
# Preliminary Drainage Report

US Highway 24 & Peterson Road Intersection Improvement Project

30% Submittal

*Colorado Springs, CO*

December 4, 2023

Prepared for: City of Colorado Springs
30 South Nevada Avenue, Suite 403, Colorado Springs, CO 80903
(719) 385-5908

Prepared by: HDR Engineering, Inc.
Samuel Acosta, PE
5555 Tech Center Drive, Suite 310, Colorado Springs, CO 80919
(719) 272-8894

# Engineer's Statement

This report and plan for the drainage design of US Highway 24 & Peterson Road Intersection Improvement Project was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal):_______________________________________________

Colorado P.E. No. _______________Date_______________

**City Project Manager's Statement**

I hereby certify that the drainage for US Highway 24 & Peterson Road Intersection Improvement Project shall be constructed according to the design presented in this report. I further understand that field changes must be reviewed by the City Review Engineer to ensure conformance with the original design intent. I am employed by and perform engineering services solely for the City of Colorado Springs, and therefore am exempt from Colorado Revised Statute Title 12, Article 120, Part 2 according to § 12-120-203(1), C.R.S.

_______________________________________
Name of City Project Manager

_______________________________________
Authorized Signature Date

**City of Colorado Springs Statement:**

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

_______________________________________ ______________________
For City Engineer Date

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# 1 Project Description

During peak travel hours, the intersection of US Highway 24 and Peterson Road is severely congested. It is situated on the east side of the city and has recently been the focus of a thorough investigation. It is a primary access point for Peterson Space Force Base (SFB) North Gate and currently consists of 2 signalized intersections with no existing pedestrian accommodations. At the east end of the city, this location also provides access west into Colorado Springs and eastbound toward Falcon and unincorporated El Paso County. The project site is mainly located in a largely undeveloped area but there is a residential neighborhood to the west side of the project.

The purpose of the project is to improve the overall flow of traffic at this intersection, add pedestrian accommodations, and improve the overall aesthetic quality in the area. Along with the two roundabouts on either side of US-24, additional roadway, drainage, and traffic improvements will be provided to the eastbound and westbound US-24 on- and off-ramps. The following analysis has determined that proposed improvements will not adversely affect adjacent or downstream properties or existing floodplains.

## 1.1 Purpose

This report provides a narrative of the existing project area, proposed project improvements and hydrologic and hydraulic analyses of the proposed drainage system.

The project will provide the design and environmental approval necessary to reconstruct the US 24/Peterson Boulevard Interchange to provide a safer, more secure, and more efficient path to the Peterson SFB North Gate. The project will support Peterson SFB access control in routine and emergency operations and take into consideration increased traffic capacity on adjacent roadways due to planned development in the Pikes Peak region. The project will take into account all available modes of transit in the nearby corridors, such as bus and bicycle lanes, sidewalks, and trails.

North of the intersection, the Sand Creek East Fork flows west under Peterson Road toward Sand Creek. Sand Creek flows south under US-24 just west of the project site, parallel to Peterson Road. The most current hydraulic data from the City of Colorado Springs shows no existing floodplain will be impacted by proposed improvements. Hydraulic models for these sections of creek are available on the City of Colorado Springs GIS database.

## 1.2 Study Area Description

The project is located at the intersection of US-24 and Peterson Road, including access ramps to and from US-24, as shown in Figure 1. The project site is extremely flat and ultimately drains to Sand Creek. Runoff from the north intersection is conveyed to Sand Creek via a roadside swale and runoff at the south intersection is left to sheet flow into a field at the north end of Peterson SFB. Access ramps on both the north and south side and adjacent areas also drain to Sand Creek, including the golf course to the northwest and the parking lot to the southwest.

**Figure 1: Vicinity Map**


## 1.3 Previous Studies

Research was conducted into previously completed drainage studies that cover the areas located within or drain to the project limits. Aerial images and offsite contours were reviewed to determine offsite flows that are conveyed to the existing corrugated metal pipe (CMP) culverts that cross underneath the project site.

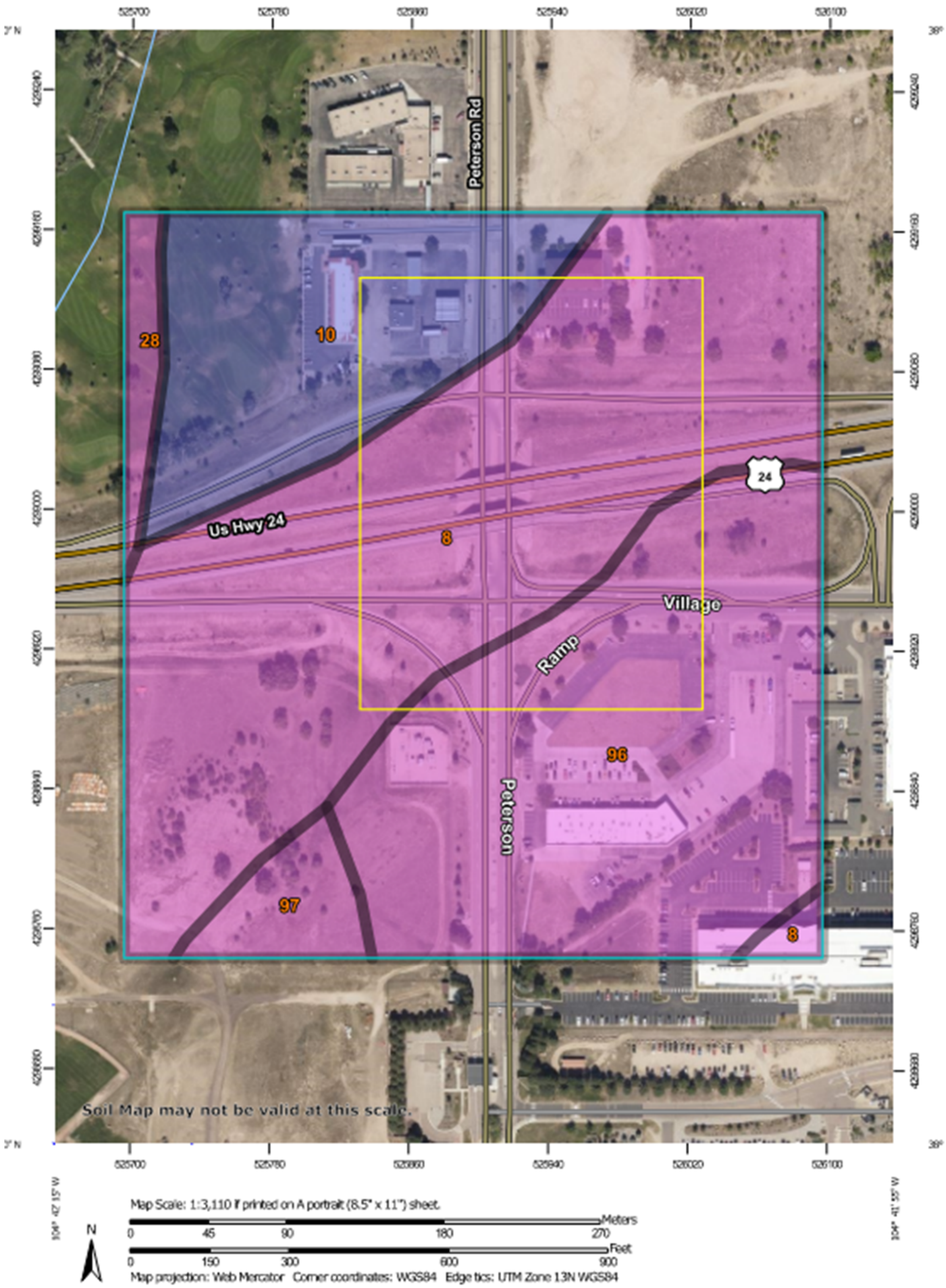
The Sand Creek Drainage Basin Planning Study from January 2021 documents stormwater runoff peak flows and volumes collected by Sand Creek's tributary basins. The study consists of an in-depth analysis of the hydrology and hydraulic features based on existing and future conditions. Before its confluence with Sand Creek, the Sand Creek East Fork system conveys flows west under Peterson Road via 5 staggered 36" elliptical CMP culverts to the north of the project area. This section of creek then flows south under a 125' wide bridge at US-24/E Platte Ave west of the project limits. The study indicates the existing weir structure at Peterson Road has insufficient capacity to accommodate the 100-year runoff event or future flows due to expected development in the area. The study proposes 10 adjacent 10' x 10' reinforced concrete boxes (RCBs) in order to accommodate future flows at this design point. Despite this insufficiency, hydraulic models from the study show no split flow entering the project area to the south.

## 1.4 Soil Conditions

Soils information for this report were obtained from the US Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Websoil Survey.

In most of the project areas, soils are Hydrologic Type A soils (shaded in color purple), as shown in Figure 2. These soils have a high infiltration rate when thoroughly wet and consist mainly of deep, well-drained to excessively drained sands or gravelly sands. At the northwest end of the project limits and continuing offsite to the undeveloped areas northeast, the type B soils (shaded in blue) have a moderate infiltration (low runoff potential) 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. See Figure 2 for the Hydrologic Soils Group Map for more information. The soils report can be found in Appendix 9.5.

**Figure 2: Hydrologic Soil Group**



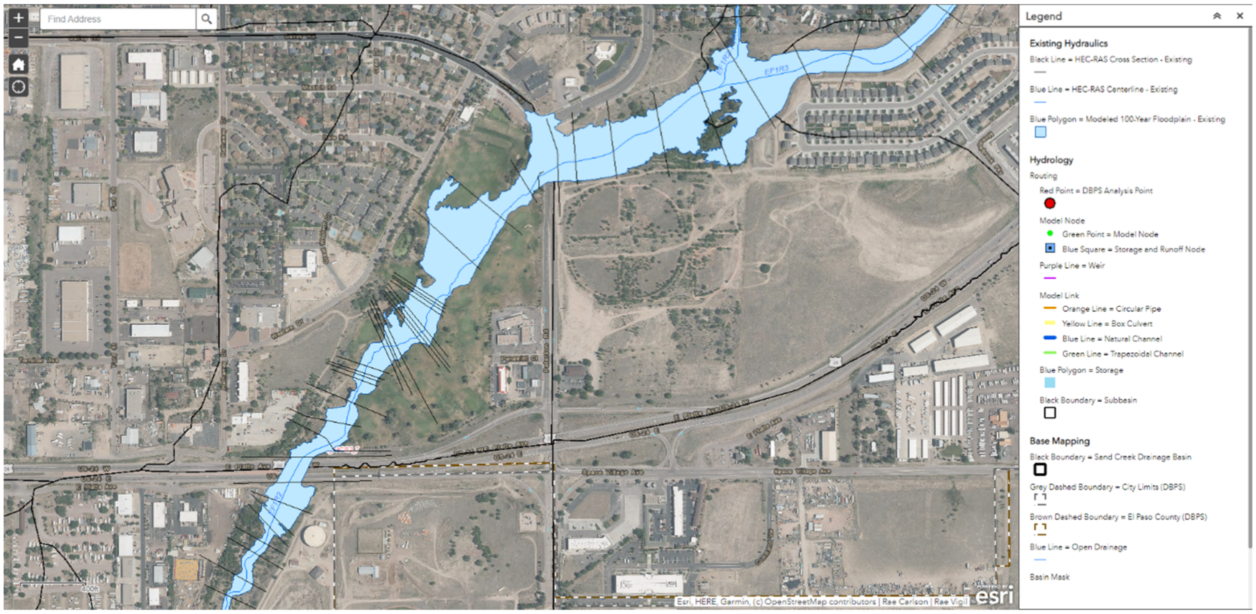
## 1.5 FEMA Floodplain

The project is located next to Sand Creek East Fork, which is designated as a Zone AE floodplain with elevations as shown on the FEMA Flood Insurance Rate Map (FIRM) panel 08041C0754G, effective on December 7, 2018 and shown in Figure 3. The existing culvert where the Zone AE floodplain is shown to cross Peterson Road in Figure 3 will be replaced by a culvert with greater capacity so no rise in water surface elevation is expected at this location due to the proposed improvements. Instead of sheet flow into the field to the southwest of the intersection, runoff at the south roundabout will be re-routed north and west into the existing Zone AE ditch, upstream of the bridge at US-24.

However, since the 2021 Drainage Planning Study mentioned in section 1.3 is more current, conducted by local authorities, and the data is accepted by the City of Colorado Springs, the FEMA floodplain data is assumed to be out of date. Figure 4 on the next page shows the extents of the floodplain from the Drainage Basin Planning Study. While the project site is not located within the Zone AE, the proposed design is expected to alter existing flow patterns and further investigation will be conducted in later phases of the design process.

**Figure 3: FEMA Regulatory Floodplain**

**Figure 4: Drainage Basin Planning Study Floodplain**




# 2 Design Criteria

Improvements were designed in accordance with the City of Colorado Springs Drainage Criteria Manual (DCM). This criteria is supplemented with the Mile High Flood District's (Flood District) Urban Storm Drainage Criteria as needed.

Criteria for the major (100-year) and minor (5-year) storm events have been provided in Appendix 9.1. Development of peak flows and project runoff was in accordance with Chapter 6 of the DCM. Due to the relatively small size of project basins, the Rational Method was used. Runoff coefficients were used from Chapter 6 of the DCM. Rainfall intensity values were taken from NOAA Atlas 14. The precipitation values for the project are 1.30-inches and 2.74-inches for the 5-year and 100-year, 1-hour rainfall events, from Table 6.2 Rainfall Depths of Colorado Springs.

## 2.1 Street Capacity

Street capacity and surface runoff improvements were designed in accordance with Chapter 7 of the DCM. For spread and depth criteria, both Peterson Road and Space Village Avenue have been classified as Minor Arterials, including the eastbound offramp from US-24. However, US-24 itself is classified as an expressway. The existing intersections currently only have curb and gutter on the southern side of Space Village Ave, but the proposed design will have curb and gutter all the way around the proposed roundabouts. Table 1 on the next page outlines spread and depth criteria for both the major and minor events. It is assumed that the roundabouts and each of their respective exits will be classified as minor arterials with 6-inch tall curbs and gutter with a 2% cross slope.

**Table 1: Street Criteria**

| Roadway | Criteria | 5-Year | 100-Year |
|---|---|---|---|
| **Central Roundabouts, Peterson Road, Space Village Ave** | Allowable Spread | 10-feet clear | Contained within ROW |
| | Allowable Ponding Depth | 6-inch | 0-inch max. at crown/median |

## 2.2 Storm Sewer

Proposed inlets were designed in accordance with Chapter 8 of the DCM. The project uses CDOT standard Type R, Type C, and Type D inlets. On-grade inlets are sized to collect 70-80% of the flow and meet spread and depth criteria for the 5- and 100-year storm event. Type D inlets located at sumps are sized to collect flow from off-site basins. Type R inlets on floating medians are placed with the intent that they will be located in sump locations in order to meet spread and depth criteria. Inlets are designed using the Mile High Flood District UD-Inlet spreadsheet version 4.06, dated August 2018.

Storm sewer improvements were designed in accordance with Chapter 9 of the DCM and incorporate the following guidelines:

- A minimum pipe size of 15-inch for laterals and 18-inch for trunk lines.
- All pipes are reinforced concrete pipe unless otherwise noted.
- Minor storm hydraulic grade line (HGL) must be contained within the pipe.
- Major storm HGL shall be at least 1 foot below final grade along the storm sewer system, measured from the lowest gutter flowline elevation at the adjacent inlets.
- Velocities will be between 3 and 18 feet per second for both, minor and major storm event.
- The storm system analysis is being performed with Bentley's StormCAD version 10.03.04.53, using the standard method.

## 2.3 Permanent Water Quality

The project is anticipated to require permanent water quality solutions as part of the roadway improvements, despite a minimal increase in new impervious area and minor area of disturbance. The total disturbance area for this project is listed below:

- Total Area of Proposed Roadway Improvements: 5.70 acres
- Total Disturbance Area Excluding Existing Pavement: 2.74 acres
- Total Net Impervious Area (Impervious Added minus Impervious Removed): 1.52 acres

According to the Colorado Springs DCM, this project area is classified as a "Redevelopment Site" because the disturbed area is greater than one acre. Permanent Water Quality will follow criteria, according to DCM four step process.

- Employ Runoff Reduction Practices
- Implement BMPs that provide a Water Quality Capture Volume (WQCV) with slow release

- Stabilize Drainageways
- Implement site specific and other control measures

Proposed design will utilize hydrodynamic separators (HDSs) as well as a permanent water quality pond in order to meet DCM criteria for water quality, but not for detention. HDR will investigate the effectiveness of HDSs instead of the pond before the next submittal. Per Colorado Springs criteria, an exemption for stormwater detention may be granted if the downstream receiving waters are shown to have adequate capacity. HDR will perform a hydraulic analysis of the channel in future phases of the project and no rise is expected in the water surface elevation in Sand Creek.

# 3 Hydrology

Drainage basins were delineated based on existing topography, aerial images, El Paso County LiDAR data, proposed contours, and Google Earth imagery. Basins were delineated for proposed conditions with the assumption that proposed topography will closely match existing outside of proposed contours.

## 3.1 Design Frequency

Design frequency follows guidelines of the City DCM for the specified roadway classification. Peak flows were estimated using the Rational Method for the Design Storm (5-year), and the Major Storm (100-year).

## 3.2 Peak Flows

The Site is located at an extremely shallow grade with no existing storm structures to capture runoff. Runoff primarily sheet flows across the site from the northeast to the southwest, and a few CMP culverts convey flows under the roadway at these locations. North of the US-24 overpass, flows are conveyed into the northwest ditch that flows west to Sand Creek East Fork, while south of the overpass, flows continue to sheet flow into a field at the north end of Peterson SFB before eventually joining Sand Creek East Fork further downstream. Large off-site basins northeast of the site generate a significant amount of flow through the project area. The existing 36" CMP located under Peterson Road at the north end of the north intersection is at full capacity capturing the majority of the off-site runoff. The peak flows and the full calculations can be found in the appendices.

# 4 Hydraulics

The site is located at an extremely shallow grade with no existing storm structures to capture runoff. Runoff primarily sheet flows across the site from the northeast to the southwest, and a few CMP culverts convey flows under the roadway. North of the US-24 overpass, flows are conveyed into the northwest ditch that flows west to Sand Creek East Fork, while south of the overpass, flows continue to sheet flow into a field at the north end of Peterson SFB before eventually joining Sand Creek East Fork further downstream.

## 4.1 Existing Storm Drain System

The existing site contains a very basic storm system, consisting of a few crossing culverts that convey flows to the westbound roadside ditch on the north side of US-24 or to the field at the north end of Peterson SFB, which ultimately both outlet to Sand Creek East Fork. Each segment of the project is described below.

### 4.1.1 Offsite Undeveloped Area, Northeast of Project Area

Northeast of the project, there is a large undeveloped area that slopes and drains toward either Peterson Road, north of the project area, or the roadside ditch along the north end of US-24. Flow that reaches Peterson Road is conveyed south along the east edge of the roadway via curb and gutter, while the ditch along the north end of US-24 conveys flow west toward Peterson Road. This area consists of a single motel and parking lot, a portion of a small new housing development at the northeast end, and a large amount of undeveloped land. Runoff from this off-site area sheet flows overland to a 36” CMP culvert that runs west under Peterson Road and into the roadside ditch on the west side of Peterson Road, which outfalls into Sand Creek East Fork further west outside of the project area. This area comprises the majority of the off-site flow. Preliminary calculations show the existing 36” CMP is close to full capacity.

### 4.1.2 Offsite Southbound Peterson, Northwest of Project Area

This section of paved area is located north of the westbound US-24 on-ramp. It is comprised of the west half of Peterson Road, along the Sand Creek Golf Course, and two small business parking lots at the northwest corner of the project area. Runoff from this location drains south along the west end of Peterson Road via curb and gutter and into the westbound roadside ditch toward East Fork Sand Creek.

### 4.1.3 Roundabout at North Intersection, North Half of Project Area

There is an existing signalized intersection at Peterson Road and the US-24 on- and off-ramps, respectively. Flows in this area generally flow south along Peterson Road and away from the crown of the road into a roadside swale on either side. Flow from the westbound off-ramp at this intersection drains into the northern ditch and southeast vegetated slope. Flow from the westbound on-ramp drains to the northern ditch and southwest vegetated slope. The southeast slope conveys flow under Peterson Road through an 18” CMP culvert to the southwest slope. Flow in the southwest slope then drains to the northern ditch or roadside swale which brings runoff to Sand Creek East Fork. Flows not captured by either of the southern vegetated slopes at this intersection continue to flow south down Peterson Road under US-24 and toward the South Intersection.

### 4.1.4 Roundabout at South Intersection, South Half of Project Area

This signalized intersection has a similar layout to the North Intersection. There are also two depressed dirt and grass swales in this location on the west and east side of Peterson Road between US-24 and Space Village Ave. The east ditch captures runoff from the east half of Peterson Road to the north as well as off-site runoff from the southern, eastbound half of US-24 and the north half of Space Village Ave to the RV Storage lot and all the area in between. The grass slope north of the eastbound off-ramp and west of Peterson Road receives runoff from the west half of Peterson Road north of the intersection, the north half of the eastbound off-ramp, the eastbound side of US-24 west of Peterson Road, and all the area between. The remaining runoff in this area sheet flows across the intersection to the southwest before one of several rundowns directs flow into a field on Peterson SFB southwest of the intersection. A culvert of unknown diameter brings flow from the east ditch to the west ditch, where a 24" CMP culvert conveys flow to the field southwest of the intersection. Additionally, runoff from the parking lot southeast of the intersection collects at the west end of the parking lot where a 24" reinforced concrete pipe (RCP) directs flow under Peterson Road to the same field on Peterson SFB's north end. Flow that is not captured by one of these rundowns or grass slopes continues south along Peterson Road and away from the crown on either side.

### 4.1.5 Downstream

There are no existing drainage features to capture runoff downstream of the project area. In existing conditions, flow continues south along Peterson Road via a network of conveyance pans on the surface. Flow continues onto Peterson SFB to the south before eventually sheet flowing west into a field where runoff is eventually conveyed to Sand Creek East Fork further downstream of the project area.

## 4.2 Proposed Storm Drain Improvements

Proposed construction begins just north of the US-24 westbound on and off-ramps at Peterson Road and extends south almost to the Peterson SFB North Gate, including both signalized intersections on either side of US-24 and their turn lanes or ramps at Peterson Road. Proposed roadway improvements consist of the addition of a roundabout on either side of US-24 where the existing signalized intersections are located. Sidewalks are to be added all the way around both roundabouts for pedestrian safety and access from the businesses at the southeast corner of Peterson and Space Village up to the businesses northwest and northeast of US-24 and Peterson. The existing US-24 bridge over Peterson Road will have its sloped sidewalls replaced with vertical retaining walls to make room for added sidewalk on either side of the underpass. Proposed basins and storm improvements can be found in the Basin Maps in Appendix 9.2. Proposed storm improvements will capture and convey design flows through the project area based on existing flow patterns while also meeting Colorado Springs DCM criteria. It is assumed that some minor to moderate regrading will be needed. Where applicable, existing culverts will be replaced with larger storm pipe to accommodate future flows. Curb and gutters are expected to be present at all proposed roadway edges and medians within the project area and assumed to be standard 6" depth. Proposed roadways have been designed at a 2% cross slope. Multiple new networks of catch basins and reinforced concrete pipe (RCP) have been proposed to ensure design flows are adequately captured and conveyed to the outfall. Proposed drainage improvements were difficult to model due to the shallow grades. With larger pipes needed to accommodate design flows, cover depth criteria was difficult to meet. To resolve this issue, the proposed storm design utilizes elliptical pipes and daylights further downstream. Future designs may need to include moderate regrading of the existing swales as well as at the system outfalls in order to ensure DCM criteria is met. Each segment of the project is described below.

### 4.2.1 North Peterson Flow System, North End of North Roundabout

At the northern end of the project, there are a few large off-site basins that direct flow south into the roadside swale. The existing culvert that conveys flow under Peterson Road at this intersection will be replaced with a 45” x 29” elliptical RCP (36” circular equivalent) in order to both increase capacity and meet cover depth criteria. The upstream end of this culvert is positioned to maximize the amount of runoff captured in the ditch. Several Type R inlets are to be placed at the north end of the design to capture runoff from off-site basins to the north and tie into the new culvert. Two additional Type R inlets have also been placed next to the proposed crosswalks to minimize impacts to pedestrians. A flared end section is proposed at the system outfall to the west. In order to meet spread and depth criteria, CDOT Type R inlets will be added on-grade on either side of Peterson Road, north of the intersection to capture off-site flow and convey it to the elliptical RCP, via a manhole between them. It is also important to note that these inlets will be placed directly in front of the proposed sidewalk to minimize runoff in the proposed sidewalk areas.

This proposed storm system is able to capture and convey off-site flows to the existing outfall at the roadside ditch along the north side of the westbound on-ramp. Flows not captured by these Type R inlets continue south to the roundabout and into the on-site system. The elliptical pipe allows this system to meet the 2’ minimum cover depth recommended by the Colorado Springs DCM. Similarly, these pipe slopes will need to be even shallower than the existing grades in order to meet cover depth criteria. A minimum design slope of 0.3% was used in developing these storm systems. Riprap will be added at the outfall as outfall protection and energy dissipation.

#### 4.2.2 North Roundabout Flow System, North Roundabout

Runoff from the proposed design is anticipated to roughly match existing conditions – south along Peterson Road and away from the crown of the road to the west and east vegetated slopes on the north side of US-24. Runoff will be captured and conveyed through a series of inlets placed strategically and symmetrically at both the westbound off-ramp and on-ramp and adjacent to proposed pedestrian crossings.

The primary trunk line for this system runs west under the roundabout from the westbound off-ramp to the vegetated slope south of the westbound on-ramp, roughly where an existing 18” CMP culvert is located. Instead of directing flow north into the ditch to match existing flow patterns, the new system proposes routing flow to a new water quality pond in this swale before outfalling further downstream in the existing swale on the north side of the US-24 westbound on-ramp. This design change was necessary to solve a few different problems: mainly, the pipe would have needed to convey flow to the ditch from a sump inlet and would need to be sloped uphill in order to daylight. Instead, the proposed design conveys flow further downstream until the 36” RCP was able to daylight. The proposed system outlets at an elevation of 6255.78’. Considering the 100-Year Base Flood Elevation (BFE) is 6258.99’, a flap gate will likely be needed at the outlet pipe. This is based on best available data from the Sand Creek Drainage Basin Planning Study (DBPS).

This proposed storm system is able to capture and convey off-site flows to the new outfall further downstream in the roadside ditch along the north side of the westbound on-ramp. Flows not captured by these Type R inlets on both the west and east side of the roundabout continue south under US-24 and toward the South Roundabout. This system is also able to meet cover depth criteria with the 2’ minimum cover depth recommended by the Colorado Springs DCM. The minimum design slope of 0.3% was also used in developing this storm system.

#### 4.2.3 South Roundabout System

In this region, runoff is expected to travel south down Peterson Road and away from the crown, southeast toward the proposed roundabout from the eastbound US-24 off-ramp, and west toward the proposed roundabout from Space Village Ave and away from the crown. Runoff will be captured by mostly symmetrically positioned Type R inlets along the roundabout edges and adjacent to pedestrian crossings. Additionally, Type C and D inlets will be added in sump locations northwest, northeast, and southeast of the intersection to capture runoff from eastbound US-24 as well as off-site flow from the east. A Type 13 inlet in a sump will also be placed in the grassy area at the west end of the southwest parking lot, roughly where an existing 24” RCP culvert is located.

Contrary to existing flow patterns, the proposed design consists of one main trunk line that starts southwest of the intersection before draining north to bypass the proposed water quality pond, mentioned in the previous section. There are four main lateral branches:

- The first of these runs west from the Type 13 inlet in the southeast corner of the intersection from the existing parking lot and collects runoff from the Type R inlets in the southeast region of the roundabout.
- The next runs east from the Type R inlets in southwest corner of the roundabout.
- The third runs west from the Type D inlet at the northeast corner of the southern roundabout and collects runoff from the Type R inlets in the northeast region of the southern roundabout.
- The final branch runs north and east and collects runoff from the northwestern region of the southern roundabout.

A series of Type R inlets along the curbs of the roundabout will tie into these main trunk lines. The main trunk line is expected to bypass the proposed water quality detention system which will be located southwest of the northern roundabout and go directly to the outfall. Any flow not captured by this system of inlets will continue south down Peterson Road and into the Downstream System.

#### 4.2.4 Downstream System

Runoff in this region consists of bypass flow from the Southern Roundabout System, runoff from roadway area south of the roundabout that is flowing south and away from the crown of the road, and off-site runoff from the east half of the parking lot area not captured by the sump inlet on its west end. This system is comprised of symmetrically placed Type R inlets on the west and east sides of Peterson Road. Storm pipes will convey runoff from the east inlets to the southwesternmost Type R inlet at the southern extent of the project area before outfalling west to the field or the grassy area on the west side of Peterson Road for water quality treatment.

## 4.3 Hydraulic Calculations

### 4.3.1 Storm Sewer System

The storm sewer system is proposed to collect and convey roadway and off-site drainage. Curb inlets collect street runoff and grate inlets are used to collect ditch runoff. The storm sewer system conveys the runoff to proposed water quality features or connects to an existing system. Bentley StormCAD 10.3.4.53 was used to model the storm sewer network. Urban Drainage Flood District UD-Inlet spreadsheet version 4.05 was used to calculate inlet spread and capture. The StormCAD results and inlet spreadsheets are located in Appendices 9.7 and 9.8, respectively. The results in the inlet capacity spreadsheets show no adverse effect on the downstream conditions as all of the inlets are located within the storm sewer network and not immediately adjacent to an outfall location.

Several pipes in the proposed system do not meet velocity requirements. This is due to the constraints of the terrain. Pipes have been placed at minimum slope in order to both maintain flow and meet cover depth criteria. The existing terrain is very flat so there is not much vertical space available to move the pipes.

### 4.3.2 Swales

The proposed design utilizes 6 existing swales on either side of US-24 to convey off-site and some on-site flows to follow maintain existing drainage patterns. The Colorado Springs DCM recommends ditches should be designed with a minimum of 1-ft of freeboard from the shoulder elevation with 8:1 side slopes or flatter. Although most of the existing swales do not currently meet these criteria, capacity calculations primarily utilized existing data. Velocity and capacity calculations performed with Bentley FlowMaster 10.3.0.3 can be found in Appendix 9.9.

5 of the existing swales utilize a v-shaped section, and 1 is trapezoidal. Side slopes of the existing swales vary between 35.7:1 to as steep as 1.6:1. Since the site is so flat already, several of the existing ditches are less than 1 foot deep, and therefore, do not meet the minimum requirement of 1-ft of freeboard during the 100-year storm. 2 of the ditches do not have capacity for the 100-year event without any freeboard. Future analysis in the next phase of the project should include regraded swales that meet criteria and alternative solutions will need to be explored if regrading is not an option.

# 5 Water Quality

Permanent water quality requirements are addressed through the Four Step Process outlined in Volume 2 of the Drainage Criteria Manual. This process is applicable to all new and re-development projects with construction activities that disturb one acre or greater.

## 5.1 The Four Step Process

- Step 1: Reduce Runoff LID/MDCIA.
  - This project will be utilizing the existing grass-lined swales as planned infiltration areas (PIAs). The runoff from the roadway will flow through these swales before entering the storm sewer system. This will help to reduce the velocity and

promote some infiltration before entering the storm sewer system. Additionally, the proposed water quality pond in the northwest swale will be used to reduce runoff at the outfall and increase infiltration to meet Green Infrastructure Manual (GIM) criteria.

- Step 2: Control Measures for Water Quality.
  - Two hydrodynamic separators are being constructed as part of this project for water quality. These will be placed in two of the manholes downstream of the permanent water quality pond. The project area as a whole currently has no water quality treatment or detention provided.
- Step 3: Stabilize Drainageways.
  - There is expected to be some channel stabilization as part of this project in the swales adjacent to US-24 as well as at the outfalls. New riprap will also be placed at the pipe outfalls in order to prevent erosion and undercutting.
- Step 4: Site Specific Control Measures (CMs).
  - Site specific CMs should be included as part of the Grading and Erosion Control (GEC) plan which include sweeping, and spill prevention. Both will occur based on requirements from the City of Colorado Springs Stormwater Construction Manual (SCM).

## 5.2 Water Quality Control Measures

Water Quality is required on this project as the total disturbance area is 6.89 acres. A permanent water quality pond will be located in an existing swale where runoff from the north roundabout will collect. Downstream of the project, the southernmost system is constrained both horizontally and vertically by right of way and existing grades, respectively. Future designs will address water quality concerns in this area. While not all runoff from the project area will pass through the proposed pond, it has been sized to treat the equivalent disturbed area of the whole project. Additionally, there is one hydrodynamic separator located along the main trunk line just upstream of where the proposed pond outfall ties in. And another hydrodynamic separator has been placed at the downstream end of the northernmost system in order to treat runoff at the north end of the project. No detention is provided because the proposed re-development of the roadway does not increase the water surface elevation in Sand Creek due to the rerouting of runoff in the project area.

Initial water quality designs had proposed underground detention at the southwest corner of the south roundabout where water sheet flows under existing conditions. Further investigation determined that this design was not feasible due to size constraints and available space. In order to adequately treat the expected flow at this proposed outfall, 5-137”x87” chambers would have been needed, totaling 46506 $ft^3$ in storage volume. Flow was instead routed north to join flow leaving the proposed water quality pond northwest into the existing swale before outfalling at Sand Creek. The pond was sized to account for the additional runoff that bypasses it, and hydrodynamic separators were added at two manholes downstream of this confluence to provide additional treatment.

# 6 Operation and Maintenance

The Hydrodynamic Separators do require additional or specialty operations or maintenance (O&M) activities beyond the City's normal O&M for their stormwater drainage system. Please see separate document that includes O&M plans for the proposed pond and Hydrodynamic separators.

# 7 Summary

Stormwater runoff from the US-24 and Peterson Intersection project should not adversely affect the downstream and surrounding developments, but further investigation will be conducted to confirm this. Stormwater runoff will not adversely affect Sand Creek. This report and findings are in general conformance with prior reports for which this site was the subject.

# 8 References

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Flood Insurance Study. El Paso County, Colorado and Incorporated Areas. 08041C0754G. December 7, 2018.

National Oceanic and Atmospheric Association (NOAA) Atlas 14. https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

Sand Creek Drainage Basin Planning Study. City of Colorado Springs. January 2021. https://coloradosprings.gov/document/scdbpsfinal2021.01.21reduced.pdf

Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3. August 2018.

Web Soil Survey. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

# 9 Appendices

## 9.1 Drainage Criteria Memo

# Memo

| | |
|---|---|
| Date: | Wednesday, November 22, 2023 |
| Project: | US-24 and Peterson Road Intersection |
| To: | City of Colorado Springs |
| From: | Sam Acosta, PE and Maria Barraza, HDR |
| Subject: | Drainage Design Criteria Memo, Circle Drive Bridges |

## Design Criteria References

Drainage for US-24 and Peterson Road Intersection has been designed to meet criteria from the City of Colorado Springs Drainage Criteria Manual (DCM) and Urban Drainage and Flood Control District Manual (UDFCD). The references used for the roadway drainage, offsite drainage, and water quality are listed below.

- Drainage Criteria Manual, Volume I and Volume II, City of Colorado Springs, May 2014.
- Urban Storm Drainage Criteria Manual Volume 3, January 2016.
- Flood Insurance Study, El Paso County, Colorado and Incorporated Areas, 08041C0754G, December 7, 2018.
- Sand Creek Drainage Basin Planning Study, Final Report, January 2021.

## General Information

The site is located on at the intersection of US-24 and Peterson Road, including access ramps to and from US-24, in Colorado Springs, Colorado. The project scope includes designing two roundabouts on either side of US-24, along with additional roadway, drainage, and traffic improvements to improve the flow of traffic at the intersection. The proposed design will also feature pedestrian accommodations and improve the overall aesthetic quality of the intersection. The project site is extremely flat, and while it all ultimately drains to Sand Creek, runoff from the north intersection is conveyed there via a roadside swale and runoff at the south intersection is left to sheet flow into a field at the north end of Peterson Space Force Base (SFB). Access ramps on both the north and south side and adjacent areas also drain to Sand Creek, including the golf course to the northwest and the parking lot to the southwest. Roadway improvements include replacing the existing signalized intersections with roundabouts. Drainage improvements consist of two separate drainage systems for the north and south intersections, respectively. These systems consist of new curb inlets proposed throughout the site to collect roadway runoff, replacing the existing culvert system and maintaining existing drainage patterns.

## Hydrology

Hydrology will be developed for local basins using the Rational Method. This method is accepted in the City of Colorado Springs Drainage Criteria Manual (DCM), Chapter 6, Volume I, for basins less than 130 acres. Soil information will be obtained from the National Resource

Conservation Service (NRCS) Websoil Survey. Rainfall data will be determined by using Figure 6-5, Chapter 6, from the DCM, which is sourced from NOAA Atlas 2 f. Hydrologic criteria has been summarized below in Table 1.0.

| **Table 1.0 Hydrologic Criteria Summary Table** | |
|---|---|
| **Hydrology** | **City of Colorado Springs Drainage Criteria Manual** |
| Acceptable Methods | Rational Method for Basin < 130 acres |
| Precipitation Data | Figure 6-5 of DCM (NOAA Atlas 2), NOAA Atlas14, or Fountain Creek Rainfall Characterization Study |
| Runoff Coefficients | A function of imperviousness per Table 6.6 of DCM (source UDSCM 2001) |
| Imperviousness Values | Table 6.6 of DCM (source UDSCM 2001) |

## Hydraulics

### Roadway Drainage

The proposed on-site drainage system will be designed to capture roadway runoff and convey flows in the storm drain system according to the DCM. For spread and depth criteria, both Peterson Road and Space Village Avenue have been classified as Minor Arterials, including the eastbound offramp from US-24. However, US-24 itself is classified as an expressway or principle arterial spread criteria. The existing intersections currently only have curb and gutter on the southern side of Space Village Ave, but the proposed design will have curb and gutter all the way around the proposed roundabouts. It is assumed that the roundabouts and each of their respective exits will be classified as minor arterials. A summary of the hydraulic criteria has been outlined below in Table 2.0.

| **Table 2.0 Hydraulic Criteria Summary Table** | |
|---|---|
| **Hydraulics** | **City of Colorado Springs Drainage Criteria Manual** |
| ***Pipes*** | |
| Design /Check Storms | 5-yr /100-yr (Ch. 3, Sect. 4.1/4.2) |
| Pipe Sizes | A minimum of 15-inch for laterals and 18-inch for trunk lines |
| Velocity | Min: 3 fps for all design flows<br>Max: 18 fps for all design flows |
| HGL | Minor storm HGL must be contained within the pipe.<br>Major storm HGL shall be at least 1 foot below final grade along the storm sewer system, measured from the lowest gutter flowline elevation at inlets<br>(Ch. 9, Sect. 7.2 & 7.3) |

| **Table 2.0 Hydraulic Criteria Summary Table** | |
|---|---|
| **Hydraulics** | **City of Colorado Springs Drainage Criteria Manual** |
| Material | Reinforced Concrete Pipes (RCP) |
| ***Culverts*** | |
| Design /Check Storms | The procedures and data to be used for the design and hydraulic evaluation of culverts shall be consistent with the Culverts and Bridges Chapter of Volume 1 of the DCM. The UDFCD Manual may be used to fill in unavailable data in the DCM (Ch. 11, Sect. 2.1) |
| Size | Min size: 18-inch (Ch. 11, Sect. 4.3)<br>Sizing dependent on application ranging from 15-inch – 36-inch (Sect. 9.2.3, Table 9.4) |
| Material | Culverts shall be made of reinforced concrete in round or elliptical cross-sections (minimum Class 3) or reinforced concrete box shapes that are either cast-in-place or supplied in precast sections (Ch. 11 Sect. 4.1) |
| Velocity | Min: 3 fps checked with 25% of the minor storm event flow<br>Max: Velocity shall not exceed 15 fps in the major storm event |
| Allowable HW/D | For all residential, industrial, and collector roadways, the maximum headwater to depth ratio (HW/D) for the major storm design flows will be 1.5 times the culvert opening height (D or H). For culverts through arterial roads and highways, the maximum HW/D ratio for the major storm design flows will be 1.2 times the culvert opening height. HW/D is typically measured from the culvert invert at its centerline. (Ch. 11, Sect. 3.2) |
| Outlet Protection | Shall be required when engineer assesses risk of scour holes, gully scour. Outlet protection will be implanted per Ch. 10, Sect. 3.0, DCM in conjunction with UDFCD Manual 1, Energy Dissipation. |
| ***Manholes*** | |
| Spacing | 18” – 36”: Max. 500’<br>42” – 60”: Max. 600’<br>66” + : Max. 750’<br>Based on corresponding pipe size (Table 9.2, Sect. 6.1, Ch.9) |
| ***Street Spread*** | |
| Design/Check Storms | Design: 5-year<br>Check: 100-year |
| Flow Width | Minor Arterials:<br>- Minor Storm: Minimum 10’ lane clear, no conveyance behind curb<br>- Major Storm: Flow can spread to crown of road or edge of median curb. Conveyance behind curb allowed but must be contained in ROW<br>Based on Ch. 7, Sect. 7.8, Figure 7-3<br><br>Expressway/Principle Arterial Type I:<br>- Minor Storm: No crown overtopping, no conveyance behind curb<br>- Major Storm: Flow can spread to crown of road or edge of median curb. Conveyance behind curb allowed but must be contained in ROW<br>Based on Ch. 7, Sect. 7.8, Figure 7-6 |

| **Table 2.0 Hydraulic Criteria Summary Table** | |
|---|---|
| **Hydraulics** | **City of Colorado Springs Drainage Criteria Manual** |
| Flow Depth | Minor Arterials:<br>- Minor storm event: 5.82” allowable depth based on a 6” vertical curb. Cross street flow is not allowed.<br>- Major storm event: Depth limited to 7.68” at gutter flowline based on a 6” vertical curb, flow must be within right-of-way.<br>- Max: 0-inches at the crown or median curb<br>Based on Ch. 7, Sect. 7.3 and Sect. 7.8, Figure 7-3<br><br>Expressway/Principle Arterial Type I:<br>- Minor storm event: 6-inches allowable depth based on a 6-inch vertical curb and 0-inches at the crown.<br>- Major storm event: Depth limited to 9.12” at gutter flowline based on a 6” vertical curb and 0-inches at street crown, flow must be within right-of-way.<br>Based on Ch. 7, Sect. 7.3 and Sect. 7.8, Figure 7-1 |
| ***Inlets*** | |
| Capture | Varies-depending on inlet type, recommends using UD-inlet Spreadsheets from UDFCD. Typically 70%-80% of design flow |
| Allowable Types | Curb-opening Inlets:<br>- D-10-R (City of Colorado Springs)<br>- Type R (CDOT)<br>- Type 14 (CCD)<br>Grate Inlets<br>- Type C (CDOT)<br>- Type D (CDOT)<br>Combination Curb<br>- Type 16 (CCD)<br>Other inlets may be used when special circumstances exist but will be evaluated on case-by-case basis. |
| ***Roadside Swales*** | |
| Geometry | Dependent on site conditions, but generally (Sect. 6, Ch. 9):<br><br>Depth: 6”-9” below shoulder<br><br>Bottom width: 2’ minimum<br><br>Side Slopes: 8:1 or flatter |
| Capacity | Major storm: 100-year WSE at least 1’ below shoulder elevation |

Storm sewer hydraulics will be evaluated using StormCAD V8i to calculate capacity, velocity, and HGL/EGL. Urban Drainage’s UD-Inlet spreadsheet will be used in inlet design and calculating roadway spread and depth. Federal Highways Administration (FHWA) HEC-21 will be used to design bridge deck inlets. HY-8 will be used for culvert design. Bentley Flowmaster will be used to determine ditch capacity.

## FEMA

Fountain Creek is the closest waterway located within the project site limits, it underpasses two of the bridges being replaced and is a FEMA regulated channel and included in the Flood Insurance Study, El Paso County, Colorado and Incorporated Areas, 08041C0754G, December 7, 2018. The project is located within a FEMA regulated floodway area (Zone AE). A no rise floodplain permit is anticipated for this project.

## Erosion Control

Erosion and sediment control will be developed based on the City of Colorado Springs Drainage Criteria Manual, Volume 2, in conjunction with other recommended resources in the manual. Erosion and sediment control will be provided for construction activity throughout the entirety of the project. It is anticipated this project will be required to meet the new City of Colorado Springs Stormwater Construction Manual expected to be released prior to completion of design.

## Water Quality and Detention

The project is located within a the City of Colorado Springs municipal separate storm sewer (MS4) area and will require permanent water quality as part of the roadway improvements. Water quality will be provided according to DCM four step process for Low Impact Design (LID), described below. Above ground BMP's such as extended detention basins are the preferred treatment option, when the space is available and will be used on site. All water quality areas will be designed to meet DCM criteria, outlined below in Table 3.0.

The four step process to minimize adverse impacts of urbanization will be applied, per the DCM, Volume 2.

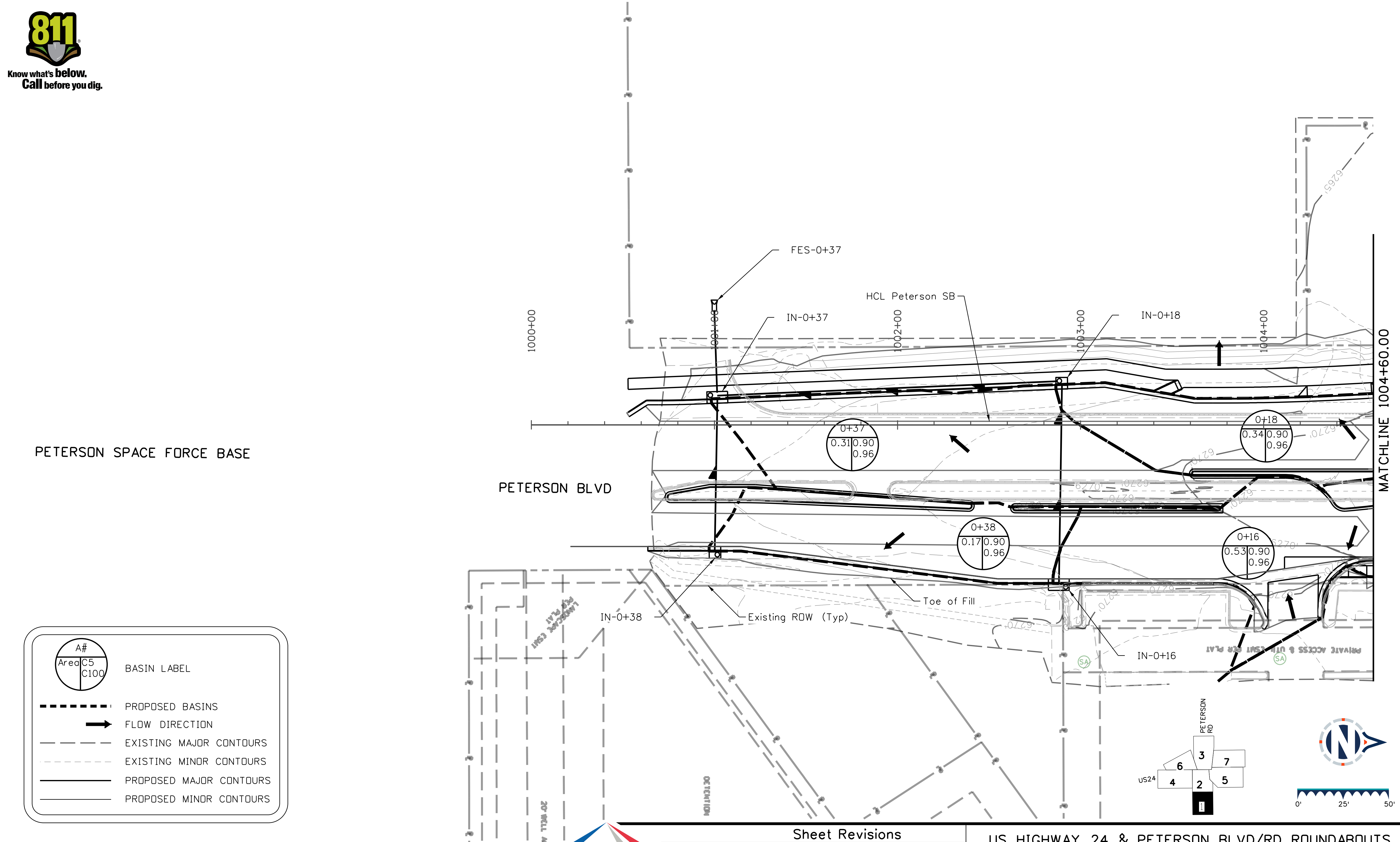
- Employ Runoff Reduction Practices
- Implement BMPs that provide a Water Quality Capture Volume (WQCM) with slow release
- Stabilize Drainage ways
- Implement site specific and other source control BMPs

According to the Colorado Springs DCM, this project area is classified as a "Redevelopment Site" because the disturbed area is greater than one acre. Permanent Water Quality will follow criteria, according to DCM four step process.

| **Table 3.0 Water Quality and Detention Criteria Summary Table** | |
|---|---|
| ***Water Quality/Detention*** | |
| Required Detention | On-site (Less than 20 acres): Total storage volume can be calculated using UD-Detention spreadsheets or calculation spreadsheets provided by the City of Colorado Springs.. Add 50% of the WQCV for multi-level facilities. Do not add WQCV for FSD facilities. |

| **Table 3.0 Water Quality and Detention Criteria Summary Table** | |
|---|---|
| Release Rates | The release rates from the proposed detention pond must be equal to or less than the estimated pre-development runoff rates. Predevelopment runoff estimates must be based on the appropriate basin parameters, methods, and storm characteristics as described in Chapter 6, Hydrology from the DCM. (Ch. 13, Sect. 4.2.1) |
| Freeboard | A minimum freeboard of one foot above the computed water surface elevation when the emergency spillway is conveying its design flow. (Ch. 13, Sect. 5.5) |
| Drain Time | WCQV: 40-hour<br>EURV: 68 to 72 hours |
| ***Pond Design Criteria*** | |
| Forebay Design | Provides an opportunity for larger particles to settle out in an area that can be easily maintained. Flow path length should be maximized and slope minimized to encourage settling. |
| Trickle Channel | Concrete Trickle Channel:<br>A slope between 0.5% - 1%.<br><br>The lowflow channel must be a minimum of 7 feet wide with a 6" curb head on one or both sides. The concrete bottom m ust be either 8" with fiber mesh reinforcement or 6" with #4 @ 15" O.C. rebar reinforcement. |
| Micropool and Outlet Structure | Side slopes may be stabilized slopes of 4:1, or up to 3:1 maximum for constrained sites.<br><br>Micropool Location: Directly in front of outlet structure. For watersheds with less than 5 impervious acres, the micropool can be located inside the outlet structure. A concrete ramp is required for access.<br><br>Size: Minimum 2.5 feet in depth with a minimum surface area of 10 SF<br><br>Install depth gage at outlet structure. |
| Vehicular Access | Vehicle access shall be limited by a locking gate or chain.<br><br>Vehicle access shall be at least 15 feet wide, unless site is constrained and prior approval is obtained. |

# 9.2 Basin Maps

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# US HIGHWAY 24 & PETERSON BLVD/RD ROUNDABOUTS

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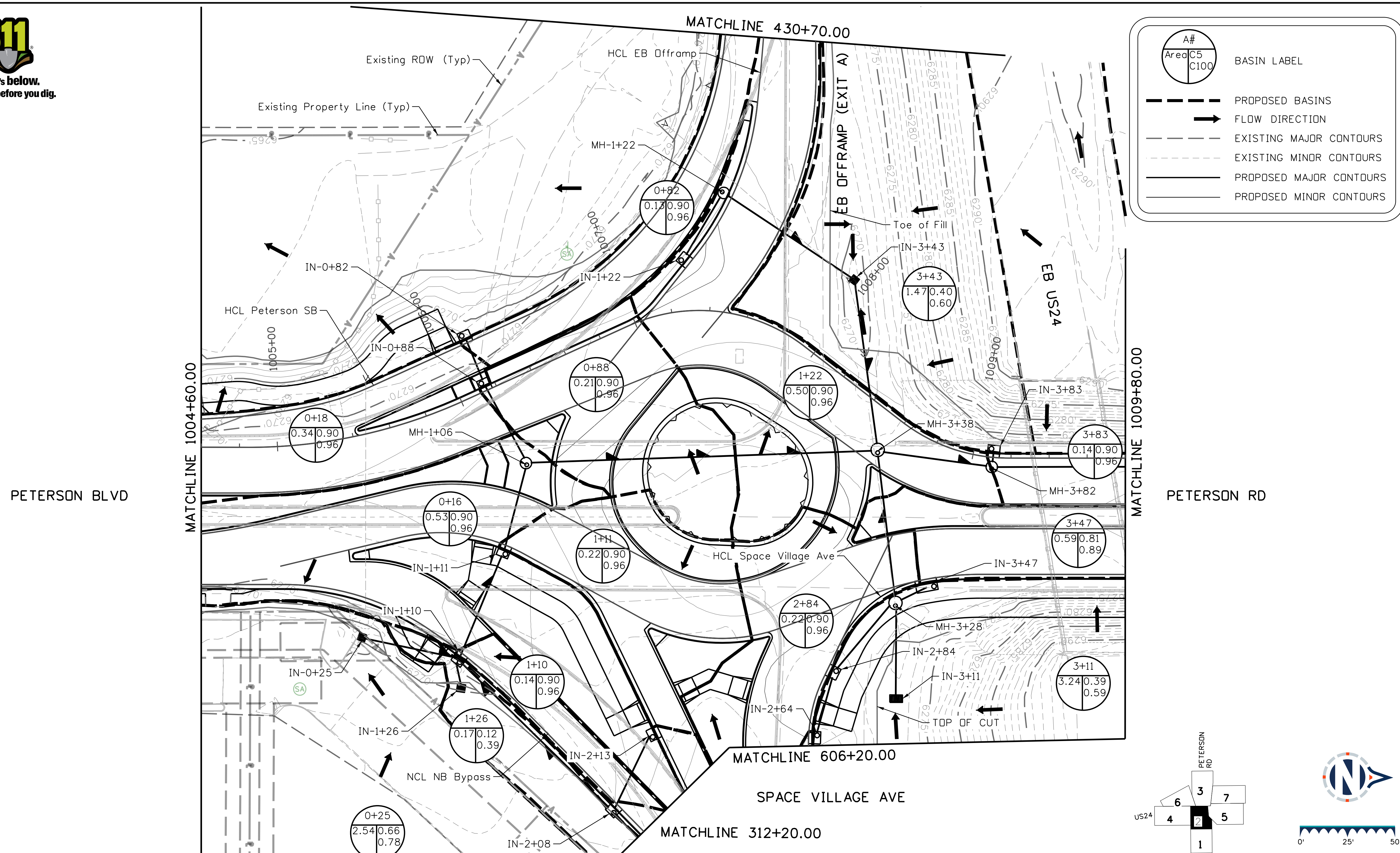


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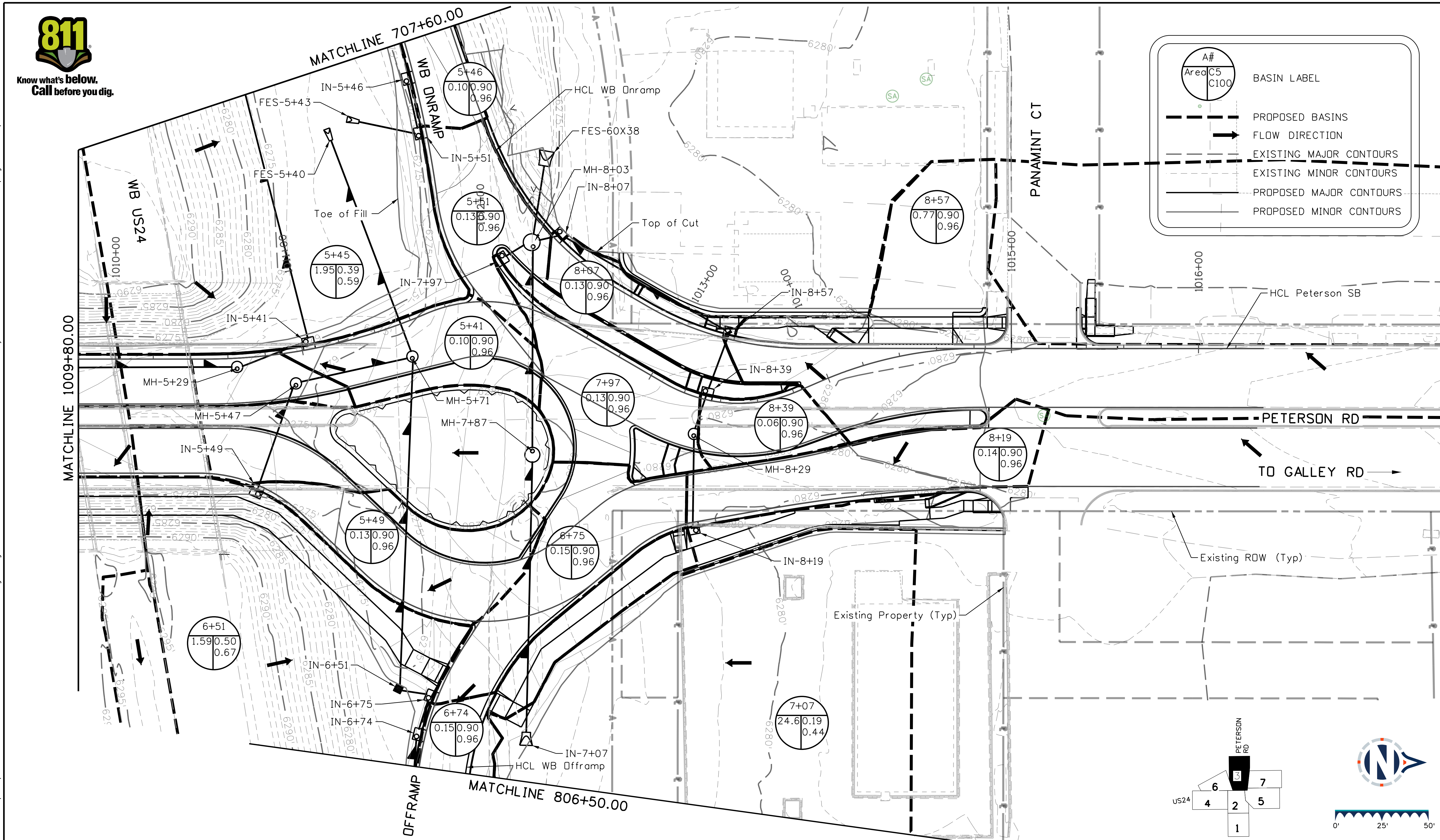






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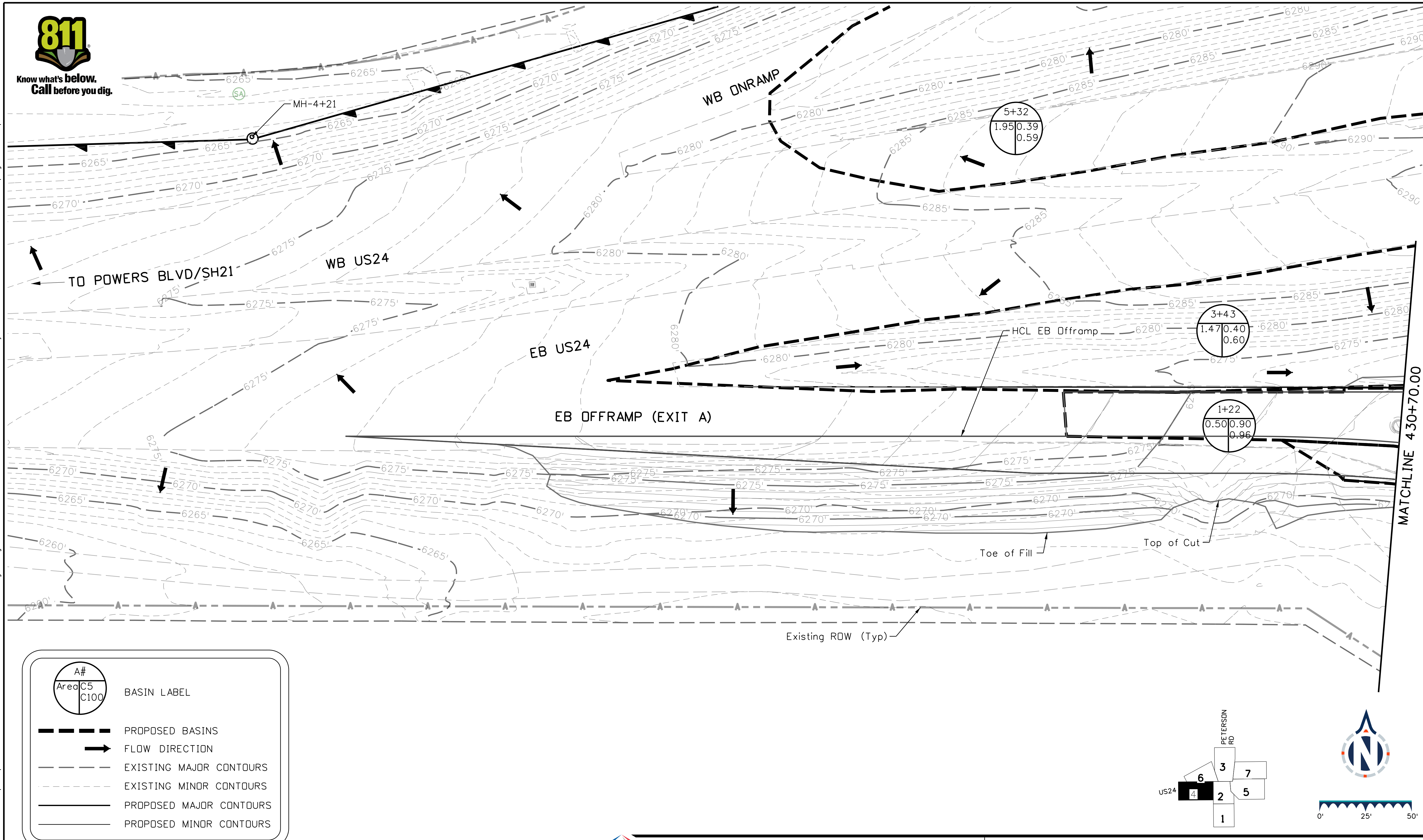


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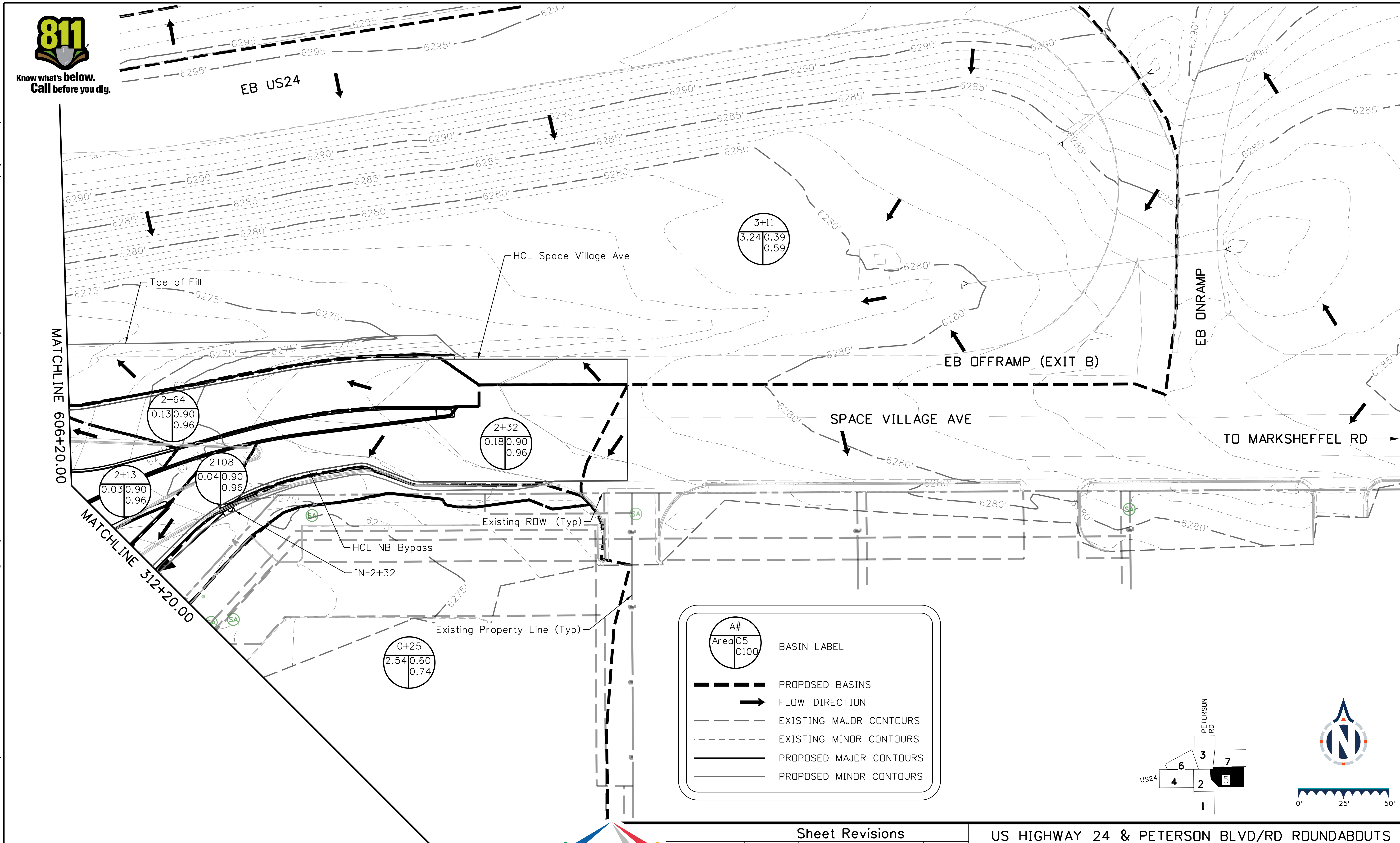


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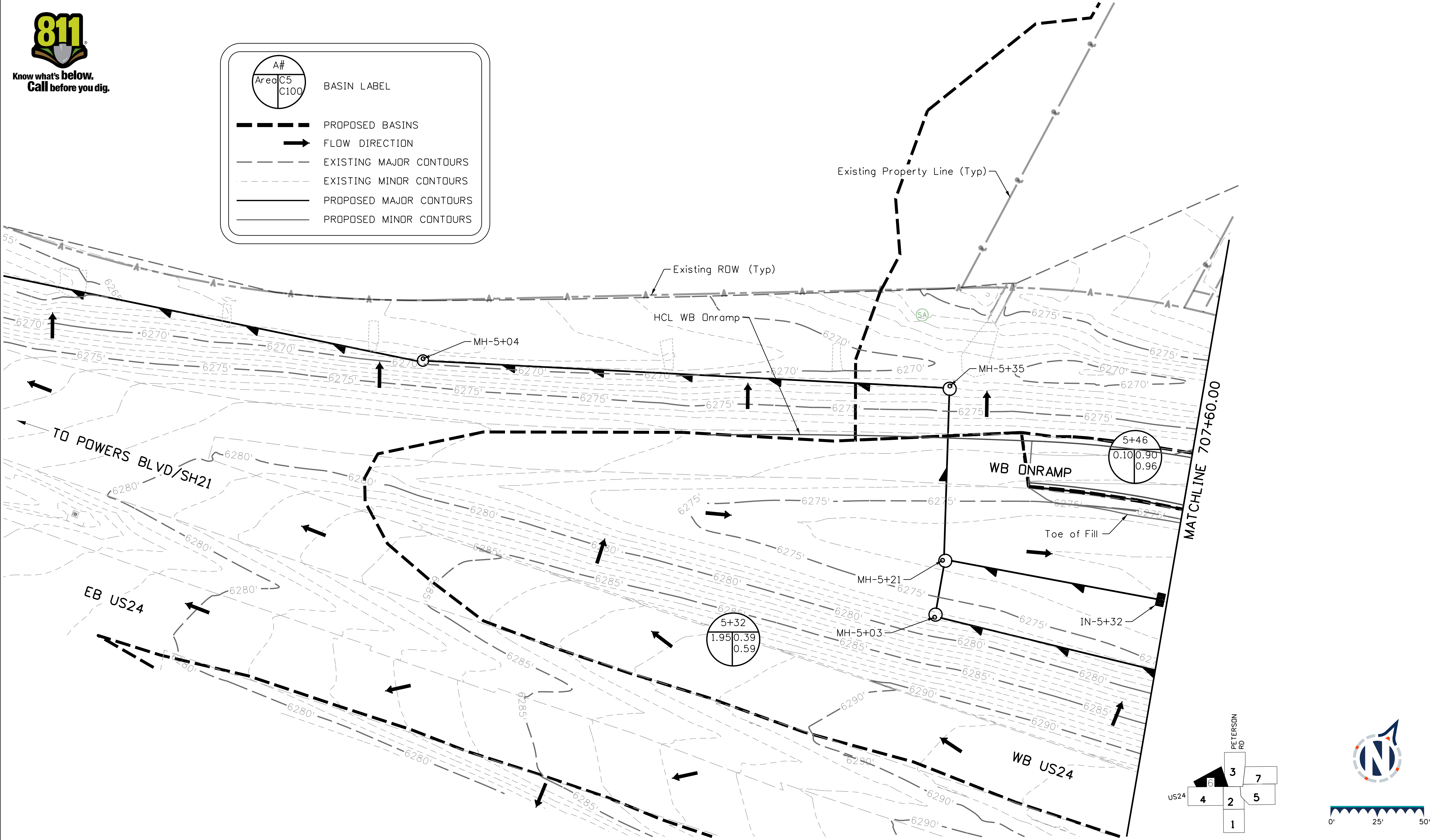






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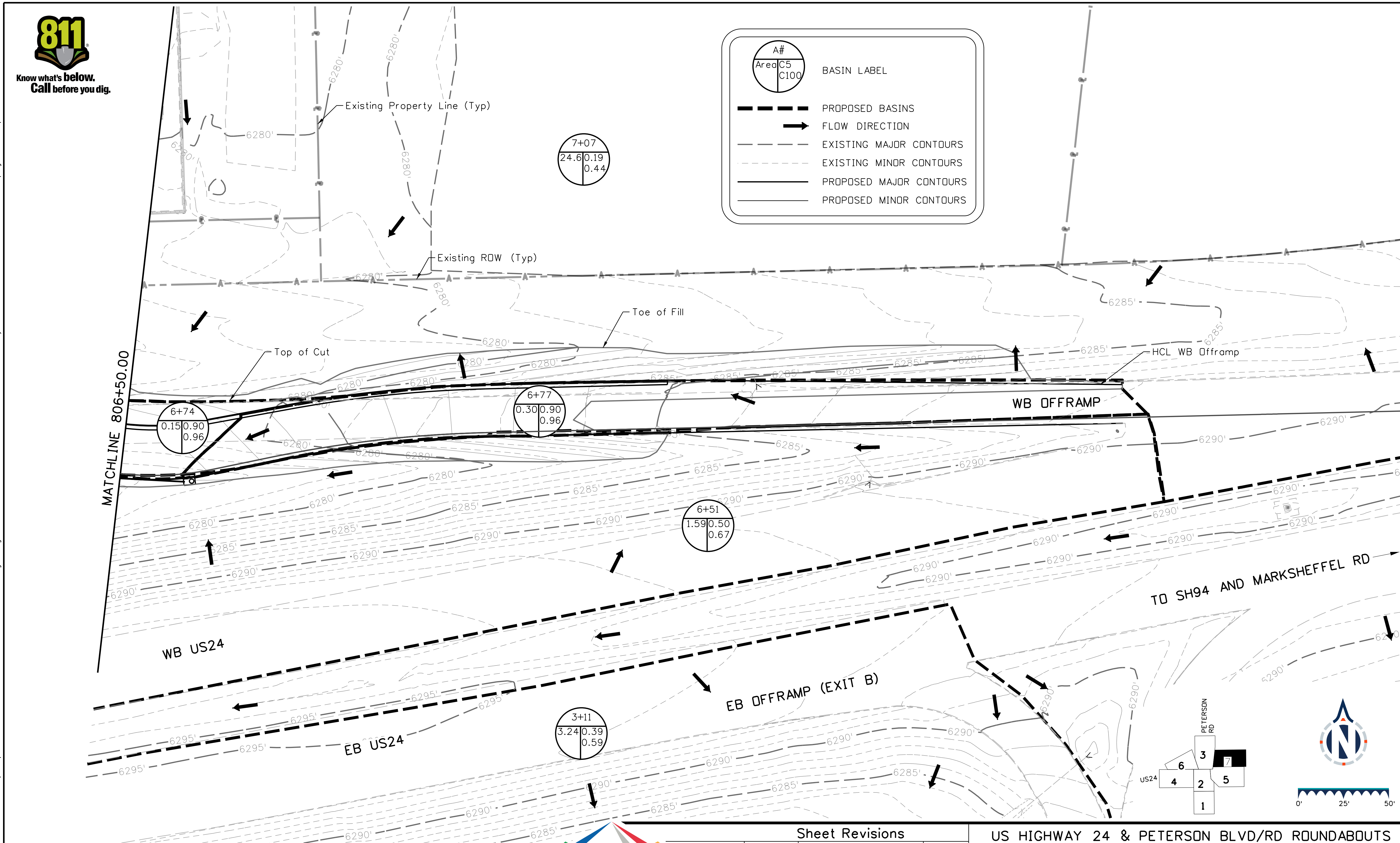


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COLORADO SPRINGS

Subset 7 of 7

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# 9.3 Rainfall Information

**NOAA Atlas 14, Volume 8, Version 2**
**Location name: Colorado Springs, Colorado, USA***
**Latitude: 38.8383°, Longitude: -104.719°**
**Elevation: 6206.14 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

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

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **0.238** (0.199-0.286) | **0.288** (0.241-0.348) | **0.377** (0.314-0.456) | **0.456** (0.378-0.554) | **0.573** (0.460-0.729) | **0.669** (0.522-0.861) | **0.770** (0.578-1.02) | **0.878** (0.629-1.19) | **1.03** (0.707-1.44) | **1.15** (0.765-1.63) |
| 10-min | **0.348** (0.291-0.419) | **0.422** (0.353-0.509) | **0.552** (0.461-0.668) | **0.668** (0.553-0.811) | **0.839** (0.673-1.07) | **0.979** (0.764-1.26) | **1.13** (0.847-1.49) | **1.29** (0.922-1.75) | **1.51** (1.03-2.11) | **1.69** (1.12-2.38) |
| 15-min | **0.424** (0.355-0.511) | **0.515** (0.431-0.621) | **0.674** (0.562-0.814) | **0.815** (0.675-0.989) | **1.02** (0.821-1.30) | **1.19** (0.932-1.54) | **1.38** (1.03-1.82) | **1.57** (1.12-2.13) | **1.84** (1.26-2.57) | **2.06** (1.37-2.91) |
| 30-min | **0.642** (0.538-0.773) | **0.777** (0.650-0.937) | **1.01** (0.846-1.23) | **1.23** (1.01-1.49) | **1.54** (1.24-1.96) | **1.80** (1.40-2.31) | **2.07** (1.55-2.73) | **2.36** (1.69-3.21) | **2.77** (1.90-3.87) | **3.09** (2.06-4.37) |
| 60-min | **0.854** (0.715-1.03) | **1.01** (0.844-1.22) | **1.29** (1.08-1.56) | **1.56** (1.29-1.90) | **1.98** (1.60-2.54) | **2.34** (1.83-3.03) | **2.73** (2.05-3.62) | **3.15** (2.27-4.31) | **3.77** (2.59-5.29) | **4.27** (2.84-6.04) |
| 2-hr | **1.07** (0.900-1.27) | **1.24** (1.05-1.48) | **1.57** (1.32-1.89) | **1.90** (1.59-2.29) | **2.42** (1.98-3.11) | **2.88** (2.28-3.72) | **3.38** (2.57-4.49) | **3.95** (2.87-5.38) | **4.77** (3.31-6.67) | **5.45** (3.65-7.65) |
| 3-hr | **1.18** (0.999-1.40) | **1.35** (1.14-1.61) | **1.69** (1.43-2.02) | **2.04** (1.71-2.45) | **2.62** (2.16-3.37) | **3.14** (2.50-4.07) | **3.72** (2.85-4.94) | **4.39** (3.21-5.98) | **5.37** (3.75-7.50) | **6.19** (4.16-8.65) |
| 6-hr | **1.35** (1.15-1.60) | **1.53** (1.30-1.81) | **1.90** (1.62-2.26) | **2.30** (1.94-2.74) | **2.96** (2.48-3.81) | **3.58** (2.88-4.62) | **4.27** (3.30-5.64) | **5.06** (3.73-6.86) | **6.24** (4.39-8.68) | **7.23** (4.90-10.0) |
| 12-hr | **1.50** (1.29-1.76) | **1.72** (1.48-2.02) | **2.17** (1.86-2.56) | **2.62** (2.23-3.10) | **3.36** (2.81-4.26) | **4.02** (3.25-5.14) | **4.77** (3.71-6.24) | **5.61** (4.16-7.53) | **6.85** (4.85-9.44) | **7.89** (5.38-10.9) |
| 24-hr | **1.67** (1.45-1.95) | **1.95** (1.69-2.28) | **2.47** (2.13-2.90) | **2.98** (2.56-3.51) | **3.78** (3.17-4.72) | **4.47** (3.63-5.64) | **5.24** (4.09-6.77) | **6.09** (4.53-8.09) | **7.32** (5.22-9.99) | **8.34** (5.73-11.4) |
| 2-day | **1.91** (1.67-2.21) | **2.23** (1.95-2.59) | **2.83** (2.46-3.29) | **3.38** (2.92-3.95) | **4.22** (3.56-5.21) | **4.95** (4.04-6.17) | **5.73** (4.50-7.33) | **6.58** (4.93-8.66) | **7.81** (5.60-10.6) | **8.81** (6.10-12.0) |
| 3-day | **2.08** (1.83-2.40) | **2.44** (2.14-2.82) | **3.08** (2.69-3.57) | **3.66** (3.18-4.26) | **4.54** (3.83-5.56) | **5.28** (4.32-6.54) | **6.07** (4.78-7.71) | **6.92** (5.20-9.05) | **8.14** (5.85-10.9) | **9.12** (6.34-12.4) |
| 4-day | **2.23** (1.96-2.57) | **2.61** (2.30-3.01) | **3.28** (2.88-3.79) | **3.88** (3.39-4.51) | **4.79** (4.05-5.84) | **5.54** (4.55-6.83) | **6.34** (5.01-8.03) | **7.20** (5.43-9.38) | **8.42** (6.07-11.3) | **9.40** (6.56-12.7) |
| 7-day | **2.60** (2.31-2.98) | **3.02** (2.68-3.47) | **3.76** (3.32-4.32) | **4.41** (3.87-5.10) | **5.38** (4.57-6.50) | **6.17** (5.10-7.56) | **7.01** (5.57-8.81) | **7.91** (5.99-10.2) | **9.17** (6.65-12.2) | **10.2** (7.14-13.7) |
| 10-day | **2.93** (2.62-3.35) | **3.39** (3.02-3.87) | **4.18** (3.70-4.79) | **4.87** (4.29-5.61) | **5.89** (5.02-7.08) | **6.72** (5.57-8.19) | **7.60** (6.06-9.50) | **8.53** (6.48-11.0) | **9.83** (7.15-13.0) | **10.9** (7.65-14.6) |
| 20-day | **3.87** (3.48-4.39) | **4.44** (3.98-5.04) | **5.40** (4.83-6.15) | **6.23** (5.53-7.12) | **7.40** (6.34-8.78) | **8.33** (6.95-10.0) | **9.29** (7.45-11.5) | **10.3** (7.87-13.1) | **11.7** (8.53-15.3) | **12.7** (9.03-17.0) |
| 30-day | **4.64** (4.19-5.25) | **5.33** (4.81-6.03) | **6.46** (5.80-7.32) | **7.40** (6.61-8.43) | **8.71** (7.48-10.3) | **9.73** (8.14-11.6) | **10.7** (8.65-13.2) | **11.8** (9.05-14.9) | **13.2** (9.69-17.2) | **14.3** (10.2-18.9) |
| 45-day | **5.63** (5.11-6.34) | **6.48** (5.87-7.29) | **7.83** (7.07-8.84) | **8.93** (8.01-10.1) | **10.4** (8.96-12.2) | **11.5** (9.68-13.7) | **12.6** (10.2-15.4) | **13.7** (10.6-17.2) | **15.1** (11.2-19.6) | **16.2** (11.6-21.4) |
| 60-day | **6.48** (5.90-7.27) | **7.47** (6.79-8.38) | **9.02** (8.17-10.2) | **10.3** (9.24-11.6) | **11.9** (10.3-13.8) | **13.1** (11.0-15.5) | **14.3** (11.6-17.3) | **15.4** (11.9-19.3) | **16.8** (12.4-21.7) | **17.9** (12.8-23.5) |

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

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

Please refer to NOAA Atlas 14 document for more information.

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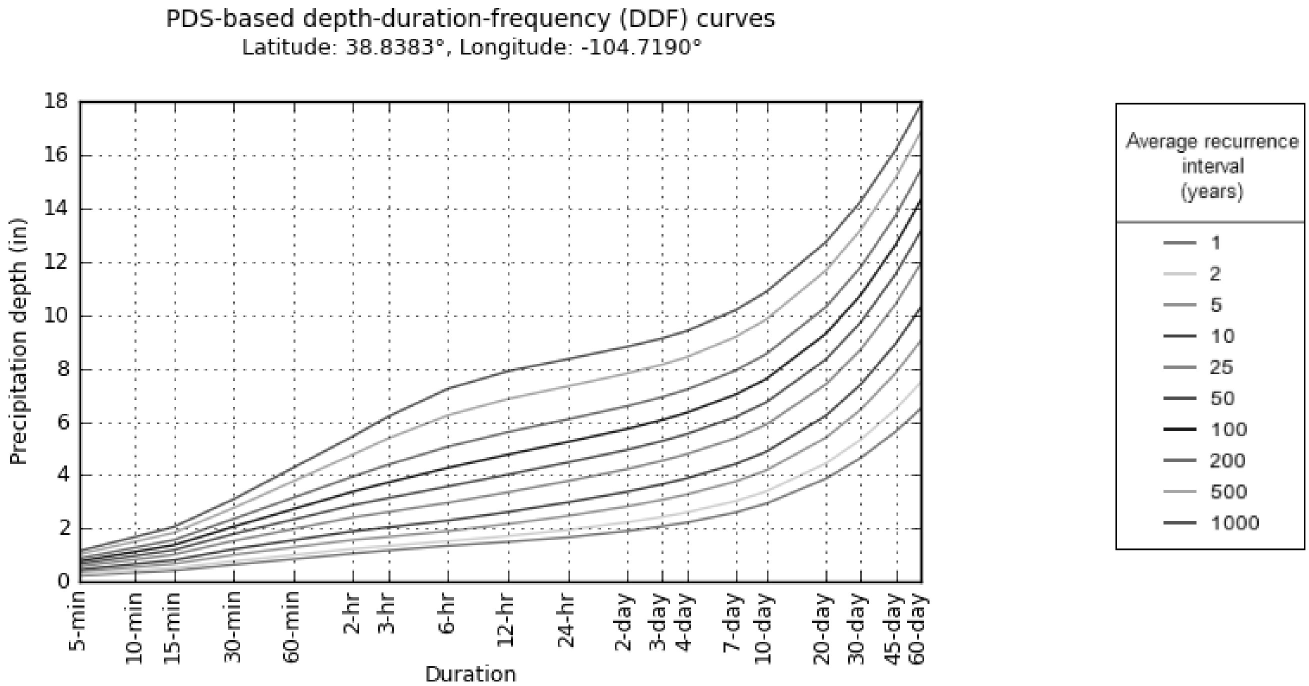
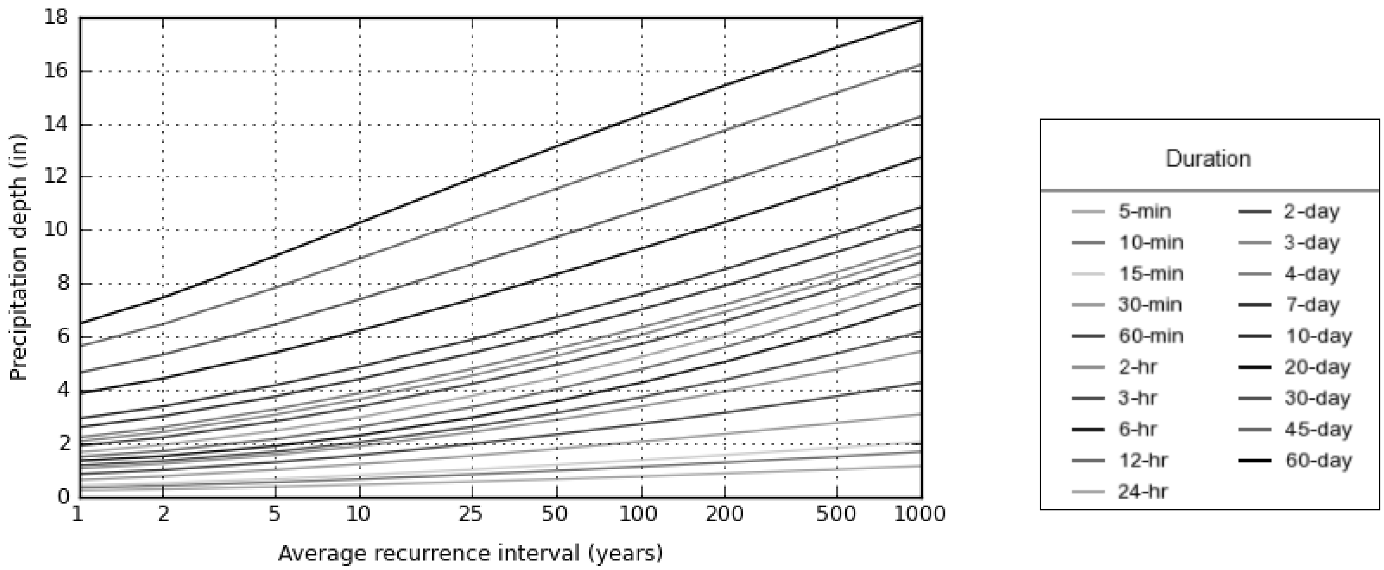
## PF graphical

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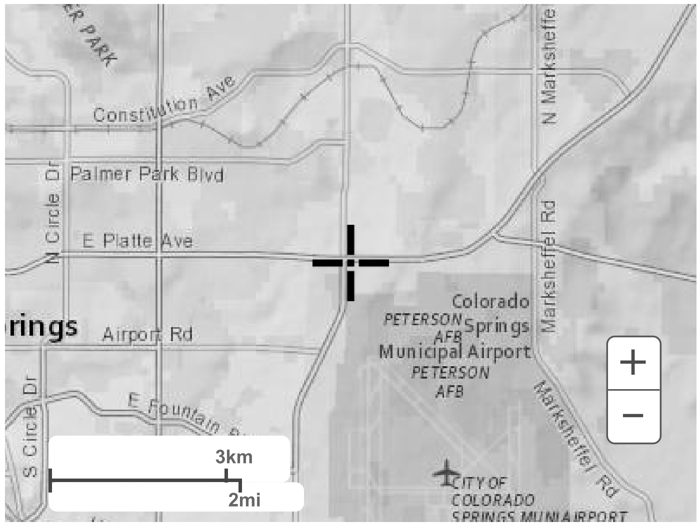
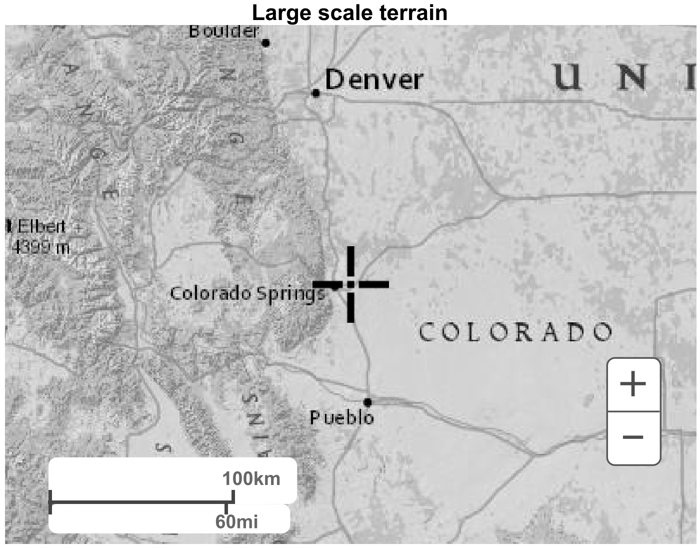
## Maps & aerials

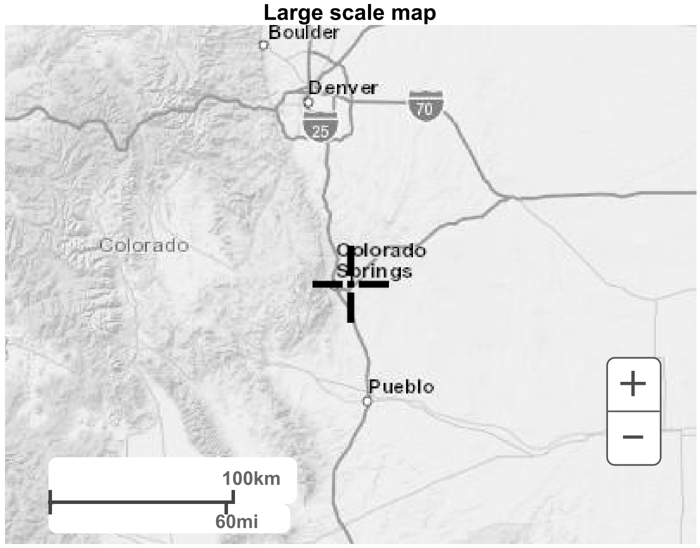
**Small scale terrain**



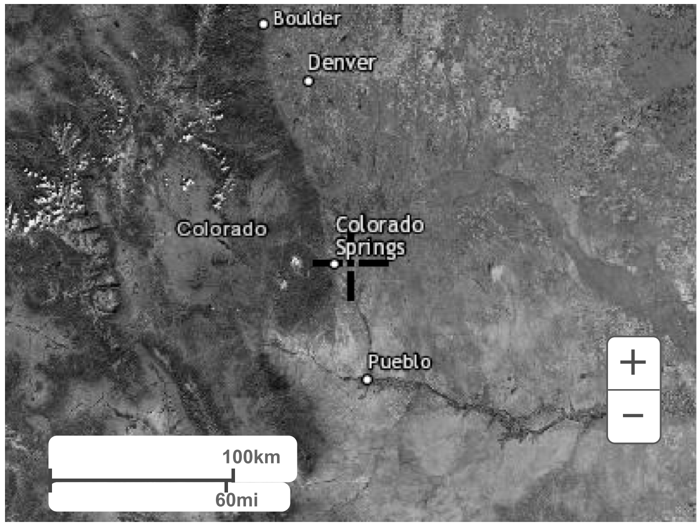

Large scale terrain




Large scale map




Large scale aerial

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

Disclaimer

## 9.4 Rational Method

## Runoff Coefficients

Corridor / Design Package: US 24 & Peterson | Computed: CB | Date: 11/7/2023
System Name: Proposed System | Checked: | Date:

| Sub-Basin Data | | Composite C | | | Sub Area - Pavement (100%) | | | Sub Area - Parks and Cemeteries HSG A-B (10%) | | | WQ CM |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Basin ID | Description | Total Area (ac) | $C_5$ | $C_{100}$ | $C_5$ | $C_{100}$ | Area (ac) | $C_5$ | $C_{100}$ | Area (ac) | Control Measure ID |
| 0+37 | Alignment 60, Northbound Peterson | 0.31 | 0.90 | 0.96 | 0.90 | 0.96 | 0.31 | 0.12 | 0.39 | | |
| 0+38 | Alignment 60, Southbound Peterson | 0.17 | 0.90 | 0.96 | 0.90 | 0.96 | 0.17 | 0.12 | 0.39 | | |
| 0+16 | Alignment 34, Northbound Peterson | 0.53 | 0.90 | 0.96 | 0.90 | 0.96 | 0.53 | 0.12 | 0.39 | | |
| 0+18 | Alignment 60, Southbound Peterson | 0.34 | 0.90 | 0.96 | 0.90 | 0.96 | 0.34 | 0.12 | 0.39 | | |
| 1+26 | Northbound Peterson, South RAB | 0.17 | 0.12 | 0.39 | 1.90 | 0.96 | 0.00 | 0.12 | 0.39 | 0.17 | |
| 0+25 | Northbound Peterson, South RAB | 2.54 | 0.66 | 0.78 | 0.90 | 0.96 | 1.75 | 0.12 | 0.39 | 0.79 | SS |
| 0+82 | Eastbound Space Village offramp, inner lane | 0.13 | 0.90 | 0.96 | 0.90 | 0.96 | 0.13 | 0.12 | 0.39 | | SS |
| 0+88 | Eastbound Space Village offramp, outter lane | 0.21 | 0.90 | 0.96 | 0.90 | 0.96 | 0.21 | 0.12 | 0.39 | | SS |
| 1+10 | Northbound Peterson, South RAB | 0.14 | 0.90 | 0.96 | 0.90 | 0.96 | 0.14 | 0.12 | 0.39 | | SS |
| 1+11 | Northbound Peterson, South RAB | 0.22 | 0.90 | 0.96 | 0.90 | 0.96 | 0.22 | 0.12 | 0.39 | | SS |
| 1+22 | Eastbound Space Village offramp | 0.50 | 0.90 | 0.96 | 0.90 | 0.96 | 0.50 | 0.12 | 0.39 | | SS |
| 2+08 | Westbound Space Village onramp, inner lane | 0.04 | 0.90 | 0.96 | 0.90 | 0.96 | 0.04 | 0.12 | 0.39 | | SS |
| 2+13 | Westbound Space Village onramp, outter lane | 0.03 | 0.90 | 0.96 | 0.90 | 0.96 | 0.03 | 0.12 | 0.39 | | SS |
| 2+32 | Westbound Space Village onramp | 0.18 | 0.90 | 0.96 | 0.90 | 0.96 | 0.18 | 0.12 | 0.39 | | SS |
| 2+64 | Westbound Space Villave offramp | 0.13 | 0.90 | 0.96 | 0.90 | 0.96 | 0.13 | 0.12 | 0.39 | | SS |
| 2+84 | Westbound Space Village offramp | 0.22 | 0.90 | 0.96 | 0.90 | 0.96 | 0.22 | 0.12 | 0.39 | | SS |
| 3+11 | Offsite, northeast corner of South RAB | 3.24 | 0.39 | 0.59 | 0.90 | 0.96 | 1.13 | 0.12 | 0.39 | 2.11 | SS |
| 3+43 | Offsite, northwest corner of South RAB | 1.47 | 0.40 | 0.60 | 0.90 | 0.96 | 0.53 | 0.12 | 0.39 | 0.94 | SS |
| 3+47 | Northbound Peterson, South RAB | 0.59 | 0.81 | 0.89 | 0.90 | 0.96 | 0.52 | 0.12 | 0.39 | 0.07 | SS |
| 3+83 | Southbound Peterson, South RAB | 0.14 | 0.90 | 0.96 | 0.90 | 0.96 | 0.14 | 0.12 | 0.39 | | SS |
| 5+41 | Southbound Peterson, North RAB | 0.10 | 0.90 | 0.96 | 0.90 | 0.96 | 0.10 | 0.12 | 0.39 | | NS |
| 5+32 | Offsite, southwest corner of North RAB | 1.95 | 0.39 | 0.59 | 0.90 | 0.96 | 0.68 | 0.12 | 0.39 | 1.28 | NS |
| 5+46 | Westbound US 24 onramp | 0.10 | 0.90 | 0.96 | 0.90 | 0.96 | 0.10 | 0.12 | 0.39 | | NS |
| 5+51 | Westbound US 24 onramp | 0.13 | 0.90 | 0.96 | 0.90 | 0.96 | 0.13 | 0.12 | 0.39 | | NS |
| 5+49 | Northbound Peterson, North RAB | 0.13 | 0.90 | 0.96 | 0.90 | 0.96 | 0.13 | 0.12 | 0.39 | | NS |
| 5+69 | FES Outfall for Ditch 5+69 | 3.17 | 0.90 | 0.96 | 0.90 | 0.96 | 3.17 | 0.12 | 0.39 | | |
| 6+51 | Offsite, southeast corner of North RAB | 1.59 | 0.50 | 0.67 | 0.90 | 0.96 | 0.78 | 0.12 | 0.39 | 0.81 | NS |
| 6+74 | Westbound US 24 offramp | 0.15 | 0.90 | 0.96 | 0.90 | 0.96 | 0.15 | 0.12 | 0.39 | | NS |
| 6+75 | Westbound US 24 offramp | 0.15 | 0.90 | 0.96 | 0.90 | 0.96 | 0.15 | 0.12 | 0.39 | | NS |
| 6+77 | Westbound US 24 offramp | 0.30 | 0.90 | 0.96 | 0.90 | 0.96 | 0.30 | 0.12 | 0.39 | | NS |
| 7+07 | Offsite, northeast corner of North RAB | 24.63 | 0.19 | 0.44 | 0.90 | 0.96 | 2.21 | 0.12 | 0.39 | 22.42 | |
| 7+97 | Westbound US 24 onramp, inner lane | 0.13 | 0.90 | 0.96 | 0.90 | 0.96 | 0.13 | 0.12 | 0.39 | | |
| 8+07 | Westbound US 24 onramp, outter lane | 0.13 | 0.90 | 0.96 | 0.90 | 0.96 | 0.13 | 0.12 | 0.39 | | |
| 8+19 | Northbound Peterson, North RAB | 0.14 | 0.90 | 0.96 | 0.90 | 0.96 | 0.14 | 0.12 | 0.39 | | |
| 8+39 | Southbound Peterson, inner lane, North RAB, | 0.06 | 0.90 | 0.96 | 0.90 | 0.96 | 0.06 | 0.12 | 0.39 | | |
| 8+57 | Southbound Peterson, outter lane, North RAB | 0.77 | 0.90 | 0.96 | 0.90 | 0.96 | 0.77 | 0.12 | 0.39 | | |
| | **Total** | **45.35** | | | | | **16.33** | | | **116.45** | |

**Standard Form SF-1 . Time of Concentration**

Corridor / Design Package: US 24 & Peterson
System Name: Proposed System

Computed: CB    Date: 11/7/2023
Checked:    Date:

| SUB-BASIN DATA | | | | INITIAL/OVERLAND FLOW ($t_i$) | | | | | TRAVEL TIME ($t_t$) | | | | | | | | | Total | Tc CHECK - Regional Tc (Urbanized basins) | | | | FINAL Tc (min) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Type of Land Surface | | | | | | | | | | |
| Basin ID | Description | C5 | Area (ac) | Length (ft) | Start Elevation (ft) | End Elevation (ft) | Slope (ft/ft) | $t_i$ (min) | Length (ft) | Start Elevation (ft) | End Elevation (ft) | $S_w$ (ft/ft) | Cover | Description | Convey Coef ($C_v$) | Velocity (ft/s) | Travel Time (min) | $t_c = t_i + t_t$ (min) | Urban (Yes /No) | Total Length (ft) | $T_{c\ max}$ (min) | $Tc_{max} > t_c$ | |
| 0+37 | Alignment 60, Northbound Peterson | 0.90 | 0.31 | 60.594 | 6270.5 | 6269.9 | 0.010 | 2.82 | 180.138 | 6269.9 | 6267.051 | 0.016 | 6 | Paved areas and shallow paved swales | 20 | 2.52 | 1.19 | 4.01 | Yes | 241 | 11.34 | Check | 5.00 |
| 0+38 | Alignment 60, Southbound Peterson | 0.90 | 0.17 | 42.75 | 6269.584 | 6268.725 | 0.020 | 1.88 | 185.808 | 6268.73 | 6264.848 | 0.021 | 6 | Paved areas and shallow paved swales | 20 | 2.89 | 1.07 | 2.95 | Yes | 229 | 11.27 | Check | 5.00 |
| 0+16 | Alignment 34, Northbound Peterson | 0.90 | 0.53 | 43.6 | 6271.228 | 6270.11 | 0.026 | 1.75 | 364.0 | 6270.11 | 6265.578 | 0.012 | 6 | Paved areas and shallow paved swales | 20 | 2.23 | 2.72 | 4.46 | Yes | 408 | 12.26 | Check | 5.00 |
| 0+18 | Alignment 60, Southbound Peterson | 0.90 | 0.34 | 29.216 | 6271.067 | 6270.67 | 0.014 | 1.76 | 332.918 | 6270.67 | 6265.269 | 0.016 | 6 | Paved areas and shallow paved swales | 20 | 2.55 | 2.18 | 3.94 | Yes | 362 | 12.01 | Check | 5.00 |
| 1+26 | Northbound Peterson, South RAB | 0.12 | 0.17 | 30.02 | 6278.057 | 6277.4 | 0.022 | 7.49 | 339.822 | 6277.4 | 6270.002 | 0.022 | 3 | Short pasture and lawns | 7 | 1.03 | 5.48 | 12.97 | Yes | 370 | 12.05 | Regional Tc | 12.05 |
| 0+25 | Northbound Peterson, South RAB | 0.66 | 2.54 | 56.2 | 6278 | 6275.366 | 0.047 | 3.60 | 524.597 | 6275.37 | 6267.968 | 0.014 | 3 | Short pasture and lawns | 7 | 0.83 | 10.52 | 14.11 | Yes | 581 | 13.23 | Regional Tc | 13.23 |
| 0+82 | Eastbound Space Village offramp, inner lane | 0.90 | 0.13 | 38.226 | 6273.52 | 6272.454 | 0.028 | 1.59 | 250.381 | 6272.45 | 6270.569 | 0.008 | 6 | Paved areas and shallow paved swales | 20 | 1.74 | 2.40 | 4.00 | Yes | 289 | 11.60 | Check | 5.00 |
| 0+88 | Eastbound Space Village offramp, outter lane | 0.90 | 0.21 | 79.271 | 6277.78 | 6276.543 | 0.016 | 2.78 | 142.926 | 6276.54 | 6270.861 | 0.040 | 6 | Paved areas and shallow paved swales | 20 | 3.99 | 0.60 | 3.37 | Yes | 222 | 11.23 | Check | 5.00 |
| 1+10 | Northbound Peterson, South RAB | 0.90 | 0.14 | 56.175 | 6278.013 | 6275.374 | 0.047 | 1.62 | 524.597 | 6275.37 | 6267.41 | 0.015 | 6 | Paved areas and shallow paved swales | 20 | 2.46 | 3.55 | 5.17 | Yes | 581 | 13.23 | Check | 5.17 |
| 1+11 | Northbound Peterson, South RAB | 0.90 | 0.22 | 43.447 | 6273.074 | 6272.091 | 0.023 | 1.82 | 62.265 | 6272.09 | 6271.296 | 0.013 | 6 | Paved areas and shallow paved swales | 20 | 2.26 | 0.46 | 2.28 | Yes | 106 | 10.59 | Check | 5.00 |
| 1+22 | Eastbound Space Village offramp | 0.90 | 0.50 | 59.089 | 6276.656 | 6275 | 0.028 | 1.98 | 255.82 | 6275 | 6271.117 | 0.015 | 6 | Paved areas and shallow paved swales | 20 | 2.46 | 1.73 | 3.71 | Yes | 315 | 11.75 | Check | 5.00 |
| 2+08 | Westbound Space Village onramp, inner lane | 0.90 | 0.04 | 42.159 | 6276.322 | 6274.313 | 0.048 | 1.40 | 67.641 | 6274.31 | 6271.923 | 0.035 | 6 | Paved areas and shallow paved swales | 20 | 3.76 | 0.30 | 1.70 | Yes | 110 | 10.61 | Check | 5.00 |
| 2+13 | Westbound Space Village onramp, outter lane | 0.90 | 0.03 | 38.681 | 6275.702 | 6273.856 | 0.048 | 1.34 | 64.888 | 6273.86 | 6272.396 | 0.023 | 6 | Paved areas and shallow paved swales | 20 | 3.00 | 0.36 | 1.70 | Yes | 104 | 10.58 | Check | 5.00 |
| 2+32 | Westbound Space Village onramp | 0.90 | 0.18 | 79.014 | 6278.9 | 6276.888 | 0.025 | 2.36 | 176.03 | 6276.89 | 6274.5 | 0.014 | 6 | Paved areas and shallow paved swales | 20 | 2.33 | 1.26 | 3.62 | Yes | 255 | 11.42 | Check | 5.00 |
| 2+64 | Westbound Space Villave offramp | 0.90 | 0.13 | 28.256 | 6277.8 | 6276.42 | 0.049 | 1.14 | 218.547 | 6276.42 | 6272.356 | 0.019 | 6 | Paved areas and shallow paved swales | 20 | 2.73 | 1.34 | 2.47 | Yes | 247 | 11.37 | Check | 5.00 |
| 2+84 | Westbound Space Village offramp | 0.90 | 0.22 | 57.827 | 6275.448 | 6273.662 | 0.031 | 1.89 | 93.744 | 6273.66 | 6271.955 | 0.018 | 6 | Paved areas and shallow paved swales | 20 | 2.70 | 0.58 | 2.47 | Yes | 152 | 10.84 | Check | 5.00 |
| 3+11 | Offsite, northeast corner of South RAB | 0.39 | 3.24 | 80.448 | 6294.179 | 6294 | 0.002 | 18.81 | 877.068 | 6294 | 6272.229 | 0.025 | 3 | Short pasture and lawns | 7 | 1.10 | 13.25 | 32.06 | Yes | 958 | 15.32 | Regional Tc | 15.32 |
| 3+43 | Offsite, northwest corner of South RAB | 0.40 | 1.47 | 85.159 | 6279.249 | 6279 | 0.003 | 17.47 | 471.779 | 6279 | 6267.108 | 0.025 | 3 | Short pasture and lawns | 7 | 1.11 | 7.08 | 24.54 | Yes | 557 | 13.09 | Regional Tc | 13.09 |
| 3+47 | Northbound Peterson, South RAB | 0.81 | 0.59 | 94.209 | 6284.036 | 6279.473 | 0.048 | 3.05 | 303.924 | 6279.47 | 6272.193 | 0.024 | 6 | Paved areas and shallow paved swales | 20 | 3.10 | 1.64 | 4.68 | Yes | 398 | 12.21 | Check | 5.00 |
| 3+83 | Southbound Peterson, South RAB | 0.90 | 0.14 | 54.76 | 6276.3 | 6274.508 | 0.033 | 1.81 | 173.845 | 6274.51 | 6272.342 | 0.012 | 6 | Paved areas and shallow paved swales | 20 | 2.23 | 1.30 | 3.10 | Yes | 229 | 11.27 | Check | 5.00 |
| 5+41 | Southbound Peterson, North RAB | 0.90 | 0.10 | 81.212 | 6280.248 | 6277.21 | 0.037 | 2.11 | 99.924 | 6277.21 | 6274.616 | 0.026 | 6 | Paved areas and shallow paved swales | 20 | 3.22 | 0.52 | 2.62 | Yes | 181 | 11.01 | Check | 5.00 |
| 5+32 | Offsite, southwest corner of North RAB | 0.39 | 1.95 | 18.289 | 6282.515 | 6279 | 0.192 | 2.06 | 440 | 6279 | 6269.048 | 0.023 | 3 | Short pasture and lawns | 7 | 1.05 | 6.97 | 9.03 | Yes | 458 | 12.55 | Check | 9.03 |
| 5+46 | Westbound US 24 onramp | 0.90 | 0.10 | 29.102 | 6277.47 | 6275.949 | 0.052 | 1.13 | 102.397 | 6275.95 | 6275.394 | 0.005 | 6 | Paved areas and shallow paved swales | 20 | 1.47 | 1.16 | 2.29 | Yes | 131 | 10.73 | Check | 5.00 |
| 5+51 | Westbound US 24 onramp | 0.90 | 0.13 | 9.82 | 6279.624 | 6279.139 | 0.049 | 0.67 | 252.161 | 6279.14 | 6275.479 | 0.015 | 6 | Paved areas and shallow paved swales | 20 | 2.41 | 1.74 | 2.41 | Yes | 262 | 11.46 | Check | 5.00 |
| 5+49 | Northbound Peterson, North RAB | 0.90 | 0.13 | 31.12 | 6280.374 | 6278.652 | 0.055 | 1.15 | 69.254 | 6278.65 | 6273.731 | 0.071 | 6 | Paved areas and shallow paved swales | 20 | 5.33 | 0.22 | 1.36 | Yes | 100 | 10.56 | Check | 5.00 |
| 5+69 | FES Outfall for Ditch 5+69 | 0.90 | 3.17 | 54.668 | 6289 | 6286 | 0.055 | 1.52 | 819.361 | 6286 | 6271 | 0.018 | 6 | Paved areas and shallow paved swales | 20 | 2.71 | 5.05 | 6.57 | Yes | 874 | 14.86 | Check | 6.57 |
| 6+51 | Offsite, southeast corner of North RAB | 0.50 | 1.59 | 28.499 | 6289.4 | 6288.976 | 0.015 | 5.05 | 619.934 | 6288.98 | 6276.7 | 0.020 | 3 | Short pasture and lawns | 7 | 0.99 | 10.49 | 15.54 | Yes | 648 | 13.60 | Regional Tc | 13.60 |
| 6+74 | Westbound US 24 offramp | 0.90 | 0.15 | 26.312 | 6279.495 | 6278.82 | 0.026 | 1.36 | 156.191 | 6278.82 | 6275.952 | 0.018 | 6 | Paved areas and shallow paved swales | 20 | 2.71 | 0.96 | 2.32 | Yes | 183 | 11.01 | Check | 5.00 |
| 6+75 | Westbound US 24 offramp | 0.90 | 0.15 | 25.864 | 6280.318 | 6278.8 | 0.059 | 1.02 | 166.537 | 6278.8 | 6276.045 | 0.017 | 6 | Paved areas and shallow paved swales | 20 | 2.57 | 1.08 | 2.10 | Yes | 192 | 11.07 | Check | 5.00 |
| 6+77 | Westbound US 24 offramp | 0.90 | 0.30 | 25.519 | 6289.4 | 6288.985 | 0.016 | 1.55 | 518.429 | 6288.99 | 6276.625 | 0.024 | 6 | Paved areas and shallow paved swales | 20 | 3.09 | 2.80 | 4.35 | Yes | 544 | 13.02 | Check | 5.00 |
| 7+07 | Offsite, northeast corner of North RAB | 0.19 | 24.63 | 100 | 6321.126 | 6312.6 | 0.085 | 8.10 | 2220.99 | 6312.6 | 6275.591 | 0.017 | 3 | Short pasture and lawns | 7 | 0.90 | 40.97 | 49.07 | Yes | 2321 | 22.89 | Regional Tc | 22.89 |
| 7+97 | Westbound US 24 onramp, inner lane | 0.90 | 0.13 | 10.56 | 6280.138 | 6279.528 | 0.058 | 0.66 | 171.854 | 6279.53 | 6276.848 | 0.016 | 6 | Paved areas and shallow paved swales | 20 | 2.50 | 1.15 | 1.80 | Yes | 182 | 11.01 | Check | 5.00 |
| 8+07 | Westbound US 24 onramp, outter lane | 0.90 | 0.13 | 39.33 | 6278.759 | 6278.435 | 0.008 | 2.41 | 103.049 | 6278.44 | 6276.497 | 0.019 | 6 | Paved areas and shallow paved swales | 20 | 2.74 | 0.63 | 3.04 | Yes | 142 | 10.79 | Check | 5.00 |
| 8+19 | Northbound Peterson, North RAB | 0.90 | 0.14 | 42.854 | 6281.175 | 6280.167 | 0.024 | 1.78 | 180.827 | 6280.17 | 6279 | 0.006 | 6 | Paved areas and shallow paved swales | 20 | 1.61 | 1.88 | 3.66 | Yes | 224 | 11.24 | Check | 5.00 |
| 8+39 | Southbound Peterson, inner lane, North RAB, | 0.90 | 0.06 | 37.894 | 6280.071 | 6279.145 | 0.024 | 1.66 | 51.512 | 6279.15 | 6273.39 | 0.112 | 6 | Paved areas and shallow paved swales | 20 | 6.68 | 0.13 | 1.78 | Yes | 89 | 10.50 | Check | 5.00 |
| 8+57 | Southbound Peterson, outter lane, North RAB | 0.90 | 0.77 | 44.393 | 6286.928 | 6285.881 | 0.024 | 1.81 | 667.663 | 6285.88 | 6278.118 | 0.012 | 6 | Paved areas and shallow paved swales | 20 | 2.16 | 5.16 | 6.97 | Yes | 712 | 13.96 | Check | 6.97 |

**Standard Form SF-2 . Storm Drainage System Design (Rational Method Procedure)**

Corridor / Design Package: US 24 & Peterson  Computed: CB  Date: 11/7/2023

System Name: Proposed System  Checked:  Date:

Design Storm: 5-yr

| LOCATION | DIRECT RUNOFF | | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | AREA DESIGN | AREA (AC) | RUNOFF COEFF | $t_c$ (MIN) | C.A. (AC) | I IN / HR | Q (CFS) | |
| (1) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (22) |
| 0+37 | Alignment 60, Northbound Peterson | 0.31 | 0.90 | 5.00 | 0.27 | 4.52 | 1.24 | |
| 0+38 | Alignment 60, Southbound Peterson | 0.17 | 0.90 | 5.00 | 0.15 | 4.52 | 0.68 | |
| 0+16 | Alignment 34, Northbound Peterson | 0.53 | 0.90 | 5.00 | 0.47 | 4.52 | 2.14 | |
| 0+18 | Alignment 60, Southbound Peterson | 0.34 | 0.90 | 5.00 | 0.30 | 4.52 | 1.37 | |
| 1+26 | Northbound Peterson, South RAB | 0.17 | 0.12 | 12.05 | 0.02 | 3.07 | 0.06 | |
| 0+25 | Northbound Peterson, South RAB | 2.54 | 0.66 | 13.23 | 1.67 | 2.95 | 4.92 | |
| 0+82 | Eastbound Space Village offramp, inner lane | 0.13 | 0.90 | 5.00 | 0.12 | 4.52 | 0.54 | |
| 0+88 | Eastbound Space Village offramp, outter lane | 0.21 | 0.90 | 5.00 | 0.19 | 4.52 | 0.87 | |
| 1+10 | Northbound Peterson, South RAB | 0.14 | 0.90 | 5.17 | 0.12 | 4.52 | 0.56 | |
| 1+11 | Northbound Peterson, South RAB | 0.22 | 0.90 | 5.00 | 0.20 | 4.52 | 0.90 | |
| 1+22 | Eastbound Space Village offramp | 0.50 | 0.90 | 5.00 | 0.45 | 4.52 | 2.03 | |
| 2+08 | Westbound Space Village onramp, inner lane | 0.04 | 0.90 | 5.00 | 0.04 | 4.52 | 0.17 | |
| 2+13 | Westbound Space Village onramp, outter lane | 0.03 | 0.90 | 5.00 | 0.02 | 4.52 | 0.11 | |
| 2+32 | Westbound Space Village onramp | 0.18 | 0.90 | 5.00 | 0.16 | 4.52 | 0.71 | |
| 2+64 | Westbound Space Villave offramp | 0.13 | 0.90 | 5.00 | 0.12 | 4.52 | 0.55 | |
| 2+84 | Westbound Space Village offramp | 0.22 | 0.90 | 5.00 | 0.20 | 4.52 | 0.91 | |
| 3+11 | Offsite, northeast corner of South RAB | 3.24 | 0.39 | 15.32 | 1.27 | 2.70 | 3.43 | |
| 3+43 | Offsite, northwest corner of South RAB | 1.47 | 0.40 | 13.09 | 0.59 | 2.95 | 1.74 | |
| 3+47 | Northbound Peterson, South RAB | 0.59 | 0.81 | 5.00 | 0.48 | 4.52 | 2.15 | |
| 3+83 | Southbound Peterson, South RAB | 0.14 | 0.90 | 5.00 | 0.13 | 4.52 | 0.58 | |
| 5+41 | Southbound Peterson, North RAB | 0.10 | 0.90 | 5.00 | 0.09 | 4.52 | 0.39 | |
| 5+32 | Offsite, southwest corner of North RAB | 1.95 | 0.39 | 9.03 | 0.76 | 3.56 | 2.72 | |
| 5+46 | Westbound US 24 onramp | 0.10 | 0.90 | 5.00 | 0.09 | 4.52 | 0.39 | |
| 5+51 | Westbound US 24 onramp | 0.13 | 0.90 | 5.00 | 0.12 | 4.52 | 0.54 | |
| 5+49 | Northbound Peterson, North RAB | 0.13 | 0.90 | 5.00 | 0.12 | 4.52 | 0.54 | |
| 5+69 | FES Outfall for Ditch 5+69 | 3.17 | 0.90 | 6.57 | 2.85 | 4.28 | 28.21 | Used for Ditch calc at Culvert Out, added flows from contributing inlets: 8+19,8+39,8+57,8+07, 7+97 and Culvert 7+07 |
| 6+51 | Offsite, southeast corner of North RAB | 1.59 | 0.50 | 13.60 | 0.80 | 2.95 | 2.36 | |
| 6+74 | Westbound US 24 offramp | 0.15 | 0.90 | 5.00 | 0.13 | 4.52 | 0.60 | |
| 6+75 | Westbound US 24 offramp | 0.15 | 0.90 | 5.00 | 0.13 | 4.52 | 0.60 | |
| 6+77 | Westbound US 24 offramp | 0.30 | 0.90 | 5.00 | 0.27 | 4.52 | 1.23 | |
| 7+07 | Offsite, northeast corner of North RAB | 24.63 | 0.19 | 22.89 | 4.68 | 2.39 | 11.18 | |
| 7+97 | Westbound US 24 onramp, inner lane | 0.13 | 0.90 | 5.00 | 0.12 | 4.52 | 0.52 | |
| 8+07 | Westbound US 24 onramp, outter lane | 0.13 | 0.90 | 5.00 | 0.11 | 4.52 | 0.52 | |
| 8+19 | Northbound Peterson, North RAB | 0.14 | 0.90 | 5.00 | 0.13 | 4.52 | 0.58 | |
| 8+39 | Southbound Peterson, inner lane, North RAB, | 0.06 | 0.90 | 5.00 | 0.05 | 4.52 | 0.23 | |
| 8+57 | Southbound Peterson, outter lane, North RAB | 0.77 | 0.90 | 6.97 | 0.70 | 4.28 | 2.98 | |

(1) Basin Description linked to C-Value Sheet  =Column 4 x Column 5  (12) =Intensity for Tc

(2) Basin Design Point  =Intensity for Tc  (13) Sum of Qs

(3) Enter the Basin Name from C Value Sheet  =Column 7 x Column 8  (14) Slope of additonal street flow

(4) Basin Area linked to C-Value Sheet  =Column 6 + Column 21  (15) Additonal Street Overland Flow

(5) Composite C linked to C-Value Sheet  Add the Basin Areas (7) to get the combined basin AC  (16) Design Pipe Flow

(6) Time of Concentration linked to C-Value Sheet

Design Storm: 100-yr

| LOCATION | DIRECT RUNOFF | | | | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|
| | AREA DESIGN | AREA (AC) | RUNOFF COEFF | $t_c$ (MIN) | C.A. (AC) | I IN / HR | Q (CFS) | |
| (1) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (22) |
| 0+37 | Alignment 60, Northbound Peterson | 0.31 | 0.92 | 5.00 | 0.28 | 9.25 | 2.60 | |
| 0+38 | Alignment 60, Southbound Peterson | 0.17 | 0.92 | 5.00 | 0.15 | 9.25 | 1.42 | |
| 0+16 | Alignment 34, Northbound Peterson | 0.53 | 0.92 | 5.00 | 0.48 | 9.25 | 4.48 | |
| 0+18 | Alignment 60, Southbound Peterson | 0.34 | 0.92 | 5.00 | 0.31 | 9.25 | 2.86 | |
| 1+26 | Northbound Peterson, South RAB | 0.17 | 0.20 | 12.05 | 0.03 | 6.26 | 0.22 | |
| 0+25 | Northbound Peterson, South RAB | 2.54 | 0.70 | 13.23 | 1.77 | 6.01 | 10.62 | |
| 0+82 | Eastbound Space Village offramp, inner lane | 0.13 | 0.92 | 5.00 | 0.12 | 9.25 | 1.12 | |
| 0+88 | Eastbound Space Village offramp, outter lane | 0.21 | 0.92 | 5.00 | 0.20 | 9.25 | 1.82 | |
| 1+10 | Northbound Peterson, South RAB | 0.14 | 0.92 | 5.17 | 0.13 | 9.25 | 1.17 | |
| 1+11 | Northbound Peterson, South RAB | 0.22 | 0.92 | 5.00 | 0.20 | 9.25 | 1.88 | |
| 1+22 | Eastbound Space Village offramp | 0.50 | 0.92 | 5.00 | 0.46 | 9.25 | 4.25 | |
| 2+08 | Westbound Space Village onramp, inner lane | 0.04 | 0.92 | 5.00 | 0.04 | 9.25 | 0.35 | |
| 2+13 | Westbound Space Village onramp, outter lane | 0.03 | 0.92 | 5.00 | 0.03 | 9.25 | 0.23 | |
| 2+32 | Westbound Space Village onramp | 0.18 | 0.92 | 5.00 | 0.16 | 9.25 | 1.49 | |
| 2+64 | Westbound Space Villave offramp | 0.13 | 0.92 | 5.00 | 0.12 | 9.25 | 1.15 | |
| 2+84 | Westbound Space Village offramp | 0.22 | 0.92 | 5.00 | 0.21 | 9.25 | 1.91 | |
| 3+11 | Offsite, northeast corner of South RAB | 3.24 | 0.45 | 15.32 | 1.46 | 5.50 | 8.04 | |
| 3+43 | Offsite, northwest corner of South RAB | 1.47 | 0.46 | 13.09 | 0.68 | 6.01 | 4.06 | |
| 3+47 | Northbound Peterson, South RAB | 0.59 | 0.83 | 5.00 | 0.49 | 9.25 | 4.55 | |
| 3+83 | Southbound Peterson, South RAB | 0.14 | 0.92 | 5.00 | 0.13 | 9.25 | 1.21 | |
| 5+41 | Southbound Peterson, North RAB | 0.10 | 0.92 | 5.00 | 0.09 | 9.25 | 0.81 | |
| 5+32 | Offsite, southwest corner of North RAB | 1.95 | 0.45 | 9.03 | 0.88 | 7.27 | 6.40 | |
| 5+46 | Westbound US 24 onramp | 0.10 | 0.92 | 5.00 | 0.09 | 9.25 | 0.82 | |
| 5+51 | Westbound US 24 onramp | 0.13 | 0.92 | 5.00 | 0.12 | 9.25 | 1.12 | |
| 5+49 | Northbound Peterson, North RAB | 0.13 | 0.92 | 5.00 | 0.12 | 9.25 | 1.13 | |
| 5+69 | FES Outfall for Ditch 5+69 | 3.17 | 0.92 | 6.57 | 2.91 | 8.75 | 67.33 | Used for Ditch calc at Culvert Out, added flows from contributing inlets: 8+19,8+39,8+57,8+07, 7+97 and Culvert 7+07 |
| 6+51 | Offsite, southeast corner of North RAB | 1.59 | 0.55 | 13.60 | 0.88 | 6.01 | 5.29 | |
| 6+74 | Westbound US 24 offramp | 0.15 | 0.92 | 5.00 | 0.14 | 9.25 | 1.26 | |
| 6+75 | Westbound US 24 offramp | 0.15 | 0.92 | 5.00 | 0.13 | 9.25 | 1.25 | |
| 6+77 | Westbound US 24 offramp | 0.30 | 0.92 | 5.00 | 0.28 | 9.25 | 2.57 | |
| 7+07 | Offsite, northeast corner of North RAB | 24.63 | 0.26 | 22.89 | 6.52 | 4.87 | 31.74 | |
| 7+97 | Westbound US 24 onramp, inner lane | 0.13 | 0.92 | 5.00 | 0.12 | 9.25 | 1.09 | |
| 8+07 | Westbound US 24 onramp, outter lane | 0.13 | 0.92 | 5.00 | 0.12 | 9.25 | 1.08 | |
| 8+19 | Northbound Peterson, North RAB | 0.14 | 0.92 | 5.00 | 0.13 | 9.25 | 1.22 | |
| 8+39 | Southbound Peterson, inner lane, North RAB, | 0.06 | 0.92 | 5.00 | 0.05 | 9.25 | 0.47 | |
| 8+57 | Southbound Peterson, outter lane, North RAB | 0.77 | 0.92 | 6.97 | 0.71 | 8.75 | 6.23 | |

(1) Basin Description linked to C-Value Sheet
(2) Basin Design Point
(3) Enter the Basin Name from C Value Sheet
(4) Basin Area linked to C-Value Sheet
(5) Composite C linked to C-Value Sheet
(6) Time of Concentration linked to C-Value Sheet

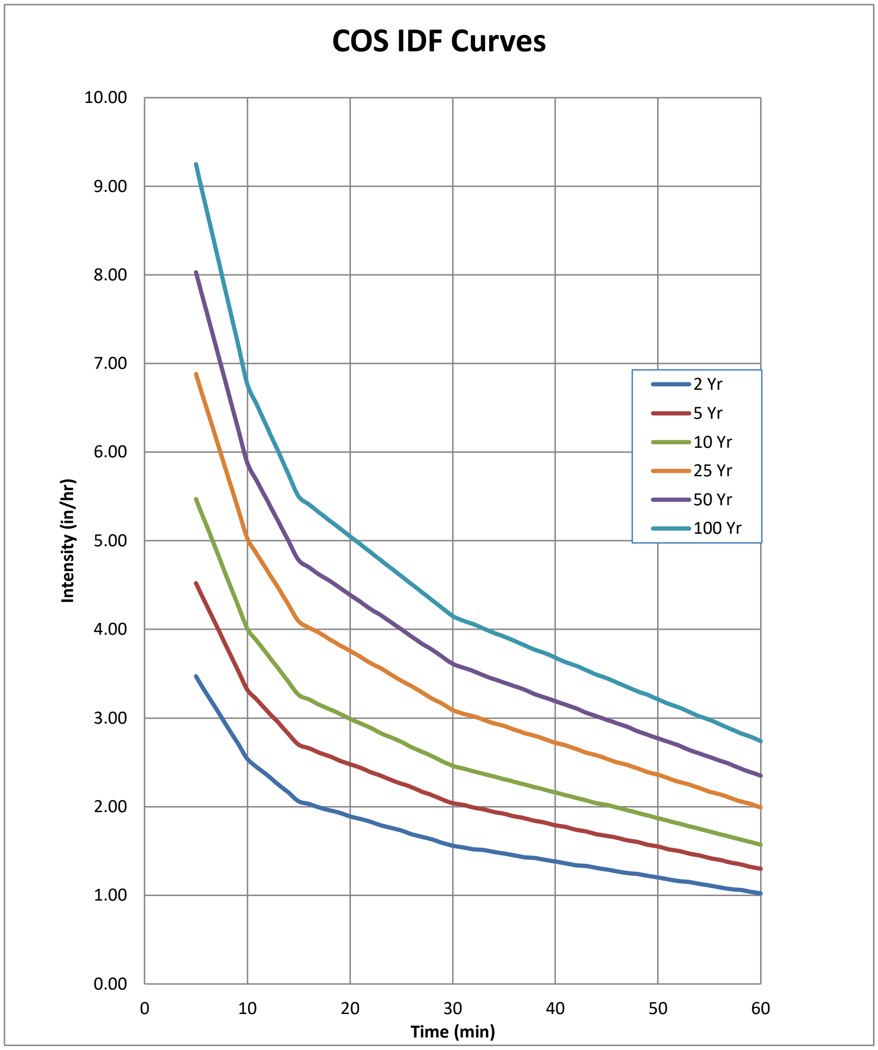
=Column 4 x Column 5
=Intensity for Tc
=Column 7 x Column 8
=Column 6 + Column 21
Add the Basin Areas (7) to get the combined basin AC

(12) =Intensity for Tc
(13) Sum of Qs
(14) Slope of additonal street flow
(15) Additonal Street Overland Flow
(16) Design Pipe Flow

| | Computed: | CB | Date: | 11/7/2023 | |
|---|---|---|---|---|---|
| | Checked: | | Date: | | |

| **Time (min)** | **(in/hr)** | | | | | |
|---|---|---|---|---|---|---|
| | **2 Yr** | **5 Yr** | **10 Yr** | 25 Yr | **50 Yr** | **100 Yr** |
| 5 | 3.47 | 4.52 | 5.47 | 6.88 | 8.03 | 9.25 |
| 6 | 3.28 | 4.28 | 5.18 | 6.51 | 7.60 | 8.75 |
| 7 | 3.10 | 4.04 | 4.89 | 6.14 | 7.17 | 8.26 |
| 8 | 2.91 | 3.80 | 4.59 | 5.77 | 6.74 | 7.76 |
| 9 | 2.73 | 3.56 | 4.30 | 5.40 | 6.31 | 7.27 |
| 10 | 2.54 | 3.32 | 4.01 | 5.03 | 5.88 | 6.77 |
| 11 | 2.44 | 3.20 | 3.86 | 4.84 | 5.66 | 6.52 |
| 12 | 2.35 | 3.07 | 3.71 | 4.65 | 5.44 | 6.26 |
| 13 | 2.25 | 2.95 | 3.56 | 4.47 | 5.22 | 6.01 |
| 14 | 2.16 | 2.82 | 3.41 | 4.28 | 5.00 | 5.75 |
| 15 | 2.06 | 2.70 | 3.26 | 4.09 | 4.78 | 5.50 |
| 16 | 2.03 | 2.66 | 3.21 | 4.02 | 4.70 | 5.41 |
| 17 | 1.99 | 2.61 | 3.15 | 3.96 | 4.62 | 5.32 |
| 18 | 1.96 | 2.57 | 3.10 | 3.89 | 4.55 | 5.23 |
| 19 | 1.93 | 2.52 | 3.05 | 3.82 | 4.47 | 5.14 |
| 20 | 1.89 | 2.48 | 2.99 | 3.76 | 4.39 | 5.05 |
| 21 | 1.86 | 2.44 | 2.94 | 3.69 | 4.31 | 4.96 |
| 22 | 1.83 | 2.39 | 2.89 | 3.62 | 4.23 | 4.87 |
| 23 | 1.79 | 2.35 | 2.83 | 3.56 | 4.16 | 4.78 |
| 24 | 1.76 | 2.30 | 2.78 | 3.49 | 4.08 | 4.69 |
| 25 | 1.73 | 2.26 | 2.73 | 3.42 | 4.00 | 4.60 |
| 26 | 1.69 | 2.22 | 2.67 | 3.36 | 3.92 | 4.51 |
| 27 | 1.66 | 2.17 | 2.62 | 3.29 | 3.84 | 4.42 |
| 28 | 1.63 | 2.13 | 2.57 | 3.22 | 3.77 | 4.33 |
| 29 | 1.59 | 2.08 | 2.51 | 3.16 | 3.69 | 4.24 |
| 30 | 1.56 | 2.04 | 2.46 | 3.09 | 3.61 | 4.15 |
| 31 | 1.54 | 2.02 | 2.43 | 3.05 | 3.57 | 4.10 |
| 32 | 1.52 | 1.99 | 2.40 | 3.02 | 3.53 | 4.06 |
| 33 | 1.51 | 1.97 | 2.37 | 2.98 | 3.48 | 4.01 |
| 34 | 1.49 | 1.94 | 2.34 | 2.94 | 3.44 | 3.96 |
| 35 | 1.47 | 1.92 | 2.31 | 2.91 | 3.40 | 3.92 |
| 36 | 1.45 | 1.89 | 2.28 | 2.87 | 3.36 | 3.87 |
| 37 | 1.43 | 1.87 | 2.25 | 2.83 | 3.32 | 3.82 |
| 38 | 1.42 | 1.84 | 2.22 | 2.80 | 3.27 | 3.77 |
| 39 | 1.40 | 1.82 | 2.19 | 2.76 | 3.23 | 3.73 |
| 40 | 1.38 | 1.79 | 2.16 | 2.72 | 3.19 | 3.68 |
| 41 | 1.36 | 1.77 | 2.13 | 2.69 | 3.15 | 3.63 |
| 42 | 1.34 | 1.74 | 2.10 | 2.65 | 3.11 | 3.59 |
| 43 | 1.33 | 1.72 | 2.07 | 2.61 | 3.06 | 3.54 |
| 44 | 1.31 | 1.69 | 2.04 | 2.58 | 3.02 | 3.49 |
| 45 | 1.29 | 1.67 | 2.02 | 2.54 | 2.98 | 3.45 |
| 46 | 1.27 | 1.65 | 1.99 | 2.50 | 2.94 | 3.40 |
| 47 | 1.25 | 1.62 | 1.96 | 2.47 | 2.90 | 3.35 |
| 48 | 1.24 | 1.60 | 1.93 | 2.43 | 2.85 | 3.30 |
| 49 | 1.22 | 1.57 | 1.90 | 2.39 | 2.81 | 3.26 |
| 50 | 1.20 | 1.55 | 1.87 | 2.36 | 2.77 | 3.21 |
| 51 | 1.18 | 1.52 | 1.84 | 2.32 | 2.73 | 3.16 |
| 52 | 1.16 | 1.50 | 1.81 | 2.28 | 2.69 | 3.12 |
| 53 | 1.15 | 1.47 | 1.78 | 2.25 | 2.64 | 3.07 |
| 54 | 1.13 | 1.45 | 1.75 | 2.21 | 2.60 | 3.02 |
| 55 | 1.11 | 1.42 | 1.72 | 2.17 | 2.56 | 2.98 |
| 56 | 1.09 | 1.40 | 1.69 | 2.14 | 2.52 | 2.93 |
| 57 | 1.07 | 1.37 | 1.66 | 2.10 | 2.48 | 2.88 |
| 58 | 1.06 | 1.35 | 1.63 | 2.06 | 2.43 | 2.83 |
| 59 | 1.04 | 1.32 | 1.60 | 2.03 | 2.39 | 2.79 |
| 60 | 1.02 | 1.30 | 1.57 | 1.99 | 2.35 | 2.74 |

*Note: Intensity values for the IDF curves were generated from the IDF equations provided on the City of Colorado Springs Drainage Criteria Manual, Volume I, Chapter 6, Figure 6-5.



COS IDF Curves
Intensity (in/hr)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0
10
20
30
40
50
60
Time (min)
2 Yr
5 Yr
10 Yr
25 Yr
50 Yr
100 Yr

**NOAA Atlas 14, Volume 8, Version 2**
**Location name: Colorado Springs, Colorado, USA***
**Latitude: 38.8395°, Longitude: -104.7013°**
**Elevation: 6273.45 ft****
* source: ESRI Maps
** source: USGS

### POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

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

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 2.86 (2.40-3.43) | 3.47 (2.90-4.18) | 4.52 (3.78-5.47) | 5.47 (4.55-6.64) | 6.88 (5.53-8.74) | 8.03 (6.28-10.3) | 9.25 (6.95-12.2) | 10.5 (7.57-14.3) | 12.4 (8.50-17.3) | 13.8 (9.20-19.5) |
| 10-min | 2.09 (1.75-2.51) | 2.54 (2.12-3.05) | 3.32 (2.77-4.00) | 4.01 (3.32-4.86) | 5.03 (4.04-6.40) | 5.88 (4.59-7.56) | 6.77 (5.09-8.93) | 7.72 (5.54-10.5) | 9.06 (6.22-12.6) | 10.1 (6.74-14.3) |
| 15-min | 1.70 (1.42-2.04) | 2.06 (1.73-2.48) | 2.70 (2.25-3.26) | 3.26 (2.70-3.95) | 4.09 (3.29-5.20) | 4.78 (3.73-6.14) | 5.50 (4.14-7.26) | 6.28 (4.50-8.51) | 7.37 (5.06-10.3) | 8.24 (5.48-11.6) |
| 30-min | 1.29 (1.08-1.55) | 1.56 (1.31-1.88) | 2.04 (1.70-2.46) | 2.46 (2.04-2.99) | 3.09 (2.48-3.93) | 3.61 (2.82-4.64) | 4.15 (3.12-5.48) | 4.74 (3.40-6.42) | 5.56 (3.82-7.75) | 6.22 (4.13-8.75) |
| 60-min | 0.861 (0.722-1.03) | 1.02 (0.851-1.22) | 1.30 (1.09-1.57) | 1.57 (1.30-1.91) | 1.99 (1.61-2.55) | 2.35 (1.84-3.04) | 2.74 (2.07-3.63) | 3.17 (2.28-4.32) | 3.79 (2.61-5.30) | 4.29 (2.86-6.05) |
| 2-hr | 0.538 (0.455-0.643) | 0.625 (0.528-0.748) | 0.792 (0.667-0.950) | 0.956 (0.800-1.15) | 1.22 (0.997-1.56) | 1.45 (1.15-1.87) | 1.70 (1.30-2.25) | 1.98 (1.44-2.70) | 2.40 (1.67-3.34) | 2.74 (1.84-3.83) |
| 3-hr | 0.396 (0.336-0.471) | 0.452 (0.384-0.538) | 0.567 (0.479-0.677) | 0.684 (0.574-0.821) | 0.876 (0.725-1.13) | 1.05 (0.839-1.36) | 1.25 (0.956-1.65) | 1.47 (1.07-1.99) | 1.80 (1.25-2.50) | 2.07 (1.39-2.88) |
| 6-hr | 0.227 (0.195-0.269) | 0.257 (0.220-0.304) | 0.320 (0.273-0.379) | 0.386 (0.327-0.460) | 0.497 (0.416-0.638) | 0.599 (0.483-0.772) | 0.715 (0.554-0.943) | 0.847 (0.625-1.15) | 1.04 (0.736-1.45) | 1.21 (0.820-1.68) |
| 12-hr | 0.125 (0.108-0.147) | 0.143 (0.124-0.169) | 0.181 (0.155-0.213) | 0.218 (0.186-0.258) | 0.279 (0.235-0.354) | 0.334 (0.271-0.426) | 0.396 (0.309-0.517) | 0.466 (0.346-0.624) | 0.569 (0.403-0.782) | 0.655 (0.447-0.901) |
| 24-hr | 0.070 (0.061-0.081) | 0.081 (0.071-0.095) | 0.103 (0.090-0.121) | 0.124 (0.107-0.146) | 0.158 (0.133-0.197) | 0.187 (0.152-0.235) | 0.218 (0.171-0.282) | 0.254 (0.189-0.336) | 0.305 (0.217-0.415) | 0.347 (0.239-0.475) |
| 2-day | 0.040 (0.035-0.046) | 0.047 (0.041-0.054) | 0.059 (0.051-0.069) | 0.070 (0.061-0.082) | 0.088 (0.074-0.108) | 0.103 (0.084-0.128) | 0.119 (0.094-0.152) | 0.137 (0.103-0.180) | 0.162 (0.116-0.219) | 0.183 (0.127-0.248) |
| 3-day | 0.029 (0.026-0.033) | 0.034 (0.030-0.039) | 0.043 (0.038-0.050) | 0.051 (0.044-0.059) | 0.063 (0.053-0.077) | 0.073 (0.060-0.090) | 0.084 (0.066-0.107) | 0.096 (0.072-0.125) | 0.112 (0.081-0.151) | 0.126 (0.088-0.170) |
| 4-day | 0.023 (0.021-0.027) | 0.027 (0.024-0.031) | 0.034 (0.030-0.039) | 0.040 (0.035-0.047) | 0.050 (0.042-0.060) | 0.058 (0.047-0.071) | 0.066 (0.052-0.083) | 0.075 (0.056-0.097) | 0.087 (0.063-0.116) | 0.097 (0.068-0.131) |
| 7-day | 0.015 (0.014-0.018) | 0.018 (0.016-0.021) | 0.022 (0.020-0.026) | 0.026 (0.023-0.030) | 0.032 (0.027-0.038) | 0.037 (0.030-0.045) | 0.042 (0.033-0.052) | 0.047 (0.036-0.060) | 0.054 (0.039-0.072) | 0.060 (0.042-0.081) |
| 10-day | 0.012 (0.011-0.014) | 0.014 (0.013-0.016) | 0.017 (0.015-0.020) | 0.020 (0.018-0.023) | 0.024 (0.021-0.029) | 0.028 (0.023-0.034) | 0.032 (0.025-0.039) | 0.035 (0.027-0.045) | 0.041 (0.030-0.054) | 0.045 (0.032-0.060) |
| 20-day | 0.008 (0.007-0.009) | 0.009 (0.008-0.010) | 0.011 (0.010-0.013) | 0.013 (0.012-0.015) | 0.015 (0.013-0.018) | 0.017 (0.015-0.021) | 0.019 (0.016-0.024) | 0.021 (0.016-0.027) | 0.024 (0.018-0.032) | 0.026 (0.019-0.035) |
| 30-day | 0.006 (0.006-0.007) | 0.007 (0.007-0.008) | 0.009 (0.008-0.010) | 0.010 (0.009-0.012) | 0.012 (0.010-0.014) | 0.014 (0.011-0.016) | 0.015 (0.012-0.018) | 0.016 (0.013-0.021) | 0.018 (0.013-0.024) | 0.020 (0.014-0.026) |
| 45-day | 0.005 (0.005-0.006) | 0.006 (0.005-0.007) | 0.007 (0.007-0.008) | 0.008 (0.007-0.009) | 0.010 (0.008-0.011) | 0.011 (0.009-0.013) | 0.012 (0.009-0.014) | 0.013 (0.010-0.016) | 0.014 (0.010-0.018) | 0.015 (0.011-0.020) |
| 60-day | 0.005 (0.004-0.005) | 0.005 (0.005-0.006) | 0.006 (0.006-0.007) | 0.007 (0.006-0.008) | 0.008 (0.007-0.010) | 0.009 (0.008-0.011) | 0.010 (0.008-0.012) | 0.011 (0.008-0.013) | 0.012 (0.009-0.015) | 0.012 (0.009-0.016) |

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

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

Please refer to NOAA Atlas 14 document for more information.

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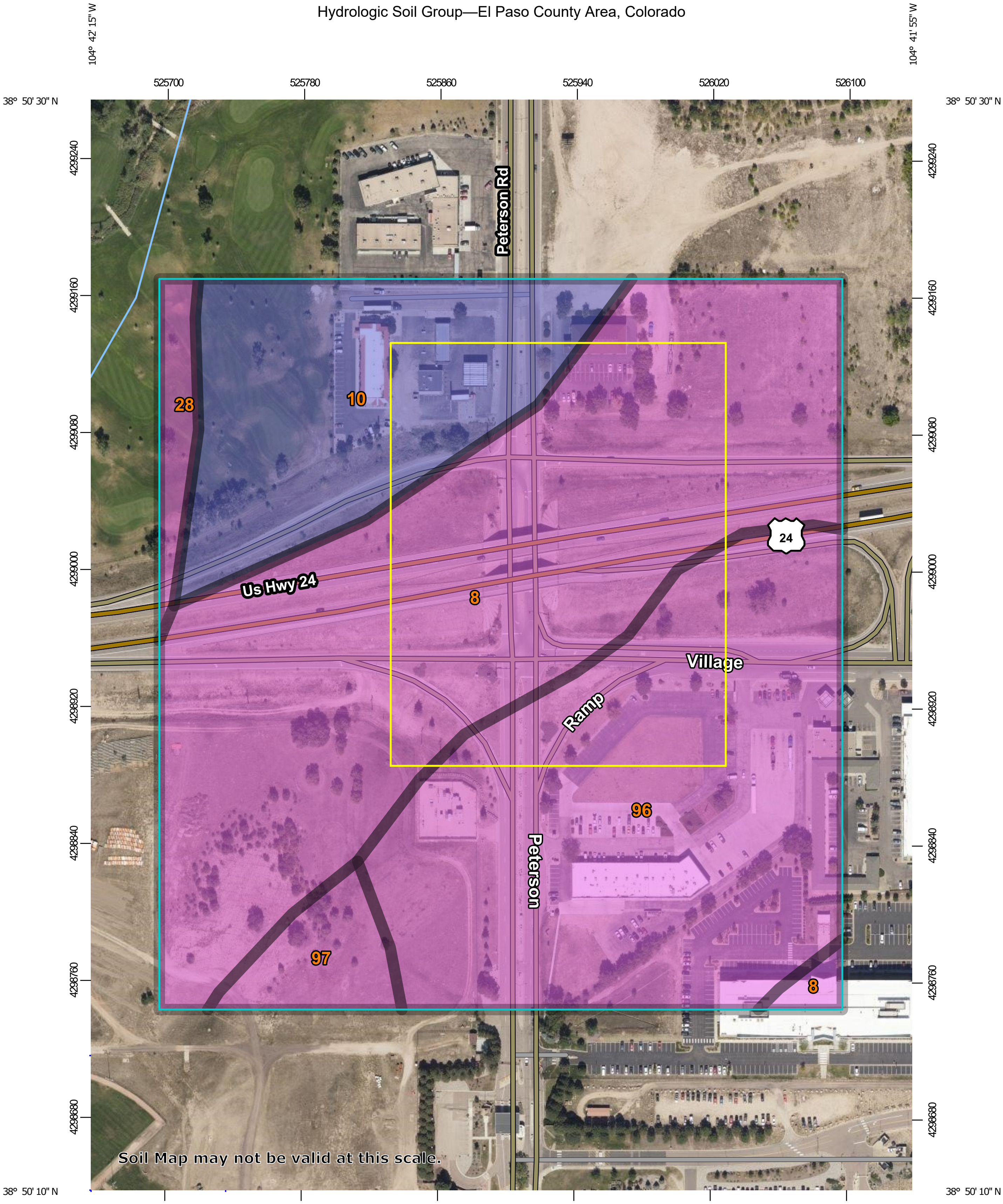
# 9.5 Soil Data Report




Map Scale: 1:3,110 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

## MAP LEGEND

**Area of Interest (AOI)**

- Area of Interest (AOI)

**Soils**

**Soil Rating Polygons**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Lines**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Soil Rating Points**

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

**Water Features**

- Streams and Canals

**Transportation**

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

**Background**

- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

# Hydrologic Soil Group

| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
|---|---|---|---|---|
| 8 | Blakeland loamy sand, 1 to 9 percent slopes | A | 18.6 | 43.9% |
| 10 | Blendon sandy loam, 0 to 3 percent slopes | B | 7.4 | 17.3% |
| 28 | Ellicott loamy coarse sand, 0 to 5 percent slopes | A | 0.9 | 2.1% |
| 96 | Truckton sandy loam, 0 to 3 percent slopes | A | 14.2 | 33.4% |
| 97 | Truckton sandy loam, 3 to 9 percent slopes | A | 1.4 | 3.2% |
| **Totals for Area of Interest** | | | **42.4** | **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

# 9.6 FEMA FIRM


JOINS PANEL 0752
ZONE AE
Sand Creek Center Tributary
Sand Creek East Fork
ZONE AE
ZONE AE
EL PASO COUNTY UNINCORPORATED AREAS
CITY OF COLORADO SPRINGS
EL PASO COUNTY
CITY OF COLORADO SPRINGS
PETERSON AIR FORCE BASE
ZONE D
ZONE D
17
18
CITY OF COLORADO SPRINGS
JOINS PANEL 0753
LEGEND
OTHER FLOOD AREAS
OTHER AREAS
COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
OTHERWISE PROTECTED AREAS (OPAs)
MAP SCALE 1" = 500'
FEET
METERS

# 9.7 Inlet Calculations

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-8+57 | IN-8+07 | IN-8+39 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 2.98 | 0.52 | 0.23 |
| Major $Q_{Known}$ (cfs) | 6.50 | 1.13 | 0.49 |

**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 | IN-8+57 | No Bypass Flow Received |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.9 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 3.5 | 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)** | **3.0** | **1.4** | **0.2** |
| **Major Total Design Peak Flow, Q (cfs)** | **6.5** | **4.6** | **0.5** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.9 | 0.1 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 3.5 | 2.1 | 0.0 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| INLET NAME | IN-7+97 | IN-8+19 |
|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | |
|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.52 | 0.58 |
| Major $Q_{Known}$ (cfs) | 1.14 | 1.27 |

**Bypass (Carry-Over) Flow from Upstream**

| | | |
|---|---|---|
| Receive Bypass Flow from: | IN-8+39 | No Bypass Flow Received |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 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) | | |

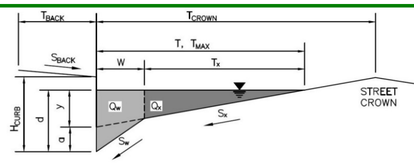
## CALCULATED OUTPUT

| | | |
|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **0.5** | **0.6** |
| **Major Total Design Peak Flow, Q (cfs)** | **1.1** | **1.3** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.1 | 0.1 |

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

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

**Project:**
**Inlet ID: IN-8+57**



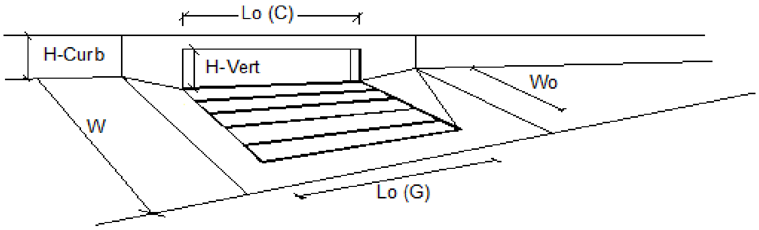

Gutter Geometry:

| | | | | |
|---|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | | 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 | $T_{CROWN}$ = | 21.0 | | 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) | $S_W$ = | 0.063 | | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.015 | | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | | |
| | | Minor Storm | Major Storm | |
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 11.0 | 21.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |
| | | Minor Storm | Major Storm | |
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **4.4** | **21.5** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.98 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 6.50 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

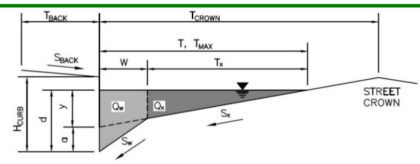



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Design Information (Input)** CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 3.0 | 6.5 | cfs |
| Water Spread Width | T = | 9.3 | 12.9 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 3.3 | 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 | $E_o$ = | 0.572 | 0.427 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 1.3 | 3.7 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 1.7 | 2.8 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.42 | 0.56 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 4.1 | 4.9 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 6.3 | 7.1 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.116 | 0.091 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 9.39 | 15.58 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 5.00 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 2.2 | 3.3 | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **2.1** | **3.0** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.9** | **3.5** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **2.1** | **3.0** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.9** | **3.5** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **69** | **46** | **%** |

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

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

**Project:**
**Inlet ID: IN-8+07**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 21.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.019 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.012 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

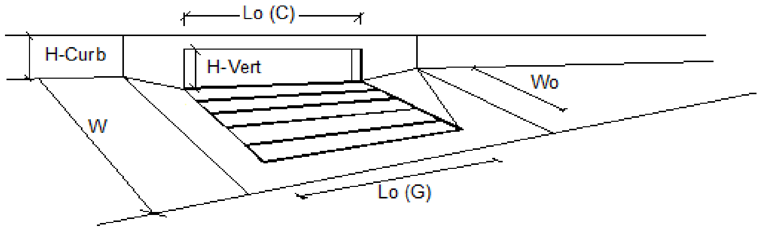
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 11.0 | 21.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **3.7** | **18.2** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.44 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 4.65 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



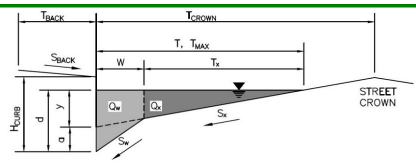

| Design Information (Input) | CDOT Type R Curb Opening | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 1.4 | 4.6 | cfs |
| Water Spread Width | T = | 7.2 | 12.2 | 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 | $E_o$ = | 0.702 | 0.457 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.4 | 2.5 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 1.0 | 2.1 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.32 | 0.51 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 3.1 | 4.1 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.7 | 6.8 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.137 | 0.096 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 5.92 | 12.68 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 5.00 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 1.4 | 2.8 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **1.3** | **2.5** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.1** | **2.1** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **1.3** | **2.5** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.1** | **2.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **92** | **55** | **%** |

*MHFD-Inlet, Version 5.03 (August 2023)*

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

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

**Project:**
**Inlet ID:** **IN-8+39**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 27.0 | 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) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.015 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

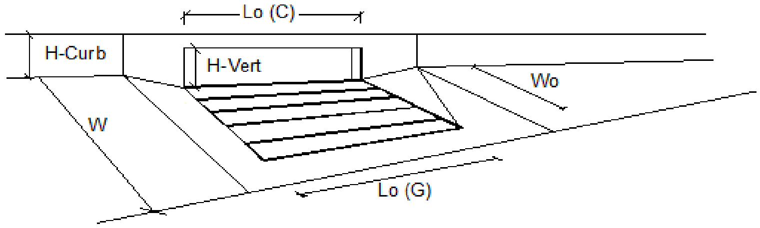
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 17.0 | 27.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion<br>MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **12.9** | **21.5** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.23 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.49 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



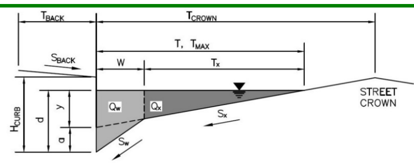

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) — CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.2 | 0.5 | cfs |
| Water Spread Width | T = | 1.9 | 3.5 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.5 | 1.9 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 1.000 | 0.961 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.0 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.2 | 0.5 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.00 | 0.19 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 0.0 | 2.5 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.5 | 4.9 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.188 | 0.181 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 2.04 | 3.05 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 2.04 | 3.05 | ft |
| Interception Capacity | $Q_i$ = | 0.2 | 0.5 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 2.04 | 3.05 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.2** | **0.5** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.2** | **0.5** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **100** | **%** |

*MHFD-Inlet, Version 5.03 (August 2023)*

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

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

**Project:**
**Inlet ID: IN-7+97**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $S_X$ = | 0.005 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.034 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

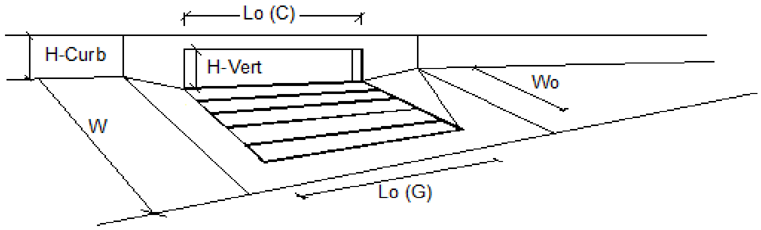
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 8.0 | 18.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion<br>MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **0.8** | **2.9** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.52 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.14 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

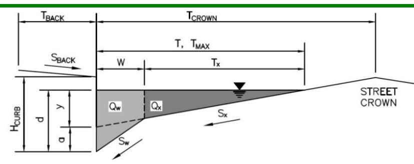



| Design Information (Input) | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | | $Q_o$ = | 0.5 | 1.1 | cfs |
| Water Spread Width | | T = | 2.2 | 10.5 | ft |
| Water Depth at Flowline (outside of local depression) | | d = | 1.5 | 2.0 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | | $E_o$ = | 1.000 | 0.752 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | | $Q_x$ = | 0.0 | 0.3 | cfs |
| Discharge within the Gutter Section W | | $Q_w$ = | 0.5 | 0.9 | cfs |
| Discharge Behind the Curb Face | | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | | $A_W$ = | 0.13 | 0.21 | sq ft |
| Velocity within the Gutter Section W | | $V_W$ = | 4.1 | 4.1 | fps |
| Water Depth for Design Condition | | $d_{LOCAL}$ = | 4.5 | 5.0 | inches |
| **Grate Analysis (Calculated)** | | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | | $R_x$ = | N/A | N/A | |
| Interception Capacity | | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | | $S_e$ = | 0.187 | 0.142 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | | $L_T$ = | 3.24 | 5.49 | ft |
| **Under No-Clogging Condition** | | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | | L = | 3.24 | 5.00 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | | $L_e$ = | 3.24 | 4.50 | ft |
| Actual Interception Capacity | | **$Q_a$ =** | **0.5** | **1.1** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| **Summary** | | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | | **Q =** | **0.5** | **1.1** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | | **C% =** | **100** | **95** | **%** |

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

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

**Project:**
**Inlet ID:** **IN-8+19**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.006 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

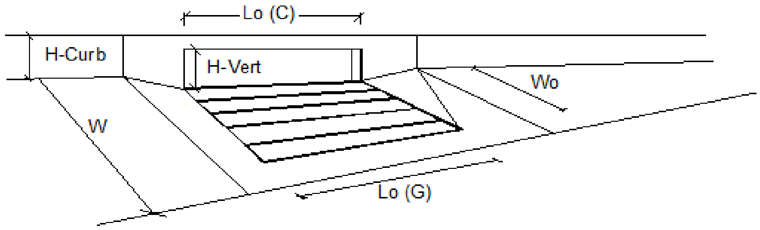
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | $Q_{allow}$ = | **2.0** | **6.2** | **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 1.27 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




| Design Information (Input) | CDOT Type R Curb Opening | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.6 | 1.3 | cfs |
| Water Spread Width | T = | 6.5 | 11.7 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.8 | 2.2 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.907 | 0.660 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.1 | 0.4 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.5 | 0.8 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.18 | 0.24 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.9 | 3.5 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.8 | 5.2 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.171 | 0.126 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.48 | 5.97 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.48 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.6 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.48 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.6** | **1.2** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.6** | **1.2** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **92** | **%** |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| INLET NAME | IN-5+49 | IN-5+46 | IN-6+75 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | In Sump | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.54 | 0.54 | 0.60 |
| Major $Q_{Known}$ (cfs) | 1.18 | 0.85 | 1.30 |

**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 |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 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)** | **0.5** | **0.5** | **0.6** |
| **Major Total Design Peak Flow, Q (cfs)** | **1.2** | **0.9** | **1.3** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | N/A | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | N/A | 0.1 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-6+74 | IN-6+77 |
|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET |
| Hydraulic Condition | In Sump | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | |
|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.60 | 1.23 |
| Major $Q_{Known}$ (cfs) | 1.31 | 2.68 |

**Bypass (Carry-Over) Flow from Upstream**

| | | |
|---|---|---|
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 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) | | |

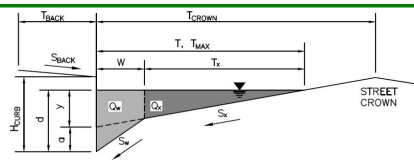
## CALCULATED OUTPUT

| | | |
|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **0.6** | **1.2** |
| **Major Total Design Peak Flow, Q (cfs)** | **1.3** | **2.7** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | N/A | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | N/A | 0.7 |

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

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

**Project:**
**Inlet ID: IN-5+49**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.019 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

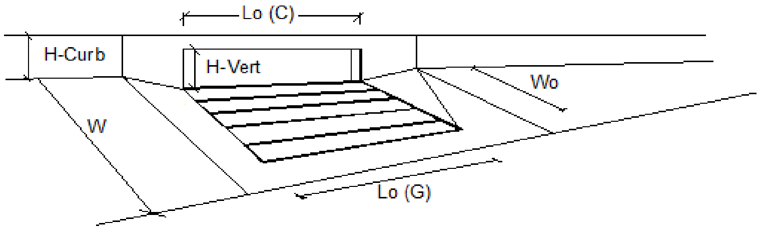
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **5.0** | **12.9** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.54 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.18 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

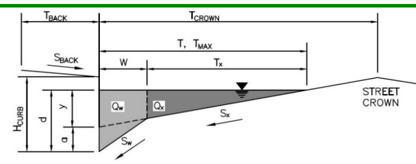



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) — CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.5 | 1.2 | cfs |
| Water Spread Width | T = | 5.5 | 8.1 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.3 | 2.9 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.830 | 0.646 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.1 | 0.4 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.4 | 0.8 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.26 | 0.36 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 1.7 | 2.1 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.3 | 5.9 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.159 | 0.128 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.19 | 5.25 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.19 | 5.00 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.19 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.5** | **1.1** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.5** | **1.1** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **97** | **%** |

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

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

**Project:**
**Inlet ID: IN-5+46**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.019 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

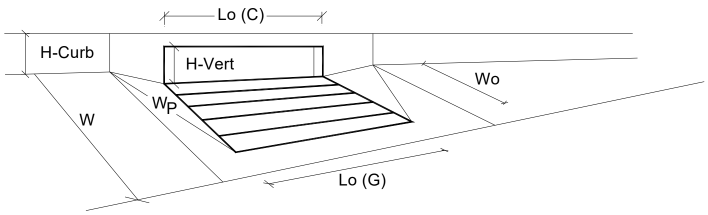
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

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 5.03 (August 2023)*




| Design Information (Input) | CDOT Type R Curb Opening | | MINOR | MAJOR | |
|---|---|---|---|---|---|
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 4.5 | 6.0 | inches |
| Grate Information | | | MINOR | MAJOR | Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| Curb Opening Information | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |

| Grate Flow Analysis (Calculated) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Clogging Coefficient for Multiple Units | Coef = | N/A | N/A | |
| Clogging Factor for Multiple Units | Clog = | N/A | N/A | |
| Grate Capacity as a Weir (based on 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 |
| Grate 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 |
| Grate Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | N/A | N/A | cfs |
| Interception with Clogging | $Q_{ma}$ = | N/A | N/A | cfs |
| Resulting Grate Capacity (assumes clogged condition) | **$Q_{Grate}$ =** | **N/A** | **N/A** | **cfs** |

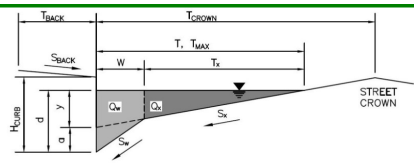
| Curb Opening Flow Analysis (Calculated) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Clogging Coefficient for Multiple Units | Coef = | 1.00 | 1.00 | |
| Clogging Factor for Multiple Units | Clog = | 0.10 | 0.10 | |
| Curb Capacity as a Weir (based on MHFD - CSU 2010 Study) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{wi}$ = | 3.8 | 7.1 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 3.4 | 6.4 | cfs |
| Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{oi}$ = | 8.5 | 9.8 | cfs |
| Interception with Clogging | $Q_{oa}$ = | 7.6 | 8.8 | cfs |
| Curb Opening Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | 5.3 | 7.7 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 4.8 | 7.0 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **3.4** | **6.4** | **cfs** |

| Resultant Street Conditions | | MINOR | MAJOR | |
|---|---|---|---|---|
| Total Inlet Length | L = | 5.00 | 5.00 | feet |
| Resultant Street Flow Spread (based on street geometry from above) | T = | 15.0 | 21.7 | ft |
| Resultant Flow Depth at Street Crown | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Low Head Performance Reduction (Calculated) | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.25 | 0.38 | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | N/A | N/A | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | N/A | N/A | |
| | | MINOR | MAJOR | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **3.4** | **6.4** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)** | $Q_{PEAK\ REQUIRED}$ = | 0.5 | 0.9 | cfs |

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

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

**Project:**
**Inlet ID:** **IN-6+75**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.007 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

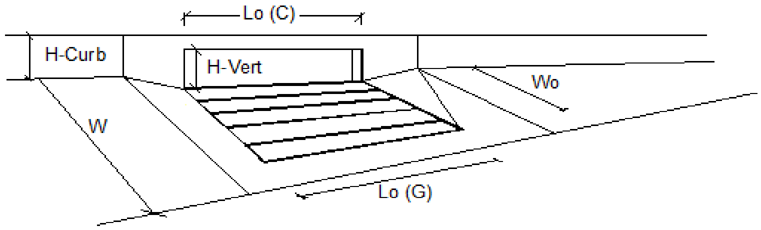
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **2.2** | **7.0** | **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 1.30 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

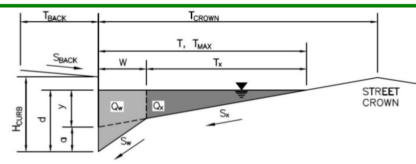



| Design Information (Input) | CDOT Type R Curb Opening | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.6 | 1.3 | cfs |
| Water Spread Width | T = | 6.7 | 11.5 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.9 | 2.3 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.876 | 0.640 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.1 | 0.5 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.5 | 0.8 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.19 | 0.26 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.7 | 3.2 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.9 | 5.3 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.165 | 0.123 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.55 | 6.04 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.55 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.6 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.55 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.6** | **1.2** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.6** | **1.2** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **91** | **%** |

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

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

**Project:**
**Inlet ID:** **IN-6+74**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.019 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

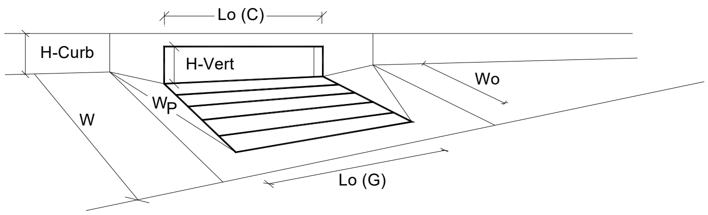
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

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 5.03 (August 2023)*

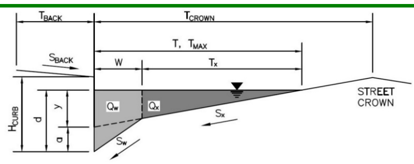



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Design Information (Input)** CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 4.5 | 6.0 | inches |
| **Grate Information** | | MINOR | MAJOR | Override Depths |
| Length of a Unit Grate | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | $W_o$ = | N/A | N/A | feet |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | $C_o$ (C) = | 0.67 | 0.67 | |
| **Grate Flow Analysis (Calculated)** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | N/A | N/A | |
| Clogging Factor for Multiple Units | Clog = | N/A | N/A | |
| **Grate Capacity as a Weir (based on 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 |
| **Grate 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 |
| **Grate Capacity as Mixed Flow** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | N/A | N/A | cfs |
| Interception with Clogging | $Q_{ma}$ = | N/A | N/A | cfs |
| Resulting Grate Capacity (assumes clogged condition) | **$Q_{Grate}$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening Flow Analysis (Calculated)** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | 1.00 | 1.00 | |
| Clogging Factor for Multiple Units | Clog = | 0.10 | 0.10 | |
| **Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{wi}$ = | 3.8 | 7.1 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 3.4 | 6.4 | cfs |
| **Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{oi}$ = | 8.5 | 9.8 | cfs |
| Interception with Clogging | $Q_{oa}$ = | 7.6 | 8.8 | cfs |
| **Curb Opening Capacity as Mixed Flow** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | 5.3 | 7.7 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 4.8 | 7.0 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **3.4** | **6.4** | **cfs** |
| **Resultant Street Conditions** | | MINOR | MAJOR | |
| Total Inlet Length | L = | 5.00 | 5.00 | feet |
| Resultant Street Flow Spread (based on street geometry from above) | T = | 15.0 | 21.7 | ft |
| Resultant Flow Depth at Street Crown | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.25 | 0.38 | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | N/A | N/A | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | N/A | N/A | |
| | | MINOR | MAJOR | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **3.4** | **6.4** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)** | $Q_{PEAK\ REQUIRED}$ = | 0.6 | 1.3 | cfs |

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

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

**Project:**
**Inlet ID: IN-6+77**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.024 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

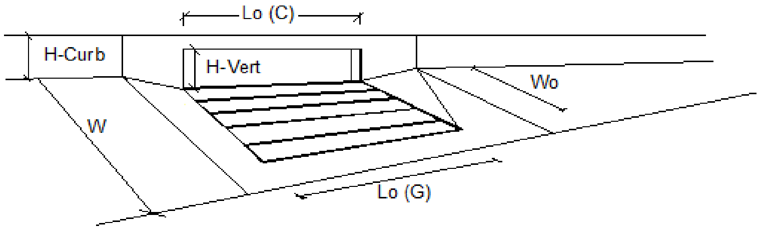
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **14.8** | **22.1** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.23 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.68 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Design Information (Input)** CDOT Type R Curb Opening | | | | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 1.2 | 2.7 | cfs |
| Water Spread Width | T = | 5.1 | 7.4 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.4 | 3.1 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.830 | 0.659 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.2 | 0.9 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 1.0 | 1.8 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.27 | 0.38 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 3.7 | 4.6 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.4 | 6.1 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.160 | 0.132 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 5.26 | 8.55 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 5.00 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 1.2 | 2.1 | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **1.2** | **2.0** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.7** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **1.2** | **2.0** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.7** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **97** | **74** | **%** |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| | | | |
|---|---|---|---|
| **INLET NAME** | IN-5+41 | IN-3+83 | IN-1+22 |
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade | In Sump |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.39 | 0.58 | 2.03 |
| Major $Q_{Known}$ (cfs) | 0.84 | 1.26 | 4.44 |

**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 | IN-5+41 | IN-3+83 |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.1 |

**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)** | **0.4** | **0.6** | **2.0** |
| **Major Total Design Peak Flow, Q (cfs)** | **0.8** | **1.3** | **4.5** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | N/A |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.1 | N/A |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-2+13 | IN-2+32 | IN-2+08 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.11 | 0.71 | 0.17 |
| Major $Q_{Known}$ (cfs) | 0.24 | 1.56 | 0.37 |

**Bypass (Carry-Over) Flow from Upstream**

| | | | |
|---|---|---|---|
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received | IN-2+32 |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.1 |

**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)** | **0.1** | **0.7** | **0.2** |
| **Major Total Design Peak Flow, Q (cfs)** | **0.2** | **1.6** | **0.5** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.1 | 0.0 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| INLET NAME | IN-2+64 | IN-2+84 | IN-3+47 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | In Sump | In Sump |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.55 | 0.91 | 2.15 |
| Major $Q_{Known}$ (cfs) | 1.20 | 1.99 | 4.87 |

**Bypass (Carry-Over) Flow from Upstream**

| | | | |
|---|---|---|---|
| Receive Bypass Flow from: | No Bypass Flow Received | IN-2+64 | User-Defined |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.1 | 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) | | | |

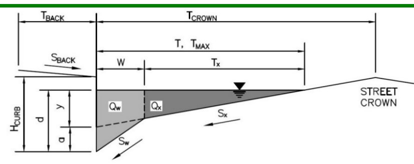
## CALCULATED OUTPUT

| | | | |
|---|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **0.6** | **0.9** | **2.2** |
| **Major Total Design Peak Flow, Q (cfs)** | **1.2** | **2.0** | **4.9** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | N/A | N/A |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.1 | 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:**
**Inlet ID:** **IN-5+41**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 24.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.028 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

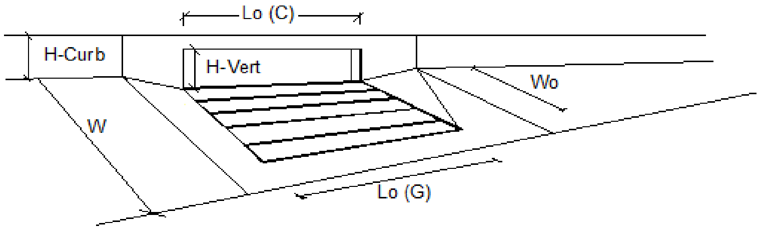
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 14.0 | 24.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **15.4** | **19.6** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.39 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.84 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



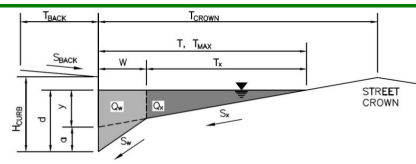

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) CDOT Type R Curb Opening | | | | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.4 | 0.8 | cfs |
| Water Spread Width | T = | 2.2 | 3.9 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.6 | 2.1 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 1.000 | 0.913 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.1 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.4 | 0.8 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.14 | 0.23 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.9 | 3.3 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.6 | 5.1 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.187 | 0.174 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 2.71 | 4.15 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 2.71 | 4.15 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 2.71 | 4.15 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.4** | **0.8** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.4** | **0.8** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **100** | **%** |

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

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

**Project:**

**Inlet ID: IN-3+83**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 24.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.011 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

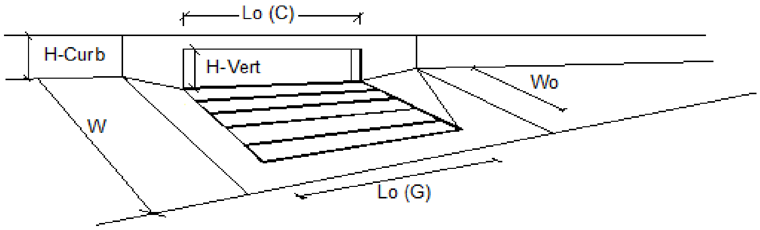
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 14.0 | 24.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **1.9** | **7.0** | **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 1.26 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

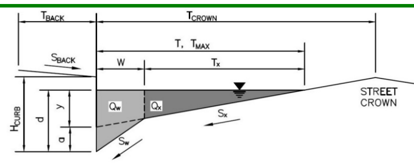



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) CDOT Type R Curb Opening | | | | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.6 | 1.3 | cfs |
| Water Spread Width | T = | 7.8 | 11.6 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.3 | 2.8 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.751 | 0.551 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.1 | 0.6 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.4 | 0.7 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.25 | 0.34 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 1.7 | 2.1 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.3 | 5.8 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.144 | 0.108 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.46 | 5.86 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.46 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.6 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.46 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.6** | **1.2** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.6** | **1.2** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **93** | **%** |

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

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

**Project:**
**Inlet ID:** **IN-1+22**




Gutter Geometry:

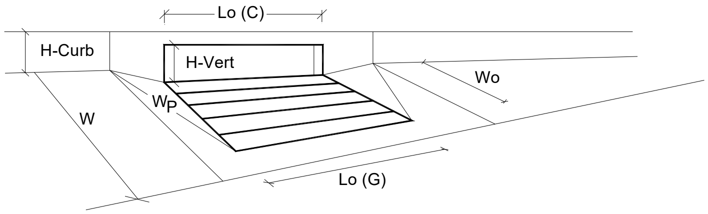
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 30.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.015 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | 30.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is not applicable to Sump Condition<br>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 5.03 (August 2023)*

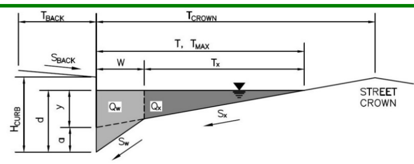



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Design Information (Input)** — CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 4.7 | 6.0 | inches |
| **Grate Information** | | MINOR | MAJOR | Override Depths |
| Length of a Unit Grate | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | $W_o$ = | N/A | N/A | feet |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | $C_o$ (G) = | N/A | N/A | |
| **Curb Opening Information** | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | $C_o$ (C) = | 0.67 | 0.67 | |
| **Grate Flow Analysis (Calculated)** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | N/A | N/A | |
| Clogging Factor for Multiple Units | Clog = | N/A | N/A | |
| **Grate Capacity as a Weir (based on 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 |
| **Grate 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 |
| **Grate Capacity as Mixed Flow** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | N/A | N/A | cfs |
| Interception with Clogging | $Q_{ma}$ = | N/A | N/A | cfs |
| Resulting Grate Capacity (assumes clogged condition) | **$Q_{Grate}$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening Flow Analysis (Calculated)** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | 1.00 | 1.00 | |
| Clogging Factor for Multiple Units | Clog = | 0.10 | 0.10 | |
| **Curb Capacity as a Weir (based on MHFD - CSU 2010 Study)** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{wi}$ = | 4.3 | 7.1 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 3.9 | 6.4 | cfs |
| **Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study)** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{oi}$ = | 8.7 | 9.8 | cfs |
| Interception with Clogging | $Q_{oa}$ = | 7.9 | 8.8 | cfs |
| **Curb Opening Capacity as Mixed Flow** | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | 5.7 | 7.7 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 5.2 | 7.0 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **3.9** | **6.4** | **cfs** |
| **Resultant Street Conditions** | | MINOR | MAJOR | |
| Total Inlet Length | L = | 5.00 | 5.00 | feet |
| Resultant Street Flow Spread (based on street geometry from above) | T = | 20.0 | 27.0 | ft |
| Resultant Flow Depth at Street Crown | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| **Low Head Performance Reduction (Calculated)** | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.27 | 0.38 | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | N/A | N/A | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | N/A | N/A | |
| | | MINOR | MAJOR | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **3.9** | **6.4** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)** | $Q_{PEAK\ REQUIRED}$ = | 2.0 | 4.5 | cfs |

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

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

**Project:**
**Inlet ID: IN-2+13**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 19.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.018 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.083 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.011 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

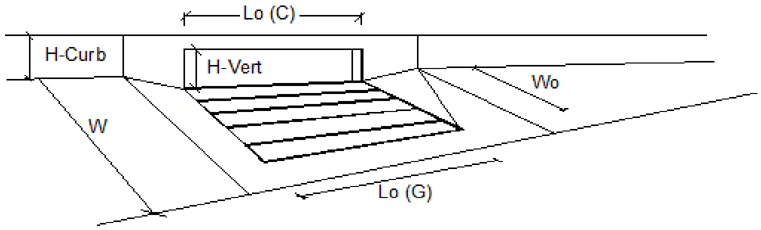
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 8.0 | 18.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **1.8** | **11.2** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.11 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.24 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



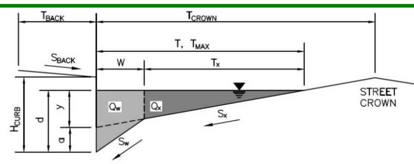

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.1 | 0.2 | cfs |
| Water Spread Width | T = | 1.3 | 1.7 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.8 | 1.9 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 1.000 | 1.000 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.0 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.1 | 0.2 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.00 | 0.00 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 0.0 | 0.0 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.8 | 4.9 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o-GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.208 | 0.208 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 1.31 | 1.95 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 1.31 | 1.95 | ft |
| Interception Capacity | $Q_i$ = | 0.1 | 0.2 | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 1.31 | 1.95 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.1** | **0.2** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.1** | **0.2** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **100** | **%** |

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

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

**Project:**

**Inlet ID: IN-2+32**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 28.0 | 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) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.038 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

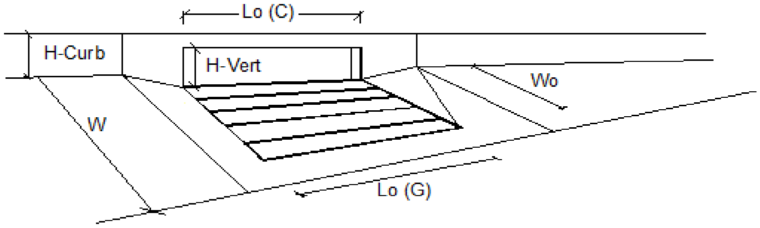
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 18.0 | 28.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **21.0** | **21.0** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.71 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.56 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

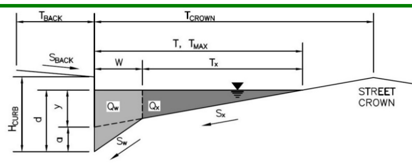



| Design Information (Input) | CDOT Type R Curb Opening | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.7 | 1.6 | cfs |
| Water Spread Width | T = | 3.3 | 5.4 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.8 | 2.3 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.973 | 0.825 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.3 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.7 | 1.3 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.18 | 0.26 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 3.9 | 4.9 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.8 | 5.3 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.183 | 0.158 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.86 | 6.17 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.86 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.7 | 1.5 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.86 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.7** | **1.4** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.7** | **1.4** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **90** | **%** |

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

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

**Project:**
**Inlet ID: IN-2+08**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 16.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.016 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.023 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

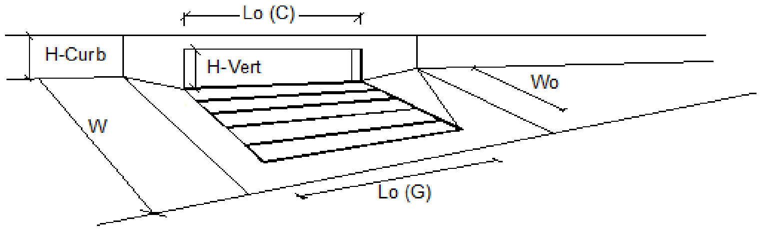
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 6.0 | 16.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion<br>MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **1.2** | **9.7** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.17 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 0.52 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




| Design Information (Input) | CDOT Type R Curb Opening | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |

| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.2 | 0.5 | cfs |
| Water Spread Width | T = | 1.6 | 3.4 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.4 | 1.8 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 1.000 | 0.976 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.0 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.2 | 0.5 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.00 | 0.17 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 0.0 | 3.0 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.4 | 4.8 | inches |

| Grate Analysis (Calculated) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |

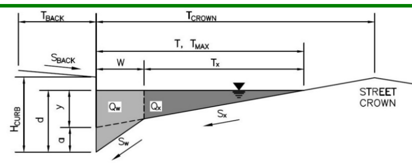
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Equivalent Slope $S_e$ | $S_e$ = | 0.188 | 0.183 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 1.79 | 3.19 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 1.79 | 3.19 | ft |
| Interception Capacity | $Q_i$ = | 0.2 | 0.5 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 1.79 | 3.19 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.2** | **0.5** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |

| Summary | | MINOR | MAJOR | |
|---|---|---|---|---|
| Total Inlet Interception Capacity | **Q =** | **0.2** | **0.5** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **100** | **%** |

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

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

**Project:**
**Inlet ID:** **IN-2+64**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 33.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.011 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.022 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

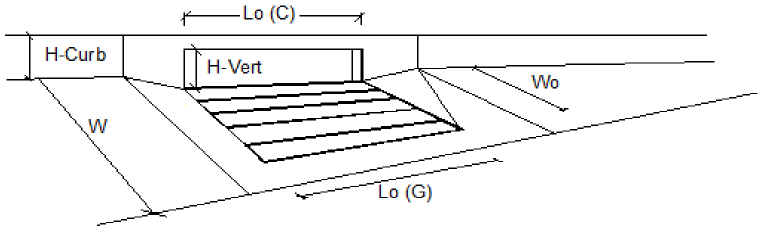
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 23.0 | 33.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **13.1** | **32.9** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.55 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'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

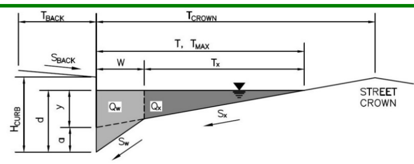



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| **Design Information (Input)** CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.6 | 1.2 | cfs |
| Water Spread Width | T = | 4.3 | 7.7 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.8 | 2.3 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.953 | 0.756 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.3 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.5 | 0.9 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.18 | 0.25 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 3.0 | 3.6 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.8 | 5.3 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.179 | 0.144 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.32 | 5.45 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.32 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.6 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.32 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.6** | **1.1** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.6** | **1.1** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **96** | **%** |

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

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

**Project:**
**Inlet ID: IN-2+84**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 33.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.018 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

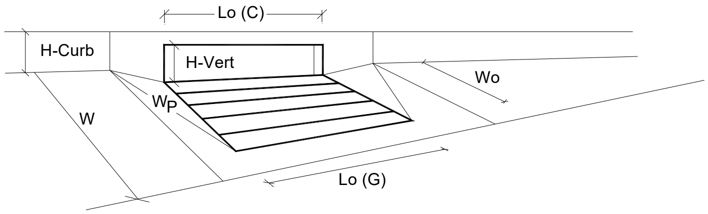
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 23.0 | 33.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

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 5.03 (August 2023)*



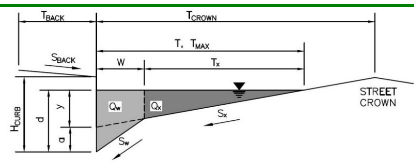

| | | | | | |
|---|---|---|---|---|---|
| Design Information (Input) | CDOT Type R Curb Opening | | MINOR | MAJOR | |
| Type of Inlet | | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | | Ponding Depth = | 6.0 | 6.0 | inches |
| Grate Information | | | MINOR | MAJOR | ☐ Override Depths |
| Length of a Unit Grate | | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | | $W_o$ = | N/A | N/A | feet |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | | $C_o$ (G) = | N/A | N/A | |
| Curb Opening Information | | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat | | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | | $C_o$ (C) = | 0.67 | 0.67 | |

| | | | | |
|---|---|---|---|---|
| Grate Flow Analysis (Calculated) | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | N/A | N/A | |
| Clogging Factor for Multiple Units | Clog = | N/A | N/A | |
| Grate Capacity as a Weir (based on 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 |
| Grate 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 |
| Grate Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | N/A | N/A | cfs |
| Interception with Clogging | $Q_{ma}$ = | N/A | N/A | cfs |
| Resulting Grate Capacity (assumes clogged condition) | **$Q_{Grate}$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening Flow Analysis (Calculated) | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | 1.00 | 1.00 | |
| Clogging Factor for Multiple Units | Clog = | 0.10 | 0.10 | |
| Curb Capacity as a Weir (based on MHFD - CSU 2010 Study) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{wi}$ = | 7.1 | 7.1 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 6.4 | 6.4 | cfs |
| Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{oi}$ = | 9.8 | 9.8 | cfs |
| Interception with Clogging | $Q_{oa}$ = | 8.8 | 8.8 | cfs |
| Curb Opening Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | 7.7 | 7.7 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 7.0 | 7.0 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **6.4** | **6.4** | **cfs** |
| Resultant Street Conditions | | MINOR | MAJOR | |
| Total Inlet Length | L = | 5.00 | 5.00 | feet |
| Resultant Street Flow Spread (based on street geometry from above) | T = | 22.8 | 22.8 | ft |
| Resultant Flow Depth at Street Crown | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Low Head Performance Reduction (Calculated) | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.38 | 0.38 | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | N/A | N/A | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | N/A | N/A | |
| | | MINOR | MAJOR | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **6.4** | **6.4** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)** | $Q_{PEAK\ REQUIRED}$ = | 0.9 | 2.0 | cfs |

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

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

**Project:**
**Inlet ID: IN-3+47**




Gutter Geometry:

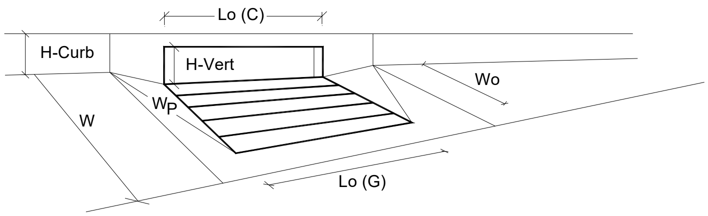
| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.014 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | $T_{MAX}$ = | 15.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Check boxes are not applicable in SUMP conditions | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is not applicable to Sump Condition<br>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 5.03 (August 2023)*




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) — CDOT Type R Curb Opening | | | | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | $a_{local}$ = | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | No = | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | Ponding Depth = | 3.7 | 5.4 | inches |
| Grate Information | | MINOR | MAJOR | Override Depths |
| Length of a Unit Grate | $L_o$ (G) = | N/A | N/A | feet |
| Width of a Unit Grate | $W_o$ = | N/A | N/A | feet |
| Open Area Ratio for a Grate (typical values 0.15-0.90) | $A_{ratio}$ = | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | $C_f$ (G) = | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | $C_w$ (G) = | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | $C_o$ (G) = | N/A | N/A | |
| Curb Opening Information | | MINOR | MAJOR | |
| Length of a Unit Curb Opening | $L_o$ (C) = | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | $H_{vert}$ = | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | $H_{throat}$ = | 6.00 | 6.00 | inches |
| Angle of Throat | Theta = | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | $W_p$ = | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | $C_f$ (C) = | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | $C_w$ (C) = | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | $C_o$ (C) = | 0.67 | 0.67 | |
| Grate Flow Analysis (Calculated) | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | N/A | N/A | |
| Clogging Factor for Multiple Units | Clog = | N/A | N/A | |
| Grate Capacity as a Weir (based on 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 |
| Grate 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 |
| Grate Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | N/A | N/A | cfs |
| Interception with Clogging | $Q_{ma}$ = | N/A | N/A | cfs |
| Resulting Grate Capacity (assumes clogged condition) | **$Q_{Grate}$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening Flow Analysis (Calculated) | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple Units | Coef = | 1.00 | 1.00 | |
| Clogging Factor for Multiple Units | Clog = | 0.10 | 0.10 | |
| Curb Capacity as a Weir (based on MHFD - CSU 2010 Study) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{wi}$ = | 2.4 | 5.7 | cfs |
| Interception with Clogging | $Q_{wa}$ = | 2.2 | 5.1 | cfs |
| Curb Capacity as an Orifice (based on MHFD - CSU 2010 Study) | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{oi}$ = | 7.8 | 9.2 | cfs |
| Interception with Clogging | $Q_{oa}$ = | 7.0 | 8.3 | cfs |
| Curb Opening Capacity as Mixed Flow | | MINOR | MAJOR | |
| Interception without Clogging | $Q_{mi}$ = | 4.0 | 6.7 | cfs |
| Interception with Clogging | $Q_{ma}$ = | 3.6 | 6.1 | cfs |
| Resulting Curb Opening Capacity (assumes clogged condition) | **$Q_{Curb}$ =** | **2.2** | **5.1** | **cfs** |
| Resultant Street Conditions | | MINOR | MAJOR | |
| Total Inlet Length | L = | 5.00 | 5.00 | feet |
| Resultant Street Flow Spread (based on street geometry from above) | T = | 15.0 | 25.0 | ft |
| Resultant Flow Depth at Street Crown | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Low Head Performance Reduction (Calculated) | | MINOR | MAJOR | |
| Depth for Grate Midwidth | $d_{Grate}$ = | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | $d_{Curb}$ = | 0.18 | 0.32 | ft |
| Grated Inlet Performance Reduction Factor for Long Inlets | $RF_{Grate}$ = | N/A | N/A | |
| Curb Opening Performance Reduction Factor for Long Inlets | $RF_{Curb}$ = | 1.00 | 1.00 | |
| Combination Inlet Performance Reduction Factor for Long Inlets | $RF_{Combination}$ = | N/A | N/A | |
| | | MINOR | MAJOR | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **2.2** | **5.1** | **cfs** |
| **Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)** | $Q_{PEAK\ REQUIRED}$ = | 2.2 | 4.9 | cfs |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-0+16 | IN-0+18 | IN-0+37 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 2.14 | 1.37 | 1.24 |
| Major $Q_{Known}$ (cfs) | 4.68 | 2.98 | 2.71 |

**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 | IN-0+18 |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.1 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.2 | 1.2 |

**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)** | **2.1** | **1.4** | **1.3** |
| **Major Total Design Peak Flow, Q (cfs)** | **4.7** | **3.2** | **3.9** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.5 | 0.1 | 0.1 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 2.3 | 1.2 | 1.8 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-0+38 | IN-1+11 | IN-0+82 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.68 | 0.90 | 0.54 |
| Major $Q_{Known}$ (cfs) | 1.48 | 1.96 | 1.17 |

**Bypass (Carry-Over) Flow from Upstream**

| | | | |
|---|---|---|---|
| Receive Bypass Flow from: | IN-0+16 | User-Defined | User-Defined |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.5 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 2.3 | 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)** | **1.1** | **0.9** | **0.5** |
| **Major Total Design Peak Flow, Q (cfs)** | **3.8** | **2.0** | **1.2** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 1.7 | 0.4 | 0.2 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-0+88 | IN-1+10 |
|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN |
| Inlet Application (Street or Area) | STREET | STREET |
| Hydraulic Condition | On Grade | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | |
|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.87 | 0.56 |
| Major $Q_{Known}$ (cfs) | 1.90 | 1.23 |

**Bypass (Carry-Over) Flow from Upstream**

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

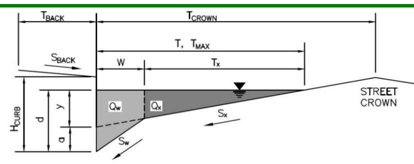
## CALCULATED OUTPUT

| | | |
|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **0.9** | **0.6** |
| **Major Total Design Peak Flow, Q (cfs)** | **1.9** | **1.2** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 0.0 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.5 | 0.2 |

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

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

**Project:**
**Inlet ID: IN-0+16**




<u>Gutter Geometry:</u>

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.001 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

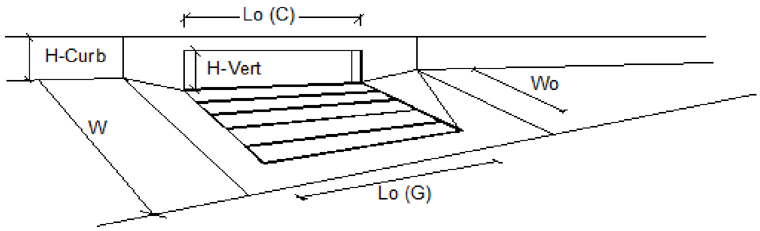
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 8.0 | 18.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **0.5** | **3.8** | **cfs** |

**WARNING: MINOR STORM max. allowable capacity is less than the design peak flow of 2.14 cfs on sheet 'Inlet Management'**
**WARNING: MAJOR STORM max. allowable capacity is less than the design peak flow of 4.06 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




CDOT Type R Curb Opening

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MINOR & MAJOR STORM** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 2.1 | 4.7 | cfs |
| Water Spread Width | T = | 14.3 | 18.0 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 4.4 | 5.4 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.1 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.390 | 0.396 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 1.3 | 2.8 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.8 | 1.9 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.62 | 0.78 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 1.4 | 2.4 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 7.4 | 8.4 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.085 | 0.086 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 7.80 | 11.78 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 5.00 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 1.8 | 2.6 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **1.7** | **2.4** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.5** | **1.7** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **1.7** | **2.4** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.5** | **2.3** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **79** | **50** | **%** |

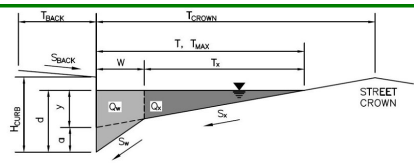
*MHFD-Inlet, Version 5.03 (August 2023)*

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

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

**Project:**

**Inlet ID: IN-0+18**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 64.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.014 | 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 | $T_{MAX}$ = | 22.0 | 64.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

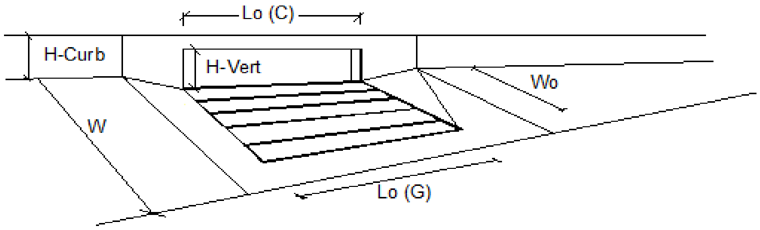
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **8.4** | **12.6** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.37 cfs on sheet 'Inlet Management'**

**Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.79 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



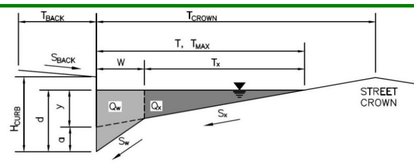

CDOT Type R Curb Opening

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 1.4 | 3.2 | cfs |
| Water Spread Width | T = | 9.9 | 13.8 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 3.3 | 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 | $E_o$ = | 0.641 | 0.539 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.5 | 1.5 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.9 | 1.7 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.39 | 0.50 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.3 | 3.4 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 6.3 | 7.0 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o-GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.138 | 0.119 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 5.46 | 8.87 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 5.00 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 1.4 | 2.2 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **1.3** | **2.0** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.1** | **0.8** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **1.3** | **2.0** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.1** | **1.2** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **96** | **63** | **%** |

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

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

**Project:**
**Inlet ID: IN-0+37**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 44.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.017 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

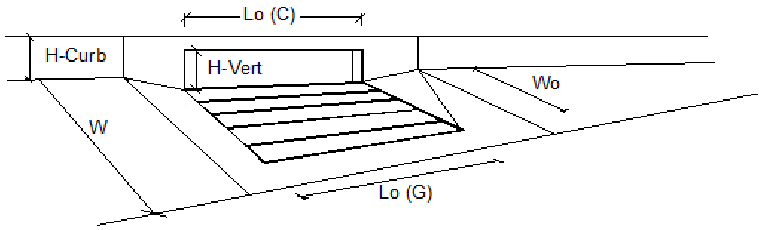
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 32.0 | 44.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **27.8** | **27.8** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.30 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.13 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



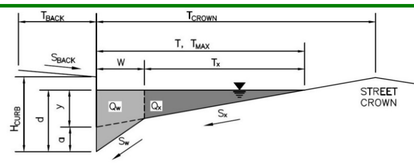

CDOT Type R Curb Opening

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 1.3 | 3.9 | cfs |
| Water Spread Width | T = | 6.4 | 9.8 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.4 | 3.1 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.776 | 0.652 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.3 | 1.3 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 1.0 | 2.5 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.28 | 0.39 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 3.7 | 6.4 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.4 | 6.1 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.150 | 0.129 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 5.56 | 9.85 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 5.00 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 1.3 | 2.3 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **1.2** | **2.1** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.1** | **1.0** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **1.2** | **2.1** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.1** | **1.8** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **95** | **54** | **%** |

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

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

**Project:**
**Inlet ID:** **IN-0+38**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 24.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.028 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

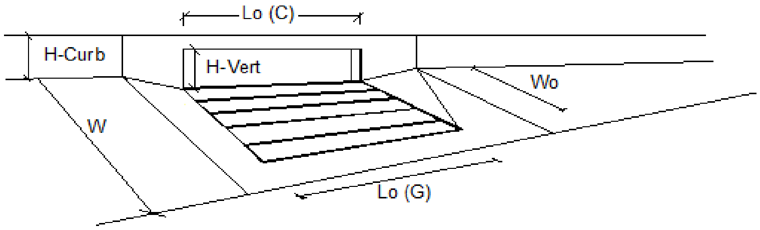
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 14.0 | 24.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **12.4** | **15.8** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.14 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.00 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




CDOT Type R Curb Opening

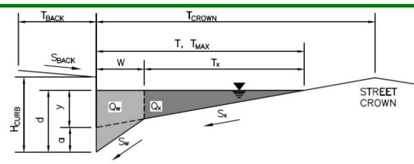
| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 1.1 | 3.8 | cfs |
| Water Spread Width | T = | 5.1 | 7.9 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.5 | 3.5 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.813 | 0.692 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.2 | 1.2 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.9 | 2.6 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.30 | 0.46 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 3.1 | 5.8 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.5 | 6.5 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.158 | 0.138 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 4.94 | 9.01 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 4.94 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 1.1 | 2.3 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.50 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **1.1** | **2.1** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.9** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **1.1** | **2.1** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **1.7** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **99** | **56** | **%** |

MHFD-Inlet, Version 5.03 (August 2023)

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

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

**Project:**
**Inlet ID:** **IN-1+11**



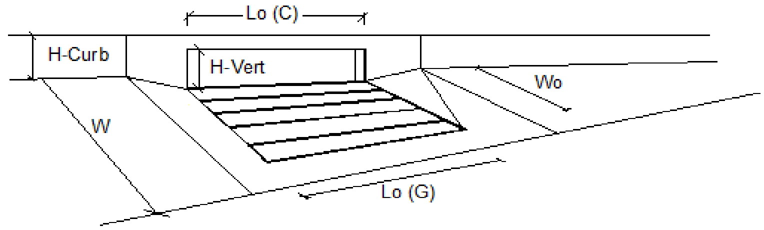

Gutter Geometry:

| | | | | |
|---|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | | 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 | $T_{CROWN}$ = | 27.0 | | ft |
| Gutter Width | W = | 2.00 | | ft |
| Street Transverse Slope | $S_X$ = | 0.017 | | 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 | $S_O$ = | 0.012 | | 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 | $T_{MAX}$ = | 8.0 | 16.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |
| | | Minor Storm | Major Storm | |
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **1.8** | **8.0** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.90 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.70 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



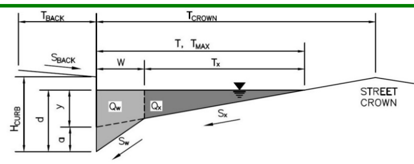

CDOT Type R Curb Opening

| | | | | |
|---|---|---|---|---|
| **Design Information (Input)** | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.9 | 2.0 | cfs |
| Water Spread Width | T = | 5.2 | 7.8 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.7 | 3.2 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.891 | 0.762 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.1 | 0.5 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.8 | 1.5 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.28 | 0.36 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.9 | 4.1 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.7 | 6.2 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.187 | 0.163 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 4.04 | 6.08 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 4.04 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.9 | 1.6 | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.04 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.9** | **1.6** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.9** | **1.6** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.4** | **cfs** |
| Capture Percentage = $Q_a/Q_o$ | **C% =** | **100** | **79** | **%** |

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

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

**Project:**
**Inlet ID: IN-0+82**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | ft/ft |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK}$ = | 0.020 | |
| Height of Curb at Gutter Flow Line | $H_{CURB}$ = | 6.00 | inches |
| Distance from Curb Face to Street Crown | $T_{CROWN}$ = | 16.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.018 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

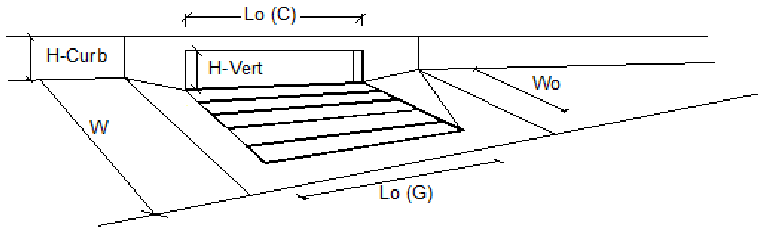
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 6.0 | 8.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion<br>MAJOR STORM Allowable Capacity is based on Spread Criterion | **$Q_{allow}$ =** | **1.2** | **2.0** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.54 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.01 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*



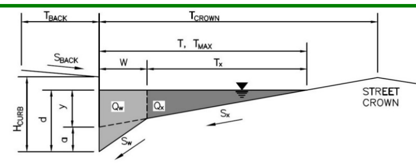

CDOT Type R Curb Opening

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.5 | 1.2 | cfs |
| Water Spread Width | T = | 3.7 | 5.6 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 1.9 | 2.3 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.956 | 0.852 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.0 | 0.2 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.5 | 1.0 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.19 | 0.25 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.8 | 3.9 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 4.9 | 5.3 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.180 | 0.162 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.24 | 4.73 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.24 | 4.73 | ft |
| Interception Capacity | $Q_i$ = | 0.5 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.24 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.5** | **1.0** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.5** | **1.0** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.2** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **86** | **%** |

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

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

**Project:**
**Inlet ID: IN-0+88**




<u>Gutter Geometry:</u>

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 25.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.019 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | 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 | |

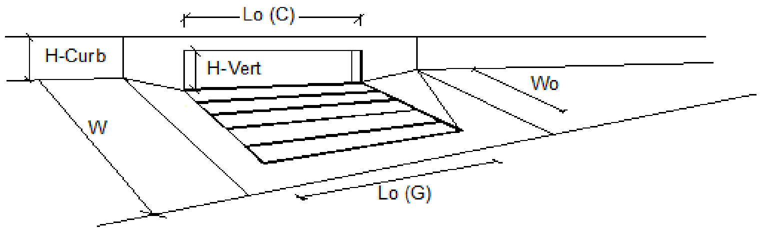
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 14.0 | 25.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion<br>MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **4.2** | **12.9** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.87 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.65 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




CDOT Type R Curb Opening

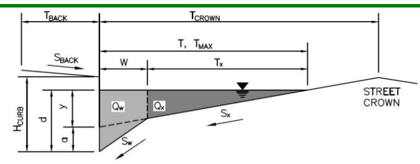
| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Design Information (Input) | | MINOR | MAJOR | |
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity' | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.9 | 1.9 | cfs |
| Water Spread Width | T = | 7.0 | 9.4 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.6 | 3.2 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.717 | 0.630 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.2 | 0.7 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.6 | 1.2 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.32 | 0.41 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.0 | 2.9 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.6 | 6.2 | inches |
| Grate Analysis (Calculated) | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| Curb Opening or Slotted Inlet Analysis (Calculated) | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.140 | 0.125 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 4.31 | 6.52 | ft |
| Under No-Clogging Condition | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 4.31 | 5.00 | ft |
| Interception Capacity | $Q_i$ = | 0.9 | 1.5 | cfs |
| Under Clogging Condition | | MINOR | MAJOR | |
| Clogging Coefficient | CurbCoeff = | 1.00 | 1.00 | |
| Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet | CurbClog = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 4.31 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.9** | **1.4** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.2** | **cfs** |
| Summary | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.9** | **1.4** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.5** | **cfs** |
| Capture Percentage = $Q_a$/$Q_o$ | **C% =** | **100** | **76** | **%** |

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

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

**Project:**

**Inlet ID:** **IN-1+10**




Gutter Geometry:

| | | | |
|---|---|---|---|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK}$ = | | ft |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK}$ = | | 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 | $T_{CROWN}$ = | 22.0 | ft |
| Gutter Width | W = | 2.00 | ft |
| Street Transverse Slope | $S_X$ = | 0.019 | ft/ft |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_W$ = | 0.063 | ft/ft |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_O$ = | 0.009 | ft/ft |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET}$ = | 0.016 | |

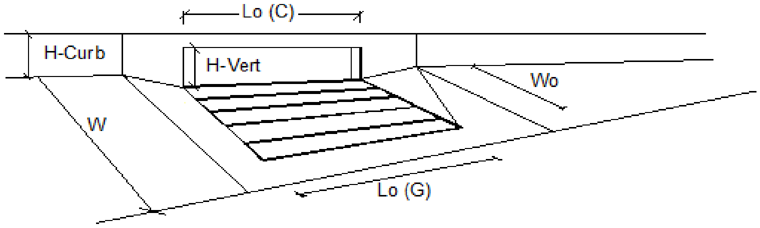
| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Max. Allowable Spread for Minor & Major Storm | $T_{MAX}$ = | 12.0 | 22.0 | ft |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | $d_{MAX}$ = | 6.0 | 6.0 | inches |
| Allow Flow Depth at Street Crown (check box for yes, leave blank for no) | | ☐ | ☐ | |

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | **$Q_{allow}$ =** | **3.9** | **17.3** | **cfs** |

**Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.56 cfs on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.06 cfs on sheet 'Inlet Management'**

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*




CDOT Type R Curb Opening

| Design Information (Input) | | MINOR | MAJOR | |
|---|---|---|---|---|
| Type of Inlet | Type = | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | $a_{LOCAL}$ = | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | No = | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | $L_o$ = | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | $W_o$ = | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | $C_f$ (G) = | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | $C_f$ (C) = | 0.10 | 0.10 | |
| **Street Hydraulics: OK - Q < Allowable Street Capacity'** | | MINOR | MAJOR | |
| Design Discharge for Half of Street (from *Inlet Management*) | $Q_o$ = | 0.6 | 1.2 | cfs |
| Water Spread Width | T = | 4.7 | 6.7 | ft |
| Water Depth at Flowline (outside of local depression) | d = | 2.1 | 2.6 | inches |
| Water Depth at Street Crown (or at $T_{MAX}$) | $d_{CROWN}$ = | 0.0 | 0.0 | inches |
| Ratio of Gutter Flow to Design Flow | $E_o$ = | 0.888 | 0.776 | |
| Discharge outside the Gutter Section W, carried in Section $T_x$ | $Q_x$ = | 0.1 | 0.3 | cfs |
| Discharge within the Gutter Section W | $Q_w$ = | 0.5 | 1.0 | cfs |
| Discharge Behind the Curb Face | $Q_{BACK}$ = | 0.0 | 0.0 | cfs |
| Flow Area within the Gutter Section W | $A_W$ = | 0.23 | 0.30 | sq ft |
| Velocity within the Gutter Section W | $V_W$ = | 2.2 | 3.2 | fps |
| Water Depth for Design Condition | $d_{LOCAL}$ = | 5.1 | 5.6 | inches |
| **Grate Analysis (Calculated)** | | MINOR | MAJOR | |
| Total Length of Inlet Grate Opening | L = | N/A | N/A | ft |
| Ratio of Grate Flow to Design Flow | $E_{o\text{-}GRATE}$ = | N/A | N/A | |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Interception Capacity | $Q_i$ = | N/A | N/A | cfs |
| **Under Clogging Condition** | | MINOR | MAJOR | |
| Clogging Coefficient for Multiple-unit Grate Inlet | GrateCoeff = | N/A | N/A | |
| Clogging Factor for Multiple-unit Grate Inlet | GrateClog = | N/A | N/A | |
| Effective (unclogged) Length of Multiple-unit Grate Inlet | $L_e$ = | N/A | N/A | ft |
| Minimum Velocity Where Grate Splash-Over Begins | $V_o$ = | N/A | N/A | fps |
| Interception Rate of Frontal Flow | $R_f$ = | N/A | N/A | |
| Interception Rate of Side Flow | $R_x$ = | N/A | N/A | |
| Actual Interception Capacity | **$Q_a$ =** | **N/A** | **N/A** | **cfs** |
| Carry-Over Flow = $Q_o$-$Q_a$ (to be applied to curb opening or next d/s inlet) | **$Q_b$ =** | **N/A** | **N/A** | **cfs** |
| **Curb Opening or Slotted Inlet Analysis (Calculated)** | | MINOR | MAJOR | |
| Equivalent Slope $S_e$ | $S_e$ = | 0.169 | 0.150 | ft/ft |
| Required Length $L_T$ to Have 100% Interception | $L_T$ = | 3.27 | 4.87 | ft |
| **Under No-Clogging Condition** | | MINOR | MAJOR | |
| Effective Length of Curb Opening or Slotted Inlet (minimum of L, $L_T$) | L = | 3.27 | 4.87 | ft |
| Interception Capacity | $Q_i$ = | 0.6 | 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 = | 0.10 | 0.10 | |
| Effective (Unclogged) Length | $L_e$ = | 3.27 | 4.50 | ft |
| Actual Interception Capacity | **$Q_a$ =** | **0.6** | **1.0** | **cfs** |
| Carry-Over Flow = $Q_{b(GRATE)}$-$Q_a$ | **$Q_b$ =** | **0.0** | **0.0** | **cfs** |
| **Summary** | | MINOR | MAJOR | |
| Total Inlet Interception Capacity | **Q =** | **0.6** | **1.0** | **cfs** |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | **$Q_b$ =** | **0.0** | **0.2** | **cfs** |
| Capture Percentage = $Q_a/Q_o$ | **C% =** | **100** | **85** | **%** |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-1+26 | IN-0+25 | IN-3+11 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | AREA | AREA | AREA |
| Hydraulic Condition | Swale | Swale | Swale |
| Inlet Type | CDOT Type C | CDOT Type C | CDOT Type C |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 0.06 | 4.92 | 3.43 |
| Major $Q_{Known}$ (cfs) | 0.42 | 11.94 | 10.49 |

**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 |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 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)** | **0.1** | **4.9** | **3.4** |
| **Major Total Design Peak Flow, Q (cfs)** | **0.4** | **11.9** | **10.5** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 0.0 | 3.9 | 2.9 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 0.1 | 10.2 | 9.5 |

*MHFD-Inlet, Version 5.03 (August 2023)*

# INLET MANAGEMENT

Worksheet Protected

| **INLET NAME** | IN-3+43 | IN-6+51 | IN-7+07 |
|---|---|---|---|
| Site Type (Urban or Rural) | URBAN | URBAN | URBAN |
| Inlet Application (Street or Area) | AREA | AREA | AREA |
| Hydraulic Condition | Swale | Swale | Swale |
| Inlet Type | CDOT Type C | CDOT Type C | CDOT Type C |

## USER-DEFINED INPUT

**User-Defined Design Flows**

| | | | |
|---|---|---|---|
| Minor $Q_{Known}$ (cfs) | 1.74 | 2.36 | 11.18 |
| Major $Q_{Known}$ (cfs) | 5.26 | 6.40 | 52.91 |

**Bypass (Carry-Over) Flow from Upstream**

| | | | |
|---|---|---|---|
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received | No Bypass Flow Received |
| Minor Bypass Flow Received, $Q_b$ (cfs) | 0.0 | 0.0 | 0.0 |
| Major Bypass Flow Received, $Q_b$ (cfs) | 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**

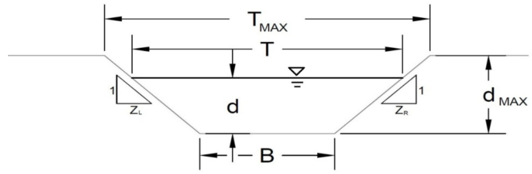
| | | | |
|---|---|---|---|
| Design Storm Return Period, $T_r$ (years) | | | |
| One-Hour Precipitation, $P_1$ (inches) | | | |

## CALCULATED OUTPUT

| | | | |
|---|---|---|---|
| **Minor Total Design Peak Flow, Q (cfs)** | **1.7** | **2.4** | **11.2** |
| **Major Total Design Peak Flow, Q (cfs)** | **5.3** | **6.4** | **52.9** |
| Minor Flow Bypassed Downstream, $Q_b$ (cfs) | 1.1 | 1.6 | 10.1 |
| Major Flow Bypassed Downstream, $Q_b$ (cfs) | 3.9 | 4.7 | 51.2 |

# AREA INLET IN A SWALE

**IN-1+26**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 2.9500 | ft/ft |
| Bottom Width | B = | 4.00 | ft |
| Left Side Slope | Z1 = | 14.00 | ft/ft |
| Right Side Sloe | Z2 = | 10.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ Non-Cohesive
- ☐ Cohesive
- ☐ Paved

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **28.00** | **28.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **0.25** | **0.25** | **ft** |

## Maximum Channel Capacity Based On Allowable Top Width

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width | $T_{MAX}$ = | **28.00** | **28.00** | **ft** |
| Water Depth | d = | 1.00 | 1.00 | ft |
| Flow Area | A = | 16.00 | 16.00 | sq ft |
| Wetted Perimeter | P = | 28.09 | 28.09 | ft |
| Hydraulic Radius | R = | 0.57 | 0.57 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.062 | 0.062 | |
| Flow Velocity | V = | 28.20 | 28.20 | fps |
| Velocity-Depth Product | VR = | 16.07 | 16.07 | ft^2/s |
| Hydraulic Depth | D = | 0.57 | 0.57 | ft |
| Froude Number | Fr = | 6.57 | 6.57 | |
| Maximum Flow Based on Allowable Water Depth | $Q_T$ = | **451.2** | **451.2** | **cfs** |

## Maximum Channel Capacity Based On Allowable Water Depth

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Water Depth | $d_{MAX}$ = | **0.25** | **0.25** | **ft** |
| Top Width | T = | 10.00 | 10.00 | ft |
| Flow Area | A = | 1.75 | 1.75 | sq ft |
| Wetted Perimeter | P = | 10.02 | 10.02 | ft |
| Hydraulic Radius | R = | 0.17 | 0.17 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.368 | 0.368 | |
| Flow Velocity | V = | 2.17 | 2.17 | fps |
| Velocity-Depth Product | VR = | 0.38 | 0.38 | ft^2/s |
| Hydraulic Depth | D = | 0.18 | 0.18 | ft |
| Froude Number | Fr = | 0.92 | 0.92 | |
| Maximum Flow Based On Allowable Water Depth | $Q_d$ = | **3.8** | **3.8** | **cfs** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Depth Criterion | $Q_{allow}$ = | **3.8** | **3.8** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | $d_{allow}$ = | **0.25** | **0.25** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | | | |
|---|---|---|---|---|---|
| | Design Peak Flow | $Q_o$ = | **0.1** | **0.4** | **cfs** |
| | Water Depth | **d =** | **0.02** | **0.06** | **ft** |
| | Top Width | T = | 4.50 | 5.55 | ft |
| | Flow Area | A = | 0.09 | 0.31 | sq ft |
| | Wetted Perimeter | P = | 4.50 | 5.56 | ft |
| | Hydraulic Radius | R = | 0.02 | 0.06 | ft |
| | Manning's n based on NRCS Vegetal Retardance | n = | 0.275 | 0.275 | |
| **Warning 03** | Flow Velocity | V = | 0.68 | 1.36 | fps |
| | Velocity-Depth Product | VR = | 0.01 | 0.08 | ft^2/s |
| | Hydraulic Depth | D = | 0.02 | 0.06 | ft |
| **Warning 04** | Froude Number | Fr = | 0.85 | 1.01 | |

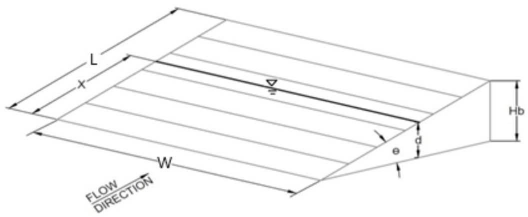
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**IN-1+26**

Inlet Design Information (Input)

| | | | | |
|---|---|---|---|---|
| Type of Inlet | CDOT Type C | Inlet Type = | CDOT Type C | |
| Angle of Inclined Grate (must be <= 30 degrees) | | θ = | 0.00 | degrees |
| Width of Grate | | W = | 3.00 | ft |
| Length of Grate | | L = | 3.00 | ft |
| Open Area Ratio | | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | | $H_B$ = | 0.00 | ft |
| Clogging Factor | | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | | $C_d$ = | 0.96 | |
| Orifice Coefficient | | $C_o$ = | 0.64 | |
| Weir Coefficient | | $C_w$ = | 2.05 | |

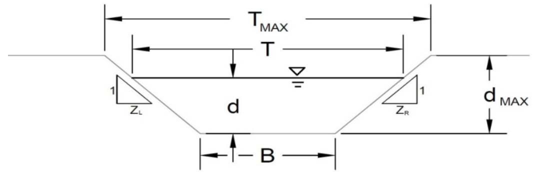



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.02 | 0.06 | |
| Grate Capacity as a Weir | | | | |
| Submerged Side Weir Length | X = | 3.00 | 3.00 | ft |
| Inclined Side Weir Flow | $Q_{ws}$ = | 0.0 | 0.2 | cfs |
| Base Weir Flow | $Q_{wb}$ = | 0.0 | 0.3 | cfs |
| Interception Without Cloggging | $Q_{wi}$ = | 0.1 | 0.6 | cfs |
| Interception With Clogging | $Q_{wa}$ = | 0.1 | 0.3 | cfs |
| Grate Capacity as an Orifice | | | | |
| Interception Without Clogging | $Q_{oi}$ = | 4.7 | 8.2 | cfs |
| Interception With Clogging | $Q_{oa}$ = | 2.3 | 4.1 | cfs |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **0.1** | **0.3** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **0.0** | **0.1** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **93** | **73** | **%** |

**Warning 03: Velocity exceeds USDCM Volume I recommendation.**
**Warning 04: Froude No. exceeds USDCM Volume I recommendation.**

# AREA INLET IN A SWALE

**IN-0+25**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 23.7500 | ft/ft |
| Bottom Width | B = | 4.00 | ft |
| Left Side Slope | Z1 = | 23.75 | ft/ft |
| Right Side Sloe | Z2 = | 28.09 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **14.00** | **14.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **0.90** | **0.90** | **ft** |

## Maximum Channel Capacity Based On Allowable Top Width

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width | $T_{MAX}$ = | **14.00** | **14.00** | **ft** |
| Water Depth | d = | 0.19 | 0.19 | ft |
| Flow Area | A = | 1.74 | 1.74 | sq ft |
| Wetted Perimeter | P = | 14.01 | 14.01 | ft |
| Hydraulic Radius | R = | 0.12 | 0.12 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.345 | 0.345 | |
| Flow Velocity | V = | 5.23 | 5.23 | fps |
| Velocity-Depth Product | VR = | 0.65 | 0.65 | ft^2/s |
| Hydraulic Depth | D = | 0.12 | 0.12 | ft |
| Froude Number | Fr = | 2.62 | 2.62 | |
| Maximum Flow Based on Allowable Water Depth | $Q_T$ = | **9.1** | **9.1** | **cfs** |

## Maximum Channel Capacity Based On Allowable Water Depth

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Water Depth | $d_{MAX}$ = | **0.90** | **0.90** | **ft** |
| Top Width | T = | 50.66 | 50.66 | ft |
| Flow Area | A = | 24.60 | 24.60 | sq ft |
| Wetted Perimeter | P = | 50.69 | 50.69 | ft |
| Hydraulic Radius | R = | 0.49 | 0.49 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 74.73 | 74.73 | fps |
| Velocity-Depth Product | VR = | 36.26 | 36.26 | ft^2/s |
| Hydraulic Depth | D = | 0.49 | 0.49 | ft |
| Froude Number | Fr = | 18.90 | 18.90 | |
| Maximum Flow Based On Allowable Water Depth | $Q_d$ = | **1,837.9** | **1,837.9** | **cfs** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | **9.1** | **9.1** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | $d_{allow}$ = | **0.19** | **0.19** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | Minor Storm | Major Storm | |
|---|---|---|---|---|---|
| | Design Peak Flow | $Q_o$ = | **4.9** | **11.9** | **cfs** |
| | Water Depth | **d =** | **0.15** | **0.21** | **ft** |
| **Warning 06** | Top Width | T = | 11.69 | 14.89 | ft |
| | Flow Area | A = | 1.16 | 1.98 | sq ft |
| | Wetted Perimeter | P = | 11.70 | 14.90 | ft |
| | Hydraulic Radius | R = | 0.10 | 0.13 | ft |
| | Manning's n based on NRCS Vegetal Retardance | n = | 0.369 | 0.315 | |
| **Warning 03** | Flow Velocity | V = | 4.22 | 6.02 | fps |
| | Velocity-Depth Product | VR = | 0.42 | 0.80 | ft^2/s |
| | Hydraulic Depth | D = | 0.10 | 0.13 | ft |
| **Warning 04** | Froude Number | Fr = | 2.36 | 2.90 | |

**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'**

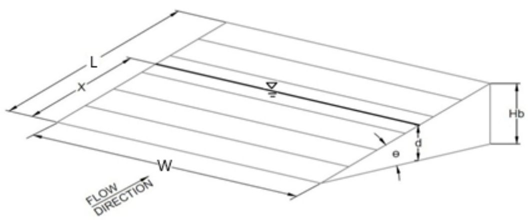
# AREA INLET IN A SWALE

**IN-0+25**

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C

| | | | | |
|---|---|---|---|---|
| Angle of Inclined Grate (must be <= 30 degrees) | $\theta$ = | 0.00 | | degrees |
| Width of Grate | W = | 3.00 | | ft |
| Length of Grate | L = | 3.00 | | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | | |
| Height of Inclined Grate | $H_B$ = | 0.00 | | ft |
| Clogging Factor | $C_f$ = | 0.50 | | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | | |
| Orifice Coefficient | $C_o$ = | 0.64 | | |
| Weir Coefficient | $C_w$ = | 2.05 | | |



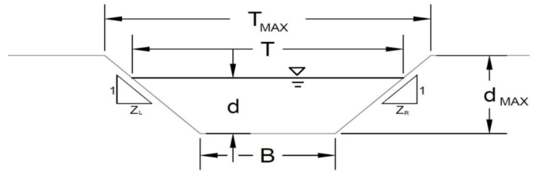

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.15 | 0.21 | |
| **Grate Capacity as a Weir** | | | | |
| Submerged Side Weir Length | X = | 3.00 | 3.00 | ft |
| Inclined Side Weir Flow | $Q_{ws}$ = | 0.6 | 1.0 | cfs |
| Base Weir Flow | $Q_{wb}$ = | 0.9 | 1.5 | cfs |
| Interception Without Cloggging | $Q_{wi}$ = | 2.1 | 3.6 | cfs |
| Interception With Clogging | $Q_{wa}$ = | 1.1 | 1.8 | cfs |
| **Grate Capacity as an Orifice** | | | | |
| Interception Without Clogging | $Q_{oi}$ = | 12.5 | 14.8 | cfs |
| Interception With Clogging | $Q_{oa}$ = | 6.2 | 7.4 | cfs |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **1.1** | **1.8** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **3.9** | **10.2** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **21** | **15** | **%** |

**Warning 03: Velocity exceeds USDCM Volume I recommendation.**
**Warning 04: Froude No. exceeds USDCM Volume I recommendation.**

**Warning 06: Top Width (T) exceeds max allowable top width (Tmax).**

# AREA INLET IN A SWALE

**IN-3+11**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 85.4700 | ft/ft |
| Bottom Width | B = | 4.00 | ft |
| Left Side Slope | Z1 = | 6.19 | ft/ft |
| Right Side Sloe | Z2 = | 34.60 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **20.00** | **20.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **0.68** | **0.68** | **ft** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | **411.4** | **411.4** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | $d_{allow}$ = | **0.39** | **0.39** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | | |
|---|---|---|---|---|
| Design Peak Flow | $Q_o$ = | **3.4** | **10.5** | **cfs** |
| Water Depth | d = | **0.09** | **0.14** | **ft** |

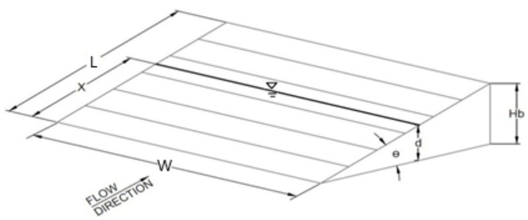
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**IN-3+11**

Inlet Design Information (Input)

| | | | |
|---|---|---|---|
| Type of Inlet | CDOT Type C | Inlet Type = | CDOT Type C |
| Angle of Inclined Grate (must be <= 30 degrees) | θ = | 0.00 | degrees |
| Width of Grate | W = | 3.00 | ft |
| Length of Grate | L = | 3.00 | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | $H_B$ = | 0.00 | ft |
| Clogging Factor | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | |
| Orifice Coefficient | $C_o$ = | 0.64 | |
| Weir Coefficient | $C_w$ = | 2.05 | |

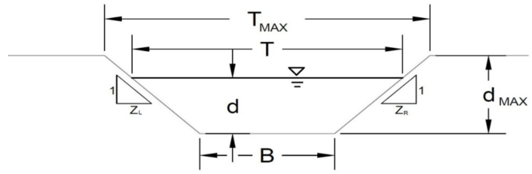



| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.09 | 0.14 | |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **0.5** | **1.0** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **2.9** | **9.5** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **15** | **9** | **%** |

**Warning 03: Velocity exceeds USDCM Volume I recommendation.**
**Warning 04: Froude No. exceeds USDCM Volume I recommendation.**

# AREA INLET IN A SWALE

**IN-3+43**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | | |
|---|---|---|---|---|
| | NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| | Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| | Channel Invert Slope | $S_O$ = | 18.7600 | ft/ft |
| | Bottom Width | B = | 4.00 | ft |
| **Warning 01** | Left Side Slope | Z1 = | 3.65 | ft/ft |
| **Warning 01** | Right Side Sloe | Z2 = | 3.50 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- ☐ **Non-Cohesive**
- ☐ **Cohesive**
- ☐ **Paved**

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **23.00** | **23.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **2.70** | **2.70** | **ft** |

## Maximum Channel Capacity Based On Allowable Top Width

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width | $T_{MAX}$ = | **23.00** | **23.00** | **ft** |
| Water Depth | d = | 2.66 | 2.66 | ft |
| Flow Area | A = | 35.87 | 35.87 | sq ft |
| Wetted Perimeter | P = | 23.73 | 23.73 | ft |
| Hydraulic Radius | R = | 1.51 | 1.51 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 141.68 | 141.68 | fps |
| Velocity-Depth Product | VR = | 214.19 | 214.19 | ft^2/s |
| Hydraulic Depth | D = | 1.56 | 1.56 | ft |
| Froude Number | Fr = | 19.99 | 19.99 | |
| Maximum Flow Based on Allowable Water Depth | $Q_T$ = | **5,082.7** | **5,082.7** | **cfs** |

## Maximum Channel Capacity Based On Allowable Water Depth

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Water Depth | $d_{MAX}$ = | **2.70** | **2.70** | **ft** |
| Top Width | T = | 23.31 | 23.31 | ft |
| Flow Area | A = | 36.86 | 36.86 | sq ft |
| Wetted Perimeter | P = | 24.05 | 24.05 | ft |
| Hydraulic Radius | R = | 1.53 | 1.53 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 143.00 | 143.00 | fps |
| Velocity-Depth Product | VR = | 219.21 | 219.21 | ft^2/s |
| Hydraulic Depth | D = | 1.58 | 1.58 | ft |
| Froude Number | Fr = | 20.04 | 20.04 | |
| Maximum Flow Based On Allowable Water Depth | $Q_d$ = | **5,271.2** | **5,271.2** | **cfs** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | **5,082.7** | **5,082.7** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | $d_{allow}$ = | **2.66** | **2.66** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | Minor Storm | Major Storm | |
|---|---|---|---|---|---|
| | Design Peak Flow | $Q_o$ = | **1.7** | **5.3** | **cfs** |
| | Water Depth | **d =** | **0.11** | **0.18** | **ft** |
| | Top Width | T = | 4.76 | 5.26 | ft |
| | Flow Area | A = | 0.47 | 0.82 | sq ft |
| | Wetted Perimeter | P = | 4.79 | 5.31 | ft |
| | Hydraulic Radius | R = | 0.10 | 0.15 | ft |
| | Manning's n based on NRCS Vegetal Retardance | n = | 0.366 | 0.287 | |
| **Warning 03** | Flow Velocity | V = | 3.73 | 6.45 | fps |
| | Velocity-Depth Product | VR = | 0.36 | 0.99 | ft^2/s |
| | Hydraulic Depth | D = | 0.10 | 0.15 | ft |
| **Warning 04** | Froude Number | Fr = | 2.10 | 2.89 | |

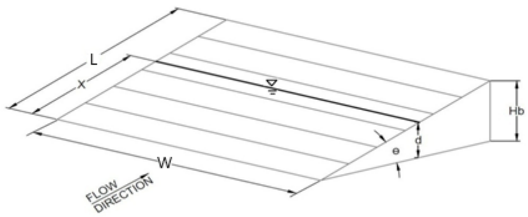
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**IN-3+43**

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C




| | | | |
|---|---|---|---|
| Angle of Inclined Grate (must be <= 30 degrees) | $\theta$ = | 0.00 | degrees |
| Width of Grate | W = | 3.00 | ft |
| Length of Grate | L = | 3.00 | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | $H_B$ = | 0.00 | ft |
| Clogging Factor | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | |
| Orifice Coefficient | $C_o$ = | 0.64 | |
| Weir Coefficient | $C_w$ = | 2.05 | |

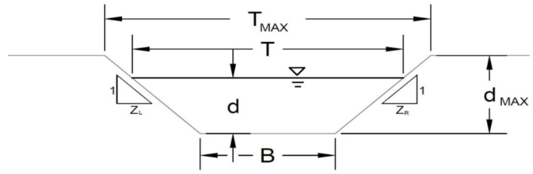
| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.11 | 0.18 | |
| Grate Capacity as a Weir | | | | |
| Submerged Side Weir Length | X = | 3.00 | 3.00 | ft |
| Inclined Side Weir Flow | $Q_{ws}$ = | 0.4 | 0.8 | cfs |
| Base Weir Flow | $Q_{wb}$ = | 0.5 | 1.1 | cfs |
| Interception Without Cloggging | $Q_{wi}$ = | 1.3 | 2.7 | cfs |
| Interception With Clogging | $Q_{wa}$ = | 0.6 | 1.4 | cfs |
| Grate Capacity as an Orifice | | | | |
| Interception Without Clogging | $Q_{oi}$ = | 10.6 | 13.6 | cfs |
| Interception With Clogging | $Q_{oa}$ = | 5.3 | 6.8 | cfs |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **0.6** | **1.4** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **1.1** | **3.9** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **37** | **26** | **%** |

**Warning 01: Sideslope steepness exceeds USDCM Volume I recommendation.**

**Warning 03: Velocity exceeds USDCM Volume I recommendation.**
**Warning 04: Froude No. exceeds USDCM Volume I recommendation.**

# AREA INLET IN A SWALE

**IN-6+51**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

## Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 14.2900 | ft/ft |
| Bottom Width | B = | 4.00 | ft |
| Left Side Slope | Z1 = | 25.00 | ft/ft |
| Right Side Sloe | Z2 = | 5.88 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- (●) Non-Cohesive
- ( ) Cohesive
- ( ) Paved

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **34.00** | **34.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **1.00** | **1.00** | **ft** |

## Maximum Channel Capacity Based On Allowable Top Width

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width | $T_{MAX}$ = | **34.00** | **34.00** | **ft** |
| Water Depth | d = | 0.97 | 0.97 | ft |
| Flow Area | A = | 18.46 | 18.46 | sq ft |
| Wetted Perimeter | P = | 34.10 | 34.10 | ft |
| Hydraulic Radius | R = | 0.54 | 0.54 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 62.35 | 62.35 | fps |
| Velocity-Depth Product | VR = | 33.75 | 33.75 | ft^2/s |
| Hydraulic Depth | D = | 0.54 | 0.54 | ft |
| Froude Number | Fr = | 14.91 | 14.91 | |
| Maximum Flow Based on Allowable Water Depth | $Q_T$ = | **1,150.9** | **1,150.9** | **cfs** |

## Maximum Channel Capacity Based On Allowable Water Depth

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Water Depth | $d_{MAX}$ = | **1.00** | **1.00** | **ft** |
| Top Width | T = | 34.88 | 34.88 | ft |
| Flow Area | A = | 19.44 | 19.44 | sq ft |
| Wetted Perimeter | P = | 34.98 | 34.98 | ft |
| Hydraulic Radius | R = | 0.56 | 0.56 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 63.45 | 63.45 | fps |
| Velocity-Depth Product | VR = | 35.26 | 35.26 | ft^2/s |
| Hydraulic Depth | D = | 0.56 | 0.56 | ft |
| Froude Number | Fr = | 14.98 | 14.98 | |
| Maximum Flow Based On Allowable Water Depth | $Q_d$ = | **1,233.5** | **1,233.5** | **cfs** |

## Allowable Channel Capacity Based On Channel Geometry

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | **1,150.9** | **1,150.9** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | $d_{allow}$ = | **0.97** | **0.97** | **ft** |

## Water Depth in Channel Based On Design Peak Flow

| | | | Minor Storm | Major Storm | |
|---|---|---|---|---|---|
| | Design Peak Flow | $Q_o$ = | **2.4** | **6.4** | **cfs** |
| | Water Depth | **d =** | **0.12** | **0.20** | **ft** |
| | Top Width | T = | 7.80 | 10.33 | ft |
| | Flow Area | A = | 0.73 | 1.47 | sq ft |
| | Wetted Perimeter | P = | 7.81 | 10.35 | ft |
| | Hydraulic Radius | R = | 0.09 | 0.14 | ft |
| | Manning's n based on NRCS Vegetal Retardance | n = | 0.355 | 0.351 | |
| **Warning 03** | Flow Velocity | V = | 3.25 | 4.36 | fps |
| | Velocity-Depth Product | VR = | 0.30 | 0.62 | ft^2/s |
| | Hydraulic Depth | D = | 0.09 | 0.14 | ft |
| **Warning 04** | Froude Number | Fr = | 1.88 | 2.04 | |

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

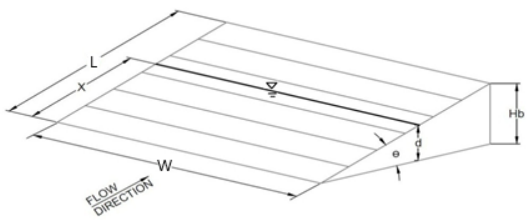
# AREA INLET IN A SWALE

**IN-6+51**

Inlet Design Information (Input)

Type of Inlet: CDOT Type C — Inlet Type = CDOT Type C

| | | | |
|---|---|---|---|
| Angle of Inclined Grate (must be <= 30 degrees) | $\theta$ = | 0.00 | degrees |
| Width of Grate | W = | 3.00 | ft |
| Length of Grate | L = | 3.00 | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | |
| Height of Inclined Grate | $H_B$ = | 0.00 | ft |
| Clogging Factor | $C_f$ = | 0.50 | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | |
| Orifice Coefficient | $C_o$ = | 0.64 | |
| Weir Coefficient | $C_w$ = | 2.05 | |



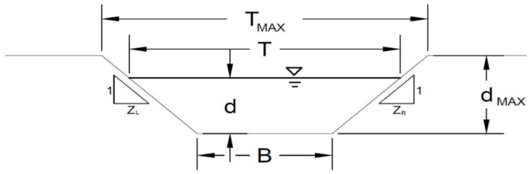

| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.12 | 0.20 | |
| **Grate Capacity as a Weir** | | | | |
| Submerged Side Weir Length | X = | 3.00 | 3.00 | ft |
| Inclined Side Weir Flow | $Q_{ws}$ = | 0.5 | 1.0 | cfs |
| Base Weir Flow | $Q_{wb}$ = | 0.7 | 1.4 | cfs |
| Interception Without Cloggging | $Q_{wi}$ = | 1.6 | 3.4 | cfs |
| Interception With Clogging | $Q_{wa}$ = | 0.8 | 1.7 | cfs |
| **Grate Capacity as an Orifice** | | | | |
| Interception Without Clogging | $Q_{oi}$ = | 11.3 | 14.6 | cfs |
| Interception With Clogging | $Q_{oa}$ = | 5.7 | 7.3 | cfs |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **0.8** | **1.7** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **1.6** | **4.7** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **34** | **27** | **%** |

**Warning 03: Velocity exceeds USDCM Volume I recommendation.**
**Warning 04: Froude No. exceeds USDCM Volume I recommendation.**

*MHFD-Inlet, Version 5.03 (August 2023)*

# AREA INLET IN A SWALE

**IN-7+07**




This worksheet uses the NRCS vegetal retardance method to determine Manning's n for grass-lined channels.

An override Manning's n can be entered for other channel materials.

Analysis of Trapezoidal Channel (Grass-Lined uses SCS Method)

| | | | |
|---|---|---|---|
| NRCS Vegetal Retardance (A, B, C, D, or E) | A, B, C, D, or E = | A | |
| Manning's n (Leave cell D16 blank to manually enter an n value) | n = | see details below | |
| Channel Invert Slope | $S_O$ = | 67.5700 | ft/ft |
| Bottom Width | B = | 4.00 | ft |
| Left Side Slope | Z1 = | 33.33 | ft/ft |
| Right Side Sloe | Z2 = | 10.00 | ft/ft |

Check one of the following soil types:

| Soil Type: | Max. Velocity ($V_{MAX}$) | Max Froude No. ($F_{MAX}$) |
|---|---|---|
| Non-Cohesive | 5.0 fps | 0.60 |
| Cohesive | 7.0 fps | 0.80 |
| Paved | N/A | N/A |

Choose One:
- Non-Cohesive
- Cohesive
- Paved

| | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width of Channel for Minor & Major Storm | $T_{MAX}$ = | **40.00** | **40.00** | **ft** |
| Maximum Allowable Water Depth in Channel for Minor & Major Storm | $d_{MAX}$ = | **0.90** | **0.90** | **ft** |

| Maximum Channel Capacity Based On Allowable Top Width | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Top Width | $T_{MAX}$ = | **40.00** | **40.00** | **ft** |
| Water Depth | d = | 0.83 | 0.83 | ft |
| Flow Area | A = | 18.28 | 18.28 | sq ft |
| Wetted Perimeter | P = | 40.05 | 40.05 | ft |
| Hydraulic Radius | R = | 0.46 | 0.46 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 121.00 | 121.00 | fps |
| Velocity-Depth Product | VR = | 55.22 | 55.22 | ft^2/s |
| Hydraulic Depth | D = | 0.46 | 0.46 | ft |
| Froude Number | Fr = | 31.54 | 31.54 | |
| Maximum Flow Based on Allowable Water Depth | $Q_T$ = | **2,211.6** | **2,211.6** | **cfs** |

| Maximum Channel Capacity Based On Allowable Water Depth | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| Maximum Allowable Water Depth | $d_{MAX}$ = | **0.90** | **0.90** | **ft** |
| Top Width | T = | 43.00 | 43.00 | ft |
| Flow Area | A = | 21.15 | 21.15 | sq ft |
| Wetted Perimeter | P = | 43.06 | 43.06 | ft |
| Hydraulic Radius | R = | 0.49 | 0.49 | ft |
| Manning's n based on NRCS Vegetal Retardance | n = | 0.060 | 0.060 | |
| Flow Velocity | V = | 127.08 | 127.08 | fps |
| Velocity-Depth Product | VR = | 62.42 | 62.42 | ft^2/s |
| Hydraulic Depth | D = | 0.49 | 0.49 | ft |
| Froude Number | Fr = | 31.93 | 31.93 | |
| Maximum Flow Based On Allowable Water Depth | $Q_d$ = | **2,687.6** | **2,687.6** | **cfs** |

| Allowable Channel Capacity Based On Channel Geometry | | Minor Storm | Major Storm | |
|---|---|---|---|---|
| MINOR STORM Allowable Capacity is based on Top Width Criterion | $Q_{allow}$ = | **2,211.6** | **2,211.6** | **cfs** |
| MAJOR STORM Allowable Capacity is based on Top Width Criterion | $d_{allow}$ = | **0.83** | **0.83** | **ft** |

| | Water Depth in Channel Based On Design Peak Flow | | | | |
|---|---|---|---|---|---|
| | Design Peak Flow | $Q_o$ = | **11.2** | **52.9** | **cfs** |
| | Water Depth | **d =** | **0.15** | **0.21** | **ft** |
| | Top Width | T = | 10.70 | 12.89 | ft |
| | Flow Area | A = | 1.14 | 1.73 | sq ft |
| | Wetted Perimeter | P = | 10.71 | 12.90 | ft |
| | Hydraulic Radius | R = | 0.11 | 0.13 | ft |
| | Manning's n based on NRCS Vegetal Retardance | n = | 0.279 | 0.105 | |
| **Warning 03** | Flow Velocity | V = | 9.84 | 30.53 | fps |
| | Velocity-Depth Product | VR = | 1.04 | 4.10 | ft^2/s |
| | Hydraulic Depth | D = | 0.11 | 0.13 | ft |
| **Warning 04** | Froude Number | Fr = | 5.32 | 14.68 | |

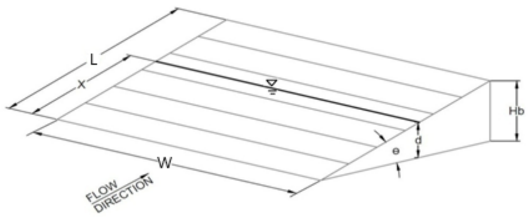
**Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**
**Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'**

# AREA INLET IN A SWALE

**IN-7+07**

Inlet Design Information (Input)

| | | | | |
|---|---|---|---|---|
| Type of Inlet: CDOT Type C | Inlet Type = | CDOT Type C | | |
| Angle of Inclined Grate (must be <= 30 degrees) | $\theta$ = | 0.00 | | degrees |
| Width of Grate | W = | 3.00 | | ft |
| Length of Grate | L = | 3.00 | | ft |
| Open Area Ratio | $A_{RATIO}$ = | 0.70 | | |
| Height of Inclined Grate | $H_B$ = | 0.00 | | ft |
| Clogging Factor | $C_f$ = | 0.50 | | |
| Grate Discharge Coefficient | $C_d$ = | 0.96 | | |
| Orifice Coefficient | $C_o$ = | 0.64 | | |
| Weir Coefficient | $C_w$ = | 2.05 | | |




| | | MINOR | MAJOR | |
|---|---|---|---|---|
| Water Depth at Inlet (for depressed inlets, 1 foot is added for depression) | d = | 0.15 | 0.21 | |
| **Grate Capacity as a Weir** | | | | |
| Submerged Side Weir Length | X = | 3.00 | 3.00 | ft |
| Inclined Side Weir Flow | $Q_{ws}$ = | 0.7 | 1.0 | cfs |
| Base Weir Flow | $Q_{wb}$ = | 0.9 | 1.4 | cfs |
| Interception Without Cloggging | $Q_{wi}$ = | 2.2 | 3.4 | cfs |
| Interception With Clogging | $Q_{wa}$ = | 1.1 | 1.7 | cfs |
| **Grate Capacity as an Orifice** | | | | |
| Interception Without Clogging | $Q_{oi}$ = | 12.7 | 14.6 | cfs |
| Interception With Clogging | $Q_{oa}$ = | 6.4 | 7.3 | cfs |
| Total Inlet Interception Capacity (assumes clogged condition) | **$Q_a$ =** | **1.1** | **1.7** | **cfs** |
| Bypassed Flow | **$Q_b$ =** | **10.1** | **51.2** | **cfs** |
| Capture Percentage = Qa/Qo | **C% =** | **10** | **3** | **%** |

**Warning 03: Velocity exceeds USDCM Volume I recommendation.**
**Warning 04: Froude No. exceeds USDCM Volume I recommendation.**

## 9.8 StormCAD Analysis

Drainage Report-StormCAD Results
Element Type:Conduit
100-yr US-24 and Peterson Intersection Improvements

| Conduit ID | U/S ID | D/S ID | Mannings n | Material | Conduit Description | Diameter (in) | Span (ft) | Rise (ft) | Length (ft) | Invert (Start) (ft) | Invert (Stop) (ft) | Slope (ft/ft) | Flow (cfs) | Capacity (cfs) | Velocity (ft/s) | Depth (ft) | U/S HGL (ft) | D/S HGL (ft) | U/S EGL (ft) | D/S EGL (ft) | Headloss (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P-0+16 | IN-0+16 | IN-0+18 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 109 | 6,265.60 | 6,265.27 | 0.003 | 4.68 | 5.59 | 2.66 | 0.8 | 6,268.53 | 6,268.30 | 6,268.64 | 6,268.41 | 0.23 |
| P-0+18 | IN-0+18 | IN-0+37 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 185.8 | 6,265.17 | 6,264.44 | 0.004 | 7.66 | 6.33 | 4.36 | (N/A) | 6,267.91 | 6,266.81 | 6,268.20 | 6,267.10 | 1.1 |
| P-0+25 | IN-0+25 | IN-1+10 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 48.1 | 6,266.43 | 6,266.29 | 0.003 | 11.94 | 5.5 | 6.76 | (N/A) | 6,271.36 | 6,270.68 | 6,272.07 | 6,271.39 | 0.68 |
| P-0+37 | IN-0+37 | FES-0+37 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 44.7 | 6,264.22 | 6,264.09 | 0.003 | 11.85 | 5.34 | 6.75 | (N/A) | 6,265.87 | 6,265.15 | 6,266.58 | 6,265.92 | 0.72 |
| P-0+38 | IN-0+38 | IN-0+37 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 83 | 6,264.47 | 6,264.22 | 0.003 | 1.48 | 5.6 | 0.84 | 0.42 | 6,266.82 | 6,266.81 | 6,266.83 | 6,266.82 | 0.02 |
| P-0+82 | IN-0+82 | IN-0+88 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 24 | 6,266.76 | 6,266.52 | 0.01 | 1.17 | 9.9 | 0.66 | 0.35 | 6,270.88 | 6,270.87 | 6,270.88 | 6,270.88 | 0 |
| P-1+10 | IN-1+10 | IN-1+11 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 58.2 | 6,266.19 | 6,265.96 | 0.004 | 15.76 | 13.94 | 5.02 | (N/A) | 6,271.61 | 6,271.31 | 6,272.00 | 6,271.70 | 0.3 |
| P-1+11 | IN-1+11 | STM-MH-10 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 44.6 | 6,265.76 | 6,265.58 | 0.004 | 17.72 | 14.03 | 5.64 | (N/A) | 6,272.58 | 6,272.30 | 6,273.07 | 6,272.79 | 0.28 |
| P-2+08 | IN-2+08 | IN-1+10 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 108.1 | 6,266.82 | 6,266.39 | 0.004 | 2.17 | 13.97 | 0.69 | 0.53 | 6,270.69 | 6,270.68 | 6,270.70 | 6,270.69 | 0.01 |
| P-2+13 | IN-2+13 | IN-2+08 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 42.5 | 6,268.64 | 6,268.22 | 0.01 | 0.24 | 10.23 | 0.14 | 0.16 | 6,270.70 | 6,270.70 | 6,270.70 | 6,270.70 | 0 |
| P-2+32 | IN-2+32 | IN-2+08 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 65.8 | 6,269.54 | 6,268.22 | 0.02 | 1.56 | 30.73 | 5.12 | 0.31 | 6,270.70 | 6,270.70 | 6,270.71 | 6,270.70 | 0 |
| P-2+64 | IN-2+64 | IN-2+84 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 30.4 | 6,268.91 | 6,268.61 | 0.01 | 1.2 | 9.62 | 0.68 | 0.36 | 6,272.05 | 6,272.05 | 6,272.06 | 6,272.06 | 0 |
| P-2+84 | IN-2+84 | MH-3+28 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 44.5 | 6,268.41 | 6,267.97 | 0.01 | 3.19 | 9.92 | 1.81 | 0.58 | 6,272.23 | 6,272.18 | 6,272.28 | 6,272.23 | 0.05 |
| P-3+11 | IN-3+11 | MH-3+28 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 47.7 | 6,268.11 | 6,267.87 | 0.005 | 10.49 | 15.37 | 3.34 | 1.21 | 6,272.29 | 6,272.18 | 6,272.47 | 6,272.36 | 0.11 |
| P-3+28 | MH-3+28 | MH-3+38 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 73.8 | 6,267.77 | 6,267.40 | 0.005 | 18.55 | 15.48 | 5.9 | (N/A) | 6,273.22 | 6,272.69 | 6,273.76 | 6,273.23 | 0.53 |
| P-3+43 | MH-1 | IN-3+43 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 79.4 | 6,265.42 | 6,265.10 | 0.004 | 4.44 | 14.01 | 1.41 | 0.77 | 6,267.89 | 6,267.85 | 6,267.92 | 6,267.89 | 0.03 |
| P-3+47 | IN-3+47 | MH-3+28 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 16 | 6,268.11 | 6,267.97 | 0.008 | 4.87 | 8.87 | 2.76 | 0.79 | 6,272.22 | 6,272.18 | 6,272.34 | 6,272.30 | 0.04 |
| P-5+41 | IN-5+41 | MH-5+03 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 253.6 | 6,262.55 | 6,261.28 | 0.005 | 51.14 | 46.6 | 7.23 | (N/A) | 6,269.19 | 6,267.66 | 6,270.00 | 6,268.48 | 1.53 |
| P-5+45(1) | IN-5+32 | MH-5+21 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 113.5 | 6,269.32 | 6,266.49 | 0.025 | 0 | 16.33 | 0 | (N/A) | 6,269.32 | 6,267.08 | 6,269.32 | 6,267.08 | 2.24 |
| P-5+45(2) | MH-5+21 | MH-4 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 87.4 | 6,260.76 | 6,260.41 | 0.004 | 51.14 | 41.03 | 7.23 | (N/A) | 6,266.68 | 6,266.13 | 6,267.49 | 6,266.95 | 0.54 |
| P-5+46 | IN-5+46 | IN-5+51 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 24.9 | 6,267.55 | 6,267.18 | 0.015 | 0.85 | 11.72 | 3.86 | 0.27 | 6,267.90 | 6,267.78 | 6,268.02 | 6,267.81 | 0.12 |
| P-5+47 | MH-5+47 | MH-5+71 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 58.9 | 6,269.00 | 6,268.41 | 0.01 | 1.18 | 10.09 | 3.82 | 0.35 | 6,270.02 | 6,270.01 | 6,270.03 | 6,270.02 | 0 |
| P-5+49 | IN-5+49 | MH-5+47 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 57.7 | 6,269.78 | 6,269.20 | 0.01 | 1.18 | 10.29 | 3.88 | 0.34 | 6,270.18 | 6,270.02 | 6,270.33 | 6,270.04 | 0.16 |
| P-5+51 | IN-5+51 | FES-5+43 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 25.5 | 6,266.98 | 6,266.60 | 0.015 | 2.02 | 12.03 | 5.06 | 0.42 | 6,267.52 | 6,267.02 | 6,267.72 | 6,267.41 | 0.5 |
| P-5+71 | MH-5+71 | FES-5+40 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 107.1 | 6,268.21 | 6,266.60 | 0.015 | 12.87 | 12.72 | 8.2 | 1.25 | 6,269.55 | 6,267.85 | 6,270.47 | 6,268.89 | 1.71 |
| P-6+51 | IN-6+51 | MH-5+71 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 174.2 | 6,270.15 | 6,268.41 | 0.01 | 11.69 | 10.39 | 6.62 | (N/A) | 6,272.22 | 6,270.01 | 6,272.90 | 6,270.69 | 2.2 |
| P-6+74 | IN-6+74 | IN-6+75 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 16.6 | 6,270.86 | 6,270.69 | -0.014 | 3.99 | 9.39 | 2.26 | 0.68 | 6,273.38 | 6,273.35 | 6,273.46 | 6,273.43 | 0.03 |
| P-6+75 | IN-6+75 | IN-6+51 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 14.4 | 6,270.49 | 6,270.35 | 0.02 | 5.29 | 8.93 | 2.99 | 0.83 | 6,273.16 | 6,273.11 | 6,273.30 | 6,273.25 | 0.05 |
| P-6+77 | IN-6+77 | IN-6+74 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 50.7 | 6,272.07 | 6,271.57 | -0.01 | 2.68 | 10.07 | 4.82 | 0.53 | 6,273.42 | 6,273.39 | 6,273.46 | 6,273.42 | 0.03 |
| P-7+07 | H-1 | MH-7+87 | 0.013 | Concrete | Ellipse - 3.8 x 2.4 ft | | 3.8 | 2.4 | 149.3 | 6,273.22 | 6,272.77 | 0.003 | 11.18 | 35.64 | 4.32 | 0.95 | 6,274.17 | 6,273.85 | 6,274.46 | 6,274.06 | 0.31 |
| P-7+87 | MH-7+87 | STM-MH-8+4 | 0.013 | Concrete | Ellipse - 5.0 x 3.2 ft | | 5 | 3.2 | 106.3 | 6,272.67 | 6,272.24 | 0.004 | 11.18 | 85.58 | 4.53 | 0.8 | 6,273.79 | 6,273.80 | 6,273.91 | 6,273.85 | -0.01 |
| P-7+97 | IN-7+97 | STM-MH-8+4 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 13.5 | 6,272.31 | 6,272.24 | 0.005 | 1.14 | 13.3 | 2.59 | 0.4 | 6,273.80 | 6,273.80 | 6,273.80 | 6,273.80 | 0 |
| P-8+03 | STM-MH-8+4 | CULV-FES- | 0.013 | Concrete | Ellipse - 5.0 x 3.2 ft | | 5 | 3.2 | 40.3 | 6,272.14 | 6,271.98 | 0.004 | 21.71 | 84.99 | 5.53 | 1.12 | 6,273.30 | 6,273.10 | 6,273.73 | 6,273.57 | 0.2 |
| P-8+07 | IN-8+07 | STM-MH-8+4 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 12.5 | 6,272.30 | 6,272.24 | 0.005 | 9.39 | 14.93 | 5.02 | 1.15 | 6,273.82 | 6,273.80 | 6,274.03 | 6,274.00 | 0.02 |
| P-8+19 | IN-8+19 | MH-8+29 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 46.9 | 6,274.73 | 6,274.24 | 0.01 | 1.27 | 10.47 | 4.01 | 0.35 | 6,275.15 | 6,274.59 | 6,275.30 | 6,274.84 | 0.56 |
| P-8+29 | MH-8+29 | IN-8+39 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 19.6 | 6,273.66 | 6,273.56 | 0.005 | 1.27 | 7.1 | 3.04 | 0.43 | 6,274.56 | 6,274.56 | 6,274.58 | 6,274.57 | 0 |
| P-8+39 | IN-8+39 | IN-8+57 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 31.6 | 6,273.36 | 6,273.20 | 0.005 | 1.76 | 7.1 | 3.33 | 0.51 | 6,274.55 | 6,274.55 | 6,274.57 | 6,274.57 | 0.01 |
| P-8+57 | IN-8+57 | IN-8+07 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 99.5 | 6,273.00 | 6,272.50 | 0.005 | 8.26 | 15.53 | 5.02 | 1.04 | 6,274.05 | 6,273.95 | 6,274.43 | 6,274.13 | 0.1 |
| STM- | IN-1+26 | IN-1+10 | 0.013 | Concrete | Circle - 2.0 ft | 15 | | | 13 | 6,266.34 | 6,266.29 | 0.004 | 0.42 | 3.65 | 0.34 | 0.29 | 6,270.68 | 6,270.68 | 6,270.68 | 6,270.68 | 0 |
| STM-8 | MH-4 | MH-5+04 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 277 | 6,260.21 | 6,259.10 | 0.004 | 51.14 | 41.81 | 7.23 | (N/A) | 6,265.73 | 6,264.07 | 6,266.54 | 6,264.88 | 1.66 |
| STM-9 | MH-5+04 | MH-4+21 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 284.6 | 6,259.00 | 6,257.86 | 0.004 | 51.14 | 41.83 | 7.23 | (N/A) | 6,263.66 | 6,261.96 | 6,264.47 | 6,262.77 | 1.7 |
| STM-10 | MH-4+21 | MH-4+11 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 271.9 | 6,257.76 | 6,256.67 | 0.004 | 51.14 | 41.8 | 7.23 | (N/A) | 6,261.55 | 6,259.92 | 6,262.37 | 6,260.74 | 1.63 |
| STM-11 | MH-4+11 | FES-OUTFALL | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 197.2 | 6,256.57 | 6,255.78 | 0.004 | 51.14 | 41.92 | 7.23 | (N/A) | 6,259.51 | 6,258.11 | 6,260.33 | 6,259.28 | 1.41 |
| STM-12 | IN-3+43 | MH-3+38 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 86 | 6,264.90 | 6,264.56 | 0.004 | 9.7 | 13.95 | 3.09 | 1.23 | 6,272.86 | 6,272.69 | 6,273.01 | 6,272.84 | 0.17 |
| STM-13 | STM-MH-10 | MH-3+38 | 0.013 | Concrete | Circle - 30.0 in | 30 | | | 179.7 | 6,265.28 | 6,264.56 | 0.004 | 20.79 | 25.59 | 4.24 | 1.71 | 6,273.17 | 6,272.69 | 6,273.45 | 6,272.97 | 0.47 |
| STM-14 | IN-0+88 | STM-MH-10 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 43.5 | 6,266.32 | 6,265.88 | 0.01 | 3.07 | 10.3 | 1.74 | 0.56 | 6,272.33 | 6,272.30 | 6,272.38 | 6,272.34 | 0.04 |
| STM-15 | MH-3+38 | STM-MH-11 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 55.5 | 6,264.36 | 6,264.08 | 0.005 | 49.04 | 45.18 | 6.94 | (N/A) | 6,272.49 | 6,272.16 | 6,273.23 | 6,272.91 | 0.33 |
| STM-16 | IN-3+83 | STM-MH-11 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 5.2 | 6,268.08 | 6,267.98 | 0.02 | 1.26 | 12.78 | 0.71 | 0.32 | 6,272.16 | 6,272.16 | 6,272.17 | 6,272.17 | 0 |
| STM-17 | STM-MH-11 | MH-5+29 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 149.9 | 6,263.88 | 6,263.13 | 0.005 | 50.3 | 46.39 | 7.12 | (N/A) | 6,271.77 | 6,270.89 | 6,272.55 | 6,271.67 | 0.88 |
| STM-18 | MH-5+29 | IN-5+41 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 35.5 | 6,262.93 | 6,262.75 | 0.005 | 50.3 | 44.39 | 7.12 | (N/A) | 6,270.49 | 6,270.26 | 6,271.28 | 6,271.05 | 0.23 |
| STM-19 | MH-5+03 | MH-5+21 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 24.8 | 6,261.08 | 6,260.96 | 0.005 | 51.14 | 43.02 | 7.23 | (N/A) | 6,267.26 | 6,267.08 | 6,268.07 | 6,267.90 | 0.17 |
| STM-20 | IN-1+22 | MH-1 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 36 | 6,265.98 | 6,265.62 | 0.01 | 4.44 | 21.25 | 5.35 | 0.62 | 6,267.92 | 6,267.90 | 6,267.95 | 6,267.93 | 0.02 |

Drainage Report-StormCAD Results
Element Type:Conduit
5-yr US-24 and Peterson Intersection Improvements

| Conduit ID | U/S ID | D/S ID | Mannings n | Material | Conduit Description | Diameter (in) | Span (ft) | Rise (ft) | Length (ft) | Invert (Start) (ft) | Invert (Stop) (ft) | Slope (ft/ft) | Flow (cfs) | Capacity (cfs) | Velocity (ft/s) | Depth (ft) | U/S HGL (ft) | D/S HGL (ft) | U/S EGL (ft) | D/S EGL (ft) | Headloss (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P-0+16 | IN-0+16 | IN-0+18 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 109 | 6,265.60 | 6,265.27 | 0.003 | 2.14 | 5.59 | 2.92 | 0.51 | 6,266.14 | 6,266.07 | 6,266.25 | 6,266.11 | 0.07 |
| P-0+18 | IN-0+18 | IN-0+37 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 185.8 | 6,265.17 | 6,264.44 | 0.004 | 3.51 | 6.33 | 3.71 | 0.62 | 6,265.79 | 6,265.40 | 6,266.00 | 6,265.48 | 0.39 |
| P-0+25 | IN-0+25 | IN-1+10 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 48.1 | 6,266.43 | 6,266.29 | 0.003 | 4.92 | 5.5 | 3.52 | 1.11 | 6,267.65 | 6,267.54 | 6,267.81 | 6,267.69 | 0.11 |
| P-0+37 | IN-0+37 | FES-0+37 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 44.7 | 6,264.22 | 6,264.09 | 0.003 | 5.43 | 5.34 | 3.58 | 0.94 | 6,265.10 | 6,264.83 | 6,265.33 | 6,265.16 | 0.27 |
| P-0+38 | IN-0+38 | IN-0+37 | 0.013 | Concrete | Ellipse - 3.17 x 2.00 ft | | 1.9 | 1.2 | 83 | 6,264.47 | 6,264.22 | 0.003 | 0.68 | 5.6 | 2.04 | 0.29 | 6,265.40 | 6,265.40 | 6,265.41 | 6,265.40 | 0 |
| P-0+82 | IN-0+82 | IN-0+88 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 24 | 6,266.76 | 6,266.52 | 0.01 | 0.54 | 9.9 | 3 | 0.24 | 6,267.04 | 6,266.76 | 6,267.13 | 6,266.90 | 0.27 |
| P-1+10 | IN-1+10 | IN-1+11 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 58.2 | 6,266.19 | 6,265.96 | 0.004 | 6.47 | 13.94 | 4.36 | 0.96 | 6,267.15 | 6,266.86 | 6,267.44 | 6,267.21 | 0.29 |
| P-1+11 | IN-1+11 | STM-MH-10 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 44.6 | 6,265.76 | 6,265.58 | 0.004 | 7.37 | 14.03 | 4.52 | 1.03 | 6,266.79 | 6,266.54 | 6,267.11 | 6,266.92 | 0.24 |
| P-2+08 | IN-2+08 | IN-1+10 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 108.1 | 6,266.82 | 6,266.39 | 0.004 | 0.99 | 13.97 | 2.57 | 0.36 | 6,267.54 | 6,267.54 | 6,267.56 | 6,267.54 | 0 |
| P-2+13 | IN-2+13 | IN-2+08 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 42.5 | 6,268.64 | 6,268.22 | 0.01 | 0.11 | 10.23 | 1.9 | 0.11 | 6,268.77 | 6,268.33 | 6,268.81 | 6,268.39 | 0.44 |
| P-2+32 | IN-2+32 | IN-2+08 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 65.8 | 6,269.54 | 6,268.22 | 0.02 | 0.71 | 30.73 | 4.04 | 0.21 | 6,269.83 | 6,268.43 | 6,269.93 | 6,268.68 | 1.4 |
| P-2+64 | IN-2+64 | IN-2+84 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 30.4 | 6,268.91 | 6,268.61 | 0.01 | 0.55 | 9.62 | 2.95 | 0.24 | 6,269.19 | 6,268.85 | 6,269.28 | 6,268.99 | 0.33 |
| P-2+84 | IN-2+84 | MH-3+28 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 44.5 | 6,268.41 | 6,267.97 | 0.01 | 1.46 | 9.92 | 4.02 | 0.39 | 6,268.87 | 6,268.90 | 6,269.03 | 6,268.92 | -0.03 |
| P-3+11 | IN-3+11 | MH-3+28 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 47.7 | 6,268.11 | 6,267.87 | 0.005 | 3.43 | 15.37 | 3.94 | 0.64 | 6,268.90 | 6,268.90 | 6,269.04 | 6,268.97 | 0 |
| P-3+28 | MH-3+28 | MH-3+38 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 73.8 | 6,267.77 | 6,267.40 | 0.005 | 7.04 | 15.48 | 4.81 | 0.95 | 6,268.72 | 6,268.35 | 6,269.08 | 6,268.71 | 0.37 |
| P-3+43 | MH-1 | IN-3+43 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 79.4 | 6,265.42 | 6,265.10 | 0.004 | 2.03 | 14.01 | 3.18 | 0.51 | 6,266.12 | 6,266.11 | 6,266.19 | 6,266.13 | 0.01 |
| P-3+47 | IN-3+47 | MH-3+28 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 16 | 6,268.11 | 6,267.97 | 0.008 | 2.15 | 8.87 | 4.13 | 0.5 | 6,268.89 | 6,268.90 | 6,268.97 | 6,268.95 | -0.01 |
| P-5+41 | IN-5+41 | MH-5+03 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 253.6 | 6,262.55 | 6,261.28 | 0.005 | 20.56 | 46.6 | 6.39 | 1.39 | 6,264.00 | 6,262.83 | 6,264.57 | 6,263.31 | 1.18 |
| P-5+45(1) | IN-5+32 | MH-5+21 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 113.5 | 6,269.32 | 6,266.49 | 0.025 | 0 | 16.33 | 0 | (N/A) | 6,269.32 | 6,266.49 | 6,269.32 | 6,266.49 | 2.84 |
| P-5+45(2) | MH-5+21 | MH-4 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 87.4 | 6,260.76 | 6,260.41 | 0.004 | 20.56 | 41.03 | 5.81 | 1.5 | 6,262.26 | 6,261.96 | 6,262.79 | 6,262.44 | 0.3 |
| P-5+46 | IN-5+46 | IN-5+51 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 24.9 | 6,267.55 | 6,267.18 | 0.015 | 0.39 | 11.72 | 3.07 | 0.19 | 6,267.78 | 6,267.51 | 6,267.86 | 6,267.54 | 0.27 |
| P-5+47 | MH-5+47 | MH-5+71 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 58.9 | 6,269.00 | 6,268.41 | 0.01 | 0.54 | 10.09 | 3.04 | 0.24 | 6,269.27 | 6,269.28 | 6,269.37 | 6,269.28 | -0.01 |
| P-5+49 | IN-5+49 | MH-5+47 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 57.7 | 6,269.78 | 6,269.20 | 0.01 | 0.54 | 10.29 | 3.08 | 0.23 | 6,270.05 | 6,269.43 | 6,270.14 | 6,269.58 | 0.62 |
| P-5+51 | IN-5+51 | FES-5+43 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 25.5 | 6,266.98 | 6,266.60 | 0.015 | 0.93 | 12.03 | 4.04 | 0.28 | 6,267.34 | 6,266.88 | 6,267.47 | 6,267.14 | 0.46 |
| P-5+71 | MH-5+71 | FES-5+40 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 107.1 | 6,268.21 | 6,266.60 | 0.015 | 5.33 | 12.72 | 6.88 | 0.68 | 6,269.10 | 6,267.28 | 6,269.47 | 6,268.01 | 1.82 |
| P-6+51 | IN-6+51 | MH-5+71 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 174.2 | 6,270.15 | 6,268.41 | 0.01 | 4.79 | 10.39 | 5.76 | 0.72 | 6,270.99 | 6,269.28 | 6,271.34 | 6,269.60 | 1.71 |
| P-6+74 | IN-6+74 | IN-6+75 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 16.6 | 6,270.86 | 6,270.69 | -0.014 | 1.83 | 9.39 | 4.12 | 0.45 | 6,271.51 | 6,271.53 | 6,271.61 | 6,271.58 | -0.02 |
| P-6+75 | IN-6+75 | IN-6+51 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 14.4 | 6,270.49 | 6,270.35 | 0.02 | 2.43 | 8.93 | 4.3 | 0.53 | 6,271.44 | 6,271.45 | 6,271.51 | 6,271.49 | 0 |
| P-6+77 | IN-6+77 | IN-6+74 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 50.7 | 6,272.07 | 6,271.57 | -0.01 | 1.23 | 10.07 | 3.86 | 0.35 | 6,272.48 | 6,271.92 | 6,272.63 | 6,272.15 | 0.56 |
| P-7+07 | H-1 | MH-7+87 | 0.013 | Concrete | Ellipse - 3.8 x 2.4 ft | | 3.8 | 2.4 | 149.3 | 6,273.22 | 6,272.77 | 0.003 | 11.18 | 35.64 | 4.32 | 0.95 | 6,274.17 | 6,273.67 | 6,274.46 | 6,274.00 | 0.5 |
| P-7+87 | MH-7+87 | STM-MH-8+4 | 0.013 | Concrete | Ellipse - 5.0 x 3.2 ft | | 5 | 3.2 | 106.3 | 6,272.67 | 6,272.24 | 0.004 | 11.18 | 85.58 | 4.53 | 0.8 | 6,273.50 | 6,273.55 | 6,273.78 | 6,273.63 | -0.05 |
| P-7+97 | IN-7+97 | STM-MH-8+4 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 13.5 | 6,272.31 | 6,272.24 | 0.005 | 0.52 | 13.3 | 2.05 | 0.27 | 6,273.55 | 6,273.55 | 6,273.55 | 6,273.55 | 0 |
| P-8+03 | STM-MH-8+4 | CULV-FES- | 0.013 | Concrete | Ellipse - 5.0 x 3.2 ft | | 5 | 3.2 | 40.3 | 6,272.14 | 6,271.98 | 0.004 | 16.01 | 84.99 | 5.03 | 0.96 | 6,273.13 | 6,272.94 | 6,273.49 | 6,273.33 | 0.19 |
| P-8+07 | IN-8+07 | STM-MH-8+4 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 12.5 | 6,272.30 | 6,272.24 | 0.005 | 4.31 | 14.93 | 4.11 | 0.74 | 6,273.55 | 6,273.55 | 6,273.62 | 6,273.61 | 0 |
| P-8+19 | IN-8+19 | MH-8+29 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 46.9 | 6,274.73 | 6,274.24 | 0.01 | 0.58 | 10.47 | 3.18 | 0.24 | 6,275.01 | 6,274.48 | 6,275.11 | 6,274.64 | 0.53 |
| P-8+29 | MH-8+29 | IN-8+39 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 19.6 | 6,273.66 | 6,273.56 | 0.005 | 0.58 | 7.1 | 2.42 | 0.29 | 6,274.02 | 6,274.01 | 6,274.07 | 6,274.04 | 0 |
| P-8+39 | IN-8+39 | IN-8+57 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 31.6 | 6,273.36 | 6,273.20 | 0.005 | 0.81 | 7.1 | 2.67 | 0.34 | 6,274.01 | 6,274.01 | 6,274.03 | 6,274.02 | 0 |
| P-8+57 | IN-8+57 | IN-8+07 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 99.5 | 6,273.00 | 6,272.50 | 0.005 | 3.79 | 15.53 | 4.08 | 0.67 | 6,273.68 | 6,273.60 | 6,273.93 | 6,273.67 | 0.08 |
| STM- | IN-1+26 | IN-1+10 | 0.013 | Concrete | Circle - 2.0 ft | 15 | | | 13 | 6,266.34 | 6,266.29 | 0.004 | 0 | 3.65 | 0 | (N/A) | 6,267.54 | 6,267.54 | 6,267.54 | 6,267.54 | 0 |
| STM-8 | MH-4 | MH-5+04 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 277 | 6,260.21 | 6,259.10 | 0.004 | 20.56 | 41.81 | 5.89 | 1.49 | 6,261.69 | 6,260.75 | 6,262.23 | 6,261.17 | 0.94 |
| STM-9 | MH-5+04 | MH-4+21 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 284.6 | 6,259.00 | 6,257.86 | 0.004 | 20.56 | 41.83 | 5.89 | 1.49 | 6,260.48 | 6,259.51 | 6,261.02 | 6,259.92 | 0.97 |
| STM-10 | MH-4+21 | MH-4+11 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 271.9 | 6,257.76 | 6,256.67 | 0.004 | 20.56 | 41.8 | 5.89 | 1.49 | 6,259.24 | 6,258.32 | 6,259.78 | 6,258.73 | 0.92 |
| STM-11 | MH-4+11 | FES-OUTFALL | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 197.2 | 6,256.57 | 6,255.78 | 0.004 | 20.56 | 41.92 | 5.9 | 1.48 | 6,258.05 | 6,257.24 | 6,258.59 | 6,257.80 | 0.82 |
| STM-12 | IN-3+43 | MH-3+38 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 86 | 6,264.90 | 6,264.56 | 0.004 | 3.77 | 13.95 | 3.77 | 0.71 | 6,266.07 | 6,266.05 | 6,266.13 | 6,266.09 | 0.02 |
| STM-13 | STM-MH-10 | MH-3+38 | 0.013 | Concrete | Circle - 30.0 in | 30 | | | 179.7 | 6,265.28 | 6,264.56 | 0.004 | 8.78 | 25.59 | 4.73 | 1.01 | 6,266.29 | 6,266.05 | 6,266.64 | 6,266.18 | 0.24 |
| STM-14 | IN-0+88 | STM-MH-10 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 43.5 | 6,266.32 | 6,265.88 | 0.01 | 1.41 | 10.3 | 4.08 | 0.37 | 6,266.77 | 6,266.46 | 6,266.93 | 6,266.54 | 0.3 |
| STM-15 | MH-3+38 | STM-MH-11 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 55.5 | 6,264.36 | 6,264.08 | 0.005 | 19.59 | 45.18 | 6.16 | 1.38 | 6,265.78 | 6,265.60 | 6,266.33 | 6,266.06 | 0.18 |
| STM-16 | IN-3+83 | STM-MH-11 | 0.013 | Concrete | Circle - 2.0 ft | 18 | | | 5.2 | 6,268.08 | 6,267.98 | 0.02 | 0.58 | 12.78 | 3.66 | 0.22 | 6,268.36 | 6,268.20 | 6,268.46 | 6,268.39 | 0.16 |
| STM-17 | STM-MH-11 | MH-5+29 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 149.9 | 6,263.88 | 6,263.13 | 0.005 | 20.17 | 46.39 | 6.33 | 1.38 | 6,265.32 | 6,264.92 | 6,265.88 | 6,265.25 | 0.4 |
| STM-18 | MH-5+29 | IN-5+41 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 35.5 | 6,262.93 | 6,262.75 | 0.005 | 20.17 | 44.39 | 6.13 | 1.42 | 6,264.76 | 6,264.75 | 6,265.07 | 6,265.00 | 0.01 |
| STM-19 | MH-5+03 | MH-5+21 | 0.013 | Concrete | Circle - 36.0 in | 36 | | | 24.8 | 6,261.08 | 6,260.96 | 0.005 | 20.56 | 43.02 | 6.02 | 1.46 | 6,262.55 | 6,262.52 | 6,263.11 | 6,263.00 | 0.03 |
| STM-20 | IN-1+22 | MH-1 | 0.013 | Concrete | Circle - 24.0 in | 24 | | | 36 | 6,265.98 | 6,265.62 | 0.01 | 2.03 | 21.25 | 4.27 | 0.42 | 6,266.47 | 6,266.15 | 6,266.65 | 6,266.29 | 0.32 |

Drainage Report-StormCAD Results
Element Type:Manhole
100-yr US-24 and Peterson Intersection Improvements

| Manhole ID | Shape | Diameter (in) | Flow (Total Out) (cfs) | Elevation (Rim) (ft) | Invert Out (ft) | Headloss Method | Headloss (ft) |
|---|---|---|---|---|---|---|---|
| MH-1 | Circular Structure | 48 | 4.44 | 6,272.27 | 6,265.42 | Standard | 0.02 |
| MH-3+28 | Circular Structure | 72 | 18.55 | 6,272.18 | 6,267.77 | Standard | 0.27 |
| MH-3+38 | Circular Structure | 72 | 49.04 | 6,272.69 | 6,264.36 | Standard | 0.37 |
| MH-4 | Circular Structure | 72 | 51.14 | 6,271.79 | 6,260.21 | Standard | 0.41 |
| MH-4+11 | Circular Structure | 60 | 51.14 | 6,261.83 | 6,256.57 | Standard | 0.41 |
| MH-4+21 | Circular Structure | 60 | 51.14 | 6,264.33 | 6,257.76 | Standard | 0.41 |
| MH-5+03 | Circular Structure | 72 | 51.14 | 6,276.67 | 6,261.08 | Standard | 0.41 |
| MH-5+04 | Circular Structure | 60 | 51.14 | 6,268.94 | 6,259.00 | Standard | 0.41 |
| MH-5+21 | Circular Structure | 72 | 51.14 | 6,273.73 | 6,260.76 | Standard | 0.41 |
| MH-5+29 | Circular Structure | 60 | 50.3 | 6,273.91 | 6,262.93 | Standard | 0.39 |
| MH-5+47 | Circular Structure | 60 | 1.18 | 6,274.86 | 6,269.00 | Standard | 0.01 |
| MH-5+71 | Circular Structure | 60 | 12.87 | 6,276.63 | 6,268.21 | Standard | 0.46 |
| MH-7+87 | Circular Structure | 84 | 11.18 | 6,283.73 | 6,272.67 | Standard | 0.06 |
| MH-8+29 | Circular Structure | 60 | 1.27 | 6,279.33 | 6,273.66 | Standard | 0 |
| STM-MH-8+4 | Circular Structure | 96 | 21.71 | 6,276.63 | 6,272.14 | Standard | 0.5 |
| STM-MH-10 | Circular Structure | 60 | 20.79 | 6,272.30 | 6,265.28 | Standard | 0.14 |
| STM-MH-11 | Circular Structure | 60 | 50.3 | 6,272.54 | 6,263.88 | Standard | 0.39 |

Drainage Report-StormCAD Results
Element Type:Manhole
5-yr US-24 and Peterson Intersection Improvements

| Manhole ID | Shape | Diameter (in) | Flow (Total Out) (cfs) | Elevation (Rim) (ft) | Invert Out (ft) | Headloss Method | Headloss (ft) |
|---|---|---|---|---|---|---|---|
| MH-1 | Circular Structure | 48 | 2.03 | 6,272.27 | 6,265.42 | Standard | 0.03 |
| MH-3+28 | Circular Structure | 72 | 7.04 | 6,272.18 | 6,267.77 | Standard | 0.18 |
| MH-3+38 | Circular Structure | 72 | 19.59 | 6,272.69 | 6,264.36 | Standard | 0.27 |
| MH-4 | Circular Structure | 72 | 20.56 | 6,271.79 | 6,260.21 | Standard | 0.27 |
| MH-4+11 | Circular Structure | 60 | 20.56 | 6,261.83 | 6,256.57 | Standard | 0.27 |
| MH-4+21 | Circular Structure | 60 | 20.56 | 6,264.33 | 6,257.76 | Standard | 0.27 |
| MH-5+03 | Circular Structure | 72 | 20.56 | 6,276.67 | 6,261.08 | Standard | 0.28 |
| MH-5+04 | Circular Structure | 60 | 20.56 | 6,268.94 | 6,259.00 | Standard | 0.27 |
| MH-5+21 | Circular Structure | 72 | 20.56 | 6,273.73 | 6,260.76 | Standard | 0.26 |
| MH-5+29 | Circular Structure | 60 | 20.17 | 6,273.91 | 6,262.93 | Standard | 0.15 |
| MH-5+47 | Circular Structure | 60 | 0.54 | 6,274.86 | 6,269.00 | Standard | 0.05 |
| MH-5+71 | Circular Structure | 60 | 5.33 | 6,276.63 | 6,268.21 | Standard | 0.19 |
| MH-7+87 | Circular Structure | 84 | 11.18 | 6,283.73 | 6,272.67 | Standard | 0.14 |
| MH-8+29 | Circular Structure | 60 | 0.58 | 6,279.33 | 6,273.66 | Standard | 0.01 |
| STM-MH-8+4 | Circular Structure | 96 | 16.01 | 6,276.63 | 6,272.14 | Standard | 0.42 |
| STM-MH-10 | Circular Structure | 60 | 8.78 | 6,272.30 | 6,265.28 | Standard | 0.17 |
| STM-MH-11 | Circular Structure | 60 | 20.17 | 6,272.54 | 6,263.88 | Standard | 0.28 |

Drainage Report-StormCAD Results
Element Type:Catch Basin
100-yr US-24 and Peterson Intersection Improvements

| Inlet ID | Inlet Type | Elevation (FL) (ft) | Invert Out (ft) | Flow (Additional Carryover) (cfs) | Headloss Method | Headloss (ft) |
|---|---|---|---|---|---|---|
| IN-0+16 | INLET - TYPE R-10' | 6,268.62 | 6,265.60 | 4.68 | Standard | 0.01 |
| IN-0+18 | INLET - TYPE R-5' | 6,268.60 | 6,265.17 | 2.98 | Standard | 0.39 |
| IN-0+25 | INLET - TYPE C | 6,269.36 | 6,266.43 | 11.94 | Standard | 0.04 |
| IN-0+37 | INLET - TYPE R-10' | 6,267.06 | 6,264.22 | 2.71 | Standard | 0.93 |
| IN-0+38 | INLET - TYPE R-5' | 6,267.10 | 6,264.47 | 1.48 | Standard | 0 |
| IN-0+82 | INLET - TYPE R-5' | 6,270.50 | 6,266.76 | 1.17 | Standard | 0 |
| IN-0+88 | INLET - TYPE R-5' | 6,270.87 | 6,266.32 | 1.9 | Standard | 0 |
| IN-1+10 | INLET - TYPE R-5' | 6,270.68 | 6,266.19 | 1.23 | Standard | 0.52 |
| IN-1+11 | INLET - TYPE R-5' | 6,271.31 | 6,265.76 | 1.96 | Standard | 0.05 |
| IN-1+22 | INLET - TYPE R-5' | 6,271.13 | 6,265.98 | 4.44 | Standard | 0 |
| IN-1+26 | INLET - TYPE 13 | 6,270.01 | 6,266.34 | 0.42 | Standard | 0 |
| IN-2+08 | INLET - TYPE R-5' | 6,271.94 | 6,266.82 | 0.37 | Standard | 0.01 |
| IN-2+13 | INLET - TYPE R-5' | 6,272.40 | 6,268.64 | 0.24 | Standard | 0 |
| IN-2+32 | INLET - TYPE R-5' | 6,274.34 | 6,269.54 | 1.56 | Standard | 0 |
| IN-2+64 | INLET - TYPE R-5' | 6,272.37 | 6,268.91 | 1.2 | Standard | 0 |
| IN-2+84 | INLET - TYPE R-5' | 6,272.05 | 6,268.41 | 1.99 | Standard | 0.01 |
| IN-3+11 | INLET - TYPE D | 6,272.24 | 6,268.11 | 10.49 | Standard | 0.01 |
| IN-3+43 | INLET - TYPE C | 6,267.85 | 6,264.90 | 5.26 | Standard | 0.09 |
| IN-3+47 | INLET - TYPE R-10' | 6,272.21 | 6,268.11 | 4.87 | Standard | 0.01 |
| IN-3+83 | INLET - TYPE R-5' | 6,272.35 | 6,268.08 | 1.26 | Standard | 0 |
| IN-5+32 | INLET - TYPE D | 6,272.31 | 6,269.32 | 0 | Standard | 0 |
| IN-5+41 | INLET - TYPE R-5' | 6,274.33 | 6,262.55 | 0.84 | Standard | 1.07 |
| IN-5+46 | INLET - TYPE R-5' | 6,275.37 | 6,267.55 | 0.85 | Standard | 0.01 |
| IN-5+49 | INLET - TYPE R-5' | 6,273.68 | 6,269.78 | 1.18 | Standard | 0.01 |
| IN-5+51 | INLET - TYPE R-5' | 6,275.49 | 6,266.98 | 1.17 | Standard | 0.26 |
| IN-6+51 | INLET - TYPE C | 6,275.21 | 6,270.15 | 6.4 | Standard | 0.9 |
| IN-6+74 | INLET - TYPE R-5' | 6,275.95 | 6,270.86 | 1.31 | Standard | 0.01 |
| IN-6+75 | INLET - TYPE R-5' | 6,276.06 | 6,270.64 | 1.3 | Standard | 0.18 |
| IN-6+77 | INLET - TYPE R-5' | 6,276.64 | 6,272.07 | 2.68 | Standard | 0 |
| IN-7+97 | INLET - TYPE R-5' | 6,276.86 | 6,272.31 | 1.14 | Standard | 0 |
| IN-8+07 | INLET - TYPE R-5' | 6,276.39 | 6,272.30 | 1.13 | Standard | 0.13 |
| IN-8+19 | INLET - TYPE R-5' | 6,278.89 | 6,274.73 | 1.27 | Standard | 0.01 |
| IN-8+39 | INLET - TYPE R-5' | 6,278.81 | 6,273.36 | 0.49 | Standard | 0 |
| IN-8+57 | INLET - TYPE R-5' | 6,278.00 | 6,273.00 | 6.5 | Standard | 0.5 |

Drainage Report-StormCAD Results
Element Type:Catch Basin
5-yr US-24 and Peterson Intersection Improvements

| Inlet ID | Inlet Type | Elevation (FL) (ft) | Invert Out (ft) | Flow (Additional Carryover) (cfs) | Headloss Method | Headloss (ft) |
|---|---|---|---|---|---|---|
| IN-0+16 | INLET - TYPE R-10' | 6,268.62 | 6,265.60 | 2.14 | Standard | 0.01 |
| IN-0+18 | INLET - TYPE R-5' | 6,268.60 | 6,265.17 | 1.37 | Standard | 0.28 |
| IN-0+25 | INLET - TYPE C | 6,269.36 | 6,266.43 | 4.92 | Standard | 0.01 |
| IN-0+37 | INLET - TYPE R-10' | 6,267.06 | 6,264.22 | 1.24 | Standard | 0.3 |
| IN-0+38 | INLET - TYPE R-5' | 6,267.10 | 6,264.47 | 0.68 | Standard | 0 |
| IN-0+82 | INLET - TYPE R-5' | 6,270.50 | 6,266.76 | 0.54 | Standard | 0 |
| IN-0+88 | INLET - TYPE R-5' | 6,270.87 | 6,266.32 | 0.87 | Standard | 0.02 |
| IN-1+10 | INLET - TYPE R-5' | 6,270.68 | 6,266.19 | 0.56 | Standard | 0.39 |
| IN-1+11 | INLET - TYPE R-5' | 6,271.31 | 6,265.76 | 0.9 | Standard | 0.03 |
| IN-1+22 | INLET - TYPE R-5' | 6,271.13 | 6,265.98 | 2.03 | Standard | 0.01 |
| IN-1+26 | INLET - TYPE 13 | 6,270.01 | 6,266.34 | 0 | Standard | 0 |
| IN-2+08 | INLET - TYPE R-5' | 6,271.94 | 6,266.82 | 0.17 | Standard | 0.02 |
| IN-2+13 | INLET - TYPE R-5' | 6,272.40 | 6,268.64 | 0.11 | Standard | 0 |
| IN-2+32 | INLET - TYPE R-5' | 6,274.34 | 6,269.54 | 0.71 | Standard | 0 |
| IN-2+64 | INLET - TYPE R-5' | 6,272.37 | 6,268.91 | 0.55 | Standard | 0 |
| IN-2+84 | INLET - TYPE R-5' | 6,272.05 | 6,268.41 | 0.91 | Standard | 0.02 |
| IN-3+11 | INLET - TYPE D | 6,272.24 | 6,268.11 | 3.43 | Standard | 0.01 |
| IN-3+43 | INLET - TYPE C | 6,267.85 | 6,264.90 | 1.74 | Standard | 0.04 |
| IN-3+47 | INLET - TYPE R-10' | 6,272.21 | 6,268.11 | 2.15 | Standard | 0 |
| IN-3+83 | INLET - TYPE R-5' | 6,272.35 | 6,268.08 | 0.58 | Standard | 0 |
| IN-5+32 | INLET - TYPE D | 6,272.31 | 6,269.32 | 0 | Standard | 0 |
| IN-5+41 | INLET - TYPE R-5' | 6,274.33 | 6,262.55 | 0.39 | Standard | 0.75 |
| IN-5+46 | INLET - TYPE R-5' | 6,275.37 | 6,267.55 | 0.39 | Standard | 0 |
| IN-5+49 | INLET - TYPE R-5' | 6,273.68 | 6,269.78 | 0.54 | Standard | 0 |
| IN-5+51 | INLET - TYPE R-5' | 6,275.49 | 6,266.98 | 0.54 | Standard | 0.17 |
| IN-6+51 | INLET - TYPE C | 6,275.21 | 6,270.15 | 2.36 | Standard | 0.45 |
| IN-6+74 | INLET - TYPE R-5' | 6,275.95 | 6,270.86 | 0.6 | Standard | 0.01 |
| IN-6+75 | INLET - TYPE R-5' | 6,276.06 | 6,270.64 | 0.6 | Standard | 0.09 |
| IN-6+77 | INLET - TYPE R-5' | 6,276.64 | 6,272.07 | 1.23 | Standard | 0.01 |
| IN-7+97 | INLET - TYPE R-5' | 6,276.86 | 6,272.31 | 0.52 | Standard | 0 |
| IN-8+07 | INLET - TYPE R-5' | 6,276.39 | 6,272.30 | 0.52 | Standard | 0.04 |
| IN-8+19 | INLET - TYPE R-5' | 6,278.89 | 6,274.73 | 0.58 | Standard | 0 |
| IN-8+39 | INLET - TYPE R-5' | 6,278.81 | 6,273.36 | 0.23 | Standard | 0 |
| IN-8+57 | INLET - TYPE R-5' | 6,278.00 | 6,273.00 | 2.98 | Standard | 0.33 |

## 9.9 FlowMaster Swale Calculations

Flow Master and Hydraulic Toolbox DITCH PROTECTION CALCULATIONS
US24 & Peterson
30% Submission

COMPUTED BY: CMB 12/12/2023
CHECKED: NES 12/12/2023

**5-YR Capacity Calculations**

| Ditch | Solve For | Friction Method | Roughness Coefficient | Channel Slope (ft/ft) | Normal Depth (in) | Design Ditch Depth (in) | Left Side Slope (H:V) | Right Side Slope (H:V) | Bottom Width (ft) | 5-YR Discharge (cfs) | Flow Area (Sq. ft) | Wetted Perimeter (ft) | Hydraulic Radius (in) | Top Width (ft) | Critical Depth (in) | Critical Slope (ft/ft) | Velocity (fps) | Velocity Head (ft) | Specific Energy (ft) | Froude Number | Flow Type | Max Shear (lb/ft$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1+26 | Normal Depth | Manning Formula | 0.035 | 0.031 | 0.9 | 16.86 | 23.20 | 6.00 | - | 0.06 | 0.1 | 2.1 | 0.4 | 2.08 | 0.8 | 0.057 | 0.81 | 0.01 | 0.08 | 0.756 | Subcritical | 0.138 |
| 3+11 | Normal Depth | Manning Formula | 0.035 | 0.015 | 3.8 | 10.00 | 35.71 | 8.53 | - | 3.43 | 2.2 | 14.1 | 1.9 | 14.10 | 3.3 | 0.035 | 1.53 | 0.04 | 0.35 | 0.298 | Subcritical | 0.035 |
| 3+43 | Normal Depth | Manning Formula | 0.035 | 0.040 | 2.5 | 2.95 | 14.43 | 27.62 | - | 1.74 | 0.9 | 8.8 | 1.3 | 8.81 | 2.5 | 0.038 | 1.89 | 0.06 | 0.26 | 1.027 | Supercritical | 0.538 |
| 5+69 | Normal Depth | Manning Formula | 0.035 | 0.018 | 17.9 | 32.40 | 2.26 | 1.56 | 1.08 | 28.21 | 5.9 | 7.5 | 9.3 | 6.78 | 17.2 | 0.022 | 4.82 | 0.36 | 1.85 | 0.913 | Subcritical | 1.674 |
| 6+51 | Normal Depth | Manning Formula | 0.035 | 0.024 | 3.9 | 5.57 | 14.29 | 8.79 | - | 2.36 | 1.2 | 7.5 | 1.9 | 7.48 | 3.6 | 0.034 | 1.95 | 0.06 | 0.38 | 0.854 | Subcritical | 0.485 |
| 7+07 | Normal Depth | Manning Formula | 0.035 | 0.015 | 6.7 | 8.48 | 7.40 | 24.88 | - | 11.18 | 5.0 | 18.1 | 3.3 | 18.04 | 5.9 | 0.029 | 2.22 | 0.08 | 0.64 | 0.740 | Subcritical | 0.523 |

**100-YR Capacity Calculations**

| Ditch | Solve For | Friction Method | Roughness Coefficient | Channel Slope (ft/ft) | Normal Depth (in) | Design Ditch Depth (in) | Left Side Slope (H:V) | Right Side Slope (H:V) | Bottom Width (ft) | 100-YR Discharge (cfs) | Flow Area (Sq. ft) | Wetted Perimeter (ft) | Hydraulic Radius (in) | Top Width (ft) | Critical Depth (in) | Critical Slope (ft/ft) | Velocity (fps) | Velocity Head (ft) | Specific Energy (ft) | Froude Number | Flow Type | Max Shear (lb/ft$^2$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1+26 | Normal Depth | Manning Formula | 0.035 | 0.031 | 4.8 | 16.9 | 23.20 | 6.00 | - | 6.00 | 2.3 | 11.8 | 2.4 | 11.71 | 4.8 | 0.031 | 2.56 | 0.10 | 0.50 | 1.006 | Supercritical | 0.776 |
| 3+11 | Normal Depth | Manning Formula | 0.035 | 0.015 | 5.3 | 10.0 | 35.71 | 8.53 | - | 8.04 | 4.3 | 19.4 | 2.6 | 19.41 | 4.6 | 0.031 | 1.89 | 0.06 | 0.49 | 0.711 | Subcritical | 0.411 |
| 3+43 | Normal Depth | Manning Formula | 0.035 | 0.040 | 3.5 | 3.0 | 27.62 | 27.62 | - | 4.06 | 1.7 | 12.1 | 1.7 | 12.10 | 3.6 | 0.034 | 2.33 | 0.08 | 0.37 | 1.083 | Supercritical | 0.739 |
| 5+69 | Normal Depth | Manning Formula | 0.035 | 0.018 | 25.9 | 32.4 | 2.26 | 1.56 | 1.08 | 67.33 | 11.2 | 10.4 | 12.9 | 9.33 | 25.5 | 0.020 | 5.99 | 0.56 | 2.72 | 0.962 | Subcritical | 2.425 |
| 6+51 | Normal Depth | Manning Formula | 0.035 | 0.024 | 5.3 | 5.6 | 14.29 | 8.79 | - | 5.29 | 2.2 | 10.2 | 2.6 | 10.12 | 5 | 0.030 | 2.39 | 0.09 | 0.53 | 0.898 | Subcritical | 0.657 |
| 7+07 | Normal Depth | Manning Formula | 0.035 | 0.015 | 9.9 | 8.5 | 24.88 | 24.88 | - | 31.74 | 11.0 | 26.7 | 4.9 | 26.68 | 9 | 0.025 | 2.88 | 0.13 | 0.96 | 0.790 | Subcritical | 0.774 |

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 1+26-5yr

Notes:

### Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 23.2000 ft/ft
Side Slope 2 (Z2): 6.0000 ft/ft
Longitudinal Slope: 0.0310 ft/ft
Manning's n: 0.0350
Flow 0.0600 cfs

### Result Parameters

Depth 0.0713 ft
Area of Flow 0.0743 ft^2
Wetted Perimeter 2.0900 ft
Hydraulic Radius 0.0355 ft
Average Velocity 0.8079 ft/s
Top Width 2.0825 ft
Froude Number: 0.7540
Critical Depth 0.0694 ft
Critical Velocity 0.8540 ft/s
Critical Slope: 0.0359 ft/ft
Critical Top Width 3.10 ft
Calculated Max Shear Stress 0.1380 lb/ft^2
Calculated Avg Shear Stress 0.0687 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON

Designer:

Project Date: Monday, December 11, 2023

Project Units: U.S. Customary Units

Notes:

## Channel Analysis: DITCH 1+26-100yr

Notes:

### Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 23.2000 ft/ft

Side Slope 2 (Z2): 6.0000 ft/ft

Longitudinal Slope: 0.0310 ft/ft

Manning's n: 0.0350

Flow 6.0000 cfs

### Result Parameters

Depth 0.4011 ft

Area of Flow 2.3484 ft^2

Wetted Perimeter 11.7527 ft

Hydraulic Radius 0.1998 ft

Average Velocity 2.5550 ft/s

Top Width 11.7109 ft

Froude Number: 1.0055

Critical Depth 0.4377 ft

Critical Velocity 2.1452 ft/s

Critical Slope: 0.0194 ft/ft

Critical Top Width 19.57 ft

Calculated Max Shear Stress 0.7758 lb/ft^2

Calculated Avg Shear Stress 0.3865 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units:  U.S. Customary Units
Notes:

## Channel Analysis: DITCH 3+11-5yr

Notes:

### Input Parameters

Channel Type:  Triangular
Side Slope 1 (Z1): 35.7100 ft/ft
Side Slope 2 (Z2): 8.5300 ft/ft
Longitudinal Slope: 0.0150 ft/ft
Manning's n:  0.0350
Flow 3.4300 cfs

### Result Parameters

Depth 0.3187 ft
Area of Flow 2.2467 ft^2
Wetted Perimeter 14.1222 ft
Hydraulic Radius 0.1591 ft
Average Velocity 1.5267 ft/s
Top Width 14.0991 ft
Froude Number:  0.6740
Critical Depth 0.2992 ft
Critical Velocity 1.7318 ft/s
Critical Slope: 0.0210 ft/ft
Critical Top Width 21.26 ft
Calculated Max Shear Stress 0.2983 lb/ft^2
Calculated Avg Shear Stress 0.1489 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 3+11-100yr

Notes:

### Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 35.7100 ft/ft
Side Slope 2 (Z2): 8.5300 ft/ft
Longitudinal Slope: 0.0150 ft/ft
Manning's n: 0.0350
Flow 8.0400 cfs

### Result Parameters

Depth 0.4386 ft
Area of Flow 4.2561 ft^2
Wetted Perimeter 19.4374 ft
Hydraulic Radius 0.2190 ft
Average Velocity 1.8891 ft/s
Top Width 19.4056 ft
Froude Number: 0.7108
Critical Depth 0.4207 ft
Critical Velocity 2.0535 ft/s
Critical Slope: 0.0187 ft/ft
Critical Top Width 29.90 ft
Calculated Max Shear Stress 0.4106 lb/ft^2
Calculated Avg Shear Stress 0.2050 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units:  U.S. Customary Units
Notes:

## Channel Analysis: DITCH 3+43-5yr

Notes:

### Input Parameters

Channel Type:  Triangular
Side Slope 1 (Z1): 14.4300 ft/ft
Side Slope 2 (Z2): 24.6200 ft/ft
Longitudinal Slope: 0.0400 ft/ft
Manning's n:  0.0350
Flow 1.7400 cfs

### Result Parameters

Depth 0.2154 ft
Area of Flow 0.9060 ft^2
Wetted Perimeter 8.4238 ft
Hydraulic Radius 0.1076 ft
Average Velocity 1.9205 ft/s
Top Width 8.4120 ft
Froude Number:  1.0312
Critical Depth 0.2212 ft
Critical Velocity 1.8217 ft/s
Critical Slope: 0.0347 ft/ft
Critical Top Width 9.27 ft
Calculated Max Shear Stress 0.5377 lb/ft^2
Calculated Avg Shear Stress 0.2685 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units:  U.S. Customary Units
Notes:

## Channel Analysis: DITCH 3+43-100yr

Notes:

### Input Parameters

Channel Type:  Triangular
Side Slope 1 (Z1): 14.4300 ft/ft
Side Slope 2 (Z2): 24.6200 ft/ft
Longitudinal Slope: 0.0400 ft/ft
Manning's n:  0.0350
Flow 4.0600 cfs

### Result Parameters

Depth 0.2960 ft
Area of Flow 1.7105 ft^2
Wetted Perimeter 11.5744 ft
Hydraulic Radius 0.1478 ft
Average Velocity 2.3736 ft/s
Top Width 11.5582 ft
Froude Number:  1.0873
Critical Depth 0.3104 ft
Critical Velocity 2.1581 ft/s
Critical Slope: 0.0310 ft/ft
Critical Top Width 13.01 ft
Calculated Max Shear Stress 0.7388 lb/ft^2
Calculated Avg Shear Stress 0.3689 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 5+69-5yr

Notes:

### Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 2.2600 ft/ft
Side Slope 2 (Z2): 1.5600 ft/ft
Channel Width 1.08 ft
Longitudinal Slope: 0.0180 ft/ft
Manning's n: 0.0350
Flow 28.2100 cfs

### Result Parameters

Depth 1.4908 ft
Area of Flow 5.8550 ft^2
Wetted Perimeter 7.5268 ft
Hydraulic Radius 0.7779 ft
Average Velocity 4.8181 ft/s
Top Width 6.7749 ft
Froude Number: 0.9133
Critical Depth 1.4296 ft
Critical Velocity 5.1786 ft/s
Critical Slope: 0.0218 ft/ft
Critical Top Width 6.54 ft
Calculated Max Shear Stress 1.6745 lb/ft^2
Calculated Avg Shear Stress 0.8737 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 5+69-100yr

Notes:

### Input Parameters

Channel Type: Trapezoidal
Side Slope 1 (Z1): 2.2600 ft/ft
Side Slope 2 (Z2): 1.5600 ft/ft
Channel Width 1.08 ft
Longitudinal Slope: 0.0180 ft/ft
Manning's n: 0.0350
Flow 67.3300 cfs

### Result Parameters

Depth 2.1593 ft
Area of Flow 11.2374 ft^2
Wetted Perimeter 10.4175 ft
Hydraulic Radius 1.0787 ft
Average Velocity 5.9916 ft/s
Top Width 9.3284 ft
Froude Number: 0.9620
Critical Depth 2.1224 ft
Critical Velocity 6.1795 ft/s
Critical Slope: 0.0195 ft/ft
Critical Top Width 9.19 ft
Calculated Max Shear Stress 2.4253 lb/ft^2
Calculated Avg Shear Stress 1.2116 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 6+51-5yr

Notes:

### Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 14.2900 ft/ft
Side Slope 2 (Z2): 8.7900 ft/ft
Longitudinal Slope: 0.0240 ft/ft
Manning's n: 0.0350
Flow 2.3600 cfs

### Result Parameters

Depth 0.3239 ft
Area of Flow 1.2108 ft^2
Wetted Perimeter 7.5057 ft
Hydraulic Radius 0.1613 ft
Average Velocity 1.9491 ft/s
Top Width 7.4760 ft
Froude Number: 0.8535
Critical Depth 0.3076 ft
Critical Velocity 2.1613 ft/s
Critical Slope: 0.0316 ft/ft
Critical Top Width 7.53 ft
Calculated Max Shear Stress 0.4851 lb/ft^2
Calculated Avg Shear Stress 0.2416 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 6+51-100yr

Notes:

### Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 14.2900 ft/ft
Side Slope 2 (Z2): 8.7900 ft/ft
Longitudinal Slope: 0.0240 ft/ft
Manning's n: 0.0350
Flow 5.2900 cfs

### Result Parameters

Depth 0.4384 ft
Area of Flow 2.2181 ft^2
Wetted Perimeter 10.1588 ft
Hydraulic Radius 0.2183 ft
Average Velocity 2.3849 ft/s
Top Width 10.1186 ft
Froude Number: 0.8977
Critical Depth 0.4248 ft
Critical Velocity 2.5399 ft/s
Critical Slope: 0.0284 ft/ft
Critical Top Width 10.40 ft
Calculated Max Shear Stress 0.6566 lb/ft^2
Calculated Avg Shear Stress 0.3270 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON

Designer:

Project Date: Monday, December 11, 2023

Project Units: U.S. Customary Units

Notes:

## Channel Analysis: DITCH 7+07-5yr

Notes:

### Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 7.4000 ft/ft

Side Slope 2 (Z2): 24.8800 ft/ft

Longitudinal Slope: 0.0150 ft/ft

Manning's n: 0.0350

Flow 11.1800 cfs

### Result Parameters

Depth 0.5588 ft

Area of Flow 5.0398 ft^2

Wetted Perimeter 18.0868 ft

Hydraulic Radius 0.2786 ft

Average Velocity 2.2183 ft/s

Top Width 18.0380 ft

Froude Number: 0.7396

Critical Depth 0.5309 ft

Critical Velocity 2.4578 ft/s

Critical Slope: 0.0197 ft/ft

Critical Top Width 24.25 ft

Calculated Max Shear Stress 0.5230 lb/ft^2

Calculated Avg Shear Stress 0.2608 lb/ft^2

# Hydraulic Analysis Report

## Project Data

Project Title: US24PETERSON
Designer:
Project Date: Monday, December 11, 2023
Project Units: U.S. Customary Units
Notes:

## Channel Analysis: DITCH 7+07-100yr

Notes:

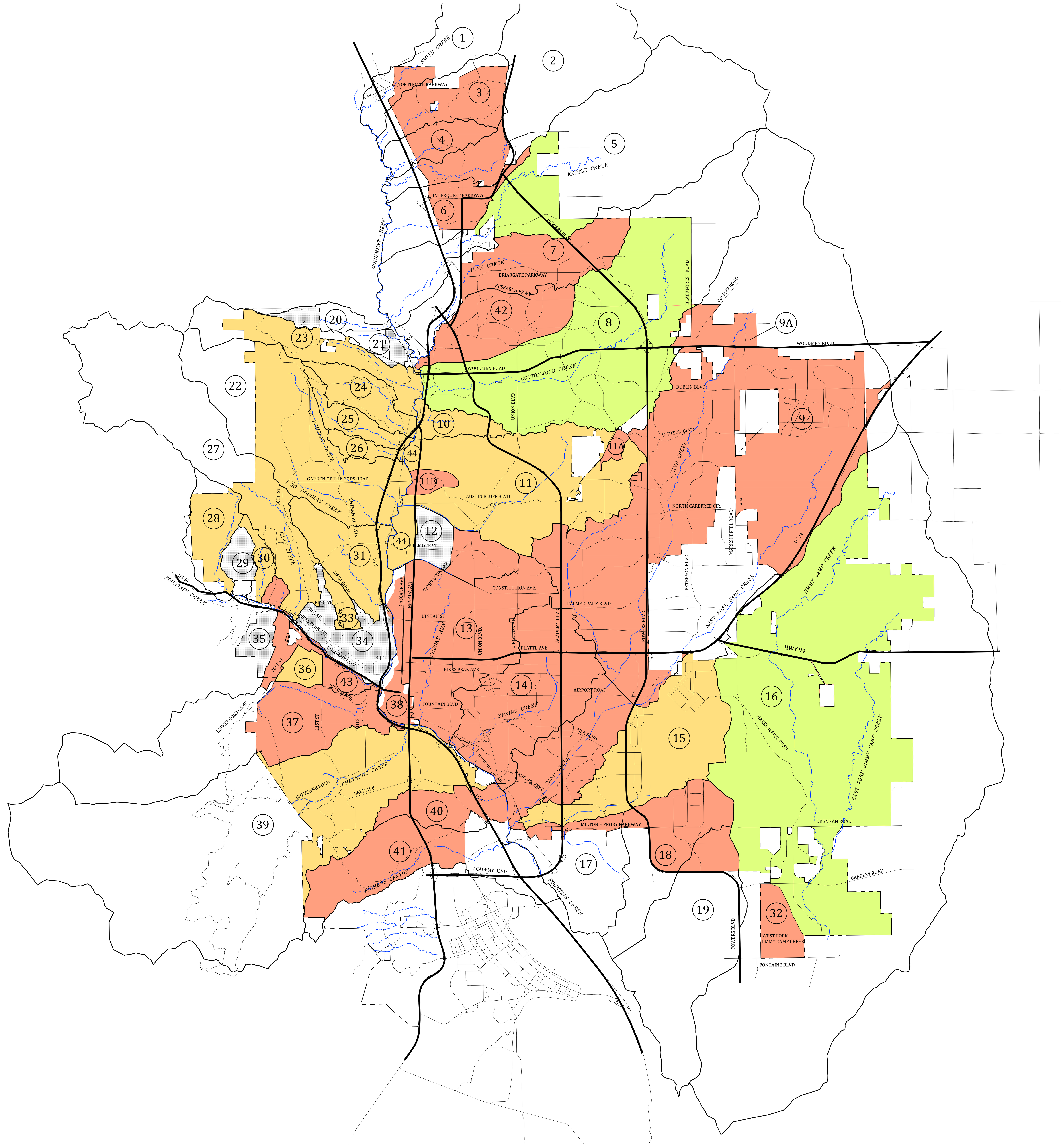
### Input Parameters

Channel Type: Triangular
Side Slope 1 (Z1): 7.4000 ft/ft
Side Slope 2 (Z2): 24.8800 ft/ft
Longitudinal Slope: 0.0150 ft/ft
Manning's n: 0.0350
Flow 31.7400 cfs

### Result Parameters

Depth 0.8264 ft
Area of Flow 11.0226 ft^2
Wetted Perimeter 26.7484 ft
Hydraulic Radius 0.4121 ft
Average Velocity 2.8795 ft/s
Top Width 26.6762 ft
Froude Number: 0.7894
Critical Depth 0.8059 ft
Critical Velocity 3.0282 ft/s
Critical Slope: 0.0172 ft/ft
Critical Top Width 36.81 ft
Calculated Max Shear Stress 0.7735 lb/ft^2
Calculated Avg Shear Stress 0.3857 lb/ft^2

## 9.10 Colorado Springs Drainage Basin Master Plan




LEGEND

CITY LIMITS

BASIN BOUNDARY

2014 DCM

POST-1987 DCM

PRE - 1987 DCM

UNSTUDIED

1 BASIN NUMBER

| BASIN NUMBER | BASIN NAME |
|---|---|
| 1 | SMITH CREEK |
| 2 | BLACK SQUIRREL CREEK |
| 3 | MONUMENT BRANCH |
| 4 | MIDDLE TRIBUTARY |
| 5 | KETTLE CREEK |
| 6 | ELKHORN |
| 7 | PINE CREEK |
| 8 | COTTONWOOD CREEK |
| 9 | SAND CREEK |
| 9A | UPPER SAND CREEK |
| 10 | PULPIT ROCK |
| 11 | NORTH SHOOKS RUN TEMPLETON GAP BASIN |
| 11A | SHOOKS RUN NORTH TEMPLETON GAP BASIN A |
| 11B | ADDENDUM NORTH SHOOKS RUN TEMPLETON GAP BASIN |
| 12 | UNSTUDIED MISCELLANEOUS BASIN |
| 13 | SHOOKS RUN |
| 14 | SPRING CREEK |
| 15 | PETERSON FIELD |
| 16 | JIMMY CAMP CREEK |
| 17 | LITTLE JOHNSON RESERVOIR |
| 18 | WINDMILL GULCH |
| 19 | BIG JOHNSON RESERVOIR CREWS GULCH |
| 20 | UNSTUDIED |

| BASIN NUMBER | BASIN NAME |
|---|---|
| 21 | UNSTUDIED |
| 22 | DOUGLAS CREEK |
| 23 | DRY CREEK |
| 24 | ROCKRIMMON NORTH |
| 25 | ROCKRIMMON SOUTH |
| 26 | POPES BLUFF |
| 27 | CAMP CREEK |
| 28 | BLACK CANYON |
| 29 | BALANCED ROCK |
| 30 | COLUMBIA ROAD |
| 31 | MESA DRAINAGE BASIN |
| 32 | WEST FORK JIMMY CAMP CREEK |
| 33 | NINETEENTH STREET |
| 34 | WESTSIDE BASIN |
| 35 | MIDLAND BASIN |
| 36 | TWENTY-FIRST STREET SOUTH |
| 37 | BEAR CREEK |
| 38 | MONUMENT CREEK |
| 39 | SOUTHWEST AREA UPPER CHEYENNE CREEK, CHEYENNE RUN, AND SPRING RUN |
| 40 | STRATTON BASIN |
| 41 | FISHERS CANYON |
| 42 | SOUTH PINE CREEK |
| 43 | FOUNTAIN CREEK |
| 44 | ROSWELL |

0 4000' 8000'

SCALE: 1"=4000'

17002 basin map.dwg/Jul 19, 2017

| | |
|---|---|
| Project No.: | 17002 |
| Date: | 7/13/17 |
| Design: | RNW |
| Drawn: | EAK |
| Check: | RNW |
| Revisions: | |

# DRAINAGE BASIN PLANNING STUDY INVENTORY

CITY OF COLORADO SPRINGS, COLORADO

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

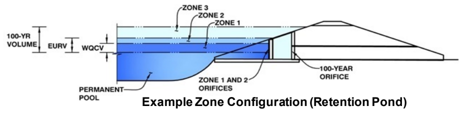
# 9.11 Colorado Springs Water Quality Sizing Worksheets

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**Project:** ______________________

**Basin ID:** ______________________




**Example Zone Configuration (Retention Pond)**

Depth Increment = 0.50 ft

## Watershed Information

| | | | Optional User Overrides | |
|---|---|---|---|---|
| Selected BMP Type = | **EDB** | | | |
| Watershed Area = | 4.32 | acres | | |
| Watershed Length = | 1,195 | ft | | |
| Watershed Length to Centroid = | 582 | ft | | |
| Watershed Slope = | 0.024 | ft/ft | | |
| Watershed Imperviousness = | 47.00% | percent | | |
| Percentage Hydrologic Soil Group A = | 87.0% | percent | | |
| Percentage Hydrologic Soil Group B = | 13.0% | percent | | |
| Percentage Hydrologic Soil Groups C/D = | 0.0% | percent | | |
| Target WQCV Drain Time = | 40.0 | hours | | |
| Location for 1-hr Rainfall Depths = | User Input | | | |

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

| | | | Optional User Overrides | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.071 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.228 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.02 in.) = | 0.143 | acre-feet | 1.02 | inches |
| 5-yr Runoff Volume (P1 = 1.3 in.) = | 0.195 | acre-feet | 1.30 | inches |
| 10-yr Runoff Volume (P1 = 1.57 in.) = | 0.245 | acre-feet | 1.57 | inches |
| 25-yr Runoff Volume (P1 = 1.99 in.) = | 0.371 | acre-feet | 1.99 | inches |
| 50-yr Runoff Volume (P1 = 2.35 in.) = | 0.481 | acre-feet | 2.35 | inches |
| 100-yr Runoff Volume (P1 = 2.74 in.) = | 0.627 | acre-feet | 2.74 | inches |
| 500-yr Runoff Volume (P1 = 3.79 in.) = | 1.000 | acre-feet | 3.79 | inches |
| Approximate 2-yr Detention Volume = | 0.128 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.172 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.221 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.296 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 0.344 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 0.406 | acre-feet | | |

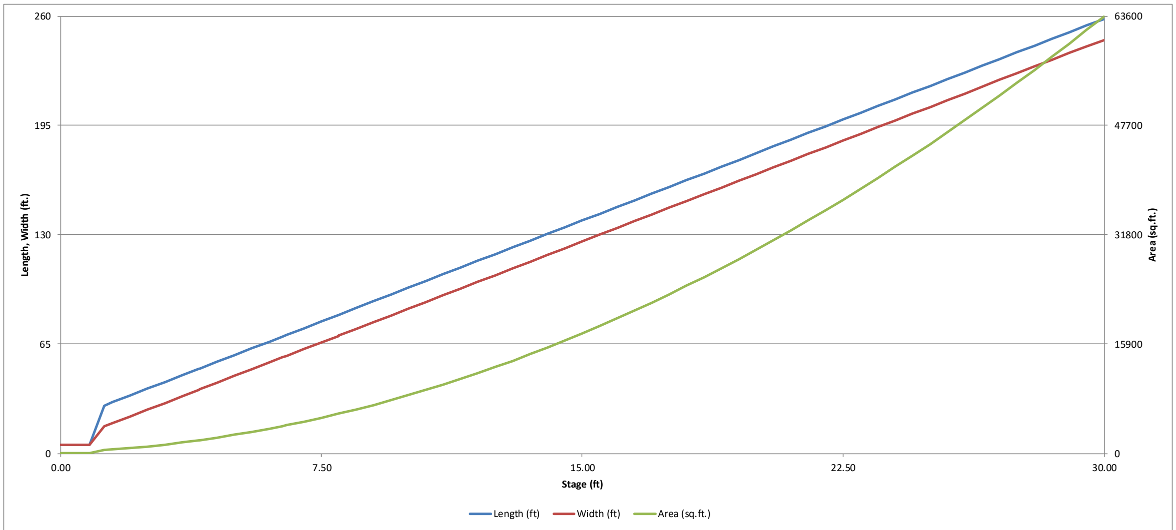
## Define Zones and Basin Geometry

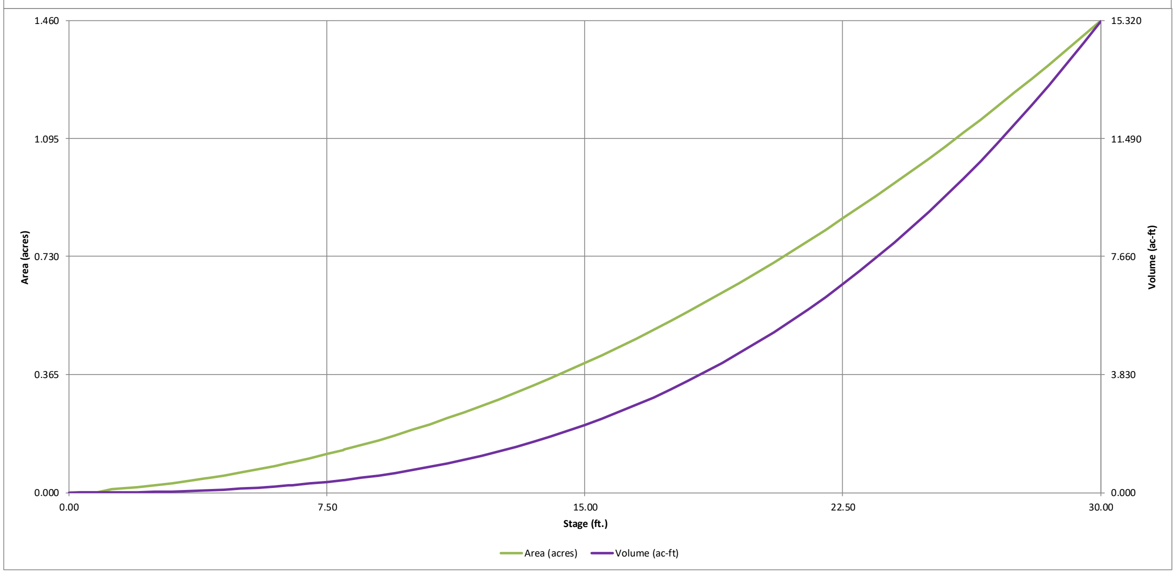
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.071 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 0.157 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 0.178 | acre-feet |
| Total Detention Basin Volume = | 0.406 | acre-feet |
| Initial Surcharge Volume (ISV) = | 9 | $ft^3$ |
| Initial Surcharge Depth (ISD) = | 0.33 | ft |
| Total Available Detention Depth ($H_{total}$) = | 8.00 | ft |
| Depth of Trickle Channel ($H_{TC}$) = | 0.50 | ft |
| Slope of Trickle Channel ($S_{TC}$) = | 0.020 | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | 4 | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | 2 | |
| Initial Surcharge Area ($A_{ISV}$) = | 28 | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | 5.3 | ft |
| Surcharge Volume Width ($W_{ISV}$) = | 5.3 | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | 0.43 | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | 28.5 | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | 16.0 | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | 457 | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | 86 | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | 6.74 | ft |
| Length of Main Basin ($L_{MAIN}$) = | 82.4 | ft |
| Width of Main Basin ($W_{MAIN}$) = | 69.9 | ft |
| Area of Main Basin ($A_{MAIN}$) = | 5,763 | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | 17,616 | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **0.407** | acre-feet |

| 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 | | 5.3 | 5.3 | 28 | | 0.001 | | |
| | 0.33 | | 5.3 | 5.3 | 28 | | 0.001 | 9 | 0.000 |
| | 0.83 | | 5.3 | 5.3 | 28 | | 0.001 | 23 | 0.001 |
| **Floor** | 1.26 | | 28.3 | 16.0 | 453 | | 0.010 | 108 | 0.002 |
| | 1.50 | | 30.4 | 17.9 | 545 | | 0.013 | 228 | 0.005 |
| | 2.00 | | 34.4 | 21.9 | 755 | | 0.017 | 552 | 0.013 |
| | 2.50 | | 38.4 | 25.9 | 996 | | 0.023 | 989 | 0.023 |
| | 3.00 | | 42.4 | 29.9 | 1,270 | | 0.029 | 1,554 | 0.036 |
| | 3.50 | | 46.4 | 33.9 | 1,575 | | 0.036 | 2,264 | 0.052 |
| **Zone 1 (WQCV)** | 3.99 | | 50.3 | 37.9 | 1,905 | | 0.044 | 3,115 | 0.072 |
| | 4.00 | | 50.4 | 37.9 | 1,912 | | 0.044 | 3,134 | 0.072 |
| | 4.50 | | 54.4 | 41.9 | 2,282 | | 0.052 | 4,181 | 0.096 |
| | 5.00 | | 58.4 | 45.9 | 2,683 | | 0.062 | 5,421 | 0.124 |
| | 5.50 | | 62.4 | 49.9 | 3,116 | | 0.072 | 6,870 | 0.158 |
| | 6.00 | | 66.4 | 53.9 | 3,582 | | 0.082 | 8,543 | 0.196 |
| **Zone 2 (EURV)** | 6.38 | | 69.4 | 57.0 | 3,957 | | 0.091 | 9,975 | 0.229 |
| | 6.50 | | 70.4 | 57.9 | 4,079 | | 0.094 | 10,457 | 0.240 |
| | 7.00 | | 74.4 | 61.9 | 4,609 | | 0.106 | 12,628 | 0.290 |
| | 7.50 | | 78.4 | 65.9 | 5,170 | | 0.119 | 15,071 | 0.346 |
| **Zone 3 (100-year)** | 7.99 | | 82.3 | 69.9 | 5,751 | | 0.132 | 17,745 | 0.407 |
| | 8.00 | | 82.4 | 69.9 | 5,763 | | 0.132 | 17,803 | 0.409 |
| | 8.50 | | 86.4 | 73.9 | 6,389 | | 0.147 | 20,840 | 0.478 |
| | 9.00 | | 90.4 | 77.9 | 7,046 | | 0.162 | 24,197 | 0.555 |
| | 9.50 | | 94.4 | 81.9 | 7,736 | | 0.178 | 27,891 | 0.640 |
| | 10.00 | | 98.4 | 85.9 | 8,457 | | 0.194 | 31,938 | 0.733 |
| | 10.50 | | 102.4 | 89.9 | 9,210 | | 0.211 | 36,353 | 0.835 |
| | 11.00 | | 106.4 | 93.9 | 9,996 | | 0.229 | 41,154 | 0.945 |
| | 11.50 | | 110.4 | 97.9 | 10,813 | | 0.248 | 46,354 | 1.064 |
| | 12.00 | | 114.4 | 101.9 | 11,662 | | 0.268 | 51,972 | 1.193 |
| | 12.50 | | 118.4 | 105.9 | 12,544 | | 0.288 | 58,022 | 1.332 |
| | 13.00 | | 122.4 | 109.9 | 13,457 | | 0.309 | 64,521 | 1.481 |
| | 13.50 | | 126.4 | 113.9 | 14,403 | | 0.331 | 71,485 | 1.641 |
| | 14.00 | | 130.4 | 117.9 | 15,380 | | 0.353 | 78,929 | 1.812 |
| | 14.50 | | 134.4 | 121.9 | 16,389 | | 0.376 | 86,870 | 1.994 |
| | 15.00 | | 138.4 | 125.9 | 17,431 | | 0.400 | 95,324 | 2.188 |
| | 15.50 | | 142.4 | 129.9 | 18,504 | | 0.425 | 104,306 | 2.395 |
| | 16.00 | | 146.4 | 133.9 | 19,610 | | 0.450 | 113,833 | 2.613 |
| | 16.50 | | 150.4 | 137.9 | 20,747 | | 0.476 | 123,921 | 2.845 |
| | 17.00 | | 154.4 | 141.9 | 21,916 | | 0.503 | 134,585 | 3.090 |
| | 17.50 | | 158.4 | 145.9 | 23,118 | | 0.531 | 145,843 | 3.348 |
| | 18.00 | | 162.4 | 149.9 | 24,351 | | 0.559 | 157,708 | 3.620 |
| | 18.50 | | 166.4 | 153.9 | 25,616 | | 0.588 | 170,199 | 3.907 |
| | 19.00 | | 170.4 | 157.9 | 26,914 | | 0.618 | 183,330 | 4.209 |
| | 19.50 | | 174.4 | 161.9 | 28,243 | | 0.648 | 197,118 | 4.525 |
| | 20.00 | | 178.4 | 165.9 | 29,605 | | 0.680 | 211,579 | 4.857 |
| | 20.50 | | 182.4 | 169.9 | 30,998 | | 0.712 | 226,728 | 5.205 |
| | 21.00 | | 186.4 | 173.9 | 32,423 | | 0.744 | 242,582 | 5.569 |
| | 21.50 | | 190.4 | 177.9 | 33,881 | | 0.778 | 259,157 | 5.949 |
| | 22.00 | | 194.4 | 181.9 | 35,370 | | 0.812 | 276,468 | 6.347 |
| | 22.50 | | 198.4 | 185.9 | 36,891 | | 0.847 | 294,532 | 6.762 |
| | 23.00 | | 202.4 | 189.9 | 38,445 | | 0.883 | 313,365 | 7.194 |
| | 23.50 | | 206.4 | 193.9 | 40,030 | | 0.919 | 332,982 | 7.644 |
| | 24.00 | | 210.4 | 197.9 | 41,648 | | 0.956 | 353,400 | 8.113 |
| | 24.50 | | 214.4 | 201.9 | 43,297 | | 0.994 | 374,635 | 8.600 |
| | 25.00 | | 218.4 | 205.9 | 44,978 | | 1.033 | 396,703 | 9.107 |
| | 25.50 | | 222.4 | 209.9 | 46,692 | | 1.072 | 419,619 | 9.633 |
| | 26.00 | | 226.4 | 213.9 | 48,437 | | 1.112 | 443,400 | 10.179 |
| | 26.50 | | 230.4 | 217.9 | 50,215 | | 1.153 | 468,061 | 10.745 |
| | 27.00 | | 234.4 | 221.9 | 52,024 | | 1.194 | 493,620 | 11.332 |
| | 27.50 | | 238.4 | 225.9 | 53,865 | | 1.237 | 520,091 | 11.940 |
| | 28.00 | | 242.4 | 229.9 | 55,739 | | 1.280 | 547,490 | 12.569 |
| | 28.50 | | 246.4 | 233.9 | 57,644 | | 1.323 | 575,835 | 13.219 |
| | 29.00 | | 250.4 | 237.9 | 59,581 | | 1.368 | 605,140 | 13.892 |
| | 29.50 | | 254.4 | 241.9 | 61,551 | | 1.413 | 635,421 | 14.587 |
| | 30.00 | | 258.4 | 245.9 | 63,552 | | 1.459 | 666,696 | 15.305 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*



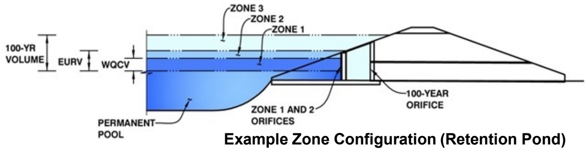



# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project:**

**Basin ID:**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 3.99 | 0.071 | Orifice Plate |
| Zone 2 (EURV) | 6.38 | 0.157 | Orifice Plate |
| Zone 3 (100-year) | 7.99 | 0.178 | Weir&Pipe (Restrict) |
| Total (all zones) | | 0.406 | |

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

| | | | | Calculated Parameters for Underdrain | | |
|---|---|---|---|---|---|---|
| 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 |

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

| | | | | Calculated Parameters for Plate | | |
|---|---|---|---|---|---|---|
| Centroid of Lowest Orifice = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | | WQ Orifice Area per Row = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 6.38 | ft (relative to basin bottom at Stage = 0 ft) | | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | 25.50 | inches | | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | | sq. inches | | Elliptical Slot Area = | N/A | $ft^2$ |

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

| | Row 1 (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 | 2.13 | 4.25 | | | | | |
| Orifice Area (sq. inches) | 0.00 | 0.00 | 0.00 | | | | | |

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

User Input: Vertical Orifice (Circular or Rectangular)

| | Not Selected | Not Selected | | Calculated Parameters for Vertical Orifice | 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 | | | | |

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 | | Calculated Parameters for Overflow Weir | Zone 3 Weir | Not Selected | |
|---|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 6.38 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | | N/A | feet |
| Overflow Weir Front Edge Length = | | N/A | feet | Overflow Weir Slope Length = | | N/A | feet |
| Overflow Weir Grate Slope = | | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | | N/A | |
| Horiz. Length of Weir Sides = | | N/A | feet | Overflow Grate Open Area w/o Debris = | | N/A | $ft^2$ |
| Overflow Grate Type = | Close Mesh Grate | N/A | | Overflow Grate Open Area w/ Debris = | | N/A | $ft^2$ |
| Debris Clogging % = | | N/A | % | | | | |

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

| | Zone 3 Restrictor | Not Selected | | Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | | N/A | $ft^2$ |
| Outlet Pipe Diameter = | | N/A | inches | Outlet Orifice Centroid = | | N/A | feet |
| Restrictor Plate Height Above Pipe Invert = | | | inches | Half-Central Angle of Restrictor Plate on Pipe = | | N/A | radians |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | Calculated Parameters for Spillway | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | | feet |
| Spillway Crest Length = | | feet | Stage at Top of Freeboard = | | feet |
| Spillway End Slopes = | | H:V | Basin Area at Top of Freeboard = | | acres |
| Freeboard above Max Water Surface = | | feet | Basin Volume at Top of Freeboard = | | acre-ft |

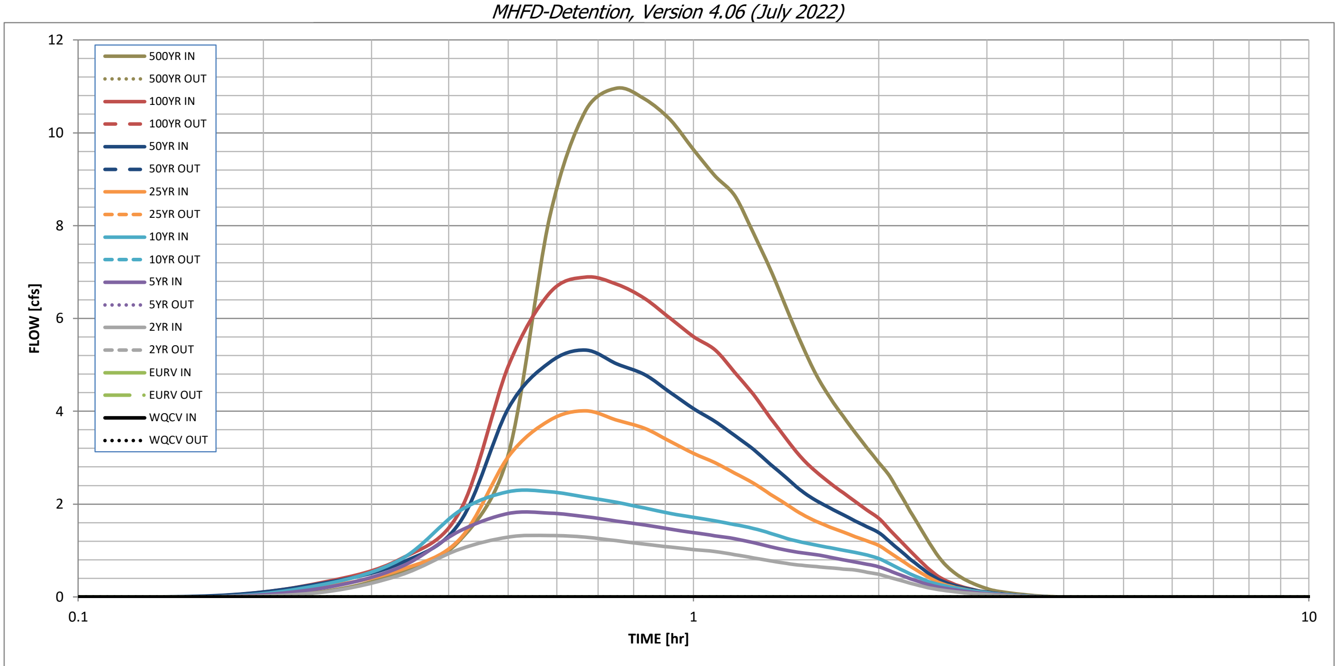
Routed Hydrograph Results

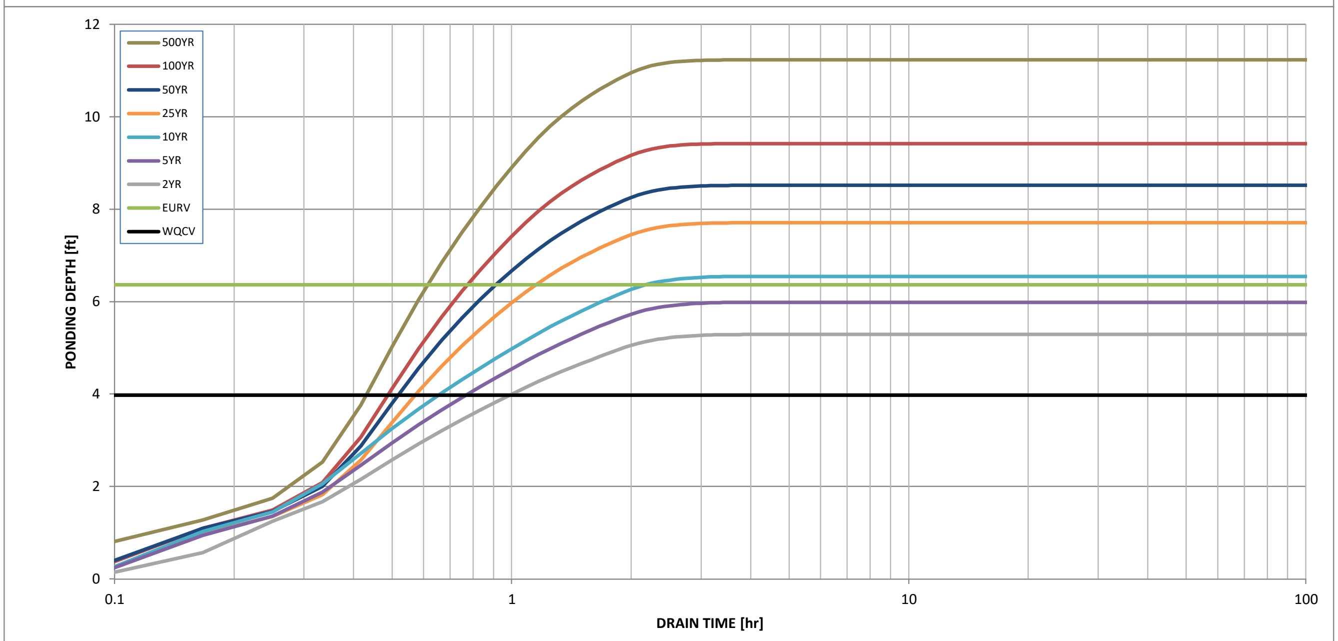
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

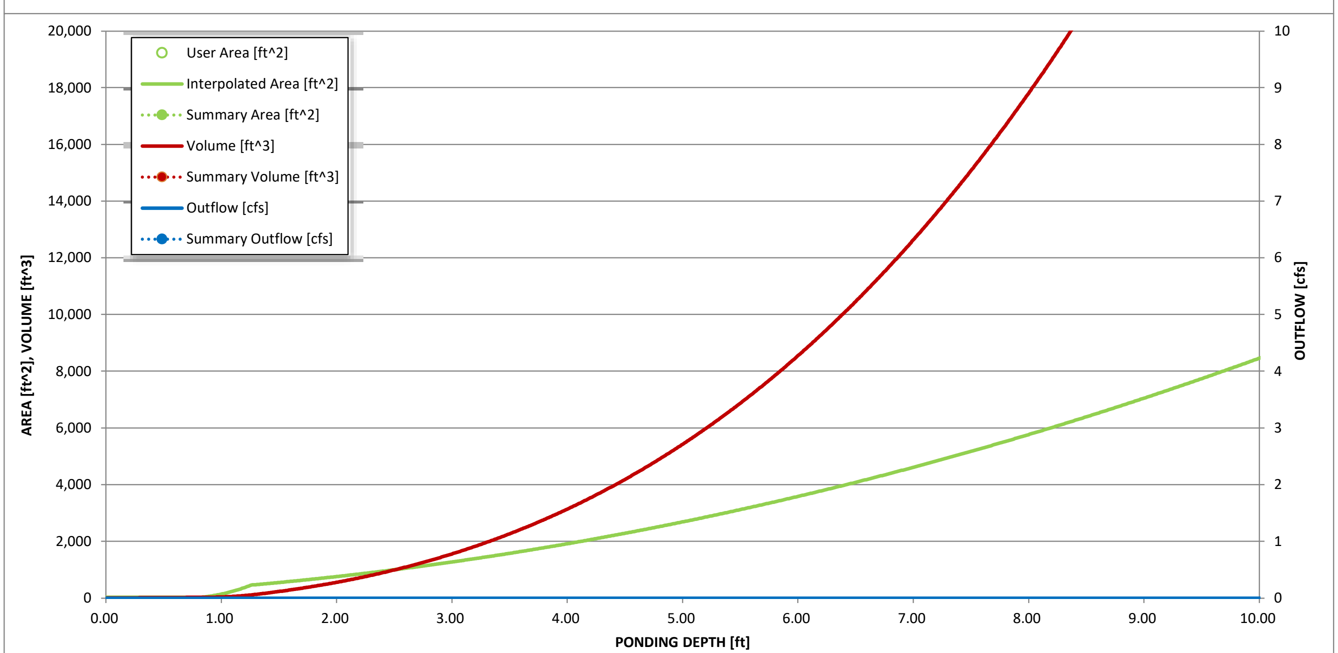
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.02 | 1.30 | 1.57 | 1.99 | 2.35 | 2.74 | 3.79 |
| CUHP Runoff Volume (acre-ft) = | 0.071 | 0.228 | 0.143 | 0.195 | 0.245 | 0.371 | 0.481 | 0.627 | 1.000 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.143 | 0.195 | 0.245 | 0.371 | 0.481 | 0.627 | 1.000 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.0 | 0.0 | 0.0 | 0.8 | 1.5 | 2.5 | 5.0 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.00 | 0.01 | 0.01 | 0.18 | 0.34 | 0.57 | 1.16 |
| Peak Inflow Q (cfs) = | N/A | N/A | 1.3 | 1.8 | 2.3 | 4.0 | 5.3 | 6.9 | 11.0 |
| Peak Outflow Q (cfs) = | | | | | | | | | |
| Ratio Peak Outflow to Predevelopment Q = | | | | | | | | | |
| Structure Controlling Flow = | | | | | | | | | |
| Max Velocity through Grate 1 (fps) = | | | | | | | | | |
| Max Velocity through Grate 2 (fps) = | | | | | | | | | |
| Time to Drain 97% of Inflow Volume (hours) = | | | | | | | | | |
| Time to Drain 99% of Inflow Volume (hours) = | | | | | | | | | |
| Maximum Ponding Depth (ft) = | | | | | | | | | |
| Area at Maximum Ponding Depth (acres) = | | | | | | | | | |
| Maximum Volume Stored (acre-ft) = | | | | | | | | | |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*



# DETENTION BASIN OUTLET STRUCTURE DESIGN

*Outflow Hydrograph Workbook Filename:*

Inflow Hydrographs

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

| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Interval | TIME | WQCV [cfs] | EURV [cfs] | 2 Year [cfs] | 5 Year [cfs] | 10 Year [cfs] | 25 Year [cfs] | 50 Year [cfs] | 100 Year [cfs] | 500 Year [cfs] |
| 5.00 min | 0:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 0:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.12 |
| | 0:15:00 | 0.00 | 0.00 | 0.11 | 0.20 | 0.27 | 0.22 | 0.30 | 0.32 | 0.53 |
| | 0:20:00 | 0.00 | 0.00 | 0.47 | 0.64 | 0.80 | 0.58 | 0.73 | 0.82 | 1.22 |
| | 0:25:00 | 0.00 | 0.00 | 1.03 | 1.42 | 1.85 | 1.24 | 1.60 | 1.83 | 3.06 |
| | 0:30:00 | 0.00 | 0.00 | 1.29 | 1.80 | 2.27 | 3.02 | 4.06 | 4.97 | 8.16 |
| | 0:35:00 | 0.00 | 0.00 | 1.32 | 1.81 | 2.27 | 3.81 | 5.05 | 6.55 | 10.47 |
| | 0:40:00 | 0.00 | 0.00 | 1.29 | 1.73 | 2.16 | 4.01 | 5.32 | 6.89 | 10.97 |
| | 0:45:00 | 0.00 | 0.00 | 1.21 | 1.64 | 2.04 | 3.81 | 5.03 | 6.74 | 10.73 |
| | 0:50:00 | 0.00 | 0.00 | 1.14 | 1.55 | 1.92 | 3.63 | 4.79 | 6.43 | 10.28 |
| | 0:55:00 | 0.00 | 0.00 | 1.07 | 1.46 | 1.80 | 3.35 | 4.41 | 6.00 | 9.64 |
| | 1:00:00 | 0.00 | 0.00 | 1.03 | 1.39 | 1.72 | 3.10 | 4.06 | 5.61 | 9.07 |
| | 1:05:00 | 0.00 | 0.00 | 0.98 | 1.32 | 1.64 | 2.89 | 3.79 | 5.33 | 8.65 |
| | 1:10:00 | 0.00 | 0.00 | 0.91 | 1.26 | 1.56 | 2.67 | 3.48 | 4.84 | 7.85 |
| | 1:15:00 | 0.00 | 0.00 | 0.85 | 1.17 | 1.48 | 2.45 | 3.18 | 4.37 | 7.06 |
| | 1:20:00 | 0.00 | 0.00 | 0.78 | 1.08 | 1.38 | 2.22 | 2.86 | 3.86 | 6.22 |
| | 1:25:00 | 0.00 | 0.00 | 0.72 | 1.01 | 1.26 | 2.00 | 2.56 | 3.40 | 5.44 |
| | 1:30:00 | 0.00 | 0.00 | 0.68 | 0.95 | 1.18 | 1.78 | 2.28 | 2.99 | 4.78 |
| | 1:35:00 | 0.00 | 0.00 | 0.65 | 0.91 | 1.12 | 1.63 | 2.08 | 2.70 | 4.29 |
| | 1:40:00 | 0.00 | 0.00 | 0.63 | 0.86 | 1.06 | 1.51 | 1.91 | 2.46 | 3.89 |
| | 1:45:00 | 0.00 | 0.00 | 0.60 | 0.80 | 1.01 | 1.40 | 1.77 | 2.25 | 3.54 |
| | 1:50:00 | 0.00 | 0.00 | 0.58 | 0.75 | 0.96 | 1.30 | 1.64 | 2.05 | 3.21 |
| | 1:55:00 | 0.00 | 0.00 | 0.53 | 0.70 | 0.90 | 1.21 | 1.51 | 1.87 | 2.90 |
| | 2:00:00 | 0.00 | 0.00 | 0.49 | 0.65 | 0.83 | 1.11 | 1.39 | 1.70 | 2.61 |
| | 2:05:00 | 0.00 | 0.00 | 0.42 | 0.56 | 0.72 | 0.96 | 1.19 | 1.45 | 2.22 |
| | 2:10:00 | 0.00 | 0.00 | 0.36 | 0.48 | 0.60 | 0.81 | 1.00 | 1.22 | 1.85 |
| | 2:15:00 | 0.00 | 0.00 | 0.30 | 0.40 | 0.50 | 0.67 | 0.82 | 0.99 | 1.50 |
| | 2:20:00 | 0.00 | 0.00 | 0.24 | 0.32 | 0.41 | 0.54 | 0.65 | 0.78 | 1.17 |
| | 2:25:00 | 0.00 | 0.00 | 0.20 | 0.26 | 0.33 | 0.42 | 0.50 | 0.59 | 0.87 |
| | 2:30:00 | 0.00 | 0.00 | 0.16 | 0.21 | 0.27 | 0.32 | 0.38 | 0.44 | 0.65 |
| | 2:35:00 | 0.00 | 0.00 | 0.13 | 0.18 | 0.23 | 0.25 | 0.30 | 0.34 | 0.50 |
| | 2:40:00 | 0.00 | 0.00 | 0.11 | 0.15 | 0.19 | 0.20 | 0.24 | 0.27 | 0.39 |
| | 2:45:00 | 0.00 | 0.00 | 0.09 | 0.13 | 0.16 | 0.17 | 0.20 | 0.21 | 0.30 |
| | 2:50:00 | 0.00 | 0.00 | 0.08 | 0.10 | 0.13 | 0.14 | 0.16 | 0.16 | 0.23 |
| | 2:55:00 | 0.00 | 0.00 | 0.06 | 0.09 | 0.11 | 0.11 | 0.13 | 0.13 | 0.18 |
| | 3:00:00 | 0.00 | 0.00 | 0.05 | 0.07 | 0.09 | 0.09 | 0.10 | 0.10 | 0.14 |
| | 3:05:00 | 0.00 | 0.00 | 0.04 | 0.06 | 0.07 | 0.07 | 0.09 | 0.08 | 0.11 |
| | 3:10:00 | 0.00 | 0.00 | 0.04 | 0.05 | 0.06 | 0.06 | 0.07 | 0.07 | 0.09 |
| | 3:15:00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.05 | 0.05 | 0.06 | 0.05 | 0.07 |
| | 3:20:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 | 0.06 |
| | 3:25:00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 |
| | 3:30:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 |
| | 3:35:00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | 3:40:00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 3:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | 3:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 3:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 4:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:05:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:10:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:15:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:20:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:25:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:30:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:35:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:40:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:45:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:50:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 5:55:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 6:00:00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# 9.12 Summary of Quantities

**US-24 & PETERSON INTERSECTION IMPROVEMENT 30% COST ESTIMATE**

https://www.codot.gov/business/eema/assets/cost-data-book-2023-quarter-1.pdf

https://www.codot.gov/business/eema/assets/2022/2022-cost-data-book.pdf

| COS Item Number | Description | Units | Unit Cost | Quantity | Project Cost |
|---|---|---|---|---|---|
| 202-00000 | UNCLASSIFIED EXCAVATION | CY | 26.53 | 406.00 | $10,771.18 |
| 220-00035 | REMOVAL OF PIPE | LF | 96.59 | 587.00 | $56,698.33 |
| 220-00037 | REMOVAL OF END SECTION | EACH | 532.36 | 2.00 | $1,064.72 |
| | | | | | |
| 300-06000 | AGGREGATE BASE COURSE (CLASS 6) | TON | 71.72 | 77.00 | $5,522.44 |
| | | | | | $0.00 |
| 624-00090 | RIPRAP (TYPE L, 9 INCH) | CY | 206.14 | 2579.50 | $531,738.13 |
| 625-06060 | CONCRETE SLOPE AND DITCH PAVING (REINFORCED) (6 INCH) | CY | 1,800.00 | 27.70 | $49,860.00 |
| | | | | | |
| 630-01150 | 15 INCH REINFORCED CONCRETE PIPE (COMPLETE IN PLACE) | LF | 245.44 | 13.00 | $3,190.72 |
| 630-01180 | 18 INCH REINFORCED CONCRETE PIPE (COMPLETE IN PLACE) | LF | 282.11 | 996.00 | $280,981.56 |
| 630-01240 | 24 INCH REINFORCED CONCRETE PIPE (COMPLETE IN PLACE) | LF | 210.00 | 725.00 | $152,250.00 |
| 630-01300 | 30 INCH REINFORCED CONCRETE PIPE (COMPLETE IN PLACE) | LF | 339.00 | 180.00 | $61,020.00 |
| 630-01360 | 36 INCH REINFORCED CONCRETE PIPE (COMPLETE IN PLACE) | LF | 372.00 | 1637.00 | $608,964.00 |
| | | | | | |
| 630-05018 | 18 INCH REINFORCED CONCRETE END SECTION (COMPLETE IN PLACE) | EACH | 2,738.00 | 2.00 | $5,476.00 |
| 630-05036 | 36 INCH REINFORCED CONCRETE END SECTION (COMPLETE IN PLACE) | EACH | 3,942.00 | 1.00 | $3,942.00 |
| | | | | | |
| 630-20180 | 23X14 INCH REINFORCED CONCRETE PIPE ELLIPTICAL (COMPLETE IN PLACE) | LF | 218.76 | 424.00 | $92,754.24 |
| 630-20360 | 45X29 INCH REINFORCED CONCRETE PIPE ELLIPTICAL (COMPLETE IN PLACE) | LF | 542.67 | 150.00 | $81,400.50 |
| 630-20480 | 60X38 INCH REINFORCED CONCRETE PIPE ELLIPTICAL (COMPLETE IN PLACE) | LF | 750.00 | 147.00 | $110,250.00 |
| | | | | | |
| 630-25180 | 23X14 INCH REINFORCED CONCRETE END SECTION ELLIPTICAL (COMPLETE IN PLACE) | EACH | 2,035.00 | 1.00 | $2,035.00 |
| 630-25360 | 45X29 INCH REINFORCED CONCRETE END SECTION ELLIPTICAL (COMPLETE IN PLACE) | EACH | 3,183.03 | 1.00 | $3,183.03 |
| 630-25480 | 60X38 INCH REINFORCED CONCRETE END SECTION ELLIPTICAL (COMPLETE IN PLACE) | EACH | 5,424.47 | 1.00 | $5,424.47 |
| | | | | | |
| 636-03050 | CDOT TYPE C INLET (5 FT) | EACH | 6,748.81 | 2.00 | $13,497.62 |
| 636-03100 | CDOT TYPE C INLET (10 FT) | EACH | 8,939.94 | 1.00 | $8,939.94 |
| 636-04050 | CDOT TYPE D INLET (5 FT) | EACH | 9,198.64 | 1.00 | $9,198.64 |
| 636-10005 | INLET TYPE 10R L=5 (5 FT) | EACH | 8,769.55 | 15.00 | $131,543.25 |
| 636-10010 | INLET TYPE 10R L=5 (10 FT) | EACH | 16,307.14 | 10.00 | $163,071.40 |
| 636-10110 | INLET TYPE 10R L=10 (5 FT) | EACH | 12,973.24 | 3.00 | $38,919.72 |
| 636-13050 | CDOT TYPE 13 INLET (5 FT) | EACH | 8,370.22 | 1.00 | $8,370.22 |
| | | | | | |
| 636-37050 | CDOT SLAB BASE MANHOLE (5 FT) | EACH | 7,360.40 | 4.00 | $29,441.60 |
| 636-37100 | CDOT SLAB BASE MANHOLE (10 FT) | EACH | 11,267.92 | 14.00 | $157,750.88 |
| 636-37150 | CDOT SLAB BASE MANHOLE (15 FT) | EACH | 17,139.08 | 8.00 | $137,112.64 |
| 636-40050 | MANHOLE SPECIAL (5 FT) | EACH | 19,281.40 | 1.00 | $19,281.40 |
| 636-40200 | MANHOLE SPECIAL (20 FT) | EACH | 19,281.40 | 1.00 | $19,281.40 |
| | | | | | |
| 636-83302 | WATER QUALITY POND OUTLET STRUCTURE | EACH | 9,500.00 | 1.00 | $9,500.00 |
| | | | | | |
| 906-00001 | SOIL RETENTION BLANKET (BIODEGRADABLE STRAW/COCONUT) (CLASS 1) | SY | 3.98 | 415.00 | $1,651.70 |
| 907-00111 | GEOTEXTILE (DRAINAGE) (CLASS B) | SY | 12.20 | 415.00 | $5,063.00 |
| | | | | **SUBTOTAL** | **$2,819,149.73** |
| | | | | **CONTINGENCY** | **30.00%** |
| | | | | **TOTAL** | **$ 3,664,894.65** |