

SPRINGS AT WATERVIEW  
PRELIMINARY and FINAL DRAINAGE REPORT  
EL PASO COUNTY, COLORADO

February 2018

PREPARED FOR:

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PROJECT NO.16-01

PCD No. SP-16-005  
PCD No. SF-16-017

CERTIFICATIONS

**Design Engineer's Statement:**

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

\_\_\_\_\_  
Charles K. Cothorn, P.E. #24997

Seal

**Owner/Developer's Statement:**

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

By (signature): \_\_\_\_\_

Date: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_  
\_\_\_\_\_

**El Paso County:**

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual Volumes 1 and 2, and the Engineering Criteria Manual, as amended.

\_\_\_\_\_  
Jennifer Irvine, P.E.,  
County Engineer / ECM Administrator

\_\_\_\_\_  
Date

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## **1.0 INTRODUCTION**

The Springs at Waterview area has been studied as part of the Windmill Gulch Drainage Basin Planning Study (DBPS) by Wilson and Company. This site has been analyzed in the Master Drainage Development Plan for Waterview by Merrick and Company. A Preliminary Drainage Report has also been prepared for Waterview Phase II by Merrick and Company of Colorado Springs, as well as a Final Drainage Report for Filings 1 and 2 by Merrick and Company. The subject area is located south of the Colorado Springs Airport, and northwest of Big Johnson Reservoir, Colorado.

### ***Purpose***

The purpose of this report is to present the preliminary and final drainage improvements associated with the construction of Springs at Waterview.

In addition, this report provides documents related to issuance of an Early Grading Permit including calculations for a sedimentation pond and an exhibit depicting the drainage area and size. The remaining Early Grading Permit documents; SWMP, Financial Assurance, etc. are being submitted simultaneously.

Runoff quantities and proposed facilities have been calculated using the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM).

## **2.0 General Location and Description**

### ***Location***

Springs at Waterview is a planned 85 unit multi-family residential development within the north half of the northeast quarter of Section 7, Township 15 South, Range 65 West of the 6<sup>th</sup> Principal Meridian, in El Paso County, Colorado. It is located south of Goldfield Drive, east of Grinnell Boulevard, north of Bradley Road and west of Painted Sky at Waterview Filing No. 1. This portion of the Waterview development is in the Windmill Gulch Drainage Basin.

### ***Description of Property***

The proposed site encompasses 15.68 acres. The topography of the site and surrounding area is typical of a high desert; short prairie grass and weeds with slopes generally ranging from 1% to 9%. The area generally drains to the west.

The site is comprised of several different soil types. From the Soil Survey of El Paso County, the site falls into the following soil types:

1. “3” Ascalon sandy loam, 3 to 9 percent slopes.
2. “8” Blakeland loamy sand, 1 to 9 percent slopes.
3. “97” Truckton sandy loam, 3 to 9 percent slopes.

The Blakeland and Truckton soils are classified at Hydrological Group A and the Ascalon soil is classified as Hydrological Group B. Note: “#” indicates Soil Conservation Survey soil classification number. See Appendix A: Soils Data.

## ***Climate***

Mild summers and winter, light precipitation; high evaporation and moderately high wind velocities characterize the climate of the study area.

The average annual monthly temperature is 48.4 F with an average monthly low of 30.3 F in the winter and an average monthly high of 68.1 F in the summer. Two years in ten will have a maximum temperature higher than 98 F and a minimum temperature lower than -16 F. Precipitation averages 15.73 inches annually, with 80% of this occurring during the months of April through September. The average annual Class A pan evaporation is 45 inches.

## ***Utilities and other Encumbrances***

The site is currently undeveloped. There is an existing sanitary sewer main crossing the site, which services Painted Sky Filings No.1 and No. 2 to the east of the project site. There are no other known utilities or other encumbrances on the site.

## **3.0 Drainage Basins and Sub-Basins**

### ***Major Basin Description***

Springs at Waterview residential development is located within the Windmill Gulch Drainage Basin. This report complies with the Windmill Gulch Drainage Basin Planning Study (DBPS) by Wilson and Company, the Master Development Drainage Plan for Waterview by Merrick and Company, the Preliminary Drainage Report for Waterview Phase II, also by Merrick and Company and Painted Sky at Waterview Filing 1 and 2 Final Drainage Report by Merrick and Company. All developed runoff will meet El Paso County standards for discharge rates.

### ***Floodplains***

The Flood Insurance Rate Map (FIRM No. 08041C0764-F dated 3/17/97) indicates that there is no floodplain in the vicinity of the proposed site. See Figure 2: FIRM.

## **4.0 DRAINAGE DESIGN CRITERIA**

### ***Development Criteria Reference***

The City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM) was used in preparation of this report. Additional preliminary and final drainage plans, master development drainage plans and drainage basin planning studies used in the preparation of the report are listed in the References Section.

### **Hydrologic Criteria**

#### ***Rational Method***

Because Springs at Waterview is less than 100 acres, the rational method was used to determine onsite flows, and to size inlets and ditches, as required by the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM). Both the 5-year and 100-year storm events were considered in this analysis. Runoff coefficients appropriate to the existing and proposed land uses were selected for an

SCS type “B” soil from Table 5-1 of the DCM. The existing runoff coefficients for this site are  $C_5=0.08$  and  $C_{100}=0.35$  based on existing pasture land. The DBPS, the MDDP, and the PDR for Waterview Phase II used existing coefficients of 0.35 and 0.55. The runoff coefficients for the developed residential lots are  $C_5=0.49$  and  $C_{100}=0.60$  based on multi-family acre lots. The time of concentration was calculated per DCM requirements and intensities for each basin were calculated from storm intensity curve formulas provided by the City of Colorado Springs. Rational Method results are shown in Appendix B (Existing) and C (Proposed).

## **5.0 DRAINAGE BASINS**

The basin descriptions for Springs at Waterview are as follows.

### ***Offsite Basins***

There are no off site basins which contribute flows to the proposed Springs at Waterview, however there are 3 separate sets of storm systems which release flows into the site. These will be addressed later in the report.

### ***Historic Drainage Analysis***

The proposed site was studied in the Windmill Gulch Drainage Basin Planning Study (DBPS), Master Development & Drainage Plan for Waterview (MDDP) and in the Preliminary Drainage Report for Painted Sky at Waterview Phase II. Efforts have been made to comply with the recommendations set forth in the approved DBPS and MDDP. The existing analysis addresses the current situation, which includes the construction of Filings No. 1 & No. 2.

### ***Existing Drainage Analysis***

- Basin E-1 (12.6 acres) is undeveloped and is approximately the northern two-thirds of the site. Flows are conveyed to the west where they are intercepted by an existing 72” rcp under Grinnell Boulevard. Flows from the basin are 3.3 cfs for the 5-year event and 25.0 cfs for the 100-year event.
- Basin E-2 (8.61 acres) is the south portion of the site. Flow is conveyed to the west where it enters an existing roadside ditch along Grinnell Blvd to the existing low point in the road. Flooding of Grinnell Boulevard has been observed at this low point during significant storm events; the ponded water eventually discharges to the existing 72” rcp to the north under Grinnell Boulevard. Runoff produced from this basin are 1.9 cfs and 14.8 cfs for the 5-year and 100-year storms.

### ***Existing Design Points***

These design points correspond to the same design points in the FDR for Filings No. 1 and 2 of Painted Sky.

- DP-42a ( $Q_5=12.4$ ,  $Q_{100}=38.2$ ) is the combined flows from Basin E-2 with the released flow from the storm system in Bradley Road. The design point is an existing low point in Grinnell Blvd where flows will pond in the roadway and eventually enter the existing pond on the west of the road via the existing 72: rcp.

- DP-43 ( $Q_5=44.3$ ,  $Q_{100}=112.7$ ) is combined flows from Basin E-1 and the released flow from the existing storm system at the north end of the site under Goldfield Drive and the storm system which releases on the east side of the project from Escanaba Drive. Flows are conveyed under Grinnell Blvd via a 72" rcp.

## ***Proposed Drainage Analysis***

- Basin D-1 (0.31 acres) is located at the northern boundary of the site, just south of Goldfield Drive. Flows are released into Goldfield Drive where they are intercepted by an existing inlet. Runoff produced in this basin is 0.7 cfs and 1.6 cfs for the 5 and 100-year events. Currently, there is existing asphalt runoff which was constructed as part of Painted Sky Filing No. 1. According to the FDR for Painted Sky, this structure will collect any flow by from the existing inlet and is to remain in place until the intersection at Grinnell Boulevard and Goldfield Drive is improved; once this intersection is improved the "flow by" will be carried in Grinnell Boulevard curb and gutter.
- Basin D-2 (0.20 acres) is located at the eastern corner of the site, which drains to Escanaba Drive and is intercepted by an existing inlet. Flows from the basin are 0.4 cfs for the 5-year event and 1.0 cfs for the 100-year event.
- Basin D-3 (0.35 acres) is the western portion of Escanaba Drive north of Dancing Moon Way. An existing inlet in Escanaba Drive intercepts the street flow at DP-11. Runoff produced in this basin is 1.6 cfs and 3.1 cfs for the 5 and 100-year storms.
- Basin D-3a (0.28 acres) is the western portion of Escanaba Drive south of Dancing Moon Way. An existing inlet in Escanaba Drive intercepts the street flow at DP-32 per the Painted Sky Filing No. 1 FDR. Part of the design for Painted Sky Filing No. 1 was a curb at the westerly end of Painted Sky tall enough to insure the storm runoff was directed north to the existing Painted Sky Filing No. 1 at DP 32. Springs at Waterview construction will not change this storm routing in that the curb will be left in place as is; no modification to allow access to Escanaba Drive from the Springs at Waterview lots is proposed. Runoff produced in this basin is 1.3 cfs and 2.4 cfs for the 5 and 100-year storms.
- Basin D-4 (0.11 acres) is south of Basin D-3a. Flow is conveyed to the south in Escanaba Drive to DP-41. This basin creates 0.5 cfs for the 5-year storm and 1.0 cfs for the 100-year storm.
- Basin D-5 (0.31 acres) is between Basins D-17 and D-4 and is located between Passing Sky Drive and Escanaba Dr. Flows will continue towards the west as gutter flow in Bradley Road to DP-K. Flows from this basin are 0.8 cfs for the 5 year storm and 1.9 cfs for the 100 year storm.
- Basin D-6 (0.07 acres) is the west portion of Road A that releases into Bradley Road. Flows will be conveyed to the west in Bradley Road to DP-K. This basin produces 0.3 cfs and 0.6 cfs for the 5 and 100 year storm events.

- Basin D-7 (2.35 acres) is north of D-6 and between Escanaba Drive and Road A. Flow is conveyed as gutter flow in Road A to the north to a proposed on-grade inlet. Flows from this basin are 3.4 cfs for the 5 year storm and 7.9 cfs for the 100 year storm.
- Basin D-8 (1.10 acres) is north of D-7 between Escanaba Drive and Road A. Flows will be carried through curb and gutter to the north to a proposed on-grade inlet. This basin generates 2.1 cfs and 4.9 cfs for the 5 and 100 year storms.
- Basin D-9 (0.47 acres) is north and half of Road A. Runoff is conveyed as gutter flow to the south to a proposed on-grade inlet. Flow for this basin is 1.9 cfs for the minor storm and 3.5 cfs for the major storm.
- Basin D-10 (0.29 acres) is the south and west half of Road A. Flows are conveyed to the north via curb and gutter to a proposed on-grade inlet. Flows from the basin are 1.2 and 2.3 cfs for the 5 and 100-year storms.
- Basin D-11 (1.53 acres) contains the north and east portion of Passing Sky Drive. Basin flows are conveyed via curb and gutter to the south. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 2.5 cfs for the 5-year storm and 5.9 cfs for the 100-year storm.
- Basin D-11a (1.43 acres) is south of Basin D-11 and north of Road B. Basin flows are conveyed via curb and gutter to the south. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 2.4 cfs for the 5-year storm and 5.6 cfs for the 100-year storm.
- Basin D-12 (0.18 acres) is a portion of the site that releases into the north half of Road B. Runoff produced from this basin is 0.6 cfs and 1.2 cfs for the 5 and 100-year storms.
- Basin D-13 (0.23 acres) is the south half of Road B. Basin flow is conveyed via curb and gutter to the west. Flows from this area are 0.8 cfs for the 5-year event and 1.6 cfs for the 100-year event.
- Basin D-14 (1.70 acres) is the south and east portion of Passing Sky Way. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 2.6 cfs and 5.9 cfs for the 5 and 100-year storms.
- Basin D-14a (1.05 acres) is north of D-14 and the east portion of Passing Sky Way. There will be cross lot drainage for this basin. Small lot swales will be constructed along the property lines between lots to keep flows directed away from structures and towards the proposed roads. This basin produces 1.7 cfs and 4.0 cfs for the 5 and 100-year storms.



- Basin D-15 (0.65 acres) is the south and west portion of Passing Sky Way. Flow will be conveyed as gutter flow to the north to a proposed on-grade inlet. This basin produces 1.9 cfs and 3.6 cfs for the 5 and 100-year storms.
- Basin D-16 (0.48 acres) is the west half of Passing Sky Way north of Road B. Flows are conveyed as gutter flow to the south to a proposed on-grade inlet. This basin has a 5-year flow of 1.3 cfs and a 100-year flow of 2.5 cfs.
- Basin D-17 (1.80 acres) is north of Basin D-16 and D-18. Runoff is conveyed to the west towards a proposed area inlet. Flows in this basin are 3.1 cfs and 7.1 cfs for the 5 and 100-year storms.
- Basin D-18 (1.56 acres) is located along the western side of the site, where it is intercepted by a proposed area inlet. This basin produces 4.0 cfs and 9.2 cfs for the 5 and 100-year storms.
- D-21 (0.64 acres) is located along the western side of Escanaba Dr, where it is intercepted by an existing Type R inlet. This area has a 5-year flow of 1.3 cfs and a 100-year flow of 2.7 cfs.
- Basin D-19 (4.80 acres) is the south half of the site along the western boundary at Grinnell Boulevard. Flow is conveyed as surface flow towards the west. This basin does include flows from the eastern half of Grinnell Blvd. Flows from this basin are 6.1 cfs for the 5-year storm and 14.2 cfs for the 100-year storm. Surface flows from the east are intercepted by Type D inlets. When Grinnell Boulevard is reconstructed in the future the Grinnell Boulevard storm sewer collection system will collect storm water from Grinnell Boulevard and convey it west to the 72-inch existing storm sewer on the west side of Grinnell Boulevard and then on to the detention pond.

### ***Proposed Design Points***

- DP-11 ( $Q_5=1.6$ ,  $Q_{100}=3.1$ ) contains Basin D-3. Flow is intercepted by an existing Type R inlet in Escanaba Dr.
- DP 32 ( $Q_5=1.3$ ,  $Q_{100}=2.4$ ) contains Basin D-3a. Flow is intercepted by an existing Type R inlet in Escanaba Dr.
- DP-A ( $Q_5=0.3$ ,  $Q_{100}=4.3$ ) combines flow-by from on-grade inlets in Basins D-7 and D-8. A proposed sump inlet will intercept these flows.
- DP-B ( $Q_5=0.8$ ,  $Q_{100}=2.3$ ) combines Basin D-12 with flow-by from the on-grade inlet in D-9. An on-grade Type R inlet intercepts this flow. Flow by continues to the west.
- DP-C ( $Q_5=0.8$ ,  $Q_{100}=2.1$ ) combines Basin D-13 with flow-by from the on-grade inlet in Basin D-10. An on-grade Type R inlet intercepts the flow. Any by-pass flow will continue via curb and gutter to the west.

- DP-D ( $Q_5=2.4$ ,  $Q_{100}=6.7$ ) is Basin D-11 combined with the flow-by from on-grade inlets in Basin D-11 and DP-B. Flow will be to the south to an on-grade inlet at the northeast corner of Passing Sky Way.
- DP-E ( $Q_5=1.6$ ,  $Q_{100}=4.7$ ) is Basin D-14a combined with the flow-by from the on-grade inlets in Basin D-14 and DP-C. Flow will be intercepted by an on-grade inlet at the southeast corner of Passing Sky Way.
- DP-F ( $Q_5=0.2$ ,  $Q_{100}=3.1$ ) is the flow-by from on-grade inlets in Basins D-15 and D-16 along with DP-D and DP-E. Flow is intercepted by a sump Type R inlet.
- DP-G ( $Q_5=3.1$ ,  $Q_{100}=7.1$ ) is Basin D-17. An area inlet intercepts this flow.
- DP-K ( $Q_5=11.5$ ,  $Q_{100}=24.1$ ) combines Basins D-5 and D-6 and the existing storm system from Bradley Road. Flow will be conveyed thru a drainage swale to an area inlet at DP-42a.
- DP-39 ( $Q_5=1.1$ ,  $Q_{100}=2.5$ ) combines flow from Basins D-1 and D-2. An existing inlet in Goldfield Drive will intercept this flow.
- DP-41 ( $Q_5=0.5$ ,  $Q_{100}=1.0$ ) is flow from Basin D-4. An existing inlet in Escanaba Drive will intercept the flow.
- DP-42a ( $Q_5=11.9$ ,  $Q_{100}=26.3$ ) is flow from Basin D-19 combined with DP-K. An area inlet will be used to intercept the flow.
- DP-43 ( $Q_5=4.0$ ,  $Q_{100}=92.0$ ) is the surface flow from Basin D-19. These flows will be intercepted by an area inlet and will connect to the existing 72" rcp. The release flow at this location is the combined flows from Basin D-19 with Design Points 42a, and Filing No. 1 design Points 31, 38, 39 and 41 along with all intercepted flows on site.

### ***Proposed Storm System***

There are three existing storm sewers that discharge onto the site and one existing system that releases flow offsite under Grinnell Boulevard. This report proposes that the three storm systems be extended and incorporated into the drainage plan for the subject property. The three existing storm systems include:

- 1) An existing 48-inch RCP that discharges from Escanaba Drive midway along the eastern boundary of the property. This pipe is the discharge point for drainage from Painted Sky Filings No. 1 and No. 2.
- 2) An existing 48-inch RCP that discharges into the northwesterly corner of the site. This storm system drains the westerly portion of Goldfield Drive up to Grinnell Boulevard.
- 3) An existing 24-inch RCP that discharges into the southwestern corner of the property near the Grinnell Boulevard r.o.w. This storm system drains the north half of Bradley Road east of Grinnell Boulevard.

The system releasing offsite includes:

4) An existing 72-inch RCP that drains the site west under Grinnell Boulevard. Storm water discharge from storm systems 1 through 3 generally drain by overland flow to the existing 72-inch for conveyance under Grinnell Boulevard.

The general concept is to extend each of storm systems 1 through 3 to convey flow directly to the 72-inch pipe while collecting additional site flow.

The proposed storm system will collect flows from the 3 proposed roads. Several on-grade and sump inlets will be installed to collect flows. On-grade inlets will be installed along Passing Sky Way and Road A to ensure gutter flow does not exceed capacity, until flows can reach and be intercepted by sump inlets. The existing storm systems from Escanaba Drive, Goldfield Drive and Bradley Road (existing storm systems 1, 2 and 3) will connect to this new system. The existing 72" culvert under Grinnell Blvd will extend east to provide an outlet for this system, releasing flows into the detention pond on the west side of Grinnell Blvd.

The extension of existing Storm System 2 south from Goldfield Drive and the extension of existing storm system 3 north from Bradley Road will be located within the Grinnell Boulevard existing r.o.w. Due to existing water and sewer utilities the alignment of this storm sewer will be between the future projected back of curb and the easterly r.o.w. line.

The extension of storm system 3 from Bradley road north will include a pipe stub and flared end section from Manhole No. 2 to provide some interim (prior to expansion and reconstruction of Grinnell Boulevard) relief to the existing ponding conditions at the low point of Grinnell Boulevard on the east side particularly during minor storms.

When Grinnell Boulevard is expanded to include additional laneage, curb and gutter and storm water collection systems the interim drain pipe at Manhole No. 2 will be eliminated; storm water from Grinnell Boulevard should be collected and conveyed to the west side of Grinnell prior to connection to the existing 72-inch RCP.

Refer to the storm CAD analysis in Appendix D for results.

## **6.0 DRAINAGE FACILITY DESIGN**

### ***General Concept***

Springs at Waterview is located completely within the Windmill Gulch Drainage Basin. The site drains westerly, storm flow is collected by a series of inlets and storm pipes, conveyed to an existing 72-inch RCP that conveys storm flow under Grinnell Boulevard where it eventually releases into the existing water quality pond, which releases into the existing detention pond previously constructed for development of Painted Sky Filings No. 1 and No. 2 west of Grinnell Blvd.

### ***Early Grading Permit***

This Drainage Report, the accompanying Grading and Erosion Control Plan and SWMP provides for issuance of an Early Grading Permit. The early grading GEC and permanent GEC pond both have one sedimentation basin located just upstream of the existing 72-inch culvert under Grinnell Boulevard. The sedimentation basin drains approximately 15 acres of the site. The basin will be 54000 cf or 1.3 acre-ft.

(3600 cf per acre x 15 =54000 cf) See the exhibit at the end of the text for the location as well as the Grading and Erosion Control Plan.

### ***Downstream Facilities***

The downstream facility for this site is an existing 72-inch RCP pipe under Grinnell Boulevard and an existing detention pond west of Grinnell Blvd. The pond was designed to capture the flows from the Waterview development; specifically, Painted Sky Filing No. 1 and No. 2, including the subject property. The proposed drainage of the site is in conformance with the MDDP for Waterview.

### ***Detention/Water Quality Ponds***

Water quality and detention has already been constructed for this development. The water quality pond was designed and constructed as part of the Painted Sky Filing No. 1 and No. 2 developments. The WQ pond was built prior to the approval of the FDR for Painted Sky Filings No. 1 and No. 2, as part of the over lot grading for the site. The detention pond (Windmill Gulch Detention Pond #4) was built under the construction drawings provided by Kirkham Michael, which were approved by El Paso County on July 5, 2001. The two existing facilities on the west side of Grinnell Blvd provide detention and water quality for the entire Waterview development area, as discussed in the Windmill Gulch DBPS and the FDR for Painted Sky at Waterview Filings 1 and 2. The WQ pond is maintained by the Waterview I Metropolitan District.

The water quality pond in the FDR for Filings No. 1 and No. 2 was determined to be 2.285 ac-ft. based on 65.15% imperviousness. Based on the new imperviousness for Springs at Waterview, the overall imperviousness has changed to 62.3% (See below calculations); the volume necessary for the water quality pond is 1.825 ac-ft. Current survey information shows that the pond has a volume of 3.06 ac-ft., which is sufficient volume for either design. The UDFCD SDI spreadsheet has been included in the appendix for verification that the WQ pond is in compliance with the current criteria.

In the FDR for Filings No. 1 and No.2, the water quality pond was designed for an area of 89.69 acres with a 65.15% imperviousness. Springs at Waterview is 15.68 acres of single family development, Filing No. 1 is 33.29 acres of single family development and Filing No. 2 is 18.59 acres of single family development. Total area east of Grinnell Boulevard draining to the existing WQ pond is 67.56 acres; the remaining acreage draining to the WQ pond is west of Springs at Waterview and is estimated to be an additional 22.13 acres (89.69 – 67.56 area). About 23 acres of the 89.69 acres was assumed to be commercial and 11 acres was assumed to be multifamily.

Springs at Waterview was planned to be 5 acres of commercial and 10.69 acres of multifamily; using imperviousness of 95% and 65%, the average imperviousness for the Springs at Waterview site would have been 75%. As a single family site based on the 85 lot design, the imperviousness for the 15.68 acres is estimated to be 48.89% (see calculation below in the drainage fee section). This is a significant drop in the imperviousness of the 15.68 acre site and reduces the overall imperviousness of the 89.69 acres draining to the WQ pond from 65.15% to 62.3%:

$$\begin{array}{rcl} (89.69 - 15.68) \times 65.15\% & = & 48.2 \text{ impervious acres} \\ 15.68 \times 48.89\% & = & \underline{7.7} \text{ impervious acres} \\ & & 55.9 \text{ impervious acres} \qquad 55.9/89.69 = 62.3\% \end{array}$$

Since the overall impervious area is considerably less than the original design of the WQ pond, it is more than adequate to treat the design flow with the development of the Springs at Waterview site, as it was designed to do.

### ***Four Step Process***

In accordance with the El Paso County Engineering Criteria Manual, Appendix I this site has implemented the four step process to minimize adverse impacts of urbanization and helps with the management of smaller, frequently occurring events. The four step process includes reducing runoff volumes, treating and slowly releasing the water quality capture volume (WQCV), stabilizing drainageways, and consideration of the need for industrial and commercial BMPs.

In order to reduce runoff volume, the overall impervious area for the site was reduced from previous reports.

The WQCV is treated through an extended detention basin. The UDFCD SDI spreadsheet was used to verify that the existing WQ pond meets current criteria for water quality requirements. Existing drainageways will be maintained in their current condition to help with overall site impacts. These facilities are upstream of the development, so there are no impacts to these channels due to the development of this project. Downstream of the project, all flows enter into existing storm systems, which have been designed for this site to be developed. Therefore, those downstream channel/facilities would also not see any increase or adverse effects to their functionality.

Some site-specific source control BMPs that will be implemented include, but are not limited to, silt fencing placed around downstream areas of disturbance, construction vehicle tracking pads at the entrances, designated concrete truck washout basin, designated vehicle fueling areas, covered storage areas, spill containment and control, etc.

## **7.0 DRAINAGE FEES, COST ESTIMATE & MAINTENANCE**

### ***Maintenance***

The streets and major improvements within this site will be dedicated and maintained by El Paso County. This includes the roads and drainage facilities. The remaining utilities (gas, phone, electric, cable, etc.) will be owned and maintained by their respective companies. Easements will be issued to ensure each entity is able to access and maintain their facilities.

### ***Drainage Fees***

The proposed development falls within the Windmill Gulch Basin. The entire development occupies approximately 15.68 acres. The current development consists of 2.71 acres of right-of-way, 0.59 acres of open tracts and 12.39 acres of residential lots. From the preliminary plan, the maximum coverage allowed per lots is 40%.

Average Residential Imperviousness = 40 %

R.O.W. area 2.71 acres; imperviousness 100 %

Tract area 0.59 acres; imperviousness 0 %

Average imperviousness for developed area:

$(0.40 \times 12.39) + (1.0 \times 2.71)/(15.68) = 0.4889 = 48.89\%$ . The impervious area that the fees will be based on is 7.67 acres (15.68 x 48.89%)

2017 Drainage fees in the Windmill Gulch Basin are \$16,270 and bridge fees are \$244. The calculated fees due will be as follows:

Drainage Fees: \$124,791 (7.67 x \$16,270)

Bridge Fees: \$1871 (7.67 x \$244)

### Proposed Facilities Estimate

ITEM	UNITS	UNIT COST	QUANTITY	ITEM COST
<b>GRADING AND EROSION CONTROL</b>				
CURB BACKFILL	LF	\$ 2.50	4235	\$ 10,588
MISC SEEDING AND MULCH	AC	\$ 3,500.00	2	\$ 7,000
HAY BALE CHECKS	EA	\$ 10.00	50	\$ 500
VEHICLE TRACKING CONTROL	EA	\$ 1,500.00	2	\$ 3,000
SILT FENCING	LF	\$ 5.00	1,210	\$ 6,050
INLET PROTECTION	EA	\$ 300.00	11	\$ 3,300
<b>SUBTOTAL GRADING &amp; EROSION CONTROL</b>				<b>\$ 30,438</b>
<b>DRAINAGE</b>				
18" RCP	LF	\$ 75.00	464	\$ 34,800
24" RCP	LF	\$ 100.00	178	\$ 17,800
30" RCP	LF	\$ 125.00	36	\$ 4,500
48" RCP	LF	\$ 225.00	945	\$ 212,625
66" RCP	LF	\$ 350.00	178	\$ 61,950
72" RCP	LF	\$ 475.00	154	\$ 73,150
5' Type R Inlet	EA	\$ 5,000.00	7	\$ 35,000
10' Type R Inlet	EA	\$ 6,800.00	7	\$ 47,600
Type D Inlet	EA	\$ 8,000.00	1	\$ 8,000
Type D Inlet - Double	EA	\$ 13,000.00	2	\$ 26,000
Storm Manholes	EA	\$ 7,000.00	4	\$ 28,000
<b>SUBTOTAL DRAINAGE</b>				<b>\$ 506,585</b>
<b>SUBTOTAL DRAINAGE &amp; GRADING/EROSION CONTROL</b>				<b>\$ 537,023</b>
ENGINEERING (10%)				\$ 53,702
CONTINGENCY (25%)				\$ 134,256
<b>TOTAL</b>				<b>\$ 724,981</b>

## **8.0 EROSION CONTROL**

### ***General Concept***

During construction, best management practices for erosion control will be employed based on El Paso County criteria and the erosion control plan. The erosion control plan is included at the end of this report.

Ditches will be designed to meet El Paso County criteria for slope and velocity, keeping velocities below scouring levels.

During construction, best management practices (BMP) for erosion control will be employed based on El Paso County Criteria. BMP's will be utilized as deemed necessary by contractor and/or engineer and are not limited to measure shown on construction drawing set. The contractor shall minimize amount of area disturbed during all construction activities.

In general the following shall be applied in developing the sequence of major activities:

- Install downslope and side slope perimeter BMP's before the land disturbing activity occurs.
- Do not disturb an area until it is necessary for the construction activity to proceed.
- Cover or stabilize as soon as possible.
- Time the construction activities to reduce the impacts from seasonal climatic changes or weather events.
- The construction of filtration BMP's should wait until the end of the construction project when upstream drainage areas have been stabilized.
- Do not remove temporary perimeter controls until after all upstream areas are stabilized.

### ***Silt Fence***

Silt fence will be placed along downstream limits of disturbed areas. This will prevent suspended sediment from leaving the site during infrastructure construction. Silt fencing is to remain in place until vegetation is reestablished.

### ***Erosion Bales***

Erosion bales will be placed ten (10) feet from the inlet of all culverts and inlets during construction to prevent culverts from filling with sediment. Erosion bales will remain in place until vegetation is reestablished in graded roadside ditches. Erosion bale ditch checks will be used on slopes greater than 1% to reduce flow velocities until vegetation is reestablished.

### ***Vehicle Tracking Control***

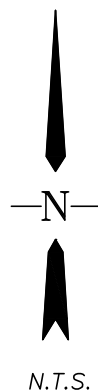
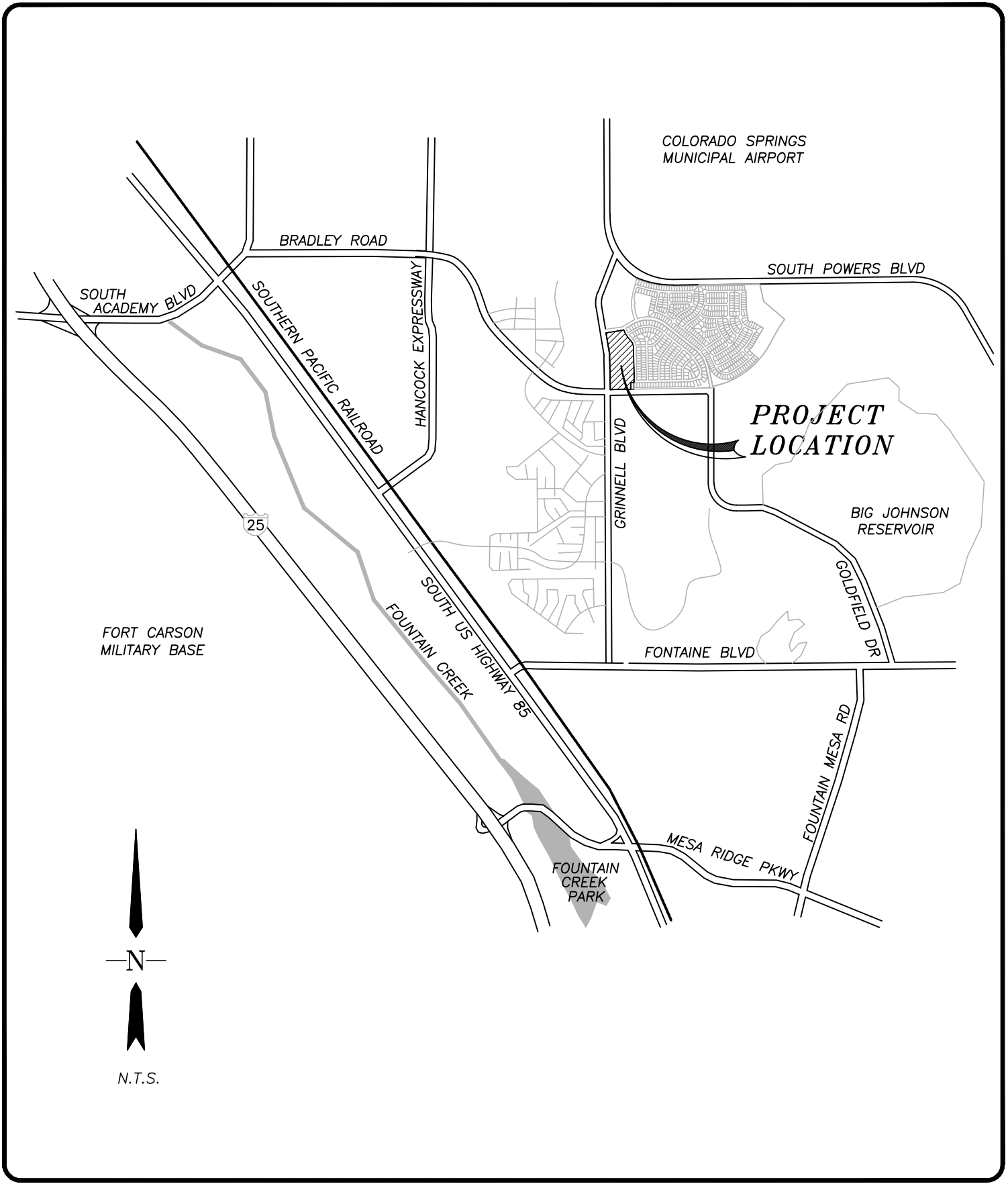
This BMP is used to stabilize construction entrances, roads, parking areas and staging areas to prevent the tracking of sediment from the construction site. A vehicle tracking control (VTC) is to be used at all locations where vehicles exit the construction site onto public roads, loading and unloading areas, storage and staging areas, where construction trailers are to be located, any construction area that receives high vehicular traffic, construction roads and parking areas. VTC's should not be installed in areas where soils erode easily or are wet.

## 9.0 REFERENCE MATERIALS

1. “City of Colorado Springs/El Paso County Drainage Criteria Manual” May 2014.
2. “Windmill Gulch Drainage Basin Planning Study”, Wilson and Company, February 1992.
3. Master Development Drainage Plan for Waterview, May 2006. Prepared by Merrick & Co.
4. Preliminary Drainage Report for Waterview Phase II, January 2007. Prepared by Merrick & Co.
5. Final Drainage Report for Painted Sky at Waterview Filings 1 and 2, January 2007. Prepared by Merrick & Co.
6. Soils Survey of El Paso County Area, Natural Resources Conservation Services of Colorado.
7. Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas. Federal Emergency Management Agency, Revised March 17, 1997.
8. “City of Colorado Springs/El Paso County Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices” May 2014.



**Figure 1: Vicinity Map**



**THE SPRINGS AT WATERVIEW  
VICINITY MAP**

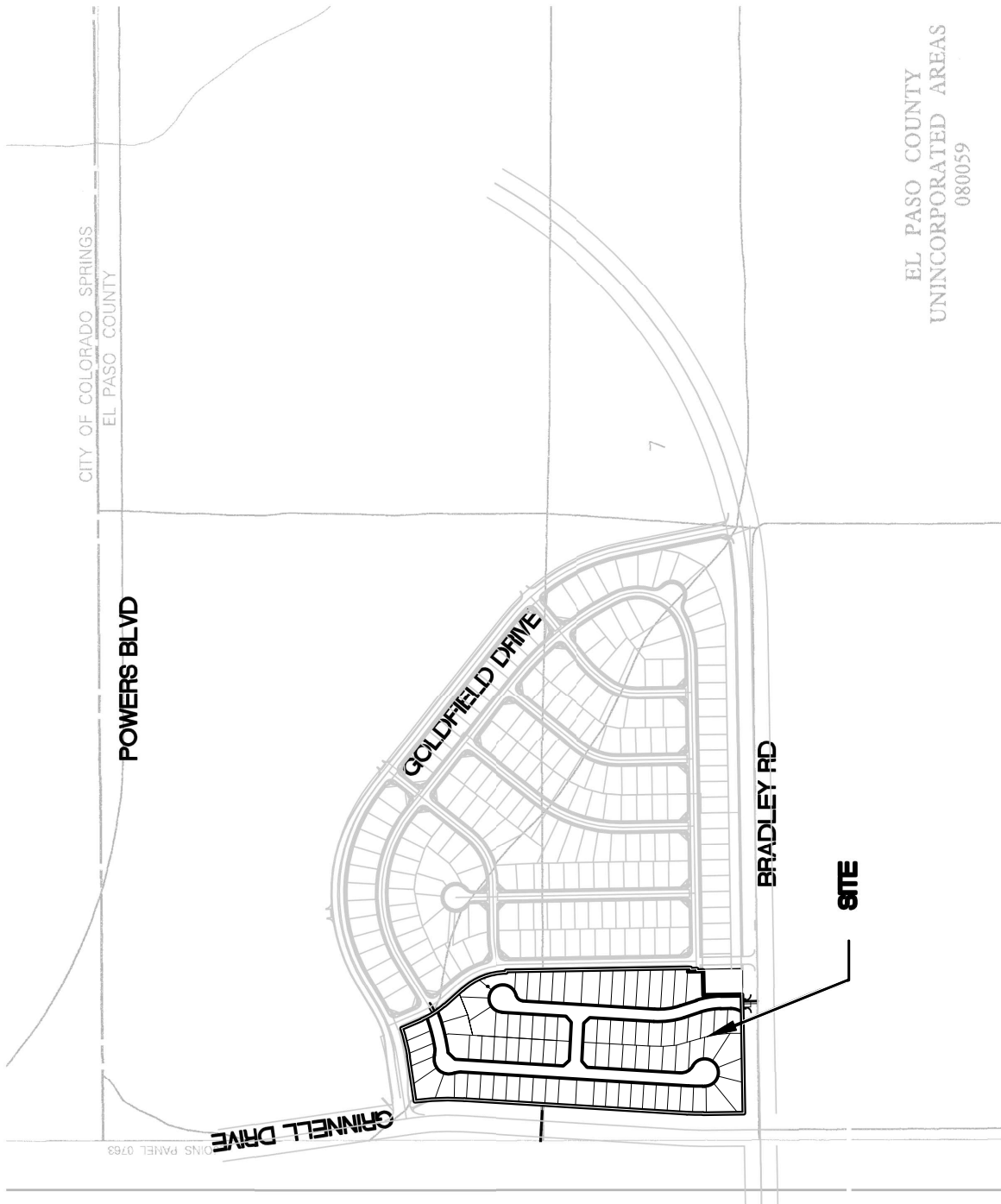
**DSE** Dakota Springs  
Engineering

31 NORTH TEJON, SUITE 500  
COLORADO SPRINGS, CO 80903  
TEL: (719) 227-7388  
FAX: (719) 227-7392

**EXHIBIT**

PROJECT NO. 0001-02-16-01

**Figure 2: FEMA Floodplain Map**



EL PASO COUNTY  
UNINCORPORATED AREAS  
080059

APPROXIMATE SCALE IN FEET  
500  
0

**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM**  
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,  
COLORADO AND  
INCORPORATED AREAS

PANEL 764 OF 1300  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:	COMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS CITY OF	080059	0764	F	
EL PASO COUNTY	080059	0764	F	
UNINCORPORATED AREAS	080059	0764	F	

MAP NUMBER  
08041C0764 F

EFFECTIVE DATE:  
MARCH 17, 1997

Federal Emergency Management Agency

This is an office copy of a portion of the above referenced floor plate. It was prepared using FIRM data. This map shows the flood hazard areas and the boundaries which may have been made subject to the data on this map. For more information on the National Flood Insurance Program, flood maps, check the FEMA Flood Map Store at www.fema.gov.

**SE** Springs  
Engineering

31 NORTH TEJON, SUITE 300  
COLORADO SPRINGS, CO 80903  
TEL: (719) 227-7388  
FAX: (719) 227-7392

PROJECT NO. 12-005

**SPRINGS AT WATERVIEW**  
**PDR**  
**FLOOD INSURANCE RATE MAP**

## **Appendix A: Soils Data Report**

# Custom Soil Resource Report for El Paso County Area, Colorado



# Preface

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Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2\\_053951](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951)).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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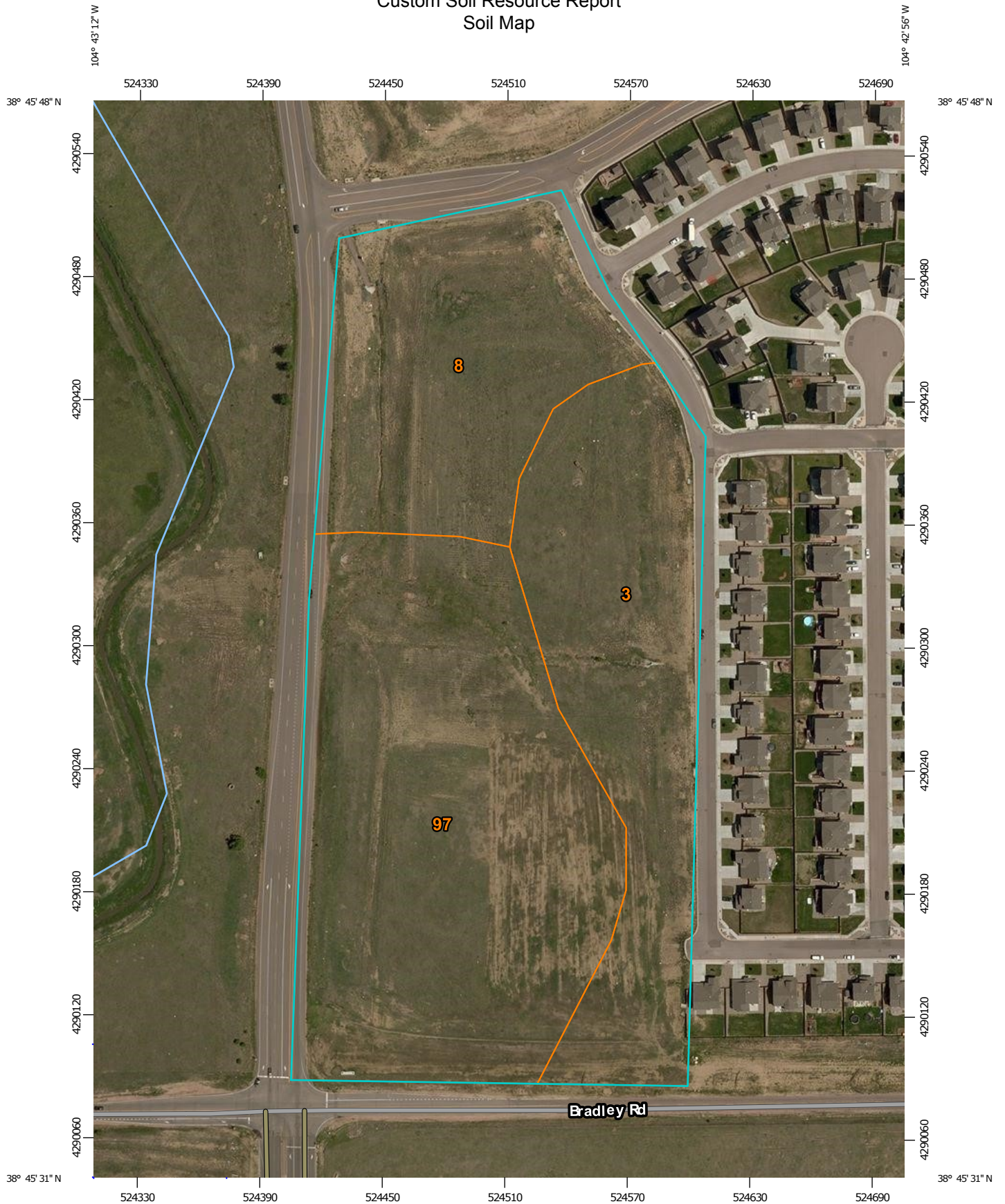
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# Soil Map

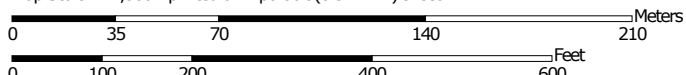
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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

# Custom Soil Resource Report Soil Map



Map Scale: 1:2,560 if printed on A portrait (8.5" x 11") sheet.



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

## 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: <http://websoilsurvey.nrcs.usda.gov>  
 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 13, Sep 22, 2015

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

Date(s) aerial images were photographed: Jun 3, 2014—Jun 17, 2014

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

## MAP LEGEND

 Area of Interest (AOI)	 Spoil Area
 Soil Map Unit Polygons	 Stony Spot
 Soil Map Unit Lines	 Very Stony Spot
 Soil Map Unit Points	 Wet Spot
 Special Point Features	 Other
 Blowout	 Special Line Features
 Borrow Pit	<b>Water Features</b>
 Clay Spot	 Streams and Canals
 Closed Depression	<b>Transportation</b>
 Gravel Pit	 Rails
 Gravelly Spot	 Interstate Highways
 Landfill	 US Routes
 Lava Flow	 Major Roads
 Marsh or swamp	 Local Roads
 Mine or Quarry	<b>Background</b>
 Miscellaneous Water	 Aerial Photography
 Perennial Water	
 Rock Outcrop	
 Saline Spot	
 Sandy Spot	
 Severely Eroded Spot	
 Sinkhole	
 Slide or Slip	
 Sodic Spot	

## Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Ascalon sandy loam, 3 to 9 percent slopes	5.5	28.7%
8	Blakeland loamy sand, 1 to 9 percent slopes	4.7	24.8%
97	Truckton sandy loam, 3 to 9 percent slopes	8.9	46.5%
<b>Totals for Area of Interest</b>		<b>19.0</b>	<b>100.0%</b>

## Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments

## Custom Soil Resource Report

on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

## El Paso County Area, Colorado

### 3—Ascalon sandy loam, 3 to 9 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2tlny  
*Elevation:* 3,870 to 5,960 feet  
*Mean annual precipitation:* 13 to 18 inches  
*Mean annual air temperature:* 46 to 54 degrees F  
*Frost-free period:* 95 to 155 days  
*Farmland classification:* Not prime farmland

#### Map Unit Composition

*Ascalon and similar soils:* 85 percent  
*Minor components:* 15 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Ascalon

##### Setting

*Landform:* Interfluves  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Wind-reworked alluvium and/or calcareous sandy eolian deposits

##### Typical profile

*Ap - 0 to 6 inches:* sandy loam  
*Bt1 - 6 to 12 inches:* sandy clay loam  
*Bt2 - 12 to 19 inches:* sandy clay loam  
*Bk1 - 19 to 35 inches:* fine sandy loam  
*Bk2 - 35 to 80 inches:* fine sandy loam

##### Properties and qualities

*Slope:* 3 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Medium  
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high  
(0.60 to 5.98 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Calcium carbonate, maximum in profile:* 10 percent  
*Salinity, maximum in profile:* Nonsaline (0.1 to 1.9 mmhos/cm)  
*Sodium adsorption ratio, maximum in profile:* 1.0  
*Available water storage in profile:* Moderate (about 7.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* 6e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* B  
*Ecological site:* Sandy Plains (R067BY024CO)

## Minor Components

### Olnest

*Percent of map unit:* 10 percent  
*Landform:* Interfluves  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* Sandy Plains (R067BY024CO)

### Vona

*Percent of map unit:* 5 percent  
*Landform:* Interfluves  
*Landform position (two-dimensional):* Backslope  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Ecological site:* Sandy Plains (R067BY024CO)

## 8—Blakeland loamy sand, 1 to 9 percent slopes

### Map Unit Setting

*National map unit symbol:* 369v  
*Elevation:* 4,600 to 5,800 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 48 degrees F  
*Frost-free period:* 125 to 145 days  
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Blakeland and similar soils:* 85 percent  
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Blakeland

#### Setting

*Landform:* Flats, hills  
*Landform position (three-dimensional):* Side slope, talf  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium derived from sedimentary rock and/or eolian deposits  
derived from sedimentary rock

#### Typical profile

*A - 0 to 11 inches:* loamy sand  
*AC - 11 to 27 inches:* loamy sand  
*C - 27 to 60 inches:* sand



## Custom Soil Resource Report

### Properties and qualities

*Slope:* 1 to 9 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Somewhat excessively drained

*Runoff class:* Low

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Calcium carbonate, maximum in profile:* 5 percent

*Available water storage in profile:* Low (about 4.5 inches)

### Interpretive groups

*Land capability classification (irrigated):* 3e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* A

*Ecological site:* Sandy Foothill (R049BY210CO)

### Minor Components

#### Other soils

*Percent of map unit:*

#### Pleasant

*Percent of map unit:*

*Landform:* Depressions

## 97—Truckton sandy loam, 3 to 9 percent slopes

### Map Unit Setting

*National map unit symbol:* 36bg

*Elevation:* 6,000 to 7,000 feet

*Mean annual precipitation:* 14 to 16 inches

*Mean annual air temperature:* 46 to 50 degrees F

*Frost-free period:* 125 to 145 days

*Farmland classification:* Not prime farmland

### Map Unit Composition

*Truckton and similar soils:* 80 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Truckton

#### Setting

*Landform:* Hills

*Landform position (three-dimensional):* Side slope

*Down-slope shape:* Linear

*Across-slope shape:* Linear

## Custom Soil Resource Report

*Parent material:* Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

### Typical profile

*A - 0 to 8 inches:* sandy loam  
*Bt - 8 to 24 inches:* sandy loam  
*C - 24 to 60 inches:* coarse sandy loam

### Properties and qualities

*Slope:* 3 to 9 percent  
*Depth to restrictive feature:* More than 80 inches  
*Natural drainage class:* Well drained  
*Runoff class:* Low  
*Capacity of the most limiting layer to transmit water (Ksat):* High (1.98 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water storage in profile:* Low (about 5.7 inches)

### Interpretive groups

*Land capability classification (irrigated):* 4e  
*Land capability classification (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Sandy Foothill (R049BY210CO)

### Minor Components

#### Haplaquolls

*Percent of map unit:*  
*Landform:* Marshes

#### Other soils

*Percent of map unit:*

#### Pleasant

*Percent of map unit:*  
*Landform:* Depressions

# References

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American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_054262](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262)

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053577](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577)

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053580](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580)

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2\\_053374](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374)

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

## Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2\\_054242](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242)

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. [http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2\\_053624](http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624)

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. [http://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_052290.pdf](http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf)

## **Appendix B: Existing Rational Calculations**

**WATERVIEW SPRINGS - EXISTING  
(RATIONAL METHOD Q=CIA)**

BASIN	TOTAL FLOWS			AREA TOTAL (Ac)	WEIGHTED			OVERLAND				CHANNEL				Tc		INTENSITY		COMMENTS
	Q(5) (c.f.s.)	Q(100) (c.f.s.)	CA(equiv.) 100 YR		C(5)	C(100)	C(5)	Length (ft)	Slope (ft)	Tc (min)	Length (ft)	Slope (%)	Description Code	Convey Factor (K)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	
E-1	3.3	25.0	4.42	12.63	0.08	0.35	100	5.9%	10.6	575	5.9%	3	7	1.7	5.6	16.3	3.2	5.7		
E-2	1.9	14.8	3.01	8.61	0.08	0.35	80	10.0%	8.0	995	3.1%	3	7	1.2	13.5	21.4	2.8	4.9		

UDFCD Table 6-2 NRCS Conveyance Factors, K

Code	Description	K
1	Heavy meadow	2.5
2	Tillage/field	5
3	Short pasture and lawns	7
4	Nearly bare ground	10
5	Grassed waterway	15
6	Paved areas and shallow paved swale	20

## WATERVIEW SPRINGS - EXISTING SURFACE ROUTING

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc	INTENSITY		TOTAL FLOWS		
		CA(5)	CA(100)		I(5)	I(100)	Q(5)	Q(100)	
		0.00	0.00	TRAVEL TIME					
				Type/flow	8.61136777	Velocity (fps)	d. Time (min)	T. Time (min)	
43	E-1	1.01	4.42	24.6	2.6	4.5	44.3	112.7	
	DP 31*	2.91	4.00						
	DP 32*	0.41	1.15						
	DP 38*	1.93	3.22						
	DP 39*	3.79	4.08						
	DP 41*	6.99	7.93						
		17.04	24.80	TRAVEL TIME					
				Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				Swale	120	5.3	0.4	25.0	
42a	E-2	0.69	3.01	17.2	3.2	5.5	12.4	38.2	
	OS Bradley Road*	3.24	3.93	TRAVEL TIME					
		3.93	6.94	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						0.0	0.0	17.2	

\* - Information obtained from previously approved drainage report.

## **Appendix C: Proposed Rational Calculations**



## WATERVIEW SPRINGS - PROPOSED (RATIONAL METHOD Q=CIA)

BASIN	TOTAL FLOWS			AREA		WEIGHTED			OVERLAND			CHANNEL					INTENSITY		COMMENTS	
	Q(5) (c.f.s.)	Q(100) (c.f.s.)	CA(equiv.) 100 YR	TOTAL (Ac)	C(5)	C(100)	C(5)	Length (ft)	Slope (ft)	Tc (min)	Length (ft)	Slope (%)	Description Code	Convey Factor (K)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	I(5) (in/hr)		I(100) (in/hr)
D-1	0.7	1.6	0.15	0.20	0.31	0.49	0.65	0.49	50	2.0%	6.4	190	4.0%	6	20	4.0	0.8	7.2	4.6	8.0
D-2	0.4	1.0	0.10	0.13	0.20	0.49	0.65	0.49	85	2.0%	8.4	20	2.1%	6	20	2.9	0.1	8.5	4.3	7.6
D-3	1.6	3.1	0.32	0.34	0.35	0.90	0.96	0.49	5	25.0%	0.9	560	5.0%	6	20	4.5	2.1	5.0	5.2	9.1
D-3A	1.3	2.4	0.25	0.27	0.28	0.90	0.96	0.49	5	25.0%	0.9	650	5.0%	6	20	4.5	2.4	5.0	5.2	9.1
D-4	0.5	1.0	0.10	0.11	0.11	0.90	0.96	0.49	5	2.0%	2.0	140	5.0%	6	20	4.5	0.5	5.0	5.2	9.1
D-5	0.8	1.9	0.15	0.20	0.31	0.49	0.65	0.49	25	2.0%	4.5	105	4.0%	6	20	4.0	0.4	5.0	5.2	9.1
D-6	0.3	0.6	0.06	0.07	0.07	0.90	0.96	0.49	5	2.0%	2.0	120	4.0%	6	20	4.0	0.5	5.0	5.2	9.1
D-7	3.4	7.9	1.15	1.52	2.35	0.49	0.65	0.49	150	5.0%	8.2	460	1.0%	3	7	0.7	11.0	19.2	3.0	5.2
D-8	2.1	4.9	0.54	0.72	1.10	0.49	0.65	0.49	55	25.0%	2.9	325	1.0%	3	7	0.7	7.7	10.7	3.9	6.9
D-9	1.9	3.5	0.42	0.45	0.47	0.90	0.96	0.49	130	15.0%	5.3	265	1.0%	6	20	2.2	7.5	4.5	7.9	
D-10	1.2	2.3	0.26	0.28	0.29	0.90	0.96	0.49	5	2.0%	2.0	550	1.0%	6	20	2.0	4.6	6.6	4.7	8.3
D-11	2.5	5.9	0.75	1.00	1.53	0.49	0.65	0.49	25	2.0%	4.5	500	1.3%	3	7	0.8	10.3	14.8	3.4	5.9
D-11A	2.4	5.6	0.70	0.93	1.43	0.49	0.65	0.49	210	4.0%	10.5	175	1.3%	3	7	0.8	3.6	14.1	3.5	6.1
D-12	0.6	1.2	0.13	0.15	0.18	0.70	0.81	0.49	50	4.0%	5.1	175	2.5%	6	20	3.2	0.9	6.0	4.9	8.5
D-13	0.8	1.6	0.16	0.19	0.23	0.70	0.81	0.49	55	4.0%	5.4	190	2.5%	6	20	3.2	1.0	6.4	4.8	8.4
D-14	2.6	5.9	0.83	1.11	1.70	0.49	0.65	0.49	215	4.0%	10.6	315	1.0%	3	7	0.7	7.5	18.1	3.1	5.4
D-14A	1.7	4.0	0.52	0.68	1.05	0.49	0.65	0.49	215	4.0%	10.6	190	1.0%	3	7	0.7	4.5	15.1	3.4	5.9
D-15	1.9	3.6	0.59	0.62	0.65	0.90	0.96	0.49	230	4.0%	10.9	605	1.0%	6	20	2.0	5.0	16.0	3.3	5.7
D-16	1.3	2.5	0.43	0.46	0.48	0.90	0.96	0.49	5	2.0%	2.0	760	1.3%	3	7	0.8	16.2	18.2	3.1	5.3
D-17	3.1	7.1	0.88	1.17	1.80	0.49	0.65	0.49	220	5.0%	9.9	250	2.0%	3	7	1.0	4.2	14.2	3.5	6.1
D-18	4.0	9.2	0.76	1.01	1.56	0.49	0.65	0.49	5	4.0%	1.6	125	4.0%	6	20	4.0	0.5	5.0	5.2	9.1
D-19	6.1	14.2	2.35	3.12	4.80	0.49	0.65	0.49	300	4.0%	12.5	750	2.2%	3	7	1.0	12.0	24.5	2.6	4.5

Code	Description	K
1	Heavy meadow	2.5
2	Tillage/field	5
3	Short pasture and lawns	7
4	Nearly bare ground	10
5	Grassed waterway	15
6	Paved areas and shallow paved swale	20

## WATERVIEW SPRINGS - PROPOSED SURFACE ROUTING

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc	INTENSITY		TOTAL FLOWS			
		CA(5)	CA(100)		I(5)	I(100)	Q(5)	Q(100)		
11	D-3	0.32	0.34	5.0	5.2	9.1	1.6	3.1		
		TRAVEL TIME								
		0.32	0.34	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
					0.0	0.0	5.0			
32	D-3A	0.25	0.27	5.0	5.2	9.1	1.3	2.4		
		TRAVEL TIME								
		0.25	0.27	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
					0.0	0.0	5.0			
A	FLOWBY D-7 FLOWBY D-8	0.00	0.26	10.7	3.9	6.9	0.3	4.3		
		0.08	0.36	TRAVEL TIME						
		0.08	0.62	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
			Street	220	2.5	1.5	12.1			
B	FLOWBY D-9 D-12	0.04	0.15	7.5	4.5	7.9	0.8	2.3		
		0.13	0.15	TRAVEL TIME						
		0.17	0.30	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
			Street	160	3.0	0.9	8.4			
C	FLOWBY D-10 D-13	0.00	0.06	6.4	4.8	8.4	0.8	2.1		
		0.16	0.19	TRAVEL TIME						
		0.16	0.25	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
			Street	150	3.0	0.8	7.2			
D	D-11A FLOWBY DP B FLOWBY D-11	0.70	0.93	14.1	3.5	6.1	2.4	6.7		
		0.00	0.07	TRAVEL TIME						
		0.00	0.12	TRAVEL TIME						
		0.70	1.11	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
				Street	5	3.0	0.0	14.1		
E	D-14A FLOWBY DP C FLOWBY D-14	0.52	0.68	18.1	3.1	5.4	1.6	4.7		
		0.00	0.06	TRAVEL TIME						
		0.00	0.13	TRAVEL TIME						
		0.52	0.87	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
				Street	5	3.0	0.0	18.1		
F	FLOWBY D-15 FLOWBY D-16 FLOWBY DP D FLOWBY DP E	0.07	0.22	18.1	3.1	5.4	0.2	3.1		
		0.00	0.09	TRAVEL TIME						
		0.00	0.21	TRAVEL TIME						
		0.00	0.06	TRAVEL TIME						
		0.07	0.58	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
				Street	240	3.0	1.3	19.4		
G	D-17	0.88	1.17	14.2	3.5	6.1	3.1	7.1		
		TRAVEL TIME								
		0.88	1.17	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
			Street	180	1.3	2.3	16.5			
K	D-5 D-6 OS Flow Bradley Rd*	0.15	0.20	5.0	5.2	9.1	11.5	24.1		
		0.06	0.07	TRAVEL TIME						
		2.00	2.38	TRAVEL TIME						
		2.22	2.66	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
						0.0	0.0	5.0		
39	D-1 D-2	0.15	0.20	8.5	4.3	7.6	1.1	2.5		
		0.10	0.13	TRAVEL TIME						
		0.25	0.33	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)		
			Pipe	125	2.5	0.8	9.3			

DESIGN POINT	CONTRIBUTING BASINS	CA (equivalent)		Tc	INTENSITY		TOTAL FLOWS		
		CA(5)	CA(100)		I(5)	I(100)	Q(5)	Q(100)	
41	D-4	0.10	0.11	5.0	5.2	9.1	0.5	1.0	
		TRAVEL TIME							
		0.10	0.11	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
			Pipe	125	2.5	0.8	5.8		
42a	D-19 DP K	2.35	3.12	24.5	2.6	4.5	11.9	26.3	
		2.22	2.66	TRAVEL TIME					
		4.57	5.78	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
					2.5	0.0	24.5		
43 (Surf Flow)	D-18	0.76	1.01	5.0	5.2	9.1	4.0	9.2	
		TRAVEL TIME							
		0.76	1.01	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
					1.3	0.0	5.0		

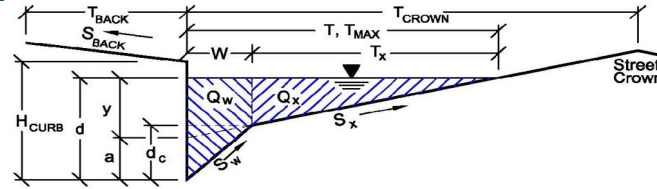
## **Appendix D: Inlet Design & Rundown Analysis**

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

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

Project: Springs at Waterview

Inlet ID: Basin D-7



Gutter Geometry (Enter data in the blue cells)													
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft												
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft												
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$												
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches												
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft												
Gutter Width	$W = 2.00$ ft												
Street Transverse Slope	$S_x = 0.020$ ft/ft												
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft												
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft												
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$												
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>T_{MAX}</math></td> <td>7.0</td> <td>15.0</td> <td>ft</td> </tr> <tr> <td><math>d_{MAX}</math></td> <td>6.0</td> <td>12.0</td> <td>inches</td> </tr> </tbody> </table>		Minor Storm	Major Storm		$T_{MAX}$	7.0	15.0	ft	$d_{MAX}$	6.0	12.0	inches
	Minor Storm	Major Storm											
$T_{MAX}$	7.0	15.0	ft										
$d_{MAX}$	6.0	12.0	inches										
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm													
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes												

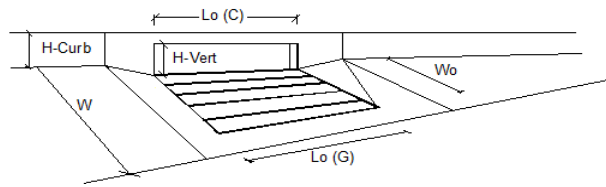
Maximum Capacity for 1/2 Street based On Allowable Spread	
Water Depth without Gutter Depression (Eq. ST-2)	$y = 1.68$ inches (Minor Storm), $3.60$ inches (Major Storm)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 2.0$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a = 1.52$ inches
Water Depth at Gutter Flowline	$d = 3.20$ inches (Minor Storm), $5.12$ inches (Major Storm)
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x = 5.0$ ft (Minor Storm), $13.0$ ft (Major Storm)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.753$ (Minor Storm), $0.397$ (Major Storm)
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.4$ cfs (Minor Storm), $5.1$ cfs (Major Storm)
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w = 1.2$ cfs (Minor Storm), $3.4$ cfs (Major Storm)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T = 1.6$ cfs (Minor Storm), $8.5$ cfs (Major Storm)
Flow Velocity within the Gutter Section	$V = 3.3$ fps (Minor Storm), $4.9$ fps (Major Storm)
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d = 0.9$ (Minor Storm), $2.1$ (Major Storm)

Maximum Capacity for 1/2 Street based on Allowable Depth	
Theoretical Water Spread	$T_{TH} = 18.7$ ft (Minor Storm), $43.7$ ft (Major Storm)
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{xTH} = 16.7$ ft (Minor Storm), $41.7$ ft (Major Storm)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.319$ (Minor Storm), $0.131$ (Major Storm)
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} = 10.0$ cfs (Minor Storm), $114.8$ cfs (Major Storm)
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x = 9.8$ cfs (Minor Storm), $72.4$ cfs (Major Storm)
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w = 4.7$ cfs (Minor Storm), $17.2$ cfs (Major Storm)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 14.5$ cfs (Minor Storm), $111.6$ cfs (Major Storm)
Average Flow Velocity Within the Gutter Section	$V = 5.6$ fps (Minor Storm), $9.4$ fps (Major Storm)
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d = 2.8$ (Minor Storm), $9.4$ (Major Storm)
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R = 1.00$
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d = 14.5$ cfs (Minor Storm), $111.6$ cfs (Major Storm)
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d = 6.00$ inches (Minor Storm), $12.00$ inches (Major Storm)
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} = 0.88$ inches (Minor Storm), $6.88$ inches (Major Storm)

MINOR STORM Allowable Capacity is based on Spread Criterion									
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>Q_{allow}</math></td> <td>1.6</td> <td>8.5</td> <td>cfs</td> </tr> </tbody> </table>		Minor Storm	Major Storm		$Q_{allow}$	1.6	8.5	cfs
	Minor Storm	Major Storm							
$Q_{allow}$	1.6	8.5	cfs						
WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak' Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'									

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-7

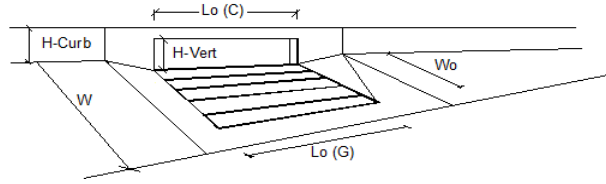


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	a <sub>LOCAL</sub> = 3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L <sub>o</sub> = 10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>r-C</sub> = 0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
	MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet Q-Peak)	Q <sub>o</sub> = 3.4	7.9	cfs
Water Spread Width	T = 10.1	14.6	ft
Water Depth at Flowline (outside of local depression)	d = 3.9	5.0	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	d <sub>CROWN</sub> = 0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E <sub>o</sub> = 0.574	0.410	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	Q <sub>x</sub> = 1.5	4.7	cfs
Discharge within the Gutter Section W	Q <sub>w</sub> = 2.0	3.2	cfs
Discharge Behind the Curb Face	Q <sub>BACK</sub> = 0.0	0.0	cfs
Flow Area within the Gutter Section W	A <sub>w</sub> = 1.14	2.24	sq ft
Velocity within the Gutter Section W	V <sub>w</sub> = 3.0	3.5	fps
Water Depth for Design Condition	d <sub>o,LOCAL</sub> = 6.9	8.0	inches
<b>Grate Analysis (Calculated)</b>			
	MINOR	MAJOR	
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Actual Interception Capacity	Q <sub>a</sub> = N/A	N/A	cfs
Carry-Over Flow = Q <sub>o</sub> - Q <sub>a</sub> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
	MINOR	MAJOR	
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.128	0.097	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 9.65	16.84	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 9.65	10.00	ft
Interception Capacity	Q <sub>i</sub> = 3.4	6.3	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.06	0.06	
Effective (Unclogged) Length	L <sub>e</sub> = 8.75	8.75	ft
Actual Interception Capacity	Q <sub>a</sub> = 3.4	6.1	cfs
Carry-Over Flow = Q <sub>b(GRATE)</sub> - Q <sub>a</sub>	Q <sub>b</sub> = 0.0	1.8	cfs
<b>Summary</b>			
	MINOR	MAJOR	
Total Inlet Interception Capacity	Q = 3.40	6.13	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	1.8	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 100	78	%



## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-8



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	a <sub>LOCAL</sub> = 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 <sub>o</sub> = 5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>T-C</sub> = 0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
	MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet Q-Peak)	Q <sub>o</sub> = 2.1	4.9	cfs
Water Spread Width	T = 8.0	11.9	ft
Water Depth at Flowline (outside of local depression)	d = 3.4	4.4	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	d <sub>CROWN</sub> = 0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E <sub>o</sub> = 0.689	0.497	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	Q <sub>x</sub> = 0.7	2.5	cfs
Discharge within the Gutter Section W	Q <sub>w</sub> = 1.4	2.4	cfs
Discharge Behind the Curb Face	Q <sub>BACK</sub> = 0.0	0.0	cfs
Flow Area within the Gutter Section W	A <sub>w</sub> = 0.77	1.54	sq ft
Velocity within the Gutter Section W	V <sub>w</sub> = 2.7	3.2	fps
Water Depth for Design Condition	d <sub>LOCAL</sub> = 6.4	7.4	inches
<b>Grate Analysis (Calculated)</b>			
	MINOR	MAJOR	
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Actual Interception Capacity	Q <sub>a</sub> = N/A	N/A	cfs
Carry-Over Flow = Q <sub>o</sub> - Q <sub>a</sub> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
	MINOR	MAJOR	
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.150	0.114	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 7.03	12.28	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 5.00	5.00	ft
Interception Capacity	Q <sub>i</sub> = 1.9	3.0	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.10	0.10	
Effective (Unclogged) Length	L <sub>e</sub> = 4.50	4.50	ft
Actual Interception Capacity	Q <sub>a</sub> = 1.8	2.7	cfs
Carry-Over Flow = Q <sub>b(GRATE)</sub> - Q <sub>a</sub>	Q <sub>b</sub> = 0.3	2.2	cfs
<b>Summary</b>			
	MINOR	MAJOR	
Total Inlet Interception Capacity	Q = 1.77	2.74	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.3	2.2	cfs
Capture Percentage = Q <sub>i</sub> /Q <sub>o</sub> =	C% = 84	56	%

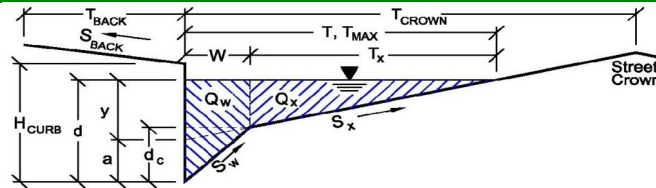


## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: **Springs at Waterview**  
 Inlet ID:

**Design Point A (Sump Inlet - Type R)**



<b>Gutter Geometry (Enter data in the blue cells)</b>					
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft				
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft				
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$				
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches				
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft				
Gutter Width	$W = 2.00$ ft				
Street Transverse Slope	$S_x = 0.020$ ft/ft				
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft				
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft				
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$				
Max. Allowable Spread for Minor & Major Storm	$T_{MAX}$ = <table border="1"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td>7.0</td><td>15.0</td></tr></table> ft	Minor Storm	Major Storm	7.0	15.0
Minor Storm	Major Storm				
7.0	15.0				
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX}$ = <table border="1"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td>6.0</td><td>12.0</td></tr></table> inches	Minor Storm	Major Storm	6.0	12.0
Minor Storm	Major Storm				
6.0	12.0				
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes				

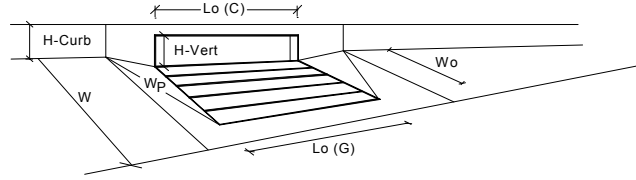
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>					
Water Depth without Gutter Depression (Eq. ST-2)	$y =$ <table border="1"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td>1.68</td><td>3.60</td></tr></table> inches	Minor Storm	Major Storm	1.68	3.60
Minor Storm	Major Storm				
1.68	3.60				
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c =$ <table border="1"><tr><td>2.0</td><td>2.0</td></tr></table> inches	2.0	2.0		
2.0	2.0				
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a =$ <table border="1"><tr><td>1.52</td><td>1.52</td></tr></table> inches	1.52	1.52		
1.52	1.52				
Water Depth at Gutter Flowline	$d =$ <table border="1"><tr><td>3.20</td><td>5.12</td></tr></table> inches	3.20	5.12		
3.20	5.12				
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x =$ <table border="1"><tr><td>5.0</td><td>13.0</td></tr></table> ft	5.0	13.0		
5.0	13.0				
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o =$ <table border="1"><tr><td>0.753</td><td>0.397</td></tr></table>	0.753	0.397		
0.753	0.397				
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x =$ <table border="1"><tr><td>0.4</td><td>5.1</td></tr></table> cfs	0.4	5.1		
0.4	5.1				
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_W =$ <table border="1"><tr><td>1.2</td><td>3.4</td></tr></table> cfs	1.2	3.4		
1.2	3.4				
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} =$ <table border="1"><tr><td>0.0</td><td>0.0</td></tr></table> cfs	0.0	0.0		
0.0	0.0				
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T =$ <table border="1"><tr><td>1.6</td><td>8.5</td></tr></table> cfs	1.6	8.5		
1.6	8.5				
Flow Velocity within the Gutter Section	$V =$ <table border="1"><tr><td>3.3</td><td>4.9</td></tr></table> fps	3.3	4.9		
3.3	4.9				
$V * d$ Product: Flow Velocity times Gutter Flowline Depth	$V * d =$ <table border="1"><tr><td>0.9</td><td>2.1</td></tr></table>	0.9	2.1		
0.9	2.1				

<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>					
Theoretical Water Spread	$T_{TH} =$ <table border="1"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td>18.7</td><td>43.7</td></tr></table> ft	Minor Storm	Major Storm	18.7	43.7
Minor Storm	Major Storm				
18.7	43.7				
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{xTH} =$ <table border="1"><tr><td>16.7</td><td>41.7</td></tr></table> ft	16.7	41.7		
16.7	41.7				
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o =$ <table border="1"><tr><td>0.319</td><td>0.131</td></tr></table>	0.319	0.131		
0.319	0.131				
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} =$ <table border="1"><tr><td>10.0</td><td>114.8</td></tr></table> cfs	10.0	114.8		
10.0	114.8				
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x =$ <table border="1"><tr><td>9.8</td><td>72.4</td></tr></table> cfs	9.8	72.4		
9.8	72.4				
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_W =$ <table border="1"><tr><td>4.7</td><td>17.2</td></tr></table> cfs	4.7	17.2		
4.7	17.2				
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} =$ <table border="1"><tr><td>0.0</td><td>21.9</td></tr></table> cfs	0.0	21.9		
0.0	21.9				
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q =$ <table border="1"><tr><td>14.5</td><td>111.6</td></tr></table> cfs	14.5	111.6		
14.5	111.6				
Average Flow Velocity Within the Gutter Section	$V =$ <table border="1"><tr><td>5.6</td><td>9.4</td></tr></table> fps	5.6	9.4		
5.6	9.4				
$V * d$ Product: Flow Velocity Times Gutter Flowline Depth	$V * d =$ <table border="1"><tr><td>2.8</td><td>9.4</td></tr></table>	2.8	9.4		
2.8	9.4				
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6$ ") Storm	$R =$ <table border="1"><tr><td>1.00</td><td>1.00</td></tr></table>	1.00	1.00		
1.00	1.00				
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d =$ <table border="1"><tr><td>14.5</td><td>111.6</td></tr></table> cfs	14.5	111.6		
14.5	111.6				
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d =$ <table border="1"><tr><td>6.00</td><td>12.00</td></tr></table> inches	6.00	12.00		
6.00	12.00				
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} =$ <table border="1"><tr><td>0.88</td><td>6.88</td></tr></table> inches	0.88	6.88		
0.88	6.88				

<b>MINOR STORM Allowable Capacity is based on Spread Criterion</b>					
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>	$Q_{allow} =$ <table border="1"><tr><td>Minor Storm</td><td>Major Storm</td></tr><tr><td>1.6</td><td>8.5</td></tr></table> cfs	Minor Storm	Major Storm	1.6	8.5
Minor Storm	Major Storm				
1.6	8.5				
<b>Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>					
<b>Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>					

# INLET IN A SUMP OR SAG LOCATION

**Project =** Springs at Waterview  
**Inlet ID =** Design Point A (Sump Inlet - Type R)



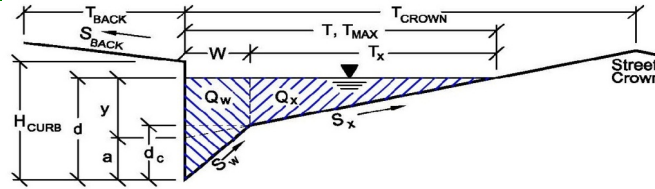
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## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: **Springs at Waterview**

Inlet ID: **Basin D-9**



<b>Gutter Geometry (Enter data in the blue cells)</b>							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} =$ <input type="text" value="10.0"/> ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} =$ <input type="text" value="0.020"/> ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} =$ <input type="text" value="0.015"/>						
Height of Curb at Gutter Flow Line	$H_{CURB} =$ <input type="text" value="6.00"/> inches						
Distance from Curb Face to Street Crown	$T_{CROWN} =$ <input type="text" value="15.0"/> ft						
Gutter Width	$W =$ <input type="text" value="2.00"/> ft						
Street Transverse Slope	$S_x =$ <input type="text" value="0.020"/> ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w =$ <input type="text" value="0.083"/> ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o =$ <input type="text" value="0.010"/> ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} =$ <input type="text" value="0.015"/>						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="font-size: small;">Minor Storm</th> <th style="font-size: small;">Major Storm</th> <th style="font-size: small;">ft</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><input type="text" value="7.0"/></td> <td style="text-align: center;"><input type="text" value="15.0"/></td> <td style="font-size: small;"></td> </tr> </tbody> </table>	Minor Storm	Major Storm	ft	<input type="text" value="7.0"/>	<input type="text" value="15.0"/>	
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Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="font-size: small;">Minor Storm</th> <th style="font-size: small;">Major Storm</th> <th style="font-size: small;">inches</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><input type="text" value="6.0"/></td> <td style="text-align: center;"><input type="text" value="12.0"/></td> <td style="font-size: small;"></td> </tr> </tbody> </table>	Minor Storm	Major Storm	inches	<input type="text" value="6.0"/>	<input type="text" value="12.0"/>	
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<input type="text" value="6.0"/>	<input type="text" value="12.0"/>						
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes						

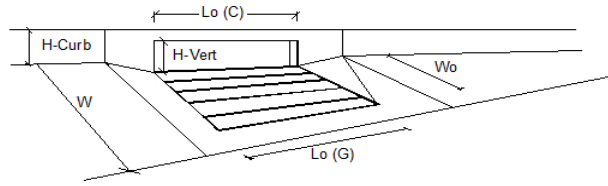
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>							
Water Depth without Gutter Depression (Eq. ST-2)	$y =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">inches</td></tr><tr><td style="text-align: center;"><input type="text" value="1.68"/></td><td style="text-align: center;"><input type="text" value="3.60"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	inches	<input type="text" value="1.68"/>	<input type="text" value="3.60"/>	
Minor Storm	Major Storm	inches					
<input type="text" value="1.68"/>	<input type="text" value="3.60"/>						
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">inches</td></tr><tr><td style="text-align: center;"><input type="text" value="2.0"/></td><td style="text-align: center;"><input type="text" value="2.0"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	inches	<input type="text" value="2.0"/>	<input type="text" value="2.0"/>	
Minor Storm	Major Storm	inches					
<input type="text" value="2.0"/>	<input type="text" value="2.0"/>						
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">inches</td></tr><tr><td style="text-align: center;"><input type="text" value="1.52"/></td><td style="text-align: center;"><input type="text" value="1.52"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	inches	<input type="text" value="1.52"/>	<input type="text" value="1.52"/>	
Minor Storm	Major Storm	inches					
<input type="text" value="1.52"/>	<input type="text" value="1.52"/>						
Water Depth at Gutter Flowline	$d =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">inches</td></tr><tr><td style="text-align: center;"><input type="text" value="3.20"/></td><td style="text-align: center;"><input type="text" value="5.12"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	inches	<input type="text" value="3.20"/>	<input type="text" value="5.12"/>	
Minor Storm	Major Storm	inches					
<input type="text" value="3.20"/>	<input type="text" value="5.12"/>						
Allowable Spread for Discharge outside the Gutter Section W (T - W)	$T_x =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">ft</td></tr><tr><td style="text-align: center;"><input type="text" value="5.0"/></td><td style="text-align: center;"><input type="text" value="13.0"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	ft	<input type="text" value="5.0"/>	<input type="text" value="13.0"/>	
Minor Storm	Major Storm	ft					
<input type="text" value="5.0"/>	<input type="text" value="13.0"/>						
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;"></td></tr><tr><td style="text-align: center;"><input type="text" value="0.753"/></td><td style="text-align: center;"><input type="text" value="0.397"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm		<input type="text" value="0.753"/>	<input type="text" value="0.397"/>	
Minor Storm	Major Storm						
<input type="text" value="0.753"/>	<input type="text" value="0.397"/>						
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="0.4"/></td><td style="text-align: center;"><input type="text" value="5.1"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="0.4"/>	<input type="text" value="5.1"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="0.4"/>	<input type="text" value="5.1"/>						
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="1.2"/></td><td style="text-align: center;"><input type="text" value="3.4"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="1.2"/>	<input type="text" value="3.4"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="1.2"/>	<input type="text" value="3.4"/>						
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="0.0"/></td><td style="text-align: center;"><input type="text" value="0.0"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="0.0"/>	<input type="text" value="0.0"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="0.0"/>	<input type="text" value="0.0"/>						
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="1.6"/></td><td style="text-align: center;"><input type="text" value="8.5"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="1.6"/>	<input type="text" value="8.5"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="1.6"/>	<input type="text" value="8.5"/>						
Flow Velocity within the Gutter Section	$V =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">fps</td></tr><tr><td style="text-align: center;"><input type="text" value="3.3"/></td><td style="text-align: center;"><input type="text" value="4.9"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	fps	<input type="text" value="3.3"/>	<input type="text" value="4.9"/>	
Minor Storm	Major Storm	fps					
<input type="text" value="3.3"/>	<input type="text" value="4.9"/>						
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;"></td></tr><tr><td style="text-align: center;"><input type="text" value="0.9"/></td><td style="text-align: center;"><input type="text" value="2.1"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm		<input type="text" value="0.9"/>	<input type="text" value="2.1"/>	
Minor Storm	Major Storm						
<input type="text" value="0.9"/>	<input type="text" value="2.1"/>						

<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>							
Theoretical Water Spread	$T_{TH} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">ft</td></tr><tr><td style="text-align: center;"><input type="text" value="18.7"/></td><td style="text-align: center;"><input type="text" value="43.7"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	ft	<input type="text" value="18.7"/>	<input type="text" value="43.7"/>	
Minor Storm	Major Storm	ft					
<input type="text" value="18.7"/>	<input type="text" value="43.7"/>						
Theoretical Spread for Discharge outside the Gutter Section W (T - W)	$T_{xTH} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">ft</td></tr><tr><td style="text-align: center;"><input type="text" value="16.7"/></td><td style="text-align: center;"><input type="text" value="41.7"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	ft	<input type="text" value="16.7"/>	<input type="text" value="41.7"/>	
Minor Storm	Major Storm	ft					
<input type="text" value="16.7"/>	<input type="text" value="41.7"/>						
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;"></td></tr><tr><td style="text-align: center;"><input type="text" value="0.319"/></td><td style="text-align: center;"><input type="text" value="0.131"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm		<input type="text" value="0.319"/>	<input type="text" value="0.131"/>	
Minor Storm	Major Storm						
<input type="text" value="0.319"/>	<input type="text" value="0.131"/>						
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="10.0"/></td><td style="text-align: center;"><input type="text" value="114.8"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="10.0"/>	<input type="text" value="114.8"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="10.0"/>	<input type="text" value="114.8"/>						
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="9.8"/></td><td style="text-align: center;"><input type="text" value="72.4"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="9.8"/>	<input type="text" value="72.4"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="9.8"/>	<input type="text" value="72.4"/>						
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="4.7"/></td><td style="text-align: center;"><input type="text" value="17.2"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="4.7"/>	<input type="text" value="17.2"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="4.7"/>	<input type="text" value="17.2"/>						
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="0.0"/></td><td style="text-align: center;"><input type="text" value="21.9"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="0.0"/>	<input type="text" value="21.9"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="0.0"/>	<input type="text" value="21.9"/>						
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="14.5"/></td><td style="text-align: center;"><input type="text" value="111.6"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="14.5"/>	<input type="text" value="111.6"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="14.5"/>	<input type="text" value="111.6"/>						
Average Flow Velocity Within the Gutter Section	$V =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">fps</td></tr><tr><td style="text-align: center;"><input type="text" value="5.6"/></td><td style="text-align: center;"><input type="text" value="9.4"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	fps	<input type="text" value="5.6"/>	<input type="text" value="9.4"/>	
Minor Storm	Major Storm	fps					
<input type="text" value="5.6"/>	<input type="text" value="9.4"/>						
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;"></td></tr><tr><td style="text-align: center;"><input type="text" value="2.8"/></td><td style="text-align: center;"><input type="text" value="9.4"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm		<input type="text" value="2.8"/>	<input type="text" value="9.4"/>	
Minor Storm	Major Storm						
<input type="text" value="2.8"/>	<input type="text" value="9.4"/>						
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;"></td></tr><tr><td style="text-align: center;"><input type="text" value="1.00"/></td><td style="text-align: center;"><input type="text" value="1.00"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm		<input type="text" value="1.00"/>	<input type="text" value="1.00"/>	
Minor Storm	Major Storm						
<input type="text" value="1.00"/>	<input type="text" value="1.00"/>						
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="14.5"/></td><td style="text-align: center;"><input type="text" value="111.6"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="14.5"/>	<input type="text" value="111.6"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="14.5"/>	<input type="text" value="111.6"/>						
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">inches</td></tr><tr><td style="text-align: center;"><input type="text" value="6.00"/></td><td style="text-align: center;"><input type="text" value="12.00"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	inches	<input type="text" value="6.00"/>	<input type="text" value="12.00"/>	
Minor Storm	Major Storm	inches					
<input type="text" value="6.00"/>	<input type="text" value="12.00"/>						
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">inches</td></tr><tr><td style="text-align: center;"><input type="text" value="0.88"/></td><td style="text-align: center;"><input type="text" value="6.88"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	inches	<input type="text" value="0.88"/>	<input type="text" value="6.88"/>	
Minor Storm	Major Storm	inches					
<input type="text" value="0.88"/>	<input type="text" value="6.88"/>						

<b>MINOR STORM</b> Allowable Capacity is based on Spread Criterion	$Q_{allow} =$ <table border="1" style="display: inline-table; border-collapse: collapse;"><tr><td style="font-size: small;">Minor Storm</td><td style="font-size: small;">Major Storm</td><td style="font-size: small;">cfs</td></tr><tr><td style="text-align: center;"><input type="text" value="1.6"/></td><td style="text-align: center;"><input type="text" value="8.5"/></td><td style="font-size: small;"></td></tr></table>	Minor Storm	Major Storm	cfs	<input type="text" value="1.6"/>	<input type="text" value="8.5"/>	
Minor Storm	Major Storm	cfs					
<input type="text" value="1.6"/>	<input type="text" value="8.5"/>						
<b>MAJOR STORM</b> Allowable Capacity is based on Spread Criterion							
<b>WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'</b> <b>Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>							

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-9



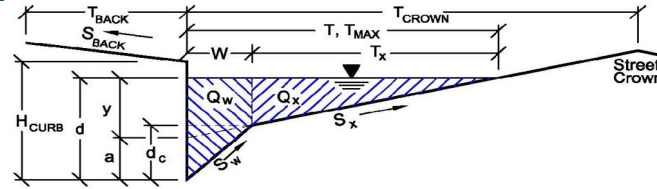
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	a <sub>LOCAL</sub> = 3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L <sub>o</sub> = 5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>T-C</sub> = 0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
	MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet Q-Peak)	Q <sub>o</sub> = 1.9	3.5	cfs
Water Spread Width	T = 7.6	10.2	ft
Water Depth at Flowline (outside of local depression)	d = 3.4	4.0	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	d <sub>CROWN</sub> = 0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E <sub>o</sub> = 0.714	0.568	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	Q <sub>x</sub> = 0.5	1.5	cfs
Discharge within the Gutter Section W	Q <sub>w</sub> = 1.4	2.0	cfs
Discharge Behind the Curb Face	Q <sub>BACK</sub> = 0.0	0.0	cfs
Flow Area within the Gutter Section W	A <sub>w</sub> = 0.71	1.17	sq ft
Velocity within the Gutter Section W	V <sub>w</sub> = 2.7	3.0	fps
Water Depth for Design Condition	d <sub>o,LOCAL</sub> = 6.4	7.0	inches
<b>Grate Analysis (Calculated)</b>			
	MINOR	MAJOR	
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Actual Interception Capacity	Q <sub>a</sub> = N/A	N/A	cfs
Carry-Over Flow = Q <sub>o</sub> - Q <sub>a</sub> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
	MINOR	MAJOR	
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.154	0.127	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 6.58	9.83	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 5.00	5.00	ft
Interception Capacity	Q <sub>i</sub> = 1.8	2.5	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.10	0.10	
Effective (Unclogged) Length	L <sub>e</sub> = 4.50	4.50	ft
Actual Interception Capacity	Q <sub>a</sub> = 1.7	2.3	cfs
Carry-Over Flow = Q <sub>b(GRATE)</sub> - Q <sub>a</sub>	Q <sub>b</sub> = 0.2	1.2	cfs
<b>Summary</b>			
	MINOR	MAJOR	
Total Inlet Interception Capacity	Q = 1.66	2.34	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.2	1.2	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 87	67	%

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

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

Project: Springs at Waterview

Inlet ID: Basin D-10



<b>Gutter Geometry (Enter data in the blue cells)</b>							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft						
Gutter Width	$W = 1.17$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td><math>T_{MAX} = 7.0</math></td> <td><math>T_{MAX} = 15.0</math></td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 7.0$	$T_{MAX} = 15.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 7.0$	$T_{MAX} = 15.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td><math>d_{MAX} = 6.0</math></td> <td><math>d_{MAX} = 12.0</math></td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 6.0$	$d_{MAX} = 12.0$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 6.0$	$d_{MAX} = 12.0$						
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes						

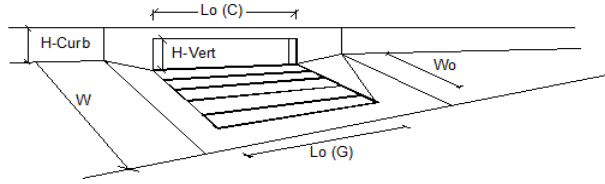
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>	
Water Depth without Gutter Depression (Eq. ST-2)	$y = 1.68$ inches (Minor Storm), $3.60$ inches (Major Storm)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 1.2$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a = 0.89$ inches
Water Depth at Gutter Flowline	$d = 2.57$ inches
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x = 5.8$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.492$
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.6$ cfs
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w = 0.6$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T = 1.2$ cfs
Flow Velocity within the Gutter Section	$V = 1.0$ fps
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d = 0.2$

<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>	
Theoretical Water Spread	$T_{TH} = 21.3$ ft (Minor Storm), $46.3$ ft (Major Storm)
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{xTH} = 20.1$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.158$
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} = 16.5$ cfs
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x = 15.8$ cfs
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w = 3.1$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 18.9$ cfs
Average Flow Velocity Within the Gutter Section	$V = 2.0$ fps
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d = 1.0$
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R = 1.00$
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d = 18.9$ cfs
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d = 6.00$ inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} = 1.52$ inches

<b>MINOR STORM Allowable Capacity is based on Spread Criterion</b>	$Q_{allow} = 1.2$ cfs
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>	$Q_{allow} = 7.9$ cfs
<b>WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'</b> <b>Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>	

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-10



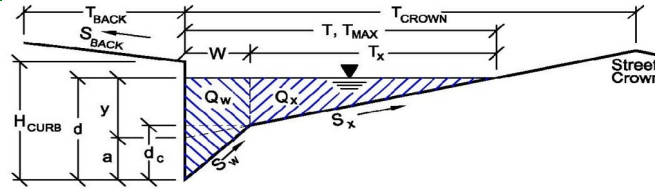
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
	MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet Q-Peak)	1.2	2.3	cfs
Water Spread Width	7.0	9.2	ft
Water Depth at Flowline (outside of local depression)	2.6	3.1	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	0.492	0.377	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	0.6	1.4	cfs
Discharge within the Gutter Section W	0.6	0.9	cfs
Discharge Behind the Curb Face	0.0	0.0	cfs
Flow Area within the Gutter Section W	0.54	0.89	sq ft
Velocity within the Gutter Section W	2.2	2.6	fps
Water Depth for Design Condition	5.6	6.1	inches
<b>Grate Analysis (Calculated)</b>			
	MINOR	MAJOR	
Total Length of Inlet Grate Opening	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Interception Capacity	N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Actual Interception Capacity	N/A	N/A	cfs
Carry-Over Flow = Q <sub>c</sub> - Q <sub>a</sub> (to be applied to curb opening or next d/s inlet)	N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
	MINOR	MAJOR	
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	0.156	0.125	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	5.18	8.00	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>c</sub> , L <sub>T</sub> )	5.00	5.00	ft
Interception Capacity	1.2	1.9	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	0.10	0.10	
Effective (Unclogged) Length	4.50	4.50	ft
Actual Interception Capacity	1.2	1.8	cfs
Carry-Over Flow = Q <sub>b(GRATE)</sub> - Q <sub>a</sub>	0.0	0.5	cfs
<b>Summary</b>			
	MINOR	MAJOR	
Total Inlet Interception Capacity	1.17	1.78	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.5	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>c</sub> =	97	77	%

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

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

Project: **Springs at Waterview**

Inlet ID: **Basin D-11**



**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb  
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)

Height of Curb at Gutter Flow Line  
 Distance from Curb Face to Street Crown  
 Gutter Width  
 Street Transverse Slope  
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  
 Street Longitudinal Slope - Enter 0 for sump condition  
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

Max. Allowable Spread for Minor & Major Storm  
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm  
 Allow Flow Depth at Street Crown (leave blank for no)

T <sub>BACK</sub>	10.0	ft
S <sub>BACK</sub>	0.020	ft/ft
n <sub>BACK</sub>	0.015	
H <sub>CURB</sub>	6.00	inches
T <sub>CROWN</sub>	15.0	ft
W	2.00	ft
S <sub>x</sub>	0.020	ft/ft
S <sub>w</sub>	0.083	ft/ft
S <sub>o</sub>	0.010	ft/ft
n <sub>STREET</sub>	0.015	

	Minor Storm	Major Storm	
T <sub>MAX</sub>	7.0	15.0	ft
d <sub>MAX</sub>	6.0	12.0	inches

check = yes

**Maximum Capacity for 1/2 Street based On Allowable Spread**

Water Depth without Gutter Depression (Eq. ST-2)  
 Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")  
 Gutter Depression ( $d_c - (W * S_x * 12)$ )  
 Water Depth at Gutter Flowline  
 Allowable Spread for Discharge outside the Gutter Section W (T - W)  
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)  
 Discharge outside the Gutter Section W, carried in Section T<sub>x</sub>  
 Discharge within the Gutter Section W ( $Q_T - Q_x$ )  
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)

**Maximum Flow Based On Allowable Spread**

Flow Velocity within the Gutter Section  
 V\*d Product: Flow Velocity times Gutter Flowline Depth

	Minor Storm	Major Storm	
y	1.68	3.60	inches
d <sub>c</sub>	2.0	2.0	inches
a	1.52	1.52	inches
d	3.20	5.12	inches
T <sub>x</sub>	5.0	13.0	ft
E <sub>o</sub>	0.753	0.397	
Q <sub>x</sub>	0.4	5.1	cfs
Q <sub>w</sub>	1.2	3.4	cfs
Q <sub>BACK</sub>	0.0	0.0	cfs
Q <sub>T</sub>	1.6	8.5	cfs
V	3.3	4.9	fps
V*d	0.9	2.1	

**Maximum Capacity for 1/2 Street based on Allowable Depth**

Theoretical Water Spread  
 Theoretical Spread for Discharge outside the Gutter Section W (T - W)  
 Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)  
 Theoretical Discharge outside the Gutter Section W, carried in Section T<sub>x TH</sub>  
 Actual Discharge outside the Gutter Section W, (limited by distance T<sub>CROWN</sub>)  
 Discharge within the Gutter Section W ( $Q_d - Q_x$ )  
 Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)  
 Total Discharge for Major & Minor Storm (Pre-Safety Factor)  
 Average Flow Velocity Within the Gutter Section  
 V\*d Product: Flow Velocity Times Gutter Flowline Depth  
 Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm

**Max Flow Based on Allowable Depth (Safety Factor Applied)**

Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)  
 Resultant Flow Depth at Street Crown (Safety Factor Applied)

	Minor Storm	Major Storm	
T <sub>TH</sub>	18.7	43.7	ft
T <sub>x TH</sub>	16.7	41.7	ft
E <sub>o</sub>	0.319	0.131	
Q <sub>x TH</sub>	10.0	114.8	cfs
Q <sub>x</sub>	9.8	72.4	cfs
Q <sub>w</sub>	4.7	17.2	cfs
Q <sub>BACK</sub>	0.0	21.9	cfs
Q	14.5	111.6	cfs
V	5.6	9.4	fps
V*d	2.8	9.4	
R	1.00	1.00	
Q <sub>d</sub>	14.5	111.6	cfs
d	6.00	12.00	inches
d <sub>CROWN</sub>	0.88	6.88	inches

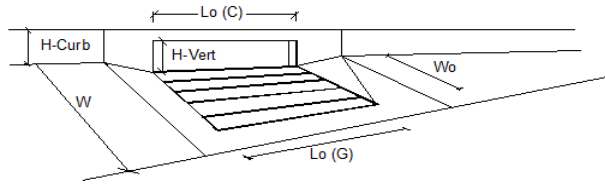
**MINOR STORM Allowable Capacity is based on Spread Criterion**  
**MAJOR STORM Allowable Capacity is based on Spread Criterion**

	Minor Storm	Major Storm	
Q <sub>allow</sub>	1.6	8.5	cfs

**WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'**  
**Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'**

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-11



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	a <sub>LOCAL</sub> = 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 <sub>o</sub> = 10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>r-C</sub> = 0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
	MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet Q-Peak)	Q <sub>o</sub> = 2.5	5.9	cfs
Water Spread Width	T = 8.7	12.9	ft
Water Depth at Flowline (outside of local depression)	d = 3.6	4.6	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	d <sub>CROWN</sub> = 0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E <sub>o</sub> = 0.646	0.462	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	Q <sub>x</sub> = 0.9	3.2	cfs
Discharge within the Gutter Section W	Q <sub>w</sub> = 1.6	2.7	cfs
Discharge Behind the Curb Face	Q <sub>BACK</sub> = 0.0	0.0	cfs
Flow Area within the Gutter Section W	A <sub>w</sub> = 0.89	1.78	sq ft
Velocity within the Gutter Section W	V <sub>w</sub> = 2.8	3.3	fps
Water Depth for Design Condition	d <sub>o,LOCAL</sub> = 6.6	7.6	inches
<b>Grate Analysis (Calculated)</b>			
	MINOR	MAJOR	
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
<b>Actual Interception Capacity</b>	Q <sub>a</sub> = N/A	N/A	cfs
<b>Carry-Over Flow = Q<sub>o</sub> - Q<sub>a</sub></b> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
	MINOR	MAJOR	
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.142	0.107	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 7.88	13.89	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 7.88	10.00	ft
Interception Capacity	Q <sub>i</sub> = 2.5	5.3	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.06	0.06	
Effective (Unclogged) Length	L <sub>e</sub> = 8.75	8.75	ft
<b>Actual Interception Capacity</b>	Q <sub>a</sub> = 2.5	5.2	cfs
<b>Carry-Over Flow = Q<sub>b(GRATE)</sub> - Q<sub>a</sub></b>	Q <sub>b</sub> = 0.0	0.7	cfs
<b>Summary</b>			
	MINOR	MAJOR	
Total Inlet Interception Capacity	Q = 2.50	5.16	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	0.7	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 100	87	%

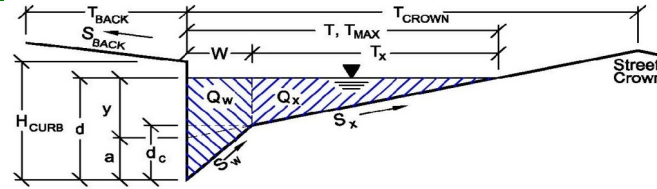


## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Springs at Waterview

Inlet ID: Design Point D (Sump Inlet - Type R)



Gutter Geometry (Enter data in the blue cells)							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">ft</th> </tr> <tr> <td style="text-align: center;">7.0</td> <td style="text-align: center;">15.0</td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	7.0	15.0	
Minor Storm	Major Storm	ft					
7.0	15.0						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">inches</th> </tr> <tr> <td style="text-align: center;">6.0</td> <td style="text-align: center;">12.0</td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	6.0	12.0	
Minor Storm	Major Storm	inches					
6.0	12.0						
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes						

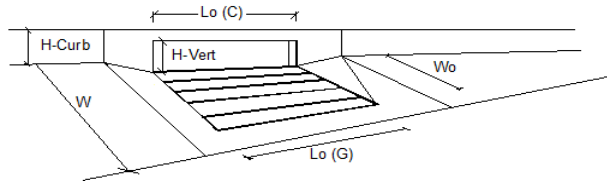
Maximum Capacity for 1/2 Street based On Allowable Spread	
Water Depth without Gutter Depression (Eq. ST-2)	$y = 1.68$ inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 2.0$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a = 1.52$ inches
Water Depth at Gutter Flowline	$d = 3.20$ inches
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x = 5.0$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.753$
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.4$ cfs
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w = 1.2$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T = 1.6$ cfs
Flow Velocity within the Gutter Section	$V = 3.3$ fps
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d = 0.9$

Maximum Capacity for 1/2 Street based on Allowable Depth	
Theoretical Water Spread	$T_{TH} = 18.7$ ft
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{xTH} = 16.7$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.319$
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} = 10.0$ cfs
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x = 9.8$ cfs
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w = 4.7$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 14.5$ cfs
Average Flow Velocity Within the Gutter Section	$V = 5.6$ fps
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d = 2.8$
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R = 1.00$
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d = 14.5$ cfs
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d = 6.00$ inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} = 0.88$ inches

MINOR STORM Allowable Capacity is based on Spread Criterion							
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px;">Minor Storm</th> <th style="padding: 2px;">Major Storm</th> <th style="padding: 2px;">cfs</th> </tr> <tr> <td style="text-align: center;">1.6</td> <td style="text-align: center;">8.5</td> <td></td> </tr> </table>	Minor Storm	Major Storm	cfs	1.6	8.5	
Minor Storm	Major Storm	cfs					
1.6	8.5						
<b>WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'</b> <b>Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>							

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Design Point D (Sump Inlet - Type R)



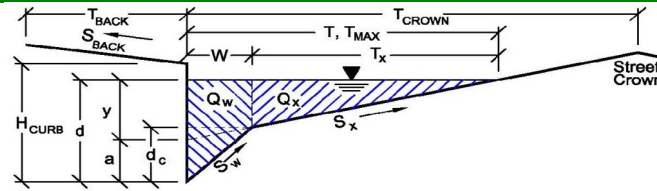
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	a <sub>LOCAL</sub> = 3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L <sub>o</sub> = 10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>T-C</sub> = 0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
<b>Design Discharge for Half of Street (from Sheet Q-Peak)</b>			
Water Spread Width	Q <sub>o</sub> = 2.4	6.7	cfs
Water Depth at Flowline (outside of local depression)	T = 8.6	13.6	ft
Water Depth at Street Crown (or at T <sub>max</sub> )	d = 3.6	4.8	inches
Ratio of Gutter Flow to Design Flow	d <sub>CROWN</sub> = 0.0	0.0	inches
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	E <sub>o</sub> = 0.656	0.438	
Discharge within the Gutter Section W	Q <sub>x</sub> = 0.8	3.8	cfs
Discharge Behind the Curb Face	Q <sub>w</sub> = 1.6	2.9	cfs
Flow Area within the Gutter Section W	Q <sub>BACK</sub> = 0.0	0.0	cfs
Velocity within the Gutter Section W	A <sub>w</sub> = 0.86	1.97	sq ft
Water Depth for Design Condition	V <sub>w</sub> = 2.8	3.4	fps
	d <sub>LOCAL</sub> = 6.6	7.8	inches
<b>Grate Analysis (Calculated)</b>			
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Actual Interception Capacity	Q <sub>a</sub> = N/A	N/A	cfs
Carry-Over Flow = Q <sub>o</sub> - Q <sub>a</sub> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.143	0.103	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 7.67	15.10	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 7.67	10.00	ft
Interception Capacity	Q <sub>i</sub> = 2.4	5.7	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.06	0.06	
Effective (Unclogged) Length	L <sub>e</sub> = 8.75	8.75	ft
Actual Interception Capacity	Q <sub>a</sub> = 2.4	5.6	cfs
Carry-Over Flow = Q <sub>b(GRATE)</sub> - Q <sub>a</sub>	Q <sub>b</sub> = 0.0	1.1	cfs
<b>Summary</b>			
Total Inlet Interception Capacity	Q = 2.40	5.58	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	1.1	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 100	83	%

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point B (Sump Inlet - Type R)**



<b>Gutter Geometry (Enter data in the blue cells)</b>							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.025$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table;"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>7.0</td> <td>15.0</td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	7.0	15.0	
Minor Storm	Major Storm	ft					
7.0	15.0						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table;"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td>6.0</td> <td>12.0</td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	6.0	12.0	
Minor Storm	Major Storm	inches					
6.0	12.0						
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> Minor Storm <input type="checkbox"/> Major Storm    check = yes						

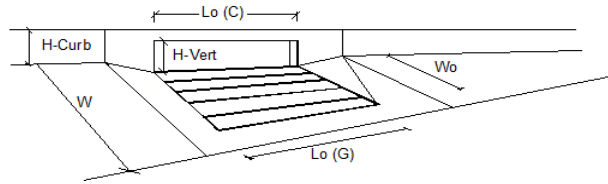
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>	
Water Depth without Gutter Depression (Eq. ST-2)	$y = 1.68$ inches (Minor Storm) / $3.60$ inches (Major Storm)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 2.0$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a = 1.52$ inches
Water Depth at Gutter Flowline	$d = 3.20$ inches (Minor Storm) / $5.12$ inches (Major Storm)
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x = 5.0$ ft (Minor Storm) / $13.0$ ft (Major Storm)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.753$ (Minor Storm) / $0.397$ (Major Storm)
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.6$ cfs (Minor Storm) / $8.1$ cfs (Major Storm)
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w = 1.9$ cfs (Minor Storm) / $5.4$ cfs (Major Storm)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs (Minor Storm) / $0.0$ cfs (Major Storm)
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T = 2.6$ cfs (Minor Storm) / $13.5$ cfs (Major Storm)
Flow Velocity within the Gutter Section	$V = 5.3$ fps (Minor Storm) / $7.8$ fps (Major Storm)
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d = 1.4$ (Minor Storm) / $3.3$ (Major Storm)

<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>	
Theoretical Water Spread	$T_{TH} = 18.7$ ft (Minor Storm) / $43.7$ ft (Major Storm)
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{xTH} = 16.7$ ft (Minor Storm) / $41.7$ ft (Major Storm)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.319$ (Minor Storm) / $0.131$ (Major Storm)
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} = 15.8$ cfs (Minor Storm) / $181.5$ cfs (Major Storm)
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x = 15.5$ cfs (Minor Storm) / $114.5$ cfs (Major Storm)
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w = 7.4$ cfs (Minor Storm) / $27.3$ cfs (Major Storm)
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs (Minor Storm) / $34.6$ cfs (Major Storm)
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 22.9$ cfs (Minor Storm) / $176.4$ cfs (Major Storm)
Average Flow Velocity Within the Gutter Section	$V = 8.8$ fps (Minor Storm) / $14.9$ fps (Major Storm)
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d = 4.4$ (Minor Storm) / $14.9$ (Major Storm)
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R = 0.86$ (Minor Storm) / $0.70$ (Major Storm)
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d = 19.7$ cfs (Minor Storm) / $123.1$ cfs (Major Storm)
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d = 5.73$ inches (Minor Storm) / $10.50$ inches (Major Storm)
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} = 0.61$ inches (Minor Storm) / $5.38$ inches (Major Storm)

<b>MINOR STORM Allowable Capacity is based on Spread Criterion</b>	Minor Storm	Major Storm	
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>	$Q_{allow} = 2.6$ cfs	$13.5$ cfs	
<p style="color: red;">Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</p> <p style="color: red;">Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</p>			

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Design Point B (Sump Inlet - Type R)



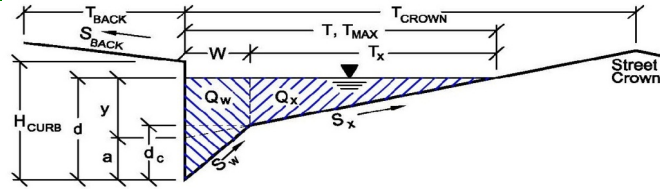
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a <sub>LOCAL</sub> = 3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L <sub>o</sub> = 5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>T-C</sub> = 0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; maximum allowable from sheet 'Q-Allow'</b>			
<b>Design Discharge for Half of Street (from Sheet Q-Peak)</b>	<b>Q<sub>o</sub> = 0.8</b>	<b>2.3</b>	<b>cfs</b>
Water Spread Width	T = 2.3	6.6	ft
Water Depth at Flowline (outside of local depression)	d = 2.1	3.1	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	d <sub>CROWN</sub> = 0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E <sub>o</sub> = 1.008	0.782	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	Q <sub>x</sub> = 0.0	0.5	cfs
Discharge within the Gutter Section W	Q <sub>w</sub> = 0.8	1.8	cfs
Discharge Behind the Curb Face	Q <sub>BACK</sub> = 0.0	0.0	cfs
Flow Area within the Gutter Section W	A <sub>w</sub> = 0.18	0.56	sq ft
Velocity within the Gutter Section W	V <sub>w</sub> = 4.5	4.1	fps
Water Depth for Design Condition	d <sub>LOCAL</sub> = 5.1	6.1	inches
<b>Grate Analysis (Calculated)</b>			
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
<b>Actual Interception Capacity</b>	<b>Q<sub>a</sub> = N/A</b>	<b>N/A</b>	<b>cfs</b>
<b>Carry-Over Flow = Q<sub>o</sub> - Q<sub>a</sub></b> (to be applied to curb opening or next d/s inlet)	<b>Q<sub>b</sub> = N/A</b>	<b>N/A</b>	<b>cfs</b>
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.208	0.167	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 3.89	7.38	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 3.89	5.00	ft
Interception Capacity	Q <sub>i</sub> = 0.8	2.0	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.10	0.10	
Effective (Unclogged) Length	L <sub>e</sub> = 4.50	4.50	ft
<b>Actual Interception Capacity</b>	<b>Q<sub>a</sub> = 0.8</b>	<b>1.9</b>	<b>cfs</b>
<b>Carry-Over Flow = Q<sub>b(GRATE)</sub> - Q<sub>a</sub></b>	<b>Q<sub>b</sub> = 0.0</b>	<b>0.4</b>	<b>cfs</b>
<b>Summary</b>			
Total Inlet Interception Capacity	Q = 0.80	1.88	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	0.4	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 100	82	%

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

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

Project: **Springs at Waterview**

Inlet ID: **Basin D-14**



**Gutter Geometry (Enter data in the blue cells)**

Maximum Allowable Width for Spread Behind Curb  $T_{BACK} = 10.0$  ft

Side Slope Behind Curb (leave blank for no conveyance credit behind curb)  $S_{BACK} = 0.020$  ft/ft

Manning's Roughness Behind Curb (typically between 0.012 and 0.020)  $n_{BACK} = 0.015$

Height of Curb at Gutter Flow Line  $H_{CURB} = 6.00$  inches

Distance from Curb Face to Street Crown  $T_{CROWN} = 15.0$  ft

Gutter Width  $W = 2.00$  ft

Street Transverse Slope  $S_x = 0.020$  ft/ft

Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)  $S_w = 0.083$  ft/ft

Street Longitudinal Slope - Enter 0 for sump condition  $S_o = 0.010$  ft/ft

Manning's Roughness for Street Section (typically between 0.012 and 0.020)  $n_{STREET} = 0.015$

	Minor Storm	Major Storm	ft
Max. Allowable Spread for Minor & Major Storm $T_{MAX}$	7.0	15.0	
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm $d_{MAX}$	6.0	12.0	inches

Allow Flow Depth at Street Crown (leave blank for no)  check = yes

**Maximum Capacity for 1/2 Street based On Allowable Spread**

	Minor Storm	Major Storm	inches
Water Depth without Gutter Depression (Eq. ST-2) $y$	1.68	3.60	
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2") $d_c$	2.0	2.0	
Gutter Depression ( $d_c - (W * S_x * 12)$ ) $a$	1.52	1.52	
Water Depth at Gutter Flowline $d$	3.20	5.12	
Allowable Spread for Discharge outside the Gutter Section W (T - W) $T_x$	5.0	13.0	ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7) $E_o$	0.753	0.397	
Discharge outside the Gutter Section W, carried in Section $T_x$ $Q_x$	0.4	5.1	cfs
Discharge within the Gutter Section W ( $Q_T - Q_x$ ) $Q_w$	1.2	3.4	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns) $Q_{BACK}$	0.0	0.0	cfs
<b>Maximum Flow Based On Allowable Spread</b>			
Flow Velocity within the Gutter Section $Q_T$	1.6	8.5	cfs
Flow Velocity within the Gutter Section $V$	3.3	4.9	fps
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	0.9	2.1	

**Maximum Capacity for 1/2 Street based on Allowable Depth**

	Minor Storm	Major Storm	ft
Theoretical Water Spread $T_{TH}$	18.7	43.7	
Theoretical Spread for Discharge outside the Gutter Section W (T - W) $T_{X TH}$	16.7	41.7	
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7) $E_o$	0.319	0.131	
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X TH}$ $Q_{X TH}$	10.0	114.8	cfs
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ ) $Q_x$	9.8	72.4	cfs
Discharge within the Gutter Section W ( $Q_d - Q_x$ ) $Q_w$	4.7	17.2	cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns) $Q_{BACK}$	0.0	21.9	cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor) $Q$	14.5	111.6	cfs
Average Flow Velocity Within the Gutter Section $V$	5.6	9.4	fps
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	2.8	9.4	
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm $R$	1.00	1.00	
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>			
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied) $Q_d$	14.5	111.6	cfs
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied) $d$	6.00	12.00	inches
Resultant Flow Depth at Street Crown (Safety Factor Applied) $d_{CROWN}$	0.88	6.88	inches

**MINOR STORM Allowable Capacity is based on Spread Criterion**

**MAJOR STORM Allowable Capacity is based on Spread Criterion**

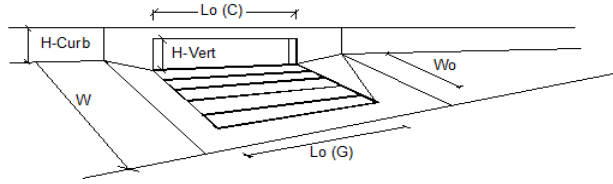
	Minor Storm	Major Storm	cfs
$Q_{allow}$	1.6	8.5	

**WARNING: MINOR STORM max. allowable capacity is less than flow given on sheet 'Q-Peak'**

**Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'**

# INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-14



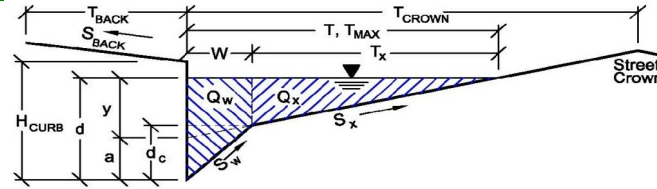
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	a <sub>LOCAL</sub> = 3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L <sub>o</sub> = 10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>r-C</sub> = 0.10	0.10	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
	MINOR	MAJOR	
Design Discharge for Half of Street (from Sheet Q-Peak)	Q <sub>o</sub> = 2.6	5.9	cfs
Water Spread Width	T = 8.9	12.9	ft
Water Depth at Flowline (outside of local depression)	d = 3.7	4.6	inches
Water Depth at Street Crown (or at T <sub>max</sub> )	d <sub>CROWN</sub> = 0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	E <sub>o</sub> = 0.637	0.462	
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	Q <sub>x</sub> = 0.9	3.2	cfs
Discharge within the Gutter Section W	Q <sub>w</sub> = 1.7	2.7	cfs
Discharge Behind the Curb Face	Q <sub>BACK</sub> = 0.0	0.0	cfs
Flow Area within the Gutter Section W	A <sub>w</sub> = 0.92	1.78	sq ft
Velocity within the Gutter Section W	V <sub>w</sub> = 2.8	3.3	fps
Water Depth for Design Condition	d <sub>o,LOCAL</sub> = 6.7	7.6	inches
<b>Grate Analysis (Calculated)</b>			
	MINOR	MAJOR	
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
<b>Actual Interception Capacity</b>	Q <sub>a</sub> = N/A	N/A	cfs
<b>Carry-Over Flow = Q<sub>o</sub> - Q<sub>a</sub></b> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
	MINOR	MAJOR	
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.140	0.107	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 8.08	13.89	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>o</sub> , L <sub>T</sub> )	L = 8.08	10.00	ft
Interception Capacity	Q <sub>i</sub> = 2.6	5.3	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.06	0.06	
Effective (Unclogged) Length	L <sub>e</sub> = 8.75	8.75	ft
<b>Actual Interception Capacity</b>	Q <sub>a</sub> = 2.6	5.2	cfs
<b>Carry-Over Flow = Q<sub>b(GRATE)</sub> - Q<sub>a</sub></b>	Q <sub>b</sub> = 0.0	0.7	cfs
<b>Summary</b>			
	MINOR	MAJOR	
Total Inlet Interception Capacity	Q = 2.60	5.16	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	0.7	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 100	87	%

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point E (Sump Inlet - Type R)**



<b>Gutter Geometry (Enter data in the blue cells)</b>										
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft									
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft									
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$									
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches									
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft									
Gutter Width	$W = 2.00$ ft									
Street Transverse Slope	$S_x = 0.020$ ft/ft									
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft									
Street Longitudinal Slope - Enter 0 for sump condition	$S_d = 0.010$ ft/ft									
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$									
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Minor Storm</th> <th style="text-align: left;">Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: right;"><math>T_{MAX} = 7.0</math></td> <td style="text-align: right;"><math>15.0</math></td> <td>ft</td> </tr> <tr> <td style="text-align: right;"><math>d_{MAX} = 6.0</math></td> <td style="text-align: right;"><math>12.0</math></td> <td>inches</td> </tr> </tbody> </table>	Minor Storm	Major Storm		$T_{MAX} = 7.0$	$15.0$	ft	$d_{MAX} = 6.0$	$12.0$	inches
Minor Storm	Major Storm									
$T_{MAX} = 7.0$	$15.0$	ft								
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Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Minor Storm</th> <th style="text-align: left;">Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: right;"><math>d_{MAX} = 6.0</math></td> <td style="text-align: right;"><math>12.0</math></td> <td>inches</td> </tr> </tbody> </table>	Minor Storm	Major Storm		$d_{MAX} = 6.0$	$12.0$	inches			
Minor Storm	Major Storm									
$d_{MAX} = 6.0$	$12.0$	inches								
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes									

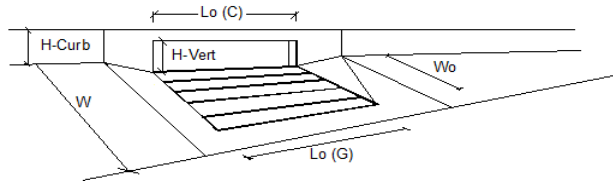
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>																																								
Water Depth without Gutter Depression (Eq. ST-2)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Minor Storm</th> <th style="text-align: left;">Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: right;"><math>y = 1.68</math></td> <td style="text-align: right;"><math>3.60</math></td> <td>inches</td> </tr> <tr> <td style="text-align: right;"><math>d_c = 2.0</math></td> <td style="text-align: right;"><math>2.0</math></td> <td>inches</td> </tr> <tr> <td style="text-align: right;"><math>a = 1.52</math></td> <td style="text-align: right;"><math>1.52</math></td> <td>inches</td> </tr> <tr> <td style="text-align: right;"><math>d = 3.20</math></td> <td style="text-align: right;"><math>5.12</math></td> <td>inches</td> </tr> <tr> <td style="text-align: right;"><math>T_x = 5.0</math></td> <td style="text-align: right;"><math>13.0</math></td> <td>ft</td> </tr> <tr> <td style="text-align: right;"><math>E_o = 0.753</math></td> <td style="text-align: right;"><math>0.397</math></td> <td></td> </tr> <tr> <td style="text-align: right;"><math>Q_x = 0.4</math></td> <td style="text-align: right;"><math>5.1</math></td> <td>cfs</td> </tr> <tr> <td style="text-align: right;"><math>Q_w = 1.2</math></td> <td style="text-align: right;"><math>3.4</math></td> <td>cfs</td> </tr> <tr> <td style="text-align: right;"><math>Q_{BACK} = 0.0</math></td> <td style="text-align: right;"><math>0.0</math></td> <td>cfs</td> </tr> <tr> <td style="text-align: right;"><math>Q_T = 1.6</math></td> <td style="text-align: right;"><math>8.5</math></td> <td>cfs</td> </tr> <tr> <td style="text-align: right;"><math>V = 3.3</math></td> <td style="text-align: right;"><math>4.9</math></td> <td>fps</td> </tr> <tr> <td style="text-align: right;"><math>V*d = 0.9</math></td> <td style="text-align: right;"><math>2.1</math></td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm		$y = 1.68$	$3.60$	inches	$d_c = 2.0$	$2.0$	inches	$a = 1.52$	$1.52$	inches	$d = 3.20$	$5.12$	inches	$T_x = 5.0$	$13.0$	ft	$E_o = 0.753$	$0.397$		$Q_x = 0.4$	$5.1$	cfs	$Q_w = 1.2$	$3.4$	cfs	$Q_{BACK} = 0.0$	$0.0$	cfs	$Q_T = 1.6$	$8.5$	cfs	$V = 3.3$	$4.9$	fps	$V*d = 0.9$	$2.1$	
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<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>																																														
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Total Discharge for Major & Minor Storm (Pre-Safety Factor)																																														
Average Flow Velocity Within the Gutter Section																																														
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth																																														
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm																																														
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>																																														
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)																																														
Resultant Flow Depth at Street Crown (Safety Factor Applied)																																														

<b>MINOR STORM Allowable Capacity is based on Spread Criterion</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Minor Storm</th> <th style="text-align: left;">Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: right;"><math>Q_{allow} = 1.6</math></td> <td style="text-align: right;"><math>8.5</math></td> <td>cfs</td> </tr> </tbody> </table>	Minor Storm	Major Storm		$Q_{allow} = 1.6$	$8.5$	cfs
Minor Storm	Major Storm						
$Q_{allow} = 1.6$	$8.5$	cfs					
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>							
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'							
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'							

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Design Point E (Sump Inlet - Type R)



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	a <sub>LOCAL</sub> = 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 <sub>o</sub> = 10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	W <sub>o</sub> = N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C <sub>T-G</sub> = N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C <sub>T-C</sub> = 0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; maximum allowable from sheet 'Q-Allow'</b>			
<b>Design Discharge for Half of Street (from Sheet Q-Peak)</b>			
Water Spread Width	Q <sub>o</sub> = 1.6	4.7	cfs
Water Depth at Flowline (outside of local depression)	T = 7.0	11.7	ft
Water Depth at Street Crown (or at T <sub>max</sub> )	d = 3.2	4.3	inches
Ratio of Gutter Flow to Design Flow	d <sub>CROWN</sub> = 0.0	0.0	inches
Discharge outside the Gutter Section W, carried in Section T <sub>x</sub>	E <sub>o</sub> = 0.757	0.506	
Discharge within the Gutter Section W	Q <sub>x</sub> = 0.4	2.3	cfs
Discharge Behind the Curb Face	Q <sub>w</sub> = 1.2	2.4	cfs
Flow Area within the Gutter Section W	Q <sub>BACK</sub> = 0.0	0.0	cfs
Velocity within the Gutter Section W	A <sub>w</sub> = 0.61	1.49	sq ft
Water Depth for Design Condition	V <sub>w</sub> = 2.6	3.2	fps
	d <sub>LOCAL</sub> = 6.2	7.3	inches
<b>Grate Analysis (Calculated)</b>			
Total Length of Inlet Grate Opening	L = N/A	N/A	ft
Ratio of Grate Flow to Design Flow	E <sub>o-GRATE</sub> = N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Interception Capacity	Q <sub>i</sub> = N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	GrateCoef = N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	GrateClog = N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	L <sub>e</sub> = N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	V <sub>o</sub> = N/A	N/A	fps
Interception Rate of Frontal Flow	R <sub>f</sub> = N/A	N/A	
Interception Rate of Side Flow	R <sub>s</sub> = N/A	N/A	
Actual Interception Capacity	Q <sub>a</sub> = N/A	N/A	cfs
Carry-Over Flow = Q <sub>o</sub> - Q <sub>a</sub> (to be applied to curb opening or next d/s inlet)	Q <sub>b</sub> = N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
Equivalent Slope S <sub>e</sub> (based on grate carry-over)	S <sub>e</sub> = 0.163	0.115	ft/ft
Required Length L <sub>T</sub> to Have 100% Interception	L <sub>T</sub> = 5.89	11.95	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of L <sub>e</sub> , L <sub>T</sub> )	L = 5.89	10.00	ft
Interception Capacity	Q <sub>i</sub> = 1.6	4.5	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	CurbCoef = 1.25	1.25	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	CurbClog = 0.06	0.06	
Effective (Unclogged) Length	L <sub>e</sub> = 8.75	8.75	ft
Actual Interception Capacity	Q <sub>a</sub> = 1.6	4.4	cfs
Carry-Over Flow = Q <sub>b(GRATE)</sub> - Q <sub>a</sub>	Q <sub>b</sub> = 0.0	0.3	cfs
<b>Summary</b>			
Total Inlet Interception Capacity	Q = 1.60	4.43	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	Q <sub>b</sub> = 0.0	0.3	cfs
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub> =	C% = 100	94	%

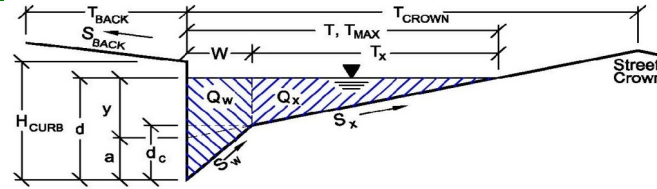


## ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: Springs at Waterview

Inlet ID: Design Point C (Sump Inlet - Type R)



Gutter Geometry (Enter data in the blue cells)													
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft												
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft												
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$												
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches												
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft												
Gutter Width	$W = 2.00$ ft												
Street Transverse Slope	$S_x = 0.020$ ft/ft												
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft												
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.025$ ft/ft												
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$												
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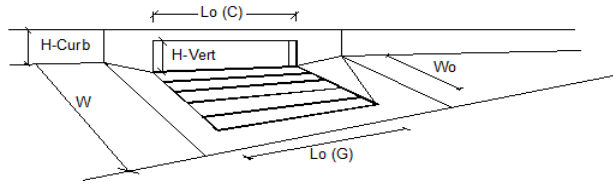
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## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Design Point C (Sump Inlet - Type R)



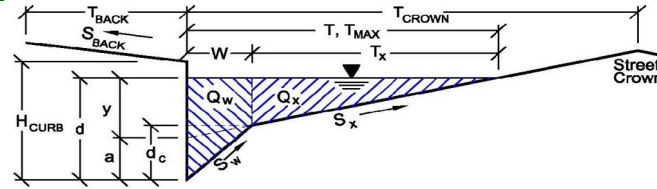
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; maximum allowable from sheet 'Q-Allow'</b>			
<b>Design Discharge for Half of Street (from Sheet Q-Peak)</b>			
Water Spread Width	2.3	6.3	ft
Water Depth at Flowline (outside of local depression)	2.1	3.0	inches
Water Depth at Street Crown (or at $T_{max}$ )	0.0	0.0	inches
Ratio of Gutter Flow to Design Flow	1.008	0.805	
Discharge outside the Gutter Section W, carried in Section $T_x$	0.0	0.4	cfs
Discharge within the Gutter Section W	0.8	1.7	cfs
Discharge Behind the Curb Face	0.0	0.0	cfs
Flow Area within the Gutter Section W	0.18	0.52	sq ft
Velocity within the Gutter Section W	4.5	4.1	fps
Water Depth for Design Condition	5.1	6.0	inches
<b>Grate Analysis (Calculated)</b>			
Total Length of Inlet Grate Opening	N/A	N/A	ft
Ratio of Grate Flow to Design Flow	N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Interception Capacity	N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	N/A	N/A	
Clogging Factor for Multiple-unit Grate Inlet	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Actual Interception Capacity	N/A	N/A	cfs
Carry-Over Flow = $Q_o - Q_a$ (to be applied to curb opening or next d/s inlet)	N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
Equivalent Slope $S_e$ (based on grate carry-over)	0.208	0.171	ft/ft
Required Length $L_T$ to Have 100% Interception	3.89	6.96	ft
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of $L$ , $L_T$ )	3.89	5.00	ft
Interception Capacity	0.8	1.9	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient	1.00	1.00	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	0.10	0.10	
Effective (Unclogged) Length	4.50	4.50	ft
Actual Interception Capacity	0.8	1.8	cfs
Carry-Over Flow = $Q_b(GRATE) - Q_a$	0.0	0.3	cfs
<b>Summary</b>			
Total Inlet Interception Capacity	0.80	1.78	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	0.0	0.3	cfs
Capture Percentage = $Q_c/Q_o =$	100	85	%

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

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

Project: **Springs at Waterview**

Inlet ID: **Basin D-15**



<b>Gutter Geometry (Enter data in the blue cells)</b>										
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft									
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft									
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$									
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches									
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft									
Gutter Width	$W = 2.00$ ft									
Street Transverse Slope	$S_x = 0.020$ ft/ft									
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft									
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft									
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$									
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Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes									

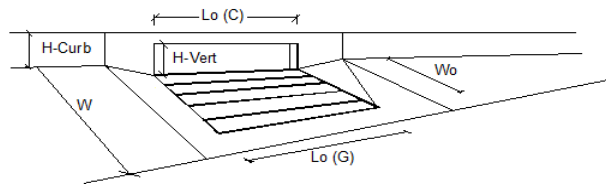
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>	
Water Depth without Gutter Depression (Eq. ST-2)	$y = 1.68$ inches
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 2.0$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a = 1.52$ inches
Water Depth at Gutter Flowline	$d = 3.20$ inches
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x = 5.0$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.753$
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.4$ cfs
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w = 1.2$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
<b>Maximum Flow Based On Allowable Spread</b>	
Flow Velocity within the Gutter Section	$Q_T = 1.6$ cfs
$V * d$ Product: Flow Velocity times Gutter Flowline Depth	$V = 3.3$ fps
	$V * d = 0.9$

<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>	
Theoretical Water Spread	$T_{TH} = 18.7$ ft
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{x TH} = 16.7$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.319$
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{x TH}$	$Q_{x TH} = 10.0$ cfs
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x = 9.8$ cfs
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w = 4.7$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 14.5$ cfs
Average Flow Velocity Within the Gutter Section	$V = 5.6$ fps
$V * d$ Product: Flow Velocity Times Gutter Flowline Depth	$V * d = 2.8$
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R = 1.00$
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$Q_d = 14.5$ cfs
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d = 6.00$ inches
	$d_{CROWN} = 0.88$ inches

<b>MINOR STORM Allowable Capacity is based on Spread Criterion</b>							
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## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-15



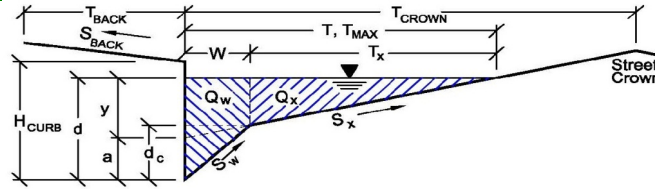
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	Type = CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow)	$a_{LOCAL} = 3.0$	$3.0$	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No = 1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	$L_o = 5.00$	$5.00$	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	$W_o = N/A$	$N/A$	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$C_T-G = N/A$	$N/A$	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_T-C = 0.10$	$0.10$	
<b>Street Hydraulics: WARNING: Q &gt; ALLOWABLE Q FOR MINOR STORM!</b>			
<b>Design Discharge for Half of Street (from Sheet Q-Peak)</b>	$Q_o = 1.9$	$3.6$	cfs
Water Spread Width	$T = 7.6$	$10.4$	ft
Water Depth at Flowline (outside of local depression)	$d = 3.4$	$4.0$	inches
Water Depth at Street Crown (or at $T_{MAX}$ )	$d_{CROWN} = 0.0$	$0.0$	inches
Ratio of Gutter Flow to Design Flow	$E_o = 0.714$	$0.562$	
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.5$	$1.6$	cfs
Discharge within the Gutter Section W	$Q_w = 1.4$	$2.0$	cfs
Discharge Behind the Curb Face	$Q_{BACK} = 0.0$	$0.0$	cfs
Flow Area within the Gutter Section W	$A_w = 0.71$	$1.20$	sq ft
Velocity within the Gutter Section W	$V_w = 2.7$	$3.0$	fps
Water Depth for Design Condition	$d_{LOCAL} = 6.4$	$7.0$	inches
<b>Grate Analysis (Calculated)</b>			
Total Length of Inlet Grate Opening	$L = N/A$	$N/A$	ft
Ratio of Grate Flow to Design Flow	$E_{O-GRATE} = N/A$	$N/A$	
<b>Under No-Clogging Condition</b>			
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	$R_s = N/A$	$N/A$	
Interception Capacity	$Q_i = N/A$	$N/A$	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	$GrateCoef = N/A$	$N/A$	
Clogging Factor for Multiple-unit Grate Inlet	$GrateClog = N/A$	$N/A$	
Effective (unclogged) Length of Multiple-unit Grate Inlet	$L_e = N/A$	$N/A$	ft
Minimum Velocity Where Grate Splash-Over Begins	$V_o = N/A$	$N/A$	fps
Interception Rate of Frontal Flow	$R_f = N/A$	$N/A$	
Interception Rate of Side Flow	$R_s = N/A$	$N/A$	
<b>Actual Interception Capacity</b>	$Q_a = N/A$	$N/A$	cfs
<b>Carry-Over Flow = <math>Q_o - Q_a</math></b> (to be applied to curb opening or next d/s inlet)	$Q_b = N/A$	$N/A$	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
Equivalent Slope $S_e$ (based on grate carry-over)	$S_e = 0.154$	$0.126$	ft/ft
Required Length $L_T$ to Have 100% Interception	$L_T = 6.58$	$10.02$	ft
<b>Under No-Clogging Condition</b>			
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
<b>Under Clogging Condition</b>			
Clogging Coefficient	$CurbCoef = 1.00$	$1.00$	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	$CurbClog = 0.10$	$0.10$	
Effective (Unclogged) Length	$L_e = 4.50$	$4.50$	ft
<b>Actual Interception Capacity</b>	$Q_a = 1.7$	$2.4$	cfs
<b>Carry-Over Flow = <math>Q_b(Grate) - Q_a</math></b>	$Q_b = 0.2$	$1.2$	cfs
<b>Summary</b>			
Total Inlet Interception Capacity	$Q = 1.66$	$2.37$	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b = 0.2$	$1.2$	cfs
Capture Percentage = $Q_i/Q_o =$	$C\% = 87$	$66$	%

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

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

Project:  
Inlet ID:

**Springs at Waterview**  
**Basin D-16**



<b>Gutter Geometry (Enter data in the blue cells)</b>	
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 10.0$ ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft
Gutter Width	$W = 2.00$ ft
Street Transverse Slope	$S_x = 0.020$ ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.010$ ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$
	<b>Minor Storm    Major Storm</b>
Max. Allowable Spread for Minor & Major Storm	$T_{MAX} = 7.0$ $15.0$ ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	$d_{MAX} = 6.0$ $12.0$ inches
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes

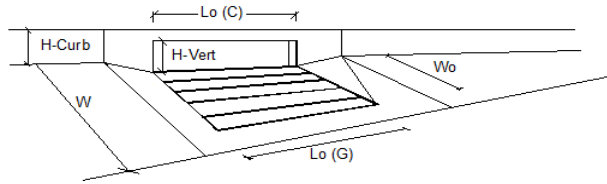
<b>Maximum Capacity for 1/2 Street based On Allowable Spread</b>	
Water Depth without Gutter Depression (Eq. ST-2)	<b>Minor Storm    Major Storm</b>
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$y = 1.68$ $3.60$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$d_c = 2.0$ $2.0$ inches
Water Depth at Gutter Flowline	$a = 1.52$ $1.52$ inches
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$d = 3.20$ $5.12$ inches
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$T_x = 5.0$ $13.0$ ft
Discharge outside the Gutter Section W, carried in Section $T_x$	$E_o = 0.753$ $0.397$
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_x = 0.4$ $5.1$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_w = 1.2$ $3.4$ cfs
<b>Maximum Flow Based On Allowable Spread</b>	$Q_{BACK} = 0.0$ $0.0$ cfs
Flow Velocity within the Gutter Section	$Q_T = 1.6$ $8.5$ cfs
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V = 3.3$ $4.9$ fps
	$V*d = 0.9$ $2.1$

<b>Maximum Capacity for 1/2 Street based on Allowable Depth</b>	
Theoretical Water Spread	<b>Minor Storm    Major Storm</b>
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{TH} = 18.7$ $43.7$ ft
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$T_{X TH} = 16.7$ $41.7$ ft
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{X TH}$	$E_o = 0.319$ $0.131$
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_{X TH} = 10.0$ $114.8$ cfs
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_x = 9.8$ $72.4$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_w = 4.7$ $17.2$ cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q_{BACK} = 0.0$ $21.9$ cfs
Average Flow Velocity Within the Gutter Section	$Q = 14.5$ $111.6$ cfs
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V = 5.6$ $9.4$ fps
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$V*d = 2.8$ $9.4$
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$R = 1.00$ $1.00$
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$Q_d = 14.5$ $111.6$ cfs
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d = 6.00$ $12.00$ inches
	$d_{CROWN} = 0.88$ $6.88$ inches

<b>MINOR STORM Allowable Capacity is based on Spread Criterion</b>	<b>Minor Storm    Major Storm</b>
<b>MAJOR STORM Allowable Capacity is based on Spread Criterion</b>	$Q_{allow} = 1.6$ $8.5$ cfs
<b>Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>	
<b>Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'</b>	

## INLET ON A CONTINUOUS GRADE

Project: Springs at Waterview  
 Inlet ID: Basin D-16



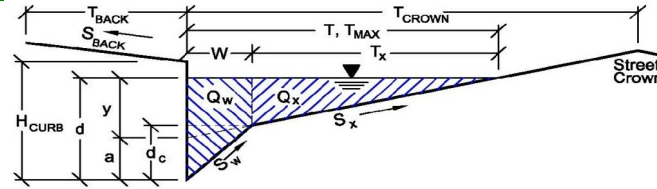
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W from Q-Allow)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
<b>Street Hydraulics: OK - Q &lt; maximum allowable from sheet 'Q-Allow'</b>			
<b>Design Discharge for Half of Street (from Sheet Q-Peak)</b>	MINOR	MAJOR	
Water Spread Width	1.3	2.5	cfs
Water Depth at Flowline (outside of local depression)	6.2	8.7	ft
Water Depth at Street Crown (or at $T_{max}$ )	3.0	3.6	inches
Ratio of Gutter Flow to Design Flow	0.0	0.0	inches
Discharge outside the Gutter Section W, carried in Section $T_x$	0.810	0.646	
Discharge within the Gutter Section W	0.2	0.9	cfs
Discharge Behind the Curb Face	1.1	1.6	cfs
Flow Area within the Gutter Section W	0.0	0.0	cfs
Velocity within the Gutter Section W	0.51	0.89	sq ft
Water Depth for Design Condition	2.6	2.8	fps
	6.0	6.6	inches
<b>Grate Analysis (Calculated)</b>			
Total Length of Inlet Grate Opening	MINOR	MAJOR	ft
Ratio of Grate Flow to Design Flow	N/A	N/A	
<b>Under No-Clogging Condition</b>			
Minimum Velocity Where Grate Splash-Over Begins	MINOR	MAJOR	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Interception Capacity	N/A	N/A	cfs
<b>Under Clogging Condition</b>			
Clogging Coefficient for Multiple-unit Grate Inlet	MINOR	MAJOR	
Clogging Factor for Multiple-unit Grate Inlet	N/A	N/A	
Effective (unclogged) Length of Multiple-unit Grate Inlet	N/A	N/A	ft
Minimum Velocity Where Grate Splash-Over Begins	N/A	N/A	fps
Interception Rate of Frontal Flow	N/A	N/A	
Interception Rate of Side Flow	N/A	N/A	
Actual Interception Capacity	N/A	N/A	cfs
Carry-Over Flow = $Q_o - Q_a$ (to be applied to curb opening or next d/s inlet)	N/A	N/A	cfs
<b>Curb or Slotted Inlet Opening Analysis (Calculated)</b>			
Equivalent Slope $S_e$ (based on grate carry-over)	MINOR	MAJOR	ft/ft
Required Length $L_T$ to Have 100% Interception	0.172	0.142	
<b>Under No-Clogging Condition</b>			
Effective Length of Curb Opening or Slotted Inlet (minimum of $L$ , $L_T$ )	MINOR	MAJOR	ft
Interception Capacity	5.00	5.00	
<b>Under Clogging Condition</b>			
Clogging Coefficient	MINOR	MAJOR	
Clogging Factor for Multiple-unit Curb Opening or Slotted Inlet	1.00	1.00	
Effective (Unclogged) Length	0.10	0.10	ft
Actual Interception Capacity	4.50	4.50	
Carry-Over Flow = $Q_b(GRATE) - Q_a$	1.3	2.0	cfs
	0.0	0.5	cfs
<b>Summary</b>			
Total Inlet Interception Capacity	MINOR	MAJOR	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	1.27	1.96	
Capture Percentage = $Q_c/Q_o =$	0.0	0.5	cfs
	98	78	%

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

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

Project: **Springs at Waterview**

Inlet ID: **Design Point F (Sump Inlet - Type R)**



Gutter Geometry (Enter data in the blue cells)													
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 15.0$ ft												
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft												
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.015$												
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches												
Distance from Curb Face to Street Crown	$T_{CROWN} = 15.0$ ft												
Gutter Width	$W = 2.00$ ft												
Street Transverse Slope	$S_x = 0.020$ ft/ft												
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft												
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.000$ ft/ft												
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.015$												
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Minor Storm</th> <th>Major Storm</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>T_{MAX}</math></td> <td>7.0</td> <td>15.0</td> <td>ft</td> </tr> <tr> <td><math>d_{MAX}</math></td> <td>6.0</td> <td>12.0</td> <td>inches</td> </tr> </tbody> </table>		Minor Storm	Major Storm		$T_{MAX}$	7.0	15.0	ft	$d_{MAX}$	6.0	12.0	inches
	Minor Storm	Major Storm											
$T_{MAX}$	7.0	15.0	ft										
$d_{MAX}$	6.0	12.0	inches										
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm													
Allow Flow Depth at Street Crown (leave blank for no)	<input type="checkbox"/> <input type="checkbox"/> check = yes												

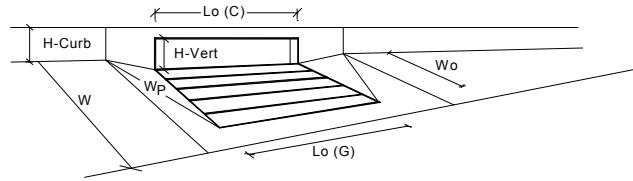
Maximum Capacity for 1/2 Street based On Allowable Spread	
Water Depth without Gutter Depression (Eq. ST-2)	$y = 1.68$ inches (Minor Storm), $3.60$ inches (Major Storm)
Vertical Depth between Gutter Lip and Gutter Flowline (usually 2")	$d_c = 2.0$ inches
Gutter Depression ( $d_c - (W * S_x * 12)$ )	$a = 1.52$ inches
Water Depth at Gutter Flowline	$d = 3.20$ inches (Minor Storm), $5.12$ inches (Major Storm)
Allowable Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_x = 5.0$ ft (Minor Storm), $13.0$ ft (Major Storm)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.753$ (Minor Storm), $0.397$ (Major Storm)
Discharge outside the Gutter Section W, carried in Section $T_x$	$Q_x = 0.0$ cfs
Discharge within the Gutter Section W ( $Q_T - Q_x$ )	$Q_w = 0.0$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
<b>Maximum Flow Based On Allowable Spread</b>	$Q_T = \text{SUMP}$ cfs
Flow Velocity within the Gutter Section	$V = 0.0$ fps
$V*d$ Product: Flow Velocity times Gutter Flowline Depth	$V*d = 0.0$

Maximum Capacity for 1/2 Street based on Allowable Depth	
Theoretical Water Spread	$T_{TH} = 18.7$ ft (Minor Storm), $43.7$ ft (Major Storm)
Theoretical Spread for Discharge outside the Gutter Section W ( $T - W$ )	$T_{xTH} = 16.7$ ft (Minor Storm), $41.7$ ft (Major Storm)
Gutter Flow to Design Flow Ratio by FHWA HEC-22 method (Eq. ST-7)	$E_o = 0.319$ (Minor Storm), $0.131$ (Major Storm)
Theoretical Discharge outside the Gutter Section W, carried in Section $T_{xTH}$	$Q_{xTH} = 0.0$ cfs
Actual Discharge outside the Gutter Section W, (limited by distance $T_{CROWN}$ )	$Q_x = 0.0$ cfs
Discharge within the Gutter Section W ( $Q_d - Q_x$ )	$Q_w = 0.0$ cfs
Discharge Behind the Curb (e.g., sidewalk, driveways, & lawns)	$Q_{BACK} = 0.0$ cfs
Total Discharge for Major & Minor Storm (Pre-Safety Factor)	$Q = 0.0$ cfs
Average Flow Velocity Within the Gutter Section	$V = 0.0$ fps
$V*d$ Product: Flow Velocity Times Gutter Flowline Depth	$V*d = 0.0$
Slope-Based Depth Safety Reduction Factor for Major & Minor ( $d \geq 6"$ ) Storm	$R = \text{SUMP}$
<b>Max Flow Based on Allowable Depth (Safety Factor Applied)</b>	$Q_d = \text{SUMP}$ cfs
Resultant Flow Depth at Gutter Flowline (Safety Factor Applied)	$d =$ inches
Resultant Flow Depth at Street Crown (Safety Factor Applied)	$d_{CROWN} =$ inches

<b>MINOR STORM Allowable Capacity is based on Depth Criterion</b>	
<b>MAJOR STORM Allowable Capacity is based on Depth Criterion</b>	
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'	
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'	

## INLET IN A SUMP OR SAG LOCATION

Project = Springs at Waterview  
 Inlet ID = Design Point F (Sump Inlet - Type R)

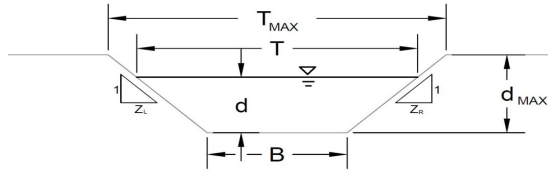


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from 'Q-Allow')	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	1	1	
Water Depth at Flowline (outside of local depression)	3.2	5.1	inches <input type="checkbox"/> Override Depths
<b>Grate Information</b>	MINOR	MAJOR	
Length of a Unit Grate	N/A	N/A	feet
Width of a Unit Grate	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	N/A	N/A	
<b>Curb Opening Information</b>	MINOR	MAJOR	
Length of a Unit Curb Opening	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	0.67	0.67	
<b>Grate Flow Analysis (Calculated)</b>	MINOR	MAJOR	
Clogging Coefficient for Multiple Units	N/A	N/A	
Clogging Factor for Multiple Units	N/A	N/A	
<b>Grate Capacity as a Weir (based on UDFCD - CSU 2010 Study)</b>	MINOR	MAJOR	
Interception without Clogging	N/A	N/A	cfs
Interception with Clogging	N/A	N/A	cfs
<b>Grate Capacity as an Orifice (based on UDFCD - CSU 2010 Study)</b>	MINOR	MAJOR	
Interception without Clogging	N/A	N/A	cfs
Interception with Clogging	N/A	N/A	cfs
<b>Grate Capacity as Mixed Flow</b>	MINOR	MAJOR	
Interception without Clogging	N/A	N/A	cfs
Interception with Clogging	N/A	N/A	cfs
<b>Resulting Grate Capacity (assumes clogged condition)</b>	N/A	N/A	cfs
<b>Curb Opening Flow Analysis (Calculated)</b>	MINOR	MAJOR	
Clogging Coefficient for Multiple Units	1.00	1.00	
Clogging Factor for Multiple Units	0.10	0.10	
<b>Curb Opening as a Weir (based on UDFCD - CSU 2010 Study)</b>	MINOR	MAJOR	
Interception without Clogging	0.94	4.10	cfs
Interception with Clogging	0.84	3.69	cfs
<b>Curb Opening as an Orifice (based on UDFCD - CSU 2010 Study)</b>	MINOR	MAJOR	
Interception without Clogging	7.28	9.05	cfs
Interception with Clogging	6.55	8.14	cfs
<b>Curb Opening Capacity as Mixed Flow</b>	MINOR	MAJOR	
Interception without Clogging	2.43	5.67	cfs
Interception with Clogging	2.19	5.10	cfs
<b>Resulting Curb Opening Capacity (assumes clogged condition)</b>	0.84	3.69	cfs
<b>Resultant Street Conditions</b>	MINOR	MAJOR	
Total Inlet Length	5.00	5.00	feet
Resultant Street Flow Spread (based on sheet Q-Allow geometry)	7.0	15.0	ft
Resultant Flow Depth at Street Crown	0.0	0.0	inches
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	MINOR	MAJOR	
	0.8	3.7	cfs
<b>Inlet Capacity IS GOOD for Minor and Major Storms (&gt;Q PEAK)</b>	Q PEAK REQUIRED	3.1	cfs



## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs  
Basin D17



Grass Type	Limiting Manning's n
A	0.06
B	0.04
C	0.033
D	0.03
E	0.024

### Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)  
 Manning's n (Leave cell D16 blank to manually enter an n value)  
 Channel Invert Slope  
 Bottom Width  
 Left Side Slope  
 Right Side Slope

A, B, C, D or E: **B**  
 n = see details below  
 $S_o = 0.0120$  ft/ft  
 $B = 10.00$  ft  
 $Z_1 = 4.00$  ft/ft  
 $Z_2 = 4.00$  ft/ft

Check one of the following soil types:

Soil Type	Max. Velocity ( $V_{MAX}$ )	Max Froude No. ( $F_{MAX}$ )
Sandy	5.0 fps	0.50
Non-Sandy	7.0 fps	0.80

Choose One:  
 Sandy  
 Non-Sandy

Max. Allowable Top Width of Channel for Minor & Major Storm  
 Max. Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
$T_{MAX} =$	20.00	25.00	feet
$d_{MAX} =$	1.00	1.50	feet

### Maximum Channel Capacity Based On Allowable Top Width

**Max. Allowable Top Width**

Water Depth  
 Flow Area  
 Wetted Perimeter  
 Hydraulic Radius  
 Manning's n based on NRCS Vegetal Retardance  
 Flow Velocity  
 Velocity-Depth Product  
 Hydraulic Depth  
 Froude Number

	Minor Storm	Major Storm	
$T_{MAX} =$	20.00	25.00	ft
$d =$	1.25	1.88	ft
$A =$	18.75	32.81	sq ft
$P =$	20.31	25.46	ft
$R =$	0.92	1.29	ft
$n =$	0.172	0.077	
$V =$	0.90	2.50	fps
$VR =$	0.83	3.22	ft <sup>2</sup> /s
$D =$	0.94	1.31	ft
$Fr =$	0.16	0.38	
$Q_T =$	16.89	81.98	cfs

**Max. Flow Based On Allowable Top Width**

### Maximum Channel Capacity Based On Allowable Water Depth

**Max. Allowable Water Depth**

Top Width  
 Flow Area  
 Wetted Perimeter  
 Hydraulic Radius  
 Manning's n based on NRCS Vegetal Retardance  
 Flow Velocity  
 Velocity-Depth Product  
 Hydraulic Depth  
 Froude Number

	Minor Storm	Major Storm	
$d_{MAX} =$	1.00	1.50	feet
$T =$	18.00	22.00	feet
$A =$	14.00	24.00	square feet
$P =$	18.25	22.37	feet
$R =$	0.77	1.07	feet
$n =$	0.300	0.118	
$V =$	0.46	1.46	fps
$VR =$	0.35	1.56	ft <sup>2</sup> /s
$D =$	0.78	1.09	feet
$Fr =$	0.09	0.25	
$Q_d =$	6.38	34.93	cfs

**Max. Flow Based On Allowable Water Depth**

### Allowable Channel Capacity Based On Channel Geometry

**MINOR STORM** Allowable Capacity is based on Depth Criterion

**MAJOR STORM** Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
$Q_{allow} =$	6.38	34.93	cfs
$d_{allow} =$	1.00	1.50	ft

### Water Depth in Channel Based On Design Peak Flow

**Design Peak Flow**

**Water Depth**  
 Top Width  
 Flow Area  
 Wetted Perimeter  
 Hydraulic Radius  
 Manning's n based on NRCS Vegetal Retardance  
 Flow Velocity  
 Velocity-Depth Product  
 Hydraulic Depth  
 Froude Number

	Minor Storm	Major Storm	
$Q_o =$	3.10	7.10	cfs
$d =$	0.70	1.04	feet
$T =$	15.60	18.33	feet
$A =$	8.95	14.74	square feet
$P =$	15.77	18.58	feet
$R =$	0.57	0.79	feet
$n =$	0.323	0.290	
$V =$	0.35	0.48	fps
$VR =$	0.20	0.38	ft <sup>2</sup> /s
$D =$	0.57	0.80	feet
$Fr =$	0.08	0.09	

**Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'**

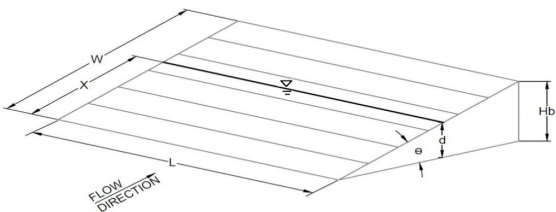
**Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'**

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs  
Basin D17

Inlet Design Information (Input)	
Type of Inlet	Inlet Type = <span style="border: 1px solid black; padding: 2px;">CDOT Type C</span>
Angle of Inclined Grate (must be <= 30 degrees)	$\theta =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> degrees
Width of Grate	$W =$ <span style="border: 1px solid black; padding: 2px;">3.00</span> feet
Length of Grate	$L =$ <span style="border: 1px solid black; padding: 2px;">3.00</span> feet
Open Area Ratio	$A_{RATIO} =$ <span style="border: 1px solid black; padding: 2px;">0.70</span>
Height of Inclined Grate	$H_B =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> feet
Clogging Factor	$C_f =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Grate Discharge Coefficient	$C_d =$ <span style="border: 1px solid black; padding: 2px;">0.96</span>
Orifice Coefficient	$C_o =$ <span style="border: 1px solid black; padding: 2px;">0.64</span>
Weir Coefficient	$C_w =$ <span style="border: 1px solid black; padding: 2px;">2.05</span>



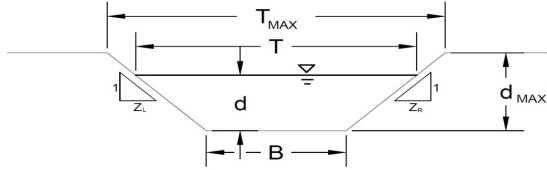
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	$d =$	MINOR	MAJOR
		0.70	1.04

		MINOR	MAJOR
<b>Grate Capacity as a Weir</b>	$X =$	3.00	3.00
Submerged Side Weir Length	$Q_{ws} =$	6.30	11.44
Inclined Side Weir Flow	$Q_{wb} =$	9.01	16.35
Base Weir Flow	$Q_{wi} =$	21.62	39.24
Interception without Clogging	$Q_{wa} =$	10.81	19.62
Interception with Clogging			
<b>Grate Capacity as an Orifice</b>			
Interception without Clogging	$Q_{oi} =$	27.04	32.99
Interception with Clogging	$Q_{oia} =$	13.52	16.49
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	$Q_a =$	10.81	16.49
<span style="color: red;">Inlet Capacity IS GOOD for Minor and Major Storms (&gt; Q PEAK)</span>	Bypassed Flow, $Q_b =$	0.00	0.00
	Capture Percentage = $Q_a/Q_o = C\%$	100	100

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs  
DP 42a



Grass Type	Limiting Manning's n
A	0.06
B	0.04
C	0.033
D	0.03
E	0.024

### Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)  
Manning's n (Leave cell D16 blank to manually enter an n value)  
Channel Invert Slope  
Bottom Width  
Left Side Slope  
Right Side Slope

A, B, C, D or E: **B**  
n = see details below  
S<sub>0</sub> = 0.0050 ft/ft  
B = 6.00 ft  
Z<sub>1</sub> = 3.00 ft/ft  
Z<sub>2</sub> = 3.00 ft/ft

Check one of the following soil types:

Soil Type	Max. Velocity (V <sub>MAX</sub> )	Max Froude No. (F <sub>MAX</sub> )
Sandy	5.0 fps	0.50
Non-Sandy	7.0 fps	0.80

Choose One:  
 Sandy  
 Non-Sandy

Max. Allowable Top Width of Channel for Minor & Major Storm  
Max. Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
T <sub>MAX</sub>	28.00	30.00	feet
d <sub>MAX</sub>	2.00	2.50	feet

### Maximum Channel Capacity Based On Allowable Top Width

Max. Allowable Top Width

Water Depth  
Flow Area  
Wetted Perimeter  
Hydraulic Radius  
Manning's n based on NRCS Vegetal Retardance  
Flow Velocity  
Velocity-Depth Product  
Hydraulic Depth  
Froude Number

	Minor Storm	Major Storm	
T <sub>MAX</sub>	28.00	30.00	ft
d	3.67	4.00	ft
A	62.33	72.00	sq ft
P	29.19	31.30	ft
R	2.14	2.30	ft
n	0.055	0.052	
V	3.19	3.56	fps
VR	6.82	8.18	ft <sup>2</sup> /s
D	2.23	2.40	ft
Fr	0.38	0.40	
Q <sub>T</sub>	198.97	255.98	cfs

Max. Flow Based On Allowable Top Width

### Maximum Channel Capacity Based On Allowable Water Depth

Max. Allowable Water Depth

Top Width  
Flow Area  
Wetted Perimeter  
Hydraulic Radius  
Manning's n based on NRCS Vegetal Retardance  
Flow Velocity  
Velocity-Depth Product  
Hydraulic Depth  
Froude Number

	Minor Storm	Major Storm	
d <sub>MAX</sub>	2.00	2.50	feet
T	18.00	21.00	feet
A	24.00	33.75	square feet
P	18.65	21.81	feet
R	1.29	1.55	feet
n	0.149	0.090	
V	0.84	1.57	fps
VR	1.08	2.44	ft <sup>2</sup> /s
D	1.33	1.61	feet
Fr	0.13	0.22	
Q <sub>d</sub>	20.14	53.13	cfs

Max. Flow Based On Allowable Water Depth

### Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q <sub>allow</sub>	20.14	53.13	cfs
d <sub>allow</sub>	2.00	2.50	ft

### Water Depth in Channel Based On Design Peak Flow

Design Peak Flow

Water Depth

Top Width  
Flow Area  
Wetted Perimeter  
Hydraulic Radius  
Manning's n based on NRCS Vegetal Retardance  
Flow Velocity  
Velocity-Depth Product  
Hydraulic Depth  
Froude Number

	Minor Storm	Major Storm	
Q <sub>o</sub>	11.90	26.30	cfs
d	1.78	2.14	feet
T	16.69	18.82	feet
A	20.20	26.52	square feet
P	17.26	19.52	feet
R	1.17	1.36	feet
n	0.199	0.130	
V	0.59	0.99	fps
VR	0.69	1.35	ft <sup>2</sup> /s
D	1.21	1.41	feet
Fr	0.09	0.15	

Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

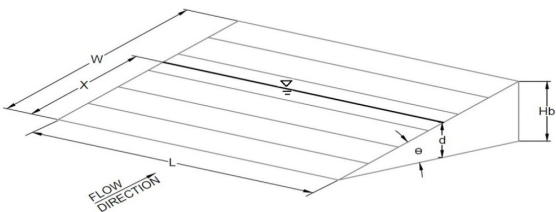
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs  
DP 42a

<b>Inlet Design Information (Input)</b>	
Type of Inlet	Inlet Type = <span style="border: 1px solid black; padding: 2px;">User-Defined</span>
Angle of Inclined Grate (must be <= 30 degrees)	$\theta =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> degrees
Width of Grate	$W =$ <span style="border: 1px solid black; padding: 2px;">8.00</span> feet
Length of Grate	$L =$ <span style="border: 1px solid black; padding: 2px;">8.00</span> feet
Open Area Ratio	$A_{RATIO} =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Height of Inclined Grate	$H_B =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> feet
Clogging Factor	$C_f =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Grate Discharge Coefficient	$C_d =$ <span style="border: 1px solid black; padding: 2px;">N/A</span>
Orifice Coefficient	$C_o =$ <span style="border: 1px solid black; padding: 2px;">0.64</span>
Weir Coefficient	$C_w =$ <span style="border: 1px solid black; padding: 2px;">2.05</span>



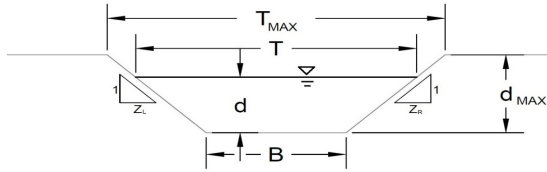
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	$d =$				
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%; text-align: center;">MINOR</th> <th style="width: 50%; text-align: center;">MAJOR</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><span style="border: 1px solid black; padding: 2px;">1.78</span></td> <td style="text-align: center;"><span style="border: 1px solid black; padding: 2px;">2.14</span></td> </tr> </tbody> </table>	MINOR	MAJOR	<span style="border: 1px solid black; padding: 2px;">1.78</span>	<span style="border: 1px solid black; padding: 2px;">2.14</span>
MINOR	MAJOR				
<span style="border: 1px solid black; padding: 2px;">1.78</span>	<span style="border: 1px solid black; padding: 2px;">2.14</span>				

<b>Grate Capacity as a Weir</b>		
Submerged Side Weir Length	$X =$	<span style="border: 1px solid black; padding: 2px;">8.00</span> <span style="border: 1px solid black; padding: 2px;">8.00</span> feet
Inclined Side Weir Flow	$Q_{ws} =$	<span style="border: 1px solid black; padding: 2px;">48.73</span> <span style="border: 1px solid black; padding: 2px;">64.04</span> cfs
Base Weir Flow	$Q_{wb} =$	<span style="border: 1px solid black; padding: 2px;">97.46</span> <span style="border: 1px solid black; padding: 2px;">128.08</span> cfs
Interception without Clogging	$Q_{wi} =$	<span style="border: 1px solid black; padding: 2px;">194.91</span> <span style="border: 1px solid black; padding: 2px;">256.16</span> cfs
Interception with Clogging	$Q_{wa} =$	<span style="border: 1px solid black; padding: 2px;">97.46</span> <span style="border: 1px solid black; padding: 2px;">128.08</span> cfs
<b>Grate Capacity as an Orifice</b>		
Interception without Clogging	$Q_{oi} =$	<span style="border: 1px solid black; padding: 2px;">219.34</span> <span style="border: 1px solid black; padding: 2px;">240.25</span> cfs
Interception with Clogging	$Q_{oa} =$	<span style="border: 1px solid black; padding: 2px;">109.67</span> <span style="border: 1px solid black; padding: 2px;">120.13</span> cfs
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	$Q_a =$	<span style="border: 1px solid black; padding: 2px;">97.46</span> <span style="border: 1px solid black; padding: 2px;">120.13</span> cfs
<span style="color: red;">Inlet Capacity IS GOOD for Minor and Major Storms (&gt; Q PEAK)</span>	Bypassed Flow, $Q_b =$	<span style="border: 1px solid black; padding: 2px;">0.00</span> <span style="border: 1px solid black; padding: 2px;">0.00</span> cfs
	Capture Percentage = $Q_a/Q_o = C\%$	<span style="border: 1px solid black; padding: 2px;">100</span> <span style="border: 1px solid black; padding: 2px;">100</span> %

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs  
DP 43



Grass Type	Limiting Manning's n
A	0.06
B	0.04
C	0.033
D	0.03
E	0.024

### Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)  
Manning's n (Leave cell D16 blank to manually enter an n value)  
Channel Invert Slope  
Bottom Width  
Left Side Slope  
Right Side Slope

A, B, C, D or E: **B**  
n = see details below  
S<sub>0</sub> = 0.0100 ft/ft  
B = 15.00 ft  
Z<sub>1</sub> = 4.00 ft/ft  
Z<sub>2</sub> = 4.00 ft/ft

Check one of the following soil types:

Soil Type	Max. Velocity (V <sub>MAX</sub> )	Max Froude No. (F <sub>MAX</sub> )
Sandy	5.0 fps	0.50
Non-Sandy	7.0 fps	0.80

Choose One:  
 Sandy  
 Non-Sandy

Max. Allowable Top Width of Channel for Minor & Major Storm  
Max. Allowable Water Depth in Channel for Minor & Major Storm

	Minor Storm	Major Storm	
T <sub>MAX</sub>	28.00	30.00	feet
d <sub>MAX</sub>	2.00	2.50	feet

### Maximum Channel Capacity Based On Allowable Top Width

#### Max. Allowable Top Width

Water Depth  
Flow Area  
Wetted Perimeter  
Hydraulic Radius  
Manning's n based on NRCS Vegetal Retardance  
Flow Velocity  
Velocity-Depth Product  
Hydraulic Depth  
Froude Number

	Minor Storm	Major Storm	
T <sub>MAX</sub>	28.00	30.00	ft
d	1.63	1.88	ft
A	34.94	42.19	sq ft
P	28.40	30.46	ft
R	1.23	1.38	ft
n	0.095	0.075	
V	1.81	2.47	fps
VR	2.22	3.42	ft <sup>2</sup> /s
D	1.25	1.41	ft
Fr	0.29	0.37	
Q <sub>T</sub>	63.16	104.21	cfs

#### Max. Flow Based On Allowable Top Width

### Maximum Channel Capacity Based On Allowable Water Depth

#### Max. Allowable Water Depth

Top Width  
Flow Area  
Wetted Perimeter  
Hydraulic Radius  
Manning's n based on NRCS Vegetal Retardance  
Flow Velocity  
Velocity-Depth Product  
Hydraulic Depth  
Froude Number

	Minor Storm	Major Storm	
d <sub>MAX</sub>	2.00	2.50	feet
T	31.00	35.00	feet
A	46.00	62.50	square feet
P	31.49	35.62	feet
R	1.46	1.75	feet
n	0.068	0.054	
V	2.82	4.02	fps
VR	4.12	7.06	ft <sup>2</sup> /s
D	1.48	1.79	feet
Fr	0.41	0.53	
Q <sub>d</sub>	129.62	251.46	cfs

#### Max. Flow Based On Allowable Water Depth

### Allowable Channel Capacity Based On Channel Geometry

MINOR STORM Allowable Capacity is based on Top Width Criterion  
MAJOR STORM Allowable Capacity is based on Top Width Criterion

	Minor Storm	Major Storm	
Q <sub>allow</sub>	63.16	104.21	cfs
d <sub>allow</sub>	1.63	1.88	ft

### Water Depth in Channel Based On Design Peak Flow

#### Design Peak Flow

Water Depth  
Top Width  
Flow Area  
Wetted Perimeter  
Hydraulic Radius  
Manning's n based on NRCS Vegetal Retardance  
Flow Velocity  
Velocity-Depth Product  
Hydraulic Depth  
Froude Number

	Minor Storm	Major Storm	
Q <sub>o</sub>	4.00	9.20	cfs
d	0.69	1.04	feet
T	20.53	23.31	feet
A	12.29	19.90	square feet
P	20.70	23.57	feet
R	0.59	0.84	feet
n	0.323	0.288	
V	0.33	0.46	fps
VR	0.19	0.39	ft <sup>2</sup> /s
D	0.60	0.85	feet
Fr	0.07	0.09	

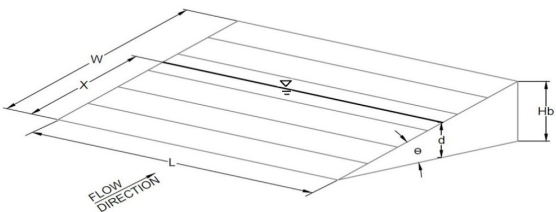
Minor storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'  
Major storm max. allowable capacity GOOD - greater than flow given on sheet 'Q-Peak'

## AREA INLET IN A TRAPEZOIDAL GRASS-LINED CHANNEL

Waterview Springs  
DP 43

<b>Inlet Design Information (Input)</b>	
Type of Inlet	Inlet Type = <span style="border: 1px solid black; padding: 2px;">User-Defined</span>
Angle of Inclined Grate (must be <= 30 degrees)	$\theta =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> degrees
Width of Grate	$W =$ <span style="border: 1px solid black; padding: 2px;">8.00</span> feet
Length of Grate	$L =$ <span style="border: 1px solid black; padding: 2px;">8.00</span> feet
Open Area Ratio	$A_{RATIO} =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Height of Inclined Grate	$H_B =$ <span style="border: 1px solid black; padding: 2px;">0.00</span> feet
Clogging Factor	$C_l =$ <span style="border: 1px solid black; padding: 2px;">0.50</span>
Grate Discharge Coefficient	$C_d =$ <span style="border: 1px solid black; padding: 2px;">N/A</span>
Orifice Coefficient	$C_o =$ <span style="border: 1px solid black; padding: 2px;">0.64</span>
Weir Coefficient	$C_w =$ <span style="border: 1px solid black; padding: 2px;">2.05</span>



	MINOR	MAJOR
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	$d =$ <span style="border: 1px solid black; padding: 2px;">0.69</span>	<span style="border: 1px solid black; padding: 2px;">1.04</span>

	MINOR	MAJOR
<b>Grate Capacity as a Weir</b>		
Submerged Side Weir Length	$X =$ <span style="border: 1px solid black; padding: 2px;">8.00</span>	<span style="border: 1px solid black; padding: 2px;">8.00</span> feet
Inclined Side Weir Flow	$Q_{ws} =$ <span style="border: 1px solid black; padding: 2px;">11.79</span>	<span style="border: 1px solid black; padding: 2px;">21.70</span> cfs
Base Weir Flow	$Q_{wb} =$ <span style="border: 1px solid black; padding: 2px;">23.58</span>	<span style="border: 1px solid black; padding: 2px;">43.40</span> cfs
Interception without Clogging	$Q_{wi} =$ <span style="border: 1px solid black; padding: 2px;">47.16</span>	<span style="border: 1px solid black; padding: 2px;">86.81</span> cfs
Interception with Clogging	$Q_{wa} =$ <span style="border: 1px solid black; padding: 2px;">23.58</span>	<span style="border: 1px solid black; padding: 2px;">43.40</span> cfs
<b>Grate Capacity as an Orifice</b>		
Interception without Clogging	$Q_{oi} =$ <span style="border: 1px solid black; padding: 2px;">136.68</span>	<span style="border: 1px solid black; padding: 2px;">167.50</span> cfs
Interception with Clogging	$Q_{oa} =$ <span style="border: 1px solid black; padding: 2px;">68.34</span>	<span style="border: 1px solid black; padding: 2px;">83.75</span> cfs
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>	$Q_a =$ <span style="border: 1px solid black; padding: 2px;">23.58</span>	<span style="border: 1px solid black; padding: 2px;">43.40</span> cfs
<span style="color: red;">Inlet Capacity IS GOOD for Minor and Major Storms (&gt; Q PEAK)</span>	Bypassed Flow, $Q_b =$ <span style="border: 1px solid black; padding: 2px;">0.00</span>	<span style="border: 1px solid black; padding: 2px;">0.00</span> cfs
	Capture Percentage = $Q_a/Q_o =$ C%	<span style="border: 1px solid black; padding: 2px;">100</span> %

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## Worksheet for Ex Asphalt Rundown

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### Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

### Input Data

Roughness Coefficient	0.016	
Channel Slope	0.01430	ft/ft
Bottom Width	4.00	ft
Discharge	15.50	ft <sup>3</sup> /s

### Results

Normal Depth	0.59	ft
Flow Area	2.36	ft <sup>2</sup>
Wetted Perimeter	5.18	ft
Hydraulic Radius	0.46	ft
Top Width	4.00	ft
Critical Depth	0.78	ft
Critical Slope	0.00629	ft/ft
Velocity	6.57	ft/s
Velocity Head	0.67	ft
Specific Energy	1.26	ft
Froude Number	1.51	
Flow Type	Supercritical	

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

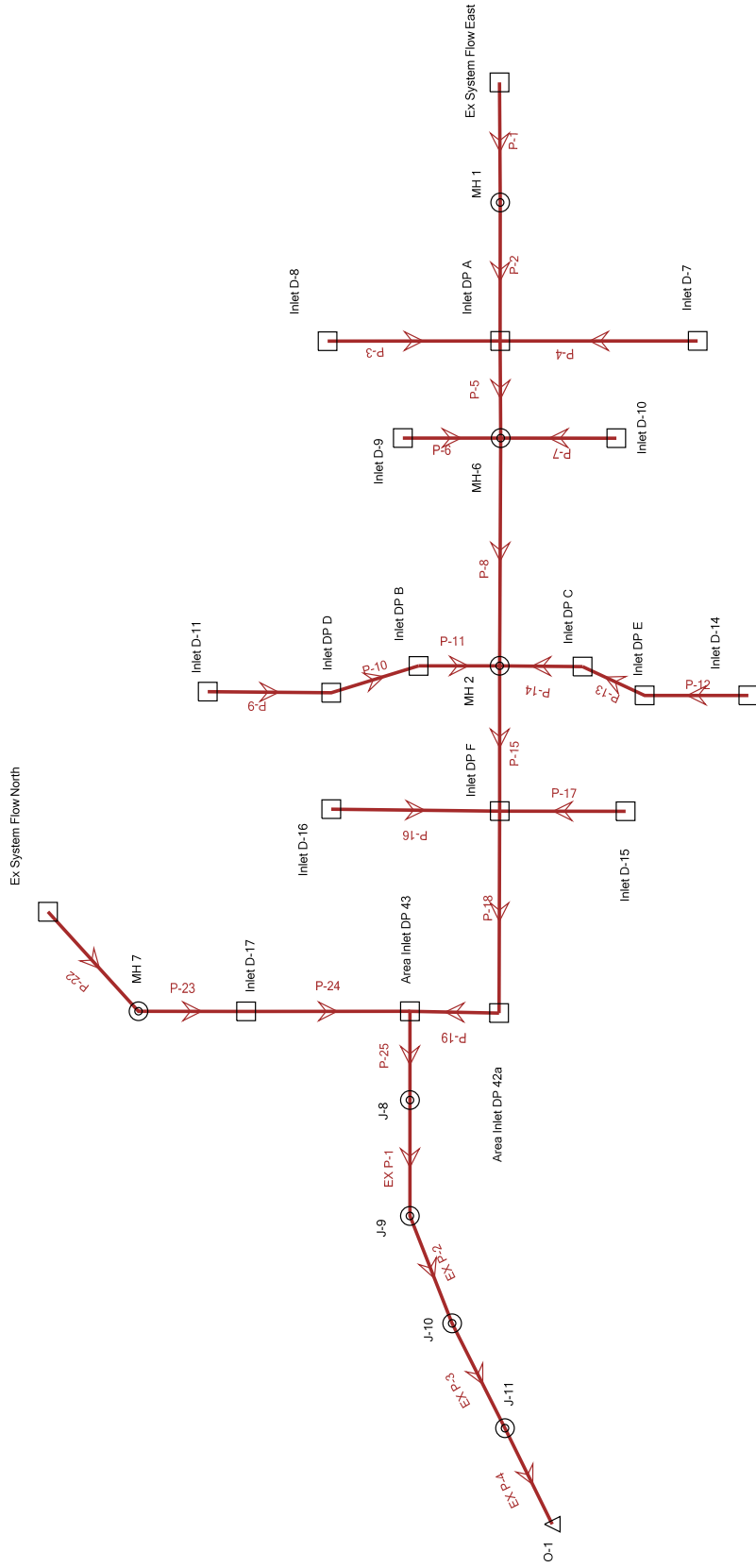
### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.59	ft
Critical Depth	0.78	ft
Channel Slope	0.01430	ft/ft
Critical Slope	0.00629	ft/ft

## **Appendix E: StormCAD Design**



# Scenario: 100-YR

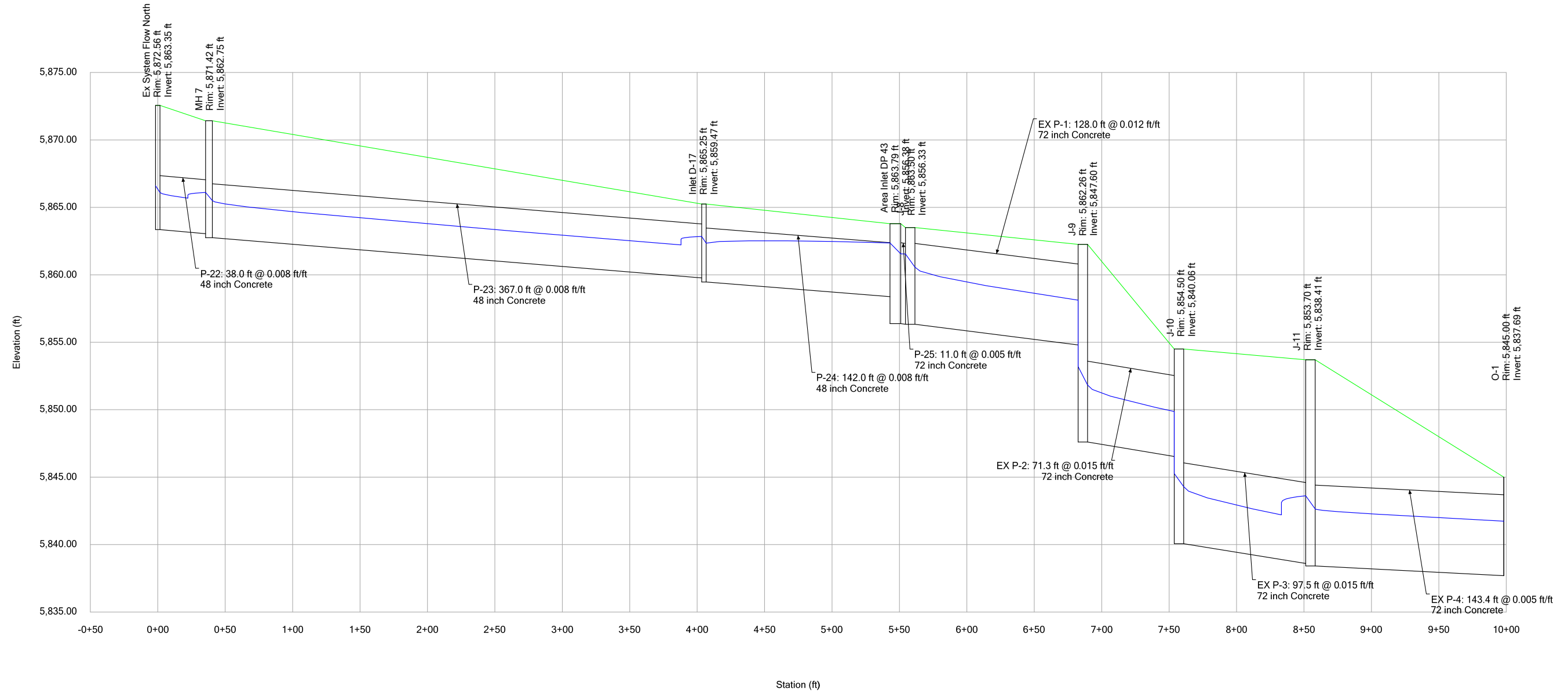


# SPRINGS AT WATERVIEW - STORMCAD OUTPUT 100 YEAR

Label	Up. Node	Dn. Node	L (ft)	Size	Q Full (cfs)	System Q (cfs)	Avg. v (ft/s)	Up. Gr Elev. (ft)	HGL In (ft)	Up. Invert (ft)	Up. Cover (ft)	Dn. Gr. Elev. (ft)	Dn. Invert (ft)	Dn. Cover (ft)	S (ft/ft)
P-19	Area Inlet DP 42a	Area Inlet DP 43	121.0	72 inch	148.1	285.5	10.19	5864.51	5863.26	5856.93	1.58	5863.79	5856.38	1.41	0.50%
P-25	Area Inlet DP 43	J-8	11.0	72 inch	239.1	285.5	11.31	5863.79	5862.36	5856.38	1.41	5863.50	5856.33	1.17	0.50%
EX P-1	J-8	J-9	128.0	72 inch	239.1	463.0	16.51	5863.50	5861.54	5856.33	1.17	5862.26	5854.80	1.46	1.20%
EX P-2	J-9	J-10	71.3	72 inch	238.8	518.8	17.97	5862.26	5853.20	5847.60	8.66	5854.50	5846.53	1.97	1.50%
EX P-3	J-10	J-11	97.5	72 inch	238.7	518.2	17.95	5854.50	5845.27	5840.06	8.44	5853.70	5838.60	9.10	1.50%
EX P-4	J-11	O-1	143.4	72 inch	238.6	300.1	11.78	5853.70	5843.61	5838.41	9.29	5845.00	5837.69	1.31	0.50%
P-4	Inlet D-7	Inlet DP A	60.0	18 inch	6.8	18.8	9.80	5881.53	5879.12	5877.84	2.19	5881.02	5875.91	3.61	3.20%
P-3	Inlet D-8	Inlet DP A	63.0	18 inch	4.1	15.6	7.41	5881.53	5878.25	5877.29	2.74	5881.02	5875.91	3.61	2.20%
P-1	Ex System Flow East	MH 1	73.0	48 inch	86.1	254.4	18.29	5899.57	5884.38	5881.07	14.50	5884.39	5878.78	1.61	3.10%
P-2	MH 1	Inlet DP A	80.0	48 inch	86.1	253.4	18.23	5884.39	5879.51	5876.20	4.19	5881.02	5873.71	3.31	3.10%
P-15	MH 2	Inlet DP F	54.0	66 inch	122.7	403.6	14.90	5872.56	5867.69	5863.81	3.25	5872.94	5863.03	4.41	1.40%
P-18	Inlet DP F	Area Inlet DP 42a	115.0	66 inch	130.0	720.9	23.01	5872.94	5866.70	5862.73	4.71	5864.51	5857.43	1.58	4.60%
P-16	Inlet D-16	Inlet DP F	63.0	18 inch	2.1	22.9	8.09	5873.45	5870.28	5869.73	2.22	5872.94	5866.73	4.71	4.80%
P-22	Ex System Flow North	MH 7	38.0	48 inch	82.7	127.6	10.81	5872.56	5866.61	5863.35	5.21	5871.42	5863.05	4.37	0.80%
P-23	MH 7	Inlet D-17	367.0	48 inch	82.7	129.4	10.92	5871.42	5866.11	5862.75	4.67	5865.25	5859.77	1.48	0.80%
P-24	Inlet D-17	Area Inlet DP 43	142.0	48 inch	88.6	125.8	10.85	5865.25	5862.85	5859.47	1.78	5863.79	5858.38	1.41	0.80%
P-17	Inlet D-15	Inlet DP F	63.0	18 inch	3.0	22.9	8.93	5873.46	5870.38	5869.72	2.24	5872.94	5866.73	4.71	4.70%
P-11	Inlet DP B	MH 2	25.0	30 inch	11.7	41.0	7.21	5873.06	5868.71	5867.06	3.50	5872.56	5866.81	3.25	1.00%
P-14	Inlet DP C	MH 2	5.0	30 inch	10.1	89.9	12.12	5873.04	5868.61	5867.05	3.49	5872.56	5866.81	3.25	4.80%
P-12	Inlet D-14	Inlet DP E	135.0	18 inch	5.1	11.0	6.09	5874.52	5871.13	5870.26	2.76	5873.06	5868.79	2.77	1.10%
P-13	Inlet DP E	Inlet DP C	28.0	24 inch	9.0	36.8	9.67	5873.06	5869.86	5868.29	2.77	5873.04	5867.55	3.49	2.60%
P-9	Inlet D-11	Inlet DP D	128.0	18 inch	4.9	11.1	6.11	5874.66	5871.25	5870.40	2.76	5873.24	5868.96	2.78	1.10%
P-10	Inlet DP D	Inlet DP B	28.0	24 inch	10.3	40.6	10.77	5873.24	5870.11	5868.46	2.78	5873.06	5867.56	3.50	3.20%
P-5	Inlet DP A	MH-6	34.0	48 inch	98.9	181.0	14.72	5881.02	5877.12	5873.41	3.61	5880.27	5872.87	3.40	1.60%
P-8	MH-6	MH 2	184.0	48 inch	102.1	228.6	17.68	5880.27	5873.23	5869.47	6.80	5872.56	5864.81	3.75	2.50%
P-7	Inlet D-10	MH-6	25.0	18 inch	1.9	22.1	7.65	5881.03	5877.00	5876.48	3.05	5880.27	5875.37	3.40	4.40%
P-6	Inlet D-9	MH-6	45.0	18 inch	2.9	14.9	6.56	5881.19	5877.08	5876.28	3.41	5880.27	5875.37	3.40	2.00%

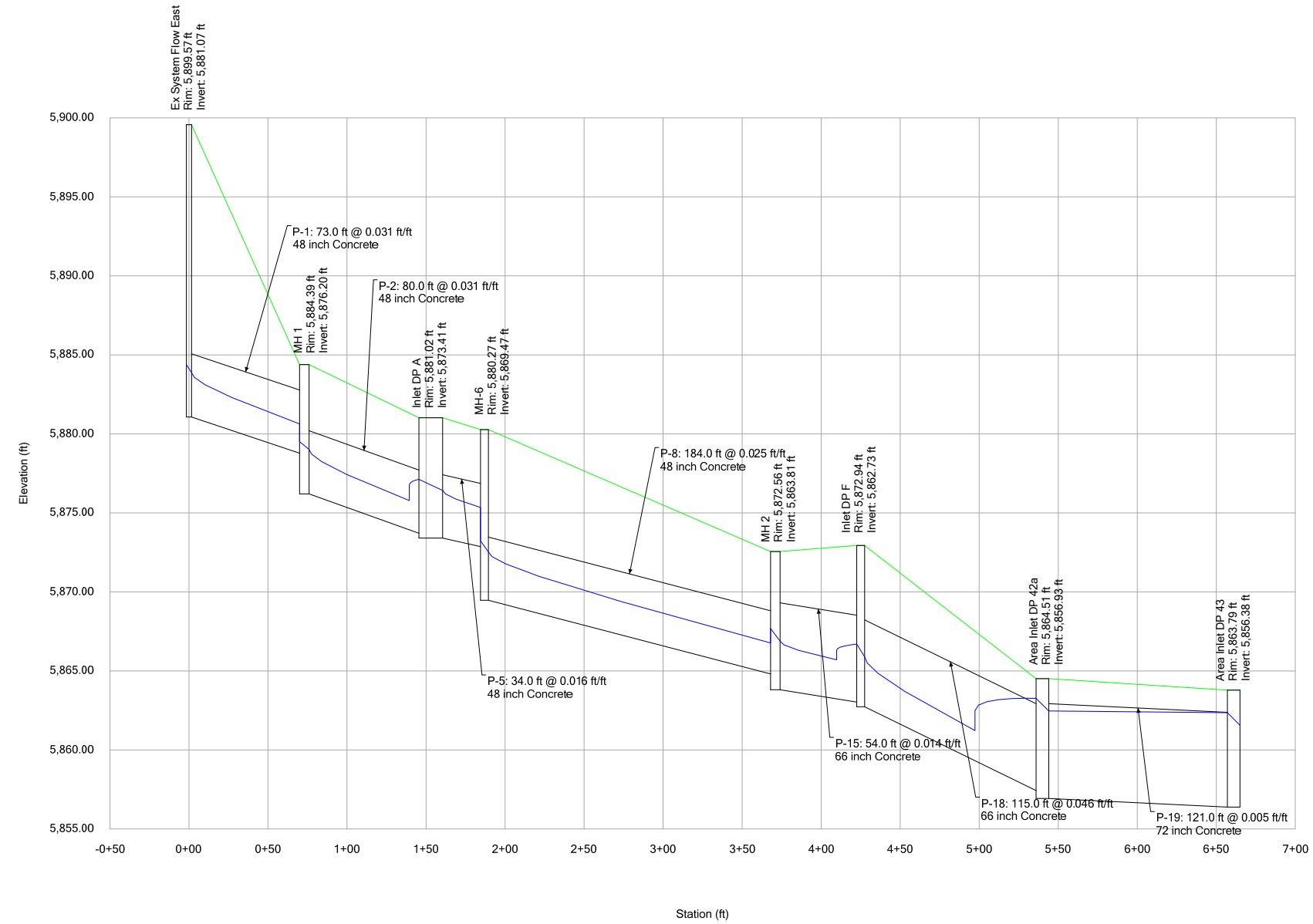
## Profile Report

### Engineering Profile - Mainline West Side and Outlet (WV-Storm Sys.stsw)



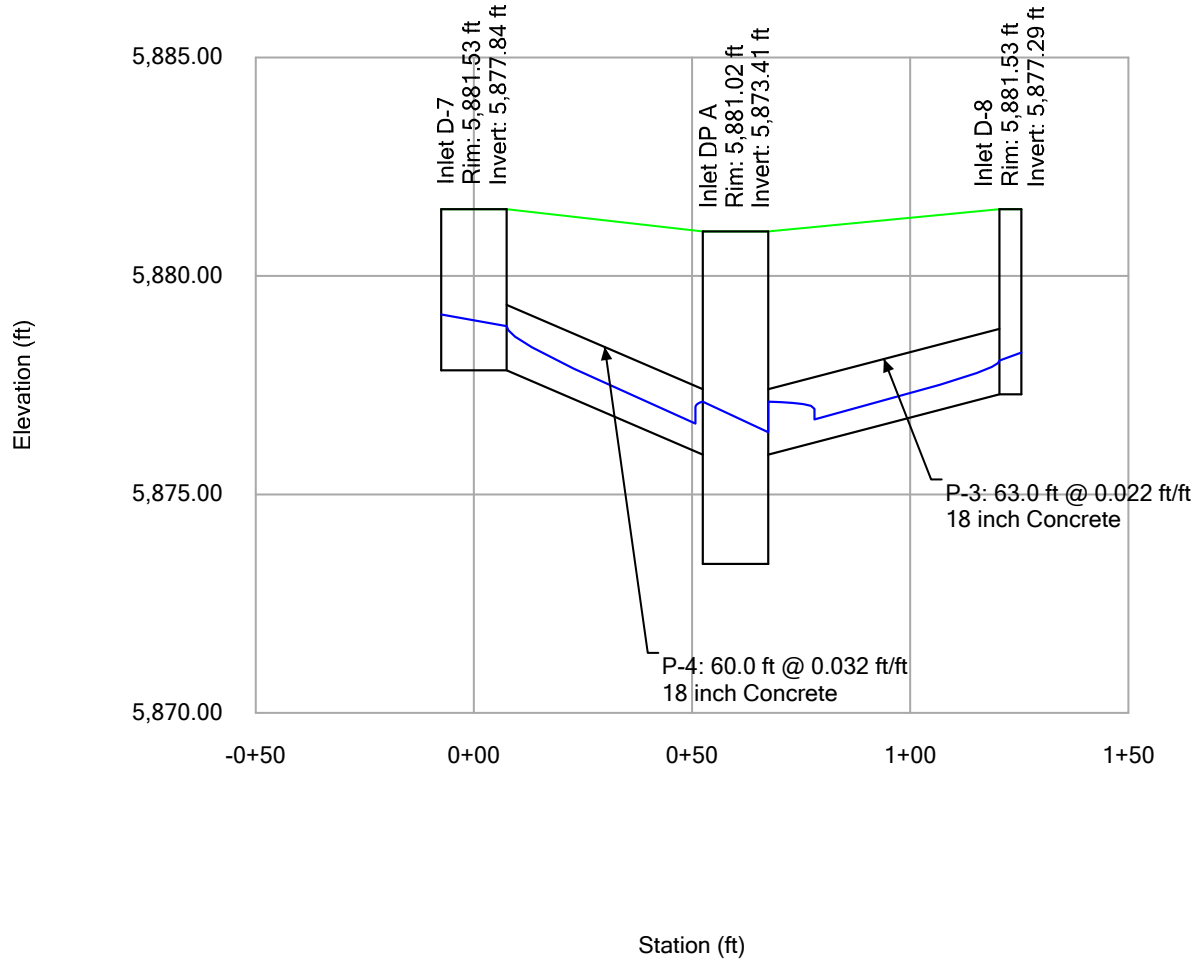
## Profile Report

### Engineering Profile - Mainline thru Site (WV-Storm Sys.stsw)



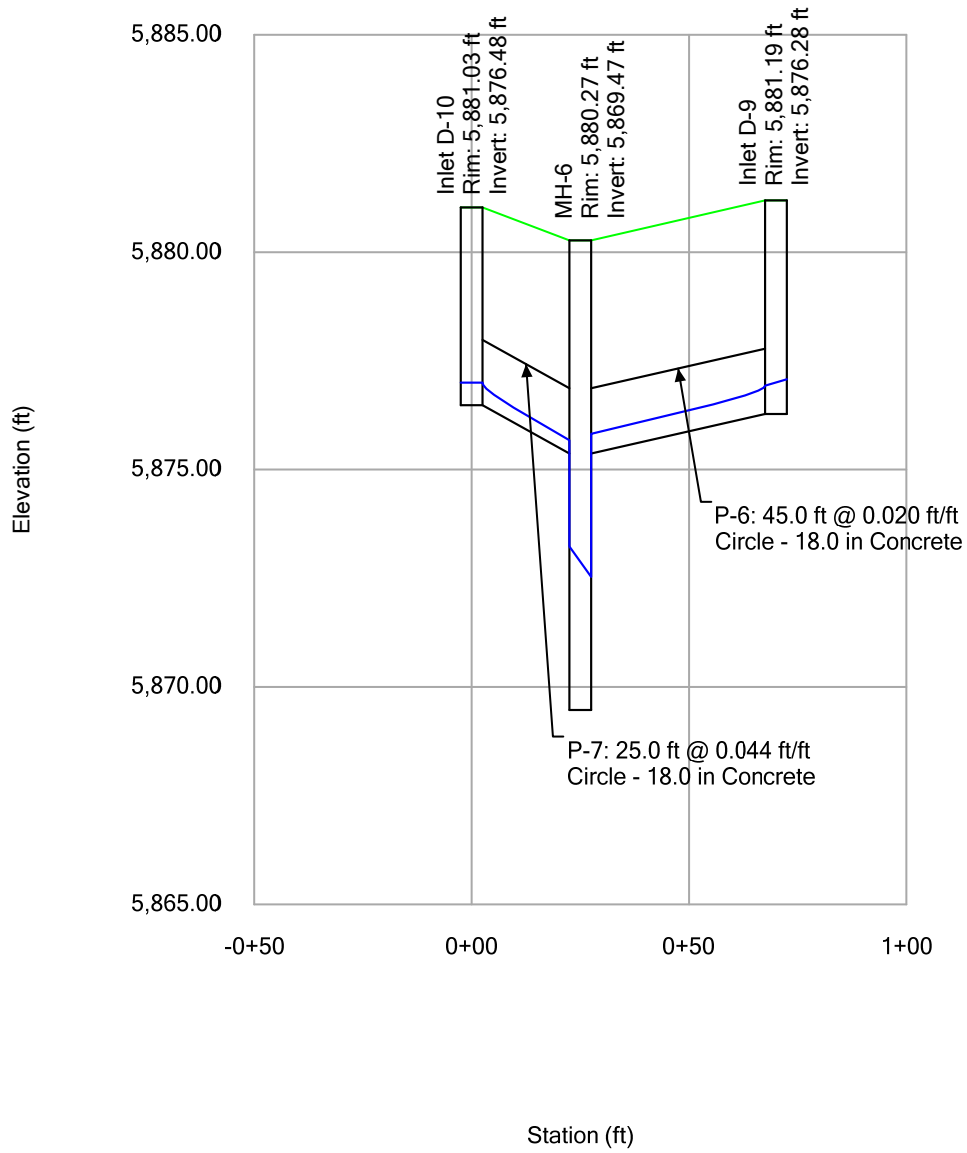
# Profile Report

## Engineering Profile - East Rd East Lats (WV-Storm Sys.stsw)



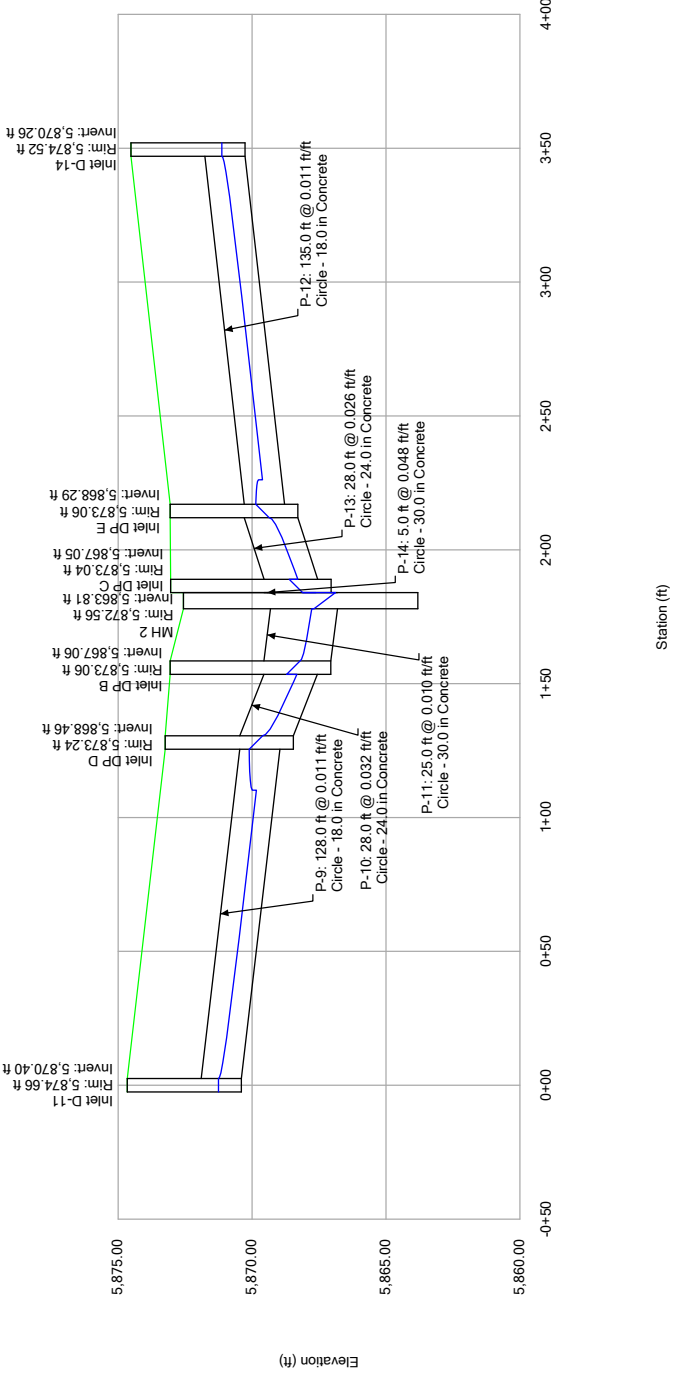
# Profile Report

## Engineering Profile - East Rd West Lats (WV-Storm Sys.stsw)



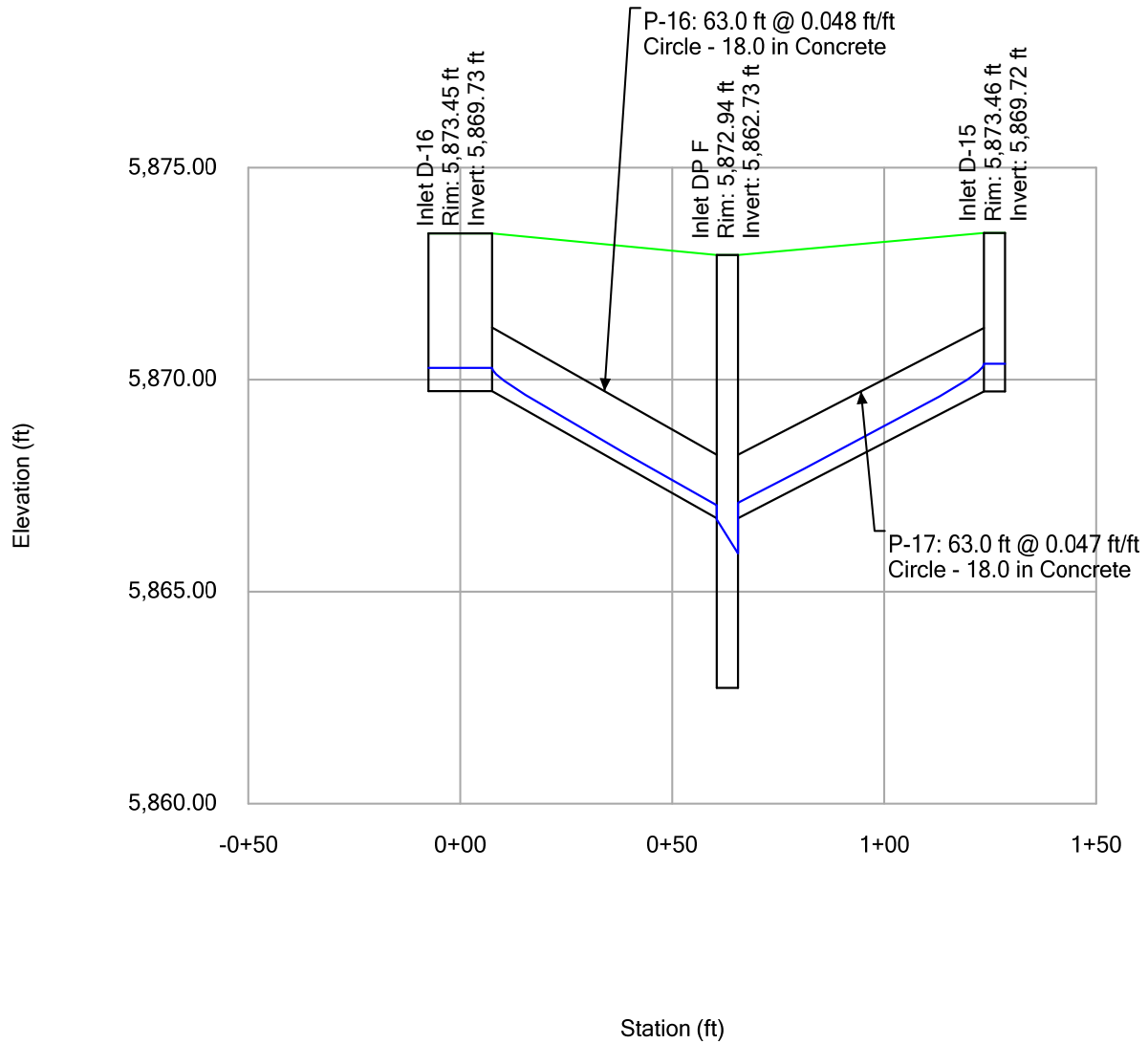
# Profile Report

## Engineering Profile - West Rd East Lats (WV-Storm Sys.stsw)



# Profile Report

## Engineering Profile - West Rd West Lats (WV-Storm Sys.stsw)



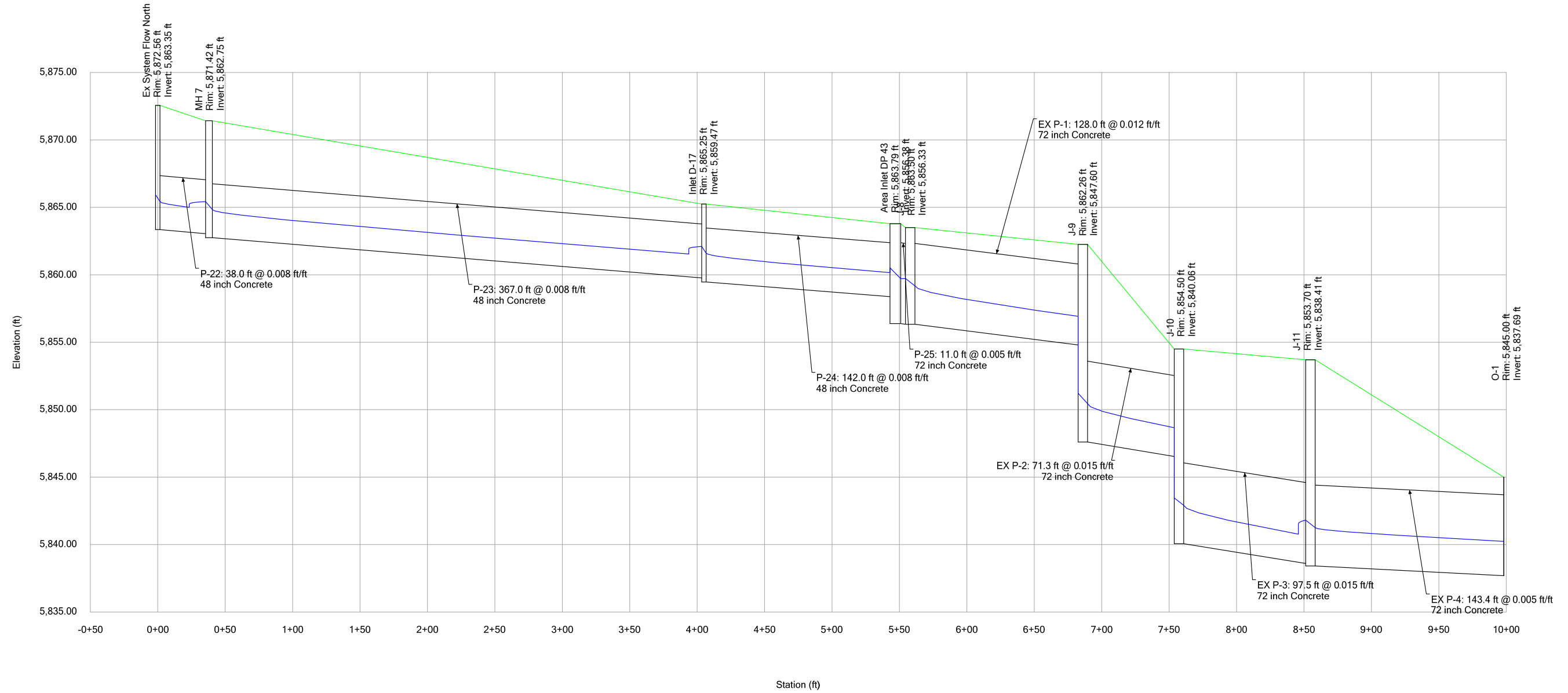


## SPRINGS AT WATERVIEW - STORMCAD OUTPUT 5 YEAR

Label	Up. Node	Dn. Node	L (ft)	Size	Q Full (cfs)	System Q (cfs)	Avg. v (ft/s)	Up. Gr Elev. (ft)	HGL In (ft)	Up. Invert (ft)	Up. Cover (ft)	Dn. Gr. Elev. (ft)	Dn. Invert (ft)	Dn. Cover (ft)	S (ft/ft)
P-19	Area Inlet DP 42a	Area Inlet DP 43	121.0	72 inch	60.5	285.5	8.01	5864.51	5861.31	5856.93	1.58	5863.79	5856.38	1.41	0.50%
P-25	Area Inlet DP 43	J-8	11.0	72 inch	111.5	285.5	9.48	5863.79	5860.52	5856.38	1.41	5863.50	5856.33	1.17	0.50%
EX P-1	J-8	J-9	128.0	72 inch	111.5	463.0	13.47	5863.50	5859.73	5856.33	1.17	5862.26	5854.80	1.46	1.20%
EX P-2	J-9	J-10	71.3	72 inch	111.4	518.8	14.62	5862.26	5851.22	5847.60	8.66	5854.50	5846.53	1.97	1.50%
EX P-3	J-10	J-11	97.5	72 inch	111.4	518.2	14.61	5854.50	5843.46	5840.06	8.44	5853.70	5838.60	9.10	1.50%
EX P-4	J-11	O-1	143.4	72 inch	111.4	300.1	9.83	5853.70	5841.81	5838.41	9.29	5845.00	5837.69	1.31	0.50%
P-4	Inlet D-7	Inlet DP A	60.0	18 inch	2.7	18.8	7.57	5881.53	5878.60	5877.84	2.19	5881.02	5875.91	3.61	3.20%
P-3	Inlet D-8	Inlet DP A	63.0	18 inch	1.6	15.6	5.68	5881.53	5877.87	5877.29	2.74	5881.02	5875.91	3.61	2.20%
P-1	Ex System Flow East	MH 1	73.0	48 inch	42.2	254.4	14.99	5899.57	5883.51	5881.07	14.50	5884.39	5878.78	1.61	3.10%
P-2	MH 1	Inlet DP A	80.0	48 inch	42.2	253.4	14.95	5884.39	5878.64	5876.20	4.19	5881.02	5873.71	3.31	3.10%
P-15	MH 2	Inlet DP F	54.0	66 inch	51.3	403.6	11.65	5872.56	5866.56	5863.81	3.25	5872.94	5863.03	4.41	1.40%
P-18	Inlet DP F	Area Inlet DP 42a	115.0	66 inch	53.1	720.9	17.73	5872.94	5865.52	5862.73	4.71	5864.51	5857.43	1.58	4.60%
P-16	Inlet D-16	Inlet DP F	63.0	18 inch	1.0	22.9	6.55	5873.45	5870.11	5869.73	2.22	5872.94	5866.73	4.71	4.80%
P-22	Ex System Flow North	MH 7	38.0	48 inch	48.4	127.6	9.46	5872.56	5865.94	5863.35	5.21	5871.42	5863.05	4.37	0.80%
P-23	MH 7	Inlet D-17	367.0	48 inch	48.4	129.4	9.56	5871.42	5865.44	5862.75	4.67	5865.25	5859.77	1.48	0.80%
P-24	Inlet D-17	Area Inlet DP 43	142.0	48 inch	50.7	125.8	9.47	5865.25	5862.11	5859.47	1.78	5863.79	5858.38	1.41	0.80%
P-17	Inlet D-15	Inlet DP F	63.0	18 inch	1.5	22.9	7.29	5873.46	5870.18	5869.72	2.24	5872.94	5866.73	4.71	4.70%
P-11	Inlet DP B	MH 2	25.0	30 inch	2.7	41.0	4.70	5873.06	5868.09	5867.06	3.50	5872.56	5866.81	3.25	1.00%
P-14	Inlet DP C	MH 2	5.0	30 inch	3.6	89.9	8.92	5873.04	5868.17	5867.05	3.49	5872.56	5866.81	3.25	4.80%
P-12	Inlet D-14	Inlet DP E	135.0	18 inch	2.0	11.0	4.71	5874.52	5870.79	5870.26	2.76	5873.06	5868.79	2.77	1.10%
P-13	Inlet DP E	Inlet DP C	28.0	24 inch	3.2	36.8	7.19	5873.06	5869.42	5868.29	2.77	5873.04	5867.55	3.49	2.60%
P-9	Inlet D-11	Inlet DP D	128.0	18 inch	1.9	11.1	4.73	5874.66	5870.92	5870.40	2.76	5873.24	5868.96	2.78	1.10%
P-10	Inlet DP D	Inlet DP B	28.0	24 inch	3.7	40.6	8.03	5873.24	5869.63	5868.46	2.78	5873.06	5867.56	3.50	3.20%
P-5	Inlet DP A	MH-6	34.0	48 inch	46.3	181.0	12.05	5881.02	5876.15	5873.41	3.61	5880.27	5872.87	3.40	1.60%
P-8	MH-6	MH 2	184.0	48 inch	46.2	228.6	14.25	5880.27	5872.21	5869.47	6.80	5872.56	5864.81	3.75	2.50%
P-7	Inlet D-10	MH-6	25.0	18 inch	0.9	22.1	6.18	5881.03	5876.84	5876.48	3.05	5880.27	5875.37	3.40	4.40%
P-6	Inlet D-9	MH-6	45.0	18 inch	0.7	14.9	4.30	5881.19	5876.65	5876.28	3.41	5880.27	5875.37	3.40	2.00%

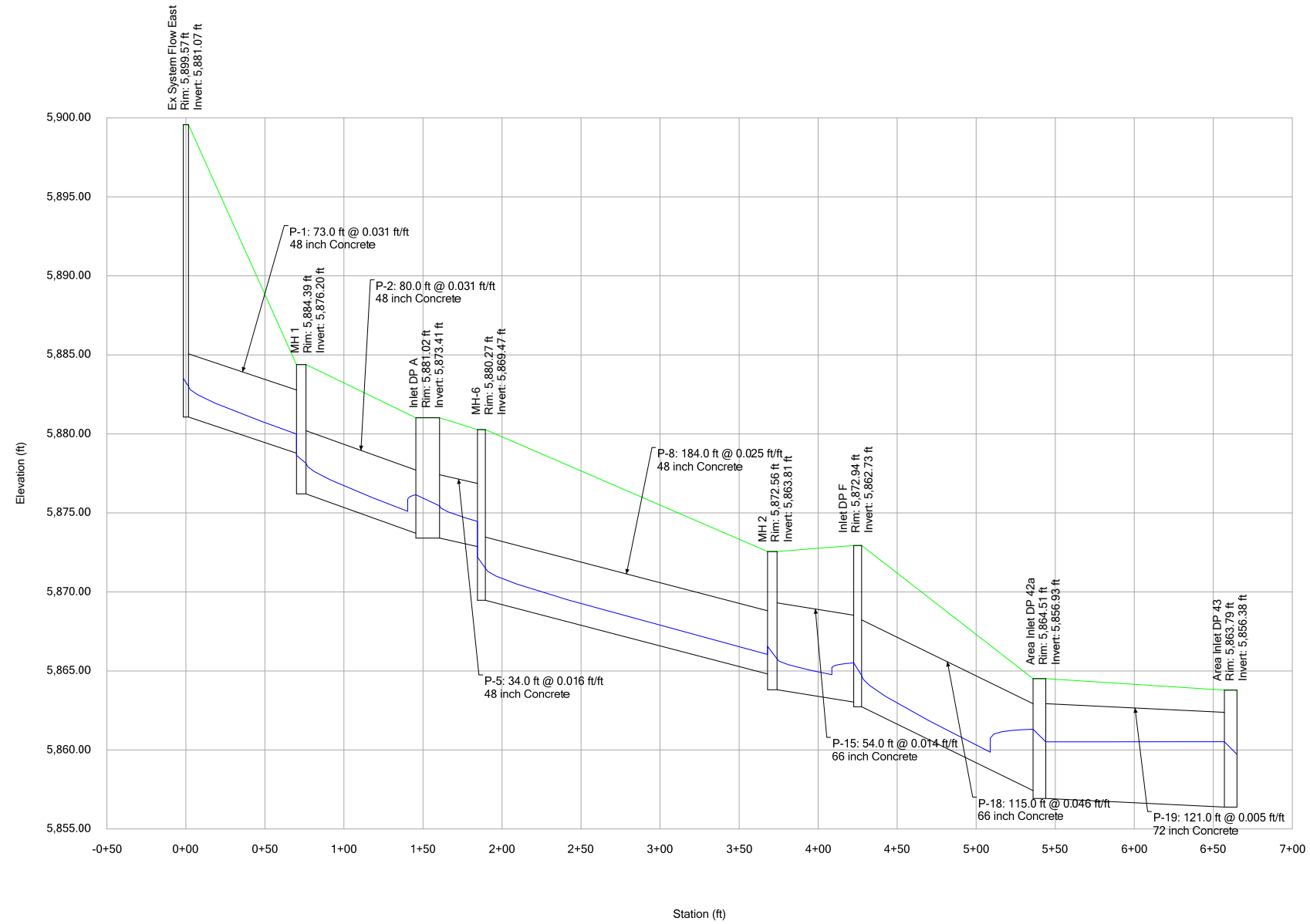
## Profile Report

### Engineering Profile - Mainline West Side and Outlet (WV-Storm Sys.stsw)



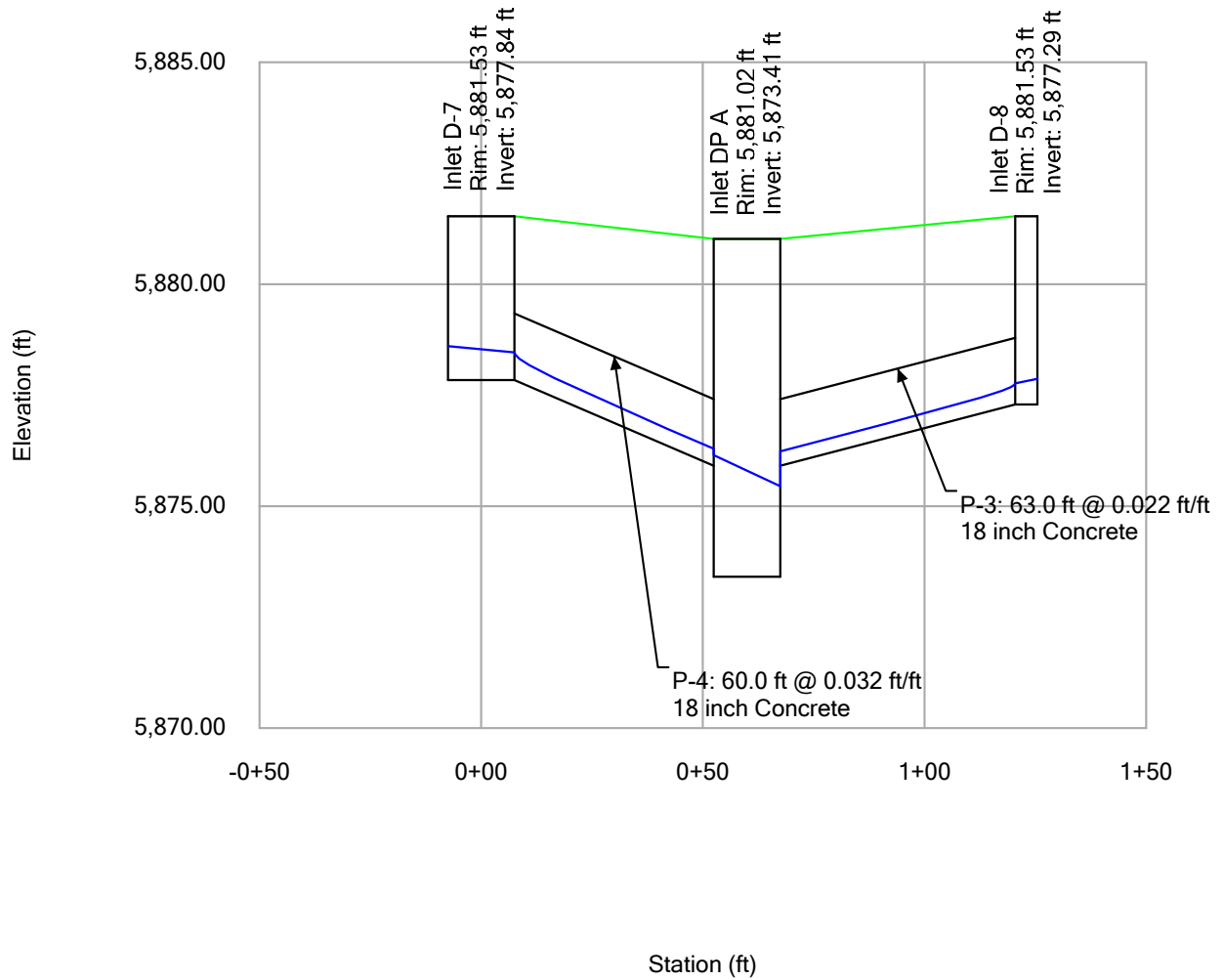
## Profile Report

### Engineering Profile - Mainline thru Site (WV-Storm Sys.stsw)



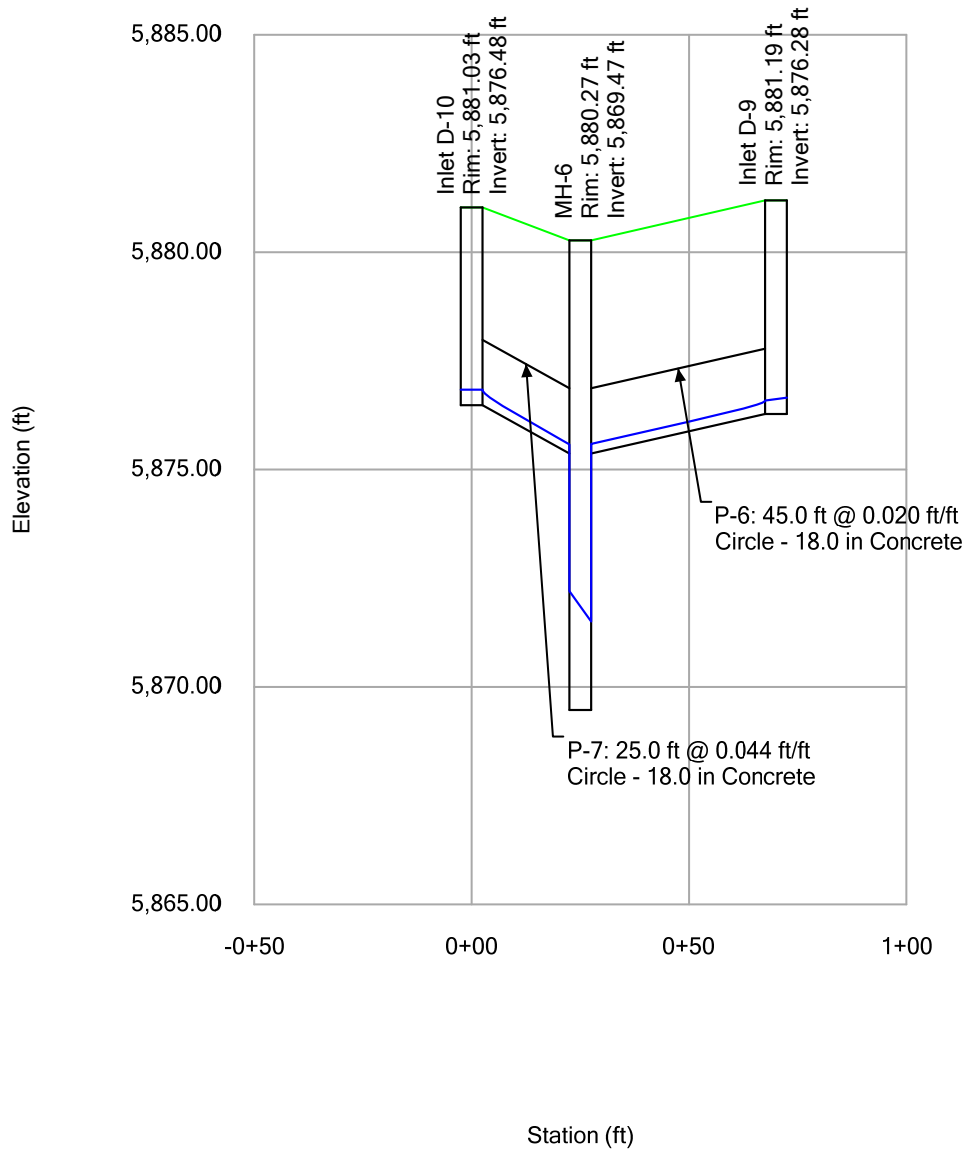
# Profile Report

## Engineering Profile - East Rd East Lats (WV-Storm Sys.stsw)



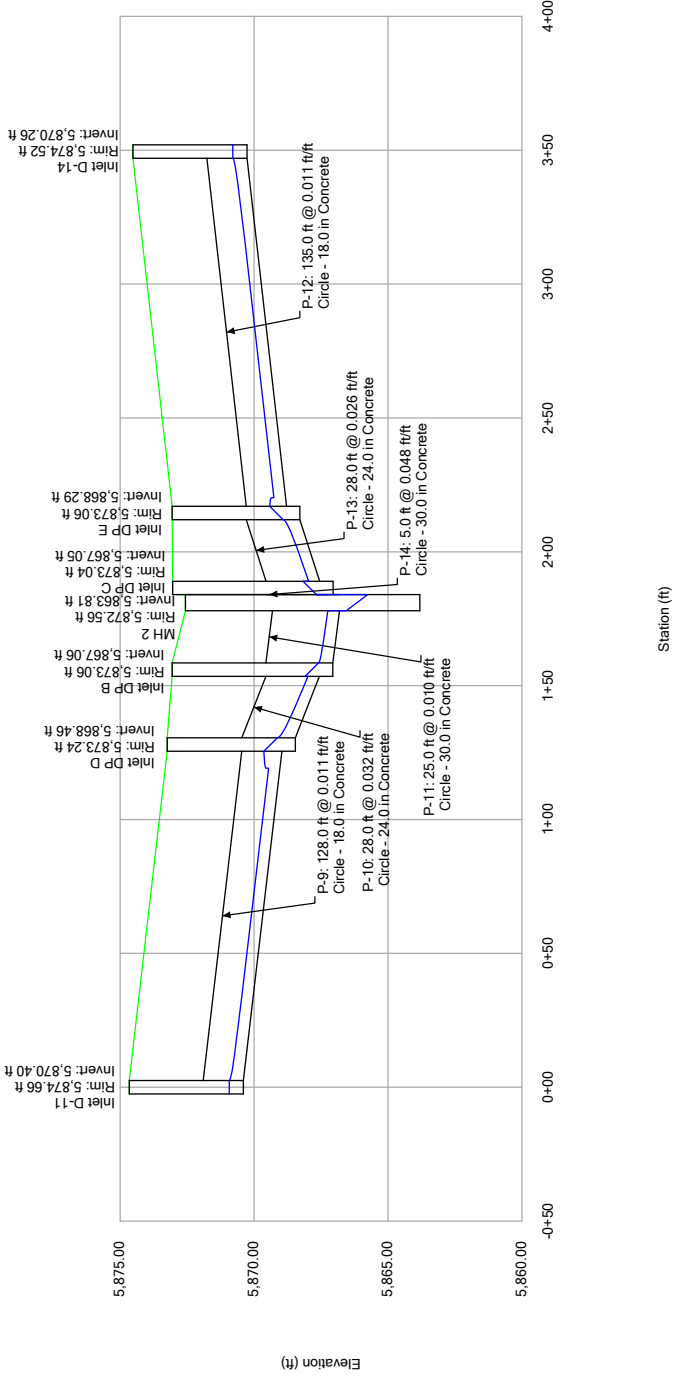
# Profile Report

## Engineering Profile - East Rd West Lats (WV-Storm Sys.stsw)



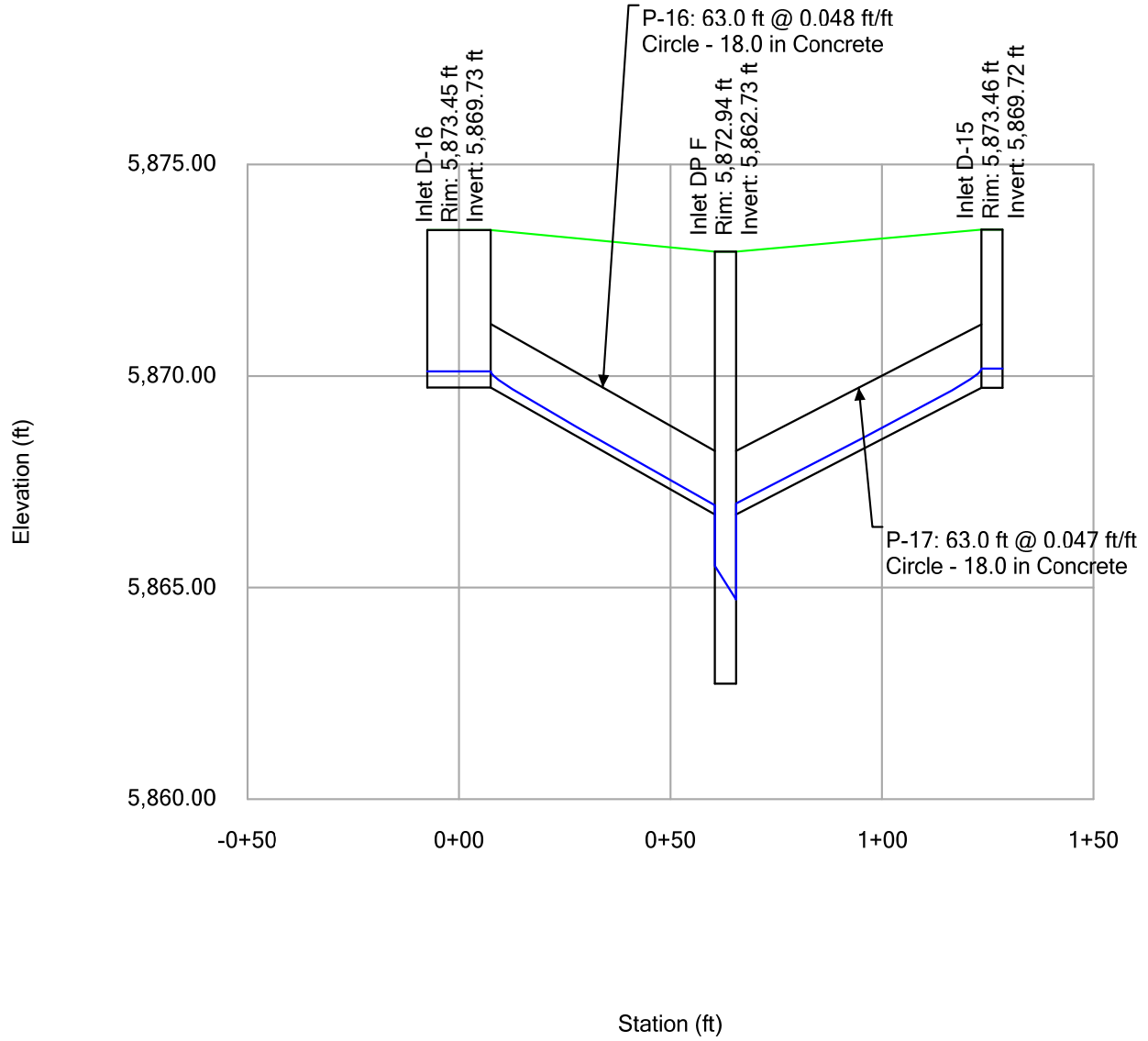
# Profile Report

## Engineering Profile - West Rd East Lats (WV-Storm Sys.stsw)



# Profile Report

## Engineering Profile - West Rd West Lats (WV-Storm Sys.stsw)



## **Appendix F: Existing WQ Pond**



# Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected

Worksheet Protected

**Stormwater Facility Name: Painted Sky at Waterview - Existing Water Quality Pond**

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**Facility Location & Jurisdiction: West of Grinnell Blvd - El Paso County**

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**User Input: Watershed Characteristics**

Watershed Slope =	0.060	ft/ft
Watershed Length =	2000	ft
Watershed Area =	89.69	acres
Watershed Imperviousness =	62.3%	percent
Percentage Hydrologic Soil Group A =	71.0%	percent
Percentage Hydrologic Soil Group B =	29.0%	percent
Percentage Hydrologic Soil Groups C/D =		percent

Location for 1-hr Rainfall Depths (use dropdown):

WQCV Treatment Method =

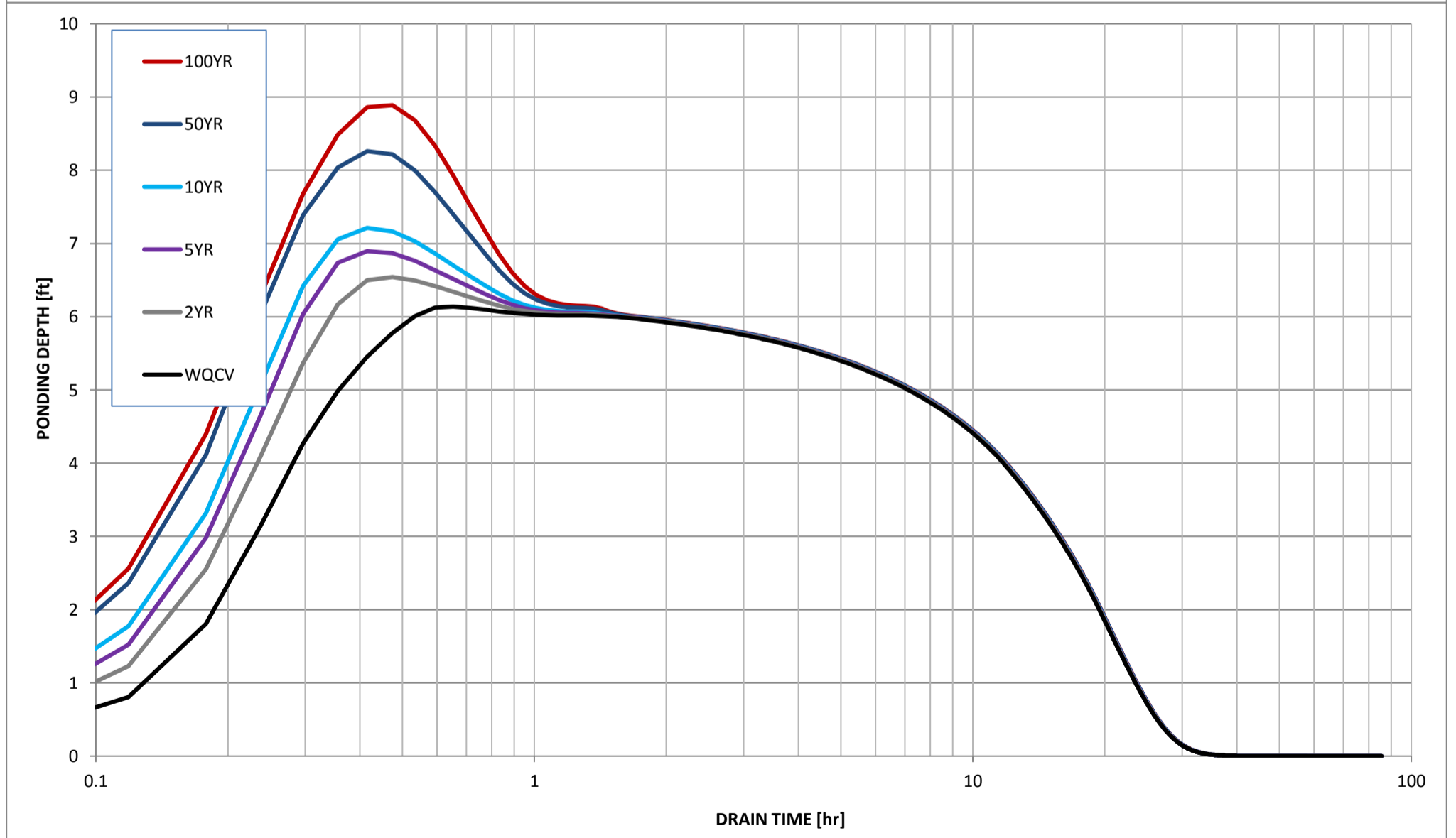
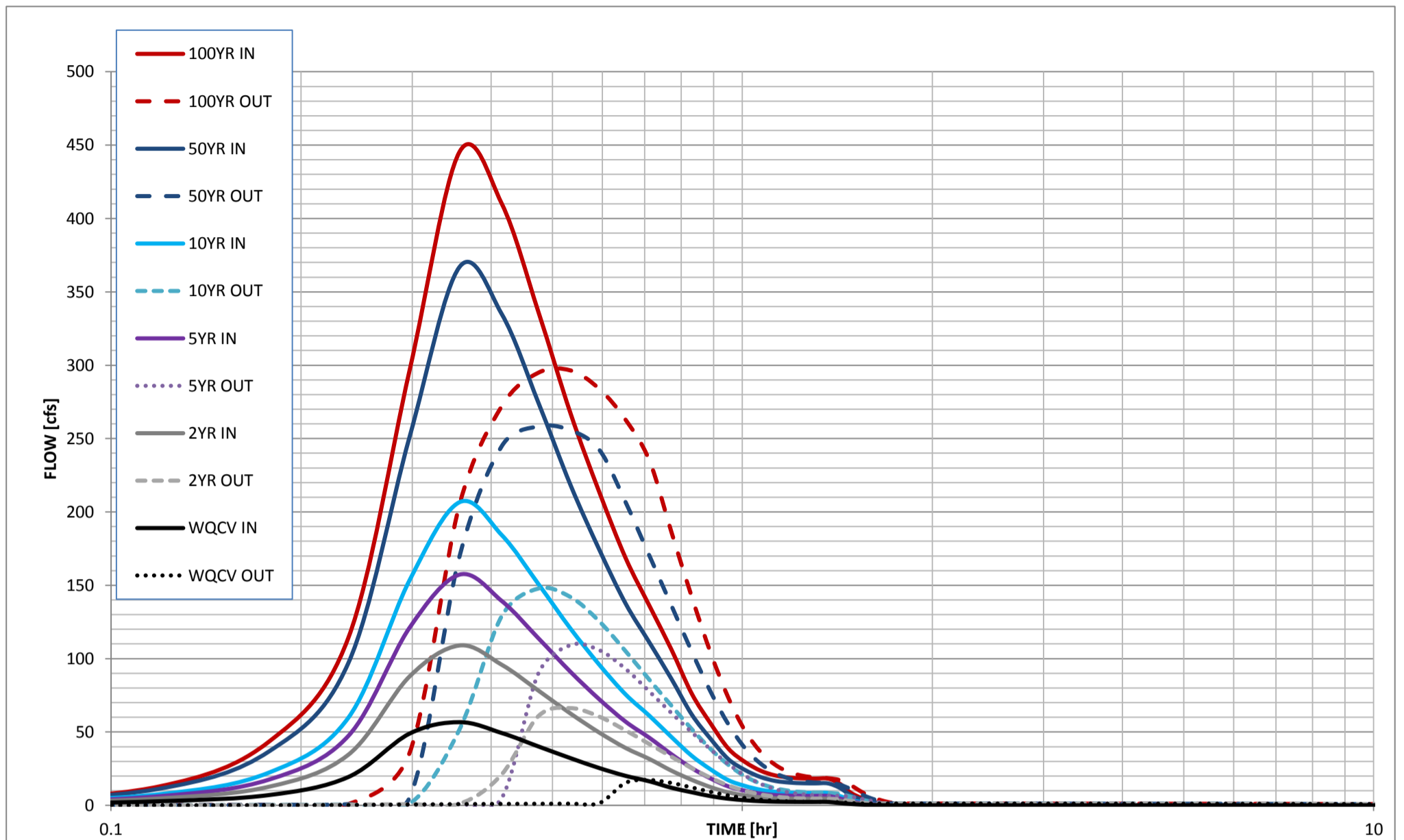
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	1,158	0.00	0.00
2.00	3,651	2.00	0.28
4.00	10,828	4.00	0.76
6.00	26,066	6.00	1.22
8.00	51,145	8.00	242.46

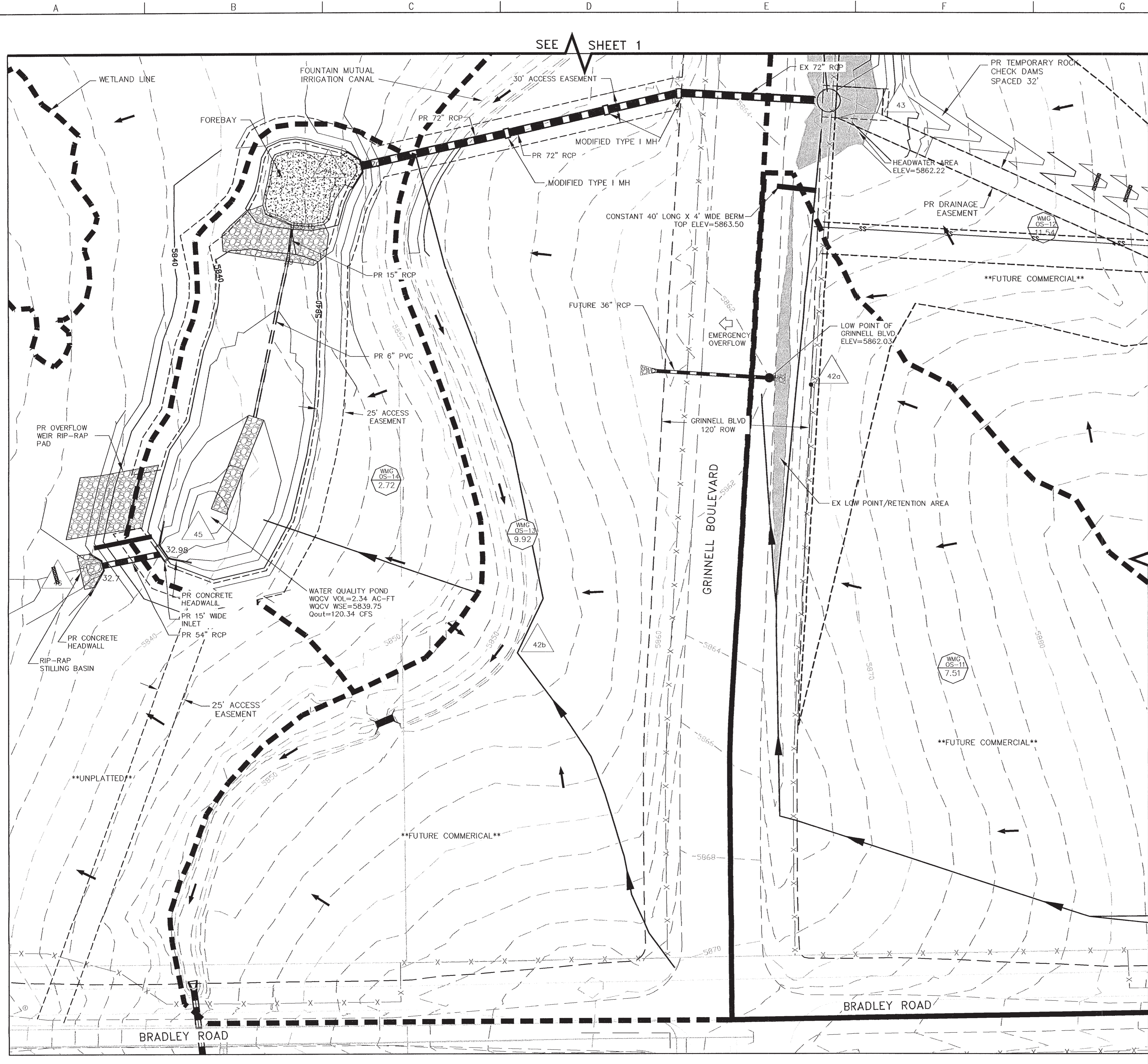
After completing and printing this worksheet to a pdf, go to: <https://maperture.digitaldataservices.com/gvh/?viewer=cswdif>  
 create a new stormwater facility, and  
 attach the pdf of this worksheet to that record.

**Routed Hydrograph Results**

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	0.88	1.18	1.44	2.15	2.49	in
Calculated Runoff Volume =	1.825	3.485	5.019	6.585	11.717	14.239	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	1.824	3.484	5.014	6.581	11.708	14.237	acre-ft
Time to Drain 97% of Inflow Volume =	22.4	19.8	<b>18.1</b>	16.7	13.5	12.2	hours
Time to Drain 99% of Inflow Volume =	26.1	24.2	22.9	21.9	19.4	<b>18.4</b>	hours
Maximum Ponding Depth =	6.14	6.54	6.90	7.21	8.26	<b>8.89</b>	WARNING!
Maximum Poned Area =	0.64	0.75	0.86	0.95	1.17	<b>1.17</b>	acres
Maximum Volume Stored =	1.370	1.650	1.935	2.218	3.059	3.059	acre-ft

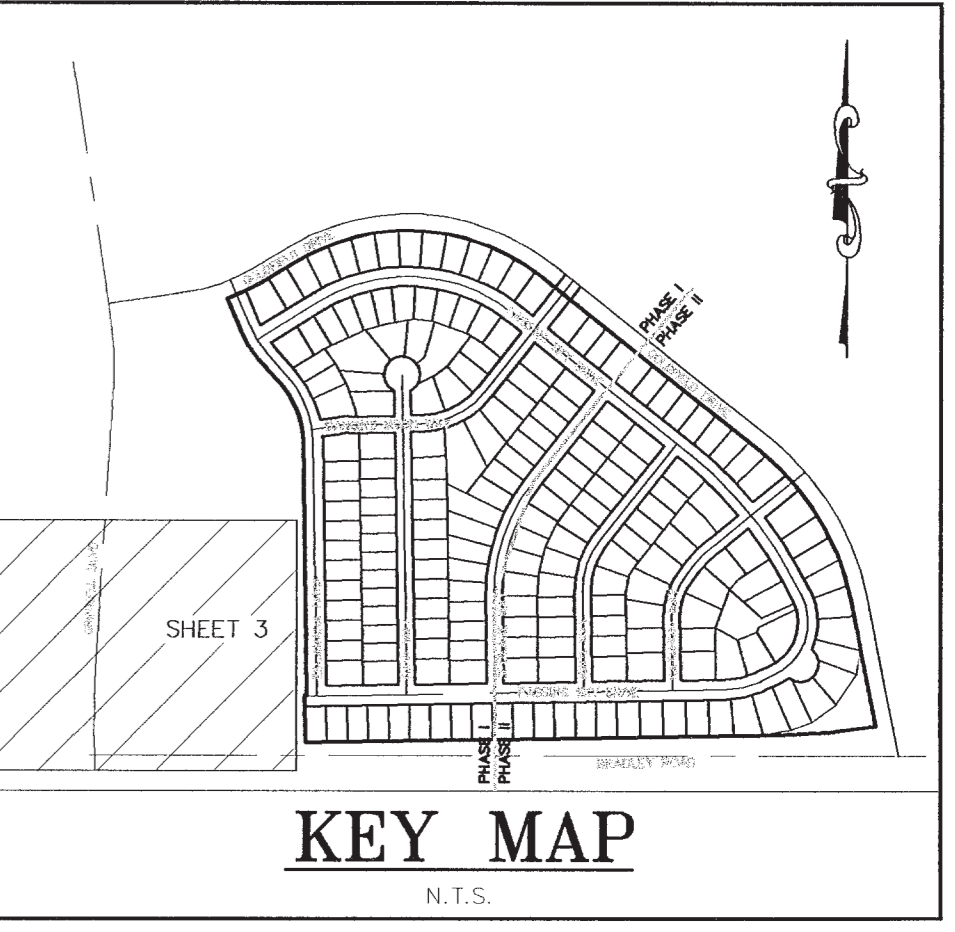
# Stormwater Detention and Infiltration Design Data Sheet





### LEGEND

- PROPOSED STORM SEWER
- MAJOR BASIN BOUNDARY (DEVELOPED)
- DIRECTION OF FLOW
- CONTOUR - MAJOR (EXIST.)
- CONTOUR - MINOR (EXIST.)
- CONTOUR - MAJOR (PROPOSED)
- CONTOUR - MINOR (PROPOSED)
- SUBDIVISION BOUNDARY
- OVERLAND TIME FLOW PATH
- CHANNEL FLOW PATH
- INLET
- FB SUMP INLET
- BASIN IDENTIFIER
- BASIN AREA
- OVERLAND DESIGN POINT
- STORM DRAIN DESIGN POINT
- EMERGENCY OVERFLOW ROUTING



#### AREA DRAINAGE SUMMARY

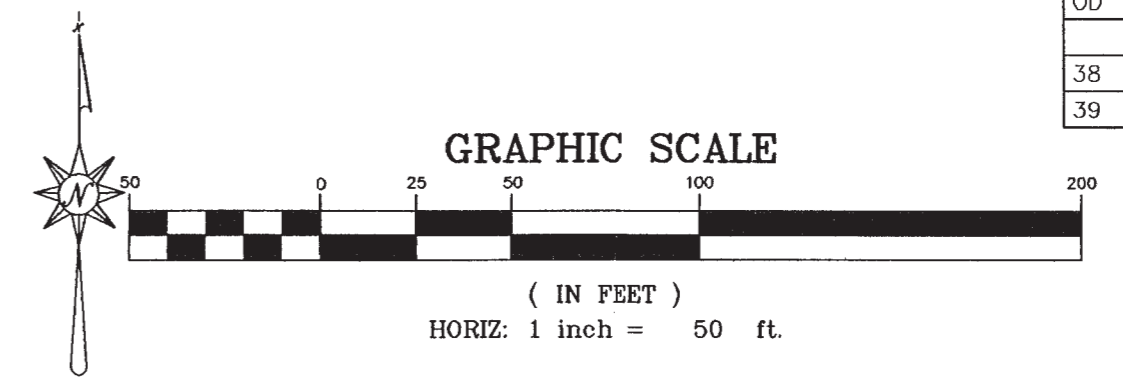
BASIN	AREA TOTAL (ACRES)	TOTAL FLOWS Q10 (c.f.s.)	TOTAL FLOWS Q100 (c.f.s.)
1	1.43	3.5	6.2
2	2.92	6.4	11.3
3	2.79	6.8	12.1
4	2.33	5.6	10.0
5	1.84	4.6	8.1
6	2.67	6.4	11.3
7	1.68	4.2	7.5
8	0.98	2.4	4.2
9	0.85	2.2	4.0
9a	0.66	1.9	3.3
10	0.11	0.6	0.9
11	0.25	1.3	2.2
12	1.01	2.7	4.9
13	0.22	1.2	1.9
14	0.23	1.1	1.7
15	2.90	6.5	11.6
16	0.66	1.7	3.1
17	2.48	5.8	10.3
18	1.26	3.1	5.4
19	3.45	7.9	14.0
20	0.88	2.2	3.8
21	1.68	4.1	7.2
22	4.10	8.9	15.8
23	0.83	2.1	3.7
24	1.91	4.6	8.2
25	1.60	4.0	7.2
26	0.82	2.1	3.7
27	0.66	1.8	3.1
28	0.19	0.9	1.5
29	0.79	2.0	3.5
30	0.39	1.0	1.8
31	1.16	3.1	5.6
32	0.20	1.1	1.7
33	0.25	1.3	2.1
34	1.62	4.0	7.2
35	2.16	2.5	5.2
OS-1	0.60	2.8	4.5
OS-2	0.98	4.6	7.4
OS-3	0.67	3.6	5.7
OS-4	0.86	4.3	6.9
OS-5	N/A	N/A	N/A
OS-6	1.33	5.1	8.4
OS-7	0.59	2.6	4.2
OS-8	2.64	9.6	15.8
OS-9	0.90	4.0	6.5
OS-10	2.58	10.6	17.1
OS-11	7.51	6.5	13.6
OS-12	11.54	9.6	16.4
OS-13	9.92	22.6	36.1
OS-14	2.72	7.7	12.6
OS-A	41.64	70.1	124.8
OS-B	26.91	48.8	86.9
OS-C	9.83	15.6	27.8
OS-D	5.53	7.4	13.2

#### SURFACE ROUTING SUMMARY

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTAL FLOWS Q100 (c.f.s.)
1	3.5	6.2
2	11.3	19.8
3	15.9	28.0
4	5.6	10.0
5	4.6	8.1
6	6.4	11.3
7	4.2	7.5
8	6.8	13.0
9	12.2	21.6
9a	7.5	15.2
10	0.6	0.9
11	1.3	2.2
12	15.8	30.9
13	1.1	1.9
14a	21.6	41.5
14b	15.0	26.8
15	6.5	11.6
16	1.7	3.1
17	5.8	10.3
18	10.5	18.7
19	12.3	24.4
20	7.6	13.5
21	15.6	30.2
22	17.3	28.2
23	9.2	26.1
24	20.9	31.2
25	15.9	25.0
26	10.7	31.2
27	17.3	27.5
28a	17.4	30.5
28b	10.0	18.6
29	12.1	30.5
30	6.7	19.8
31	9.5	19.9
32	2.3	10.1
33	2.5	5.2
34	2.8	4.5
35	4.3	6.9
36	4.6	7.4
37	8.9	14.5
38	6.1	15.5
39	17.7	29.0
40	4.0	6.5
41	25.5	44.1
42a	6.5	13.6
42b	29.5	36.1
43	59.5	126.8
44	87.5	161.1
45	92.8	169.7
46	92.8	169.7
OA	86.7	154.2
OB	142.3	253.2
OC	15.6	27.8
OD	7.4	13.2

#### STORM SEWER ROUTING SUMMARY

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTAL FLOWS Q100 (c.f.s.)
100	6.7	8.1
101	6.1	8.1
102	13.8	19.1
103	18.9	24.9
104	26.3	35.1
105	26.5	39.5
106	42.2	67.2
107	5.7	7.7
108	12.6	15.6
109	20.4	27.4
110	33.1	49.9
111	38.9	57.9
112	48.4	81.6



REV	REVISION DESCRIPTION	DATE	CHANGED BY	CHECKED BY	APPROVED BY

**WATERVIEW JV PARTNERS, LLC**

**MERRICK**  
Engineers & Architects  
7222 COMMERCE CENTER DR., SUITE 120  
COLORADO SPRINGS, CO 80919  
PHONE: (719) 260-8874

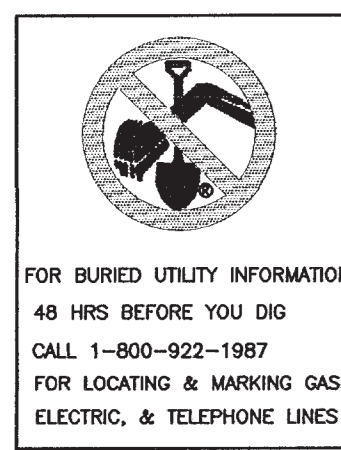
MERRICK	SIGNATURE	DATE
DESIGN	JAG	11/15/06
DESIGNED	EAS	11/15/06
OC REVIEW	MJP	11/15/06
APPROVED	MJP	11/15/06
CLIENT	SIGNATURE	DATE
REVIEW		
APPROVED		
CD FILE NAME	4899-FPPR03.DWG	

**PAINTED SKY AT WATERVIEW**  
BRADLEY ROAD  
AND GRINNELL BOULEVARD

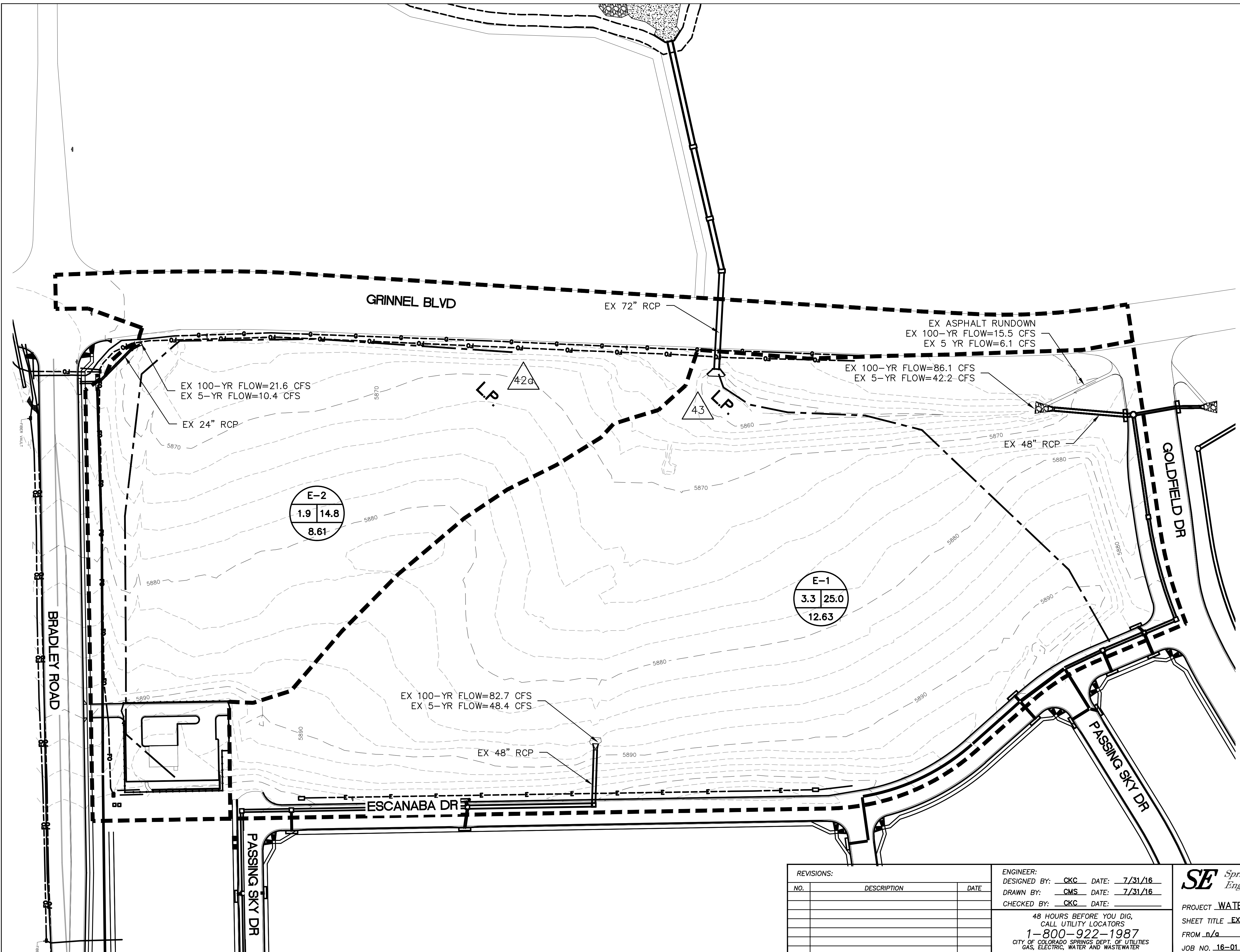
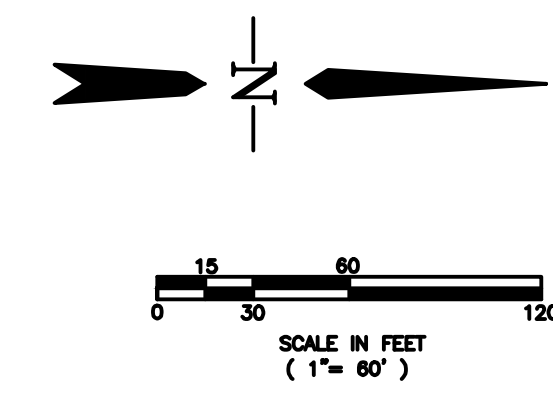
CLIENT PROJECT NO. -  
MERRICK PROJECT NO. 18014899  
SCALE: 1"=50'

MICHAEL J. PINSONEAULT  
Colorado Registered Professional  
Colorado PE #36336  
For and on Behalf of  
Merrick & Company  
Merrick & Company Job No. 18014899

TITLE: PAINTED SKY AT WATERVIEW WATERVIEW METROPOLITAN DISTRICT FINAL DRAINAGE REPORT JANUARY 2007		
REVISION:	DRAWING NO. 4899D-FPPR03	SHEET NO. 3 OF 5



**Figure 3: Existing Drainage Plan**



**LEGEND**

- EXISTING 2' CONTOUR
- EXISTING 10' CONTOUR
- EXISTING FLOW PATH
- EXISTING BASIN BOUNDARY
- DESIGN POINT
- BASIN LABEL

DESIGN POINT	Q (5)	Q (100)
43	44.3	112.7
42a	12.4	38.2

FIGURE 5

REVISIONS:		
NO.	DESCRIPTION	DATE

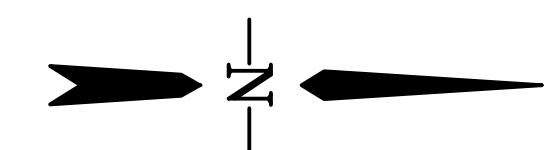
ENGINEER:  
 DESIGNED BY: CKC DATE: 7/31/16  
 DRAWN BY: CMS DATE: 7/31/16  
 CHECKED BY: CKC DATE:  

48 HOURS BEFORE YOU DIG,  
 CALL UTILITY LOCATORS  
**1-800-922-1987**  
 CITY OF COLORADO SPRINGS DEPT. OF UTILITIES  
 GAS, ELECTRIC, WATER AND WASTEWATER

**SE Springs Engineering**  
 31 N. TEJON, SUITE 315  
 COLORADO SPRINGS, CO 80903  
 P: (719) 227-7386  
 F: (719) 227-7392

PROJECT WATERVIEW SPRINGS  
 SHEET TITLE EXISTING DRAINAGE MAP  
 FROM n/a TO n/a  
 JOB NO. 16-01 SHEET 1 OF 1

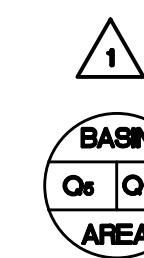
**Figure 4: Proposed Drainage Plan**



SCALE IN FEET  
(1" = 80')

LEGEND

- - - - - EXISTING 2' CONTOUR
- - - - - EXISTING 10' CONTOUR
- - - - - DITCH CENTERLINE
- — — — — PROPOSED 2' CONTOUR
- — — — — PROPOSED 10' CONTOUR
- - - - - PROPOSED BASIN BOUNDARY
- - - - - PROPOSED FLOW PATH
- ▲ DESIGN POINT



BASIN LABEL

DESIGN POINT	Q (5)	Q (100)
11	1.6	3.1
32	1.3	2.4
A	0.3	4.3
B	0.8	2.3
C	0.8	2.1
D	2.4	6.7
E	1.6	4.7
F	0.2	3.1
G	3.1	7.1
K	11.5	24.1
39	1.1	2.5
41	0.5	1.0
42a	11.9	26.3
43	4.0	9.2

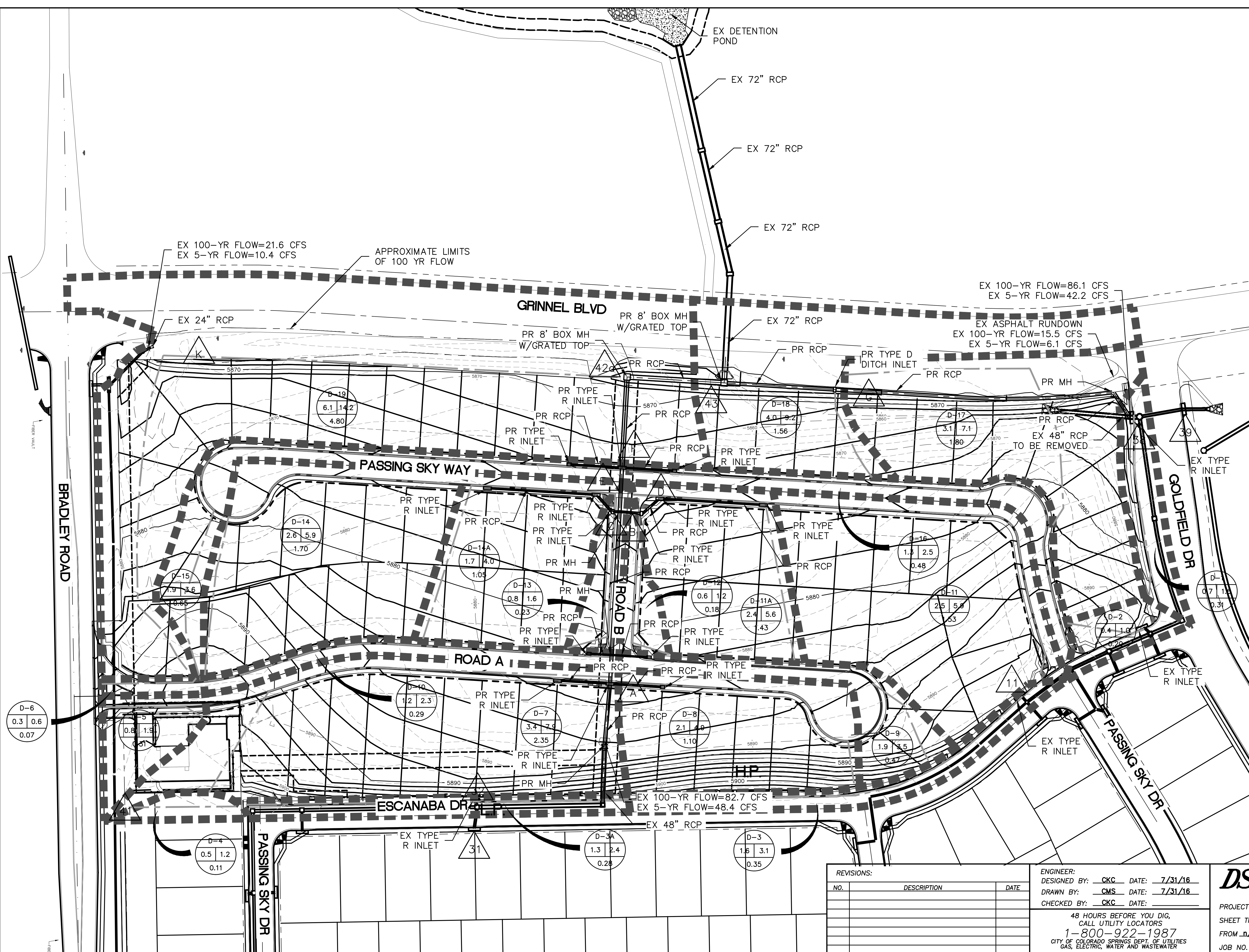


FIGURE 4

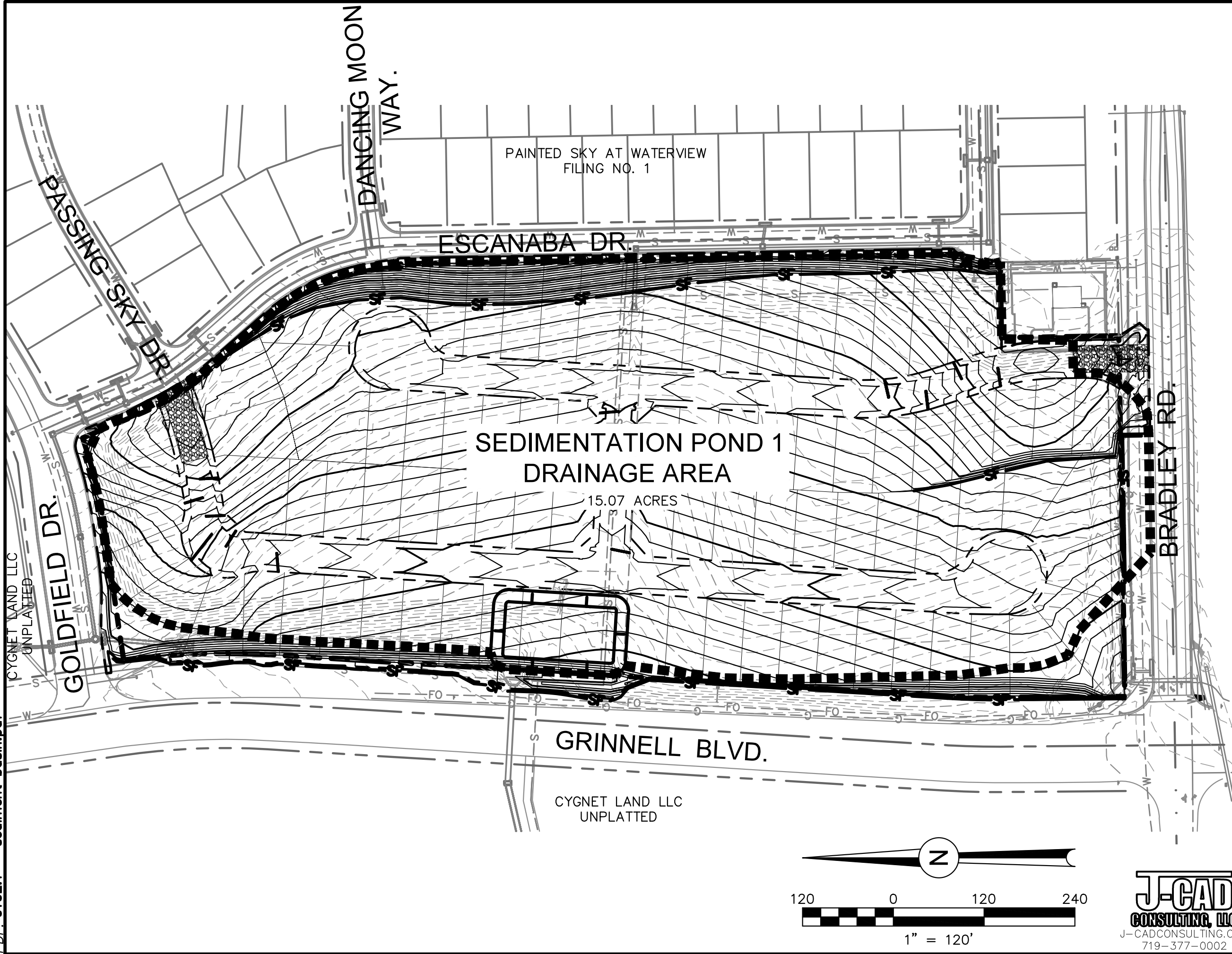
REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER: \_\_\_\_\_  
 DESIGNED BY: CKC DATE: 7/31/16  
 DRAWN BY: CMS DATE: 7/31/16  
 CHECKED BY: CKC DATE: \_\_\_\_\_

48 HOURS BEFORE YOU DIG,  
 CALL UTILITY LOCATORS  
 1-800-922-1987  
 CITY OF COLORADO SPRINGS DEPT. OF UTILITIES  
 GAS, ELECTRIC, WATER AND WASTEWATER

**DSE** Dakota Springs Engineering  
 31 N. TEJON, SUITE 315  
 COLORADO SPRINGS, CO 80903  
 P: (719) 227-7388  
 F: (719) 227-7392

PROJECT SPRINGS AT WATERVIEW  
 SHEET TITLE PROPOSED DRAINAGE MAP  
 FROM n/a TO n/a  
 JOB NO. 16-01 SHEET 1 OF 1



# DSE

Dakota Springs  
Engineering

31 N. TEJON, SUITE 500  
COLORADO SPRINGS, CO 80903  
P: (719) 227-7388  
F: (719) 227-7392

SPRINGS AT WATERVIEW

SEDIMENTATION BASIN EXHIBIT

JOB NO. 0102.1

DESIGNED BY: JUM DATE: 3/5/18  
 DRAWN BY: JUM DATE: 3/5/18  
 CHECKED BY: DATE:

48 HOURS BEFORE YOU DIG,  
CALL UTILITY LOCATORS

1-800-922-1987

CITY OF COLORADO SPRINGS DEPT. OF UTILITIES  
GAS, ELECTRIC, WATER AND WASTEWATER

**J-CAD**  
CONSULTING, LLC  
J-CADCONSULTING.COM  
719-377-0002