# PRELIMINARY DRAINAGE REPORT

## GRANDVIEW RESERVE FILING NO. 1

El Paso County, Colorado

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

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

DATE:
**March 04, 2022**

**Engineering Review**
*04/20/2022 8:22:53 AM*
*dsdrice*
JeffRice@elpasoco.com
**(719) 520-7877**
**EPC Planning & Community Development Department**

*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.

## 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.*

_____ _____

Jennifer Irvine, P.E. Date
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 is bounded by Eastonville Road to the west, the proposed extension of Rex Road to the north, 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 568 dwelling units.

567? LOT COUNT IS NOW 567

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.

# 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.

OFFSITE BASINS ARE NOW INCLUDED WITHIN BOTH EXISTING CONDITIONS AND PROPOSED CONDITIONS

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.

Address the offsite basins as well

**Basin EX-1** (16.18 AC, $Q_5$ = 4.4 cfs, $Q_{100}$ = 31.5 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)**.

Address the combined flows including flows from the west

**Basin EX-2** (46.06 AC, $Q_5$ = 10.3 cfs, $Q_{100}$ = 72.8 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)**.

COMBINED FLOWS FROM THE WEST HAVE BEEN ADDRESSED WITH ADDITIONAL DESIGN POINTS.

**Basin EX-3** (64.34 AC, $Q_5$ = 13.1 cfs, $Q_{100}$ = 93.3 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, $Q_5$ = 0.8 cfs, $Q_{100}$ = 6.1 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, $Q_5$ = 6.5 cfs, $Q_{100}$ = 46.5 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, $Q_5$ = 8.6 cfs, $Q_{100}$ = 60.9 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)**.

Runoff generated at Design Points 3, 4, 5, and 6 combine at Design Point 7 at the southeast corner of the property within the Main Stem Tributary #2 channel **(DP 7)**.

## 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 Channel (MS) is to be completed by others and a report for the channel improvements will be submitted for review separately.

Main Stem Tributary #2?

CORRECT

### 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 five (5) larger basins (A, B, C, D, &E) which have been broken down into fifty-three (53) smaller sub-basins. Site runoff will be collected via inlets & pipes and diverted to one of the nine proposed full spectrum detention ponds. 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) 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.

**Basin OS-1** (3.28 AC, $Q_5$ = 7.2 cfs, $Q_{100}$ = 15.1 cfs) and **Basin OS-2** (2.31 AC, $Q_5$ = 4.6 cfs, $Q_{100}$ = 10.3 cfs): Located at the northwestern border of the site within the public ROW for Eastonville Road, contains the proposed improvements to Eastonville Road. This drainage basin consists entirely of onsite roadway improvements outside of the project site. Runoff from this basin will sheet flow to the proposed curb & gutter along Eastonville Road. The flows will then be routed to the south where they will be captured by a combination of inlets, roadside swale, and storm sewer piping, which will convey and discharge the developed runoff into a detention pond on the north side of the MS and west of Eastonville Road (Northern Pond). Runoff will be treated prior to being released at historic rates immediately upstream from the MS and Eastonville Road.

**Basin OS-3** (3.02 AC, $Q_5$ = 7.0 cfs, $Q_{100}$ = 15.3 cfs) and **Basin OS-4** (3.00 AC, $Q_5$ = 6.2 cfs, $Q_{100}$ = 14.3 cfs): Located at the southwestern border of the site within the public ROW for Eastonville Road, contains the proposed improvements to Eastonville Road. This drainage basin consists entirely of onsite roadway improvements outside of the project site. Runoff from this basin will sheet flow to the proposed curb & gutter along Eastonville Road. The flows will then be routed to the north where they will be captured by a combination of inlets, roadside swale, and storm sewer piping, which will convey and discharge the developed runoff into a detention pond on the north side of the MS and west of Eastonville Road (Southern Pond). Runoff will be treated prior to being released at historic rates immediately upstream from the MS and Eastonville Road.

south? CORRECT

Preliminary sizing calculations for the two FSD facilities has been completed with the northern and southern ponds requiring approximately 1.035 ac-ft and 0.522 ac-ft of storage capacity, respectively. Preliminary sizing for the MS and Eastonville Road crossing has been included as part of the "*Final Drainage Report for Eastonville Road from Future Rex Road to Londonderry Drive*", by HR Green, March

2022. 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.

SBs HAVE BEEN SIZED TO FUNCTION AS PBMPs (& WILL REMAIN IN PLACE UNTIL SUCH TIME DEVELOPMENT EAST OF THE PROPOSED SITE TAKES PLACE)

discharge treated runoff at historic rates directly into either the MS or MST Channel. The project site will also provide two (2) Temporary Sediment Basins (TSBs). TSB-1 at Rex Road and TSB-2 at the southern corner of the church property will discharge treated runoff at historic rates directly into MST at the northern portion of the project site.

The Rex Rd. TSB or SFB will need to be sized to function as a PBMP.

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.

TSB? SB-2

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 imperviousness value of 90%. Sub-basin A-1 encompasses an area of 11.23 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, runoff from this basin ($Q_5$ = 4.2 cfs, $Q_{100}$ = 29.9 cfs) will sheet flow from the northwest to the southeast, to a separate, temporary onsite detention and water quality facility (SFB) 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)**. 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 Sand Filter Basin (SFB) where runoff will be treated prior to discharging into Main Stem Tributary #2 channel. SB-1

**Basin A-2a** (4.21 AC, $Q_5$ = 8.1 cfs, $Q_{100}$ = 18.9 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** (6.05 AC, $Q_5$ = 9.4 cfs, $Q_{100}$ = 21.9 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) 10' 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** (3.81 AC, $Q_5$ = 6.2 cfs, $Q_{100}$ = 14.5 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) 10' 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 northeast of the

CORRECTED

private?

ALL PROPOSED STORM SEWER INFRASTRUCTURE WILL BE PRIVATELY OWNED & MAINTAINED WITH THE EXCEPTION OF EASTONVILLE AS THAT IS PUBLIC ROW

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** (3.33 AC, $Q_5$ = 5.3 cfs, $Q_{100}$ = 12.3 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** (4.51 AC, $Q_5$ = 7.1 cfs, $Q_{100}$ = 16.5 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) 15' 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** (4.05 AC, $Q_5$ = 7.8 cfs, $Q_{100}$ = 18.2 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) 15' 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** (1.35 AC, $Q_5$ = 4.5 cfs, $Q_{100}$ = 9.2 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) 10' 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**.

Stoke Gabriel Way and Glampton Dr. and Totness Terrace

CORRECTED

**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 O & R. 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**.

This doesn't match the grading now

**Basin C-3** (1.56 AC, $Q_5$ = 3.3 cfs, $Q_{100}$ = 7.7 cfs): Located on the southeast portion of the site, this basin consists of residential lots and the eastern half of Totness Terrace. 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 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**.

DESCRIPTION OF RUNOFF PATTERN HAS BEEN CORRECGTED & NOW INCLUDES RUNOFF REDUCTION DISCUSSION

**Basin C-4** (2.47 AC, Q [illegible] on 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 Galmpton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17g**.

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 Galmpton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 17h**.

BASIN C-7 DIVIDED INTO 2 BASINS AND DESCRFIPTIONS HAVE BEEN CORRECTED

**Basin C-7** (6.72 AC, $Q_5$ = 11.3 cfs, $Q_{100}$ = 26.3 cfs): Located in the central portion of the site, this basin consists of residential lots and the eastern half of Galmpton 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' at-grade inlet **(DP 18a)**, located on the west side of the intersection of Totness Terrace and Galmpton Drive. Bypass flows are conveyed downstream via curb & gutter to **DP 18b**.

CORRECTED

**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 the western half of Galmpton 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' at-grade inlet **(DP 17f)**, located on the southeast side of the intersection of Totness Terrace and Galmpton 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 Galmpton 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 north side of Galmpton Drive just north of Hope Cove Loop. Bypass flows are conveyed downstream via curb & gutter to **DP 17h.** Emergency overflows will overtop the crown of Galmpton Drive and be routed downstream via proposed curb and gutter to Design Point **18b** within Galmpton Drive. CORRECTED

CORRECTED

**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 Galmpton 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 Galmpton Drive just north of Hope Cove Loop. Emergency overflows will overtop the crown of Galmpton Drive and be routed downstream via proposed curb and gutter to Design Point **18b** within Galmpton Drive. CONFIRMED

**Basin C-10** (3.51 AC, $Q_5$ = 5.2 cfs, $Q_{100}$ = 12.2 cfs): Located on the southeast corner of the site, this basin consists of residential lots and the southern half of Galmpton 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 18b)**, located on the south side of Galmpton Drive just north of Hope Cove Loop. Emergency overflows will overtop the curb & gutter of Galmpton 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.

CORRECTED

**Basin C-12** (1.79 AC, $Q_5$ = 3.1 cfs, $Q_{100}$ = 7.2 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 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).

CORRECTED TO A FLOW BY INLET

Verify grades, ped crossing and crosspan

**Basin D-1** (2.98 AC, $Q_5$ = 4.6 cfs, $Q_{100}$ = 10.9 cfs): Located on the southwest portion of the site, adjacent to Eastonville Road. This basin consists of residential lots, the west half of Kate Meadow Lane, and the north half of Brixham Drive. 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' inlet in sump conditions, located on the west side of Kate Meadow Lane **(DP 22)**, just north of the intersection of Kate Meadow Lane & Farm Close Court. Emergency overflows will overtop the crown of Kate Meadow Lane and be routed downstream via curb & gutter to Design Point **23** within Kate Meadow Lane.

enter crosspan and flow to DP24?

CORRECTED

**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' inlet in sump conditions, 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.

CORRECTED

**Basin D-3** (3.66 AC, $Q_5$ = 6.0 cfs, $Q_{100}$ = 14.0 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) 15' CDOT Type 'R' inlet in sump conditions, located on the west side of Farm Close Court **(DP 24)**, ~~just~~ 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** (2.00 AC, $Q_5$ = 3.7 cfs, $Q_{100}$ = 8.5 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**.

CONFIRMED

**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).

Address the Eastonville Road culvert crossings into Basins D1, E1, and A-4a

EASTONVILLE CULVERT CROSSINGS HAVE BEEN INCLUDED

**Basin D-7** (1.80 AC, $Q_5$ = 2.5 cfs, $Q_{100}$ = 6.5 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. 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** (5.13 AC, $Q_5$ = 9.5 cfs, $Q_{100}$ = 22.1 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) 15' 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

CORRECTED

## 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 nine storm sewer systems will discharge storm water into its correlated WQCV pond. Each system will consist of reinforced concrete pipe (RCP), CDOT Type 'R' inlets, and storm sewer manholes.

CORRECTED TO PROVIDE DISCUSSION ON ALL PROPOSED SWALES

Swales in A-1 and C-7 also?

Additionally, there is one (1) proposed drainage swale that runs along the back of the residential lots in Basin D-7. The swale was analyzed using the Bentley software FlowMaster to properly size a trapezoidal channel to convey the 100-year flows from the basin to Pond D, while providing 1.0-ft of freeboard. The sizing calculations can be found in **Appendix D.**

Describe the size and provide cross-sections on the drainage plan.

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

Nine (9) Water Quality Capture Volume Detention Ponds will be provided for the proposed site, two (2) of which are temporary in nature. All of the proposed ponds 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:

**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 0.75 Ac-Ft & 2.104 Ac-Ft, respectively. The total required detention basin volume is 4.254 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 0.592 Ac-Ft & 1.653 Ac-Ft, respectively. The total required detention basin volume is 3.355 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 0.875 Ac-Ft & 2.405 Ac-Ft, respectively. The total required detention basin volume is 4.941 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 0.251 Ac-Ft & 0.672 Ac-Ft, respectively. The total required detention basin volume is 1.404 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 0.426 Ac-Ft & 1.150 Ac-Ft, respectively. The total required detention basin volume is 2.395 Ac-Ft.

CORRECTED TO PROVIDE BOTH CALCULATED & PROVIDED STORAGE

Provide the volumes calculated by the MHFD routed hydrographs

**TSB-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.

**TSB-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.

Address the other 2 for Eastonville Rd

EASTONVILLE POND ADDRESSED

# 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. 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**). 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.

All developed runoff will be captured and conveyed to one of the corresponding water quality and detention facilities and release at or below historic levels. 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 B.

not found; also provide HEC-RAS tables showing velocities, FR, shear, depths, etc.

CORRECTED TO PROVIDE REFERENCE TO THE CLOMR REPORT, WHICH IS INCLUDED WITHIN APPENDIX D

# X. Maintenance

After completion of construction and upon the Board of County Commissioners [illegible] anticipated all drainage facilities within the public Right-of-Way are to be owne[illegible] 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.

CORRECTED TO PROVIDE REFERENCE TO THE CLOMR REPORT, WHICH IS INCLUDED WITHIN APPENDIX D

In Appendix? Provide report title and date

## 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 will be analyzed with the channel report by others. Wetlands maintenance will be the responsibility of the the Grandview Reserve Metropolitan District No. 2 (DISTRICT).

provide final USACE determination

## XII. Floodplain Statement

CORRECTED TO PROVIDE APPROVAL WITH THE CLOMR REPORT

A portion of the project sit lies with Zone A Special Flood Haz o 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 five on-site Full Spectrum Detention Ponds; Ponds A, B, C, D, & E as well as two Temporary Sediment Basins; TSB-1 and TSB-2. All drainage facilities within this report were sized according to the El Paso County Drainage Criteria Manuals. 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 five (5) 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. *Final Drainage Report for Eastonville Road from Future Rex Road to Londonderry Drive*, by HR Green, March 2022.
9. *Grandview Reserve CLOMR Report*, HR Green; September 2021; revised January 2022.

# 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 updated or additional flood hazard information.

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

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

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

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

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

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

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

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

**Base Map** information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

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

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

**El Paso County Vertical Datum Offset Table**

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

**Panel Location Map**

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

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

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 |
| 87° 07' 30.00"<br>32° 22' 30.00" | Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) |
| 4275000mN | 1000-meter Universal Transverse Mercator grid ticks, zone 13 |
| 6000000 FT | 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection |
| DX5510 × | Bench mark (see explanation in Notes to Users section of this FIRM panel) |
| • M1.5 | River Mile |

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

**MAP SCALE 1" = 500'**

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

**PANEL 0556G**

# 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**

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.

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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.

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:

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1315 East-West Highway
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**Base Map** information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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

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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.

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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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**

# 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.

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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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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:

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NOAA, N/NGS12
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1315 East-West Highway
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**El Paso County Vertical Datum Offset Table**

| Flooding Source | Vertical Datum Offset (ft) |
|---|---|
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**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.

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FLOODWAY AREAS IN ZONE AE

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OTHER FLOOD AREAS

| | |
|---|---|
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OTHER AREAS

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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

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| | Zone D Boundary |
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| 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) |
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| • 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
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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

# NOTES TO USERS

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

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

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

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

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

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

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

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

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

**Base Map** information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

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

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

**El Paso County Vertical Datum Offset Table**

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

**Panel Location Map**

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

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

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

**MAP SCALE 1" = 500'**

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

**PANEL 0556G**

# 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 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

Douglas County
Elbert County
Teller County
Lincoln County
Pueblo County
Fremont County
SITE
Drainage Basins
El Paso County
Colorado
Legend
Drainage Basins Source: Muller Engineering Company (1988)
US Interstate Highways
US Highways
Colorado State Highways
Major Roadways
Local Streets & Roads
Creeks
Perennial
Intermittent
Lakes & Reservoirs
Summits
Unincorporated Urban Areas
Incorporated Cities
Military
Forest
County Lines
N
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S
Miles
0 0.5 1 2 3 4 5
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Upper Monument Creek FOMO5800
Monument Rock FOMO5000
Jackson Creek FOMO4400
Beaver Creek FOMO4600
Pike National Forest
Air Force Academy FOMO3200
USAF Academy
Black Forest FOMO4200
Monument Branch FOMO3800
Black Squirrel Creek FOMO3600
West Cherry Creek CYCY0400
Dirty Woman Creek FOMO5200
East Cherry Creek CYCY0200
West Kiowa Creek KIKI0200
East Kiowa Creek KIKI0400
Bijou Creek BIBI0200
Upper Big Sandy Creek BGBG1400
Antelope Creek BGBG0000
Lenard BGBG1200
Simla BGBG0400
Ramah BGBG0600
Mustang Creek BGBG0200
Calhan BGBG1000
Upper Black Squirrel CHBS2000
Upper Bracket Creek CHBR0600
North Fork HOHO0400
Kettle Creek FOMO3000
Bennett Ranch CHWS1200
Geick Ranch CHMS0400
La Vega Ranch CHBR0400
Horse Creek HOHO0600
Pine Creek FOMO2800
South Pine Creek FOMO2600
Dry Creek FOMO2400
Falcon CHWS1400
Hook And Line Ranch CHBS1800
Baggett CHBR0200
Little Horse Creek HOHO0200
Steels Fork HOPO1000
Cottonwood Creek FOMO2200
Cascade Creek FOFO5800
Douglas Creek FOMO1000
Templeton Gap FOMO1200
Williams Canyon FOFO7200
Manitou Reservoir FOFO7400
Sand Creek FOFO4000
Solbers Ranch CHWS0800
Curtis Ranch CHWS1000
Haegler Ranch CHMS0200
West Big Springs Creek CHBG0200
Upper Big Springs Creek CHBG0400
Rush HOPO0800
Ruxton Creek FOFO7000
Sutherland Creek FOFO6400
Shooks Run FOFO4400
Livestock Company CHWS0400
Ellicott
Yoder
Rush
Lower Big Springs Creek CHBS1400
Telephone Exchange CHWS0200
Ellicott Consolidated CHBS1200
Upper Pond Creek HOPO0600
Lower Pond Creek HOPO0400
Bear Creek FOFO4800
Peterson Field FOFO3400
Jimmy Camp Creek FOFO2000
Upper East Chico CHEC0400
Schriever AFB
Crows Roost CHBS1000
Southwest Area FOFO4600
Fishers Canyon FOFO3600
Windmill Gulch FOFO3000
Big Johnson Reservoir FOFO2600
Drennan CHDS0400
Middle East Chico CHEC0200
Truckston
Upper Williams Creek FOWI0600
Upper Chico Creek CHCH1600
Upper Dry Squirrel CHDS0200
Fort Carson FOFO2200
Upper Williams Tributary FOWI0400
West Chico Tributary CHCH1200
Lower Black Squirrel CHBS0600
Haynes Creek HAHA0600
St.lukes HOPO0200
Little Fountain Creek FOFO1800
Squirrel Creek CHBS0200
Chico Creek CHCH1400
Calhan Reservoir FOFO1400
Lower Williams Creek FOFO1000
Lower Williams Tributary FOWI0200
Lower Dry Squirrel CHBS0400
East Kramer KRKR0600
Fort Carson
Sand Canyon FOFO1600
Lower East Chico CHCH0800
Turkey Creek TUTU0200
East Haynes HAHA0400
Kramer Creek KRKR0400
Hammer Ranch CHCH0600
Sand Creek FOFO0600
Williams Ranch FOFO0400
Finch Ranch CHCH0400
Windmill CHCH0200
West Haynes HAHA0200
Red Creek BEBE0200
Midway Ranch FOFO0800
West Chico Creek CHCH0600
West Kramer KRKR0200
Young Hollow FOFO0200

THIS DRAWING IS CONCEPTUAL IN NATURE AND IS NOT TO BE USED AS THE SOLE BASIS FOR FINAL DESIGN, CONSTRUCTION, OR REMEDIAL ACTION. FURTHER STUDIES UNDER EPC DOT'S DIRECTION SHOULD BE PERFORMED PRIOR TO SUCH DECISIONS.

## Legend

- Streams
- Roads
- Basin Boundary
- Matchlines

0 1 2 Miles

PREPARED BY: Drexel, Barrell & Co. Engineers Surveyors
1800 38TH STREET, BOULDER, COLORADO 80301 (303) 443-4338
2 S 7TH STREET, COLORADO SPRINGS, COLORADO 80905 (719) 258-6887
6813 W 4TH STREET, GREELEY, COLORADO 80634 (970) 351-9646
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: SLF
CHECKED BY: RJB

REVISION DESCRIPTIONS | DATE

DRAWING INFO: GIECK RANCH
KEY MAP
MAIN STEM

DATE: AUGUST 2007
JOB NO: C7706-1
SET: PL
SCALE: H: 1" = 5000' V:
DRAWING NO.: 6D 038
SHEET: K1

THIS DRAWING IS CONCEPTUAL IN NATURE AND IS NOT TO BE USED AS THE SOLE BASIS FOR FINAL DESIGN, CONSTRUCTION, OR REMEDIAL ACTION. FURTHER STUDIES UNDER EPC DOT'S DIRECTION SHOULD BE PERFORMED PRIOR TO SUCH DECISIONS.

## Legend

- Streams
- Roads
- Basin Boundary
- Matchlines

0 1 2 Miles

PREPARED BY: Drexel, Barrell & Co. Engineers Surveyors
1690 30TH STREET, BOULDER, COLORADO 80301 (303) 443-4338
3 S 7TH STREET, COLORADO SPRINGS, COLORADO 80905 (719) 260-0887
6513 W 4TH STREET, GREELEY, COLORADO 80634 (970) 351-9646
CONTACT: ROBERT BENNETT

PREPARED FOR: REALTY DEVELOPMENT SERVICES
25 NORTH TEJON STREET, SUITE 300
COLORADO SPRINGS, COLORADO 80903
CONTACT: RAY O' SULLIVAN (719) 227-1022

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

DESIGNED BY: RJB
DRAWN BY: BLF
CHECKED BY: RJB

REVISION DESCRIPTIONS | DATE

DRAWING INFO: GIECK RANCH
KEY MAP
MAIN STEM TRIBUTARY #2

DATE: AUGUST 2007
SCALE: H 1" = 6000' V
JOB NO: C7706-1
DRAWING NO.: 6D 038
SET: PL
SHEET: K5

MCFARLAND, CHRISTIAN, 11/3/2020 11:50 AM

VICINITY MAP

LEGEND:

- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- 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
- POTENTIAL WATER QUALITY LOCATION
- SWMM CONVEYANCE ELEMENT
- PROPOSED PEAK FLOW RATE (CFS)
- DESIGN POINT
- PROPOSED BASIN LABEL
- AREA (AC.)

LAND USE

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

NOTES:

| Basin | Design Point | 5 Year Pre Development | 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

0 200
100

HRGreen

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

EXISTING EX1

FIG.EX1

HRGreen DRAWING PATH:J:\2019\191897.01\CAD\Dwgs\Exhibits\00-Drainage Basins-Overall-EXISTING.dwg

MCFARLAND, CHRISTIAN, 11/3/2020 12:56 PM

| 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

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

NORTH
0 400
200

HRGreen

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

PROPOSED DR1

FIG.DR1

HRGreen DRAWING PATH:J:\2019\191897.01\CAD\Dwgs\Exhibits\00-Drainage Basins-Overall.dwg

# APPENDIX C

# Hydrologic Computations

(Tables and cross-sections not cross-checked with plans on this review)

# COMPOSITE % IMPERVIOUS CALCULATIONS: EXISTING & PROPOSED

**Subdivision:** Grandview Reserve
**Location:** CO, El Paso County

Provide for all existing offsite basins

CORRECTED TO PROVIDE OFFSITE CALCULATIONS (HR GREEN)

**Project Name:** Grandview Subdivision PDR
**Project No.:** HRG01
**Calculated By:** TJE
**Checked By:** BAS
**Date:** 3/1/22

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 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 |
| Basin ID | Total Area (ac) | % 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. | Weighted % Imp. |
| **EXISTING** | | | | | | | | | | | | | | | | | | | | | | | |
| OS-W | 108.8 | | | | | | | | | | | | | | | | | | | | | | 55* |
| OS-NW | 105.72 | | | | | | | | | | | | | | | | | | | | | | 56* |
| 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 |
| OS-1 | 3.28 | 100 | 2.35 | 71.6 | 2 | 0.93 | 0.6 | 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 | 72.2 |
| OS-2 | 2.31 | 100 | 1.35 | 58.4 | 2 | 0.96 | 0.8 | 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 | 59.2 |
| OS-3 | 3.02 | 100 | 1.90 | 62.9 | 2 | 1.12 | 0.7 | 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 | 63.6 |
| OS-4 | 3.00 | 100 | 1.68 | 56.0 | 2 | 1.32 | 0.9 | 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 | 56.9 |
| A-1 | 11.23 | 100 | 0.00 | 0.0 | 2 | 11.23 | 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 | 4.21 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 4.21 | 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 | 6.05 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 6.05 | 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 | 3.81 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 3.81 | 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 | 3.33 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 3.33 | 65.0 | 40 | 0.00 | 0.0 | 30 | 0.00 | 0.0 | 25 | 0.00 | 0.0 | 20 | 0.00 | 0.0 | 65.0 |
| B-2 | 4.51 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 4.51 | 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-3 | 4.05 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 4.05 | 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 | 1.35 | 100 | 1.05 | 77.8 | 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 | 78.2 |
| 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 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 1.56 | 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-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-7 | 6.72 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 6.72 | 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 | 3.51 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 3.51 | 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 | 1.79 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 1.79 | 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 |
| D-1 | 2.98 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 2.98 | 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 | 3.66 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 3.66 | 65.0 | 40 | 0.00 | 0.0 | 30 | 0.00 | 0.0 | 25 | 0.00 | 0.0 | 20 | 0.00 | 0.0 | 65.0 |
| D-4 | 2.00 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 2.00 | 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-7 | 1.80 | 100 | 0.00 | 0.0 | 2 | 0.42 | 0.5 | 65.0 | 1.38 | 49.8 | 40 | 0.00 | 0.0 | 30 | 0.00 | 0.0 | 25 | 0.00 | 0.0 | 20 | 0.00 | 0.0 | 50.3 |
| E-1 | 5.13 | 100 | 0.00 | 0.0 | 2 | 0.00 | 0.0 | 65.0 | 5.13 | 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)*
*: Taken from NRCS Curve Numbers within HR Green MDDP

# 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:** 3/1/22

| 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** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| OS-W | 108.8 | | | | | | | | | | | | | | | | | | | | | | | | | | 55.04* |
| OS-NW | 105.72 | | | | | | | | | | | | | | | | | | | | | | | | | | 56.49* |
| 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 |
| OS-1 | 3.28 | 0.90 | 0.96 | 2.35 | 0.09 | 0.36 | 0.93 | 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 | 0.67 | 0.79 |
| OS-2 | 2.31 | 0.90 | 0.96 | 1.35 | 0.09 | 0.36 | 0.96 | 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 | 0.56 | 0.71 |
| OS-3 | 3.02 | 0.90 | 0.96 | 1.90 | 0.09 | 0.36 | 1.12 | 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 | 0.60 | 0.74 |
| OS-4 | 3.00 | 0.90 | 0.96 | 1.68 | 0.09 | 0.36 | 1.32 | 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 | 0.54 | 0.70 |
| A-1 | 11.23 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 11.23 | 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 | 0.09 | 0.36 |
| A-2a | 4.21 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 4.21 | 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 | 6.05 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 6.05 | 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 | 3.81 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 3.81 | 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 | 3.33 | 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 | 0.45 | 0.59 |
| B-2 | 4.51 | 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 | 0.45 | 0.59 |
| B-3 | 4.05 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 4.05 | 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 | 1.35 | 0.90 | 0.96 | 1.05 | 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 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 1.56 | 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-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-7 | 6.72 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 6.72 | 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 | 3.51 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 3.51 | 0.30 | 0.50 | 0.00 | 0.25 | 0.47 | 0.00 | 0.22 | 0.46 | 0.00 | 0.20 | 0.44 | 0.00 | 0.45 | 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 | 1.79 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 1.79 | 0.30 | 0.50 | 0.00 | 0.25 | 0.47 | 0.00 | 0.22 | 0.46 | 0.00 | 0.20 | 0.44 | 0.00 | 0.45 | 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 |
| D-1 | 2.98 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 2.98 | 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 | 3.66 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 3.66 | 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 |
| D-4 | 2.00 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 2.00 | 0.30 | 0.50 | 0.00 | 0.25 | 0.47 | 0.00 | 0.22 | 0.46 | 0.00 | 0.20 | 0.44 | 0.00 | 0.45 | 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-7 | 1.80 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.42 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 1.38 | 0.30 | 0.50 | 0.00 | 0.25 | 0.47 | 0.00 | 0.22 | 0.46 | 0.00 | 0.20 | 0.44 | 0.00 | 0.37 | 0.54 |
| E-1 | 5.13 | 0.90 | 0.96 | 0.00 | 0.09 | 0.36 | 0.00 | 0.73 | 0.81 | 0.00 | 0.45 | 0.59 | 5.13 | 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*
*: SCS Curve Number from HR Green MDDP

# 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:** 3/1/22

the computed value needs to be used for existing conditions if it's higher than the Tc check (the area isn't urbanized yet)

CORRECTED TO USE NON-URBANIZED CONDITIONS

| 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** | | | | | | | | | | | | | | | | | |
| OS-W | | | | | | | | | | | | | | | | | |
| OS-NW | | | | | | | | | | | | | | | | | |
| 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 | 19.6 |
| 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 | 29.0 |
| 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 | 33.7 |
| 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 | 14.2 |
| 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 | 23.4 |
| 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 | 19.9 |
| **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 |
| OS-1 | 3.28 | A | 72.2 | 0.67 | 0.79 | 48 | 3.0 | 3.8 | 1795 | 1.3 | 20 | 2.3 | 13.1 | 16.9 | 1843.0 | 20.2 | 16.9 |
| OS-2 | 2.31 | A | 59.2 | 0.56 | 0.71 | 45 | 4.0 | 4.2 | 1426 | 1.4 | 20 | 2.4 | 10.0 | 14.2 | 1471.0 | 18.2 | 14.2 |
| OS-3 | 3.02 | A | 63.6 | 0.60 | 0.74 | 34 | 2.0 | 4.2 | 1050 | 1.4 | 20 | 2.4 | 7.4 | 11.6 | 1084.0 | 16.0 | 11.6 |
| OS-4 | 3.00 | A | 56.9 | 0.54 | 0.70 | 34 | 2.0 | 4.7 | 1020 | 1.4 | 20 | 2.4 | 7.2 | 11.9 | 1054.0 | 15.9 | 11.9 |
| A-1 | 11.23 | 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 | 4.21 | 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 | 6.05 | 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 | 3.81 | 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 | 3.33 | A | 65.0 | 0.45 | 0.59 | 210 | 3.5 | 11.4 | 560 | 1.7 | 20 | 2.6 | 3.6 | 14.9 | 770.0 | 14.3 | 14.3 |
| B-2 | 4.51 | A | 65.0 | 0.45 | 0.59 | 230 | 3.0 | 12.5 | 611 | 2.5 | 20 | 3.2 | 3.2 | 15.7 | 841.0 | 14.7 | 14.7 |
| B-3 | 4.05 | 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 | 1.35 | A | 78.2 | 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 | 65.0 | 0.45 | 0.59 | 77 | 4.0 | 6.6 | 0 | 0.0 | 20 | 0.0 | 0.0 | 6.6 | 77.0 | 10.4 | 6.6 |
| 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-7 | 6.72 | 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 | 3.51 | 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 | 1.79 | 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 |
| D-1 | 2.98 | A | 65.0 | 0.45 | 0.59 | 170 | 1.0 | 15.5 | 715 | 1.0 | 20 | 2.0 | 6.0 | 21.5 | 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 | 3.66 | 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 | 2.00 | A | 65.0 | 0.45 | 0.59 | 50 | 3.0 | 5.8 | 750 | 2.0 | 20 | 2.8 | 4.4 | 10.3 | 800.0 | 14.4 | 10.3 |
| 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-7 | 1.80 | A | 50.3 | 0.37 | 0.54 | 75 | 8.0 | 5.8 | 855 | 2.0 | 15 | 2.1 | 6.7 | 12.5 | 930.0 | 15.2 | 12.5 |
| E-1 | 5.13 | 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)

Not checked on this review

**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:** 3/1/22

| 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** | | | | | | | | | | | | | | | | | | | | | |
| | | OS-W | 108.80 | | | | | | | | | 67.0 | | | | | | | | | Sheet flow to Main Stem Channel<br>Total Flow - Q(5)=67 cfs (from MDDP) |
| | | OS-NW | 105.72 | | | | | | | | | 59.0 | | | | | | | | | Sheet flow to Main Stem Tributary #2 Channel<br>Total Flow - Q(5)=59 cfs (from MDDP) |
| | 1 | EX-1 | 16.18 | 0.09 | 19.6 | 1.46 | 3.04 | 4.4 | | | | | | | | | | | | | Sheet flow to Main Stem Channel<br>Total Flow - Incl. Offsite flow of Q(5)=67 cfs (from MDDP) |
| | 2 | EX-2 | 46.06 | 0.09 | 29.0 | 4.15 | 2.47 | 10.3 | | | | 77.3 | | | | | | | | | Sheet flow to Main Stem Channel<br>Total Flow - Incl. Offsite flow of Q(5)=67 cfs (from MDDP) |
| | 3 | EX-3 | 64.34 | 0.09 | 33.7 | 5.79 | 2.27 | 13.1 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 4 | EX-4 | 2.68 | 0.09 | 14.2 | 0.24 | 3.54 | 0.8 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 5 | EX-5 | 26.15 | 0.09 | 23.4 | 2.35 | 2.77 | 6.5 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 6 | EX-6 | 31.53 | 0.09 | 19.9 | 2.84 | 3.02 | 8.6 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 7 | | | | | | | | 33.7 | 16.8 | 2.3 | 164.2 | | | | | | | | | Total Existing Flow Leaving Property offsite - outfalls to Main Stem Tributary #2 Channel |
| **PROPOSED** | | | | | | | | | | | | | | | | | | | | | |
| | | Basin-1 | 1.22 | 0.74 | 7.0 | 0.90 | 4.64 | 4.2 | | | | | | | | | | | | | East Leg of Rex Road Intersection |
| | 1 | A-1 | 11.23 | 0.09 | 9.6 | 1.01 | 4.16 | 4.2 | | | | | | | | | | | | | Institutional Tract<br>Basin will have own water quality & detention pond |
| | 2a | A-2a | 4.21 | 0.45 | 8.8 | 1.89 | 4.29 | 8.1 | | | | | | | | | | | | | On-Grade 15' CDOT Type R Inlet (0.4 cfs bypass to DP 2b) |
| | 2b | A-2b | 2.75 | 0.74 | 9.9 | 2.04 | 4.13 | 8.4 | | | | 8.8 | | | | | | | | | Sump 20' CDOT Type R Inlet (Receives 0.4 cfs upstream bypass) |
| | 3 | A-3 | 0.36 | 0.90 | 5.0 | 0.32 | 5.10 | 1.6 | | | | | | | | | | | | | Sump 5' CDOT Type R Inlet |
| | 4a | A-4a | 6.05 | 0.45 | 15.2 | 2.72 | 3.44 | 9.4 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (2.9 cfs bypass to DP 2) |
| | 4b<br>4 | A-4b | 3.81 | 0.45 | 13.5 | 1.71 | 3.63 | 6.2 | | | | 4.2 | | | | | | | | | On-Grade 10' CDOT Type R Inlet (1.3 cfs bypass to DP 2)<br>Sump 15' CDOT Type R Inlet (Receives 4.2 cfs upstream bypass) |
| | 5 | A-5 | 0.35 | 0.90 | 5.0 | 0.32 | 5.10 | 1.6 | | | | | | | | | | | | | Sump 5' CDOT Type R Inlet |
| | 6 | A-6 | 2.76 | 0.45 | 12.9 | 1.24 | 3.70 | 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 | | | | | | | | | | | | | 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 | | | | | | | | | | | | | 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 | 17.48 | 3.31 | 57.9 | | | | | | | | | Total of Flows to Pond A |
| | 9 | B-1 | 3.33 | 0.45 | 14.3 | 1.50 | 3.54 | 5.3 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 10a | B-2 | 4.51 | 0.45 | 14.7 | 2.03 | 3.50 | 7.1 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (1.5 cfs bypass to DP 10b) |
| | 10b | B-3 | 4.05 | 0.45 | 9.0 | 1.82 | 4.27 | 7.8 | | | | 9.3 | | | | | | | | | Sump 20' CDOT Type R Inlet (Receives 1.5 cfs of upstream bypass) |
| | 11 | B-4 | 1.35 | 0.72 | 7.0 | 0.97 | 4.63 | 4.5 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 12a | B-5 | 5.12 | 0.45 | 15.3 | 2.30 | 3.43 | 7.9 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (2.0 cfs bypass to DP 12b) |
| | 14 | B-6 | 2.28 | 0.45 | 13.7 | 1.03 | 3.61 | 3.7 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (0.1 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:** 5-Year

**Project Name:** Grandview Subdivision PDR
**Project No.:** HRG01
**Calculated By:** TJE
**Checked By:** BAS
**Date:** 3/1/22

| 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) | |
| | 15 | B-7 | 0.89 | 0.45 | 10.7 | 0.40 | 3.99 | 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 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 16 | B-10 | 1.10 | 0.09 | 6.7 | 0.10 | 4.70 | 0.5 | 15.3 | 12.69 | 3.43 | 43.5 | | | | | | | | | Total of flows to Pond B |
| | 17b | C-1 | 4.12 | 0.45 | 13.0 | 1.85 | 3.69 | 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 | | | | | | | | | | | | | On-Grade 15' CDOT Type R (1.7 cfs bypass to DP 17c) |
| | | C-3 | 1.56 | 0.45 | 6.6 | 0.70 | 4.73 | 3.3 | | | | | | | | | | | | | Sheet Flows off-site east |
| | 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<br>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<br>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<br>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 | | | | | | | | | | | | | 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<br>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-7 | 6.72 | 0.45 | 12.6 | 3.02 | 3.74 | 11.3 | | | | | | | | | | | | | On-Grade 15' CDOT Type R (1.7 cfs bypass to DP 18b) |
| | 18b | C-10 | 3.51 | 0.45 | 16.5 | 1.58 | 3.31 | 5.2 | | | | 6.9 | | | | | | | | | Sump 15' CDOT Type R (Receives 1.7 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 | 1.79 | 0.45 | 11.8 | 0.81 | 3.84 | 3.1 | | | | 3.1 | | | | | | | | | Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass) |
| | 21a | C-13 | 2.37 | 0.09 | 13.2 | 0.21 | 3.66 | 0.8 | 16.5 | 18.59 | 3.31 | 61.5 | | | | | | | | | Total combined flows to Pond C |
| | 21b | C-14 | 1.53 | 0.09 | 11.7 | 0.14 | 3.86 | 0.5 | | | | | | | | | | | | | Un-developed area - Sheet flows to MS 2 |
| | 22 | D-1 | 2.98 | 0.45 | 14.9 | 1.34 | 3.47 | 4.6 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (0.4 cfs bypass to DP 24) |
| | 23 | D-2 | 0.87 | 0.45 | 8.1 | 0.39 | 4.42 | 1.7 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (0.0 cfs bypass to DP 24) |
| | 24 | D-3 | 3.66 | 0.45 | 13.5 | 1.65 | 3.63 | 6.0 | | | | 6.4 | | | | | | | | | Receives 0.4 cfs of upstream bypass<br>Sump 15' CDOT Type R Inlet |
| | 25 | D-4 | 2.00 | 0.45 | 10.3 | 0.90 | 4.06 | 3.7 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 26 | D-5 | 1.53 | 0.28 | 7.1 | 0.43 | 4.63 | 2.0 | 14.9 | 4.71 | 3.47 | 16.3 | | | | | | | | | 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 |
| | 25a | D-7 | 1.80 | 0.37 | 12.5 | 0.67 | 3.75 | 2.5 | | | | | | | | | | | | | Sheet flows to Channel and Conveyed to Pond D |
| | 27 | E-1 | 5.13 | 0.45 | 10.0 | 2.31 | 4.10 | 9.5 | | | | | | | | | | | | | 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 | | | | | | | | | | | | | 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<br>Sump 15' CDOT Type R Inlet |
| | 30 | E-4 | 6.28 | 0.45 | 17.9 | 2.83 | 3.18 | 9.0 | | | | | | | | | | | | | Sump 20' CDOT Type R Inlet |

# 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:** 3/1/22

| | | DIRECT RUNOFF | | | | | | | TOTAL RUNOFF | | | | STREET | | PIPE | | | TRAVEL TIME | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREET | Design Point | Basin ID | Area (Ac) | Runoff Coeff. | Tc (min) | C*A (Ac) | I (in/hr) | Q (cfs) | Tc (min) | C*A (Ac) | I (in/hr) | Q (cfs) | Slope (%) | Street Flow (cfs) | Design Flow (cfs) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | Tt (min) | REMARKS |
| | 31 | E-5 | 1.13 | 0.09 | 9.8 | 0.10 | 4.14 | 0.4 | 17.9 | 9.12 | 3.18 | 29.0 | | | | | | | | | 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 |
| | 32 | OS-1 | 3.28 | 0.67 | 16.9 | 2.20 | 3.27 | 7.2 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - NW Segment |
| | 33 | OS-2 | 2.31 | 0.56 | 14.2 | 1.29 | 3.55 | 4.6 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - NE Segment |
| | 34 | | | | | | | | 16.9 | 3.49 | 3.27 | 11.4 | | | | | | | | | Total Prelim Flows to North Eastonville Rd. Pond |
| | 35 | OS-3 | 3.02 | 0.60 | 11.6 | 1.81 | 3.86 | 7.0 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - SW Segment |
| | 36 | OS-4 | 3.00 | 0.54 | 11.9 | 1.62 | 3.82 | 6.2 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - SE Segment |
| | 37 | | | | | | | | 11.9 | 3.43 | 3.82 | 13.1 | | | | | | | | | Total Prelim Flows to South Eastonville Rd. Pond |

# 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:** 3/1/22

| 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** | | | | | | | | | | | | | | | | | | | | | |
| | | OS-W | 108.80 | | | | | | | | | 413.0 | | | | | | | | | Sheet flow to Main Stem Channel<br>Total Flow - Q(100)=413 cfs (from MDDP) |
| | | OS-NW | 105.72 | | | | | | | | | 280.0 | | | | | | | | | Sheet flow to Main Stem Tributary #2 Channel<br>Total Flow - Q(100)=280 cfs (from MDDP) |
| | 1 | EX-1 | 16.18 | 0.36 | 19.6 | 5.82 | 5.42 | 31.5 | | | | | | | | | | | | | Sheet flow to Main Stem Channel<br>Total Flow - Incl. Offsite flow of Q(100)=413 cfs (from MDDP) |
| | 2 | EX-2 | 46.06 | 0.36 | 29.0 | 16.58 | 4.39 | 72.8 | | | | 485.8 | | | | | | | | | Sheet flow to Main Stem Channel<br>Total Flow - Incl. Offsite flow of Q(100)=413 cfs (from MDDP) |
| | 3 | EX-3 | 64.34 | 0.36 | 33.7 | 23.16 | 4.03 | 93.3 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 4 | EX-4 | 2.68 | 0.36 | 14.2 | 0.96 | 6.31 | 6.1 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 5 | EX-5 | 26.15 | 0.36 | 23.4 | 9.41 | 4.94 | 46.5 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 6 | EX-6 | 31.53 | 0.36 | 19.9 | 11.35 | 5.37 | 60.9 | | | | | | | | | | | | | Sheet flow offiste - outfalls to Main Stem Tributary #2 Channel |
| | 7 | | | | | | | | 33.7 | 67.28 | 4.03 | 964.1 | | | | | | | | | Total Existing Flow Leaving Property offsite - outfalls to Main Stem Tributary #2 Channel |
| **PROPOSED** | | | | | | | | | | | | | | | | | | | | | |
| | | Basin-1 | 1.22 | 0.84 | 7.0 | 1.02 | 8.26 | 8.4 | | | | | | | | | | | | | East Leg of Rex Road Intersection |
| | 1 | A-1 | 11.23 | 0.36 | 9.6 | 4.04 | 7.40 | 29.9 | | | | | | | | | | | | | Institutional Tract<br>Basin will have own water quality & detention pond |
| | 2a | A-2a | 4.21 | 0.59 | 8.8 | 2.48 | 7.64 | 18.9 | | | | | | | | | | | | | On-Grade 15' CDOT Type R Inlet (6.1 cfs bypass to DP 2b) |
| | 2b | A-2b | 2.75 | 0.83 | 9.9 | 2.28 | 7.34 | 16.7 | | | | 22.8 | | | | | | | | | Sump 20' CDOT Type R Inlet (Receives 6.1 cfs upstream bypass) |
| | 3 | A-3 | 0.36 | 0.96 | 5.0 | 0.35 | 9.09 | 3.2 | | | | | | | | | | | | | Sump 5' CDOT Type R Inlet |
| | 4a | A-4a | 6.05 | 0.59 | 15.2 | 3.57 | 6.13 | 21.9 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (12.2 cfs bypass to DP 2) |
| | 4b<br>4 | A-4b | 3.81 | 0.59 | 13.5 | 2.25 | 6.46 | 14.5 | | | | 19.6 | | | | | | | | | On-Grade 10' CDOT Type R Inlet (7.4 cfs bypass to DP 2)<br>Sump 15' CDOT Type R Inlet (Receives 19.6 cfs upstream bypass) |
| | 5 | A-5 | 0.35 | 0.96 | 5.0 | 0.34 | 9.09 | 3.1 | | | | | | | | | | | | | Sump 5' CDOT Type R Inlet |
| | 6 | A-6 | 2.76 | 0.59 | 12.9 | 1.63 | 6.58 | 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 | | | | | | | | | | | | | 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 | | | | | | | | | | | | | 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 | 22.49 | 5.90 | 132.7 | | | | | | | | | Total of Flows to Pond A |
| | 9 | B-1 | 3.33 | 0.59 | 14.3 | 1.96 | 6.30 | 12.3 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 10a | B-2 | 4.51 | 0.59 | 14.7 | 2.66 | 6.22 | 16.5 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (8.0 cfs bypass to DP 10b) |
| | 10b | B-3 | 4.05 | 0.59 | 9.0 | 2.39 | 7.61 | 18.2 | | | | 26.2 | | | | | | | | | Sump 15' CDOT Type R Inlet (Receives 8.0 cfs of upstream bypass) |
| | 11 | B-4 | 1.35 | 0.83 | 7.0 | 1.12 | 8.25 | 9.2 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 12a | B-5 | 5.12 | 0.59 | 15.3 | 3.02 | 6.11 | 18.5 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (9.5 cfs bypass to DP 12b) |
| | 14 | B-6 | 2.28 | 0.59 | 13.7 | 1.35 | 6.42 | 8.7 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (2.5 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:** 3/1/22

| | | DIRECT RUNOFF | | | | | | | TOTAL RUNOFF | | | | STREET | | PIPE | | | TRAVEL TIME | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREET | Design Point | Basin ID | Area (Ac) | Runoff Coeff. | Tc (min) | C*A (Ac) | I (in/hr) | Q (cfs) | Tc (min) | C*A (Ac) | I (in/hr) | Q (cfs) | Slope (%) | Street Flow (cfs) | Design Flow (cfs) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | Tt (min) | REMARKS |
| | 15 | B-7 | 0.89 | 0.59 | 10.7 | 0.53 | 7.10 | 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 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 16 | B-10 | 1.10 | 0.36 | 6.7 | 0.40 | 8.37 | 3.3 | 15.3 | 16.77 | 6.11 | 102.5 | | | | | | | | | Total of flows to Pond B |
| | 17b | C-1 | 4.12 | 0.59 | 13.0 | 2.43 | 6.57 | 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 | | | | | | | | | | | | | On-Grade 15' CDOT Type R (11.2 cfs bypass to DP 17c) |
| | | C-3 | 1.56 | 0.59 | 6.6 | 0.92 | 8.42 | 7.7 | | | | | | | | | | | | | Sheet Flows off-site east |
| | 17c | C-4 | 2.47 | 0.59 | 13.0 | 1.46 | 6.57 | 9.6 | | | | 13.9 | | | | | | | | | Receives 4.3 cfs of Bypass from DP 17a<br>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<br>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<br>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 | | | | | | | | | | | | | 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<br>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-7 | 6.72 | 0.59 | 12.6 | 3.96 | 6.65 | 26.3 | | | | | | | | | | | | | On-Grade 15' CDOT Type R (11.2 cfs bypass to DP 18b) |
| | 18b | C-10 | 3.51 | 0.59 | 16.5 | 2.07 | 5.90 | 12.2 | | | | 23.4 | | | | | | | | | Sump 15' CDOT Type R (Receives 11.2 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 | 1.79 | 0.59 | 11.8 | 1.06 | 6.83 | 7.2 | | | | 7.2 | | | | | | | | | Sump 5' CDOT Type R (Receives 0.0 cfs of upstream bypass) |
| | 21a | C-13 | 2.37 | 0.36 | 13.2 | 0.85 | 6.52 | 5.5 | 16.5 | 24.94 | 5.90 | 147.1 | | | | | | | | | Total combined flows to Pond C |
| | 21b | C-14 | 1.53 | 0.36 | 11.7 | 0.55 | 6.87 | 3.8 | | | | | | | | | | | | | Un-developed area - Sheet flows to MS 2 |
| | 22 | D-1 | 2.98 | 0.59 | 14.9 | 1.76 | 6.18 | 10.9 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (4.0 cfs bypass to DP 24) |
| | 23 | D-2 | 0.87 | 0.59 | 8.1 | 0.51 | 7.88 | 4.0 | | | | | | | | | | | | | On-Grade 10' CDOT Type R Inlet (0.2 cfs bypass to DP 24) |
| | 24 | D-3 | 3.66 | 0.59 | 13.5 | 2.16 | 6.46 | 14.0 | | | | 18.2 | | | | | | | | | Receives 4.2 cfs of upstream bypass<br>Sump 15' CDOT Type R Inlet |
| | 25 | D-4 | 2.00 | 0.59 | 10.3 | 1.18 | 7.23 | 8.5 | | | | | | | | | | | | | Sump 10' CDOT Type R Inlet |
| | 26 | D-5 | 1.53 | 0.48 | 7.1 | 0.73 | 8.24 | 6.0 | 14.9 | 6.34 | 6.18 | 39.2 | | | | | | | | | 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 |
| | 25a | D-7 | 1.80 | 0.54 | 12.5 | 0.97 | 6.67 | 6.5 | | | | | | | | | | | | | Sheet flows to Channel and Conveyed to Pond D |
| | 27 | E-1 | 5.13 | 0.59 | 10.0 | 3.03 | 7.30 | 22.1 | | | | | | | | | | | | | On-Grade 15' CDOT Type R Inlet (8.3 cfs bypass to DP 29) |
| | 28 | E-2 | 5.42 | 0.59 | 9.8 | 3.20 | 7.36 | 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 | | | | 31.6 | | | | | | | | | Receives 17.6 cfs of upstream bypass<br>Sump 15' CDOT Type R Inlet |
| | 30 | E-4 | 6.28 | 0.59 | 17.9 | 3.71 | 5.66 | 21.0 | | | | | | | | | | | | | Sump 20' CDOT Type R Inlet |

# 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:** 3/1/22

| | | DIRECT RUNOFF | | | | | | | TOTAL RUNOFF | | | | STREET | | PIPE | | | TRAVEL TIME | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREET | Design Point | Basin ID | Area (Ac) | Runoff Coeff. | Tc (min) | C*A (Ac) | I (in/hr) | Q (cfs) | Tc (min) | C*A (Ac) | I (in/hr) | Q (cfs) | Slope (%) | Street Flow (cfs) | Design Flow (cfs) | Slope (%) | Pipe Size (inches) | Length (ft) | Velocity (fps) | Tt (min) | REMARKS |
| | 31 | E-5 | 1.13 | 0.36 | 9.8 | 0.41 | 7.37 | 3.0 | 17.9 | 12.24 | 5.66 | 69.3 | | | | | | | | | 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 |
| | 32 | OS-1 | 3.28 | 0.79 | 16.9 | 2.59 | 5.83 | 15.1 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - NW Segment |
| | 33 | OS-2 | 2.31 | 0.71 | 14.2 | 1.64 | 6.31 | 10.3 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - NE Segment |
| | 34 | | | | | | | | 16.9 | 4.23 | 5.83 | 24.7 | | | | | | | | | Total Prelim Flows to North Eastonville Rd. Pond |
| | 35 | OS-3 | 3.02 | 0.74 | 11.6 | 2.23 | 6.88 | 15.3 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - SW Segment |
| | 36 | OS-4 | 3.00 | 0.70 | 11.9 | 2.10 | 6.81 | 14.3 | | | | | | | | | | | | | Prelim Eastonvill Rd. Flows - SE Segment |
| | 37 | | | | | | | | 11.9 | 4.33 | 6.81 | 29.5 | | | | | | | | | Total Prelim Flows to South Eastonville Rd. Pond |

# APPENDIX D

# Hydraulic Computations

Inlets not checked in detail with this review.

*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-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 ≥ 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)*

| 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*) | $Q_o$ = | 8.1 | 18.9 | 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 = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.4** | **6.1** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **7.7** | **12.8** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.4** | **6.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ = | **C% =** | **95** | **68** | **%** |

# 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 ≥ 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 = | 4 | 4 | |
| 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 = | 1.33 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 8.8 | 22.8 | 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 ≥ 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) = | 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 |

*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:** **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 | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion<br>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 |
| 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 | $Q_{wi}$ = | 5.4 | 26.6 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 5.2 | 25.5 | 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 | $Q_{mi}$ = | 10.9 | 27.5 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 10.4 | 26.3 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **5.2** | **25.5** | **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 = | 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) | **$Q_a$ =** | **5.2** | **25.5** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)** | $Q_{PEAK\ REQUIRED}$ = | 4.2 | 19.6 | 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 ≥ 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)*

| 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*) | $Q_o$ = | 9.4 | 21.9 | cfs |
| Water Spread Width | T = | 14.0 | 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 | 0.8 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.172 | 0.123 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 7.8 | 19.2 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 1.6 | 2.7 | 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 | 8.1 | 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) | $S_e$ = | 0.083 | 0.065 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 20.29 | 34.90 | 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 | $Q_i$ = | 6.6 | 10.0 | 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 | **$Q_a$ =** | **6.5** | **9.7** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **2.9** | **12.2** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **6.5** | **9.7** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **2.9** | **12.2** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ = | **C% =** | **69** | **44** | **%** |

# 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 ≥ 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)*

| 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*) | $Q_o$ = | 6.7 | 15.7 | 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 | 0.2 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.198 | 0.140 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 5.4 | 13.5 | 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 | $A_W$ = | 0.22 | 0.30 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 6.1 | 7.4 | 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) | $S_e$ = | 0.092 | 0.071 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 16.26 | 28.26 | 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 | $Q_i$ = | 5.5 | 8.5 | 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 | **$Q_a$ =** | **5.4** | **8.3** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **1.3** | **7.4** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **5.4** | **8.3** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **1.3** | **7.4** | **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:** **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 ≥ 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 = | 4.3 | 5.6 | 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 |
| 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 ≥ 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)*

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet (CDOT Type R Curb Opening) | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 2 | 2 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$-G = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$-C = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | 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 ≥ 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 | |
| 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** | **%** |

# 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 ≥ 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 = | 4 | 4 | |
| 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 = | 1.33 | 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)*

| | | | | |
|---|---|---|---|---|
| **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 = | 4.3 | 8.0 | inches |
| **Grate Information** | | MINOR | MAJOR | ☑ Override Depths |
| Length of a Unit Grate | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | $W_o$ = | N/A | N/A | feet |
| 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)*

| | | | | | |
|---|---|---|---|---|---|
| **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 = | 2 | 2 | |
| 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 = | 1.25 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 5.3 | 12.3 | 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-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 ≥ 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 = | 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*) | $Q_o$ = | 7.1 | 16.5 | 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 | 0.132 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 5.8 | 14.3 | 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 | 0.31 | 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 | 29.21 | 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 | 8.7 | 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 | **$Q_a$ =** | **5.6** | **8.5** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **1.5** | **8.0** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **5.6** | **8.5** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **1.5** | **8.0** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ = | **C% =** | **78** | **52** | **%** |

# 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)*

| | | | | | |
|---|---|---|---|---|---|
| **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 = | 4 | 4 | |
| 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 = | 1.33 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 9.3 | 26.2 | 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 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 ≥ 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 = | 2 | 2 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 4.3 | 5.6 | 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 |
| 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 | $Q_{wi}$ = | 4.2 | 9.3 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 3.9 | 8.7 | cfs |
| Curb Opening as an Orifice (based on Modified HEC22 Method) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{oi}$ = | 16.6 | 18.9 | cfs |
| Interception with Clogging | $Q_{oa}$ = | 15.6 | 17.7 | cfs |
| Curb Opening Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | 7.7 | 12.3 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 7.3 | 11.5 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **3.9** | **8.7** | **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 = | 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 | $RF_{Curb}$ = | 0.81 | 0.91 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | N/A | N/A | |
| | | MINOR | MAJOR | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **3.9** | **8.7** | **cfs** |
| **WARNING: Inlet Capacity less than Q Peak for Minor and Major Storr** | $Q_{PEAK\ REQUIRED}$ = | 4.5 | 9.2 | 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 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 ≥ 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 = | 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 ≥ 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 = | 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 ≥ 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 = | 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 | $E_{o\text{-}GRATE}$ = | 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) | $S_e$ = | 0.143 | 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** | **%** |

*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 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)*

| | | | | | |
|---|---|---|---|---|---|
| **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 = | 4 | 4 | |
| 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 = | 1.33 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 8.0 | 26.0 | 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 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)*

| | | | | | |
|---|---|---|---|---|---|
| **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 = | 2 | 2 | |
| 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 = | 1.25 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 4.1 | 9.7 | 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 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 ≥ 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)*

| 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*) | $Q_o$ = | 6.8 | 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** | **%** |

*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-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)*

| 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*) | $Q_o$ = | 11.3 | 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 | $E_{o\text{-}GRATE}$ = | 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) | $S_e$ = | 0.078 | 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 ≥ 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*) | $Q_o$ = | 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** | **%** |

# 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 ≥ 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)*

| 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*) | $Q_o$ = | 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)*

| 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*) | $Q_o$ = | 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 | $E_{o\text{-}GRATE}$ = | 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) | $S_e$ = | 0.106 | 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** | **%** |

*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-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 ≥ 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)*

| 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*) | $Q_o$ = | 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** | **%** |

*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-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) | | ☐ | ☑ | |
| | | 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 | |
| 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)*

| | | | | | |
|---|---|---|---|---|---|
| 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 = | 4 | 4 | |
| 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 = | 1.33 | 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-7 (DP 18a)**

| 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 ≥ 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)*

| 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*) | $Q_o$ = | 11.3 | 26.3 | cfs |
| Water Spread Width | T = | 15.3 | 16.0 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 4.3 | 5.7 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 1.3 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.156 | 0.113 | |
| 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 | $A_W$ = | 0.27 | 0.37 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 6.6 | 8.1 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 7.3 | 8.7 | 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) | $S_e$ = | 0.077 | 0.061 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 22.89 | 39.11 | 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-10 (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 | $S_O$ = | 0.000 | | 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 ≥ 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)** | | $Q_{PEAK\ REQUIRED}$ = | 6.9 | 23.4 | 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 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 ≥ 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<br>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) = | 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 |

# 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 ≥ 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<br>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) = | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 3.1 | 7.2 | 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 ≥ 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 | |
| Total Inlet Interception Capacity | **Q =** | **4.2** | **6.9** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.4** | **4.0** | **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 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 ≥ 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 | |
| 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 ≥ 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)** | | $Q_{PEAK\ REQUIRED}$ = | 6.4 | 18.2 | 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)**

| 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 = | 2 | 2 | |
| 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 = | 1.25 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 3.7 | 8.5 | 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 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 ≥ 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)*

| 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*) | $Q_o$ = | 9.5 | 22.1 | cfs |
| Water Spread Width | T = | 13.3 | 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 | 0.6 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.181 | 0.130 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 7.8 | 19.3 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 1.7 | 2.9 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.23 | 0.32 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 7.3 | 9.0 | 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) | $S_e$ = | 0.086 | 0.067 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 20.35 | 35.08 | 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 | $Q_i$ = | 8.6 | 14.0 | 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 | **$Q_a$ =** | **8.6** | **13.8** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.9** | **8.3** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **8.6** | **13.8** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.9** | **8.3** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ = | **C% =** | **90** | **63** | **%** |

# 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 ≥ 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)*

| 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*) | $Q_o$ = | 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 ≥ 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<br>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 = | 4 | 4 | |
| 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 = | 1.33 | 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)** | | $Q_{PEAK\ REQUIRED}$ = | 8.1 | 31.6 | 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 ≥ 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<br>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 = | 4 | 4 | |
| 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 = | 1.33 | 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.**

# Worksheet for Basin D-7 Swale

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 0.02000 | ft/ft |
| Left Side Slope | 3.00 | ft/ft (H:V) |
| Right Side Slope | 3.00 | ft/ft (H:V) |
| Bottom Width | 1.00 | ft |
| Discharge | 7.30 | $ft^3/s$ |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.71 | ft |
| Flow Area | 2.22 | $ft^2$ |
| Wetted Perimeter | 5.49 | ft |
| Hydraulic Radius | 0.40 | ft |
| Top Width | 5.26 | ft |
| Critical Depth | 0.67 | ft |
| Critical Slope | 0.02558 | ft/ft |
| Velocity | 3.28 | ft/s |
| Velocity Head | 0.17 | ft |
| Specific Energy | 0.88 | ft |
| Froude Number | 0.89 | |
| Flow Type | Subcritical | |

## GVF Input Data

| | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

## GVF Output Data

| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.71 | ft |
| Critical Depth | 0.67 | ft |
| Channel Slope | 0.02000 | ft/ft |

# Worksheet for Basin D-7 Swale

## GVF Output Data

| | | |
|---|---|---|
| Critical Slope | 0.02558 | ft/ft |

# APPENDIX E

# Water Quality Computations

# 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 | 4.21 | 65 |
| A-2b | 2.75 | 88 |
| A-3 | 0.36 | 100 |
| A-4a | 6.05 | 65 |
| A-4b | 3.81 | 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** | **35.45** | **64.3** |

## Pond B

| Basin | Area | % Imp |
|---|---|---|
| B-1 | 3.33 | 65 |
| B-2 | 4.51 | 65 |
| B-3 | 4.05 | 65 |
| B-4 | 1.35 | 78.2 |
| 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** | **28.28** | **63.2** |

## Pond C

| Basin | Area | % Imp |
|---|---|---|
| C-1 | 4.12 | 65 |
| C-2 | 2.71 | 65 |
| C-3 | 1.56 | 65 |
| C-4 | 2.47 | 65 |
| C-5 | 3.09 | 65 |
| C-6 | 2.10 | 65 |
| C-7 | 6.72 | 65 |
| C-8 | 5.11 | 65 |
| C-9a | 3.50 | 65 |
| C-9b | 3.69 | 65 |
| C-10 | 3.51 | 65 |
| C-11 | 0.46 | 65 |
| C-12 | 1.79 | 65 |
| C-13 | 2.37 | 2 |
| **Total** | **43.20** | **61.5** |

## Pond D

| Basin | Area | % Imp |
|---|---|---|
| D-1 | 2.98 | 65 |
| D-2 | 0.87 | 65 |
| D-3 | 3.66 | 65 |
| D-4 | 2.00 | 65 |
| D-5 | 1.53 | 35.7 |
| D-7 | 1.80 | 50.3 |
| **Total** | **12.84** | **59.4** |

## Pond E

| Basin | Area | % Imp |
|---|---|---|
| E-1 | 5.13 | 65 |
| E-2 | 5.42 | 65 |
| E-3 | 3.20 | 65 |
| E-4 | 6.28 | 65 |
| E-5 | 1.13 | 2 |
| **Total** | **21.16** | **61.6** |

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:** | **March 3, 2022** |
| **Project:** | **Grandviewe Reserve** |
| **Location:** | **Pond A** |

**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) | 4.210 | 2.750 | 0.360 | 6.050 | 3.810 | 0.350 | 2.760 | 0.230 | 5.440 | 4.910 | 1.020 | 3.560 |
| Directly Connected Impervious Area (DCIA, acres) | 2.736 | 2.420 | 0.360 | 3.933 | 2.477 | 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) | 1.474 | 0.330 | 0.000 | 2.117 | 1.333 | 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)**

| | A-2a | A-2b | A-3 | A-4a | A-4b | A-5 | A-6 | A-7 | A-8 | A-9 | A-10 | A-11 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 4.210 | 2.750 | 0.360 | 6.050 | 3.810 | 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% | 65.0% | 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% | 35.0% | 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% | 65.0% | 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% | 65.0% | 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% | 65.0% | 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% | 65.0% | 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**

| | | A-2a | A-2b | A-3 | A-4a | A-4b | A-5 | A-6 | A-7 | A-8 | A-9 | A-10 | A-11 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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

| | | | |
|---|---|---|---|
| ***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:** | **March 3, 2022** |
| **Project:** | **Grandview Reserve** |
| **Location:** | **Pond B** |

**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) | 3.330 | 4.510 | 4.050 | 1.350 | 5.120 | 2.280 | 0.890 | 3.230 | 2.420 | 1.100 | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 2.165 | 2.932 | 2.633 | 1.056 | 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) | 1.166 | 1.579 | 1.418 | 0.294 | 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) | 3.330 | 4.510 | 4.050 | 1.350 | 5.120 | 2.280 | 0.890 | 3.230 | 2.420 | 1.100 | | | | |
| Directly Connected Impervious Area (DCIA, %) | 65.0% | 65.0% | 65.0% | 78.2% | 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, %) | 35.0% | 35.0% | 35.0% | 21.8% | 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: $I_{total}$ | 65.0% | 65.0% | 65.0% | 78.2% | 65.0% | 65.0% | 65.0% | 65.0% | 65.0% | 2.0% | | | | |
| Effective Imperviousness for WQCV Event: | 65.0% | 65.0% | 65.0% | 78.2% | 65.0% | 65.0% | 65.0% | 65.0% | 65.0% | 2.0% | | | | |
| Effective Imperviousness for 5-Year Event: | 65.0% | 65.0% | 65.0% | 78.2% | 65.0% | 65.0% | 65.0% | 65.0% | 65.0% | 2.0% | | | | |
| Effective Imperviousness for 100-Year Event: | 65.0% | 65.0% | 65.0% | 78.2% | 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:** | **63.2%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **63.2%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **63.2%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **63.2%** |
| **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:** | **March 3, 2022** |
| **Project:** | **Grandview Reserve** |
| **Location:** | **Pond C** |

**SITE INFORMATION (USER-INPUT)**

| Sub-basin Identifier | C-1 | C-2 | C-3 | C-4 | C-5 | C-6 | C-7 | 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 | 1.560 | 2.470 | 3.090 | 2.100 | 6.720 | 5.110 | 3.500 | 3.690 | 3.510 | 0.460 | 1.790 | 2.370 |
| Directly Connected Impervious Area (DCIA, acres) | 2.678 | 1.762 | 1.014 | 1.606 | 2.009 | 1.365 | 4.368 | 3.322 | 2.275 | 2.399 | 2.282 | 0.299 | 1.164 | 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 | 0.546 | 0.865 | 1.082 | 0.735 | 2.352 | 1.789 | 1.225 | 1.292 | 1.229 | 0.161 | 0.627 | 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)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 4.120 | 2.710 | 1.560 | 2.470 | 3.090 | 2.100 | 6.720 | 5.110 | 3.500 | 3.690 | 3.510 | 0.460 | 1.790 | 2.370 |
| Directly Connected Impervious Area (DCIA, %) | 65.0% | 65.0% | 65.0% | 65.0% | 65.0% | 65.0% | 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% | 35.0% | 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% | 65.0% | 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% | 65.0% | 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% | 65.0% | 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% | 65.0% | 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**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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% | 0.0% | 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:** | **61.5%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **61.5%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **61.5%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **61.5%** |
| **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:** | **March 3, 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) | 2.980 | 0.870 | 3.660 | 2.000 | 1.530 | 1.800 | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 1.937 | 0.566 | 2.379 | 1.300 | 0.546 | 0.905 | | | | | | | | |
| 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) | 1.043 | 0.305 | 1.281 | 0.700 | 0.984 | 0.895 | | | | | | | | |
| 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) | 2.980 | 0.870 | 3.660 | 2.000 | 1.530 | 1.800 | | | | | | | | |
| Directly Connected Impervious Area (DCIA, %) | 65.0% | 65.0% | 65.0% | 65.0% | 35.7% | 50.3% | | | | | | | | |
| 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% | 49.7% | | | | | | | | |
| $A_R$ (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% | 50.3% | | | | | | | | |
| Effective Imperviousness for WQCV Event: | 65.0% | 65.0% | 65.0% | 65.0% | 35.7% | 50.3% | | | | | | | | |
| Effective Imperviousness for 5-Year Event: | 65.0% | 65.0% | 65.0% | 65.0% | 35.7% | 50.3% | | | | | | | | |
| Effective Imperviousness for 100-Year Event: | 65.0% | 65.0% | 65.0% | 65.0% | 35.7% | 50.3% | | | | | | | | |
| 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:** | **59.4%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **59.4%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **59.4%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **59.4%** |
| **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:** | **March 3, 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) | 5.130 | 5.420 | 3.200 | 6.280 | 1.130 | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 3.335 | 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) | 1.796 | 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) | 5.130 | 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:** | **61.6%** |
| **Total Site Effective Imperviousness for WQCV Event:** | **61.6%** |
| **Total Site Effective Imperviousness for 5-Year Event:** | **61.6%** |
| **Total Site Effective Imperviousness for 100-Year Event:** | **61.6%** |
| **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

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:** | **March 3, 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) | 11.230 | | | | | | | | | | | | | |
| Directly Connected Impervious Area (DCIA, acres) | 0.225 | | | | | | | | | | | | | |
| Unconnected Impervious Area (UIA, acres) | 0.000 | | | | | | | | | | | | | |
| Receiving Pervious Area (RPA, acres) | 0.000 | | | | | | | | | | | | | |
| Separate Pervious Area (SPA, acres) | 11.005 | | | | | | | | | | | | | |
| RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP) | C | | | | | | | | | | | | | |

**CALCULATED RESULTS (OUTPUT)**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Calculated Area (ac, check against input) | 11.230 | | | | | | | | | | | | | |
| 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

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:** | **March 3, 2022** |
| **Project:** | **Grandview Reserve** |
| **Location:** | **Rex Rd Pond** |

**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 | 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 | 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 | 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 - Pond A**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 35.45 | acres |
| Watershed Length = | 2,360 | ft |
| Watershed Length to Centroid = | 1,180 | ft |
| Watershed Slope = | 0.020 | ft/ft |
| Watershed Imperviousness = | 64.90% | 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) = | 0.750 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 2.854 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 2.109 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 2.766 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 3.293 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 3.982 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 4.658 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 5.480 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.68 in.) = | 8.908 | acre-feet | 3.68 | inches |
| Approximate 2-yr Detention Volume = | 1.856 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 2.427 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 2.926 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 3.521 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 3.880 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 4.254 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.750 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 2.104 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 1.400 | acre-feet |
| Total Detention Basin Volume = | 4.254 | 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 |

20
15
10
5
0
Length, Width (ft.)
61200
45900
30600
15300
0
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

1.420
1.065
0.710
0.355
0.000
Area (acres)
6.020
4.515
3.010
1.505
0.000
Volume (ac-ft)
0.00
2.00
4.00
6.00
8.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project:** **Grandview - Pond A**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.05 | 0.750 | Orifice Plate |
| Zone 2 (EURV) | 4.04 | 2.104 | Rectangular Orifice |
| Zone 3 (100-year) | 5.20 | 1.400 | Weir&Pipe (Restrict) |
| Total (all zones) | | 4.254 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 1.979E-02 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 2.05 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 8.20 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 2.85 | sq. inches (diameter = 1-7/8 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 0.70 | 1.40 | | | | | |
| Orifice Area (sq. inches) | 2.85 | 2.85 | 2.85 | | | | | |

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

User Input: Vertical Orifice (Circular or Rectangular)

| | Zone 2 Rectangular | Not Selected | | | Zone 2 Rectangular | Not Selected | |
|---|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | 2.05 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | 0.06 | N/A | $ft^2$ |
| Depth at top of Zone using Vertical Orifice = | 4.04 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | 0.06 | N/A | feet |
| Vertical Orifice Height = | 1.50 | N/A | inches | | | | |
| Vertical Orifice Width = | 6.00 | | inches | | | | |

Calculated Parameters for Vertical Orifice

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

| | Zone 3 Weir | Not Selected | | | Zone 3 Weir | Not Selected | |
|---|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 4.04 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 4.79 | N/A | feet |
| Overflow Weir Front Edge Length = | 3.00 | N/A | feet | Overflow Weir Slope Length = | 3.09 | N/A | feet |
| Overflow Weir Grate Slope = | 4.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 3.74 | N/A | |
| Horiz. Length of Weir Sides = | 3.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 6.46 | N/A | $ft^2$ |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 3.23 | N/A | $ft^2$ |
| Debris Clogging % = | 50% | N/A | % | | | | |

Calculated Parameters for Overflow Weir

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

| | Zone 3 Restrictor | Not Selected | | | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | 0.25 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 1.73 | N/A | $ft^2$ |
| Outlet Pipe Diameter = | 18.00 | N/A | inches | Outlet Orifice Centroid = | 0.73 | N/A | feet |
| Restrictor Plate Height Above Pipe Invert = | 17.00 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 2.67 | N/A | radians |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 5.50 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.57 | feet |
| Spillway Crest Length = | 60.00 | feet | Stage at Top of Freeboard = | 7.07 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 1.40 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 6.00 | acre-ft |

Calculated Parameters for Spillway

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) = | 0.750 | 2.854 | 2.109 | 2.766 | 3.293 | 3.982 | 4.658 | 5.480 | 8.908 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 2.109 | 2.766 | 3.293 | 3.982 | 4.658 | 5.480 | 8.908 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.2 | 0.4 | 0.5 | 4.9 | 9.9 | 16.4 | 43.0 |
| 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 | 0.46 | 1.21 |
| Peak Inflow Q (cfs) = | N/A | N/A | 28.5 | 37.3 | 44.0 | 56.4 | 67.1 | 80.1 | 131.1 |
| Peak Outflow Q (cfs) = | 0.3 | 0.9 | 0.8 | 0.9 | 1.3 | 3.4 | 6.4 | 10.7 | 71.8 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 2.3 | 2.4 | 0.7 | 0.6 | 0.6 | 1.7 |
| Structure Controlling Flow = | Vertical Orifice 1 | Overflow Weir 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 | 0.1 | 0.4 | 0.8 | 1.5 | 2.5 |
| 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) = | 40 | 72 | 64 | 72 | 77 | 78 | 78 | 76 | 70 |
| Time to Drain 99% of Inflow Volume (hours) = | **43** | 78 | 69 | 77 | 83 | 85 | 85 | 85 | 82 |
| Maximum Ponding Depth (ft) = | 2.05 | 4.04 | 3.25 | 3.83 | 4.26 | 4.71 | 5.05 | 5.44 | 5.94 |
| Area at Maximum Ponding Depth (acres) = | 0.96 | 1.16 | 1.08 | 1.13 | 1.18 | 1.22 | 1.26 | 1.29 | 1.35 |
| Maximum Volume Stored (acre-ft) = | 0.752 | 2.859 | 1.977 | 2.607 | 3.104 | 3.643 | 4.076 | 4.561 | 5.234 |

# 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 | 2.01 |
| | 0:15:00 | 0.00 | 0.00 | 2.98 | 4.84 | 6.01 | 4.04 | 5.10 | 4.94 | 9.29 |
| | 0:20:00 | 0.00 | 0.00 | 11.08 | 14.67 | 17.31 | 10.97 | 12.83 | 13.68 | 21.63 |
| | 0:25:00 | 0.00 | 0.00 | 23.17 | 30.62 | 36.83 | 22.92 | 26.21 | 28.19 | 45.46 |
| | 0:30:00 | 0.00 | 0.00 | 28.50 | 37.33 | 44.00 | 46.89 | 55.86 | 62.97 | 104.50 |
| | 0:35:00 | 0.00 | 0.00 | 27.28 | 35.17 | 41.02 | 56.36 | 67.15 | 80.13 | 131.14 |
| | 0:40:00 | 0.00 | 0.00 | 24.87 | 31.53 | 36.67 | 54.99 | 65.39 | 78.64 | 128.15 |
| | 0:45:00 | 0.00 | 0.00 | 21.92 | 28.05 | 32.75 | 49.70 | 58.94 | 72.37 | 118.25 |
| | 0:50:00 | 0.00 | 0.00 | 19.29 | 25.12 | 29.06 | 44.82 | 52.96 | 64.98 | 106.76 |
| | 0:55:00 | 0.00 | 0.00 | 17.03 | 22.20 | 25.74 | 39.41 | 46.40 | 57.57 | 94.76 |
| | 1:00:00 | 0.00 | 0.00 | 15.15 | 19.65 | 22.96 | 34.34 | 40.23 | 51.00 | 84.00 |
| | 1:05:00 | 0.00 | 0.00 | 13.89 | 17.95 | 21.18 | 30.12 | 35.11 | 45.41 | 74.97 |
| | 1:10:00 | 0.00 | 0.00 | 12.49 | 16.74 | 19.90 | 26.57 | 30.87 | 39.18 | 64.47 |
| | 1:15:00 | 0.00 | 0.00 | 11.16 | 15.34 | 18.72 | 23.71 | 27.45 | 33.86 | 55.30 |
| | 1:20:00 | 0.00 | 0.00 | 9.98 | 13.75 | 17.01 | 20.77 | 23.98 | 28.60 | 46.32 |
| | 1:25:00 | 0.00 | 0.00 | 8.85 | 12.20 | 14.79 | 17.97 | 20.66 | 23.78 | 38.18 |
| | 1:30:00 | 0.00 | 0.00 | 7.79 | 10.79 | 12.74 | 15.15 | 17.36 | 19.55 | 31.09 |
| | 1:35:00 | 0.00 | 0.00 | 6.92 | 9.65 | 11.09 | 12.57 | 14.33 | 15.79 | 24.76 |
| | 1:40:00 | 0.00 | 0.00 | 6.38 | 8.49 | 10.04 | 10.46 | 11.83 | 12.65 | 19.52 |
| | 1:45:00 | 0.00 | 0.00 | 6.11 | 7.66 | 9.43 | 9.11 | 10.28 | 10.68 | 16.36 |
| | 1:50:00 | 0.00 | 0.00 | 5.97 | 7.10 | 9.03 | 8.31 | 9.35 | 9.50 | 14.41 |
| | 1:55:00 | 0.00 | 0.00 | 5.38 | 6.68 | 8.59 | 7.79 | 8.77 | 8.73 | 13.10 |
| | 2:00:00 | 0.00 | 0.00 | 4.79 | 6.22 | 7.94 | 7.43 | 8.36 | 8.19 | 12.17 |
| | 2:05:00 | 0.00 | 0.00 | 3.84 | 5.02 | 6.39 | 6.01 | 6.75 | 6.52 | 9.62 |
| | 2:10:00 | 0.00 | 0.00 | 2.96 | 3.86 | 4.92 | 4.60 | 5.16 | 4.90 | 7.18 |
| | 2:15:00 | 0.00 | 0.00 | 2.28 | 2.97 | 3.78 | 3.52 | 3.95 | 3.70 | 5.38 |
| | 2:20:00 | 0.00 | 0.00 | 1.75 | 2.27 | 2.87 | 2.68 | 3.00 | 2.81 | 4.08 |
| | 2:25:00 | 0.00 | 0.00 | 1.33 | 1.72 | 2.16 | 2.02 | 2.27 | 2.13 | 3.08 |
| | 2:30:00 | 0.00 | 0.00 | 1.00 | 1.27 | 1.61 | 1.50 | 1.68 | 1.59 | 2.30 |
| | 2:35:00 | 0.00 | 0.00 | 0.74 | 0.93 | 1.19 | 1.11 | 1.24 | 1.18 | 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 | 0.60 | 0.67 | 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 | 0.29 | 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 | 0.05 | 0.05 | 0.06 | 0.06 | 0.06 | 0.08 |
| | 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 - Pond B**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 28.28 | acres |
| Watershed Length = | 1,700 | ft |
| Watershed Length to Centroid = | 850 | ft |
| Watershed Slope = | 0.020 | ft/ft |
| Watershed Imperviousness = | 64.20% | 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) = | 0.592 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 2.245 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.658 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 2.175 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 2.590 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 3.137 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 3.674 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 4.327 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.68 in.) = | 7.052 | acre-feet | 3.68 | inches |
| Approximate 2-yr Detention Volume = | 1.460 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.909 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 2.303 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 2.773 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 3.057 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 3.355 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.592 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 1.653 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 1.110 | acre-feet |
| Total Detention Basin Volume = | 3.355 | 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 |

20
15
10
5
0
39600
29700
19800
9900
0
Length, Width (ft.)
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

0.920
0.690
0.460
0.230
0.000
3.740
2.805
1.870
0.935
0.000
Area (acres)
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project:** **Grandview - Pond B**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 1.57 | 0.592 | Orifice Plate |
| Zone 2 (EURV) | 3.76 | 1.653 | Rectangular Orifice |
| Zone 3 (100-year) | 5.08 | 1.110 | Weir&Pipe (Restrict) |
| Total (all zones) | | 3.355 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 1.875E-02 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 1.57 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 6.30 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 2.70 | sq. inches (diameter = 1-13/16 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 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 = | 1.30 | N/A | inches |
| Vertical Orifice Width = | 4.00 | | inches |

Calculated Parameters for Vertical Orifice

| | Zone 2 Rectangular | Not Selected | |
|---|---|---|---|
| Vertical Orifice Area = | 0.04 | N/A | $ft^2$ |
| Vertical Orifice Centroid = | 0.05 | 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 = | 6.12 | 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 = | 21.00 | N/A | inches |
| Restrictor Plate Height Above Pipe Invert = | 11.90 | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 1.41 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 0.57 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 1.70 | 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 Design Flow Depth= | 0.49 | feet |
| Spillway Crest Length = | 68.00 | feet | Stage at Top of Freeboard = | 6.74 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.90 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 3.74 | acre-ft |

Calculated Parameters for Spillway

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) = | 0.592 | 2.245 | 1.658 | 2.175 | 2.590 | 3.137 | 3.674 | 4.327 | 7.052 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 1.658 | 2.175 | 2.590 | 3.137 | 3.674 | 4.327 | 7.052 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.2 | 0.4 | 0.5 | 4.8 | 9.6 | 15.6 | 40.8 |
| 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 | 0.55 | 1.44 |
| Peak Inflow Q (cfs) = | N/A | N/A | 25.9 | 33.9 | 39.8 | 51.0 | 60.8 | 73.3 | 119.9 |
| Peak Outflow Q (cfs) = | 0.3 | 0.7 | 0.6 | 0.7 | 1.2 | 3.6 | 6.6 | 11.8 | 41.2 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.9 | 2.2 | 0.8 | 0.7 | 0.8 | 1.0 |
| 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 | N/A |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | 0.0 | 0.3 | 0.7 | 1.3 | 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) = | 40 | 72 | 65 | 72 | 77 | 77 | 76 | 75 | 68 |
| Time to Drain 99% of Inflow Volume (hours) = | **43** | 78 | 69 | 77 | 83 | 84 | 84 | 83 | 81 |
| Maximum Ponding Depth (ft) = | 1.57 | 3.76 | 2.89 | 3.53 | 4.01 | 4.46 | 4.77 | 5.20 | 5.50 |
| Area at Maximum Ponding Depth (acres) = | 0.70 | 0.81 | 0.77 | 0.80 | 0.82 | 0.85 | 0.86 | 0.89 | 0.90 |
| Maximum Volume Stored (acre-ft) = | 0.594 | 2.246 | 1.560 | 2.061 | 2.450 | 2.817 | 3.091 | 3.458 | 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 | 0.35 | 0.04 | 2.10 |
| | 0:15:00 | 0.00 | 0.00 | 3.12 | 5.08 | 6.29 | 4.23 | 5.28 | 5.16 | 9.38 |
| | 0:20:00 | 0.00 | 0.00 | 11.10 | 14.55 | 17.11 | 10.80 | 12.57 | 13.48 | 21.07 |
| | 0:25:00 | 0.00 | 0.00 | 22.43 | 29.65 | 35.73 | 22.18 | 25.29 | 27.23 | 43.95 |
| | 0:30:00 | 0.00 | 0.00 | 25.88 | 33.87 | 39.78 | 45.24 | 54.14 | 61.34 | 102.23 |
| | 0:35:00 | 0.00 | 0.00 | 23.48 | 30.21 | 35.16 | 50.99 | 60.80 | 73.32 | 119.91 |
| | 0:40:00 | 0.00 | 0.00 | 20.59 | 25.95 | 30.11 | 47.49 | 56.55 | 68.34 | 111.46 |
| | 0:45:00 | 0.00 | 0.00 | 17.37 | 22.25 | 25.97 | 40.94 | 48.58 | 60.30 | 98.87 |
| | 0:50:00 | 0.00 | 0.00 | 14.67 | 19.22 | 22.13 | 35.95 | 42.50 | 52.43 | 86.49 |
| | 0:55:00 | 0.00 | 0.00 | 12.68 | 16.55 | 19.18 | 30.13 | 35.41 | 44.46 | 73.33 |
| | 1:00:00 | 0.00 | 0.00 | 11.36 | 14.74 | 17.30 | 25.51 | 29.79 | 38.28 | 63.34 |
| | 1:05:00 | 0.00 | 0.00 | 10.30 | 13.31 | 15.75 | 22.37 | 26.02 | 34.22 | 56.90 |
| | 1:10:00 | 0.00 | 0.00 | 8.77 | 11.93 | 14.22 | 19.15 | 22.17 | 28.36 | 46.74 |
| | 1:15:00 | 0.00 | 0.00 | 7.35 | 10.30 | 12.78 | 16.26 | 18.74 | 23.10 | 37.66 |
| | 1:20:00 | 0.00 | 0.00 | 6.19 | 8.73 | 11.04 | 13.24 | 15.17 | 17.84 | 28.73 |
| | 1:25:00 | 0.00 | 0.00 | 5.43 | 7.68 | 9.41 | 10.75 | 12.22 | 13.46 | 21.35 |
| | 1:30:00 | 0.00 | 0.00 | 5.03 | 7.14 | 8.41 | 8.74 | 9.89 | 10.46 | 16.40 |
| | 1:35:00 | 0.00 | 0.00 | 4.82 | 6.82 | 7.78 | 7.52 | 8.48 | 8.72 | 13.50 |
| | 1:40:00 | 0.00 | 0.00 | 4.70 | 6.16 | 7.32 | 6.76 | 7.61 | 7.66 | 11.68 |
| | 1:45:00 | 0.00 | 0.00 | 4.62 | 5.61 | 7.00 | 6.25 | 7.03 | 6.93 | 10.42 |
| | 1:50:00 | 0.00 | 0.00 | 4.56 | 5.22 | 6.77 | 5.91 | 6.64 | 6.44 | 9.57 |
| | 1:55:00 | 0.00 | 0.00 | 3.99 | 4.93 | 6.44 | 5.67 | 6.38 | 6.08 | 8.95 |
| | 2:00:00 | 0.00 | 0.00 | 3.50 | 4.57 | 5.86 | 5.50 | 6.19 | 5.85 | 8.56 |
| | 2:05:00 | 0.00 | 0.00 | 2.63 | 3.44 | 4.39 | 4.16 | 4.67 | 4.40 | 6.42 |
| | 2:10:00 | 0.00 | 0.00 | 1.92 | 2.49 | 3.17 | 3.00 | 3.37 | 3.18 | 4.62 |
| | 2:15:00 | 0.00 | 0.00 | 1.39 | 1.80 | 2.28 | 2.17 | 2.43 | 2.31 | 3.35 |
| | 2:20:00 | 0.00 | 0.00 | 1.00 | 1.28 | 1.64 | 1.56 | 1.75 | 1.67 | 2.42 |
| | 2:25:00 | 0.00 | 0.00 | 0.70 | 0.89 | 1.15 | 1.09 | 1.22 | 1.17 | 1.69 |
| | 2:30:00 | 0.00 | 0.00 | 0.47 | 0.60 | 0.80 | 0.76 | 0.85 | 0.81 | 1.17 |
| | 2:35:00 | 0.00 | 0.00 | 0.31 | 0.41 | 0.54 | 0.53 | 0.59 | 0.56 | 0.81 |
| | 2:40:00 | 0.00 | 0.00 | 0.18 | 0.26 | 0.33 | 0.33 | 0.37 | 0.35 | 0.51 |
| | 2:45:00 | 0.00 | 0.00 | 0.09 | 0.14 | 0.18 | 0.19 | 0.21 | 0.20 | 0.28 |
| | 2:50:00 | 0.00 | 0.00 | 0.04 | 0.06 | 0.07 | 0.08 | 0.09 | 0.08 | 0.11 |
| | 2:55:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | 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 - Pond C**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 43.20 | acres |
| Watershed Length = | 1,890 | ft |
| Watershed Length to Centroid = | 1,050 | ft |
| Watershed Slope = | 0.020 | ft/ft |
| Watershed Imperviousness = | 62.00% | 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) = | 0.875 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 3.280 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 2.439 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 3.207 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 3.822 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 4.648 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 5.461 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 6.456 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.68 in.) = | 10.609 | acre-feet | 3.68 | inches |
| Approximate 2-yr Detention Volume = | 2.129 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 2.787 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 3.367 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 4.064 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 4.487 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 4.941 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.875 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 2.405 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 1.661 | acre-feet |
| Total Detention Basin Volume = | 4.941 | 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 |

20
15
10
5
0
Length, Width (ft.)
56800
42600
28400
14200
0
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

1.320
0.990
0.660
0.330
0.000
Area (acres)
5.360
4.020
2.680
1.340
0.000
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project:** **Grandview - Pond C**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.07 | 0.875 | Orifice Plate |
| Zone 2 (EURV) | 4.32 | 2.405 | Rectangular Orifice |
| Zone 3 (100-year) | 5.69 | 1.661 | Weir&Pipe (Restrict) |
| Total (all zones) | | 4.941 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 2.153E-02 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 2.07 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 8.30 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 3.10 | sq. inches (diameter = 2 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 0.69 | 1.38 | | | | | |
| Orifice Area (sq. inches) | 3.10 | 3.10 | 3.10 | | | | | |

| | 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 = | 4.32 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Vertical Orifice Height = | 2.00 | N/A | inches |
| Vertical Orifice Width = | 6.00 | | inches |

Calculated Parameters for Vertical Orifice

| | Zone 2 Rectangular | Not Selected | |
|---|---|---|---|
| Vertical Orifice Area = | 0.08 | 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 = | 4.33 | 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, $H_t$ = | 5.08 | N/A | feet |
| Overflow Weir Slope Length = | 3.09 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 3.74 | 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 = | 17.00 | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 1.73 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 0.73 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 2.67 | 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 Design Flow Depth= | 0.70 | feet |
| Spillway Crest Length = | 60.00 | feet | Stage at Top of Freeboard = | 7.70 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 1.30 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 5.35 | acre-ft |

Calculated Parameters for Spillway

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) = | 0.875 | 3.280 | 2.439 | 3.207 | 3.822 | 4.648 | 5.461 | 6.456 | 10.609 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 2.439 | 3.207 | 3.822 | 4.648 | 5.461 | 6.456 | 10.609 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.3 | 0.6 | 0.8 | 7.6 | 15.1 | 24.8 | 64.6 |
| 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 | 0.18 | 0.35 | 0.57 | 1.50 |
| Peak Inflow Q (cfs) = | N/A | N/A | 38.5 | 50.5 | 59.6 | 76.8 | 92.1 | 111.4 | 183.9 |
| Peak Outflow Q (cfs) = | 0.4 | 1.2 | 1.0 | 1.1 | 1.7 | 4.6 | 8.2 | 14.0 | 14.5 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.9 | 2.0 | 0.6 | 0.5 | 0.6 | 0.2 |
| 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 | N/A |
| Max Velocity through Grate 1 (fps) = | N/A | N/A | N/A | N/A | 0.1 | 0.5 | 1.0 | 1.9 | 2.0 |
| 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) = | 40 | 72 | 65 | 72 | 76 | 77 | 76 | 75 | 71 |
| Time to Drain 99% of Inflow Volume (hours) = | **42** | 76 | 69 | 76 | 81 | 83 | 84 | 83 | 84 |
| Maximum Ponding Depth (ft) = | 2.07 | 4.32 | 3.44 | 4.10 | 4.60 | 5.11 | 5.49 | 5.97 | 6.00 |
| Area at Maximum Ponding Depth (acres) = | 0.98 | 1.16 | 1.09 | 1.14 | 1.18 | 1.23 | 1.26 | 1.30 | 1.30 |
| Maximum Volume Stored (acre-ft) = | 0.880 | 3.284 | 2.284 | 3.030 | 3.600 | 4.226 | 4.698 | 5.298 | 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 | 0.51 | 0.05 | 3.03 |
| | 0:15:00 | 0.00 | 0.00 | 4.50 | 7.31 | 9.07 | 6.10 | 7.64 | 7.45 | 13.68 |
| | 0:20:00 | 0.00 | 0.00 | 16.20 | 21.30 | 25.08 | 15.85 | 18.48 | 19.79 | 30.99 |
| | 0:25:00 | 0.00 | 0.00 | 32.99 | 43.59 | 52.63 | 32.60 | 37.19 | 40.01 | 64.90 |
| | 0:30:00 | 0.00 | 0.00 | 38.46 | 50.54 | 59.57 | 66.90 | 80.41 | 91.32 | 153.70 |
| | 0:35:00 | 0.00 | 0.00 | 34.96 | 45.17 | 52.67 | 76.83 | 92.11 | 111.40 | 183.89 |
| | 0:40:00 | 0.00 | 0.00 | 30.52 | 38.60 | 44.85 | 71.51 | 85.56 | 103.98 | 170.98 |
| | 0:45:00 | 0.00 | 0.00 | 25.69 | 32.96 | 38.52 | 61.41 | 73.22 | 91.28 | 150.97 |
| | 0:50:00 | 0.00 | 0.00 | 21.61 | 28.38 | 32.71 | 53.60 | 63.65 | 78.96 | 131.50 |
| | 0:55:00 | 0.00 | 0.00 | 18.64 | 24.41 | 28.30 | 44.80 | 52.84 | 66.61 | 110.93 |
| | 1:00:00 | 0.00 | 0.00 | 16.67 | 21.68 | 25.45 | 37.79 | 44.27 | 57.12 | 95.46 |
| | 1:05:00 | 0.00 | 0.00 | 15.06 | 19.49 | 23.08 | 33.00 | 38.48 | 50.86 | 85.47 |
| | 1:10:00 | 0.00 | 0.00 | 12.78 | 17.39 | 20.74 | 28.13 | 32.64 | 42.01 | 69.97 |
| | 1:15:00 | 0.00 | 0.00 | 10.63 | 14.97 | 18.57 | 23.73 | 27.38 | 33.91 | 55.77 |
| | 1:20:00 | 0.00 | 0.00 | 8.95 | 12.67 | 16.05 | 19.21 | 22.02 | 25.96 | 42.09 |
| | 1:25:00 | 0.00 | 0.00 | 7.92 | 11.22 | 13.78 | 15.50 | 17.59 | 19.35 | 30.81 |
| | 1:30:00 | 0.00 | 0.00 | 7.37 | 10.47 | 12.35 | 12.71 | 14.36 | 15.11 | 23.79 |
| | 1:35:00 | 0.00 | 0.00 | 7.08 | 10.02 | 11.42 | 10.97 | 12.36 | 12.67 | 19.67 |
| | 1:40:00 | 0.00 | 0.00 | 6.91 | 9.06 | 10.75 | 9.89 | 11.12 | 11.14 | 17.01 |
| | 1:45:00 | 0.00 | 0.00 | 6.79 | 8.25 | 10.28 | 9.15 | 10.29 | 10.11 | 15.20 |
| | 1:50:00 | 0.00 | 0.00 | 6.70 | 7.66 | 9.94 | 8.66 | 9.74 | 9.40 | 13.96 |
| | 1:55:00 | 0.00 | 0.00 | 5.89 | 7.23 | 9.47 | 8.32 | 9.35 | 8.89 | 13.07 |
| | 2:00:00 | 0.00 | 0.00 | 5.15 | 6.71 | 8.62 | 8.08 | 9.08 | 8.57 | 12.52 |
| | 2:05:00 | 0.00 | 0.00 | 3.89 | 5.07 | 6.47 | 6.15 | 6.91 | 6.51 | 9.49 |
| | 2:10:00 | 0.00 | 0.00 | 2.81 | 3.65 | 4.63 | 4.39 | 4.93 | 4.66 | 6.77 |
| | 2:15:00 | 0.00 | 0.00 | 2.02 | 2.62 | 3.32 | 3.16 | 3.54 | 3.36 | 4.88 |
| | 2:20:00 | 0.00 | 0.00 | 1.44 | 1.85 | 2.37 | 2.26 | 2.53 | 2.41 | 3.50 |
| | 2:25:00 | 0.00 | 0.00 | 1.00 | 1.27 | 1.65 | 1.57 | 1.76 | 1.68 | 2.42 |
| | 2:30:00 | 0.00 | 0.00 | 0.67 | 0.86 | 1.13 | 1.08 | 1.21 | 1.16 | 1.67 |
| | 2:35:00 | 0.00 | 0.00 | 0.43 | 0.58 | 0.76 | 0.74 | 0.82 | 0.79 | 1.13 |
| | 2:40:00 | 0.00 | 0.00 | 0.25 | 0.36 | 0.46 | 0.46 | 0.51 | 0.49 | 0.69 |
| | 2:45:00 | 0.00 | 0.00 | 0.12 | 0.19 | 0.23 | 0.25 | 0.27 | 0.26 | 0.36 |
| | 2:50:00 | 0.00 | 0.00 | 0.05 | 0.08 | 0.09 | 0.10 | 0.11 | 0.10 | 0.13 |
| | 2:55:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 |
| | 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 - Pond D**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 12.84 | acres |
| Watershed Length = | 1,200 | ft |
| Watershed Length to Centroid = | 600 | ft |
| Watershed Slope = | 0.020 | ft/ft |
| Watershed Imperviousness = | 59.40% | 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) = | 0.251 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.923 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 0.678 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 0.894 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.066 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 1.304 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 1.538 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 1.827 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.68 in.) = | 3.032 | acre-feet | 3.68 | inches |
| Approximate 2-yr Detention Volume = | 0.598 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.784 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.949 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.148 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 1.270 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 1.404 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.251 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.672 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.481 | acre-feet |
| Total Detention Basin Volume = | 1.404 | 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 |

20
15
10
5
0
Length, Width (ft.)
22000
16500
11000
5500
0
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

0.500
0.375
0.250
0.125
0.000
Area (acres)
1.760
1.320
0.880
0.440
0.000
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project:** **Grandview - Pond D**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 1.84 | 0.251 | Orifice Plate |
| Zone 2 (EURV) | 3.66 | 0.672 | Circular Orifice |
| Zone 3 (100-year) | 4.77 | 0.481 | Weir&Pipe (Restrict) |
| Total (all zones) | | 1.404 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 6.597E-03 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 1.84 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 7.10 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 0.95 | sq. inches (diameter = 1-1/16 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 0.61 | 1.23 | | | | | |
| 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 | | | Zone 2 Circular | Not Selected | |
|---|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | 1.84 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | 0.02 | N/A | $ft^2$ |
| Depth at top of Zone using Vertical Orifice = | 3.66 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | 0.09 | N/A | feet |
| Vertical Orifice Diameter = | 2.10 | N/A | inches | | | | |

Calculated Parameters for Vertical Orifice

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

| | Zone 3 Weir | Not Selected | | | Zone 3 Weir | Not Selected | |
|---|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 3.67 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 4.42 | N/A | feet |
| Overflow Weir Front Edge Length = | 3.00 | N/A | feet | Overflow Weir Slope Length = | 3.09 | N/A | feet |
| Overflow Weir Grate Slope = | 4.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 9.78 | N/A | |
| Horiz. Length of Weir Sides = | 3.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 6.46 | N/A | $ft^2$ |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 3.23 | N/A | $ft^2$ |
| Debris Clogging % = | 50% | N/A | % | | | | |

Calculated Parameters for Overflow Weir

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

| | Zone 3 Restrictor | Not Selected | | | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | 0.25 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 0.66 | N/A | $ft^2$ |
| Outlet Pipe Diameter = | 18.00 | N/A | inches | Outlet Orifice Centroid = | 0.35 | N/A | feet |
| Restrictor Plate Height Above Pipe Invert = | 7.20 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 1.37 | N/A | radians |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 4.80 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.29 | feet |
| Spillway Crest Length = | 60.00 | feet | Stage at Top of Freeboard = | 6.09 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.50 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 1.76 | acre-ft |

Calculated Parameters for Spillway

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) = | 0.251 | 0.923 | 0.678 | 0.894 | 1.066 | 1.304 | 1.538 | 1.827 | 3.032 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.678 | 0.894 | 1.066 | 1.304 | 1.538 | 1.827 | 3.032 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.1 | 0.2 | 0.2 | 2.1 | 4.3 | 7.0 | 18.0 |
| 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 | 0.17 | 0.33 | 0.54 | 1.40 |
| Peak Inflow Q (cfs) = | N/A | N/A | 10.0 | 13.2 | 15.6 | 20.4 | 24.5 | 29.9 | 49.8 |
| Peak Outflow Q (cfs) = | 0.1 | 0.3 | 0.3 | 0.3 | 0.6 | 1.9 | 3.4 | 6.4 | 33.8 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 1.8 | 2.4 | 0.9 | 0.8 | 0.9 | 1.9 |
| 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 | 0.5 | 0.9 | 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) = | 40 | 72 | 65 | 72 | 76 | 76 | 75 | 73 | 66 |
| Time to Drain 99% of Inflow Volume (hours) = | **42** | 77 | 68 | 77 | 82 | 82 | 82 | 81 | 79 |
| Maximum Ponding Depth (ft) = | 1.84 | 3.66 | 2.93 | 3.46 | 3.85 | 4.19 | 4.43 | 4.76 | 5.08 |
| Area at Maximum Ponding Depth (acres) = | 0.33 | 0.41 | 0.38 | 0.40 | 0.42 | 0.43 | 0.45 | 0.46 | 0.48 |
| Maximum Volume Stored (acre-ft) = | 0.253 | 0.925 | 0.634 | 0.844 | 1.000 | 1.149 | 1.254 | 1.400 | 1.550 |

# 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 | 0.82 |
| | 0:15:00 | 0.00 | 0.00 | 1.22 | 1.98 | 2.45 | 1.65 | 2.06 | 2.02 | 3.65 |
| | 0:20:00 | 0.00 | 0.00 | 4.31 | 5.64 | 6.63 | 4.18 | 4.87 | 5.23 | 8.19 |
| | 0:25:00 | 0.00 | 0.00 | 8.70 | 11.54 | 13.98 | 8.62 | 9.84 | 10.58 | 17.32 |
| | 0:30:00 | 0.00 | 0.00 | 10.01 | 13.22 | 15.60 | 17.92 | 21.71 | 24.78 | 42.24 |
| | 0:35:00 | 0.00 | 0.00 | 9.20 | 11.94 | 13.96 | 20.35 | 24.52 | 29.86 | 49.75 |
| | 0:40:00 | 0.00 | 0.00 | 8.20 | 10.43 | 12.15 | 19.20 | 23.11 | 28.16 | 46.81 |
| | 0:45:00 | 0.00 | 0.00 | 7.05 | 9.10 | 10.66 | 16.73 | 20.05 | 25.10 | 41.98 |
| | 0:50:00 | 0.00 | 0.00 | 6.06 | 7.98 | 9.22 | 14.90 | 17.79 | 22.09 | 37.24 |
| | 0:55:00 | 0.00 | 0.00 | 5.26 | 6.90 | 8.00 | 12.68 | 15.04 | 19.01 | 32.03 |
| | 1:00:00 | 0.00 | 0.00 | 4.73 | 6.16 | 7.24 | 10.77 | 12.68 | 16.36 | 27.62 |
| | 1:05:00 | 0.00 | 0.00 | 4.35 | 5.64 | 6.68 | 9.50 | 11.13 | 14.66 | 24.94 |
| | 1:10:00 | 0.00 | 0.00 | 3.80 | 5.17 | 6.16 | 8.28 | 9.65 | 12.38 | 20.87 |
| | 1:15:00 | 0.00 | 0.00 | 3.28 | 4.57 | 5.62 | 7.20 | 8.36 | 10.37 | 17.27 |
| | 1:20:00 | 0.00 | 0.00 | 2.81 | 3.92 | 4.91 | 6.02 | 6.95 | 8.29 | 13.66 |
| | 1:25:00 | 0.00 | 0.00 | 2.42 | 3.39 | 4.12 | 4.99 | 5.73 | 6.50 | 10.55 |
| | 1:30:00 | 0.00 | 0.00 | 2.16 | 3.04 | 3.57 | 4.00 | 4.54 | 4.98 | 7.94 |
| | 1:35:00 | 0.00 | 0.00 | 2.02 | 2.85 | 3.27 | 3.31 | 3.74 | 3.96 | 6.22 |
| | 1:40:00 | 0.00 | 0.00 | 1.96 | 2.57 | 3.07 | 2.91 | 3.28 | 3.38 | 5.25 |
| | 1:45:00 | 0.00 | 0.00 | 1.91 | 2.35 | 2.92 | 2.66 | 2.99 | 3.01 | 4.60 |
| | 1:50:00 | 0.00 | 0.00 | 1.88 | 2.19 | 2.82 | 2.49 | 2.80 | 2.77 | 4.16 |
| | 1:55:00 | 0.00 | 0.00 | 1.66 | 2.06 | 2.68 | 2.38 | 2.67 | 2.59 | 3.85 |
| | 2:00:00 | 0.00 | 0.00 | 1.47 | 1.92 | 2.45 | 2.30 | 2.58 | 2.47 | 3.63 |
| | 2:05:00 | 0.00 | 0.00 | 1.12 | 1.46 | 1.87 | 1.76 | 1.97 | 1.86 | 2.72 |
| | 2:10:00 | 0.00 | 0.00 | 0.84 | 1.09 | 1.39 | 1.30 | 1.46 | 1.37 | 1.99 |
| | 2:15:00 | 0.00 | 0.00 | 0.63 | 0.81 | 1.03 | 0.96 | 1.08 | 1.02 | 1.48 |
| | 2:20:00 | 0.00 | 0.00 | 0.46 | 0.60 | 0.76 | 0.71 | 0.80 | 0.76 | 1.09 |
| | 2:25:00 | 0.00 | 0.00 | 0.34 | 0.43 | 0.55 | 0.52 | 0.58 | 0.55 | 0.79 |
| | 2:30:00 | 0.00 | 0.00 | 0.24 | 0.30 | 0.39 | 0.37 | 0.41 | 0.39 | 0.56 |
| | 2:35:00 | 0.00 | 0.00 | 0.17 | 0.21 | 0.28 | 0.27 | 0.30 | 0.28 | 0.41 |
| | 2:40:00 | 0.00 | 0.00 | 0.11 | 0.15 | 0.19 | 0.18 | 0.21 | 0.20 | 0.28 |
| | 2:45:00 | 0.00 | 0.00 | 0.07 | 0.09 | 0.12 | 0.12 | 0.13 | 0.12 | 0.18 |
| | 2:50:00 | 0.00 | 0.00 | 0.03 | 0.05 | 0.06 | 0.07 | 0.07 | 0.07 | 0.09 |
| | 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 - Pond E**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 21.16 | acres |
| Watershed Length = | 1,800 | ft |
| Watershed Length to Centroid = | 900 | ft |
| Watershed Slope = | 0.020 | ft/ft |
| Watershed Imperviousness = | 61.60% | 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) = | 0.426 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 1.576 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 1.195 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 1.568 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 1.867 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 2.322 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 2.722 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 3.227 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.68 in.) = | 5.285 | acre-feet | 3.68 | inches |
| Approximate 2-yr Detention Volume = | 1.040 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 1.366 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 1.661 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 1.982 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 2.176 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 2.395 | acre-feet | | |

Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.426 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 1.150 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.819 | acre-feet |
| Total Detention Basin Volume = | 2.395 | 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 |

20
15
10
5
0
Length, Width (ft.)
40400
30300
20200
10100
0
Area (sq.ft.)
0.00
1.50
3.00
4.50
6.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

0.920
0.690
0.460
0.230
0.000
Area (acres)
3.680
2.760
1.840
0.920
0.000
Volume (ac-ft)
0.00
1.50
3.00
4.50
6.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

**Project:** **Grandview - Pond E**

**Basin ID:**

**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 1.71 | 0.426 | Orifice Plate |
| Zone 2 (EURV) | 3.45 | 1.150 | Rectangular Orifice |
| Zone 3 (100-year) | 4.52 | 0.819 | Weir&Pipe (Restrict) |
| Total (all zones) | | 2.395 | |

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 Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Invert of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | 1.215E-02 | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 1.71 | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 6.80 | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | 1.75 | sq. inches (diameter = 1-1/2 inches) | Elliptical Slot Area = | N/A | $ft^2$ |

Calculated Parameters for Plate

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 0.57 | 1.14 | | | | | |
| Orifice Area (sq. inches) | 1.75 | 1.75 | 1.75 | | | | | |

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

User Input: Vertical Orifice (Circular or Rectangular)

| | 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 = | 3.45 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Vertical Orifice Height = | 1.50 | N/A | inches |
| Vertical Orifice Width = | 4.00 | | inches |

Calculated Parameters for Vertical Orifice

| | Zone 2 Rectangular | Not Selected | |
|---|---|---|---|
| Vertical Orifice Area = | 0.04 | 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 = | 3.45 | 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, $H_t$ = | 4.20 | N/A | feet |
| Overflow Weir Slope Length = | 3.09 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 5.77 | 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 = | 10.90 | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

| | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|
| Outlet Orifice Area = | 1.12 | N/A | $ft^2$ |
| Outlet Orifice Centroid = | 0.52 | N/A | feet |
| Half-Central Angle of Restrictor Plate on Pipe = | 1.78 | 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 Design Flow Depth= | 0.40 | feet |
| Spillway Crest Length = | 60.00 | feet | Stage at Top of Freeboard = | 6.15 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 0.92 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 3.67 | acre-ft |

Calculated Parameters for Spillway

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) = | 0.426 | 1.576 | 1.195 | 1.568 | 1.867 | 2.322 | 2.722 | 3.227 | 5.285 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 1.195 | 1.568 | 1.867 | 2.322 | 2.722 | 3.227 | 5.285 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.1 | 0.3 | 0.4 | 4.6 | 7.6 | 11.8 | 28.3 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.01 | 0.01 | 0.02 | 0.22 | 0.36 | 0.56 | 1.34 |
| Peak Inflow Q (cfs) = | N/A | N/A | 16.2 | 21.2 | 25.0 | 33.2 | 39.6 | 47.4 | 77.9 |
| Peak Outflow Q (cfs) = | 0.2 | 0.6 | 0.5 | 0.5 | 0.9 | 2.9 | 5.1 | 8.7 | 47.3 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 2.0 | 2.6 | 0.6 | 0.7 | 0.7 | 1.7 |
| Structure Controlling Flow = | Plate | Overflow Weir 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 | 0.1 | 0.4 | 0.7 | 1.3 | 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) = | 40 | 71 | 65 | 72 | 76 | 76 | 75 | 73 | 66 |
| Time to Drain 99% of Inflow Volume (hours) = | **42** | 76 | 69 | 77 | 81 | 83 | 82 | 82 | 79 |
| Maximum Ponding Depth (ft) = | 1.71 | 3.45 | 2.79 | 3.31 | 3.68 | 4.10 | 4.37 | 4.73 | 5.08 |
| Area at Maximum Ponding Depth (acres) = | 0.60 | 0.72 | 0.67 | 0.71 | 0.74 | 0.77 | 0.79 | 0.82 | 0.85 |
| Maximum Volume Stored (acre-ft) = | 0.431 | 1.579 | 1.118 | 1.472 | 1.748 | 2.057 | 2.276 | 2.558 | 2.858 |

# 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 | 0.20 | 0.02 | 1.20 |
| | 0:15:00 | 0.00 | 0.00 | 1.78 | 2.90 | 3.59 | 2.42 | 3.03 | 2.95 | 5.45 |
| | 0:20:00 | 0.00 | 0.00 | 6.45 | 8.51 | 10.03 | 6.34 | 7.40 | 7.91 | 12.47 |
| | 0:25:00 | 0.00 | 0.00 | 13.28 | 17.82 | 21.49 | 13.18 | 15.22 | 16.39 | 27.11 |
| | 0:30:00 | 0.00 | 0.00 | 16.20 | 21.25 | 25.03 | 28.11 | 33.61 | 38.01 | 63.71 |
| | 0:35:00 | 0.00 | 0.00 | 15.36 | 19.79 | 23.11 | 33.22 | 39.56 | 47.43 | 77.87 |
| | 0:40:00 | 0.00 | 0.00 | 13.99 | 17.73 | 20.64 | 32.38 | 38.49 | 46.28 | 75.62 |
| | 0:45:00 | 0.00 | 0.00 | 12.32 | 15.79 | 18.47 | 29.14 | 34.53 | 42.70 | 69.89 |
| | 0:50:00 | 0.00 | 0.00 | 10.87 | 14.17 | 16.39 | 26.31 | 31.06 | 38.47 | 63.30 |
| | 0:55:00 | 0.00 | 0.00 | 9.62 | 12.52 | 14.53 | 23.03 | 27.12 | 34.04 | 56.31 |
| | 1:00:00 | 0.00 | 0.00 | 8.57 | 11.09 | 12.97 | 20.03 | 23.53 | 30.14 | 50.09 |
| | 1:05:00 | 0.00 | 0.00 | 7.85 | 10.13 | 11.96 | 17.53 | 20.54 | 26.85 | 44.83 |
| | 1:10:00 | 0.00 | 0.00 | 7.04 | 9.46 | 11.25 | 15.40 | 17.99 | 23.03 | 38.35 |
| | 1:15:00 | 0.00 | 0.00 | 6.31 | 8.67 | 10.59 | 13.73 | 15.97 | 19.89 | 32.91 |
| | 1:20:00 | 0.00 | 0.00 | 5.66 | 7.78 | 9.61 | 12.01 | 13.93 | 16.77 | 27.53 |
| | 1:25:00 | 0.00 | 0.00 | 5.04 | 6.92 | 8.36 | 10.40 | 12.01 | 13.97 | 22.73 |
| | 1:30:00 | 0.00 | 0.00 | 4.45 | 6.13 | 7.22 | 8.76 | 10.08 | 11.50 | 18.52 |
| | 1:35:00 | 0.00 | 0.00 | 3.94 | 5.47 | 6.28 | 7.27 | 8.32 | 9.29 | 14.74 |
| | 1:40:00 | 0.00 | 0.00 | 3.61 | 4.77 | 5.66 | 6.02 | 6.84 | 7.42 | 11.58 |
| | 1:45:00 | 0.00 | 0.00 | 3.44 | 4.30 | 5.31 | 5.19 | 5.87 | 6.18 | 9.59 |
| | 1:50:00 | 0.00 | 0.00 | 3.36 | 3.99 | 5.08 | 4.70 | 5.31 | 5.45 | 8.36 |
| | 1:55:00 | 0.00 | 0.00 | 3.01 | 3.75 | 4.83 | 4.40 | 4.96 | 4.98 | 7.54 |
| | 2:00:00 | 0.00 | 0.00 | 2.68 | 3.50 | 4.45 | 4.19 | 4.72 | 4.64 | 6.95 |
| | 2:05:00 | 0.00 | 0.00 | 2.14 | 2.79 | 3.55 | 3.34 | 3.76 | 3.65 | 5.41 |
| | 2:10:00 | 0.00 | 0.00 | 1.66 | 2.15 | 2.74 | 2.57 | 2.88 | 2.75 | 4.04 |
| | 2:15:00 | 0.00 | 0.00 | 1.28 | 1.67 | 2.11 | 1.97 | 2.21 | 2.08 | 3.03 |
| | 2:20:00 | 0.00 | 0.00 | 0.99 | 1.28 | 1.61 | 1.50 | 1.69 | 1.58 | 2.29 |
| | 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 | 0.68 | 0.63 | 0.70 | 0.67 | 0.97 |
| | 2:40:00 | 0.00 | 0.00 | 0.31 | 0.39 | 0.51 | 0.47 | 0.53 | 0.51 | 0.73 |
| | 2:45:00 | 0.00 | 0.00 | 0.22 | 0.28 | 0.36 | 0.35 | 0.39 | 0.37 | 0.53 |
| | 2:50:00 | 0.00 | 0.00 | 0.14 | 0.19 | 0.25 | 0.24 | 0.27 | 0.25 | 0.36 |
| | 2:55:00 | 0.00 | 0.00 | 0.09 | 0.12 | 0.15 | 0.15 | 0.17 | 0.16 | 0.22 |
| | 3:00:00 | 0.00 | 0.00 | 0.04 | 0.07 | 0.08 | 0.08 | 0.09 | 0.09 | 0.12 |
| | 3:05:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.05 |
| | 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).

SB
INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
FLOW
1" TO 2" CRUSHED ROCK
RISER PIPE
6" PVC
RIPRAP PAD
L=2 x W MIN.
BOTTOM LENGTH
W
BOTTOM WIDTH
00
01
02
03
04
A
B
SPILLWAY
SEDIMENT BASIN PLAN
HOLE DIAMETER, HD
1"
EL. 03.00
SINGLE COLUMN OF FIVE HOLES*
4" TYP.
EL. 01.25
*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

TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN

| Upstream Drainage Area (rounded to nearest acre), (ac) | Basin Bottom Width (W), (ft) | Spillway Crest Length (CL), (ft) | Hole Diameter (HD), (in) |
|---|---|---|---|
| 1 | 12 ½ | 2 | 9/32 |
| 2 | 21 | 3 | 13/16 |
| 3 | 28 | 5 | ½ |
| 4 | 33 ½ | 6 | 9/16 |
| 5 | 38 ½ | 8 | 21/32 |
| 6 | 43 | 9 | 21/32 |
| 7 | 47 ¼ | 11 | 25/32 |
| 8 | 51 | 12 | 27/32 |
| 9 | 55 | 13 | 7/8 |
| 10 | 58 ¼ | 15 | 15/16 |
| 11 | 61 | 16 | 31/32 |
| 12 | 64 | 18 | 1 |
| 13 | 67 ½ | 19 | 1 1/16 |
| 14 | 70 ½ | 21 | 1 1/8 |
| 15 | 73 ¼ | 22 | 1 3/16 |

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

MHFD SPREADSHEETS PROVIDED FOR SB-1 & SB-2 FOR SFB DRAIN TIMES

Also provide the MHFD calculation sheets for this design to verify drain times.

TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN

| Upstream Drainage Area (rounded to nearest acre), (ac) | Basin Bottom Width (W), (ft) | Spillway Crest Length (CL), (ft) | Hole Diameter (HD), (in) |
|---|---|---|---|
| 1 | 12 ½ | 2 | 9/32 |
| 2 | 21 | 3 | 13/16 |
| 3 | 28 | 5 | ½ |
| 4 | 33 ½ | 6 | 9/16 |
| 5 | 38 ½ | 8 | 21/32 |
| 6 | 43 | 9 | 21/32 |
| 7 | 47 ¼ | 11 | 25/32 |
| 8 | 51 | 12 | 27/32 |
| 9 | 55 | 13 | 7/8 |
| 10 | 58 ¼ | 15 | 15/16 |
| 11 | 61 | 16 | 31/32 |
| 12 | 64 | 18 | 1 |
| 13 | 67 ½ | 19 | 1 1/16 |
| 14 | 70 ½ | 21 | 1 1/8 |
| 15 | 73 ¼ | 22 | 1 3/16 |

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

# APPENDIX F

# Drainage Maps

KEY MAP SCALE: (1"=2,000')

## DRAINAGE LEGEND

- EXISTING PROPERTY LINE
- PROPOSED PROPERTY LINE
- 6485 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
- TELE EXISTING TELEPHONE LINE
- OH EXISTING POWER LINE
- EXISTING FENCE
- GAS 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 | 4.4 | 31.5 |
| EX-2 | 46.06 | 10.3 | 72.8 |
| EX-3 | 64.34 | 13.1 | 93.3 |
| EX-4 | 2.68 | 0.8 | 6.1 |
| EX-5 | 26.15 | 6.5 | 46.5 |
| EX-6 | 31.53 | 8.6 | 60.9 |

## DESIGN POINT SUMMARY TABLE

| Design Point | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|
| 1 | 4.4 | 31.5 |
| 2 | 77.3 | 485.8 |
| 3 | 13.1 | 93.3 |
| 4 | 0.8 | 6.1 |
| 5 | 6.5 | 46.5 |
| 6 | 8.6 | 60.9 |
| 7 | 164.2 | 964.1 |


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


PRELIMINARY
NOT FOR BIDDING
NOT FOR CONSTRUCTION


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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: | 3/1/2022 |

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 WATERSHED ELEVATION
- 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 ROADS (DESIGN BY OTHERS – SEE NOTE #1)
- PROPOSED CHANNEL ALIGNMENT (DESIGN BY OTHERS – SEE NOTE #2)

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.
2. 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 | 11.23 | 4.2 | 29.9 |
| A-2a | 4.21 | 8.1 | 18.9 |
| A-2b | 2.75 | 8.4 | 16.7 |
| A-3 | 0.36 | 1.6 | 3.2 |
| A-4a | 6.05 | 9.4 | 21.9 |
| A-4b | 3.81 | 6.2 | 14.5 |
| 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-10 | 1.02 | 2.1 | 4.9 |
| A-11 | 3.56 | 2.0 | 8.6 |
| B-1 | 3.33 | 5.3 | 12.3 |
| B-2 | 4.51 | 7.1 | 16.5 |
| B-3 | 4.05 | 7.8 | 18.2 |

### DESIGN POINT SUMMARY TABLE

| Design Point | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|
| 1 | 4.2 | 29.9 |
| 2a | 8.1 | 18.9 |
| 2b | 8.8 | 22.8 |
| 3 | 1.6 | 3.2 |
| 4a | 9.4 | 21.9 |
| 4b | 6.2 | 14.5 |
| 4 | 4.2 | 19.6 |
| 5 | 1.6 | 3.1 |
| 6 | 4.6 | 10.7 |
| 7 | 1.1 | 2.0 |
| 7a | 7.8 | 21.1 |
| 7b | 2.2 | 5.3 |
| 8 | 14.7 | 30.8 |
| 8a | 57.9 | 132.7 |
| 9 | 5.3 | 12.3 |
| 10a | 7.1 | 16.5 |


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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: | 3/4/2022 |

PROPOSED DRAINAGE MAP

DR-1

Sheet 1 of 3

KEY MAP SCALE: (1"=2,000')

N

SCALE: 1"=100'

## 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 WATERSHED ELEVATION
- 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 ROADS (DESIGN BY OTHERS – SEE NOTE #1)
- PROPOSED CHANNEL ALIGNMENT (DESIGN BY OTHERS – SEE NOTE #2)

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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### DESIGN POINT SUMMARY TABLE

| Design Point | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|
| 1 | 4.2 | 29.9 |
| 2a | 8.1 | 18.9 |
| 2b | 8.8 | 22.8 |
| 3 | 1.6 | 3.2 |
| 4a | 9.4 | 21.9 |
| 4b | 6.2 | 14.5 |
| 4 | 4.2 | 19.6 |
| 5 | 1.6 | 3.1 |
| 6 | 4.6 | 10.7 |
| 7 | 1.1 | 2.0 |
| 7a | 7.8 | 21.1 |
| 7b | 2.2 | 5.3 |
| 8 | 14.7 | 30.8 |
| 8a | 57.9 | 132.7 |
| 9 | 5.3 | 12.3 |
| 10a | 7.1 | 16.5 |
| 10b | 9.3 | 26.2 |
| 11 | 4.5 | 9.2 |
| 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 | 43.5 | 102.5 |
| 17a | 4.9 | 11.4 |
| 17b | 6.8 | 16.0 |
| 17c | 5.8 | 13.9 |
| 17d | 5.5 | 20.2 |

### RUNOFF SUMMARY TABLE

| Basin ID | Area (acres) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|
| Basin-1 | 1.22 | 4.2 | 8.4 |
| A-1 | 11.23 | 4.2 | 29.9 |
| A-2a | 4.21 | 8.1 | 18.9 |
| A-2b | 2.75 | 8.4 | 16.7 |
| A-3 | 0.36 | 1.6 | 3.2 |
| A-4a | 6.05 | 9.4 | 21.9 |
| A-4b | 3.81 | 6.2 | 14.5 |
| 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-10 | 1.02 | 2.1 | 4.9 |
| A-11 | 3.56 | 2.0 | 6.6 |
| B-1 | 3.33 | 5.3 | 12.3 |
| B-2 | 4.51 | 7.1 | 16.5 |
| B-3 | 4.05 | 7.8 | 18.2 |
| B-4 | 1.35 | 4.5 | 9.2 |
| 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-2 | 2.71 | 4.9 | 11.4 |
| C-3 | 1.56 | 3.3 | 7.7 |
| C-4 | 2.47 | 4.1 | 9.6 |

### RUNOFF SUMMARY TABLE

| Basin ID | Area (acres) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|
| C-5 | 3.09 | 5.5 | 12.8 |
| C-6 | 2.10 | 3.2 | 7.4 |
| C-7 | 6.72 | 11.3 | 26.3 |
| C-8 | 5.11 | 8.6 | 20.0 |
| C-9a | 3.50 | 5.6 | 13.1 |
| C-9b | 3.69 | 5.9 | 13.7 |
| C-10 | 3.51 | 5.2 | 12.2 |
| C-11 | 0.46 | 1.0 | 2.3 |
| C-12 | 1.79 | 3.1 | 7.2 |
| C-13 | 2.37 | 0.8 | 5.5 |
| C-14 | 1.53 | 0.5 | 3.8 |
| D-1 | 2.98 | 4.6 | 10.9 |
| D-2 | 0.87 | 1.7 | 4.0 |
| D-3 | 3.66 | 6.0 | 14.0 |
| D-4 | 2.00 | 3.7 | 8.5 |
| D-5 | 1.53 | 2.0 | 6.0 |
| D-6 | 0.83 | 0.3 | 2.1 |
| D-7 | 1.80 | 2.5 | 6.5 |
| E-1 | 5.13 | 9.5 | 22.1 |
| 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 |
| OS-1 | 3.28 | 7.2 | 15.1 |
| OS-2 | 2.31 | 4.6 | 10.3 |
| OS-3 | 3.02 | 7.0 | 15.3 |
| OS-4 | 3.00 | 6.2 | 14.3 |

### DESIGN POINT SUMMARY TABLE

| Design Point | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|
| 17e | 3.3 | 11.7 |
| 17f | 8.6 | 20.0 |
| 17g | 6.2 | 20.0 |
| 17h | 5.9 | 29.5 |
| 18a | 11.3 | 26.3 |
| 18b | 6.9 | 23.4 |
| 19 | 1.0 | 2.3 |
| 20 | 3.1 | 7.2 |
| 21a | 61.5 | 147.1 |
| 21b | 0.5 | 3.8 |
| 22 | 4.6 | 10.9 |
| 23 | 1.7 | 4.0 |
| 24 | 6.4 | 18.2 |
| 25 | 3.7 | 8.5 |
| 25a | 2.5 | 6.5 |
| 26 | 16.3 | 39.2 |
| 27 | 9.5 | 22.1 |
| 28 | 10.1 | 23.6 |
| 29 | 8.1 | 31.6 |
| 30 | 9.0 | 21.0 |
| 31 | 29.0 | 69.3 |
| 32 | 7.2 | 15.1 |
| 33 | 4.6 | 10.3 |
| 34 | 11.4 | 24.7 |
| 35 | 7.0 | 15.3 |
| 36 | 6.2 | 14.3 |
| 37 | 13.1 | 29.5 |


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| | |
|---|---|
| Project No: | HRG 1.20 |
| Drawn By: | TJE |
| Checked By: | GRD |
| Date: | 3/4/2022 |

PROPOSED DRAINAGE MAP

DR-2

Sheet 2 of 3

GRADING REVISED

show grading for the spillway

Will this much fill be allowed above the gas line?

NUSTAR APPROVAL NOTE ADDED TO DRAINAGE MAPS

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
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### RUNOFF SUMMARY TABLE

| Basin ID | Area (acres) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|
| Basin-1 | 1.22 | 4.2 | 8.4 |
| A-1 | 11.23 | 4.2 | 29.9 |
| A-2a | 4.21 | 8.1 | 18.9 |
| A-2b | 2.75 | 8.4 | 16.7 |
| A-3 | 0.36 | 1.6 | 3.2 |
| A-4a | 6.05 | 9.4 | 21.9 |
| A-4b | 3.81 | 6.2 | 14.5 |
| 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-10 | 1.02 | 2.1 | 4.9 |
| A-11 | 3.56 | 2.0 | 8.6 |
| B-1 | 3.33 | 5.3 | 12.3 |
| B-2 | 4.51 | 7.1 | 16.5 |
| B-3 | 4.05 | 7.8 | 18.2 |
| B-4 | 1.35 | 4.5 | 9.2 |
| 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-2 | 2.71 | 4.9 | 11.4 |
| C-3 | 1.56 | 3.3 | 7.7 |
| C-4 | 2.47 | 4.1 | 9.6 |

### RUNOFF SUMMARY TABLE

| Basin ID | Area (acres) | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|---|
| C-5 | 3.09 | 5.5 | 12.8 |
| C-6 | 2.10 | 3.2 | 7.4 |
| C-7 | 6.72 | 11.3 | 26.3 |
| C-8 | 5.11 | 8.6 | 20.0 |
| C-9a | 3.50 | 5.6 | 13.1 |
| C-9b | 3.69 | 5.9 | 13.7 |
| C-10 | 3.51 | 5.2 | 12.2 |
| C-11 | 0.46 | 1.0 | 2.3 |
| C-12 | 1.79 | 3.1 | 7.2 |
| C-13 | 2.37 | 0.8 | 5.5 |
| C-14 | 1.53 | 0.5 | 3.8 |
| D-1 | 2.98 | 4.6 | 10.9 |
| D-2 | 0.87 | 1.7 | 4.0 |
| D-3 | 3.66 | 6.0 | 14.0 |
| D-4 | 2.00 | 3.7 | 8.5 |
| D-5 | 1.53 | 2.0 | 6.0 |
| D-6 | 0.83 | 0.3 | 2.1 |
| D-7 | 1.80 | 2.5 | 6.5 |
| E-1 | 5.13 | 9.5 | 22.1 |
| 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 |
| OS-1 | 3.28 | 7.2 | 15.1 |
| OS-2 | 2.31 | 4.6 | 10.3 |
| OS-3 | 3.02 | 7.0 | 15.3 |
| OS-4 | 3.00 | 6.2 | 14.3 |

### DESIGN POINT SUMMARY TABLE

| Design Point | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|
| 1 | 4.2 | 29.9 |
| 2a | 8.1 | 18.9 |
| 2b | 8.8 | 22.8 |
| 3 | 1.6 | 3.2 |
| 4a | 9.4 | 21.9 |
| 4b | 6.2 | 14.5 |
| 4 | 4.2 | 19.6 |
| 5 | 1.6 | 3.1 |
| 6 | 4.6 | 10.7 |
| 7 | 1.1 | 2.0 |
| 7a | 7.8 | 21.1 |
| 7b | 2.2 | 5.3 |
| 8 | 14.7 | 30.8 |
| 8a | 57.9 | 132.7 |
| 9 | 5.3 | 12.3 |
| 10a | 7.1 | 16.5 |
| 10b | 9.3 | 26.2 |
| 11 | 4.5 | 9.2 |
| 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 | 43.5 | 102.5 |
| 17a | 4.9 | 11.4 |
| 17b | 6.8 | 16.0 |
| 17c | 5.8 | 13.9 |
| 17d | 5.5 | 20.2 |

### DESIGN POINT SUMMARY TABLE

| Design Point | $Q_5$ (cfs) | $Q_{100}$ (cfs) |
|---|---|---|
| 17e | 3.3 | 11.7 |
| 17f | 8.6 | 20.0 |
| 17g | 6.2 | 20.0 |
| 17h | 5.9 | 29.5 |
| 18a | 11.3 | 26.3 |
| 18b | 6.9 | 23.4 |
| 19 | 1.0 | 2.3 |
| 20 | 3.1 | 7.2 |
| 21a | 61.5 | 147.1 |
| 21b | 0.5 | 3.8 |
| 22 | 4.6 | 10.9 |
| 23 | 1.7 | 4.0 |
| 24 | 6.4 | 18.2 |
| 25 | 3.7 | 8.5 |
| 25a | 2.5 | 6.5 |
| 26 | 16.3 | 39.2 |
| 27 | 9.5 | 22.1 |
| 28 | 10.1 | 23.6 |
| 29 | 8.1 | 31.6 |
| 30 | 9.0 | 21.0 |
| 31 | 29.0 | 69.3 |
| 32 | 7.2 | 15.1 |
| 33 | 4.6 | 10.3 |
| 34 | 11.4 | 24.7 |
| 35 | 7.0 | 15.3 |
| 36 | 6.2 | 14.3 |
| 37 | 13.1 | 29.5 |


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|---|---|---|---|

| | |
|---|---|
| Project No: | HRG 1.20 |
| Drawn By: | TJE |
| Checked By: | GRD |
| Date: | 3/4/2022 |

PROPOSED DRAINAGE MAP

DR-3

Sheet 3 of 3