PRELIMINARY DRAINAGE REPORT

GRANDVIEW RESERVE FILING NO. 1

El Paso County, Colorado

Engineering Review

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See comment memo also

PREPARED FOR:
D.R. Horton
9555 S. Kingston Court
Englewood, CO

PREPARED BY:
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DATE:
May 27, 2022

PCD Filing No.: PUDSP2110

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.

______________________________________ ____________________

Brady A. Shyrock, PE #38164 Date
For and on behalf of Galloway & Company, Inc.

Provide signatures

DEVELOPER'S CERTIFICATION

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

By:______________________________________ ____________________

Date

Address: D.R. Horton
9555 S. Kingston Court
Englewood, CO

EL PASO COUNTY CERTIFICATION

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.

______________________________________ ____________________

Joshua Palmer, P.E. Date
Interim County Engineer/ECM Administrator

Conditions:

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I. Purpose

The purpose of this Preliminary Drainage Report is to identify on and offsite drainage patterns, locate and identify tributary or downstream drainage features and facilities that impact the site, and to identify which types of drainage facilities will be needed and where they will be located. This report will remain in general compliance with the approved MDDP prepared by HR Green, dated November 2020.

II. General Description

The project is a single-family residential development located in the Falcon area of El Paso County, Colorado. The site is located in a portion of the South half of Section 21, the North half of Section 28, Township 12 South, Range 64 West of the 6th Principal Meridian, County of El Paso, State of Colorado. The subject property includes Eastonville Road to the west, the proposed extension of Rex Road to the north and is bounded by undeveloped land proposed as future development to the east, and undeveloped land within the Waterbury Development to the south. A Vicinity Map is included in **Appendix A**.

This preliminary drainage report is the basis for the drainage facility design in conformance with the previously approved MDDP for the site prepared by HR Green, "*Grandview Reserve Master Development Drainage Plan",* HR Green, November 2020 (**MDDP**). The site consists of approximately 189.479 acres and includes 565 dwelling units.

The existing soil types within the proposed site as determined by the NRCS Web Soil Survey for El Paso County Area consist of Columbine gravelly sandy loam (hydrologic soil group A) and Stapleton sandy loam (hydrologic soil group B). See the soils map included in **Appendix A**.

III. 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. The 5-year event was used as the minor event. The UD-Inlets v5.01 spreadsheet was utilized for the sizing of the proposed sump inlets.

The UD-Detention v4.04 spreadsheet was utilized for the design of the proposed on-site water quality ponds, Ponds A, B, C, D, E, and Eastonville Pond.

IV. Existing Drainage Conditions

The site is contained fully within one major drainage basin; the Gieck Ranch Drainage Basin and is tributary to Black Squirrel Creek. The site generally drains from north to south with an average slope of 2% outside of the channel. The rational method was used to analyze the individual basins within the site because their size permits it.

There are two (2) major drainageways that currently convey existing on & off-site flows through the site to the southeast. These are the Main Stem (MS) and Main Stem Tributary Number 2 (MST) as referenced in the **MDDP**. Both drainageways generally flow to the southeast towards Highway 24, before crossing via existing drainage structures. Currently, these channels receive flows from two off-site basins, one from the west (west of Basin B1 per the **MDDP;** 0.17 mi^2, Q_5 = ±67 cfs, Q_{100} = ±413 cfs) and the second from the northwest (northwest of Basin C1 per the **MDDP;** 0.44 mi^2, Q_5 = ±59 cfs, Q_{100} = ±280 cfs) and are routed under Eastonville Road via existing pipe culverts. There is an existing 24” CMP that conveys runoff under Eastonville Road at the MS, a location approximately 650 feet north of the proposed Rex Road extension that directs runoff via overtopping Eastonville Road at MST, and a 20” x 27” ECMP that directs runoff beneath Eastonville Road at the Falcon Regional Park.

While the **MDDP** shows a total of 22 basins that were analyzed as part of the overall Grandview Reserve development, for the purposes of this report, 7 of the Basins within the MDDP will be used for analysis. These Basins include A1, B1, B2, C1, B3, and the two off-site Basins situated to the northwest of Eastonville Road.

For a more in-depth analysis of existing tributary conditions as it pertains to this phase of development, an existing basin map has been prepared. The existing map can be found in **Appendix F** and basins are described below.

Basin OS-1 (1.57 AC, Q_5 = 0.5 cfs, Q_{100} = 3.6 cfs): Located to the southwest of the project site, this basin consists of undeveloped land west of Eastonville Road. Runoff is captured at **DP11** in an existing 18” CMP culvert that conveys the flow east across Eastonville Road.

Basin OS-2 (2.86 AC, Q_5 = 0.8 cfs, Q_{100} = 5.3 cfs): Located to the southwest of the project site, this basin consists of undeveloped land west of Eastonville Road. Runoff is captured at **DP10** in an existing 18" CMP culvert that conveys the flow east across Eastonville Road.

Basin OS-3 (21.61 AC, Q_5 = 4.5 cfs, Q_{100} = 30.5 cfs): Located to the west-southwest of the project site, this basin consists of undeveloped land west of Eastonville Road. Runoff is captured at **DP9** in an existing 18" CMP culvert that conveys the flow east across Eastonville Road.

Basin OS-4 (112.71 AC, Q_5 = 19.5 cfs, Q_{100} = 134.6 cfs): Located to the west of the project site, this basin consists of undeveloped land west of Eastonville Road and a small portion of Falcon Regional Park. Runoff is captured at **DP8** in an existing 24" CMP culvert that conveys the flow east across Eastonville Road.

Basin OS-5 (51.01 AC, Q_5 = 18.6 cfs, Q_{100} = 138.0 cfs): Located to the northwest of the project site, this basin consists of undeveloped land and the Falcon Regional Park, west of Eastonville Road. Runoff is captured at **DP7** in an existing 24" CMP culvert that conveys the flow east across Eastonville Road.

Basin EX-1 (16.18 AC, Q_5 = 3.4 cfs, Q_{100} = 24.4 cfs): Located on the southwest portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Main Stem channel **(DP 1)**.

Design Point 1 (Q_5 = 4.7 cfs, Q_{100} = 33.3 cfs): Located on the southern portion of the site, this design point accounts for the total combined flows from **Basins OS-1, OS-2 & EX-1**. Flows from this design point are conveyed off-site to the south, via a naturally formed channel, and discharges into the existing main stem tributary channel.

Basin EX-2 (46.06 AC, Q_5 = 7.6 cfs, Q_{100} = 53.7 cfs): Located in the southwest portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the Main Stem channel **(DP 2)**.

Design Point 2 (Q_5 = 79.1 cfs, Q_{100} = 497.2 cfs): Located on the southern portion of the site, this design point accounts for the total combined flows from **Basins OS-3, OS-4 & EX-2** and represents the total existing main stem tributary channel flows at that point. Flows from this design point are conveyed off-site to the south, via the main stem tributary channel.

Basin EX-3 (64.34 AC, Q_5 = 10.0 cfs, Q_{100} = 71.6 cfs): Located in the central portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Main Stem Tributary #2 channel **(DP 3)**.

Basin EX-4 (2.68 AC, Q_5 = 0.6 cfs, Q_{100} = 4.4 cfs): Located on the eastern portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the east into Main Stem Tributary #2 channel **(DP 4)**.

Basin EX-5 (26.15 AC, Q_5 = 5.0 cfs, Q_{100} = 35.5 cfs): Located in the north central portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Main Stem Tributary #2 channel **(DP 5)**.

Basin EX-6 (31.53 AC, Q_5 = 6.6 cfs, Q_{100} = 46.9 cfs): Located on the northern portion of the site, this basin consists of un-developed land. Runoff from this basin will sheet flow to the southeast before channelizing and eventually out falling into Main Stem Tributary #2 channel **(DP 6)**.

Design Point 6 (Q_5 = 14.6 cfs, Q_{100} = 584.9 cfs): Located on the northeast portion of the site, this design point accounts for the total combined flows from **Basins OS-5 & EX-6** and represents the total existing main stem tributary #2 channel flows at that point. Flows from this design point are conveyed off-site to the southeast, via the main stem tributary #2 channel.

Design Point 12 (Q_5 = 89.2 cfs, Q_{100} = 976.3 cfs): Located on the southeast portion of the site, this design point accounts for the total combined flows from **Design Points 3, 4, 5 & 6** and represents the total existing main stem tributary #2 channel flows at that point. Flows from this design point are conveyed off-site to the south, via the main stem tributary #2 channel.

V. 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

This step uses low impact development (LID) practices to reduce runoff at the source. Generally, rather than creating point discharges that are directly connected to impervious areas runoff is routed through pervious areas to promote infiltration. The Impervious Reduction Factor (IRF) method was used and calculations can be found in **Appendix E.**

2. Stabilize Channels

This step implements stabilization to channels 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. The existing channel analysis and design for the Main Stem Tributary #2 (MST) is to be completed by others and a report for the channel improvements will be submitted for review separately.

3. Provide Water Quality Capture Volume (WQCV)

This step utilizes formalized water quality capture volume to slow the release of runoff from the site. The EURV volume will release in 72 hours, while the WQCV will release in no less than 40 hours. On-site water quality control volume detention ponds will provide water quality treatment for all of the developed areas, prior to the runoff being released into either of the major drainage ways. Refer to WQCV Plan in **Appendix F.**

4. Consider Need for Industrial and Commercial BMPs

As this project is all residential development and no commercial or industrial development is proposed, there will be no need for any specialized BMPs which would be associated with an industrial or commercial site.

VI. Proposed Drainage Conditions

The proposed development lies completely within the Gieck Ranch Drainage Basin and consists of six (6) larger basins (EA, A, B, C, D, &E) which have been broken down into fifty-three (53) smaller sub-basins. Adjacent Off-site Basins (OS) were also analyzed in the proposed condition and have been broken down into five (5) smaller sub-basins. Site runoff will be collected via inlets & pipes and diverted to one of the six proposed full spectrum detention ponds or two sediment basins. All necessary calculations can be found within the appendices of this report.

According to the **MDDP**, there are two major drainageways that run through the site. As was discussed within the Existing Conditions portion of the report, both the Main Stem (MS) and Main Stem Tributary Number 2 (MST) run through the site conveying runoff from the northwest to the southeast. Presently, these channels receive flows from two off-site basins, one from the west (west of Sub-basin OS-3 per this report and Basin B1 per the **MDDP;** 0.17 mi^2, Q_5 = ±67 cfs, Q_{100} = ±413 cfs) and the second from the north (northwest of Sub-basin OS-1 per this report and Basin C1 per the **MDDP;** 0.44 mi^2, Q_5 = ±59 cfs, Q_{100} = ±280 cfs).

Basin OS-1 (6.73 AC, Q_5 = 1.3 cfs, Q_{100} = 8.7 cfs): Located to the southwest of the project site, this basin consists of undeveloped land west of Eastonville Road. Runoff is captured at **DP32** in a proposed 30" public RCP culvert that conveys the flow east across Eastonville Road and to Channel Main Stem, via a storm sewer system, per the Grandview Reserve MDDP.

Basin OS-2 (17.28 AC, Q_5 = 2.6 cfs, Q_{100} = 17.3 cfs): Located to the southwest of the project site, this basin consists of undeveloped land west of Eastonville Road. Runoff is captured at **DP32** in a proposed 30" public RCP culvert that conveys the flow east across Eastonville Road and to Channel Main Stem, via a storm sewer system, per the Grandview Reserve MDDP.

Design Point 32 (Q_5 = 3.6 cfs, Q_{100} = 24.0 cfs): Located on the southwest side of Eastonville road, this design point accounts for the total combined flows from **Basins OS-1 & OS-2** and represents the total existing upstream flows at that point. Flows from this design point are conveyed in a proposed 30" public RCP culvert that conveys the flow east across Eastonville Road and to Channel Main Stem, via a storm sewer system, per the Grandview Reserve MDDP.

Basin OS-3 (91.28 AC, Flows superseded by MDDP Flows): Located to the west-southwest of the project site, this basin consists of undeveloped land west of Eastonville Road. Runoff is captured at **DP34** in proposed public (3) – 60" RCP culverts that convey the flow east across Eastonville Road and to Channel Main Stem per the Grandview Reserve MDDP.

Basin OS-4 (20.30 AC, Flows superseded by MDDP Flows): Located to the west of the project site, this basin consists of undeveloped land west of Eastonville Road and a small portion of Falcon Regional Park. Runoff is captured at **DP34** in proposed public (3) – 60" RCP culverts that convey the flow east across Eastonville Road and to Channel Main Stem per the Grandview Reserve MDDP.

Design Point 34 (Q_5 = 67.0 cfs, Q_{100} = 413.00 cfs): Located on the northwest side of Eastonville road, the flows for this Design Point were taken from the approved 4 Way Ranch LOMR, 2004, Case No. 04-08-0012P. Flows from this design point are conveyed in proposed public (3) – 60" RCP culverts that convey the flow east across Eastonville Road and to Channel Main Stem per the Grandview Reserve MDDP.

What are the MDDP flows at DP 34 -- 413 cfs? FEMA flows account for (~1.5 sq mi) at then-existing conditions. Meridian Ranch MDDP - DP-G06 1.45 sq. mi., historic Q100=628, developed 663 cfs should be referenced also. See MDDP in SKP-17-1 file.

Basin OS-5 (47.27 AC, Q_5 = 8.0 cfs, Q_{100} = 125.0 cfs): Located to the northwest of the project site, this basin consists of undeveloped land and the Falcon Regional Park, west of Eastonville Road. The flows provided were taken from the approved Falcon Regional Park Drainage Report, 2015. Runoff is captured at **DP35** in a proposed public 48" RCP culvert that bypasses the flow through Grandview Reserve to Channel Main Stem Tributary 2 per the Grandview Reserve MDDP.

Preliminary sizing calculations for the FSD facility have been completed with the Eastonville Pond requiring approximately 1.301 ac-ft of storage capacity. Preliminary sizing for the MS and Eastonville Road crossing has been included within Appendix D, by HR Green. This crossing will require 3-60" RCP pipes with type M riprap for 50' L x 30' W at the downstream end.

There are no proposed major channel improvements for MS associated with this development -however, MST is proposed to be re-routed. The analysis for both channels and design of MST were done by others and a separate report will be submitted for review for all channel improvements.

The site will provide six (6) Full Spectrum Extended Detention Basins (EDBs). Ponds A, B, C, D, E, & Eastonville Pond will discharge treated runoff at historic rates directly into either the MS or MST Channel. The project site will also provide two (2) Sediment Basins (SBs). SB-1 at Rex Road and SB-2 at the southern corner of the church property. Both of these SBs have been sized to function as PBMPs (and will remain in place until such time development east of the proposed site takes place) and will discharge treated runoff at historic rates directly into MST at the northern portion of the project site.

As has been mentioned previously, the site is proposed to have a land use of single family residential. The site will consist primarily of 1/8 Acre lots, with some 1/4 Acre and 1/3 Acre lots, public roadways, along with dedicated Tracts for amenity and/or institutional uses.

The proposed institutional use (**Sub-basin A-1**) area flows have been included in this analysis at a preliminary level only. The Sub-basin is located on the northwest corner of the site, East of Eastonville Rd. & south of the proposed extension of Rex Rd. It is assumed that the area will have a conservative ultimate imperviousness value of 90%. Sub-basin A-1 encompasses an area of 11.67 acres and proposed developed runoff for the site has been calculated to be Q_5 = 46.4 cfs, Q_{100} = 90.7 cfs. However, in the interim conditions (imperviousness of 2.0%), runoff from this basin (Q_5 = 4.4 cfs, Q_{100} = 31.1 cfs) will sheet flow from the northwest to the southeast, to a separate, onsite detention and water quality facility (SB-2) positioned at the southeastern corner of the property, where treated flows will be released to a proposed modified CDOT Type 'C' inlet on the west side of Ivybridge Boulevard **(DP 1)**. Runoff that originates from the east side of Eastonville Road, outside of the dedicated ROW, will be conveyed to SB-2 via a proposed 4' bottom x 2' deep trapezoidal swale (Swale A-1). Flows will then be routed under Ivybridge Boulevard, via 24" RCP, to the updated Main Stem Tributary 2 channel. It is anticipated that the property will be developed at a later date as a fill in subsequent to the proposed development of the majority of this project site. This property will need to submit a separate drainage report, complete with an updated water quality and detention design, as part of its development. Installation of an internal storm sewer system separate from the outfall for the property will be required. The development is responsible for ensuring the site drainage, once constructed, will not adversely impact any adjacent properties and downstream facilities. Preliminary pond sizing calculations have been provided in Appendix E for reference. As stated above, water quality and detention will be addressed with the future development of the institutional site.

Basin-1 (1.22 AC, Q_5 = 4.2 cfs, Q_{100} = 8.4 cfs): Located at the northern border of the site, Basin-1 contains the proposed Phase 1 improvements to Rex Rd. This drainage basin consists entirely of onsite roadway improvements within the project site. Runoff from this basin will sheet flow to the proposed curb & gutter along Rex Rd. The flows will then be routed to the east where they will be conveyed to a proposed Sediment Basin (SB-1) where runoff will be treated prior to discharging into Main Stem Tributary #2 channel.

Basin A-2a (4.42 AC, Q_5 = 8.5 cfs, Q_{100} = 19.9 cfs): Located on the north portion of the site, this basin consists of residential lots, Tintagel Trail, and a portion of the north half of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent road. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the northeast side of the intersection of Tintagel Trail and Dawlish Drive **(DP 2a)**.

Basin A-2b (2.75 AC, Q_5 = 8.4 cfs, Q_{100} = 16.7 cfs): Located on the north portion of the site, this basin consists of residential lots, Ivybridge Boulevard, and a portion of the north half of Dawlish Drive. Runoff from this basin will sheet flow from the residential lots to the adjacent Dawlish Drive and directly from within the ROW of Ivybridge Boulevard. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' inlet in sump conditions, located on the northeast side of the intersection of Ivybridge Boulevard and Dawlish Drive **(DP 2b)**.

Basin A-3 (0.36 AC, Q_5 = 1.6 cfs, Q_{100} = 3.2 cfs): Located on the north portion of the site, this basin consists of a portion of the south half of Dawlish Drive. Flows will be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' inlet in sump conditions, located on the southeast side of the intersection of Ivybridge Boulevard and Dawlish Drive **(DP 3)**.

Basin A-4a (6.31 AC, Q_5 = 9.8 cfs, Q_{100} = 22.8 cfs): Located on the northwestern portion of the site, this basin consists of residential lots, Primley Woods Path, and a portion of the west half of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the west side of Dawlish Drive **(DP 4a),** between Primley Woods Path and St Ives Way. Bypass flows will then be routed downstream to a proposed (public) 15' CDOT Type 'R' sump inlet, located on the west side of Dawlish Drive directly across from Sparkwell Street **(DP4)**. Emergency overflows will be routed downstream via proposed curb and gutter to Design Point 7 within Sparkwell Street.

Basin A-4b (3.99 AC, Q_5 = 6.5 cfs, Q_{100} = 15.2 cfs): Located on the northwestern portion of the site, this basin consists of residential lots, St Ives Way, and a portion of the west half of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the west side of Dawlish Drive **(DP 4b),** between Primley Woods Path and St Ives Way. Bypass flows will then be routed downstream to a proposed (public) 15' CDOT Type 'R' sump inlet, located on the west side of Dawlish Drive directly across from Sparkwell Street **(DP4)**. Emergency overflows will be routed downstream via proposed curb and gutter to Design Point 7 within Sparkwell Street.

Basin A-5 (0.35 AC, Q_5 = 1.6 cfs, Q_{100} = 3.1 cfs): Located on the north portion of the site, this basin consists of a portion of the east half of Dawlish Drive. Flows will be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' inlet in sump conditions, located on the east side of Dawlish Drive **(DP 5),** Just north of the intersection of Sparkwell Street and Dawlish Drive. Emergency overflows will be routed downstream via proposed curb and gutter to Design Point 7 within Sparkwell Street.

Basin A-6 (2.76 AC, Q_5 = 4.6 cfs, Q_{100} = 10.7 cfs): Located centrally on the site, this basin consists of residential lots, Penryn Circle, and a portion of the south half of Sparkwell Street. Runoff from this basin will sheet flow from the lots to the adjacent road. Flows will then be routed, via curb & gutter, to a proposed (public) 10’ CDOT Type ‘R’ inlet in sump conditions, located on the south side of Sparkwell Street **(DP 6),** Just southeast of the intersection of Penryn Circle & Sparkwell Street. Emergency overflows will overtop Sparkwell Street crown to Design Point 7 **(DP 7)**, then overtop curb and gutter and be routed downstream via an overflow swale to proposed Pond A.

Basin A-7 (0.23 AC, Q_5 = 1.1 cfs, Q_{100} = 2.0 cfs): Located centrally on the site, this basin consists of a portion of the north half of Sparkwell Street. Runoff from this basin will sheet flow from edge of ROW to the adjacent road. Flows will then be routed, via curb & gutter, to a proposed (public) 5’ CDOT Type ‘R’ inlet in sump conditions, located on the north side of Sparkwell Street **(DP 7),** Just east of the intersection of Penryn Circle & Sparkwell Street. Emergency overflows will overtop curb and gutter and be routed downstream via an overflow swale to proposed Pond A.

Basin A-8 (5.44 AC, Q_5 = 14.7 cfs, Q_{100} = 30.8 cfs): Located centrally on the site, this basin consists entirely of proposed amenity / park facilities. Runoff from this basin will sheet flow to paved parking lot and drive aisle with curb and gutter. Flows will then be routed, via curb & gutter, to a series of proposed (public) CDOT Type ‘R’ inlets and area inlets with storm sewer piping conveying generated runoff downstream to Design Point 8 **(DP 8),** located at the southeast corner of the park site. Emergency overflows will overtop curb and gutter and will sheet flow, across green space, to proposed Pond A.

Basin A-9 (4.91 AC, Q_5 = 7.4 cfs, Q_{100} = 17.3 cfs): Located in the central portion of the site, directly west from Pond A. This basin consists of residential lots, one-half of Pixie Place, a section of Salcombe Trail, and a section of the west half of Sparkwell Street. Runoff from this basin will sheet flow to the proposed roadways, where runoff will be directed downstream, via curb & gutter, a proposed (public) 20’ CDOT Type ‘R’ sump inlet **(DP 7a)**. Runoff is then conveyed downstream to **DP 7b** where additional runoff is added from Sub-basin A-10.

Basin A-10 (1.02 AC, Q_5 = 2.1 cfs, Q_{100} = 4.9 cfs): Located in the central portion of the site, directly west from Pond A. This basin consists of residential lots and the easter half of a section of Sparkwell Street. Runoff from this basin will sheet flow to the proposed roadway, where runoff will be directed downstream, via curb & gutter, a proposed (public) 5’ CDOT Type ‘R’ sump inlet **(DP 7b)**. Runoff is then directed downstream to the northwest corner of Pond A. Flows will then be routed to the outlet structure **(DP 8)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Main Stem Tributary #2 channel. Emergency overflows will overtop via an emergency spillway and be routed downstream directly to MST.

Basin A-11 (3.56 AC, Q_5 = 2.0 cfs, Q_{100} = 8.6 cfs): Located on the eastern limits of the site, adjacent to the proposed Main Stem Tributary #2 drainageway. This basin consists of the rear portion of lots along Sparkwell Street and the proposed (private) Full Spectrum Detention Pond A. Runoff from this basin will sheet flow directly to Pond A. Flows will then be routed to the outlet structure **(DP 8)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Main Stem Tributary #2 channel. Emergency overflows will overtop via an emergency spillway and be routed downstream directly to MST.

Basin B-1 (3.81 AC, Q_5 = 5.3 cfs, Q_{100} = 12.5 cfs): Located on the western limits of the site, adjacent to Eastonville Road. This basin consists of residential lots and the southwest portion of Pixie Place. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15’ CDOT Type ‘R’ inlet in sump conditions, located at the end of the Cul-De-Sac of Pixie Place **(DP 9)**. Emergency overflows will overtop curb and gutter and be routed downstream via an overflow swale to Dawlish Drive and then downstream via curb & gutter to Design Point **DP 10b**.

Basin B-2 (4.62 AC, Q_5 = 7.1 cfs, Q_{100} = 16.7 cfs): Located on the western limits of the site, partially adjacent to Eastonville Road. This basin consists of residential lots, the northwest portion of Pixie Place and the northwestern portion of Dawlish Drive. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet **(DP 10a)**, located on the northwest side of Dawlish Drive, northeast of Marazion Way. Bypass flows are conveyed downstream via curb & gutter to **DP 10b** where a proposed (public) 15' CDOT Type 'R' sump inlet captures flows.

Basin B-3 (4.15 AC, Q_5 = 8.0 cfs, Q_{100} = 18.6 cfs): Located on the western portion of the site, this basin consists of residential lots, the northwest portion of Dawlish Drive, and Marazion Way. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet **(DP 10b)**, located northeast from the intersection of Dawlish Drive and Zelda Street. on the northwest side of Dawlish Drive, northeast of Marazion Way. Emergency overflows will overtop the crown of the roadway and be conveyed downstream via curb and gutter to Design Point **DP 11, DP12b, and DP13**.

Basin B-4 (1.37 AC, Q_5 = 4.6 cfs, Q_{100} = 9.4 cfs): Located in the west-central portion of the site. This basin consists of the southeast portion of Dawlish Drive. Runoff from this basin will sheet flow directly to the curb & gutter and be directed downstream to a proposed (public) 15' CDOT Type 'R' inlet in sump conditions, located east of the intersection of Dawlish Drive & Zelda Street **(DP 11)**. Emergency overflows will overtop the curb return flowline and be conveyed downstream via curb and gutter to Design Point **DP 12b**.

Basin B-5 (5.12 AC, Q_5 = 7.9 cfs, Q_{100} = 18.5 cfs): Located centrally on the site, this basin consists of residential lots, Marazion Way, the northwest portion of Salcombe Trail, and the southwest portion of Pixie Place. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet **(DP 12a)**, located on the northwest side of Salcombe Trail, northeast of the intersection between Zelda Street and Salcombe Trail. Bypass flows are conveyed downstream via curb & gutter to **DP 12b**.

Basin B-6 (2.28 AC, Q_5 = 3.7 cfs, Q_{100} = 8.7 cfs): Located centrally on the site. This basin consists of residential lots and the northwest portion of Plinky Plonk Path. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet, located on the northwest side of Plinky Plonk Path **(DP 14)**. Bypass flows are conveyed downstream via curb & gutter to **DP 12b**.

Basin B-7 (0.89 AC, Q_5 = 1.6 cfs, Q_{100} = 3.8 cfs): Located centrally on the site. This basin consists of residential lots and the southeast portion of Plinky Plonk Path. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet, located on the southeast side of Plinky Plonk Path **(DP 15)**. Bypass flows are conveyed downstream via curb & gutter to **DP 12b**.

Basin B-8 (3.23 AC, Q_5 = 5.3 cfs, Q_{100} = 12.4 cfs): Located centrally on the site. This basin consists of residential lots, the southeast portion of Plinky Plonk Path, and the northeast portion of Zelda Street. Runoff from this basin will sheet flow from the lots to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet, located on the southeast side of the intersection between Plinky Plonk Path and Zelda Street **(DP 12b)**. Emergency overflows will overtop the crown of the roadway and be conveyed downstream via curb and gutter to Design Point **DP 13**.

Basin B-9 (2.42 AC, Q_5 = 3.8 cfs, Q_{100} = 9.0 cfs): Located centrally on the site, adjacent to the Main Stem channel. This basin consists residential lots and the southwest portion of Zelda Street. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' sump inlet, located on the southwest side of the intersection between Plinky Plonk Path and Zelda Street **(DP 13)**. Emergency overflows will overtop the curb & gutter of the roadway and be conveyed downstream via a graded swale into Pond B **(DP 16)**.

Basin B-10 (1.10 AC, Q_5 = 0.5 cfs, Q_{100} = 3.3 cfs): Located centrally on the site, adjacent to the Main Stem channel. This basin consists of the proposed (private) Full Spectrum Detention Pond B. Runoff from this basin will sheet flow directly to Pond B. Flows will then be routed to the outlet structure **(DP 16)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Main Stem channel.

Basin C-1 (4.12 AC, Q_5 = 6.8 cfs, Q_{100} = 16.0 cfs): Located on the east portion of the site, this basin consists of residential lots and the eastern half of a portion of Salcombe Trail. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the southeast side of the intersection of Stoke Gabriel Way and Totness Terrace **(DP 17b)**. Bypass flows are conveyed downstream via curb & gutter to **DP 17e**.

Basin C-2 (2.71 AC, Q_5 = 4.9 cfs, Q_{100} = 11.4 cfs): Located on the eastern portion of the site, this basin consists of residential lots and the southern portion of Roads Stoke Gabriel Way and Glampton Drive, and the full section of Totness Terrace. Runoff from this basin will sheet flow from the lots to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17a)**, located on the southwest side of the intersection of Stoke Gabriel Way and Totness Terrace. Bypass flows are conveyed downstream via curb & gutter to **DP 17c**.

Basin C-3 (1.56 AC, Q_5 = 0.8 cfs, Q_{100} = 4.5 cfs): Located on the southeast portion of the site, this basin consists of the rear portion of residential lots along Stoke Gabriel Way. Runoff from this basin will sheet flow in an eastward direction towards the proposed channel. All roof drains (for lots 409-426 & 443) within this sub-basin will be directed toward Stoke Gabriel Way, no impervious surfaces will be allowed within the rear lot setbacks and runoff reduction will be implemented within this sub-basin.

Basin C-4 (2.47 AC, Q_5 = 4.1 cfs, Q_{100} = 9.6 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the eastern half of Frogmore Lane. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17c)**, located on the southwest side of the intersection of Stoke Gabriel Way and Frogmore Lane. Bypass flows are conveyed downstream via curb & gutter to **DP 17d**.

Basin C-5 (3.09 AC, Q_5 = 5.5 cfs, Q_{100} = 12.8 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the western half of Stoke Gabriel Way. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17d)**, located on the northwest side of the intersection of Stoke Gabriel Way and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17h**.

Basin C-6 (2.10 AC, Q_5 = 3.2 cfs, Q_{100} = 7.4 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the eastern half of Stoke Gabriel Way. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17e)**, located on the northeast side of the intersection of Stoke Gabriel Way and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17h**.

Basin C-7a (0.81 AC, Q_5 = 1.1 cfs, Q_{100} = 3.2 cfs): Located in the central portion of the site, this basin consists of the rear portion of residential lots, existing gas main, and proposed drainage swale (Swale C-7). Runoff from this basin will sheet flow to the proposed swale which will direct runoff to the adjacent roadway **(DP 18a)**.

Basin C-7b (5.91 AC, Q_5 = 9.9 cfs, Q_{100} = 23.2 cfs): Located in the central portion of the site, this basin consists of residential lots, the western half of Glampton Drive, and a portion of Zelda Drive & Sparkwell Street. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 18b)**, located on the southwest side of the intersection of Totness Terrace and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 18c**.

Basin C-8 (5.11 AC, Q_5 = 8.6 cfs, Q_{100} = 20.0 cfs): Located in the central portion of the site, this basin consists of residential lots, a portion of Totness Terrace, and a portion of Glampton Drive to the west and south of the sub-basin. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet **(DP 17f)**, located on the southeast side of the intersection of Totness Terrace and Glampton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17g and DP 17h**.

Basin C-9a (3.5 AC, Q_5 = 5.6 cfs, Q_{100} = 13.1 cfs): Located on the southeast corner of the site, this basin consists of residential lots, a portion of Frogmore Lane, and the northern half of Glampton Drive. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' sump inlet **(DP 17g)**, located on the northeast corner of Glampton Drive and Frogmore Lane. Bypass flows are conveyed downstream via curb & gutter to **DP 17h.** Emergency overflows will overtop the crown of Glampton Drive and be routed downstream via proposed curb and gutter to Design Point **18b** within Glampton Drive.

Basin C-9b (3.69 AC, Q_5 = 5.9 cfs, Q_{100} = 13.7 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the northern half of Glampton Drive. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet **(DP 17h)**, located on the north side of Glampton Drive just north of Hope Cove Loop. Emergency overflows will overtop the crown of Glampton Drive and be routed downstream via proposed curb and gutter to Design Point **18b** within Glampton Drive.

Basin C-10 (3.47 AC, Q_5 = 5.2 cfs, Q_{100} = 12.1 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the southern half of Glampton Drive. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' sump inlet **(DP 18c)**, located on the south side of Glampton Drive just north of Hope Cove Loop. Emergency overflows will overtop the curb & gutter of Glampton Drive and be routed downstream via a graded grassed swale and curb & gutter within Hope Cove Loop to Design Point **19** within Hope Cove Loop.

Basin C-11 (0.46 AC, Q_5 = 1.0 cfs, Q_{100} = 2.3 cfs): Located on the southeast corner of the site, this basin consists of a grassed amenity area and the north half of Hope Cove Loop. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' sump inlet **(DP 19)**, located on the north side of Hope Cove Loop. Emergency overflows will overtop the crown of Hope Cove Loop and be routed downstream via curb & gutter to Design Point **20** within Hope Cove Loop.

Basin C-12 (1.66 AC, Q_5 = 2.9 cfs, Q_{100} = 6.7 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the south portion of Hope Cove Loop. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 5' CDOT Type 'R' sump inlet **(DP 20)**, located on the south side of Hope Cove Loop. Emergency overflows will overtop the curb & gutter of Hope Cove Loop and be routed downstream via a graded swale to Design Point **21** within Pond C.

Basin C-13 (2.37 AC, Q_5 = 0.8 cfs, Q_{100} = 5.5 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the proposed (private) Full Spectrum Detention Pond C. Runoff from this basin will sheet flow directly to Pond C. Flows will then be routed to the outlet structure **(DP 21)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Main Stem channel.

Basin C-14 (1.53 AC, Q_5 = 0.5 cfs, Q_{100} = 3.8 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the undeveloped area outside and downstream of the proposed (private) Full Spectrum Detention Pond C. Runoff from this basin will sheet flow directly to the Main Stem Tributary Number 2 (MST).

Basin C-15 (0.16 AC, Q_5 = 0.1 cfs, Q_{100} = 0.5 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the rear portion of Lot 444. Runoff from this basin will sheet flow directly to the Main Stem Tributary Number 2 (MST). Runoff from this basin will sheet flow in an eastward direction towards the proposed channel. All roof drains (for lot 444) within this sub-basin will be directed toward Glampton Drive, no impervious surfaces will be allowed within the rear lot setbacks and runoff reduction will be implemented within this sub-basin.

Basin D-1 (3.48 AC, Q_5 = 5.4 cfs, Q_{100} = 12.7 cfs): Located on the southwest portion of the site, adjacent to Eastonville Road. This basin consists of residential lots and the west half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' at-grade inlet, located on the west side of Kate Meadow Lane **(DP 22)**, just south of the intersection of Kate Meadow Lane & Farm Close Court. Flows will continue downstream to Design Point **24** within Farm Close Court.

Basin D-2 (0.87 AC, Q_5 = 1.7 cfs, Q_{100} = 4.0 cfs): Located on the southwest portion of the site, this basin consists of residential lots and the eastern half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' flow by inlet, located on the east side of Kate Meadow Lane **(DP 23)**, just southeast of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will pool up and be routed around the curb return at the intersection of Kate Meadow Lane and Farm Close Court downstream via curb & gutter to Design Point **24** within Farm Close Court.

Basin D-3 (3.62 AC, Q_5 = 5.9 cfs, Q_{100} = 13.8 cfs): Located on the southwest portion of the site, this basin consists of residential lots and the western half of Farm Close Court. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' inlet in sump conditions, located on the west side of Farm Close Court **(DP 24)**, southeast of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will overtop the crown and be routed downstream via curb & gutter in Farm Close Court to Design Point **25**.

Basin D-4 (1.77 AC, Q_5 = 3.3 cfs, Q_{100} = 7.7 cfs): Located on the southwest portion of the site, this basin consists of residential lots and the eastern half of Farm Close Court. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 10' CDOT Type 'R' inlet in sump conditions, located on the east side of Farm Close Court **(DP 25)**, just southeast of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will overtop curb & gutter and be routed downstream via a graded swale within the maintenance access path to Pond D at Design Point **26**.

Basin D-5 (1.53 AC, Q_5 = 2.0 cfs, Q_{100} = 6.0 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists partially of residential lots and the proposed (private) Full Spectrum Detention Pond D. Runoff from this basin will sheet flow directly to Pond D. Flows will then be routed to the outlet structure **(DP 26)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Main Stem channel.

Basin D-6 (0.83 AC, Q_5 = 0.3 cfs, Q_{100} = 2.1 cfs): Located on the southwest corner of the site, adjacent to the Main Stem channel. This basin consists of the undeveloped area outside and downstream of the proposed (private) Full Spectrum Detention Pond D. Runoff from this basin will sheet flow directly to the Main Stem channel (MS).

Basin D-7a (0.25 AC, Q_5 = 0.2 cfs, Q_{100} = 0.8 cfs): Located on the southwest corner of the site, adjacent to the Main Stem channel. This basin consists of the back portions of residential lots. Runoff from this basin will sheet flow directly to the Main Stem Channel. All roof drains (for lots 18-20) within this sub-basin will be directed toward Farm Close Court, no impervious surfaces will be allowed within the rear lot setbacks and runoff reduction will be implemented within this sub-basin.

Basin D-7b (0.88 AC, Q_5 = 1.7 cfs, Q_{100} = 4.0 cfs): Located on the southwest corner of the site, adjacent to the Main Stem channel. This basin consists of the back portions of residential lots and a drainage swale (Swale D-7). Runoff from this basin will sheet flow from the residential lots, into the adjacent swale and will be routed directly to Pond D.

Basin E-1 (5.33 AC, Q_5 = 9.8 cfs, Q_{100} = 22.9 cfs): Located on the southern portion of the site, this basin consists of residential lots, the southern half of Brixham Drive, Starcross Court, and the southern half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the southwest corner of the intersection between Kate Meadow Lane and Mill Yard Circle **(DP 27)**, just north of the cul-de-sac. Bypass flows are conveyed downstream via curb & gutter to **DP 29**.

Basin E-2 (5.42 AC, Q_5 = 10.1 cfs, Q_{100} = 23.6 cfs): Located on the southern portion of the site, this basin consists of residential lots, a small portion of Mill Yard Circle, and the north half of Kate Meadow Lane. Runoff from this basin will sheet flow to the adjacent roadways. Flows will then be routed, via curb & gutter, to a proposed (public) 15' CDOT Type 'R' at-grade inlet, located on the northwest corner of the intersection between Kate Meadow Lane and Mill Yard Circle **(DP 28)**, just north of the cul-de-sac. Bypass flows are conveyed downstream via curb & gutter to **DP 29**.

Basin E-3 (3.20 AC, Q_5 = 6.0 cfs, Q_{100} = 14.0 cfs): Located on the southern portion of the site, this basin consists of residential lots and the western half of Mill Yard Circle. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet, located just northeast from the cul-de-sac of Mill Yard Circle **(DP 29)**. Emergency overflows will overtop the crown of Mill Yard Circle and be routed downstream via curb & gutter to Design Point **30**.

Basin E-4 (6.28 AC, Q_5 = 9.0 cfs, Q_{100} = 21.0 cfs): Located on the southern portion of the site, this basin consists of residential lots and the eastern half of Mill Yard Circle. Runoff from this basin will sheet flow to the adjacent roadway. Flows will then be routed, via curb & gutter, to a proposed (public) 20' CDOT Type 'R' sump inlet, located just northeast from the cul-de-sac of Mill Yard Circle **(DP 30)**. Emergency overflows will overtop the curb & gutter and be routed downstream via a graded swale within the maintenance access to Pond E at Design Point **31**.

Basin E-5 (1.13 AC, Q_5 = 0.4 cfs, Q_{100} = 3.0 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the proposed (private) Full Spectrum Detention Pond E. Runoff from this basin will sheet flow directly to Pond E. Flows will then be routed to the outlet structure **(DP 31)**, via a concrete trickle channel, where it will eventually discharge, at historic rates, into the adjacent Main Stem channel.

Basin E-6 (0.74 AC, Q_5 = 0.3 cfs, Q_{100} = 1.8 cfs): Located on the southeast corner of the site, adjacent to the Main Stem channel. This basin consists of the undeveloped area outside and downstream of the proposed (private) Full Spectrum Detention Pond E. Runoff from this basin will sheet flow directly to the Main Stem channel (MS) and offsite to the south.

Basin EA-1 (7.79 AC, Q_5 = 9.2 cfs, Q_{100} = 19.5 cfs): Located on the western side of the site. This basin consists of the public right of way (Eastonville Road). Runoff from this basin will sheet flow to proposed curb & gutter and be conveyed downstream to a public 10' CDOT Type R inlet in sump conditions **(EA1)** located just west from Lots 17 & 18 at the end of the cul-de-sac for Farm Close Court. Emergency overflows will overtop the crown of Eastonville Road to Design Point **EA2**.

Basin EA-2 (5.59 AC, Q_5 = 7.0 cfs, Q_{100} = 14.9 cfs): Located on the western side of the site. This basin consists of the public right of way (Eastonville Road). Runoff from this basin will sheet flow to proposed curb & gutter and be conveyed downstream to a public 10' CDOT Type R inlet in sump conditions **(EA2)** located just west from Lots 16 & 17 at the end of the cul-de-sac for Farm Close Court. Emergency overflows will overtop the curb & gutter on the east side of Eastonville Road and be directed into the proposed Eastonville Pond via swale.

Basin EA-3 (0.94 AC, Q_5 = 0.4 cfs, Q_{100} = 3.1 cfs): Located immediately adjacent to the Main Stem Tributary on the south side, just east of Eastonville Road. This basin consists of the proposed (private) Eastonville Full Spectrum Detention Pond. Runoff from this basin will sheet flow directly to the Pond.

VII. Storm Sewer System

All development is anticipated to be urban and will include storm sewer & street inlets. Storm sewers collect storm water runoff and convey the water to the water quality facilities prior to discharging. Storm sewer systems will be designed to the 100-year storm and checked with the 5-year storm. Inlets will be placed at sump areas and intersections where street flow is larger than street capacity. UDFCD Inlet spreadsheet has been used to determine the size of all sump inlets.

There will be a minimum of 5 proposed storm systems within the site. Each of the five storm sewer systems will discharge storm water into its correlated WQCV pond. Additionally, there will be two bypass storm sewer systems that collect off-site basin flows at **DP 32 & DP 35.**

The bypass system at **DP 32** will cross through on-site sub-basins **EA-1, EA-2, EA-3, D-1, D-3 & D-4,** and tie-into the outfall pipe from the Eastonville Road Pond, discharging directly into the main stem tributary channel. This bypass system will only convey flows from **DP 32** and will not be connected to any storm systems within any of the on-site sub-basins it crosses.

The bypass system at **DP 35** will cross through on-site sub-basins **EA-1, EA-2, A-4a, A-5 & A-8** and discharge directly main stem tributary #2. This bypass system will only convey flows from **DP 35** and will not be connected to any storm systems within any of the on-site sub-basins it crosses.

Each system will consist of reinforced concrete pipe (RCP), CDOT Type ‘R’ inlets, and storm sewer manholes.

Furthermore, there are three (3) proposed drainage swales that runs along the back of the residential lots in Basins A-1, C-7a, and D-7. The swales were analyzed using the Bentley software FlowMaster to properly size a trapezoidal channel (4’ W x 2.0’ D), (1’ W x 1.50’ D), & (1’ W x 1.54’ D), respectively, to convey the 100-year flows from the basin to corresponding outfall locations (SB-2, Glampton Drive, & Pond D), while providing 1.0-ft of freeboard. The sizing calculations can be found in **Appendix D.**

The Final drainage report will include details concerning at-grade inlet locations, street capacity, storm sewer sizing, outlet protection and location. Preliminary sump inlets have been sized and the calculations can be found in **Appendix D**. As mentioned, these sump inlets sizes are preliminary and are currently oversized. It is anticipated that the inlets will reduce in size with the addition of at-grade inlets at the time of the Final Drainage Report.

VIII. Proposed Water Quality Detention Ponds

Eight (8) Water Quality Capture Volume Detention Ponds will be provided for the proposed site, six (6) of which are full spectrum ponds and two (2) of which are sediment basins. Of These, all six (6) of the ponds and the (2) Sediment Basins on-site are private and will be maintained by the DISTRICT, once established. These detention ponds are proposed to be full spectrum and will provide water quality and detention. The WQCV and EURV release will be controlled with an orifice plate. The release rates for the WQCV and EURV will be 40-hours and 72-hours, respectively. The 100-year volume will be controlled by orifice and/or restrictor plate and will be designed to release at or below the pre-development flow rate. Outlet structures, forebays, trickle channels, etc. will be designed with the final drainage report during final plat. The required FSD pond volumes are as described below:

Eastonville Road Pond: Located along the southwest side of the site. This pond will discharge into the Main Stem Tributary. The required volume WQCV and EURV are 0.233 Ac-Ft & 0.614 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.234 Ac-Ft & 0.850 Ac-Ft, respectively. The total required detention basin volume is 1.301 Ac-Ft. The total provided detention basin storage is 1.320 Ac-Ft.

Pond A: Located to the north of the site, just west of the newly routed Main Stem Tributary #2 channel. This pond will discharge into the Main Stem Tributary #2, ultimately merging with Main Stem to the south, off-site. The required volume WQCV and EURV are 0.756 Ac-Ft & 2.115 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.761 Ac-Ft & 2.882 Ac-Ft, respectively. The total required detention basin volume is 4.290 Ac-Ft. The total provided detention basin storage is 4.626 Ac-Ft.

Pond B: Located centrally on the site, just east of the Main Stem drainage way. This pond will discharge into the Main Stem channel. The required volume WQCV and EURV are 0.586 Ac-Ft & 1.610 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.587 Ac-Ft & 2.197 Ac-Ft, respectively. The total required detention basin volume is 3.310 Ac-Ft. The total provided detention basin storage is 3.449 Ac-Ft.

Pond C: Located on the southeast portion of the site, between the Main Stem & Main Stem Tributary #2 channels. This pond will discharge into the Main Stem channel. The required volume WQCV and EURV are 0.828 Ac-Ft & 2.256 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.831 Ac-Ft & 3.088 Ac-Ft, respectively. The total required detention basin volume is 4.633 Ac-Ft. The total provided detention basin storage is 5.040 Ac-Ft.

Pond D: Located centrally on the site, just west of the Main Stem channel. This pond will discharge into the Main Stem channel. The required volume WQCV and EURV are 0.244 Ac-Ft & 0.666 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.246 Ac-Ft & 0.913 Ac-Ft, respectively. The total required detention basin volume is 1.373 Ac-Ft. The total provided detention basin storage is 1.373 Ac-Ft.

Pond E: Located on the south side of the site, just west of the Main Stem channel. This pond will discharge into the Main Stem channel. The required volume WQCV and EURV are 0.431 Ac-Ft & 1.163 Ac-Ft, respectively. The provided storage for the WQCV and EURV are 0.437 Ac-Ft & 1.601 Ac-Ft, respectively. The total required detention basin volume is 2.421 Ac-Ft. The total provided detention basin storage is 2.583 Ac-Ft.

SB-1: Located on the far north side of the site, just east of the extension of Rex Road. This TSB will discharge into the Main Stem Tributary Number 2 (MST). The TSB has been sized to treat the developed runoff for water quality prior to releasing into MST. This TSB captures an upstream tributary area of approximately 1.22 acres and per the MHFD standard, this TSB has been upsized to 2-acre tributary area.

SB-2: Located on the north side of the site, at the southeast corner of the church property. This TSB will discharge into the Main Stem Tributary Number 2 (MST This TSB captures an upstream tributary area of approximately 11.23 acres and per the MHFD standard, this TSB has been upsized to 12-acre tributary area.

IX. Proposed Channel Improvements

According to the **MDDP**, there are two major drainage ways that run through the site. As was discussed within the Existing Conditions portion of the report, both the Main Stem channel (MS) and Main Stem Tributary #2 channel (MST) run through the site. There are no proposed major channel improvements for MS as part of this project (to be determined with CDR-22-008). An analysis has been done for the Main Stem channel (MS) with both existing and future condition flows as described within the *Grandview Reserve CLOMR Report*, HR Green; September 2021; revised January 2022 (**CLOMR**). All HEC-RAS modelling, velocities, shear, depths, etc. are included within the CLOMR, which can be found in Appendix D. Both scenarios, throughout the channel fall within the channel stability criteria.

The MST is proposed to be rerouted. As part of this rerouting of MST, offsite upstream tributary flows will be captured upstream from the proposed Rex Road extension and be conveyed via culvert to the rerouted MST. An analysis has been done for the Main Stem Tributary Number 2 (MST) with both existing and future condition flows as described within the *Grandview Reserve CLOMR Report*, HR Green; September 2021; revised January 2022 (**CLOMR**). Both scenarios, throughout the channel fall within the channel stability criteria.

A majority of the developed runoff will be captured and conveyed to one of the corresponding water quality and detention facilities and release at or below historic levels. Some basins will release directly into the respective adjacent channels. These basins are contained within the backs of lots and will provide water quality through runoff reduction; impervious areas and will not be permitted in the back of these lots and roof drains are to drain to the front. Therefore, there will be no adverse impact to downstream facilities. The analysis for both drainage ways (MS and MST), offsite upstream tributary capture, and design of MST were done by HR Green within the *Grandview Reserve CLOMR Report*, HR Green; September 2021; revised January 2022 (**CLOMR**) which will be submitted separately for review. A copy of this report is included in Appendix D.

Additional channel stabilization may be required for erosion control prevention measures at a later date, pending the channel design review with the County.

delete?

X. Maintenance

After completion of construction and upon the Board of County Commissioners acceptance, it is anticipated all drainage facilities within the public Right-of-Way are to be owned and maintained by El Paso County.

All private detention ponds are to be owned and maintained by the Grandview Reserve Metropolitan District No. 2 (DISTRICT), once established, unless an agreement is reached stating otherwise. The proposed Main Stem channel (MS) and Main Stem Tributary Number 2 (MST) will be maintained by the DISTRICT. Maintenance access for all full spectrum detention facilities will be provided from public Right-of-Way. Maintenance access for MS and MST will be provided along the respective eastern top of channel bank within the proposed tracts.

XI. Wetlands Mitigation

There are two existing wetlands on site associated with the two major channels, MS and MST. The wetlands are both contained within the existing channels with the wetland in MS being classified as jurisdictional and the wetland in MST classified as non-jurisdictional. The wetlands USACE determination will be provided with the *Grandview Reserve CLOMR Report*, HR Green; April 2022, which can be found in Appendix D. Wetlands maintenance will be the responsibility of the Grandview Reserve Metropolitan District No. 2 (DISTRICT).

XII. Floodplain Statement

A portion of the project sit lies with Zone A Special Flood Hazard Area as defined by the FIRM Map number 08041C0552G and 08041C0556G effective December 7, 2018. A copy of the FIRM Panel is included in **Appendix A.** FEMA-approved floodplain elevations are required to be shown on final plats.

XIII. Drainage Fees & Maintenance

Gieck Ranch Basin is not listed as part of the El Paso County drainage basin fee program. Unless otherwise instructed, no drainage fees will be assessed. If it is found drainage basin fees are required, these will be included in the Final Drainage Report.

XIV. Conclusion

The Grandview Reserve residential subdivision lies within the Gieck Ranch Drainage Basin. Water quality for the site is provided in six on-site Full Spectrum Detention Ponds; Ponds A, B, C, D, E, & Eastonville Pond as well as two Sediment Basins; SB-1 and SB-2. Both of these SBs have been sized to function as PBMPs (and will remain in place until such time development east of the proposed site takes place) and will discharge treated runoff at historic rates directly into MST at the northern portion of the project site. All drainage facilities within this report were sized according to the El Paso County Drainage Criteria Manuals. The proposed facilities are adequate to protect the site from generated runoff. The site runoff will not adversely affect the downstream facilities and surrounding developments. There are two major channels passing through the site Main Stem channel and Main Stem Tributary Number 2, which will be addressed by HR Green within the *Grandview Reserve CLOMR Report*, HR Green; September 2021; revised January 2022. The six (6) WQCV ponds will be maintained by a newly established Grandview Reserve Metropolitan District No. 2 (DISTRICT). A Final Drainage Report will be submitted along with the final plat and construction drawings.

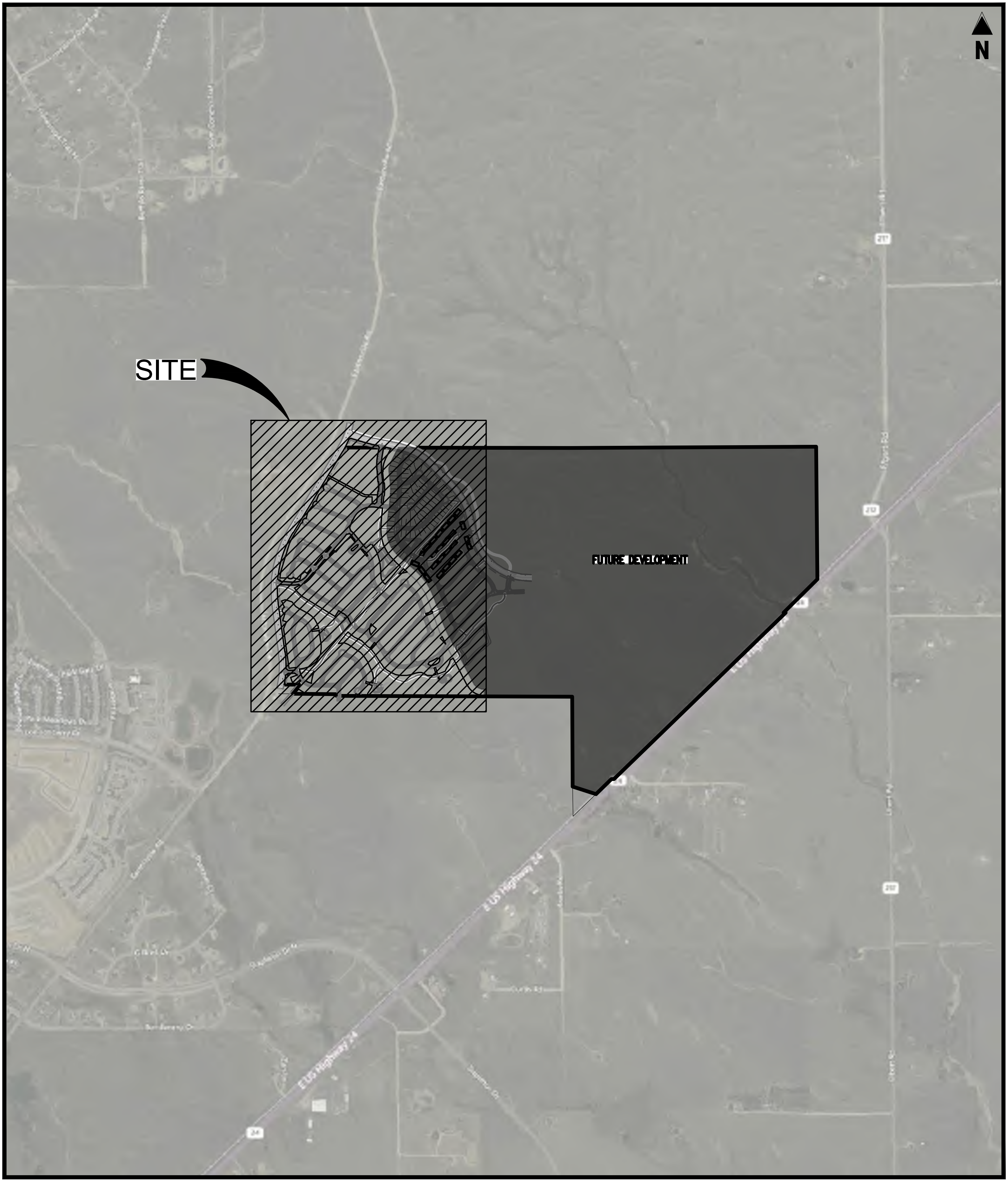
XV. References

1. *El Paso County Drainage Criteria Manual*, 1990.
2. *Drainage Criteria Manual, Volume 2*, City of Colorado Springs, 2002.
3. *El Paso County Drainage Criteria Manual Update*, 2015.
4. *El Paso County Engineering Criteria Manual*, 2020.
5. *Urban Storm Drainage Criteria Manual*, Urban Drainage and Flood Control District, January 2016 (with current revisions).
6. *Gieck Ranch Drainage Basin Study (DBPS),* Drexel Barrell, October 2010 (Not adopted by County).
7. *Grandview Reserve Master Development Drainage Plan (MDDP),* HR Green, November 2020.
8. *Grandview Reserve CLOMR Report*, HR Green; April 2022.

Add: Meridian Ranch MDDP; January 2018 (also July 2015 version if needed)

APPENDIX A

Exhibits and Figures



GRANDVIEW RESERVE

-

EASTONVILLE RD

SCALE: 1"=2,000'

VICINITY MAP

Project No:	HRG1.20
Drawn By:	JDP
Checked By:	RGD
Date:	07/26/2021

Galloway

1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920
719.900.7220 • GallowayUS.com

possible updates 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.

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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.

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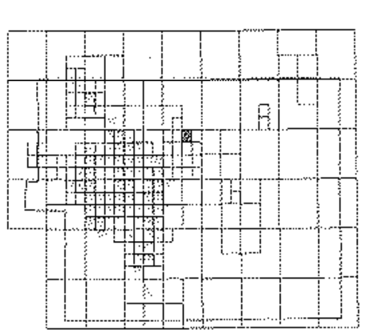
El Paso County Vertical Datum Offset Table

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



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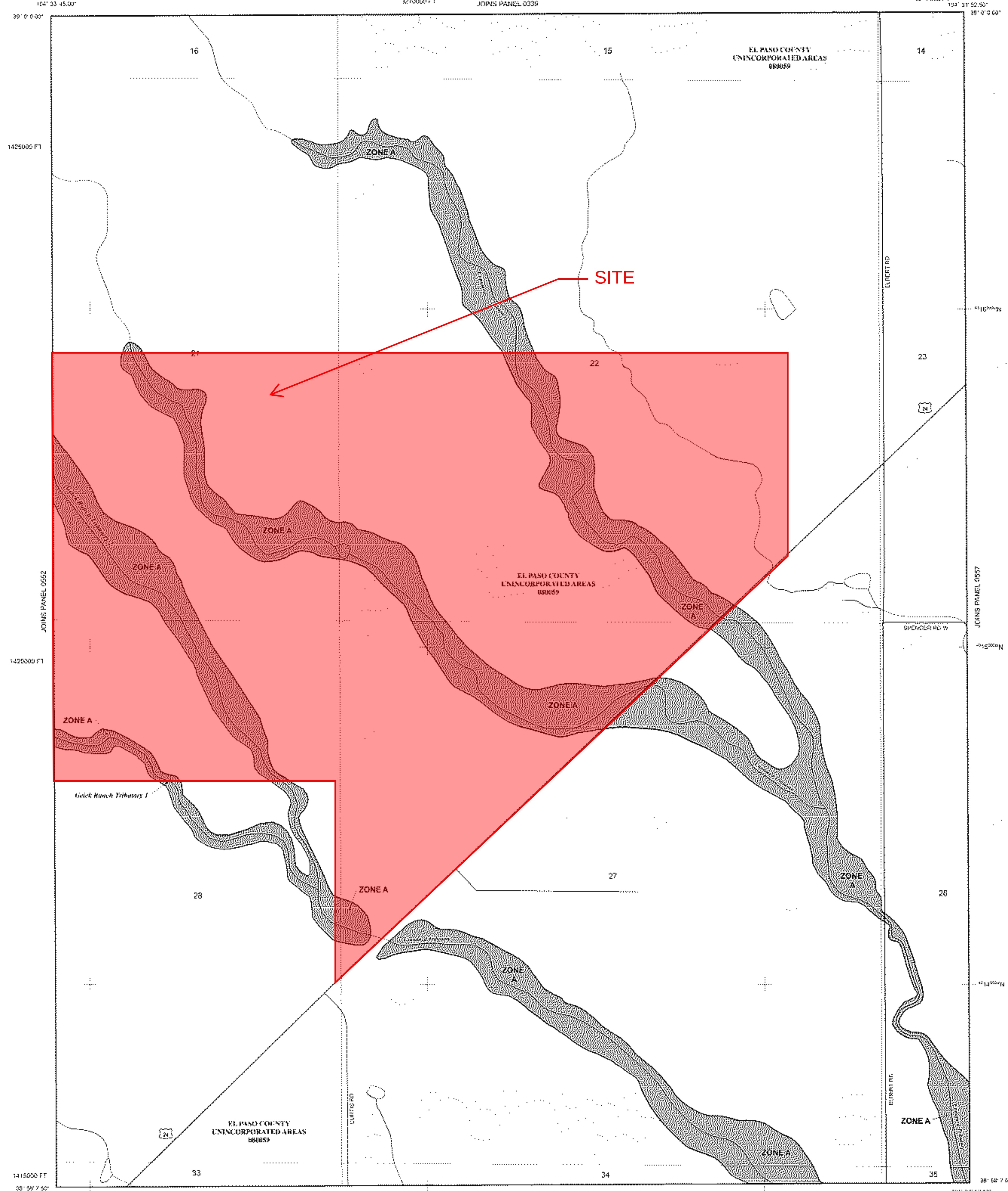

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, 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)

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.

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0556G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 556 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
[illegible]	[illegible]	[illegible]	[illegible]

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
08041C0556G

MAP REVISED
~~~

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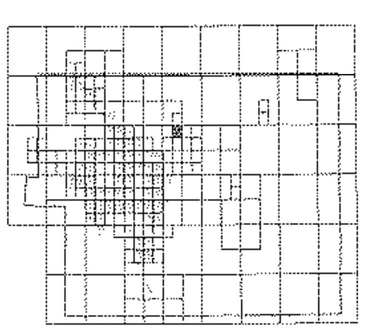

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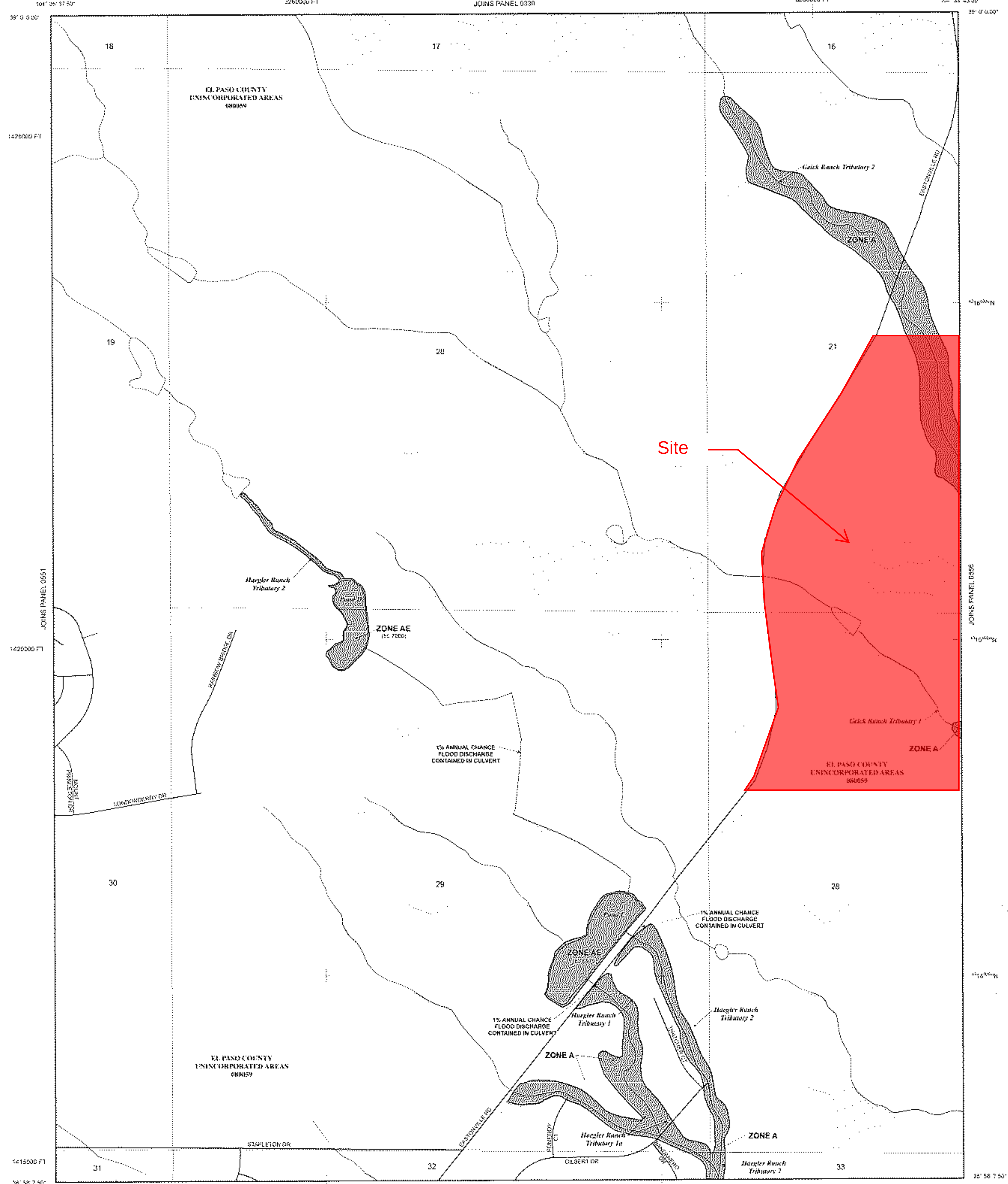

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FLOODWAY AREAS IN ZONE AE

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.
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- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities
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MAP SCALE 1" = 500'

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NFIP

PANEL 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	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
08041C0552G

MAP REVISED

NOTES TO USERS

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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.

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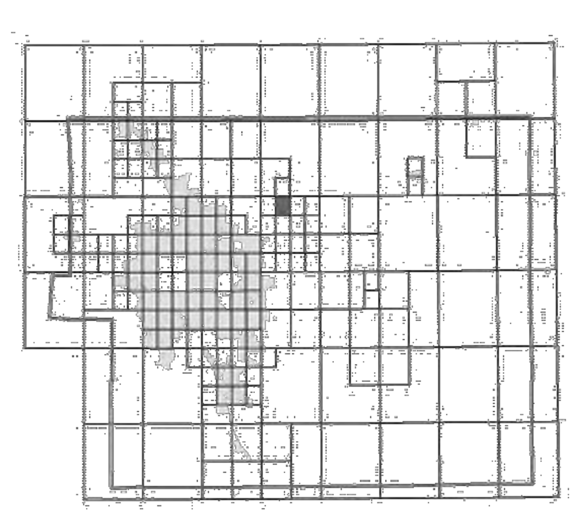
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this 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

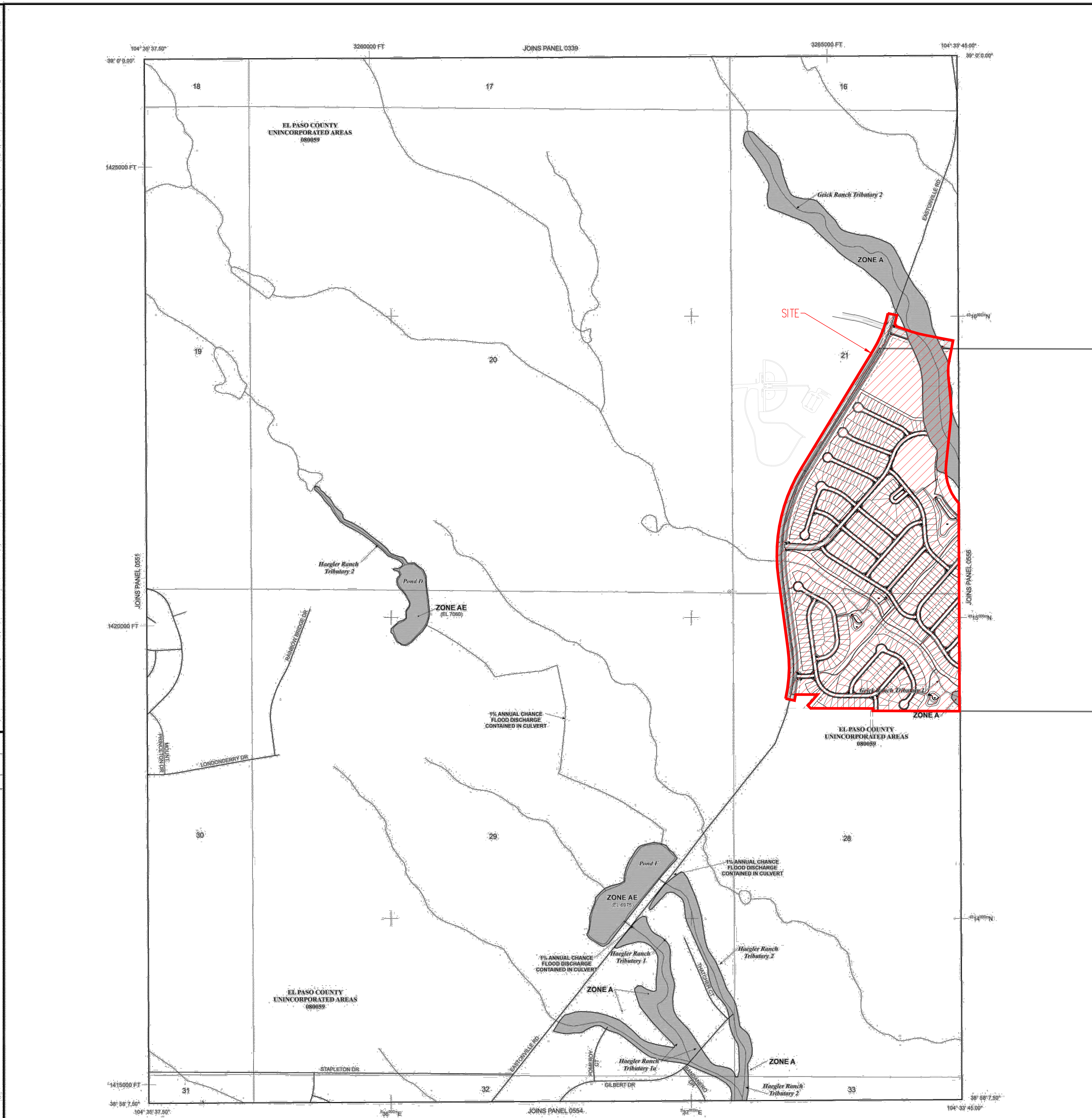
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

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.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST.

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)
4275000 N	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 0552G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	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
08041C0552G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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/.

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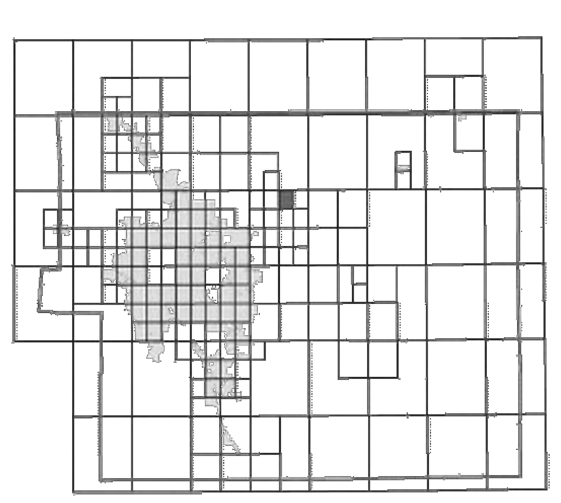

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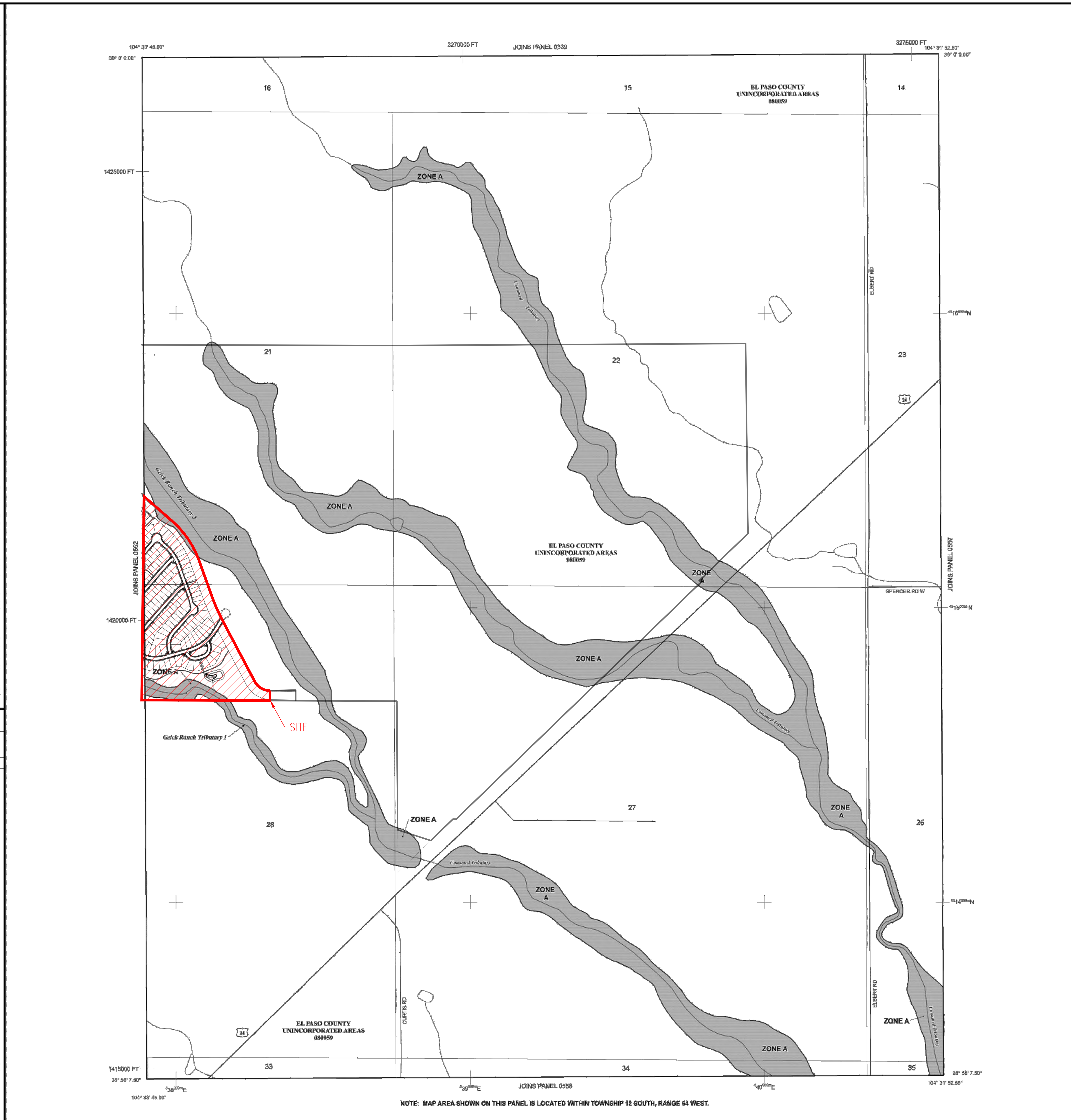

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST.

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

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

PANEL 0556G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO

AND INCORPORATED AREAS

PANEL 556 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0556	G

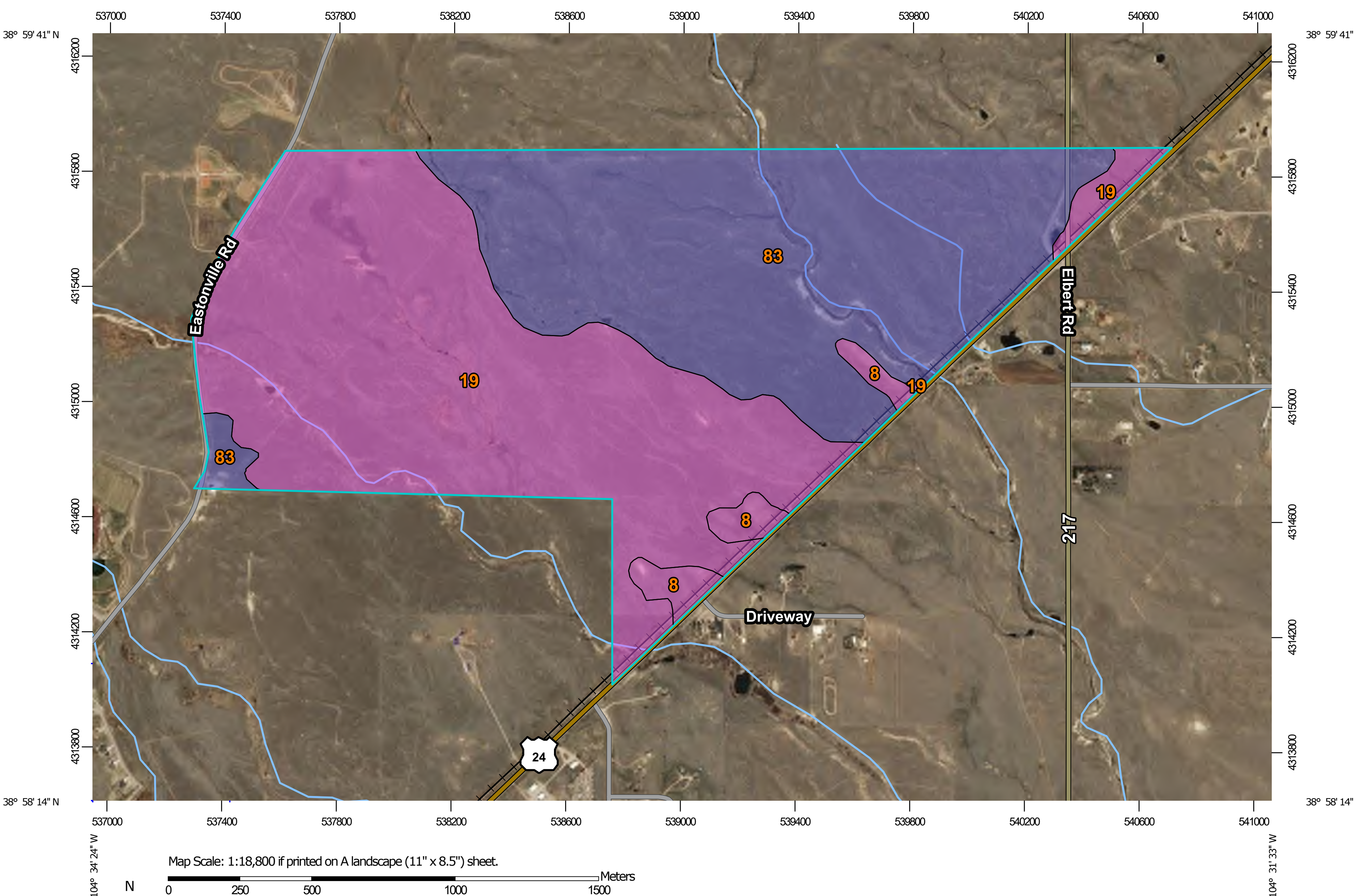
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0556G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado
(Grandview Reserve Soil Map)



Map Scale: 1:18,800 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 250, 500, 1000, 1500

Feet: 0, 500, 1000, 2000, 3000

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.

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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	22.4	2.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	450.7	52.5%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	385.4	44.9%
Totals for Area of Interest			**858.5**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOAA Atlas 14, Volume 8, Version 2
Location name: Peyton, Colorado, USA*
Latitude: 38.985°, Longitude: -104.565°
Elevation: 6975.71 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.239 (0.189-0.303)	0.291 (0.231-0.370)	0.381 (0.301-0.486)	0.461 (0.361-0.589)	0.576 (0.440-0.768)	0.671 (0.499-0.904)	0.770 (0.554-1.06)	0.875 (0.604-1.24)	1.02 (0.678-1.48)	1.14 (0.733-1.67)
10-min	0.350 (0.277-0.444)	0.426 (0.338-0.542)	0.558 (0.441-0.711)	0.674 (0.529-0.863)	0.844 (0.644-1.13)	0.982 (0.731-1.32)	1.13 (0.811-1.56)	1.28 (0.884-1.81)	1.49 (0.992-2.17)	1.66 (1.07-2.44)
15-min	0.426 (0.338-0.541)	0.520 (0.412-0.660)	0.681 (0.537-0.867)	0.823 (0.645-1.05)	1.03 (0.785-1.37)	1.20 (0.891-1.62)	1.37 (0.988-1.90)	1.56 (1.08-2.21)	1.82 (1.21-2.65)	2.03 (1.31-2.98)
30-min	0.608 (0.482-0.771)	0.740 (0.586-0.940)	0.968 (0.764-1.23)	1.17 (0.916-1.49)	1.46 (1.11-1.94)	1.70 (1.26-2.29)	1.94 (1.40-2.68)	2.21 (1.52-3.12)	2.57 (1.71-3.73)	2.86 (1.85-4.19)
60-min	0.775 (0.615-0.984)	0.933 (0.739-1.19)	1.21 (0.956-1.54)	1.46 (1.15-1.87)	1.84 (1.41-2.47)	2.16 (1.61-2.92)	2.49 (1.80-3.45)	2.85 (1.97-4.05)	3.37 (2.24-4.90)	3.78 (2.44-5.55)
2-hr	0.943 (0.754-1.19)	1.13 (0.898-1.42)	1.46 (1.16-1.84)	1.76 (1.39-2.23)	2.22 (1.72-2.97)	2.62 (1.97-3.52)	3.04 (2.21-4.19)	3.50 (2.45-4.95)	4.16 (2.80-6.03)	4.70 (3.06-6.85)
3-hr	1.03 (0.829-1.29)	1.22 (0.978-1.53)	1.57 (1.25-1.97)	1.90 (1.51-2.40)	2.41 (1.88-3.22)	2.86 (2.17-3.84)	3.35 (2.45-4.60)	3.88 (2.73-5.48)	4.66 (3.15-6.74)	5.29 (3.46-7.69)
6-hr	1.20 (0.968-1.49)	1.40 (1.13-1.74)	1.78 (1.44-2.22)	2.16 (1.73-2.70)	2.76 (2.18-3.66)	3.28 (2.52-4.39)	3.86 (2.86-5.29)	4.51 (3.21-6.34)	5.46 (3.73-7.86)	6.24 (4.12-9.01)
12-hr	1.38 (1.13-1.70)	1.61 (1.31-1.98)	2.05 (1.67-2.53)	2.48 (2.00-3.07)	3.15 (2.51-4.15)	3.74 (2.89-4.96)	4.39 (3.28-5.96)	5.12 (3.67-7.13)	6.17 (4.25-8.82)	7.04 (4.69-10.1)
24-hr	1.60 (1.31-1.95)	1.87 (1.54-2.28)	2.38 (1.94-2.91)	2.85 (2.32-3.51)	3.60 (2.88-4.67)	4.24 (3.29-5.56)	4.94 (3.71-6.63)	5.71 (4.12-7.87)	6.82 (4.73-9.66)	7.73 (5.20-11.0)
2-day	1.85 (1.54-2.24)	2.18 (1.80-2.63)	2.76 (2.28-3.35)	3.29 (2.70-4.01)	4.11 (3.30-5.27)	4.80 (3.76-6.22)	5.54 (4.19-7.36)	6.35 (4.62-8.68)	7.50 (5.25-10.5)	8.44 (5.73-11.9)
3-day	2.03 (1.69-2.44)	2.39 (1.98-2.87)	3.02 (2.50-3.64)	3.60 (2.97-4.36)	4.47 (3.60-5.69)	5.20 (4.09-6.70)	5.98 (4.55-7.90)	6.83 (4.99-9.28)	8.03 (5.65-11.2)	9.00 (6.15-12.7)
4-day	2.18 (1.82-2.61)	2.56 (2.13-3.06)	3.22 (2.68-3.87)	3.82 (3.16-4.62)	4.73 (3.83-6.00)	5.49 (4.33-7.04)	6.30 (4.81-8.30)	7.18 (5.26-9.72)	8.43 (5.95-11.7)	9.43 (6.46-13.3)
7-day	2.58 (2.17-3.07)	2.98 (2.50-3.54)	3.68 (3.08-4.39)	4.32 (3.60-5.18)	5.29 (4.31-6.65)	6.09 (4.84-7.76)	6.96 (5.34-9.09)	7.89 (5.82-10.6)	9.21 (6.55-12.8)	10.3 (7.10-14.4)
10-day	2.93 (2.48-3.47)	3.37 (2.84-3.98)	4.13 (3.47-4.90)	4.81 (4.02-5.74)	5.83 (4.76-7.29)	6.68 (5.32-8.45)	7.58 (5.85-9.86)	8.55 (6.34-11.4)	9.92 (7.09-13.7)	11.0 (7.65-15.4)
20-day	3.91 (3.33-4.58)	4.51 (3.84-5.29)	5.52 (4.68-6.50)	6.39 (5.39-7.55)	7.63 (6.25-9.37)	8.62 (6.90-10.8)	9.64 (7.47-12.4)	10.7 (7.98-14.1)	12.2 (8.74-16.6)	13.3 (9.31-18.4)
30-day	4.70 (4.02-5.47)	5.44 (4.65-6.34)	6.65 (5.66-7.78)	7.66 (6.49-9.00)	9.06 (7.44-11.0)	10.1 (8.15-12.5)	11.2 (8.74-14.3)	12.3 (9.24-16.2)	13.8 (9.98-18.7)	15.0 (10.5-20.6)
45-day	5.67 (4.88-6.57)	6.55 (5.63-7.60)	7.97 (6.82-9.27)	9.12 (7.77-10.7)	10.7 (8.79-12.9)	11.9 (9.56-14.5)	13.0 (10.2-16.4)	14.2 (10.6-18.4)	15.6 (11.3-21.0)	16.7 (11.9-23.0)
60-day	6.49 (5.60-7.48)	7.46 (6.43-8.62)	9.01 (7.74-10.4)	10.3 (8.77-11.9)	11.9 (9.82-14.3)	13.1 (10.6-16.0)	14.3 (11.2-18.0)	15.5 (11.7-20.0)	16.9 (12.3-22.6)	18.0 (12.8-24.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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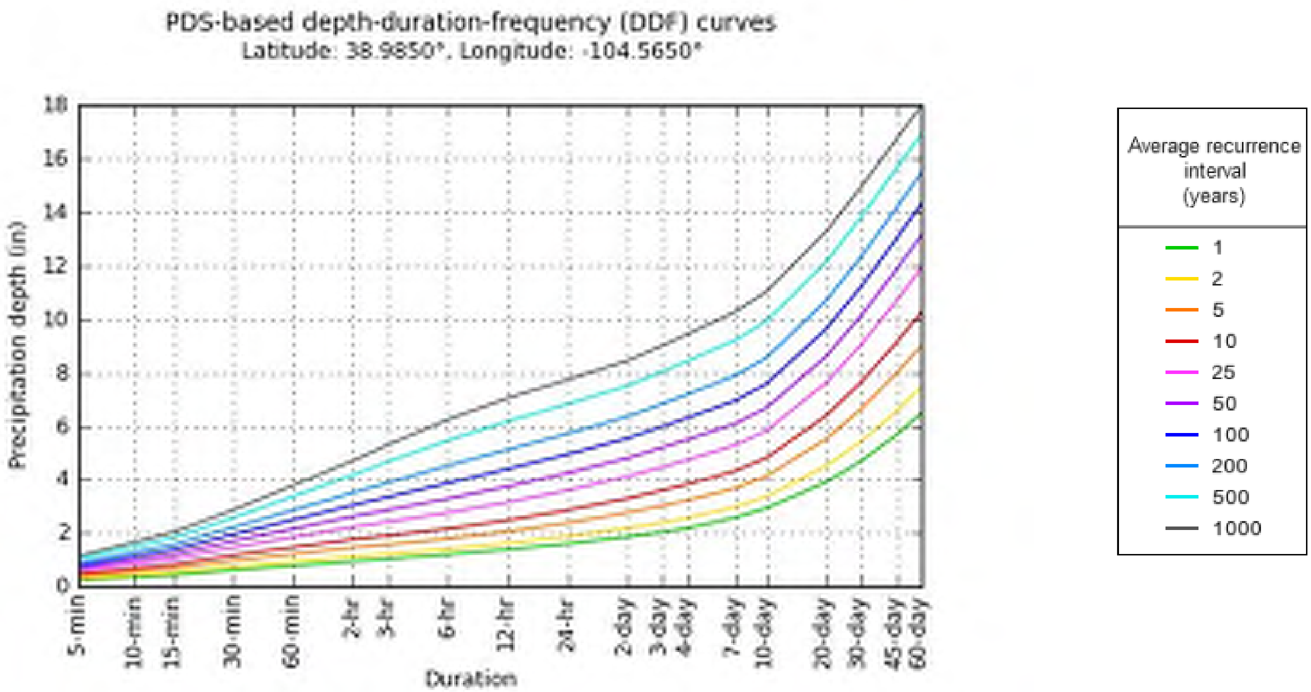
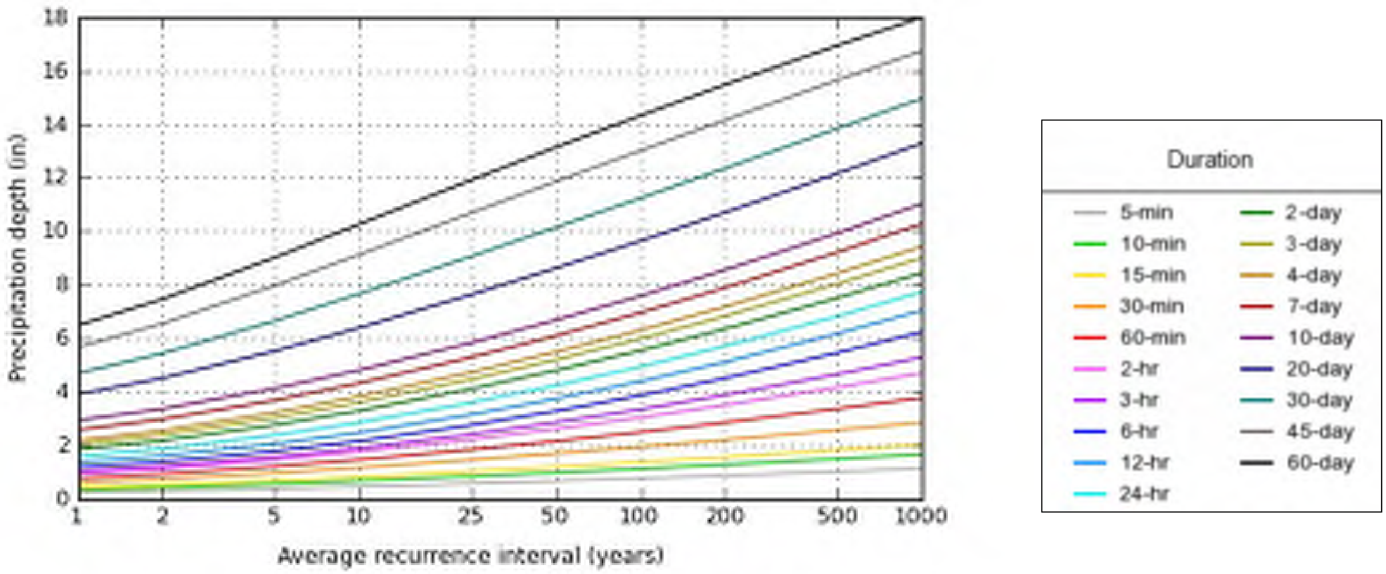
PF graphical





NOAA Atlas 14, Volume 8, Version 2 Created (GMT): Thu Dec 2 17:16:51 2021

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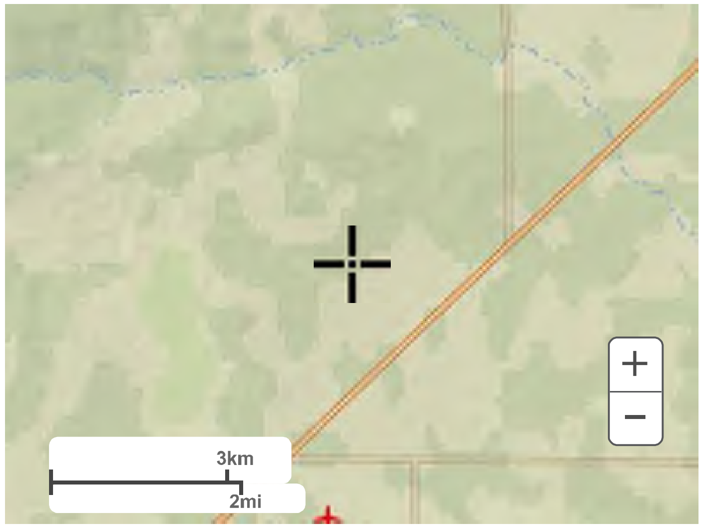
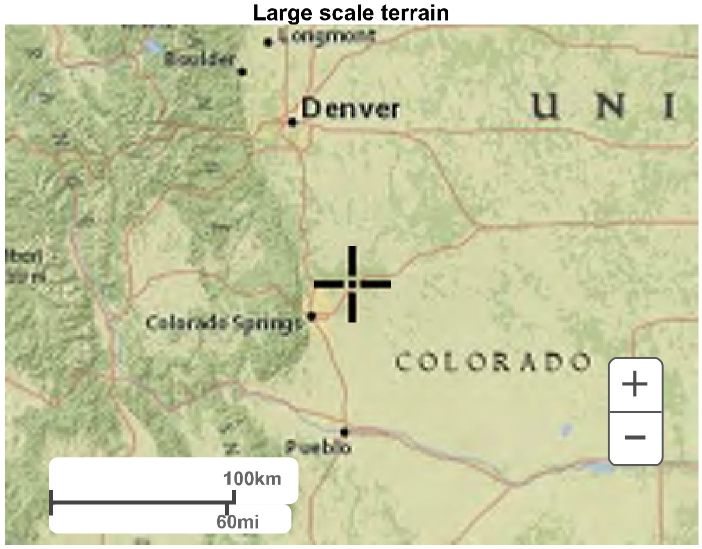
Maps & aerials

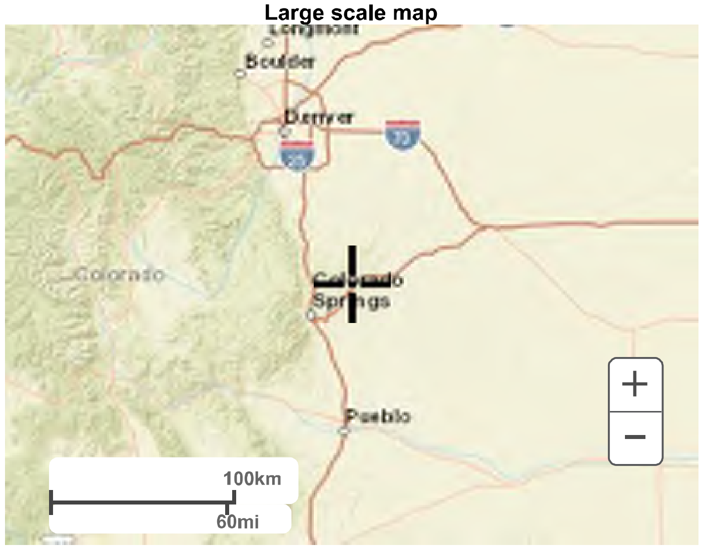
Small scale terrain



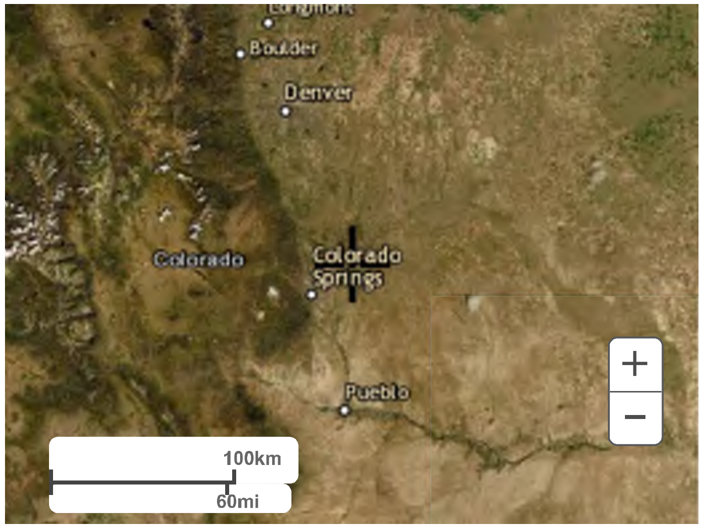
Large scale terrain



Large scale map



Large scale aerial



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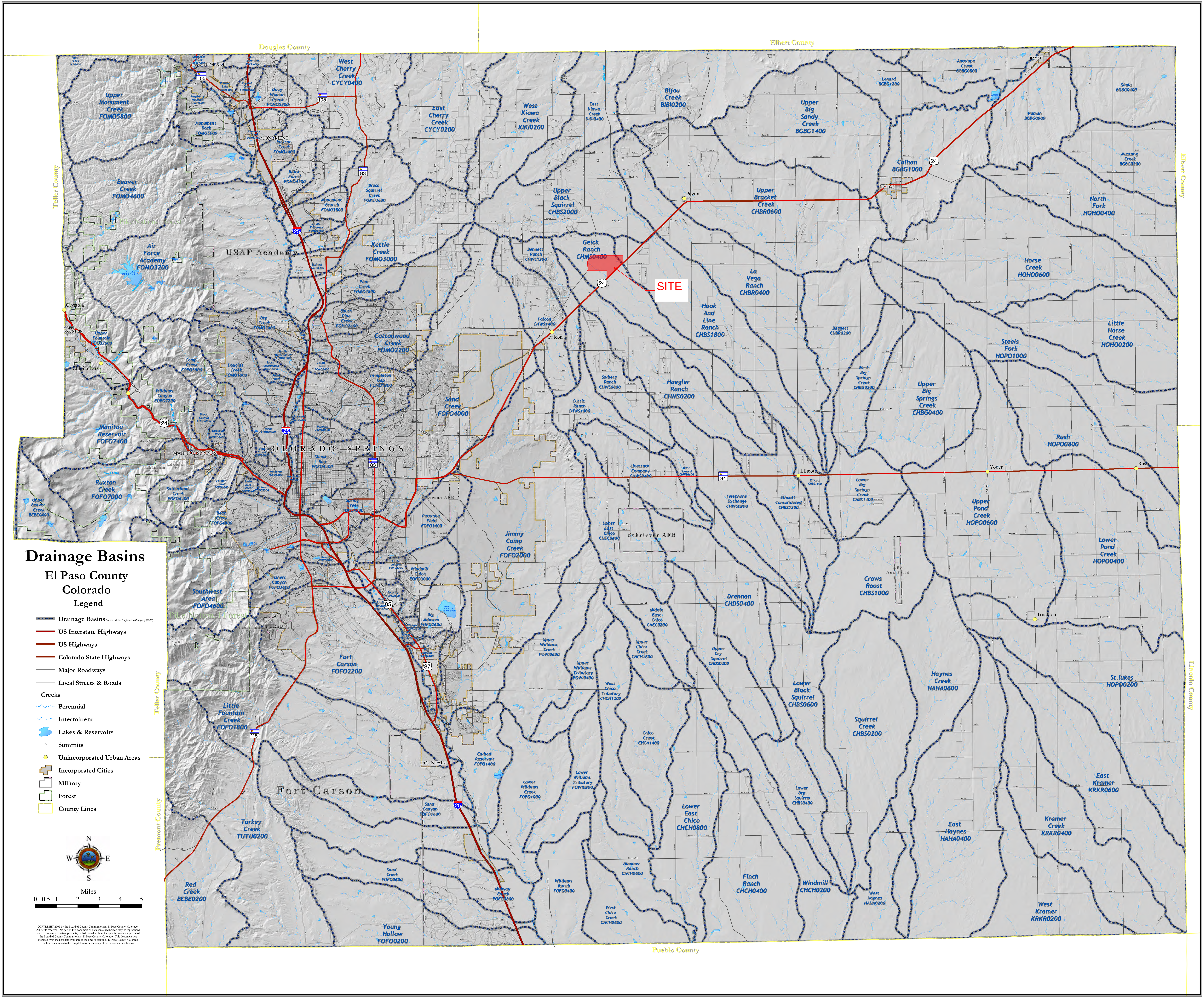
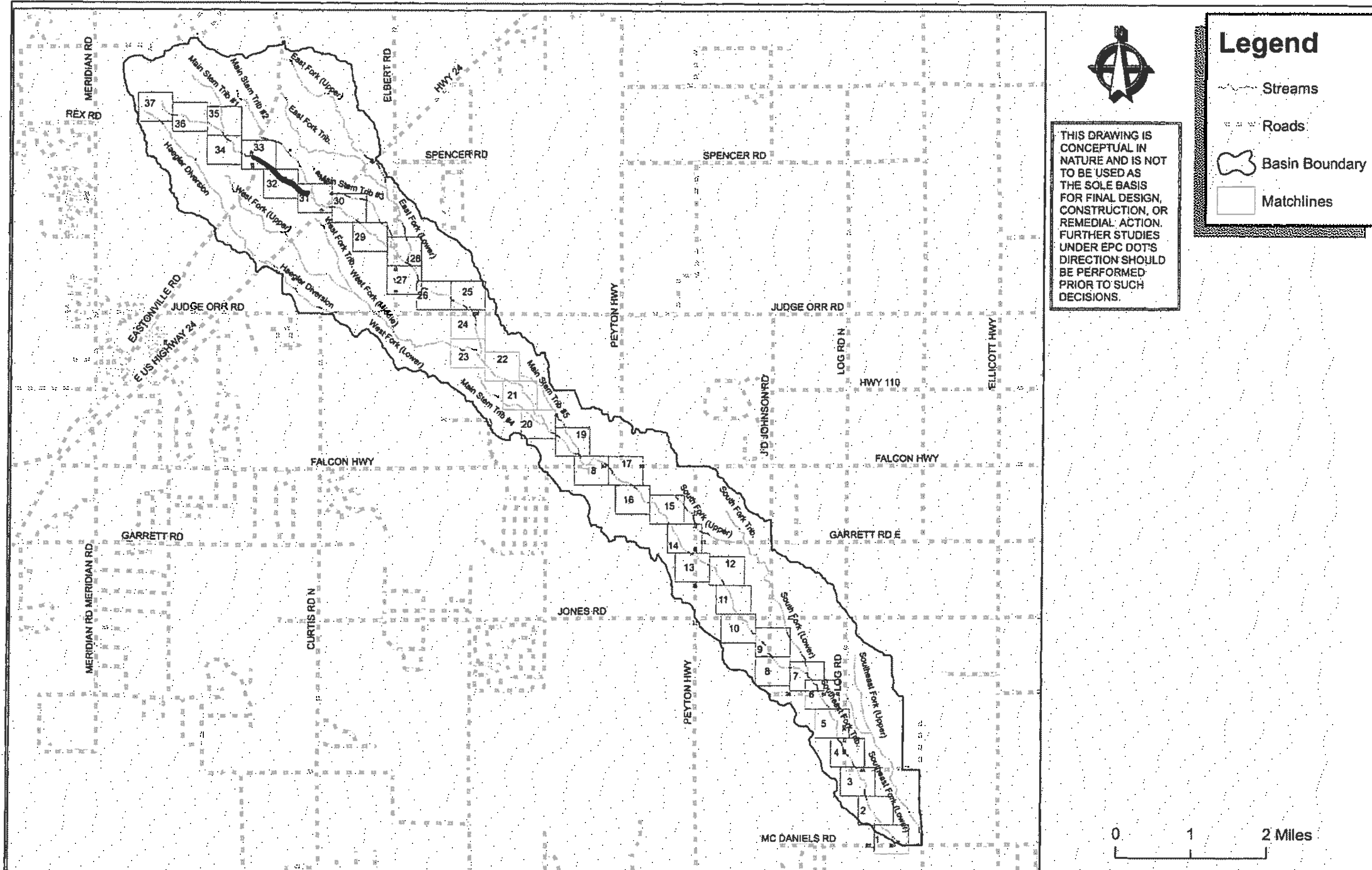
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

APPENDIX B

MDDP & DBPS Sheet References


Drainage Basins
El Paso County
Colorado
Legend
Drainage Basins
US Interstate Highways
US Highways
Colorado State Highways
Major Roadways
Local Streets & Roads
Creeks
Perennial
Intermittent
Lakes & Reservoirs
Summits
Unincorporated Urban Areas
Incorporated Cities
Military
Forest
County Lines
N
W
E
S
Miles
0 0.5 1 2 3 4 5
Douglas County
Elbert County
Teller County
Lincoln County
Pueblo County
Fremont County
SITE
USAF Academy
COLORADO SPRINGS
Fort Carson
Schriever AFB
Peyton
Falcon
Ellicott
Yoder
Rush
Truckton
Calhan
Fountain
Upper Monument Creek FOMO5800
Beaver Creek FOMO4600
Air Force Academy FOMO3200
West Cherry Creek CYCY0400
East Cherry Creek CYCY0200
West Kiowa Creek KIKI0200
Bijou Creek BIBI0200
Upper Big Sandy Creek BGBG1400
Calhan BGBG1000
Upper Black Squirrel Creek CHBS2000
Geick Ranch CHMS0400
Upper Bracket Creek CHBR0600
North Fork HOHO0400
Kettle Creek FOMO3000
Horse Creek HOHO0600
La Vega Ranch CHBR0400
Hook And Line Ranch CHBS1800
Little Horse Creek HOHO0200
Steels Fork HOPO1000
Cottonwood Creek FOMO2200
Haegler Ranch CHMS0200
Upper Big Springs Creek CHBG0400
Sand Creek FOFO4000
Manitou Reservoir FOFO7400
Rush HOPO0800
Ruxton Creek FOFO7000
Upper Pond Creek HOPO0600
Jimmy Camp Creek FOFO2000
Lower Pond Creek HOPO0400
Crows Roost CHBS1000
Drennan CHDS0400
Southwest Area FOFO4600
Fort Carson FOFO2200
Haynes Creek HAHA0600
St.lukes HOPO0200
Little Fountain Creek FOFO1800
Lower Black Squirrel CHBS0600
Squirrel Creek CHBS0200
East Kramer KRKR0600
Turkey Creek TUTU0200
Lower East Chico CHCH0800
East Haynes HAHA0400
Kramer Creek KRKR0400
Red Creek BEBE0200
Finch Ranch CHCH0400
Windmill CHCH0200
West Kramer KRKR0200
Young Hollow FOFO0200



PREPARED BY: Drexel, Barrell & Co. Engineers Surveyors
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3 S 7TH STREET, COLORADO SPRINGS, COLORADO 80905 (719) 260-0887
5813 W 4TH STREET, GREELEY, COLORADO 80634 (970) 351-0045
CONTACT: ROBERT BENNETT

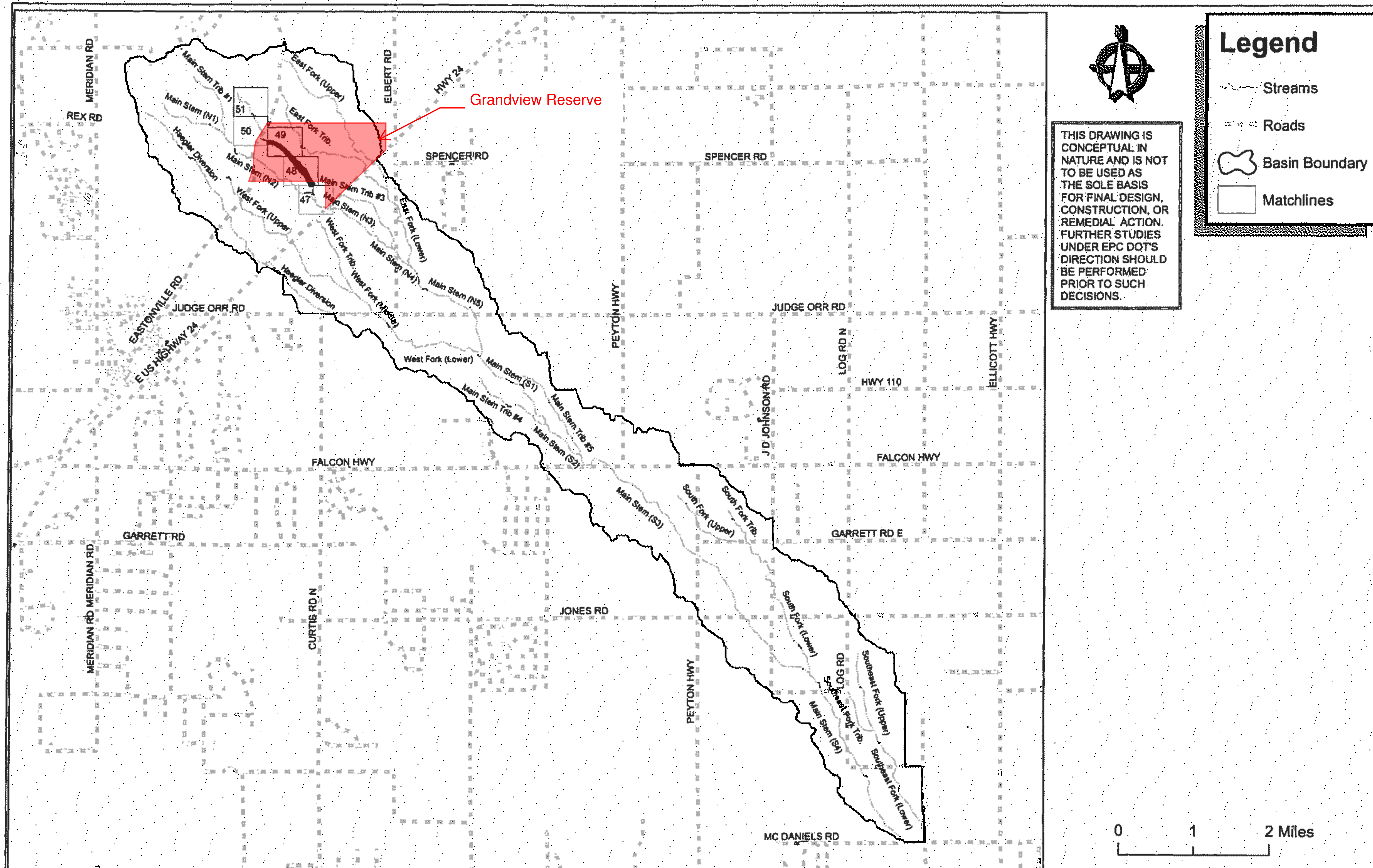
PREPARED FOR: REALTY DEVELOPMENT SERVICES
25 NORTH TEJON STREET, SUITE 300
COLORADO SPRINGS, COLORADO 80903
CONTACT: RAY O' SULLIVAN (719) 227-1822

PROJECT INFO: GIECK RANCH
DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

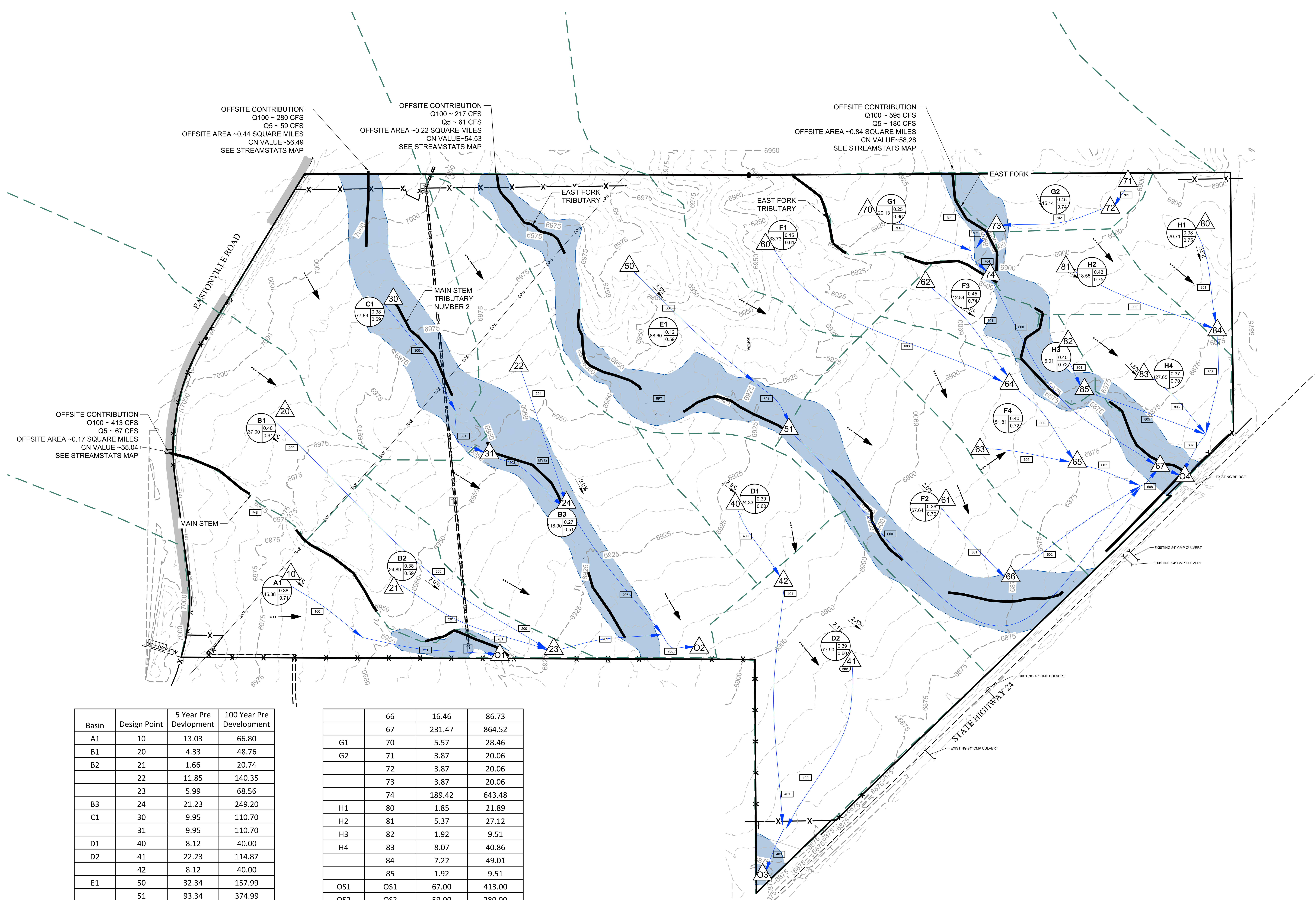
DESIGNED BY: RJB	REVISION DESCRIPTIONS	DATE	
DRAWN BY: SLF			
CHECKED BY: RJB			

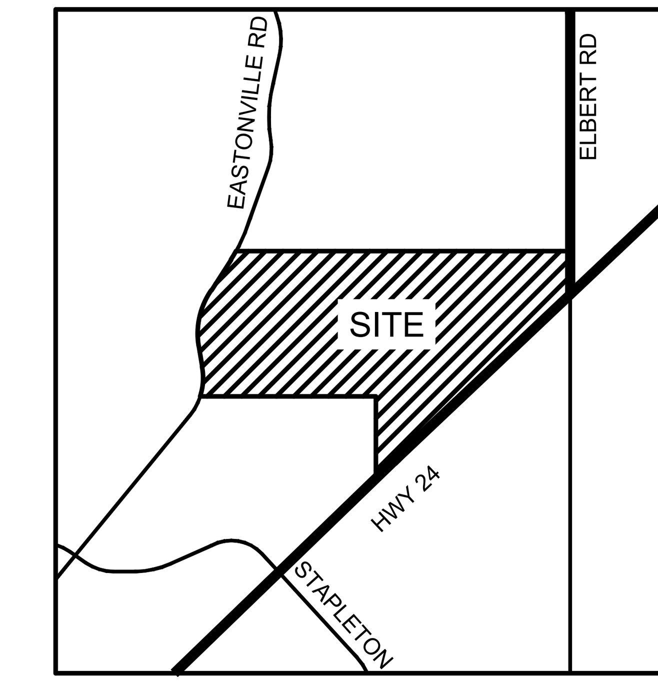
DRAWING INFO: GIECK RANCH
KEY MAP
MAIN STEM

DATE: AUGUST 2007	JOB NO. C7706-1	SET PL
SCALE: 1" = 6000'	DRAWING NO. 6D 038	SHEET K1



PREPARED BY: Drexel, Barrell & Co. Engineers · Surveyors; CONTACT: ROBERT BENNETT	PREPARED FOR: REALTY DEVELOPMENT SERVICES; 25 NORTH TEJON STREET, SUITE 300; COLORADO SPRINGS, COLORADO 80903; CONTACT: RAY O' SULLIVAN (719) 227-1622	PROJECT INFO: GIECK RANCH; DRAINAGE BASIN PLANNING STUDY; EL PASO COUNTY, COLORADO	DESIGNED BY: RJB; DRAWN BY: BLF; CHECKED BY: RJB	DRAWING INFO: GIECK RANCH KEY MAP MAIN STEM TRIBUTARY #2	DATE: AUGUST 2007; SCALE: 1" = 6000'; JOB NO: C7706-1; DRAWING NO: 6D 038; SET: PL; SHEET: K5





VICINITY MAP

LEGEND:

PROPOSED MAJOR CONTOUR — 5250
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR — 5250
EXISTING MINOR CONTOUR
PROPOSED STORM DRAIN PIPE
EXISTING STORM DRAIN PIPE
PROPOSED DRAINAGE CHANNEL
PROPOSED ROAD
PROPERTY LINE
DIRECTIONAL FLOW ARROW
EMERGENCY OVERFLOW ARROW
EXISTING 100-YR FLOODWAY
EXISTING 100-YR FLOODPLAIN
PROPOSED 100-YR FLOODPLAIN
WATERSHED BOUNDARY
MAJOR BASIN LINE
100YR ZONE A FLOODPLAIN
PROPOSED DETENTION LOCATION — A
POTENTIAL WATER QUALITY LOCATION — WQ
SWMM CONVEYANCE ELEMENT — SWMM
PROPOSED PEAK FLOW RATE (CFS) — 850
DESIGN POINT — X
PROPOSED BASIN LABEL — XX: BASIN DESIGNATION; AREA (AC.) XX; XX C5; XX C100

LAND USE
LOW DENSITY
MEDIUM DENSITY
HIGH/MED DENSITY
HIGH DENSITY
CHURCH
COMMERCIAL
ELEMENTARY SCHOOL
COMMUNITY PARK

NOTES:

Basin	Design Point	5 Year Pre Devlopment	100 Year Pre Development
A1	10	13.03	66.80
B1	20	4.33	48.76
B2	21	1.66	20.74
	22	11.85	140.35
	23	5.99	68.56
B3	24	21.23	249.20
C1	30	9.95	110.70
	31	9.95	110.70
D1	40	8.12	40.00
D2	41	22.23	114.87
	42	8.12	40.00
E1	50	32.34	157.99
	51	93.34	374.99
F1	60	9.70	49.45
F2	61	16.46	86.73
F3	62	3.65	18.42
F4	63	12.98	67.82
	64	13.35	67.87
	65	26.04	135.62

	66	16.46	86.73
	67	231.47	864.52
G1	70	5.57	28.46
G2	71	3.87	20.06
	72	3.87	20.06
	73	3.87	20.06
	74	189.42	643.48
H1	80	1.85	21.89
H2	81	5.37	27.12
H3	82	1.92	9.51
H4	83	8.07	40.86
	84	7.22	49.01
	85	1.92	9.51
OS1	OS1	67.00	413.00
OS2	OS2	59.00	280.00
OS3	OS3	61.00	217.00
OS4	OS4	180.00	595.00
	Outfall1	80.03	479.80
	Outfall2	85.96	597.41
	Outfall3	30.00	154.35
	Outfall4	341.05	1335.77

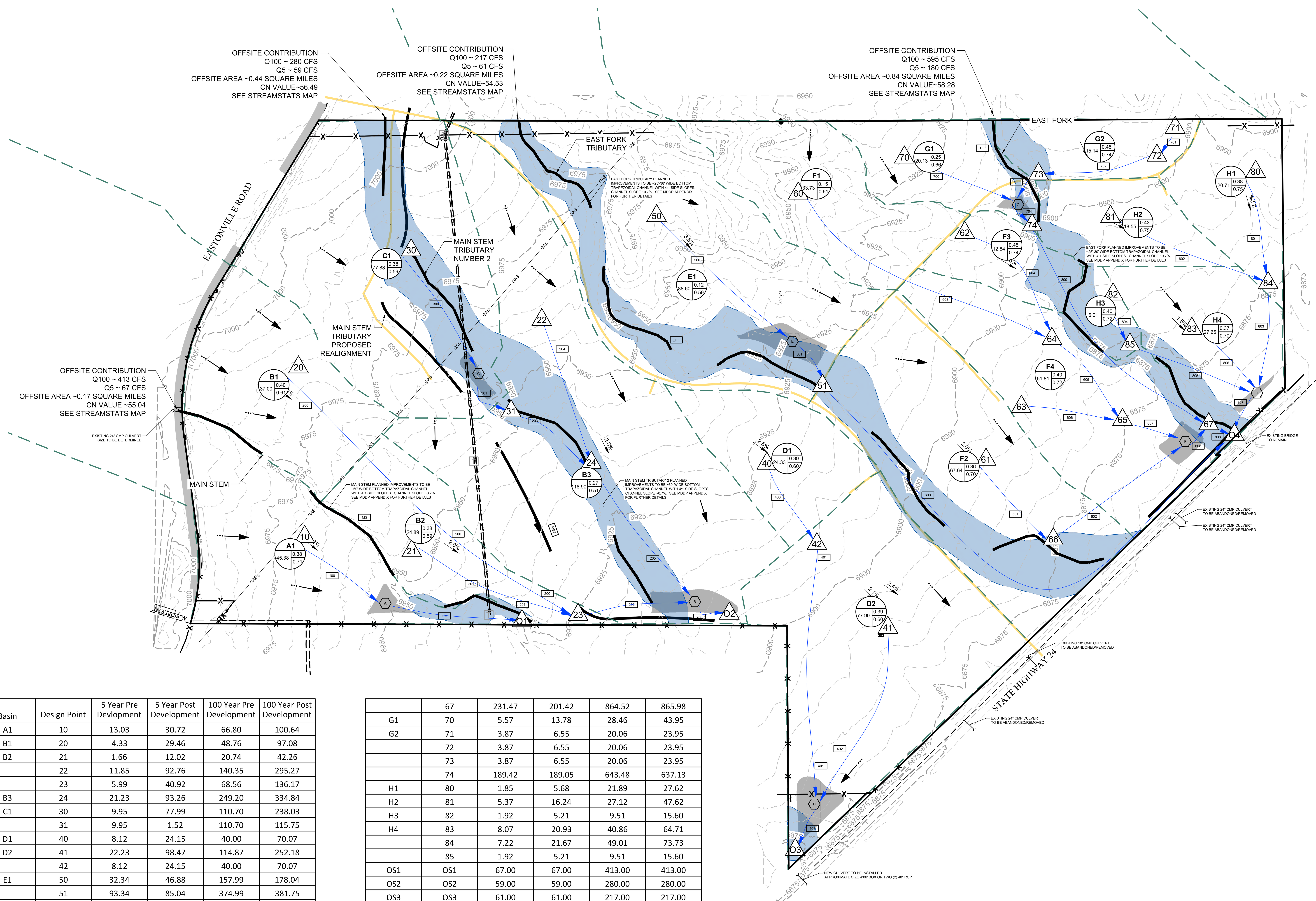
NORTH
0 100 200

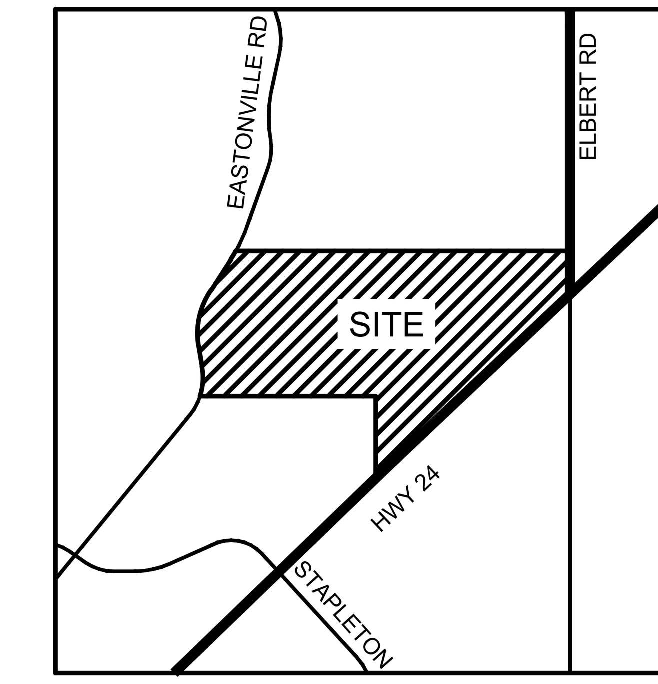
HRGreen

Job No.:	191897.01
Prepared By:	TBI
Date:	04/14/2020

EXISTING EX1

FIG.EX1





VICINITY MAP

LEGEND:

PROPOSED MAJOR CONTOUR — 5250
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR — 5250
EXISTING MINOR CONTOUR
PROPOSED STORM DRAIN PIPE
EXISTING STORM DRAIN PIPE
PROPOSED DRAINAGE CHANNEL
PROPOSED ROAD
PROPERTY LINE
DIRECTIONAL FLOW ARROW
EMERGENCY OVERFLOW ARROW
EXISTING 100–YR FLOODWAY
EXISTING 100–YR FLOODPLAIN
PROPOSED 100–YR FLOODPLAIN
WATERSHED BOUNDARY
MAJOR BASIN LINE
100YR ZONE A FLOODPLAIN
PROPOSED DETENTION LOCATION — A
POTENTIAL WATER QUALITY LOCATION — WQ
SWMM CONVEYANCE ELEMENT — SWMM
PROPOSED PEAK FLOW RATE (CFS) — 850
DESIGN POINT — X
PROPOSED BASIN LABEL — XX BASIN DESIGNATION; AREA (AC.) XX; XX C5; XX C100

LAND USE
LOW DENSITY
MEDIUM DENSITY
HIGH/MED DENSITY
HIGH DENSITY
CHURCH
COMMERCIAL
ELEMENTARY SCHOOL
COMMUNITY PARK

NOTES:

PRELIMINARY CHANNEL GEOMETRY (BY OTHERS)

MAIN STEM
BOTTOM WIDTH: 60'
SIDE SLOPES: 4:1

MAIN STEM TRIBUTARY 2
BOTTOM WIDTH: 60'
SIDE SLOPES: 4:1

EAST FORK TRIBUTARY 1 REACH 2
BOTTOM WIDTH: 38'
SIDE SLOPES: 4:1

EAST FORK TRIBUTARY 1 REACH 1
BOTTOM WIDTH: 25'
SIDE SLOPES: 4:1

Basin	Design Point	5 Year Pre Devlopment	5 Year Post Development	100 Year Pre Development	100 Year Post Development
A1	10	13.03	30.72	66.80	100.64
B1	20	4.33	29.46	48.76	97.08
B2	21	1.66	12.02	20.74	42.26
	22	11.85	92.76	140.35	295.27
	23	5.99	40.92	68.56	136.17
B3	24	21.23	93.26	249.20	334.84
C1	30	9.95	77.99	110.70	238.03
	31	9.95	1.52	110.70	115.75
D1	40	8.12	24.15	40.00	70.07
D2	41	22.23	98.47	114.87	252.18
	42	8.12	24.15	40.00	70.07
E1	50	32.34	46.88	157.99	178.04
	51	93.34	85.04	374.99	381.75
F1	60	9.70	16.28	49.45	58.95
F2	61	16.46	60.11	86.73	170.90
F3	62	3.65	11.36	18.42	32.93
F4	63	12.98	42.32	67.82	124.89
	64	13.35	26.88	67.87	90.88
	65	26.04	69.12	135.62	215.63
	66	16.46	60.11	86.73	170.90

	67	231.47	201.42	864.52	865.98
G1	70	5.57	13.78	28.46	43.95
G2	71	3.87	6.55	20.06	23.95
	72	3.87	6.55	20.06	23.95
	73	3.87	6.55	20.06	23.95
	74	189.42	189.05	643.48	637.13
H1	80	1.85	5.68	21.89	27.62
H2	81	5.37	16.24	27.12	47.62
H3	82	1.92	5.21	9.51	15.60
H4	83	8.07	20.93	40.86	64.71
	84	7.22	21.67	49.01	73.73
	85	1.92	5.21	9.51	15.60
OS1	OS1	67.00	67.00	413.00	413.00
OS2	OS2	59.00	59.00	280.00	280.00
OS3	OS3	61.00	61.00	217.00	217.00
OS4	OS4	180.00	180.00	595.00	595.00
	Outfall1	80.03	67.69	479.80	466.95
	Outfall2	85.96	61.68	597.41	536.11
	Outfall3	30.00	8.58	154.35	160.70*
	Outfall4	341.05	276.10	1335.77	1291.25

*THIS VALUE IS HIGHER THAN PRE-EXISTING AND WILL BE ADJUSTED TO MEET CRITERIA WITH THE PRELIMINARY DRAINAGE REPORT

NORTH
0 200 400

HRGreen

Job No.:	191897.01
Prepared By:	TBI
Date:	04/14/2020

PROPOSED DR1

FIG.DR1

APPENDIX C

Hydrologic Computations

HRGreen

EASTONVILLE ROAD
EXISTING CONDITIONS
LOCATION: EL PASO COUNTY, COLORADO

Calc'd by:	**CLB**
Checked by:	**NQJ**
Date:	**5/27/2022**

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
OS1	1.57	2	0.5	3.6
OS2	2.86	2	0.8	5.3
OS3	21.61	2	4.5	30.5
OS4*	112.71	2	67.0	413.0
OS5**	51.01	2	8.0	125.0

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
11	OS1	0.5	3.6
10	OS2	0.8	5.3
9	OS3	4.5	30.5
8*	OS4	67.0	413.0
7**	OS5	8.0	125.0

* TAKEN FROM APPROVED FALCON REGIONAL PARK DRAINAGE REPORT, 2015

** TAKEN FROM APPROVED 4 WAY RANCH LOMR, 2004, CASE No. 04-08-0012P

36 / 628 per Meridian Ranch MDDP

Asterisks need to be switched?

HRGreen

EASTONVILLE ROAD

EXISTING CONDITIONS

LOCATION: EL PASO COUNTY, COLORADO

Calc'd by: CLB

Checked by: NQJ

Date: 5/9/2022

COMPOSITE 'C' FACTORS

BASIN	MEADOW/FIELD	BLDGS/CONCRETE	GRAVEL PARKING	NEIGHBORHOOD AREA	TOTAL	SOIL TYPE	MEADOW/FIELD			BLDGS/CONCRETE			GRAVEL PARKING			NEIGHBORHOOD AREA			COMPOSITE IMPERVIOUSNESS & C		
	ACRES						%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}
OS1	1.57	0.00	0.00	0.00	1.57	A/B	2	0.09	0.36	100	0.90	0.96	80	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS2	2.86	0.00	0.00	0.00	2.86	A/B	2	0.09	0.36	100	0.90	0.96	80	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS3	21.61	0.00	0.00	0.00	21.61	A/B	2	0.09	0.36	100	0.90	0.96	80	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS4	112.71	0.00	0.00	0.00	112.71	A/B	2	0.09	0.36	100	0.90	0.96	80	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS5	51.01	0.00	0.00	0.00	51.01	A/B	2	0.09	0.36	100	0.90	0.96	80	0.45	0.59	70	0.49	0.62	2	0.09	0.36
Total					**189.76**														**2.0**		

	EASTONVILLE ROAD	Calc'd by:	CLB
HRGreen	EXISTING CONDITIONS	Checked by:	NQJ
	LOCATION: EL PASO COUNTY, COLORADO	Date:	5/9/2022

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)
OS1	0.09	1.57	77	3.2	11.0	7	143	5.2	1.6	1.5	12.5
OS2	0.09	2.86	119	1.5	17.6	7	332	8.0	2.0	2.8	20.4
OS3	0.09	21.61	194	2.0	20.5	7	980	3.4	1.3	12.7	33.1
OS4	0.09	112.71	300	1.0	32.1	7	830	3.0	1.2	11.4	43.5
OS5	0.09	51.01	200	1.0	26.2	7	250	2.6	1.1	3.7	29.9

FORMULAS:

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

Table 6-7. Conveyance Coefficient, C_v

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

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

HRGreen

EASTONVILLE ROAD
EXISTING CONDITIONS
DESIGN STORM: 5-YEAR

Calc'd by: CPM
Checked by:
Date: 5/27/2022

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C_5	t_c (min)	C_5*A (ac)	*I* (in./ hr.)	Q (cfs)	t_c (min)	C_5*A (ac)	*I* (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_5*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_5*A (ac)	SLOPE %	PIPE SIZE (in)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
	11	OS1	1.57	0.09	12.5	0.14	3.79	0.5															BASIN OS2 FLOW @ DP11, CAPTURED IN EX 18" CULVERT
	10	OS2	2.86	0.09	20.4	0.26	3.06	0.8															BASIN OS2 FLOW @ DP10, CAPTURED IN EX 18" CULVERT
	9	OS3	21.61	0.09	33.1	1.94	2.33	4.5															BASIN OS3 FLOW @ DP9, CAPTURED IN EX 18" CULVERT
	8	OS4	112.71					67.0															**TAKEN FROM APPROVED 4 WAY RANCH LOMR, 2004, CASE No. 04-08-0012P** INCLUDES OFFSITE FLOWS FROM MERIDIAN RANCH BASIN OS4 FLOW @ D8, CAPTURED IN EX 24" CULVERT
	7	OS5	51.01					8.0															**TAKEN FROM APPROVED FALCON REGIONAL PARK DRAINAGE REPORT, 2015** BASIN OS5 FLOW @ DP7, CAPTURED IN EX 24" CULVERT

HRGreen	EASTONVILLE ROAD EXISTING CONDITIONS DESIGN STORM: 100-YEAR	Calc'd by: Checked by: Date:	CPM 5/27/2022

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF: AREA (ac)	C_{100}	t_c (min)	C_{100}*A (ac)	*I* (in./ hr.)	Q (cfs)	TOTAL RUNOFF: t_c (min)	C_{100}*A (ac)	*I* (in./ hr.)	Q (cfs)	STREET: Q_{street} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE: Q_{PIPE} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE SIZE (ft)	TRAVEL TIME: LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	REMARKS
	11	OS1	1.57	0.36	12.5	0.57	6.37	3.6															BASIN OS2 FLOW @ DP11, CAPTURED IN EX 18" CULVERT
	10	OS2	2.86	0.36	20.4	1.03	5.13	5.3															BASIN OS2 FLOW @ DP10, CAPTURED IN EX 18" CULVERT
	9	OS3	21.61	0.36	33.1	7.78	3.91	30.5															BASIN OS3 FLOW @ DP9, CAPTURED IN EX 18" CULVERT
	8	OS4	112.71					413.0															**TAKEN FROM APPROVED 4 WAY RANCH LOMR, 2004, CASE No. 04-08-0012P** INCLUDES OFFSITE FLOWS FROM MERIDIAN RANCH BASIN OS4 FLOW @ D8, CAPTURED IN EX 24" CULVERT
	7	OS5	51.01					125.0															**TAKEN FROM APPROVED FALCON REGIONAL PARK DRAINAGE REPORT, 2015** BASIN OS5 FLOW @ DP7, CAPTURED IN EX 24" CULVERT

Is this correct? Total overall basin should be ~1.5 sq miles per previous studies

HRGreen	EASTONVILLE ROAD	Calc'd by:	CPM
	PROPOSED CONDITIONS	Checked by:	
	LOCATION: EL PASO COUNTY, COLORADO	Date:	5/27/2022

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q_5 (cfs)	Q_{100} (cfs)
EA1	7.79	59	9.2	19.5
EA2	5.59	59	7.0	14.9
OS1	6.73	2	1.3	8.7
OS2	17.28	2	2.6	17.3
OS3	91.28	59	-	-
OS4	20.30	59	-	-
OS3&OS4*	111.58	59	67.0	413.0
OS5**	47.27	2	8.0	125.0

DESIGN POINT SUMMARY TABLE

DESIGN POINT	CONTRIBUTING BASINS	ΣQ_5 (cfs)	ΣQ_{100} (cfs)
EA1	EA1	7.6	16.1
EA2	EA2	7.0	14.9
EA2.1	DPEA1 & DPEA2	14.1	30
32	OS1 & OS2	3.6	24
33	DP32	3.9	25.8
34*	OS3 & OS4	67	413
35**	OS5	8.0	125.0

*	TAKEN FROM APPROVED 4 WAY RANCH LOMR, 2004, CASE No. 04-08-0012P
**	TAKEN FROM APPROVED FALCON REGIONAL PARK DRAINAGE REPORT, 2015

Add a note that 663 cfs should be used for "emergency conditions" analysis, per Meridian Ranch MDDP (or provide updated calculations)

EASTONVILLE ROAD

PROPOSED CONDITIONS

LOCATION: EL PASO COUNTY, COLORADO

Calc'd by: NQJ

Checked by:

Date: 5/9/2022

COMPOSITE 'C' FACTORS

BASIN	UNDEVELOPED	ROADWAY	SINGLE FAMILY	NEIGHBORHOOD AREA	TOTAL	SOIL TYPE	UNDEVELOPED			ROADWAY			SINGLE FAMILY			NEIGHBORHOOD AREA			COMPOSITE IMPERVIOUSNESS & C		
	ACRES						%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}	%I	C_5	C_{100}
EA1	2.70	3.72	0.00	0.00	6.42	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	59	0.56	0.71
EA2	2.35	3.24	0.00	0.00	5.59	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	59	0.56	0.71
OS1	6.73	0.00	0.00	0.00	6.73	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS2	17.28	0.00	0.00	0.00	17.28	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS3	91.28	0.00	0.00	0.00	91.28	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS4	20.30	0.00	0.00	0.00	20.30	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	2	0.09	0.36
OS5	48.60	0.00	0.00	0.00	48.60	A/B	2	0.09	0.36	100	0.90	0.96	65	0.45	0.59	70	0.49	0.62	2	0.09	0.36
Eastonville Pond					**12.01**														**59**		
Total					**196.20**														**5**		

	EASTONVILLE ROAD	Calc'd by:	NQJ
HRGreen	PROPOSED CONDITIONS	Checked by:	
	LOCATION: EL PASO COUNTY, COLORADO	Date:	5/9/2022

TIME OF CONCENTRATION

BASIN DATA			OVERLAND TIME (T_i)			TRAVEL TIME (T_t)					TOTAL
DESIGNATION	C_5	AREA (ac)	LENGTH (ft)	SLOPE %	t_i (min)	C_V	LENGTH (ft)	SLOPE %	V (ft/s)	t_t (min)	t_c (min)
EA1	0.56	6.42	50	2.0	5.6	20	3750	0.9	1.9	32.9	38.5
EA2	0.56	5.59	50	2.0	5.6	20	3350	0.9	1.9	29.4	35.0
OS1	0.09	6.73	178	1.0	24.7	10	770	1.0	1.0	12.8	37.5
OS2	0.09	17.28	300	1.0	32.1	10	1200	1.0	1.0	20.0	52.1
OS3	0.09	91.28	300	1.0	32.1	10	3300	1.0	1.0	55.0	87.1
OS4	0.09	20.30	300	1.0	32.1	10	1400	1.0	1.0	23.3	55.4
OS5	0.09	48.60	300	1.0	32.1	10	1600	1.0	1.0	26.7	58.7

FORMULAS:

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

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

Table 6-7. Conveyance Coefficient, C_v

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

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

EASTONVILLE ROAD
PROPOSED CONDITIONS
DESIGN STORM: 5-YEAR

Calc'd by:	CPM
Checked by:	
Date:	5/27/2022

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C_5	t_c (min)	C_5*A (ac)	*I* (in./hr.)	Q (cfs)	t_c (min)	C_5*A (ac)	*I* (in./hr.)	Q (cfs)	Q_{Street} (cfs)	C_5*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_5*A (ac)	SLOPE %	PIPE SIZE (in)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min	
	EA1	EA1	7.79	0.56	38.5	4.36	2.11	9.2								9.2	4.36	2.0	1.5	52	8.4	0.10	BASIN EA1 FLOW CAPTURED IN 10' TYPE R SUMP @ DPEA1, PIPE TO DPEA2.1
	EA2	EA2	5.59	0.56	35.0	3.13	2.25	7.0															BASIN EA2 FLOW CAPTURED IN 10' TYPE R SUMP @ DPEA2 PIPE TO DPEA2.1
	EA2.1								38.6	7.49	2.10	15.8				15.8	7.49	2.0	2.0	56	10.2	0.09	COMBINED DPEA1 & DPEA2 FLOW @ DPEA2.1, PIPE TO EASTONVILLE POND
		OS1	6.73	0.09	37.5	0.61	2.14	1.3															BASIN OS1 FLOW, CONVEYED IN ROADSIDE SWALE TO DP32
		OS2	17.28	0.09	52.1	1.56	1.65	2.6															BASIN OS2 FLOW, CONVEYED IN ROADSIDE SWALE TO DP32
	32								52.1	2.16	1.65	3.6				3.6	2.16	1.0	2.5	830	8.4	1.66	BASIN OS1 & BASIN OS2 FLOW CAPTURED @ DP32 IN 30" RCP CULVERT, PIPE TO DP33
	33											3.9											EASTONVILLE POND DISCHARGE & DP32 COMBINED @ DP33, PIPE TO CHANNEL
		OS3	91.28																				INCLUDES OFFSITE FLOWS FROM MERIDIAN RANCH BASIN OS3 FLOW @ DP34
		OS4	20.30																				BASIN OS4 FLOW, CONVEYED IN ROADSIDE SWALE TO DP34
	34							67.0															**TAKEN FROM APPROVED 4 WAY RANCH LOMR, 2004, CASE No. 04-08-0012P** BASIN OS3 & BASIN OS4 @ DP34, CAPTURED IN TRIPLE 60" RCP CULVERTS
	35	OS5	47.27					8.0															**TAKEN FROM APPROVED FALCON REGIONAL PARK DRAINAGE REPORT, 2015** BASIN OS5 FLOW @ DP35, CAPTURED IN 48" RCP CULVERT

HRGreen	EASTONVILLE ROAD	Calc'd by:	CPM
	PROPOSED CONDITIONS	Checked by:	
	DESIGN STORM: 100-YEAR	Date:	5/27/2022

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C_{100}	t_c (min)	C_{100}*A (ac)	*I* (in./ hr.)	Q (cfs)	t_c (min)	C_{100}*A (ac)	*I* (in./ hr.)	Q (cfs)	Q_{street} (cfs)	C_{100}*A (ac)	SLOPE %	Q_{PIPE} (cfs)	C_{100}*A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
	EA1	EA1	7.79	0.71	38.5	5.52	3.54	19.5								19.5	5.52	2.0	1.5	52	8.4	0.10	BASIN EA1 FLOW CAPTURED IN 10' TYPE R SUMP @ DPEA1, PIPE TO DPEA2.1
	EA2	EA2	5.59	0.71	35.0	3.96	3.78	14.9															BASIN EA2 FLOW CAPTURED IN 10' TYPE R SUMP @ DPEA2 PIPE TO DPEA2.1
	EA2.1								38.6	9.47	3.53	33.4				33.4	9.47	2.0	2.0	56	10.2	0.09	COMBINED DPEA1 & DPEA2 FLOW @ DPEA2.1, PIPE TO EASTONVILLE POND
		OS1	6.73	0.36	37.5	2.42	3.60	8.7															BASIN OS1 FLOW, CONVEYED IN ROADSIDE SWALE TO DP32
		OS2	17.28	0.36	52.1	6.22	2.77	17.3															BASIN OS2 FLOW, CONVEYED IN ROADSIDE SWALE TO DP32
	32								52.1	8.64	2.77	24.0				24.0	8.64	1.0	2.5	830	8.4	1.66	BASIN OS1 & BASIN OS2 FLOW CAPTURED @ DP32 IN 30" RCP CULVERT, PIPE TO DP33
	33											25.8											EASTONVILLE POND DISCHARGE & DP32 COMBINED @ DP33, PIPE TO CHANNEL
		OS3	91.28																				INCLUDES OFFSITE FLOWS FROM MERIDIAN RANCH BASIN OS3 FLOW @ DP34
		OS4	20.30																				BASIN OS4 FLOW, CONVEYED IN ROADSIDE SWALE TO DP34
	34											413.0											**TAKEN FROM APPROVED 4 WAY RANCH LOMR, 2004, CASE No. 04-08-0012P** BASIN OS3 & BASIN OS4 @ DP34, CAPTURED IN TRIPLE 60" RCP CULVERTS
	35	OS5	47.27					125.0															**TAKEN FROM APPROVED FALCON REGIONAL PARK DRAINAGE REPORT, 2015** BASIN OS5 FLOW @ DP35, CAPTURED IN 48" RCP CULVERT

COMPOSITE % IMPERVIOUS CALCULATIONS: EXISTING & PROPOSED

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

1	2	3	4	5	6	7	8	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Basin ID	**Total Area (ac)**	**Paved/Gravel Roads**			**Lawns/Undeveloped**			**Residential - 1/8 Acre**			**Residential - 1/4 Acre**			**Residential - 1/3 Acre**			**Residential - 1/2 Acre**			**Residential - 1 Acre**			**Basins Total Weighted % Imp.**
		% Imp.	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	**% Imp.**	**Area (ac)**	**Weighted % Imp.**	
EXISTING																							
See HR Green Rational Calcs Included, titled "Eastonville Road - Existing Conditions," for Western Off-site Sub-Basins																							
EX-1	16.18	100	0	0	2	16.18	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
EX-2	46.06	100	0	0	2	46.06	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
EX-3	64.34	100	0	0	2	64.34	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
EX-4	2.68	100	0	0	2	2.68	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
EX-5	26.15	100	0	0	2	26.15	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
EX-6	31.53	100	0	0	2	31.53	2	65	0	0	40	0	0	30	0	0	25	0	0	20	0	0	2
PROPOSED																							
Basin-1	1.22	100	0.98	80.3	2	0.24	0.4	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	80.7
See HR Green Rational Calcs Included, titled "Eastonville Road - Proposed Conditions," for Eastonville Road Sub-Basins EA-1, EA-2 & Western Off-site Sub-Basins																							
EA-3	0.94	100	0.00	0.0	2	0.94	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
A-1	11.67	100	0.00	0.0	2	11.67	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
A-2a	4.42	100	0.00	0.0	2	0.00	0.0	65.0	4.42	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-2b	2.75	100	1.80	65.5	2	0.00	0.0	65.0	0.95	22.5	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	88.0
A-3	0.36	100	0.36	100.0	2	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	100.0
A-4a	6.31	100	0.00	0.0	2	0.00	0.0	65.0	6.31	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-4b	3.99	100	0.00	0.0	2	0.00	0.0	65.0	3.99	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-5	0.35	100	0.35	100.0	2	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	100.0
A-6	2.76	100	0.00	0.0	2	0.00	0.0	65.0	2.76	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-7	0.23	100	0.23	100.0	2	0.00	0.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	100.0
A-8	5.44	100	4.06	74.5	2	1.39	0.5	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	75.0
A-9	4.91	100	0.00	0.0	2	0.00	0.0	65.0	4.91	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-10	1.02	100	0.00	0.0	2	0.00	0.0	65.0	1.02	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
A-11	3.56	100	0.00	0.0	2	2.77	1.6	65.0	0.79	14.4	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	16.0
B-1	3.81	100	0.00	0.0	2	0.00	0.0	65.0	3.33	56.8	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	56.8
B-2	4.62	100	0.00	0.0	2	0.00	0.0	65.0	4.51	63.5	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	63.5
B-3	4.15	100	0.00	0.0	2	0.00	0.0	65.0	4.15	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-4	1.37	100	1.07	78.1	2	0.30	0.4	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	78.5
B-5	5.12	100	0.00	0.0	2	0.00	0.0	65.0	5.12	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-6	2.28	100	0.00	0.0	2	0.00	0.0	65.0	2.28	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-7	0.89	100	0.00	0.0	2	0.00	0.0	65.0	0.89	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-8	3.23	100	0.00	0.0	2	0.00	0.0	65.0	3.23	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-9	2.42	100	0.00	0.0	2	0.00	0.0	65.0	2.42	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
B-10	1.10	100	0.00	0.0	2	1.10	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-1	4.12	100	0.00	0.0	2	0.00	0.0	65.0	4.12	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-2	2.71	100	0.00	0.0	2	0.00	0.0	65.0	2.71	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-3	1.56	100	0.08	5.1	2	1.48	1.9	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	7.0
C-4	2.47	100	0.00	0.0	2	0.00	0.0	65.0	2.47	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-5	3.09	100	0.00	0.0	2	0.00	0.0	65.0	3.09	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-6	2.1	100	0.00	0.0	2	0.00	0.0	65.0	2.10	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-7a	0.81	100	0.00	0.0	2	0.26	0.6	65.0	0.55	44.1	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	44.7
C-7b	5.91	100	0.00	0.0	2	0.00	0.0	65.0	5.91	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-8	5.11	100	0.00	0.0	2	0.00	0.0	65.0	5.11	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-9a	3.5	100	0.00	0.0	2	0.00	0.0	65.0	3.50	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-9b	3.69	100	0.00	0.0	2	0.00	0.0	65.0	3.69	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-10	3.47	100	0.00	0.0	2	0.00	0.0	65.0	3.47	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-11	0.46	100	0.00	0.0	2	0.00	0.0	65.0	0.46	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-12	1.66	100	0.00	0.0	2	0.00	0.0	65.0	1.66	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
C-13	2.37	100	0.00	0.0	2	2.37	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-14	1.53	100	0.00	0.0	2	1.53	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
C-15	0.16	100	0.01	6.3	2	0.15	1.9	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	8.2
D-1	3.48	100	0.00	0.0	2	0.00	0.0	65.0	3.48	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-2	0.87	100	0.00	0.0	2	0.00	0.0	65.0	0.87	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-3	3.62	100	0.00	0.0	2	0.00	0.0	65.0	3.62	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-4	1.77	100	0.00	0.0	2	0.00	0.0	65.0	1.77	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
D-5	1.53	100	0.00	0.0	2	0.71	0.9	65.0	0.82	34.8	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	35.7
D-6	0.83	100	0.00	0.0	2	0.83	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
D-7a	0.25	100	0.02	8.0	2	0.23	1.8	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	9.8
D-7b	0.88	100	0.00	0.0	2	0.00	0.0	65.0	0.88	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-1	5.33	100	0.00	0.0	2	0.00	0.0	65.0	5.33	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-2	5.42	100	0.00	0.0	2	0.00	0.0	65.0	5.42	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-3	3.20	100	0.00	0.0	2	0.00	0.0	65.0	3.20	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-4	6.28	100	0.00	0.0	2	0.00	0.0	65.0	6.28	65.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	65.0
E-5	1.13	100	0.00	0.0	2	1.13	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0
E-6	0.74	100	0.00	0.0	2	0.74	2.0	65.0	0.00	0.0	40	0.00	0.0	30	0.00	0.0	25	0.00	0.0	20	0.00	0.0	2.0

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

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: EXISTING & PROPOSED

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Basin ID	Total Area (ac)	Paved/Gravel Roads			Lawns/Undeveloped			Roofs			Residential - 1/8 Acre			Residential - 1/4 Acre			Residential - 1/3 Acre			Residential - 1/2 Acre			Residential - 1 Acre			Composite C_5	Composite C_{100}
		C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)	C_5	C_{100}	Area (ac)		
EXISTING																											
See HR Green Rational Calcs Included, titled "Eastonville Road - Existing Conditions," for Western Off-site Sub-Basins																											
EX-1	16.18	0.90	0.96	0.00	0.09	0.36	16.18	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
EX-2	46.06	0.90	0.96	0.00	0.09	0.36	46.06	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
EX-3	64.34	0.90	0.96	0.00	0.09	0.36	64.34	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
EX-4	2.68	0.90	0.96	0.00	0.09	0.36	2.68	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
EX-5	26.15	0.90	0.96	0.00	0.09	0.36	26.15	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
EX-6	31.53	0.90	0.96	0.00	0.09	0.36	31.53	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
PROPOSED																											
Basin-1	1.22	0.90	0.96	0.98	0.09	0.36	0.24	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.74	0.84
See HR Green Rational Calcs Included, titled "Eastonville Road - Proposed Conditions," for Eastonville Road Sub-Basins EA-1, EA-2 & Western Off-site Sub-Basins																											
EA-3	0.94	0.90	0.96	0.00	0.09	0.36	0.94	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
A-1	11.67	0.90	0.96	0.00	0.09	0.36	11.67	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
A-2a	4.42	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.42	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-2b	2.75	0.90	0.96	1.80	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.95	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.74	0.83
A-3	0.36	0.90	0.96	0.36	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.90	0.96
A-4a	6.31	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	6.31	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-4b	3.99	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.99	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-5	0.35	0.90	0.96	0.35	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.90	0.96
A-6	2.76	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.76	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-7	0.23	0.90	0.96	0.23	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.90	0.96
A-8	5.44	0.90	0.96	4.06	0.09	0.36	1.39	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.69	0.81
A-9	4.91	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.91	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-10	1.02	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.02	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
A-11	3.56	0.90	0.96	0.00	0.09	0.36	2.77	0.73	0.81	0.00	0.45	0.59	0.79	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.17	0.41
B-1	3.81	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.33	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.39	0.52
B-2	4.62	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.51	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.44	0.58
B-3	4.15	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.15	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-4	1.37	0.90	0.96	1.07	0.09	0.36	0.30	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.72	0.83
B-5	5.12	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.12	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-6	2.28	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.28	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-7	0.89	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.89	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-8	3.23	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.23	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-9	2.42	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.42	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
B-10	1.10	0.90	0.96	0.00	0.09	0.36	1.10	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-1	4.12	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	4.12	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-2	2.71	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.71	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-3	1.56	0.90	0.96	0.08	0.09	0.36	1.48	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.13	0.39
C-4	2.47	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.47	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-5	3.09	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.09	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-6	2.10	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	2.10	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-7a	0.81	0.90	0.96	0.00	0.09	0.36	0.26	0.73	0.81	0.00	0.45	0.59	0.55	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.33	0.52
C-7b	5.91	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.91	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-8	5.11	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.11	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-9a	3.50	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.50	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-9b	3.69	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.69	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-10	3.47	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.47	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-11	0.46	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.46	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-12	1.66	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.66	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
C-13	2.37	0.90	0.96	0.00	0.09	0.36	2.37	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-14	1.53	0.90	0.96	0.00	0.09	0.36	1.53	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
C-15	0.16	0.90	0.96	0.01	0.09	0.36	0.15	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.14	0.40
D-1	3.48	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.48	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-2	0.87	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.87	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-3	3.62	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.62	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-4	1.77	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	1.77	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
D-5	1.53	0.90	0.96	0.00	0.09	0.36	0.71	0.73	0.81	0.00	0.45	0.59	0.82	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.28	0.48
D-6	0.83	0.90	0.96	0.00	0.09	0.36	0.83	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
D-7a	0.25	0.90	0.96	0.02	0.09	0.36	0.23	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.15	0.41
D-7b	0.88	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	0.88	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-1	5.33	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.33	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-2	5.42	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	5.42	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-3	3.20	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	3.20	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-4	6.28	0.90	0.96	0.00	0.09	0.36	0.00	0.73	0.81	0.00	0.45	0.59	6.28	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.45	0.59
E-5	1.13	0.90	0.96	0.00	0.09	0.36	1.13	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36
E-6	0.74	0.90	0.96	0.00	0.09	0.36	0.74	0.73	0.81	0.00	0.45	0.59	0.00	0.30	0.50	0.00	0.25	0.47	0.00	0.22	0.46	0.00	0.20	0.44	0.00	0.09	0.36

Lot Type Identification:	
Lot Size (SF)	*Lot Size (Acre)*
0 - 8,167	<= 1/8 Acre
8,168 - 12,704	1/4 Acre
12,705 - 18,149	1/3 Acre
18,150 - 32,670	1/2 Acre
32,671 - 43,560	1 Acre

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: EXISTING & PROPOSED TIME OF CONCENTRATION

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

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 (T_c)			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)	Calculated T_c (MIN)	T_c (MIN)
EXISTING																	
See HR Green Rational Calcs Included, titled "Eastonville Road - Existing Conditions," for Western Off-site Sub-Basins																	
EX-1	16.18	A	2.0	0.09	0.36	300	3.3	21.6	1433	2.5	15	2.4	10.0	31.6	1732.7	19.6	31.6
EX-2	46.06	A	2.0	0.09	0.36	300	2.5	23.6	3127	2.0	15	2.1	24.7	48.3	3427.0	29.0	48.3
EX-3	64.34	A	2.0	0.09	0.36	300	3.2	21.7	3964	2.1	15	2.2	30.4	52.1	4263.6	33.7	52.1
EX-4	2.68	A	2.0	0.09	0.36	300	2.5	23.8	462	2.4	15	2.3	3.3	27.1	762.3	14.2	27.1
EX-5	26.15	A	2.0	0.09	0.36	300	3.1	22.1	2121	2.3	15	2.3	15.6	37.7	2420.8	23.4	37.7
EX-6	31.53	A	2.0	0.09	0.36	300	3.6	20.9	1488	2.1	15	2.2	11.4	32.3	1788.5	19.9	32.3
PROPOSED																	
Basin-1	1.22	A	80.7	0.74	0.84	46	2.0	3.5	556	1.8	20	2.7	3.5	7.0	602.0	13.3	7.0
See HR Green Rational Calcs Included, titled "Eastonville Road - Proposed Conditions," for Eastonville Road Sub-Basins EA-1, EA-2 & Western Off-site Sub-Basins																	
EA-3	0.94	A	2.0	0.09	0.36	22	25.0	3.0	285	3.0	20	3.5	1.4	4.3	307.0	11.7	5.0
A-1	11.67	A	2.0	0.09	0.36	50	10.0	6.1	957	5.0	20	4.5	3.6	9.6	1007.0	15.6	9.6
A-2a	4.42	A	65.0	0.45	0.59	50	5.0	4.9	742	2.5	20	3.2	3.9	8.8	792.0	14.4	8.8
A-2b	2.75	A	88.0	0.74	0.83	250	2.0	8.3	300	2.5	20	3.2	1.6	9.9	550.0	13.1	9.9
A-3	0.36	A	100.0	0.90	0.96	18	2.0	1.2	560	1.9	20	2.8	3.4	4.6	578.0	13.2	5.0
A-4a	6.31	A	65.0	0.45	0.59	230	2.0	14.3	700	2.5	20	3.2	3.7	18.0	930.0	15.2	15.2
A-4b	3.99	A	65.0	0.45	0.59	100	2.0	9.4	770	2.5	20	3.2	4.1	13.5	870.0	14.8	13.5
A-5	0.35	A	100.0	0.90	0.96	18	2.0	1.2	332	1.4	20	2.4	2.3	3.6	350.0	11.9	5.0
A-6	2.76	A	65.0	0.45	0.59	217	4.5	10.6	310	1.0	20	2.0	2.6	13.2	527.0	12.9	12.9
A-7	0.23	A	100.0	0.90	0.96	36	3.0	1.5	340	2.3	20	3.0	1.9	3.4	376.0	12.1	5.0
A-8	5.44	A	75.0	0.69	0.81	250	2.0	9.4	300	2.0	20	2.8	1.8	11.2	550.0	13.1	11.2
A-9	4.91	A	65.0	0.45	0.59	160	2.0	11.9	950	1.5	20	2.4	6.5	18.4	1110.0	16.2	16.2
A-10	1.02	A	65.0	0.45	0.59	18	3.0	3.5	450	1.0	20	2.0	3.8	7.3	468.0	12.6	7.3
A-11	3.56	A	16.0	0.17	0.41	450	5.0	21.1	718	1.0	20	2.0	6.0	27.1	1168.0	16.5	16.5
B-1	3.81	A	56.8	0.39	0.52	210	3.5	12.4	560	1.7	20	2.6	3.6	16.0	770.0	14.3	14.3
B-2	4.62	A	63.5	0.44	0.58	230	3.0	12.7	611	2.5	20	3.2	3.2	15.9	841.0	14.7	14.7
B-3	4.15	A	65.0	0.45	0.59	34	2.0	5.5	680	2.7	20	3.3	3.4	9.0	714.0	14.0	9.0
B-4	1.37	A	78.5	0.72	0.83	10	6.0	1.2	700	1.0	20	2.0	5.8	7.0	710.0	13.9	7.0
B-5	5.12	A	65.0	0.45	0.59	60	1.0	9.2	946	1.7	20	2.6	6.0	15.3	1006.0	15.6	15.3
B-6	2.28	A	65.0	0.45	0.59	186	3.0	11.3	480	1.0	20	2.0	4.0	15.3	666.0	13.7	13.7
B-7	0.89	A	65.0	0.45	0.59	62	3.0	6.5	509	1.0	20	2.0	4.2	10.7	571.0	13.2	10.7
B-8	3.23	A	65.0	0.45	0.59	177	5.0	9.3	700	2.0	20	2.8	4.1	13.4	877.0	14.9	13.4
B-9	2.42	A	65.0	0.45	0.59	152	3.0	10.2	800	2.4	20	3.1	4.3	14.5	952.0	15.3	14.5
B-10	1.10	A	2.0	0.09	0.36	66	25.0	5.1	187	1.0	20	2.0	1.6	6.7	253.0	11.4	6.7
C-1	4.12	A	65.0	0.45	0.59	65	3.0	6.7	1077	2.0	20	2.8	6.3	13.0	1142.0	16.3	13.0
C-2	2.71	A	65.0	0.45	0.59	55	2.0	7.0	620	1.9	20	2.8	3.7	10.8	675.0	13.8	10.8
C-3	1.56	A	7.0	0.13	0.39	77	4.0	9.8	0	0.0	20	0.0	0.0	9.8	77.0	10.4	9.8
C-4	2.47	A	65.0	0.45	0.59	194	2.0	13.2	345	1.3	20	2.3	2.5	15.7	539.0	13.0	13.0
C-5	3.09	A	65.0	0.45	0.59	38	4.0	4.6	761	1.0	20	2.0	6.3	11.0	799.0	14.4	11.0
C-6	2.10	A	65.0	0.45	0.59	61	3.0	6.4	1176	1.0	20	2.0	9.8	16.2	1236.5	16.9	16.2
C-7a	0.81	A	44.7	0.33	0.52	142	8.3	8.3	136	2.5	15	2.4	1.0	9.3	278.0	11.5	9.3
C-7b	5.91	A	65.0	0.45	0.59	35	4.0	4.4	1278	1.7	20	2.6	8.2	12.6	1313.0	17.3	12.6
C-8	5.11	A	65.0	0.45	0.59	58	2.0	7.2	834	1.6	20	2.5	5.5	12.7	892.0	15.0	12.7
C-9a	3.50	A	65.0	0.45	0.59	193	2.0	13.1	570	0.7	20	1.7	5.7	18.8	763.0	14.2	14.2
C-9b	3.69	A	65.0	0.45	0.59	160	3.0	10.4	665	2.0	20	2.8	3.9	14.4	825.0	14.6	14.4
C-10	3.47	A	65.0	0.45	0.59	122	3.0	9.1	1084	1.5	20	2.4	7.4	16.5	1206.0	16.7	16.5
C-11	0.46	A	65.0	0.45	0.59	26	2.0	4.8	152	0.5	20	1.4	1.8	6.6	178.0	11.0	6.6
C-12	1.66	A	65.0	0.45	0.59	160	4.0	9.5	200	0.5	20	1.4	2.4	11.8	360.0	12.0	11.8
C-13	2.37	A	2.0	0.09	0.36	225	15.0	11.3	352	1.0	20	2.0	2.9	14.2	577.0	13.2	13.2
C-14	1.53	A	2.0	0.09	0.36	300	5.0	18.7	0	0.0	10	0.0	0.0	18.7	300.0	11.7	11.7
C-15	0.16	A	8.2	0.14	0.40	72	5.0	8.7	0	0.0	20	0.0	0.0	8.7	72.0	10.4	8.7
D-1	3.48	A	65.0	0.45	0.59	170	3.0	10.8	715	1.0	20	2.0	6.0	16.7	885.0	14.9	14.9
D-2	0.87	A	65.0	0.45	0.59	10	2.0	3.0	700	1.3	20	2.3	5.1	8.1	710.0	13.9	8.1
D-3	3.62	A	65.0	0.45	0.59	140	3.0	9.8	660	2.2	20	3.0	3.7	13.5	800.0	14.4	13.5
D-4	1.77	A	65.0	0.45	0.59	50	3.0	5.8	663	2.0	20	2.8	3.9	9.7	713.0	14.0	9.7
D-5	1.53	A	35.7	0.28	0.48	110	25.0	5.4	201	1.0	20	2.0	1.7	7.1	311.0	11.7	7.1
D-6	0.83	A	2.0	0.09	0.36	300	5.0	18.7	0	0.0	10	0.0	0.0	18.7	300.0	11.7	11.7
D-7a	0.25	A	9.8	0.15	0.41	75	5.0	8.8	0	0.0	20	0.0	0.0	8.8	75.0	10.4	8.8
D-7b	0.88	A	65.0	0.45	0.59	75	8.0	5.2	478	2.0	15	2.1	3.8	8.9	553.0	13.1	8.9
E-1	5.33	A	65.0	0.45	0.59	25	4.0	3.7	1360	3.3	20	3.6	6.2	10.0	1385.0	17.7	10.0
E-2	5.42	A	65.0	0.45	0.59	20	2.0	4.2	1250	3.5	20	3.7	5.6	9.8	1270.0	17.1	9.8
E-3	3.20	A	65.0	0.45	0.59	10	2.0	3.0	965	1.5	20	2.4	6.6	9.6	975.0	15.4	9.6
E-4	6.28	A	65.0	0.45	0.59	305	7.0	10.9	1125	1.6	20	2.5	7.4	18.3	1430.0	17.9	17.9
E-5	1.13	A	2.0	0.09	0.36	127	25.0	7.1	315	1.0	20	2.0	2.6	9.8	442.0	12.5	9.8
E-6	0.74	A	2.0	0.09	0.36	350	2.0	27.5	113	2.0	10	1.4	1.3	28.8	463.0	12.6	12.6

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

Tc 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: EXISTING & PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 5-Year

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		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)	
EXISTING																					
	1	EX-1	16.18	0.09	31.6	1.46	2.35	3.4				4.7									Sheet flow to Main Stem Channel Total Flow from DP 10, DP 11 & Basin EX-1
	2	EX-2	46.06	0.09	48.3	4.15	1.82	7.6				79.1									Sheet flow to Main Stem Channel Total Flow from DP 8, DP 9 & Basin EX-2
	3	EX-3	64.34	0.09	52.1	5.79	1.73	10.0				10.0									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel
	4	EX-4	2.68	0.09	27.1	0.24	2.57	0.6				0.6									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel
	5	EX-5	26.15	0.09	37.7	2.35	2.12	5.0				5.0									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel
	6	EX-6	31.53	0.09	32.3	2.84	2.32	6.6				14.6									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel Total Flow from DP 7 & EX-6
See HR Green Rational Calcs Included, titled "Eastonville Road - Existing Conditions," for Western Off-site Sub-Basins																					
	12											30.2									Total Existing Flow offsite - outfalls to Main Stem Tributary #2 Channel
PROPOSED																					
		Basin-1	1.22	0.74	7.0	0.90	4.64	4.2				4.2									East Leg of Rex Road Intersection
See HR Green Rational Calcs Included, titled "Eastonville Road - Proposed Conditions," for Eastonville Road Sub-Basins EA-1, EA-2 & Western Off-site Sub-Basins																					
		EA-3	0.94	0.09	5.0	0.08	5.10	0.4													Eastonville Road Pond
	1	A-1	11.67	0.09	9.6	1.05	4.16	4.4				4.4									Institutional Tract Basin will have own water quality & detention pond
	2a	A-2a	4.42	0.45	8.8	1.99	4.29	8.5				8.5									On-Grade 15' CDOT Type R Inlet (0.6 cfs bypass to DP 2b)
	2b	A-2b	2.75	0.74	9.9	2.04	4.13	8.4				9.0									Sump 20' CDOT Type R Inlet (Receives 0.6 cfs upstream bypass)
	3	A-3	0.36	0.90	5.0	0.32	5.10	1.6				1.6									Sump 5' CDOT Type R Inlet
	4a	A-4a	6.31	0.45	15.2	2.84	3.44	9.8				9.8									On-Grade 15' CDOT Type R Inlet (1.2 cfs bypass to DP 4)
	4b 4	A-4b	3.99	0.45	13.5	1.80	3.63	6.5				6.5 2.5									On-Grade 15' CDOT Type R Inlet (1.3 cfs bypass to DP 4) Sump 15' CDOT Type R Inlet (Receives 2.5 cfs upstream bypass)
	5	A-5	0.35	0.90	5.0	0.32	5.10	1.6				1.6									Sump 5' CDOT Type R Inlet
	6	A-6	2.76	0.45	12.9	1.24	3.70	4.6				4.6									On-Grade 10' CDOT Type R Inlet (0.4 cfs bypass to DP 7a)
	7	A-7	0.23	0.90	5.0	0.21	5.10	1.1				1.1									On-Grade 5' CDOT Type R Inlet (0.1 cfs bypass to DP 7b)
	8	A-8	5.44	0.69	11.2	3.75	3.93	14.7				14.7									Proposed Amenitity Center - Assumed 75% Imperviousness
	7a	A-9	4.91	0.45	16.2	2.21	3.34	7.4				7.8									Sump 20' CDOT Type R Inlet (Receives 0.4 cfs upstream bypass)
	7b	A-10	1.02	0.45	7.3	0.46	4.59	2.1				2.2									Sump 5' CDOT Type R Inlet (Receives 0.1 cfs upstream bypass)
	8a	A-11	3.56	0.17	16.5	0.61	3.31	2.0	16.5	17.79	3.31	58.9									Total of Flows to Pond A
	9	B-1	3.81	0.39	14.3	1.49	3.54	5.3				5.3									Sump 15' CDOT Type R Inlet
	10a	B-2	4.62	0.44	14.7	2.03	3.50	7.1				7.1									On-Grade 10' CDOT Type R Inlet (1.6 cfs bypass to DP 10b)
	10b	B-3	4.15	0.45	9.0	1.87	4.27	8.0				9.6									Sump 20' CDOT Type R Inlet (Receives 1.6 cfs of upstream bypass)
	11	B-4	1.37	0.72	7.0	0.99	4.63	4.6				4.6									Sump 15' CDOT Type R Inlet
	12a	B-5	5.12	0.45	15.3	2.30	3.43	7.9				7.9									On-Grade 10' CDOT Type R Inlet (2.0 cfs bypass to DP 12b)

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project Name: Grandview Subdivision PDR
Subdivision: Grandview Reserve
Project No.: HRG01
Location: CO, El Paso County
Calculated By: TJE
Design Storm: 5-Year
Checked By: BAS
Date: 5/26/22

STREET		DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
	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)	
	14	B-6	2.28	0.45	13.7	1.03	3.61	3.7				3.7									On-Grade 10' CDOT Type R Inlet (0.1 cfs bypass to DP 12b)
	15	B-7	0.89	0.45	10.7	0.40	3.99	1.6				1.6									On-Grade 10' CDOT Type R Inlet (0.0 cfs bypass to DP 12b)
	12b	B-8	3.23	0.45	13.4	1.45	3.64	5.3				7.4									Sump 20' CDOT Type R Inlet (Receives 2.1 cfs of upstream bypass)
	13	B-9	2.42	0.45	14.5	1.09	3.52	3.8				3.8									Sump 10' CDOT Type R Inlet
	16	B-10	1.10	0.09	6.7	0.10	4.70	0.5	15.3	12.75	3.43	43.7									Total of flows to Pond B
	17b	C-1	4.12	0.45	13.0	1.85	3.69	6.8				6.8									On-Grade 15' CDOT Type R (0.1 cfs bypass to DP 17e)
	17a	C-2	2.71	0.45	10.8	1.22	3.99	4.9				4.9									On-Grade 15' CDOT Type R (1.7 cfs bypass to DP 17c)
	17c	C-4	2.47	0.45	13.0	1.11	3.69	4.1				5.8									Receives 1.7 cfs of Bypass from DP 17a On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17d)
	17d	C-5	3.09	0.45	11.0	1.39	3.96	5.5				5.5									Receives 0.0 cfs of Bypass from DP 17c On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17h)
	17e	C-6	2.10	0.45	16.2	0.95	3.34	3.2				3.3									Receives 0.1 cfs of Bypass from DP 17b On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17h)
	17f	C-8	5.11	0.45	12.7	2.30	3.73	8.6				8.6									On-Grade 15' CDOT Type R (0.6 cfs bypass to DP 17g)
	17g	C-9a	3.50	0.45	14.2	1.58	3.54	5.6				6.2									Receives 0.6 cfs of Bypass from DP 17f On-Grade 15' CDOT Type R (0.0 cfs bypass to DP 17h)
	17h	C-9b	3.69	0.45	14.4	1.66	3.53	5.9				5.9									Sump 20' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	18a	C-7a	0.81	0.33	9.3	0.27	4.22	1.1				1.1									Drainage Swale/SW Chase - Flows to DP 18b
	18b	C-7b	5.91	0.45	12.6	2.66	3.74	9.9	12.6	2.93	3.74	11.0									On-Grade 15' CDOT Type R (1.6 cfs bypass to DP 18c)
	18c	C-10	3.47	0.45	16.5	1.56	3.31	5.2				6.9									Sump 15' CDOT Type R (Receives 1.6 cfs of upstream bypass)
	19	C-11	0.46	0.45	6.6	0.21	4.72	1.0				1.0									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	20	C-12	1.66	0.45	11.8	0.75	3.84	2.9				2.9									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	21	C-13	2.37	0.09	13.2	0.21	3.66	0.8	16.5	17.72	3.31	58.7									Total combined flows to Pond C
		C-3	1.56	0.13	9.8	0.20	4.13	0.8													Back of Lots 409-426 - Sheet Flows to MS 2
		C-14	1.53	0.09	11.7	0.14	3.86	0.5													Un-developed area - Sheet flows to MS 2
		C-15	0.16	0.14	8.7	0.02	4.31	0.1													Portion of Lot 444 - Sheet flows to MS 2
	22	D-1	3.48	0.45	14.9	1.57	3.47	5.4				5.4									On-Grade 10' CDOT Type R Inlet (0.7 cfs bypass to DP 24)
	23	D-2	0.87	0.45	8.1	0.39	4.42	1.7				1.7									On-Grade 10' CDOT Type R Inlet (0.0 cfs bypass to DP 24)
	24	D-3	3.62	0.45	13.5	1.63	3.63	5.9				6.6									Receives 0.4 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	25	D-4	1.77	0.45	9.7	0.80	4.14	3.3				3.3									Sump 10' CDOT Type R Inlet
	25a	D-7b	0.88	0.45	8.9	0.40	4.28	1.7				1.7									Sheet flows to Channel and Conveyed to Pond D
	26	D-5	1.53	0.28	7.1	0.43	4.63	2.0	14.9	5.22	3.47	18.1									Total of flows to Pond D
		D-6	0.83	0.09	11.7	0.07	3.86	0.3													Un-developed area - Sheet flows to MS
		D-7a	0.25	0.15	8.8	0.04	4.30	0.2													Back of Lots 18-20 - Sheet Flows to MST

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STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 5-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		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)	
	27	E-1	5.33	0.45	10.0	2.40	4.10	9.8				9.8									On-Grade 15' CDOT Type R Inlet (0.9 cfs bypass to DP 29)
	28	E-2	5.42	0.45	9.8	2.44	4.13	10.1				10.1									On-Grade 15' CDOT Type R Inlet (1.2 cfs bypass to DP 29)
	29	E-3	3.20	0.45	9.6	1.44	4.17	6.0				8.1									Receives 2.1 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	30	E-4	6.28	0.45	17.9	2.83	3.18	9.0				9.0									Sump 20' CDOT Type R Inlet
	31	E-5	1.13	0.09	9.8	0.10	4.14	0.4	17.9	9.21	3.18	29.3									Total of flows to Pond E
		E-6	0.74	0.09	12.6	0.07	3.74	0.3													Un-developed area - Sheet flows to MS

Address the remaining design points with culverts or pipes DP32-DP35. Add lines or text.

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Project Name: Grandview Subdivision PDR
Subdivision: Grandview Reserve
Project No.: HRG01
Location: CO, El Paso County
Calculated By: TJE
Design Storm: 100-Year
Checked By: BAS
Date: 5/26/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		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)	
EXISTING																					
	1	EX-1	16.18	0.36	31.6	5.82	4.19	24.4				33.3									Sheet flow to Main Stem Channel Total Flow from DP 10, DP 11 & Basin EX-1
	2	EX-2	46.06	0.36	48.3	16.58	3.24	53.7				497.2									Sheet flow to Main Stem Channel Total Flow from DP 8, DP 9 & Basin EX-2
	3	EX-3	64.34	0.36	52.1	23.16	3.09	71.6				71.6									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel
	4	EX-4	2.68	0.36	27.1	0.96	4.57	4.4				4.4									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel
	5	EX-5	26.15	0.36	37.7	9.41	3.77	35.5				35.5									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel
	6	EX-6	31.53	0.36	32.3	11.35	4.13	46.9				584.9									Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel Total Flow from DP 7 & EX-6
See HR Green Rational Calcs Included, titled "Eastonville Road - Existing Conditions," for Western Off-site Sub-Basins																					
	12											696.3									Total Existing Flow offsite - outfalls to Main Stem Tributary #2 Channel
PROPOSED																					
		Basin-1	1.22	0.84	7.0	1.02	8.26	8.4				8.4									East Leg of Rex Road Intersection
See HR Green Rational Calcs Included, titled "Eastonville Road - Proposed Conditions," for Eastonville Road Sub-Basins EA-1, EA-2 & Western Off-site Sub-Basins																					
		EA-3	0.94	0.36	5.0	0.34	9.09	3.1													Eastonville Road Pond
	1	A-1	11.67	0.36	9.6	4.20	7.40	31.1				31.1									Institutional Tract Basin will have own water quality & detention pond
	2a	A-2a	4.42	0.59	8.8	2.61	7.64	19.9				19.9									On-Grade 15' CDOT Type R Inlet (7.0 cfs bypass to DP 2b)
	2b	A-2b	2.75	0.83	9.9	2.28	7.34	16.7				23.7									Sump 20' CDOT Type R Inlet (Receives 7.0 cfs upstream bypass)
	3	A-3	0.36	0.96	5.0	0.35	9.09	3.2				3.2									Sump 5' CDOT Type R Inlet
	4a	A-4a	6.31	0.59	15.2	3.72	6.13	22.8				22.8									On-Grade 15' CDOT Type R Inlet (9.0 cfs bypass to DP 4)
	4b 4	A-4b	3.99	0.59	13.5	2.35	6.46	15.2				15.2 16.1									On-Grade 15' CDOT Type R Inlet (7.1 cfs bypass to DP 4) Sump 15' CDOT Type R Inlet (Receives 16.1 cfs upstream bypass)
	5	A-5	0.35	0.96	5.0	0.34	9.09	3.1				3.1									Sump 5' CDOT Type R Inlet
	6	A-6	2.76	0.59	12.9	1.63	6.58	10.7				10.7									On-Grade 10' CDOT Type R Inlet (3.8 cfs bypass to DP 7a)
	7	A-7	0.23	0.96	5.0	0.22	9.09	2.0				2.0									On-Grade 5' CDOT Type R Inlet (0.4 cfs bypass to DP 7b)
	8	A-8	5.44	0.81	11.2	4.41	6.99	30.8				30.8									Proposed Amenitity Center - Assumed 75% Imperviousness
	7a	A-9	4.91	0.59	16.2	2.90	5.95	17.3				21.1									Sump 20' CDOT Type R Inlet (Receives 3.8 cfs upstream bypass)
	7b	A-10	1.02	0.59	7.3	0.60	8.17	4.9				5.3									Sump 5' CDOT Type R Inlet (Receives 0.4 cfs upstream bypass)
	8a	A-11	3.56	0.41	16.5	1.46	5.90	8.6	16.5	22.87	5.90	134.9									Total of Flows to Pond A
	9	B-1	3.81	0.52	14.3	1.98	6.30	12.5				12.5									Sump 15' CDOT Type R Inlet
	10a	B-2	4.62	0.58	14.7	2.68	6.22	16.7				16.7									On-Grade 10' CDOT Type R Inlet (8.3 cfs bypass to DP 10b)
	10b	B-3	4.15	0.59	9.0	2.45	7.61	18.6				26.9									Sump 20' CDOT Type R Inlet (Receives 8.3 cfs of upstream bypass)
	11	B-4	1.37	0.83	7.0	1.14	8.25	9.4				9.4									Sump 15' CDOT Type R Inlet
	12a	B-5	5.12	0.59	15.3	3.02	6.11	18.5				18.5									On-Grade 10' CDOT Type R Inlet (9.5 cfs bypass to DP 12b)

STANDARD FORM SF-3: EXISTING & PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 100-Year

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		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)	
	14	B-6	2.28	0.59	13.7	1.35	6.42	8.7				8.7									On-Grade 10' CDOT Type R Inlet (2.5 cfs bypass to DP 12b)
	15	B-7	0.89	0.59	10.7	0.53	7.10	3.8				3.8									On-Grade 10' CDOT Type R Inlet (0.1 cfs bypass to DP 12b)
	12b	B-8	3.23	0.59	13.4	1.91	6.48	12.4				24.5									Sump 20' CDOT Type R Inlet (Receives 12.1 cfs of upstream bypass)
	13	B-9	2.42	0.59	14.5	1.43	6.26	9.0				9.0									Sump 10' CDOT Type R Inlet
	16	B-10	1.10	0.36	6.7	0.40	8.37	3.3	15.3	16.89	6.11	103.2									Total of flows to Pond B
	17b	C-1	4.12	0.59	13.0	2.43	6.57	16.0				16.0									On-Grade 15' CDOT Type R (4.3 cfs bypass to DP 17e)
	17a	C-2	2.71	0.59	10.8	1.60	7.10	11.4				11.4									On-Grade 15' CDOT Type R (11.2 cfs bypass to DP 17c)
	17c	C-4	2.47	0.59	13.0	1.46	6.57	9.6				20.8									Receives 11.2 cfs of Bypass from DP 17a On-Grade 15' CDOT Type R (7.4 cfs bypass to DP 17d)
	17d	C-5	3.09	0.59	11.0	1.82	7.04	12.8				20.2									Receives 7.4 cfs of Bypass from DP 17c On-Grade 15' CDOT Type R (7.0 cfs bypass to DP 17h)
	17e	C-6	2.10	0.59	16.2	1.24	5.94	7.4				11.7									Receives 4.3 cfs of Bypass from DP 17b On-Grade 15' CDOT Type R (2.0 cfs bypass to DP 17h)
	17f	C-8	5.11	0.59	12.7	3.01	6.63	20.0				20.0									On-Grade 15' CDOT Type R (6.9 cfs bypass to DP 17g)
	17g	C-9a	3.50	0.59	14.2	2.07	6.31	13.1				20.0									Receives 6.9 cfs of Bypass from DP 17f On-Grade 15' CDOT Type R (6.8 cfs bypass to DP 17h)
	17h	C-9b	3.69	0.59	14.4	2.18	6.29	13.7				29.5									Sump 20' CDOT Type R (Receives 15.8 cfs of upstream bypass)
	18a	C-7a	0.81	0.52	9.3	0.42	7.51	3.2				3.2									Drainage Swale/SW Chase - Flows to DP 18b
	18b	C-7b	5.91	0.59	12.6	3.49	6.65	23.2	12.6	3.91	6.65	26.0									On-Grade 15' CDOT Type R (11.3 cfs bypass to DP 18c)
	18c	C-10	3.47	0.59	16.5	2.05	5.90	12.1				23.3									Sump 15' CDOT Type R (Receives 11.3 cfs of upstream bypass)
	19	C-11	0.46	0.59	6.6	0.27	8.41	2.3				2.3									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	20	C-12	1.66	0.59	11.8	0.98	6.83	6.7				6.7									Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass)
	21	C-13	2.37	0.36	13.2	0.85	6.52	5.5	16.5	23.87	5.90	140.8									Total combined flows to Pond C
		C-3	1.56	0.39	9.8	0.61	7.35	4.5													Back of Lots 409-426 - Sheet Flows to MS 2
		C-14	1.53	0.36	11.7	0.55	6.87	3.8													Un-developed area - Sheet flows to MS 2
		C-15	0.16	0.40	8.7	0.06	7.68	0.5													Portion of Lot 444 - Sheet flows to MS 2
	22	D-1	3.48	0.59	14.9	2.05	6.18	12.7				12.7									On-Grade 10' CDOT Type R Inlet (5.2 cfs bypass to DP 24)
	23	D-2	0.87	0.59	8.1	0.51	7.88	4.0				4.0									On-Grade 10' CDOT Type R Inlet (0.2 cfs bypass to DP 24)
	24	D-3	3.62	0.59	13.5	2.14	6.46	13.8				19.2									Receives 5.4 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	25	D-4	1.77	0.59	9.7	1.04	7.37	7.7				7.7									Sump 10' CDOT Type R Inlet
	25a	D-7b	0.88	0.59	8.9	0.52	7.62	4.0				4.0									Sheet flows to Channel and Conveyed to Pond D
	26	D-5	1.53	0.48	7.1	0.73	8.24	6.0	14.9	6.99	6.18	43.2									Total of flows to Pond D
		D-6	0.83	0.36	11.7	0.30	6.87	2.1													Un-developed area - Sheet flows to MS
		D-7a	0.25	0.41	8.8	0.10	7.65	0.8													Back of Lots 18-20 - Sheet Flows to MST

STANDARD FORM SF-3: EXISTING & PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Project Name: Grandview Subdivision PDR
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 5/26/22

Subdivision: Grandview Reserve
Location: CO, El Paso County
Design Storm: 100-Year

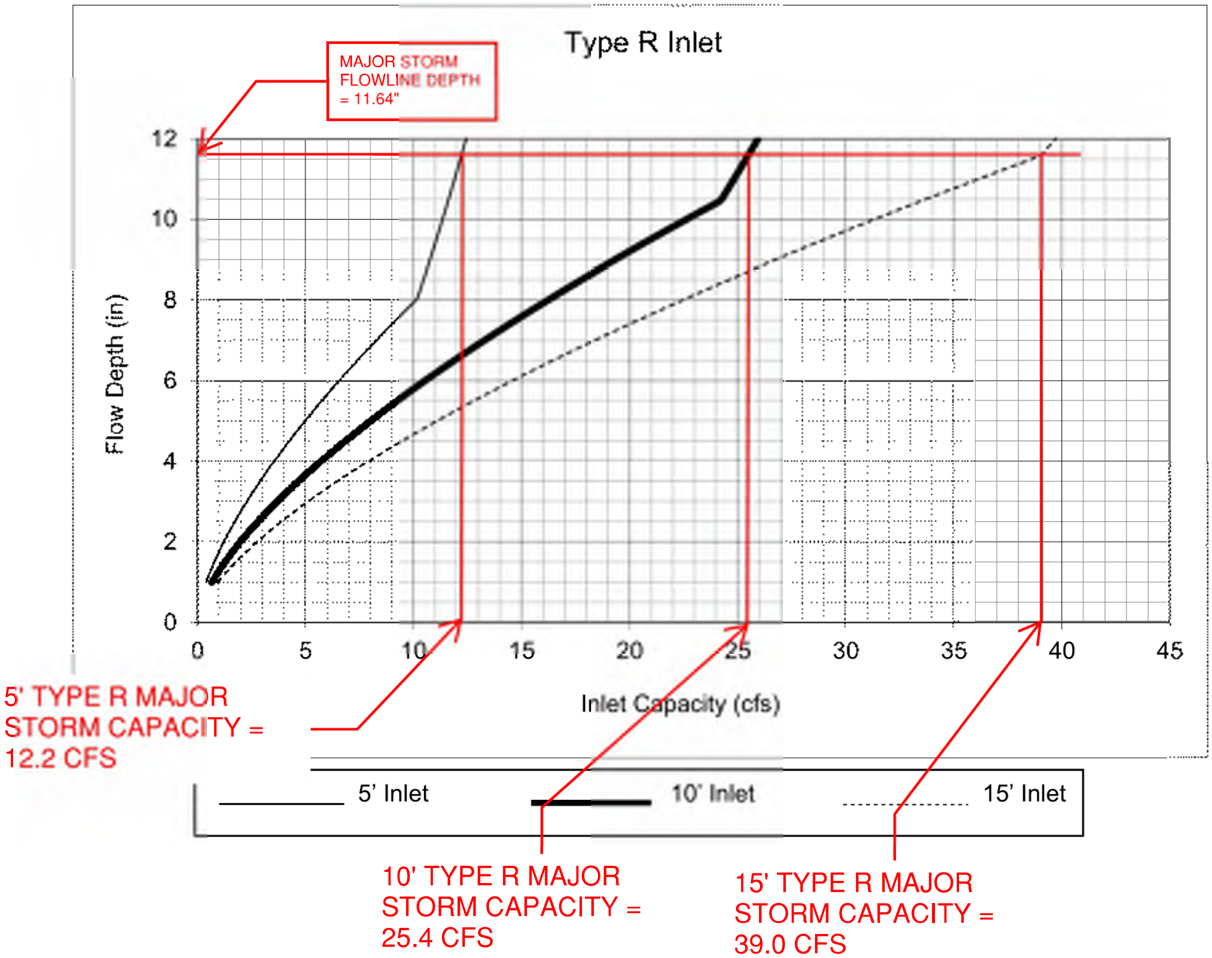
STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Tc (min)	C*A (Ac)	I (in/hr)	Q (cfs)	Slope (%)	Street Flow (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	Tt (min)	
	27	E-1	5.33	0.59	10.0	3.14	7.30	22.9				22.9									On-Grade 15' CDOT Type R Inlet (8.8 cfs bypass to DP 29)
	28	E-2	5.42	0.59	9.8	3.20	7.36	23.6				23.6									On-Grade 15' CDOT Type R Inlet (9.3 cfs bypass to DP 29)
	29	E-3	3.20	0.59	9.6	1.89	7.43	14.0				32.1									Receives 18.1 cfs of upstream bypass Sump 15' CDOT Type R Inlet
	30	E-4	6.28	0.59	17.9	3.71	5.66	21.0				21.0									Sump 20' CDOT Type R Inlet
	31	E-5	1.13	0.36	9.8	0.41	7.37	3.0	17.9	12.35	5.66	69.9									Total of flows to Pond E
		E-6	0.74	0.36	12.6	0.27	6.66	1.8													Un-developed area - Sheet flows to MS

Address the remaining design points with culverts or pipes DP32-DP35. Add lines or text.

APPENDIX D

Hydraulic Computations

Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet



EASTONVILLE ROAD SUMP INLETS

EA1 - Q100 = 19.5 CFS -> 10' TYPE R
EA2 - Q100 = 14.9 CFS -> 10' TYPE R

Notes:

1. The standard inlet parameters must apply to use this chart.

Channel Report

DP 32 30-Inch Bypass Culvert

Circular

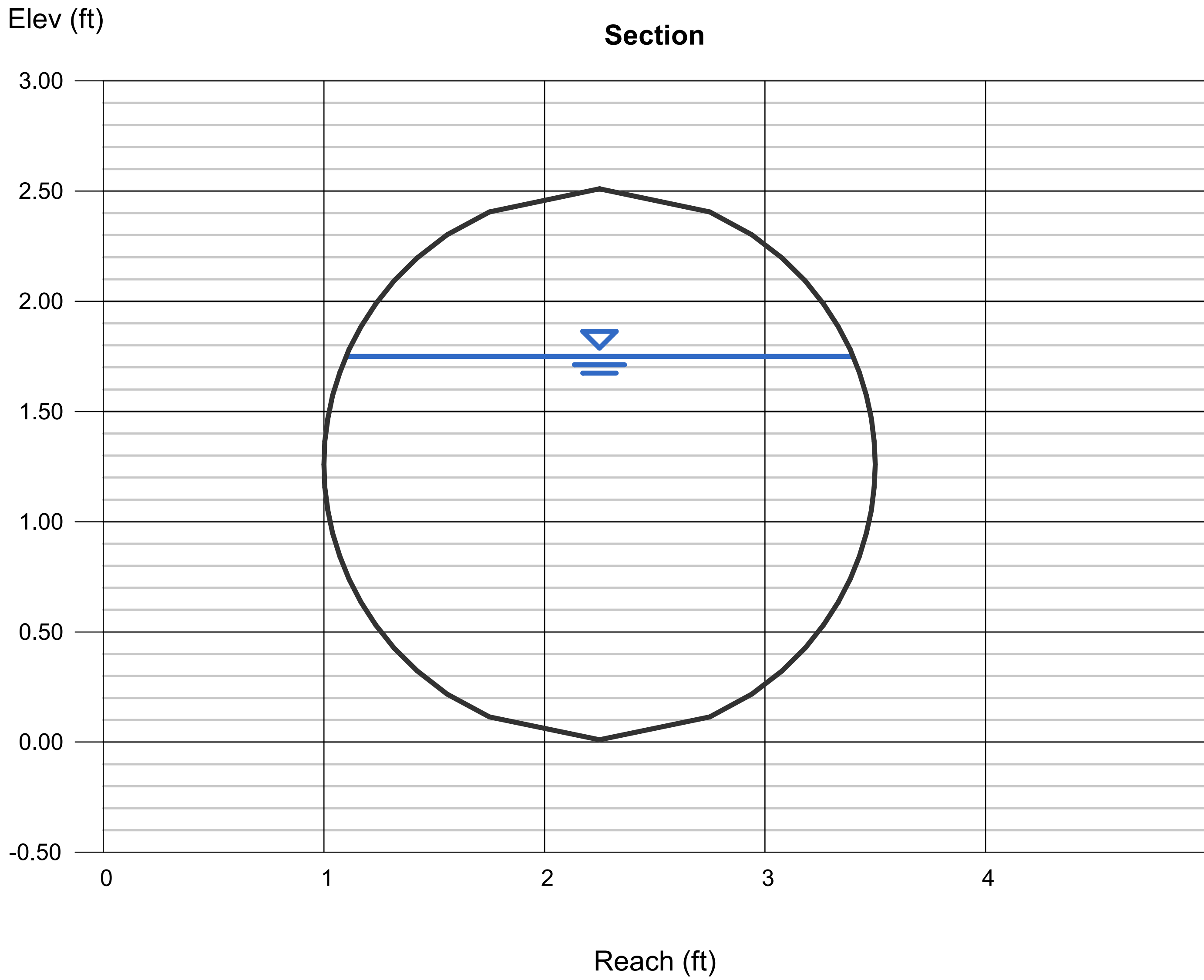
Diameter (ft)	= 2.50
Invert Elev (ft)	= 0.01
Slope (%)	= 0.50
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 24.00

Highlighted

Depth (ft)	= 1.74
Q (cfs)	= 24.00
Area (sqft)	= 3.65
Velocity (ft/s)	= 6.57
Wetted Perim (ft)	= 4.94
Crit Depth, Yc (ft)	= 1.67
Top Width (ft)	= 2.30
EGL (ft)	= 2.41

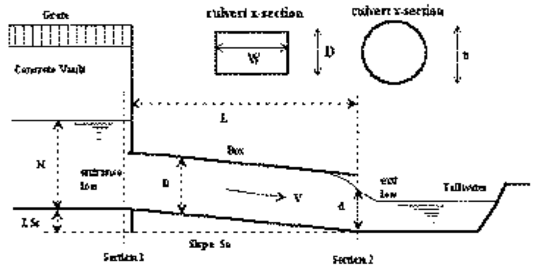


CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

Project: DP 32 headwater calc

ID:



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	30	inches
	Inlet Edge Type (Choose from pull-down list)	Square Edge Projecting		
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	H (Rise) =		ft
	Barrel Width (Span) in Feet	W (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	# Barrels =	1	
	Inlet Elevation at Culvert Invert	Elev IN =	5000	ft
	Outlet Elevation **OR** Slope	So =	0.005	ft/ft
	Culvert Length	L =	800	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	K_b =	0.7	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	7.34
Sum of All Loss Coefficients	K_s =	9.24
Minimum Energy Condition Coefficient	KE_{low} =	0.1127
Orifice Inlet Condition Coefficient	C_d =	0.60

Calculations of Culvert Capacity (output):

Backwater calculations required to obtain Outlet Control Flowrate when HWo < 0.75 * Culvert Ris

Headwater Surface Elevation (ft)	Tailwater Surface Elevation (ft)	Inlet Control Equation Used	Inlet Control Flowrate (cfs)	Outlet Control Flowrate (cfs)	Controlling Culvert Flowrate (cfs)	Flow Control Used
5000.00	5000.00	No Flow (WS < inlet)	0.00	0.00	**0.00**	N/A
5000.30		Min. Energy. Eqn.	0.41	#N/A	#N/A	#N/A
5000.60		Min. Energy. Eqn.	1.77	#N/A	#N/A	#N/A
5000.90		Min. Energy. Eqn.	3.86	#N/A	#N/A	#N/A
5001.20		Min. Energy. Eqn.	6.63	#N/A	#N/A	#N/A
5001.50		Regression Eqn.	9.83	#N/A	#N/A	#N/A
5001.80		Regression Eqn.	13.36	#N/A	#N/A	#N/A
5002.10		Regression Eqn.	17.12	25.87	**17.12**	INLET
5002.40		Regression Eqn.	20.89	26.78	**20.89**	INLET
5002.70		Regression Eqn.	24.51	27.65	**24.51**	INLET
5003.00		Regression Eqn.	27.86	28.51	**27.86**	INLET
5003.30		Regression Eqn.	30.95	29.35	**29.35**	OUTLET
5003.60		Regression Eqn.	33.80	30.16	**30.16**	OUTLET
5003.90		Regression Eqn.	36.42	30.95	**30.95**	OUTLET
5004.20		Regression Eqn.	38.87	31.72	**31.72**	OUTLET
5004.50		Regression Eqn.	41.15	32.48	**32.48**	OUTLET
5004.80		Regression Eqn.	43.31	33.22	**33.22**	OUTLET
5005.10		Regression Eqn.	45.35	33.94	**33.94**	OUTLET
5005.40		Regression Eqn.	47.29	34.66	**34.66**	OUTLET
5005.70		Regression Eqn.	49.15	35.35	**35.35**	OUTLET
5006.00		Regression Eqn.	50.93	36.04	**36.04**	OUTLET
5006.30		Regression Eqn.	52.65	36.71	**36.71**	OUTLET
5006.60		Regression Eqn.	54.31	37.38	**37.38**	OUTLET
5006.90		Regression Eqn.	55.91	38.03	**38.03**	OUTLET
5007.20		Regression Eqn.	57.47	38.67	**38.67**	OUTLET
5007.50		Regression Eqn.	59.01	39.30	**39.30**	OUTLET
5007.80		Orifice Eqn.	60.41	39.92	**39.92**	OUTLET
5008.10		Orifice Eqn.	61.81	40.53	**40.53**	OUTLET
5008.40		Orifice Eqn.	63.12	41.14	**41.14**	OUTLET
5008.70		Orifice Eqn.	64.43	41.73	**41.73**	OUTLET

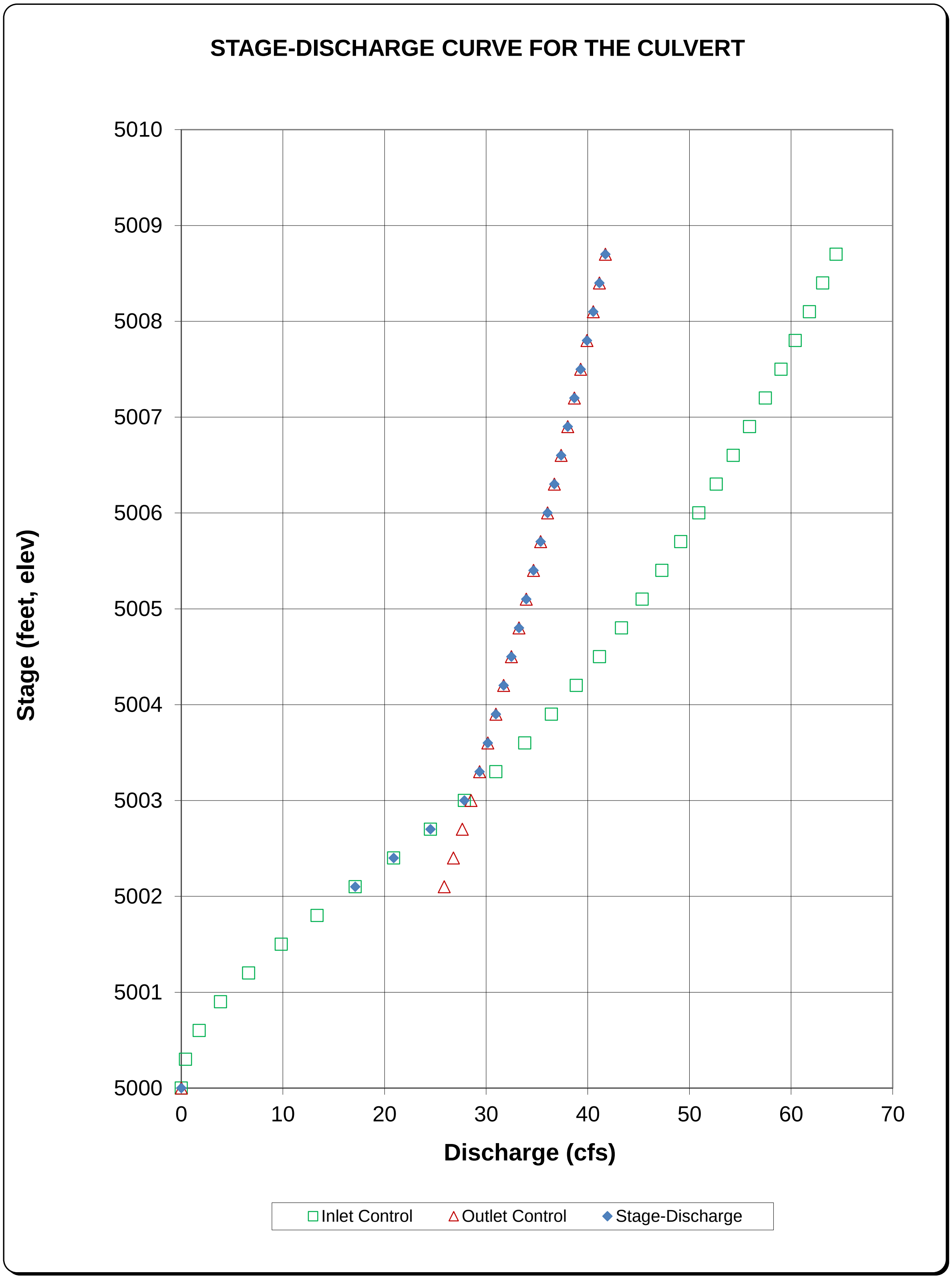
Processing Time: **02.56 Seconds**

CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

Project: DP 32 headwater calc

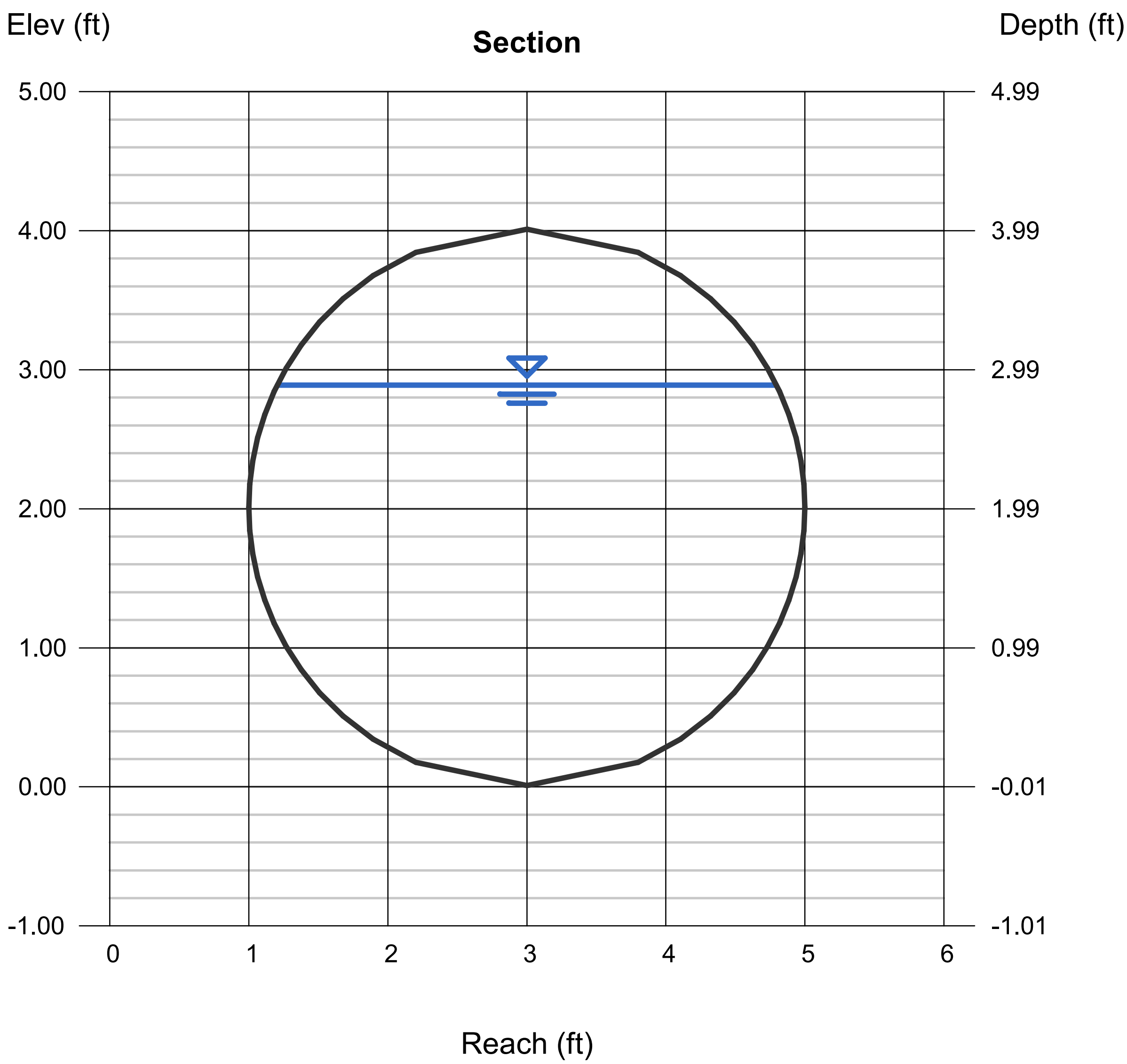
ID:



Channel Report

DP 35 48-Inch Bypass Culvert

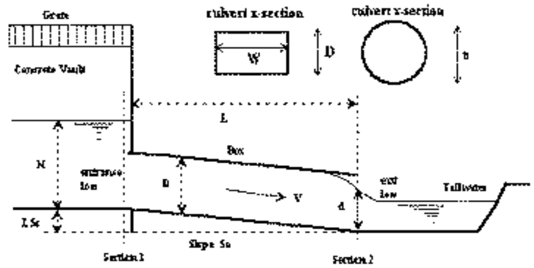
Circular		**Highlighted**	
Diameter (ft)	= 4.00	Depth (ft)	= 2.88
		Q (cfs)	= 125.00
		Area (sqft)	= 9.71
Invert Elev (ft)	= 0.01	Velocity (ft/s)	= 12.87
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.12
N-Value	= 0.013	Crit Depth, Yc (ft)	= 3.36
		Top Width (ft)	= 3.59
Calculations		EGL (ft)	= 5.46
Compute by:	Known Q		
Known Q (cfs)	= 125.00		



CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

Project: DP 35 headwater calc
ID:



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	48	inches
	Inlet Edge Type (Choose from pull-down list)		Square Edge Projecting	
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	H (Rise) =		ft
	Barrel Width (Span) in Feet	W (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	# Barrels =	1	
	Inlet Elevation at Culvert Invert	Elev IN =	5000	ft
	Outlet Elevation **OR** Slope	So =	0.01	ft/ft
	Culvert Length	L =	800	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	K_b =	0.7	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	3.92
Sum of All Loss Coefficients	K_s =	5.82
Minimum Energy Condition Coefficient	KE_{low} =	0.0961
Orifice Inlet Condition Coefficient	C_d =	0.60

Calculations of Culvert Capacity (output):

Backwater calculations required to obtain Outlet Control Flowrate when HWo < 0.75 * Culvert Ris

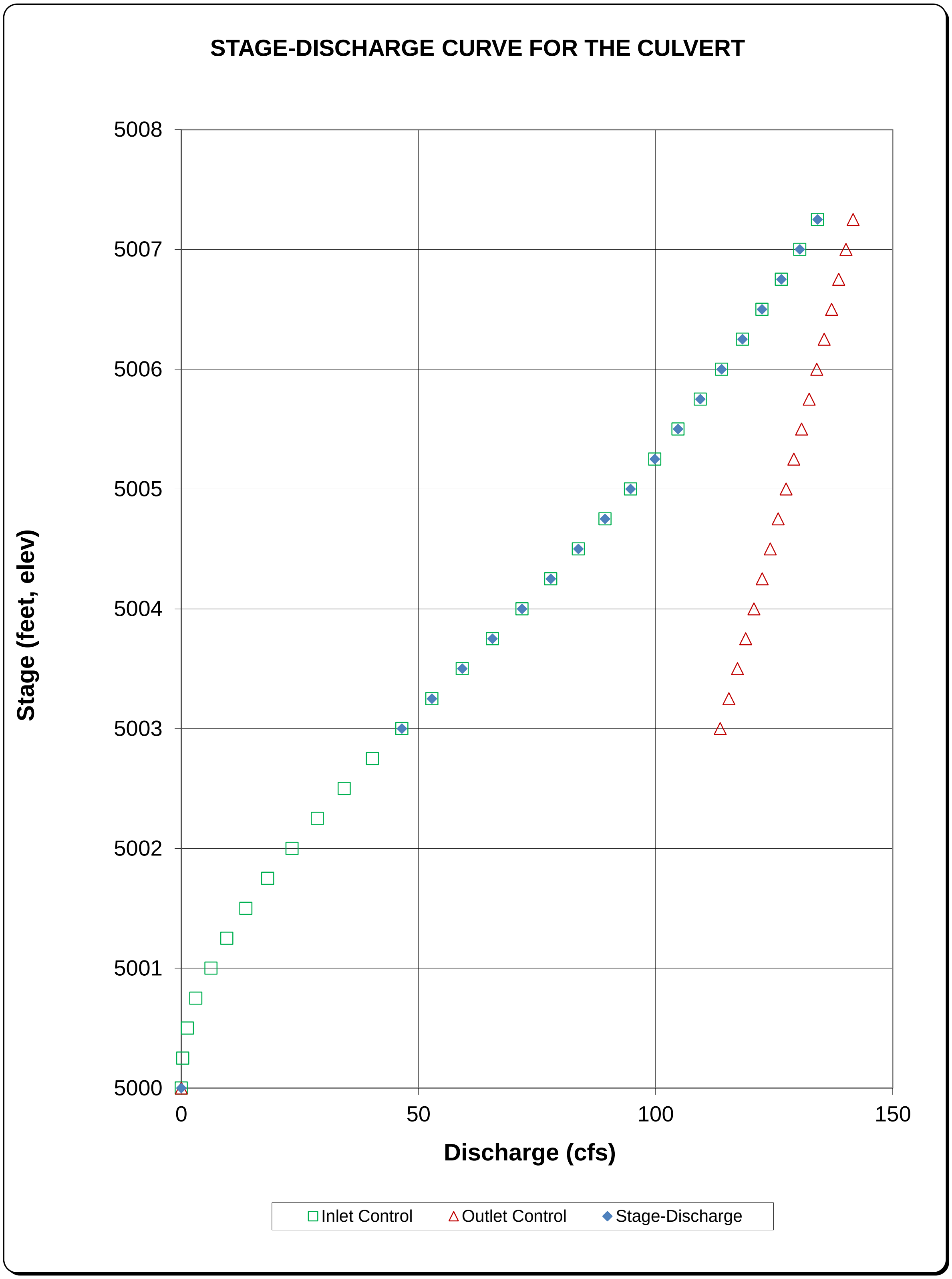
Headwater Surface Elevation (ft)	Tailwater Surface Elevation (ft)	Inlet Control Equation Used	Inlet Control Flowrate (cfs)	Outlet Control Flowrate (cfs)	Controlling Culvert Flowrate (cfs)	Flow Control Used
5000.00	5000.00	No Flow (WS < inlet)	0.00	0.00	**0.00**	N/A
5000.25		Min. Energy. Eqn.	0.32	#N/A	#N/A	#N/A
5000.50		Min. Energy. Eqn.	1.31	#N/A	#N/A	#N/A
5000.75		Min. Energy. Eqn.	3.07	#N/A	#N/A	#N/A
5001.00		Min. Energy. Eqn.	6.25	#N/A	#N/A	#N/A
5001.25		Min. Energy. Eqn.	9.61	#N/A	#N/A	#N/A
5001.50		Min. Energy. Eqn.	13.61	#N/A	#N/A	#N/A
5001.75		Min. Energy. Eqn.	18.21	#N/A	#N/A	#N/A
5002.00		Min. Energy. Eqn.	23.35	#N/A	#N/A	#N/A
5002.25		Regression Eqn.	28.71	#N/A	#N/A	#N/A
5002.50		Regression Eqn.	34.34	#N/A	#N/A	#N/A
5002.75		Regression Eqn.	40.31	#N/A	#N/A	#N/A
5003.00		Regression Eqn.	46.51	113.63	**46.51**	INLET
5003.25		Regression Eqn.	52.85	115.45	**52.85**	INLET
5003.50		Regression Eqn.	59.26	117.25	**59.26**	INLET
5003.75		Regression Eqn.	65.62	119.01	**65.62**	INLET
5004.00		Regression Eqn.	71.86	120.75	**71.86**	INLET
5004.25		Regression Eqn.	77.91	122.48	**77.91**	INLET
5004.50		Regression Eqn.	83.74	124.18	**83.74**	INLET
5004.75		Regression Eqn.	89.33	125.86	**89.33**	INLET
5005.00		Regression Eqn.	94.71	127.51	**94.71**	INLET
5005.25		Regression Eqn.	99.82	129.16	**99.82**	INLET
5005.50		Regression Eqn.	104.72	130.79	**104.72**	INLET
5005.75		Regression Eqn.	109.42	132.39	**109.42**	INLET
5006.00		Regression Eqn.	113.94	133.97	**113.94**	INLET
5006.25		Regression Eqn.	118.31	135.55	**118.31**	INLET
5006.50		Regression Eqn.	122.45	137.10	**122.45**	INLET
5006.75		Regression Eqn.	126.51	138.63	**126.51**	INLET
5007.00		Regression Eqn.	130.41	140.16	**130.41**	INLET
5007.25		Regression Eqn.	134.15	141.66	**134.15**	INLET

Processing Time: **02.28 Seconds**

CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

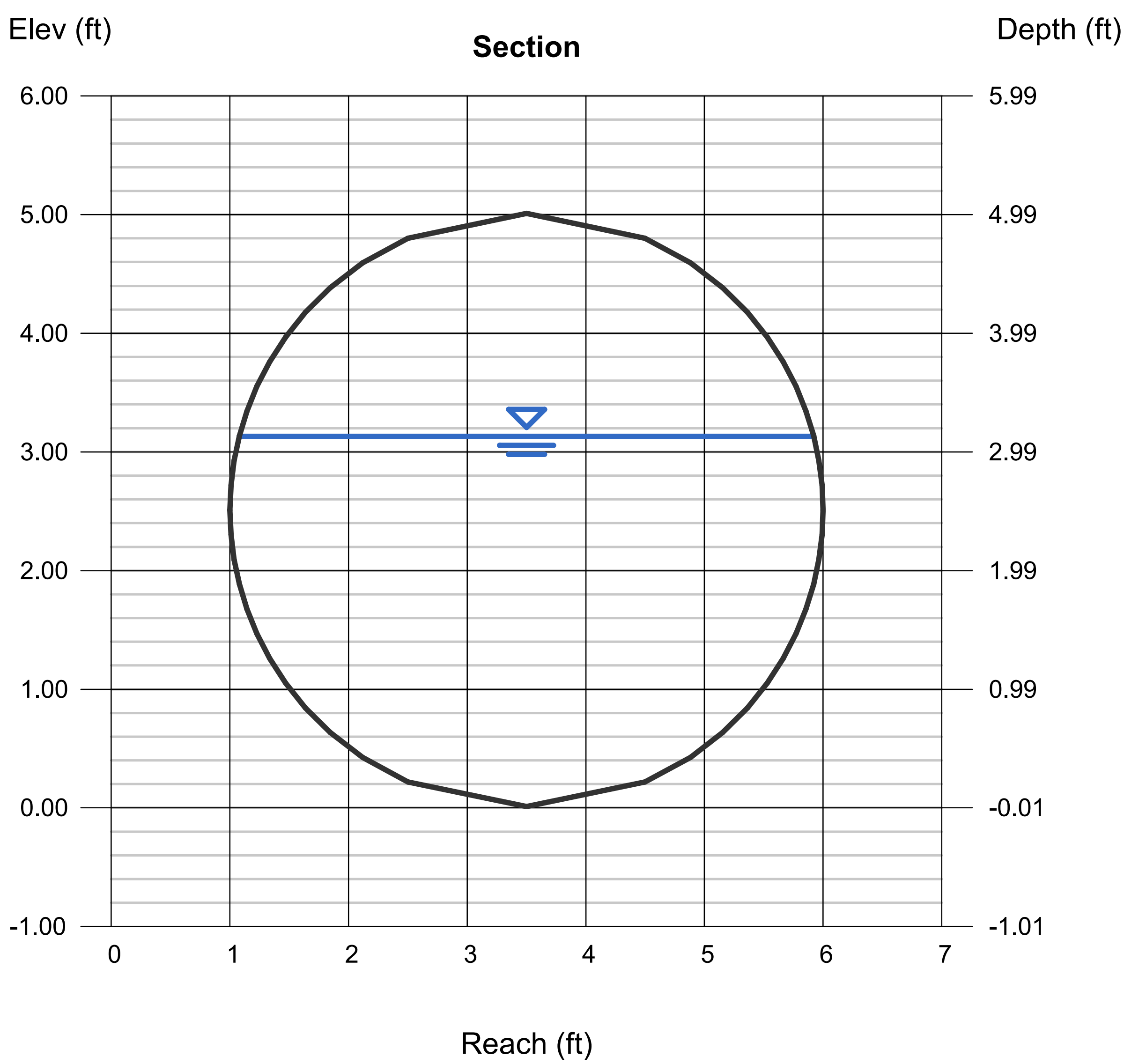
Project: DP 35 headwater calc
ID:



Channel Report

DP 34 3 - 60-Inch RCP Culverts

Circular		**Highlighted**	
Diameter (ft)	= 5.00	Depth (ft)	= 3.12
		Q (cfs)	= 138.00
		Area (sqft)	= 12.93
Invert Elev (ft)	= 0.01	Velocity (ft/s)	= 10.67
Slope (%)	= 0.55	Wetted Perim (ft)	= 9.12
N-Value	= 0.013	Crit Depth, Yc (ft)	= 3.36
		Top Width (ft)	= 4.84
Calculations		EGL (ft)	= 4.89
Compute by:	Known Q		
Known Q (cfs)	= 138.00		

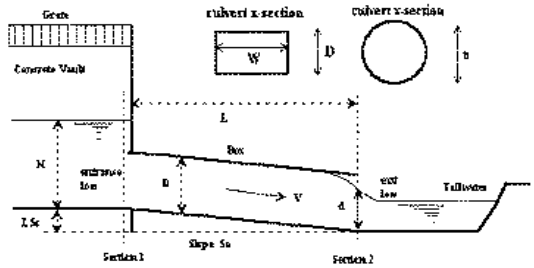


CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

Project: DP 34 headwater calc

ID:



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	60	inches
	Inlet Edge Type (Choose from pull-down list)	Square Edge Projecting		
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	H (Rise) =		ft
	Barrel Width (Span) in Feet	W (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	# Barrels =	3	
	Inlet Elevation at Culvert Invert	Elev IN =	5000	ft
	Outlet Elevation **OR** Slope	So =	0.0055	ft/ft
	Culvert Length	L =	170	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	K_b =	0	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.62
Sum of All Loss Coefficients	K_s =	1.82
Minimum Energy Condition Coefficient	KE_{low} =	0.1131
Orifice Inlet Condition Coefficient	C_d =	0.60

Calculations of Culvert Capacity (output):

Backwater calculations required to obtain Outlet Control Flowrate when HWo < 0.75 * Culvert Ris

Headwater Surface Elevation (ft)	Tailwater Surface Elevation (ft)	Inlet Control Equation Used	Inlet Control Flowrate (cfs)	Outlet Control Flowrate (cfs)	Controlling Culvert Flowrate (cfs)	Flow Control Used
5000.00	5000.00	No Flow (WS < inlet)	0.00	0.00	**0.00**	N/A
5000.30		Min. Energy. Eqn.	1.53	#N/A	#N/A	#N/A
5000.60		Min. Energy. Eqn.	6.21	#N/A	#N/A	#N/A
5000.90		Min. Energy. Eqn.	14.82	#N/A	#N/A	#N/A
5001.20		Min. Energy. Eqn.	30.03	#N/A	#N/A	#N/A
5001.50		Min. Energy. Eqn.	46.23	#N/A	#N/A	#N/A
5001.80		Min. Energy. Eqn.	65.40	#N/A	#N/A	#N/A
5002.10		Min. Energy. Eqn.	87.63	#N/A	#N/A	#N/A
5002.40		Min. Energy. Eqn.	112.53	#N/A	#N/A	#N/A
5002.70		Regression Eqn.	138.96	#N/A	#N/A	#N/A
5003.00		Regression Eqn.	166.83	#N/A	#N/A	#N/A
5003.30		Regression Eqn.	196.23	#N/A	#N/A	#N/A
5003.60		Regression Eqn.	226.83	#N/A	#N/A	#N/A
5003.90		Regression Eqn.	258.42	323.65	**258.42**	INLET
5004.20		Regression Eqn.	290.55	361.75	**290.55**	INLET
5004.50		Regression Eqn.	322.83	397.56	**322.83**	INLET
5004.80		Regression Eqn.	354.63	431.46	**354.63**	INLET
5005.10		Regression Eqn.	385.68	463.94	**385.68**	INLET
5005.40		Regression Eqn.	415.86	494.79	**415.86**	INLET
5005.70		Regression Eqn.	444.93	524.60	**444.93**	INLET
5006.00		Regression Eqn.	472.86	553.11	**472.86**	INLET
5006.30		Regression Eqn.	499.62	580.75	**499.62**	INLET
5006.60		Regression Eqn.	525.33	607.64	**525.33**	INLET
5006.90		Regression Eqn.	549.93	633.42	**549.93**	INLET
5007.20		Regression Eqn.	573.63	658.75	**573.63**	INLET
5007.50		Regression Eqn.	596.28	683.29	**596.28**	INLET
5007.80		Regression Eqn.	618.15	707.16	**618.15**	INLET
5008.10		Regression Eqn.	639.24	730.45	**639.24**	INLET
5008.40		Regression Eqn.	659.73	753.43	**659.73**	INLET
5008.70		Regression Eqn.	679.32	775.71	**679.32**	INLET

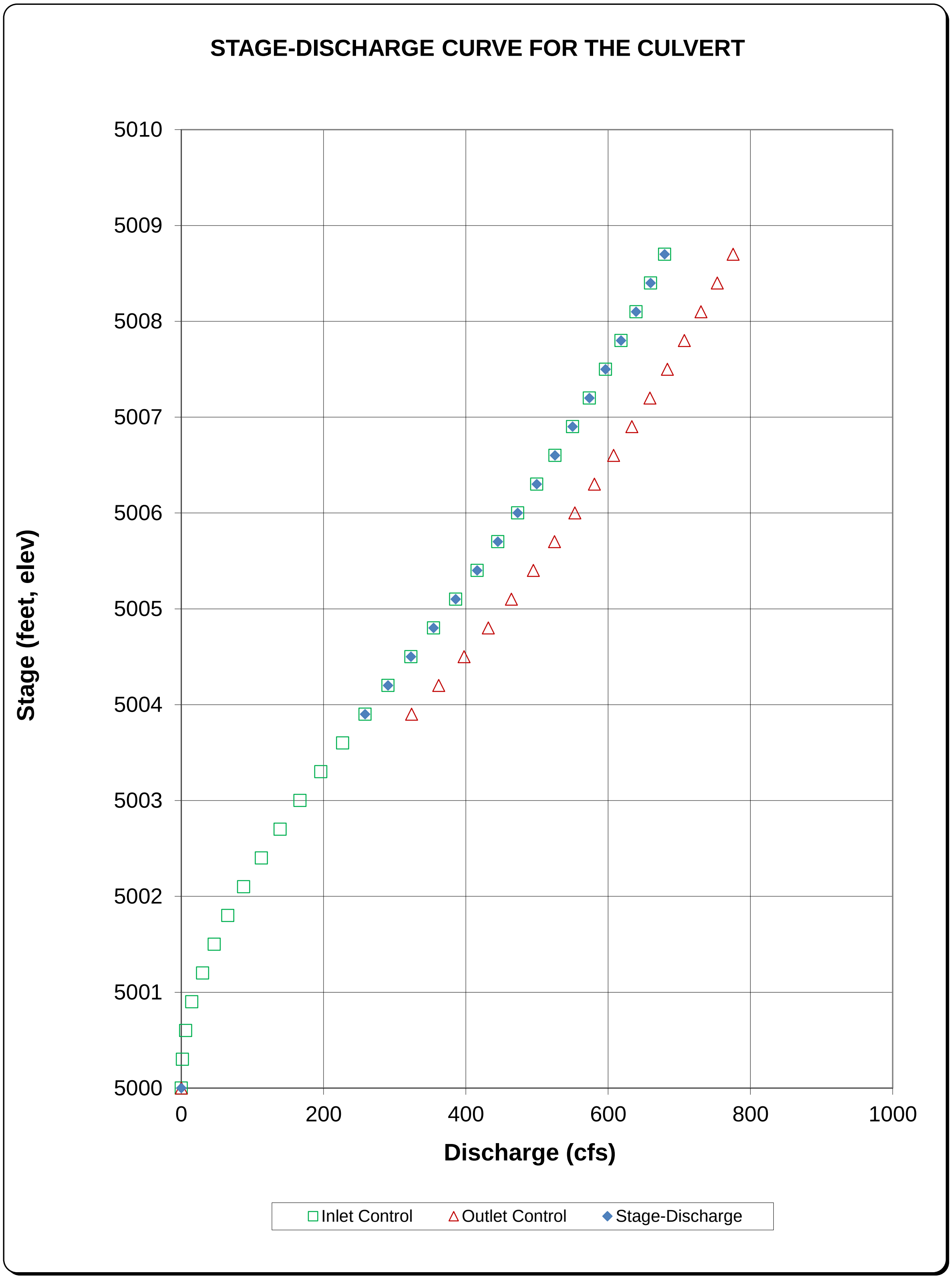
Processing Time: **01.87 Seconds**

Per Meridian Ranch 628 cfs

CULVERT SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

MHFD-Culvert, Version 4.00 (May 2020)

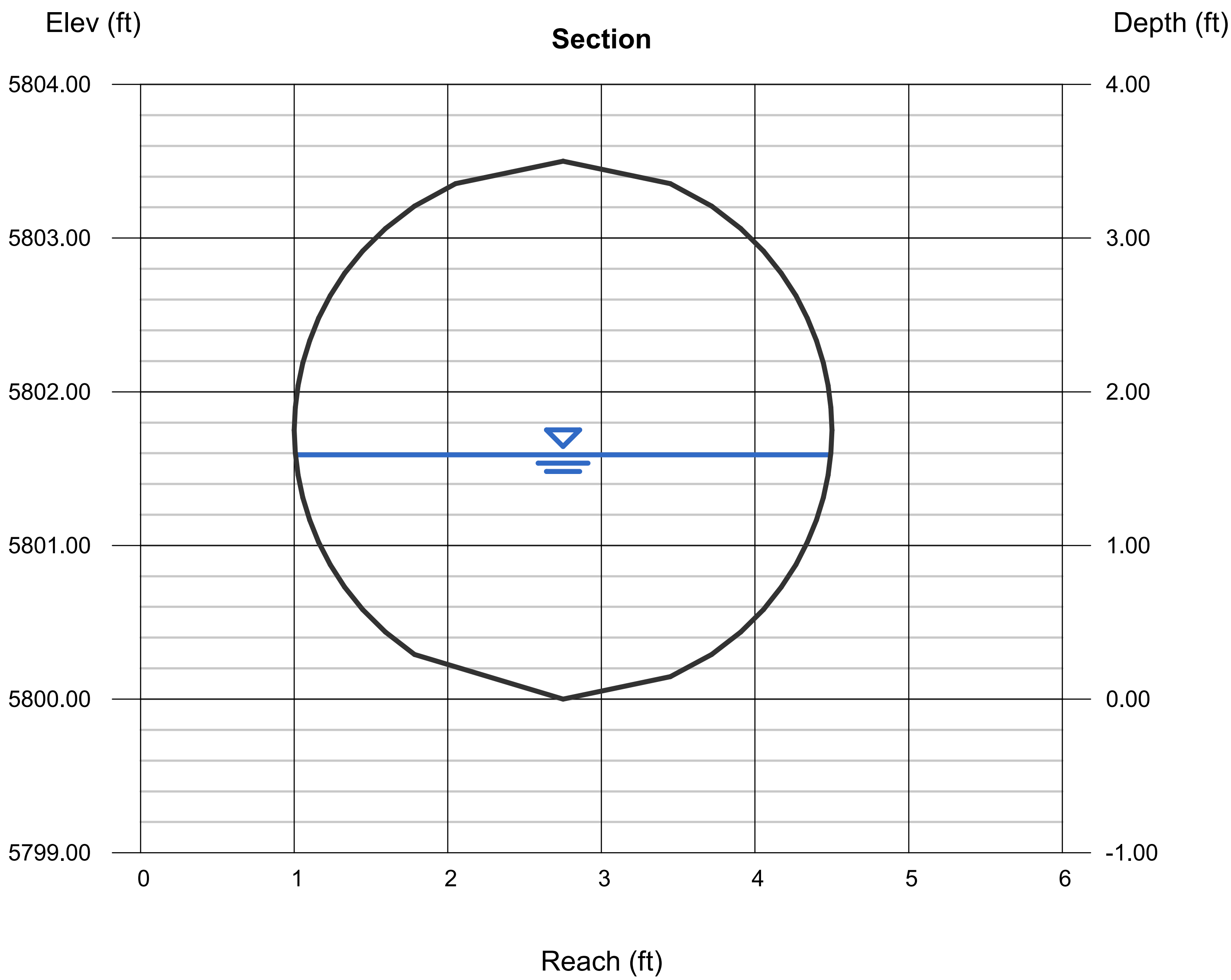
Project: DP 34 headwater calc
ID:



Channel Report

DP33 - Q100 = 25.8 cfs

Circular		**Highlighted**	
Diameter (ft)	= 3.50	Depth (ft)	= 1.59
		Q (cfs)	= 30.00
		Area (sqft)	= 4.26
Invert Elev (ft)	= 5800.00	Velocity (ft/s)	= 7.05
Slope (%)	= 0.50	Wetted Perim (ft)	= 5.18
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.69
		Top Width (ft)	= 3.49
Calculations		EGL (ft)	= 2.36
Compute by:	Known Q		
Known Q (cfs)	= 30.00		

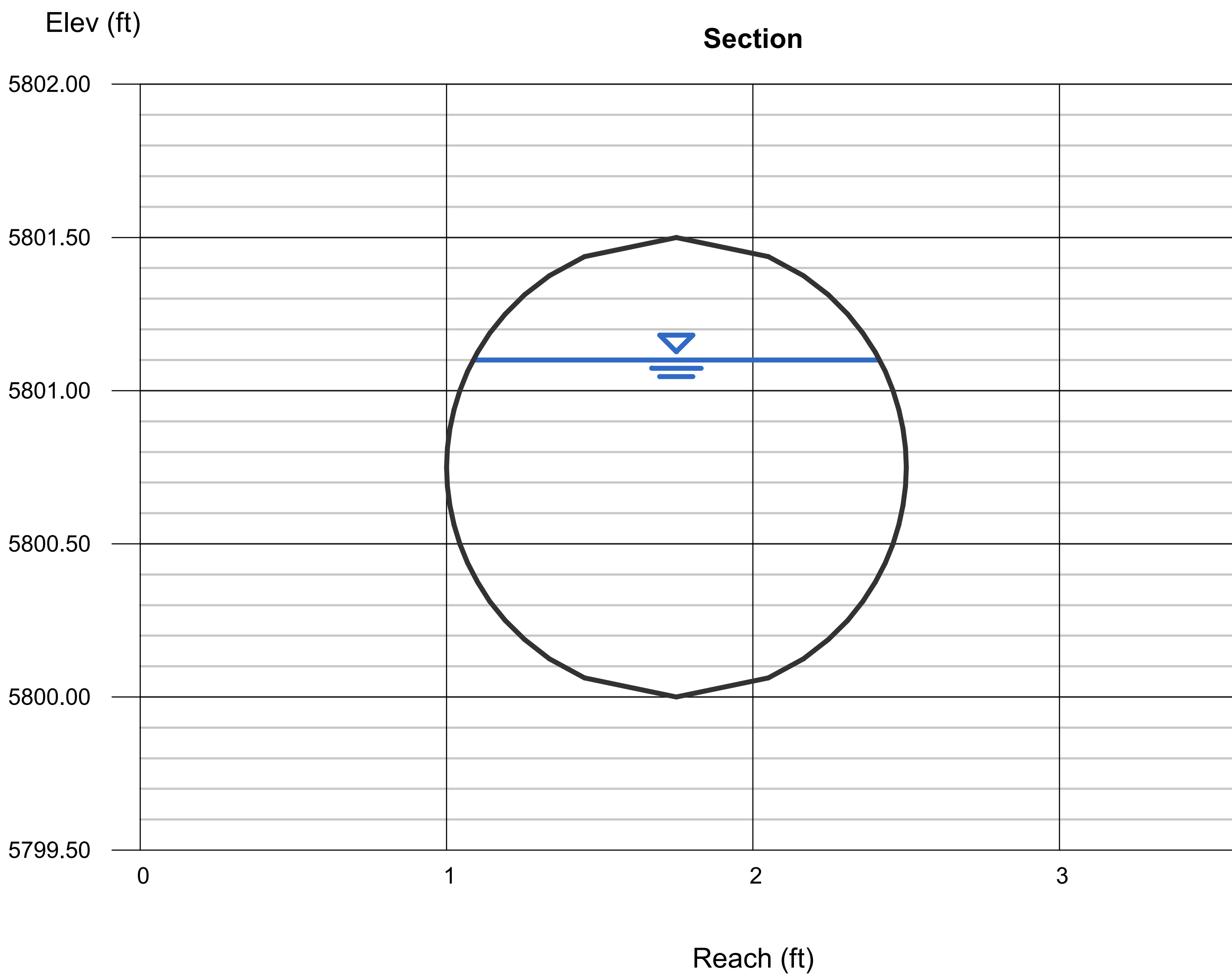


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, May 10 2022

DPEA1 - Q100 = 16.1 cfs

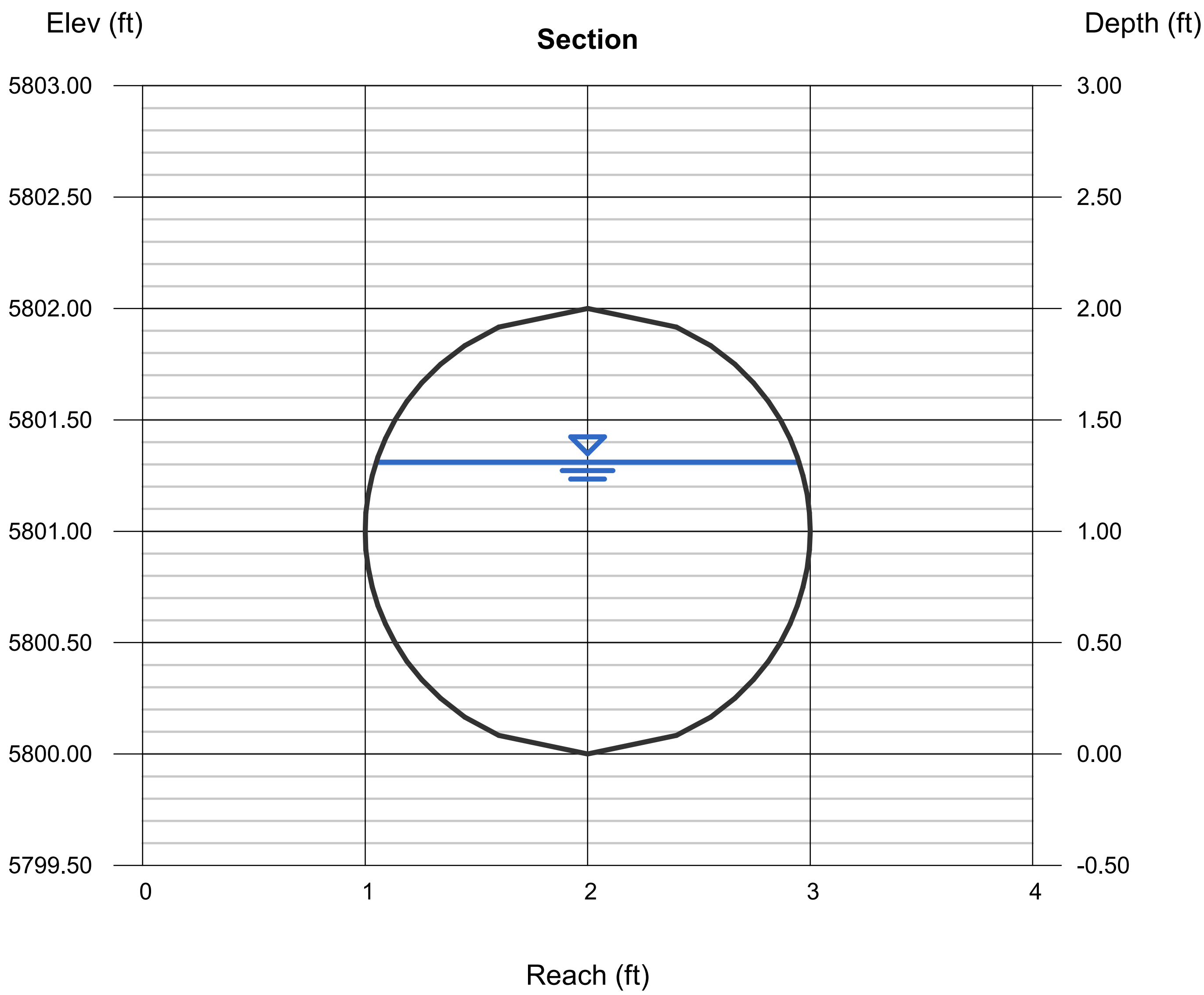
Circular		**Highlighted**	
Diameter (ft)	= 1.50	Depth (ft)	= 1.10
		Q (cfs)	= 16.10
		Area (sqft)	= 1.39
Invert Elev (ft)	= 5800.00	Velocity (ft/s)	= 11.57
Slope (%)	= 3.00	Wetted Perim (ft)	= 3.09
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.43
		Top Width (ft)	= 1.32
Calculations		EGL (ft)	= 3.18
Compute by:	Known Q		
Known Q (cfs)	= 16.10		



Channel Report

DPEA2.1 - Q100 = 30.0 cfs

Circular		**Highlighted**	
Diameter (ft)	= 2.00	Depth (ft)	= 1.31
		Q (cfs)	= 30.00
		Area (sqft)	= 2.19
Invert Elev (ft)	= 5800.00	Velocity (ft/s)	= 13.71
Slope (%)	= 3.00	Wetted Perim (ft)	= 3.78
N-Value	= 0.013	Crit Depth, Yc (ft)	= 1.87
		Top Width (ft)	= 1.90
Calculations		EGL (ft)	= 4.23
Compute by:	Known Q		
Known Q (cfs)	= 30.00		



Channel Report

Show location on
a plan sheet

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, May 6 2022

INTERIM SWALE FOR GEC

Label DP35(?)

Trapezoidal

Bottom Width (ft)	=	2.00
Side Slopes (z:1)	=	3.00, 3.00
Total Depth (ft)	=	2.50
Invert Elev (ft)	=	1.00
Slope (%)	=	2.00
N-Value	=	0.040

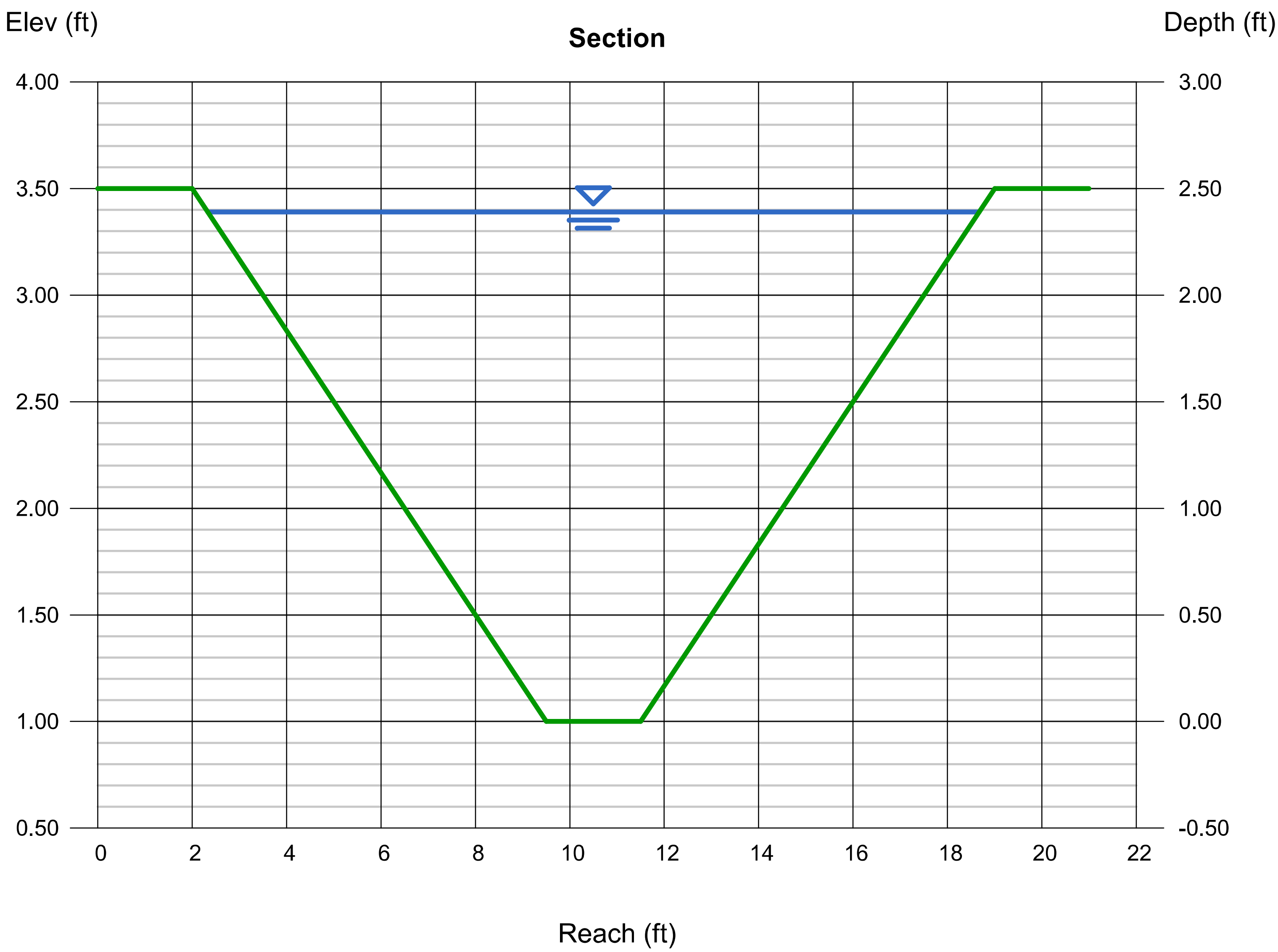
Calculations

Compute by:		Known Q
Known Q (cfs)	=	135.00

Highlighted

Depth (ft)	=	2.39
Q (cfs)	=	135.00
Area (sqft)	=	21.92
Velocity (ft/s)	=	6.16
Wetted Perim (ft)	=	17.12
Crit Depth, Yc (ft)	=	2.33
Top Width (ft)	=	16.34
EGL (ft)	=	2.98

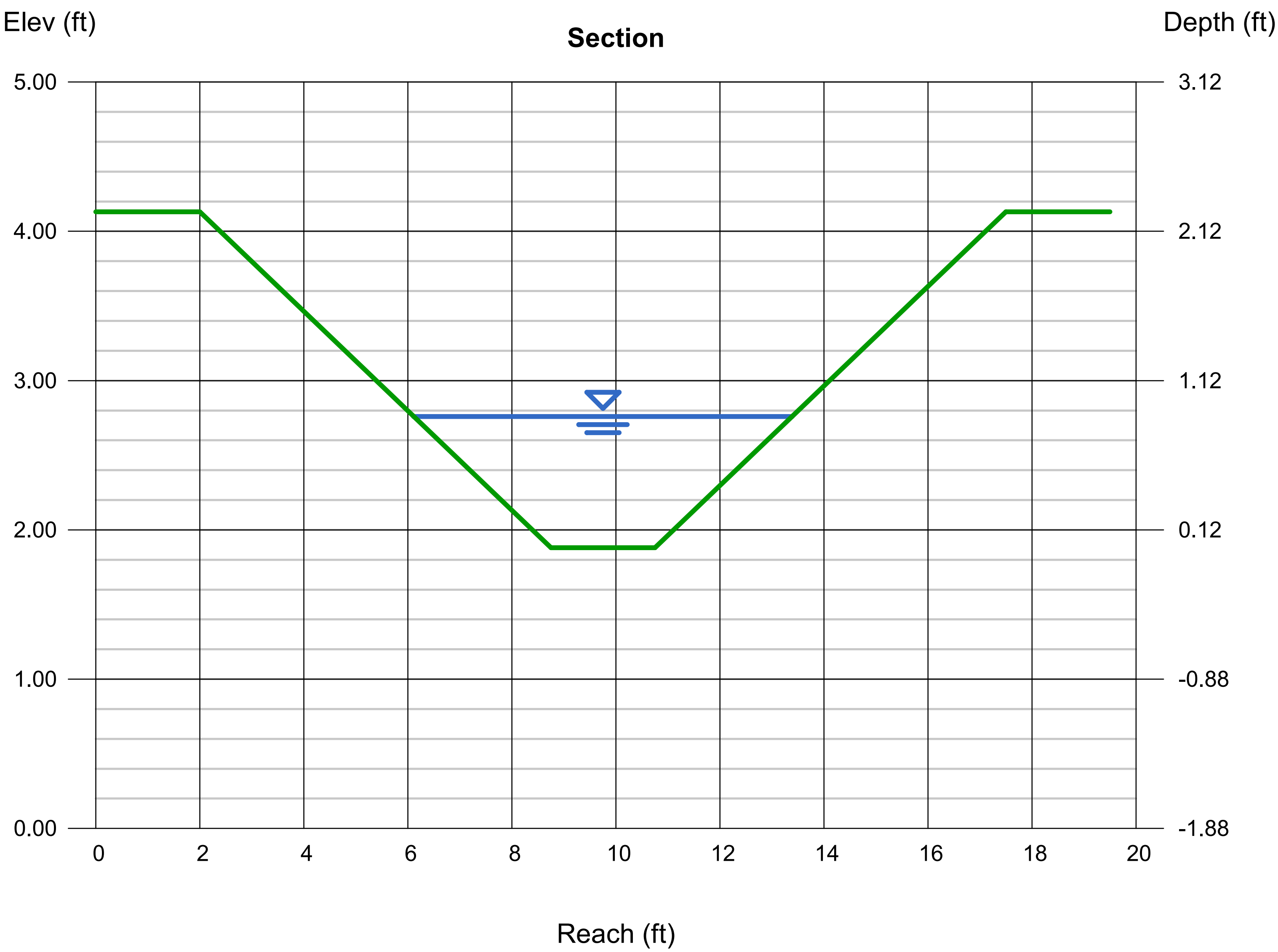
ADD ECB (velocity > 5 fps)



Channel Report

PROPOSED OFFSITE BASIN 0S-1 SWALE

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.88
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 8.700
Total Depth (ft)	= 2.25	Area (sqft)	= 4.08
Invert Elev (ft)	= 1.88	Velocity (ft/s)	= 2.13
Slope (%)	= 0.78	Wetted Perim (ft)	= 7.57
N-Value	= 0.040	Crit Depth, Yc (ft)	= 0.62
		Top Width (ft)	= 7.28
Calculations		EGL (ft)	= 0.95
Compute by:	Known Q		
Known Q (cfs)	= 8.70		



Channel Report

PROPOSED OFFSITE BASIN 0S-2 SWALE

Trapezoidal

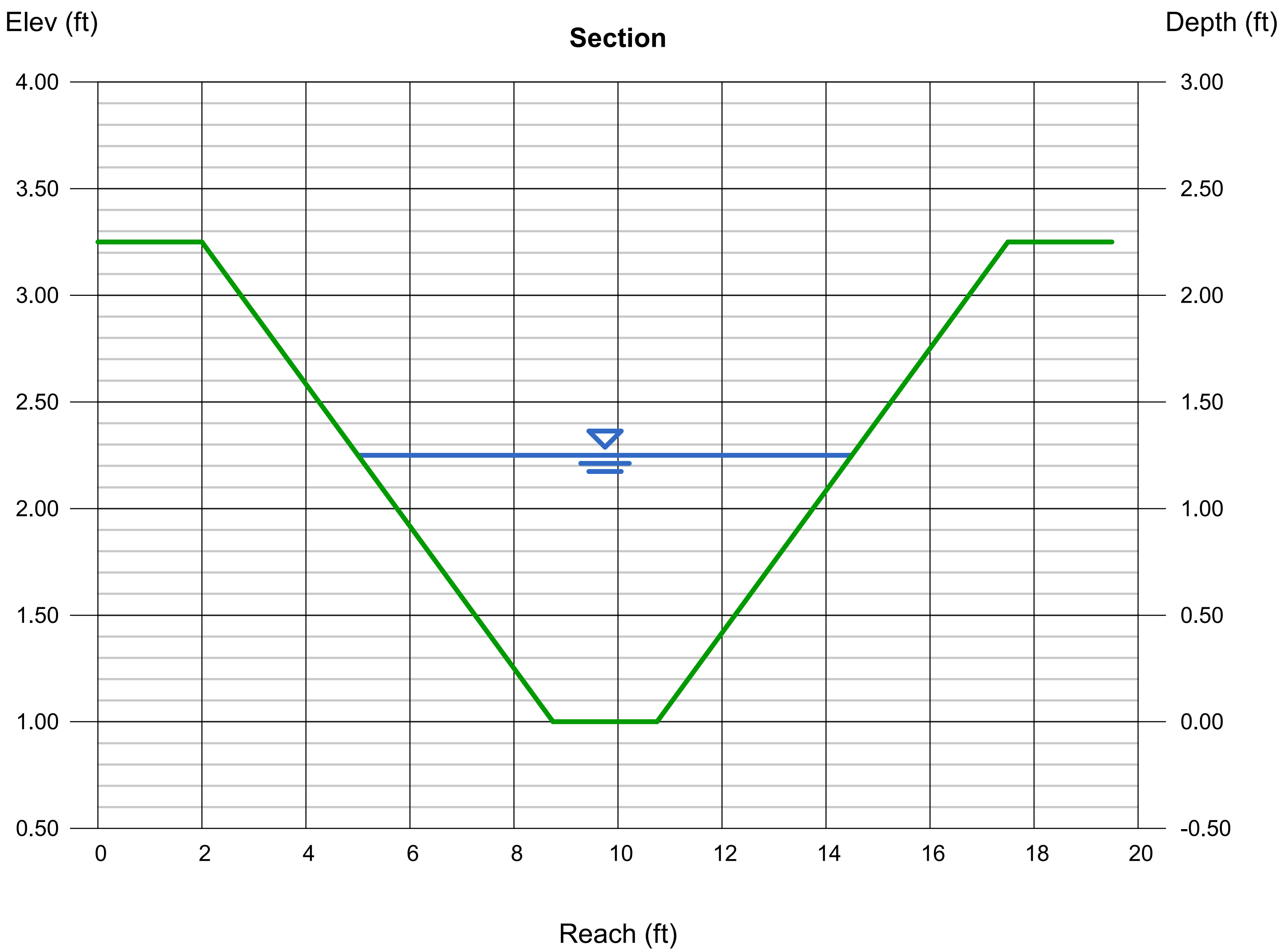
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.25
Invert Elev (ft)	= 1.00
Slope (%)	= 0.66
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 17.30

Highlighted

Depth (ft)	= 1.25
Q (cfs)	= 17.30
Area (sqft)	= 7.19
Velocity (ft/s)	= 2.41
Wetted Perim (ft)	= 9.91
Crit Depth, Yc (ft)	= 0.88
Top Width (ft)	= 9.50
EGL (ft)	= 1.34



Channel Report

PROPOSED OFFSITE BASIN 0S-4 SWALE

Trapezoidal

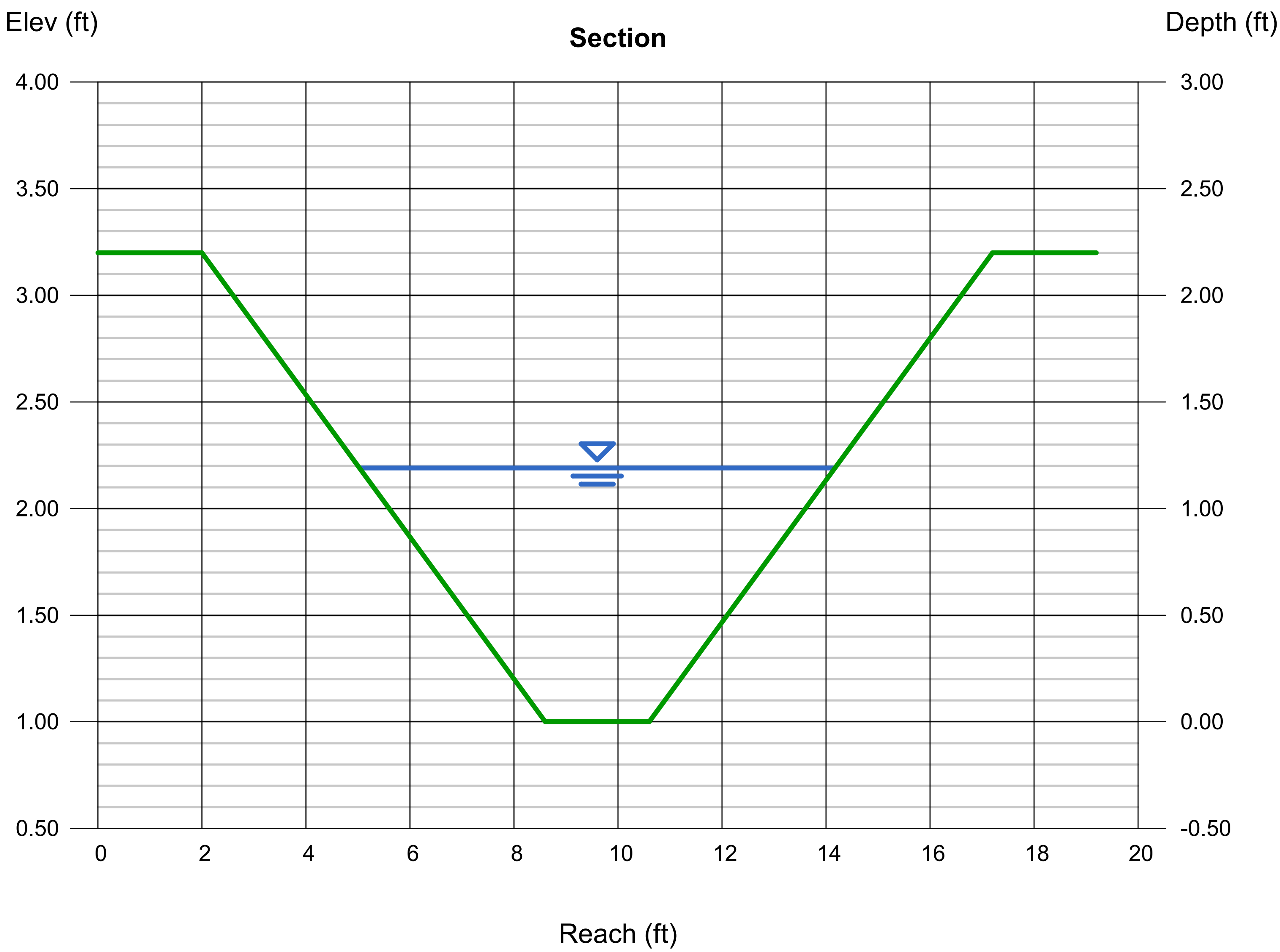
Bottom Width (ft)	= 2.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.20
Invert Elev (ft)	= 1.00
Slope (%)	= 1.00
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 19.10

Highlighted

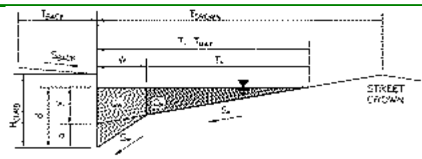
Depth (ft)	= 1.19
Q (cfs)	= 19.10
Area (sqft)	= 6.63
Velocity (ft/s)	= 2.88
Wetted Perim (ft)	= 9.53
Crit Depth, Yc (ft)	= 0.93
Top Width (ft)	= 9.14
EGL (ft)	= 1.32



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

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

Project: Grandview Reserve
Inlet ID: Basin A-2a (DP2a)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.025		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)			☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

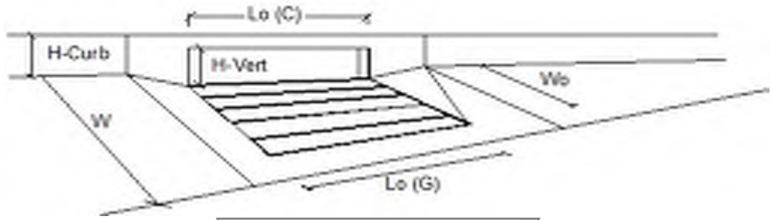
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.5**	**42.1**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



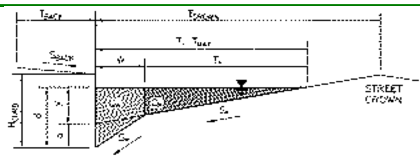
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	8.5	19.9	cfs
Water Spread Width	T =	13.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.8	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.5	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.183	0.130	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	6.6	16.4	cfs
Discharge within the Gutter Section W	Q_w =	1.5	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.32	sq ft
Velocity within the Gutter Section W	V_W =	6.3	7.8	fps
Water Depth for Design Condition	d_{LOCAL} =	6.8	8.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.087	0.068	ft/ft
Required Length L_T to Have 100% Interception	L_T =	18.41	31.80	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	7.7	12.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**7.7**	**12.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.8**	**7.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**7.7**	**12.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.8**	**7.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**90**	**64**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-2b (DP2b)**



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

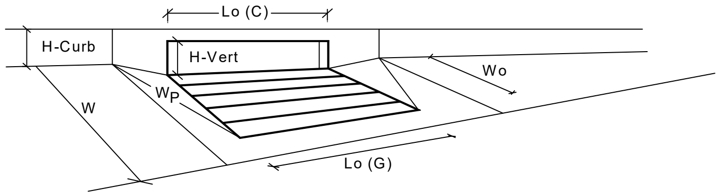
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	4	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	20.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**

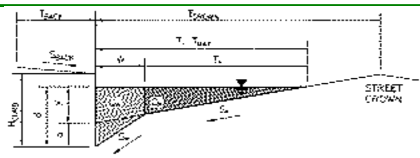
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.2	23.8	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin A-3 (DP3)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

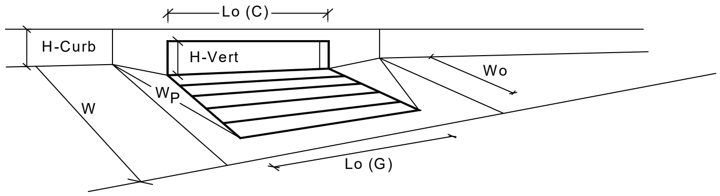
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

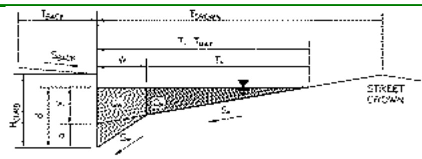
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.7	10.1	cfs
Interception with Clogging	Q_{wa} =	2.4	9.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.4	11.0	cfs
Interception with Clogging	Q_{oa} =	7.6	9.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.4	9.8	cfs
Interception with Clogging	Q_{ma} =	4.0	8.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.4**	**8.8**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	25.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.3	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.98	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.0	cfs

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

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

Project: Grandview Reserve
Inlet ID: Basin A-4a (DP4a)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches	
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft	
Gutter Width	W =	0.83	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 =	0.025	ft/ft	
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

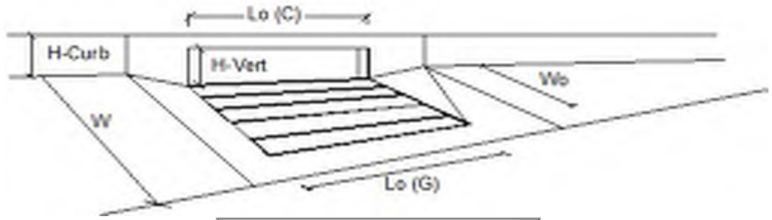
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.5**	**42.1**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



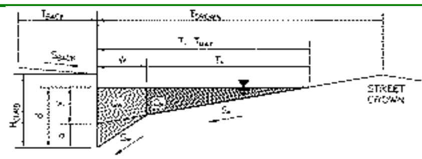
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	9.8	22.8	cfs
Water Spread Width	T =	14.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.0	5.3	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.9	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.169	0.122	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	8.1	20.0	cfs
Discharge within the Gutter Section W	Q_w =	1.7	2.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.25	0.34	sq ft
Velocity within the Gutter Section W	V_W =	6.6	8.2	fps
Water Depth for Design Condition	d_{LOCAL} =	7.0	8.3	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.082	0.064	ft/ft
Required Length L_T to Have 100% Interception	L_T =	20.84	35.80	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	8.8	14.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	13.03	13.03	ft
Actual Interception Capacity	**Q_a =**	**8.6**	**13.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.2**	**9.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.6**	**13.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**9.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**61**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin A-4b (DP4b)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches	
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft	
Gutter Width	W =	0.83	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 =	0.025	ft/ft	
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

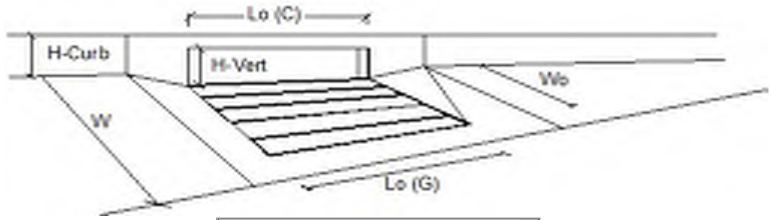
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.5**	**42.1**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



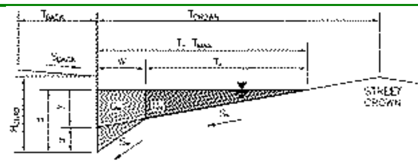
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	6.5	15.2	cfs
Water Spread Width	T =	12.1	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	4.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.2	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.200	0.142	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.2	13.1	cfs
Discharge within the Gutter Section W	Q_W =	1.3	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.29	sq ft
Velocity within the Gutter Section W	V_W =	6.0	7.4	fps
Water Depth for Design Condition	d_{LOCAL} =	6.5	7.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.093	0.072	ft/ft
Required Length L_T to Have 100% Interception	L_T =	15.94	27.68	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	5.4	8.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**5.2**	**8.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.3**	**7.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.2**	**8.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.3**	**7.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**80**	**53**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **DP 4**



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

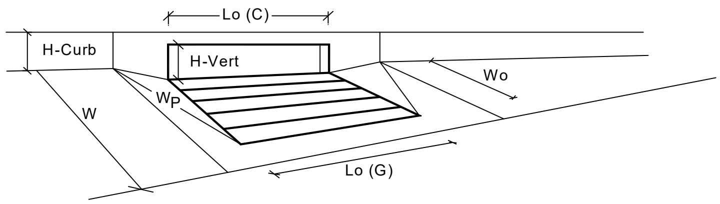
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



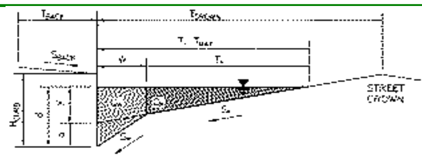
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.9	19.2	cfs
Interception with Clogging	Q_{wa} =	3.8	18.4	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	25.2	32.9	cfs
Interception with Clogging	Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.2	23.4	cfs
Interception with Clogging	Q_{ma} =	8.8	22.4	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.8**	**18.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	25.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.3	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.8**	**18.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.5	16.1	cfs

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

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

Project: Grandview Reserve
Inlet ID: Basin A-5 (DP5)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

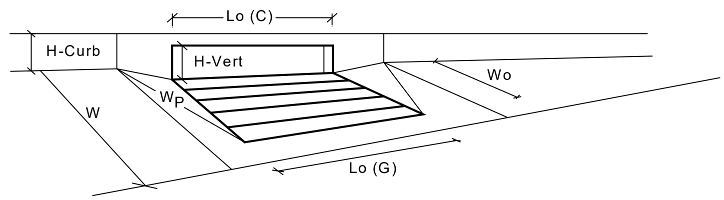
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	5.6	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

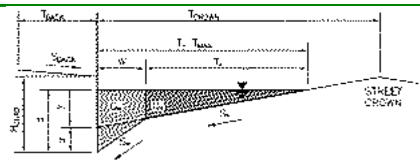
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.6	5.1	cfs
Interception with Clogging	Q_{wa} =	2.3	4.6	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.3	9.4	cfs
Interception with Clogging	Q_{oa} =	7.5	8.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.3	6.4	cfs
Interception with Clogging	Q_{ma} =	3.9	5.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.3**	**4.6**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.5	17.0	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.19	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.55	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.3**	**4.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.6	3.1	cfs

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

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

Project: Grandview Reserve
Inlet ID: Basin A-6 (DP6)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.6	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.3	1.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.5**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	0.8	0.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.3	0.3	

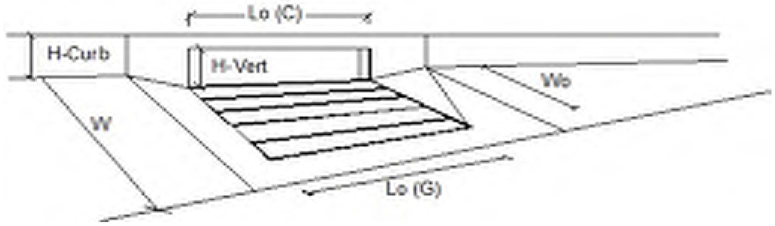
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	16.7	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	15.8	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.142	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	8.2	39.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.2	34.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.4	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.5	38.2	cfs
Average Flow Velocity Within the Gutter Section	V =	0.8	1.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.5**	**38.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.63	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.17	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**8.5**	**38.2**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

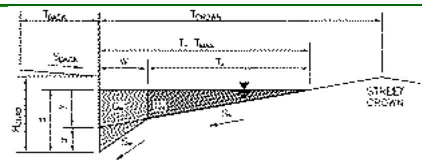


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	4.6	10.7	cfs
Water Spread Width	T =	12.6	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.7	4.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.4	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.191	0.136	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	3.7	9.2	cfs
Discharge within the Gutter Section W	Q_w =	0.9	1.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.30	sq ft
Velocity within the Gutter Section W	V_W =	3.9	4.8	fps
Water Depth for Design Condition	d_{LOCAL} =	6.7	7.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.090	0.070	ft/ft
Required Length L_T to Have 100% Interception	L_T =	12.88	22.25	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	4.3	7.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**4.2**	**6.9**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.4**	**3.8**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.2**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**3.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**92**	**64**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-7 (DP7)**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	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 =	1.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	58.7	58.7	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	34.8	34.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**93.5**	**93.5**	**cfs**
Flow Velocity within the Gutter Section	V =	48.0	48.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	21.4	21.4	

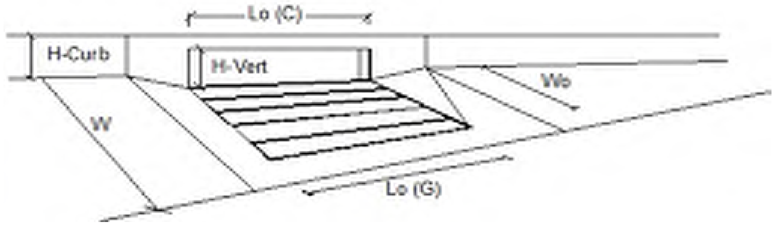
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	23.1	239.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	23.1	217.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	22.8	70.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	7.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	45.9	295.0	cfs
Average Flow Velocity Within the Gutter Section	V =	40.6	63.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	14.8	40.6	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	0.13	0.04	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.2**	**10.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	2.43	2.89	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**6.2**	**10.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



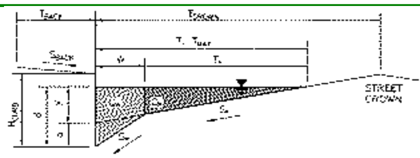
Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.1	2.0	cfs
Water Spread Width	T =	1.3	1.6	ft
Water Depth at Flowline (outside of local depression)	d =	1.3	1.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.012	1.000	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	0.0	cfs
Discharge within the Gutter Section W	Q_w =	1.1	2.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.05	0.10	sq ft
Velocity within the Gutter Section W	V_W =	22.0	19.2	fps
Water Depth for Design Condition	d_{LOCAL} =	4.3	4.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.208	0.208	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.50	7.47	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.00	5.00	ft
Interception Capacity	Q_i =	1.1	1.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.10	0.10	
Effective (Unclogged) Length	L_e =	4.50	4.50	ft
Actual Interception Capacity	**Q_a =**	**1.0**	**1.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**0.4**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.0**	**1.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**0.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**95**	**81**	**%**

MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: Grandview Reserve
Inlet ID: Basin A-9(DP7a)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

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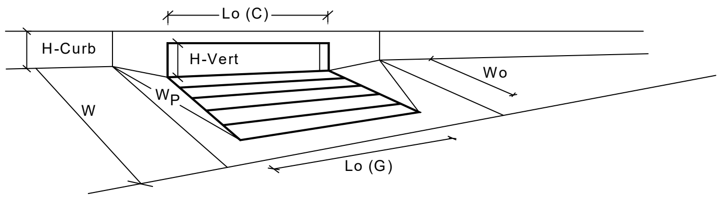


CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	☑ Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**

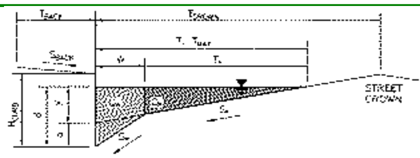
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	7.8	21.1	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin A-10(DP7b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

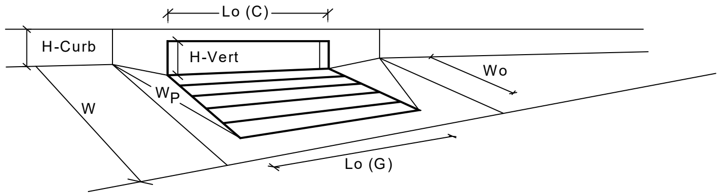
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	8.0	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.6	10.8	cfs
Interception with Clogging	Q_{wa} =	3.2	9.7	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.3	11.2	cfs
Interception with Clogging	Q_{oa} =	7.5	10.1	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	5.1	10.2	cfs
Interception with Clogging	Q_{ma} =	4.6	9.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.2**	**9.2**	**cfs**

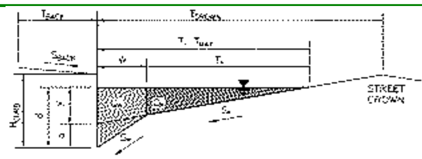
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.2	30.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.5	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.60	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.55	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.2**	**9.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.2	5.3	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin B-1 (DP 9)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

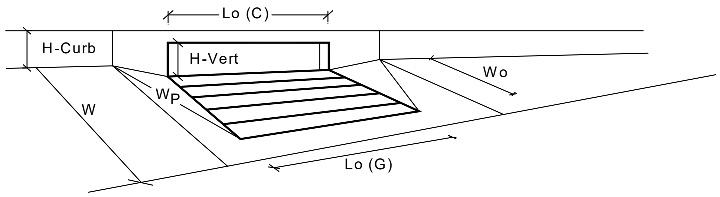
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.3	22.5	cfs
Interception with Clogging	Q_{wa} =	6.1	21.5	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	25.2	32.9	cfs
Interception with Clogging	Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	11.8	25.3	cfs
Interception with Clogging	Q_{ma} =	11.2	24.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**6.1**	**21.5**	**cfs**

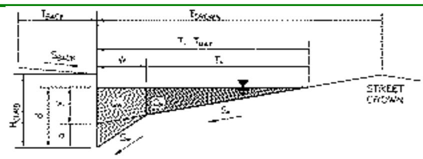
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**6.1**	**21.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.3	12.5	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin B-2 (DP 10a)



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)				

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

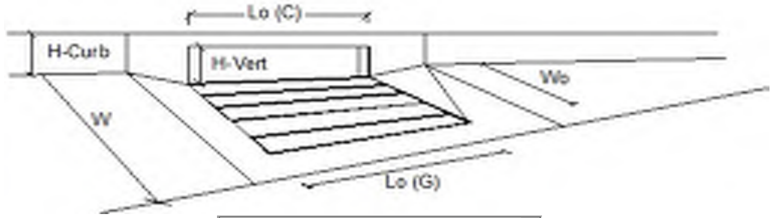
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



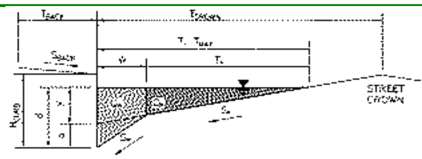
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	7.1	16.7	cfs
Water Spread Width	T =	13.1	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.8	5.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.5	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.184	0.131	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.8	14.5	cfs
Discharge within the Gutter Section W	Q_w =	1.3	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.23	0.32	sq ft
Velocity within the Gutter Section W	V_W =	5.7	6.9	fps
Water Depth for Design Condition	d_{LOCAL} =	6.8	8.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.087	0.068	ft/ft
Required Length L_T to Have 100% Interception	L_T =	16.94	29.43	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	5.7	8.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	8.75	8.75	ft
Actual Interception Capacity	**Q_a =**	**5.5**	**8.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.6**	**8.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.5**	**8.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**8.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**77**	**50**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin B-3 (DP 10b)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

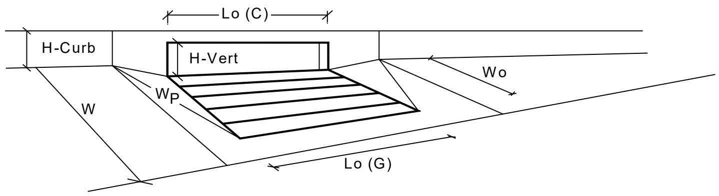
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

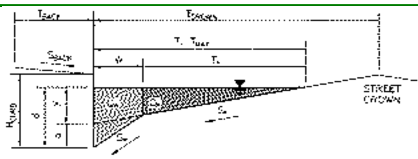
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.6	26.9	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin B-4 (DP 11)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0		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} =	17.0		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	**Major Storm**	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	11.5	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	2.76	4.08	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	4.27	5.59	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	9.5	15.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.511	0.350	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

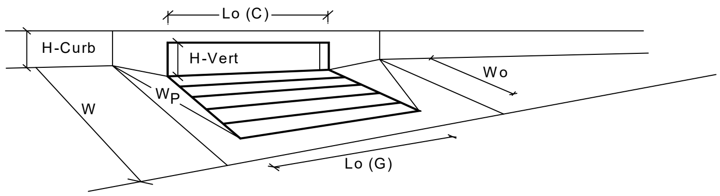
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	27.0	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.7	25.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.318	0.216	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



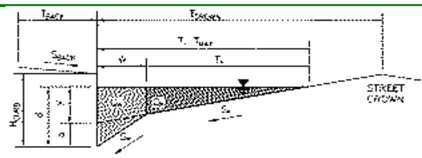
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.3	5.6	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.1	11.6	cfs
Interception with Clogging	Q_{wa} =	4.9	11.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	24.9	28.3	cfs
Interception with Clogging	Q_{oa} =	23.8	27.1	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	10.5	16.9	cfs
Interception with Clogging	Q_{ma} =	10.0	16.1	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**4.9**	**11.1**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.5	17.0	ft
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.0	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.19	0.30	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.40	0.53	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.66	0.76	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**4.9**	**11.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.6	9.4	cfs

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

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

Project: Grandview Reserve
Inlet ID: Basin B-5 (DP 12a)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)				

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

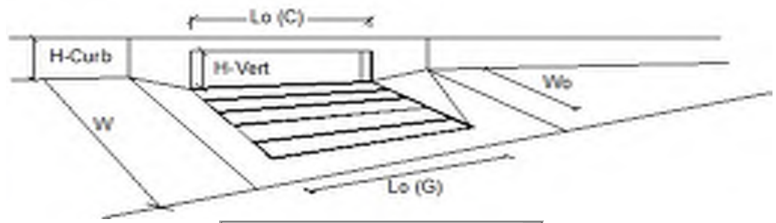
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



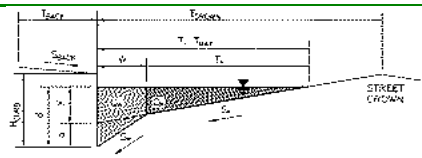
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	7.9	18.5	cfs
Water Spread Width	T =	13.6	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.7	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.177	0.126	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	6.5	16.2	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.33	sq ft
Velocity within the Gutter Section W	V_W =	5.8	7.1	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.084	0.066	ft/ft
Required Length L_T to Have 100% Interception	L_T =	18.17	31.40	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	6.0	9.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**5.9**	**9.0**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**2.0**	**9.5**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.9**	**9.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.0**	**9.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**75**	**49**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin B-6 (DP 14)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

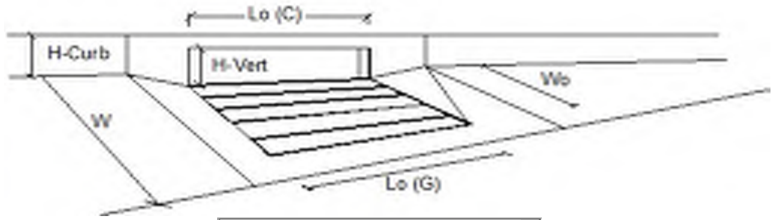
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



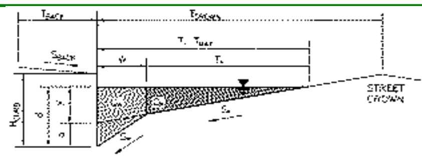
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	3.7	8.7	cfs
Water Spread Width	T =	10.2	14.1	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	4.0	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.240	0.170	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	2.8	7.2	cfs
Discharge within the Gutter Section W	Q_w =	0.9	1.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.18	0.25	sq ft
Velocity within the Gutter Section W	V_W =	4.8	5.9	fps
Water Depth for Design Condition	d_{LOCAL} =	6.1	7.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.107	0.082	ft/ft
Required Length L_T to Have 100% Interception	L_T =	11.03	19.34	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	3.6	6.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**3.6**	**6.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**2.5**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.6**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**2.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**71**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin B-7 (DP 15)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)				

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

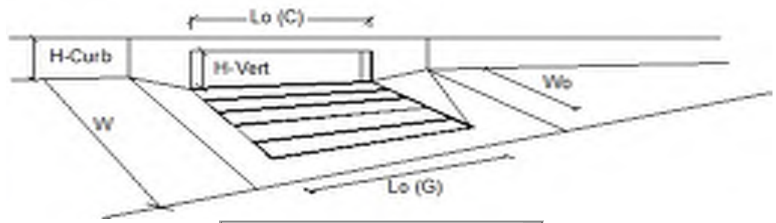
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6$") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



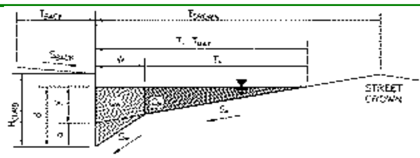
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	1.6	3.8	cfs
Water Spread Width	T =	7.3	10.3	ft
Water Depth at Flowline (outside of local depression)	d =	2.4	3.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.339	0.238	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.1	2.9	cfs
Discharge within the Gutter Section W	Q_w =	0.5	0.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.14	0.19	sq ft
Velocity within the Gutter Section W	V_W =	4.0	4.9	fps
Water Depth for Design Condition	d_{LOCAL} =	5.4	6.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.143	0.106	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.31	11.23	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.31	10.00	ft
Interception Capacity	Q_i =	1.6	3.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**1.6**	**3.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**0.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.6**	**3.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.1**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**97**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin B-8 (DP 12b)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

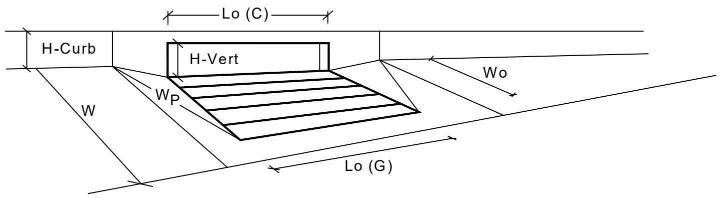
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

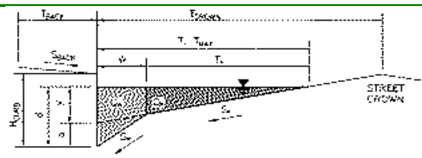
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**9.7**	**34.3**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	7.4	24.5	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin B-9 (DP 13)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches	
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft	
Gutter Width	W =	0.83	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 =	0.000	ft/ft	
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

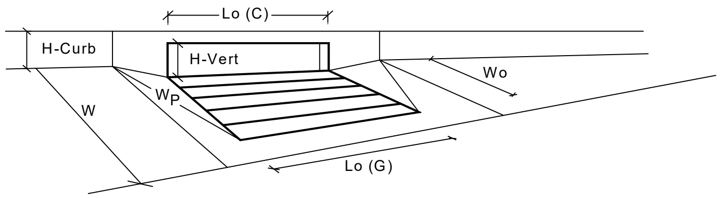
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6$") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.1	20.2	cfs
Interception with Clogging	Q_{wa} =	5.7	18.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.8	21.9	cfs
Interception with Clogging	Q_{oa} =	15.7	20.6	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.4	19.6	cfs
Interception with Clogging	Q_{ma} =	8.8	18.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**5.7**	**18.3**	**cfs**

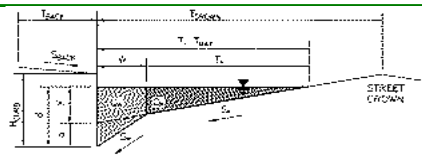
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.82	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.7**	**18.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.8	9.0	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-1 (DP 17b)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

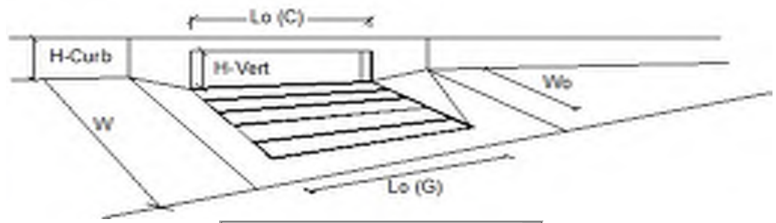
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.5**	**42.1**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



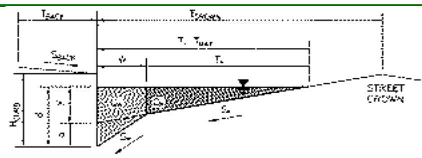
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	6.8	16.0	cfs
Water Spread Width	T =	12.3	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	4.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.3	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.196	0.139	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	5.5	13.8	cfs
Discharge within the Gutter Section W	Q_W =	1.3	2.2	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.30	sq ft
Velocity within the Gutter Section W	V_W =	6.1	7.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	7.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.091	0.071	ft/ft
Required Length L_T to Have 100% Interception	L_T =	16.42	28.60	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	6.7	11.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**6.7**	**11.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.1**	**4.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.7**	**11.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**4.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**98**	**73**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin C-2 (DP 17a)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.025	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	11.5	11.5	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.0	2.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.5**	**13.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

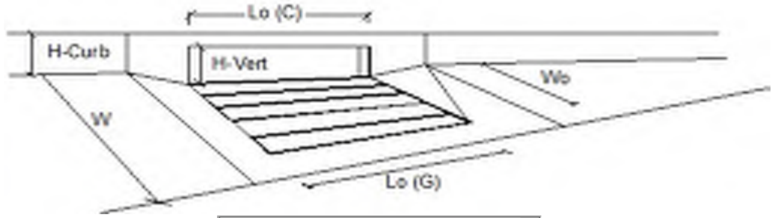
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.6	62.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.6	53.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.9	5.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.5	60.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.2	1.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.2	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	0.70	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.5**	**42.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.69	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.5**	**42.1**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



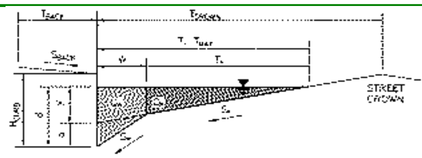
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	11.3	26.3	cfs
Water Spread Width	T =	15.0	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.2	5.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.1	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.160	0.116	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	9.5	23.3	cfs
Discharge within the Gutter Section W	Q_W =	1.8	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.26	0.36	sq ft
Velocity within the Gutter Section W	V_W =	6.9	8.5	fps
Water Depth for Design Condition	d_{LOCAL} =	7.2	8.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.078	0.062	ft/ft
Required Length L_T to Have 100% Interception	L_T =	22.86	39.13	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.6	15.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**9.6**	**15.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.7**	**11.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.6**	**15.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.7**	**11.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**57**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin C-4 (DP 17c)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)			☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

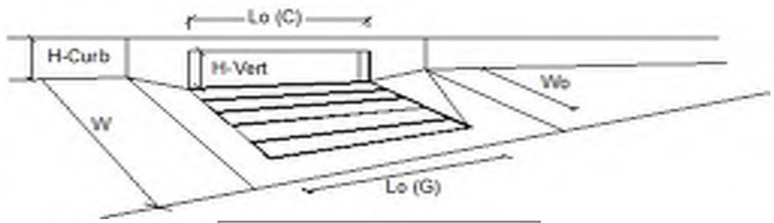
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

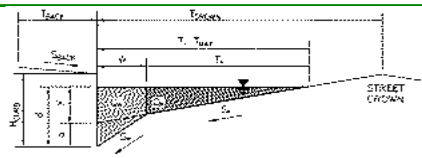
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	5.8	20.8	cfs
Water Spread Width	T =	12.1	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	5.4	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.9	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.200	0.121	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.7	18.3	cfs
Discharge within the Gutter Section W	Q_W =	1.2	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.34	sq ft
Velocity within the Gutter Section W	V_W =	5.4	7.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.5	8.4	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.093	0.064	ft/ft
Required Length L_T to Have 100% Interception	L_T =	14.91	33.79	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	14.91	15.00	ft
Interception Capacity	Q_i =	5.8	13.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**5.8**	**13.4**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**7.4**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.8**	**13.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**7.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**64**	**%**

MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: Grandview Reserve
Inlet ID: Basin C-5 (DP 17d)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.015		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.9	8.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.6	1.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.5**	**10.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.0	1.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

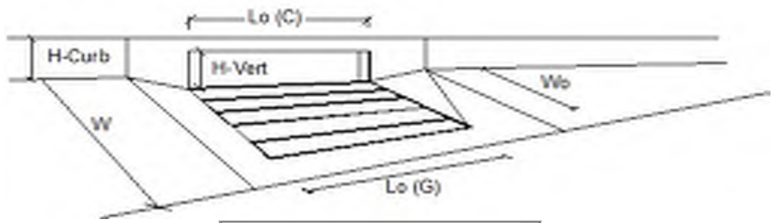
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	8.2	48.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.2	41.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.5	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.7	46.8	cfs
Average Flow Velocity Within the Gutter Section	V =	0.9	1.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.7**	**46.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.7**	**46.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



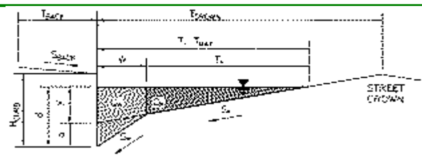
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	5.5	20.2	cfs
Water Spread Width	T =	12.5	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	5.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.1	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.193	0.116	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.4	17.9	cfs
Discharge within the Gutter Section W	Q_w =	1.1	2.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.22	0.36	sq ft
Velocity within the Gutter Section W	V_W =	4.8	6.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.6	8.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.090	0.062	ft/ft
Required Length L_T to Have 100% Interception	L_T =	14.40	33.15	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	14.40	15.00	ft
Interception Capacity	Q_i =	5.5	13.4	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**5.5**	**13.2**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**7.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.5**	**13.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**7.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**65**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin C-6 (DP 17e)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	8.9	8.9	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.6	1.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.5**	**10.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.0	1.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

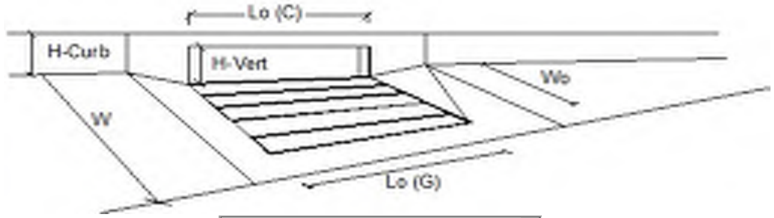
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	8.2	48.1	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	8.2	41.7	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.5	4.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.7	46.8	cfs
Average Flow Velocity Within the Gutter Section	V =	0.9	1.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.9	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.7**	**46.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**9.7**	**46.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



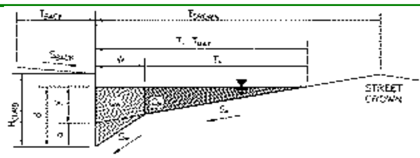
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	3.3	11.7	cfs
Water Spread Width	T =	10.3	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.1	4.6	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.2	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.237	0.142	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	2.5	10.1	cfs
Discharge within the Gutter Section W	Q_W =	0.8	1.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.19	0.29	sq ft
Velocity within the Gutter Section W	V_W =	4.2	5.7	fps
Water Depth for Design Condition	d_{LOCAL} =	6.1	7.6	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.106	0.072	ft/ft
Required Length L_T to Have 100% Interception	L_T =	10.30	23.52	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.30	15.00	ft
Interception Capacity	Q_i =	3.3	9.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**3.3**	**9.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**2.0**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.3**	**9.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**83**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-8 (DP 17f)**



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.022		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.8	10.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	1.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

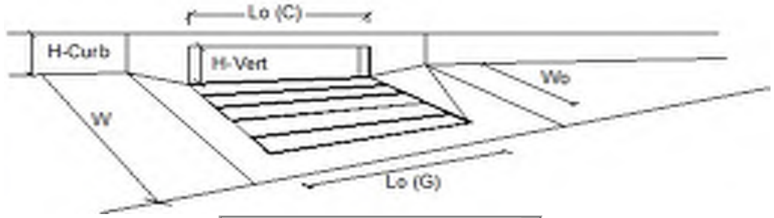
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.0	58.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.0	50.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.8	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	56.6	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.8**	**43.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.8**	**43.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



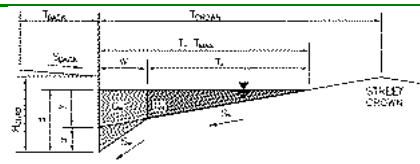
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	8.6	20.0	cfs
Water Spread Width	T =	13.8	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.7	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.174	0.125	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	7.1	17.5	cfs
Discharge within the Gutter Section W	Q_w =	1.5	2.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.33	sq ft
Velocity within the Gutter Section W	V_W =	6.1	7.5	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.083	0.065	ft/ft
Required Length L_T to Have 100% Interception	L_T =	19.17	32.97	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	8.0	13.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**8.0**	**13.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.6**	**6.9**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.0**	**13.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.6**	**6.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**66**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin C-9a (DP17g)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.3	10.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.8	1.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.1**	**12.1**	**cfs**
Flow Velocity within the Gutter Section	V =	1.1	1.1	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

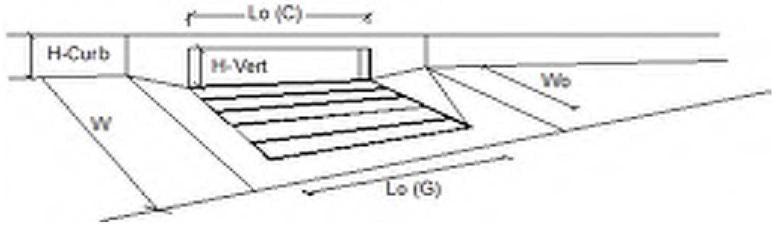
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.5	55.6	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	9.5	48.2	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.7	4.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.2	54.0	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.83	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.2**	**45.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.17	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.70	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.2**	**45.0**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

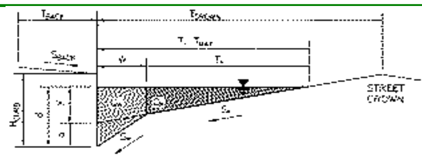


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)		Q_o =	6.2	20.0	cfs
Water Spread Width		T =	12.4	16.0	ft
Water Depth at Flowline (outside of local depression)		d =	3.6	5.3	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.8	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.195	0.123	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	5.0	17.5	cfs
Discharge within the Gutter Section W		Q_w =	1.2	2.4	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.22	0.34	sq ft
Velocity within the Gutter Section W		V_W =	5.5	7.3	fps
Water Depth for Design Condition		d_{LOCAL} =	6.6	8.3	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.091	0.065	ft/ft
Required Length L_T to Have 100% Interception		L_T =	15.52	32.93	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	15.00	15.00	ft
Interception Capacity		Q_i =	6.2	13.3	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.04	0.04	
Effective (Unclogged) Length		L_e =	14.34	14.34	ft
Actual Interception Capacity		**Q_a =**	**6.2**	**13.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**6.8**	**cfs**
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**6.2**	**13.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**6.8**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**66**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin C-9b (DP17h)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	ft
Street Transverse Slope	S_X =	0.018	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.46	3.46	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.65	0.65	inches
Water Depth at Gutter Flowline	d =	4.10	4.10	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.151	0.151	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

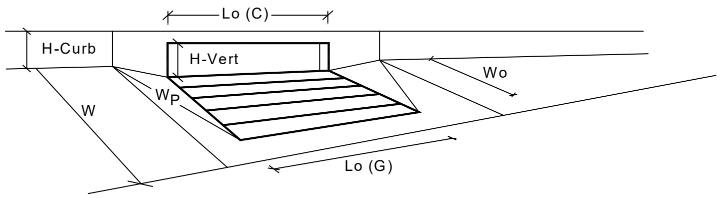
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	17.2	32.6	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	16.4	31.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.140	0.071	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

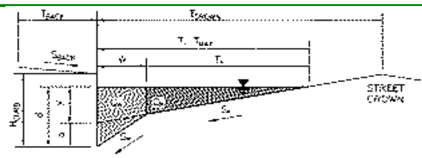
			MINOR	MAJOR	
	Design Information (Input)		MINOR	MAJOR	
	Type of Inlet	Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	Override Depths
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
	Grate Information		MINOR	MAJOR	
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
	Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
	Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
	Clogging Factor for Multiple Units	Clog =	0.03	0.03	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
	Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
	Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
	Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	20.00	20.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	17.2	32.6	ft.>T-Crown
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.3	3.6	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.9	29.5	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin C-7b (DP 18b)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.8	10.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	1.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

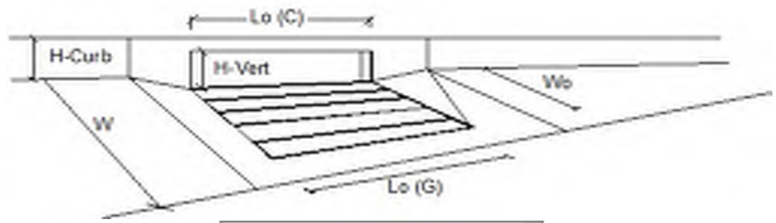
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	58.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.0	50.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.8	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	56.6	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.8**	**43.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.8**	**43.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



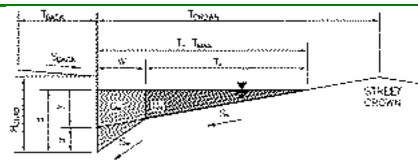
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	11.0	26.4	cfs
Water Spread Width	T =	15.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.3	5.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.3	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.158	0.113	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	9.3	23.4	cfs
Discharge within the Gutter Section W	Q_w =	1.7	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.27	0.37	sq ft
Velocity within the Gutter Section W	V_W =	6.5	8.1	fps
Water Depth for Design Condition	d_{LOCAL} =	7.3	8.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.077	0.061	ft/ft
Required Length L_T to Have 100% Interception	L_T =	22.49	39.20	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.5	15.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**9.4**	**15.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.6**	**11.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.4**	**15.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**11.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**57**	**%**

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

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

Project: **Grandview Reserve**
Inlet ID: **Basin C-7b (DP 18b)**



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Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	10.8	10.8	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.9	1.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**12.7**	**12.7**	**cfs**
Flow Velocity within the Gutter Section	V =	1.2	1.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.4	0.4	

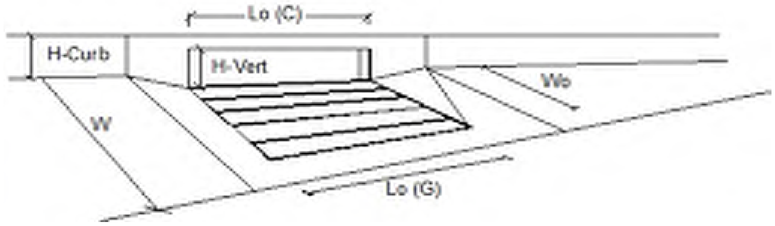
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	58.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	10.0	50.6	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.8	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.8	56.6	cfs
Average Flow Velocity Within the Gutter Section	V =	1.1	1.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.4	1.1	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.77	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.8**	**43.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.96	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	2.49	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.8**	**43.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

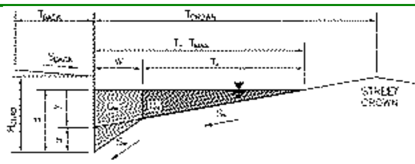


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	11.0	26.4	cfs
Water Spread Width	T =	15.2	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	4.3	5.8	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	1.3	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.158	0.113	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	9.3	23.4	cfs
Discharge within the Gutter Section W	Q_w =	1.7	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.27	0.37	sq ft
Velocity within the Gutter Section W	V_W =	6.5	8.1	fps
Water Depth for Design Condition	d_{LOCAL} =	7.3	8.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.077	0.061	ft/ft
Required Length L_T to Have 100% Interception	L_T =	22.49	39.20	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.5	15.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**9.4**	**15.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.6**	**11.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**9.4**	**15.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.6**	**11.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**85**	**57**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin C-10 (DP 18c)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

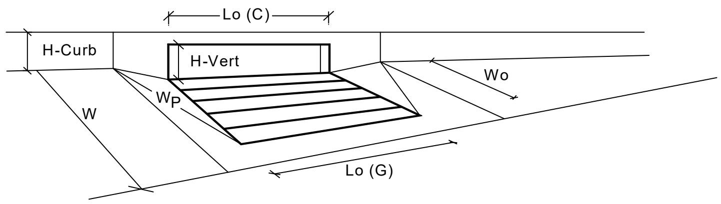
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



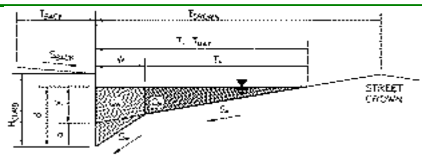
			MINOR	MAJOR	
	Design Information (Input) CDOT Type R Curb Opening				
	Type of Inlet	Type =	CDOT Type R Curb Opening		
	Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
	Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
	Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
	Grate Information		MINOR	MAJOR	☑ Override Depths
	Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
	Width of a Unit Grate	W_o =	N/A	N/A	feet
	Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
	Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
	Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
	Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
	Curb Opening Information		MINOR	MAJOR	
	Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
	Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
	Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
	Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1	Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
	Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
	Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
	Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
	Grate Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
	Clogging Factor for Multiple Units	Clog =	N/A	N/A	
	Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
	Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
	Grate Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
	Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
	Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
	Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
	Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
	Clogging Factor for Multiple Units	Clog =	0.04	0.04	
	Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{wi} =	7.5	26.6	cfs
	Interception with Clogging	Q_{wa} =	7.2	25.4	cfs
	Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
	Interception without Clogging	Q_{oi} =	25.2	32.9	cfs
	Interception with Clogging	Q_{oa} =	24.1	31.5	cfs
	Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
	Interception without Clogging	Q_{mi} =	12.8	27.5	cfs
	Interception with Clogging	Q_{ma} =	12.2	26.3	cfs
	Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**7.2**	**25.4**	**cfs**
	Resultant Street Conditions		MINOR	MAJOR	
	Total Inlet Length	L =	15.00	15.00	feet
	Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
	Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
	Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
	Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
	Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
	Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
	Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
	Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
	Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**7.2**	**25.4**	**cfs**
	Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.8	23.4	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin C-11 (DP 19)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

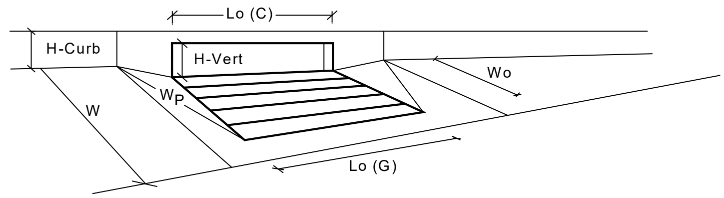
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	11.9	25.7	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	9.9	23.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.497	0.228	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor ($d \geq 6"$) Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

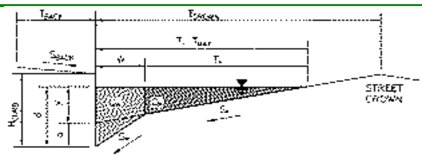
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	☑ Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.7	10.1	cfs
Interception with Clogging	Q_{wa} =	2.4	9.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.4	11.0	cfs
Interception with Clogging	Q_{oa} =	7.6	9.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	4.4	9.8	cfs
Interception with Clogging	Q_{ma} =	4.0	8.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.4**	**8.8**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	11.9	25.7	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.3	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.20	0.47	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.98	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.3	cfs

MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: Grandview Reserve
Inlet ID: Basin C-12 (DP 20)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

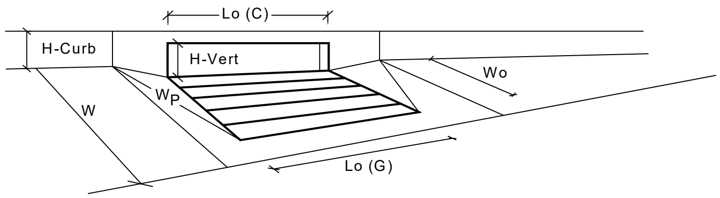
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.10	0.10	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.7	10.1	cfs
Interception with Clogging	Q_{wa} =	3.4	9.1	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	8.4	11.0	cfs
Interception with Clogging	Q_{oa} =	7.6	9.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	5.2	9.8	cfs
Interception with Clogging	Q_{ma} =	4.7	8.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.4**	**8.8**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	5.00	5.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.56	0.98	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	2.9	6.7	cfs

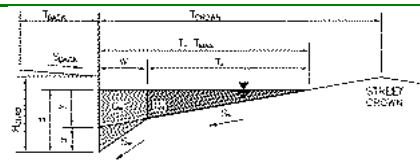
Warning 1: Dimension entered is not a typical dimension for inlet type specified.

MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: Grandview Reserve
Inlet ID: Basin D-1 (DP 22)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.3	1.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.5**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	0.8	0.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.3	0.3	

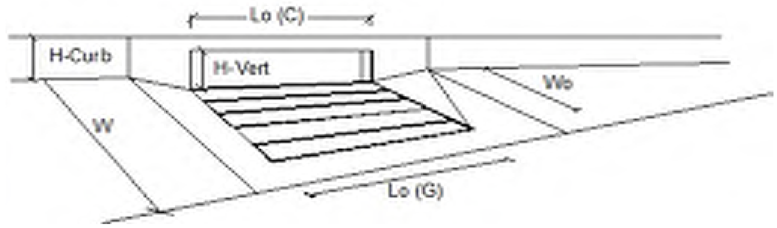
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	6.7	39.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	6.7	34.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.9	38.2	cfs
Average Flow Velocity Within the Gutter Section	V =	0.8	1.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.9**	**38.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**7.9**	**38.2**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

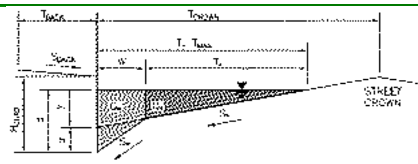


Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	5.4	12.7	cfs
Water Spread Width	T =	13.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.6	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.179	0.128	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	4.4	11.1	cfs
Discharge within the Gutter Section W	Q_w =	1.0	1.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.32	sq ft
Velocity within the Gutter Section W	V_W =	4.1	5.0	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.085	0.066	ft/ft
Required Length L_T to Have 100% Interception	L_T =	14.30	24.81	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	10.00	10.00	ft
Interception Capacity	Q_i =	4.8	7.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	9.37	9.37	ft
Actual Interception Capacity	**Q_a =**	**4.7**	**7.5**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.7**	**5.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.7**	**7.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.7**	**5.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**87**	**59**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin D-2 (DP 23)



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	1.3	1.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**8.5**	**8.5**	**cfs**
Flow Velocity within the Gutter Section	V =	0.8	0.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.3	0.3	

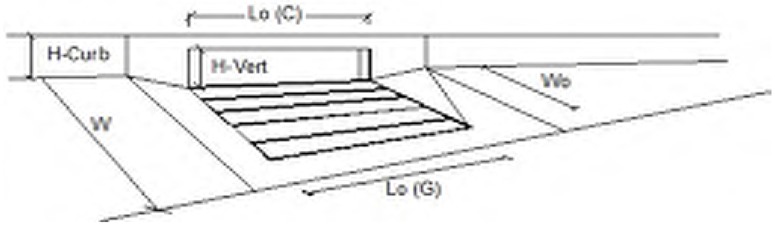
Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.7	39.3	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	6.7	34.1	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	7.9	38.2	cfs
Average Flow Velocity Within the Gutter Section	V =	0.8	1.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.3	0.7	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	1.00	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**7.9**	**38.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	7.68	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	3.22	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**7.9**	**38.2**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

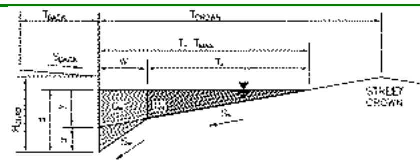


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)		Q_o =	1.7	4.0	cfs
Water Spread Width		T =	8.6	12.0	ft
Water Depth at Flowline (outside of local depression)		d =	2.7	3.5	inches
Water Depth at Street Crown (or at T_{MAX})		d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow		E_o =	0.287	0.202	
Discharge outside the Gutter Section W, carried in Section T_x		Q_x =	1.2	3.2	cfs
Discharge within the Gutter Section W		Q_w =	0.5	0.8	cfs
Discharge Behind the Curb Face		Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W		A_W =	0.16	0.21	sq ft
Velocity within the Gutter Section W		V_W =	3.1	3.8	fps
Water Depth for Design Condition		d_{LOCAL} =	5.7	6.5	inches
Grate Analysis (Calculated)			MINOR	MAJOR	
Total Length of Inlet Grate Opening		L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow		$E_{o-GRATE}$ =	N/A	N/A	
Under No-Clogging Condition			MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Interception Capacity		Q_i =	N/A	N/A	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet		GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet		GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet		L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins		V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow		R_f =	N/A	N/A	
Interception Rate of Side Flow		R_x =	N/A	N/A	
Actual Interception Capacity		**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)		**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)			MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)		S_e =	0.124	0.094	ft/ft
Required Length L_T to Have 100% Interception		L_T =	6.67	11.75	ft
Under No-Clogging Condition			MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)		L =	6.67	10.00	ft
Interception Capacity		Q_i =	1.7	3.9	cfs
Under Clogging Condition			MINOR	MAJOR	
Clogging Coefficient		CurbCoef =	1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet		CurbClog =	0.06	0.06	
Effective (Unclogged) Length		L_e =	9.37	9.37	ft
Actual Interception Capacity		**Q_a =**	**1.7**	**3.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a		**Q_b =**	**0.0**	**0.2**	**cfs**
Summary			MINOR	MAJOR	
Total Inlet Interception Capacity		**Q =**	**1.7**	**3.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)		**Q_b =**	**0.0**	**0.2**	**cfs**
Capture Percentage = Q_a/Q_o =		**C% =**	**100**	**96**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin D-3 (DP 24)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

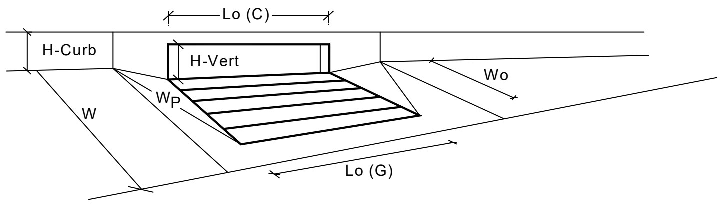
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	3	3	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.4	7.7	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.31	1.31	
Clogging Factor for Multiple Units	Clog =	0.04	0.04	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.5	26.6	cfs
Interception with Clogging	Q_{wa} =	7.2	25.4	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	25.2	32.9	cfs
Interception with Clogging	Q_{oa} =	24.1	31.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	12.8	27.5	cfs
Interception with Clogging	Q_{ma} =	12.2	26.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**7.2**	**25.4**	**cfs**

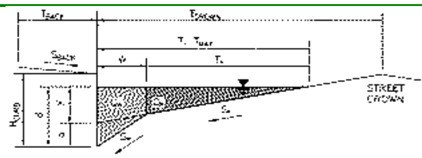
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	15.00	15.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**7.2**	**25.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	6.6	19.2	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin D-4 (DP 25)



<u>Gutter Geometry:</u>

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

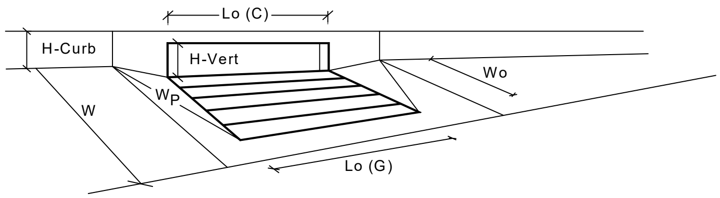
<u>Maximum Capacity for 1/2 Street based On Allowable Spread</u>		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

<u>Maximum Capacity for 1/2 Street based on Allowable Depth</u>		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d ≥ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

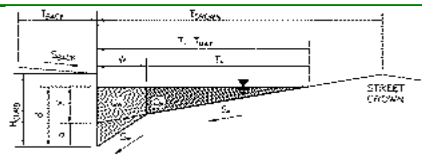
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.25	1.25	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	6.1	20.2	cfs
Interception with Clogging	Q_{wa} =	5.7	18.9	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.8	21.9	cfs
Interception with Clogging	Q_{oa} =	15.7	20.6	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.4	19.6	cfs
Interception with Clogging	Q_{ma} =	8.8	18.3	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**5.7**	**18.3**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	10.00	10.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.82	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.7**	**18.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.3	7.7	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin E-1 (DP 27)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5		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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0		ft
Gutter Width	W =	0.83		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 =	0.033		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.2	13.2	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.3	2.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**15.5**	**15.5**	**cfs**
Flow Velocity within the Gutter Section	V =	1.4	1.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

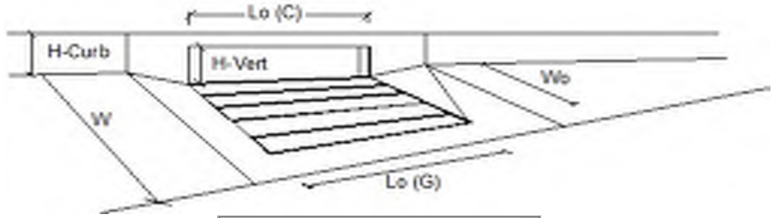
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	12.2	71.4	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	12.2	61.9	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.2	6.1	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.3	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.4	69.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.4	2.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.5	1.3	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.56	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.4**	**38.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.15	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.68	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.4**	**38.8**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



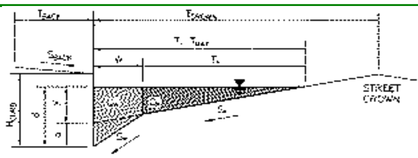
CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	9.8	22.9	cfs
Water Spread Width	T =	13.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.6	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.179	0.128	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	8.1	20.0	cfs
Discharge within the Gutter Section W	Q_W =	1.8	2.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.32	sq ft
Velocity within the Gutter Section W	V_W =	7.4	9.1	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.085	0.067	ft/ft
Required Length L_T to Have 100% Interception	L_T =	20.77	35.88	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	8.8	14.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**8.8**	**14.1**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.0**	**8.8**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.8**	**14.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.0**	**8.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**89**	**62**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin E-2 (DP 28)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.035	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☑	

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	13.6	13.6	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	2.4	2.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**16.0**	**16.0**	**cfs**
Flow Velocity within the Gutter Section	V =	1.5	1.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.5	0.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

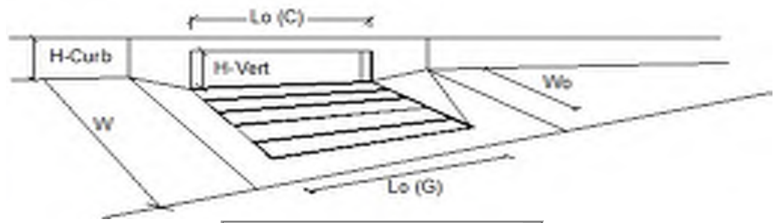
		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\,TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	12.6	73.5	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	12.6	63.8	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	2.3	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	1.4	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.8	71.4	cfs
Average Flow Velocity Within the Gutter Section	V =	1.4	2.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.5	1.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	1.00	0.53	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.8**	**38.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.36	6.04	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.57	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.8**	**38.1**	**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'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



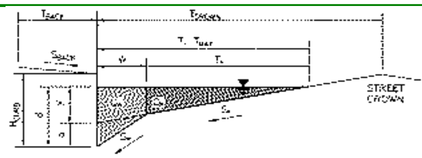
CDOT Type R Curb Opening

		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Design Discharge for Half of Street (from *Inlet Management*)	Q_o =	10.1	23.6	cfs
Water Spread Width	T =	13.4	16.0	ft
Water Depth at Flowline (outside of local depression)	d =	3.9	5.1	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.6	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.179	0.128	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	8.3	20.6	cfs
Discharge within the Gutter Section W	Q_w =	1.8	3.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.24	0.32	sq ft
Velocity within the Gutter Section W	V_W =	7.6	9.3	fps
Water Depth for Design Condition	d_{LOCAL} =	6.9	8.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	N/A	N/A	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Interception Capacity	Q_i =	N/A	N/A	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef =	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	N/A	N/A	fps
Interception Rate of Frontal Flow	R_f =	N/A	N/A	
Interception Rate of Side Flow	R_x =	N/A	N/A	
Actual Interception Capacity	**Q_a =**	**N/A**	**N/A**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**N/A**	**N/A**	**cfs**
Curb or Slotted Inlet Opening Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e (based on grate carry-over)	S_e =	0.085	0.067	ft/ft
Required Length L_T to Have 100% Interception	L_T =	21.17	36.56	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	15.00	15.00	ft
Interception Capacity	Q_i =	9.0	14.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoef =	1.31	1.31	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.04	0.04	
Effective (Unclogged) Length	L_e =	14.34	14.34	ft
Actual Interception Capacity	**Q_a =**	**8.9**	**14.3**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**1.2**	**9.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**8.9**	**14.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.2**	**9.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**88**	**61**	**%**

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

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

Project: Grandview Reserve
Inlet ID: Basin E-3 (DP 29)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft
Gutter Width	W =	0.83	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 =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

Maximum Capacity for 1/2 Street based On Allowable Spread

		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

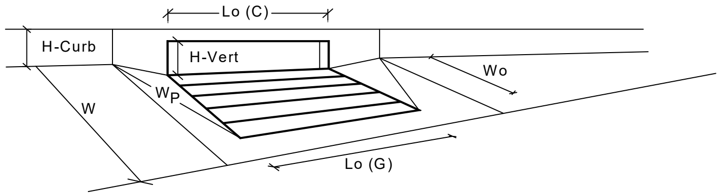
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

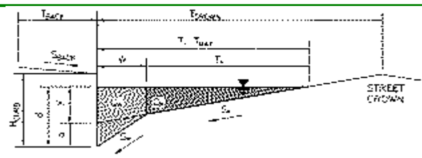
		MINOR	MAJOR	
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	Q_{Grate} =	**N/A**	**N/A**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	Q_{Curb} =	**9.7**	**34.3**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	8.2	32.1	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

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

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

Project: Grandview Reserve
Inlet ID: Basin E-4 (DP 30)



Gutter Geometry:				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches	
Distance from Curb Face to Street Crown	T_{CROWN} =	16.0	ft	
Gutter Width	W =	0.83	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 =	0.000	ft/ft	
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	16.0	16.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.4	7.7	inches
Check boxes are not applicable in SUMP conditions				

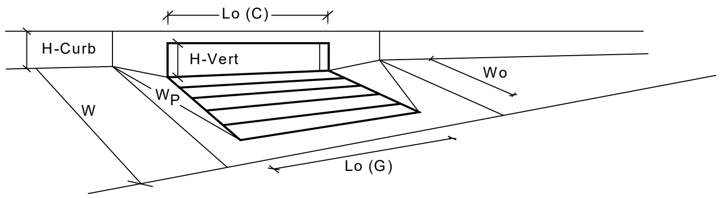
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (Eq. ST-2)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	d_C =	0.8	0.8	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	0.63	0.63	inches
Water Depth at Gutter Flowline	d =	4.47	4.47	inches
Allowable Spread for Discharge outside the Gutter Section W (T - W)	T_X =	15.2	15.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.149	0.149	
Discharge outside the Gutter Section W, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_T - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**SUMP**	**SUMP**	**cfs**
Flow Velocity within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	0.0	0.0	

Maximum Capacity for 1/2 Street based on Allowable Depth		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.6	29.4	ft
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{X\ TH}$ =	14.7	28.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	E_O =	0.153	0.079	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section W, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section W (Q_d - Q_X)	Q_W =	0.0	0.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	0.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	0.0	0.0	cfs
Average Flow Velocity Within the Gutter Section	V =	0.0	0.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	0.0	0.0	
Slope-Based Depth Safety Reduction Factor for Major & Minor (d $\geq$ 6") Storm	R =	SUMP	SUMP	
Max Flow Based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**SUMP**	**SUMP**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =			inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =			inches

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



CDOT Type R Curb Opening

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	4	4	Override Depths
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.4	7.7	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Warning 1 Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	N/A	N/A	
Clogging Factor for Multiple Units	Clog =	N/A	N/A	
Grate Capacity as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Grate Capacity as a Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	N/A	N/A	cfs
Interception with Clogging	Q_{ma} =	N/A	N/A	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**N/A**	**N/A**	**cfs**

Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.33	1.33	
Clogging Factor for Multiple Units	Clog =	0.03	0.03	
Curb Opening as a Weir (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	10.0	35.4	cfs
Interception with Clogging	Q_{wa} =	9.7	34.3	cfs
Curb Opening as an Orifice (based on Modified HEC22 Method)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	33.6	43.9	cfs
Interception with Clogging	Q_{oa} =	32.5	42.4	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	17.0	36.7	cfs
Interception with Clogging	Q_{ma} =	16.5	35.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**9.7**	**34.3**	**cfs**

Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	20.00	20.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.6	29.4	ft.>T-Crown
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	3.2	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.29	0.57	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.41	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**9.7**	**34.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	9.0	21.0	cfs

Warning 1: Dimension entered is not a typical dimension for inlet type specified.

Channel Report

BASIN D-7 SWALE

Trapezoidal

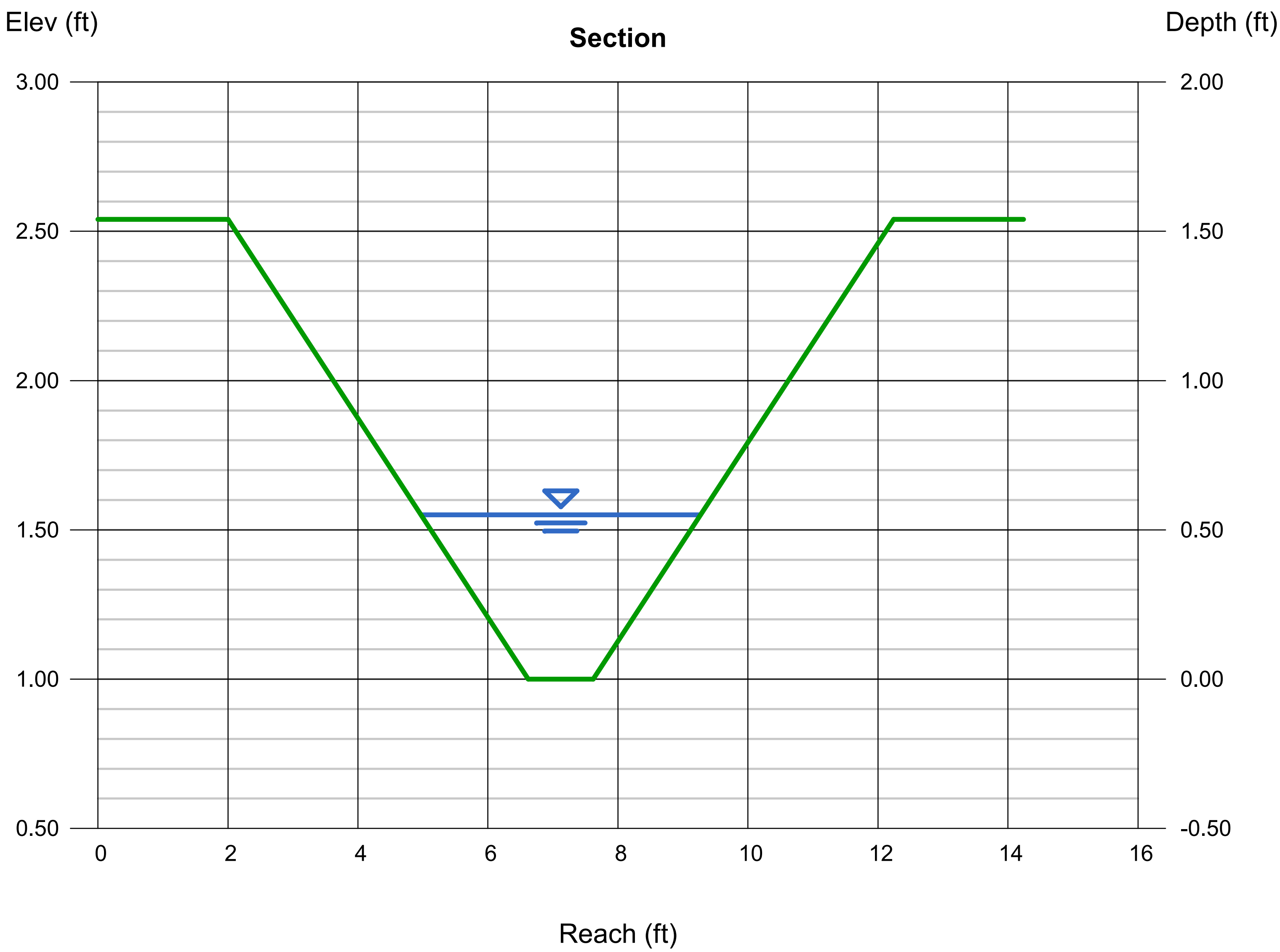
Bottom Width (ft)	=	1.00
Side Slopes (z:1)	=	3.00, 3.00
Total Depth (ft)	=	1.54
Invert Elev (ft)	=	1.00
Slope (%)	=	2.00
N-Value	=	0.035

Calculations

Compute by:		Known Q
Known Q (cfs)	=	4.00

Highlighted

Depth (ft)	=	0.55
Q (cfs)	=	4.000
Area (sqft)	=	1.46
Velocity (ft/s)	=	2.74
Wetted Perim (ft)	=	4.48
Crit Depth, Yc (ft)	=	0.51
Top Width (ft)	=	4.30
EGL (ft)	=	0.67



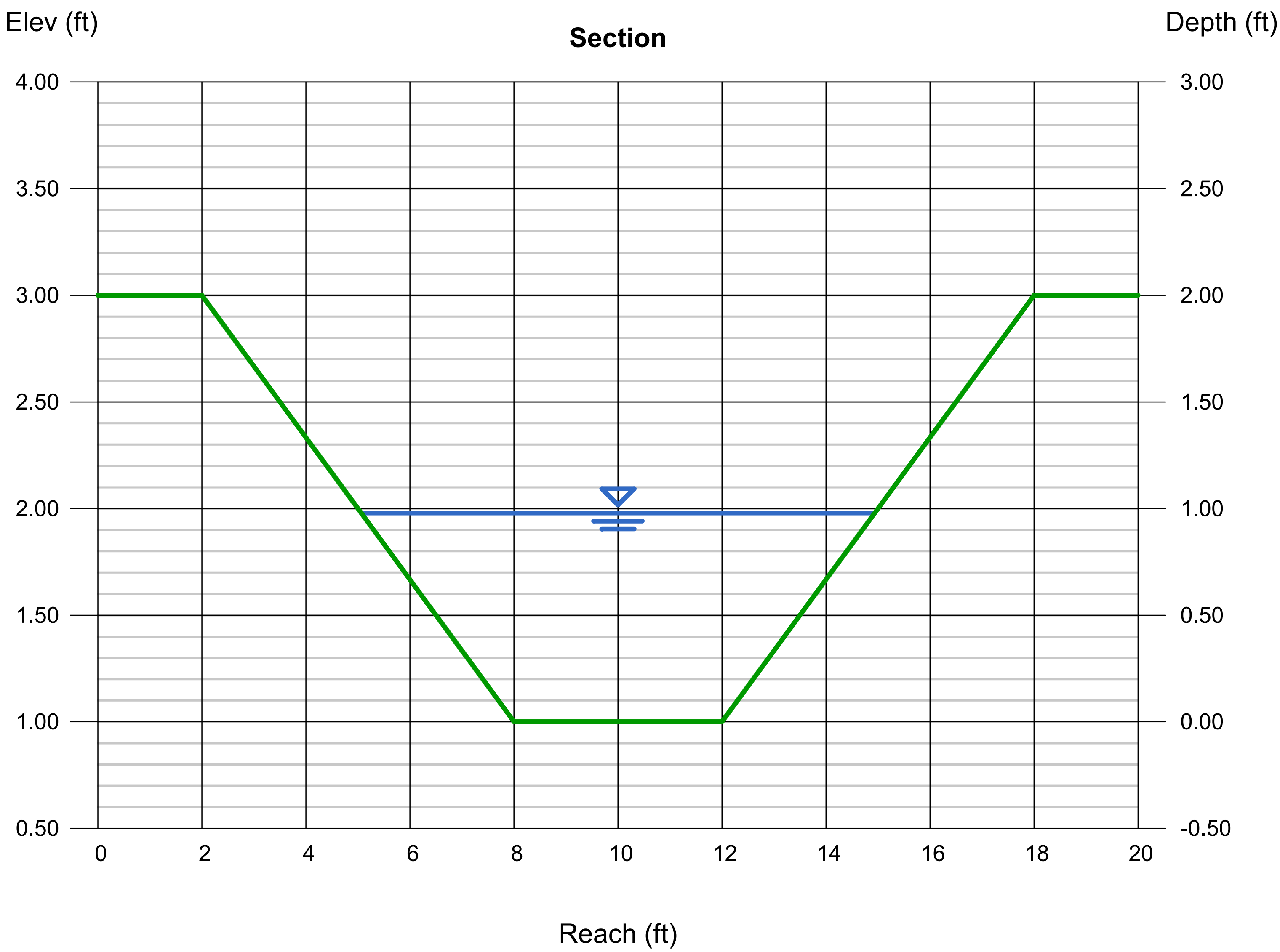
Channel Report

SWALE BASIN A-1

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

Calculations
Compute by: Known Q
Known Q (cfs) = 31.10

Highlighted
Depth (ft) = 0.98
Q (cfs) = 31.10
Area (sqft) = 6.80
Velocity (ft/s) = 4.57
Wetted Perim (ft) = 10.20
Crit Depth, Yc (ft) = 0.97
Top Width (ft) = 9.88
EGL (ft) = 1.31



Channel Report

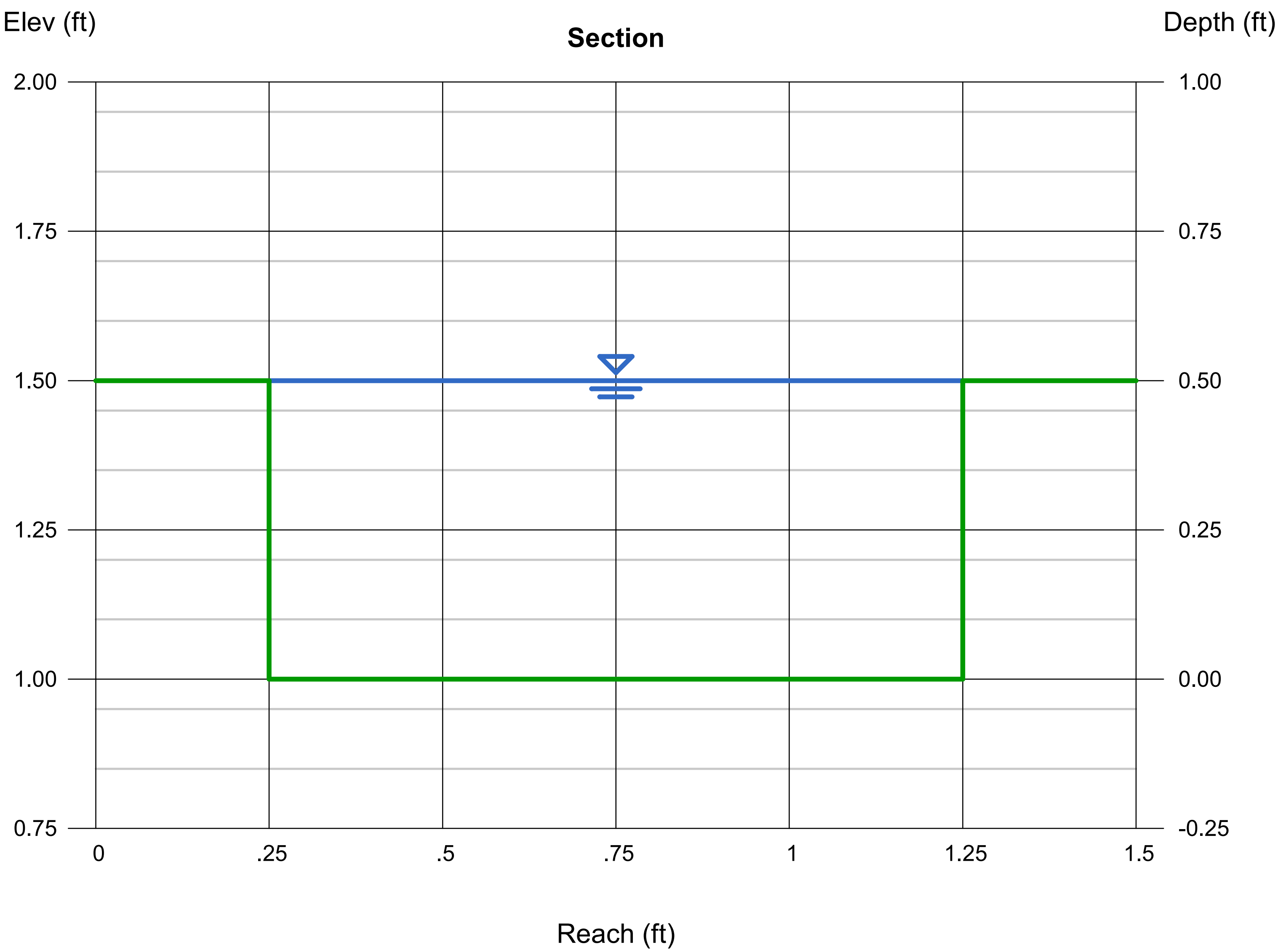
Sidewalk Chase C-7a

Rectangular
Bottom Width (ft) = 1.00
Total Depth (ft) = 0.50

Invert Elev (ft) = 1.00
Slope (%) = 2.00
N-Value = 0.013

Calculations
Compute by: Known Q
Known Q (cfs) = 3.20

Highlighted
Depth (ft) = 0.50
Q (cfs) = 3.200
Area (sqft) = 0.50
Velocity (ft/s) = 6.40
Wetted Perim (ft) = 2.00
Crit Depth, Yc (ft) = 0.50
Top Width (ft) = 1.00
EGL (ft) = 1.14



Channel Report

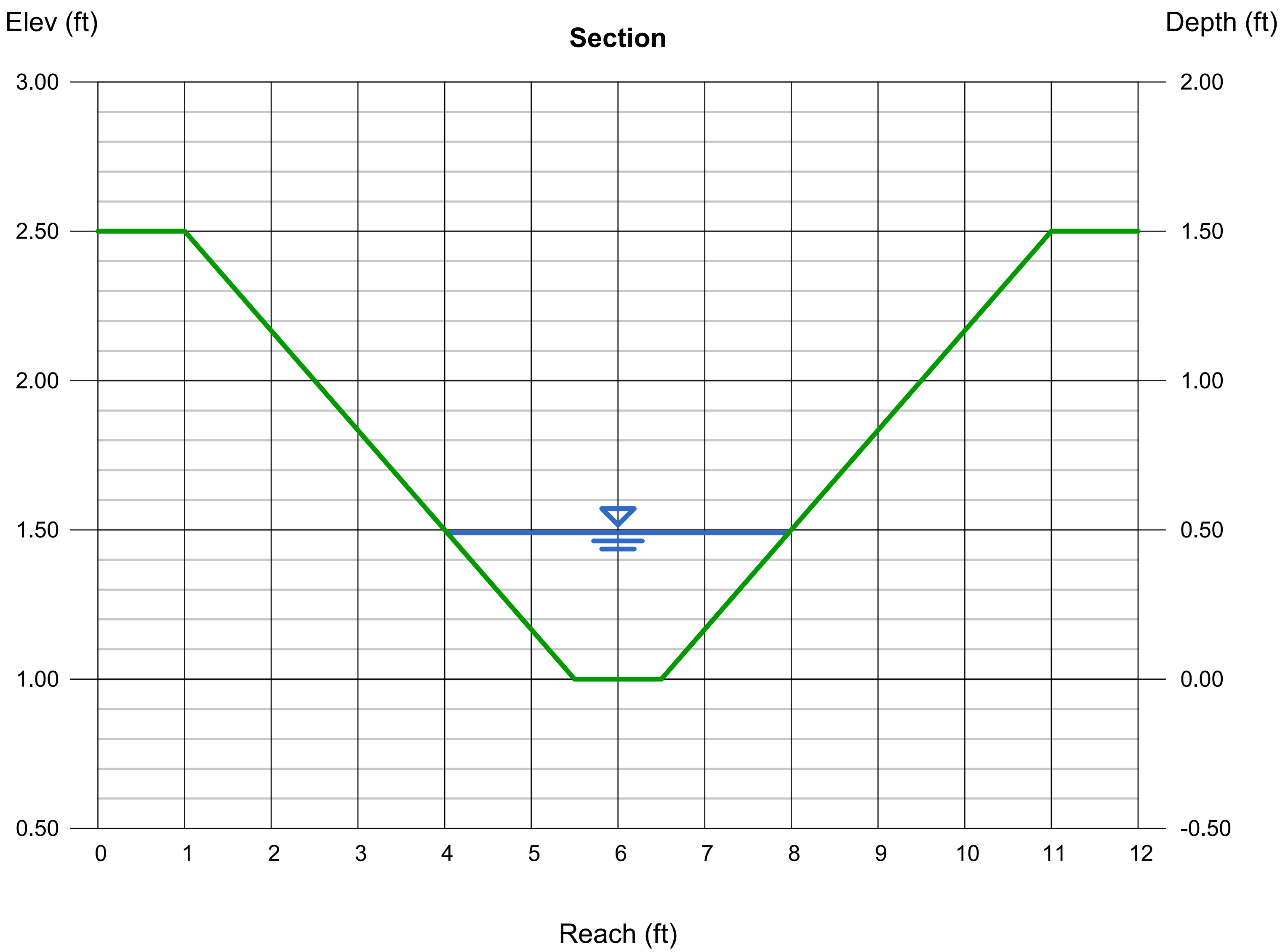
SWALE BASIN C-7a

Trapezoidal		Highlighted	
Bottom Width (ft)	= 1.00	Depth (ft)	= 0.49
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 3.200
Total Depth (ft)	= 1.50	Area (sqft)	= 1.21
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 2.64
Slope (%)	= 2.00	Wetted Perim (ft)	= 4.10
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.45
		Top Width (ft)	= 3.94
		EGL (ft)	= 0.60

Calculations

Compute by: Known Q

Known Q (cfs) = 3.20



HRGreen

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Grandview Reserve
CLOMR REPORT

April 2022

HR Green Project No: 201662.03

Prepared By:

HR Green Development, LLC

Contact: Chris McFarland, PE

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720-602-4999

Table of Contents

Grandview Reserve CLOMR Report

Project Narrative

This report was prepared by HR Green to support the submission of MT-2 forms and documents in a request for a Conditional Letter of Map Revision (CLOMR) for channel improvements along Main Stem and Main Stem Tributary. This request impacts the current delineation of the 100-year boundary on Flood Insurance Rate Maps (FIRMs) 08041C0552G and 08041C0556G.

Grandview Reserve is located in Falcon, Colorado within El Paso County and contains approximately 776 acres within the south half of section 21 and 22 and the north half of section 27 and 28, Township 12 South, and Range 66 West of the Sixth Principal Meridian in Ela Paso County, Colorado.

Grandview Reserve (GVR) falls within the Gieck Ranch Drainage Basin which covers approximately 22 square miles. This drainage basin is tributary to Black Squirrel Creek and joins said creek just to the south of Elicott, CO about 18 miles to the south. Black Squirrel Creek eventually drains to the Arkansas River in Pueblo Colorado. Much of the Gieck Ranch Drainage basin is undeveloped consisting of rural farmland. The Gieck Ranch Drainage basin lies north of the Haegler Ranch drainage basin. The channels through the Grandview property can all be described as gently sloping drainages that roll through the site towards the creeks, they are tributary too.

Per the NRCS web soil survey, the site is made up entirely of Type A and B soils. The majority of which are Type A soils. The predominate soils are Blakeland loamy sand, Columbine gravelly sandy loam, and Stapleton sandy loam. The first two soils are Type A soil and cover approximately 55.1% of the site and the later soil is a Type B soil and covers the remaining 44.9% of the site.

The vegetation found within Grandview Reserve consists of wetland communities in the floodplain with a transitional area to shortgrass prairie communities that dominate the site. The primary species found in the shortgrass prairie regions include little bluestem, blue grama, and buffalograss. The transitional area between the wetlands and shortgrass prairie includes patches of snowberry, and wood's rose. There are a few plains cottonwoods along the main channels. The area has historically been heavily grazed and there are weeds throughout the site. Weeds found onsite include Canada thistle, Russian thistle, common mullein and yellow toadflax spp.

Observations of the existing channels suggest that by and large they are equilibrium with their watershed flows; evidence including relatively stable bankfull channels, adequate floodplain (above bankfull channel elevations) and in-tact plant communities that would be expected in this type of reach support the notion that the reach is in equilibrium.

At present, the preliminary analysis and design of Main Stem (MS) and Main Stem Tributary (MST) has been completed. Main Stem is to by and large be left in its current state with the exception of the reach surrounding the existing breached stock pond berm. This berm is to be removed and the surrounding region is to be regraded and stabilized to match the existing channel conditions.

Proposed improvements for Main Stem Tributary include the realignment of the channel, generally shifting the channel towards the west to accommodate the proposed land plan. There is to be a dedicated 100' wide corridor in which the valley will meander. The valley is the area needed to fully contain the 100 year event plus freeboard requirements. Preliminary analysis indicates the valley will have an average width of approximately 63'; initial sizing approximates the bankfull width to be 6.8'. The valley and channel thalweg will generally follow the same profile, with some deviation as the bankfull channel meanders through the valley in turn decreasing the low flow channels average slope. The average valley profile is to be approximately 1% with a series of grade control structures to both decrease elevation and dissipate energy to meet natural channel criteria as outline in El Paso County criteria and agreed upon channel parameters.

Hydrology

For modeling the floodplain, flows were assumed to remain the same as presented in the 4 Way Ranch LOMR completed by Kiowa Engineering in March of 2004. Flows are to remain the same and increased runoff attributed to development will be controlled by the various ponds that are to be constructed near the channel.

Per the existing LOMR completed in March 2004, the 100-year flow corresponds to ~280 cfs as MST enters the north boundary of the site (station 45+30 along the existing channel alignment). As the channel works through the existing site, the 100 year flows increase to ~391 cfs at station 22+59 along the existing channel alignment and ~597 cfs at station 6+14 along the existing channel alignment. Along MS in the existing condition there is a minor increase in flow attributed to overland flow from the basin. See Table 1 and Table 2 for summaries of existing flows for MS and MST respectively.

Table 1 - EXISTING FLOWS FOR MAIN STEM

STATION	2-YR STORM	5-YR STORM	100-YR STORM
37+13	23 cfs	67 cfs	413 cfs
25+92	26.45 cfs	80.03 cfs	479.80 cfs
15+57	26.45 cfs	80.03 cfs	479.80 cfs

Table 2 - EXISTING FLOWS FOR MAIN STEM TRIBUTARY

STATION	2-YR STORM	5-YR STORM	100-YR STORM
45+30	19 cfs	59 cfs	280 cfs
22+59	20.14 cfs	68.95 cfs	390.70 cfs
6+14	22.14 cfs	85.99 cfs	597.42 cfs

Future hydrology derived via CUHP was modeled in SWMM to determine future flow rates anticipated along MS and the realigned MST channel. Table 3 and Table 4 summarize all future flows for MS and the realigned portion of MST respectively.

Table 3 - FUTURE FLOWS FOR MAIN STEM

STATION	2-YR STORM	5-YR STORM	100-YR STORM
37+13	23 cfs	67 cfs	413 cfs
25+92	23 cfs	67 cfs	413 cfs
15+57	27.75 cfs	67.69 cfs	466.95 cfs

Table 4- FUTURE FLOWS FOR MAIN STEM TRIBUTARY

STATION	2-YR STORM	5-YR STORM	100-YR STORM
47+49	19 cfs	59 cfs	280 cfs
36+50	31.72 cfs	60.52 cfs	395.83 cfs
5+54	33.53 cfs	63.16 cfs	553.68 cfs

Exceeded in both channels?

Provide values

Hydraulics

Design criteria were developed to guide a preliminary layout of channel dimension, planform, and profile for the realigned segment of MST. Published criteria from the Urban Stormwater Drainage Criteria Manual, Volume 1 (USDCM; Urban Drainage and Flood Control District, 2016), El Paso County DCM and various other reports currently in process for the drainages through GVR and completed for GVR drainages were used for initial design parameter and flow rates. Parameters used and minimum bankfull geometry is summarized in Table 5.

Table 5 - DESIGN PARAMETERS

Design Parameter	Design Value
Roughness values	EPC Table 10-2
Maximum 5-year velocity, main channel (within bankfull channel width) (ft/s)	Consideration given to both MHFD and EPC
Maximum 100-year velocity, main channel (within bankfull channel width) (ft/s)	Consideration given to both MHFD and EPC
Froude No., 5-year, main channel (within bankfull channel width)	0.7
Froude No., 100-year, main channel (within bankfull channel width)	0.85
Maximum shear stress, 100-year, main channel (within bankfull channel width)	1.2 lb/sf
Minimum bankfull capacity of bankfull channel (based on future development conditions)	70% of 2 year, 10.5 cfs
Minimum bankfull channel geometry[1]	
Design Channel Type	C4
Entrenchment Ratio	2.7-31.65 (x=5.26)
Width to depth ratio	13.5-75.0 (x=29.28)
Sinuosity	1.43-2.80 (x=1.92)
Slope	0.0001-0.0184 (x=0.0045)
D_{50}	12-14mm (~0.5 in)
d_{84}	32-48mm (~1.6in)
Meander Length[2]	34-92 (x=56)
Belt Width[2]	18-55 (x=32)
Radius of Curvature[2]	7-28 (x=11)
Minimum Floodplain Terrace	6 ft
Maximum overbank side slope	4(H):1(V)
Maximum bankfull side slope	2.5(H):1(V)
Maximum bankfull side slope	2.5(H):1(V)
Minimum bottom width[3]	3.8 ft
Freeboard	1.5 ft

[1] These values were derived from empirical data and will be used as guidelines for design and will be used in conjunction with hydraulic regime equations as outlined in "Spreadsheet Tools for River Evaluation, Assessment, and Monitoring: The STREAM Diagnostic Modules"
[2] These values are derived from "Spreadsheet Tools for River Evaluation, Assessment, and Monitoring: The STREAM Diagnostic Modules"
[3] Minimum bottom width shown is for the low flow channel only. The main channel will be ~41 ft wide

The 2-year frequency was selected for the design of the bankfull channel to approximate the flow most likely to govern a stable geometry. Prior reports estimated future 2-year flow as ~15-cfs and assumes no culvert effects; i.e., open channel flow un-affected by a culvert. The assumption of using approximately 70% of the future 2-year flow (10.5 cfs) was used to size the low flow channel. This resulted in a channel with a minimum bottom width of 3.8 feet, 0.6 feet deep with 2.5:1 side slopes for a bankfull width of 6.8' assuming a mean channel longitudinal slope of 0.9%. Equations as shown in the spreadsheet should produce low shear values within the channel section however further analysis using HEC-RAS was completed to determine the final geometry of said channel. The effective discharge channel is highly correlated to the "bankfull" channel (Leopold 1994) As several channel geometrics are derived from bankfull channel width, depth, cross sectional area and sinuosity, and that USDCM and the OSP report design criteria parameters relate to bankfull width, we have chosen bankfull width to serve as the foundation of design.

To determine an appropriate bankfull width, Leopold's generalized width estimate was first calculated (1994, as presented in USDCM Vol 1):

$W = aQ^{0.5}$

Where:

w = bankfull width of channel (top width when conveying bankfull discharge)

Q = bankfull discharge (10.5 cfs)

a = 2.7 (wide bankfull channel)
2.1 (average bankfull channel width)
1.5 (narrow bankfull channel)

Assuming an average bankfull width, the equation would estimate a 6.8-ft bankfull width. It is important to note that the Leopold equation lumps all channel types of varying width-to-depth rations. To perform a check on this estimation, worksheet alternative iterations of channel width from 4-12 feet were performed to find the depth associated with 70% of the 2-year flow. Chanel slope was set to 0.09 to best fit the average valley slope, side slopes were assumed to be 2.5:1 and manning's "n" was assumed to be 0.035. The resulting channel depth was divided into each iteration's width to identify the iteration with a width-to-depth ratio most closely associated with a Type-C channel. Given the valley type of the proposed project (Unconfined Alluvial Valley), we can expect Type-C and Type-E channels to represent stable channel geomorphologies. Given the setting and valley slope, we have chosen a Type-C (riffle-pool morphology) channel. Type-C channels typical have width-to-depth ratios >12, with gravel and sand bottomed systems averaging 29 and 27, respectively (13.5-28.7 for 60% of gravel bed streams 12.6-29.2 for 50% of sand bed streams; Rosgen 1996). Given these ranges, the channel alternative with a OPC 2-yr flow-dependent channel depth that, when divided into its corresponding width, yielded a W/D between 10.7 – 36.7.

The resulting channel, then, has the following general dimensions:

- Bottom width = 3.8-ft
- Top Width = 6.8-ft
- Average $Depth_{Riffle}$ = 0.6-ft
- Width:Depth (W/D) Ratio = 11.3
- Cross Sectional Area = 3.18-ft^2

The resulting channel dimensions listed above were then used to do the initial site grading of MST. The channel was then modeled in HEC- RAS and the geometry was further refined to reduce velocities, shear stresses, and the Froude number to fall within acceptable ranges.

By and large MS is to be left in its current state as analysis indicates it will remain in a stable state despite development. the existing stock pond is to be removed and that segment of the channel is to be graded to match the surrounding existing state.

Ultimate project hydraulics were evaluated through HEC-RAS 5.0.5. The following sections delve into the use and evaluation of the duplicate effective model and the development of the proposed conditions model.

a. Duplicate Effective Model

There is no existing effective model.

b. Existing Conditions Model

The existing conditions models were created to serve as a baseline for comparing future conditions to existing conditions. The existing conditions models were created by exporting cross sections from CAD along the existing channel alignments. Manning's roughness "n" values were selected to represent the existing conditions of the channel by following EPC's guidance in table 10-2. Existing flow rates were used from the 2004 LOMR completed by Matrix Engineering and are summarized in Table 1 and Table 2. Resulting water surface elevation for the 100-year event can be found in Appendix H.

c. Proposed Conditions Model

The proposed conditions model for MS was developed by copying the geometry for the existing channel and updating the cross sections surrounding the existing stock pond to account for its removal and regrading of that segment of the channel. Manning's roughness "n" values were selected to represent the proposed conditions of the project area and follow EPC's guidance in table 10-2. In the existing model, the steady flow rate data included two changes in flow rate at cross sections 25+92 and 15+57, which correspond to the same sections in the proposed condition model. While the location in which flows change remained the same there were slight changes in flow rates that are attributed to future detention along the channel, these flows are summarized in the preceding hydrology section in Table 2 and Table 3. The last three cross sections were used to confirm the water surface elevation remained within tolerance. Cross sections can be referenced in Appendix I.

The proposed conditions model for MST was developed to account for changes to the channel alignment, geometry, and the proposed culverts along the new channel alignment. The proposed conditions model was created by exporting sample lines along the new alignment that sampled the proposed grading. Manning's roughness "n" values were selected to represent the proposed conditions of the project area and follow EPC's guidance in table 10-2. In the existing model, the steady flow rate data included two changes in flow rate at cross sections 22+58.77 and 6+13.67, which roughly corresponded to cross sections 36+50 and 7+00 respectively in the proposed condition model. While the location in which flows change remained the same there were slight changes in flow rates that are attributed to future releases from water quality ponds along the channel, these flows are summarized in the preceding hydrology section in Table 2 and Table 4. Ineffective flow areas were added to cross sections within the project reach upstream and downstream of culverts to account for areas not actively conveying water due to turbulence. The last three cross sections along the modeled channel are identical to the last three cross sections in the existing conditions model and were used to confirm the water surface elevation remained within tolerance. Cross sections can be referenced in Appendix I.

Maintenance Considerations

Natural stream design approaches take into consideration short and long term maintenance needs by providing a high functioning low maintenance stream (HFLMS). By spreading more frequent storm events into the floodplain terrace, water is introduced into the uplands species of the riparian corridor to provide irrigation flows. Additionally using naturally armored rundown riffles and pools vs larger grade control structures maintenance is limited to mainly trash removal and noxious weed control. Additionally as outlined above the design takes into consideration various flow regimes in order to analyze proposed stream corridor stresses and apply low maintenance stabilization measures to help stabilize and control sediment degradation and aggradation within the channel.

Conclusion

After evaluating the impacts of the proposed channel improvements to the segment of MS and MST between Eastonville Road to the northwest (upstream) and the south-central project boundary (downstream) it is not anticipated that the BFE will change outside of the project. The reevaluation of the 1% chance of annual occurrence event limits has been delineated and has a footprint for MST that does not fall entirely within the boundary delineated in the FIRM effective 2018; this is largely due to the realignment of the channel and the overall footprint of the 1% chance of annual occurrence is significantly narrower than the previous delineation. BFEs at the location of tie in at the boundary of the site is not shown to rise more than 0.00’ in the modeling completed in this assessment. Cross sections for MS and MST can be found in Appendix H and Appendix I to compare the 100year water surface elevation for both the existing and proposed conditions.

Appendix A
MT-2 Forms

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

OVERVIEW & CONCURRENCE FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless it displays a valid OMB control number. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a (NFIP) Flood Insurance Rate Maps (FIRM).

A. REQUESTED RESPONSE FROM DHS-FEMA

This request is for a (check one):

☐ CLOMR: A letter from DHS-FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60, 65 & 72).

☐ LOMR: A letter from DHS-FEMA officially revising the current NFIP map to show the changes to floodplains, regulatory floodway or flood elevations. (See 44 CFR Ch. 1, Parts 60, 65 & 72)

B. OVERVIEW

1. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Example: 480301 480287	City of Katy Harris County	TX TX	48473C 48201C	0005D 0220G	02/08/83 09/28/90
080059	EL PASO COUNTY	CO	08041C0552G	0552G	12/7/2018
080059	EL PASO COUNTY	CO	08041C0556G	0556G	12/7/2018

2. a. Flooding Source: Geick Ranch Tributary 2

   b. Types of Flooding: ■ Riverine ☐ Coastal ☐ Shallow Flooding (e.g., Zones AO and AH)
   ☐ Alluvial fan ☐ Lakes ☐ Other (Attach Description)

3. Project Name/Identifier: GRANDVIEW RESERVE CHANNEL B IMPROVEMENTS (CHANNEL B IS THE SAME AS GIECK RANCH TRIBUTARY 2)

4. FEMA zone designations affected: A (choices: A, AH, AO, A1-A30, A99, AE, AR, V, V1-V30, VE, B, C, D, X)

5. Basis for Request and Type of Revision:

   a. The basis for this revision request is (check all that apply)

   ■ Physical Change ■ Improved Methodology/Data ■ Regulatory Floodway Revision ☐ Base Map Changes
   ☐ Coastal Analysis ■ Hydraulic Analysis ☐ Hydrologic Analysis ☐ Corrections
   ☐ Weir-Dam Changes ☐ Levee Certification ☐ Alluvial Fan Analysis ☐ Natural Changes
   ■ New Topographic Data ☐ Other (Attach Description)

   Note: A photograph and narrative description of the area of concern is not required, but is very helpful during review.

b. The area of revision encompasses the following structures (check all that apply)

Structures: ☐ Channelization ☐ Levee/Floodwall ■ Bridge/Culvert

☐ Dam ☐ Fill ☐ Other (Attach Description)

6. ☐ Documentation of ESA compliance is submitted (required to initiate CLOMR review). Please refer to the instructions for more information.

C. REVIEW FEE

Has the review fee for the appropriate request category been included? ☐ Yes Fee amount: $_____

☐ No, Attach Explanation

Please see the DHS-FEMA Web site at http://www.fema.gov/plan/prevent/fhm/frm_fees.shtm **for Fee Amounts and Exemptions.**

D. SIGNATURE

All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: CHRIS MCFARLAND	Company: HR GREEN	
Mailing Address: 5619 DTC PARKWAY SUITE 1150 GREENWOOD VILLAGE, CO 80111	Daytime Telephone No.: 720-602-4956	Fax No.:
	E-Mail Address: cmcfarland@hrgreen.com	
Signature of Requester (required):	Date:	

As the community official responsible for floodplain management, I hereby acknowledge that we have received and reviewed this Letter of Map Revision (LOMR) or conditional LOMR request. Based upon the community's review, we find the completed or proposed project meets or is designed to meet all of the community floodplain management requirements, including the requirements for when fill is placed in the regulatory floodway, and that all necessary Federal, State, and local permits have been, or in the case of a conditional LOMR, will be obtained. For Conditional LOMR requests, the applicant has documented Endangered Species Act (ESA) compliance to FEMA prior to FEMA's review of the Conditional LOMR application. For LOMR requests, I acknowledge that compliance with Sections 9 and 10 of the ESA has been achieved independently of FEMA's process. For actions authorized, funded, or being carried out by Federal or State agencies, documentation from the agency showing its compliance with Section 7(a)(2) of the ESA will be submitted. In addition, we have determined that the land and any existing or proposed structures to be removed from the SFHA are or will be reasonably safe from flooding as defined in 44CFR 65.2(c), and that we have available upon request by FEMA, all analyses and documentation used to make this determination.

Community Official's Name and Title: Jeff Rice	Community Name: El Paso County	
Mailing Address: 2880 International Circle, Suite 110 Colorado Springs, CO 80910	Daytime Telephone No.:	Fax No.:
	E-Mail Address: JeffRice@elpasoco.com	
Community Official's Signature (required):	Date:	

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is to be signed and sealed by a licensed land surveyor, registered professional engineer, or architect authorized by law to certify elevation information data, hydrologic and hydraulic analysis, and any other supporting information as per NFIP regulations paragraph 65.2(b) and as described in the MT-2 Forms Instructions. All documents submitted in support of this request are correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Certifier's Name: CHRIS MCFARLAND	License No.: 44947	Expiration Date: 10-31-2021
Company Name: HR GREEN	Telephone No.: 720-602-4956	Fax No.:
Signature:	Date:	E-Mail Address: cmcfarland@hrgreen.com

Ensure the forms that are appropriate to your revision request are included in your submittal.

Form Name and (Number)	**Required if …**
■ Riverine Hydrology and Hydraulics Form (Form 2)	New or revised discharges or water-surface elevations
■ Riverine Structures Form (Form 3)	Channel is modified, addition/revision of bridge/culverts, addition/revision of levee/floodwall, addition/revision of dam
☐ Coastal Analysis Form (Form 4)	New or revised coastal elevations
☐ Coastal Structures Form (Form 5)	Addition/revision of coastal structure
☐ Alluvial Fan Flooding Form (Form 6)	Flood control measures on alluvial fans

Seal (Optional)

U.S. DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY

RIVERINE HYDROLOGY & HYDRAULICS FORM

O.M.B No. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 3.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington VA 20958-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

AUTHORITY: The National Flood Insurance Act of 1968, Public Law 90-448, as amended by the Flood Disaster Protection Act of 1973, Public Law 93-234.

PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program (NFIP); Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Geick Ranch Tributary 2

Note: Fill out one form for each flooding source studied

A. HYDROLOGY

1. Reason for New Hydrologic Analysis (check all that apply)

- [x] Not revised (skip to section B)
- [ ] No existing analysis
- [ ] Improved data
- [ ] Alternative methodology
- [ ] Proposed Conditions (CLOMR)
- [ ] Changed physical condition of watershed

2. Comparison of Representative 1%-Annual-Chance Discharges

Location	Drainage Area (Sq. Mi.)	Effective/FIS (cfs)	Revised (cfs)

3. Methodology for New Hydrologic Analysis (check all that apply)

- [ ] Statistical Analysis of Gage Records
- [ ] Precipitation/Runoff Model → Specify Model: ________________________
- [ ] Regional Regression Equations
- [ ] Other (please attach description)

Please enclose all relevant models in digital format, maps, computations (including computation of parameters), and documentation to support the new analysis.

4. Review/Approval of Analysis

If your community requires a regional, state, or federal agency to review the hydrologic analysis, please attach evidence of approval/review.

5. Impacts of Sediment Transport on Hydrology

Is the hydrology for the revised flooding source(s) affected by sediment transport? ☐ Yes ☐ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation..

B. HYDRAULICS

1. Reach to be Revised

	Description	Cross Section	Water-Surface Elevations (ft.) Effective	Proposed/Revised
Downstream Limit*				
Upstream Limit*				

*Proposed/Revised elevations must tie-into the Effective elevations within 0.5 foot at the downstream and upstream limits of revision.

2. Hydraulic Method/Model Used: ______

3. Pre-Submittal Review of Hydraulic Models*

DHS-FEMA has developed two review programs, CHECK-2 and CHECK-RAS, to aid in the review of HEC-2 and HEC-RAS hydraulic models, respectively. We recommend that you review your HEC-2 and HEC-RAS models with CHECK-2 and CHECK-RAS.

4.

Models Submitted	Natural Run		Floodway Run		Datum
Duplicate Effective Model*	File Name:	Plan Name: N/A	File Name:	Plan Name:	
Corrected Effective Model*	File Name:	Plan Name:	File Name:	Plan Name:	
Existing or Pre-Project Conditions Model	File Name: Drainage_B.prj	Plan Name: Existing	File Name:	Plan Name:	
Revised or Post-Project Conditions Model	File Name: Drainage_B_Proposed.prj	Plan Name: PR_Geom&Flows	File Name:	Plan Name:	
Other - (attach description)	File Name:	Plan Name: N/A	File Name:	Plan Name:	

* For details, refer to the corresponding section of the instructions.

☐ Digital Models Submitted? (Required)

C. MAPPING REQUIREMENTS

A **certified topographic work map** must be submitted showing the following information (where applicable): the boundaries of the effective, existing, and proposed conditions 1%-annual-chance floodplain (for approximate Zone A revisions) or the boundaries of the 1%- and 0.2%-annual-chance floodplains and regulatory floodway (for detailed Zone AE, AO, and AH revisions); location and alignment of all cross sections with stationing control indicated; stream, road, and other alignments (e.g., dams, levees, etc.); current community easements and boundaries; boundaries of the requester's property; certification of a registered professional engineer registered in the subject State; location and description of reference marks; and the referenced vertical datum (NGVD, NAVD, etc.).

☐ Digital Mapping (GIS/CADD) Data Submitted (preferred)

Topographic Information: ______

Source: ______ Date: ______

Accuracy: ______

Note that the boundaries of the existing or proposed conditions floodplains and regulatory floodway to be shown on the revised FIRM and/or FBFM must tie-in with the effective floodplain and regulatory floodway boundaries. Please attach **a copy of the effective FIRM and/or FBFM**, at the same scale as the original, annotated to show the boundaries of the revised 1%-and 0.2%-annual-chance floodplains and regulatory floodway that tie-in with the boundaries of the effective 1%-and 0.2%-annual-chance floodplain and regulatory floodway at the upstream and downstream limits of the area on revision.

☐ Annotated FIRM and/or FBFM (Required)

D. COMMON REGULATORY REQUIREMENTS*

1. For LOMR/CLOMR requests, do Base Flood Elevations (BFEs) increase? ☐ Yes ☐ No

   a. For CLOMR requests, if either of the following is true, please submit **evidence of compliance with Section 65.12 of the NFIP regulations**:

   - The proposed project encroaches upon a regulatory floodway and would result in increases above 0.00 foot compared to pre-project conditions.
   - The proposed project encroaches upon a SFHA with or without BFEs established and would result in increases above 1.00 foot compared to pre-project conditions.

   b. Does this LOMR request cause increase in the BFE and/or SFHA compared with the effective BFEs and/or SFHA? ☐ Yes ☐ No

   If Yes, please attach **proof of property owner notification and acceptance (if available)**. Elements of and examples of property owner notifications can be found in the MT-2 Form 2 Instructions.

2. Does the request involve the placement or proposed placement of fill? ☐ Yes ☐ No

   If Yes, the community must be able to certify that the area to be removed from the special flood hazard area, to include any structures or proposed structures, meets all of the standards of the local floodplain ordinances, and is reasonably safe from flooding in accordance with the NFIP regulations set forth at 44 CFR 60.3(A)(3), 65.5(a)(4), and 65.6(a)(14). Please see the MT-2 instructions for more information.

3. For LOMR requests, is the regulatory floodway being revised? ☐ Yes ☐ No

   If Yes, attach **evidence of regulatory floodway revision notification**. As per Paragraph 65.7(b)(1) of the NFIP Regulations, notification is required for requests involving revisions to the regulatory floodway. (Not required for revisions to approximate 1%-annual-chance floodplains [studied Zone A designation] unless a regulatory floodway is being established. Elements and examples of regulatory floodway revision notification can be found in the MT-2 Form 2 Instructions.)

4. For CLOMR requests, please submit documentation to FEMA and the community to show that you have complied with Sections 9 and 10 of the Endangered Species Act (ESA).

For actions authorized, funded, or being carried out by Federal or State agencies, please submit documentation from the agency showing its compliance with Section 7(a)(2) of the ESA. Please see the MT-2 instructions for more detail.

* Not inclusive of all applicable regulatory requirements. For details, see 44 CFR parts 60 and 65.

DEPARTMENT OF HOMELAND SECURITY
FEDERAL EMERGENCY MANAGEMENT AGENCY
RIVERINE STRUCTURES FORM

O.M.B. NO. 1660-0016
Expires February 28, 2014

PAPERWORK BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 7 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing, reviewing, and submitting the form. You are not required to respond to this collection of information unless a valid OMB control number appears in the upper right corner of this form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Department of Homeland Security, Federal Emergency Management Agency, 1800 South Bell Street, Arlington, VA 20598-3005, Paperwork Reduction Project (1660-0016). Submission of the form is required to obtain or retain benefits under the National Flood Insurance Program. **Please do not send your completed survey to the above address.**

PRIVACY ACT STATEMENT

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PRINCIPAL PURPOSE(S): This information is being collected for the purpose of determining an applicant's eligibility to request changes to National Flood Insurance Program (NFIP) Flood Insurance Rate Maps (FIRM).

ROUTINE USE(S): The information on this form may be disclosed as generally permitted under 5 U.S.C § 552a(b) of the Privacy Act of 1974, as amended. This includes using this information as necessary and authorized by the routine uses published in DHS/FEMA/NFIP/LOMA-1 National Flood Insurance Program; Letter of Map Amendment (LOMA) February 15, 2006, 71 FR 7990.

DISCLOSURE: The disclosure of information on this form is voluntary; however, failure to provide the information requested may delay or prevent FEMA from processing a determination regarding a requested change to a NFIP Flood Insurance Rate Maps (FIRM).

Flooding Source: Geick Ranch Tributary 2

Note**:** Fill out one form for each flooding source studied.

A. GENERAL

Complete the appropriate section(s) for each Structure listed below:
Channelization...............complete Section B
Bridge/Culvert................complete Section C
Dam...............................complete Section D
Levee/Floodwall.............complete Section E
Sediment Transport........complete Section F (if required)

Description Of Modeled Structure

1. Name of Structure: Tributary 2

Type (check one): ☒ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

2. Name of Structure: XX" DIA Culvert at DS end of project

Type (check one): ☐ Channelization ☒ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

3. Name of Structure: _____

Type (check one) ☐ Channelization ☐ Bridge/Culvert ☐ Levee/Floodwall ☐ Dam

Location of Structure: _____

Downstream Limit/Cross Section: _____

Upstream Limit/Cross Section: _____

NOTE: FOR MORE STRUCTURES, ATTACH ADDITIONAL PAGES AS NEEDED.

B. CHANNELIZATION

Flooding Source: Geick Ranch Tributary 2

Name of Structure: Tributary 2

1. Hydraulic Considerations

The channel was designed to carry _____ (cfs) and/or the 100 -year flood.

The design elevation in the channel is based on (check one):

☐ Subcritical flow ☐ Critical flow ☐ Supercritical flow ☐ Energy grade line

If there is the potential for a hydraulic jump at the following locations, check all that apply and attach an explanation of how the hydraulic jump is controlled without affecting the stability of the channel.

☐ Inlet to channel ☐ Outlet of channel ☐ At Drop Structures ☐ At Transitions

☐ Other locations (specify): _____

2. Channel Design Plans

Attach the plans of the channelization certified by a registered professional engineer, as described in the instructions.

3. Accessory Structures

The channelization includes (check one):

☐ Levees [Attach Section E (Levee/Floodwall)] ☐ Drop structures ☐ Superelevated sections

☐ Transitions in cross sectional geometry ☐ Debris basin/detention basin [Attach Section D (Dam/Basin)] ☐ Energy dissipator

☐ Weir ☐ Other (Describe):

4. Sediment Transport Considerations

Are the hydraulics of the channel affected by sediment transport? ☐ Yes ■ No

If yes, then fill out Section F (Sediment Transport) of Form 3. If No, then attach your explanation for why sediment transport was not considered. THE CHANNEL WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

C. BRIDGE/CULVERT

Flooding Source: Geick Ranch Tributary 2

Name of Structure: XX" DIA Culvert at DS end of project

1. This revision reflects (check one):

   ■ Bridge/culvert not modeled in the FIS There is no existing FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

   ☐ Revised analysis of bridge/culvert previously modeled in the FIS

2. Hydraulic model used to analyze the structure (e.g., HEC-2 with special bridge routine, WSPRO, HY8): HEC-RAS
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structures. Attach justification.

3. Attach plans of the structures certified by a registered professional engineer. The plan detail and information should include the following (check the information that has been provided):

   ☐ Dimensions (height, width, span, radius, length)

   ☐ Shape (culverts only)

   ☐ Material

   ☐ Beveling or Rounding

   ☐ Wing Wall Angle

   ☐ Skew Angle

   ☐ Distances Between Cross Sections

   ☐ Erosion Protection

   ☐ Low Chord Elevations – Upstream and Downstream

   ☐ Top of Road Elevations – Upstream and Downstream

   ☐ Structure Invert Elevations – Upstream and Downstream

   ☐ Stream Invert Elevations – Upstream and Downstream

   ☐ Cross-Section Locations

4. Sediment Transport Considerations

   Are the hydraulics of the structure affected by sediment transport? ☐ Yes ■ No

   If Yes, then fill out Section F (Sediment Transport) of Form 3. If no, then attach an explanation.

THE CULVERT WAS DESIGNED TO INCLUDE ARMORING AS NEEDED TO PREVENT ADVERSE SEDIMENT TRANSPORT/ SCOURING.

FEDERAL EMERGENCY MANAGEMENT AGENCY
PAYMENT INFORMATION FORM

Community Name:

Project Identifier:

THIS FORM MUST BE MAILED, ALONG WITH THE APPROPRIATE FEE, TO THE ADDRESS BELOW OR FAXED TO THE FAX NUMBER BELOW.

Please make check or money order payable to the National Flood Insurance Program.

Type of Request:

☐ MT-1 application
☐ MT-2 application

LOMC Clearinghouse
3601 Eisenhower Ave. Suite 500
Alexandria, VA 22304-6426
Attn.: LOMC Manager

☐ EDR application

FEMA Project Library
3601 Eisenhower Ave. Suite 500
Alexandria, VA 22304-6426
FAX (703) 960-9125

Request No. (if known): ____________________ **Check No.:** ____________________ **Amount:** _____

☐ INITIAL FEE* ☐ FINAL FEE ☐ FEE BALANCE** ☐ MASTER CARD ☐ VISA ☐ CHECK ☐ MONEY ORDER

*Note: Check only for EDR and/or Alluvial Fan requests (as appropriate).

****Note: Check only if submitting a corrected fee for an ongoing request.**

COMPLETE THIS SECTION *ONLY* IF PAYING BY CREDIT CARD

CARD NUMBER EXP. DATE

☐☐☐☐ – ☐☐☐☐ – ☐☐☐☐ – ☐☐☐☐ ☐☐ – ☐☐

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Month Year

____________ ____

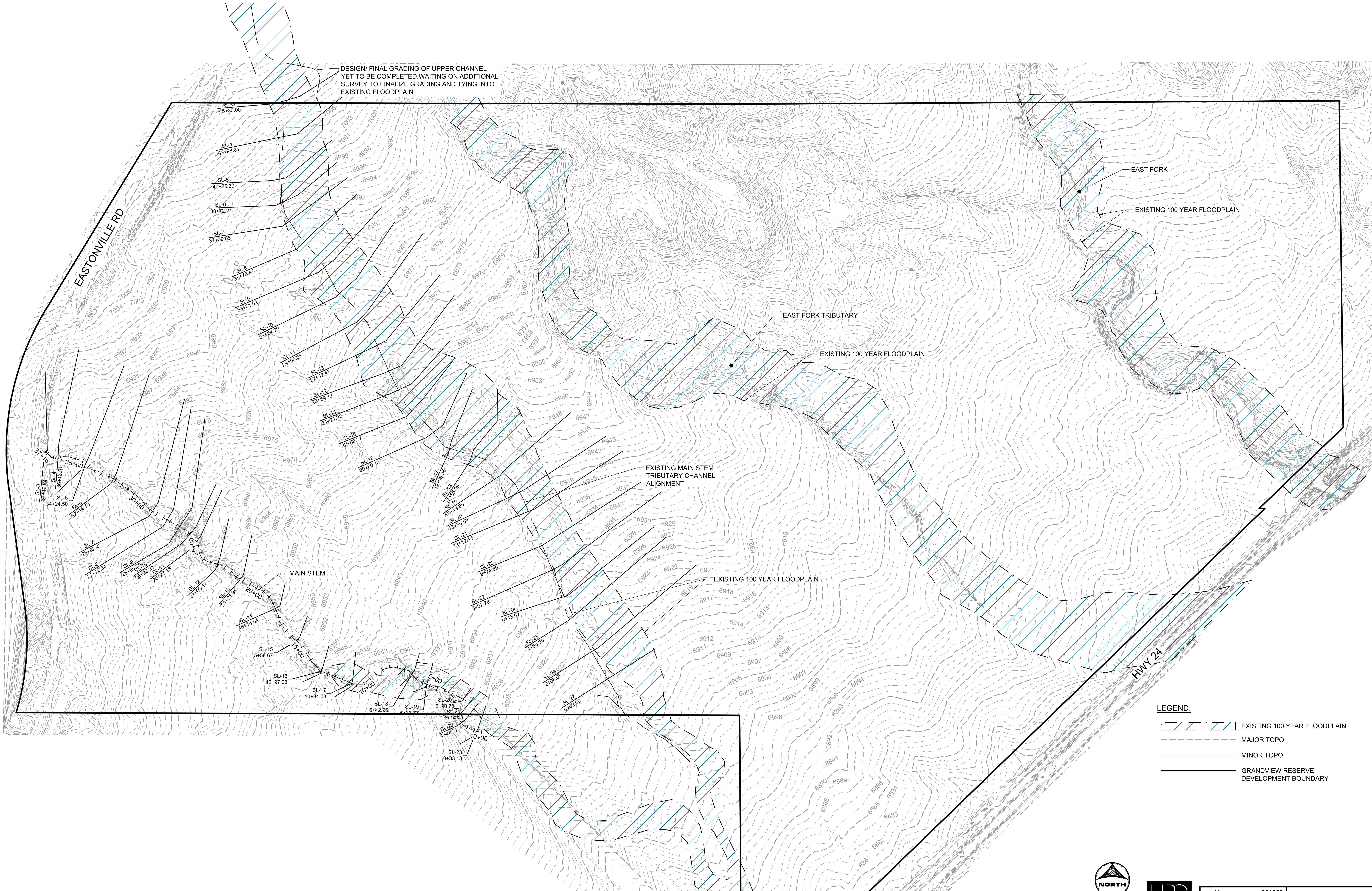
Date Signature

NAME *(AS IT APPEARS ON CARD)*: ______________________
(please print or type)

ADDRESS: ____________________________________
(*for your credit card receipt-please print or type*) ____________________________________

DAYTIME PHONE: ____________________________

Appendix B
Certified Topo



HRGreen

Job No.:	201662
Prepared By:	SJF
Date:	9/24/2021

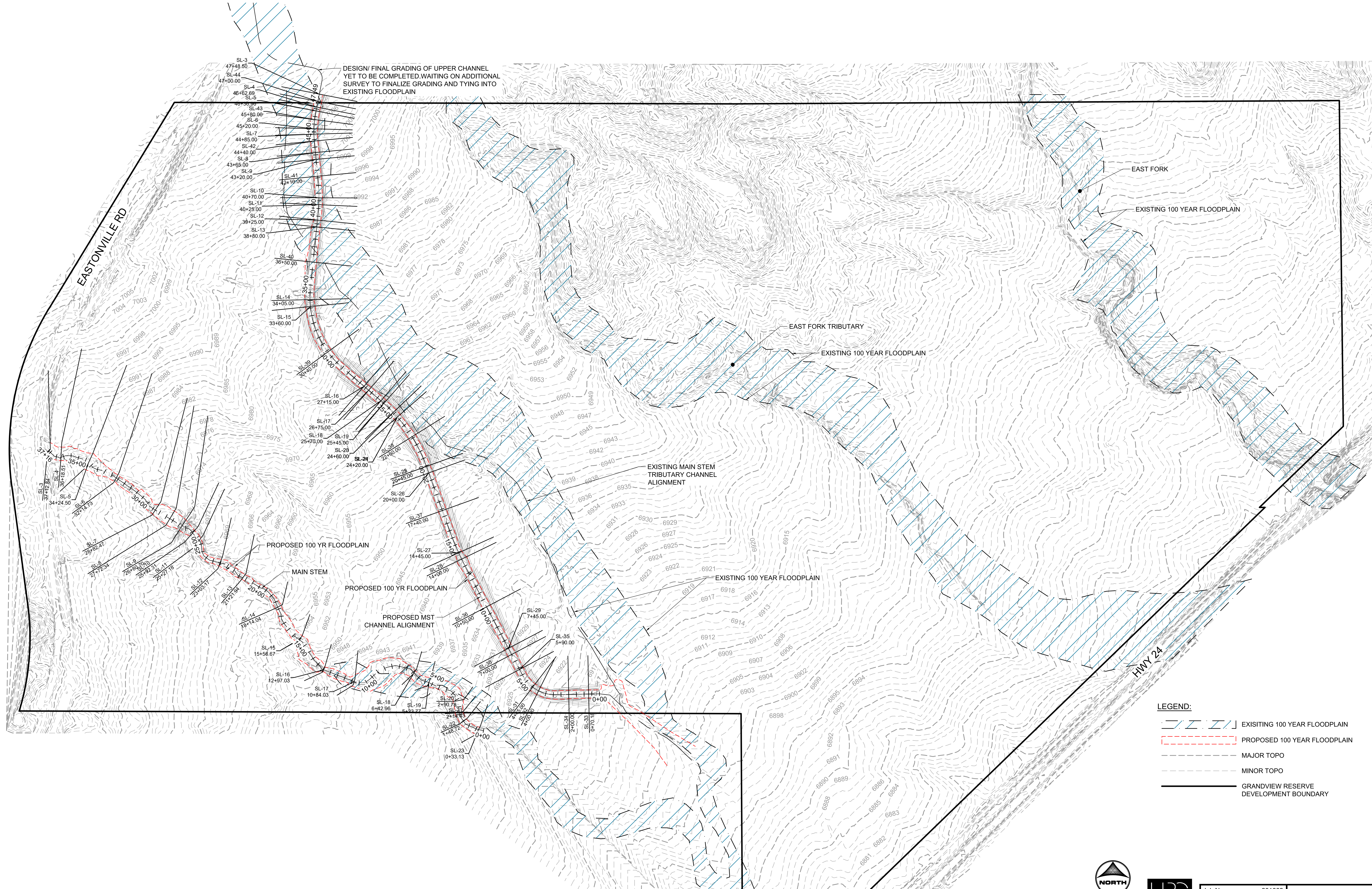
EXISTING FLOODPLAIN EXHIBIT

FIG.1

HRGreen DRAWING PATH:J:\2020\201662.03\CAD\Dwgs_Exhibits\MT-2_Form_2_Part_C_TOPO_existing.dwg

IGEL, TREVOR, 9/24/2021 12:34 PM

IGEL, TREVOR, 9/24/2021 12:32 PM



LEGEND:

- EXISITING 100 YEAR FLOODPLAIN
- PROPOSED 100 YEAR FLOODPLAIN
- MAJOR TOPO
- MINOR TOPO
- GRANDVIEW RESERVE DEVELOPMENT BOUNDARY

HRGreen

Job No.:	201662	FLOODPLAIN EXHIBIT
Prepared By:	SJF	
Date:	9/24/2021	

FIG.2

HRGreen DRAWING PATH:J:\2020\201662.03\CAD\Dwgs_Exhibits\MT-2_Form_2_Part_C_TOPO.dwg

Appendix C
Annotated Firm

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.

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

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El Paso County Vertical Datum Offset Table

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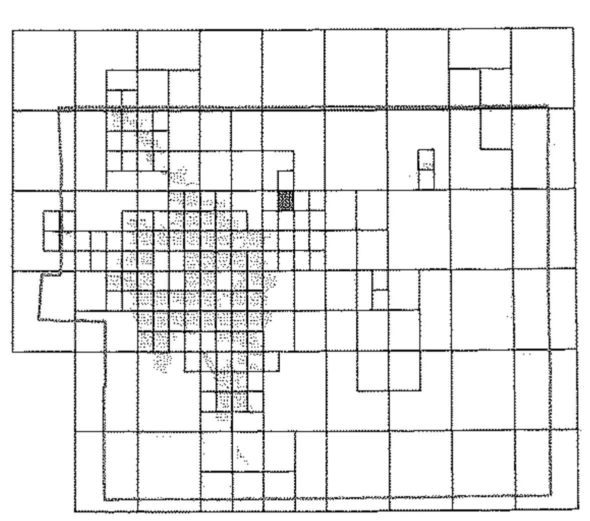
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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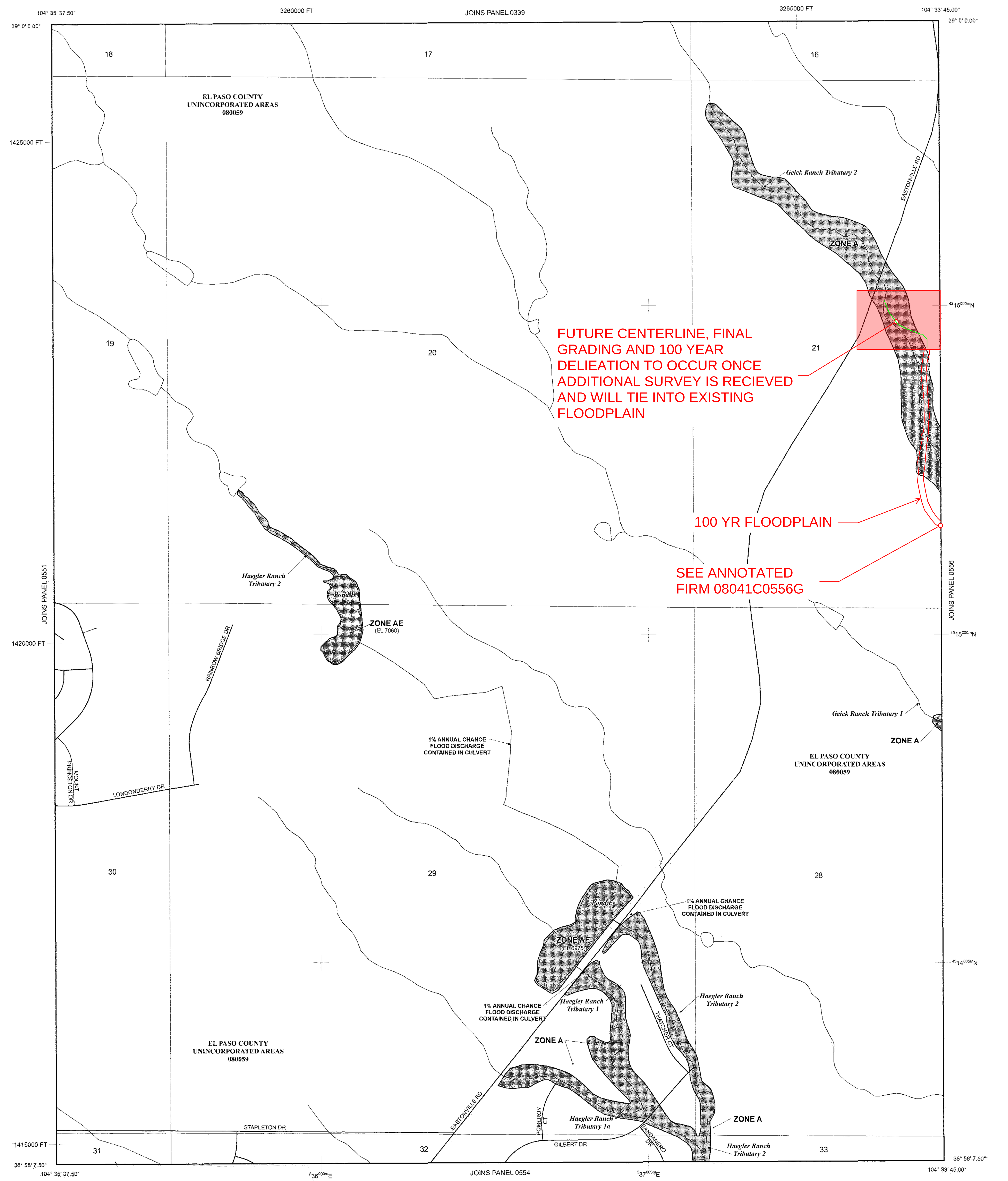
Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST.

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.
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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.
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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
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- 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*

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- (A)—(A) Cross section line
- (23)- - - -(23) Transect line
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- DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
- • M1.5 River Mile

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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.

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0552G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 552 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0552	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
08041C0552G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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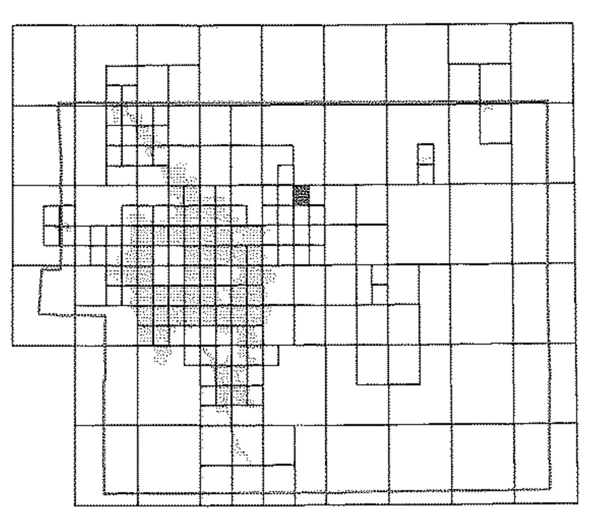

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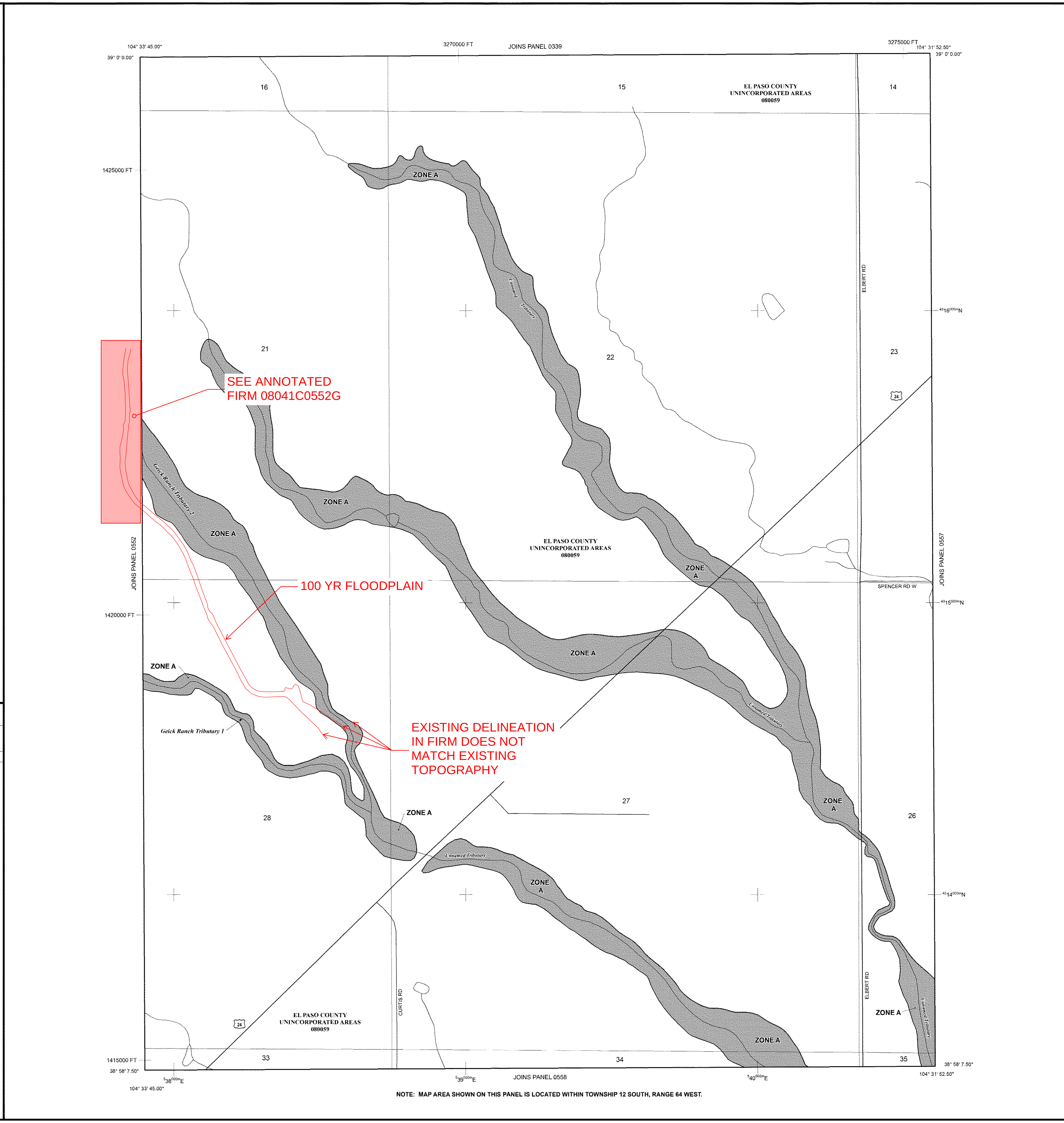

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250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0556G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 556 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0556	G

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MAP NUMBER
08041C0556G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Appendix D
Proposed Plans

Appendix E
Floodway Notice

HRGreen
5619 DTC Parkway | Suite 1150 | Greenwood Village, CO 80111
Main 720.602.4999 + **Fax** 844.273.1057
HRGREEN.COM

September 2021

Property owner

Property owner address

Re: Notification of increases in 1-percent-annual-chance water-surface elevations and/or future flood hazard revisions

The Flood Insurance Rate Map (FIRM) for a community depicts the Special Flood Hazard Area (SFHA), the area that has been determined to be subject to a 1-percent or greater chance of flooding in any given year. The floodway is the portion of the floodplain that includes the channel of a river or other watercourse and the adjacent land area that must be reserved in order to discharge the 1-percent-annual-chance (base) flood without cumulatively increasing the water-surface elevation by more than a designated height. The FIRM is used to determine flood insurance rates and to help the community with floodplain management.

{Revision Requester} is applying for a Conditional Letter of Map Revision (CLOMR) from the Federal Emergency Management Agency (FEMA) on behalf of {Revision requester's client} to revise FIRMs 08041C0552G and 08041C0556G for El Paso County along Gieck Ranch Tributary 2. {Revision requester' client} is proposing to realign and create a creek corridor as part of the Grandview Reserve Development.

Once the project has been completed, a Letter of Map Revision (LOMR) request should be submitted that will, in part, revise the following flood hazards along Gieck Ranch Tributary 2.

The floodway will be revised from the south-central project boundary to Eastonville Road near the northwest corner of GVR along Gieck Ranch Tributary 2.

This letter is to inform you of the proposed project that may affect flood elevations on your property at {insert physical address}. This letter is also to inform you of the potential changes to the effective flood hazard information that would result after the project is completed and a LOMR request is submitted to FEMA.

Maps and detailed analysis of the floodway revision can be reviewed at the {location TBD} at {location address TBD}. If you have any questions or concerns about the proposed project or its affect on your property, you may contact {name of appropriate community official} of {name of community} at {community official contact information} from {date TBD} to {date TBD} or {name of appropriate community official} with Mile High Flood District at {community official contact information} from {date TBD} to {date TBD}.

HR GREEN, INC

Chris McFarland, PE
Lead Engineer

Appendix F
Endangered Species Act Compliance

Natural Features and Wetland Report for the Grandview Reserve Project in El Paso County, Colorado

April 10, 2020

Prepared for:

4 Site Investments
1271 Kelly Johnson Blvd., Ste. 100
Colorado Springs, CO 80920

Prepared by:

ecos ecosystem services LLC

1455 Washburn Street
Erie, Colorado 80516
(p): 970-812-3267

Project Number: 2018-15-1

TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF APPENDICES

LIST OF ACROYNMS AND ABBREVIATIONS

AMSL	above mean sea level
Applicant	4 Site Investments
CCRs	Codes, Covenants and Restrictions
CDA	Colorado Department of Agriculture
CNHP	Colorado Natural Heritage Program
COGCC	Colorado Oil and Gas Conservation Commission
CPW	Colorado Parks and Wildlife
CWA	Clean Water Act
Ecos or ecos	Ecosystem Services, LLC
JD	Jurisdictional under the Clean Water Act
Non-JD	Non- jurisdictional under the Clean Water Act
PMJM	Preble's meadow jumping mouse
Report	Natural Features and Wetland Report
Site	Grandview Reserve
NRCS	Natural Resource Conservation Service
NTCHS	National Technical Committee for Hydric Soils
NWI	National Wetland Inventory
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WOUS	Waters of the United States

1.0 INTRODUCTION

Ecosystem Services, LLC (Ecos or ecos) was retained by 4 Site Investments (Applicant) to perform a natural resource assessment for the proposed Grandview Reserve project (Project) and to prepare this Natural Features and Wetland Report (Report).

The contact information for the Applicant and ecos representatives for this Report is provided below:

Applicant

Peter Martz
4 Site Investments
1271 Kelly Johnson Blvd., Ste. 100
Colorado Springs, Colorado 80920
Phone: 719-492-1993
pmartzlrg@comcast.net

Agent

Grant E. Gurnée, P.W.S.
Ecosystem Services, LLC
1455 Washburn Street
Erie, Colorado 80516
Phone: (970) 812-6167
grant@ecologicalbenefits.com

1.1 Purpose

The purpose of this Report is to identify and document the natural resources, ecological characteristics and existing conditions of the Project site (Site); identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources. The specific resources and issues of concern addressed in this Report are in conformance with the El Paso County requirements (refer to Section 2.0), and include:

- Mineral and Natural Resource Extraction;
- Vegetation;
- Wetland Habitat and Waters of the U.S.
- Weeds;
- Wildfire Hazard;
- Wildlife;
- Federal and State Listed, Candidate, Threatened and Endangered Species; and
- Raptors and Migratory Birds.

1.2 Site Location and Project Description

The Site is located in the Falcon/Peyton area of El Paso County and is bounded along the north by 4 Way Ranch Phase I, along the south by Waterbury, along the southeast by Highway 24, and along the west by Eastonville Road. There are no existing structures, roads, or other infrastructure on the Site. The Site is located approximately 4.14 miles southwest of Peyton, 4.16 miles northeast of Falcon and 4.66 miles south of Eastonville, in El Paso County, Colorado. The Site is generally located within the south ½ of Section 21, south ½ of Section 22, the north ½ of Section 27, and the north ½ of Section 28, Township 12 South, Range 64 West in El Paso County, Colorado. The center of the Site is situated at approximately Latitude 38.98541389 north, -104.55472222 east (refer to Figure 1).

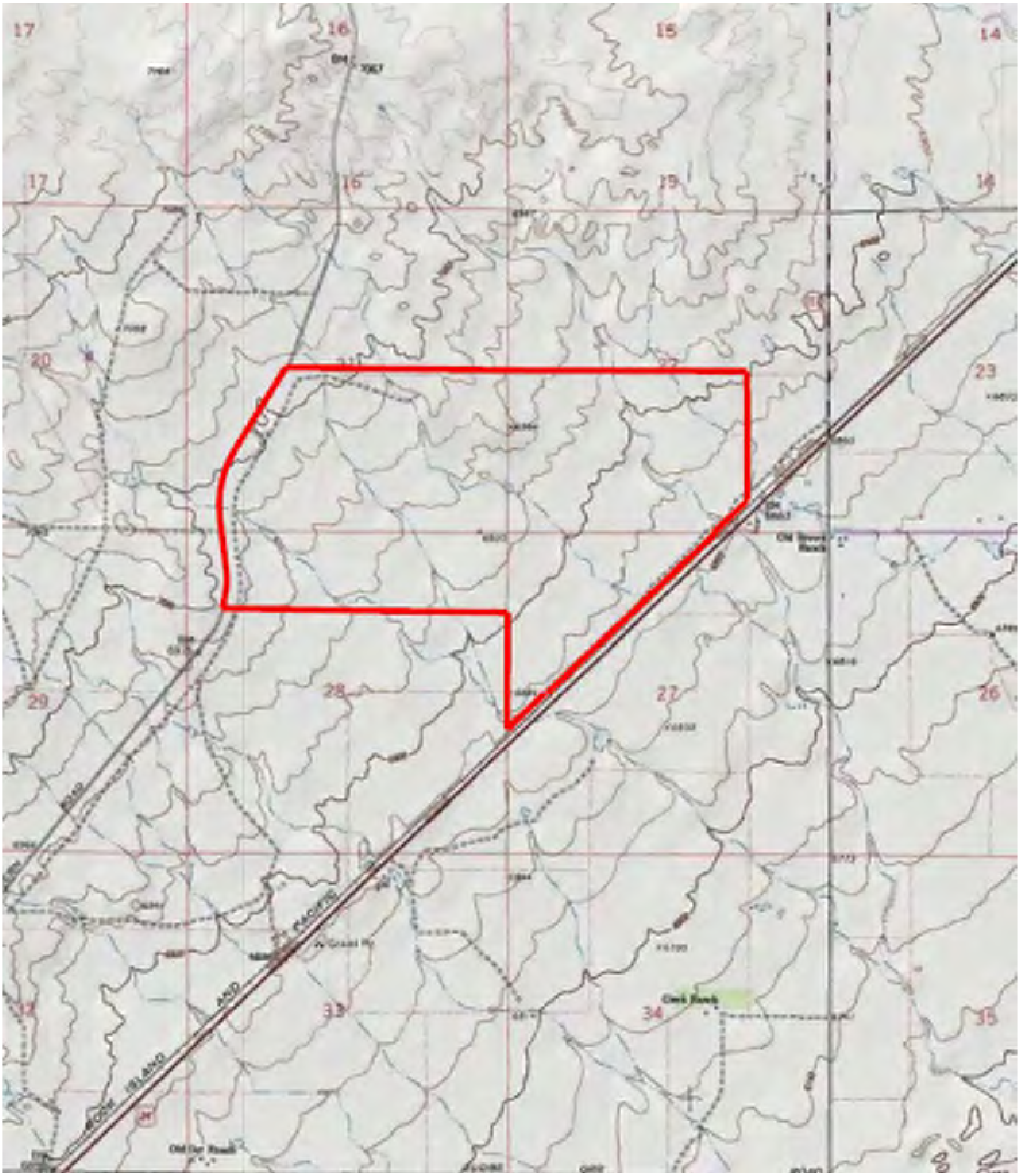
The Applicant proposes to develop the 768.2-acre Site as a mixed use residential and commercial community with the total number of units ranging from 2,496 to 3,261 as summarized below:

Table 1 – Land Use Summary

Land Use Category	Acreage	Acreage %	Density Units/Acre		Units	
			Min.	Max.	Min.	Max.
Institutions	16.9 acres	2.2%	NA	NA	NA	NA
Low Density Residential	136.4 acres	17.8%	1	2	136	272
Medium Density Residential	258.4 acres	33.6%	3	4	775	1033
Medium-High Density Residential	68.6 acres	8.9%	6	8	411	548
High Density Residential	117.4 acres	15.3%	10	12	1174	1408
Commercial	17.0 acres	2.2%	NA	NA	NA	NA
Open Space[1]	132.5 acres	17.2%	NA	NA	NA	NA
Rex Rd. & Collector	21.0 acres	2.7%	NA	NA	NA	NA
TOTAL	**768.2 acres**	**100%**	**NA**	**NA**	**NA**	**NA**

Note 1: Open Space includes: Detention Ponds, Drainage Corridors, General Open Space & Easements and R.O.W. Buffers of Eastonville Road and Highway 24

Please refer to Figure 2.



USGS 7.5 min. Quad: Falcon
Latitude: 38.985713°N
Longitude: -104.552854°W
Section 21, 22, 27 & 28, Township 12 South, Range 64 West

Figure 1 USGS SITE LOCATION MAP

Land Use Summary

LAND USE CATEGORY	ACREAGE	ACREAGE %	MIN. DU/AC	MAX. DU/AC	MIN. UNITS	MAX. UNITS
INSTITUTIONS	16.9 ac.	2.2%	N/A	N/A	N/A	N/A
LOW DENSITY	136.4 ac.	17.8%	1	2	136	272
MEDIUM DENSITY	258.4 ac.	33.6%	3	4	775	1033
MED. - HIGH DENSITY	68.6 ac.	8.9%	6	8	411	548
HIGH DENSITY	117.4 ac.	15.3%	10	12	1174	1408
COMMERCIAL	17.0 ac.	2.2%	N/A	N/A	N/A	N/A
OPEN SPACE	132.5 ac.	17.2%	N/A	N/A	N/A	N/A
REX & COLLECTOR	21.0 ac.	2.7%	N/A	N/A	N/A	N/A
*OPEN SPACE INCLUDES: DETENTION, DRAINAGE CORRIDORS, GENERAL OPEN SPACE AND EASEMENTS,AND R.O.W./BUFFER OF EASTONVILLE RD. & HWY 24						
Total	768.2 ac.	**100%**			2496	3261

SKETCH PLAN - DRAFT 4-09-20

HRGreen

GRANDVIEW RESERVE

FALCON, CO

NORTH 0 300 600 900 SCALE: 1" = 300'

2.0 METHODOLOGY

Ecos performed an office assessment in which available databases, resources, literature and field guides on local flora and fauna were reviewed to gather background information on the environmental setting of the Site. We consulted several organizations, agencies, and their databases, including:

- Colorado Department of Agriculture (CDA) Noxious Weed List;
- Colorado Natural Heritage Program (CNHP);
- Colorado Oil and Gas Conservation Commission (COGCC) GIS Online;
- Colorado Parks and Wildlife (CPW);
- El Paso County Master Plan;
- El Paso County, Sub-Area Plan (provided by Client);
- Federal Emergency Management Agency (FEMA);
- Google Earth current and historic aerial imagery;
- Survey of Critical Biological Resources, El Paso County, Colorado;
- Survey of Critical Wetlands and Riparian Areas in EI Paso and Pueblo Counties, Colorado;
- U.S. Army Corps of Engineers (USACE) 1987 Corps of Engineers Wetlands Delineation Manual;
- USACE 2010 Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Great Plains Region;
- U.S. Department of Agriculture (USDA) PLANTS Database;
- U.S. Fish and Wildlife Service (USFWS) Region 6;
- USFWS National Wetland Inventory (NWI);
- USFWS IPaC database search; and
- U.S. Geological Survey (USGS).

Ecos also reviewed pertinent, site-specific background data provided by 4 Site Investments and their consulting Team, including: topographic base mapping, site development plans, and other data pertinent to the assessment.

Ecos reviewed, and incorporated the requirements of the following regulations into, this Report:

1) Chapter IV. Zoning Regulations, Section 35.13 – Development Requirements for Mineral and Natural Resource Extraction Operations;
2) Chapter V. Subdivision Regulations:
    a. Section 51.5 – Wildlife Hazard and Vegetation Reports; and
    b. Section 51.6 – Streams, Lakes, Physical Features and Wildlife Habitats.
3) Chapter 6 - General Development Standards:
    a. Section 6.3.3 - Wildfire Protection and Wildfire Mitigation;
    b. Section 6.3.7 - Noxious Weeds;

    c. Section 6.3.8 – Wetlands; and
    d. Section 6.3.9 – Wildlife.
4) Chapter 8 - Subdivision Design, Improvements and Dedications:
    a. Section 8.4.2 Environmental Considerations:
        i. Item A.4. – Threatened and Endangered Species Compliance; and
        ii. Item B.1. - Hazards
            1. l00-year floodplain as identified by the applicant, review agency, or the Floodplain Administrator; and
            2. Wildfire hazards as identified on the County and State wildfire hazard inventory or maps.

5) El Paso County Master Plan: Pertinent Maps and descriptors to append all of the topics, regulations and guidance referenced above, including:
    a. Wetland Habitat Maps and descriptors; and
    b. Wildlife Habitat Maps and descriptors.

Following the collection and review of existing data and background information, ecos conducted a field assessment of the Site to identify any potential impacts to natural resources associated with the Project. Field reconnaissance concentrated on identification of wetland habitat, waters of the U.S., wildlife habitat (including habitat suitable to support threatened and endangered wildlife) significant topographic features, noxious weeds and vegetation. Wetland habitat and waters of the U.S. boundaries, wildlife habitat, major vegetation communities, and significant weed stands were sketched on topographic and aerial base maps and located using a hand-held Global Positioning System as deemed necessary. Representative photographs were taken to assist in describing and documenting Site conditions and potential ecological impacts.

The office and onsite assessment data, the pertinent El Paso County regulations outlined above, and Natural Resource Assessment and Wetland report examples used in previous County land development review submittals (provided by El Paso County) were used in the preparation of the Report.

3.0 ENVIRONMENTAL SETTING

The Site is located in the Southwestern Tablelands Ecological Region (Chapman et al, 2006), which is primarily comprised of sub-humid grassland and semiarid rangeland. More specifically, the Site is located in the Foothills Grassland sub-region (26j) which contains a mix of grassland types with some small areas of isolated tallgrass prairie species that are more common much farther east. The proximity to runoff and moisture from the Front Range and the more loamy, gravelly, and deeper soils are able to support more tallgrass and midgrass species than neighboring ecoregions. Big and little bluestem, yellow indiangrass and switchgrass occur, along with foothill grassland communities. The annual precipitation of 14 to 20 inches tends to be greater than in regions farther east. Soils are loamy, gravelly, moderately deep, and mesic. Rangeland and pasture are common , with small areas of cropland. Urban and suburban development has increased in recent years, expanding out from Colorado Springs and the greater Denver area.

3.1 Topography

The Site is generally characterized as gently sloping from northwest to southeast with four ephemeral drainages (prairie sloughs) present, two of which are discontinuous and two are tributary to Black Squirrel Creek offsite. Naturally undulating swales drain toward the sloughs, which contain wetlands in low areas and dry areas where alluvial deposits have formed. Site topography ranges from a high elevation of 7020 feet above mean sea level (AMSL) in the northwestern corner to a low elevation of 6860 feet above AMSL where the northeastern tributary exits the Site on the east boundary along Highway 24; for a total elevation drop of 160 feet. An ill-defined and undulating hill, which is likely an eroded remnant bluff, is present in the north-central portion of the Site. Refer to Figure 3 for the Topographic Map.

3.2 Soils

Ecos utilized the U.S. Department of Agriculture, Natural Resource Conservation Service Web Soil Survey (USDA, NRCS, 2020) to determine if hydric soils are present within the Site, as this data assist in informing the presence/absence of potential wetland habitat regulated under the Clean Water Act. The soils data were also utilized to supplement the field observations of vegetation, as the USDA provides correlation of native vegetation species by soils types. Please refer to Appendix A for the USDA Soil Map and additional information.

Blakeland loamy sand (Map Unit #8), Columbine gravelly sandy loam (Map Unit #19) and Stapleton sandy loam (Map Unit #83) are listed by the NRCS as hydric soils that are found in swales and depressions. Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS, 1994) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in *Field Indicators of Hydric Soils in the United States* (USDA, NRCS, 2010).

Additional, detailed soil data for the Project are presented in the Soils & Geology Report that will be included in the Project submittal.

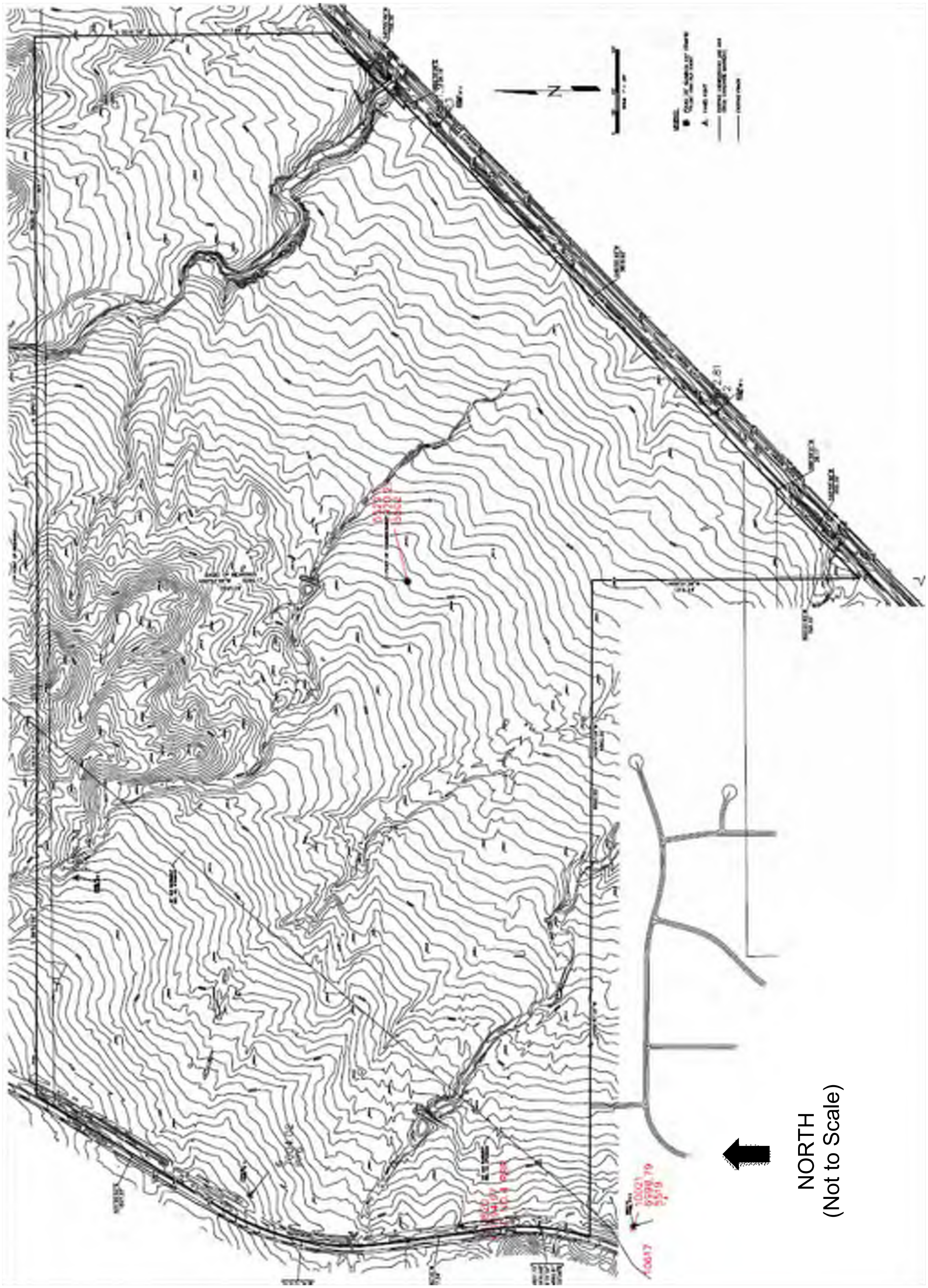


Figure 3 TOPOGRAPHIC MAP

3.3 Vegetation

The vegetation within the Site is primarily comprised of shortgrass prairie with wetland vegetation in the swales and sloughs (Figure 4). The shortgrass prairie is dominated by little bluestem (*Schizachyrium scoparium*), blue grama (*Bouteloua gracilis*), and buffalograss (*Bouteloua dactyloides*) with occasional associative grass and forb species including western wheatgrass (*Pascopyrum smithii*), yellow Indiangrass (*Sorghastrum nutans*), Canada wildrye (*Elymus canadensis*), needle and thread (*Hesperostipa comata*), switchgrass (*Panicum virgatum*), Western yarrow (*Achillea millefolium*), broom snakeweed (*Gutierrezia sarothrae*), fringed sage (*Artemisia frigida*), Prickly pear (*Opuntia* spp.), and prairie aster spp. (*Symphyotrichum* spp.). Occasional patches of snowberry (*Symphoricarpos albus*) and Wood's rose (*Rosa woodsii*) occupy the transitional areas between uplands and wetlands. A few, single plains cottonwood (*Populus deltoides*) occur along the drainages. The Site is heavily grazed and there are weeds scattered throughout, including Canada thistle (*Cirsium arvense*), Scotch thistle (*Onopordum acanthium*), Russian thistle (*Salsola kali*), common mullein (*Verbascum thapsus*), and yellow toadflax spp. (*Linaria vulgaris*).

Hydrophytic vegetation (wetland vegetation) is present within the swales and sloughs (refer to Section 3.4.2).

Figure 4 VEGETATION COMMUNITY MAP

3.4 Wetland Habitat and Waters of the U.S.

3.4.1 Methodology

Ecos utilized the National Wetland Inventory (NWI) Wetlands Mapper (USFWS 2020a); Colorado Wetland Inventory Mapping Tool (CNHP, 2018); historic and current Google Earth aerial photography; USGS 7.5-minute topographic mapping; and detailed Project topographic mapping to screen the Site for potential wetland habitat and waters of the U.S. Additionally, ecos performed a jurisdictional delineation to identify the Waters of the United States (WOUS), including wetlands.

The mapping data above were proofed during the filed assessment and a wetland delineation was conducted to determine the presence/absence of potential WOUS, including wetland habitat. Once a feature was verified to be present, ecos determined whether it is a jurisdictional wetland/waters under the Clean Water Act. The USACE, wetland delineation methodology was employed to document the 3 field indicators (parameters) of wetland habitat (i.e., wetland hydrology, hydric soils and a predominance of hydrophytic vegetation as explained in the *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory, 1987) and supplemented by the Regional Supplement to the *Corps of Engineers Wetlands Delineation Manual: Western Mountains, Valleys and Coast Region (Version 2)* (USACE, 2010). The wetland delineation was surveyed by the project team surveyor

Consistent with the NWI and Colorado Wetland Inventory Mapping Tool (Figure 5) and topographic mapping, the wetland/waters delineation revealed the presence of four drainages with the potential to support wetland habitat (Figure 6). Two of the drainages (i.e. northeast Drainage D and southwest Drainage A) were determined to be jurisdictional, and support predominantly palustrine emergent wetland (PEMC1) habitat with minor occurrences of palustrine scrub-shrub (PSS) and palustrine forested (PFO) species along their fringes. The central Drainage C and south-central Drainage B were investigated found to be discontinuous, prairie sloughs that are non-jurisdictional, “isolated” features, as verified by the USACE (Appendix B). Please refer to Figure 5 for a composite of the NWI and CNHP Wetland and Riparian Areas mapping, to Figure 6 for the ECOS Wetland and Waters Sketch Map, and to Appendix B for the USACE Non-Jurisdictional Verification email.

3.4.2 Field Assessment Findings

The results of the onsite assessment for each of the four onsite drainages is summarized below, with an explanation of the field indicators (parameters) of wetland habitat/waters that were observed, and an explanation as to whether ecos determined each feature was jurisdictional or non- jurisdictional under Section 404 of the Clean Water Act (as verified by the USACE). Jurisdictional features are mapped on Figure 6.

1) Jurisdictional wetland habitat and waters of the U.S.

   a. PEMC1 Wetland Habitat – Northeast Drainage D is classified as a Palustrine Emergent, Persistent, Seasonally Flooded wetland (PEMC1). Wetland Area A is tributary to Black Squirrel Creek off of the Site to the southeast. It is dominated by Nebraska sedge, redtop, clustered field sedge, three-square bulrush, swordleaf rush, soft-stem bulrush, poverty rush, Baltic rush, and watercress. Other species were present, including water mint, sporadic patches of sandbar willow, cutleaf evening primrose, fireweed, curly dock, and water milfoil, and snowberry, wild licorice and Wood's rose along the high banks. Soil samples indicate the presence of field indicators of hydric soils (organic horizon from 0-2 inches, 10YR4/2 clay loam from 2-9 inches, 10YR4/1 clay loam from 9-14 inches, and 10YR5/1 sandy clay from 14-18+ inches). Sustaining hydrology was evident as flowing water is present within a defined channel and saturated soils are present at the surface and throughout the floodplain, including groundwater driven side-slope seepage. This area meets all 3 parameters for jurisdictional wetland habitat.
   b. PEMC1 Wetland Habitat – Southwest Drainage A is classified as a Palustrine Emergent, Persistent, Seasonally Flooded wetlands (PEMC1 Wetland Area D is tributary to Black Squirrel Creek off of the Site to the southeast. It is dominated by Nebraska sedge, clustered field sedge, swordleaf rush, redtop, poverty rush, Baltic rush, and pussytoes. Other species were present, including soft-stem bulrush, three-square bulrush, smartweed, saltgrass, foxtail barley, water mint, scouring rush, wild geranium, watercress, narrowleaf cattail, and snowberry, wild licorice and Wood's rose along the high banks. Sporadic occurrences of sandbar willow, crack willow and plains cottonwood were present. Soil samples indicate the presence of field indicators of hydric soils (10YR2/2 loamy clay from 0-6 inches, 10YR4/2 sand from 6-12 inches, 10YR4/1 sand from 12-16 inches, and 10YR4/1 clayey sand from 16-18+ inches). Sustaining hydrology from groundwater seepage was evident as saturated soil is present at or within 8-12 inches of the ground surface. These areas meet all 3 parameters for jurisdictional wetland habitat.

2) Non-Jurisdictional, Isolated Wetlands - The central Drainage C and south-central Drainage B were investigated found to be discontinuous, prairie sloughs with reaches that are upland swales; they exhibited upland "breaks" in which they did not exhibit defined bed or bank (Figure 6); and they were also found to be "isolated" as they did not connect with downstream WOUS. Patches of PEMC1 Wetland exists in these drainages that exhibits the same characteristics of other wetlands on site and meets all 3 parameters for jurisdictional wetland habitat. However, they are clearly disconnected from Black Squirrel Creek by uplands that do not exhibit a defined bed or bank. Therefore, these drainages are isolated, non-jurisdictional features and as such were not delineated.

3.4.3 Summary of Jurisdictional and Non-Jurisdictional Wetlands and Waters

Jurisdictional Habitat – Northeast Drainage D and southwest Drainage A (refer to Figure 6) are jurisdictional wetland habitat and WOUS as they are tributary to the jurisdictional habitat in Black Squirrel Creek. These natural features meet the criteria that the USACE uses to assert jurisdiction, as they are:

- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months); and
- Wetlands that directly abut such tributaries.

Non-Jurisdictional Areas – The central Drainage C and south-central Drainage B are considered non-jurisdictional. They do not meet the criteria that the Corps uses to assert jurisdiction, as they are not:

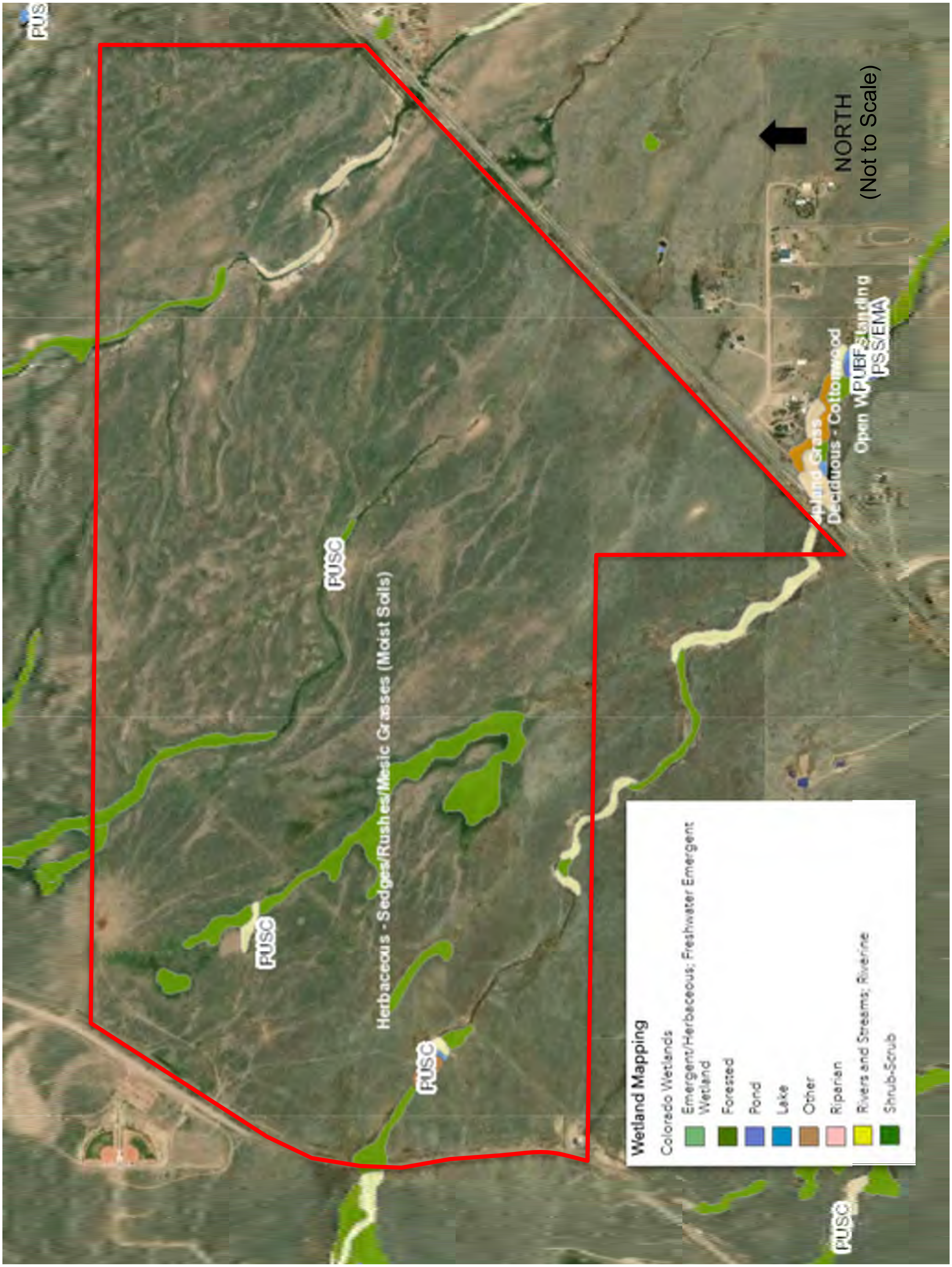
- Traditional navigable waters;
- Wetlands adjacent to traditional navigable waters;
- Non-navigable tributaries of traditional navigable waters that are relatively permanent where the tributaries typically flow year-round or have continuous flow at least seasonally (e.g., typically three months); and
- Wetlands that directly abut such tributaries.

Furthermore, Drainages B and C are not considered "tributaries", as "a tributary includes natural, man-altered, or man-made water bodies that carry flow directly or indirectly into a traditional navigable water." These drainages are ephemeral swales or erosional features (e.g., gullies, small washes characterized by low volume, infrequent, or short duration flow) over which the Corps does not assert jurisdiction.

3.4.4 Verification by the U.S. Army Corps of Engineers

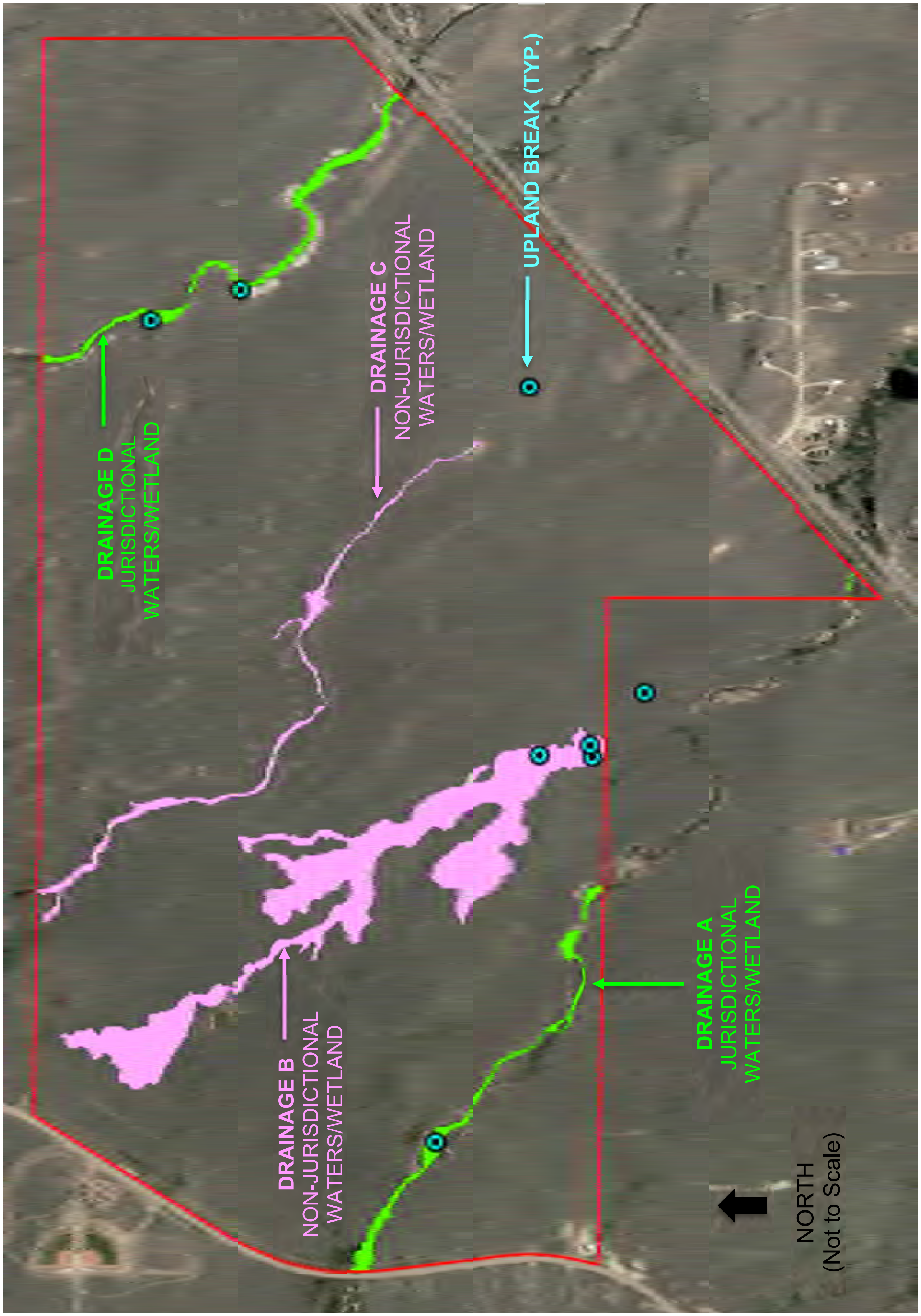
On July 5, 2019 the USACE provided an email to Ecos to confirm our findings of non-jurisdiction for Drainages B and C. Note that we did not request a jurisdictional determination of Drainages A and D as we have documented them to be jurisdictional. An excerpt of the USACE response from Tony Martinez, Regulatory Program Manager for the Albuquerque District, Southern Colorado Regulatory Branch of the USACE is copied below, and the original email is contained in Appendix B.

"Based on the information provided in the attached email and our site visit on June 21, 2019 our office concurs with your observations that central Drainage C and south-central Drainage B are isolated and are located entirely upland therefore, we conclude that No permit is required."



SOURCE: USFWS, National Wetland Inventory & CNHP, Colorado Wetland Inventory

Figure 5 NATIONAL WETLAND INVENTORY & CNHP WETLAND & RIPARIAN AREAS MAP



SOURCE: Ecosystem Services, LLC On-site Delineation, 10-11-18

3.5 Weeds

3.5.1 Regulatory Background

The Colorado Department of Agriculture maintains a list of noxious weed species (CDA, 2020a) and works with counties to manage noxious weeds. Weed management on Site must follow County requirements, including the "El Paso County Noxious Weeds and Control Methods" report (El Paso County, 2015b).

There are four CDA categories of noxious weeds:

- List A: Rare noxious that are designated for eradication statewide.
- List B: Discretely distributed noxious weeds that must be eradicated, contained, or suppressed, depending on their location, to stop their continued spread.
- List C. These species are well-established in Colorado. Species management plans are designed to support the efforts of local governing bodies to facilitate more effective integrated weed management. The goal of such plans is not to stop the continued spread of these species, but to provide additional education, research, and biological control resources to jurisdictions that choose to require management of List C species.
- Watch List Species are those may pose a potential threat to the agricultural productivity and environmental values. The Watch List is intended to serve advisory and educational purposes only. Its purpose is to encourage the identification and reporting of these species to the Commissioner in order to assist in determining which species should be designated as noxious weeds.

3.5.2 Noxious Weed Survey Results

Weed species on the Site were very limited, sporadic and dispersed; and as such, no large patches were identified or mapped by ecos.

No noxious weed species on the Colorado Department of Agriculture List A or the Watch List (CDA, 2020a) were observed on the Site.

Three List B noxious weed species (CDA, 2020a) were observed on the Site:

- Canada thistle (*Cirsium arvense*);
- Scotch thistle (*Onopordum acanthium*)
- yellow toadflax (*Linaria vulgaris*).

One List C noxious weed species (CDA, 2020a) were observed on Site:

- common mullein (*Verbascum thapsus*).

3.5.3 Noxious Weed Management Plan

All of the List B species on the Site are designated for suppression (CDA, 2018a). The Colorado Noxious Weed Act defines suppression as "*reducing the vigor of noxious weed populations within an infested region, decreasing the propensity of noxious weed species* *to spread to surrounding lands, and mitigating the negative effects of noxious weed populations on infested lands*." Suppression efforts may employ a wide variety of integrated management techniques. Per the El Paso County Noxious Weed and Control Methods document (El Paso County, 2018a): "*The most effective way to control noxious weeds is through Integrated Pest Management (IPM). IPM incorporates weed biology, environmental information, and available management techniques to create a management plan that prevents unacceptable damage from pests, such as weeds, and poses the least risk to people and the environment. IPM is a combination of treatment options that, when used together, provide optimum control for noxious weeds; however, IPM does not necessarily imply that multiple control techniques have to be used or that chemical control options should be avoided.*

- *Prevention: The most effective, economical, and ecologically sound management technique. The spread of noxious weeds can be prevented by cleaning equipment, vehicles, clothing, and shoes before moving to weed free areas; using weed-free sand, soil, and gravel; and using certified weed free seed and feed.*
- *Cultural: Promoting and maintaining healthy native or other desirable vegetation. Methods include proper grazing management (prevention of overgrazing), re-vegetating or re-seeding, fertilizing, and irrigation.*
- *Biological: The use of an organism such as insects, diseases, and grazing animals to control noxious weeds; useful for large, heavily infested areas. Not an effective method when eradication is the objective but can be used to reduce the impact and dominance of noxious weeds.*
- *Mechanical: Manual or mechanical means to remove, kill, injure, or alter growing conditions of unwanted plants. Methods include mowing, hand pulling, tilling, mulching, cutting, and clipping seed heads.*
- *Chemical: The use of herbicides to suppress or kill noxious weeds by disrupting biochemical processes unique to plants."*

The following information provides general measures to prevent introducing new weeds and spreading existing weeds during construction:

<u>Prior to Construction</u>:

1. Create a native habitat restoration and weed control plan for the Open Space areas. Since there is such dense knapweed mixed with other weeds along the Creek, total re-vegetation of some areas may be necessary. One option in the weediest areas would be to remove the top three to six inches of topsoil and replace it with topsoil from the non-weedy short grass prairie north of the Creek that will be developed. If topsoil can be transferred directly, or is only briefly stockpiled, then re-seeding may not be needed. Planning topsoil management ahead of construction may decrease costs for weed control, restoration, and grading.

2. Biological control is a low cost and non-invasive way to begin controlling weeds. Optimum results take 3-5 years. Contact the Colorado Department of Agriculture Request-A-Bug program at 970-464-7916 to reserve insects, determine the species/quantity needed, and discuss release schedules (CDA, 2020b). At a minimum, species should be introduced to control the knapweed. Biological control may also be available for yellow toadflax, musk thistle, and Canada thistle; with the dense patches of yellow toadflax in the northwest corner of the Site being the highest priority of these three.
3. Reduce grazing overall. Eliminate cattle grazing in knapweed-infested areas, unless using grazing for weed control. Cattle will eat young knapweed prior to bolting but avoid it once the plant matures and develops spines. Thus, targeted grazing can reduce knapweed, but prolonged heavy grazing increases it. Cattle grazing in areas of diffuse knapweed twice in spring may decrease seed by 50%. If cattle are being used for weed control, grazing should consist of two, 10-day intervals in the spring when diffuse knapweed is bolting and about 6 to 12 inches tall (see CSU, 2013). Grazing may reduce the efficacy of biological control.
4. Develop a mowing program to control weeds. This will be most effective for the large areas of common mullein, but may also be used for Canada thistle, musk thistle, and cheatgrass. Mowing in the knapweed areas may reduce the efficacy of biological control for this species.

<u>During construction staging</u>:

1. Fence off all the open space areas to prevent vehicles from driving through them and spreading knapweed, etc. to new areas (Note: fencing will also prevent unpermitted wetland impacts and likely be required by the stormwater management plan).
2. Designate a minimal number of vehicle crossings of the Open Space areas. Construct crossings with weed free soil so that noxious weed seeds are not tracked into new areas.

<u>During construction</u>:

1. Prior to any grading of the non-weedy areas on the slopes north of the Creek, salvage the top six inches of topsoil so that it can be used to construct vehicle crossings and for re-vegetation of natural areas. If possible, immediately move soil to re-vegetation areas. If soil must be stockpiled, minimize the time in order to maintain native seed viability. Excess topsoil may be used for development areas.
2. Do not move weedy soil to new areas within the Site or import weedy soil from other Sites.
3. Control weeds within staging areas and along construction access roads on an ongoing basis.

4. Noxious weeds are most likely to become established in areas where the native vegetation and soil have been disturbed by construction. Thus, maintaining and then quickly re-establishing desirable vegetation post-construction will minimize weed infestations. Desirable vegetation may consist of native plant communities or landscaped areas.

The Site development plan should include measures to prevent introducing new weeds and spreading existing weeds during construction (including prevention measures above). Following construction, the Homeowner's Association (HOA) will be responsible for weed control. Weed management recommendations for the species observed on the Site are summarized in Table 2. Refer to the El Paso County "Noxious Weed and Control Methods" booklet for additional detail (El Paso County, 2018a).

TABLE 2 – NOXIOUS WEED MANAGEMENT SUMMARY		
Species	**Occurrence**	**Management[1,2,3]**
LIST B[4]		
Canada thistle (*Cirsium arvense*)	Uncommon and dispersed.	Mowing combined with herbicide treatment. Mow every 10 to 21 days during the growing season to prevent seeding. Spot treatment with herbicide will likely be needed in open space areas.
Scotch thistle (*Onopordum acanthium*)	Uncommon and dispersed.	No known biological control agents effective against Scotch thistle. Any physical method that severs the root below the soil surface prior to seed production will kill the plant. Properly dispose of flowering cut plants, as seeds can mature and become viable. Spot treatment with herbicide will likely be needed in open space areas.
Yellow toadflax (*Linaria vulgaris*)	Uncommon and dispersed.	Difficult to control; control when infestations are small. Biological control is available and recommended, particularly in the northwest corner where this species is most abundant. Spot treatment with herbicide will likely be needed in open space areas.
LIST C		

TABLE 2 – NOXIOUS WEED MANAGEMENT SUMMARY		
Species	**Occurrence**	**Management[1,2,3]**
Common mullein (*Verbascum thapsus*)	Uncommon and dispersed.	Reduce grazing to increase density of other vegetation. Mow in the bolting to early flowering stage to reduce seed production. Use herbicide to kill existing rosettes. Hand-pulling is effective, but likely not feasible for such large areas. Establish other vegetation and minimize disturbance to prevent existing seeds from sprouting in bare soil.

[1]Refer to the El Paso County "Noxious Weed and Control Methods" booklet for additional detail (El Paso County, 2018a).

[2]When using herbicides, always read and follow the product label to ensure proper use and application.

[3]If near water or wetlands, only use herbicides and formulations approved for use near water.

[4]All of the List B species on the Site are designated for suppression (Colorado Code of regulations, 2018).

3.6 Wildfire Hazard

The stated purpose and intent of the 2018 El Paso County Development Standards" for "Fire Protection and Wildfire Mitigation" is to ensure that proposed development is reviewed for wildfire risks and adequate fire protection. No permit or approval associated with development, construction or occupancy shall be approved or issued until the provisions of these standards are satisfied.

The El Paso County Wildfire Hazard Map is based on the existing vegetation and classifies the grassland areas that comprise the Site as "Low Hazard – Non Forested". [Note: the Vegetation Map required to be referenced in the current Land Development Code is not available, therefore we used the most current map (Figure 7).] "Wildland areas" include land shown as "High Hazard – Forested" or areas identified as such in the "Wildland Fire Risk and Hazard Mitigation Plan." Since the Site does not include forested (high hazard) areas, it is not subject to the wildland areas requirements and does not requires the preparation of a Wildland Fire and Hazard Mitigation Plan.

3.6.1 Fire Protection

Falcon Fire Protection District

A portion of the Site is located within the jurisdiction and boundaries of the Falcon Fire Protection District (FFPD). The portion of the Site within the boundaries of the Falcon Fire Protection District is that portion west of the North/South section line beginning at the intersection of Highway 24 and Curtis Road. The Falcon Fire Department (Fire Department) has provided a letter for the previous iteration of this Project dated October 15, 2018 (Appendix C) to confirm its commitment to provide fire suppression, fire prevention, emergency rescue, ambulance, hazardous materials and emergency medical services (collectively, "Emergency Services") to the applicable portion of the Site, subject to the following conditions:

- All new construction, renovations or developments within the Fire Department's jurisdiction must comply with the applicable fire code and nationally recognized life-safety standards adopted by the El Paso County Board of County Commissioners and the FFPD's Board of Directors, as amended from time to time;
- All development, water and construction plans must be reviewed and approved by the Fire Department for compliance with the applicable fire code and nationally recognized life-safety standards prior to final plat or construction permit being issued; and,
- All development or construction projects shall meet the fire code and nationally recognized standards' pertaining to fire protection water. Please note that approved and inspected fire cisterns are permitted by the Fire Department in an attempt to help the property owner/developer meet these requirements.

Note: A new letter from FFPD will be obtained for the current iteration of this Project prior to Preliminary Plan submittal.

The three staffed FFPD stations are located as follows:

- Station 1, 12072 Royal County Down Road, Peyton (1.94 miles from Site)
- Station 3, 7030 Old Meridian Road, Peyton (4.21 miles from Site)
- Station 4, 2710 Capital Drive, Colorado Springs, CO (9.95 miles from Site)

One unstaffed station is located as follows:

- Station 2 located at 14450 Meridian Road (4.16 miles from the Site.

The closest station to the Site entrance is Station 1. Equipment at Station 1 includes an engine, a water tender (water truck), a brush truck, an AMR ambulance, a utility truck, and a command vehicle (FFPD, 2018). Equipment at the second closest station, Station 2, includes a 4-wheel drive engine, a water tender, and a brush truck.

Peyton Fire Protection District

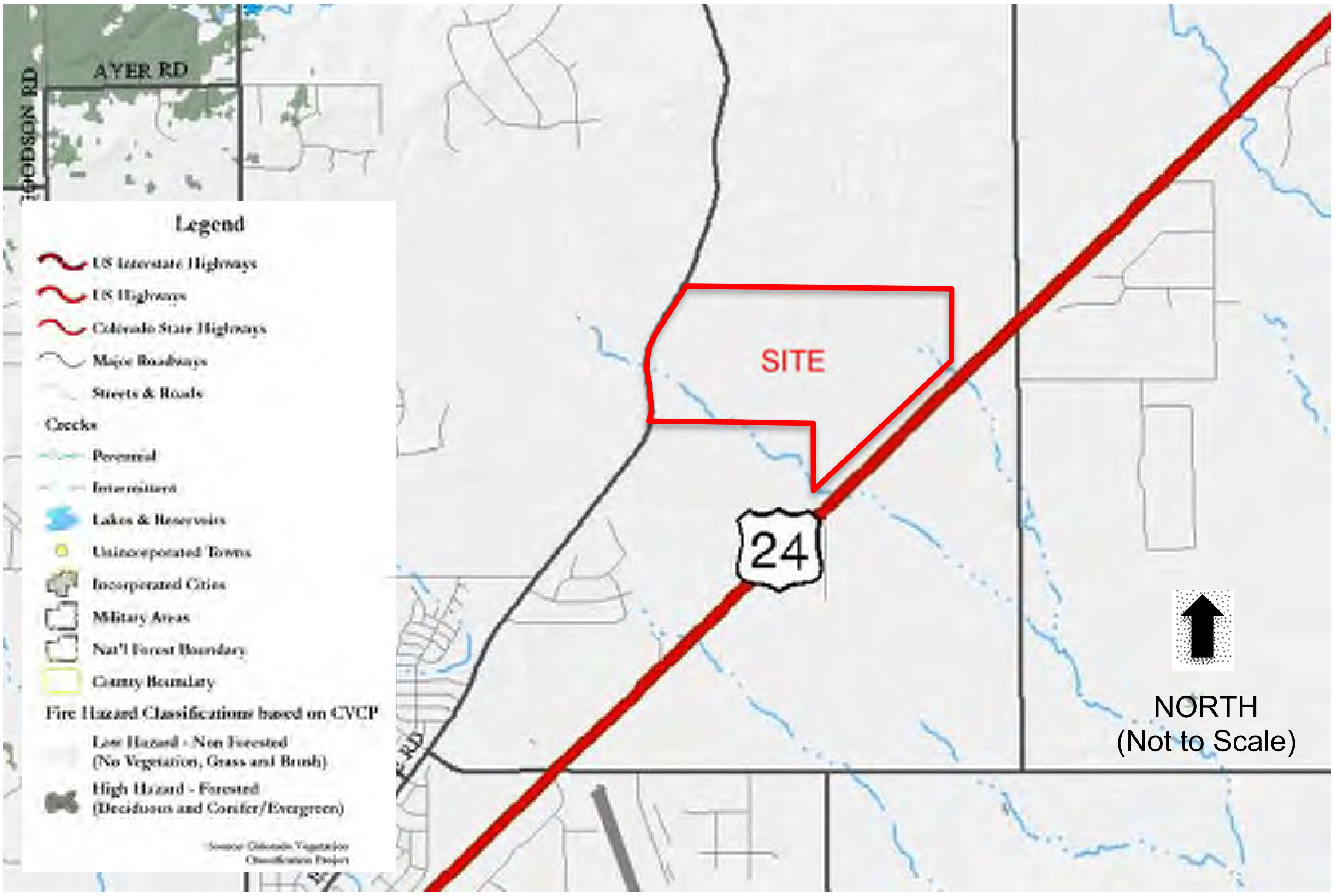
Peyton Fire Protection District (PFPD) will serve that potion of the Site east of the North/South section line beginning at the intersection of Highway 24 and Curtis Road.

The PFPD has provided a letter for the previous iteration of this Project dated October 30, 2018 (Appendix C) to confirm its commitment to provide fire prevention and suppression, emergency rescue, emergency medical and emergency hazardous materials response services (collectively, "Emergency Services") to the applicable portion of the Site, subject to the following conditions:

- All new construction, renovations or developments within the Fire Department's jurisdiction must comply with the applicable fire code and nationally recognized life-safety standards adopted by the El Paso County Board of County Commissioners and the PFPD's Board of Directors, as amended from time to time;
- All development, water and construction plans must be reviewed and approved by the PFPD for compliance with the applicable fire code and nationally recognized life-safety standards prior to final plat or construction permit being issued; and,
- All development or construction projects shall meet the fire code and nationally recognized standards' pertaining to fire protection water. Approved and inspected fire cisterns are permitted by the PFPD in an attempt to help the property owner/developer meet these requirements .

Note: A new letter from PFPD will be obtained for the current iteration of this Project prior to Preliminary Plan submittal.

PFPD is a paid/volunteer fire department located at 13665 Railroad Street, Peyton, Colorado, which is 4.26 miles from the Site. PFPD covers 110 square miles and has an ISO rating of 8B.



SOURCE: El Paso County, Colorado Wildfire Hazards (Based on CVCP Indicators), Map, 2007

Colorado Vegetation Classification Project (CVCP) Indicator Groupings

Low Hazard - Non Forested

No Vegetation:
(1) Urban/Built Up
(6) Barren Land
(8) Riparian
(9) Water
(11) Residential
(12) Commercial
(61) Rock
(6101) Talus Slopes & Rock Outcroppings
(62) Soil

Grass:
(21) Dryland Agriculture
(22) Irrigated Agriculture
(3102) Grassland
(3104) Grass/Forb Mix
(3111) Sparse Grass/Blowouts
(3304) Grass/Misc. Cactus Mix
(3307) Grass/Yucca Mix
(7102) Alpine Grass Dominated
(7103) Alpine Grass/Forb Mix
(7401) Subalpine Grass/Forb Mix
(83) Herbaceous Riparian

Brush:
(3201) Sagebrush Community
(3202) Saltbush Community
(3203) Greasewood
(33) Shrub/Grass/Forb Mix
(3301) Sagebrush/Grass Mix
(3302) Rabbitbrush/Grass Mix
(4202) Xeric Mountain Shrub Mix
(4203) Mesic Mountain Shrub Mix
(4205) Upland Willow/Shrub Mix
(72) Subalpine Shrub Community
(82) Shrub Riparian
(8201) Willow

High Hazard - Forested

Deciduous:
(4201) Gambel Oak
(5101) Aspen
(5102) Aspen/Mesic Mountain Shrub Mix
(81) Forested Riparian
(8101) Cottonwood

Conifer/Evergreen:
(4101) Pinyon Juniper
(4102) Juniper
(4301) PJ-Oak Mix
(4303) PJ-MNT Shrub Mix
(4304) Sparse PJ/Shrub/Rock Mix
(4305) Sparse Juniper/Shrub/Rock Mix
(5201) Ponderosa Pine
(5202) Engelmann Spruce/Fir Mix
(5203) Douglas Fir
(5204) Lodgepole Pine
(5207) Spruce/Lodgepole Pine Mix
(5208) Bristlecone Pine
(5209) Ponderosa Pine/Douglas Fir Mix
(5211) Limber Pine
(5213) Lodgepole/Spruce/Fir Mix
(5214) Fir/Lodgepole Pine Mix
(5215) Douglas Fir/Engelmann Spruce Mix
(5301) Spruce/Fir/Aspen Mix
(5302) P. Pine/Gambel Oak Mix
(5303) Ponderosa Pine/Aspen Mix
(5304) Douglas Fir/Aspen Mix
(5306) Lodgepole Pine/Aspen Mix
(5307) Spruce/Fir/Lodgepole/Aspen Mix
(5308) P. Pine/Mountain Shrub Mix
(5309) P. Pine/Aspen/Mesic Mountain Shrub Mix

3.7 Wildlife Communities

The stated purpose and intent of the "El Paso County Development Standards" section on wildlife is to ensure that proposed development is reviewed in consideration of the impacts on wildlife and wildlife habitat, and to implement the provisions of the Master Plan (El Paso County, 2018b). Ecos has determined that the wildlife impact potential for development of the Site is expected to be low.

The Site currently provides poor to moderate habitat for wildlife. There are two primary vegetation types on the Site, including shortgrass prairie and wetlands.

The project would develop most of the shortgrass prairie, however the drainages and adjacent short grass prairie would be preserved as Open Space. A noxious weed management plan will be implemented per State and County requirements to improve wildlife habitat; and a native plant re-vegetation plan for the Open Space is recommended to provide additional benefit to wildlife habitat.

The habitat preferences of the observed species are reflective of the habitat on Site. Two species of raptors were observed and appear to either be residents or frequent hunters to this Site: ferruginous hawk (*Buteo regalis*) and great horned owl (*Bubo virginianus*). Sandhill crane (*Grus canadensis*) were observed flying over during their migration, although they are not likely to utilize the Site. Prairie species such as jackrabbit (*Lepus townsendii*), pronghorn (*Antilocapra americana*), black-tailed prairie dog (*Cynomys ludovicianus*) and thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*) were present. The remaining species are considered generalists and included mourning doves (*Zenaida macroura*) and American crows (*Corvus brachyrhynchos*). The Site provides very limited tree nesting habitat for raptors; however, ferruginous hawks may also use ground nests. No existing nest sites for any raptors were noted during the Site visit.

The Site provides habitat for mammals including rodents, antelope, and carnivores. The site provides foraging and breeding habitat for predators such as coyote and fox. The Site also provides good habitat for reptiles but limited habitat for amphibians due to the lack of persistent standing and flowing water. No other species were observed by ecos during our field assessment.

The Site contains no Wildlife Refuges or Hatcheries according to the USFWS IPaC Trust Resources Report (USFWS, 2020b) (Appendix D).

4.0 FEDERAL LISTED SPECIES

A number of species that occur in El Paso County are listed as candidate, threatened or endangered by the USFWS (USFWS, 2020b) under the Endangered Species Act (ESA). Ecos compiled the Federally-listed species for the Site in Table 3 based on the Site-specific, USFWS IPaC Trust Resources Report we ran for the Project (Appendix D); and our onsite assessment. Ecos has provided our professional opinion regarding the probability that these species may occur within the Site and their probability of being impacted by the Project.

The likelihood that the Project would impact any of the species listed below is very low to none. Most are not expected occur in the Project area or on the Site; nor will they be affected by the indirect effects of the project. The Preble's meadow jumping mouse is discussed in more detail below because there is USFWS designated Critical Habitat in the County.

TABLE 3 - FEDERAL LISTED SPECIES ASSESSED FOR THE PROJECT			
Species	**Status**	**Habitat Requirements and Presence**	**Probability of Impact by Project**
FISH			
Greenback cutthroat trout (*Oncorhynchus clarki stomias*)	Threatened	Cold, clear, gravely headwater streams and mountain lakes that provide an abundant food supply of insects.	None. Suitable habitat does not exist on the Site.
Pallid sturgeon (*Scaphirhynchus albus*)	Endangered	Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.	None. The proposed project is not in the watershed for any of the listed river basins.
BIRDS			
Least tern (*Sternula antillarum*)	Endangered	Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.	None. The proposed project is not in the watershed for any of the listed river basins.
Mexican spotted owl (*Strix occidentalis lucida*)	Threatened	Mature, old-growth forests of white pine, Douglas fir, and ponderosa pine; steep slopes and canyons with rocky cliffs. The closest USFWS designated Critical habitat is over 15 miles southwest of the Site in mountainous terrain.	None. Suitable habitat does not exist on the Site.

TABLE 3 - FEDERAL LISTED SPECIES ASSESSED FOR THE PROJECT			
Species	**Status**	**Habitat Requirements and Presence**	**Probability of Impact by Project**
Piping plover (*Charadrius melodus*)	Threatened	Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.	None. The proposed project is not in the watershed for any of the listed river basins.
Whooping crane (*Grus americana*)	Endangered	Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.	None. The proposed project is not in the watershed for any of the listed river basins.
MAMMALS			

TABLE 3 - FEDERAL LISTED SPECIES ASSESSED FOR THE PROJECT			
Species	**Status**	**Habitat Requirements and Presence**	**Probability of Impact by Project**
Preble's meadow jumping mouse (*Zapus hudsonius preblei*)	Threatened	Inhabits well-developed riparian habitat with adjacent, relatively undisturbed grassland communities, and a nearby water source. Well-developed riparian habitat includes a dense combination of grasses, forbs and shrubs; a taller shrub and tree canopy may be present. Has been found to regularly use uplands at least as far out as 100 meters beyond the 100-year floodplain.	None. Unlikely to occur on Site due to: 1) the absence of habitat required to support the life requisites of the species; 2) negative trapping results reported by USFWS adjacent to the Site; 3) 10.22-mile distance from closest CPW "Potential" Occupied Habitat (west/northwest of the Site in Colorado Springs); 4) 6.5-mile distance from closest USFWS Critical Habitat (southwest of the Site along Black Squirrel Creek in Colorado Springs); and 5) lack of habitat connection corridor from known habitat to the Site.
PLANTS			

TABLE 3 - FEDERAL LISTED SPECIES ASSESSED FOR THE PROJECT			
Species	**Status**	**Habitat Requirements and Presence**	**Probability of Impact by Project**
Ute ladies'-tresses orchid (*Spiranthes diluvialis*)	Threatened	Primarily occurs along seasonally flooded river terraces, sub-irrigated or spring-fed abandoned stream channels or valleys, and lakeshores. May also occur along irrigation canals, berms, levees, irrigated meadows, excavated gravel pits, roadside borrow pits, reservoirs, and other human-modified wetlands.	Very Low. Unlikely to occur as the Site is situated between 6,860 and 7,020 feet above mean sea level, which is higher than the 6,500-foot elevation limits documented for the species and recommended for conducting surveys by the USFWS.
Western prairie fringed orchid (*Platanthera praeclara*)	Threatened	Occurs in tallgrass prairie in Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and Oklahoma. Upstream depletions to the Platte River system in Colorado and Wyoming may affect the species in Nebraska.	None. The proposed project will not alter or deplete flows to the South Platte.

4.1 Preble's meadow jumping mouse

4.1.1 Natural History

The Preble's meadow jumping mouse (PMJM) is a small mammal approximately 9-inches in length with large hind feet adapted for jumping, a long bicolor tail (which accounts for 60% of its length), and a distinct dark stripe down the middle of its back, bordered on either side by gray to orange-brown fur (USFWS, 2016). This largely nocturnal mouse lives primarily in the foothills of southeastern Wyoming, and south to Colorado Springs, along the eastern edge of the Front Range of Colorado. PMJM are true hibernators. They usually enter into hibernation in September or October and emerge in May of the following spring.

PMJM typically inhabits areas characterized by well-developed plains riparian vegetation with relatively undisturbed grassland and a water source in close proximity (Armstrong et al. 1997). PMJM regularly range into adjacent uplands to feed, hibernate, and avoid flooding. Radio-tracking studies conducted by CPW have documented PMJM using upland habitat adjacent to wetlands and riparian areas (Shenk and Sivert 1999).

4.1.2 Threats

Threats to PMJM and their habitat include habitat alteration, degradation, loss, and fragmentation resulting from human land uses including urban development, flood control, water development, and agriculture. Habitat destruction may impact individual PMJM directly or by destroying nest sites, food resources, and hibernation sites; by disrupting behavior; or by forming a barrier to movement. Invasive non-native and noxious weeds can alter habitat and decrease its value.

4.1.3 Critical Habitat

Critical habitat is specific areas identified by the USFWS as being essential to the conservation of PMJM (USFWS, 2016). In determining which areas to designate as critical habitat, the USFWS must use the best scientific and commercial data available and consider physical and biological features (primary, constituent elements) that are essential to conservation of the species, and that may require special management consideration and protection. The primary constituent elements for the PMJM include those habitat components essential for the biological needs of reproducing, rearing of young, foraging, sheltering, hibernation, dispersal, and genetic exchange. Thus, critical habitat includes riparian areas located within grassland, shrub land, forest, and mixed vegetation types where dense herbaceous or woody vegetation occurs near the ground level, where available open water exists during their active season, and where there are ample upland habitats of sufficient width and quality for foraging, hibernation, and refugia from catastrophic flooding events. Section 7 of the Endangered Species Act prohibits destruction or adverse modification of a critical habitat by any activity funded, authorized, or carried out by any Federal agency, and Federal Agencies proposing actions affecting areas designated as critical habitat must consult with the USFWS on the effects of their proposed actions, pursuant to Section 7(a)(2) of the Act.

4.1.4 Potentially Occupied Range

Colorado Parks and Wildlife (CPW) mapped areas of “potential” PMJM occupied range (CPW, 2005). The occupied range mapping is based on known occurrences of PMJM (i.e., trapping data) and mapped riparian vegetation (i.e., potential habitat that was not necessarily trapped or verified). For each known PMJM location, a one-mile buffer is applied to riparian areas both upstream and downstream. This includes both the main channel and side channels. Additionally, a 100-meter lateral buffer is applied which, in general, represents foraging and hibernaculum habitat. This buffer serves as a general guideline. Site specific topographic and vegetative features may increase or decrease the area considered locally as foraging and hibernaculum habitat. Where riparian vegetation maps don't exist, the stream centerline is buffered laterally by 100 meters.

4.1.5 Summary

PMJM are very unlikely to occur on the Site or be affected by the Project due to:

1) the absence of onsite habitat required to support the life requisites of the species;

2) negative trapping results reported by USFWS adjacent to the Site;

3) 10.22-mile distance from closest CPW “Potential” Occupied Range (west/northwest of the Site in Colorado Springs);

4) 6.5-mile distance from closest USFWS Critical Habitat (southwest of the Site along Black Squirrel Creek in Colorado Springs); and

5) lack of a habitat connection corridor from known habitat to the Site.

Refer to Figure 8 – USFWS PMJM Trapping Map and Figure 9 – PMJM Habitat Map.

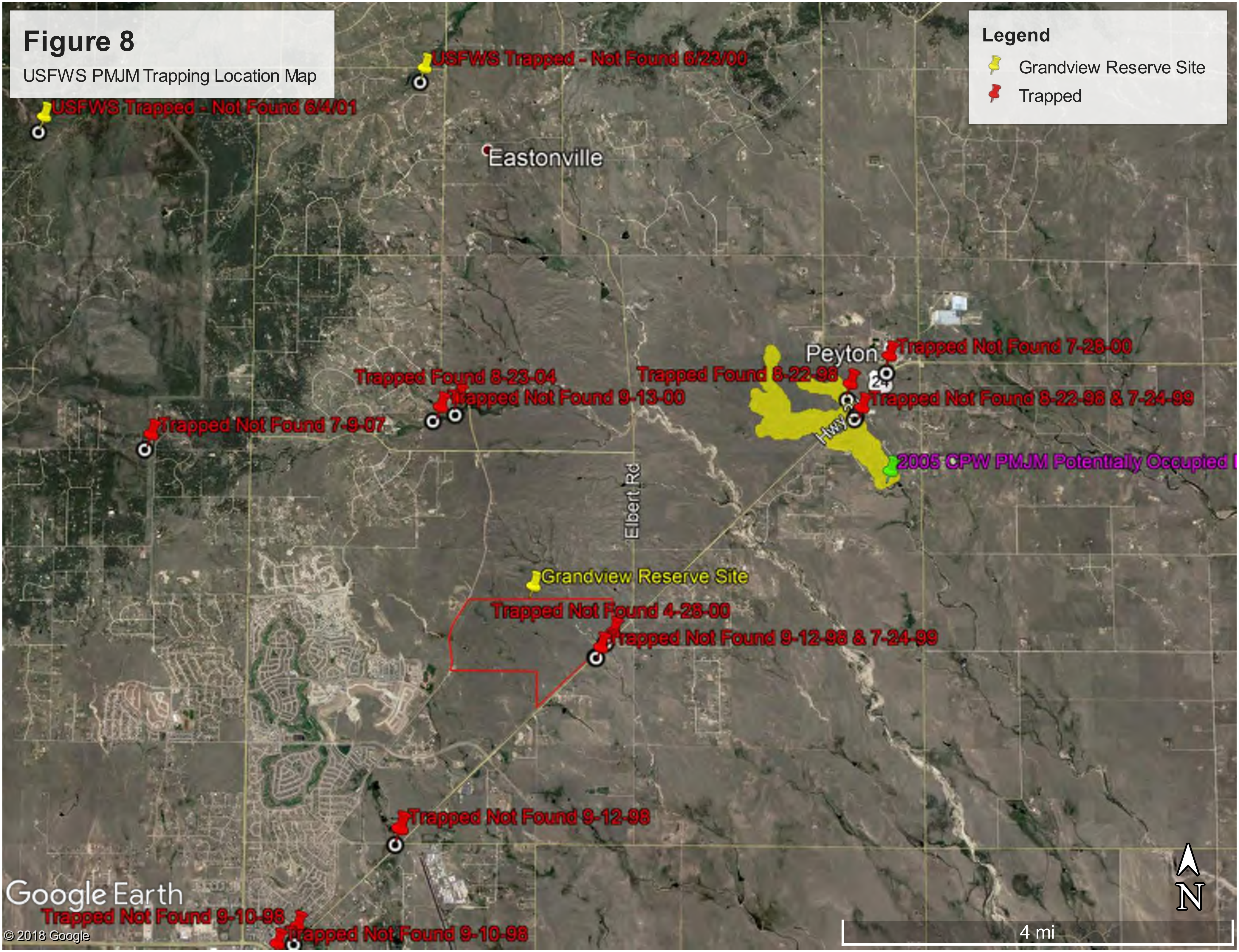


Figure 8

USFWS PMJM Trapping Location Map

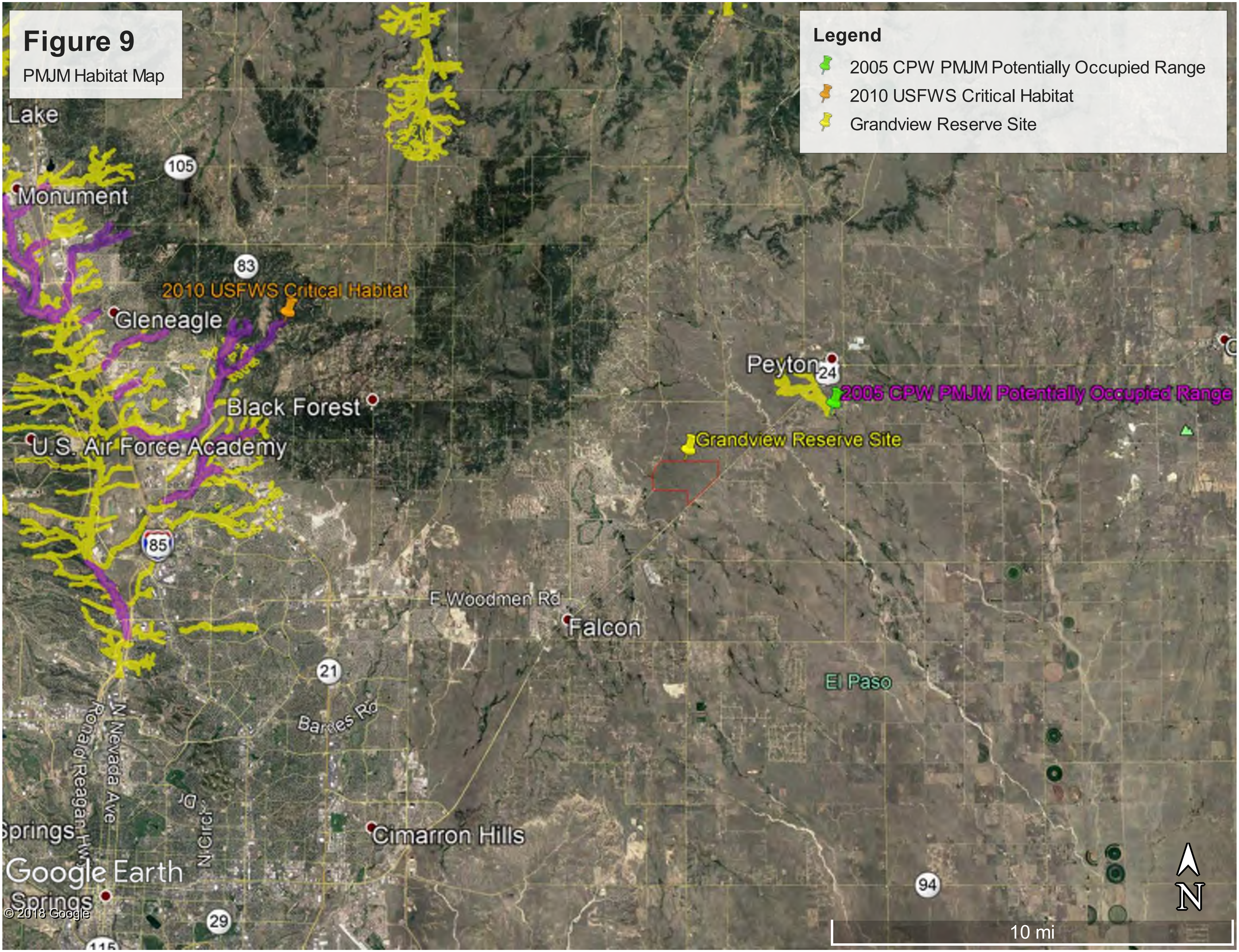


Figure 9
PMJM Habitat Map
Legend
2005 CPW PMJM Potentially Occupied Range
2010 USFWS Critical Habitat
Grandview Reserve Site
Lake
Monument
105
83
2010 USFWS Critical Habitat
Gleneagle
Peyton
24
2005 CPW PMJM Potentially Occupied Range
Black Forest
U.S. Air Force Academy
Grandview Reserve Site
85
E Woodmen Rd
Falcon
21
El Paso
Barnes Rd
N Nevada Ave
Ronald Reagan Hwy
N Circle Dr
Springs
Cimarron Hills
Google Earth
Springs
© 2018 Google
29
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5.0 RAPTORS AND MIGRATORY BIRDS

Raptors and most birds are protected by the Colorado Nongame Wildlife Regulations, as well as by the federal Migratory Bird Treaty Act and/or the Bald and Golden Eagle Protection Act. No raptor nests have been mapped within one mile of the Site (COGCC, 2020). No raptors nests were observed during the site visit. However, the short grass prairie and wetland habitats are valuable nesting and foraging habitat for birds.

6.0 SUMMARY OF POTENTIAL IMPACTS

6.1 Mineral and Natural Resource Extraction

The previous project engineer researched the records of the El Paso County Clerk and Recorder and established that there is not a mineral estate owner on the Site (Appendix E). This research will be replicated for this current iteration of the Project and provided prior to Preliminary Plan submittal. However, Mineral or Natural Resource Extraction will not occur as a part of this Project, and no associated impacts to habitat will occur.

6.2 Vegetation

There are two main types of vegetation on Site; wetlands and short-grass prairie. Long-term cattle grazing has degraded vegetation by increasing weeds (although mild) in many areas and severely reducing woody riparian vegetation along the drainages. Direct negative impacts to vegetation will result from the construction of roads, trails, and homes; and indirect negative impacts will result such as spreading weeds to new areas or alteration of wetland hydrology. Since the project will preserve the onsite drainages and an open space area, there is good potential to improve vegetation in these areas. The following recommendations are intended to minimize negative impacts and increase positive impacts:

1. Create a habitat restoration and management plan for the drainages and Open Space areas that begins as soon as possible, continues through construction, and is taken over and implemented by the Metropolitan District following construction.
2. Increase native vegetation in the disturbed shortgrass prairie areas by seeding with native species. Another option would be to spread ~1” of salvaged topsoil obtained/stockpiled from any non-weedy shortgrass prairie area that would be impacted by infrastructure construction, such as roads and associated disturbances, and use it in undisturbed areas.
3. Include requirements in the Codes, Covenants and Restrictions (CCRs) to preserve native vegetation and minimize non-native landscaping and irrigation.
4. Implement a stormwater management system that does not significantly increase flows into the drainages and prepare a natural channel stabilization plan for all drainages.

6.3 Wetland Habitat and Waters of the U.S.

Drainages A and D are both jurisdictional WOUS, including adjacent wetlands; therefore, potential regulatory impacts to these drainages are discussed below:

Drainage A is located between Parcels E and F (Medium Density) along the west side; and Parcels C, D and G (Medium Density) along the east side. The Sketch Plan (Figure 2) illustrates an Open Space buffer along both sides of the drainage that will assist in ameliorating the effects of residential runoff. This buffer area should be planted with multi-story palette of native upland and riparian species to supplement the regrowth and regeneration of previous woody vegetation (now that grazing has been removed), provide shading to regulate pH and water quality, and assist in stabilizing the streambanks. Given that Parcels E and F are proposed to be accessed via the Waterbury project to the south, it does not appear that a road crossing of Drainage A will be necessary. Utility lines will need to cross Drainage A to get service to all lots; however, this impact may be avoided by bringing utilities into Parcels E and F from Waterbury or boring beneath the drainage. A Detention Pond is proposed along the downstream, west side of the drainage that will require an outfall into the drainage. However, with proper location and alignment, impacts for this outfall should be minimal and primarily restored in-place.

Drainage D is located between Parcels Q (Low Density), R (Medium Density) and M (Medium-High Density) along the west side; and Parcels N (Medium Density) and P (Low Density) along the east side. The Sketch Plan (Figure 2) illustrates an Open Space buffer along both sides of the drainage that will assist in ameliorating the effects of residential runoff. This buffer area should be planted with multi-story palette of native upland and riparian species to supplement the regrowth and regeneration of previous woody vegetation (now that grazing has been removed), provide shading to regulate pH and water quality, and assist in stabilizing the streambanks. A road crossing is proposed over the upstream reach of Drainage D that may cause impacts to WOUS and wetlands; however, these impacts may be significantly reduced if a free-span bridge is used. Utility lines will need to cross Drainage D to get service to all lots; however, this impact may be avoided running the lines beneath the proposed road crossing or by boring beneath the drainage. Three Detention Ponds are proposed along the drainage, one upstream and two downstream, all of which will require outfalls into the drainage. However, with proper location and alignment, impacts for these outfalls should be minimal and primarily restored in-place.

All Drainages: Project phasing should be used to avoid Site-wide, over-lot grading and related impacts from runoff, erosion and pollutant discharge into the drainages. Given the proposed density of development, strategic stormwater control before, during and after construction will be required to avoid these impacts and associated channel incision and streambank degradation. Stormwater runoff from streets and impervious surfaces should be treated via vegetated swales, separators, (e.g., “Stormceptors” or similar oil and sediment separators) and/or the proposed detention basins prior to discharge into the drainages.

6.4 Weeds

Weeds observed on Site included three List B noxious weed species and one List C noxious weed species (CDA, 2018a). Suppression is required for all List B species. Site development typically causes weeds to increase due to increased earth disturbance and new weeds being brought in (on vehicles and shoes, in soil and fill material, in landscaping supplies, etc.). The following recommendations are intended to minimize negative impacts and increase positive impacts:

1. Introduce biological control agents for weed control as soon as possible.
2. Implement an integrated noxious weed management plan that begins as soon as possible, continues through construction, and is taken over and implemented by the Metropolitan District following construction. Control of List B species should be the highest priority, particularly knapweed.
3. Include requirements in the CCRs that landowners manage weeds on their property per the Colorado Noxious Weed Act and El Paso County guidelines.
4. Prohibit importation of fill dirt and landscaping material from other locations unless it is certified as weed free.

6.5 Wildfire Hazard

The Site is comprised entirely of herbaceous prairie and wetland vegetation designated as "Low Hazard – Non Forested" and has no forested (high hazard) areas (Figure 7). Therefore, it is not subject to the wildland areas requirements and does not require the preparation of a Wildland Fire and Hazard Mitigation Plan.

6.6 Wildlife Communities

The impact to wildlife is similar to that for vegetation. Species that occur in wetland and riparian habitat are expected to benefit from Open Space protection. Implementation of the stormwater management plan will assist in protecting water quality in the drainages, to ameliorate development impacts on aquatic wildlife species. Many shortgrass prairie specialist species avoid areas with buildings, overhead powerlines, and trees; thus, the project is expected to have the most significant negative impact on these species. The following, additional recommendations are intended to reduce impacts to wildlife:

1. Limit the use of herbicides, pesticides, and fertilizers as they can negatively impact aquatic wildlife species.
2. Minimize the installation of fencing. When fencing is needed, use wildlife friendly fences or include specific wildlife crossings along fence lines. Pronghorn are of particular concern because they do not jump over fences and can be injured by barbed-wire fences.
3. Road crossings over the drainages should be designed to enable wildlife underpass and allow use of the drainages as movement corridors to reduce collisions with vehicles.

4. Dogs should be kept in fenced pens and be leashed when on walks. At least one designated off-leash area for dogs should be provided, as this will increase compliance with leash rules in other areas.
5. Cats should no be allowed outdoors because they kill birds and native rodents. Cats may also be eaten by foxes and coyotes.

6.7 Federal Listed Species

The Site is not located within any USFWS designated critical habitat or known occupied habitat for federally designated threatened or endangered species, including the Preble's meadow jumping mouse. Therefore, no direct or indirect impacts to federally designated threatened or endangered species are expected to occur from the Project.

6.8 Raptors and Migratory Birds

The Project is expected to have minimal impacts on raptors and migratory birds. Preservation of Open Space along the drainages will likely have a positive impact on the birds that use this habitat. The project is expected to have slight negative impact on shortgrass prairie birds due to habitat alteration and increased disturbance by people, dogs, and cats. Negative impacts can be minimized by following the recommendations in the vegetation and wildlife sections.

7.0 REGULATIONS AND RECOMMENDATIONS

7.1 Clean Water Act

Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into waters of the U.S. (including wetland habitat) without a valid permit. Ecos identified jurisdictional wetland habitat and WOUS along Drainages A and D. However, the majority of the WOUS and wetlands on the Site will be set aside and included in Open Space with buffers; and no jurisdictional wetlands or waters will occur within private lots. Therefore, it is evident that impact minimization has been incorporated since the early stages of the design process. Any proposed impacts to WOUS or wetlands resulting from road or utility crossings, stormwater outfalls, channel stabilization, grading operations or other associated development disturbances should be avoided or minimized to the extent feasible. 4 Site Investments will need to obtain Clean Water Act (CWA) Section 404 Permit authorization from the USACE prior to construction to authorize development-related impacts. At the Sketch Plan phase, detailed data are not available to assess cumulative impacts and assign the type of 404 Permit that may be applicable. However, if feasible, the cost and timeframe associated with the Project may be minimized if cumulative impacts are avoided and minimized to the extent that they meet the requirements for Nationwide Permit 29 for Residential Developments.

7.2 Endangered Species Act

The Site is not located within any USFWS designated critical habitat or known occupied habitat for federally designated threatened or endangered species, including the

Preble's meadow jumping mouse. Therefore, no direct or indirect impacts to federally designated threatened or endangered species are expected to occur from the Project. Therefore, 4 Site Investments is not required to initiate consultation with the USFWS under the ESA. A “Clearance Letter” dated May 25, 2019 was obtained from the USFWS for the previous iteration of this Project that concurred with ecos’ findings and “cleared” the entire Site (refer to Appendix F).

Note: 4 Site Investments will obtain an updated Clearance Letter from USFWS prior to Preliminary Plan submittal.

7.3 Migratory Bird Treaty Act & Bald and Golden Eagle Protection Act

No raptor nests have been mapped within one mile of the Site (COGCC, 2020) and no migratory bird nests were observed within the Site during ecos’ assessment. However, given the transitory nature of these species ecos recommends a nesting bird inventory immediately prior to construction to identify any new nests within the Site or within the CPW recommended buffers of the Site. If these species are found to be present, construction activities should be restricted during the breeding season near any newly identified nests.

7.4 Colorado Noxious Weed Act

In order to ensure Project compliance with the Act, the Noxious Weed Management Plan referenced in Section 3.5.3 of this Report should be implemented, and further site-specific weed management should be implemented on an ongoing basis, starting as soon as feasible.

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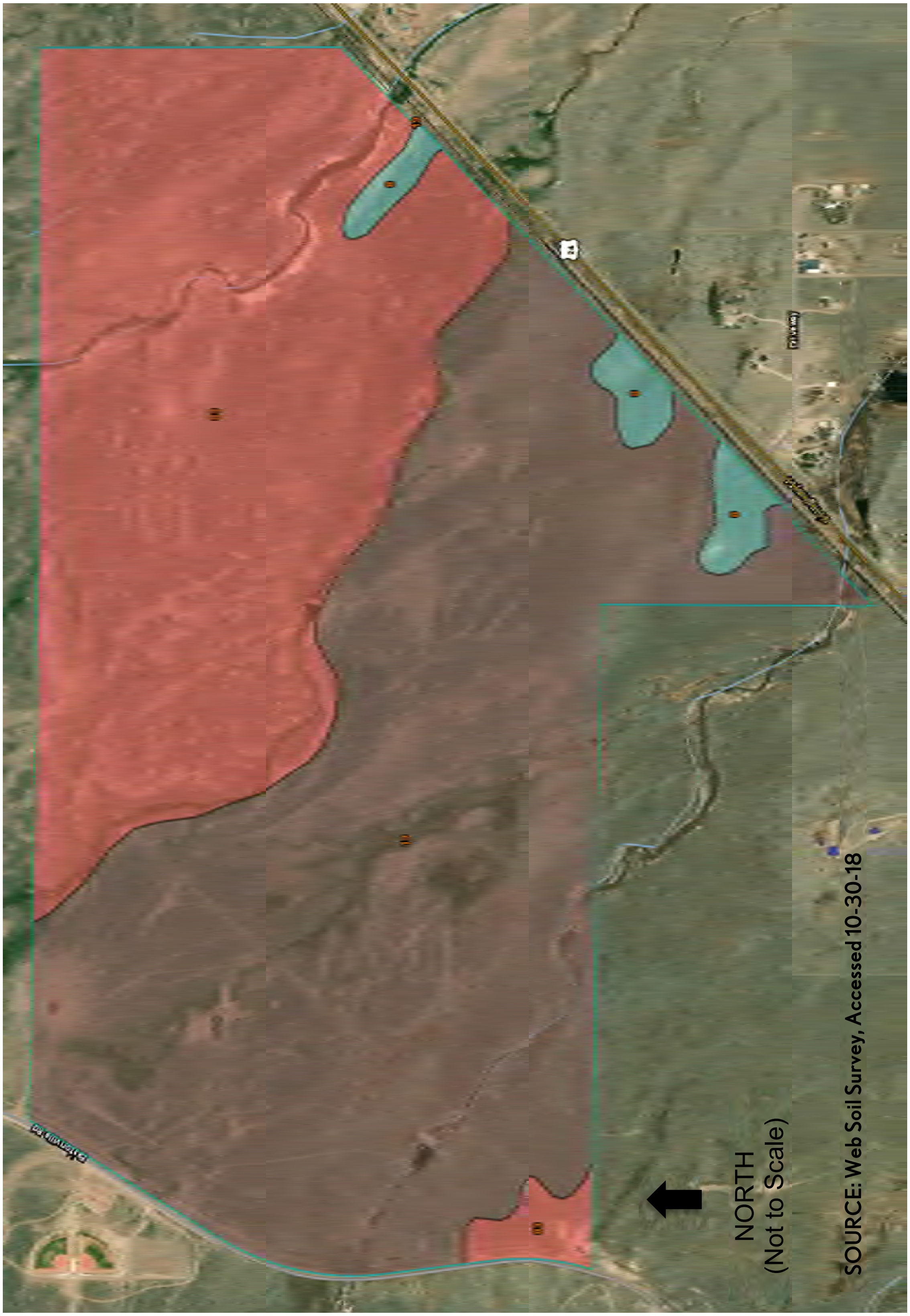
Appendix A

USDA Soil Data



Summary by Map Unit — El Paso County Area, Colorado (CO625)

Summary by Map Unit — El Paso County Area, Colorado (CO625)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	Blakeland loamy sand, 1 to 9 percent slopes	17.5	2.3%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	Columbine gravelly sandy loam, 0 to 3 percent slopes	428.6	55.8%
83	Stapleton sandy loam, 3 to 8 percent slopes	Stapleton sandy loam, 3 to 8 percent slopes	322.2	41.9%
Totals for Area of Interest			**768.3**	**100.0%**

Appendix B

USACE Verification Email

From: Martinez, Joseph A CIV USARMY CESPA (US)
To: Grant Gurnee
Subject: RE: [Non-DoD Source] FW: Grandview Reserve Project - Request for Verification of Non-JD Drainages (UNCLASSIFIED)
Date: Friday, July 5, 2019 1:58:43 PM

CLASSIFICATION: UNCLASSIFIED

Mr. Gurnee,

Based on the information provided in the attached email and our site visit on June 21, 2019 our office concurs with your observations that central Drainage C and south-central Drainage B are isolated and are located entirely upland therefore, we conclude that No permit is required.

If you should have any questions, please contact me at (719).600.8641.

Respectfully,

Tony Martinez, R.E.M.

Regulatory Program Manager| U.S. Army Corps Of Engineers | Office: (719) 600.8641 | Email: joseph.a.martinez@usace.army.mil|

Albuquerque District
Southern Colorado Regulatory Branch
201 West 8th Street, Suite 350, Pueblo Colorado 81003

Visit our Web Site at: http://www.spa.usace.army.mil/Missions/Regulatory-Program-and-Permits/

-----Original Message-----
From: Grant Gurnee [mailto:grant@ecologicalbenefits.com]
Sent: Tuesday, June 18, 2019 2:21 PM
To: Martinez, Joseph A CIV USARMY CESPA (US) <Joseph.A.Martinez@usace.army.mil>
Subject: [Non-DoD Source] FW: Grandview Reserve Project - Request for Verification of Non-JD Drainages

Hi Tony –

Here is the email I sent Van on May 20, 2019.

I hope you received my calendar invitation to meet at 10:30 this Friday (June 21) at the intersection of Stapleton Road and Hwy. 24.

Thank you,

Grant

From: Grant Gurnee <grant@ecologicalbenefits.com <mailto:grant@ecologicalbenefits.com> >
Sent: Monday, May 20, 2019 10:23 AM
To: Truan, Van A SPA <van.a.truan@usace.army.mil <mailto:van.a.truan@usace.army.mil> >
Cc: Peter Martz <pmartzlrg@comcast.net <mailto:pmartzlrg@comcast.net> >; Mike Bramlett <mbramlett@jrengineering.com <mailto:mbramlett@jrengineering.com> >; Jon Dauzvardis <jon@ecologicalbenefits.com <mailto:jon@ecologicalbenefits.com> >

Subject: Grandview Reserve Project - Request for Verification of Non-JD Drainages
Importance: High

Hello Van –

Ecos would like to request the Corps' formal concurrence regarding the non-jurisdictional status of Drainages B and C on the Grandview Reserve Site in El Paso County (refer to Section 3.4 and additional information in the attached report). Please let us know if you would like to schedule a site visit to review these drainages with us.

Summary:

The central Drainage C and south-central Drainage B were investigated found to be discontinuous, prairie sloughs with reaches that are upland swales; they exhibited upland "breaks" in which they did not exhibit defined bed or bank (Figure 6 in attached report); and they were also found to be "isolated" as they did not connect with downstream WOUS. Patches of PEMC1 Wetland exists in these drainages that exhibits the 3 parameters for jurisdictional wetland habitat. However, they are clearly disconnected from Black Squirrel Creek by uplands that do not exhibit a defined bed or bank. Therefore, ecos determined that these drainages are isolated, non-jurisdictional features – pending Corps verification.

Thank you,

Grant

Grant Gurnée, P.W.S.

Owner – Restoration Ecologist

ecosystem services LLC

(o): 970-812-ECOS (3267)

(c): 303-746-0091

(w): Blockedwww.ecologicalbenefits.com <Blockedhttp://www.ecologicalbenefits.com/>

(e): grant@ecologicalbenefits.com <mailto:grant@ecologicalbenefits.com>

P Life is like a river…we all must learn to adapt to the challenges of dynamic equilibrium

Appendix C

Commitment Letters to Provide Fire and Emergency Services

FALCON FIRE PROTECTION DISTRICT
Administration Office
7030 Old Meridian Road
Falcon, Colorado 80831
Business Number: 719-495-4050   Business Fax: 719-495-3112

October 15, 2018

4 Site Investments, LLC
1271 Kelly Johnson Blvd, Suite 100
Colorado Springs, CO 80920

Re: Conditional Commitment to Provide Emergency Services
Property: A portion of 4 Way Ranch- Phase 2

Based upon the information you have provided, a portion of the above-referenced real property is located within the jurisdiction and boundaries of the Falcon Fire Protection District ("Fire Department"). The portion within the boundaries of the Falcon Fire Protection District is that portion west of the North/South section line beginning at the intersection of Highway 24 and Curtis   By this letter, the Fire Department confirms its commitment to provide fire suppression, fire prevention, emergency rescue, ambulance, hazardous materials and emergency medical services (collectively, "Emergency Services") to the property within the District boundaries, subject to the following conditions:

- ☒ All new construction, renovations or developments within the Fire Department's jurisdiction must comply with the applicable fire code and nationally recognized life-safety standards adopted by the El Paso County Board of County Commissioners and the Fire Department's Board of Directors, as amended from time to time;
- ☒ All development, water and construction plans must be reviewed and approved by the Fire Department for compliance with the applicable fire code and nationally recognized life-safety standards prior to final plat or construction permit being issued; and,
- ☒ All development or construction projects shall meet the fire code and nationally recognized standards' pertaining to fire protection water. Please note that approved and inspected fire cisterns are permitted by the Fire Department in an attempt to help the property owner/developer meet these requirements.

Please do not hesitate to call the fire administration office or me for further information between 9:00 am and 4:00 pm, Monday through Friday.

Sincerely,
Trent Harwig
Fire Chief/Administrator

PEYTON FIRE PROTECTION DISTRICT
Administrative Offices
141 Union Boulevard, Suite 150
Lakewood, Colorado 80228-1898
Tel: 303-987-0835 800-741-3254
Fax: 303-987-2032

October 30, 2018

4 Site Investments, LLC
1274 Kelly Johnson Blvd., Suite 100
Colorado Springs, CO 80923

Re: A portion of 4 Way Ranch – Phase 2 (the "Project") – Fire Protection to Serve Letter

To Whom It May Concern:

Based upon the provided information, a portion of the above-referenced Project is located within the jurisdiction and boundaries of the Peyton Fire Protection District (the "District"). The portion within the boundaries of the District is that portion east of the North/South section line beginning at the intersection of Highway 24 and Curtis Road.

The District is able to provide fire prevention and suppression, emergency rescue, emergency medical, and emergency hazardous materials response to the portion of the Project that is within the District service area, subject to the following conditions:

- All new construction, renovations, or developments within the District's jurisdiction must comply with the applicable fire code and nationally recognized life-safety standards adopted by the El Paso County Board of County Commissioners and the District's Board of Directors, as amended from time to time;
- All development, water, and construction plans must be reviewed and approved by the District for compliance with the applicable fire code and nationally recognized life-safety standards prior to final plat or construction permit being issued; and
- All development or construction projects shall meet the fire code and nationally recognized standards pertaining to fire protection water. Approved and inspected fire cisterns are permitted by the District in an attempt to help the property owner/developer meet these requirements.

If additional information is required, please contact our administrative office at 303-987-0835. Thank you.

Sincerely,

Ashley B. Frisbie
District Manager

cc: Patrick Palacol, District President
Jeffery Turner, Fire Chief

Appendix D

USFWS IPaC Trust Resources Report

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

El Paso County, Colorado

Local office

Colorado Ecological Services Field Office

(303) 236-4773
(303) 236-4005

MAILING ADDRESS
Denver Federal Center
P.O. Box 25486
Denver, CO 80225-0486

PHYSICAL ADDRESS

134 Union Boulevard, Suite 670
Lakewood, CO 80228-1807

http://www.fws.gov/coloradoES
http://www.fws.gov/platteriver

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information.
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Preble's Meadow Jumping Mouse *Zapus hudsonius preblei* — Threatened

There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/4090

Birds

NAME	STATUS

Least Tern *Sterna antillarum* — Endangered

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/8505

Mexican Spotted Owl *Strix occidentalis lucida* — Threatened

There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/8196

Piping Plover *Charadrius melodus* — Threatened

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/6039

Whooping Crane *Grus americana* — Endangered

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

There is **final** critical habitat for this species. Your location is outside the critical habitat.
https://ecos.fws.gov/ecp/species/758

Fishes

NAME	STATUS

Greenback Cutthroat Trout *Oncorhynchus clarkii stomias* — Threatened

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2775

Pallid Sturgeon Scaphirhynchus albus — Endangered

This species only needs to be considered if the following condition applies:

- Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska.

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7162

Flowering Plants

NAME	STATUS
Ute Ladies'-tresses Spiranthes diluvialis No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2159	Threatened
Western Prairie Fringed Orchid Platanthera praeclara This species only needs to be considered if the following condition applies: • Water-related activities/use in the N. Platte, S. Platte and Laramie River Basins may affect listed species in Nebraska. No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1669	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

THERE ARE NO MIGRATORY BIRDS OF CONSERVATION CONCERN EXPECTED TO OCCUR AT THIS LOCATION.

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures and/or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ “What does IPaC use to generate the migratory birds potentially occurring in my specified location”. Please be aware this report provides the “probability of presence” of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the “no data” indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER POND
- Palustrine

RIVERINE
- Riverine

A full description for each wetland code can be found at the National Wetlands Inventory website

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

Appendix E

Mineral Estate Owner Certification

CERTIFICATION:

I Mike Bramlett on behalf of JR Engineering researched the records of the El Paso County Clerk and Recorder and established that there was/was not a mineral estate owner(s) on the real property known as Grandview Reserve . An initial public hearing on Grandview Reserve Preliminary Plan which is the subject of the hearing, is schedules for to be determined , ~~2000~~ 2019.

~~Pursuant to §24-65.5-103(4), C.R.S., I certify that a Notice of an initial public hearing was mailed to the mineral estate owner(s) (if established above) and a copy was mailed to the El Paso County Planning Department on _________________, 200____.~~

Dated this 8 day of January, 20~~0~~19.

[signature]

STATE OF COLORADO)
) s.s.
COUNTY OF EL PASO)

The foregoing certification was acknowledged before me this 8 day of January, 20~~0~~19, by Mike Bramlett.

Witness my hand and official seal.

My Commission Expires: 09-01-2020

LADONNA NELSON
Notary Public
State of Colorado
Notary ID # 20164033617
My Commission Expires 09-01-2020

[signature]
Notary Public

Appendix F

ESA Clearance Letter from the USFWS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
P.O. Box 25486, DFC (65412)
Denver, Colorado 80225-0486

IN REPLY REFER TO:
TAILS: 06E24000-2019-TA-0460

MAR 25 2019

Mr. Jon Dauzvardis, P.W.S.
Grant E. Gurnée, P.W.S.
Ecosystems Services
1455 Washburn Street
Erie, Colorado 80516

Dear Mr. Dauzvardis and Mr. Gurnée,

The U.S. Fish and Wildlife Service (Service) received your letter and habitat evaluation report on February 5, 2019, regarding the 4 Sites Investments proposed Grandview Reserve residential subdivision in El Paso County, Colorado. You requested concurrence that the proposed action would have no effect on listed species including the Ute-ladies'-tresses orchid (*Spiranthes diluvialis*) (ULTO), and Preble's meadow jumping mouse (*Zapus hudsonius preblei*) (Preble's mouse). These comments have been prepared under the provisions of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et. seq.).

The proposed action consists of the proposed development of a 768-acre residential community including 184 single-family multi-acre lots, streets, utilities, and open space areas between the towns of Falcon and Peyton. The project site is located on gently sloping and mildly undulating prairie dissected by four unnamed intermittent drainages which support limited wetland habitat. Two of these swale were preliminarily determined to contain jurisdictional wetlands and waters of the United States under the Clean Water Act pending US Army Corps of Engineers verification. Most of the upland acres would be developed while the drainage swales would be left as open space. The proposed project has no Federal nexus at this time.

The action area under consideration is located within the species' ranges for the Preble's mouse and ULTO, both of which rely on healthy riparian habitat.

The current condition of the riparian zones are not favorable for supporting Preble's mouse. The site photos in the report's appendices show a lack of cover from tall herbaceous or woody species. The considerable distance of unsuitable and disconnected habitat to the nearest known population would indicate that it is unlikely that Preble's mice are present within the action area.

Based on the information provided in your letter including area photos and project maps, the Service agrees that it is unlikely that the proposed project would result in "take" of the Preble's mouse. The project area does not occur within critical habitat for the Preble's mouse.

Although the project area's riparian habitats have been impacted by livestock grazing and invasive plants, even heavy grazing is not certain to preclude a site from supporting ULTO. The project area has not yet been surveyed for ULTO during the flowering season. Thus, it is not certain that ULTO is absent. The Grandview Reserve subdivision would be located between 7020 and 6860 feet above mean sea level, which is higher than the 6500-foot elevation recommended for conducting ULTO surveys.

You have indicated in your report that at Grandview Reserve, livestock grazing will cease, a landscape restoration program will begin for the areas to be retained as open space, a stormwater management plan would be developed to protect water quality and provide consistent flows to the drainage swales, and an in-season survey for ULTO shall be conducted for all wetland areas to be impacted, including road and trail crossings, utility installation areas, and stormwater outfalls. Such measures could have beneficial affects to ULTO if the species is present. The Service agrees that the proposed project would not affect ULTO if it is not present where construction activities would intersect wetland and riparian sites. However, ULTO needs three consecutive years of surveys to conclude presence or absence. Application of the above conservation measures as planned for the project, and best management practices would most effectively conserve the riparian habitats in the absence of enough surveying. The Service recommends careful consideration of the means by which invasive species are controlled, native herbaceous and woody species are selected and seeded and/or planted, stormwaters are released into the swales, and public access is managed. If future surveys reveal the presence of ULTO population(s) in the project area, additional consultation with this office would be recommended to further consider site-specific conservation measures.

Based on the information provided in your letter, including area photos and project maps, the Service agrees that the proposed project is unlikely to negatively impact ULTO because the project area is located at an elevation higher than where the species would be expected to occur.

If any additional species that are Federally-listed, proposed for Federal listing, or candidate for Federal listing are found in the project area, if critical habitat is designated in the project area, or if new information becomes available that reveals that the action may impact such species in a manner or to an extent that was not previously considered, this office should be contacted to determine if further ESA consultation will be required.

We appreciate your efforts to ensure the conservation of threatened and endangered species under the Endangered Species Act. If you have questions or comments related to this issue, please contact George San Miguel of this office at 303-236-4752.

Sincerely,

Drue DeBerry
Colorado and Nebraska Field Supervisor

Reference: Projects\ElPasoCounty_Grandview_FWSconcur

Appendix G

Professional Qualifications

ecos ecosystem services LLC

RESUME

Grant E. Gurnée, P.W.S.

Owner/Managing Partner
Senior Restoration Ecologist
Professional Wetland Scientist
Fisheries and Wildlife Biologist

AREAS OF EXPERTISE:

- Project Management for Complex, Environmental Regulatory and Restoration Projects
- Habitat Assessment, Surveys, Planning, Permitting, Restoration Design, Construction Oversight & Monitoring for:
  - Aquatic, Wetland and Riparian Habitat, and Wildlife Habitat
  - Threatened & Endangered Species, Special Status Species, and Species of Concern
  - Nesting Birds & Raptors
  - Natural Areas, Open Space, Trails and Environmental Education Facilities
  - Conservation and Resource Mitigation Banks
- Natural Resources/Environmental Regulatory Compliance
- Construction Oversight & Best Management Practices
- Grant Funding Support for Conservation and Restoration Projects
- Expert Witness Testimony

EDUCATION:

- MCRP, Environmental Planning and Law Program, Rutgers University, 1994
- Bachelor of Science, Biology, Richard Stockton College of N.J., 1984

EMPLOYMENT HISTORY:

- 2008-Present: Owner, Managing Partner and Senior Restoration Ecologist
  Ecosystem Services, LLC, Erie, Colorado
- 1999-2011: Ecological Restoration Group Manager
  Walsh Environmental Scientists and Engineers, LLC, Boulder, Colorado
- 1994-1999: Vice President and Consulting Division Manager
  Aquatic and Wetland Company, Boulder, Colorado
- 1987-1994: Ecological Assessment Group Manager
  Killam Associates, Millburn, New Jersey
- 1989 – 1994: Owner and Ecologist, Westhill Environmental, Colonia, NJ
- 1986-1987: Project Manager, Connolly Environmental, Denville, New Jersey
- 1985-1986: Biological Technician/Team Lead, EA Engineering Science and Technology, Forked River Field Station, New Jersey

CONTINUING EDUCATION:

- Navigable Waters Protection Rule (NWPR) USEPA Webcast - 2020
- Colorado Stream Restoration Network, Stream Restoration Body of Knowledge Seminar Series – 2014 to 2019
- Stream Functions Pyramid Workshop, Denver, CO - 2014
- Colorado Natural Heritage Program, Wetland Plant Identification - 2014
- Colorado Natural Heritage Program, Ecological Integrity Assessment for Colorado Wetlands - 2013
- FACWet – Functional Assessment of Colorado Wetlands - 2010, 2012 and 2013
- Natural Treatment System Design and Implementation, Southwest Wetlands, Phoenix, AZ - 1995
- Continuing Education in Coastal and Wetland Ecology, Rutgers University, 1985 – 1994

CERTIFICATIONS:

- Professional Wetland Scientist, Certification (#559), Society of Wetland Scientists Certification Program, 1995
- Certified Wetland Delineator, Army Corps of Engineers Wetland Delineator Certification Program, 1993
- Wetland Mitigation Planning and Design Certification, Environmental Concern, Sparks, MD, 1992
- Certified Ornithologist, Marine Biologist, Aquatic Biologist and Ecologist for the preparation and certification of Environmentally Sensitive Areas Protection Plans, N.J. Dept. of Environmental Protection and Energy, 1988
- Wetland Delineation and Regulatory Certification, National Wetland Science Training Institute, 1988

PROTECTED SPECIES SURVEYS AND HABITAT ASSESSMENTS:

- Ute-ladies' tresses orchid and Colorado butterfly plant
- Preble's meadow jumping mouse
- Nesting birds and raptors, including burrowing owls
- Swift fox and bobcat
- Boreal toad
- Pine Barrens and grey tree frogs
- Freshwater, estuarine and marine surveys for native fish
- Western Tiger Salamander
- Terrestrial and sea turtles

EXPERIENCE SUMMARY:

Mr. Gurnée is a founder and managing partner of Ecosystem Services, LLC (ecos), a design-build, ecological planning and design firm that is the culmination of his life's work and passion for restoring and conserving the natural world. Grant is a certified Professional Wetland Scientist with over 36 years of experience in wetland ecology, restoration ecology, wildlife and fisheries biology, environmental planning, and regulatory compliance. Prior to ecos Grant established the Ecological Restoration Group at Walsh Environmental and was the Vice President in charge of the Consulting & Design Division for Aquatic and Wetland Company, the first design-build-grow firm in Colorado. Mr. Gurnée utilizes his diverse field assessment and hands-on experience to bring a unique and pragmatic, big-picture perspective to projects from conceptual planning through implementation. Grant's environmental planning and law education combined with his regulatory compliance experience make him one of the leading experts in the Intermountain West in Clean Water Act and Endangered Species Act issues. He enjoys teaching and furthering the science and art that comprise the field of restoration ecology. As such, Grant has published and presented papers and technical manuals, and lectured nationally and internationally at educational programs that further the understanding of aquatic, wetland, riparian and Threatened and Endangered (T&E) species habitat assessment and restoration. Mr. Gurnée has also been called upon to provide expert reports, expert witness testimony and liaison representation in complex regulatory compliance matters.

RELEVANT PROJECT EXPERIENCE:

The following is a sampling of select projects and clientele that Grant has successfully completed or is currently involved in:

Habitat Assessment and Regulatory Compliance

- **Cinemark Preliminary Habitat Assessment and Jurisdictional Assessment, Colorado Springs, CO** – ecos was hired by Classic Consulting Engineers and Surveyors to perform a Preliminary Habitat Assessment (PHA) and Jurisdictional Assessment of waters of the U.S. (WOUS) under the Clean Water Act (CWA)for Cinemark property within Colorado Springs, Colorado. The PHA included an assessment and mapping of vegetation, noxious weeds, Federal and State Listed Candidate, T&E Species, Wildlife Species of Concern (including Raptors), Waters of the U.S. and Wetland Habitat, Floodplains, and Cultural, Archeological and Paleontological Resources. The PHA Report summarizes ecos' Site assessment findings and includes the mapping of all ecological constraints and cultural resources, a preliminary jurisdictional status determination of all potential wetland habitat and WOUS under the CWA, a summary of ecological opportunities and constraints, and provides regulatory guidance to assist in planning and implementing the future development of the site.

- **Morning Fresh Dairy Farm Clean Water Act Jurisdictional Assessment, Bellvue, CO** – ecos was retained by Otis, Bedingfield & Peters, LLC to assist the Morning Fresh Dairy Farm in determining the jurisdictional status of onsite drainages under the CWA, including the assessment of onsite and offsite, downstream connections to Waters of the United States.
- **4 Way Ranch Assessment & Regulatory Compliance Report, El Paso County, CO** - ecos was retained by 4 Way Ranch to perform a natural resource assessment for their Phase 2 development, and to prepare a Natural Features Wetland, Wildfire, Noxious Weeds & Wildlife Report (Report) pursuant to El Paso County environmental review regulations. The purpose of the project was to identify and document the natural resources, ecological characteristics and existing conditions of the Site; identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources, including: Mineral and Natural Resource Extraction; Vegetation; Wetland Habitat and WOUS; Noxious Weeds; Wildfire Hazard; Wildlife; Federal and State Listed Candidate, Threatened and Endangered Species; and Raptors and Migratory Birds.
- **Banning Lewis Ranch, Colorado Springs, CO** – ecos was hired by Norwood Homes to perform a PHA for the Banning Lewis Ranch (BLR), an 18,000-acre property within El Paso County, Colorado that will double the size of Colorado Springs once it is developed. The PHA included an assessment and mapping of vegetation, noxious weeds, Federal and State Listed Candidate, T&E Species, Wildlife Species of Concern (including Raptors), Waters of the U.S. and Wetland Habitat, Floodplains, and Cultural, Archeological and Paleontological Resources. The PHA Report summarizes ecos' Site assessment findings and includes the mapping of all ecological constraints and cultural resources, a preliminary jurisdictional status determination of all potential wetland habitat and WOUS under the CWA, a summary of ecological opportunities and constraints, and provides regulatory guidance to assist in planning and implementing the future development of the BLR. Norwood and their planning team, in association with ecos, are currently uploading and interpreting all of the ecos Site assessment mapping into their base GIS layers to inform future site planning and recommend proactive measures to conserve wildlife and wetland habitat, pristine prairie and ephemeral creeks, floodplains, and significant cultural resources.
- **Clean Water Act Jurisdictional Assessment of El Guique Mine in Estaca, New Mexico –** Ecos assisted Espanola Transit Mix, LLC (ETM) in their assessment at the El Guique Mine in Estaca, New Mexico (Site) by determining the potential jurisdictional status of onsite drainages and other waters under the CWA. We reviewed available background information and base mapping to gain a better understanding of the Site and the adjacent offsite area and prepared an overlay of potential WOUS on Google Earth aerial Imagery for mark-up and notation in the field. Ecos then conducted a field assessment to review Site conditions, and potential offsite, downstream connections to WOUS, and particularly the presence of a Significant Nexus to the Rio Grande, a TNW. We drafted a Technical Memorandum summarizing the methodology employed, the results of the field assessment, the rationale under the CWA for all areas deemed to be excluded or non-jurisdictional and illustrated the locations of potential jurisdictional and non-jurisdictional features identified in the field on Google Earth aerial imagery.
- **Bellvue Pipeline Project, BMP Facilitator, Larimer County, CO** – ecos was retained by the City of Greeley as Best Management Practices (BMP) Facilitators to provide pre-construction documentation post-construction oversight of pipeline reclamation processes. Essential responsibilities include meeting with landowners prior to construction to facilitate project understanding and post-construction outcomes; to document landowner needs and wants relative to project goals and land use; to document and monitor pre- and post-construction reclamation and maintenance requirements; and to ensure the contractors maintain compliance with all state and federal laws, county regulations, and Greeley construction and restoration specifications.
- **Encana Oil and Gas (USA), Denver Julesburg Basin, CO** – Encana hired ecos to assess their ecological constraints, recommend means and methods to avoid, minimize and permit unavoidable impacts; and to mitigate, restore and prepare ecological management plans for their drilling and pipeline operations in the Denver Julesburg basin. Grant's role on the team is to perform site assessments, research background data, and prepare assessment reports and mapping data that can be utilized by Encana's project managers to proactively track ecological resources before issues arise. In addition to client consultation, Ecos is responsible for tracking drill site schedules, constraints, restoration and management efforts in a data base and reporting said information to Encana's project manager on a regular basis.
- **Georgetown Lake, Georgetown, CO** –ecos was hired to perform an onsite assessment of ecological resources and prepare a summary report to describe the physical/ecological characteristics of the Project

area and evaluate the potential effects of the construction of a loop trail project on environmental issues and species of concern to support a GOCO grant application. Items evaluated and documented, include site location/ownership, general site characteristics, current land use, proposed impacts, possible effects on Federal– and State-listed T&E animal and plant species, unique or important wildlife, water quality, water bodies, wetlands, and floodplains, stormwater runoff, sedimentation, soil erosion, and invasive species. The assessment report also included mitigation measures, project benefits, and environmental compliance recommendations under applicable regulatory programs.

- **Site Assessments for General Vegetation Cover and T&E Species Presence/Absence** – ecos was retained by JADE Consulting, LLC to perform the assessment of two future development sites located in Lafayette and Yuma, Colorado. We performed a desk-top assessment to identify existing site characteristics and screen the potential presence/absence of federally-listed T&E species and followed up with onsite assessments to verify our preliminary findings. Our findings and recommendations were summarized in a Technical Memorandum in which we determined that no further assessment or regulatory compliance actions are required.
- **The Cove Assessment & Regulatory Compliance Report, El Paso County, CO** - ecos was retained by Lake Woodmoor Development, Inc.to perform a natural resource assessment for The Cove development, and to prepare a Natural Features Wetland, Wildfire, Noxious Weeds & Wildlife Report (Report) pursuant to El Paso County environmental review regulations. The purpose of the project was to identify and document the natural resources, ecological characteristics and existing conditions of the Site; identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources, including: Mineral and Natural Resource Extraction; Vegetation; Wetland Habitat and Waters of the U.S.; Noxious Weeds; Wildfire Hazard; Wildlife; Federal and State Listed Candidate, Threatened and Endangered Species; and Raptors and Migratory Birds.
- **Jurisdictional Determination Request for Banning Lewis Ranch, Villages 1 and 2 Residential Development, El Paso County, CO** - ecos was retained by Oakwood Homes, LLC to review a 2014 Jurisdictional Boundary Delineation and determine if a portion of the wetlands and waters within the site could be deemed non-jurisdictional under the Clean Water Act (CWA) based on their "isolated" status. Following data review, ecos arranged a field assessment with the U.S. Army Corps of Engineers (Corps) to review site conditions, and potential offsite, downstream connections to waters of the U.S. (WOUS), and particularly the presence of a Significant Nexus to Traditional Navigable Waters TNW). Ecos and the Corps agreed that several of the intermittent drainages on the suite are not jurisdictional under the CWA, as they are not: 1) a TNW or wetland adjacent to a TNW; 2) a Relatively Permanent Water (RPW) or a wetland directly abutting an RPW with perennial or seasonal flow; 3) a tributary to a TNW; or 4) a direct tributary to a downstream WOUS as the feature loses it bed and banks. The Corps submitted ecos' findings to the U.S. Environmental Protection Agency (EPA) and they concurred and issued an Approved Jurisdictional Determination stating that the drainages were indeed "isolated" features exempt from the CWA.
- **Bellvue Pipeline Project, CWA and ESA Regulatory Negotiation, Larimer County, CO** – ecos assisted the City of Greeley from 2011 through 2014 in their negotiations with the Corps to facilitate review and verification of the Project under CWA, Nationwide Permit12 (NP12) in 2014. Grant aided the City during Corps meetings, field visits and teleconferences; in coordinating with the Corps and the technical experts on the Corps Common Technical Platform (CTP) team; and in utilizing the CTP Poudre watershed data to assess the probability of Project-specific impacts. Grant also provided regulatory and technical support to the City for the CWA, Pre-Construction Notification (PCN) Supplement for the Project from 2014 through the USACE's 2017 issuance of the "removal of capacity conditions for the Northern and Fort Collins segments" placed on the 2014 NP12. His tasks included performing Impact Avoidance Evaluations, providing historical context and data from the initial work performed for the City on this Project, assisting a Team of multi-disciplinary professionals in the preparation of Impact Assessment Reports, meeting with the City to discuss overall regulatory strategy, assisting with the preparation of the cover letter to transmit the PCN Supplement to the USACE, and assisting with discussions and presentations to the USACE during their review and processing of a Minimal Effects Determination for the Project.

  Mr. Gurnée also assisted Greeley in their negotiations with the FWS to facilitate review and consultation for the Northern Segment of the Project under Section 7 of the ESA. Grant led the field assessment with FWS, identification and prioritization of potential PMJM habitat mitigation sites, development of a conceptual design for the selected PMJM habitat mitigation sites, and preparation of the Biological Assessment

Addendum and Habitat Mitigation Plan. Grant also aided the City during agency review and approval of the FWS Biological Opinion by utilizing his relationships with the FWS, and extensive experience of ESA regulations, policies and precedents.

- **Appraisal Support Documentation Report for the 1st Bank Parcel, Colorado Springs, CO** - ecos was retained by 1st Bank Holding Company to perform a Preble's meadow jumping mouse (PMJM) habitat assessment, mitigation cost analysis and conceptual lot layout for the approximate 9.4-acre 1st Bank Parcel (Site) situated south of the Gleneagle residential development and north of the current Northgate Open Space along Smith Creek in Colorado Springs, Colorado.
- **South Boulder Canon Ditch Maintenance, CWA Exemption Determination, Erie, CO** – ecos assisted the Town of Erie in exempting their proposed ditch maintenance project by performing an assessment of site conditions, submitting the assessment report to the Corps, and verifying that said project is exempt pursuant to Section 404(f) of the CWA.
- **Endangered Species Act (ESA) Compliance Documentation for the Pinon Lake tributary CLOMR Application, Forest Lakes Filing 2B in El Paso County, Colorado** – ecos performed an assessment to document the absence of federally-listed T&E species and their habitat and prepared a report for FEMA that documents that the proposed CLOMR action will not result in a "take" of T&E species.
- **Gleneagle Infill Development Assessment & Regulatory Compliance Report, El Paso County, CO** - ecos was retained by G & S Development, Inc. to perform a natural resource assessment for the proposed Gleneagle Infill Development at the former Gleneagle Golf Course, and to prepare a Natural Features and Wetland Report (Report) pursuant to El Paso County environmental review regulations. The purpose of the project was to identify and document the natural resources, ecological characteristics and existing conditions of the Site; identify potential ecological impacts associated with Site development; and provide current regulatory guidance related to potential development-related impacts to natural resources, including: Mineral and Natural Resource Extraction; Vegetation; Wetland Habitat and Waters of the U.S.; Weeds; Wildfire Hazard; Wildlife; Federal and State Listed Candidate, Threatened and Endangered Species; and Raptors and Migratory Birds. As part of the Project, ecos obtained an Approved Jurisdictional Determination from the Corps.
- **North Fork at Briargate Habitat Evaluation and ESA Compliance, Colorado Springs, CO** - ecos performed a habitat evaluation on behalf of High Valley Land Co., Inc. and La Plata Communities to support informal consultation with the U.S. Fish and Wildlife Service (FWS) under the ESA for potential effects to the Federally-listed, threatened PMJM from the proposed North Fork development, Filings 3 through 7 at Briargate.
- **C Lazy U Preserves Natural Resource Inventory and Conservation Easement Documentation, Grand County, CO** – ecos is assisting the C Lazy U Preserves in assessing and documenting the conservation values of the 980-acre site known as C Lazy U Preserves near Granby, CO such that the site may be protected under Conservation Easements (CE's) held by The Nature Conservancy. The purpose of the CE's is the long-term preservation of the scenic, open space, agricultural, significant natural habitat, native vegetation, rare plant communities, riparian, and wetland values of the Property. ecos staff completed the Easement Documentation Reports Phase 1 of the CE's in 2006, Phase 2 in 2007, and Phase 3 in 2015.
- **Seaman Water Management Project, Riparian-Wetland Technical Support -** Mr. Gurnée supported Greeley in the NEPA EIS process by reviewing riparian and wetland technical reports prepared by the Corps CTP team, and providing comments to assist the City in their formal review and response to the Corps. He also provided technical and regulatory support for CWA and ESA (PMJM habitat) assessment, consultation, and compensatory mitigation planning and design.
- **City of Louisville, City of Westminster, Jefferson County and Town of Monument** – ecos performed numerous wetland habitat, wildlife, MBTA and T&E species habitat ecological assessments, wetland delineations, and Clean Water Act Section 404 and Endangered Species Act Section 7 Permits and mitigation plans for counties, municipalities and quasi- municipalities, including Highway 42 and 96th Street realignment, Jim Baker Reservoir, Standley Lake Protection Project, Triview Metro District Preble's and wetland habitat mitigation planning.
- **ARCO Clark Fork River Basin Anaconda Smelter Superfund Site, Anaconda, MT** – Grant and his Team performed wetland delineation, functional assessments, and impact analysis over a 200 square mile area affected by historic mining practices and current remedial actions required by an EPA consent decree.

- **ARCO Clark Fork River Basin Milltown Reservoir Superfund Site, Missoula, MT** – Mr. Gurnée and his Team performed wetland delineation, functional assessments, and impact analysis of proposed remedial actions that will remove metal laden sediments from the site prior to dam removal.
- **C-Lazy-U and Horn Ranch Environmental Assessments, Granby, CO** – Mr. Gurnée and his Team performed an assessment of ecological opportunities and constraints in the aquatic, riparian, wetland and threatened and endangered species habitat along the Colorado River for the development and enhancement of fishing/resort ranch amenities.
- **Village at Avon, Avon, CO** – Grant and his Team performed a wetland delineation and prepared CWA Section 404 permitting for the town center expansion and low-density ranchette development.

Protected Species Surveys and Habitat Assessments

- **Golden Eagle Monitoring at Meadow Park in Lyons, CO** - ecos was retained by the Town of Lyons (Town) to perform the monthly monitoring of the Golden Eagle (*Aquila chrysaetos*) nest sites at Meadow Park, to prepare monthly Monitoring Summary Memorandum following each event, and to prepare and submit annual reporting to the U.S. Fish and Wildlife Service (USFWS) associated with the *Lyons Federal Fish and Wildlife Permit #MB82833B-0, Eagle Take Associated With But Not The Purpose Of An Activity* (Take Permit).
- **Nesting Birds, Raptors and Burrowing Owls** – Grant has completed over 100 pre-construction nesting surveys and numerous monitoring surveys for raptors and burrowing owls. His projects include pipeline rights-of-way, housing and commercial development projects, stream and river restoration projects, wind and solar farm projects, and oil and gas projects along the Front Range of Colorado, as well as projects in the Pine Barrens of southern New Jersey. His avian experience includes golden eagle nest monitoring; barred owl roost and nest monitoring, and call playback inventory; and multi-species raptor surveys.
- **Native Plants** - Grant has completed numerous pre-construction and monitoring surveys for Ute ladies' tresses orchid and Colorado butterfly plant since 1994. His projects include pipeline rights-of way, mined land reclamation projects, housing and commercial development projects, stream and river restoration projects, wind and solar farm projects, and oil and gas projects along the Front Range of Colorado.
- **Threatened, Endangered and Candidate Species** – Grant trained with the leading expert, Robert Stoecker, PhD, in 1994 and 1995 to gain an understanding of the soon to be listed, Preble's meadow jumping mouse, a threatened species; and since that time, he has completed numerous surveys, habitat assessments, and ESA consultations. He has also performed night-time Swift fox surveys at windfarm sites in southern CO and Boreal toad surveys in northern CO. Prior to relocating to CO Grant performed numerous surveys in N.J., including bobcat surveys to assist in protecting the Pyramid Rock Natural Area; Pine Barrens and gray tree frog surveys, and native Pine Barrens fish surveys with his mentor, Dr. Rudy Arndt; and Eastern box turtle surveys. He also assessed migration routes and alternative mitigation measures for sea turtles that were being impacted by the Garden State Parkway.

Wetland Mitigation and Habitat Restoration

- **Park Creek Mitigation Bank, Fort Collins, CO –** ecos was retained by Burns and McDonnell to assess, map, and prepare preliminary mitigation design of aquatic, wetland, riparian and terrestrial habitat in support of a mitigation banking prospectus. Upon completion and acceptance of the prospectus by the USACE, ecos has been tasked to manage the baseline assessment of the site, including groundwater testing, topographic surveys, and hydrology; prepare a detailed habitat design for inclusion in mitigation banking instrument; as well as coordinate design-build process with a selected nursery and contractor.
- **Front Range Mitigation and Habitat Conservation Bank –** ecos is assisting Restoration Systems, LLC (RS), the Bank Sponsor, with the assessment, planning and design of the Front Range Umbrella Bank for Aquatic Resource Mitigation & Habitat Conservation (Bank). This "umbrella" Bank is intended to provide habitat mitigation for projects along the entire Front Range of Colorado. The **ecos**/RS Team is in the process of securing viable sites in the major watersheds along the Front Range; and recently submitted the Draft Prospectus for the establishment of the Bank to the U.S. Army Corps of Engineers, Albuquerque District, Southern Colorado Regulatory Office and Omaha District, Denver Regulatory Office.
- **Lions Park Poudre River CWA and ESA Mitigation Site** - ecos assisted Greeley in developing and constructing an advance river and wetland mitigation site at Lions Park in LaPorte, Colorado that may be used for future CWA impacts in the Poudre River watershed. We also prepared a conceptual design for Preble's meadow jumping mouse habitat that will be used to support ESA consultation. ecos assessed the

site, prepared the designs, and coordinated review with Greeley, Colorado Department of Parks and Wildlife, Larimer County Parks and Open Lands and Larimer County Engineering Department. The mitigation site provides compensatory mitigation for impacts to wetland and waters of the U.S. under the CWA and will also provide compensation for PMJM habitat under the ESA. This mitigation project entails development of mitigation measures including bioengineered streambank stabilization, fishery habitat enhancement, riparian and wetland habitat restoration and PMJM habitat enhancement.

- **Bellvue Transmission Line Project, Preliminary Compensatory Mitigation Plan (PCMP) -** Mr. Gurnée was the Project Manager for the preparation of the Preliminary Compensatory Mitigation Plan (PCMP) for the Bellvue Transmission Line Project. Built upon preferred strategies in the 2008 Corps Compensatory Mitigation Rules, the PCMP leverages a broad strategy to ensure mitigation success and employs a watershed approach to select and prioritize compensatory mitigation (CM) measures that will best mitigate adverse environmental effects. It is intended to support a Corps determination of minimal adverse effect and allow verification of the Northern Segment of the Project under Nationwide Permit 12. Grant led the Team during the watershed assessment of the Poudre River, identification and prioritization of potential CM and preservation sites, development of a Pilot Watershed Plan, and conceptual design of priority CM sites. The PCMP has been submitted to the Corps for review and approval.
- **Flatirons Parcel Riparian and Wetland Habitat Restoration Project** – Grant assisted Greeley in developing a multiple use project at the Flatirons Parcel, a gravel quarry site in Greeley, Colorado. The site is being decommissioned over the next decade and offers great potential to create a system of ponds connected via a naturalized stream that discharges into the Poudre. The concept design incorporates recreation opportunities that are tied into the Poudre River Trail, a passive park, and the development of wetland, riparian and wildlife habitat.
- **Ruby Pipeline Wetland, Riparian and Waterbody Mitigation and Restoration Plan, WY, UT, NV AND OR -** Mr. Gurnée was the lead restoration ecologist and wetland scientist for the 675-mile, Ruby Pipeline; a natural gas pipeline traversing four states. He was the lead for the preparation of Wetland Mitigation, Riparian and Waterbody Restoration Plans under the CWA, BLM regulations and state equivalent programs. The plans included regulatory guidelines, requirements, and processes; and ecoregion specific restoration plans. The plans detailed specifications for the basis of design, construction, and revegetation; outlined performance criteria, maintenance and monitoring methods for the restoration of approximately 460 acres of temporary wetland impacts.
- **River Point, Sheridan, CO -** Mr. Gurnée was the project manager and lead restoration ecologist for the team that assessed, permitted and designed the natural and aesthetic features of this Brownfields project. The project included a naturalized water quality swale and riverfront improvements which complement the aesthetics and ecology of the South Platte River corridor. The swale was designed to mimic the form and function of a tributary stream, providing passive water treatment with native wetland and riparian vegetation, as well as flood attenuation with instream structures and grade control. The project utilized natural, “bio-engineering” and “bio-technical” techniques to repair and maintain channel and stream bank stability, and native vegetation to enhance and restore habitat. This project also addressed the interface of proposed restaurants, a regional greenway trail, and the river through planning and design of nature trails, interpretive nodes and overlooks/access features that will function to both stabilize banks and help connect people with the river.
- **Caribou Peat Bog Restoration, Nederland, CO –** Grant performed the impact assessment, prepared native plant community design, planting cost estimate, and on-the-ground oversight of restoration volunteers to restore a high-altitude peat bog disturbed by an illegal off-road-vehicle “mudfest”.
- **Opportunity Ponds Operational Unit, Anaconda, MT -** Mr. Gurnée was the project manager and lead restoration ecologist providing technical support to Atlantic Richfield/British Petroleum at a Superfund site in the Upper Clark Fork River basin in Montana between 1995 and 2008. Services included wetland delineation and functional assessment of over 3,000 acres of wetland, stream and pond habitat; design of stream and wetland habitat mitigation projects; and permitting/compliance services. The largest project within the Superfund site was the Opportunity Ponds, a 908-acre wetland, stream and wildlife habitat creation project. The project will result in the largest freshwater mitigation project in the U.S; and is intended to mitigate for historic wetland/waters impacts from Anaconda Mining Company operations and current impacts resulting from remedial actions associated with the Superfund cleanup process.
- **The Club at Flying Horse Golf Course, Colorado Springs, CO –** On behalf of Classic Communities, Grant and his Team assessed wetland habitat, recommended impact avoidance and minimization

measures, and prepared the Section 404, CWA permit for a 1500-acre mixed use development and Weiskopf golf course. The project aesthetic and mitigation measures included the design of native prairie roughs, meandering stream channels and native wetland meadows within the golf course. Extra wetland mitigation was created to serve as a private mitigation bank for the client.

- **Maloit Park, Minturn, CO -** Grant was the project manager and restoration ecologist for the Maloit Park Restoration Project, which was necessitated by the accidental release of mine slurry that contaminated the soils and vegetation of critical wetland habitat at the confluence of Cross Creek and the Eagle River. The project included the assessment of the site, the collection of native wetland seed (that was adapted to site conditions); the selection of appropriate replacement soil; the design of the restoration grading and planting plans; and oversight during the soil replacement, grading and planting phases. Mr. Gurnée also provided follow-up monitoring and reporting to ensure the successful establishment of the wetland habitat.
- **Department of Energy, Private Mitigation Bank, Westminster, CO -** Mr. Gurnée provided the project assessment, design, permitting, mitigation banking instrument negotiation with the Corps and EPA, and construction supervision of a 12-acre wetland mitigation bank for the Department of Energy in Westminster, CO. The project provides compensatory mitigation for impacts associated with the Rocky Flats clean-up and remediation project. It should be noted that this was the first private mitigation bank negotiated in Colorado, and as such it assisted in setting the precedent for future negotiations.
- **Saudi Arabia Coastal Wetland Restoration -** Mr. Gurnée assisted in the restoration planning for 67 square kilometers (41 square miles) of high salt marsh (sabhka) impacted by Gulf War oil spills.

Aquatic, Wetland, and Riparian Habitat Design

- **Saint Vrain Creek Reach 3 Phase 2 Flood Recovery and Restoration, Boulder County, CO** - ecos is part of the Design Team assisting Boulder County Parks & Open Space (BCPOS) with the restoration, repair and enhancement of the Phase 2 reach of the Saint Vrain Creek in rural Boulder County, which was damaged by the 2013 floods. Our role on the project includes: 1) desktop and field assessment to inventory and document the characteristics of the stream reach and riparian corridor (e.g. stream/in-stream features, vegetation, wildlife habitat); identifying and locating significant habitat features within the areas of proposed construction; identifying potential sources of native plant materials for restoration; and identifying areas of opportunity within the breach repair work areas for native vegetation, wetland, PMJM, and fishery habitat restoration; and delineate wetland habitat and waters of the U.S. in all areas of proposed/potential construction-related impact; 2) vegetation community and wildlife habitat restoration design and fish passage design parameters; 3) permitting and compliance under the CWA and ESA; 4) construction oversight for restoration construction; and 5) monitoring and reporting project success/establishment to BCPOS, stakeholders, the Corps, FWS and the State of Colorado Department of Local Affairs (DOLA) under the (the Grant funding agency under the Community Development Block Grant Disaster Recovery (CDBGDR) Resilience Planning Program grant.
- **Big Thompson River Flood Recovery and Restoration, Loveland, CO -** ecos is currently part of a multi-disciplinary team assisting the Big Thompson Watershed Coalition (BTWC) with assessment, design, and construction of the Big Thompson between Rossum and Wilson Drives which are majority-owned by the City of Loveland and Loveland Ready-mix. As with all the flood recovery projects ecos has worked on, we produced 30%, 60% and 100% design plans, construction cost estimates, and specifications guiding soil development/enrichment; upland, riparian, and wetland seeding and planting; and numerous bioengineering techniques aimed at restoring the river and making it more resilient to future flood events. This project is aimed at completion in the summer of 2019.
- **Saint Vrain Creek Reach 3 Flood Recovery and Restoration, Boulder County, CO** - ecos was part of the Design Team assisting BCPOS with the restoration, repair and enhancement of the reach of the Saint Vrain Creek from Highway 36 downstream to Hygiene Road in rural Boulder County, which was damaged by the 2013 floods. Our role on the project included: 1) desktop and field assessment to inventory and document the characteristics of the stream reach and riparian corridor (e.g. stream/in-stream features, vegetation, wildlife habitat); identifying and locating significant habitat features within the areas of proposed construction; identify potential sources of native plant materials for restoration; and identify areas of opportunity within the breach repair work areas for native vegetation, wetland, PMJM, leopard frog and fishery habitat restoration; and delineate wetland habitat and waters of the U.S. in all areas of proposed/potential construction-related impact; 2) vegetation community and wildlife habitat restoration design and fish passage design parameters; 3) permitting and compliance under the CWA, ESA and

NHPA; 4) construction oversight for restoration construction; and 5) monitoring and reporting project success/establishment to BCPOS, stakeholders, the Corps, FWS and the State of Colorado DOLA under the CDBGDR Resilience Planning Program grant.

- **Bohn Park Flood Recovery Design, Town of Lyons, CO** – ecos is part of the Design Team assisting the Town with the restoration, repair and enhancement of Bohn Park in Lyons, which was damaged by the 2013 floods. Ecos roles is to assess and design the natural restoration of the vegetation communities and habitat along St. Vrain Creek and riparian corridor; and to support the project design by acquiring permits/approvals and maintaining regulatory compliance under the CWA, ESA and National Historic Preservation Act (NHPA). The final design will address goals and priorities associated with the Parks Flood Recovery Planning Process, FEMA Project Worksheets and Project Scopes, the Lyons Recovery Action Plan (LRAP), associated Program Development Guides (PDG's), existing Town master plans, comprehensive plans and other relevant documentation and studies.
- **James Creek Post-Flood Restoration, Lefthand Watershed Oversight Group (LWOG), Jamestown, CO** – ecos was part of the LWOG and Boulder County Department of Transportation Team responsible for preparing the 30-60% design package for James Creek Reach 16 as identified in the Left Hand Creek Watershed Master Plan. ecos performed pre- and post-flood plant community assessment; developed revegetation goals and objectives, the basis of design, monitoring protocols, and revegetation plans in accordance with Colorado Department of Local Affairs (DOLA), Community Development Block Grant – Disaster Recovery (CDBG-DR) 30% Guidelines. Specific resources and issues of concern addressed by ecos, included federal and state listed candidate, threatened and endangered species, wildlife species of concern (including raptors), fisheries and fish passage, native plant communities, and management of noxious weeds, all in concert with geomorphic, hydrology and hydraulic analysis and design prepared by other team members.
- **Saint Vrain Creek Restoration and Floodplain Resiliency Plan, Lyons, CO** – ecos is part of the design-build team intent on restoring the St. Vrain Creek corridor in the Town of Lyons that was damaged during the September 2013 flood event. The goal of the project is to create a more resilient floodplain and natural channel condition that will alleviate future threats to the community, reestablish floodplain connectivity, stabilize banks, and restore aquatic, wetland and riparian habitat that was wiped out during the flood. Grant is responsible for CWA, ESA, Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act permitting; as well as developing the plant communities and revegetation strategies needed to restore aquatic and riparian structure and functions within the corridor that support fish, wildlife, recreation, and help the town regain the ecological benefits and economic value they receive from outdoor enthusiasts.
- **Bellvue Raw Water Ponds Riverbank Restoration, Bellvue, CO –** The 2013 flood on the Poudre River altered the course of the river and severely eroded a bank nearly causing a breach of the City of Greeley's raw water ponds – their main municipal water supply. The goal of the project was to stabilize the bank to protect the ponds and to create riparian habitat for the Preble's meadow jumping mouse, a federally listed threatened and endangered species. Jon was responsible for preparing bioengineering design plans and specifications that include soil/cobble encapsulated lifts, stream barbs to deflect flows away from the bank, and harder, biotechnical design of soil/riprap and stream bed scour protection measures to prevent erosion and further undermining and sloughing of the bank. Design plans included specification of native plant materials and various techniques to restore cottonwood forest and willow habitat to further stabilize the bank.
- **Poudre River Pipeline Crossing at Kodak, Windsor, CO –** ecos role on the project was to assess restoration potential, techniques, and prepare design plans and performance specifications to reclaim a pipeline corridor across the lower Poudre River where the City of Greely had to replace 3 major water supply lines. ecos also provided oversight during the construction of site and riverbank stabilization and restoration measures following installation of the pipelines.
- **Lions Park Poudre River Restoration Plan, Laporte, CO –** ecos role on the project was to assess habitat conditions; gather, compile and analyze field survey data; and to prepare the mapping and mitigation design plans for the Lions Park PMJM habitat and the Poudre River Bank Stabilization Plans. We designed and executed the technical drawings for the structural components of the habitat, ensuring that the proposed riparian plant community, habitat structures (brush piles), and bioengineered streambank stabilization measures will create the conditions that alleviate the current habitat fragmentation; support the life requisites of the PMJM; and enhance the overall health of the Poudre River fishery.

- **C Lazy U Ranch, Willow Creek Fishery Enhancement Plan, Granby, CO -** Mr. Gurnée was the lead fisheries biologist and wetland ecologist for the assessment and design of this project. The project entailed 2 miles of instream and riparian cover habitat aimed at enhancing water quality through increased bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach given existing land-use constraints, and ongoing ranching activities. Bank-side improvements included wetland mitigation design to support ranch impacts, detailed seeding and planting plans indicating site-specific plant and seed locations, life zones, and species palettes according to hydrologic, soil, and aspect conditions. Grant was the regulatory lead, consulting with the Corps under Section 404 of the CWA.
- **Edwards Eagle River Restoration Project, Edwards, CO –** Grant was the senior wetland ecologist and fisheries biologist for the Edwards Eagle River Restoration Project (Project); which is roughly 1.5 miles long covering an area of 168 acres of floodplain along the Eagle River in the heart of the Edwards community. The project utilized indigenous materials and methods to naturally integrate habitat structure in the landscape context. He provided grant funding support; stream, riparian, wetland and fisheries habitat assessment, planning and design; and construction oversight services to the Eagle River Watershed Council for the Project. He assisted the ERWC in facilitating the public process associated with developing stakeholder support and gaining funding through the Eagle Mine Natural Resources Damage Fund. The Project was awarded over $2,000,000 in grant funding; $1,400,000 of which was from the Eagle Mine NRDF. The total project cost is projected at $4,300,000.
- **Gypsum Creek Fisheries Enhancement, Gypsum, CO -** Mr. Gurnée was the lead fisheries biologist and restoration ecologist for the instream and riparian habitat assessment, design, permitting and implementation of habitat improvements along Gypsum Creek. Project treatments included both instream and bankside treatments. Instream treatments served to improve deep-water habitat, create flow separation or concentration zones, increase low flow sinuosity, provide instream cover, improve adult fish habitat, create nursery areas, and enhance spawning opportunities. Bankside treatments for aquatic habitat improvements included creation or enhancement of overhead cover; provision of protective cover; and enhancing shading, cooling, and nutrient cycling functions. Bank protection treatments served to correct localized bank instabilities and reduce bank erosion and the potential for sediment deposition downstream. The Colorado Division of Wildlife (CDOW) commented that, “The Gypsum Creek project was implemented in such a low impact manner that you cannot tell that construction had occurred in the area.”
- **Cache La Poudre River Removal Action, Fort Collins, CO -** On behalf of the City of Fort Collins, Mr. Gurnée led negotiations between the EPA, stakeholders and the City regarding riverine, riparian and wetland regulatory and restoration design standards during the removal and remediation of a contaminated reach of the Poudre River. He also provided design review and revision, as well as construction oversight to ensure successful implementation of the instream and streambank restoration along the 0.50 mile, highly visible reach of the river near downtown Fort Collins.
- **TZ Ranch, Elk Hollow Creek Fishery Habitat Enhancement Plan, Saratoga, WY -** ecos performed the assessment and design of the Elk Hollow Creek Project, which included instream and riparian habitat improvements aimed at increasing bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach. Instream improvements included drop structures, plunge pools, deep pools, riffles and spawning habitat. Bank improvements included seeding and planting plans for native wetland and riparian species. Grant was the regulatory lead, consulting with the Corps under Section 404 of the CWA and the Wyoming Department of Fish and Game. ecos also provided construction oversight and native plant installation services to ensure the successful implementation of the Project.
- **Brush Creek Fishery Enhancement Plans, Saratoga, WY –** Grant assisted in the preparation of access and staging plans, design plans and details, and performed on-site construction oversight of instream and riparian habitat enhancements and bioengineered bank stabilization for a 3-mile reach of Brush Creek. The purpose of the project is to enhance fish, bird and wildlife habitat and use these resources to facilitate education and improve the recreational experience of Ranch guests.
- **Brush Creek Ranch Pond Creation Plans, Saratoga, WY –** ecos provided design-build services including site optimization selection; excavation, grading, drainage and revegetation plans; and construction oversight for a 0.30-acre fishing pond. The pond design included an innovative undercut bank design incorporating a framework of trees supporting transplanted, native sod; which provided excellent fish habitat.
- **Boulder Creek Fishery Enhancement and Pond Creation Project, Boulder, CO -** Grant was the lead fisheries biologist and restoration ecologist for this project along a private reach of South Boulder Creek

adjacent to City of Boulder, Eldorado Canyon Open Space. His tasks included instream and riparian habitat assessment, design of instream and pond fishery habitat and riparian enhancement measures and permitting and consultation. Grant was also the regulatory lead, consulting with the FWS regarding PMJM habitat and with the Corps under Section 404 of the CWA.

- **Stream and Floodplain Restoration at A.T. Massey Coal Mining Facility, KY -** Grant was the Project Manager, fisheries biologist and restoration ecologist for the technical team tasked with assessment and restoration of 26 miles of stream corridor following the accidental release of 250 million gallons of coal slurry into two separate drainages in eastern Kentucky. He was the first ecologist to respond after the spill to ensure that fisheries, stream and riparian habitat restoration objectives were incorporated into the selected cleanup measures. As such, Grant devised a "triage" categorization and remediation system for all affected reaches that minimized impacts to sensitive aquatic and riparian habitat based on the site-specific level of cleanup and remediation required. In addition to instream and bank restoration and stabilization, comprehensive riparian corridor restoration was a major component of the project. Grant was the regulatory and permitting lead and coordinated permits and approval with EPA, Corps and State agencies.
- **Roaring Fork Golf and Fishing Club, Basalt, CO -** Mr. Gurnée was the lead fisheries biologist and restoration ecologist for the assessment, design, permitting and construction supervision of a native trout stream (1 mile) with associated wetland complexes (3 acres). The trout stream was created as an amenity and functional fly-fishing challenge for this fishing component of the Roaring Fork Club; and the associated wetland and riparian habitat were created to naturalize the stream and provide compensatory mitigation for impacts associated with the development of the club facilities. Grant was the regulatory and permitting lead and coordinated permits and approval with Corps and CDOW.
- **Spring Creek Wetland Mitigation, Colorado Springs, CO** – Grant and his team generated wetland and creek creation plans that integrated required mitigation into a high density, "new urban" development. The design emphasized re-utilization of urban storm water to sustain wetlands, use of indigenous plants, construction materials, and natural geomorphic relationships.
- **Tobacco Island Project, Kansas City, MO -** Grant was the lead fisheries biologist and restoration ecologist on a multi-disciplinary Team for the Corps, Tobacco Island Project - a portion of the Missouri River Bank Stabilization and Navigation, Fish and Wildlife Mitigation Project. Project tasks included assessment and conceptual design of measures aimed at reconnecting floodplain and riparian habitat to a reach of the Missouri River near Kansas City. He prepared preliminary designs of channel and backwater wetlands; provided regulatory analysis under Section 404 of the CWA; and assisted in the preparation of an Environmental Impact Statement.
- **San Miguel River Corridor Restoration Plan -** Mr. Gurnée was the lead restoration ecologist, planner and designer for phase 1 of the San Miguel River Corridor Restoration Plan, which included a 1-mile reach through Town. He and his team assisted the Town of Telluride in applying for and winning approximately $500,000 in Natural Resource Damage Assessment Fund money from the State of Colorado. The money, along with other funding, was utilized for final design and construction of the project which included instream habitat, streambank restoration, riparian and wetland restoration, trails and parks. Grant was responsible for leading all public meetings, regulatory negotiation and permitting; assisted the Town with grant funding; and provided construction oversight services.
- **High Altitude Stream Restoration at Copper Mountain Resort, CO -** Grant was the lead ecologist for the restoration of an alpine stream and enhancement of associated wetland and riparian habitat situated within tundra habitat atop Union Peak at Copper Mountain Resort. Grant performed the assessment, design, permitting, and construction oversight for one of the highest altitude stream restoration and wetland mitigation projects in Colorado (approximately 11,500 feet above sea level). Innovative bioengineering and construction techniques were designed and adapted to this sensitive environment to minimize construction-related impacts and maximize environmental benefits.

Threatened & Endangered Species Consultation & Habitat Restoration

- **Jackson Creek Land Company PMJM and Wetland Mitigation, Colorado Springs, CO –** ecos has been performing PMJM habitat biological assessments, conservation, mitigation planning and design throughout its range since 1994. Among numerous other private land developers in the Colorado Springs areas, ecos is currently assisting the Jackson Creek Land Company and Triview Metropolitan District with the implementation of physical habitat preservation and mitigation measures, including shortgrass prairie, upland hibernaculum, and riparian habitat restoration. We are also assisting the client with construction oversight and maintaining regulatory compliance during the implementation of the phased mitigation plans.

- **The Farm (formerly Allison Valley Ranch), Colorado Springs, CO –** Mr. Gurnée performed the habitat assessment and mapping; and prepared ESA, Section 7 and CWA, Section 404 consultation documents as required by the FWS and Corps, including mitigation construction documents, specifications, on-site layout of plant communities and construction supervision aimed at restoring wetland and riparian habitat occupied by Preble's meadow jumping mouse. Ecos is currently assisting the owner with construction oversight for habitat restoration and native planting.
- **Advance Mitigation for PMJM Habitat** – ecos is assisting a private client in identifying, assessing, prioritizing and designing advance mitigation sites for PMJM habitat in the North Fork and main stem of the Cache la Poudre River.
- **TriView Metropolitan District ESA and CWA Permit Resolution, Monument, CO -** Mr. Gurnée represented the TriView Metropolitan District (TriView) and Phoenix Bell as the lead consultant to resolve outstanding compliance issues related to a joint ESA, Section 7 Consultation and CWA, Section 404 Permit. Grant lead negotiations amongst the various landowners, TriView and the Town to resolve compliance issues related to PMJM and wetland habitat, such that development may proceed in this core area of the town. Upon resolution and agreement of the stakeholders, he led the negotiations with the FWS and Corps to formally amend the Biological Opinion and 404 Permit. Once the approvals were amended, Grant lead the planning and design of PMJM and wetland habitat to meet mitigation requirements under the ESA and CWA.
- **Bernardi Residential Property, Eldorado Canyon, Boulder, CO –** ecos consulted with the Corps and FWS to document and fulfill regulatory requirements for a residential home construction project in PMJM, wetland and riparian habitat. Mr. Gurnée coordinated with the FWS and Corps and obtained approvals under ESA, Section 7 and CWA, Section 404. He prepared all consultation documents, including the Biological Assessment, mitigation plan, and construction documents and specifications. Grant is leading the on-site layout of plant communities and construction supervision, aimed at restoring wetland and riparian habitat occupied by the PMJM.
- **Northgate Boulevard Realignment, Colorado Springs, CO –** Mr. Gurnée performed the habitat assessment and mapping; and coordinated and prepared ESA, Section 7 and CWA, Section 404 consultation documents as required by the FWS and Corps, including mitigation construction documents, specifications, on-site layout of plant communities and construction supervision aimed at restoring wetland and riparian habitat occupied by Preble's meadow jumping mouse.
- **Jefferson County Highways and Transportation Department Gunbarrel Bridge Replacement, Oxyoke, CO -** ecos staff consulted with the Corps, FWS, CDOT, and the FHWA to document regulatory requirements for a bridge replacement project in PMJM, wetland and riparian habitat. He and his Team produced a CDOT Wetland Finding Report, Biological Assessment, acquired a Section 404 Permit and Biological Opinion (Section 7 of the ESA), and then implemented habitat mitigation improvements at the site.
- **Northgate Project, Colorado Springs, CO -** As project manager, Mr. Gurnée led the team in the assessment, permitting and regulatory negotiation (Section 404 of the CWA and Section 7 of the ESA) for the project which included the planning, design and construction supervision of a precedent setting, "joint" mitigation plan for 60 acres of wetland, riparian and PMJM habitat.

Ecological Master Planning

- **Sundance Trail Guest Ranch, Larimer County,** CO – ecos is currently assisting a local guest ranch in the assessment of natural resources and site features, and the development of site plans to balance natural habitat and aesthetic values with the expansion of guest facilities and services.
- **Sand Creek Channel Improvements Stability Analysis at Indigo Ranch, Colorado Springs, CO** - ecos was retained to perform an analysis of channel stability under proposed development conditions for a 1.17-mile reach of Sand Creek. Ecos utilized existing vegetation composition data, density and height within the Project reach as a basis; and compared the 10-year and 100-year storm event modelling data (specifically flow velocity, flow depth and shear stress) to reference literature to provide a professional opinion regarding the future stability of the channel under developed conditions. The analysis of channel stability for the proposed Project assumes a bioengineering and biotechnical approach that preserves and enhances the existing vegetation, as well as substrate cohesion and stability, within the channel and its

streambanks. The Stability Analysis will likely serve as a benchmark study for the City of Colorado Springs to use to preserve other naturally stable channels.

- **Uncompahgre River Corridor Master Plan, Montrose, CO –** Grant and his Team assessed the character, condition and quality of aquatic, wetland and riparian habitat along a 10-mile rural and urban corridor of the Uncompahgre River through the City of Montrose. Habitats were then rated, ranked, prioritized and master planned for their preservation potential and integration in to the parks, recreation and trail system. The master plans form the foundation for the City to focus environmental stewardship, tourism and generate riverfront economic development with a focus on the river – the major asset of the Community.
- **Brush Creek Stewardship and Enhancement Plan, Saratoga, WY –** Mr. Gurnée managed the assessment of a 12,000-acre, private ranch near Saratoga, Wyoming and the preparation of the Ranch Stewardship Plan (Plan). The Plan includes land and resource stewardship goals, objectives, and implementation action items; including ranch-wide master planning of the trail and recreational systems, design of the Brush Creek riparian corridor trail, and restoration/fisheries habitat enhancement of Brush Creek. Trail and recreation planning and design focused on universal access, habitat sensitivity, environmental education, and wildlife observation opportunities and unique landscape experiences.

Environmental Assessment and Impact Studies

- **NEPA EA for Eagle County Airport Runway Expansion, Eagle County, CO -** Grant was project manager and senior ecologist for an Environmental Assessment (EA) under the National Environmental Policy Act (NEPA) for a proposed 1000-foot runway expansion and ILS installation at the Eagle County Airport, west of Vail, Colorado. Critical issues addressed included noise, ecological, and public opinion considerations. Grant conducted the work under FAA guidance requirements for EAs.
- **NEPA EA for the Avon Interstate 70 Interchange -** Mr. Gurnée was project manager and senior ecologist for this NEPA EA. He performed environmental assessment and data compilation work for construction of a new CDOT interchange and associated development on Interstate 70. This included evaluating T&E Species; a wetlands inventory; a cultural/archeological resources survey; noise and air pollution modeling and studies; and reviewing soils, meteorology, geologic hazards, and other impacts.
- **Raritan River Wetland Inundation Impact Study, N.J. -** Grant's work on the preparation and processing of the first Individual Permit under the New Jersey Freshwater Wetlands Protection Act of 1987 included a precedent setting wetland inundation study. This study shaped the N.J. Department of Environmental Protection's policy regarding the need to assess hydrologic impacts during wetland permit reviews.

Construction Oversight and Plant Installation

- **St. Vrain Creek Reach 3 Flood Recovery and Restoration, Lyons, CO –** Ecos performed construction lay-out and observation during the implementation of the restoration and enhancement of 0.60-acre of riparian Preble's Meadow Jumping Mouse Habitat (PMJM) along the St. Vrain River.
- **2013 Flood and 2014 Runoff Events, Damage Restoration, Cache la Poudre River, CO** - ecos performed the construction oversight of 3 flood and runoff damage restoration projects along the Cache la Poudre River for the City of Greeley, including the Bellvue Treatment Plant Raw Water Ponds Restoration, the Kodak Pipeline Crossing Restoration and the Watson Lake Pipeline Crossing Restoration.
- **Lions Park CWA and ESA Mitigation Site** - ecos performed the construction oversight for an advance river and wetland mitigation site at Lions Park in LaPorte, Colorado.
- **TZ Ranch, Elk Hollow Creek Fishery Habitat Enhancement Plan, Saratoga, WY -** ecos performed the construction oversight for the Elk Hollow Creek Project.
- **Brush Creek Ranch Fishery Enhancement Plans, Saratoga, WY –** Mr. Gurnée assisted in the construction oversight for a 3-mile reach of Brush Creek to improve fisheries and outdoor recreation experiences for guests of the Ranch.
- **C Lazy U Ranch, Willow Creek Fishery Enhancement Plan, Granby, CO -** Grant assisted in the construction oversight for this fishery habitat, channel stabilization and streambank restoration project.
- **Standley Lake Protection Project, Westminster, CO –** Mr. Gurnée performed construction oversight of a 12-acre created emergent wetland that he and his Team designed to fulfill CWA mitigation requirements and bring closure to the City's drinking water protection project.

- **Caribou Peat Bog Restoration, Nederland, CO –** Grant prepared native plant community design, planting cost estimate, and on-the-ground oversight of volunteers to restore a high-altitude peat bog disturbed by an illegal four-wheel drive "mudfest".
- **Department of Energy Wetland Mitigation Bank, Westminster, CO –** Mr. Gurnée provided construction supervision of the grading and planting of a 12-acre wetland mitigation bank that he and his Team designed for the Department of Energy.
- **ARCO Lower Area One and Butte Reduction Works, Butte, MT –** Grant performed construction observation and supervision of temporary labor crews to plant a passive treatment wetland designed to absorb heavy metals from groundwater.

Natural Treatment System Design

- **Natural Treatment Wetlands, Butte, MT -** Mr. Gurnée and his Team performed the assessment and design of the ARCO Lower Area One and Butte Reduction Works passive treatment wetlands. These natural treatment systems were situated within two units of a reclaimed superfund site to treat heavy metals in surface and groundwater.
- **Natural Treatment Wetlands, Avondale, AZ –** Grant and his Team performed the assessment and design of a constructed wetland system to treat surface water and inject/recharge the municipal well system for the City of Avondale, AZ. This system successfully alleviated a well moratorium necessitated by a contaminated groundwater aquifer.

PUBLICATIONS:

Giordanengo, John H., Randy Mandel, William Spitz, Matthew Bossler, Michael Blazewicz, Steven Yochum, Katie Yagt, William LaBarre, Grant Gurnée, Robert Humphries and Kelly Uhing. 2016. Living Streambanks, A Manual of Bioengineering Treatments for Colorado Streams. Submitted to the State of Colorado, Colorado Water Conservation Board Denver, Colorado. Submitted by AloTerra Restoration Services, LLC, and Golder Associates, Inc.

Gurnée, Grant E. 1998. Wetland Revegetation Techniques chapter in Native Plant Revegetation Guide for Colorado, Caring for the Land Series, Volume III. A joint publication of the Colorado Natural Areas Program, Colorado State Parks, and Colorado Department of Natural Resources. Denver, Colorado.

Gurnée, Grant E. 1995. Optimizing Water Reclamation, Remediation and Reuse with Constructed Wetlands. Environmental Concern Wetland Journal, Summer 1995 Issue. Environmental Concern, Inc. St. Michaels, Maryland.

PRESENTATIONS & INSTRUCTION:

Gurnée, Grant E., 2016. Clean Water Act, Section 404 Permits for Flood Recovery Projects. Presented at the Colorado Stream Restoration Network (CSRN) conference in Longmont, CO on March 23, 2016.

Gurnée, Grant E., 2016. Endangered Species Act Consultation for Flood Recovery Projects. Presented at the Colorado Stream Restoration Network (CSRN) conference in Longmont, CO on March 23, 2016

Gurnée, Grant E., 2010. Stream Corridor/Bioengineering Round Table. Presented at the Colorado Riparian Association (CRA) Sustaining Colorado Watersheds Conference. October 5 - 7, 2010. Vail, Colorado.

Gurnée, Grant E. and Greg A. Fentchel, 2009. Stream Corridor/Bioengineering Workshop. Presented at the Colorado Riparian Association (CRA) Sustaining Colorado Watersheds Conference. October 7 - 9, 2009. Vail, Colorado.

Gurnée, Grant E. and Scott J. Franklin, 2008. Section 404 Individual Permits: Negotiating the Application and Follow-up Process. Presented at the CLE International, Colorado Wetlands Conference. May 8 – 9, 2008. Denver, Colorado.

Gurnée, Grant E. and Julie, E. Ash, P.E., 2007. Edwards Eagle River Restoration Project. Presented at the Colorado Riparian Association (CRA) Sustaining Colorado Watersheds Conference. October 5 - 7, 2009. Breckinridge, Colorado.

Gurnée, Grant E. 2000. Natural Treatment Alternatives for Surface Discharges, Surface Runoff, and Mined Land Reclamation. Presented at the International Mining Technology Seminar. September 13 – 15, 2000. Belo Horizonte, Minas Gerais, Brazil.

Gurnée, Grant E. 1999. Wetland Mitigation: Considering Mitigation Requirements in the Project Planning Process. Presented at the Continuing Legal Education (CLE) Wetlands & Mitigation Banking Conference. October 21 & 22, 1999. Denver, Colorado.

Hoag, Chris, Hollis Allen, Craig Fischenich and Grant Gurnée. Assistant instructor for a Bioengineering Workshop sponsored by the U.S. Army Corps of Engineers Waterways Experiment Station and the U.S. Department of Agriculture – Aberdeen Plant Materials Center. September 1998. Carson City, Nevada.

Hoag, Chris and Grant Gurnée. 1998 Glancy Riparian Demonstration Project. Assistant instructor for a hands-on bioengineering workshop on the Carson River. September 1998 near Dayton, Nevada.

Gurnée, Grant E. 1998. Stream and Wetland Restoration Successes and Failures: The Good, the Bad, and the Ugly. Presented at the Colorado Riparian Association (CRA) Restoring the Greenline Conference. October 16, 1998. Salida, Colorado.

Gurnée, Grant E. 1998. Save Our Streams, Wetland Conservation and Sustainability Workshop. Lead Instructor of wetland assessment and restoration course presented with the Izaak Walton League. April 21 & 22, 1998. Boulder, Colorado.

Windell, Jay, and Grant Gurnée. 1998. Creation of a Stream, Riparian and Wetland Ecosystem: Tributary to the Roaring Fork River, Basalt, Colorado. Presented at the American Society of Civil Engineers, Wetlands Engineering & River Restoration Conference. March 23 – 27, 1998. Denver, Colorado.

Gurnée, Grant E. 1998. A Case Study: Department of Energy's Wetland Mitigation Bank at Standley Lake. Presented at the Continuing Legal Education (CLE) International, Colorado Wetlands Conference. January 27 – 29, 1998. Denver, Colorado.

Gurnée, Grant E. 1997. Wetland Mitigation: Design and Implementation via the Design/Build/Grow Process. Presented at the International Erosion Control Association, Erosion & Sediment Control Workshop. November 19, 1997. Northglenn, Colorado.

Gurnée, Grant E. and Gary Bentrup. 1996. Wetland and Riparian Protection Strategies. Presented at the Sierra Club, Regional Growth Strategies Conference, "New Perspectives and Strategies to Preserve Mountain Communities." February 16 – 17, 1996. Glenwood Springs, Colorado.

Gurnée, Grant E. 1994. How to Recognize and Deal with Wetland Regulation Issues. Presented at the Continuing Legal Education (CLE) International, 3rd Annual Western Agricultural and Rural Law Roundup. June 23-25, 1994. Fort Collins, Colorado.

AWARDS:

- Colorado Landscape Contractors Award, Sand Creek Enhancement Project – 2000

PROFESSIONAL ASSOCIATIONS:

- Association of State Wetland Managers (ASWM)
- Society of Wetland Scientists (SWS)
- Environmental Concern (EC)

ecos ecosystem services LLC

RESUME

Jon Dauzvardis, M.L.A, P.W.S.

Owner/Managing Partner
Senior Restoration Ecologist
Landscape Architect
Wetland Ecologist

AREAS OF EXPERTISE:

- Vegetation Inventories and Mapping
- Habitat Assessment, Functional Assessment and Wetland Delineation
- Aquatic, Wetland, and Riparian Restoration Ecology, Planning and Design
- Landscape Ecology, Planning and Landscape Architecture
- Conservation and Resource Mitigation Bank Support Services
- Grant Funding Support for Conservation and Restoration Projects
- Open Space and Trail Planning, Design and Habitat Management
- Construction Oversight & Best Management Practices
- AutoCAD, Mapping, Presentation Graphics

EDUCATION:

- Master of Landscape Architecture, Texas A&M University, College Station, Texas, 1995
- Bachelor of Science, Environmental Design, University of Missouri, Columbia, 1991
- Architecture Study, Harvard University Graduate School of Design, Cambridge, Massachusetts, 1989

EMPLOYMENT HISTORY:

- 2008-Present, Owner/Manager and Senior Restoration Ecologist, Ecosystem Services, LLC, Erie Colorado
- 2000 – 2011, Senior Restoration Ecologist, Walsh Environmental Scientists and Engineers, LLC, Boulder, Colorado
- 1997 – 2000, Restoration Ecologist, Construction Supervisor, Aquatic and Wetland Company, Boulder, Colorado
- 1996-1997, Landscape Architect, Design Studios West, Denver, Colorado
- 1995-1996, Landscape Architect, Wenk Associates, Denver, Colorado
- 1994-1995, Graduate Researcher, ALCOA – Texas A&M University, College Station, Texas
- 1994, Johnson County Parks and Recreation Department, Shawnee Mission, Kansas
- 1992-1994, Grounds Maintenance Superintendent, Brazos County, Texas

CONTINUING EDUCATION:

- Stream Functions Pyramid Workshop, Denver, CO - 2014
- Colorado Natural Heritage Program, Wetland Plant Identification - 2014
- Colorado Natural Heritage Program, Ecological Integrity Assessment for Colorado Wetlands - 2013
- FACWet – Functional Assessment of Colorado Wetlands - 2010, 2012 and 2013
- ESRI, ARC View Geographic Information System (GIS) Training, 1996
- Bicycle Planning and Facilities Training, 1994
- AutoCAD Drafting and Design, Self-taught, 1991

CERTIFICATIONS:

- Professional Wetland Scientist Certification (# 1699), Society of Wetland Scientists Certification Program, 2004

EXPERIENCE SUMMARY:
Mr. Dauzvardis is a founder and managing partner of Ecosystem Services, LLC (**ecos**), an ecological planning and design business dedicated to the restoration, enhancement and creation of aquatic, wetland and riparian habitat. Jon is a certified Professional Wetland Scientist with over 25 years of experience working in the fields of landscape architecture and ecological restoration in Colorado, Wyoming, Texas, Kansas and the Intermountain West. Jon's academic and professional work history in housing design and construction, community planning, architecture, landscape architecture, ecological planning and restoration is unique and makes him a valuable and multi-faceted asset to his company, clients and their projects. His diverse knowledge and skills in landscape planning, habitat design, bioengineering, and hands-on experience demonstrate that he can easily negotiate between art and science, man-made and natural systems, generalities and detail, and from concept to construction. Jon takes a practical and realistic approach to problem solving, concentrating on broad scale ecological master planning simultaneously with fine scale design of aquatic, wetland, riparian and terrestrial habitats. As a restoration ecologist, Jon specializes in restoring and enriching habitat structure, stability and health and how to manage landscapes and natural systems so that they function, change, and respond positively over time. Jon's strengths are rooted in his understanding of natural and landscape processes; finding design solutions that integrate the needs of people, wildlife, and visual quality; sustaining ecosystem goods and services; and integration of nature-based recreation and environmental education programs and facilities.

RELEVANT PROJECT EXPERIENCE:

Mr. Dauzvardis has been an essential team lead and player in hundreds of habitat assessments; permitting efforts; master plans; and aquatic, wetland, and riparian habitat design and mitigation projects. The following is a sampling of select projects and clientele that Jon has successfully completed or is currently involved with:

Habitat Assessment and Regulatory Compliance
Mr. Dauzvardis routinely performs ecological site and resource impacts assessments, jurisdictional wetland determinations and functional assessments to assist clients in site planning, design, and permitting processes. Assessment methods established by the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and Colorado Department of Transportation among others are used to assess habitat elements and screen sites for threatened and endangered plants and animals, wetlands, migratory birds and other wildlife. Jon stresses habitat impact avoidance and minimization to preserve a site's ecological benefits and to minimize regulatory constraints, timing and permitting costs. Jon has performed a multitude of site assessments, delineations and prepared permits, including but not limited to the following notable projects as well as others listed throughout this resume:

- **Banning Lewis Ranch, Colorado Springs, CO –** ecos was hired by Norwood Homes to perform and ecological assessment of wetlands, Sand Creek, Jimmy Camp Creek and its tributaries; and provide regulatory guidance for the Banning Lewis Ranch (BLR), an 18,000-acre site that will double the size of Colorado Springs. Part of Jon's work on the project included mapping and buffer recommendations on how to best conserve pristine prairie and sandy creeks that are highly susceptible to degradation caused by urbanization.
- **Bellvue Pipeline Project, Larimer County, CO** – ecos was retained by the City of Greeley as Best Management Practices (BMP) Facilitators to provide pre-construction documentation post-construction oversight of pipeline reclamation processes. Essential responsibilities include meeting with landowners prior to construction to facilitate project understanding and post-construction outcomes; to document landowner needs and wants relative to project goals and land use; and to document and monitor pre- and post-construction reclamation and maintenance requirements.
- **Georgetown Lake, Georgetown, CO –**ecos was hired to prepare an office level assessment report of ecological resources to describe the physical/ecological characteristics of the Project area and evaluate the potential effects of the construction of a loop trail project on environmental issues and species of concern to support a GOCO grant application. Items evaluated and documented, include site location/ownership, general site characteristics, current land use, proposed impacts, possible effects on Federal– and State-listed T&E animal and plant species, unique or important wildlife, water quality, water bodies, wetlands, and floodplains, stormwater runoff, sedimentation, soil erosion, and invasive species. The assessment report also included mitigation measures, project benefits, and environmental compliance recommendations under applicable regulatory programs.

- **Appraisal Support Documentation Report for the 1st Bank Parcel, Colorado Springs, CO** - ecos was retained by 1st Bank Holding Company to perform a Preble's meadow jumping mouse (PMJM) habitat assessment, mitigation cost analysis, and conceptual lot layout for the approximate 9.4-acre Parcel located adjacent to the Northgate Open Space along Smith Creek. Jon was responsible for preparing the lot layout, existing habitat aerial photo interpretation/delineation, proposed conceptual mitigation, and quantification of impacts and associated mitigation to ascertain appraisal value of the site if it were to be developed.
- **Encana Oil and Gas (USA), Denver Julesburg Basin, CO** – Encana hired ecos to assess their ecological constraints, recommend means and methods to avoid, minimize and permit impacts; and to mitigate, restore and prepare ecological management plans for their drilling and pipeline operations in the Denver Julesburg basin. Jon's role on the team is to perform site assessments, research background data, and prepare assessment reports and mapping data that can be utilized by Encana's project managers and geographic information systems (GIS) department to proactively track ecological resources before issues arise. In addition to client consultation, Jon is responsible for tracking drill site schedules, constraints, restoration and management efforts in a data base and reporting said information to Encana's project manager on a regular basis.
- **Tollgate Creek Riparian and Wetland Habitat Assessment, Aurora, CO** – Jon performed high level aerial photo interpretation and delineation of riparian and wetland habitat along Toll Gate Creek and East Toll Gate Creek from confluence with Sand Creek upstream to East Hampden Avenue. The delineation was performed in Google Earth and imported into AutoCAD by digitizing riparian and wetland habitat zones. Once complete, the data was turned over to the project engineer to incorporate into a Drainage Master Plan for the Urban Drainage and Flood Control District (UDFCD).
- **Eagle River Meadows Ecological Inventory and Strategic Wetland Action Plan, Edwards, CO** – Mr. Dauzvardis delineated, assessed, and provided an analysis of potential adverse effects to wetlands within a complex site adjacent to the Eagle River. Jon also developed a strategic process and decision making tool to determine avoidance, minimization, low impact development (LID), and mitigation measures in support of a County Sketch Plan application for a Multi-use Health Care Community.
- **Mesa County Colorado Riverfront Trail, Grand Junction, CO** – Jon performed wetland delineation, jurisdictional determination, Section 404 Permitting; and prepared wetland mitigation plans to construct approximately two miles of regional trail along the north side of the Colorado River between the James M. Robb and the Colorado River State Park at Corn Lake.
- **ARCO Upper Clark Fork River Basin Superfund Site Functional Wetland Assessment, MT** – Between 2000 and 2008, Jon managed the assessment team and performed extensive wetland delineation, GPS surveying, functional assessments, and impact mapping and analysis covering a 200 square mile Superfund Site affected by historic mining practices. Assessments we done in preparation for soil remediation of heavy metals, capping of tailings ponds, sediment and dam removal, and implementation of compensatory wetland mitigation plans required under a consent decree. Assessment areas included the Anaconda Smelter, Old Works, Opportunity Ponds, and Milltown Reservoir.
- **Jefferson County Highways & Transportation Department Gunbarrel Bridge Replacement, Oxyoke, CO** – Jon consulted with the USACE, USFWS, CDOT, and the FHWA to document regulatory requirements. Produced a CDOT Wetland Finding Report, Biological Assessment, Preble's meadow jumping mouse and wetland mitigation plans, and helped acquire a Section 404 Permit and Biological Opinion.
- **Pole Canyon Wind Farm, Babcock and Brown, Huerfano County,** CO – Assessed and prepared critical issues analysis and County 1041 Permit application for a 125-megawatt wind farm and associated transmission lines located on a 5,800-acre site. The project included detailed site assessments to document the presence or absence of potential development constraints and site-specific ecological conditions as well as preparation of permit maps, plot plans, and environmental analyses, alternatives analysis, and mitigation measures.
- **Dalton Property Wetland Assessment, Longmont, CO** – Provided site assessment, regulatory analyses, and developed a restoration plan for critical riparian and wetland habitat along Left Hand Creek in Boulder County, CO.
- **Colowyo Coal Mine Wetland Delineation, Meeker,** CO – Delineated 1.5 miles of jurisdictional waters and wetlands in preparation for wetland mitigation design along West New Goodspring Creek.
- **Lafarge Northbank Resources Gravel Pit Wetland Assessment, Rifle, CO** – Delineated and acquired a jurisdictional determination from the USACE for complex tailwater and riparian wetlands along the

Colorado River. Prepared gravel pit reclamation plans aimed at providing suitable shallow-water lake edge wetlands to serve as compensatory wetland mitigation.

- **Jefferson County Highways & Transportation Department Highway 73 Expansion, Conifer,** CO – Performed presence/absence study, habitat assessment and documentation of wetlands, Migratory Birds, State Species of Concern, and federally listed T&E Species including Bald eagle, Preble's meadow jumping mouse, the Pawnee montane skipper butterfly and Colorado butterfly plant along a one-mile corridor of highway.
- **Flying Horse Ranch and the Club at Flying Horse Golf Course, Colorado Springs, CO** – Conducted an assessment of wetland habitat, impact avoidance and minimization and Section 404 of the Clean Water Act permitting for a 1500-acre mixed use development and Weiskopf golf course design being implemented by Neiber Golf.
- **C-Lazy-U and Horn Ranch Environmental Assessments, Granby, CO** – Performed site assessment of ecological opportunities and constraints of aquatic, riparian, wetland and threatened and endangered species habitat along the Colorado River for the development and enhancement of fishing/resort ranch amenities.
- **Village at Avon, Avon, CO** – Delineated wetlands and prepared a Section 404 Permit for the town center expansion and low-density ranchette development.
- **Residential Developers and Realtors** – Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for residential developers and realtors, including: 4 Site Investments, Nor'wood, Proterra Properties, Denver Transit Oriented Development Fund, La Plata Communities, Windsor Ridge Homes, Clearwater Communities, Schuck Corporation, Equinox Land Group, DR Horton, Melody Homes, Standard Pacific Homes, Gateway American Properties, Zephyr Real Estate Company, Lowell Development Partners, and Palmer-McAlister, Classic Communities, Stoll Properties, Karen Bernardi, Colorado Commercial Builders, Terra Visions, Smith Creek Holdings, Picolan, Realty Development Services, Northgate Properties.
- **Commercial and Industrial Developers** - Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for commercial and industrial developers, including: Atira Group, Leadership Circle, Ridgeway Valley Enterprises, Morley Companies, HF Holdings, Regency Centers, Miller-Weingarten, Gulf Coast Commercial Development, Traer Creek, Mountain Property Associates, Morley Golf, Executive Consulting, Inc.
- **Architectural and Engineering Companies** – Jon has performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for A&E firms, including: William Guman and Associates, JVA, Beyers Group, Engineering Analytics, Classic Consulting Engineers, J3 Engineering, DHM Design, Del-Mont Consultants, JW Nakai and Associates, Nolte and Associates, JR Engineering, Hyrdosphere, Executive Consulting Engineers, Muller Engineering, Farnsworth Group.
- **Counties, Municipalities, Metro Districts and Quasi-Public Institutions** – Mr. Dauzvardis has performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for counties, municipalities, and quasi-public institutions, including: City of Louisville Highway 42 and 96th Street realignment, City of Westminster Jim Baker Reservoir and Standley Lake Protection Projects, Jefferson County Highway 73 and 67 Improvement Projects, Todd Creek Village Metro District, Town of Monument/Triview Metro District, Boulder Community Hospital, and City of Fort Collins Regulatory Fact Sheets Preparation Project, Todd Creek Village Metro District on-call consultant, Three-lakes Water and Sanitation District, City of Greeley,
- **Educational Institutions** – Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and prepared Clean Water Act Section 404 Permits and mitigation plans for educational institutions, including: Colorado Mountain College - Steamboat Springs, The Classical Academy – Colorado Springs, and Coal Ridge High School – Rifle.
- **Wind Energy Developers** – Performed numerous wetland and T&E species habitat ecological assessments, wetland delineations, and critical issues analyses for wind development projects, including: Cedar Creek Windfarm – Weld County, CO, Wheatland Windfarm – Platte County, WY, Silver Mountain Windfarm – Huerfano County, CO, Pole Canyon Windfarm, Huerfano Count, CO.

- **Mining Companies** – Performed wetland and T&E species habitat ecological assessments, wetland delineations, and critical issues analyses for mining companies, including: Brannan Sand and Gravel Company, Lafarge and Kennecott Coal.

Ecological Master Planning

- **Jackson Creek Land Company PMJM and Wetland Mitigation, Colorado Springs, CO** – ecos has been performing Preble's meadow jumping mouse (PMJM) habitat biological assessments, conservation, mitigation planning and design throughout its range since 1994. Among numerous other private land developers in the Colorado Springs areas, ecos is currently assisting the Jackson Creek Land Company and Triview Metropolitan District with the implementation of physical habitat conservation and mitigation measures, including shortgrass prairie, upland hibernaculum, and riparian habitat restoration. Jon is responsible for mapping, design assessment and restoration plan preparation.
- **Park Creek Mitigation Bank, Fort Collins, CO –** ecos was retained by Burns and McDonnell to assess, map, and prepare preliminary mitigation design of aquatic, wetland, riparian and terrestrial habitat in support of a mitigation banking prospectus. Upon completion and acceptance of the prospectus by the USACE, ecos has been tasked to manage the baseline assessment of the site, including groundwater testing, topographic surveys, and hydrology; prepare a detailed habitat design for inclusion in mitigation banking instrument; as well as coordinate design-build process with a selected nursery and contractor. Jon has been responsible for the mapping and preparation of design documents and will co-manage construction and long-term monitoring to help our client meet their performance criteria and sell bank credits.
- **Front Range Umbrella Mitigation Bank, CO –** ecos was retained by Restoration Systems, a nationally renowned wetland mitigation banking firm, to help identify and prepare conceptual design plans for mitigation banking sites to establish the Front Range Umbrella Mitigation Bank (Bank). The purpose of the Bank is to provide compensatory mitigation credits for unavoidable, permitted impacts to aquatic, wetland, riparian, upland, wildlife, and threatened and endangered (T&E) species habitat regulated under the Clean Water and Endangered Species Acts; and to restore, enhance and preserve valuable natural resource functions at degraded mitigation sites within multiple watersheds along Colorado's Front Range. Currently, the Bank is developing banks sites that serve the Cache la Poudre, St. Vrain, Upper South Platte, Fountain and Upper Arkansas watersheds. Jon's primary role on the team is to perform functional habitat assessments; prepare mapping and graphics of baseline and future conditions; grading and plant community design based on hydrologic, hydraulic, and geomorphic modelling and engineering; and communicate with landowners and stakeholders regarding the process, technicalities, and outcomes.
- **Sand Creek Channel Improvements Stability Analysis at Indigo Ranch, Colorado Springs, CO** - ecos was retained to perform an analysis of channel stability under proposed development conditions for a 1.17 mile reach of Sand Creek. Ecos utilized existing vegetation composition data, density and height within the Project reach as a basis; and compared the 10-year and 100-year storm event modelling data (specifically flow velocity, flow depth and shear stress) to reference literature to provide a professional opinion regarding the future stability of the channel under developed conditions. The analysis of channel stability for the proposed Project assumes a bioengineering and biotechnical approach that preserves and enhances the existing vegetation, as well as substrate cohesion and stability, within the channel and its streambanks. The Stability Analysis will likely serve as a benchmark study for the City of Colorado Springs to use to preserve other naturally stable channels.
- **Brush Creek Ranch Stewardship Plan, Saratoga, WY** – Brush Creek Ranch Stewardship Plan, Fishery Enhancement and Bank Stabilization, Saratoga, WY – Mr. Dauzvardis managed the organization, generation and graphic design of the Ranch Stewardship Plan. Jon assessed and prepared stewardship goals, objectives, and implementation action items, including ranch-wide master planning of the trail and recreational systems and design of the Brush Creek riparian corridor trail. Trail and recreation planning and design focused on universal access, habitat sensitivity, environmental education, wildlife observation opportunities and unique landscape experiences. Simultaneously with the master plan, Jon developed revegetation plans to support geomorphic stream alterations and bank stabilization to enhance the creek fishery. Jon was responsible for the design and supervised construction of a cold-water pond to be used by novice anglers to learn the art and experience the pleasure of catching trout.
- **Town of Erie, Comprehensive Plan, Parks Recreation Open Space and Trails Master Plan, and Natural Areas Inventory, Erie, CO -** As a former 8-year Member, Chair, and Vice Chair of the Town Erie

Open Space and Trails Advisory Board (OSTAB) and an Erie resident and small business owner, Jon has an intimate knowledge of Erie's political and physical landscape and public processes. During his tenure on OSTAB, Jon actively participated in the writing and development of the Town's guiding documents. Jon authored the Open Space Chapter of the Comprehensive Plan which eventually was codified in the Town's Unified Development Code (UDC). Jon was the key commenter on the content, analysis and synthesis of the of the Open Space and Trail Chapters and Mapping that was adopted with the Town's first Parks Recreation Open Space and Trails Master Plan (PROST). Jon guided the process used in the development of the Erie Natural Areas Inventory (ENAI) to identify and design a habitat condition, quality and restoration rating and ranking system of significant natural areas throughout the Town's 49-square mile planning area.

- **Uncompahgre River Corridor Master Plan, Montrose, CO** – Jon was responsible for the development of an ecological master plan focusing on the Uncompahgre River as a natural asset for eco-tourism and the generation of riverfront economic development. Mr. Dauzvardis was responsible for assessing the character, condition and quality of aquatic, wetland and riparian habitat; and developing a rating, ranking, land acquisition prioritization system, and associated mapping aimed at the preservation and integration of open space and habitat within the City's parks, recreation and trail system.
- **Ruby Pipeline Wetland, Riparian and Waterbody Mitigation and Restoration Plan, WY, UT, NV and OR** – Jon was responsible for assisting with the generation of a Comprehensive Wetland Mitigation Plan outlining Clean Water Act regulatory guidelines, requirements, and processes. Jon developed an eco-region specific restoration plan for a 675-mile natural gas pipeline specifying the basis of design, construction, revegetation, maintenance, performance criteria, and monitoring means and methods for restoring approximately 460 acres of temporarily impacted riparian and wetland habitat.
- **Dry Creek Regional Urbanization Area, Weld County, CO** – Mr. Dauzvardis performed an ecological inventory and prepared the assessment report for a 6,000-acre Regional Urbanization Area (RUA); and a1000-acre multi-use site development in un-incorporated Weld County. Subsequent phases included establishing ecological policy, goals, and objectives for the study area that will assist the County in the refining their first ever Comprehensive Plan.
- **City of Broomfield I-25 Subarea Environmental Guidelines, Broomfield, CO** – Jon drafted development sensitivity design and ecological sustainability standards.
- **McStain Development Corporation, Mountain Village III Master Plan, Loveland, CO** – Conducted concept planning for recreational and environmental interpretation facilities focusing on lake and wetland habitat features of the community.
- **Estes Park Comprehensive Land Use Plan, Estes Park, Larimer County, CO** – Teamed with town planning staff in producing a county-wide land use plan using GIS as a public involvement/participation tool.
- **San Miguel River Park Corridor Master Plan, Telluride, CO** – Prepared park, trail, wetland and riparian corridor master plan and design for the San Miguel River Park Corridor. Jon prepared illustrative plan graphics that assisted the Town in applying for and winning approximately $500,000 in Natural Resource Damage Assessment Fund money from the State of Colorado, which was used for final design and implementation.
- **South Platte River Wildlife and Recreation Corridor Plan, Denver, CO** – Designed the Zuni Riverfront Park and planned the wildlife and recreation corridor between I-25 and 8th Street near Mile High Stadium. Prepared, steered and presented graphics that the City and County of Denver Mayor's Commission (Wellington Webb) and the Urban Drainage and Flood Control District used to help sell the project to the public and federal funding sources in Washington D.C.
- **Historic Arkansas River Walk, Pueblo, CO** – Coordinated and steered the design and presentation of riparian, aquatic, and palustrine wetlands in the HARP Natural Area. Designed environmental Education Park to include outdoor classroom, access, and multi-thematic interpretive nodes.
- **Pueblo Natural Resources and Environmental Education Council Plan, Pueblo, CO** – Designed the identity and jointly produced strategic natural resource based environmental education plan for Pueblo County (PNREEC). The plan helped build consensus among multiple private and governmental agencies and stakeholders on funding, conservation, restoration, and enhancement priorities throughout the County.
- **Aluminum Company of America (ALCOA) Huisache Cove Master and Design Plan Master of Landscape Architecture Thesis, Port Lavaca, TX** – Served as environmental consultant in researching and generating wildlife habitat restoration plan and multi-functional landfill cap redesign incorporating

coastal prairie, lacustrine, palustrine, estuarine wetlands, passive recreation, bird watching and ecological interpretation facilities on an industrial superfund clean-up site.

Aquatic, Wetland, and Riparian Habitat and Mitigation Design:

- **Big Thompson River Flood Recovery and Restoration, Loveland, CO -** ecos is currently part of a multi-disciplinary team assisting the Big Thompson Watershed Coalition (BTWC) with assessment, design, and construction of the Big Thompson between Rossum and Wilson Drives which are majority-owned by the City of Loveland and Loveland Ready-mix. As with all the flood recovery projects ecos has worked on, Jon produced 30%, 60% and 100% design plans, construction cost estimates, and specifications guiding soil development/enrichment; upland, riparian, and wetland seeding and planting; and numerous bioengineering techniques aimed at restoring the river and making it more resilient to future flood events. This project is aimed at completion in the summer of 2019.
- **Saint Vrain Creek Reach 3 Flood Recovery and Restoration, Boulder County, CO** - ecos is part of the multi-disciplinary team assisting Boulder County Parks & Open Space (BCPOS) with resilient design for the restoration of Reach 3 of the Saint Vrain Creek (from Highway 36 downstream to Hygiene Road) that was damaged by the 2013 floods. Jon's role in the project includes: 1) desktop and field assessment to inventory and document the characteristics of the stream reach and riparian corridor (e.g. in-stream features, vegetation, wildlife habitat); identify and locate significant habitat features within the areas of proposed construction; identify potential sources of native plant materials for restoration; and identify areas of opportunity within the reach that require native vegetation, wetland, PMJM, leopard frog and fishery habitat restoration; and delineate wetland habitat and waters of the U.S. in all areas of proposed/potential construction-related impact; 2) vegetation community and wildlife habitat restoration design; 3) permitting and compliance under the CWA, ESA and NHPA; and 4) construction oversight of restoration construction activities. This project was completed in the summer of 2018.
- **Bohn Park Flood Recovery and Restoration, Town of Lyons, CO** – ecos is part of the Design Team assisting the Town with the restoration, enhancement and stabilization of Bohn Park which was damaged by the 2013 floods. Ecos role is to assess, design, and prepare design-bid-build specifications for the natural restoration of the vegetation communities and habitat along South St. Vrain Creek that have been incorporated in to the landscape architecture of Bohn Park, the Towns largest and most used recreational asset. This project was completed in the spring of 2018.
- **Fourmile Creek Flood Recovery and Restoration, Boulder County, CO** – ecos was part of the Fourmile Watershed Coalition design-build team tasked with restoring flood-damaged properties that were prioritized in the watershed master plan. Jon generated seeding and planting plans, performance notes, cost estimates, and co-managed construction oversight in collaboration with the executive director of the Watershed Coalition. This project was completed in the summer of 2017.
- **James Creek Post-flood Restoration, Lefthand Watershed Oversight Group (LWOG), Jamestown, CO –** ecos was part of the LWOG Team responsible for preparing the 30-60% design package for James Creek Reach 16 as identified in the Lefthand Creek Watershed Master Plan. ecos performed pre- and post-flood plant community assessment; developed revegetation goals and objectives, the basis of design, monitoring protocols, and revegetation plans according to Colorado Department of Local Affairs, Community Development Block Grant – Disaster Recovery 30% Guidelines. Specific resources and issues of concern addressed by ecos, included federal and state listed candidate, threatened and endangered species, wildlife species of concern (including raptors), fisheries and fish passage, native plant communities, and management of noxious weeds.
- **Saint Vrain Creek Flood Recovery and Restoration, Town of Lyons, CO –** ecos is part of a design-build team tasked with restoring the St. Vrain Creek corridor in the Town of Lyons that was damaged during the September 2013 flood event. The goal of the project is to work with the Town and affected land-owners to create a more resilient floodplain and natural channel condition that will help alleviate future threats to the community, reestablish floodplain connectivity, stabilize banks, and restore aquatic, wetland and riparian habitat that was wiped out during the flood. Mr. Dauzvardis is responsible for developing the plant communities and revegetation strategies needed to restore aquatic and riparian structure and functions within the corridor that support fish, wildlife, recreation, and help the Town regain the ecological benefits and economic value they receive from outdoor enthusiasts. This project was completed in the summer of 2016.

- **Plum Creek Mitigation Bank, Sedalia, CO –** ecos was retained by Restoration Systems to prepare conceptual design plans for the Plum Creek Mitigation Bank Site that is currently under consideration by the Chatfield Reservoir Mitigation Company (CRMC). The purpose of the Site is to provide compensatory mitigation credits for unavoidable, permitted impacts to wetland, PMJM and bird (target resources) habitat regulated under the CWA and ESA; and to restore, enhance and preserve natural resource functions. Jon has guided agency and CRMC staff on tours of the Site; performed plant community mapping, baseline EFU assessment for PMJM, and FACWet assessment of wetlands. Jon was responsible for mapping, interpretation, and quantification of historic and existing habitat on the site. Jon prepared Conceptual Design Plans for resource mitigation including channel geomorphology, PMJM and wetland habitat setting the stage for post-mitigation calculations of EFU's.
- **Bellvue Raw Water Ponds Riverbank Restoration, Bellvue, CO –** The 2013 flood on the Poudre River altered the course of the river and severely eroded a bank nearly causing a breach of the City of Greeley's raw water ponds – their main municipal water supply. The goal of the project was to stabilize the bank to protect the ponds and to create riparian habitat for the Preble's meadow jumping mouse, a federally listed threatened and endangered species. Jon was responsible for preparing bioengineering design plans and specifications that include soil/cobble encapsulated lifts, stream barbs to deflect flows away from the bank, and harder, biotechnical design of soil/riprap and stream bed scour protection measures to prevent erosion and further undermining and sloughing of the bank. Design plans included specification of native plant materials and various techniques to restore cottonwood forest and willow habitat to further stabilize the bank.
- **Poudre River Pipeline Crossing at Kodak, Windsor, CO –** Jon's role on the ecos team was to assess restoration potential, techniques, and prepare design plans and performance specifications to reclaim a pipeline corridor across the lower Poudre River where the City of Greely had to replace 3 major water supply lines. Flooding on the Poudre River in 2013 and 2014 temporarily suspended construction of the pipeline. Jon will oversee site stabilization and restoration measures once all 3 pipelines have been installed.
- **Lions Park Poudre River Restoration Plan, Laporte, CO –** Jon's role on the ecos team was to assess habitat conditions; gather, compile and analyze field survey data; and to prepare the mapping and mitigation design plans for the Lions Park PMJM habitat and the Poudre River Bank Stabilization Plans. Jon simultaneously designed and executed the technical drawings for the structural components of the habitat, ensuring that the proposed riparian plant community, habitat structures (brush piles), and bioengineered streambank stabilization measures will create the conditions that alleviate the current habitat fragmentation; support the life requisites of the PMJM; and enhance the overall health of the Poudre River fishery.
- **St. Vrain River Riparian Corridor Enhancement, Lyons, CO –** Jon designed, managed and led the construction of the Preble's Meadow Jumping Mouse Habitat (PMJM) enhancement project along the St. Vrain River. Jon worked in coordination with the project sponsor and Director of the Town of Lyons, Parks, Recreation and Cultural Events Department to implement required mitigation within a passive greenway park along the St. Vrain. Jon's role included riparian/PMJM mitigation site identification and habitat assessment; and design; and implementation of riverbank stabilization and riparian habitat enhancement measures.
- **Brush Creek Fishery Enhancement Plan, Saratoga, WY** – Prepared access, staging and design plans, details and performed on-site construction oversight of instream and riparian habitat enhancements and bioengineered bank stabilization along a 3-mile reach of Brush Creek. The purpose of the project is to enhance fish, bird and wildlife habitat and use these resources to facilitate education and improve the recreational experience of Ranch guests. Access routes were planned so that they can be easily converted to trails to avoid repetitive impacts to high quality habitat and productive pastures.
- **St. Vrain River Riparian Corridor Enhancement, Lyons, CO** – Jon is the lead Landscape Architect for the restoration and enhancement of Preble's Meadow Jumping Mouse Habitat (PMJM) along the St. Vrain River. Jon and ecos are working in coordination with the Town of Lyons, Parks, Recreation and Cultural Events team to implement this restoration project within a passive park area along the St. Vrain. Jon's tasks include riparian/PMJM habitat assessment; PMJM site location and habitat design; and implementation of riverbank stabilization and riparian habitat enhancement measures.
- **TZ Ranch, Elk Hollow Creek Fishery Habitat Enhancement Plan, Saratoga, WY -** ecos performed the assessment and design of the Elk Hollow Creek Project, which included instream and riparian habitat

improvements aimed at increasing bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach. Instream improvements included drop structures, plunge pools, deep pools, riffles and spawning habitat. Bank improvements included seeding and planting plans for native wetland and riparian species. Jon was the lead on the generation of design-build plans and provided construction oversight of instream structure and native plant installation.

- **Brush Creek Ranch Pond Creation Plan, Saratoga, WY** – Prepared below grade pond excavation, grading, drainage and revegetation plan for a 0.30-acre fishing pond, followed by on-site field layout and surveying, wetland sod transplanting, submerged aquatic habitat and construction support of heavy equipment operators. The pond was designed to be a self-sustaining, cold water fishery that supports all components of the aquatic food-chain and incorporates all necessary life requisites for trout; and provide fishing opportunities during high water in Brush Creek.
- **Edwards Eagle River Restoration Project, Edwards, CO** – Assessment, planning, native plant community design and construction oversight of aquatic, wetland, riparian habitat along 1.5 mile reach and 168-acres of floodplain along the Eagle River utilizing indigenous materials and methods that naturally integrate habitat structure in the landscape context. Planning and design included trails, boat launch, boardwalks, overlooks, and interpretive sign systems and thematic content.
- **Boone Property, Boulder Creek Fishery Enhancement Project, Boulder, CO** – Performed site assessment and identified instream and overhead cover habitat to enhance fish habitat along a short reach of Boulder Creek adjacent to City of Boulder, Eldorado Canyon Open Space.
- **C-Lazy-U Ranch Willow Creek Fishery Enhancement Plan, Granby, CO** – Assessed and prepared design plans for 2 miles of instream and overhead cover habitat aimed at enhancing water quality through increased bank stability, improving aquatic habitat and angling opportunities, and providing long-term stability to the reach influenced ongoing ranching activities. Bank-side improvements include detailed seeding and planting plans indicating site-specific plant and seed locations, life zones, and species palettes according to hydrologic, soil, and aspect conditions.
- **Colowyo Coal Mine Wetland Creation Plan, Meeker, CO** – Performed wetland mitigation site feasibility assessment and design of 2.2-acres of created wetland benches along a 1.5-mile reach of the West New Goodspring Creek.
- **Uncompahgre River Wetland Creation and Streambank Stabilization, Montrose, CO** – Mr. Dauzvardis developed a Clean Water Act Individual Section 404, alternatives analysis and mitigation plans that successfully defrayed public descent and offset unavoidable impacts related to the River Landing Retail Development Project. Once approved by the USACE, the project turned a degraded, gravel-mined portion of the floodplain into functional and aesthetic riparian habitat that is now enjoyed by the public via a segment of trail that Mr. Dauzvardis designed. Two acres of riparian and “backwater” wetland habitat were strategically created along the Uncompahgre River to ensure reliable hydrologic connectivity and support of the designed wetland plant community. Nearly 350 lineal feet of severely degraded stream bank was stabilized using a naturalized bio-engineering approach that incorporated soil, native seed, erosion control blanket, shrubs, trees, and strategically located river boulders and logs to restore the riparian habitat, create fish habitat and redirect scouring flows away from the once barren bank.
- **River Point at Sheridan Brownfield Redevelopment, Sheridan, CO** – Designed and oversaw the construction of a “bio-engineered” and “bio-technical” vegetative landfill cap system and water quality swale that drains to the South Platte River. Jon was responsible for integrating the swale in to the River Point at Sheridan commercial redevelopment and the City of Englewood Golf Course renewal – renamed to the Broken Tee Golf Course.
- **Broken Tee Golf Course Flood Protection, City of Englewood, CO –** Oversaw the construction of a biotechnical subsurface stabilization and flood protection system (under-armor) designed to ensure that the woodland golf course tees, fairways and greens in the South Platte River floodplain are not compromised by flood scour. Designed and implemented bioengineered bank stabilization and under-armor on Bear Creek that was essential for protecting tees and greens. Jon was responsible for disproving the jurisdictional status of artificially supported wetlands via a groundwater monitoring system.
- **Lafarge Northbank Resources Gravel Pit Wetland Design, Rifle, CO** – Jon asses DMG requirements and prepared gravel pit reclamation plans aimed at providing suitable shallow-water wetlands and islands within the pit closure area to serve as compensatory mitigation for wetland impacts associated with mine operations adjacent to the Colorado River.

- **Leach Creek Stream Enhancement, Grand Junction, CO** – Designed stream corridor enhancements for a ½-mile section of Leach Creek that was channelized and used as an irrigation canal. Enhancements were designed to restore natural channel form and function, improve the aquatic environment, and provide mitigation for jurisdictional impacts permitted under the Nationwide Permit program. This project is being used as a model and replicated along other reaches of Leach Creek
- **Castro Property Wetlands and Wildlife Ponds, Beulah, CO** – Performed the site assessment, feasibility analysis, water resource and minor dam design, native plant design, landscape architecture, and supported the water rights application needed to create shallow water wetland habitat for amphibians, waterfowl, migrating bird and ungulates, and deep water habitat for trout at a sub-alpine elevation of 9000 feet. Project included development of a spring, creation of a creek and a mechanical water circulation and aeration system to support the aquatic, wetland, and riparian ecosystem. Organized, supervised and participated in a volunteer planting effort.
- **Jefferson County Gunbarrel Bridge Replacement, Oxyoke, CO** – Developed construction plans and specifications and oversaw construction of wetland and Preble's mouse habitat mitigation to enhance weedy and degraded wetland and Preble's mouse habitat along Gunbarrel Creek, a tributary to the upper South Platte River near Deckers, CO.
- **Coal Creek Bank Stabilization, Erie, CO** – Assessed, permitted, designed and performed construction oversight of bio-engineered/bio-technical bank stabilization and wetland creation associated with the Vista Parkway bridge crossing over Coal Creek in Erie, CO. The project involved pulling back vertical banks and restoring native wetland, riparian, and short grass prairie habitat.
- **Spring Creek Wetland Mitigation, Colorado Springs, CO** – Generated wetland and creek creation plans that integrated required mitigation into a high density, "new urban" development. The design emphasized re-utilization of urban storm water to sustain wetlands, use of indigenous plants, construction materials, and natural geomorphic relationships.
- **Sulphur Gulch, Parker, CO** – Developed a naturalized sculpted concrete drop structure design, planting and bio-engineering plans for a highly visible, urbanizing reach of a sandy creek through the center of the Town of Parker.
- **Skylark Creek Restoration Plan, Kremmling, CO** – Designed and performed construction oversight of aquatic, wetland and riparian plant community, and trail system along a historic side channel of the Upper Colorado River on a private fishing ranch.
- **ARCO Opportunity Ponds Wetland Mitigation Design, Anaconda, MT –** Jon generated the design of a 908-acre complex of wetlands and terrestrial habitat required to meet the Consent Decree and the functional assessment criteria established during the wetland assessment process mentioned previously. The design is currently being implemented. Once complete, the grading, drainage, hydrology, and revegetation strategy used to create wetlands from massive soil borrow pits will potentially be the largest inland, freshwater wetland mitigation project in the United States.
- **Northgate Boulevard Realignment, Colorado Springs, CO** – Coordinated and prepared ESA Section 7 and CWA Section 404 consultation documents as required by the USFWS and USACE, including mitigation construction documents, specifications, on-site layout of plant communities and construction supervision aimed at restoring wetland and riparian habitat occupied by Preble's meadow jumping mouse.
- **Northgate PMJM and Wetland Mitigation Plan, Colorado Springs, CO** – Mr. Dauzvardis was an instrumental member of multidisciplinary team responsible for delineating wetlands, preparing ESA Section 7 and CWA Section 404 assessment, impact analysis and consultation documents as required by the USFWS and USACE. As the lead designer, Jon was responsible for the design of over 80 acres of wetland, riparian, and grassland habitat utilized as primary and secondary habitat for Preble's Meadow Jumping Mouse, a Federally-listed threatened species. Jon prepared mitigation construction documents, specifications, onsite layout of plant communities and supervised construction for this precedent setting mitigation plan designed to offset impacts to critical habitat over a 1200-acre site.
- **Martin County Coal Corporation, Inez, KY** – Mr. Dauzvardis bioengineered and performed on-the-ground triage of two stream corridors, consisting of 26 miles, impacted by a coal slurry spill that originated from a mountaintop mine reservoir used to hold liquefied coal dust. Jon identified and documented critically imperiled stream banks and human settlements, and then designed, coordinated, led and supervised local crews during the implementation of specified floodplain, bioengineered bank stabilization, and reforestation efforts.

- **Uncompahgre River Restoration and Park Corridor, Ouray, CO** – Jon designed and performed construction oversight of the restoration and reclamation of one mile of upland, riparian and wetland habitat left barren by historic placer mining. The major challenge presented by this project was a lack of soil, organic matter and nutrients to sustain vegetation. This constraint was addressed by amending the soil with humate and planting and seeding riparian vegetation to initiate natural succession and bioaccumulation of matter, assisted by an irrigation system that injected organic fertilizer and microbes (mycorrhizea) in to the substrate.
- **Burlington Mine Remediation, Jamestown, CO** – Preparation and management of specification package, best management practices (BMPs), and revegetation design for mine waste capping and closure.
- **Powder River Coal Company – Porcupine Creek Restoration, Douglas, WY** – Designed and supervised the construction of this post mine wetland/creek restoration project. Following the pit closure, reclamation specialists reestablished the original location and geomorphic relationships of the creek using historic aerial photography using a trapezoidal channel cross-section design. Jon adapted the design creating grading and wetland planting plans that mimic the landform, natural lateral and longitudinal channel tilt, and plant communities that are indigenous to ephemeral creeks in the shortgrass prairie landscapes of eastern Wyoming.
- **Sand Creek Corridor Habitat Enhancement at Bluff Lake, Denver, CO** – Prepared plant community, bioengineering and bank stabilization design. Prepared visualization graphics to present and receive design approval.
- **Intrawest Resort Development, West Ten Mile Creek, Copper Mountain Village, CO** – Prepared vegetation community and concept design of village base streamside recreational amenities.

Construction and Plant Installation:

- **St. Vrain River Riparian Corridor Enhancement, Lyons, CO –** Jon managed construction and implementation of the restoration and enhancement of 0.60-acre of riparian Preble's Meadow Jumping Mouse Habitat (PMJM) along the St. Vrain River.
- **Standley Lake Protection Project, Westminster, CO** – Designed and supervised construction of a 0.50-acre created emergent wetland to fulfill final mitigation requirements of the USACE and bring closure to the City's drinking water protection project.
- **Caribou Peat Bog Restoration, Nederland, CO** –Prepared native plant community design, planting cost estimate, and on-the-ground oversight of volunteers to restore a high-altitude peat bog disturbed by an illegal four-wheel drive "mudfest".
- **Department of Energy (DOE) Wetland Mitigation Bank, Westminster, CO** – Construction supervision of grading and planting plans of a 12-acre wetland mitigation bank design for the Department of Energy.
- **ARCO Lower Area One and Butte Reduction Works, Butte, MT** – Performed construction observation and supervision of temporary labor crews to plant a passive treatment wetland designed to absorb heavy metals from groundwater.
- **Colorado Department of Transportation Mitigation Bank, Limon, CO** – Performed in-field planting design and supervised local labor to complete a 10-acre wetland mitigation bank designed by CDOT to offset future wetland impacts in the transportation region.
- **Irvine Ranch Water District – San Joaquin Wetland Treatment System, Irvine, CA** – Planting superintendent of a wetland designed to be a used as tertiary wastewater treatment facility and waterfowl refuge.

PRESENTATIONS & INSTRUCTION:

Dauzvardis, Jonathan B. 2008. Preserving the Ecological Services of Willow Cuttings. Research presented at the Colorado Riparian Association (CRA) Sustaining Colorado Watersheds Conference. October 2, 2008. Vail, Colorado.

Dauzvardis, Jonathan B. 2006. Water Pollution and Wetland Plant Tolerance to Various Ph Levels. Classroom instruction with Elementary Students. Flagstaff Academy Charter School. February 2, 2006. Longmont, Colorado.

Dauzvardis, Jonathan B. 2006. Soil Erosion and Habitat Destruction. Classroom instruction with Elementary Students. Flagstaff Academy Charter School. January 26, 2006. Longmont, Colorado.

Dauzvardis, Jonathan B. 2004. Wetland and Wildlife Habitat Restoration, Opportunity Ponds, Anaconda, Montana. Poster Presentation at Ecological Restoration Conference. October, 2003. Orlando, Florida.

Dauzvardis, Jonathan B. 2003. Application of Landscape Ecology Principles to Mine Remediation and Wetland Creation: An Ecological Restoration Seminar using a Case Study of the Opportunity Ponds Wetlands Plan, Anaconda, Montana. Presented at the University of Colorado, Denver. November, 2003. Denver, Colorado.

Dauzvardis, Jonathan B. 2000. Endangered Species Act Issues: Incorporating the ESA into Mitigation Projects. Presented at the Continuing Legal Education (CLE, International) Colorado Wetlands Conference. September 18, 2000. Denver, Colorado.

AWARDS:

- Colorado Landscape Contractors Award, Sand Creek Enhancement Project – 2000
- Colorado Landscape Contractors Award, Skylark Creek Restoration Project – 1998
- Colorado American Society of Landscape Architects, Research, and Communications – 1997
- Texas American Society of Landscape Architects Honor Award – 1995
- Texas A&M Landscape Architecture Faculty Award – 1995

PROFESSIONAL ASSOCIATIONS:

- Town of Erie, Colorado Open Space and Trails Advisory Board (OSTAB) - As a former member and chair of the Town of Erie Open Space and Trails Advisory Board (OSTAB), Mr. Dauzvardis routinely collaborated with Town Administrator, Community Planning, Public Works, and Parks and Recreation Directors and Staff, and advised the Board of Trustees on all matters related to the goals, objectives, prioritization, acquisition, conservation, and the management of open space and trails throughout a 49-square mile planning area. Jon's 8-year experience on the OSTAB translates to an intimate knowledge of public processes.
- Society of Wetland Scientists (SWS)

Appendix G
MT – 2 Checklist

MT-2 REVISION REQUEST SUBMITTAL CHECKLIST

PART A: GENERAL REQUIREMENTS

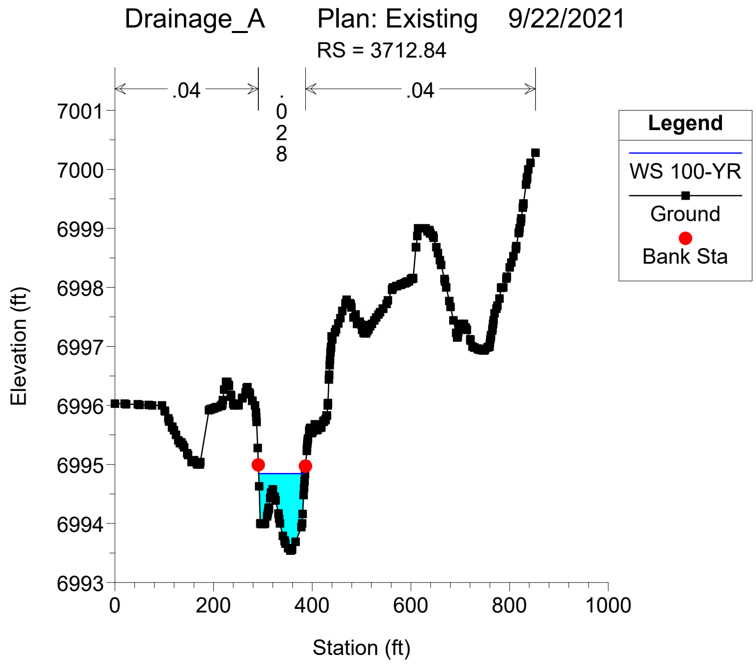
ELEMENTS	Yes	N/A
NARRATIVE: Please provide a written description about the purpose of the request and the scope of the proposed/as-built project and the methodology used to analyze the project effects.		
MT-2 APPLICATION FORMS: Please provide completed forms applicable to your request. Ensure that MT-2 Form 1 was signed by the requester, certifying engineer, and each community affected by the revision.		
HYDROLOGIC ANALYSIS: If applicable, please provide a FEMA acceptable hydrologic analysis in digital format, drainage area map and associated backup information (e.g., calculations used to determine lag time, CN and loss values as well as landuse and soil maps). FEMA-acceptable models can be accessed at www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/numerical-models-meeting-minimum-requirements.		
HYDRAULIC ANALYSIS: Please provide a FEMA acceptable hydraulic analysis in digital format. FEMA-acceptable models can be accessed at www.fema.gov/national-flood-insurance-program-flood-hazard-mapping/numerical-models-meeting-minimum-requirements.		
CERTIFIED TOPOGRAPHIC WORK MAP: Please provide a certified topographic work map that meets the mapping requirements outlined in MT-2 Form 2. If available, please provide digital Computer-Aided Design (CAD) or Geographic Information System (GIS) data that is spatially referenced.		
ANNOTATED FIRM: Please submit a revised FIRM, at the scale of the effective FIRM, which shows the revised boundary delineation of the base floodplain, 0.2-percent-annual-chance floodplain, and regulatory floodway and how it ties into the boundary delineation shown on the effective FIRM at the downstream and upstream ends of the revised reach.		
REVIEW FEE PAYMENT: Please include the appropriate review fee payment. The current fee schedule is available on the FEMA Web site at https://www.fema.gov/flood-map-related-fees.		
MEET 65.10 REQUIREMENT: If the request intends to show that a berm/levee/flood wall provides flood protection, please submit all of the data requirements outlined in Section 65.10 of the NFIP regulations.		
OPERATION AND MAINTENANCE PLAN: If the request involves a berm, levee, flood wall, dam, and/or detention basin project, please submit an officially adopted maintenance and operation plan.		
PROPOSED/AS-BUILT PLANS: If applicable, please submit proposed/as-built plans, certified by a registered Professional Engineer, for all the project elements.		
FLOODWAY NOTICE: If the revision result in changing or establishing floodway boundaries, please provide floodway public notice or a statement by your community that it has notified all affected property owners, in compliance with NFIP regulation Subparagraph 65.7(b)(1).		
PROPERTY OWNER NOTIFICATION: If the revision result in any widening/shifting/establishing of the base floodplain and/or any BFE increases/establishing BFEs, please provide copy of the individual legal notices sent to all the property owners affected by any increases in the flood hazard information.		

PART B: CLOMR SPECIFIC REQUIREMENTS

Endangered Species Act COMPLIANCE: Please submit documentation of compliance with the ESA Requirements. To learn more about ESA Compliance, please see the MT-2 Instructions manual.		
65.12 REGULATORY REQUIREMENTS: If the Base (1-percent-annual-chance) Flood Elevation (BFE) increases greater than 0.00 foot as a result of encroachment within a floodway or 1.0 foot within Zone AE that has no floodway/Zone A, between the pre-project (existing) conditions and the proposed conditions as a result of the proposed project. Please submit a). Certification that no structures are affected by the increased BFE; b). Documentation of individual legal notice to all affected property owners, explaining the impact of the proposed action on their property; and c). An evaluation of alternatives that would not result in an increase in BFE.		

Note: Applicants are encouraged to submit their revision request using the Online LOMC tool. To learn more about the Online LOMC tool, visit the FEMA website at www.fema.gov/online-lomc.

Appendix H
Existing Condition Cross Sections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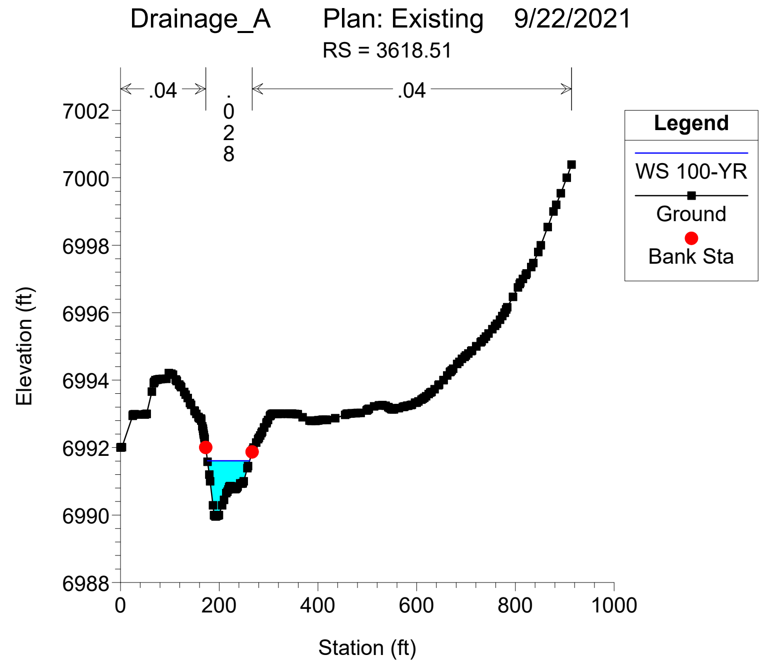
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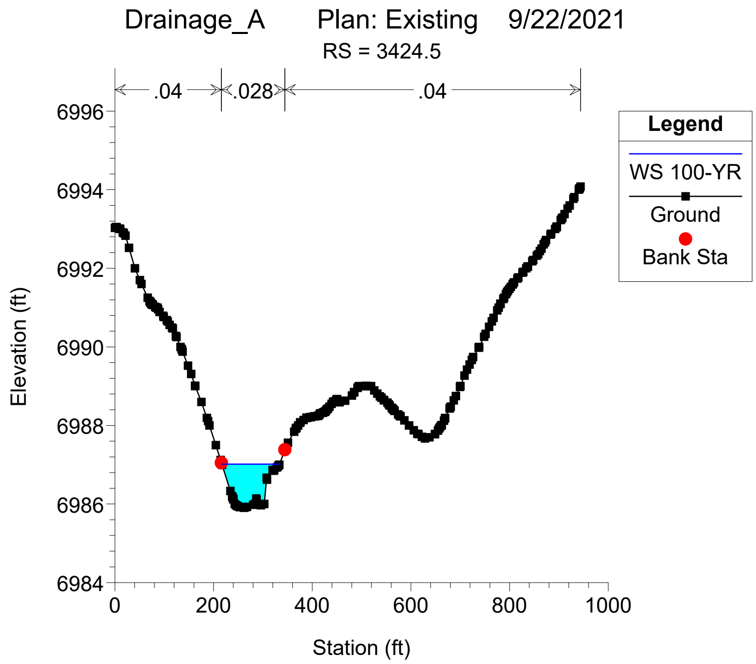
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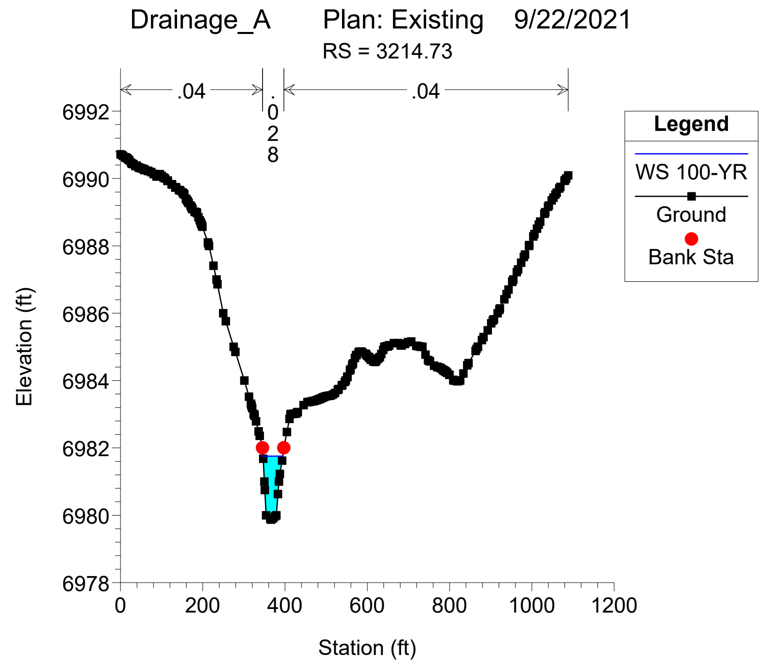
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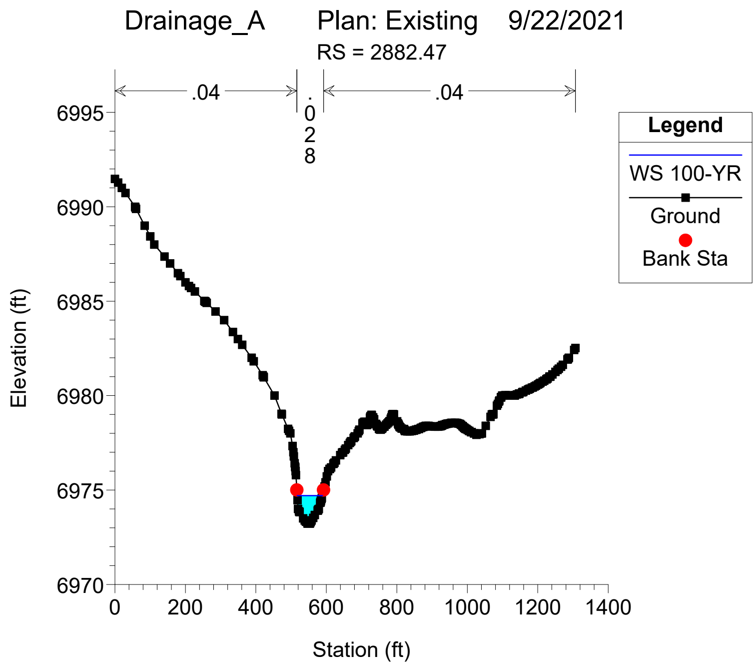
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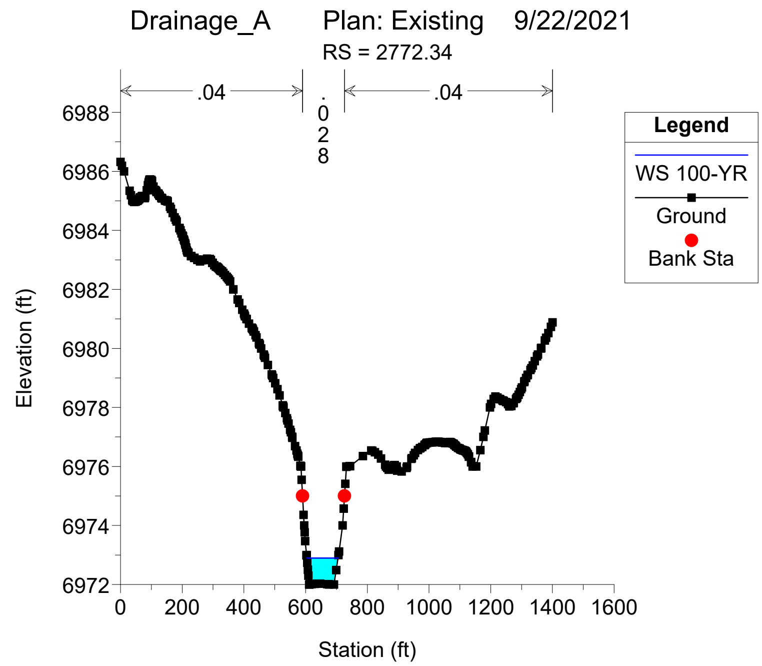
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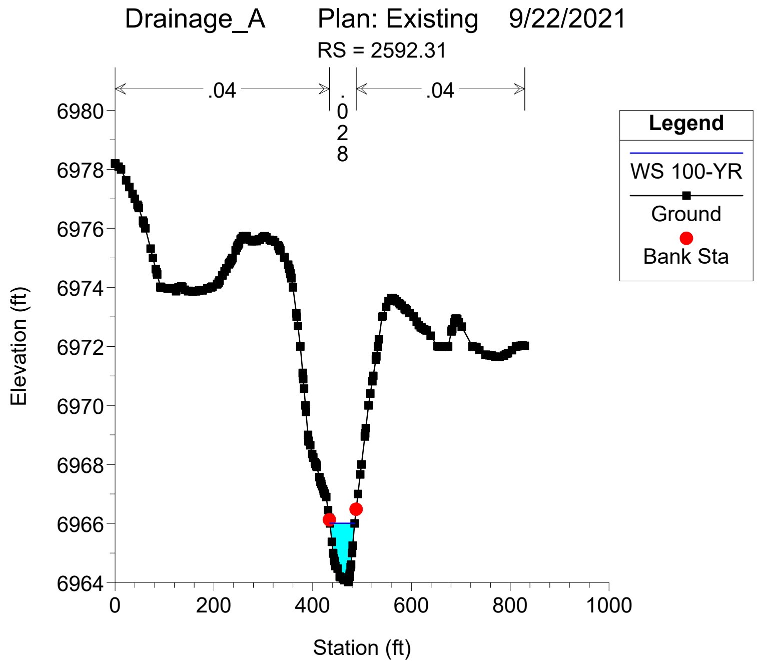
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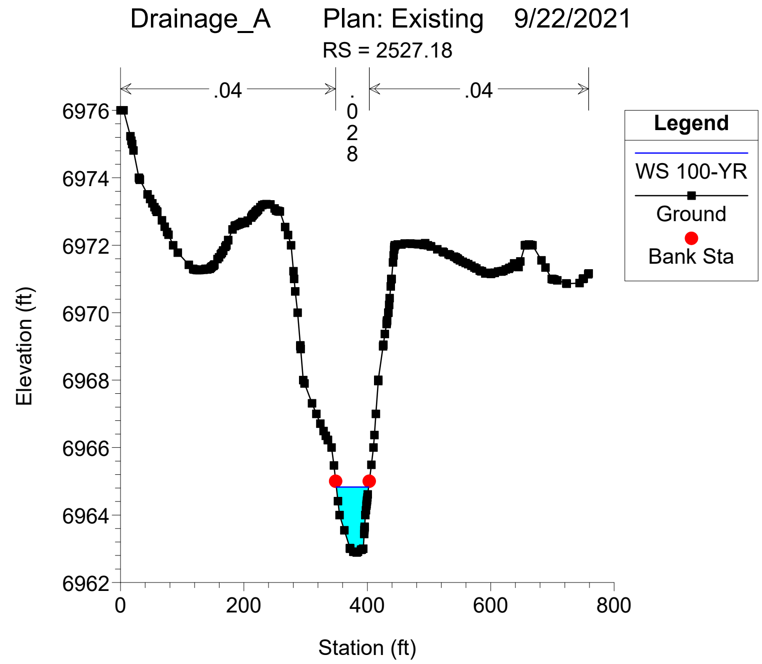
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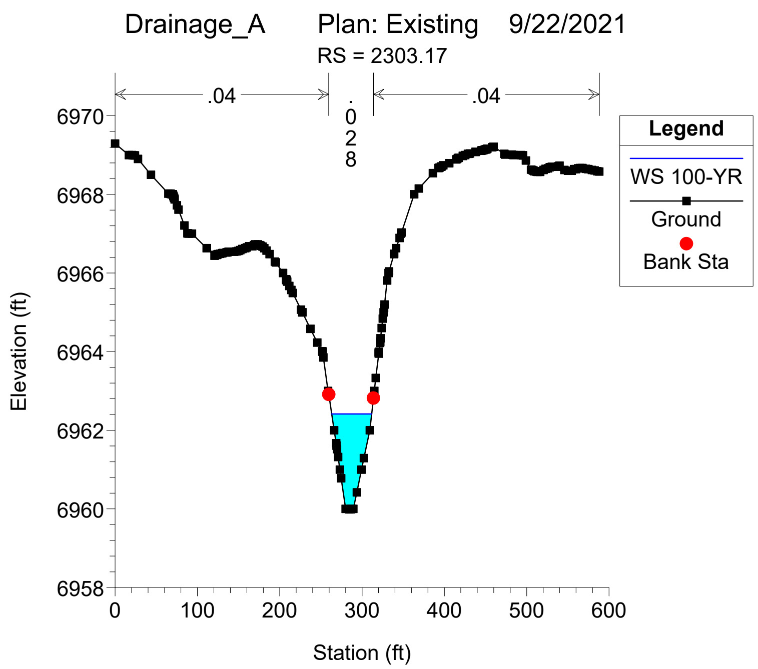
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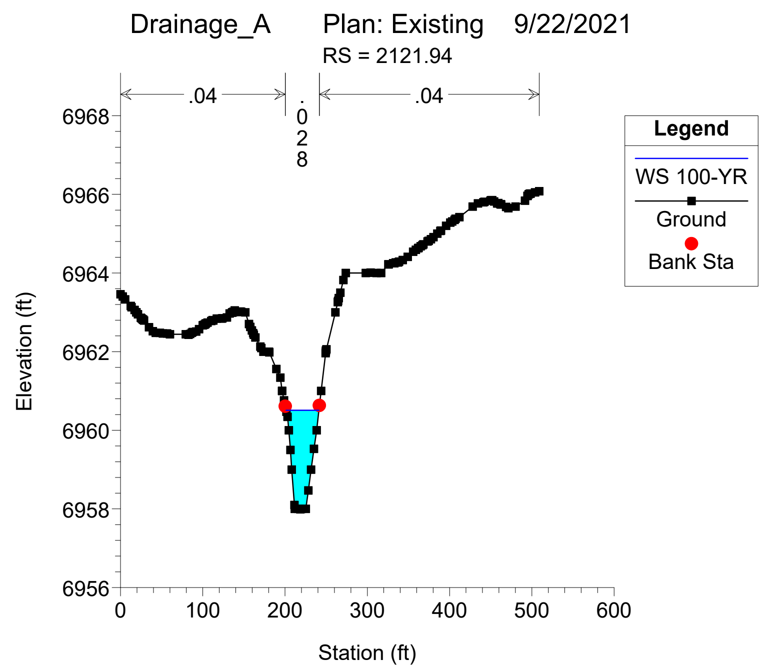
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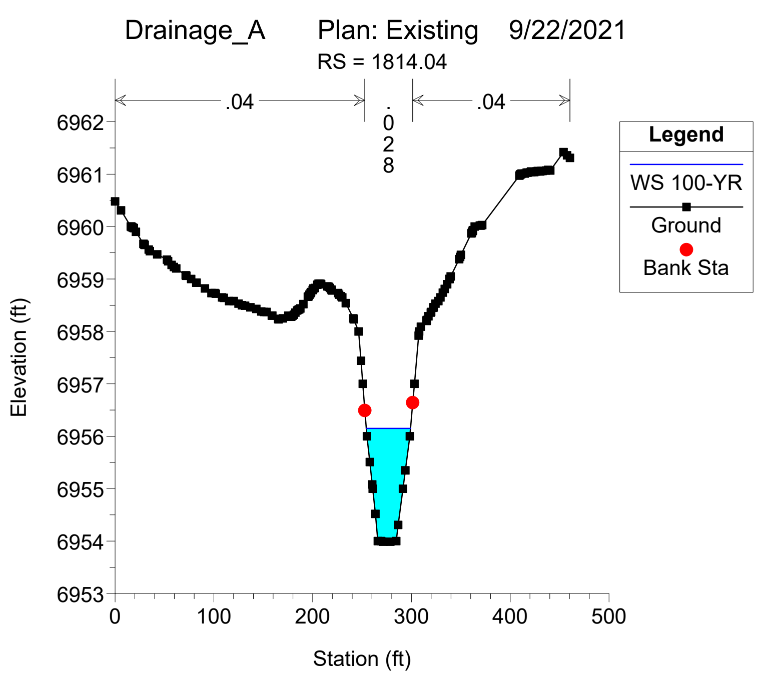
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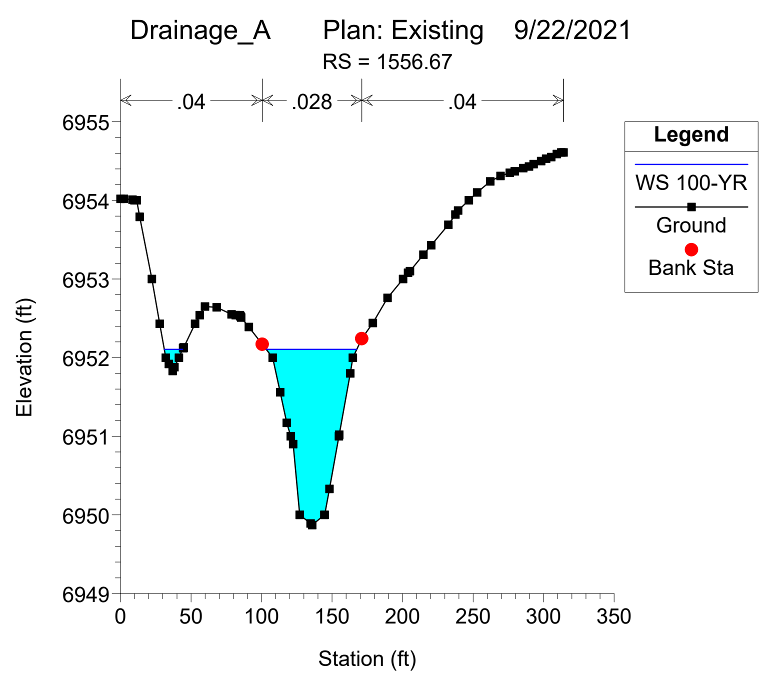
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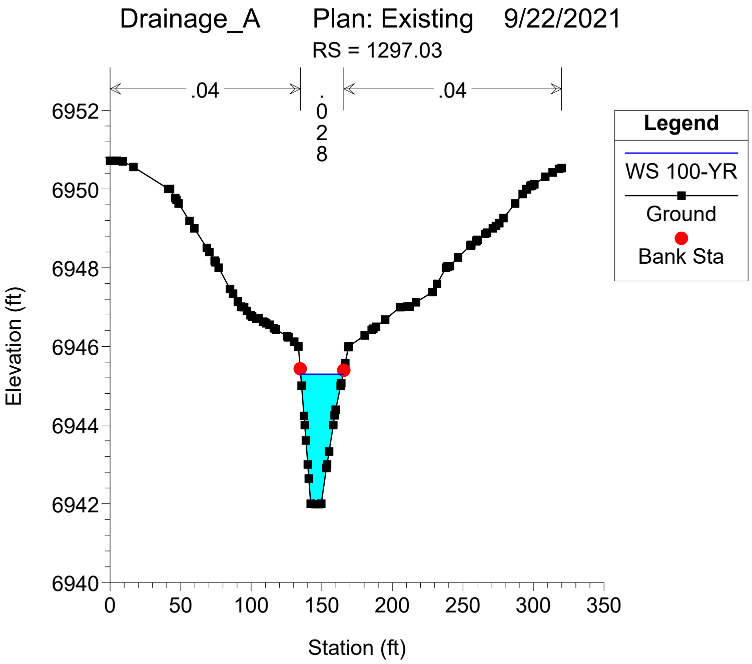
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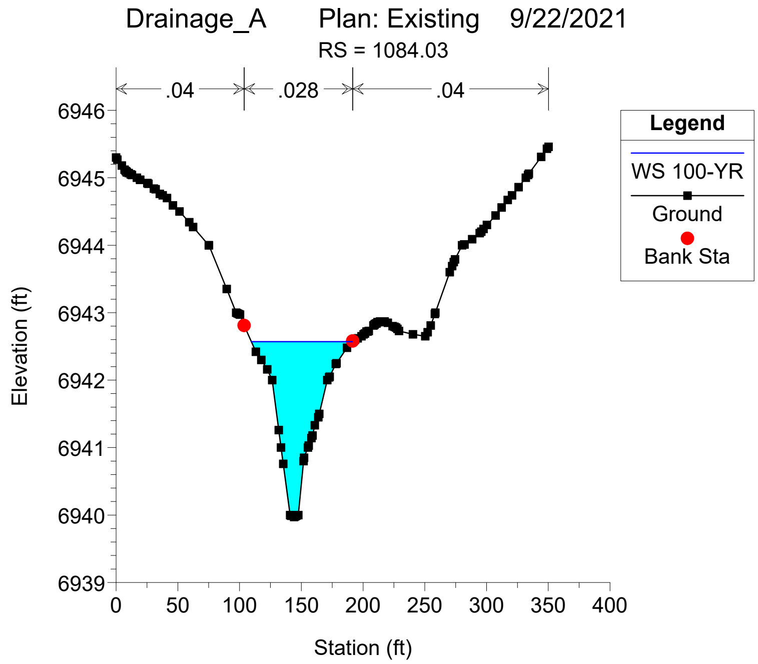
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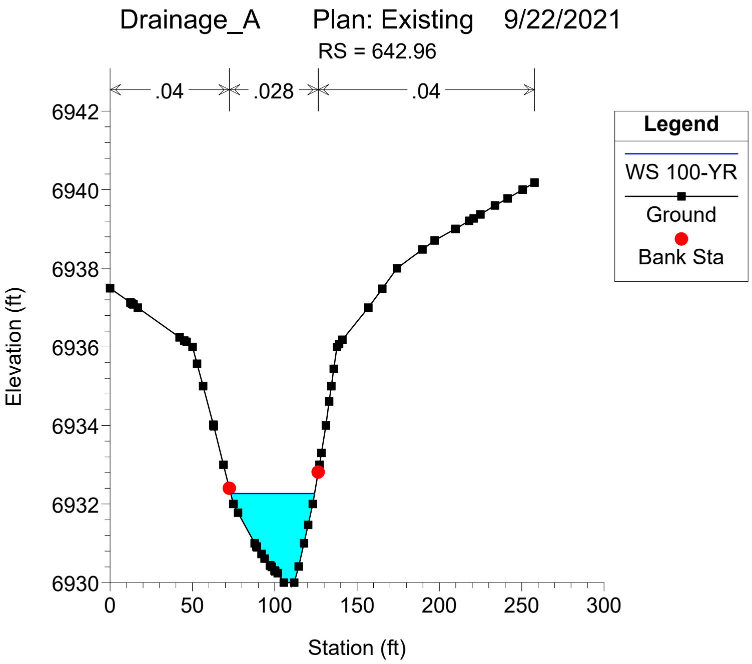
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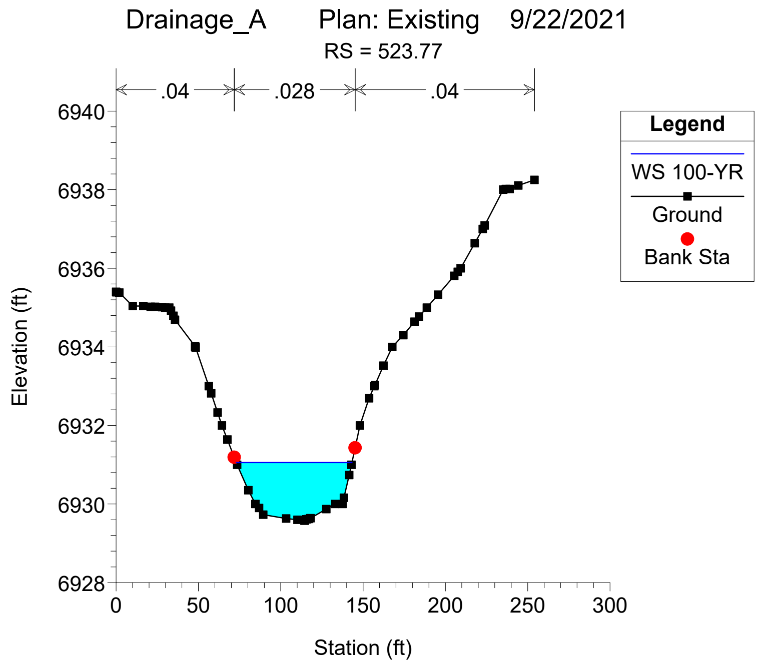
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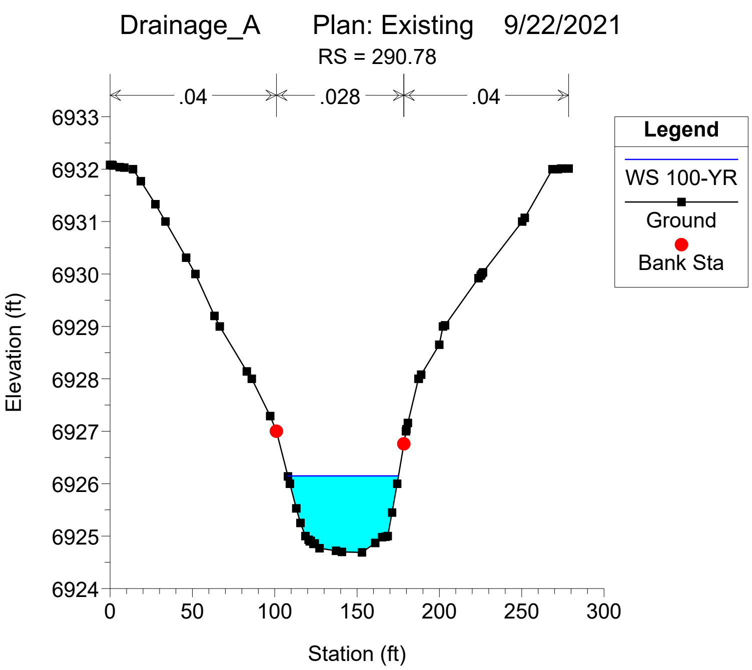
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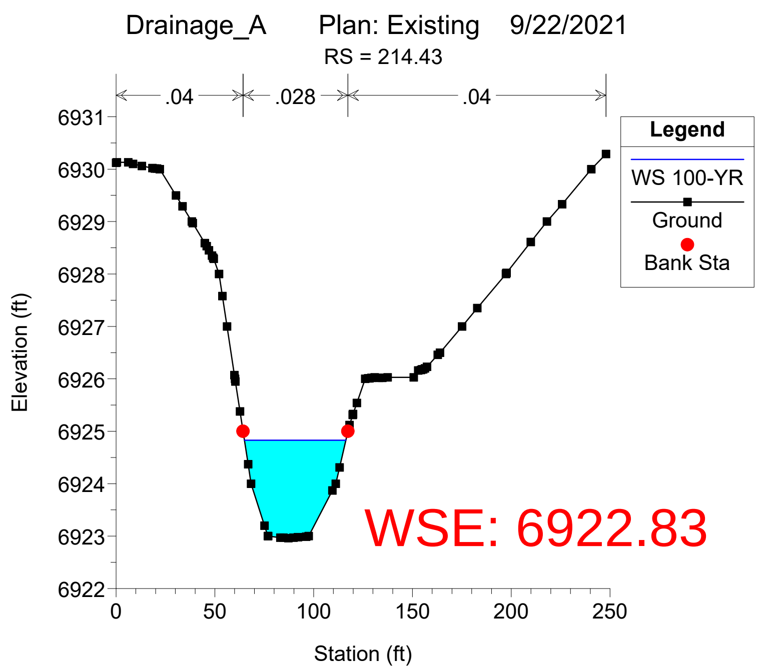
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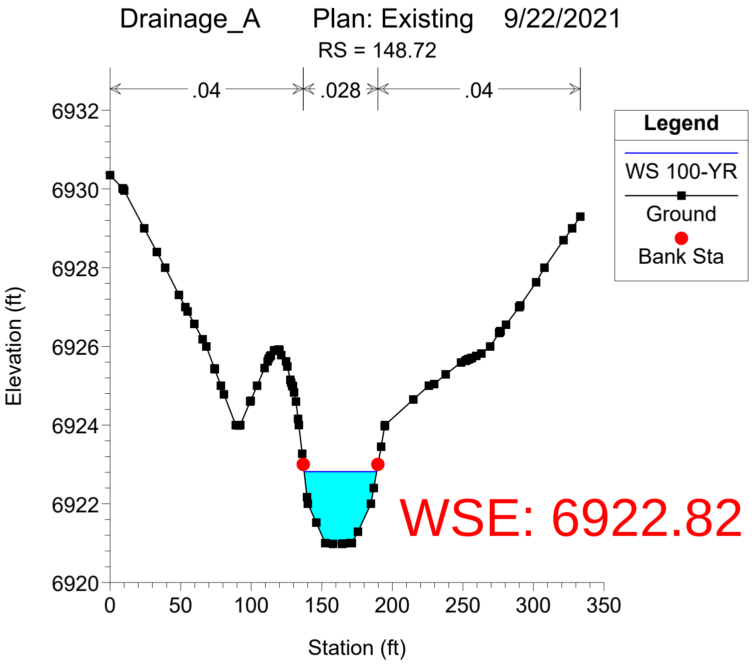

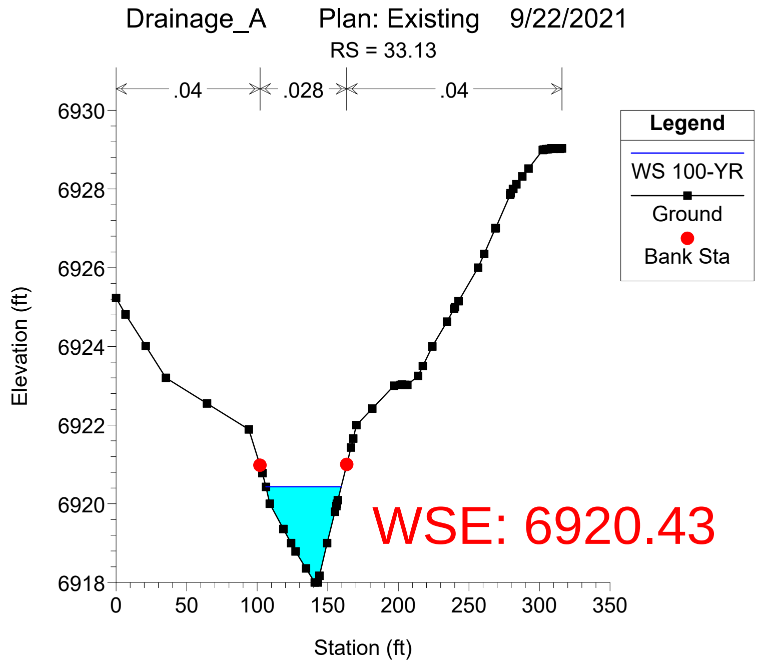

WSE COMPARISON

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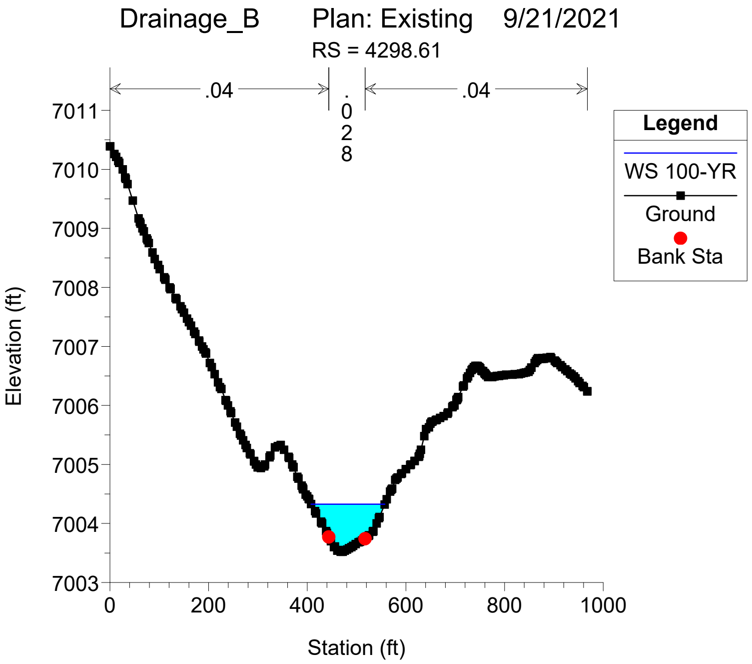
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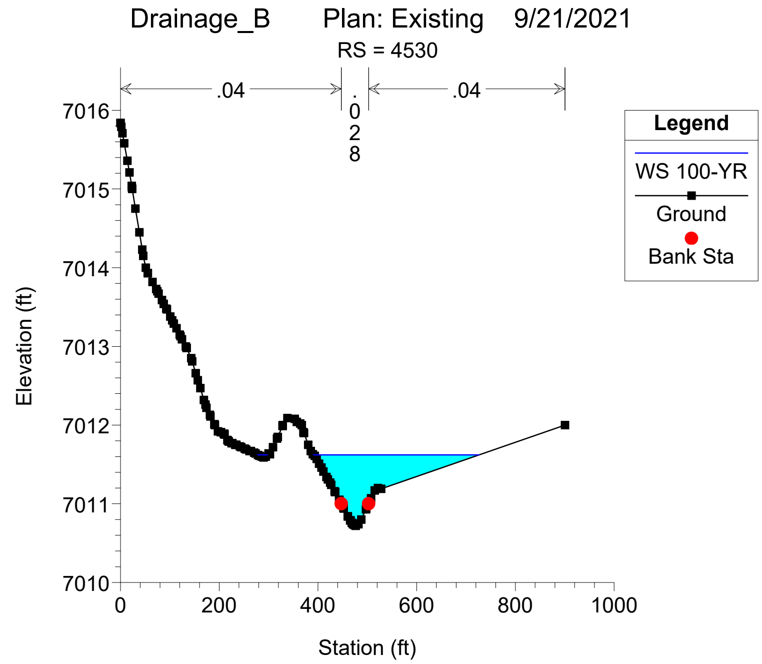
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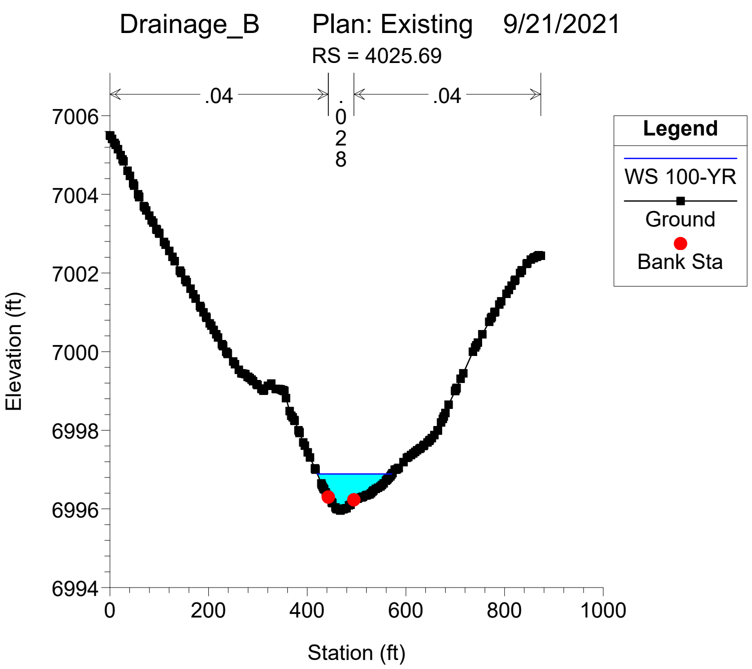
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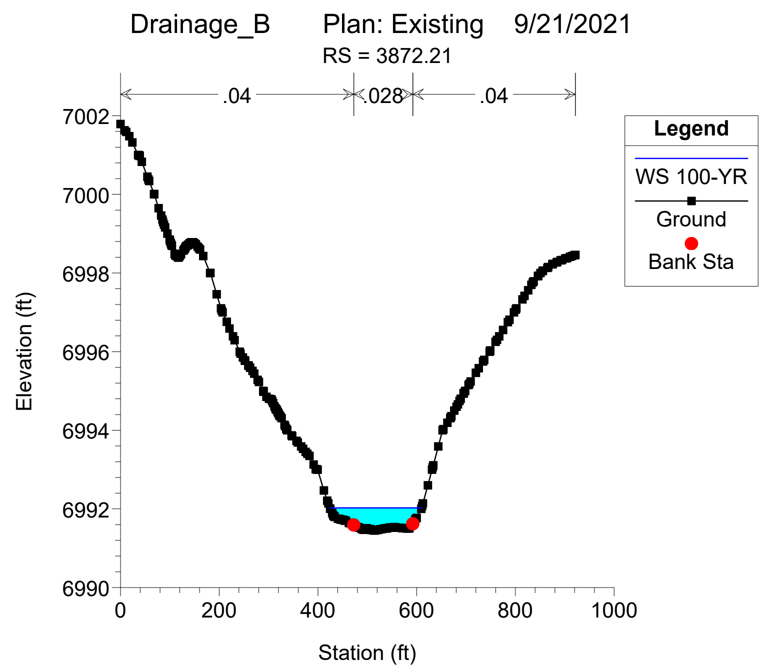
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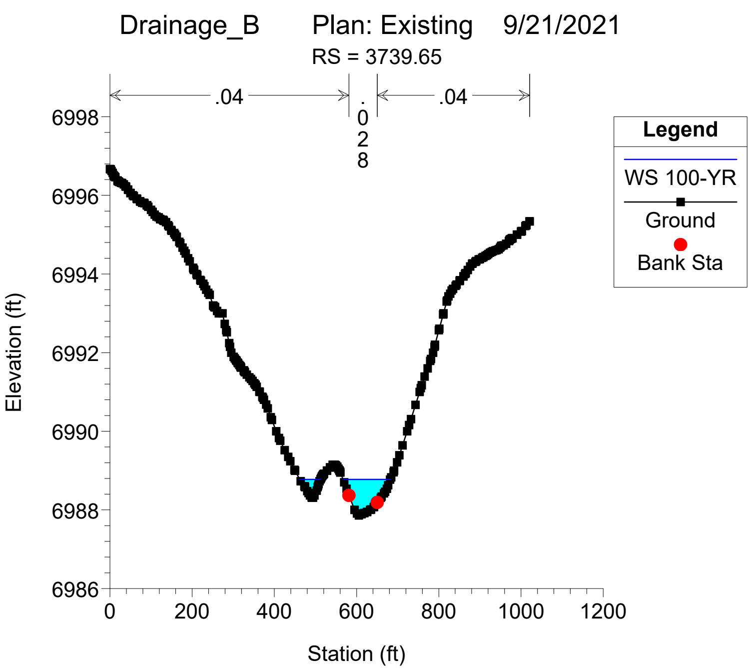
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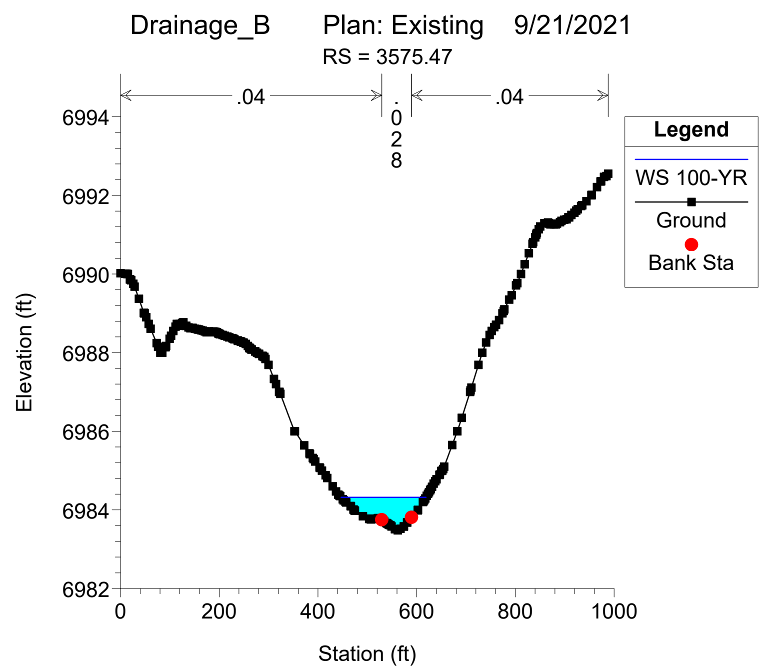
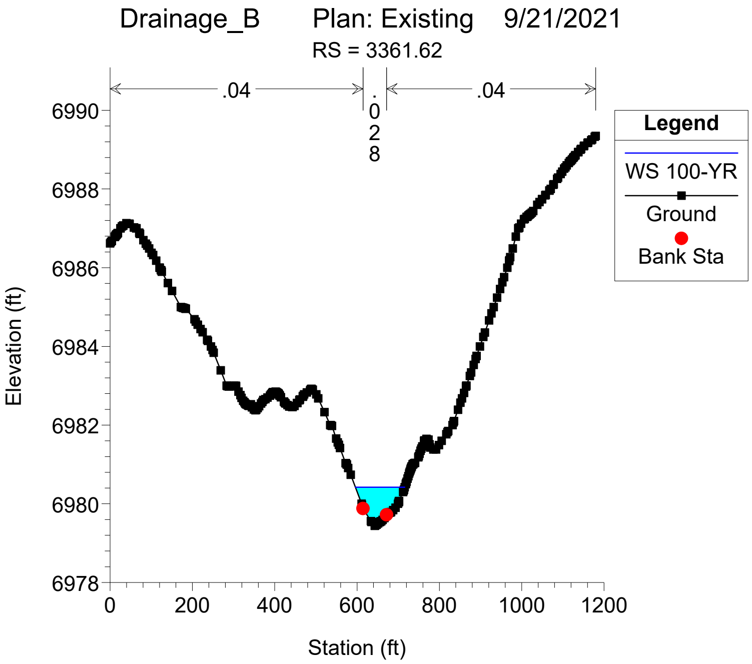
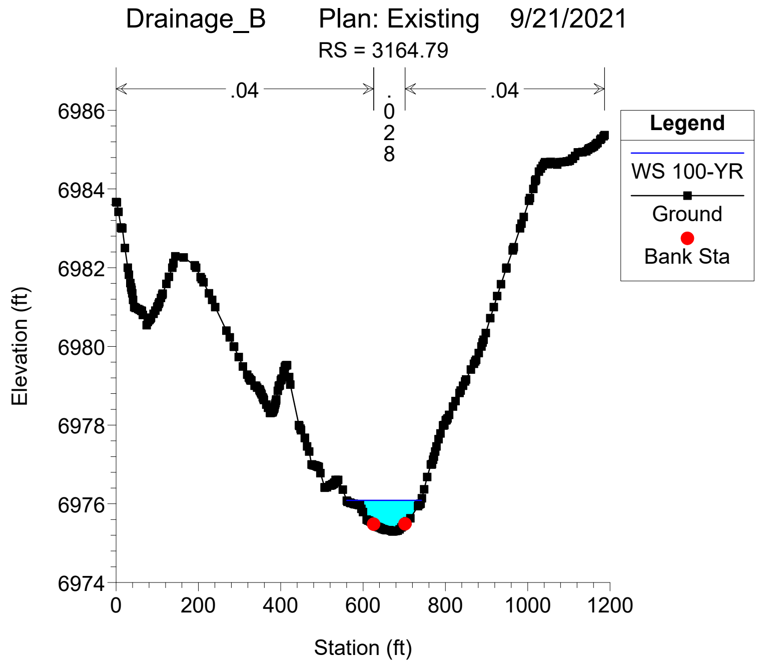
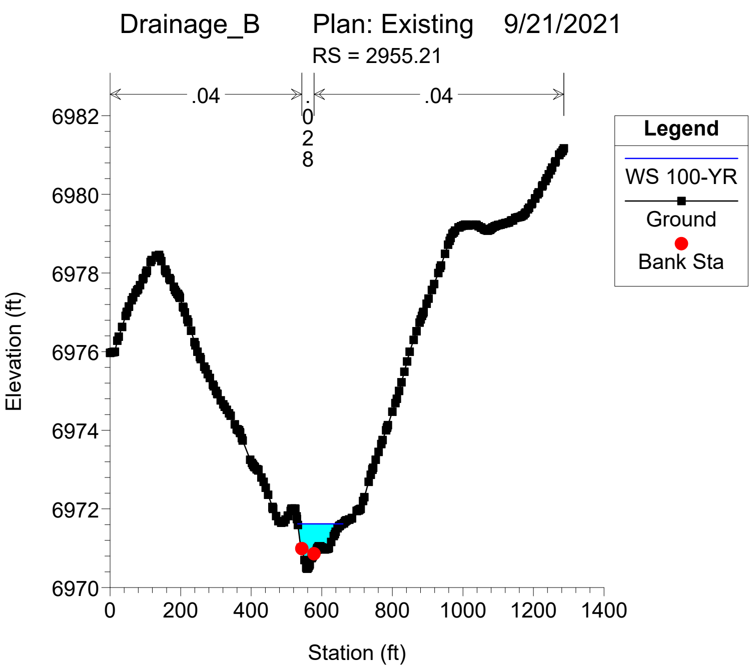
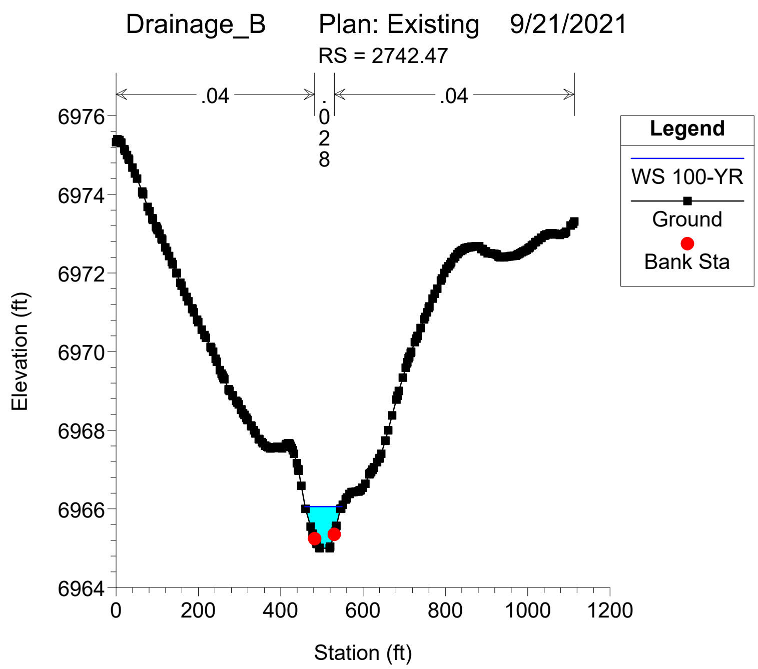
Ground
Bank Sta
Elevation (ft)
Station (ft)

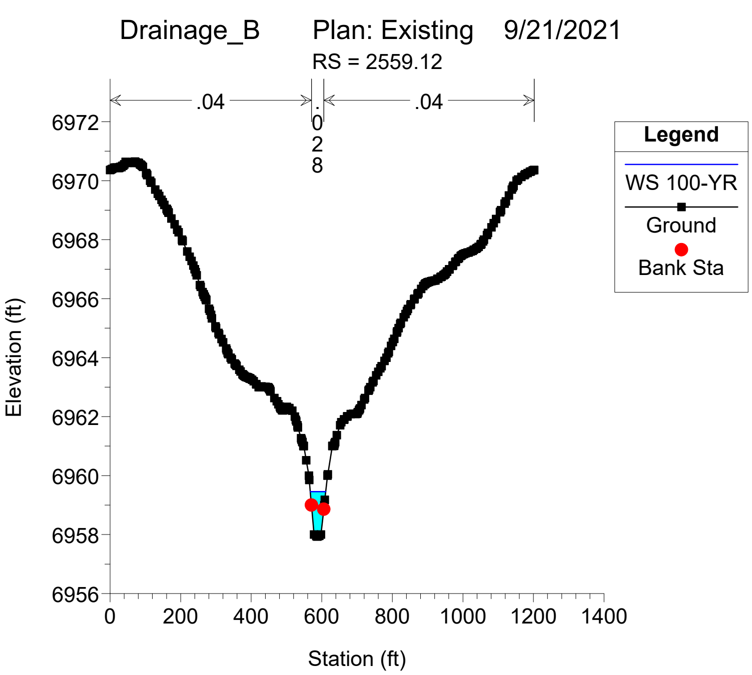

Drainage_B Plan: Existing 9/21/2021
RS = 3575.47
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

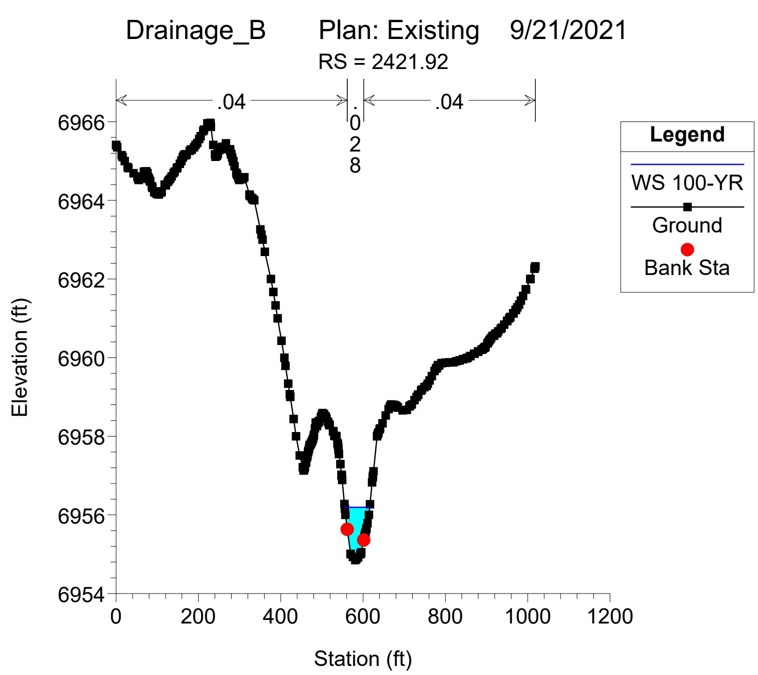

Drainage_B Plan: Existing 9/21/2021
RS = 3361.62
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6978
6980
6982
6984
6986
6988
6990
Station (ft)
0
200
400
600
800
1000
1200

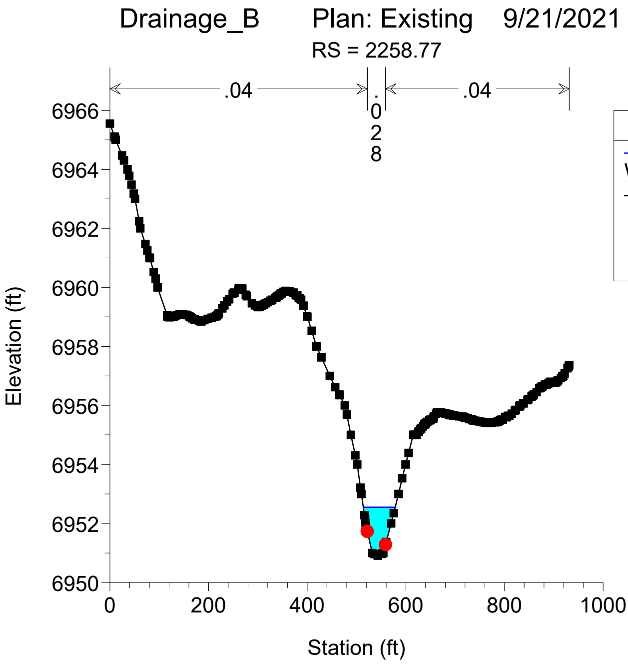

Drainage_B Plan: Existing 9/21/2021
RS = 3164.79
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6974
6976
6978
6980
6982
6984
6986
Station (ft)
0
200
400
600
800
1000
1200

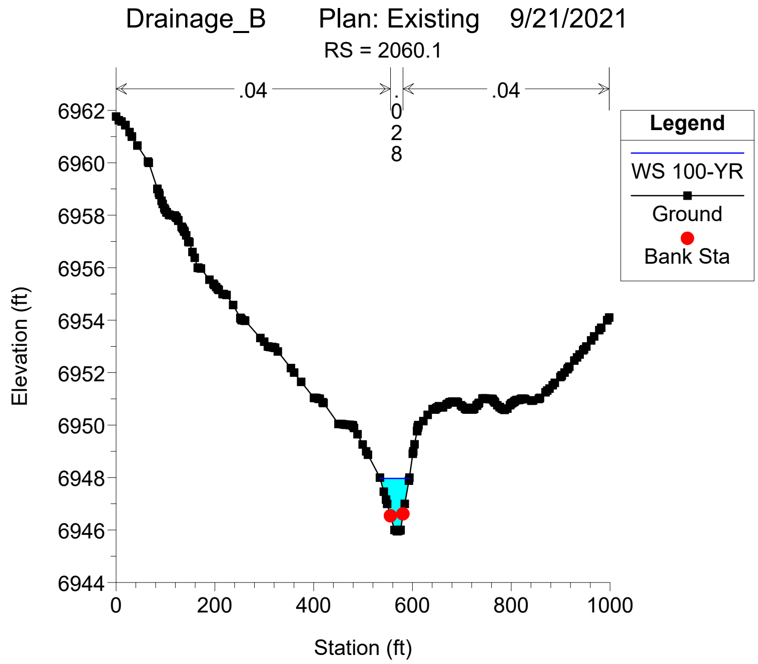

Drainage_B Plan: Existing 9/21/2021
RS = 2955.21
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6970
6972
6974
6976
6978
6980
6982
Station (ft)
0
200
400
600
800
1000
1200
1400

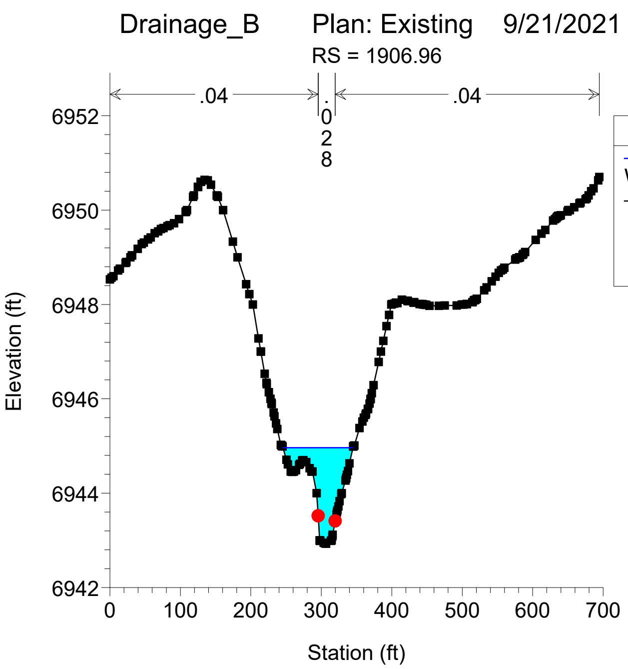

Drainage_B Plan: Existing 9/21/2021
RS = 2742.47
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6964
6966
6968
6970
6972
6974
6976
Station (ft)
0
200
400
600
800
1000
1200

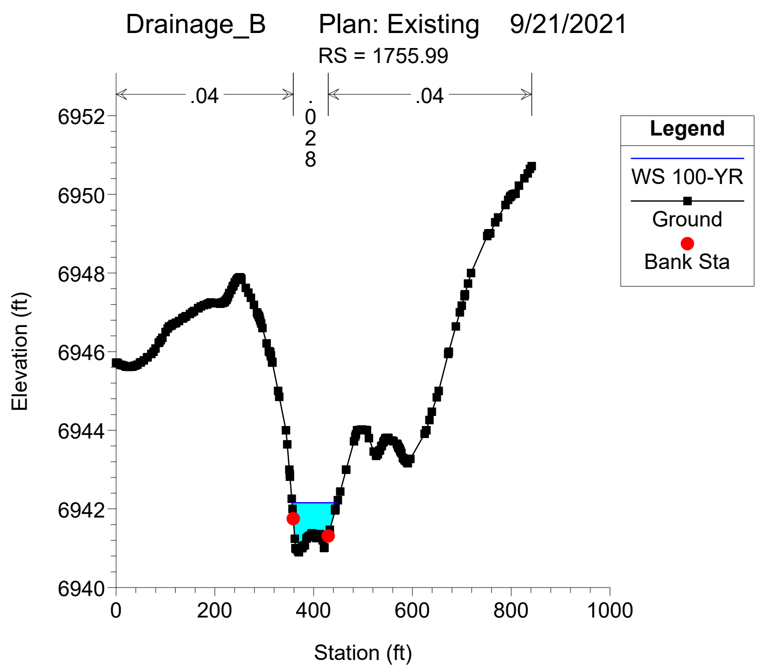

Drainage_B Plan: Existing 9/21/2021
RS = 2559.12
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6956
6958
6960
6962
6964
6966
6968
6970
6972
Station (ft)
0
200
400
600
800
1000
1200
1400

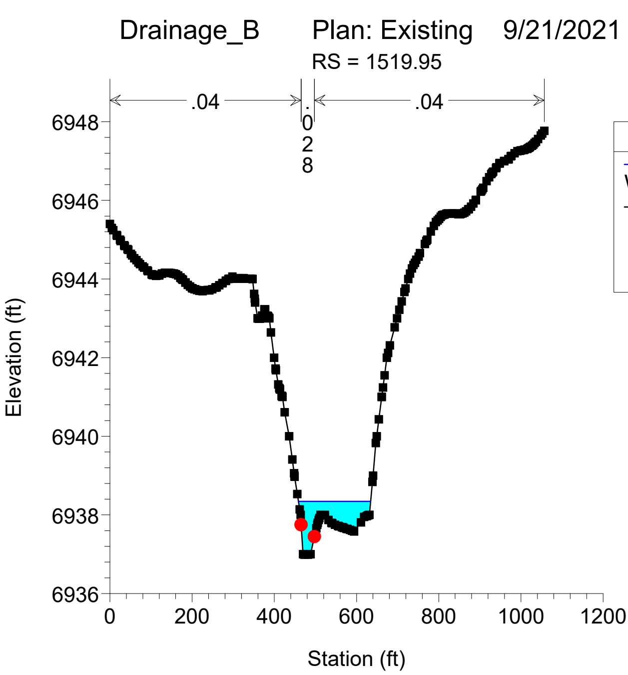

Drainage_B Plan: Existing 9/21/2021
RS = 2421.92
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6954
6956
6958
6960
6962
6964
6966
Station (ft)
0
200
400
600
800
1000
1200

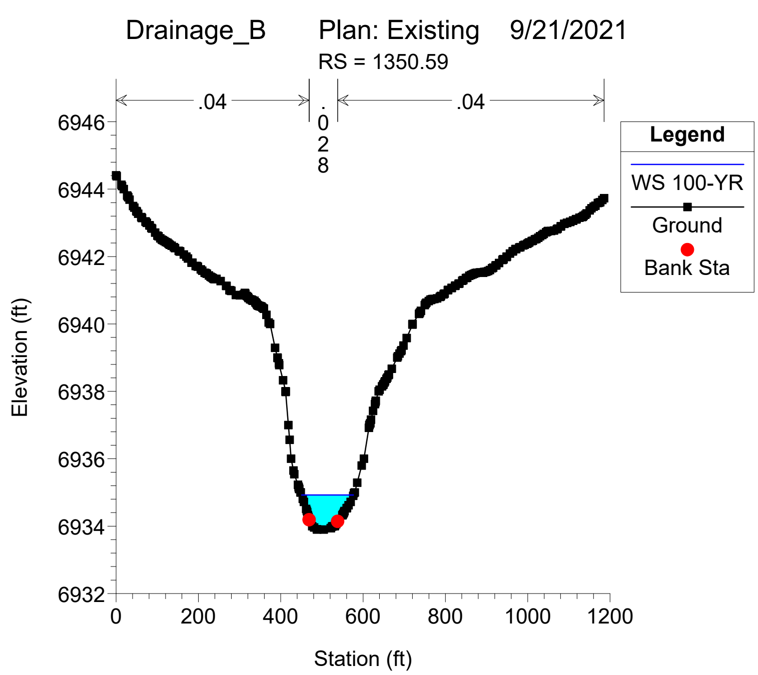

Drainage_B Plan: Existing 9/21/2021
RS = 2258.77
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6950
6952
6954
6956
6958
6960
6962
6964
6966
Station (ft)
0
200
400
600
800
1000

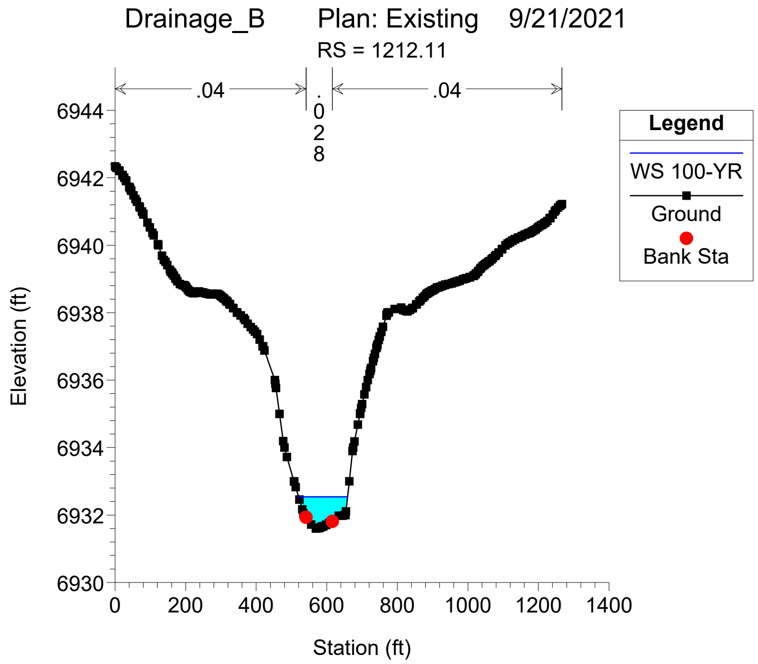

Drainage_B Plan: Existing 9/21/2021
RS = 2060.1
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6944
6946
6948
6950
6952
6954
6956
6958
6960
6962
Station (ft)
0
200
400
600
800
1000

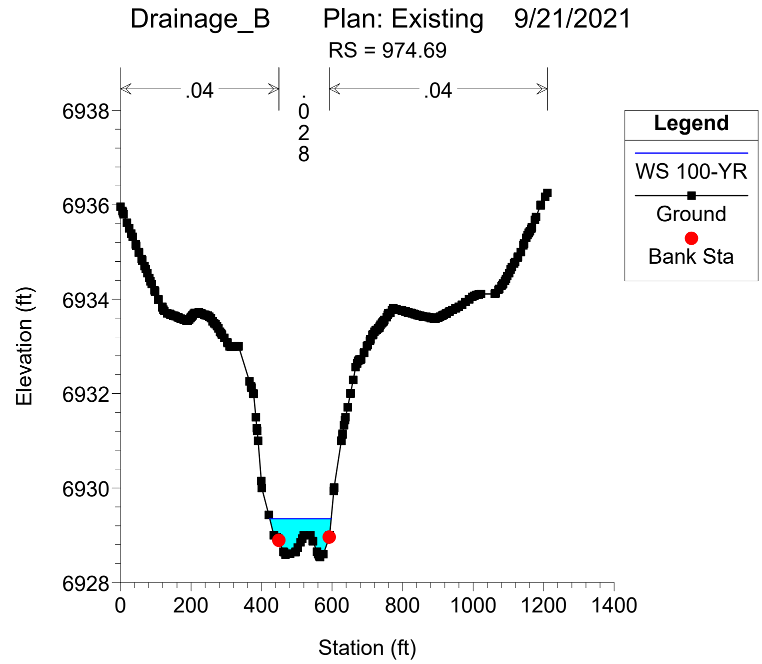

Drainage_B Plan: Existing 9/21/2021
RS = 1906.96
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6942
6944
6946
6948
6950
6952
Station (ft)
0
100
200
300
400
500
600
700

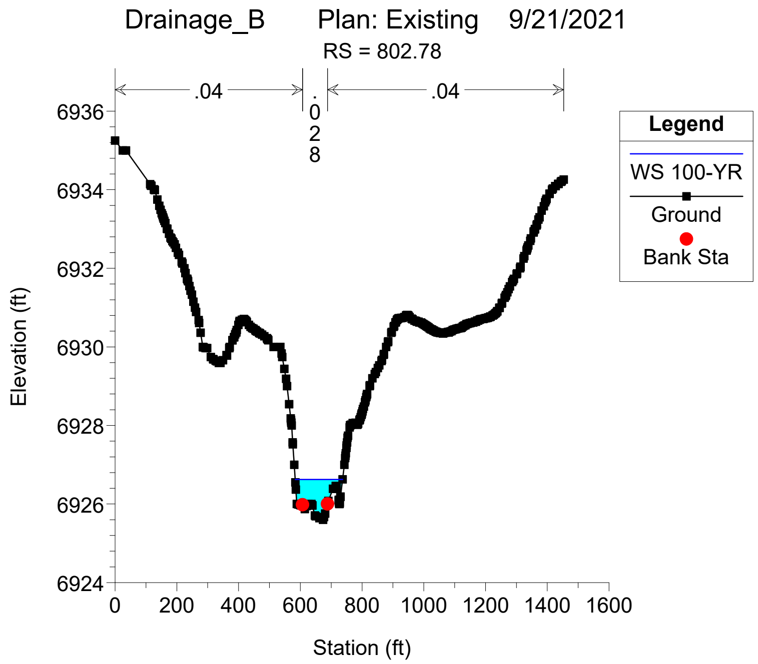

Drainage_B Plan: Existing 9/21/2021
RS = 1755.99
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6940
6942
6944
6946
6948
6950
6952
Station (ft)
0
200
400
600
800
1000

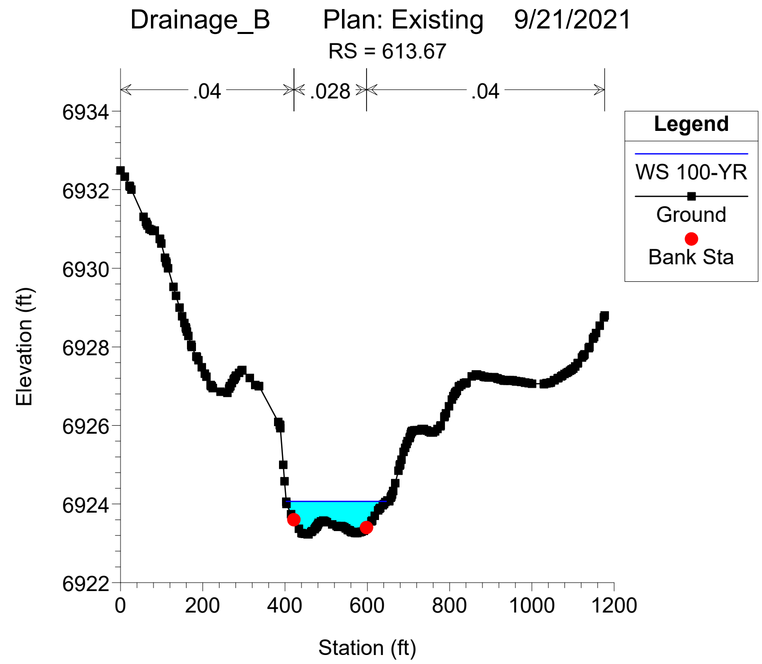

Drainage_B Plan: Existing 9/21/2021
RS = 1519.95
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6936
6938
6940
6942
6944
6946
6948
Station (ft)
0
200
400
600
800
1000
1200

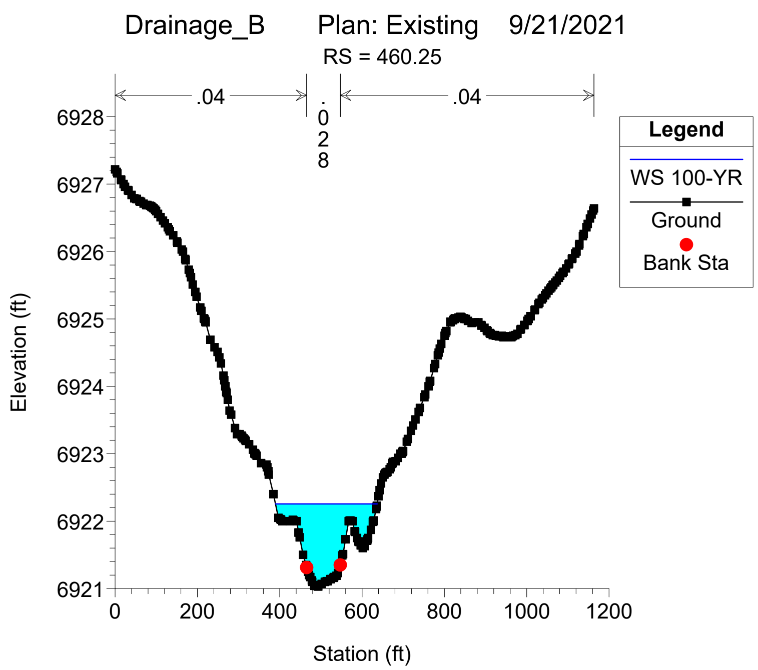

Drainage_B Plan: Existing 9/21/2021
RS = 1350.59
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6932
6934
6936
6938
6940
6942
6944
6946
Station (ft)
0
200
400
600
800
1000
1200

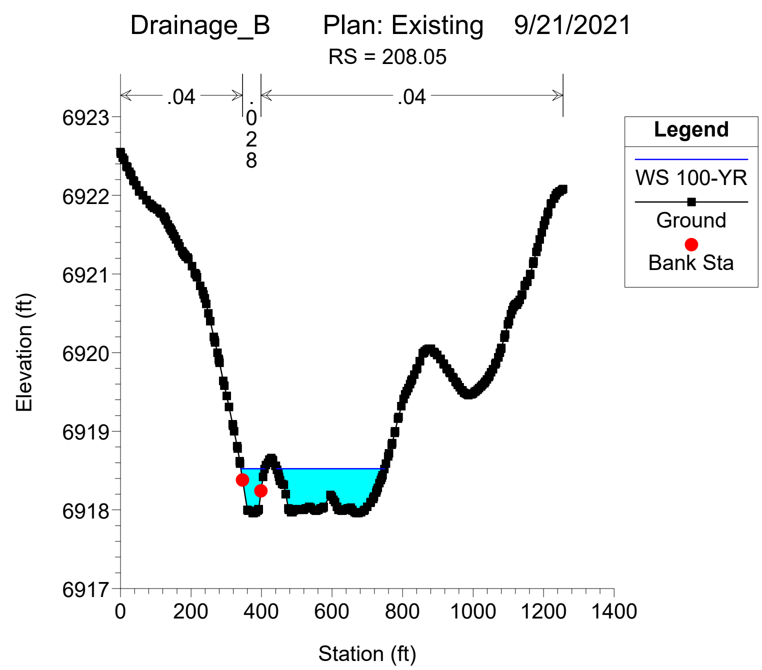

Drainage_B Plan: Existing 9/21/2021
RS = 1212.11
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6944
6942
6940
6938
6936
6934
6932
6930
Station (ft)
0
200
400
600
800
1000
1200
1400

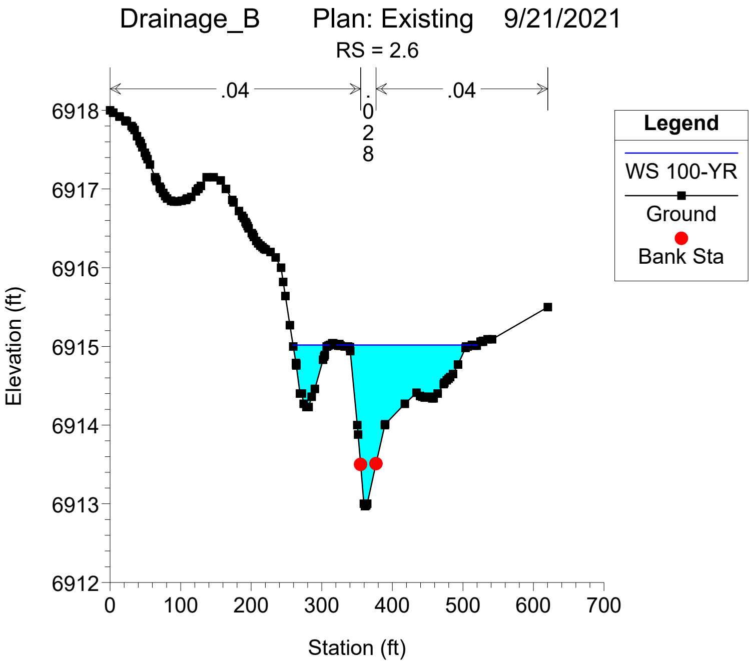

Drainage_B Plan: Existing 9/21/2021
RS = 974.69
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6938
6936
6934
6932
6930
6928
Station (ft)
0
200
400
600
800
1000
1200
1400

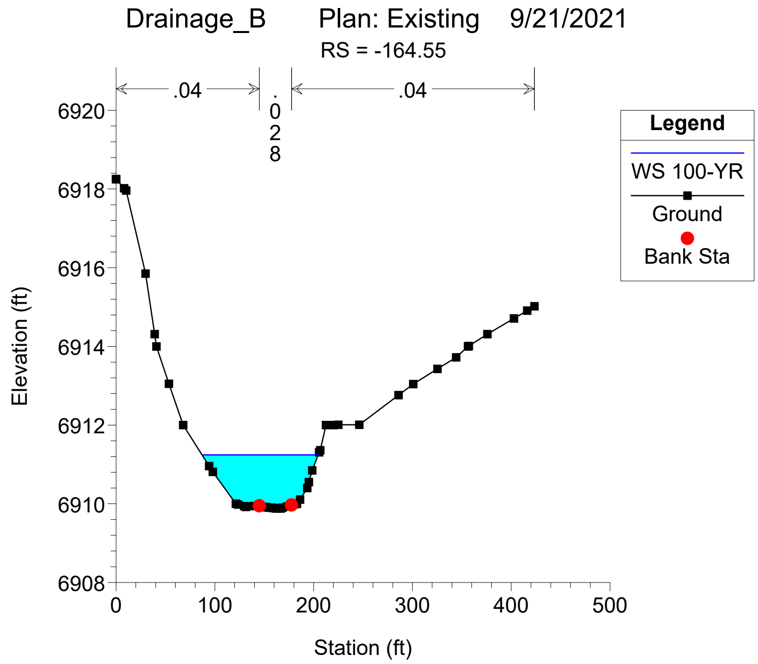

Drainage_B Plan: Existing 9/21/2021
RS = 802.78
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6936
6934
6932
6930
6928
6926
6924
Station (ft)
0
200
400
600
800
1000
1200
1400
1600

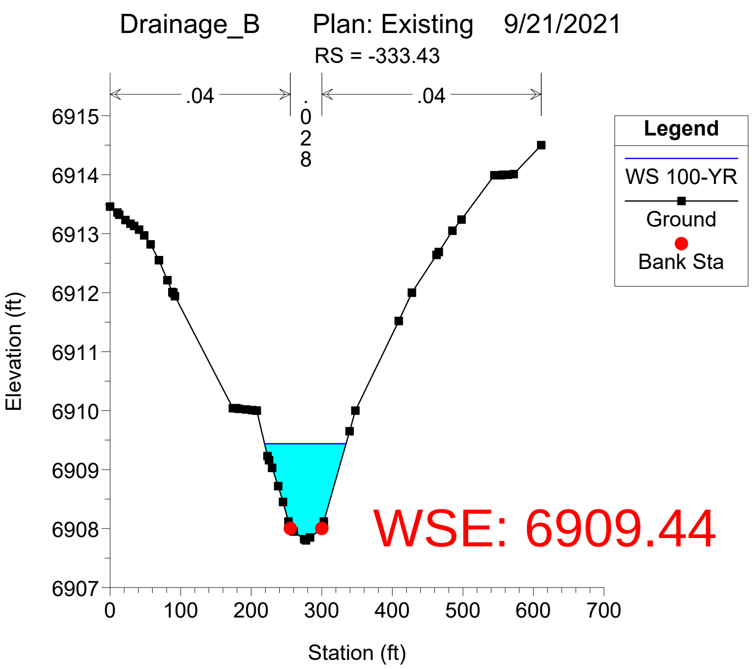

Drainage_B Plan: Existing 9/21/2021
RS = 613.67
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6934
6932
6930
6928
6926
6924
6922
Station (ft)
0
200
400
600
800
1000
1200

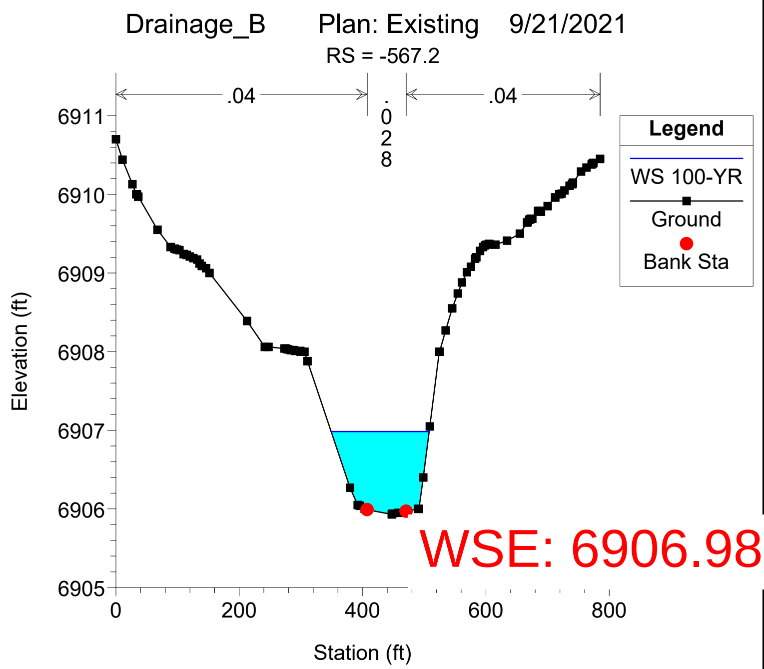

Drainage_B Plan: Existing 9/21/2021
RS = 460.25
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6928
6927
6926
6925
6924
6923
6922
6921
Station (ft)
0
200
400
600
800
1000
1200

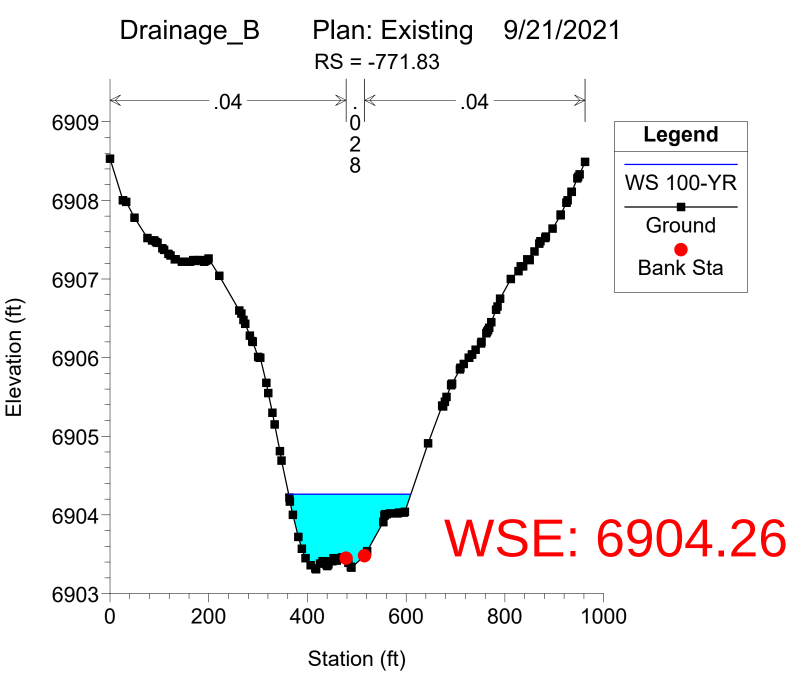

Drainage_B Plan: Existing 9/21/2021
RS = 208.05
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6923
6922
6921
6920
6919
6918
6917
Station (ft)
0
200
400
600
800
1000
1200
1400







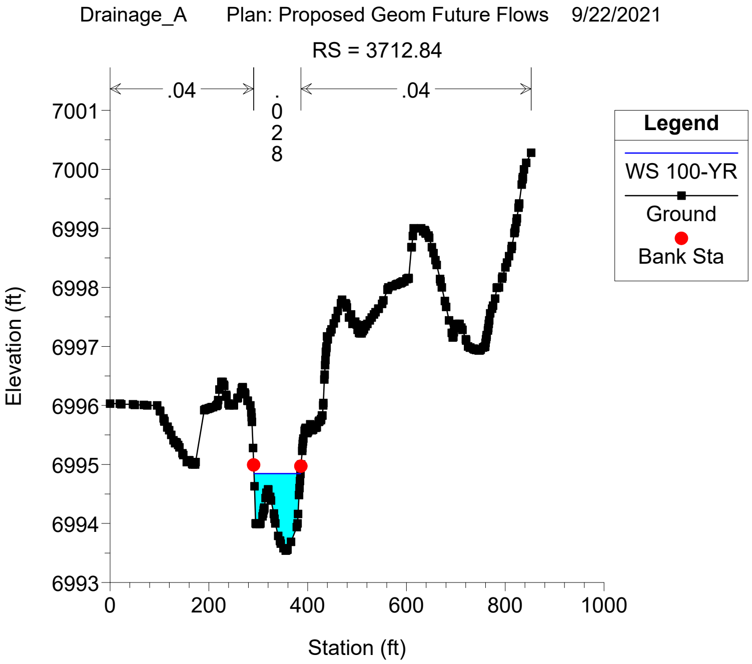


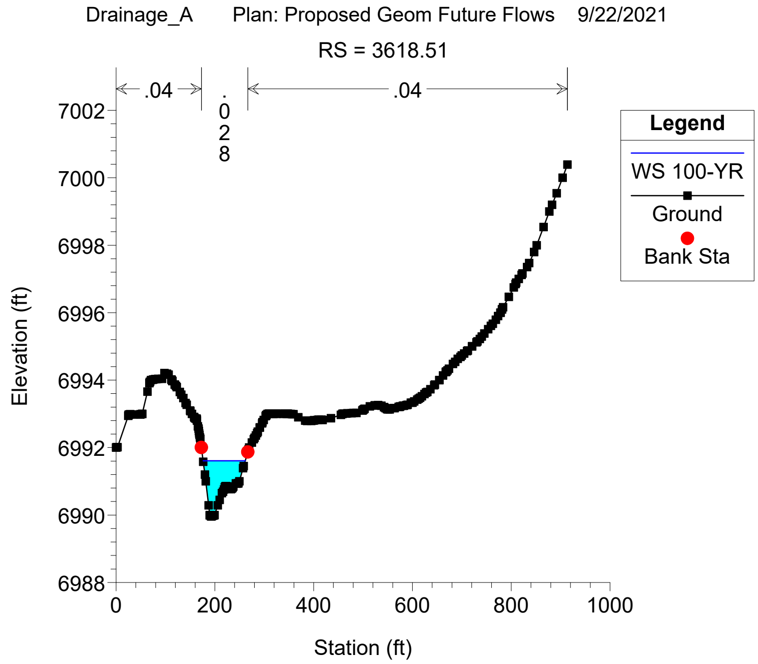


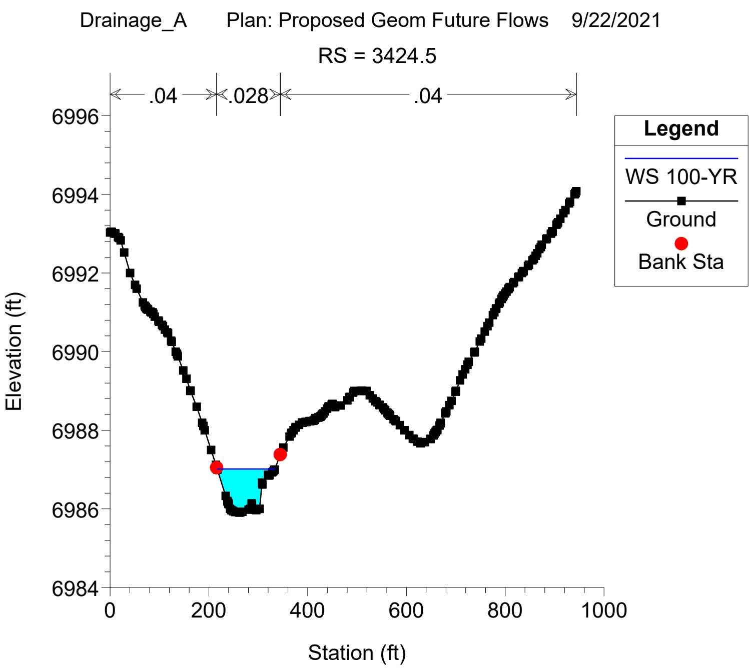
WSE COMPARISON

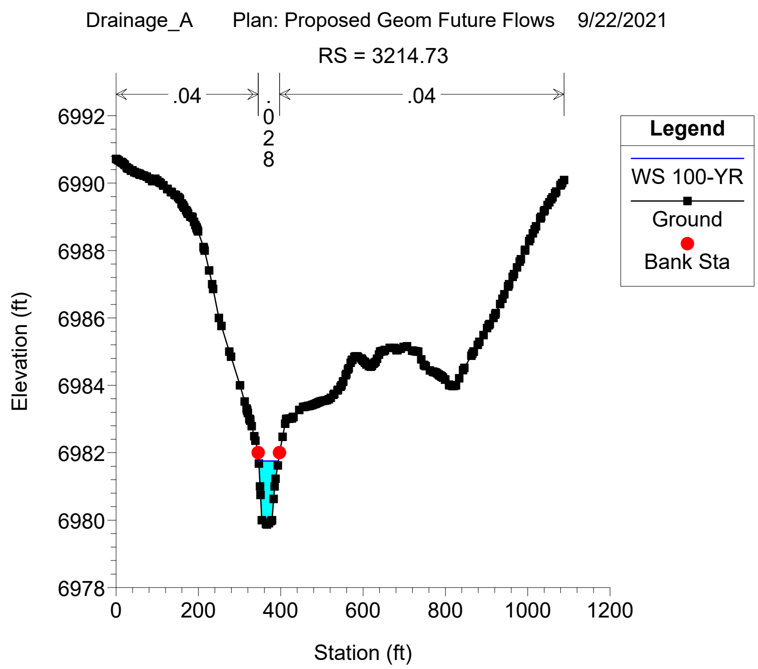
EXISTING	FUTURE
6909.44	6909.36
6906.98	6906.97
6904.26	6904.23

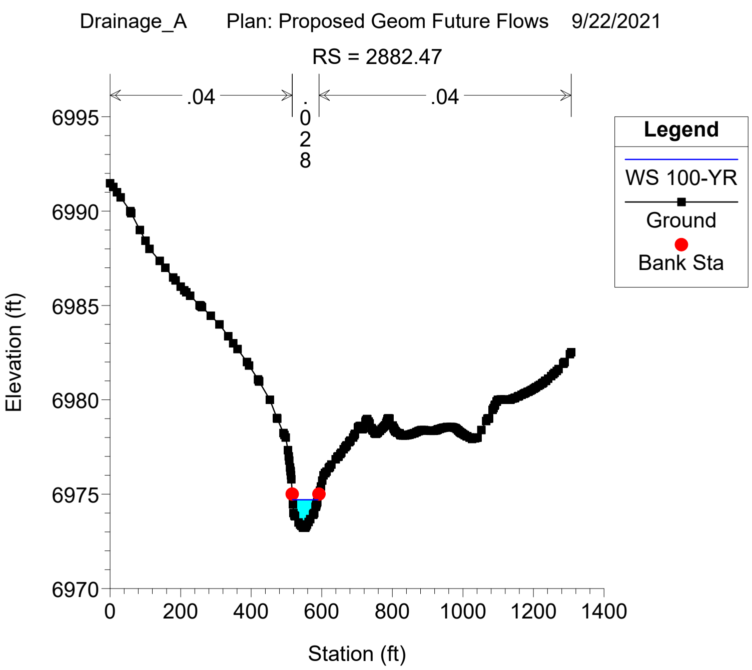
Appendix I
Future Condition Cross Sections

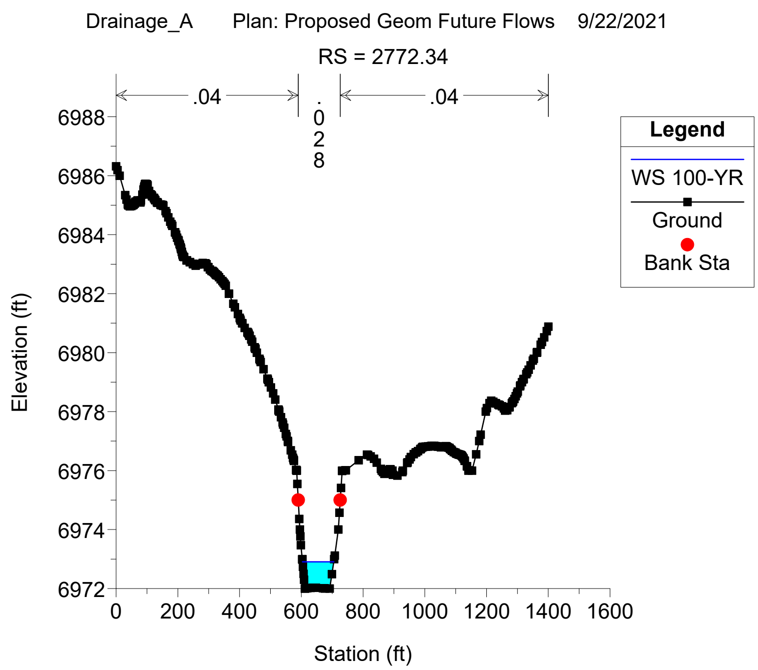

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 3712.84
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7001
7000
6999
6998
6997
6996
6995
6994
6993
Station (ft)
0
200
400
600
800
1000

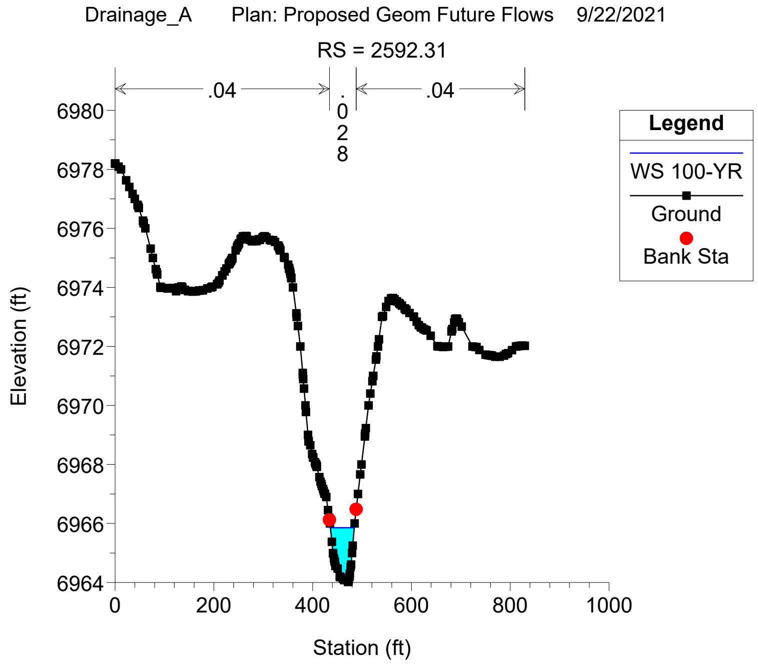

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 3618.51
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7002
7000
6998
6996
6994
6992
6990
6988
Station (ft)
0
200
400
600
800
1000

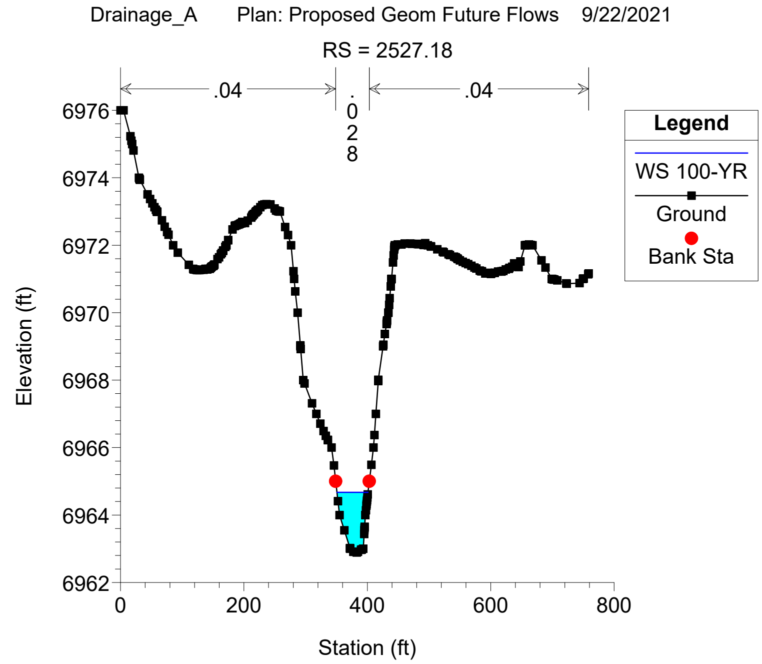

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 3424.5
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6996
6994
6992
6990
6988
6986
6984
Station (ft)
0
200
400
600
800
1000

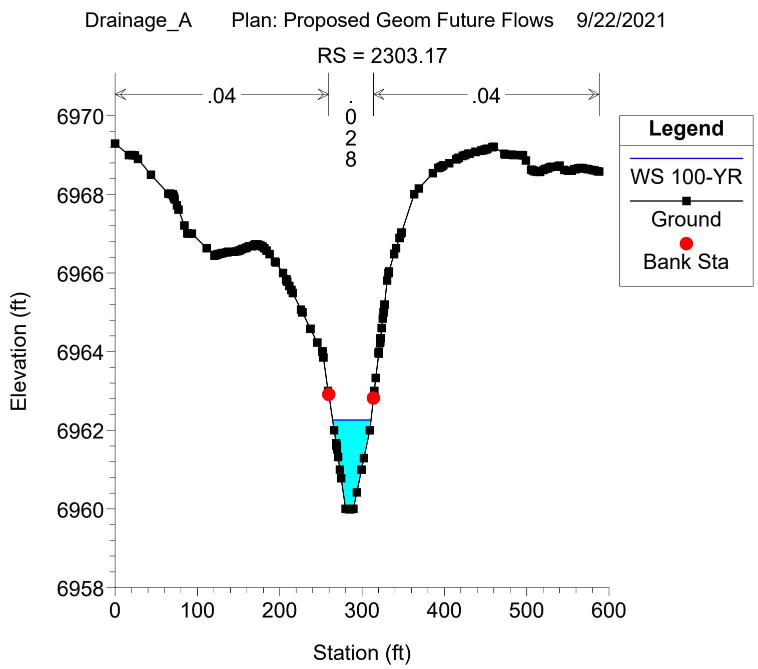

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 3214.73
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6992
6990
6988
6986
6984
6982
6980
6978
Station (ft)
0
200
400
600
800
1000
1200

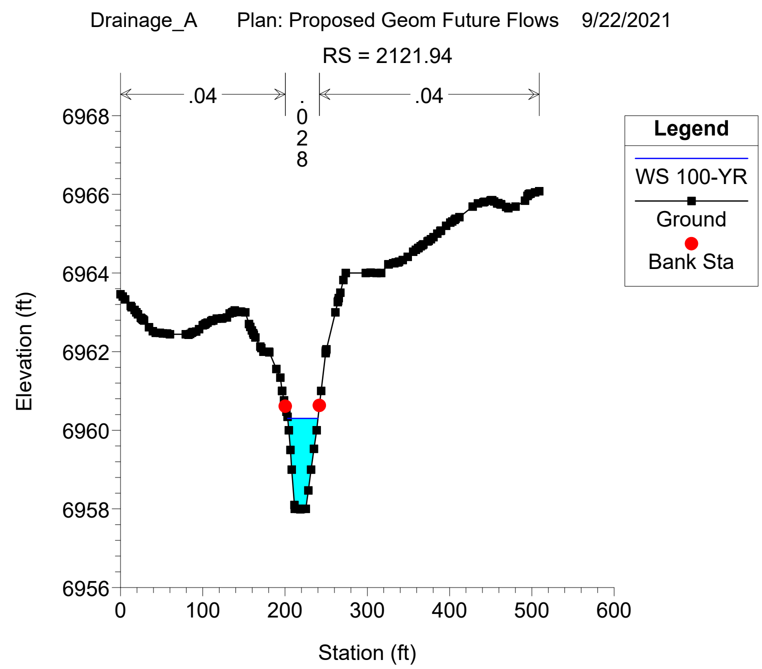

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 2882.47
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6995
6990
6985
6980
6975
6970
Station (ft)
0
200
400
600
800
1000
1200
1400

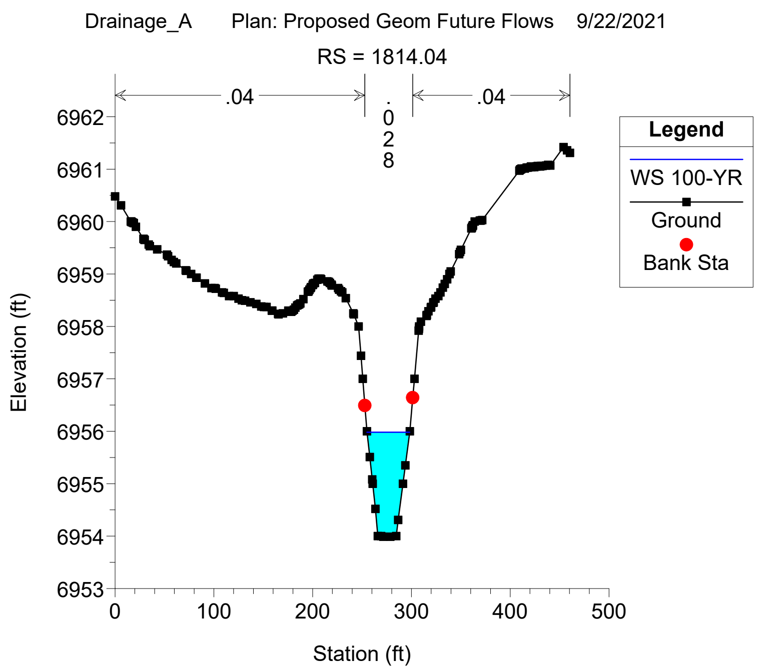

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 2772.34
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6988
6986
6984
6982
6980
6978
6976
6974
6972
Station (ft)
0
200
400
600
800
1000
1200
1400
1600

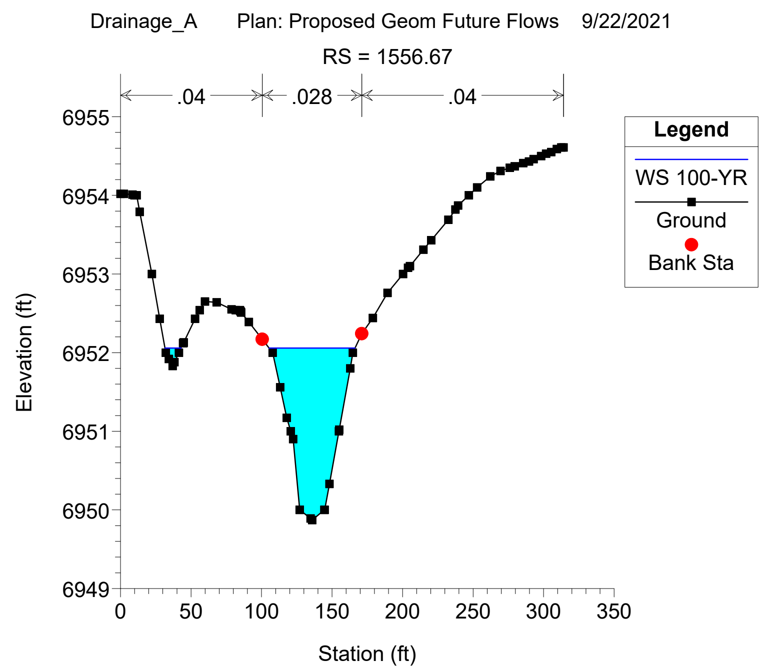

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 2592.31
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6964
6966
6968
6970
6972
6974
6976
6978
6980
0
200
400
600
800
1000

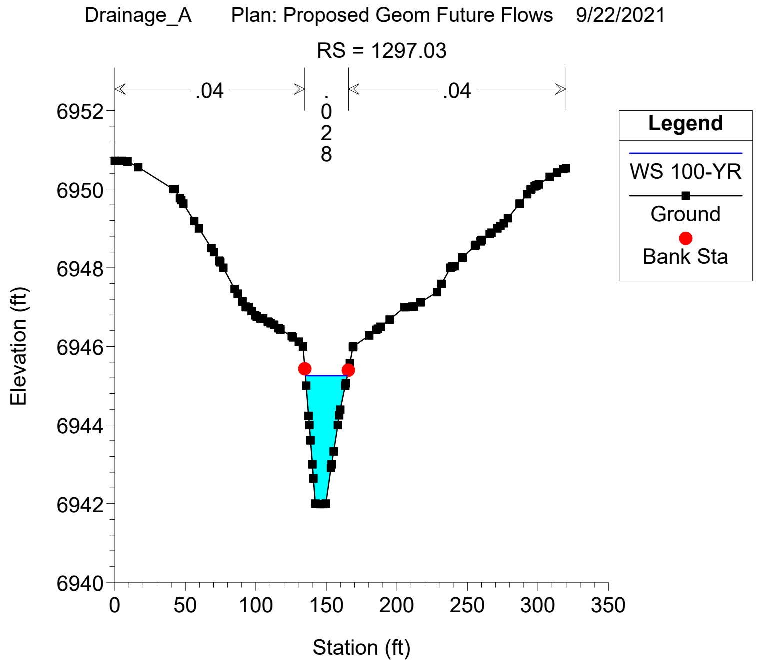

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 2527.18
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6962
6964
6966
6968
6970
6972
6974
6976
0
200
400
600
800

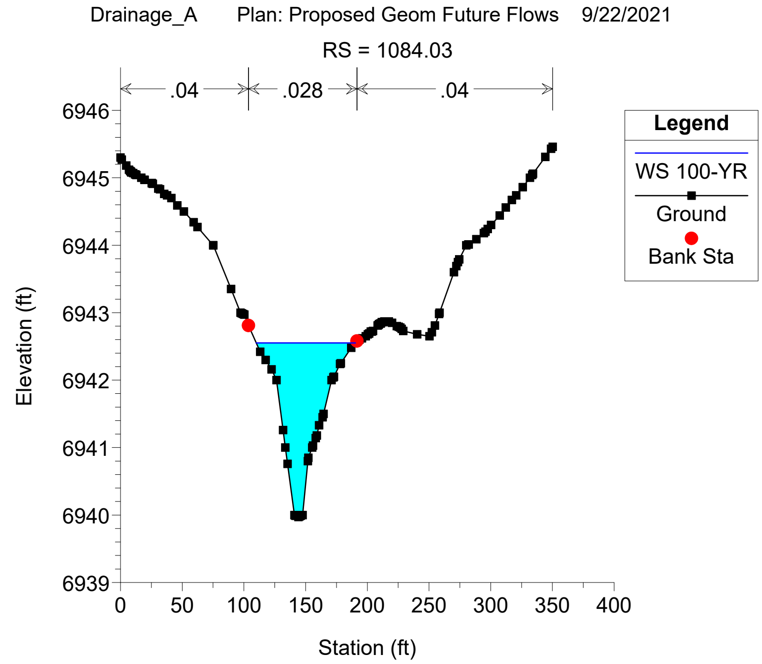

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 2303.17
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6958
6960
6962
6964
6966
6968
6970
0
100
200
300
400
500
600

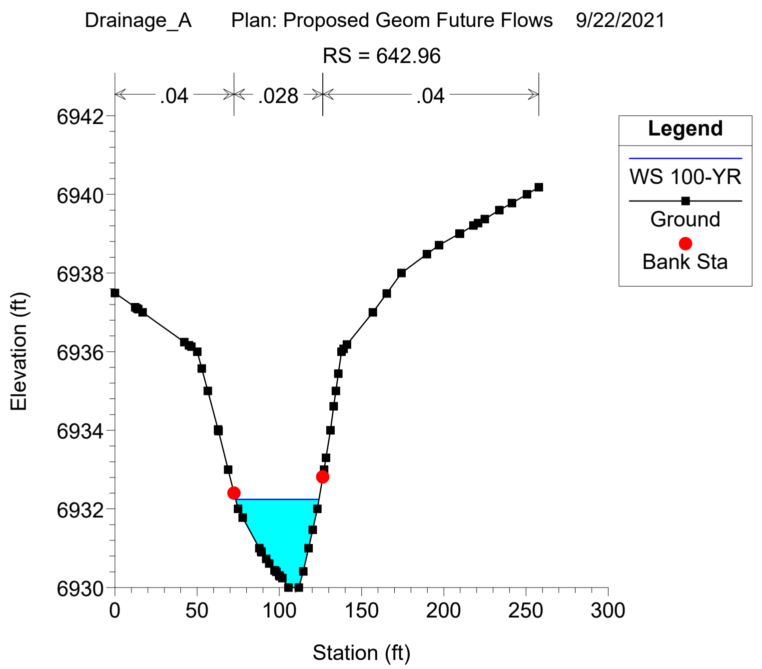

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 2121.94
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6956
6958
6960
6962
6964
6966
6968
0
100
200
300
400
500
600

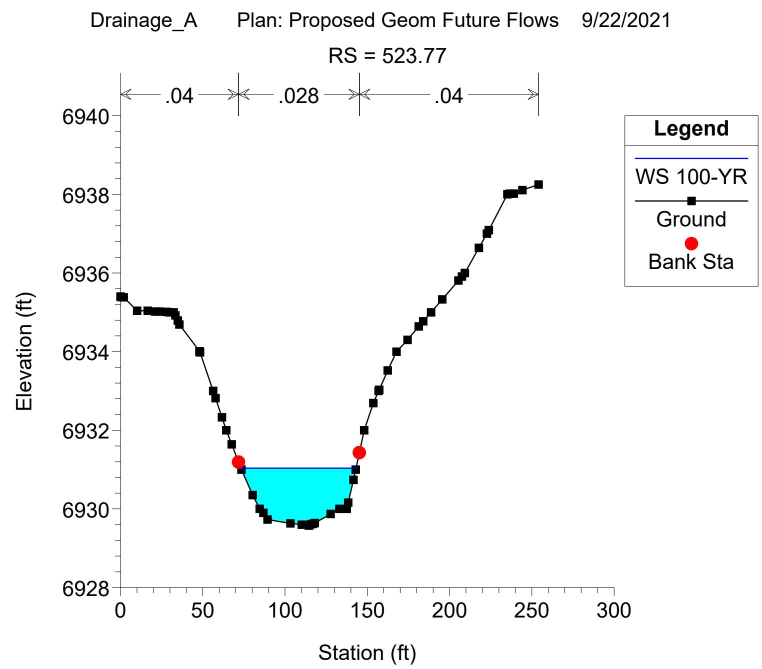

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 1814.04
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6953
6954
6955
6956
6957
6958
6959
6960
6961
6962
0
100
200
300
400
500

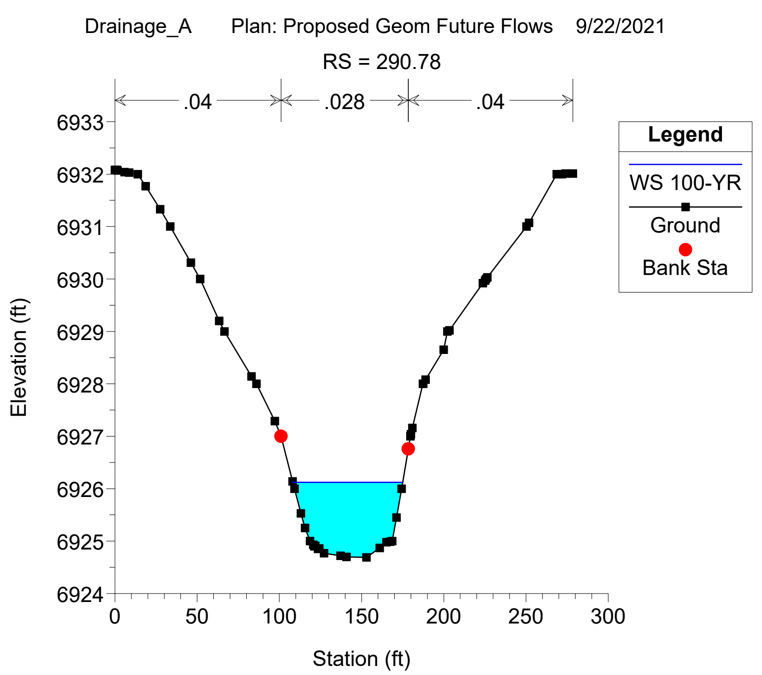

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 1556.67
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6949
6950
6951
6952
6953
6954
6955
0
50
100
150
200
250
300
350

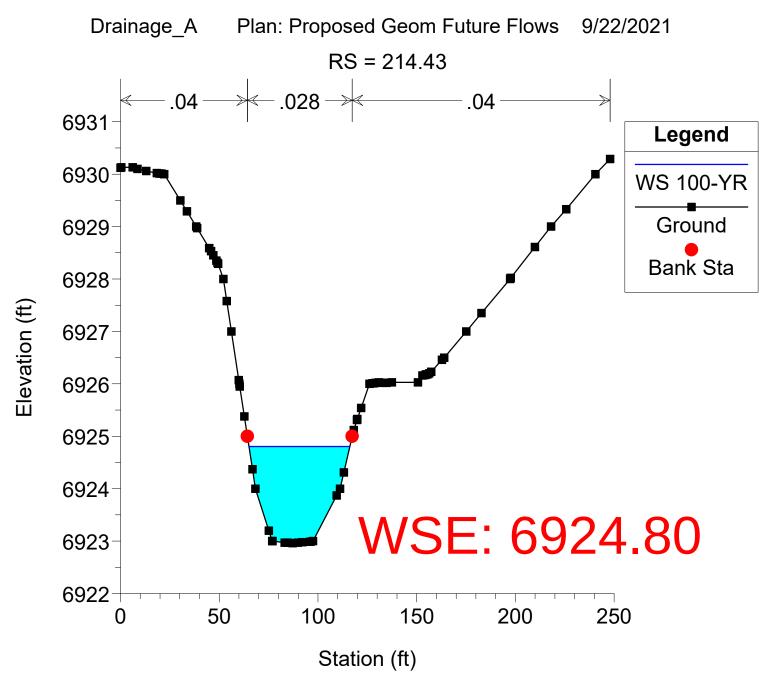

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 1297.03
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

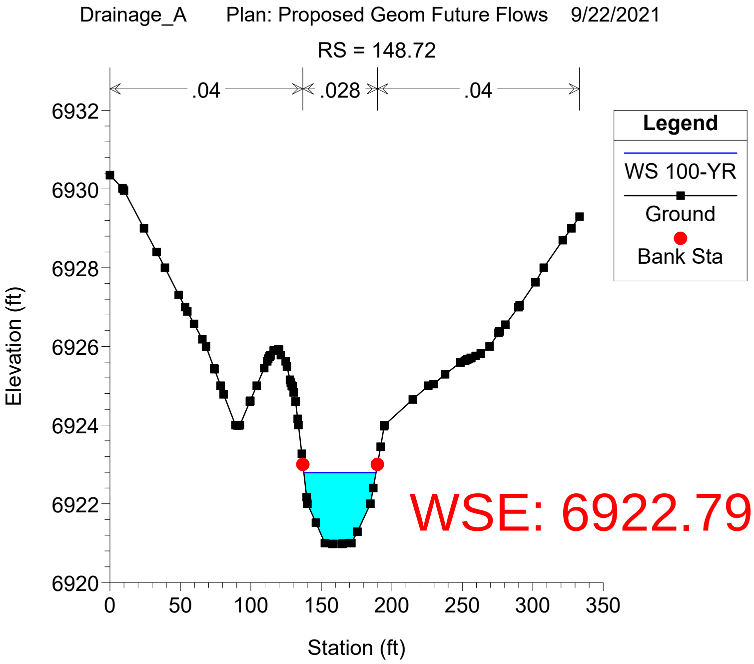

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 1084.03
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

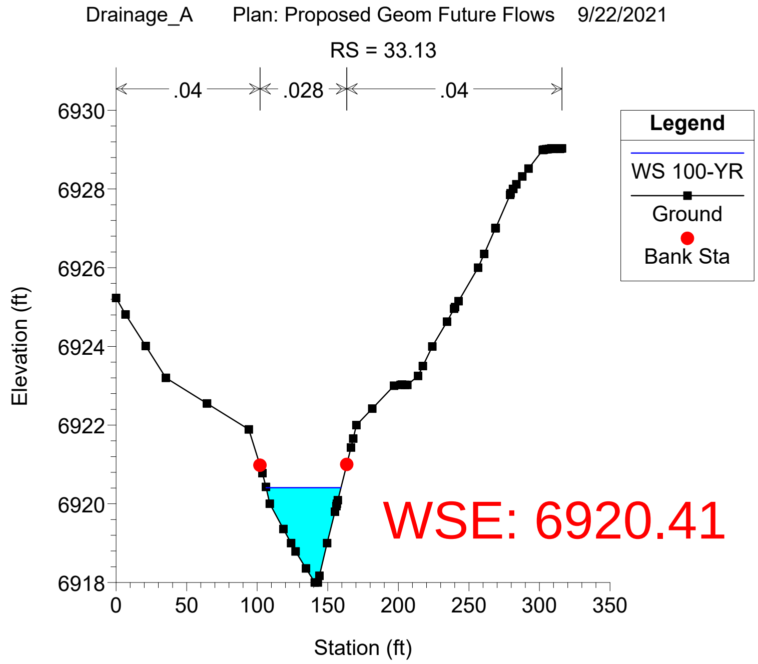

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 642.96
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 523.77
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 290.78
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

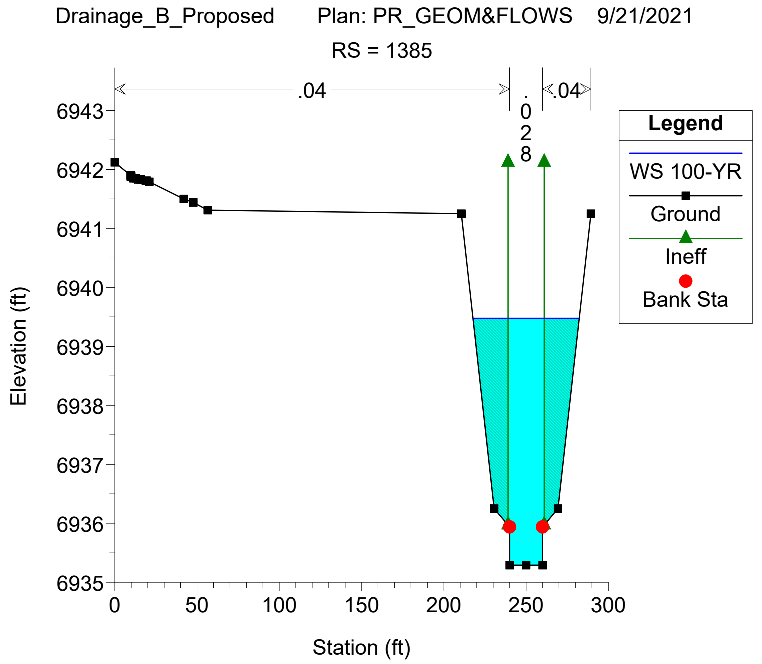

Drainage_A Plan: Proposed Geom Future Flows 9/22/2021
RS = 214.43
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
WSE: 6924.80
Elevation (ft)
Station (ft)

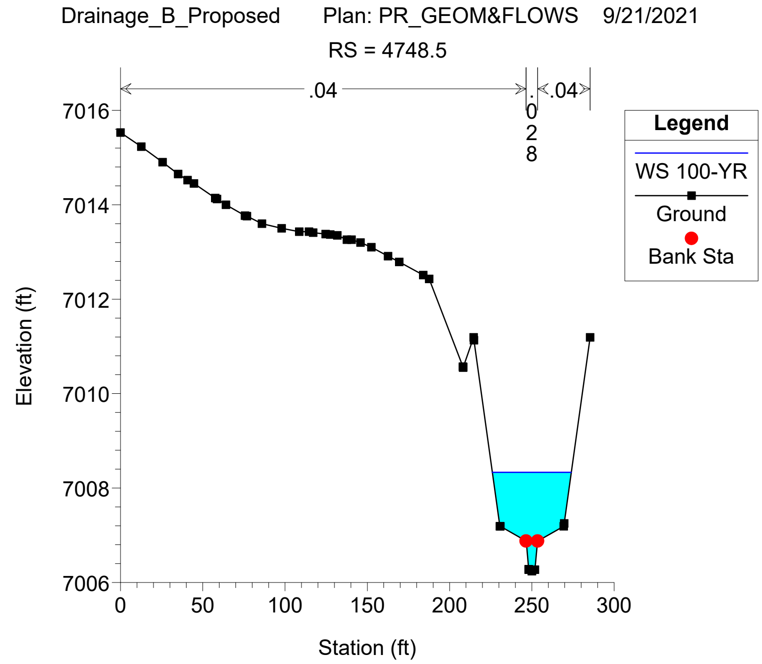


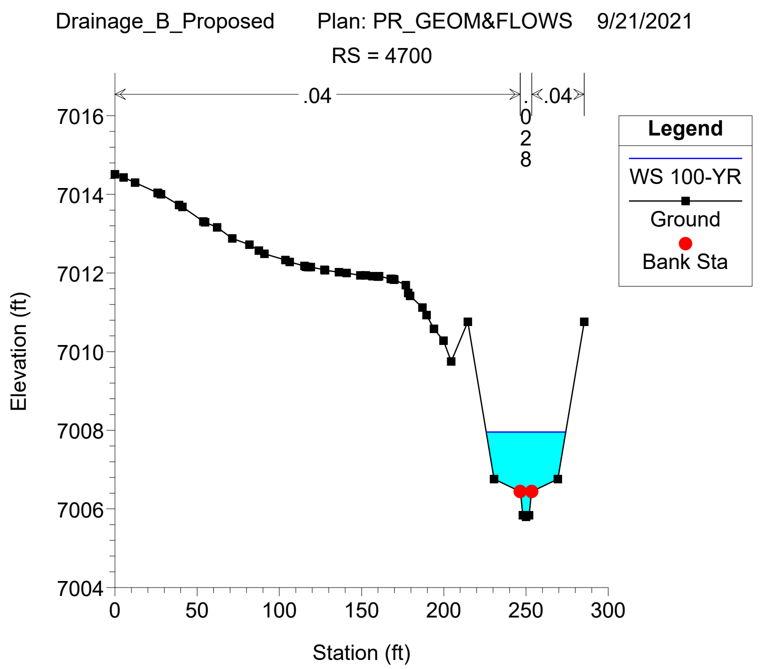


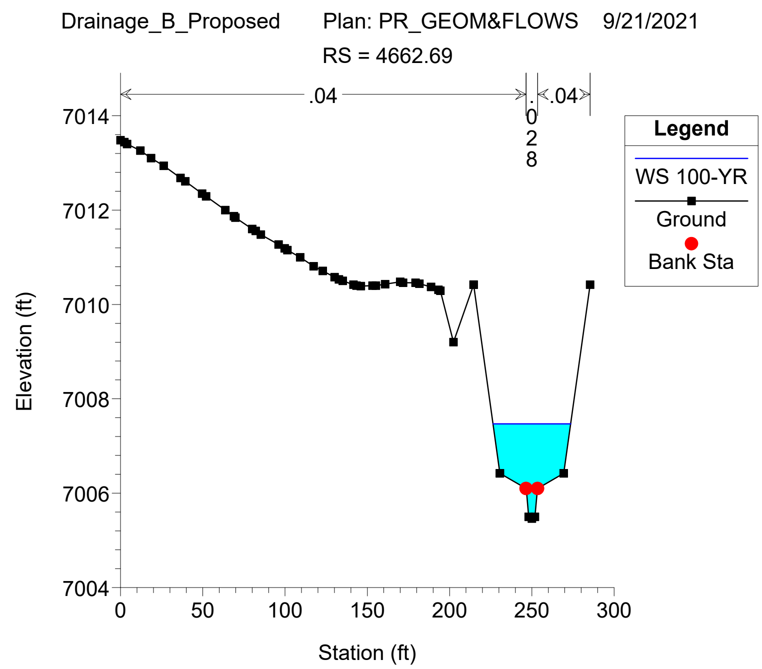
WSE COMPARISON

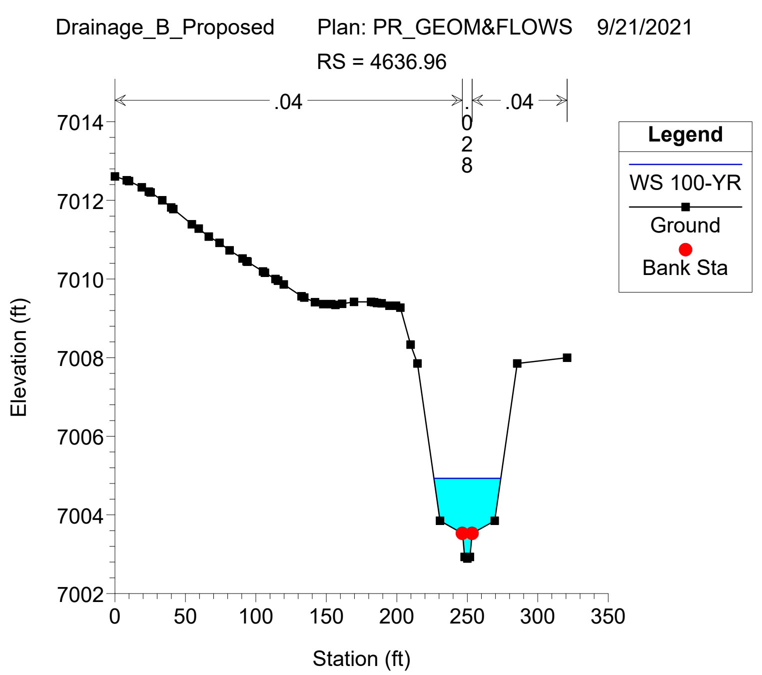
EXISTING	FUTURE
6924.80	6922.83
6922.79	6922.82
6920.41	6920.43

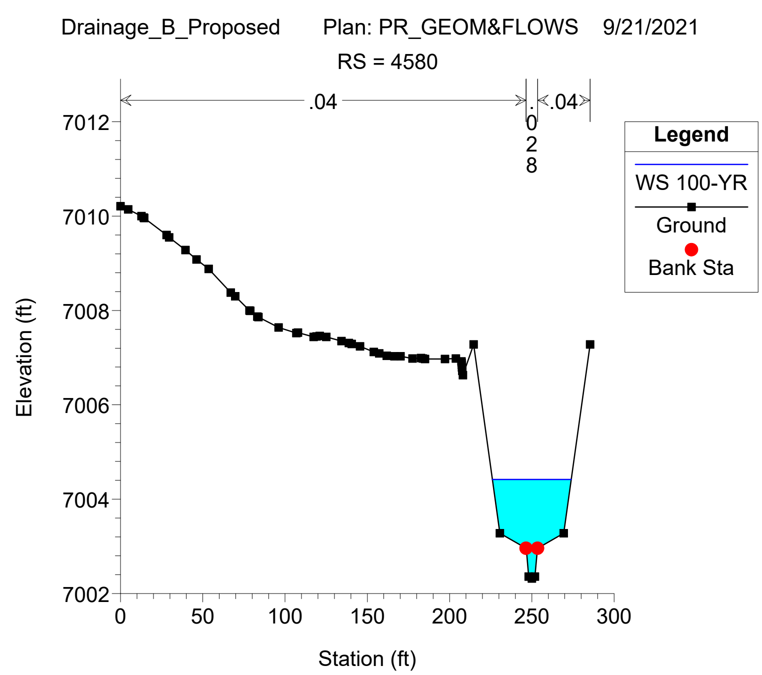

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1385
.04
.028
.04
Legend
WS 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
6935
6936
6937
6938
6939
6940
6941
6942
6943
0 50 100 150 200 250 300


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4748.5
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
7006
7008
7010
7012
7014
7016
0 50 100 150 200 250 300


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4700
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
7004
7006
7008
7010
7012
7014
7016
0 50 100 150 200 250 300


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4662.69
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
7004
7006
7008
7010
7012
7014
0 50 100 150 200 250 300


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4636.96
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
7002
7004
7006
7008
7010
7012
7014
0 50 100 150 200 250 300 350


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4580
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
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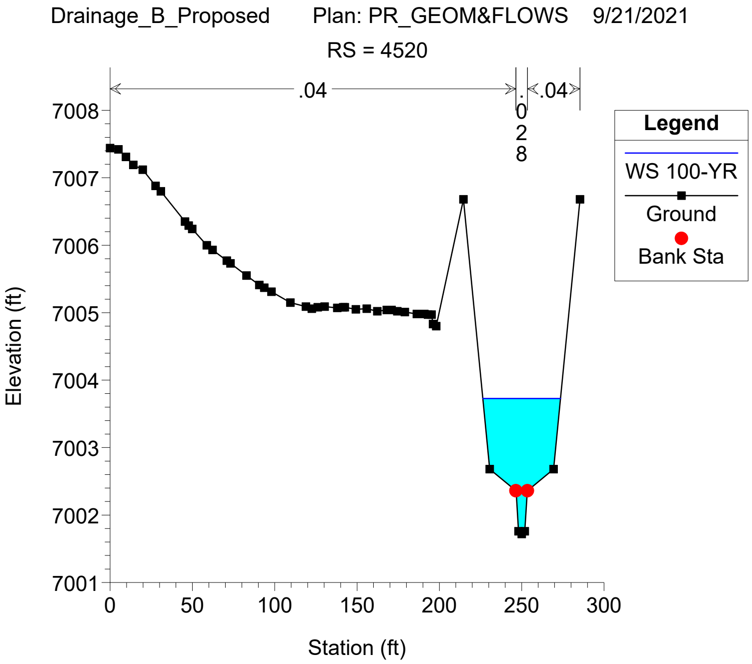
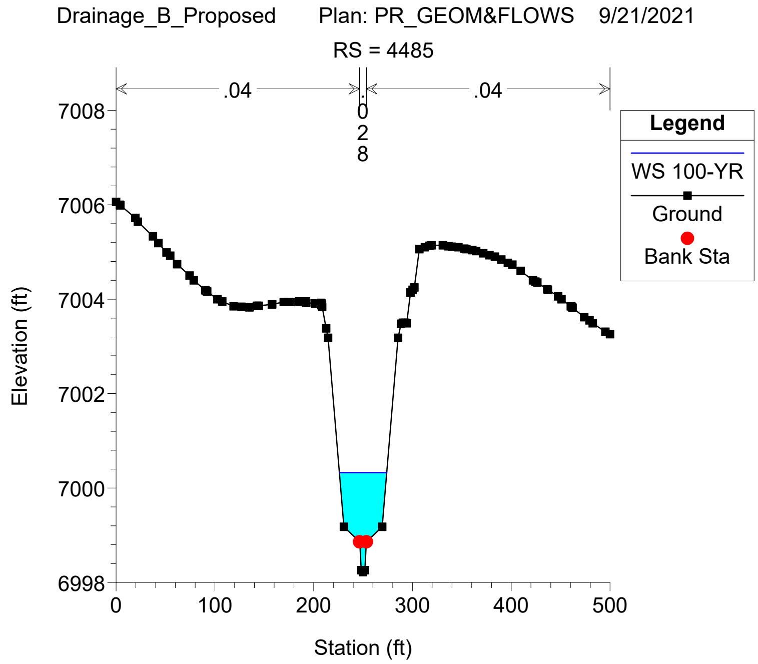
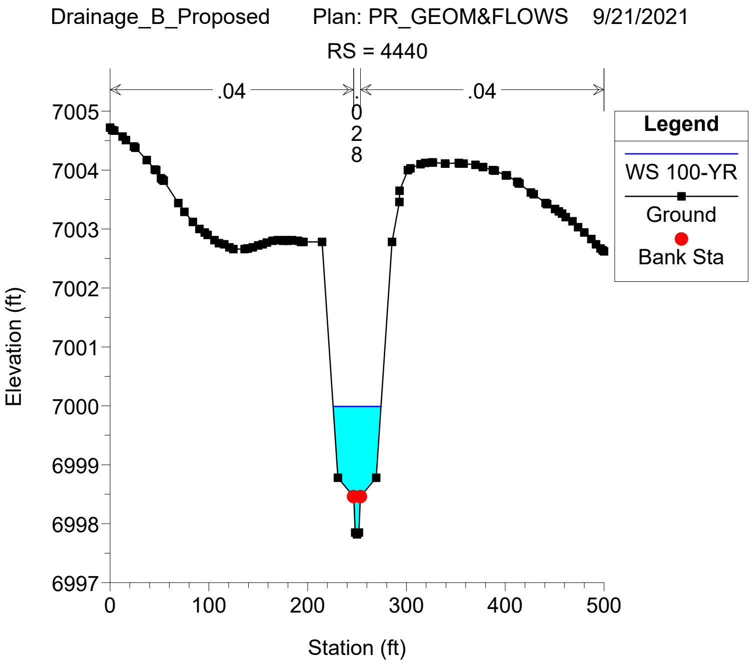
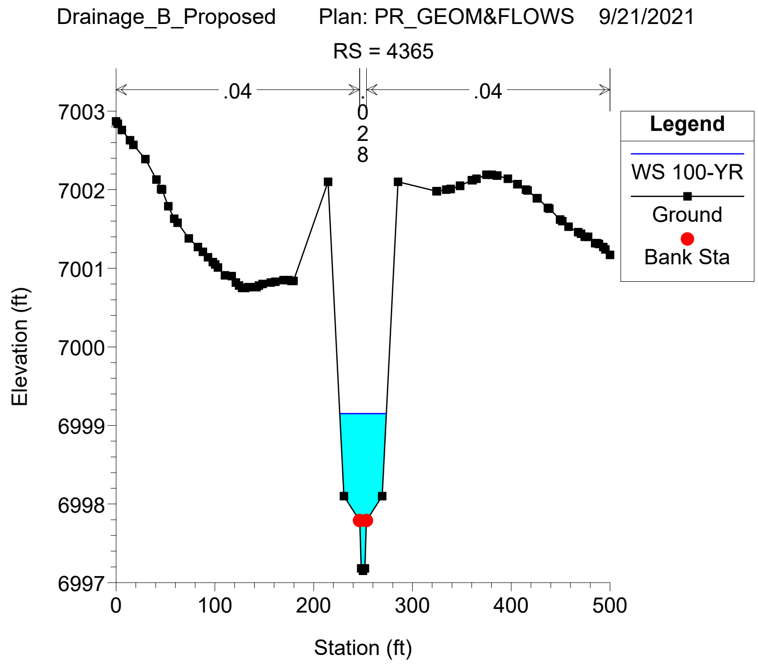
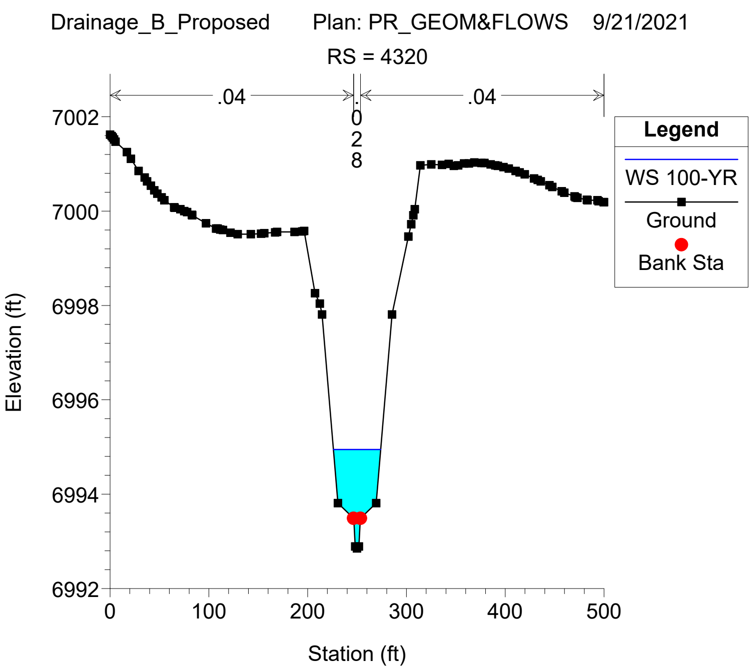
7010
7012
0 50 100 150 200 250 300

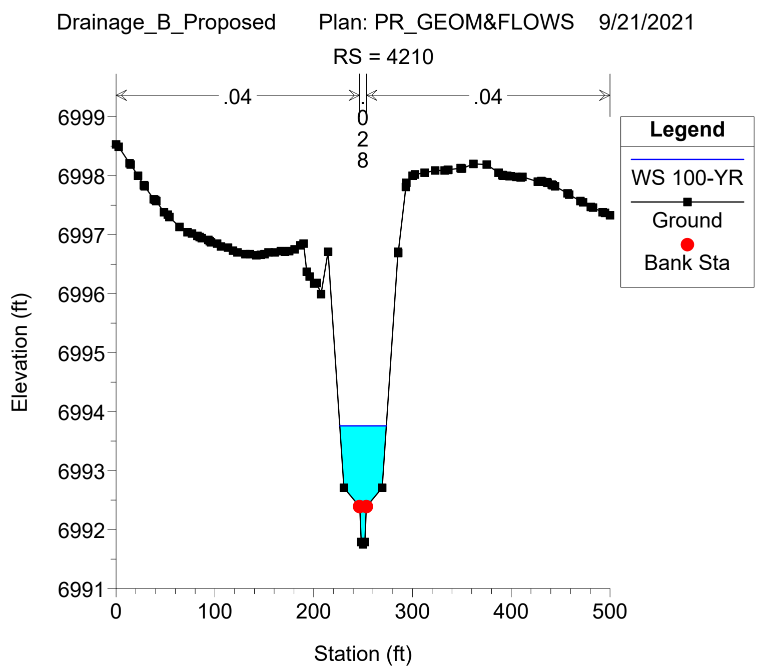

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4520
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7008
7007
7006
7005
7004
7003
7002
7001
0 50 100 150 200 250 300
Station (ft)

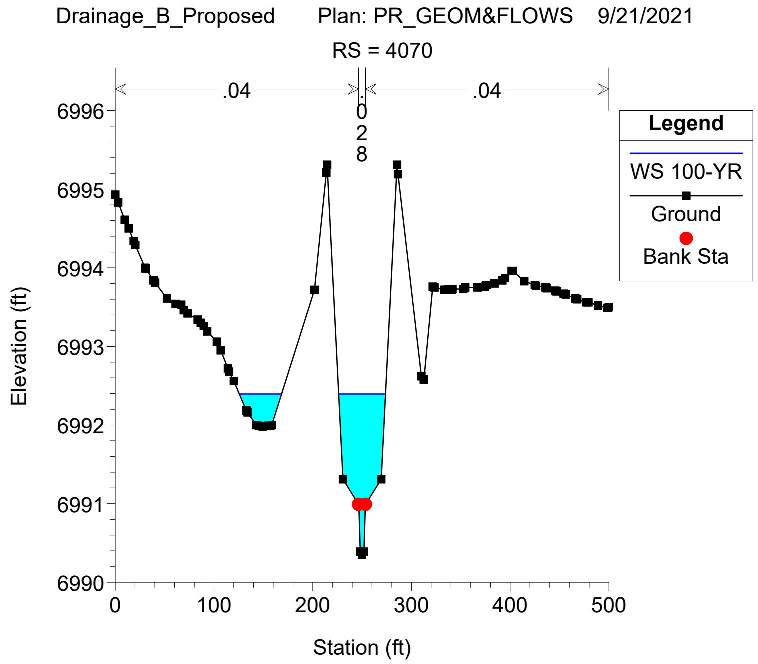

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4485
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7008
7006
7004
7002
7000
6998
0 100 200 300 400 500
Station (ft)

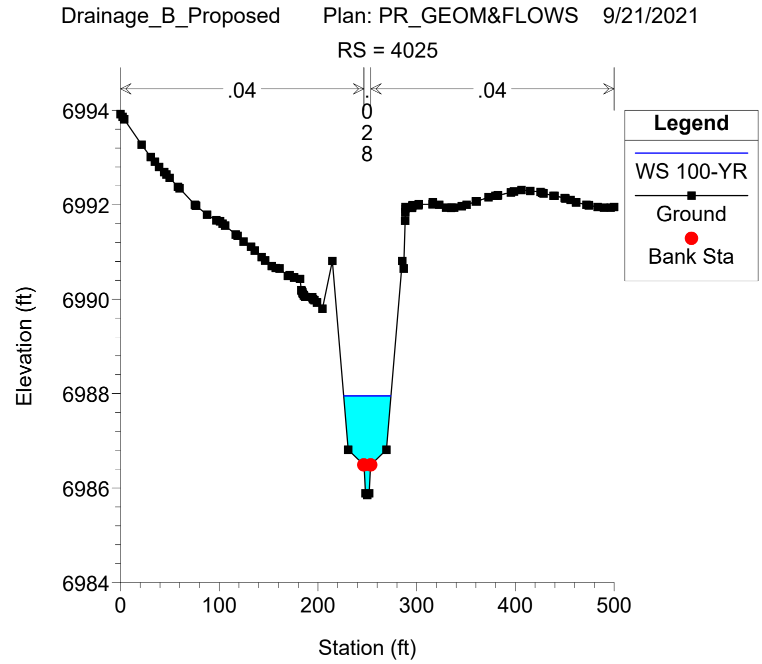

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4440
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7005
7004
7003
7002
7001
7000
6999
6998
6997
0 100 200 300 400 500
Station (ft)

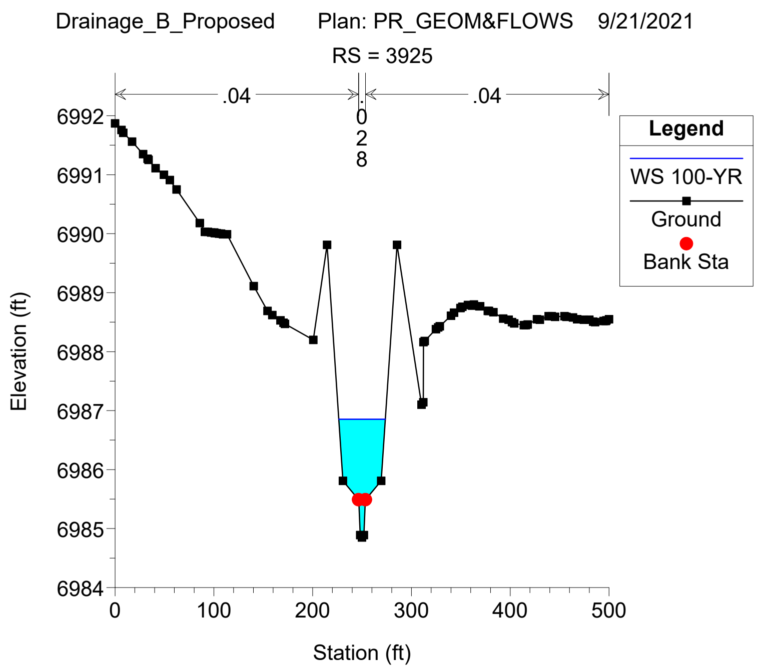

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4365
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7003
7002
7001
7000
6999
6998
6997
0 100 200 300 400 500
Station (ft)

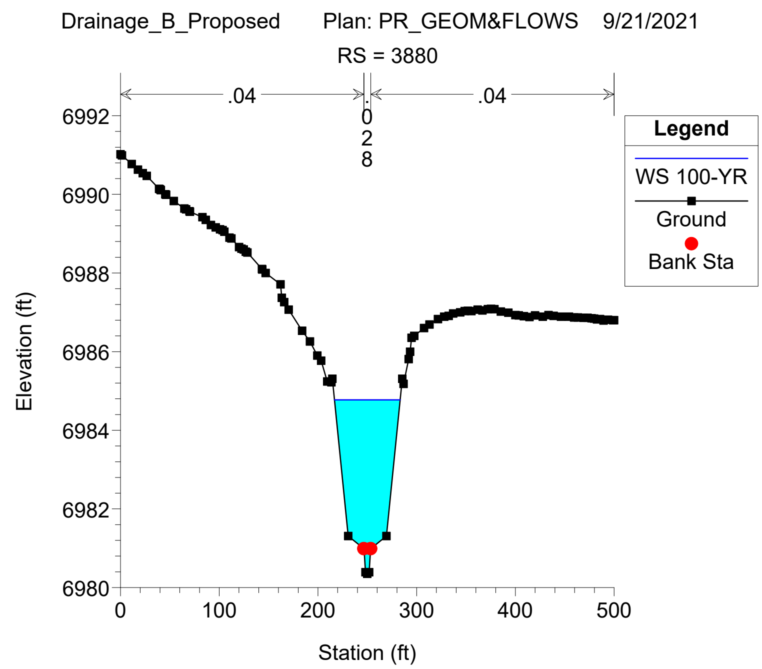

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4320
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
7002
7000
6998
6996
6994
6992
0 100 200 300 400 500
Station (ft)

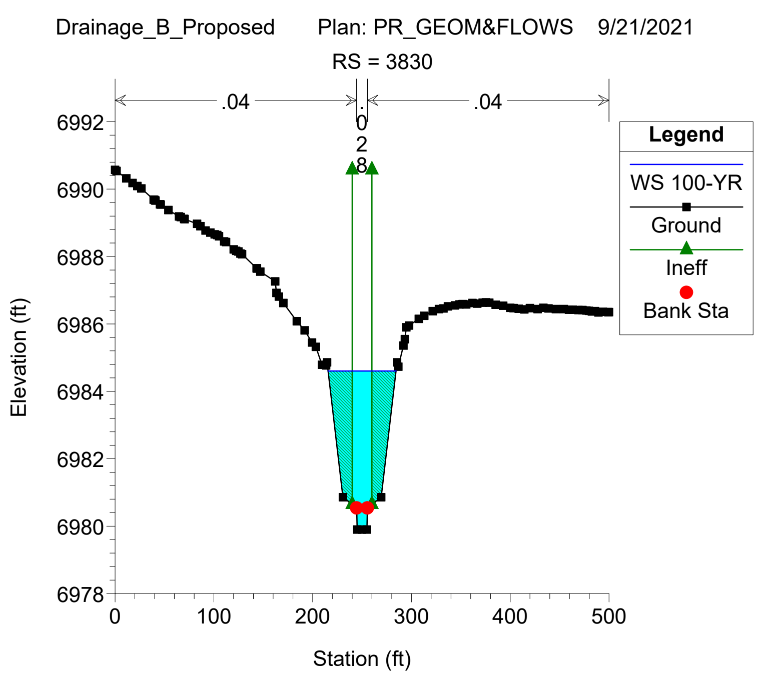

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4210
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6999
6998
6997
6996
6995
6994
6993
6992
6991
0 100 200 300 400 500
Station (ft)

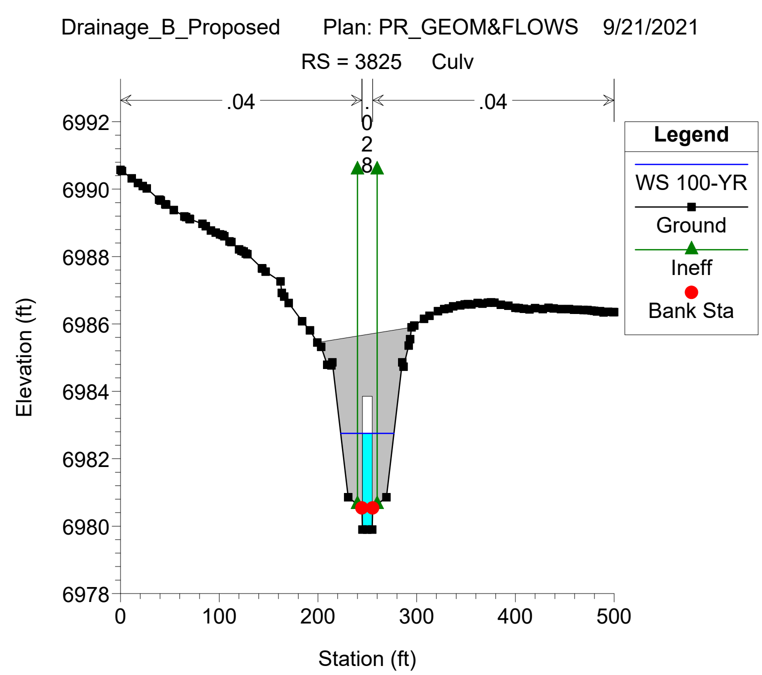

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4070
.04
.028
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
Ground
Bank Sta

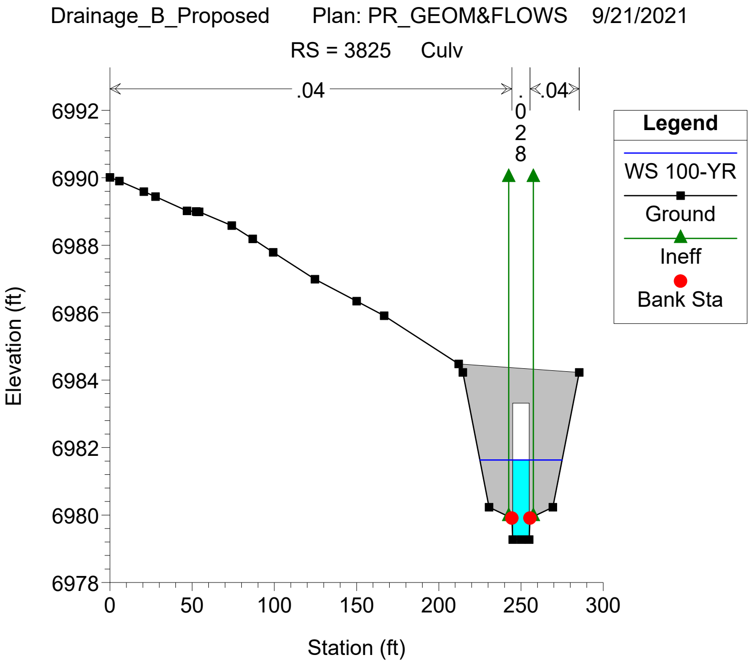

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 4025
.04
.028
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
Ground
Bank Sta

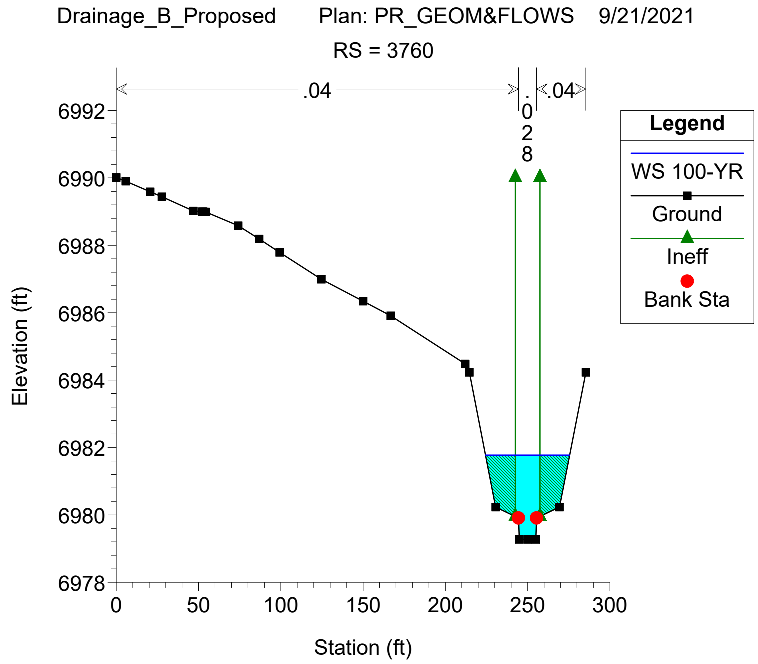

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 3925
.04
.028
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
Ground
Bank Sta

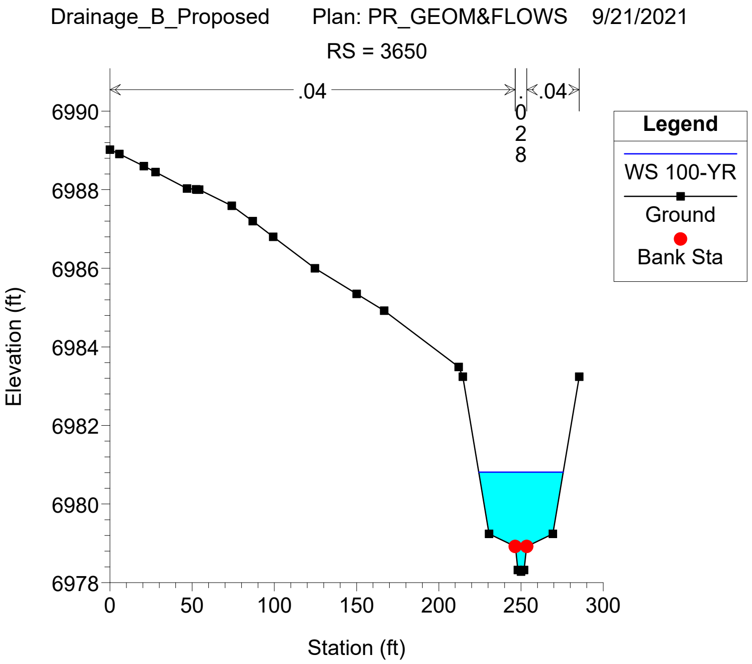

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 3880
.04
.028
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
Ground
Bank Sta

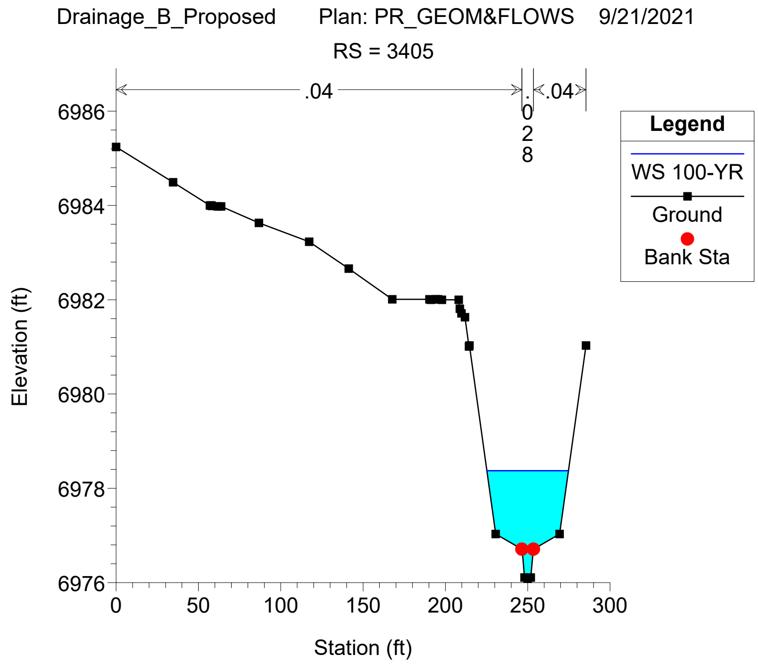

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 3830
.04
.028
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
Ground
Ineff
Bank Sta

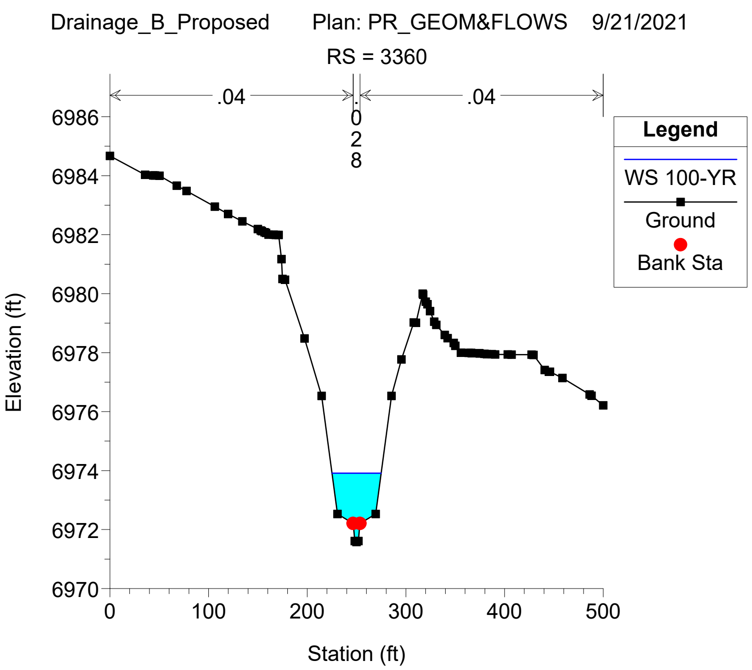

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 3825 Culv
.04
.028
.04
Elevation (ft)
Station (ft)
Legend
WS 100-YR
Ground
Ineff
Bank Sta

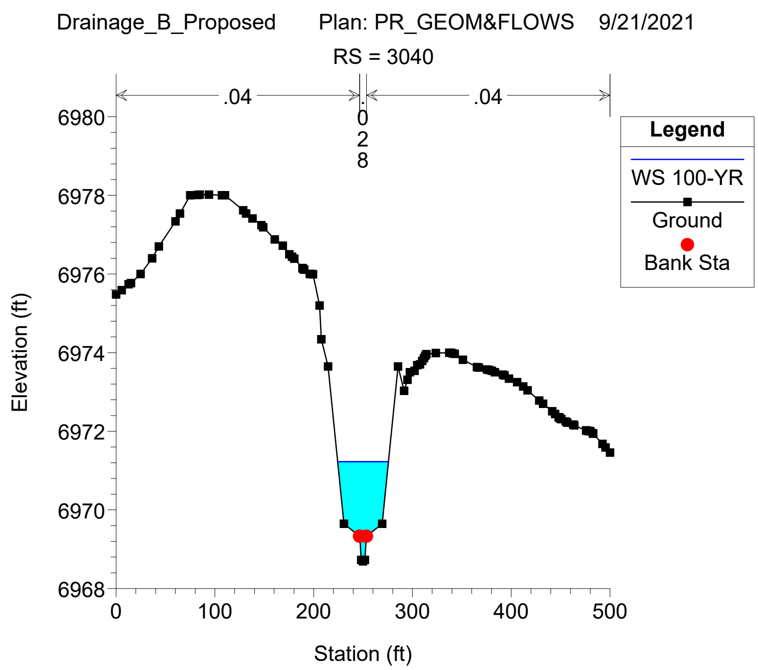

Drainage_B_Proposed
Plan: PR_GEOM&FLOWS
9/21/2021
RS = 3825
Culv
.04
.04
Legend
WS 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)

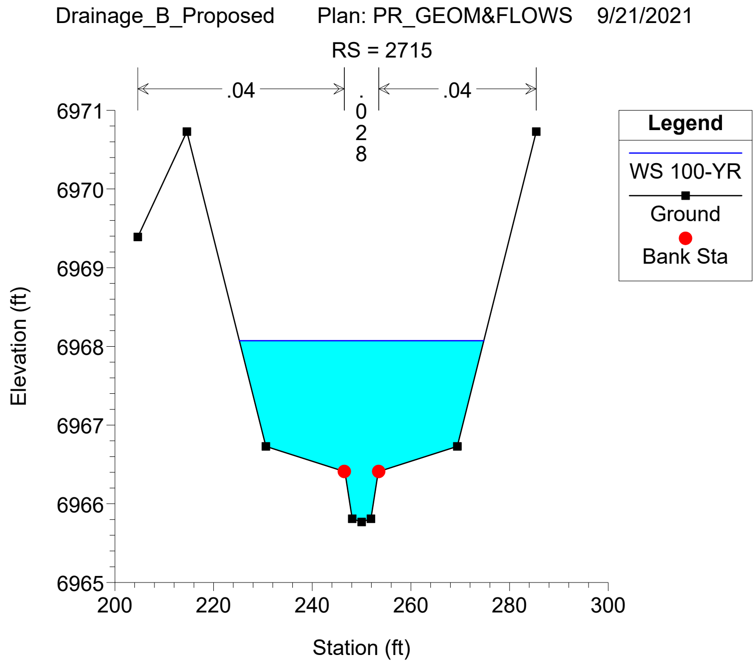
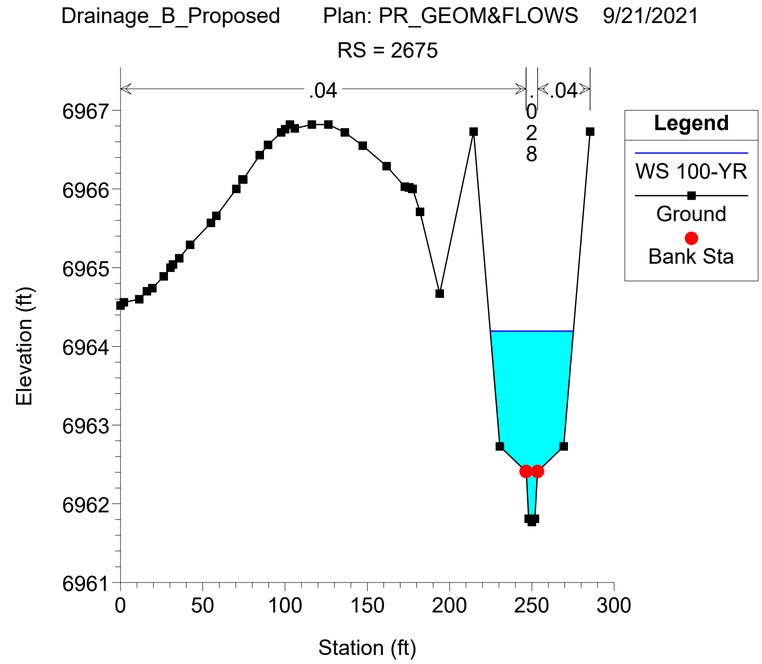
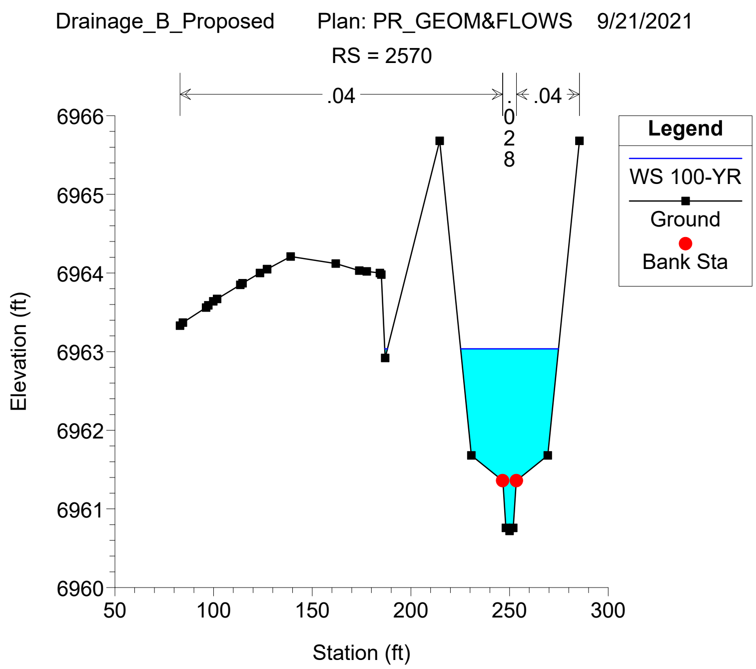

Drainage_B_Proposed
Plan: PR_GEOM&FLOWS
9/21/2021
RS = 3760
.04
.04
Legend
WS 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Drainage_B_Proposed
Plan: PR_GEOM&FLOWS
9/21/2021
RS = 3650
.04
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Drainage_B_Proposed
Plan: PR_GEOM&FLOWS
9/21/2021
RS = 3405
.04
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Drainage_B_Proposed
Plan: PR_GEOM&FLOWS
9/21/2021
RS = 3360
.04
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Drainage_B_Proposed
Plan: PR_GEOM&FLOWS
9/21/2021
RS = 3040
.04
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2715
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6965
6966
6967
6968
6969
6970
6971
200
220
240
260
280
300

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2675
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6961
6962
6963
6964
6965
6966
6967
0
50
100
150
200
250
300

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2570
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
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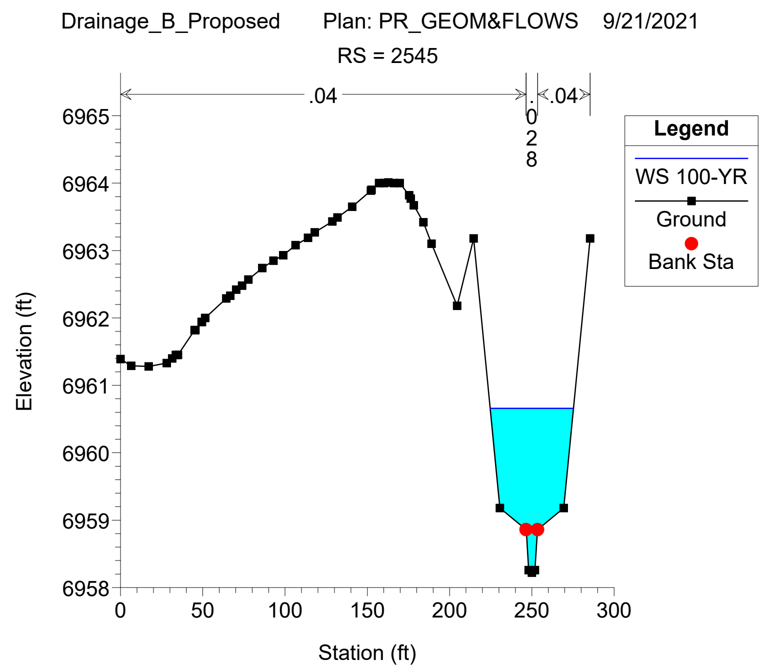
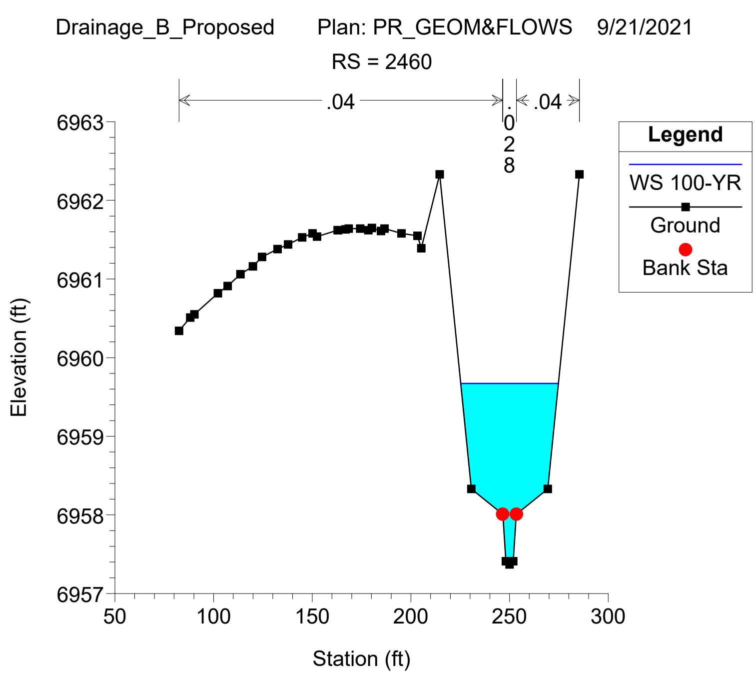
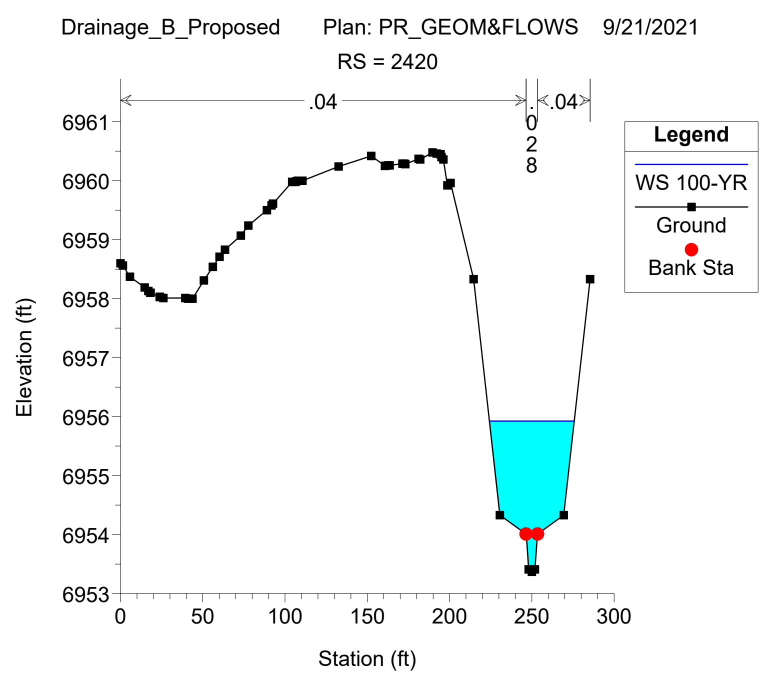
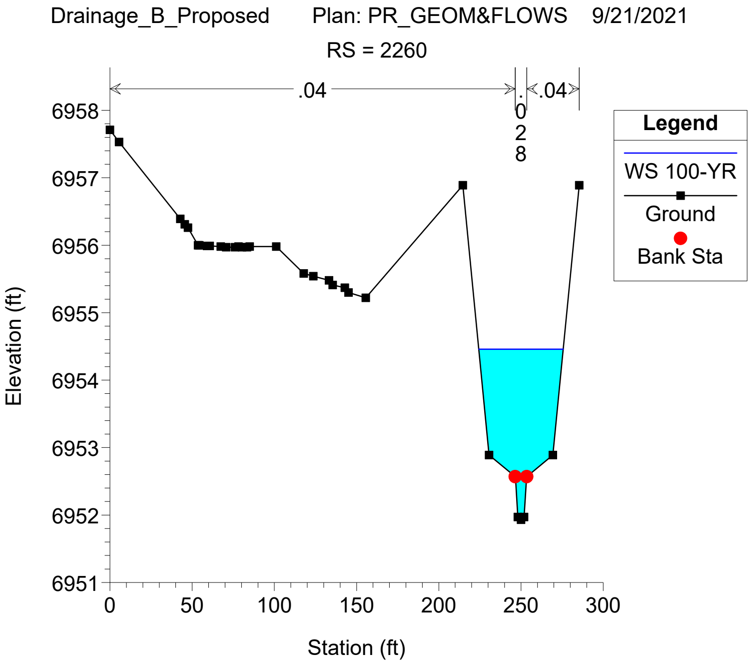
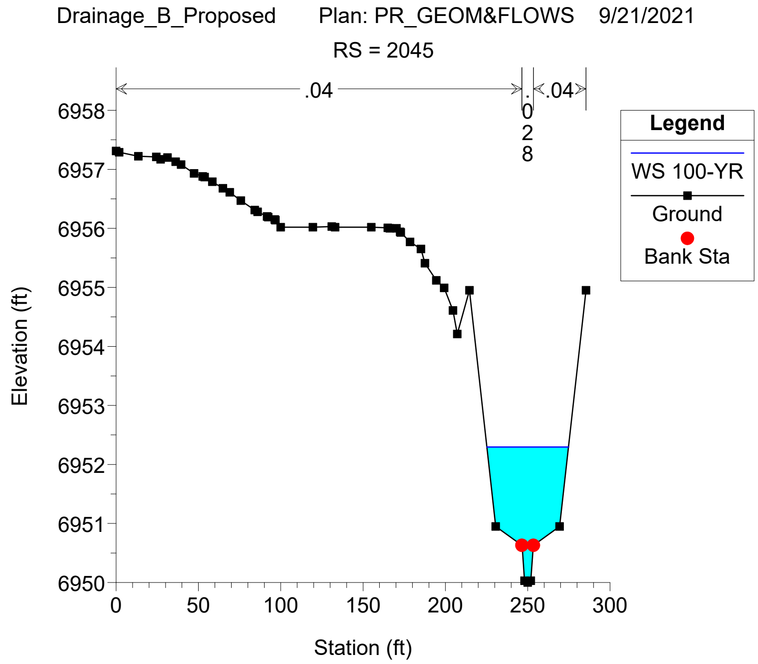
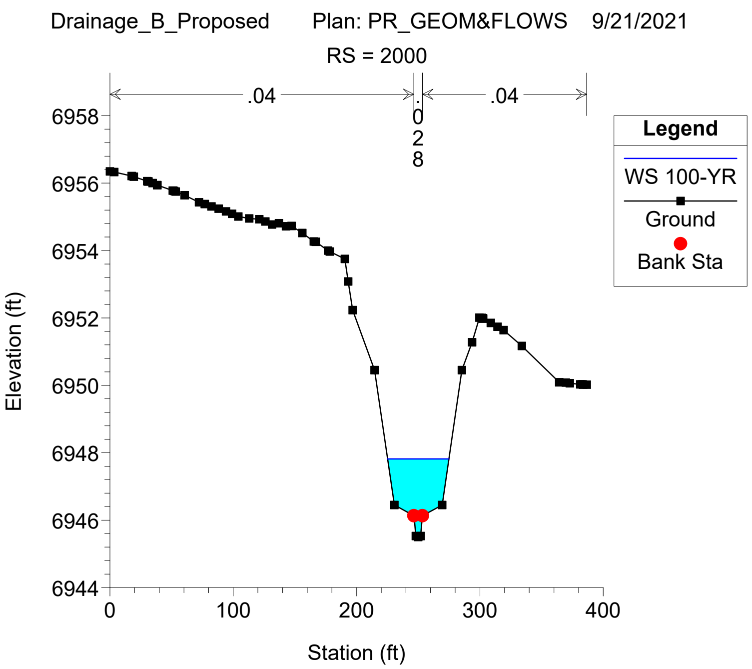
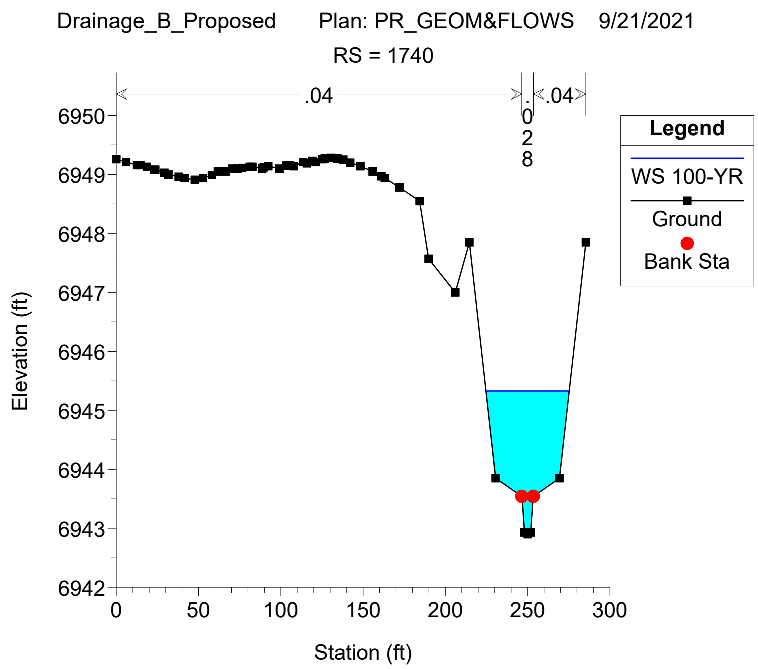
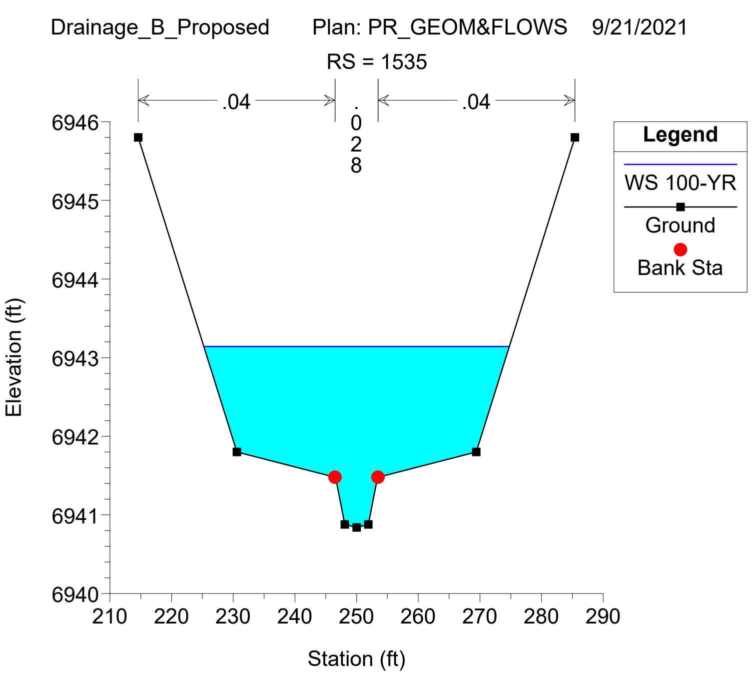
100
150
200
250
300

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2545
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6958
6959
6960
6961
6962
6963
6964
6965
0
50
100
150
200
250
300

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2460
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6957
6958
6959
6960
6961
6962
6963
50
100
150
200
250
300

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2420
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
6953
6954
6955
6956
6957
6958
6959
6960
6961
0
50
100
150
200
250
300

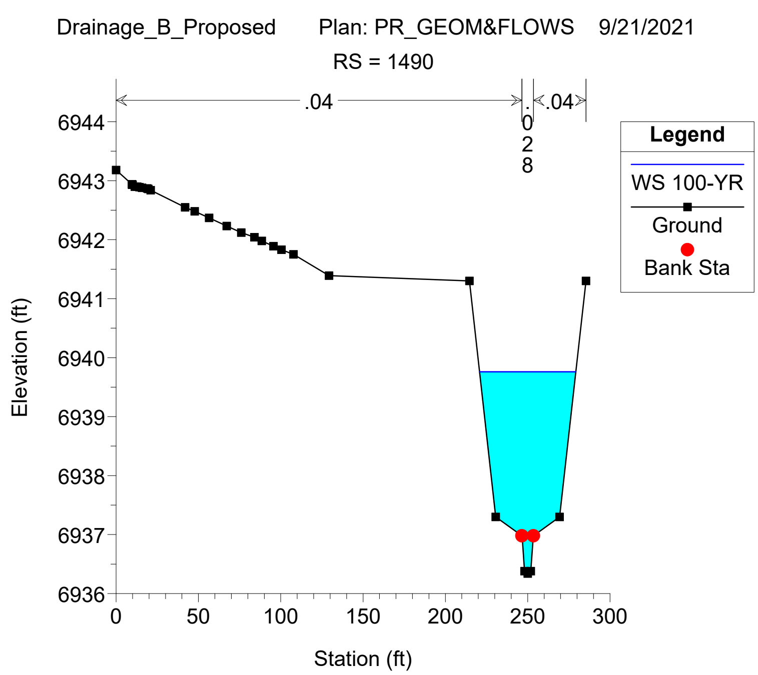

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2260
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

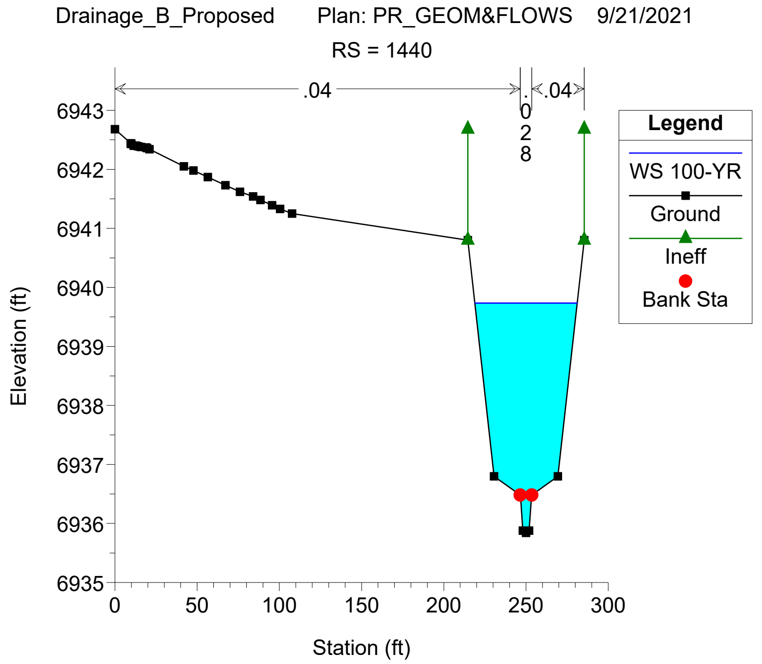

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2045
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

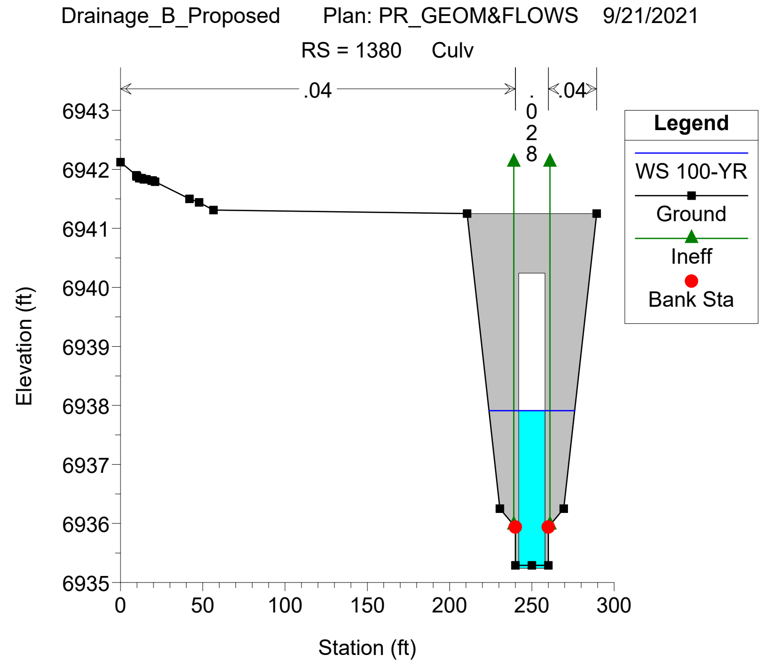

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 2000
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

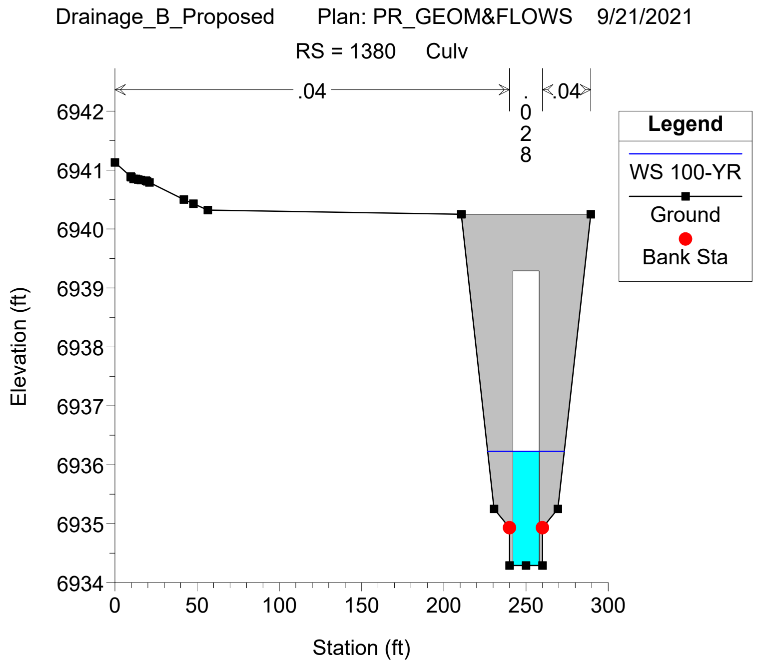

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1740
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

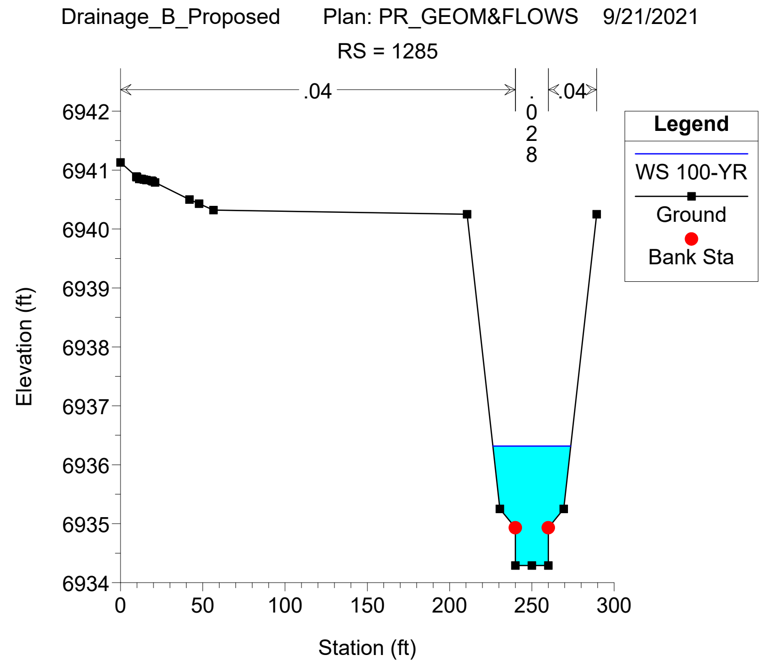

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1535
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

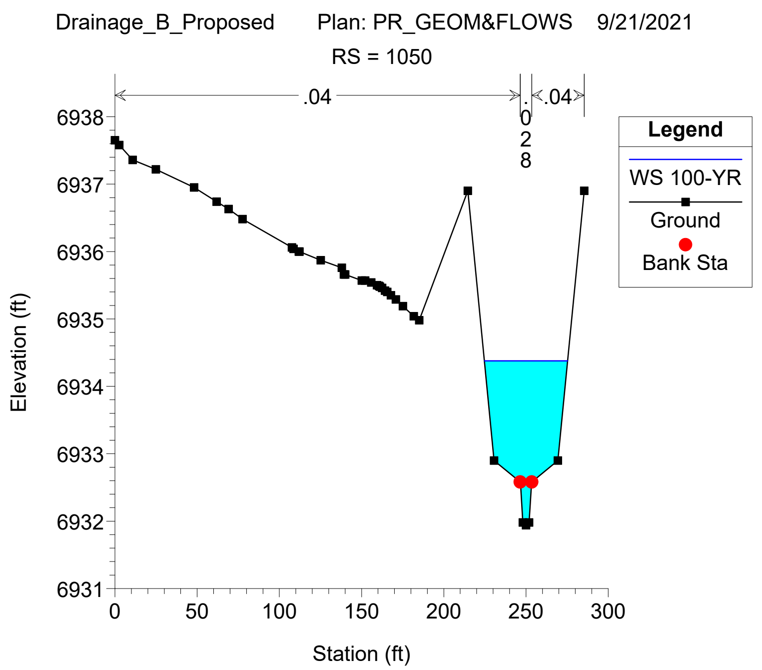

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1490
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

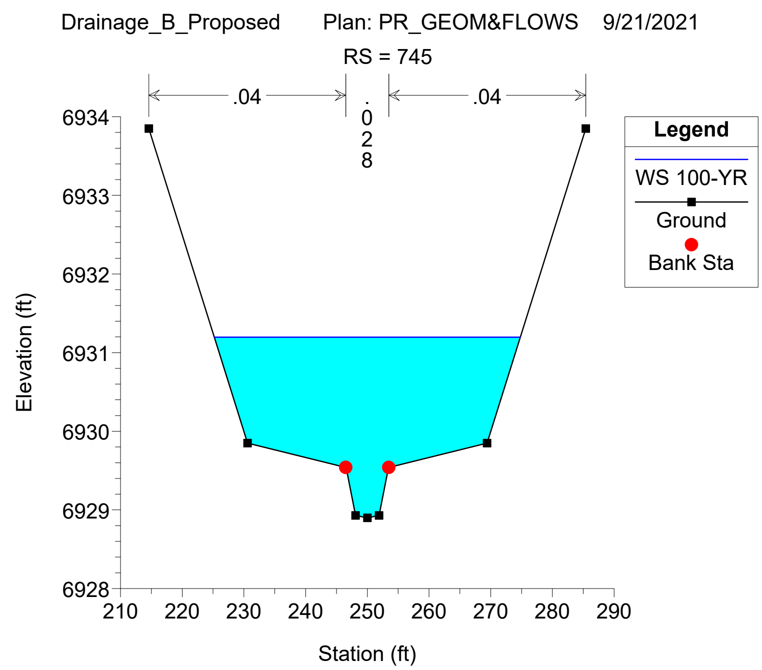

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1440
.04
.028
.04
Legend
WS 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
6935
6936
6937
6938
6939
6940
6941
6942
6943
Station (ft)
0
50
100
150
200
250
300

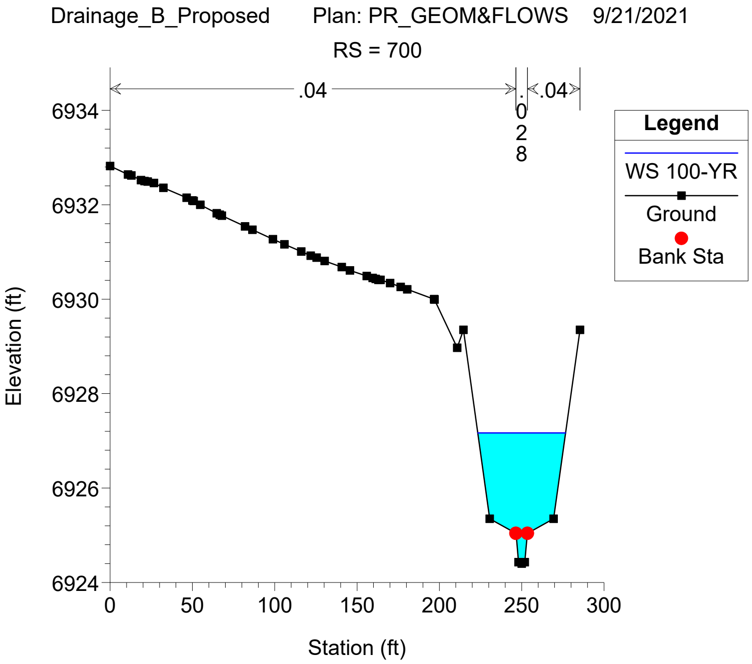

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1380 Culv
.04
.028
.04
Legend
WS 100-YR
Ground
Ineff
Bank Sta
Elevation (ft)
6935
6936
6937
6938
6939
6940
6941
6942
6943
Station (ft)
0
50
100
150
200
250
300


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1380 Culv
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6934
6935
6936
6937
6938
6939
6940
6941
6942
Station (ft)
0
50
100
150
200
250
300

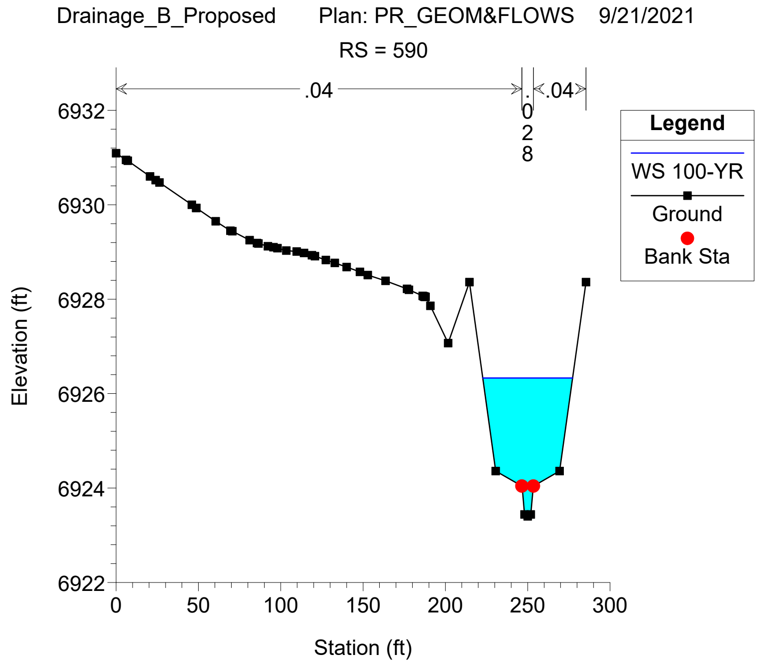

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1285
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6934
6935
6936
6937
6938
6939
6940
6941
6942
Station (ft)
0
50
100
150
200
250
300


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 1050
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6931
6932
6933
6934
6935
6936
6937
6938
Station (ft)
0
50
100
150
200
250
300

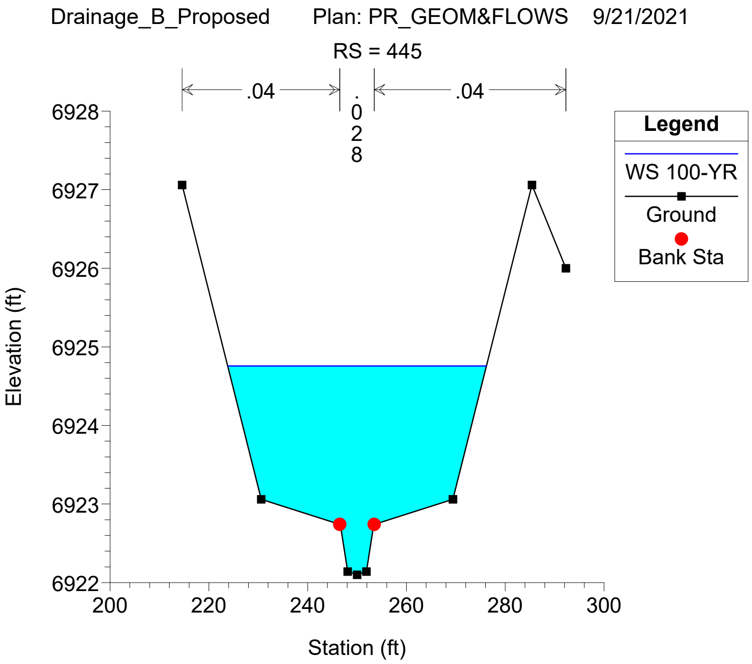

Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 745
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
6928
6929
6930
6931
6932
6933
6934
Station (ft)
210
220
230
240
250
260
270
280
290



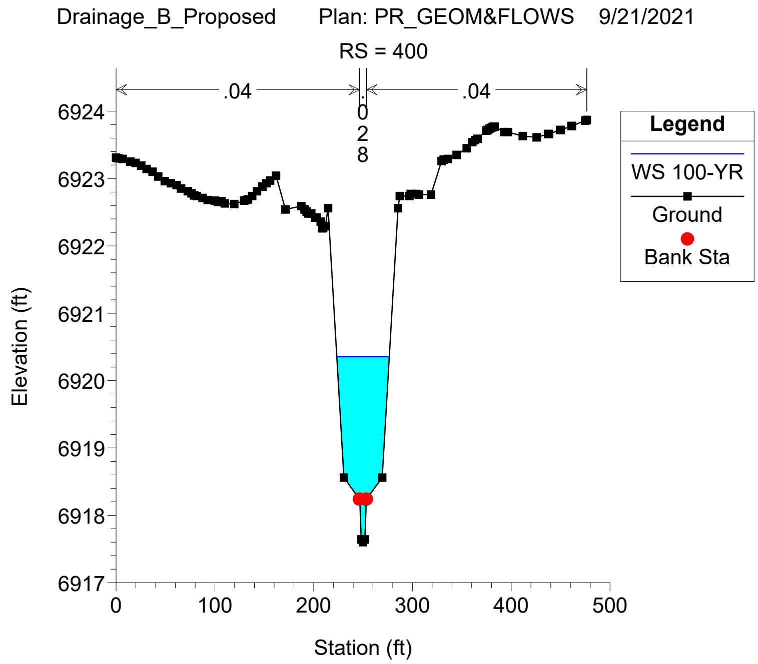
Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 700
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)



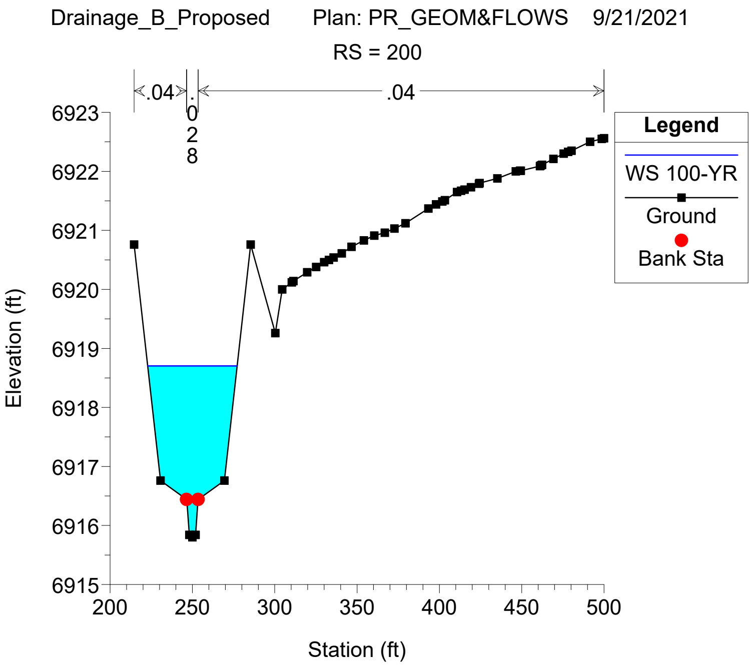
Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 590
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)



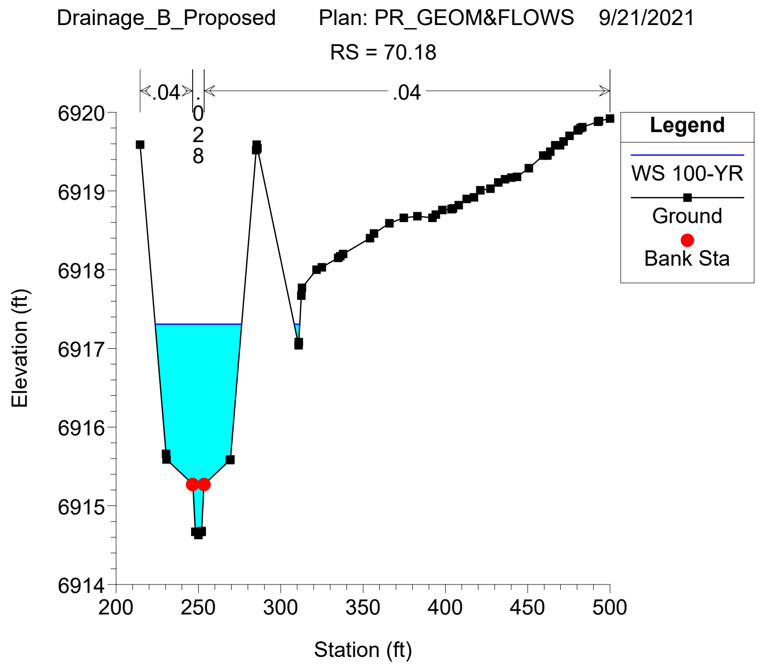
Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 445
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)



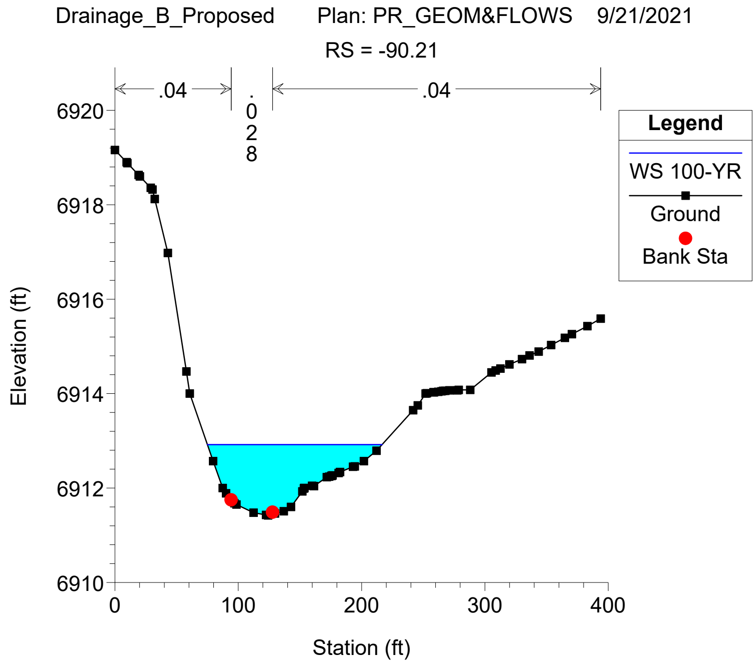
Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 400
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

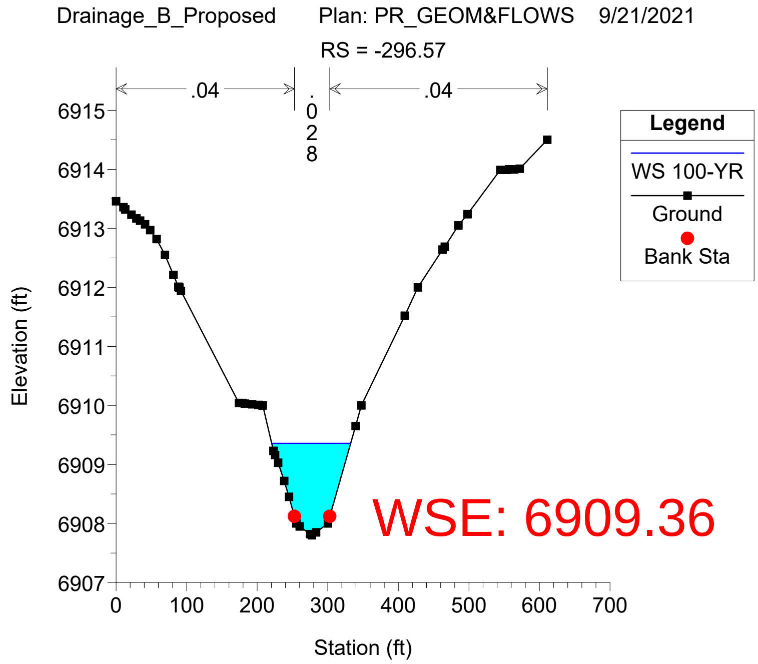


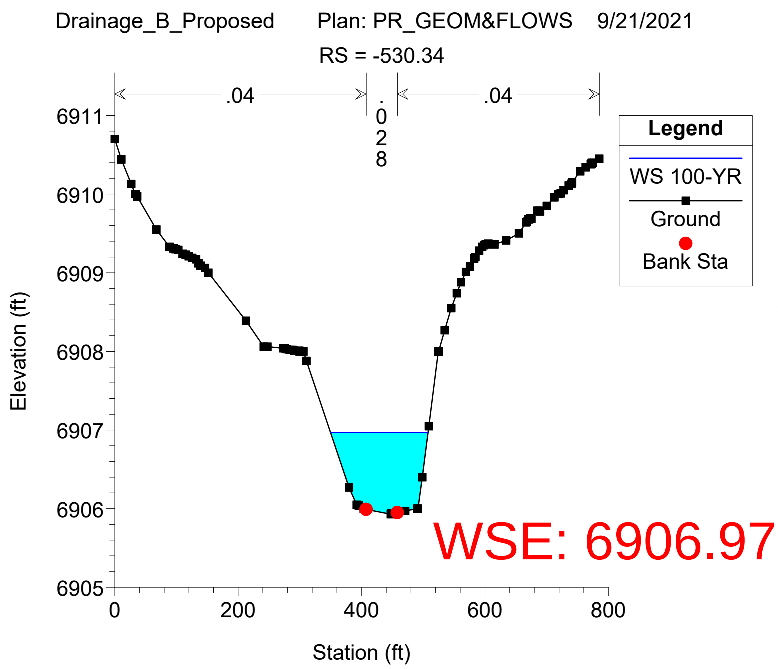
Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 200
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

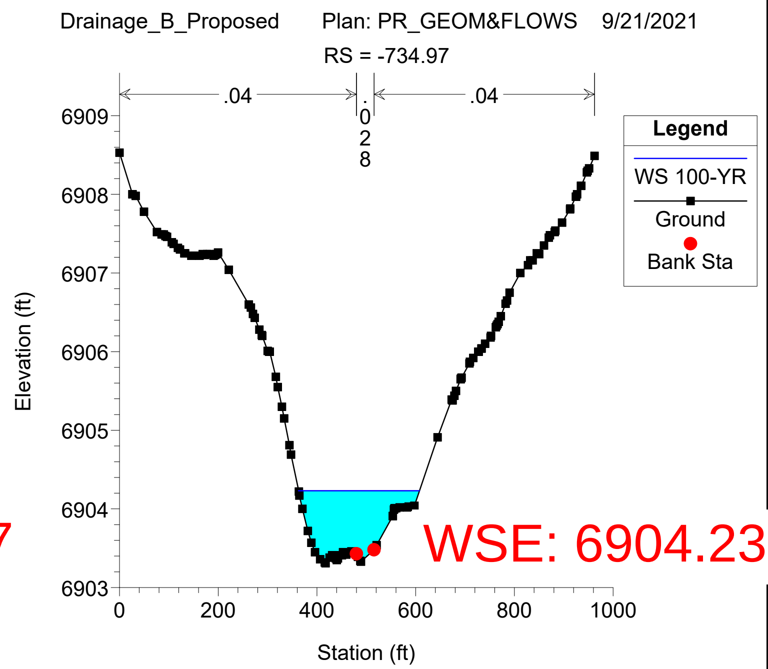


Drainage_B_Proposed Plan: PR_GEOM&FLOWS 9/21/2021
RS = 70.18
.04
.028
.04
Legend
WS 100-YR
Ground
Bank Sta
Elevation (ft)
Station (ft)









WSE COMPARISON

EXISTING	FUTURE
6909.44	6909.36
6906.98	6906.97
6904.26	6904.23

HEC-RAS Plan: PR_No_Detention River: Drainage A Reach: Alignment - (2) Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Froude # Chl	Shear LOB	Shear Chan	Shear ROB	Power LOB	Power Chan	Power ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/ft s)	(lb/ft s)	(lb/ft s)
Alignment - (2)	3712.84	100-YR	413.00	6993.54	6994.84	6994.84	6995.27	0.012379	5.24	78.75	1.01		0.65			3.39	
Alignment - (2)	3618.51	100-YR	413.00	6989.96	6991.61	6991.61	6992.06	0.012115	5.42	76.24	1.01		0.68			3.66	
Alignment - (2)	3424.5	100-YR	413.00	6985.91	6987.02	6987.02	6987.39	0.013081	4.88	84.55	1.01		0.59			2.88	
Alignment - (2)	3214.73	100-YR	413.00	6979.87	6981.76	6981.76	6982.42	0.010605	6.55	63.05	1.00		0.87			5.69	
Alignment - (2)	2882.47	100-YR	413.00	6973.22	6974.71	6974.71	6975.21	0.011487	5.72	72.23	1.00		0.72			4.13	
Alignment - (2)	2772.34	100-YR	413.00	6972.00	6973.29		6973.47	0.003528	3.38	122.37	0.56		0.24			0.82	
Alignment - (2)	2748.72	100-YR	413.00	6972.00	6972.91	6972.91	6973.31	0.012331	5.08	81.29	1.00		0.62			3.13	
Alignment - (2)	2592.31	100-YR	413.00	6966.70	6968.54	6968.54	6969.20	0.010672	6.54	63.17	1.01		0.87			5.67	
Alignment - (2)	2527.18	100-YR	413.00	6964.78	6966.57	6966.57	6967.22	0.010794	6.45	64.06	1.01		0.85			5.49	
Alignment - (2)	2478.84	100-YR	413.00	6963.36	6965.59	6965.59	6966.27	0.010541	6.63	62.25	1.01		0.88			5.87	
Alignment - (2)	2303.17	100-YR	413.00	6959.99	6962.26	6962.21	6962.90	0.009632	6.43	64.26	0.96		0.82			5.30	
Alignment - (2)	2121.94	100-YR	413.00	6957.99	6960.30	6960.30	6961.10	0.010139	7.15	57.75	1.01		0.98			7.01	
Alignment - (2)	1814.04	100-YR	413.00	6953.99	6955.98	6955.98	6956.70	0.010511	6.80	60.78	1.01		0.92			6.22	
Alignment - (2)	1556.67	100-YR	466.95	6949.87	6952.06	6952.06	6952.64	0.010044	6.14	77.22	0.97	0.08	0.78		0.07	4.78	
Alignment - (2)	1297.03	100-YR	466.95	6941.99	6945.25	6945.25	6946.24	0.009590	7.97	58.58	1.00		1.14			9.07	
Alignment - (2)	1084.03	100-YR	466.95	6939.97	6942.55	6942.55	6943.07	0.011691	5.76	81.05	1.01		0.73			4.23	
Alignment - (2)	642.96	100-YR	466.95	6930.00	6932.24	6932.24	6932.94	0.010518	6.70	69.71	1.01		0.90			6.01	
Alignment - (2)	523.77	100-YR	466.95	6929.58	6931.04	6931.04	6931.60	0.011270	6.02	77.51	1.01		0.78			4.69	
Alignment - (2)	290.78	100-YR	466.95	6924.69	6926.12	6926.12	6926.70	0.011177	6.12	76.32	1.01		0.79			4.86	
Alignment - (2)	214.43	100-YR	466.95	6922.96	6924.80	6924.80	6925.50	0.010470	6.67	69.98	1.01		0.89			5.94	
Alignment - (2)	148.72	100-YR	466.95	6920.98	6922.79	6922.79	6923.48	0.010396	6.65	70.17	1.00		0.89			5.89	
Alignment - (2)	33.13	100-YR	466.95	6918.00	6920.41	6920.41	6921.08	0.010467	6.58	71.01	1.00		0.87			5.73	

See channel
comments - this is
all supercritical

HEC-RAS Plan: Proposed River: Channel B Reach: Alignment Channe Profile: 100-YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Froude # Chl	Shear LOB	Shear Chan	Shear ROB	Power LOB	Power Chan	Power ROB
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)		(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(lb/ft s)	(lb/ft s)	(lb/ft s)
Alignment Channe	4748.5	100-YR	280.00	7006.24	7008.33	7008.24	7008.81	0.008985	7.62	59.97	0.97	0.63	1.05	0.63	2.41	7.96	2.42
Alignment Channe	4700	100-YR	280.00	7005.80	7007.96		7008.39	0.007874	7.27	62.74	0.91	0.58	0.94	0.58	2.11	6.86	2.11
Alignment Channe	4662.69	100-YR	280.00	7005.46	7007.47	7007.47	7008.02	0.011159	8.22	55.66	1.07	0.74	1.24	0.74	3.01	10.16	3.01
Alignment Channe	4636.96	100-YR	280.00	7002.89	7004.93	7004.90	7005.46	0.010337	8.00	57.14	1.03	0.70	1.16	0.70	2.78	9.32	2.78
Alignment Channe	4580	100-YR	280.00	7002.32	7004.42	7004.33	7004.89	0.008889	7.59	60.18	0.96	0.63	1.04	0.63	2.39	7.86	2.39
Alignment Channe	4520	100-YR	280.00	7001.72	7003.72	7003.72	7004.28	0.011298	8.25	55.45	1.08	0.74	1.25	0.74	3.03	10.30	3.04
Alignment Channe	4485	100-YR	280.00	6998.22	7000.33	7000.23	7000.79	0.008854	7.58	60.26	0.96	0.63	1.03	0.63	2.38	7.82	2.38
Alignment Channe	4440	100-YR	280.00	6997.82	6999.99		7000.41	0.007652	7.20	63.35	0.90	0.56	0.92	0.56	2.05	6.65	2.05
Alignment Channe	4365	100-YR	280.00	6997.15	6999.15	6999.15	6999.71	0.011186	8.23	55.70	1.07	0.73	1.24	0.74	2.98	10.19	3.01
Alignment Channe	4320	100-YR	280.00	6992.85	6994.88	6994.86	6995.42	0.010640	8.08	56.58	1.05	0.71	1.19	0.71	2.87	9.63	2.87
Alignment Channe	4210	100-YR	280.00	6991.75	6993.85	6993.76	6994.32	0.008970	7.61	59.99	0.97	0.63	1.04	0.63	2.41	7.94	2.41
Alignment Channe	4070	100-YR	280.00	6990.35	6992.36	6992.36	6992.92	0.011191	8.23	55.58	1.07	0.74	1.24	0.74	3.01	10.19	3.02
Alignment Channe	4025	100-YR	280.00	6985.85	6987.95	6987.86	6988.42	0.008981	7.61	59.97	0.97	0.63	1.04	0.63	2.41	7.95	2.41
Alignment Channe	3925	100-YR	280.00	6984.85	6986.86	6986.86	6987.42	0.011191	8.23	55.58	1.07	0.74	1.24	0.74	3.02	10.19	3.02
Alignment Channe	3880	100-YR	280.00	6980.35	6984.77		6984.81	0.000314	2.41	192.87	0.21	0.05	0.08	0.05	0.07	0.19	0.07
Alignment Channe	3830	100-YR	280.00	6979.90	6984.60	6982.19	6984.78	0.000681	3.73	87.49	0.30	0.17	0.19	0.17	0.42	0.70	0.42
Alignment Channe	3825		Culvert														
Alignment Channe	3760	100-YR	280.00	6979.27	6981.78	6981.78	6982.88	0.008939	8.85	34.61	0.99	1.03	1.31	1.03	5.42	11.58	5.42
Alignment Channe	3650	100-YR	395.83	6978.28	6980.81		6981.31	0.007371	7.90	81.46	0.91	0.67	1.05	0.67	2.73	8.29	2.73
Alignment Channe	3405	100-YR	395.83	6976.08	6978.37	6978.37	6979.05	0.011504	9.21	69.90	1.11	0.92	1.48	0.92	4.33	13.61	4.33
Alignment Channe	3360	100-YR	395.83	6971.58	6973.91	6973.87	6974.56	0.010624	8.96	71.84	1.07	0.87	1.39	0.87	3.99	12.45	3.99
Alignment Channe	3040	100-YR	395.83	6968.69	6971.23		6971.72	0.007303	7.87	81.72	0.90	0.66	1.04	0.66	2.70	8.20	2.70
Alignment Channe	2715	100-YR	395.83	6965.77	6968.07	6968.07	6968.75	0.011533	9.22	69.82	1.11	0.92	1.48	0.92	4.34	13.67	4.34
Alignment Channe	2675	100-YR	395.83	6961.77	6964.21	6964.07	6964.77	0.008847	8.41	76.50	0.99	0.76	1.21	0.76	3.30	10.16	3.30
Alignment Channe	2570	100-YR	395.83	6960.72	6963.02	6963.02	6963.70	0.011459	9.20	70.05	1.11	0.92	1.47	0.92	4.29	13.56	4.31
Alignment Channe	2545	100-YR	395.83	6958.22	6960.66	6960.52	6961.22	0.008761	8.38	76.75	0.98	0.76	1.20	0.76	3.27	10.05	3.27
Alignment Channe	2460	100-YR	395.83	6957.37	6959.67	6959.67	6960.36	0.011557	9.23	69.74	1.12	0.93	1.48	0.92	4.36	13.70	4.35
Alignment Channe	2420	100-YR	395.83	6953.37	6955.92		6956.40	0.007102	7.80	82.51	0.89	0.65	1.02	0.65	2.63	7.95	2.63
Alignment Channe	2260	100-YR	395.83	6951.93	6954.46		6954.95	0.007381	7.90	81.53	0.91	0.67	1.05	0.67	2.72	8.30	2.73
Alignment Channe	2045	100-YR	395.83	6950.00	6952.29	6952.29	6952.97	0.011529	9.21	69.87	1.11	0.92	1.48	0.92	4.34	13.64	4.34
Alignment Channe	2000	100-YR	395.83	6945.50	6947.82	6947.80	6948.47	0.010948	9.05	71.10	1.09	0.89	1.42	0.89	4.12	12.87	4.12
Alignment Channe	1740	100-YR	395.83	6942.90	6945.33	6945.20	6945.89	0.008826	8.41	76.57	0.99	0.76	1.21	0.76	3.29	10.14	3.29
Alignment Channe	1535	100-YR	395.83	6940.84	6943.14	6943.14	6943.82	0.011533	9.22	69.82	1.11	0.92	1.48	0.92	4.34	13.67	4.34
Alignment Channe	1490	100-YR	395.83	6936.34	6939.76		6939.95	0.001908	4.97	130.26	0.49	0.25	0.37	0.25	0.65	1.86	0.65
Alignment Channe	1440	100-YR	395.83	6935.84	6939.73		6939.86	0.001086	4.11	158.80	0.38	0.16	0.24	0.16	0.35	1.00	0.35
Alignment Channe	1385	100-YR	395.83	6935.29	6939.48	6937.56	6939.78	0.001149	4.48	90.75	0.39	0.25	0.28	0.25	0.73	1.26	0.73
Alignment Channe	1380		Culvert														
Alignment Channe	1285	100-YR	395.83	6934.29	6936.32	6936.29	6937.02	0.008344	7.45	68.14	0.92	0.52	0.99	0.52	1.77	7.40	1.77
Alignment Channe	1050	100-YR	395.83	6931.94	6934.38	6934.24	6934.94	0.008788	8.39	76.82	0.98	0.75	1.20	0.76	3.25	10.08	3.28
Alignment Channe	745	100-YR	395.83	6928.90	6931.20	6931.20	6931.88	0.011517	9.22	69.86	1.11	0.92	1.48	0.92	4.33	13.65	4.33
Alignment Channe	700	100-YR	553.68	6924.40	6927.17	6927.06	6927.88	0.009480	9.56	94.18	1.05	0.96	1.49	0.96	4.80	14.24	4.80
Alignment Channe	590	100-YR	553.68	6923.40	6926.33		6926.93	0.007424	8.79	102.50	0.93	0.80	1.24	0.80	3.71	10.86	3.71
Alignment Channe	445	100-YR	553.68	6922.10	6924.76	6924.76	6925.58	0.011539	10.23	87.98	1.14	1.11	1.73	1.11	5.91	17.71	5.91
Alignment Channe	400	100-YR	553.68	6917.60	6920.35	6920.26	6921.08	0.009902	9.68	92.67	1.07	0.99	1.53	0.99	5.01	14.84	5.02
Alignment Channe	200	100-YR	553.68	6915.80	6918.72	6918.46	6919.32	0.007559	8.84	101.93	0.94	0.81	1.25	0.81	3.78	11.08	3.77
Alignment Channe	70.18	100-YR	553.68	6914.63	6917.29	6917.29	6918.11	0.011428	10.19	88.46	1.14	1.10	1.72	1.10	5.83	17.50	5.80
Alignment Channe	-90.21	100-YR	553.68	6911.42	6912.92	6912.92	6913.37	0.010023	6.62	126.87	0.99	0.42	0.87	0.47	1.20	5.76	1.46
Alignment Channe	-296.57	100-YR	553.68	6907.80	6909.36	6909.36	6909.89	0.008785	6.35	109.97	0.93	0.33	0.79	0.34	0.81	5.02	0.86
Alignment Channe	-530.34	100-YR	553.68	6905.93	6906.97	6906.93	6907.34	0.012180	5.90	127.40	1.03	0.46	0.77	0.63	1.36	4.53	2.27
Alignment Channe	-734.97	100-YR	553.68	6903.33	6904.23	6904.23	6904.53	0.015444	5.84	144.65	1.13	0.69	0.80	0.32	2.57	4.69	0.71

See channel comments - this is almost all supercritical

APPENDIX E

Water Quality Computations

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator
LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	1.19	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.25	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.50	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: NQJ
Company: HR GREEN
Date: May 3, 2022
Project: EASTONVILLE ROAD
Location: COLORADO SPRINGS

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**EA1**	**EA2**												
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam												
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	6.420	5.590												
Directly Connected Impervious Area (DCIA, acres)	3.403	2.963												
Unconnected Impervious Area (UIA, acres)	0.321	0.280												
Receiving Pervious Area (RPA, acres)	0.514	0.447												
Separate Pervious Area (SPA, acres)	2.183	1.901												
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C												

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	6.420	5.590												
Directly Connected Impervious Area (DCIA, %)	53.0%	53.0%												
Unconnected Impervious Area (UIA, %)	5.0%	5.0%												
Receiving Pervious Area (RPA, %)	8.0%	8.0%												
Separate Pervious Area (SPA, %)	34.0%	34.0%												
A_R (RPA / UIA)	1.600	1.600												
I_a Check	0.380	0.380												
f / I for WQCV Event:	0.9	0.9												
f / I for 5-Year Event:	0.5	0.5												
f / I for 100-Year Event:	0.3	0.3												
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.78	0.78												
IRF for 5-Year Event:	0.87	0.87												
IRF for 100-Year Event:	0.91	0.91												
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	58.0%	58.0%												
Effective Imperviousness for WQCV Event:	56.9%	56.9%												
Effective Imperviousness for 5-Year Event:	57.4%	57.4%												
Effective Imperviousness for 100-Year Event:	57.6%	57.6%												
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	1.5%	1.5%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.7%	0.7%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**58.0%**
Total Site Effective Imperviousness for WQCV Event:	**56.9%**
Total Site Effective Imperviousness for 5-Year Event:	**57.4%**
Total Site Effective Imperviousness for 100-Year Event:	**57.6%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

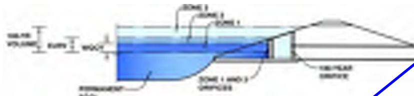
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: **EASTONVILLE ROAD - ALONG GRANDVIEW RESERVE**

Basin ID: **EA1 & EA2**



Example Zone Configuration (Retention Pond)

14.3?

this should be lower, <0.5x3,500

Watershed Information

Selected BMP Type =	**EDB**		**Note: L / W Ratio > 8**	
Watershed Area =	12.01	acres	**L / W Ratio = 23.42**	
Watershed Length =	3,500	ft		
Watershed Length to Centroid =	3,000	ft		
Watershed Slope =	0.009	ft/ft		
Watershed Imperviousness =	59.00%	percent		
Percentage Hydrologic Soil Group A =	90.0%	percent		
Percentage Hydrologic Soil Group B =	10.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.233	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.847	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.649	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.853	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.017	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.276	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.503	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.790	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	2.962	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.558	acre-feet		
Approximate 5-yr Detention Volume =	0.734	acre-feet		
Approximate 10-yr Detention Volume =	0.895	acre-feet		
Approximate 25-yr Detention Volume =	1.070	acre-feet		
Approximate 50-yr Detention Volume =	1.177	acre-feet		
Approximate 100-yr Detention Volume =	1.301	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.233	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.614	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.454	acre-feet
Total Detention Basin Volume =	1.301	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

Depth Increment = ft

6983.5

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	--	--	--	0	0.000		
6984	--	0.50	--	--	--	2,607	0.060	587	0.013
6985	--	1.50	--	--	--	6,779	0.156	5,121	0.118
6986	--	2.50	--	--	--	8,208	0.188	12,598	0.289
6987	--	3.50	--	--	--	9,743	0.224	21,657	0.497
6988	--	4.50	--	--	--	11,388	0.261	32,435	0.745
6989	--	5.50	--	--	--	13,141	0.302	45,067	1.035
6990	--	6.50	--	--	--	15,025	0.345	59,691	1.370
6991	--	7.50	--	--	--	17,034	0.391	76,443	1.755
6992	--	8.50	--	--	--	19,185	0.440	95,037	2.182
6993	--	9.50	--	--	--	21,967	0.504	115,149	2.643
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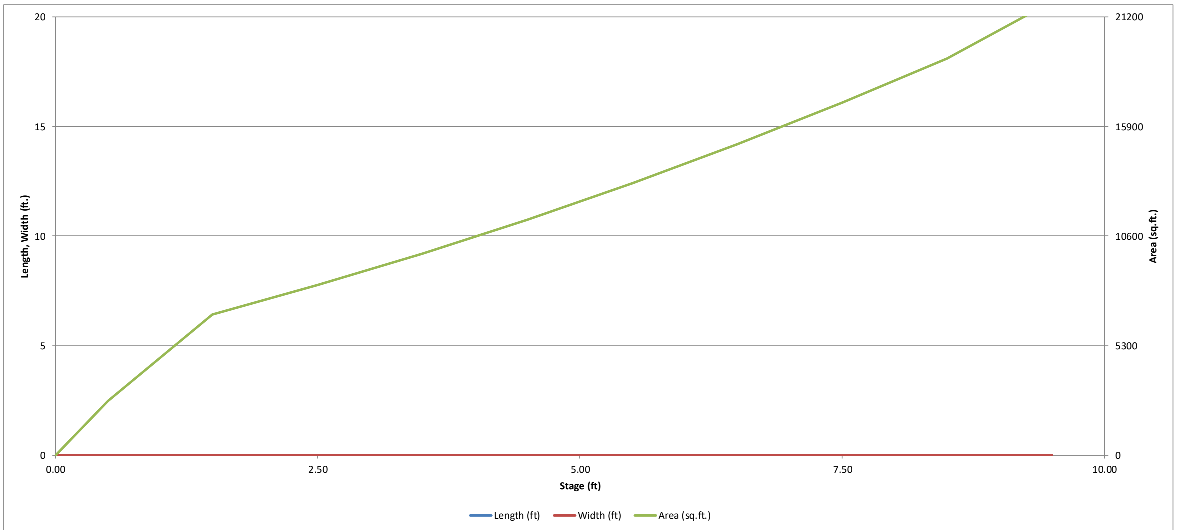
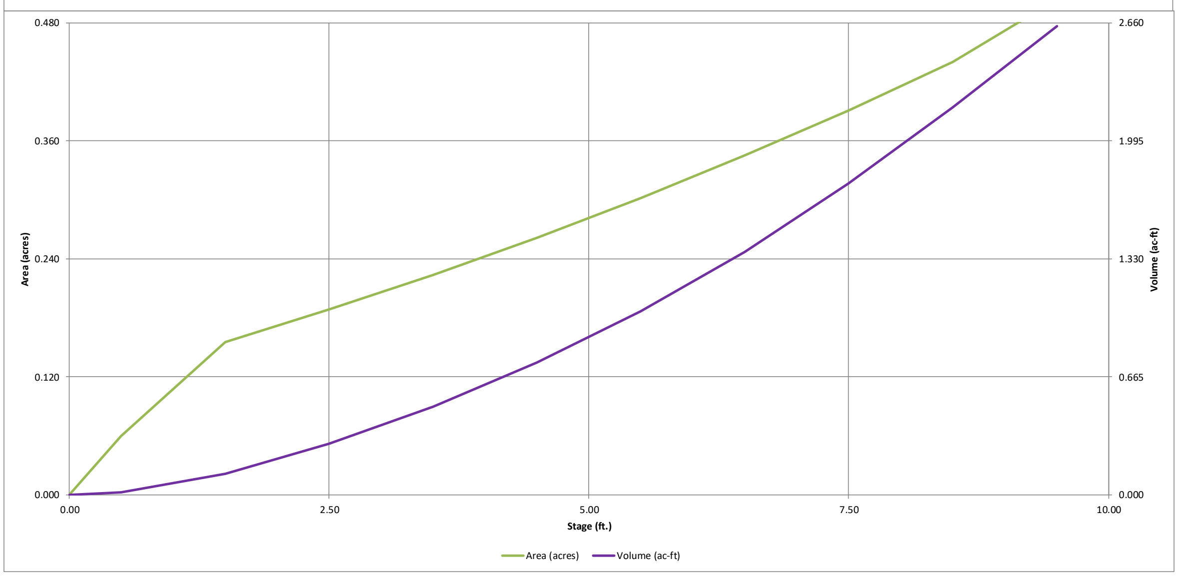
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



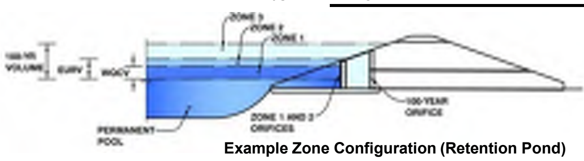


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: EASTONVILLE ROAD - ALONG GRANDVIEW RESERVE

Basin ID: EA1 & EA2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.20	0.233	Orifice Plate
Zone 2 (EURV)	4.88	0.614	Circular Orifice
Zone 3 (100-year)	6.31	0.454	Weir&Pipe (Restrict)
Total (all zones)		1.301	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.20	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.80	inches
Orifice Plate: Orifice Area per Row =	1.19	sq. inches (diameter = 1-3/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	8.264E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.73	1.47					
Orifice Area (sq. inches)	1.19	1.19	1.19					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	2.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	4.88	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	0.70	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft^2
Vertical Orifice Centroid =	0.03	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.92	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	0%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.92	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	50.77	N/A	
Overflow Grate Open Area w/o Debris =	6.26	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.26	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	2.20		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.12	N/A	ft^2
Outlet Orifice Centroid =	0.11	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.71	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.40	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	2.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.28	feet
Stage at Top of Freeboard =	8.68	feet
Basin Area at Top of Freeboard =	0.45	acres
Basin Volume at Top of Freeboard =	2.26	acre-ft

Routed Hydrograph Results

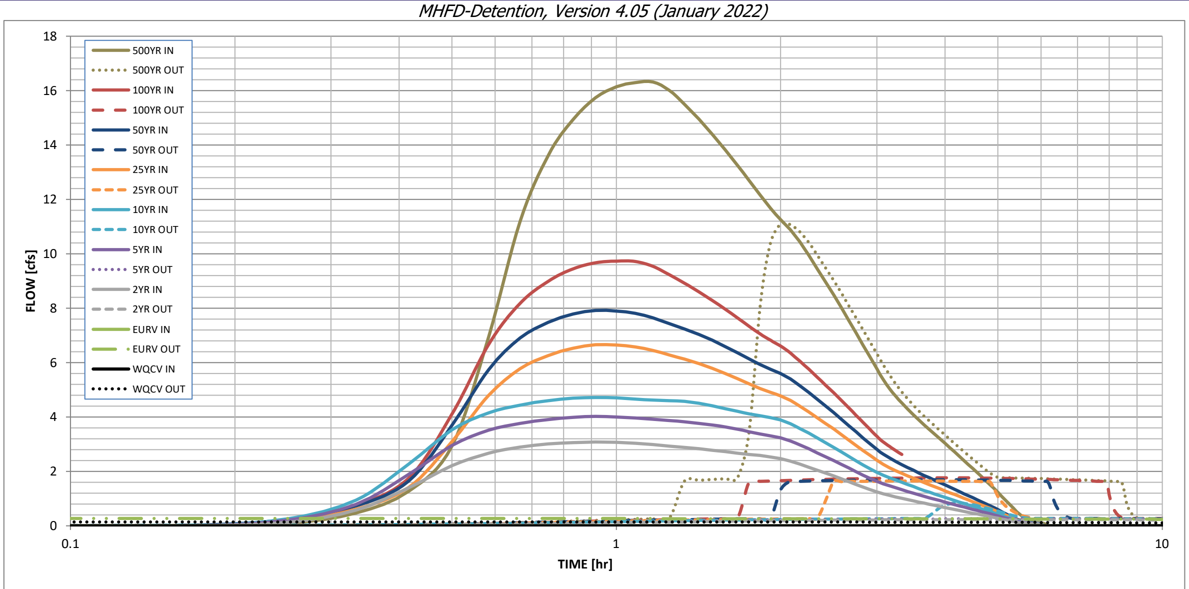
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

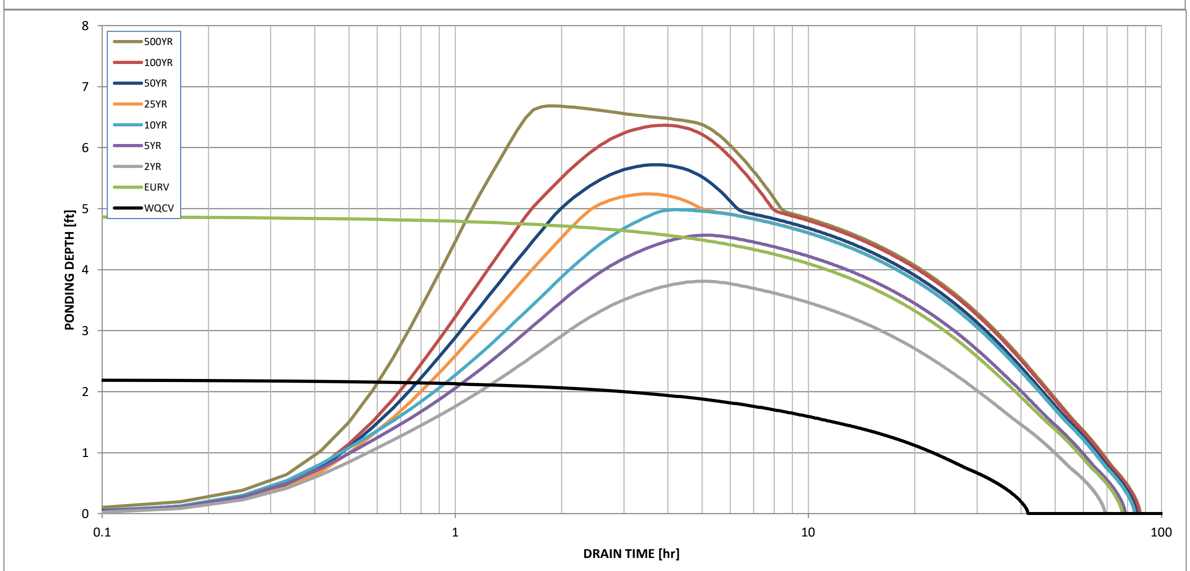
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.233	0.847	0.649	0.853	1.017	1.276	1.503	1.790	2.962
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.648	0.852	1.016	1.275	1.501	1.789	2.960
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.1	0.7	1.2	1.9	5.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.00	0.00	0.06	0.10	0.16	0.42
Peak Inflow Q (cfs) =	N/A	N/A	3.1	4.0	4.7	6.7	7.9	9.7	16.3
Peak Outflow Q (cfs) =	0.1	0.3	0.2	0.3	0.8	1.6	1.7	1.8	11.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	6.2	14.4	2.3	1.4	0.9	2.2
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.2	0.2	0.2	0.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	65	59	67	70	68	67	67	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	65	74	78	77	77	77	73
Maximum Ponding Depth (ft) =	2.20	4.88	3.81	4.56	4.98	5.24	5.72	6.36	6.68
Area at Maximum Ponding Depth (acres) =	0.18	0.28	0.24	0.27	0.29	0.30	0.32	0.35	0.37
Maximum Volume Stored (acre-ft) =	0.234	0.850	0.567	0.761	0.878	0.952	1.101	1.320	1.436

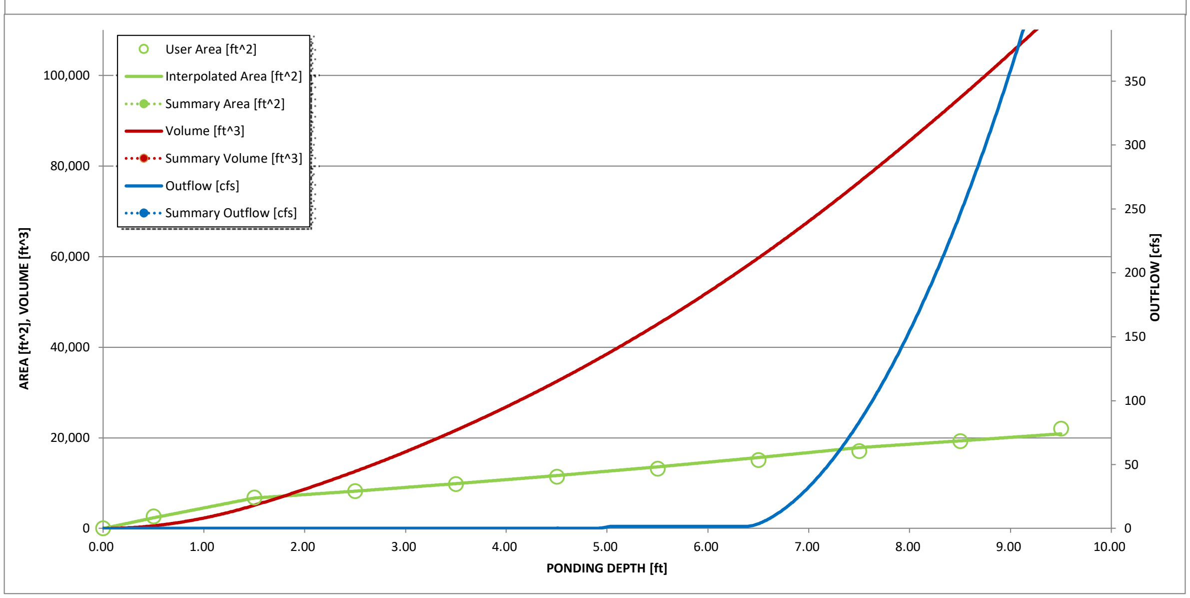
should be ~33 per DP

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.09
	0:15:00	0.00	0.00	0.13	0.20	0.25	0.17	0.23	0.21	0.46
	0:20:00	0.00	0.00	0.57	0.79	0.94	0.60	0.73	0.75	1.27
	0:25:00	0.00	0.00	1.40	1.89	2.27	1.40	1.64	1.75	2.93
	0:30:00	0.00	0.00	2.21	2.95	3.53	3.09	3.68	4.10	6.95
	0:35:00	0.00	0.00	2.67	3.51	4.15	4.79	5.74	6.67	11.19
	0:40:00	0.00	0.00	2.89	3.76	4.43	5.77	6.90	8.18	13.62
	0:45:00	0.00	0.00	3.01	3.90	4.60	6.26	7.48	8.98	14.94
	0:50:00	0.00	0.00	3.06	3.99	4.69	6.53	7.79	9.45	15.74
	0:55:00	0.00	0.00	3.07	4.02	4.72	6.65	7.92	9.67	16.14
	1:00:00	0.00	0.00	3.06	4.00	4.70	6.64	7.90	9.73	16.30
	1:05:00	0.00	0.00	3.03	3.96	4.66	6.58	7.81	9.72	16.32
	1:10:00	0.00	0.00	2.98	3.91	4.62	6.45	7.64	9.53	16.02
	1:15:00	0.00	0.00	2.93	3.87	4.60	6.28	7.43	9.23	15.49
	1:20:00	0.00	0.00	2.88	3.83	4.57	6.12	7.24	8.92	14.96
	1:25:00	0.00	0.00	2.83	3.77	4.50	5.96	7.04	8.60	14.39
	1:30:00	0.00	0.00	2.78	3.70	4.41	5.79	6.82	8.28	13.82
	1:35:00	0.00	0.00	2.72	3.64	4.31	5.59	6.59	7.96	13.26
	1:40:00	0.00	0.00	2.67	3.55	4.21	5.41	6.36	7.64	12.70
	1:45:00	0.00	0.00	2.62	3.46	4.11	5.22	6.14	7.34	12.16
	1:50:00	0.00	0.00	2.58	3.38	4.04	5.05	5.92	7.05	11.67
	1:55:00	0.00	0.00	2.53	3.30	3.97	4.91	5.75	6.82	11.25
	2:00:00	0.00	0.00	2.46	3.23	3.89	4.78	5.60	6.60	10.88
	2:05:00	0.00	0.00	2.37	3.12	3.75	4.61	5.40	6.35	10.44
	2:10:00	0.00	0.00	2.26	2.97	3.58	4.40	5.15	6.06	9.95
	2:15:00	0.00	0.00	2.15	2.83	3.40	4.19	4.90	5.76	9.46
	2:20:00	0.00	0.00	2.04	2.68	3.23	3.98	4.65	5.47	8.97
	2:25:00	0.00	0.00	1.93	2.54	3.05	3.77	4.40	5.18	8.49
	2:30:00	0.00	0.00	1.83	2.40	2.88	3.56	4.16	4.89	8.02
	2:35:00	0.00	0.00	1.72	2.26	2.71	3.35	3.92	4.61	7.55
	2:40:00	0.00	0.00	1.62	2.12	2.55	3.15	3.68	4.33	7.09
	2:45:00	0.00	0.00	1.52	1.99	2.39	2.95	3.45	4.06	6.64
	2:50:00	0.00	0.00	1.42	1.86	2.23	2.76	3.23	3.79	6.20
	2:55:00	0.00	0.00	1.33	1.74	2.09	2.58	3.01	3.53	5.77
	3:00:00	0.00	0.00	1.24	1.63	1.96	2.41	2.81	3.29	5.37
	3:05:00	0.00	0.00	1.17	1.54	1.85	2.25	2.63	3.08	5.03
	3:10:00	0.00	0.00	1.11	1.46	1.76	2.13	2.49	2.91	4.76
	3:15:00	0.00	0.00	1.06	1.39	1.67	2.02	2.36	2.76	4.51
	3:20:00	0.00	0.00	1.01	1.32	1.59	1.92	2.25	2.62	4.29
	3:25:00	0.00	0.00	0.96	1.26	1.51	1.83	2.14	2.50	4.08
	3:30:00	0.00	0.00	0.91	1.20	1.44	1.75	2.04	2.38	3.89
	3:35:00	0.00	0.00	0.87	1.14	1.37	1.66	1.94	2.27	3.70
	3:40:00	0.00	0.00	0.82	1.08	1.30	1.58	1.85	2.16	3.53
	3:45:00	0.00	0.00	0.78	1.02	1.23	1.50	1.76	2.06	3.36
	3:50:00	0.00	0.00	0.74	0.97	1.16	1.43	1.67	1.95	3.19
	3:55:00	0.00	0.00	0.70	0.92	1.10	1.35	1.58	1.86	3.03
	4:00:00	0.00	0.00	0.67	0.87	1.04	1.28	1.50	1.76	2.87
	4:05:00	0.00	0.00	0.63	0.82	0.98	1.21	1.41	1.66	2.71
	4:10:00	0.00	0.00	0.59	0.77	0.93	1.14	1.33	1.57	2.55
	4:15:00	0.00	0.00	0.56	0.73	0.87	1.08	1.25	1.47	2.40
	4:20:00	0.00	0.00	0.52	0.69	0.82	1.01	1.18	1.38	2.25
	4:25:00	0.00	0.00	0.49	0.64	0.76	0.95	1.10	1.29	2.10
	4:30:00	0.00	0.00	0.46	0.60	0.71	0.88	1.03	1.20	1.95
	4:35:00	0.00	0.00	0.43	0.56	0.66	0.82	0.95	1.12	1.80
	4:40:00	0.00	0.00	0.40	0.52	0.62	0.76	0.88	1.03	1.66
	4:45:00	0.00	0.00	0.37	0.48	0.57	0.70	0.81	0.94	1.51
	4:50:00	0.00	0.00	0.34	0.44	0.52	0.64	0.74	0.86	1.37
	4:55:00	0.00	0.00	0.31	0.40	0.47	0.58	0.66	0.77	1.23
	5:00:00	0.00	0.00	0.28	0.36	0.42	0.51	0.59	0.68	1.08
	5:05:00	0.00	0.00	0.25	0.32	0.37	0.45	0.52	0.60	0.94
	5:10:00	0.00	0.00	0.21	0.28	0.33	0.39	0.45	0.51	0.79
	5:15:00	0.00	0.00	0.18	0.24	0.28	0.33	0.37	0.43	0.65
	5:20:00	0.00	0.00	0.15	0.20	0.23	0.27	0.31	0.34	0.52
	5:25:00	0.00	0.00	0.13	0.16	0.19	0.22	0.24	0.27	0.39
	5:30:00	0.00	0.00	0.11	0.14	0.16	0.17	0.19	0.20	0.30
	5:35:00	0.00	0.00	0.09	0.12	0.14	0.14	0.16	0.16	0.24
	5:40:00	0.00	0.00	0.08	0.10	0.12	0.12	0.13	0.13	0.19
	5:45:00	0.00	0.00	0.07	0.09	0.11	0.10	0.11	0.11	0.16
	5:50:00	0.00	0.00	0.06	0.08	0.09	0.08	0.09	0.09	0.13
	5:55:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.07	0.10
	6:00:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.08

Detention Pond Tributary Areas

Subdivision: Grandview Reserve
Location: CO, El Paso County

Project Name: Grandview Reserve
Project No.: HRG01
Calculated By: TJE
Checked By: BAS
Date: 3/1/22

Pond A

Basin	Area	% Imp
A-2a	4.42	65
A-2b	2.75	88
A-3	0.36	100
A-4a	6.31	65
A-4b	3.99	65
A-5	0.35	100
A-6	2.76	65
A-7	0.23	100
A-8	5.44	75
A-9	4.91	65
A-10	1.02	65
A-11	3.56	16
Total	**36.10**	**64.3**

Pond B

Basin	Area	% Imp
B-1	3.81	56.8
B-2	4.62	63.5
B-3	4.15	65
B-4	1.37	78.5
B-5	5.12	65
B-6	2.28	65
B-7	0.89	65
B-8	3.23	65
B-9	2.42	65
B-10	1.10	2
Total	**28.99**	**61.9**

Pond C

Basin	Area	% Imp
C-1	4.12	65
C-2	2.71	65
C-4	2.47	65
C-5	3.09	65
C-6	2.10	65
C-7a	0.81	44.7
C-7b	5.91	65
C-8	5.11	65
C-9a	3.50	65
C-9b	3.69	65
C-10	3.47	65
C-11	0.46	65
C-12	1.66	65
C-13	2.37	2
Total	**41.47**	**61.0**

Pond D

Basin	Area	% Imp
D-1	3.48	65
D-2	0.87	65
D-3	3.62	65
D-4	1.77	65
D-5	1.53	35.7
D-7b	0.88	65
Total	**12.15**	**61.3**

Pond E

Basin	Area	% Imp
E-1	5.33	65
E-2	5.42	65
E-3	3.20	65
E-4	6.28	65
E-5	1.13	2
Total	**21.36**	**61.7**

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input	
Calculated cells	

Designer:	**TJE**
Company:	**Galloway & Co.**
Date:	**May 3, 2022**
Project:	**Grandviewe Reserve**
Location:	**Pond A**

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier		**A-2a**	**A-2b**	**A-3**	**A-4a**	**A-4b**	**A-5**	**A-6**	**A-7**	**A-8**	**A-9**	**A-10**	**A-11**	
Receiving Pervious Area Soil Type		Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)		4.420	2.750	0.360	6.310	3.990	0.350	2.760	0.230	5.440	4.910	1.020	3.560	
Directly Connected Impervious Area (DCIA, acres)		2.873	2.420	0.360	4.100	2.590	0.350	1.794	0.230	4.080	3.192	0.663	0.570	
Unconnected Impervious Area (UIA, acres)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Receiving Pervious Area (RPA, acres)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Separate Pervious Area (SPA, acres)		1.547	0.330	0.000	2.210	1.400	0.000	0.966	0.000	1.360	1.718	0.357	2.990	
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)		C	C	C	C	C	C	C	C	C	C	C	C	

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)		4.420	2.750	0.360	6.310	3.990	0.350	2.760	0.230	5.440	4.910	1.020	3.560	
Directly Connected Impervious Area (DCIA, %)		65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%	
Unconnected Impervious Area (UIA, %)		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Receiving Pervious Area (RPA, %)		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Separate Pervious Area (SPA, %)		35.0%	12.0%	0.0%	35.0%	35.1%	0.0%	35.0%	0.0%	25.0%	35.0%	35.0%	84.0%	
A_R (RPA / UIA)		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
I_a Check		1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	
f / I for WQCV Event:		1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	
f / I for 5-Year Event:		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
f / I for 100-Year Event:		0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
IRF for 5-Year Event:		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
IRF for 100-Year Event:		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}		65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%	
Effective Imperviousness for WQCV Event:		65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%	
Effective Imperviousness for 5-Year Event:		65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%	
Effective Imperviousness for 100-Year Event:		65.0%	88.0%	100.0%	65.0%	64.9%	100.0%	65.0%	100.0%	75.0%	65.0%	65.0%	16.0%	
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	N/A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	N/A	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**64.3%**
Total Site Effective Imperviousness for WQCV Event:	**64.3%**
Total Site Effective Imperviousness for 5-Year Event:	**64.3%**
Total Site Effective Imperviousness for 100-Year Event:	**64.3%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

Designer:	**TJE**
Company:	**Galloway & Co.**
Date:	**May 4, 2022**
Project:	**Grandview Reserve**
Location:	**Pond B**

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**B-1**	**B-2**	**B-3**	**B-4**	**B-5**	**B-6**	**B-7**	**B-8**	**B-9**	**B-10**				
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam				
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	3.810	4.620	4.150	1.370	5.120	2.280	0.890	3.230	2.420	1.100				
Directly Connected Impervious Area (DCIA, acres)	2.164	2.934	2.698	1.075	3.328	1.482	0.579	2.100	1.573	0.022				
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
Separate Pervious Area (SPA, acres)	1.646	1.686	1.453	0.295	1.792	0.798	0.312	1.131	0.847	1.078				
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C				

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	3.810	4.620	4.150	1.370	5.120	2.280	0.890	3.230	2.420	1.100				
Directly Connected Impervious Area (DCIA, %)	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%				
Separate Pervious Area (SPA, %)	43.2%	36.5%	35.0%	21.5%	35.0%	35.0%	35.0%	35.0%	35.0%	98.0%				
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000				
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7				
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5				
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3				
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00				
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for WQCV Event:	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for 5-Year Event:	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for 100-Year Event:	56.8%	63.5%	65.0%	78.5%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%				
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	-364.4%	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**61.9%**
Total Site Effective Imperviousness for WQCV Event:	**61.9%**
Total Site Effective Imperviousness for 5-Year Event:	**61.9%**
Total Site Effective Imperviousness for 100-Year Event:	**61.9%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Pond C

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**C-1**	**C-2**	**C-4**	**C-5**	**C-6**	**C-7a**	**C-7b**	**C-8**	**C-9a**	**C-9b**	**C-10**	**C-11**	**C-12**	**C-13**
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	4.120	2.710	2.470	3.090	2.100	0.810	5.910	5.110	3.500	3.690	3.470	0.460	1.660	2.370
Directly Connected Impervious Area (DCIA, acres)	2.678	1.762	1.606	2.009	1.365	0.362	3.842	3.322	2.275	2.399	2.256	0.299	1.079	0.047
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Separate Pervious Area (SPA, acres)	1.442	0.949	0.865	1.082	0.735	0.448	2.069	1.789	1.225	1.292	1.215	0.161	0.581	2.323
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C	C	C	C	C

CALCULATED RESULTS (OUTPUT)

	C-1	C-2	C-4	C-5	C-6	C-7a	C-7b	C-8	C-9a	C-9b	C-10	C-11	C-12	C-13
Total Calculated Area (ac, check against input)	4.120	2.710	2.470	3.090	2.100	0.810	5.910	5.110	3.500	3.690	3.470	0.460	1.660	2.370
Directly Connected Impervious Area (DCIA, %)	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Separate Pervious Area (SPA, %)	35.0%	35.0%	35.0%	35.0%	35.0%	55.3%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	35.0%	98.0%
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for WQCV Event:	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for 5-Year Event:	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for 100-Year Event:	65.0%	65.0%	65.0%	65.0%	65.0%	44.7%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	2.0%
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

	C-1	C-2	C-4	C-5	C-6	C-7a	C-7b	C-8	C-9a	C-9b	C-10	C-11	C-12	C-13
WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	-169.1%
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**61.0%**
Total Site Effective Imperviousness for WQCV Event:	**61.0%**
Total Site Effective Imperviousness for 5-Year Event:	**61.0%**
Total Site Effective Imperviousness for 100-Year Event:	**61.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Pond D

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	D-1	D-2	D-3	D-4	D-5	D-7								
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam								
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	3.480	0.870	3.620	1.770	1.530	0.880								
Directly Connected Impervious Area (DCIA, acres)	2.262	0.566	2.353	1.151	0.546	0.572								
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000								
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000								
Separate Pervious Area (SPA, acres)	1.218	0.305	1.267	0.620	0.984	0.308								
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C								

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	3.480	0.870	3.620	1.770	1.530	0.880								
Directly Connected Impervious Area (DCIA, %)	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%								
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%								
Separate Pervious Area (SPA, %)	35.0%	35.0%	35.0%	35.0%	64.3%	35.0%								
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000								
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000								
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7								
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5								
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3								
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00								
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00								
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00								
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for WQCV Event:	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for 5-Year Event:	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for 100-Year Event:	65.0%	65.0%	65.0%	65.0%	35.7%	65.0%								
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	61.3%
Total Site Effective Imperviousness for WQCV Event:	61.3%
Total Site Effective Imperviousness for 5-Year Event:	61.3%
Total Site Effective Imperviousness for 100-Year Event:	61.3%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator
LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Pond E

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	E-1	E-2	E-3	E-4	E-5									
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam									
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	5.330	5.420	3.200	6.280	1.130									
Directly Connected Impervious Area (DCIA, acres)	3.465	3.523	2.080	4.082	0.023									
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000									
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000									
Separate Pervious Area (SPA, acres)	1.866	1.897	1.120	2.198	1.107									
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C									

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	5.330	5.420	3.200	6.280	1.130									
Directly Connected Impervious Area (DCIA, %)	65.0%	65.0%	65.0%	65.0%	2.0%									
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%									
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%									
Separate Pervious Area (SPA, %)	35.0%	35.0%	35.0%	35.0%	98.0%									
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000									
I_a Check	1.000	1.000	1.000	1.000	1.000									
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7									
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5									
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3									
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00									
IRF for 5-Year Event:	1.00	1.00	1.00	1.00	1.00									
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00									
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for WQCV Event:	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for 5-Year Event:	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for 100-Year Event:	65.0%	65.0%	65.0%	65.0%	2.0%									
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	0.0%	0.0%	0.0%	-354.7%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	61.7%
Total Site Effective Imperviousness for WQCV Event:	61.7%
Total Site Effective Imperviousness for 5-Year Event:	61.7%
Total Site Effective Imperviousness for 100-Year Event:	61.7%
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Sub-basin A-1

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**A-1**													
Receiving Pervious Area Soil Type	Sandy Loam													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	11.670													
Directly Connected Impervious Area (DCIA, acres)	0.233													
Unconnected Impervious Area (UIA, acres)	0.000													
Receiving Pervious Area (RPA, acres)	0.000													
Separate Pervious Area (SPA, acres)	11.437													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	11.670													
Directly Connected Impervious Area (DCIA, %)	2.0%													
Unconnected Impervious Area (UIA, %)	0.0%													
Receiving Pervious Area (RPA, %)	0.0%													
Separate Pervious Area (SPA, %)	98.0%													
A_R (RPA / UIA)	0.000													
I_a Check	1.000													
f / I for WQCV Event:	1.7													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.3													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00													
IRF for 5-Year Event:	1.00													
IRF for 100-Year Event:	1.00													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	2.0%													
Effective Imperviousness for WQCV Event:	2.0%													
Effective Imperviousness for 5-Year Event:	2.0%													
Effective Imperviousness for 100-Year Event:	2.0%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**2.0%**
Total Site Effective Imperviousness for WQCV Event:	**2.0%**
Total Site Effective Imperviousness for 5-Year Event:	**2.0%**
Total Site Effective Imperviousness for 100-Year Event:	**2.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

Designer: TJE
Company: Galloway & Co.
Date: March 3, 2022
Project: Grandview Reserve
Location: Rex Rd Pond

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**Basin-1**													
Receiving Pervious Area Soil Type	Sandy Loam													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	1.220													
Directly Connected Impervious Area (DCIA, acres)	0.985													
Unconnected Impervious Area (UIA, acres)	0.000													
Receiving Pervious Area (RPA, acres)	0.000													
Separate Pervious Area (SPA, acres)	0.235													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	1.220													
Directly Connected Impervious Area (DCIA, %)	80.7%													
Unconnected Impervious Area (UIA, %)	0.0%													
Receiving Pervious Area (RPA, %)	0.0%													
Separate Pervious Area (SPA, %)	19.3%													
A_R (RPA / UIA)	0.000													
I_a Check	1.000													
f / I for WQCV Event:	1.7													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.3													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	1.00													
IRF for 5-Year Event:	1.00													
IRF for 100-Year Event:	1.00													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	80.7%													
Effective Imperviousness for WQCV Event:	80.7%													
Effective Imperviousness for 5-Year Event:	80.7%													
Effective Imperviousness for 100-Year Event:	80.7%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	0.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**80.7%**
Total Site Effective Imperviousness for WQCV Event:	**80.7%**
Total Site Effective Imperviousness for 5-Year Event:	**80.7%**
Total Site Effective Imperviousness for 100-Year Event:	**80.7%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

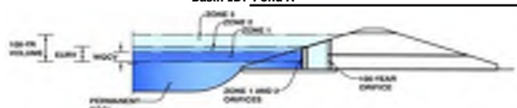
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**
Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	36.10	acres
Watershed Length =	2,360	ft
Watershed Length to Centroid =	1,180	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	64.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.756	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.872	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.125	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.788	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.319	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.018	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.705	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.540	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	9.026	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	1.867	acre-feet		
Approximate 5-yr Detention Volume =	2.442	acre-feet		
Approximate 10-yr Detention Volume =	2.945	acre-feet		
Approximate 25-yr Detention Volume =	3.546	acre-feet		
Approximate 50-yr Detention Volume =	3.909	acre-feet		
Approximate 100-yr Detention Volume =	4.290	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.756	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.115	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.418	acre-feet
Total Detention Basin Volume =	4.290	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

Depth Increment = 0.50 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	--	--	--	35	0.001		
6971	--	0.50	--	--	--	2,047	0.047	520	0.012
	--	1.00	--	--	--	10,771	0.247	3,725	0.086
6972	--	1.50	--	--	--	27,585	0.633	13,313	0.306
	--	2.00	--	--	--	41,785	0.959	30,656	0.704
6973	--	2.50	--	--	--	43,839	1.006	52,062	1.195
	--	3.00	--	--	--	45,918	1.054	74,501	1.710
6974	--	3.50	--	--	--	48,022	1.102	97,986	2.249
	--	4.00	--	--	--	50,151	1.151	122,529	2.813
6975	--	4.50	--	--	--	52,306	1.201	148,144	3.401
	--	5.00	--	--	--	54,486	1.251	174,842	4.014
6976	--	5.50	--	--	--	56,691	1.301	202,636	4.652
	--	6.00	--	--	--	58,921	1.353	231,538	5.315
6977	--	6.50	--	--	--	61,176	1.404	261,562	6.005
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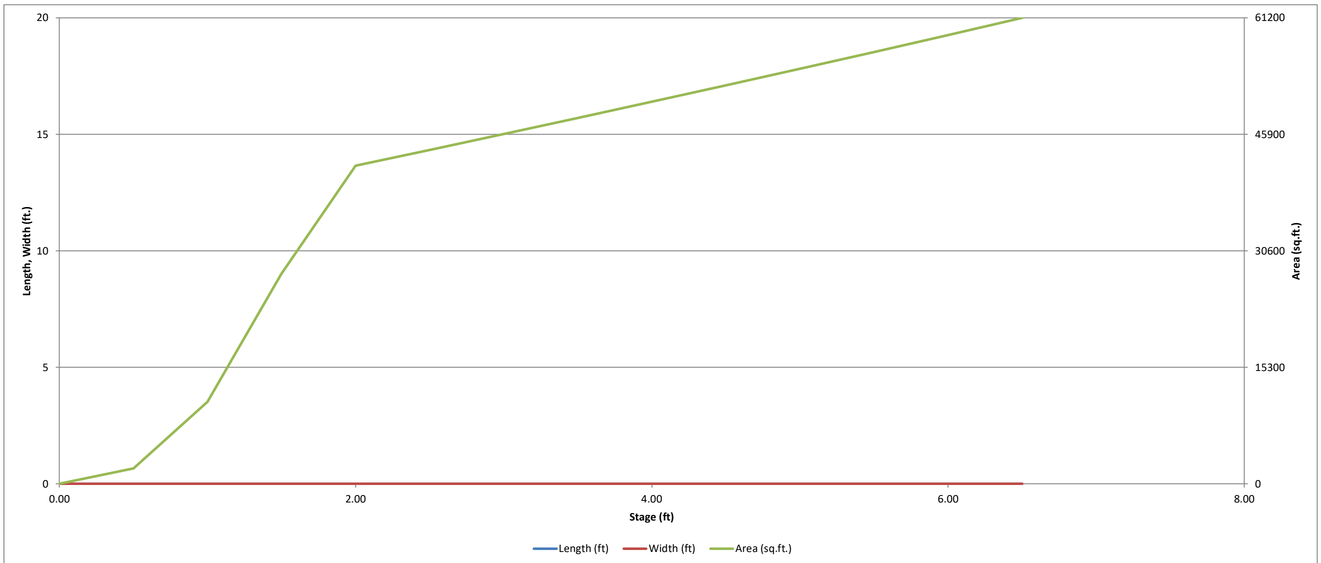
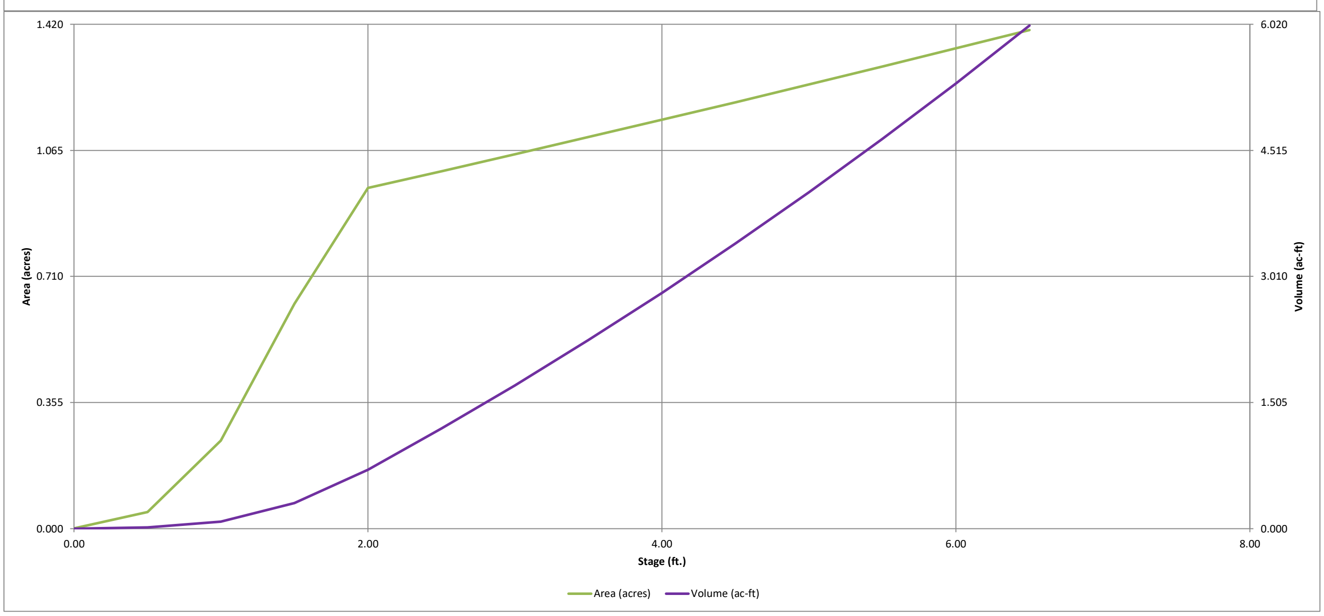
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

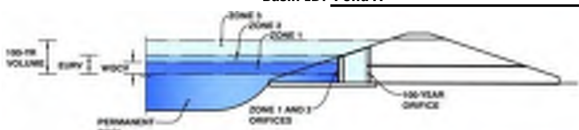




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**
Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.06	0.756	Orifice Plate
Zone 2 (EURV)	4.06	2.115	Rectangular Orifice
Zone 3 (100-year)	5.22	1.418	Weir&Pipe (Restrict)
	Total (all zones)	4.290	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.06	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.20	inches
Orifice Plate: Orifice Area per Row =	3.00	sq. inches (diameter = 1-15/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.083E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40					
Orifice Area (sq. inches)	3.00	3.00	3.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.10	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	4.06	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	7.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.10	N/A	ft^2
Vertical Orifice Centroid =	0.08	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.10	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.85	N/A	feet
Overflow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.31	N/A	
Overflow Grate Open Area w/o Debris =	6.46	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.23	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	9.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.88	N/A	ft^2
Outlet Orifice Centroid =	0.43	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.60	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.57	feet
Stage at Top of Freeboard =	7.17	feet
Basin Area at Top of Freeboard =	1.40	acres
Basin Volume at Top of Freeboard =	6.00	acre-ft

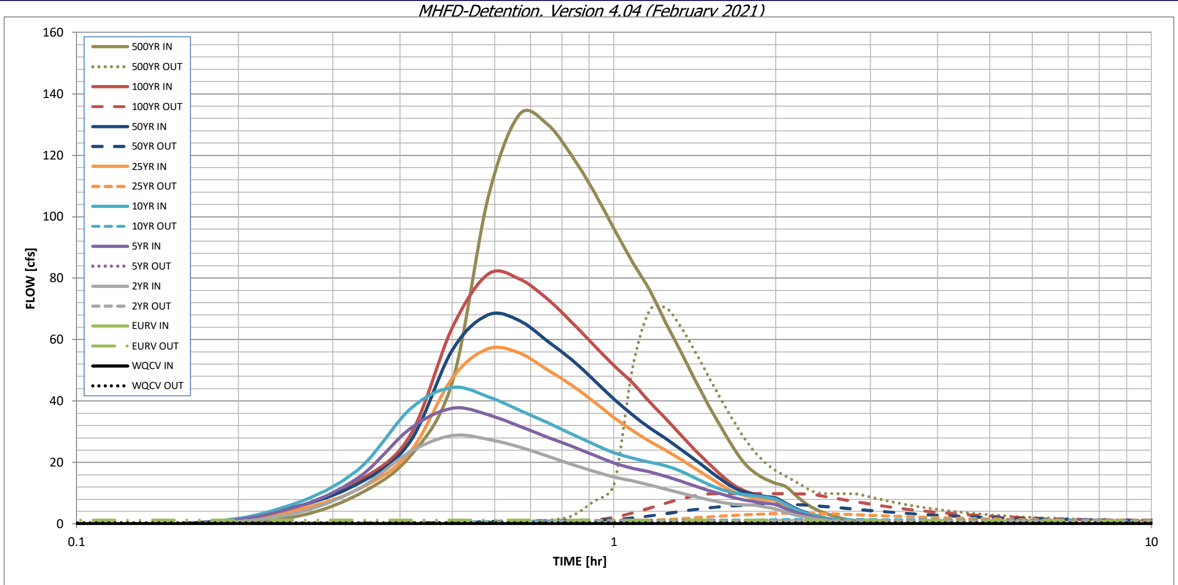
Routed Hydrograph Results

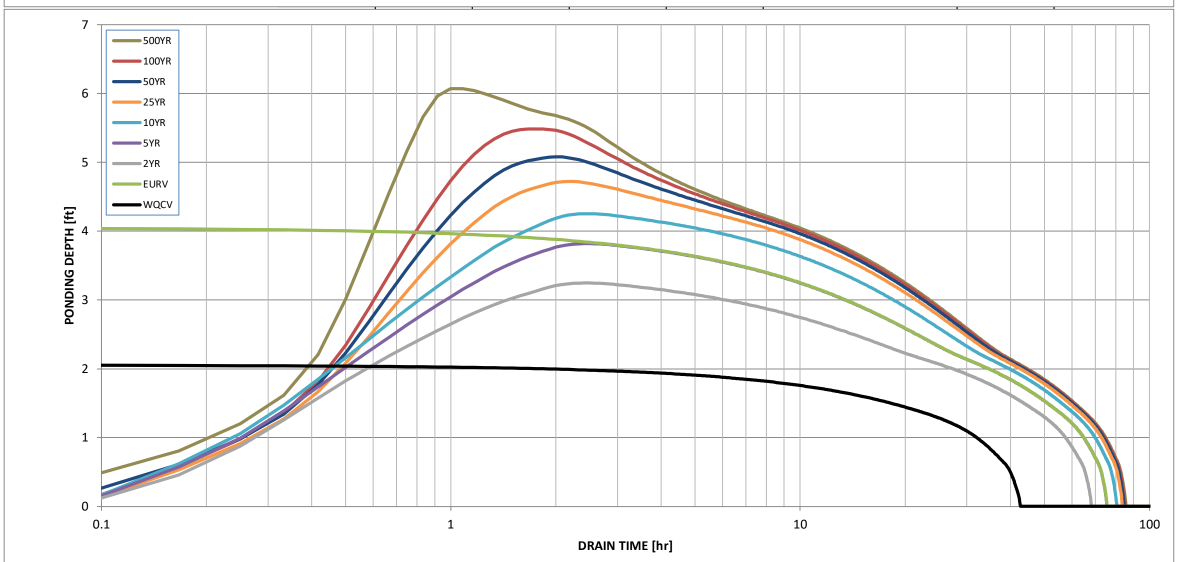
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

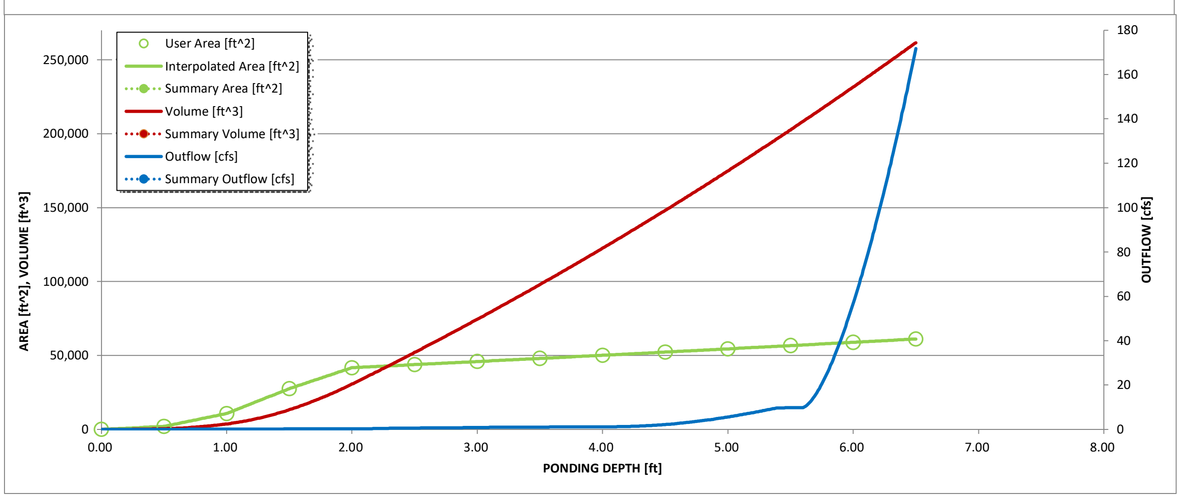
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.756	2.872	2.125	2.788	3.319	4.018	4.705	5.540	9.026
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.125	2.788	3.319	4.018	4.705	5.540	9.026
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.6	5.0	10.1	16.9	44.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.14	0.28	0.47	1.22
Peak Inflow Q (cfs) =	N/A	N/A	28.7	37.7	44.4	57.0	68.0	81.3	133.3
Peak Outflow Q (cfs) =	0.3	1.2	1.0	1.4	1.4	3.4	6.4	9.8	70.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.8	2.6	0.7	0.6	0.6	1.6
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.8	1.3	1.3
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	59	65	69	70	70	69	63
Time to Drain 99% of Inflow Volume (hours) =	**41**	70	64	70	75	77	77	77	75
Maximum Ponding Depth (ft) =	2.06	4.06	3.25	3.82	4.25	4.72	5.08	5.49	6.07
Area at Maximum Ponding Depth (acres) =	0.96	1.16	1.08	1.13	1.18	1.22	1.26	1.30	1.36
Maximum Volume Stored (acre-ft) =	0.761	2.882	1.966	2.596	3.104	3.668	4.114	4.626	5.410

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.03	2.02
	0:15:00	0.00	0.00	3.00	4.88	6.06	4.07	5.14	4.98	9.37
	0:20:00	0.00	0.00	11.17	14.80	17.46	11.06	12.95	13.80	21.83
	0:25:00	0.00	0.00	23.37	30.89	37.17	23.12	26.44	28.44	45.91
	0:30:00	0.00	0.00	28.73	37.68	44.43	47.38	56.52	63.76	106.09
	0:35:00	0.00	0.00	27.51	35.49	41.42	57.02	68.02	81.26	133.30
	0:40:00	0.00	0.00	25.06	31.80	37.01	55.62	66.23	79.74	130.23
	0:45:00	0.00	0.00	22.09	28.29	33.04	50.24	59.65	73.33	120.11
	0:50:00	0.00	0.00	19.43	25.32	29.30	45.28	53.56	65.81	108.39
	0:55:00	0.00	0.00	17.14	22.37	25.94	39.80	46.90	58.26	96.14
	1:00:00	0.00	0.00	15.25	19.80	23.14	34.65	40.63	51.57	85.17
	1:05:00	0.00	0.00	13.98	18.08	21.34	30.38	35.43	45.88	75.95
	1:10:00	0.00	0.00	12.57	16.86	20.05	26.79	31.15	39.58	65.30
	1:15:00	0.00	0.00	11.24	15.45	18.85	23.90	27.69	34.19	55.97
	1:20:00	0.00	0.00	10.04	13.84	17.12	20.93	24.17	28.86	46.85
	1:25:00	0.00	0.00	8.90	12.27	14.88	18.09	20.81	23.97	38.57
	1:30:00	0.00	0.00	7.83	10.85	12.81	15.24	17.47	19.68	31.36
	1:35:00	0.00	0.00	6.96	9.70	11.15	12.64	14.40	15.87	24.93
	1:40:00	0.00	0.00	6.42	8.54	10.11	10.51	11.88	12.70	19.61
	1:45:00	0.00	0.00	6.15	7.71	9.50	9.16	10.33	10.73	16.45
	1:50:00	0.00	0.00	6.01	7.15	9.09	8.36	9.41	9.55	14.50
	1:55:00	0.00	0.00	5.41	6.72	8.65	7.84	8.82	8.79	13.19
	2:00:00	0.00	0.00	4.82	6.27	7.99	7.48	8.41	8.24	12.25
	2:05:00	0.00	0.00	3.86	5.05	6.43	6.05	6.80	6.56	9.68
	2:10:00	0.00	0.00	2.98	3.88	4.95	4.63	5.19	4.93	7.22
	2:15:00	0.00	0.00	2.30	2.99	3.80	3.54	3.97	3.72	5.41
	2:20:00	0.00	0.00	1.76	2.28	2.88	2.69	3.02	2.82	4.10
	2:25:00	0.00	0.00	1.33	1.73	2.17	2.03	2.28	2.14	3.10
	2:30:00	0.00	0.00	1.01	1.28	1.61	1.51	1.69	1.60	2.31
	2:35:00	0.00	0.00	0.74	0.93	1.20	1.11	1.24	1.19	1.71
	2:40:00	0.00	0.00	0.54	0.68	0.89	0.83	0.93	0.89	1.28
	2:45:00	0.00	0.00	0.38	0.48	0.63	0.61	0.68	0.64	0.92
	2:50:00	0.00	0.00	0.24	0.33	0.42	0.41	0.46	0.44	0.62
	2:55:00	0.00	0.00	0.14	0.20	0.26	0.26	0.28	0.27	0.38
	3:00:00	0.00	0.00	0.07	0.11	0.13	0.14	0.15	0.14	0.20
	3:05:00	0.00	0.00	0.03	0.04	0.05	0.06	0.06	0.05	0.07
	3:10:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

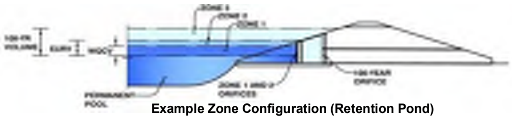
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond B



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	28.99	acres
Watershed Length =	1,700	ft
Watershed Length to Centroid =	850	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.90%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.586	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.197	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.628	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.140	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.552	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.104	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.648	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	4.314	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	7.093	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	1.426	acre-feet		
Approximate 5-yr Detention Volume =	1.867	acre-feet		
Approximate 10-yr Detention Volume =	2.255	acre-feet		
Approximate 25-yr Detention Volume =	2.722	acre-feet		
Approximate 50-yr Detention Volume =	3.006	acre-feet		
Approximate 100-yr Detention Volume =	3.310	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.586	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.610	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.114	acre-feet
Total Detention Basin Volume =	3.310	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

Depth Increment = 0.50 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	--	--	--	35	0.001		
	--	0.50	--	--	--	3,203	0.074	809	0.019
6964	--	1.00	--	--	--	29,135	0.669	8,894	0.204
	--	1.50	--	--	--	30,250	0.694	23,740	0.545
6965	--	2.00	--	--	--	31,366	0.720	39,144	0.899
	--	2.50	--	--	--	32,485	0.746	55,107	1.265
6966	--	3.00	--	--	--	33,606	0.771	71,629	1.644
	--	3.50	--	--	--	34,729	0.797	88,713	2.037
6967	--	4.00	--	--	--	35,856	0.823	106,360	2.442
	--	4.50	--	--	--	36,987	0.849	124,570	2.860
6968	--	5.00	--	--	--	38,126	0.875	143,348	3.291
6968.5	--	5.50	--	--	--	39,275	0.902	162,698	3.735
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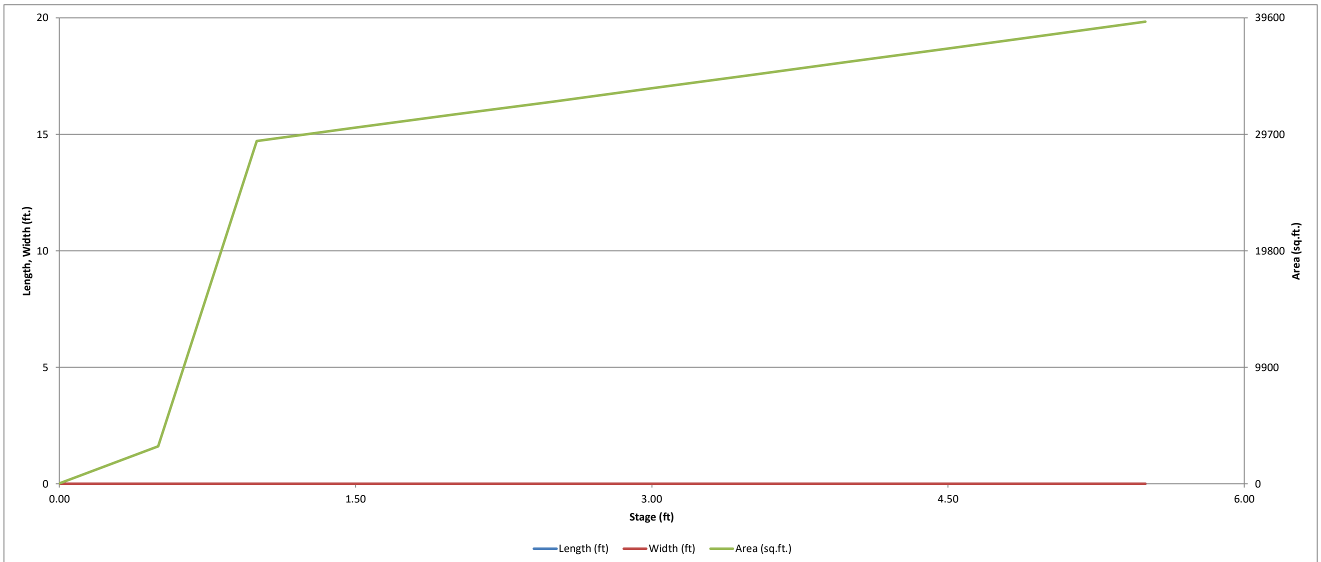
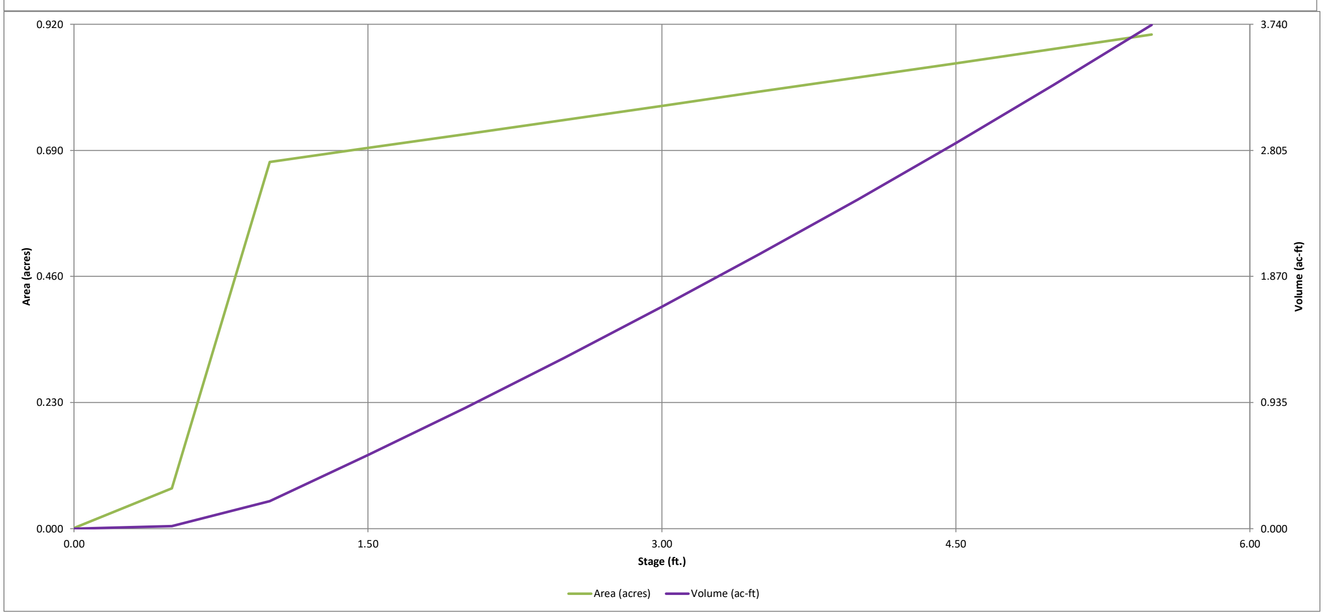
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

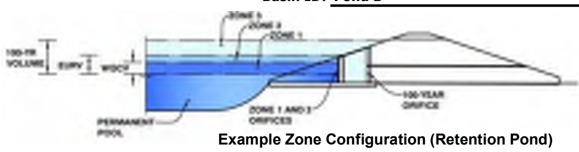




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview
Basin ID: Pond B



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.56	0.586	Orifice Plate
Zone 2 (EURV)	3.70	1.610	Rectangular Orifice
Zone 3 (100-year)	5.03	1.114	Weir&Pipe (Restrict)
	Total (all zones)	3.310	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.57	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	6.30	inches
Orifice Plate: Orifice Area per Row =	2.70	sq. inches (diameter = 1-13/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.875E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.52	1.05					
Orifice Area (sq. inches)	2.70	2.70	2.70					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	1.60	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.76	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	1.50	N/A	inches
Vertical Orifice Width =	6.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.06	N/A	ft^2
Vertical Orifice Centroid =	0.06	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.80	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.55	N/A	feet
Overflow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.04	N/A	
Overflow Grate Open Area w/o Debris =	8.61	N/A	ft^2
Overflow Grate Open Area w/ Debris =	4.30	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	10.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.07	N/A	ft^2
Outlet Orifice Centroid =	0.50	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.74	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	68.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.49	feet
Stage at Top of Freeboard =	6.74	feet
Basin Area at Top of Freeboard =	0.90	acres
Basin Volume at Top of Freeboard =	3.74	acre-ft

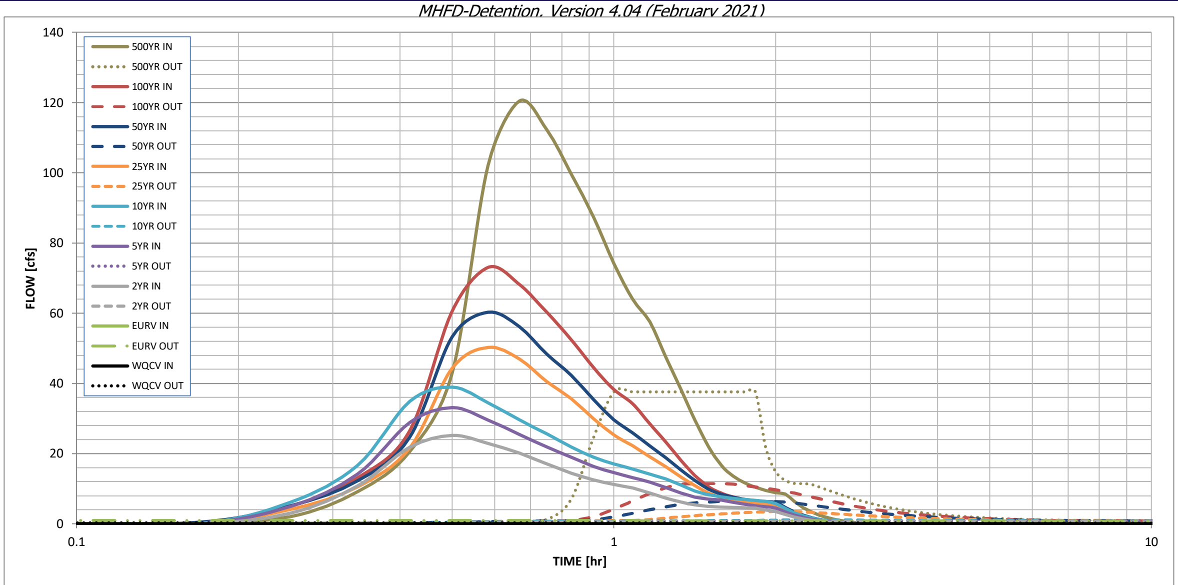
Routed Hydrograph Results

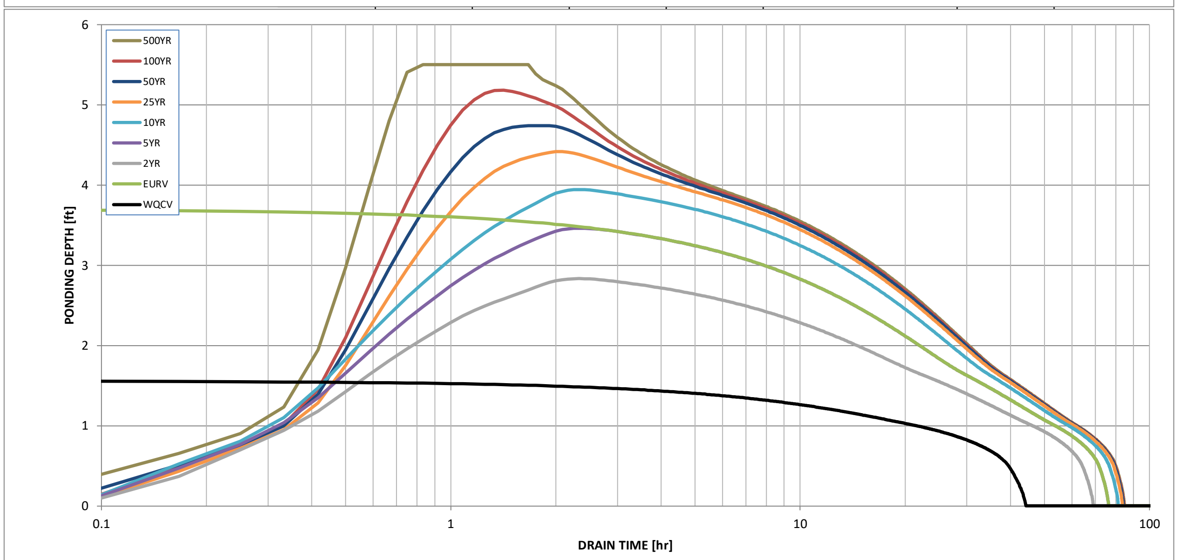
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

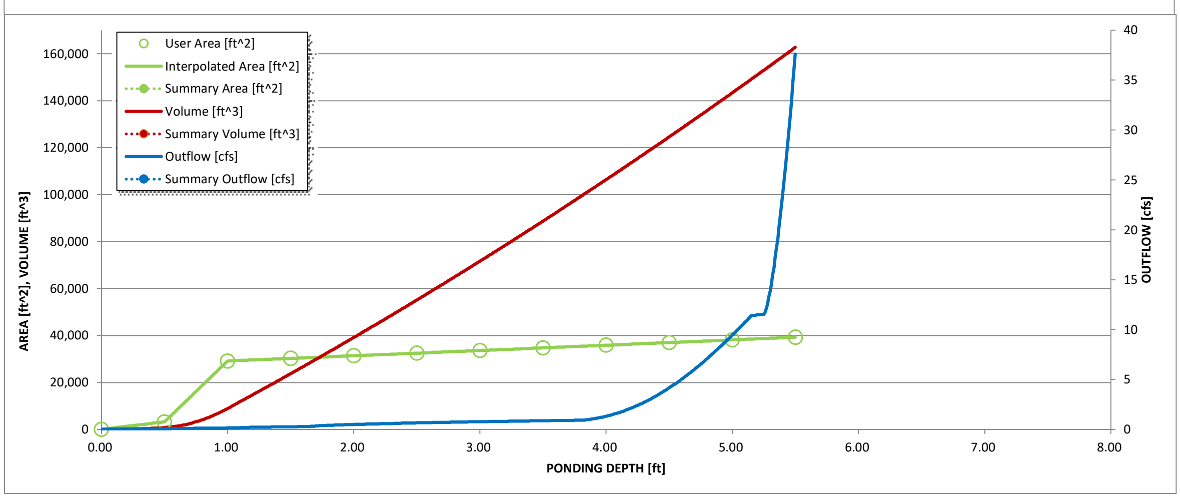
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.586	2.197	1.628	2.140	2.552	3.104	3.648	4.314	7.093
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.628	2.140	2.552	3.104	3.648	4.314	7.093
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.5	5.0	9.9	16.2	42.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.34	0.56	1.45
Peak Inflow Q (cfs) =	N/A	N/A	25.2	33.1	38.9	50.3	60.3	73.0	120.5
Peak Outflow Q (cfs) =	0.3	0.9	0.7	0.9	1.2	3.5	6.5	11.4	37.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	2.1	0.7	0.7	0.7	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.6	1.2	1.2
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	66	60	66	70	71	70	68	62
Time to Drain 99% of Inflow Volume (hours) =	**42**	71	65	71	76	77	77	77	74
Maximum Ponding Depth (ft) =	1.56	3.70	2.84	3.46	3.94	4.42	4.74	5.18	5.50
Area at Maximum Ponding Depth (acres) =	0.70	0.81	0.76	0.80	0.82	0.84	0.86	0.88	0.90
Maximum Volume Stored (acre-ft) =	0.587	2.197	1.514	2.005	2.392	2.784	3.065	3.449	3.735

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.03	2.04
	0:15:00	0.00	0.00	3.02	4.91	6.09	4.10	5.12	5.00	9.11
	0:20:00	0.00	0.00	10.77	14.11	16.60	10.48	12.21	13.09	20.49
	0:25:00	0.00	0.00	21.79	28.81	34.81	21.55	24.59	26.44	42.94
	0:30:00	0.00	0.00	25.16	33.07	38.94	44.29	53.29	60.57	102.02
	0:35:00	0.00	0.00	22.90	29.59	34.51	50.29	60.28	73.00	120.48
	0:40:00	0.00	0.00	20.14	25.48	29.62	46.96	56.21	68.24	112.28
	0:45:00	0.00	0.00	17.06	21.91	25.61	40.51	48.31	60.24	99.69
	0:50:00	0.00	0.00	14.44	18.97	21.87	35.63	42.32	52.43	87.38
	0:55:00	0.00	0.00	12.47	16.33	18.94	29.94	35.34	44.54	74.23
	1:00:00	0.00	0.00	11.19	14.55	17.09	25.32	29.67	38.26	63.98
	1:05:00	0.00	0.00	10.18	13.18	15.62	22.22	25.93	34.19	57.50
	1:10:00	0.00	0.00	8.72	11.88	14.16	19.09	22.17	28.45	47.40
	1:15:00	0.00	0.00	7.35	10.29	12.75	16.28	18.81	23.27	38.32
	1:20:00	0.00	0.00	6.19	8.73	11.02	13.32	15.30	18.09	29.42
	1:25:00	0.00	0.00	5.40	7.62	9.32	10.84	12.35	13.72	21.96
	1:30:00	0.00	0.00	4.97	7.05	8.31	8.74	9.89	10.55	16.67
	1:35:00	0.00	0.00	4.76	6.73	7.68	7.47	8.43	8.72	13.60
	1:40:00	0.00	0.00	4.63	6.08	7.23	6.70	7.54	7.63	11.71
	1:45:00	0.00	0.00	4.55	5.54	6.90	6.19	6.96	6.89	10.41
	1:50:00	0.00	0.00	4.49	5.15	6.68	5.84	6.56	6.38	9.52
	1:55:00	0.00	0.00	3.94	4.86	6.36	5.60	6.30	6.02	8.89
	2:00:00	0.00	0.00	3.46	4.51	5.79	5.43	6.11	5.78	8.46
	2:05:00	0.00	0.00	2.61	3.41	4.35	4.12	4.63	4.36	6.36
	2:10:00	0.00	0.00	1.91	2.48	3.15	2.98	3.35	3.16	4.59
	2:15:00	0.00	0.00	1.39	1.80	2.28	2.17	2.43	2.30	3.34
	2:20:00	0.00	0.00	1.00	1.29	1.65	1.57	1.76	1.67	2.43
	2:25:00	0.00	0.00	0.71	0.90	1.16	1.10	1.24	1.18	1.71
	2:30:00	0.00	0.00	0.48	0.61	0.81	0.77	0.86	0.82	1.19
	2:35:00	0.00	0.00	0.32	0.42	0.56	0.54	0.60	0.57	0.83
	2:40:00	0.00	0.00	0.19	0.27	0.35	0.35	0.39	0.37	0.53
	2:45:00	0.00	0.00	0.10	0.16	0.19	0.20	0.22	0.21	0.30
	2:50:00	0.00	0.00	0.04	0.07	0.08	0.09	0.10	0.10	0.13
	2:55:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

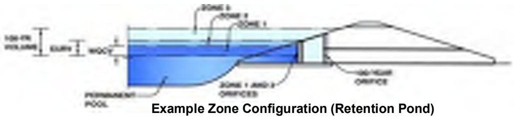
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**

Basin ID: **Pond C**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	41.47	acres
Watershed Length =	1,890	ft
Watershed Length to Centroid =	1,050	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.00%	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
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.828	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.084	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.295	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.020	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.602	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.390	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.166	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.119	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	10.099	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	2.001	acre-feet		
Approximate 5-yr Detention Volume =	2.620	acre-feet		
Approximate 10-yr Detention Volume =	3.167	acre-feet		
Approximate 25-yr Detention Volume =	3.827	acre-feet		
Approximate 50-yr Detention Volume =	4.228	acre-feet		
Approximate 100-yr Detention Volume =	4.663	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.828	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.256	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.579	acre-feet
Total Detention Basin Volume =	4.663	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

Depth Increment = 0.50 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	--	--	--	35	0.001		
6927	--	0.50	--	--	--	246	0.006	70	0.002
	--	1.00	--	--	--	8,508	0.195	2,258	0.052
6928	--	1.50	--	--	--	40,729	0.935	14,567	0.334
	--	2.00	--	--	--	42,406	0.974	35,351	0.812
6929	--	2.50	--	--	--	44,107	1.013	56,979	1.308
	--	3.00	--	--	--	45,833	1.052	79,464	1.824
6930	--	3.50	--	--	--	47,584	1.092	102,818	2.360
	--	4.00	--	--	--	49,360	1.133	127,054	2.917
6931	--	4.50	--	--	--	51,160	1.174	152,184	3.494
	--	5.00	--	--	--	52,986	1.216	178,221	4.091
6932	--	5.50	--	--	--	54,836	1.259	205,176	4.710
6932.5	--	6.00	--	--	--	56,711	1.302	233,063	5.350
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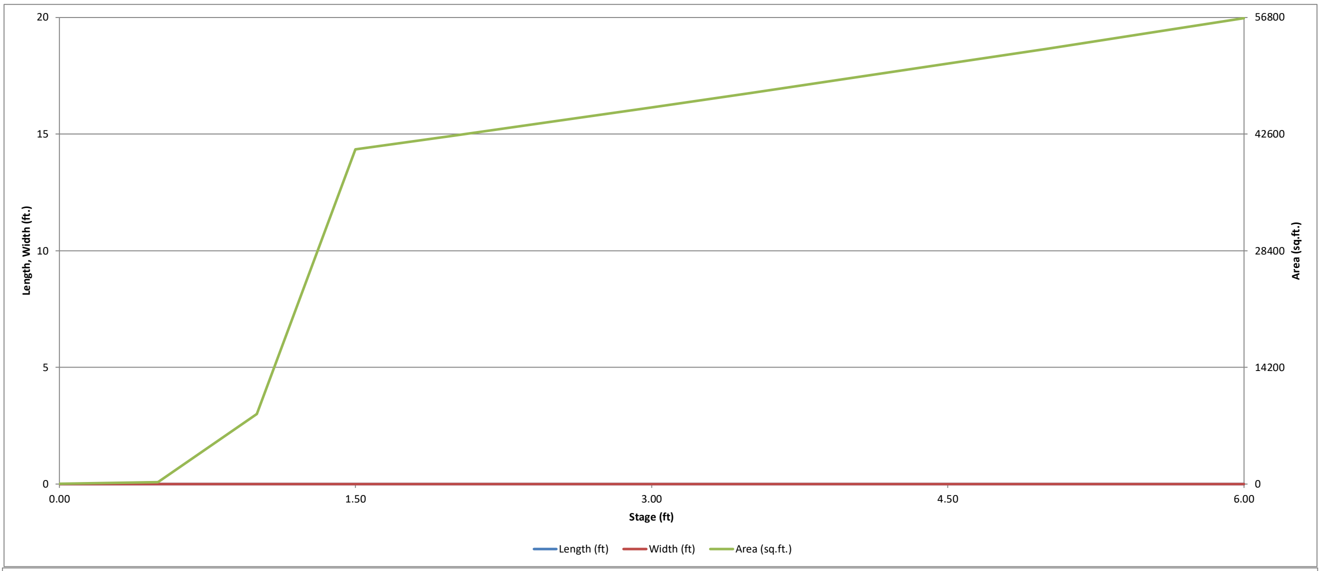
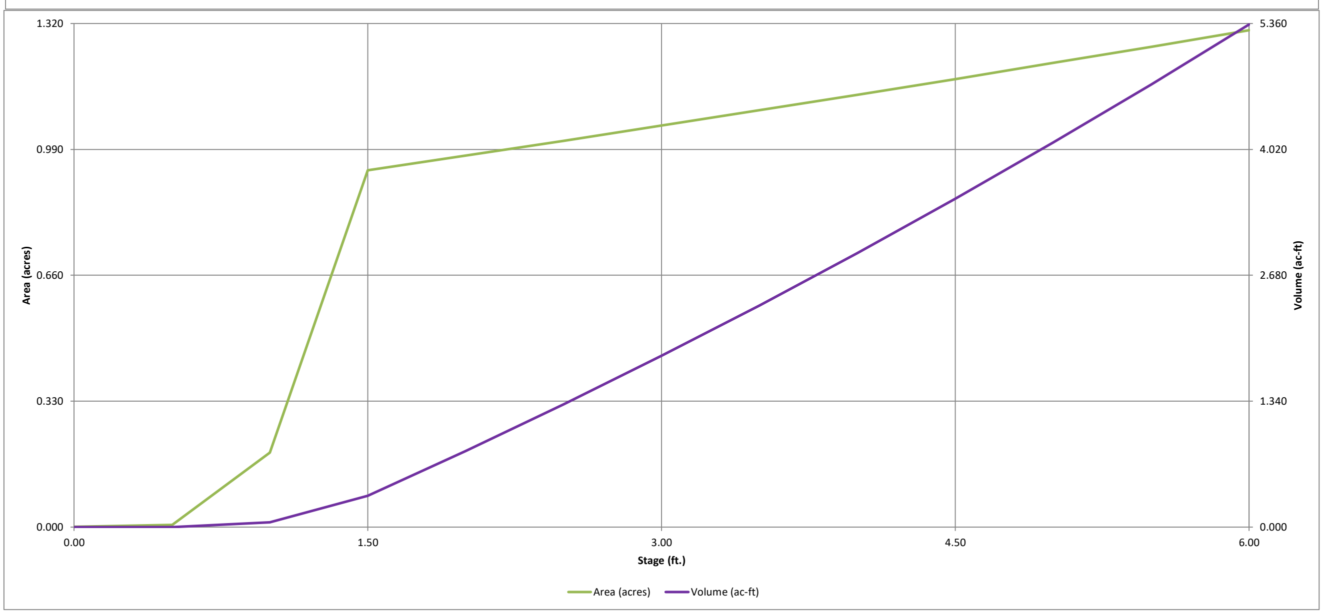
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

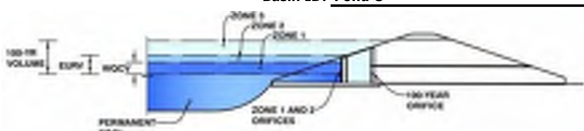




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview
Basin ID: Pond C



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.02	0.828	Orifice Plate
Zone 2 (EURV)	4.15	2.256	Rectangular Orifice
Zone 3 (100-year)	5.47	1.579	Weir&Pipe (Restrict)
Total (all zones)		4.663	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.02	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.30	inches
Orifice Plate: Orifice Area per Row =	3.00	sq. inches (diameter = 1-15/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.083E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.67	1.35					
Orifice Area (sq. inches)	3.00	3.00	3.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.02	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	4.15	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.50	N/A	inches
Vertical Orifice Width =	6.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.10	N/A	ft^2
Vertical Orifice Centroid =	0.10	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.95	N/A	feet
Overflow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.00	N/A	
Overflow Grate Open Area w/o Debris =	6.46	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.23	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	9.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.08	N/A	ft^2
Outlet Orifice Centroid =	0.44	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.32	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.67	feet
Stage at Top of Freeboard =	7.67	feet
Basin Area at Top of Freeboard =	1.30	acres
Basin Volume at Top of Freeboard =	5.35	acre-ft

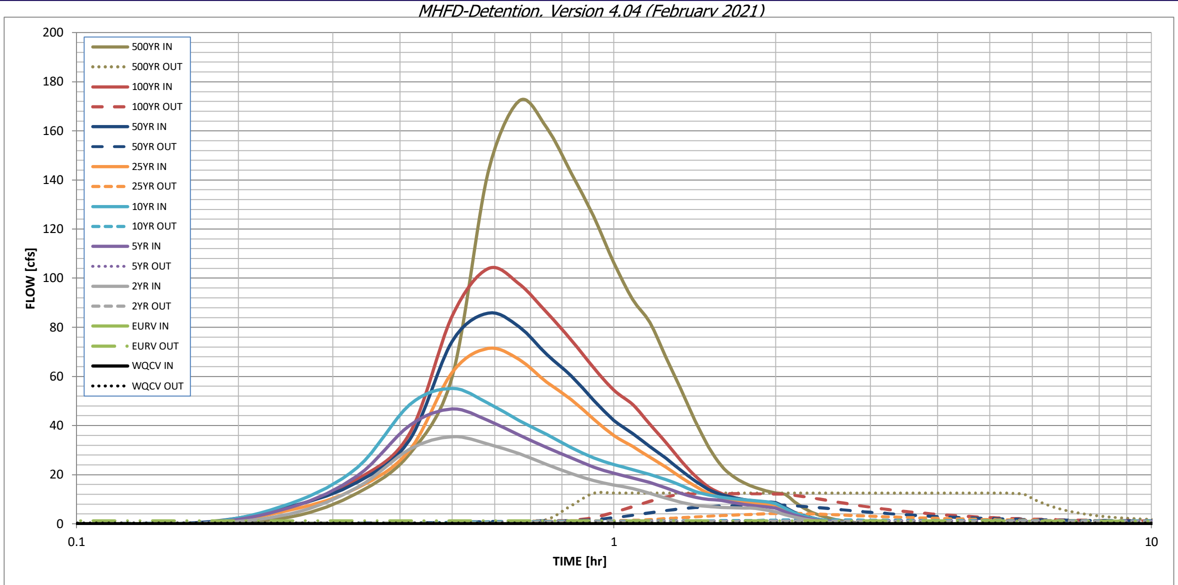
Routed Hydrograph Results

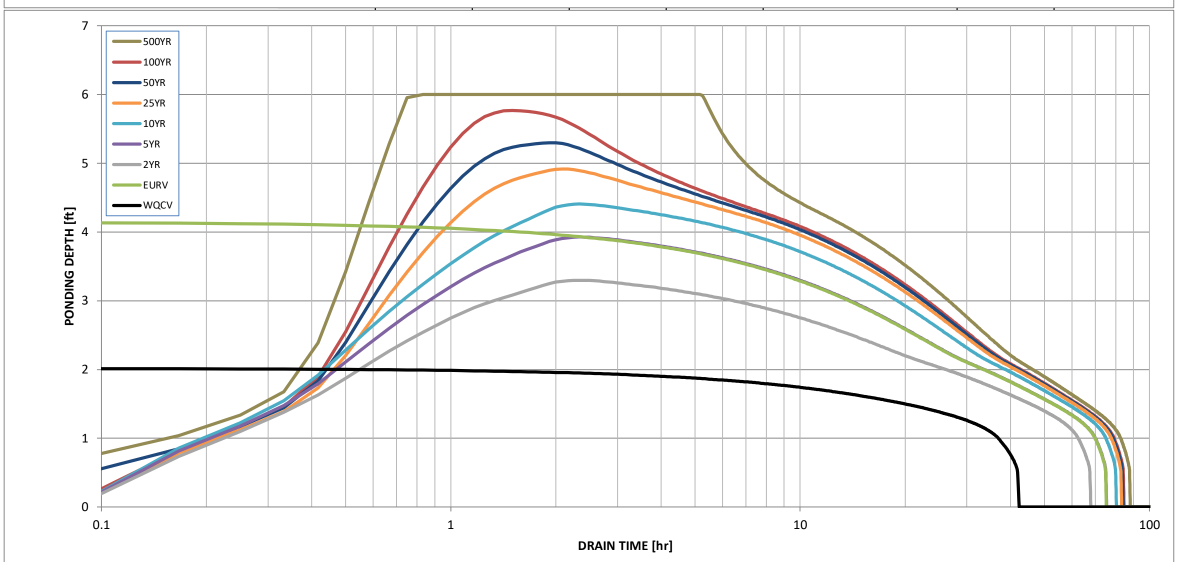
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

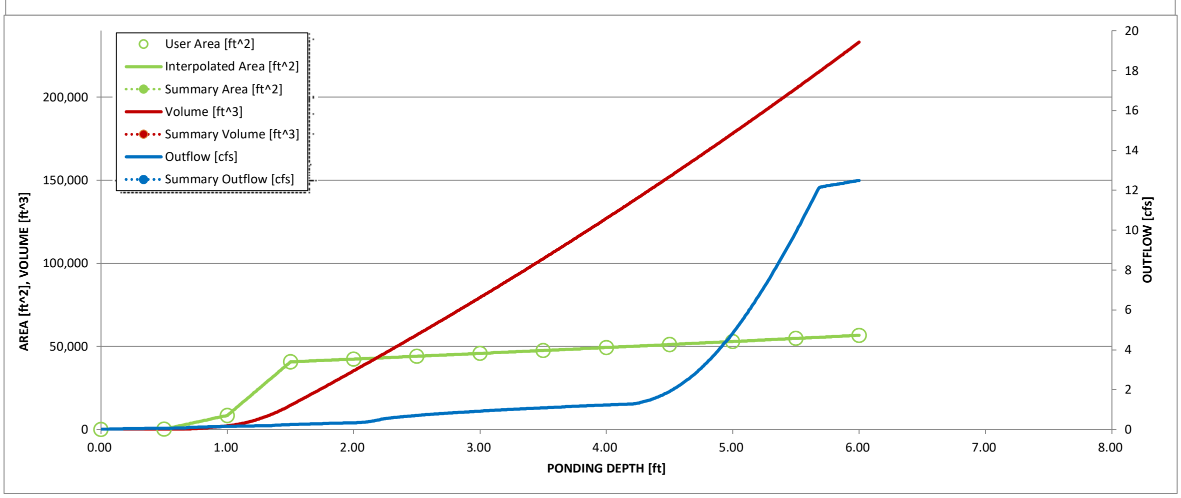
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.828	3.084	2.295	3.020	3.602	4.390	5.166	6.119	10.099
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.295	3.020	3.602	4.390	5.166	6.119	10.099
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	0.6	0.8	7.2	14.3	23.5	61.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.34	0.57	1.47
Peak Inflow Q (cfs) =	N/A	N/A	35.5	46.7	55.2	71.4	85.8	103.9	172.3
Peak Outflow Q (cfs) =	0.3	1.3	1.0	1.2	1.6	4.2	7.6	12.2	12.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.2	2.1	0.6	0.5	0.5	0.2
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	1.0	1.6	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	67	61	67	71	72	72	70	67
Time to Drain 99% of Inflow Volume (hours) =	**41**	72	65	72	76	78	79	79	79
Maximum Ponding Depth (ft) =	2.02	4.15	3.30	3.93	4.40	4.92	5.30	5.77	6.00
Area at Maximum Ponding Depth (acres) =	0.98	1.15	1.08	1.13	1.17	1.21	1.24	1.28	1.30
Maximum Volume Stored (acre-ft) =	0.831	3.088	2.133	2.826	3.377	3.982	4.448	5.040	5.350

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.05	2.77
	0:15:00	0.00	0.00	4.11	6.67	8.28	5.57	6.99	6.81	12.53
	0:20:00	0.00	0.00	14.84	19.53	23.00	14.54	16.96	18.16	28.48
	0:25:00	0.00	0.00	30.31	40.06	48.42	29.97	34.20	36.77	59.81
	0:30:00	0.00	0.00	35.49	46.73	55.15	61.71	74.34	84.53	142.93
	0:35:00	0.00	0.00	32.45	42.04	49.08	71.41	85.81	103.91	172.29
	0:40:00	0.00	0.00	28.50	36.14	42.03	66.86	80.18	97.61	161.15
	0:45:00	0.00	0.00	24.17	31.05	36.32	57.67	68.91	86.01	142.85
	0:50:00	0.00	0.00	20.44	26.87	31.02	50.61	60.24	74.82	125.19
	0:55:00	0.00	0.00	17.63	23.10	26.80	42.59	50.37	63.54	106.35
	1:00:00	0.00	0.00	15.80	20.57	24.16	35.91	42.16	54.43	91.39
	1:05:00	0.00	0.00	14.38	18.63	22.07	31.48	36.78	48.56	82.03
	1:10:00	0.00	0.00	12.34	16.79	20.01	27.07	31.47	40.52	67.82
	1:15:00	0.00	0.00	10.39	14.56	18.01	23.07	26.68	33.08	54.71
	1:20:00	0.00	0.00	8.76	12.35	15.60	18.89	21.72	25.74	42.02
	1:25:00	0.00	0.00	7.62	10.77	13.20	15.35	17.50	19.50	31.32
	1:30:00	0.00	0.00	7.02	9.95	11.74	12.37	14.01	14.96	23.71
	1:35:00	0.00	0.00	6.71	9.50	10.85	10.57	11.92	12.34	19.28
	1:40:00	0.00	0.00	6.54	8.59	10.21	9.47	10.66	10.78	16.58
	1:45:00	0.00	0.00	6.42	7.83	9.74	8.74	9.83	9.73	14.72
	1:50:00	0.00	0.00	6.33	7.27	9.42	8.24	9.27	9.02	13.46
	1:55:00	0.00	0.00	5.58	6.86	8.98	7.90	8.89	8.50	12.55
	2:00:00	0.00	0.00	4.89	6.37	8.19	7.66	8.62	8.16	11.95
	2:05:00	0.00	0.00	3.72	4.86	6.20	5.87	6.60	6.21	9.07
	2:10:00	0.00	0.00	2.72	3.52	4.48	4.24	4.76	4.49	6.53
	2:15:00	0.00	0.00	1.97	2.56	3.24	3.07	3.45	3.27	4.74
	2:20:00	0.00	0.00	1.42	1.84	2.34	2.22	2.49	2.38	3.44
	2:25:00	0.00	0.00	1.01	1.28	1.65	1.57	1.75	1.68	2.42
	2:30:00	0.00	0.00	0.69	0.87	1.15	1.09	1.22	1.17	1.69
	2:35:00	0.00	0.00	0.46	0.60	0.79	0.76	0.85	0.81	1.17
	2:40:00	0.00	0.00	0.28	0.39	0.50	0.49	0.55	0.52	0.75
	2:45:00	0.00	0.00	0.14	0.22	0.27	0.28	0.31	0.30	0.42
	2:50:00	0.00	0.00	0.06	0.10	0.12	0.13	0.14	0.14	0.19
	2:55:00	0.00	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

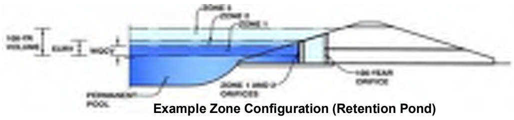
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview

Basin ID: Pond D



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	12.15	acres
Watershed Length =	1,200	ft
Watershed Length to Centroid =	600	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	61.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.244	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.909	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.666	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.876	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.045	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.272	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.496	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.770	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	2.916	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.590	acre-feet		
Approximate 5-yr Detention Volume =	0.772	acre-feet		
Approximate 10-yr Detention Volume =	0.934	acre-feet		
Approximate 25-yr Detention Volume =	1.128	acre-feet		
Approximate 50-yr Detention Volume =	1.246	acre-feet		
Approximate 100-yr Detention Volume =	1.373	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.244	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.666	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.464	acre-feet
Total Detention Basin Volume =	1.373	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

Depth Increment = 0.50 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	--	--	--	35	0.001		
6969	--	0.50	--	--	--	35	0.001	18	0.000
	--	1.00	--	--	--	5,514	0.127	1,404	0.032
6970	--	1.50	--	--	--	13,763	0.316	6,223	0.143
	--	2.00	--	--	--	14,669	0.337	13,331	0.306
6971	--	2.50	--	--	--	15,600	0.358	20,899	0.480
	--	3.00	--	--	--	16,556	0.380	28,938	0.664
6972	--	3.50	--	--	--	17,537	0.403	37,461	0.860
	--	4.00	--	--	--	18,542	0.426	46,481	1.067
6973	--	4.50	--	--	--	19,573	0.449	56,009	1.286
	--	5.00	--	--	--	20,628	0.474	66,059	1.517
6974	--	5.50	--	--	--	21,708	0.498	76,643	1.759
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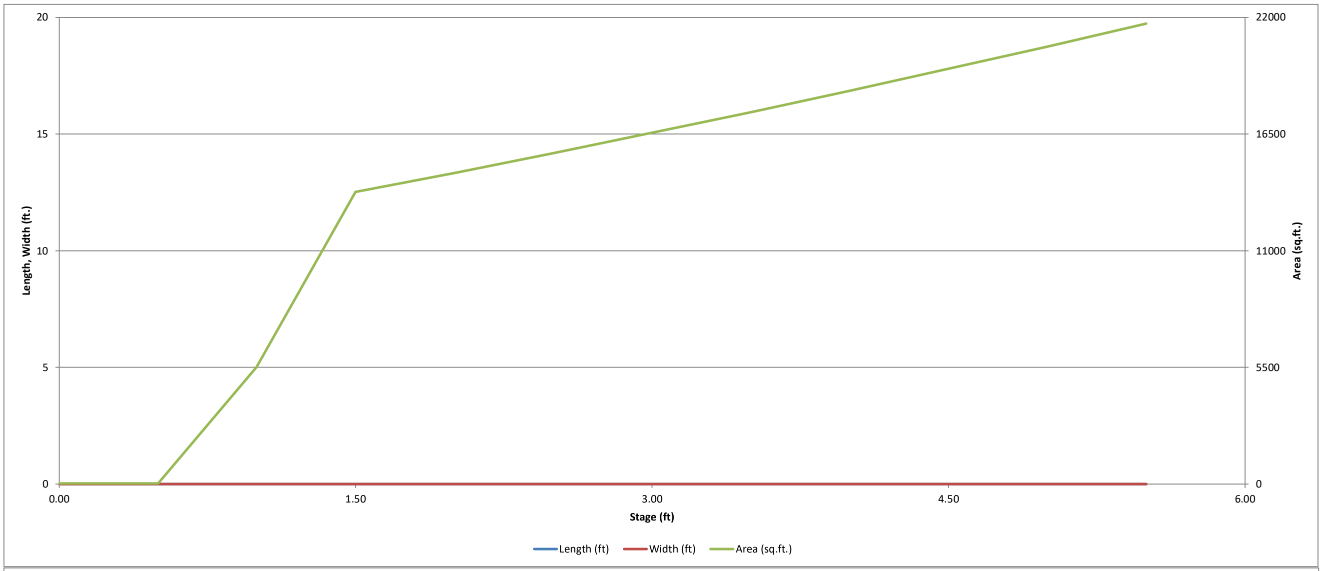
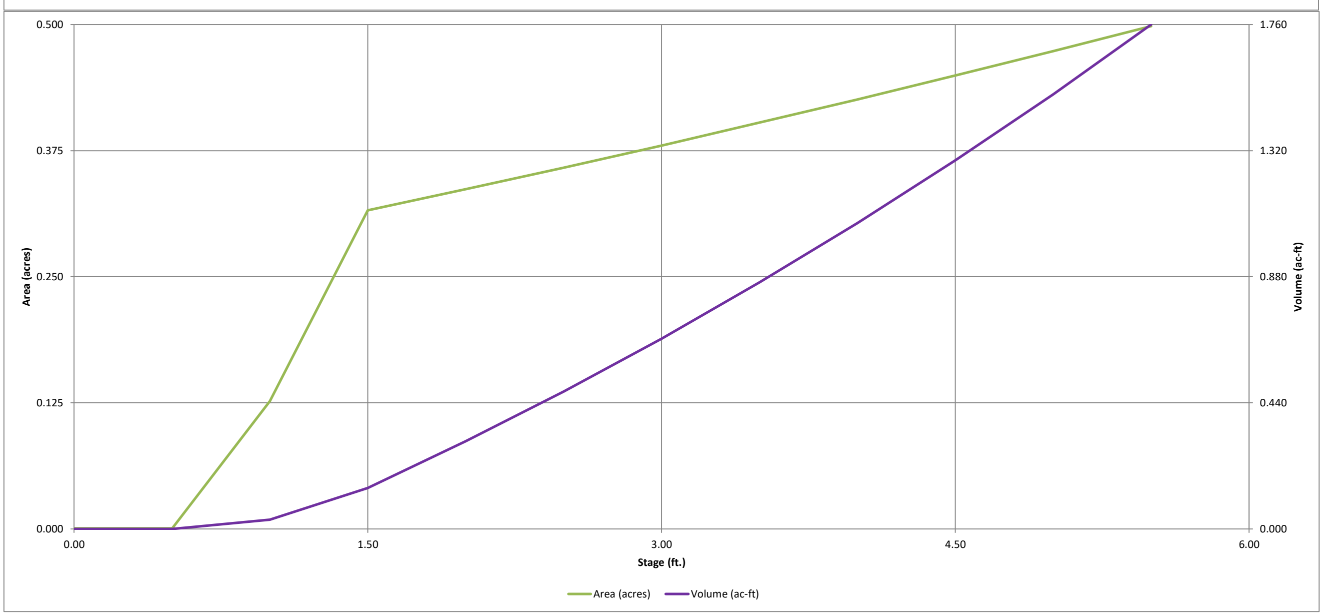
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

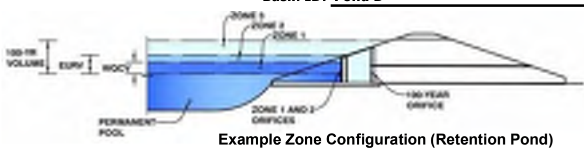




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**
Basin ID: **Pond D**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.82	0.244	Orifice Plate
Zone 2 (EURV)	3.63	0.666	Circular Orifice
Zone 3 (100-year)	4.70	0.464	Weir&Pipe (Restrict)
Total (all zones)		1.373	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.82	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	7.10	inches
Orifice Plate: Orifice Area per Row =	0.95	sq. inches (diameter = 1-1/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.597E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.61	1.21					
Orifice Area (sq. inches)	0.95	0.95	0.95					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.90	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.63	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	2.50	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.03	N/A	ft^2
Vertical Orifice Centroid =	0.10	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.67	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.42	N/A	feet
Overflow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.78	N/A	
Overflow Grate Open Area w/o Debris =	6.46	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.23	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	7.20		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.66	N/A	ft^2
Outlet Orifice Centroid =	0.35	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.37	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.75	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.32	feet
Stage at Top of Freeboard =	6.07	feet
Basin Area at Top of Freeboard =	0.50	acres
Basin Volume at Top of Freeboard =	1.76	acre-ft

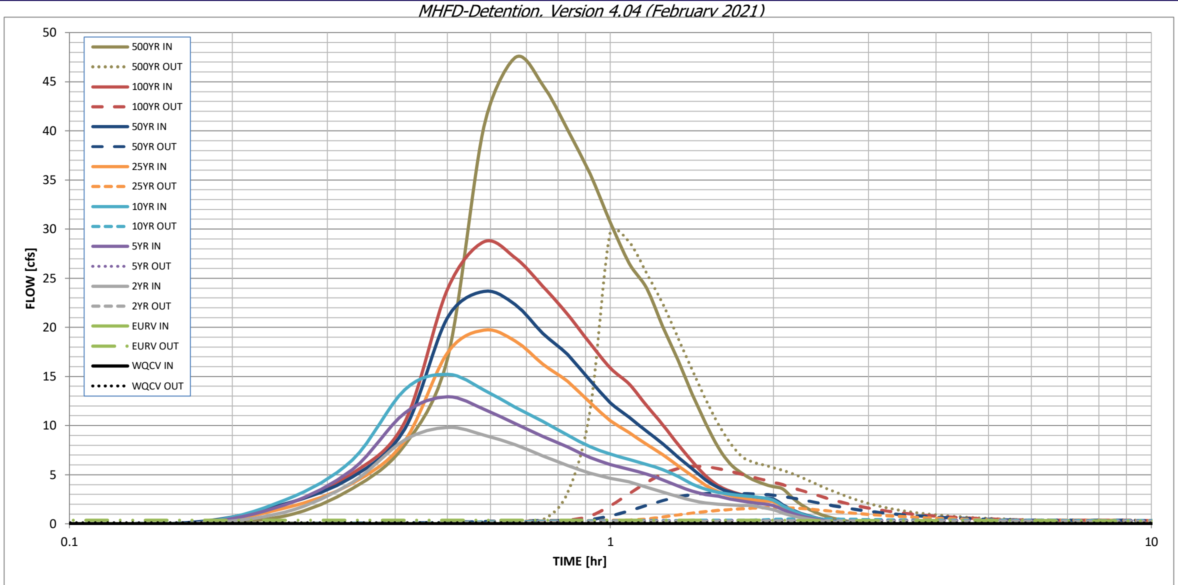
Routed Hydrograph Results

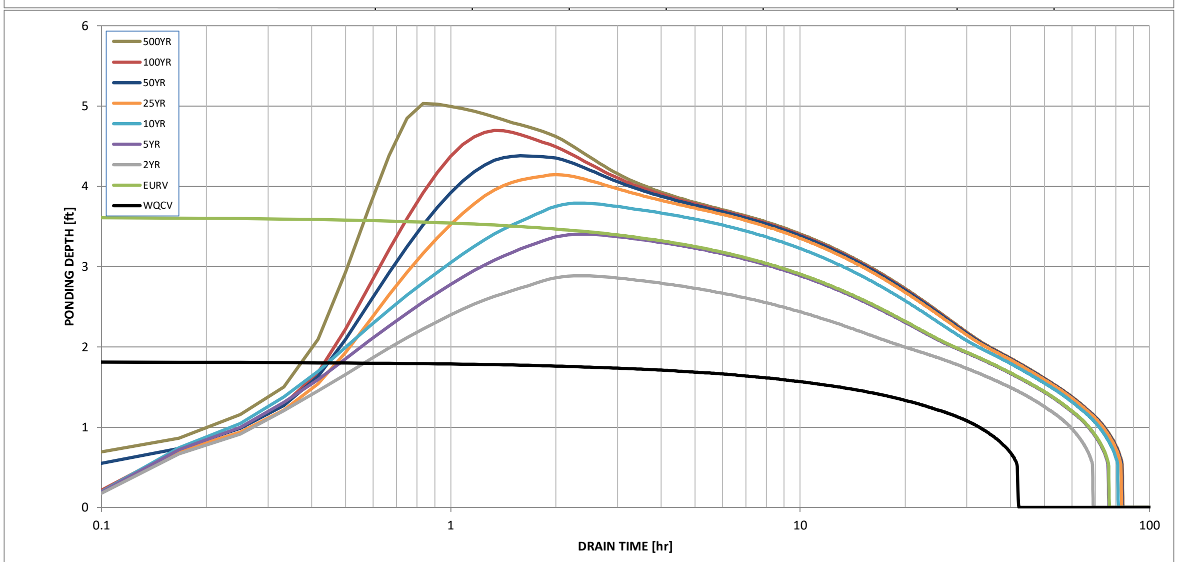
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

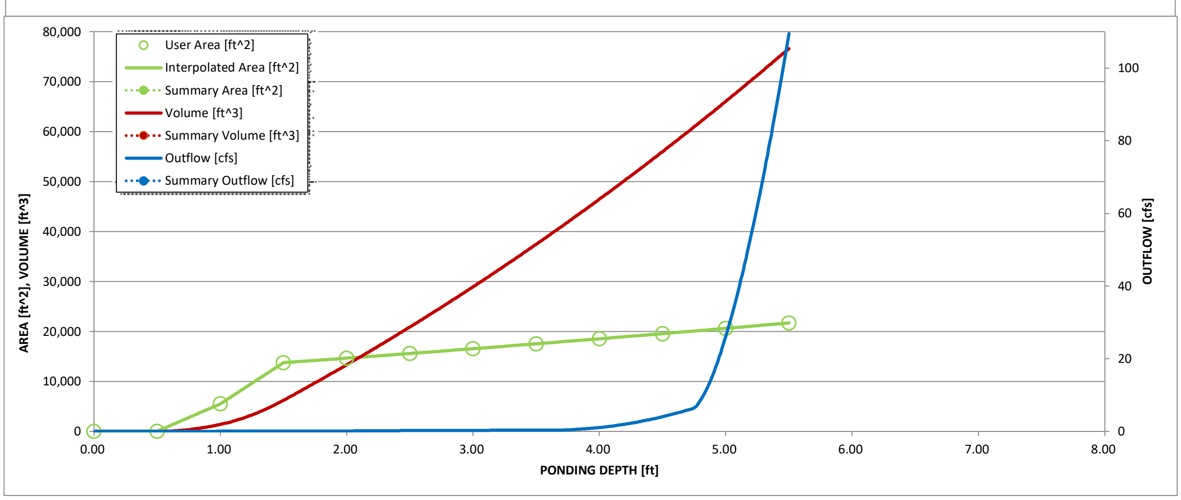
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.244	0.909	0.666	0.876	1.045	1.272	1.496	1.770	2.916
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.666	0.876	1.045	1.272	1.496	1.770	2.916
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.2	2.0	4.0	6.5	16.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.16	0.33	0.53	1.38
Peak Inflow Q (cfs) =	N/A	N/A	9.8	12.9	15.2	19.7	23.7	28.7	47.5
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.4	0.5	1.7	3.1	5.8	29.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.3	2.4	0.9	0.8	0.9	1.8
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.4	0.8	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	68	62	68	72	72	71	70	63
Time to Drain 99% of Inflow Volume (hours) =	**41**	73	66	73	78	79	78	78	75
Maximum Ponding Depth (ft) =	1.82	3.63	2.89	3.40	3.79	4.14	4.38	4.69	5.03
Area at Maximum Ponding Depth (acres) =	0.33	0.41	0.37	0.40	0.42	0.43	0.44	0.46	0.48
Maximum Volume Stored (acre-ft) =	0.246	0.913	0.619	0.820	0.979	1.127	1.228	1.372	1.531

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.01	0.80
	0:15:00	0.00	0.00	1.19	1.94	2.41	1.62	2.02	1.98	3.58
	0:20:00	0.00	0.00	4.23	5.53	6.50	4.10	4.78	5.12	8.02
	0:25:00	0.00	0.00	8.53	11.29	13.66	8.45	9.65	10.36	16.88
	0:30:00	0.00	0.00	9.83	12.93	15.22	17.43	21.01	23.91	40.39
	0:35:00	0.00	0.00	9.02	11.68	13.64	19.73	23.67	28.70	47.46
	0:40:00	0.00	0.00	8.05	10.21	11.88	18.62	22.32	27.08	44.68
	0:45:00	0.00	0.00	6.92	8.91	10.43	16.25	19.40	24.18	40.12
	0:50:00	0.00	0.00	5.95	7.82	9.03	14.49	17.24	21.32	35.63
	0:55:00	0.00	0.00	5.17	6.77	7.85	12.35	14.60	18.38	30.71
	1:00:00	0.00	0.00	4.65	6.05	7.10	10.51	12.33	15.86	26.53
	1:05:00	0.00	0.00	4.27	5.53	6.55	9.28	10.85	14.23	23.97
	1:10:00	0.00	0.00	3.73	5.07	6.04	8.09	9.41	12.03	20.09
	1:15:00	0.00	0.00	3.23	4.49	5.53	7.04	8.16	10.09	16.66
	1:20:00	0.00	0.00	2.76	3.86	4.82	5.90	6.80	8.09	13.22
	1:25:00	0.00	0.00	2.38	3.33	4.05	4.90	5.61	6.35	10.25
	1:30:00	0.00	0.00	2.12	2.99	3.51	3.93	4.47	4.89	7.75
	1:35:00	0.00	0.00	1.99	2.81	3.21	3.26	3.68	3.89	6.09
	1:40:00	0.00	0.00	1.92	2.53	3.01	2.86	3.23	3.32	5.14
	1:45:00	0.00	0.00	1.88	2.31	2.87	2.62	2.94	2.96	4.51
	1:50:00	0.00	0.00	1.85	2.15	2.77	2.45	2.76	2.72	4.09
	1:55:00	0.00	0.00	1.63	2.03	2.64	2.34	2.63	2.55	3.78
	2:00:00	0.00	0.00	1.44	1.88	2.41	2.26	2.54	2.43	3.57
	2:05:00	0.00	0.00	1.10	1.44	1.84	1.73	1.94	1.83	2.67
	2:10:00	0.00	0.00	0.83	1.07	1.36	1.28	1.44	1.35	1.96
	2:15:00	0.00	0.00	0.62	0.80	1.01	0.95	1.07	1.00	1.45
	2:20:00	0.00	0.00	0.46	0.59	0.74	0.70	0.79	0.75	1.08
	2:25:00	0.00	0.00	0.33	0.42	0.54	0.51	0.57	0.54	0.78
	2:30:00	0.00	0.00	0.24	0.30	0.39	0.36	0.41	0.39	0.56
	2:35:00	0.00	0.00	0.17	0.21	0.28	0.26	0.30	0.28	0.41
	2:40:00	0.00	0.00	0.11	0.14	0.19	0.18	0.20	0.19	0.28
	2:45:00	0.00	0.00	0.06	0.09	0.12	0.12	0.13	0.12	0.17
	2:50:00	0.00	0.00	0.03	0.05	0.06	0.07	0.07	0.07	0.10
	2:55:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.04
	3:00:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

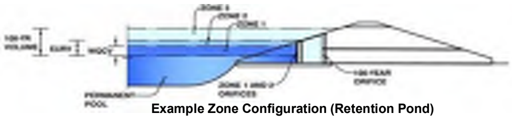
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**

Basin ID: **Pond E**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	21.36	acres		
Watershed Length =	1,800	ft		
Watershed Length to Centroid =	900	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	61.70%	percent		
Percentage Hydrologic Soil Group A =	90.0%	percent		
Percentage Hydrologic Soil Group B =	10.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.431	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.594	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.208	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.585	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.887	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.347	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.751	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.260	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	5.338	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	1.052	acre-feet		
Approximate 5-yr Detention Volume =	1.381	acre-feet		
Approximate 10-yr Detention Volume =	1.680	acre-feet		
Approximate 25-yr Detention Volume =	2.004	acre-feet		
Approximate 50-yr Detention Volume =	2.201	acre-feet		
Approximate 100-yr Detention Volume =	2.421	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.431	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.163	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.828	acre-feet
Total Detention Basin Volume =	2.421	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

Depth Increment = 0.50 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	--	--	--	35	0.001		
	--	0.50	--	--	--	1,362	0.031	349	0.008
6947	--	1.00	--	--	--	12,615	0.290	3,843	0.088
	--	1.50	--	--	--	25,422	0.584	13,352	0.307
6948	--	2.00	--	--	--	26,944	0.619	26,443	0.607
	--	2.50	--	--	--	28,490	0.654	40,302	0.925
6949	--	3.00	--	--	--	30,062	0.690	54,940	1.261
	--	3.50	--	--	--	31,660	0.727	70,370	1.615
6950	--	4.00	--	--	--	33,282	0.764	86,606	1.988
	--	4.50	--	--	--	34,931	0.802	103,659	2.380
6951	--	5.00	--	--	--	36,604	0.840	121,543	2.790
	--	5.50	--	--	--	38,303	0.879	140,270	3.220
6952	--	6.00	--	--	--	40,027	0.919	159,852	3.670
	--		--	--	--				
	--		--	--	--				
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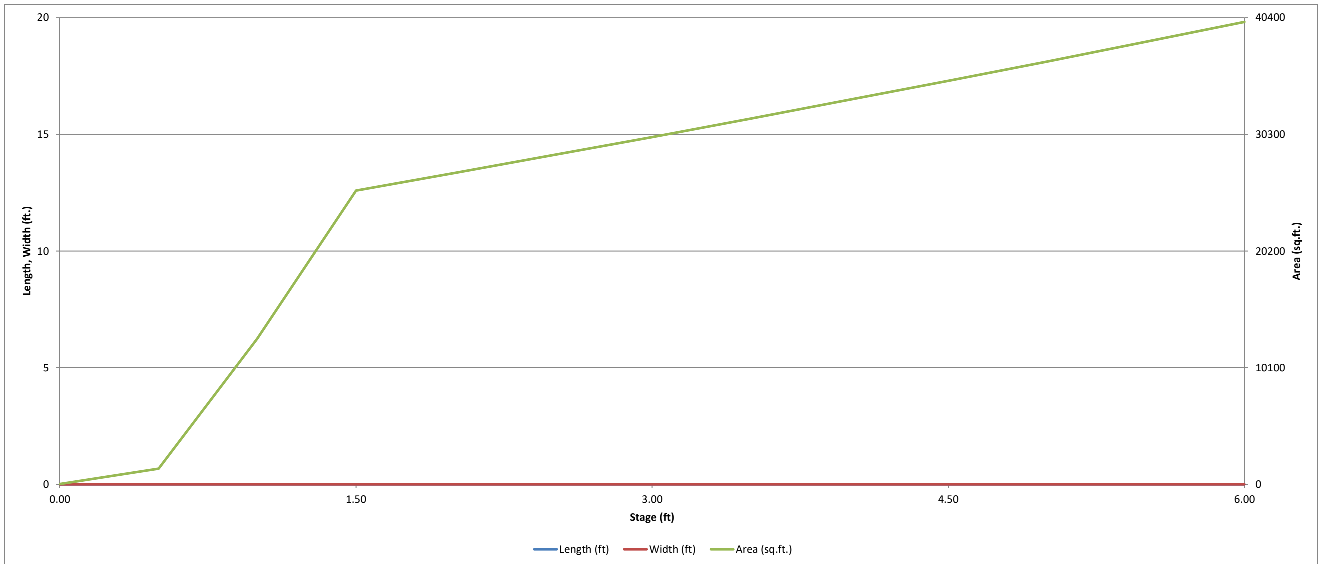
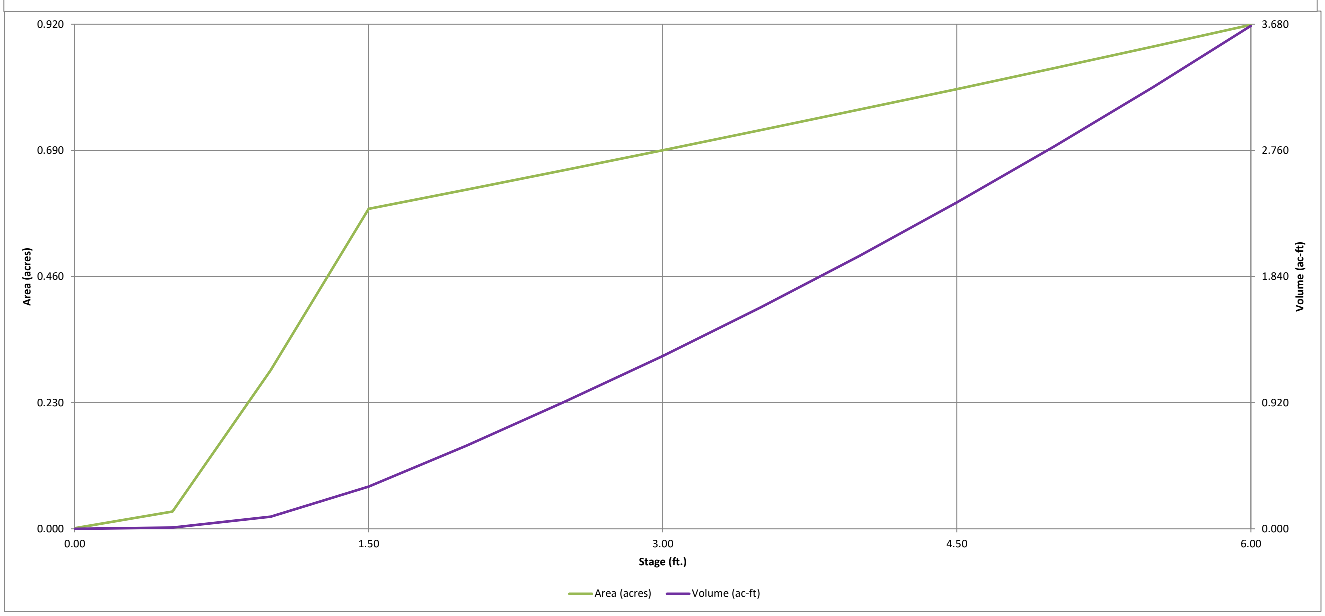
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

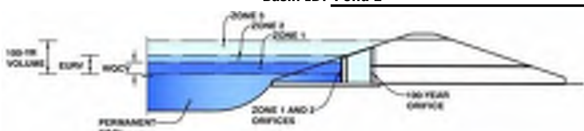




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**
Basin ID: **Pond E**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.72	0.431	Orifice Plate
Zone 2 (EURV)	3.48	1.163	Rectangular Orifice
Zone 3 (100-year)	4.56	0.828	Weir&Pipe (Restrict)
Total (all zones)		2.421	

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.72	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	6.80	inches
Orifice Plate: Orifice Area per Row =	1.80	sq. inches (diameter = 1-1/2 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.250E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.57	1.15					
Orifice Area (sq. inches)	1.80	1.80	1.80					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	1.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.48	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	1.50	N/A	inches
Vertical Orifice Width =	6.00		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.06	N/A	ft^2
Vertical Orifice Centroid =	0.06	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.25	N/A	feet
Overflow Weir Slope Length =	3.09	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.40	N/A	
Overflow Grate Open Area w/o Debris =	6.46	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.23	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	10.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.01	N/A	ft^2
Outlet Orifice Centroid =	0.48	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.68	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.40	feet
Stage at Top of Freeboard =	6.20	feet
Basin Area at Top of Freeboard =	0.92	acres
Basin Volume at Top of Freeboard =	3.67	acre-ft

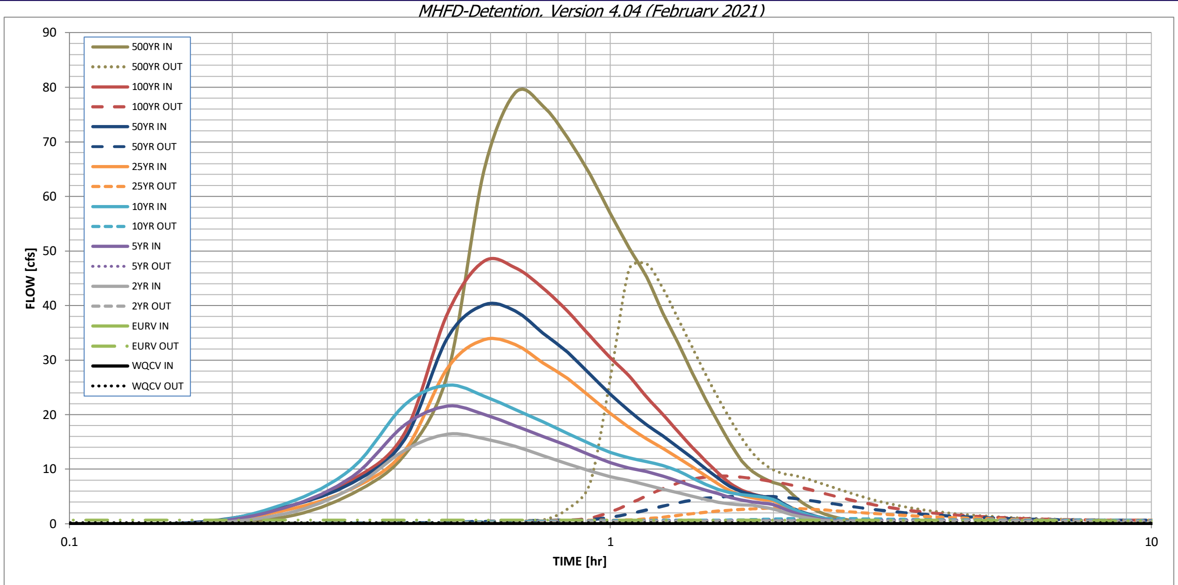
Routed Hydrograph Results

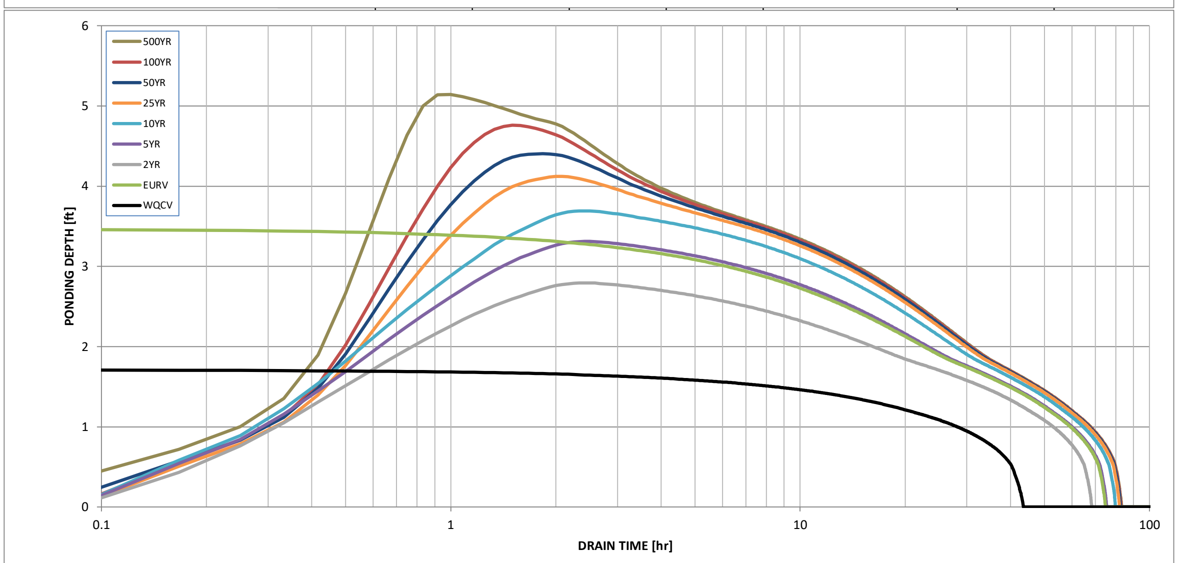
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

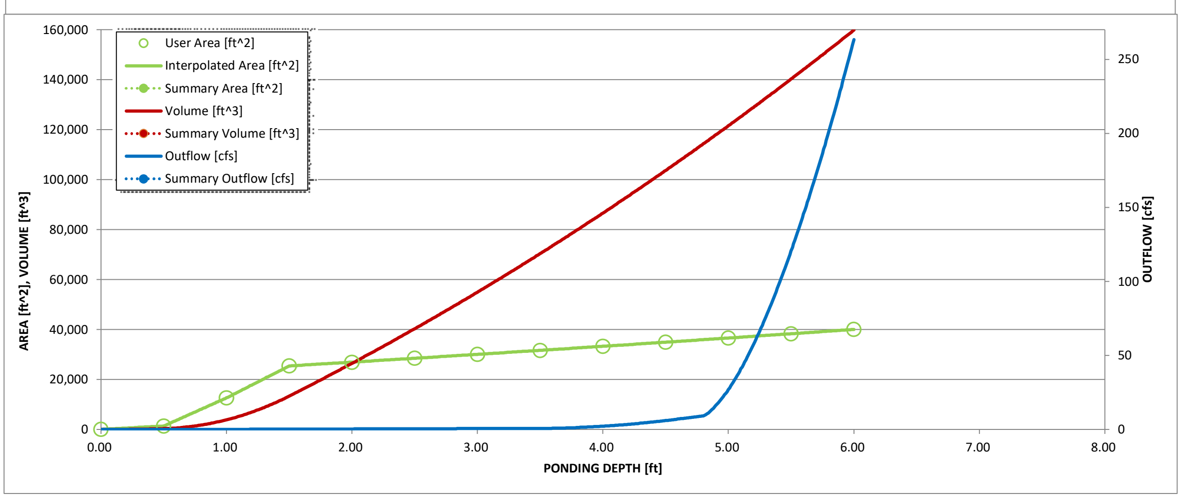
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.431	1.594	1.208	1.585	1.887	2.347	2.751	3.260	5.338
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.208	1.585	1.887	2.347	2.751	3.260	5.338
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	0.4	4.6	7.7	12.0	28.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.22	0.36	0.56	1.34
Peak Inflow Q (cfs) =	N/A	N/A	16.4	21.6	25.4	33.7	40.1	48.1	79.0
Peak Outflow Q (cfs) =	0.2	0.7	0.6	0.7	1.0	2.9	5.1	8.8	47.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.5	2.7	0.6	0.7	0.7	1.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.3	0.7	1.2	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	65	60	65	69	69	68	67	60
Time to Drain 99% of Inflow Volume (hours) =	**42**	70	64	70	74	76	76	75	72
Maximum Ponding Depth (ft) =	1.72	3.48	2.79	3.31	3.69	4.12	4.40	4.76	5.14
Area at Maximum Ponding Depth (acres) =	0.60	0.73	0.67	0.71	0.74	0.77	0.79	0.82	0.85
Maximum Volume Stored (acre-ft) =	0.437	1.601	1.118	1.472	1.755	2.080	2.300	2.583	2.909

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.02	1.22
	0:15:00	0.00	0.00	1.81	2.94	3.65	2.46	3.08	3.00	5.54
	0:20:00	0.00	0.00	6.56	8.65	10.19	6.44	7.52	8.04	12.67
	0:25:00	0.00	0.00	13.50	18.10	21.83	13.40	15.46	16.66	27.54
	0:30:00	0.00	0.00	16.45	21.57	25.41	28.55	34.13	38.59	64.65
	0:35:00	0.00	0.00	15.58	20.07	23.43	33.71	40.14	48.11	78.96
	0:40:00	0.00	0.00	14.18	17.96	20.91	32.82	39.01	46.90	76.61
	0:45:00	0.00	0.00	12.48	15.99	18.69	29.51	34.96	43.23	70.73
	0:50:00	0.00	0.00	11.00	14.33	16.57	26.62	31.43	38.92	64.02
	0:55:00	0.00	0.00	9.71	12.64	14.68	23.28	27.41	34.41	56.89
	1:00:00	0.00	0.00	8.65	11.20	13.09	20.22	23.75	30.43	50.54
	1:05:00	0.00	0.00	7.93	10.23	12.08	17.68	20.71	27.08	45.20
	1:10:00	0.00	0.00	7.11	9.55	11.36	15.54	18.15	23.23	38.67
	1:15:00	0.00	0.00	6.37	8.75	10.68	13.85	16.11	20.05	33.16
	1:20:00	0.00	0.00	5.71	7.84	9.69	12.10	14.03	16.89	27.70
	1:25:00	0.00	0.00	5.07	6.96	8.41	10.46	12.08	14.04	22.81
	1:30:00	0.00	0.00	4.46	6.16	7.25	8.79	10.11	11.53	18.54
	1:35:00	0.00	0.00	3.96	5.50	6.30	7.28	8.32	9.28	14.71
	1:40:00	0.00	0.00	3.63	4.81	5.70	6.02	6.83	7.40	11.53
	1:45:00	0.00	0.00	3.48	4.34	5.35	5.21	5.89	6.19	9.59
	1:50:00	0.00	0.00	3.39	4.03	5.12	4.73	5.34	5.47	8.39
	1:55:00	0.00	0.00	3.04	3.79	4.87	4.43	5.00	5.01	7.58
	2:00:00	0.00	0.00	2.71	3.53	4.49	4.22	4.76	4.68	7.00
	2:05:00	0.00	0.00	2.16	2.81	3.58	3.37	3.79	3.67	5.44
	2:10:00	0.00	0.00	1.67	2.17	2.76	2.58	2.90	2.76	4.05
	2:15:00	0.00	0.00	1.29	1.68	2.12	1.98	2.22	2.08	3.03
	2:20:00	0.00	0.00	0.99	1.28	1.62	1.51	1.69	1.58	2.30
	2:25:00	0.00	0.00	0.75	0.97	1.22	1.14	1.28	1.20	1.74
	2:30:00	0.00	0.00	0.57	0.72	0.91	0.85	0.95	0.90	1.30
	2:35:00	0.00	0.00	0.42	0.53	0.67	0.63	0.70	0.67	0.96
	2:40:00	0.00	0.00	0.31	0.39	0.50	0.47	0.53	0.50	0.73
	2:45:00	0.00	0.00	0.22	0.27	0.36	0.34	0.38	0.37	0.53
	2:50:00	0.00	0.00	0.14	0.19	0.24	0.24	0.26	0.25	0.36
	2:55:00	0.00	0.00	0.08	0.12	0.15	0.15	0.16	0.16	0.22
	3:00:00	0.00	0.00	0.04	0.06	0.08	0.08	0.09	0.08	0.12
	3:05:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.03	0.04
	3:10:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

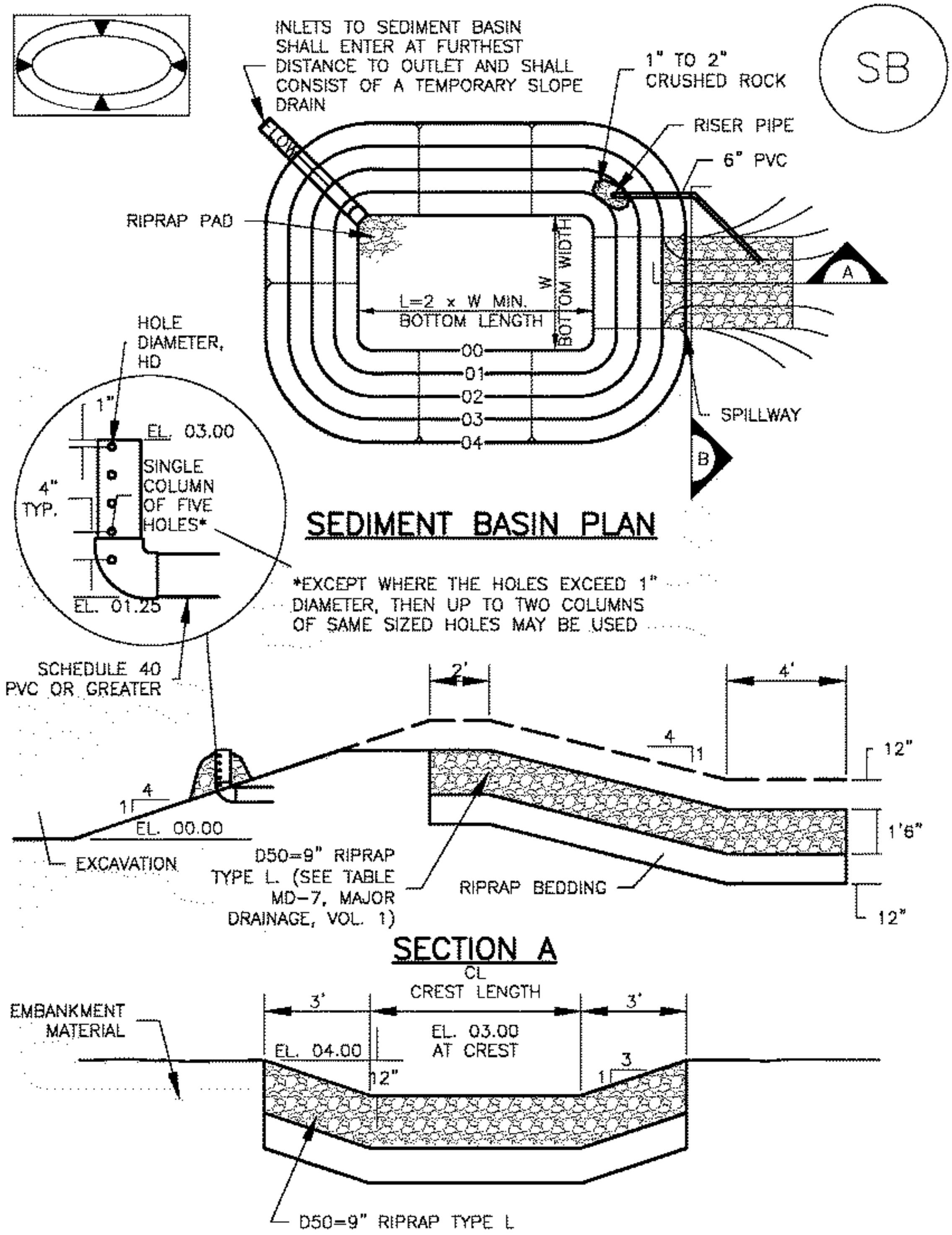
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).



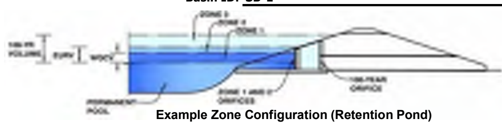
INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
1" TO 2" CRUSHED ROCK
SB
RISER PIPE
6" PVC
FLOW
RIPRAP PAD
L=2 x W MIN. BOTTOM LENGTH
W BOTTOM WIDTH
00
01
02
03
04
A
SPILLWAY
B
HOLE DIAMETER, HD
1"
EL. 03.00
SINGLE COLUMN OF FIVE HOLES*
4" TYP.
EL. 01.25
SEDIMENT BASIN PLAN
*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED
SCHEDULE 40 PVC OR GREATER
2'
4'
4
1
12"
1'6"
12"
EL. 00.00
EXCAVATION
D50=9" RIPRAP TYPE L (SEE TABLE MD-7, MAJOR DRAINAGE, VOL. 1)
RIPRAP BEDDING
SECTION A
CL
CREST LENGTH
3'
3'
EMBANKMENT MATERIAL
EL. 04.00
EL. 03.00 AT CREST
12"
3
1
D50=9" RIPRAP TYPE L

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview - Pond REX RD**

Basin ID: **SB-1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**	
Watershed Area =	1.22	acres
Watershed Length =	625	ft
Watershed Length to Centroid =	400	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	100.00%	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
Target WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.041	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.171	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.119	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.153	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.180	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.206	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.233	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.263	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	0.388	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.113	acre-feet		
Approximate 5-yr Detention Volume =	0.146	acre-feet		
Approximate 10-yr Detention Volume =	0.173	acre-feet		
Approximate 25-yr Detention Volume =	0.203	acre-feet		
Approximate 50-yr Detention Volume =	0.220	acre-feet		
Approximate 100-yr Detention Volume =	0.234	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.041	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.041	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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 = 0.20 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)
Media Surface	--	0.00	--	--	--	35	0.001		
	--	0.20	--	--	--	979	0.022	101	0.002
	--	0.40	--	--	--	1,076	0.025	307	0.007
	--	0.60	--	--	--	1,178	0.027	532	0.012
	--	0.80	--	--	--	1,284	0.029	778	0.018
	--	1.00	--	--	--	1,394	0.032	1,046	0.024
	--	1.20	--	--	--	1,508	0.035	1,336	0.031
	--	1.40	--	--	--	1,626	0.037	1,650	0.038
	--	1.60	--	--	--	1,748	0.040	1,987	0.046
	--	1.80	--	--	--	1,874	0.043	2,349	0.054
	--	2.00	--	--	--	2,003	0.046	2,737	0.063
	--	2.20	--	--	--	2,138	0.049	3,151	0.072
	--	2.40	--	--	--	2,276	0.052	3,592	0.082
	--	2.60	--	--	--	2,418	0.056	4,062	0.093
	--	2.80	--	--	--	2,564	0.059	4,560	0.105
	--	3.00	--	--	--	2,714	0.062	5,087	0.117
	--	3.20	--	--	--	2,868	0.066	5,646	0.130
	--	3.40	--	--	--	3,026	0.069	6,235	0.143
	--	3.60	--	--	--	3,188	0.073	6,856	0.157
	--	3.80	--	--	--	3,354	0.077	7,511	0.172
	--	4.00	--	--	--	3,525	0.081	8,199	0.188
	--	4.20	--	--	--	3,699	0.085	8,921	0.205
	--	4.40	--	--	--	3,877	0.089	9,678	0.222
	--	4.60	--	--	--	4,060	0.093	10,472	0.240
	--	4.80	--	--	--	4,246	0.097	11,303	0.259
	--	5.00	--	--	--	4,436	0.102	12,171	0.279
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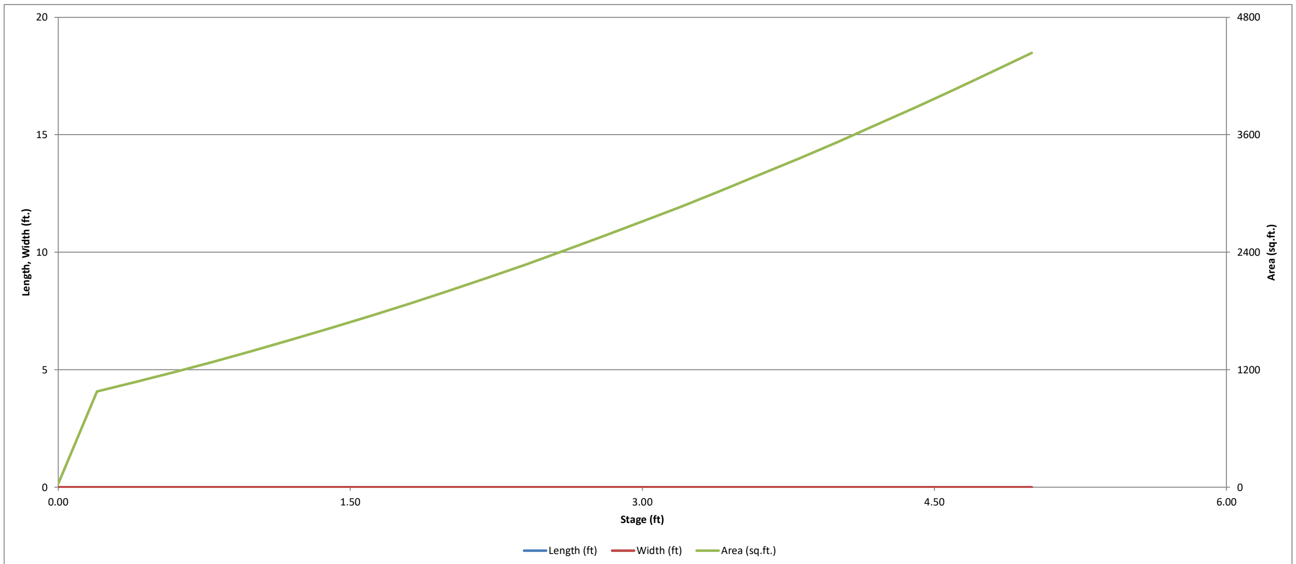
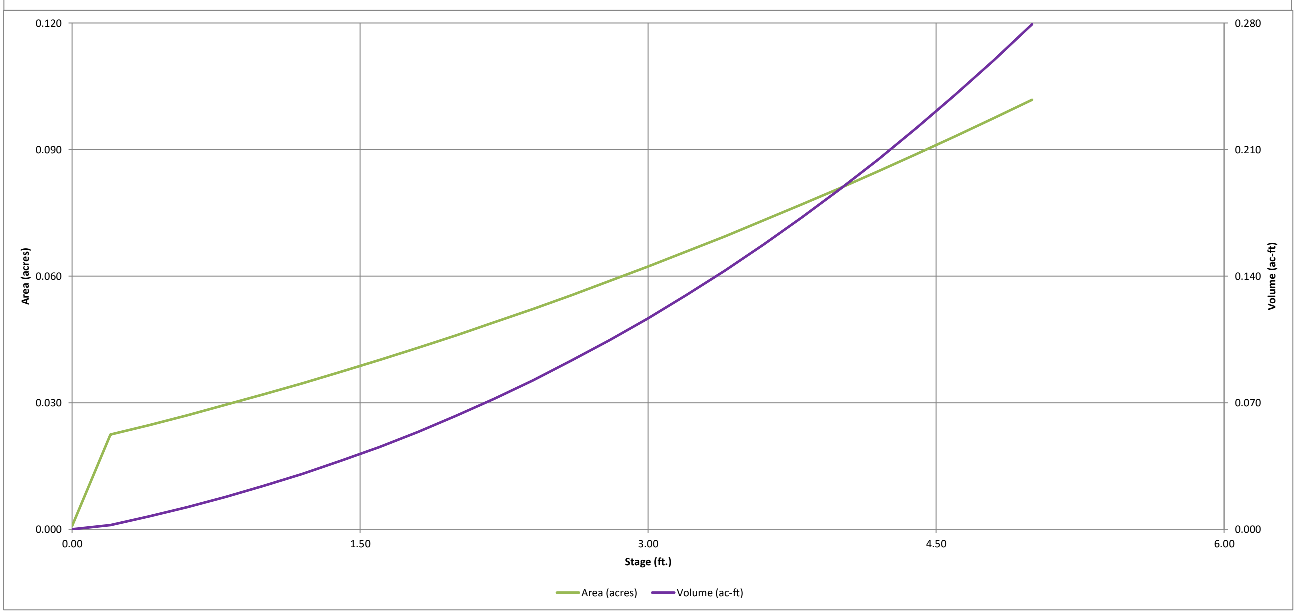
MHFD-Detention, Version 4.04 (February 2021)



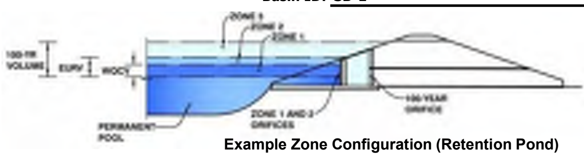


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview - Pond REX RD

Basin ID: SB-1



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.48	0.041	Filtration Media
Zone 2			Not Utilized
Zone 3			Not Utilized
Total (all zones)		0.041	

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

Underdrain Orifice Invert Depth =	2.00	ft (distance below the filtration media surface)	
Underdrain Orifice Diameter =	1.00	inches	

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.04	feet

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

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

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	N/A	N/A	feet
Overflow Weir Grate Slope =	N/A	N/A	H:V
Horiz. Length of Weir Sides =	N/A	N/A	feet
Overflow Grate Type =	N/A	N/A	
Debris Clogging % =	N/A	N/A	%

Calculated Parameters for Overflow Weir

	Not Selected	Not Selected	
Height of Grate Upper Edge, H_t =	N/A	N/A	feet
Overflow Weir Slope Length =	N/A	N/A	feet
Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Overflow Grate Open Area w/o Debris =	N/A	N/A	ft^2
Overflow Grate Open Area w/ Debris =	N/A	N/A	ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =	N/A	N/A	ft^2
Outlet Orifice Centroid =	N/A	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres
Basin Volume at Top of Freeboard =		acre-ft

Routed Hydrograph Results

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

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.041	0.171	0.119	0.153	0.180	0.206	0.233	0.263	0.388
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.119	0.153	0.180	0.206	0.233	0.263	0.388
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.1	0.3	0.4	1.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.10	0.21	0.34	0.92
Peak Inflow Q (cfs) =	N/A	N/A	1.5	1.9	2.2	2.6	2.9	3.3	4.9
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	6.2	4.6	0.5	0.3	0.2	0.1
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	11	38	28	35	40	44	49	54	75
Time to Drain 99% of Inflow Volume (hours) =	11	39	29	36	41	46	50	56	77
Maximum Ponding Depth (ft) =	1.49	3.79	2.85	3.36	3.73	4.07	4.38	4.69	5.00
Area at Maximum Ponding Depth (acres) =	0.04	0.08	0.06	0.07	0.08	0.08	0.09	0.10	0.10
Maximum Volume Stored (acre-ft) =	0.041	0.172	0.108	0.140	0.166	0.193	0.220	0.249	0.279

DETENTION BASIN OUTLET STRUCTURE DESIGN

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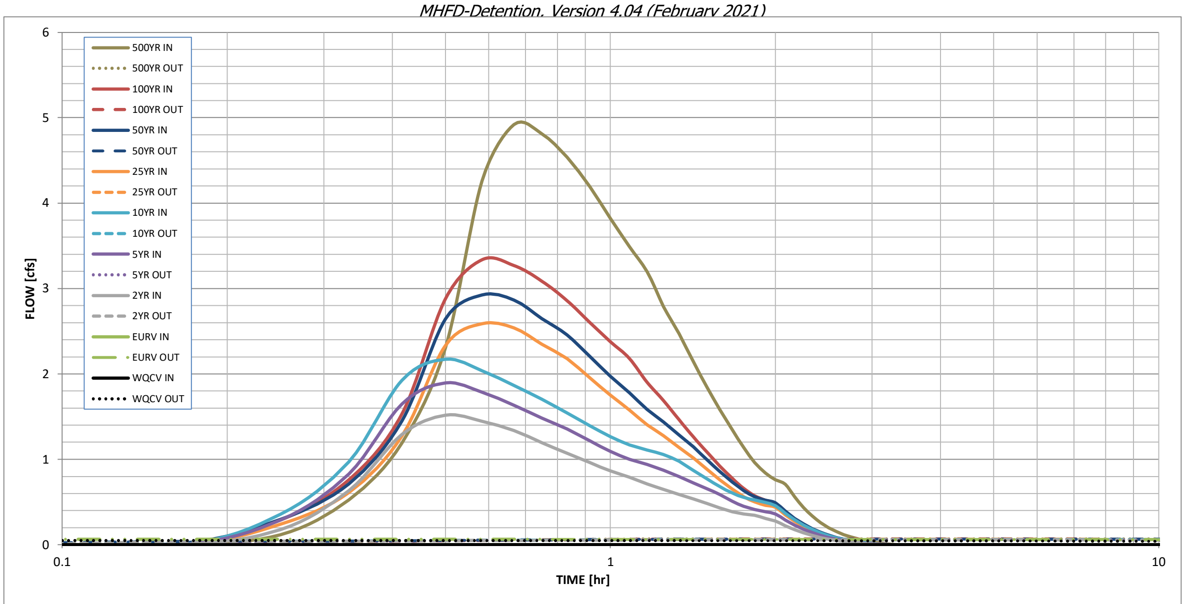
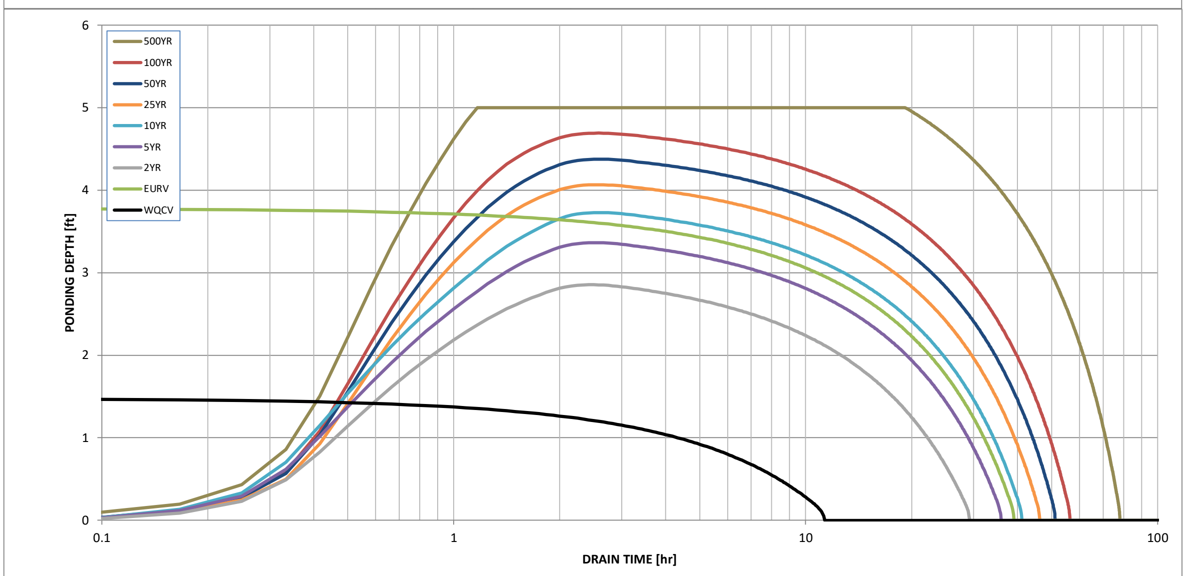
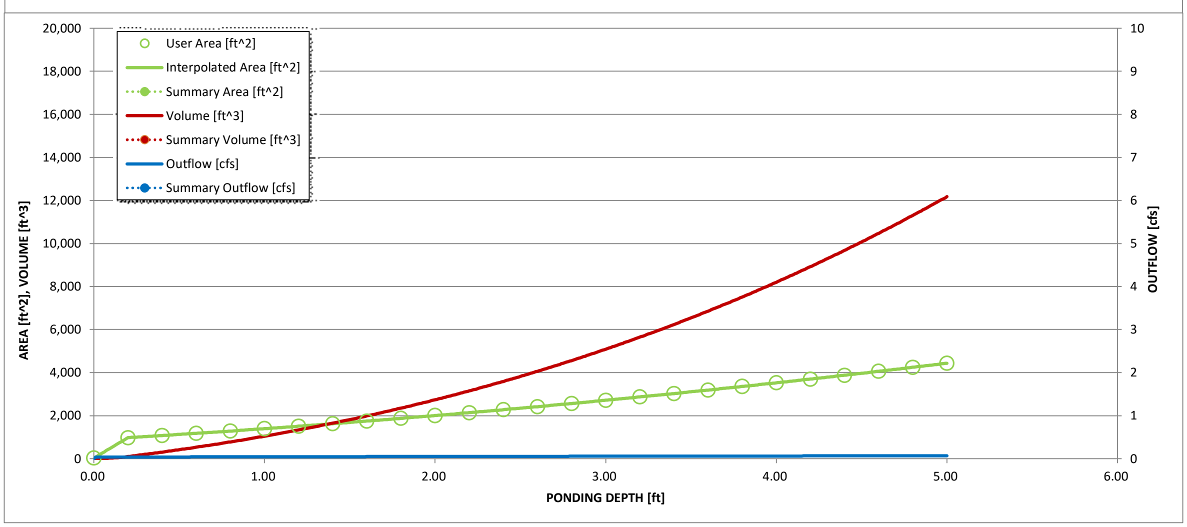






S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.12
	0:15:00	0.00	0.00	0.18	0.29	0.36	0.24	0.30	0.29	0.53
	0:20:00	0.00	0.00	0.63	0.83	0.97	0.61	0.71	0.76	1.19
	0:25:00	0.00	0.00	1.29	1.65	1.93	1.27	1.45	1.53	2.30
	0:30:00	0.00	0.00	1.52	1.90	2.17	2.33	2.64	2.88	4.26
	0:35:00	0.00	0.00	1.45	1.79	2.04	2.59	2.92	3.34	4.92
	0:40:00	0.00	0.00	1.34	1.63	1.86	2.54	2.87	3.27	4.81
	0:45:00	0.00	0.00	1.19	1.48	1.70	2.35	2.65	3.09	4.54
	0:50:00	0.00	0.00	1.07	1.35	1.54	2.18	2.46	2.86	4.19
	0:55:00	0.00	0.00	0.96	1.22	1.39	1.95	2.20	2.60	3.82
	1:00:00	0.00	0.00	0.86	1.09	1.27	1.75	1.97	2.38	3.49
	1:05:00	0.00	0.00	0.79	1.00	1.17	1.58	1.78	2.18	3.20
	1:10:00	0.00	0.00	0.71	0.94	1.11	1.40	1.58	1.90	2.79
	1:15:00	0.00	0.00	0.65	0.87	1.06	1.28	1.44	1.69	2.47
	1:20:00	0.00	0.00	0.59	0.80	0.98	1.14	1.28	1.46	2.14
	1:25:00	0.00	0.00	0.54	0.72	0.87	1.02	1.14	1.26	1.85
	1:30:00	0.00	0.00	0.48	0.65	0.77	0.88	0.99	1.09	1.58
	1:35:00	0.00	0.00	0.43	0.59	0.68	0.76	0.86	0.92	1.35
	1:40:00	0.00	0.00	0.39	0.51	0.61	0.65	0.73	0.78	1.14
	1:45:00	0.00	0.00	0.36	0.45	0.55	0.56	0.63	0.66	0.96
	1:50:00	0.00	0.00	0.34	0.41	0.52	0.50	0.56	0.57	0.84
	1:55:00	0.00	0.00	0.31	0.39	0.50	0.46	0.52	0.52	0.76
	2:00:00	0.00	0.00	0.28	0.36	0.46	0.44	0.49	0.49	0.71
	2:05:00	0.00	0.00	0.22	0.29	0.37	0.35	0.39	0.38	0.56
	2:10:00	0.00	0.00	0.18	0.23	0.29	0.27	0.31	0.30	0.43
	2:15:00	0.00	0.00	0.14	0.18	0.23	0.22	0.24	0.23	0.34
	2:20:00	0.00	0.00	0.11	0.14	0.18	0.17	0.19	0.18	0.26
	2:25:00	0.00	0.00	0.08	0.11	0.14	0.13	0.15	0.14	0.20
	2:30:00	0.00	0.00	0.07	0.08	0.11	0.10	0.11	0.10	0.15
	2:35:00	0.00	0.00	0.05	0.06	0.08	0.08	0.08	0.08	0.12
	2:40:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.09
	2:45:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.05	0.07
	2:50:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.03	0.05
	2:55:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.02	0.04
	3:00:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	3:05:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

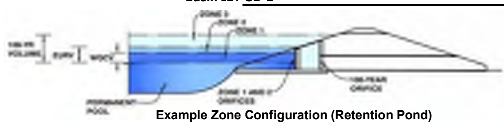
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Grandview**

Basin ID: **SB-2**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**SF**	
Watershed Area =	11.67	acres
Watershed Length =	930	ft
Watershed Length to Centroid =	465	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	2.00%	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
Target WQCV Drain Time =	12.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.012	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.011	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.006	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.012	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.016	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.146	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.294	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.496	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.68 in.) =	1.453	acre-feet	3.68	inches
Approximate 2-yr Detention Volume =	0.006	acre-feet		
Approximate 5-yr Detention Volume =	0.009	acre-feet		
Approximate 10-yr Detention Volume =	0.012	acre-feet		
Approximate 25-yr Detention Volume =	0.019	acre-feet		
Approximate 50-yr Detention Volume =	0.046	acre-feet		
Approximate 100-yr Detention Volume =	0.126	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.012	acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.012	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	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 = 0.20 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)
Media Surface	--	0.00	--	--	--	35	0.001		
	--	0.20	--	--	--	979	0.022	101	0.002
	--	0.40	--	--	--	1,076	0.025	307	0.007
	--	0.60	--	--	--	1,178	0.027	532	0.012
	--	0.80	--	--	--	1,284	0.029	778	0.018
	--	1.00	--	--	--	1,394	0.032	1,046	0.024
	--	1.20	--	--	--	1,508	0.035	1,336	0.031
	--	1.40	--	--	--	1,626	0.037	1,650	0.038
	--	1.60	--	--	--	1,748	0.040	1,987	0.046
	--	1.80	--	--	--	1,874	0.043	2,349	0.054
	--	2.00	--	--	--	2,003	0.046	2,737	0.063
	--	2.20	--	--	--	2,138	0.049	3,151	0.072
	--	2.40	--	--	--	2,276	0.052	3,592	0.082
	--	2.60	--	--	--	2,418	0.056	4,062	0.093
	--	2.80	--	--	--	2,564	0.059	4,560	0.105
	--	3.00	--	--	--	2,714	0.062	5,087	0.117
	--	3.20	--	--	--	2,868	0.066	5,646	0.130
	--	3.40	--	--	--	3,026	0.069	6,235	0.143
	--	3.60	--	--	--	3,188	0.073	6,856	0.157
	--	3.80	--	--	--	3,354	0.077	7,511	0.172
	--	4.00	--	--	--	3,525	0.081	8,199	0.188
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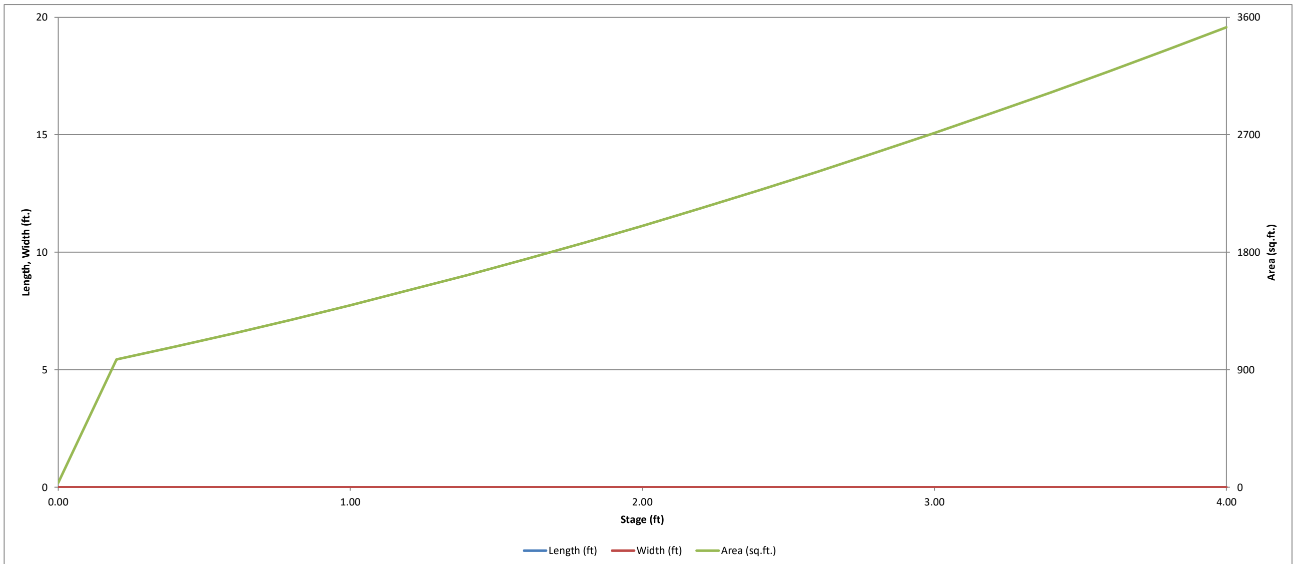
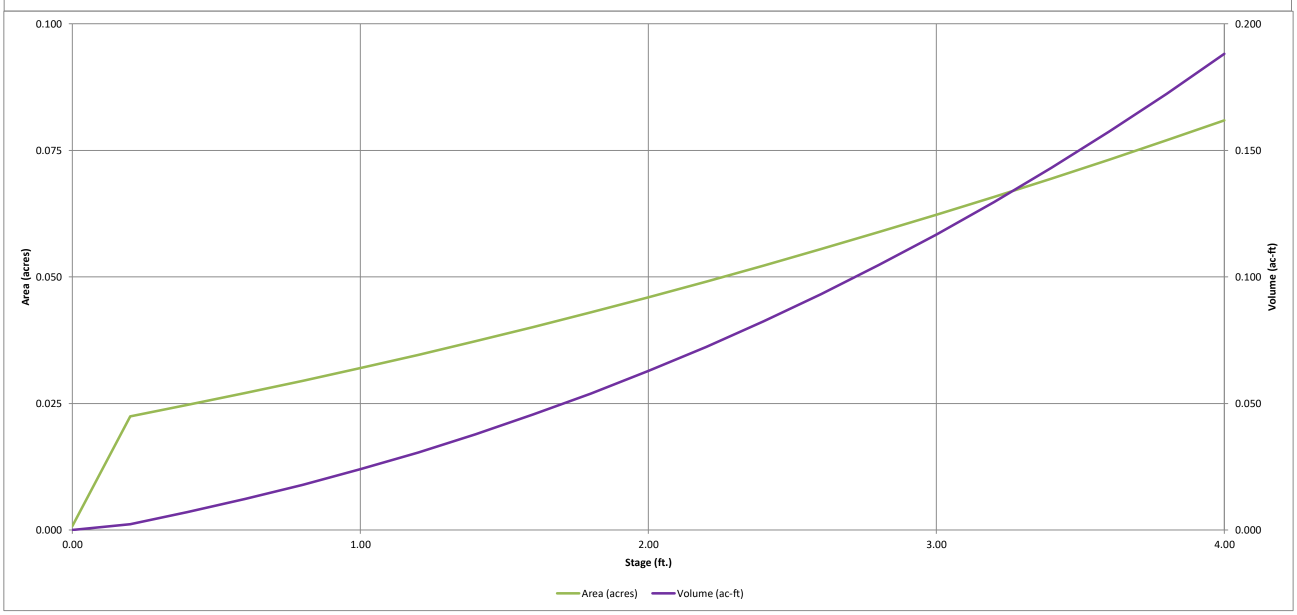
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

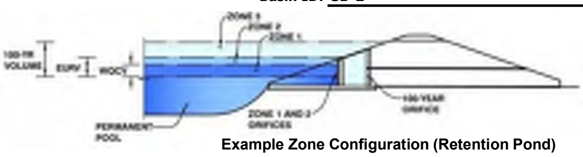




DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Grandview
Basin ID: SB-2



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.59	0.012	Filtration Media
Zone 2			Weir&Pipe (Circular)
Zone 3			
Total (all zones)		0.012	

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

Underdrain Orifice Invert Depth =	2.00	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	3.42	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.1	ft^2
Underdrain Orifice Centroid =	0.14	feet

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

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

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =			ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =			feet
Overflow Weir Grate Slope =			H:V
Horiz. Length of Weir Sides =			feet
Overflow Grate Type =			
Debris Clogging % =			%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =			feet
Overflow Weir Slope Length =			feet
Grate Open Area / 100-yr Orifice Area =			
Overflow Grate Open Area w/o Debris =			ft^2
Overflow Grate Open Area w/ Debris =			ft^2

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

	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =			ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =			inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Circular	Not Selected	
Outlet Orifice Area =			ft^2
Outlet Orifice Centroid =			feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres
Basin Volume at Top of Freeboard =		acre-ft

Routed Hydrograph Results

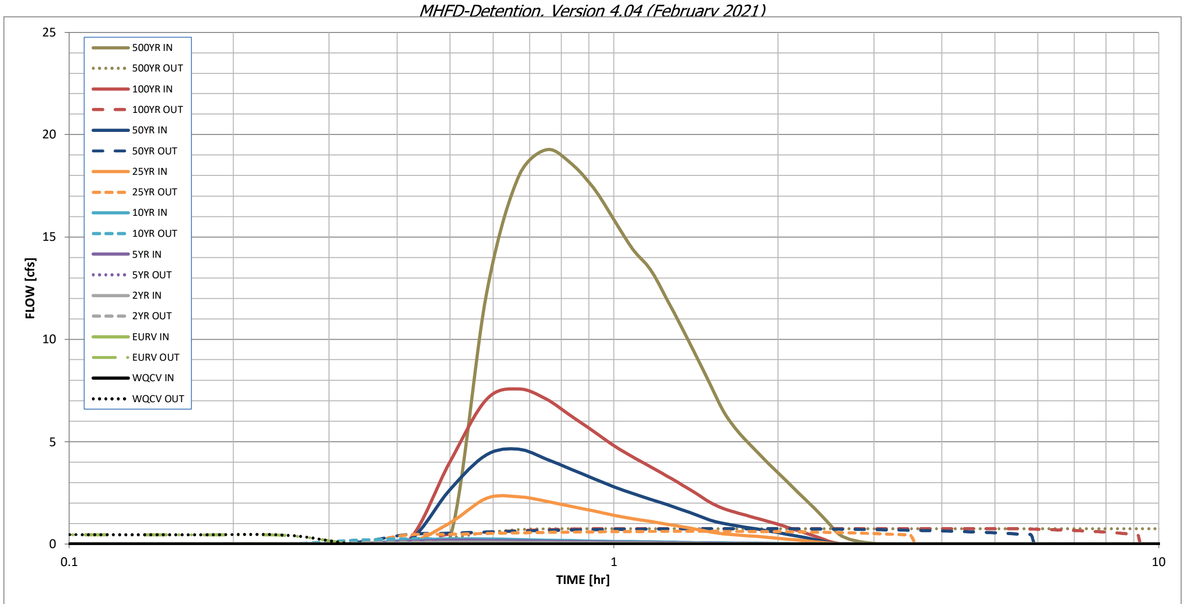
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

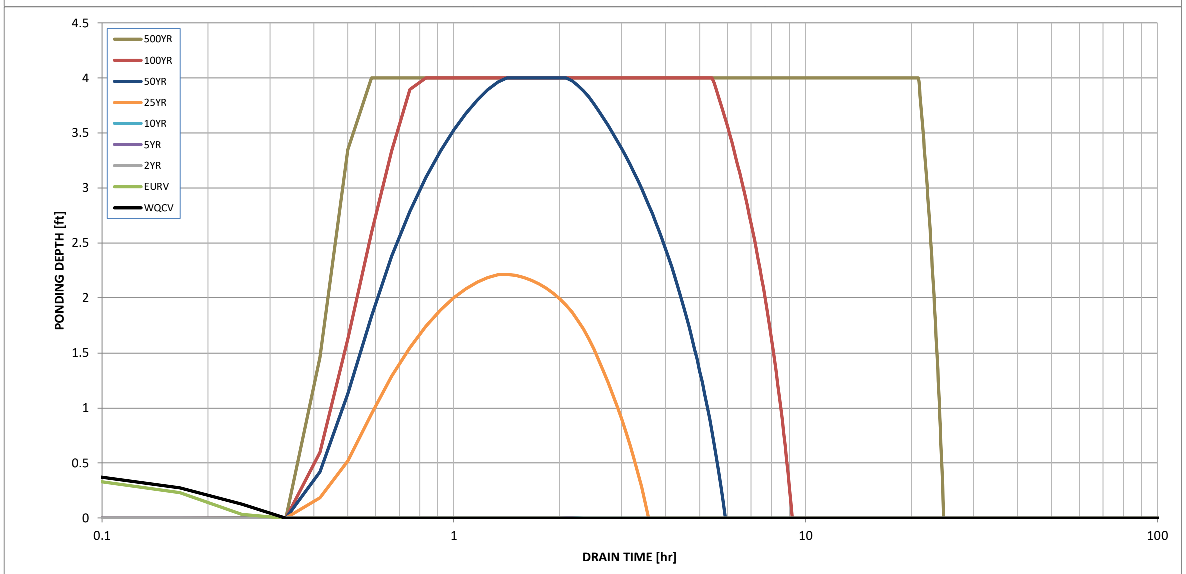
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.012	0.011	0.006	0.012	0.016	0.146	0.294	0.496	1.453
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.006	0.012	0.016	0.146	0.294	0.496	1.453
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.6	19.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.20	0.40	0.65	1.65
Peak Inflow Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.3	4.6	7.6	19.3
Peak Outflow Q (cfs) =	0.5	0.5	0.1	0.2	0.3	0.6	0.7	0.7	0.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	1.0	0.3	0.2	0.1	0.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	0	0	1	1	1	3	6	9	24
Time to Drain 99% of Inflow Volume (hours) =	**0**	0	1	1	1	4	6	9	24
Maximum Ponding Depth (ft) =	0.60	0.56	0.00	0.00	0.01	2.21	4.00	4.00	4.00
Area at Maximum Ponding Depth (acres) =	0.03	0.03	0.00	0.00	0.00	0.05	0.08	0.08	0.08
Maximum Volume Stored (acre-ft) =	0.012	0.011	0.000	0.000	0.000	0.073	0.188	0.188	0.188

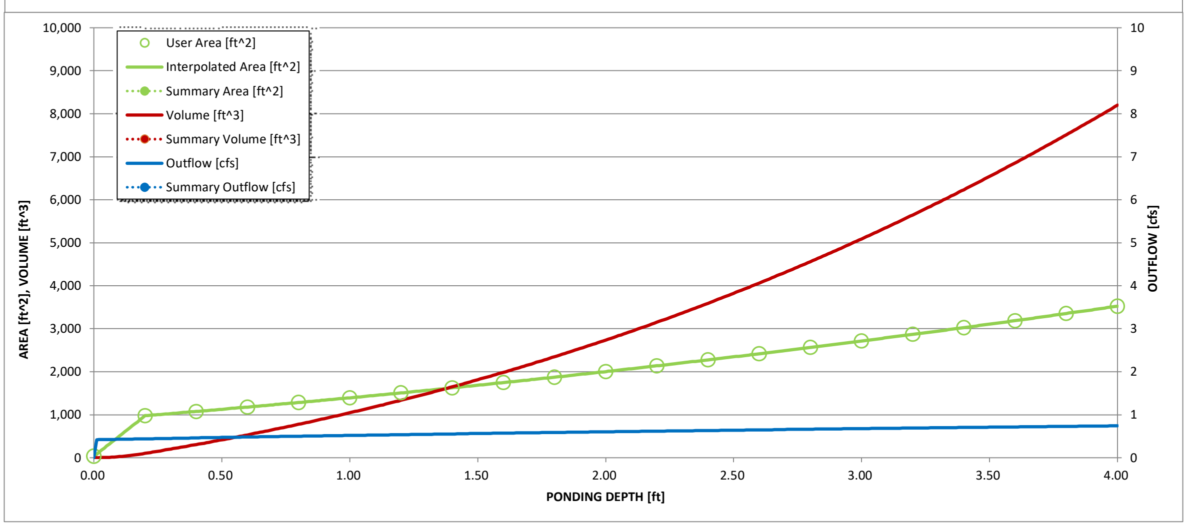
Calculations aren't working correctly without the spillway

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:20:00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	0:25:00	0.00	0.00	0.05	0.12	0.18	0.03	0.07	0.09	0.30
	0:30:00	0.00	0.00	0.09	0.19	0.25	1.02	2.66	4.01	12.22
	0:35:00	0.00	0.00	0.09	0.18	0.25	2.23	4.35	7.06	17.90
	0:40:00	0.00	0.00	0.08	0.16	0.22	2.32	4.63	7.58	19.26
	0:45:00	0.00	0.00	0.07	0.14	0.19	2.10	4.16	7.09	18.60
	0:50:00	0.00	0.00	0.06	0.12	0.17	1.84	3.66	6.26	17.41
	0:55:00	0.00	0.00	0.05	0.10	0.15	1.62	3.21	5.51	15.85
	1:00:00	0.00	0.00	0.05	0.09	0.13	1.41	2.79	4.81	14.39
	1:05:00	0.00	0.00	0.04	0.08	0.12	1.23	2.46	4.25	13.42
	1:10:00	0.00	0.00	0.04	0.07	0.10	1.10	2.19	3.77	11.98
	1:15:00	0.00	0.00	0.03	0.06	0.09	0.97	1.93	3.33	10.56
	1:20:00	0.00	0.00	0.03	0.05	0.08	0.85	1.68	2.89	9.17
	1:25:00	0.00	0.00	0.02	0.05	0.07	0.72	1.42	2.46	7.84
	1:30:00	0.00	0.00	0.02	0.04	0.06	0.60	1.17	2.04	6.55
	1:35:00	0.00	0.00	0.02	0.04	0.05	0.50	1.01	1.74	5.68
	1:40:00	0.00	0.00	0.02	0.03	0.05	0.45	0.90	1.56	5.04
	1:45:00	0.00	0.00	0.02	0.03	0.04	0.41	0.82	1.40	4.48
	1:50:00	0.00	0.00	0.01	0.03	0.04	0.37	0.73	1.25	3.97
	1:55:00	0.00	0.00	0.01	0.02	0.03	0.32	0.64	1.11	3.49
	2:00:00	0.00	0.00	0.01	0.02	0.03	0.28	0.56	0.96	3.02
	2:05:00	0.00	0.00	0.01	0.02	0.02	0.24	0.47	0.82	2.58
	2:10:00	0.00	0.00	0.01	0.01	0.02	0.20	0.39	0.67	2.16
	2:15:00	0.00	0.00	0.01	0.01	0.01	0.16	0.30	0.53	1.74
	2:20:00	0.00	0.00	0.00	0.01	0.01	0.11	0.22	0.39	1.32
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.07	0.13	0.25	0.90
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.11	0.50
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.29
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.18
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.11
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: Treven Edwards
Company: Galloway & Company
Date: May 4, 2022
Project: Grandview
Location: Basins C-3 & C-15

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**C-3**	**C-15**												
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam												
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	1.560	0.160												
Directly Connected Impervious Area (DCIA, acres)	0.000	0.000												
Unconnected Impervious Area (UIA, acres)	0.109	0.013												
Receiving Pervious Area (RPA, acres)	1.451	0.147												
Separate Pervious Area (SPA, acres)	0.000	0.000												
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C												

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	1.560	0.160												
Directly Connected Impervious Area (DCIA, %)	0.0%	0.0%												
Unconnected Impervious Area (UIA, %)	7.0%	8.2%												
Receiving Pervious Area (RPA, %)	93.0%	91.8%												
Separate Pervious Area (SPA, %)	0.0%	0.0%												
A_R (RPA / UIA)	13.286	11.195												
I_a Check	0.070	0.080												
f / I for WQCV Event:	1.7	1.7												
f / I for 5-Year Event:	0.5	0.5												
f / I for 100-Year Event:	0.3	0.3												
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.18	0.21												
IRF for 5-Year Event:	0.30	0.34												
IRF for 100-Year Event:	0.31	0.35												
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	7.0%	8.2%												
Effective Imperviousness for WQCV Event:	1.3%	1.7%												
Effective Imperviousness for 5-Year Event:	2.1%	2.8%												
Effective Imperviousness for 100-Year Event:	2.2%	2.9%												
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	80.1%	77.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	96.6%	87.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**7.1%**
Total Site Effective Imperviousness for WQCV Event:	**1.3%**
Total Site Effective Imperviousness for 5-Year Event:	**2.1%**
Total Site Effective Imperviousness for 100-Year Event:	**2.2%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: TJE
Company: Galloway & Co.
Date: May 4, 2022
Project: Grandview Reserve
Location: Basin D-7a

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**D-7a**													
Receiving Pervious Area Soil Type	Sandy Loam													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.250													
Directly Connected Impervious Area (DCIA, acres)	0.000													
Unconnected Impervious Area (UIA, acres)	0.025													
Receiving Pervious Area (RPA, acres)	0.226													
Separate Pervious Area (SPA, acres)	0.000													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.250													
Directly Connected Impervious Area (DCIA, %)	0.0%													
Unconnected Impervious Area (UIA, %)	9.8%													
Receiving Pervious Area (RPA, %)	90.2%													
Separate Pervious Area (SPA, %)	0.0%													
A_R (RPA / UIA)	9.204													
I_a Check	0.100													
f / I for WQCV Event:	1.7													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.3													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.26													
IRF for 5-Year Event:	0.42													
IRF for 100-Year Event:	0.44													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	9.8%													
Effective Imperviousness for WQCV Event:	2.6%													
Effective Imperviousness for 5-Year Event:	4.1%													
Effective Imperviousness for 100-Year Event:	4.3%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	70.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	69.7%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

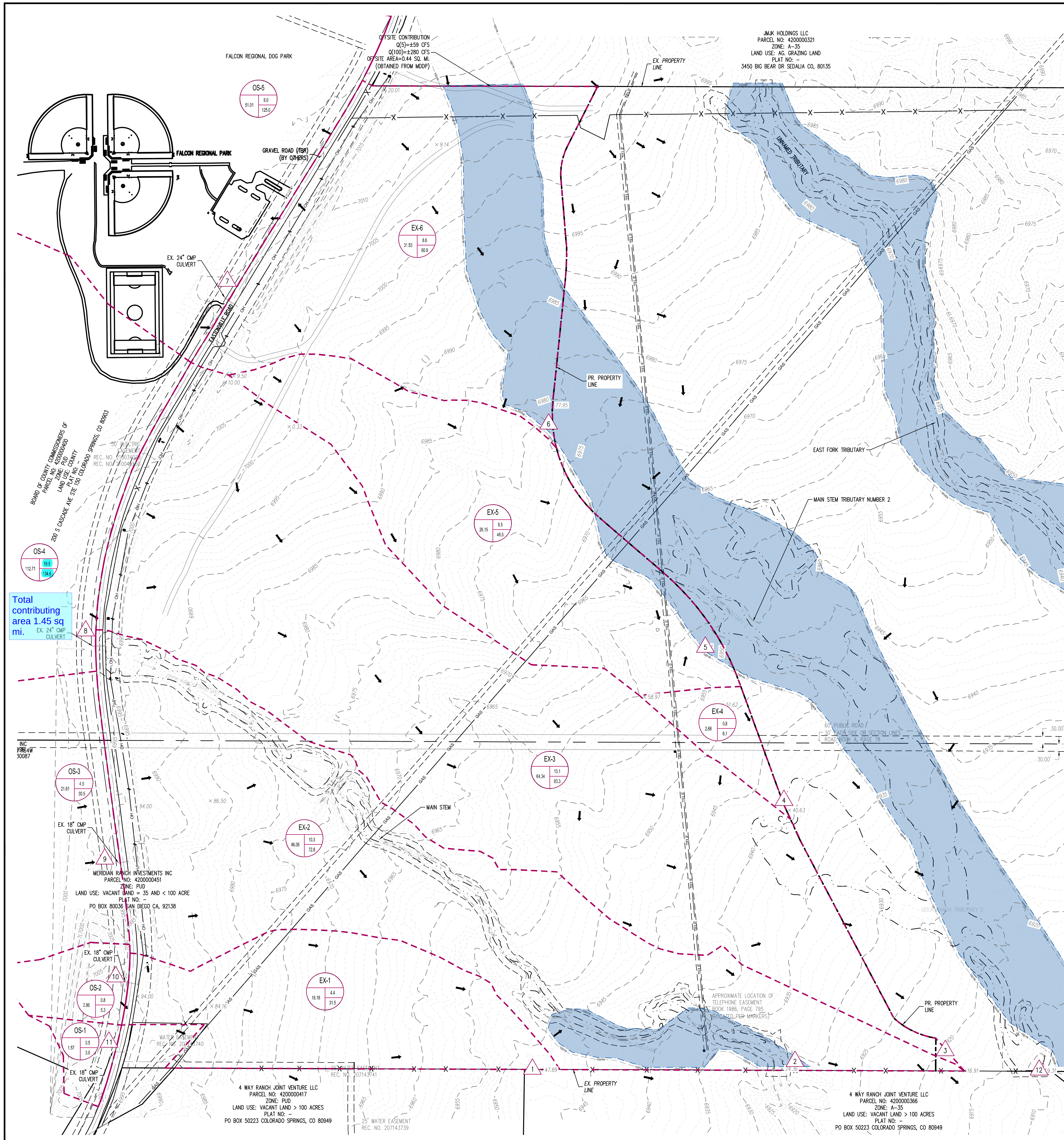
Total Site Imperviousness:	**9.8%**
Total Site Effective Imperviousness for WQCV Event:	**2.6%**
Total Site Effective Imperviousness for 5-Year Event:	**4.1%**
Total Site Effective Imperviousness for 100-Year Event:	**4.3%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

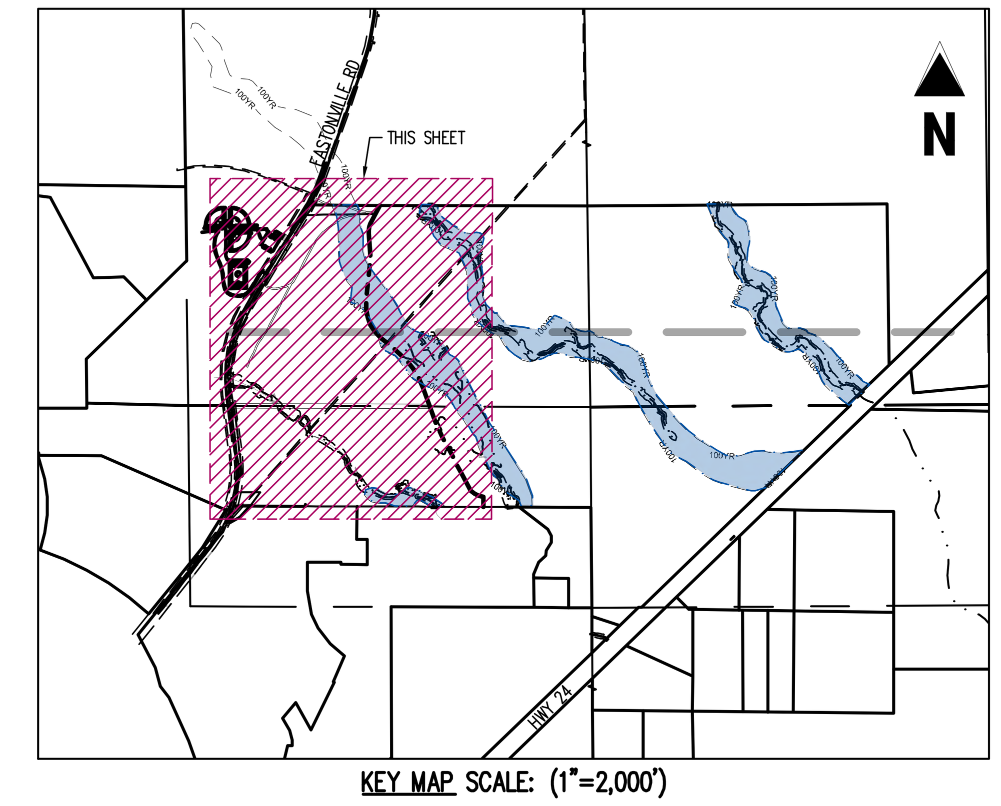
Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

APPENDIX F

Drainage Maps





DRAINAGE LEGEND

- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- EXISTING MAJOR CONTOUR
- 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
- EXISTING BOUNDARY EASEMENT
- EXISTING TELEPHONE LINE
- EXISTING POWER LINE
- EXISTING FENCE
- EXISTING GAS LINE
- EXISTING WETLANDS
- EXISTING LIMITS OF WETLAND
- EXISTING WETLAND SETBACK
- EXISTING FEMA FLOOD PLAIN, ZONE A

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
EX-1	16.18	3.4	24.4
EX-2	46.06	7.6	53.7
EX-3	64.34	10.0	71.6
EX-4	2.68	0.6	4.4
EX-5	26.15	5.0	35.5
EX-6	31.53	6.6	46.9
OS-1	1.57	0.5	3.6
OS-2	2.86	0.8	5.3
OS-3	21.61	4.5	30.5
OS-4	112.71	67.0	413.0
OS-5	51.01	8.0	125.0

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	4.7	33.3
2	79.1	497.2
3	10.0	71.6
4	0.6	4.4
5	5.0	35.5
6	14.6	584.9
7	8.0	125.0
8	67.0	413.0
9	4.5	30.5
10	0.8	5.3
11	0.5	3.6
12	89.2	976.3

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

PRELIMINARY
NOT FOR BIDDING
NOT FOR CONSTRUCTION

PRELIMINARY DRAINAGE PLAN
GRANDVIEW RESERVE
FOR
HR GREEN, INC

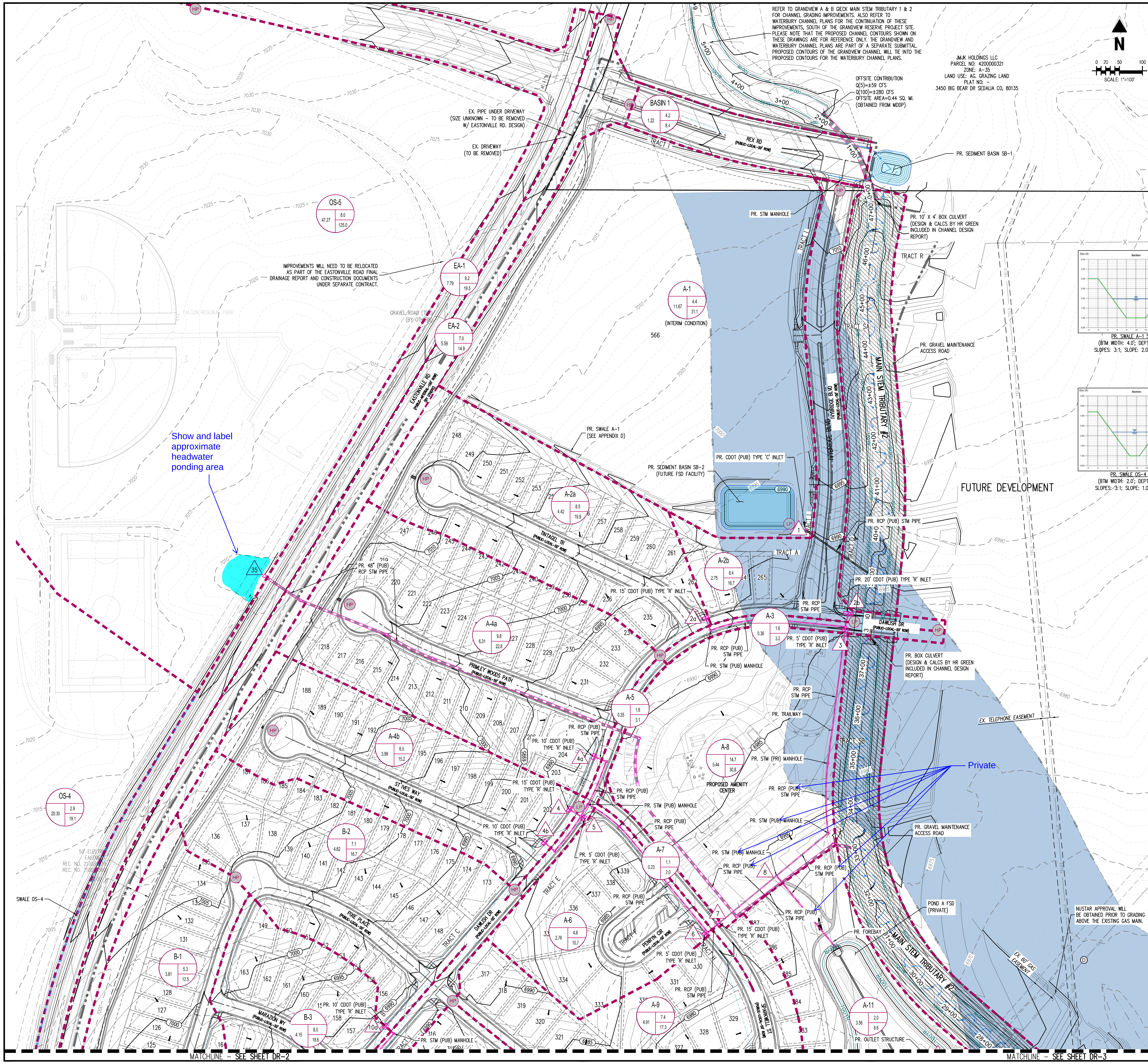
EASTONVILLE RD
EL PASO COUNTY, PEYTON, CO 80831

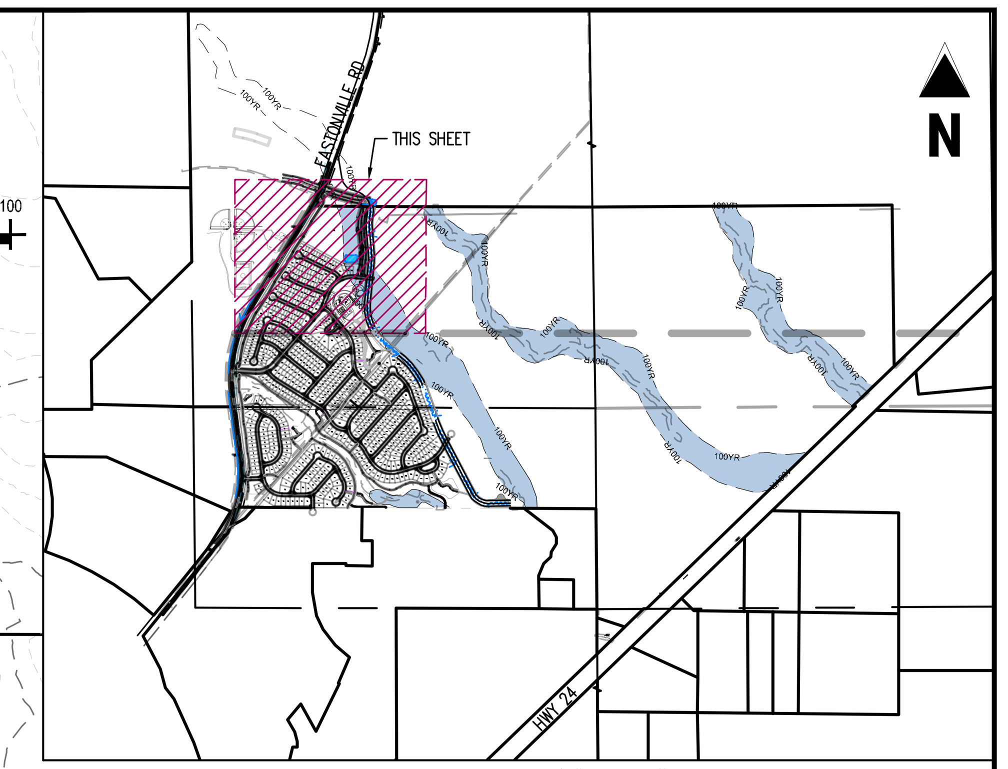
#	Date	Issue / Description	Init.

Project No:	HRG 1.20
Drawn By:	TJE
Checked By:	GRD
Date:	5/27/2022

EXISTING DRAINAGE MAP

EX-1





KEY MAP SCALE: (1"=2,000')

DRAINAGE LEGEND

- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- LOT BOUNDARY LINE
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED ROAD CENTERLINE
- BASIN BOUNDARY LINE
- PROPOSED STORM SEWER
- PROPOSED STORM STRUCTURES
- EXISTING WETLANDS
- EXISTING LIMITS OF WETLAND
- EXISTING WETLAND SETBACK
- EXISTING FEMA FLOOD PLAIN, ZONE A
- PROPOSED EMERGENCY OVERFLOW ROUTE
- CENTERLINE OF STREAM
- 100-YEAR WATER SURFACE ELEVATION AND FLOODPLAIN
- PROPOSED RIPRAP
- PROPOSED GRAVEL ACCESS
- 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
- PROPOSED CHANNEL ALIGNMENT (DESIGN BY OTHERS – SEE NOTE #1)

NOTES:

1. PROPOSED CHANNEL DESIGN AND ANALYSIS FOR BOTH ON-SITE TRIBUTARIES (MAIN STEM AND MAIN STEM TRIBUTARY NUMBER 2) IS PROVIDED IN A SEPARATE REPORT "GRANDVIEW RESERVE CLOMR REPORT", BY HR GREEN, MARCH 2022. ALL CHANNEL CULVERTS ARE SHOWN FOR REFERENCE ONLY AND ACTUAL SIZING AND ANALYSIS IS PROVIDED WITHIN THE CLOMR REPORT.

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
Basin-1	1.22	4.2	8.4
A-1	11.67	4.4	31.1
A-2a	4.42	8.5	19.9
A-2b	2.75	8.4	16.7
A-3	0.36	1.6	3.2
A-4a	6.31	9.8	22.8
A-4b	3.99	6.5	15.2
A-5	0.35	1.6	3.1
A-6	2.76	4.6	10.7
A-7	0.23	1.1	2.0
A-8	5.44	14.7	30.8
A-9	4.91	7.4	17.3
A-11	3.56	2.0	8.6
B-1	3.81	5.3	12.5
B-2	4.62	7.1	16.7
B-3	4.15	8.0	18.6
EA-1	7.79	9.2	19.5
EA-2	5.59	7.0	14.9
OS-4	20.30	-	-
OS-5	47.27	8.0.	125.0

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	4.4	31.1
2a	8.5	19.9
2b	9.0	23.7
3	1.6	3.2
4a	9.8	22.8
4b	6.5	15.2
4	2.5	16.1
5	1.6	3.1
6	4.6	10.7
7	1.1	2.0
8	14.7	30.8
10a	7.1	16.7
35	8.0	125.0
34	67.0	413.0

See other comments regarding Meridian Ranch calculated flows.

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
EA1	9.2	19.5
EA2	7.0	14.9
EA2.1	14.1	30.0
32	3.6	24.0
33	3.9	25.8
34	67.0	413.0
35	8.0	125.0

Galloway
1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920
719.900.7220
GallowayUS.com

PRELIMINARY
NOT FOR BIDDING
NOT FOR CONSTRUCTION

PRELIMINARY DRAINAGE PLAN
GRANDVIEW RESERVE FILING NO. 1
FOR
HR GREEN, INC

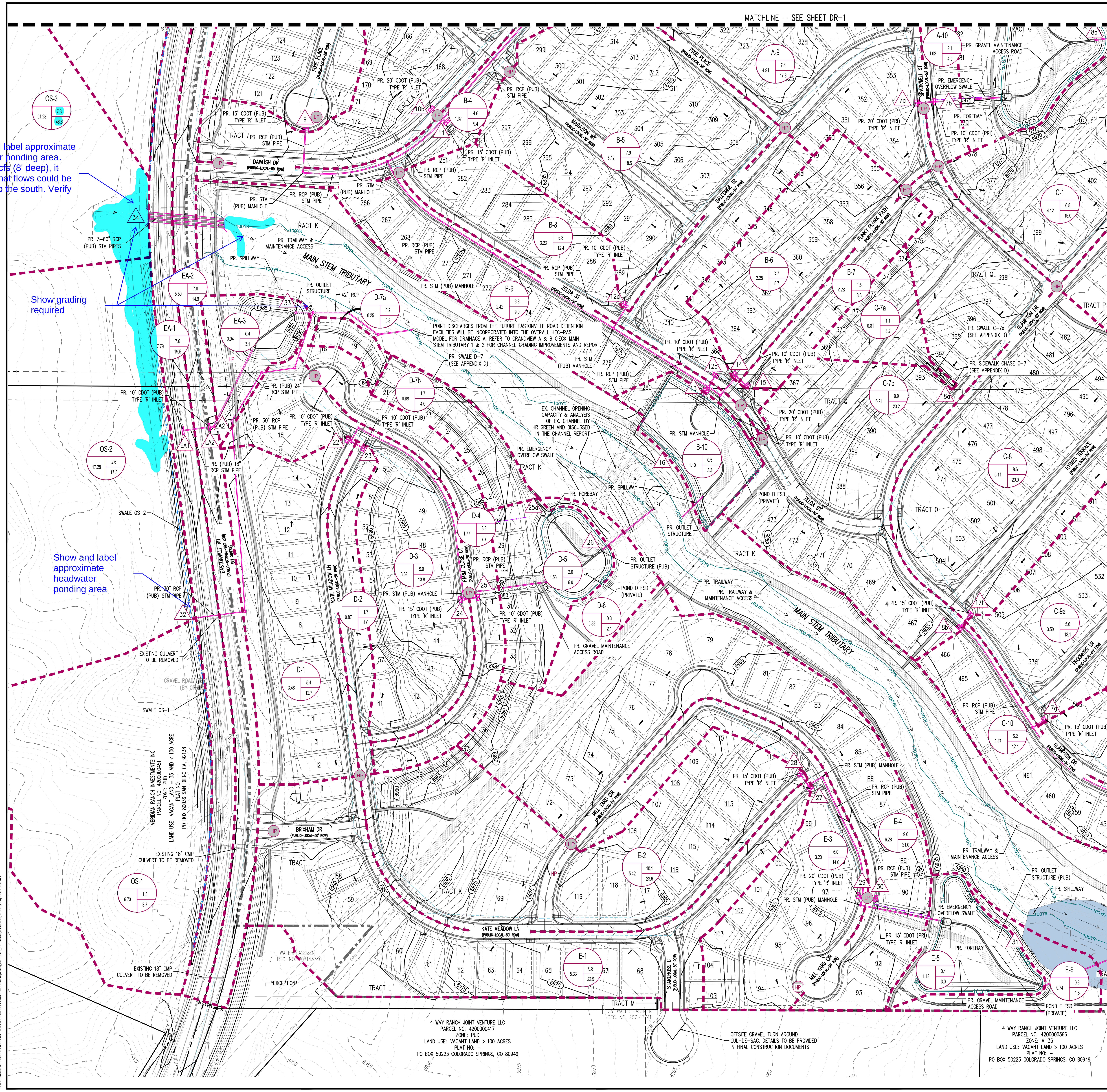
EASTONVILLE RD
EL PASO COUNTY, PEYTON, CO 80831

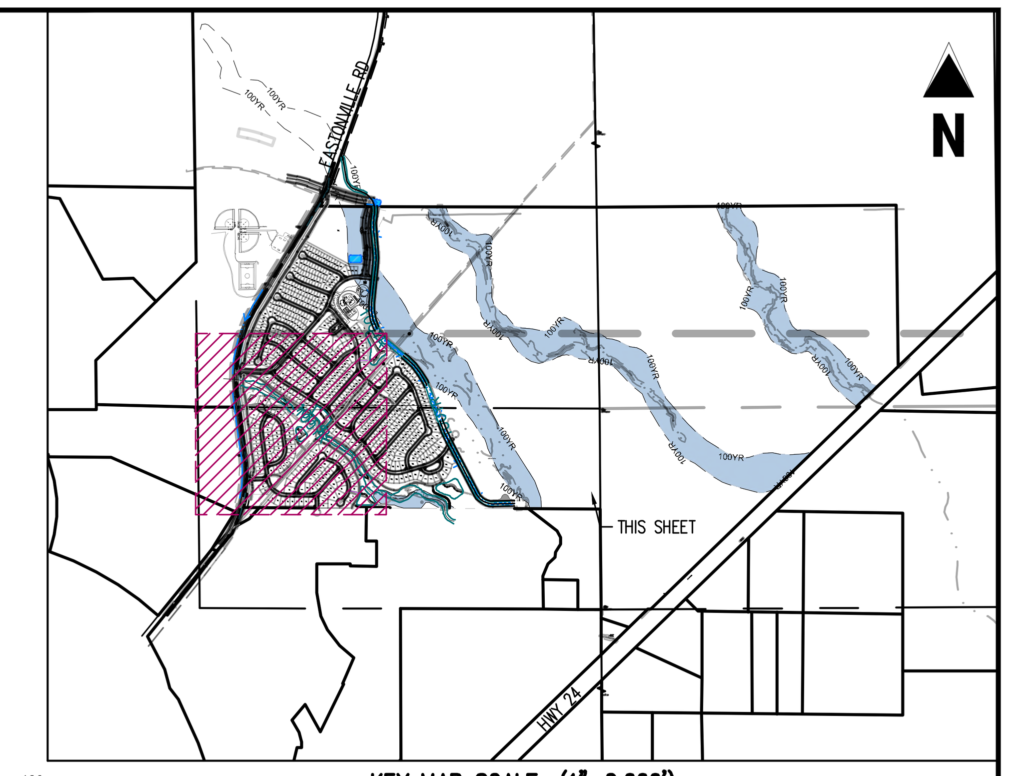
#	Date	Issue / Description	Init.

Project No: HRG 1.20
Drawn By: TJE
Checked By: GRD
Date: 6/8/2022

PROPOSED DRAINAGE MAP

DR-1





N

SCALE: 1"=100'

KEY MAP SCALE: (1"=2,000')

DESIGN POINT SUMMARY TABLE		
Design Point	Q_5 (cfs)	Q_{100} (cfs)
7a	7.8	21.1
7b	2.2	5.3
8a	58.9	134.9
9	5.3	12.5
10b	9.6	26.9
11	4.6	9.4
12a	7.9	18.5
12b	7.4	24.5
13	3.8	9.0
14	3.7	8.7
15	1.6	3.8
16	43.7	103.2
17f	8.6	20.0
17g	6.2	20.0
18a	1.1	3.2
18b	11.0	26.0
22	5.4	12.7
23	1.7	4.0
24	6.6	19.2
25	3.3	7.7
26	18.1	43.2
27	9.8	22.9
28	10.1	23.6
29	8.1	32.1
30	9.0	21.0
31	29.3	69.9
32	3.6	24.0
33	3.9	25.8
34	67.0	414.0
EA1	9.2	19.5
EA2	7.0	14.9
EA2.1	15.8	33.4

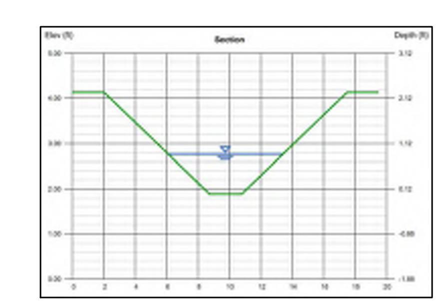
RUNOFF SUMMARY TABLE			
Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
A-9	4.91	7.4	17.3
A-10	1.02	2.1	4.9
B-4	1.37	4.6	9.4
B-5	5.12	7.9	18.5
B-6	2.28	3.7	8.7
B-7	0.89	1.6	3.8
B-8	3.23	5.3	12.4
B-9	2.42	3.8	9.0
B-10	1.10	0.5	3.3
C-1	4.12	6.8	16.0
C-7a	0.81	1.1	3.2
C-7b	5.91	9.9	23.2
C-8	5.11	8.6	20.0
C-9a	3.50	5.6	13.1
C-10	3.47	5.2	12.1
D-1	3.48	5.4	12.7
D-2	0.87	1.7	4.0
D-3	3.62	5.9	13.8
D-4	1.77	3.3	7.7
D-5	1.53	2.0	6.0
D-6	0.83	0.3	2.1
D-7a	0.25	0.2	0.8
D-7b	0.88	1.7	4.0
E-1	5.33	9.8	22.9
E-2	5.42	10.1	23.6
E-3	3.20	6.0	14.0
E-4	6.28	9.0	21.0
E-5	1.13	0.4	3.0
E-6	0.74	0.3	1.8
EA-1	7.79	9.2	19.5
EA-2	5.59	7.0	14.9
EA-3	0.94	0.4	3.1
OS-1	6.73	1.3	8.7
OS-2	17.28	2.6	17.3
OS-3	91.28	-	-

DRAINAGE LEGEND

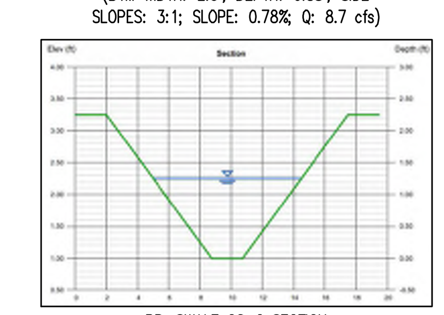
- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- LOT BOUNDARY LINE
- EXISTING MAJOR CONTOUR (6480)
- EXISTING MINOR CONTOUR
- PROPOSED MAJOR CONTOUR (6480)
- PROPOSED MINOR CONTOUR
- PROPOSED ROAD CENTERLINE
- BASIN BOUNDARY LINE
- PROPOSED STORM SEWER
- PROPOSED STORM STRUCTURES
- EXISTING WETLANDS
- EXISTING LIMITS OF WETLAND
- EXISTING WETLAND SETBACK
- EXISTING FEMA FLOOD PLAIN, ZONE A
- PROPOSED EMERGENCY OVERFLOW ROUTE
- CENTERLINE OF STREAM
- 100-YEAR WATER SURFACE ELEVATION AND FLOODPLAIN (100YR)
- PROPOSED RIPRAP
- PROPOSED GRAVEL ACCESS
- 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
- PROPOSED CHANNEL ALIGNMENT (DESIGN BY OTHERS - SEE NOTE #1)

NOTES:

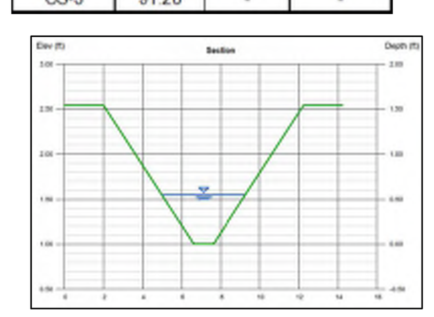
1. PROPOSED CHANNEL DESIGN AND ANALYSIS FOR BOTH ON-SITE TRIBUTARIES (MAIN STEM AND MAIN STEM TRIBUTARY NUMBER 2) IS PROVIDED IN A SEPARATE REPORT "GRANDVIEW RESERVE CLOMR REPORT", BY HR GREEN, MARCH 2022. ALL CHANNEL CULVERTS ARE SHOWN FOR REFERENCE ONLY AND ACTUAL SIZING AND ANALYSIS IS PROVIDED WITHIN THE CLOMR REPORT.



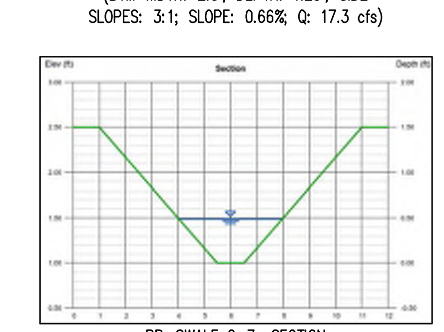
PR. SWALE OS-1 SECTION
(BTM WIDTH: 2.0'; DEPTH: 0.88'; SIDE SLOPES: 3:1; SLOPE: 0.78%; Q: 8.7 cfs)



PR. SWALE OS-2 SECTION
(BTM WIDTH: 2.0'; DEPTH: 1.25'; SIDE SLOPES: 3:1; SLOPE: 0.66%; Q: 17.3 cfs)



PR. SWALE D-7 SECTION
(BTM WIDTH: 1.0'; DEPTH: 0.55'; SIDE SLOPES: 3:1; SLOPE: 2.0%; Q: 4.0 cfs)



PR. SWALE C-7a SECTION
(BTM WIDTH: 1.0'; DEPTH: 0.49'; SIDE SLOPES: 3:1; SLOPE: 2.0%; Q: 3.2 cfs)

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1155 Kelly Johnson Blvd., Suite 305
Colorado Springs, CO 80920
719.900.7220
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PRELIMINARY DRAINAGE PLAN
GRANDVIEW RESERVE FILING NO. 1
FOR
HR GREEN, INC

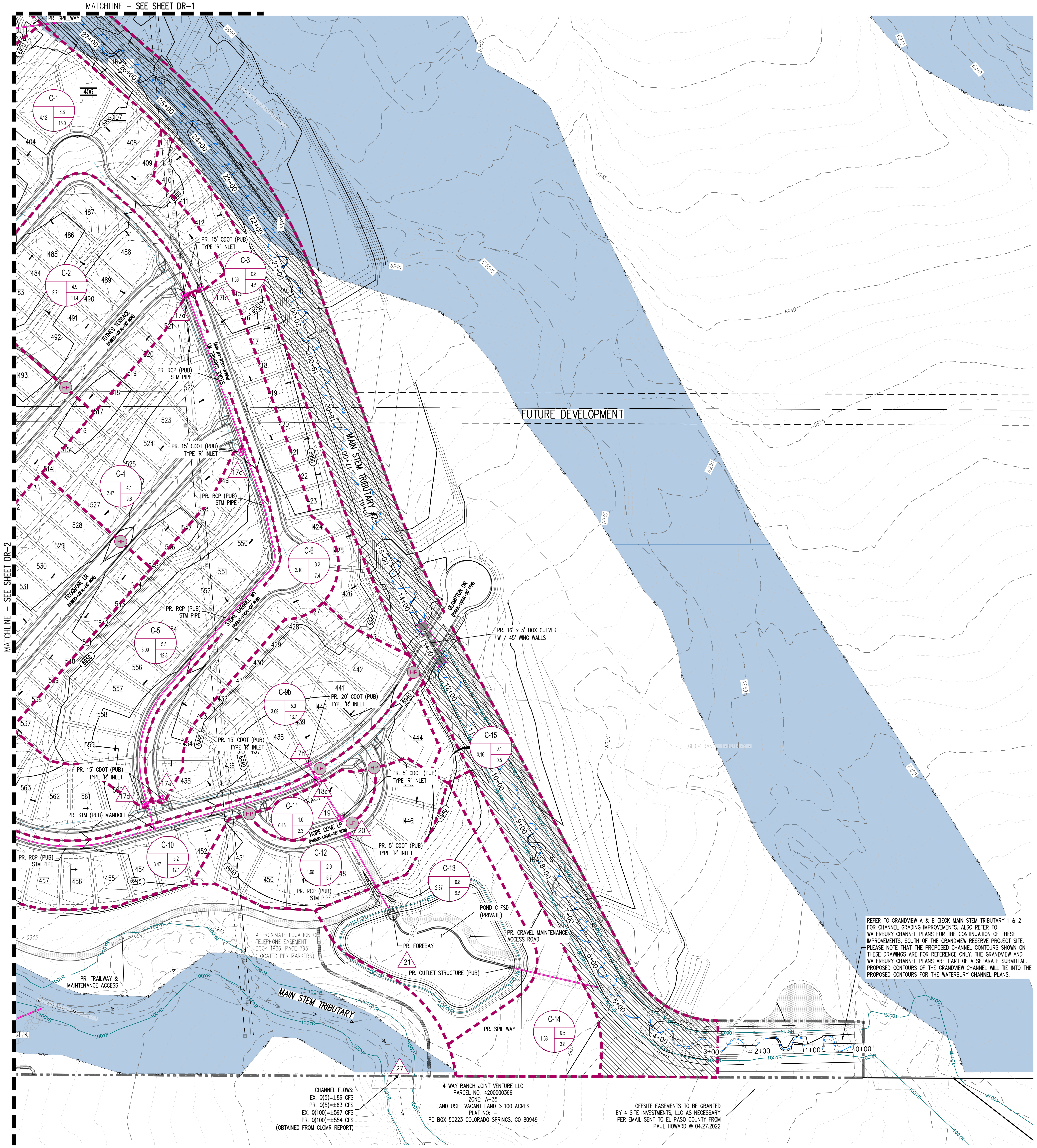
EASTONVILLE RD
EL PASO COUNTY, PEYTON, CO 80831

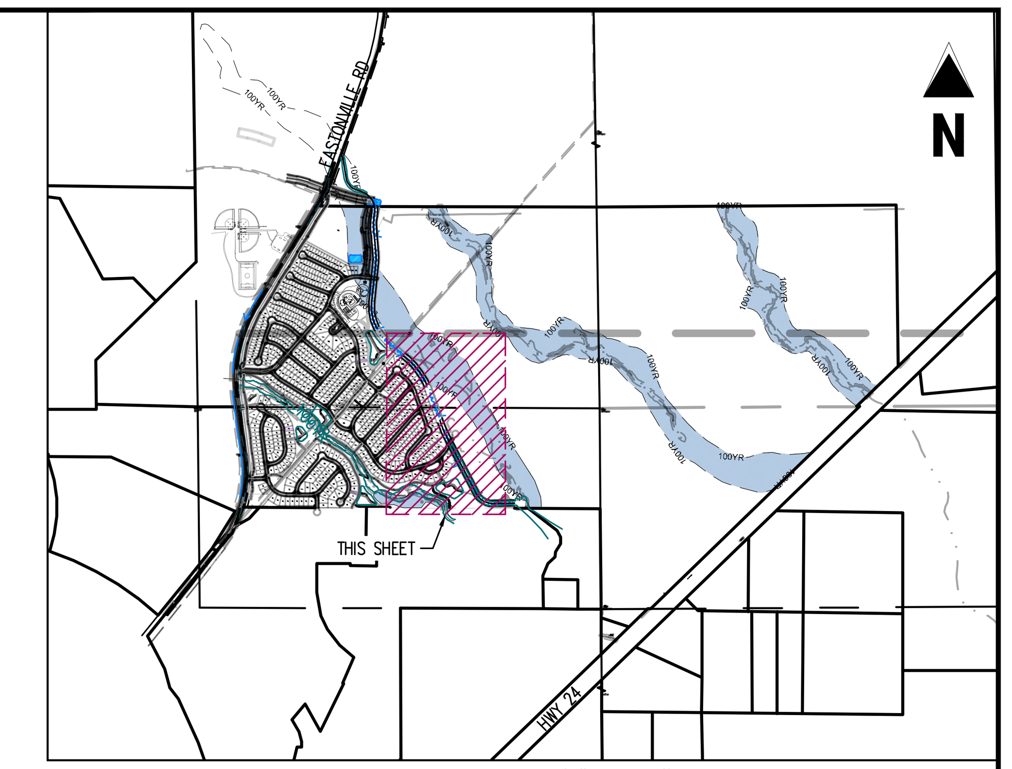
#	Date	Issue / Description	Init.

Project No:	HRG 1.20
Drawn By:	TJE
Checked By:	GRD
Date:	6/8/2022

PROPOSED DRAINAGE MAP

DR-2





KEY MAP SCALE: (1"=2,000')

DRAINAGE LEGEND

- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- LOT BOUNDARY LINE
- 6480 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- 6480 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED ROAD CENTERLINE
- BASIN BOUNDARY LINE
- PROPOSED STORM SEWER
- PROPOSED STORM STRUCTURES
- EXISTING WETLANDS
- EXISTING LIMITS OF WETLAND
- EXISTING WETLAND SETBACK
- EXISTING FEMA FLOOD PLAIN, ZONE A
- PROPOSED EMERGENCY OVERFLOW ROUTE
- CENTERLINE OF STREAM
- 100YR 100-YEAR WATER SURFACE ELEVATION AND FLOODPLAIN
- PROPOSED RIPRAP
- PROPOSED GRAVEL ACCESS
- 1 — BASIN DESIGNATION; 1.8 — 5-YEAR RUNOFF IN CUBIC FEET PER SECOND; 4.8 — 100-YEAR RUNOFF IN CUBIC FEET PER SECOND; 0.71 — BASIN AREA IN ACRES
- 1 DESIGN POINT
- DIRECTION OF RUNOFF
- PROPOSED CHANNEL ALIGNMENT (DESIGN BY OTHERS - SEE NOTE #1)

NOTES:

1. PROPOSED CHANNEL DESIGN AND ANALYSIS FOR BOTH ON-SITE TRIBUTARIES (MAIN STEM AND MAIN STEM TRIBUTARY NUMBER 2) IS PROVIDED IN A SEPARATE REPORT "GRANDVIEW RESERVE CLOMR REPORT", BY HR GREEN, MARCH 2022. ALL CHANNEL CULVERTS ARE SHOWN FOR REFERENCE ONLY AND ACTUAL SIZING AND ANALYSIS IS PROVIDED WITHIN THE CLOMR REPORT.

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
C-1	4.12	6.8	16.0
C-2	2.71	4.9	11.4
C-3	1.56	0.8	4.5
C-4	2.47	4.1	9.6
C-5	3.09	5.5	12.8
C-6	2.10	3.2	7.4
C-9b	3.69	5.9	13.7
C-10	3.47	5.2	12.1
C-11	0.46	1.0	2.3
C-12	1.66	2.9	6.7
C-13	2.37	0.8	5.5
C-14	1.53	0.5	3.8
C-15	0.16	0.1	0.5

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
17a	4.9	11.4
17b	6.8	16.0
17c	5.8	20.8
17d	5.5	20.2
17e	3.3	11.7
17h	5.9	29.5
18c	6.9	23.3
19	1.0	2.3
20	2.9	6.7
21	58.7	140.8

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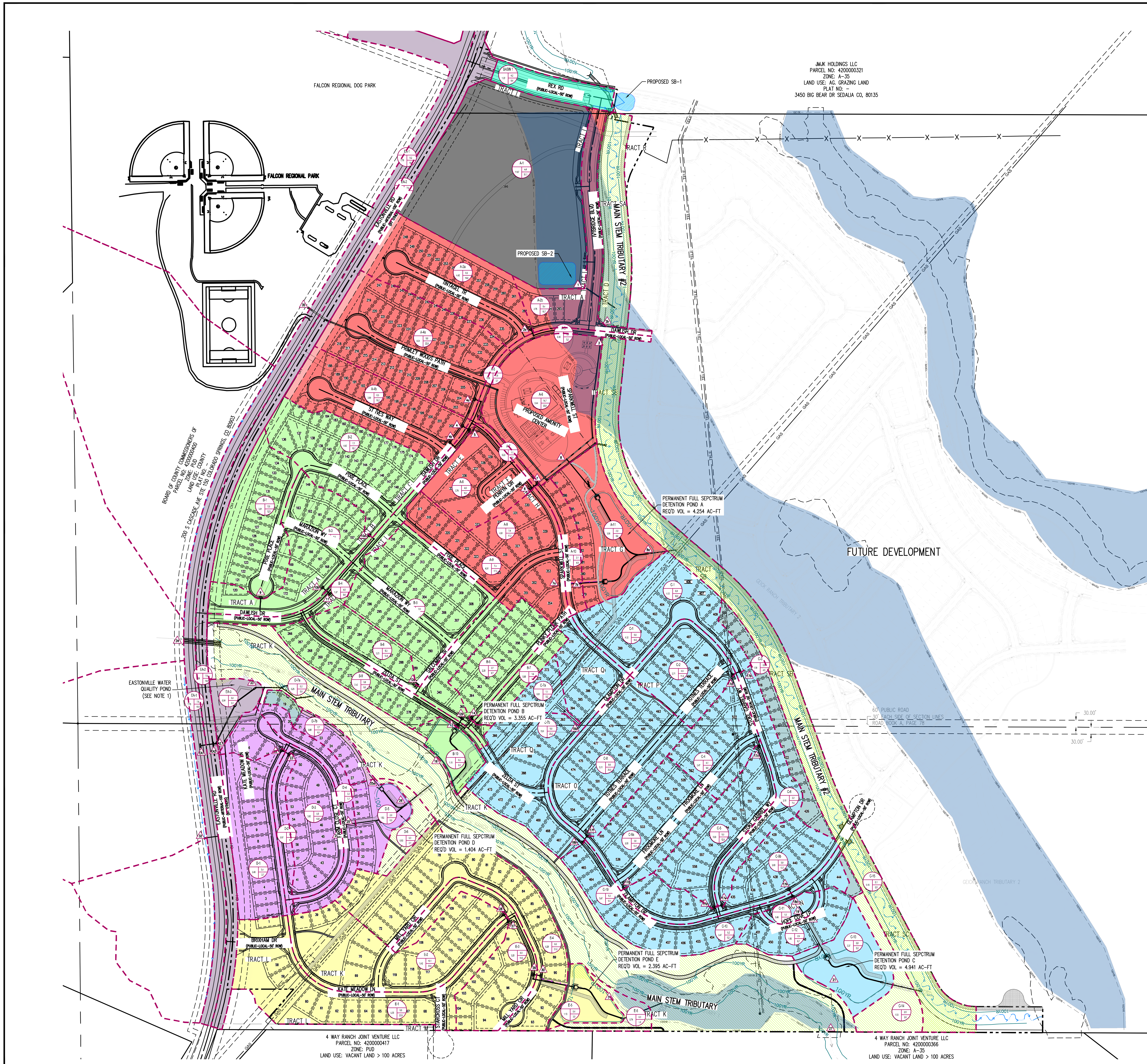
PRELIMINARY DRAINAGE PLAN GRANDVIEW RESERVE FILING NO. 1 FOR HR GREEN, INC

EASTONVILLE RD
EL PASO COUNTY, PEYTON, CO 80831

#	Date	Issue / Description	Init.

Project No:	HRG 1.20
Drawn By:	TJE
Checked By:	GRD
Date:	6/8/2022

PROPOSED DRAINAGE MAP



DRAINAGE LEGEND

- PROPERTY LINE
- PROPOSED ROAD CENTERLINE
- BASIN BOUNDARY LINE
- EXISTING WETLANDS
- EXISTING LIMITS OF WETLAND
- EXISTING WETLAND SETBACK
- EXISTING FEMA FLOOD PLAIN, ZONE A
- CENTERLINE OF STREAM
- PROPOSED RIPRAP
- PROPOSED MAINTENANCE ACCESS
- 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)
- FUTURE DEVELOPMENT (NOT PART – TSB PROVIDED)
- ROADWAY (DESIGN BY OTHERS – SEE NOTE 1)
- AREA TO BE DETAINED IN PBMP (POND A)
- AREA TO BE DETAINED IN PBMP (POND B)
- AREA TO BE DETAINED IN PBMP (POND C)
- AREA TO BE DETAINED IN PBMP (POND D)
- AREA TO BE DETAINED IN PBMP (POND E)
- AREA NOT TO BE DETAINED IN PBMP PER SECTION I.7.1.B.7 (LAND DISTURBANCE TO UNDEVELOPED LAND THAT WILL REMAIN UNDEVELOPED)
- AREA TO BE DETAINED IN FUTURE PBMP WITH THE REMAINDER OF THE REX RD DEVELOPMENT – TSB PROVIDED
- AREA WHERE WATER QUALITY IS ACHIEVED THROUGH RUNOFF REDUCTION (ROOF DRAINS & IMPERVIOUS SURFACES NOT PERMITTED ON BACK OF THESE LOTS)
- AREA TO BE DETAINED IN PUBLIC PBMP (EASTONVILLE ROAD)

NOTES:

1. EASTONVILLE ROAD AND THE WESTERN PORTION OF REX ROAD AT EASTONVILLE IS TO BE CONSTRUCTED CONCURRENTLY WITH THIS DEVELOPMENT. DRAINAGE FOR THESE AREAS WILL BE CAPTURED AND TREATED BY OFFSITE INFRASTRUCTURE AND PONDS AS DESCRIBED IN THE "FINAL DRAINAGE REPORT FOR EASTONVILLE ROAD FROM FUTURE REX ROAD TO LONDONDERRY DRIVE", BY HR GREEN, MARCH 2022. BASIN SHOWN ARE FOR REFERENCE ONLY.

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PRELIMINARY DRAINAGE PLAN
GRANDVIEW RESERVE FILING NO. 1
FOR
HR GREEN, INC

EASTONVILLE RD
EL PASO COUNTY, PEYTON, CO 80831

#	Date	Issue / Description	Init.
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Project No:	HRG 1.20
Drawn By:	NJA
Checked By:	GRD
Date:	5/27/2022

WQ MAP

DR-4