PHASE III DRAINAGE REPORT

FOR

DAWSON TRAILS PARCEL B1
(DAWSON TRAILS FILING 2, TRACT Q)
TOWN OF CASTLE ROCK, COLORADO
PROJECT NO. CD24-XXXX

Prepared for:

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November 20, 2024

ENGINEER'S STATEMENT:

I affirm that this report and plan for the Phase III drainage design of Dawson Trails Parcel B1 was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.

SIGNATURE: _____

Jeff Killingsworth, P.E.
Registered Professional Engineer State
Of Colorado No. _____
(Affix Seal)

OWNER/DEVELOPER'S STATEMENT:

Town of Castle Rock hereby certifies that the drainage facilities for Dawson Trails Filing 2, Tract Q shall be constructed according to the design presented in this report. I understand that the Town of Castle Rock does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that The Town of Castle Rock reviews drainage plans pursuant to the Municipal Code; but cannot, on behalf of ACM Dawson Trails VIII JV LLC, guarantee that final drainage design review will absolve ACM Dawson Trails VIII JV LLC and/or their successors and/or assigns of future liability for improper design.

_____
Print Name

_____
Authorized Signature

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I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

This Phase III Drainage Report provides an analysis of the drainage patterns and facilities for Dawson Trails Parcel B1 within the Dawson Trails Planned Development Plan (PDP). The project consists of roadways, landscaping. community park sidewalks, drainage channels, trails, along with utility infrastructure for 229 single-family residential lots within the eastern half of Planning Area B1.

Dawson Trails Parcel B1 is located within portions of Sections 21, 22, and 28, Township 8 South, Range 66 West of the Sixth Principal Meridian, Town of Castle Rock, County of Douglas, State of Colorado. Phase 1 is located within the Southeast Quarter of Section 21 and the Northeast Quarter of Section 28. The project site is generally bounded by Twin Oaks Subdivision on the north, Dawson Trails Gambel Ridge Boulevard on the south and east, and a future phase of Planning Area B1 on the west. An open space buffer zone, with a minimum width of 250 feet, separates the residential development area of Planning Area B1 from the Large Rural Residential (LRR)-zoned lots of Twin Oak Subdivision of the north. A Vicinity Map is included in **Appendix A.**

B. Description of Property

Planning Area B1 is identified within an area of 124.4 acres on the Dawson Trails Planned Development Plan, with a total buildout of 484 dwelling units. The project will develop the eastern 47.5 acres of Planning Area B1, consisting of 229 single-family lots. The parcel consists of 57.01 acres within the Tract Q Site Development Plan, which includes open space tracts.

Dawson Trails Filing 2, Tract Q is generally undeveloped. Abandoned roadway infrastructure in the south part of the project area is currently programmed for removal by a separate demolition plan. Once demolition is completed, no other improvements will be located within the planning area.

Current ground cover largely consists of medium-length grasses and scattered pockets of short trees and scrub vegetation. The topography is moderately hilly, with slopes generally ranging between 5% and 30%.

According to the NRCS Web Soil Survey, on-site soils include Fondis-Kutch association (Fu) and Bresser-Truckton sandy loams (BtE). These soils are classified as hydrologic soil group C (having slow infiltration rates with high surface runoff) and hydrologic soil group B (having moderate infiltration rates and moderate rate of water transmission), respectively. A Hydrologic Soil Group Map is included in **Appendix A.**

Gambel Ridge Tributary, the major drainageway within the area, flows along the north property boundary, then exits the site across the same boundary line approximately 500 feet east. The drainageway does not cross directly into Planning Area B1, and has been contained to remain north of the project within an open-space buffer and is delineated along the Dawson Trails planned development boundary. Gambel Ridge Tributary crosses

through Dawson Trails, continues easterly and ultimately discharges to East Plum Creek on the east side of Interstate 25.

The Town of Castle Rock designates a flood hazard zone along Gambel Ridge Tributary. The flood limits are based on the a May 2024 Floodplain Modification Study by Jacobs Engineering Group. The study support drainageway improvements to Gambel Ridge Tributary associated with the Crystal Valley Interchange project. The most recent FHAD study is the July 2014 *Flood Hazard Area Delineation — Gambel Ridge and Douglas Lane Tributary Watersheds* by Respec Consulting and Service [Reference F].

All of Planning Area B1 is depicted as Flood Zone X (not shaded) on Flood Insurance Rate Map (FIRM) Panel 08035C0284G. There are no FEMA-mapped flood zones on any reach of Gambel Ridge Tributary shown on the FIRM Panel. Floodplain maps are included in **Appendix A**.

There are no irrigation facilities on or adjacent to the project site.

There are no notable geologic features on or adjacent to the site.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

Gambel Ridge Tributary Watershed

The development lies within the Gambel Ridge Tributary watershed, in an area designated as Major Basin H on the Dawson Trails Filing 2 Phase III Drainage Report by CORE Consultants, October 13, 2023 [Reference I]. Gambel Ridge Tributary flows west to east just north of the site. It crosses underneath the existing BNSF through triple 9' x 6' CMP Arch culverts railway and under Interstate I-25 through a 10' x 6' concrete box culvert. The Tributary ultimately discharges into East Plum Creek, the primary receiving drainageway of the area.

Planning Area B1 forms a significant part of the upper watershed of Gambel Ridge Tributary. The upper basins of Gambel Ridge Tributary have been analyzed within the Dawson Trails Filing 2 Infrastructure Phase III drainage report. The report provided analysis for both Colorado Urban Hydrograph Procedure (CUHP) and EPA Stormwater Management Model (SWMM). The watershed and conveyance components provided within Dawson Trails Filing 2 Drainage Report will be used and refined as future Phase III drainage reports within the watershed are proposed and developed. The areas of upper Gambel Ridge Tributary proposed within the PD boundary are designated as Major Basin H, with offsite areas of the upper watershed delineated into basin OS2.1 and OS2.2.

Gamble Ridge Watershed Sub-basins (CUHP Method)
The Upper Gamble Ridge Watershed, as analyzed in the Dawson Trails Filing 2 Infrastructure Phase III Drainage Report (Reference I], is divided into 8 sub-basins. Each of these sub basins—designated as H1 through H8, have some level of influence on the detailed drainage design of Parcel B1 and are described below. Flow rates noted below are taken directly from the Filing 2 Infrastructure report and have been evaluated through CUHP

method. The drainage analyses in the report do not attempt to re-analyze the greater flow patterns within the watershed, but instead aim to demonstrate adherence to the assumptions and constraints stated in the Dawson Filing 2 Infrastructure Phase III Drainage Report.

Watershed Sub-Basin H1 *(55.5 acres, Q100 = 68.7 cfs)* and **Watershed Sub-Basin H2** *(76.0 acres, Q100 = 124.8 cfs)*
Off-site basins H1 and H2 contain undeveloped areas west of the site that drain through the project area, toward Gambel Ridge Tributary. Flows from Basins H1 and H2 will be conveyed through the project areas through Open Channel B with box culvert crossings under Amen Street and Sweet Valley Street.

H1 is ultimately reserved for open space and park facilities. H2 contains the second phase of Planning Area B1, which is designated for future residential development per the Dawson Trails development plan.

A future, on-site detention pond may be constructed to attenuate developed flows from Basin H1. However, Channel B and its two box culverts are designed to convey offsite flows assuming un-detained and fully developed conditions. Water quality treatment for off-site Basins H1 and H2, along with on-site basins H3, H4 and H5, is accommodated in regional Pond B1.

Watershed Sub-Basin H3 *(5.5 acres, Q100 = 12.4 cfs)*
Major Basin H3 is depicted in the Dawson Trails Filing 2 Phase III Drainage Report as the area between the current and future phase of residential Planning Area B1. It contributes to the total flow in Channel B where it enters the development parcel at Design Point H3.

Watershed Sub-Basin H4 *(8.1 acres, Q100 = 18.0 cfs)*
Major Basin H4 is depicted in the Dawson Trails Filing 2 Phase III Drainage Report as the area that is directly tributary to Channel B via overland flow within development parcel B. It contributes to the total flow in Channel B at Design Points H4 and H5.

Watershed Sub-Basin H5 *(39.3 acres, Q100 = 106.0 cfs)*
Major Basin H5 is defined in the Dawson Trails Filing 2 Phase III Drainage Report as the residential lot areas of Parcel B1. In the detailed drainage design for Parcel B1, most of major basin H5 will outfall to Channel B at several different locations within the development. The basin also contains the residential lot areas on the north end of the development that drain to a perimeter swale, and areas that outfall to Pond B1 directly.

Watershed Sub-Basin H6 *(23.7 acres, Q100 = 32.7 cfs)* and **Watershed Sub-Basin H7** *(7.0 acres, Q100 = 18.9 cfs)*
Major Basin H6 and H7 contain the Gambel Ridge Boulevard right-of-way and Pond B1, respectively, in the Dawson Trails Filing 2 Phase III Drainage Report. These adjacent basins are not tributary to Planning Area B1, or any of its proposed improvements. They are referenced in this report for the purpose of comprehensively analyzing Pond B1 and ensuring that the overall discharge from Major Basin H is compliant with Town policy.

Watershed Sub-Basin H8 *(10.6 acres, Q100 = 9.7 cfs)*
Major Basin H8 is depicted in the Dawson Trails Filing 2 Phase III Drainage Report as the northern fringe of the Parcel B1 residential development area. It accounts for north

draining lots that cannot be practicably captured by the internal drainage system. Major Basin H8 anticipates a surface swale to route flows to Regional Pond B1.

Offsite Drainage Basins (CUHP Method)

Offsite Basin OS-1 *(69 acres, Q100 =81cfs)*
Basin OS-1 contains rural residential areas directly north of the project site that surface drain across the site's north boundary to an existing, poorly defined swale. The existing swale flows eastward, roughly paralleling the property boundary, to Gambel Ridge Tributary where it crosses into the site at Design Point O1. Hydrology of OS-1 is analyzed by CUHP method in the Gambel Ridge Watershed Analysis. Drainage improvements proposed with this project will define a channel that roughly follows the existing flowpath to bypass flows from Basin OS-1 across the north edge of the site. Basin OS-1 is outside of the Town limits and there are no planning documents that anticipate further development.

Offsite Basin OS-2 *(101 acres, Q100 = 108 cfs)*
Basin OS-2 contains rural residential areas in Gambel Ridge Tributary's main stem. Gambel Ridge Tributary crosses into the site at Design Point O2, near the northeast corner. The drainageway exits the site across the north boundary about 500 feet further east. Drainage patterns from OS-2 will generally remain unchanged from historic conditions. Hydrology of OS-2 is analyzed by CUHP method in the Gambel Ridge Watershed Analysis. Basin OS-2 is outside of the Town limits and there are no planning documents that anticipate further development.

B. Minor Drainage Basins

On-site Drainage Basins (Rational Method)
For the design of specific drainage features that will built in the Parcel B1 Construction Plans, onsite primary basins and sub-basins are delineated within the larger watershed areas that have been previously defined. Generally, most of on-site drainage infrastructure will be installed within sub-watersheds H4 and H5, with peripheral impacts to sub-watersheds H3, H7, and H8. The sub-basins defined below for on-site drainage design used rational method for flow computations, detailed further in Section III.B of this report.

Sub-basins are grouped together according to their *surface* flow patterns, with all sub-basin of each group having a common ultimate sump location. This is to facilitate clear, sequential tracking of bypass flows from different series of on-grade inlets. In some cases the surface flow routing differs from the storm sewer routing due to topography variation and utility alignment. Quantification of peak flows for each particular storm outfall system is accounted for in the StormCAD model, with two separate scenario for full, unclogged interception and on-grade bypass flow per MHFD clogging factors. The StormCAD model and output is included in Appendix C.

Primary basin H3 includes areas west of Parcel B1's residential lots that route to Channel B near its entrance into the parcel. The sub-areas are used to size diversion swales along the residential area's west end and are described below:

3.1 *(1.72 acres, Q5 = 0.3 cfs, Q100 = 3.7 cfs)*
Sub-basin 3.01 contains the cut slope at the southwest corner of the development and existing ground directly southwest. The area's runoff is intercepted by a small swale that is graded onto the cut slope and diverted from residential lots.

3.2 *(7.66 acres, Q5 = 4.4 cfs, Q100 =22.0 cfs)*
Sub-basin 3.02 contains existing ground that drains toward Channel B from the south. It is captured by a continuation of the swale from 3.01 after the cut slope transitions to fill.

3.3 *(1.47 acres, Q5 = 0.2 cfs, Q100 = 3.7 cfs)*
Sub-basin 3.03 contains the cut slope at the northwest edge of the residential lot area. Runoff from this area is captured in a swale along the back of the residential lots and conveyed to Channel B.

4.0 *(8.15 acres, Q5 = 5.5 cfs, Q100 = 25.9 cfs)*
Basin 4.0 consists of park areas and adjacent residential lots that surface drain to channel B. The Basin 4.0 drainage area is accounted for in the Channel B design as part of the combined routed flow at SWMM node L-15.

Primary Basin H5, which generally covers the residential lot areas of Parcel B1, contains several sub-areas that outfall to Channel B or to Pond B1. These are sorted below by outfall location, according to surface drainage patterns. In some locations, the surface flow that bypasses an on-grade inlet routes to a different sump location than the storm sewer that conveys its captured flow. Subsurface flow routing in storm sewers is detailed in the StormCAD model (to be provided in Phase III report). Ultimately, all on-site surface and storm sewer flows route to regional Pond B1.

Basin 5.A
Basin 5.A contains areas along Amen Street that surface drain to the low point in Amen Street over Channel B. Peak major storm runoff from the full basin is approximately 18 cfs. 1 on-grade inlet and 2 sump inlets are required for complete interception of major storm flows with full adherence to major storm performance criteria.

5.A1 *(1.15 acres, Q5 = 1.8 cfs, Q100 = 5.3 cfs)*
Sub-basin 5.A1 contains residential lots north of Kadi Park Street and west of Amen Street. The basin drains to on-grade inlet A1 on the west leg of the Kadi Park Street / Amen Street intersection. Bypassed flows route to Inlet A2.

5.A2 *(2.82 acres, Q5 = 3.6 cfs, Q100 = 10.9 cfs)*
Sub-basin 5.A3 contains residential lots on the west side of Amen Street, north of Channel B. The basin surface drains Inlet A4.

5.A3 *(0.07 acres, Q5 = 0.3 cfs, Q100 = 0.6 cfs) and*
5.A4 *(0.07 acres, Q5 = 0.3 cfs, Q100 = 0.6 cfs)*
Sub-basins 5.A3 and 5.A4 contain the north and south halves of Hammer Street. The basins surface drain to Inlet A4.

5.A5 *(0.06 acres, Q5 = 0.2 cfs, Q100 = 0.4 cfs)*
Sub-basin 5.A4 contains the west half of Amen Street across the Channel B drainageway tract. The basin receives bypass flows from Inlet A1 on the south and surface drainage

from Basin 5.A2, 5.A3 and 5.A4 on the north. The basin drains to sump inlet A4, which connects directly to the Amen Street box culvert. Major storm flows that exceed the inlet's clogging-reduced interception rate pond to the back of walk, and flow directly to Channel B over a buried riprap slope.

5.A6 *(0.25 acres, Q5 = 1.0 cfs, Q100 = 1.9 cfs)*
Sub-basin 5.A5 contains residential lots on the east side of Amen Street, north of Channel B. The basin drains to sump Inlet A5, which connects directly to the Channel B box culvert.

Basin 5.B
Basin 5.B contains areas east of Dewdrop Street that surface drain to two separate low points in Dewdrop Street, at the Kadi Park Street intersection and on the Dewdrop Street entry segment. Peak major storm runoff from the full basin is approximately 29 cfs. 1 on-grade inlet and 4 sump inlets are required for complete interception of major storm flows with full adherence to major storm performance criteria.

5.B1 *(1.72 acres, Q5 = 2.6 cfs, Q100 = 7.6 cfs)*
Sub-basin 5.B1 contains residential lots on the north side of Dryden Street, west of Dewdrop Street. The basin drains to on-grade Inlet B1 on west leg of the Dryden Street / Dewdrop Street intersection. Bypassed flows route to Inlet B2.

5.B2 *(1.73 acres, Q5 = 2.8 cfs, Q100 = 8.2 cfs)*
Sub-basin 5.B1 contains residential lots on the south side of Kadi Park Street, west of Dewdrop Street. The basin drains to sump Inlet B2 south of the Kadi Park Street / Dewdrop Street intersection. Major storm flows pond that exceed the inlet's clogging-reduced interception rate pond up to the street crown and flow eastward to Inlet B3.

5.B3 *(0.14 acres, Q5 = 0.6 cfs, Q100 = 1.1 cfs)*
Sub-basin 5.D1 contains the east half of the Dewdrop Street right-of-way, between Kadi Park Street and Dryden Street. The basin drains to sump Inlet B3 on west leg of the Kadi Park Street / Dewdrop Street intersection.

5.B4 *(2.99 acres, Q5 = 4.4 cfs, Q100 = 12.7 cfs)*
Sub-basin 5.B4 contains residential lots on the south side of Dryden Street, west of Dewdrop Street, and the west half of Dewdrop Street's entrance segment. The basin drains to sump Inlet B4 on the south leg of the Dewdrop Street / Dryden Street intersection.

The entry street segment of Dewdrop Street is warped on its southbound side to meet the Town's cross-slope transition criteria on the approach to Gambel Ridge Blvd. As a result, the low point on the southbound entry segment occurs on the median flowline. Therefore, Inlet B4 is located on the median curb to intercept the routed flows in the major and minor storms. Inlet B4A is located in the outer curb of Dewdrop Street to capture higher frequency and nuisance flows that might otherwise sheet flow across the entry street segment.

5.B5 *(0.15 acres, Q5 = 0.6 cfs, Q100 = 1.2 cfs)*
Sub-basin 5.B5 contains the east half of Dewdrop Street's entrance segment. The basin drains to sump Inlet B5 on the south leg of the Dewdrop Street / Dryden Street intersection.

Basin 5.C
Basin 5.C contains areas roughly along Ralphie Court and Sweet Valley Street that surface drain to the low points at the Sweet Valley Street/ Ralphie Court intersection. Peak major storm runoff from the full basin is approximately 16 cfs. 1 on-grade inlet and 1 sump inlet are required for complete interception of major storm flows with full adherence to major storm performance criteria.

5.C1 *(1.07 acres, Q5 = 1.4 cfs, Q100 = 4.3 cfs)*
Sub-basin 5.C1 contains residential lots on the east side of Amen Street, north of Sweet Valley Street. The basin surface drains over curb and gutter to Sub-Basin 5.C3.

5.C3 *(1.24 acres, Q5 = 2.3 cfs, Q100 = 6.0 cfs)*
Sub-basin 5.C3 contains the western leg of the Ralphie Court loop and receives surface flows from basin 5.C1. The basin drains to on-grade Inlet C3 on the north side of Sweet Valley Street between the two intersections with the Ralphie Court loop. Bypass flows route to Inlet C4.

5.C4 *(1.68 acres, Q5 = 2.4 cfs, Q100 = 7.2 cfs)*
Sub-basin 5.C4 contains residential lots on inner frontage of the Ralphie Court loop. The basin receives bypass flow from Inlet C3. The basin drains to sump Inlet C4 on the north leg of the eastern Ralphie Court / Sweet Valley Street intersection. Major storm flows pond that exceed the inlet's clogging-reduced interception rate pond up to the street crown and flow eastward to Inlet E11.

Basin 5.D
Basin 5.D contains the block between Kadi Park Street and Dryden Street, bounded by Dewdrop Street and Cam Way. The basin surface drains to the low point in Cam Way, north of the intersection with Dryden Street. Peak major storm runoff from the full basin is approximately 17 cfs. 1 on-grade inlets and 2 sump inlets are required for complete interception of major storm flows with full adherence to major storm performance criteria.

5.D1 *(1.76 acres, Q5 =2.9 cfs, Q100 = 8.2 cfs)*
Sub-basin 5.D1 contains residential lots on the south side of Kadi Park Street between Dewdrop Street and Cam Way. The basin drains to on-grade Inlet D1 on the south leg of the Kadi Park Street / Cam Way intersection. Bypassed flows route to Inlet D2.

5.D2 *(1.67 acres, Q5 = 2.8 cfs, Q100 = 7.9 cfs)*
Sub-basins 5.D2 contains residential lots on the north side of Dryden Street between Dewdrop Street and Cam Way. The basin drains sump Inlet D2 on the north leg of the Dryden Street / Cam Way intersection. Major storm flows pond that exceed the inlet's clogging-reduced interception rate pond up to the street crown and flow eastward to Inlet D3.

5.D3 *(0.14 acres, Q5 = 0.6 cfs, Q100 = 1.1 cfs)*
Sub-basin 5.D3 contains the east half of the Cam Way right-of-way, between Kadi Park Street and Dryden Street. The basin drains to sump Inlet D3 on west leg of the Cam Way / Dryden Street intersection.

Basin 5.E

Basin 5.E contains the areas of the site that surface drain to the low point on the Sweet Valley Street crossing over Channel B. The basin includes residential lots that front Sweet Valley Street and Ralphie Court. Peak major storm runoff from the full basin is approximately 32 cfs. 3 on-grade inlets and 5 sump inlets are required for complete interception of major storm flows with full adherence to major storm performance criteria.

5.E1 *(1.17 acres, Q5 = 2.4 cfs, Q100 = 6.4 cfs)*

Sub-basin 5.E1 contains residential lots on the north side of Kadi Park Street, between Amen Street and Cam Way. The basin drains to on-grade Inlet E1 at the Kadi Park Street / Cam Way intersection. Bypassed flows route to Inlet E2.

5.E2 *(0.76 acres, Q5 = 1.3 cfs, Q100 = 3.9 cfs)*

Sub-basin 5.E2 contains residential lots on the north side of Kadi Park Street, between Cam Way and Dewdrop Street. The basin receives bypass flows from Inlet E1. The basin drains to sump Inlet E2 just west of the Kadi Park Street / Sweet Valley Street intersection.

5.E3 *(1.39 acres, Q5 = 2.1 cfs, Q100 = 6.3 cfs)*

Sub-basin 5.E3 contains residential lots on the south side of Kadi Park Street, between Cam Way and Dewdrop Street. The basin drains to and sump Inlet E3 just west of the Kadi Park Street / Sweet Valley Street intersection.

5.E4 *(1.06 acres, Q5 = 1.4 cfs, Q100 = 4.2 cfs)*

Sub-basin 5.E4 contains residential lots on the south side of Sweet Valley Street, between Amen Street and Ralphie Court. The basin drains to on-grade Inlet E4 at the eastern Sweet Valley Street / Ralphie Court intersection. Bypassed flows route to Inlet E5.

5.E5 *(1.00 acres, Q5 = 1.7 cfs, Q100 = 5.0 cfs)*

Sub-basin 5.E5 contains residential lots on the south side of Sweet Valley Street, east of Ralphie Court. The basin receives bypass flows from Inlet E4. The basin surface flows into Sub-basin 5.E6 and ultimately to Inlet E6.

5.E6 *(0.20 acres, Q5 = 0.7 cfs, Q100 = 1.5 cfs)*

Sub-basin 5.E6 contains the west half of Sweet Valley Street across the Channel B drainageway tract. The basin receives surface flows from Inlet E5 on the north. The basin drains to sump inlet E6 near the Sweet Valley Street box culvert.

5.E11 *(2.62 acres, Q5 = 3.2 cfs, Q100 = 9.6 cfs)*

Sub-basin 5.E11 contains residential lots on the outer half of the Ralphie Court loop. The basin drains to on-grade Inlets E11 and E12, on the north and east legs, respectively of the eastern Ralphie Court / Sweet Valley Street intersection. The secondary inlet is necessary to limit downstream bypass flows to acceptable performance limits in the major storm. Bypassed flows route to Inlet E13.

5.E13 *(1.35 acres, Q5 = 1.6 cfs, Q100 = 4.6 cfs)*

Sub-basin 5.E13 contains residential lots on the north side of Sweet Valley Street, between Ralphie Court and the Channel B culvert crossing. The basin also receives bypass flows from Inlet E12. The basin drains to sump Inlet E14, east of the Sweet Valley Street crossing over Channel B.

5.E14 *(0.32 acres, Q5 = 0.6 cfs, Q100 = 1.7 cfs)*
Sub-basin 5.E14 contains residential lots on the east side of Sweet Valley Street, between Kadi Park Street and the Channel B culvert crossing. The basin also receives bypass flows from Inlet E13. The basin drains to sump Inlet E14 near the Sweet Valley Street crossing over Channel B. Major storm flows that exceed the inlet's clogging-reduced interception rate pond to the back of walk, and flow directly to Channel B over a buried riprap slope.

Basin 5.F
Basin 5.F contains the areas of the site that surface drain to the eastern corner of the site, generally near the Sweet Valley Street / Dryden Street intersection. The basin mostly includes residential lots that the eastern segments of Dryden Street. Peak major storm runoff from the full basin is approximately 32 cfs. 2 on-grade inlets and 5 sump inlets are required for complete interception of major storm flows with full adherence to major storm performance criteria.

5.F3 *(1.53 acres, Q5 = 2.3 cfs, Q100 = 7.0 cfs)*
Sub-basin 5.F3 contains residential lots on the north side of Dryden Street between Cam Way and Sweet Valley Street. The basin drains to sump Inlet F4 west of the Dryden Street / Sweet Valley Street intersection.

5.F4 *(0.34 acres, Q5 = 0.8 cfs, Q100 = 2.0 cfs)*
Sub-basin 5.F4 contains the west half of Sweet Valley Street between Kadi Park Street and Dryden Street. The basin drains to sump Inlet F4 at the Kadi Park Street / Sweet Valley Street intersection. The length of Inlet 5.F4 is limited by driveway and curb ramp clearances. Major storm flows pond that exceed the inlet's clogging-reduced interception rate pond up to the street crown and flow southward to Inlet F7.

5.F5 *(2.13 acres, Q5 = 3.0 cfs, Q100 = 8.9 cfs)*
Sub-basin 5.F5 contains residential lots on the south side of Dryden Street between Dewdrop Street and Cam Way. The basins drain on-grade Inlets F5 at the Dryden Street / Cam Way intersection. Bypassed flows route to Inlet F6.

5.F6 *(1.86 acres, Q5 = 2.8 cfs, Q100 = 8.3 cfs)*
Sub-basin 5.F6 contains residential lots on the south side of Dryden Street between Cam Way and Sweet Valley Street. The basin also receives bypassed flows from Inlet F5. The basins drain to on-grade Inlet F6 at the Dryden Street / Sweet Valley Street intersection. Bypassed flows route to Inlet F7.

5.F7 *(0.15 acres, Q5 = 0.6 cfs, Q100 = 1.2 cfs)*
Sub-basin 5.F7 contains the west half of Sweet Valley Street's entrance segment. The basin receives bypass flows from Inlet F6, and major storm cross-street flow from the Inlet F4 low point. The basin drains to sump Inlet F7 at the Sweet Valley Street intersection with Gambel Ridge Boulevard.

The entry street segment of Sweet Valley Street is warped on its southbound side to meet the Town's cross-slope transition criteria on the approach to Gambel Ridge Blvd. As a result, the low point on the southbound entry segment occurs on the median flowline. Therefore, Inlet F7 is located on the median curb to intercept the routed flows in the major and minor storms. Inlet F7A is located in the outer curb of Swet Valley Street to capture

higher frequency and nuisance flows that might otherwise sheet flow across the entry street segment.

5.F8 *(0.15 acres, Q5 = 0.6 cfs, Q100 = 1.2 cfs)*
Sub-basin 5.F8 contains the west half of Sweet Valley Street's entrance segment. The basin drains to sump Inlet F8 at the Sweet Valley Street intersection with Gambel Ridge Boulevard.

5.F11 *(0.31 acres, Q5 = 0.7 cfs, Q100 = 1.9 cfs)*
Sub-basin 5.F11 contains the residential lots on the east side of Sweet Valley Street between Kadi Park Street and Dryden Street. The basin surface drains to the Dryden Street / Sweet Valley Street intersection, with flows routing to sub-basin 5.F12.

5.F12 *(1.12 acres, Q5 = 1.7 cfs, Q100 = 5.2cfs)*
Sub-basin 5.F12 contains residential lots on the eastern cul-de-sac segment of Dryden Street. The basin receives surface flows from Inlet F11. The basin drains to sump Inlet F12 at the end of the Dryden Street cul-de-sac.

6.11 *(0.22 acres, Q5 = 0.1 cfs, Q100 = 0.8 cfs)*
Sub-basin 6.11 contains a landscape buffer between proposed residential lots and the Gambel Ridge Boulevard right-of-way, west of the Dewdrop Street entrance. The sub-basin surface drains to Gambel Ridge Boulevard's curb/gutter, then to a curb inlet at the Dewdrop Street intersection. The inlet routes to Pond B1 through the Gambel Ridge Boulevard storm sewer.

6.12 *(0.59 acres, Q5 = 0.1 cfs, Q100 = 2.3 cfs) and*
6.13 *(0.59 acres, Q5 = 0.1 cfs, Q100 = 2.1 cfs)*
Sub-basins 6.12 and 6.13 contain a landscape buffer between proposed residential lots and the Gambel Ridge Boulevard right-of-way, between the Dewdrop Street and Sweet Valley Street entrances. Both sub-basin surface drains to Gambel Ridge Boulevard's curb/gutter, then to curb inlets on the north side of Gambel Ridge Boulevard. Both inlets route to Pond B1 through the Gambel Ridge Boulevard storm sewer.

6.14 *(0.41 acres, Q5 = 0.4 cfs, Q100 = 1.8 cfs)*
Sub-basin 6.14 contains the back halves of residential lots on the cul-de-sac segment of Dryden Street that back to Gambel Ridge Boulevard. The sub-basin's runoff is conveyed in Gambel Ridge Boulevard's curb/gutter to a curb inlet 400 feet north that routes directly to Pond B1.

7.1 *(0.62 acres, Q5 = 0.7 cfs,Q100 = 2.9 cfs)*
Sub-basin 7.1 contains the back halves of residential lots on the cul-de-sac segment of Dryden Street. Flows within this basin overland flow northeast directly to Pond B1.

7.2 *(4.80 acres, Q5 = 14.1 cfs, Q100 = 32.6 cfs)*
Sub-basin 7.2 contains Pond B1 and its surrounding directly tributary slopes. Pond B1 is designed and constructed with the Dawson Trails Filing 2 Infrastructure project. It is included in this analysis for accounting of imperviousness within watershed sub-area H7, and because it is within the boundary of the plat amendment that subdivides Parcel B1.

8.1, 8.2 and 8.3
Sub-basins 8.1, 8.2 and 8.3 contain the back halves single-family residential lot and adjacent open space areas that surface drain northward from the site. Flows within this basin are collected in Swale 8.1 and conveyed eastward to Channel B at design point 8.3. The full drainage area of Swale 8.1 is sub-divided into 3 sub-areas to design specific reaches of the swale.

8.1 *(4.82 acres, Q5 = 1.5 cfs, Q100 = 13.7 cfs)*
Sub-basin 8.1 contains the uppermost (western) reach of Swale 8.1. The maximum slope of this reach is about 6.7%. The sub-basin's flowrate is used for Swale design above Design Point 8.1

8.2 *(2.30 acres, Q5 = 2.1 cfs,Q100 = 9.8 cfs)*
Sub-basin 8.2 contains the middle reach of Swale 8.1. The maximum slope of this reach is about 5.1%. The combined flowrate of sub-basins 8.1 and 8.2 is used for Swale design between Design Points 8.1 and 8.2.

8.3 *(1.08 acres, Q5 = 1.0 cfs, Q100 = 4.6 cfs)*
Sub-basin 8.3 contains the lower (eastern) reach of Swale 8.1. The maximum slope of this reach is about 2.9%. The combined flowrate of sub-basins 8.1, 8.2 and 8.3 is used for Swale design between Design Points 8.2 and 8.3.

8.4 *(2.85 acres, Q5 = 1.7 cfs, Q100 = 10.4 cfs)*
Basin 8.4 contains the back halves single-family residential lot and adjacent open space areas that surface drain northeastward to Channel B. Flows within this basin are accounted for in the Channel B design as part of the combined routed flow at SWMM node L-15.

There are no irrigation facilities on or adjacent to the project site.

Hydrologic Calculations are included in **Appendix B.** Drainage Maps are included in **Appendix G.**

III. DRAINAGE DESIGN CRITERIA

A. Regulations

This Phase III Drainage Report is in accordance with the Town of Castle Rock (TOCR) Storm *Drainage Design and Technical Criteria Manual* (Criterial Manual) and the Mile High Flood District (MHFD) *Urban Storm Drainage Criteria Manual Volumes 1-3* (Criteria Manual). The drainage design provided herein complies with Colorado Revised Statue (CRS) §37-92-602 (8) *"Concerning a Determination that Water Detention Facilities Designed to Mitigate the Adverse Effects of Storm Water Runoff Do Not Materially Injure Water Rights."*

B. Drainage Studies, Master Plans, Site Constraints

The following drainage studies contain analyses that are relevant to Planning Area B1:

- Flood Hazard Area – Delineation Gambel Ridge and Douglas Lane Tributary Watersheds by Respec Consulting and Service, July 2014 [Reference F]

  This FHAD study shows the limits of flood hazard areas along Gamble Ridge Tributary and where the floodplain crosses into the Dawson Trails planned development. The water surface elevations, cross-sections, and developed flow rates from this study are used to assess potential impact to the flood zone from development activities. This information is also used the ensure that proposed drainage elements near the drainageway will be adequately protected from potential flooding.

- Gambel Ridge and Douglas Lane Tributary Watersheds – Master Plan by Respec Consulting and Service, July 2014. [Reference G]

  This drainageway master plan identifies recommended improvements to Gamble Ridge Tributary. Recommendations for bio-engineered improvements on the reach adjacent to Planning Area B1 are implemented separately with the construction of regional Pond B1, as part of the Dawson Trails Filing 2 improvements. The Regional Pond B1 Plan from the Dawson Trails Filing 2 Construction Documents—currently in the review and approval process—is included in **Appendix E** for reference. These drainageway improvements are also identified on the Drainage Maps in this report.

  The Gambel Ridge bioengineering improvements comprise the drainageway stabilization that mitigates changes in the watershed's hydrology due to development in this part of the basin. Any disturbance to the depicted stabilization measures will be restored to the design condition before the conclusion of construction activities in Planning Area B1.

  There are no major constraints posed by existing infrastructure or topographical features. The100-year release rate from regional Pond B1 is limited to no more than 0.9 of the tributary area's pre-development peak. In addition, combined off-site and attenuated release flows in Gamble Ridge Tributary at the north property line are limited to no more than the watershed's pre-developed peak flow. Adherence to these constraints is incorporated in the Dawson Trails Filing No. 2 Infrastructure drainage design and is outside of the scope of the Planning Area B1 drainage design.

- Phase III Drainage Report for Dawson Trails Filing No. 2 Infrastructure by CORE Consultants, (in review) [Reference I]

  This study is used as the guiding document for on-site and off-site watershed analyses for all areas within the planned development. It is the basis of the Phase III drainage design for Planning Area B1, Dawson Trails Filing 2 Infrastructure, and drainage improvements in the lower reaches of Gambel Ridge Watershed. The included CUHP and SWMM analyses support the design of initial phase regional facilities, as well as the preliminary siting and sizing of future facilities. The Dawson Trails Filing No. 2 Infrastructure Phase III Drainage Report includes detailed design for regional Pond B1 and the Gambel Ridge

Boulevard roadway immediately south of Planning Area B1. The report also assesses the allowable flow rates in Gambel Ridge Tributary across the boundaries of the planned development and ensures that the watershed's overall drainage meets those constraints. Stabilization Improvements and erosion protection in the Gambel Ridge drainageway are designed and constructed by the Dawson Trails Filing 2 project.

Pertinent excerpts from this report are included in **Appendix E.**

C. Hydrology

Design of off-site and regional infrastructure is based on the hydrologic analysis of Upper Gambel Ridge watershed from the Dason Trails Filing 2 Infrastructure Phase III Drainage report [Ref. J]. The watershed's hydrology, which includes Basins H1-H8 and OS1-OS2, uses Colorado Urban Hydrograph Procedure (CUHP) method for analysis. Detailed information of input parameters and baseline assumptions of the Gamble Ridge Watershed CUHP evaluation are described int Section II.C of that report.

The Dawson Trails Filing 2 Infrastructure Phase III Drainage Report also uses a Stormwater Management Model (SWMM) to route combined flows in the watershed with consideration of future detention basin and channel improvements. The routed flows from the SWMM are used for design of critical drainage components within Parcel B1 that convey site-generated flows after combing with offsite runoff. Specifically, CUHP/SWMM flows are used to size Channel B through the site, the Amen Street box culvert and the Sweet Valley Street box culvert.

Evaluation of street conveyance, inlet sizing, and pipe outfalls into Channel B are all based on rational method to compute local flows. The Rational method calculations utilize rainfall data found in Table 6-1 of the TOCR Criteria Manual and conforms to the guidance set forth by MHFD Criteria Manual Volume 1, Chapter 6 as well as the MHFD standard forms for the Rational method. Rational method is used for runoff calculations within the proposed Phase 1 residential development areas of Planning Area B1.

The 5-year mean recurrence interval is used for the minor drainage system design. The 100-year mean recurrence interval is used for the major drainage system design.

Design 1-hour rainfall amounts are 1.43 in. for the 5-year event and 2.60 in. for the 100-year event.

Water quality treatment and detention storage for all of Planning Area B1 are provided off-site in regional Pond B1. Although its design is outside of the scope of this report, Water Quality Capture Volume for Pond B1 is determined from the MHFD-Detention_v4-05 spreadsheet, using the methods defined in MHFD Criteria Manual Volume 3. The MHFD-Detention_v4-05 spreadsheet is also used for Pond B1's 100-year detention storage and outflow calculations.

Regional Pond B1 sizing and outflow calculations from the Dawson Trails Filing 2 Infrastructure Phase III Drainage Report are included in Appendix E. The analyses in this report demonstrate conformance of the Parcel B1 design with the hydrologic assumptions made in the preceding design of regional Pond B1.

D. Hydraulics

Detailed hydraulic calculations are provided in Appendix C consisting of the following:

- Street and inlet capacity design calculations
- Culvert sizing calculations
- Swale/ channel sizing calculations
- Forebay and trickle channel sizing calculations

Street and inlet capacity designed based on Chapter 8 of the Town's Drainage Criteria, and design spreadsheets provided by MHFD. Minor and major storm performance parameters for street conveyance and inlet capacities are summarized below.

Typical Street Conveyance and Inlet parameters for proposed roadways

Street Type	Curb Type	Drainage Classification	t_{BACK} [ft.]	t_{CROWN} [ft.]	t_{MAX} (minor) [ft.]	d_{MAX} (minor) [ft.]	d_{MAX} (major) [ft.]
Interior Streets	MS2	A	5.92	16.0	16.0	0.43	0.45
Entry Streets	VC2	A	13.5	25.5	25.5	0.50	0.76

Generally, street conveyance and inlet ponding limitations for the major storm events follow the same limitations as the minor storm event to avoid stormwater impacts outside of the right-of-way.

Storm sewer sizing and HGL calculations utilize StormCAD software version 10.03.04.53.

Swale sizing calculations utilize Hydraflow Express Extension for Autodesk Civil 3D by Autodesk, Version 2022.

Culvert performance for the 2 proposed box culverts is analyzed using HY-8 software. Inlet condition models 45-degree wingwalls for the box culvert ends. Both proposed culverts cross streets with a Type A drainage classification per Section 11.2 of the Town's drainage criteria. Both culverts are designed to be compliant with the Town's requirements for major drainageway crossings. The Culverts are designed to pass the major storm flow with a headwater to pipe height ratio of 1.5 or less and with internal flow velocities less than 15 feet per second. The culvert performance properties during the major storm are also used as design parameters for riprap aprons at the culvert outlets.

Hydraulic analysis of Channel B utilizes Hydrologic Engineering Center's River Analysis System (HEC-RAS) Version 6.4.1 to evaluate flow depths and velocities in the low-flow, overbank, drop structure components of the channel design. HEC-RAS is an open-source program developed by United States Army Core of Engineers (USACE).

Channel B will be located within drainage tracts that are owned and maintained by the development's metro district. A combination of engineered cross sections, Grouted Stepped Boulder Drop Structures, and vegetation-lined channel conveyance were chosen

to best accomplish creating Channel B from the existing abandoned road. Figure 12-3 of TOCR Storm Drainage Design and Technical Criteria Manual (SDDTCM) was used to help develop the channel concept with supplemental design information from MHFD Chapter 8 – Open Channel criteria manual where needed.

The longitudinal slope of the channel was determined first by using the recommended equilibrium slope of 0.4% per the FHAD study for the Gambel Ridge Tributary. Iterations of the channel design showed that this slope resulted in unreasonable velocities and Froude numbers that exceeded the design criteria set forth by TOCR. Altering the longitudinal slope to 0.3% resulted in velocities and Froude numbers which were generally within acceptable ranges. Where ranges were exceeded, additional stabilization measures have been proposed. Please see **Appendix C** for a PDF printout of the proposed HEC-RAS analysis.

Initial sizing parameters of the Low Flow channel and Floodplain Terrace were taken from MHFD Criteria Manual, Volume 2: Chapter 8 – Open Channels, Table 8-2: Minimum Dimensions for Naturalized Channels. The channel design also incorporates TOCR SDDTCM Table 12-3 which specifies 2.0-feet of freeboard within a Grass-lined channel. Manning's N values were maintained consistent with the approved FHAD and 0.04 was chosen to represent the left and right overbanks within the channel.

Where velocities are outside the range of acceptable values from the TOCR SDDTCM, soil stabilization measures are proposed to reduce erosivity in the channel and on banks as required.

The TOCR SDDTCM, Section 12.4.3 outlines preferred methods of drop structures and considerations during the design process. The design of Gambel Ridge North Tributary utilizes the GSBs to dissipate energy, develop a stable channel grade, and produce a more natural aesthetic. Design parameters are discussed below:

- 4-ft and 5-ft Grouted Stepped Boulder Drop Structures (GSBs) with no stilling basins.
- Using Equation 9-7 of the MHFD Criteria Manual, GSBs will utilize B24 Boulders.
- Table 9-1 within Volume 2 of the MHFD Criteria Manual specifies a maximum unit discharge over any portion of the drop width to be 35 CFS/FT of drop width at any point over the drop structure. With an average drop structure width of 75 feet and a proposed flow rate of 444 CFS, the expected unit discharge Is approximately 5.9 CFS/FT across the drop structures.
- A Manning's N value of 0.7 was used in the HEC-RAS analysis to emulate the GSBs within the proposed drop structures. Figure 9-3 in Volume 2, Chapter 9 of the MHFD Criteria Manual recommends a Manning's N value of 0.08 would be appropriate, however a value of 0.07 was chosen as a conservative measure as velocity is the primary concern within the channel. Resulting water surface elevations exceed the minimum 2.0-foot required freeboard within the channel.

Open channel flow depths for bypass and perimeter collection swales are computed with Hydraflow Express Extensions for Autodesk Civil 3D software, version 2022.

The Pond B1 regional detention facility that serves the development site is not designed or constructed with this project. However, the outflow calculations for Pond B1 that are referenced by this report use the MHFD-Detention_v4-05 spreadsheet. Major basin flows, including releases from regional Pond B1, are routed with a SWMM. Future off-site Pond B2 is not regional, therefore no credit for storage or attenuation from Pond B2 is incorporated into the model. This report demonstrates conformance of the Parcel B1 design with the hydrologic assumptions made in the Dawson Trails Filing 2 Infrastructure Phase III Drainage Report.

E. Storage and Water Quality Enhancement

Storage water quality enhancement measures for the entirety of the developed Site are provided by regional Pond B1. Pond B1 is designed and constructed separately by the Dawson Trails Filing No. 2 Infrastructure project. This pond is designed as an Extended Detention Basins (EDB). Pond volumes were calculated using version 4.06 of the Detention Basin Design Workbook provided by MHFD. Pond sizing and inflow calculations are included in **Appendix E** with the Dawson Trails Filing No. 2 Infrastructure Phase III Drainage Report. Pond outlet structure design and release rate calculations are not included in this Phase III report (see Hydraulics section below).

In addition to the water quality capture volume that is provided in regional Pond B1, implementation of the Town's four-step process for water quality enhancement is detailed in **Section IV.C** is this report.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

The general concept for the drainage design is to maintain the historic drainage patterns and keep runoff leaving the Site at or below peak historic rates, while providing water quality enhancement for the entirety of the developed Site.

Developed runoff from the Site will be conveyed to proposed water quality and detention facilities via proposed storm sewer and grass-lined swales, and conveyance ditches. The ponds will release into Gambel Ridge Tributary. The general stormwater conveyance strategy for Parcel B1 consists of the following main components:

1. Collection of off-site flows that cross the north site boundary into a bypass channel that routes to Gambel Ridge Tributary

2. Conveyance of off-site runoff from future development areas of Planning Area B1 in Open Channel B, which routes through the center of the site to regional Pond B1

3. Collection of runoff from residential lots via surface drainage and storm sewer that routes to the Open Channel B or directly to Pond B1

4. Capture of surface flows from back-draining residential lots on Parcel B1's north edge and routing through open swale to Pond B1

5. Reliance on regional Pond B1 for water quality treatment and 100-year detention

The SWMM routing for Major Basin H in the Dawson Trails Filing 2 Infrastructure Phase III Drainage Report is referenced for design flows of several critical drainage elements in this project. These elements and their corresponding design are listed in the table below:

SWMM Key Design Pont Summary				
Key Flow Location	**Design Point**	**Tributary Basins**	**SWMM Link**	**100-year Peak Flow**
Swale A	OS-1	OS-1	L_O1	81
Channel B	H5	H1-H5	L-16	267*
Amen Street Culvert	H3	H1-H3	L-17	171
Sweet Valley Street Culvert	H5	H1-H5	L-15	267*
Pond B1 Trickle Channel for Channel B	H5	H1-H5	L-15	267*
Gambel Ridge Discharge Exiting PD Boundary	H0	OS-1, OS-2, H1-H8	L_10	308
Historic Gambel Ridge Discharge Exiting PD Boundary	H0	OS-1, OS-2, H1-H8	FHAD Design Pt 1050 [Ref. F]	531

* 267 cfs used as controlling design flow for full length of Channel B and Sweet Valley Street crossing.

Swale A

Runoff that crosses into the Dawson Trails Planned development from the north is collected by a swale in the open space buffer. This swale roughly parallels the planned development boundary and empties into Gambel Ridge Tributary where it crosses into Dawson Trails. The swale is designed for the 100-year runoff from Basin OS-2.1 and utilizes a stepped profile with buried riprap drops to keep flow velocities less than 5 feet per second. The undeveloped nature of the tributary basin is expected to significantly limit the frequency high-runoff event, which will accommodate vegetation growth in the swale.

Channel B

Offsite, un-detained flows from Basins H1 and H2 are conveyed eastward through the site in Channel B. In addition to offsite flows, Channel B collects on-site runoff from multiple local storm sewer runs that outfall to the channel. Channel B is sized for the 100-year developed flows at design point H5, which represents the total of site-generated and offsite flows that enter Pond B1 from the west. Channel B is designed with a low-flow channel to convey the 2-year developed flows of 25 cfs. 10-foot width overbank benches on each side of the low-flow can convey larger storm flows. Drop structures with a maximum height of 5 feet are utilized to maintain a stable channel grade of 0.30%.

Open channel maintenance considerations are detailed in Section IV.F of this report.

Channel B Forebay

Channel B is designed to discharge to Pond B1 through a concrete-bottom forebay. The forebay will be constructed between the lowest drop structure of the channel and the existing Pond B1 berm, with the berm height reduced and armored to act on overflow weir from the forebay into the pond. The forebay is designed with a maintenance access into the forebay bottom, complaint with Town maintenance requirements, to facilitate removal of accumulated sediment. A concrete notch cut through the berm between the forebay and pond will provide a controlled discharge rate for high-frequency storm events. A low-flow channel extending from the notch will tie to the existing low-flow in the bottom of Pond B1.

Amen Street and Sweet Valley Street Box Culverts

Channel B crosses 2 proposed local streets within the development. 8' x 6' concrete box culverts are selected for both crossings. In the 100-year event, both crossings maintain a headwater to depth ration of less than 1, with flow velocities kept below 15 feet per second. 45 degree wingwalls are designed for the culvert transitions.

Physical properties and hydraulic performance for the box culvert designs are summarized in **Appendix C**.

On-site (Residential Lots) Drainage System

The drainage system for the street network and residential lots of Parcel B1 generally relies on curb/gutter conveyance to on-grade and sump curb inlets at street intersections. The drainage areas, flows paths, and inlets of this system are largely detailed in Section II.B of this report, sub-basin groups 5.A through 5.F.

Street conveyance capacity and inlet interception calculations are included in Appendix C this report.

The onsite drainage design includes 6 storm sewer outfalls. Outfall 100 discharges directly to Pond B1 with a concrete forebay that connects to the pond's existing low flow channel. Outfalls 200 and 210 connect directly into the Amen Street box culvert. Outfalls 300, 400 and 500 discharge to the overbanks of Channel. Outfalls 600 and 610 connect directly into the Sweet Valley Street box culvert.

Back-of lot run-off from the north edge of the residential lots is captured in a swale that flows eastward to Channel B. Interception by the perimeter swale ensures that all of the runoff from residential lots is routed to Pond B1 for water quality treatment and detention.

Conveyance of stormwater between adjacent residential lots is minimized or avoided in the project's drainage design. Where surrounding topography tends to direct runoff toward the rear boundaries of residential lots, swales have been designed to intercept and divert flows. A few isolated areas, such as lots in sub-basins 5.C4 and 5.F3 have small areas of storm-water run-on to lots that does not exceed the area of a half-lot. Resultant flows between houses, including adjacent half-lots and rear yards, are not expected to exceed 0.8 cfs, with flows depths less than 0.3 ft.

B. Stormwater Storage Facilities

Water quality treatment and stormwater detention are accommodated in regional Pond B1 immediately east of Planning Area B1. Pond B1 is designed by the Phase III drainage report for Dawson Trails Filing No. 2 Infrastructure. Ponds B1 is a full-spectrum facility that provides storage for Water Quality Capture Volume (WQCV), Excess Urban Runoff volume (EURV), and the 100-year runoff attenuation. The pond will release at, or less than, the predeveloped runoff rates. Pond B1 is designated as a regional facility that will be owned and maintained by the Town of Castle Rock.

Pond B1 is sized for tributary basins H2 through H8, as defined on the overall drainage map. The Parcel B1 development areas overlays very closely on watershed sub-areas H4, H5 and H8. These areas assume a combined basin area of 58.06 acres in the In the watershed (CUHP) analysis of the Filing 2 Infrastructure Phase III Drainage Report, H3, H4 and H8 contains a combined basin area of 58.1 acres and a combined impervious area of 21.6 acres. The proposed development areas within these limits will contain an area of 54.9 acres and an impervious area of 20.9 acres. Therefore, the development proposed imperviousness will be within the design assumptions for Pond B1.

Sub-basins 6.11, 6.12 and 6.13 are within the H5 CUHP basin delineation, but their flows are conveyed to Pond B1 through the Gambel Ridge Boulevard storm system.

Sub-basins 6.14 and 7.1 are within the H7 CUHP basin and their residential lot areas are accounted for in the 51.5% imperviousness assumed for basin H7.

Most of the western boundary of Plat Amendment area is contained within watershed sub-area H3. However, none of Parcel B1's residential development or street infrastructure will extend into sub-area H3. All of the proposed disturbance into H3 will remain at undeveloped imperviousness. Basin H3's drainage patterns toward Channel B will also remain as assumed by the SWMM routing in the Dawson Trails Filing 2 Infrastructure Phase III Drainage Report.

Pond sizing and inflow calculations from the Dawson Trails Filing 2 Infrastructure Report can be found in **Appendix E**.

A Summary Table of impervious areas within the Pond B1 tributary watershed can be found below. Parcel B1 is in conformance with the Pond design in the Dawson Trails Filing No. 2 Infrastructure Phase III Drainage Report.

Regional Detention Pond B1 - Tributary Summary Table					
		Basin	**Area (Ac)**	**Percent Impervious**	**Impervious Acres**
Dawson Trails Filing No 2 Infrastructure Phase III Drainage Report (See Appendix E)	Watershed Analysis (CUHP)	H-1	46.4	7.8%	3.6
		H-2	76	28.2%	21.4
		H-3	5.51	45.0%	2.5
		H-4	8.06	45.0%	3.6
		H-5	39.4	45.0%	17.7
		H-6	25.3	36.2%	9.2
		H-7	6.4	51.5%	3.3
		H-8	10.6	2.0%	0.2
		Parcel B-1 Phase 1 Sub-Total	**64.46**	**38.6%**	**24.9**
		Total	217.67	28.3%	61.6
Dawson Trails Parcel B1 Phase 1 - Development Area Only	Proposed	**Developed Onsite**	**62.44**	**39.3%**	**24.5**

Note: Basins colors depict associated basins between Reports/ Maps
The 100-year release rate for Pond B1 is limited to 0.9 of the pre-development peak flow. The 100-year combined flow rate (off-site + detained) in Gamble Ridge Tributary across the Dawson Trails north boundary is less than the existing 100-year drainageway flow.

Pond design elements, including outlet structure, emergency spillway, and outfall to Gamble Ridge Tributary are detailed in the Dawson Trails Filing No. 2 Infrastructure Construction Plans, with supporting calculations included in the Phase III drainage report for that project [Reference J].

C. Water Quality Enhancement Control Measures

Implementation of the four-step process of water quality control include the following features:

1) Minimization of directly connected impervious areas occurs in multiple areas of the project's drainage design:

   a. Residential lot roof areas, which are a primary element of the development's impervious area, drain to pervious yard space before concentrating in street gutters.
   b. Local storm sewer systems (Outfalls 300, 400, 500) discharge to the vegetated overbanks of Channel B before routing to Pond H1.

c. Offsite flows are conveyed around or through the development site in vegetated, pervious open channels.

2) Water quality treatment and full spectrum detention for Planning Area B1 are accommodated in regional Pond B1, immediately east. Design information of Pond B1 is detailed in the Phase III Drainage Report for Dawson Trails Filing No. 2 Infrastructure [Reference I].

3) Open channels that convey runoff through or around the site are designed to maintain stable flow velocities. Check structures are used to manage topographical fall and to maintain a stable grade for each channel's design flow. Channels and swales are designed to be grass-lined as much as possible, avoiding excessive use of riprap. Additionally, pipe outfalls are designed to dissipate energy and slow water flow to non-erosive velocities.

4) The proposed residential land use of Planning Area B1 has relatively low risk of illicit discharge compared to other land uses. Incidental pollutants sources are generally not concentrated. The minimization of directly connected impervious areas, as detailed under item 1 of this sub-section, provides opportunity for pollutants to naturally filter out through vegetated areas before reaching receiving drainageways.

Water quality measures will be included in the design of Pond B1 that serve the Site. The pond's incorporate structures which extend the emptying time of the WQCV to a minimum of 40 hours to facilitate pollutant removal by sedimentation of suspended solids. The water quality treatment function and outfall design of regional Pond B1 are detailed in the Phase III Drainage Report for Dawson Trails Filing No. 2 Infrastructure [Reference I]. Relevant excerpts from that report are included in **Appendix E**.

Pond sizing calculations from the Dawson Trails Filing No. 2 Infrastructure Phase III Drainage Report can be found in **Appendix E**.

Operation and Maintenance of stormwater facilities—including those for water quality enhancement—are detailed in **Section IV.F** of this report.

D. Floodplain Modification

The floodway of Gambel Ridge Tributary will largely be left in its current state in its 450-foot meander into the property. No engineered improvements are recommended by the drainageway's master plan [Reference G] for the adjacent channel reach (Reach 4). Stabilization and sediment mitigation for proposed Swale A at the confluence with Gambel Ridge Tributary will be analyzed in conjunction with the floodplain study.

A 0.5 acre area of the floodway fringe will receive fill material per the project's grading design. The area of encroachment is shown on the drainage map and annotated on relevant pages of the FHAD study [Reference F] in **Appendix E**.

The affected area is an existing low point on the south bank that backwaters during high-flow storm events. It does not contribute to the effective conveyance cross-section of the drainageway.

A Floodplain Modification Study (FMS) for the segment of Gambel Ridge Tributary within the project limits will be provided with the subsequent submittal of this Phase III drainage report, following pending final design of the Pond B1 outfall by the Dawson Trails Filing 2 project. The FMS for this project will be separate from the FMS by Jacobs and Shrewsberry that supports the Crystal Valley Interchange Project, and that has recently amended the Gambel Ridge Floodplain. The FMS for this project will demonstrate that no adverse impacts are created for the floodway or for upstream or downstream properties by the final grading within Planning Area B1 or proposed flow paths to the drainageway.

Since there is no flood hazard area shown along Gambel Ridge Tributary on the FIRM (Panel 08035C0284G), there is no need for a map revision.

E. Geotechnical Investigation and Sub-surface Collection System Design

A geotechnical study for the site was produced by A.G. Wassenaar, Inc. in fall of 2023 [Reference K]. The site investigation observed groundwater at depths between 14.5 and 39.5 feet. The report's recommendations relating to sub-surface drainage include benching of existing slopes steeper than 5:1, sub-surface blanket drains where fill is placed in existing drainage paths, and foundation drains around structure footings. Details of the geotechnical investigation and development recommendation can be reviewed in the *Geotechnical Site Development Study – Dawson Trails, Parcel B-1, Castle Rock Colorado*, by A. G. Wassenaar, Inc, revised November 13, 2023 [Reference K].

The residential areas of the development are graded such that no lot will surface run-on with the exception adjacent residential lost area no greater than 50% of the receiving lot's size.

F. Operation and Maintenance

There are no water quality or storage facilities on this development site or designed by this report. The water quality and detention storage for this development is accommodated in Regional Pond B1. The pond will be constructed with the Dawson Trails Filing 2 Infrastructure project and is designed by that project's Phase III Drainage Report by CORE (see **Appendix E**). All operation and maintenance for Pond B1 is the responsibility of the Town of Castle Rock.

Channel B will be located within drainage tracts that are owned and maintained by the development's metro district. A recreational path that also functions as a maintenance access will be constructed parallel to the channel. The design of the access path adheres to section 12.5.4 of the Town's drainage criteria.

Regular maintenance of the drainageway will include:

- Inspection and debris removal – annually, and after significant storm events

Regular maintenance of the drop structures will include:

- Inspection – annually, and after significant storm events

Occasional or as-needed maintenance activities will include:

- Repair of eroded areas—as determined by inspection

G. Additional Permitting Requirements

There are no attributes of this project, associated disturbance areas, or impacted drainages that are expected to trigger additional permitting requirements.

H. General

The following published tables and charts have been used in the drainage design and are referenced in Appendix E:

a. *TOCR Criteria Manual Table 6-1*: Point Rainfall Values
b. *TOCR Criteria Manual Table 6-3*: Comparison of Hydrological Methods
c. *TOCR Criteria Manual Figure 7-7*: Street Capacity Chart
d. *TOCR Criteria Manual Figure 12-3*: Major Drainageway Stabilization Design Elements
e. *TOCR Criteria Manual Section 12.2.2*: Low Flow Channel Design Criteria
f. *TOCR Criteria Manual Table 12-3*: Hydraulic Design Criteria for Grass-Lined Channels
g. *TOCR Criteria Manual Figure 13-7*: Embankment Protection Details and Rock Sizing Chart
h. *MHFD USDCM Table 6-3: Recommended Impervious Values*
i. *MHFD USDCM Table 8-2: Minimum Dimensions for Naturalized Channels*
j. *HFD USDCM Table 8-22: Swale Stability Chart*
k. *MHFD USDCM Table 9-1: Design Criteria for Drop Structures Using Simplified Design Procedures*
l. *MHFD USDCM Table 9-3: Drop Structure Manning's N Value*

The following published tables and charts have been used in the drainage design and are referenced in the Appendices:

m. *Castle Rock Storm Drainage Design and Technical Criteria*, Figure 7-7, Town of Castle Rock Street Capacity Chart: This chart is used to verify that street flows for all basins are within allowable limits.
n. *Urban Storm Drainage Criteria Manual, Volume 1*, Figure 8-22, Swale Stability Chart: This chart is used to determine appropriate grass or riprap lining for roadside swales, based on flow and grade.
o. *Castle Rock Storm Drainage Design and Technical Criteria*, Figure 13-7, Embankment Protection Details and Rock Sizing Chart: This chart is used to determine appropriate riprap protection on emergency overflow paths through drainage tracts.
p. *TOCR Table 12-3: Hydraulic Criteria for Grass-lined Channels:* These criteria guide multiple design elements of open channels.

V. CONCLUSIONS

A. Compliance with Standards

The drainage design for Dawson Trails Parcel B1 conforms to the Town of Castle Rock *Storm Drainage Design and Technical Criteria Manual*, the Mile High Flood District *Urban Storm Drainage Criteria Manuals*, the Chatfield Reservoir Control Regulation No. 73, and all applicable local, state, and federal requirements for drainage design and stormwater discharge.

B. Variances

No variances for drainage-related items are submitted with this project.

C. Drainage Concept

The stormwater runoff within the development will be captured by a subsurface storm sewer system and conveyed to a regional pond immediately east of the site. The pond will provide flood attenuation and water quality treatment and will ultimately discharge into Gambel Ridge Tributary at or below historic flow rates. All proposed stormwater facilities are designed to accommodate the minor (5-year) and major (100-year) storm events in accordance with Town policy.

The implementation of the drainage design presented within this PHASE III DRAINAGE REPORT is to provide proper treatment and attenuation of stormwater discharges from the proposed development with no anticipated adverse impacts to natural channels, upstream or downstream infrastructure and property, or public health, safety, or welfare.

Any subsequent changes in land use or drainage patterns from what is shown in this report will require updated drainage analyses to be shown in a future report, ensuring proper function and performance of all associated drainage facilities.

VI. REFERENCES

A. Town of Castle Rock Storm Drainage Design and Technical Criteria Manual, June 2019.

B. Mile High Flood District Urban Storm Drainage Criteria Manual, January 2021.

C. Web Soil Survey, Soil Survey Staff (Natural Resources Conservation Service), United States Department of Agriculture. Available online at the following link: https://websoilsurvey.sc.egov.usda.gov/. Accessed May 15, 2023.

D. Flood Insurance Rate Map (FIRM) No. 08035C0284G, Federal Emergency Management Agency, Revised March 16, 2016. Available online at the following link: https://msc.fema.gov/portal/home. Accessed May 15, 2023.

E. Modeling Hydraulic and Energy Gradients in Storm Sewers: A Comparison of Computational Methods by AMEC, October 2009

F. Flood Hazard Area Delineation — Gambel Ridge and Douglas Lane Tributary Watersheds by Respec Consulting and Service, July 2014

G. Gambel Ridge and Douglas Lane Tributary Watersheds – Master Plan by Respec Consulting and Service, July 2014.

H. Dawson Trails Planned Development Plan and Zoning Regulations by Norris Design, June 9, 2022 (PDP-05)

I. Phase III Drainage Report for Dawson Trails Filing No. 2 Infrastructure by CORE Consultants, October 13, 2023

J. *Geotechnical Site Development Study – Dawson Trails, Parcel B-1, Castle Rock Colorado*, by A. G. Wassenaar, Inc, revised November 13, 2023

Computer Modeling Programs:

A. StormCAD by Bentley Systems, Inc., Version 10.03.04.53.

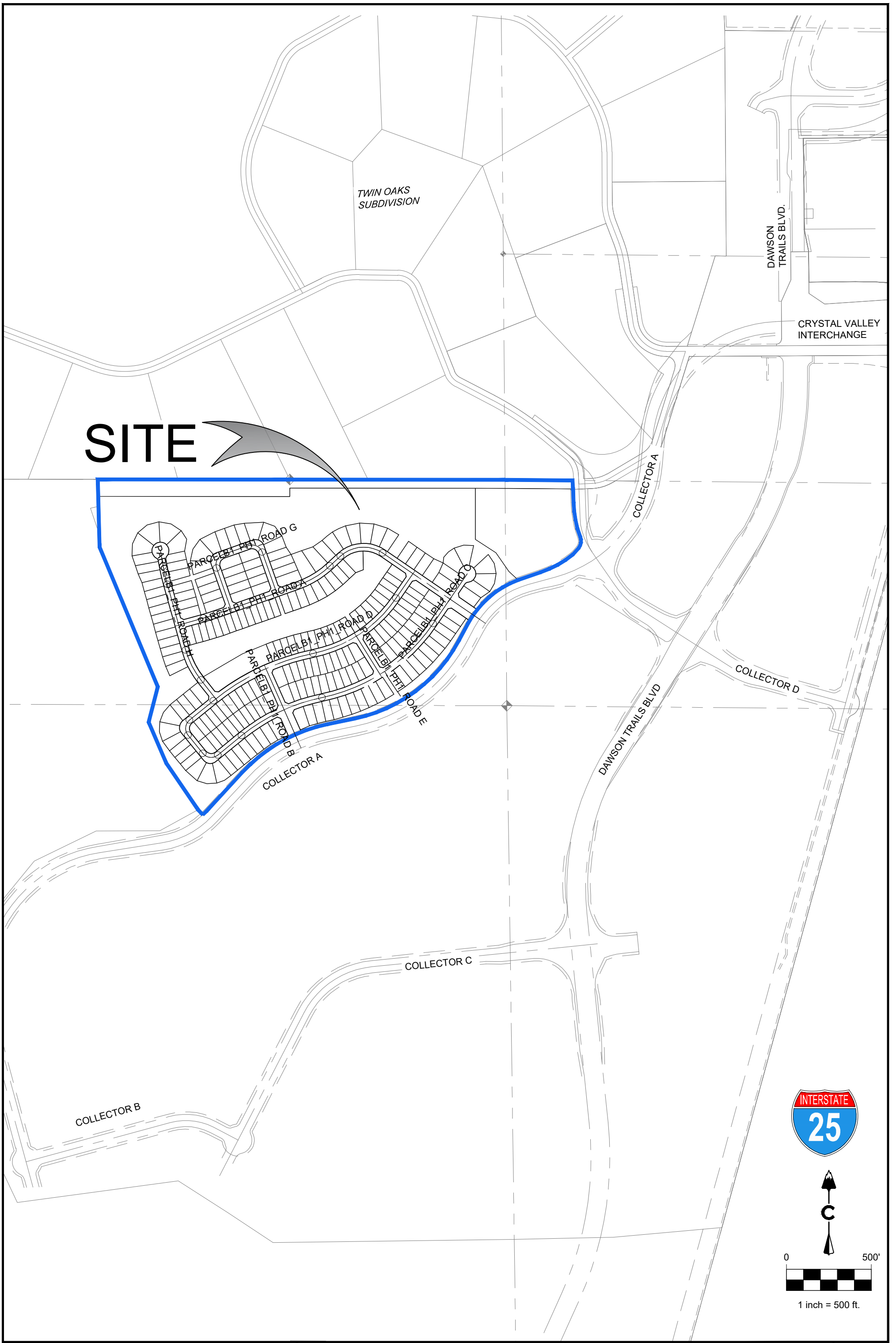
B. Hydraflow Express Extension for Autodesk Civil 3D by Autodesk, Version 2022.

C. Street and Inlet Hydraulics Workbook (MHFD-Detention v4.54.xlsm) by Mile High Flood District, Version 4.05, March 2017.

D. HY-8 by Federal Highway Administration, Version 7.80.0.2, November 2022. APPENDICES

Appendix A - Figures

Vicinity Map
Floodplain Maps
Hydrologic Soil Group Map



CORE
CORE CONSULTANTS. INC.
3473 S. BROADWAY
ENGLEWOOD, CO 80113
303.703.4444
LIVEYOURCORE.COM
LAND DEVELOPMENT
ENERGY
PUBLIC INFRASTUCTURE

DAWSON TRAILS FILING NO. 2 LOT 1 PARCEL B

VICINITY MAP

DATE: 9/15/23
CREATED: CGV
JOB NO. 20-224
SHEET 1

2021-09-11 (4:35 PM) Caroline Van Horn X:\20-224 Dawson\Civil\Reports\Parcel B1\Phase 1\Drainage\Phase II\2-Figures Vicinity Map - Parcel B.dwg

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 shown on 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 Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

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 Floodway Data table shown on this FIRM.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM 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. 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, Maryland 20910-3282
(301) 713-3242

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 by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

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 **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

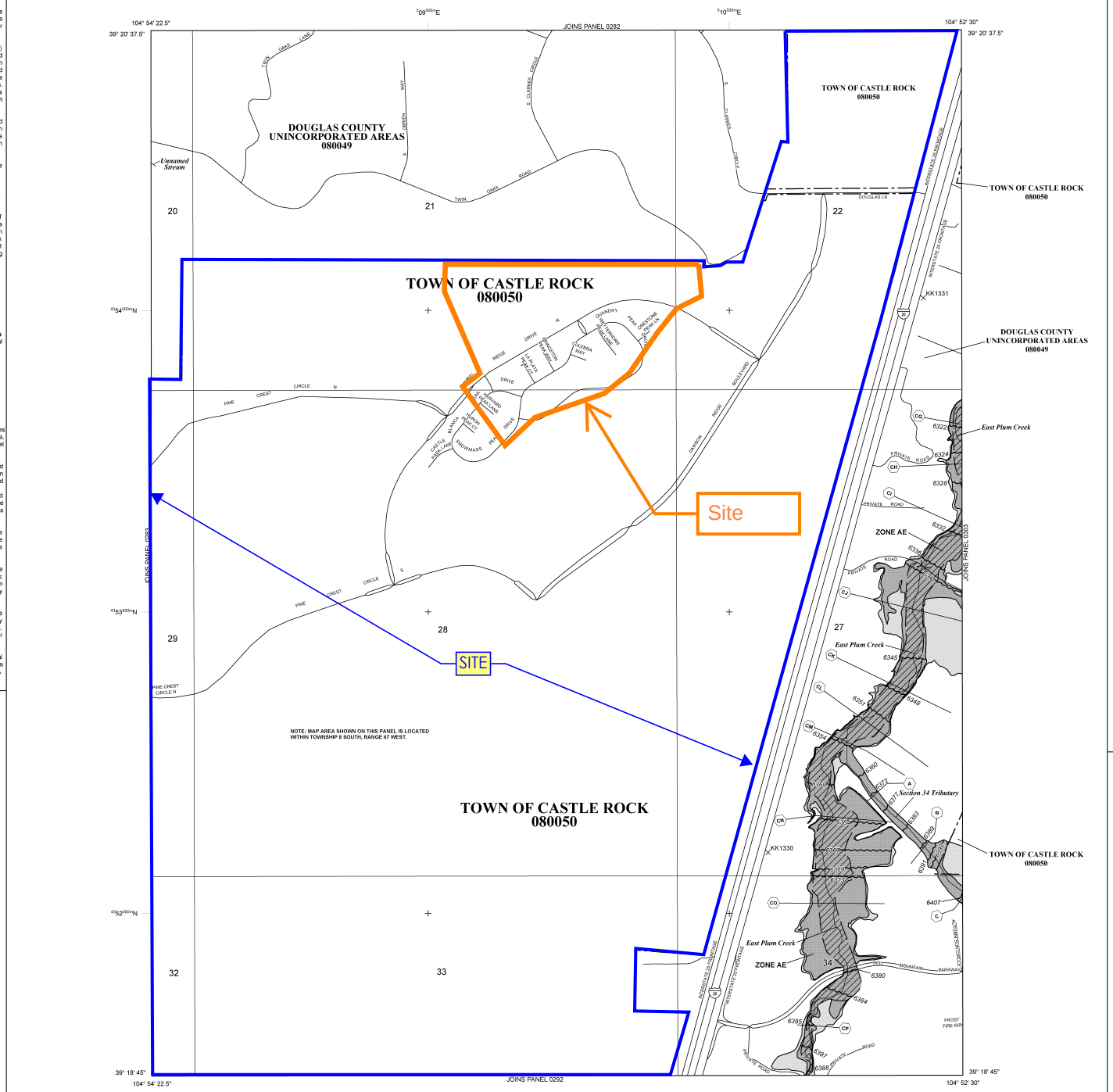
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

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.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

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



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 Areas 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.

1% Annual Chance Floodplain Boundary

0.2% Annual Chance Floodplain Boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Area Zones and 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

A — A — Cross section line

23 — 23 — Transect line

45° 02' 08", 93° 02' 12" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

4489000m N — 1000-meter Universal Transverse Mercator grid values, zone 13

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

SEPTEMBER 30, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, 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 0284G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 284 OF 495

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

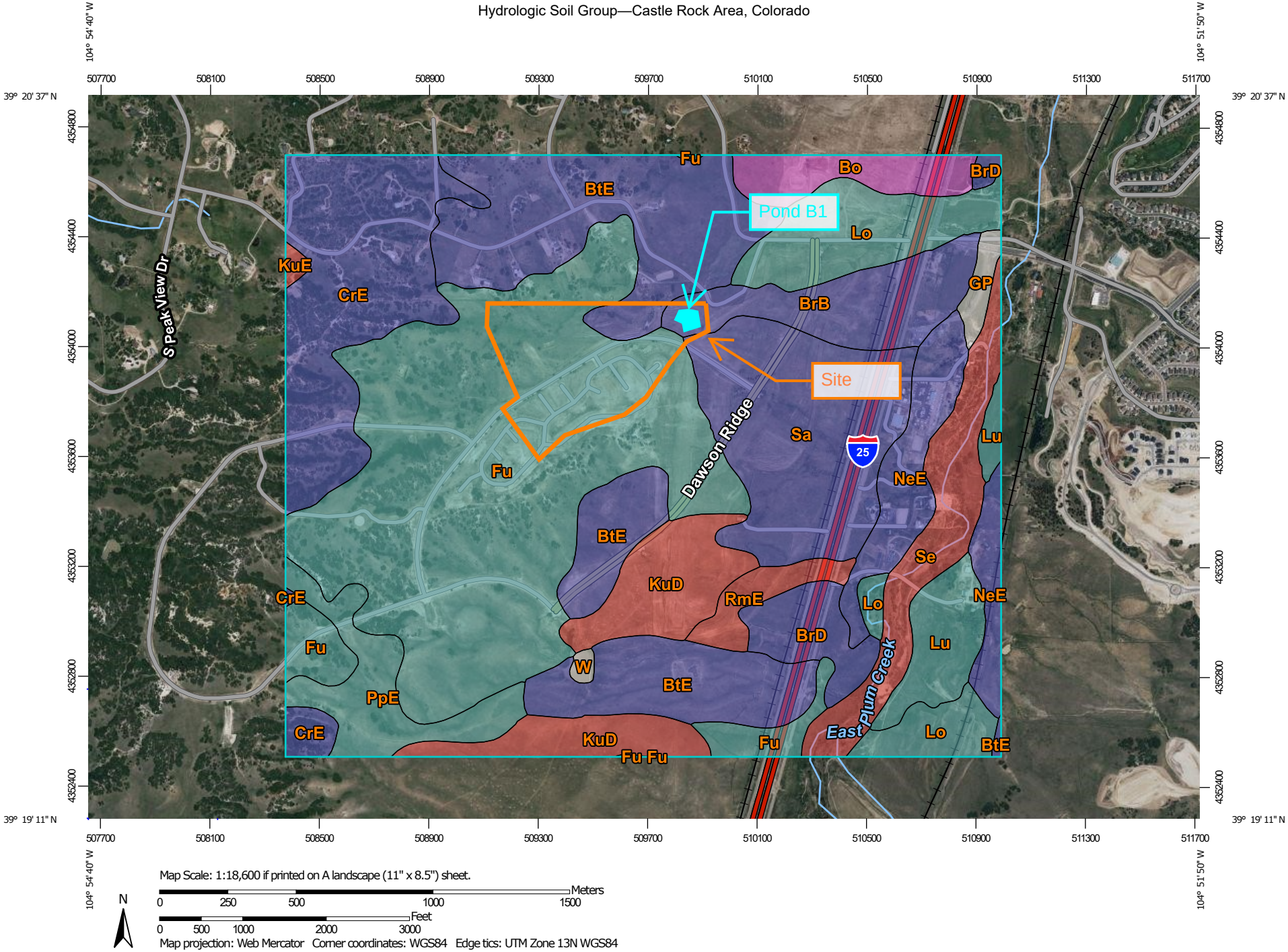
COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	0284	G
DOUGLAS COUNTY	080049	0284	G

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
08035C0284G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

Hydrologic Soil Group—Castle Rock Area, Colorado



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 1:20,000.

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: Castle Rock Area, Colorado
Survey Area Data: Version 15, Sep 1, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	30.6	2.2%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	B	58.8	4.1%
BrD	Bresser sandy loam, cool, 5 to 9 percent slopes	B	31.8	2.2%
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	223.0	15.7%
CrE	Crowfoot-Tomah sandy loams, 5 to 25 percent slopes	B	136.9	9.6%
Fu	Fondis-Kutch association	C	409.5	28.8%
GP	Pits, gravel		8.1	0.6%
KuD	Kutch clay loam, 4 to 8 percent slopes	D	76.6	5.4%
KuE	Kutch clay loam, 8 to 20 percent slopes	D	2.3	0.2%
Lo	Loamy alluvial land	C	83.3	5.9%
Lu	Loamy alluvial land, dark surface	C	37.4	2.6%
NeE	Newlin gravelly sandy loam, 8 to 30 percent slopes	B	60.4	4.2%
PpE	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes	C	49.6	3.5%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	17.6	1.2%
Sa	Sampson loam	B	130.3	9.2%
Se	Sandy wet alluvial land	D	63.1	4.4%
W	Water		2.3	0.2%
Totals for Area of Interest			**1,421.6**	**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

Appendix B - Hydrologic Computations

Impervious Calculations
Runoff Coefficient Calculations
Time of Concentration Calculations
5-Year Peak Runoff Calculations
100-Year Peak Runoff Calculations

Dawson Trails Parcel B1 Proposed/ Interim Condition

CORE Project #: 20-224
Prepared By: LCC

*Refer to Dawson Trails Filing 2 Infrastructure Phase III Drainage Report
**Refer to CUHP Analysis

IMPERVIOUS CALCULATIONS

-REFERENCE UDFCD Vol.1 RUNOFF Table 6-3

		Residential & Commercial							Landscape Area					Soil Type		
		Single Family			Multi-Family											
		0.25 acres or less	0.25 - 0.75 acres	2.5 acres or larger	Attached	Roof/ Concrete	Asphalt/ Ponded Water	Packed Gravel	2-7% Slope	>7% Slope	Historic			Soil Type A Area	Soil Type B Area	Soil Type C/D Area
% Imperv.		45.00%	30.00%	12.00%	75.00%	90.00%	100.00%	40.00%	2.00%	2.00%	2.00%					
BASIN	Design Point	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Total Area (ac)	Percent Impervious	Area (ac)	Area (ac)	Area (ac)
3.1	3.1	0.16	-	-	-	-	-	-	1.56	-	-	1.72	6.0%	-	-	1.72
3.2	3.2	3.32	-	-	-	-	-	-	4.34	-	-	7.66	20.6%	-	-	7.66
3.3	3.3	0.27	-	-	-	-	-	-	1.21	-	-	1.47	9.8%	-	-	1.47
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
4.0	4.0	2.63	-	-	-	0.65	-	-	4.87	-	-	8.15	22.9%	-	-	8.15
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.A1	A1	1.08	-	-	-	-	0.07	-	-	-	-	1.15	48.3%	-	-	1.14
5.A2	A2	2.82	-	-	-	-	-	-	-	-	0.00	2.82	45.0%	-	-	2.82
5.A3	A3	-	-	-	-	-	0.07	-	-	-	-	0.07	100.0%	-	-	0.07
5.A4	A4	-	-	-	-	-	0.07	-	-	-	-	0.07	100.0%	-	-	0.07
5.A5	A5	-	-	-	-	-	0.06	-	-	-	-	0.06	100.0%	-	-	0.06
5.A6	A6	-	-	-	-	-	0.25	-	-	-	-	0.25	100.0%	-	-	0.25
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.B1	B1	1.66	-	-	-	-	0.05	-	-	-	-	1.72	46.7%	-	-	1.72
5.B2	B2	1.67	-	-	-	-	0.06	-	-	-	-	1.73	47.0%	-	-	1.73
5.B3	B3	-	-	-	-	-	0.14	-	-	-	-	0.14	100.0%	-	-	0.14
5.B4	B4	2.84	-	-	-	-	0.15	-	-	-	-	2.99	47.7%	-	-	2.99
5.B5	B5	-	-	-	-	-	0.15	-	-	-	-	0.15	100.0%	-	-	0.15
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.C1	C1	1.08	-	-	-	-	-	-	-	-	-	1.08	45.0%	-	-	1.08
5.C3	C3	0.92	-	-	-	-	0.31	-	-	-	-	1.24	58.9%	-	-	1.24
5.C4	C4	1.68	-	-	-	-	-	-	-	-	-	1.68	45.0%	-	-	1.68
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.D1	D1	1.62	-	-	-	-	0.14	-	-	-	-	1.76	49.3%	-	-	1.76
5.D2	D2	1.54	-	-	-	-	0.14	-	-	-	-	1.67	49.5%	-	-	1.67
5.D3	D3	-	-	-	-	-	0.14	-	-	-	-	0.14	100.0%	-	-	0.14
		-	-	-	-	-	-	-	-	-	-	-		-	-	-

		Residential & Commercial												Soil Type		
		Single Family			Multi-Family				Landscape Area							
		0.25 acres or less	0.25 - 0.75 acres	2.5 acres or larger	Attached	Roof/ Concrete	Asphalt/ Ponded Water	Packed Gravel	2-7% Slope	>7% Slope	Historic			Soil Type A Area	Soil Type B Area	Soil Type C/D Area
% Imperv.		45.00%	30.00%	12.00%	75.00%	90.00%	100.00%	40.00%	2.00%	2.00%	2.00%					
BASIN	Design Point	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Area (ac)	Total Area (ac)	Percent Impervious	Area (ac)	Area (ac)	Area (ac)
5.E1	E1	0.97	-	-	-	-	0.20	-	-	-	-	1.17	54.4%	-	-	1.17
5.E2	E2	0.76	-	-	-	-	-	-	-	-	-	0.76	45.0%	-	-	0.76
5.E3	E3	1.39	-	-	-	-	-	-	-	-	-	1.39	45.0%	-	-	1.39
5.E4	E4	1.06	-	-	-	-	-	-	-	-	-	1.06	45.0%	-	-	1.06
5.E5	E5	1.00	-	-	-	-	-	-	-	-	-	1.00	45.0%	-	-	1.00
5.E6	E6	-	-	-	-	-	0.17	-	-	0.04	-	0.20	81.7%	-	-	0.20
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.E11	E11	2.62	-	-	-	-	-	-	-	-	-	2.62	45.0%	-	-	2.62
5.E13	E13	1.25	-	-	-	-	0.10	-	-	-	-	1.35	49.0%	-	-	1.34
5.E14	E14	0.32	-	-	-	-	-	-	-	-	-	0.32	45.0%	-	-	0.32
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.F3	F3	1.53	-	-	-	-	-	-	-	-	-	1.53	45.0%	-	-	1.53
5.F4	F4	0.22	-	-	-	-	0.12	-	-	-	-	0.34	64.0%	-	-	0.34
5.F5	F5	1.99	-	-	-	-	-	-	-	-	-	1.99	45.0%	-	-	1.99
5.F6	F6	1.87	-	-	-	-	-	-	-	-	-	1.87	45.0%	-	-	1.87
5.F7	F7	-	-	-	-	-	0.15	-	-	-	0.00	0.15	100.0%	-	-	0.15
5.F8	F8	-	-	-	-	-	0.15	-	-	-	-	0.15	100.0%	-	-	0.15
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
5.F11	F11	0.23	-	-	-	-	0.08	-	-	-	-	0.31	59.2%	-	-	0.31
5.F12	F12	1.11	-	-	-	-	-	-	-	-	-	1.11	45.0%	-	-	1.11
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
6.11	6.11	-	-	-	-	-	-	-	0.22	-	-	0.22	2.0%	-	-	0.22
6.12	6.12	-	-	-	-	-	-	-	0.59	-	-	0.59	2.0%	-	-	0.59
6.13	6.13	-	-	-	-	-	-	-	0.59	-	-	0.59	2.0%	-	-	0.59
6.14	6.14	0.22	-	-	-	-	-	-	0.19	-	-	0.41	25.2%	-	-	0.41
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
7.1	7.1	0.22	-	-	-	0.06	-	-	0.35	-	-	0.62	25.3%	-	-	0.62
7.2	7.2	-	-	-	-	-	3.32	-	-	1.48	-	4.80	69.8%	-	-	4.80
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
8.1	8.1	0.61	-	-	-	-	-	0.12	-	4.09	-	4.82	8.4%	-	-	4.82
8.2	8.2	1.08	-	-	-	-	-	0.04	-	1.17	-	2.30	23.0%	-	-	2.30
8.3	8.3	0.50	-	-	-	-	-	0.05	-	0.53	-	1.08	23.7%	-	-	1.08
8.4	8.4	0.66	-	-	-	0.11	-	0.01	-	2.06	-	2.84	15.6%	-	-	2.84
		-	-	-	-	-	-	-	-	-	-	-		-	-	-

Dawson Trails Parcel B1 Proposed/ Interim Condition

CORE Project #: 20-224
Prepared By: LCC

COMPOSITE DEVELOPED BASIN WEIGHTED "C" CALCULATIONS
-REFERENCE UDFCD Vol.1 RUNOFF Table 6-4

i = % imperviousness/100 expressed as a decimal
C_A = Runoff coefficient for NRCS HSG A soils
C_B = Runoff coefficient for NRCS HSG B soils
C_{CD} = Runoff coefficient for NRCS HSG C and D soils.
Natural Resource Conservation Service (NRCS)

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A = 0.84i^{1.302}$	$C_A = 0.86i^{1.276}$	$C_A = 0.87i^{1.232}$	$C_A = 0.84i^{1.124}$	$C_A = 0.85i+0.025$	$C_A = 0.78i+0.110$	$C_A = 0.65i+0.254$
B	$C_B = 0.84i^{1.169}$	$C_B = 0.86i^{1.088}$	$C_B = 0.81i+0.057$	$C_B = 0.63i+0.249$	$C_B = 0.56i+0.328$	$C_B = 0.47i+0.426$	$C_B = 0.37i+0.536$
C/D	$C_{C/D} = 0.83i^{1.122}$	$C_{C/D} = 0.82i+0.035$	$C_{C/D} = 0.74i+0.132$	$C_{C/D} = 0.56i+0.319$	$C_{C/D} = 0.49i+0.393$	$C_{C/D} = 0.41i+0.484$	$C_{C/D} = 0.32i+0.588$

Total Weighted Runoff Coefficients, C			
2-Year	5-Year	10-Year	100-Year
0.14	0.19	0.28	0.56

Basin ID	% Imperv.	*i*	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
3.1	6.0%	0.06	A	0.02	0.02	0.03	0.16		1.72	0.04	0.08	0.18	0.51
			B	0.03	0.04	0.11	0.45						
			C or D	0.04	0.08	0.18	0.51	1.72					
3.2	20.6%	0.21	A	0.11	0.11	0.12	0.27		7.66	0.14	0.20	0.28	0.57
			B	0.13	0.15	0.22	0.52						
			C or D	0.14	0.20	0.28	0.57	7.66					
3.3	9.8%	0.10	A	0.04	0.04	0.05	0.19		1.47	0.06	0.12	0.20	0.52
			B	0.06	0.07	0.14	0.47						
			C or D	0.06	0.12	0.20	0.52	1.47					
										-	-	-	-
4.0	22.9%	0.23	A	0.12	0.13	0.14	0.29		8.15	0.16	0.22	0.30	0.58
			B	0.15	0.17	0.24	0.53						
			C or D	0.16	0.22	0.30	0.58	8.15					
										-	-	-	-
5.A1	48.3%	0.48	A	0.33	0.34	0.35	0.49		1.14	0.37	0.43	0.49	0.68
			B	0.36	0.39	0.45	0.65						
			C or D	0.37	0.43	0.49	0.68	1.14					
5.A2	45.0%	0.45	A	0.30	0.31	0.33	0.46		2.82	0.34	0.40	0.46	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.46	0.67	2.82					
5.A3	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.07	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.07					
5.A4	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.07	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.07					
5.A5	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.06	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.06					
5.A6	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.25	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.25					
										-	-	-	-
										-	-	-	-

Basin ID	% Imperv.	*i*	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
5.B1	46.7%	0.47	A	0.31	0.33	0.34	0.47		1.72	0.35	0.42	0.48	0.68
			B	0.34	0.38	0.44	0.65						
			C or D	0.35	0.42	0.48	0.68	1.72					
5.B2	47.0%	0.47	A	0.31	0.33	0.34	0.48		1.73	0.36	0.42	0.48	0.68
			B	0.35	0.38	0.44	0.65						
			C or D	0.36	0.42	0.48	0.68	1.73					
5.B3	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.14	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.14					
5.B4	47.7%	0.48	A	0.32	0.33	0.35	0.48		2.99	0.36	0.43	0.49	0.68
			B	0.35	0.38	0.44	0.65						
			C or D	0.36	0.43	0.49	0.68	2.99					
5.B5	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.15	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.15					
										-	-	-	-
										-	-	-	-
5.C1	45.0%	0.45	A	0.30	0.31	0.33	0.46		1.08	0.34	0.40	0.47	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.47	0.67	1.08					
5.C3	58.9%	0.59	A	0.42	0.44	0.45	0.57		1.24	0.46	0.52	0.57	0.73
			B	0.45	0.48	0.53	0.70						
			C or D	0.46	0.52	0.57	0.73	1.24					
5.C4	45.0%	0.45	A	0.30	0.31	0.33	0.46		1.68	0.34	0.40	0.47	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.47	0.67	1.68					
										-	-	-	-
5.D1	49.3%	0.49	A	0.33	0.35	0.36	0.49		1.76	0.38	0.44	0.50	0.69
			B	0.37	0.40	0.46	0.66						
			C or D	0.38	0.44	0.50	0.69	1.76					
5.D2	49.5%	0.49	A	0.34	0.35	0.37	0.50		1.67	0.38	0.44	0.50	0.69
			B	0.37	0.40	0.46	0.66						
			C or D	0.38	0.44	0.50	0.69	1.67					
5.D3	100.0%	1.00	A	0.84	0.86	0.87	0.89		0.14	0.83	0.86	0.87	0.89
			B	0.84	0.86	0.87	0.90						
			C or D	0.83	0.86	0.87	0.89	0.14					
										-	-	-	-
5.E1	54.4%	0.54	A	0.38	0.40	0.41	0.53		1.17	0.42	0.48	0.53	0.71
			B	0.41	0.44	0.50	0.68						
			C or D	0.42	0.48	0.53	0.71	1.17					
5.E2	45.0%	0.45	A	0.30	0.31	0.33	0.46		0.76	0.34	0.40	0.47	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.47	0.67	0.76					
5.E3	45.0%	0.45	A	0.30	0.31	0.33	0.46		1.39	0.34	0.40	0.47	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.47	0.67	1.39					
5.E4	45.0%	0.45	A	0.30	0.31	0.33	0.46		1.06	0.34	0.40	0.47	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.47	0.67	1.06					
5.E5	45.0%	0.45	A	0.30	0.31	0.33	0.46		1.00	0.34	0.40	0.47	0.67
			B	0.33	0.36	0.42	0.64						
			C or D	0.34	0.40	0.47	0.67	1.00					
5.E6	81.7%	0.82	A	0.65	0.66	0.68	0.75		0.20	0.66	0.71	0.74	0.82
			B	0.66	0.69	0.72	0.81						
			C or D	0.66	0.71	0.74	0.82	0.20					

Basin ID	% Imperv.	*i*	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
										-	-	-	-
			A	0.30	0.31	0.33	0.46						
5.E11	45.0%	0.45	B	0.33	0.36	0.42	0.64		2.62	0.34	0.40	0.47	0.67
			C or D	0.34	0.40	0.47	0.67	2.62					
			A	0.33	0.35	0.36	0.49						
5.E13	49.0%	0.49	B	0.36	0.40	0.45	0.66		1.34	0.37	0.44	0.49	0.68
			C or D	0.37	0.44	0.49	0.68	1.34					
			A	0.30	0.31	0.33	0.46						
5.E14	45.0%	0.45	B	0.33	0.36	0.42	0.64		0.32	0.34	0.40	0.47	0.67
			C or D	0.34	0.40	0.47	0.67	0.32					
										-	-	-	-
			A	0.30	0.31	0.33	0.46						
5.F3	45.0%	0.45	B	0.33	0.36	0.42	0.64		1.53	0.34	0.40	0.47	0.67
			C or D	0.34	0.40	0.47	0.67	1.53					
			A	0.47	0.49	0.50	0.61						
5.F4	64.0%	0.64	B	0.50	0.53	0.58	0.73		0.34	0.50	0.56	0.61	0.75
			C or D	0.50	0.56	0.61	0.75	0.34					
			A	0.30	0.31	0.33	0.46						
5.F5	45.0%	0.45	B	0.33	0.36	0.42	0.64		1.99	0.34	0.40	0.47	0.67
			C or D	0.34	0.40	0.47	0.67	1.99					
			A	0.30	0.31	0.33	0.46						
5.F6	45.0%	0.45	B	0.33	0.36	0.42	0.64		1.87	0.34	0.40	0.47	0.67
			C or D	0.34	0.40	0.47	0.67	1.87					
			A	0.84	0.86	0.87	0.89						
5.F7	100.0%	1.00	B	0.84	0.86	0.87	0.90		0.15	0.83	0.85	0.87	0.89
			C or D	0.83	0.85	0.87	0.89	0.15					
			A	0.84	0.86	0.87	0.89						
5.F8	100.0%	1.00	B	0.84	0.86	0.87	0.90		0.15	0.83	0.86	0.87	0.89
			C or D	0.83	0.86	0.87	0.89	0.15					
										-	-	-	-
			A	0.42	0.44	0.46	0.57						
5.F11	59.2%	0.59	B	0.46	0.49	0.54	0.70		0.31	0.46	0.52	0.57	0.73
			C or D	0.46	0.52	0.57	0.73	0.31					
			A	0.30	0.31	0.33	0.46						
5.F12	45.0%	0.45	B	0.33	0.36	0.42	0.64		1.11	0.34	0.40	0.47	0.67
			C or D	0.34	0.40	0.47	0.67	1.11					
										-	-	-	-
			A	0.01	0.01	0.01	0.13						
6.11	2.0%	0.02	B	0.01	0.01	0.07	0.44		0.22	0.01	0.05	0.15	0.49
			C or D	0.01	0.05	0.15	0.49	0.22					
			A	0.01	0.01	0.01	0.13						
6.12	2.0%	0.02	B	0.01	0.01	0.07	0.44		0.59	0.01	0.05	0.15	0.49
			C or D	0.01	0.05	0.15	0.49	0.59					
			A	0.01	0.01	0.01	0.13						
6.13	2.0%	0.02	B	0.01	0.01	0.07	0.44		0.59	0.01	0.05	0.15	0.49
			C or D	0.01	0.05	0.15	0.49	0.59					
			A	0.14	0.15	0.16	0.31						
6.14	25.2%	0.25	B	0.17	0.19	0.26	0.54		0.41	0.18	0.24	0.32	0.59
			C or D	0.18	0.24	0.32	0.59	0.41					
	69.8%	0.70								-	-	-	-

Basin ID	% Imperv.	*i*	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
7.1	25.3%	0.25	A	0.14	0.15	0.16	0.31		0.62	0.18	0.24	0.32	0.59
			B	0.17	0.19	0.26	0.54						
			C or D	0.18	0.24	0.32	0.59	0.62					
7.2	69.8%	0.70	A	0.53	0.54	0.56	0.65		4.80	0.55	0.61	0.65	0.77
			B	0.55	0.58	0.62	0.75						
			C or D	0.55	0.61	0.65	0.77	4.80					
										-	-	-	-
8.1	8.4%	0.08	A	0.03	0.04	0.04	0.18		4.82	0.05	0.10	0.19	0.52
			B	0.05	0.06	0.13	0.47						
			C or D	0.05	0.10	0.19	0.52	4.82					
8.2	23.0%	0.23	A	0.12	0.13	0.14	0.29		2.30	0.16	0.22	0.30	0.58
			B	0.15	0.17	0.24	0.53						
			C or D	0.16	0.22	0.30	0.58	2.30					
8.3	23.7%	0.24	A	0.13	0.14	0.15	0.29		1.08	0.17	0.23	0.31	0.58
			B	0.16	0.18	0.25	0.54						
			C or D	0.17	0.23	0.31	0.58	1.08					
8.4	15.6%	0.16	A	0.07	0.08	0.09	0.23		2.84	0.10	0.16	0.25	0.55
			B	0.10	0.11	0.18	0.50						
			C or D	0.10	0.16	0.25	0.55	2.84					

Dawson Trails Parcel B1 Proposed/ Interim Condition

CORE Project #: 20-224

Prepared By: LCC

TIME OF CONCENTRATION CALCULATIONS

-REFERENCE UDFCD Vol.1 Section 2.4 *NRCS Conveyance factors, K -REFERENCE UDFCD Vol.1 RUNOFF Table 6-2*

SF-2

Heavy Meadow	3	Short Grass Pasture & Lawns	7	Grassed Waterway	15
Tillage/field	5	Nearly Bare Ground	10	Paved Area & Shallow Gutter	20

SUB-BASIN DATA			INITIAL / OVERLAND TIME			CHANNEL / TRAVEL TIME T(t)						T(c) CHECK (URBANIZED BASINS)		FINAL T(c)
DRAIN BASIN	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	% IMPER-VIOUS	USDCM Eq . 6-5	min.
3.1	1.72	0.08	300	5.0	18.7	800	4.4	7	1.5	9.1	27.8	6.0%		27.8
3.2	7.66	0.20	300	6.7	15.0	250	1.2	7	0.8	5.4	20.4	20.6%	25.7	20.4
3.3	1.47	0.12	125	20.0	7.4	700	2.0	7	1.0	11.8	19.2	9.8%		19.2
4.0	8.15	0.22	186	7.7	11.0	1202	4.4	15	3.1	6.4	17.4	22.9%	30.0	17.4
5.A1	1.15	0.43	123	3.7	8.7	366	1.9	20	2.8	2.2	10.9	48.3%	20.6	10.9
5.A2	2.82	0.40	120	3.0	9.6	800	1.2	20	2.2	6.1	15.7	45.0%	26.3	15.7
5.A3	0.07	0.86	20	2.0	1.6	90	2.7	20	3.3	0.5	2.0	100.0%	9.4	5.0
5.A4	0.07	0.86	20	2.0	1.6	90	2.7	20	3.3	0.5	2.0	100.0%	9.4	5.0
5.A5	0.06	0.86	20	2.0	1.6	60	1.0	20	2.0	0.5	2.1	100.0%	9.4	5.0
5.A6	0.25	0.86	20	2.0	1.6	260	1.2	20	2.1	2.0	3.6	100.0%	10.8	5.0
5.B1	1.72	0.42	106	2.5	9.4	530	3.7	20	3.8	2.3	11.7	46.7%	21.0	11.7
5.B2	1.73	0.42	117	4.9	7.9	437	2.5	20	3.2	2.3	10.2	47.0%	21.0	10.2
5.B3	0.14	0.86	7	6.2	0.6	192	1.9	20	2.7	1.2	1.8	100.0%	10.0	5.0
5.B4	2.99	0.43	126	3.6	8.9	733	2.0	20	2.8	4.3	13.2	47.7%	23.4	13.2
5.B5	0.15	0.86	20	2.0	1.6	200	3.0	20	3.5	1.0	2.5	100.0%	9.8	5.0
5.C1	1.08	0.40	119	3.2	9.4	794	1.4	20	2.4	5.5	14.9	45.0%	25.6	14.9
5.C3	1.24	0.52	121	2.7	8.3	583	2.5	20	3.2	3.1	11.4	58.9%	19.6	11.4
5.C4	1.68	0.40	170	2.9	11.5	180	2.7	20	3.3	0.9	12.4	45.0%	19.6	12.4
5.D1	1.76	0.44	120	3.3	8.8	508	4.1	20	4.0	2.1	10.9	49.3%	20.3	10.9
5.D2	1.67	0.44	120	3.3	8.8	512	4.9	20	4.4	1.9	10.7	49.5%	20.0	10.7
5.D3	0.14	0.86	20	2.0	1.6	140	1.4	20	2.4	1.0	2.5	100.0%	9.8	5.0

SUB-BASIN DATA			INITIAL / OVERLAND TIME			CHANNEL / TRAVEL TIME T(t)						T(c) CHECK (URBANIZED BASINS)		FINAL T(c)
DRAIN BASIN	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	% IMPER-VIOUS	USDCM Eq . 6-5	min.
5.E1	1.17	0.48	55	3.6	5.4	530	3.9	20	4.0	2.2	7.6	54.4%	19.4	7.6
5.E2	0.76	0.40	55	3.6	6.1	400	4.5	20	4.2	1.6	7.7	45.0%	20.4	7.7
5.E3	1.39	0.40	120	3.3	9.3	400	4.5	20	4.2	1.6	10.8	45.0%	20.4	10.8
5.E4	1.06	0.40	55	3.6	6.1	550	4.7	20	4.3	2.1	8.2	45.0%	21.1	8.2
5.E5	1.00	0.40	55	3.6	6.1	650	5.1	20	4.5	2.4	8.5	45.0%	21.5	8.5
5.E6	0.20	0.71	20	2.5	2.4	120	1.7	20	2.6	0.8	3.1	81.7%	12.9	5.0
5.E11	2.62	0.40	210	3.8	11.7	720	1.1	20	2.1	5.7	17.4	45.0%	25.8	17.4
5.E13	1.35	0.44	91	0.2	20.3	591	4.0	20	4.0	2.4	22.7	49.0%	20.8	20.8
5.E14	0.32	0.40	57	4.3	5.9	170	2.4	20	3.1	0.9	6.8	45.0%	19.6	6.8
5.F3	1.53	0.40	120	3.3	9.3	385	5.7	20	4.8	1.3	10.6	45.0%	20.1	10.6
5.F4	0.34	0.56	120	3.3	7.2	80	3.1	20	3.5	0.4	7.6	64.0%	15.5	7.6
5.F5	1.99	0.40	120	3.3	9.3	508	4.9	20	4.4	1.9	11.2	45.0%	20.9	11.2
5.F6	1.87	0.40	120	3.3	9.3	522	4.2	20	4.1	2.1	11.4	45.0%	21.1	11.4
5.F7	0.15	0.85	16	2.5	1.3	100	2.5	20	3.2	0.5	1.8	100.0%	9.5	5.0
5.F8	0.15	0.86	16	2.5	1.3	100	2.5	20	3.2	0.5	1.8	100.0%	9.5	5.0
				0.0			0.0							
5.F11	0.31	0.52	57	4.3	4.9	223	2.6	20	3.2	1.2	6.0	59.2%	17.3	6.0
5.F12	1.11	0.40	123	3.9	8.9	192	1.6	20	2.5	1.3	10.1	45.0%	20.0	10.1
				0.0			0.0							
6.11	0.22	0.05	40	5.0	7.0	340	4.1	20	4.1	1.4	8.4	2.0%		8.4
6.12	0.59	0.05	20	5.0	5.0	520	4.6	20	4.3	2.0	7.0	2.0%		7.0
6.13	0.59	0.05	60	6.7	7.8	460	4.8	20	4.4	1.8	9.6	2.0%		9.6
6.14	0.41	0.24	53	6.6	6.0	139	1.2	7	0.8	3.0	9.0	25.2%	23.4	9.0
7.1	0.62	0.24	67	6.4	6.9	42	6.0	7	1.7	0.4	7.3	25.3%	21.9	7.3
7.2	4.80	0.61	50	20.0	2.3						2.3	69.8%		5.0
8.1	4.82	0.10	260	13.5	12.3	1075	5.1	15	3.4	5.3	17.6	8.4%		17.6
8.2	2.30	0.22	120	11.7	7.7	300	6.7	15	3.9	1.3	9.0	23.0%	23.7	9.0
8.3	1.08	0.23	90	11.1	6.7	400	3.0	15	2.6	2.6	9.3	23.7%	25.1	9.3
8.4	2.84	0.16	130	10.0	9.0	400	3.3	15	2.7	2.5	11.5	15.6%		11.5

Dawson Trails Parcel B1 Proposed/ Interim Condition

CORE Project #: 20-224

Prepared By: LCC

RATIONAL METHOD PEAK RUNOFF

5-Year STORM Rainfall Depth-Duration-Frequency (1-hr) = **1.4**

SF-3

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	5yr Runoff COEFF	T(c) min	C x A	I in/hr	Q cfs
3.1	3.1	1.72	0.08	27.8	0.14	2.3	0.3
3.2	3.2	7.66	0.20	20.4	1.56	2.8	4.4
3.3	3.3	1.47	0.12	19.2	0.17	2.9	0.5
4.0	4.0	8.15	0.22	17.4	1.82	3.0	5.5
A1	5.A1	1.15	0.43	10.9	0.49	3.7	1.8
A2	5.A2	2.82	0.40	15.7	1.14	3.2	3.6
A3	5.A3	0.07	0.86	5.0	0.06	4.9	0.3
A4	5.A4	0.07	0.86	5.0	0.06	4.9	0.3
A5	5.A5	0.06	0.86	5.0	0.05	4.9	0.2
A6	5.A6	0.25	0.86	5.0	0.21	4.9	1.0
A	**5.A Total**	**4.41**		**15.7**	**2.01**	**3.2**	**6.4**
B1	5.B1	1.72	0.42	11.7	0.72	3.6	2.6
B2	5.B2	1.73	0.42	10.2	0.73	3.8	2.8
B3	5.B3	0.14	0.86	5.0	0.12	4.9	0.6
B4	5.B4	2.99	0.43	13.2	1.27	3.4	4.4
B5	5.B5	0.15	0.86	5.0	0.13	4.9	0.6
B	**5.B Total**	**6.72**		**13.2**	**2.96**	**3.4**	**10.2**
C1	5.C1	1.08	0.40	14.9	0.44	3.3	1.4
C3	5.C3	1.24	0.52	11.4	0.64	3.7	2.3
C4	5.C4	1.68	0.40	12.4	0.68	3.5	2.4
C	**5.C Total**	**3.99**		**14.9**	**1.75**	**3.3**	**5.7**
D1	5.D1	1.76	0.44	10.9	0.77	3.7	2.9
D2	5.D2	1.67	0.44	10.7	0.74	3.8	2.8
D3	5.D3	0.14	0.86	5.0	0.12	4.9	0.6
D	**5.D Total**	**3.57**		**10.9**	**1.63**	**3.7**	**6.1**
E1	5.E1	1.17	0.48	7.6	0.57	4.3	2.4
E2	5.E2	0.76	0.40	7.7	0.31	4.3	1.3
E3	5.E3	1.39	0.40	10.8	0.56	3.7	2.1
E4	5.E4	1.06	0.40	8.2	0.43	4.2	1.8
E5	5.E5	1.00	0.40	8.5	0.41	4.1	1.7
E6	5.E6	0.20	0.71	5.0	0.14	4.9	0.7
E11	5.E11	2.62	0.40	17.4	1.06	3.0	3.2
E13	5.E13	1.35	0.44	20.8	0.59	2.8	1.6
E14	5.E14	0.32	0.40	6.8	0.13	4.4	0.6
E	**5.E Total**	**9.55**		**20.8**	**4.06**	**2.8**	**11.2**

RATIONAL METHOD PEAK RUNOFF

5-Year STORM Rainfall Depth-Duration-Frequency (1-hr) = **1.4**

SF-3

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	5yr Runoff COEFF	T(c) min	C x A	I in/hr	Q cfs
F3	5.F3	1.53	0.40	10.6	0.62	3.8	2.3
F4	5.F4	0.34	0.56	7.6	0.19	4.3	0.8
F5	5.F5	1.99	0.40	11.2	0.80	3.7	3.0
F6	5.F6	1.87	0.40	11.4	0.75	3.7	2.8
F7	5.F7	0.15	0.85	5.0	0.13	4.9	0.6
F8	5.F8	0.15	0.86	5.0	0.13	4.9	0.6
F11	5.F11	0.31	0.52	6.0	0.16	4.6	0.7
F12	5.F12	1.11	0.40	10.1	0.45	3.8	1.7
F	**5.F Total**	**7.45**		**11.4**	**3.23**	**3.7**	**11.9**
6.11	6.11	0.22	0.05	8.4	0.01	4.1	0.0
6.12	6.12	0.59	0.05	7.0	0.03	4.4	0.1
6.13	6.13	0.59	0.05	9.6	0.03	3.9	0.1
6.14	6.14	0.41	0.24	9.0	0.10	4.0	0.4
7.1	7.1	0.62	0.24	7.3	0.15	4.3	0.7
7.2	7.2	4.80	0.61	5.0	2.91	4.9	14.1
8.1	8.1	4.82	0.10	17.6	0.50	3.0	1.5
8.2	8.2	2.30	0.22	9.0	0.51	4.0	2.1
8.3	8.3	1.08	0.23	9.3	0.25	4.0	1.0
8.4	8.4	2.84	0.16	11.5	0.46	3.7	1.7

Dawson Trails Parcel B1 Proposed/ Interim Condition

CORE Project #: 20-224

Prepared By: LCC

RATIONAL METHOD PEAK RUNOFF

100-YR STORM

SF-3 Rainfall Depth-Duration-Frequency (1-hr) = **2.6**

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	100YR RUNNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
3.1	3.1	1.72	0.51	27.8	0.88	4.3	3.7
3.2	3.2	7.66	0.57	20.4	4.35	5.1	22.0
3.3	3.3	1.47	0.52	19.2	0.77	5.2	4.0
4.0	4.0	8.15	0.58	17.4	4.71	5.5	25.9
A1	5.A1	1.15	0.68	10.9	0.78	6.8	5.3
A2	5.A2	2.82	0.67	15.7	1.89	5.8	10.9
A3	5.A3	0.07	0.89	5.0	0.07	8.8	0.6
A4	5.A4	0.07	0.89	5.0	0.06	8.8	0.6
A5	5.A5	0.06	0.89	5.0	0.05	8.8	0.4
A6	5.A6	0.25	0.89	5.0	0.22	8.8	1.9
A	**5.A Total**	**4.41**		**15.7**	**3.06**	**5.8**	**17.7**
B1	5.B1	1.72	0.68	11.7	1.16	6.6	7.6
B2	5.B2	1.73	0.68	10.2	1.17	7.0	8.2
B3	5.B3	0.14	0.89	5.0	0.12	8.8	1.1
B4	5.B4	2.99	0.68	13.2	2.03	6.3	12.7
B5	5.B5	0.15	0.89	5.0	0.13	8.8	1.2
B	**5.B Total**	**6.72**		**13.2**	**4.61**	**6.3**	**28.9**
C1	5.C1	1.08	0.67	14.9	0.72	5.9	4.3
C3	5.C3	1.24	0.73	11.4	0.90	6.7	6.0
C4	5.C4	1.68	0.67	12.4	1.12	6.4	7.2
C	**5.C Total**	**3.99**		**14.9**	**2.74**	**5.9**	**16.2**
D1	5.D1	1.76	0.69	10.9	1.21	6.8	8.2
D2	5.D2	1.67	0.69	10.7	1.15	6.9	7.9
D3	5.D3	0.14	0.89	5.0	0.12	8.8	1.1
D	**5.D Total**	**3.57**		**10.9**	**2.48**	**6.8**	**16.9**
E1	5.E1	1.17	0.71	7.6	0.83	7.8	6.4
E2	5.E2	0.76	0.67	7.7	0.51	7.8	3.9
E3	5.E3	1.39	0.67	10.8	0.93	6.8	6.3
E4	5.E4	1.06	0.67	8.2	0.71	7.6	5.4
E5	5.E5	1.00	0.67	8.5	0.67	7.5	5.0
E6	5.E6	0.20	0.82	5.0	0.17	8.8	1.5
E11	5.E11	2.62	0.67	17.4	1.75	5.5	9.6
E13	5.E13	1.35	0.68	20.8	0.92	5.0	4.6
E14	5.E14	0.32	0.67	6.8	0.21	8.1	1.7
E	**5.E Total**	**9.87**		**20.8**	**6.70**	**5.0**	**33.6**

RATIONAL METHOD PEAK RUNOFF

100-YR STORM

SF-3 Rainfall Depth-Duration-Frequency (1-hr) = **2.6**

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	100YR RUNNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
F3	5.F3	1.53	0.67	10.6	1.02	6.9	7.0
F4	5.F4	0.34	0.75	7.6	0.25	7.8	2.0
F5	5.F5	1.99	0.67	11.2	1.33	6.7	8.9
F6	5.F6	1.87	0.67	11.4	1.25	6.7	8.3
F7	5.F7	0.15	0.89	5.0	0.14	8.8	1.2
F8	5.F8	0.15	0.89	5.0	0.14	8.8	1.2
F11	5.F11	0.31	0.73	6.0	0.23	8.4	1.9
F12	5.F12	1.11	0.67	10.1	0.74	7.0	5.2
F	**5.F Total**	**7.45**		**11.4**	**5.09**	**6.7**	**34.0**
6.11	6.11	0.22	0.49	8.4	0.11	7.5	0.8
6.12	6.12	0.59	0.49	7.0	0.29	8.0	2.3
6.13	6.13	0.59	0.49	9.6	0.29	7.1	2.1
6.14	6.14	0.41	0.59	9.0	0.24	7.3	1.8
7.1	7.1	0.62	0.59	7.3	0.36	7.9	2.9
7.2	7.2	4.80	0.77	5.0	3.70	8.8	32.6
8.1	8.1	4.82	0.52	17.6	2.50	5.5	13.7
8.2	8.2	2.30	0.58	9.0	1.33	7.3	9.8
8.3	8.3	1.08	0.58	9.3	0.63	7.2	4.5
8.4	8.4	2.84	0.55	11.5	1.56	6.6	10.4

Appendix C - Hydraulic Computations

Open Channel Summary Table
Channel and Swale Calculations
Box Culvert Summary Table
Box Culvert Calculations
Surface Conveyance and Inlet Capture Summary
Street Conveyance Evaluation
Inlet Calculations
Storm Sewer Model Maps
Storm Sewer Model Output
Forebay Calculations

Dawson Trails Parcel B1

CORE Project #: 20-224

Prepared By: LCC

OPEN CHANNEL & SWALE DESIGN SUMMARY

-REFERENCE UDFCD Vol.1 Section 8.6.3

SUB-BASIN DATA				OPEN CHANNEL GEOMETRIC PARAMETERS					MAX DROP HEIGHT (FT.)	OPEN CHANNEL FLOW PROPERTIES		
Channel / Swale	Design Pt.	AREA ac.	Q100 cfs	Bottom Width (ft)	Side Slope	Low-Flow Depth (ft)	Overbank Width (ft)	Swale Grade (%)		Max velocity ft/s	Flow depth ft	Froude Number
Channel B	H5	175.4	267.0	14.0	4:1	1.5	10	0.40%	5.0	3.76	2.33	0.43
Swale A	OS2.1	69.4	81.4	10.0	5:1			1.00%	5.0	4.00	1.37	0.60
Swale 8.1	8.1	2.6	8.4	4.0	5:1	2.0		6.69%		4.33	0.34	1.31
Swale 8.1	8.2	5.3	17.2	4.0	5:1	2.0		5.13%		4.88	0.53	1.18
Swale 8.1	8.3	6.6	21.4	4.0	5:1	2.0		2.86%		4.25	0.68	0.91
Swale 3.1	3.1	1.9	4.0	2.0	5:1			0.48%		1.46	0.57	0.34
Swale 3.3	3.3	1.5	3.8	2.0	5:1			2.20%		2.47	0.39	0.70
Pond Inflow	H5	175.4	267.0	14.0	4:1	1.5	10	0.40%	5.0	3.76	2.33	0.43

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jan 8 2024

Grass Lined Swale 8, Upper (Design Pt. 8.1)

Trapezoidal

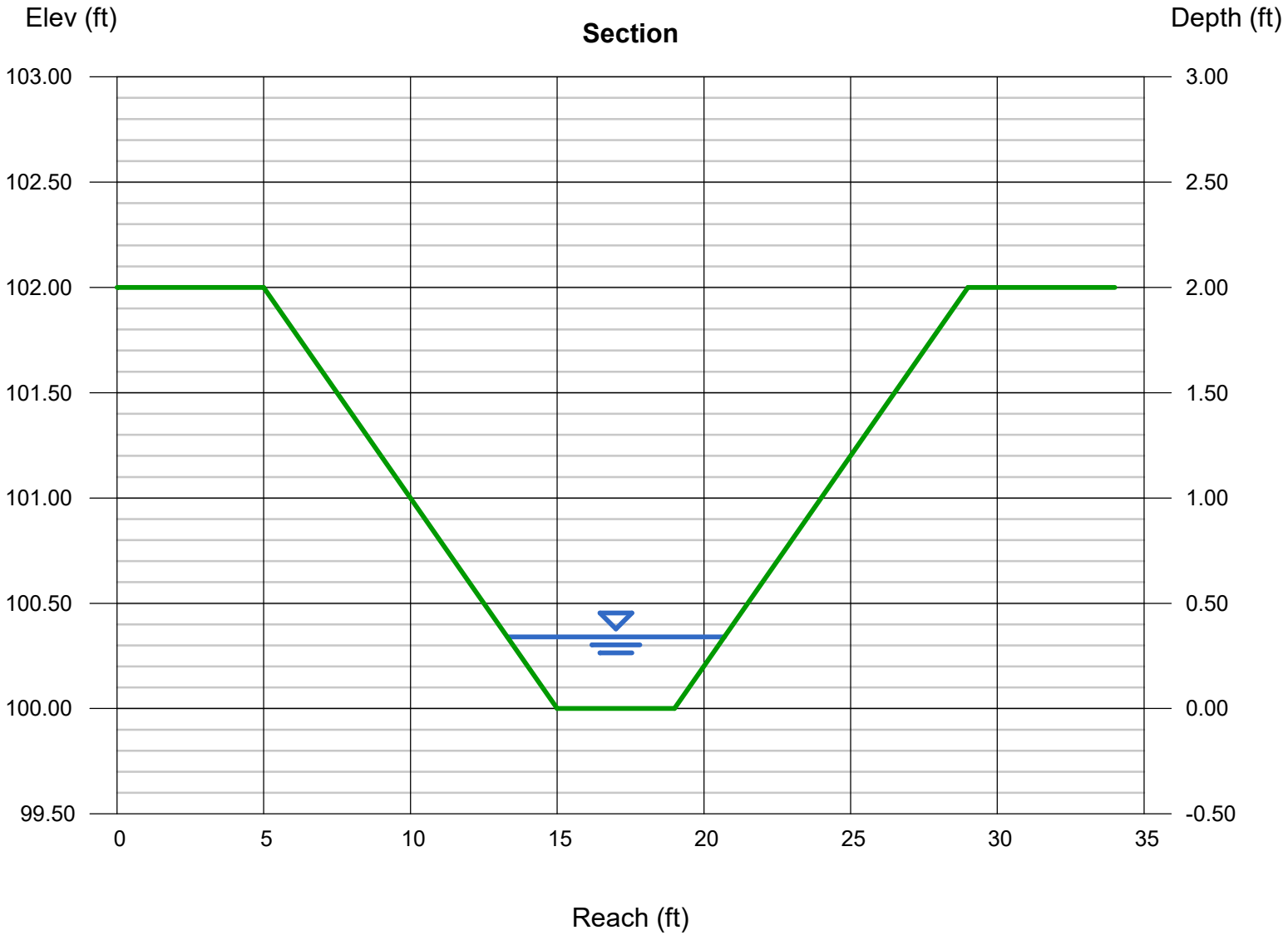
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 6.69
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.40

Highlighted

Depth (ft)	= 0.34
Q (cfs)	= 8.400
Area (sqft)	= 1.94
Velocity (ft/s)	= 4.33
Wetted Perim (ft)	= 7.47
Crit Depth, Yc (ft)	= 0.43
Top Width (ft)	= 7.40
EGL (ft)	= 0.63



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jan 8 2024

Grass Lined Swale 8, Mid (Design Pt. 8.2)

Trapezoidal

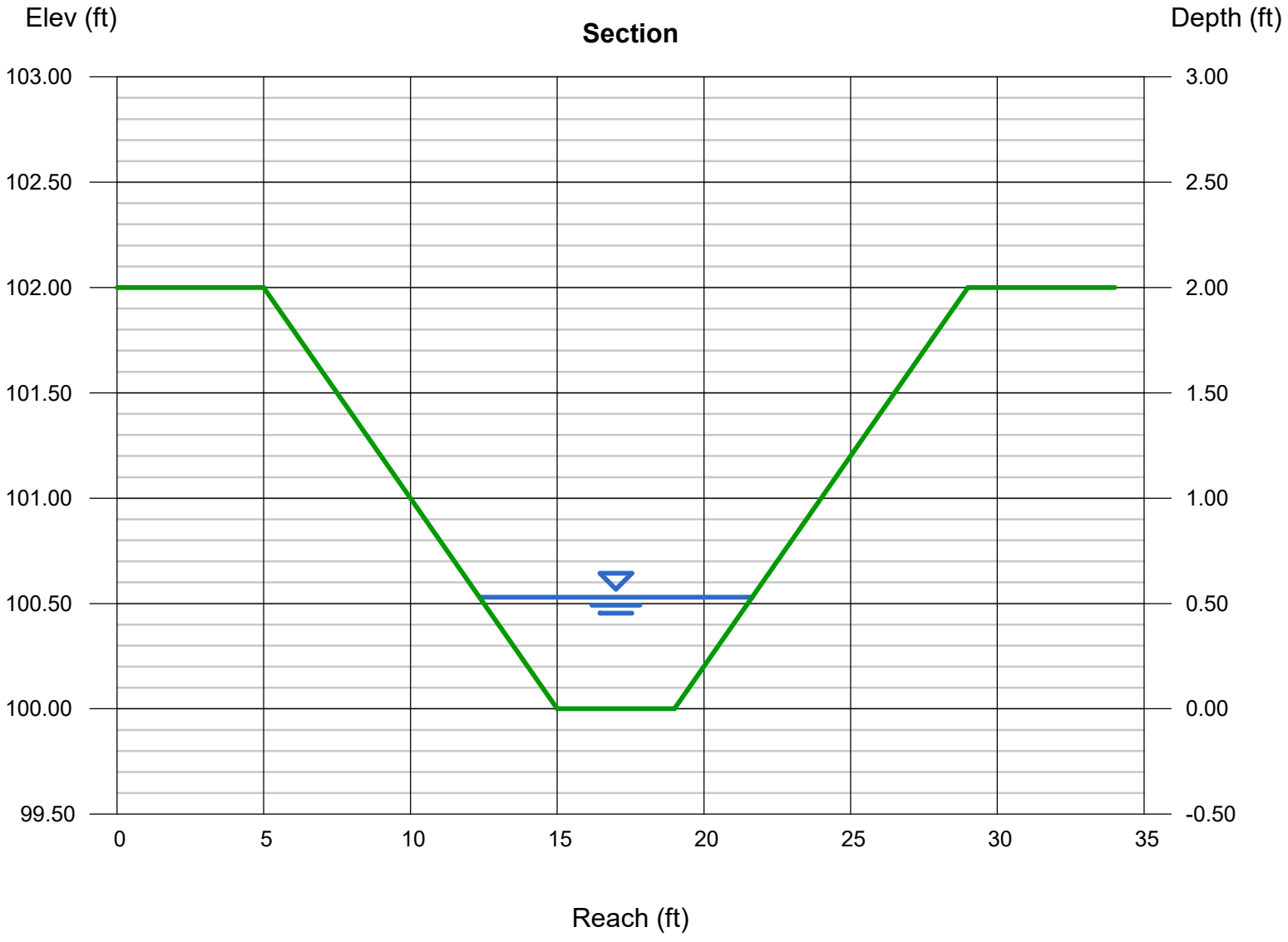
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 5.13
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 17.20

Highlighted

Depth (ft)	= 0.53
Q (cfs)	= 17.20
Area (sqft)	= 3.52
Velocity (ft/s)	= 4.88
Wetted Perim (ft)	= 9.40
Crit Depth, Yc (ft)	= 0.64
Top Width (ft)	= 9.30
EGL (ft)	= 0.90



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jan 8 2024

Grass Lined Swale 8, Lower (Design Pt. 8.3)

Trapezoidal

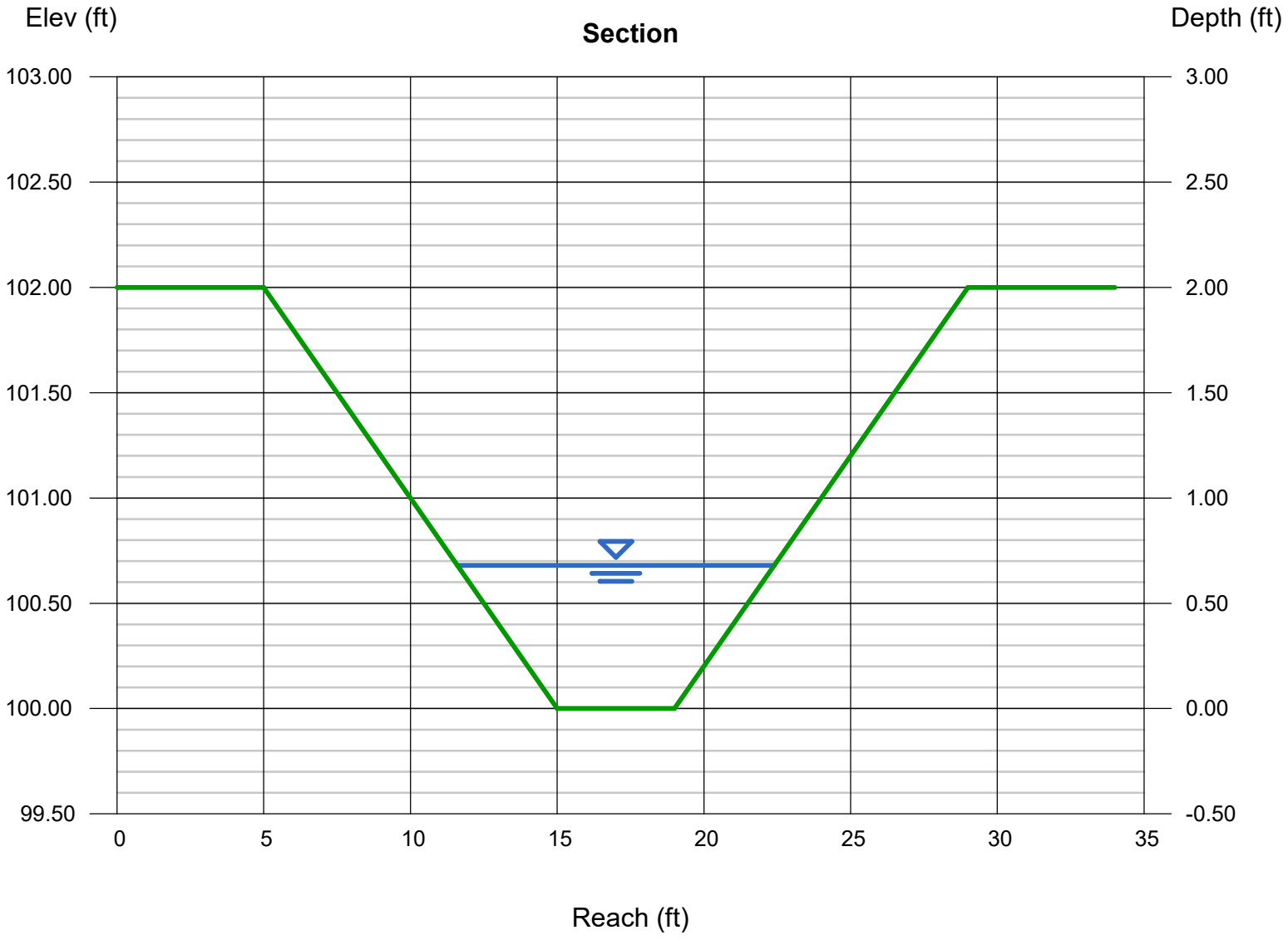
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 5.00, 5.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 2.86
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 21.40

Highlighted

Depth (ft)	= 0.68
Q (cfs)	= 21.40
Area (sqft)	= 5.03
Velocity (ft/s)	= 4.25
Wetted Perim (ft)	= 10.93
Crit Depth, Yc (ft)	= 0.72
Top Width (ft)	= 10.80
EGL (ft)	= 0.96



Dawson Trails Parcel B1

CORE Project #: 20-224

Prepared By: LCC

BOX CULVERT DESIGN SUMMARY

-REFERENCE Town of Castle Rock Storm Drainage Design and Technical Criteria Sections 11.2, 11.3

SUB-BASIN DATA					CROSSING TOPOGRPAHY						CULVERT DESIGN						HYDRAULIC PROPERTIES			
Road Crossing	Tributary Basins	Design Pt.	AREA ac.	Q100 cfs	Road Sta.	Length (ft.)	Entrance Invert	Exit Invert	Slope	Road CL Elev.	Span (ft.)	Rise (ft.)	Entrance WSE	Q100 HW/D	Allowable HW/D	In/Out Control	Outlet velocity (ft/s)	Outlet depth (ft.)	Froude Number	Tailwater depth (ft.)
Road H	H1-H3	H3	128.0	203.8	17+35	112	6516.74	6515.17	1.40%	6526.00	8	6	6520.73	0.66	1.5	Inlet	13.26	1.92	1.69	2.16
Road A	H1-H5	H5	175.4	267.0	23+79	188	6461.09	6458.84	1.19%	6470.50	8	6	6466.17	0.85	1.5	Inlet	14.67	3.16	1.45	2.48

HY-8 Culvert Analysis Report

Crossing Discharge Data

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

Minimum Flow: 25.00 cfs

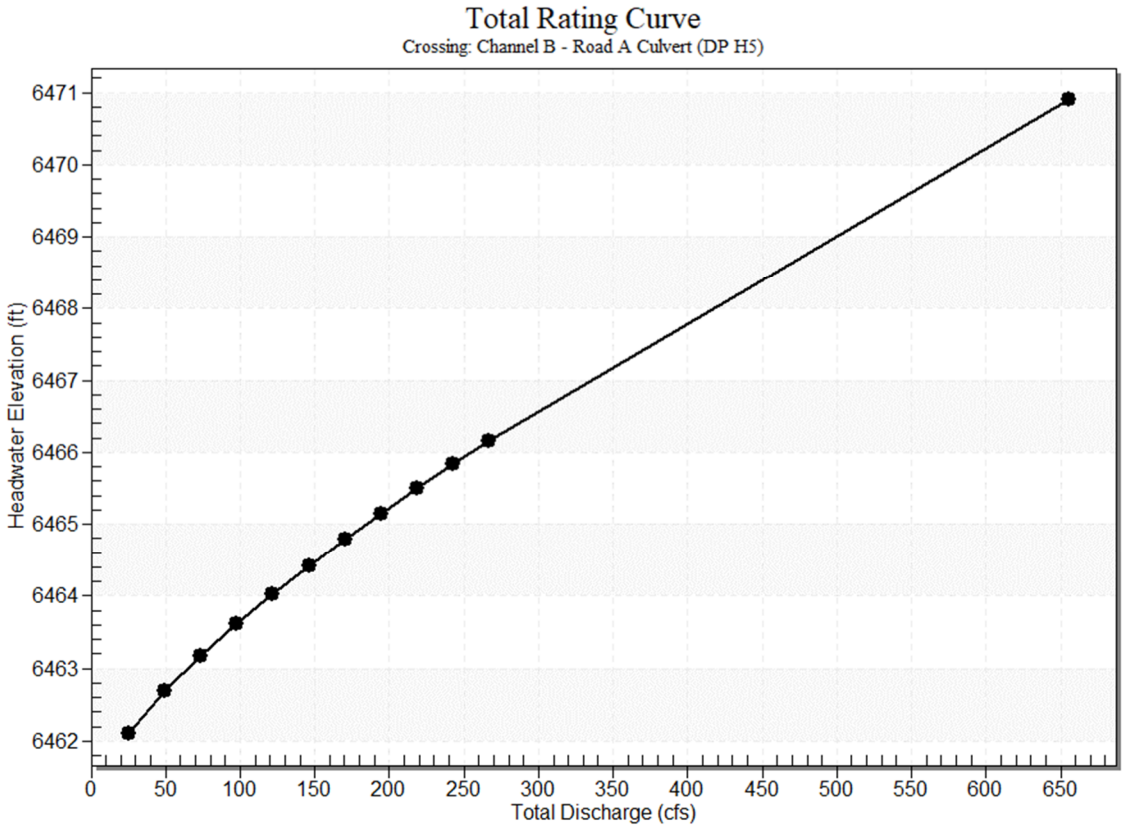
Design Flow: 267.00 cfs

Maximum Flow: 267.00 cfs

Table 1 - Summary of Culvert Flows at Crossing: Channel B - Road A Culvert (DP H5)

Headwater Elevation (ft)	Total Discharge (cfs)	Road A Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6462.11	25.00	25.00	0.00	1
6462.69	49.20	49.20	0.00	1
6463.18	73.40	73.40	0.00	1
6463.62	97.60	97.60	0.00	1
6464.02	121.80	121.80	0.00	1
6464.41	146.00	146.00	0.00	1
6464.79	170.20	170.20	0.00	1
6465.15	194.40	194.40	0.00	1
6465.49	218.60	218.60	0.00	1
6465.83	242.80	242.80	0.00	1
6466.17	267.00	267.00	0.00	1
6470.50	570.05	570.05	0.00	Overtopping

Rating Curve Plot for Crossing: Channel B - Road A Culvert (DP H5)



Culvert Data: Road A Culvert

Table 1 - Culvert Summary Table: Road A Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
25.00 cfs	25.00 cfs	6462.11	1.02	0.190	1-S2n	0.64	0.67	0.64	0.68	4.89	2.19
49.20 cfs	49.20 cfs	6462.69	1.60	0.580	1-S2n	0.99	1.06	0.99	1.00	6.21	2.72
73.40 cfs	73.40 cfs	6463.18	2.09	0.932	1-S2n	1.29	1.38	1.29	1.25	7.13	3.09
97.60 cfs	97.60 cfs	6463.62	2.53	1.262	1-S2n	1.56	1.67	1.56	1.46	7.82	3.37
121.80 cfs	121.80 cfs	6464.02	2.93	1.581	1-S2n	1.81	1.93	1.82	1.65	8.38	3.59
146.00 cfs	146.00 cfs	6464.41	3.32	1.894	1-S2n	2.05	2.18	2.06	1.81	8.86	3.79
170.20 cfs	170.20 cfs	6464.79	3.70	2.206	1-S2n	2.29	2.41	2.29	1.97	9.28	3.96
194.40 cfs	194.40 cfs	6465.15	4.06	2.519	1-S2n	2.51	2.64	2.52	2.11	9.65	4.12
218.60 cfs	218.60 cfs	6465.49	4.40	2.834	1-S2n	2.73	2.85	2.74	2.24	9.98	4.25
242.80 cfs	242.80 cfs	6465.83	4.74	3.154	1-S2n	2.95	3.06	2.95	2.36	10.28	4.38
267.00 cfs	267.00 cfs	6466.17	5.08	3.478	1-S2n	3.16	3.26	3.16	2.48	10.55	4.50

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

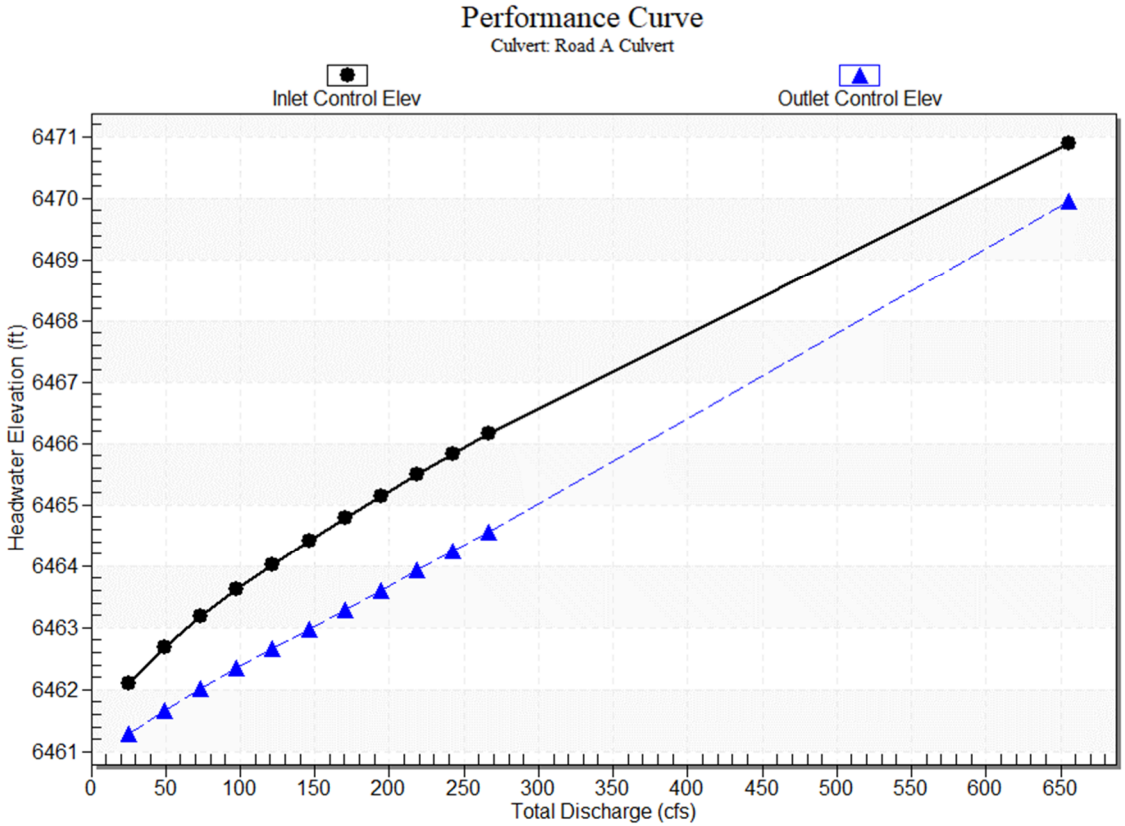
Inlet Elevation (invert): 6461.09 ft,

Outlet Elevation (invert): 6460.59 ft

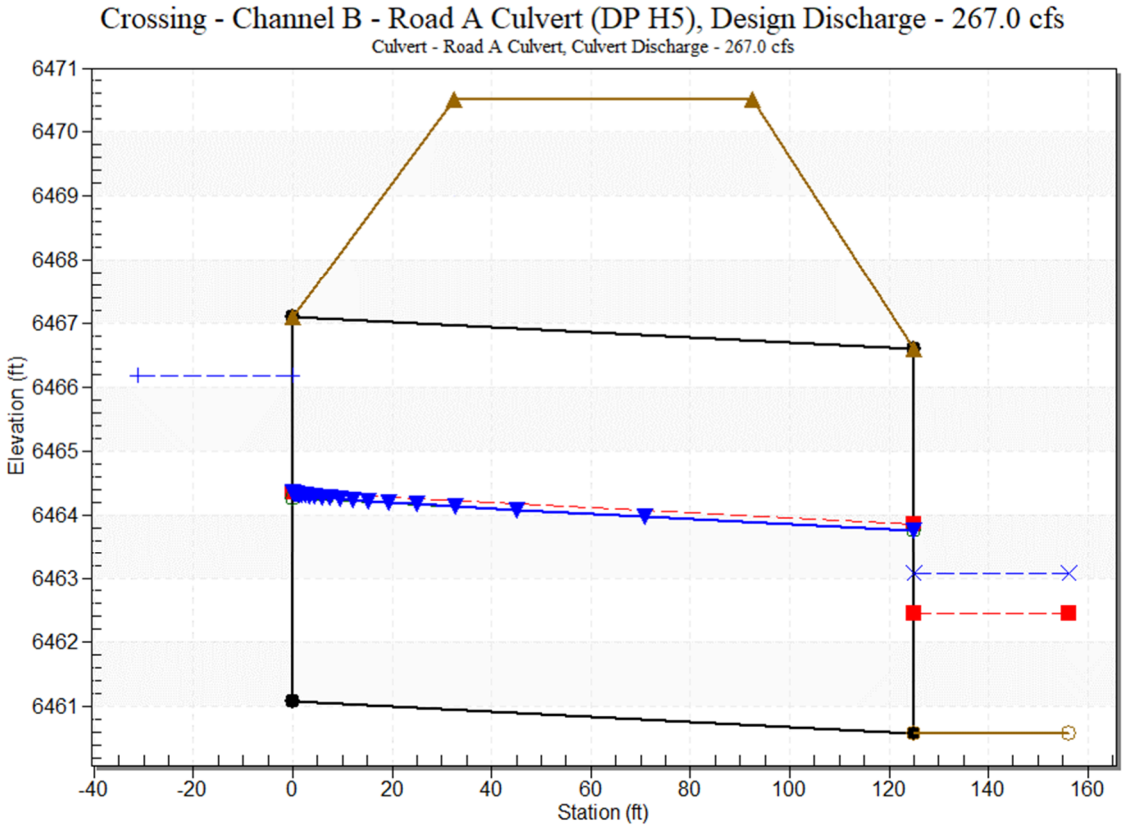
Culvert Length: 125.00 ft,

Culvert Slope: 0.0040

Culvert Performance Curve Plot: Road A Culvert



Water Surface Profile Plot for Culvert: Road A Culvert



Site Data - Road A Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6461.09 ft

Outlet Station: 125.00 ft

Outlet Elevation: 6460.59 ft

Number of Barrels: 1

Culvert Data Summary - Road A Culvert

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: 1:1 Bevel (45º flare) Wingwall (Ke=0.2)

Inlet Depression: None

Roadway Data for Crossing: Channel B - Road A Culvert (DP H5)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 80.00 ft

Crest Elevation: 6470.50 ft

Roadway Surface: Paved

Roadway Top Width: 60.00 ft

Tailwater Data for Crossing: Channel B - Road A Culvert (DP H5)

Table 2 - Downstream Channel Rating Curve (Crossing: Channel B - Road A Culvert (DP H5))

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
25.00	6461.27	0.68	2.19	0.17	0.50
49.20	6461.59	1.00	2.72	0.25	0.53
73.40	6461.84	1.25	3.09	0.31	0.55
97.60	6462.05	1.46	3.37	0.36	0.56
121.80	6462.24	1.65	3.59	0.41	0.57
146.00	6462.40	1.81	3.79	0.45	0.57
170.20	6462.56	1.97	3.96	0.49	0.58
194.40	6462.70	2.11	4.12	0.53	0.59
218.60	6462.83	2.24	4.25	0.56	0.59
242.80	6462.95	2.36	4.38	0.59	0.60
267.00	6463.07	2.48	4.50	0.62	0.60

Tailwater Channel Data - Channel B - Road A Culvert (DP H5)

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 14.00 ft

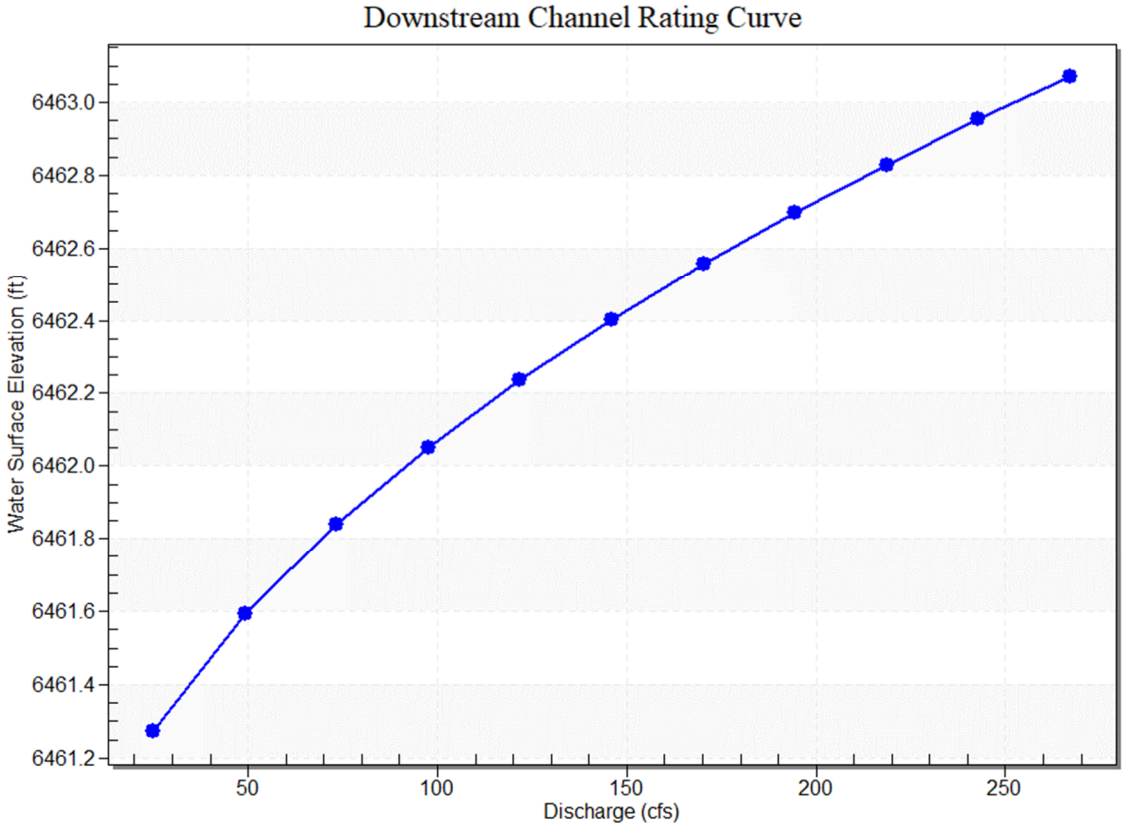
Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0040

Channel Manning's n: 0.0300

Channel Invert Elevation: 6460.59 ft

Tailwater Rating Curve Plot for Crossing: Channel B - Road A Culvert (DP H5)



HY-8 Culvert Analysis Report

Crossing Discharge Data

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

Minimum Flow: 25.00 cfs

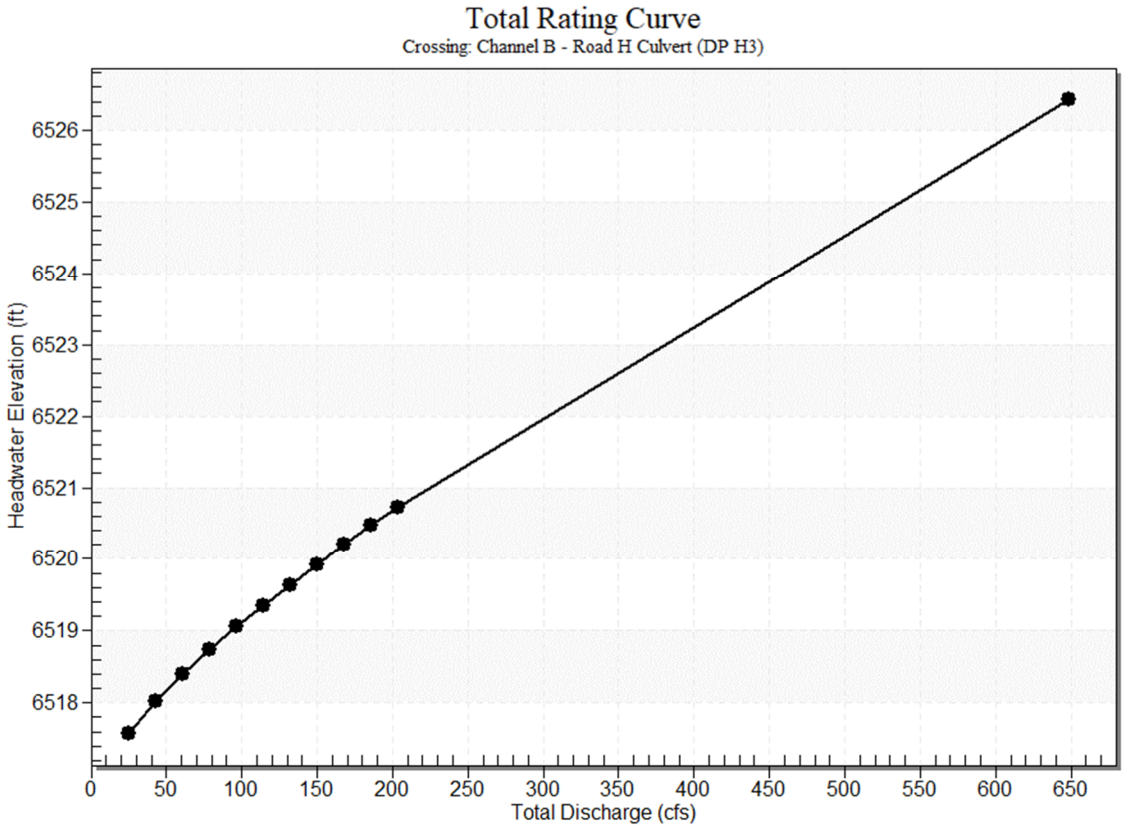
Design Flow: 203.80 cfs

Maximum Flow: 203.80 cfs

Table 1 - Summary of Culvert Flows at Crossing: Channel B - Road H Culvert (DP H3)

Headwater Elevation (ft)	Total Discharge (cfs)	Road H Culvert Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6517.58	25.00	25.00	0.00	1
6518.02	42.88	42.88	0.00	1
6518.40	60.76	60.76	0.00	1
6518.74	78.64	78.64	0.00	1
6519.06	96.52	96.52	0.00	1
6519.35	114.40	114.40	0.00	1
6519.64	132.28	132.28	0.00	1
6519.93	150.16	150.16	0.00	1
6520.20	168.04	168.04	0.00	1
6520.47	185.92	185.92	0.00	1
6520.73	203.80	203.80	0.00	1
6526.00	573.13	573.13	0.00	Overtopping

Rating Curve Plot for Crossing: Channel B - Road H Culvert (DP H3)



Culvert Data: Road H Culvert

Table 1 - Culvert Summary Table: Road H Culvert

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
25.00 cfs	25.00 cfs	6517.58	1.01	0.0*	1-S2n	0.43	0.67	0.43	0.68	7.31	2.19
42.88 cfs	42.88 cfs	6518.02	1.45	0.0*	1-S2n	0.60	0.96	0.62	0.93	8.60	2.61
60.76 cfs	60.76 cfs	6518.40	1.83	0.059	1-S2n	0.75	1.21	0.80	1.13	9.51	2.91
78.64 cfs	78.64 cfs	6518.74	2.17	0.311	1-S2n	0.89	1.44	0.95	1.30	10.31	3.15
96.52 cfs	96.52 cfs	6519.06	2.49	0.551	1-S2n	1.02	1.65	1.10	1.45	10.94	3.35
114.40 cfs	114.40 cfs	6519.35	2.78	0.785	1-S2n	1.14	1.85	1.25	1.59	11.44	3.53
132.28 cfs	132.28 cfs	6519.64	3.07	1.015	1-S2n	1.25	2.04	1.39	1.72	11.88	3.68
150.16 cfs	150.16 cfs	6519.93	3.36	1.243	1-S2n	1.36	2.22	1.53	1.84	12.27	3.82
168.04 cfs	168.04 cfs	6520.20	3.63	1.469	1-S2n	1.47	2.39	1.66	1.95	12.62	3.95
185.92 cfs	185.92 cfs	6520.47	3.90	1.696	1-S2n	1.57	2.56	1.80	2.06	12.95	4.06
203.80 cfs	203.80 cfs	6520.73	4.16	1.923	1-S2n	1.67	2.72	1.92	2.16	13.26	4.17

* Full Flow Headwater elevation is below inlet invert.

Culvert Barrel Data

Culvert Barrel Type Straight Culvert

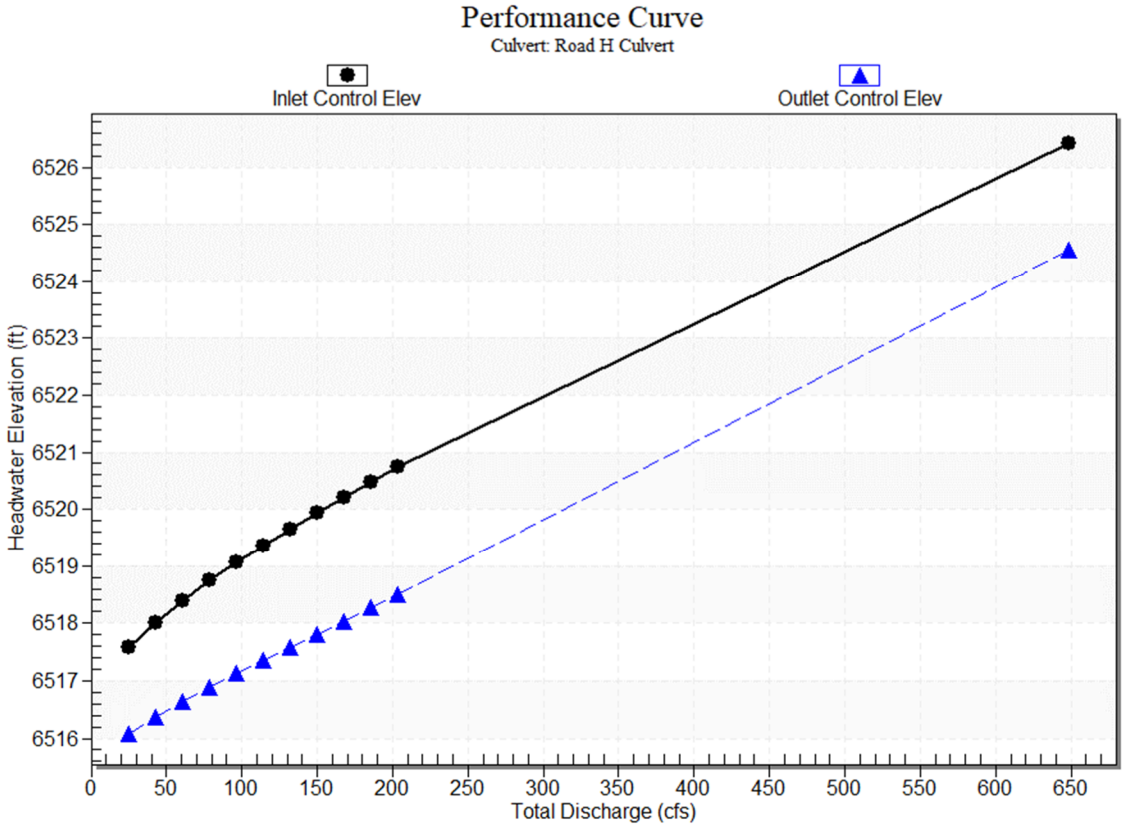
Inlet Elevation (invert): 6516.57 ft,

Outlet Elevation (invert): 6515.38 ft

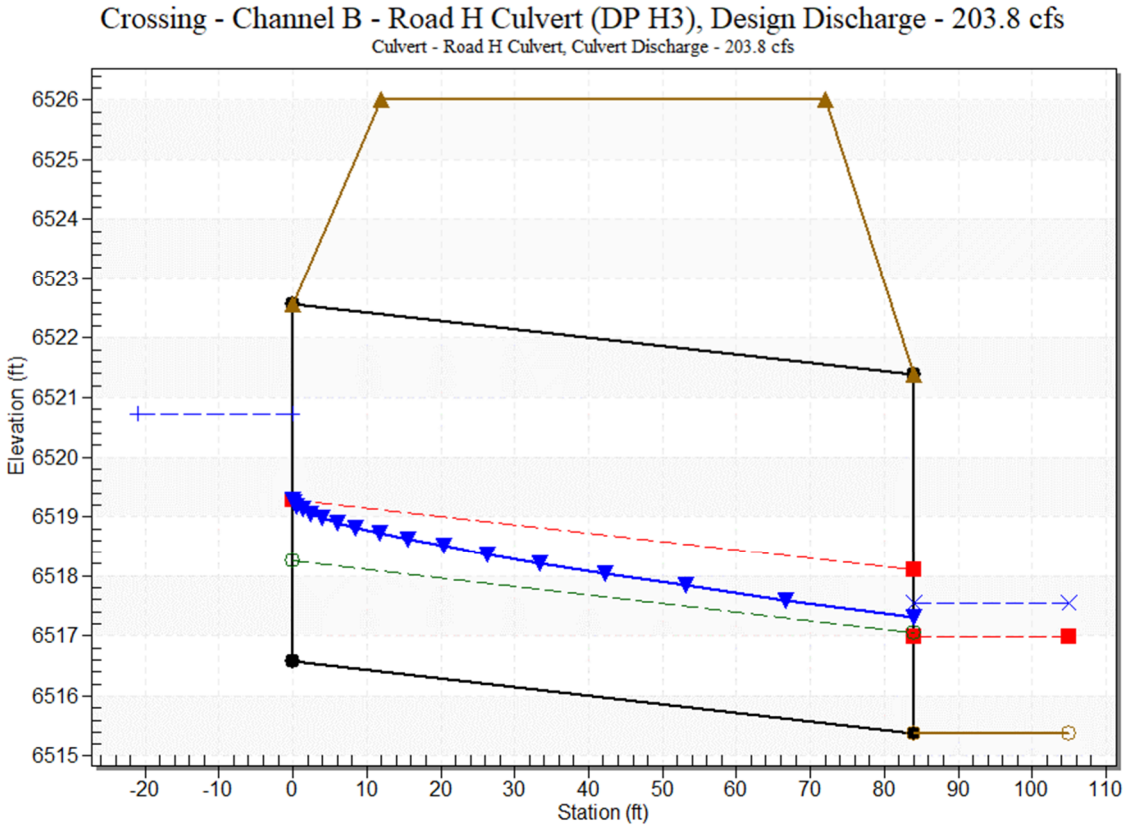
Culvert Length: 84.01 ft,

Culvert Slope: 0.0142

Culvert Performance Curve Plot: Road H Culvert



Water Surface Profile Plot for Culvert: Road H Culvert



Site Data - Road H Culvert

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6516.57 ft

Outlet Station: 84.00 ft

Outlet Elevation: 6515.38 ft

Number of Barrels: 1

Culvert Data Summary - Road H Culvert

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 6.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: 1:1 Bevel (45º flare) Wingwall (Ke=0.2)

Inlet Depression: None

Roadway Data for Crossing: Channel B - Road H Culvert (DP H3)

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 60.00 ft

Crest Elevation: 6526.00 ft

Roadway Surface: Paved

Roadway Top Width: 60.00 ft

Tailwater Data for Crossing: Channel B - Road H Culvert (DP H3)

Table 2 - Downstream Channel Rating Curve (Crossing: Channel B - Road H Culvert (DP H3))

Flow (cfs)	Water Surface Elev (ft)	Velocity (ft/s)	Depth (ft)	Shear (psf)	Froude Number
25.00	6516.06	0.68	2.19	0.17	0.50
42.88	6516.31	0.93	2.61	0.23	0.52
60.76	6516.51	1.13	2.91	0.28	0.54
78.64	6516.68	1.30	3.15	0.32	0.55
96.52	6516.83	1.45	3.35	0.36	0.56
114.40	6516.97	1.59	3.53	0.40	0.56
132.28	6517.10	1.72	3.68	0.43	0.57
150.16	6517.22	1.84	3.82	0.46	0.58
168.04	6517.33	1.95	3.95	0.49	0.58
185.92	6517.44	2.06	4.06	0.51	0.58
203.80	6517.54	2.16	4.17	0.54	0.59

Tailwater Channel Data - Channel B - Road H Culvert (DP H3)

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 14.00 ft

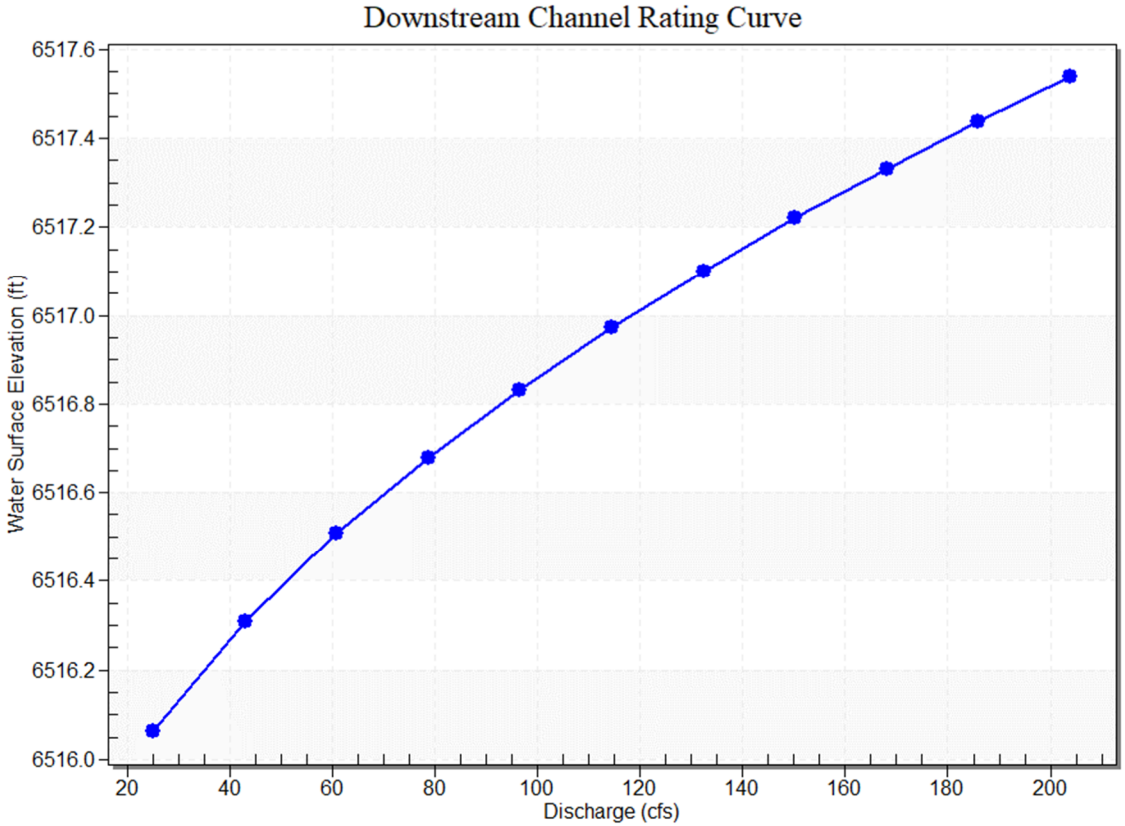
Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0040

Channel Manning's n: 0.0300

Channel Invert Elevation: 6515.38 ft

Tailwater Rating Curve Plot for Crossing: Channel B - Road H Culvert (DP H3)



Dawson Trails Parcel B1 Proposed/ Interim Condition

CORE Project #: *20-224*
Prepared By: *LCC*

SURFACE CONVEYANCE AND INLET CAPTURE SUMMARY

-REFERENCE Town of Castle Rock Storm Drainage Design and Technical Criteria Sections 11.2, 11.3

SUB-BASIN DATA										SURFACE CONVEYANCE							INLET CAPTURE										
Tributary Basin	Design Pt.	*Area ac*	Bypass from	Q5 local	Q5 bypass	Q5 total	Q100 local	Q100 bypass	Q100 total	Street	Curb Type	Longitudinal Grade	Q5 Allow. Depth	Q100 Allow. Depth	Q5 Capacity	Q100 Capacity	Inlet Type	Inlet Size	Sump / On-grade	Q5 Allow. Depth	Q100 Allow. Depth	Q5 Max Capture	Q100 Max Capture	Q5 Bypass	Q100 Bypass	Bypass to
3.1	3.1	*1.72*		0.3		0.3	3.7		3.7	Overland to Swale																
3.3	3.3	*1.47*		0.5		0.5	4.0		4.0	Overland to Swale																
4.0	4.0	*8.15*		5.5		5.5	25.9		25.9	Overland Direct to Channel B - Refer to SWMM for combined flows																
5.A1	A1	*1.15*	-	1.8		1.8	5.3		5.3	Amen St	Type MS2	2.05%	0.43	0.43	12.9	12.9	Type 16 C	9'	On-Grade			1.8	4.1	0.0	1.2	A5
5.A2	A2	*2.82*	-	3.6		3.6	10.9		10.9	Amen St	Type MS2	1.26%	0.43	0.50	11.0	11.0	Cross-pan to A5							3.6	10.9	A5
5.A3	A3	*0.07*	-	0.3		0.3	0.6		0.6	Hammer St	Type MS2	3.00%	0.43	0.43	10.1	11.3	Cross-pan to A5							0.3	0.6	A5
5.A4	A4	*0.07*	-	0.3		0.3	0.6		0.6	Hammer St	Type MS2	3.00%	0.43	0.43	13.3	13.3	Cross-pan to A5							0.3	0.6	A5
5.A5	A5	*0.06*	A3,A1,A4,A2	0.2	4.3	4.5	0.4	13.2	13.7	Amen St	Type MS2	0.50%	0.43	0.45	6.3	6.3	Type 16 C	9'	Sump	0.43	0.45	5.8	6.5		7.2	Channel
5.A6	A6	*0.25*	-	1.0		1.0	1.9		1.9	Amen St	Type MS2	0.50%	0.43	0.43	6.3	6.3	Type 16 C	3'	Sump	0.43	0.43	5.8	6.5			
5.B1	B1	*1.72*	-	2.6		2.6	7.6		7.6	Dewdrop	Type MS2	2.00%	0.43	0.43	12.7	12.7	Type 16 C	9'	On-Grade			2.4	5.3	0.2	2.3	B2
5.B2	B2	*1.73*	B1	2.8	0.2	3.0	8.2	2.3	10.5	Dewdrop	Type MS2	1.32%	0.43	0.43	10.3	10.3	Type 16 C	9'	Sump	0.43	0.55	5.8	6.5		4.0	B3
5.B3	B3	*0.14*	B2	0.6		0.6	1.1	4.0	5.1	Dewdrop	Type MS2	2.00%	0.43	0.43	12.7	12.7	Type 16 C	3'	Sump	0.43	0.55	2.3	5.1			
5.B4	B4	*2.99*		4.4		4.4	12.7		12.7	Dewdrop	Type VC2	2.00%	0.50	0.76	12.7	12.7	Type 16 C	9'	Sump	0.50	0.76	5.8	25.3			
5.B5	B5	*0.15*		0.6		0.6	1.2		1.2	Dewdrop	Type VC2	3.00%	0.50	0.76	14.6	14.6	Type 16 C	3'	Sump	0.33	0.33	1.8	1.8			
5.C1	C1	*1.08*	-	1.4		1.4	4.3		4.3	Amen St	Type MS2	1.26%	0.43	0.43	9.0	9.0	Street Flow to C3							1.4	4.3	C3
5.C3	C3	*1.24*	C1	2.3	1.4	3.8	6.0	4.3	10.3	Sweet Valley	Type MS2	4.00%	0.43	0.43	18.0	18.0	Type 16 C	9'	On-Grade			0.0	0.0	3.8	10.3	C4
5.C4	C4	*1.68*	-	2.4	3.8	6.2	7.2	10.3	17.5	Ralphie Ct	Type MS2	1.77%	0.43	0.43	11.7	11.7	Type 16 C	9'	Sump	0.43	0.45	5.8	6.5		11.0	E11
5.D1	D1	*1.76*		2.9		2.9	8.2		8.2	Cam Way	Type MS2	1.75%	0.43	0.43	11.9	11.9	Type 16 C	9'	On-Grade			2.7	5.7	0.2	2.5	D2
5.D2	D2	*1.67*	D1	2.8	0.2	3.0	7.9	2.5	10.4	Cam Way	Type MS2	1.00%	0.43	0.43	9.0	9.0	Type 16 C	9'	Sump	0.43	0.45	5.8	6.8		3.6	D3
5.D3	D3	*0.14*	D2	0.6		0.6	1.1	3.6	4.7	Cam Way	Type MS2	1.00%	0.43	0.45	9.0	9.0	Type 16 C	9'	Sump	0.43	0.45	5.8	6.8			
5.E1	E1	*1.17*		2.4		2.4	6.4		6.4	Kadi Park	Type MS2	3.65%	0.43	0.45	16.9	16.9	Type 16 C	9'	On-Grade			2.1	4.2	0.3	2.2	E2
5.E2	E2	*0.76*	E1	1.3	0.3	1.6	3.9	2.2	6.2	Kadi Park	Type MS2	1.00%	0.43	0.43	9.0	9.0	Type 16 C	9'	Sump	0.43	0.45	5.1	6.5			
5.E3	E3	*1.39*		2.1		2.1	6.3		6.3	Kadi Park	Type MS2	1.00%	0.43	0.43	9.0	9.0	Type 16 C	9'	Sump	0.43	0.45	5.1	6.5			
5.E4	E4	*1.06*		1.8		1.8	5.4		5.4	Sweet Valley	Type MS2	4.00%	0.43	0.43	18.0	18.0	Type 16 C	9'	On-Grade			0.0	0.0	1.6	3.7	E5
5.E5	E5	*1.00*	E4	1.7		1.7	5.0		5.0	Sweet Valley	Type MS2	5.12%	0.43	0.43	17.2	17.2	Street Flow to E6							1.7	5.0	E6
5.E6	E6	*0.20*	E5	0.7	1.7	2.4	1.5	5.0	6.5	Sweet Valley	Type MS2	2.12%	0.43	0.45	9.0	9.0	Type 16 C	9'	Sump	0.43	0.43	5.1	6.5			
5.E11	E11	*2.62*	-	3.2		3.2	9.6	11.0	20.6	Ralphie Ct	Type MS2	1.77%	0.43	0.45	11.9	13.4	Type 16 C	9'	On-Grade			5.8	6.5	0.0	14.1	E12
	E12		E11,C4		0.0	0.0		14.1	14.1	Sweet Valley	Type MS2	5.12%	0.43	0.43	17.2	17.2	Type 16 C	9'	On-Grade			0.3	8.5	0.0	5.6	E13
5.E13	E13	*1.35*	E12	1.6	0.0	1.6	4.6	5.6	10.2	Sweet Valley	Type MS2	2.12%	0.43	0.43	10.8	14.8	Type 16 C	9'	On-Grade			0.0	0.0	1.6	10.2	E14
5.E14	E14	*0.32*	E13	0.6	1.6	2.2	1.7	10.2	11.9	Sweet Valley	Type MS2	0.50%	0.43	0.43	8.2	8.2	Type 16 C	6'	Sump	0.43	0.43	5.1	5.8		6.1	Channel
5.F3	F3	*1.53*	-	2.3		2.3	7.0		7.0	Dryden St	Type MS2	5.69%	0.43	0.43	16.6	16.6	Type 16 C	9'	On-Grade			0.0	0.0	2.3	7.0	F4
5.F4	F4	*0.34*	F3,F2	0.8	2.3	3.1	2.0	7.0	9.0	Dryden St	Type MS2	1.00%	0.43	0.45	6.3	7.1	Type 16 C	3'	Sump	0.43	0.45	3.9	4.2		4.8	F7
5.F5	F5	*1.99*	-	3.0		3.0	8.9		8.9	Dryden St	Type MS2	3.69%	0.43	0.43	17.2	17.2	Type 16 C	9'	On-Grade			2.5	5.2	0.5	3.7	F6
5.F6	F6	*1.87*	F5	2.8	0.5	3.2	8.3	3.7	12.1	Dryden St	Type MS2	5.69%	0.43	0.43	16.3	16.3	Type 16 C	9'	On-Grade			5.8	6.3	0.0	5.8	F7
5.F7	F7	*0.15*	F6,F4	0.6	0.0	0.6	1.2	10.5	11.7	Sweet Valley	Type VC2	3.30%	0.50	0.76	17.8	58.3	Type 16 C	9'	Sump	0.50	0.76	8.7	25.8			
5.F8	F8	*0.15*	-	0.6		0.6	1.2		1.2	Sweet Valley	Type VC2	3.30%	0.50	0.76	17.8	58.3	Type 16 C	9'	Sump	0.50	0.76	8.7	25.8			
5.F11	F11	*0.31*	-	0.7		0.7	1.9		1.9	Sweet Valley	Type MS2	3.30%	0.43	0.43	15.5	15.5	Street Flow to F12							0.7	1.9	F12
5.F12	F12	*1.11*	F11	1.7	0.7	2.5	5.2	1.9	7.1	Dryden St	Type MS2	1.54%	0.43	0.43	12.7	12.7	Type 16 C	9'	Sump	0.43	0.58	5.8	7.2			
6.11	6.11	*0.22*		0.0			0.8		0.8	Overland Direct to Collector A																
6.12	6.12	*0.59*		0.1		0.1	2.3		2.3	Overland Direct to Collector A																
6.13	6.13	*0.59*		0.1		0.1	2.1		2.1	Overland Direct to Collector A																
6.14	6.14	*0.41*		0.4		0.4	1.8		1.8	Overland Direct to Collector A																
7.1	7.1	*0.62*		0.7		0.7	2.9		2.9	Overland Direct to Pond																
7.2	7.2	*4.80*		14.1		14.1	32.6		32.6	Overland Direct to Pond																
8.1	8.1	*4.82*		1.5			13.7		13.7	Overland to Swale																
8.2	8.2	*2.30*		2.1		2.1	9.8		9.8	Overland to Swale																
8.3	8.3	*1.08*		1.0		1.0	4.5		4.5	Overland to Swale																
8.4	8.4	*2.84*		1.7		1.7	10.4		10.4	Overland Direct to Channel B - Refer to SWMM for combined flows																

Shading Key

100-year design flow

Capacity > design flow

Ponding depth limited by local grading

On-Grade Inlet: Allowable depth N/A

Inlet length limited by curb, driveway or utility clearance constraints

Over-crown ponding to opposite side sump inlet in major storm

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	A1	A2 - Gutter	A3 - Gutter	A4 - Gutter	A5 - Sump	A6 - Sump
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade	In Sump	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination			Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.8	3.6	0.3	0.3	0.2	1.0
Major Q_{Known} (cfs)	5.3	10.9	0.6	0.6	0.4	1.9

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	4.3	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0	13.2	0.0

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

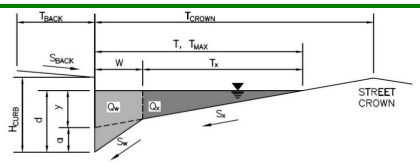
Minor Total Design Peak Flow, Q (cfs)	**1.8**	**3.6**	**0.3**	**0.3**	**4.5**	**1.0**
Major Total Design Peak Flow, Q (cfs)	**5.3**	**10.9**	**0.6**	**0.6**	**13.6**	**1.9**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	0.3			N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	1.2	3.9			N/A	N/A

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **A1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.021	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	8.4	8.4	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	5.0	5.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**14.4**	**14.4**	**cfs**
Flow Velocity within the Gutter Section	V =	6.9	6.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.1	3.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.4	7.4	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	7.4	7.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.7	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.9	12.9	cfs
Average Flow Velocity Within the Gutter Section	V =	6.7	6.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.9	2.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.9**	**12.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

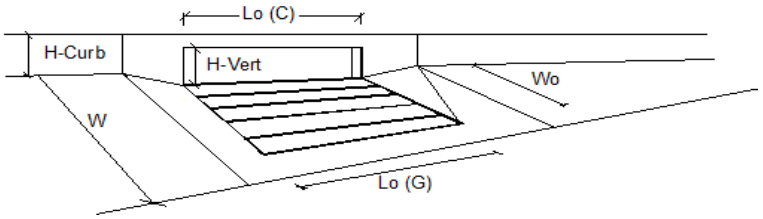
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.9**	**12.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.80 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.30 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



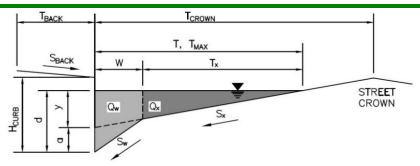
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	1.8	5.3	cfs
Water Spread Width	T =	6.3	10.8	ft
Water Depth at Flowline (outside of local depression)	d =	3.0	4.1	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 =	0.799	0.540	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.4	2.4	cfs
Discharge within the Gutter Section W	Q_w =	1.4	2.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.34	0.52	sq ft
Velocity within the Gutter Section W	V_W =	4.3	5.5	fps
Water Depth for Design Condition	d_{LOCAL} =	5.0	6.1	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.753	0.498	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	1.00	0.95	
Interception Rate of Side Flow	R_x =	0.69	0.62	
Interception Capacity	Q_i =	1.7	4.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.96	0.90	
Interception Rate of Side Flow	R_x =	0.50	0.43	
Actual Interception Capacity	**Q_a =**	**1.5**	**3.5**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.3**	**1.8**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.137	0.099	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.65	7.94	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.65	7.94	ft
Interception Capacity	Q_i =	0.3	0.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	2.65	7.94	ft
Actual Interception Capacity	**Q_a =**	**0.3**	**0.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**1.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.8**	**4.1**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**78**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **A2 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.013	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	6.0	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 ($T * S_x * 12$)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	6.6	6.6	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.9	3.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.3**	**11.3**	**cfs**
Flow Velocity within the Gutter Section	V =	5.4	5.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.4	2.4	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	18.7	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	16.7	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.318	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	5.8	10.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	5.8	10.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	3.7	4.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	2.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	10.1	17.5	cfs
Average Flow Velocity Within the Gutter Section	V =	5.3	5.9	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	2.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**10.1**	**17.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	6.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.65	inches

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**10.1**	**11.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.60 cfs on sheet 'Inlet Management'

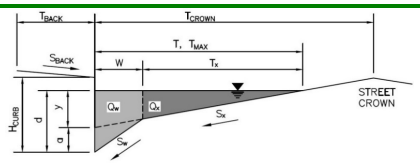
Major storm max. allowable capacity GOOD - greater than the design peak flow of 10.90 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **A3 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.030	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 ($T * S_x * 12$)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	10.2	10.2	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	6.0	6.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.2	1.2	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**17.4**	**17.4**	**cfs**
Flow Velocity within the Gutter Section	V =	8.3	8.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.7	3.7	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.0	9.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	9.0	9.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	5.7	5.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	15.5	15.5	cfs
Average Flow Velocity Within the Gutter Section	V =	8.1	8.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.5	3.5	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**15.5**	**15.5**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**15.5**	**15.5**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.30 cfs on sheet 'Inlet Management'

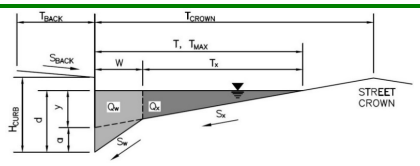
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.60 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **A4 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.9	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} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.005	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	4.2	4.2	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	2.5	2.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.4	0.4	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**7.0**	**7.0**	**cfs**
Flow Velocity within the Gutter Section	V =	3.4	3.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.5	1.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	3.7	3.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	3.7	3.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	2.3	2.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.3	0.3	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	6.3	6.3	cfs
Average Flow Velocity Within the Gutter Section	V =	3.3	3.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.4	1.4	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**6.3**	**6.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**6.3**	**6.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.30 cfs on sheet 'Inlet Management'

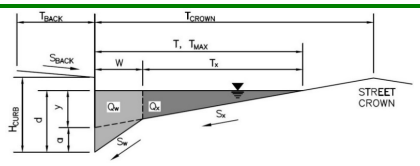
Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.60 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **A5 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

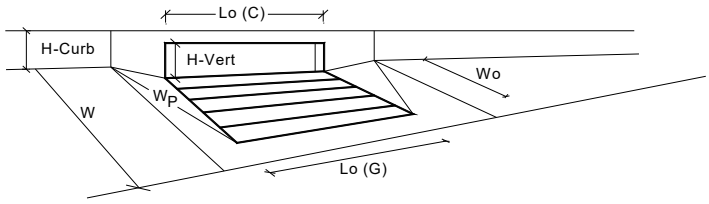
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



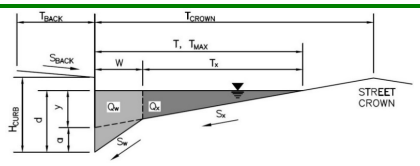
Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.4	cfs
Interception with Clogging	Q_{wa} =	3.5	3.8	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	16.0	cfs
Interception with Clogging	Q_{oa} =	11.1	11.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	8.4	cfs
Interception with Clogging	Q_{ma} =	5.6	5.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**3.8**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.6	cfs
Interception with Clogging	Q_{wa} =	3.0	3.4	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.4	cfs
Interception with Clogging	Q_{oa} =	15.3	15.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.6	cfs
Interception with Clogging	Q_{ma} =	5.8	6.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	16.2	**ft. >T-Crown**
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} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.5**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	4.5	13.6	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **A6 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

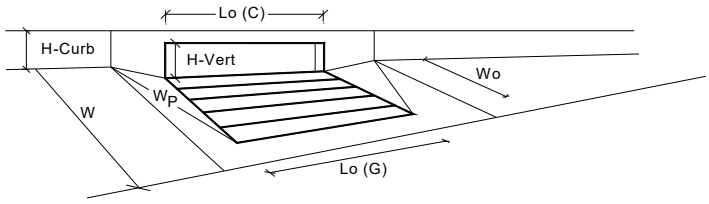
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.4	cfs
Interception with Clogging	Q_{wa} =	3.5	3.8	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	16.0	cfs
Interception with Clogging	Q_{oa} =	11.1	11.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	8.4	cfs
Interception with Clogging	Q_{ma} =	5.6	5.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**3.8**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.6	cfs
Interception with Clogging	Q_{wa} =	3.0	3.4	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.4	cfs
Interception with Clogging	Q_{oa} =	15.3	15.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.6	cfs
Interception with Clogging	Q_{ma} =	5.8	6.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	16.2	**ft. >T-Crown**
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} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.0	1.9	cfs

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	B1	B2 - Gutter	B2 - Sump	B3 - Sump	B4 - Gutter	B4 - Sump	B5 - Sump
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	In Sump	On Grade	In Sump	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.6	2.8	2.8	0.6	4.4	4.4	0.6
Major Q_{Known} (cfs)	7.6	8.1	8.1	1.1	12.7	12.7	1.2

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	B1	User-Defined	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	2.3	4.0	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)							
Percent Impervious							
NRCS Soil Type							

Watershed Profile

Overland Slope (ft/ft)							
Overland Length (ft)							
Channel Slope (ft/ft)							
Channel Length (ft)							

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)							
One-Hour Precipitation, P_1 (inches)							

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)							
One-Hour Precipitation, P_1 (inches)							

CALCULATED OUTPUT

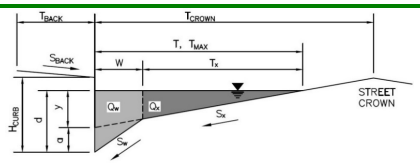
Minor Total Design Peak Flow, Q (cfs)	**2.6**	**2.8**	**3.0**	**0.6**	**4.4**	**4.4**	**0.6**
Major Total Design Peak Flow, Q (cfs)	**7.6**	**8.1**	**10.4**	**5.1**	**12.7**	**12.7**	**1.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.2	0.1	N/A	N/A	0.8	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	2.3	2.2	N/A	N/A	5.0	N/A	N/A

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.020	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	8.3	8.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	4.9	4.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**14.2**	**14.2**	**cfs**
Flow Velocity within the Gutter Section	V =	6.8	6.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.0	3.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.3	7.3	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	4.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	12.7	12.7	cfs
Average Flow Velocity Within the Gutter Section	V =	6.6	6.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.9	2.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.7**	**12.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

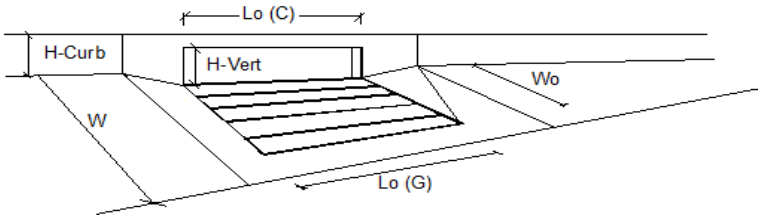
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**12.7**	**12.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.56 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.60 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



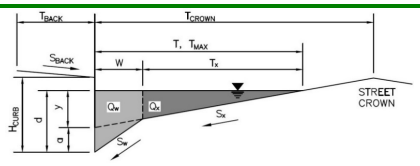
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	2.6	7.6	cfs
Water Spread Width	T =	7.7	12.6	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.707	0.467	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.7	4.0	cfs
Discharge within the Gutter Section W	Q_w =	1.8	3.5	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W	A_W =	0.39	0.59	sq ft
Velocity within the Gutter Section W	V_W =	4.6	5.9	fps
Water Depth for Design Condition	d_{LOCAL} =	5.4	6.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.661	0.428	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	1.00	0.92	
Interception Rate of Side Flow	R_x =	0.68	0.59	
Interception Capacity	Q_i =	2.3	5.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.94	0.87	
Interception Rate of Side Flow	R_x =	0.49	0.40	
Actual Interception Capacity	**Q_a =**	**2.0**	**4.5**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.5**	**3.0**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.124	0.088	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.87	10.88	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.87	9.00	ft
Interception Capacity	Q_i =	0.4	1.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	3.87	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.4**	**0.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**2.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**5.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**2.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**93**	**70**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B2 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.013	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	6.7	6.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	4.0	4.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**11.5**	**11.5**	**cfs**
Flow Velocity within the Gutter Section	V =	5.5	5.5	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.5	2.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.0	6.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	6.0	6.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	3.8	3.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	0.6	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	10.3	10.3	cfs
Average Flow Velocity Within the Gutter Section	V =	5.4	5.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.3	2.3	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**10.3**	**10.3**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**10.3**	**10.3**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.80 cfs on sheet 'Inlet Management'

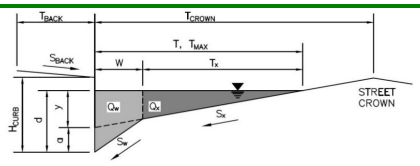
Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.10 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B2 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

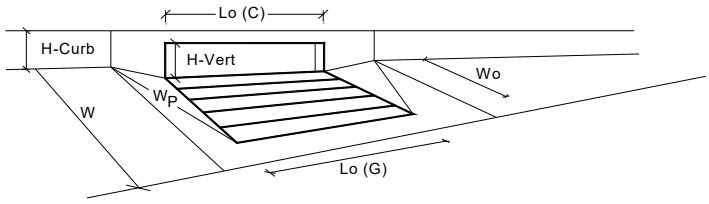
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	

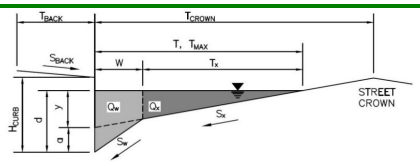
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.5**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	3.0	10.4	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B3 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.4	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

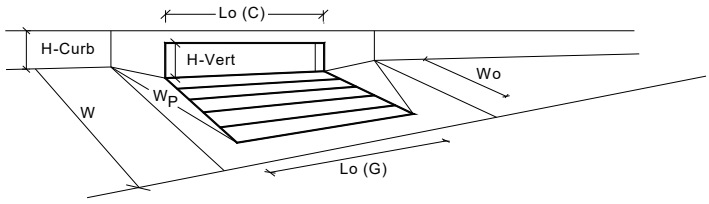
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	6.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.52	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.81	0.94	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.81	0.94	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.9**	**5.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	5.1	cfs

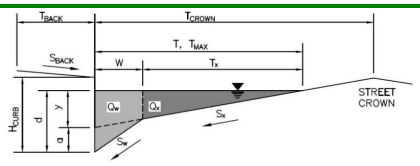
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B4 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.5	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 =	0.020	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} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	8.3	8.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	4.9	4.9	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 =**	**13.2**	**13.2**	**cfs**
Flow Velocity within the Gutter Section	V =	6.8	6.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.0	3.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	7.3	7.3	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	7.3	7.3	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.6	4.6	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 =	12.0	12.0	cfs
Average Flow Velocity Within the Gutter Section	V =	6.6	6.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.9	2.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**12.0**	**12.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**12.0**	**12.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 4.40 cfs on sheet 'Inlet Management'

WARNING: MAJOR STORM max. allowable capacity is less than the design peak flow of 12.70 cfs on sheet 'Inlet Management'

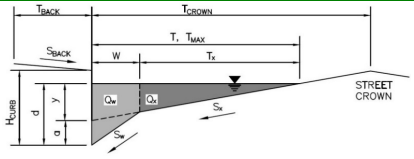
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B4 - Sump**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.5	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} =	25.5	25.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

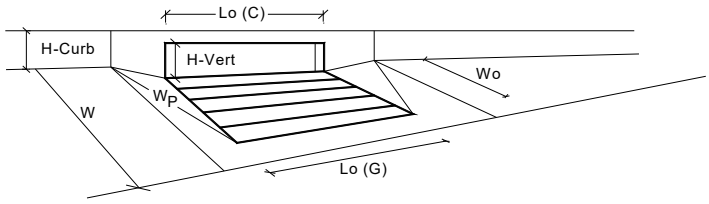
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	6.12	6.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	7.63	7.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	23.5	23.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.230	0.230	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	25.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	23.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.231	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	9.1	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.0	19.4	cfs
Interception with Clogging	Q_{wa} =	5.0	13.7	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.8	20.5	cfs
Interception with Clogging	Q_{oa} =	11.9	14.5	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.8	18.0	cfs
Interception with Clogging	Q_{ma} =	6.9	12.7	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**5.0**	**12.7**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.1	18.2	cfs
Interception with Clogging	Q_{wa} =	4.8	17.2	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	17.0	20.1	cfs
Interception with Clogging	Q_{oa} =	16.1	18.9	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	8.0	16.5	cfs
Interception with Clogging	Q_{ma} =	7.6	15.5	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**4.8**	**15.5**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	18.7	31.6	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	1.5	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.52	0.78	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.59	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.57	0.86	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.86	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.7**	**25.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.4	12.7	cfs

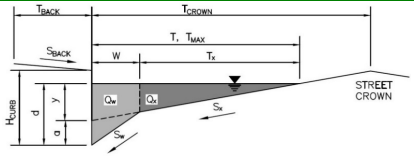
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **B5 - Sump**



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	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} =	25.5	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} =	25.5	25.5	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	7.6	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

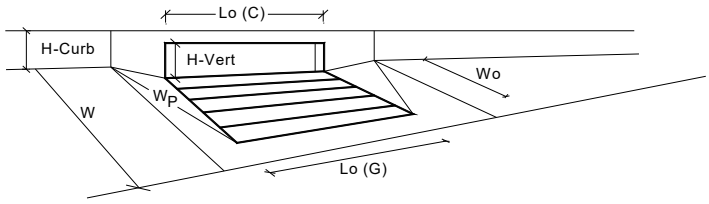
Maximum Capacity for 1/2 Street based On Allowable Spread		Minor Storm	Major Storm	
Water Depth without Gutter Depression (T * S_x * 12)	y =	6.12	6.12	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	d_C =	2.0	2.0	inches
Gutter Depression (d_C - (W * S_x * 12))	a =	1.51	1.51	inches
Water Depth at Gutter Flowline (y + a)	d =	7.63	7.63	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	23.5	23.5	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.230	0.230	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	25.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	23.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.231	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.0	4.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.50	0.50	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	2.3	2.3	cfs
Interception with Clogging	Q_{wa} =	1.1	1.1	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	4.6	4.6	cfs
Interception with Clogging	Q_{oa} =	2.3	2.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	2.9	2.9	cfs
Interception with Clogging	Q_{ma} =	1.5	1.5	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**1.1**	**1.1**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.17	0.17	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	1.0	1.0	cfs
Interception with Clogging	Q_{wa} =	0.9	0.9	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	4.9	4.9	cfs
Interception with Clogging	Q_{oa} =	4.1	4.1	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	1.9	1.9	cfs
Interception with Clogging	Q_{ma} =	1.6	1.6	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**0.9**	**0.9**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	3.00	3.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	10.4	10.4	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} =	0.36	0.36	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.17	0.17	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.63	0.63	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.63	0.63	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.8**	**1.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.2	cfs

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	C1 - Gutter	C3	C4 - Gutter	C4 - Sump
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	In Sump
Inlet Type		Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.4	2.3	2.4	2.4
Major Q_{Known} (cfs)	4.3	6.0	7.2	7.2

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined	No Bypass Flow Received	C3
Minor Bypass Flow Received, Q_b (cfs)	0.0	1.4	0.0	0.9
Major Bypass Flow Received, Q_b (cfs)	0.0	4.3	0.0	4.8

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.4**	**3.7**	**2.4**	**3.3**
Major Total Design Peak Flow, Q (cfs)	**4.3**	**10.3**	**7.2**	**12.0**
Minor Flow Bypassed Downstream, Q_b (cfs)		0.9	0.5	N/A
Major Flow Bypassed Downstream, Q_b (cfs)		4.8	3.4	N/A

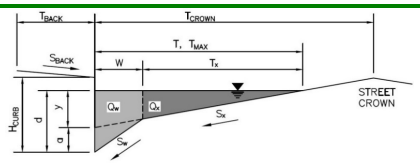
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **C1 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.010	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	5.9	5.9	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.5	3.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.1**	**10.1**	**cfs**
Flow Velocity within the Gutter Section	V =	4.8	4.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	5.2	5.2	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	5.2	5.2	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	3.3	3.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.5	0.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.0	9.0	cfs
Average Flow Velocity Within the Gutter Section	V =	4.7	4.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.0	2.0	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.0**	**9.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**9.0**	**9.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.40 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 4.30 cfs on sheet 'Inlet Management'

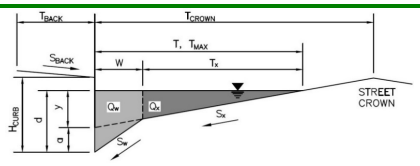
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **C3**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.040	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	11.7	11.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	7.0	7.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.4	1.4	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**20.1**	**20.1**	**cfs**
Flow Velocity within the Gutter Section	V =	9.6	9.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.3	4.3	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.4	10.4	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	10.4	10.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	6.6	6.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	18.0	18.0	cfs
Average Flow Velocity Within the Gutter Section	V =	9.4	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.1	4.1	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**18.0**	**18.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

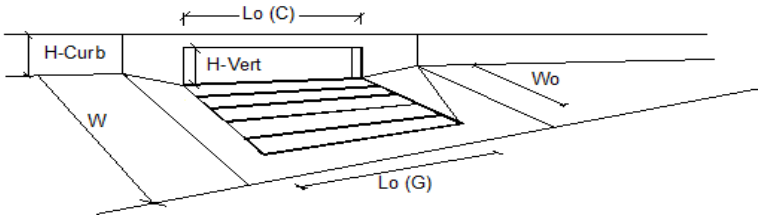
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.0**	**18.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.70 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 10.30 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



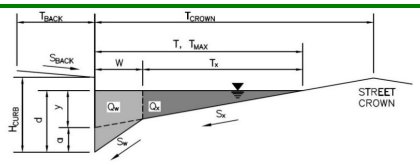
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	10.3	cfs
Water Spread Width	T =	7.8	12.4	ft
Water Depth at Flowline (outside of local depression)	d =	3.4	4.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.701	0.475	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.1	5.4	cfs
Discharge within the Gutter Section W	Q_w =	2.6	4.8	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W	A_W =	0.40	0.58	sq ft
Velocity within the Gutter Section W	V_W =	6.5	8.3	fps
Water Depth for Design Condition	d_{LOCAL} =	5.4	6.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.655	0.436	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.86	0.76	
Interception Rate of Side Flow	R_x =	0.53	0.44	
Interception Capacity	Q_i =	2.8	5.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.81	0.71	
Interception Rate of Side Flow	R_x =	0.34	0.26	
Actual Interception Capacity	**Q_a =**	**2.4**	**4.7**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**1.3**	**5.5**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.123	0.090	ft/ft
Required Length L_T to Have 100% Interception	L_T =	6.36	15.33	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	6.36	9.00	ft
Interception Capacity	Q_i =	0.5	1.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	6.36	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.4**	**0.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.9**	**4.7**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.8**	**5.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.9**	**4.8**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**76**	**54**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **C4 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.017	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	7.7	7.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	4.5	4.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.1**	**13.1**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	6.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.8	2.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.8	6.8	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	6.8	6.8	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.3	4.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.7	11.7	cfs
Average Flow Velocity Within the Gutter Section	V =	6.1	6.1	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.6	2.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.7**	**11.7**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**11.7**	**11.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.40 cfs on sheet 'Inlet Management'

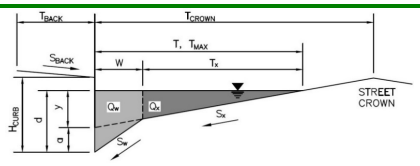
Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.20 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **C4 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

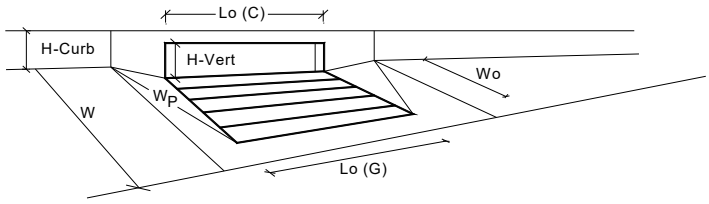
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.4	cfs
Interception with Clogging	Q_{wa} =	3.5	3.8	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	16.0	cfs
Interception with Clogging	Q_{oa} =	11.1	11.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	8.4	cfs
Interception with Clogging	Q_{ma} =	5.6	5.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**3.8**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.6	cfs
Interception with Clogging	Q_{wa} =	3.0	3.4	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.4	cfs
Interception with Clogging	Q_{oa} =	15.3	15.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.6	cfs
Interception with Clogging	Q_{ma} =	5.8	6.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	16.2	**ft. >T-Crown**
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} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.5**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	3.3	12.0	cfs

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	D1	D2 - Gutter	D2 - Sump	D3 - Sump
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.5	2.4	2.4	0.6
Major Q_{Known} (cfs)	7.4	7.1	7.1	1.1

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	D1	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.1	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	2.1	0.0

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				

CALCULATED OUTPUT

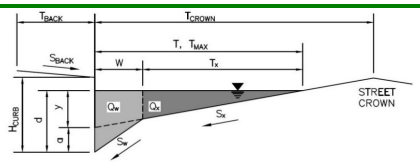
Minor Total Design Peak Flow, Q (cfs)	**2.5**	**2.4**	**2.5**	**0.6**
Major Total Design Peak Flow, Q (cfs)	**7.4**	**7.1**	**9.2**	**1.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.1	0.0	N/A	
Major Flow Bypassed Downstream, Q_b (cfs)	2.1	1.5	N/A	

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **D1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.018	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	7.8	7.8	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	4.6	4.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.3**	**13.3**	**cfs**
Flow Velocity within the Gutter Section	V =	6.3	6.3	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.8	2.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.9	6.9	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	6.9	6.9	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.3	4.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.9	11.9	cfs
Average Flow Velocity Within the Gutter Section	V =	6.2	6.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.7	2.7	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.9**	**11.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

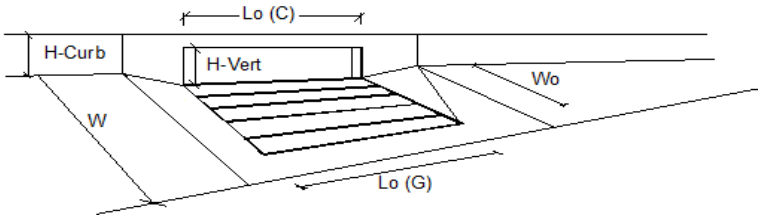
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.9**	**11.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.90 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.20 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



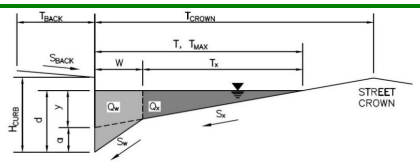
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	2.9	8.2	cfs
Water Spread Width	T =	8.5	13.4	ft
Water Depth at Flowline (outside of local depression)	d =	3.5	4.7	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.659	0.443	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.0	4.5	cfs
Discharge within the Gutter Section W	Q_w =	1.9	3.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.2	cfs
Flow Area within the Gutter Section W	A_W =	0.42	0.62	sq ft
Velocity within the Gutter Section W	V_W =	4.5	5.7	fps
Water Depth for Design Condition	d_{LOCAL} =	5.5	6.7	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.614	0.405	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	1.00	0.93	
Interception Rate of Side Flow	R_x =	0.69	0.60	
Interception Capacity	Q_i =	2.6	5.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.96	0.88	
Interception Rate of Side Flow	R_x =	0.50	0.41	
Actual Interception Capacity	**Q_a =**	**2.3**	**4.8**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.6**	**3.2**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.116	0.085	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.29	11.36	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.29	9.00	ft
Interception Capacity	Q_i =	0.5	1.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	4.29	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.4**	**0.9**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**2.3**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.7**	**5.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**2.5**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**92**	**69**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **D2 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.010	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	5.9	5.9	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.5	3.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.0**	**10.0**	**cfs**
Flow Velocity within the Gutter Section	V =	4.8	4.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	5.2	5.2	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	5.2	5.2	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	3.3	3.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.5	0.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.0	9.0	cfs
Average Flow Velocity Within the Gutter Section	V =	4.7	4.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.0	2.0	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.0**	**9.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**9.0**	**9.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.80 cfs on sheet 'Inlet Management'

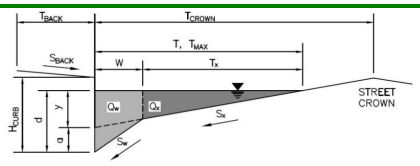
Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.90 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **D2 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.9	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

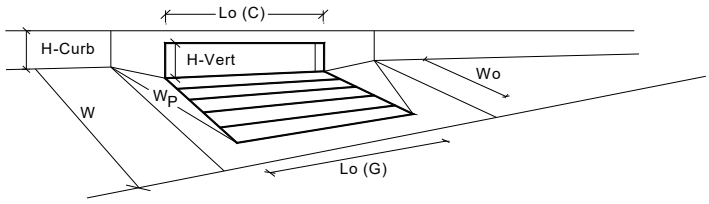
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.5	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.48	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.29	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.52	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.52	

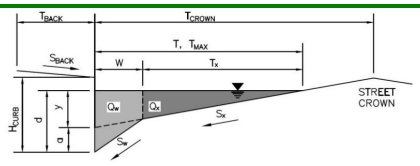
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.8**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	3.0	10.4	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **D3 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

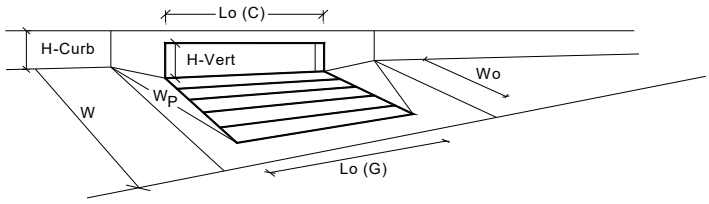
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition			
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.5	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.7	cfs
Interception with Clogging	Q_{wa} =	3.5	4.0	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	16.1	cfs
Interception with Clogging	Q_{oa} =	11.1	11.4	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	8.6	cfs
Interception with Clogging	Q_{ma} =	5.6	6.1	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**4.0**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.8	cfs
Interception with Clogging	Q_{wa} =	3.0	3.6	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.5	cfs
Interception with Clogging	Q_{oa} =	15.3	15.6	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.8	cfs
Interception with Clogging	Q_{ma} =	5.8	6.4	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.6**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	16.6	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	0.1	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.48	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.29	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.52	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.52	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.1	cfs

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	E4	E5	E6 - Sump	E11	E12	E13
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	In Sump	On Grade	On Grade	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.8	1.7	0.7	3.2	0.0	1.6
Major Q_{Known} (cfs)	5.4	5.0	1.5	9.6	0.0	4.6

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	E4	User-Defined	No Bypass Flow Received	User-Defined	E12
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.2	1.7	0.0	0.3	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	1.7	5.0	0.0	8.9	4.1

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.8**	**1.9**	**2.4**	**3.2**	**0.3**	**1.6**
Major Total Design Peak Flow, Q (cfs)	**5.4**	**6.7**	**6.5**	**9.6**	**8.9**	**8.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.2	0.3	N/A	0.3	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	1.7	2.7	N/A	3.4	4.1	3.3

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	E14 - Gutter	E14 - Sump
Site Type (Urban or Rural)	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET
Hydraulic Condition	On Grade	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6	0.6
Major Q_{Known} (cfs)	1.7	1.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	E13
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	3.3

Watershed Characteristics

Subcatchment Area (acres)		
Percent Impervious		
NRCS Soil Type		

Watershed Profile

Overland Slope (ft/ft)		
Overland Length (ft)		
Channel Slope (ft/ft)		
Channel Length (ft)		

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)		
One-Hour Precipitation, P_1 (inches)		

CALCULATED OUTPUT

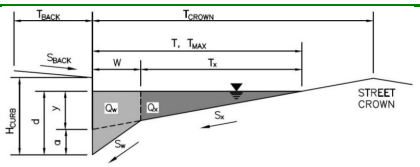
Minor Total Design Peak Flow, Q (cfs)	**0.6**	**0.6**
Major Total Design Peak Flow, Q (cfs)	**1.7**	**5.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	-0.1	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	-0.1	N/A

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.036	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 ($T * S_x * 12$)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	11.1	11.1	cfs
Discharge within the Gutter Section ($Q_T - Q_X - Q_{BACK}$)	Q_W =	6.6	6.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.3	1.3	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**19.0**	**19.0**	**cfs**
Flow Velocity within the Gutter Section	V =	9.0	9.0	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.0	4.0	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.8	9.8	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	9.8	9.8	cfs
Discharge within the Gutter Section ($Q_d - Q_X$)	Q_W =	6.2	6.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	16.9	16.9	cfs
Average Flow Velocity Within the Gutter Section	V =	8.8	8.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.8	3.8	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**16.9**	**16.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

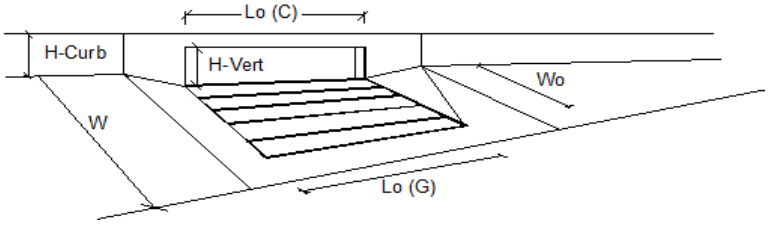
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.9**	**16.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.40 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 6.40 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



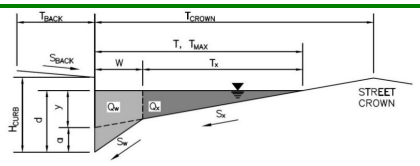
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	2.4	6.4	cfs
Water Spread Width	T =	6.3	10.4	ft
Water Depth at Flowline (outside of local depression)	d =	3.0	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 =	0.797	0.558	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.5	2.8	cfs
Discharge within the Gutter Section W	Q_w =	1.9	3.6	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.34	0.50	sq ft
Velocity within the Gutter Section W	V_W =	5.6	7.1	fps
Water Depth for Design Condition	d_{LOCAL} =	5.0	6.0	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.750	0.515	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.91	0.84	
Interception Rate of Side Flow	R_x =	0.58	0.51	
Interception Capacity	Q_i =	2.0	4.3	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.86	0.79	
Interception Rate of Side Flow	R_x =	0.38	0.32	
Actual Interception Capacity	**Q_a =**	**1.8**	**3.6**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.6**	**2.8**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.137	0.102	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.13	10.18	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.13	9.00	ft
Interception Capacity	Q_i =	0.4	0.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	4.13	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.3**	**0.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.3**	**2.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.1**	**4.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**87**	**66**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

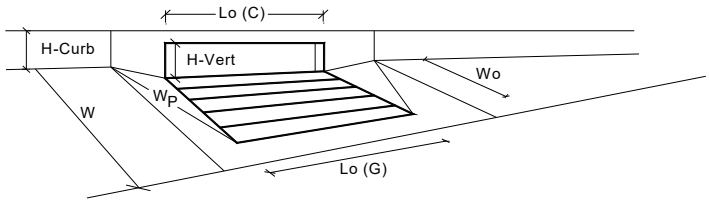
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition			
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



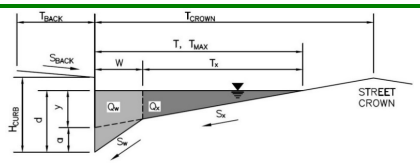
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.4	cfs
Interception with Clogging	Q_{wa} =	3.5	3.8	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	16.0	cfs
Interception with Clogging	Q_{oa} =	11.1	11.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	8.4	cfs
Interception with Clogging	Q_{ma} =	5.6	5.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**3.8**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.6	cfs
Interception with Clogging	Q_{wa} =	3.0	3.4	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.4	cfs
Interception with Clogging	Q_{oa} =	15.3	15.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.6	cfs
Interception with Clogging	Q_{ma} =	5.8	6.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	16.2	**ft. >T-Crown**
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} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.6	6.1	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E3**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

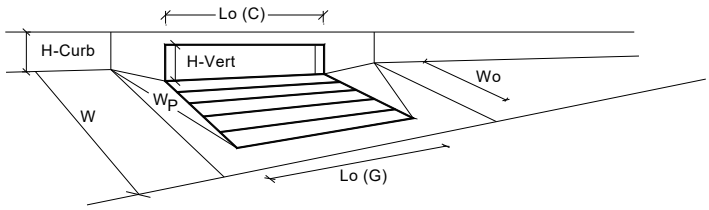
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.4	cfs
Interception with Clogging	Q_{wa} =	3.5	3.8	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	16.0	cfs
Interception with Clogging	Q_{oa} =	11.1	11.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	8.4	cfs
Interception with Clogging	Q_{ma} =	5.6	5.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**3.8**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.6	cfs
Interception with Clogging	Q_{wa} =	3.0	3.4	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.4	cfs
Interception with Clogging	Q_{oa} =	15.3	15.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.6	cfs
Interception with Clogging	Q_{ma} =	5.8	6.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	16.2	**ft. >T-Crown**
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} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.1	6.3	cfs

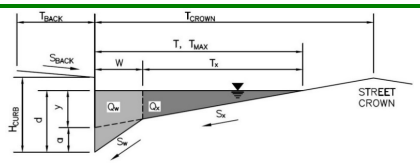
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E4**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.040	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	11.7	11.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	7.0	7.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.4	1.4	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**20.1**	**20.1**	**cfs**
Flow Velocity within the Gutter Section	V =	9.6	9.6	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.3	4.3	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	10.4	10.4	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	10.4	10.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	6.6	6.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	18.0	18.0	cfs
Average Flow Velocity Within the Gutter Section	V =	9.4	9.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.1	4.1	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**18.0**	**18.0**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

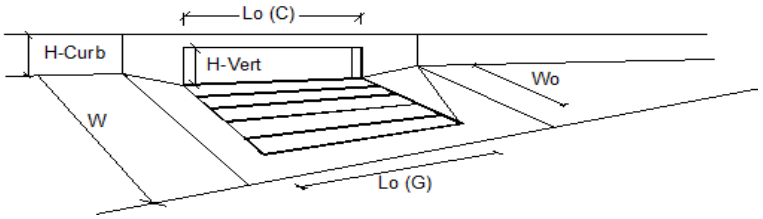
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.0**	**18.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.80 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.40 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	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 =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	1.8	5.4	cfs
Water Spread Width	T =	5.1	9.3	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.8	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 =	0.882	0.610	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.2	2.1	cfs
Discharge within the Gutter Section W	Q_w =	1.6	3.3	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.29	0.46	sq ft
Velocity within the Gutter Section W	V_W =	5.5	7.2	fps
Water Depth for Design Condition	d_{LOCAL} =	4.7	5.8	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.838	0.565	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.90	0.83	
Interception Rate of Side Flow	R_x =	0.57	0.50	
Interception Capacity	Q_i =	1.5	3.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.85	0.78	
Interception Rate of Side Flow	R_x =	0.37	0.31	
Actual Interception Capacity	**Q_a =**	**1.4**	**3.1**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.4**	**2.3**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.149	0.109	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.23	8.92	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.23	8.92	ft
Interception Capacity	Q_i =	0.3	0.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	3.23	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.2**	**0.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.2**	**1.7**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.6**	**3.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.2**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**91**	**68**	**%**

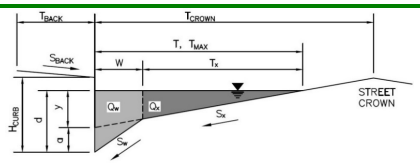
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.051	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	13.3	13.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	7.9	7.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.6	1.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**22.7**	**22.7**	**cfs**
Flow Velocity within the Gutter Section	V =	10.9	10.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.8	4.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	11.7	11.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	11.7	11.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	7.4	7.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	20.3	20.3	cfs
Average Flow Velocity Within the Gutter Section	V =	10.6	10.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.6	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.84	0.84	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**17.2**	**17.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.98	4.98	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

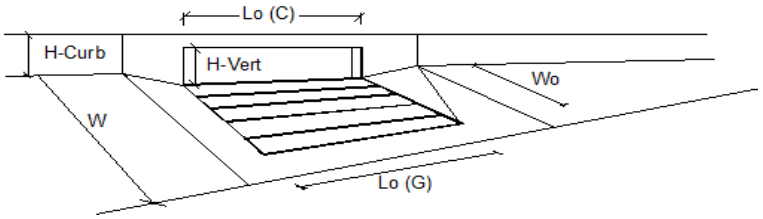
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.2**	**17.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.86 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 6.73 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



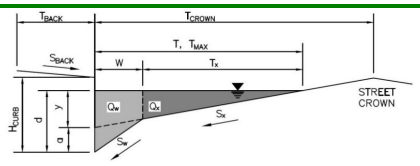
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	1.9	6.7	cfs
Water Spread Width	T =	4.8	9.8	ft
Water Depth at Flowline (outside of local depression)	d =	2.7	3.9	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 =	0.901	0.588	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.2	2.8	cfs
Discharge within the Gutter Section W	Q_w =	1.7	4.0	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.28	0.48	sq ft
Velocity within the Gutter Section W	V_W =	6.0	8.3	fps
Water Depth for Design Condition	d_{LOCAL} =	4.7	5.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.858	0.544	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.85	0.76	
Interception Rate of Side Flow	R_x =	0.52	0.44	
Interception Capacity	Q_i =	1.5	4.1	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.80	0.71	
Interception Rate of Side Flow	R_x =	0.32	0.26	
Actual Interception Capacity	**Q_a =**	**1.4**	**3.4**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.5**	**3.3**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.152	0.106	ft/ft
Required Length L_T to Have 100% Interception	L_T =	3.59	11.14	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	3.59	9.00	ft
Interception Capacity	Q_i =	0.3	0.7	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	3.59	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.2**	**0.6**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.3**	**2.7**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.6**	**4.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**86**	**59**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E6 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.9	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

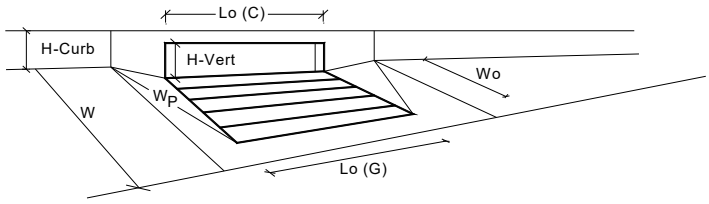
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.2	15.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.2	13.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.392	0.392	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition			
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



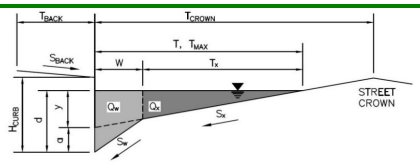
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	5.4	cfs
Interception with Clogging	Q_{wa} =	3.4	3.8	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.6	16.0	cfs
Interception with Clogging	Q_{oa} =	11.1	11.3	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.8	8.4	cfs
Interception with Clogging	Q_{ma} =	5.6	5.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.4**	**3.8**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.1	3.6	cfs
Interception with Clogging	Q_{wa} =	2.9	3.4	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.1	16.4	cfs
Interception with Clogging	Q_{oa} =	15.2	15.5	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.6	cfs
Interception with Clogging	Q_{ma} =	5.7	6.2	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**2.9**	**3.4**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.2	16.2	**ft. >T-Crown**
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} =	0.45	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.26	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.51	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.51	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.7**	**6.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.4	6.5	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E11**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.018	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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 ($T * S_x * 12$)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	7.8	7.8	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	4.6	4.6	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.9	0.9	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**13.4**	**13.4**	**cfs**
Flow Velocity within the Gutter Section	V =	6.4	6.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.8	2.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	6.9	8.1	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	6.9	8.1	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	4.4	4.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	11.9	13.8	cfs
Average Flow Velocity Within the Gutter Section	V =	6.2	6.4	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.7	2.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**11.9**	**13.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.40	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.05	inches

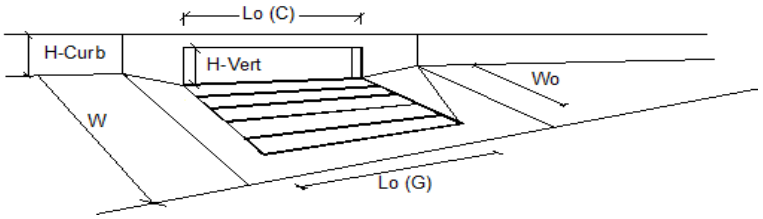
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**11.9**	**13.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.20 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 9.60 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



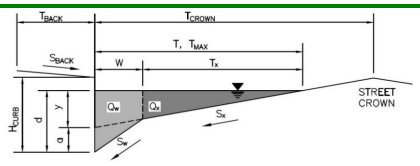
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	3.2	9.6	cfs
Water Spread Width	T =	8.8	14.2	ft
Water Depth at Flowline (outside of local depression)	d =	3.6	4.9	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 =	0.637	0.419	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	1.2	5.4	cfs
Discharge within the Gutter Section W	Q_w =	2.0	3.9	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.3	cfs
Flow Area within the Gutter Section W	A_W =	0.44	0.65	sq ft
Velocity within the Gutter Section W	V_W =	4.6	5.9	fps
Water Depth for Design Condition	d_{LOCAL} =	5.6	6.9	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.592	0.382	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	1.00	0.91	
Interception Rate of Side Flow	R_x =	0.68	0.58	
Interception Capacity	Q_i =	2.8	6.6	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.95	0.86	
Interception Rate of Side Flow	R_x =	0.49	0.39	
Actual Interception Capacity	**Q_a =**	**2.4**	**5.3**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.8**	**4.0**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.113	0.081	ft/ft
Required Length L_T to Have 100% Interception	L_T =	4.76	12.96	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	4.76	9.00	ft
Interception Capacity	Q_i =	0.5	1.2	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	4.76	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.4**	**0.9**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.3**	**3.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.9**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**3.4**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**90**	**65**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E12**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.9	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.051	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	13.3	13.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	7.9	7.9	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.6	1.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**22.7**	**22.7**	**cfs**
Flow Velocity within the Gutter Section	V =	10.9	10.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.8	4.8	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	11.7	11.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	11.7	11.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	7.4	7.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	20.3	20.3	cfs
Average Flow Velocity Within the Gutter Section	V =	10.6	10.6	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.6	4.6	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.84	0.84	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**17.1**	**17.1**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.98	4.98	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

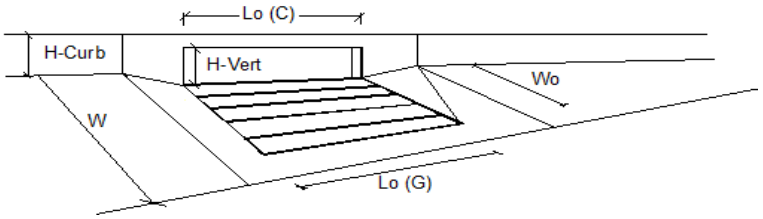
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.1**	**17.1**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.30 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.90 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	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 =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	0.3	8.9	cfs
Water Spread Width	T =	1.4	11.1	ft
Water Depth at Flowline (outside of local depression)	d =	1.8	4.2	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	1.000	0.528	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.0	4.2	cfs
Discharge within the Gutter Section W	Q_w =	0.3	4.7	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.00	0.53	sq ft
Velocity within the Gutter Section W	V_W =	0.0	8.9	fps
Water Depth for Design Condition	d_{LOCAL} =	3.8	6.2	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.991	0.486	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.98	0.73	
Interception Rate of Side Flow	R_x =	0.66	0.41	
Interception Capacity	Q_i =	0.3	5.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.93	0.68	
Interception Rate of Side Flow	R_x =	0.47	0.24	
Actual Interception Capacity	**Q_a =**	**0.3**	**4.0**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.0**	**4.9**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.166	0.097	ft/ft
Required Length L_T to Have 100% Interception	L_T =	0.71	14.03	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	0.71	9.00	ft
Interception Capacity	Q_i =	0.1	0.9	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	0.71	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.0**	**0.7**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**4.1**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**4.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**4.1**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**109**	**53**	**%**

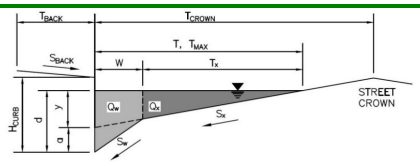
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E13**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.027	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	9.6	9.6	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	5.7	5.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.1	1.1	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**16.5**	**16.5**	**cfs**
Flow Velocity within the Gutter Section	V =	7.9	7.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.5	3.5	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	8.5	8.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	8.5	8.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	5.4	5.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	14.8	14.8	cfs
Average Flow Velocity Within the Gutter Section	V =	7.7	7.7	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.3	3.3	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**14.8**	**14.8**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

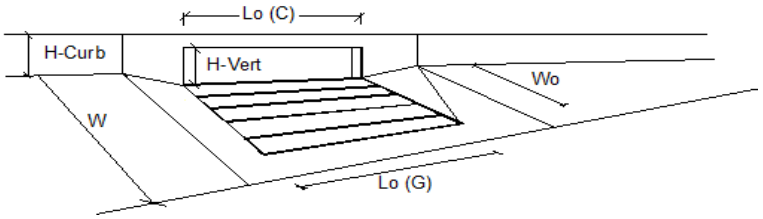
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.8**	**14.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.55 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.77 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



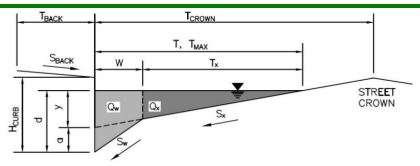
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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	8.8	cfs
Water Spread Width	T =	5.3	12.6	ft
Water Depth at Flowline (outside of local depression)	d =	2.8	4.5	inches
Water Depth at Street Crown (or at T_{MAX})	d_{CROWN} =	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E_o =	0.870	0.469	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.2	4.6	cfs
Discharge within the Gutter Section W	Q_w =	1.4	4.1	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.1	cfs
Flow Area within the Gutter Section W	A_W =	0.30	0.59	sq ft
Velocity within the Gutter Section W	V_W =	4.5	6.9	fps
Water Depth for Design Condition	d_{LOCAL} =	4.8	6.5	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.826	0.429	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.97	0.86	
Interception Rate of Side Flow	R_x =	0.65	0.53	
Interception Capacity	Q_i =	1.4	5.8	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.92	0.81	
Interception Rate of Side Flow	R_x =	0.46	0.33	
Actual Interception Capacity	**Q_a =**	**1.3**	**4.7**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.2**	**4.0**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.147	0.089	ft/ft
Required Length L_T to Have 100% Interception	L_T =	2.45	12.80	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	2.45	9.00	ft
Interception Capacity	Q_i =	0.3	1.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	2.45	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.2**	**0.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.0**	**3.2**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.5**	**5.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**3.3**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**99**	**63**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E14 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.9	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.008	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	5.3	5.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.2	3.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.6	0.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**9.2**	**9.2**	**cfs**
Flow Velocity within the Gutter Section	V =	4.4	4.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	1.9	1.9	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	4.7	4.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	4.7	4.7	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	3.0	3.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.5	0.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	8.2	8.2	cfs
Average Flow Velocity Within the Gutter Section	V =	4.3	4.3	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	1.9	1.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**8.2**	**8.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**8.2**	**8.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.58 cfs on sheet 'Inlet Management'

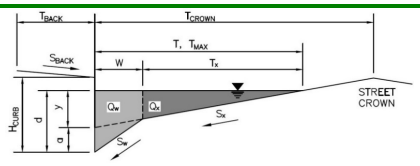
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.72 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **E14 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.9	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

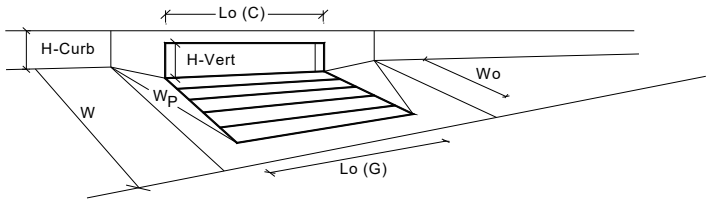
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (Denver No. 16 Combination)	Type =	Denver No. 16 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.2	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	4.9	cfs
Interception with Clogging	Q_{wa} =	3.5	3.5	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	15.7	cfs
Interception with Clogging	Q_{oa} =	11.1	11.1	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	7.9	cfs
Interception with Clogging	Q_{ma} =	5.6	5.6	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**3.5**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	3.2	3.2	cfs
Interception with Clogging	Q_{wa} =	3.0	3.0	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.2	16.2	cfs
Interception with Clogging	Q_{oa} =	15.3	15.3	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	6.1	6.1	cfs
Interception with Clogging	Q_{ma} =	5.8	5.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**3.0**	**3.0**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	15.4	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} =	0.46	0.46	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.27	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.49	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.49	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**5.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	5.0	cfs

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	F3 - Gutter	F4 - Sump	F5	F6 - Gutter	F6 - Sump	F7-F8 - Gutter
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	On Grade	On Grade	In Sump	On Grade
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination		Denver No. 16 Combination	

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.3	0.8	3.0	2.8	2.8	0.6
Major Q_{Known} (cfs)	7.0	2.0	8.9	8.3	8.3	1.2

Bypass (Carry-Over) Flow from Upstream Inlets must be organized from upstream (left) to downstream (right) in order for bypass flows to be linked.

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	2.3	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	7.0	0.0	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)						
Percent Impervious						
NRCS Soil Type						

Watershed Profile

Overland Slope (ft/ft)						
Overland Length (ft)						
Channel Slope (ft/ft)						
Channel Length (ft)						

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)						
One-Hour Precipitation, P_1 (inches)						

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.3**	**3.1**	**3.0**	**2.8**	**2.8**	**0.6**
Major Total Design Peak Flow, Q (cfs)	**7.0**	**9.0**	**8.9**	**8.3**	**8.3**	**1.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.5	N/A	0.5		N/A	
Major Flow Bypassed Downstream, Q_b (cfs)	3.0	N/A	3.7		N/A	

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	F7 - Sump	F8 - Sump	F11 - Gutter	F12 - Gutter	F12 - Sump
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	On Grade	On Grade	In Sump
Inlet Type	Denver No. 16 Combination	Denver No. 16 Combination	Denver No. 16 Combination		Denver No. 16 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6	0.6	0.7	1.2	1.7
Major Q_{Known} (cfs)	1.2	1.2	1.9	5.2	5.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.7	0.7
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	1.9	1.9

Watershed Characteristics

Subcatchment Area (acres)					
Percent Impervious					
NRCS Soil Type					

Watershed Profile

Overland Slope (ft/ft)					
Overland Length (ft)					
Channel Slope (ft/ft)					
Channel Length (ft)					

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)					
One-Hour Precipitation, P_1 (inches)					

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)					
One-Hour Precipitation, P_1 (inches)					

CALCULATED OUTPUT

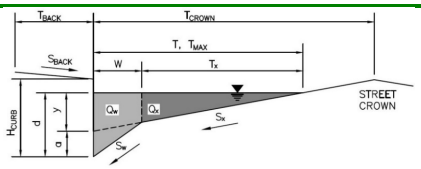
Minor Total Design Peak Flow, Q (cfs)	**0.6**	**0.6**	**0.7**	**1.9**	**2.4**
Major Total Design Peak Flow, Q (cfs)	**1.2**	**1.2**	**1.9**	**7.1**	**7.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.0		N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	0.1		N/A

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

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

Project: Dawson Trails Parcel B1, Phase 1

Inlet ID: F3 - Gutter



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.057	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	14.0	14.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	8.3	8.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.6	1.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**24.0**	**24.0**	**cfs**
Flow Velocity within the Gutter Section	V =	11.4	11.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.1	5.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	12.4	12.4	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	12.4	12.4	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	7.8	7.8	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.2	1.2	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	21.4	21.4	cfs
Average Flow Velocity Within the Gutter Section	V =	11.2	11.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.8	4.8	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.78	0.78	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**16.6**	**16.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.87	4.87	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**16.6**	**16.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.30 cfs on sheet 'Inlet Management'

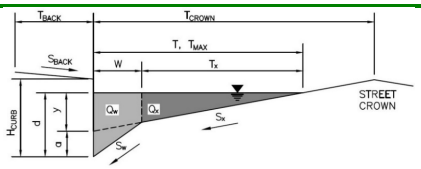
Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.00 cfs on sheet 'Inlet Management'

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

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

Project: Dawson Trails Parcel B1, Phase 1

Inlet ID: F4 - Sump



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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

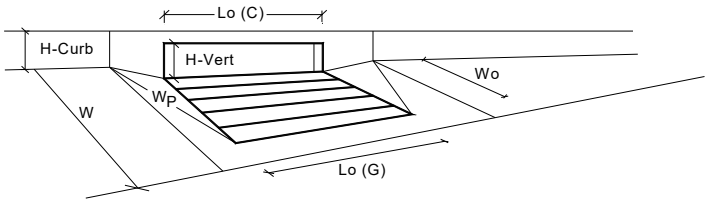
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Denver No. 16 Combination

Design Information (Input)		MINOR	MAJOR	
		er No. 16 Combination		
		00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	☑ Override Depths
Width of a Unit Grate	W_o =	1.73	1.73	
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.81	0.84	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.81	0.84	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.9**	**4.2**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	3.1	9.0	cfs

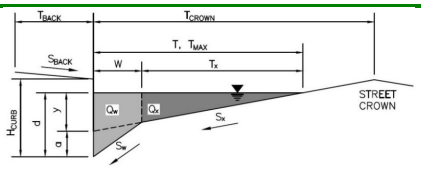
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F5**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.037	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.2	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 (T * S_x * 12)	y =	3.84	3.84	
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	11.3	11.3	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	6.7	6.7	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.3	1.3	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**19.3**	**19.3**	**cfs**
Flow Velocity within the Gutter Section	V =	9.2	9.2	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	4.1	4.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	15.4	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	13.4	13.4	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.388	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	10.0	10.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	10.0	10.0	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	6.3	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.0	1.0	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	17.2	17.2	cfs
Average Flow Velocity Within the Gutter Section	V =	9.0	9.0	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.9	3.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**17.2**	**17.2**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

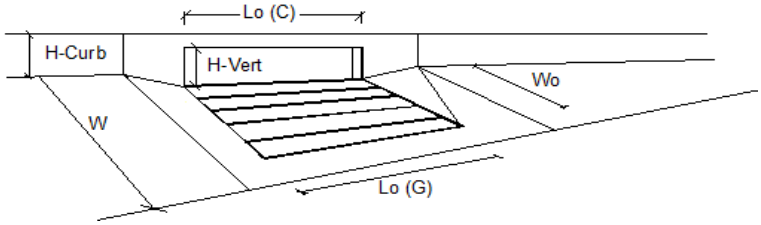
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.2**	**17.2**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 3.00 cfs on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.90 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



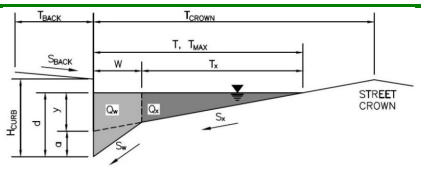
Design Information (Input)		MINOR	MAJOR	
Denver No. 16 Combination	Type =	Denver No. 16 Combination		
	a_{LOCAL} =	2.0	2.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	3.00	3.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	1.73	1.73	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	0.50	0.50	
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 =	3.0	8.9	cfs
Water Spread Width	T =	7.1	11.9	ft
Water Depth at Flowline (outside of local depression)	d =	3.2	4.4	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 =	0.744	0.495	
Discharge outside the Gutter Section W, carried in Section T_x	Q_x =	0.8	4.5	cfs
Discharge within the Gutter Section W	Q_w =	2.2	4.4	cfs
Discharge Behind the Curb Face	Q_{BACK} =	0.0	0.0	cfs
Flow Area within the Gutter Section W	A_W =	0.37	0.56	sq ft
Velocity within the Gutter Section W	V_W =	6.0	7.8	fps
Water Depth for Design Condition	d_{LOCAL} =	5.2	6.4	inches
Grate Analysis (Calculated)		MINOR	MAJOR	
Total Length of Inlet Grate Opening	L =	9.00	9.00	ft
Ratio of Grate Flow to Design Flow	$E_{o\text{-}GRATE}$ =	0.698	0.454	
Under No-Clogging Condition		MINOR	MAJOR	
Minimum Velocity Where Grate Splash-Over Begins	V_o =	3.53	3.53	fps
Interception Rate of Frontal Flow	R_f =	0.89	0.80	
Interception Rate of Side Flow	R_x =	0.56	0.47	
Interception Capacity	Q_i =	2.4	5.5	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoeff =	1.75	1.75	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog =	0.29	0.29	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L_e =	6.38	6.38	ft
Minimum Velocity Where Grate Splash-Over Begins	V_o =	2.97	2.97	fps
Interception Rate of Frontal Flow	R_f =	0.84	0.75	
Interception Rate of Side Flow	R_x =	0.36	0.29	
Actual Interception Capacity	**Q_a =**	**2.1**	**4.4**	**cfs**
Carry-Over Flow = Q_o-Q_a (to be applied to curb opening or next d/s inlet)	**Q_b =**	**0.9**	**4.5**	**cfs**
Curb Opening or Slotted Inlet Analysis (Calculated)		MINOR	MAJOR	
Equivalent Slope S_e	S_e =	0.129	0.092	ft/ft
Required Length L_T to Have 100% Interception	L_T =	5.16	13.49	ft
Under No-Clogging Condition		MINOR	MAJOR	
Effective Length of Curb Opening or Slotted Inlet (minimum of L, L_T)	L =	5.16	9.00	ft
Interception Capacity	Q_i =	0.4	1.0	cfs
Under Clogging Condition		MINOR	MAJOR	
Clogging Coefficient	CurbCoeff =	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog =	0.06	0.06	
Effective (Unclogged) Length	L_e =	5.16	8.50	ft
Actual Interception Capacity	**Q_a =**	**0.4**	**0.8**	**cfs**
Carry-Over Flow = $Q_{b(GRATE)}$-Q_a	**Q_b =**	**0.5**	**3.7**	**cfs**
Summary		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.5**	**5.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.5**	**3.7**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**82**	**58**	**%**

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F6 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.057	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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 ($T * S_x * 12$)	y =	3.84	3.84	
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	14.0	14.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	8.3	8.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.6	1.6	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**24.0**	**24.0**	**cfs**
Flow Velocity within the Gutter Section	V =	11.4	11.4	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.1	5.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	12.4	14.5	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	12.4	14.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	7.8	8.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	1.2	1.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	21.4	24.8	cfs
Average Flow Velocity Within the Gutter Section	V =	11.2	11.5	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.8	5.2	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.78	0.67	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**16.6**	**16.6**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	4.87	4.87	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.00	inches

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	**16.6**	**16.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.80 cfs on sheet 'Inlet Management'

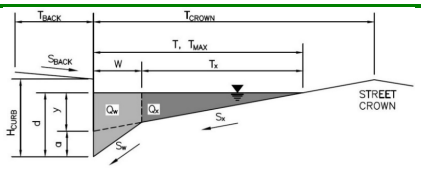
Major storm max. allowable capacity GOOD - greater than the design peak flow of 8.30 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F6 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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 (T * S_x * 12)	y =	3.84	3.84	
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	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

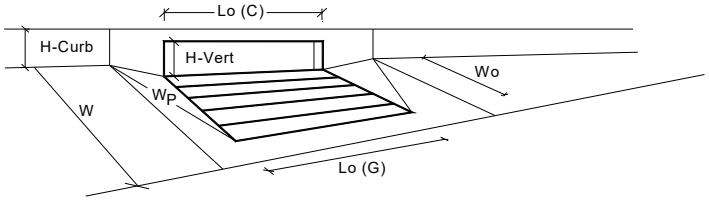
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Denver No. 16 Combination

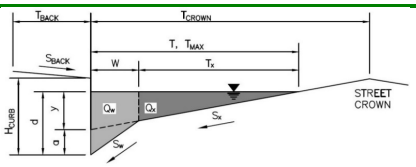
Design Information (Input)		MINOR	MAJOR	
	Type =	Denver No. 16 Combination		
	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	5.4	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	☑ Override Depths
Width of a Unit Grate	W_o =	1.73	1.73	
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	4.50	4.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.47	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.28	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.50	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.49	0.50	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.8**	**6.3**	**cfs**
WARNING: Inlet Capacity < Q Peak for Major Storm	$Q_{PEAK\ REQUIRED}$ =	2.8	8.3	cfs

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

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

Project: Dawson Trails Parcel B1, Phase 1

Inlet ID: F7 - Sump



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	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} =	20.0	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} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.1	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 (T * S_x * 12)	y =	4.80	4.80	
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	6.31	6.31	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	18.0	18.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.296	0.296	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	31.6	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	29.6	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.183	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d $\geq$ 6"	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

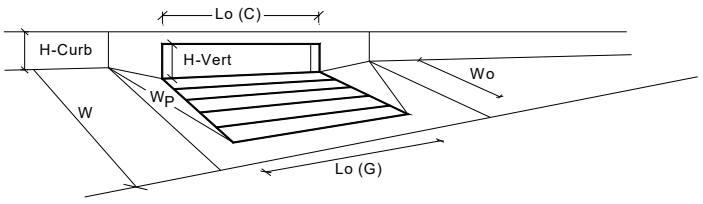
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



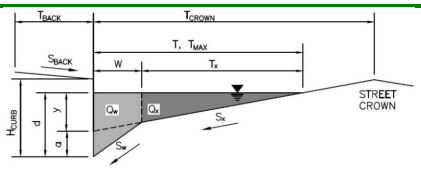
Design Information (Input)		MINOR	MAJOR	
Denver No. 16 Combination	Type =	Denver No. 16 Combination		
	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	9.2	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	☑ Override Depths
Width of a Unit Grate	W_o =	1.73	1.73	
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.0	19.9	cfs
Interception with Clogging	Q_{wa} =	5.0	14.1	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.8	20.6	cfs
Interception with Clogging	Q_{oa} =	11.9	14.6	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.8	18.3	cfs
Interception with Clogging	Q_{ma} =	6.9	12.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**5.0**	**12.9**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.1	18.8	cfs
Interception with Clogging	Q_{wa} =	4.8	17.8	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	17.0	20.1	cfs
Interception with Clogging	Q_{oa} =	16.1	19.0	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	8.0	16.8	cfs
Interception with Clogging	Q_{ma} =	7.6	15.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**4.8**	**15.8**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	18.7	32.0	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	2.9	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.52	0.79	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.60	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.57	0.87	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.87	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.7**	**25.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.2	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F7-F8 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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 =	0.033	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} =	20.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.2	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 (T * S_x * 12)	y =	4.80	7.80	
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	6.31	6.31	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	18.0	18.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.296	0.296	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	20.8	20.8	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	8.8	8.8	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 =**	**29.7**	**29.7**	**cfs**
Flow Velocity within the Gutter Section	V =	9.9	9.9	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	5.2	5.2	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	18.7	32.0	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\ TH}$ =	16.7	30.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.181	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\ TH}$	$Q_{X\ TH}$ =	17.1	81.7	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	17.1	74.5	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	8.0	18.0	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.0	7.5	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	25.0	100.1	cfs
Average Flow Velocity Within the Gutter Section	V =	9.5	13.2	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	4.8	10.1	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	0.69	0.56	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**17.3**	**55.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.38	7.65	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	1.34	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} =**	**17.3**	**55.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.60 cfs on sheet 'Inlet Management'

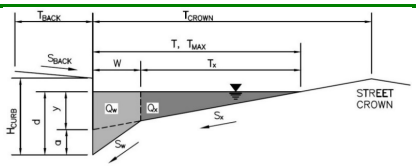
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.20 cfs on sheet 'Inlet Management'

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

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

Project: Dawson Trails Parcel B1, Phase 1

Inlet ID: F8 - Sump



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	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} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	9.2	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 (T * S_x * 12)	y =	4.32	4.32	
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.83	5.83	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	16.0	16.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.330	0.330	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	32.0	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	16.7	30.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.318	0.181	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d $\geq$ 6"	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

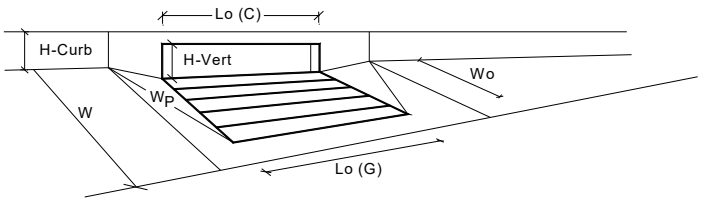
MINOR STORM Allowable Capacity is not applicable to Sump Condition

MAJOR STORM Allowable Capacity is not applicable to Sump Condition

	Minor Storm	Major Storm	
Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



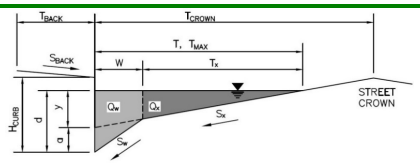
Design Information (Input)		MINOR	MAJOR	
Denver No. 16 Combination	Type =	Denver No. 16 Combination		
	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	9.2	inches
Grate Information		MINOR	MAJOR	
Length of a Unit Grate	L_o (G) =	3.00	3.00	☑ Override Depths
Width of a Unit Grate	W_o =	1.73	1.73	
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	7.0	19.9	cfs
Interception with Clogging	Q_{wa} =	5.0	14.1	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	16.8	20.6	cfs
Interception with Clogging	Q_{oa} =	11.9	14.6	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	9.8	18.3	cfs
Interception with Clogging	Q_{ma} =	6.9	12.9	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**5.0**	**12.9**	**cfs**
Curb Opening Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.00	1.00	
Clogging Factor for Multiple Units	Clog =	0.06	0.06	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	5.1	18.8	cfs
Interception with Clogging	Q_{wa} =	4.8	17.8	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	17.0	20.1	cfs
Interception with Clogging	Q_{oa} =	16.1	19.0	cfs
Curb Opening Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	8.0	16.8	cfs
Interception with Clogging	Q_{ma} =	7.6	15.8	cfs
Resulting Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**4.8**	**15.8**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	18.7	32.0	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.2	3.4	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.52	0.79	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.60	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.57	0.87	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.87	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.7**	**25.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.2	cfs

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F11 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	4.00	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 =	0.033	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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	r Storm	
Water Depth without Gutter Depression ($T * S_x * 12$)	y =	3.84	.84	
Vertical Depth between Gutter Lip and Gutter Flowline ($W * S_w * 12$)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	10.7	10.7	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	6.3	6.3	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.8	0.8	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**17.7**	**17.7**	**cfs**
Flow Velocity within the Gutter Section	V =	8.7	8.7	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	3.9	3.9	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	9.4	11.1	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	9.4	11.1	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	6.0	6.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.5	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	15.9	18.3	cfs
Average Flow Velocity Within the Gutter Section	V =	8.5	8.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	3.7	3.9	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	0.87	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**15.9**	**15.9**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.20	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} =**	**15.9**	**15.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.70 cfs on sheet 'Inlet Management'

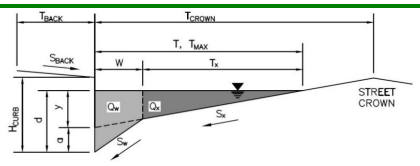
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.90 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F12 - Gutter**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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 =	0.010	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	5.9	5.9	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	Q_W =	3.5	3.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.7	0.7	cfs
Maximum Flow Based On Allowable Spread	**Q_T =**	**10.0**	**10.0**	**cfs**
Flow Velocity within the Gutter Section	V =	4.8	4.8	fps
V*d Product: Flow Velocity times Gutter Flowline Depth	V*d =	2.1	2.1	

Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	5.2	6.1	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	5.2	6.1	cfs
Discharge within the Gutter Section (Q_d - Q_X)	Q_W =	3.3	3.5	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	Q_{BACK} =	0.5	0.8	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	Q =	9.0	10.4	cfs
Average Flow Velocity Within the Gutter Section	V =	4.7	4.8	fps
V*d Product: Flow Velocity Times Gutter Flowline Depth	V*d =	2.0	2.2	
Slope-Based Safety Factor for Minor/Major Storm depth reduction, d ≥ 6"	R =	1.00	1.00	
Max Flow based on Allowable Depth (Safety Factor Applied)	**Q_d =**	**9.0**	**10.4**	**cfs**
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	d =	5.20	5.40	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	d_{CROWN} =	0.00	0.05	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} =**	**9.0**	**10.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.90 cfs on sheet 'Inlet Management'

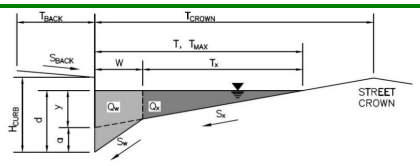
Major storm max. allowable capacity GOOD - greater than the design peak flow of 7.10 cfs on sheet 'Inlet Management'

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

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

Project: **Dawson Trails Parcel B1, Phase 1**

Inlet ID: **F12 - Sump**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	4.00	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
Warning 02 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.2	5.4	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 (T * S_x * 12)	y =	3.84	3.84	inches
Vertical Depth between Gutter Lip and Gutter Flowline (W * S_w * 12)	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 (y + a)	d =	5.35	5.35	inches
Allowable Spread for Discharge outside the Gutter Section (T - W)	T_X =	14.0	14.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.372	0.372	
Discharge outside the Gutter Section, carried in Section T_X	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (Q_T - Q_X - Q_{BACK})	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	

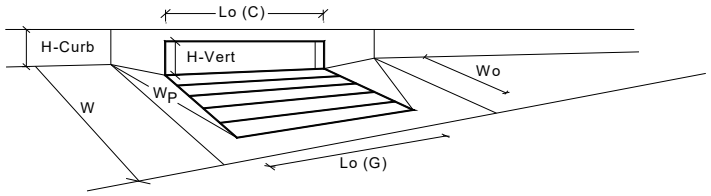
Maximum Capacity for 1/2 Street based on Allowable Depth

		Minor Storm	Major Storm	
Theoretical Water Spread	T_{TH} =	15.4	16.2	ft
Theoretical Spread for Discharge outside the Gutter Section (T - W)	$T_{X\,TH}$ =	13.4	14.2	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. 7-7)	E_O =	0.388	0.368	
Theoretical Discharge outside the Gutter Section, carried in Section $T_{X\,TH}$	$Q_{X\,TH}$ =	0.0	0.0	cfs
Actual Discharge outside the Gutter Section, (limited by distance T_{CROWN})	Q_X =	0.0	0.0	cfs
Discharge within the Gutter Section (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 =	SUMP	SUMP	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 Safety Factor for Minor/Major Storm depth reduction, d $\geq$ 6"	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 not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

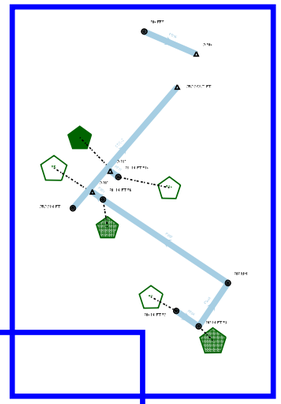


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	Denver No. 16 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	7.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.31	0.31	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.60	3.60	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Grate Flow Analysis (Calculated)		MINOR	MAJOR	
Clogging Coefficient for Multiple Units	Coef =	1.75	1.75	
Clogging Factor for Multiple Units	Clog =	0.29	0.29	
Grate Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	4.9	10.2	cfs
Interception with Clogging	Q_{wa} =	3.5	7.2	cfs
Grate Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	15.7	18.1	cfs
Interception with Clogging	Q_{oa} =	11.1	12.8	cfs
Grate Capacity as Mixed Flow		MINOR	MAJOR	
Interception without Clogging	Q_{mi} =	7.9	12.2	cfs
Interception with Clogging	Q_{ma} =	5.6	8.7	cfs
Resulting Grate Capacity (assumes clogged condition)	**Q_{Grate} =**	**3.5**	**7.2**	**cfs**
Curb Opening 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	
Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{wi} =	N/A	N/A	cfs
Interception with Clogging	Q_{wa} =	N/A	N/A	cfs
Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)		MINOR	MAJOR	
Interception without Clogging	Q_{oi} =	N/A	N/A	cfs
Interception with Clogging	Q_{oa} =	N/A	N/A	cfs
Curb Opening 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 Curb Opening Capacity (assumes clogged condition)	**Q_{Curb} =**	**N/A**	**N/A**	**cfs**
Resultant Street Conditions		MINOR	MAJOR	
Total Inlet Length	L =	9.00	9.00	feet
Resultant Street Flow Spread (based on street geometry from above)	T =	15.4	22.9	**ft. >T-Crown**
Resultant Flow Depth at Street Crown	d_{CROWN} =	0.0	1.6	inches
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.46	0.61	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.49	0.66	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.5**	**7.2**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.4	7.1	cfs

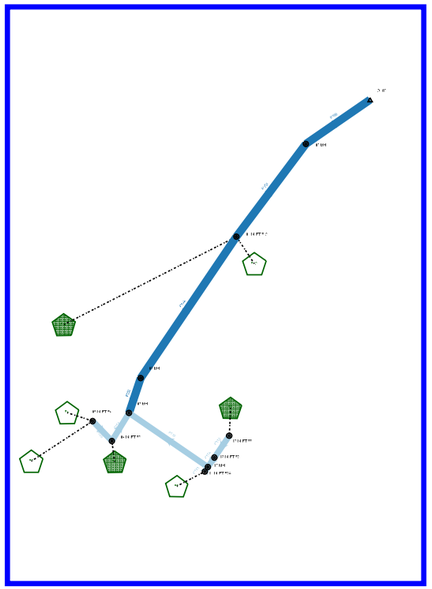
StormCAD Network Map Key

Scenario: Major

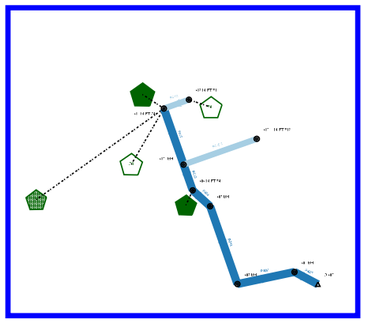
MAP 200



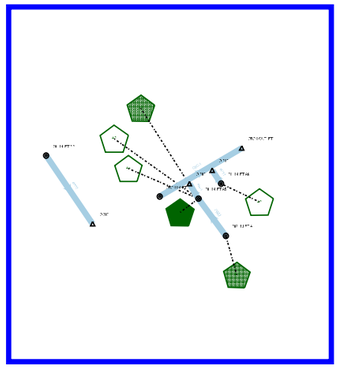
MAP 100

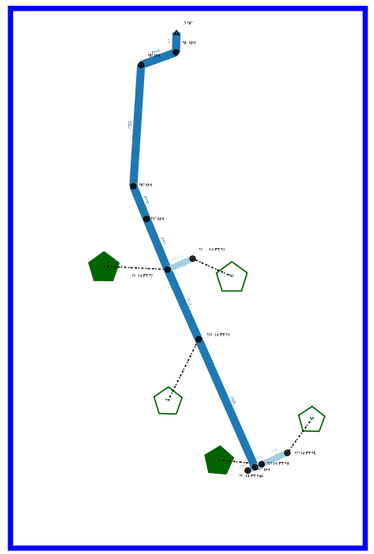


MAP 400



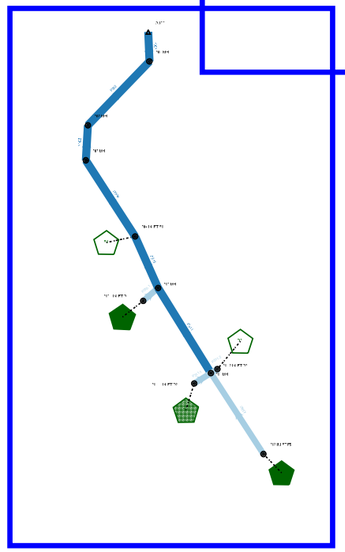
MAP 600





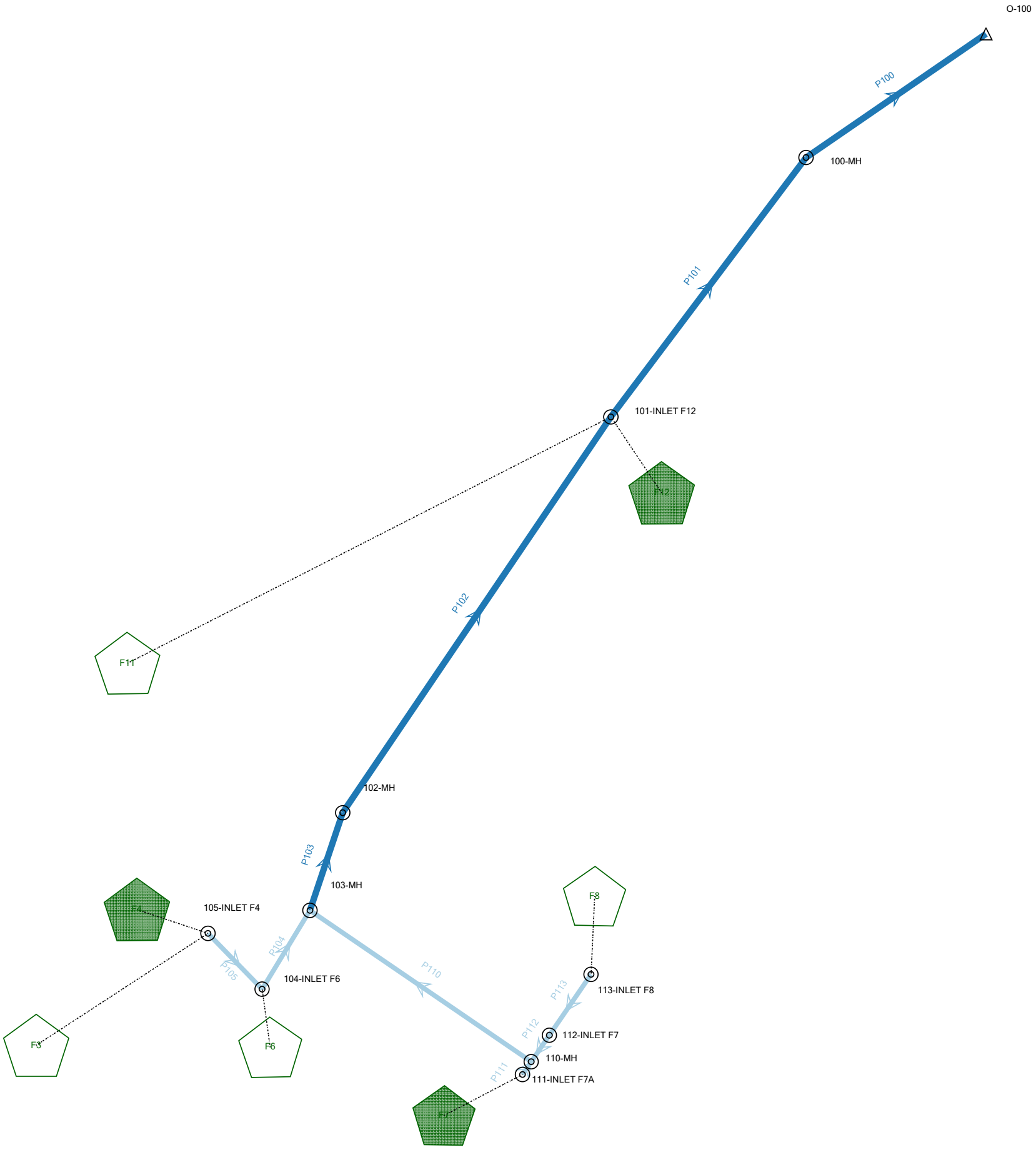
MAP 500

MAP 300



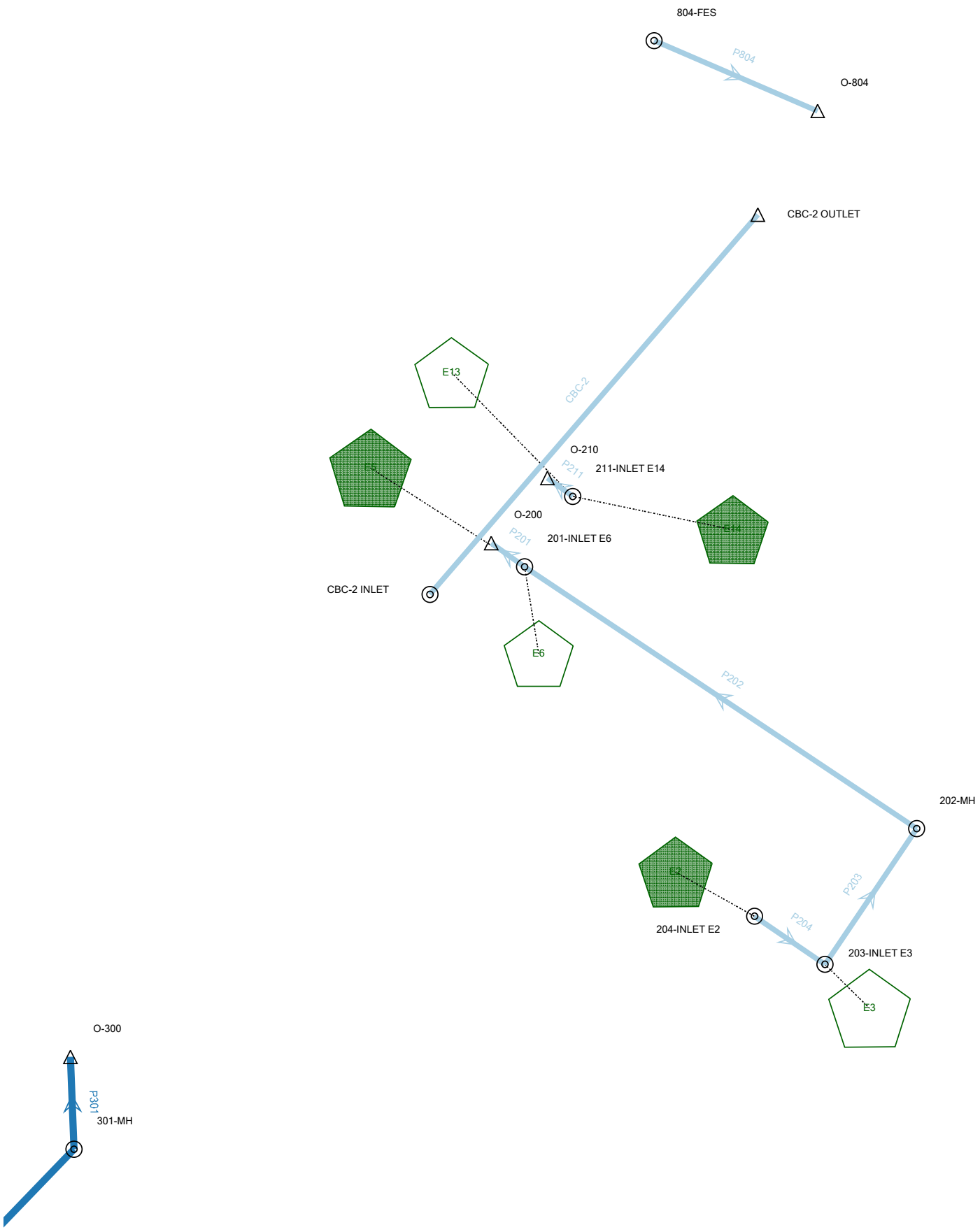
StormCAD Network Map: Outfall 100

Scenario: Major



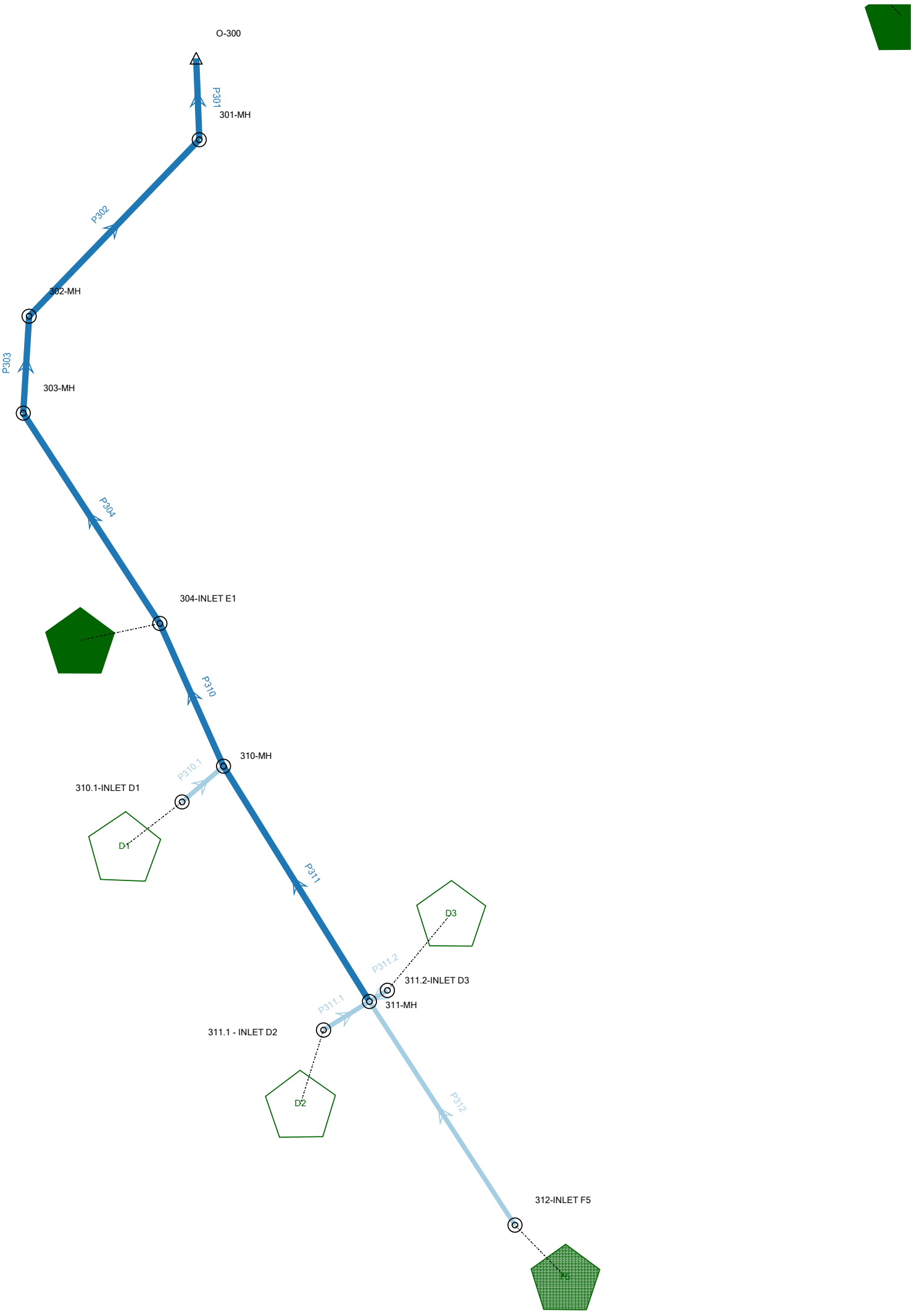
StormCAD Network Map: Outfall 200

Scenario: Major



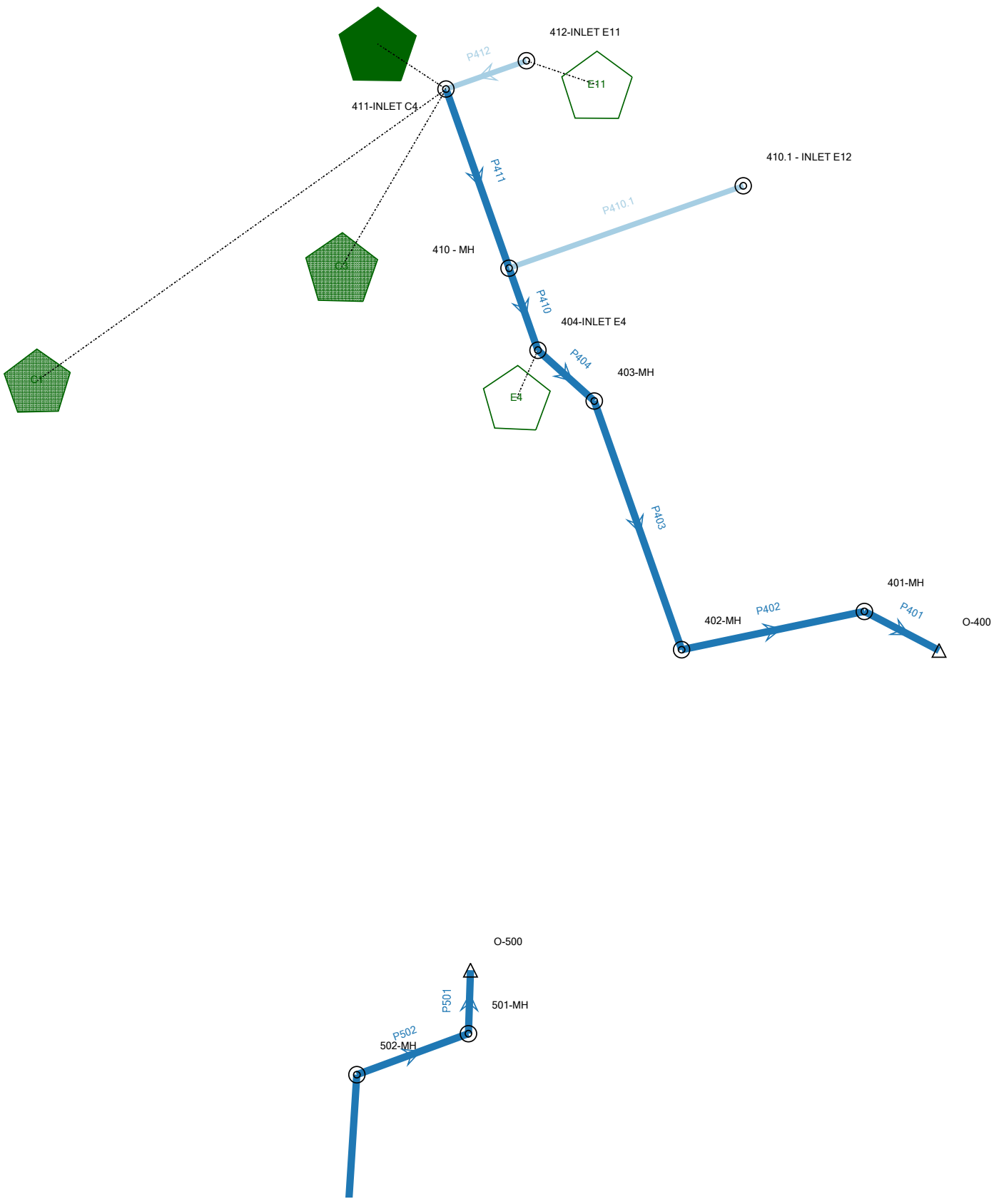
StormCAD Network Map: Outfall 300

Scenario: Major



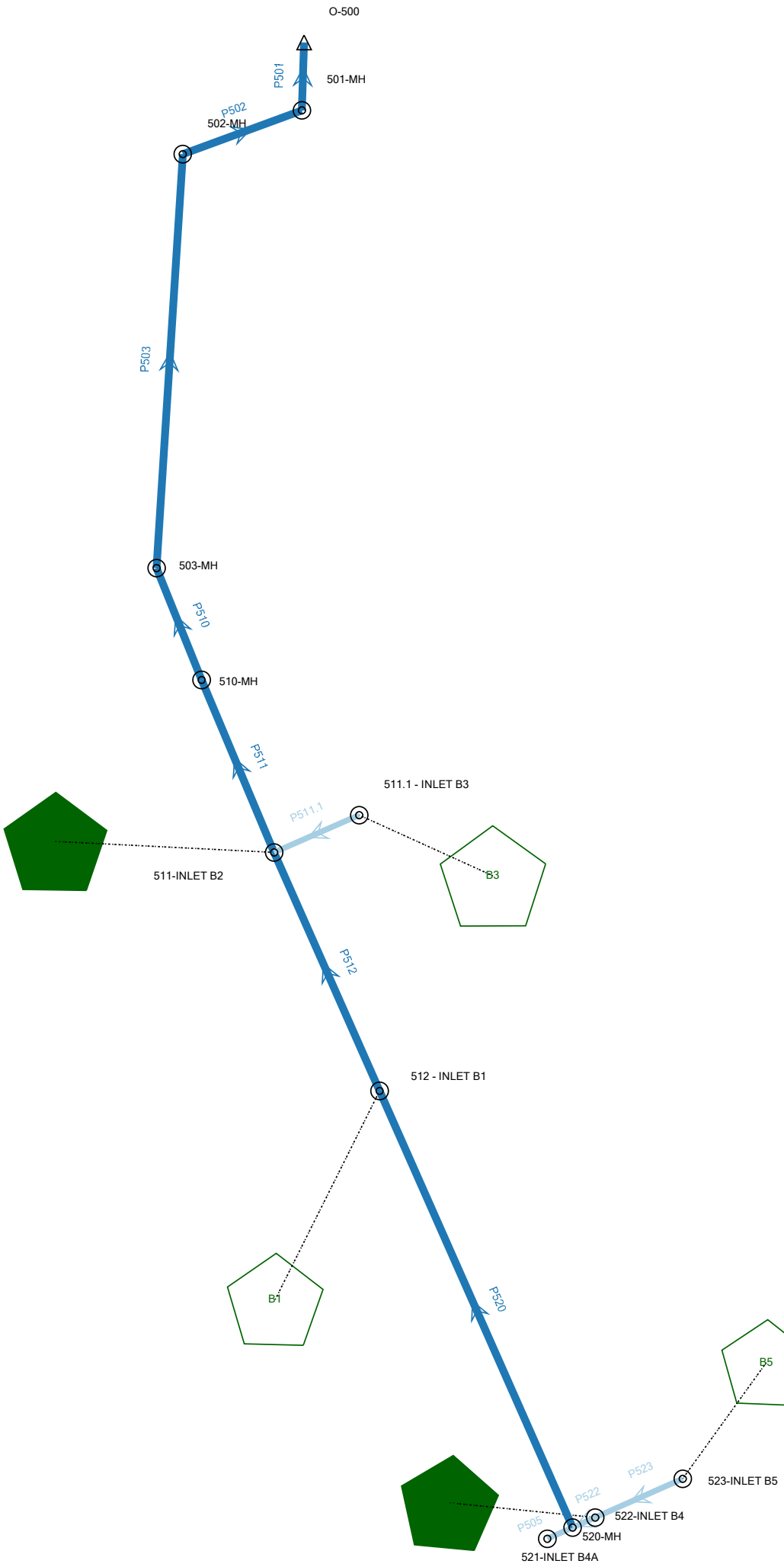
StormCAD Network Map: Outfall 400

Scenario: Major



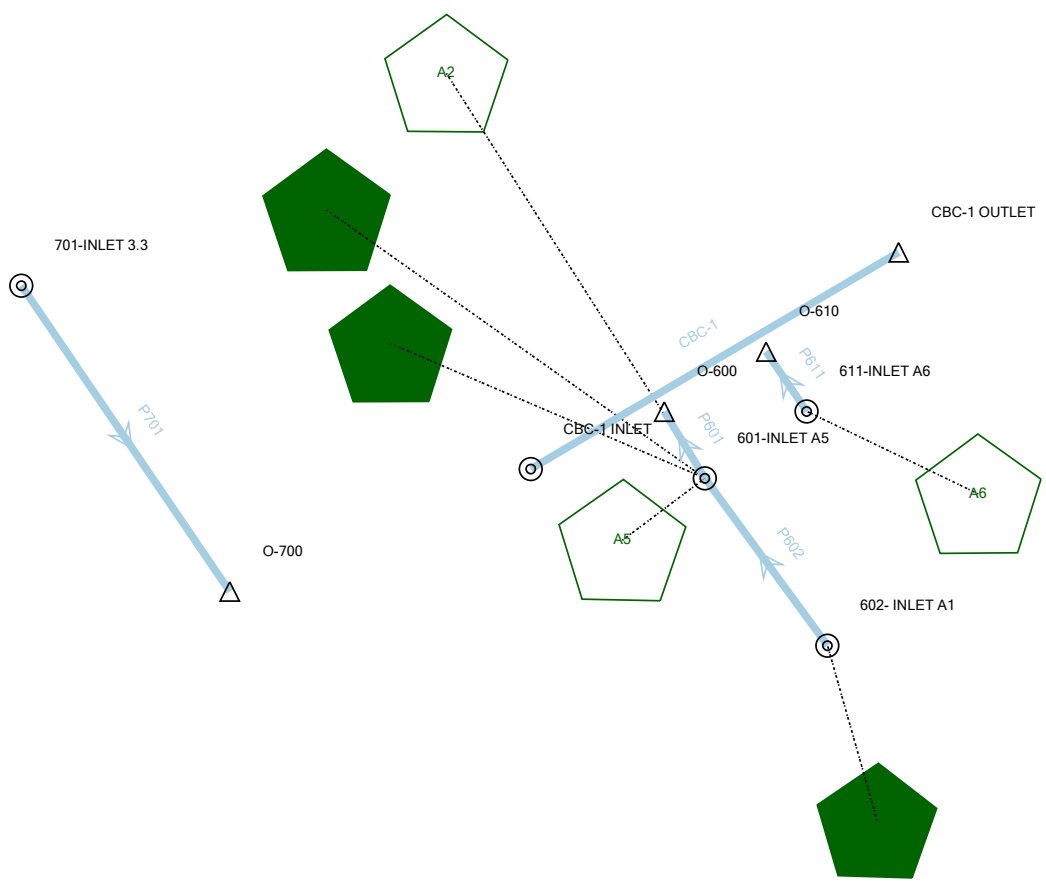
StormCAD Network Map: Outfall 500

Scenario: Major



StormCAD Network Map: Outfall 600

Scenario: Major



Basin Hydrology: Minor Storm (1 of 1)

FlexTable: Catchment Table

Label	Outflow Element	Area (User Defined) (acres)	Runoff Coefficient (Rational)	Time of Concentration (min)
A1	602- INLET A1	1.15	0.43	10.9
A2	601-INLET A5	2.82	0.40	15.7
A3	601-INLET A5	0.07	0.86	5.0
A4	601-INLET A5	0.07	0.86	5.0
A5	601-INLET A5	0.06	0.86	5.0
A6	611-INLET A6	0.25	0.86	5.0
B1	512 - INLET B1	1.72	0.42	11.7
B2	511-INLET B2	1.73	0.42	10.2
B3	511.1 - INLET B3	0.14	0.86	5.0
B4	522-INLET B4	2.99	0.43	13.2
B5	523-INLET B5	0.15	0.86	5.0
C1	411-INLET C4	1.08	0.40	14.9
C3	411-INLET C4	1.24	0.52	11.4
C4	411-INLET C4	1.68	0.40	12.4
D1	310.1-INLET D1	1.76	0.44	10.9
D2	311.1 - INLET D2	1.67	0.44	10.7
D3	311.2-INLET D3	0.14	0.86	5.0
E1	304-INLET E1	1.17	0.48	7.6
E2	204-INLET E2	0.76	0.40	7.7
E3	203-INLET E3	1.39	0.40	10.8
E4	404-INLET E4	1.06	0.40	8.2
E5	201-INLET E6	1.00	0.40	8.5
E6	201-INLET E6	0.20	0.71	5.0
E11	412-INLET E11	2.62	0.40	17.4
E13	211-INLET E14	1.35	0.44	20.8
E14	211-INLET E14	0.32	0.40	6.8
F3	105-INLET F4	1.53	0.40	10.6
F4	105-INLET F4	0.34	0.56	7.6
F5	312-INLET F5	1.99	0.40	11.2
F6	104-INLET F6	1.87	0.40	11.4
F7	112-INLET F7	0.15	0.85	5.0
F8	113-INLET F8	0.15	0.86	5.0
F11	101-INLET F12	0.31	0.52	6.0
F12	101-INLET F12	1.11	0.40	10.1

Basin Hydrology: Major Storm (1 of 1)

FlexTable: Catchment Table

Label	Outflow Element	Area (User Defined) (acres)	Runoff Coefficient (Rational)	Time of Concentration (min)
A1	602- INLET A1	1.15	0.68	10.9
A2	601-INLET A5	2.82	0.67	15.7
A3	601-INLET A5	0.07	0.89	5.0
A4	601-INLET A5	0.07	0.89	5.0
A5	601-INLET A5	0.06	0.89	5.0
A6	611-INLET A6	0.25	0.89	5.0
B1	512 - INLET B1	1.72	0.68	11.7
B2	511-INLET B2	1.73	0.68	10.2
B3	511.1 - INLET B3	0.14	0.89	5.0
B4	522-INLET B4	2.99	0.68	13.2
B5	523-INLET B5	0.15	0.89	5.0
C1	411-INLET C4	1.08	0.67	14.9
C3	411-INLET C4	1.24	0.73	11.4
C4	411-INLET C4	1.68	0.67	12.4
D1	310.1-INLET D1	1.76	0.69	10.9
D2	311.1 - INLET D2	1.67	0.69	10.7
D3	311.2-INLET D3	0.14	0.89	5.0
E1	304-INLET E1	1.17	0.71	7.6
E2	204-INLET E2	0.76	0.67	7.7
E3	203-INLET E3	1.39	0.67	10.8
E4	404-INLET E4	1.06	0.67	8.2
E5	201-INLET E6	1.00	0.67	8.5
E6	201-INLET E6	0.20	0.82	5.0
E11	412-INLET E11	2.62	0.67	17.4
E13	211-INLET E14	1.35	0.68	20.8
E14	211-INLET E14	0.32	0.67	6.8
F3	105-INLET F4	1.53	0.67	10.6
F4	105-INLET F4	0.34	0.75	7.6
F5	312-INLET F5	1.99	0.67	11.2
F6	104-INLET F6	1.87	0.67	11.4
F7	111-INLET F7A	0.15	0.89	5.0
F8	113-INLET F8	0.15	0.89	5.0
F11	101-INLET F12	0.31	0.73	6.0
F12	101-INLET F12	1.11	0.67	10.1

Structure Table: Minor Storm (1 of 2)

FlexTable: Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Local Known Flow (cfs)	Flow (Total Out) (cfs)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
CBC-2 INLET	6,468.32	6,461.10	267.0	267.0	Standard	0.05	0.08	6,464.44	6,464.36
CBC-1 INLET	6,523.97	6,516.75	217.0	217.0	Standard	0.05	0.07	6,519.66	6,519.59
804-FES	6,461.09	6,461.09	21.2	21.2	Standard	0.05	0.11	6,461.20	6,461.09
701-INLET 3.3	6,534.71	6,530.01	4.0	4.0	Standard	0.05	0.02	6,530.79	6,530.78
611-INLET A6	6,530.23	6,520.38	0.0	1.1	Standard	0.05	0.01	6,520.77	6,520.76
602- INLET A1	6,530.86	6,522.99	0.0	1.9	Standard	0.05	0.01	6,523.52	6,523.51
601-INLET A5	6,530.23	6,520.35	0.0	5.7	Standard	0.05	0.02	6,521.30	6,521.28
523-INLET B5	6,522.00	6,517.88	0.0	0.6	Standard	0.05	0.01	6,518.18	6,518.17
522-INLET B4	6,522.29	6,517.31	0.0	4.9	Standard	0.05	0.02	6,518.18	6,518.16
521-INLET B4A	6,522.94	6,517.51	0.0	0.0	Standard	0.05	0.00	6,518.16	6,518.16
520-MH	6,522.46	6,516.94	0.0	4.9	Standard	1.52	0.44	6,518.16	6,517.72
512 - INLET B1	6,521.26	6,515.57	0.0	7.3	Standard	0.05	0.02	6,516.55	6,516.53
511.1 - INLET B3	6,519.78	6,513.78	0.0	0.6	Standard	0.05	0.00	6,514.12	6,514.12
511-INLET B2	6,520.34	6,512.53	0.0	10.1	Standard	1.02	0.47	6,514.15	6,513.67
510-MH	6,521.09	6,508.46	0.0	10.1	Standard	0.05	0.02	6,509.62	6,509.60
503-MH	6,521.56	6,506.26	0.0	10.1	Standard	0.10	0.05	6,507.44	6,507.40
502-MH	6,502.58	6,498.00	0.0	10.0	Standard	0.64	0.30	6,499.42	6,499.13
501-MH	6,500.44	6,495.25	0.0	10.0	Standard	0.64	0.30	6,496.67	6,496.38
412-INLET E11	6,504.68	6,500.92	0.0	3.2	Standard	0.05	0.01	6,501.62	6,501.60
411-INLET C4	6,505.17	6,499.68	0.0	8.5	Standard	1.32	0.54	6,501.27	6,500.72
410.1 - INLET E12	6,502.13	6,495.93	0.0	0.0	Standard	0.05	0.00	6,496.45	6,496.45
410 - MH	6,506.06	6,494.99	0.0	8.5	Standard	1.02	0.42	6,496.45	6,496.03
404-INLET E4	6,506.25	6,494.33	0.0	9.7	Standard	0.10	0.04	6,495.50	6,495.46
403-MH	6,505.83	6,493.69	0.0	9.7	Standard	0.10	0.05	6,494.85	6,494.81
402-MH	6,496.22	6,488.41	0.0	9.7	Standard	1.32	0.60	6,490.12	6,489.53
401-MH	6,490.48	6,484.32	0.0	9.6	Standard	0.40	0.18	6,485.61	6,485.43
312-INLET F5	6,489.27	6,484.21	0.0	3.0	Standard	0.05	0.01	6,484.88	6,484.87
311.2-INLET D3	6,488.67	6,483.51	0.0	0.6	Standard	0.05	0.00	6,484.49	6,484.49
311.1 - INLET D2	6,489.23	6,484.01	0.0	2.8	Standard	0.05	0.01	6,484.66	6,484.65
311-MH	6,488.65	6,483.11	0.0	6.1	Standard	1.52	0.50	6,484.49	6,483.98
310.1-INLET D1	6,490.85	6,485.77	0.0	2.9	Standard	0.05	0.01	6,486.43	6,486.42
310-MH	6,490.25	6,481.09	0.0	8.8	Standard	1.02	0.43	6,482.58	6,482.14
304-INLET E1	6,490.60	6,480.07	0.0	10.8	Standard	0.10	0.05	6,481.30	6,481.25
303-MH	6,487.72	6,476.22	0.0	10.7	Standard	0.40	0.19	6,477.59	6,477.40
302-MH	6,482.75	6,474.33	0.0	10.7	Standard	0.40	0.19	6,475.69	6,475.50
301-MH	6,475.60	6,469.36	0.0	10.7	Standard	0.40	0.19	6,470.72	6,470.53
211-INLET E14	6,470.58	6,464.46	0.0	2.0	Standard	0.05	0.01	6,465.57	6,465.56
204-INLET E2	6,472.28	6,467.44	0.0	1.3	Standard	0.05	0.01	6,467.88	6,467.87
203-INLET E3	6,472.27	6,466.95	0.0	3.3	Standard	1.02	0.27	6,467.91	6,467.64
202-MH	6,472.81	6,466.19	0.0	3.2	Standard	1.02	0.27	6,467.14	6,466.88
201-INLET E6	6,470.61	6,464.62	0.0	5.1	Standard	0.05	0.02	6,465.76	6,465.74
113-INLET F8	6,462.54	6,458.02	0.0	0.6	Standard	0.05	0.01	6,458.32	6,458.32
112-INLET F7	6,463.03	6,457.42	0.0	1.2	Standard	0.05	0.00	6,457.97	6,457.97
111-INLET F7A	6,463.81	6,457.76	0.0	0.0	Standard	0.05	0.00	6,457.76	6,457.76
110-MH	6,463.37	6,456.79	0.0	1.2	Standard	1.52	0.22	6,457.42	6,457.20
105-INLET F4	6,465.48	6,455.58	0.0	3.1	Standard	0.05	0.01	6,456.47	6,456.46
104-INLET F6	6,464.89	6,455.03	0.0	5.7	Standard	1.32	0.52	6,456.47	6,455.96
103-MH	6,464.87	6,454.22	0.0	6.7	Standard	1.02	0.36	6,455.49	6,455.13
102-MH	6,465.15	6,453.57	0.0	6.6	Standard	0.10	0.04	6,454.52	6,454.48

Structure Table: Minor Storm (2 of 2)

FlexTable: Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Local Known Flow (cfs)	Flow (Total Out) (cfs)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
101-INLET F12	6,461.30	6,448.47	0.0	8.7	Standard	0.05	0.02	6,449.54	6,449.52
100-MH	6,450.22	6,436.80	0.0	8.6	Standard	0.10	0.04	6,437.89	6,437.85

Structure Table: Major Storm (1 of 2)

FlexTable: Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Local Known Flow (cfs)	Flow (Total Out) (cfs)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
CBC-2 INLET	6,468.32	6,461.10	267.0	267.0	Standard	0.05	0.08	6,464.44	6,464.36
CBC-1 INLET	6,523.97	6,516.75	217.0	217.0	Standard	0.05	0.07	6,519.66	6,519.59
804-FES	6,461.09	6,461.09	21.2	21.2	Standard	0.05	0.11	6,461.20	6,461.09
701-INLET 3.3	6,534.71	6,530.01	4.0	4.0	Standard	0.05	0.02	6,530.79	6,530.78
611-INLET A6	6,530.23	6,520.38	0.0	2.0	Standard	0.05	0.01	6,520.92	6,520.91
602- INLET A1	6,530.86	6,522.99	0.0	5.4	Standard	0.05	0.02	6,523.90	6,523.88
601-INLET A5	6,530.23	6,520.35	0.0	16.6	Standard	0.05	0.07	6,521.86	6,521.79
523-INLET B5	6,522.00	6,517.88	0.0	1.2	Standard	0.05	0.00	6,519.36	6,519.36
522-INLET B4	6,522.29	6,517.31	0.0	13.7	Standard	0.05	0.05	6,519.36	6,519.31
521-INLET B4A	6,522.94	6,517.51	0.0	0.0	Standard	0.05	0.00	6,519.17	6,519.17
520-MH	6,522.46	6,516.94	0.0	13.7	Standard	1.52	0.89	6,519.17	6,518.27
512 - INLET B1	6,521.26	6,515.57	0.0	20.7	Standard	0.05	0.04	6,517.25	6,517.21
511.1 - INLET B3	6,519.78	6,513.78	0.0	1.1	Standard	0.05	0.00	6,515.81	6,515.81
511-INLET B2	6,520.34	6,512.53	0.0	28.7	Standard	1.02	1.43	6,515.80	6,514.37
510-MH	6,521.09	6,508.46	0.0	28.6	Standard	0.05	0.07	6,510.37	6,510.30
503-MH	6,521.56	6,506.26	0.0	28.6	Standard	0.10	0.14	6,508.24	6,508.10
502-MH	6,502.58	6,498.00	0.0	28.5	Standard	0.64	0.88	6,500.72	6,499.83
501-MH	6,500.44	6,495.25	0.0	28.4	Standard	0.64	0.81	6,498.12	6,497.30
412-INLET E11	6,504.68	6,500.92	0.0	9.7	Standard	0.05	0.02	6,503.22	6,503.20
411-INLET C4	6,505.17	6,499.68	0.0	24.9	Standard	1.32	1.48	6,502.93	6,501.44
410.1 - INLET E12	6,502.13	6,495.93	0.0	0.0	Standard	0.05	0.00	6,498.12	6,498.12
410 - MH	6,506.06	6,494.99	0.0	24.8	Standard	1.02	0.99	6,498.12	6,497.13
404-INLET E4	6,506.25	6,494.33	0.0	28.7	Standard	0.10	0.13	6,496.71	6,496.58
403-MH	6,505.83	6,493.69	0.0	28.7	Standard	0.10	0.14	6,495.67	6,495.53
402-MH	6,496.22	6,488.41	0.0	28.6	Standard	1.32	1.83	6,492.09	6,490.25
401-MH	6,490.48	6,484.32	0.0	28.5	Standard	0.40	0.51	6,486.94	6,486.43
312-INLET F5	6,489.27	6,484.21	0.0	9.0	Standard	0.05	0.02	6,486.59	6,486.57
311.2-INLET D3	6,488.67	6,483.51	0.0	1.1	Standard	0.05	0.00	6,485.73	6,485.73
311.1 - INLET D2	6,489.23	6,484.01	0.0	8.0	Standard	0.05	0.02	6,485.88	6,485.87
311-MH	6,488.65	6,483.11	0.0	17.4	Standard	1.52	1.12	6,485.73	6,484.62
310.1-INLET D1	6,490.85	6,485.77	0.0	8.3	Standard	0.05	0.03	6,486.92	6,486.89
310-MH	6,490.25	6,481.09	0.0	25.4	Standard	1.02	1.18	6,484.03	6,482.86
304-INLET E1	6,490.60	6,480.07	0.0	30.7	Standard	0.10	0.16	6,482.10	6,481.95
303-MH	6,487.72	6,476.22	0.0	30.6	Standard	0.40	0.62	6,478.72	6,478.09
302-MH	6,482.75	6,474.33	0.0	30.5	Standard	0.40	0.62	6,476.82	6,476.20
301-MH	6,475.60	6,469.36	0.0	30.4	Standard	0.40	0.58	6,472.17	6,471.58
211-INLET E14	6,470.58	6,464.46	0.0	5.7	Standard	0.05	0.02	6,465.96	6,465.95
204-INLET E2	6,472.28	6,467.44	0.0	4.0	Standard	0.05	0.00	6,469.57	6,469.56
203-INLET E3	6,472.27	6,466.95	0.0	9.9	Standard	1.02	0.50	6,469.52	6,469.02
202-MH	6,472.81	6,466.19	0.0	9.8	Standard	1.02	0.49	6,468.47	6,467.98
201-INLET E6	6,470.61	6,464.62	0.0	15.2	Standard	0.05	0.06	6,466.34	6,466.28
113-INLET F8	6,462.54	6,458.02	0.0	1.2	Standard	0.05	0.01	6,458.44	6,458.43
112-INLET F7	6,463.03	6,457.42	0.0	1.2	Standard	0.05	0.00	6,457.95	6,457.95
111-INLET F7A	6,463.81	6,457.76	0.0	1.2	Standard	0.05	0.01	6,458.18	6,458.17
110-MH	6,463.37	6,456.79	0.0	2.3	Standard	1.52	0.33	6,457.69	6,457.36
105-INLET F4	6,465.48	6,455.58	0.0	8.9	Standard	0.05	0.02	6,459.75	6,459.73
104-INLET F6	6,464.89	6,455.03	0.0	17.0	Standard	1.32	1.91	6,459.51	6,457.61
103-MH	6,464.87	6,454.22	0.0	18.8	Standard	1.02	0.81	6,456.59	6,455.78
102-MH	6,465.15	6,453.57	0.0	18.7	Standard	0.10	0.08	6,455.21	6,455.13

Structure Table: Major Storm (2 of 2)

FlexTable: Manhole Table

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Local Known Flow (cfs)	Flow (Total Out) (cfs)	Headloss Method	Headloss Coefficient (Standard)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
101-INLET F12	6,461.30	6,448.47	0.0	24.8	Standard	0.05	0.06	6,450.28	6,450.23
100-MH	6,450.22	6,436.80	0.0	24.6	Standard	0.10	0.11	6,438.66	6,438.55

Pipe Table: Minor Storm (1 of 2)

FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Material	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
P804	804-FES	6,461.09	O-804	6,460.01	66.8	0.016	18	Concrete	0.013	21.2	12.0	6,464.23	6,461.49	13.3	159.3
P701	701-INLET 3.3	6,530.01	O-700	6,529.01	97.1	0.010	18	Concrete	0.013	4.0	5.6	6,530.78	6,529.65	10.7	37.5
P611	611-INLET A6	6,520.38	O-610	6,519.43	18.9	0.050	18	Concrete	0.013	1.1	6.7	6,520.76	6,519.65	23.5	4.5
P602	602- INLET A1	6,522.99	601-INLET A5	6,520.65	54.4	0.043	18	Concrete	0.013	1.9	7.5	6,523.51	6,521.30	21.8	8.6
P601	601-INLET A5	6,520.35	O-600	6,519.57	20.5	0.038	18	Concrete	0.013	5.7	10.0	6,521.28	6,520.18	20.5	28.0
P523	523-INLET B5	6,517.88	522-INLET B4	6,517.61	33.0	0.008	18	Concrete	0.013	0.6	3.0	6,518.17	6,518.18	9.4	6.7
P522	522-INLET B4	6,517.31	520-MH	6,517.24	8.5	0.008	18	Concrete	0.013	4.9	5.4	6,518.16	6,518.16	9.4	52.3
P520	520-MH	6,516.94	512 - INLET B1	6,515.87	164.4	0.006	24	Concrete	0.013	4.9	4.9	6,517.72	6,516.58	18.2	26.9
P512	512 - INLET B1	6,515.57	511-INLET B2	6,512.78	89.8	0.031	24	Concrete	0.013	7.3	9.7	6,516.53	6,514.15	39.9	18.2
P511.1	511.1 - INLET B3	6,513.78	511-INLET B2	6,513.49	32.0	0.009	18	Concrete	0.013	0.6	3.1	6,514.12	6,514.15	10.0	5.9
P511	511-INLET B2	6,512.53	510-MH	6,510.46	64.4	0.032	24	Concrete	0.013	10.1	10.7	6,513.67	6,511.16	40.5	24.9
P510	510-MH	6,508.46	503-MH	6,506.51	41.5	0.047	24	Concrete	0.013	10.1	12.3	6,509.60	6,507.18	49.0	20.6
P505	521-INLET B4A	6,517.51	520-MH	6,517.24	9.5	0.028	18	Concrete	0.013	0.0	0.0	6,518.16	6,518.16	17.7	0.0
P503	503-MH	6,506.26	502-MH	6,499.00	142.8	0.051	24	Concrete	0.013	10.1	12.6	6,507.40	6,499.60	51.0	19.7
P502	502-MH	6,498.00	501-MH	6,496.25	43.7	0.040	24	Concrete	0.013	10.0	11.6	6,499.13	6,496.93	45.2	22.1
P501	501-MH	6,495.25	O-500	6,495.01	23.4	0.010	24	Concrete	0.013	10.0	7.0	6,496.38	6,495.98	22.6	44.1
P412	412-INLET E11	6,500.92	411-INLET C4	6,499.98	31.4	0.030	18	Concrete	0.013	3.2	7.7	6,501.60	6,501.27	18.2	17.5
P411	411-INLET C4	6,499.68	410 - MH	6,496.49	69.9	0.046	24	Concrete	0.013	8.5	11.6	6,500.72	6,497.07	48.3	17.6
P410.1	410.1 - INLET E12	6,495.93	410 - MH	6,495.24	91.3	0.007	18	Concrete	0.013	0.0	0.0	6,496.45	6,496.45	9.1	0.0
P410	410 - MH	6,494.99	404-INLET E4	6,494.83	32.0	0.005	24	Concrete	0.013	8.5	5.2	6,496.03	6,495.87	16.0	53.0
P404	404-INLET E4	6,494.33	403-MH	6,494.19	27.9	0.005	24	Concrete	0.013	9.7	5.3	6,495.46	6,495.31	16.0	60.8
P403	403-MH	6,493.69	402-MH	6,489.41	97.0	0.044	24	Concrete	0.013	9.7	11.9	6,494.81	6,490.03	47.5	20.4
P402	402-MH	6,488.41	401-MH	6,485.32	68.7	0.045	24	Concrete	0.013	9.7	11.9	6,489.53	6,485.94	48.0	20.2
P401	401-MH	6,484.32	O-400	6,484.01	31.0	0.010	24	Concrete	0.013	9.6	6.9	6,485.43	6,484.95	22.6	42.6
P312	312-INLET F5	6,484.21	311-MH	6,483.36	113.5	0.007	18	Concrete	0.013	3.0	4.6	6,484.87	6,484.49	9.1	32.6
P311.2	311.2-INLET D3	6,483.51	311-MH	6,483.42	9.0	0.010	18	Concrete	0.013	0.6	3.2	6,484.49	6,484.49	10.5	5.6
P311.1	311.1 - INLET D2	6,484.01	311-MH	6,483.84	23.0	0.007	18	Concrete	0.013	2.8	4.5	6,484.65	6,484.49	9.1	30.7
P311	311-MH	6,483.11	310-MH	6,481.34	117.8	0.015	24	Concrete	0.013	6.1	7.1	6,483.98	6,482.58	27.8	21.8
P310.1	310.1-INLET D1	6,485.77	310-MH	6,485.45	23.3	0.015	18	Concrete	0.013	2.9	5.9	6,486.42	6,485.96	12.9	22.7
P310	310-MH	6,481.09	304-INLET E1	6,480.32	66.5	0.011	24	Concrete	0.013	8.8	7.1	6,482.14	6,481.16	24.2	36.4
P304	304-INLET E1	6,480.07	303-MH	6,476.47	106.7	0.034	24	Concrete	0.013	10.8	11.1	6,481.25	6,477.17	41.6	26.0
P303	303-MH	6,476.22	302-MH	6,474.65	41.3	0.038	24	Concrete	0.013	10.7	11.6	6,477.40	6,475.38	44.1	24.3
P302	302-MH	6,474.33	301-MH	6,470.36	104.3	0.038	24	Concrete	0.013	10.7	11.6	6,475.50	6,471.03	44.1	24.3
P301	301-MH	6,469.36	O-300	6,469.01	34.7	0.010	24	Concrete	0.013	10.7	7.1	6,470.53	6,470.00	22.6	47.1
P211	211-INLET E14	6,465.02	O-210	6,463.44	11.7	0.133	18	Concrete	0.013	2.0	11.5	6,465.56	6,463.71	38.4	5.2
P204	204-INLET E2	6,467.44	203-INLET E3	6,467.20	32.0	0.007	18	Concrete	0.013	1.3	3.7	6,467.87	6,467.91	9.1	14.3
P203	203-INLET E3	6,466.95	202-MH	6,466.44	61.5	0.008	18	Concrete	0.013	3.3	4.9	6,467.64	6,467.14	9.6	34.0
P202	202-MH	6,466.19	201-INLET E6	6,465.12	177.0	0.006	18	Concrete	0.013	3.2	4.4	6,466.88	6,465.77	8.2	39.4
P201	201-INLET E6	6,464.87	O-200	6,463.79	15.3	0.070	18	Concrete	0.013	5.1	12.0	6,465.74	6,464.30	27.8	18.5
P113	113-INLET F8	6,458.02	112-INLET F7	6,457.71	31.0	0.010	18	Concrete	0.013	0.6	3.3	6,458.32	6,457.96	10.5	6.0
P112	110-MH	6,457.42	112-INLET F7	6,457.28	13.5	0.010	18	Concrete	0.013	1.2	0.7	6,457.97	6,457.83	10.5	11.8
P111	111-INLET F7A	6,457.76	110-MH	6,457.44	6.5	0.050	18	Concrete	0.013	0.0	0.0	6,457.76	6,457.44	23.5	0.0
P110	110-MH	6,456.79	103-MH	6,454.53	112.7	0.020	18	Concrete	0.013	1.2	5.1	6,457.20	6,455.49	14.9	8.2
P105	105-INLET F4	6,455.58	104-INLET F6	6,455.33	32.6	0.008	18	Concrete	0.013	3.1	4.8	6,456.46	6,456.47	9.4	32.5
P104	104-INLET F6	6,455.03	103-MH	6,454.72	38.7	0.008	18	Concrete	0.013	5.7	5.6	6,455.96	6,455.57	9.4	61.0
P103	103-MH	6,454.22	102-MH	6,453.87	43.3	0.008	24	Concrete	0.013	6.7	5.8	6,455.13	6,454.67	20.2	32.9
P102	102-MH	6,453.57	101-INLET F12	6,451.97	200.9	0.008	24	Concrete	0.013	6.6	5.8	6,454.48	6,452.75	20.2	32.7
P101	101-INLET F12	6,448.47	100-MH	6,443.02	136.4	0.040	24	Concrete	0.013	8.7	11.1	6,449.52	6,443.61	45.2	19.1

Pipe Table: Minor Storm (2 of 2)

FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Material	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
P100	100-MH	6,436.80	O-100	6,433.51	91.8	0.036	24	Concrete	0.013	8.6	10.6	6,437.85	6,434.12	42.8	20.1
CBC-2	CBC-2 INLET	6,461.10	CBC-2 OUTLET	6,459.07	188.3	0.011		Concrete	0.013	267.0	15.1	6,464.36	6,461.40	817.2	32.7
CBC-1	CBC-1 INLET	6,516.75	CBC-1 OUTLET	6,516.22	112.1	0.005		Concrete	0.013	217.0	10.6	6,519.59	6,518.81	540.1	40.2

Pipe Table: Major Storm (1 of 2)

FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Material	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
P804	804-FES	6,461.09	O-804	6,460.01	66.8	0.016	18	Concrete	0.013	21.2	12.0	6,464.23	6,461.49	13.3	159.3
P701	701-INLET 3.3	6,530.01	O-700	6,529.01	97.1	0.010	18	Concrete	0.013	4.0	5.6	6,530.78	6,529.65	10.7	37.5
P611	611-INLET A6	6,520.38	O-610	6,519.43	18.9	0.050	18	Concrete	0.013	2.0	8.1	6,520.91	6,519.74	23.5	8.4
P602	602- INLET A1	6,522.99	601-INLET A5	6,520.65	54.4	0.043	18	Concrete	0.013	5.4	10.2	6,523.88	6,521.86	21.8	24.6
P601	601-INLET A5	6,520.35	O-600	6,519.57	20.5	0.038	18	Concrete	0.013	16.6	12.9	6,521.79	6,520.74	20.5	80.9
P523	523-INLET B5	6,517.88	522-INLET B4	6,517.61	33.0	0.008	18	Concrete	0.013	1.2	3.6	6,519.36	6,519.36	9.4	12.6
P522	522-INLET B4	6,517.31	520-MH	6,517.24	8.5	0.008	18	Concrete	0.013	13.7	7.7	6,519.31	6,519.17	9.4	145.5
P520	520-MH	6,516.94	512 - INLET B1	6,515.87	164.4	0.006	24	Concrete	0.013	13.7	6.4	6,518.27	6,517.25	18.2	74.9
P512	512 - INLET B1	6,515.57	511-INLET B2	6,512.78	89.8	0.031	24	Concrete	0.013	20.7	12.8	6,517.21	6,515.80	39.9	52.0
P511.1	511.1 - INLET B3	6,513.78	511-INLET B2	6,513.49	32.0	0.009	18	Concrete	0.013	1.1	0.6	6,515.81	6,515.80	10.0	11.1
P511	511-INLET B2	6,512.53	510-MH	6,510.46	64.4	0.032	24	Concrete	0.013	28.7	14.0	6,514.37	6,511.79	40.5	70.8
P510	510-MH	6,508.46	503-MH	6,506.51	41.5	0.047	24	Concrete	0.013	28.6	16.2	6,510.30	6,507.77	49.0	58.5
P505	521-INLET B4A	6,517.51	520-MH	6,517.24	9.5	0.028	18	Concrete	0.013	0.0	0.0	6,519.17	6,519.17	17.7	0.0
P503	503-MH	6,506.26	502-MH	6,499.00	142.8	0.051	24	Concrete	0.013	28.6	16.7	6,508.10	6,500.08	51.0	56.1
P502	502-MH	6,498.00	501-MH	6,496.25	43.7	0.040	24	Concrete	0.013	28.5	15.2	6,499.83	6,498.12	45.2	62.9
P501	501-MH	6,495.25	O-500	6,495.01	23.4	0.010	24	Concrete	0.013	28.4	9.0	6,497.30	6,496.85	22.6	125.6
P412	412-INLET E11	6,500.92	411-INLET C4	6,499.98	31.4	0.030	18	Concrete	0.013	9.7	5.5	6,503.20	6,502.93	18.2	53.4
P411	411-INLET C4	6,499.68	410 - MH	6,496.49	69.9	0.046	24	Concrete	0.013	24.9	15.5	6,501.44	6,497.58	48.3	51.5
P410.1	410.1 - INLET E12	6,495.93	410 - MH	6,495.24	91.3	0.007	18	Concrete	0.013	0.0	0.0	6,498.12	6,498.12	9.1	0.0
P410	410 - MH	6,494.99	404-INLET E4	6,494.83	32.0	0.005	24	Concrete	0.013	24.8	7.9	6,497.13	6,496.71	16.0	155.3
P404	404-INLET E4	6,494.33	403-MH	6,494.19	27.9	0.005	24	Concrete	0.013	28.7	9.1	6,496.58	6,496.03	16.0	179.4
P403	403-MH	6,493.69	402-MH	6,489.41	97.0	0.044	24	Concrete	0.013	28.7	15.8	6,495.53	6,492.09	47.5	60.4
P402	402-MH	6,488.41	401-MH	6,485.32	68.7	0.045	24	Concrete	0.013	28.6	15.9	6,490.25	6,486.52	48.0	59.6
P401	401-MH	6,484.32	O-400	6,484.01	31.0	0.010	24	Concrete	0.013	28.5	9.1	6,486.43	6,485.85	22.6	126.1
P312	312-INLET F5	6,484.21	311-MH	6,483.36	113.5	0.007	18	Concrete	0.013	9.0	5.1	6,486.57	6,485.73	9.1	99.3
P311.2	311.2-INLET D3	6,483.51	311-MH	6,483.42	9.0	0.010	18	Concrete	0.013	1.1	0.6	6,485.73	6,485.73	10.5	10.5
P311.1	311.1 - INLET D2	6,484.01	311-MH	6,483.84	23.0	0.007	18	Concrete	0.013	8.0	4.5	6,485.87	6,485.73	9.1	87.4
P311	311-MH	6,483.11	310-MH	6,481.34	117.8	0.015	24	Concrete	0.013	17.4	9.3	6,484.62	6,484.03	27.8	62.8
P310.1	310.1-INLET D1	6,485.77	310-MH	6,485.45	23.3	0.015	18	Concrete	0.013	8.3	7.7	6,486.89	6,486.38	12.9	64.7
P310	310-MH	6,481.09	304-INLET E1	6,480.32	66.5	0.011	24	Concrete	0.013	25.4	8.7	6,482.86	6,482.10	24.2	104.8
P304	304-INLET E1	6,480.07	303-MH	6,476.47	106.7	0.034	24	Concrete	0.013	30.7	14.5	6,481.95	6,478.72	41.6	73.9
P303	303-MH	6,476.22	302-MH	6,474.65	41.3	0.038	24	Concrete	0.013	30.6	15.2	6,478.09	6,476.82	44.1	69.4
P302	302-MH	6,474.33	301-MH	6,470.36	104.3	0.038	24	Concrete	0.013	30.5	15.1	6,476.20	6,471.63	44.1	69.3
P301	301-MH	6,469.36	O-300	6,469.01	34.7	0.010	24	Concrete	0.013	30.4	9.7	6,471.58	6,470.88	22.6	134.5
P211	211-INLET E14	6,465.02	O-210	6,463.44	11.7	0.133	18	Concrete	0.013	5.7	15.6	6,465.95	6,463.93	38.4	14.9
P204	204-INLET E2	6,467.44	203-INLET E3	6,467.20	32.0	0.007	18	Concrete	0.013	4.0	2.2	6,469.56	6,469.52	9.1	43.7
P203	203-INLET E3	6,466.95	202-MH	6,466.44	61.5	0.008	18	Concrete	0.013	9.9	5.6	6,469.02	6,468.47	9.6	103.4
P202	202-MH	6,466.19	201-INLET E6	6,465.12	177.0	0.006	18	Concrete	0.013	9.8	5.6	6,467.98	6,466.34	8.2	120.1
P201	201-INLET E6	6,464.87	O-200	6,463.79	15.3	0.070	18	Concrete	0.013	15.2	16.1	6,466.28	6,464.79	27.8	54.8
P113	113-INLET F8	6,458.02	112-INLET F7	6,457.71	31.0	0.010	18	Concrete	0.013	1.2	3.9	6,458.43	6,458.05	10.5	11.3
P112	110-MH	6,457.42	112-INLET F7	6,457.28	13.5	0.010	18	Concrete	0.013	1.2	0.7	6,457.95	6,457.82	10.5	11.2
P111	111-INLET F7A	6,457.76	110-MH	6,457.44	6.5	0.050	18	Concrete	0.013	1.2	6.9	6,458.17	6,457.70	23.5	5.1
P110	110-MH	6,456.79	103-MH	6,454.53	112.7	0.020	18	Concrete	0.013	2.3	6.1	6,457.36	6,456.59	14.9	15.6
P105	105-INLET F4	6,455.58	104-INLET F6	6,455.33	32.6	0.008	18	Concrete	0.013	8.9	5.0	6,459.73	6,459.51	9.4	94.4
P104	104-INLET F6	6,455.03	103-MH	6,454.72	38.7	0.008	18	Concrete	0.013	17.0	9.6	6,457.61	6,456.59	9.4	181.3
P103	103-MH	6,454.22	102-MH	6,453.87	43.3	0.008	24	Concrete	0.013	18.8	7.3	6,455.78	6,455.40	20.2	92.8
P102	102-MH	6,453.57	101-INLET F12	6,451.97	200.9	0.008	24	Concrete	0.013	18.7	7.3	6,455.13	6,453.48	20.2	92.5
P101	101-INLET F12	6,448.47	100-MH	6,443.02	136.4	0.040	24	Concrete	0.013	24.8	14.7	6,450.23	6,444.08	45.2	54.8

Pipe Table: Major Storm (2 of 2)

FlexTable: Conduit Table

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (Scaled) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Material	Manning's n	Flow (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
P100	100-MH	6,436.80	O-100	6,433.51	91.8	0.036	24	Concrete	0.013	24.6	14.1	6,438.55	6,434.65	42.8	57.6
CBC-2	CBC-2 INLET	6,461.10	CBC-2 OUTLET	6,459.07	188.3	0.011		Concrete	0.013	267.0	15.1	6,464.36	6,461.40	817.2	32.7
CBC-1	CBC-1 INLET	6,516.75	CBC-1 OUTLET	6,516.22	112.1	0.005		Concrete	0.013	217.0	10.6	6,519.59	6,518.81	540.1	40.2

Outfall Table: Minor Storm (1 of 1)

FlexTable: Outfall Table

Label	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Depth (Node) (ft)	Hydraulic Grade (ft)
CBC-1 OUTLET	6,516.22	217.0	Free Outfall		2.58	6,518.81
CBC-2 OUTLET	6,459.07	267.0	Free Outfall		2.34	6,461.40
O-100	6,433.51	8.6	Free Outfall		0.61	6,434.12
O-200	6,463.79	5.1	Free Outfall		0.51	6,464.30
O-210	6,463.44	2.0	Free Outfall		0.26	6,463.71
O-300	6,469.01	10.6	Free Outfall		0.99	6,470.00
O-400	6,484.01	9.6	Free Outfall		0.94	6,484.95
O-500	6,495.01	10.0	Free Outfall		0.97	6,495.98
O-600	6,519.57	5.7	Free Outfall		0.61	6,520.18
O-610	6,519.43	1.0	Free Outfall		0.22	6,519.65
O-700	6,529.01	4.0	Free Outfall		0.64	6,529.65
O-804	6,460.01	21.2	Free Outfall		1.47	6,461.49

Outfall Table: Major Storm (1 of 1)

FlexTable: Outfall Table

Label	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Depth (Node) (ft)	Hydraulic Grade (ft)
CBC-1 OUTLET	6,516.22	217.0	Free Outfall		2.58	6,518.81
CBC-2 OUTLET	6,459.07	267.0	Free Outfall		2.34	6,461.40
O-100	6,433.51	24.6	Free Outfall		1.13	6,434.65
O-200	6,463.79	15.2	Free Outfall		1.00	6,464.79
O-210	6,463.44	5.7	Free Outfall		0.49	6,463.93
O-300	6,469.01	30.4	Free Outfall		1.87	6,470.88
O-400	6,484.01	28.5	Free Outfall		1.84	6,485.85
O-500	6,495.01	28.4	Free Outfall		1.84	6,496.85
O-600	6,519.57	16.6	Free Outfall		1.17	6,520.74
O-610	6,519.43	2.0	Free Outfall		0.31	6,519.74
O-700	6,529.01	4.0	Free Outfall		0.64	6,529.65
O-804	6,460.01	21.2	Free Outfall		1.47	6,461.49

FOREBAY B (POND B1) - FOREBAY & TRICKLE CHANNEL CALCULATIONS

Project Name: Dawson Ridge Parcel B1, Phase 1

Project No.: 20-224

Per MHFD USDCM Vol. 3, Ch. 3, S. 3.0 & Table EDB-4; Vol. 2, Ch. 12, S. 5.14.2; Vol. 1, & Ch. 8, S. 7.1. Based on an octagonal forebay typical of local installations.

Water Quality Capture Volume (WQCV)

$WQCV = (\alpha(0.91I^3 - 1.19I^2 + 0.78I)/12)A$ — *Water Quality Capture Volume (ac-ft); Equations 3-1 & 3-2 combined*

$\alpha =$ 1.0 — *BMP type coefficient; typ. 1.0 for 40 hr drain time; Table 3-2*

$I =$ 0.2788 — *Imperviousness (percent expressed as a decimal)*

$A =$ 175.37 ac — *watershed tributary area upstream*

WQCV =	2.114	ac-ft

Forebay Sizing

$V = p(WQCV)43560/100$ — *minimum forebay volume (ft^3)*

$p =$ 3 % — *percentage of WQCV; Table EDB-4*

V =	2763.00	ft^3	*minimum forebay volume*

D_M =	2.50	ft	*maximum forebay depth (sidewall depth); Table EDB-4*
D_F =	2.25	ft	*forebay front edge depth (D_M - 3"); Figure 14-8*

V_P =	2803.5	ft^2	*forebay area provided (must be ≥ A_R);*

determined by increasing the central longitudinal dimension shown on the typical forebay detail;
see detail in construction drawings for complete forebay configuration and dimensions

Forebay Notch Sizing

$Q_{100} =$ 267.00 cfs — *undetained peak discharge (from StormCAD calcs)*

$Q_{Rm} = 0.02*Q_{100}$ — *minimum forebay release (cfs); 2% of Q100; Table EDB-4*

$Q_{Rm} =$ 5.34 cfs

H =	2.25	ft	*notch depth = D_F*

$L_{Nm} = Q_{Rm}/C_{BCW}H^{1.5}$ — *minimum notch width (ft); (broad crested weir calculation); Equation 12-8; CBCW = 3.3*

$L_{Nm} =$ 0.48 ft

L_N =	0.93	ft	*notch width used for design;*
=	12.0	in	*(minimum notch width [LNm] increased by 20% of notch depth [DF] for clogged condition per MHFD BMP Worksheet and rounded up to nearest whole inch)*

Trickle Channel Sizing

$Q_R = C_{BCW}L_NH^{1.5}$ — *maximum forebay notch capacity (cfs); (broad crested weir calculation); Equation 12-8; CBCW = 3.3*

$Q_R =$ 10.35 cfs

$Q_T = (1.49/n)AR^{2/3}S^{1/2}$ — *flow in trickle channel (cfs); (Manning's Equation for uniform open channel flow); Equation 8-7*

$n =$ 0.013 — *Manning's roughness coefficient for concrete*

$S =$ 0.005 ft/ft — *friction slope (approx. slope of trickle channel for normal flow); 0.4% - 1% recommended by MHFD*

$A = WH$ — *cross-sectional area of flow in channel (ft^2); assume channel flowing full*

W =	4.0	ft	*width of trickle channel bottom*
H =	0.5	ft	*height of trickle channel sides*

$A =$ 2.00 ft^2

$R =$ A/P — *hydraulic radius (ft)*

$R =$ 0.40 ft

$P =$ W+2H — *wetted perimeter (ft)*

$P =$ 5.00 ft

Q_T =	8.80	cfs	*maximum capacity of trickle channel (must be ≥ Q_R)*

FOREBAY 1 (POND B1) - FOREBAY & TRICKLE CHANNEL CALCULATIONS

Project Name: Dawson Ridge Parcel B1, Phase 1

Project No.: 20-224

Per MHFD USDCM Vol. 3, Ch. 3, S. 3.0 & Table EDB-4; Vol. 2, Ch. 12, S. 5.14.2; Vol. 1, & Ch. 8, S. 7.1. Based on an octagonal forebay typical of local installations.

Water Quality Capture Volume (WQCV)

$WQCV = (\alpha(0.91I^3 - 1.19I^2 + 0.78I)/12)A$ — *Water Quality Capture Volume (ac-ft); Equations 3-1 & 3-2 combined*

$\alpha =$ 1.0 — *BMP type coefficient; typ. 1.0 for 40 hr drain time; Table 3-2*

$I =$ 0.4808 — *Imperviousness (percent expressed as a decimal)*

$A =$ 7.73 ac — *watershed tributary area upstream*

WQCV =	0.130	ac-ft

Forebay Sizing

$V = p(WQCV)43560/100$ — *minimum forebay volume (ft^3)*

$p =$ 3 % — *percentage of WQCV; Table EDB-4*

V =	169.29	ft^3	*minimum forebay volume*

$A_R = V/D_F$ — *minimum required forebay area (ft^2)*

D_M =	1.50	ft	*maximum forebay depth (sidewall depth); Table EDB-4*
D_F =	1.25	ft	*forebay front edge depth (D_M - 3"); Figure 14-8*

$A_R =$ 135.4 ft^2

A_P =	137.5	ft^2	*forebay area provided (must be ≥ A_R);*

determined by increasing the central longitudinal dimension shown on the typical forebay detail;
see detail in construction drawings for complete forebay configuration and dimensions

Forebay Notch Sizing

$Q_{100} =$ 33.19 cfs — *undetained peak discharge (from StormCAD calcs)*

$Q_{Rm} = 0.02*Q_{100}$ — *minimum forebay release (cfs); 2% of Q100; Table EDB-4*

$Q_{Rm} =$ 0.66 cfs

H =	1.25	ft	*notch depth = D_F*

$L_{Nm} = Q_{Rm}/C_{BCW}H^{1.5}$ — *minimum notch width (ft); (broad crested weir calculation); Equation 12-8; CBCW = 3.3*

$L_{Nm} =$ 0.14 ft

L_N =	0.39	ft	*notch width used for design;*
=	5.0	in	*(minimum notch width [LNm] increased by 20% of notch depth [DF] for clogged condition per MHFD BMP Worksheet and rounded up to nearest whole inch)*

Trickle Channel Sizing

$Q_R = C_{BCW}L_NH^{1.5}$ — *maximum forebay notch capacity (cfs); (broad crested weir calculation); Equation 12-8; CBCW = 3.3*

$Q_R =$ 1.82 cfs

$Q_T = (1.49/n)AR^{2/3}S^{1/2}$ — *flow in trickle channel (cfs); (Manning's Equation for uniform open channel flow); Equation 8-7*

$n =$ 0.013 — *Manning's roughness coefficient for concrete*

$S =$ 0.005 ft/ft — *friction slope (approx. slope of trickle channel for normal flow); 0.4% - 1% recommended by MHFD*

$A = WH$ — *cross-sectional area of flow in channel (ft^2); assume channel flowing full*

W =	2.0	ft	*width of trickle channel bottom*
H =	0.5	ft	*height of trickle channel sides*

$A =$ 1.00 ft^2

$R =$ A/P — *hydraulic radius (ft)*

$R =$ 0.33 ft

$P =$ W+2H — *wetted perimeter (ft)*

$P =$ 3.00 ft

Q_T =	3.90	cfs	*maximum capacity of trickle channel (must be ≥ Q_R)*

OUTFALL 300 - OUTLET RIPRAP CACLULATIONS SHEET 1 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

Riprap Sizing per Section 3.2.3

L_p =	$(1/2\tan\Theta)[(A_t/Y_t)-W]$		Length of protection; Equation 9-11
D =	24.00	in	Pipe diamter
	2.00	ft	
Y_n =	1.87	ft	Normal depth of flow at culvert outlet
V =	9.7	ft/s	Flow velocity at culvert outlet
FR =	1.25		Froude Number
	Y		Superciritical flow?
Y_t =	1.00	ft	Tailwater depth
D_a =	1.94		D parameter for supercritical flow
A_t =	Q/V	ft^2	Required area of flow at allowable velocity; Equation 9-12
Q =	30.4	cfs	100-year discharge
V =	5	ft/sec	Max velocity allowed by UDFCD for non-cohesive soils
A_t =	6.08	ft^2	
$Q/D^{1.5}$ =	10.75		Froude Parameter (for Rock Sizing figure 9-38)
Y_t/D =	0.50		Tailwater Depth/Conduit Height
Y_t/D_a =	0.52		(use 0.40 if unknown or hydraulic jump is suspected downstream)

Use Type L Riprap per Figure 9-38	**D_{50} =**	**9**	**in**	See Figure 9-38
Thickness of Riprap Layer = $2D_{50}$ =		**1.5**	**ft**	See Figure 9-34

$Q/D^{2.5}$ =	5.37		Froude Parameter (for Extent of Protection figure 9-35) (must be ≤ 6.0)
$1/2\tan\Theta$ =	5		(F_E) Expansion factor; Figure 9-35
L_p =	**20**	**ft**	See Figure 9-34
T =	$2(L_p\tan\Theta)+W$		Width of riprap at furthest downstream point; Equation 9-13
Θ =	$\tan^{-1}[1/(2*F_E)]$		Equation 9-13
Θ =	0.10	°	
T =	**6**	**ft**	See Figure 9-34

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.3

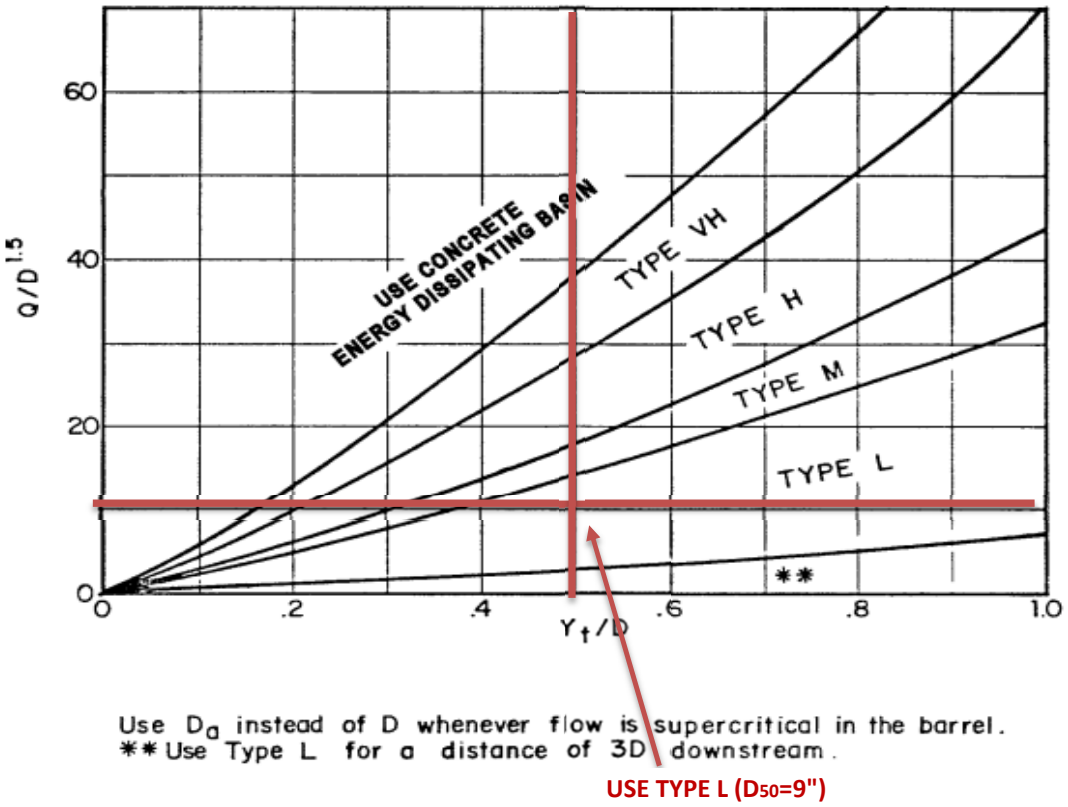


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

THICKNESS REQUIREMENTS FOR GRANULAR BEDDING			
RIPRAP DESIGNATION	MINIMUM BEDDING THICKNESS (INCHES)		
	FINE–GRAINED SOILS [1]		COARSE–GRAINED SOILS [2]
	TYPE I (LOWER LAYER)	TYPE II (UPPER LAYER)	TYPE II
VL (D_{50} = 6 IN)	4	4	6
L (D_{50} = 9 IN)	4	4	6
M (D_{50} = 12 IN)	4	4	6
H (D_{50} = 18 IN)	4	6	8
VH (D_{50} = 24 IN)	4	6	8

NOTES:
1. MAY SUBSTITUTE ONE 12–INCH LAYER OF TYPE II BEDDING. THE SUBSTITUTION OF ONE LAYER OF TYPE II BEDDING SHALL NOT BE PERMITTED AT DROP STRUCTURES. THE USE OF A COMBINATION OF FILTER FABRIC AND TYPE II BEDDING AT DROP STRUCTURES IS ACCEPTABLE.
2. FIFTY PERCENT OR MORE BY WEIGHT RETAINED ON THE #40 SIEVE.

Figure 8-34. Riprap and soil riprap placement and gradation (part 3 of 3)

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.1

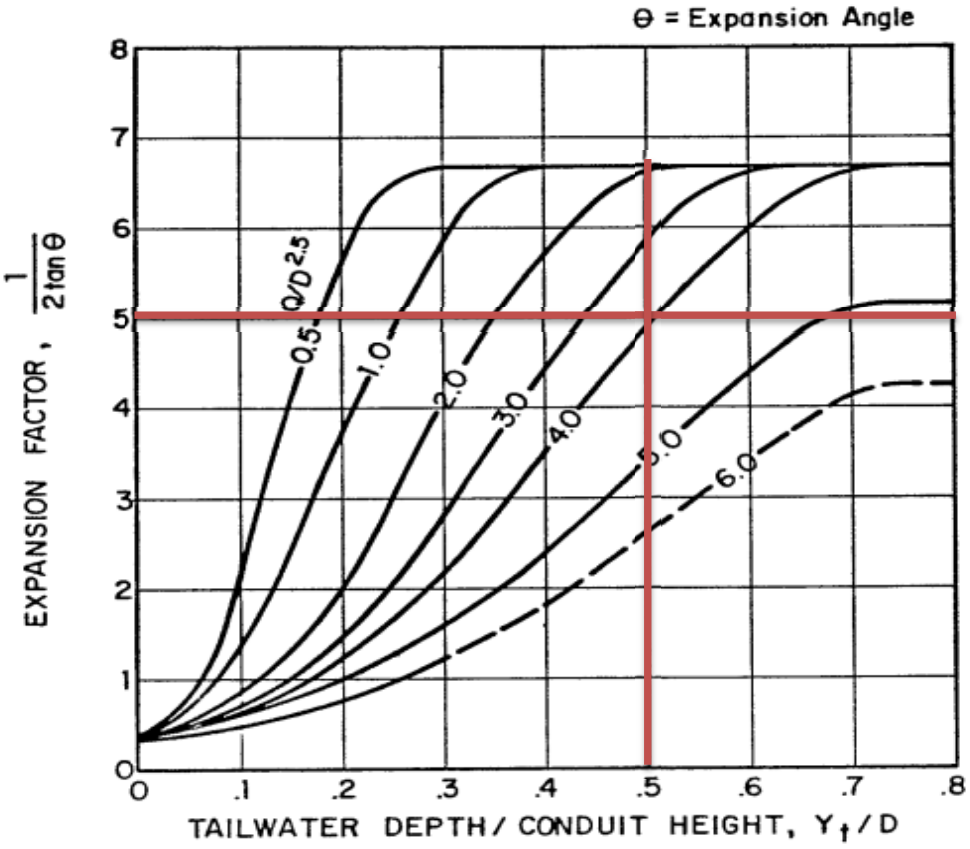


Figure 9-35. Expansion factor for circular conduits

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.1

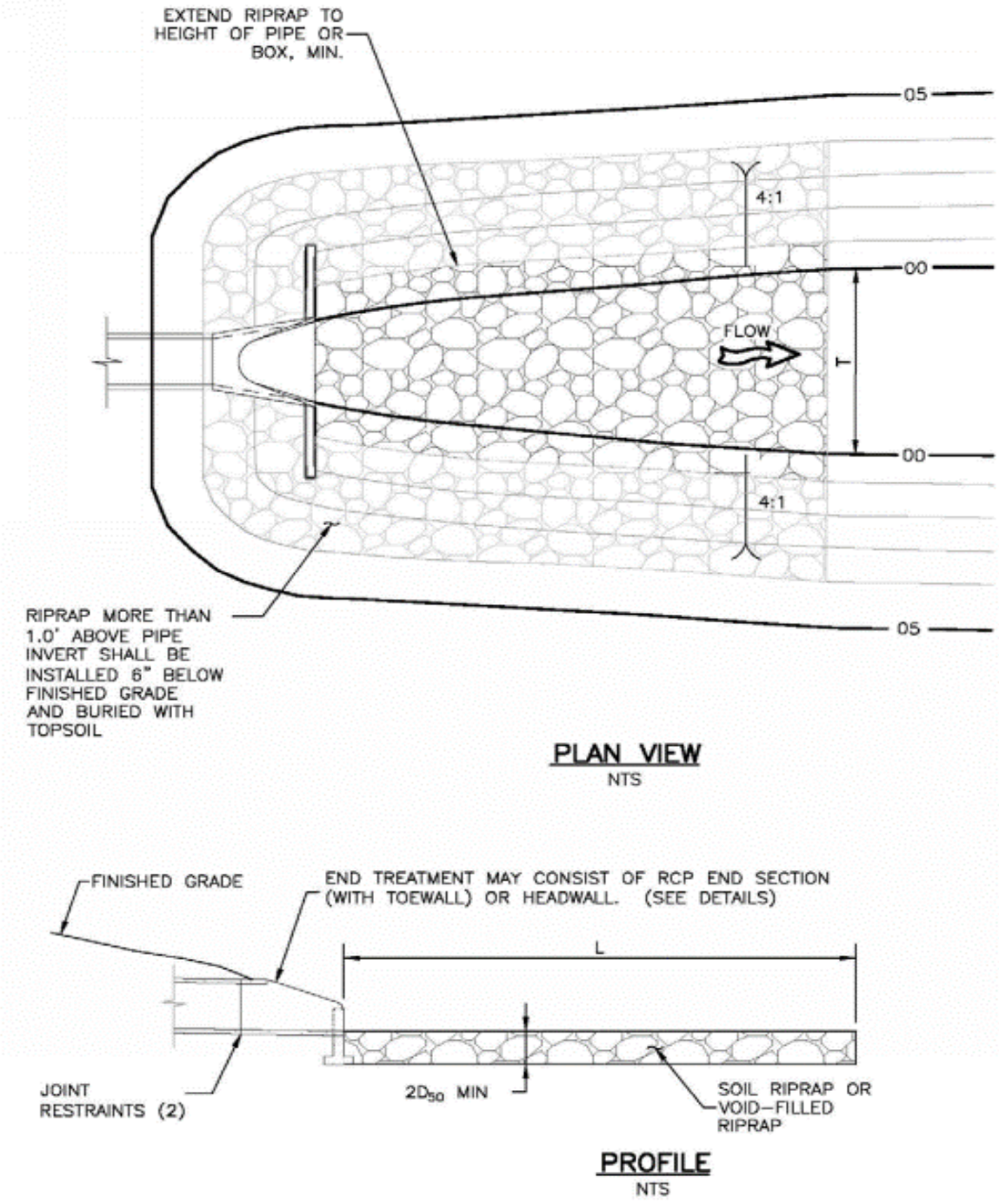
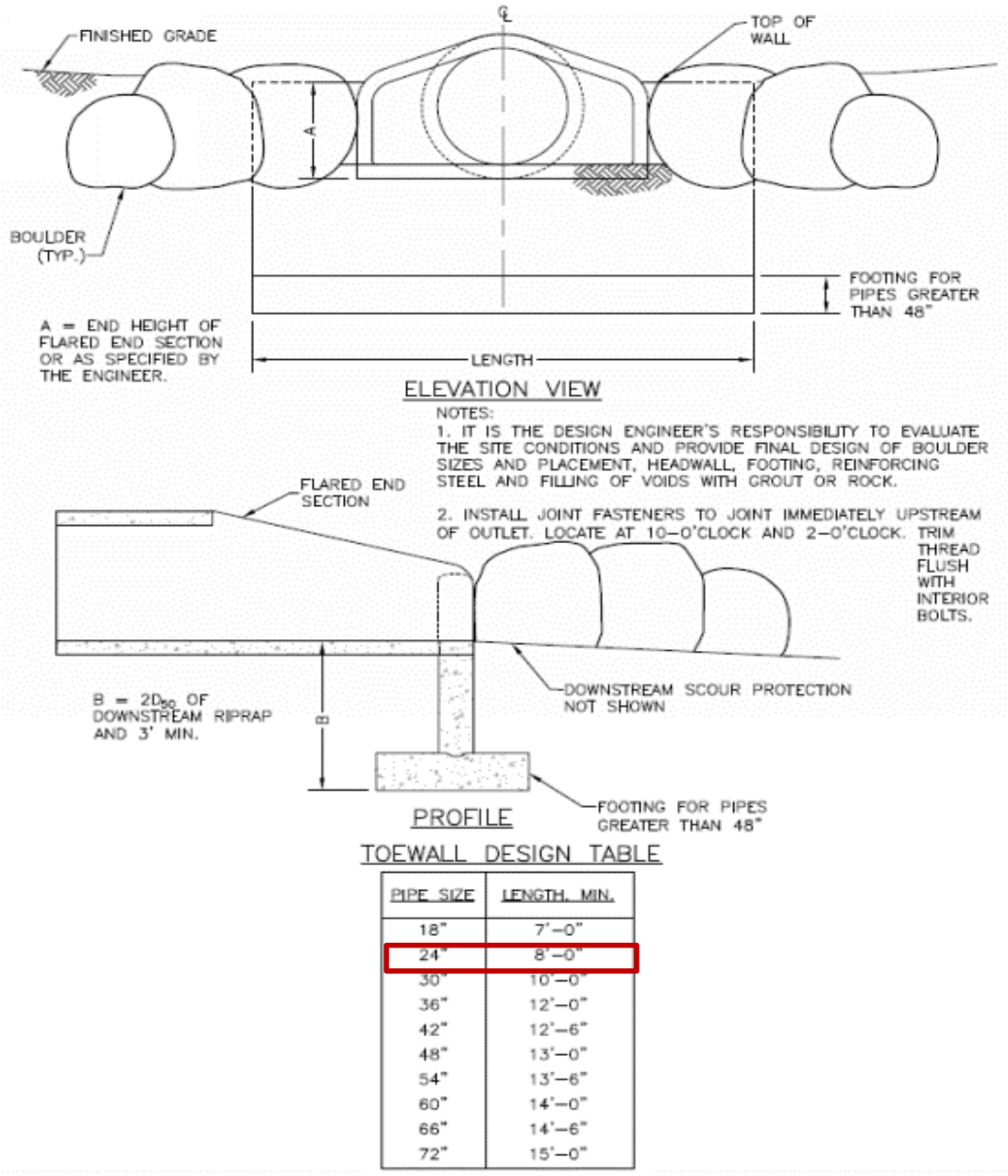


Figure 9-34. Riprap apron detail for culverts in-line with the channel

OUTFALL 300 - OUTLET RIPRAP CACLULATIONS SHEET 5 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.1.2



TOEWALL DESIGN TABLE

PIPE SIZE	LENGTH, MIN.
18"	7'-0"
24"	8'-0"
30"	10'-0"
36"	12'-0"
42"	12'-6"
48"	13'-0"
54"	13'-6"
60"	14'-0"
66"	14'-6"
72"	15'-0"

Figure 9-30. Flared end section (FES) headwall concept

Toe wall Dimensions		
Length =	8	ft
Depth (B) =	1.5	ft
Footing Required =	N	

OUTFALL 400 - OUTLET RIPRAP CACLULATIONS SHEET 1 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

Riprap Sizing per Section 3.2.3

L_p =	$(1/2\tan\Theta)[(A_t/Y_t)-W]$		Length of protection; Equation 9-11
D =	24.00	in	Pipe diamter
	2.00	ft	
Y_n =	1.84	ft	Normal depth of flow at culvert outlet
V =	9.1	ft/s	Flow velocity at culvert outlet
FR =	1.18		Froude Number
	Y		Superciritical flow?
Y_t =	1.00	ft	Tailwater depth
D_a =	1.92		D parameter for supercritical flow
A_t =	Q/V	ft^2	Required area of flow at allowable velocity; Equation 9-12
Q =	28.5	cfs	100-year discharge
V =	5	ft/sec	Max velocity allowed by UDFCD for non-cohesive soils
A_t =	5.70	ft^2	
$Q/D^{1.5}$ =	10.08		Froude Parameter (for Rock Sizing figure 9-38)
Y_t/D =	0.50		Tailwater Depth/Conduit Height
Y_t/D_a =	0.52		(use 0.40 if unknown or hydraulic jump is suspected downstream)

Use Type L Riprap per Figure 9-38	**D_{50} =**	**9**	**in**	See Figure 9-38
Thickness of Riprap Layer = $2D_{50}$ =		**1.5**	**ft**	See Figure 9-34

$Q/D^{2.5}$ =	5.04		Froude Parameter (for Extent of Protection figure 9-35) (must be ≤ 6.0)
$1/2\tan\Theta$ =	3.4		(F_E) Expansion factor; Figure 9-35
L_p =	**13**	**ft**	See Figure 9-34
T =	$2(L_p\tan\Theta)+W$		Width of riprap at furthest downstream point; Equation 9-13
Θ =	$\tan^{-1}[1/(2*F_E)]$		Equation 9-13
Θ =	0.15	°	
T =	**6**	**ft**	See Figure 9-34

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.3

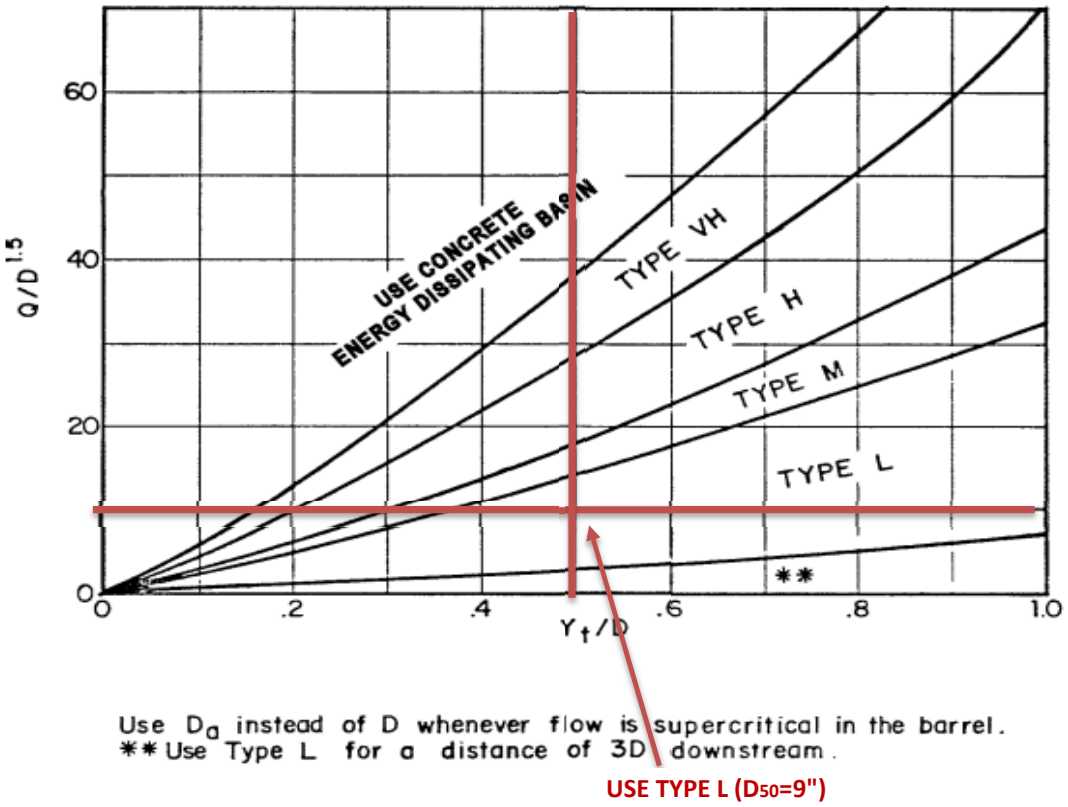


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

THICKNESS REQUIREMENTS FOR GRANULAR BEDDING			
RIPRAP DESIGNATION	MINIMUM BEDDING THICKNESS (INCHES)		
	FINE–GRAINED SOILS [1]		COARSE–GRAINED SOILS [2]
	TYPE I (LOWER LAYER)	TYPE II (UPPER LAYER)	TYPE II
VL (D_{50} = 6 IN)	4	4	6
L (D_{50} = 9 IN)	4	4	6
M (D_{50} = 12 IN)	4	4	6
H (D_{50} = 18 IN)	4	6	8
VH (D_{50} = 24 IN)	4	6	8

NOTES:
1. MAY SUBSTITUTE ONE 12–INCH LAYER OF TYPE II BEDDING. THE SUBSTITUTION OF ONE LAYER OF TYPE II BEDDING SHALL NOT BE PERMITTED AT DROP STRUCTURES. THE USE OF A COMBINATION OF FILTER FABRIC AND TYPE II BEDDING AT DROP STRUCTURES IS ACCEPTABLE.
2. FIFTY PERCENT OR MORE BY WEIGHT RETAINED ON THE #40 SIEVE.

Figure 8-34. Riprap and soil riprap placement and gradation (part 3 of 3)

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.1

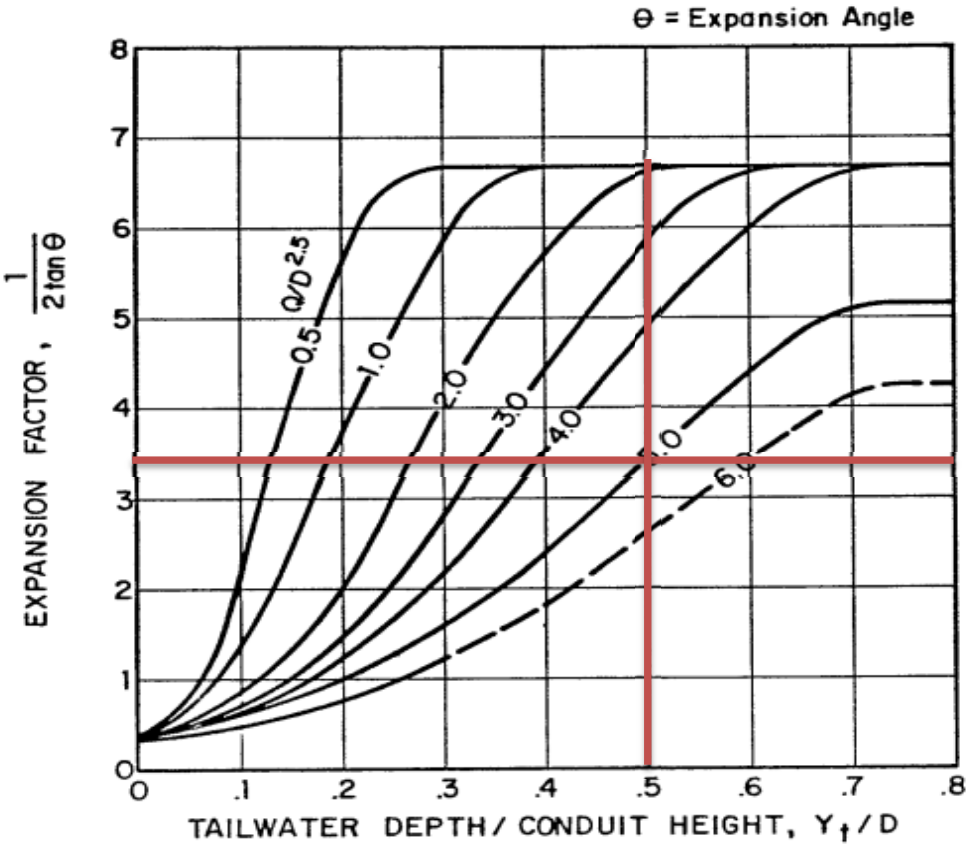


Figure 9-35. Expansion factor for circular conduits

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.1

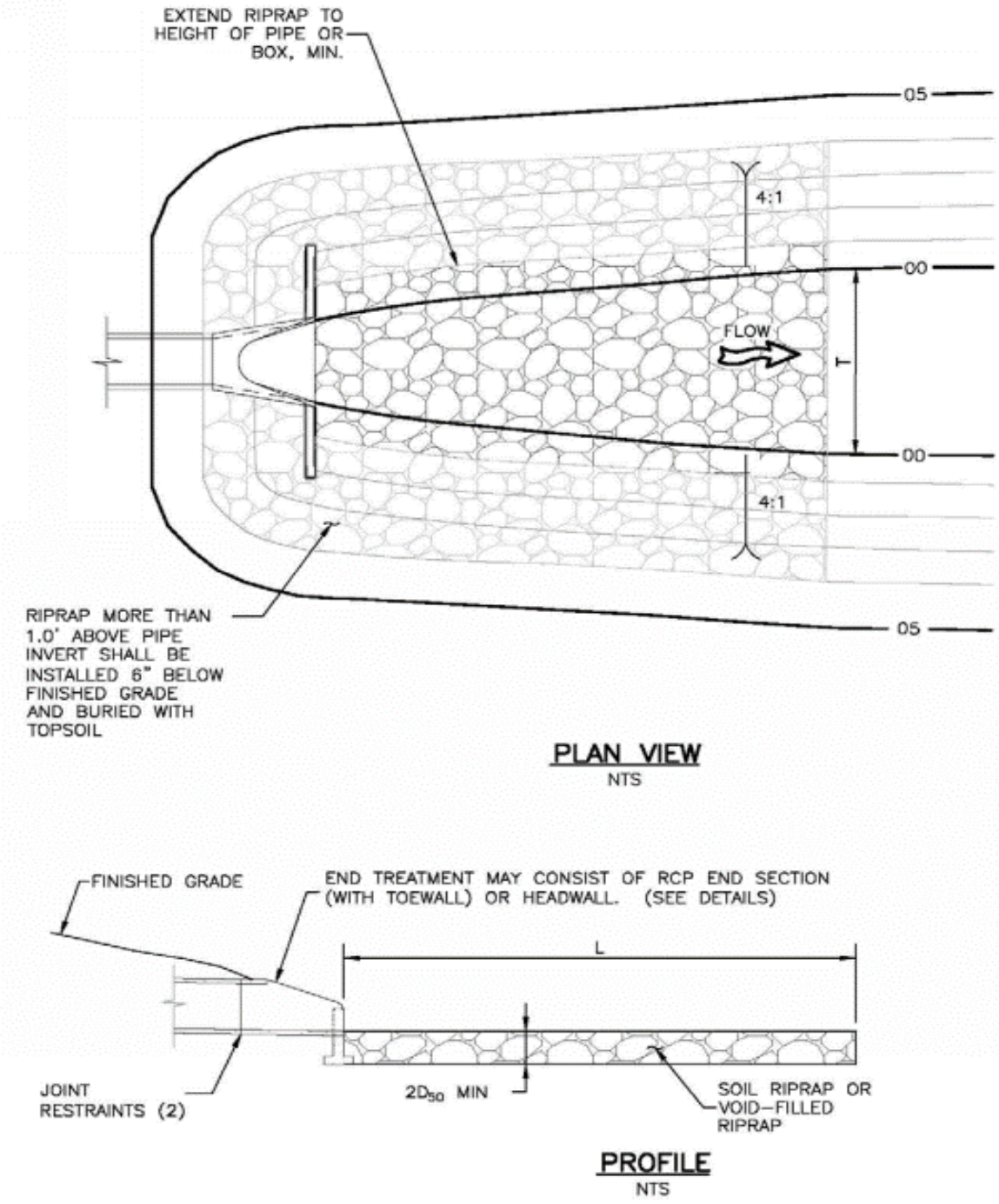
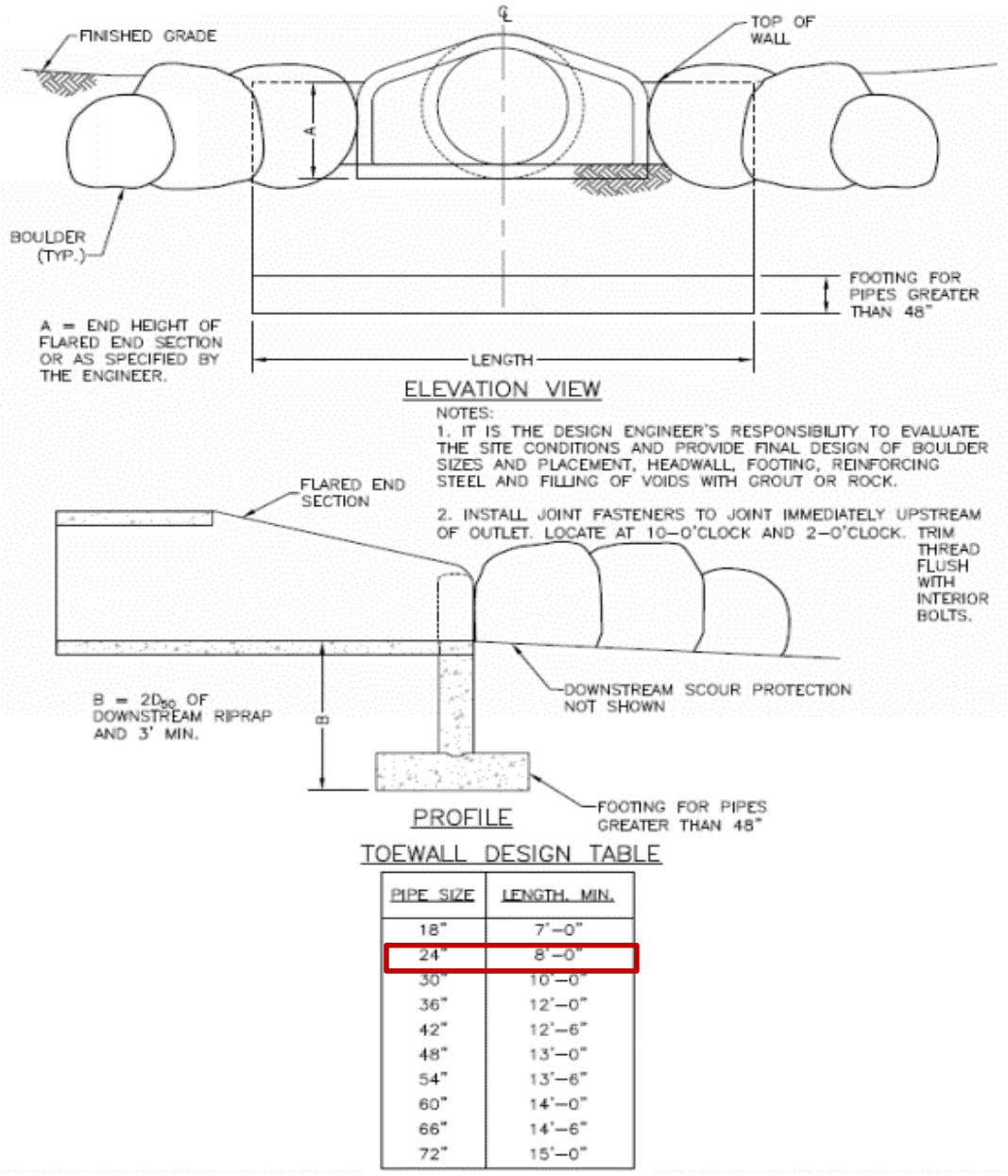


Figure 9-34. Riprap apron detail for culverts in-line with the channel

OUTFALL 400 - OUTLET RIPRAP CACLULATIONS SHEET 5 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.1.2



TOEWALL DESIGN TABLE

PIPE SIZE	LENGTH, MIN.
18"	7'-0"
24"	8'-0"
30"	10'-0"
36"	12'-0"
42"	12'-6"
48"	13'-0"
54"	13'-6"
60"	14'-0"
66"	14'-6"
72"	15'-0"

Figure 9-30. Flared end section (FES) headwall concept

Toe wall Dimensions		
Length =	8	ft
Depth (B) =	1.5	ft
Footing Required =	N	

OUTFALL 500 - OUTLET RIPRAP CACLULATIONS SHEET 1 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.1 & 3.2

Riprap Sizing per Section 3.2.3

L_p =	$(1/2\tan\Theta)[(A_t/Y_t)-W]$		Length of protection; Equation 9-11
D =	24.00	in	Pipe diamter
	2.00	ft	
Y_n =	1.84	ft	Normal depth of flow at culvert outlet
V =	9.0	ft/s	Flow velocity at culvert outlet
FR =	1.17		Froude Number
	Y		Superciritical flow?
Y_t =	1.00	ft	Tailwater depth
D_a =	1.92		D parameter for supercritical flow
A_t =	Q/V	ft^2	Required area of flow at allowable velocity; Equation 9-12
Q =	28.4	cfs	100-year discharge
V =	5	ft/sec	Max velocity allowed by UDFCD for non-cohesive soils
A_t =	5.68	ft^2	
$Q/D^{1.5}$ =	10.04		Froude Parameter (for Rock Sizing figure 9-38)
Y_t/D =	0.50		Tailwater Depth/Conduit Height
Y_t/D_a =	0.52		(use 0.40 if unknown or hydraulic jump is suspected downstream)

Use Type L Riprap per Figure 9-38	**D_{50} =**	**9**	**in**	See Figure 9-38
Thickness of Riprap Layer = $2D_{50}$ =		**1.5**	**ft**	See Figure 9-34

$Q/D^{2.5}$ =	5.02		Froude Parameter (for Extent of Protection figure 9-35) (must be ≤ 6.0)
$1/2\tan\Theta$ =	3.4		(F_E) Expansion factor; Figure 9-35
L_p =	**13**	**ft**	See Figure 9-34
T =	$2(L_p\tan\Theta)+W$		Width of riprap at furthest downstream point; Equation 9-13
Θ =	$\tan^{-1}[1/(2*F_E)]$		Equation 9-13
Θ =	0.15	°	
T =	**6**	**ft**	See Figure 9-34

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.3

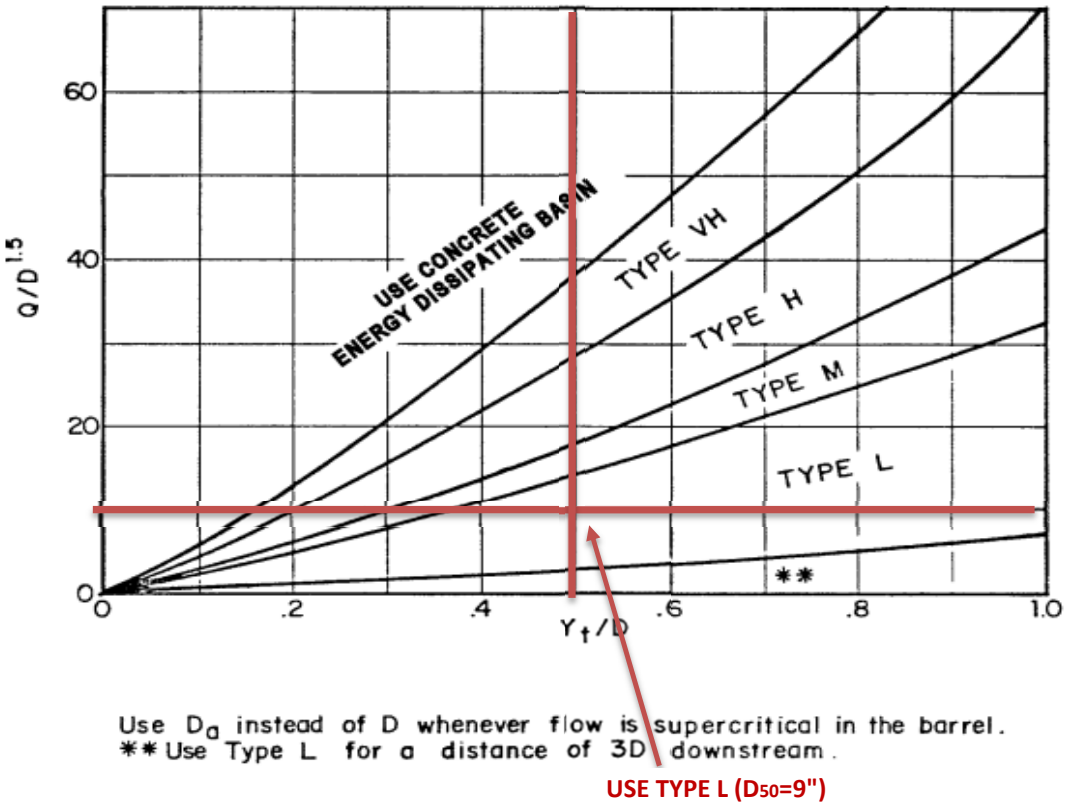


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

THICKNESS REQUIREMENTS FOR GRANULAR BEDDING			
RIPRAP DESIGNATION	MINIMUM BEDDING THICKNESS (INCHES)		
	FINE–GRAINED SOILS [1]		COARSE–GRAINED SOILS [2]
	TYPE I (LOWER LAYER)	TYPE II (UPPER LAYER)	TYPE II
VL (D_{50} = 6 IN)	4	4	6
L (D_{50} = 9 IN)	4	4	6
M (D_{50} = 12 IN)	4	4	6
H (D_{50} = 18 IN)	4	6	8
VH (D_{50} = 24 IN)	4	6	8

NOTES:

1. MAY SUBSTITUTE ONE 12–INCH LAYER OF TYPE II BEDDING. THE SUBSTITUTION OF ONE LAYER OF TYPE II BEDDING SHALL NOT BE PERMITTED AT DROP STRUCTURES. THE USE OF A COMBINATION OF FILTER FABRIC AND TYPE II BEDDING AT DROP STRUCTURES IS ACCEPTABLE.
2. FIFTY PERCENT OR MORE BY WEIGHT RETAINED ON THE #40 SIEVE.

Figure 8-34. Riprap and soil riprap placement and gradation (part 3 of 3)

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.1

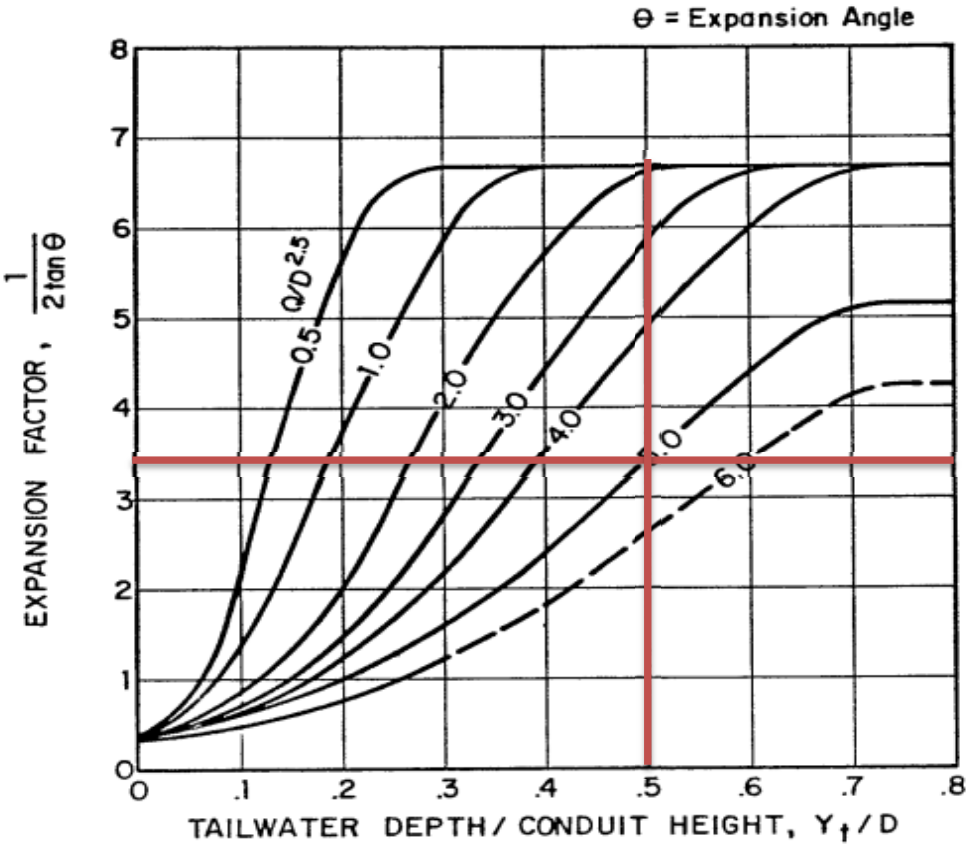


Figure 9-35. Expansion factor for circular conduits

OUTFALL 500 - OUTLET RIPRAP CACLULATIONS SHEET 4 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.2.1

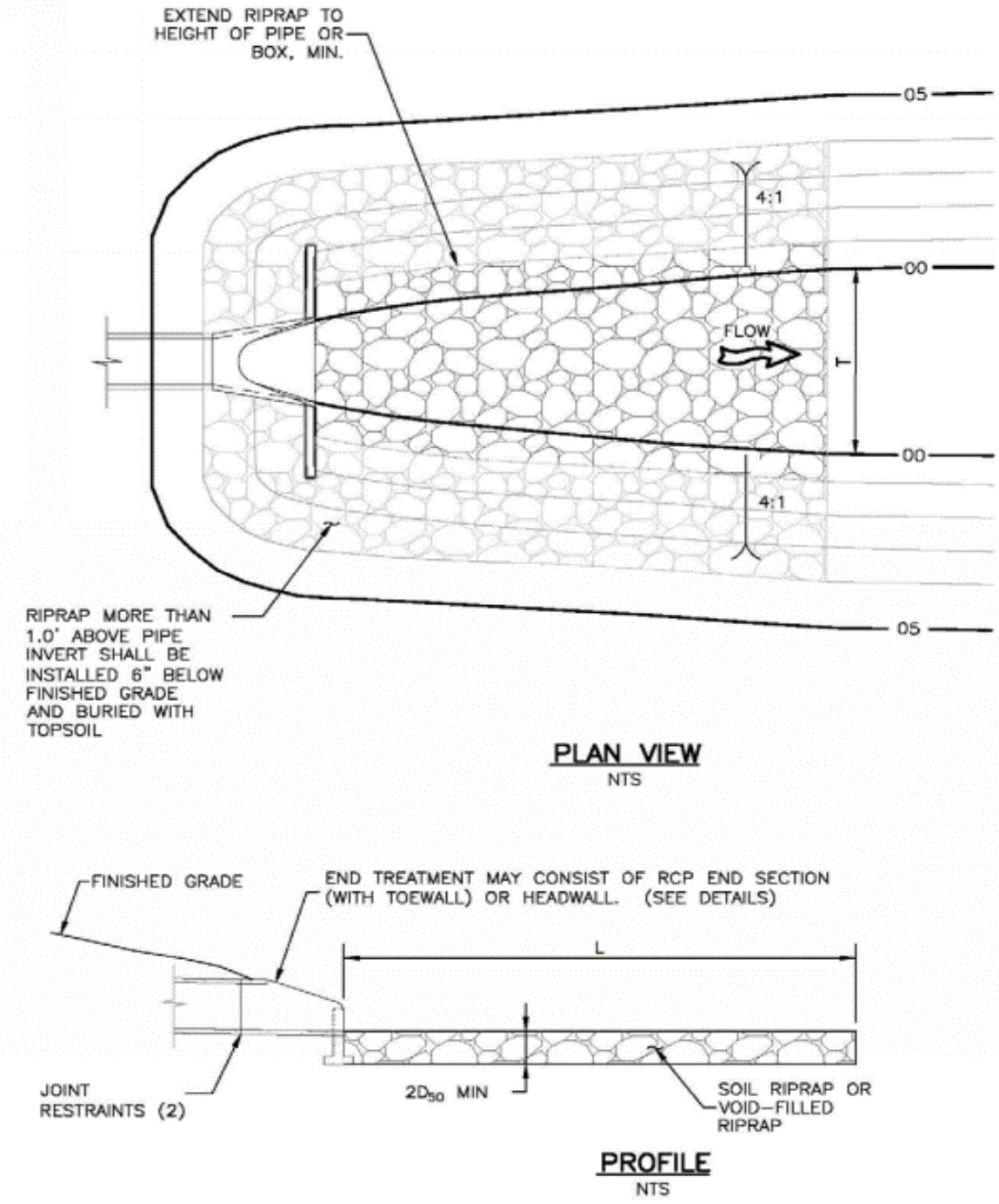
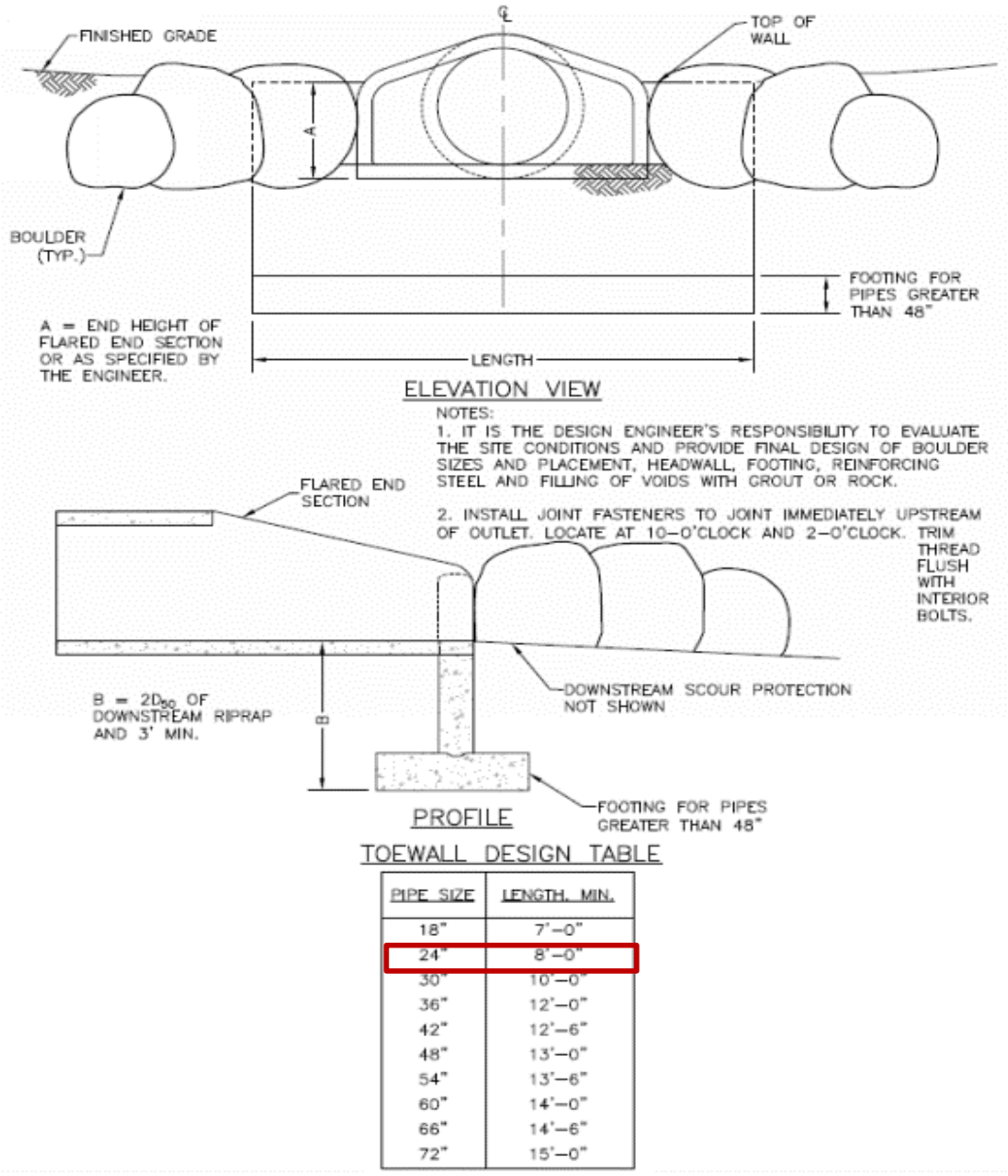


Figure 9-34. Riprap apron detail for culverts in-line with the channel

OUTFALL 500 - OUTLET RIPRAP CACLULATIONS SHEET 5 OF 5

Project: Dawson Trails Parcel B1

Per USDCM Vol. 2, Ch. 9, S. 3.1.2



TOEWALL DESIGN TABLE

PIPE SIZE	LENGTH, MIN.
18"	7'-0"
24"	8'-0"
30"	10'-0"
36"	12'-0"
42"	12'-6"
48"	13'-0"
54"	13'-6"
60"	14'-0"
66"	14'-6"
72"	15'-0"

Figure 9-30. Flared end section (FES) headwall concept

Toe wall Dimensions		
Length =	8	ft
Depth (B) =	1.5	ft
Footing Required =	N	

Appendix D - Water Quality Enhancement Best Management Practices

Summary of Water Quality Conformance to MS4 Permit
Permanent Water Quality Determination Worksheet

Permanent Water Quality Determination Worksheet (Taken from 2019 SDDTCM Sections 13.1.4 and 13.1.5)

Project: Dawson Trails - Filing No. 2 Tract Q (Planning Area B-1) **CRW#** SDP23-0023 **Applicant:** ACM Dawson Trails VIII JV LLC

Section	Questions	Response	Check those that apply	Instructions
1	**Non-applicable Sites**			
	Will the project result in a temporary disturbance of greater than one acre?	No	☐	Proceed to next line.
		Yes	☑	Proceed to section 2.
	Is the project part of a larger common plan of development or sale where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related and are within 1/4 mile of each other? (A common plan of development will generally be documented on a site development plan, master plan, or equivalent, for the property/project)	No	☐	Proceed to next line.
		Yes	☐	Proceed to section 2.
	Is the project within the Cherry Creek Watershed?	Yes	☐	Exclusions do not apply. Permanent water quality is required per Control Regulation 72.7.
		No	☐	Permanent water quality is not required. No further action is required.
2	**Applicable Site Types and Exclusions by Variance**			
	Does the project have more than 35% impervious area on the existing site?	No	☑	Project is an applicable Development Site. Proceed to section 3.
		Yes	☐	Proceed to next line.
	Does the project have greater than 75% impervious area on the existing site?	No	☐	Project is an applicable Redevelopment Site. Proceed to section 3.
		Yes	☐	Proceed to next line.
	Will 100% of the runoff from the existing and proposed site be captured and treated for permanent water quality?	Yes	☐	Document in drainage report. No further action required.
		No	☐	Proceed to next line.
	Do any other water quality exclusions apply to the site?	No	☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
		Yes	☐	Proceed to next section. Following approval of other variances, design remaining site in accordance with Constrained Redevelopment standards and apply for **variance** for Constrained Redevelopment Sites.
3	**Applicable Sites with Other Exclusions by Variance**			
3.1	**Category 1: Roadways, bridges and trails only**			
3.1.1	Is the project a bike or pedestrian trail?	Yes	☐	Proceed to next line.
		No	☑	Proceed to 3.1.2.
	Is the trail for a roadway?	Yes	☐	Proceed to 3.1.2.
		No	☐	Project is excluded. Submit **variance** for Trails Excluded from Permanent Water Quality Requirements.
3.1.2	Is the project primarily used for parking or access to parking?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☑	Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	No	☐	Project is excluded. Submit **variance** for Pavement Management Sites Excluded from Permanent Water Quality Requirements.
		Yes	☑	Proceed to 3.1.4.

3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☑	Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No	☐	Project is excluded. Submit **variance** for Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements.
		Yes	☑	Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No	☐	Existing areas of site are excluded only. Submit **variance** for Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements.
		Yes	☑	This exclusion does not apply. Permanent water quality is required.
3.2	**Category 2: Non-residential and non-commercial projects only**			
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	Yes	☐	Project is excluded. Submit **variance** for Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes	☐	Project is excluded. Submit **variance** for Stream Stabilization Sites Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	Yes	☐	Project is excluded. Submit **variance** for Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	Yes	☐	Project is excluded. Submit **variance** for Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements.
		No	☐	Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.3	**Category 3: Residential and Commercial projects**			
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	Yes	☐	Proceed to next line.
		No	☑	Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No	☐	Project is excluded. Submit **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	Proceed to next line.
	Is the project site greater than 20% impervious?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit **study** along with **variance** for Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☑	Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes	☐	This portion of the project is excluded. Submit **variance** for Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements. Proceed to next line.
		No	☑	Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☑	Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes	☑	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No	☑	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the **drainage report**. No further action is needed.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

Summary of Water Quality Conformance to MS4 Permit

The purpose of this worksheet is to document conformance with the Town of Castle Rock's MS4 permit with regard to permanent water quality on land disturbance projects.

Project Name Dawson Trails - Filing No. 2 Tract Q (Planning Area B-1)

Project Owner ACM Dawson Trails VIII JV LLC

Project Location West side of I-25 just south of the Twin Oaks Subdivision

ToCR Project Number SDP23-0023

Total Site Area 55.98 **acres**

Total Size of Common Plan of Development N/A **acres**

Check all that apply:

- ☑ **Project within Plum Creek Basin**
- ☐ **Project within Cherry Creek Basin**

Estimated construction completion date December 2026

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1. The water quality control measure(s) for applicable development sites shall meet one of the following base design standards as per the SDDTCM Section 14.4. Please select all design standards that were applied to meet conformance with the MS4 on this site.

   - ☑ WQCV standard
   - ☑ Pollutant removal standard
   - ☑ Runoff reduction standard
   - ☐ Applicable site draining to regional WQVC control measure (accepts drainage prior to discharging to WOTS)
   - ☐ Applicable site draining to regional WQVC control facility (with receiving pervious area control measure upstream of WOTS)
   - ☐ Constrained redevelopment sites standard
     - Imperviousness of existing site _____/_____(Imp. Ac/Site Ac) =____%
     - Variance required TCV No. _____
   - ☐ Existing control measure with WQCV per previous criteria standards
     - Reference Construction Permit No. _____
   - ☐ Cherry Creek Basin only, choose one: ☐ Tier 1 ☐ Tier 2 ☐ Tier 3
   - ☐ No control measures provided (See Permanent WQ Worksheet for applicability)

Summary of Water Quality Conformance to MS4 Permit

2. Was an exclusion to water quality applied as per SDDTCM Section 13.1.5? ☐ Yes ☑ No

   i. If yes, please select all that apply, provide total excluded impervious area(s) and submit variance, as applicable: TCV No. _____

- ☐ Pavement management site
  Excluded impervious area: _____ acres
- ☐ Excluded roadway redevelopment
  Excluded impervious area: _____ acres
- ☐ Excluded existing roadway areas
  Excluded impervious area: _____ acres
- ☐ Above ground and below ground utilities
- ☐ Large lot single family home
- ☐ Non-residential and non-commercial infiltration
  Excluded impervious area: _____ acres
- ☐ Land disturbance for land to remain undeveloped
  Excluded impervious area: _____ acres
- ☐ Stream Stabilization Sites
  Excluded impervious area: _____ acres
- ☑ Trails
  Excluded impervious area: _____ acres
- ☐ Oil and Gas Exploration

3. For Development and Redevelopment sites, following any exclusions claimed above, was any portion of the site excluded up to 20% of the site and not to exceed one acre? ☐ Yes ☑ No

   If yes, complete the following:

   Excluded area: _____ acres

   Total Site area: _____ acres, _____ % site excluded

4. For Constrained sites, was any portion of the site excluded up to 50% of the site and not to exceed 50% of the impervious area? ☐ Yes ☐ No

   If yes, complete the following:

   Excluded area: _____ acres

   Excluded impervious area: _____ acres

   Total Site area: _____ acres, _____ % site excluded

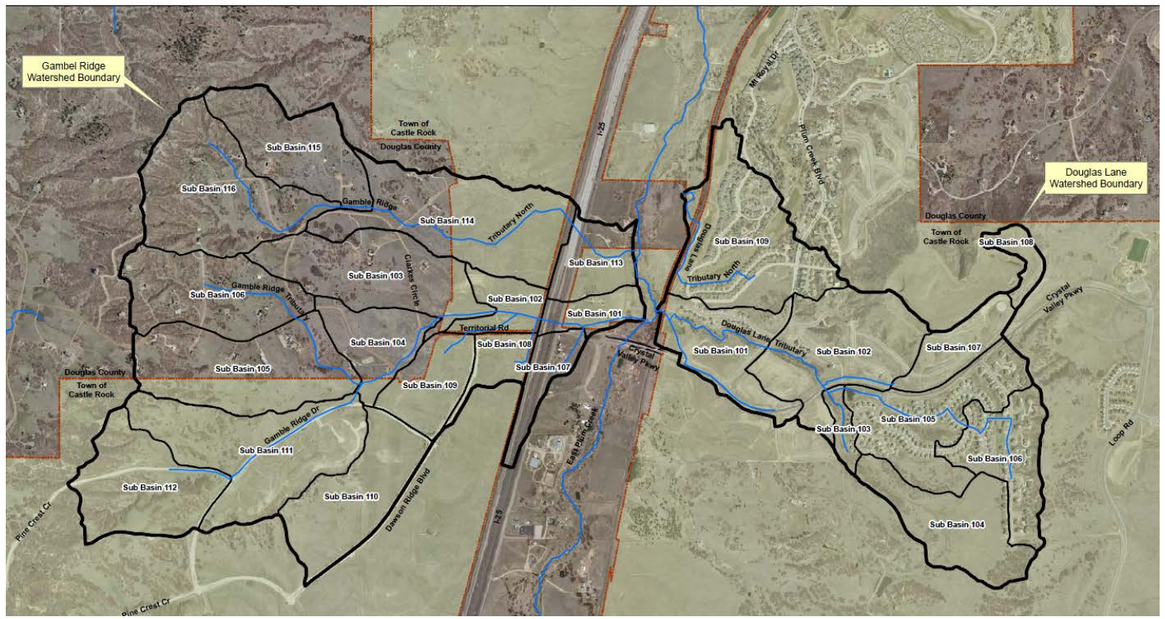
   Total Impervious area: _____ acres, _____ % impervious excluded

Appendix E - Reference Information

Gambel Ridge and Douglas Lane Tributary Watersheds Master Plan
Phase III Drainage Report for Dawson Trails Filing 2 Infrastructure by CORE

FLOOD HAZARD AREA DELINEATION

GAMBEL RIDGE AND DOUGLAS LANE TRIBUTARY WATERSHEDS



Project Sponsor:

TOWN OF CASTLE ROCK

Prepared by:

RESPEC CONSULTING & SERVICES

720 South Colorado Boulevard
Suite 410 S
Denver, Colorado 80246
phone (303) 757-3655
fax (303) 300-1635

July 2014

Reference F - p31

Gambel Ridge Watershed Boundary

Culverts within Gambel Ridge are Undersized for even 10-Year Event

Douglas Lane Watershed Boundary

Culverts at Railroad and I-25 Undersized Convey Approximately 10-Year Event

FHAD DP 1050 corresponds to Design Pt. H0;

Town of Castle Rock
Douglas County
Douglas County
Town of Castle Rock
Douglas County
Town of Castle Rock

Gamble Ridge Tributary North
Gamble Ridge Tributary
Clarkes Circle
Territorial Rd
Gamble Ridge Dr
Dawson Ridge Blvd
Pine Crest Cr
Pine Crest Cr
East Plum Creek
I-25
I-25

115 116 1160 1151 1150 1140 1121 113 1130 114 103 102 1031 1030 1025 1022 1021 1020 101 1010 1011 1071 1070 106 1060 1051 1040 104 1041 1090 1080 108 105 1050 1055 109 1091 107 1110 111 1111 1100 112 1120 110

0 312.5625 1,250 1,875 2,500 Feet

N

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WATER & NATURAL RESOURCES
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Suite 410S
Denver, CO 80246
303-757-3655
www.Respec.com

Legend

- Watershed Boundary
- Subwatershed Boundary
- Town of Castle Rock
- Streams
- Conveyance Link
- XXX Basin ID
- XXX Design Point
- XXXX Detention
- XXXX Conveyance
- XXXX Diversion

Gambel Ridge - Problem Areas
Figure A-4-1
Gambel Ridge and Douglas Lane Tributary Watersheds Master Plan

Reference F - p51

Table B-11 Peak Flow Summary Table - Gamble Ridge Tributary

Station	Design Point	Location	Drainage Area (acres)	Drainage Area (sq.mi.)	100-Year Runoff Volume FuLU (ac-ft)	2-Year Existing (cfs)	2-Year Future (cfs)	5-Year Existing (cfs)	5-Year Future (cfs)	10-Year Existing (cfs)	10-Year Future (cfs)	25-Year Existing (cfs)	25-Year Future (cfs)	50-Year Existing (cfs)	50-Year Future (cfs)	100-Year Existing (cfs)	100-Year Future (cfs)	500-Year Existing (cfs)	500-Year Future (cfs)
	101		22.2	0.03	4.2	4	24	9	39	12	47	21	64	25	74	32	88	43	111
	102		26.0	0.04	5.1	0	41	5	58	9	68	21	90	27	102	36	123	49	153
	103		89.4	0.14	11.0	2	8	14	22	23	33	57	68	72	84	97	112	134	153
	104		43.2	0.07	5.6	2	3	11	12	16	17	34	35	41	43	54	56	73	76
	105		105.6	0.17	15.1	5	17	26	43	39	58	78	104	95	124	126	159	171	213
	106		81.4	0.13	10.2	3	3	24	24	35	35	73	73	89	89	117	117	158	158
	107		24.4	0.04	4.1	12	12	21	21	26	26	40	40	47	47	57	57	74	74
	108		21.0	0.03	4.4	2	29	6	42	8	49	15	65	18	73	24	85	32	106
	109		41.1	0.06	7.8	6	43	15	65	20	78	37	109	44	125	57	149	76	188
	110		76.1	0.12	15.3	11	118	31	173	43	206	77	272	92	308	119	362	159	451
	111		117.6	0.18	20.3	15	86	44	150	61	183	110	267	132	309	171	382	228	489
	112		79.8	0.12	13.4	8	55	30	99	42	127	79	191	95	224	123	272	166	353
	113		35.3	0.06	5.8	8	36	15	53	23	67	45	98	55	115	73	145	99	188
	114		116.6	0.18	17.9	2	71	7	108	19	140	61	222	80	263	114	333	164	438
	115		72.1	0.11	9.0	2	2	17	17	26	26	55	55	67	67	88	88	119	119
	116		112.1	0.18	14.0	4	4	28	28	43	43	91	91	111	111	146	146	198	198
	1010	Outfall to East Plum Creek D/S Study Limits (Gambel Outfall)	727.9	1.14	116.7	54	340	208	600	305	757	609	1,178	741	1,378	977	1,720	1,324	2,243
	1020	Upstream of Railroad and I-25 Crossing	681.3	1.06	108.3	46	316	187	561	278	708	560	1,099	682	1,286	901	1,604	1,224	2,092
	1022		634.3	0.99	98.8	43	281	178	507	264	643	528	1,004	642	1,176	846	1,468	1,147	1,917
	1030		517.0	0.81	75.7	30	154	138	316	206	414	420	688	512	815	677	1,030	919	1,361
	1040	Downstream of Territorial Road and Clarkes Circle	427.6	0.67	64.6	28	148	126	296	186	383	365	621	443	733	581	921	785	1,212
	1050		384.4	0.60	59.0	28	149	119	290	173	373	336	593	406	698	531	874	717	1,148
	1060	Twin Oaks Road and Clarkes Circle	81.4	0.13	10.2	3	3	24	24	35	35	73	73	89	89	117	117	158	158
	1070		705.7	1.10	112.5	52	327	201	579	296	731	590	1,137	718	1,330	947	1,659	1,284	2,163
	1080	Territorial Road and Frontage Road	21.0	0.03	4.4	2	29	6	42	8	49	15	65	18	73	24	85	32	106
	1090		117.3	0.18	23.2	14	139	41	210	58	249	108	343	130	391	169	469	229	593
	1100	Gamble Ridge Drive North and Dawson Ridge Boulevard	76.1	0.12	15.3	11	118	31	173	43	206	77	272	92	308	119	362	159	451
	1110	Gamble Ridge Drive North	197.4	0.31	33.8	20	132	70	236	100	296	185	444	224	517	290	639	390	826
	1120	Gamble Ridge Drive North and Pine Crest Circle	79.8	0.12	13.4	8	55	30	99	42	127	79	191	95	224	123	272	166	353
	1130	Outfall to East Plum Creek D/S Study Limits (North Outfall)	336.1	0.53	46.9	8	94	51	143	87	185	216	310	273	378	380	504	533	693
	1140	Upstream of Railroad and I-25 Crossing	300.8	0.47	41.1	6	71	44	109	77	143	191	272	241	332	334	444	467	608
	1150	Upstream of Clarkes Circle and Briscoe Lane	184.2	0.29	23.0	6	6	45	45	69	69	145	145	177	177	234	234	317	317
	1160		112.1	0.18	14.0	4	4	28	28	43	43	91	91	111	111	146	146	198	198

Reference F - p69

HEC-RAS OUTPUT SUMMARY TABLE
Gambel Ridge

River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
471.3955	10-yr	757	6301.3	6302.76	6302.76	6303.13	0.023441	6.01	166.25	210.18	0.93
471.3955	50-yr	1378	6301.3	6303.12	6303.12	6303.66	0.023663	7.12	244.79	219.89	0.97
471.3955	100-yr	1720	6301.3	6303.29	6303.29	6303.91	0.023985	7.64	281.31	223.94	1
471.3955	500-yr	2243	6301.3	6303.54	6303.54	6304.26	0.023104	8.17	338.04	229.88	1
471.3955	Culv Cap	757	6301.3	6302.76	6302.76	6303.13	0.023441	6.01	166.25	210.18	0.93
794.4155	10-yr	757	6309.07	6312.36	6312.36	6313.47	0.019022	9.58	94.76	43.88	0.96
794.4155	50-yr	1378	6309.07	6313.52	6313.52	6314.98	0.01713	11.28	151.31	52.84	0.97
794.4155	100-yr	1720	6309.07	6314.04	6314.04	6315.66	0.016585	11.98	179.58	56.53	0.97
794.4155	500-yr	2243	6309.07	6314.75	6314.75	6316.56	0.015802	12.83	221.52	61.6	0.97
794.4155	Culv Cap	757	6309.07	6312.36	6312.36	6313.47	0.019022	9.58	94.76	43.88	0.96
1140.495	10-yr	757	6320.76	6324.3	6324.3	6325.45	0.016973	9.73	95.52	42.39	0.93
1140.495	50-yr	1378	6320.76	6325.5	6325.5	6327.02	0.015926	11.52	152.3	52.32	0.94
1140.495	100-yr	1720	6320.76	6326.06	6326.06	6327.71	0.015306	12.19	183.06	57.71	0.94
1140.495	500-yr	2243	6320.76	6326.82	6326.82	6328.61	0.014407	12.95	229.46	65	0.94
1140.495	Culv Cap	757	6320.76	6324.3	6324.3	6325.45	0.016973	9.73	95.52	42.39	0.93
1385.473	10-yr	757	6323.27	6327.62		6328.28	0.008222	7.44	122.85	44.65	0.66
1385.473	50-yr	1378	6323.27	6328.9		6329.88	0.00874	9.26	185.32	52.87	0.71
1385.473	100-yr	1720	6323.27	6329.44		6330.58	0.009065	10.07	214.94	56.3	0.74
1385.473	500-yr	2243	6323.27	6330.12		6331.51	0.0097	11.21	254.66	60.58	0.78
1385.473	Culv Cap	757	6323.27	6327.62		6328.28	0.008222	7.44	122.85	44.65	0.66
1434.485	10-yr	708	6324.11	6328.47	6328.47	6329.97	0.023797	9.84	71.94	24.23	1.01
1434.485	50-yr	1286	6324.11	6330.12	6330.12	6331.98	0.022138	10.93	117.7	32.21	1.01
1434.485	100-yr	1604	6324.11	6330.87	6330.87	6332.8	0.021523	11.14	143.94	37.77	1.01
1434.485	500-yr	2092	6324.11	6331.78	6331.78	6333.85	0.020287	11.56	181.26	44.87	1
1434.485	Culv Cap	650	6324.11	6328.27	6328.27	6329.72	0.02415	9.68	67.16	23.48	1.01
1706.496		Culvert									
1791.644	10-yr	708	6342.8	6352.22	6346.3	6352.26	0.000196	1.57	510.29	383.86	0.12
1791.644	50-yr	1286	6342.8	6352.93	6347.51	6352.99	0.000328	2.2	814.01	471.24	0.16
1791.644	100-yr	1604	6342.8	6353.04	6348.02	6353.13	0.000456	2.63	866.49	479.96	0.19
1791.644	500-yr	2092	6342.8	6353.32	6348.71	6353.44	0.000583	3.06	1005.18	500.69	0.21
1791.644	Culv Cap	650	6342.8	6351.82	6346.17	6351.86	0.000218	1.59	409.13	80.74	0.12
1830.031		Culvert									
1879.06	10-yr	708	6344.67	6353.01	6346.89	6353.04	0.000122	1.69	579.72	163.33	0.1
1879.06	50-yr	1286	6344.67	6353.84	6347.85	6353.93	0.000312	2.88	759.64	318.8	0.17
1879.06	100-yr	1604	6344.67	6354.02	6348.3	6354.16	0.000445	3.48	826.91	397.13	0.2
1879.06	500-yr	2092	6344.67	6354.29	6348.91	6354.47	0.000603	4.13	938.01	425.93	0.23
1879.06	Culv Cap	650	6344.67	6352.55	6346.77	6352.58	0.000109	1.54	521.52	98.85	0.1
2163.353	10-yr	708	6354.02	6356.92	6356.92	6357.88	0.015331	9.19	96.85	52.64	0.96
2163.353	50-yr	1286	6354.02	6357.9	6357.9	6359.15	0.01421	10.8	155.42	66.27	0.97
2163.353	100-yr	1604	6354.02	6358.38	6358.38	6359.71	0.013355	11.33	189.53	75.29	0.96
2163.353	500-yr	2092	6354.02	6358.99	6358.99	6360.45	0.012869	12.14	239.06	89.24	0.97
2163.353	Culv Cap	650	6354.02	6356.8	6356.8	6357.72	0.015287	8.93	90.98	51.02	0.95
2652.073	10-yr	708	6369.23	6371.86	6371.86	6372.71	0.016441	8.79	102.5	63.07	0.98
2652.073	50-yr	1286	6369.23	6372.78	6372.78	6373.84	0.014603	10.2	168.52	82.45	0.97
2652.073	100-yr	1604	6369.23	6373.15	6373.15	6374.33	0.014768	10.98	200.97	93.94	0.99
2652.073	500-yr	2092	6369.23	6373.67	6373.67	6374.98	0.014536	11.87	255.51	116.94	1.01
2652.073	Culv Cap	650	6369.23	6371.76	6371.76	6372.57	0.016599	8.58	95.89	61.1	0.98
3000	10-yr	414	6377.69	6379.58	6379.58	6380.21	0.018474	7.45	68.26	55.69	0.98
3000	50-yr	815	6377.69	6380.33	6380.33	6381.2	0.017291	9.11	116.92	74.08	1.01
3000	100-yr	1030	6377.69	6380.7	6380.7	6381.61	0.016074	9.61	146.76	88.02	0.99
3000	500-yr	1361	6377.69	6381.47	6381.47	6382.16	0.011045	9.32	259.31	206.54	0.85
3000	Culv Cap	414	6377.69	6379.58	6379.58	6380.21	0.018474	7.45	68.26	55.69	0.98
3500	10-yr	414	6387.62	6389.49	6389.49	6390.11	0.018446	7.4	68.75	55.94	0.98
3500	50-yr	815	6387.62	6390.24	6390.24	6391.09	0.016832	8.95	115.91	69.62	0.99
3500	100-yr	1030	6387.62	6390.56	6390.56	6391.51	0.016381	9.55	138.98	75.54	1
3500	500-yr	1361	6387.62	6391	6391	6392.07	0.015886	10.37	175.18	87.37	1.01
3500	Culv Cap	414	6387.62	6389.49	6389.49	6390.11	0.018446	7.4	68.75	55.94	0.98

HEC-RAS OUTPUT SUMMARY TABLE
Gambel Ridge

River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
3906.503	10-yr	414	6400.38	6402.99	6402.99	6403.62	0.014403	6.75	71.23	61.31	0.87
3906.503	50-yr	815	6400.38	6403.83	6403.83	6404.56	0.01163	7.76	138.25	101.93	0.83
3906.503	100-yr	1030	6400.38	6404.12	6404.12	6404.91	0.011416	8.23	170.82	118.63	0.83
3906.503	500-yr	1361	6400.38	6404.59	6404.59	6405.37	0.010045	8.49	234.14	156.42	0.8
3906.503	Culv Cap	414	6400.38	6402.99	6402.99	6403.62	0.014403	6.75	71.23	61.31	0.87
3943.826		Culvert									
3996.147	10-yr	414	6400.59	6405.88	6403.6	6405.95	0.000827	2.39	222.47	151.41	0.23
3996.147	50-yr	815	6400.59	6406.4	6404.66	6406.56	0.001553	3.6	310.35	184.14	0.32
3996.147	100-yr	1030	6400.59	6406.62	6405.43	6406.82	0.00184	4.07	353.12	195.47	0.35
3996.147	500-yr	1361	6400.59	6406.93	6405.87	6407.17	0.002194	4.65	413.92	208.69	0.39
3996.147	Culv Cap	414	6400.59	6405.88	6403.6	6405.95	0.000827	2.39	222.47	151.41	0.23
4428.602	10-yr	383	6415.07	6416.27	6416.27	6416.62	0.021633	6.07	85.83	123.33	0.99
4428.602	50-yr	733	6415.07	6416.67	6416.67	6417.14	0.021183	7.28	139.84	153.53	1.03
4428.602	100-yr	921	6415.07	6416.85	6416.85	6417.36	0.020215	7.65	169.22	169.24	1.02
4428.602	500-yr	1212	6415.07	6417.09	6417.09	6417.65	0.019491	8.19	212.97	193.61	1.02
4428.602	Culv Cap	80	6415.07	6415.69	6415.69	6415.86	0.022653	3.93	26.61	79.4	0.9
4711.959	10-yr	383	6419.43	6421.77	6421.77	6422.57	0.017935	7.18	54.58	39.72	0.95
4711.959	50-yr	733	6419.43	6422.83	6422.83	6423.58	0.010162	7.4	122.55	88.6	0.78
4711.959	100-yr	921	6419.43	6423.12	6423.12	6423.93	0.010146	7.89	149.33	98.07	0.79
4711.959	500-yr	1212	6419.43	6423.39	6423.39	6424.4	0.01181	8.99	177.23	109.36	0.86
4711.959	Culv Cap	80	6419.43	6420.57	6420.38	6420.82	0.013474	3.97	20.17	22.6	0.74
4768.087		Culvert									
4822.813	10-yr	373	6420.5	6424.27	6422.85	6424.47	0.0029	3.6	114.34	99.11	0.4
4822.813	50-yr	698	6420.5	6425.4	6423.75	6425.55	0.001742	3.44	270.78	178.91	0.33
4822.813	100-yr	874	6420.5	6425.77	6424.59	6425.92	0.001605	3.54	343.32	211.3	0.32
4822.813	500-yr	1148	6420.5	6426.18	6424.93	6426.33	0.001576	3.76	434.82	237.32	0.32
4822.813	Culv Cap	80	6420.5	6421.74	6421.46	6421.96	0.010498	3.72	21.51	21.95	0.66
5154.495	10-yr	373	6428.9	6430.42	6430.42	6430.92	0.02023	6.78	68.54	68.75	0.99
5154.495	50-yr	698	6428.9	6430.96	6430.96	6431.65	0.018568	8.04	109.22	80.11	1
5154.495	100-yr	874	6428.9	6431.19	6431.19	6431.97	0.018259	8.57	128.27	84.18	1.01
5154.495	500-yr	1148	6428.9	6431.54	6431.54	6432.41	0.01711	9.14	158.39	89.93	1
5154.495	Culv Cap	80	6428.9	6429.62	6429.62	6429.85	0.025498	4.47	21.51	46.42	0.97
5483.639	10-yr	373	6441.54	6442.6	6442.6	6442.98	0.024034	5.98	77.59	104.17	1.02
5483.639	50-yr	698	6441.54	6443.01	6443.01	6443.53	0.021611	7.05	123.59	119.99	1.03
5483.639	100-yr	874	6441.54	6443.19	6443.19	6443.78	0.021219	7.54	145.4	126.79	1.04
5483.639	500-yr	1148	6441.54	6443.45	6443.45	6444.11	0.020156	8.09	179.16	136.59	1.03
5483.639	Culv Cap	80	6441.54	6442.03	6442.03	6442.2	0.028947	3.91	25.6	76.71	0.99
5983.639	10-yr	35	6459.05	6459.63	6459.63	6459.83	0.028101	3.76	10.12	26.6	0.97
5983.639	50-yr	89	6459.05	6459.99	6459.99	6460.3	0.022197	4.88	21.07	34.61	0.94
5983.639	100-yr	117	6459.05	6460.12	6460.12	6460.48	0.021942	5.33	25.57	36.83	0.96
5983.639	500-yr	158	6459.05	6460.3	6460.3	6460.71	0.020337	5.75	32.39	39.98	0.95
5983.639	Culv Cap	35	6459.05	6459.63	6459.63	6459.83	0.028101	3.76	10.12	26.6	0.97
6483.639	10-yr	35	6476.88	6477.41	6477.41	6477.58	0.026667	3.62	11.3	34.12	0.94
6483.639	50-yr	89	6476.88	6477.71	6477.71	6477.97	0.022806	4.67	23.12	44.32	0.94
6483.639	100-yr	117	6476.88	6477.82	6477.82	6478.12	0.02228	5.06	28.24	47.29	0.96
6483.639	500-yr	158	6476.88	6477.97	6477.97	6478.31	0.021237	5.48	35.5	51.2	0.96
6483.639	Culv Cap	35	6476.88	6477.41	6477.41	6477.58	0.026667	3.62	11.3	34.12	0.94
6983.639	10-yr	35	6493.33	6493.7	6493.7	6493.81	0.029956	3.17	13.68	58.12	0.95
6983.639	50-yr	89	6493.33	6493.9	6493.9	6494.08	0.027662	4.15	27.23	74.65	0.99
6983.639	100-yr	117	6493.33	6493.99	6493.99	6494.19	0.026173	4.43	33.74	80.98	0.98
6983.639	500-yr	158	6493.33	6494.09	6494.09	6494.32	0.025339	4.81	42.24	88.15	0.99
6983.639	Culv Cap	35	6493.33	6493.7	6493.7	6493.81	0.029956	3.17	13.68	58.12	0.95

Effective flow area approaching floodway fringe fill area

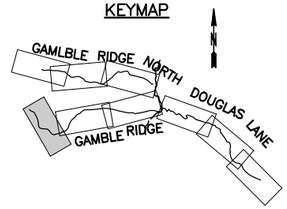
Reference F - p81

BFE in drainageway adjacent segment within Dawson Trails PD boundary

Proposed grading modification in this area of floodway fringe

MATCHLINE SHEET 2 - 50+00

KEYMAP



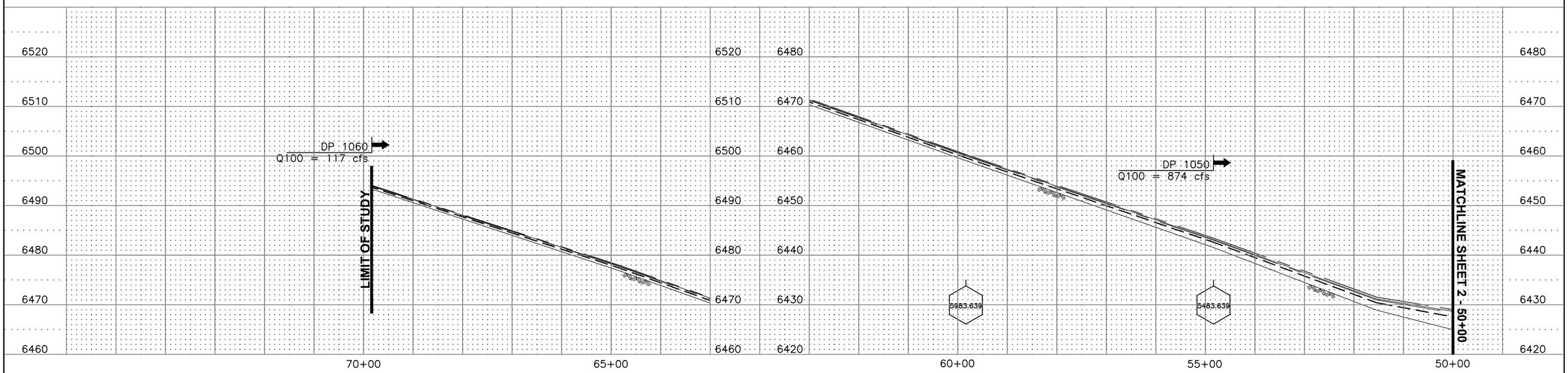
PLAN LEGEND

- XXXX — CROSS SECTION
- 100–YEAR FLOODPLAIN
- 500–YEAR FLOODPLAIN
- FLOODWAY
- BFE
- EXISTING CONTOURS

PROFILE LEGEND

- XXXX — CROSS SECTION
- 500–YEAR FLOODPLAIN
- 100–YEAR FLOODPLAIN
- 50–YEAR FLOODPLAIN
- 10–YEAR FLOODPLAIN
- EXISTING GROUND

HORIZONTAL ORIGINAL SCALE: 1" = 200'
VERTICAL ORIGINAL SCALE: 1" = 20'



NAME: Z:\Castle Rock\TCR Planning Studies\CAD\Dwg-Fhad\Gambel Ridge FHAD P & P.dwg
PLOT DATE: Jul 25, 2014 1:16pm

NO.	DATE	DESCRIPTION	BY

DESIGNED WPF DATE 7/8/13
DRAWN ACT DATE 7/8/13
CHECKED RCO DATE 7/8/13

RESPEC WATER & NATURAL RESOURCES
720 S. COLORADO BLVD. SUITE 410S
DENVER, CO 80246
PH: (303) 757–3655

PROJECT NO.

TOWN OF CASTLE ROCK COLORADO

TOWN OF CASTLE ROCK

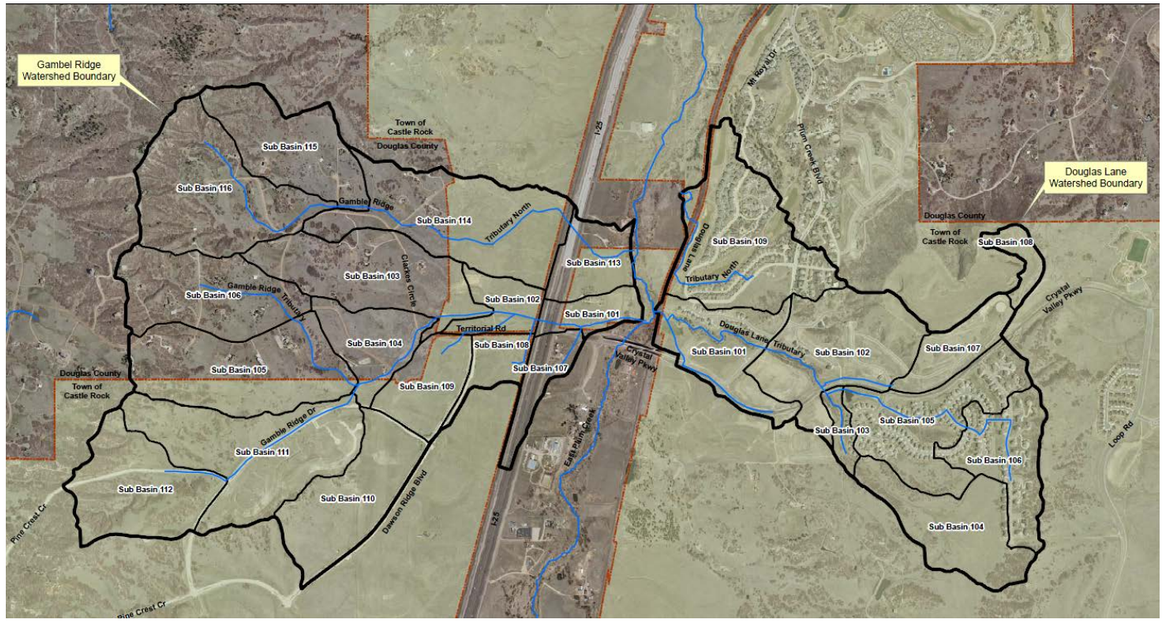
GAMBEL RIDGE
FLOOD HAZARD AREA
DELINEATION

PLAN AND PROFILE
50+00 TO 75+00

FIGURE 3 OF 6

Reference G - Cover

GAMBEL RIDGE AND DOUGLAS LANE TRIBUTARY WATERSHEDS MASTER PLAN



Project Sponsor:

TOWN OF CASTLE ROCK

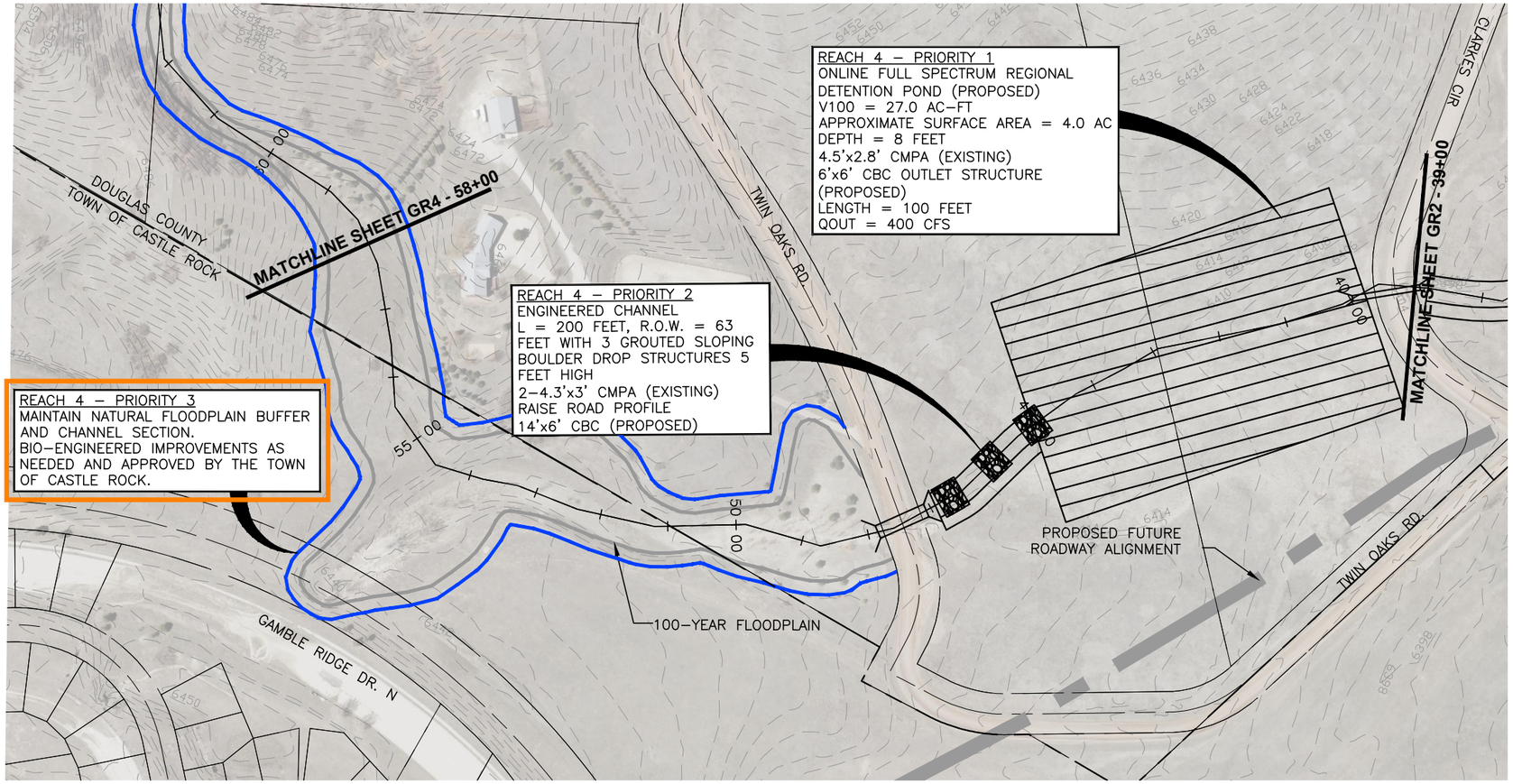
Prepared by:

RESPEC CONSULTING & SERVICES

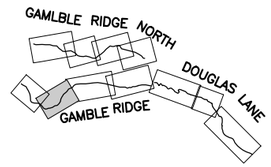
720 South Colorado Boulevard
Suite 410 S
Denver, Colorado 80246
phone (303) 757-3655
fax (303) 300-1635

July 2014

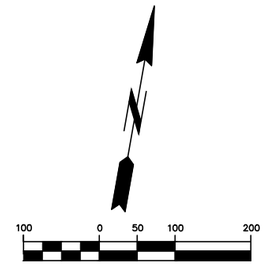
Reference G - p179



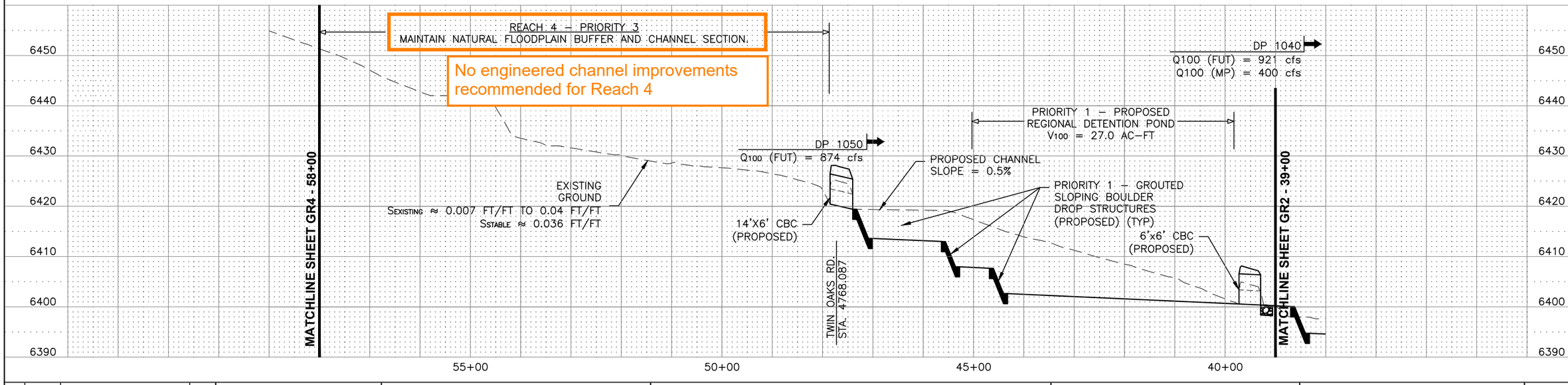
KEYMAP



NOTES:
1. SEE COVER SHEET FOR LEGEND AND NOTES.
2. SEE DETAIL SHEET FOR CHANNEL IMPROVEMENT DETAILS.
3. BUFFER ZONE AREA SHOWN IS DEFINED BY A 20' OFF SET OF THE 100–YEAR FLOODPLAIN BOUNDARY.



HORIZONTAL ORIGINAL SCALE: 1" = 200'
VERTICAL ORIGINAL SCALE: 1" = 20'



NO.	DATE	DESCRIPTION	BY

DESIGNED WPF DATE 7/8/13
DRAWN ACT DATE 7/8/13
CHECKED RCO DATE 7/8/13

RESPEC WATER & NATURAL RESOURCES
720 S. COLORADO BLVD. SUITE 410S
DENVER, CO 80246
PH: (303) 757–3655

PROJECT NO. _____

TOWN OF CASTLE ROCK COLORADO

TOWN OF CASTLE ROCK

GAMBEL RIDGE
PROPOSED IMPROVEMENTS

PLAN AND PROFILE
39+00 TO 58+00

GR3

NAME: Z:\Castle Rock\TCR Planning Studies\CAD\Dwg-PrelimDgn\Gambel Ridge Conceptual Design.dwg
PLOT DATE: Jul 28, 2014 11:52am

Reference I - Cover

PHASE III DRAINAGE REPORT

FOR

DAWSON TRAILS INFRASTRUCTURE 1
TOWN OF CASTLE ROCK, COLORADO
PROJECT NO. 23-00XX

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Report Output files, Link flow, Storage Volume, and outfall loading results have been provided in **Appendix B.**

Gambel Ridge Tributary:

The Gambel Ridge SWMM model is made up of two major drainage basin drainage systems, which together form the Gambel Ridge Tributary. The area in the upper watershed has been designated as "H" basins and the area in the lower water shed has been designated as "C" basins. "C" basins are, by and in large, associated with the Crystal Valley Interchange (CVI) project that is anticipated to be in construction prior to the build out of Infrastructure 1. These drainage systems are built of junction nodes which coincide with their assigned basins. Pipe links, which are primarily used to ensure the maximum flow is conveyed through the system with minimal routing error, dummy links, and storage nodes to represent the proposed flood control facilities. Junctions, links, and storage nodes have been named in accordance with what drainage system they are considered within.

Manning N values are consistent with those used in the North Dawson Tributary SWMM analysis. Please see **Appendix D** for relevant excerpts.

Pond B1 function

The overall drainage concept of the Gambel Ridge Tributary is to use proposed and existing off-site channels as the main flow conveyance with three full spectrum Extended Detention Basins (EDB) utilized to attenuate flows during major storm events. These ponds are identified as Pond B1, Pond B2, and Pond C1. Several parcels within the Gambel Ridge Tributary will have private Water Quality (WQ) ponds which will accomplish Water Quality Capture Volume (WQCV) and Excess Urban Runoff Volume (EURV) treatment before releasing into the Gambel Ridge proposed channel. All WQ ponds have been modeled as junctions.

Within the "H" basins, two in-line EDB's were considered in the SWMM model. These Ponds are identified as Pond B2 and Pond B1. Pond B1's proposed location is on the northern property line, in the northeast corner of Basin B7 of the Proposed Drainage Map. This location also corresponds to Basin H-7 of the Proposed Overall SWMM Map provided in **Appendix D.** Pond B1's proposed location coincides with the "Regional Pond Location A" from the approved PDP. Pond B2's proposed location is on the northeast corner of Basin B1 of the Proposed Drainage Map. This location also corresponds to Basin H-1 of the Proposed Overall SWMM Map provided in **Appendix D** Pond B2's proposed location will be within the northern portion of PL-1.03 of the approved PDP. Pond B1 is part of the Phase I construction process and will be required as part of the Infrastructure 1 construction efforts. No flooding concerns of Pond B1 were immediately present during the interim condition analysis and therefore, Pond B2 will be built as part of the future Phase II construction process and is not required until Parcel B – Phase II begins development. Both the ultimate and interim conditions were analyzed to ensure no adverse effects to downstream storm infrastructure. Inflow hydrograph data was extracted from SWMM and routed through the MHFD Detention workbook for Pond B-1. The outflow of Pond B1 will exit the Dawson Trail Development on the north property line before reentering the site on the west side of the Crystal Valley Interchange and into the "C" basins.

"C" basins within this model largely represent the CVI project area and outfall from Gambel Ride Tributary. Within the "C" basin, one regional EDB was considered in the

SWMM model. This pond is identified as Pond C1. Pond C1's proposed location will be at the intersection of Dawson Trails Boulevard and Crystal Valley Parkway within Basin C3 of the Proposed Drainage Basin Map and will be required as construction begins on and around the Crystal Valley Interchange. This location also corresponds to Basin C-3 of the Proposed Overall SWMM Map provided in **Appendix D**. CORE Consultants collaborated and shared anticipated tributary areas and impervious percentages with others to help facilitate the most efficient and accurate design of this regional facility. Pond C1's design, construction, and certification will ultimately be the responsibility of the consultants and engineers associated with the CVI project. Basins C-7 and C-8 are anticipated to only require WQ and EURV ponds within their basins. Pond C1 will be designed to over detain to account for those basins lack of detention within the Gambel Ridge Tributary system.

Pond B1 function

The storage curve and rating curves for Ponds B-1 and B-2 were developed using the MHFD detention workbook version 4.06. The storage curves in SWMM reflect the most up to date proposed topography available and release rates were developed in coordination with Shrewsberry and Jacob's Engineering to best ensure proposed flow rates do not exceed historic flow conditions. The upstream Pond B2 saw a maximum percent full of 80% with a maximum release of 49 CFS during the 100-year storm event. The downstream Pond B1 saw a maximum percent full of 97.3% with a maximum release of 147 CFS during the 100-year storm event. With the most up to date information available through coordination with the consultants involved in the CVI project, Pond C1 saw a maximum percent full of 93.9% with a maximum release of 115 CFS during the 100-year storm event.

A significant amount of un-detained offsite flow will enter the Gambel Ridge at several points along the main tributary. These offsite basins have been identified as OS-1, OS-2, OS-3, and OS-4. Offsite flow which enters the site will not be treated or detained within the proposed EDBs and will instead be conveyed along their historic drainage routes to Gambel Ridge, entering the tributary at different locations along its reach.

Report Output files, Link flow, Storage Volume, and outfall loading results have been provided in **Appendix B.**

The combined release rates from Pond B1 and Pond C1, in addition to un-detained off-site flow, is below both the existing CUHP analysis completed by CORE consultants and the *Flood Hazard Area Delineation – Gambel Ridge and Douglas Lane Tributary Watersheds* completed by *RESPEC Consulting & Services.* Please see the table on the following page for a results summary of the SWMM model.

SWMM design point coordination

SWMM Key Design Pont Summary				
Key Flow Location	**Model Node**	**Tributary Basins**	**100-year Peak Flow**	**Peak Flow Modeled Time**
Future Pond B2 Release	EDB-B2	H-1	48.5	1:05
Pond B1 Release	EDB-B1	H2-H7	146.6	1:45
Gambel Ridge Offsite + Pond B1 Release	J_6	H1-H7, OS1-OS4	470.9	1:05
Pond C1 Release	EDB-C1	C1-C6	110.1	1:35
Total Basin Release at BNSF Culvert	OUT-1	All	631	1:10
Max Allowable at Outfall	OUT-1	All	640 (Existing)	N/A

C. Hydrology

Colorado Urban Hydrograph Procedure (CUHP) Method

The Colorado Urban Hydrograph Procedure (CUHP) is a hydrologic analysis method based upon the Snyder's Unit Hydrograph. It has been calibrated by the Mile High Flood District (MHFD) for the front range region using local simulations of rainfall-runoff data. CUHP considers physical characteristics of each watershed basin including shape, slope, impervious area, and soil conditions. CUHP is able to produce hydrographs based on these characteristics for each basin and route them together using EPA SWMM. This results in a more accurate representation of peak flow times throughout the drainage systems. The Rational Method is a simpler hydrologic approach and is only able to produce peak flows from each subject basin. For this reason, CUHP was chosen as the preferred methodology when analyzing each major tributary on a holistic scale. Please see **Section III.B** of this report for further discussion on EPA SWMM.

Per the TOCR SDDTCM, Chapter 6, Section 6.2; Table 6-3, CUHP is an appropriate methodology to determine runoff values for basins ranging from 5-3,000 or more acres. For basins less than 5 acres, flows from the rational method will be used to determine peak flow values. CUHP method is used for calculations of major basin flows, offsite flows, and future development area flows.

Runoff calculations use CUHP 2005v_2.0.1 for the minor (5-year) and the major (100-year) storm events. The workbook utilizes rainfall data found in Table 6-1 of the TOCR Criteria Manual as well as imperviousness values for the various land uses per Table 6-3 of the MHFD Criteria Manual Volume 1. Tables 6-1 & 6-3 are included in **Appendix D.**

Maximum Depression Storage, Horton's infiltration Parameters and Disconnected Impervious Areas (DCIA) standard values were determined by using recommended values from Table B-1 & B-2 within the *CUHP 2005 User Manual, Version 2.0.0* dated September 9, 2016, prepared by the MHFD.

- 100-year pond volume of approximately 27.7 acre-feet

The design parameters listed above are critical to ensuring that the Pond C1 can integrate with the ultimate development conditions of the watershed, hydrograph routing of upstream Regional Pond B1, and total anticipated discharge from Gambel Ridge Tributary across the eastern Dawson Trails Planned Development boundary.

The proposed, existing, and future storage facilities with the Gambel Ridge and North Dawson watersheds are listed below. Detention ponds and water quality ponds are listed separately, with full-spectrum ponds shown in both tables:

Flood Control accommodations

Gambel & North Dawson Watersheds: Regional Detention Pond Summary (100-year Detention)					
Pond	**Tributary Basins (CUHP)**	**Tributary Area (ac)**	**% Imp.**	**Req. 100-year Volume (ac-ft)**	**Design/ Const**
B1	B2-B7	170.8	40.0%	13.74	Proposed; Infra 1 by CORE
B2	B1	46.4	7.8%	1.58	Future; P.A. B1, Phase 2
C1	C1-C7	185.2	76.9%	24.42 *	Proposed; CVI by Jacobs
A1	A1-A8	277.5	63.9%	31.39 **	Proposed; Infra 1 by CORE
E1	E1-E3	133.8	32.6%	9.49 **	Future; Planning Area C1

* Basins C7 and C8 are not directly tributary to Pond C1; 100-year volume for C7 is accounted for in Pond C1

** Ponds A1 and E1 are in direct series and accommodate combined required volume between both ponds

WQCV/EURV accommodations

Gambel & North Dawson Watersheds: Water Quality / EURV Pond Summary					
Pond	**Tributary Basins (CUHP)**	**Tributary Area (ac)**	**% Imp.**	**WQCV / EURV (ac-ft)**	**Design/ Const**
B1	H2-H8	170.8	40.0%	2.56	Proposed; Infra 1 by CORE
B2	H1	46.4	7.8%	0.21	Future; Planning Area B1
C1	C1-C6	185.2	76.9%	4.78	Proposed; CVI by Jacobs
E1	C7	9.1	90.8%	0.31	Proposed; DTB North by CORE
C3	C8	20.5	90.8%	0.70 (WQCV only)	Proposed; Costco by CORE
D3	A4	91.9	66.9%		Proposed; Infra 1 by CORE
D4	D4(minor basin)	2.77	100%		Proposed; Infra 1 by CORE

D5	D5(minor basin)	2.64	100%		Proposed; Infra 1 by CORE
A7	A7	35.2	TBD	TBD	Future; Planning Area C1
A6	A6	10.5	TBD	TBD	Future; Planning Area G1
E2	E2	39.7	TBD	TBD	Future; Planning Area D
A8	A8	34.8	TBD	TBD	Future; Planning Area C2,D
E3	E3	44.2	TBD	TBD	Future; Planning Area C1
A6	A6	8.2	TBD	TBD	Future; Planning Area C2

Regional Pond B1 (Full-spectrum)

Regional Pond B1 is proposed in the upper portion of the Gambel Ridge watershed. It is designed to treat and detain developed runoff from the areas of the upper watershed that lie within the planned development boundary. The pond is an off-line from the main drainageway stem, and off-site flows bypass the pond on the north. The pond outfall releases to Gambel Ridge Tributary immediately upstream of its (initial) exit from the planned development. A future regional facility (Pond B2) is planned upstream of Pond B1, when that area develops. Pond B1's storage volume is sized for tributary basins B2 through, downstream of Pond B2. The 100-year release rate for pond B1 is limited to 0.9 of the pre-development peak flow. The 100-year combined flow rate (off-site + detained) in Gamble Ridge Tributary across the Dawson Trails north boundary is less than the existing 100-year drainageway flow. Pond B1's incoming, outgoing and emergency conveyances are designed for the full developed flows in the tributary watershed, without reduction from attenuation in Pond B2.

The normal and emergency flow conditions for Pond B1 were at the forefront during the design process. In the normal outflow condition, flows will leave the pond by way of outlet structure and outfall pipe where they will enter Gambel Ridge Tributary at a point along the northern property line of the site. In the emergency overflow condition, riprap on the downstream side of the spillway will help to dissipate flow energy before storm flows leave the site via their historic conveyance the Gambel Ridge tributary.

Pond B1 function

Regional Pond A1 (Flood Control)

Regional Pond A1 is located at the low point of the North Dawson Watershed, adjacent to the eastern boundary of the planned development. Due to space constraints and land use considerations, it was determined that two regional ponds in series was the most efficient use of space and capital. These ponds are identified as Flood Control Ponds A1 and E1. Please see **Section III.B** of this report for detailed information on how these ponds interact. .

The existing bridge crossing of the BNSF railway over North Dawson Tributary is a critical constraint that affects overall pond design.

INTERIM BUILDOUT CONDITION

Reference I - p73

CUHP SUBCATCHMENTS

Columns with this color heading are for required user-input
Columns with this color heading are for optional override values
Columns with this color heading are for program-calculated values

Parcel B1 hydrology

Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi^2)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
								Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
H-1	J_H1	100-year	0.0725514	0.221212121	0.5210227	0.058	2	0.4	0.1	3.7	0.0018	0.5	0
H-2	J_H2	100-year	0.1187964	0.357386364	0.7441288	0.045	2	0.35	0.05	3.5	0.0018	0.5	0
H-3	J_H3	100-year	0.0086165	0.098863636	0.1977273	0.033	45	0.35	0.05	3	0.0018	0.5	0
H-4	J_H4	100-year	0.0126001	0.131439394	0.2606061	0.045	45	0.35	0.05	3	0.0018	0.5	0
H-5	J_H5	100-year	0.0614924	0.2	0.4005682	0.036	45	0.35	0.05	3.1	0.0018	0.5	0
H-6	J_H6	100-year	0.0394709	0.359469697	0.7189394	0.045	32.6	0.35	0.1	3	0.0018	0.5	0
H-7	J_H7	100-year	0.0100076	0.052840909	0.1988636	0.031	51.5	0.35	0.05	4.2	0.0018	0.6	0
H-8	J_H8	100-year	0.0165493	0.225776932	0.4346471	0.0533	2	0.4	0.01	3	0.0018	0.5	0
C-1	J_C1	100-year	0.0570767	0.16969697	0.4077652	0.06321412	75	0.35	0.1	4	0.0018	0.6	0
C-2	J_C2	100-year	0.0760191	0.226704545	0.4401515	0.022934596	75	0.35	0.1	3.3	0.001745	0.5	0
C-3	J_C3	100-year	0.0508346	0.219128788	0.4765152	0.019475358	75	0.35	0.1	3.4	0.0018	0.5	0
C-4	J_C4	100-year	0.033502	0.130681818	0.3314394	0.024257143	75	0.35	0.1	3.7	0.0018	0.5	0
C-5	J_C5	100-year	0.0377594	0.358522727	0.7168561	0.018124174	80.4	0.35	0.1	3.7	0.0018	0.5	0
C-6	J_C6	100-year	0.0130523	0.21969697	0.5893939	0.01722365	80.4	0.35	0.1	4.2	0.001714589	0.6	0
C-7	J_C7	100-year	0.0210999	0.148674242	0.2666667	0.011576705	88.6	0.35	0.1	4.4	0.001010314	0.9	0
C-8	J_C8	100-year	0.030106	0.130492424	0.2907197	0.015	95	0.35	0.1	4.5	0.001	0.9	0
C-9	J_C9	100-year	0.0066354	0.131439394	0.2712121	0.02	2	0.35	0.05	3	0.0018	0.5	0
OS-1	J_O1	100-year	0.1084434	0.422916667	0.7518939	0.066	8.7	0.4	0.05	4.1	0.0018	0.6	0
OS-2	J_O2	100-year	0.1579448	0.522727273	0.9541667	0.059	3.9	0.4	0.05	4.2	0.0018	0.6	0
OS-3	J_O3	100-year	0.1543167	0.297727273	0.8047348	0.059	10.4	0.4	0.05	3	0.0018	0.5	0
OS-4	J_O4	100-year	0.0394811	0.148106061	0.4035985	0.057	11.5	0.4	0.05	3	0.0018	0.5	0

INTERIM BUILDOUT CONDITION - 100 YEAR STORM EVENT

Reference I - p74

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Parcel B1 hydrology

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.156	0.144	35.8	5.45	18.6	3.85	9.1	61	168,551	1.53	257,995	45.0	66	257,577	1.43
H-2		0.156	0.179	45.5	7.77	23.7	5.49	13.0	78	275,988	1.59	438,879	50.0	96	438,634	1.26
H-3		0.091	0.060	24.3	2.63	12.7	1.86	4.4	11	20,018	2.13	42,550	40.0	12	41,629	2.24
H-4		0.091	0.071	24.9	2.87	13.0	2.03	4.8	15	29,273	2.13	62,222	40.0	18	61,250	2.23
H-5		0.091	0.146	19.4	3.67	10.1	2.59	6.1	95	142,859	2.12	303,242	35.0	106	301,391	2.69
H-6		0.098	0.098	51.8	5.39	27.0	3.81	9.0	23	91,699	1.96	180,024	50.0	33	179,860	1.30
H-7		0.088	0.069	15.5	2.32	8.1	1.64	3.9	19	23,250	2.12	49,276	35.0	19	47,053	2.95
H-8		0.156	0.074	65.8	5.23	34.2	3.70	8.7	8	38,447	1.57	60,277	55.0	10	60,204	0.92
C-1		0.079	0.174	11.4	3.03	6.0	2.14	5.0	150	132,601	2.42	320,554	35.0	141	312,291	3.86
C-2		0.079	0.198	15.3	3.82	7.9	2.70	6.4	149	176,608	2.45	433,560	35.0	168	431,561	3.46
C-3		0.079	0.165	19.5	3.96	10.1	2.80	6.6	78	118,099	2.46	290,053	35.0	95	288,347	2.93
C-4		0.079	0.137	14.6	3.03	7.6	2.14	5.1	69	77,832	2.45	190,843	35.0	74	186,479	3.45
C-5		0.077	0.147	33.6	5.29	17.5	3.74	8.8	34	87,723	2.52	220,908	45.0	50	220,635	2.08
C-6		0.077	0.091	39.5	4.26	20.5	3.01	7.1	10	30,323	2.49	75,389	45.0	15	75,187	1.83
C-7		0.075	0.115	19.0	3.17	9.9	2.24	5.3	33	49,019	2.53	124,250	35.0	41	122,947	3.01
C-8		0.074	0.136	14.4	3.01	7.5	2.13	5.0	63	69,942	2.66	186,018	35.0	70	181,518	3.61
C-9		0.156	0.049	77.2	4.40	40.2	3.11	7.3	3	15,415	1.62	24,918	60.0	4	24,888	0.83
OS-1		0.134	0.150	46.5	6.86	24.2	4.84	11.4	70	251,936	1.50	377,209	50.0	81	377,215	1.17
OS-2		0.150	0.196	50.7	9.14	26.3	6.46	15.2	94	366,937	1.44	526,741	55.0	108	526,352	1.07
OS-3		0.128	0.169	35.3	6.07	18.3	4.29	10.1	131	358,509	1.66	596,421	45.0	153	596,044	1.55
OS-4		0.125	0.090	33.6	3.81	17.4	2.69	6.4	35	91,722	1.68	153,820	45.0	40	153,345	1.58

ULTIMATE BUILDOUT CONDITION

Reference I - p75

CUHP SUBCATCHMENTS

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Parcel B1 hydrology

Subcatchment Name	EPA SWMM Target Node	Raingage	Area (mi^2)	Length to Centroid (mi)	Length (mi)	Slope (ft/ft)	Percent Imperviousness	Maximum Depression Storage (Watershed inches)		Horton's Infiltration Parameters			DCIA
								Pervious	Impervious	Initial Rate (in/hr)	Decay Coefficient (1/seconds)	Final Rate (in/hr)	Level 0, 1, or 2
H-1	H1	2-Year	0.0725514	0.221212121	0.5210227	0.058	7.8	0.4	0.1	3.7	0.0018	0.5	0
H-2	H2	2-Year	0.1187964	0.357386364	0.7441288	0.045	28.2	0.35	0.05	3.5	0.0018	0.5	0
H-3	H3	2-Year	0.0086165	0.098863636	0.1977273	0.033	45	0.35	0.05	3	0.0018	0.5	0
H-4	H4	2-Year	0.0126001	0.131439394	0.2606061	0.045	45	0.35	0.05	3	0.0018	0.5	0
H-5	H5	2-Year	0.0614924	0.2	0.4005682	0.036	45	0.35	0.05	3.1	0.0018	0.5	0
H-6	H6	2-Year	0.0394709	0.359469697	0.7189394	0.045	32.6	0.35	0.1	3	0.0018	0.5	0
H-7	H7	2-Year	0.0100076	0.052840909	0.1988636	0.031	51.5	0.35	0.05	4.2	0.0018	0.6	0
H-8	H8	2-Year	0.0165493	0.225776932	0.4346471	0.0533	2	0.4	0.01	3	0.0018	0.5	0
C-1	C1	2-Year	0.0570767	0.16969697	0.4077652	0.06321412	75	0.35	0.1	4	0.0018	0.6	0
C-2	C2	2-Year	0.0760191	0.226704545	0.4401515	0.022934596	75	0.35	0.1	3.3	0.001745	0.5	0
C-3	C3	2-Year	0.0508346	0.219128788	0.4765152	0.019475358	75	0.35	0.1	3.4	0.0018	0.5	0
C-4	C4	2-Year	0.033502	0.130681818	0.3314394	0.024257143	75	0.35	0.1	3.7	0.0018	0.5	0
C-5	C5	2-Year	0.0377594	0.358522727	0.7168561	0.018124174	80.4	0.35	0.1	3.7	0.0018	0.5	0
C-6	C6	2-Year	0.0130523	0.21969697	0.5893939	0.01722365	80.4	0.35	0.1	4.2	0.001714589	0.6	0
C-7	C7	2-Year	0.0210999	0.148674242	0.2666667	0.011576705	88.6	0.35	0.1	4.4	0.001010314	0.9	0
C-8	C8	2-Year	0.030106	0.130492424	0.2907197	0.015	95	0.35	0.1	4.5	0.001	0.9	0
C-9	C9	2-Year	0.0066354	0.131439394	0.2712121	0.02	2	0.35	0.05	3	0.0018	0.5	0
OS-1	O1	2-Year	0.1084434	0.422916667	0.7518939	0.066	8.7	0.4	0.05	4.1	0.0018	0.6	0
OS-2	O2	2-Year	0.1579448	0.522727273	0.9541667	0.059	3.9	0.4	0.05	4.2	0.0018	0.6	0
OS-3	O3	2-Year	0.1543167	0.297727273	0.8047348	0.059	10.4	0.4	0.05	3	0.0018	0.5	0
OS-4	O4	2-Year	0.0394811	0.148106061	0.4035985	0.057	11.5	0.4	0.05	3	0.0018	0.5	0

ULTIMATE BUILDOUT CONDITION - 2 YEAR STORM EVENT

Reference I - p76

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Parcel B1 hydrology

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.140	0.130	35.5	5.05	18.5	3.57	8.4	61	168,551	0.07	11,034	40.0	3	11,009	0.06
H-2		0.104	0.141	38.7	5.68	20.1	4.01	9.5	92	275,988	0.32	88,762	40.0	21	88,680	0.27
H-3		0.092	0.059	24.8	2.63	12.9	1.86	4.4	10	20,018	0.52	10,368	35.0	3	10,151	0.53
H-4		0.092	0.070	25.4	2.88	13.2	2.03	4.8	15	29,273	0.52	15,161	35.0	4	14,940	0.53
H-5		0.092	0.144	19.8	3.68	10.3	2.60	6.1	93	142,859	0.52	73,722	30.0	25	73,175	0.64
H-6		0.100	0.095	54.0	5.44	28.1	3.85	9.1	22	91,699	0.37	33,623	40.0	6	33,596	0.23
H-7		0.089	0.068	15.8	2.32	8.2	1.64	3.9	19	23,250	0.54	12,647	30.0	5	12,098	0.73
H-8		0.157	0.074	65.8	5.25	34.2	3.71	8.8	8	38,447	0.04	1,465	45.0	0	1,464	0.03
C-1		0.079	0.173	11.5	3.03	6.0	2.14	5.1	149	132,601	0.78	103,829	30.0	45	101,107	1.24
C-2		0.079	0.197	15.4	3.83	8.0	2.70	6.4	148	176,608	0.80	141,348	30.0	54	140,725	1.12
C-3		0.079	0.164	19.6	3.97	10.2	2.81	6.6	78	118,099	0.80	94,626	30.0	31	94,031	0.94
C-4		0.079	0.136	14.7	3.04	7.6	2.15	5.1	68	77,832	0.80	62,147	30.0	24	60,766	1.12
C-5		0.077	0.146	33.8	5.29	17.6	3.74	8.8	34	87,723	0.86	75,055	35.0	16	74,963	0.68
C-6		0.077	0.091	39.7	4.27	20.7	3.02	7.1	10	30,323	0.84	25,500	40.0	5	25,432	0.58
C-7		0.075	0.115	19.0	3.18	9.9	2.25	5.3	33	49,019	0.92	45,075	30.0	15	44,607	1.08
C-8		0.074	0.136	14.5	3.01	7.5	2.13	5.0	62	69,942	1.00	70,115	30.0	27	68,423	1.38
C-9		0.157	0.049	77.2	4.42	40.2	3.13	7.4	3	15,415	0.09	1,340	45.0	0	1,338	0.05
OS-1		0.139	0.154	46.7	7.03	24.3	4.96	11.7	70	251,936	0.07	16,883	40.0	4	16,884	0.05
OS-2		0.152	0.199	50.7	9.25	26.4	6.54	15.4	93	366,937	0.03	10,527	45.0	2	10,520	0.02
OS-3		0.132	0.173	35.5	6.21	18.4	4.39	10.4	131	358,509	0.11	40,206	40.0	11	40,179	0.11
OS-4		0.128	0.092	33.8	3.87	17.6	2.74	6.5	35	91,722	0.12	11,260	40.0	3	11,229	0.13

ULTIMATE BUILDOUT CONDITION - 5 YEAR STORM EVENT

Reference I - p77

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Parcel B1 hydrology

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.139	0.129	35.4	5.01	18.4	3.54	8.4	61	168,551	0.32	54,347	40.0	15	54,227	0.33
H-2		0.103	0.143	37.8	5.65	19.7	3.99	9.4	94	275,988	0.62	171,597	40.0	40	171,306	0.53
H-3		0.091	0.060	24.6	2.63	12.8	1.86	4.4	10	20,018	0.85	16,973	30.0	5	16,614	0.90
H-4		0.091	0.071	25.2	2.87	13.1	2.03	4.8	15	29,273	0.85	24,820	30.0	7	24,439	0.89
H-5		0.091	0.145	19.6	3.68	10.2	2.60	6.1	94	142,859	0.84	120,707	30.0	43	119,890	1.09
H-6		0.099	0.096	53.1	5.42	27.6	3.83	9.0	22	91,699	0.68	62,565	40.0	11	62,507	0.43
H-7		0.088	0.068	15.7	2.32	8.1	1.64	3.9	19	23,250	0.86	19,981	30.0	8	19,101	1.20
H-8		0.157	0.074	65.8	5.25	34.2	3.71	8.7	8	38,447	0.29	11,330	45.0	2	11,317	0.19
C-1		0.079	0.173	11.5	3.03	6.0	2.14	5.0	149	132,601	1.14	151,819	30.0	67	147,868	1.82
C-2		0.079	0.197	15.3	3.82	8.0	2.70	6.4	149	176,608	1.17	207,162	30.0	80	206,234	1.64
C-3		0.079	0.165	19.5	3.97	10.2	2.80	6.6	78	118,099	1.17	138,658	30.0	45	137,811	1.38
C-4		0.079	0.136	14.7	3.04	7.6	2.15	5.1	69	77,832	1.17	91,068	30.0	35	89,021	1.63
C-5		0.077	0.146	33.7	5.29	17.5	3.74	8.8	34	87,723	1.24	108,383	35.0	23	108,251	0.96
C-6		0.077	0.091	39.6	4.26	20.6	3.01	7.1	10	30,323	1.21	36,726	35.0	7	36,629	0.82
C-7		0.075	0.115	19.0	3.18	9.9	2.25	5.3	33	49,019	1.28	62,765	30.0	20	62,111	1.48
C-8		0.074	0.136	14.5	3.01	7.5	2.13	5.0	62	69,942	1.39	97,150	30.0	36	94,804	1.85
C-9		0.157	0.049	77.2	4.42	40.2	3.12	7.4	3	15,415	0.34	5,297	45.0	1	5,290	0.19
OS-1		0.137	0.152	46.6	6.95	24.2	4.91	11.6	70	251,936	0.26	64,435	40.0	15	64,438	0.22
OS-2		0.152	0.198	50.7	9.21	26.4	6.51	15.3	93	366,937	0.20	72,312	45.0	17	72,264	0.17
OS-3		0.130	0.171	35.4	6.15	18.4	4.35	10.3	131	358,509	0.39	139,202	40.0	39	139,114	0.40
OS-4		0.126	0.090	33.7	3.84	17.5	2.71	6.4	35	91,722	0.40	36,795	35.0	10	36,688	0.41

ULTIMATE BUILDOUT CONDITION - 100 YEAR STORM EVENT

Reference I - p78

Summary of Unit Hydrograph Parameters Used By Program and Calculated Results (Version 2.0.1)

Parcel B1 hydrology

		Unit Hydrograph Parameters and Results									Excess Precip.		Storm Hydrograph			
Catchment Name/ID	User Comment for Catchment	CT	Cp	W50 (min.)	W50 Before Peak	W75 (min.)	W75 Before Peak	Time to Peak (min.)	Peak (cfs)	Volume (c.f)	Excess (inches)	Excess (c.f.)	Time to Peak (min.)	Peak Flow (cfs)	Total Volume (c.f.)	Runoff per Unit Area (cfs/acre)
H-1		0.137	0.127	35.4	4.96	18.4	3.50	8.3	62	168,551	1.60	269,381	45.0	69	268,785	1.48
H-2		0.102	0.146	36.6	5.61	19.0	3.96	9.3	97	275,988	1.90	524,509	45.0	125	523,680	1.64
H-3		0.091	0.060	24.3	2.63	12.7	1.86	4.4	11	20,018	2.13	42,550	40.0	12	41,629	2.24
H-4		0.091	0.071	24.9	2.87	13.0	2.03	4.8	15	29,273	2.13	62,222	40.0	18	61,250	2.23
H-5		0.091	0.146	19.4	3.67	10.1	2.59	6.1	95	142,859	2.12	303,242	35.0	106	301,391	2.69
H-6		0.098	0.098	51.8	5.39	27.0	3.81	9.0	23	91,699	1.96	180,024	50.0	33	179,860	1.30
H-7		0.088	0.069	15.5	2.32	8.1	1.64	3.9	19	23,250	2.12	49,276	35.0	19	47,053	2.95
H-8		0.156	0.074	65.8	5.23	34.2	3.70	8.7	8	38,447	1.57	60,277	55.0	10	60,204	0.92
C-1		0.079	0.174	11.4	3.03	6.0	2.14	5.0	150	132,601	2.42	320,554	35.0	141	312,291	3.86
C-2		0.079	0.198	15.3	3.82	7.9	2.70	6.4	149	176,608	2.45	433,560	35.0	168	431,561	3.46
C-3		0.079	0.165	19.5	3.96	10.1	2.80	6.6	78	118,099	2.46	290,053	35.0	95	288,347	2.93
C-4		0.079	0.137	14.6	3.03	7.6	2.14	5.1	69	77,832	2.45	190,843	35.0	74	186,479	3.45
C-5		0.077	0.147	33.6	5.29	17.5	3.74	8.8	34	87,723	2.52	220,908	45.0	50	220,635	2.08
C-6		0.077	0.091	39.5	4.26	20.5	3.01	7.1	10	30,323	2.49	75,389	45.0	15	75,187	1.83
C-7		0.075	0.115	19.0	3.17	9.9	2.24	5.3	33	49,019	2.53	124,250	35.0	41	122,947	3.01
C-8		0.074	0.136	14.4	3.01	7.5	2.13	5.0	63	69,942	2.66	186,018	35.0	70	181,518	3.61
C-9		0.156	0.049	77.2	4.40	40.2	3.11	7.3	3	15,415	1.62	24,918	60.0	4	24,888	0.83
OS-1		0.134	0.150	46.5	6.86	24.2	4.84	11.4	70	251,936	1.50	377,209	50.0	81	377,215	1.17
OS-2		0.150	0.196	50.7	9.14	26.3	6.46	15.2	94	366,937	1.44	526,741	55.0	108	526,352	1.07
OS-3		0.128	0.169	35.3	6.07	18.3	4.29	10.1	131	358,509	1.66	596,421	45.0	153	596,044	1.55
OS-4		0.125	0.090	33.6	3.81	17.4	2.69	6.4	35	91,722	1.68	153,820	45.0	40	153,345	1.58

Parcel B1 SWMM
Key Design Points

Link Flow Summary

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow	Max / Full Depth
L_C9	DUMMY	3.53	0	01:00			
L_1	CONDUIT	611.07	0	01:12	9.52	0.70	0.62
L_10	CONDUIT	307.92	0	01:03	5.26	0.07	0.30
L_11	CONDUIT	308.24	0	00:59	10.22	0.46	0.47
L_12	CONDUIT	308.27	0	00:59	5.26	0.07	0.30
L_12-1	CONDUIT	188.52	0	00:53	4.52	0.04	0.24
L_12-2	CONDUIT	81.32	0	00:51	3.49	0.02	0.16
L_13	CONDUIT	144.39	0	01:38	8.90	0.75	0.65
L_13-1	DUMMY	32.71	0	00:51			
L_13-2	CONDUIT	32.71	0	00:51	10.36	0.69	0.61
L_14	DUMMY	266.96	0	00:51			
L_15	CONDUIT	266.96	0	00:51	17.42	0.25	0.34
L_16	CONDUIT	170.07	0	00:55	3.03	0.20	0.53
L_17	CONDUIT	171.77	0	00:51	15.04	0.09	0.20
L_18	CONDUIT	160.80	0	00:51	2.96	0.19	0.52
L_19	CONDUIT	66.23	0	00:46	12.21	0.86	0.72
L_2	CONDUIT	611.06	0	01:12	3.86	0.28	0.50
L_2-1	DUMMY	69.30	0	00:36			
L_2-2	CONDUIT	69.30	0	00:36	12.42	0.23	0.33
L_3-1	DUMMY	108.37	0	01:38			
L_3-10	CONDUIT	140.54	0	00:35	14.77	0.85	0.71

Reference I - p153

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow	Max / Full Depth
L_3-11	DUMMY	73.59	0	00:36			
L_3-12	CONDUIT	73.59	0	00:36	12.74	0.64	0.58
L_3-13	DUMMY	50.24	0	00:45			
L_3-14	CONDUIT	50.24	0	00:45	11.52	0.30	0.38
L_3-2	CONDUIT	108.37	0	01:38	13.65	0.94	0.77
L_3-3	DUMMY	0.00	0	00:00			
L_3-4	CONDUIT	0.00	0	00:00	0.00	0.00	0.00
L_3-5	DUMMY	389.80	0	00:45			
L_3-6	CONDUIT	389.80	0	00:45	9.67	0.37	0.42
L_3-7	CONDUIT	374.85	0	00:44	4.04	0.40	0.70
L_3-8	CONDUIT	300.11	0	00:37	18.00	0.29	0.37
L_3-9	CONDUIT	136.79	0	00:38	2.92	0.16	0.48
L_4	CONDUIT	500.48	0	01:05	3.63	0.23	0.45
L_5	CONDUIT	498.38	0	01:03	10.50	0.84	0.74
L_5-1	DUMMY	40.60	0	00:36			
L_5-2	CONDUIT	40.60	0	00:36	10.80	0.86	0.72
L_6	CONDUIT	473.95	0	01:03	3.56	0.21	0.43
L_6-1	DUMMY	39.79	0	00:45			
L_6-2	CONDUIT	39.79	0	00:45	10.77	0.84	0.70
L_7	CONDUIT	440.10	0	01:02	3.48	0.20	0.41
L_8	CONDUIT	307.85	0	01:05	3.06	0.16	0.43
L_9	CONDUIT	307.91	0	01:03	10.22	0.46	0.47

INTERIM BUILDOUT CONDITION - 100 YEAR STORM EVENT

Reference I - p154

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow	Max / Full Depth
L_C1	DUMMY	140.96	0	00:35			
L_C2	DUMMY	168.23	0	00:35			
L_C3	DUMMY	95.41	0	00:35			
L_C4	DUMMY	73.89	0	00:35			
L_C5	DUMMY	50.24	0	00:45			
L_C6	DUMMY	15.26	0	00:45			
L_C7	DUMMY	40.69	0	00:35			
L_C8	DUMMY	69.61	0	00:35			
L_H1	DUMMY	66.41	0	00:45			
L_H2	DUMMY	95.75	0	00:50			
L_H3	DUMMY	12.35	0	00:40			
L_H4	DUMMY	17.99	0	00:40			
L_H5	DUMMY	106.01	0	00:35			
L_H6	DUMMY	32.73	0	00:50			
L_H7	DUMMY	18.89	0	00:35			
L_H8	DUMMY	9.70	0	00:55			
L_O1	DUMMY	81.38	0	00:50			
L_O2	DUMMY	108.41	0	00:55			
L_O4	DUMMY	39.81	0	00:45			
L_WQ_C2	DUMMY	69.61	0	00:35			
L_WQ_C3	DUMMY	40.69	0	00:35			
L_3	CONDUIT	587.49	0	01:12	3.81	0.26	0.49

Parcel B1 SWMM
Key Design Points

Link Flow Summary

Reference I - p173

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow
L_1	CONDUIT	630.99	0	01:08	9.63	0.72
L_10	CONDUIT	307.71	0	01:05	5.26	0.07
L_11	CONDUIT	308.10	0	00:58	10.22	0.46
L_12	CONDUIT	308.15	0	00:58	5.26	0.07
L_12-1	CONDUIT	188.52	0	00:53	4.52	0.04
L_12-2	CONDUIT	81.32	0	00:51	3.49	0.02
L_13	CONDUIT	146.60	0	01:43	8.92	0.76
L_13-1	DUMMY	32.71	0	00:51		
L_13-2	CONDUIT	32.71	0	00:51	10.36	0.69
L_14	DUMMY	257.43	0	00:53		
L_15	CONDUIT	257.43	0	00:53	17.25	0.25
L_16	CONDUIT	166.19	0	01:02	3.01	0.19
L_17	CONDUIT	166.71	0	00:56	14.90	0.09
L_18	CONDUIT	156.75	0	00:57	2.94	0.18
L_19	CONDUIT	48.53	0	01:16	11.47	0.63
L_2	CONDUIT	631.00	0	01:07	3.90	0.28
L_2-1	DUMMY	69.30	0	00:36		
L_2-2	CONDUIT	69.30	0	00:36	12.42	0.23
L_3	CONDUIT	601.93	0	01:08	3.84	0.27
L_3-1	DUMMY	110.17	0	01:37		
L_3-10	CONDUIT	140.54	0	00:35	14.77	0.85
L_3-11	DUMMY	73.59	0	00:36		
L_3-12	CONDUIT	73.59	0	00:36	12.74	0.64
L_3-13	DUMMY	50.24	0	00:45		
L_3-14	CONDUIT	50.24	0	00:45	11.52	0.30
L_3-2	CONDUIT	110.17	0	01:37	13.67	0.95
L_3-3	DUMMY	0.00	0	00:00		
L_3-4	CONDUIT	0.00	0	00:00	0.00	0.00
L_3-5	DUMMY	389.80	0	00:45		

ULTIMATE BUILDOUT CONDITION - 100 YEAR STORM EVENT

Reference I - p174

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow
L_3-6	CONDUIT	389.80	0	00:45	9.67	0.37
L_3-7	CONDUIT	374.85	0	00:44	4.04	0.40
L_3-8	CONDUIT	300.11	0	00:37	18.00	0.29
L_3-9	CONDUIT	136.79	0	00:38	2.92	0.16
L_4	CONDUIT	500.38	0	01:05	3.63	0.23
L_5	CONDUIT	498.24	0	01:03	10.50	0.83
L_5-1	DUMMY	40.60	0	00:36		
L_5-2	CONDUIT	40.60	0	00:36	10.80	0.86
L_6	CONDUIT	473.81	0	01:03	3.56	0.21
L_6-1	DUMMY	39.79	0	00:45		
L_6-2	CONDUIT	39.79	0	00:45	10.77	0.84
L_7	CONDUIT	439.96	0	01:02	3.48	0.20
L_8	CONDUIT	307.70	0	01:06	3.06	0.16
L_9	CONDUIT	307.71	0	01:05	10.21	0.46
L_B1_OUTLET	DUMMY	146.60	0	01:43		
L_B2_OUTLET	DUMMY	48.53	0	01:15		
L_C1	DUMMY	140.96	0	00:35		
L_C1_OUTLET	DUMMY	110.17	0	01:37		
L_C2	DUMMY	168.23	0	00:35		
L_C3	DUMMY	95.41	0	00:35		
L_C4	DUMMY	73.89	0	00:35		
L_C5	DUMMY	50.24	0	00:45		
L_C6	DUMMY	15.26	0	00:45		
L_C7	DUMMY	40.69	0	00:35		
L_C8	DUMMY	69.61	0	00:35		
L_C9	DUMMY	3.53	0	01:00		
L_H1	DUMMY	68.70	0	00:45		
L_H2	DUMMY	124.75	0	00:45		
L_H3	DUMMY	12.35	0	00:40		
L_H4	DUMMY	17.99	0	00:40		

ULTIMATE BUILDOUT CONDITION - 100 YEAR STORM EVENT

Reference I - p175

Link	Type	Maximum |Flow| CFS	Day of Maximum Flow	Hour of Maximum Flow	Maximum |Velocity| ft/sec	Max / Full Flow
L_H5	DUMMY	106.01	0	00:35		
L_H6	DUMMY	32.73	0	00:50		
L_H7	DUMMY	18.89	0	00:35		
L_H8	DUMMY	9.70	0	00:55		
L_O1	DUMMY	81.38	0	00:50		
L_O2	DUMMY	108.41	0	00:55		
L_O4	DUMMY	39.81	0	00:45		
L_WQ_C2	DUMMY	69.61	0	00:35		
L_WQ_C3	DUMMY	40.69	0	00:35		
L-O3	DUMMY	153.27	0	00:45		

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

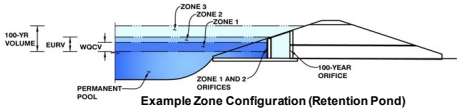
MHFD-Detention, Version 4.06 (July 2022)

Pond B1 design

Reference I - p325

Project: DAWSON TRAILS

Basin ID: INFRA 1 - EDB B1 (REGIONAL) (GAMBEL RIDGE TRIB)



Example Zone Configuration (Retention Pond)

Pond bottom elev = 6431.00

Depth Increment = 1.00 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	--	--	--	36	0.001		
6432	--	1.00	--	--	--	1,859	0.043	947	0.022
6433	--	2.00	--	--	--	23,777	0.546	13,765	0.316
6434	--	3.00	--	--	--	73,236	1.681	62,271	1.430
6435	--	4.00	--	--	--	119,363	2.740	158,571	3.640
6436	--	5.00	--	--	--	130,383	2.993	283,444	6.507
6437	--	6.00	--	--	--	135,206	3.104	416,239	9.556
6438	--	7.00	--	--	--	140,143	3.217	553,913	12.716
6439 (SPILLWAY)	--	8.00	--	--	--	145,238	3.334	696,604	15.992
6440 (BERM)	--	9.00	--	--	--	151,790	3.485	845,118	19.401
6441 (BERM)	--	10.00	--	--	--	159,375	3.659	1,000,700	22.973

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	170.81	acres
Watershed Length =	6,799	ft
Watershed Length to Centroid =	3,400	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	40.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	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.

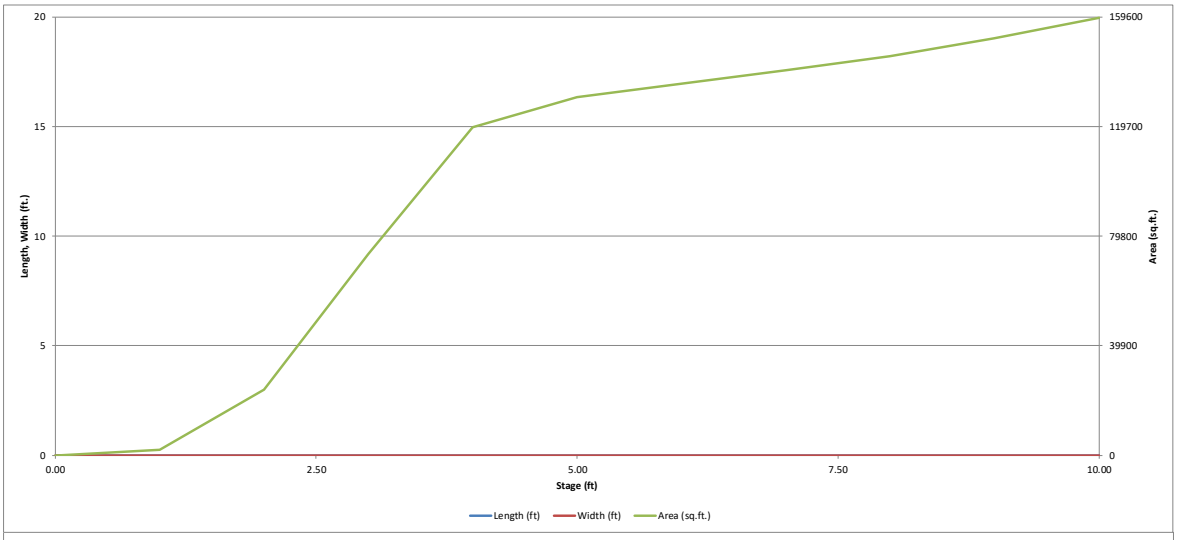
			Optional User Overrides
Water Quality Capture Volume (WQCV) =	2.560	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	6.349	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.06 in.) =	6.354	acre-feet	1.06 inches
5-yr Runoff Volume (P1 = 1.43 in.) =	10.953	acre-feet	1.43 inches
10-yr Runoff Volume (P1 = 1.66 in.) =	14.108	acre-feet	1.66 inches
25-yr Runoff Volume (P1 = 1.69 in.) =	15.183	acre-feet	inches
50-yr Runoff Volume (P1 = 2.26 in.) =	23.454	acre-feet	2.26 inches
100-yr Runoff Volume (P1 = 2.6 in.) =	29.122	acre-feet	2.60 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	37.210	acre-feet	inches
Approximate 2-yr Detention Volume =	4.932	acre-feet	
Approximate 5-yr Detention Volume =	8.248	acre-feet	
Approximate 10-yr Detention Volume =	9.392	acre-feet	
Approximate 25-yr Detention Volume =	9.194	acre-feet	
Approximate 50-yr Detention Volume =	11.377	acre-feet	
Approximate 100-yr Detention Volume =	13.744	acre-feet	

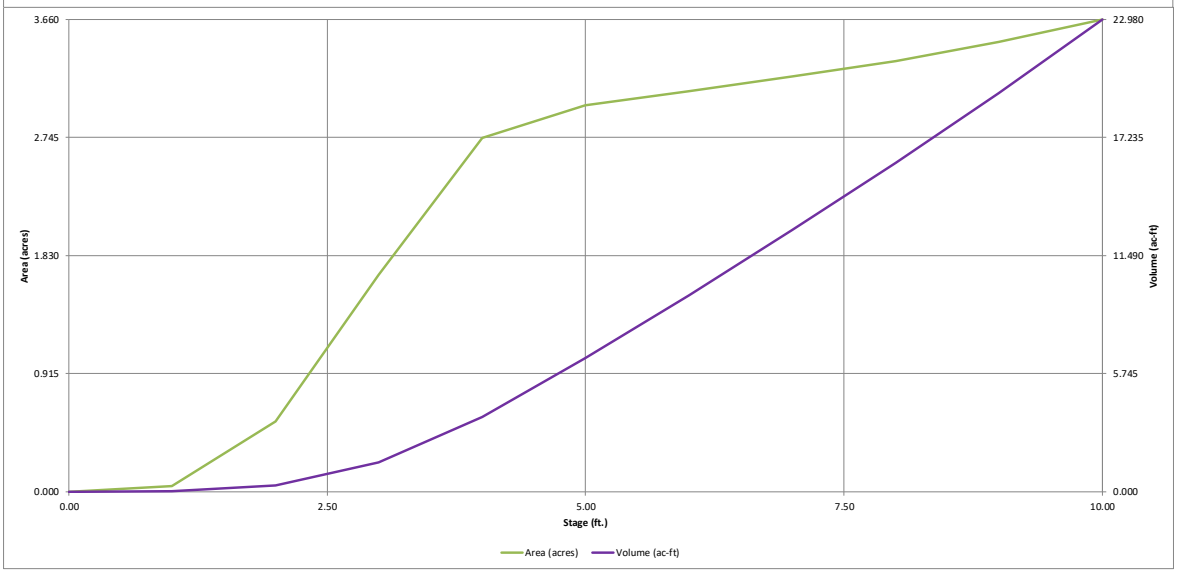
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.560	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.790	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	8.674	acre-feet
Total Detention Basin Volume =	15.024	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

Pond B1 design

Reference I - p326





Pond B1 design

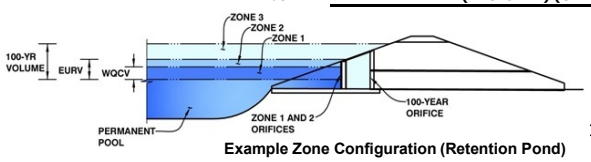
Reference I - p327

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: DAWSON TRAILS

Basin ID: INFRA 1 - EDB B1 (REGIONAL) (GAMBEL RIDGE TRIB)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.57	2.560	Orifice Plate
Zone 2 (EURV)	4.95	3.790	Orifice Plate
3 (100+1/2WQCV)	7.71	8.674	Weir&Pipe (Restrict)
Total (all zones)		15.024	

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)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.208E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.95	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	19.80	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	8.94	sq. inches (use rectangular openings)	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	1.65	3.30					
Orifice Area (sq. inches)	8.94	8.94	8.94					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	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 =	4.95	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.95	N/A	feet
Overflow Weir Front Edge Length =	30.00	N/A	feet	Overflow Weir Slope Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.31	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	104.40	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	52.20	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 =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	N/A	ft^2
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	2.00	N/A	feet
Restrictor Plate Height Above Pipe Invert =	48.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.98	feet
Spillway Crest Length =	106.00	feet	Stage at Top of Freeboard =	9.98	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.66	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	22.90	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).*

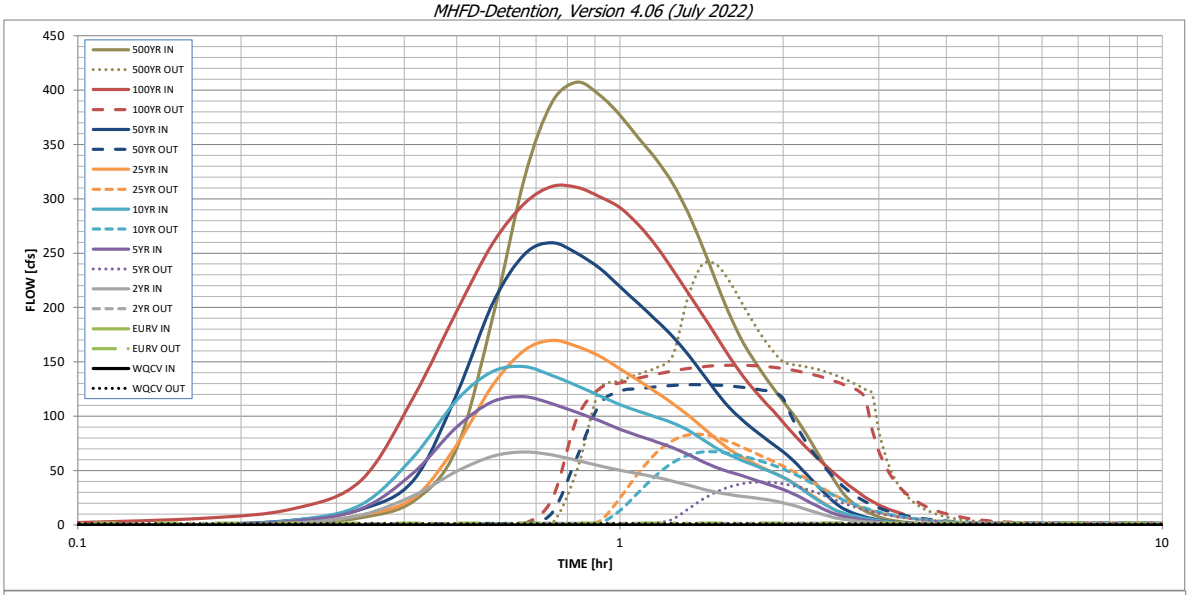
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.69	2.26	2.60	3.14
CUHP Runoff Volume (acre-ft) =	2.560	6.349	6.354	10.953	14.108	15.183	23.454	29.122	37.210
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	6.354	10.953	14.108	15.183	23.454	33.769	37.210
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	11.7	44.2	63.0	81.8	142.7	187.5	246.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.07	0.26	0.37	0.48	0.84	1.10	1.44
Peak Inflow Q (cfs) =	N/A	N/A	67.1	117.8	145.5	169.7	259.6	311.5	407.2
Peak Outflow Q (cfs) =	1.1	1.6	1.6	39.4	67.3	83.3	129.0	146.9	240.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.1	1.0	0.9	0.8	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.4	0.6	0.8	1.2	1.4	1.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	69	70	68	67	63	60	57
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	73	75	74	74	72	71	70
Maximum Ponding Depth (ft) =	3.58	4.95	4.83	5.43	5.65	5.76	6.55	7.90	8.42
Area at Maximum Ponding Depth (acres) =	2.30	2.98	2.95	3.04	3.06	3.08	3.17	3.32	3.40
Maximum Volume Stored (acre-ft) =	2.583	6.358	6.002	7.804	8.445	8.783	11.248	15.626	17.371

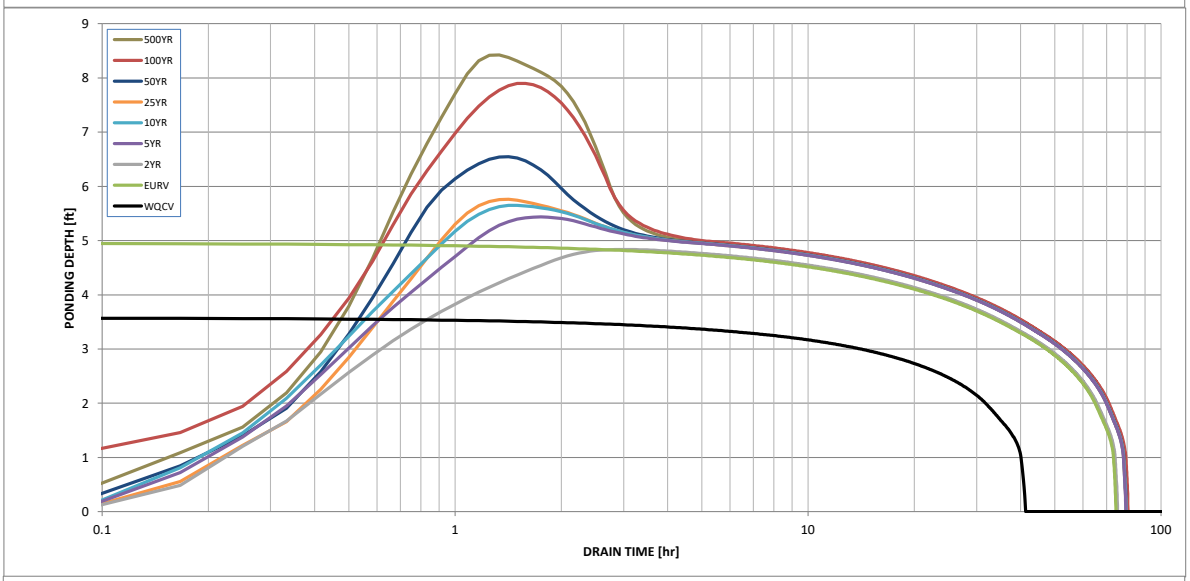
100-yr WSEL = 6431.00 + 7.90 = 6438.90

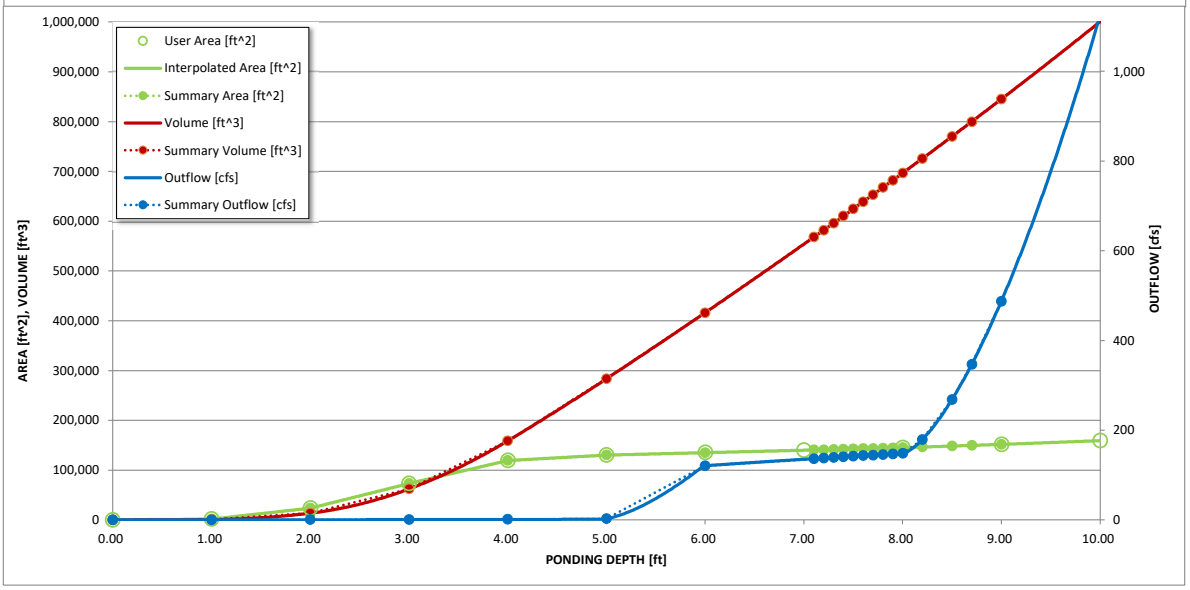
Reference I - p328

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

Pond B1 design

Reference I - p329

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	USER	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	1.06	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	5.92	0.89
	0:15:00	0.00	0.00	1.76	3.59	4.46	2.24	4.46	14.84	6.74
	0:20:00	0.00	0.00	9.14	14.83	18.62	9.00	14.44	41.21	22.06
	0:25:00	0.00	0.00	27.06	48.30	62.94	24.81	41.43	117.93	70.63
	0:30:00	0.00	0.00	49.26	90.13	114.79	73.45	120.31	196.71	191.44
	0:35:00	0.00	0.00	63.17	113.41	141.24	128.80	204.20	259.33	319.39
	0:40:00	0.00	0.00	67.09	117.84	145.50	160.61	249.00	295.63	388.93
	0:45:00	0.00	0.00	64.36	111.34	137.37	169.69	259.57	311.47	407.23
	0:50:00	0.00	0.00	59.26	103.40	128.05	164.16	249.71	310.53	395.64
	0:55:00	0.00	0.00	54.48	95.77	118.96	155.31	236.34	302.02	377.03
	1:00:00	0.00	0.00	50.25	88.06	110.64	143.62	219.11	291.84	355.65
	1:05:00	0.00	0.00	47.03	81.88	104.44	132.55	203.20	275.86	336.32
	1:10:00	0.00	0.00	43.87	76.57	99.19	122.20	188.43	256.55	314.51
	1:15:00	0.00	0.00	40.33	71.04	93.90	111.88	173.50	235.25	287.75
	1:20:00	0.00	0.00	36.72	64.85	87.27	101.13	157.22	214.00	257.39
	1:25:00	0.00	0.00	33.22	58.56	79.05	90.20	140.06	194.22	225.64
	1:30:00	0.00	0.00	30.22	53.07	71.05	79.71	123.46	175.08	196.71
	1:35:00	0.00	0.00	28.03	49.22	64.93	70.36	109.10	156.48	172.78
	1:40:00	0.00	0.00	26.46	45.86	60.08	63.35	98.28	140.38	154.64
	1:45:00	0.00	0.00	25.12	42.36	55.78	57.61	89.25	126.76	139.52
	1:50:00	0.00	0.00	23.88	38.97	51.83	52.63	81.33	115.18	126.04
	1:55:00	0.00	0.00	22.29	35.73	47.96	48.09	74.10	104.92	113.75
	2:00:00	0.00	0.00	20.37	32.61	43.74	43.87	67.34	94.41	102.23
	2:05:00	0.00	0.00	18.05	28.86	38.56	39.01	59.63	84.38	89.77
	2:10:00	0.00	0.00	15.45	24.59	32.76	33.50	50.98	75.18	76.43
	2:15:00	0.00	0.00	12.92	20.32	27.04	27.98	42.35	67.10	63.29
	2:20:00	0.00	0.00	10.51	16.30	21.76	22.67	34.12	59.72	50.70
	2:25:00	0.00	0.00	8.34	12.72	17.14	17.79	26.58	52.88	39.06
	2:30:00	0.00	0.00	6.52	9.84	13.55	13.36	19.85	46.53	28.90
	2:35:00	0.00	0.00	5.20	7.89	11.06	9.98	15.07	40.46	21.81
	2:40:00	0.00	0.00	4.27	6.50	9.14	7.70	11.76	35.06	16.79
	2:45:00	0.00	0.00	3.53	5.36	7.52	6.03	9.25	30.09	12.90
	2:50:00	0.00	0.00	2.93	4.40	6.15	4.74	7.26	25.56	9.83
	2:55:00	0.00	0.00	2.42	3.59	4.98	3.73	5.71	21.78	7.44
	3:00:00	0.00	0.00	2.00	2.92	4.01	2.95	4.47	18.56	5.58
	3:05:00	0.00	0.00	1.65	2.36	3.21	2.34	3.51	15.67	4.24
	3:10:00	0.00	0.00	1.36	1.90	2.55	1.88	2.79	13.41	3.36
	3:15:00	0.00	0.00	1.11	1.51	2.00	1.50	2.21	11.55	2.68
	3:20:00	0.00	0.00	0.89	1.19	1.56	1.19	1.74	9.92	2.14
	3:25:00	0.00	0.00	0.69	0.90	1.21	0.93	1.35	8.47	1.67
	3:30:00	0.00	0.00	0.52	0.67	0.91	0.70	1.02	7.23	1.26
	3:35:00	0.00	0.00	0.37	0.47	0.65	0.52	0.74	6.08	0.91
	3:40:00	0.00	0.00	0.25	0.32	0.44	0.36	0.51	5.16	0.61
	3:45:00	0.00	0.00	0.15	0.20	0.27	0.23	0.32	4.42	0.38
	3:50:00	0.00	0.00	0.08	0.11	0.14	0.13	0.17	3.78	0.20
	3:55:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	3.23	0.07
	4:00:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	2.75	0.01
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.33	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.95	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.63	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.07	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00

Pond B1 design

Reference I - p330

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

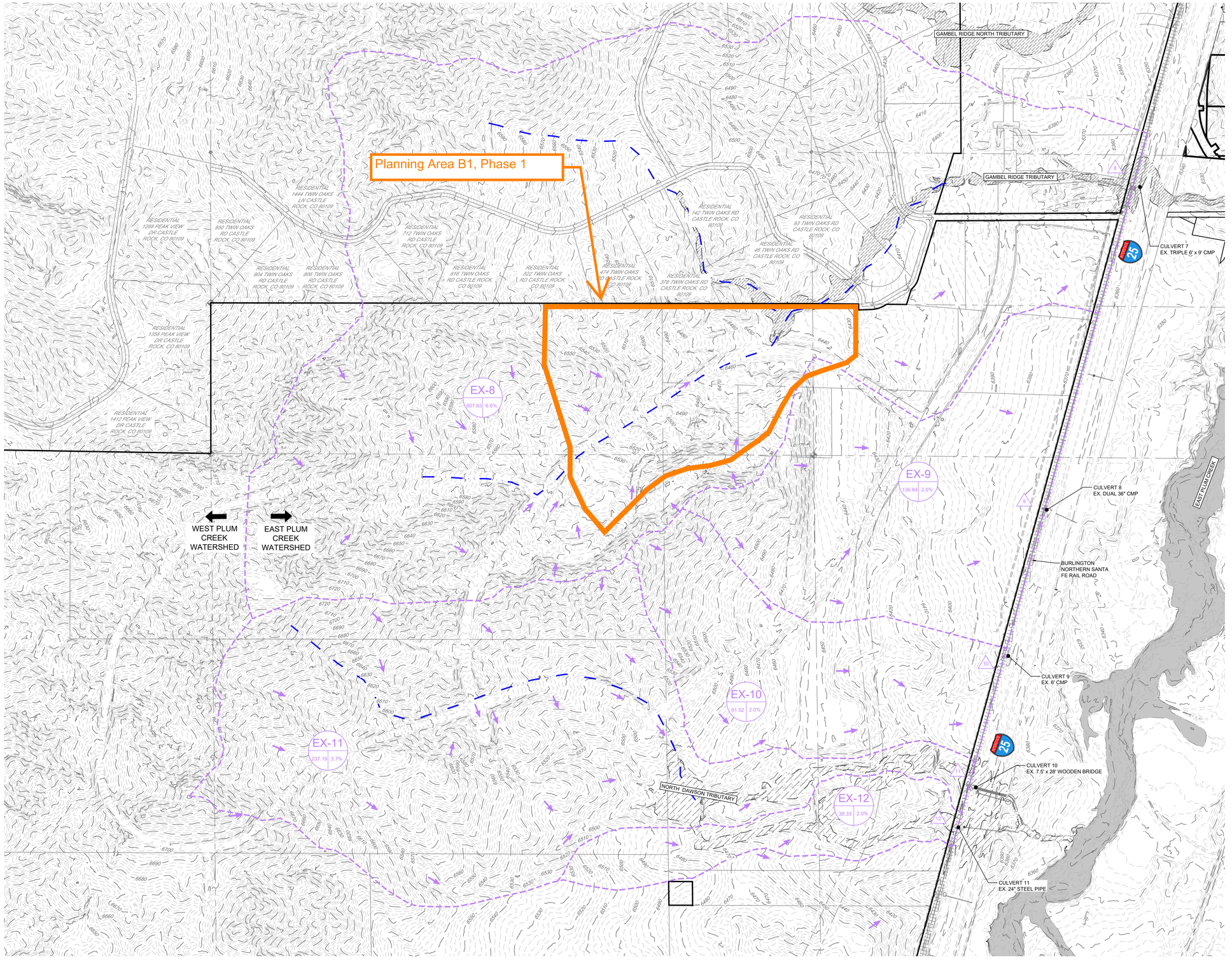
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

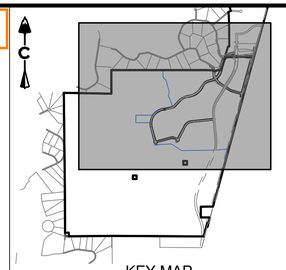
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	36	0.001	0	0.000	0.00
	1.00	1,859	0.043	947	0.022	0.30
	2.00	23,777	0.546	13,765	0.316	0.60
	3.00	73,236	1.681	62,271	1.430	0.87
	4.00	119,363	2.740	158,571	3.640	1.31
	5.00	130,383	2.993	283,444	6.507	2.87
	6.00	135,206	3.104	416,239	9.556	121.01
	7.10	140,652	3.229	567,953	13.038	136.64
	7.20	141,162	3.241	582,044	13.362	137.98
	7.30	141,671	3.252	596,185	13.687	139.30
	7.40	142,181	3.264	610,378	14.012	140.61
	7.50	142,690	3.276	624,622	14.339	141.90
	7.60	143,200	3.287	638,916	14.667	143.19
	7.70	143,710	3.299	653,262	14.997	144.46
	7.80	144,219	3.311	667,658	15.327	145.72
	7.90	144,729	3.323	682,105	15.659	146.97
	8.00	145,238	3.334	696,604	15.992	148.21
	8.20	146,548	3.364	725,782	16.662	179.28
	8.50	148,514	3.409	770,042	17.678	268.39
	8.70	149,824	3.439	799,875	18.363	346.79
	9.00	151,790	3.485	845,118	19.401	487.69

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).

Reference I - Appendix D - p3





C

0 400' 800'

1 inch = 400 ft.

LEGEND

UNDISTURBED DISTURBED

- BASIN DESIGNATION
- 5 YEAR COEFFICIENTS
- 100 YEAR COEFFICIENTS
- DESIGN POINT
- DIRECTIONAL FLOW ARROW
- PROPOSED DRAINAGE BASIN
- EXISTING DRAINAGE BASIN
- 5280 PROPOSED MAJOR CONTOUR
- 5279 PROPOSED MINOR CONTOUR
- 5280 EXISTING MAJOR CONTOUR
- 5279 EXISTING MINOR CONTOUR
- PROJECT BOUNDARY
- RIPRAP
- DD DIVERSION DITCH
- SB SEDIMENT BASIN
- MAJOR DRAINAGEWAY
- PHASING LINE
- DAWSON RIDGE BLVD PLANS CORE CIP22-0012
- CRYSTAL VALLEY INTERCHANGE PROJECT PLANS JACOBS CIP22-0013
- 100-YEAR FEMA FLOODPLAIN
- 100-YEAR TOWN FLOODPLAIN

NOTES:

1. REFER TO TESC PLAN FOR ADDITIONAL DIVERSION DITCH AND SEDIMENT BASIN LOCATIONS
2. REFER TO APPENDIX B CUHP CALCULATIONS FOR BASIN A-0

EXISTING RUNOFF SUMMARY TABLE (CUHP)

DIRECT RUNOFF				
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)
8	EX-8	607.63	149.21	632.63
9	EX-9	136.84	55.78	230.04
10	EX-10	91.52	27.97	121.78
11	EX-11	237.19	52.92	234.56
12	EX-12	38.33	7.34	35.45
13	EX-13	25.80	7.76	35.01
Total		1137.31	300.98	1289.48

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DAWSON TRAILS
CASTLE ROCK, COLORADO
PHASE III DRAINAGE REPORT
EXISTING DETAILED DRAINAGE MAP

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DESIGNED BY: XXX
DRAWN BY: XXX
CHECKED BY: XXX

JOB NO. 20-224

SHEET 2 OF 15

10/20/2023 1:36 PM - X:\20-224 Dawson\Civil\CAD\Plans\INFRA1\Phase III Drainage Existing Detailed Map - Phase III.dwg

Reference I - Appendix D - p4

Planning Area B1, Phase 1

OS-1 69.4 8.7%
OS-2 101.1 3.9%
OS-3 99.0 10.4%
OS-4 25.3 11.5%
H-1 46.4 7.8%
H-2 76.0 28.2%
H-3 5.51 45.0%
H-4 8.06 45.0%
H-5 39.4 45.0%
H-7 7.00 51.5%
H-8
A-7 33.1 60%
A-8 34.8 60%
C-7 13.5 75.0%
C-8 19.3 95.0%
C-9 4.2 2.0%
C1.0 35.16 0.15 0.49
C2.0 47.21 0.15 0.49
C3.0 33.15 0.15 0.49
C4.0 21.53 0.15 0.49
C5.01 2.24 0.62 0.78
C5.02 1.60 0.64 0.79
C5.03 1.10 0.65 0.79
C5.04 0.92 0.70 0.82
C5.11 1.56 0.63 0.78
C5.12 1.56 0.63 0.78
C5.13 1.80 0.67 0.80
C5.14 0.64 0.68 0.81
C5.15 1.81 0.62 0.78
C5.16 1.65 0.67 0.80
C6.01 1.89 0.60 0.76
C6.02 1.13 0.64 0.79
C6.03 1.66 0.55 0.74
C6.04 1.54 0.49 0.71
B6.01 0.64 0.59 0.76
B6.02 2.00 0.18 0.56
B6.03 1.20 0.54 0.73
B6.04 8.15 0.13 0.53
B6.05 0.83 0.56 0.74
B6.06 4.67 0.14 0.53
B6.07 0.49 0.55 0.74
B6.08 1.63 0.21 0.57
B6.09 0.66 0.44 0.69
B6.10 0.54 0.58 0.76
D-3.16 1.14 0.46 0.69
D1.0 8.28 0.65 0.79
D1.10 1.36 0.71 0.82
D1.11 0.73 0.70 0.82
D1.2 9.02 0.65 0.79
D1.30 1.42 0.66 0.80
D1.31 0.54 0.61 0.77
D1.32 1.43 0.66 0.80
D1.33 0.55 0.60 0.77
D1.4 17.34 0.81 0.87
D1.5 2.60 0.73 0.83
D1.6 13.42 0.73 0.83
D3.0 12.31 0.05 0.49
D3.10 0.67 0.54 0.74
D3.11 0.64 0.56 0.75
D3.12 3.02 0.16 0.55
D3.13 0.90 0.41 0.67
D3.14 13.28 0.16 0.54
D3.15 0.95 0.46 0.70
D3.17 11.99 0.30 0.62
D3.18 0.33 0.59 0.76
D3.19 1.12 0.46 0.70
D3.20 2.41 0.40 0.67
D3.21 1.79 0.54 0.74
D3.3 34.98 0.52 0.73
D4.0 0.27 0.32 0.62
D4.1 1.22 0.58 0.75
D4.2 1.28 0.58 0.76
D5.0 0.28 0.39 0.66
D5.1 1.92 0.38 0.66
D5.2 2.03 0.37 0.65
D9.1 1.86 0.05 0.49
D9.2 6.32 0.05 0.49
D10 26.72 0.05 0.49

GAMBEL RIDGE TRIBUTARY
FUTURE PARCEL B DEVELOPMENT
FUTURE POND B2
FUTURE POND E1
POND B1
POND C1
POND A1
ARTERIAL A
DAWSON TRAILS BLVD
COLLECTOR A
COLLECTOR B
COLLECTOR C
COLLECTOR D
COLLECTOR E
NORTH DAWSON TRIBUTARY
CULVERT 7
EX. TRIPLE 6' x 9' CMP
CVI
BNSF RAILROAD
CULVERT 10
EX. 7.5' x 28' WOODEN BRIDGE
CULVERT 11
EX. 24" STEEL PIPE
FUTURE SUBSTATION

KEY MAP
SCALE: 1" = 2000'

0 400' 800'
1 inch = 400 ft.

LEGEND

EXISTING / PROPOSED
BASIN DESIGNATION
5 YEAR COEFFICIENTS
100 YEAR COEFFICIENTS
DESIGN POINT
DIRECTIONAL FLOW ARROW
EMERGENCY OVERFLOW ROUTE
PROPOSED DRAINAGE BASIN
EXISTING DRAINAGE BASIN
5280 PROPOSED MAJOR CONTOUR
5279 PROPOSED MINOR CONTOUR
5280 EXISTING MAJOR CONTOUR
5279 EXISTING MINOR CONTOUR
EASEMENT
RIGHT OF WAY (R.O.W.)
CENTERLINE
PROJECT BOUNDARY
PROPOSED STORM & STUB OUT
EXISTING STORM & STUB OUT
STORM MANHOLES
STORM INLETS
FES, FOREBAY, & TRICKLE CHANNEL
OUTLET STRUCTURE
CRUSHER FINES MAINTENANCE ACCESS
RIPRAP
100 YEAR FLOODPLAIN
WETLAND
LIMITS OF CONSTRUCTION
RETAINING WALL
DRAINAGE SWALE

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PHASE III DRAINAGE REPORT
PROPOSED OVERALL DRAINAGE MAP

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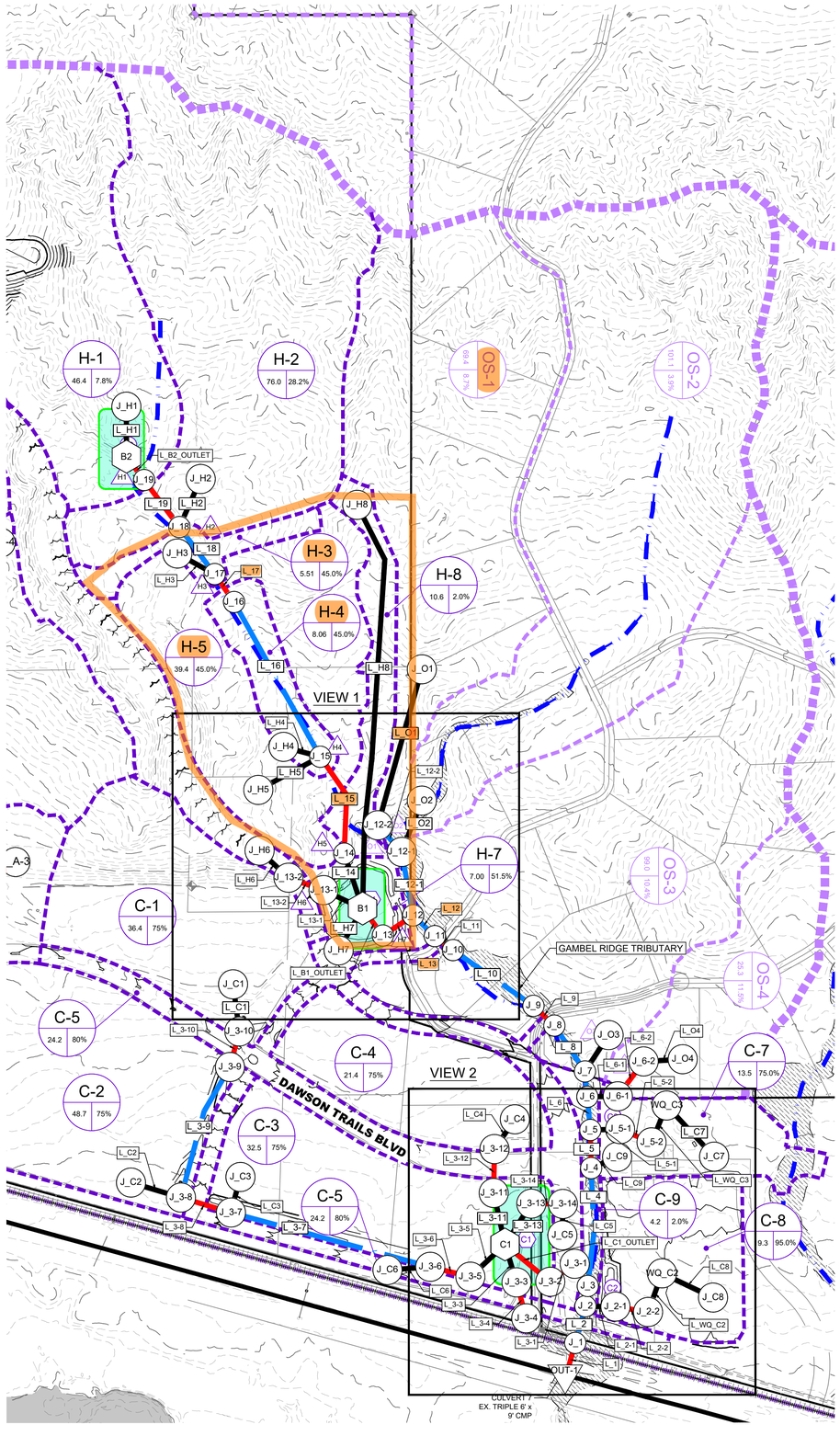
DESIGNED BY: XXX
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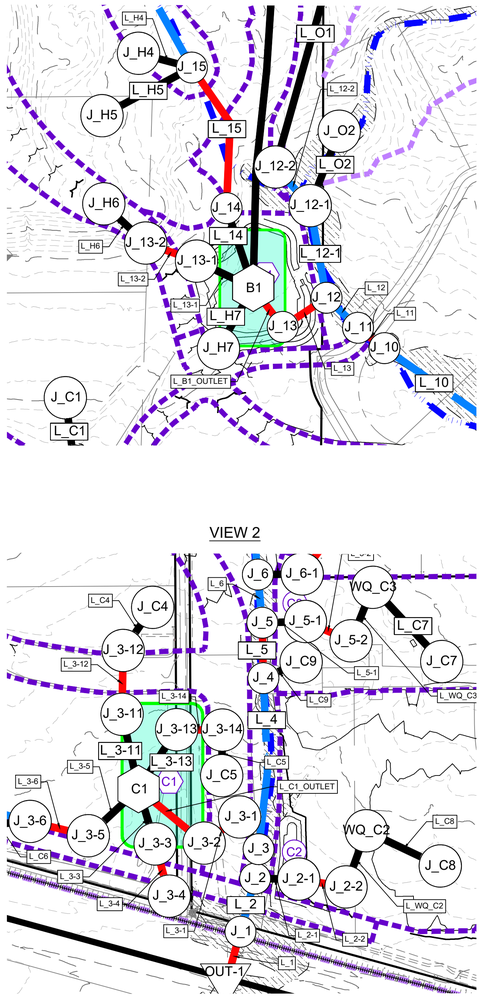
JOB NO. 20-224

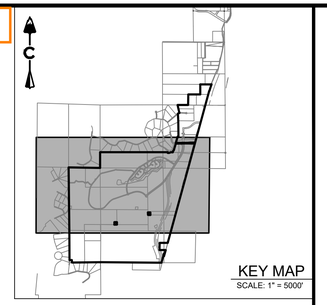
SHEET 3 OF 15

10/20/2023 1:38 PM - X:\20-224 Dawson\Civil\CAD\Plans\INFRA1\Phase III Drainage Proposed Overall Map - Phase III.dwg

Reference I - Appendix D - p19







LEGEND

- OUTFALL DESIGNATION
- DESIGN POINT/JUNCTION DESIGNATION
- POND DESIGNATION
- PIPE/CHANNEL DESIGNATION
- JUNCTION/NODE DESIGNATION
- DUMMY LINK
- PROPOSED STORM SEWER
- PROPOSED CHANNEL

0 400' 800'

1 inch = 400 ft.

LEGEND

EXISTING	PROPOSED	
X 00.0 00.0%	X 00.0 00.0%	BASIN DESIGNATION
		AREA (AC) / IMPERVIOUSNESS
X	X	DESIGN POINT
		DIRECTIONAL FLOW ARROW
		EMERGENCY OVERFLOW ROUTE
		PROPOSED DRAINAGE BASIN
		EXISTING DRAINAGE BASIN
5280		PROPOSED MAJOR CONTOUR
5279		PROPOSED MINOR CONTOUR
5280		EXISTING MAJOR CONTOUR
5279		EXISTING MINOR CONTOUR
		EASEMENT
		RIGHT OF WAY (R.O.W.)
		CENTERLINE
		PROJECT BOUNDARY
		PROPOSED STORM & STUB OUT
		EXISTING STORM & STUB OUT
		100-YEAR FEMA FLOODPLAIN
		100-YEAR TOWN FLOODPLAIN

NOTES:

1. DRAINAGE BASINS AND POND LOCATIONS ARE APPROXIMATE.
2. POND CONFIGURATIONS AND LOCATIONS ARE CONCEPTUAL AND MAY CHANGE DUE TO FIELD CONDITIONS AND/OR FINAL SITE CONFIGURATIONS.
3. THE SITE LIES WITHIN FEMA FLOOD ZONE X.
4. TOWN 100-YEAR FLOODPLAINS ASSOCIATED WITH THE SOUTH DAWSON, NORTH DAWSON, GAMBEL RIDGE, AND GAMBEL RIDGE NORTH TRIBUTARIES WILL BE RE-EVALUATED BY A FLOODPLAIN MODIFICATION STUDY.
5. EFFORTS WILL BE MADE TO STABILIZE, PROTECT, AND PRESERVE THE MAJOR DRAINAGEWAYS ON-SITE. IMPACTS WILL BE LIMITED TO IMPROVEMENTS IN THE AREAS OF DISCHARGES FROM THE PROPOSED DETENTION FACILITIES AND AS IDENTIFIED IN THE MASTER DRAINAGE PLANS FOR THE DRAINAGEWAYS. THE IMPROVEMENTS WILL CONFORM TO THE TOWN OF CASTLE ROCK STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA MANUAL. THESE IMPROVEMENTS WILL BE DESIGNED TO MITIGATE EROSION AND PRESERVE THE NATURAL CHARACTER AND HISTORICAL DRAINAGE PATTERNS TO THE GREATEST EXTENT FEASIBLE.
6. THE INTERCHANGE AT TERRITORIAL ROAD, CRYSTAL VALLEY PARKWAY, AND I-25 (CVI) IS A TOWN, COUNTY AND STATE PROJECT. CHANNEL IMPROVEMENTS FOR THE GAMBLE RIDGE MAJOR DRAINAGEWAY THROUGH THE SITE WILL BE PART OF THE CVI PROJECT.

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CASTLE ROCK, COLORADO

PHASE III DRAINAGE REPORT
PROPOSED BASIN D SWMM MAP

NOT FOR CONSTRUCTION

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DRAWN BY: EKT
CHECKED BY:

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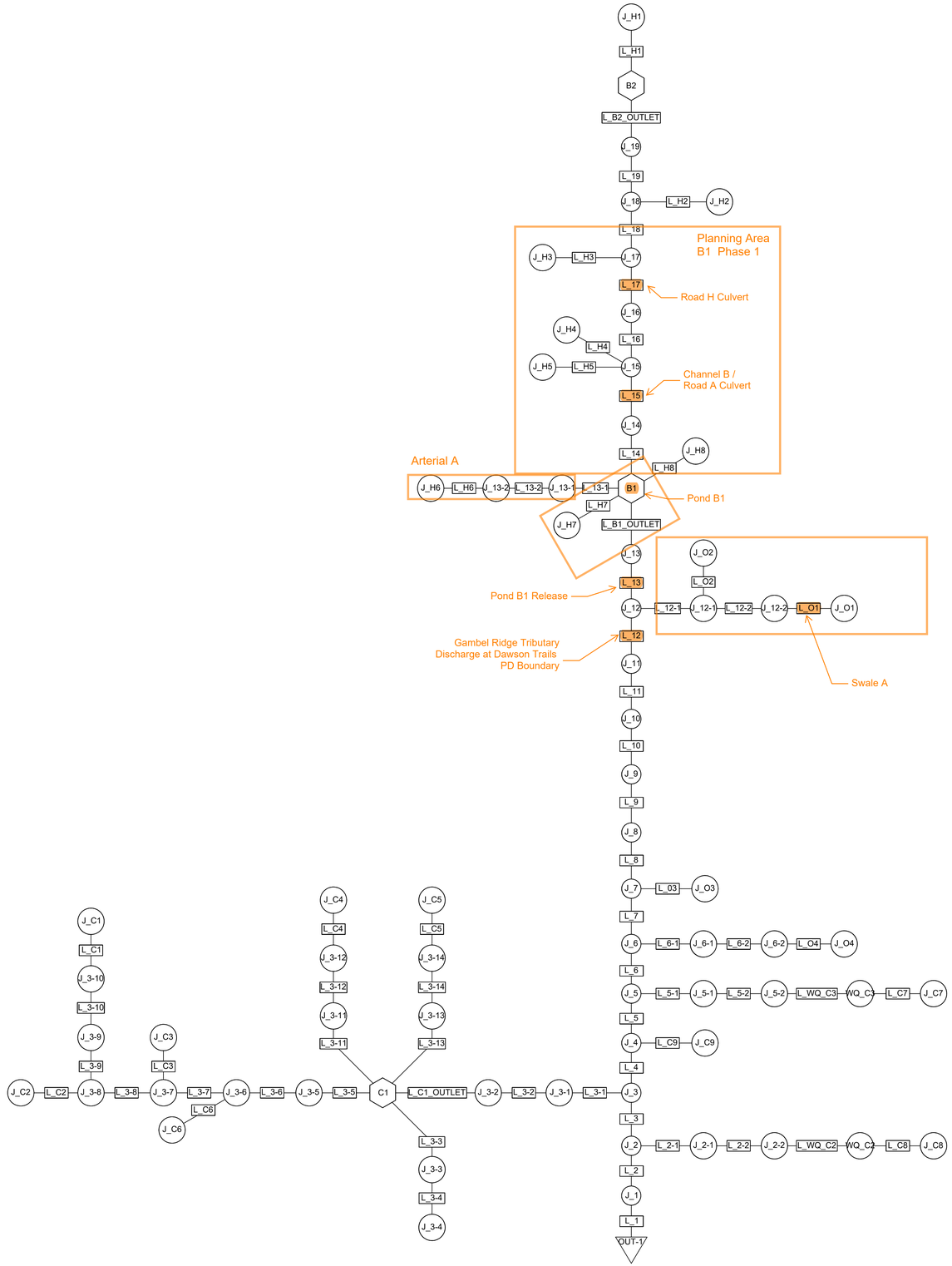
SHEET 1 OF 1

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2021-09-11 (4:30 PM) X:\20-224 Dawson\Civil\CAD\Plans_Overall\Master Drainage Report Proposed Overall SWMM Map - Master.dwg

Reference I - Appendix D - p21

GAMBEL RIDGE TRIBUTARY



LEGEND

- X — OUTFALL DESIGNATION
- X — DESIGN POINT/JUNCTION DESIGNATION
- X — POND DESIGNATION
- X — PIPE/CHANNEL DESIGNATION
- X — JUNCTION/NODE DESIGNATION

0 400' 800'

1 inch = 400 ft.

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PHASE III DRAINAGE REPORT
SWMM LINK TREE DIAGRAM

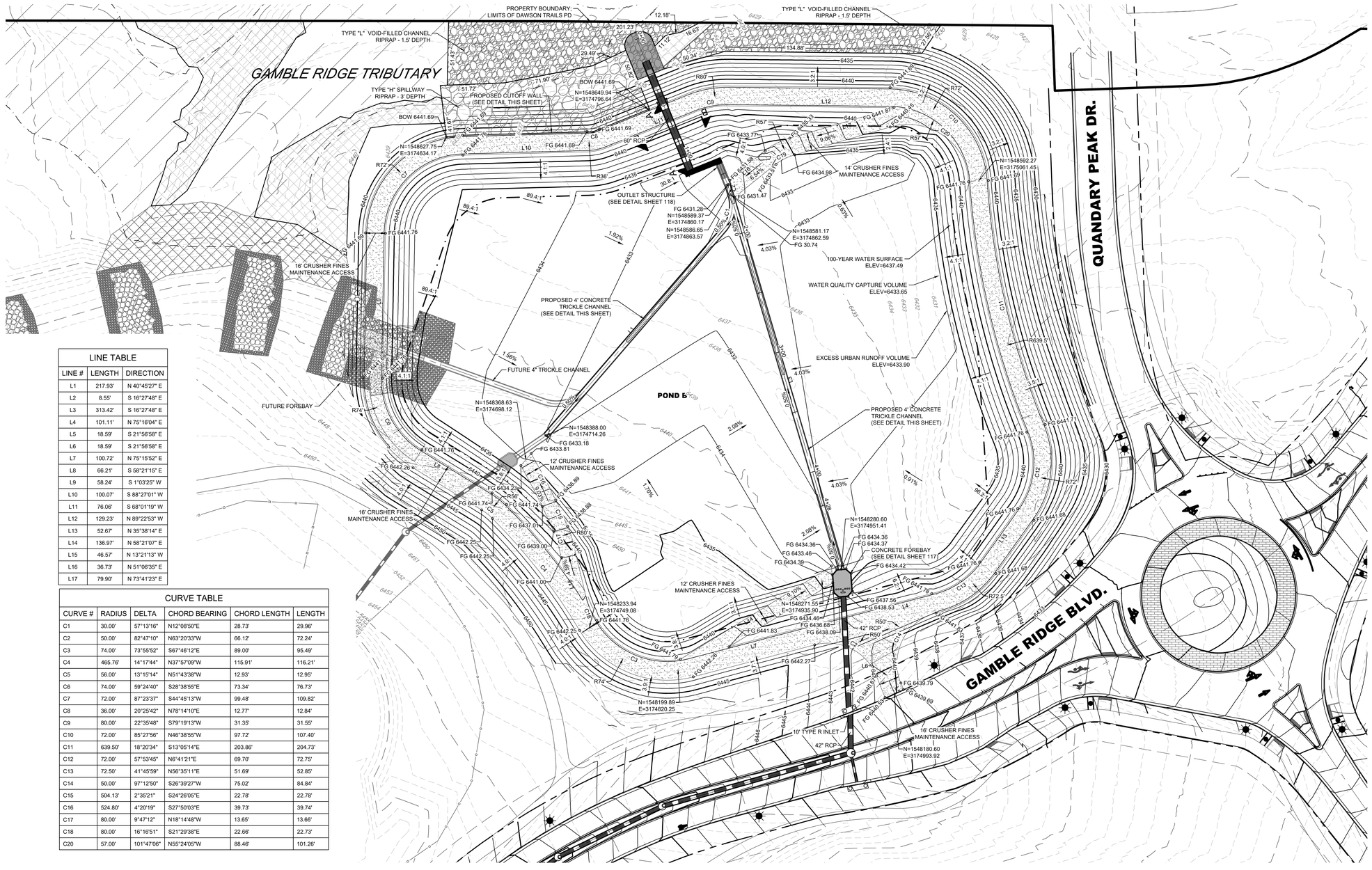
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DRAWN BY: EKT
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SHEET 1 OF 1

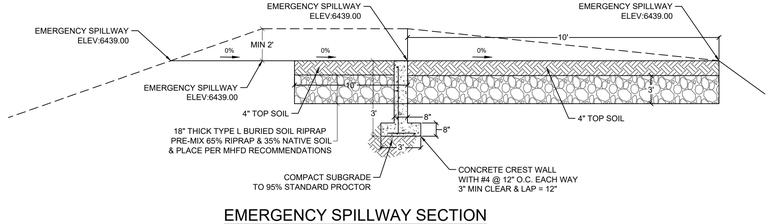
2021-09-11 (4:30 PM) X:\20-224 Dawson\Civil\CAD\Plans_Overall\Master Drainage Report Proposed Overall SWMM Link Tree Map - Master.dwg
2022-10-25 (9:44 AM) Justin Keller X:\20-224 Dawson\Civil\CAD\Plans_Overall\Master Drainage Report Proposed Overall SWMM Link Tree Map - Master.dwg



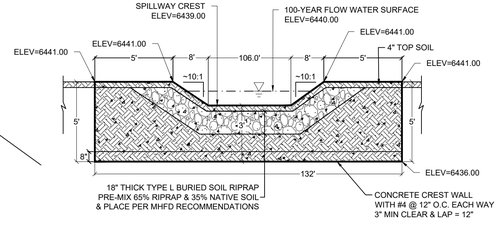
LINE TABLE		
LINE #	LENGTH	DIRECTION
L1	217.93'	N 40°45'27" E
L2	8.55'	S 16°27'48" E
L3	313.42'	S 16°27'48" E
L4	101.11'	N 75°16'04" E
L5	18.59'	S 21°56'58" E
L6	18.59'	S 21°56'58" E
L7	100.72'	N 75°15'52" E
L8	66.21'	S 58°21'15" E
L9	58.24'	S 1°03'25" W
L10	100.07'	S 88°27'01" W
L11	76.06'	S 68°01'19" W
L12	129.23'	N 89°22'53" W
L13	52.67'	N 35°38'14" E
L14	136.97'	N 58°21'07" E
L15	46.57'	N 13°21'13" W
L16	36.73'	N 51°06'35" E
L17	79.90'	N 73°41'23" E

CURVE TABLE					
CURVE #	RADIUS	DELTA	CHORD BEARING	CHORD LENGTH	LENGTH
C1	30.00'	57°13'16"	N12°08'50"E	28.73'	29.96'
C2	50.00'	82°47'10"	N63°20'33"W	66.12'	72.24'
C3	74.00'	73°55'52"	S67°46'12"E	89.00'	95.49'
C4	465.76'	14°17'44"	N37°57'09"W	115.91'	116.21'
C5	56.00'	13°15'14"	N51°43'38"W	12.93'	12.95'
C6	74.00'	59°24'40"	S28°38'55"E	73.34'	76.73'
C7	72.00'	87°23'37"	S44°45'13"W	99.48'	109.82'
C8	36.00'	20°25'42"	N78°14'10"E	12.77'	12.84'
C9	80.00'	22°35'48"	S79°19'13"W	31.35'	31.55'
C10	72.00'	85°27'56"	N46°38'55"W	97.72'	107.40'
C11	639.50'	18°20'34"	S13°05'14"E	203.86'	204.73'
C12	72.00'	57°53'45"	N6°41'21"E	69.70'	72.75'
C13	72.50'	41°45'59"	N56°35'11"E	51.69'	52.85'
C14	50.00'	97°12'50"	S26°39'27"W	75.02'	84.84'
C15	504.13'	2°35'21"	S24°26'05"E	22.78'	22.78'
C16	524.80'	4°20'19"	S27°50'03"E	39.73'	39.74'
C17	80.00'	9°47'12"	N18°14'48"W	13.65'	13.66'
C18	80.00'	16°16'51"	S21°29'38"E	22.66'	22.73'
C20	57.00'	101°47'06"	N55°24'05"W	88.46'	101.26'

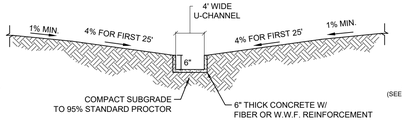
POND B1 | SPILLWAY FLOW



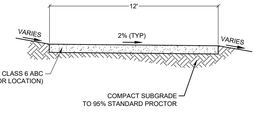
EMERGENCY SPILLWAY SECTION
NTS



CONCRETE CREST WALL SECTION
NTS

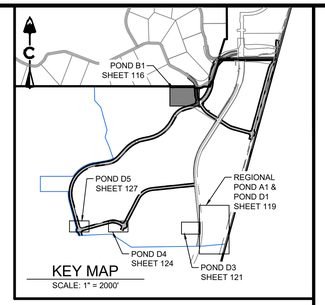


TRICKLE CHANNEL TYPICAL SECTION
NTS

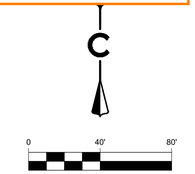


MAINTENANCE ACCESS TYPICAL SECTION
NTS

NOTES:
1. ALL EXPOSED CONCRETE EDGES SHALL BE CONSTRUCTED WITH 1/2" RADIUS OF CHAMFER.
2. ALL TRASH RACKS SHALL BE HOT DIPPED GALVANIZED (TYPICAL).
3. ALL STEEL REINFORCEMENT SHALL BE GALVANIZED OR EPOXY COATED.



Reference I - Pond B1 Plan [2-CD23-0045 SHT 116]



LEGEND

- EASEMENT
- RIGHT OF WAY (R.O.W.)
- CENTERLINE
- PROJECT BOUNDARY
- PROPOSED CURB & GUTTER
- PROPOSED SANITARY & STUB OUT
- EXISTING SANITARY & STUB OUT
- SANITARY SERVICE
- WATER SERVICE
- PROPOSED WATER & STUB OUT
- EXISTING WATER & STUB OUT
- PROPOSED STORM & STUB OUT
- EXISTING STORM & STUB OUT
- FUTURE STORM & STUB OUT
- STORM MAJOR HGL
- STORM MINOR HGL
- STORM UNDERDRAIN

EXISTING / PROPOSED

- STORM MANHOLES
- STORM INLETS
- FES, FOREBAY, & TRICKLE CHANNEL
- OUTLET STRUCTURE
- CRUSHER FINES MAINTENANCE ACCESS
- RIPRAP
- BLOCK NUMBER
- 100 YEAR FLOODPLAIN
- WETLAND

BASIS OF BEARINGS

SEE COVER SHEET FOR BASIS OF BEARINGS & BENCHMARK.

PROFESSIONAL ENGINEER CERTIFICATION

I HEREBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS WERE PREPARED UNDER MY DIRECT SUPERVISION, IN ACCORDANCE WITH ALL APPLICABLE TOWN OF CASTLE ROCK AND STATE OF COLORADO STANDARDS AND STATUTES, RESPECTIVELY; AND THAT I AM FULLY RESPONSIBLE FOR ALL DESIGN AND REVISIONS RELATIVE TO SAID PLANS.

BYRON J. GLENN — DATE

STATE OF COLORADO # 31485

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL.

APPROVED BY:

DEVELOPMENT SERVICES — DATE

CORE CONSULTANTS, INC.
3473 S. BROADWAY
ENGLEWOOD, CO 80113
303.703.4444
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CORE

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#	REVISION DESCRIPTION	DATE	BY
1	1ST SUBMITTAL	10/31/23	JF
2	2ND SUBMITTAL	8/23/24	BG

DAWSON TRAILS - FILING 2 INFRASTRUCTURE

CASTLE ROCK, COLORADO

CONSTRUCTION DOCUMENTS

POND B1 - PLAN

NOT FOR CONSTRUCTION

DESIGNED BY: GP
DRAWN BY: CT
CHECKED BY: BG

JOB NO. 20-224

SHEET 116 OF 288

8/27/2024 1:24 PM X:\20-224 Dawson\Civil\CAD\Plans\INFRA1\CDs POND DETAILS-B1.dwg

Appendix F – Checklist

Town of Castle Rock Phase II Drainage Report Checklist

175 Kellogg Court, Castle Rock CO 80109
720-733-6000

Phase III Drainage Report Checklist

The Phase III Drainage Report must be in conformance with the latest Town of Castle Rock Storm Drainage Design and Technical Criteria Manual available on the Town's website.

The Phase III Drainage Report must be signed and sealed by a Professional Engineer licensed in the State of Colorado. The purpose of the Phase III Drainage Report is to update the concepts, and to present the design details on construction plans for the drainage facilities discussed in the Phase II Drainage Report.

The preparer should contact and work with the Town Stormwater Engineering Staff regarding any design, master planning and existing system questions (720-733-6000). The following outline sets forth the **required minimum** content to be provided in the Phase III Drainage Report that shall be submitted with the Planned Development Plan or Straight Zoning documents. A copy of this checklist must be submitted with the Phase III Drainage Report.

Please see Chapter 4 of the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual for additional details and information. Please check off the following items to assure your report is complete. Appropriate notations shall be provided with the checklist. For example, if a specific item is not addressed or not applicable, an explanation needs to be provided.

Included	N/A	
✓		**I. COVER SHEET**
✓		A. Name of Project, including legal name of development
✓		B. Address
✓		C. Owner
✓		D. Developer
✓		E. Engineer
✓		F. Submittal date and revision dates as applicable
✓		**II. GENERAL LOCATION AND DESCRIPTION**
✓		A. Site Location
✓		B. Description of Property and Land Use
✓		**III. DRAINAGE BASIN AND SUB-BASINS**
✓		A. Major Drainage Basins
✓		B. Minor Drainage Basins
✓		**IV. DRAINAGE DESIGN CRITERIA**
✓		A. Regulations
✓		B. Drainage Studies, Master Plans, Site Constraints
✓		C. Hydrology
✓		D. Hydraulics
✓		E. Water Quality Enhancement

Phase III Drainage Report Checklist

Included	N/A	
✓		**V. STORMWATER MANAGEMENT FACILITY DESIGN**
✓		A. Stormwater Conveyance Facilities
✓		B. Stormwater Storage Facilities
✓		C. Water Quality Enhancement Best Management Practices
✓		D. Floodplain Modification
✓		E. Additional Permitting Requirements
✓		F. General
✓		**VI. CONCLUSIONS**
✓		A. Compliance with Standards
✓		B. Variances
✓		C. Drainage Concept
✓		**VII. REFERENCES**
✓		**VIII. APPENDICES**
✓		A. Hydrologic Computations
✓		B. Hydraulic Computations
✓		C. Water Quality Enhancement Best Management Practices
✓		D. Referenced Information
✓		**OVERALL DRAINAGE PLAN (IN POCKET)**
✓		**DETAILED DRAINAGE PLANS (IN POCKET)**

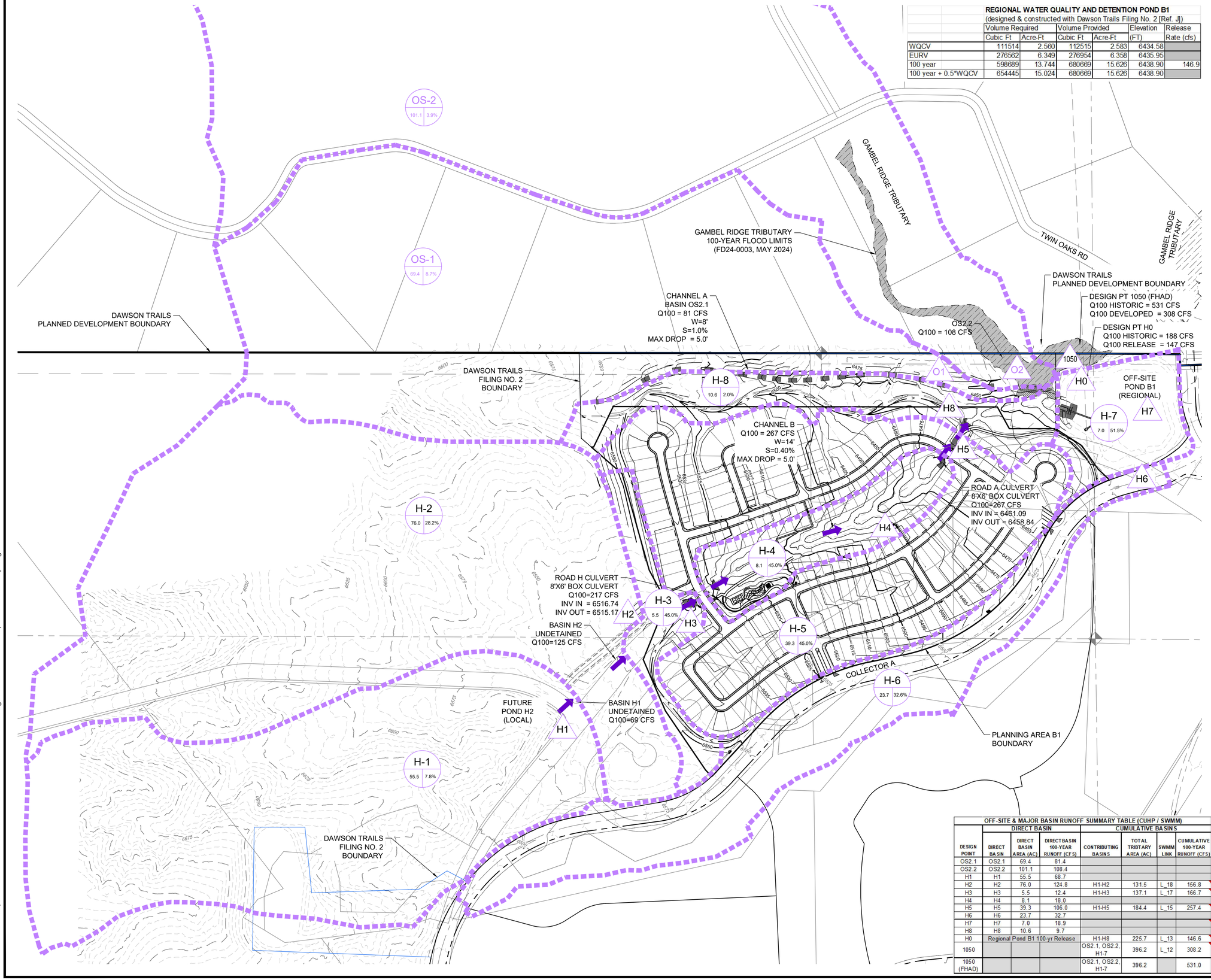
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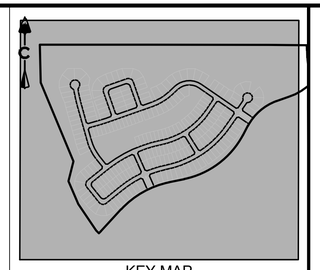
Appendix G - Drainage Maps

Watershed Map
Overall Proposed Drainage Map
Detailed Proposed Drainage Maps

REGIONAL WATER QUALITY AND DETENTION POND B1
(designed & constructed with Dawson Trails Filing No. 2 [Ref. J])

	Volume Required		Volume Provided		Elevation	Release
	Cubic Ft	Acre-Ft	Cubic Ft	Acre-Ft	(FT)	Rate (cfs)
WQCV	111514	2.560	112515	2.583	6434.58	
EURV	276562	6.349	276954	6.358	6435.95	
100 year	598689	13.744	680669	15.626	6438.90	146.9
100 year + 0.5*WQCV	654445	15.024	680669	15.626	6438.90	





KEY MAP
SCALE: 1" = 750'

C

0 200' 400'

1 inch = 200 ft.

LEGEND

EXISTING / PROPOSED

- BASIN DESIGNATION
- 5 YEAR COEFFICIENTS / 100 YEAR COEFFICIENTS
- DESIGN POINT
- DIRECTIONAL FLOW ARROW
- BYPASS OR OVERFLOW PATH
- EXISTING WATERSHED AREA [CUHP]
- PROPOSED DRAINAGE BASIN
- PROPOSED DRAINAGE SUB-BASIN
- 5280 PROPOSED MAJOR CONTOUR
- 5279 PROPOSED MINOR CONTOUR
- 5280 EXISTING MAJOR CONTOUR
- 5279 EXISTING MINOR CONTOUR
- EASEMENT
- RIGHT OF WAY (R.O.W.)
- CENTERLINE
- PROJECT BOUNDARY
- W PROPOSED WATER
- SS PROPOSED SANITARY SEWER
- PROPOSED STORM & STUB OUT
- EXISTING STORM & STUB OUT
- STORM MANHOLES
- STORM INLETS
- FES, FOREBAY, & TRICKLE CHANNEL
- CRUSHER FINES MAINTENANCE ACCESS
- CONCRETE FOREBAY & MAINTENANCE ACCESS
- RIPRAP
- 100 YEAR FLOODPLAIN
- AREA OF GRADING WITHIN 100-YEAR FLOODPLAIN LIMITS
- LIMITS OF CONSTRUCTION
- DRAINAGE SWALE
- EXISTING FLOW CONVEYANCE

NOTES:

1. GAMBEL RIDGE TRIBUTARY FLOODPLAIN LIMITS ARE BASED ON *FLOODPLAIN MODIFICATION STUDY - GAMBEL RIDGE - E PLUM CREEK TO DAWSON TRAILS BOULEVARD*, BY JACOBS ENGINEERING GROUP, MAY 2024.
2. ALL PROPOSED CURB IS TYPE MS2, EXPECT ON ENTRY STREET SEGMENTS AS NOTED.

OFF-SITE & MAJOR BASIN RUNOFF SUMMARY TABLE (CUHP / SWMM)

	DIRECT BASIN			CUMULATIVE BASINS			
DESIGN POINT	DIRECT BASIN	DIRECT BASIN AREA (AC)	DIRECT BASIN 100-YEAR RUNOFF (CFS)	CONTRIBUTING BASINS	TOTAL TRIBTARY AREA (AC)	SWMM LINK	CUMULATIVE 100-YEAR RUNOFF (CFS)
OS2.1	OS2.1	69.4	81.4				
OS2.2	OS2.2	101.1	108.4				
H1	H1	55.5	68.7				
H2	H2	76.0	124.8	H1-H2	131.5	L_18	156.8
H3	H3	5.5	12.4	H1-H3	137.1	L_17	166.7
H4	H4	8.1	18.0				
H5	H5	39.3	106.0	H1-H5	184.4	L_15	257.4
H6	H6	23.7	32.7				
H7	H7	7.0	18.9				
H8	H8	10.6	9.7				
H0	Regional Pond B1 100-yr Release			H1-H8	225.7	L_13	146.6
1050				OS2.1, OS2.2, H1-7	396.2	L_12	308.2
1050 (FHAD)				OS2.1, OS2.2, H1-7	396.2		531.0

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NOT FOR CONSTRUCTION

JEFFREY M. KILLINGSWORTH DATE

STATE OF COLORADO # 41217

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
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APPROVED BY:

DEVELOPMENT SERVICES DATE

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DAWSON TRAILS - PARCEL B1
CASTLE ROCK, COLORADO

DRAINAGE MAPS
WATERSHED MAP

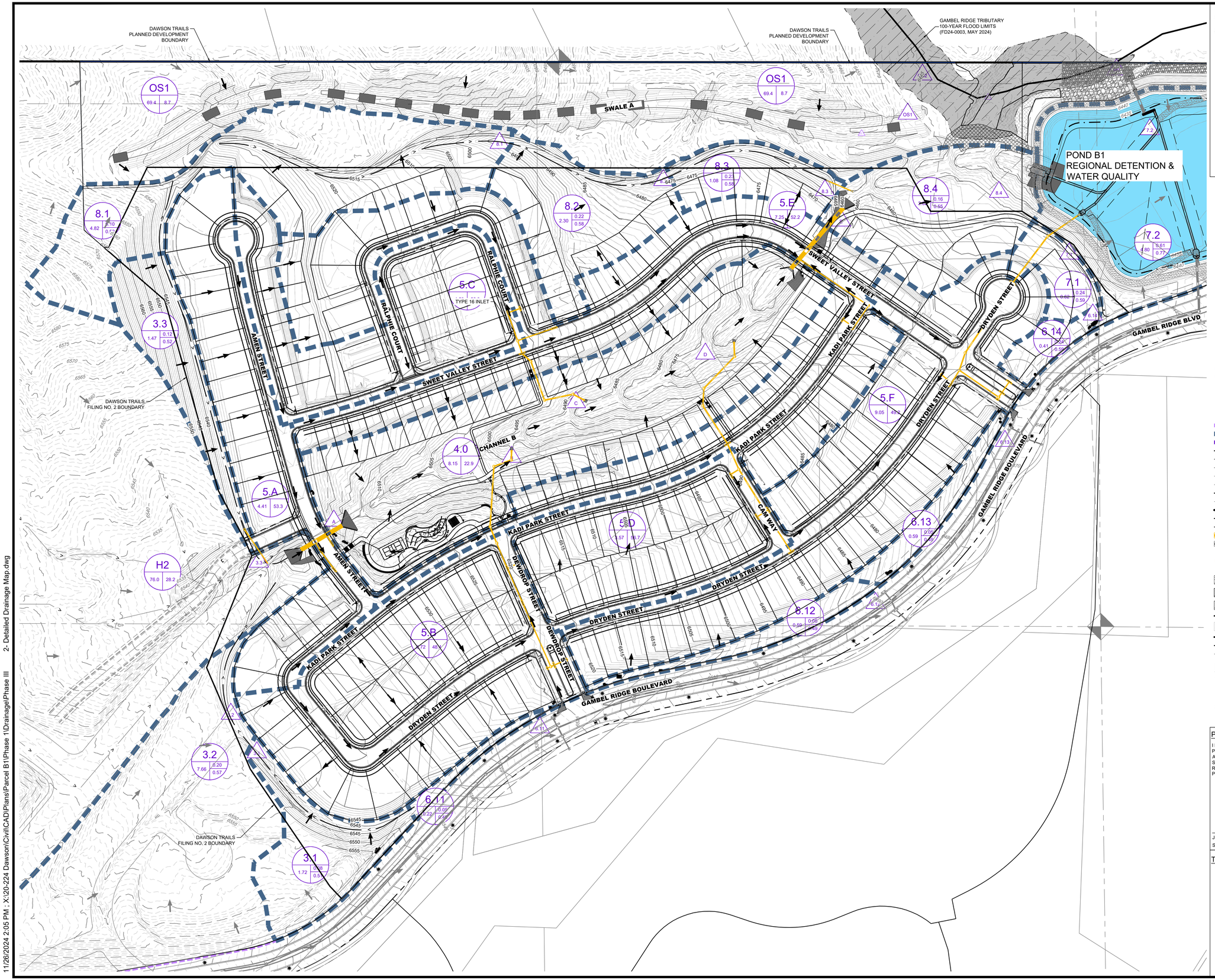
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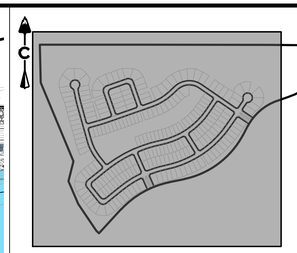
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DRAWN BY: CGV
CHECKED BY: LCC

JOB NO. 20-224

SHEET 1 OF 5

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KEY MAP
SCALE: 1" = 750'

0 100' 200'
1 inch = 100 ft.

LEGEND

EXISTING / PROPOSED

- BASIN DESIGNATION
- 5 YEAR COEFFICIENTS / 100 YEAR COEFFICIENTS
- DESIGN POINT
- DIRECTIONAL FLOW ARROW
- BYPASS OR OVERFLOW PATH
- EXISTING WATERSHED AREA [CUHP]
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- PROPOSED DRAINAGE SUB-BASIN
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- CONCRETE FOREBAY & MAINTENANCE ACCESS
- RIPRAP
- 100 YEAR FLOODPLAIN
- AREA OF GRADING WITHIN 100-YEAR FLOODPLAIN LIMITS
- LIMITS OF CONSTRUCTION
- DRAINAGE SWALE
- EXISTING FLOW CONVEYANCE

NOTES:

1. GAMBEL RIDGE TRIBUTARY FLOODPLAIN LIMITS ARE BASED ON *FLOODPLAIN MODIFICATION STUDY - GAMBEL RIDGE - E PLUM CREEK TO DAWSON TRAILS BOULEVARD*, BY JACOBS ENGINEERING GROUP, MAY 2024.
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JEFFREY M. KILLINGSWORTH DATE
STATE OF COLORADO # 41217

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DAWSON TRAILS - PARCEL B1
CASTLE ROCK, COLORADO

DRAINAGE MAPS
OVERALL DRAINAGE MAP

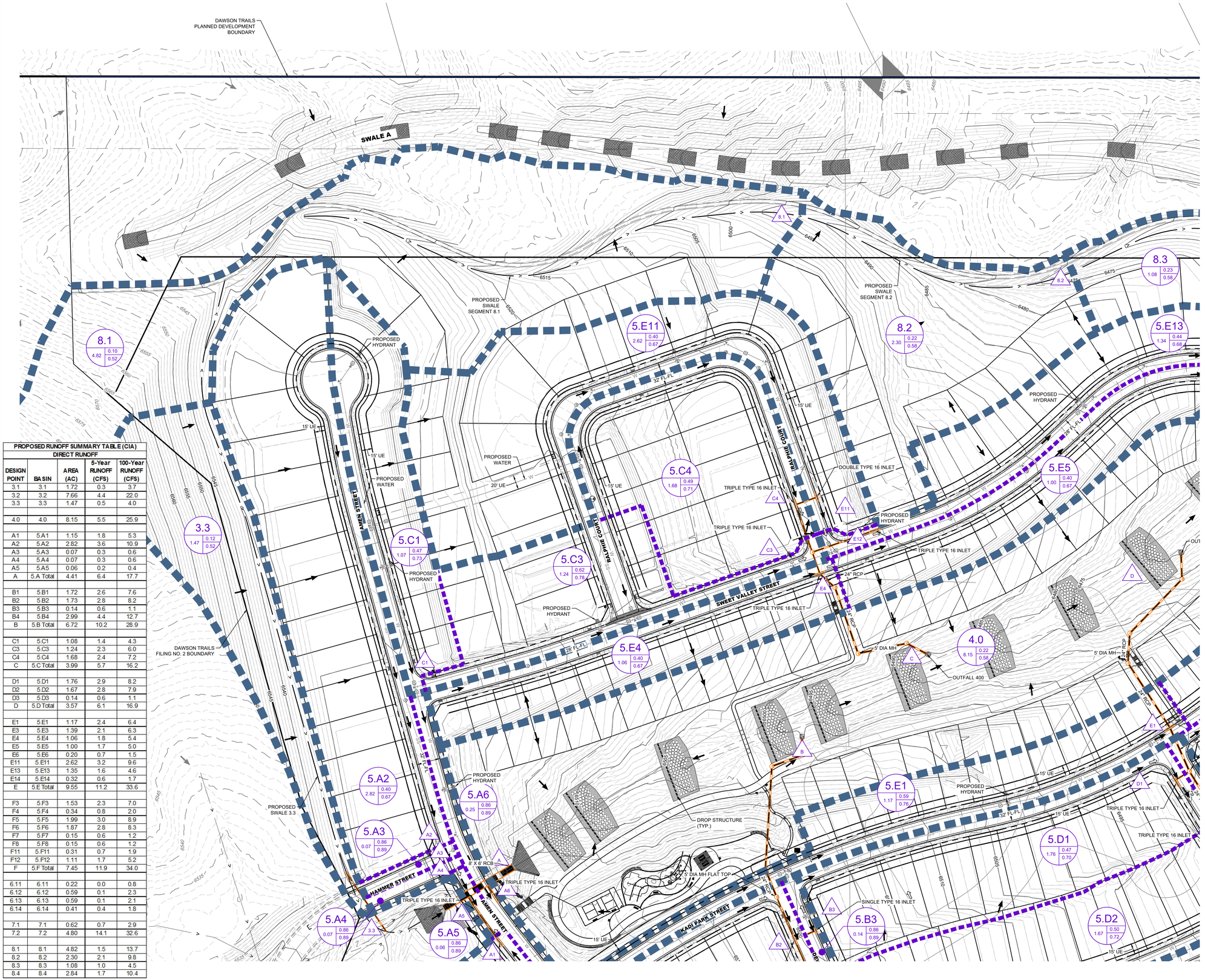
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CHECKED BY: LCC

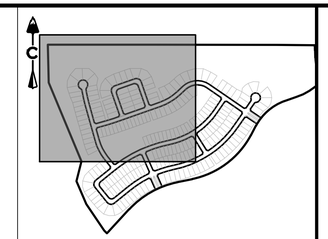
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SHEET 2 OF 5

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PROPOSED RUNOFF SUMMARY TABLE (CIA)				
DIRECT RUNOFF				
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)
3.1	3.1	1.72	0.3	3.7
3.2	3.2	7.66	4.4	22.0
3.3	3.3	1.47	0.5	4.0
4.0	4.0	8.15	5.5	25.9
A1	5.A1	1.15	1.8	5.3
A2	5.A2	2.82	3.6	10.9
A3	5.A3	0.07	0.3	0.6
A4	5.A4	0.07	0.3	0.6
A5	5.A5	0.06	0.2	0.4
A	5.A Total	4.41	6.4	17.7
B1	5.B1	1.72	2.6	7.6
B2	5.B2	1.73	2.8	8.2
B3	5.B3	0.14	0.6	1.1
B4	5.B4	2.99	4.4	12.7
B	5.B Total	6.72	10.2	28.9
C1	5.C1	1.08	1.4	4.3
C3	5.C3	1.24	2.3	6.0
C4	5.C4	1.68	2.4	7.2
C	5.C Total	3.99	5.7	16.2
D1	5.D1	1.76	2.9	8.2
D2	5.D2	1.67	2.8	7.9
D3	5.D3	0.14	0.6	1.1
D	5.D Total	3.57	6.1	16.9
E1	5.E1	1.17	2.4	6.4
E3	5.E3	1.39	2.1	6.3
E4	5.E4	1.06	1.8	5.4
E5	5.E5	1.00	1.7	5.0
E6	5.E6	0.20	0.7	1.5
E11	5.E11	2.62	3.2	9.6
E13	5.E13	1.35	1.6	4.6
E14	5.E14	0.32	0.6	1.7
E	5.E Total	9.55	11.2	33.6
F3	5.F3	1.53	2.3	7.0
F4	5.F4	0.34	0.8	2.0
F5	5.F5	1.99	3.0	8.9
F6	5.F6	1.87	2.8	8.3
F7	5.F7	0.15	0.6	1.2
F8	5.F8	0.15	0.6	1.2
F11	5.F11	0.31	0.7	1.9
F12	5.F12	1.11	1.7	5.2
F	5.F Total	7.45	11.9	34.0
6.11	6.11	0.22	0.0	0.8
6.12	6.12	0.59	0.1	2.3
6.13	6.13	0.59	0.1	2.1
6.14	6.14	0.41	0.4	1.8
7.1	7.1	0.62	0.7	2.9
7.2	7.2	4.80	14.1	32.6
8.1	8.1	4.82	1.5	13.7
8.2	8.2	2.30	2.1	9.8
8.3	8.3	1.08	1.0	4.5
8.4	8.4	2.84	1.7	10.4



C

0 60' 120'

1 inch = 60 ft.

LEGEND

EXISTING / PROPOSED

- BASIN DESIGNATION
- 5 YEAR COEFFICIENTS / 100 YEAR COEFFICIENTS
- DESIGN POINT
- DIRECTIONAL FLOW ARROW
- BYPASS OR OVERFLOW PATH
- EXISTING WATERSHED AREA [CUHP]
- PROPOSED DRAINAGE BASIN
- PROPOSED DRAINAGE SUB-BASIN
- PROPOSED MAJOR CONTOUR
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- PROPOSED STORM & STUB OUT
- EXISTING STORM & STUB OUT
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- STORM INLETS
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- CRUSHER FINES MAINTENANCE ACCESS
- CONCRETE FOREBAY & MAINTENANCE ACCESS
- RIPRAP
- 100 YEAR FLOODPLAIN
- AREA OF GRADING WITHIN 100-YEAR FLOODPLAIN LIMITS
- LIMITS OF CONSTRUCTION
- DRAINAGE SWALE
- EXISTING FLOW CONVEYANCE

NOTES:

1. GAMBEL RIDGE TRIBUTARY FLOODPLAIN LIMITS ARE BASED ON *FLOODPLAIN MODIFICATION STUDY - GAMBEL RIDGE - E PLUM CREEK TO DAWSON TRAILS BOULEVARD*, BY JACOBS ENGINEERING GROUP, MAY 2024.
2. ALL PROPOSED CURB IS TYPE MS2, EXPECT ON ENTRY STREET SEGMENTS AS NOTED.

PROFESSIONAL ENGINEER CERTIFICATION

I HEREBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS WERE PREPARED UNDER MY DIRECT SUPERVISION, IN ACCORDANCE WITH ALL APPLICABLE TOWN OF CASTLE ROCK AND STATE OF COLORADO STANDARDS AND STATUTES, RESPECTIVELY; AND THAT I AM FULLY RESPONSIBLE FOR ALL DESIGN AND REVISIONS RELATIVE TO SAID PLANS.

NOT FOR CONSTRUCTION

JEFFREY M. KILLINGSWORTH — DATE
STATE OF COLORADO # 41217

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL.

APPROVED BY:

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Know what's below. Call before you dig. 811

#	REVISION DESCRIPTION	DATE	BY
1.	1ST SUBMITTAL	11/26/24	JK

DAWSON TRAILS - PARCEL B1

CASTLE ROCK, COLORADO

DRAINAGE MAPS
DETAILED DRAINAGE MAP-1

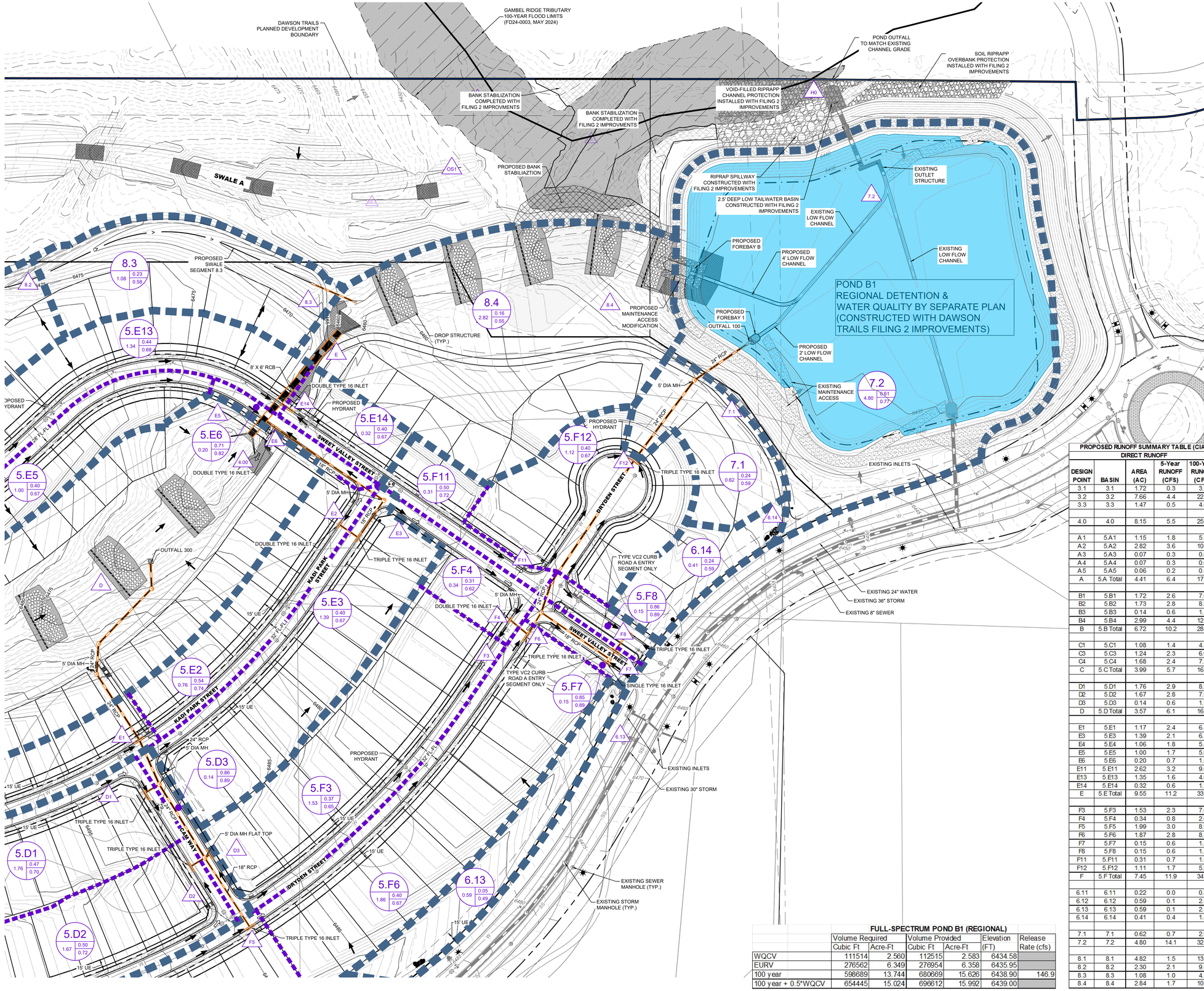
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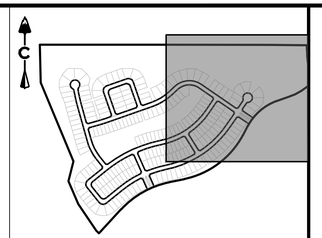
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DRAWN BY: CGV
CHECKED BY: LCC

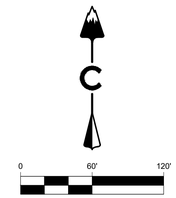
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SHEET 3 OF 5

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LEGEND

EXISTING / PROPOSED

- BASIN DESIGNATION
- 5 YEAR COEFFICIENTS
- 100 YEAR COEFFICIENTS
- DESIGN POINT
- DIRECTIONAL FLOW ARROW
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- RIPRAP
- 100 YEAR FLOODPLAIN
- AREA OF GRADING WITHIN 100-YEAR FLOODPLAIN LIMITS
- LIMITS OF CONSTRUCTION
- DRAINAGE SWALE
- EXISTING FLOW CONVEYANCE

NOTES:

1. GAMBEL RIDGE TRIBUTARY FLOODPLAIN LIMITS ARE BASED ON *FLOODPLAIN MODIFICATION STUDY - GAMBEL RIDGE - E PLUM CREEK TO DAWSON TRAILS BOULEVARD*, BY JACOBS ENGINEERING GROUP, MAY 2024.
2. ALL PROPOSED CURB IS TYPE MS2, EXPECT ON ENTRY STREET SEGMENTS AS NOTED.

PROFESSIONAL ENGINEER CERTIFICATION

I HEREBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS WERE PREPARED UNDER MY DIRECT SUPERVISION, IN ACCORDANCE WITH ALL APPLICABLE TOWN OF CASTLE ROCK AND STATE OF COLORADO STANDARDS AND STATUTES, RESPECTIVELY; AND THAT I AM FULLY RESPONSIBLE FOR ALL DESIGN AND REVISIONS RELATIVE TO SAID PLANS.

NOT FOR CONSTRUCTION

JEFFREY M. KILLINGSWORTH — DATE
STATE OF COLORADO # 41217

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL.

APPROVED BY:

DEVELOPMENT SERVICES — DATE

PROPOSED RUNOFF SUMMARY TABLE (CIA)

DESIGN POINT	BASIN	AREA (AC)	DIRECT RUNOFF 5-Year RUNOFF (CFS)	DIRECT RUNOFF 100-Year RUNOFF (CFS)
3.1	3.1	1.72	0.3	3.7
3.2	3.2	7.66	4.4	22.0
3.3	3.3	1.47	0.5	4.0
4.0	4.0	8.15	5.5	25.9
A1	5.A1	1.15	1.8	5.3
A2	5.A2	2.82	3.6	10.9
A3	5.A3	0.07	0.3	0.6
A4	5.A4	0.07	0.3	0.6
A5	5.A5	0.06	0.2	0.4
A	5.A Total	4.41	6.4	17.7
B1	5.B1	1.72	2.6	7.6
B2	5.B2	1.73	2.8	8.2
B3	5.B3	0.14	0.6	1.1
B4	5.B4	2.99	4.4	12.7
B	5.B Total	6.72	10.2	28.9
C1	5.C1	1.08	1.4	4.3
C3	5.C3	1.24	2.3	6.0
C4	5.C4	1.68	2.4	7.2
C	5.C Total	3.99	5.7	16.2
D1	5.D1	1.76	2.9	8.2
D2	5.D2	1.67	2.8	7.9
D3	5.D3	0.14	0.6	1.1
D	5.D Total	3.57	6.1	16.9
E1	5.E1	1.17	2.4	6.4
E3	5.E3	1.39	2.1	6.3
E4	5.E4	1.06	1.8	5.4
E5	5.E5	1.00	1.7	5.0
E6	5.E6	0.20	0.7	1.5
E11	5.E11	2.62	3.2	9.6
E13	5.E13	1.35	1.6	4.6
E14	5.E14	0.32	0.6	1.7
E	5.E Total	9.55	11.2	33.6
F3	5.F3	1.53	2.3	7.0
F4	5.F4	0.34	0.8	2.0
F5	5.F5	1.99	3.0	8.9
F6	5.F6	1.87	2.8	8.3
F7	5.F7	0.15	0.6	1.2
F8	5.F8	0.15	0.6	1.2
F11	5.F11	0.31	0.7	1.9
F12	5.F12	1.11	1.7	5.2
F	5.F Total	7.45	11.9	34.0
6.11	6.11	0.22	0.0	0.8
6.12	6.12	0.59	0.1	2.3
6.13	6.13	0.59	0.1	2.1
6.14	6.14	0.41	0.4	1.8
7.1	7.1	0.62	0.7	2.9
7.2	7.2	4.80	14.1	32.6
8.1	8.1	4.82	1.5	13.7
8.2	8.2	2.30	2.1	9.8
8.3	8.3	1.08	1.0	4.5
8.4	8.4	2.84	1.7	10.4

FULL-SPECTRUM POND B1 (REGIONAL)

	Volume Required Cubic Ft	Volume Required Acre-Ft	Volume Provided Cubic Ft	Volume Provided Acre-Ft	Elevation (FT)	Release Rate (cfs)
WQCV	111514	2.560	112515	2.583	6434.58	
EURV	276562	6.349	276954	6.358	6435.95	
100 year	598689	13.744	680669	15.626	6438.90	146.9
100 year + 0.5*WQCV	654445	15.024	696612	15.992	6439.00	

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#	REVISION DESCRIPTION	DATE	BY
1	1ST SUBMITTAL	11/26/24	JK

DAWSON TRAILS - PARCEL B1
CASTLE ROCK, COLORADO

DRAINAGE MAPS
DETAILED DRAINAGE MAP-2

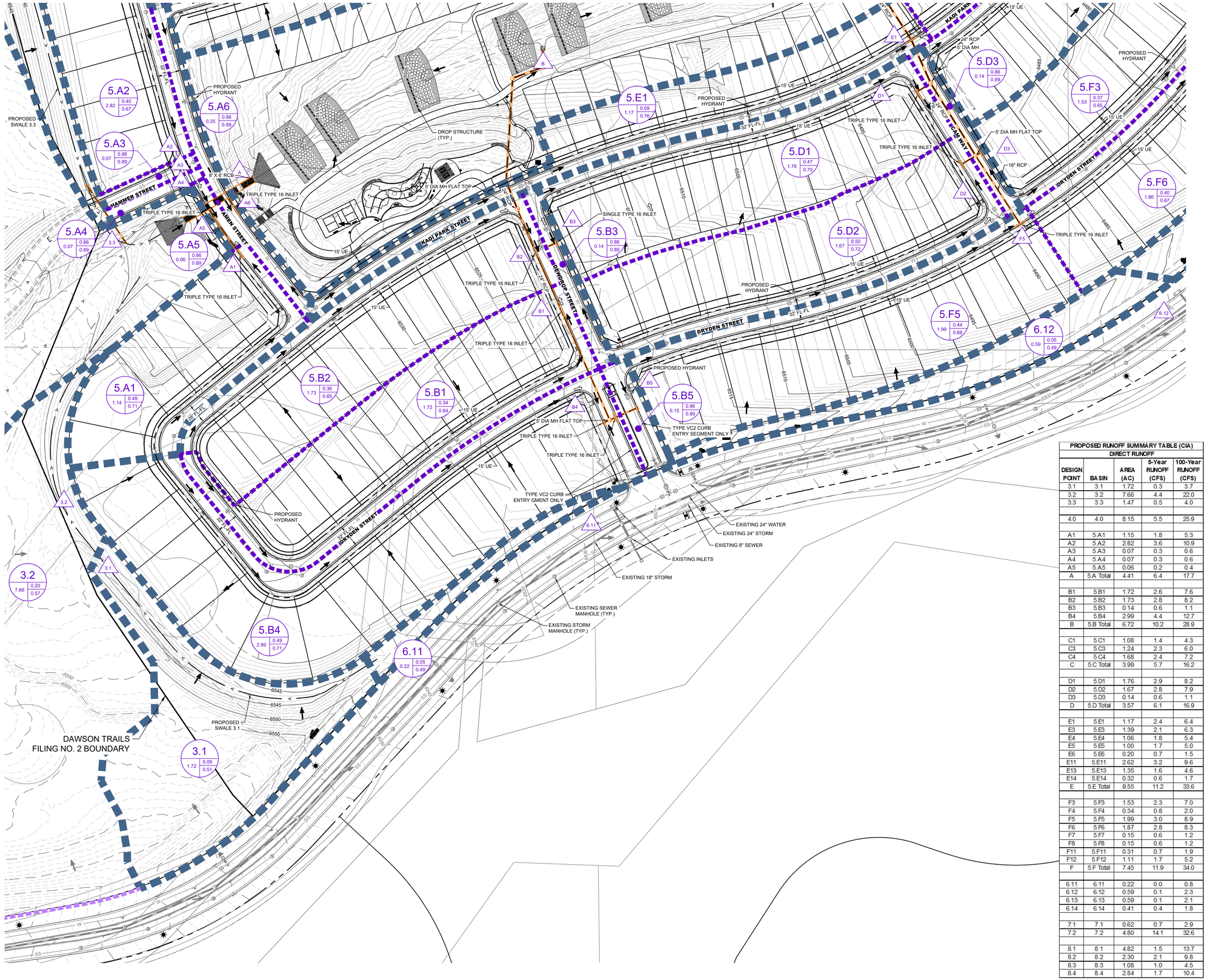
NOT FOR CONSTRUCTION

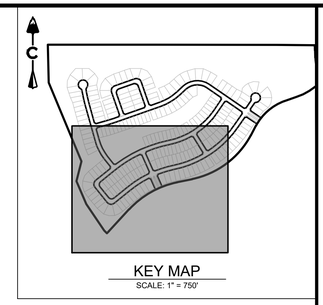
DESIGNED BY: CGV
DRAWN BY: CGV
CHECKED BY: LCC

JOB NO. 20-224

SHEET 4 OF 5

11/26/2024 2:05 PM - X:\20-224 Dawson\Civil\CAD\Plans\Parcel B1\Phase 1\Drainage\Phase III 3-5- Detailed Drainage Maps.dwg





0 60' 120'

1 inch = 60 ft.

LEGEND

EXISTING / PROPOSED

- BASIN DESIGNATION
- 5 YEAR COEFFICIENTS / 100 YEAR COEFFICIENTS
- DESIGN POINT
- DIRECTIONAL FLOW ARROW
- BYPASS OR OVERFLOW PATH
- EXISTING WATERSHED AREA [CUHP]
- PROPOSED DRAINAGE BASIN
- PROPOSED DRAINAGE SUB-BASIN
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EASEMENT
- RIGHT OF WAY (R.O.W.)
- CENTERLINE
- PROJECT BOUNDARY
- PROPOSED WATER
- PROPOSED SANITARY SEWER
- PROPOSED STORM & STUB OUT
- EXISTING STORM & STUB OUT
- STORM MANHOLES
- STORM INLETS
- FES, FOREBAY, & TRICKLE CHANNEL
- CRUSHER FINES MAINTENANCE ACCESS
- CONCRETE FOREBAY & MAINTENANCE ACCESS
- RIPRAP
- 100 YEAR FLOODPLAIN
- AREA OF GRADING WITHIN 100-YEAR FLOODPLAIN LIMITS
- LIMITS OF CONSTRUCTION
- DRAINAGE SWALE
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DIRECT RUNOFF				
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A3	5.A3	0.07	0.3	0.6
A4	5.A4	0.07	0.3	0.6
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B4	5.B4	2.99	4.4	12.7
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C1	5.C1	1.08	1.4	4.3
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C4	5.C4	1.68	2.4	7.2
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D	5.D Total	3.57	6.1	16.9
E1	5.E1	1.17	2.4	6.4
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6.13	6.13	0.59	0.1	2.1
6.14	6.14	0.41	0.4	1.8
7.1	7.1	0.62	0.7	2.9
7.2	7.2	4.80	14.1	32.6
8.1	8.1	4.82	1.5	13.7
8.2	8.2	2.30	2.1	9.8
8.3	8.3	1.08	1.0	4.5
8.4	8.4	2.84	1.7	10.4

NOTES:

1. GAMBEL RIDGE TRIBUTARY FLOODPLAIN LIMITS ARE BASED ON *FLOODPLAIN MODIFICATION STUDY - GAMBEL RIDGE - E PLUM CREEK TO DAWSON TRAILS BOULEVARD*, BY JACOBS ENGINEERING GROUP, MAY 2024.
2. ALL PROPOSED CURB IS TYPE MS2, EXPECT ON ENTRY STREET SEGMENTS AS NOTED.

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NOT FOR CONSTRUCTION

JEFFREY M. KILLINGSWORTH DATE

STATE OF COLORADO # 41217

TOWN APPROVAL BLOCK

TOWN OF CASTLE ROCK APPROVAL
PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF DEVELOPMENT SERVICES APPROVAL.

APPROVED BY:

DEVELOPMENT SERVICES DATE

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Know what's below. Call before you dig. 811

#	REVISION DESCRIPTION	DATE	BY
1	1ST SUBMITTAL	11/26/24	JK

DAWSON TRAILS - PARCEL B1

CASTLE ROCK, COLORADO

DRAINAGE MAPS
DETAILED DRAINAGE MAP-3

NOT FOR CONSTRUCTION

DESIGNED BY: CGV
DRAWN BY: CGV
CHECKED BY: LCC

JOB NO. 20-224

SHEET 5 OF 5

11/26/2024 2:05 PM - X:\20-224 Dawson\Civil\CAD\Plans\Parcel B1\Phase 1\Drainage\Phase III 3-5- Detailed Drainage Maps.dwg