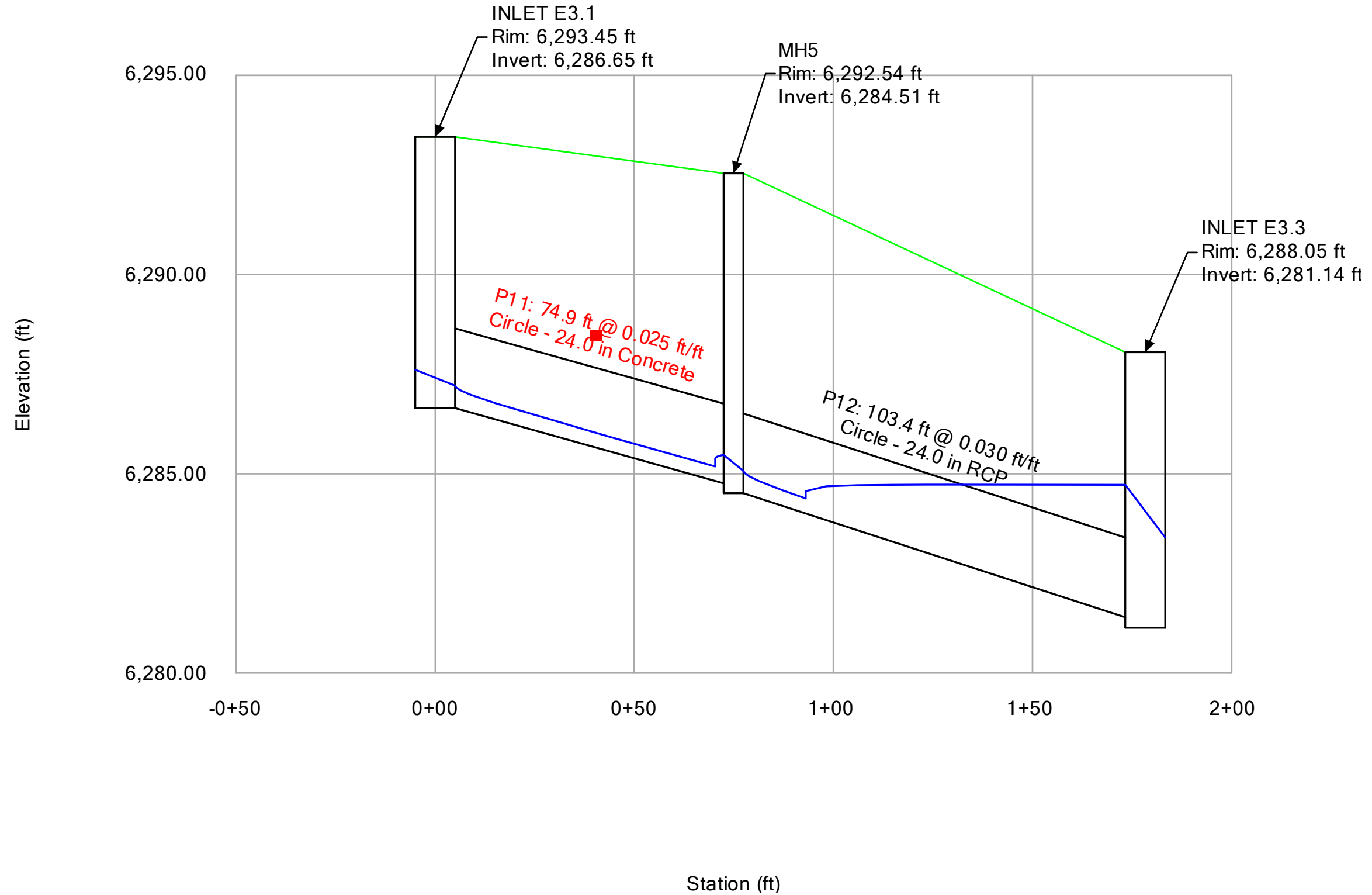
Outfall Table - Time: 0.00 hours

ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Boundary Element	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
49	OUTFALL FES	6,267.65	True	6,265.28	Free Outfall	<None>	0.00	6,266.33	21.00	24" FES
127	O-1	6,273.12	True	6,270.70	User Defined Tailwater	<None>	6,275.00	6,275.00	27.29	FOREBAY 2
128	O-2	6,273.95	True	6,271.53	User Defined Tailwater	<None>	6,275.00	6,275.00	82.81	FOREBAY 1

5-YEAR

Profile Report

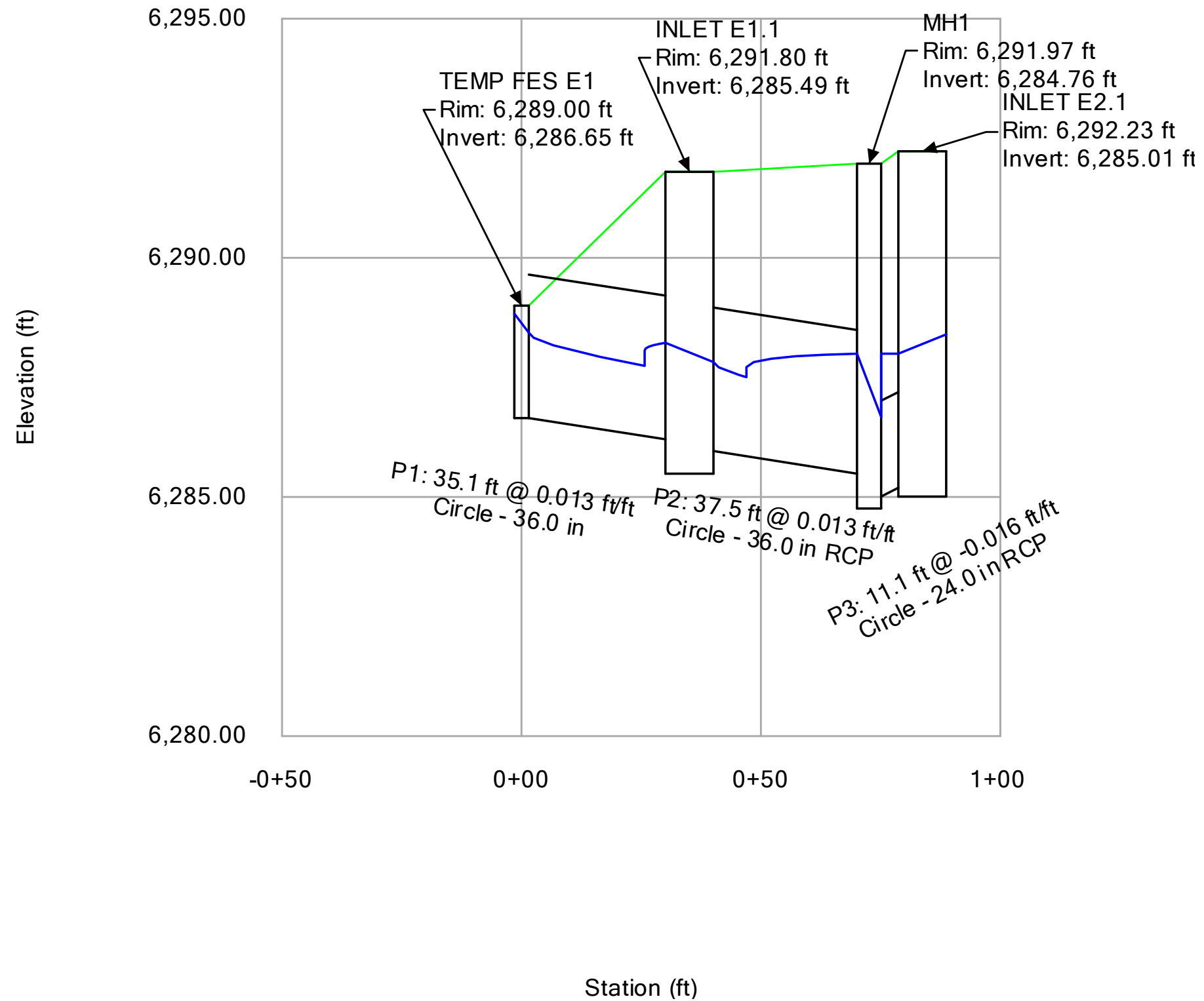
Engineering Profile - NE ROUNDABOUT STORM LATERAL 1 (Prairie Hawk North Phase 1.stsw)



5-YEAR

Profile Report

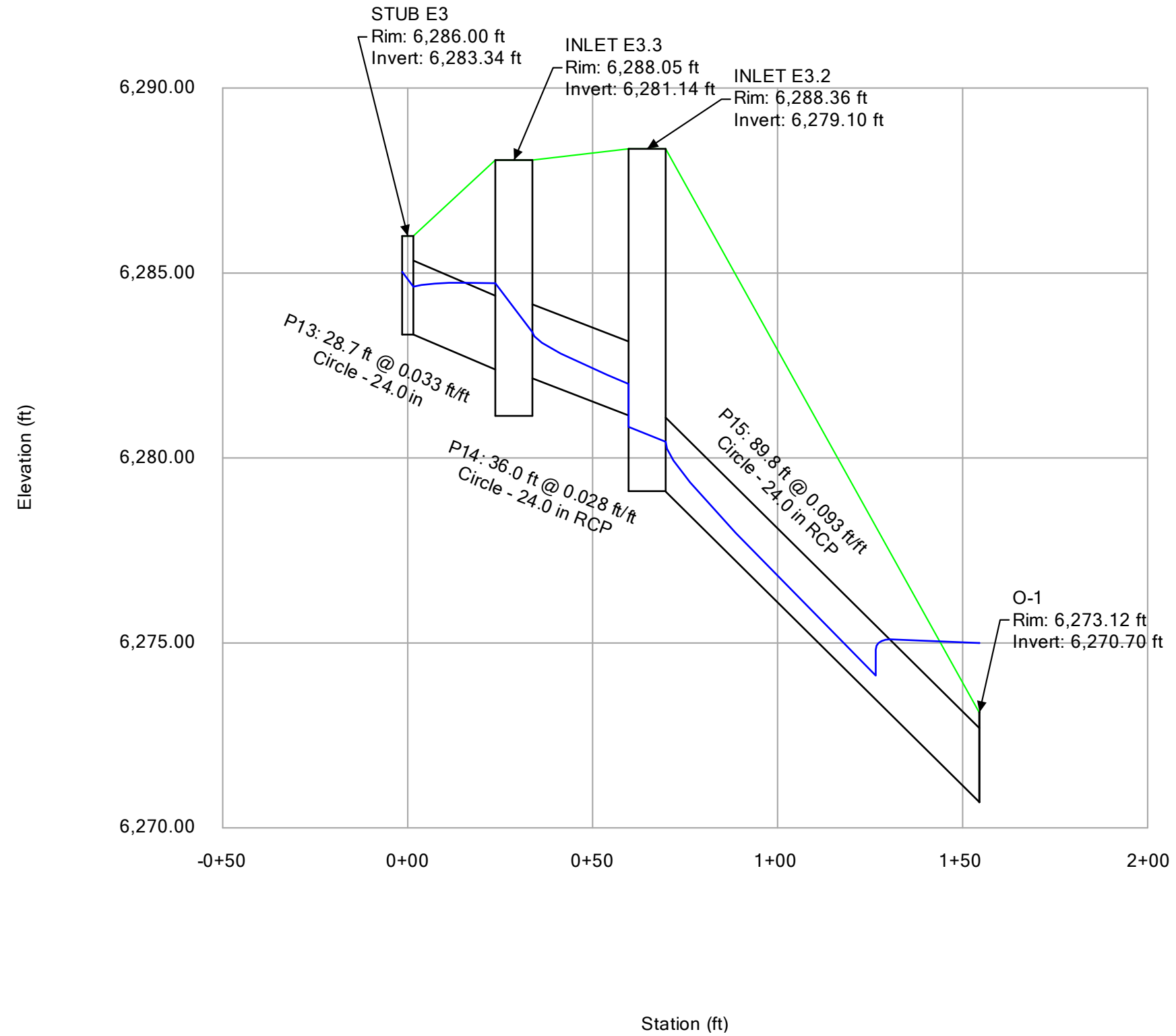
Engineering Profile - NW ROUNDABOUT STORM LATERAL 1 (Prairie Hawk North Phase 1.stsw)



5-YEAR

Profile Report

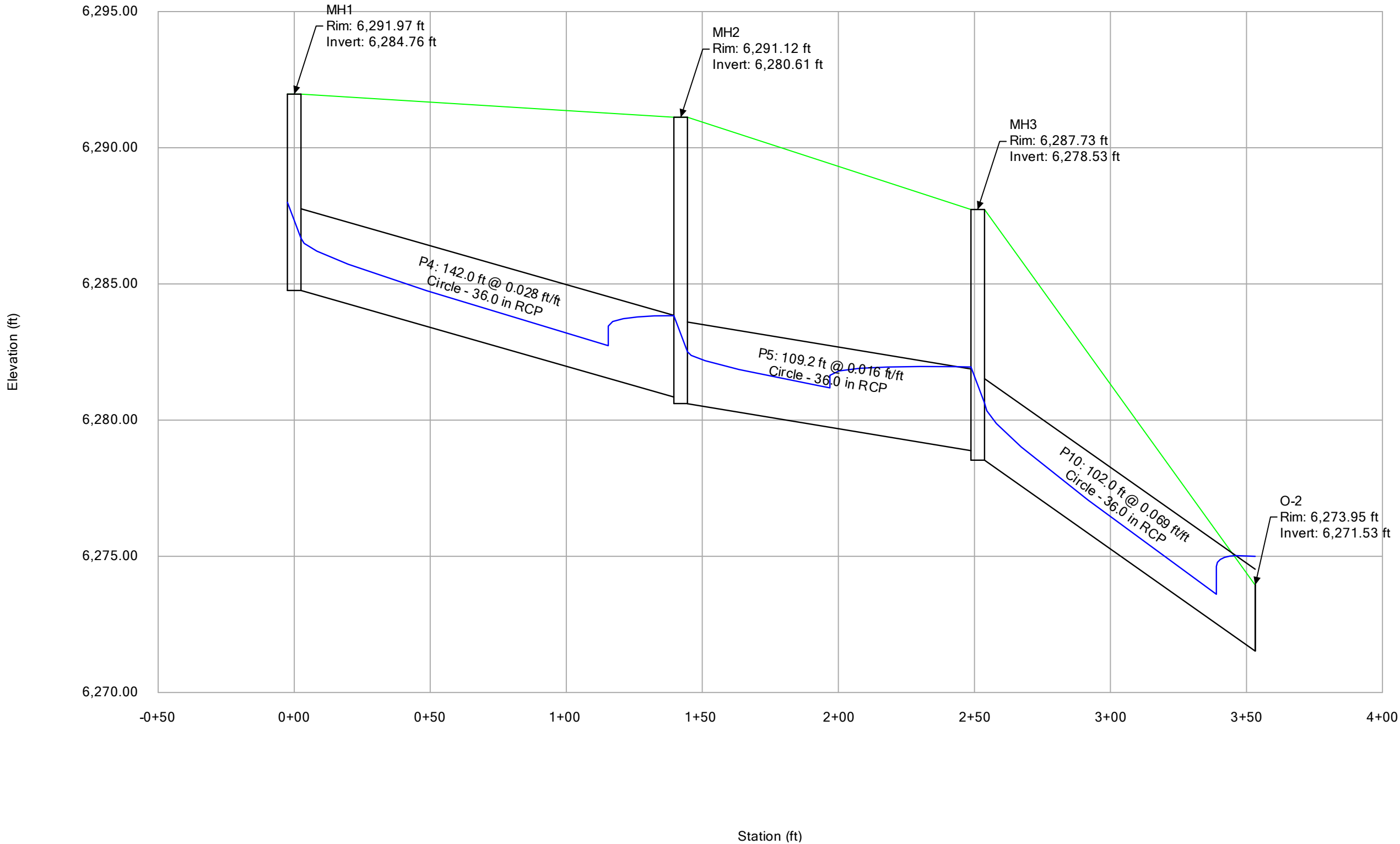
Engineering Profile - NE ROUNDABOUT STORM MAIN (Prairie Hawk North Phase 1.stsw)



5-YEAR

Profile Report

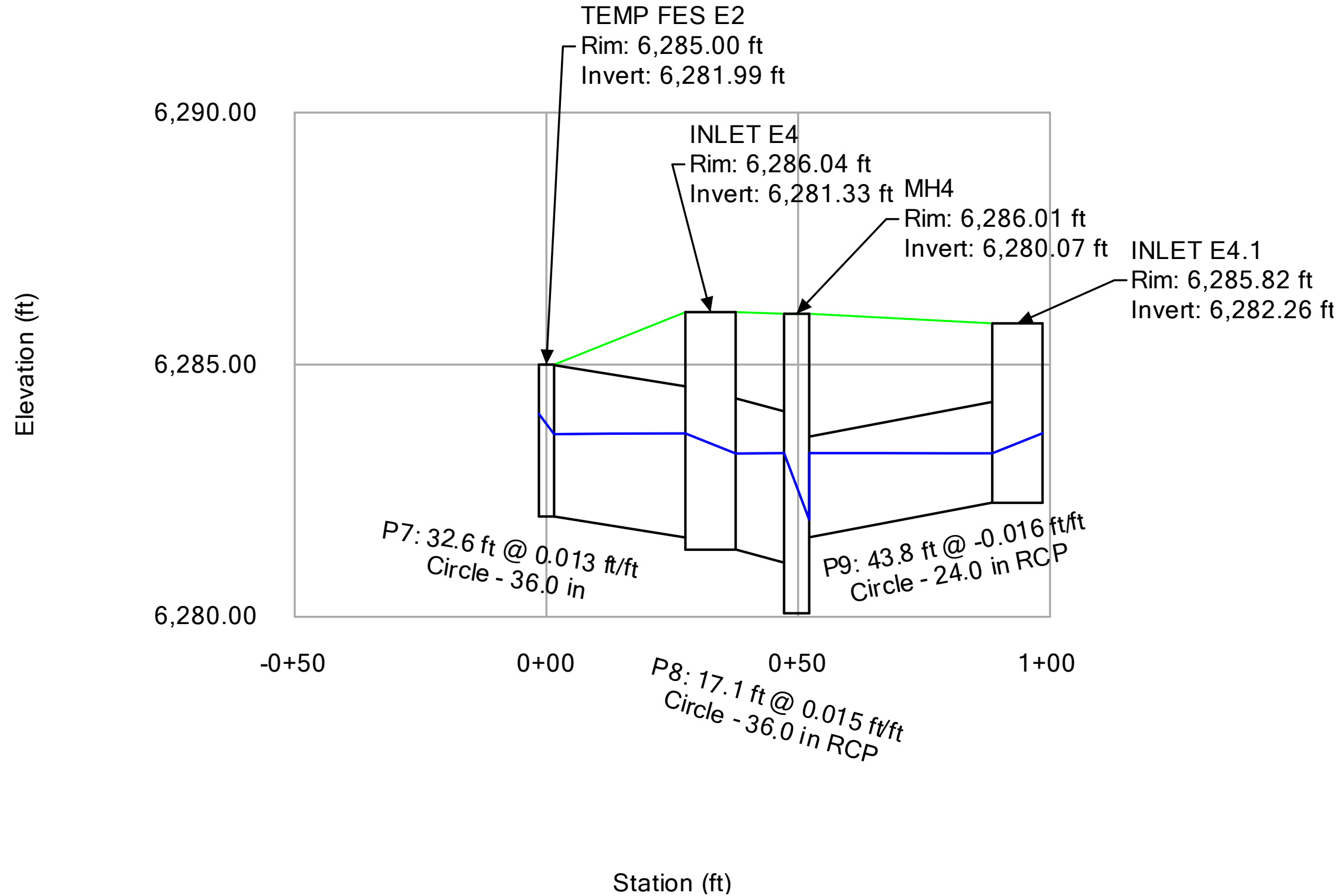
Engineering Profile - NW ROUNDABOUT STORM MAIN (Prairie Hawk North Phase 1.stsw)



5-YEAR

Profile Report

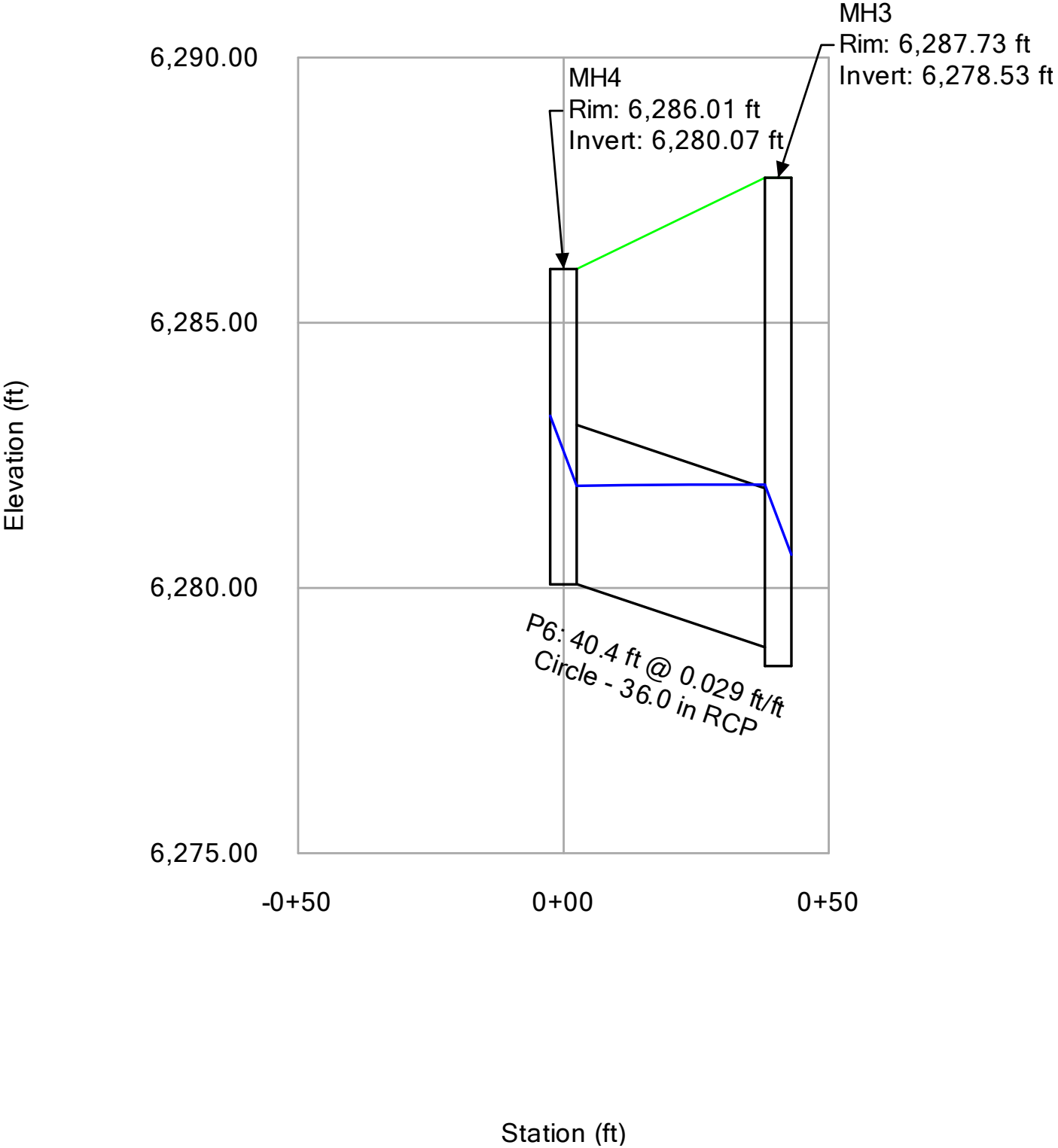
Engineering Profile - NW ROUNDABOUT STORM LATERAL 2 (Prairie Hawk North Phase 1.stsw)



5-YEAR

Profile Report

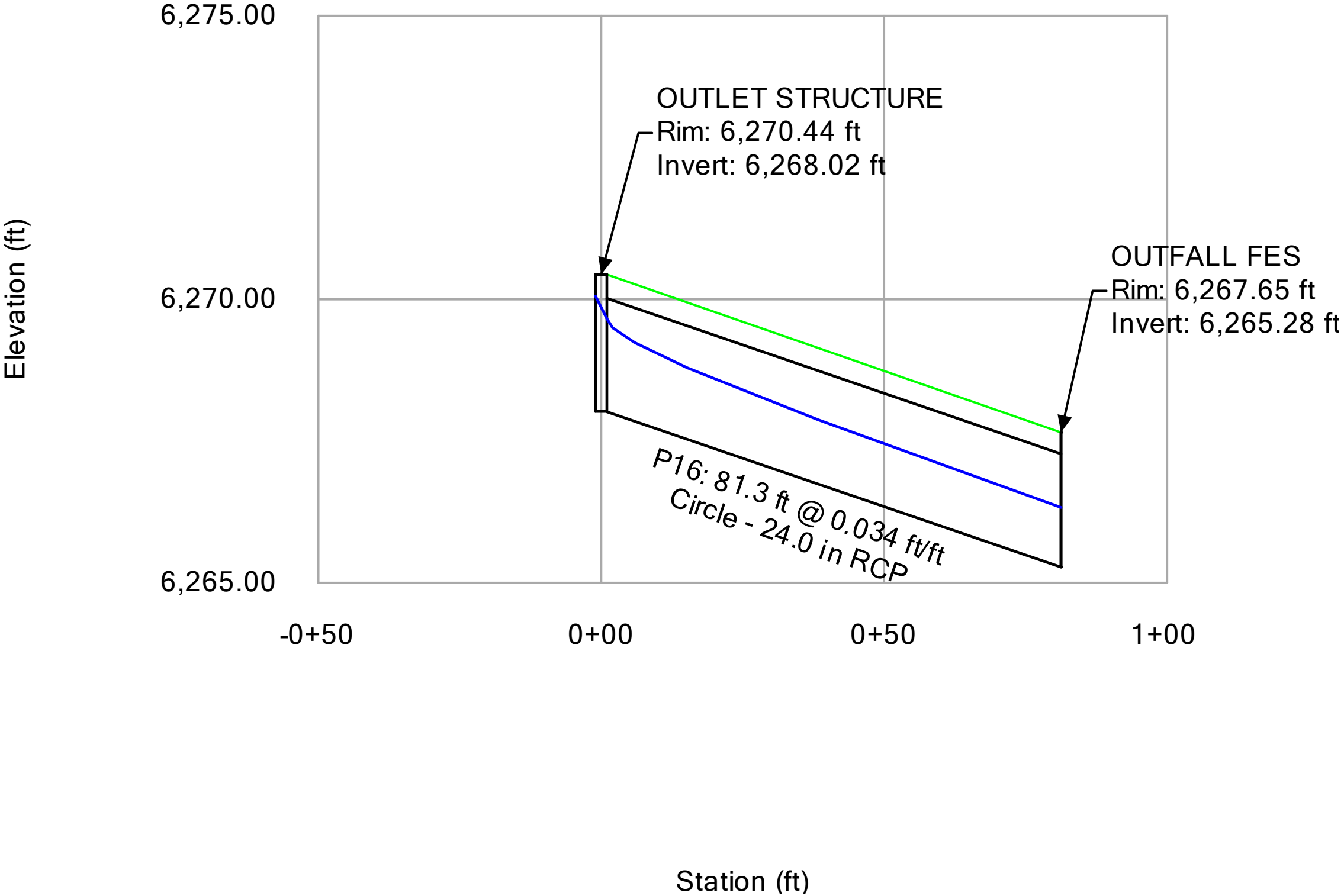
Engineering Profile - NW ROUNDABOUT STORM LATERAL 2 TO OUTFALL (Prairie Hawk North Phase 1.stsw)



5-YEAR

Profile Report

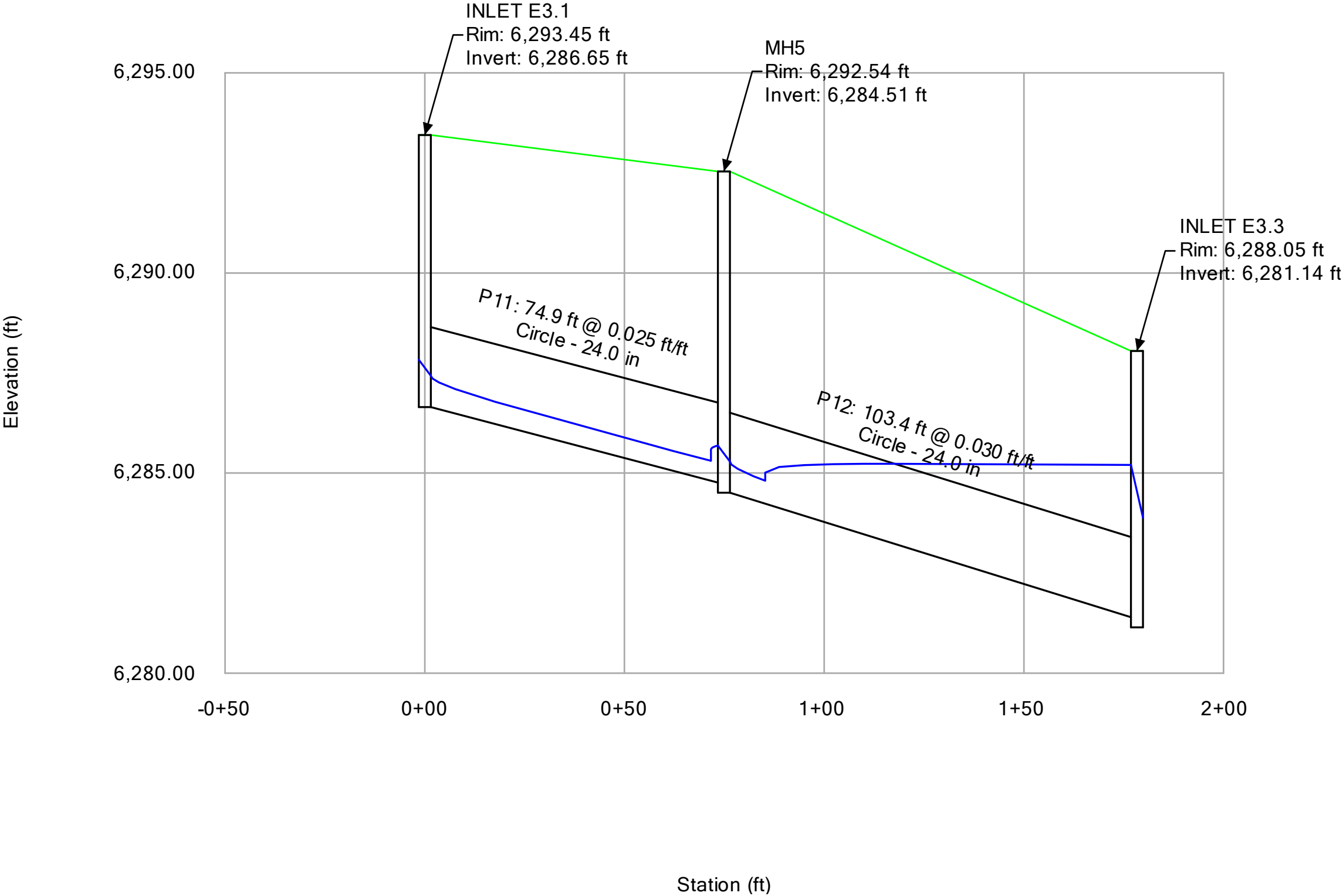
Engineering Profile - POND E OUTFALL (Prairie Hawk North Phase 1.stsw)



100-YEAR

Profile Report

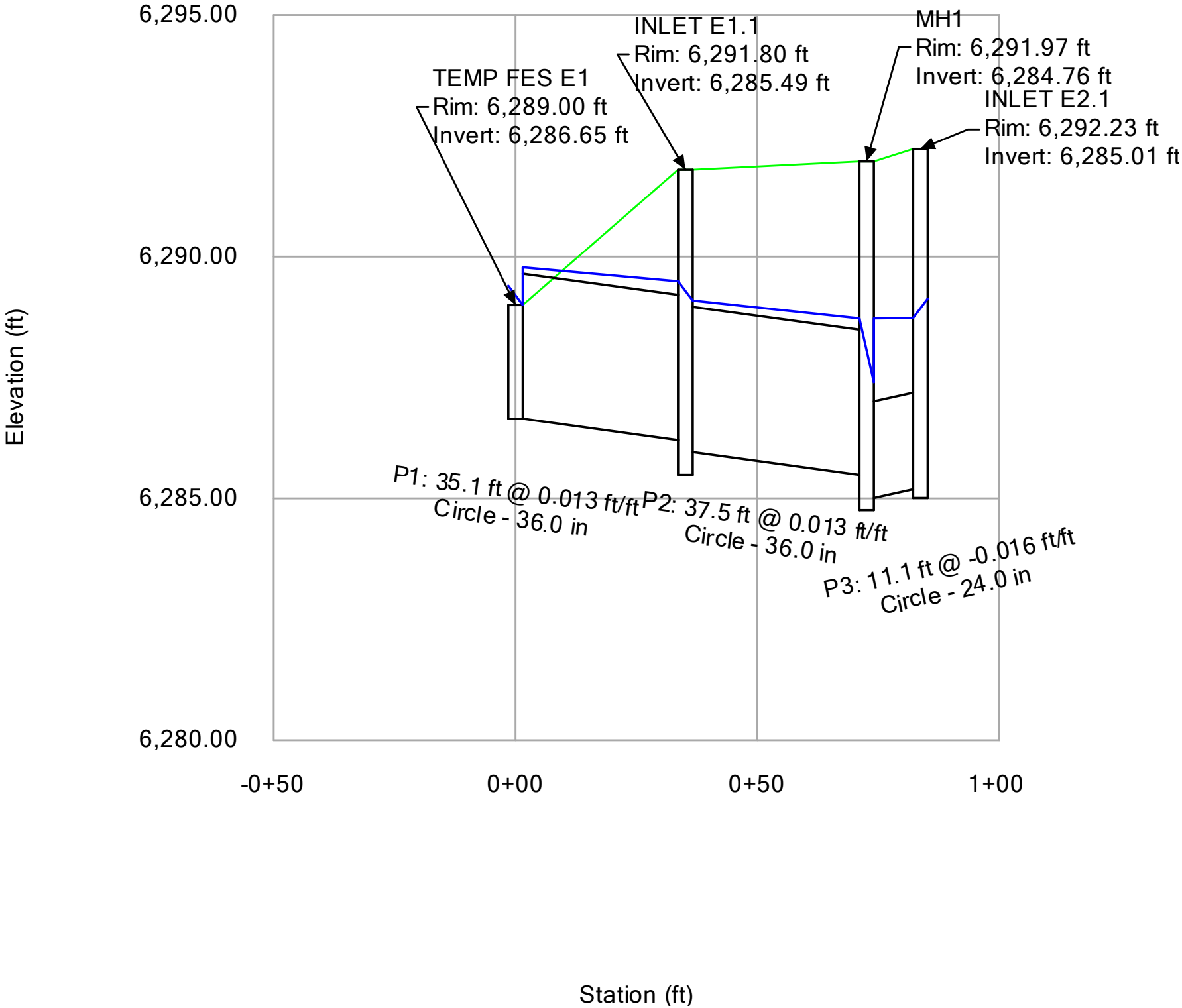
Engineering Profile - NE ROUNDABOUT STORM LATERAL 1 (Prairie Hawk North Phase 1.stsw)



100-YEAR

Profile Report

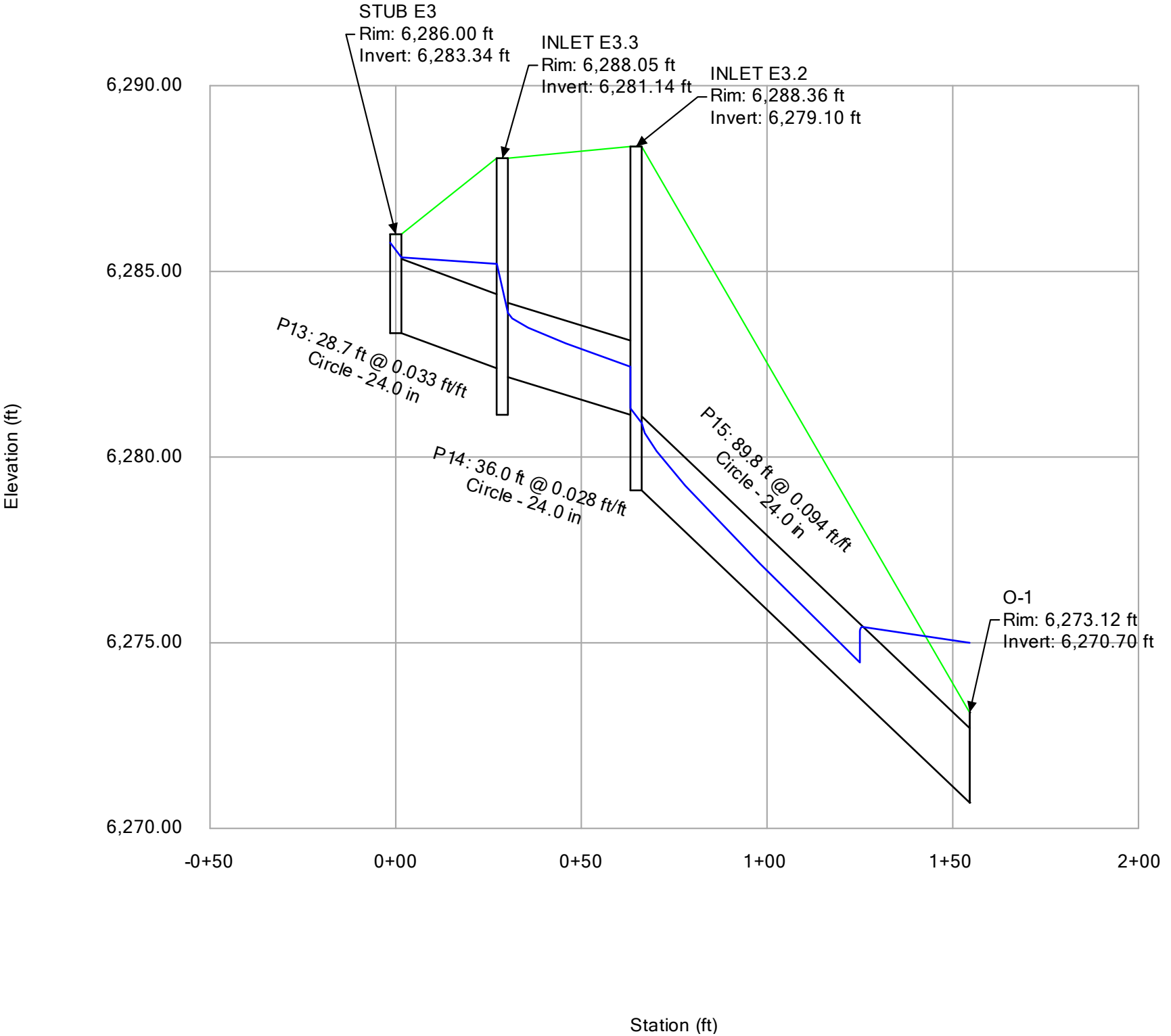
Engineering Profile - NW ROUNDABOUT STORM LATERAL 1 (Prairie Hawk North Phase 1.stsw)



100-YEAR

Profile Report

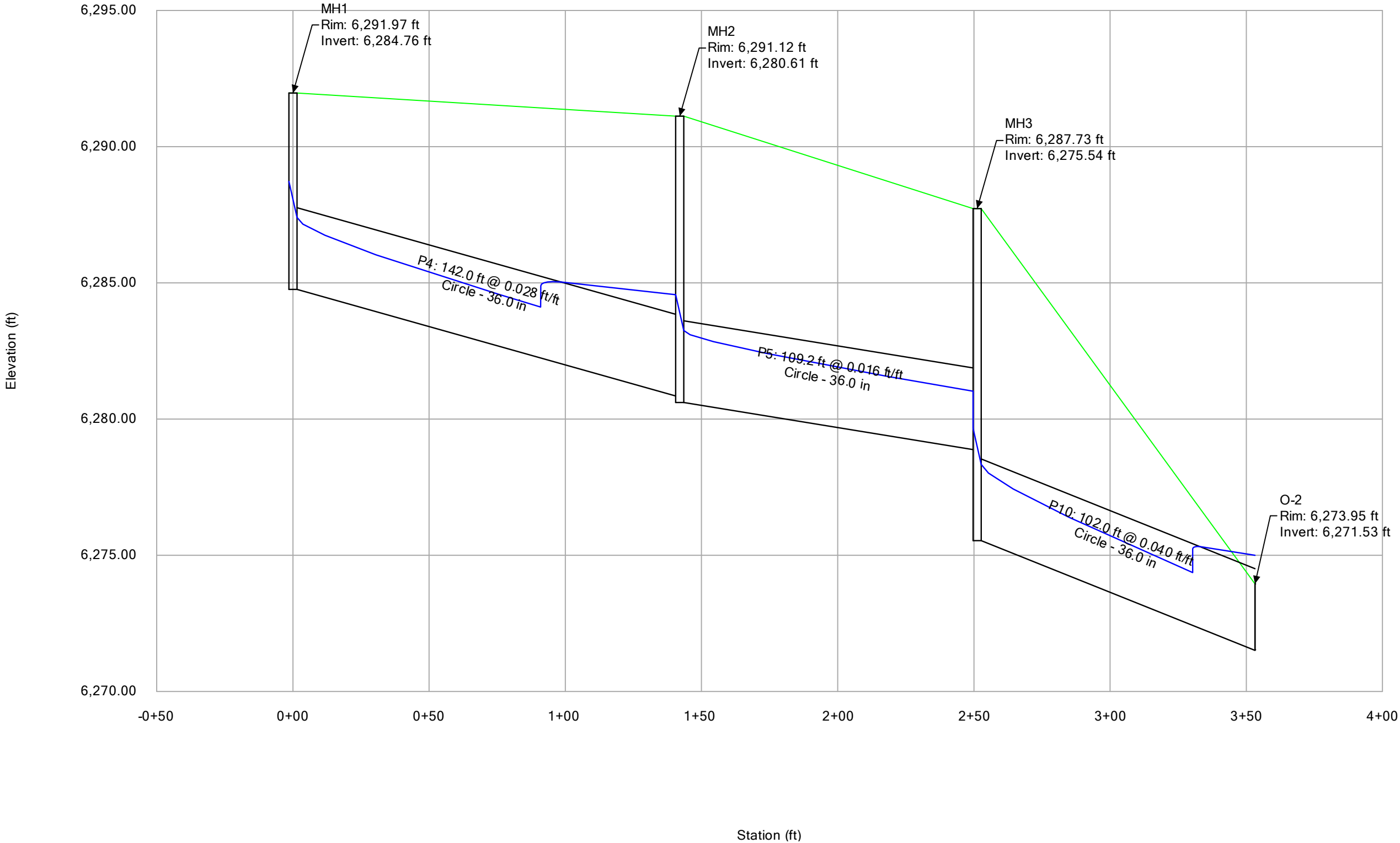
Engineering Profile - NE ROUNDABOUT STORM MAIN (Prairie Hawk North Phase 1.stsw)



100-YEAR

Profile Report

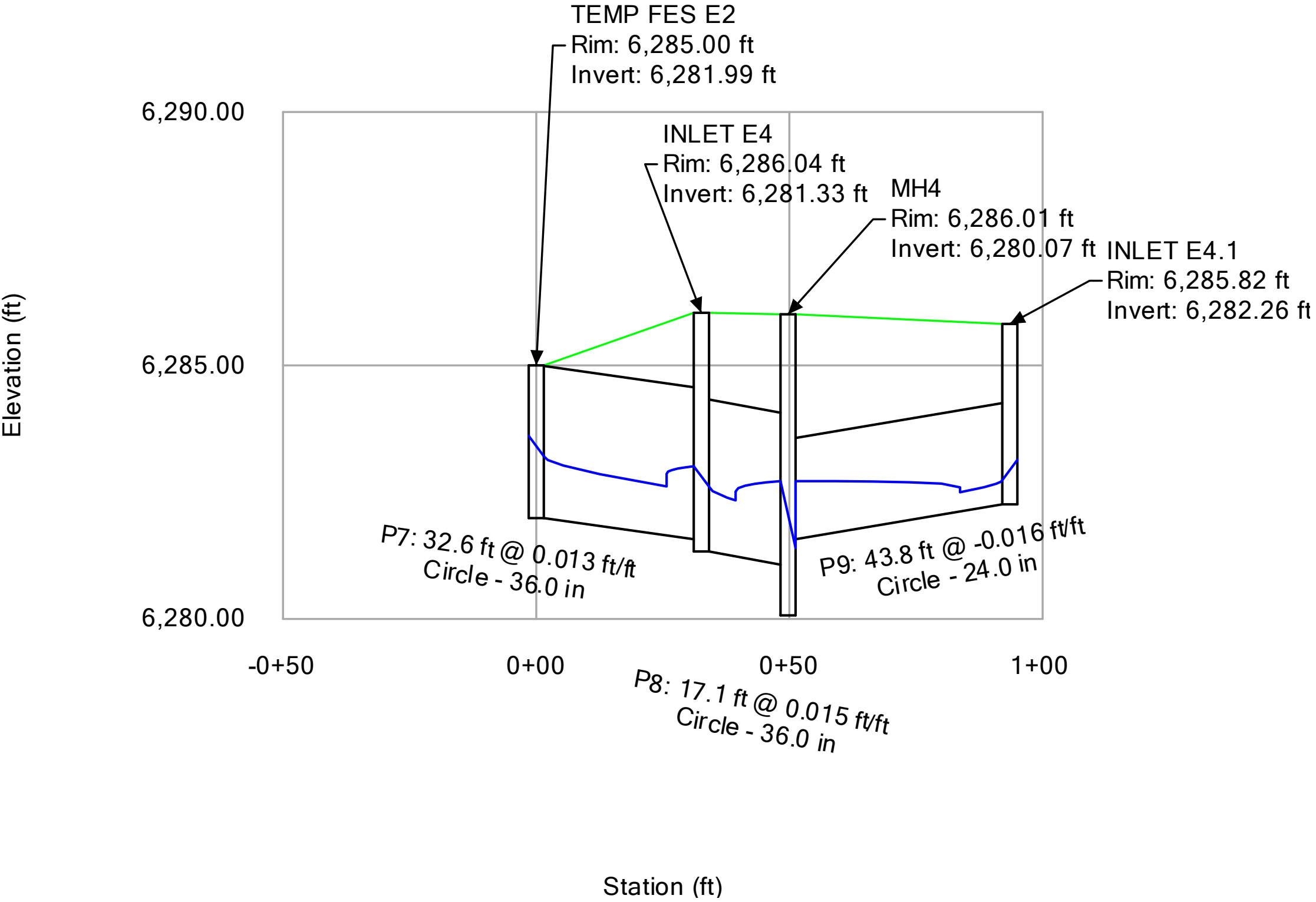
Engineering Profile - NW ROUNDABOUT STORM MAIN (Prairie Hawk North Phase 1.stsw)



100-YEAR

Profile Report

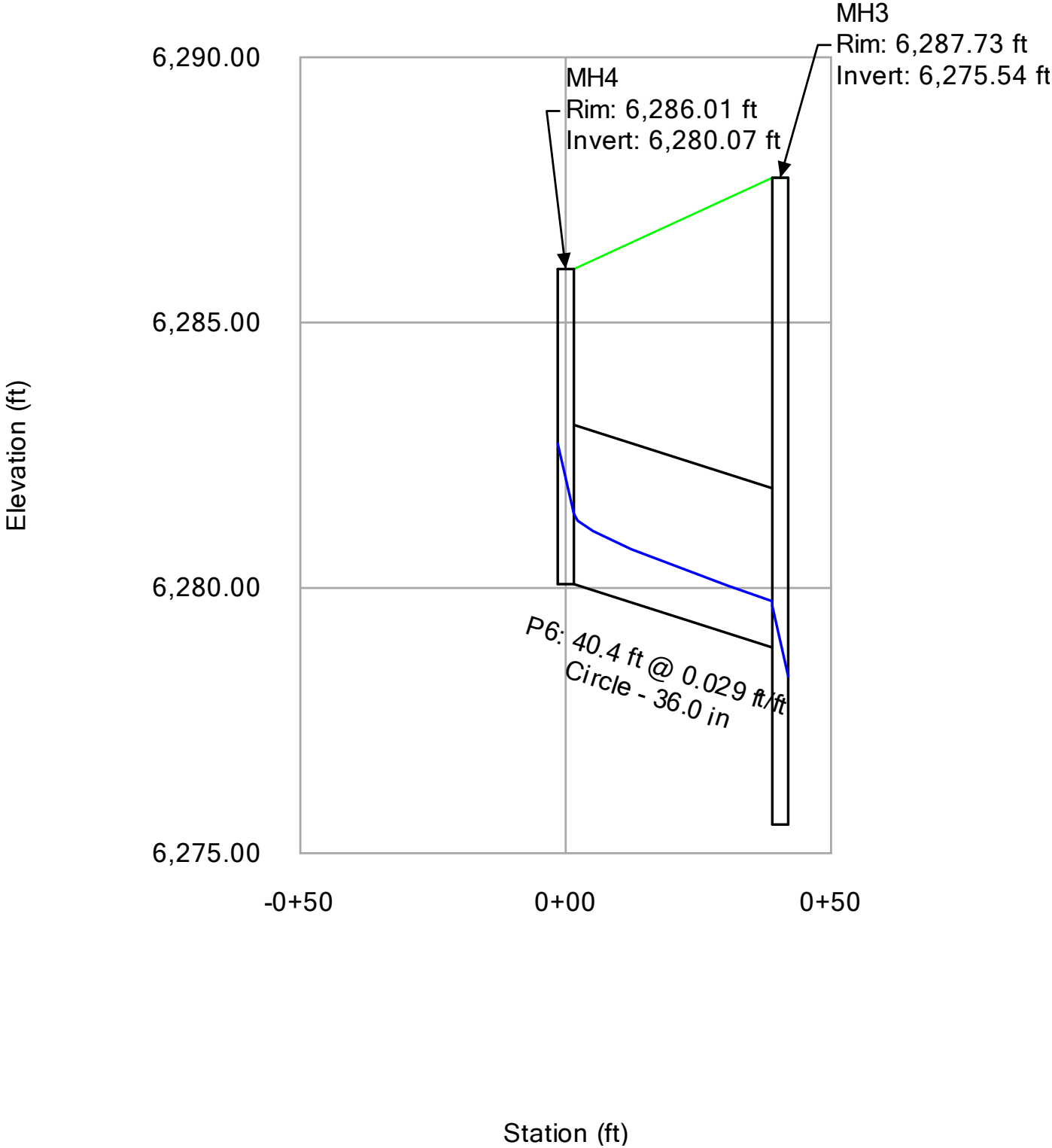
Engineering Profile - NW ROUNDABOUT STORM LATERAL 2 (Prairie Hawk North Phase 1.stsw)



100-YEAR

Profile Report

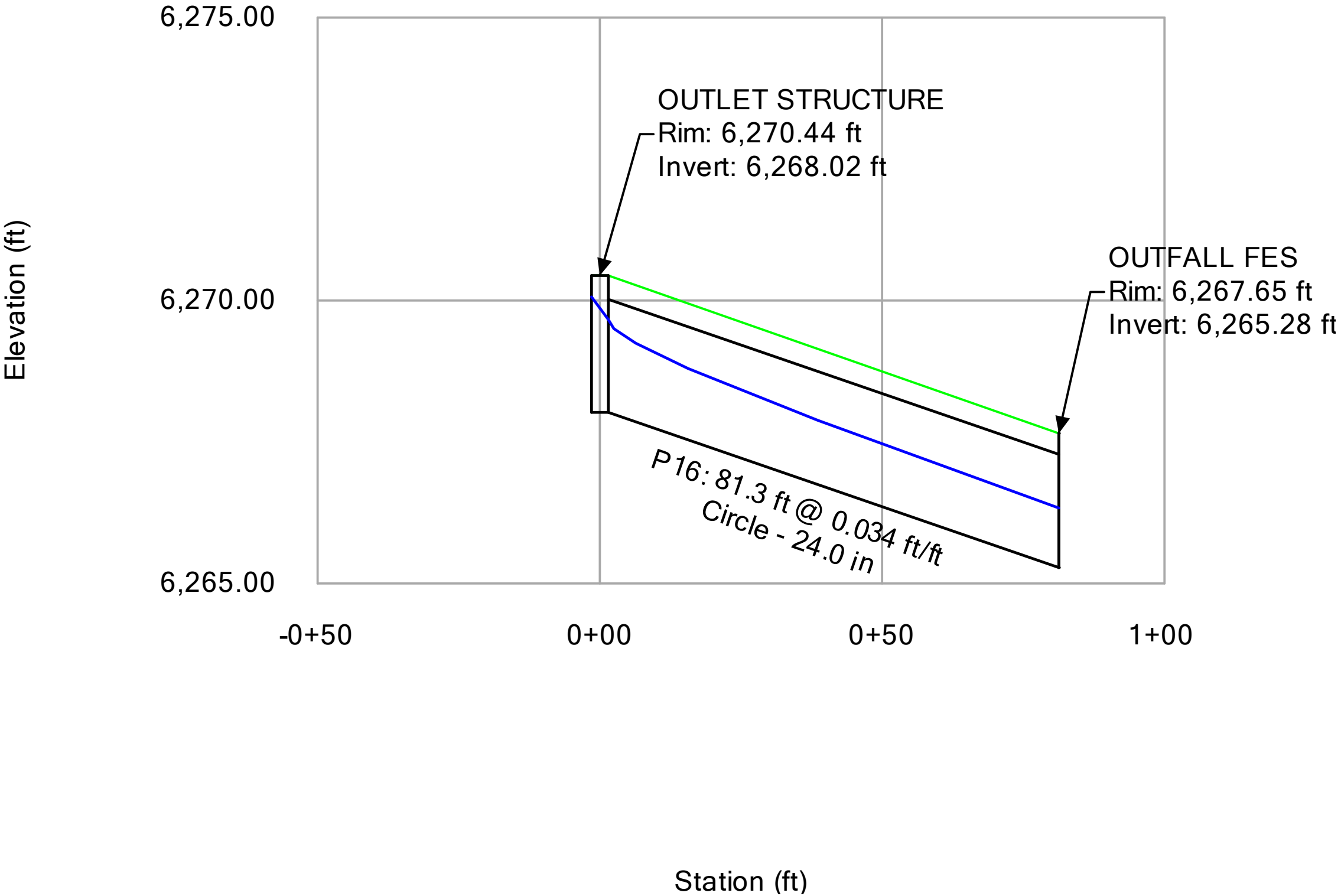
Engineering Profile - NW ROUNDABOUT STORM LATERAL 2 TO OUTFALL (Prairie Hawk North Phase 1.stsw)



100-YEAR

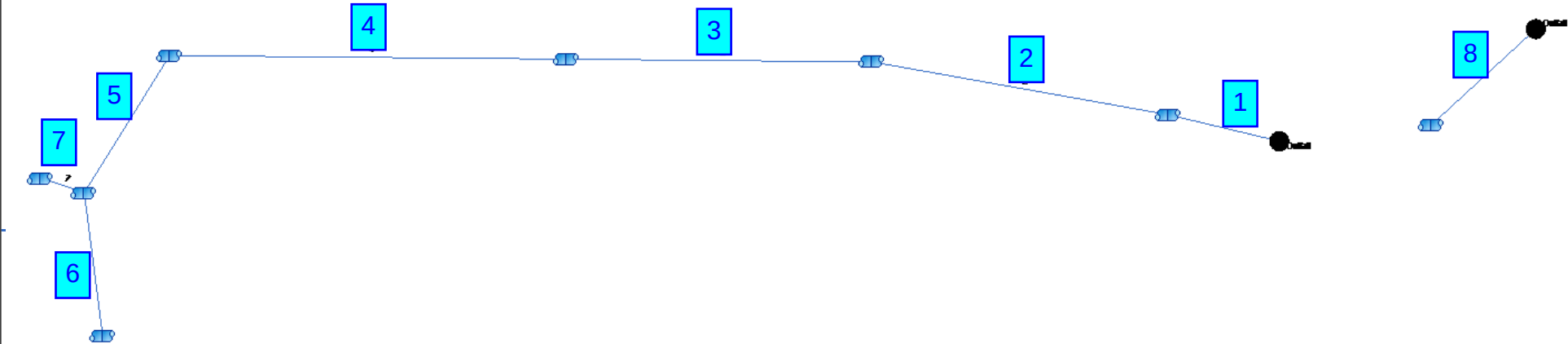
Profile Report

Engineering Profile - POND E OUTFALL (Prairie Hawk North Phase 1.stsw)



Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan

Prairie Hawk
South Area
Model



Project File: 5-YEAR

Number of lines: 8

Date: 12/12/2022

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-7	7.09	24	Cir	89.499	6259.03	6259.52	0.547	6260.84	6260.46	0.06	6260.46	End	None
2	P-6	7.09	24	Cir	237.365	6259.72	6261.00	0.541	6260.59	6261.95	0.07	6261.95	1	None
3	P-5	7.09	24	Cir	240.846	6261.20	6272.20	4.566	6261.95	6273.14	0.06	6273.14	2	None
4	P-4	7.09	24	Cir	312.941	6272.40	6277.79	1.723	6273.14	6278.74	0.32	6278.74	3	None
5	P-3	7.09	24	Cir	127.146	6277.99	6279.19	0.945	6278.74	6280.13	0.36	6280.13	4	None
6	P-8	3.54	18	Cir	113.376	6279.39	6280.26	0.767	6280.13	6280.98	n/a	6280.98 j	5	None
7	P-2	3.55	18	Cir	35.754	6279.39	6279.70	0.867	6280.13	6280.42	n/a	6280.42 j	5	None
8	P-11	3.30	18	Cir	110.934	6257.31	6259.00	1.523	6258.41	6259.69	n/a	6259.69 j	End	None
Project File: 5-yr.stm									Number of lines: 8			Run Date: 12/12/2022		
NOTES: Return period = 100 Yrs. ; j - Line contains hyd. jump.														

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross SI, Sw (ft/ft)	Cross SI, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	1.46	1.46	n/a	0.20	0.50	0.90	18.12	0.94				-166.621	1.81	0.94**	Outfall	0.00	3178955.15	6261.21	6260.83	0.557
2	1.32	1.46	n/a	0.20	0.50	0.90	18.02	0.94				-3.290	0.87	0.94**	1	0.00	3178721.46	6260.96	6262.31	1.685
3	1.06	1.46	n/a	0.20	0.50	0.90	52.36	0.94				-9.556	0.74	0.94**	2	0.00	3178480.62	6262.31	6273.51	1.720
4	1.06	1.46	n/a	0.20	0.50	0.90	32.16	0.94				-0.013	0.74	0.94**	3	0.00	3178167.70	6273.51	6279.10	0.000
5	1.08	1.46	n/a	0.20	0.50	0.90	23.82	0.94				-58.613	0.75	0.94**	4	0.00	3178100.49	6279.10	6280.50	0.000
6	0.83	0.83	n/a	0.20	0.50	0.90	9.96	0.72				-39.257	0.74	0.72**	5	0.00	3178115.00	6280.41	6281.26	0.809
7	0.84	0.84	n/a	0.20	0.50	0.90	10.59	0.72				76.674	0.74	0.72**	5	0.00	3178066.60	6280.41	6280.70	0.000
8	0.80	0.80	n/a	0.20	0.50	0.90	14.04	0.69				137.350	1.10	0.69**	Outfall	0.00	3179162.57	6258.68	6259.96	0.000

Project File: 5-yr.stm

Number of lines: 8

Date: 12/12/2022

NOTES: ** Critical depth

MyReport

Flow Rate	Sf Ave	Sf Dn	Grate Area	Grate Len	Grate Width	Gnd/Rim El Dn	Gnd/Rim El Up	Gutter Depth	Gutter Slope	Gutter Spread	Gutter Width	HGL Dn	HGL Up	HGL Jnct	HGL Jmp Dn	HGL Jmp Up	Incr CxA	Incr Q	Inlet Depth	Inlet Eff
(cfs)	(ft/ft)	(ft/ft)	(sqft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)		(cfs)	(ft)	(%)
7.09	0.622	0.621				0.00	6268.00					6260.84	6260.46	6260.46			0.00	0.00		
7.09	0.710	0.710				6268.00	6280.15					6260.59	6261.95	6261.95			0.00	0.00		
7.09	0.714	0.710				6280.15	6287.46					6261.95	6273.14	6273.14			0.00	0.00		
7.09	0.000	0.000				6287.46	6286.50					6273.14	6278.74	6278.74			0.00	0.00		
7.09	0.000	0.000				6286.50	6284.26					6278.74	6280.13	6280.13			0.00	0.00		
3.54	0.713	0.677				6284.26	6283.86					6280.13	6280.98 j	6280.98	6280.20	6280.14	0.00	3.54		
3.55	0.000	0.000				6284.26	6283.74					6280.13	6280.42 j	6280.42	6280.15	6280.11	0.00	3.55		
3.30	0.000	0.000				6259.14	0.00					6258.41	6259.69 j	6259.69	6258.34	6258.22	0.00	3.30		

Project File: 5-yr.stm

Number of lines: 8

Date: 12/12/2022

NOTES: ** Critical depth

Inlet ID	Inlet Loc		Inlet Time	i Sys	i Inlet	Invert Dn	Invert Up	Jump Loc	Jump Len	Vel Hd Jmp Dn	Vel Hd Jmp Up	J-Loss Coeff	Junct Type	Known Q	Cost RCP	Cost CMP	Cost PVC	Line ID	
		(ft)	(min)	(in/hr)	(in/hr)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)			(cfs)					
STRC-8	On Grade		0.0	0.00	0.00	6259.03	6259.52			0.00	0.00	0.15 z	None	0.00	3,344	3,010	2,842	P-7	
STRC-7	On Grade		0.0	0.00	0.00	6259.72	6261.00			0.00	0.00	0.20 z	None	0.00	17,228	15,505	14,643	P-6	
STRC-6	On Grade		0.0	0.00	0.00	6261.20	6272.20			0.00	0.00	0.15 z	None	0.00	19,475	17,528	16,554	P-5	
STRC-5	On Grade		0.0	0.00	0.00	6272.40	6277.79			0.00	0.00	0.88 z	None	0.00	21,148	19,033	17,975	P-4	
STRC-4	On Grade		0.0	0.00	0.00	6277.99	6279.19			0.00	0.00	0.98 z	None	0.00	6,596	5,936	5,607	P-3	
STRC-10	On Grade		0.0	0.00	0.00	6279.39	6280.26	11.34	3.61	0.28	0.38	1.00 z	None	3.54	4,336	3,902	3,686	P-8	
STRC-2	On Grade		0.0	0.00	0.00	6279.39	6279.70	3.58	3.63	0.27	0.36	1.00 z	None	3.55	1,540	1,386	1,309	P-2	
Null Structure	On Grade		0.0	0.00	0.00	6257.31	6259.00	22.19	3.46	0.27	0.57	1.00 z	None	3.30	3,636	3,272	3,091	P-11	

Project File: 5-yr.stm

Number of lines: 8

Date: 12/12/2022

NOTES: Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82 -- Return period = 100 Yrs. ; ** Critical depth

Line Length	Line Size	Line Slope	Line Type	Local Depr	n-val Gutter	n-val Pipe	Minor Loss	Northing Y	Pipe Travel	Q Byp	Q Capt	Q Carry	Line Rise	Runoff Coeff	Line Span	Area A1	Area A2	Area A3	Tc	Throat Ht	Total Area		
(ft)	(in)	(%)		(in)			(ft)	(ft)	(min)	(cfs)	(cfs)	(cfs)	(in)	(C)	(in)	(ac)	(ac)	(ac)	(min)	(in)	(ac)		
89.499	24	0.55	Cir			0.012	0.06	1559964.87	0.66				24	0.00	24	0.00	0.00	0.00	7.7		0.00		
237.365	24	0.54	Cir			0.012	0.07	1560006.45	1.75				24	0.00	24	0.00	0.00	0.00	6.0		0.00		
240.846	24	4.57	Cir			0.012	0.06	1560008.70	1.78				24	0.00	24	0.00	0.00	0.00	4.2		0.00		
312.941	24	1.72	Cir			0.012	0.32	1560011.54	2.31				24	0.00	24	0.00	0.00	0.00	1.9		0.00		
127.146	24	0.95	Cir			0.012	0.36	1559903.61	0.94				24	0.00	24	0.00	0.00	0.00	0.9		0.00		
113.376	18	0.77	Cir			0.012	n/a	1559791.16	0.94				18	0.00	18	0.00	0.00	0.00	0.0		0.00		
35.754	18	0.87	Cir			0.012	n/a	1559915.00	0.30				18	0.00	18	0.00	0.00	0.00	0.0		0.00		
110.934	18	1.52	Cir			0.012	n/a	1559957.23	0.99				18	0.00	18	0.00	0.00	0.00	0.0		0.00		
Project File: 5-yr.stm													Number of lines: 8				Date: 12/12/2022						
NOTES: ** Critical depth																							

Total CxA	Total Runoff	Vel Ave	Vel Dn	Vel Hd Dn	Vel Hd Up	Vel Up	Cover Dn	Cover Up	Storage			
	(cfs)	(ft/s)	(ft/s)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(cft)			
0.00	0.00	3.61	2.37	0.37	0.37	4.86	n/a	6.48	203.98			
0.00	0.00	5.12	5.39	0.37	0.37	4.86	6.28	17.14	329.33			
0.00	0.00	5.76	6.66	0.37	0.37	4.86	16.94	13.26	303.71			
0.00	0.00	5.76	6.66	0.37	0.37	4.86	13.06	6.71	394.42			
0.00	0.00	5.73	6.59	0.37	0.37	4.86	6.51	3.07	161.04			
0.00	0.00	4.15	4.06	0.28	0.28	4.24	3.37	2.10	96.70			
0.00	0.00	4.16	4.07	0.28	0.28	4.24	3.37	2.54	30.54			
0.00	0.00	3.26	2.38	0.27	0.27	4.14	0.33	n/a	121.79			

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	24	7.09	6259.03	6260.84	1.81	1.46	2.37	0.37	6261.21	0.621	89.499	6259.52	6260.46	0.94**	1.46	4.86	0.37	6260.83	0.623	0.622	n/a	0.15	0.06
2	24	7.09	6259.72	6260.59	0.87*	1.32	5.39	0.37	6260.96	0.710	237.36	6261.00	6261.95	0.94**	1.46	4.86	0.37	6262.31	0.710	0.710	n/a	0.20	0.07
3	24	7.09	6261.20	6261.95	0.74	1.06	6.66	0.37	6262.31	0.710	240.84	6272.20	6273.14	0.94**	1.46	4.86	0.37	6273.51	0.719	0.714	n/a	0.15	0.06
4	24	7.09	6272.40	6273.14	0.74	1.06	6.66	0.37	6273.51	0.000	312.94	6277.79	6278.74	0.94**	1.46	4.86	0.37	6279.10	0.000	0.000	n/a	0.88	0.32
5	24	7.09	6277.99	6278.74	0.75	1.08	6.59	0.37	6279.10	0.000	127.14	6279.19	6280.13	0.94**	1.46	4.86	0.37	6280.50	0.000	0.000	n/a	0.98	0.36
6	18	3.54	6279.39	6280.13	0.74	0.83	4.06	0.28	6280.41	0.677	113.37	6280.26	6280.98 j	0.72**	0.83	4.24	0.28	6281.26	0.749	0.713	n/a	1.00	n/a
7	18	3.55	6279.39	6280.13	0.74	0.84	4.07	0.28	6280.41	0.000	35.754	6279.70	6280.42 j	0.72**	0.84	4.24	0.28	6280.70	0.000	0.000	n/a	1.00	0.28
8	18	3.30	6257.31	6258.41	1.10	0.80	2.38	0.27	6258.68	0.000	110.934	6259.00	6259.69 j	0.69**	0.80	4.14	0.27	6259.96	0.000	0.000	n/a	1.00	0.27
Project File: 5-yr.stm														Number of lines: 8					Run Date: 12/12/2022				
Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box																							

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

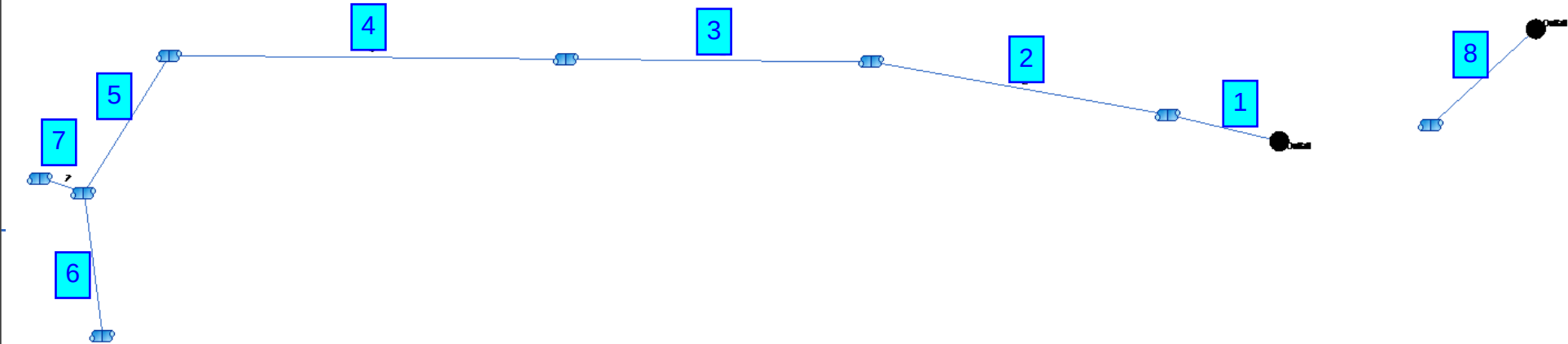
Col. 22 Energy loss. Average $Sf/100 \times \text{Line Length}$ (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan

Prairie Hawk
South Area
Model



Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	P-7	20.64	24	Cir	89.499	6259.03	6259.52	0.547	6260.84	6261.45	0.10	6261.56	End	None
2	P-6	20.64	24	Cir	237.365	6259.72	6261.00	0.541	6261.72*	6263.40*	0.13	6263.54	1	None
3	P-5	20.64	24	Cir	240.846	6261.20	6272.20	4.566	6263.54	6273.83	n/a	6273.83 j	2	None
4	P-4	20.64	24	Cir	312.941	6272.40	6277.79	1.723	6273.83	6279.42	0.78	6279.42	3	None
5	P-3	20.64	24	Cir	127.146	6277.99	6279.19	0.945	6279.43	6280.82	0.87	6280.82	4	None
6	P-8	10.06	18	Cir	113.376	6279.39	6280.26	0.767	6280.82	6281.52	0.63	6282.15	5	None
7	P-2	10.58	18	Cir	35.754	6279.39	6279.70	0.867	6280.82	6280.95	n/a	6280.95	5	None
8	P-11	3.30	18	Cir	110.934	6257.31	6259.00	1.523	6258.41	6259.69	n/a	6259.69 j	End	None

Project File: 100-yr.stm

Number of lines: 8

Run Date: 12/12/2022

NOTES: Return period = 100 Yrs. ; *Surcharged (HGL above crown). ; j - Line contains hyd. jump.

Line No.	Area Dn (sqft)	Area Up (sqft)	Byp Ln No	Coeff C1 (C)	Coeff C2 (C)	Coeff C3 (C)	Capac Full (cfs)	Crit Depth (ft)	Cross SI, Sw (ft/ft)	Cross SI, Sx (ft/ft)	Curb Len (ft)	Defl Ang (Deg)	Depth Dn (ft)	Depth Up (ft)	DnStm Ln No	Drng Area (ac)	Easting X (ft)	EGL Dn (ft)	EGL Up (ft)	Energy Loss (ft)
1	2.99	3.11	n/a	0.20	0.50	0.90	18.12	1.63				-166.621	1.81	1.94	Outfall	0.00	3178955.15	6261.58	6262.14	0.557
2	3.14	3.14	n/a	0.20	0.50	0.90	18.02	1.63				-3.290	2.00	2.00	1	0.00	3178721.46	6262.39	6264.08	1.685
3	2.74	2.74	n/a	0.20	0.50	0.90	52.36	1.63				-9.556	2.00	1.63**	2	0.00	3178480.62	6264.21	6274.71	1.720
4	2.40	2.74	n/a	0.20	0.50	0.90	32.16	1.63				-0.013	1.43	1.63**	3	0.00	3178167.70	6274.71	6280.30	0.000
5	2.42	2.74	n/a	0.20	0.50	0.90	23.82	1.63				-58.613	1.44	1.63**	4	0.00	3178100.49	6280.31	6281.70	0.000
6	1.73	1.59	n/a	0.20	0.50	0.90	9.96	1.22				-39.257	1.43	1.26	5	0.00	3178115.00	6281.34	6282.15	0.809
7	1.57	1.57	n/a	0.20	0.50	0.90	10.59	1.25				76.674	1.43	1.25**	5	0.00	3178066.60	6281.52	6281.65	0.000
8	0.80	0.80	n/a	0.20	0.50	0.90	14.04	0.69				137.350	1.10	0.69**	Outfall	0.00	3179162.57	6258.67	6259.96	0.000

Project File: 100-yr.stm

Number of lines: 8

Date: 12/12/2022

NOTES: ** Critical depth

Flow Rate	Sf Ave	Sf Dn	Grate Area	Grate Len	Grate Width	Gnd/Rim El Dn	Gnd/Rim El Up	Gutter Depth	Gutter Slope	Gutter Spread	Gutter Width	HGL Dn	HGL Up	HGL Jnct	HGL Jmp Dn	HGL Jmp Up	Incr CxA	Incr Q	Inlet Depth	Inlet Eff
(cfs)	(ft/ft)	(ft/ft)	(sqft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)		(cfs)	(ft)	(%)
20.64	0.622	0.621				0.00	6268.00					6260.84	6261.45	6261.56			0.00	0.00		
20.64	0.710	0.710				6268.00	6280.15					6261.72	6263.40	6263.54			0.00	0.00		
20.64	0.714	0.710				6280.15	6287.46					6263.54	6273.83 j	6273.83	6263.93	6263.76	0.00	0.00		
20.64	0.000	0.000				6287.46	6286.50					6273.83	6279.42	6279.42			0.00	0.00		
20.64	0.000	0.000				6286.50	6284.26					6279.43	6280.82	6280.82			0.00	0.00		
10.06	0.713	0.677				6284.26	6283.86					6280.82	6281.52	6282.15			0.00	10.06		
10.58	0.000	0.000				6284.26	6283.74					6280.82	6280.95	6280.95			0.00	10.58		
3.30	0.000	0.000				6259.14	0.00					6258.41	6259.69 j	6259.69	6258.34	6258.22	0.00	3.30		

Project File: 100-yr.stm

Number of lines: 8

Date: 12/12/2022

NOTES: ** Critical depth

Inlet ID	Inlet Loc		Inlet Time	i Sys	i Inlet	Invert Dn	Invert Up	Jump Loc	Jump Len	Vel Hd Jmp Dn	Vel Hd Jmp Up	J-Loss Coeff	Junct Type	Known Q	Cost RCP	Cost CMP	Cost PVC	Line ID	
		(ft)	(min)	(in/hr)	(in/hr)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)			(cfs)					
STRC-8	On Grade		0.0	0.00	0.00	6259.03	6259.52			0.00	0.00	0.15	None	0.00	3,344	3,010	2,842	P-7	
STRC-7	On Grade		0.0	0.00	0.00	6259.72	6261.00			0.00	0.00	0.20	None	0.00	17,228	15,505	14,643	P-6	
STRC-6	On Grade		0.0	0.00	0.00	6261.20	6272.20	24.08	8.14	0.88	2.19	0.15 z	None	0.00	19,475	17,528	16,554	P-5	
STRC-5	On Grade		0.0	0.00	0.00	6272.40	6277.79			0.00	0.00	0.88 z	None	0.00	21,148	19,033	17,975	P-4	
STRC-4	On Grade		0.0	0.00	0.00	6277.99	6279.19			0.00	0.00	0.98 z	None	0.00	6,596	5,936	5,607	P-3	
STRC-10	On Grade		0.0	0.00	0.00	6279.39	6280.26			0.00	0.00	1.00	None	10.06	4,336	3,902	3,686	P-8	
STRC-2	On Grade		0.0	0.00	0.00	6279.39	6279.70			0.00	0.00	1.00 z	None	10.58	1,540	1,386	1,309	P-2	
Null Structure	On Grade		0.0	0.00	0.00	6257.31	6259.00	22.19	3.46	0.27	0.57	1.00 z	None	3.30	3,636	3,272	3,091	P-11	

Project File: 100-yr.stm

Number of lines: 8

Date: 12/12/2022

NOTES: Intensity = 127.16 / (Inlet time + 17.80) ^ 0.82 -- Return period = 100 Yrs. ; ** Critical depth

Line Length	Line Size	Line Slope	Line Type	Local Depr	n-val Gutter	n-val Pipe	Minor Loss	Northing Y	Pipe Travel	Q Byp	Q Capt	Q Carry	Line Rise	Runoff Coeff	Line Span	Area A1	Area A2	Area A3	Tc	Throat Ht	Total Area	
(ft)	(in)	(%)		(in)			(ft)	(ft)	(min)	(cfs)	(cfs)	(cfs)	(in)	(C)	(in)	(ac)	(ac)	(ac)	(min)	(in)	(ac)	
89.499	24	0.55	Cir			0.012	0.10	1559964.87	0.23				24	0.00	24	0.00	0.00	0.00	2.7		0.00	
237.365	24	0.54	Cir			0.012	0.13	1560006.45	0.60				24	0.00	24	0.00	0.00	0.00	2.1		0.00	
240.846	24	4.57	Cir			0.012	n/a	1560008.70	0.61				24	0.00	24	0.00	0.00	0.00	1.4		0.00	
312.941	24	1.72	Cir			0.012	0.78	1560011.54	0.79				24	0.00	24	0.00	0.00	0.00	0.7		0.00	
127.146	24	0.95	Cir			0.012	0.87	1559903.61	0.32				24	0.00	24	0.00	0.00	0.00	0.3		0.00	
113.376	18	0.77	Cir			0.012	0.63	1559791.16	0.33				18	0.00	18	0.00	0.00	0.00	0.0		0.00	
35.754	18	0.87	Cir			0.012	n/a	1559915.00	0.10				18	0.00	18	0.00	0.00	0.00	0.0		0.00	
110.934	18	1.52	Cir			0.012	n/a	1559957.23	0.99				18	0.00	18	0.00	0.00	0.00	0.0		0.00	
Project File: 100-yr.stm													Number of lines: 8				Date: 12/12/2022					
NOTES: ** Critical depth																						

Total CxA	Total Runoff	Vel Ave	Vel Dn	Vel Hd Dn	Vel Hd Up	Vel Up	Cover Dn	Cover Up	Storage		
	(cfs)	(ft/s)	(ft/s)	(ft)	(ft)	(ft/s)	(ft)	(ft)	(cft)		
0.00	0.00	6.77	6.90	0.74	0.68	6.64	n/a	6.48	273.55		
0.00	0.00	6.57	6.57	0.67	0.67	6.57	6.28	17.14	745.56		
0.00	0.00	7.05	6.57	0.67	0.88	7.54	16.94	13.26	739.63		
0.00	0.00	8.07	8.60	0.88	0.88	7.54	13.06	6.71	805.01		
0.00	0.00	8.04	8.53	0.88	0.88	7.54	6.51	3.07	328.32		
0.00	0.00	6.07	5.80	0.52	0.63	6.35	3.37	2.10	188.85		
0.00	0.00	6.41	6.10	0.70	0.70	6.73	3.37	2.54	59.36		
0.00	0.00	3.27	2.39	0.27	0.27	4.14	0.33	n/a	121.46		
										</	

Hydraulic Grade Line Computations

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)		Invert elev (ft)	HGL elev (ft)	Depth (ft)	Area (sqft)	Vel (ft/s)	Vel head (ft)	EGL elev (ft)	Sf (%)	Ave Sf (%)	Enrgy loss (ft)		
(1)	(in) (2)	(cfs) (3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(ft) (12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
1	24	20.64	6259.03	6260.84	1.81	2.99	6.90	0.74	6261.58	0.621	89.499	6259.52	6261.45	1.94	3.11	6.64	0.68	6262.14	0.623	0.622	0.557	0.15	0.10
2	24	20.64	6259.72	6261.72	2.00*	3.14	6.57	0.67	6262.39	0.710	237.36	6261.00	6263.40	2.00	3.14	6.57	0.67	6264.08	0.710	0.710	1.685	0.20	0.13
3	24	20.64	6261.20	6263.54	2.00	2.74	6.57	0.67	6264.21	0.710	240.84	6272.20	6273.83 j	1.63**	2.74	7.54	0.88	6274.71	0.719	0.714	n/a	0.15	0.13
4	24	20.64	6272.40	6273.83	1.43	2.40	8.60	0.88	6274.71	0.000	312.94	6277.79	6279.42	1.63**	2.74	7.54	0.88	6280.30	0.000	0.000	n/a	0.88	0.78
5	24	20.64	6277.99	6279.43	1.44*	2.42	8.53	0.88	6280.31	0.000	127.14	6279.19	6280.82	1.63**	2.74	7.54	0.88	6281.70	0.000	0.000	n/a	0.98	0.87
6	18	10.06	6279.39	6280.82	1.43	1.73	5.80	0.52	6281.34	0.677	113.37	6280.26	6281.52	1.26	1.59	6.35	0.63	6282.15	0.749	0.713	0.809	1.00	0.63
7	18	10.58	6279.39	6280.82	1.43	1.57	6.10	0.70	6281.52	0.000	35.754	6279.70	6280.95	1.25**	1.57	6.73	0.70	6281.65	0.000	0.000	n/a	1.00	n/a
8	18	3.30	6257.31	6258.41	1.10	0.80	2.39	0.27	6258.67	0.000	110.934	6259.00	6259.69 j	0.69**	0.80	4.14	0.27	6259.96	0.000	0.000	n/a	1.00	0.27
Project File: 100-yr.stm														Number of lines: 8					Run Date: 12/12/2022				
Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box																							

General Procedure:

Hydraflow computes the HGL using the Bernoulli energy equation. Manning's equation is used to determine energy losses due to pipe friction. In a standard step, iterative procedure, Hydraflow assumes upstream HGLs until the energy equation balances. If the energy equation cannot balance, supercritical flow exists and critical depth is temporarily assumed at the upstream end. A supercritical flow Profile is then computed using the same procedure in a downstream direction using momentum principles.

Col. 1 The line number being computed. Calculations begin at Line 1 and proceed upstream.

Col. 2 The line size. In the case of non-circular pipes, the line rise is printed above the span.

Col. 3 Total flow rate in the line.

Col. 4 The elevation of the downstream invert.

Col. 5 Elevation of the hydraulic grade line at the downstream end. This is computed as the upstream HGL + Minor loss of this line's downstream line.

Col. 6 The downstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 7 Cross-sectional area of the flow at the downstream end.

Col. 8 The velocity of the flow at the downstream end, (Col. 3 / Col. 7).

Col. 9 Velocity head (Velocity squared / 2g).

Col. 10 The elevation of the energy grade line at the downstream end, HGL + Velocity head, (Col. 5 + Col. 9).

Col. 11 The friction slope at the downstream end (the S or Slope term in Manning's equation).

Col. 12 The line length.

Col. 13 The elevation of the upstream invert.

Col. 14 Elevation of the hydraulic grade line at the upstream end.

Col. 15 The upstream depth of flow inside the pipe (HGL - Invert elevation) but not greater than the line size.

Col. 16 Cross-sectional area of the flow at the upstream end.

Col. 17 The velocity of the flow at the upstream end, (Col. 3 / Col. 16).

Col. 18 Velocity head (Velocity squared / 2g).

Col. 19 The elevation of the energy grade line at the upstream end, HGL + Velocity head, (Col. 14 + Col. 18) .

Col. 20 The friction slope at the upstream end (the S or Slope term in Manning's equation).

Col. 21 The average of the downstream and upstream friction slopes.

Col. 22 Energy loss. Average $S_f/100 \times \text{Line Length}$ (Col. 21/100 x Col. 12). Equals (EGL upstream - EGL downstream) +/- tolerance.

Col. 23 The junction loss coefficient (K).

Col. 24 Minor loss. (Col. 23 x Col. 18). Is added to upstream HGL and used as the starting HGL for the next upstream line(s).

APPENDIX C – WATER QUALITY POND DESIGN

UD DETENTION DESIGN SHEETS FOR WATER QUALITY POND

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Basin ID: Pond F

ZONE 3
ZONE 2



Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	5.19	acres
Watershed Length =	1.100	
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	48.20%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths = User Input		
Water Quality Capture Volume (WQCV) =	0.087	acre-feet
Excess Urban Runoff Volume (EURV) =	0.267	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	0.191	acre-feet
5-yr Runoff Volume (P1 = 1.43 in.) =	0.280	acre-feet
10-yr Runoff Volume (P1 = 1.66 in.) =	0.379	acre-feet
25-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
50-yr Runoff Volume (P1 = 2.26 in.) =	0.881	acre-feet
100-yr Runoff Volume (P1 = 2.6 in.) =	0.852	acre-feet
500-yr Runoff Volume (P1 = 0 in.) =	0.000	acre-feet
Approximate 2-yr Detention Volume =	0.179	acre-feet
Approximate 5-yr Detention Volume =	0.263	acre-feet
Approximate 10-yr Detention Volume =	0.348	acre-feet
Approximate 25-yr Detention Volume =	0.000	acre-feet
Approximate 50-yr Detention Volume =	0.424	acre-feet
Approximate 100-yr Detention Volume =	0.488	acre-feet

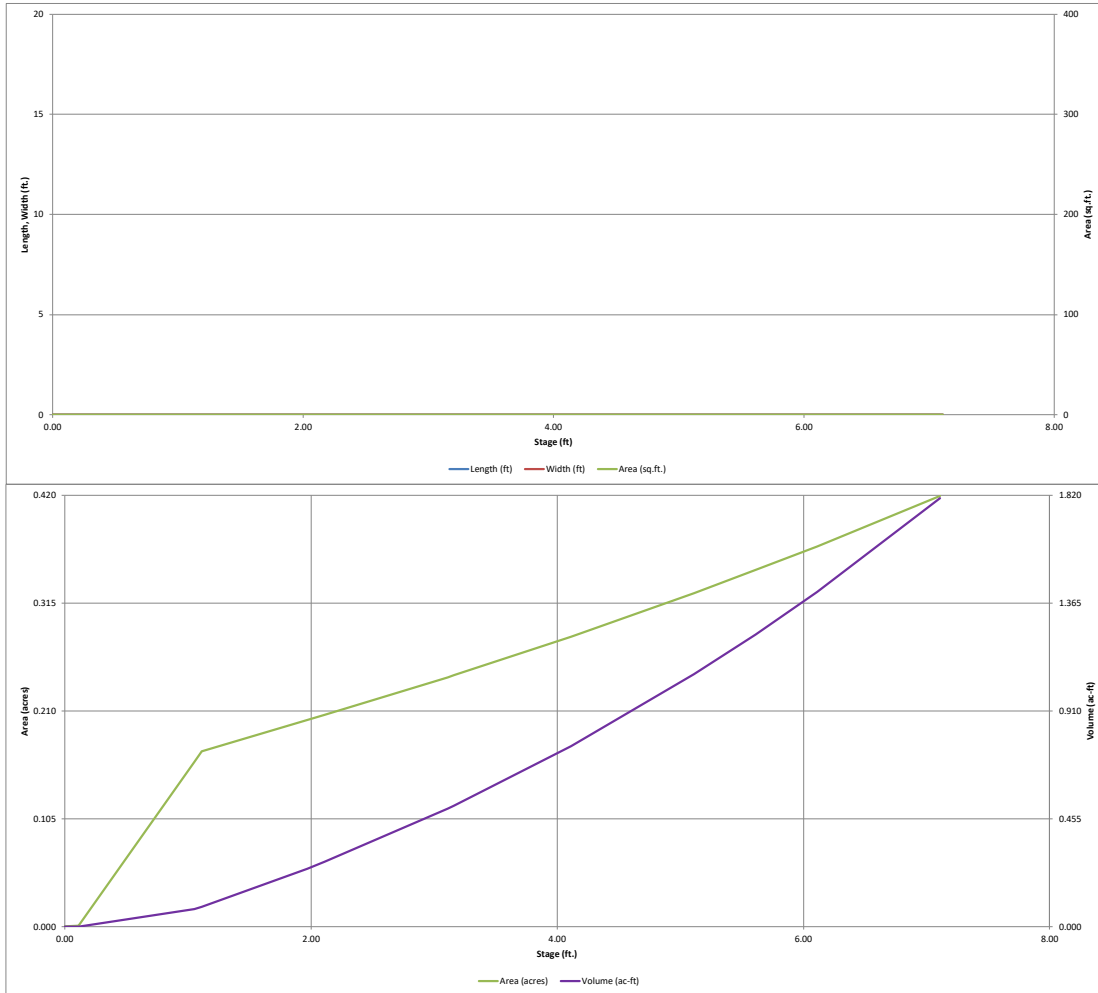
Stage-Storage Calculation

Zone 1 Volume (V_{WC1})	=	0.087	acre-feet
Zone 2 Volume ($V_{EURV} - Zone 1$)	=	0.180	acre-feet
Zone 3 Volume (User Defined - Zones 1 & 2)	=	0.754	acre-feet
Total Detention Basin Volume	=	1.021	acre-feet
Initial Surcharge Volume (ISV)	=	user	ft ³
Initial Surcharge Depth (ISD)	=	user	ft
Total Available Detention Depth ($H_{(det)}$)	=	user	ft
Depth of Trickle Channel (H_{TC})	=	user	ft
Slope of Trickle Channel (S_{TC})	=	user	ft/ft
Slopes of Main Basin Sides ($S_{(main)}$)	=	user	H:V
Basin Length-to-Width Ratio ($R_{(W)}$)	=	user	
Initial Surcharge Area ($A_{(ISV)}$)	=	user	ft ²
Surcharge Volume Length ($L_{(ISV)}$)	=	user	ft
Surcharge Volume Width ($W_{(ISV)}$)	=	user	ft
Depth of Basin Floor ($H_{(L,LOC)}$)	=	user	ft
Length of Basin Floor ($L_{(L,LOC)}$)	=	user	ft
Width of Basin Floor ($W_{(L,LOC)}$)	=	user	ft
Area of Basin Floor ($A_{(L,LOC)}$)	=	user	ft ²
Volume of Basin Floor ($V_{(L,LOC)}$)	=	user	ft ³
Depth of Main Basin ($H_{(MAIN)}$)	=	user	ft
Length of Main Basin ($L_{(MAIN)}$)	=	user	ft
Width of Main Basin ($W_{(MAIN)}$)	=	user	ft
Area of Main Basin ($A_{(MAIN)}$)	=	user	ft ²
Volume of Main Basin ($V_{(MAIN)}$)	=	user	ft ³
Calculated Total Basin Volume ($V_{(det)}$)	=	user	acre-feet

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

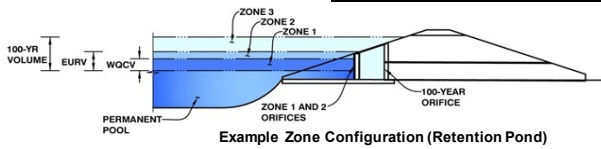


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Prairie Hawk Phase 1**

Basin ID: **Pond F**



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.12	0.087	Orifice Plate
Zone 2 (EURV)	2.08	0.180	Not Utilized
Zone 3 (User)	4.98	0.754	Weir&Pipe (Restrict)
		1.021	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = inches

Calculated Parameters for Plate

W/Q Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50						
Orifice Area (sq. inches)	0.40	1.75						

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft ²
Vertical Orifice Centroid =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H _o =	<input type="text" value="2.50"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	<input type="text" value="2.25"/>	<input type="text" value="N/A"/>	feet
Overflow Weir Slope =	<input type="text" value="4.00"/>	<input type="text" value="N/A"/>	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	<input type="text" value="3.35"/>	<input type="text" value="N/A"/>	feet
Overflow Grate Open Area % =	<input type="text" value="80%"/>	<input type="text" value="N/A"/>	%, grate open area/total area
Debris Clogging % =	<input type="text" value="50%"/>	<input type="text" value="N/A"/>	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H _i =	<input type="text" value="2.50"/>	<input type="text" value="N/A"/>	feet
Over Flow Weir Slope Length =	<input type="text" value="3.35"/>	<input type="text" value="N/A"/>	feet
Grate Open Area / 100-yr Orifice Area =	<input type="text" value="12.25"/>	<input type="text" value="N/A"/>	should be ≥ 4
Overflow Grate Open Area w/o Debris =	<input type="text" value="6.03"/>	<input type="text" value="N/A"/>	ft ²
Overflow Grate Open Area w/ Debris =	<input type="text" value="3.02"/>	<input type="text" value="N/A"/>	ft ²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	<input type="text" value="0.00"/>	<input type="text" value="N/A"/>	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	<input type="text" value="18.00"/>	<input type="text" value="N/A"/>	inches
Restrictor Plate Height Above Pipe Invert =	<input type="text" value="5.80"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	<input type="text" value="0.49"/>	<input type="text" value="N/A"/>	ft ²
Outlet Orifice Centroid =	<input type="text" value="0.28"/>	<input type="text" value="N/A"/>	feet
Half-Central Angle of Restrictor Plate on Pipe =	<input type="text" value="1.21"/>	<input type="text" value="N/A"/>	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	<input type="text" value="4.50"/>	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	<input type="text" value="10.00"/>	feet
Spillway End Slopes =	<input type="text" value="4.00"/>	H:V
Freeboard above Max Water Surface =	<input type="text" value="1.00"/>	feet

Calculated Parameters for Spillway

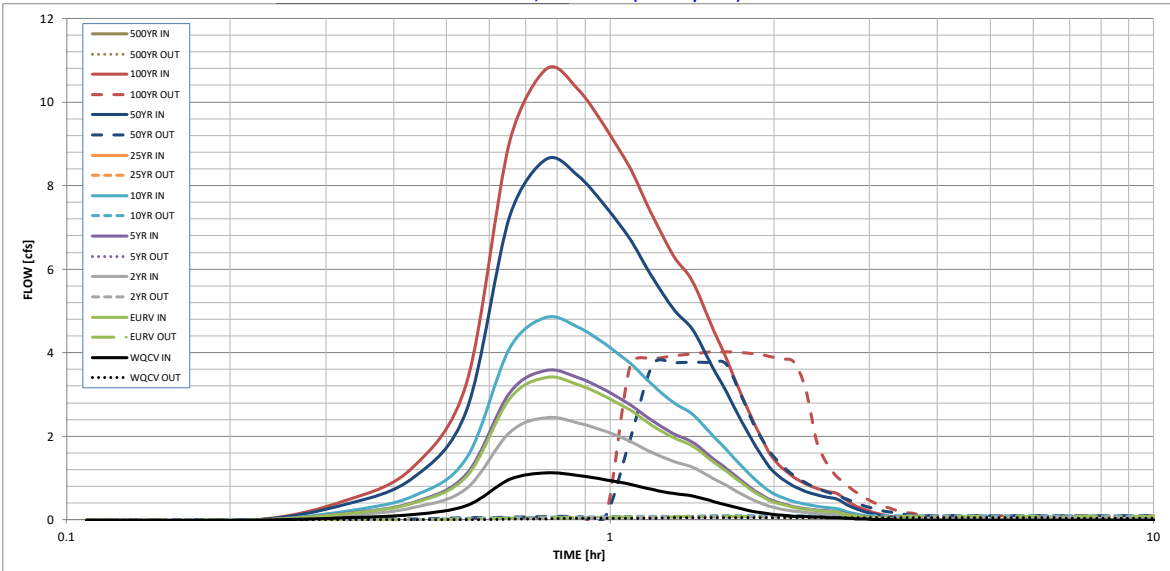
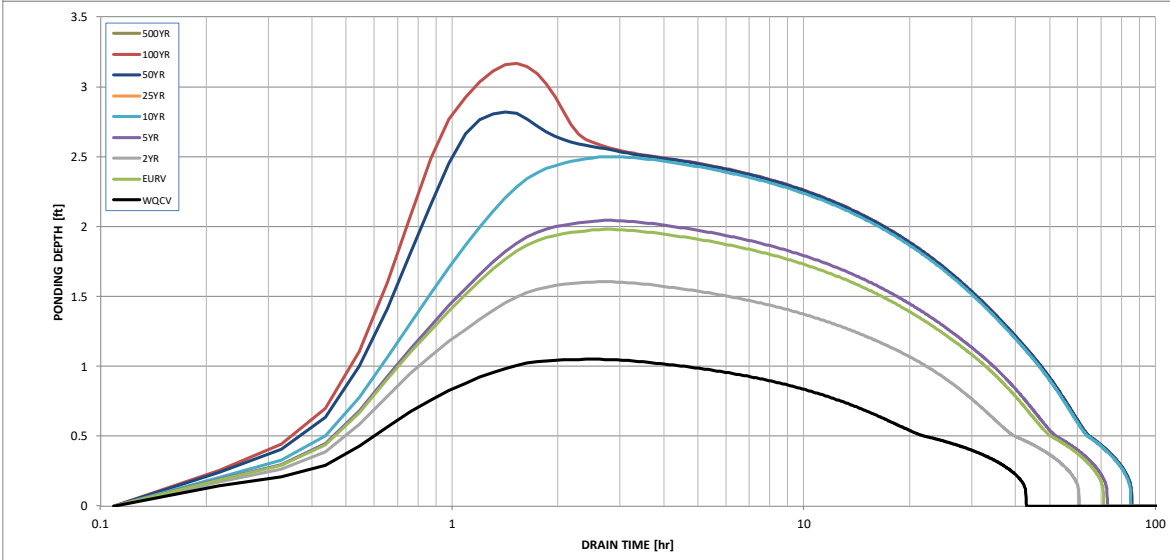
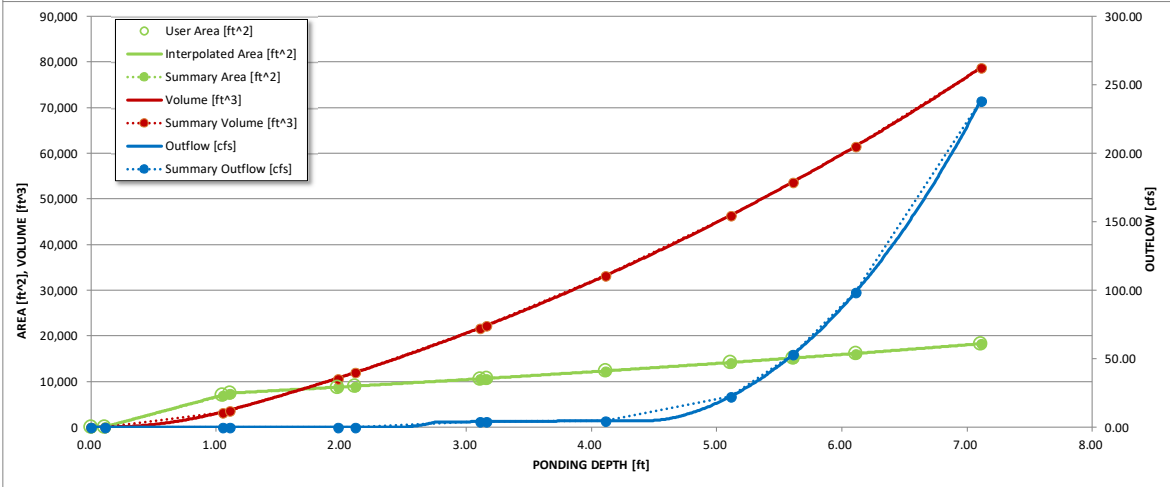
Spillway Design Flow Depth =	<input type="text" value="0.40"/>	feet
Stage at Top of Freeboard =	<input type="text" value="5.90"/>	feet
Basin Area at Top of Freeboard =	<input type="text" value="0.36"/>	acres

Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.06	1.43	1.66	0.00	2.26	2.60	0.00
One-Hour Rainfall Depth (in) =	0.087	0.267	0.191	0.280	0.379	0.000	0.681	0.852	0.000
Calculated Runoff Volume (acre-ft) =	0.087	0.267	0.191	0.280	0.379	0.000	0.681	0.852	0.000
OPTIONAL Override Runoff Volume (acre-ft) =	0.086	0.266	0.190	0.279	0.379	#N/A	0.680	0.852	#N/A
Inflow Hydrograph Volume (acre-ft) =	0.00	0.00	0.01	0.01	0.13	0.00	0.67	0.93	0.00
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.0	0.0	0.0	0.1	0.7	0.0	3.5	4.9	0.0
Predevelopment Peak Q (cfs) =	1.1	3.4	2.5	3.6	4.9	#N/A	8.6	10.8	#N/A
Peak Inflow Q (cfs) =	0.1	0.1	0.1	0.1	0.1	#N/A	3.8	4.0	#N/A
Peak Outflow Q (cfs) =	N/A	N/A	N/A	1.3	0.2	#N/A	1.1	0.8	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.3	0.2	#N/A	1.1	0.8	#N/A
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	#N/A	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	#N/A	0.6	0.6	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	#N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	38	58	51	59	67	#N/A	61	59	#N/A
Time to Drain 99% of Inflow Volume (hours) =	41	66	57	67	78	#N/A	74	71	#N/A
Maximum Ponding Depth (ft) =	1.05	1.98	1.61	2.05	2.50	#N/A	2.82	3.17	#N/A
Area at Maximum Ponding Depth (acres) =	0.16	0.20	0.19	0.20	0.22	#N/A	0.23	0.25	#N/A
Maximum Volume Stored (acre-ft) =	0.076	0.248	0.174	0.260	0.358	#N/A	0.430	0.514	#N/A

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Weir Report

Pond F Forebay Slot

Rectangular Weir

Crest = Sharp
Bottom Length (ft) = 0.10
Total Depth (ft) = 1.50

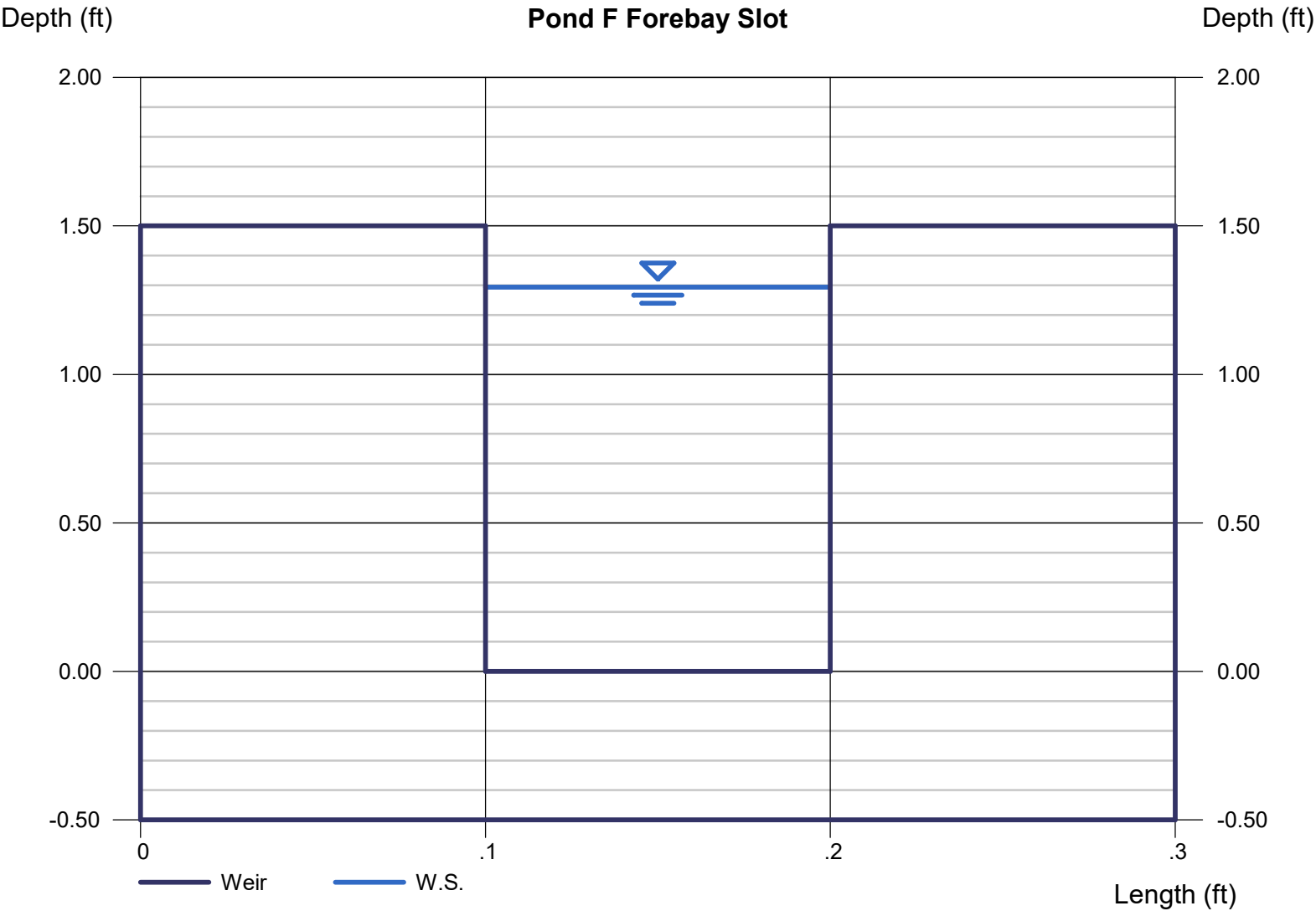
Highlighted

Depth (ft) = 1.29
Q (cfs) = 0.490
Area (sqft) = 0.13
Velocity (ft/s) = 3.79
Top Width (ft) = 0.10

Calculations

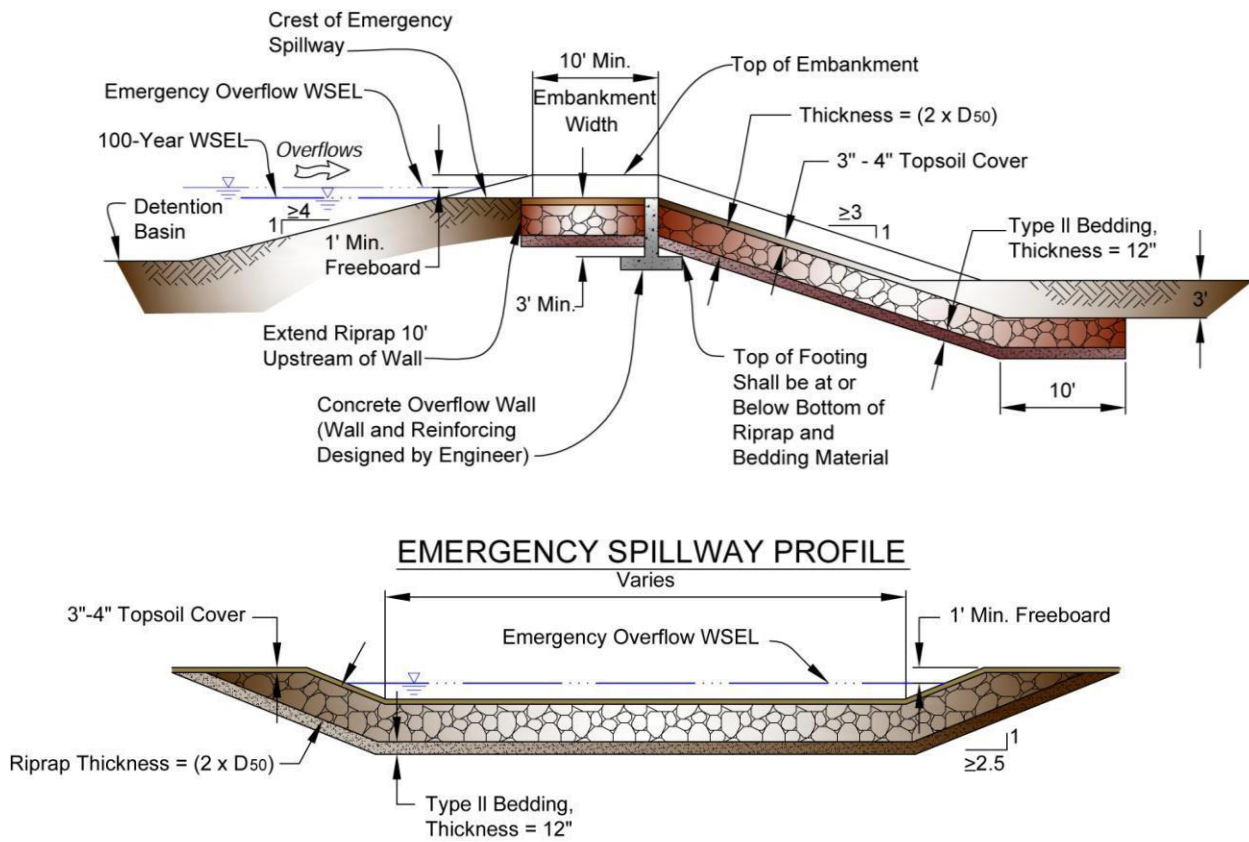
Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 0.49

100-year inflow to
Forebay F is 24.71
cfs. 2% is 0.49 cfs

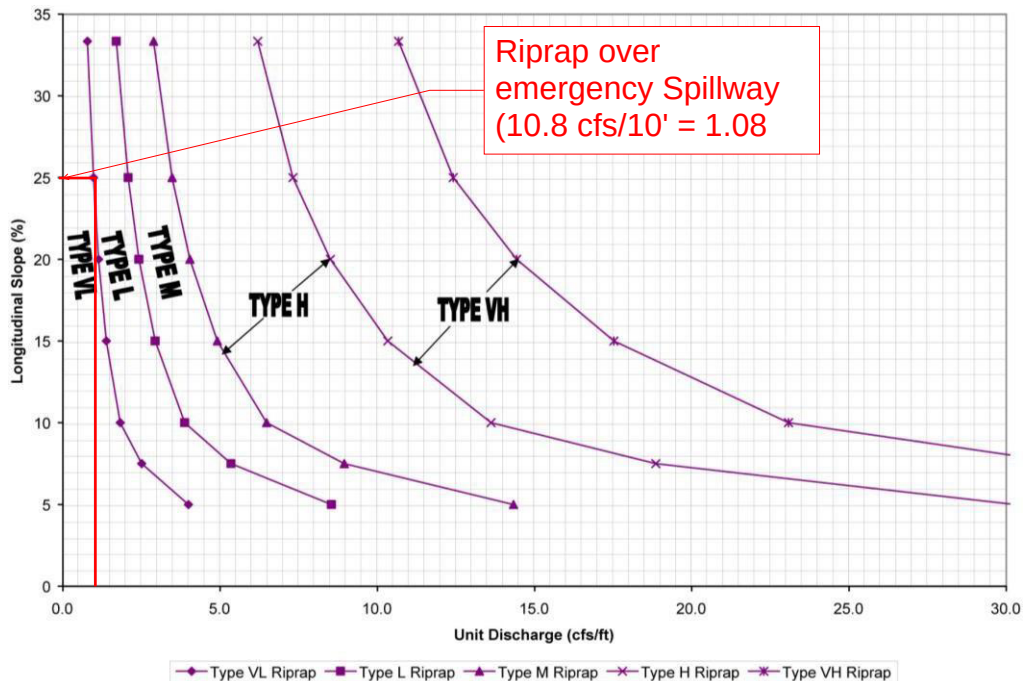


Chapter 13. Storage

**FIGURE 13-7
EMBANKMENT PROTECTION DETAILS AND ROCK SIZING CHART**



SPILLWAY CHANNEL AT CREST AND DOWNSTREAM SIDE OF EMBANKMENT



POND F OUTLET PIPE RIPRAP PROTECTION

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

Riprap Sizing per Section 3.2.3

$$L_p = (1/2 \tan \Theta) [(A_u/Y_1) - D] \text{ ft} \quad \text{length of protection; Equation 9-11}$$

$$D = \frac{18}{1.50} \text{ in} \quad \text{diameter of outlet pipe}$$

$$Y = \quad \text{ft} \quad \text{flow in pipe is supercritical (Y or N), N if unknown}$$

$$D_a = (D + Y_n)/2 \text{ ft} \quad \text{adjusted value of D for supercritical flow; Equation 9-19}$$

$$Y_n = \frac{1.00}{1.00} \text{ ft} \quad \text{normal depth in pipe, NA if unknown or flow is not supercritical}$$

$$D_a = 1.25 \text{ ft}$$

$$Y_1 = \frac{0.60}{0.60} \text{ ft} \quad \text{depth of tailwater, 0.4D if unknown or if hydraulic jump downstream}$$

$$Q = \frac{4.00}{4.00} \text{ cfs} \quad \text{100-year discharge}$$

$$Q/D^{1.5} = \frac{2.86}{2.86} \quad \text{Froude Parameter; for use with Figure 9-38}$$

$$Y_1/D = \frac{0.48}{0.48} \quad \text{tailwater depth/pipe diameter; for use with Figure 9-38}$$

NOTE: the formula below is used for rock sizing in lieu of Figure 9-38

$$D_{50} = 0.023 Q / (Y_1^{1.2} D^{0.3}) \text{ in} \quad \text{mean rock diameter; Equation 9-17}$$

$D_{50} =$	9	in	use Type L riprap per Figure 9-38
$2D_{50} =$	1.5	ft	thickness of riprap layer

RIPRAP & TOEWALL CALCULATIONS FOR CIRCULAR PIPE - FES A5

Project: Terrain North Basin (Phase I)

Sheet 2 of 3

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

Extent of Protection per Section 3.1.1

$$L_p = (1/2 \tan \Theta) [(A_u/Y_1) - D] \text{ ft} \quad \text{length of protection; Equation 9-11}$$

$$D = 1.50 \text{ ft} \quad \text{diameter of outlet pipe}$$

$$Y_1 = 0.60 \text{ ft} \quad \text{depth of tailwater, 0.4D if unknown or if hydraulic jump downstream}$$

$$A_1 = Q/V \text{ ft}^2 \quad \text{required area of flow at allowable velocity; Equation 9-12}$$

$$Q = 4.00 \text{ cfs} \quad \text{100-year discharge}$$

$$V = 7 \text{ ft/sec} \quad \text{maximum velocity allowed; see Table 8-1}$$

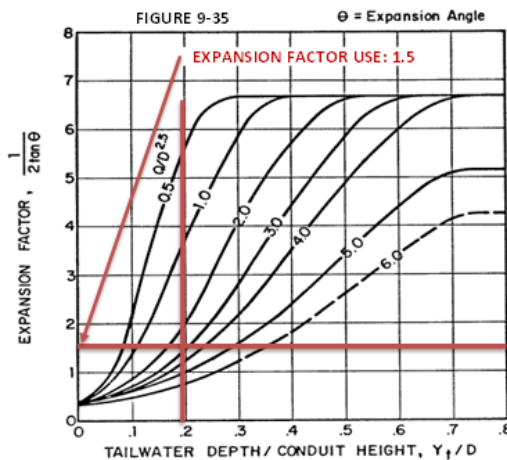
5 ft/sec for non-cohesive soils; 7 ft/sec for cohesive soils

$$A_1 = 0.57 \text{ ft}^2$$

$$Y_1/D = \frac{0.40}{0.40} \quad \text{(for use with Figure 9-35)}$$

$$Q/D^{2.5} = \frac{1.45}{1.45} \quad \text{(for use with Figure 9-35)}$$

(P_F) Froude Parameter (for use with Figure 9-35)
if $P_F \leq 6.0$: min. $L_p = 3D$, max. $L_p = 10D$, else if $P_F > 6.0$:
 $L_p = L_p$ per above + ($F_E - 6.0$) rounded up to whole number $\times 0.25D$



$$1/2 \tan \Theta = \frac{1.5}{1.5}$$

$$\Theta = \tan^{-1} [1/(2 \cdot F_E)] \text{ rad}$$

$$\Theta = 0.32 \text{ rad}$$

Equation 9-13

$$L_p = 5 \text{ ft}$$

see Figure 9-34; accounts for min. and max. conditions described above

$$T = 2(L_p \tan \Theta) + D \text{ ft}$$

$$T = 5 \text{ ft}$$

width of riprap at furthest downstream point; Equation 9-13

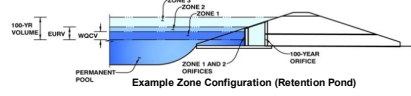
downstream width of protection; see Figure 9-34

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Basin ID: Pond E

—PAGE 3

Selected BMP Type = **EDB**

Watershed Area	24.63	acres
Watershed Length	1,430	ft
Watershed Slope	0.045	%ft
Watershed Imperviousness	87.30%	percent
Percentage Hydrologic Soil Group A	0.0%	percent
Percentage Hydrologic Soil Group B	20.0%	percent
Percentage Hydrologic Soil Groups C/D	80.0%	percent
Desired WQCV Drain Time	40.0	hours
Water Quality for 1-hr Rainfall Depths =	User Input	
Location Capture Volume (WQCV)	0.779	acre-feet
Excess Urban Runoff Volume (EURV)	2.182	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.)	1.833	acre-feet
5-yr Runoff Volume (P1 = 1.43 in.)	2.611	acre-feet
10-yr Runoff Volume (P1 = 1.66 in.)	3.096	acre-feet
25-yr Runoff Volume (P1 = 0 in.)	0.000	acre-feet
50-yr Runoff Volume (P1 = 2.26 in.)	4.439	acre-feet
100-yr Runoff Volume (P1 = 2.6 in.)	5.236	acre-feet
500-yr Runoff Volume (P1 = 0 in.)	0.000	acre-feet
Approximate 2-yr Detention Volume	1.721	acre-feet
Approximate 5-yr Detention Volume	2.458	acre-feet
Approximate 10-yr Detention Volume	2.864	acre-feet
Approximate 25-yr Detention Volume	0.000	acre-feet
Approximate 50-yr Detention Volume	3.298	acre-feet
Approximate 100-yr Detention Volume	3.530	acre-feet

Optional User Override 1-hr Precipitation

1.06	inches
1.43	inches
1.66	inches
	inches
2.26	inches
2.60	inches
	inches

Stage-Storage Calculation

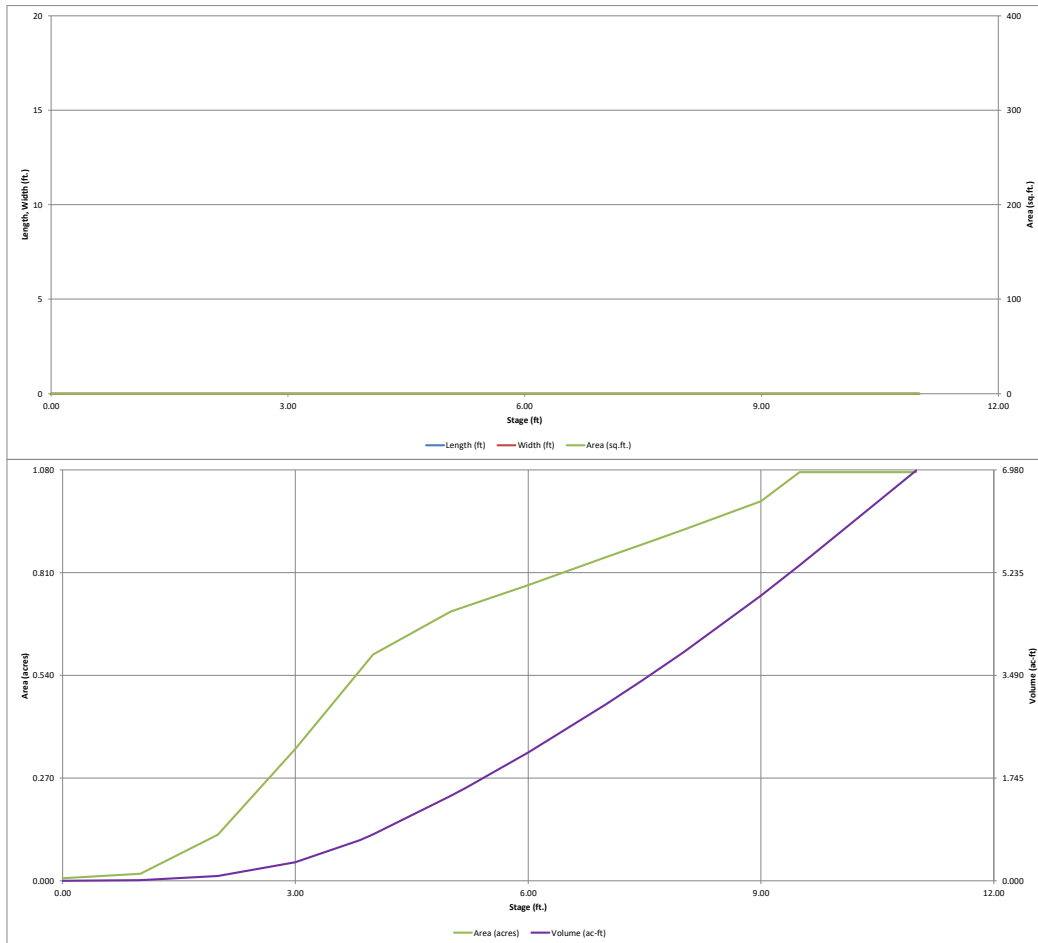
Zone 1 Volume ($WQVC_1$)	0.779	acre-feet
Zone 2 Volume ($EURV - Zone 1$)	1.403	acre-feet
Zone 3 ($100yr + 1/2 WQVC - Zones 1 \& 2$)	1.738	acre-feet
Total Detention Basin Volume	3.920	acre-feet
Initial Surcharge Volume (ISV)	user	ft ³
Initial Surcharge Depth (ISD)	user	ft
Total Available Detention Depth ($H_{(det)}$)	user	ft
Depth of Trickle Channel ($H_{(TC)}$)	user	ft
Slope of Trickle Channel ($S_{(TC)}$)	user	ft/ft
Slopes of Main Basin Sides ($S_{(mb)}$)	user	H:V
Basin Length-to-Width Ratio ($R_{(LW)}$)	user	
Initial Surcharge Area ($A_{(IS)}$)	user	ft ²
Surcharge Volume Length ($L_{(IS)}$)	user	ft
Surcharge Volume Width ($W_{(IS)}$)	user	ft
Depth of Basin Floor ($H_{(LCOB)}$)	user	ft
Length of Basin Floor ($L_{(LCOB)}$)	user	ft
Width of Basin Floor ($W_{(LCOB)}$)	user	ft
Area of Basin Floor ($A_{(LCOB)}$)	user	ft ²
Volume of Basin Floor ($V_{(LCOB)}$)	user	ft ³
Depth of Main Basin ($H_{(mb)}$)	user	ft
Length of Main Basin ($L_{(mb)}$)	user	ft
Width of Main Basin ($W_{(mb)}$)	user	ft
Area of Main Basin ($A_{(mb)}$)	user	ft ²
Volume of Main Basin ($V_{(mb)}$)	user	ft ³
Calculated Total Basin Volume ($V_{(det)}$)	user	acre-feet

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466
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DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

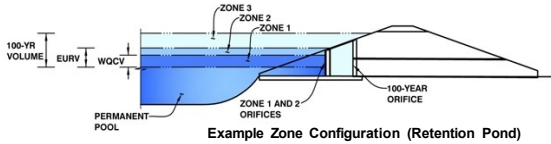


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Prairie Hawk Road Improvements Phase 1**

Basin ID: **Pond E**



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.99	0.779	Orifice Plate
Zone 2 (EURV)	6.01	1.403	Rectangular Orifice
(100+1/2WQCV)	8.05	1.738	Weir&Pipe (Restrict)
		3.920	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (diameter = 1 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	<input type="text" value="0.00"/>	<input type="text" value="1.00"/>						
Orifice Area (sq. inches)	<input type="text" value="0.83"/>	<input type="text" value="0.83"/>						

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Zone 2 Rectangular Not Selected ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height = inches
Vertical Orifice Width = inches

Calculated Parameters for Vertical Orifice

Zone 2 Rectangular Not Selected ft²
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

Zone 3 Weir Not Selected ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Slope = H:V (enter zero for flat grate)
Horiz. Length of Weir Sides = feet
Overflow Grate Open Area % = %
Debris Clogging % = %

Calculated Parameters for Overflow Weir

Zone 3 Weir Not Selected feet
Height of Grate Upper Edge, H_u = feet
Over Flow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area = should be ≥ 4
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Zone 3 Restrictor Not Selected ft (distance below basin bottom at Stage = 0 ft)
Depth to Invert of Outlet Pipe = inches
Outlet Pipe Diameter = inches
Restrictor Plate Height Above Pipe Invert = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Zone 3 Restrictor Not Selected ft²
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway

Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres

Routed Hydrograph Results

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	0.53	1.07	1.06	1.43	1.66	0.00	2.26	2.60	0.00
One-Hour Rainfall Depth (in) =	0.779	2.182	1.833	2.611	3.096	0.000	4.439	5.236	0.000
Calculated Runoff Volume (acre-ft) =									
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.778	2.180	1.832	2.608	3.093	#N/A	4.435	5.227	#N/A
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.11	0.34	0.00	1.17	1.57	0.00
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	2.8	8.4	0.0	28.8	38.6	0.0
Peak Inflow Q (cfs) =	14.7	40.6	34.2	48.5	57.4	#N/A	81.7	96.0	#N/A
Peak Outflow Q (cfs) =	0.8	11.2	7.5	14.7	18.2	#N/A	23.1	24.3	#N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	5.2	2.2	#N/A	0.8	0.6	#N/A
Structure Controlling Flow =	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	#N/A	Outlet Plate 1	Outlet Plate 1	#N/A
Max Velocity through Grate 1 (fps) =	N/A	1.79	1.14	2.4	3.0	#N/A	3.8	4.0	#N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	#N/A	N/A	N/A	#N/A
Time to Drain 97% of Inflow Volume (hours) =	40	36	38	34	32	#N/A	25	22	#N/A
Time to Drain 99% of Inflow Volume (hours) =	45	46	47	45	44	#N/A	41	40	#N/A
Maximum Ponding Depth (ft) =	3.83	5.20	4.97	5.48	5.80	#N/A	6.82	7.47	#N/A
Area at Maximum Ponding Depth (acres) =	0.55	0.72	0.70	0.74	0.76	#N/A	0.84	0.88	#N/A
Maximum Volume Stored (acre-ft) =	0.685	1.574	1.410	1.786	2.027	#N/A	2.834	3.402	#N/A

Weir Report

Pond E Forebay 1 Slot

Rectangular Weir

Crest = Sharp
Bottom Length (ft) = 0.35
Total Depth (ft) = 1.50

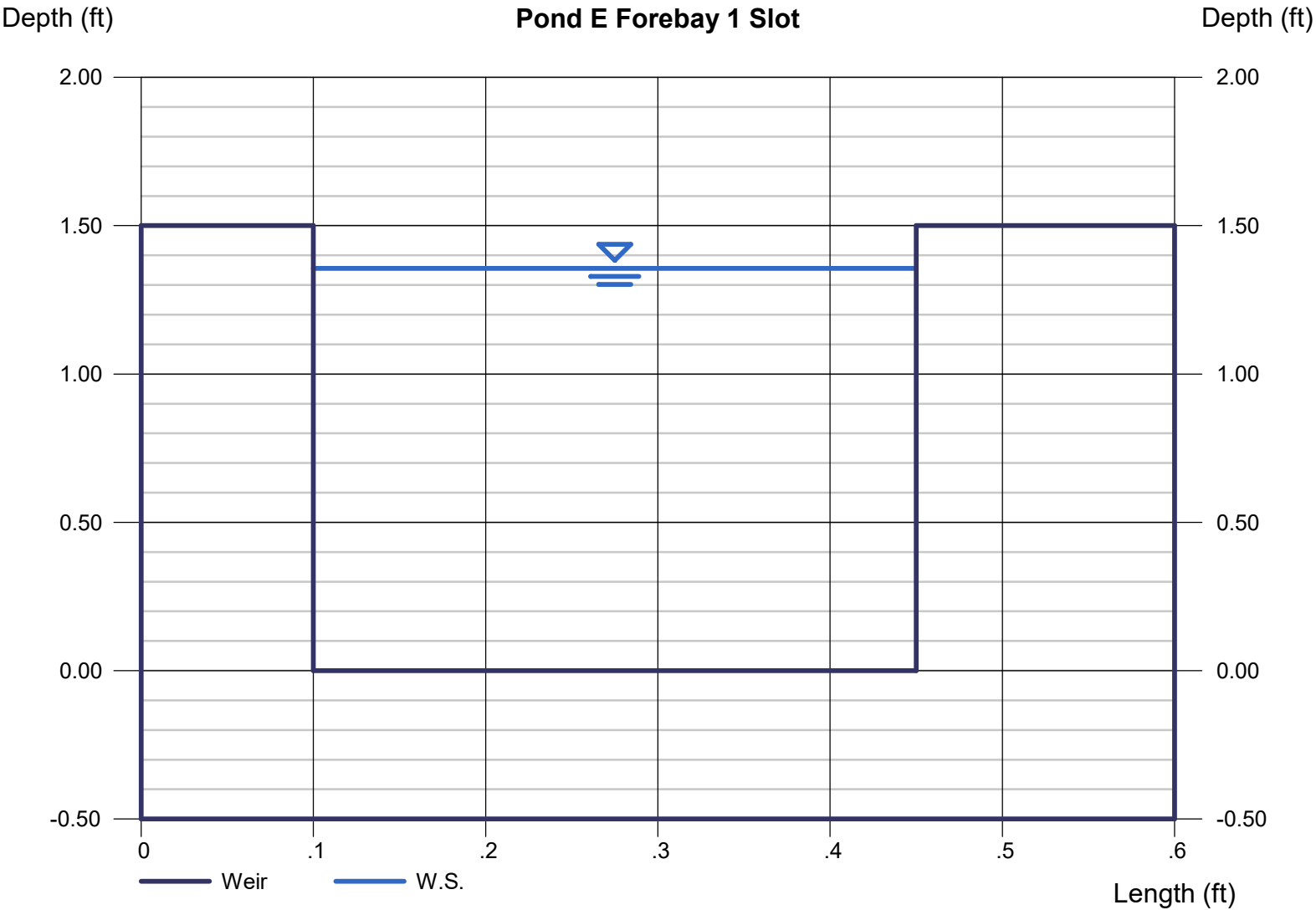
Calculations

Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 1.84

Highlighted

Depth (ft) = 1.36
Q (cfs) = 1.840
Area (sqft) = 0.47
Velocity (ft/s) = 3.88
Top Width (ft) = 0.35

100-year inflow to
Forebay 2 is 92.04
cfs. 2% is 1.84 cfs



Weir Report

Forebay 2 Slot

Pond E

Rectangular Weir

Crest = Sharp
Bottom Length (ft) = 0.10
Total Depth (ft) = 1.50

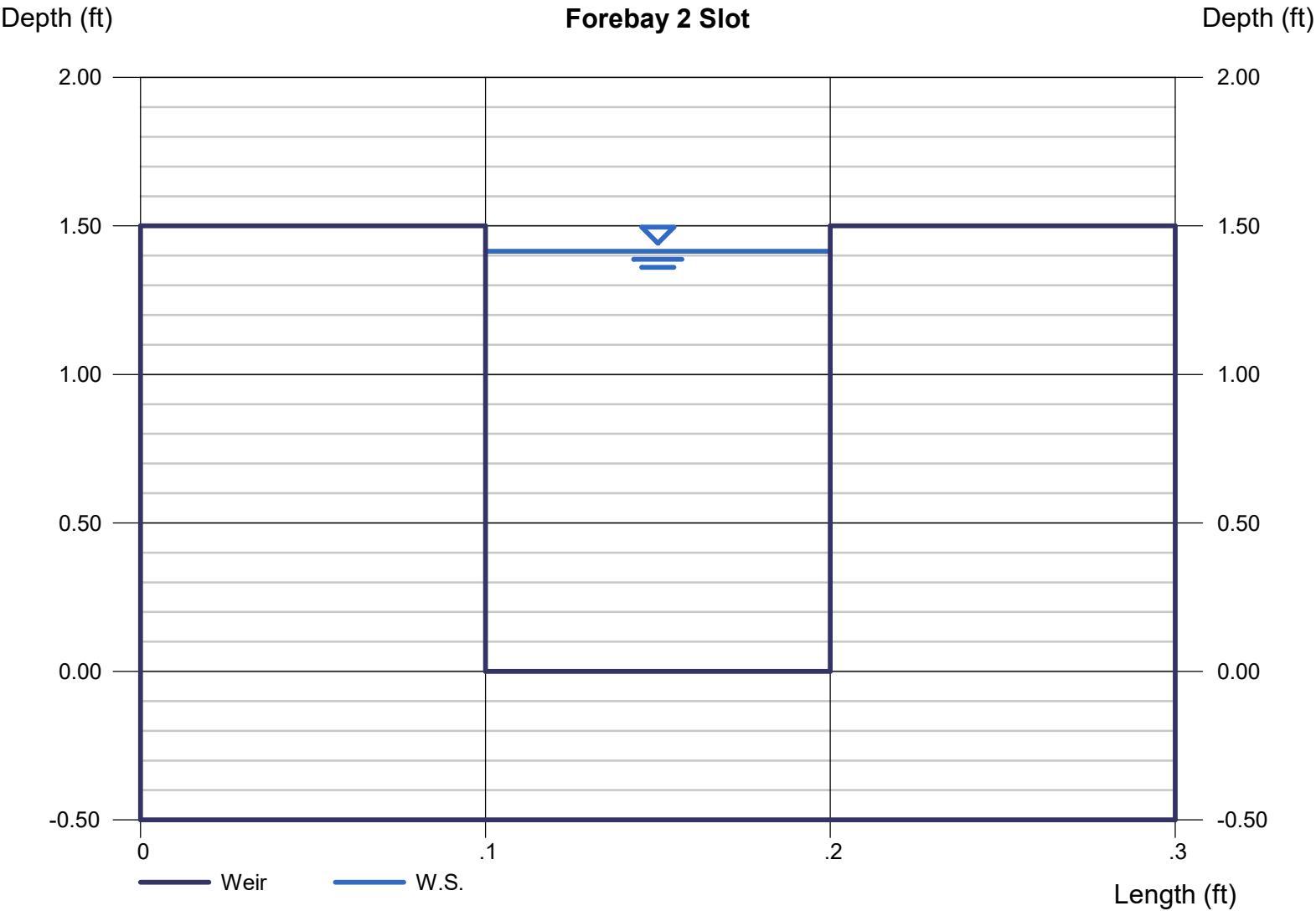
Calculations

Weir Coeff. Cw = 3.33
Compute by: Known Q
Known Q (cfs) = 0.56

Highlighted

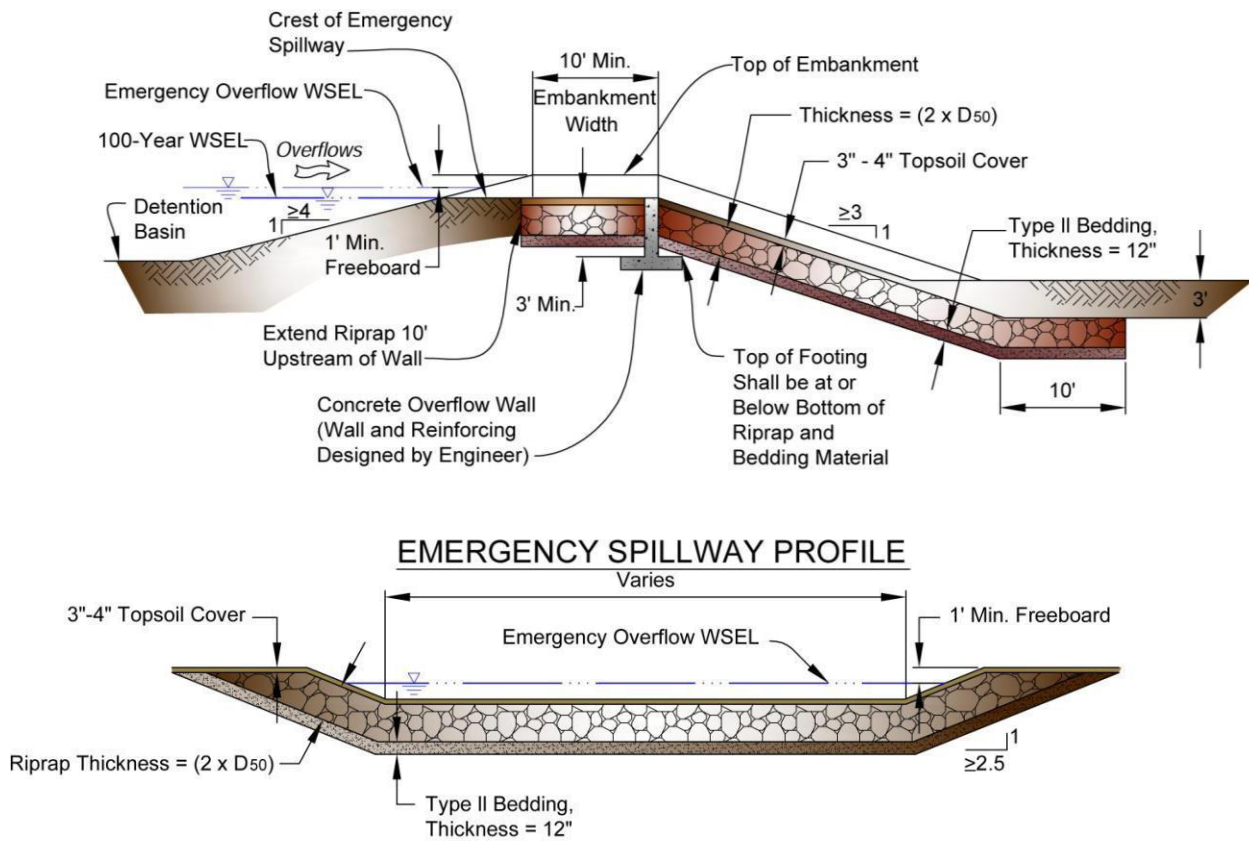
Depth (ft) = 1.41
Q (cfs) = 0.560
Area (sqft) = 0.14
Velocity (ft/s) = 3.96
Top Width (ft) = 0.10

100-year inflow to
Forebay 2 is 27.88
cfs. 2% is 0.56 cfs

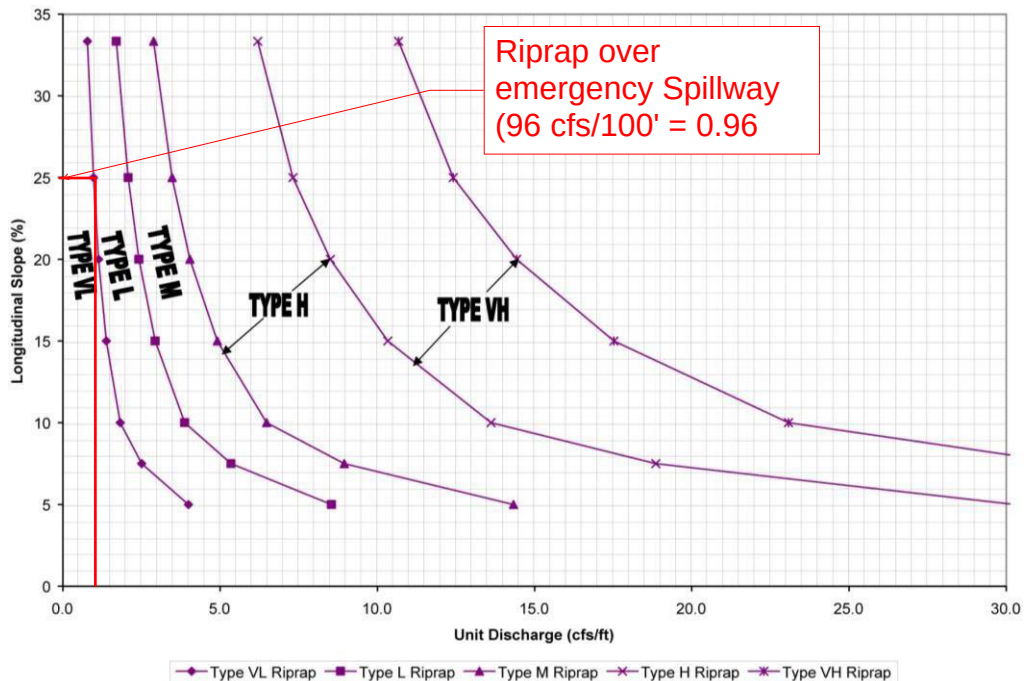


Chapter 13. Storage

**FIGURE 13-7
EMBANKMENT PROTECTION DETAILS AND ROCK SIZING CHART**



SPILLWAY CHANNEL AT CREST AND DOWNSTREAM SIDE OF EMBANKMENT



RIPRAP & TOEWALL CALCULATIONS FOR CIRCULAR PIPE - FES A5

Project: Terrain North Basin (Phase I)

Sheet 2 of 3

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

Pond E

Extent of Protection per Section 3.1.1

$L_p = (1/2 \tan \theta) [(A_t/Y_t) - D]$ ft	length of protection; Equation 9-11
D = 2.00 ft	diameter of outlet pipe
$Y_t = 1.00$ ft	depth of tailwater, 0.4D if unknown or if hydraulic jump downstream
$A_t = Q/V$ ft ²	required area of flow at allowable velocity; Equation 9-12
Q = 24.30 cfs	100-year discharge
V = 7 ft/sec	maximum velocity allowed; see Table 8-1
	5 ft/sec for non-cohesive soils; 7 ft/sec for cohesive soils
$A_t = 3.47$ ft ²	

$$Y_t/D = 0.50$$

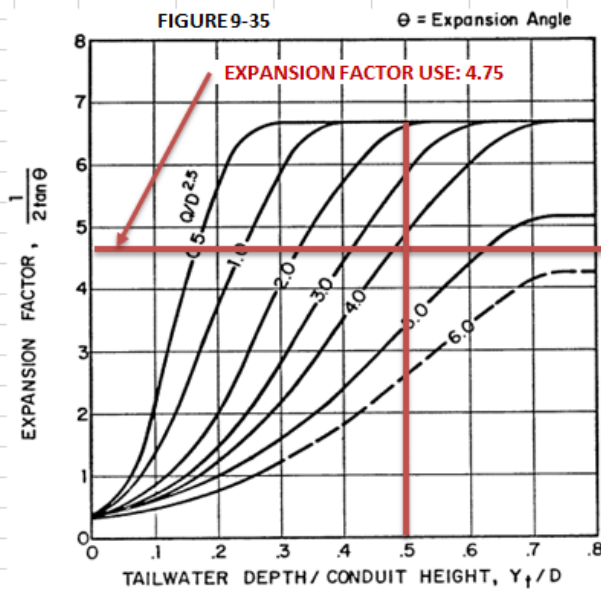
(for use with Figure 9-35)

$$Q/D^{2.5} = 4.30$$

(P_F) Froude Parameter (for use with Figure 9-35)

if $P_F \leq 6.0$: min. $L_p = 3D$, max. $L_p = 10D$, else if $P_F > 6.0$:

$L_p = L_p$ per above + $(P_F - 6.0)$ rounded up to whole number x 0.25D



$$1/2 \tan \theta = 4.75$$

(F_E) Expansion Factor, result from Figure 9-35

$$\theta = \tan^{-1} [1/(2 * F_E)] \text{ rad}$$

Equation 9-13

$$\theta = 0.10 \text{ rad}$$

RIPRAP & TOEWALL CALCULATIONS FOR CIRCULAR PIPE - FES A5

Project: Terrain North Basin (Phase I)

Sheet 1 of 3

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

$$L_p = 7 \text{ ft}$$

see Figure 9-34; accounts for min. and max. conditions

Riprap Sizing per Section 3.2.3

$$T = 2(L_p \tan \theta) + D \text{ ft}$$

width of riprap at furthest downstream point; Equation

$$T = 3 \text{ ft}$$

downstream width of protection; see Figure 9-34

$$L_p = (1/2 \tan \theta) [(A_t/Y_t) - D] \text{ ft}$$

length of protection; Equation 9-11

$$D = 24 \text{ in}$$

diameter of outlet pipe

$$Y$$

flow in pipe is supercritical (Y or N), N if unknown

$$D_a = (D + Y_n)/2 \text{ ft}$$

adjusted value of D for supercritical flow; Equation 9-19

$$Y_n = 1.00 \text{ ft}$$

normal depth in pipe, NA if unknown or flow is not supercritical

$$D_a = 1.50 \text{ ft}$$

$$Y_t = 0.80 \text{ ft}$$

depth of tailwater, 0.4D if unknown or if hydraulic jump downstream

$$Q = 24.30 \text{ cfs}$$

100-year discharge

$$Q/D^{1.5} = 13.23$$

Froude Parameter; for use with Figure 9-38

$$Y_t/D = 0.53$$

tailwater depth/pipe diameter; for use with Figure 9-38

NOTE: the formula below is used for rock sizing in lieu of Figure 9-38

$$D_{50} = 0.023Q/(Y_t^{1.2} D^{0.3}) \text{ in}$$

mean rock diameter; Equation 9-17

$$D_{50} = 9 \text{ in}$$

use Type L riprap per Figure 9-38

$$2D_{50} = 1.5 \text{ ft}$$

thickness of riprap layer



Summary of Water Quality Conformance to MS4 Permit

2. Was an exclusion to water quality applied as per SDDTCM Section 13.1.5? ☐ Yes ☐ No

i. If yes, please select all that apply, provide total excluded impervious area(s) and submit variance, as applicable: TCV No. _____

- ☐ Pavement management site
Excluded impervious area: _____ acres
- ☐ Excluded roadway redevelopment
Excluded impervious area: _____ acres
- ☐ Excluded existing roadway areas
Excluded impervious area: _____ acres
- ☐ Above ground and below ground utilities
- ☐ Large lot single family home
- ☐ Non-residential and non-commercial infiltration
Excluded impervious area: _____ acres
- ☐ Land disturbance for land to remain undeveloped
Excluded impervious area: _____ acres
- ☐ Stream Stabilization Sites
Excluded impervious area: _____ acres
- ☐ Trails
Excluded impervious area: _____ acres
- ☐ Oil and Gas Exploration

3. For Development and Redevelopment sites, following any exclusions claimed above, was any portion of the site excluded up to 20% of the site and not to exceed one acre? ☐ Yes ☐ No

If yes, complete the following:

Excluded area: _____ acres
Total Site area: _____ acres, _____ % site excluded

4. For Constrained sites, was any portion of the site excluded up to 50% of the site and not to exceed 50% of the impervious area? ☐ Yes ☐ No

If yes, complete the following:

Excluded area: _____ acres
Excluded impervious area: _____ acres
Total Site area: _____ acres, _____ % site excluded
Total Impervious area: _____ acres, _____ % impervious excluded

Permanent Water Quality Determination Worksheet (Taken from 2019 SDDTCM Sections 13.1.4 and 13.1.5)

Project:	Millers Landing East Early Grading	Project#	CD22-0049	Applicant:	Core Consultants
Section	Questions	Response	Check those that apply	Instructions	
1	Non-applicable Sites				
1.1	Will the project result in a temporary disturbance of greater than one acre?	No Yes	☐ ☒	Proceed to section 1.2. Proceed to section 2.	
1.2	Is the project part of a larger common plan of development or sale where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related and are within 1/4 mile of each other? (A common plan of development will generally be documented on a site development plan, master plan, or equivalent, for the property/project)	No Yes	☐ ☐	Proceed to section 1.3. Proceed to section 2.	
1.3	Is the project within the Cherry Creek Watershed?	Yes No	☐ ☐	Permanent water quality control measures may be required. Refer to Water Quality Control Regulation 72.7 for details and allowable exclusions. Permanent water quality control measures are not required.	
2	Applicable Site Types and Exclusions by Variance				
2.1	Does the project have more than 35% impervious area on the existing site?	No Yes	☒ ☐	Project is an applicable Development Site. Proceed to section 3. Proceed to 2.2.	
2.2	Does the project have greater than 75% impervious area on the existing site?	No Yes	☐ ☐	Project is an applicable Redevelopment Site. Proceed to section 3. Project is an applicable Constrained Redevelopment Site. Proceed to 2.3.	
2.3	Will 100% of the runoff from the existing and proposed site be captured and treated using one or more of the allowable design standards for permanent water quality?	Yes No	☐ ☐	No further action required. Proceed to 2.4.	
2.4	Do any other water quality exclusions apply to the site?	No Yes	☐ ☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for variance for <u>Constrained Redevelopment Sites</u> . Proceed to section 3. Following approval of other exclusions, design remaining site in accordance with Constrained Redevelopment standards and apply for variance for <u>Constrained Redevelopment Sites</u> .	
3	Applicable Sites with Other Exclusions by Variance				
3.1	Category 1: Roadways, bridges and trails only				
3.1.1	Is the project a bike or pedestrian trail?	Yes No	☐ ☐	Proceed to next line. Proceed to 3.1.2.	
	Is the trail for a roadway?	Yes No	☐ ☐	Proceed to 3.1.2. Project is excluded. Submit variance for <u>Trails Excluded from Permanent Water Quality Requirements</u> .	
3.1.2	Is the project primarily used for parking or access to parking?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to 3.1.3.	
3.1.3	Does the project add impervious area?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Pavement Management Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.1.4.	

Section	Questions	Response	Check those that apply	Instructions
3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No Yes	☐ ☐	Existing areas of site are excluded only. Submit variance for <u>Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements</u> . This exclusion does not apply. Permanent water quality is required.
3.2	Category 2: Non-residential and non-commercial projects only			
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	Yes No	☐ ☐	Project is excluded. Submit variance for <u>Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes No	☐ ☐	Project is excluded. Submit variance for <u>Stream Stabilization Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of aboveground or underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	Yes No	☐ ☐	Project is excluded. Submit variance for <u>Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	Yes No	☐ ☐	Project is excluded. Submit variance for <u>Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No Yes	☐ ☐	Project is excluded. Submit study along with variance for <u>Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements</u> . This exclusion does not apply. Permanent water quality is required.
3.3	Category 3: Residential, Agricultural and Commercial projects			
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	Yes No	☐ ☒	Proceed to next line. Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No Yes	☐ ☐	Project is excluded. Submit variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Is the project site greater than 20% impervious?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No Yes	☐ ☐	Project is excluded. Submit study along with variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> . This exclusion does not apply. Permanent water quality is required.

Section	Questions	Response	Check those that apply	Instructions
3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	Yes No	☒ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes No	☐ ☐	This portion of the project is excluded. Submit variance for <u>Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . Proceed to next line. Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes No	☐ ☐	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No Yes	☐ ☐	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the drainage report . No further action is needed. This exclusion does not apply. Permanent water quality is required.



Phase III Drainage Report Checklist

The Phase III Drainage Report must be in conformance with the latest Town of Castle Rock Storm Drainage Design and Technical Criteria Manual available on the Town's website.

The Phase III Drainage Report must be signed and sealed by a Professional Engineer licensed in the State of Colorado. The purpose of the Phase III Drainage Report is to update the concepts, and to present the design details on construction plans for the drainage facilities discussed in the Phase II Drainage Report.

The preparer should contact and work with the Town Stormwater Engineering Staff regarding any design, master planning and existing system questions (720-733-6000). The following outline sets forth the **required minimum** content to be provided in the Phase III Drainage Report that shall be submitted with the Planned Development Plan or Straight Zoning documents. A copy of this checklist must be submitted with the Phase III Drainage Report.

Please see Chapter 4 of the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual for additional details and information. Please check off the following items to assure your report is complete. Appropriate notations shall be provided with the checklist. For example, if a specific item is not addressed or not applicable, an explanation needs to be provided.

Included	N/A	
✓		I. COVER SHEET
✓		A. Name of Project, including legal name of development
✓		B. Address
✓		C. Owner
✓		D. Developer
✓		E. Engineer
✓		F. Submittal date and revision dates as applicable
✓		II. GENERAL LOCATION AND DESCRIPTION
✓		A. Site Location
✓		B. Description of Property and Land Use
✓		III. DRAINAGE BASIN AND SUB-BASINS
✓		A. Major Drainage Basins
✓		B. Minor Drainage Basins
✓		IV. DRAINAGE DESIGN CRITERIA
✓		A. Regulations
✓		B. Drainage Studies, Master Plans, Site Constraints
✓		C. Hydrology
✓		D. Hydraulics
✓		E. Water Quality Enhancement

Phase III Drainage Report Checklist

Included	N/A	
✓		V. STORMWATER MANAGEMENT FACILITY DESIGN
✓		A. Stormwater Conveyance Facilities
✓		B. Stormwater Storage Facilities
✓		C. Water Quality Enhancement Best Management Practices
✓		D. Floodplain Modification
✓		E. Additional Permitting Requirements
✓		F. General
✓		VI. CONCLUSIONS
✓		A. Compliance with Standards
✓		B. Variances
✓		C. Drainage Concept
✓		VII. REFERENCES
✓		VIII. APPENDICES
✓		A. Hydrologic Computations
✓		B. Hydraulic Computations
✓		C. Water Quality Enhancement Best Management Practices
✓		D. Referenced Information
✓		OVERALL DRAINAGE PLAN (IN POCKET)
✓		DETAILED DRAINAGE PLANS (IN POCKET)

Notes/Comments: