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

ENGINEER'S STATEMENT

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the Drainage Criteria Manual for the City of Colorado Springs and El Paso County. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

COLORADO LICENSED
CHARLENE M DURHAM
36727
PROFESSIONAL ENGINEER

Charlene Durham, PE 36727
For and on behalf of Galloway & Company, Inc.

9/3/20
Date

DEVELOPER'S CERTIFICATION

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

By: _____

9/3/2020
Date

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

EL PASO COUNTY

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

Jennifer Irvine, P.E.
County Engineer/ECM Adminstrator

Conditions:

*** APPROVED**
Engineering Department

09/25/2020 2:43:01 PM
dsdnijkamp
EPC Planning & Community Development Department

*Approved with exceptions as noted here within.

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A. Exhibits and Figures
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I. Purpose

The intent of the developer is to make improvements to the intersection at Meridian Road and Bent Grass Meadows Drive in association with the residential development of the Bent Grass Subdivision. The purpose of this Final Drainage Report (FDR) is to identify drainage patterns, locate and identify tributary or downstream drainage features and facilities that are impacted by the improvements, and to identify which types of drainage facilities will be needed and where they will be located. A separate report will serve as an amendment to the approved Master Development and Drainage Plan (MDDP) for Bent Grass Meadows, approved in May 2019. The MDDP Amendment, that is currently in process, will include the analysis of the flow from Meadows Filing 3 subdivision, which is now routed to the east and through the Middle Tributary of the Falcon Basin, as opposed to the West Tributary as previously studied.

II. General Description

The site is located in the Northwest ¼ and Southwest ¼ of Section 1, Township 13S, Range 65W, of the Sixth Principal Meridian, County of El Paso, State of Colorado. The proposed improvements are located at the intersection of Bent Grass Meadows Drive and Meridian Road, as well as the west side of Meridian Road from Bent Grass Meadows Drive to Owl Place. The proposed improvements include the construction of a right turn lane from Bent Grass Meadows Drive onto Meridian Road as well as a southbound acceleration lane from Bent Grass Meadows Drive to Owl Place. A Vicinity Map is included in Appendix A.

The existing soil type within the proposed site as determined by the NRCS Web Soil Survey for El Paso County Area consists of Columbine gravelly sandy loam which is defined as having a hydrologic soil group of A. See the soils map included in Appendix A.

III. Previous Reports

The proposed site has been included in multiple drainage studies in the past. The following is a composite list of the existing reports pertaining to this site and adjacent sites.

1. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
2. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
3. *Final Drainage and Erosion Control for The Meadows Filing 3 Subdivision,* by LADD Engineering, July 2000.
4. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
5. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.
6. *Final Drainage Report for Bent Grass Residential Filing No. 2,* by Galloway & Company, April 2020.

IV. Drainage Criteria

Hydrology calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and

Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

The drainage calculations were based on the criteria manual Figure 6-5 and IDF equations to determine the intensity, and are listed in Table 1 below.

Table 1 - Precipitation Data

Return Period	One Hour Depth (in).	Intensity (in/hr)
5-year	1.50	5.17
100-year	2.52	8.68

The rational method was used to calculate peak flows as the tributary areas are less than 100 acres. The rational method has been proven to be accurate for basins of this size and is based on the following formula:

Q = CIA

Where:

Q = Peak Discharge (cfs)
C = Runoff Coefficient
I = Runoff intensity (inches/hour)
A = Drainage area (acres)

The runoff coefficients are calculated based on land use, percent imperviousness, and design storm for each basin, as shown in the drainage criteria manual (Table 6-6). Composite percent impervious and C values were calculated using the residential, streets, roofs, and lawns coefficients found in Table 6-6 of the manual.

The 100-year event was used as the major storm event and the 5-year event was used as the minor event.

For the analysis of the existing channel adjacent to Meridian Road and the preliminary design of the proposed channel, Bentley Flowmaster was utilized. Flowmaster was used to evaluate velocity, Froude number, and channel depth. A Manning's n value of 0.035 was utilized for the channel which is appropriate for the existing native grass that comprises the channel section. The proposed channel was designed to have a maximum depth of 5' per the criteria manual and have a maximum velocity of 5 ft/s with a maximum Froude number of 0.6.

V. Existing Drainage Conditions

A historic basin map has been prepared for this area to analyze the existing basin contributing to the channel. The historic map is included in Appendix D and basins are described below.

Design Point 30 (225.0 AC, Q_5 = 11 cfs, Q_{100} = 160 cfs): is located north of basin OS-5, and is comprised of Basins B3 thru B6, A1, and A3 in Meadows Filing No. 3. The flows shown are from the DBPS and have been used for this report. Flows will cross under Woodmen Hills Drive via an existing culvert, then sheet flow to the southeast, passing through Basin OS-5 to DP 11.

Basin OS-5 (14.13 AC, Q_5 = 4.9 cfs, Q_{100} = 27.5 cfs): a basin that is associated with Bent Grass Filing No. 1. Runoff from this basin sheet flows from the North to the South into basin OS-6.

Basin OS-6 (5.81 AC, Q_5 = 1.9 cfs, Q_{100} = 12.7 cfs): a basin that is associated with Bent Grass Filing No. 1. Runoff from this basin sheet flows from the North to South to an existing sediment pond and then into Bent Grass Meadows Drive. Flows will continue to the east, through existing curb & gutter on the north side of Bent Grass Meadows Drive, to the Meridian Road intersection.

Design Point 12 (Q_5 = 17.7 cfs, Q_{100} = 200.3 cfs): is the combined flow from off site basins OS-5 and OS-6 with the flow from Design Point 30 in Bent Grass Meadows Filing No. 3. Flows are released into the Bent Grass Meadows Drive, where they travel to the east within the existing curb and gutter. The capacity of the north half of Bent Grass Meadows Drive is 13.8 & 65.1 cfs for the 5 and 100-year storms. The flows in excess of the current street capacity will be analyzed further in the MDDP/DBPS Amendment. This will include analysis of any locations where flow may overtop the centerline of Bent Grass Meadows Drive and continue along the curb and gutter on the south side of Bent Grass Meadows Drive, flows which may continue south through the existing development to existing ponds, or the portion of flows which will continue to the east within the north half of BGMD. Street Capacity spreadsheet has been included in the appendix.

The following basins were part of the Final Drainage Report for Bent Grass Residential Filing No. 1.

Basin H-3 (11.3 AC, Q_5 = 3.3 cfs, Q_{100} = 21.8 cfs): consists of a portion of Woodmen Hills Filing No. 3 and Bent Grass Filing No. 1. It is located between Basins OS-6 and OS-2. Flows will continue in a southeasterly manner towards Bent Grass Meadows Drive.

Basin OS-2 (4.42 AC, Q_5 = 1.4 cfs, Q_{100} = 9.6 cfs): was represented by a developed off-site basin, in the Bent Grass Filing No. 1 FDR, located between Basins H-3 and OS-3, north of Bent Grass Meadows Drive. Flows will continue to the southeast, releasing into Bent Grass Meadows Drive. Any development of this property in the future will require detention and release at historic rates.

Basin OS-3 (10.24 AC, Q_5 = 3.3 cfs, Q_{100} = 5.6 cfs): was represented by a developed off-site basin, in the Bent Grass Filing No. 1 FDR, located west of Basin OS-2, north of Bent Grass Meadows Drive. Flows will continue to the southeast, releasing into Bent Grass Meadows Drive. Any development of this property in the future will require detention and release at historic rates.

Basin C-1 (2.22 AC, Q_5 = 7.6 cfs, Q_{100} = 13.6 cfs): is the north half of Bent Grass Meadows Drive. Flows are captured with the existing curb and gutter and conveyed to the east. This flow is designated as Design Point 15 and combines with DP 14 and DP20.

Design Point 14 (Q_5 = 25.8cfs, Q_{100} = 254.2 cfs): is the combined flow from Design Point 12 with Basins H-3, OS-2, and OS-3. These flows all combine within Bent Grass Meadows Drive and conveyed as gutter flow to the east. These flows release via an existing riprap “rundown” to the inlet side of 3-elliptical rcp’s running under Bent Grass Meadows Drive. Flows in excess of the current street capacity of Bent Grass Meadows Drive will be analyzed further in the MDDP/DBPS Amendment.

Design Point 20 (Q_5 = 313.4cfs, Q_{100} = 1,117.8 cfs): is located at the northwest corner of the Bent Grass Meadows Drive and Meridian Road intersection. Flows from DP-15 combine with ditch flow along Meridian Road. From the approved DBPS, the ditch flows are 280 and 850 cfs for the 5 and 100-year storm events. Based on an analysis of the existing channel section and culverts, both facilities are undersized for the DBPS flows. Further discussion is included following the basin discussion. Analysis of these items are provided in the Appendix.

Basin H-1 (2.03 AC, Q_5 = 3.2 cfs, Q_{100} = 7.3 cfs): is associated with the western half of Meridian Road and the eastern half of the channel, south of Bent Grass Meadows Drive, in the existing conditions.

Runoff from the basin generally flows to the southwest, into the roadside channel, where it is conveyed south.

Design Point 25 (Q_5 = 316.6cfs, Q_{100} = 1125.1 cfs): is located at the northwest corner of the Bent Grass Meadows Drive and Owl Place intersection. Flows from DP-20 combine with flows from Basin H-1. Flows will exit the project area through a set of twin culverts located at Owl Place.

In the existing conditions runoff from the west half of Meridian Road near Bent Grass Meadows Drive drains directly into the roadside channel, which flows south at an average slope of 1.75%. The majority of the channel in this area is triangular in shape with a depth of approximately 3 feet. As previously stated, the existing channel was analyzed using Bentley Flowmaster. The flow rate used for the analysis was taken from the Falcon DBPS. In the DBPS this section of the channel is referred to as RMT064 which has a flow rate of 140 cfs for the 5-year storm and 580 cfs for the 100-year storm in the existing conditions. The Flowmaster calculations, which have been included in Appendix C, show that the existing channel can only convey approximately 260 cfs in its current state. When 580 cfs is analyzed in the existing channel it produces a depth of approximately 4 feet, exceeding the channel depth by 1 foot. Relevant excerpts from the DBPS are included in Appendix A.

There are also three existing 45” x 29” elliptical RCP’s that run beneath Bent Grass Meadows Drive that were analyzed with this report. The Federal Highway Administration’s HY-8 program was used to analyze the culvert and design the proposed culverts in the future conditions. The calculations included in Appendix C show that the existing culverts can convey approximately 143 cfs before flow begins to overtop Bent Grass Meadows Drive. All of the included calculations show that the culverts and channel are clearly vastly undersized and will need to be improved by El Paso County in the future to properly convey the flows outlined in the DBPS.

VI. Four Step Process

The Four Step Process is used to minimize the adverse impacts of urbanization and is a vital component of developing a balanced, sustainable project. Below identifies the approach to the four-step process:

1. Employ Runoff Reduction Practices

The proposed roadway improvements use Low Impact Development (LID) practices to reduce runoff at the source. All runoff is routed through the pervious areas in the channel to promote infiltration.

2. 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. There is no water quality being proposed with the associated roadway improvements. Per Section 1.7.1.B of the El Paso County *Stormwater Quality Policy & Procedures,* since the site is less than 1 acre, is not a sensitive or high-risk site, and does not directly discharge into State Waters, it is excluded from any water quality requirements.

Currently, the existing 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 release into the east side of Pond SR-4 (west of Falcon Market Place). Pond SR-4 is currently under construction and is almost

complete. The proposed improvements impact on the existing drainage basin and both Pond MN and Pond SR-4 are discussed later in the report.

3. Stabilize Drainageways

This step implements stabilization to the channel to accommodate developed flows while protecting infrastructure and controlling sediment loading from erosion in the drainageways. Erosion protection in the form of riprap pads at all outfall points to the channel to prevent scouring of the channel from point discharges.

A stability analysis on the existing roadside ditch along Meridian road was conducted with results shown in Appendix C. From the analysis, it was determined that the existing ditch is not in stable condition with existing DBPS flows. Improvements are anticipated to be made in the future, per 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.

4. Implement Site Specific and Other Source Control BMPs

Since this project only includes roadway work with no curb and gutter, the potential use of source control BMP's is limited. All runoff however, will be conveyed through native grass buffers and a native grass channel to promote infiltration and pollutant removal.

VII. Proposed Drainage Conditions

Design Point 30 and Basins OS-5 and OS-6 are as described under Existing Drainage Conditions and ultimate developed flows will be addressed in the MDDP/DBPS Amendment. However, Basins OS-5 and OS-6 now route through an existing sedimentation 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. The existing sedimentation pond is only temporary, and a permanent water quality detention pond will need to be provided at the time it is developed. The existing pond only has an overflow weir to release flows. Based on the grading and outlet the release rates are 0 cfs and 4.2 cfs for the 5 and 100-year flows. The UDFCD pond spreadsheet has been included in the appendix. (Note spreadsheet only has outlet information for larger storm events, as currently, pond only has a weir outlet to release flows.) An analysis of the weir has been included in the appendix. From the UDFCD pond spreadsheet, the 100 and 500 year storms are the only events to reach the weir elevation. The 100-year event has a flow depth of 0.13 feet and the 500-year has a flow depth of 0.37 ft. From the Flowmaster results, the corresponding capacities to these flow depths were 4.23 and 23.97 cfs, respectively. The weir has a total height of 1.1 ft, with a 30 ft. length. If the weir flowed full, it would have a total capacity of 141.67 cfs. Flows from Design Point 30 will be released directly to Bent Grass Meadows Drive.

Basins H-3, OS-2, OS-3 and C-1 all remain as described in the Existing Drainage Conditions. With flows from OS-5 and OS-6 reduced the flows for **Design Point 15** have been reduced to 13.8 cfs for the 5-year storm and 65.7 cfs for the100 -year storm. A street capacity analysis was performed for Bent Grass Meadows Drive. The flows shown will adequately be conveyed within the curb and gutter until released into the existing ditch at Meridian Road.

See notes on calculation sheets

Basin P-1 (2.03 AC, Q_5 = 4.2 cfs, Q_{100} = 8.7 cfs): is associated with the western half of Meridian Road and the eastern half of the channel, south of Bent Grass Meadows Drive, in the proposed conditions. Runoff from the basin generally flows to the southwest, into the roadside channel, where it is conveyed south.

Design Point 20 (Q_5 = 306.6cfs, Q_{100} = 1081.7 cfs): is located at the northwest corner of the Bent Grass Meadows Drive and Meridian Road intersection. Flows from DP-15 combine with ditch flow along Meridian Road. From the approved DBPS, the ditch flows are 280 and 850 cfs for the 5 and 100-year storm events. In addition to roadway improvements along Meridian Road, Two additional 45" x 29" Elliptical pipes are proposed to be constructed under Bent Grass Meadows Drive to convey the additional off-site flow of 160 cfs.

In the proposed conditions the historic drainage pattern will be maintained with runoff draining from Meridian Road and Bent Grass Meadows Drive directly into the roadside channel. In order to adequately determine the increase in runoff from the proposed improvements, the proposed basin, P-1, encompasses the same area as the historic basin, H-1. Basin H-1 is 48.4% impervious with peak runoff of 3.2 cfs and 7.3 cfs in the 5-year and 100-year storm events, respectively. Basin P-1 is 64.2% impervious with peak runoff of 4.2 cfs and 8.7 cfs in the 5-year and 100-year storm events, respectively. The 1.0 cfs increase in the 5-year event and the 1.4 cfs increase in the 100-year event produced by the proposed improvements will have minimal impact on any downstream properties or infrastructure.

A proposed basin map has been prepared for this area. The proposed map is included in Appendix D.

VIII. Proposed Channel Improvements

Although the existing channel and culverts are undersized and improvements will need to be made in the future, minimal channel improvements are being proposed at this time. With the construction of the right turn lane on Bent Grass Meadows Drive, the three RCP culverts will be extended approximately 15' to span the extended width of the roadway. Additionally, two more 45"x29" Elliptical RCP pipes will be installed under Bent Grass Meadows Drive to convey the flows for DP 20. The existing channel will need to lined with a temporary turf reinforcement mat (TRM) due to the excessive velocities (9.91 fps), high shear stress (5.11lbs/ft^2) & high Froude Number (1.12). With the TRM added to the channel sides, the allowable velocity is 25 fps and permissible shear stress is 12 lbs/ft^2. An analysis of the channel with the TRM is provided in the Appendix.

In the future, El Paso County will need to improve the existing culverts and channel to adequately convey the flow outlined in the DBPS. Owl Place will be included in the MDDP/DBPS amendment, and recommendations for any necessary improvements will be provided based on the updated analysis. The analysis for the future improvements will be provided in the MDDP/DBPS amendment that is currently in process.

IX. Proposed Water Quality

There is no water quality being proposed with the associated roadway improvements. Per Section 1.7.1.B of the El Paso County *Stormwater Quality Policy & Procedures,* since the site is less than 1 acre, is not a sensitive or high-risk site, and does not directly discharge into State Waters, it is excluded from any water quality requirements.

Though the site does not include the addition of any proposed water quality or detention ponds, future Pond SR-4 and existing Pond MN from the Falcon DBPS will receive flows from the improved site. The

HEC-HMS has been updated and is included in Appendix B. As discussed previously, the “School Site” have been added as an additional Basin MT060a, which is routed to the regional detention facility SR-4. Basin MT070, described in the Falcon DBPS, was analyzed to include the improvements made to the site within Basin MT070 and the effects it has on existing Pond MN.

From the analysis, Pond SR-4’s 100-yr. receiving flows remained at 1,000 cfs. Based on the increase in impervious area, Basin MT070’s Curve Number increased from 67 to 68. Subsequently, the 100-yr. receiving flows entering existing Pond MN decreased to 825.8 cfs from 850 cfs.

Release rates for SR-4 are 24.3 cfs for the 2-year storm and 696.4 cfs for the 100-year storm. Falcon DBPS has 2-year storm listed as 27 cfs and 100-year storm as 730 cfs. This gives a decrease of 2.7 cfs and 33.6 cfs for the 2 and 100-year events respectively.

Pond MN release rates 30.5 for the 2-year storm and 799.4 cfs for the 100-year storm. The DBPS has release rates listed as 32 cfs for the 2-year storm and 820 cfs for the 100-year storm. This gives a decrease of 1.5 cfs and 20.6 cfs for the 2 and 100-year events respectively.

X. Maintenance

The proposed channel will be a public facility. After completion of construction and upon the Board of County Commissioners acceptance the channel will be owned and maintained by El Paso County along with all drainage facilities within the public Right-of-Way.

XI. Wetlands Mitigation

No wetlands are located on site.

XII. Floodplain Statement

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map number 08041C0553G, effective December 7, 2018, there is no floodplain in the project area. A copy of the FIRM Panel is included in Appendix A.

XIII. Drainage/Bridge Fees and Credits/Reimbursements

Since there is no land being platted with this development, drainage and bridge fees are not required.

XIV. Conclusion

This report for the proposed roadway improvements to Meridian Road, between Bent Grass Meadows Drive and Owl Place, has been prepared using the criteria and methods as described in the El Paso County Drainage Criteria Manual. Although the roadway improvements will result in slightly higher runoff to the roadside channel, there will be minimal impact on the downstream infrastructure. The channel was analyzed in the existing conditions and determined to be undersized. Although the channel improvements will not be made with this development, recommendations will be made within the MDDP/DBPS Amendment, that is currently in process, for the future conditions of the channel. The Meridian Road channel will ultimately be publicly owned and maintained and shall be the responsibility of El Paso County.

XV. References

1. *City of Colorado Springs/County of El Paso Drainage Criteria Manual*, October 1991.
2. *Drainage Criteria Manual, Volume 2*, City of Colorado Springs, November 2002.
3. *Urban Storm Drainage Criteria Manual*, Urban Drainage and Flood Control District, January 2016 (with current revisions).
4. *Falcon Drainage Basin Planning Study*, by Matrix Design Group, September 2015.
5. *Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision*, by Kiowa Engineering Corporation, December 2006.
6. *Final Drainage Report for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2014.
7. *Final Drainage Report Addendum for Bent Grass Residential (Filing No. 1)*, by Classic Consulting Engineers & Surveyors, LLC, August 2015.

APPENDIX A

Exhibits and Figures

MERIDIAN ROAD IMPROVEMENTS

MERIDIAN RD & BENT GRASS MEADOWS DR
SCALE: 1" = 1,000'

VICINITY MAP

Project No:	CLH000015.20
Drawn By:	BHB
Checked By:	SMB
Date:	NOVEMBER 2019

Galloway
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Colorado Springs, CO 80920
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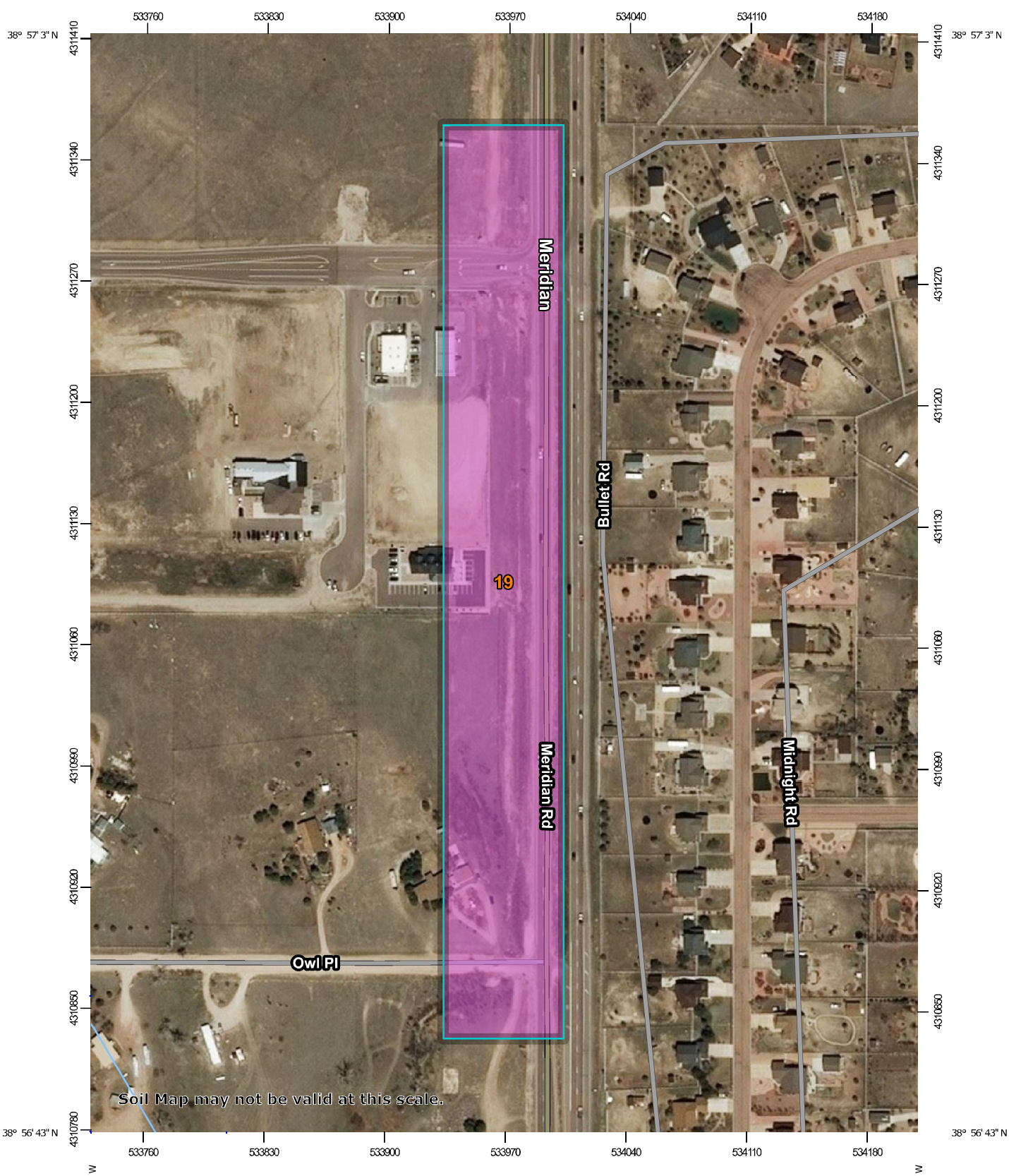
Hydrologic Soil Group—El Paso County Area, Colorado
(Meridian Road Improvements)



Map Scale: 1:3,090 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Sep 8, 2018—May 26, 2019

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	9.1	100.0%
Totals for Area of Interest			**9.1**	**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

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

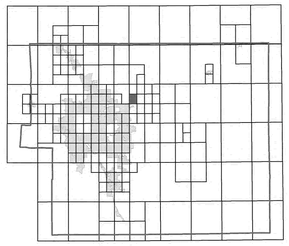
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

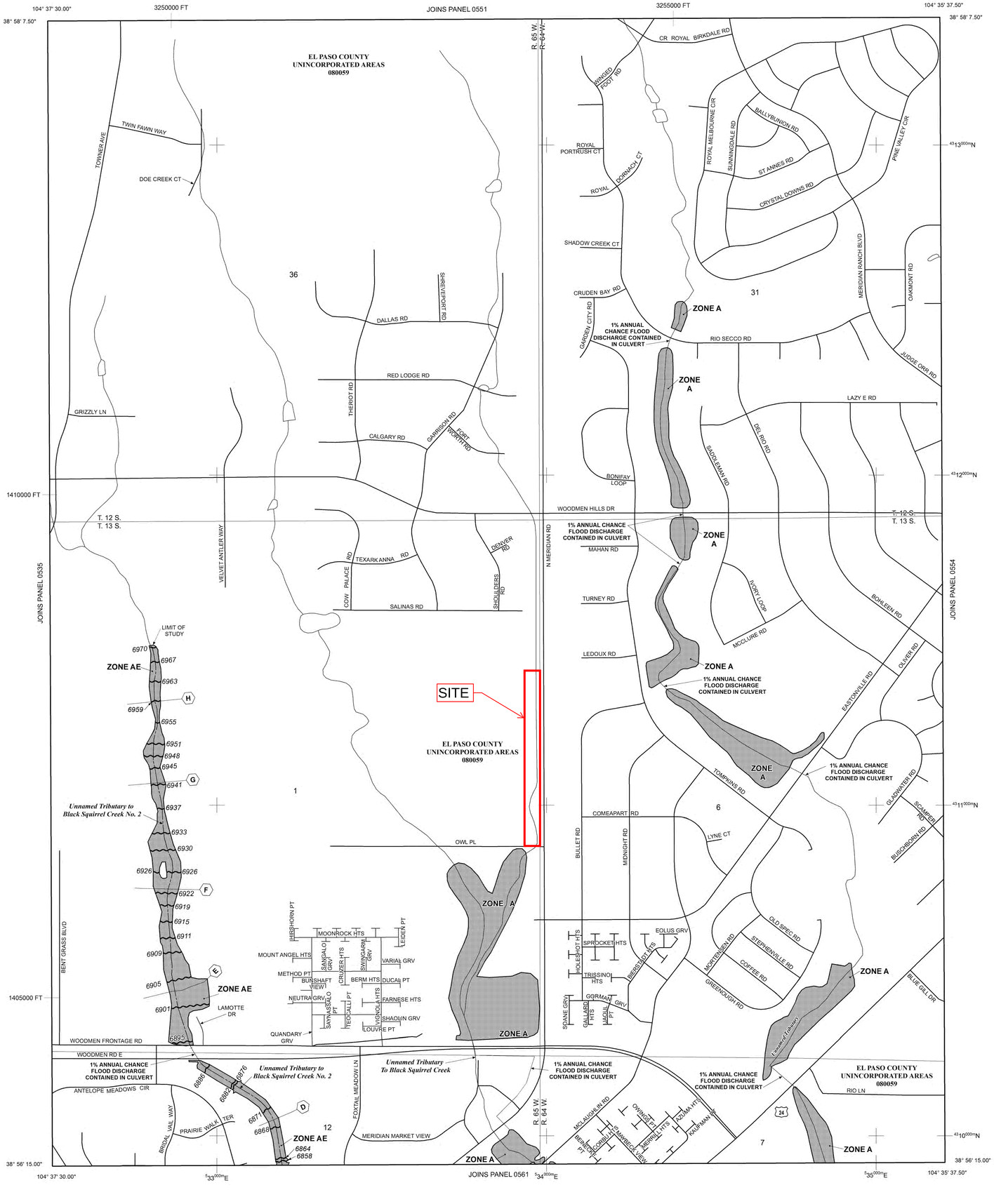
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A No Base Flood Elevations determined.
ZONE AE Base Flood Elevations determined.
ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513 — Base Flood Elevation line and value; elevation in feet*
(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A — Cross section line
23 — 23 — Transect line
97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0553G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 553 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0553	G

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

MAP NUMBER
08041C0553G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

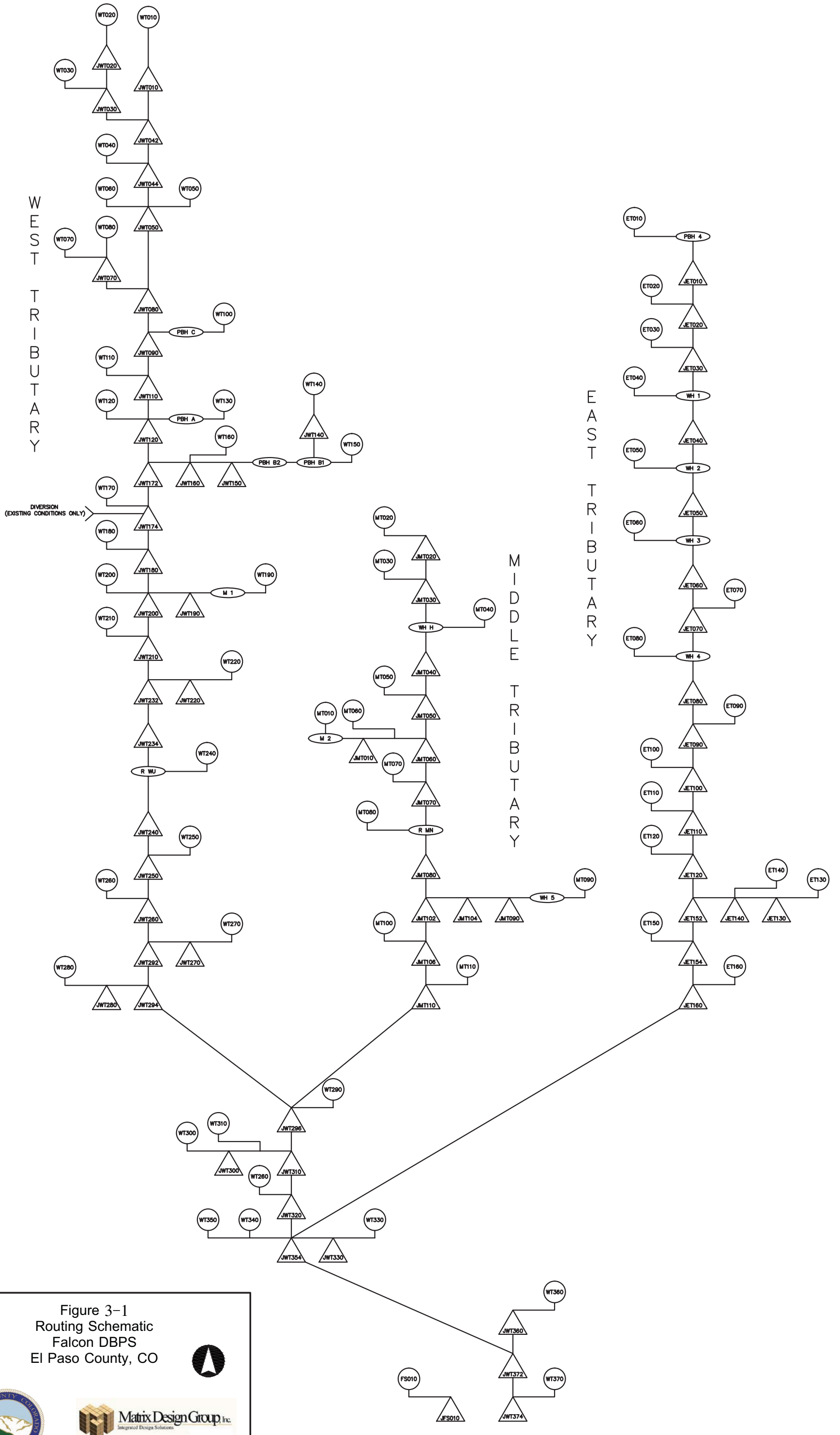


Figure 3–1
Routing Schematic
Falcon DBPS
El Paso County, CO

DRAWING NOT TO SCALE

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
ET050 0.12
ET060 0.29
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

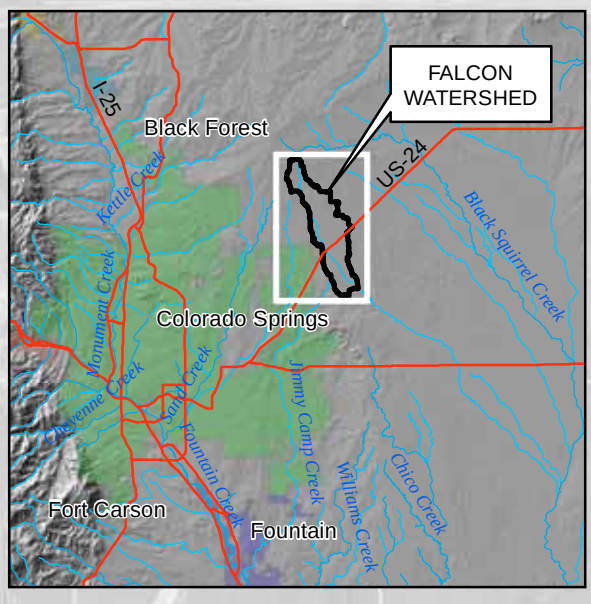


Figure 3-2
Drainage Basin Map
Falcon DBPS
El Paso County, CO

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

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
DIVERSION
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

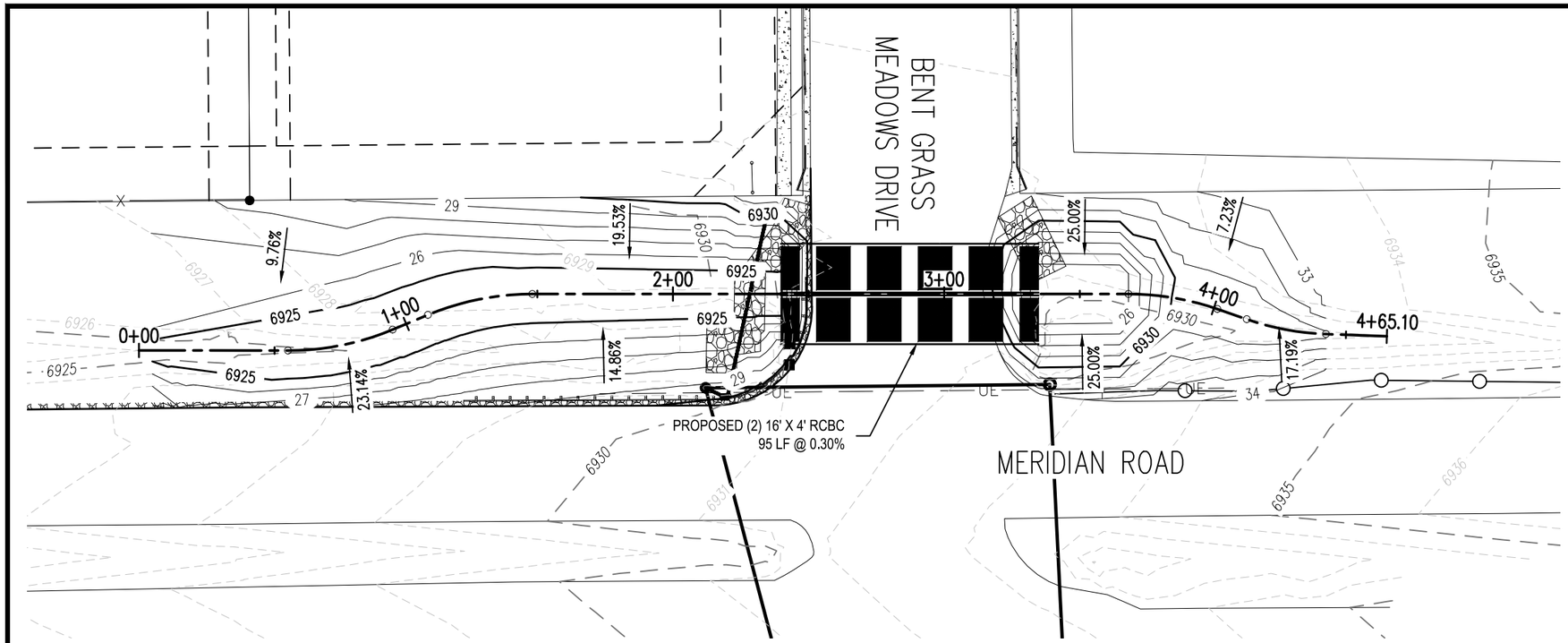
Reach Alternative
- Protect In Place
- Natural Channel Design
- Small Drop Structures w/ Toe Protection

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

0 0.5 1
Miles

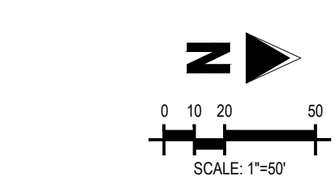
NOTE: FIGURE MUST BE VIEWED IN COLOR

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



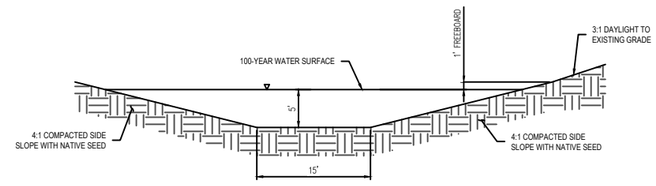
FUTURE MERIDIAN CHANNEL – PLAN

SCALE: 1"=50'



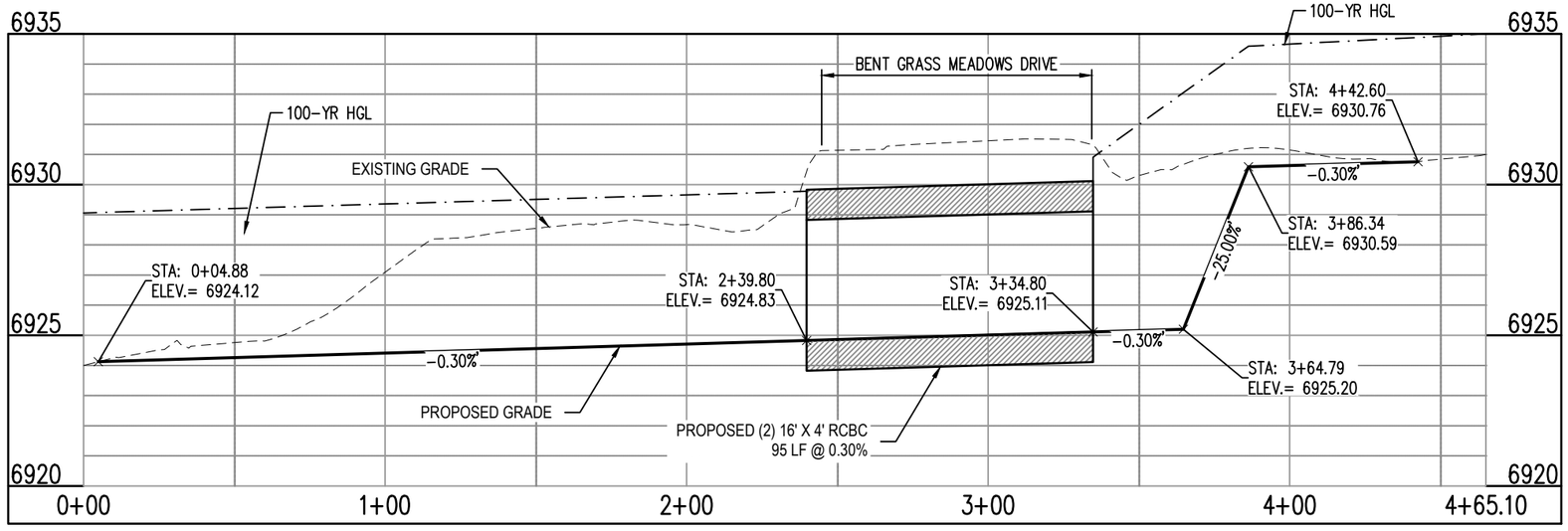
LEGEND

- 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

APPENDIX B

Hydrologic Computations

COMPOSITE % IMPERVIOUS CALCULATIONS: PROPOSED

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 3/23/20

1	2	3	4	5	6	7	8	9	10	11	12
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Roofs**			**Basins Total**
		% Imp.	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**Weighted % Imp.**
OFFSITE BASINS											
OS-5	14.13	100	0.17	1.20	2	13.74	1.90	90	0.22	1.4	4.5
OS-6	5.81	100	0.00	0.00	2	5.81	5.81	90	0.00	0.0	5.8
H3	11.30	100	0.00	0.00	2	5.81	1.00	90	0.00	0.0	1.0
C1	2.22	100	2.22	100.00	2	0.00	0.00	90	0.00	0.0	100.0
OS-2	4.42	100	0.00	0.00	2	4.42	2.00	90	0.00	0.0	2.0
OS-3	10.24	100	0.00	0.00	2	10.24	2.00	90	0.00	0.0	2.0
HISTORIC											
H-1	2.03	100	0.96	47.3	2	1.07	1.1	90	0.00	0.0	48.4
PROPOSED											
P-1	2.03	100	1.29	63.5	2	0.74	0.7	90	0.00	0.0	64.2

NOTES:
% Impervious values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)

COMPOSITE RUNOFF COEFFICIENT CALCULATIONS: PROPOSED

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 3/23/20

1	2	3	4	5	6	7	8	9	10	11	12	13
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Roofs**			**Composite C_5**	**Composite C_{100}**
		C_5	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**	**C_5**	**C_{100}**	**Area (ac)**		
OFFSITE BASINS												
OS-5	14.13	0.90	0.96	0.17	0.09	0.36	13.71	0.73	0.81	0.22	0.11	0.37
OS-6	5.81	0.90	0.96	0.00	0.09	0.36	5.81	0.73	0.81	0.00	0.09	0.36
H3	11.30	0.90	0.96	0.00	0.09	0.36	11.30	0.73	0.81	0.00	0.09	0.36
C1	2.22	0.90	0.96	2.22	0.09	0.36	0.00	0.73	0.81	0.00	0.90	0.96
OS-2	4.42	0.90	0.96	0.00	0.09	0.36	4.42	0.73	0.81	0.00	0.09	0.36
OS-3	10.24	0.90	0.96	0.00	0.09	0.36	10.24	0.73	0.81	0.00	0.09	0.36
HISTORIC												
H-1	2.03	0.90	0.96	0.96	0.09	0.36	1.07	0.73	0.81	0.00	0.47	0.64
PROPOSED												
P-1	2.03	0.90	0.96	1.29	0.09	0.36	0.74	0.73	0.81	0.00	0.60	0.74

NOTES:
C values are taken directly from Table 6-6 in the Colorado Springs DCM Vol. 1. CH. 6 (Referencing UDFCD 2001)
Coeffficients use HSG A&B soils - Refer to "Appendix A: Exhibits and Figures" for soil map

STANDARD FORM SF-2: PROPOSED
TIME OF CONCENTRATION

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 3/23/20

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
SUB-BASIN DATA						**INITIAL/OVERLAND (T_i)**			**TRAVEL TIME (T_t)**					**Tc CHECK (URBANIZED BASINS)**			**FINAL**
BASIN ID	**D.A. (AC)**	**Hydrologic Soils Group**	**Impervious (%)**	**C_5**	**C_{100}**	**L (FT)**	**S (%)**	**T_i (MIN)**	**L (FT)**	**S (%)**	**Cv**	**VEL. (FPS)**	**T_t (MIN)**	**COMP. T_c (MIN)**	**TOTAL LENGTH(FT)**	**Urbanized T_c (MIN)**	**T_c (MIN)**
OFFSITE BASINS																	
OS-5	14.13	A	4.5	0.11	0.37	300	2.5	23.1	1400	3.0	15	2.6	8.98	32.1	1700.0	19.4	19.4
OS-6	5.81	A	5.8	0.09	0.36	300	2.0	25.4	400	2.0	15	2.1	3.14	28.6	700.0	13.9	13.9
H3	11.30	A	1.0	0.09	0.36	100	6.0	10.2	1460	2.0	15	2.1	11.47	21.7	1560.0	18.7	18.7
C1	2.22	A	100.0	0.90	0.96	100	6.0	2.0	1230	1.7	15	2.0	10.48	12.5	1330.0	17.4	12.5
OS-2	4.42	A	2.0	0.09	0.36	100	1.0	18.5	650	1.0	10	1.0	10.83	29.3	750.0	14.2	14.2
OS-3	10.24	A	2.0	0.09	0.36	100	1.0	18.5	600	1.0	10	1.0	10.00	28.5	700.0	13.9	13.9
HISTORIC BASINS																	
H-1	2.03	A	48.4	0.47	0.64	100	6.0	6.4	1230	1.7	15	2.0	10.48	16.8	1330.0	17.4	16.8
PROPOSED BASINS																	
P-1	2.03	A	64.2	0.60	0.74	100	6.0	5.0	1230	1.7	15	2.0	10.48	15.5	1330.0	17.4	15.5

NOTES:

$T_i = (0.395*(1.1 - C_5)*(L)^{0.5}/((S)^{0.33})$, S in ft/ft

T_t=L/60V (Velocity From Fig. 501)

Velocity V=Cv*S^0.5, S in ft/ft

T_c Check = 10+L/180

For Urbanized basins a minimum T_c of 5.0 minutes is required.

For non-urbanized basins a minimum T_c of 10.0 minutes is required

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs
Design Storm: 100-Year

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 3/23/20

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
HISTORIC																					
Value from DBPS (Meadows Pond #2)	30							160.0													
		OS-5	14.13	0.37	19.4	5.23	5.26	27.5													
	11											187.5									Combines Meadows Filing 3 with Basin OS-5
		OS-6	5.81	0.36	13.9	2.09	6.10	12.7													
	12											200.3									Combines DP 11 with Basin OS-6
		H3	11.30	0.36	18.7	4.07	5.36	21.8													
		OS-2	4.42	0.36	14.2	1.59	6.05	9.6													
		OS-3	10.24	0.36	13.9	3.69	6.10	22.5													
	14											254.2									Combines Offsite flow fomr Meadows Fil 3, and Basins OS-5, OS-6, H3, OS-2 and OS-3
		C1	2.22	0.96	12.5	2.13	6.37	13.6													
	15											13.6									Street flow on North half of Bent Grass Meadows Drive
	H1A							850.0				850.0									Flow from Falcon DBPS
	20											1117.8									Combines DBPS Flow with DP 14 and DP 15
		H-1	2.03	0.64	16.8	1.30	5.62	7.3													
	25											1125.1									Combines flow from DP 20 with Basin H-1
PROPOSED																					
Value from DBPS (Meadows Pond #2)	30							160.0													
		OS-5	14.13	0.37	19.4	5.23	5.26	27.5													
	11											27.5									Flow from OS-5
		OS-6	5.81	0.36	13.9	2.09	6.10	12.7													
	12											40.3									Combines DP 11 with Basin OS-6
	12-P											4.2									Release rate from School Site Sed Pond
		H3	11.30	0.36	18.7	4.07	5.36	21.8													
		OS-2	4.42	0.36	14.2	1.59	6.05	9.6													
		OS-3	10.24	0.36	13.9	3.69	6.10	22.5													
	14											218.1									245
		C1	2.22	0.96	12.5	2.13	6.37	13.6													1110
	15											13.6									Street flow on North half of Bent Grass Meadows Drive
	H1A							850.0				850.0									Flow from Falcon DBPS
	20											1081.7									Combines DBPS Flow with DP 14 and DP 15
		P-1	2.03	0.74	15.5	1.50	5.82	8.7													
	25											1090.4									Combines flow from DP 20 with Basin P-1

STANDARD FORM SF-3: PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs
Design Storm: 5-Year

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 3/23/20

		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			
STREET	Design Point	Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	REMARKS
HISTORIC																					
Value from DBPS (Meadows Pond #2)	30							11.0													
		OS-5	14.13	0.11	19.4	1.55	3.13	4.9													
	11											15.9									Combines Meadows Filing 3 with Basin OS-5
		OS-6	5.81	0.09	13.9	0.52	3.64	1.9													
	12											17.7									Combines DP 11 with Basin OS-6
		H3	11.30	0.09	18.7	1.02	3.19	3.3													
		OS-2	4.42	0.09	14.2	0.40	3.61	1.4													
		OS-3	10.24	0.09	13.9	0.92	3.64	3.3													
	14											25.8									Combines Offsite flow fomr Meadows Fil 3, and Basins OS-5, OS-6, H3, OS-2 and OS-3
		C1	2.22	0.90	12.5	2.00	3.79	7.6													
	15											7.6									Street flow on North half of Bent Grass Meadows Drive
	H1A							280.0				280.0									Flow from Falcon DBPS
	20											313.4									Combines DBPS Flow with DP 14 and DP 15
		H-1	2.03	0.47	16.8	0.95	3.35	3.2													
	25											316.6									Combines flow from DP 20 with Basin H-1
PROPOSED																					
Value from DBPS (Meadows Pond #2)	30							11.0													
		OS-5	14.13	0.11	19.4	1.55	3.13	4.9													
	11											4.9									Flow from OS-5
		OS-6	5.81	0.09	13.9	0.52	3.64	1.9													
	12											6.7									Combines DP 11 with Basin OS-6
	12-P											0.0									Release rate from School Site Sed Pond
		H3	11.30	0.09	18.7	1.02	3.19	3.3													
		OS-2	4.42	0.09	14.2	0.40	3.61	1.4													
		OS-3	10.24	0.09	13.9	0.92	3.64	3.3													
	14											19.0									Combines Offsite flow fomr Meadows Fil 3, School Pond Release Flow, and Basins H3, OS-2 and OS-3 along Bent Grass Meadow Drive
		C1	2.22	0.90	12.5	2.00	3.79	7.6													
	15											7.6									Street flow on North half of Bent Grass Meadows Drive
	H1A							280.0				280.0									Flow from Falcon DBPS
	20											306.6									Combines DBPS Flow with DP 14 and DP 15
		P-1	2.03	0.60	15.5	1.22	3.47	4.2													
	25											310.9									Combines flow from DP 20 with Basin P-1

HEC-HMS 100-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
WT020	0.0671	41.9	01Jan2011, 06:21	4.8
JWT020	0.0671	41.9	01Jan2011, 06:21	4.8
RWT030	0.0671	41.9	01Jan2011, 06:29	4.8
WT030	0.0765	75.3	01Jan2011, 06:07	5.5
JWT030	0.1436	85.4	01Jan2011, 06:09	10.3
RWT042	0.1436	85.3	01Jan2011, 06:15	10.3
WT010	0.1353	88.9	01Jan2011, 06:17	9.3
JWT010	0.1353	88.9	01Jan2011, 06:17	9.3
RWT044	0.1353	88.8	01Jan2011, 06:24	9.3
JWT042	0.2789	167.0	01Jan2011, 06:21	19.6
RWT046	0.2789	166.7	01Jan2011, 06:28	19.6
WT040	0.1851	92.7	01Jan2011, 06:28	12.8
JWT044	0.4640	259.4	01Jan2011, 06:28	32.4
RWT054	0.4640	258.8	01Jan2011, 06:35	32.3
WT060	0.1956	116.8	01Jan2011, 06:26	15.1
WT050	0.1899	139.4	01Jan2011, 06:19	15.3
JWT050	0.8496	475.4	01Jan2011, 06:31	62.7
RWT092	0.8496	475.2	01Jan2011, 06:32	62.7
WT070	0.1711	133.9	01Jan2011, 06:12	11.8
JWT070	0.1711	133.9	01Jan2011, 06:12	11.8
RWT080	0.1711	133.4	01Jan2011, 06:22	11.8
WT080	0.0692	67.3	01Jan2011, 06:10	5.6
Sub Regional Pond SR1	1.0898	513.2	01Jan2011, 06:40	78.4
JWT080	1.0898	513.2	01Jan2011, 06:40	78.4
RWT094	1.0898	512.4	01Jan2011, 06:45	78.3
WT100-REV	0.1293	203.0	01Jan2011, 06:04	12.9
W26-REV	0.0720	103.6	01Jan2011, 06:03	6.4
WS3-1	0.0720	102.8	01Jan2011, 06:10	6.4
Paint Brush Hills Pond C	0.2013	64.4	01Jan2011, 06:26	19.2
WT090	0.1533	162.4	01Jan2011, 06:09	12.8
JWT090	1.4444	595.9	01Jan2011, 06:44	110.2
RWT122	1.4444	595.5	01Jan2011, 06:45	110.2
WT110	0.1943	169.9	01Jan2011, 06:14	16.2
JWT110	1.6387	651.0	01Jan2011, 06:43	126.4
RWT124	1.6387	650.8	01Jan2011, 06:47	126.3
WT130-REV	0.1016	130.0	01Jan2011, 06:11	10.9
Paint Brush Hills Pond A	0.1016	53.8	01Jan2011, 06:32	10.9
WT120-REV	0.0430	51.1	01Jan2011, 06:08	3.8
JWT120	1.7834	703.6	01Jan2011, 06:46	140.9
RWT172	1.7834	702.5	01Jan2011, 06:58	140.5
WT140-REV	0.1445	194.2	01Jan2011, 06:12	16.8
JWT140	0.1445	194.2	01Jan2011, 06:12	16.8

HEC-HMS 100-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
RWT150	0.1445	193.3	01Jan2011, 06:22	16.8
WT150-REV	0.1308	202.5	01Jan2011, 06:08	15
Paint Brush Hills Pond B1	0.2753	235.6	01Jan2011, 06:29	31.8
W34B2-REV	0.0936	141.8	01Jan2011, 06:07	10.2
Paint Brush Hills Pond B2	0.3689	234.3	01Jan2011, 06:43	38.9
JWT150	0.3689	234.3	01Jan2011, 06:43	38.9
RWT160	0.3689	234.2	01Jan2011, 06:49	38.8
WT160-REV	0.0735	109.9	01Jan2011, 06:06	7.5
JWT160	0.4424	244.8	01Jan2011, 06:48	46.3
RWT174	0.4424	244.7	01Jan2011, 06:56	46.2
WT170-REV	0.1060	85.2	01Jan2011, 06:19	9.2
W34-CY-REV	0.0465	38.1	01Jan2011, 06:16	3.8
JWT172	2.3783	981.9	01Jan2011, 06:56	199.7
RWT176	2.3783	981.6	01Jan2011, 06:57	199.7
Sub Regional Pond SR2	2.3783	972.9	01Jan2011, 07:01	194.8
JWT174	2.3783	972.9	01Jan2011, 07:01	194.8
RWT180	2.3783	972.1	01Jan2011, 07:10	194.2
WT180-REV	0.0409	29.3	01Jan2011, 06:19	3.2
JWT180	2.4193	978.0	01Jan2011, 07:10	197.4
RWT202	2.4193	977.3	01Jan2011, 07:21	196.8
WT200	0.3017	186.8	01Jan2011, 06:30	26
WT190	0.0575	74.7	01Jan2011, 06:05	5
The Meadows Pond #1	0.0575	2.1	01Jan2011, 08:29	2.8
JWT190	0.0575	2.1	01Jan2011, 08:29	2.8
RWT204	0.0575	2.1	01Jan2011, 08:55	2.7
JWT200	2.7784	1041.0	01Jan2011, 07:19	225.5
RWT210	2.7784	1040.5	01Jan2011, 07:24	225.1
WT210	0.2655	187.9	01Jan2011, 06:35	28
JWT210	3.0439	1113.0	01Jan2011, 07:23	253.1
RWT232	3.0439	1112.6	01Jan2011, 07:27	252.7
WT220	0.1895	250.4	01Jan2011, 06:12	21.3
JWT220	0.1895	250.4	01Jan2011, 06:12	21.3
RWT234	0.1895	249.6	01Jan2011, 06:20	21.3
JWT232	3.2334	1138.4	01Jan2011, 07:26	274
RWT236	3.2334	1138.3	01Jan2011, 07:26	274
WT230	0.1982	346.7	01Jan2011, 06:05	23.1
JWT234	3.4316	1155.6	01Jan2011, 07:26	297
RWT240	3.4316	1155.0	01Jan2011, 07:29	296.8
WT240	0.0761	160.3	01Jan2011, 06:01	9.1
Regional Pond WU North	3.5078	1160.9	01Jan2011, 07:30	304.7
Regional Pond WU Diversion	3.5078	1122.2	01Jan2011, 07:30	261.4
Old Meridian	0.0336	85.0	01Jan2011, 06:07	6.1

HEC-HMS 100-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
RWT-OM	0.0336	84.2	01Jan2011, 06:12	6.1
Regional Pond WU South	3.5413	997.3	01Jan2011, 07:47	255.2
RWT240_Diversion Reach	0.0000	38.8	01Jan2011, 07:35	43.1
JWT240	3.5413	1036.0	01Jan2011, 07:47	298.4
RWT250	3.5413	1035.7	01Jan2011, 07:48	298.3
WT250	0.1470	291.4	01Jan2011, 06:02	17.1
JWT250	3.6883	1048.0	01Jan2011, 07:48	315.4
RWT260	3.6883	1047.5	01Jan2011, 07:58	314.3
WT260	0.1388	77.5	01Jan2011, 06:34	11.5
JWT260	3.8271	1061.8	01Jan2011, 07:58	325.9
RWT291	3.8271	1061.7	01Jan2011, 08:00	325.6
WT270	0.0325	57.1	01Jan2011, 06:04	3.6
JWT270	0.0325	57.1	01Jan2011, 06:04	3.6
RWT292	0.0325	56.9	01Jan2011, 06:08	3.5
JWT292	3.8596	1064.3	01Jan2011, 08:00	329.2
RWT295	3.8596	1064.2	01Jan2011, 08:01	329
WT280	0.2670	251.8	01Jan2011, 06:12	22.3
JWT280	0.2670	251.8	01Jan2011, 06:12	22.3
RWT294	0.2670	251.2	01Jan2011, 06:15	22.2
JWT294	4.1265	1082.0	01Jan2011, 08:01	351.3
RWT296	4.1265	1081.4	01Jan2011, 08:07	350.6
MT040	0.3084	455.2	01Jan2011, 06:11	38.1
MT030	0.1566	228.6	01Jan2011, 06:05	15.1
MT020	0.0902	143.1	01Jan2011, 06:04	9
JMT020	0.0902	143.1	01Jan2011, 06:04	9
RMT030	0.0902	141.8	01Jan2011, 06:17	8.9
JMT030	0.2468	294.4	01Jan2011, 06:07	24
RMT040	0.2468	293.0	01Jan2011, 06:11	24
Woodmen Hills Pond H	0.5553	751.7	01Jan2011, 06:11	61.7
JMT040	0.5553	751.7	01Jan2011, 06:11	61.7
RMT050	0.5553	745.8	01Jan2011, 06:14	61.7
MT050	0.1186	109.7	01Jan2011, 06:18	11.4
JMT050	0.6739	851.9	01Jan2011, 06:14	73.1
RMT064	0.6739	847.0	01Jan2011, 06:21	73
MT010	0.2899	206.3	01Jan2011, 06:24	25
The Meadows Pond #2	0.2899	99.3	01Jan2011, 06:53	23.4
JMT010	0.2899	99.3	01Jan2011, 06:53	23.4
RMT062	0.2899	99.2	01Jan2011, 07:11	23.3
MT060a	0.0300	46.8	01Jan2011, 06:03	2.8
School Site	0.0300	7.0	01Jan2011, 06:22	1.5
RMT060a	0.0300	7.0	01Jan2011, 06:31	1.5
MT060	0.1595	197.7	01Jan2011, 06:08	14.8

HEC-HMS 100-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Sub Regional Pond SR4	1.1533	696.4	01Jan2011, 06:35	107.2
JMT060	1.1533	696.4	01Jan2011, 06:35	107.2
RMT070	1.1533	694.8	01Jan2011, 06:40	107
MT070	0.1995	170.2	01Jan2011, 06:22	19.6
JMT070	1.3527	816.0	01Jan2011, 06:38	126.6
RMT080	1.3527	815.1	01Jan2011, 06:40	126.5
MT080	0.0638	191.9	01Jan2011, 06:00	11
Regional Pond MN	1.4166	799.4	01Jan2011, 06:45	135
JMT080	1.4166	799.4	01Jan2011, 06:45	135
RMT102	1.4166	797.8	01Jan2011, 06:51	134.7
MT090	0.0435	127.4	01Jan2011, 06:00	7.1
Woodmen Hills Pond #5	0.0435	18.6	01Jan2011, 06:07	5.9
JMT090	0.0435	18.6	01Jan2011, 06:07	5.9
RMT090	0.0435	18.6	01Jan2011, 06:08	5.9
JMT104	0.0435	18.6	01Jan2011, 06:08	5.9
RMT104	0.0435	18.6	01Jan2011, 06:12	5.9
JMT102	1.4601	813.3	01Jan2011, 06:51	140.6
RMT106	1.4601	808.9	01Jan2011, 06:53	140.5
MT100	0.0558	88.2	01Jan2011, 06:05	5.9
JMT106	1.5158	816.1	01Jan2011, 06:53	146.4
RMT112	1.5158	813.2	01Jan2011, 07:04	145.8
MT110	0.1164	117.4	01Jan2011, 06:16	11.5
JMT110	1.6322	835.5	01Jan2011, 07:04	157.3
RMT114	1.6322	834.5	01Jan2011, 07:09	157
WT290	0.1038	110.3	01Jan2011, 06:09	8.7
Regional Pond R1	5.8625	1428.4	01Jan2011, 08:03	508.7
JWT296	5.8625	1428.4	01Jan2011, 08:03	508.7
RWT314	5.8625	1428.1	01Jan2011, 08:08	507.8
WT300	0.0970	91.6	01Jan2011, 06:12	8.1
JWT300	0.0970	91.6	01Jan2011, 06:12	8.1
RWT312	0.0970	91.1	01Jan2011, 06:29	8.1
WT310	0.2774	246.7	01Jan2011, 06:13	22.3
JWT310	6.2370	1452.3	01Jan2011, 08:08	538.2
RWT320	6.2370	1451.6	01Jan2011, 08:14	537.2
WT320	0.2061	200.6	01Jan2011, 06:11	17.2
JWT320	6.4431	1463.9	01Jan2011, 08:14	554.3
RWT352	6.4431	1463.1	01Jan2011, 08:23	553.1
ET020	0.2132	360.5	01Jan2011, 06:06	24.8
ET010	0.1451	198.3	01Jan2011, 06:11	16.4
Paint Brush Hills Pond #4	0.1451	150.9	01Jan2011, 06:20	16.3
JET010	0.1451	150.9	01Jan2011, 06:20	16.3
RET020	0.1451	150.0	01Jan2011, 06:37	16.3

HEC-HMS 100-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Sub Regional Pond SR6	0.3583	195.4	01Jan2011, 06:41	37.9
JET020	0.3583	195.4	01Jan2011, 06:41	37.9
RET030	0.3583	194.9	01Jan2011, 07:02	37.5
ET030	0.2043	242.0	01Jan2011, 06:15	23
JET030	0.5626	266.0	01Jan2011, 06:43	60.5
RET040	0.5626	265.2	01Jan2011, 06:50	60.3
Woodmen Hills Pond #1 North	0.7117	263.5	01Jan2011, 07:09	75.5
ET040	0.1491	165.7	01Jan2011, 06:14	15.3
Woodmen Hills Pond #1 South	0.7117	261.1	01Jan2011, 07:18	69.5
JET040	0.7117	261.1	01Jan2011, 07:18	69.5
RET050	0.7117	261.1	01Jan2011, 07:23	69.4
ET050	0.1172	197.1	01Jan2011, 06:03	11.6
Woodmen Hills Pond #2	0.8289	250.3	01Jan2011, 07:46	79.3
JET050	0.8289	250.3	01Jan2011, 07:46	79.3
RET060	0.8289	250.3	01Jan2011, 07:53	79.1
ET060	0.2854	529.3	01Jan2011, 06:01	29.3
Woodmen Hills Pond #3	1.1143	360.9	01Jan2011, 06:06	105.9
JET060	1.1143	360.9	01Jan2011, 06:06	105.9
RET070	1.1143	356.7	01Jan2011, 06:16	105.6
ET070	0.2498	461.0	01Jan2011, 06:02	27.3
JET070	1.3641	636.4	01Jan2011, 06:04	132.9
RET080	1.3641	517.5	01Jan2011, 06:23	131.3
ET080	0.2916	517.9	01Jan2011, 06:07	37.1
Woodmen Hills Pond #4	1.6557	288.0	01Jan2011, 07:00	139.2
JET080	1.6557	288.0	01Jan2011, 07:00	139.2
RET090	1.6557	287.3	01Jan2011, 07:03	139
ET090	0.1242	133.0	01Jan2011, 06:22	14.9
JET090	1.7800	330.8	01Jan2011, 06:59	153.9
RET100	1.7800	330.7	01Jan2011, 07:01	153.8
ET100	0.0481	72.0	01Jan2011, 06:02	4
JET100	1.8280	335.4	01Jan2011, 07:01	157.8
RET110	1.8280	335.2	01Jan2011, 07:05	157.6
ET110	0.2260	198.8	01Jan2011, 06:12	17.5
JET110	2.0541	362.1	01Jan2011, 07:03	175.1
RET120	2.0541	361.3	01Jan2011, 07:09	174.7
ET120	0.1091	89.4	01Jan2011, 06:14	8.5
JET120	2.1632	403.2	01Jan2011, 06:17	183.2
RET152	2.1632	402.2	01Jan2011, 06:24	182.9
ET130	0.1348	85.4	01Jan2011, 06:27	11.2
JET130	0.1348	85.4	01Jan2011, 06:27	11.2
RET140	0.1348	84.7	01Jan2011, 06:54	11.1
ET140	0.2676	122.8	01Jan2011, 06:46	22.2

HEC-HMS 100-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
JET140	0.4024	204.8	01Jan2011, 06:51	33.3
RET154	0.4024	204.4	01Jan2011, 07:05	33.2
JET152	2.5656	572.3	01Jan2011, 07:10	216.1
RET156	2.5656	572.0	01Jan2011, 07:14	215.8
ET150	0.1777	136.2	01Jan2011, 06:18	14.3
JET154	2.7433	595.8	01Jan2011, 07:12	230.1
RET162	2.7433	595.1	01Jan2011, 07:25	228.9
ET160	0.1889	137.2	01Jan2011, 06:23	16.3
JET160	2.9322	633.6	01Jan2011, 06:38	245.2
RET164	2.9322	629.0	01Jan2011, 06:47	244.7
WT350	0.3038	276.7	01Jan2011, 06:14	26.3
JWT352	9.6791	2076.7	01Jan2011, 07:39	824.1
RWT354	9.6791	2076.6	01Jan2011, 07:39	824.1
WT330	0.3267	249.3	01Jan2011, 06:19	27.2
JWT330	0.3267	249.3	01Jan2011, 06:19	27.2
RWT344	0.3267	248.4	01Jan2011, 06:25	27.2
WT340	0.2780	147.3	01Jan2011, 06:37	23.1
JWT354	10.2838	2154.8	01Jan2011, 07:38	874.3
RWT372	10.2838	2152.2	01Jan2011, 07:44	873.2
WT360	0.0657	54.8	01Jan2011, 06:15	5.3
JWT360	0.0657	54.8	01Jan2011, 06:15	5.3
RWT374	0.0657	54.6	01Jan2011, 06:24	5.3
Regional Pond R2	10.3495	2155.5	01Jan2011, 07:45	875.1
JWT372	10.3495	2155.5	01Jan2011, 07:45	875.1
RWT376	10.3495	2149.9	01Jan2011, 07:55	872.8
WT370	0.2148	123.3	01Jan2011, 06:12	11.5
JWT374_OUTLET	10.5642	2160.1	01Jan2011, 07:55	884.3
FS010	0.1220	74.9	01Jan2011, 06:16	7.7
JFS010_OUTLET	0.1220	74.9	01Jan2011, 06:16	7.7

Project: Aug15_Working_Falcon_DBPS_S
Simulation Run: FU 100-yr Reservoir: Sub Regional Pond SR4

Start of Run:	01Jan2011, 00:00	Basin Model:	Falcon_DBPS_Future
End of Run:	02Jan2011, 00:00	Meteorologic Model:	100-yr
Compute Time:	28Jul2020, 17:58:02	Control Specifications:	24-hr Storm

Volume Units: AC-FT

Computed Results

Peak Inflow :	952.3 (CFS)	Date/Time of Peak Inflow :	01Jan2011, 06:20
Peak Outflow :	696.4 (CFS)	Date/Time of Peak Outflow :	01Jan2011, 06:35
Total Inflow :	112.5 (AC-FT)	Peak Storage :	18.9 (AC-FT)
Total Outflow :	107.2 (AC-FT)	Peak Elevation :	6897.9 (FT)

Project: Aug15_Working_Falcon_DBPS_S
Simulation Run: FU 100-yr Reservoir: Regional Pond MN

Start of Run:	01Jan2011, 00:00	Basin Model:	Falcon_DBPS_Future
End of Run:	02Jan2011, 00:00	Meteorologic Model:	100-yr
Compute Time:	28Jul2020, 17:58:02	Control Specifications:	24-hr Storm

Volume Units: AC-FT

Computed Results

Peak Inflow :	825.8 (CFS)	Date/Time of Peak Inflow :	01Jan2011, 06:39
Peak Outflow :	799.4 (CFS)	Date/Time of Peak Outflow :	01Jan2011, 06:45
Total Inflow :	137.5 (AC-FT)	Peak Storage :	7.4 (AC-FT)
Total Outflow :	135.0 (AC-FT)	Peak Elevation :	6853.9 (FT)

HEC-HMS 5-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
WT020	0.0671	10.3	01Jan2011, 06:23	1.4
JWT020	0.0671	10.3	01Jan2011, 06:23	1.4
RWT030	0.0671	10.3	01Jan2011, 06:34	1.4
WT030	0.0765	19.5	01Jan2011, 06:08	1.6
JWT030	0.1436	20.0	01Jan2011, 06:09	3
RWT042	0.1436	19.9	01Jan2011, 06:18	3
WT010	0.1353	21.2	01Jan2011, 06:19	2.6
JWT010	0.1353	21.2	01Jan2011, 06:19	2.6
RWT044	0.1353	21.2	01Jan2011, 06:29	2.6
JWT042	0.2789	37.2	01Jan2011, 06:24	5.6
RWT046	0.2789	37.2	01Jan2011, 06:35	5.6
WT040	0.1851	21.9	01Jan2011, 06:31	3.6
JWT044	0.4640	58.9	01Jan2011, 06:34	9.2
RWT054	0.4640	58.7	01Jan2011, 06:43	9.2
WT060	0.1956	30.1	01Jan2011, 06:29	4.5
WT050	0.1899	37.3	01Jan2011, 06:21	4.7
JWT050	0.8496	108.6	01Jan2011, 06:38	18.4
RWT092	0.8496	108.5	01Jan2011, 06:39	18.4
WT070	0.1711	32.6	01Jan2011, 06:13	3.4
JWT070	0.1711	32.6	01Jan2011, 06:13	3.4
RWT080	0.1711	32.5	01Jan2011, 06:28	3.3
WT080	0.0692	18.5	01Jan2011, 06:12	1.7
Sub Regional Pond SR1	1.0898	113.8	01Jan2011, 06:50	21.9
JWT080	1.0898	113.8	01Jan2011, 06:50	21.9
RWT094	1.0898	113.7	01Jan2011, 06:58	21.8
WT100-REV	0.1293	67.7	01Jan2011, 06:05	4.5
W26-REV	0.0720	33.7	01Jan2011, 06:04	2.1
WS3-1	0.0720	33.4	01Jan2011, 06:13	2.1
Paint Brush Hills Pond C	0.2013	14.0	01Jan2011, 06:38	6.5
WT090	0.1533	46.0	01Jan2011, 06:10	4
JWT090	1.4444	133.8	01Jan2011, 06:57	32.3
RWT122	1.4444	133.7	01Jan2011, 07:01	32.3
WT110	0.1943	47.0	01Jan2011, 06:16	5.1
JWT110	1.6387	144.0	01Jan2011, 07:00	37.4
RWT124	1.6387	144.0	01Jan2011, 07:08	37.3
WT130-REV	0.1016	43.5	01Jan2011, 06:12	3.9
Paint Brush Hills Pond A	0.1016	9.3	01Jan2011, 06:49	3.9
WT120-REV	0.0430	14.8	01Jan2011, 06:09	1.2
JWT120	1.7834	154.4	01Jan2011, 07:08	42.4
RWT172	1.7834	154.2	01Jan2011, 07:18	42.2
WT140-REV	0.1445	65.2	01Jan2011, 06:14	6.1
JWT140	0.1445	65.2	01Jan2011, 06:14	6.1
RWT150	0.1445	64.9	01Jan2011, 06:24	6.1

HEC-HMS 5-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
WT150-REV	0.1308	71.3	01Jan2011, 06:08	5.5
Paint Brush Hills Pond B1	0.2753	110.4	01Jan2011, 06:15	11.6
W34B2-REV	0.0936	49.1	01Jan2011, 06:08	3.7
Paint Brush Hills Pond B2	0.3689	20.1	01Jan2011, 07:15	13.8
JWT150	0.3689	20.1	01Jan2011, 07:15	13.8
RWT160	0.3689	20.0	01Jan2011, 07:24	13.8
WT160-REV	0.0735	36.3	01Jan2011, 06:07	2.6
JWT160	0.4424	37.3	01Jan2011, 06:07	16.4
RWT174	0.4424	36.9	01Jan2011, 06:20	16.3
WT170-REV	0.1060	24.0	01Jan2011, 06:21	2.9
W34-CY-REV	0.0465	10.7	01Jan2011, 06:18	1.2
JWT172	2.3783	181.3	01Jan2011, 07:17	62.6
RWT176	2.3783	181.2	01Jan2011, 07:18	62.6
Sub Regional Pond SR2	2.3783	171.7	01Jan2011, 07:30	59.3
JWT174	2.3783	171.7	01Jan2011, 07:30	59.3
RWT180	2.3783	171.6	01Jan2011, 07:45	59
WT180-REV	0.0409	7.6	01Jan2011, 06:21	1
JWT180	2.4193	172.6	01Jan2011, 07:45	59.9
RWT202	2.4193	172.6	01Jan2011, 08:03	59.5
WT200	0.3017	52.2	01Jan2011, 06:33	8.3
WT190	0.0575	22.5	01Jan2011, 06:06	1.6
The Meadows Pond #1	0.0575	0.6	01Jan2011, 10:18	0.9
JWT190	0.0575	0.6	01Jan2011, 10:18	0.9
RWT204	0.0575	0.6	01Jan2011, 10:56	0.8
JWT200	2.7784	182.8	01Jan2011, 08:02	68.6
RWT210	2.7784	182.7	01Jan2011, 08:10	68.3
WT210	0.2655	59.7	01Jan2011, 06:38	9.8
JWT210	3.0439	194.3	01Jan2011, 08:09	78.2
RWT232	3.0439	194.3	01Jan2011, 08:16	77.9
WT220	0.1895	84.8	01Jan2011, 06:13	7.8
JWT220	0.1895	84.8	01Jan2011, 06:13	7.8
RWT234	0.1895	84.4	01Jan2011, 06:25	7.7
JWT232	3.2334	200.7	01Jan2011, 08:16	85.7
RWT236	3.2334	200.7	01Jan2011, 08:16	85.7
WT230	0.1982	124.0	01Jan2011, 06:06	8.5
JWT234	3.4316	205.6	01Jan2011, 08:15	94.2
RWT240	3.4316	205.4	01Jan2011, 08:21	94
WT240	0.0761	61.0	01Jan2011, 06:02	3.4
Regional Pond WU North	3.5078	206.4	01Jan2011, 08:23	96.3
Regional Pond WU Diversion	3.5078	169.3	01Jan2011, 08:23	64.8
Old Meridian	0.0336	38.2	01Jan2011, 06:09	2.8
RWT-OM	0.0336	37.8	01Jan2011, 06:14	2.8
Regional Pond WU South	3.5413	144.6	01Jan2011, 08:49	57.2

HEC-HMS 5-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
RWT240_Diversion Reach	0.0000	37.1	01Jan2011, 08:29	31.4
JWT240	3.5413	180.6	01Jan2011, 08:47	88.6
RWT250	3.5413	180.6	01Jan2011, 08:48	88.5
WT250	0.1470	107.5	01Jan2011, 06:03	6.3
JWT250	3.6883	183.2	01Jan2011, 08:48	94.9
RWT260	3.6883	183.1	01Jan2011, 09:04	94.3
WT260	0.1388	21.0	01Jan2011, 06:36	3.6
JWT260	3.8271	185.4	01Jan2011, 09:03	97.9
RWT291	3.8271	185.3	01Jan2011, 09:07	97.8
WT270	0.0325	20.0	01Jan2011, 06:04	1.3
JWT270	0.0325	20.0	01Jan2011, 06:04	1.3
RWT292	0.0325	19.9	01Jan2011, 06:10	1.3
JWT292	3.8596	185.9	01Jan2011, 09:07	99
RWT295	3.8596	185.8	01Jan2011, 09:09	99
WT280	0.2670	70.1	01Jan2011, 06:14	6.9
JWT280	0.2670	70.1	01Jan2011, 06:14	6.9
RWT294	0.2670	70.0	01Jan2011, 06:17	6.9
JWT294	4.1265	189.2	01Jan2011, 09:09	105.9
RWT296	4.1265	189.1	01Jan2011, 09:17	105.5
MT040	0.3084	163.5	01Jan2011, 06:12	14.5
MT030	0.1566	73.4	01Jan2011, 06:06	5.1
MT020	0.0902	47.3	01Jan2011, 06:05	3.1
JMT020	0.0902	47.3	01Jan2011, 06:05	3.1
RMT030	0.0902	46.8	01Jan2011, 06:21	3.1
JMT030	0.2468	93.6	01Jan2011, 06:07	8.1
RMT040	0.2468	92.8	01Jan2011, 06:12	8.1
Woodmen Hills Pond H	0.5553	242.5	01Jan2011, 06:16	22.5
JMT040	0.5553	242.5	01Jan2011, 06:16	22.5
RMT050	0.5553	242.2	01Jan2011, 06:19	22.5
MT050	0.1186	33.2	01Jan2011, 06:20	3.8
JMT050	0.6739	275.4	01Jan2011, 06:19	26.3
RMT064	0.6739	273.1	01Jan2011, 06:29	26.2
MT010	0.2899	57.8	01Jan2011, 06:26	8
The Meadows Pond #2	0.2899	20.8	01Jan2011, 07:07	6.5
JMT010	0.2899	20.8	01Jan2011, 07:07	6.5
RMT062	0.2899	20.8	01Jan2011, 07:34	6.4
MT060a	0.0300	15.1	01Jan2011, 06:03	0.9
School Site	0.0300	0.0	01Jan2011, 00:00	0
RMT060a	0.0300	0.0	01Jan2011, 00:00	0
MT060	0.1595	60.4	01Jan2011, 06:09	4.9
Sub Regional Pond SR4	1.1533	132.7	01Jan2011, 06:52	35.1
JMT060	1.1533	132.7	01Jan2011, 06:52	35.1
RMT070	1.1533	132.3	01Jan2011, 06:58	35

HEC-HMS 5-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
MT070	0.1995	51.6	01Jan2011, 06:24	6.6
JMT070	1.3527	153.8	01Jan2011, 06:57	41.6
RMT080	1.3527	153.6	01Jan2011, 06:59	41.6
MT080	0.0638	91.5	01Jan2011, 06:00	5
Regional Pond MN	1.4166	151.6	01Jan2011, 07:04	44.1
JMT080	1.4166	151.6	01Jan2011, 07:04	44.1
RMT102	1.4166	151.2	01Jan2011, 07:13	44
MT090	0.0435	59.3	01Jan2011, 06:00	3.2
Woodmen Hills Pond #5	0.0435	2.2	01Jan2011, 08:01	2.3
JMT090	0.0435	2.2	01Jan2011, 08:01	2.3
RMT090	0.0435	2.2	01Jan2011, 08:01	2.3
JMT104	0.0435	2.2	01Jan2011, 08:01	2.3
RMT104	0.0435	2.2	01Jan2011, 08:07	2.3
JMT102	1.4601	153.4	01Jan2011, 07:13	46.3
RMT106	1.4601	151.6	01Jan2011, 07:16	46.3
MT100	0.0558	29.8	01Jan2011, 06:06	2.1
JMT106	1.5158	153.6	01Jan2011, 07:15	48.3
RMT112	1.5158	153.0	01Jan2011, 07:37	47.8
MT110	0.1164	36.3	01Jan2011, 06:18	3.9
JMT110	1.6322	157.2	01Jan2011, 07:37	51.7
RMT114	1.6322	156.9	01Jan2011, 07:44	51.5
WT290	0.1038	31.2	01Jan2011, 06:10	2.7
Regional Pond R1	5.8625	257.7	01Jan2011, 09:18	152.7
JWT296	5.8625	257.7	01Jan2011, 09:18	152.7
RWT314	5.8625	257.6	01Jan2011, 09:25	152
WT300	0.0970	25.5	01Jan2011, 06:14	2.5
JWT300	0.0970	25.5	01Jan2011, 06:14	2.5
RWT312	0.0970	25.4	01Jan2011, 06:34	2.5
WT310	0.2774	67.1	01Jan2011, 06:14	6.9
JWT310	6.2370	262.2	01Jan2011, 09:25	161.4
RWT320	6.2370	262.0	01Jan2011, 09:33	160.7
WT320	0.2061	56.1	01Jan2011, 06:13	5.4
JWT320	6.4431	264.6	01Jan2011, 09:33	166.1
RWT352	6.4431	264.5	01Jan2011, 09:42	165.2
ET020	0.2132	128.1	01Jan2011, 06:07	9.2
ET010	0.1451	67.4	01Jan2011, 06:12	5.9
Paint Brush Hills Pond #4	0.1451	48.8	01Jan2011, 06:22	5.9
JET010	0.1451	48.8	01Jan2011, 06:22	5.9
RET020	0.1451	48.7	01Jan2011, 06:37	5.9
Sub Regional Pond SR6	0.3583	19.9	01Jan2011, 07:26	13.5
JET020	0.3583	19.9	01Jan2011, 07:26	13.5
RET030	0.3583	19.7	01Jan2011, 08:14	13.1
ET030	0.2043	81.2	01Jan2011, 06:17	8.4

HEC-HMS 5-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
JET030	0.5626	81.2	01Jan2011, 06:17	21.5
RET040	0.5626	80.9	01Jan2011, 06:28	21.4
Woodmen Hills Pond #1 North	0.7117	103.5	01Jan2011, 06:35	26.6
ET040	0.1491	52.6	01Jan2011, 06:15	5.3
Woodmen Hills Pond #1 South	0.7117	32.8	01Jan2011, 07:14	21.7
JET040	0.7117	32.8	01Jan2011, 07:14	21.7
RET050	0.7117	32.8	01Jan2011, 07:22	21.6
ET050	0.1172	66.6	01Jan2011, 06:03	4
Woodmen Hills Pond #2	0.8289	29.6	01Jan2011, 08:07	23.9
JET050	0.8289	29.6	01Jan2011, 08:07	23.9
RET060	0.8289	29.6	01Jan2011, 08:19	23.7
ET060	0.2854	185.5	01Jan2011, 06:02	10.2
Woodmen Hills Pond #3	1.1143	82.1	01Jan2011, 06:08	31.5
JET060	1.1143	82.1	01Jan2011, 06:08	31.5
RET070	1.1143	81.0	01Jan2011, 06:18	31.2
ET070	0.2498	164.1	01Jan2011, 06:03	9.8
JET070	1.3641	164.5	01Jan2011, 06:03	41
RET080	1.3641	123.5	01Jan2011, 06:29	40.2
ET080	0.2916	192.2	01Jan2011, 06:08	14.3
Woodmen Hills Pond #4	1.6557	26.7	01Jan2011, 14:58	26.8
JET080	1.6557	26.7	01Jan2011, 14:58	26.8
RET090	1.6557	26.7	01Jan2011, 15:03	26.6
ET090	0.1242	46.0	01Jan2011, 06:23	5.6
JET090	1.7800	50.6	01Jan2011, 06:24	32.2
RET100	1.7800	50.6	01Jan2011, 06:28	32.1
ET100	0.0481	22.3	01Jan2011, 06:02	1.3
JET100	1.8280	53.2	01Jan2011, 06:28	33.3
RET110	1.8280	53.1	01Jan2011, 06:35	33.1
ET110	0.2260	52.7	01Jan2011, 06:13	5.3
JET110	2.0541	86.0	01Jan2011, 06:13	38.4
RET120	2.0541	85.1	01Jan2011, 06:19	38.1
ET120	0.1091	23.5	01Jan2011, 06:16	2.5
JET120	2.1632	107.9	01Jan2011, 06:19	40.7
RET152	2.1632	107.7	01Jan2011, 06:25	40.4
ET130	0.1348	23.2	01Jan2011, 06:30	3.5
JET130	0.1348	23.2	01Jan2011, 06:30	3.5
RET140	0.1348	23.1	01Jan2011, 07:00	3.5
ET140	0.2676	33.4	01Jan2011, 06:49	6.9
JET140	0.4024	55.3	01Jan2011, 06:56	10.4
RET154	0.4024	55.2	01Jan2011, 07:19	10.3
JET152	2.5656	108.6	01Jan2011, 06:26	50.8
RET156	2.5656	108.3	01Jan2011, 06:30	50.6
ET150	0.1777	36.6	01Jan2011, 06:20	4.4

HEC-HMS 5-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
JET154	2.7433	138.8	01Jan2011, 06:29	55
RET162	2.7433	135.5	01Jan2011, 06:54	54.2
ET160	0.1889	38.5	01Jan2011, 06:25	5.2
JET160	2.9322	154.7	01Jan2011, 06:53	59.4
RET164	2.9322	154.3	01Jan2011, 06:58	59.2
WT350	0.3038	78.7	01Jan2011, 06:16	8.4
JWT352	9.6791	337.2	01Jan2011, 08:17	232.8
RWT354	9.6791	337.2	01Jan2011, 08:17	232.8
WT330	0.3267	68.2	01Jan2011, 06:21	8.5
JWT330	0.3267	68.2	01Jan2011, 06:21	8.5
RWT344	0.3267	67.9	01Jan2011, 06:30	8.5
WT340	0.2780	40.0	01Jan2011, 06:39	7.2
JWT354	10.2838	361.9	01Jan2011, 07:18	248.4
RWT372	10.2838	361.5	01Jan2011, 07:22	247.8
WT360	0.0657	14.8	01Jan2011, 06:17	1.6
JWT360	0.0657	14.8	01Jan2011, 06:17	1.6
RWT374	0.0657	14.7	01Jan2011, 06:32	1.6
Regional Pond R2	10.3495	363.1	01Jan2011, 07:24	246.2
JWT372	10.3495	363.1	01Jan2011, 07:24	246.2
RWT376	10.3495	361.7	01Jan2011, 07:34	245
WT370	0.2148	23.4	01Jan2011, 06:15	2.8
JWT374_OUTLET	10.5642	364.8	01Jan2011, 07:34	247.8
FS010	0.1220	16.6	01Jan2011, 06:18	2.1
JFS010_OUTLET	0.1220	16.6	01Jan2011, 06:18	2.1

Project: Aug15_Working_Falcon_DBPS_S
Simulation Run: FU 5-yr Reservoir: Sub Regional Pond SR4

Start of Run:	01Jan2011, 00:00	Basin Model:	Falcon_DBPS_Future
End of Run:	02Jan2011, 00:00	Meteorologic Model:	5-yr
Compute Time:	28Jul2020, 17:53:20	Control Specifications:	24-hr Storm

Volume Units: AC-FT

Computed Results

Peak Inflow :	293.0 (CFS)	Date/Time of Peak Inflow :	01Jan2011, 06:29
Peak Outflow :	132.7 (CFS)	Date/Time of Peak Outflow :	01Jan2011, 06:52
Total Inflow :	37.5 (AC-FT)	Peak Storage :	9.1 (AC-FT)
Total Outflow :	35.1 (AC-FT)	Peak Elevation :	6896.8 (FT)

Project: Aug15_Working_Falcon_DBPS_S
Simulation Run: FU 5-yr Reservoir: Regional Pond MN

Start of Run:	01Jan2011, 00:00	Basin Model:	Falcon_DBPS_Future
End of Run:	02Jan2011, 00:00	Meteorologic Model:	5-yr
Compute Time:	28Jul2020, 17:53:20	Control Specifications:	24-hr Storm

Volume Units: AC-FT

Computed Results

Peak Inflow :	158.7 (CFS)	Date/Time of Peak Inflow :	01Jan2011, 06:59
Peak Outflow :	151.6 (CFS)	Date/Time of Peak Outflow :	01Jan2011, 07:04
Total Inflow :	46.6 (AC-FT)	Peak Storage :	3.4 (AC-FT)
Total Outflow :	44.1 (AC-FT)	Peak Elevation :	6851.9 (FT)

HEC-HMS 2-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
WT020	0.0671	4.4	01Jan2011, 06:25	0.7
JWT020	0.0671	4.4	01Jan2011, 06:25	0.7
RWT030	0.0671	4.4	01Jan2011, 06:39	0.7
WT030	0.0765	8.6	01Jan2011, 06:09	0.8
JWT030	0.1436	8.7	01Jan2011, 06:09	1.5
RWT042	0.1436	8.7	01Jan2011, 06:20	1.5
WT010	0.1353	8.8	01Jan2011, 06:21	1.3
JWT010	0.1353	8.8	01Jan2011, 06:21	1.3
RWT044	0.1353	8.8	01Jan2011, 06:33	1.3
JWT042	0.2789	15.1	01Jan2011, 06:26	2.8
RWT046	0.2789	15.1	01Jan2011, 06:40	2.8
WT040	0.1851	9.1	01Jan2011, 06:34	1.8
JWT044	0.4640	23.9	01Jan2011, 06:39	4.5
RWT054	0.4640	23.8	01Jan2011, 06:50	4.5
WT060	0.1956	13.6	01Jan2011, 06:30	2.3
WT050	0.1899	17.3	01Jan2011, 06:23	2.4
JWT050	0.8496	42.8	01Jan2011, 06:47	9.3
RWT092	0.8496	42.7	01Jan2011, 06:49	9.3
WT070	0.1711	13.6	01Jan2011, 06:15	1.6
JWT070	0.1711	13.6	01Jan2011, 06:15	1.6
RWT080	0.1711	13.6	01Jan2011, 06:34	1.6
WT080	0.0692	8.7	01Jan2011, 06:13	0.9
Sub Regional Pond SR1	1.0898	41.9	01Jan2011, 07:03	10.4
JWT080	1.0898	41.9	01Jan2011, 07:03	10.4
RWT094	1.0898	41.9	01Jan2011, 07:14	10.3
WT100-REV	0.1293	37.0	01Jan2011, 06:05	2.5
W26-REV	0.0720	18.4	01Jan2011, 06:04	1.2
WS3-1	0.0720	18.1	01Jan2011, 06:15	1.2
Paint Brush Hills Pond C	0.2013	10.4	01Jan2011, 06:34	3.7
WT090	0.1533	22.1	01Jan2011, 06:11	2.1
JWT090	1.4444	54.5	01Jan2011, 07:12	16.1
RWT122	1.4444	54.5	01Jan2011, 07:17	16.1
WT110	0.1943	22.3	01Jan2011, 06:17	2.7
JWT110	1.6387	58.6	01Jan2011, 07:16	18.7
RWT124	1.6387	58.6	01Jan2011, 07:26	18.7
WT130-REV	0.1016	24.0	01Jan2011, 06:13	2.3
Paint Brush Hills Pond A	0.1016	4.8	01Jan2011, 06:53	2.3
WT120-REV	0.0430	7.2	01Jan2011, 06:09	0.6
JWT120	1.7834	63.9	01Jan2011, 07:26	21.6
RWT172	1.7834	63.8	01Jan2011, 07:38	21.5
WT140-REV	0.1445	35.7	01Jan2011, 06:14	3.6
JWT140	0.1445	35.7	01Jan2011, 06:14	3.6

HEC-HMS 2-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
RWT150	0.1445	35.5	01Jan2011, 06:25	3.6
WT150-REV	0.1308	40.8	01Jan2011, 06:09	3.3
Paint Brush Hills Pond B1	0.2753	58.7	01Jan2011, 06:19	6.8
W34B2-REV	0.0936	27.9	01Jan2011, 06:08	2.2
Paint Brush Hills Pond B2	0.3689	9.8	01Jan2011, 07:30	8
JWT150	0.3689	9.8	01Jan2011, 07:30	8
RWT160	0.3689	9.8	01Jan2011, 07:40	8
WT160-REV	0.0735	19.7	01Jan2011, 06:07	1.5
JWT160	0.4424	20.1	01Jan2011, 06:07	9.5
RWT174	0.4424	19.8	01Jan2011, 06:23	9.4
WT170-REV	0.1060	11.6	01Jan2011, 06:22	1.6
W34-CY-REV	0.0465	5.2	01Jan2011, 06:19	0.6
JWT172	2.3783	81.2	01Jan2011, 06:39	33.1
RWT176	2.3783	81.1	01Jan2011, 06:40	33.1
Sub Regional Pond SR2	2.3783	66.8	01Jan2011, 08:06	30
JWT174	2.3783	66.8	01Jan2011, 08:06	30
RWT180	2.3783	66.8	01Jan2011, 08:25	29.7
WT180-REV	0.0409	3.4	01Jan2011, 06:22	0.5
JWT180	2.4193	67.2	01Jan2011, 08:25	30.2
RWT202	2.4193	67.1	01Jan2011, 08:51	29.9
WT200	0.3017	25.3	01Jan2011, 06:34	4.4
WT190	0.0575	11.3	01Jan2011, 06:07	0.9
The Meadows Pond #1	0.0575	0.3	01Jan2011, 13:19	0.4
JWT190	0.0575	0.3	01Jan2011, 13:19	0.4
RWT204	0.0575	0.3	01Jan2011, 14:16	0.4
JWT200	2.7784	70.6	01Jan2011, 08:50	34.8
RWT210	2.7784	70.6	01Jan2011, 09:00	34.6
WT210	0.2655	31.9	01Jan2011, 06:39	5.6
JWT210	3.0439	74.5	01Jan2011, 08:59	40.2
RWT232	3.0439	74.5	01Jan2011, 09:08	40
WT220	0.1895	47.1	01Jan2011, 06:14	4.5
JWT220	0.1895	47.1	01Jan2011, 06:14	4.5
RWT234	0.1895	46.9	01Jan2011, 06:26	4.5
JWT232	3.2334	76.6	01Jan2011, 09:08	44.5
RWT236	3.2334	76.6	01Jan2011, 09:09	44.5
WT230	0.1982	71.3	01Jan2011, 06:06	5
JWT234	3.4316	84.5	01Jan2011, 06:43	49.5
RWT240	3.4316	84.0	01Jan2011, 06:48	49.4
WT240	0.0761	36.4	01Jan2011, 06:02	2.1
Regional Pond WU North	3.5078	89.8	01Jan2011, 06:10	50.3
Regional Pond WU Diversion	3.5078	62.4	01Jan2011, 06:10	27.5
Old Meridian	0.0336	24.6	01Jan2011, 06:09	1.9

HEC-HMS 2-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
RWT-OM	0.0336	24.3	01Jan2011, 06:16	1.8
Regional Pond WU South	3.5413	31.1	01Jan2011, 10:35	19.2
RWT240_Diversion Reach	0.0000	27.1	01Jan2011, 06:16	22.8
JWT240	3.5413	51.8	01Jan2011, 10:19	42
RWT250	3.5413	51.8	01Jan2011, 10:20	42
WT250	0.1470	63.0	01Jan2011, 06:03	3.7
JWT250	3.6883	63.4	01Jan2011, 06:03	45.7
RWT260	3.6883	61.1	01Jan2011, 06:24	45.4
WT260	0.1388	9.9	01Jan2011, 06:38	1.9
JWT260	3.8271	69.2	01Jan2011, 06:24	47.3
RWT291	3.8271	68.9	01Jan2011, 06:29	47.1
WT270	0.0325	11.3	01Jan2011, 06:05	0.7
JWT270	0.0325	11.3	01Jan2011, 06:05	0.7
RWT292	0.0325	11.2	01Jan2011, 06:11	0.7
JWT292	3.8596	71.9	01Jan2011, 06:29	47.9
RWT295	3.8596	71.5	01Jan2011, 06:31	47.8
WT280	0.2670	33.4	01Jan2011, 06:15	3.7
JWT280	0.2670	33.4	01Jan2011, 06:15	3.7
RWT294	0.2670	33.4	01Jan2011, 06:18	3.7
JWT294	4.1265	94.0	01Jan2011, 06:30	51.5
RWT296	4.1265	91.9	01Jan2011, 06:40	51.2
MT040	0.3084	94.6	01Jan2011, 06:13	8.8
MT030	0.1566	39.0	01Jan2011, 06:06	2.8
MT020	0.0902	25.8	01Jan2011, 06:05	1.7
JMT020	0.0902	25.8	01Jan2011, 06:05	1.7
RMT030	0.0902	25.4	01Jan2011, 06:20	1.7
JMT030	0.2468	50.1	01Jan2011, 06:10	4.5
RMT040	0.2468	49.3	01Jan2011, 06:16	4.5
Woodmen Hills Pond H	0.5553	107.8	01Jan2011, 06:25	13.2
JMT040	0.5553	107.8	01Jan2011, 06:25	13.2
RMT050	0.5553	107.4	01Jan2011, 06:28	13.2
MT050	0.1186	17.0	01Jan2011, 06:21	2.1
JMT050	0.6739	123.1	01Jan2011, 06:27	15.3
RMT064	0.6739	121.2	01Jan2011, 06:40	15.2
MT010	0.2899	27.9	01Jan2011, 06:27	4.3
The Meadows Pond #2	0.2899	5.4	01Jan2011, 07:46	3.1
JMT010	0.2899	5.4	01Jan2011, 07:46	3.1
RMT062	0.2899	5.4	01Jan2011, 08:25	3
MT060a	0.0300	8.0	01Jan2011, 06:04	0.5
School Site	0.0300	0.0	01Jan2011, 00:00	0
RMT060a	0.0300	0.0	01Jan2011, 00:00	0
MT060	0.1595	30.9	01Jan2011, 06:10	2.7

HEC-HMS 2-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Sub Regional Pond SR4	1.1533	24.3	01Jan2011, 08:22	19.2
JMT060	1.1533	24.3	01Jan2011, 08:22	19.2
RMT070	1.1533	24.3	01Jan2011, 08:31	19.1
MT070	0.1995	26.4	01Jan2011, 06:25	3.7
JMT070	1.3527	28.4	01Jan2011, 06:27	22.8
RMT080	1.3527	28.4	01Jan2011, 06:30	22.8
MT080	0.0638	62.4	01Jan2011, 06:00	3.4
Regional Pond MN	1.4166	30.5	01Jan2011, 06:38	23.7
JMT080	1.4166	30.5	01Jan2011, 06:38	23.7
RMT102	1.4166	30.4	01Jan2011, 06:49	23.6
MT090	0.0435	39.9	01Jan2011, 06:00	2.1
Woodmen Hills Pond #5	0.0435	1.4	01Jan2011, 08:02	1.5
JMT090	0.0435	1.4	01Jan2011, 08:02	1.5
RMT090	0.0435	1.4	01Jan2011, 08:02	1.5
JMT104	0.0435	1.4	01Jan2011, 08:02	1.5
RMT104	0.0435	1.4	01Jan2011, 08:09	1.5
JMT102	1.4601	31.8	01Jan2011, 06:49	25.1
RMT106	1.4601	31.5	01Jan2011, 06:52	25.1
MT100	0.0558	16.5	01Jan2011, 06:06	1.2
JMT106	1.5158	33.2	01Jan2011, 06:52	26.3
RMT112	1.5158	32.7	01Jan2011, 07:30	25.7
MT110	0.1164	18.9	01Jan2011, 06:19	2.2
JMT110	1.6322	35.5	01Jan2011, 07:30	27.9
RMT114	1.6322	35.4	01Jan2011, 07:40	27.7
WT290	0.1038	15.0	01Jan2011, 06:11	1.4
Regional Pond R1	5.8625	84.8	01Jan2011, 10:59	73.4
JWT296	5.8625	84.8	01Jan2011, 10:59	73.4
RWT314	5.8625	84.8	01Jan2011, 11:10	72.9
WT300	0.0970	12.2	01Jan2011, 06:15	1.3
JWT300	0.0970	12.2	01Jan2011, 06:15	1.3
RWT312	0.0970	12.1	01Jan2011, 06:39	1.3
WT310	0.2774	31.3	01Jan2011, 06:16	3.6
JWT310	6.2370	86.9	01Jan2011, 11:09	77.8
RWT320	6.2370	86.8	01Jan2011, 11:19	77.2
WT320	0.2061	26.8	01Jan2011, 06:14	2.8
JWT320	6.4431	88.0	01Jan2011, 11:19	80
RWT352	6.4431	88.0	01Jan2011, 11:31	79.4
ET020	0.2132	73.4	01Jan2011, 06:07	5.4
ET010	0.1451	37.5	01Jan2011, 06:12	3.5
Paint Brush Hills Pond #4	0.1451	29.4	01Jan2011, 06:21	3.5
JET010	0.1451	29.4	01Jan2011, 06:21	3.5
RET020	0.1451	29.3	01Jan2011, 06:37	3.5

HEC-HMS 2-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Sub Regional Pond SR6	0.3583	9.3	01Jan2011, 07:43	7.9
JET020	0.3583	9.3	01Jan2011, 07:43	7.9
RET030	0.3583	9.3	01Jan2011, 08:37	7.6
ET030	0.2043	44.9	01Jan2011, 06:17	4.9
JET030	0.5626	44.9	01Jan2011, 06:17	12.5
RET040	0.5626	44.6	01Jan2011, 06:30	12.4
Woodmen Hills Pond #1 North	0.7117	60.8	01Jan2011, 06:33	15.4
ET040	0.1491	27.9	01Jan2011, 06:16	3
Woodmen Hills Pond #1 South	0.7117	9.6	01Jan2011, 12:57	12
JET040	0.7117	9.6	01Jan2011, 12:57	12
RET050	0.7117	9.6	01Jan2011, 13:08	11.8
ET050	0.1172	36.5	01Jan2011, 06:03	2.2
Woodmen Hills Pond #2	0.8289	10.4	01Jan2011, 13:06	12.5
JET050	0.8289	10.4	01Jan2011, 13:06	12.5
RET060	0.8289	10.4	01Jan2011, 13:21	12.3
ET060	0.2854	105.0	01Jan2011, 06:02	5.8
Woodmen Hills Pond #3	1.1143	12.6	01Jan2011, 13:03	15.7
JET060	1.1143	12.6	01Jan2011, 13:03	15.7
RET070	1.1143	12.6	01Jan2011, 13:18	15.5
ET070	0.2498	93.5	01Jan2011, 06:03	5.7
JET070	1.3641	93.6	01Jan2011, 06:03	21.2
RET080	1.3641	64.9	01Jan2011, 06:31	20.7
ET080	0.2916	113.3	01Jan2011, 06:08	8.7
Woodmen Hills Pond #4	1.6557	9.8	02Jan2011, 00:00	12
JET080	1.6557	9.8	02Jan2011, 00:00	12
RET090	1.6557	9.8	02Jan2011, 00:00	11.9
ET090	0.1242	26.0	01Jan2011, 06:24	3.3
JET090	1.7800	29.2	01Jan2011, 06:25	15.3
RET100	1.7800	29.1	01Jan2011, 06:30	15.2
ET100	0.0481	11.4	01Jan2011, 06:02	0.7
JET100	1.8280	30.6	01Jan2011, 06:30	15.8
RET110	1.8280	30.6	01Jan2011, 06:38	15.7
ET110	0.2260	24.0	01Jan2011, 06:15	2.7
JET110	2.0541	41.4	01Jan2011, 06:32	18.4
RET120	2.0541	41.4	01Jan2011, 06:39	18.2
ET120	0.1091	10.7	01Jan2011, 06:17	1.3
JET120	2.1632	49.7	01Jan2011, 06:21	19.5
RET152	2.1632	49.5	01Jan2011, 06:29	19.4
ET130	0.1348	10.9	01Jan2011, 06:31	1.8
JET130	0.1348	10.9	01Jan2011, 06:31	1.8
RET140	0.1348	10.9	01Jan2011, 07:06	1.8
ET140	0.2676	15.9	01Jan2011, 06:51	3.6

HEC-HMS 2-YEAR SUMMARY TABLE

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
JET140	0.4024	25.8	01Jan2011, 07:01	5.5
RET154	0.4024	25.7	01Jan2011, 07:27	5.4
JET152	2.5656	53.7	01Jan2011, 07:01	24.8
RET156	2.5656	53.5	01Jan2011, 07:06	24.7
ET150	0.1777	17.0	01Jan2011, 06:21	2.3
JET154	2.7433	62.3	01Jan2011, 06:34	27
RET162	2.7433	59.6	01Jan2011, 07:07	26.4
ET160	0.1889	18.6	01Jan2011, 06:26	2.8
JET160	2.9322	66.8	01Jan2011, 07:06	29.2
RET164	2.9322	66.5	01Jan2011, 07:12	29.1
WT350	0.3038	38.3	01Jan2011, 06:17	4.5
JWT352	9.6791	134.2	01Jan2011, 08:21	112.9
RWT354	9.6791	134.2	01Jan2011, 08:22	112.9
WT330	0.3267	32.2	01Jan2011, 06:23	4.5
JWT330	0.3267	32.2	01Jan2011, 06:23	4.5
RWT344	0.3267	32.0	01Jan2011, 06:34	4.5
WT340	0.2780	18.9	01Jan2011, 06:42	3.8
JWT354	10.2838	143.0	01Jan2011, 08:21	121.2
RWT372	10.2838	142.9	01Jan2011, 08:26	120.7
WT360	0.0657	6.9	01Jan2011, 06:18	0.8
JWT360	0.0657	6.9	01Jan2011, 06:18	0.8
RWT374	0.0657	6.9	01Jan2011, 06:36	0.8
Regional Pond R2	10.3495	143.5	01Jan2011, 08:28	118.4
JWT372	10.3495	143.5	01Jan2011, 08:28	118.4
RWT376	10.3495	143.3	01Jan2011, 08:37	117.6
WT370	0.2148	7.2	01Jan2011, 06:17	1.2
JWT374_OUTLET	10.5642	144.1	01Jan2011, 08:37	118.8
FS010	0.1220	6.3	01Jan2011, 06:20	1
JFS010_OUTLET	0.1220	6.3	01Jan2011, 06:20	1

Project: Aug15_Working_Falcon_DBPS_S
Simulation Run: FU 2-yr Reservoir: Sub Regional Pond SR4

Start of Run:	01Jan2011, 00:00	Basin Model:	Falcon_DBPS_Future
End of Run:	02Jan2011, 00:00	Meteorologic Model:	2-yr
Compute Time:	28Jul2020, 17:06:15	Control Specifications:	24-hr Storm

Volume Units: AC-FT

Computed Results

Peak Inflow :	128.2 (CFS)	Date/Time of Peak Inflow :	01Jan2011, 06:40
Peak Outflow :	24.3 (CFS)	Date/Time of Peak Outflow :	01Jan2011, 08:22
Total Inflow :	20.9 (AC-FT)	Peak Storage :	7.3 (AC-FT)
Total Outflow :	19.2 (AC-FT)	Peak Elevation :	6896.6 (FT)

Project: Aug15_Working_Falcon_DBPS_S
Simulation Run: FU 2-yr Reservoir: Regional Pond MN

Start of Run:	01Jan2011, 00:00	Basin Model:	Falcon_DBPS_Future
End of Run:	02Jan2011, 00:00	Meteorologic Model:	2-yr
Compute Time:	28Jul2020, 17:06:15	Control Specifications:	24-hr Storm

Volume Units: AC-FT

Computed Results

Peak Inflow :	64.9 (CFS)	Date/Time of Peak Inflow :	01Jan2011, 06:01
Peak Outflow :	30.5 (CFS)	Date/Time of Peak Outflow :	01Jan2011, 06:38
Total Inflow :	26.2 (AC-FT)	Peak Storage :	2.6 (AC-FT)
Total Outflow :	23.7 (AC-FT)	Peak Elevation :	6851.5 (FT)

APPENDIX C

Hydraulic Computations

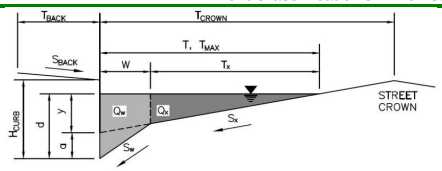
Version 4.05 Released March 2017

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

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

Project: Bent Grass Residential Filing No. 2

Inlet ID: Bent Grass Meadows Drive - Street Capacity



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	36.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.010	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

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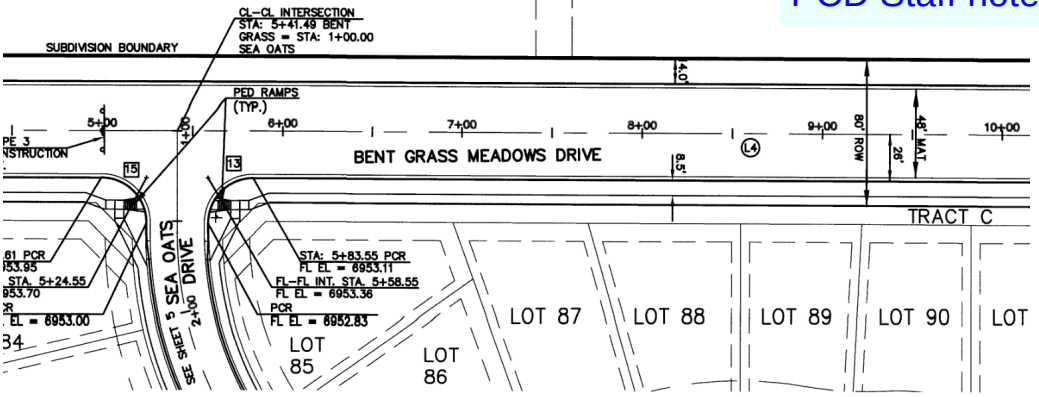
	Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} = 26.0	36.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} = 6.0	9.4	inches
Allow Flow Depth at Street Crown (leave blank for no)	☐	☐	check = yes

	Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion			
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =** **13.8**	**65.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

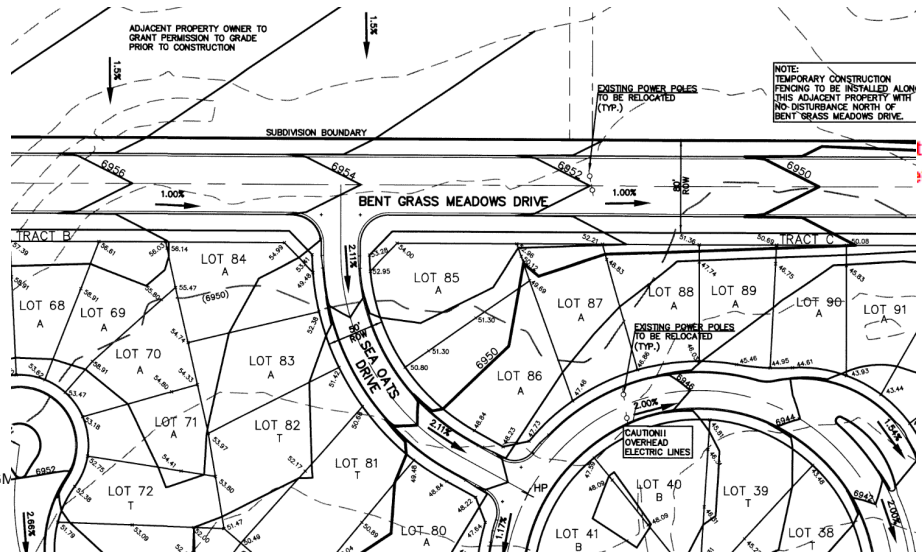
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

PCD Staff notes



T_{BACK} =	14.0	ft
S_{BACK} =	0.020	ft/ft
n_{BACK} =	0.130	
H_{CURB} =	6.00	inches
T_{CROWN} =	26.0	ft
W =	2.00	ft
S_X =	0.020	ft/ft
S_W =	0.083	ft/ft
S_O =	0.010	ft/ft
n_{STREET} =	0.016	

BENT GRASS MEADOWS DRIVE (PUBLIC)
(80' R.O.W.)
DESIGN SPEED – 40 mph RESIDENTIAL
STA:1+00.00 – 15+00.00



	Minor Storm	Major Storm	
T_{MAX} =	23.0	26.0	ft
d_{MAX} =	6.0	8.0	inches
	☐	☐	check = yes

BEEN BYPASSED

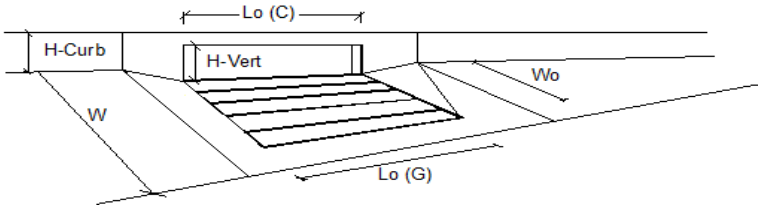
	Minor Storm	Major Storm	
Q_{allow} =	13.8	32.0	cfs

't 'Inlet Management'

'et 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =			
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =			inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =			
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =			ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =			ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =			
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =			

		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**			**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**			**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**			**%**

PCD Staff notes

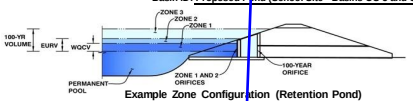
228 acres or run ponds in series with M2? Note that this result will differ from SCS method calculation and is for comparison purposes.

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Meridian Road

Basin ID: Proposed Pond (School Site - Basins OS-5 and OS-6)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	19.94	acres
Watershed Length =	2,400	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	28.00%	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
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.241	acre-feet
Excess Urban Runoff Volume (EURV) =	0.547	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.367	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.489	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.618	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.820	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	1.145	acre-feet
100-yr Runoff Volume (P1 = 2.67 in.) =	1.680	acre-feet
500-yr Runoff Volume (P1 = 3.68 in.) =	3.076	acre-feet
Approximate 2-yr Detention Volume =	0.343	acre-feet
Approximate 5-yr Detention Volume =	0.458	acre-feet
Approximate 10-yr Detention Volume =	0.575	acre-feet
Approximate 25-yr Detention Volume =	0.730	acre-feet
Approximate 50-yr Detention Volume =	0.848	acre-feet
Approximate 100-yr Detention Volume =	1.110	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.67	inches
3.68	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.241	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.241	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

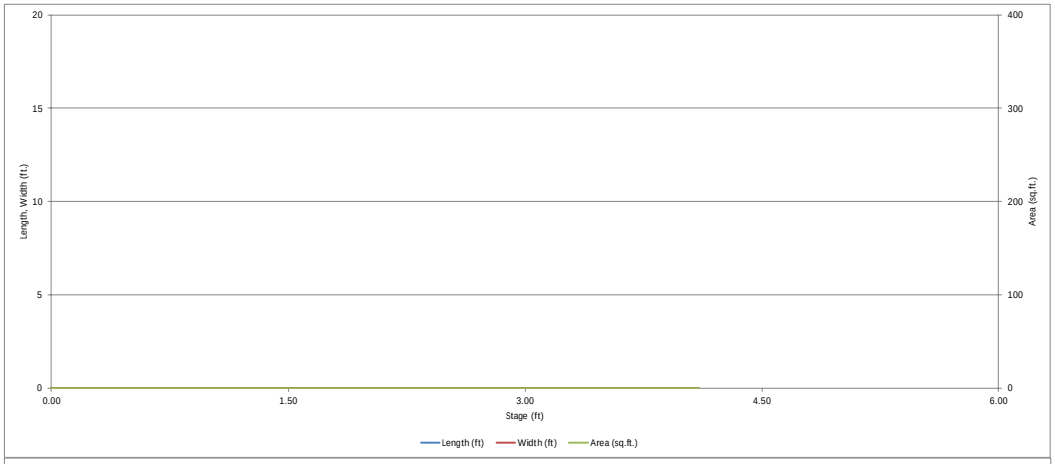
Total detention volume is less than 100-year volume.

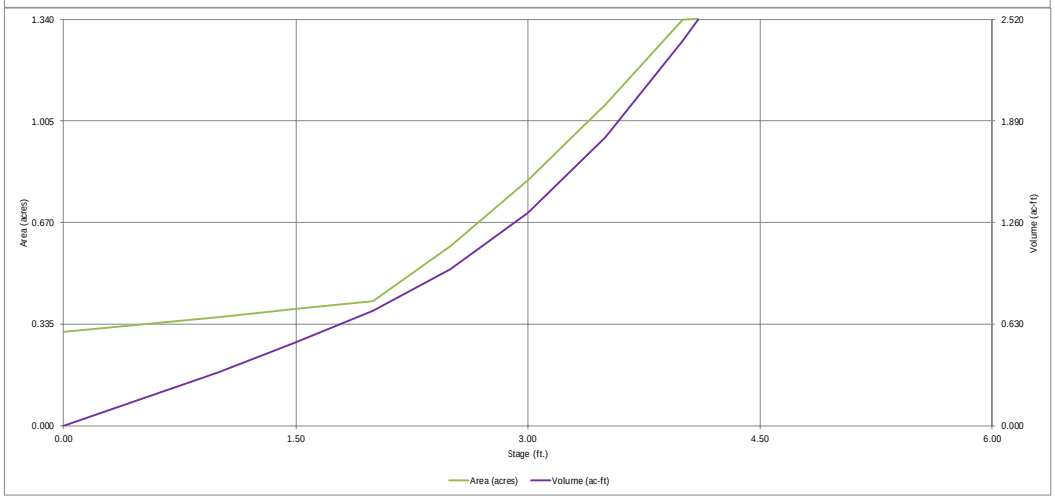
Depth Increment = User ft

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	--	--	--	13,504	0.310		
6955	--	1.00	--	--	--	15,594	0.358	14,393	0.330
6955.5	--	1.50	--	--	--	16,727	0.384	22,462	0.516
6956	--	2.00	--	--	--	17,860	0.410	31,098	0.714
6956.5	--	2.50	--	--	--	25,788	0.592	42,188	0.968
6957	--	3.00	--	--	--	35,196	0.808	57,434	1.318
6957.5	--	3.50	--	--	--	46,043	1.057	77,744	1.785
6958	--	4.00	--	--	--	58,370	1.340	103,847	2.384
6958.1	--	4.10	--	--	--	58,370	1.340	109,684	2.518

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



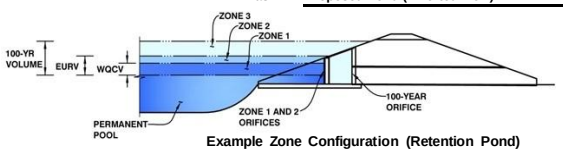


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Meridian Road

Basin ID: Proposed Pond (Diverted Flow)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.74	0.241	
Zone 2			
Zone 3			
		0.241	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		feet

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

			Calculated Parameters for Plate		
Invert of Lowest Orifice =		ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =		ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =		inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =		inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (optional)	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)								
Orifice Area (sq. inches)								

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			inches				

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

	Not Selected	Not Selected		Calculated Parameters for Overflow Weir	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =			feet
Overflow Weir Front Edge Length =			feet	Over Flow Weir Slope Length =			feet
Overflow Weir Slope =			H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =			should be ≥ 4
Horiz. Length of Weir Sides =			feet	Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area % =			%, grate open area/total area	Overflow Grate Open Area w/ Debris =			ft^2
Debris Clogging % =			%				

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

	Not Selected	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =			ft^2
Circular Orifice Diameter =			inches	Outlet Orifice Centroid =			feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	3.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	2.07	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	6.07	feet
Spillway End Slopes =	0.17	H:V	Basin Area at Top of Freeboard =	1.34	acres
Freeboard above Max Water Surface =	1.00	feet			

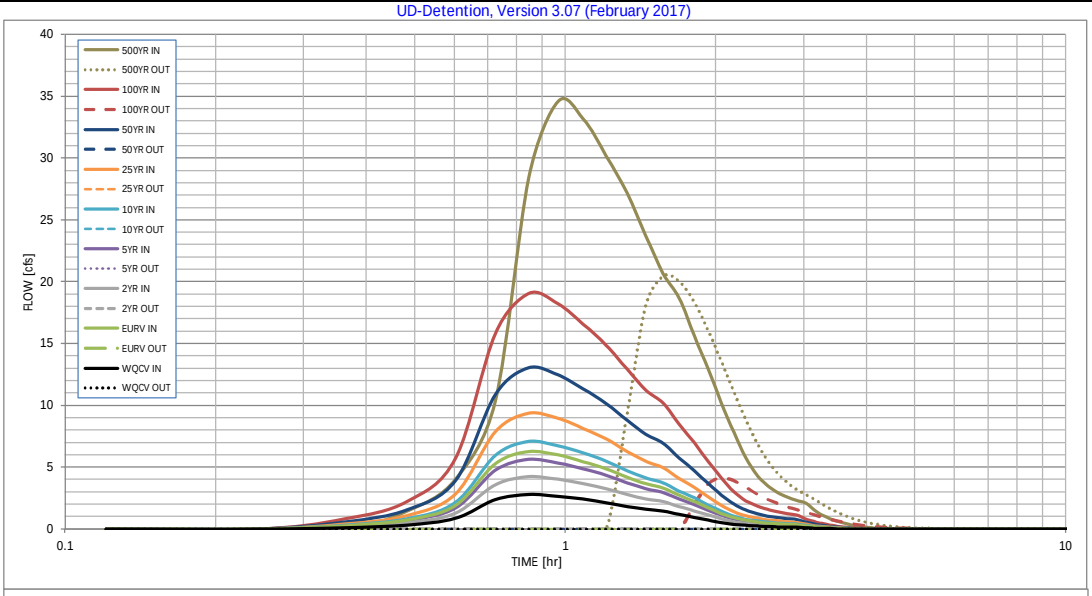
Routed Hydrograph Results

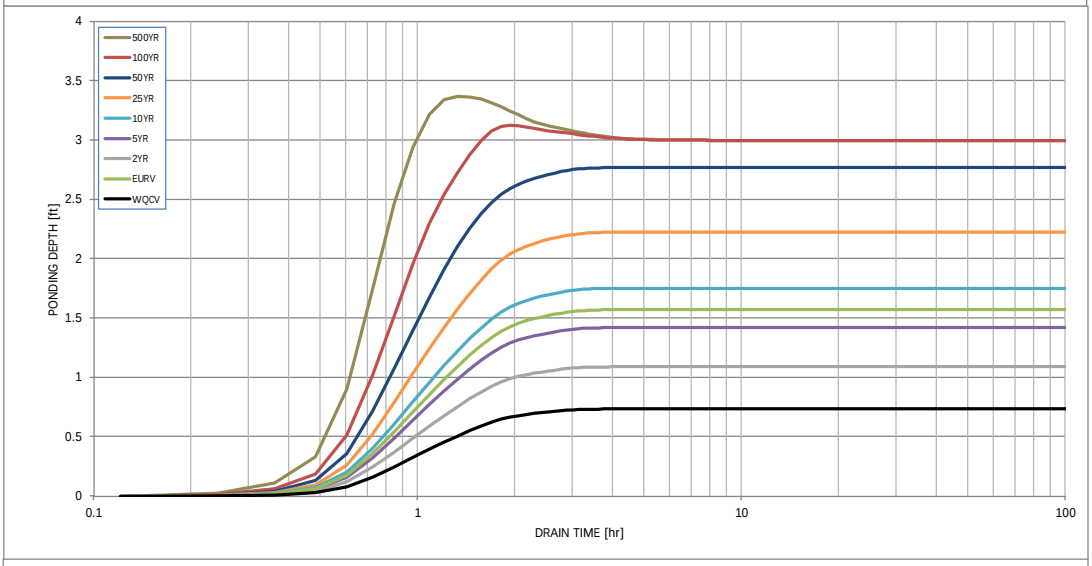
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.67	3.68
Calculated Runoff Volume (acre-ft) =	0.241	0.547	0.367	0.489	0.618	0.820	1.145	1.680	3.076
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.241	0.547	0.367	0.489	0.618	0.819	1.144	1.680	3.076
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.02	0.12	0.32	0.82
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.1	0.3	2.4	6.3	16.4
Peak Inflow Q (cfs) =	2.8	6.3	4.2	5.6	7.1	9.4	13.0	19.1	34.6
Peak Outflow Q (cfs) =								4.2	20.5
Ratio Peak Outflow to Predevelopment Q =								0.7	1.3
Structure Controlling Flow =								Spillway	Spillway
Max Velocity through Grate 1 (fps) =								N/A	N/A
Max Velocity through Grate 2 (fps) =								N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =								>120	>120
Time to Drain 99% of Inflow Volume (hours) =								>120	>120
Maximum Ponding Depth (ft) =								3.13	3.37
Area at Maximum Ponding Depth (acres) =								0.87	0.99
Maximum Volume Stored (acre-ft) =								1.419	1.652

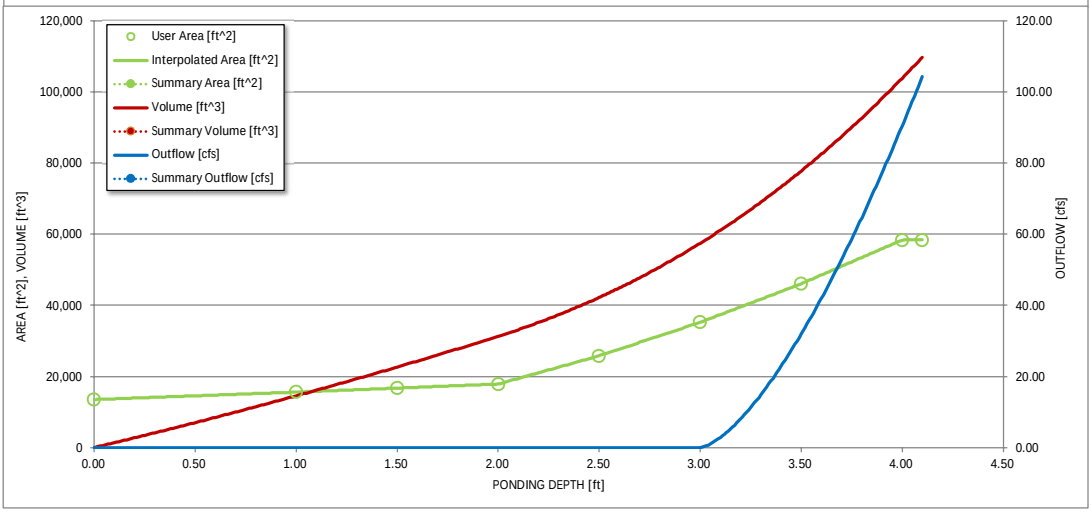
PCD Staff note: See first page of calculation worksheet

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename: _____

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
7.24 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:07:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:14:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:21:43	0.13	0.28	0.19	0.25	0.31	0.41	0.57	0.82	1.46
0.691	0:28:58	0.34	0.75	0.51	0.67	0.85	1.11	1.54	2.24	4.03
	0:36:12	0.87	1.93	1.31	1.73	2.18	2.86	3.97	5.76	10.35
	0:43:26	2.38	5.31	3.59	4.76	5.98	7.87	10.89	15.82	28.39
	0:50:41	2.80	6.29	4.23	5.63	7.09	9.37	13.04	19.05	34.60
	0:57:55	2.66	6.00	4.03	5.37	6.77	8.95	12.46	18.23	33.19
	1:05:10	2.42	5.46	3.67	4.89	6.16	8.15	11.35	16.60	30.20
	1:12:24	2.15	4.87	3.27	4.36	5.50	7.29	10.16	14.89	27.18
	1:19:38	1.84	4.20	2.81	3.76	4.75	6.30	8.80	12.93	23.72
	1:26:53	1.61	3.66	2.45	3.27	4.14	5.49	7.66	11.23	20.67
	1:34:07	1.46	3.32	2.22	2.97	3.75	4.97	6.94	10.19	18.69
	1:41:22	1.19	2.73	1.82	2.44	3.09	4.11	5.76	8.48	15.63
	1:48:36	0.96	2.23	1.48	1.99	2.52	3.37	4.73	6.99	12.93
	1:55:50	0.73	1.71	1.13	1.52	1.94	2.60	3.68	5.46	10.20
	2:03:05	0.53	1.27	0.83	1.13	1.45	1.94	2.77	4.15	7.84
	2:10:19	0.39	0.92	0.61	0.82	1.05	1.40	2.01	3.04	5.82
	2:17:34	0.31	0.72	0.47	0.64	0.81	1.09	1.54	2.31	4.39
	2:24:48	0.25	0.59	0.39	0.52	0.67	0.89	1.26	1.89	3.54
	2:32:02	0.22	0.50	0.33	0.45	0.57	0.76	1.07	1.60	2.99
	2:39:17	0.19	0.44	0.29	0.39	0.50	0.66	0.94	1.40	2.60
	2:46:31	0.17	0.40	0.26	0.35	0.45	0.60	0.84	1.25	2.33
	2:53:46	0.16	0.37	0.24	0.33	0.41	0.55	0.78	1.15	2.14
	3:01:00	0.12	0.27	0.18	0.24	0.30	0.40	0.57	0.85	1.58
	3:08:14	0.09	0.20	0.13	0.18	0.22	0.30	0.42	0.62	1.15
	3:15:29	0.06	0.14	0.10	0.13	0.16	0.22	0.31	0.45	0.85
	3:22:43	0.05	0.11	0.07	0.09	0.12	0.16	0.23	0.34	0.63
	3:29:58	0.03	0.08	0.05	0.07	0.09	0.12	0.16	0.24	0.46
	3:37:12	0.02	0.05	0.04	0.05	0.06	0.08	0.12	0.17	0.33
	3:44:26	0.02	0.04	0.02	0.03	0.04	0.06	0.08	0.13	0.24
	3:51:41	0.01	0.02	0.02	0.02	0.03	0.04	0.06	0.09	0.17
	3:58:55	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.11
	4:06:10	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.03	0.06
	4:13:24	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
	4:20:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:27:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:49:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:56:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:11:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:33:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:47:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:02:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:09:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:16:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:23:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:30:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:38:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:45:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:52:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:59:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:07:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:14:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:21:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:28:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:36:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:43:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:50:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7:57:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:05:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:12:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:19:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:26:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:34:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8:41:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Rating Table for Ex. Sed Pond Weir

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	1.00	%
Normal Depth	0.13	ft
Left Side Slope	0.17	ft/ft (H:V)
Right Side Slope	0.17	ft/ft (H:V)
Bottom Width	30.00	ft

Normal Depth (ft)	Discharge (ft³/s)	Velocity (ft/s)	Flow Area (ft²)	Wetted Perimeter (ft)	Top Width (ft)
0.13	4.23	1.08	3.90	30.26	30.04
0.37	23.97	2.16	11.12	30.75	30.13
0.61	54.71	2.98	18.36	31.24	30.21
0.85	94.34	3.68	25.62	31.72	30.29
1.09	141.67	4.31	32.90	32.21	30.37

Worksheet for Ex Channel Capacity Check

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.035	
Channel Slope	1.75	%
Normal Depth	3.00	ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)

Results

Discharge	259.64	ft^3/s
Flow Area	36.00	ft^2
Wetted Perimeter	24.74	ft
Hydraulic Radius	1.46	ft
Top Width	24.00	ft
Critical Depth	3.05	ft
Critical Slope	0.01616	ft/ft
Velocity	7.21	ft/s
Velocity Head	0.81	ft
Specific Energy	3.81	ft
Froude Number	1.04	
Flow Type	Supercritical	

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	3.00	ft
Critical Depth	3.05	ft
Channel Slope	1.75	%
Critical Slope	0.01616	ft/ft

Worksheet for Ex Channel - Pr DBPS 100 Yr Flow

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035	
Channel Slope	1.75	%
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Discharge	850.00	ft^3/s

Results

Normal Depth	4.68	ft
Flow Area	87.61	ft^2
Wetted Perimeter	38.59	ft
Hydraulic Radius	2.27	ft
Top Width	37.44	ft
Critical Depth	4.89	ft
Critical Slope	0.01379	ft/ft
Velocity	9.70	ft/s
Velocity Head	1.46	ft
Specific Energy	6.14	ft
Froude Number	1.12	
Flow Type	Supercritical	

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	4.68	ft
Critical Depth	4.89	ft
Channel Slope	1.75	%
Critical Slope	0.01379	ft/ft

Worksheet for Fut Channel - Pr DBPS 100 Yr Flow

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	850.00	ft³/s

Results

Normal Depth	4.95	ft
Flow Area	172.40	ft²
Wetted Perimeter	55.84	ft
Hydraulic Radius	3.09	ft
Top Width	54.62	ft
Critical Depth	3.43	ft
Critical Slope	0.01384	ft/ft
Velocity	4.93	ft/s
Velocity Head	0.38	ft
Specific Energy	5.33	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	4.95	ft
Critical Depth	3.43	ft
Channel Slope	0.30	%

Worksheet for Fut Channel - Pr DBPS 100 Yr Flow

GVF Output Data

Critical Slope	0.01384	ft/ft

North American Green
5401 St. Wendel-Cynthiana Rd.
Poseyville, Indiana 47633
Tel. 800.772.2040
>Fax 812.867.0247
www.nagreen.com
ECMDS v7.0

ANALYSIS COMPUTATIONS

> > > >View Computation

Inputs	
Channel Discharge (Q):	850 cfs
Peak Flow Period (H):	hours
Channel Slope (S_0):	0.0175 ft/ft
Bottom Width (B):	0 ft
Left Side Slope (Z_L):	4 (H : V)
Right Side Slope (Z_R):	4 (H : V)
Existing Channel Bend:	No
Bend Coefficient (K_b):	1
Channel Bend Radius:	
Retardance Class of Vegetation:	C 6-12 in
Vegetation Type:	Bunch Type
Vegetation Density:	Fair 50-64%
Soil Type:	Sandy Loam (GM)
Channel Lining Options	
P550 Protection Type	Permanent

Basic Relationships
A = Cross sectional area, ft2 (m^2) = (B * D) + (Z_L / 2 * D^2) + (Z_R / 2 * D^2)
Where:
B = Base width of channel, ft (m)
D = Flow depth, ft (m)
Z_L = Left side bank slope (H : 1 V)
Z_R = Right side bank slope (H : 1 V)
P = Wetted perimeter, ft (m) = B + Z_L * D + Z_R * D
R = Hydraulic radius, ft (m) = A / P
V = Flow velocity, ft/s (m/s) = Q / A
Where:
Q = Channel discharge, cfs (cms)
Tau_a Average bed shear stress, psf (Pa) = 62.4 * R * S_0
Where:
S_0 = Gradient of channel, ft/ft (m/m)
Tau_0 = Maximum bed shear stress, psf (Pa) = 62.4 * D * S_0

Unvegetated Conditions Computations:
n = Manning's n = a * Tau_a^b
and (iteratively solved)
$n = 1.486 / Q * A * R^{(2/3)} S_0^{0.5}$
Where:
n = Manning's n
a = Product specific coefficient from performance testing
b = Product specific coefficient from performance testing
SF_P = Product factor of safety = Tau_T / Tau_0

Where:
Tau_T = Permissible shear stress from testing, psf (Pa)
Tau_p = In place permissible shear, psf (Pa) = Tau_T / alpha * (Tau_S + alpha / 4.3)
Where:
alpha = unit conversion constant, 0.14 English, 6.5 Metric
Tau_S = Permissible shear stress of soil
SF_L = Factor of safety of installed liner = Tau_p / Tau_a

Vegetated Computations:
n = Manning's n = alpha * C_n* Tau_a-0.4
and (iteratively solved)
$n = 1.486 / Q * A * R_{(2/3)}S_0^{0.5}$
Where:
alpha = Unit conversion constant, 0.213 English, 1.0 Metric
C_n = Vegetation retardance coefficient
SF_P = Product factor of safety = Tau_{TV} / Tau_0
Where:
Tau_{TV} = Permissible shear stress from testing, psf (Pa)
Tau_p = In place permissible shear, psf (Pa) = Tau_S / (1 – C_{FTRM}) * (n / n_S)2
Where:
C_{FTRM} = Coefficient of TRM performance derived from testing Tau_S = Permissible shear stress of soil
n_S = Manning's of soil bed if left unprotected
SF_L = Factor of safety of installed liner = Tau_p / Tau_a

P550

Phase	Mannings N	Predicted flow depth (D)	Cross sectional area (A)	Wetted perimeter (P)	Hydraulic radius (R)	Flow velocity (V)	Froude number (FR)	Calculated Shear Stress	SF_P/SF_L
P550 Unvegetated	0.035	4.68 ft	87.61 ft2	38.59 ft	2.27 ft	9.7 ft/s	1.14	5.11 lbs/ft2	0.63 (SF_P)
Underlying Substrate	0.035	4.68 ft	87.61 ft2	38.59 ft	2.27 ft	9.7 ft/s	1.14	2.48 lbs/ft2	1.22 (SF_L)
P550 Reinforced Vegetation	0.035	4.68 ft	87.61 ft2	38.59 ft	2.27 ft	9.7 ft/s	1.14	5.11 lbs/ft2	2.74 (SF_P)
Underlying Substrate	0.035	4.68 ft	87.61 ft2	38.59 ft	2.27 ft	9.7 ft/s	1.14	2.48 lbs/ft2	1.29 (SF_L)

ROLLMAX™
ROLLED EROSION CONTROL

Specification Sheet – VMax® P550® Turf Reinforcement Mat

DESCRIPTION

The composite turf reinforcement mat (C-TRM) shall be a machine-produced mat of 100% UV stable polypropylene fiber matrix incorporated into permanent three-dimensional turf reinforcement matting. The matrix shall be evenly distributed across the entire width of the matting and stitch bonded between a ultra heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings, an ultra heavy UV stabilized, dramatically corrugated (crimped) intermediate netting with 0.5 x 0.5 inch (1.27 x 1.27 cm) openings, and covered by an ultra heavy duty UV stabilized nettings with 0.50 x 0.50 inch (1.27 x 1.27 cm) openings. The middle corrugated netting shall form prominent closely spaced ridges across the entire width of the mat. The three nettings shall be stitched together on 1.50 inch (3.81cm) centers with UV stabilized polypropylene thread to form permanent three-dimensional turf reinforcement matting. All mats shall be manufactured with a colored thread stitched along both outer edges as an overlap guide for adjacent mats.

The P550 shall meet Type 5A, 5B, and 5C specification requirements established by the Erosion Control Technology Council (ECTC) and Federal Highway Administration's (FHWA) FP-03 Section 713.18

Material Content		
Matrix	100% UV stable polypropylene fiber	0.5 lb/sy (0.27 kg/sm)
Netting	Top and Bottom, UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
	Middle, Corrugated UV-Stabilized Polypropylene	24 lb/1000 sf (11.7 kg/100 sm)
Thread	Polypropylene, UV Stable	

Standard Roll Sizes	
Width	6.5 ft (2.0 m)
Length	55.5 ft (16.9 m)
Weight ± 10%	52 lbs (23.59 kg)
Area	40 sy (33.4 sm)

Index Property	Test Method	Typical
Thickness	ASTM D6525	0.72 in. (18.29 mm)
Resiliency	ASTM 6524	95%
Density	ASTM D792	0.892 g/cm^3
Mass/Unit Area	ASTM 6566	21.25 oz/sy (723 g/sm)
UV Stability	ASTM D4355/ 1000 HR	100%
Porosity	ECTC Guidelines	96%
Stiffness	ASTM D1388	366.3 oz-in.
Light Penetration	ASTM D6567	16.5%
Tensile Strength – MD	ASTM D6818	1421 lbs/ft (21.07 kN/m)
Elongation – MD	ASTM D6818	40.5%
Tensile Strength – TD	ASTM D6818	1191.6 lbs/ft (17.67 kN/m)
Elongation – TD	ASTM D6818	28.8%
Biomass Improvement	ASTM D7322	378%

Design Permissible Shear Stress	Short Duration	Long Duration
Phase 1: Unvegetated	4.0 psf (191 Pa)	3.25 psf (156 Pa)
Phase 2: Partially Veg.	12.0 psf (576 Pa)	12.0 psf (576 Pa)
Phase 3: Fully Veg.	14.0 psf (672 Pa)	12.0 psf (576 Pa)
Unvegetated Velocity	12.5 fps (3.8 m/s)	
Vegetated Velocity	25 fps (7.6 m/s)	

NTPEP ASTM D6460 Large Scale Channel	
Vegetated Shear Stress	>13.2 psf (632 Pa)
Vegetated Velocity	>24.5 fps (7.47 m/s)

Slope Design Data: C Factors			
	Slope Gradients (S)		
Slope Length (L)	≤ 3:1	3:1 – 2.1	≥ 2:1
≤ 20 ft (6 m)	0.0005	0.015	0.043
20-50 ft	0.0173	0.031	0.050
≥ 50 ft (15.2 m)	0.035	0.047	0.057

Roughness Coefficients – Unveg.	
Flow Depth	Manning's n
≤ 0.50 ft (0.15 m)	0.041
0.50 – 2.0 ft	0.040-0.013
≥ 2.0 ft (0.60 m)	0.013

Tensar®

NORTH AMERICAN GREEN®

Tensar International Corporation
2500 Northwinds Parkway
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Alpharetta, GA 30009
800-TENSAR-1
tensarcorp.com

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 143 cfs

Maximum Flow: 143 cfs

Table 1 - Summary of Culvert Flows at Crossing: Bent Grass & Meridian Existing Ex

Headwater Elevation (ft)	Total Discharge (cfs)	Ex Culverts - Ex Pipe Capacity Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6928.05	0.00	0.00	0.00	1
6929.11	14.30	14.30	0.00	1
6929.47	28.60	28.60	0.00	1
6929.76	42.90	42.90	0.00	1
6930.02	57.20	57.20	0.00	1
6930.29	71.50	71.50	0.00	1
6930.56	85.80	85.80	0.00	1
6930.86	100.10	100.10	0.00	1
6931.18	114.40	114.40	0.00	1
6931.53	128.70	128.70	0.00	1
6931.90	143.00	143.00	0.00	1
6931.90	143.03	143.03	0.00	Overtopping

Pipe Cap Check

Rating Curve Plot for Crossing: Bent Grass & Meridian Existing Ex Pipe Cap Check

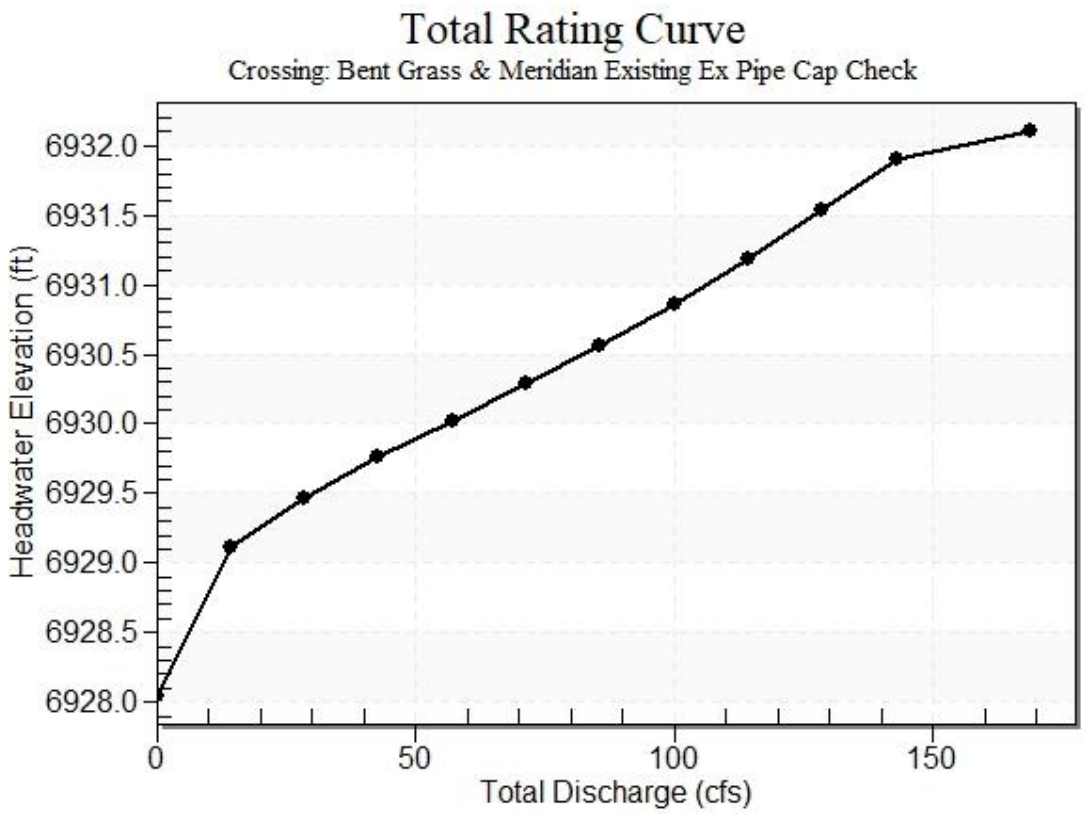


Table 2 - Culvert Summary Table: Ex Culverts - Ex Pipe Capacity

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	6928.05	0.000	0.000	0-NF	0.000	0.000	0.710	0.000	0.000	0.000
14.30	14.30	6929.11	0.753	1.061	1-S1t	0.481	0.558	1.722	1.012	0.851	3.494
28.60	28.60	6929.47	1.094	1.420	1-S1t	0.678	0.802	2.022	1.312	1.446	4.155
42.90	42.90	6929.76	1.388	1.709	1-S1t	0.835	0.995	2.237	1.527	1.997	4.598
57.20	57.20	6930.02	1.659	1.972	1-S1t	0.973	1.161	2.411	1.701	2.570	4.941
71.50	71.50	6930.29	1.913	2.237	1-S1f	1.100	1.303	2.417	1.850	3.213	5.225
85.80	85.80	6930.56	2.161	2.511	1-S1f	1.213	1.438	2.417	1.981	3.855	5.468
100.10	100.10	6930.86	2.415	2.810	1-S1f	1.321	1.562	2.417	2.098	4.498	5.683
114.40	114.40	6931.18	2.681	3.135	4-FFf	1.433	1.677	2.417	2.206	5.140	5.876
128.70	128.70	6931.53	2.968	3.481	4-FFf	1.545	1.783	2.417	2.306	5.783	6.052
143.00	143.00	6931.90	3.280	3.850	4-FFf	1.659	1.882	2.417	2.399	6.425	6.213

****

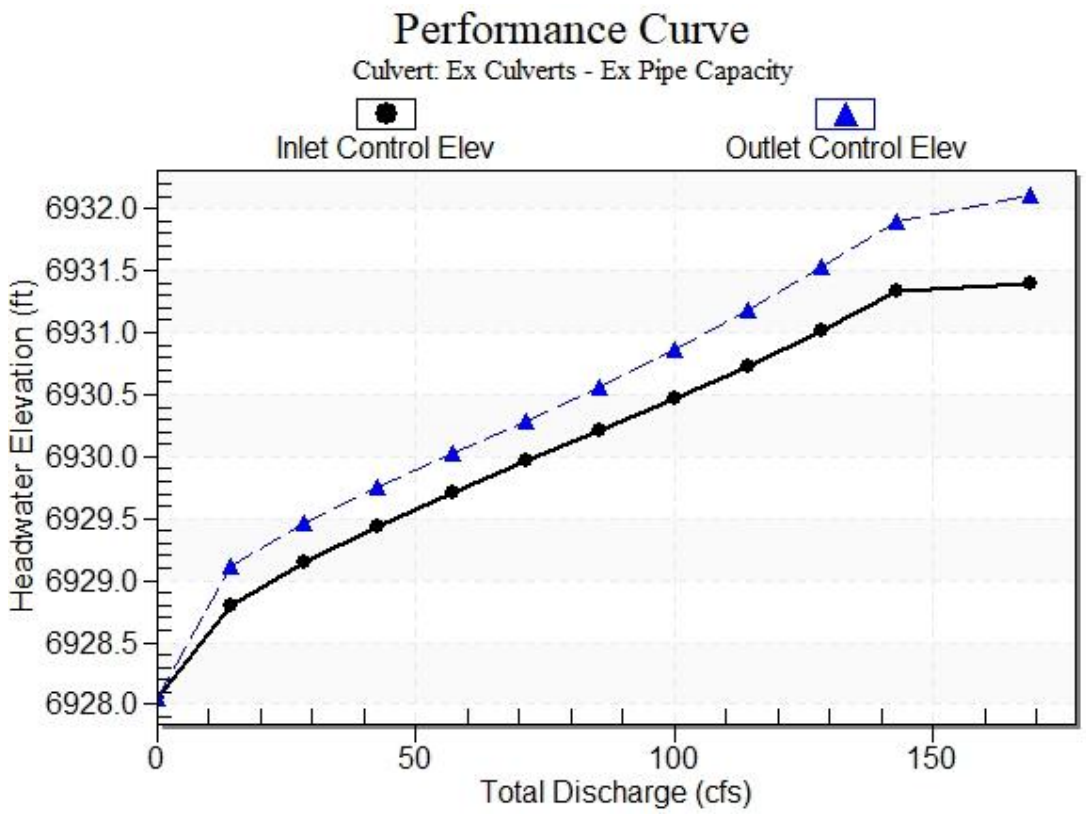
Straight Culvert

Inlet Elevation (invert): 6928.05 ft, Outlet Elevation (invert): 6927.34 ft

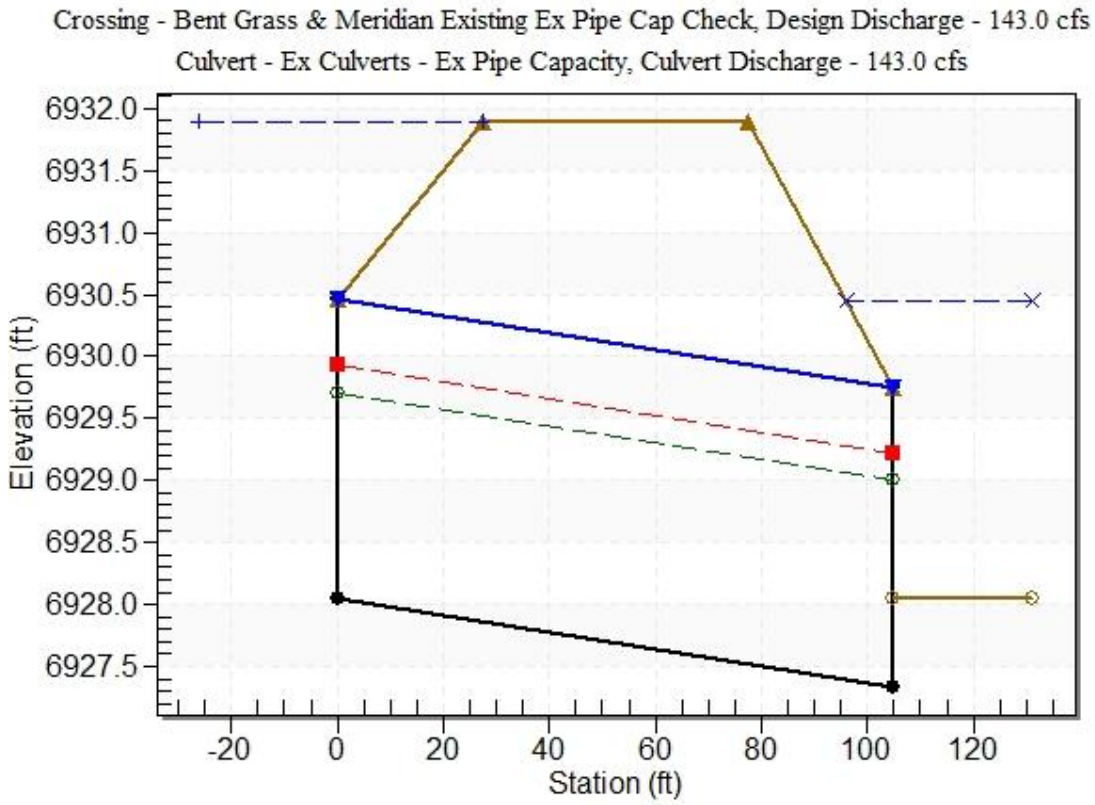
Culvert Length: 105.00 ft, Culvert Slope: 0.0068

****

Culvert Performance Curve Plot: Ex Culverts - Ex Pipe Capacity



Water Surface Profile Plot for Culvert: Ex Culverts - Ex Pipe Capacity



Site Data - Ex Culverts - Ex Pipe Capacity

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6928.05 ft

Outlet Station: 105.00 ft

Outlet Elevation: 6927.34 ft

Number of Barrels: 3

Culvert Data Summary - Ex Culverts - Ex Pipe Capacity

Barrel Shape: Elliptical

Barrel Span: 45.00 in

Barrel Rise: 29.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Bent Grass & Meridian Existing Ex Pipe Cap Check)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	6928.05	0.00	0.00	0.00	0.00
14.30	6929.06	1.01	3.49	1.10	0.87
28.60	6929.36	1.31	4.16	1.43	0.90
42.90	6929.58	1.53	4.60	1.67	0.93
57.20	6929.75	1.70	4.94	1.86	0.94
71.50	6929.90	1.85	5.22	2.02	0.96
85.80	6930.03	1.98	5.47	2.16	0.97
100.10	6930.15	2.10	5.68	2.29	0.98
114.40	6930.26	2.21	5.88	2.41	0.99
128.70	6930.36	2.31	6.05	2.52	0.99
143.00	6930.45	2.40	6.21	2.62	1.00

Tailwater Channel Data - Bent Grass & Meridian Existing Ex Pipe Cap Check

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0175

Channel Manning's n: 0.0350

Channel Invert Elevation: 6928.05 ft

Roadway Data for Crossing: Bent Grass & Meridian Existing Ex Pipe Cap Check

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 6931.90 ft

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 270 cfs

Maximum Flow: 850 cfs

Table 1 - Summary of Culvert Flows at Crossing: Bent Grass & Meridian Existing Pr

Headwater Elevation (ft)	Total Discharge (cfs)	Ex Culverts - Pr DBPS Flow Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6928.05	0.00	0.00	0.00	1
6930.55	85.00	85.00	0.00	1
6932.12	170.00	145.81	24.11	8
6932.55	270.00	143.20	126.70	5
6932.78	340.00	140.88	199.06	5
6933.02	425.00	138.39	286.31	4
6933.23	510.00	136.38	373.41	4
6933.43	595.00	134.77	460.09	4
6933.62	680.00	133.49	546.45	4
6933.79	765.00	132.46	632.08	3
6933.96	850.00	131.74	718.07	3
6931.90	143.05	143.05	0.00	Overtopping

DBPS Flows

Rating Curve Plot for Crossing: Bent Grass & Meridian Existing Pr DBPS Flows

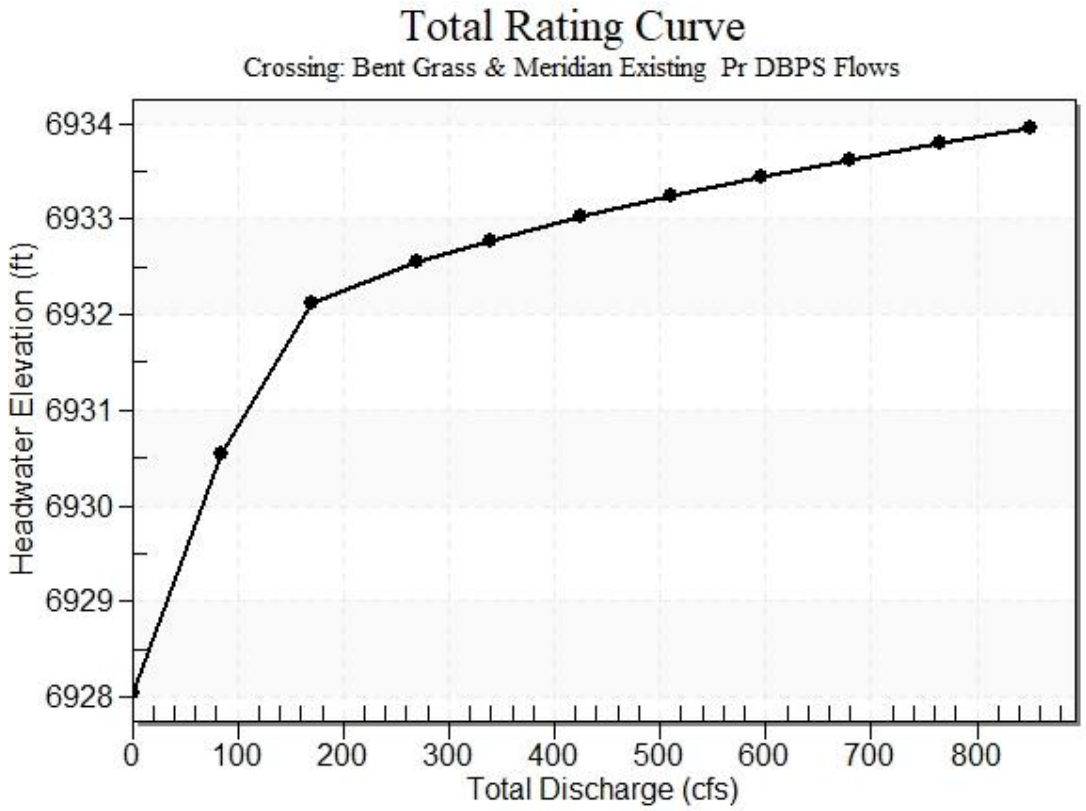


Table 2 - Culvert Summary Table: Ex Culverts - Pr DBPS Flow

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	6928.05	0.000	0.000	0-NF	0.000	0.000	0.710	0.000	0.000	0.000
85.00	85.00	6930.55	2.148	2.496	1-S1f	1.207	1.431	2.417	1.974	3.819	5.456
170.00	145.81	6932.12	3.345	4.068	4-FFf	1.682	1.900	2.417	2.559	6.551	6.488
270.00	143.20	6932.55	3.285	4.499	4-FFf	1.660	1.883	2.417	3.044	6.434	7.283
340.00	140.88	6932.78	3.232	4.727	4-FFf	1.642	1.868	2.417	3.319	6.330	7.715
425.00	138.39	6933.02	3.176	4.968	4-FFf	1.622	1.851	2.417	3.609	6.218	8.158
510.00	136.38	6933.23	3.132	5.184	4-FFf	1.606	1.837	2.417	3.864	6.128	8.539
595.00	134.77	6933.43	3.097	5.383	4-FFf	1.593	1.826	2.417	4.094	6.055	8.874
680.00	133.49	6933.62	3.069	5.569	4-FFf	1.583	1.817	2.417	4.304	5.998	9.175
765.00	132.46	6933.79	3.047	5.744	4-FFf	1.574	1.810	2.417	4.499	5.951	9.449
850.00	131.74	6933.96	3.032	5.912	4-FFf	1.569	1.805	2.417	4.680	5.919	9.702

****

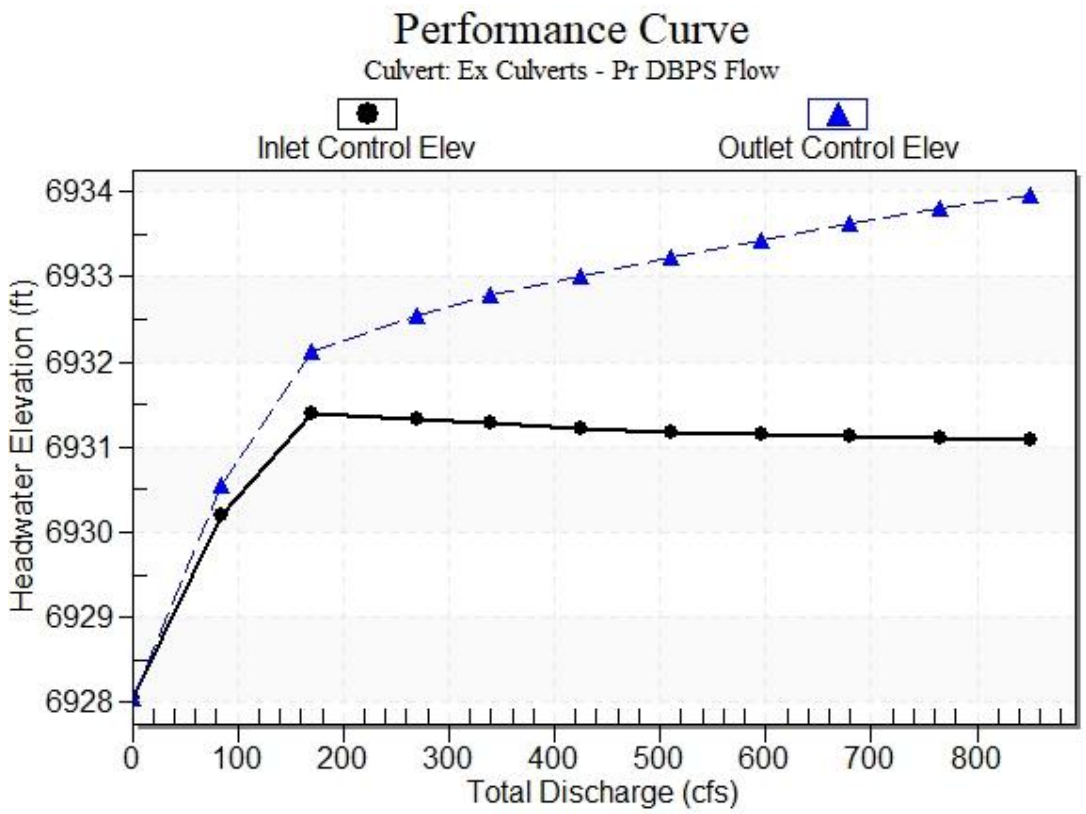
Straight Culvert

Inlet Elevation (invert): 6928.05 ft, Outlet Elevation (invert): 6927.34 ft

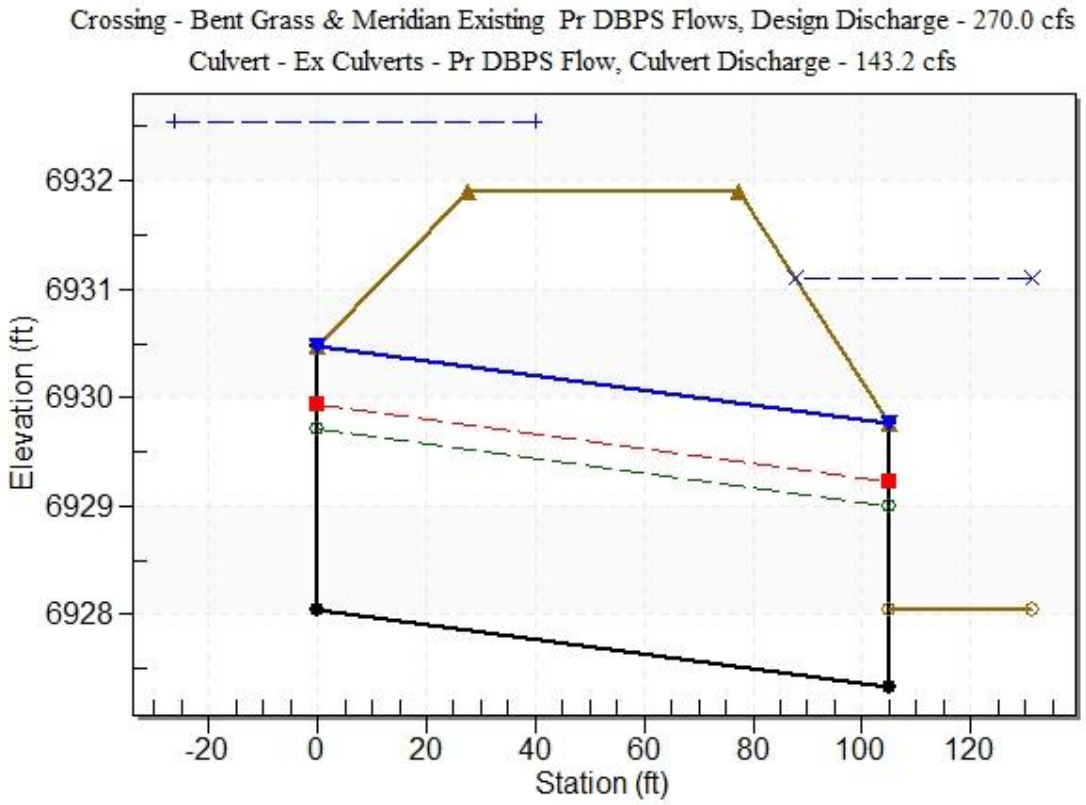
Culvert Length: 105.00 ft, Culvert Slope: 0.0068

****

Culvert Performance Curve Plot: Ex Culverts - Pr DBPS Flow



Water Surface Profile Plot for Culvert: Ex Culverts - Pr DBPS Flow



Site Data - Ex Culverts - Pr DBPS Flow

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6928.05 ft

Outlet Station: 105.00 ft

Outlet Elevation: 6927.34 ft

Number of Barrels: 3

Culvert Data Summary - Ex Culverts - Pr DBPS Flow

Barrel Shape: Elliptical

Barrel Span: 45.00 in

Barrel Rise: 29.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Bent Grass & Meridian Existing Pr DBPS Flows)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	6928.05	0.00	0.00	0.00	0.00
85.00	6930.02	1.97	5.46	2.16	0.97
170.00	6930.61	2.56	6.49	2.79	1.01
270.00	6931.09	3.04	7.28	3.32	1.04
340.00	6931.37	3.32	7.72	3.62	1.06
425.00	6931.66	3.61	8.16	3.94	1.07
510.00	6931.91	3.86	8.54	4.22	1.08
595.00	6932.14	4.09	8.87	4.47	1.09
680.00	6932.35	4.30	9.18	4.70	1.10
765.00	6932.55	4.50	9.45	4.91	1.11
850.00	6932.73	4.68	9.70	5.11	1.12

Tailwater Channel Data - Bent Grass & Meridian Existing Pr DBPS Flows

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0175

Channel Manning's n: 0.0350

Channel Invert Elevation: 6928.05 ft

Roadway Data for Crossing: Bent Grass & Meridian Existing Pr DBPS Flows

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 6931.90 ft

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 25.8 cfs

Design Flow: 255 cfs

Maximum Flow: 275 cfs

Table 1 - Summary of Culvert Flows at Crossing: Add't Culverts for Add't Offsite Flow

Headwater Elevation (ft)	Total Discharge (cfs)	New Ellp Culverts for Offsite Flow Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6929.35	25.80	25.80	0.00	1
6930.04	50.72	50.72	0.00	1
6930.71	75.64	75.64	0.00	1
6931.51	100.56	100.56	0.00	1
6932.03	125.48	114.03	11.26	9
6932.17	150.40	117.27	32.97	6
6932.28	175.32	119.82	55.38	5
6932.38	200.24	120.43	79.53	4
6932.47	225.16	119.77	105.23	4
6932.58	255.00	118.96	135.95	4
6932.65	275.00	118.48	156.17	3
6931.90	110.74	110.74	0.00	Overtopping

Rating Curve Plot for Crossing: Add't Culverts for Add't Offsite Flow

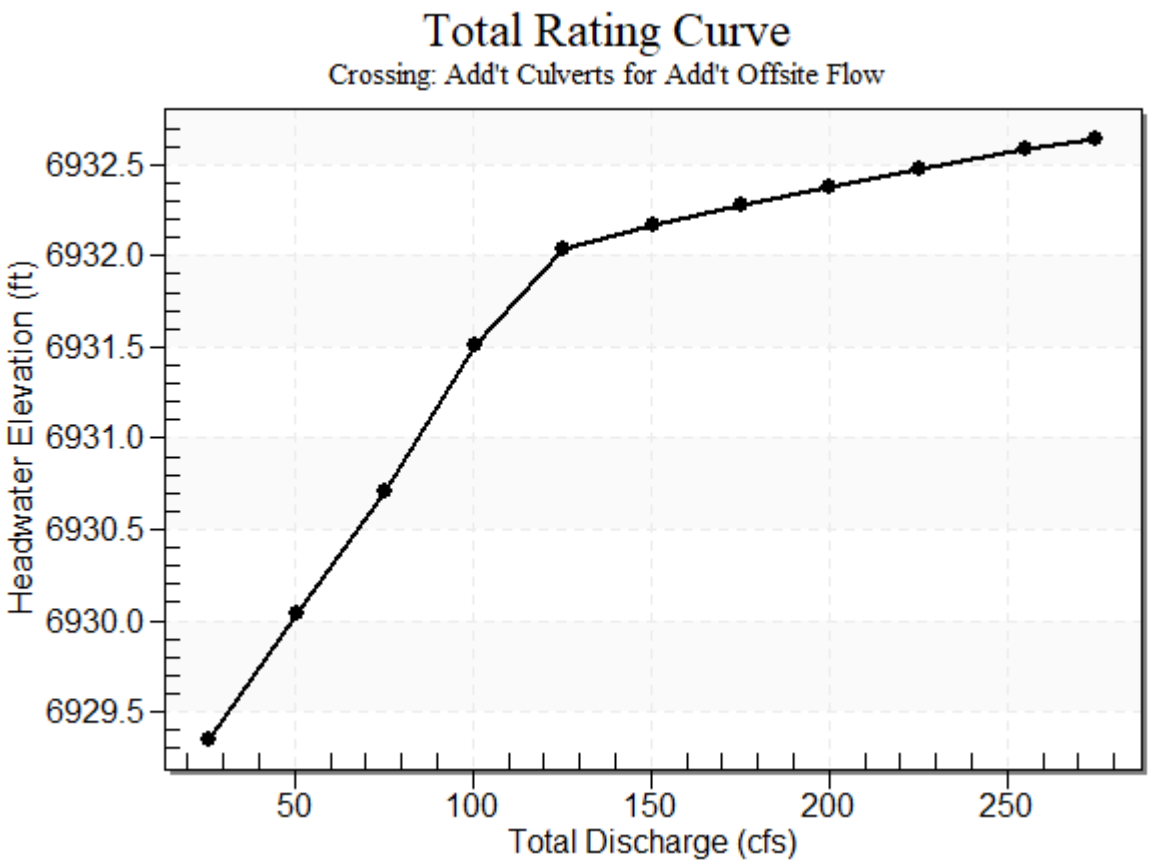


Table 2 - Culvert Summary Table: New Ellp Culverts for Offsite Flow

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
25.80	25.80	6929.35	1.303	0.658	1-JS1t	0.792	0.941	1.262	1.262	3.305	4.049
50.72	50.72	6930.04	1.993	1.327	1-S2n	1.139	1.348	1.150	1.626	7.371	4.795
75.64	75.64	6930.71	2.663	2.093	5-S2n	1.426	1.670	1.441	1.889	8.261	5.299
100.56	100.56	6931.51	3.464	3.007	5-S2n	1.723	1.932	1.737	2.102	8.884	5.690
125.48	114.03	6932.03	3.982	3.650	5-JS1t	1.905	2.046	2.284	2.284	7.861	6.014
150.40	117.27	6932.17	4.116	3.930	4-FFf	1.955	2.070	2.417	2.445	7.904	6.292
175.32	119.82	6932.28	4.225	4.171	4-FFf	1.998	2.088	2.417	2.589	8.075	6.538
200.24	120.43	6932.38	4.252	4.327	4-FFf	2.009	2.093	2.417	2.721	8.117	6.759
225.16	119.77	6932.47	4.223	4.424	4-FFf	1.997	2.088	2.417	2.844	8.072	6.960
255.00	118.96	6932.58	4.188	4.529	4-FFf	1.982	2.082	2.417	2.980	8.018	7.180
275.00	118.48	6932.65	4.168	4.596	4-FFf	1.974	2.079	2.417	3.065	7.985	7.317

****

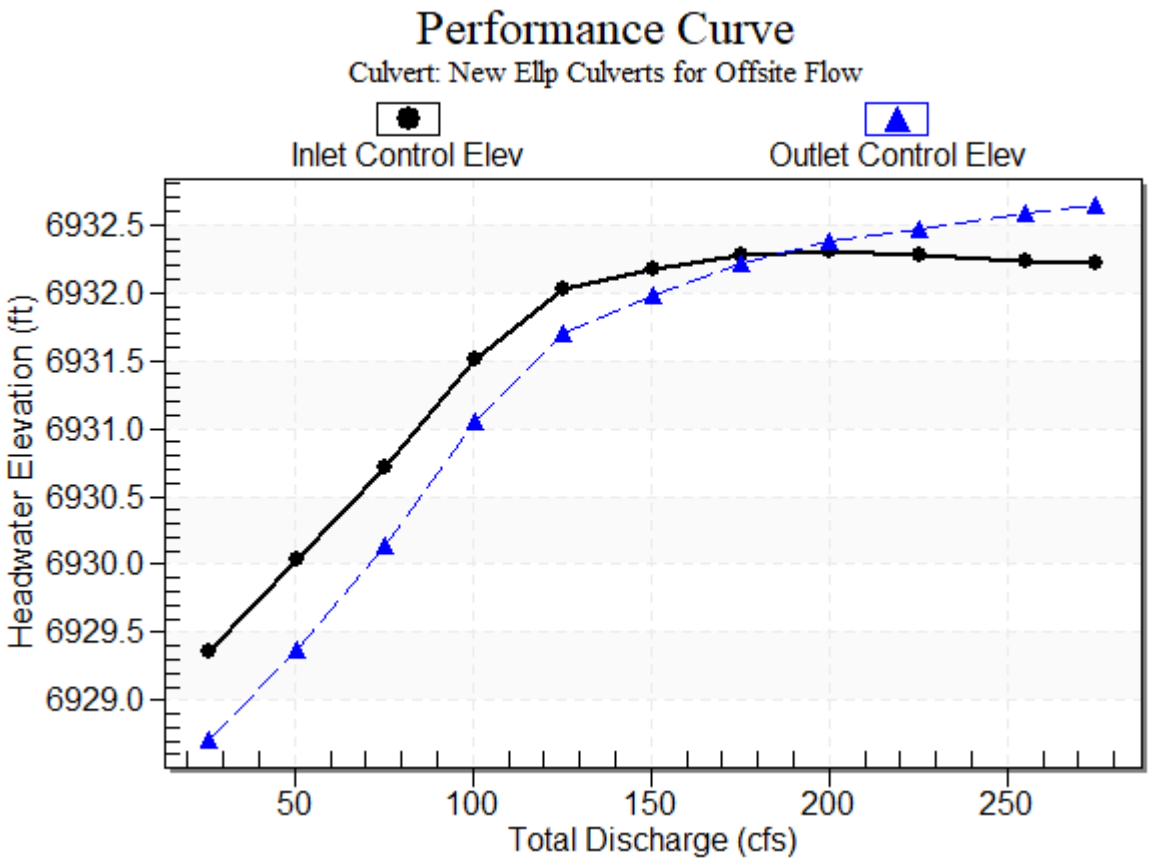
Straight Culvert

Inlet Elevation (invert): 6928.05 ft, Outlet Elevation (invert): 6927.34 ft

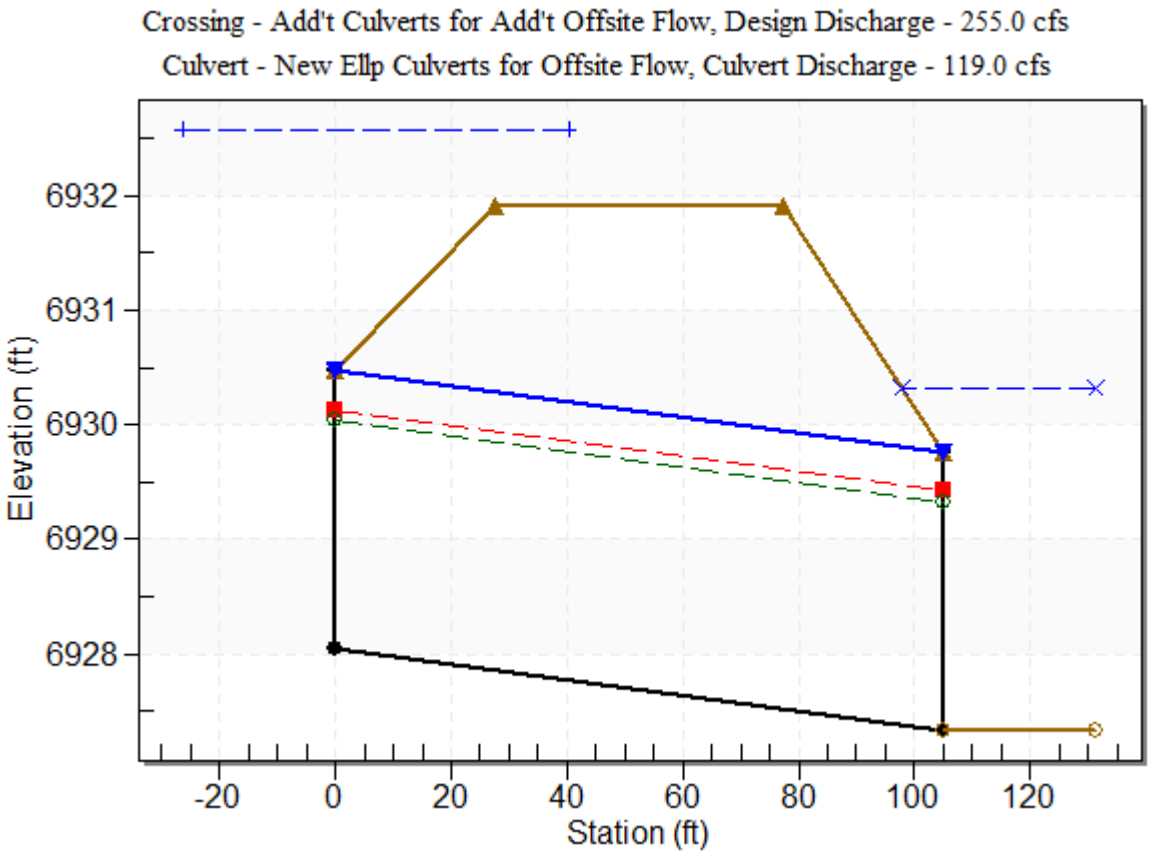
Culvert Length: 105.00 ft, Culvert Slope: 0.0068

****

Culvert Performance Curve Plot: New Ellp Culverts for Offsite Flow



Water Surface Profile Plot for Culvert: New Ellp Culverts for Offsite Flow



Site Data - New Ellp Culverts for Offsite Flow

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6928.05 ft

Outlet Station: 105.00 ft

Outlet Elevation: 6927.34 ft

Number of Barrels: 2

Culvert Data Summary - New Ellp Culverts for Offsite Flow

Barrel Shape: Elliptical

Barrel Span: 45.00 in

Barrel Rise: 29.00 in

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Add't Culverts for Add't

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
25.80	6928.60	1.26	4.05	1.38	0.90
50.72	6928.97	1.63	4.79	1.78	0.94
75.64	6929.23	1.89	5.30	2.06	0.96
100.56	6929.44	2.10	5.69	2.30	0.98
125.48	6929.62	2.28	6.01	2.49	0.99
150.40	6929.78	2.44	6.29	2.67	1.00
175.32	6929.93	2.59	6.54	2.83	1.01
200.24	6930.06	2.72	6.76	2.97	1.02
225.16	6930.18	2.84	6.96	3.11	1.03
255.00	6930.32	2.98	7.18	3.25	1.04
275.00	6930.41	3.07	7.32	3.35	1.04

Tailwater Channel Data - Add't Culverts for Add't Offsite Flow

Tailwater Channel Option: Triangular Channel

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0175

Channel Manning's n: 0.0350

Channel Invert Elevation: 6927.34 ft

Roadway Data for Crossing: Add't Culverts for Add't Offsite Flow

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 6931.90 ft

Roadway Surface: Paved

Roadway Top Width: 50.00 ft

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

Subdivision: Meridian Road Improvements
Location: CO, Colorado Springs

Project Name: Meridian Road Improvements
Project No.: CLH000015.20
Calculated By: BHB
Checked By: SMB
Date: 3/23/20

	Storm Drain System			
	DP-20 Outfall			
Q_{100} (cfs)	221.0			*Flow per "Pipe"*
D or H (in)	45			
W (ft)	29			
Slope (%)	0.68			
Yn (in)	23.78			
Y_t (ft)	2.98			*If "Unknown" Yt/D=0.4*
$Y_{t/D}$, Yt/H	0.79			
Supercritical	Yes			*Based on Froud Number >/< 1*
Q/D^2.5, Q/WH^1.5	1.05			
Q/D^1.5, Q/WH^0.5				
Da, Ha (in) *	34.39			*Da=0.5(D+Yn), Ha=0.5(H+Yn)*
Q/Da^1.5, Q/WHa^0.5 *	4.50			
d_{50} (in), Required	0.95			
Required Riprap Size	L			
Use Riprap Size	**L**			*Found using Figure 9-38 (USDCM)*
d_{50} (in)	9			
1/(2 tan θ)	6.80			*Found using Figure 9-35/9-36 (USDCM)*
Erosive Soils	No			
A_t	28.70			$A_t=Q/5.5$
L	-131.7			$L=(1/(2\tan\theta))(A_t/Yt - D)$
Min L	11.3			*Min L=3D or 3H*
Max L	37.5			*Max L=10D or 10H*
Length (ft)	11.3			
Bottom Width (ft)	11.3			*Width=3D (Minimum)*
Riprap Depth (in)	18			$Depth=2(d_{50})$
Type II Base Depth (in)	6			
Cutoff Wall	No			
Cutoff Wall Depth (ft)				*Depth of Riprap and Base*
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).
** This is a temporary minor storm culvert and the riprap has been sized for minor storm flows

FINAL DRAINAGE AND EROSION CONTROL

FOR

THE MEADOWS FILING THREE SUBDIVISION

JULY 2000

PROJECT NO. 9820

LADD ENGINEERING — **CONSULTING ENGINEERS**
LAND SURVEYOR
1975 SPRING VALLEY DRIVE
COLORADO SPRINGS, CO 80921
(719)481-6320, (719)481-6328 FAX
fredladd@worldnet.att.net

The Meadows Filing Three

Capital Pacific Homes of Colorado, Inc.

July 2000

ENGINEER'S STATEMENT

The attached drainage plan and report was prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Fred C. Ladd, PE-PLS

Se

FRED C. LADD REGISTERED PROFESSIONAL ENGINEER & LAND SURVEYOR 9132 7/28/00 STATE OF COLORADO

DEVELOPER'S STATEMENT

I, Everett Pfeiff, Agent for Capital Pacific Homes of Colorado, Inc. the Developer, have read and will comply with all the requirements specified in the drainage report and plan.

The Meadows Filing Three
Capital Pacific Homes of Colorado, Inc.

By: _____
Everett Pfeiff, Agent

Address: 1333 W. 120th Avenue, Suite 222
Westminster, CO 80234

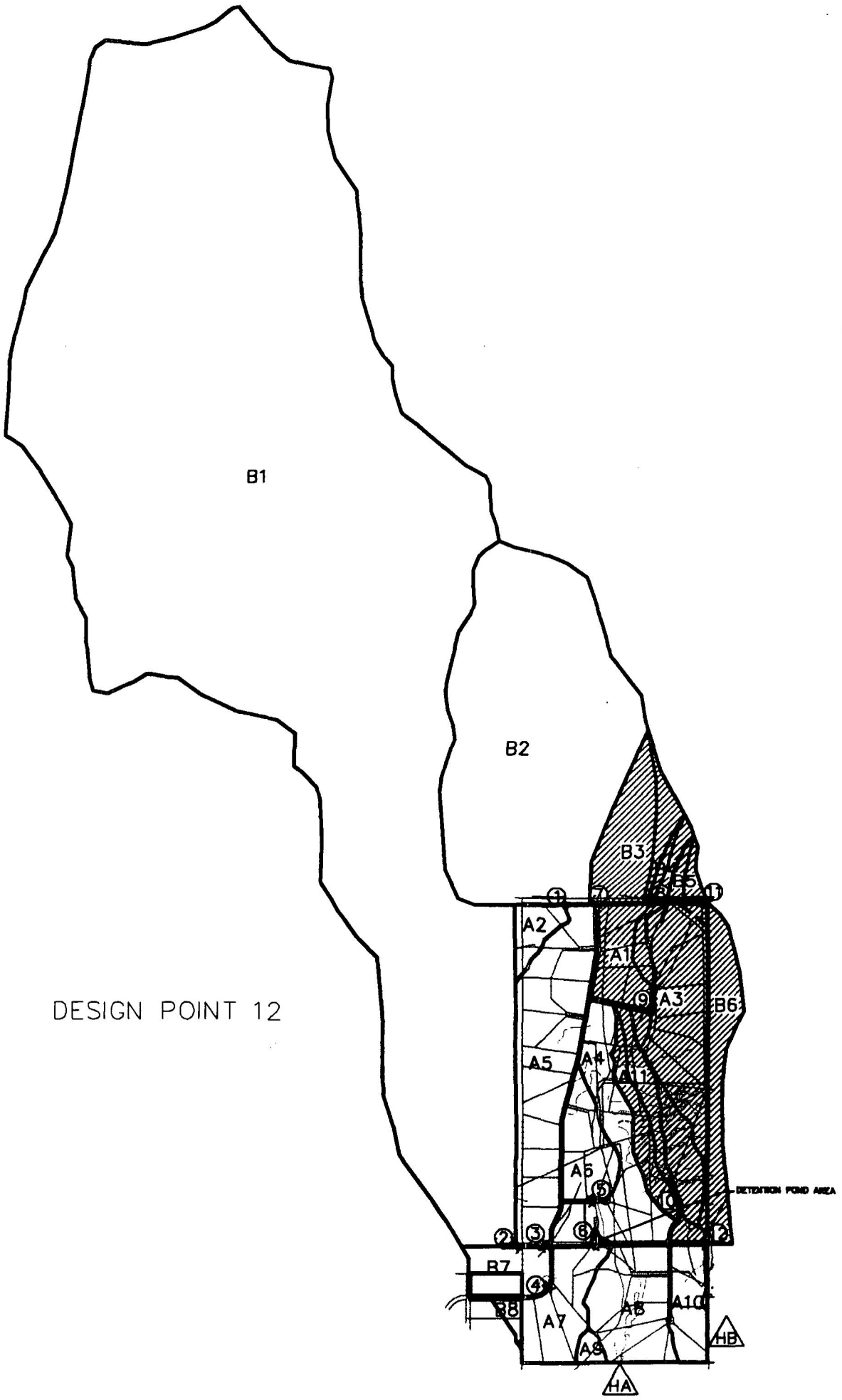
EL PASO COUNTY ONLY

Filed in accordance of section 51.1 of the El Paso Land Development Code, as amended.

John A. McCarty, P.E.-County Engineer

5-15-00
Date

Conditions:


B1
B2
B3
B5
B6
B7
B8
A1
A2
A3
A4
A5
A6
A7
A8
A10
A11
HA
HB
DESIGN POINT 12
DETENTION POND AREA

DESIGN POINT #12.

THE RUNOFF FOR THIS POINT WAS ORIGINALLY CALCULATED USING THE SCS UNIT HYDROGRAPH METHOD. BECAUSE OF THE SOILS TYPE AND LENGTH OF THE BASIN THE QUANTITY OF FLOWS CALCULATED WERE VERY SMALL, (LESS THAN 10 CFS). TO GENERATE A MORE CONSERVATIVE QUANTITY AND A RESULTING, LARGER CULVERT DIAMETER, THE RATIONAL METHOD IS BEING USED TO CALCULATE FLOWS FOR THIS BASIN.

DESIGN POINT #12

BASINS B3, B4, B5, B6, A1, A3 & A11

AREA = 42.48 + 7.13 + 7.52 + 33.84 + 27.21 + 79.22 + 27.65 = 225.05 ACRES

COEFFICIENT OF RUNOFF

B3, B4 & B5

$C_{10} = 0.25$

$C_{100} = 0.35$

B6

WOODMAN HILLS SUBDIVISION
ASSUMED 1-ACRE PARCELS

$C_{10} = 0.3$

$C_{100} = 0.4$

A1, A3 & A11

SOILS TYPE A
LAND USE IS 5-ACRE AND LARGER PARCELS
ASSUME 50% 1-ACRE PARCELS AND 50% PASTURE/MEADOW

$C_{10} = 0.5(0.3) + 0.5(0.25) = 0.275$

$C_{100} = 0.5(0.4) + 0.5(0.35) = 0.375$

COMPOSITE

$$C_{10} = \frac{0.25(42.48+7.13+7.52) + 0.3(33.84) + 0.275(27.21+79.22+27.65)}{225.05}$$

$C_{10} = 0.272$

$$C_{100} = \frac{0.35(42.48+7.13+7.52) + 0.4(33.84) + 0.375(27.21+79.22+27.65)}{225.05}$$

$C_{100} = 0.372$

DESIGN POINT #12

TIME OF CONCENTRATION

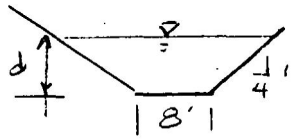
$T_1 = 52.3$ MIN (SEE DESIGN POINT #9)

$$T_T = \frac{L}{60V}$$

$L = 3725$ FT

$$V = \frac{1.49}{n}(R)^{2/3}(S)^{1/2}$$

$n = 0.03$



$A = bd + zd^2$

$$R = \frac{bd + zd^2}{b + 2d\sqrt{z^2+1}}$$

$$R = \frac{8(1) + 4(1)^2}{8 + 2(1)\sqrt{4^2+1}} = 0.739$$

$$S = \frac{7096 - 7000}{3725} = 0.026$$

$$V = \frac{1.49}{0.03}(0.739)^{2/3}(0.026)^{1/2} = 6.55 \text{ FT/S}$$

$$T_T = \frac{3725}{60(6.55)} = 9.5 \text{ MIN}$$

$$T_C = 52.3 + 9.5 = 61.8 \text{ MIN}$$

DESIGN POINT #12

RAINFALL INTENSITY

$I_5 = 1.5$
$I_{100} = 2.7$
} FIG 5-1 DRAINAGE CRITERIA MANUAL

$Q_5 = 0.272(1.5)(225.05) = 91.8 CFS$

$Q_{100} = 0.372(2.7)(225.05) = 226.0 CFS$

NEW DOC

CDR-15-006

FINAL DRAINAGE REPORT ADDENDUM FOR BENT GRASS RESIDENTIAL (FILING NO. 1)

AUGUST 2015

Prepared for:
RIVERS DEVELOPMENT, INC.
13530 NORTHGATE ESTATES DR., SUITE 200
COLORADO SPRINGS, CO 80921
Contact: Roger Miller

Prepared by:
CLASSIC CONSULTING ENGINEERS & SURVEYORS, LLC
6385 CORPORATE DRIVE, SUITE 101
COLORADO SPRINGS, CO 80919
(719) 785-0790

Job no. 2430.00

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FINAL DRAINAGE REPORT ADDENDUM
FOR BENT GRASS RESIDENTIAL (FILING NO. 1)

DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:
The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the Drainage Criteria Manual for the City of Colorado Springs and El Paso County. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

COLORADO REGISTERED MARC ALAN WHORTON 37155 PROFESSIONAL ENGINEER

Marc A. Whorton, Colorado P.E. #37155 — Date 11/6/15

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

Business Name: Rivers Development, Inc.

11/9/15

Title: Director of Engineering

Address: 13530 Northgate Estates Dr., Suite 200

Colorado Springs, CO 80921

EL PASO COUNTY:

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

For El Paso County Engineer/Director — Date 11-18-15

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

lots within The Meadows Filing No. 3 subdivision (Basin H-1) and developed 2.5-acres lots within the Woodmen Hills Filings 1, 2 and 3 subdivisions (Basin H-2). However, after further investigation into The Meadows Filing No. 3 Final Drainage Report we found that the 225+ ac. basin tributary to their Pond 2 was calculated using the modified rational method and not the SCS method for basins over 100 acres. Also, given the fact that the Meadows No. 3 development consisted entirely of 5 ac. lots with the majority of the property being soil type A and no significant overlot grading, it seems that the anticipated developed flows from this subdivision were extremely over estimated. This finding seems consistent with recent site visits downstream of this pond outfall corridor, showing no apparent erosion or significant sediment transfer and even discussions with adjacent neighbors regarding the major storm event last summer that did not seem to overtop the existing pond in existence on Lot 15 of Woodmen Hills Filing No. 3. Based on this information, we would like to document this major discrepancy with the updated Falcon DBPS and suggest that the existing flows proposed in this report are a better representation of this currently developed off-site flow condition. Thus, the following data was used to appropriately model these off-site flows:

PondPack V8i with time of concentrations estimated using SCS procedures described in the DCM based upon the hydrologic soil type A and runoff curve numbers chart. (Table 5-5)

225.28 tributary acres (Design Point 12 in The Meadows Filing No. 3 FDR)
CN Number: 51 (Table 5-5, 1 ac. res. Lots, type A soils, no overlot grading)
Time of Concentration: 60 min. (The Meadows Filing No. 3 FDR)

Basin H-1 (Q_5 = 23 cfs and Q_{100} = 43 cfs) represents these existing off-site flows from The Meadows Filing No. 3 subdivision along with the on-site undeveloped area. The total existing flow at **Design Point H1** equals Q_5 = 23 cfs and Q_{100} = 43 cfs.

Basin H-2 (Q_5 = 14 cfs and Q_{100} = 26 cfs) represents existing off-site flows from rears yards of both The Meadows Filing No. 3 subdivision and Woodmen Hills Filing No. 3. These flows, along with the release from the existing Pond 2 (Q_5 = 0 cfs and Q_{100} = 6 cfs), just north of Woodmen Hills Drive, constructed with the Meadows Filing No. 3 combine and travel in a natural drainageway within "no build" areas across these lots and through various natural weir structures (stock ponds).

Sediment Pond Spillway

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	6957.60	ft
Crest Elevation	6957.00	ft
Weir Coefficient	3.00	US
Crest Length	30.00	ft

Results

Discharge	41.83	ft^3/s
Headwater Height Above Crest	0.60	ft
Flow Area	18.00	ft^2
Velocity	2.32	ft/s
Wetted Perimeter	31.20	ft
Top Width	30.00	ft

Subsection: Elevation-Area Volume Curve
Label: SEDIMENT BASIN

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
6,954.00	0.0	0.310	0.000	0.000	0.000
6,956.00	0.0	0.410	1.077	0.718	0.718
6,958.00	0.0	1.340	2.491	1.661	2.378

Requested Pond Water Surface Elevations	
Minimum (Headwater)	6,953.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	6,957.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Stand Pipe	Riser - 1	Forward	TW	6,957.00	6,958.00
Orifice-Area	Orifice - 1	Forward	TW	6,955.25	6,958.00
Rectangular Weir	Weir - 1	Forward	TW	6,957.00	6,958.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Structure ID: Weir - 1 Structure Type: Rectangular Weir	
Number of Openings	1
Elevation	6,957.00 ft
Weir Length	35.00 ft
Weir Coefficient	3.00 (ft^0.5)/s

Structure ID: Riser - 1 Structure Type: Stand Pipe	
Number of Openings	1
Elevation	6,957.00 ft
Diameter	8.0 In
Orifice Area	0.3 ft²
Orifice Coefficient	0.600
Weir Length	2.09 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	*False*
Orifice H to crest	True

Structure ID: Orifice - 1 Structure Type: Orifice-Area	
Number of Openings	5
Elevation	6,955.25 ft
Orifice Area	0.0 ft²
Top Elevation	6,956.92 ft
Datum Elevation	6,955.25 ft
Orifice Coefficient	0.600

Structure ID: TW Structure Type: TW Setup, DS Channel	
Tailwater Type	Free Outfall

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft

Convergence Tolerances	
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Subsection: Elevation-Volume-Flow Table (Pond)
Label: SEDIMENT BASIN

Return Event: 100 years
Storm Event: TYPEIIA 24HR (4.4 in)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,954.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
6,954.00	0.00	0.000	0.310	0.00	0.00	0.00
6,954.50	0.00	0.161	0.334	0.00	0.00	77.87
6,955.00	0.00	0.334	0.358	0.00	0.00	161.58
6,955.25	0.00	0.425	0.371	0.00	0.00	205.69
6,955.50	0.06	0.519	0.384	0.00	0.06	251.39
6,956.00	0.17	0.718	0.410	0.00	0.17	347.53
6,956.50	0.29	0.967	0.592	0.00	0.29	468.25
6,957.00	0.39	1.316	0.808	0.00	0.39	637.13
6,957.50	38.76	1.781	1.057	0.00	38.76	900.54
6,958.00	107.17	2.378	1.340	0.00	107.17	1,258.36

Summary for Hydrograph Addition at 'SEDIMENT BASIN'

Upstream Link	Upstream Node
<Catchment to Outflow Node>	H-2
MID POND OUTLET	MID POND

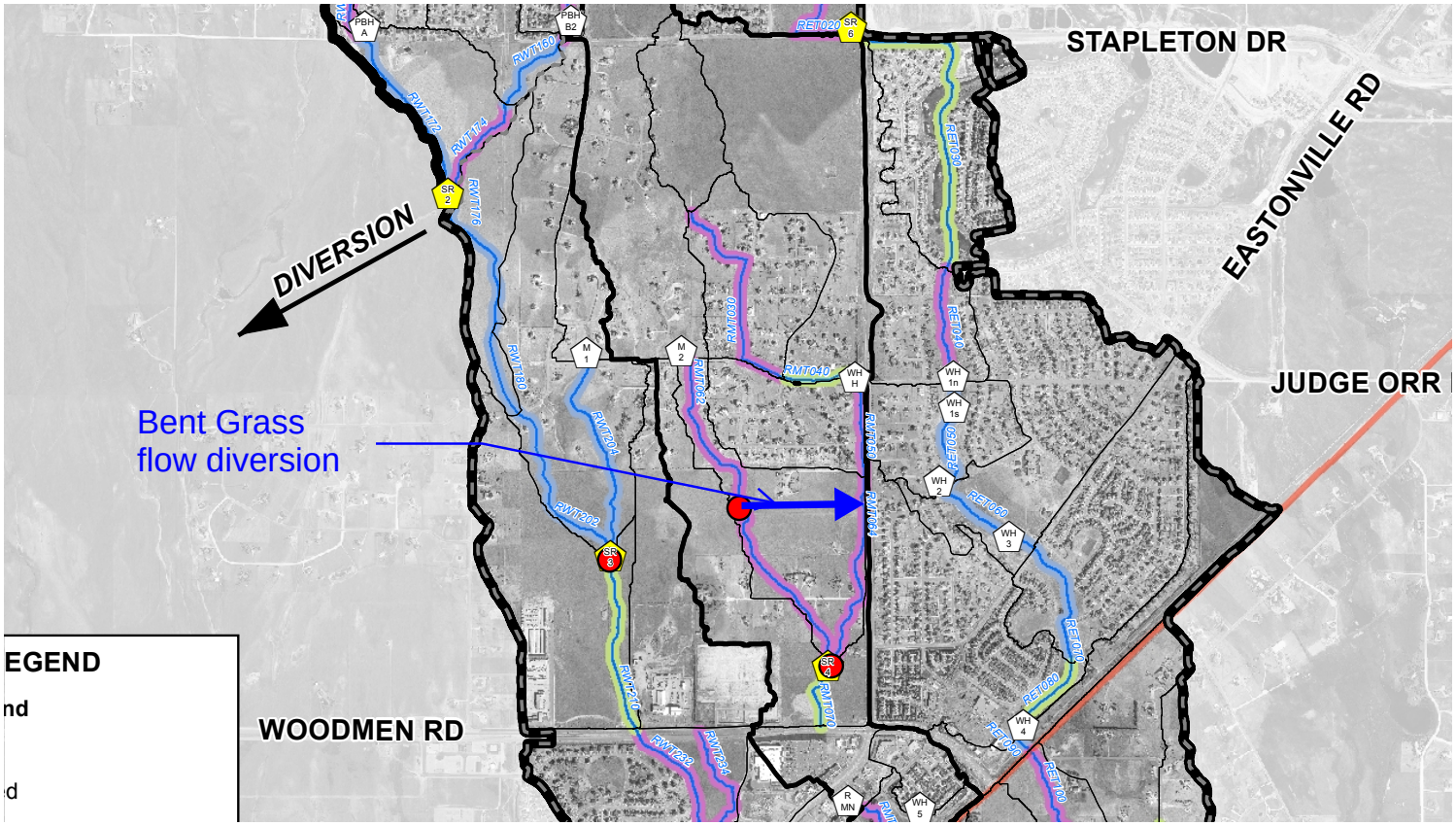
Node Inflows

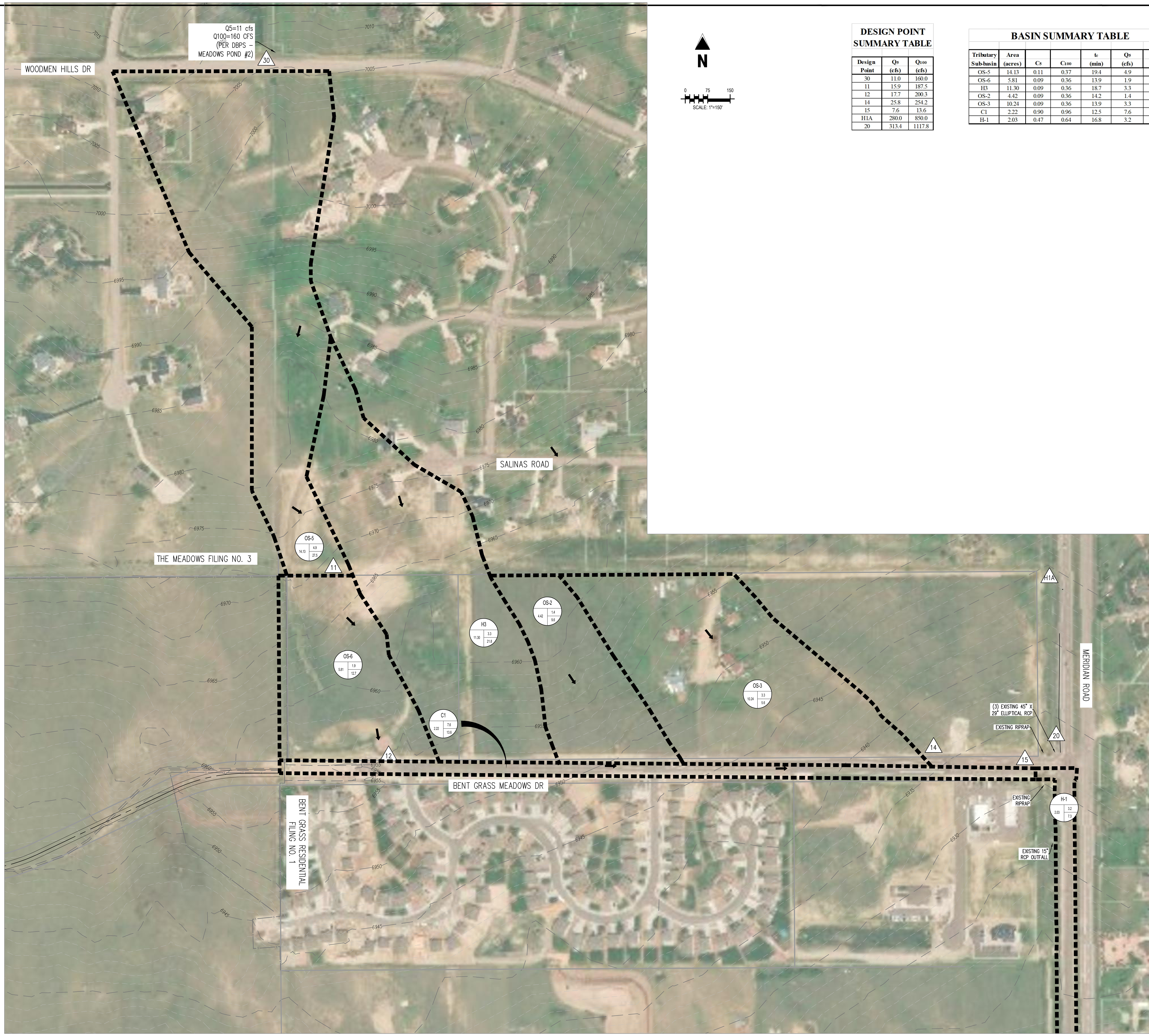
Inflow Type	Element	Volume (ac-ft)	Time to Peak (hours)	Flow (Peak) (ft^3/s)
Flow (From)	H-2	0.674	6.200	5.11
Flow (From)	MID POND OUTLET	4.452	9.700	6.25
Flow (In)	SEDIMENT BASIN	5.126	9.700	6.66

APPENDIX D

Drainage Maps

PCD Staff notes:





N

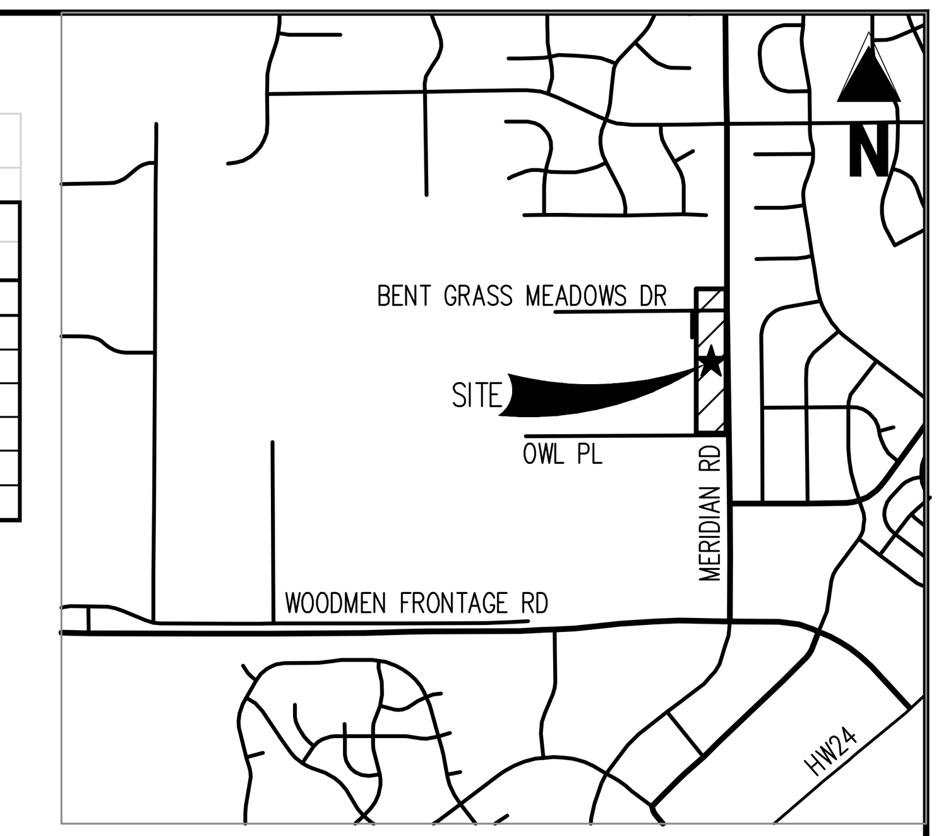
SCALE: 1"=150'

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
30	11.0	160.0
11	15.9	187.5
12	17.7	200.3
14	25.8	254.2
15	7.6	13.6
H1A	280.0	850.0
20	313.4	1117.8

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	19.4	4.9	27.5
OS-6	5.81	0.09	0.36	13.9	1.9	12.7
H3	11.30	0.09	0.36	18.7	3.3	21.8
OS-2	4.42	0.09	0.36	14.2	1.4	9.6
OS-3	10.24	0.09	0.36	13.9	3.3	22.5
C1	2.22	0.90	0.96	12.5	7.6	13.6
H-1	2.03	0.47	0.64	16.8	3.2	7.3



VICINITY MAP

DRAINAGE LEGEND

- PROPERTY LINE
- EXISTING MAJOR CONTOUR (6485)
- EXISTING MINOR CONTOUR (6483)
- BASIN BOUNDARY LINE
- FEMA EFFECTIVE 100-YR FLOODPLAIN (100YR)
- CENTERLINE OF STREAM
- BASIN DESIGNATION (1)
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND (1.8)
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND (4.8)
- BASIN AREA IN ACRES (0.75)
- DIRECTION OF RUNOFF

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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

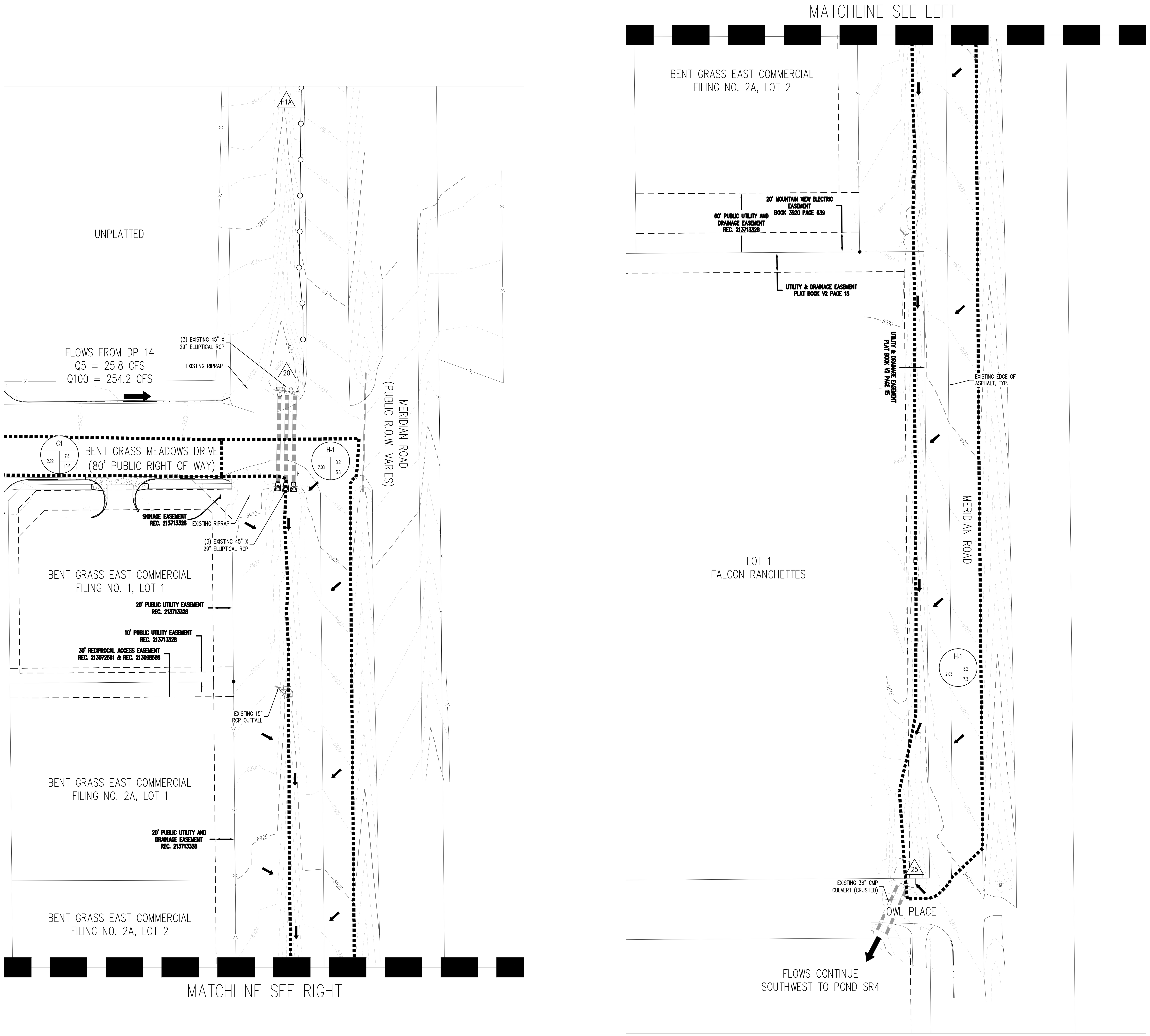
#	Date	Issue / Description	Init.

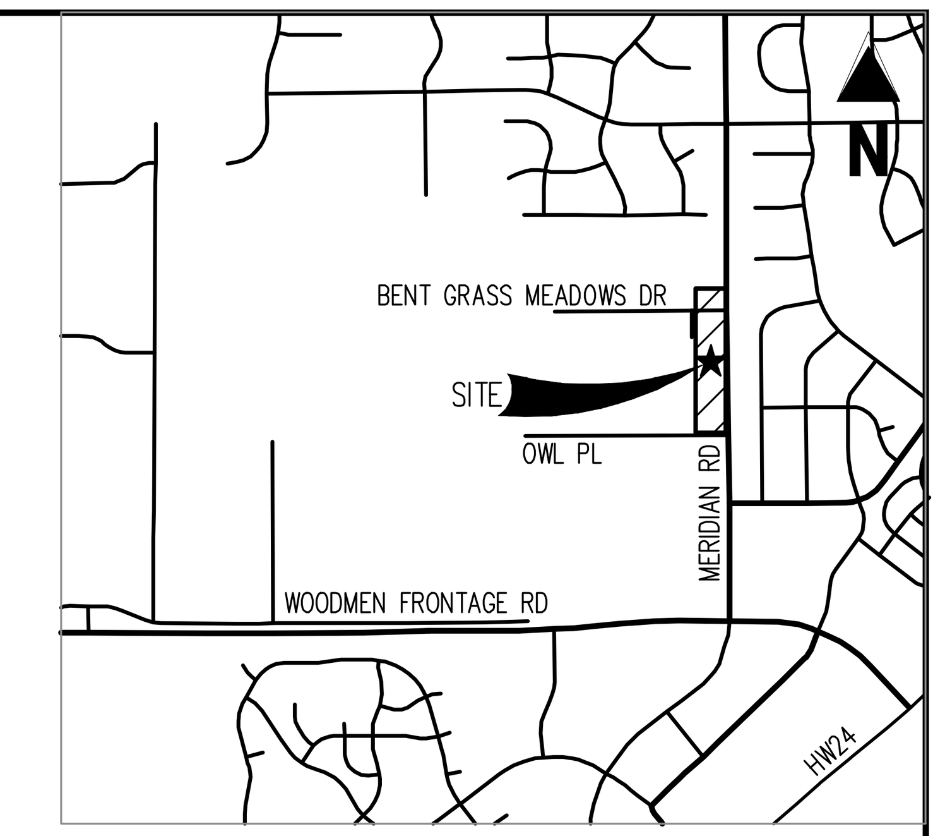
Project No:	CLH000014.20
Drawn By:	CMWJ
Checked By:	SMB
Date:	OCTOBER 2019

EXISTING DRAINAGE MAP OFFSITE

DR-1

Sheet 1 of 1





VICINITY MAP

N

0 10 20 50

SCALE: 1"=50'

DRAINAGE LEGEND

- PROPERTY LINE
- 6485 EXISTING MAJOR CONTOUR
- 6485 EXISTING MINOR CONTOUR
- BASIN BOUNDARY LINE
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

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CHALLENGER HOMES

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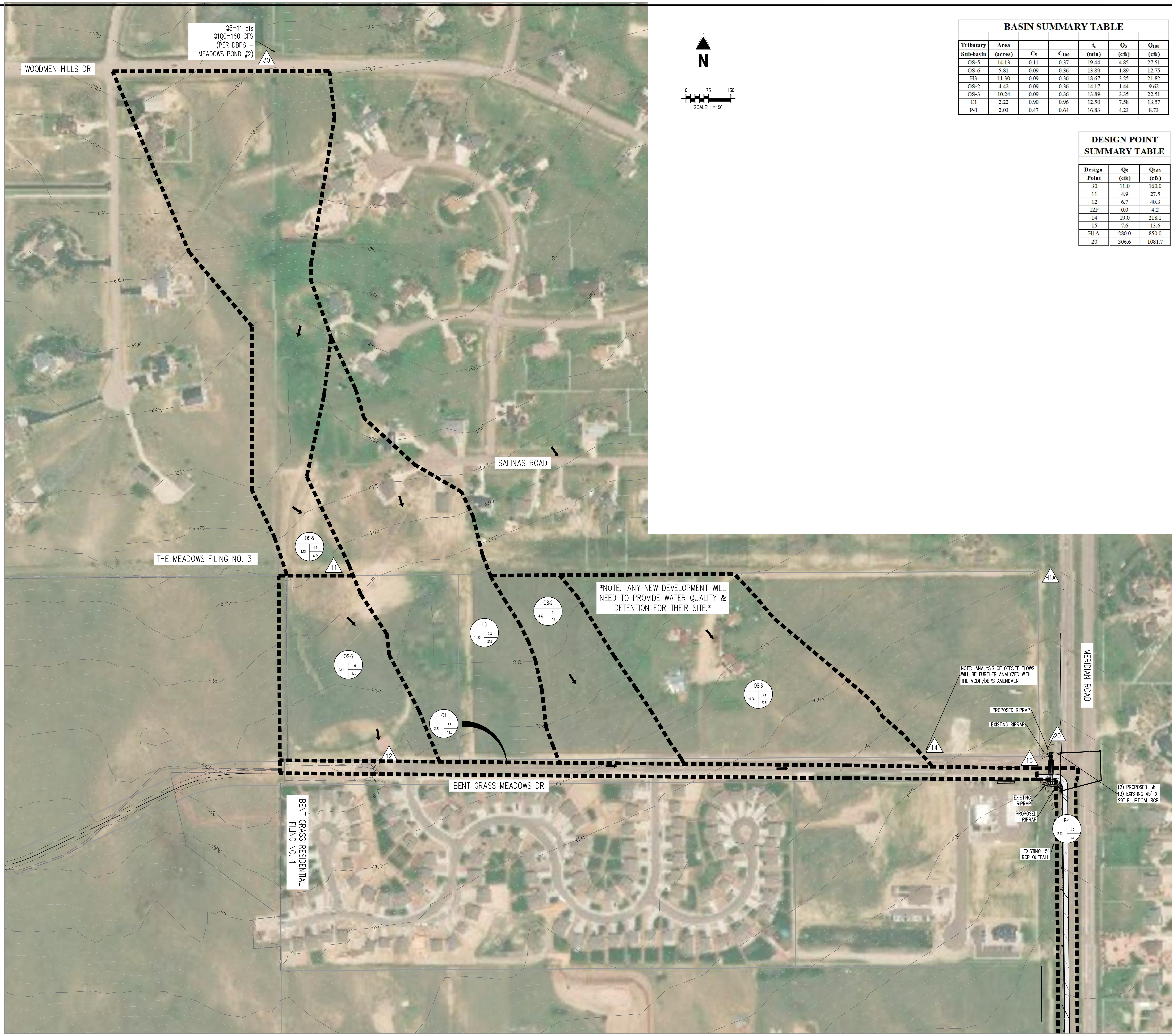
BENT GRASS MEADOWS DRIVE & MERIDIAN ROAD
COLORADO SPRINGS, COLORADO

#	Date	Issue / Description	Init.

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

HISTORIC DRAINAGE MAP

DR-2

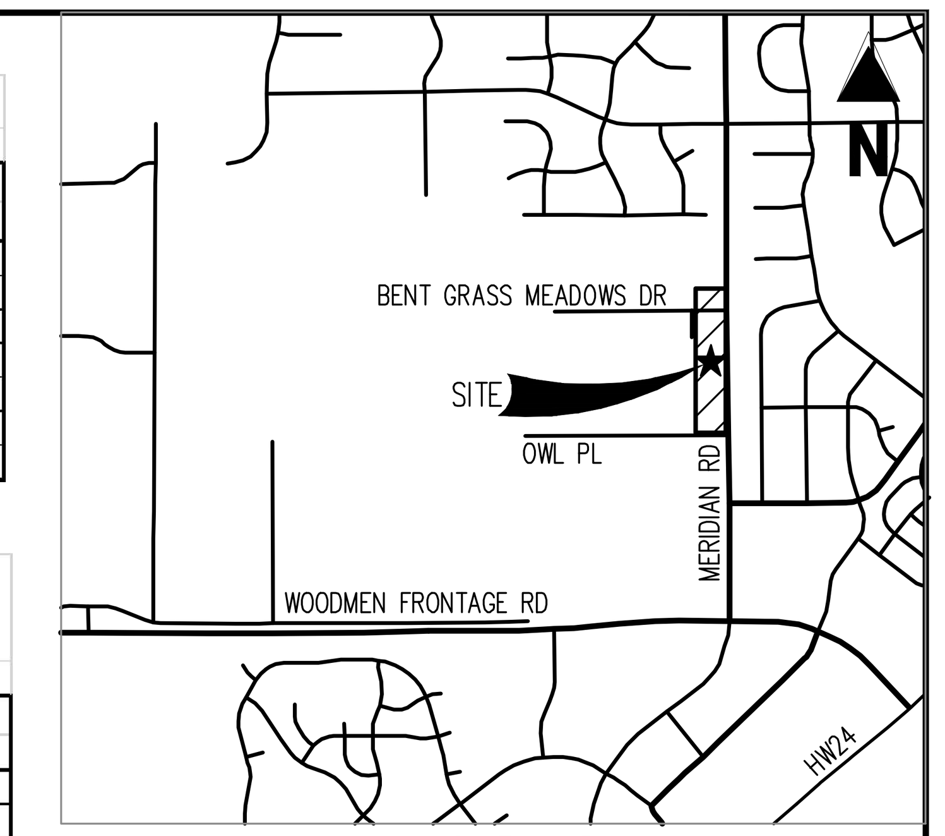


BASIN SUMMARY TABLE

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
- EXISTING MAJOR CONTOUR (6485)
- EXISTING MINOR CONTOUR (6483)
- BASIN BOUNDARY LINE
- FEMA EFFECTIVE 100-YR FLOODPLAIN (100YR)
- CENTERLINE OF STREAM
- BASIN DESIGNATION (1)
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND (1.8)
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND (4.8)
- BASIN AREA IN ACRES (0.71)
- DIRECTION OF RUNOFF

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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.
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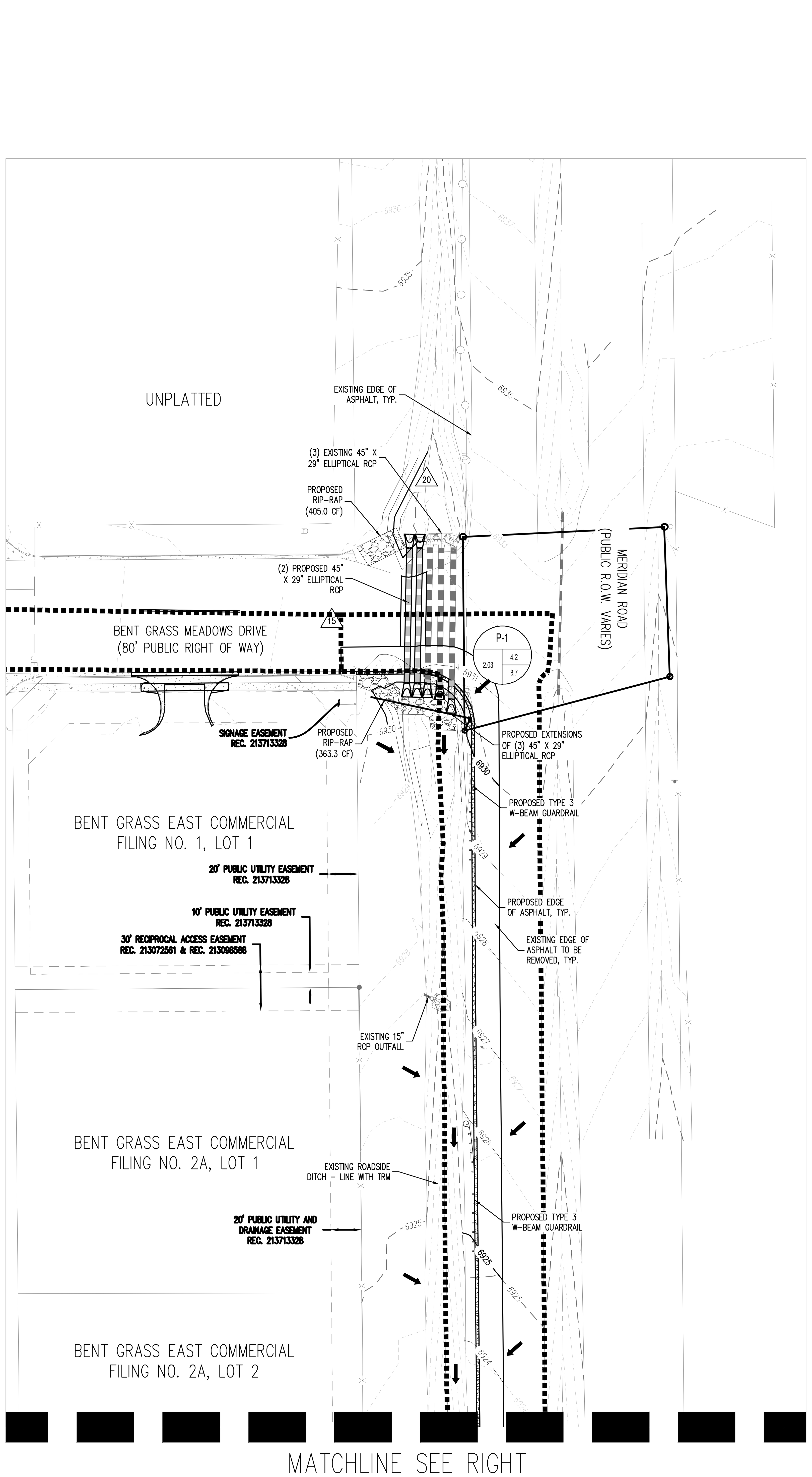
-			

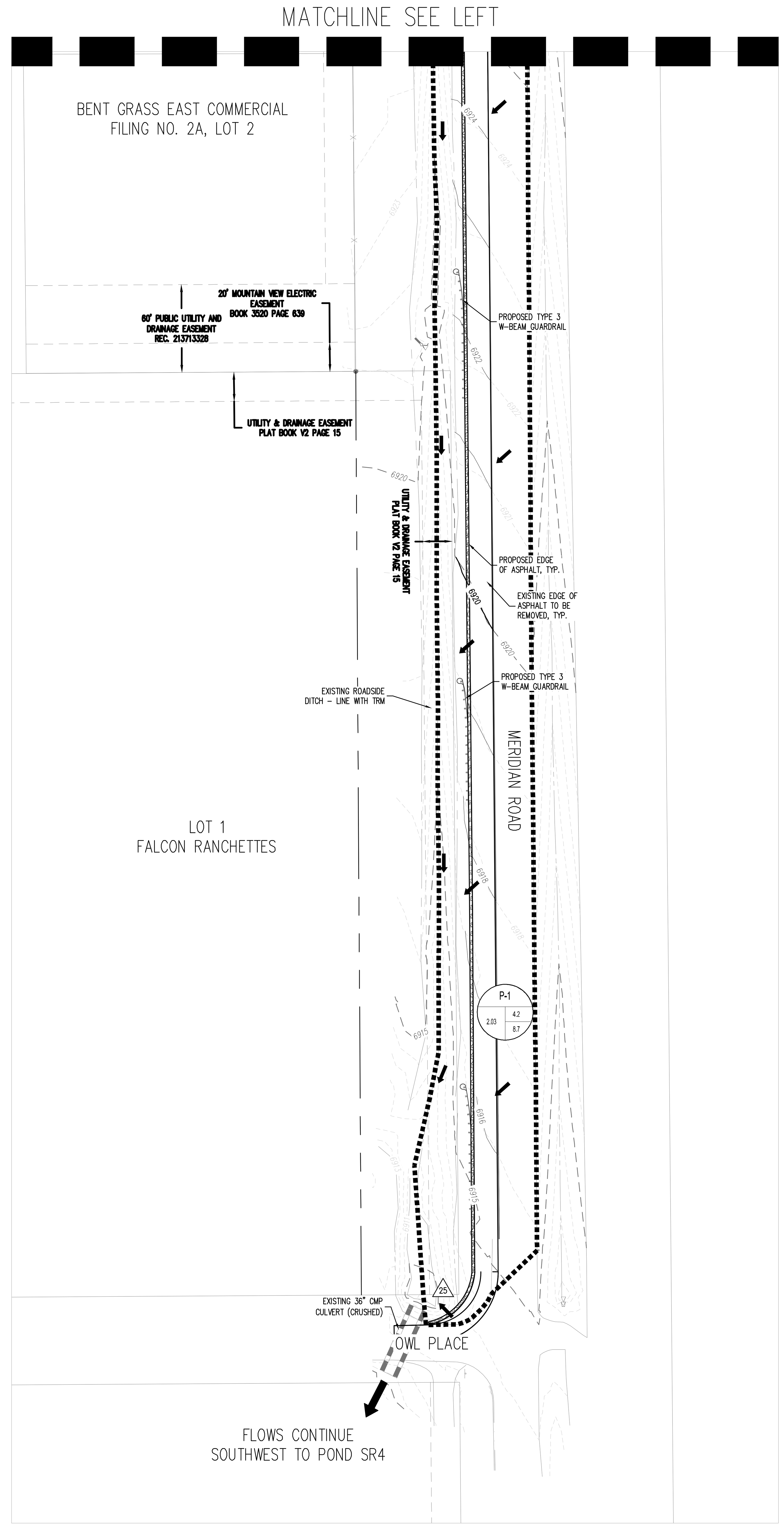
Project No:	CLH000014.20
Drawn By:	CMWJ
Checked By:	SMB
Date:	OCTOBER 2019

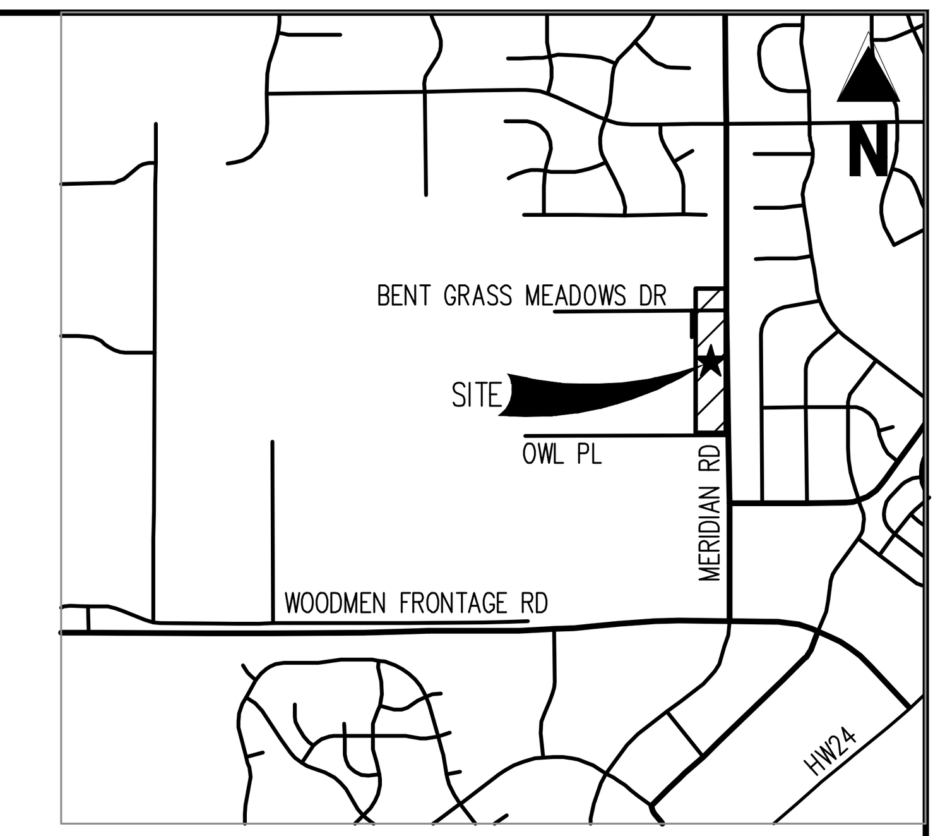
PROPOSED DRAINAGE MAP OFFSITE

DR-3

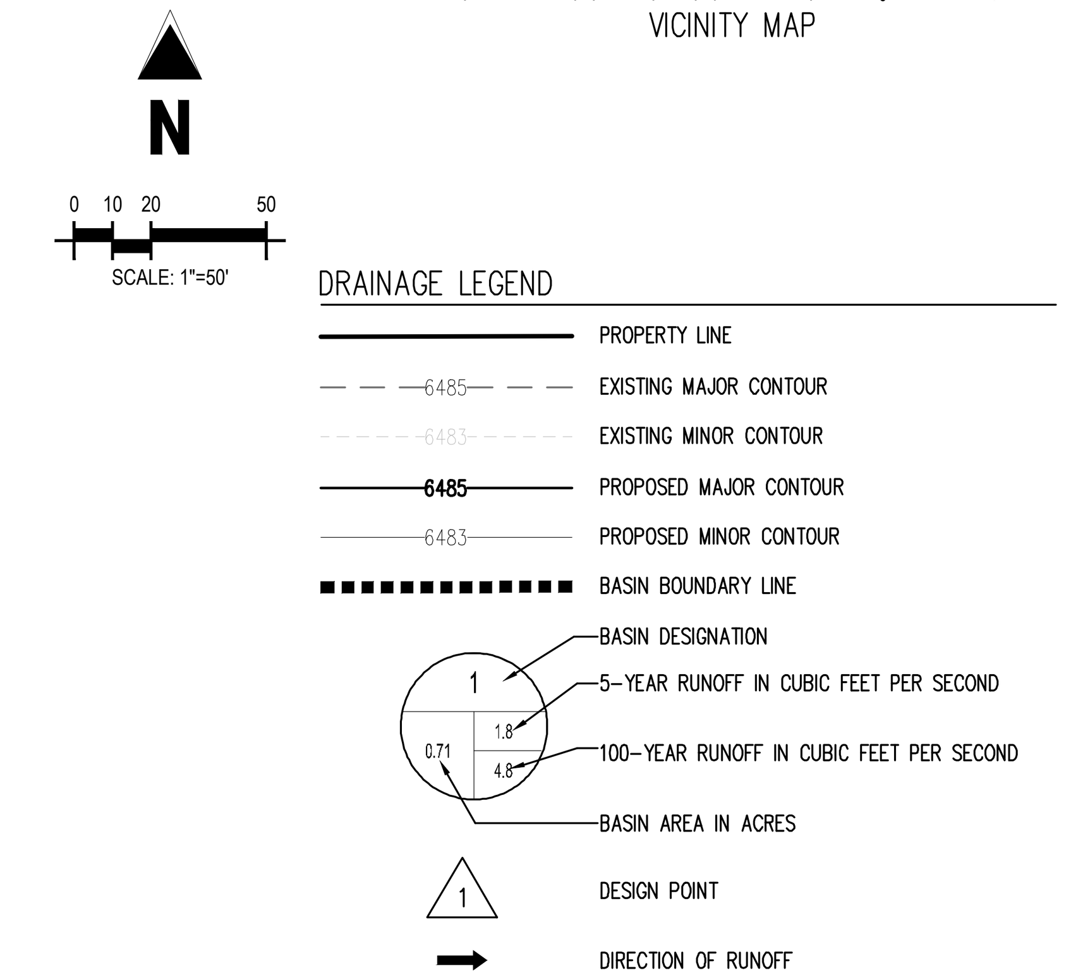
Sheet 1 of 1







VICINITY MAP



BASIN SUMMARY TABLE

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C1	2.22	0.90	0.96	12.50	7.58	13.57
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DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
30	11.0	160.0
11	4.9	27.5
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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

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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