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Final Drainage Report
for Church at Bent Grass Meadows

July 2026

HR Green Project No: 2403591

Prepared For:

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PCD File No. SF268

EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

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Engineer's Statement

This report and plan for the drainage design of the development, Church at Bent Grass Meadows, was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the *El Paso County Drainage Criteria* Manual and is in conformity with the master plan of the drainage basin. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____ _____

Richie Lyon, PE — Date

State of Colorado No. 53921

For and on behalf of HR Green Development, LLC

Developer's Statement

I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

_____ _____

FAL Realty, LLC — Date

El Paso County:

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2 and the Engineering Criteria Manual, as amended.

_____ _____

Joshua J. Palmer, P.E. — Date

County Engineer/ECM Administrator

I. General Purpose, Location and Description

a. Purpose

This Final Drainage Report (FDR) aims to identify specific solutions to drainage concerns resulting from the development of the site. The report outlines the onsite and offsite drainage patterns, details the existing and proposed storm infrastructure, and proposes a solution for effectively routing developed stormwater to an adequate detention facility. A full-spectrum detention pond is proposed as the permanent control measure and is designed based on an analysis of changes in slopes, drainage patterns, and impervious areas which yield new peak stormwater runoff quantities compared to the existing conditions. Hydrologic and hydraulic calculations for both onsite and offsite areas, along with an assessment of the existing downstream stormwater infrastructure, are provided to demonstrate compliance with County stormwater criteria and ensure that existing infrastructure is not negatively impacted by this development.

b. Location

Church at Bent Grass Meadows totals 8.34 acres, referred to as 'the site' herein, is a portion of the east half of the northeast quarter of Section 1, Township 13 South, Range 65 West of the 6th P.M., El Paso County, Colorado. The site is a lot within the Bent Grass subdivision described in the Master Development Drainage Plan by Kiowa Engineering Corporation dated April 2006 entitled *Master Development Drainage Plan and Preliminary Drainage Plan Bent Grass Subdivision El Paso County, Colorado,* approved by El Paso County in August of 2007. The site is bound to the north by the Woodmen Hills Filing No. 4 residential subdivision. To the east of the site is the 120' wide public right-of-way of Meridian Road and across the roadway is Woodmen Hills Filing No. 5 and Filing No. 8. Directly adjacent to the site's eastern property boundary is a 75' wide right-of-way dedication, Reception No. 211037676. Immediately south of the site is the 80'-wide public right-of-way of Bent Grass Meadows Drive and south of the roadway are the commercial subdivisions of Bent Grass Plaza and Bent Grass East Commercial. There are no existing or proposed public roadways internal to the site. The assessor's parcel numbers for the two lots to be platted as a single lot for this development are 5301000026 and 5301000033. The property is not within a Streamside Zone or Hillside Zone. There are no no-build or preservation easements or areas within the platted parcel.

A vicinity map is presented in Appendix A.

c. Description of Existing Conditions

The undeveloped site (zoned CS) consists of no site improvements apart from a partially paved entry to the site off Bent Grass Meadows Drive which has a concrete cross pan and curb and gutter. The overall on-site imperviousness is approximately 1% and roughly 90% of the site is covered by native grasses and wildflowers. There are no trees or shrubs of significance existing on site. The site generally slopes from the northwest down to the southeast at grades ranging from 2% to 4%, with the average slope being 2.3%. The existing Bent Grass Meadows Drive roadway to the south of the site slopes from the west to the east at roughly a 1% slope.

The site consists of 100% Columbine gravelly sandy loam per the USDA, NRCS web soil survey. This soil is categorized as Hydrologic Soil Group A. The NRCS soil survey is presented in Appendix A.

The *Natural Features and Wetlands Report* prepared by Bristlecone Ecology, dated October 2024, identifies Black-tailed Prairie Dogs and Burrowing Owls as sensitive species of concern on site. Per the report, a colony of approximately 34 Black-tailed Prairie Dogs or more were observed in a 6.8 acre area. Burrowing Owls

typically utilize abandoned Prairie Dog burrows for nesting, which was the case for one observed owl onsite. Not mentioned in the report is the undeveloped land to the west, which may likely provide a suitable relocation for the aforementioned sensitive species. A specific construction schedule has been planned in which clearing, grubbing, and earthwork cannot take place during the nesting season of the Burrowing Owl (March 15th to July 31st).

d. Description of Proposed Conditions

The developed site is to include a 39,338 square foot church building, paved parking lot areas, a private storm sewer network, and a private water quality and full spectrum detention pond. The proposed building is located in the northwest corner of the site and the proposed pond is located in the southeast corner of the site. The bulk of the on-site parking is within the northeast and southwest corners of the site. Private drive aisles go around the perimeter of the church building and throughout the parking areas on site. Landscape areas are dispersed throughout the parking area, around the detention pond, and at the perimeter of the site for landscape buffering to screen the commercial development from the adjacent residential land uses and provide landscaping along adjacent rights-of-way. The site is accessed by two entries on the adjacent public right-of-way of Bent Grass Meadows Drive roadway to the south. The primary access is the existing curb cut which is full movement and the secondary access is a right-in/right-out only ingress/egress for the site.

The on-site private storm includes a private Type D sump grate area inlet near the south of the site. This inlet drains to a forebay within the private pond through a concrete storm pipe. From the design point northeast of the pond, stormwater flows from the sump to the other forebay via a concrete rundown channel. Near the northwest corner of the pond, a curb opening with drainage chase allows stormwater to flow within a concrete channel under the sidewalk and into a riprap pad within the pond. The private water quality and detention pond includes an outlet structure with orifice plate and micropool that is designed to provide detention and release the stormwater at or below historic rates.

The entirety of the 8.34 acre site will be disturbed for development. Offsite disturbances included in the project will connect the site to existing public utilities owned and maintained by Woodmen Hills Metropolitan District within the Bent Grass Meadows right-of-way. Public improvements include the addition of a right-in lane on the north side of Bent Grass Meadows Drive for a taper and queue to enter the site, per the Traffic Impact Study. Other right-of-way improvements include the typical sections of a tree lawn and public concrete sidewalk with an ADA accessible route to the church building from the public right-of-way adjacent to the frontage of the site, on the north side of Bent Grass Meadows Drive.

e. Floodplain Statement

Based on FEMA Firm map 08041C0553G dated December 7, 2018, the site is Zone X, which are areas determined to be outside the 0.2% annual chance flood. No portion of the site is within a designated FEMA floodplain.

A map is provided in Appendix A.

II. Drainage Basins and Subbasins

a. Major Basin Description

The site is located within the Falcon Drainage Basin (CHWS1400). The site's drainage characteristics were previously studied in the following reports:

1. *Falcon Drainage Basin Planning Study* dated September 2015, prepared by Matrix Design Group (MP132)
2. *Bent Grass MDDP Amendment & DBPS Amendment* dated September 2021, prepared by Galloway & Company (MDP211)
3. *Final Drainage Report for Falcon Marketplace* dated November 2019 prepared by Drexel, Barrel & Co. (SF191)
4. *Request for Conditional Letter of Map Revision, Unnamed Tributary to Black Squirrel Creek, Falcon Owl Place* dated October 2022 (CLOMR)
5. *Final Drainage Report for Meridian Road & Bent Grass Meadows Drive* dated March 2020, prepared by Galloway & Company (CDR194)

The site is within the Middle Tributary area of the Falcon Drainage Basin, specifically within the MT060 sub-basin as designated by the 2015 DBPS and is referred to as Reach RMT064 in the 2021 DBPS Amendment by Galloway & Company. The site ultimately flows into the public roadside ditch on the west side of Meridian Road and on the north side of Bent Grass Meadows Drive where there are five existing public culvert pipes. This public ditch flows due south and into the storm system of the Owl Place development (VR2321, June 2024 by Drexel, Barrel & Co.) that conveys stormwater to the sub-regional detention pond at the King Soopers site referred to as Detention Facility SR4 (County File No. SF191). The Owl Place drainage study accounted for upstream stormwater basins with an assumption of on-site detention for development, which includes this site. The downstream Pond SR4 also assumed the same upstream drainage characteristics. Therefore, as long as on-site detention is provided so as to not exceed the historical stormwater runoff from this site, no downstream infrastructure or detention alterations are required.

b. Existing Subbasin Description

The existing subbasins were delineated based on existing drainage patterns. The on-site basins are comprised of undeveloped land except for the partially completed entry to the site. 2% imperviousness was assumed for each on site basin due classification of the site as greenbelts or agricultural land.

The following basins and sub-basins have been delineated.

Existing Basin A has a tributary area of **6.81 acres with a minor (5-year event) runoff of 2.21 cfs and major (100-year event) runoff of 14.82 cfs**. The basin is in the western 80 percent of the site. The basin contains undeveloped land (zoned CS) with and a partially completed entryway to the site. The vegetation within the basin includes native grasses, wildflowers, and weeds. Runoff within the basin flows from northwest to southeast. The basin drains to **Design Point 1**, the curb and gutter within the right of way of Bent Grass Meadows Drive. The basin ultimately drains due east to the south flowing public ditch on the west side of North Meridian Road.

Existing Basin B has a total tributary area of **1.53 acres with a total minor (5-year event) runoff of 0.54 cfs and major (100-year event) runoff of 3.63 cfs**. The basin is in the eastern 20 percent of the site. The

basin consists entirely of undeveloped land (zoned CS). The vegetation within the basin includes native grasses, wildflowers, and weeds. Runoff within the basin flows from northwest to southeast. The basin drains to **Design Point 2**, the south flowing channel west of Meridian Road.

Existing Basin OS has a total tributary area of **4.72 acres with a total minor (5-year event) runoff of 1.56 cfs and major (100-year event) runoff of 10.50 cfs**. The basin is located to the west of the site and is delineated such that all runoff that would enter the site is included. The basin contains undeveloped land (zoned RR-5 PUD) as well as improvements such as a single-family residence and accessory buildings such as sheds, barns, and stables. The vegetation within the basin includes native grasses, wildflowers, weeds, and pine and shade trees. Runoff within the basin flows from northwest to southeast. The basin drains to **Design Point 3**, the curb and gutter within the right of way of Bent Grass Meadows Drive.

Reference maps are included in Appendix G.

c. Proposed Subbasin Description

The Church at Bent Grass Meadows developed area basins and subbasins vary from the historical basins due to changes in site layout and drainage conveyance.

The following basins were delineated per the revised site layout. The on site basins are to be zoned CS. Existing **Basin OS** remains unchanged.

Developed Basin A1 has a total tributary area of **2.41 acres with a total minor (5-year event) runoff of 7.78 cfs and major (100-year event) runoff of 14.62 cfs**. Basin A1 is within the western portion of the site and spans most of the property in the north/south direction. Within Basin A1 are drive aisles, parking stalls, and landscaped area. Runoff from the building rooftop is conveyed to daylight areas within the paved parking lot via roof drains and downspouts until being channelized within the gutter system and released into landscaped areas. Runoff within Basin A1 overland sheet flows across parking areas until it concentrates within the curb and gutter and drainage pans within the site. Basin A1 drains to **Design Point 1**, a private CDOT Type D grate sump inlet within a landscape area and is conveyed via a storm pipe a forebay in the private full spectrum detention pond.

Developed Basin A2 has a total tributary area of **2.80 acres with a total minor (5-year event) runoff of 9.81 cfs and major (100-year event) runoff of 18.29 cfs**. Basin A2 spans most of the northeastern portion of the site. Within Basin A2 are drive aisles, parking stalls, and landscaped area. Runoff from the building rooftop is routed via roof drains and downspouts to daylight areas in the parking lot until being channelized within the gutter system and released into landscaped areas. Runoff within Basin A2 overland sheet flows across parking areas until it concentrates within the curb and gutter and drainage pans within the site. Basin A2 drains to a low point in the southeastern corner of the basin, **Design Point 2**, which is an opening in the curb to a concrete rundown that flows south to the private full spectrum detention pond.

Developed Basin A3 has a total tributary area of **0.37 acres with a total minor (5-year event) runoff of 1.55 cfs and major (100-year event) runoff of 2.87 cfs**. Basin A3 is in the center of the site and consists of part of the church building per its roof plan, drive aisles, and landscaped area. Runoff from the building rooftop is routed via roof drains and downspouts to daylight areas in the parking lot until being channelized within the gutter system and released into landscaped areas. Runoff within Basin A3 overland sheet flows across landscaped and paved areas until it concentrates within the curb and gutter. The basin drains to **Design Point 3**, a curb opening with drainage chase in the southeast of the basin. The concrete rundown

channel directs flow generated within a small section of roadway under the sidewalk and into a riprap pad within the full spectrum detention pond to the east.

Developed Basin A4 has a total tributary area of **0.74 acres with a total minor (5-year event) runoff of 0.42 cfs and major (100-year event) runoff of 1.94 cfs**. Basin A4 is located in the southeastern corner of the site. The basin contains the private full spectrum detention pond and surrounding landscape areas. Runoff within Basin A4 overland sheet flows into the detention pond except in the concrete rundowns and trickle channel where the flow is channelized. Basin A4 ultimately drains to **Design Point 4**, the outlet structure for the private detention pond. The private detention pond outflows to the public drainage ditch on the west side of Meridian Road which conveys stormwater due south via five public culvert pipes crossing Bent Grass Meadows Drive and continues via the public ditch due south within the public right-of-way.

Developed Basin N1 has a total tributary area of **0.24 acres with a total minor (5-year event) runoff of 0.08 cfs and major (100-year event) runoff of 0.57 cfs**. Basin N1 is a fully pervious thin landscape strip on the north of the site containing a berm and swale to direct any offsite flows to the drainage ditch to the east of the site. Runoff overland sheet flows across landscape area until it concentrates within the grass lined swale. The basin drains to **Design Point 5**, the drainage ditch east of the site.

Developed Basin E1 has a total tributary area of **0.27 acres with a total minor (5-year event) runoff of 0.11 cfs and major (100-year event) runoff of 0.81 cfs**. Basin E1 is a thin strip on the eastern edge of the property that spans most of the site north to south. The basin is fully pervious and contains landscape areas that daylight down to the existing ground to the east. Runoff overland sheet flows across the basin until reaching the drainage ditch to the east of the site, **Design Point 6**.

Developed Basin S1 has a total tributary area of **0.71 acres with a total minor (5-year event) runoff of 1.23 cfs and major (100-year event) runoff of 2.94 cfs**. Basin S1 is on the southern edge of the site and contains both the west and east site entrances. The basin is made up of landscape areas, paved sidewalks, and paved internal and public roadway surfaces. Runoff overland sheet flows across landscaped and paved areas until it concentrates within the curb and gutter within the public right of way of Bent Grass Meadows Drive, **Design Point 7**.

Developed Basin S2 has a total tributary area of **0.00 acres with a total minor (5-year event) runoff of 0.01 cfs and major (100-year event) runoff of 0.02 cfs**. Basin S2 is south of the roadway within the Bent Grass Meadows right of way. The basin is made up of landscape area and improvements within the basin include a pedestrian crossing ramp to connect the sidewalk on the north and south of the Bent Grass Meadows roadway. Runoff overland sheet flows across landscaped and paved areas until it concentrates within the curb and gutter within the public right of way of Bent Grass Meadows Drive, **Design Point 9**.

Developed Basin W1 has a total tributary area of **0.18 acres with a total minor (5-year event) runoff of 0.05 cfs and major (100-year event) runoff of 0.38 cfs**. Basin W1 is a thin strip on the western edge of the property that spans most of the site north to south. The basin contains landscape area and a grass lined swale that are fully pervious.

The swale within Basin W1 accepts overland sheet flow from existing offsite Basin OS, represented as **Design Point** E3, and ultimately drains to **Design Point 8**, a curb chase which conveys flows under the public sidewalk into the curb and gutter within the Bent Grass Meadows right of way. Combined flows at **Design Point 8** are Q_5 = 1.62 cfs, Q_{100} = 10.88 cfs.

Developed Basin RN1 has a total tributary area of **0.19 acres with a total minor (5-year event) runoff of 0.61 cfs and major (100-year event) runoff of 1.13 cfs**. Basin RN1 is delineated per the roof drainage plan. Runoff from the building rooftop is conveyed to a downspout which is directly connected to the private roof drain storm network that ultimately connects to the downstream private Type D inlet.

Developed Basin RN2 has a total tributary area of **0.15 acres with a total minor (5-year event) runoff of 0.46 cfs and major (100-year event) runoff of 0.86 cfs**. Basin RN1 is delineated per the roof drainage plan. Runoff from the building rooftop is conveyed to a downspout which is directly connected to the private roof drain storm network that ultimately connects to the downstream private Type D inlet.

Developed Basin RS1 has a total tributary area of **0.08 acres with a total minor (5-year event) runoff of 0.23 cfs and major (100-year event) runoff of 0.43 cfs**. Basin RN1 is delineated per the roof drainage plan. Runoff from the building rooftop is conveyed to an internal roof drain which is directly connected to the private roof drain storm network that ultimately connects to the downstream private Type D inlet.

Developed Basin RS2 has a total tributary area of **0.21 acres with a total minor (5-year event) runoff of 0.63 cfs and major (100-year event) runoff of 1.18 cfs**. Basin RN1 is delineated per the roof drainage plan. Runoff from the building rooftop is conveyed to an internal roof drain which is directly connected to the private roof drain storm network that ultimately connects to the downstream private Type D inlet.

Developed Basin RS3 has a total tributary area of **0.21 acres with a total minor (5-year event) runoff of 0.63 cfs and major (100-year event) runoff of 1.18 cfs**. Basin RN1 is delineated per the roof drainage plan. Runoff from the building rooftop is conveyed to an internal roof drain which is directly connected to the private roof drain storm network that ultimately connects to the downstream private Type D inlet.

Developed Basin RS4 has a total tributary area of **0.08 acres with a total minor (5-year event) runoff of 0.24 cfs and major (100-year event) runoff of 0.45 cfs**. Basin RN1 is delineated per the roof drainage plan. Runoff from the building rooftop is conveyed to an internal roof drain which is directly connected to the private roof drain storm network that ultimately connects to the downstream private Type D inlet.

d. Downstream Drainage

This development includes a private full spectrum detention facility that provides detention of stormwater from the developed site. The private on-site pond includes an outlet pipe that drains to the roadside drainage ditch within the public right-of-way of Meridian Road. Runoff is then conveyed under Bent Grass Meadows Drive via five existing 36” equivalent elliptical pipe. The MDDP & DBPS Amendment for Bent Grass Development by Galloway has analyzed these pipes and they currently overtop in the major storm event. The culverts have been analyzed with the developed flows from this proposed development, which is provided in Appendix C. In future improvements outside of this project, these culverts are to be replaced by a dual concrete box culvert and the roadside ditch upstream of the box culvert is to become a constructed channel per the MDDP & DBPS Amendment by Galloway. The public ditch conveys stormwater due south to the Owl Marketplace development that includes private storm system consisting of 10’x6’ concrete box culverts that drain to the Falcon Marketplace Pond SR4, which is considered a sub-regional detention facility. This site was not accounted for in the detention volume of Pond SR4 in its developed condition, nor within the conveyance of stormwater within the private storm system of the Owl Marketplace development. However, the downstream developments of Owl Marketplace and Falcon Marketplace analyzed upstream tributary areas and accounted for historical stormwater routing to their respective developments and infrastructure. The assumption made in the Owl Marketplace and Falcon Marketplace drainage studies was that upstream development would include full

spectrum detention to not increase the stormwater to proposed design points. The Church at Bent Grass Meadows development includes a private on-site water quality and detention pond that is designed to provide stormwater detention resulting in stormwater release from the site that is below historical rates, as shown in the hydraulic calculations in Appendix C. It is anticipated that there will be no negative impacts to downstream properties, developments, or infrastructure.

The tables below show the reduction in stormwater runoff releases from the site directed off site to Design Point X1, the design point at the northeast corner of Owl Marketplace, where the roadside ditch of Meridian Road is conveyed within the Owl Marketplace private storm infrastructure.

Peak Outflow - Existing Condition		
Basin	**5-Yr Peak Outflow (cfs)**	**100-Yr Peak Outflow (cfs)**
A	2.21	14.82
B	0.54	3.63
OS	1.56	10.50
Total To Ditch (RMT064)	**4.31**	**28.95**

Peak Outflow - Proposed Condition		
Basin	**5-Yr Peak Outflow (cfs)**	**100-Yr Peak Outflow (cfs)**
Pond A	0.37	5.99
N1	0.08	0.57
E1	0.11	0.81
S1	1.23	2.94
S2	0.01	0.02
W1	0.05	0.38
OS	1.56	10.50
Total To Ditch (RMT064)	**3.41**	**21.21**

	5-Yr Peak Outflow (cfs)	**100-Yr Peak Outflow (cfs)**
Outflow Reduction	0.90	7.74
	20.9%	26.7%

Downstream Design Point	Existing 5-Yr Peak Outflow (cfs)	Proposed 5-Yr Peak Outflow (cfs)	Existing 100-Yr Peak Outflow (cfs)	Proposed 100-Yr Peak Outflow (cfs)
X1	288.5	287.60	920	912.26

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis of existing and proposed storm sewer system follows the criteria from the *El Paso County Drainage Criteria Manual Volumes 1 and 2* (EPC DCM, latest revision October 2018).

b. Hydrologic Criteria

Hydrologic data was obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 5 Storm Runoff Methods of Analysis.* Runoff was calculated per *El Paso County, Colorado Drainage Criteria Manual – Section 5.2 - Rational Method.* Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from NOAA Atlas 14 below.

Rainfall Depths for Site Location		
Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.50	2.52

Private, full spectrum pond design was completed using the latest version of Mile High Flood District's (MHFD) UD-Detention per EPCDCM guidelines. Detention pond allowable release rate will be limited to less than historic rates.

c. Hydraulic Criteria

Hydraulic criteria for inlet sizing was obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 7 Street Drainage and Storm Water Inlets* and the UD-Inlet calculator. Hydraulic criteria for storm sewer culverts were obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 9 Culvert Design.* Hydraulic criteria for swale sizing was obtained from the *El Paso County, Colorado Drainage Criteria Manual – Chapter 10 Open Channels and Structures.*

Existing roadway and proposed drive aisle capacities are analyzed utilizing hydraulic modeling (AutoCAD Civil 3D channel analysis tool) by designing the pavement sections as user-defined channels with the proper Manning's coefficient, geometry of designed sections, and slopes. These user-defined capacity calculations are provided to determine the minor 5-year storm and major 100-year storm capacities in various areas of interest.

Storm sewer system modeling is provided in Appendix C. The hydraulic model was developed using Bentley StormCAD to assess and size private inlets and pipes, ensuring that both minor and major hydraulic grade lines comply with applicable stormwater design criteria. Table 9-4 StormCAD Standard Method Coefficients from *City of Colorado Springs, Drainage Criteria Manual, Volume 1* were used for the analysis. All proposed storm pipes are within 80% capacity for the minor storm event and do not surcharge the system to within 1' of all storm manhole rim elevations for the major storm event. The hydraulic grade lines for the minor and major storm at the outfall point of pipes that drain to the proposed private pond are set at the appropriate detention water surface elevations for tailwater conditions.

IV. Drainage Facility Design

a. General Concept

Overland runoff areas include roof runoff from the church building as well as initial overland sheet flow within paved drive aisles and across landscaped areas. Onsite stormwater is conveyed as channelized runoff within

the onsite curb and gutter and drainage pans that convey the runoff via a private storm sewer system and concrete rundowns to the private onsite full spectrum detention pond. The proposed private pond is assessed for the proposed site layout to meet stormwater criteria. The pond tributary area was assessed to include all basins that drain directly to it (Basin A1, Basin A2, Basin A3, Basin A4, Basin RN1, Basin RN2, Basin RS1, Basin RS2, Basin RS3, Basin RS4,). The outlet structure is designed such that the total developed release from the site, including both pond outflow and areas draining directly offsite (Basin N1, Basin E1, Basin S1, Basin S2, Basin W1, Basin OS), is reduced relative to existing conditions, thereby relieving hydraulic demand on the downstream public infrastructure including the immediate outfall area of the public roadside drainage ditch west of Meridian Road and downstream public culvert pipes under Bent Grass Meadows Drive.

b. Basin Design Criteria

The MHFD-Detention spreadsheet was used to design the private basin and outlet structure. The 1-hour rainfall depths for the 2, 5, 10, 25, 50, and 100 year storm events used in the spreadsheet were obtained from Table 6-2 Rainfall Depths for Colorado Springs within the EPC DCM. These rainfall depths are 1.19, 1.50, 1.75, 2.00, 2.25, and 2.52 inches, respectively.

c. Water Quality & Detention

Water quality treatment is provided for all applicable areas of the site except for excluded areas which do not exceed 20 percent of the development site or 1 acre per the El Paso County base design standard requirements and areas excluded from water quality treatment per ECM Appendix I.6.1.B.7. The private full spectrum detention pond provides water quality treatment by facilitating the settling of suspended sediments and the capture of pollutants prior to controlled discharge from the site.

Full spectrum detention is provided by the proposed private extended detention basin. The total area tributary to the detention basin is 7.19 acres and has 78.6% effective imperviousness. Included in Appendix C is the MHFD-Detention spreadsheet for the proposed private pond containing stage-storage tables and the outlet structure and orifice plate design. The total basin volume requirement including the WQCV, EURV, and 100-year volumes is calculated to be 1.058 ac-ft. The proposed pond has a total basin volume of 1.605 ac-ft of storage including the 1.0-foot of freeboard from the emergency spillway at a stage of 4.75-feet relative to bottom of pond. The design follows stormwater criteria for full spectrum detention and the release rate is 40 hours for WQCV, 70 hours for the EURV and 71 hours for the 100-year storm events. The peak outflow from the proposed pond outlet pipe in the 100-year event is 5.99 cfs. The total peak discharge from the site in the 100-year storm event including the outlet structure peak outflow and the developed basins that drain directly offsite totals 20.66 cfs. This represents a reduction of 7.74 cfs (26.7%) compared to the existing existing/historical peak outflow from the site of 28.95 cfs.

explain why the WQCV and EURV are overridden in the calculations.

HRG Response:
WQCV and EURV no longe
overridden in MHFD-Deten
spreadsheet

d. Major Drainageways

There are no formal major drainageways within the project boundary. The development lies within the Falcon Basin, which was last studied in the *Falcon Basin Planning Study* dated September 2015, prepared by Matrix Design Group. The proposed private pond outfalls into the channel east of the site and west of the roadway of Meridian Road. This channel flows south and stormwater is conveyed under the Bent Grass Medows Drive roadway via five existing public culvert pipes. This channel continues south along Meridian Road until entering a concrete box culvert which crosses under the Owl Place roadway and directs stormwater to the sub-regional detention facility SR4 as described in the drainage plans for Owl Marketplace. There are no anticipated negative impacts to surrounding and downstream developments, stormwater infrastructure, or drainageways.

e. Inspection and Maintenance

An approved Inspection and Maintenance manual will be provided for the detention pond.

f. Grading and Erosion Control Plan

Due to the project disturbance area, a separate Grading and Erosion Control plan will be required. The Grading and Erosion Control Plan will be submitted for review and approval with subsequent submittals of this FDR.

g. Four Step Method to Minimize Adverse Impacts of Urbanization

Step 1 – Reducing Runoff Volumes: Roof drains and sidewalks will route across landscaped areas whenever possible to slow runoff and promote infiltration prior to entering the drive isles and storm sewer system. Landscape buffers are provided along the border of the property to provide runoff reduction to areas of the site that flow directly off-site.

Step 2 – Treat and slowly release the WQCV: The runoff from the site is treated through the capture and slow WQCV via the designated PIA within the bottom of the private on-site full spectrum detention pond.

A table summarizing the water quality treatment within the site is provided on the following page:

Water Quality Treatment Summary Table						
Basin ID	**Total Area (ac)**	**Total Proposed Disturbed Area (ac)**	**Area Trib to Pond A (ac)**	**Disturbed Area Treated via Runoff Reduction (ac)**	**Disturbed Area Excluded from WQ per ECM App I.6.3.A.1.a (ac)**	**Disturbed Area Excluded from WQ per ECM App I.6.1.B.7 (ac)**
A1	2.41	2.41	2.41			
A2	2.80	2.80	2.80			
A3	0.32	0.32	0.32			
A4	0.74	0.74	0.74			
N1	0.24	0.24				0.24
E1	0.27	0.16				0.16
S1	0.71	0.71			0.71	
S2	0.00	0.00			0.00	
W1	0.18	0.18				0.18
RN1	0.19	0.19	0.19			
RN2	0.15	0.15	0.15			
RS1	0.08	0.08	0.08			
RS2	0.08	0.08	0.08			
RS3	0.21	0.21	0.21			
RS4	0.21	0.21	0.21			
Total	8.58	8.47	7.18	0.00	0.71	0.57

Min Required Area to Receive WQ (ac)	**Total Proposed Disturbed Area (ac)**	**Total Proposed Treated Area (ac)**	**Total Proposed Disturbed Area Excluded from WQ (ac)**	**Net Treatment (ac)**
7.18	8.47	7.18	1.28	0.00

Step 3 – Stabilize stream channels: Stormwater discharging from the curb and gutter along Bent Grass Meadows Drive and from the onsite detention pond will be stabilized with riprap at the points where the flows enter the public roadside ditch. Stormwater releases from the proposed site will not disturb the downstream ditch, as the flows released from the proposed onsite detention pond will be below historical rates. Decreased flows into the ditch east of the development help to stabilize the channelized flow. The historical combined stormwater outflow into the channel in a 100-year event is 28.95 cfs, while the proposed development combined outflow is 21.21 cfs. Landscape areas are stabilized with permanent seeding for lawn areas, shrubbery and trees, and ornamental landscaping.

All new and redevelopment projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid at the time of platting go towards channel stabilization within the drainage basin. There are no public drainageway improvements required or proposed as a part of this development.

Step 4 – Consider the need for source controls: No industrial uses are proposed within this development and therefore no industrial source controls are proposed. The developed area is not anticipated to have uses that would require commercial source controls such as a grease trap/interceptor at this time. Should the uses of that building change, the appropriate source controls will be implemented to meet code requirements.

h. Drainage and Bridge Fees

For the Falcon Drainage Basin, the 2026 Drainage Fees is $44,042 per impervious acre, the 2026 Bridge Fee is $6,050 per impervious acre. The fees will be required at final plat recording.

8.34 acres x 69.3% imperviousness = 5.78 impervious acres

$44,042 x 5.78 impervious acres = $254,562.76 (2026 Drainage Fee)

$6,050 x 5.78 impervious acres = $34,969.00 (2026 Bridge Fee)

i. Hydraulic Grade Line Calculations

Hydraulic Grade Line analysis for the storm network is presented in Appendix C.

V. Permanent Control Measure Cost Estimate

Church at Bent Grass Pond Cost Estimate				
Item	**Unit**	**Qty.**	**Unit Estimate**	**Total Estimate**
Outlet Structure & Micropool	EA	1	$25,000.00	$25,000.00
Forebay	EA	2	$20,000.00	$40,000.00
Concrete Trickle Channel	LF	206	$105.00	$21,630.00
Concrete Run Down	EA	1	$32,500.00	$32,500.00
Overflow Rip Rap Spillway	CY	163	$44.00	$7,172.00
Forebay Rip Rap	CY	32	$47.00	$1,504.00
Overflow Spillway Type II Bedding	TN	50	$38.00	$1,900.00
Handrail	LF	76	$101.00	$7,676.00
Stabilization Bedding	TN	150	$38.00	$5,700.00
Concrete Pump Truck	EA	4	$875.00	$3,500.00
Road Base	CY	314	$71.00	$22,294.00
18" RCP	LF	41	$111.00	$4,551.00
18" FES	EA	1	$666.00	$666.00
			Total	**$174,093.00**

VI. Summary

The Church at Bent Grass development remains consistent with pre-development drainage patterns and conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest El Paso

County Drainage criteria and is in accordance with previous reports. This Final Drainage Report presents the amended site layout and the resultant drainage changes with design solutions for these revisions.

VII. Drawings

Please refer to the appendices for vicinity and drainage basin maps.

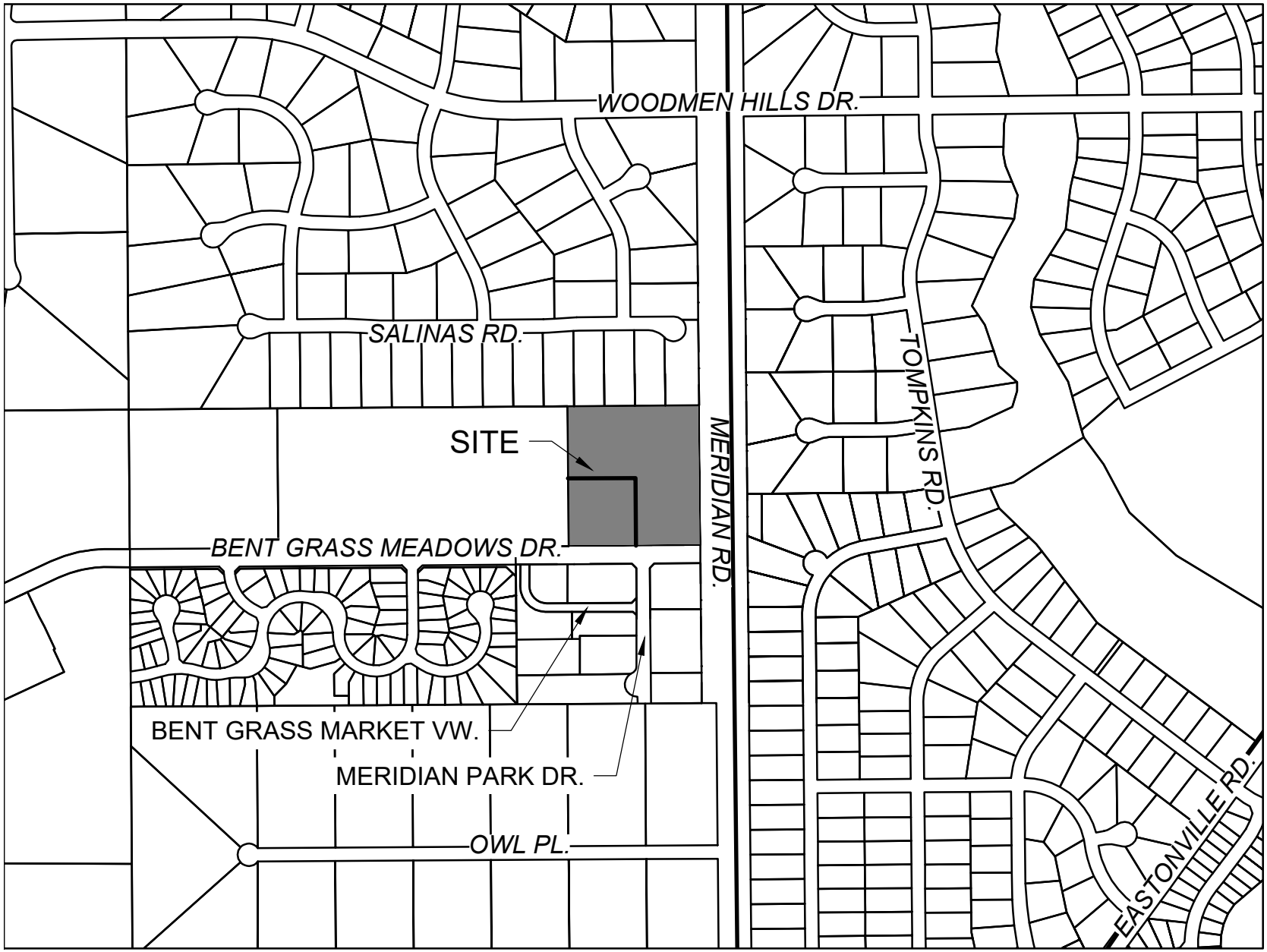
VIII. References

1. El Paso County – Drainage Criteria Manual Volume 1, Revised October 2018.
2. El Paso County – Drainage Criteria Manual Volume 2, Revised October 2018.
3. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
4. Bent Grass Commercial Final Drainage Report, Classic Consulting Engineers & Surveyors, March 2013.
5. MDDP & DBPS Amendment Bent Grass Development, Galloway & Company, Inc., March 2021.
6. Owl Marketplace Filing No. 1 Final Drainage Report, Drexel, Barrell & Co., March 2024.
7. Meridian Road & Bent Grass Meadows Drive Final Drainage Report, Galloway & Company, Inc., March 2020.

APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP

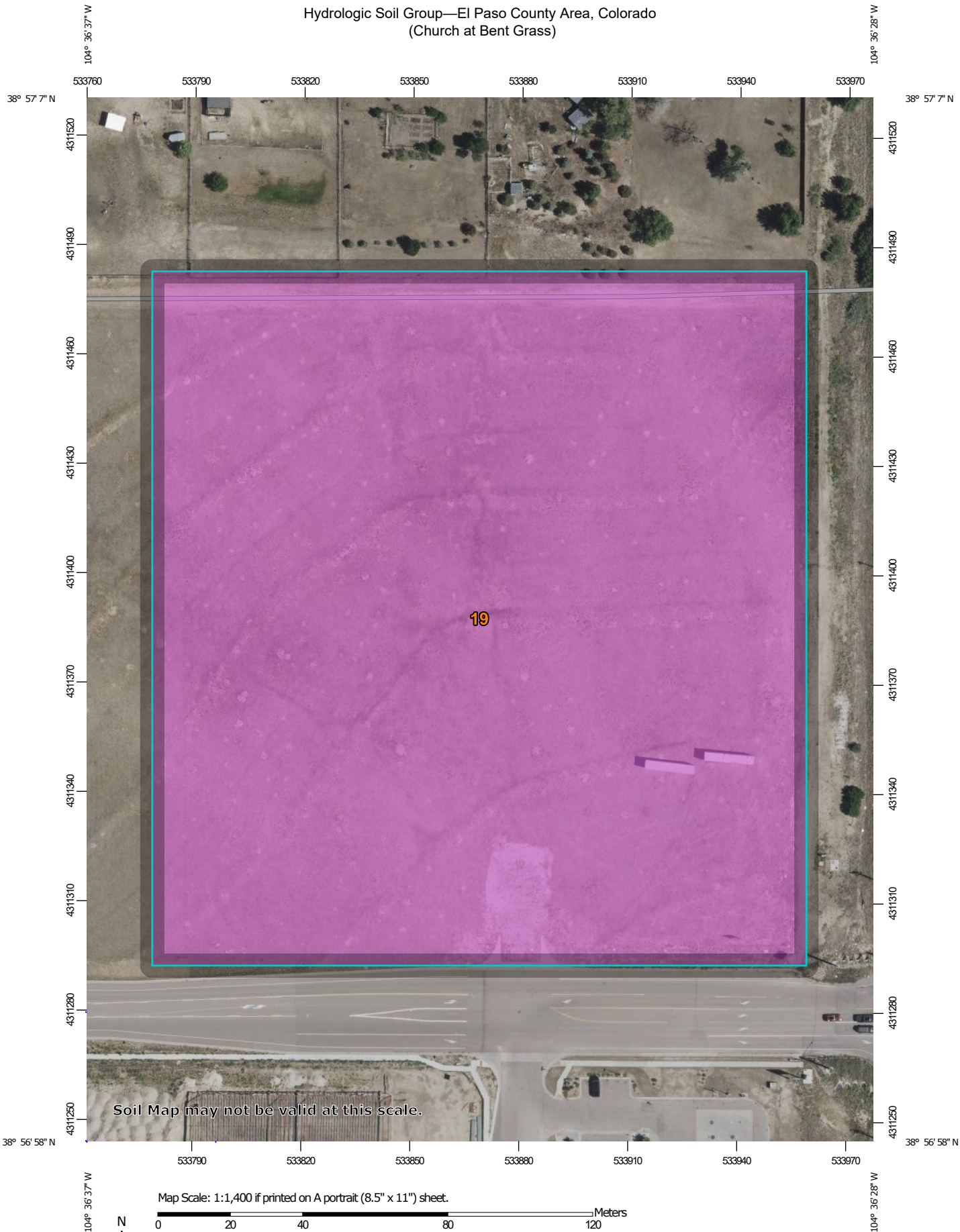
VICINITY MAP

CHURCH AT BENT GRASS



N.T.S.

Hydrologic Soil Group—El Paso County Area, Colorado
(Church at Bent Grass)



Map Scale: 1:1,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 20 40 80 120

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

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 1:24,000.

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:
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: El Paso County Area, Colorado
Survey Area Data: Version 22, Sep 3, 2024

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	8.5	100.0%
Totals for Area of Interest			**8.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

104°36'51"W 38°57'17"N



104°36'14"W 38°56'49"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/20/2025 at 4:36 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Drainage Basins

El Paso County
Colorado

Legend

- Drainage Basins Source: Muller Engineering Company (1988)
- US Interstate Highways
- US Highways
- Colorado State Highways
- Major Roadways
- Local Streets & Roads

Creeks

- Perennial
- Intermittent
- Lakes & Reservoirs
- Summits
- Unincorporated Urban Areas
- Incorporated Cities
- Military
- Forest
- County Lines

N W E S

Miles

0 0.5 1 2 3 4 5

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Douglas County
Elbert County
Teller County
Lincoln County
Fremont County
Pueblo County

Upper Monument Creek FOMO5800
Monument Rock FOMO5000
Jackson Creek FOMO4400
Dirty Woman Creek FOMO5200
West Cherry Creek CYCY0400
East Cherry Creek CYCY0200
West Kiowa Creek KIKI0200
East Kiowa Creek KIKI0400
Bijou Creek BIBI0200
Upper Big Sandy Creek BGBG1400
Lenard BGBG1200
Antelope Creek BGBG0800
Simla BGBG0400
Ramah BGBG0600
Calhan BGBG1000
Mustang Creek BGBG0200
Beaver Creek FOMO4600
Black Forest FOMO4200
Monument Branch FOMO3800
Black Squirrel Creek FOMO3600
Upper Black Squirrel CHBS2000
Upper Bracket Creek CHBR0600
North Fork HOHO0400
Pike National Forest
Air Force Academy FOMO3200
USAF Academy
Kettle Creek FOMO3000
Bennett Ranch CHWS1200
Geick Ranch CHMS0400
La Vega Ranch CHBR0400
Horse Creek HOHO0600
Pine Creek FOMO2800
SITE
Falcon CHWS1400
Hook And Line Ranch CHBS1800
Little Horse Creek HOHO0200
Steels Fork HOPO1000
Baggett CHBR0200
Cottonwood Creek FOMO2200
South Pine Creek FOMO2600
Dry Creek FOMO2400
Upper Fountain FOFO7600
Cheyenne Mountain Zoo
Cheyenne Mountain Acres
Cheyenne Mountain Estates
Cheyenne Mountain Resort
Cheyenne Mountain Country Club
Cheyenne Mountain Estates
Cheyenne Mountain Acres

LEGEND

«-- Subbasin ID
«-- Subbasin Area (square miles)

Existing Watershed Boundary
Historical and Future Watershed Boundary

Tributary Basin Boundary

East Tributary
Middle Tributary
West Tributary
Subbasin Boundary
Major Tributary
Elevation Contour (feet)

Falcon Drainage Basin	
Total Basin Area	10.7 mi^2
Average Subbasin Area	0.16 mi^2
Minimum Subbasin Area	0.03 mi^2
Maximum Subbasin Area	0.33 mi^2

East Tributary
West Tributary
Middle Tributary
SITE
FALCON WATERSHED
BURGESS RD
GOODSON RD
MERIDIAN RD
RAYGOR RD
STAPLETON DR
EASTONVILLE RD
JUDGE ORR RD
WOODMEN RD
TAMLIN RD
FALCON HWY
GARRETT RD
MERIDIAN RD
Black Forest
Colorado Springs
Fort Carson
Fountain
I-25
US-24
Kettle Creek
Monument Creek
Black Squirrel Creek
Jimmy Camp Creek
Williams Creek
Chico Creek
Fountain Creek
Sand Creek

WT020 0.07; WT010 0.14; WT030 0.08; WT040 0.19; WT050 0.19; WT070 0.17; WT060 0.20; WT080 0.07; WT090 0.15; WT100 0.19; WT110 0.19; WT140 0.13; WT150 0.23; WT120 0.05; WT130 0.10; WT160 0.11; WT170 0.12; ET010 0.15; ET020 0.21; MT020 0.09; MT040 0.31; ET030 0.20; WT180 0.10; MT010 0.29; WT190 0.06; MT030 0.16; ET040 0.15; WT200 0.30; MT050 0.12; ET050 0.12; ET060 0.29; MT060 0.19; ET070 0.25; WT210 0.27; ET090 0.12; ET080 0.29; MT070 0.20; WT220 0.19; WT230 0.20; MT080 0.06; MT090 0.04; ET130 0.13; ET100 0.05; WT240 0.08; MT100 0.06; WT250 0.15; ET110 0.23; ET140 0.27; MT110 0.12; WT260 0.14; ET120 0.11; WT270 0.03; WT290 0.10; ET150 0.18; WT280 0.27; WT310 0.28; ET160 0.19; WT300 0.10; WT320 0.21; WT360 0.07; WT350 0.30; WT370 0.21; WT340 0.28; FS010 0.12; WT330 0.33

Figure 3-2
Drainage Basin Map
Falcon DBPS
El Paso County, CO

0 0.5 1
Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20110613\basin_map.mxd, 8/29/2011, wilson_wheeler

APPENDIX B – HYDROLOGIC CALCULATIONS

HRGreen	**CHURCH AT BENT GRASS**	**Calc'd by:**	**CMD**
	EXISTING CONDITIONS	**Checked by:**	**RDL**
	EL PASO COUNTY, CO	**Date:**	**6/26/2026**

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
A	6.81	2	2.21	14.82
B	1.53	2	0.54	3.63
OS	4.72	2	1.56	10.50

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
1	A	2.21	14.82
2	B	0.54	3.63
3	OS	1.56	10.50

CHURCH AT BENT GRASS
EXISTING CONDITIONS

HRGreen

EL PASO COUNTY, CO

Calc'd by: CMD

Checked by: RDL

Date: 6/26/2026

SOIL TYPE: HSG A&B

COMPOSITE 'C' FACTORS

	LAND USE TYPE									TOTAL	COMPOSITE IMPERVIOUSNESS & C FACTOR		
	Roofs			Drive and Walks			Historic Flow Analysis--Greenbelts,						
	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}				
	90	0.73	0.81	100	0.90	0.96	2	0.09	0.36				
BASIN	ACRES			ACRES			ACRES			ACRES	%I	C_5	C_{100}
A	0.00			0.00			6.81			6.81	2.00	0.09	0.36
B	0.00			0.00			1.53			1.53	2.00	0.09	0.36
OS	0.00			0.00			4.72			4.72	2.00	0.09	0.36
ON-SITE	0.00			0.00			8.34			8.34	2.00	0.06	0.36
OFF-SITE	0.00			0.00			4.72			4.72	2.00	0.09	0.36
TOTAL	0.00			0.00			13.06			13.06	2.00	0.09	0.36

HRGreen	**CHURCH AT BENT GRASS**	**Calc'd by:**	**CMD**
	EXISTING CONDITIONS	**Checked by:**	**RDL**
	EL PASO COUNTY, CO	**Date:**	**6/26/2026**

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL	*tc=(L/180)+10*	Design tc
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)	*tc max*	*tc design (min)*
A	0.09	6.81	300	2.3	24.5	7	464	2.3	1.1	7.4	31.8	14.2	14.2
B	0.09	1.53	255	2.5	21.7	7	0	2.5	1.1	0.0	21.7	11.4	11.4
OS	0.09	4.72	300	5.8	17.9	7	322	7.4	1.9	2.8	20.7	13.5	13.5

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

HRGreen

CHURCH AT BENT GRASS
EXISTING CONDITIONS
DESIGN STORM: 5-YEAR

Calc'd by:	CMD
Checked by:	RDL
Date:	6/26/2026

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STRUCTURE	DESIGN POINT	BASIN ID	AREA (ac)	C_5	t_c (min)	C_5*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_5*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_5*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_5*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
	1	A	6.81	0.09	14.2	0.61	3.60	2.21															
	2	B	1.53	0.09	11.4	0.14	3.93	0.54															
	3	OS	4.72	0.09	13.5	0.42	3.68	1.56															

HRGreen

CHURCH AT BENT GRASS

EXISTING CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by:	CMD
Checked by:	RDL
Date:	6/26/2026

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STRUCTURE	DESIGN POINT	BASIN ID	AREA (ac)	C_{100}	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_{100}*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	1	A	6.81	0.36	14.2	2.45	6.04	14.82															
	2	B	1.53	0.36	11.4	0.55	6.60	3.63															
	3	OS	4.72	0.36	13.5	1.70	6.18	10.50															

CHURCH AT BENT GRASS	**Calc'd by:**	**CMD**
PROPOSED CONDITIONS	**Checked by:**	**RDL**
EL PASO COUNTY, CO	**Date:**	**7/23/2026**

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
A1	2.41	84.8	7.78	14.62
A2	2.80	87.1	9.81	18.29
A3	0.32	87.7	1.31	2.43
A4	0.74	7.8	0.42	1.94
N1	0.24	0.0	0.08	0.57
E1	0.27	0.0	0.11	0.81
S1	0.71	42.0	1.23	2.94
S2	0.00	39.5	0.01	0.02
W1	0.18	0.0	0.05	0.38
RN1	0.19	90.0	0.61	1.13
RN2	0.15	90.0	0.46	0.86
RS1	0.08	90.0	0.23	0.43
RS2	0.21	90.0	0.63	1.18
RS3	0.21	90.0	0.63	1.18
RS4	0.08	90.0	0.24	0.45

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
1	A1	7.78	14.62
2	A2	9.81	18.29
3	A3	1.31	2.43
4	A4	0.42	1.94
5	N1	0.08	0.57
6	E1	0.11	0.81
7	S1	1.23	2.94
9	S2	0.01	0.02
8	W1, OS	1.62	10.88
R1	RN1	0.61	1.13
R2	RN2	0.46	0.86
R3	RS1	0.23	0.43
R4	RS2	0.63	1.18
R5	RS3	0.63	1.18
R6	RS4	0.24	0.45

CHURCH AT BENT GRASS
PROPOSED CONDITIONS
EL PASO COUNTY, CO

Calc'd by: CMD
Checked by: RDL
Date: 7/23/2026

SOIL TYPE: HSG A&B

COMPOSITE 'C' FACTORS

BASIN	LAND USE TYPE									TOTAL	COMPOSITE IMPERVIOUSNESS & C FACTOR		
	Roofs			Drive and Walks			Lawns						
	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}				
	90	0.73	0.81	100	0.90	0.96	0	0.08	0.35				
	ACRES			ACRES			ACRES			ACRES	%I	C_5	C_{100}
A1	0.00			2.05			0.37			2.41	84.8	0.77	0.87
A2	0.00			2.43			0.36			2.80	87.1	0.79	0.88
A3	0.00			0.28			0.04			0.32	87.7	0.80	0.89
A4	0.00			0.06			0.69			0.74	7.8	0.14	0.40
N1	0.00			0.00			0.24			0.24	0.0	0.08	0.35
E1	0.00			0.00			0.27			0.27	0.0	0.08	0.35
S1	0.00			0.30			0.41			0.71	42.0	0.42	0.61
S2	0.00			0.00			0.00			0.00	39.5	0.40	0.59
W1	0.00			0.00			0.18			0.18	0.0	0.08	0.35
RN1	0.19			0.00			0.00			0.19	90.0	0.73	0.81
RN2	0.15			0.00			0.00			0.15	90.0	0.73	0.81
RS1	0.08			0.00			0.00			0.08	90.0	0.73	0.81
RS2	0.21			0.00			0.00			0.21	90.0	0.73	0.81
RS3	0.21			0.00			0.00			0.21	90.0	0.73	0.81
RS4	0.08			0.00			0.00			0.08	90.0	0.73	0.81
ON-SITE	0.92			4.82			1.45			7.19	78.5	0.71	0.82
OFF-SITE	0.00			0.30			1.09			1.39	21.5	0.26	0.48
TOTAL	0.92			5.12			2.55			8.58	69.2	0.64	0.76

POND SUMMARY							
FOREBAY A1	0.92	2.05	0.37	3.33	86.2	0.76	0.85
FOREBAY A2	0.00	2.43	0.36	2.80	87.1	0.79	0.88
POND A	0.92	4.82	1.45	7.19	78.5	0.71	0.82

HRGreen	**CHURCH AT BENT GRASS**	**Calc'd by:**	**CMD**
	PROPOSED CONDITIONS	**Checked by:**	**RDL**
	EL PASO COUNTY, CO	**Date:**	**7/23/2026**

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL	tc=(L/180)+10	Design tc
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)	*tc max*	*tc design (min)*
A1	0.77	2.41	57	3.7	2.9	20	884	1.1	2.1	6.9	9.8	15.2	9.8
A2	0.79	2.80	90	6.0	2.9	20	747	1.4	2.3	5.3	8.2	14.7	8.2
A3	0.80	0.32	100	3.5	3.6	20	237	4.1	4.1	1.0	5.0	11.9	5.0
A4	0.14	0.74	86	3.4	10.8	7	207	4.0	1.4	2.5	13.3	11.6	11.6
N1	0.08	0.24	5	33.0	1.3	7	575	2.3	1.1	9.0	10.3	13.2	10.3
E1	0.08	0.27	20	25.0	2.9	7	0	25.0	3.5	0.0	5.0	10.1	5.0
S1	0.42	0.71	100	5.5	7.0	15	400	1.8	2.0	3.3	10.3	12.8	10.3
S2	0.40	0.00	7	2.0	2.7	20	12	2.0	2.8	0.1	5.0	10.1	5.0
W1	0.08	0.18	13	25.0	2.3	7	618	1.5	0.9	12.0	14.3	13.5	13.5
RN1	0.73	0.19	106	0.5	8.8	20	0	0.5	1.4	0.0	8.8	10.6	8.8
RN2	0.73	0.15	106	0.5	8.8	20	0	0.5	1.4	0.0	8.8	10.6	8.8
RS1	0.73	0.08	143	0.5	10.2	20	0	0.5	1.4	0.0	10.2	10.8	10.2
RS2	0.73	0.21	143	0.5	10.2	20	0	0.5	1.4	0.0	10.2	10.8	10.2
RS3	0.73	0.21	143	0.5	10.2	20	0	0.5	1.4	0.0	10.2	10.8	10.2
RS4	0.73	0.08	143	0.5	10.2	20	0	0.5	1.4	0.0	10.2	10.8	10.2

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

HRG Response:
Adjusted to 100' overland time (urban).

HRG Response:
DP 1 updated to include flow from grate and flow from roof drain pipe.

Please include the calculation for the total runoff at Design Point 1. Currently, only the runoff from Basin A1 is accounted for in the first row of the table. The CDOT Type D inlet at this location receives flow contributions from Basins A1, RN1–RN2, and RS1–RS4, so the combined inflow must be calculated and shown.

HRGreen

CHURCH AT BENT GRASS
PROPOSED CONDITIONS
DESIGN STORM: 5-YEAR

Calc'd by:	CMD
Checked by:	RDL
Date:	7/23/2026

		DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
DESIGN POINT	BASIN ID	AREA (ac)	C_5	t_c (min)	C_5*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_5*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_5*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_5*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
1	A1	2.41	0.77	9.8	1.87	4.16	7.78															CDOT TYPE D INLET IN SUMP. ACCEPTS BASIN A1 FLOWS AND ROOF BASIN FLOWS
2	A2	2.80	0.79	8.2	2.22	4.42	9.81															CURB CUT TO CONCRETE RUNDOWN
3	A3	0.32	0.80	5.0	0.25	5.17	1.31															CURB CUT TO CONCRETE RUNDOWN
4	A4	0.74	0.14	11.6	0.11	3.90	0.42															FULL SPECTRUM DETENTION POND
5	N1	0.24	0.08	10.3	0.02	4.08	0.08															SWALE ON NORTHERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE EAST
6	E1	0.27	0.08	5.0	0.02	5.17	0.11															OFF-SITE FLOW TO THE EAST
7	S1	0.71	0.42	10.3	0.30	4.08	1.23															OFF-SITE FLOW TO THE SOUTH (BENT GRASS MEADOWS ROW)
9	S2	0.00	0.40	5.0	0.00	5.17	0.01															OFF-SITE FLOW TO THE NORTH (BENT GRASS MEADOWS ROW)
8	W1	0.18	0.08	13.5	0.01	3.68	0.05	13.5	0.44	3.68	1.62											SWALE ON WESTERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE SOUTH. ACCEPTS FLOWS FROM BASIN OS.
	RN1	0.19	0.73	8.8	0.14	4.32	0.61															ROOF DOWNSPOUT
	RN2	0.15	0.73	8.8	0.11	4.32	0.46															ROOF DOWNSPOUT
	RS1	0.08	0.73	10.2	0.06	4.10	0.23															ROOF DRAIN
	RS2	0.21	0.73	10.2	0.15	4.10	0.63															ROOF DRAIN
	RS3	0.21	0.73	10.2	0.15	4.10	0.63															ROOF DRAIN
	RS4	0.08	0.73	10.2	0.06	4.10	0.24															ROOF DRAIN

Design points labeled on the Proposed Conditions Basin Map for Basins RN1-RN2 and RS1-RS4 are Design Points R1-R6. Please revise.

HRG Response:
DP 1 updated to include flow from grate and flow from roof drain pipe.

Please include the calculation for the total runoff at Design Point 1. Currently, only the runoff from Basin A1 is accounted for in the first row of the table. The CDOT Type D inlet at this location receives flow contributions from Basins A1, RN1–RN2, and RS1–RS4, so the combined inflow must be calculated and shown.

HRGreen

CHURCH AT BENT GRASS
PROPOSED CONDITIONS
DESIGN STORM: 100-YEAR

Calc'd by:	CMD
Checked by:	RDL
Date:	7/23/2026

		DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
DESIGN POINT	BASIN ID	AREA (ac)	C_{100}	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	t_c (min)	C_{100}*A (ac)	I (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_{100}*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min	
1	A1	2.41	0.87	9.8	2.09	6.98	14.62															CDOT TYPE D INLET IN SUMP. ACCEPTS BASIN A1 FLOWS AND ROOF BASIN FLOWS
2	A2	2.80	0.88	8.2	2.46	7.42	18.29															CURB CUT TO CONCRETE RUNDOWN
3	A3	0.32	0.89	5.0	0.28	8.68	2.43															CURB CUT TO CONCRETE RUNDOWN
4	A4	0.74	0.40	11.6	0.30	6.55	1.94															FULL SPECTRUM DETENTION POND
5	N1	0.24	0.35	10.3	0.08	6.85	0.57															SWALE ON NORTHERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE EAST
6	E1	0.27	0.35	5.0	0.09	8.68	0.81															OFF-SITE FLOW TO THE EAST
7	S1	0.71	0.61	10.3	0.43	6.85	2.94															OFF-SITE FLOW TO THE SOUTH (BENT GRASS MEADOWS ROW)
9	S2	0.00	0.59	5.0	0.00	8.68	0.02															OFF-SITE FLOW TO THE NORTH (BENT GRASS MEADOWS ROW)
~~8~~ 8	W1	0.18	0.35	13.5	0.06	6.18	0.38	13.5	1.76	6.18	10.88											SWALE ON WESTERN BORDER OF SITE, DIRECTS OFF-SITE FLOW TO THE SOUTH. ACCEPTS FLOWS FROM BASIN OS.
9	RN1	0.19	0.81	8.8	0.16	7.25	1.13															ROOF DOWNSPOUT
9	RN2	0.15	0.81	8.8	0.12	7.25	0.86															ROOF DOWNSPOUT
9	RS1	0.08	0.81	10.2	0.06	6.88	0.43															ROOF DRAIN
9	RS2	0.21	0.81	10.2	0.17	6.88	1.18															ROOF DRAIN
9	RS3	0.21	0.81	10.2	0.17	6.88	1.18															ROOF DRAIN
8	RS4	0.08	0.81	10.2	0.07	6.88	0.45															ROOF DRAIN

Design points labeled on the Proposed Conditions Basin Map for Basins RN1-RN2 and RS1-RS4 are Design Points R1-R6. Please revise.

APPENDIX C – HYDRAULIC CALCULATIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jul 10 2026

Curb Chase DP 8 - 100-Yr WSEL

Rectangular

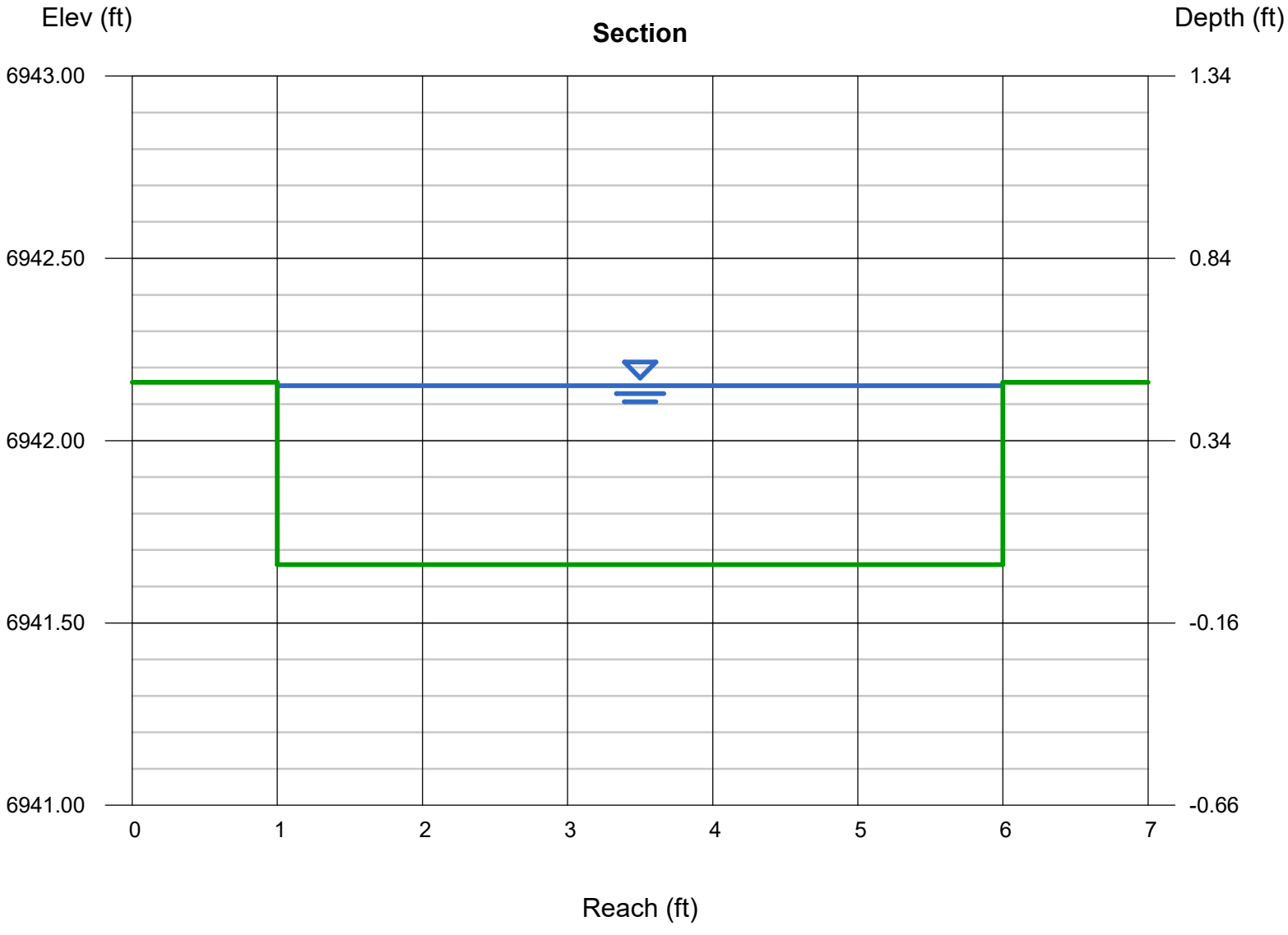
Bottom Width (ft)	= 5.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 6941.66
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.88

Highlighted

Depth (ft)	= 0.49
Q (cfs)	= 10.88
Area (sqft)	= 2.45
Velocity (ft/s)	= 4.44
Wetted Perim (ft)	= 5.98
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 5.00
EGL (ft)	= 0.80



Channel Report

Concrete Rundown Basin A2 - 100-Yr WSEL

Rectangular

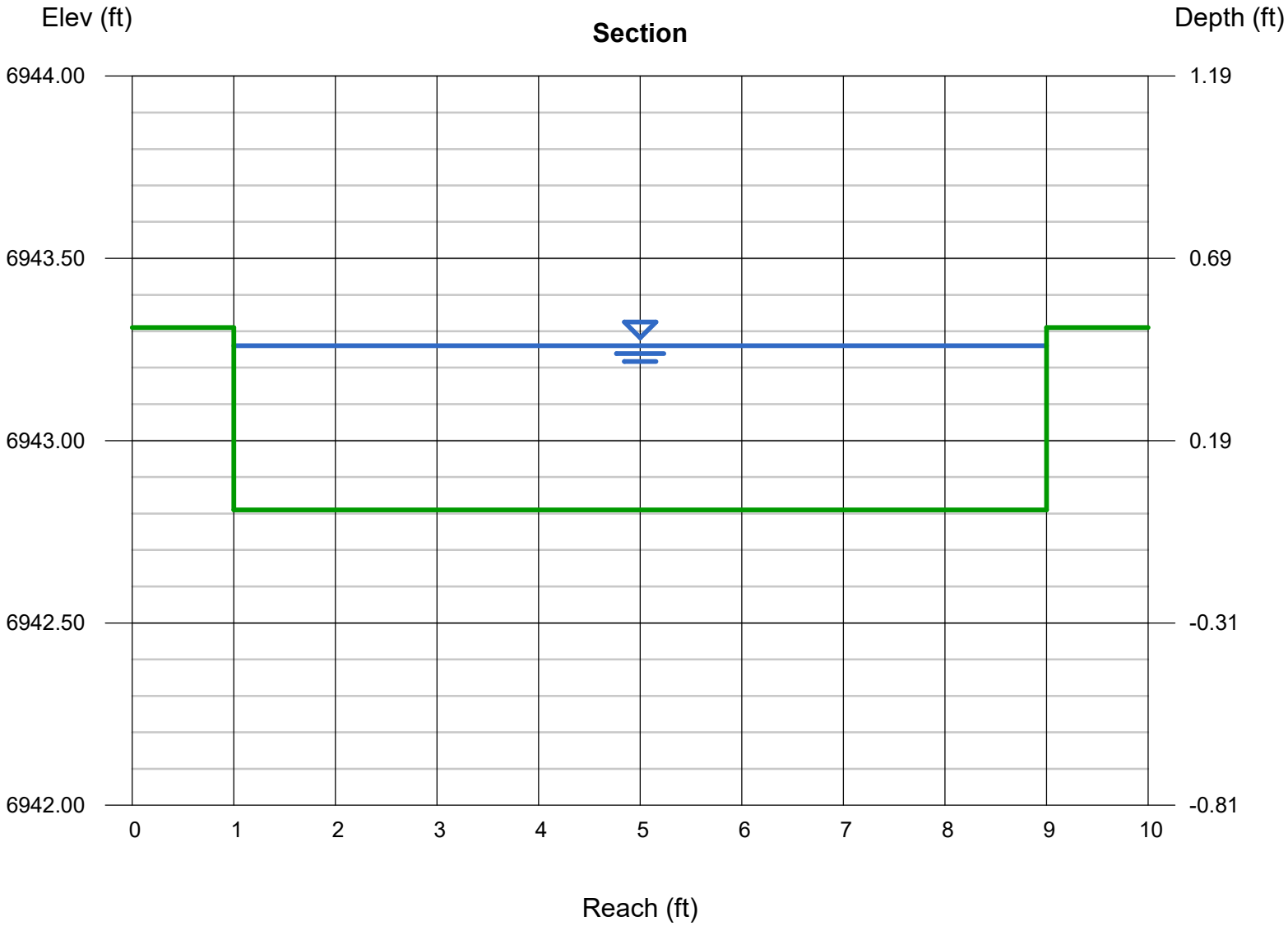
Bottom Width (ft)	= 8.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 6942.81
Slope (%)	= 0.50
N-Value	= 0.011

Calculations

Compute by:	Known Q
Known Q (cfs)	= 18.29

Highlighted

Depth (ft)	= 0.45
Q (cfs)	= 18.29
Area (sqft)	= 3.60
Velocity (ft/s)	= 5.08
Wetted Perim (ft)	= 8.90
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 8.00
EGL (ft)	= 0.85



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 23 2026

HRG Response:
Concrete rundown A3 updated on PCM Plan to match calculation.

Concrete Rundown Basin A3 - 100-Yr WSEL

Rectangular

Bottom Width (ft)	= 1.50
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 6942.81
Slope (%)	= 0.50
N-Value	= 0.011

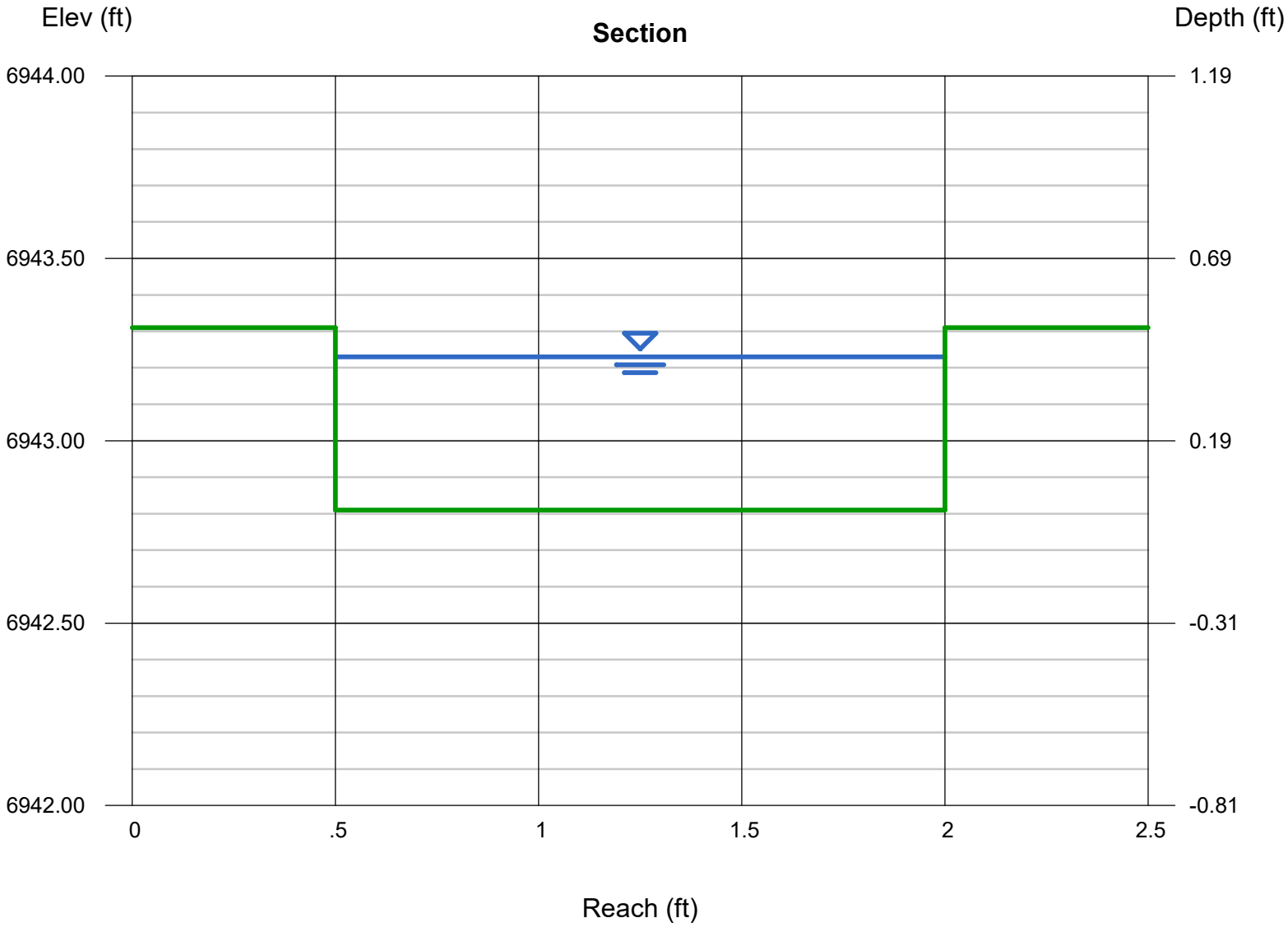
Bottom width is 2.50' on Sheet PCM 6 of CDs. Please revise.

Calculations

Compute by:	Known Q
Known Q (cfs)	= 2.43

Highlighted

Depth (ft)	= 0.42
Q (cfs)	= 2.430
Area (sqft)	= 0.63
Velocity (ft/s)	= 3.86
Wetted Perim (ft)	= 2.34
Crit Depth, Yc (ft)	= 0.44
Top Width (ft)	= 1.50
EGL (ft)	= 0.65



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Jun 26 2026

North Permanent Swale - 100-yr WSEL

Triangular

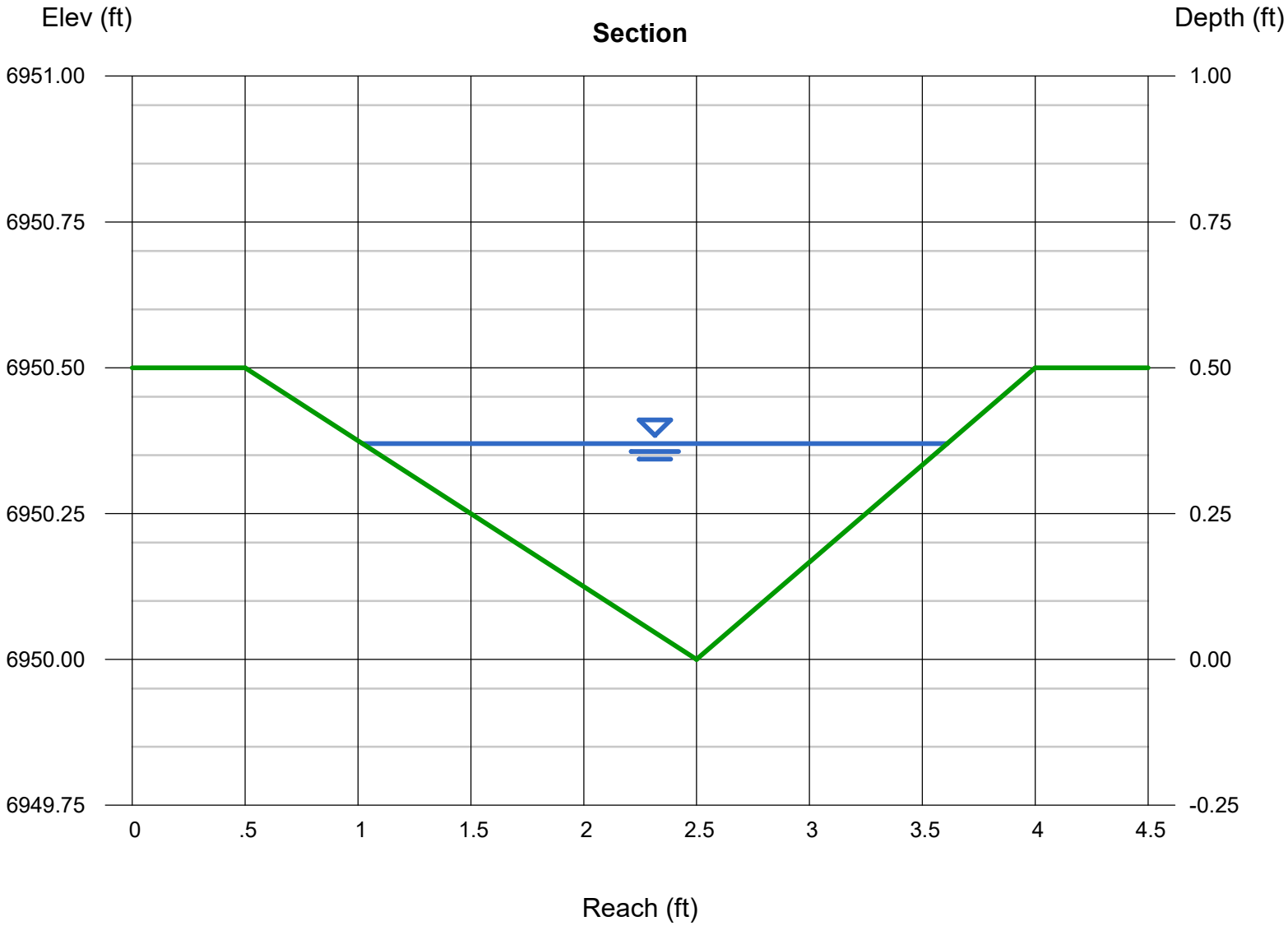
Side Slopes (z:1)	= ≤4.00, ≤3.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 6950.00
Slope (%)	= 0.50
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.57

Highlighted

Depth (ft)	= 0.37
Q (cfs)	= 0.570
Area (sqft)	= 0.48
Velocity (ft/s)	= 1.19
Wetted Perim (ft)	= 2.70
Crit Depth, Yc (ft)	= 0.28
Top Width (ft)	= 2.59
EGL (ft)	= 0.39



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 29 2026

North Permanent Swale - Max Velocity

Triangular

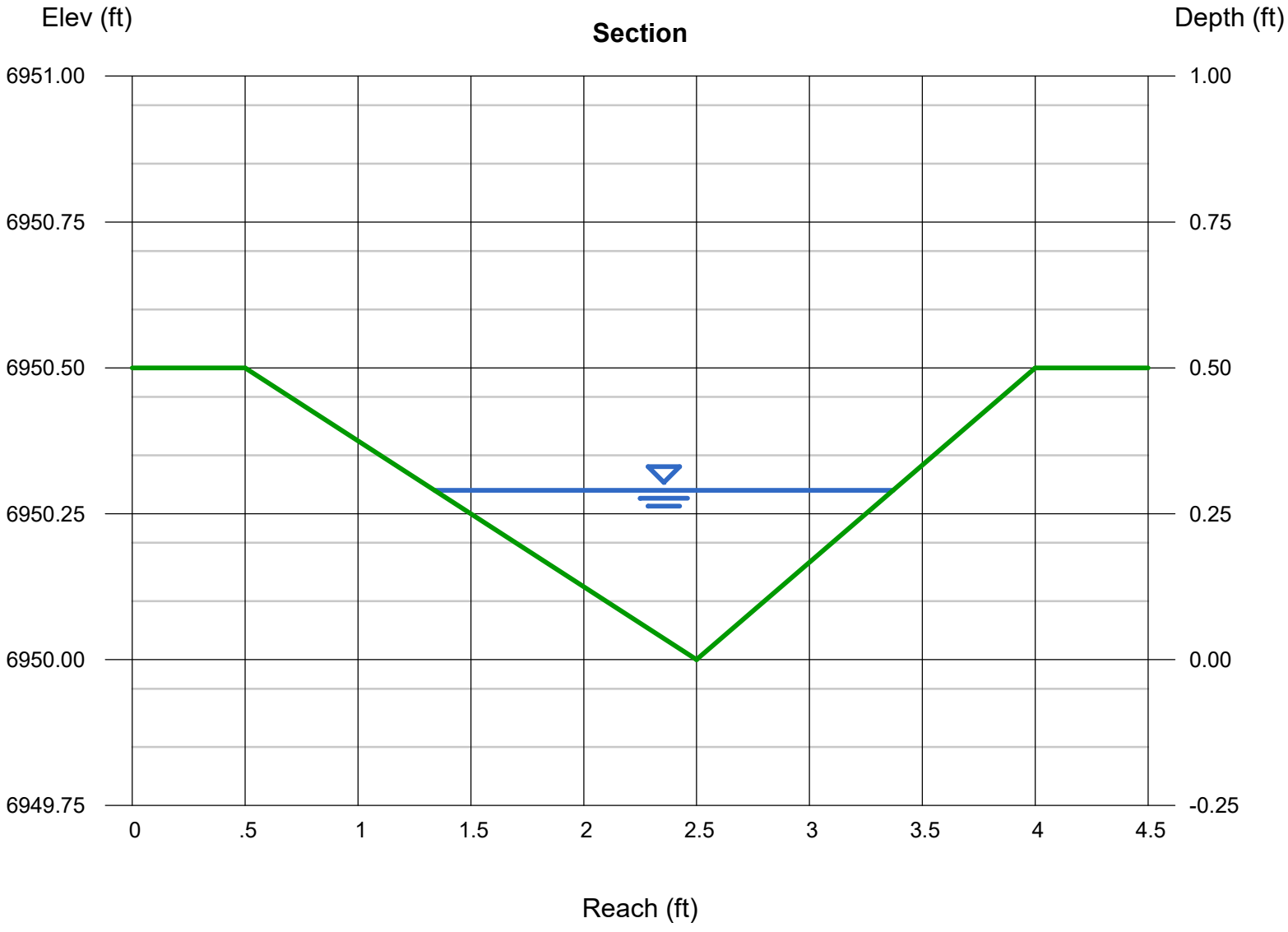
Side Slopes (z:1)	= ≤4.00, ≤3.00
Total Depth (ft)	= 0.50
Invert Elev (ft)	= 6950.00
Slope (%)	= 1.80
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 0.57

Highlighted

Depth (ft)	= 0.29
Q (cfs)	= 0.570
Area (sqft)	= 0.29
Velocity (ft/s)	= 1.94
Wetted Perim (ft)	= 2.11
Crit Depth, Yc (ft)	= 0.28
Top Width (ft)	= 2.03
EGL (ft)	= 0.35



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 29 2026

West Permanent Swale - 100-yr WSEL

Triangular

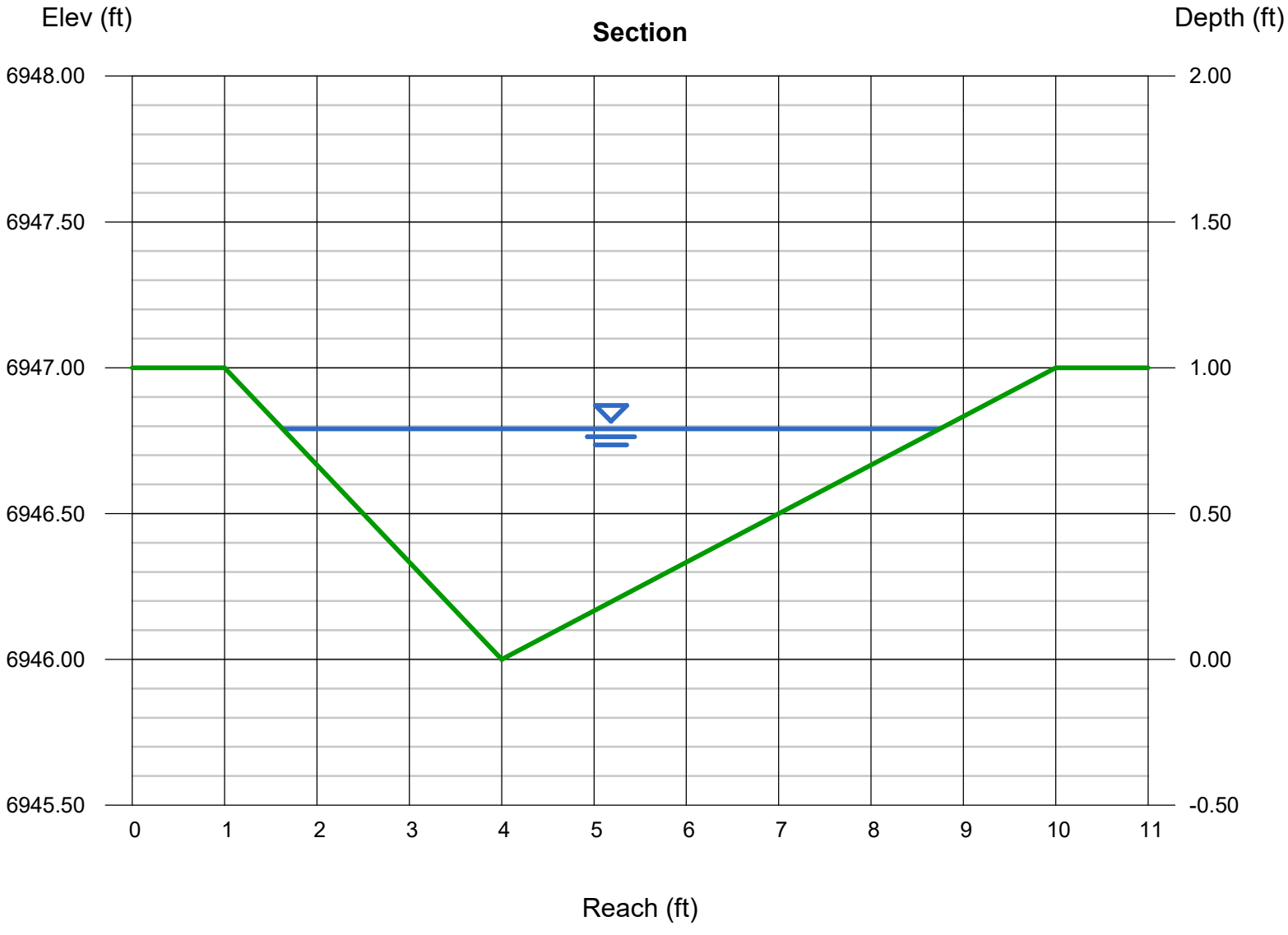
Side Slopes (z:1)	= 3.00, 6.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 6946.00
Slope (%)	= 1.86
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.88

Highlighted

Depth (ft)	= 0.79
Q (cfs)	= 10.88
Area (sqft)	= 2.81
Velocity (ft/s)	= 3.87
Wetted Perim (ft)	= 7.30
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 7.11
EGL (ft)	= 1.02



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jun 29 2026

West Permanent Swale - Max Velocity

Triangular

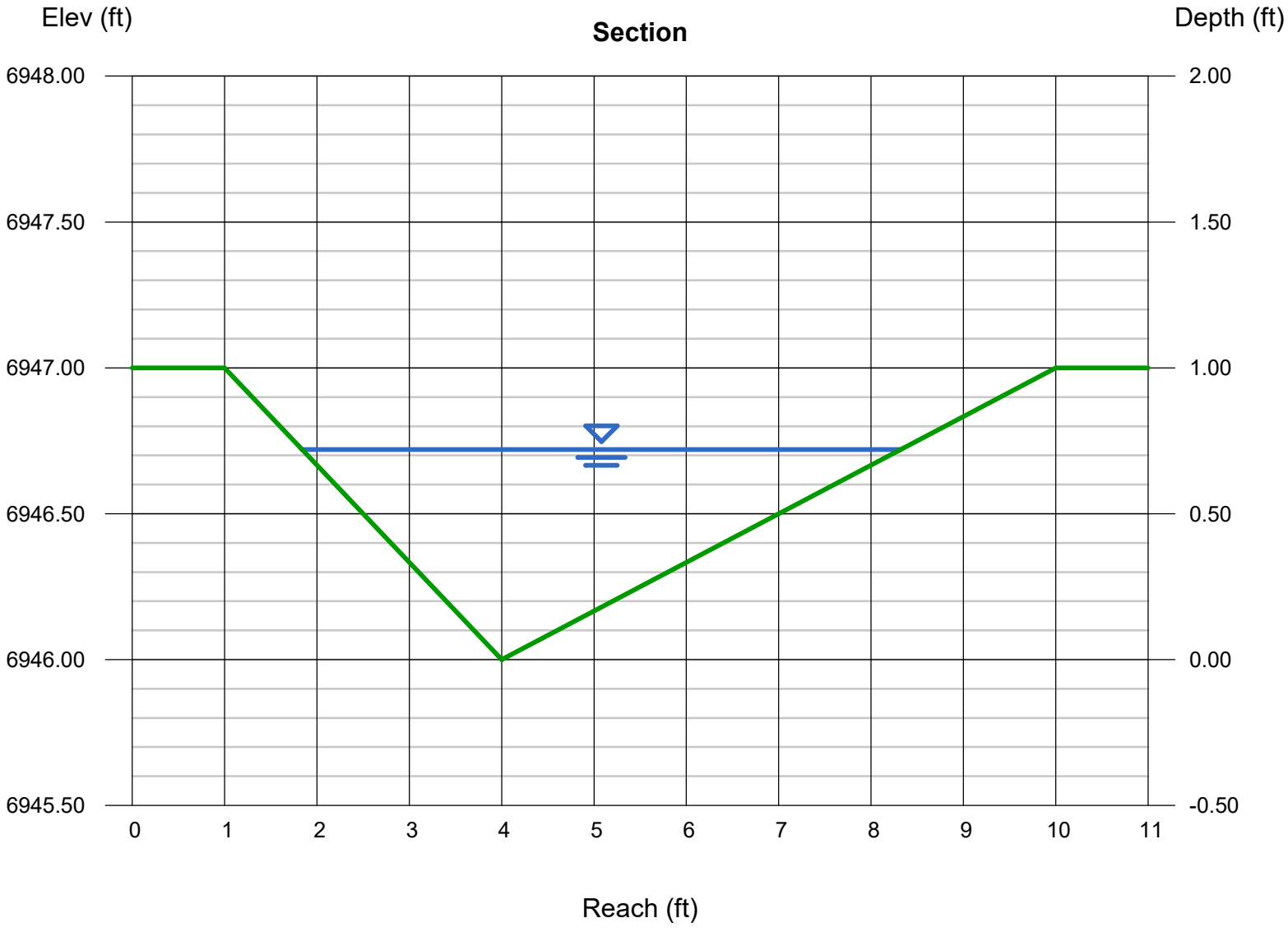
Side Slopes (z:1)	= 3.00, 6.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 6946.00
Slope (%)	= 3.00
N-Value	= 0.027

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.88

Highlighted

Depth (ft)	= 0.72
Q (cfs)	= 10.88
Area (sqft)	= 2.33
Velocity (ft/s)	= 4.66
Wetted Perim (ft)	= 6.66
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 6.48
EGL (ft)	= 1.06



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 23 2026

Internal Street Section A1 - 100-yr WSEL

User-defined

Invert Elev (ft)	= 6943.42
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

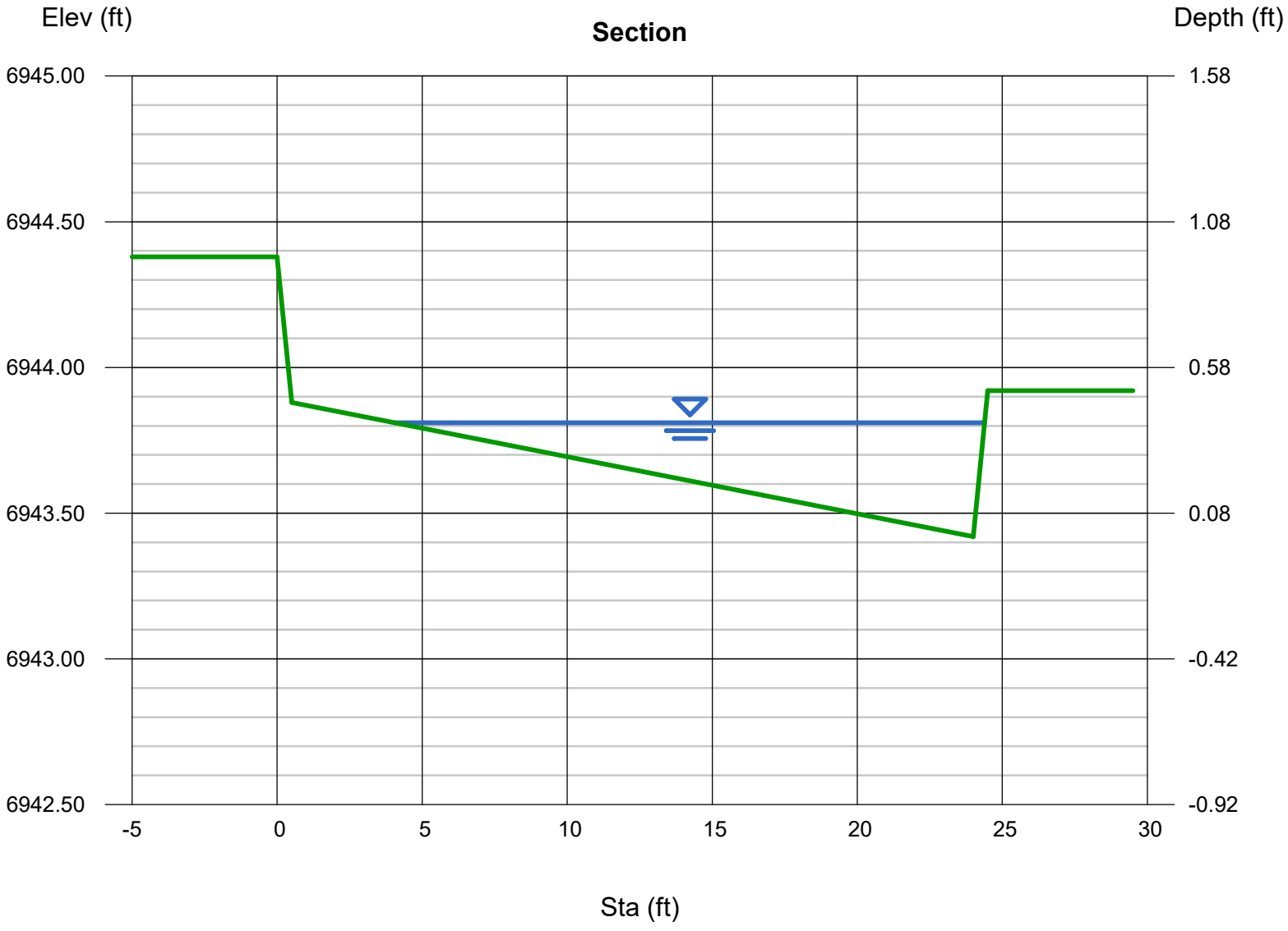
Compute by:	Known Q
Known Q (cfs)	= 14.63

Highlighted

Depth (ft)	= 0.39
Q (cfs)	= 14.63
Area (sqft)	= 3.96
Velocity (ft/s)	= 3.69
Wetted Perim (ft)	= 20.49
Crit Depth, Yc (ft)	= 0.46
Top Width (ft)	= 20.32
EGL (ft)	= 0.60

(Sta, El, n)-(Sta, El, n)...

(0.00, 6944.38)-(0.50, 6943.88, 0.013)-(24.00, 6943.42, 0.013)-(24.50, 6943.92, 0.013)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 23 2026

Internal Street Section A2 - 100-Yr WSEL

User-defined

Invert Elev (ft)	= 6942.39
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

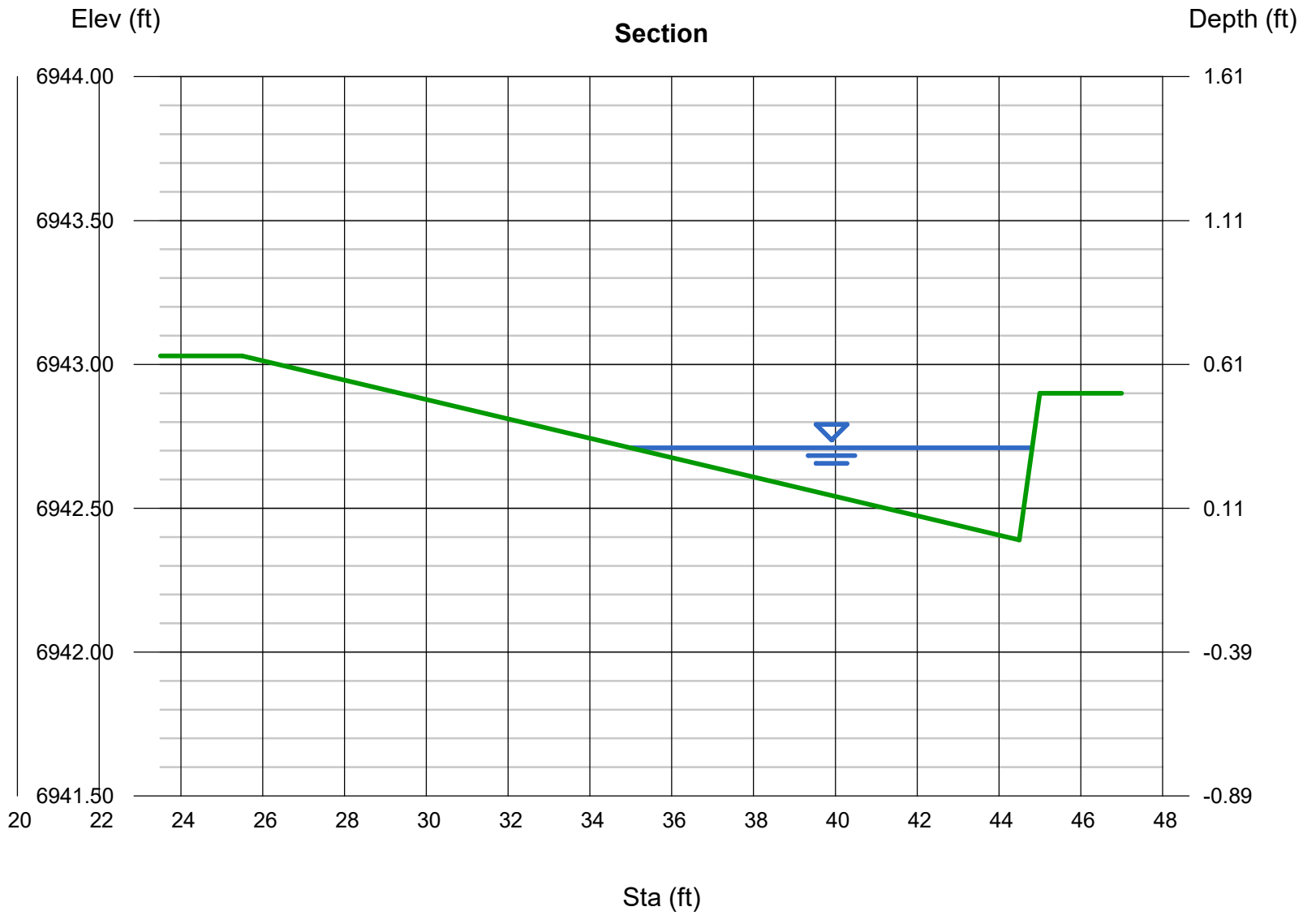
Compute by:	Known Q
Known Q (cfs)	= 4.83 (26.43% of A2 runoff)

Highlighted

Depth (ft)	= 0.32
Q (cfs)	= 4.830
Area (sqft)	= 1.57
Velocity (ft/s)	= 3.08
Wetted Perim (ft)	= 9.95
Crit Depth, Yc (ft)	= 0.37
Top Width (ft)	= 9.81
EGL (ft)	= 0.47

(Sta, El, n)-(Sta, El, n)...

(25.50, 6943.03)-(44.50, 6942.39, 0.013)-(45.00, 6942.90, 0.013)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 9 2026

Middle Tributary Bent Grass Meadows Crossing - Max Capacity

User-defined

Invert Elev (ft)	= 6933.47
Slope (%)	= 2.40
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 672.13

Highlighted

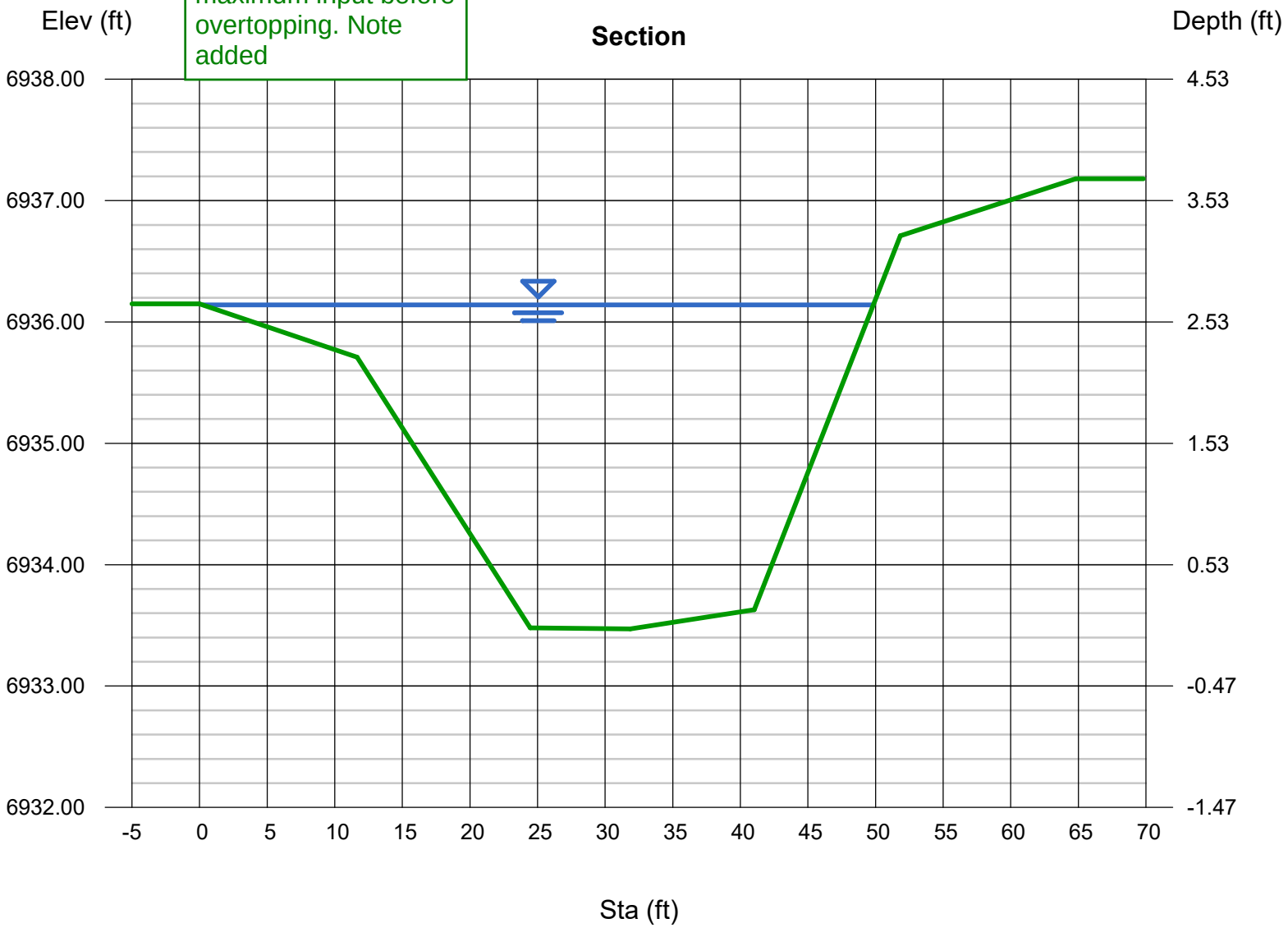
Depth (ft)	= 2.67
Q (cfs)	= 672.13
Area (sqft)	= 76.78
Velocity (ft/s)	= 8.75
Wetted Perim (ft)	= 50.14
Crit Depth, Yc (ft)	= 2.92
Top Width (ft)	= 49.58
EGL (ft)	= 3.86

(Sta, El, n)-(Sta, El, n)...

(0.00, 6936.15)-(11.66, 6935.71, 0.035)-(24.46, 6933.48, 0.035)-(31.86, 6933.47, 0.035)-(41.04, 6933.63, 0.035)-(51.84, 6936.71, 0.035)-(64.81, 6937.18, 0.035)

Please specify how this flow rate was determined and identify the source of the value.

HRG Response:
Flow rate was the maximum input before overtopping. Note added



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 23 2026

Middle Tributary Bent Grass Meadows Crossing - Ex (5) HERCP Culverts 100-Yr WSEL

Invert Elev Dn (ft)	=	6927.34
Pipe Length (ft)	=	105.00
Slope (%)	=	0.68
Invert Elev Up (ft)	=	6928.05
Rise (in)	=	29.0
Shape	=	Elliptical
Span (in)	=	45.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Square edge w/headwall (H)
Coeff. K,M,c,Y,k	=	0.01, 2, 0.0398, 0.67, 0.5

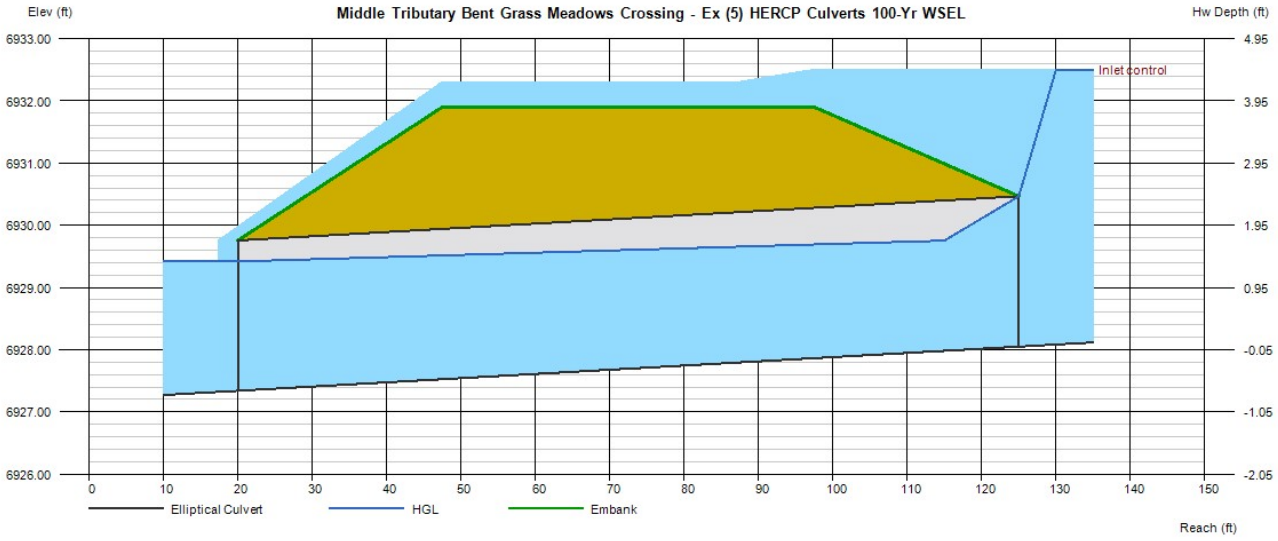
Embankment

Top Elevation (ft)	=	6931.90
Top Width (ft)	=	50.00
Crest Width (ft)	=	80.00

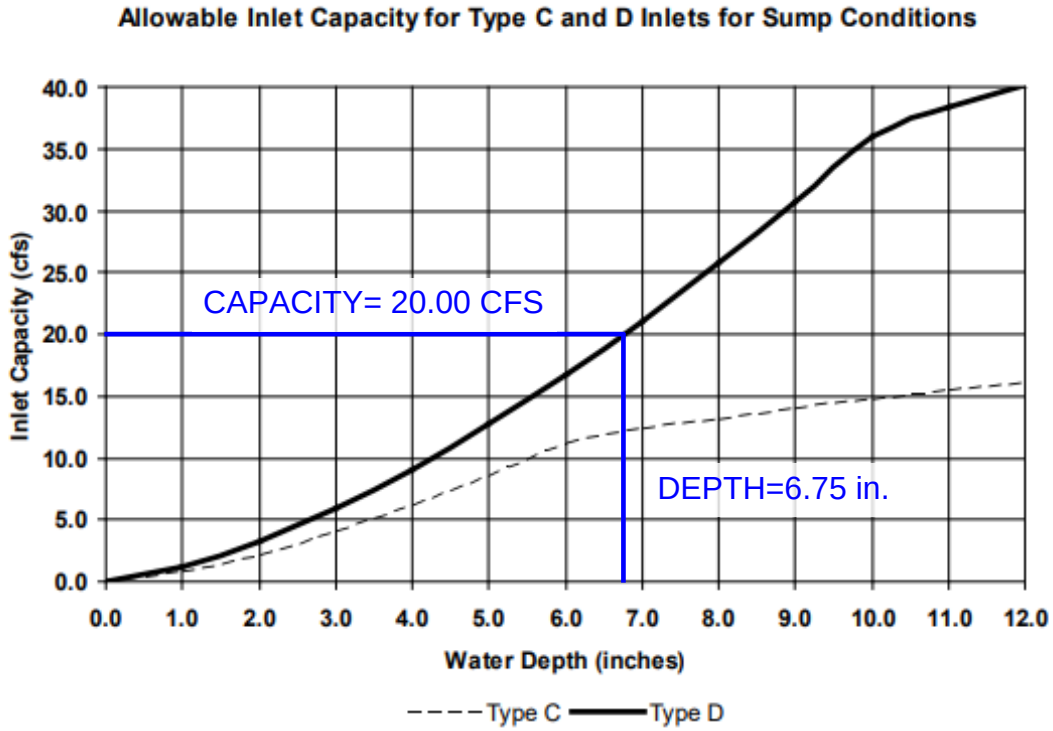
Calculations		= (850-7.74)/5
Qmin (cfs)	=	168.45
Qmax (cfs)	=	168.45
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	168.45
Qpipe (cfs)	=	60.10x5=300.50
Qovertop (cfs)	=	108.35x5=541.75
Veloc Dn (ft/s)	=	9.03
Veloc Up (ft/s)	=	10.62
HGL Dn (ft)	=	6929.42
HGL Up (ft)	=	6929.79
Hw Elev (ft)	=	6932.50
Hw/D (ft)	=	1.84
Flow Regime	=	Inlet Control



DP1 INLET CAPACITY



HRGreen	CHURCH AT BENT GRASS	Calc'd by:	CMD
	2403591	Checked by:	RDL
	DP A3 RUNDOWN RIPRAP	Date:	7/23/2026

Input Parameters	
Q (cfs)	2.43
Spillway Width (ft)	1.50
q (cfs/ft)	1.62
S (ft/ft)	0.31
C_f	2
η	0

Bottom width is 2.50' on Sheet PCM 6 of CDs. Please revise.

HRG Response: Concrete rundown A3 updated on PCM Plan to match calculation.

Calculated Parameters		
D_{50} =	7.22	in
UDFCD Riprap Type =	Type L	
Design D_{50} =	9	in
Minimum Mantle Thickness =	18	in

Calculated D_{50} for riprap was calculated using Equation 13-9 in the CCS DCM Vol 1.

$$D_{50} = 5.23\, S^{0.43}\, (1.35 C_f\, q)^{0.56} \qquad \text{Equation 13-9}$$

Where:

- D_{50} = median rock size (in)
- S = longitudinal slope (ft/ft)
- C_f = concentration factor (1.0 to 3.0)
- q = unit discharge (cfs/ft)

When:

η (porosity) = 0.0 (i.e., for buried soil riprap)

Note:

[1] Calculations follow criteria in the CCS DCM Vol. 1 Chapter 13

[2] Calculations assume buried soil riprap

HRGreen	CHURCH AT BENT GRASS	Calc'd by:	CMD
	2403591	Checked by:	RDL
	POND SPILLWAY RIPRAP	Date:	7/23/2026

Input Parameters	
Q (cfs)	42.49
Spillway Width (ft)	15.00
q (cfs/ft)	2.83
S (ft/ft)	0.33
C_f	2
η	0

Calculated Parameters		
D_{50} =	10.15	in
UDFCD Riprap Type =	Type M	
Design D_{50} =	12	in
Minimum Mantle Thickness =	24	in

Calculated D_{50} for riprap was calculated using Equation 13-9 in the CCS DCM Vol 1.

$$D_{50} = 5.23\, S^{0.43}\, (1.35 C_f\, q)^{0.56} \qquad \text{Equation 13-9}$$

Where:

D_{50} = median rock size (in)

S = longitudinal slope (ft/ft)

C_f = concentration factor (1.0 to 3.0)

q = unit discharge (cfs/ft)

When:

η (porosity) = 0.0 (i.e., for buried soil riprap)

Note:

[1] Calculations follow criteria in the CCS DCM Vol. 1 Chapter 13

[2] Calculations assume buried soil riprap

HRGreen	CHURCH AT BENT GRASS	Calc'd by:	CMD
	2403591	Checked by:	RDL
	POND OUTFALL RIPRAP	Date:	7/23/2026

Input Parameters		
Flow (Q)	5.99	cfs
Tailwater depth (Y_t)	0.60	ft
Conduit Diameter (D_c)	18	in
Expansion Factor (per Fig. 9-35)	5.8	
Soil Type	Non-Cohesive Soils	

Calculated Parameters		
Froude Parameter ($Q/D^{2.5}$)	2.17	
D_{50} =	2.70	in
UDFCD Riprap Type =	Type VL	
Design D_{50} =	6	in
Minimum Mantle Thickness =	12	in
Minimum Length of Apron =	4.50	ft

Calculated D_{50} for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left(\frac{1}{2\tan\theta}\right)\left(\frac{A_t}{Y_t} - W\right)$$ Equation 9-11

Where:

L_p = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y_t = tailwater depth (ft)

θ = the expansion angle of the culvert flow

$$A_t = \frac{Q}{V}$$ Equation 9-12

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A_t = required area of flow at allowable velocity (ft^2)

Note:

[1] Calculations follow criteria in the USDCM Vol.2 Chapter 9

[2] Calculations assume a circular culvert

[3] This spreadsheet assumes y_t/D_t=0.4 in cases where y_t is unknown or a hydraulic jump is suspected downstream of the outlet.

[4] Per the USDCM Vol.2 in no case should L_p be less than 3D, nor does L_p need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L_p required by 1/4 D_c for each whole number by which the Froude parameter is greater than 6

HRGreen	CHURCH AT BENT GRASS	Calc'd by:	CMD
	2403591	Checked by:	RDL
	MIDDLE TRIBUTARY CHANNEL RIPRAP	Date:	7/23/2026

Input Parameters	
Q (cfs)	842.26
Spillway Width (ft)	55.90
q (cfs/ft)	15.07
S (ft/ft)	0.02
C_f	1.25
η	0

Calculated Parameters		
D_{50} =	6.44	in
UDFCD Riprap Type =	Type L	
Design D_{50} =	9	in
Minimum Mantle Thickness =	18	in

Calculated D_{50} for riprap was calculated using Equation 13-9 in the CCS DCM Vol 1.

$$D_{50} = 5.23\, S^{0.43}\, (1.35 C_f\, q)^{0.56} \qquad \text{Equation 13-9}$$

Where:

D_{50} = median rock size (in)
S = longitudinal slope (ft/ft)
C_f = concentration factor (1.0 to 3.0)
q = unit discharge (cfs/ft)

When:

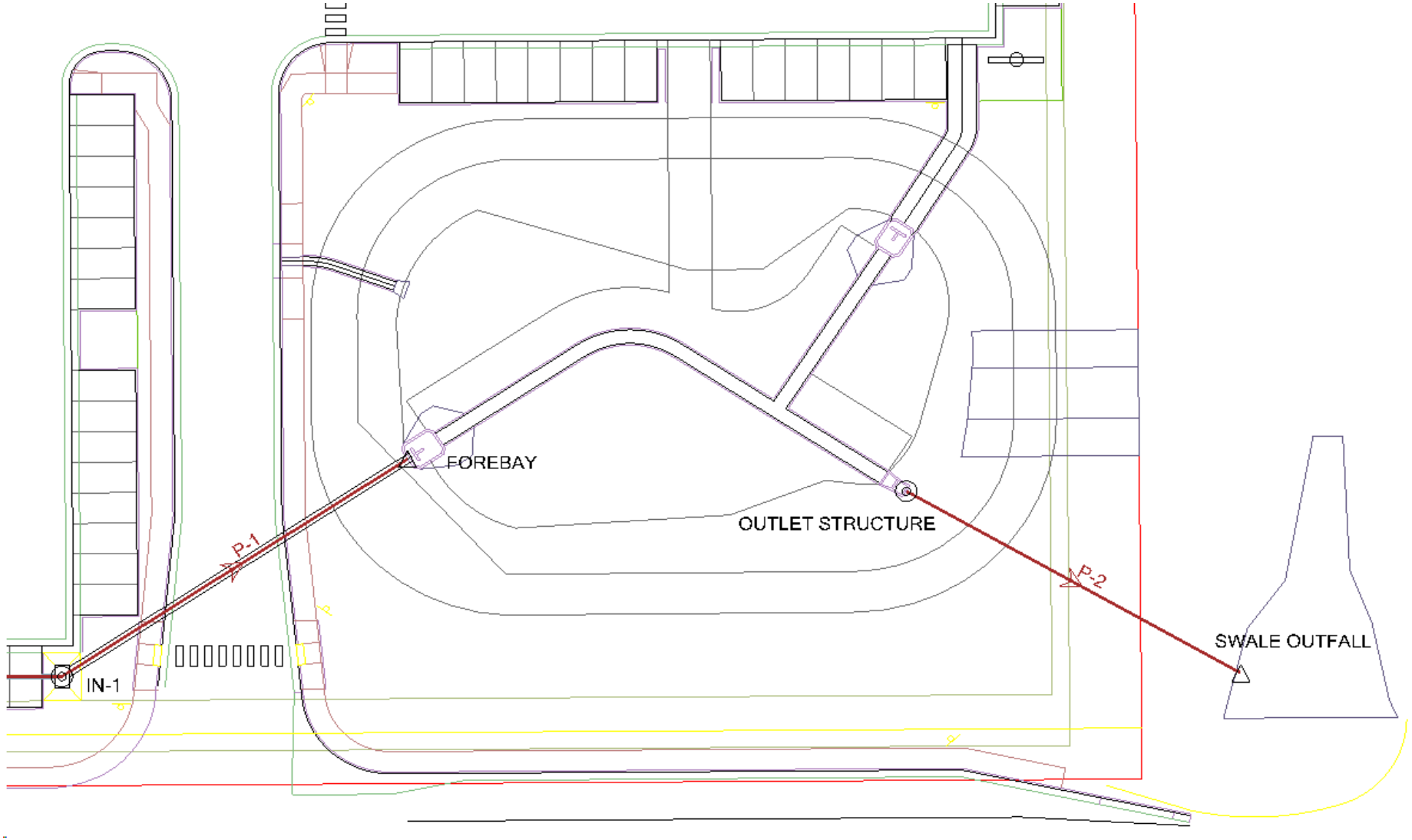
η (porosity) = 0.0 (i.e., for buried soil riprap)

Note:

[1] Calculations follow criteria in the CCS DCM Vol. 1 Chapter 13

[2] Calculations assume buried soil riprap

STORMCAD NETWORK LAYOUT



5 YEAR

Conduit Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Length (User Defined) (ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-1	IN-1	FOREBAY	24.0	117.0	0.013	10.58	5.42	6,937.17	6,936.59	6,938.36	6,937.76
P-2	OUTLET STRUCTURE	SWALE OUTFALL	18.0	118.0	0.013	0.37	3.35	6,935.00	6,933.00	6,935.22	6,933.17

5 YEAR

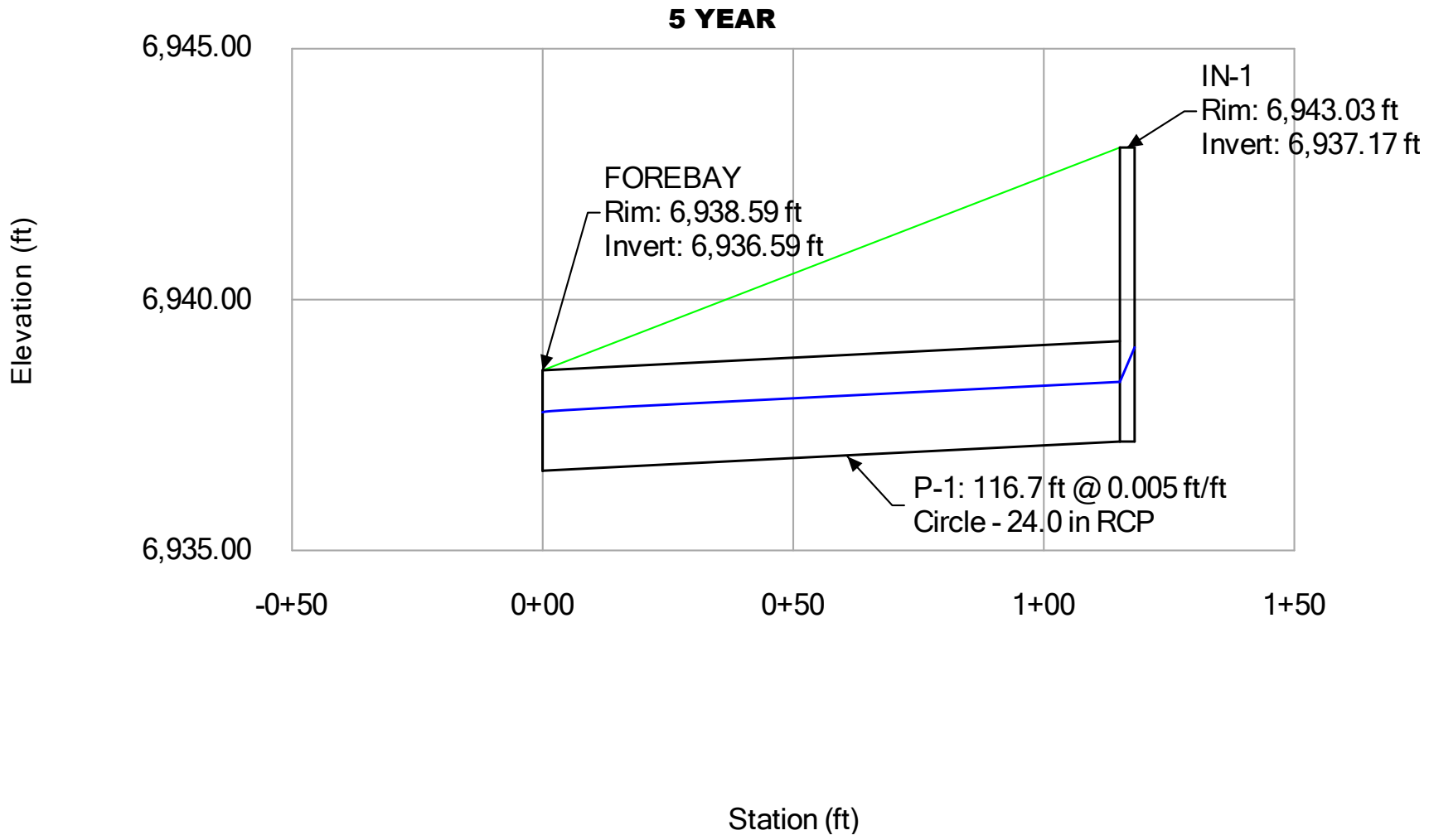
Manhole Table - Time: 0.00 hours

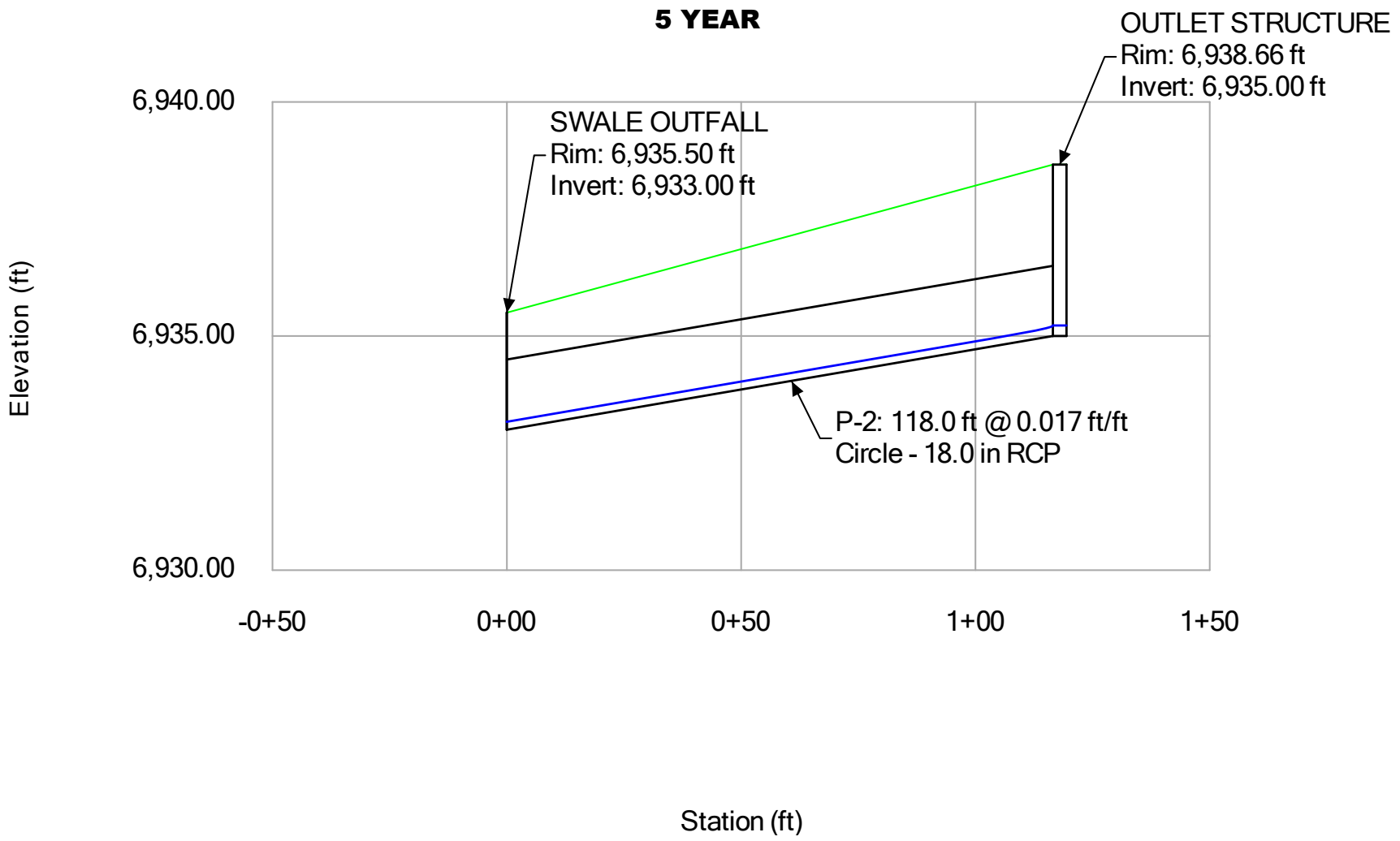
Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Known) (cfs)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Notes
IN-1	6,943.03	6,937.17	10.58	1.500	6,939.05	6,938.36	TYPE D SUMP INLET(PVT)
OUTLET STRUCTURE	6,938.66	6,935.00	0.37	0.000	6,935.22	6,935.22	TYPE-C

5 YEAR

Outfall Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
SWALE OUTFALL	6,935.50	6,933.00	Free Outfall	6,933.17	0.37	18" FES
FOREBAY	6,938.59	6,936.59	Free Outfall	6,937.76	10.58	Dummy Null Structure for LandXML purposes


5 YEAR
6,945.00
6,940.00
6,935.00
Elevation (ft)
IN-1
Rim: 6,943.03 ft
Invert: 6,937.17 ft
FOREBAY
Rim: 6,938.59 ft
Invert: 6,936.59 ft
P-1: 116.7 ft @ 0.005 ft/ft
Circle - 24.0 in RCP
-0+50
0+00
0+50
1+00
1+50
Station (ft)


5 YEAR
OUTLET STRUCTURE
Rim: 6,938.66 ft
Invert: 6,935.00 ft
SWALE OUTFALL
Rim: 6,935.50 ft
Invert: 6,933.00 ft
P-2: 118.0 ft @ 0.017 ft/ft
Circle - 18.0 in RCP
6,940.00
6,935.00
6,930.00
Elevation (ft)
-0+50
0+00
0+50
1+00
1+50
Station (ft)

100 YEAR

Conduit Table - Time: 0.00 hours

Label	Start Node	Stop Node	Diameter (in)	Length (User Defined) (ft)	Manning's n	Flow (cfs)	Velocity (ft/s)	Invert (Start) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
P-1	IN-1	FOREBAY	24.0	117.0	0.013	19.83	6.31	6,937.17	6,936.59	6,940.66	6,939.76
P-2	OUTLET STRUCTURE	SWALE OUTFALL	18.0	118.0	0.013	5.99	3.39	6,935.00	6,933.00	6,936.66	6,936.28

100 YEAR

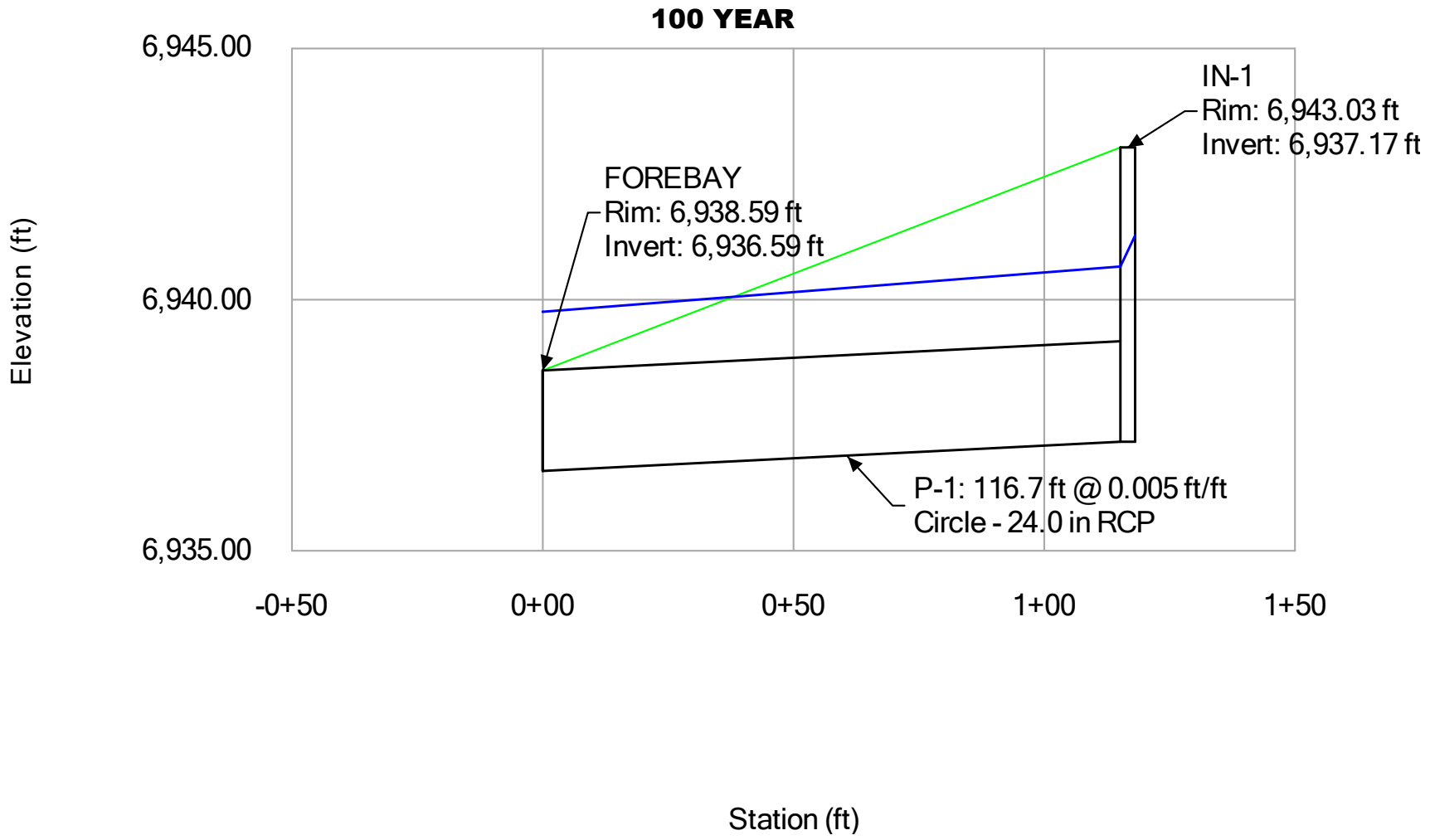
Manhole Table - Time: 0.00 hours

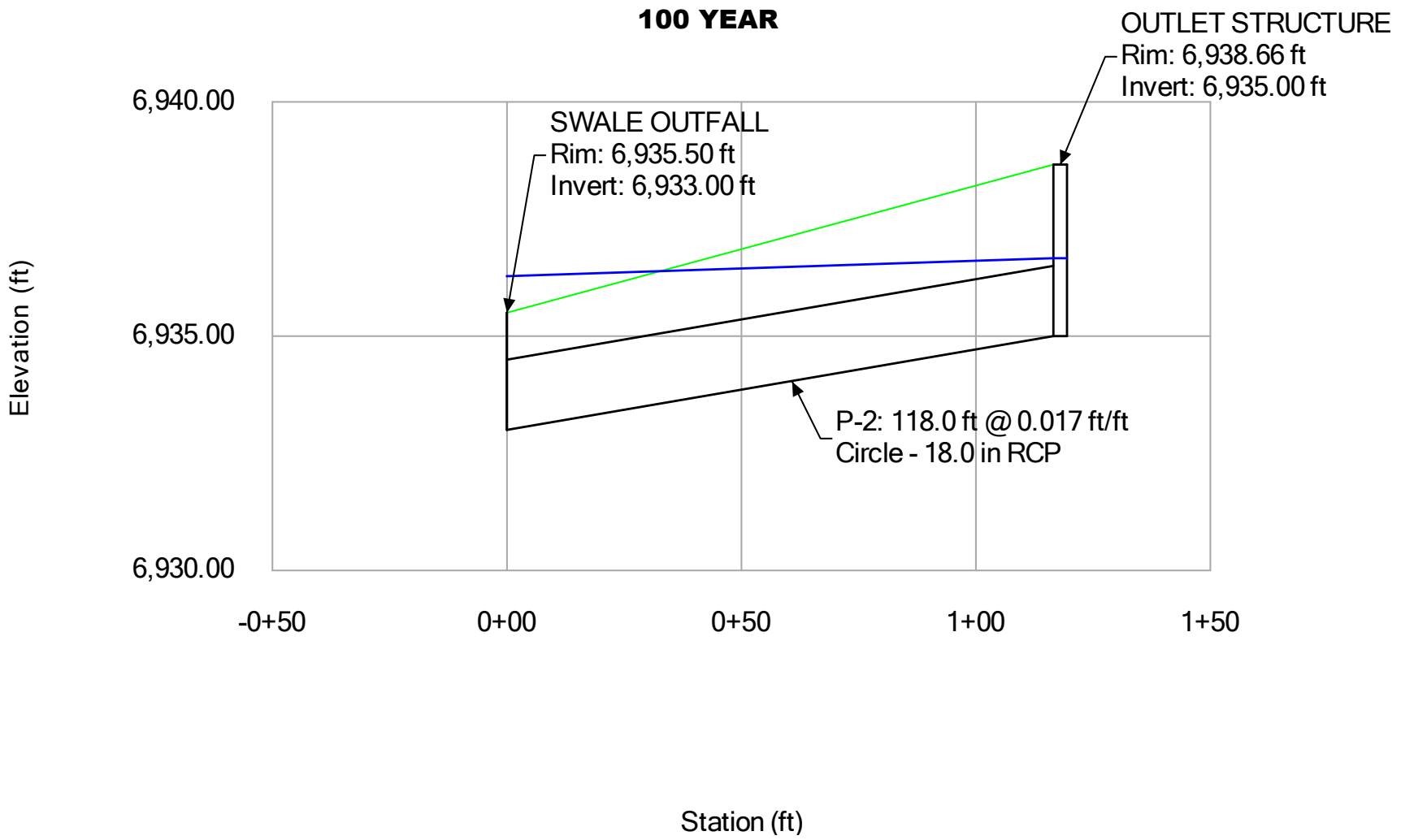
Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Known) (cfs)	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Notes
IN-1	6,943.03	6,937.17	19.83	1.000	6,941.28	6,940.66	TYPE D SUMP INLET(PVT)
OUTLET STRUCTURE	6,938.66	6,935.00	5.99	0.000	6,936.66	6,936.66	TYPE-C

100 YEAR

Outfall Table - Time: 0.00 hours

Label	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
SWALE OUTFALL	6,935.50	6,933.00	User Defined Tailwater	6,936.28	5.99	18" FES
FOREBAY	6,938.59	6,936.59	User Defined Tailwater	6,939.76	19.83	Dummy Null Structure for LandXML purposes


100 YEAR
6,945.00
6,940.00
6,935.00
Elevation (ft)
IN-1
Rim: 6,943.03 ft
Invert: 6,937.17 ft
FOREBAY
Rim: 6,938.59 ft
Invert: 6,936.59 ft
P-1: 116.7 ft @ 0.005 ft/ft
Circle - 24.0 in RCP
-0+50
0+00
0+50
1+00
1+50
Station (ft)


100 YEAR
OUTLET STRUCTURE
Rim: 6,938.66 ft
Invert: 6,935.00 ft
SWALE OUTFALL
Rim: 6,935.50 ft
Invert: 6,933.00 ft
P-2: 118.0 ft @ 0.017 ft/ft
Circle - 18.0 in RCP
6,940.00
6,935.00
6,930.00
Elevation (ft)
-0+50
0+00
0+50
1+00
1+50
Station (ft)

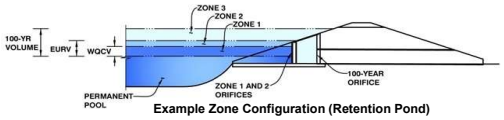
APPENDIX D – WATER QUALITY AND DETENTION CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Church at Bent Grass Meadows - FULL SPECTRUM DETENTION**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	7.19	acres
Watershed Length =	1,186	ft
Watershed Length to Centroid =	260	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	78.60%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.193	acre-feet	0.193	acre-feet
Excess Urban Runoff Volume (EURV) =	0.742	acre-feet	0.742	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.509	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.661	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.783	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.926	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.067	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.230	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.592	acre-feet		inches
Approximate 2-yr Detention Volume =	0.485	acre-feet		
Approximate 5-yr Detention Volume =	0.631	acre-feet		
Approximate 10-yr Detention Volume =	0.754	acre-feet		
Approximate 25-yr Detention Volume =	0.897	acre-feet		
Approximate 50-yr Detention Volume =	0.980	acre-feet		
Approximate 100-yr Detention Volume =	1.058	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.193	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.549	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.316	acre-feet
Total Detention Basin Volume =	1.058	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	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 ($R_{L/W}$) =	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_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	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_{total}) =	**user**	acre-feet

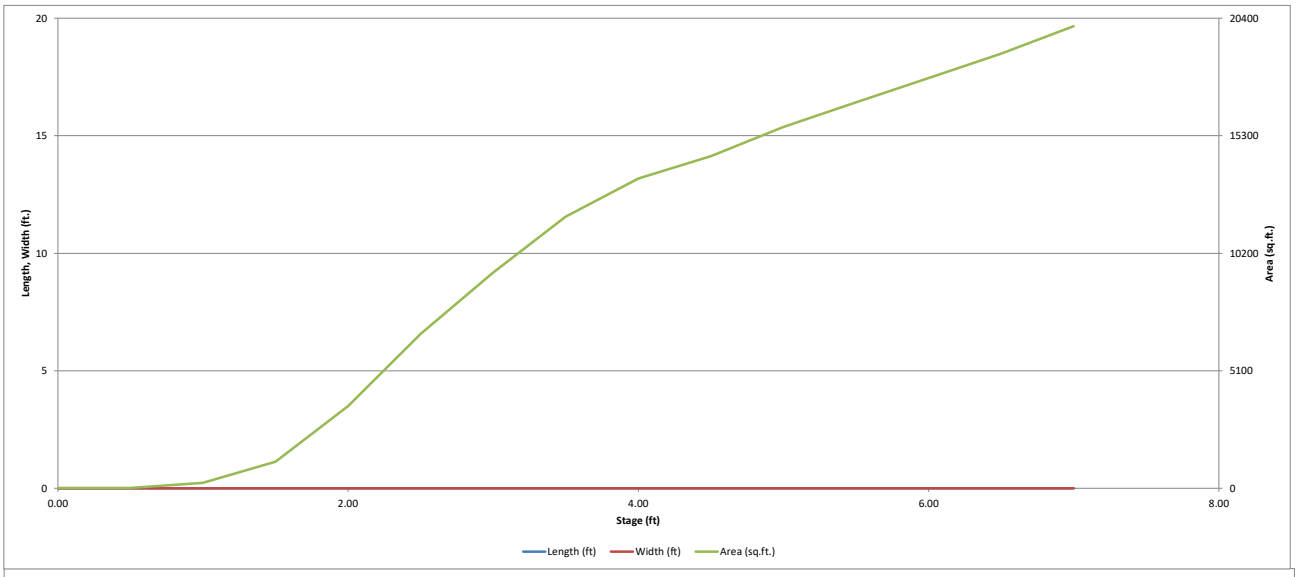
6934.5

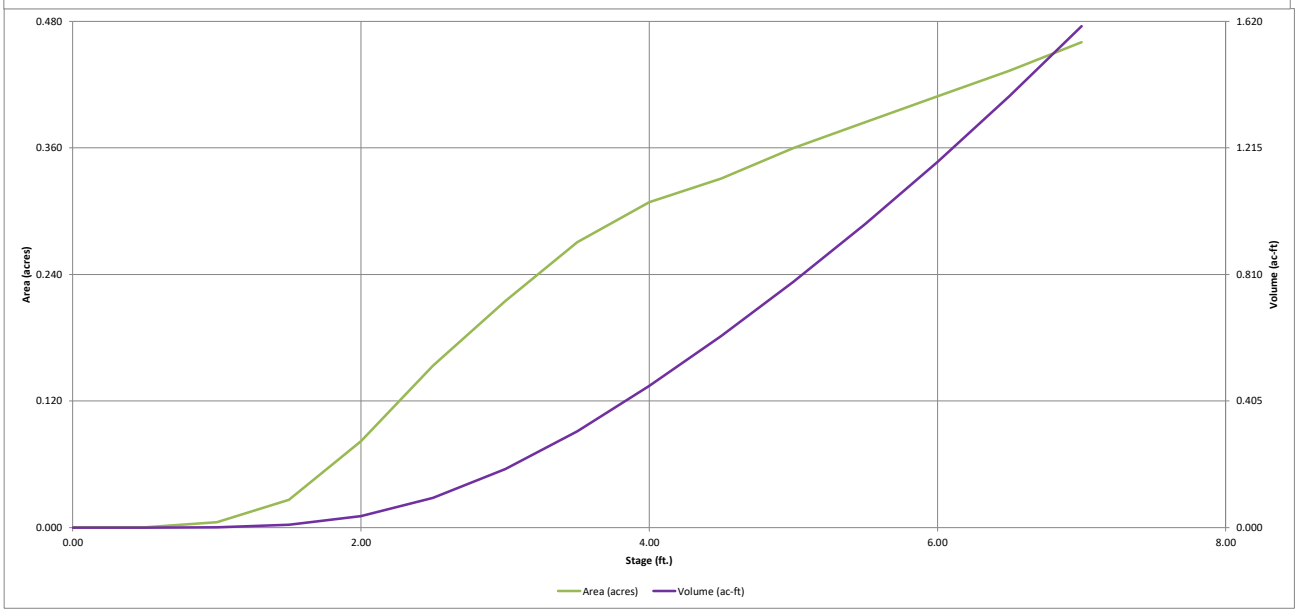
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	11	0.000		
6935	--	0.50	--	--	--	11	0.000	6	0.000
6935.5	--	1.00	--	--	--	231	0.005	66	0.002
6936	--	1.50	--	--	--	1,150	0.026	411	0.009
6936.5	--	2.00	--	--	--	3,571	0.082	1,591	0.037
6937	--	2.50	--	--	--	6,687	0.154	4,156	0.095
6937.5	--	3.00	--	--	--	9,361	0.215	8,168	0.188
6938	--	3.50	--	--	--	11,792	0.271	13,456	0.309
6938.5	--	4.00	--	--	--	13,441	0.309	19,764	0.454
6939	--	4.50	--	--	--	14,415	0.331	26,728	0.614
6939.5	--	5.00	--	--	--	15,676	0.360	34,251	0.786
6940	--	5.50	--	--	--	16,745	0.384	42,356	0.972
6940.5	--	6.00	--	--	--	17,809	0.409	50,995	1.171
6941	--	6.50	--	--	--	18,869	0.433	60,164	1.381
6941.5	--	7.00	--	--	--	20,052	0.460	69,895	1.605

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



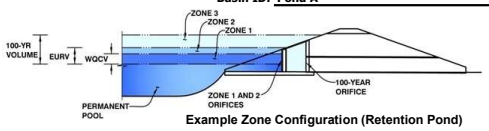


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Church at Bent Grass Meadows - FULL SPECTRUM DETENTION

Basin ID: Pond A



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.03	0.193	Orifice Plate
Zone 2 (EURV)	4.88	0.549	Rectangular Orifice
Zone 3 (100-year)	5.73	0.316	Weir&Pipe (Restrict)
Total (all zones)		1.058	

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 Area =		ft²
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		feet

Calculated Parameters for Underdrain

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft²
Depth at top of Zone using Orifice Plate =	2.75	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	16.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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	1.30	2.60					
Orifice Area (sq. inches)	0.69	0.69	0.15					

	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			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.05	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.88	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.11	N/A	feet
Vertical Orifice Height =	2.75	N/A	inches				
Vertical Orifice Width =	2.75		inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.90	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	11.49	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.26	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	6.26	N/A	ft²
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0		0.25	N/A	ft²
Outlet Pipe Diameter =	18.00	N/A	inches		0.30	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.25		inches	Half-Central		N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth =	0.59 feet
Spillway Crest Length =	15.00	feet		6.89 feet
Spillway End Slopes =	4.00	H:V		0.45 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.55 acre-ft

Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.193	0.342	0.509	0.661	0.783	0.926	1.067	1.230	1.592
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.509	0.661	0.783	0.926	1.067	1.230	1.592
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.4	2.8	4.6	8.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.19	0.39	0.63	1.13
Peak Inflow Q (cfs) =	N/A	N/A	9.4	11.9	13.7	16.8	19.4	22.2	30.0
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.37	0.4	1.8	3.8	5.99	12.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.3	2.7	1.3	1.4	1.3	1.5
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.2	0.6	0.9	0.9
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	66	61	65	67	68	67	65	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	70	64	69	72	73	72	72	71
Maximum Ponding Depth (ft) =	3.03	4.88	4.06	4.49	4.83	5.01	5.10	5.25	5.55
Area at Maximum Ponding Depth (acres) =	0.22	0.35	0.31	0.33	0.35	0.36	0.36	0.37	0.39
Maximum Volume Stored (acre-ft) =	0.194	0.744	0.469	0.610	0.726	0.786	0.819	0.862	0.988

HRG Response: PCM plan updated to match MHFD-Detention spreadsheet

plans call out 5:1

Explain why these are overridden in the text and add a note

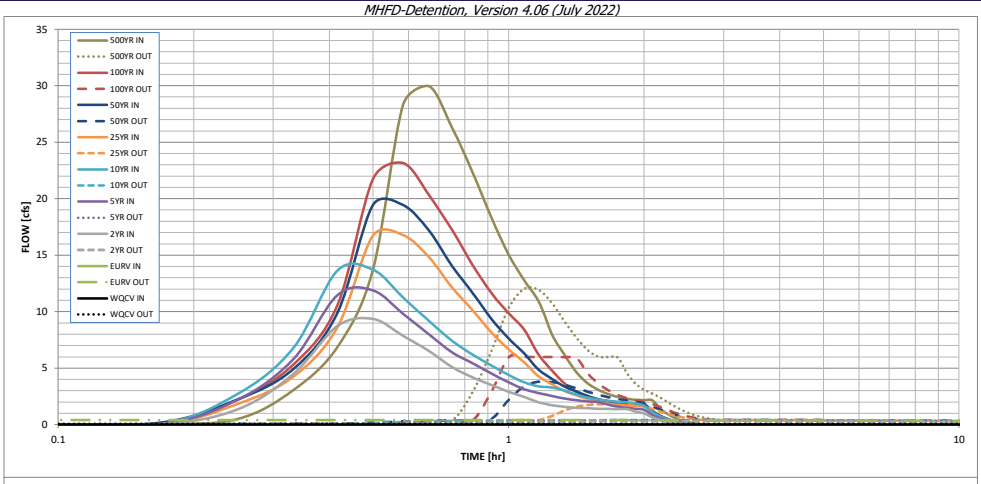
HRG Response: Removed overwrite on WQCV and EURV

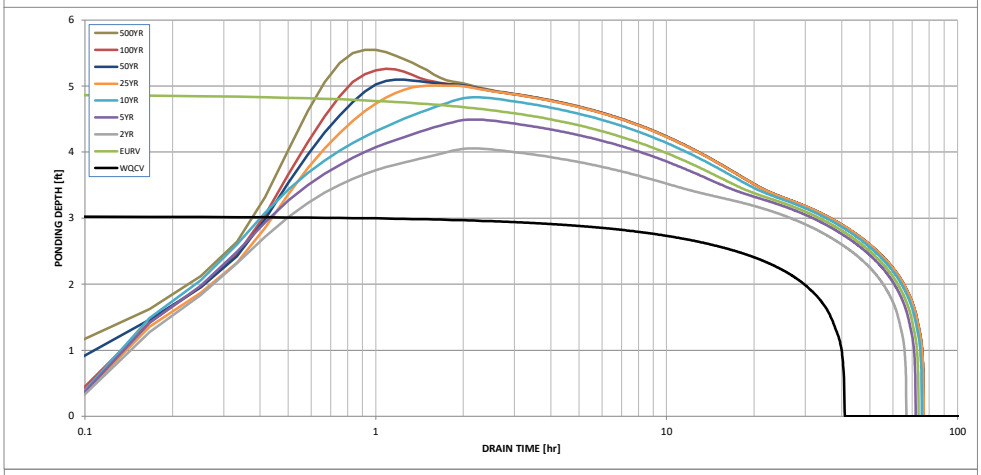
Please discuss in narrative why 1.0 could not be achieved and that impacts are negligible.

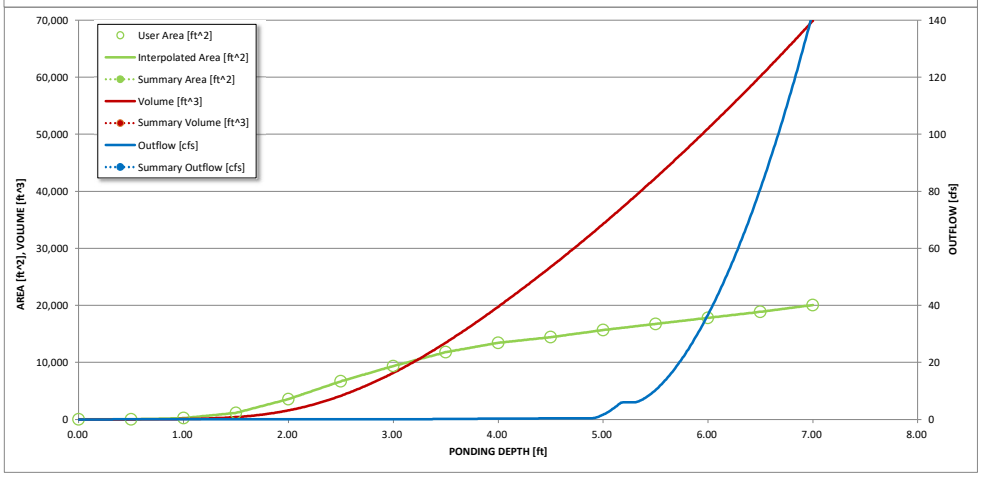
HRG Res Restrictor and spillw to achieve

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.02	0.48
	0:15:00	0.00	0.00	1.34	2.18	2.69	1.81	2.23	2.20	3.07
	0:20:00	0.00	0.00	4.51	5.83	6.81	4.27	4.94	5.33	6.87
	0:25:00	0.00	0.00	8.73	11.46	13.63	8.61	9.89	10.57	13.72
	0:30:00	0.00	0.00	9.35	11.88	13.71	16.72	19.45	21.74	28.31
	0:35:00	0.00	0.00	7.86	9.80	11.26	16.77	19.43	23.16	29.95
	0:40:00	0.00	0.00	6.50	7.97	9.15	14.80	17.15	20.28	26.24
	0:45:00	0.00	0.00	5.07	6.40	7.41	12.12	14.00	17.19	22.27
	0:50:00	0.00	0.00	4.17	5.43	6.17	10.10	11.63	14.10	18.29
	0:55:00	0.00	0.00	3.50	4.52	5.22	8.14	9.34	11.63	15.06
	1:00:00	0.00	0.00	2.91	3.74	4.39	6.66	7.63	9.86	12.77
	1:05:00	0.00	0.00	2.46	3.14	3.73	5.50	6.30	8.41	10.90
	1:10:00	0.00	0.00	1.97	2.79	3.39	4.27	4.86	6.18	7.95
	1:15:00	0.00	0.00	1.71	2.53	3.28	3.56	4.03	4.78	6.13
	1:20:00	0.00	0.00	1.57	2.30	3.01	2.96	3.34	3.61	4.61
	1:25:00	0.00	0.00	1.49	2.15	2.63	2.60	2.93	2.88	3.65
	1:30:00	0.00	0.00	1.45	2.05	2.38	2.23	2.52	2.44	3.08
	1:35:00	0.00	0.00	1.41	1.99	2.21	1.99	2.25	2.14	2.69
	1:40:00	0.00	0.00	1.39	1.76	2.10	1.84	2.07	1.95	2.44
	1:45:00	0.00	0.00	1.37	1.59	2.02	1.74	1.96	1.83	2.28
	1:50:00	0.00	0.00	1.37	1.48	1.97	1.68	1.89	1.77	2.20
	1:55:00	0.00	0.00	1.14	1.40	1.87	1.64	1.85	1.74	2.17
	2:00:00	0.00	0.00	0.99	1.31	1.67	1.62	1.82	1.74	2.17
	2:05:00	0.00	0.00	0.66	0.87	1.12	1.08	1.22	1.17	1.45
	2:10:00	0.00	0.00	0.43	0.57	0.73	0.72	0.80	0.77	0.96
	2:15:00	0.00	0.00	0.28	0.36	0.47	0.46	0.52	0.50	0.62
	2:20:00	0.00	0.00	0.17	0.22	0.29	0.29	0.32	0.31	0.38
	2:25:00	0.00	0.00	0.10	0.14	0.18	0.18	0.20	0.19	0.24
	2:30:00	0.00	0.00	0.05	0.07	0.09	0.10	0.11	0.11	0.13
	2:35:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.04	0.05
	2:40:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

HRGreen	CHURCH AT BENT GRASS	Calc'd by:	CMD
	2403591	Checked by:	RDL
	FOREBAY WQCV CALCULATION	Date:	7/23/2026

Input Parameters			
Basin	***a***	**I (%)**	**A (acres)**
A1,OS	1.0	86.2%	3.33
A2	1.0	87.1%	2.80

Calculated Parameters		
Basin	**WQCV (watershed-inches)**	**V (acre-feet)**
A1	0.371	0.103
A2	0.378	0.088

WQCV was calculated using Equation 3-1 and Equation 3-2 in the MHFD USDCM V3.

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$ **Equation 3-1**

Where:

WQCV = Water Quality Capture Volume (watershed-inches)

a = Coefficient corresponding to BMP type and based on WQCV design drain time (Table 3-2)

I = Imperviousness (percent expressed as a decimal) Note: At a planning level, the watershed imperviousness can be estimated based on the zoned density. When finalizing design, calculate imperviousness based on the site plan.

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hours)	Coefficient, a
12 hours (filtration BMPs and retention ponds)	0.8
24 hours (constructed wetland ponds)	0.9
40 hours (extended detention)	1.0
No attenuation (e.g., grass buffer or swale)	1.0

$$V = \frac{WQCV}{12} A$$ **Equation 3-2**

Where:

V = required storage volume (acre-feet)

A = watershed tributary area upstream (acres)

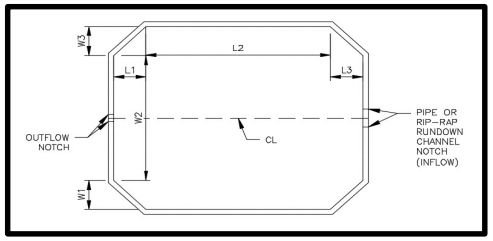
WQCV = Water Quality Capture Volume (watershed-inches)

HR GREEN FOREBAY SIZING

PROJECT: CHURCH AT BENT GRASS
DATE: 7/23/2026
DESIGNED BY: CMD
CHECKED BY: RDL
POND OR DP: FOREBAY A1

		INNER DIMENSIONS			OUTER DIMENSIONS	
LENGTH						
	L1	1	FT		1.67	FT
	L2	7.250	FT		7.916	FT
	L3	1	FT		1.67	FT
	INNER L	9.250	FT	OUTER TOTAL L	10.582	FT
WIDTH						
	W1	1	FT		1.67	FT
	W2	5.500	FT (75% of L2)		6.17	FT
	W3	1	FT		1.67	FT
	INNER W	7.500	FT	OUTER TOTAL W	8.832	FT
BAFFLE		(W2'x0.67' + 2.5'x0.67')				
	AREA	5.33	SF			

TRIANGLES	2	
RECTANGLE	39.9	
BAFFLE	5.3	
TOTAL SURFACE AREA	**36.5**	**SQ FT**



FOREBAY HT.	**1.25**	**FT**		
FOREBAY VOLUME	**45.7**	**CF**	SUFFICIENT VOLUME?	**YES**
	1.7	**CY**		
	0.0	**AC-FT**		

REQ'D VOL (1% WQCV)	0.0010295	AC-FT
	44.84500561	CF
Notch Width per Eq. 4-1	1.1	in

$$w = 9.23\ (A_{FB} / t)\ (1 / \sqrt{h_{max}})$$ **Equation 4-1**

Where:

w = width of the rectangular vertical notch (inches)

A_{FB} = surface area of the forebay (square feet)

t = emptying time of the brim-full forebay (seconds)

h_{max} = maximum depth of the forebay (feet)

TABLE 4-12. FOREBAY SIZING CRITERIA

FOREBAY SIZING CRITERIA	WATERSHED IMPERVIOUS AREA (IA)				
	IA UP TO 2 ACRES	IA 2 UP TO 5 ACRES	IA 5 UP TO 10 ACRES	IA 10 UP TO 20 ACRES	IA GREATER THAN 20 ACRES
Forebay Release Rate and Configuration	Concrete sediment pad with dense grasses surrounding, concrete pad with slotted metal edge, or similar design	Size to drain in 4 to 5 minutes using Equation 4-1			
Minimum Forebay Volume [1]		1% of WQCV			
Forebay Depth [1]		12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches

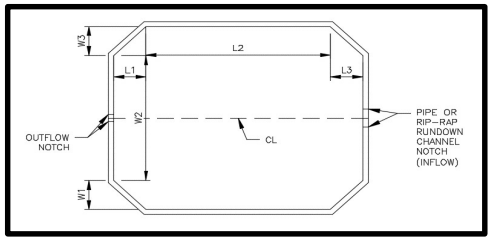
[1] Appropriate volume and depth should consider maintenance and access needs. The values provided are approximate and provide a starting point for design.

HR GREEN FOREBAY SIZING

PROJECT: CHURCH AT BENT GRASS
DATE: 7/23/2026
DESIGNED BY: CMD
CHECKED BY: RDL
POND OR DP: FOREBAY A2

		INNER DIMENSIONS			OUTER DIMENSIONS	
LENGTH						
	L1	1	FT		1.67	FT
	L2	6.750	FT		7.416	FT
	L3	1	FT		1.67	FT
	INNER L	8.750	FT	OUTER TOTAL L	10.082	FT
WIDTH						
	W1	1	FT		1.67	FT
	W2	5.000	FT (75% of L2)		5.67	FT
	W3	1	FT		1.67	FT
	INNER W	7.000	FT	OUTER TOTAL W	8.332	FT
BAFFLE		(W2'x0.67' + 2.5'x0.67')				
	AREA	5.00	SF			

TRIANGLES	2	
RECTANGLE	33.8	
BAFFLE	5.0	
TOTAL SURFACE AREA	**30.8**	**SQ FT**



FOREBAY HT.	**1.25**	**FT**		
FOREBAY VOLUME	**38.4**	**CF**	SUFFICIENT VOLUME?	**YES**
	1.4	**CY**		
	0.0	**AC-FT**		

REQ'D VOL (1% WQCV)	0.000880137	AC-FT
	38.33877611	CF
Notch Width per Eq. 4-1	0.9	in

$$w = 9.23\ (A_{FB} / t)\ (1 / \sqrt{h_{max}})$$ **Equation 4-1**

Where:

w = width of the rectangular vertical notch (inches)

A_{FB} = surface area of the forebay (square feet)

t = emptying time of the brim-full forebay (seconds)

h_{max} = maximum depth of the forebay (feet)

TABLE 4-12. FOREBAY SIZING CRITERIA

FOREBAY SIZING CRITERIA	WATERSHED IMPERVIOUS AREA (IA)				
	IA UP TO 2 ACRES	IA 2 UP TO 5 ACRES	IA 5 UP TO 10 ACRES	IA 10 UP TO 20 ACRES	IA GREATER THAN 20 ACRES
Forebay Release Rate and Configuration	Concrete sediment pad with dense grasses surrounding, concrete pad with slotted metal edge, or similar design	Size to drain in 4 to 5 minutes using Equation 4-1			
Minimum Forebay Volume [1]		1% of WQCV			
Forebay Depth [1]		12 to 15 inches	15 to 18 inches	18 to 24 inches	24 to 30 inches

[1] Appropriate volume and depth should consider maintenance and access needs. The values provided are approximate and provide a starting point for design.

APPENDIX E – APPROVED VARIANCE REQUESTS

APPENDIX F – REFERENCE MATERIAL

FINAL DRAINAGE REPORT

for

OWL MARKETPLACE FILNG NO. 1

Falcon, Colorado

June 2024

Prepared for:

Meridian & Owl X, LLC
450 N McClintock Drive
Chandler, AZ 85226
Contact: Brian Zurek
(480)-313-2724

Prepared by:

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El Paso County File No. VR2321

6.0 EXISTING ONSITE CONDITION

Rational Method Existing Runoff Summary

EXISTING				
BASIN	**DP**	**Area (Ac.)**	**Q_5 (CFS)**	**Q_{100} (CFS)**
RMT064	X1		288.5	920.0
OSE1	E1	1.26	0.9	3.1
E2		1.95	0.5	3.7
	E2	3.21	1.4	6.9
E3	E3	2.34	0.6	4.4
E4	E4	0.33	0.1	0.7
MT060	X2		60.1	196.8

Offsite flows reaching Owl Place from the roadside ditch along Meridian Road to the north are represented by **Design Point X1.** These flows are established by the DBPS (Matrix) and subsequent DBPS Amendment (Galloway) studies as DBPS Reach RMT064. The most recent CLOMR study determined rates of Q_5=288.5. cfs and Q_{100}=920 cfs for this section. See further description below.

An offsite basin for adjacent Lot 14 Falcon Ranchettes has not been delineated on the existing conditions map, but excerpts from the Falcon DBPS (Matrix) and DBPS Amendment (Galloway) have been included in the appendix to establish the existing flows entering Pond SR4 at the south of the lot, at **Design Point X2**. These flows are represented by DBPS Reach MT060 and consist of rates of Q_5=60.1 cfs and Q_{100}=196.8 cfs.

Basin OSE1 represents an offsite 1.26-acre basins to the north of Owl Place. Runoff rates of Q_5=0.9 cfs and Q_{100}=3.1 cfs are generated by this basin, and generally travel to the south towards the low point in Owl Place **(Design Point E1)** before discharging on to the Owl Marketplace property.

Basin E2 represents a 1.95 acre basin on the north side of the Owl Marketplace property to the south of Owl Place. This basin contains the Upper Black Squirrel Creek Tributary and as such flow generated by this basin (Q_5=0.5 cfs and Q_{100}=3.7 cfs) combine with those from offsite basin OSE1 and travel towards the center of the basin before following the tributary and discharging out the southwest property line at **Design Point E2.**

Basin E3 represents 3.21-acres at the south of the Owl Marketplace property. Runoff rates of Q_5=0.6 cfs and Q_{100}=4.4 cfs are generated by this basin, and generally travel to the southwest towards the property corner at **Design Point E3** before discharging into the adjacent subregional pond SR4 on the Falcon Marketplace property.

Basin E4 covers 0.33-acres along Meridian Road at the eastern boundary of the Owl Marketplace property. Runoff rates of Q_5=0.1 cfs and Q_{100}=0.7 cfs are generated by this basin, and generally travel to the east and south towards Meridian Road and **Design Point E4.**

7.0 PROPOSED CONDITION CLOMR ANALYSIS

The Middle Branch of the UTBSC flows southwest across the property and is proposed to be contained within a 10'x6' box culvert that will discharge into the Subregional Pond SR4 recently constructed on the Falcon Marketplace property.

Pond SR4 was designed for a 100-year discharge of 1,016 cfs, which includes both West and Middle branches of the UTBSC. The 100-year water surface elevation upstream of the pond as shown in the LOMR is 6902.5 (NAVD88), or 6898.7 (NGVD29). The starting HGL for the box culvert analysis was conservatively placed at the top of pipe elevation of 6895.84 feet (NGVD29) for analyzing flows to the East branch only. However, an additional analysis was performed with a starting HGL of 6898.7, to evaluate the backwater effects from the pond.

The proposed box culvert will convey the entire 100-year event (920 cfs), as established by the Falcon DBPS with an HGL of 6911.31 at the proposed headwall upstream of Owl Place, which is more than one foot below Owl Place and contained within the existing and proposed channel upstream. Channel grading will be required for approximately 30 feet to tie into the existing creek profile upstream. The channel side slopes will be reduced from approximately 5.5H:1V to 1.8H:1V and protected with Type M grouted riprap. A proposed Type VI stilling basin and additional riprap slope protection is proposed at the outfall into Pond SR4. An extension of the existing trickle channel will provide connection to the existing low flow path through the facility.

8.0 PROPOSED ONSITE CONDITION

As noted in Section 6.0 of this report, offsite flows reaching Owl Place from the roadside ditch along Meridian Road to the north are represented by **Design Point X1.** These flows are established by the DBPS (Matrix) and subsequent DBPS Amendment (Galloway) studies as DBPS Reach RMT064 and consist of rates of Q_5=288.5. cfs and Q_{100}=920 cfs. As noted above in Section 7.0 a proposed public 10'x6' box culvert will convey the full 100-year event without overtopping Owl Place from this point to Pond SR4 to the south.

An offsite basin for adjacent Lot 14 Falcon Ranchettes has not been delineated on the developed conditions map, as no changes - beyond those already incorporated into the following developed condition analysis – are proposed for Lot 14. The lot will remain in its current residential condition and any further development of Lot 14 (or Lot 5 as replatted with Owl Marketplace) will require additional drainage analysis and possible CLOMR to remove portions of the lot from the remaining floodplain. Flows reaching Pond SR4 to the south will remain as described in the existing condition as **Design Point X2** (Q_5=60.1 cfs and Q_{100}=196.8 cfs).

Basins A through D represent each of the 4 commercial pad sites within the Owl Marketplace property. For this initial stage of overlot development, each lot/pad site will be graded to direct flows towards its southwest corner, where runoff will be intercepted by a temporary sediment basins, before discharging into the proposed private 18" RCP storm sewer stubs provided to each lot. The storm sewer stubs will remain in place for use by the individual lot users.

Future Land Use Condition - Peak Discharge				
Model Location	**Physical Location**	**Branch**	**Proximity to Owl Place**	**Future Flow Q100 (cfs)**
JMT050	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	850
JMT060	Eastonville Road & Meridian Road	East and West Convergence	Downstream of site	1000

Bent Grass DPBS Amendment (Galloway)

The Bent Grass DBPS Amendment addresses a drainage diversion took place as part of the Bent Grass Residential Filing No. 1 development, specifically the rerouting of the UTBSC West Tributary to the east towards the intersection of Meridian Road and Bent Grass Meadows Drive. As a result of this diversion, a new junction was created in the Middle Tributary – JMT060a. This junction is located just south of JMT050 from the Falcon DPBS (Matrix) and is summarized below.

Future Land Use Condition - Peak Discharge				
Model Location	**Physical Location**	**Branch**	**Proximity to Owl Place**	**Future Flow Q100 (cfs)**
JMT060a	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	909.3

The Bent Grass DBPS Amendment recommends a 15' wide bottom channel with 4:1 side slopes at 6.5' deep with a longitudinal slope of 0.30% for reach RMT064.

Falcon Ranchettes Filing No. 1a – Meridian Storage (Galloway)

The Falcon Ranchettes Filing No. 1a development located directly north of Owl Place, includes regrading a portion of the UTBSC East Branch along Meridian Road with small drop structures with toe protection. The channel has been designed for a 925-cfs design flow as specified in the Bent Grass DBPS Amendment.

The improvements are intended to be intercepted by the 10'x6' box culvert proposed with this development. Per discussions with the adjacent developer, construction is expected to run concurrently with the Owl Marketplace project and design has been coordinated accordingly.

Owl Place CLOMR Analysis

This Owl Marketplace development includes regrading and rerouting a portion of the UTBSC East Branch. The improvements intercept the existing creek immediately north of Owl Place and convey is via 10'x6' box culvert to the subregional detention facility SR4 directly to the south. The box culvert is designed to convey the full 100-year discharge.

The Falcon DBPS did not include a junction on the East Branch immediately upstream of the convergence at pond SR4. Therefore, the Owl Place CLOMR modified the HMS model to create a new junction located at the southern boundary of this development. This junction is summarized below.

Future Land Use Condition - Peak Discharge				
Model Location	**Physical Location**	**Branch**	**Proximity to Owl Place**	**Future Flow Q100 (cfs)**
JMT051	Immediately upstream of Pond SR4	East Branch	Downstream of site	920

As mentioned above, a Conditional Letter of Map Revision (CLOMR) was approved by FEMA (Case No. 22-08-0669R) on December 21, 2022.

Referenced portions of the CLOMR are included in the appendix.

DBPS Analysis conclusions

Per the Falcon DBPS, channel improvements are required to stabilize RMT064 of the UTBSC East Branch. The table below compares the proposed design flow against previous reports.

Future Land Use Condition - Peak Discharge				
Model Location	**Physical Location**	**Branch**	**Proximity to Owl Place**	**Future Flow Q100 (cfs)**
RMT064	North of Owl Place, South of Bent Grass Meadows Drive	East Branch	-	925
JMT050 (Falcon DBPS)	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	850
JMT060a (Bent Grass Amendment)	Bent Grass Meadows Drive & Meridian Road	East Branch	Upstream of site	909.3
JMT051 (Owl Place CLOMR)	Immediately upstream of Pond SR4	East Branch	Downstream of site	920

Due to the added junctions (JMT060a and JMT051), no revisions to the existing HMS models are needed for identifying the proposed design flow for RMT064.

There are no proposed changes to the West Tributary proposed as part of this project. The property encumbered by this tributary and associated floodplain (Lot 14 Falcon Ranchettes – Lot 5, Owl Marketplace as replatted), will be required to undergo additional drainage analysis in the future at time of development.

17.0 REFERENCES

The sources of information used in the development of this study are listed below:

1. City of Colorado Springs/El Paso County Drainage Criteria Manual, May 2014.

2. Urban Storm Drainage Criteria Manuals, Urban Drainage and Flood Control District. June 2001, Revised April 2008.

3. Request for Conditional Letter of Map Revision, Unnamed Tributary to Black Squirrel Creek, Prepared by Drexel, Barrell & Co., October 25, 2022.

5. Natural Resources Conservation Service (NRCS) Web Soil Survey

7. EL Paso County Board Resolution No 15-042: El Paso County adoption of Chapter 6 and Section 3.2.1, Chapter 13 of the City of Colorado Springs Drainage Criteria Manual, May 2014.

8. Falcon Drainage Basin Planning Study. Prepared by Matrix Design Group, September 2015.

9. Final Drainage Report for Falcon Marketplace. Prepared by Drexel, Barrell & Co. November 2019.

10. El Paso County Engineering Criteria Manual , July 18, 2023.

11. MDDP & DBPS Amendment Bent Grass Development. Prepared by Galloway & Co. February 2021.

APPENDIX
REPORT EXCERPTS
FALCON DBPS

FALCON DRAINAGE BASIN PLANNING STUDY

SELECTED PLAN REPORT

FINAL - SEPTEMBER 2015

Prepared for:

El Paso County Public Services Department
3275 Akers Drive
Colorado Springs, CO 80922

Prepared By:

Matrix Design Group
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920

Matrix Project No. 10.122.003

LEGEND

«-- Subbasin ID
«-- Subbasin Area (square miles)

Existing Watershed Boundary
Historical and Future Watershed Boundary

Tributary Basin Boundary

East Tributary
Middle Tributary
West Tributary
Subbasin Boundary
Major Tributary
Elevation Contour (feet)

Falcon Drainage Basin	
Total Basin Area	10.7 mi^2
Average Subbasin Area	0.16 mi^2
Minimum Subbasin Area	0.03 mi^2
Maximum Subbasin Area	0.33 mi^2

East Tributary

West Tributary

Middle Tributary

BURGESS RD
GOODSON RD
MERIDIAN RD
RAYGOR RD
STAPLETON DR
EASTONVILLE RD
JUDGE ORR RD
WOODMEN RD
TAMLIN RD
FALCON HWY
GARRETT RD
MERIDIAN RD

WT020 0.07
WT010 0.14
WT030 0.08
WT040 0.19
WT050 0.19
WT070 0.17
WT060 0.20
WT080 0.07
WT090 0.15
WT110 0.19
WT100 0.19
WT140 0.13
WT150 0.23
WT120 0.05
WT130 0.10
WT160 0.11
WT170 0.12
WT180 0.10
WT190 0.06
WT200 0.30
WT210 0.27
WT220 0.19
WT230 0.20
WT240 0.08
WT250 0.15
WT260 0.14
WT270 0.03
WT280 0.27
WT290 0.10
WT300 0.10
WT310 0.28
WT320 0.21
WT330 0.33
WT340 0.28
WT350 0.30
WT360 0.07
WT370 0.21

ET010 0.15
ET020 0.21
MT020 0.09
MT040 0.31
ET030 0.20
MT010 0.29
MT030 0.16
ET040 0.15
ET060 0.29
ET050 0.12
MT050 0.12
MT060 0.19
ET070 0.25
ET090 0.12
ET080 0.29
MT070 0.20
MT080 0.06
MT090 0.04
ET130 0.13
ET100 0.05
MT100 0.06
ET110 0.23
ET140 0.27
MT110 0.12
ET120 0.11
ET150 0.18
ET160 0.19
FS010 0.12

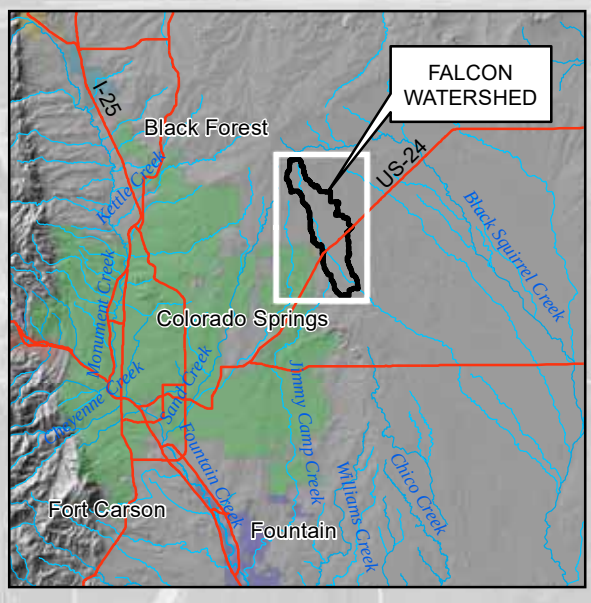
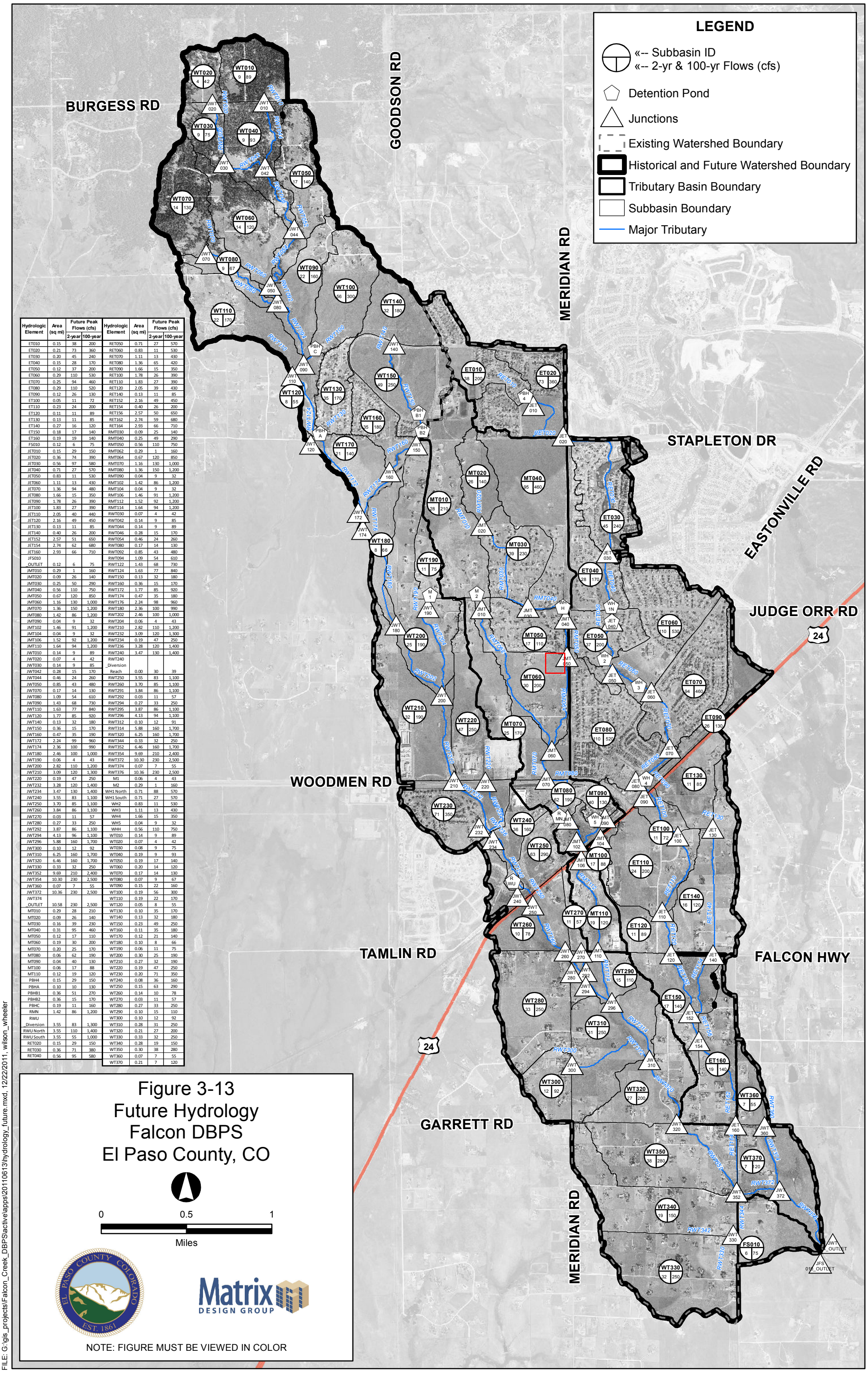


Figure 3-2
Drainage Basin Map
Falcon DBPS
El Paso County, CO

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Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20110613\basin_map.mxd, 8/29/2011, wilson_wheeler



Hydrologic Element	Area (sq mi)	Future Peak Flows (cfs)	
		2-year	100-year
ET010	0.15	38	200
ET020	0.21	73	360
ET030	0.20	45	240
ET040	0.15	28	170
ET050	0.12	37	200
ET060	0.29	110	530
ET070	0.25	94	460
ET080	0.29	110	520
ET090	0.12	26	130
ET100	0.05	11	72
ET110	0.23	24	200
ET120	0.11	11	89
ET130	0.13	11	85
ET140	0.27	16	120
ET150	0.18	17	140
ET160	0.19	19	140
FS010	0.12	6	75
JET010	0.15	29	150
JET020	0.36	74	390
JET030	0.56	97	580
JET040	0.71	27	570
JET050	0.83	11	530
JET060	1.11	13	430
JET070	1.36	94	480
JET080	1.66	15	350
JET090	1.78	26	390
JET100	1.83	27	390
JET110	2.05	40	440
JET120	2.16	49	450
JET130	0.13	11	85
JET140	0.40	26	200
JET152	2.57	51	650
JET154	2.74	62	680
JET160	2.93	66	710
JFS010 _OUTLET	0.12	6	75
JMT010	0.29	1	160
JMT020	0.09	26	140
JMT030	0.25	50	290
JMT040	0.56	110	750
JMT050	0.67	120	850
JMT060	1.16	130	1,000
JMT070	1.36	150	1,200
JMT080	1.42	86	1,200
JMT090	0.04	9	32
JMT102	1.46	91	1,200
JMT104	0.04	9	32
JMT106	1.52	94	1,200
JMT110	1.64	96	1,300
JWT010	0.14	9	89
JWT020	0.07	4	42
JWT030	0.14	9	85
JWT042	0.28	15	170
JWT044	0.46	24	260
JWT050	0.85	43	480
JWT070	0.17	14	130
JWT080	1.09	54	610
JWT090	1.43	68	730
JWT110	1.63	77	840
JWT120	1.77	85	920
JWT140	0.13	32	180
JWT150	0.36	15	170
JWT160	0.47	35	190
JWT172	2.24	99	960
JWT174	2.36	100	990
JWT180	2.46	100	1,000
JWT190	0.06	4	43
JWT200	2.82	110	1,200
JWT210	3.09	120	1,300
JWT220	0.19	47	250
JWT232	3.28	120	1,400
JWT234	3.47	130	1,400
JWT240	3.55	83	1,100
JWT250	3.70	85	1,100
JWT260	3.84	86	1,100
JWT270	0.03	11	57
JWT280	0.27	33	250
JWT292	3.87	86	1,100
JWT294	4.13	96	1,100
JWT296	5.88	160	1,700
JWT300	0.10	12	92
JWT310	6.25	160	1,700
JWT320	6.46	160	1,700
JWT330	0.33	32	250
JWT352	9.69	210	2,400
JWT354	10.30	230	2,500
JWT360	0.07	7	55
JWT372	10.36	230	2,500
JWT374 _OUTLET	10.58	230	2,500
MT010	0.29	28	210
MT020	0.09	26	140
MT030	0.16	39	230
MT040	0.31	95	460
MT050	0.12	17	110
MT060	0.19	30	200
MT070	0.20	25	170
MT080	0.06	62	190
MT090	0.04	40	130
MT100	0.06	17	88
MT110	0.12	19	120
PBH4	0.15	29	150
PBHA	0.10	10	130
PBHB1	0.36	51	270
PBHB2	0.36	15	170
PBHC	0.19	11	160
RMN	1.42	86	1,200
RWU Diversion	3.55	83	1,300
RWU North	3.55	110	1,400
RWU South	3.55	55	1,000
RET020	0.15	29	150
RET030	0.36	71	380
RET040	0.56	95	580

Hydrologic Element	Area (sq mi)	Future Peak Flows (cfs)	
		2-year	100-year
RET050	0.71	27	570
RET060	0.83	11	530
RET070	1.11	13	430
RET080	1.36	65	420
RET090	1.66	15	350
RET100	1.78	26	390
RET110	1.83	27	390
RET120	2.05	39	430
RET140	0.13	11	85
RET152	2.16	49	450
RET154	0.40	26	200
RET156	2.57	50	650
RET162	2.74	59	680
RET164	2.93	66	710
RMT030	0.09	25	140
RMT040	0.25	49	290
RMT050	0.56	110	750
RMT062	0.29	1	160
RMT064	0.67	120	850
RMT070	1.16	130	1,000
RMT080	1.36	150	1,200
RMT090	0.04	9	32
RMT102	1.42	86	1,200
RMT104	0.04	9	32
RMT106	1.46	91	1,200
RMT112	1.52	92	1,200
RMT114	1.64	94	1,200
RWT030	0.07	4	42
RWT042	0.14	9	85
RWT044	0.14	9	89
RWT046	0.28	15	170
RWT054	0.46	24	260
RWT080	0.17	14	130
RWT092	0.85	43	480
RWT094	1.09	54	610
RWT122	1.43	68	730
RWT124	1.63	77	840
RWT150	0.13	32	180
RWT160	0.36	15	170
RWT172	1.77	85	920
RWT174	0.47	35	180
RWT176	2.24	98	960
RWT180	2.36	100	990
RWT202	2.46	100	1,000
RWT204	0.06	4	43
RWT210	2.82	110	1,200
RWT232	3.09	120	1,300
RWT234	0.19	47	250
RWT236	3.28	120	1,400
RWT240 _Diversion Reach	0.00	30	39
RWT250	3.55	83	1,100
RWT260	3.70	85	1,100
RWT291	3.84	86	1,100
RWT292	0.03	11	57
RWT294	0.27	33	250
RWT295	3.87	86	1,100
RWT296	4.13	96	1,100
RWT312	0.10	12	91
RWT314	5.88	160	1,700
RWT320	6.25	160	1,700
RWT344	6.46	160	1,700
RWT352	9.69	210	2,400
RWT372	10.30	230	2,500
RWT374	10.36	230	2,500
M1	0.06	4	43
M2	0.29	1	160
WH1 North	0.71	88	570
WH1 South	0.71	27	570
WH2	0.83	11	530
WH3	1.11	13	430
WH4	1.66	15	350
WH5	0.04	9	32
WHH	0.56	110	750
WT010	0.14	9	89
WT020	0.07	4	42
WT030	0.08	9	75
WT040	0.19	9	93
WT050	0.19	17	140
WT060	0.20	14	120
WT070	0.17	14	130
WT080	0.07	9	67
WT090	0.15	22	160
WT100	0.19	56	300
WT110	0.19	22	170
WT120	0.05	8	55
WT130	0.10	35	170
WT140	0.13	32	180
WT150	0.23	49	250
WT160	0.11	35	180
WT170	0.12	21	140
WT180	0.10	8	66
WT190	0.06	11	75
WT200	0.30	25	190
WT210	0.27	32	190
WT220	0.19	47	250
WT230	0.20	71	350
WT240	0.08	36	160
WT250	0.15	63	290
WT260	0.14	10	78
WT270	0.03	11	57
WT280	0.27	33	250
WT290	0.10	15	110
WT300	0.10	12	92
WT310	0.28	31	250
WT320	0.21	27	200
WT330	0.33	32	250
WT340	0.28	19	150
WT350	0.30	38	280
WT360	0.07	7	55
WT370	0.21	7	120

Figure 3-13
Future Hydrology
Falcon DBPS
El Paso County, CO

0 0.5 1

Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20110613\hydrology_future.mxd, 12/22/2011, wilson_wheeler

Sub Regional Detention Alternative[1]						
Pond		Q_2 In (cfs)	Q_2 Out (cfs)	Q_{100} In (cfs)	Q_{100} Out (cfs)	Required Volume (AF)[2]
Paint Brush Hills Pond #4	PBH 4	38	29	200	150	1.34
Paint Brush Hills Pond A	PBH A	35	7	170	140	2.62
Paint Brush Hills Pond B1	PBH B1	80	51	420	270	9.17
Paint Brush Hills Pond B2	PBH B2	51	10	270	180	12.09
Paint Brush Hills Pond C	PBH C	56	3	300	140	6.77
Regional Pond MN	R MN	65	32	850	820	7.53
Regional Pond R1	R R1	110	77	1,600	1,500	25.00
Regional Pond R2	R R2	140	140	2,200	2,200	3.13
Regional Pond WU South	R WUs	47	22	1,100	930	39.54
Sub Regional Pond SR1	SR 1	54	42	610	510	11.03
Sub Regional Pond SR2	SR 2	65	65	840	840	2.05
Sub Regional Pond SR3	SR 3	72	72	910	910	1.03
Sub Regional Pond SR4	SR 4	130	27	1,000	730	19.37
Sub Regional Pond SR6	SR 6	74	9	390	200	11.82
The Meadows Pond #1	M 1	11	0	70	0	3.25
The Meadows Pond #2	M 2	28	5	210	100	7.94
Woodmen Hills Pond #1 North	WH 1N	65	61	390	260	7.13
Woodmen Hills Pond #1 South	WH 1S	61	10	260	260	8.78
Woodmen Hills Pond #2	WH 2	37	10	270	250	9.18
Woodmen Hills Pond #3	WH 3	110	13	530	360	8.35
Woodmen Hills Pond #4	WH 4	110	15	790	260	40.45
Woodmen Hills Pond #5	WH 5	40	1	130	20	4.10
Woodmen Hills Pond H	WH H	140	110	750	750	2.66

Notes

1: Represents future hydrology with retrofit existing detention ponds and 7 new sub regional detention ponds

2: Required volume to highest WSE not including embankment

Reach Alternative	Total (ft)
Natural Channel Design	13,216
Protect in Place	64,325
Roadside Ditch Improvement	7,519
Small Drop Structures w/ Toe Protection	50,750

BURGESS RD

GOODSON RD

MERIDIAN RD

STAPLETON DR

EASTONVILLE RD

JUDGE ORR RD

DIVERSION

WOODMEN RD

TAMLIN RD

FALCON HWY

GARRETT RD

MERIDIAN RD

24

LEGEND

Detention Pond

- Existing
- Proposed
- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary
- Subbasin Boundary
- Major Tributary
- Immediate Action Required to Preserve Existing Condition

Reach Alternative

- Natural Channel Design
- Protect In Place
- Roadside Ditch Improvement
- Small Drop Structures w/ Toe Protection

Note:
Infrastructure and channel improvements shown may vary slightly from the final list published in the accompanying report as a result of fee revisions that have occurred following the preparation of this figure. For current information as of September 2015, please see tables in Section 6 of the accompanying report.

Figure 6-1
Selected Plan
Falcon DBPS
El Paso County, CO

0 0.5 1

Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20130617\Fig_6-1_selected_plan_20150925.mxd, 9/25/2015, jeff_clonts

LEGEND

- Public Cost Reach Improvement
- Public Cost Detention Pond
- Public Cost Crossing
- Crossing

Detention Pond

- Existing
- Proposed
- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary
- Subbasin Boundary
- Major Tributary

Figure 7-1
County Cost Improvements
Falcon DBPS
El Paso County, CO

0 0.5 1

Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\Fig_7-1_County_Costs_20151229_JKC.mxd, 12/29/2015, jeff_clonts

Falcon DBPS
County Costs

Drainage Fees			
Reach/Pond	**Reach Length (ft)**	**Improvement**	**Cost**
RWT344	1,379	Roadside Ditch Improvement	$ 167,006
RET140	4,052	Roadside Ditch Improvement	$ 295,914
RET164	2,072	Roadside Ditch Improvement	$ 132,703
RET100	1,791	Small Drop Structures w/Toe Protection	$ 1,342,120
RET110	2,751	Small Drop Structures w/Toe Protection	$ 1,055,516
RET152	2,030	Small Drop Structures w/Toe Protection	$ 1,081,390
RET120	1,379	Natural Channel Design	$ 72,798
RET162	3,256	Small Drop Structures w/Toe Protection	$ 656,460
RMT050	1,568	Small Drop Structures w/Toe Protection	$ 814,189
RMT062	5,688	Small Drop Structures w/Toe Protection	$ 2,381,127
RMT064	3,358	Small Drop Structures w/Toe Protection	$ 1,231,110
RMT112	3,372	Small Drop Structures w/Toe Protection	$ 1,276,142
RWT054	2,497	Small Drop Structures w/Toe Protection	$ 1,414,531
RWT080	3,494	Small Drop Structures w/Toe Protection	$ 2,345,153
RWT092	626	Small Drop Structures w/Toe Protection	$ 414,434
RWT372	1,377	Small Drop Structures w/Toe Protection	$ 947,221
RMT102	1,021	Small Drop Structures w/Toe Protection	$ 636,082
RMT104	874	Small Drop Structures w/Toe Protection	$ 186,349
RET154	2,357	Natural Channel Design	$ 468,927
RET156	942	Natural Channel Design	$ 73,722
WT 5	43	Crossing - Culvert	$ 8,651
ET 13	50	Crossing - Culvert	$ 113,991
ET 11	40	Crossing - Culvert	$ 84,348
ET 9	40	Crossing - Culvert	$ 84,102
ET 4	61	Crossing - Culvert	$ 106,060
Sub Regional Pond SR1		Detention Pond	$ 405,769
The Meadows Pond #2		Detention Pond	$ 20,000
		Subtotal	$ 17,815,814
		Engineering/Construction Admin (15%)	$ 2,672,372
		Contingency (20%)	$ 3,563,163
		Total	**$ 24,051,349**

Bridge Fees			
Reach/Pond	**Reach Length (ft)**	**Improvement**	**Cost**
WT 6	43	Crossing - Bridge	$ 249,775
WT 4	48	Crossing - Bridge	$ 528,324
WT 3	46	Crossing - Bridge	$ 218,292
WT 1	40	Crossing - Bridge	$ 636,648
MT 2	83	Crossing - Bridge	$ 343,147
ET 10	44	Crossing - Bridge	$ 162,656
		Subtotal	$ 2,138,842
		Engineering/Construction Admin (15%)	$ 320,826
		Contingency (20%)	$ 427,768
		Total	**$ 2,887,437**

MDDP & DBPS AMENDMENT

BENT GRASS DEVELOPMENT

El Paso County, Colorado

PREPARED FOR:
Challenger Communities, LLC
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

PREPARED BY:
Galloway & Company, Inc.
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920

DATE:
January 2021
Revised: March 2021
Revised: April 2021
Revised: June 2021
Revised: August 2021
Revised: September 2021

PUDSP-20-005

recommendations from the Falcon DBPS, when additional land is obtained to expand the ROW along the southbound portion of Meridian Road.

In the interim condition, it has been proposed to add a temporary lining to the existing channel to handle the excess velocities and depth associated with the DBPS flows and Bent Grass development re-routed flows. This analysis has been included in the Appendix.

The West Tributary Channel will be natural, vegetated facility, helping to ensure that the overall velocities will be reduced, flow depth will not exceed 5' and minimize any potential for scour. If needed, grade control structures may be designed as proposed in the DBPS to ensure these criteria are met.

3. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release

This step utilizes formalized water quality capture volume to slow the release of runoff from the site. The WQCV will release in no less than 40 hours. On-site water quality control volume detention ponds will provide water quality treatment prior to the runoff being released into the channel. WQCV facilities will be designed as Extended Detention Basins.

The Falcon Meadows at Bent Grass development, west of Bent Grass Residential, Filing No. 1 and No. 2, will include several water quality ponds throughout the site to ensure flows will be treated prior to being released into the West Tributary Channel, running through the site. Only a small area, less than 1.0 acres will not be treated prior to releasing into the channel.

Currently, the existing Meridian Road roadside ditch, ultimately conveys runoff to the existing detention and water quality pond MN, as shown and discussed in the Falcon DBPS. The Falcon DBPS also shows a future detention and water quality pond SR-4 that is to receive flows from basin MT060 and discharge into basin MT070, ultimately routing to existing Pond MN. Flows from Bent Grass Meadows Drive are listed in basin MT060 but are being routed to the existing roadside ditch along Meridian Road, which is in basin MT070. The flows from the "School Site" and upstream basins will release into the east side of Pond SR-4 (west of Falcon Market Place). Pond SR-4 is currently under construction. The proposed improvements impact on the existing drainage basin and both Pond MN and Pond SR-4 are discussed later in the report.

4. Consider Need for Industrial and Commercial BMPs

Source control BMPs for homeowners include the use of garages as the primary area where pollutants can be stored. The single-family detached homes provide garages which can act as storage areas. The proposed development does not include outdoor storage or the potential for introduction of contaminants to the Counties' MS4, thus no targeted source control BMPs are necessary. The biggest source control BMP is public education and discuss topics such as: pet waste, car washing, lawn care, fall leaves, and snow melt and deicer.

Bent Grass East Commercial Filing No. 1 contains commercial development. This area will need to consider the need for Industrial & Commercial BMPs. No industrial uses or outside storage is proposed for this area. Drainage will be routed through water quality ponds prior to leaving the site to minimize contaminants into the public system.

VII. Future Drainage Conditions

MIDDLE TRIBUTARY

Design Point 30 and Basins OS-25 and OS-26 are as described under Existing Drainage Conditions. However, Basins OS-25 and OS-26 now route through proposed “future” detention pond, on what’s been previously referred to as the “School Site”, north of Bent Grass Meadows Drive and just west of Bent Grass Filing No. 2. This “future” pond will replace the current sedimentation pond on the “School Site”. Upon any additional development within the Middle Tributary area of the Bent Grass Development and north of Bent Grass Meadows Drive, this pond will need to be constructed to accommodate the re-routed flows from the Meadows Pond #2 at DP 30.

This future facility will need to provide 2.76 ac-ft of water quality, 6.26 ac-ft for EURV and 11.98 ac-ft for 100-year storage volume. Preliminary release rates for the 5 and 100-year storms are 3.8 cfs and 32.2 cfs. These flows were then routed to Bent Grass Meadows to the south. With the decrease in flows, flows will not overtop Bent Grass Meadows Drive and continue east to the future box culvert under Bent Grass Meadows Drive at DP BG20 (5-year flow=292.5 cfs, 100-year flow=909.3 cfs). Flows were still checked against street capacity on the north and south side of Bent Grass Meadows Drive, as it continues to the east. With the construction of the future pond, Bent Grass Meadows Drive will be able to adequately handle the flows and no additional storm infrastructure would need to be built to carry these future developed flows. Any area north of Bent Grass Meadows Drive that will develop in the future will need to provide its own on-site detention. Should future development not be able to release flows into Bent Grass Meadows Drive, a 42” RCP would be able to convey the flows of DP BG 15n (Q100=40.9 cfs, Q5=8.8 cfs) to the northwest corner of the Bent Grass Meadows Drive and Meridian Road intersection. Analysis for this culvert sizing has been included in the appendix.

At the Bent Grass Meadows Drive/Meridian Road intersection, the elliptical rcp’s will need to be replaced with a double 16’ x 4’ rcbc. The future roadside ditch will have a 15’ wide bottom channel with 4:1 side slope, 6.5’ deep and a longitudinal slope of 0.30%. This will result is a flow depth of 5.15’ and velocity of 5.04 fps. This channel will direct flows to Owl Place where the existing twin cmp’s will be replaced with a 20’ x 4’ rcbc or equivalent. This structure will need to be built when any development west of Meridian Road at the intersection of Owl Place happens. With future development, it is anticipated that the existing channel conveying flows to the south will be removed to accommodate the new development. The new channel will need to be a 35’ wide bottom channel with 4:1 sides, 5’ deep and a longitudinal slope of 0.30%. This will produce a flow depth of 3.7’ and a velocity of 4.6 fps. If the channel option is not viable, twin 78” rcp’s at a minimum 0.50% slope would be able to handle this future flow. Analysis for this design option has been included in the appendix.

Calculations are provided in Appendix C for the future culverts and roadside channel.

WEST TRIBUTARY

Offsite flows entering the west tributary location of Bent Grass have not changed from what was discussed under Current Conditions. Reach RWT202 at the northwest corner of the development has a 100-year flow of 1000 cfs and Reach RWT204 has a flow of 43 cfs. These were obtained from the DBPS by Matrix. The Flood Insurance Study (FIS) by FEMA does not have flows evaluated this far north. The have a flow of 1482 cfs beginning at RWT210. The 8 undeveloped on-site basins for Bent Grass West have been replaced with 17 developed basins. These basins are found in the Falcon Meadows for Bent Grass PDR. A summary of these basins is provided below and are part of the hydrology analysis provided in Appendix B.

Sub Regional Detention Alternative[1]						
Pond		Q_2 In (cfs)	Q_2 Out (cfs)	Q_{100} In (cfs)	Q_{100} Out (cfs)	Required Volume (AF)[2]
Paint Brush Hills Pond #4	PBH 4	38	29	200	150	1.34
Paint Brush Hills Pond A	PBH A	35	7	170	140	2.62
Paint Brush Hills Pond B1	PBH B1	80	51	420	270	9.17
Paint Brush Hills Pond B2	PBH B2	51	10	270	180	12.09
Paint Brush Hills Pond C	PBH C	56	3	300	140	6.77
Regional Pond MN	R MN	65	32	850	820	7.53
Regional Pond R1	R R1	110	77	1,600	1,500	25.00
Regional Pond R2	R R2	140	140	2,100	2,100	7.90
Regional Pond WU South	R WU	47	22	1,070	930	39.54
Sub Regional Pond SR1	SR 1	54	42	610	510	11.03
Sub Regional Pond SR2	SR 2	65	65	840	840	2.05
Sub Regional Pond SR3	SR 3	72	72	910	910	1.03
Sub Regional Pond SR4	SR 4	130	27	1,000	730	19.37
Sub Regional Pond SR6	SR 6	74	9	390	200	11.82
The Meadows Pond #1	M 1	11	0	75	2	3.25
The Meadows Pond #2	M 2	28	5	210	99	7.94
Woodmen Hills Pond #1 North	WH 1N	65	61	390	260	7.13
Woodmen Hills Pond #1 South	WH 1S	61	10	260	260	8.78
Woodmen Hills Pond #2	WH 2	37	10	270	250	9.18
Woodmen Hills Pond #3	WH 3	105	13	530	360	8.35
Woodmen Hills Pond #4	WH 4	110	15	790	260	40.45
Woodmen Hills Pond #5	WH 5	40	1	130	19	4.10
Woodmen Hills Pond H	WH H	140	110	750	750	2.66

Notes
1: Represents future hydrology with retrofit existing detention ponds and 5 new subregional detention ponds
2: Required volume to highest WSE

Reach Alternative	Total (ft)
Protect In Place	30,066
Natural Channel Design	32,359
Small Drop Structures w/ Toe Protection	76,812
Large Drop Structures w/ Toe Protection	0

BURGESS RD
GOODSON RD
STAPLETON DR
EASTONVILLE RD
JUDGE ORR RD
WOODMEN RD
TAMLIN RD
FALCON HWY
GARRETT RD
MERIDIAN RD
24

DIVERSION

CHANGE DUE TO BENT GRASS R2 (RWT200)

DELETE POND WITH WQCV REPLACEMENTS & CHANNEL IMPROVEMENTS

CHANGE DUE TO BENT GRASS R1 (RMT063)

LEGEND

Detention Pond
- Existing
- Proposed
- Existing Watershed Boundary
- Historical and Future Watershed Boundary
- Tributary Basin Boundary
- Subbasin Boundary
- Major Tributary
- Immediate Action Required to Preserve Existing Condition

Reach Alternative
- Protect In Place
- Natural Channel Design
- Small Drop Structures w/ Toe Protection

Figure 5-3
Sub-Regional Detention Alternative
Falcon DBPS
El Paso County, CO

0 0.5 1
Miles

NOTE: FIGURE MUST BE VIEWED IN COLOR

FILE: G:\gis_projects\Falcon_Creek_DBPS\active\apps\20111215_alternatives\subregional_detention_alt.mxd, 12/19/2011, ron_ramold

MERIDIAN ROAD

Worksheet for Fut Channel - Pr 100 Yr Flow-MR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	0.30	%
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	15.00	ft
Discharge	925.00	ft³/s

Results

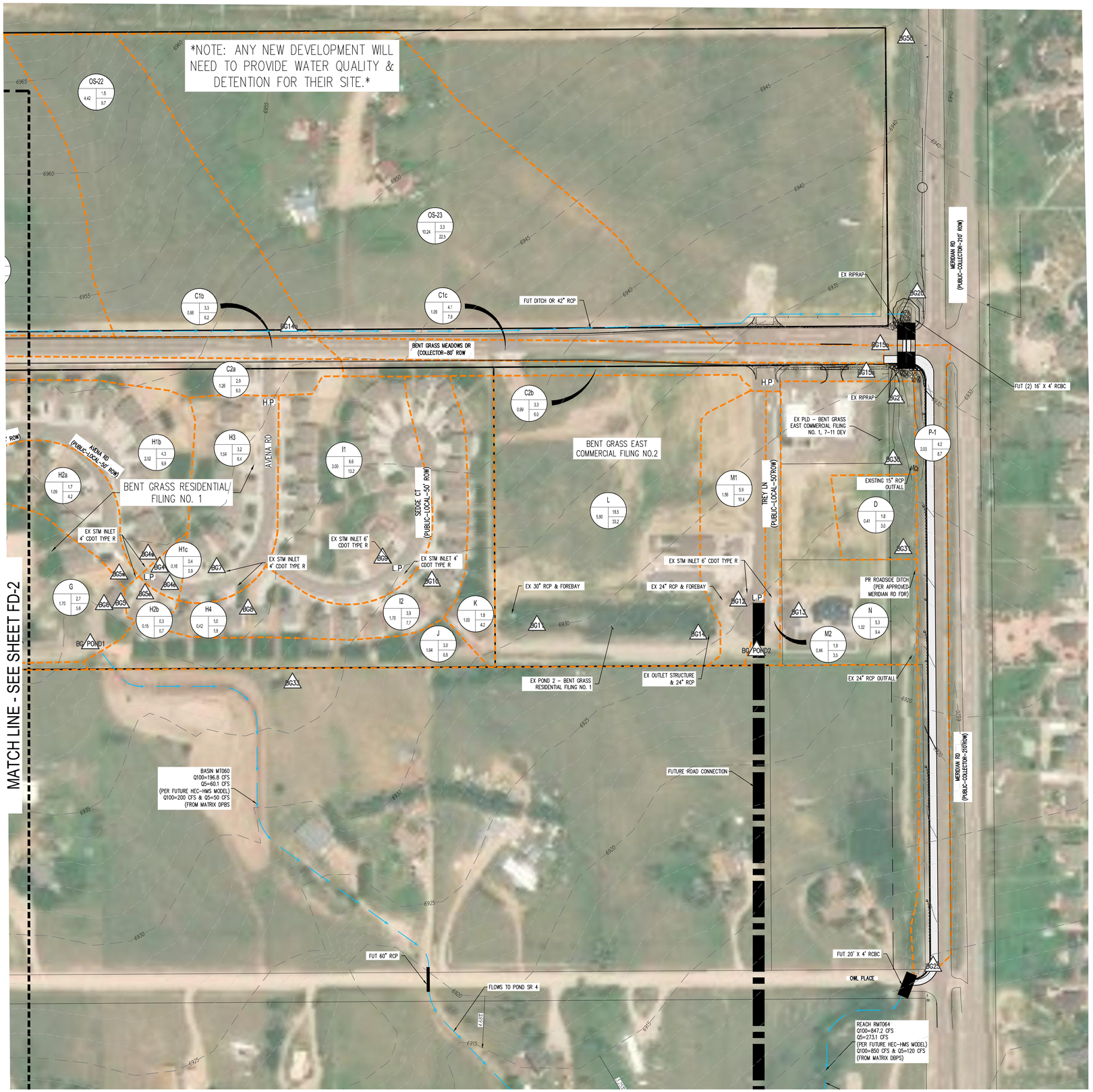
Normal Depth	5.15	ft
Flow Area	183.50	ft²
Wetted Perimeter	57.49	ft
Hydraulic Radius	3.19	ft
Top Width	56.22	ft
Critical Depth	3.58	ft
Critical Slope	0.01368	ft/ft
Velocity	5.04	ft/s
Velocity Head	0.39	ft
Specific Energy	5.55	ft
Froude Number	0.49	
Flow Type	Subcritical	

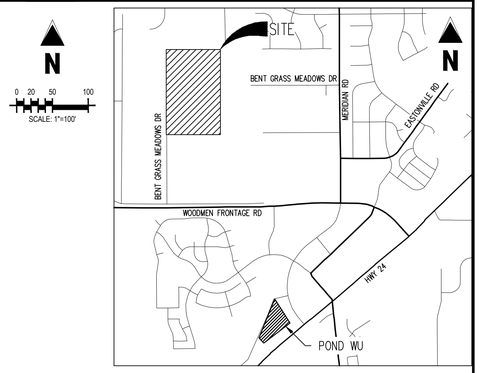
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.15	ft
Critical Depth	3.58	ft
Channel Slope	0.30	%





VICINITY MAP

N

0 20 50 100
SCALE: 1"=100'

DRAINAGE LEGEND 1"=2,000'

- PROPERTY LINE
- 6485 EXISTING MAJOR CONTOUR
- 6483 EXISTING MINOR CONTOUR
- 6485 PROPOSED/FUTURE MAJOR CONTOUR
- 6483 PROPOSED/FUTURE MINOR CONTOUR
- BASIN BOUNDARY LINE
- 100YR FEMA EFFECTIVE 100-YR FLOODPLAIN
- CENTERLINE OF STREAM
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DIRECTION OF RUNOFF

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
RWT202	1574.40	220.0	1000.0
RWT204	38.40	7.0	43.0
WT200	192.00	52.0	190.0
OS-2	20.08	9.0	43.4
OS-3	10.62	4.7	22.7
OS-25	18.74	6.3	35.8
OS-26	5.81	1.9	12.6
H5	6.37	3.2	15.1
OS-22	4.42	1.5	9.7
OS-23	10.24	3.3	22.5
C1a	0.48	1.8	3.4
C1b	0.88	3.3	6.2
C1c	1.09	4.1	7.8
D1a	0.56	1.6	3.5
D1b	0.68	2.0	4.2
D1c	1.20	3.2	6.6
D1d	2.79	6.7	13.6
C2a	1.26	2.9	6.0
C2b	0.99	3.3	6.0
D2a	1.00	1.8	4.8
D2b	0.41	1.0	2.3
H1a	0.40	1.0	2.3
H1b	2.52	4.3	9.9
H1c	0.16	0.4	0.9
H2a	1.09	1.7	4.2
H2b	0.15	0.3	0.7
F	1.37	2.6	5.9
G	1.70	2.7	5.6
H3	1.54	3.2	6.4
H4	0.42	1.0	1.9
I1	3.00	6.6	13.2
I2	1.70	3.9	7.7
J	1.64	3.0	6.8
K	1.00	1.8	4.2
L	5.90	18.5	33.2
M1	1.56	5.9	10.4
M2	0.44	1.9	3.5
N	1.32	5.3	9.4
D	0.41	1.8	3.0
OS-1	33.07	15.5	66.7
OS-4	4.46	5.6	14.0
OS-5	0.46	1.1	2.3
OS-6	1.17	2.0	4.3
A-1	2.70	3.3	8.6
A-2	1.19	1.5	4.2
A-3	1.57	2.1	5.0
A-4	2.24	2.9	7.5
C-1	1.35	2.6	5.9
C-2	6.80	7.1	18.5
C-3	2.38	3.3	7.8
C-4	3.61	5.3	12.0
C-5	7.86	10.9	24.9
C-6	5.54	7.0	16.9
C-7	0.89	0.3	2.1
E-1	1.71	3.6	7.7
E-2	0.68	2.4	4.6
E-3	0.76	2.9	5.3
E-4	0.91	3.0	5.7
E-5	0.89	3.3	6.1
F-1	0.44	0.6	1.6
F-2	0.55	1.5	3.1
G-1	1.47	1.3	4.5
H-1	0.52	0.2	1.4
I-1	0.31	1.0	2.1
AA-1	2.57	4.2	9.9
AA-2	2.28	4.2	9.3
B-1	5.25	2.3	10.7
B-2	4.16	1.4	9.1
CC-1	9.07	16.9	36.0
CC-2	1.53	4.6	9.8
CC-3	1.88	6.4	12.1
CC-4	3.64	6.2	16.0
CC-5	0.45	0.2	1.4
D-1	9.07	11.2	26.6
D-2	7.42	15.5	32.2
D-3	2.03	0.8	2.3
D-4	4.38	7.8	16.6
D-5	1.08	2.2	4.6
D-6	4.01	8.2	17.2
D-7	6.39	3.2	14.8
D-8	1.69	1.3	4.5
P-1	2.03	4.2	8.7

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)	REV HMS FLOWS Q_5 (cfs)	REV HMS FLOWS Q_{100} (cfs)
40	276.1	1227.8	181.4	1029.1
1	3.1	8.6		
2	4.3	11.9		
3	5.9	15.9		
4	8.3	22.3		
9	1.1	2.4		
11	6.0	15.5		
13	7.6	19.0		
5	10.9	27.1		
6	4.1	9.4		
7	2.9	5.5		
8	20.0	50.5		
12	4.6	10.2		
15	20.9	45.4		
10	23.9	52.7		
10A	6.0	21.9		
14	33.0	81.1		
14A	12.2	37.0		
AA	270.3	1188.7		
BB	269.5	1186.4		
16	16.6	39.4		
17	10.6	26.8		
18	13.5	39.2		
19	9.5	29.7		
20	1.3	4.6		
20A	18.4	57.1		
20B	21.3	66.0		
28	8.6	42.8		
29	12.2	60.9		
21	15.0	32.5		
22	10.5	26.0		
23	12.2	59.7		
24	2.1	15.9		
25	3.3	10.7		
26	8.0	41.7		
42	7.5	16.5		
43	10.0	21.8		
44	1.2	4.5		
45	53.8	173.9		
45A	1.1	45.8		
CC	268.2	1183.4	191.9	1075.3
30	2.1	63.5		
31	5.8	67.4		
32	6.5	64.8		
32A	4.9	34.5		
32A-N	4.9	33.2		
32A-S	12.5	3.6		
BG 1a-Os	0.0	0.0		
BG 1a-Ose	0.0	0.0		
BG 1a-Osw	0.0	0.0		
BG 4a	0.6	1.5		
BG 1b	1.3	2.8		
BG 1c	3.3	7.1		
BG 1	8.3	17.6		
BG 2e	1.8	5.0		
BG 2w	1.0	2.4		
BG 2	2.8	7.3		
BG 4e	0.4	0.9		
BG 4w	3.8	9.0		
BG 4	4.0	9.5		
BG 5e	0.3	0.7		
BG 5w	1.7	4.2		
BG 5	1.9	4.7		
BG 3	16.2	58.7		
BG 6	5.4	13.2		
BG POND1	0.3	2.9		
BG 14n	9.2	42.7		
BG 15n	8.8	40.9		
BG 50	280.0	850.0		
BG 20	292.5	969.3		
BG 14s	15.0	7.8		
BG 15s	16.8	12.4		
BG 21	304.6	915.3		
BG 32	2.6	6.1		
BG 33	2.9	7.0		
BG 7	3.1	6.4		
BG 8	1.0	2.0		
BG 9	6.5	13.4		
BG 10	3.8	7.9		
BG 11	13.5	27.8		
BG 12	5.8	10.7		
BG 13	7.0	13.0		
BG 14	12.3	22.8		
BG 15	42.2	82.0		
BG POND2	0.4	10.0		
BG 30	3.0	5.0		
BG 31	1.8	3.1		
BG 25	252.0	751.4		

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CHALLENGER HOMES

MASTER DRAINAGE DEVELOPMENT PLAN
FALCON MEADOWS AT BENT GRASS
FOR
CHALLENGER COMMUNITIES, LLC

BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
FALCON, CO 80831 - EL PASO COUNTY

#	Date	Issue / Description	Init.

Project No: CLH000014.20
Drawn By: CMWJ
Checked By: SMB
Date: OCTOBER 2019

FUTURE CONDITIONS DRAINAGE MAP

FD-3
Sheet 3 OF 5

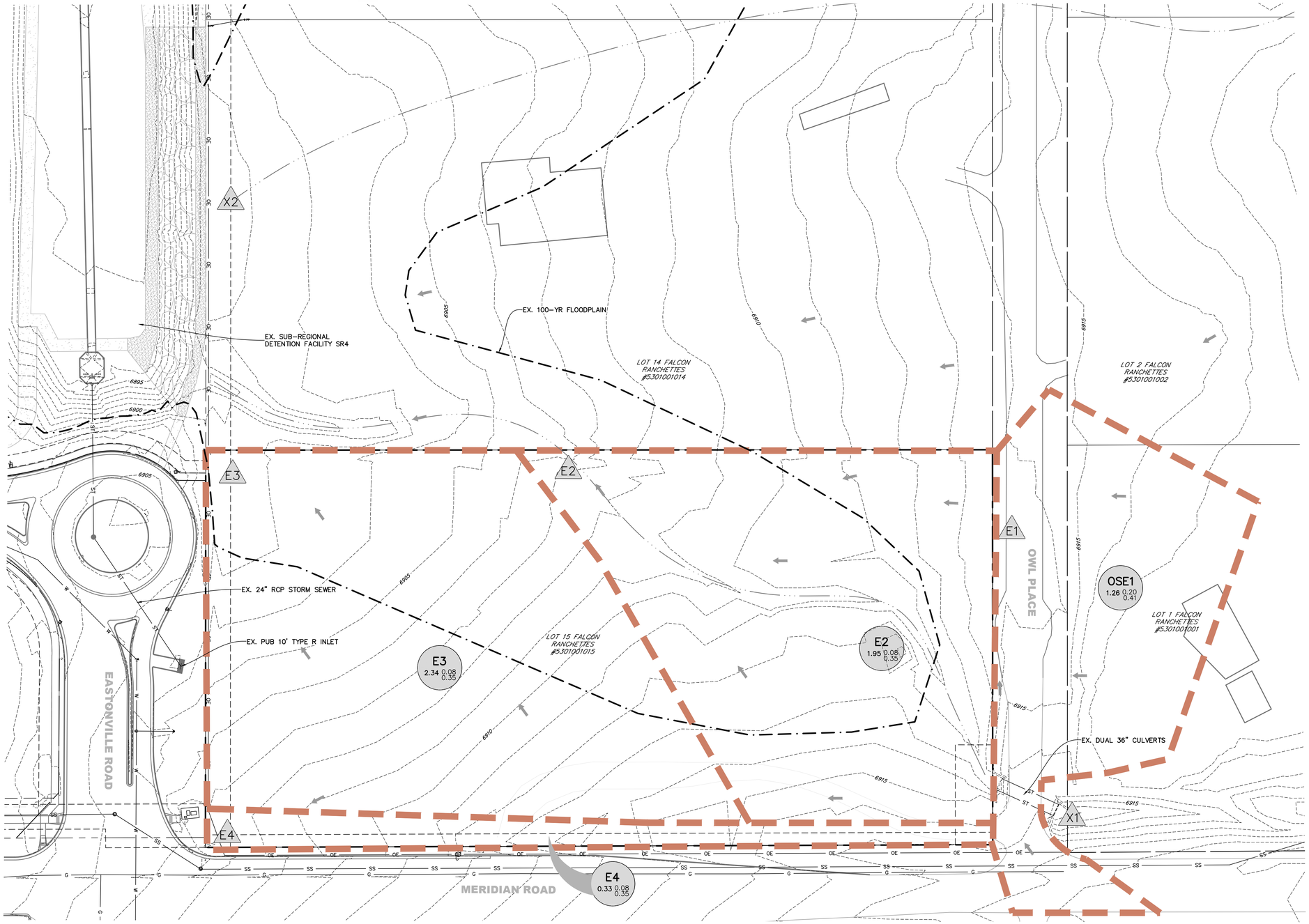
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LEGEND

EX. MINOR CONTOUR
6800 EX. MAJOR CONTOUR
PR. MINOR CONTOUR
6800 PR. MAJOR CONTOUR
ST EX. STORM DRAIN
FLOODPLAIN BOUNDARY
BASIN BOUNDARY
FLOW DIRECTION
D2 DESIGN POINT
AREA (ACRE) — OS-1 (AREA, DP, RWQ) — BASIN, C5, C100

EXISTING				
BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
RMT064	X1		288.5	920.0
OSE1	E1	1.26	0.9	3.1
E2		1.95	0.5	3.7
	E2	3.21	1.4	6.9
E3	E3	2.34	0.6	4.4
E4	E4	0.33	0.1	0.7
MT060	X2		60.1	196.8

40 0 40 80
SCALE: 1"=40'



PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
101 SAHWATCH ST, STE #100
COLORADO SPGS, COLORADO 80903
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
COLORADO SPRINGS • LAFAYETTE

CLIENT:

BH RE INVESTMENTS, LLC
450 N MCCLINTOCK DRIVE
CHANDLER, AZ 85226
(480) 313-2724

DRAINAGE PLANS FOR:

OWL MARKETPLACE

FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9-29-2023
RESUBMITTAL	3-11-2024

DESIGNED BY:	KGV
DRAWN BY:	CGH
CHECKED BY:	TDM
FILE NAME:	21611-DRN-EX

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 40'
VERTICAL: N/A

EXISTING DRAINAGE MAP

PROJECT NO. 21611-01CSCV

DRAWING NO.

DRN

LEGEND

EX. MINOR CONTOUR
EX. MAJOR CONTOUR (6800)
PR. MINOR CONTOUR
PR. MAJOR CONTOUR (6800)
STORM DRAIN
EX. STORM DRAIN (ST)
FLOODPLAIN BOUNDARY
BASIN BOUNDARY
FLOW DIRECTION
DESIGN POINT
BASIN
AREA (ACRE) — OS-1 (WQCV 0.75, C5 1.00, C100) — C5, C100

DEVELOPED				
BASIN	DP	Area (Ac.)	Q_5 (CFS)	Q_{100} (CFS)
A	1	1.21	5.0	9.1
B		0.69	2.8	5.2
	2	1.89	7.7	14.1
C		1.09	4.5	8.2
	3	2.98	12.0	22.0
D	4	1.11	4.6	8.4
	5	0.00	0.6	1.5
	6	0.00	1.0	2.1
E		0.75	3.0	5.5
	7	1.86	7.8	14.6
F		0.54	2.4	4.3
	8	0.54	3.4	6.4
	9	5.38	22.1	40.9
G	10	0.23	0.1	0.6
H	11	1.46	4.1	8.2

40 0 40 80
SCALE: 1"=40'

EX. SUB-REGIONAL DETENTION FACILITY SR4
EX. 100-YR FLOODPLAIN
LOT 14 FALCON RANCHETTES #5301001014
LOT 2 FALCON RANCHETTES #5301001002
LOT 1 FALCON RANCHETTES #5301001001
MERIDIAN PARK DR
MERIDIAN ROAD
EASTONVILLE ROAD
OWL PLACE
PRO. PUB TYPE VI IMPACT STILLING BASIN & TRICKLE CHANNEL EXTENSION TO EXISTING
PRO. PUB 10'X6' CBC BEND W/MH ACCESS
10'X6' CBC STORM SEWER
PUB 30" RCP STORM SEWER
PRO. PUB 10' TYPE R INLET
PUB 24" RCP STORM SEWER
PRO. PUB 5' STM MH
PRO. PUB 30"X4" BEND
PRO. PVT 4' STM MH
PVT 24" RCP STORM SEWER
PVT 18" RCP STORM SEWER
PVT 18" RCP STORM SEWER STUB
PRO. PUB 10' TYPE R AT GRADE INLET
EX. PVT. 24" RCP STORM SEWER
EX. INLET TO REMAIN
PRO. PUB 10'X6' CBC 45° BEND
PRO. PVT 10'X6' CBC 45° BEND W/MH ACCESS
EX. DUAL 36" CULVERTS TO BE REMOVED
TYPE MGROUTED RIPRAP RUNDOWN TOE WALL
PRO. HEADWALL
A 1.21 0.81 0.88
B 0.69 0.81 0.88
C 1.09 0.81 0.88
D 1.11 0.81 0.88
E 0.75 0.88 0.94
F 0.54 0.88 0.94
G 0.23 0.08 0.14
H 1.46 0.63 0.76

MERIDIAN ROAD DITCH. FLOWS FROM CHURCH ULTIMATELY DRAIN TO THIS DESIGN POINT AT THE OWL MARKETPLACE.

PREPARED BY:

DREXEL, BARRELL & CO.
Engineers • Surveyors
101 SAHWATCH ST, STE #100
COLORADO SPGS, COLORADO 80903
CONTACT: TIM D. McCONNELL, P.E.
(719)260-0887
COLORADO SPRINGS • LAFAYETTE

CLIENT:

BH RE INVESTMENTS, LLC
450 N MCCLINTOCK DRIVE
CHANDLER, AZ 85226
(480) 313-2724

DRAINAGE PLANS FOR:
OWL MARKETPLACE
FALCON, COLORADO

ISSUE	DATE
INITIAL ISSUE	9-29-2023
RESUBMITTAL	3-11-2024

DESIGNED BY:	KGV
DRAWN BY:	CGH
CHECKED BY:	TDM
FILE NAME:	21611-DRN-PP

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF DREXEL, BARRELL & CO.

DRAWING SCALE:
HORIZONTAL: 1" = 40'
VERTICAL: N/A

PROPOSED DRAINAGE MAP

PROJECT NO. 21611-01CSCV
DRAWING NO.
DRN

SHEET: 2 OF 2

CDR-19-004

FINAL DRAINAGE REPORT

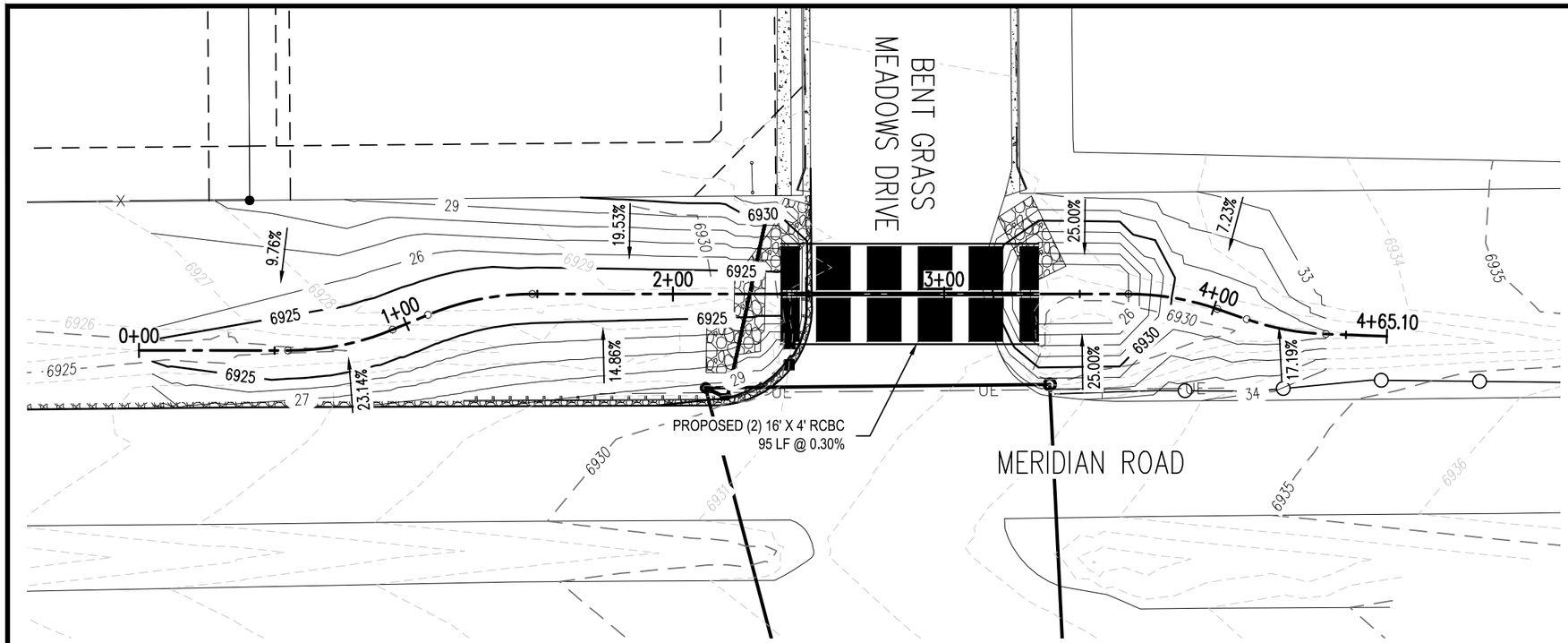
MERIDIAN ROAD & BENT GRASS MEADOWS DRIVE

El Paso County, Colorado

PREPARED FOR:
Challenger Communities, LLC
8605 Explorer Dr., Suite 250
Colorado Springs, CO 80920

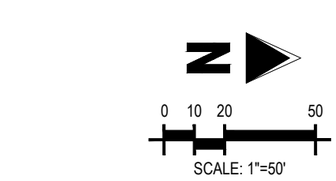
PREPARED BY:
Galloway & Company, Inc.
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920

DATE:
March 2020
Revised:July 2020
Revised: September 2020
Revised: September 23, 2020



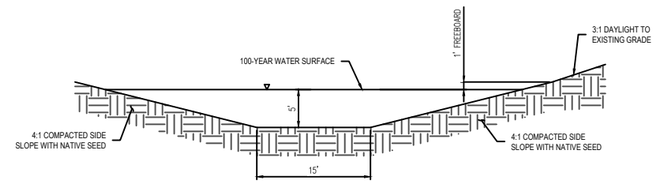
FUTURE MERIDIAN CHANNEL – PLAN

SCALE: 1"=50'



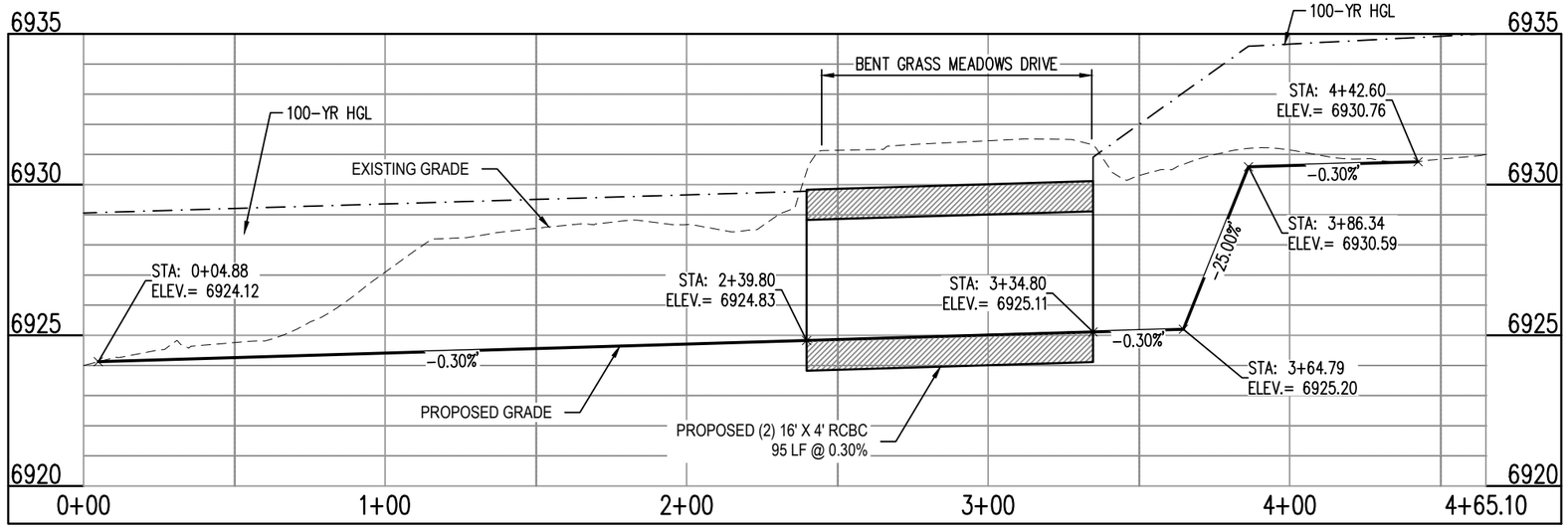
LEGEND

- 6485 — EXISTING MAJOR CONTOUR
- 6483 — EXISTING MINOR CONTOUR
- **6485** — PROPOSED MAJOR CONTOUR
- 6483 — PROPOSED MINOR CONTOUR



ROADSIDE CHANNEL FUTURE SECTION

SCALE: 1"=20'



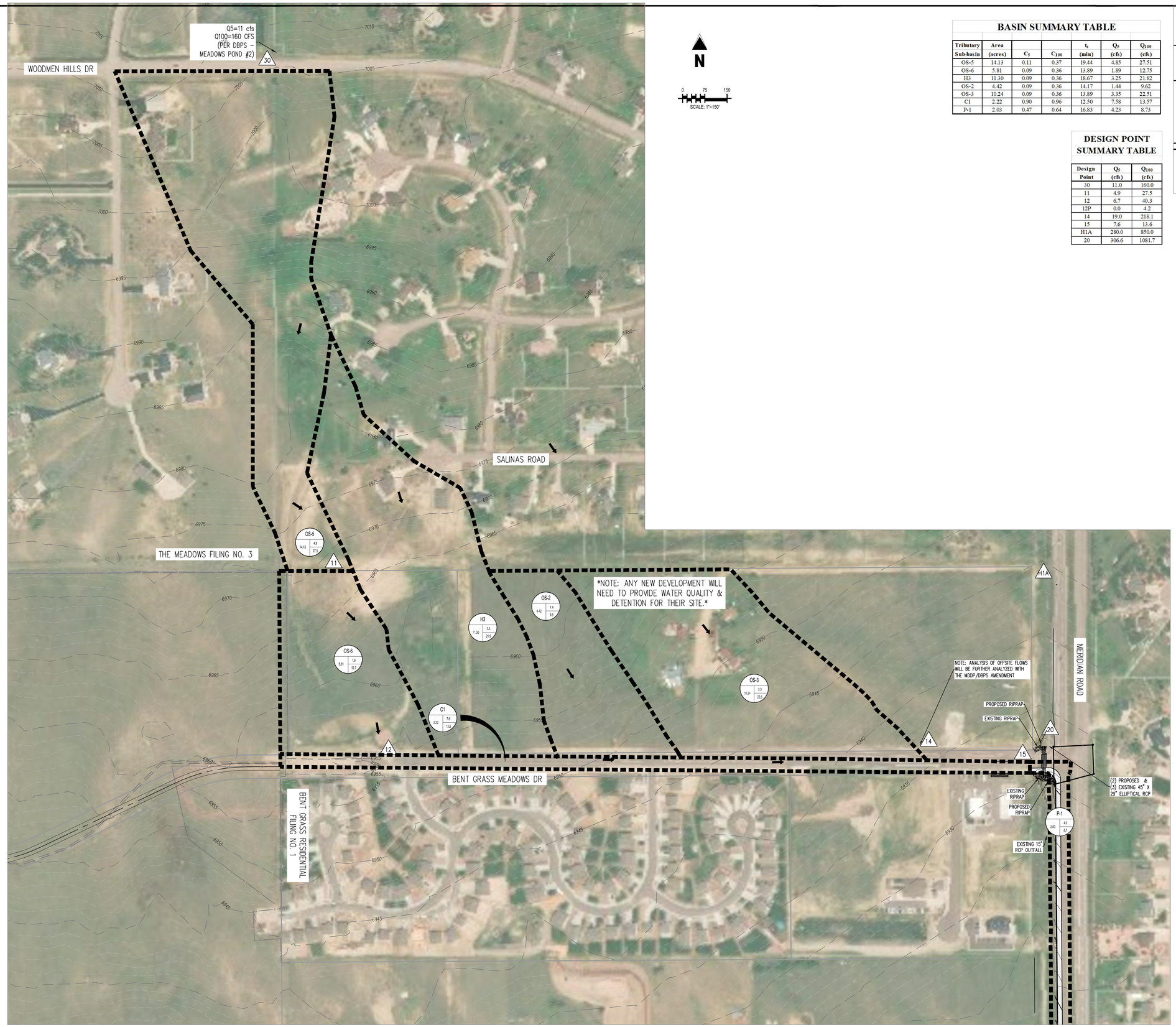
FUTURE MERIDIAN CHANNEL – PROFILE

SCALE: 1"=50' HORIZONTAL, 1"=5' VERTICAL

Galloway
6162 S. Willow Drive, Suite 320
Greenwood Village, CO 80111
303.770.8884 • GallowayUS.com

Project No:	CLH15.20
Drawn By:	BHB
Checked By:	SMB
Date:	11/15/19

BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
FINAL DRAINAGE REPORT
EL PASO COUNTY
COLORADO SPRINGS, CO
FUTURE MERIDIAN CHANNEL IMPROVEMENTS EXHIBIT

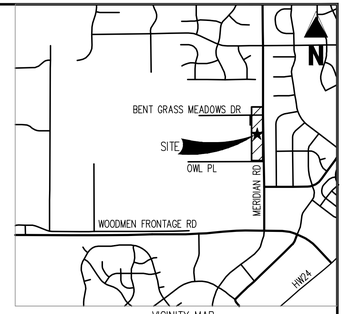


BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
OS-5	14.13	0.11	0.37	19.44	4.85	27.51
OS-6	5.81	0.09	0.36	13.89	1.89	12.75
H3	11.30	0.09	0.36	18.67	3.25	21.82
OS-2	4.42	0.09	0.36	14.17	1.44	9.62
OS-3	10.24	0.09	0.36	13.89	3.35	22.51
C1	2.22	0.90	0.96	12.50	7.58	13.57
P-1	2.03	0.47	0.64	16.83	4.23	8.73

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
30	11.0	160.0
11	4.9	27.5
12	6.7	40.3
12P	0.0	4.2
14	19.0	218.1
15	7.6	13.6
H1A	280.0	850.0
20	306.6	1081.7



VICINITY MAP

DRAINAGE LEGEND

- PROPERTY LINE
- 6485 EXISTING MAJOR CONTOUR
- 6485 EXISTING MINOR CONTOUR
- BASIN BOUNDARY LINE
- 100YR FEMA EFFECTIVE 100-YR FLOODPLAIN
- CENTERLINE OF STREAM
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DIRECTION OF RUNOFF

Galloway
1755 Telstar Drive, Suite 107
Colorado Springs, CO 80920
719.900.7220
GallowayUS.com

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CHALLENGER HOMES

BENT GRASS MEADOW DRIVE & MERIDIAN ROAD
ROADWAY IMPROVEMENTS
DRAINAGE PLAN

BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
COLORADO SPRINGS, COLORADO

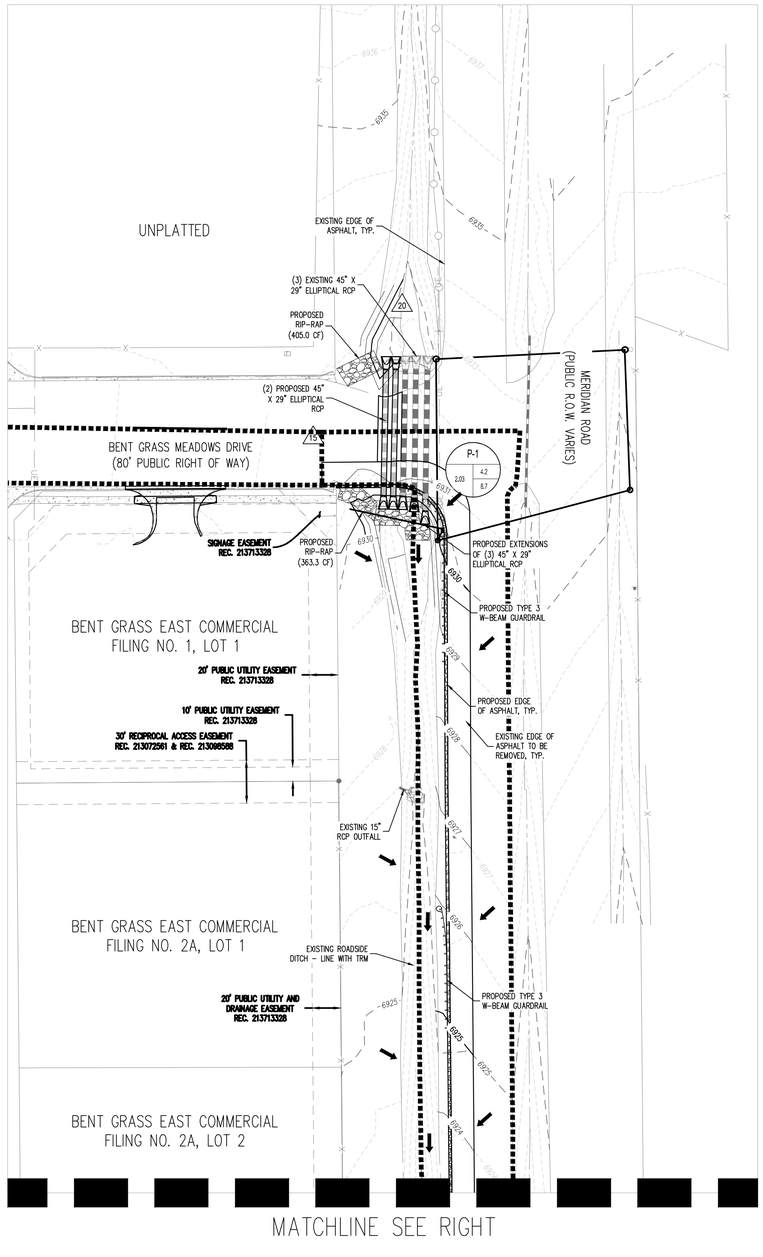
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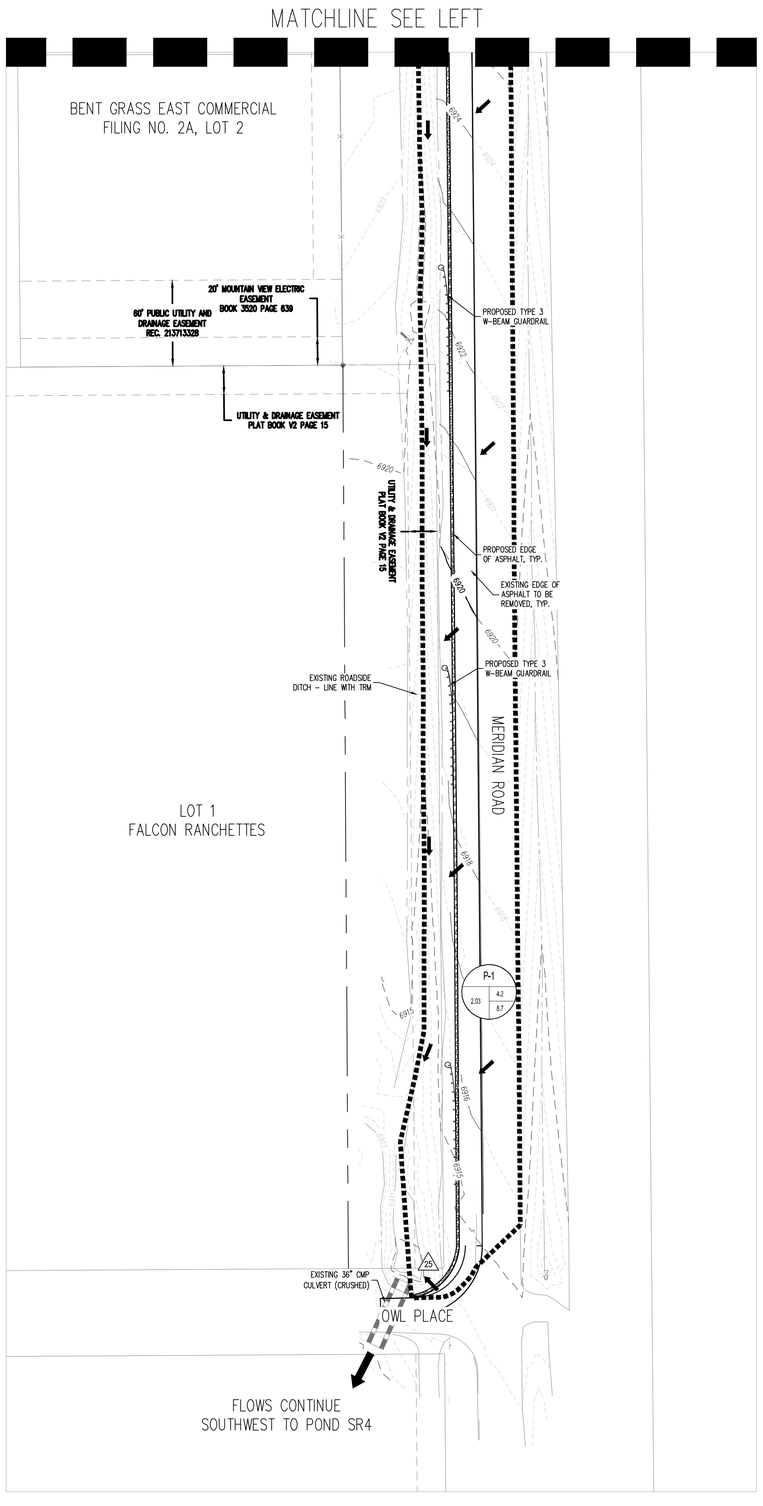
Project No:	CLH000014.20
Drawn By:	CMWJ
Checked By:	SMB
Date:	OCTOBER 2019

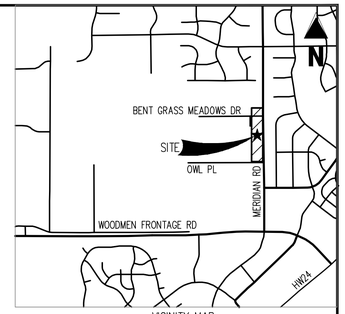
PROPOSED DRAINAGE MAP OFFSITE

DR-3
Sheet 1 of 1

H:\Challenger Homes Inc\CO - El Paso County\CLH000014.20\Meridian Road\3 Reports\Drainage Report\Draft\DR - Meridian Road Drainage Report.dwg, 10/4/2019 1:34:26 PM, BRIAN.MOOP.ray







VICINITY MAP

N

0 10 20 50

SCALE: 1"=50'

DRAINAGE LEGEND

- PROPERTY LINE
- 6485 EXISTING MAJOR CONTOUR
- 6483 EXISTING MINOR CONTOUR
- 6485 PROPOSED MAJOR CONTOUR
- 6483 PROPOSED MINOR CONTOUR
- BASIN BOUNDARY LINE
- 1 (0.71 / 1.8 / 4.8) BASIN DESIGNATION; 5-YEAR RUNOFF IN CUBIC FEET PER SECOND; 100-YEAR RUNOFF IN CUBIC FEET PER SECOND; BASIN AREA IN ACRES
- 1 DESIGN POINT
- DIRECTION OF RUNOFF

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
OS-5	14.13	0.11	0.37	19.44	4.85	27.51
OS-6	5.81	0.09	0.36	13.89	1.89	12.75
H3	11.30	0.09	0.36	18.67	3.25	21.82
OS-2	4.42	0.09	0.36	14.17	1.44	9.62
OS-3	10.24	0.09	0.36	13.89	3.35	22.51
C1	2.22	0.90	0.96	12.50	7.58	13.57
P-1	2.03	0.47	0.64	16.83	4.23	8.73

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
30	11.0	160.0
11	4.9	27.5
12	6.7	40.3
12P	0.0	4.2
14	19.0	218.1
15	7.6	13.6
H1A	280.0	850.0
20	306.6	1081.7

Galloway
1755 Telstar Drive, Suite 107
Colorado Springs, CO 80920
719.900.7220
GallowayUS.com

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CHALLENGER HOMES

BENT GRASS MEADOW DRIVE & MERIDIAN ROAD
ROADWAY IMPROVEMENTS
DRAINAGE PLAN

BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
COLORADO SPRINGS, COLORADO

#	Date	Issue / Description	Init.

Project No:	CLH15.20
Drawn By:	BHB
Checked By:	SMB
Date:	NOVEMBER 2019

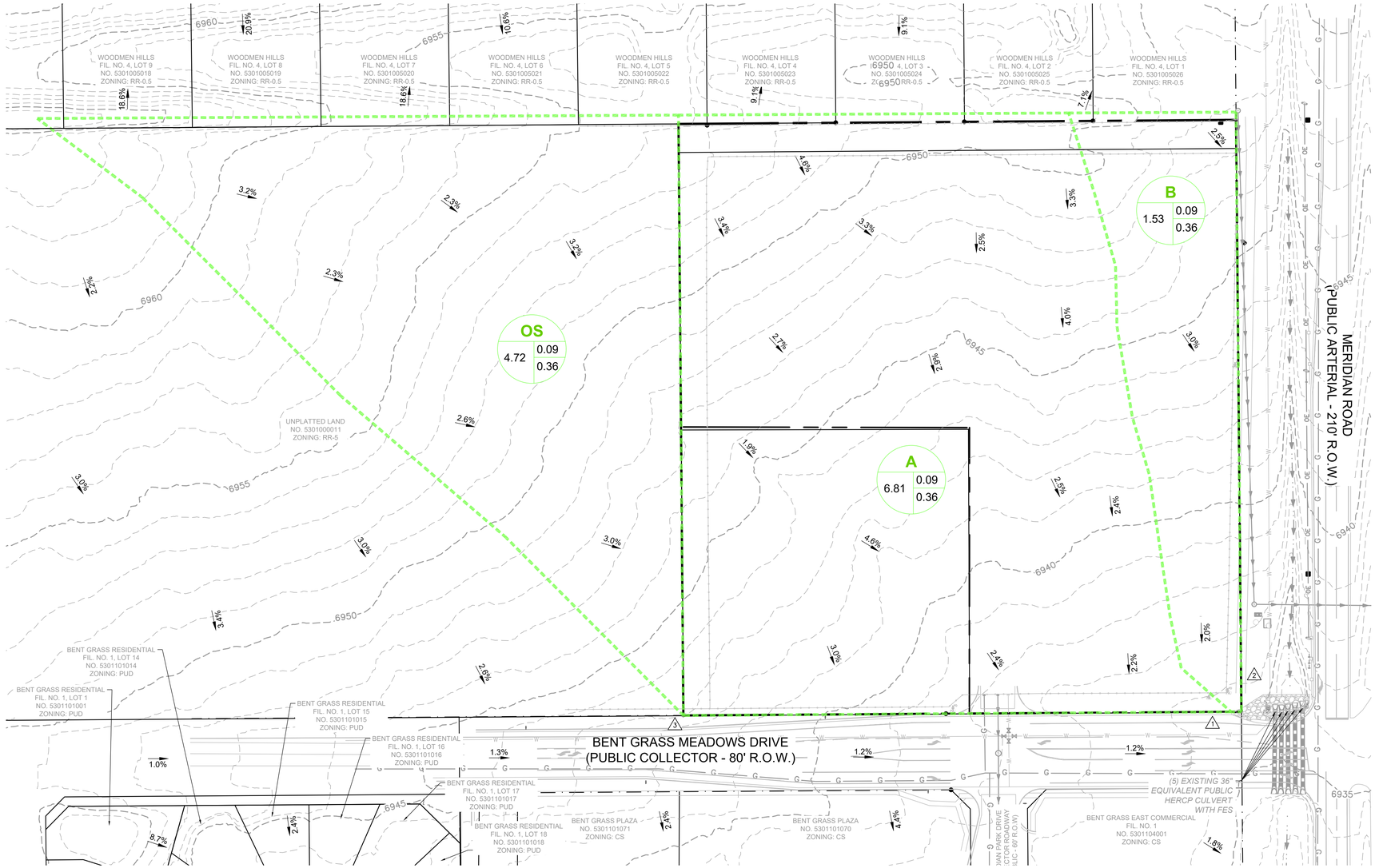
PROPOSED DRAINAGE MAP

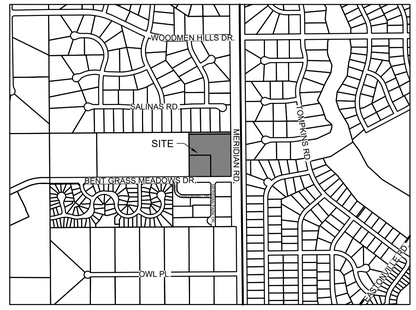
DR-4

H:\Challenger Homes Inc\CO, El Paso County\CLH000015\Meridian Road\3 Permit Corres\Drawing Sheets\Utility\Proposed Drainage Reports\drb0208 - Meridian Road\Drainage Maps\CLH15.20_Proposed Drainage.mxd - Charlene Durham - 8/29/2020

APPENDIX G – DRAINAGE MAPS

DOMBROWSKI, COLIN, 7/10/2026 12:13 PM





LEGEND

	EXISTING	PROPOSED
PROPERTY BOUNDARY		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
CURB & GUTTER		
DRAINAGE BASIN		
MAJOR CONTOUR	5900	5900
MINOR CONTOUR	5902	5902
STORM SEWER		
ADA ROUTE		
RETAINING WALL		
FLOW DIRECTION		
DESIGN POINT		

BASIN DESIGNATION
BASIN LABEL
A1
AREA (AC.) 1.00 | 0.40 MINOR 5-YR RUNOFF COEF. | 0.60 MAJOR 100-YR RUNOFF COEF.

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
A	6.81	2	2.21	14.82
B	1.53	2	0.54	3.63
OS	4.72	2	1.56	10.50

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
1	A	2.21	14.82
2	B	0.54	3.63
3	OS	1.56	10.50

PCD FILE NO.: SF268

DRAWN BY: CMD JOB DATE: 7/10/2026
APPROVED: RDL JOB NUMBER: 2403591
CAD DATE: 3/12/2025
CAD FILE: J:\2024\2403591\CAD\Dwgs\C\Drainage\Existing_Condition

BAR IS ONE INCH ON OFFICIAL DRAWINGS. 0 1"
IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

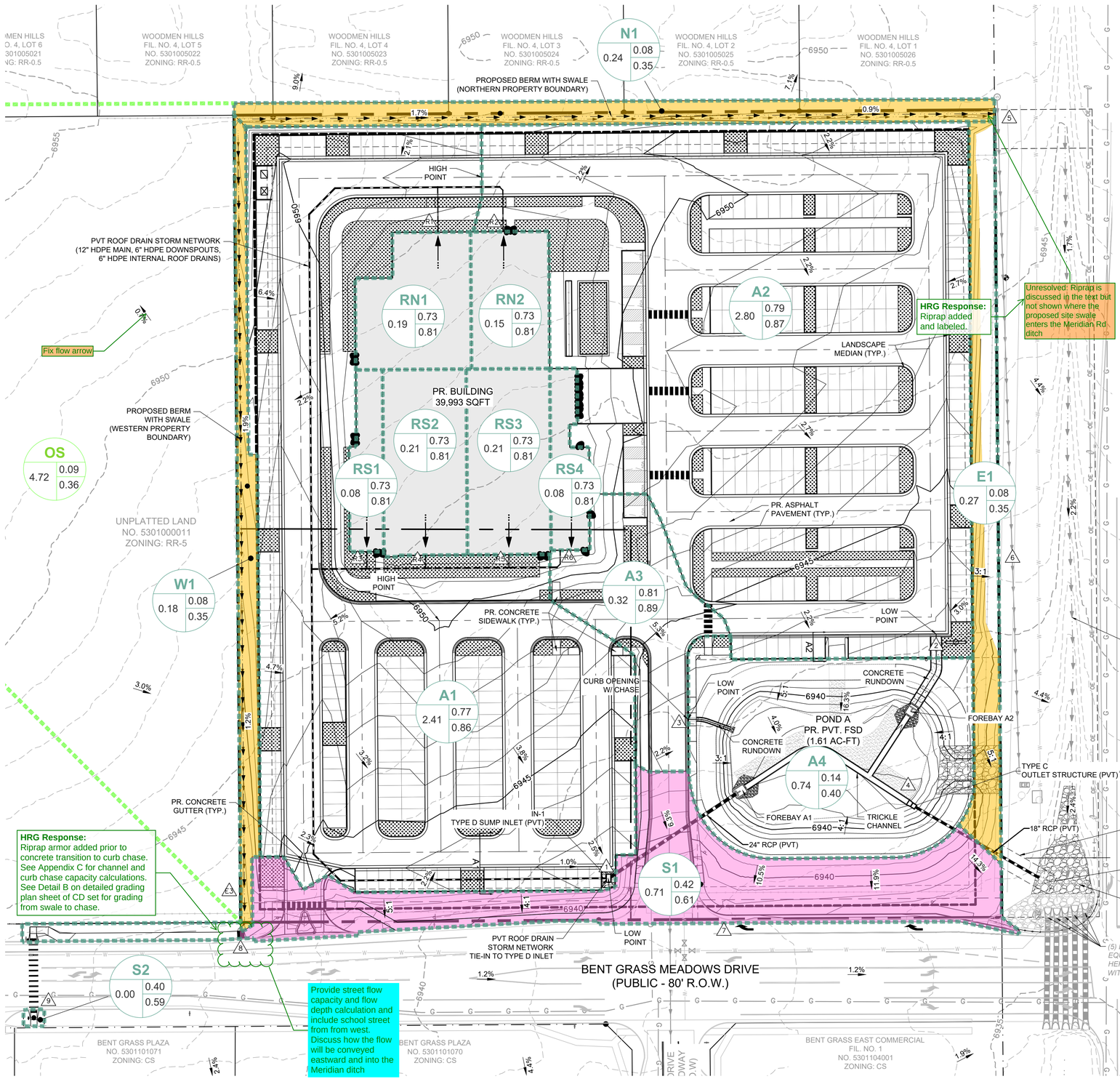
CHURCH AT BENT GRASS MEADOWS
FAL REALTY, LLC.
FALCON, COLORADO

FINAL DRAINAGE REPORT
EXISTING CONDITIONS DRAINAGE MAP

SHEET DR 1

HR GREEN Xrefs: xv--row_2403591; xv--util_2403591; xg1--1--dr01--3591.20; Vicinity_Map_Scale4; xv--dsgn_2403591

DOMBROWSKI, COLIN, 7/23/2026 3:41 PM

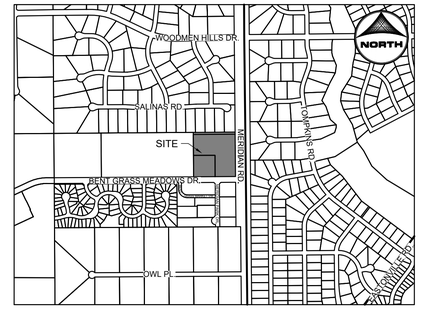


SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
A1	2.41	84.8	7.79	14.63
A2	2.80	87.1	9.81	18.29
A3	0.32	87.7	1.31	2.43
A4	0.74	7.8	0.42	1.94
N1	0.24	0.0	0.08	0.57
E1	0.27	0.0	0.11	0.81
S1	0.71	42.0	1.23	2.94
S2	0.00	39.5	0.01	0.02
W1	0.18	0.0	0.05	0.38
RN1	0.19	90.0	0.61	1.13
RN2	0.15	90.0	0.46	0.86
RS1	0.08	90.0	0.23	0.43
RS2	0.21	90.0	0.63	1.18
RS3	0.21	90.0	0.63	1.18
RS4	0.08	90.0	0.24	0.45

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
1	A1	7.78	14.62
2	A2	9.81	18.29
3	A3	1.31	2.43
4	A4	0.42	1.94
5	N1	0.08	0.57
6	E1	0.11	0.81
7	S1	1.23	2.94
9	S2	0.01	0.02
8	W1, OS	1.62	10.88
R1	RN1	0.61	1.13
R2	RN2	0.46	0.86
R3	RS1	0.23	0.43
R4	RS2	0.63	1.18
R5	RS3	0.63	1.18
R6	RS4	0.24	0.45



VICINITY MAP
N.T.S.

LEGEND

	EXISTING	PROPOSED
PROPERTY BOUNDARY		
PROPERTY LINE		
EASEMENT LINE		
RIGHT OF WAY		
CENTERLINE		
CURB & GUTTER		
DRAINAGE BASIN		
MAJOR CONTOUR	5900	5900
MINOR CONTOUR	5902	5902
STORM SEWER		
ADA ROUTE		
RETAINING WALL		
FLOW DIRECTION		
DESIGN POINT		

BASIN LABEL — BASIN DESIGNATION: A1; AREA (AC.): 1.00; MINOR 5-YR RUNOFF COEF.: 0.40; MAJOR 100-YR RUNOFF COEF.: 0.60

AREA EXCLUDED FROM WQ TREATMENT PER ECM APP I.6.3.A.1.a, TOTAL AREA = 0.71 AC.

AREA EXCLUDED FROM WQ TREATMENT PER ECM APP I.6.1.B.7, TOTAL AREA = 0.57 AC.

LANDSCAPE AREA

Water Quality Treatment Summary Table

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to Pond A (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Disturbed Area Excluded from WQ per ECM App I.6.3.A.1.a (ac)	Disturbed Area Excluded from WQ per ECM App I.6.1.B.7 (ac)
A1	2.41	2.41	2.41			
A2	2.80	2.80	2.80			
A3	0.32	0.32	0.32			
A4	0.74	0.74	0.74			
N1	0.24	0.24				0.24
E1	0.27	0.16				0.16
S1	0.71	0.71			0.71	
S2	0.00	0.00			0.00	
W1	0.18	0.18				0.18
RN1	0.19	0.19	0.19			
RN2	0.15	0.15	0.15			
RS1	0.08	0.08	0.08			
RS2	0.08	0.08	0.08			
RS3	0.21	0.21	0.21			
RS4	0.21	0.21	0.21			
Total	8.58	8.47	7.18	0.00	0.71	0.57

Min Required Area to Receive WQ (ac)	Total Proposed Disturbed Area (ac)	Total Proposed Treated Area (ac)	Total Proposed Disturbed Area Excluded from WQ (ac)	Net Treatment (ac)
7.18	8.47	7.18	1.28	0.00



PCD FILE NO.: SF268

DRAWN BY: CMD	JOB DATE: 7/23/2026	BAR IS ONE INCH ON OFFICIAL DRAWINGS.	
APPROVED: RDL	JOB NUMBER: 2403591	0 1"	
CAD DATE: 3/12/2025		IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.	
CAD FILE: J:\2024\2403591\CAD\Dwgs\C\Drainage\Proposed_Condition			

NO.	DATE	BY	REVISION DESCRIPTION

HR GREEN - COLORADO SPRINGS
1975 RESEARCH PARKWAY SUITE 160
COLORADO SPRINGS, CO 80920
PHONE: 719.300.4140
FAX: 713.965.0044

CHURCH AT BENT GRASS MEADOWS
FAL REALTY, LLC.
FALCON, COLORADO

FINAL DRAINAGE REPORT
~~EXISTING~~ CONDITIONS DRAINAGE MAP
Proposed

SHEET DR 2

HR GREEN Xrefs: xc-dsgn_2403591; xv-row_2403591; xv-util_2403591; xgl-l-dk01-3591.20; Vicinity_Map_Scaled; xv-dsgn_2403591