Land Development Consultants, Inc.
2850 Serendipity Circle West
Colorado Springs, CO 80917
Phone: 719-528-6133
Fax: 719-528-6848
Surveying • Planning • Engineering • Landscape Architecture
www.ldc-inc.com

Preliminary and Final Drainage Report

For

Mountain's Edge

Calhan, Colorado

June 23, 2010
Approved March 9, 2011
Revised and Updated June 20, 2019

Prepared For:

OGC RE2, LLC
P.O. Box 1385
Colorado Springs, CO 80901
Attn: Kelli O'Neil

Prepared By:

Land Development Consultants, Inc.
Colorado Springs, Colorado 80909
(719) 528-6133

Project # 08019

PCD Fil No. SF201

TABLE OF CONTENTS

I. CERTIFICATIONS:

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 County for drainage reports and said report is in conformity with the applicable 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.

COLORADO LICENSED
DAVID RAYMOND GORMAN
31672
6/03/20
PROFESSIONAL ENGINEER

David R. Gorman, P.E. CO 31672
For and on behalf of LDC, Inc.

DATE:

Developer's Statement

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

OGC RE2, LLC

BY: Kelli O'Neil
Kelli O'Neil
TITLE: Manager

ADDRESS: P.O. Box 1385, Colorado Springs, CO 80901

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 Administrator

DATE

II. GENERAL INFORMATION:

Purpose

The purpose of this Preliminary and Final Drainage Report is to analyze the existing and proposed drainage facilities, determine runoff quantities from both on-site and off-site sources, ensure adequacy of existing facilities, size any new proposed facilities, and present solutions for proper conveyance of developed storm water runoff.

Location of Property (City/County, Major Drainageways and Existing Facilities, FEMA Floodplain, Surrounding Development)

City/County

A tract of land being the North one-half of the North one-half of the Southwest One-Quarter of Section 13, Township 12 South, Range 63 West of the 6th P.M., situated in El Paso County, Colorado, encompassing approximately 30.613 acres.

Major drainageways and existing facilities

This tract of land is roughly rectangular in shape, with the long axis running east/west. A minor drainageway of approximately 68.89 acres passes through the parcel, draining north to south. There is no FEMA designated flood hazard area associated with this drainageway. A larger drainageway draining north to south of approximately 2,350 acres is located offsite to the east but does not pass through the subject parcel. This offsite drainageway is subject to a FEMA Zone A flood hazard designation.

FEMA Floodplain Statement

The current Flood Insurance Study of the region includes Flood Insurance Rate Maps (FIRMs), effective December 7, 2018. The project site is included in Community Panel Number 08041C0375 G of the FIRMs for El Paso County, Colorado. No portion of the site lies within FEMA designated Special Flood Hazard Areas (SFHAs). An excerpt of the current FEMA Flood Insurance Rate Maps with the site delineated is included in the Appendix.

Surrounding Development

The site is bordered to the north, east and south by single-family, multi-acre rural housing and to the west by McClelland Road, a gravel county road, beyond which to the west is more single-family, multi-acre rural housing.

Description of Property (Area, Topography, Soils, Drainageways, Irrigation, Utilities)

Area

The project involves platting the 30.613-acre parcel into 5, single-family rural residential homesites of approximately 5 to 7 acres each.

Topography
Currently the site is undeveloped and consists of two southeast trending drainages separated by a ridge. Surficial slopes range from 1% to 6% with the most southeasterly ridge sloping east from 5% to 11%. Vegetation on the property consists of native grasses with some weeds and cactus.

Soils
A 'Geology and Soils Study' was prepared for this site by Kumar and Associates, dated November 14, 2008. Their soils analysis identified five soils unit types on site, predominately sandy loams with an SCS 'B' grouping and some loamy sand on the ridge tops with an SCS 'A' grouping. Geological recommendations were also made and consisted of the delineation of two "No-Build" areas within this site that is prone to flooding. See attached NRCS soils group map and proposed Drainage Plan in the Appendix.

Drainageways
The westerly contributing watershed begins about one-half mile north and drains southerly, parallel to McClelland Road. Flows from the off-site basin enters this site from the north, continue unimpeded through the site and exit the south boundary, joining the larger offsite drainageway flows at a point just north of Scott Road. The easterly watershed drains easterly offsite and into the adjacent offsite drainage. Development of this property into rural residential home sites will have a minimal impact on both the calculated runoff quantity and the storm water quality characteristics of the existing conditions.

Irrigation
No irrigation canals cross this property.

Utilities
No public utilities are known to exist on this property. A domestic water steel well head was observed on the property.

Drainage Basins and Sub-Basins (Major Basin Description, Sub-Basin and Existing Flow Summary)

Major Basin Description
The site is located within the Upper Bracket Creek Major Drainage Basin (CHBR0600) located in the US Highway 24 area between Peyton and Calhan. This major drainage basin has not been studied and has no Drainage Basin Planning Study. The basin contains approximately 46 square miles and drains from northwest to southeast, extending from approximately 5 miles upstream of US Highway 24 and approximately 5 miles downstream of US Highway 24. The Upper Bracket Creek Drainage Basin does not have drainage fees associated with development within the basin.

Sub-Basin Description
In order to analyze runoff in the existing conditions, three contributing drainage sub-basins were delineated and studied.

Basin A contains approximately 6.19 acres and drains the east end of the undeveloped site property sheet flows to the east into the Upper Bracket Creek drainageway. Calculated runoff rates for Basin A are Q5 of 1.6 cfs and Q100 of 11.8 cfs.

Basin B contains approximately 68.89 acres including the central portion of the undeveloped site property as well as an area north of the site. Flows passes through the site in a broad swale and exit to the south in an existing narrow swale. Calculated runoff rates for Basin B are Q5 of 9.7 cfs and Q100 of 63.0 cfs.

Basin C contains approximately 2.24 acres and drains the existing McClelland roadway as well as a portion of the existing undeveloped property. These flows continue in the existing roadside ditch flow south toward Scott Road. Calculated runoff rates for Basin C are Q5 = 1.6 cfs and Q100 = 6.0 cfs.

Runoff computations were prepared for the 5-year (minor) and the 100-year (major) storm frequency. See attached Existing Drainage Plan and calculations located in the Appendix of this report.

III. DRAINAGE DESIGN CRITERIA:

Development Criteria References (Criteria References, Previous Studies)

Criteria References

The following were used for references for the calculations within this report:

1. **City of Colorado Springs and El Paso County Drainage Criteria Manual, Volume 1 and 2, May 2014.** The charts and graphs used from these manuals have been reproduced and are included within this report in the appropriate section.

2. **NRCS Web Soil Survey.** United States Department of Agriculture, Natural Resources Conservation Service.

3. **Geology and Soils Study, Mountains Edge Development,** prepared by Kumar and Associates on November 14, 2008.

Previous Studies

The "Preliminary and Final Drainage Report for Mountain's Edge, Calhan Colorado" prepared by Land Development Consultants, Inc. and dated June 23, 2010 was approved by El Paso County on March 9, 2011. This report was for the same property and subdivision as the current report, except the east side end of the originally approved subdivision is no longer contained within the property and proposed lot lines have been adjusted from the previous layout.

Hydrologic Criteria

The Rational Method as described in the Drainage Criteria Manual has been used for all Storm Runoff calculations, as the development and all sub-basins are less than 130 acres in area.

"Colorado Springs Rainfall Intensity Duration Frequency" curves, Figure 6-5 in the DCM, was used to obtain the design rainfall values; a copy is included in the Appendix. The "Overland (Initial) Flow Equation" (Eq. 6-8) in the DCM, and Manning's equation with estimated depths were used in time of concentration calculations. "Runoff Coefficients for Rational Method", Table 6-6 in the DCM, was utilized as a guide in estimating runoff coefficient and Percent Impervious values; a copy is included in the Appendix.

IV. DRAINAGE FACILITY DESIGN:

General Drainage Concept

To access the home sites, a public gravel road will be built adjacent to the north site boundary to be named Farmhouse Court. Basin B main channel runoff will be passed directly under this road through a double 38" by 24" RCP culverts with flared end sections. Basin B upstream sheet flow from the north will collected, concentrated and conveyed via the roadside borrow ditches to this same culvert. This road is the only substantial diversion of the historic drainage flow pattern. The ditch flows along McClelland Road and will continue through Basin C, passing under the proposed roadway through a 14" by 23" elliptical RCP culvert.

The site is a 5-lot rural residential development with lot sizes more than 5 acres each and features a single gravel roadway. The increase in impervious area from existing conditions is minimal compared to the overall land area in the site. The increase in Basin A flow rates for the 5-year and 100-year storm events are **Q_5 = 0.5 cfs and Q_{100} = 0.6 cfs** (for 6.2 acres). The increase in Basin B flow rates for the 5-year and 100-year storm events are **Q_5 = 1.9 cfs and Q_{100} = 2.8 cfs** (for 68.9 acres). The increase in Basin C flow rates for the 5-year and 100-year storm events are **Q_5 = 0.0 cfs and Q_{100} = 0.0 cfs** (for 2.2 acres). In comparing the increase in flows from existing conditions to developed conditions, the calculated increase in the 5-year and 100-year rainfall events are insignificant and negligible for the 30.60 acre rural residential subdivision site. Therefore, no detention is required.

Since the site is a large lot single-family rural residential site with greater than 2.5 acres per dwelling; and the total lot imperviousness is less than 10% (2.14 impervious acres/30.6 total acres = 7%) single-family rural residential lot, the site is excluded from water quality requirements for water quality capture volume. However, permanent water quality BMP's are included in the form of rock check dams at the roadside ditch exits on Farmhouse Court. These are discussed in a following section.

Specific Drainage Details

- **Existing Drainage Conditions**
  Existing sub-basins and flows are described in Section II, above. The details of the existing sub-basin characteristics are listed below.

Basin A

6.19-acres undeveloped C = 0.08/0.35 Q_5 / Q_{100} = 1.6 / 11.8 cfs

.

Basin B

68.89-acres rural residential C = 0.09/0.36 Q_5 / Q_{100} = 9.7 / 63.0 cfs

Basin C

2.25-acres gravel road/rural residential C = 0.19/0.43 Q_5/Q_{100} = 1.6 / 6.0 cfs

Specific Drainage Details

- **Proposed Drainage Conditions**
  Contributing basins in the developed condition range in size from 0.57 to 40.2 acres. Details of the proposed condition sub-basin characteristics are listed below.

Sub-Basin A1

6.19-acres 5 Ac rural residential C = 0.10/0.36 Q_5 /Q_{100} = 2.1 / 12.4 cfs

Sub-Basin A1 drains east and then offsite to the adjacent offsite drainage way.

Sub-Basin B1

40.20-acres rural residential C = 0.10/0.36 Q_5 /Q_{100} = 7.0 / 42.4 cfs

Sub-Basin B1 drains the area north of the site and flows directly into the existing broad swale. These flows will be intercepted by the proposed roadway culvert in Farmhouse Court.

Sub-Basin B2

2.16-acres rural residential C = 0.14/0.39 Q_5 /Q_{100} = 0.8 / 3.6 cfs

Sub-Basin B2 drains the northern portion of Farmhouse Court from the roadway high point west to the proposed culvert. It also drains a portion of the undeveloped property north of the site. These flows will combine with the flows from Sub-Basin B1 at the proposed culvert. A permanent Rock Check for water quality will be placed upstream of the proposed culvert.

Sub-Basin B3

3.75-acres rural residential C = 0.11/0.37 Q_5 /Q_{100} = 1.3 / 6.9 cfs

Sub-Basin B3 drains the northern portion of Farmhouse Court from the proposed culvert to the cul-de-sac. It also drains an area north of the site. These flows will combine with the flows from Sub-Basins B1 and B2 at the proposed culvert. A permanent Rock Check for water quality will be placed upstream of the proposed culvert.

Design Point 1 DP1

46.11-acres C = 0.10/0.37 Q_5 /Q_{100} = 8.3 / 49.0 cfs

Design Point DP1 includes flows from Sub-Basins B1, B2, and B3 and is located at the inlet of the proposed double 38" by 24" RCEP culverts. The resulting headwater elevation on the north side of the road is contained in the north roadside ditch and does not affect the upstream property on the north. These flows continue south in culvert to DP2 on the south side of Farmhouse Court.

Sub-Basin B4

0.57-acres gravel roadway C = 0.36/0.54 Q_5 /Q_{100} = 0.8 / 2.0 cfs

Sub-Basin B4 drains the southern portion of the Farmhouse Court from the high point west to the culvert outlet. A permanent Rock Check for water quality will be placed upstream of the proposed culvert. These flows will combine with the flows from DP1 at DP2.

Design Point 2 DP2

46.68-acres C = 0.11/0.37 Q_5 /Q_{100} = 8.6 / 49.7 cfs

The ditch flows from Sub-Basin B4 combine with the culvert flows from DP1 and flow south to through sub-basin B5 in the existing broad swale discussed below.

Sub-Basin B5

22.24-acres 5 Ac rural residential C = 0.11/0.37 Q_5 /Q_{100} = 5.0 / 27.5 cfs

Sub-Basin B5 drains the area south of the proposed roadway. A permanent Rock Check for water quality will be placed upstream of the proposed culvert. The construction of single-family residences on five-acre to seven-acre lots will contribute minimally to current flows and will be mitigated within the existing broad swale to which these flows will be tributary. This swale has a bottom width of approximately 3 feet at its narrowest point, with mild side slopes. The existing swale was analyzed for capacity and velocities. The calculated 100-yr flow depth in the swale range from 0.4 feet to 1.1 feet. The calculated velocities in this swale for the 100-year storm range from 1.7 fps to 3.7 fps. The grassed cover is adequate to convey the minor and major runoff flows without erosion or sedimentation. The swale exits the site and continues flowing in a southwesterly direction. A no-build area is established through sub-basin B5 to contain the swale and prevent disturbance of the flow area.

Design Point 3 DP3

69.92-acres C = 0.11/0.37 Q_5 /Q_{100} = 11.6 / 65.8 cfs

Design Point 3 is the combination of flows from DP2 and Sub-Basin B5. These combined flows exit the site through the existing broad swale along the south property line. The existing swale is the current outfall for the site. The swale is well vegetated and stable with no signs of erosion or sedimentation. Developed flows in the swale represent a negligible increase from existing conditions. The existing swale was analyzed for capacity and velocities. It was found that the swale has more than adequate capacity in the existing and developed conditions and the existing stable grass cover in the swale is adequate protection for the 100-year flow velocities of 3.7 fps.

Sub-Basin C1

0.64-acre gravel road/rural residential C = 0.32/0.51 Q_5/Q_{100} = 0.8 / 2.1 cfs

Sub-Basin C1 drains the western portion of McClelland Road north of the proposed development. The existing ditch flows will be transported under Farmhouse Drive through a 23" by 14" elliptical RCP culvert. These flows will then continue south through Sub-Basin C2.

Sub-Basin C2

1.60-acres gravel road/rural residential C = 0.15/0.40 Q_5/Q_{100} = 0.9 / 3.9 cfs

Sub-Basin C2 drains the western portion of McClelland Road from Farmhouse Court south to the property line and including a portion of the residential property.

Design Point 4 DP4

2.23-acres C = 0.20/0.43 Q_5/Q_{100} = 1.6 / 5.9 cfs

Design Point 4 is the combination of flows from Sub-Basins C1 and C2. These flows will continue flowing south in the existing roadside ditch.

V. DRAWING CONTENTS:

Vicinity Map
Overall Drainage Map
Drainage Plans (Existing and Proposed)
Drainage Calculations and Charts

VI. IMPROVEMENT COSTS (non-reimbursable):

No offsite drainage improvements will be required. Costs for public non-reimbursable drainage improvements are listed below.

94 LF 38"x24" Elliptical RC Pipe	$ 97/LF	=	$ 9,118
47 LF 23"x14" Elliptical RC Pipe	$ 65/LF	=	$ 3,055
4 EA 38"x24" Elliptical FES	$468/EA	=	$ 1,872
2 EA 23"x24" Elliptical FES	$390/EA	=	$ 780
12 CY Rip Rap Culvert Outlet Pad	$112/EA	=	$ 1,344
4 EA Permanent Rock Check Dam	$500/EA	=	$ 2,000
Total			$18,169

VII. DRAINAGE FEES:

The site is within the Upper Bracket Creek drainage basin, which is an unstudied basin. No drainage fees are due with the platting of the subdivision.

VIII. FOUR STEP PROCESS:

The El Paso County Engineering Criteria Manual (Appendix I, Section I.7.2) requires the consideration of a "Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long term source controls". The Four Step Process is incorporated in this project and the elements are discussed below.

1) Runoff Reduction Practices are employed in this project. Impervious surfaces have been reduced as much as practically possible due to gravel roadways and reduced residential density. All impervious surfaces on the site will drain to the surrounding pervious areas allowing infiltration and water quality mitigation. Minimized Directly Connected Impervious Areas (MDCIA) is employed on the project because runoff passes through the western open space meadow area before leaving the site.

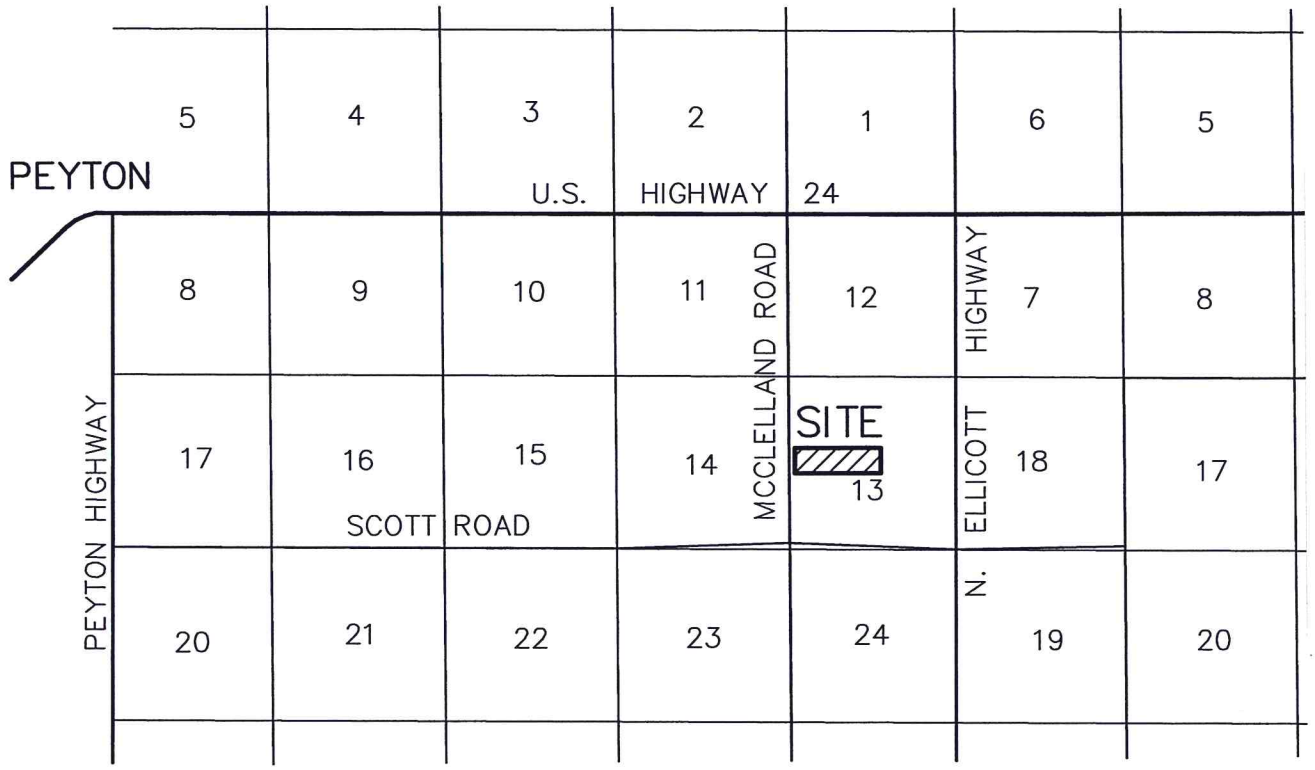
2) All drainage paths on the site are will remain stabilized with the natural native grass lining. Disturbed areas will be reseeded. All culverts will have rip-rap aprons at entrance and exits. The existing swale downstream of the new culvert crossing of proposed Farmhouse Court was analyzed for hydraulic depths velocities. The swale with the existing stable vegetative cover consisting of the natural native grasses on the site are adequate to convey the minor and major storm flows without erosion and sedimentation. No further stabilization is required.

3) The project contains no potentially hazardous uses. The site is exempted from the use of WQCV BMPs by virtue of the large lot rural residential nature of the site having percent imperviousness of less than 10%. The site includes the use of permanent rock check dams at the roadside ditch exits to control potential sedimentation from the new roadside ditches.

4) The rural residential site is not anticipated to contain storage of potentially harmful substances or use of potentially harmful substances. No Site Specific or Other Source Control BMP's are required.

IX. CONCLUSION:

This Final Drainage Report presents existing and proposed drainage conditions for the proposed Mountains Edge subdivision project. Although storm detention is not provided, the large lot rural residential single-family development will have negligible and inconsequential increases in storm runoff flows with no effects on the existing site drainage and drainage conditions downstream. The proposed project will not, with respect to stormwater runoff or water quality, negatively impact the adjacent properties and downstream properties.
.

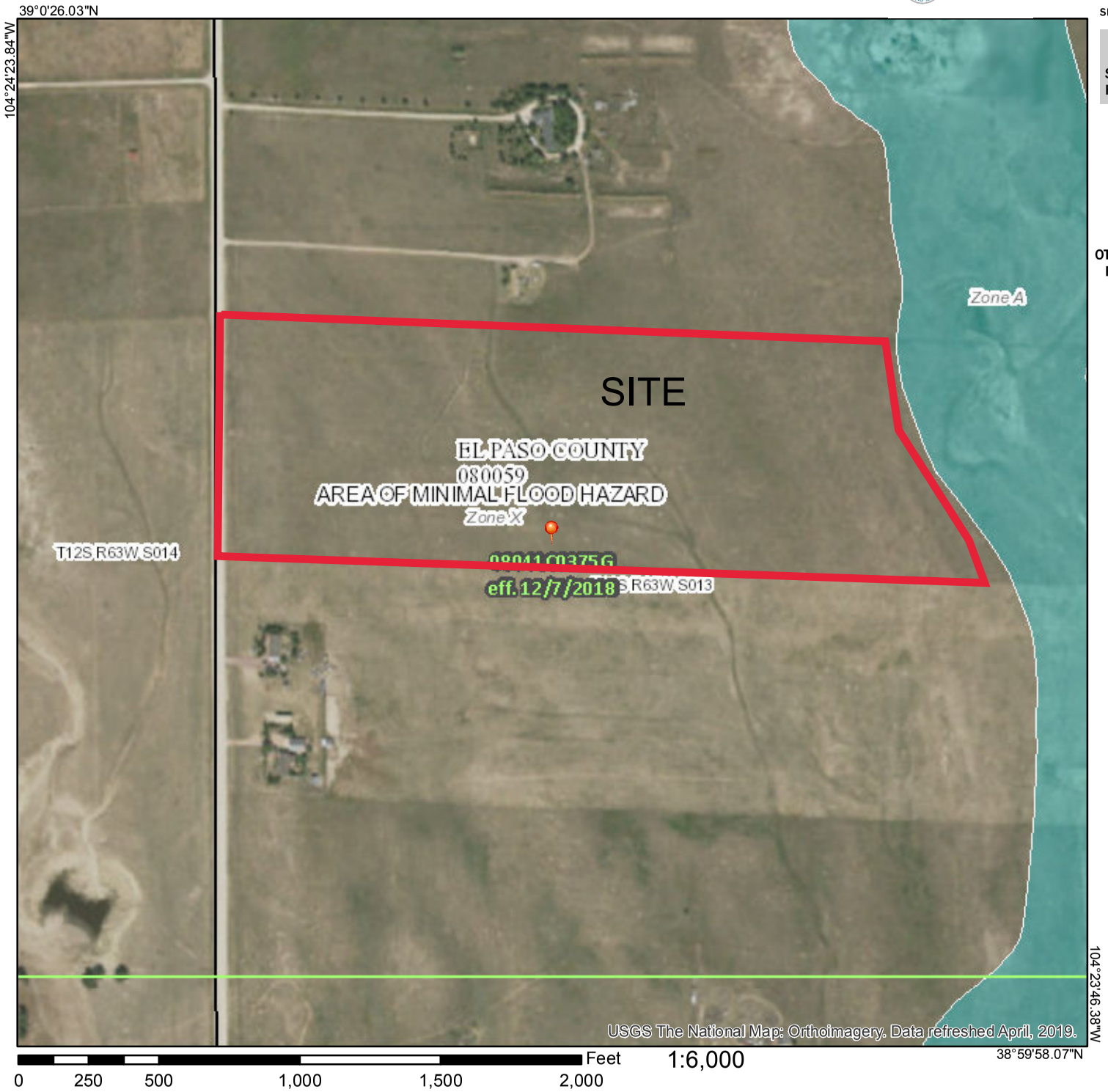


VICINITY MAP

N.T.S.

National Flood Hazard Layer FIRMette

FEMA



Legend

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

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

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

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

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

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

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

N

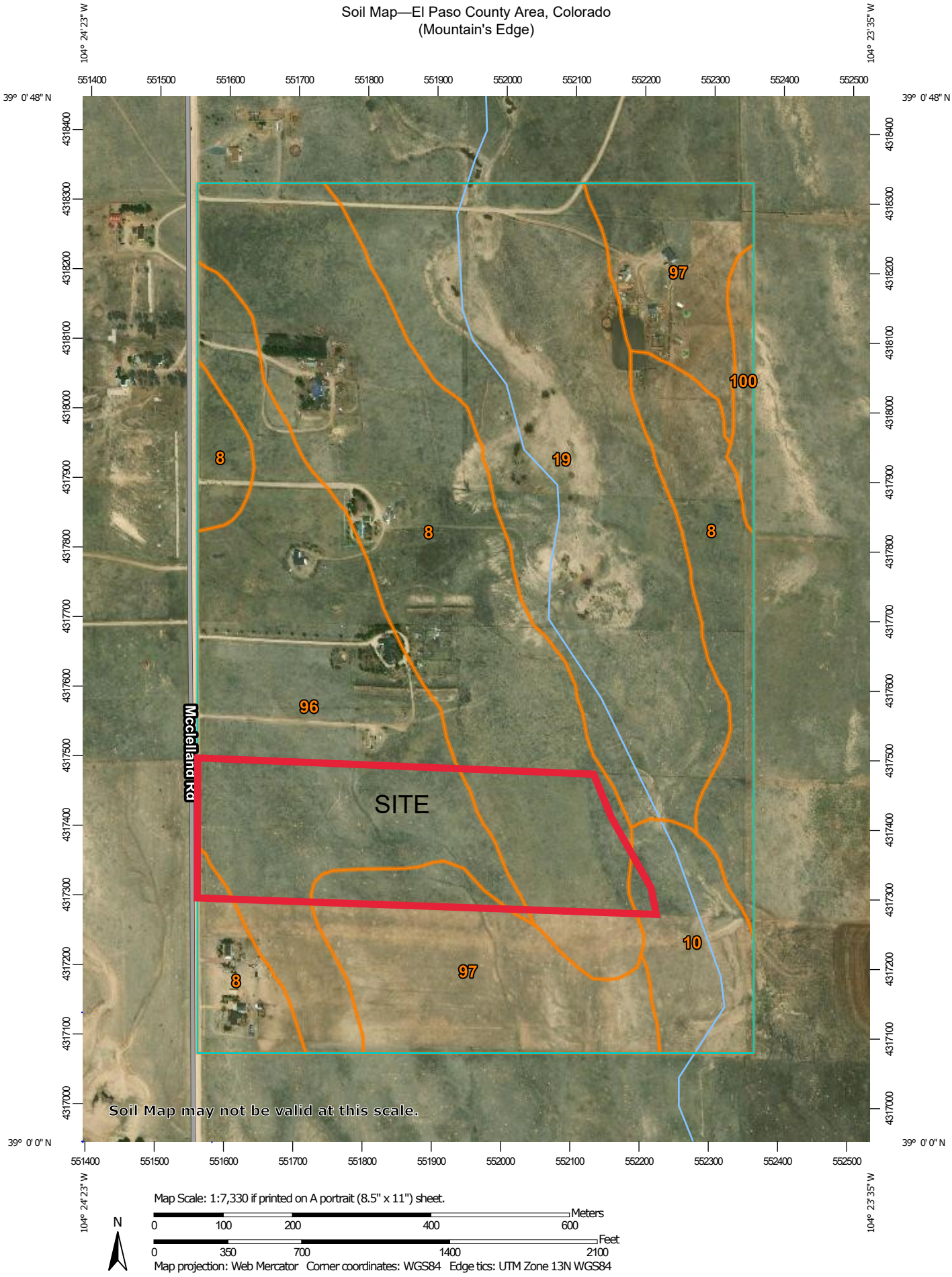
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/20/2019 at 4:30:25 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Soil Map—El Paso County Area, Colorado
(Mountain's Edge)



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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 16, Sep 10, 2018

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

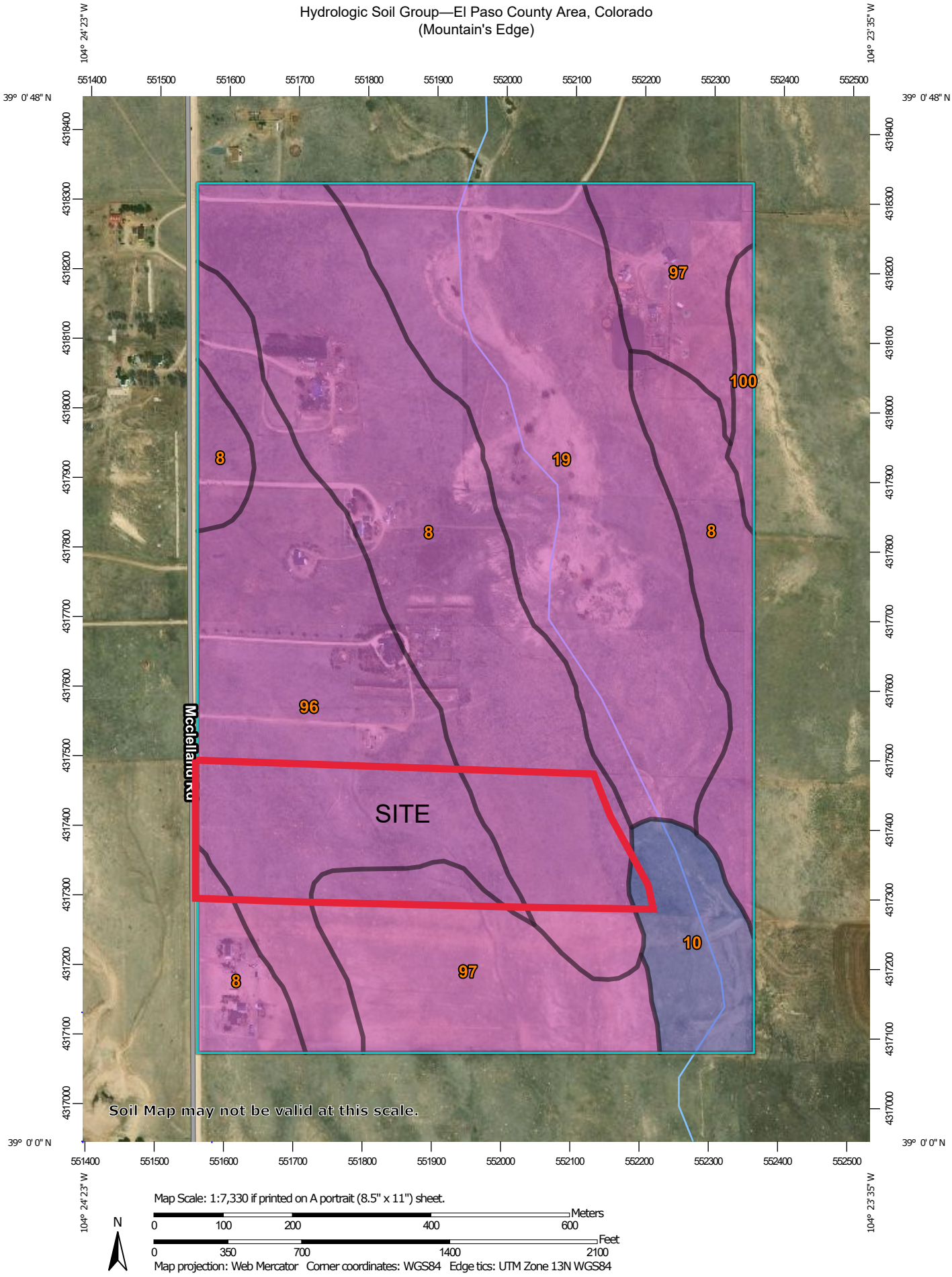
Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 2017

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	84.4	33.9%
10	Blendon sandy loam, 0 to 3 percent slopes	11.6	4.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	58.6	23.5%
96	Truckton sandy loam, 0 to 3 percent slopes	55.7	22.4%
97	Truckton sandy loam, 3 to 9 percent slopes	35.9	14.4%
100	Truckton-Bresser complex, eroded	2.8	1.1%
Totals for Area of Interest		**249.1**	**100.0%**

Hydrologic Soil Group—El Paso County Area, Colorado
(Mountain's Edge)



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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jun 7, 2016—Aug 17, 2017

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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	84.4	33.9%
10	Blendon sandy loam, 0 to 3 percent slopes	B	11.6	4.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	58.6	23.5%
96	Truckton sandy loam, 0 to 3 percent slopes	A	55.7	22.4%
97	Truckton sandy loam, 3 to 9 percent slopes	A	35.9	14.4%
100	Truckton-Bresser complex, eroded	A	2.8	1.1%
Totals for Area of Interest			**249.1**	**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

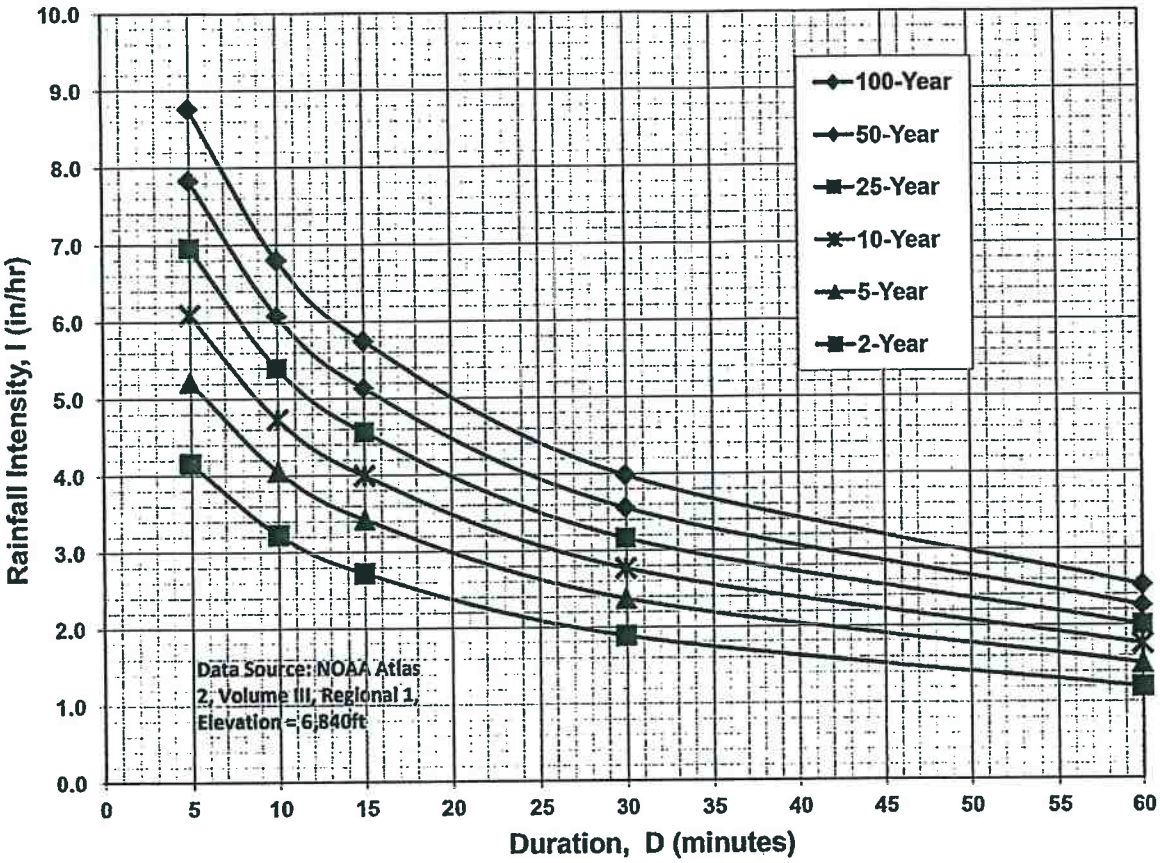
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$I_{100} = -2.52 \ln(D) + 12.735$

$I_{50} = -2.25 \ln(D) + 11.375$

$I_{25} = -2.00 \ln(D) + 10.111$

$I_{10} = -1.75 \ln(D) + 8.847$

$I_{5} = -1.50 \ln(D) + 7.583$

$I_{2} = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure.

Job No.: **08019**
Project: **Mountain's Edge**

Date: **6/2/2020 18:53**
Calcs By: **drg**
Checked By:

Time of Concentration (Modified from Standard Form SF-1)

Sub-Basin	Sub-Basin Data				Overland			Shallow Channel				Channelized				t_c Check		t_c
	Area (Acres)	C_5	C_{100}/CN	% Imp.	L_0 (ft)	S_0 (%)	t_i (min)	L_{0t} (ft)	S_{0t} (ft/ft)	v_{0sc} (ft/s)	t_t (min)	L_{0c} (ft)	S_{0c} (ft/ft)	v_{0c} (ft/s)	t_c (min)	L (min)	$t_{c,alt}$ (min)	(min)
A (EX)	6.19	0.08	0.35	0%	300	7%	16.8	86	0.029	1.2	1.2	0	0.000	0.0	0.0	386	N/A	18.0
B (EX)	68.89	0.09	0.36	2%	300	2%	25.1	1400	0.025	1.1	21.1	1700	0.020	2.6	10.9	3400	N/A	57.0
C (EX)	2.24	0.19	0.43	17%	105	3%	11.3	0	0.000	0.0	0.0	269	0.019	2.7	1.7	374	N/A	13.0
A1	6.19	0.10	0.36	3%	300	7%	16.4	86	0.029	1.2	1.2	0	0.000	0.0	0.0	386	N/A	17.6
B1	40.20	0.10	0.36	3%	300	2%	23.6	1400	0.025	1.1	21.1	715	0.025	2.4	4.9	2415	N/A	49.6
B2	2.16	0.14	0.39	10%	300	2%	23.8	110	0.018	0.9	1.9	320	0.010	1.8	3.0	730	N/A	28.7
B3	3.75	0.11	0.37	5%	300	5%	18.1	235	0.047	1.5	2.6	200	0.010	2.0	1.7	735	N/A	22.4
B4	0.57	0.36	0.54	44%	32	2%	6.0	0	0.000	0.0	0.0	590	0.010	1.8	5.5	622	N/A	11.4
B5	22.24	0.11	0.37	5%	300	2%	26.1	730	0.019	1.0	12.6	410	0.022	2.1	3.3	1440	N/A	41.9
C1	0.64	0.32	0.51	37%	32	2%	6.3	0	0.000	0.0	0.0	740	0.018	2.2	5.6	772	N/A	11.9
C2	1.60	0.15	0.40	12%	105	3%	11.8	0	0.000	0.0	0.0	269	0.019	2.3	1.9	374	N/A	13.7

Job No.: **08019**
Project: **Mountain's Edge**
Design Storm: **5-Year Storm** *(20% Probability)*
Jurisdiction: **DCM**

Date: **6/2/2020 18:53**
Calcs By: **drg**
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C5	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	t_c (min)	CA (Acres)	I5 (in/hr)	Q5 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	v_{Osc} (ft/s)	t_t (min)
	A (EX)	6.19	0.08	18.0	0.50	3.25	1.6															
	B (EX)	68.89	0.09	57.0	6.41	1.52	9.7															
	C (EX)	2.24	0.19	13.0	0.43	3.74	1.6															
	A1	6.19	0.10	17.6	0.63	3.28	2.1															
	B1	40.20	0.10	49.6	4.06	1.73	7.0															
	B2	2.16	0.14	28.7	0.31	2.55	0.8															
	B3	3.75	0.11	22.4	0.43	2.92	1.3															
DP1	B1,B2,B3	46.11	0.10					49.6	4.80	1.73	8.3											
	B4	0.57	0.36	11.4	0.21	3.93	0.8															
DP2	B1,B2,B3,B4	46.68	0.11					49.8	5.01	1.72	8.6											
	B5	22.24	0.11	41.9	2.51	1.98	5.0															
DP3	B1,B2,B3,B4,B5	68.92	0.11					56.3	7.52	1.54	11.6											
	C1	0.64	0.32	11.9	0.20	3.86	0.8															
	C2	1.60	0.15	13.7	0.25	3.66	0.9															
DP4	C1,C2	2.23	0.20					13.7	0.45	3.66	1.6											

DCM: I = C1 * ln (tc) + C2
C1: 1.5
C1: 7.583

Job No.: 08019
Project: Mountain's Edge
Design Storm: 100-Year Storm *(1% Probability)*
Jurisdiction: DCM

Date: 6/2/2020 18:53
Calcs By: drg
Checked By:

Sub-Basin and Combined Flows (Modified from Standard Form SF-2)

				Direct Runoff				Combined Runoff				Streetflow			Pipe Flow					Travel Time		
DP	Sub-Basin	Area (Acres)	C100	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	t_c (min)	CA (Acres)	I100 (in/hr)	Q100 (cfs)	Slope (%)	Length (ft)	Q (cfs)	Q (cfs)	Slope (%)	Mnngs n	Length (ft)	D_{Pipe} (in)	Length (ft)	V_{0sc} (ft/s)	t_t (min)
	A (EX)	6.19	0.35	18.0	2.17	5.45	11.8															
	B (EX)	68.89	0.36	57.0	24.73	2.55	63.0															
	C (EX)	2.24	0.43	13.0	0.95	6.28	6.0															
	A1	6.19	0.36	17.6	2.26	5.50	12.4															
	B1	40.20	0.36	49.6	14.65	2.90	42.4															
	B2	2.16	0.39	28.7	0.85	4.27	3.6															
	B3	3.75	0.37	22.4	1.40	4.91	6.9															
DP1	B1,B2,B3	46.11	0.37					49.6	16.91	2.90	49.0											
	B4	0.57	0.54	11.4	0.31	6.60	2.0															
DP2	B1,B2,B3,B4	46.68	0.37					49.8	17.22	2.89	49.7											
	B5	22.24	0.37	41.9	8.29	3.32	27.5															
DP3	B1,B2,B3,B4,B5	68.92	0.37					56.3	25.51	2.58	65.8											
	C1	0.64	0.51	11.9	0.33	6.49	2.1															
	C2	1.60	0.40	13.7	0.64	6.14	3.9															
DP4	C1,C2	2.23	0.43					13.7	0.97	6.14	5.9											

DCM: I = C1 * ln (tc) + C2
C1: 2.52
C1: 12.735

Sub-Basin A (Ex) Runoff Calculations (Historic)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	269,660	6.19	0.02	0.08	0.15	0.25	0.3	0.35	0%
Combined	**269,660**	**6.19**	**0.02**	**0.08**	**0.15**	**0.25**	**0.30**	**0.35**	**0.0%**

269660

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	386	24	-	-	-	-	
Initial Time	300	21	0.070	-	16.8	N/A	DCM Eq. 6-8
Shallow Channel	86	3	0.029	1.2	1.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**18.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.60	3.25	3.79	4.33	4.87	5.45
Runoff (cfs)	0.3	**1.6**	3.5	6.7	9.1	**11.8**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.3	**1.6**	3.5	6.7	9.1	**11.8**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin B (EX) Runoff Calculations (Historic)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	2,926,529	67.18	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	66,945	1.54	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	7,500	0.17	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**3,000,974**	**68.89**	**0.03**	**0.09**	**0.16**	**0.26**	**0.31**	**0.36**	**2.0%**

3000974

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	3,400	75	-	-	-	-	
Initial Time	300	6	0.020	-	25.1	N/A	DCM Eq. 6-8
Shallow Channel	1,400	35	0.025	1.1	21.1	-	DCM Eq. 6-9
Channelized	1,700	34	0.020	2.6	10.9	-	Trap Ditch
				t_c	**57.0**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.22	1.52	1.77	2.03	2.28	2.55
Runoff (cfs)	2.9	**9.7**	19.8	36.3	48.6	**63.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.9	**9.7**	19.8	36.3	48.6	**63.0**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin C (EX) Runoff Calculations (Historic)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	76,331	1.75	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	21,225	0.49	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**97,556**	**2.24**	**0.14**	**0.19**	**0.25**	**0.34**	**0.38**	**0.43**	**17.4%**

97556

Basin Travel Time

-

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	374	9	-	-	-	-	
Initial Time	105	4	0.033	-	11.3	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized	269	5	0.019	2.7	1.7	-	V-Ditch
				t_c	**13.0 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.98	3.74	4.36	4.98	5.61	6.28
Runoff (cfs)	0.9	**1.6**	2.5	3.8	4.8	**6.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.9	**1.6**	2.5	3.8	4.8	**6.0**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin A1 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	259,860	5.97	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	4,800	0.11	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	5,000	0.11	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**269,660**	**6.19**	**0.04**	**0.10**	**0.17**	**0.27**	**0.32**	**0.36**	**3.1%**

269660

Basin Travel Time

-

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	386	24	-	-	-	-	
Initial Time	300	21	0.070	-	16.4	N/A	DCM Eq. 6-8
Shallow Channel	86	3	0.029	1.2	1.2	-	DCM Eq. 6-9
Channelized			0.000	0.0	0.0	-	V-Ditch
				t_c	**17.6 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.62	3.28	3.82	4.37	4.92	5.50
Runoff (cfs)	0.7	**2.1**	4.0	7.2	9.6	**12.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.7	**2.1**	4.0	7.2	9.6	**12.4**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin B1 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	1,680,445	38.58	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	62,955	1.45	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	7,500	0.17	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**1,750,900**	**40.20**	**0.04**	**0.10**	**0.17**	**0.27**	**0.32**	**0.36**	**3.3%**

1750900

Basin Travel Time

-

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	2,415	60	-	-	-	-	
Initial Time	300	7	0.023	-	23.6	N/A	DCM Eq. 6-8
Shallow Channel	1,400	35	0.025	1.1	21.1	-	DCM Eq. 6-9
Channelized	715	18	0.025	2.4	4.9	-	Trap Ditch
				t_c	**49.6**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.39	1.73	2.01	2.30	2.59	2.90
Runoff (cfs)	2.4	**7.0**	13.8	24.7	32.9	**42.4**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.4	**7.0**	13.8	24.7	32.9	**42.4**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin B2 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	82,599	1.90	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	11,588	0.27	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**94,187**	**2.16**	**0.09**	**0.14**	**0.21**	**0.30**	**0.35**	**0.39**	**9.8%**

94187

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	730	11	-	-	-	-	
Initial Time	300	6	0.020	-	23.8	N/A	DCM Eq. 6-8
Shallow Channel	110	2	0.018	0.9	1.9	-	DCM Eq. 6-9
Channelized	320	3	0.010	1.8	3.0	-	V-Ditch
				t_c	**28.7**	**min.**	

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.04	2.55	2.97	3.39	3.82	4.27
Runoff (cfs)	0.4	**0.8**	1.3	2.2	2.9	**3.6**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.4	**0.8**	1.3	2.2	2.9	**3.6**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin B3 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	152,352	3.50	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	11,136	0.26	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**163,488**	**3.75**	**0.06**	**0.11**	**0.18**	**0.28**	**0.33**	**0.37**	**5.4%**

163488

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	735	28	-	-	-	-	
Initial Time	300	15	0.050	-	18.1	N/A	DCM Eq. 6-8
Shallow Channel	235	11	0.047	1.5	2.6	-	DCM Eq. 6-9
Channelized	200	2	0.010	2.0	1.7	-	V-Ditch
				t_c	**22.4 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.34	2.92	3.41	3.90	4.38	4.91
Runoff (cfs)	0.5	**1.3**	2.3	4.1	5.4	**6.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**1.3**	2.3	4.1	5.4	**6.9**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Combined Sub-Basin Runoff Calculations (DP1)

Includes Basins B1 B2 B3

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	1,915,396	43.97	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	7,500	0.17	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	85,679	1.97	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**2,008,575**	**46.11**	**0.05**	**0.10**	**0.17**	**0.27**	**0.32**	**0.37**	**3.7%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	B1	-	2,415	60	-	-	-	-	49.6
Channelized-1									
Channelized-2									
Channelized-3									
Total			2,415	60					
								t_c (min)	**49.6**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.39	1.73	2.01	2.30	2.59	2.90
Site Runoff (cfs)	2.95	**8.29**	16.04	28.61	37.99	**48.96**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**8.3**	-	-	-	**49.0**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Sub-Basin B4 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	11,053	0.25	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	13,760	0.32	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**24,813**	**0.57**	**0.33**	**0.36**	**0.42**	**0.48**	**0.51**	**0.54**	**44.4%**

24813

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	622	7	-	-	-	-	
Initial Time	32	1	0.020	-	6.0	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized	590	6	0.010	1.8	5.5	-	V-Ditch
				t_c	**11.4 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.14	3.93	4.58	5.24	5.89	6.60
Runoff (cfs)	0.6	**0.8**	1.1	1.4	1.7	**2.0**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.6	**0.8**	1.1	1.4	1.7	**2.0**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Combined Sub-Basin Runoff Calculations (DP2)

Includes Basins B1 B2 B3 B4

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	1,926,449	44.23	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	7,500	0.17	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	99,439	2.28	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**2,033,388**	**46.68**	**0.05**	**0.11**	**0.18**	**0.27**	**0.32**	**0.37**	**4.2%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	B1	-	2,415	60	-	-	-	-	49.6
Channelized-1	Pipe	RCP	75	1	9	3	0	8.2	0.2
Channelized-2									
Channelized-3									
Total			2,490	61					
								t_c (min)	**49.8**

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.39	1.72	2.01	2.30	2.58	2.89
Site Runoff (cfs)	3.20	**8.63**	16.48	29.15	38.64	**49.72**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**8.6**	-	-	-	**49.7**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Sub-Basin B5 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	911,859	20.93	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	36,890	0.85	0.57	0.59	0.63	0.66	0.68	0.7	80%
Roofs	20,000	0.46	0.71	0.73	0.75	0.78	0.8	0.81	90%
Combined	**968,749**	**22.24**	**0.06**	**0.11**	**0.18**	**0.28**	**0.32**	**0.37**	**4.9%**

968749

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	1,440	28	-	-	-	-	
Initial Time	300	5	0.017	-	26.1	N/A	DCM Eq. 6-8
Shallow Channel	730	14	0.019	1.0	12.6	-	DCM Eq. 6-9
Channelized	410	9	0.022	2.1	3.3	-	Trap Ditch
				t_c	**41.9 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.59	1.98	2.31	2.64	2.97	3.32
Runoff (cfs)	2.0	**5.0**	9.3	16.2	21.5	**27.5**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	2.0	**5.0**	9.3	16.2	21.5	**27.5**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Combined Sub-Basin Runoff Calculations (DP3)

Includes Basins B1 B2 B3 B4 B5

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	2,838,308	65.16	0.02	0.08	0.15	0.25	0.3	0.35	0%
Roofs	27,500	0.63	0.71	0.73	0.75	0.78	0.8	0.81	90%
Gravel	136,329	3.13	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**3,002,137**	**68.92**	**0.05**	**0.11**	**0.18**	**0.27**	**0.32**	**0.37**	**4.5%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	B1	-	2,415	60	-	-	-	-	49.6
Channelized-1	Pipe	RCP	75	1	9	3	0	8.2	0.2
Channelized-2	Trap Ditch	2	925	16	12	3	4	2.4	6.5
Channelized-3									
Total			3,415	77					
								t_c (min)	56.3

2 = Natural, Winding, minimal vegetation/shallow grass

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	1.24	1.54	1.79	2.05	2.31	2.58
Site Runoff (cfs)	4.38	**11.56**	21.91	38.63	51.15	**65.76**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**11.6**	-	-	-	**65.8**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Sub-Basin C1 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	14,901	0.34	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	12,825	0.29	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**27,726**	**0.64**	**0.27**	**0.32**	**0.37**	**0.44**	**0.48**	**0.51**	**37.0%**

27726

-

Basin Travel Time

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	772	14	-	-	-	-	
Initial Time	32	1	0.020	-	6.3	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized	740	13	0.018	2.2	5.6	-	V-Ditch
				t_c	**11.9 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	3.08	3.86	4.51	5.15	5.80	6.49
Runoff (cfs)	0.5	**0.8**	1.1	1.4	1.8	**2.1**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**0.8**	1.1	1.4	1.8	**2.1**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Sub-Basin C2 Runoff Calculations (Developed)

Job No.:	08019	Date:	6/2/2020 18:53
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	59,408	1.36	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	10,205	0.23	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**69,613**	**1.60**	**0.10**	**0.15**	**0.22**	**0.31**	**0.36**	**0.40**	**11.7%**

69613

Basin Travel Time

-

Shallow Channel Ground Cover Short Pasture/Lawns

$L_{max,Overland}$ 300 ft C_v 7

	L (ft)	ΔZ_0 (ft)	S_0 (ft/ft)	v (ft/s)	t (min)	t_{Alt} (min)	
Total	374	9	-	-	-	-	
Initial Time	105	4	0.033	-	11.8	N/A	DCM Eq. 6-8
Shallow Channel			0.000	0.0	0.0	-	DCM Eq. 6-9
Channelized	269	5	0.019	2.3	1.9	-	V-Ditch
				t_c	**13.7 min.**		

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.92	3.66	4.27	4.88	5.49	6.14
Runoff (cfs)	0.5	**0.9**	1.5	2.4	3.1	**3.9**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	0.5	**0.9**	1.5	2.4	3.1	**3.9**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

Combined Sub-Basin Runoff Calculations (DP 4)

Includes Basins C1 C2

Job No.:	08019	Date:	6/2/2020 19:41
Project:	Mountain's Edge	Calcs by:	drg
		Checked by:	
Jurisdiction	DCM	Soil Type	B
Runoff Coefficient	Surface Type	Urbanization	Non-Urban

Basin Land Use Characteristics

Surface	Area (SF)	Area (Acres)	Runoff Coefficient C2	C5	C10	C25	C50	C100	% Imperv.
Pasture/Meadow	74,309	1.71	0.02	0.08	0.15	0.25	0.3	0.35	0%
Gravel	23,030	0.53	0.57	0.59	0.63	0.66	0.68	0.7	80%
Combined	**97,339**	**2.23**	**0.15**	**0.20**	**0.26**	**0.35**	**0.39**	**0.43**	**18.9%**

Basin Travel Time

	Sub-basin or Channel Type	Material Type	L (ft)	Elev. ΔZ_0 (ft)	Q_i (cfs)	Base or Dia (ft)	Sides z:1 (ft/ft)	v (ft/s)	t (min)
Furthest Reach	C2	-	374	9	-	-	-	-	13.7
Channelized-1									
Channelized-2									
Channelized-3									
Total			374	9					
								t_c (min)	**13.7**
							M		

Contributing Offsite Flows (Added to Runoff and Allowed Release, below.)

Contributing Basins/Areas

Q_{Minor} (cfs) - 5-year Storm

Q_{Major} (cfs) - 100-year Storm

Rainfall Intensity & Runoff

	2-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr
Intensity (in/hr)	2.92	3.66	4.27	4.88	5.49	6.14
Site Runoff (cfs)	0.98	**1.64**	2.51	3.78	4.78	**5.94**
OffSite Runoff (cfs)	-	**0.00**	-	-	-	**0.00**
Release Rates (cfs/ac)	-	-	-	-	-	-
Allowed Release (cfs)	-	**1.6**	-	-	-	**5.9**

DCM: I = C1 * ln (tc) + C2

C1	1.19	1.5	1.75	2	2.25	2.52
C2	6.035	7.583	8.847	10.111	11.375	12.735

Notes

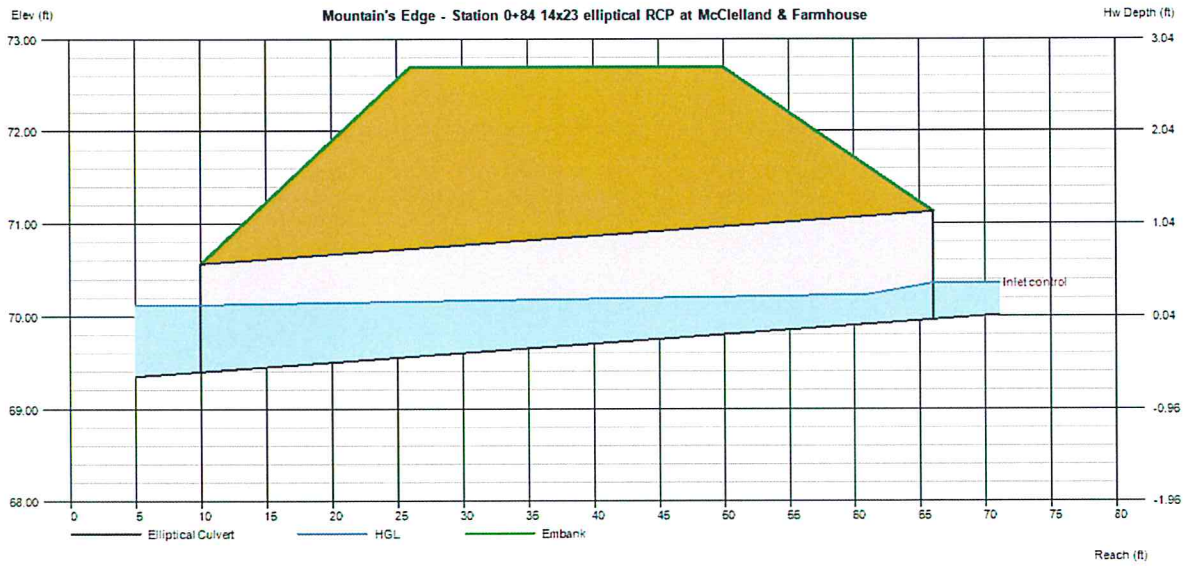
Runoff from Offsite basins have been assumed constant, despite additional times of concentration.

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

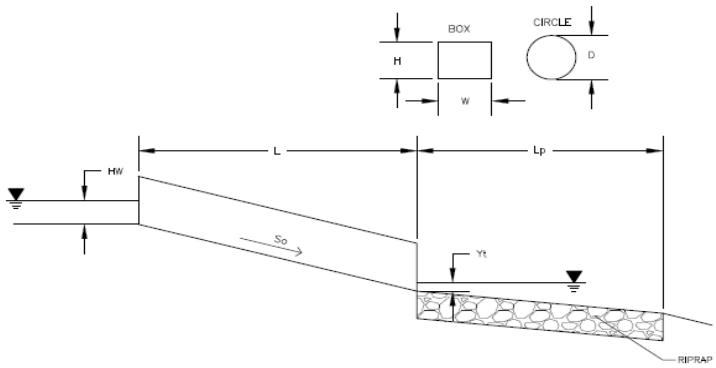
Mountain's Edge - Station 0+84 14x23 elliptical RCP at McClelland & Farmhouse

Invert Elev Dn (ft)	= 69.40	**Calculations**	
Pipe Length (ft)	= 56.00	Qmin (cfs)	= 0.80
Slope (%)	= 1.00	Qmax (cfs)	= 2.10
Invert Elev Up (ft)	= 69.96	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 14.0		
Shape	= Elliptical	**Highlighted**	
Span (in)	= 23.0	Qtotal (cfs)	= 0.80
No. Barrels	= 1	Qpipe (cfs)	= 0.80
n-Value	= 0.013	Qovertop (cfs)	= 0.00
Culvert Type	= Horizontal Ellipse Concrete	Veloc Dn (ft/s)	= 0.65
Culvert Entrance	= Square edge w/headwall (H)	Veloc Up (ft/s)	= 2.76
Coeff. K,M,c,Y,k	= 0.01, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 70.12
		HGL Up (ft)	= 70.24
Embankment		Hw Elev (ft)	= 70.35
Top Elevation (ft)	= 72.69	Hw/D (ft)	= 0.34
Top Width (ft)	= 24.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 100.00		



Determination of Culvert Headwater and Outlet Protection

Project: Mountain's Edge
Basin ID: Farmhous Ct culvert sta 0+84 - rip rap apron sizing



this sheet for riprap apron sizing using equivalent round pipe - see culvert calculations for elliptical culvert flow and headwater calculations

Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

Design Discharge	Q =	2.1	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)		Square End with Headwall	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	69.97	ft
Outlet Elevation **OR** Slope	Elev OUT =	69.4	ft
Culvert Length	L =	56	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =	70.2	ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

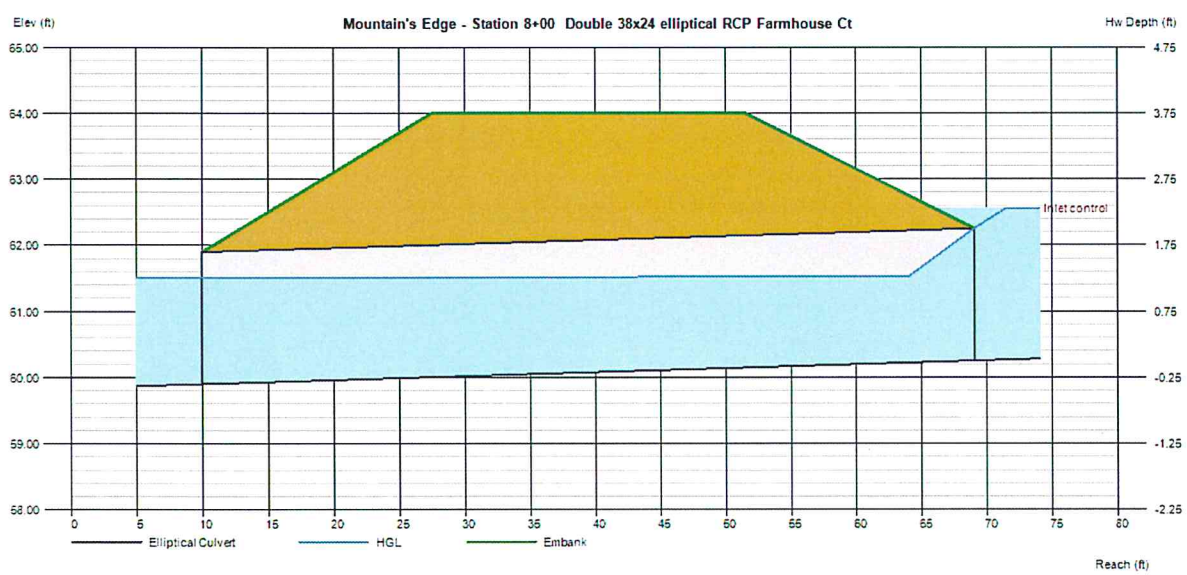
Tailwater Surface Height	Y_t =	0.80	ft
Flow Area at Max Channel Velocity	A_t =	0.42	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.69	
Sum of All Losses Coefficients	k_s =	2.19	ft
Culvert Normal Depth	Y_n =	0.41	ft
Culvert Critical Depth	Y_c =	0.50	ft
Tailwater Depth for Design	d =	1.25	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.20	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	0.37	$ft^{0.5}/s$
Froude Number	Fr =	1.50	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.66	
Inlet Control Headwater	HW_I =	0.68	ft
Outlet Control Headwater	HW_O =	0.70	
Design Headwater Elevation	**HW =**	**70.67**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.35**	
Minimum Theoretical Riprap Size	d_{50} =	1	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**6**	**ft**
Width of Protection	**T =**	**3**	**ft**

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

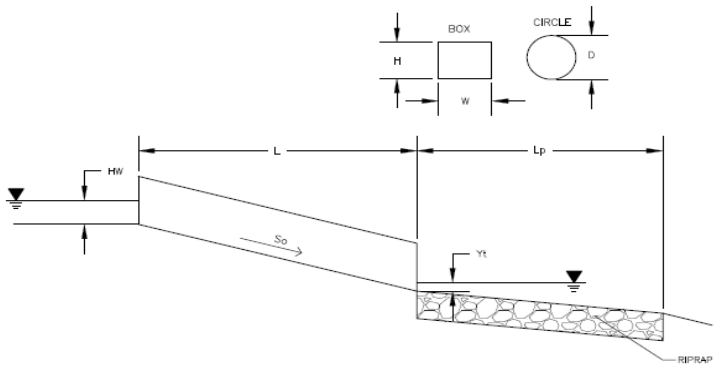
Mountain's Edge - Station 8+00 Double 38x24 elliptical RCP Farmhouse Ct

Invert Elev Dn (ft)	= 59.90	**Calculations**	
Pipe Length (ft)	= 59.00	Qmin (cfs)	= 8.30
Slope (%)	= 0.59	Qmax (cfs)	= 49.00
Invert Elev Up (ft)	= 60.25	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 24.0		
Shape	= Elliptical	**Highlighted**	
Span (in)	= 38.0	Qtotal (cfs)	= 48.30
No. Barrels	= 2	Qpipe (cfs)	= 48.30
n-Value	= 0.013	Qovertop (cfs)	= 0.00
Culvert Type	= Horizontal Ellipse Concrete	Veloc Dn (ft/s)	= 5.58
Culvert Entrance	= Square edge w/headwall (H)	Veloc Up (ft/s)	= 6.94
Coeff. K,M,c,Y,k	= 0.01, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 61.50
		HGL Up (ft)	= 61.53
Embankment		Hw Elev (ft)	= 62.56
Top Elevation (ft)	= 64.00	Hw/D (ft)	= 1.16
Top Width (ft)	= 24.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 200.00		



Determination of Culvert Headwater and Outlet Protection

Project: Mountain's Edge
Basin ID: Farmhouse Ct Culvert sta 8+00 - rip rap apron sizing



this sheet for riprap apron sizing using equivalent round pipe - see culvert calculations for elliptical culvert flow and headwater calculations

Soil Type:
Choose One:
- (●) Sandy
- ( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	49	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)		Square End with Headwall	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	2	
Inlet Elevation	Elev IN =	60.25	ft
Outlet Elevation **OR** Slope	Elev OUT =	59.9	ft
Culvert Length	L =	59	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =	61.5	ft
Max Allowable Channel Velocity	V =	7	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	1.60	ft
Flow Area at Max Channel Velocity	A_t =	3.50	ft^2
Culvert Cross Sectional Area Available	A =	3.41	ft^2
Entrance Loss Coefficient	k_e =	0.50	
Friction Loss Coefficient	k_f =	0.69	
Sum of All Losses Coefficients	k_s =	2.19	ft
Culvert Normal Depth	Y_n =	1.35	ft
Culvert Critical Depth	Y_c =	1.75	ft
Tailwater Depth for Design	d =	1.92	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	3.91	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.77	
Inlet Control Headwater	HW_I =	3.43	ft
Outlet Control Headwater	HW_O =	3.32	
Design Headwater Elevation	**HW =**	**63.68**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.64**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	3	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**7**	**ft**
Width of Protection	**T =**	**4**	**ft**

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

Cross section 1 downsream of Farmhouse Ct. - 5 YR

User-defined

Invert Elev (ft)	= 6559.00
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

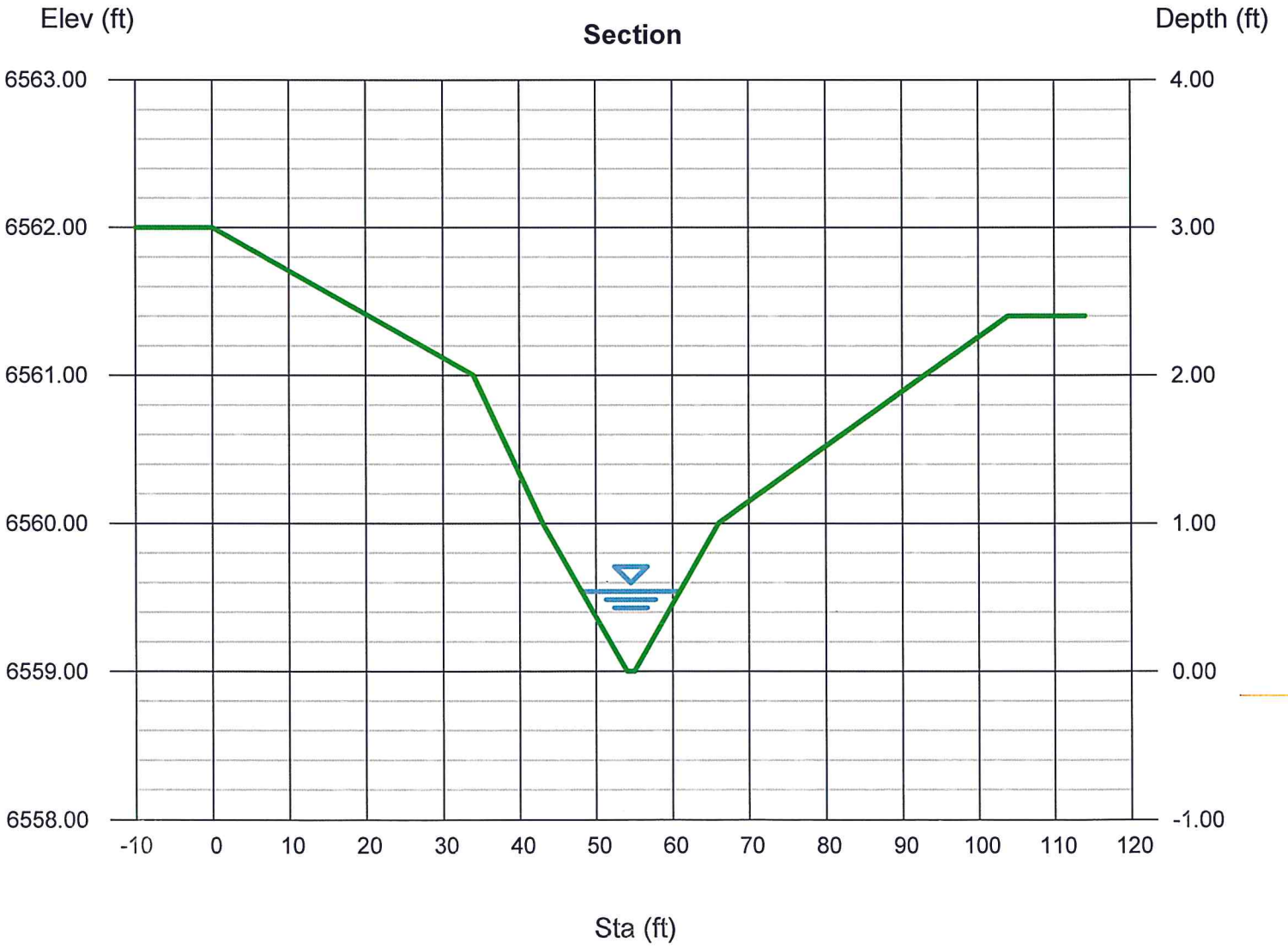
Compute by:	Known Q
Known Q (cfs)	= 8.60

Highlighted

Depth (ft)	= 0.54
Q (cfs)	= 8.600
Area (sqft)	= 3.75
Velocity (ft/s)	= 2.29
Wetted Perim (ft)	= 12.93
Crit Depth, Yc (ft)	= 0.48
Top Width (ft)	= 12.88
EGL (ft)	= 0.62

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

(0.00, 6562.00)-(34.00, 6561.00, 0.035)-(43.00, 6560.00, 0.035)-(54.00, 6559.00, 0.035)-(55.00, 6559.00, 0.035)-(66.00, 6560.00, 0.035)-(93.00, 6561.00, -(104.00, 6561.40, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

cross section 1 downsream of Farmhouse Ct. 100-YR

User-defined

Invert Elev (ft)	= 6559.00
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

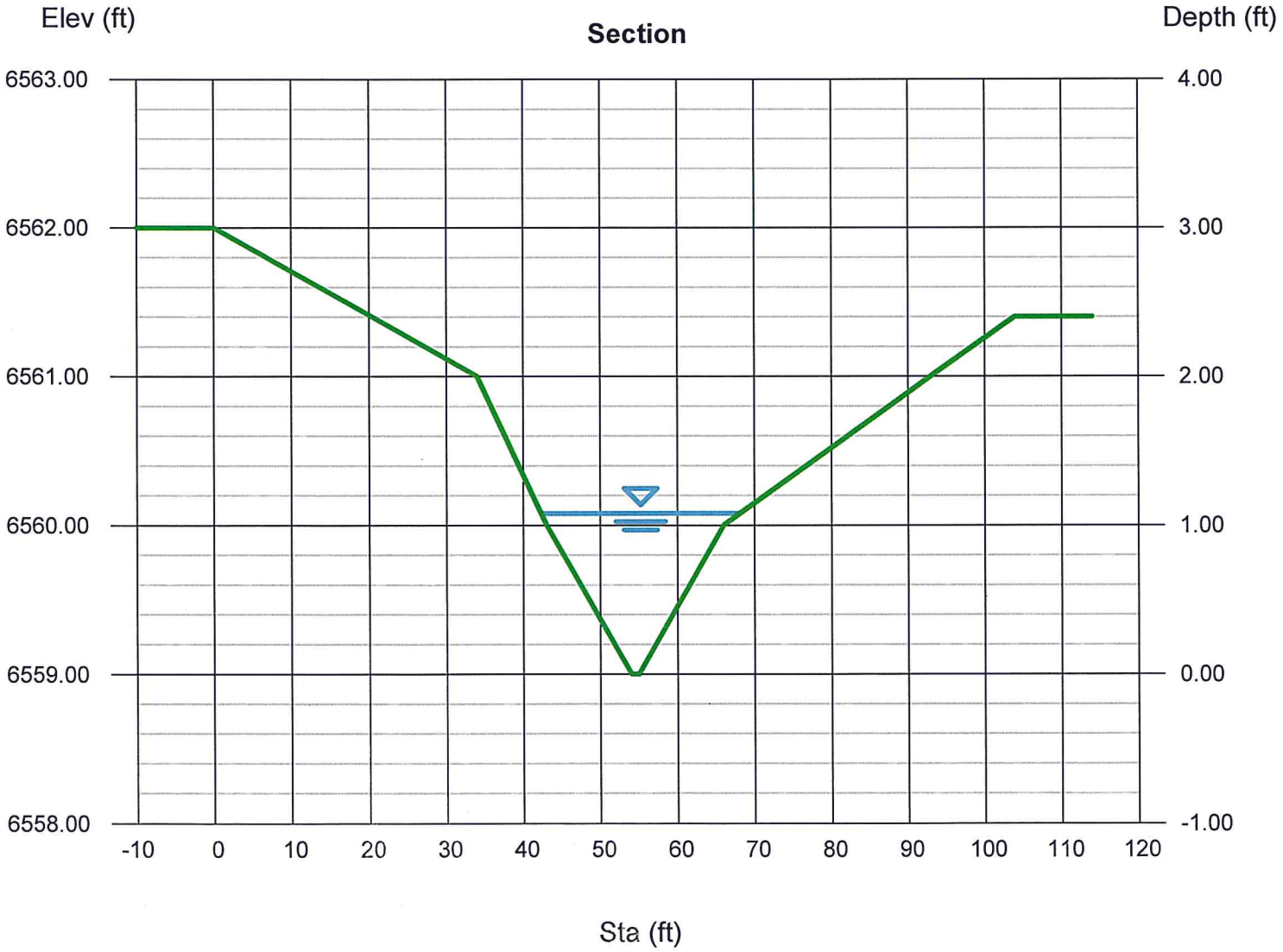
Compute by:	Known Q
Known Q (cfs)	= 49.70

Highlighted

Depth (ft)	= 1.08
Q (cfs)	= 49.70
Area (sqft)	= 13.96
Velocity (ft/s)	= 3.56
Wetted Perim (ft)	= 25.98
Crit Depth, Yc (ft)	= 1.01
Top Width (ft)	= 25.88
EGL (ft)	= 1.28

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

(0.00, 6562.00)-(34.00, 6561.00, 0.035)-(43.00, 6560.00, 0.035)-(54.00, 6559.00, 0.035)-(55.00, 6559.00, 0.035)-(66.00, 6560.00, 0.035)-(93.00, 6561.00, -(104.00, 6561.40, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

Cross section 2 downsream of Farmhouse Ct. - 5 YR

User-defined

Invert Elev (ft)	= 6554.40
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

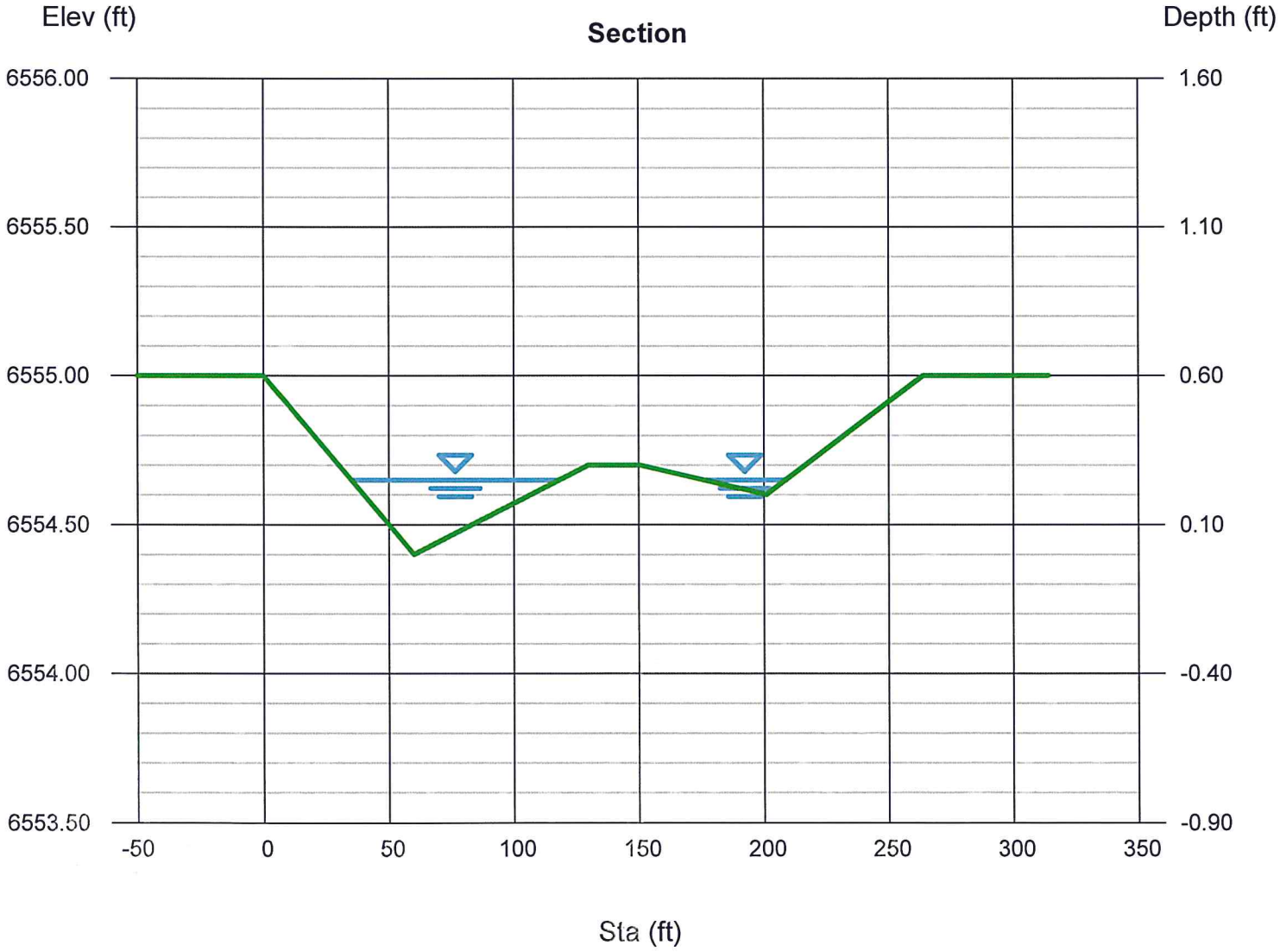
Compute by:	Known Q
Known Q (cfs)	= 11.60

Highlighted

Depth (ft)	= 0.25
Q (cfs)	= 11.60
Area (sqft)	= 11.24
Velocity (ft/s)	= 1.03
Wetted Perim (ft)	= 116.50
Crit Depth, Yc (ft)	= 0.20
Top Width (ft)	= 116.49
EGL (ft)	= 0.27

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

(0.00, 6555.00)-(60.00, 6554.40, 0.035)-(130.00, 6554.70, 0.035)-(150.00, 6554.70, 0.035)-(201.00, 6554.60, 0.035)-(264.00, 6555.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

cross section 2 downsream of Farmhouse Ct. 100-YR

User-defined

Invert Elev (ft)	= 6554.40
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

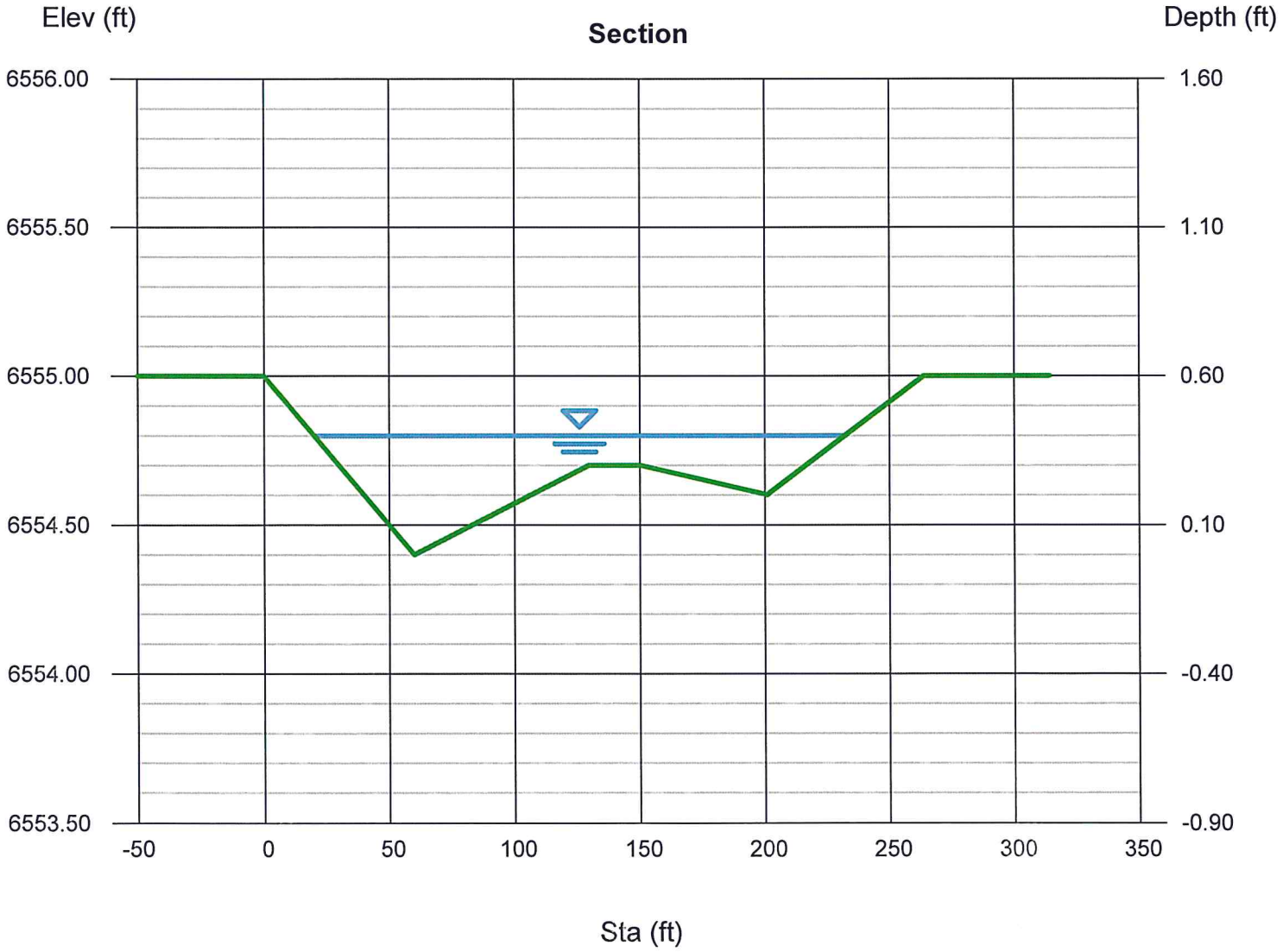
Compute by:	Known Q
Known Q (cfs)	= 65.80

Highlighted

Depth (ft)	= 0.40
Q (cfs)	= 65.80
Area (sqft)	= 38.24
Velocity (ft/s)	= 1.72
Wetted Perim (ft)	= 212.45
Crit Depth, Yc (ft)	= 0.37
Top Width (ft)	= 212.45
EGL (ft)	= 0.45

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

(0.00, 6555.00)-(60.00, 6554.40, 0.035)-(130.00, 6554.70, 0.035)-(150.00, 6554.70, 0.035)-(201.00, 6554.60, 0.035)-(264.00, 6555.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

Cross section 3 downsream of Farmhouse Ct. - 5 YR

User-defined

Invert Elev (ft)	= 6547.80
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

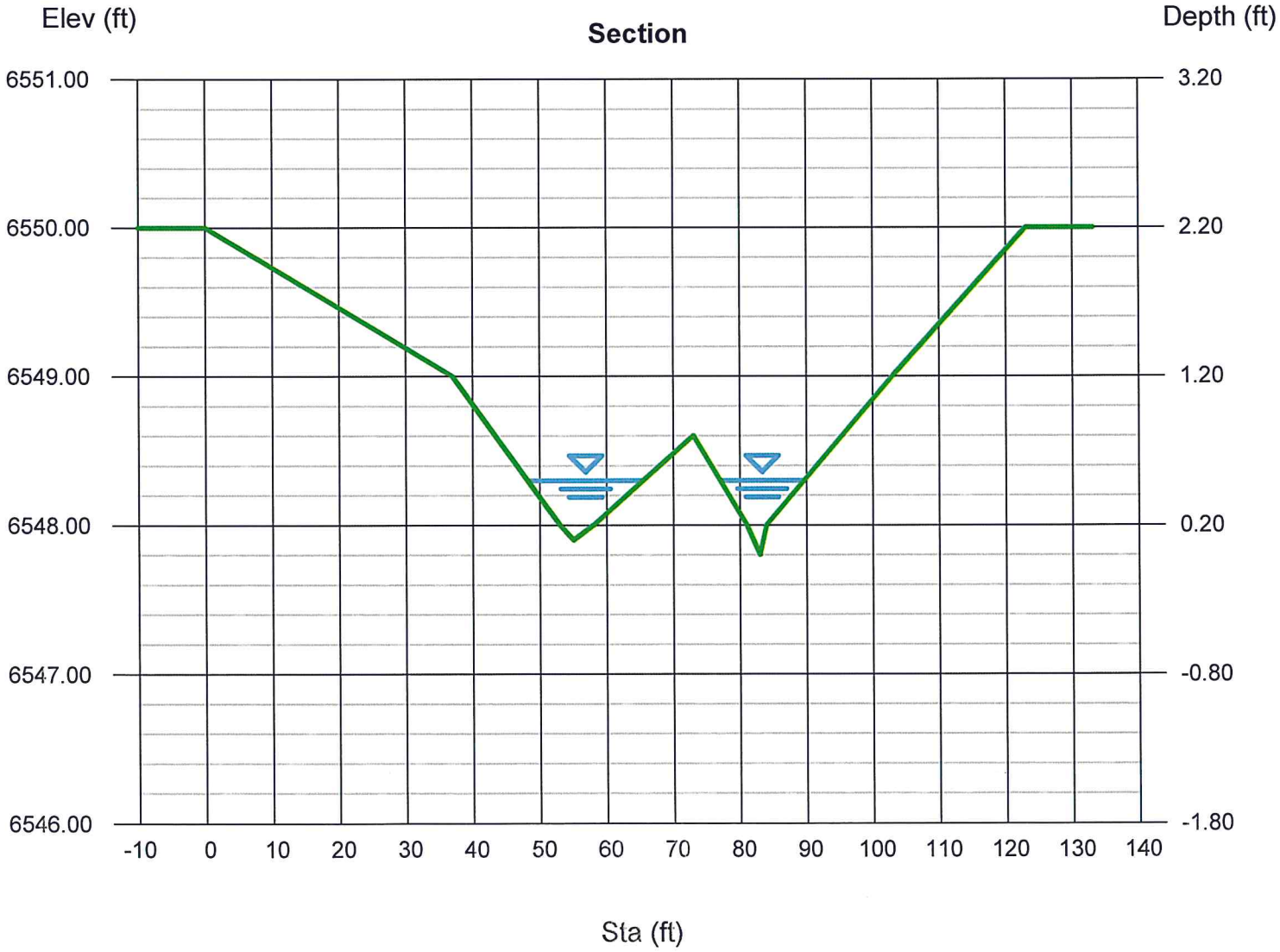
Compute by:	Known Q
Known Q (cfs)	= 11.60

Highlighted

Depth (ft)	= 0.50
Q (cfs)	= 11.60
Area (sqft)	= 6.24
Velocity (ft/s)	= 1.86
Wetted Perim (ft)	= 30.05
Crit Depth, Yc (ft)	= 0.45
Top Width (ft)	= 29.98
EGL (ft)	= 0.55

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

(0.00, 6550.00)-(37.00, 6549.00, 0.035)-(53.00, 6548.00, 0.035)-(55.00, 6547.90, 0.035)-(58.00, 6548.00, 0.035)-(73.00, 6548.60, 0.035)-(81.00, 6548.00, -(83.00, 6547.80, 0.035)-(84.00, 6548.00, 0.035)-(103.00, 6549.00, 0.035)-(123.00, 6550.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

cross section 3 downsream of Farmhouse Ct. 100-YR

User-defined

Invert Elev (ft)	= 6547.80
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

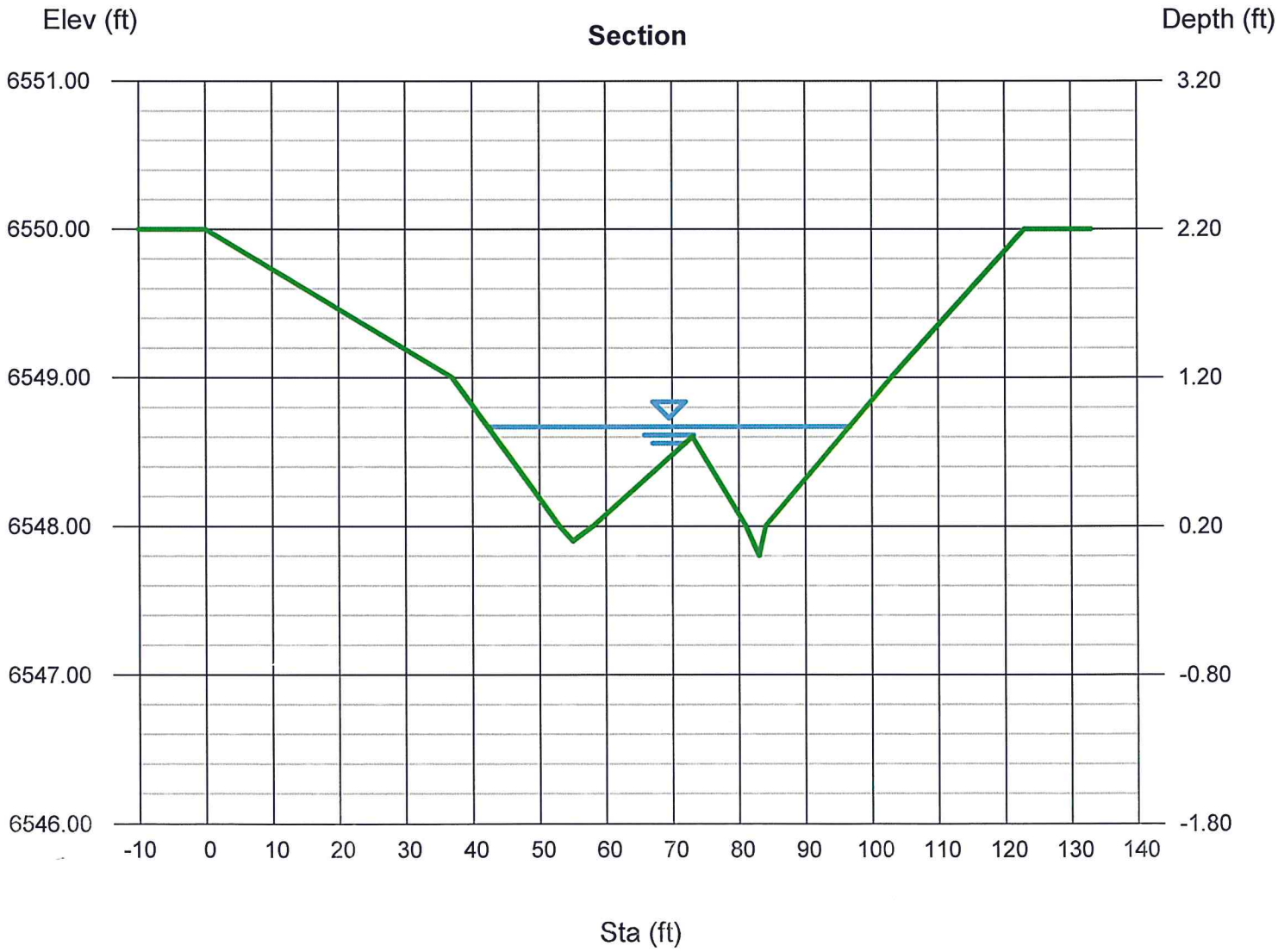
Compute by:	Known Q
Known Q (cfs)	= 65.80

Highlighted

Depth (ft)	= 0.87
Q (cfs)	= 65.80
Area (sqft)	= 22.27
Velocity (ft/s)	= 2.95
Wetted Perim (ft)	= 54.55
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 54.45
EGL (ft)	= 1.01

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

(0.00, 6550.00)-(37.00, 6549.00, 0.035)-(53.00, 6548.00, 0.035)-(55.00, 6547.90, 0.035)-(58.00, 6548.00, 0.035)-(73.00, 6548.60, 0.035)-(81.00, 6548.00, -(83.00, 6547.80, 0.035)-(84.00, 6548.00, 0.035)-(103.00, 6549.00, 0.035)-(123.00, 6550.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

cross section 4 downsream outfall 5-YR

User-defined

Invert Elev (ft)	= 6545.50
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

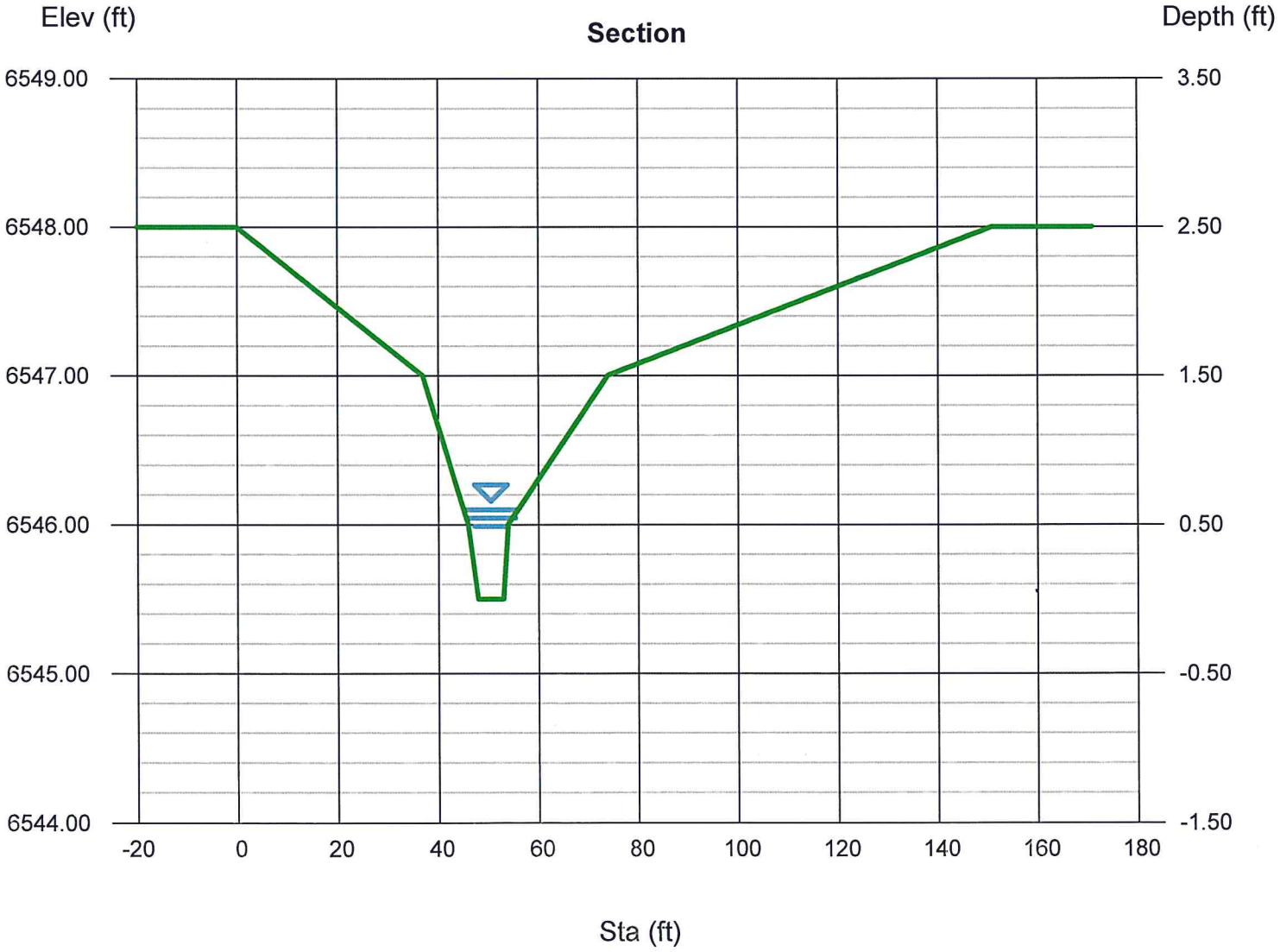
Compute by:	Known Q
Known Q (cfs)	= 11.60

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 11.60
Area (sqft)	= 4.20
Velocity (ft/s)	= 2.76
Wetted Perim (ft)	= 11.09
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 10.90
EGL (ft)	= 0.72

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

(0.00, 6548.00)-(37.00, 6547.00, 0.035)-(46.00, 6546.00, 0.035)-(48.00, 6545.50, 0.035)-(53.00, 6545.50, 0.035)-(54.00, 6546.00, 0.035)-(74.00, 6547.00, -(151.00, 6548.00, 0.035)



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jun 2 2020

cross section 4 downsream outfall 100-YR

User-defined

Invert Elev (ft)	= 6545.50
Slope (%)	= 1.62
N-Value	= 0.035

Calculations

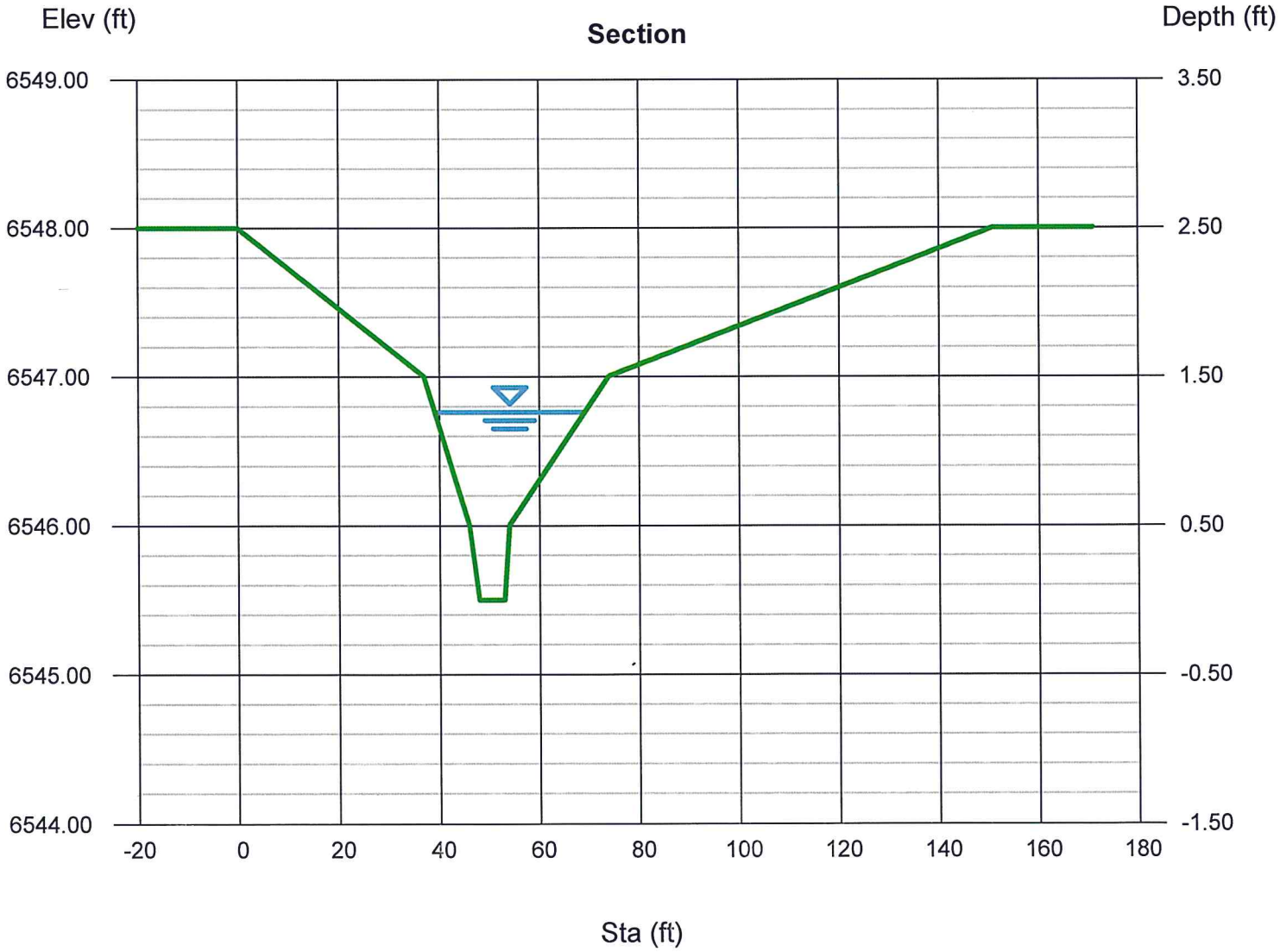
Compute by:	Known Q
Known Q (cfs)	= 65.80

Highlighted

Depth (ft)	= 1.26
Q (cfs)	= 65.80
Area (sqft)	= 17.70
Velocity (ft/s)	= 3.72
Wetted Perim (ft)	= 30.27
Crit Depth, Yc (ft)	= 1.19
Top Width (ft)	= 30.03
EGL (ft)	= 1.47

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

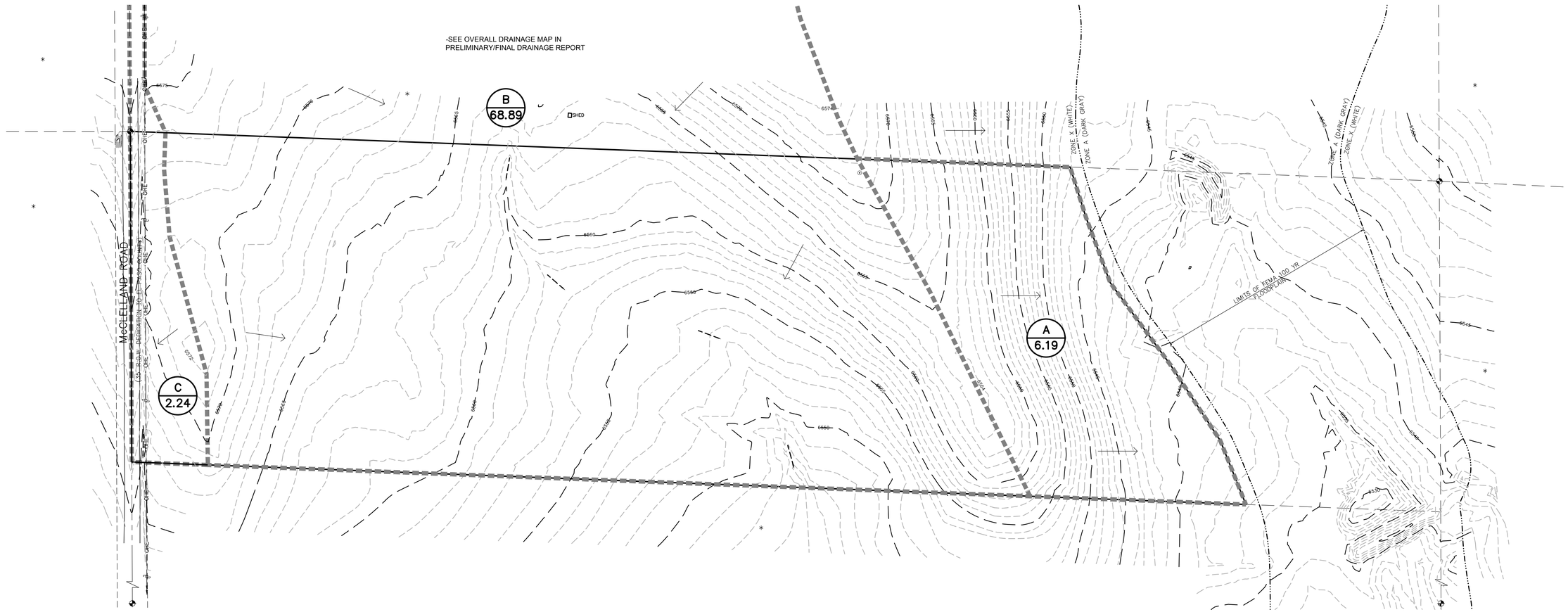
(0.00, 6548.00)-(37.00, 6547.00, 0.035)-(46.00, 6546.00, 0.035)-(48.00, 6545.50, 0.035)-(53.00, 6545.50, 0.035)-(54.00, 6546.00, 0.035)-(74.00, 6547.00, -(151.00, 6548.00, 0.035)



MOUNTAINS EDGE

PRELIMINARY / FINAL DRAINAGE REPORT
EXISTING DRAINAGE PLAN

VICINITY MAP
NO SCALE



CONTOUR LEGEND

EXISTING	(6840)	MAJOR CONTOUR
	(41)	MINOR CONTOUR
PROPOSED	6840	MAJOR CONTOUR
	41	MINOR CONTOUR

DRAINAGE PLAN LEGEND

BASIN BOUNDARY	
CONCENTRATED FLOW PATH	
FLOW DIRECTION	
C / 2.30 — BASIN NAME / ACREAGE	DRAINAGE BASIN TAG
DP 5 — DESIGN POINT DESIGNATION	DESIGN POINT TAG

DRAINAGE BASIN SUMMARY
EXISTING BASINS

BASIN	DESIGN POINT	AREA (ACRES)	MINOR FLOW (cfs): (5 YR)	MAJOR FLOW (cfs): (100 YR)
A		6.19	1.6	11.8
B		68.89	9.7	63.0
C		2.24	1.6	6.0

N

100 0 100 200

HORIZONTAL SCALE: 1" = 100'
CONTOUR INTERVAL = 1'

FOR INFORMATION ONLY

NOT FOR CONSTRUCTION:

THESE PLANS ARE INTENDED FOR SUBMITTAL, REVIEW AND APPROVAL BY CITY/CITY PLANNING DEPARTMENTS AND SHOULD NOT BE USED ON SITE FOR CONSTRUCTION OR LAYOUT.

REVISIONS

No.	Description	By	Date

H Scale: XX
V Scale: XX
Designed By: DCE
Drawn By: JAR
Checked By: DRG
Date: 6/25/19

Land Development Consultants, Inc.
Planning • Landscape Architecture
Engineering • Surveying
www.ldc-inc.com • TEL: (719) 528-6133 • FAX: (719) 528-6848
2850 Serendipity Circle West • Colorado Springs, CO 80917

MOUNTAINS EDGE
EXISTING DRAINAGE PLAN

Project No.: 08019

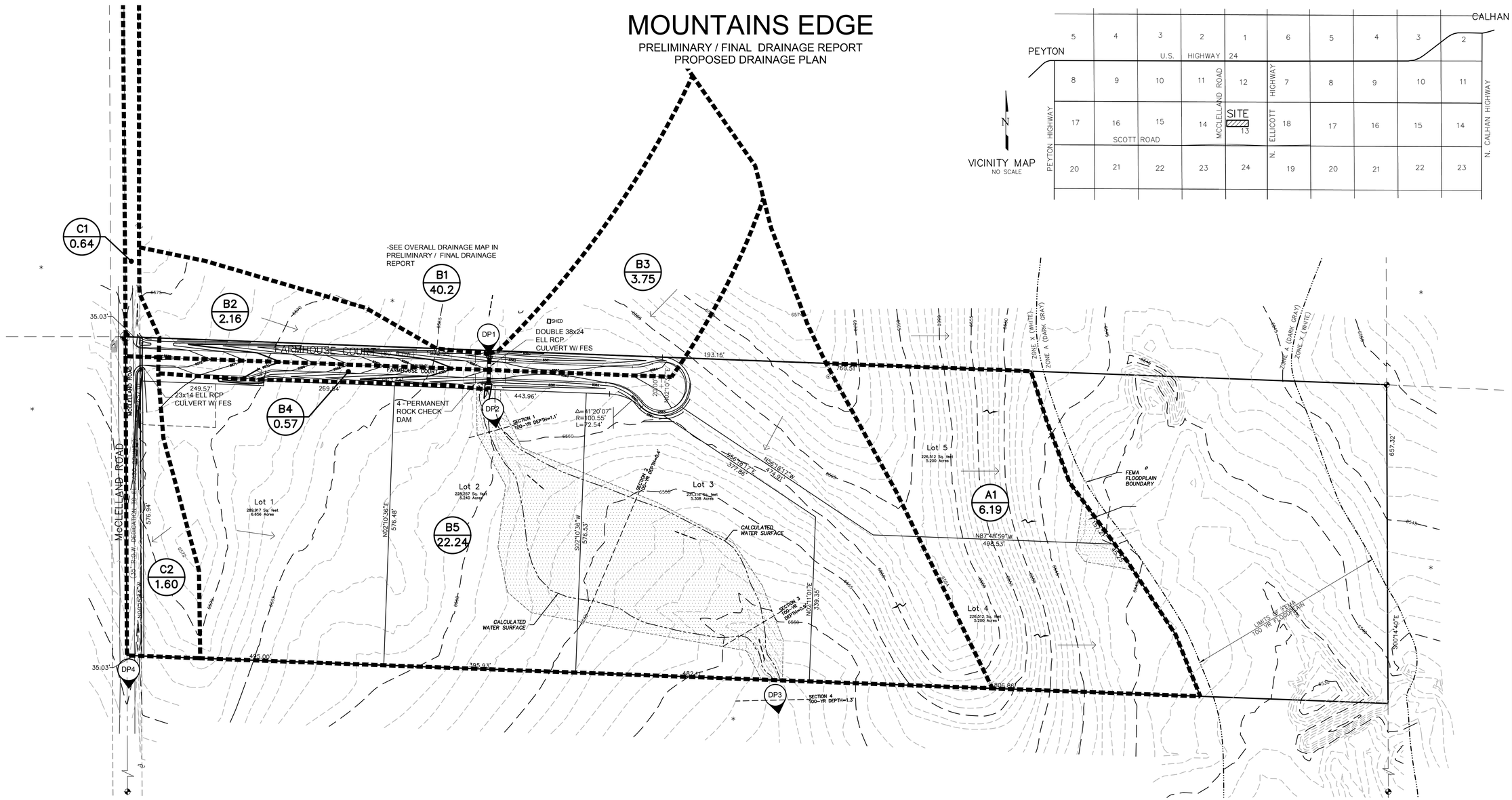
Sheet: 1 of 2

Z:\8\1997_Outside Drags\LDC\08019-EX_DRN.dwg

MOUNTAINS EDGE

PRELIMINARY / FINAL DRAINAGE REPORT
PROPOSED DRAINAGE PLAN

VICINITY MAP
NO SCALE



CONTOUR LEGEND

EXISTING	(6840)	MAJOR CONTOUR
	(41)	MINOR CONTOUR
PROPOSED	6840	MAJOR CONTOUR
	41	MINOR CONTOUR

DRAINAGE PLAN LEGEND

BASIN BOUNDARY	
CONCENTRATED FLOW PATH	
FLOW DIRECTION	
C / 2.30 — BASIN NAME / ACREAGE	DRAINAGE BASIN TAG
DP 5	DESIGN POINT TAG — DESIGN POINT DESIGNATION

DRAINAGE BASIN SUMMARY
PROPOSED BASINS

BASIN	DESIGN POINT	AREA (ACRES)	MINOR FLOW (cfs): (5 YR)	MAJOR FLOW (cfs): (100 YR)
A1		6.19	2.1	12.4
B1		40.2	7.0	42.4
B2		2.16	0.8	3.6
B3		3.75	1.3	6.9
B4		0.57	0.8	2.0
B5		2.24	5.0	27.5
C1		0.64	0.8	2.1
C2		1.60	0.9	3.9
	DP1	46.11	8.3	49.0
	DP2	46.68	8.6	49.7
	DP3	68.92	11.6	65.8
	DP4	2.24	1.6	5.9

N

100 0 100 200

HORIZONTAL SCALE: 1" = 100'
CONTOUR INTERVAL = 1'

NOT FOR CONSTRUCTION:

THESE PLANS ARE INTENDED FOR SUBMITTAL, REVIEW AND APPROVAL BY CITY/CITY PLANNING DEPARTMENTS AND SHOULD NOT BE USED ON SITE FOR CONSTRUCTION OR LAYOUT.

REVISIONS

No.	Description	By	Date

H Scale:	XX
V Scale:	XX
Designed By:	DCE
Drawn By:	JAR
Checked By:	DRG
Date:	6/25/19

Land Development Consultants, Inc.
Planning • Landscape Architecture
Engineering • Surveying
www.ldc-inc.com • TEL: (719) 528-6133 • FAX: (719) 528-6848
2850 Serendipity Circle West • Colorado Springs, CO 80917

MOUNTAINS EDGE
PROPOSED DRAINAGE PLAN

Project No.: 08019

Sheet: 2 of 2

Z:\61097_Outside Dwgs\LDC\08019-PP_DRN.dwg