HARRIS KOCHER SMITH

Final Drainage Report: Outlook Powers & Grinnell

EPC STORMWATER REVIEW COMMENTS IN ORANGE BOXES WITH BLACK TEXT

Prepared:
May 8, 2023

Prepared for:

Evergreen
Development | Services | Investments

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Prepared by:
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Harris Kocher Smith Project No. 221206

Add "PCD File No. SF2318" to the cover sheet.

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Contents

I. CERTIFICATIONS

A. 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 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.

____ ______________________

Mark West, P.E. — Date
State of Colorado Registration No. 38561
on Behalf of Harris Kocher Smith

B. Developer's Statement:

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

By (signature): ________________________________ ______________________

Date

Title: ________________________________

Address: ________________________________

____

C. El Paso County Certification Statement:

Revise county statement. See textbook below for template.

Filed in accordance with Section 51.1 of the El Paso County Land Development Code as amended.

____

Director of Public Works

Conditions:

El Paso County:

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

________________________________ ____________

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

Conditions:

A PARCEL OF LAND IN THE SOUTHWEST QUARTER OF SECTION 6 AND THE NORTHWEST QUARTER OF SECTION 7, TOWNSHIP 15 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO,

II. PURPOSE

The purpose of this study is to identify potential impacts of the proposed Outlook Powers and Grinnell development ("Site"/" Project") and surrounding areas, including on-site and off-site drainage patterns, storm sewer and inlet locations, water quality facilities, and areas tributary to the site, to safely route developed storm water to adequate receiving facilities.

III. GENERAL LOCATION AND D

"Springs at Waterview Filing No.1 and Painted Sky at Waterview Filing No. 1"

A. Location

The Outlook Powers and Grinnell property (herein referred to as "Site") lies within the County of El Paso. The Site is in the Northwest ¼ of Section 7, Township 15 South, and the Southwest ¼ of the Southwest ¼ of Section 6, Township 15 South, Range 65 West of the 6th Principal Meridian, County of El Paso, State of Colorado.

The Site is bounded by Powers Boulevard to the north, Grinnell Boulevard to the west, Goldfield Drive to the south, and Cudahy Drive to the east. The Springs at Waterview development is located to the south of Goldfield Drive and Filing No. 3 of the Painted Sky at Waterview subdivision is located east of Cudahy Drive. North of Powers exists the Colorado Springs Airport and Industrial Park and open space containing the Fountain Mutual Irrigation Canal No. 4 and Windmill Gulch exists to the west of Grinnell Boulevard.

A Vicinity Map is included in Appendix A, for reference.

B. Description of Property

The Site consists of 16.57 acres and is currently covered with native grasses and weeds. The existing topography of the Outlook Powers and Grinnell property generally slopes northeast to southwest with grades ranging from 2 to 30 percent.

Per the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey for the Property, the predominant underlying soil is Blakeland loamy sand. Blakeland loamy sand is within hydrologic soil group A, which is considered to have low runoff potential when thoroughly wet. Hydrologic soil group A will be used for the Site's rational and pond volume computations. A copy of the NRCS Soil Report can be found in Appendix B.

The Site lies within the Windmill Gulch Major Drainage Basin. While there are no irrigation facilities within the subject property, the Fountain Mutual Irrigation Canal No. 4 exists to the west of the Site. An existing dual 8' x 3' box culvert crosses below Powers Boulevard draining a portion of the Colorado Springs Airport and Industrial Park property to an existing rough channel that drains northeast to southwest across the Outlook Powers and Grinnell property. The channel drains to an existing 8' x 6' box culvert that crosses below Grinnell Boulevard and drains to the open space to the west of the Site toward Fountain Mutual Irrigation Canal No. 4 and ultimately Windmill Gulch.

An existing 48-inch RCP storm sewer crosses the southern portion of the property, turns north, and drains to the existing 8' x 6' box culvert that crosses Grinnell Boulevard. This storm sewer collects runoff from the existing Type R inlets at the intersection of Cudahy Drive and Goldfield Drive and is the outfall for the existing Painted Sky at Waterview Filing No. 3 detention and water quality pond. Additionally, an existing 24" flared end section exists at the southwest corner of the Property and drains a portion of the Site and Grinnell Boulevard to the two existing 15' Type R inlets along Goldfield Drive where flows continue south via an existing 48" RCP toward an existing water quality and detention facility on the west side of Grinnell Boulevard that detains runoff from the Painted Sky at Waterview Filing No. 1 and 2 and Springs at

Discuss the extreme erosion the runoff from the box culvert is making. This is a significant issue with the property and a clear discussion of the existing issue is necessary.

Waterview subdivisions. Further, an existing grate inlet exists along Grinnell Boulevard adjacent to the Property, north of the existing 8’ x 6’ box culvert. The inlet captures flows from a portion of Grinnell Boulevard and conveys them to an existing water quality and detention facility on the west side of Grinnell Boulevard. At the time of this report, the design report for the existing water quality and detention facility has not been located. However, the facility appears to treat runoff from the intersection and median improvements for Grinnell Boulevard that were completed with the Colorado Springs Airport and Industrial improvements prior to releasing flows to Windmill Gulch.

IV. EXISTING DRAINAGE CONDITIONS

A. Major Basin Descriptions

The Site lies within the Windmill Gulch major drainage basin as outlined in the *Windmill Gulch Drainage Basin Planning Study* prepared by Wilson & Company, revised February 1992. The Windmill Gulch drainage basin contains approximately 5.43 square miles with approximately 2.99 square miles situated in the City of Colorado Springs. The runoff from the Windmill Gulch drainage basin flows in a south and southwesterly direction and crosses U.S. Highway 85/87 in a 144” storm sewer which empties directly into Fountain Creek. The Windmill Gulch drainage basin is predominantly drained by one main channel, which carries runoff in a southerly direction from the Colorado Springs Municipal Airport into Fountain Creek.

The Site was previously analyzed within the *Master Development Drainage Plan for Waterview* prepared by Merrick & Company, revised May 2006 and the *Amendment to Waterview (West) Master Drainage Development Plan* prepared by Springs Engineering, dated July 2013. While the Windmill Gulch DBPS intended for the northern portion of the Waterview development to be treated within one detention and water quality pond downstream of both properties, an existing water quality and detention facility was already constructed with Painted Sky at Waterview Filing No. 3 at the southwest corner of Cudahy Drive and Goldfield Drive which treats the tributary area to the subdivision but not the portion of the Windmill Gulch basin within the Outlook Powers & Grinnell Property. Per the MDDP Amendment, the Site was planned to be future commercial and is required to construct its own water quality and detention facility prior to draining to the existing 8’ x 6’ concrete box culvert that crosses Grinnell Boulevard. Excerpts from applicable reports can be found in Appendix G, for reference.

Per the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) Panel Numbers 08041C0763G and 08041C0764G, effective December 7th, 2018, the Site lies within Flood Zone X and is an area of minimal flood hazard. A copy of the FEMA FIRMette for the property can be found in Appendix A.

The Fountain Mutual Irrigation Company (FMIC) Canal #4 is located within the Windmill Gulch Basin within the open space to the west of Grinnell Boulevard. Per the MDDP, FMIC is not allowed, by current State Law, to accept developed flows into the ditch without metering the flow and releasing the same amount downstream. Thus, since the detention facility for the southern portion of the Waterview development was constructed downstream of the canal, the southern portion of the Waterview development drains to the pond via an existing 72” RCP that crosses below the ditch prior to outfalling into the existing Pond #4. Additionally, per the MDDP Amendment, it was determined that the detention facilities for both Painted Sky at Waterview Filing No. 3 and the Outlook Powers and Grinnell property would be constructed upstream of the existing 8’ x 6’ concrete box culvert that crosses Grinnell Boulevard to reduce flows to historic levels prior to draining toward the existing canal.

Update this section, there is a constructed pond northeast of the project site that drains to the 8' x 3' box culvert.

B. Existing Conditions Sub-basin Description

The existing Site generally drains northeast to southwest from the existing dual 8’ x 3’ concrete box culvert crossing below Powers Boulevard to the existing 8’ x 6’ concrete box culvert crossing below Grinnell Boulevard along the western edge of the Property. A portion of the Site drains to southwest to the existing 24” flared end section (FES) at the southwestern corner of the Property. Additionally, a portion of the Site along the southern edge of the Property drains directly to Goldfield Drive where flows are captured in an existing 15’ Type R sump inlet located just east of the intersection with Grinnell Boulevard.

A portion of the Colorado Springs Airport and Industrial Park drains to the Site via the existing dual 8’ x 3’ concrete box culvert crossing Powers Boulevard. Per the *Colorado Springs Airport Peak Innovation Park Master Development Drainage Plan* prepared by Engenuity, dated August 2020, the existing flow tributary to the culvert is 191.1 cfs. Per the Airport MDDP, a detention pond is planned to be constructed upstream of the outfall to the Site, reducing the peak 100-year flow to 86 cfs. At the time of this report, Pond 400 has not been constructed and the historic runoff will be used for storm infrastructure sizing purposes. Per the Waterview MDDP, the Colorado Springs Airport and Industrial Park was not considered a part of the Waterview drainage area and pond sizing requirements as it is providing its own water quality and detention upstream of Powers Boulevard. As such, a bypass pipe is being proposed with the proposed development to convey flows from the existing Powers Boulevard box culvert to the existing box culvert that crosses Grinnell Boulevard to mimic historic drainage patterns.

A portion of Grinnell Boulevard currently drains onto the Property to the existing 24” FES at the southwest corner of the Site where it is conveyed via existing concrete pipe to the existing water quality and detention pond for Filings No. 1 and 2 of the Painted Sky at Waterview and the Springs at Waterview subdivisions. As shown in the MDDP and MDDP Amendment, proposed drainage patterns will eliminate the flared end section and send flows from Grinnell Boulevard to the existing detention pond west of Grinnell Boulevard.

Additionally, the existing detention pond for Painted Sky at Waterview Filing No. 3 discharges via an existing 48” RCP to the existing box culvert crossing Grinnell Boulevard. As these flows are already detained to historic levels, the existing pipe outfall will be maintained with a portion of the existing storm sewer being rerouted to accommodate the proposed development.

V. DRAINAGE DESIGN CRITERIA

A. Regulations

The principal design guidelines that will be sourced for the Site’s development are the El Paso County Drainage Criteria Manual (hereinafter referred to as “DCM”) and the Mile High Flood Control District (MHFD) Urban Storm Drainage Criteria (USDCM) Volume 1 (August 2018), Volume 2 (September 2017), and Volume 3 (January 2021) (hereinafter referred to as “USDCM”).

Additionally, the Site design will comply with the drainage patterns and detention requirements outlined in the Windmill Gulch DBPS, the Waterview MDDP and MDDP Amendments. Per the Waterview MDDP Amendment, a water quality and detention pond is to be constructed with the proposed development upstream of the existing 8’ x 6’ concrete box culvert that crosses below Grinnell Boulevard to reduce developed Site flows to historic levels prior to outfalling toward the existing FMIC Canal #4 and ultimately Windmill Gulch. Further, consistent with the MDDP and MDDP amendment, flows from a portion of the Site and the Grinnell Boulevard improvements will discharge to the existing water quality and detention pond southwest of the Site, west of Grinnell Boulevard. The northern portion of Grinnell Boulevard will continue

The proposed pond has been constructed. Consult the drainage report associated with those improvements as well as the MDDP.

to drain to the existing water quality and detention on the west side of Grinnell Boulevard that was constructed with the Grinnell Boulevard and Powers Boulevard intersection improvements.

As mentioned, a portion of the Colorado Springs Airport and Industrial Park drains to the Site via existing dual 8' x 3' box culverts. Per the Waterview MDDP and MDDP Amendment as well as the Colorado Springs Airport Peak Innovation Park MDDP, the Airport property is providing its own water quality and detention to reduce developed site flows to historic levels prior to discharging to the existing Powers Boulevard box culvert. Therefore, the proposed Outlook Powers and Grinnell development will convey these historic flows to the existing Grinnell Boulevard box culvert via storm sewer, which is in compliance with the MDDP and MDDP Amendments.

Further, the existing 48" storm sewer that conveys flows from the existing Painted Sky at Waterview Filing No. 3 water quality and detention pond to the existing Grinnell Boulevard box culvert will continue conveying detained flows to the existing box culvert per the MDDP Amendment.

B. Four Step Process

Both MHFD and El Paso County recommend the implementation of the Four Step Process summarized below, which helps to minimize adverse impacts of urbanization. Benefits of this process include reduced runoff, improved water quality, a decrease of the required storage volume, reduced burdens to downstream facilities, and improved site aesthetics. The Four Step Process is outlined below:

Step 1, Employ Runoff Reduction Practices: Runoff reduction for the proposed Outlook Powers and Grinnell development is being implemented by incorporating grass swales that receive tributary runoff from roof drain flow dispersed via level spreaders where practical.

Provide Runoff Reduction calculations for the swales in the appendices.

or add a statement that quantifying runoff reduction will not be used as part of the WQ treatment requirements

Step 2, Stabilize Drainageways: All new and re-development projects within El Paso County are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization within the drainage basin. Additionally, developed Site flows and surrounding Site improvements will be reduced to historic levels prior to discharging toward Windmill Gulch.

Step 3, Provide Water Quality Capture Volume (WQCV): This is being accomplished through a proposed full spectrum extended detention basin (EDB) designed to provide WQCV for all proposed subbasins except for the basins tributary to the existing water quality and detention ponds on the west side of Grinnell Boulevard. A portion of the on-site runoff also receives WQCV through grass lined swales prior to draining to the on-site EDB.

Step 4, Consider Need for Industrial and Commercial BMPs: A combination of source control BMPs will be used during Site construction including landscape maintenance, snow and ice management, and street sweeping and cleaning. Seeding and mulching will be used on disturbed open areas of the Site to stabilize the land, prevent erosion, and help protect downstream drainage facilities.

C. Hydrologic Criteria

acres

The total area of the Site is 16.57, which encompasses the Project. Runoff from the majority of the Site will be directed to the proposed on-site EDB. The Rational Method is appropriate for the project size and was used to calculate peak rates of stormwater runoff. The design storms analyzed for this Site include the 5-year and 100-year for the minor and major storm events, respectively.

Per criteria reports and calculations shall use rainfall values provided by the City/El Paso County DCM only. Revise EDB calculations to use DCM rainfall values.

One-hour rainfall P1 values used for the calculation of detention storage values were obtained from the NOAA Atlas 14, Volume 8, Version 2, Precipitation-Frequency Atlas of the United States (2013). The P1 values for the 5-Year and 100-year storms are 1.29 inches and 2.74 inches, respectively. A copy of the rainfall information can be found in Appendix A, for reference.

Rainfall intensities used for rational calculations were determined using the following Rainfall Intensity Duration (IDF) equations as applicable, excerpted from Vol. 1, Chapter 6 of the El Paso County DCM can be found in Table 1 below:

TABLE 1: RAINFALL INTENSITY DURATION
IDF Equations
I100 = -2.52ln(D) + 12.735
I50 = -2.25ln(D) + 11.375
I25 = -2.00ln(D) + 10.111
I10 = -1.75ln(D) + 8.847
I5 = -1.50ln(D) + 7.583
I2 = -1.19ln(D) + 6.035

Water quality treatment and detention area required for the proposed development in accordance with the BMP requirements outlined in Appendix I of the El Paso County Engineering Criteria Manual (ECM). Required water quality and detention storage were calculated using DCM Volume 2 and the MHFD MHFD-Detention v4.06 worksheet, released July 2022. Outflow from the Pond will be released at or below historic rates.

Results of hydrologic analyses, in addition to pertinent charts, figures, and tables, are included in Appendix C of this report.

Discuss the flows used to hydraulically analyze the 48" diversion storm drain

D. Hydraulic Criteria

Street capacities have been analyzed for the proposed conditions using the MHFD-Inlet v5.02 workbook, released August 2022, in accordance with the regulations outlined in DCM Volume 1. Minor storm capacities are based on no crown or curb overtopping while major storm capacities are based on flow being contained within the public right-of-way or private street section, including conveyance capacity behind the curb. Printouts of the worksheets can be found in Appendix D of this report.

Inlet capacities have been analyzed for the proposed conditions using the MHFD-Inlet v5.02 workbook, released August 2022. Printouts of the worksheets can be found in Appendix D of this report.

Swale capacities have been analyzed for the proposed conditions using the UD-BMP v3.07 workbook, released March 2018 in accordance with DCM Volume 2. Swale sizing worksheets can be found in Appendix D of this report.

Swale designs need to account for 5 & 100-year events.

Verify the flows used are consistent or more conservative than the flows from the recently developed pond to the North of the parcel.

Hydraulic capacity and hydraulic grade line (HGL) for the proposed storm sewer system has been analuzed using Bentley StormCAD. The HEC-22 Energy (Second Edition) headloss method with half benching method has been applied to all manholes within the storm system, the HEC-22 (Second Edition) headloss method with flat benching method has been applied to all in-line inlets within the system, while a standard headloss method with a headloss coefficient of 1.25 has been applied to all inlets that have no upstream storm connection. Printouts of the StormCAD analysis can be found in Appendix D of this report.

VI. DRAINAGE FACILITY DESIGN

A. General Concept

The proposed Outlook Powers and Grinnell Site is located entirely within the Windmill Gulch Major Drainage Basin. Proposed drainage patterns will remain relatively unchanged from current conditions. Runoff from the Site will be conveyed via proposed private swale, overland flow, and private curb and gutter to the proposed private inlets, conveyed in the proposed private inlets, detained in the proposed private pond, and released at or below historic rates. Flows captured and detained will be discharged to the existing 48" RCP that drains to the existing 8' x 6' box culvert that crosses Grinnell Boulevard.

Since the Colorado Springs Airport and Industrial Park improvements include onsite detention facilities that release flows at or below historic rates, a proposed 48" RCP stormline will convey flows from the existing dual 8' x 3' box culvert that crosses Powers Boulevard to the existing Grinnell Boulevard box culvert, consistent with the Waterview MDDP and MDDP Amendment.

Specific Site hydrologic and hydraulic calculations can be found in Appendix C and D of this report, respectively. An existing and proposed drainage plan can be found in Appendix F.

B. Specific Details

Discuss the channel in EX-1. The soils and geology report states the channel has signs of erosion.

Discuss the existing erosion and sedimentation on the property.

Existing Conditions Sub-

The entire project Site is presently undeveloped land and includes a rough drainage channel that extends from the existing dual 8' x 3' box culvert crossing Powers Boulevard to the existing 8' x 6' box culvert that crosses Grinnell Boulevard. The general stormwater flow pattern for all subbasins is generally sheet flow across the existing open land, toward facilities that ultimately discharge to Windmill Gulch. Runoff from the Site generally flows northeast to southwest. For existing conditions, the Site and relevant offsite areas were subdivided into six (6) subbasins, described in more detail below. An Existing Conditions Drainage Map can be found in Appendix F. Calculations can be found in Appendix B.

Subbasin EX-1 (16.51 acres) is comprised of vacant, undeveloped land, primarily covered with grasses and weeds and a portion of existing Grinnell Boulevard. Runoff from this subbasin flows south, southwest, and northwest toward the existing 8' x 6' box culvert that crosses Grinnell Boulevard at Design Point 1. The minor and major historic peak flows for this subbasin were computed to be 6.39 cfs and 39.31 cfs, respectively.

Discuss the condition of the box culvert.

Subbasin EX-2 (1.65 acres) is comprised of vacant, undeveloped land covered with grasses and weeds and a portion of existing Grinnell Boulevard. Runoff from this subbasin flows southeast, northwest, and southwest to the existing 24" flared end section (FES) at Design Point 2 that empties into the existing storm system along Goldfield Drive. Runoff from the system ultimately discharges to the existing water quality and detention pond that provides detention for the Painted Sky at Waterview Filing No. 1 and 2 and Springs

Discuss where the flows go after entering the 24" FES. Are they connecting to the RCP and then going to design point 4?

Provide discussion on the current conditions of the FES.

at Waterview subdivisions. The minor and major historic peak flows for this subbasin were computed to be 0.85 cfs and 4.58 cfs, respectively.

Subbasin EX-3 (1.54 acres) consists of part of existing Grinnell Boulevard, just south of the intersection with Powers Boulevard. Runoff from this subbasin generally drains southeast to an existing roadside swale that empties into an existing grated inlet at Design Point 3. Flows captured in the inlet are tributary to the existing water quality and detention facility on the west side of Grinnell Boulevard. The minor and major historic peak flows for this subbasin were computed to be 5.20 and 10.00 cfs, respectively.

Subbasin EX-4 (1.93 acres) consists of the north half of Goldfield Drive and a portion of the existing vacant, undeveloped Site. While Site topography does not extend the full limits of this basin, the exiting limits east of the Site were taken from the Painted Sky at Waterview Filing No. 1 and 2 drainage maps. Runoff from this subbasin generally drains west and southwest to the existing 15' Type R inlet along Goldfield Drive at Design Point 4. Flows captured in this inlet are tributary to the existing water quality and detention pond that provides detention for the Painted Sky at Waterview Filing No. 1 and 2 and Springs at Waterview subdivisions. The minor and major historic peak flows for this subbasin were computed to be 4.39 cfs and 9.18 cfs, respectively.

Subbasin EX-5 (0.32 acre) consists of a portion of existing Cudahy Drive. Runoff from this subbasin generally drains south to the existing 10' Type R inlet at Design Point 5. Flows captured in this inlet combine with flows captured in the existing 5' Type R Inlet on the east side of Cudahy Drive and the detention outflow from the existing water quality and detention pond that serves Painted Sky at Waterview Filing No. 3 and continue via existing 48" RCP along the southern and western boundaries of the Site before discharging to the existing 8' x 6' box culvert at Grinnell Boulevard. The minor and major historic peak flows for this subbasin were computed to be 1.45 cfs and 2.61 cfs, respectively.

Subbasin EX-6 (0.23 acre) consists of part of existing Cudahy Drive. Runoff from this subbasin generally drains south to the existing 15' Type R inlet at Design Point 6. Flows captured in this inlet drain to the existing water quality and detention pond for Painted Sky at Waterview Filing No. 3. The minor and major historic peak flows for this subbasin were computed to be 0.90 cfs and 1.71 cfs, respectively.

Proposed Conditions Sub-Basin Descriptions

As previously noted, the Site currently drains generally northeast to southwest. Development of the Site will not change he general drainage patterns: To the maximum extent practical, design storm runoff from the Site has been designed to be captured via proposed private inlets, conveyed via proposed private pipes to a proposed private on-site water quality and detention facility, detained, and released at or below historic rates to the existing 8' x 6' box culvert that crosses Grinnell Boulevard. A Proposed Drainage Plan is included in Appendix F, for reference.

The Site was subdivided into twenty-three (23) subbasins and eight (8) offsite tributary basins. All on-site subbasins except subbasins R-1 and R-2 are tributary to the proposed on-site water quality and detention pond. Subbasin OS-3 is tributary to the existing water quality and detention pond west of Grinnell Boulevard that serves the Powers Boulevard and Grinnell Boulevard intersection improvements. Subbasin OS-2 and subbasin R-1 are tributary to the existing water quality and detention pond southwest of the Site that serves Painted Sky at Waterview Filing No. 1 and 2 and the Springs at Waterview subdivision. Subbasin OS-5 is tributary to the existing water quality and detention pond east of the Site that serves Painted Sky at Waterview Filing No. 3.

Subbasin A-1 (0.74 acre) consists of the proposed on-site private water quality and detention pond. Runoff from the subbasin is conveyed north, south, and west via overland flow and proposed concrete trickle channel to the proposed pond outlet structure. The minor and major peak flow rates for the subbasin were calculated to be 0.87 cfs and 2.60 cfs, respectively.

Subbasin A-2 (0.48 acre) consists of private drive, walk, parking, and landscape area. Runoff from the subbasin is conveyed south and southwest via overland flow and curb and gutter to the proposed 5' Type R sump inlet at Design Point 5. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided to the west to the proposed water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 1.79 cfs and 3.44 cfs, respectively.

Subbasin B-1 (0.39 acre) consists of private drive, walk, parking, and landscape area. Runoff from the subbasin is conveyed south and southwest via overland flow and curb and gutter to the proposed 10' Type R sump inlet at Design Point 11. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided to the south to Goldfield Drive. The minor and major peak flow rates for the subbasin were calculated to be 1.28 cfs and 2.58 cfs, respectively.

Subbasin B-2 (0.70 acre) consists of the part of the proposed clubhouse, pool deck, and landscape area. Runoff from the subbasin is conveyed south and west via overland flow and proposed grass-lined swale to the proposed Type C inlet at Design Point 12. The minor and major peak flow rates for the subbasin were calculated to be 1.23 cfs and 2.89 cfs, respectively.

Subbasin C-1 (0.92 acre) consists of private drive, walk, parking, garage, and landscape area. Runoff from this subbasin is conveyed via overland flow and curb and gutter southwest and west to the proposed 10' Type R sump inlet at Design Point 3. In the event the inlet at this location becomes clogged and overflows, an emergency overflow path is provided to the west toward the proposed onsite water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 2.93 cfs and 5.95 cfs, respectively.

Subbasin C-2 (0.06 acre) consists of private drive, walk, garage, and parking area. Runoff from this subbasin is conveyed via overland flow and curb and gutter south to the proposed 5' Type R sump inlet at Design Point 14. In the event the inlet at this location becomes clogged and overflows, an emergency overflow path is provided to the west toward the proposed onsite water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 0.23 cfs and 0.43 cfs, respectively.

Subbasin D (0.19 acre) consists of private drive, walk, building, and parking area. Runoff from this subbasin is conveyed via overland flow and curb and gutter northwest to the proposed 5' Type R sump inlet at Design Point 10. Should the inlet become clogged and overflow, an emergency overflow path is provided to the west to Grinnell Drive. The minor and major peak flow rates for the subbasin were calculated to be 0.66 cfs and 1.31 cfs, respectively.

Subbasin E (0.68 acre) consists of building, walk, and landscape area. Runoff from this subbasin will be conveyed via overland flow and roof drain flow to the proposed grass-lined swale where flows continue west and east to the proposed Type C inlet at Design Point 7. The minor and major peak flow rates for the subbasin were calculated to be 1.09 cfs and 2.61 cfs, respectively.

Subbasin F (0.91 acre) consists of building, private drive, walk, parking, and landscape area. Runoff from the subbasin will be conveyed via overland flow and curb and gutter north, south, east, and west to the proposed 5' Type R sump inlet at Design Point 9. In the event the inlet at this location becomes clogged and overflows, an emergency overflow path is provided east toward Design Point 8. The minor and major peak flow rates for the subbasin were calculated to be 3.38 cfs and 6.47 cfs, respectively.

Subbasin G (0.22 acre) consists of garage, private drive, walk, parking, and landscape area. Runoff from the subbasin will drain via overland flow and curb and gutter north and south to the proposed 5' Type R sump inlet at Design Point 8. In the event the inlet at this location becomes clogged and overflows, an emergency overflow path is provided to the east where flows will continue south along the private drive toward Design Point 11 and ultimately Goldfield Drive. The minor and major peak flow rates for the subbasin were calculated to be 1.01 cfs and 1.81 cfs, respectively.

Subbasin H-1 (1.32 acres) consists of building, private drive, walk, parking, and landscape areas. Runoff from this subbasin will drain via overland flow and curb and gutter east and south to the proposed Double Type 13 sump inlet at Design Point 25. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided to the east to Design Point 23. The minor and major peak flow rates for the subbasin were calculated to be 4.87 cfs and 9.37 cfs, respectively.

Subbasin H-2 (1.73 acres) consists of building, garage, private drive, walk, parking, and landscape areas. Runoff from this subbasin will drain via overland flow and curb and gutter west and southwest to the proposed 5' Type R sump inlet at Design Point 23. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided to the south along the private drive toward Design Point 5 and the proposed onsite private water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 4.67 cfs and 9.39 cfs, respectively.

Subbasin J (0.31 acre) consists of private drive, walk, garage, and landscaping areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter west and southwest to the proposed 10' Type R sump inlet at Design Point 16. In the event the inlet at this location becomes clogged and overflows, an emergency overflow path is provided to the southwest toward Design Point 5 and the proposed onsite private water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 1.00 cfs and 2.02 cfs, respectively.

Subbasin K-1 (0.19 acre) consists of building, private drive, walk, and landscaping areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter east, southwest, and south to the proposed 5' Type R sump inlet at Design Point 17. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided to the south to the private access drive toward Design Point 16. The minor and major peak flow rates for the subbasin were calculated to be 0.59 cfs and 1.20 cfs, respectively.

Subbasin K-2 (0.59 acre) consists of building, garage, private drive, walk, and landscaping areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter east, west, north, and south to the proposed Double Type 13 sump inlet at Design Point 21. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided south toward Design Point 17. The minor and major peak flow rates for the subbasin were calculated to be 2.15 cfs and 4.13 cfs, respectively.

Subbasin L-1 (0.21 acre) consists of garage, private drive, walk, and landscaping areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter north, east, west, and south to the proposed 5' Type R sump inlet at Design Point 19. In the event the inlet at this location becomes clogged and overflows, an emergency overflow path is provided to the south toward the private access drive and Design Point 16. The minor and major peak flow rates for the subbasin were calculated to be 0.55 cfs and 1.19 cfs, respectively.

Subbasin L-2 (0.51 acre) consists of garage, private drive, walk, and landscaping areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter east, west, north, and south to the proposed 5' Type R sump inlet at Design Point 22. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided to the south toward Design Point 19. The minor and major peak flow rates for the subbasin were calculated to be 1.33 cfs and 2.84 cfs, respectively.

Subbasin M (1.08 acre) consists of building and landscaping area. Runoff from this subbasin will be conveyed via overland flow and roof drain flow southeast, south, and north to the proposed grass-lined swale within the subbasin where flows will continue east to the proposed Type C inlet at Design Point 27. The minor and major peak flow rates for the subbasin were calculated to be 1.83 cfs and 4.27 cfs, respectively.

Subbasin N-1 (0.68 acre) consists of private drive, walk, parking, and landscaping areas. Runoff from the subbasin will be conveyed via overland flow and curb and gutter south and west to the proposed Double Type 13 sump inlet at Design Point 33. Should the inlet within the subbasin become clogged and overflow, an emergency overflow path is provided east toward the center private access drive and ultimately the onsite water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 1.89 cfs and 4.08 cfs, respectively.

Subbasin N-2 (0.35 acre) consists of private drive, walk, and landscaping areas. Runoff from the subbasin will be conveyed via overland flow and curb and gutter southwest and west to the proposed 5' Type R sump inlet at Design Point 32. Should the inlet at this location become clogged and overflow, an emergency overflow path is provided south and west toward the center private access drive and ultimately the onsite water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 1.29 cfs and 2.49 cfs, respectively.

Subbasin P (2.80 acres) consists of building and landscape area. Runoff from this subbasin will be conveyed via overland flow southwest and southeast and roof drain flow north to the two proposed swales within the subbasin where flows will continue east and west to the proposed Type C inlet at Design Point 30. The minor and major peak flow rates for the subbasin were calculated to be 2.54 cfs and 8.24 cfs, respectively.

Subbasin Q (0.48 acre) consists of private drive, walk, and landscape areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter southwest, southeast, east, and west to the proposed 5' Type R sump inlet at Design Point 35. In the event the inlet at this location becomes clogged and overflows, an emergency overflow for the subbasin will be provided to the southwest toward the center private access drive and ultimately the proposed onsite water quality and detention pond. The minor and major peak flow rates for the subbasin were calculated to be 1.85 cfs and 3.52 cfs, respectively.

Subbasin R-1 (1.02 acres) consists of private drive, walk, and landscaping areas. Runoff from this subbasin will be conveyed via overland flow and curb and gutter west and south to sub-basin OS-2 where flows continue to the existing 15' Type R sump inlet at Design Point 38. The minor and major peak flow rates for the subbasin were calculated to be 1.23 cfs and 3.98 cfs, respectively.

Subbasin R-2 (0.03 acre) consists of private drive, walk, and landscape areas. Runoff from the subbasin will be conveyed via overland flow southeast to sub-basin OS-4 where flows continue to the existing 10' Type R sump inlet at Design Point 39. Subbasin R-2 is the only onsite subbasin that does not receive water quality treatment. The minor and major peak flow rates for the subbasin were calculated to be 0.10 cfs and 0.20 cfs, respectively.

Subbasin OS-1 (0.44 acre) consists of a portion of existing Powers Boulevard that is directly tributary to the Site. Runoff from the subbasin drains via overland flow south to subbasin P where flows continue to the proposed Type C inlet at Design Point 30. The minor and major peak flow rates for the subbasin were calculated to be 0.73 cfs and 1.95 cfs, respectively.

Subbasin OS-2 (2.12 acres) consists of a portion of Grinnell Boulevard and Goldfield Drive. Runoff from the subbasin drains south and west and via overland flow and curb and gutter to the existing 15' Type R inlet at Design Point 38 where flows will continue south and west via existing storm sewer to the existing water

Drainage map says 2.15, verify and update so both match.

quality and detention facility that serves Painted Sky at Waterview Filing No. 1 and 2 and the Springs at Waterview subdivision. The minor and major peak flow rates for the subbasin were calculated to be 5.95 cfs and 11.77 cfs, respectively.

Subbasin OS-3 (1.45 acres) consists of part of Grinnell Boulevard, just south of the intersection with Powers Boulevard. Runoff is conveyed via overland flow and curb and gutter southeast and south to the proposed 15' Type R on-grade inlet at Design Point 37. Runoff captured in this inlet is conveyed via existing storm sewer southwest to the existing water quality and detention facility on the west side of Grinnell Boulevard. The minor and major peak flow rates for the subbasin were calculated to be 5.71 cfs and 10.53 cfs, respectively.

Subbasin OS-4 (0.34 acre) consists of part of existing Cudahy Drive. Runoff is conveyed south via overland flow and curb and gutter to the existing 10' Type R inlet at design point 39. Runoff from this subbasin is conveyed to the existing 8' x 6' box culvert at Grinnell Boulevard via the proposed 48" RCP storm reroute, consistent with existing drainage patterns. The minor and major peak flow rates for the subbasin were calculated to be 1.50 cfs and 2.73 cfs, respectively.

Subbasin OS-5 (0.21 acre) consists of part of existing Cudahy Drive. Runoff is conveyed south via overland flow and curb and gutter to the existing 15' Type R inlet at Design Point 40. Flows captured at this inlet are directly tributary to the existing Painted Sky at Waterview Filing No. 3 detention pond. The minor and major peak flow rates for this subbasin were calculated to be 0.81 cfs and 1.54 cfs, respectively.

Subbasin OS-6 (0.16 acre) consists of a portion of the landscaping area within the Grinnell Boulevard right-of-way. Runoff from the subbasin drains southeast via overland flow to subbasin N-1 where flows continue to the proposed double Type 13 sump inlet at Design Point 13. The minor and major peak flow rates for this subbasin were calculated to be 0.07 cfs and 0.49 cfs, respectively.

Subbasin OS-7 (0.07 acre) consists of a portion of the landscaping area within the Grinnell Boulevard right-of-way. Runoff from the subbasin drains southeast via overland flow to subbasin M where flows will continue to the proposed Type C inlet at Design Point 27. The minor and major peak flow rates for this subbasin were calculated to be 0.03 cfs and 0.21 cfs, respectively.

Subbasin OS-8 (0.18 acre) consists of a portion of the landscape area within the Grinnell Boulevard right-of-way. Runoff from this subbasin drains southeast via overland flow to subbasin P where flows will continue to the proposed Type C inlet at Design Point 30. The minor and major peak flow rates for this subbasin were calculated to be 0.07 cfs and 0.51 cfs, respectively.

need to include areas along Grinnell south of Goldfield, where Grinnell is being widened.

C. Full Spectrum Detention

Previous studies have utilized empirical equations and outdated modeling methods to determine required storage volumes. The Mile High Flood District (MHFD) continues to innovate the process of stormwater detention for attenuation of a full range of storm events. Full Spectrum Detention, using the MHFD-Detention workbook, was the method chosen to determine the storage volumes and release rates for this study. This design reduces the runoff from a developed site to lower than pre-developed flowrates. The planned outfall for the Site is the existing 48" RCP along the west side of the site that outfalls to the existing 8' x 6' Grinnell Boulevard box culvert.

One private extended detention basin (EDB) is proposed on-site. The pond was sized for 16.39 acres at 55.3% impervious. The approximate pond footprint was determined to be 0.44 acre. The pond includes a concrete forebay to slowly release developed Site flows into the pond, a 4-foot-wide concrete trickle channel sloped at 0.75% to slowly convey flows to the proposed outlet structure, and a 15' wide

Verify imperviousness. The site appears to have a majority of impervious surfaces. This percentage should only include areas that drain to the pond.

A 48" RCP is significantly smaller than 2-8'x3' box culverts. This area has seen large flows that have caused the significant erosion across the entire project site. Verify.

maintenance access road that extends from the parking area within subbasin H-1 to the proposed forebay and outlet structures.

The Pond includes storage for water quality capture volume (WQCV), excess urban runoff volume (EURV), and 100-year storm events. The emergency overflow spillway has been designed such that the crest is set at or above the 100-year ponding depth. The outlet structure has been designed to release the minor and major storm events at reduced rates. The Pond has been designed for its release rates to adhere to state statute by releasing the 5-year event in under 72-hours and the 100-year event in under 120 hours.

The emergency overflow spillway has been designed with 1’ minimum freeboard. From the outlet structure, the treated and detained runoff will drain via proposed 18” RCP to the existing 48” RCP and ultimately the existing Grinnell Boulevard box culvert.

Printouts of the MHFD-Detention spreadsheet for the Pond and associated calculations are included in Appendix D, for reference.

D. Downstream Drainage Facilities

As previously indicated, runoff from the majority of the proposed development will be released at or below historic levels to the existing 48” RCP within the Site and ultimately the existing 8’ x 6’ box culvert at Grinnell Boulevard that discharges toward Windmill Gulch. Additionally, a proposed 48” RCP will convey historic flow rates from the existing dual 8’ x 3’ dual box culvert at Powers Boulevard to the existing Grinnell Boulevard box culvert, which is in compliance with the Waterview MDDP, MDDP Amendment, and Colorado Springs and Peak Innovation Park report. Further, the existing detention outflow from the existing Painted Sky at Waterview Filing No. 3 detention pond will continue to release at or below historic rates to the existing Grinnell Boulevard box culvert. Since all flows tributary to the existing box culvert are at or below historic levels, no adverse impacts are anticipated downstream of the existing culvert to Windmill Gulch. Provide an analysis of this existing culvert with developed flows

discuss downstream conditions and any necessary modifications. Pond must discharge to a suitable outfall. Existing outfall is not considered suitable since the blowout in 2022.

While the report for the existing water quality and detention facility that serves the Grinnell Boulevard and Powers Boulevard intersection improvements has not been located at the time of this report, it is assumed that the existing facility has adequate capacity for the flows captured at the proposed 15’ Type R inlet at Design Point 37 as it is in place of the existing grate inlet at the location. discuss if the flows are changing at this location

The Painted Sky at Waterview Filing No. 1 & 2 Final Drainage report anticipated the total 100-year runoff at the existing 15’ Type R sump inlet at Design Point 38 (Painted Sky at Waterview Filing No. 1 & 2 Design Point 39) to be 29.0 cfs. The report assumed a much higher impervious value for the portion of the Site and Grinnell Boulevard tributary to the inlet than the actual conditions proposed with the Outlook Powers and Grinnell development. Per this report, the actual 100-year flow conveyed to the existing inlet is 15.13 cfs. This indicates that the downstream existing storm sewer from the inlet has adequate capacity to convey the developed flows to the existing detention facility that serves Painted Sky at Waterview Filing No. 1 and 2 and the Springs at Waterview subdivision.

Engineer must confirm in the Drainage Report that the existing pond is functioning as intended.

VII. DRAINAGE BASIN FEES

The City of Colorado Springs and El Paso County entered into an intergovernmental agreement in 1983 to establish a joint storm drainage board to establish Drainage Basin Fees for each of the 13 major drainage basins within the County. The Drainage Basin Fees represent the equitable share of the cost of drainage improvements within each of the respective basins. According to the 2022 El Paso County Drainage Basin Fees schedule, the drainage fee for developments within Windmill Gulch is $21,134 per Impervious Acre

Please revise drainage basin fee calculation. The 2023 El Paso County Drainage Basin Fees schedule shall be used.

https://assets-planningdevelopment.elpasoco.com/wp-content/uploads/fees/2023-DFees.pdf

$23,078

while the bridge fee for developments within Windmill Gulch is $317 per Impervious Acre. The Site occupies approximately 16.59 acres at 54.9% imperviousness, which is equivalent to 9.11 impervious acres.

The drainage basin and bride fees for Outlook Powers and Grinnell are:

Drainage Basin Fees: 9.11 AC X $21,134/ AC = $192,531

Bridge Fees: 9.11 AC X $317/ AC = $2,888

$346

VIII. CONSTRUCTION COST OPINION

All storm sewer within the Site will be owned and maintained by Evergreen or the current property owner. Maintenance requirements for all best management practices shall be in accordance with the DCM and MHFD USDCM. An opinion of probably cost can be found in Appendix E.

IX. CONCULSION

A. Compliance with Standards

This Final Drainage Report for Outlook Powers and Grinnell and its findings are in general conformance with the El Paso County DCM, The Mile High Flood District USDCM, the Windmill Gulch Drainage Basin Planning Study, the Waterview MDDP, Waterview MDDP amendment, and other pertinent drainage studies.

B. Summary

Currently, the Site is nearly all pervious, and flows are otherwise undetained and untreated. The existing 48” RCP within the Site, will convey treated, developed runoff from the proposed private full spectrum EDB to the existing 8’ x 6’ box culvert at Grinnell Boulevard that discharges toward Windmill Gulch. No adverse impacts to the surrounding drainage facilities are anticipated.

downstream

Update sentence to include the pond as being maintained/owned by property owner.

X. LIST OF REFERENCES

1. *Drainage Criteria Manual, Volumes 1 and 2*, El Paso County, Colorado, Revised October 31, 2018.
2. *Urban Storm Drainage Criteria Manual (USDCM)*, Mile High Flood District (MHFD, formerly known as Urban Drainage and Flood Control District, UDFCD):

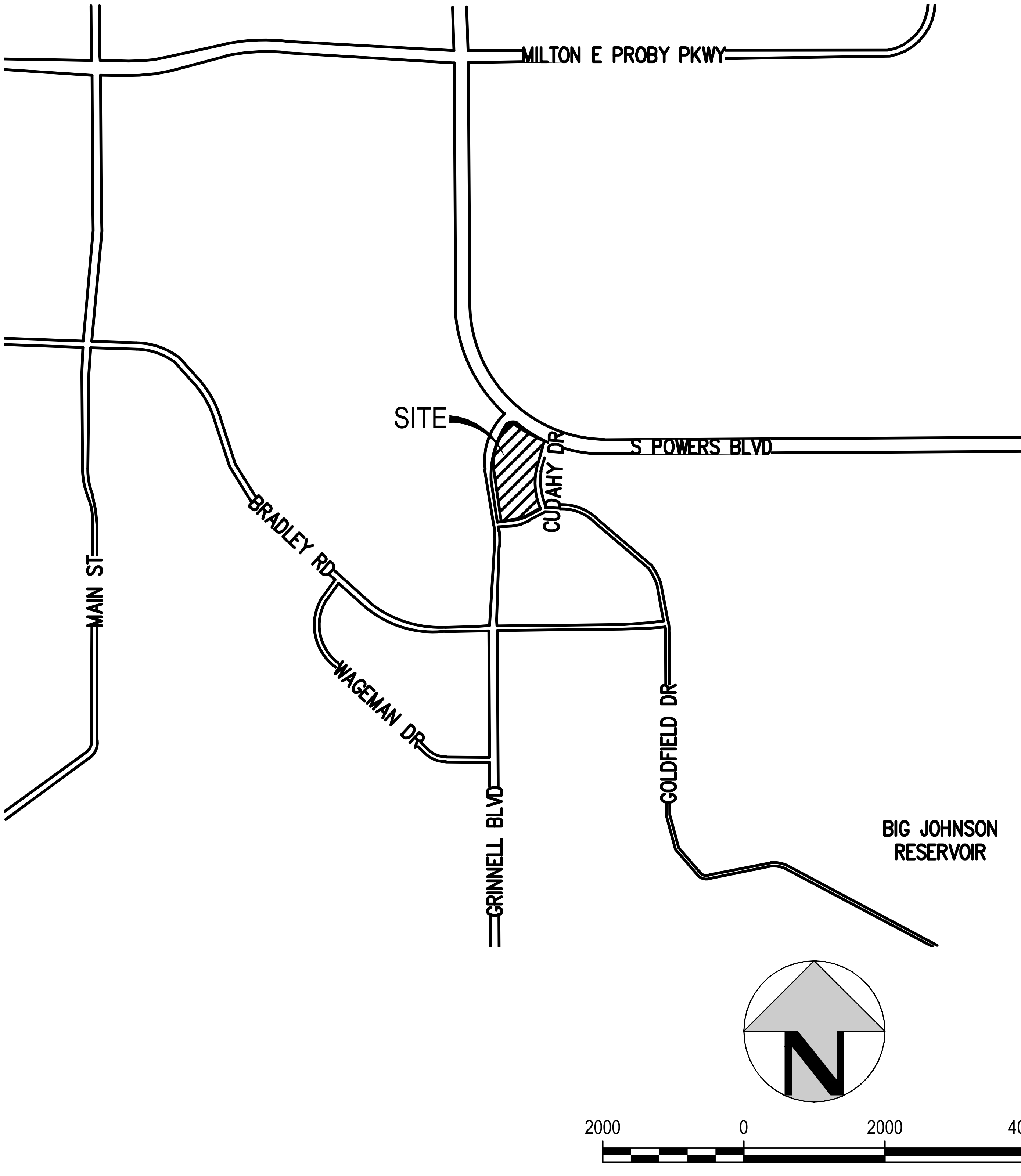
   Volume 1, Management, Hydrology and Hydraulics, Revised August 2018.

   Volume 2, Structures, Storage and Recreation, Revised September 2017.

   Volume 3, Stormwater Quality, Updated October 2019.
3. Drainage Design Manual, Colorado Department of Transportation, 2019.
4. *FIRM, Flood Insurance Rate Map, El Paso County, Colorado, and Incorporated Areas, Map Numbers 08041C0763G and 08041C0764G*, U.S. Department of Homeland Security, Federal Emergency Management Agency (FEMA), National Flood Insurance Program (NFIP), effective December 7, 2018.
5. *Master Development Drainage Plan for Waterview*, Merrick & Company, Revised May, 2006.
6. *Amendment to Waterview (West) Drainage Development Plan,* Springs Engineering, July 7, 2013.
7. *Windmill Gulch Drainage Basin Planning Study,* Wilson & Company, revised February 1992.
8. *Colorado Springs Airport Peak Innovation Park Master Development Drainage Plan,* Engenuity, August 2020.
9. *Final Drainage Report for Painted Sky at Waterview Filings 1 and 2,* Merrick and Company, January 2007.
10. *Painted Sky at Waterview Filing No. 3 Final Drainage Report,* Springs Engineering, Amended March 2012.
11. *Springs at Waterview Preliminary and Final Drainage Report,* Dakota Springs Engineering, May 2018.

APPENDIX A

Vicinity Map, FIRM Map, and Runoff Information



Plotted: MON 05/01/23 5:30:52P By: Amanda Casteel Filepath: j:\221206\engineering\xref\vic map.dwg Layout: layout1

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EVERGREEN DEVCO

OUTLOOK POWERS & GRINNELL

VICINITY MAP

PROJECT #: 221206

SHEET NUMBER

1

National Flood Hazard Layer FIRMette

FEMA

104°43'23"W 38°46'9"N

104°42'46"W 38°45'41"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 — Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/1/2022 at 6:58 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Use NOAA Atlas 2 per El Paso County DCM

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7654°, Longitude: -104.7184°
Elevation: 5893.94 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.245 (0.204-0.299)	0.295 (0.245-0.360)	0.384 (0.317-0.469)	0.463 (0.380-0.569)	0.581 (0.463-0.752)	0.680 (0.526-0.890)	0.785 (0.584-1.06)	0.898 (0.637-1.24)	1.06 (0.718-1.51)	1.19 (0.778-1.71)
10-min	0.359 (0.298-0.438)	0.432 (0.358-0.528)	0.562 (0.464-0.687)	0.678 (0.556-0.834)	0.851 (0.678-1.10)	0.996 (0.770-1.30)	1.15 (0.855-1.55)	1.32 (0.933-1.82)	1.55 (1.05-2.21)	1.74 (1.14-2.50)
15-min	0.438 (0.364-0.534)	0.527 (0.437-0.643)	0.685 (0.566-0.838)	0.827 (0.679-1.02)	1.04 (0.827-1.34)	1.21 (0.939-1.59)	1.40 (1.04-1.88)	1.60 (1.14-2.22)	1.89 (1.28-2.69)	2.12 (1.39-3.05)
30-min	0.657 (0.545-0.801)	0.789 (0.654-0.962)	1.02 (0.845-1.25)	1.23 (1.01-1.52)	1.55 (1.23-2.00)	1.81 (1.40-2.37)	2.09 (1.56-2.81)	2.39 (1.70-3.31)	2.82 (1.91-4.02)	3.16 (2.08-4.55)
60-min	0.863 (0.716-1.05)	1.01 (0.839-1.24)	1.29 (1.07-1.58)	1.56 (1.28-1.92)	1.98 (1.59-2.59)	2.35 (1.82-3.09)	2.74 (2.05-3.71)	3.19 (2.27-4.43)	3.83 (2.60-5.47)	4.35 (2.86-6.26)
2-hr	1.07 (0.894-1.30)	1.24 (1.03-1.50)	1.56 (1.30-1.90)	1.89 (1.56-2.31)	2.41 (1.96-3.15)	2.88 (2.26-3.79)	3.40 (2.56-4.59)	3.98 (2.86-5.52)	4.83 (3.32-6.89)	5.54 (3.67-7.92)
3-hr	1.17 (0.985-1.42)	1.33 (1.12-1.61)	1.67 (1.40-2.03)	2.02 (1.68-2.46)	2.60 (2.13-3.41)	3.13 (2.48-4.13)	3.73 (2.83-5.04)	4.41 (3.20-6.12)	5.43 (3.75-7.73)	6.28 (4.18-8.94)
6-hr	1.33 (1.13-1.60)	1.50 (1.27-1.80)	1.87 (1.57-2.25)	2.26 (1.89-2.74)	2.93 (2.43-3.83)	3.55 (2.83-4.66)	4.26 (3.26-5.73)	5.07 (3.70-7.00)	6.27 (4.38-8.89)	7.30 (4.89-10.3)
12-hr	1.48 (1.26-1.76)	1.69 (1.44-2.01)	2.13 (1.80-2.54)	2.57 (2.16-3.09)	3.31 (2.75-4.27)	3.97 (3.18-5.16)	4.72 (3.64-6.29)	5.57 (4.09-7.62)	6.83 (4.80-9.59)	7.88 (5.33-11.1)
24-hr	1.65 (1.41-1.95)	1.91 (1.64-2.27)	2.43 (2.07-2.88)	2.92 (2.48-3.49)	3.72 (3.09-4.72)	4.41 (3.55-5.65)	5.17 (4.00-6.81)	6.03 (4.45-8.15)	7.27 (5.14-10.1)	8.29 (5.65-11.6)
2-day	1.87 (1.62-2.20)	2.19 (1.89-2.58)	2.78 (2.39-3.28)	3.33 (2.85-3.95)	4.18 (3.48-5.23)	4.90 (3.96-6.21)	5.68 (4.42-7.39)	6.54 (4.86-8.75)	7.77 (5.53-10.7)	8.78 (6.03-12.2)
3-day	2.03 (1.76-2.38)	2.38 (2.07-2.80)	3.02 (2.61-3.55)	3.60 (3.09-4.26)	4.49 (3.75-5.59)	5.23 (4.25-6.59)	6.04 (4.71-7.81)	6.91 (5.15-9.20)	8.15 (5.82-11.2)	9.16 (6.33-12.7)
4-day	2.17 (1.89-2.54)	2.55 (2.21-2.98)	3.21 (2.78-3.76)	3.82 (3.29-4.50)	4.73 (3.96-5.86)	5.50 (4.47-6.89)	6.32 (4.95-8.13)	7.20 (5.39-9.55)	8.46 (6.06-11.6)	9.48 (6.57-13.1)
7-day	2.55 (2.23-2.96)	2.95 (2.58-3.43)	3.67 (3.20-4.28)	4.31 (3.74-5.05)	5.28 (4.44-6.49)	6.09 (4.98-7.58)	6.95 (5.47-8.89)	7.87 (5.92-10.4)	9.19 (6.62-12.5)	10.2 (7.15-14.0)
10-day	2.88 (2.53-3.33)	3.31 (2.91-3.83)	4.07 (3.56-4.73)	4.75 (4.13-5.55)	5.77 (4.87-7.05)	6.61 (5.43-8.19)	7.50 (5.93-9.54)	8.46 (6.39-11.1)	9.80 (7.09-13.2)	10.9 (7.63-14.9)
20-day	3.77 (3.34-4.33)	4.32 (3.83-4.98)	5.27 (4.64-6.08)	6.08 (5.33-7.06)	7.25 (6.14-8.75)	8.19 (6.76-10.0)	9.16 (7.28-11.5)	10.2 (7.73-13.2)	11.6 (8.43-15.5)	12.7 (8.96-17.2)
30-day	4.51 (4.01-5.16)	5.18 (4.61-5.94)	6.30 (5.58-7.24)	7.23 (6.37-8.36)	8.54 (7.25-10.2)	9.56 (7.91-11.6)	10.6 (8.45-13.2)	11.6 (8.88-15.0)	13.1 (9.55-17.3)	14.2 (10.1-19.1)
45-day	5.46 (4.88-6.22)	6.29 (5.61-7.18)	7.63 (6.78-8.73)	8.72 (7.71-10.0)	10.2 (8.67-12.1)	11.3 (9.40-13.7)	12.4 (9.94-15.4)	13.5 (10.3-17.3)	15.0 (11.0-19.7)	16.0 (11.4-21.6)
60-day	6.28 (5.63-7.14)	7.24 (6.49-8.24)	8.77 (7.83-10.0)	10.0 (8.87-11.5)	11.6 (9.90-13.7)	12.8 (10.7-15.4)	14.0 (11.2-17.3)	15.1 (11.6-19.3)	16.6 (12.2-21.8)	17.6 (12.6-23.6)

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

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

Please refer to NOAA Atlas 14 document for more information.

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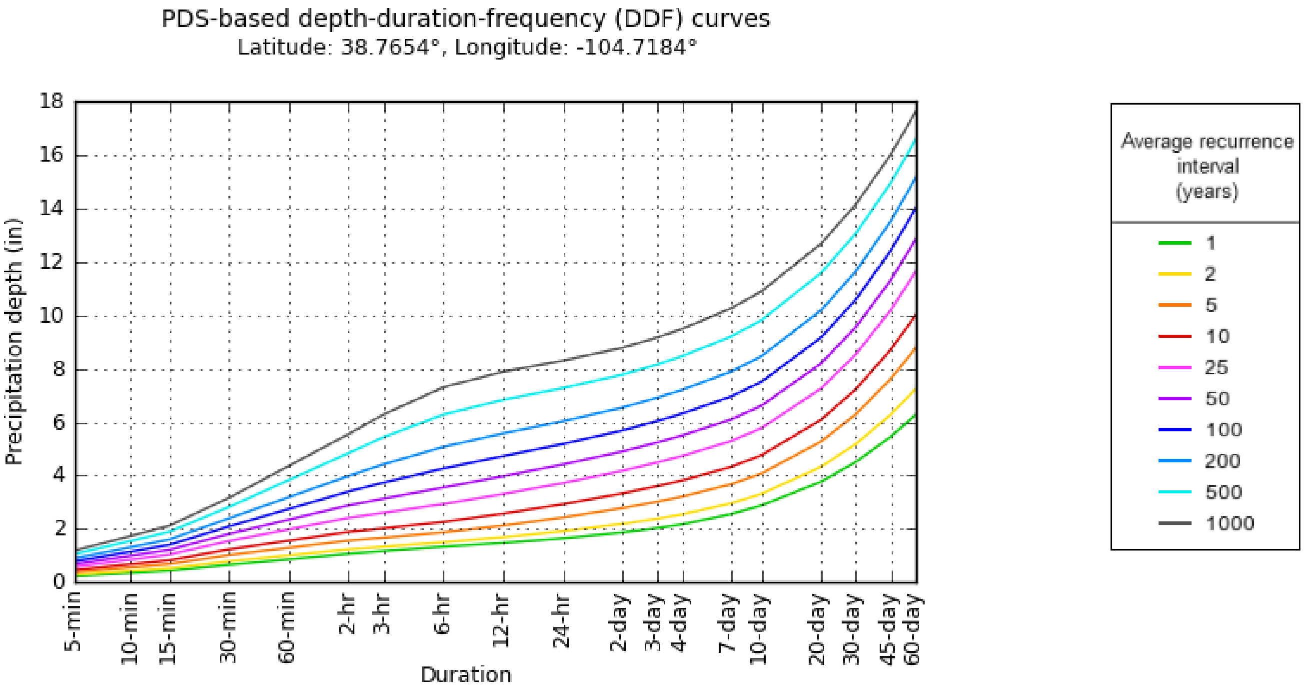
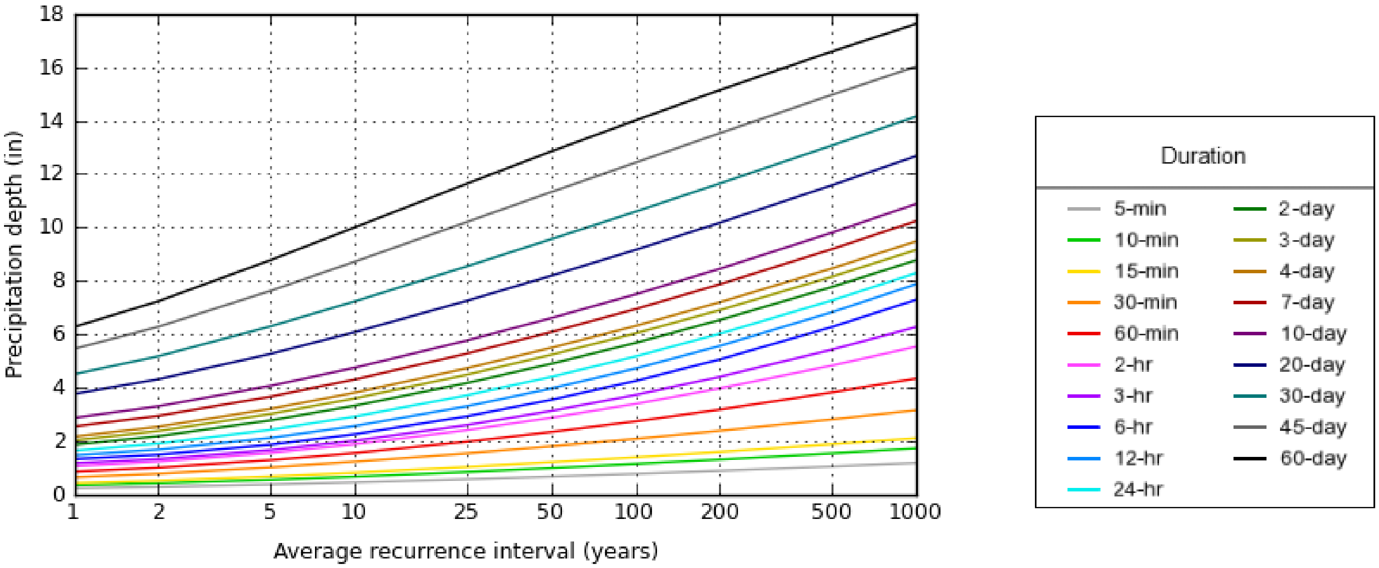
PF graphical





NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Mon Aug 1 22:42:17 2022

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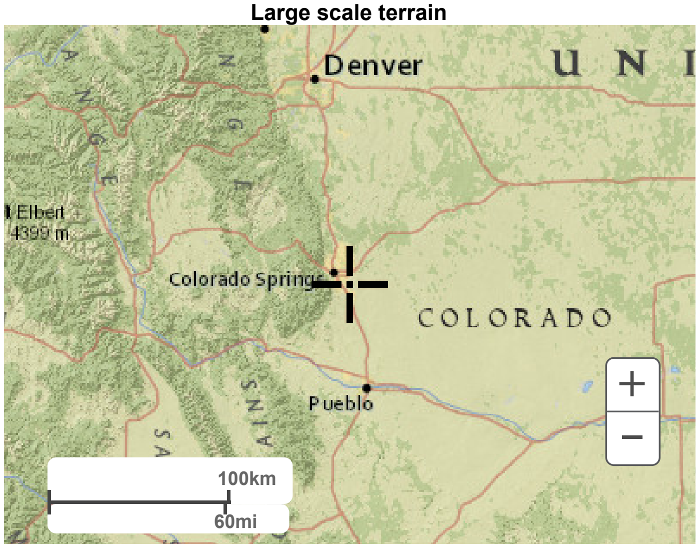
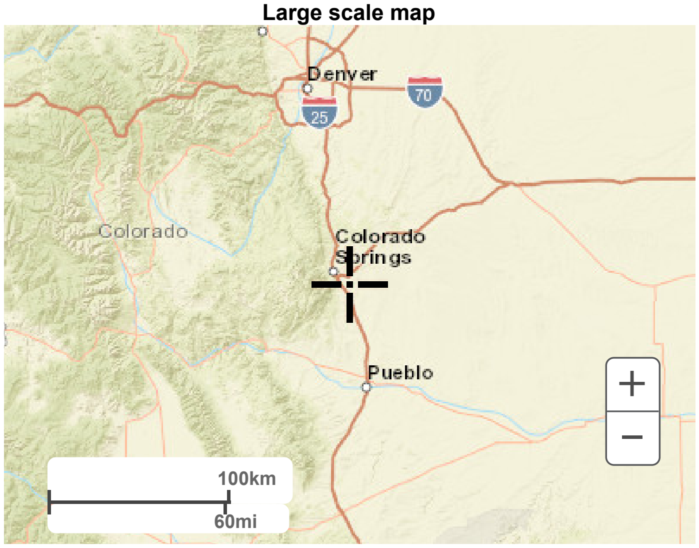
Maps & aerials

Small scale terrain

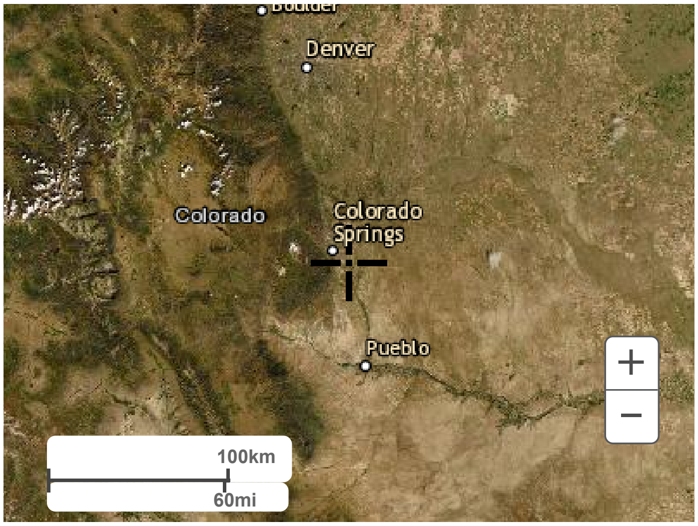
Large scale terrain



Large scale map



Large scale aerial



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

Disclaimer

APPENDIX B

NRCS Soils Map

United States Department of Agriculture

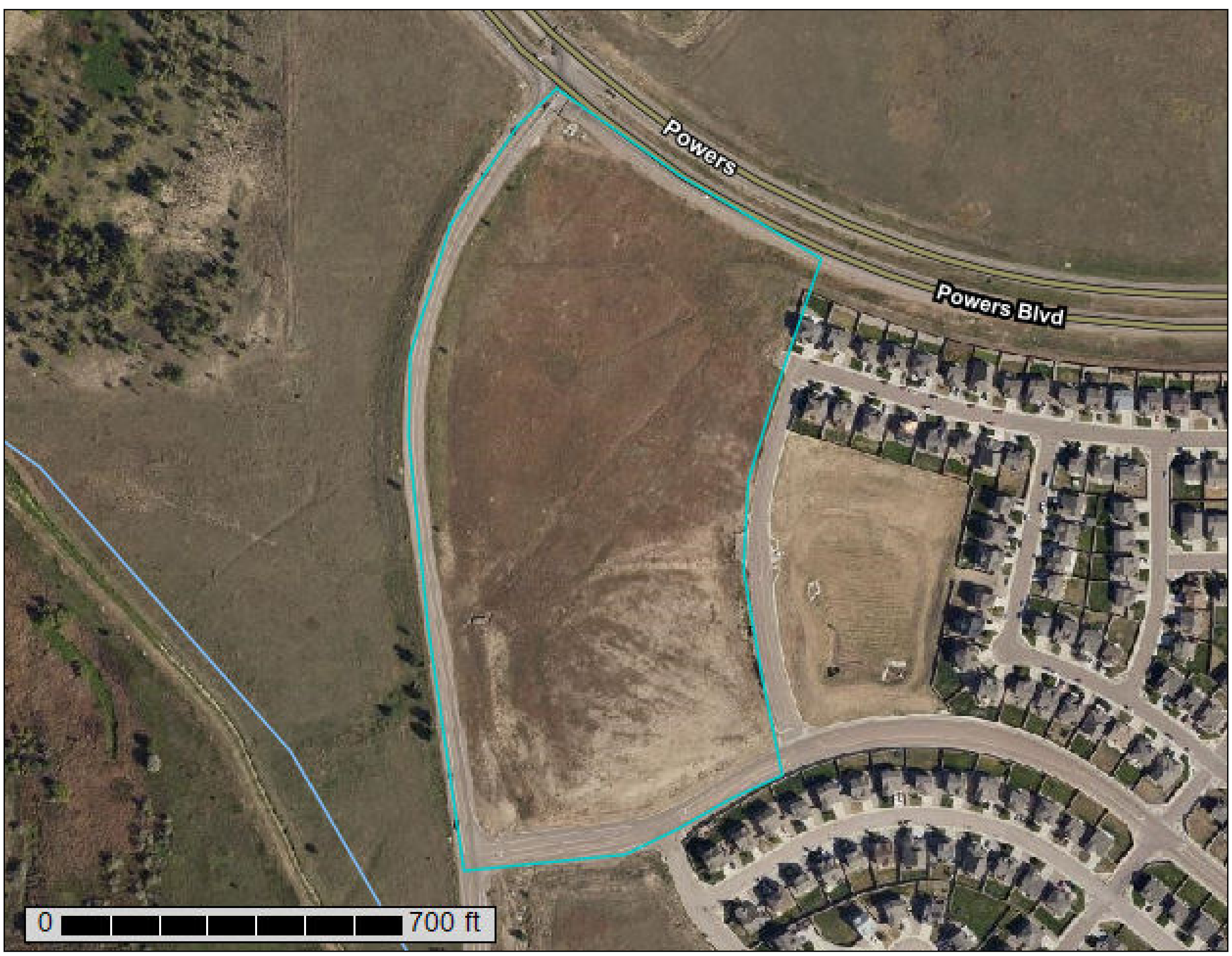
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado



July 29, 2022

Preface

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 (https://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).

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

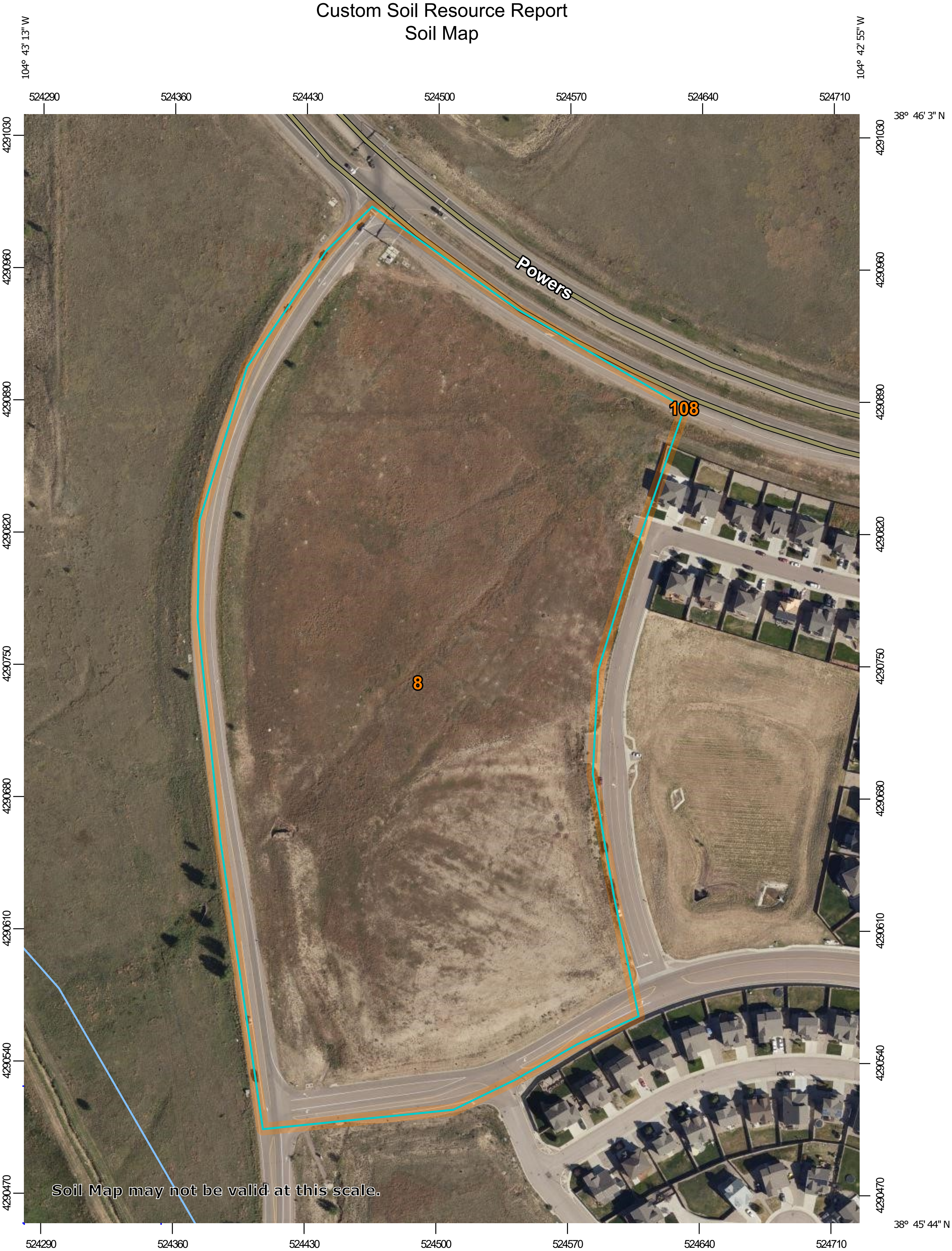
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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.

Soil Map



Map Scale: 1:2,860 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

N

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	22.5	100.0%
108	Wiley silt loam, 3 to 9 percent slopes	0.0	0.0%
Totals for Area of Interest		**22.5**	**100.0%**

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 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

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: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
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

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
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 content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent

Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

108—Wiley silt loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 367b
Elevation: 5,200 to 6,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Wiley and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wiley

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty eolian deposits

Typical profile

A - 0 to 4 inches: silt loam
Bt - 4 to 16 inches: silt loam
Bk - 16 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R067BY002CO - Loamy Plains
Other vegetative classification: LOAMY PLAINS (069AY006CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

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APPENDIX C

Hydrologic Computations

Project Name:	Powers & Grinnell
	Historic Composite C-Value Computations
	Pre-Development
Project No:	220501
Date:	05/08/23
Revised:	
Design by:	AMC
Checked by:	MAW

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

BASIN	TOTAL AREA (ACRES)	HISTORIC (2%)	PAVED STREETS & WALKS (100%)	GRAVEL ROAD (80%)	Offsite (45%)	LANDSCAPE AREA (A SOILS) (0%)	PERCENT IMPERVIOUS	C_2*=	C_5*=	C_{10}*=	C_{100}*=
EX-1	16.51	16.29	0.19	0.03	0.00	0.00	3.3%	0.04	0.10	0.18	0.37
EX-2	1.65	1.59	0.06	0.00	0.00	0.00	5.6%	0.06	0.12	0.20	0.38
EX-3	1.54	0.32	1.19	0.03	0.00	0.00	79.2%	0.71	0.73	0.76	0.83
EX-4	1.93	0.76	1.17	0.00	0.00	0.00	61.4%	0.55	0.58	0.62	0.72
EX-5	0.32	0.01	0.31	0.00	0.00	0.00	96.9%	0.86	0.87	0.90	0.94
EX-6	0.23	0.04	0.19	0.00	0.00	0.00	83.0%	0.74	0.76	0.79	0.86
Historic Total	22.18	19.01	3.11	0.06	0.00	0.00	16.0%	0.15	0.20	0.28	0.45

Add a note that Total Area includes off-site area.

*Runoff coefficients are weighted based on the land use breakdown of each basin, and the Runoff Coefficients provided in Table 6.6 of the City of Colorado Springs Drainage Criteria Manual, Volume 1, Revised January, 2021

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Include the composite C value equation being used.

Project Name: Powers & Grinnell
Project No: 221206
Date: 5/8/2023
Revised:

STANDARD FORM SF-2
TIME OF CONCENTRATION
(Pre-Development)

Designed By: AMC
Checked By: MAW

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK (URBANIZED BASINS)			FINAL	REMARKS
BASIN	AREA (AC)	C_5	LENGTH (FT)	SLOPE %	Ti (MIN)	LENGTH (FT)	SLOPE %	C_v	VELOCITY (FPS)	Tt (MIN)	COMPOS. Tc (MIN)	TOTAL LENGTH	Tc = (L/180) + 10 (MIN)	Tc (MIN)	
EX-1	16.51	0.10	100	9.91	8.53	732	5.60	15.00	3.55	3.44	11.97	832	14.62	11.97	
EX-2	1.65	0.12	61	13.12	5.95	359	2.03	15.00	2.14	2.80	8.75	420	12.33	8.75	
EX-3	1.54	0.73	100	4.38	4.19	516	4.07	15.00	3.03	2.84	7.04	616	13.42	7.04	
EX-4	1.93	0.58	37	2.00	4.59	1442	3.00	20.00	3.46	6.94	11.53	1,479	18.22	11.53	
EX-5	0.32	0.87	61	4.79	1.91	327	2.45	20.00	3.13	1.74	5.00	388	12.16	5.00	
EX-6	0.23	0.76	58	2.33	3.59	282	4.69	20.00	4.33	1.09	5.00	340	11.89	5.00	

Table RO-2—Conveyance Coefficient, C_v

Type of Land Surface	Conveyance Coefficient, C_v
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Revise to 1.5 per DCM Table 6-2

CALCULATED BY:	AMC	JOB NO:	221206
DATE:	05/08/23	PROJECT:	**Powers & Grinnell**
CHECKED BY:		DESIGN STO	5 YR
REVISED DATE:		PI	1.29 IN

STANDARD FORM SF-3

(Pre-Development)

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	T_c (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	REMARKS
EX-1	1	16.51	0.10	11.97	1.65	3.86	6.39																	Direct runoff to existing culvert at Grinnell Boulevard at DP 1
EX-2	2	1.65	0.12	8.75	0.20	4.33	0.85																	Direct runoff to Ex FES at DP 2
EX-3	3	1.54	0.73	7.04	1.12	4.66	5.20																	Direct runoff to EX Inlet at DP 3
EX-4	4	1.93	0.58	11.53	1.12	3.92	4.39																	Direct runoff to EX 15' Type R inlet at DP 4
EX-5	5	0.32	0.87	5.00	0.28	5.17	1.45																	Direct runoff to EX 10' Type R inlet at DP 5
EX-6	6	0.23	0.76	5.00	0.17	5.17	0.90																	Direct runoff to EX 15' Type R inlet at DP 6

CALCULATED BY: AMC
DATE: 05/08/23
CHECKED BY:
REVISED DATE:

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

JOB NO: 221206
PROJECT: **Powers & Grinnell**
DESIGN STO 100 YR
P1: 2.74 IN

Revise to 2.52 per Table 6-2 DCM.

		DIRECT RUNOFF							TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	T_c (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	REMARKS
EX-1	1	16.51	0.37	11.97	6.07	6.48	39.31																	Direct runoff to existing culvert at Grinnell Boulevard at DP 1
EX-2	2	1.65	0.38	8.75	0.63	7.27	4.58																	Direct runoff to Ex FES at DP 2
EX-3	3	1.54	0.83	7.04	1.28	7.82	10.00																	Direct runoff to EX Inlet at DP 3
EX-4	4	1.93	0.72	11.53	1.40	6.57	9.18																	Direct runoff to EX 15' Type R inlet at DP 4
EX-5	5	0.32	0.94	5.00	0.30	8.68	2.61																	Direct runoff to EX 10' Type R inlet at DP 5
EX-6	6	0.23	0.86	5.00	0.20	8.68	1.71																	Direct runoff to EX 15' Type R inlet at DP 6

The calculated percent impervious of the site excluding off-site basins is 63% which is higher than the shown percent impervious. Please verify calculations.

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

Project Name: Powers & Grinnell
Composite C-Value Computations
Post-Development
Project No: 221206
Date: 05/08/23
Revised:
Design by: AMC
Checked by: MAW

Provide the C values from Table 6-6 being used to calculate the composite runoff coefficient.

BASIN	TOTAL AREA (ACRES)	ROOFS (90%)	PAVED STREETS & WALKS (100%)	GRAVEL ROAD (80%)	Offsite (45%)	LANDSCAPE AREA (A SOILS) (0%)	PERCENT IMPERVIOUS	C_2*=	C_5*=	C_{10}*=	C_{100}*=
A-1	0.74	0.12	0.01	0.11	0.00	0.50	27.8%	0.23	0.27	0.33	0.48
A-2	0.48	0.02	0.36	0.00	0.00	0.10	78.8%	0.70	0.72	0.75	0.83
B-1	0.39	0.03	0.24	0.00	0.00	0.12	68.5%	0.61	0.63	0.67	0.76
B-2	0.70	0.14	0.19	0.00	0.00	0.37	45.1%	0.39	0.43	0.48	0.61
C-1	0.92	0.18	0.46	0.00	0.00	0.28	67.6%	0.59	0.62	0.65	0.75
C-2	0.06	0.01	0.04	0.00	0.00	0.01	81.7%	0.72	0.74	0.76	0.83
D	0.19	0.01	0.13	0.00	0.00	0.05	73.2%	0.65	0.68	0.71	0.79
E	0.68	0.33	0.01	0.00	0.00	0.34	45.1%	0.37	0.41	0.45	0.58
F	0.91	0.20	0.55	0.00	0.00	0.16	80.2%	0.70	0.72	0.75	0.82
G	0.22	0.02	0.20	0.00	0.00	0.00	99.1%	0.87	0.88	0.90	0.95
H-1	1.32	0.19	0.87	0.00	0.00	0.26	78.9%	0.69	0.71	0.74	0.82
H-2	1.73	0.23	0.98	0.00	0.00	0.52	68.6%	0.60	0.63	0.67	0.76
J	0.31	0.02	0.19	0.00	0.00	0.10	67.1%	0.60	0.62	0.66	0.75
K-1	0.19	0.05	0.08	0.00	0.00	0.06	65.8%	0.57	0.60	0.63	0.73
K-2	0.59	0.20	0.29	0.00	0.00	0.10	79.7%	0.68	0.70	0.73	0.81
L-1	0.21	0.02	0.10	0.00	0.00	0.09	56.2%	0.50	0.53	0.57	0.68
L-2	0.51	0.10	0.21	0.00	0.00	0.20	58.8%	0.51	0.55	0.58	0.69
M	1.08	0.58	0.00	0.00	0.00	0.50	48.3%	0.39	0.43	0.47	0.60
N-1	0.68	0.00	0.38	0.00	0.00	0.30	55.9%	0.51	0.54	0.58	0.69
N-2	0.35	0.00	0.27	0.00	0.00	0.08	77.1%	0.69	0.71	0.74	0.82
P	2.80	0.69	0.00	0.00	0.00	2.11	22.2%	0.19	0.24	0.30	0.46
Q	0.48	0.00	0.39	0.00	0.00	0.09	81.3%	0.73	0.75	0.78	0.85
R-1	1.02	0.14	0.09	0.00	0.00	0.79	21.2%	0.19	0.24	0.30	0.47
R-2	0.03	0.00	0.02	0.00	0.00	0.01	66.7%	0.60	0.63	0.66	0.76
OS-1	0.44	0.00	0.00	0.00	0.44	0.00	45.0%	0.26	0.32	0.38	0.51
OS-2	2.12	0.00	1.52	0.00	0.00	0.60	71.7%	0.64	0.67	0.70	0.79
OS-3	1.45	0.00	1.31	0.00	0.00	0.14	90.3%	0.81	0.82	0.85	0.90
OS-4	0.34	0.00	0.32	0.00	0.00	0.02	94.1%	0.84	0.85	0.87	0.92
OS-5	0.21	0.00	0.17	0.00	0.00	0.04	81.0%	0.72	0.74	0.77	0.84
OS-6	0.16	0.00	0.00	0.00	0.00	0.16	0.0%	0.02	0.08	0.15	0.35
OS-7	0.07	0.00	0.00	0.00	0.00	0.07	0.0%	0.02	0.08	0.15	0.35
OS-8	0.18	0.00	0.00	0.00	0.00	0.18	0.0%	0.02	0.08	0.15	0.35
Total to On-Site Detention	16.39	3.14	5.95	0.11	0.44	6.75	55.3%	0.48	0.51	0.55	0.67

*Runoff coefficients are weighted based on the land use breakdown of each basin, and the Runoff Coefficients provided in Table 6.6 of the City of Colorado Springs Drainage Criteria Manual, Volume 1, Revised January, 2021

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													

Revise location of Table 6-6 so that it is not cut off.

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

Project Name:	Powers & Grinnell
	Composite C-Value Computations
	Post-Development
Project No:	221206
Date:	05/08/23
Revised:	
Design by:	AMC
Checked by:	MAW

BASIN	TOTAL AREA (ACRES)	ROOFS (90%)	PAVED STREETS & WALKS (100%)	GRAVEL ROAD (80%)	Offsite (45%)	LANDSCAPE AREA (A SOILS) (0%)	PERCENT IMPERVIOUS	C_2*=	C_5*=	C_{10}*=	C_{100}*=

Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

adjust table so that columns are in line

Project Name: Powers & Grinnell
Project No: 221206
Date: 5/8/2023
Revised:

STANDARD FORM SF-2
TIME OF CONCENTRATION

Designed By: AMC
Checked By: MAW

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK (URBANIZED BASINS)			FINAL	REMARKS
BASIN	AREA (AC)	C_5	LENGTH (FT)	SLOPE %	Ti (MIN)	LENGTH (FT)	SLOPE %	C_v	VELOCITY (FPS)	Tt (MIN)	COMPOS. Tc (MIN)	TOTAL LENGTH	Tc = (L/180) + 10 (MIN)	Tc (MIN)	
A-1	0.74	0.27	46	2.29	7.81	164	1.73	20	2.63	1.04	8.85	210	11.17	8.85	
A-2	0.48	0.72	29	13.80	1.56	312	2.60	20	3.22	1.61	5.00	341	11.89	5.00	
B-1	0.39	0.63	16	31.50	1.08	247	3.66	20	3.83	1.08	5.00	263	11.46	5.00	
B-2	0.70	0.43	94	2.00	9.42	164	2.51	15	2.38	1.15	10.57	258	11.43	10.57	
C-1	0.92	0.62	42	15.41	2.31	241	2.04	20	2.86	1.41	5.00	283	11.57	5.00	
C-2	0.06	0.74	29	2.46	2.67	58	3.66	20	3.83	0.25	5.00	87	10.48	5.00	
D	0.19	0.68	12	8.33	1.49	83	2.42	20	3.11	0.44	5.00	95	10.53	5.00	
E	0.68	0.41	72	1.05	10.60	186	2.88	15	2.55	1.22	11.82	258	11.43	11.43	
F	0.91	0.72	19	13.67	1.28	253	3.21	20	3.58	1.18	5.00	272	11.51	5.00	
G	0.22	0.88	16	0.87	1.66	150	0.50	20	1.41	1.77	5.00	166	10.92	5.00	
H-1	1.32	0.71	53	3.15	3.51	215	1.95	20	2.79	1.28	5.00	268	11.49	5.00	
H-2	1.73	0.63	92	4.45	5.02	583	1.43	20	2.39	4.06	9.08	675	13.75	9.08	
J	0.31	0.62	73	4.50	4.51	145	4.68	20	4.33	0.56	5.07	218	11.21	5.07	
K-1	0.19	0.60	20	4.35	2.53	71	2.14	20	2.93	0.40	5.00	91	10.51	5.00	
K-2	0.59	0.70	25	7.30	1.87	93	1.49	20	2.44	0.63	5.00	118	10.66	5.00	
L-1	0.21	0.53	20	0.72	5.19	78	0.90	20	1.90	0.69	5.88	98	10.54	5.88	
L-2	0.51	0.55	44	2.00	5.36	119	0.90	20	1.90	1.05	6.40	163	10.91	6.40	
M	1.08	0.43	70	0.50	12.97	171	0.50	15	1.06	2.69	15.65	241	11.34	11.34	
N-1	0.68	0.54	39	6.12	3.52	136	0.65	20	1.61	1.41	5.00	175	10.97	5.00	
N-2	0.35	0.71	17	4.16	1.82	173	1.69	20	2.60	1.11	5.00	190	11.06	5.00	
P	2.80	0.24	100	2.00	12.51	370	3.25	15	2.70	2.28	14.79	470	12.61	12.61	
Q	0.48	0.75	21	2.00	2.36	153	2.03	20	2.85	0.89	5.00	174	10.97	5.00	
R-1	1.02	0.24	43	6.28	5.59	20	25.00	7	3.50	0.10	5.69	63	10.35	5.69	
R-2	0.03	0.63	14	6.38	1.75	45	4.45	20	4.22	0.18	5.00	59	10.33	5.00	
OS-1	0.44	0.32	17	12.68	2.53	23	25.00	7	3.50	0.11	5.00	40	10.22	5.00	
OS-2	2.12	0.67	98	2.00	6.22	670	2.84	20	3.37	3.31	9.54	768	14.27	9.54	
OS-3	1.45	0.82	97	2.00	4.00	568	3.92	20	3.96	2.39	6.39	665	13.69	6.39	
OS-4	0.34	0.85	54	2.00	2.65	320	2.50	20	3.16	1.69	5.00	374	12.08	5.00	
OS-5	0.21	0.74	38	2.00	3.20	238	4.62	20	4.30	0.92	5.00	276	11.53	5.00	
OS-6	0.16	0.08	15	19.11	2.71	28	16.31	7	2.83	0.17	5.00	43	10.24	5.00	
OS-7	0.07	0.08	8	14.80	2.15	50	3.95	7	1.39	0.60	5.00	58	10.32	5.00	
OS-8	0.18	0.08	15	2.00	5.75	35	4.28	7	1.45	0.40	6.15	50	10.28	6.15	

Table RO-2—Conveyance Coefficient, C_v

Type of Land Surface	Conveyance Coefficient, C_v
Heavy meadow	2.5

Project Name: Powers & Grinnell
Project No: 221206
Date: 5/8/2023
Revised:

STANDARD FORM SF-2
TIME OF CONCENTRATION

Designed By: AMC
Checked By: MAW

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

SUB-BASIN DATA			INITIAL/OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc CHECK (URBANIZED BASINS)			FINAL	REMARKS
BASIN	AREA (AC)	C_5	LENGTH (FT)	SLOPE %	Ti (MIN)	LENGTH (FT)	SLOPE %	C_v	VELOCITY (FPS)	Tt (MIN)	COMPOS. Tc (MIN)	TOTAL LENGTH	Tc = (L/180) + 10 (MIN)	Tc (MIN)	

Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Fix table shown

Project Name:	Powers & Grinnell
	1-Hour Rainfall Data
Project No:	221206
Date:	05/08/23
Revised:	
Design by:	MW
Checked by:	

Per El Paso County DCM rainfall values shall be taken from the NOAA Atlas 2, Volume 3. Rainfall values are provided in Table 6-2

1-HR Rainfall

Return Interval (YR)	1-hour Rainfall	
2	**1.01**	From NOAA Atlas 14, Volume 7, Version 2
5	**1.29**	
10	**1.56**	
100	**2.74**	

Intensity (per Vol. 1, Ch. 6 of the El Paso County DCM):

IDF Equations

$$I_{100} = -2.52 \ln(D) + 12.735$$

$$I_{50} = -2.25 \ln(D) + 11.375$$

$$I_{25} = -2.00 \ln(D) + 10.111$$

$$I_{10} = -1.75 \ln(D) + 8.847$$

$$I_{5} = -1.50 \ln(D) + 7.583$$

$$I_{2} = -1.19 \ln(D) + 6.035$$

CALCULATED BY:	AMC
DATE:	05/08/23
CHECKED BY:	
REVISED DATE:	

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

JOB NO:	221206
PROJECT:	**Powers & Grinnell**
DESIGN STO	2 YR
P1:	1.01 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-5	40	0.21	0.72	5.00	0.15	4.12	0.63																	Direct flow to Existing 15' Type R Inlet at DP 40
R-2		0.03	0.60	5.00	0.02	4.12	0.07																	Direct flow to Basin OS-4 from Basin R-2
OS-4	39	0.34	0.84	5.00	0.29	4.12	1.17																	Direct flow to DP 39
R-2 + OS-4								5.00	0.30	4.12	1.25													Total flow to DP 39
R-1		1.02	0.19	5.69	0.20	3.97	0.77																	Direct flow to Basin OS-2 from Basin R-1
OS-2	38	2.12	0.64	9.54	1.36	3.35	4.57																	Direct flow to Basin OS-2 from Basin R-1
OS-2 + R-1								9.54	1.56	3.35	5.23													Total flow to DP 38
OS-3	37	1.45	0.81	6.39	1.17	3.83	4.47																	Direct flow to Type R inlet at DP 37
Q	35	0.48	0.73	5.00	0.35	4.12	1.44																	Direct flow to DP 35
																	1.44	4.22	18	19.58	9.8	11.1	0.01	Pipe flow to DP 34
																								Direct flow to Basin P from Basin OS-1
Q + Landscape	34							5.00	0.35	4.12	1.44						1.44	0.61	18	7.44	99.1	4.2	0.39	Total flow at DP 34; Pipe flow to DP 28
OS-6		0.16	0.02	5.00	0.00	4.12	0.01																	Direct flow to Basin N-1 from Basin OS-
N-1	33	0.68	0.51	5.00	0.34	4.12	1.42																	Direct flow to DP 33
OS-6 + N-1								5.00	0.35	4.12	1.43						1.43	0.50	18	6.74	37.7	3.8	0.16	Total flow at DP 33; Pipe flow to DP 31
N-2	32	0.35	0.69	5.00	0.24	4.12	1.00																	Direct flow to DP 32
																	1.00	2.68	18	15.60	9.8	8.8	0.02	Pipe flow to DP 31
OS-6 + N-1 + N-2	31							5.16	0.59	4.08	2.41						2.41	0.50	18	6.74	105.7	3.8	0.46	Total flow at DP 31; Pipe flow to DP 29
OS-1		0.44	0.26	5.00	0.11	4.12	0.47																	Direct flow to Basin P from Basin OS-1
OS-8		0.18	0.02	6.15	0.00	3.87	0.01																	Direct flow to Basin P from Basin OS-8

CALCULATED BY: AMC
DATE: 05/08/23
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STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

JOB NO: 221206
PROJECT: **Powers & Grinnell**
DESIGN STO 2 YR
P1: 1.01 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
P	30	2.80	0.19	12.61	0.53	3.02	1.61																	Direct flow to DP 30
OS-1 + OS-8 + P								12.61	0.65	3.02	1.96						1.96	0.80	18	8.52	184.4	4.8	0.64	Total flow to DP 30; Pipe flow to DP 29
OS-1 + OS-6 + OS-8 + N-1 + N-2 + P	29							13.25	1.24	2.96	3.67						3.67	0.50	18	6.74	74.2	3.8	0.32	Total flow at DP 29; Pipe flow to DP 28
OS-1 + OS-6 + OS-8 + N-1 + N-2 + P + Q + Landscape Drains	28							13.57	1.59	2.93	4.66						4.66	0.50	24	14.51	174.1	4.6	0.63	Total flow at DP 28; Pipe flow to DP 26
OS-7		0.07	0.02	5.00	0.00	4.12	0.01																	Direct flow to Basin M from Basin OS-7
M	27	1.08	0.39	11.34	0.42	3.15	1.33																	Direct flow to Type C inlet at DP 27
								11.34	0.42	3.15	1.33						1.33	0.50	18	6.74	30.2	3.8	0.13	Total flow to DP 27; Pipe flow to DP 26
OS-1 + OS-6 + OS-7 + OS-8 + M + N-1 + N-2 + P + Q + Landscape Drains	26							14.20	2.01	2.88	5.79						5.79	0.80	24	18.36	237.1	5.8	0.68	Total flow at DP 26; Pipe flow to DP 23
H-1	25	1.32	0.69	5.00	0.91	4.12	3.77																	Direct flow to Double Type 13 Inlet at DP 25
																	3.77	0.50	18	6.74	28.1	3.8	0.12	Pipe flow to DP 24
H-2	24	1.73	0.60	9.08	1.05	3.41	3.57																	Direct flow to Type R Inlet at DP 24
H-1 + H-2								9.08	1.96	3.41	6.68						6.68	0.50	18	6.74	8.0	3.8	0.03	Total flow at DP 24; Pipe flow to DP 23

CALCULATED BY: AMC
DATE: 05/08/23
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REVISED DATE:

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

JOB NO: 221206
PROJECT: **Powers & Grinnell**
DESIGN STO 2 YR
P1: 1.01 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-1 + OS-6 + OS-7 + OS-8 + H-1 + H-2 + M + N-1 + N-2 + P + Q + Landscape Drains	23							14.88	3.97	2.82	11.21						11.21	0.50	24	14.51	30.5	4.6	0.11	Total flow at DP 23; Pipe flow to DP 15
L-2	22	0.51	0.51	6.40	0.26	3.83	1.00										1.00	0.50	18	6.74	209.4	3.8	0.92	Direct flow to Type R Inlet at DP 22 Pipe flow to DP 20
K-2	21	0.59	0.68	5.00	0.40	4.12	1.66										1.66	0.50	18	6.74	45.9	3.8	0.20	Direct flow to Double Type 13 Inlet at DP 21 Pipe flow to DP 20
K-2 + L-2	20							7.32	0.66	3.67	2.43						2.43	0.50	18	6.74	84.6	3.8	0.37	Total flow at DP 20; Pipe flow to DP 18
L-1	19	0.21	0.50	5.88	0.11	3.93	0.41										0.41	1.13	18	10.13	116.2	5.7	0.34	Direct flow to Type R inlet at DP 19 Pipe flow to DP 18
K-2 + L-1 + L-2	18							7.69	0.77	3.61	2.77						2.77	0.50	18	6.74	71.7	3.8	0.31	Total flow at DP 18; Pipe flow to DP 17
K-1	17	0.19	0.57	5.00	0.11	4.12	0.44																	Direct flow to Type R inlet at DP 17
K-1 + K-2 + L-1 + L-2								8.00	0.88	3.56	3.12						3.12	2.69	18	15.63	148.9	8.8	0.28	Total flow at DP 17; Pipe flow to DP 16
J	16	0.31	0.60	5.07	0.19	4.10	0.76																	Direct flow to Type R Inlet at DP 16
J + K-1 + K-2 + L-1 + L-2								8.28	1.06	3.52	3.74						3.74	1.00	18	9.53	66.7	5.4	0.21	Total flow at DP 16; Pipe flow to DP 15
OS-1 + OS-6 + OS-7 + OS-8 + H-1 + H-2 + J + K-1 + K-2 + L-1 + L-2 + M + N-1 + N-2 + P + Q + Landscape Drains	15							14.99	5.03	2.81	14.16						14.16	0.50	30	26.31	101.8	5.4	0.32	Total flow at DP 15; Pipe flow to DP 13
C-2	14	0.06	0.72	5.00	0.04	4.12	0.18										0.18	3.02	18	16.56	53.5	9.4	0.10	Direct flow to Type R Inlet at DP 14 Pipe flow to DP 13

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STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

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DENVER • DALLAS/FORT WORTH

JOB NO: 221206
PROJECT: **Powers & Grinnell**
DESIGN STO 2 YR
P1: 1.01 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-1 + OS-6 + OS-7 + OS-8 + C-2 + H-1 + H-2 + J + K-1 + K-2 + L-1 + L-2 + M + N-1 + N-2 + P + Q + Landscape Drains	13							15.30	5.08	2.79	14.16						14.16	3.00	30	64.45	38.8	13.1	0.05	Total flow at DP 13; Pipe flow to DP 1
B-2	12	0.70	0.39	10.57	0.28	3.23	0.89																	Direct flow to Type C inlet at DP 12
																	0.89	0.53	18	6.94	75.2	3.9	0.32	Pipe flow to DP 11
B-1	11	0.39	0.61	5.00	0.24	4.12	0.98																	Direct flow to Type R inlet at DP 11
B-1 + B-2								10.89	0.51	3.19	1.64						1.64	0.50	18	6.74	176.7	3.8	0.77	Total flow at DP 11; Pipe flow to DP 6
D	10	0.19	0.65	5.00	0.12	4.12	0.51																	Direct flow to DP 10
																	0.51	0.50	18	6.74	188.2	3.8	0.82	Pipe flow to DP 9

Missing Design Points 1-9 & Basins A-1, A-2, C-1 and E thru G. Please add to spreadsheet

CALCULATED BY:	AMC	JOB NO:	221206
DATE:	05/08/23	PROJECT:	**Powers & Grinnell**
CHECKED BY:		DESIGN STO	5 YR
REVISED DATE:		PI	1.29 IN

STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	T_c (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	REMARKS
OS-5	40	0.21	0.74	5.00	0.16	5.17	0.81																	Direct flow to Existing 15' Type R Inlet at DP 40
R-2		0.03	0.63	5.00	0.02	5.17	0.10																	Direct flow to Basin OS-4 from Basin R-2
OS-4	39	0.34	0.85	5.00	0.29	5.17	1.50																	Direct flow to DP 39
R-2 + OS-4								5.00	0.31	5.17	1.59													Total flow to DP 39
R-1		1.02	0.24	5.69	0.25	4.98	1.23																	Direct flow to Basin OS-2 from Basin R-1
OS-2	38	2.12	0.67	9.54	1.42	4.20	5.95																	Direct flow to Basin OS-2 from Basin R-1
OS-2 + R-1								9.54	1.66	4.20	6.98													Total flow to DP 38
OS-3	37	1.45	0.82	6.39	1.19	4.80	5.71																	Direct flow to Type R inlet at DP 37
Q	35	0.48	0.75	5.00	0.36	5.17	1.85										1.85	4.22	18	19.58	9.8	11.1	0.01	Direct flow to DP 35 Pipe flow to DP 34
Q + Landscape Drains	34							5.00	0.36	5.17	1.85						1.85	0.61	18	7.44	99.1	4.2	0.39	Direct flow to Basin P from Basin OS-1 Total flow at DP 34; Pipe flow to DP 28
OS-6		0.16	0.08	5.00	0.01	5.17	0.07																	Direct flow to Basin N-1 from Basin OS-6
N-1	33	0.68	0.54	5.00	0.37	5.17	1.89																	Direct flow to DP 33
OS-6 + N-1								5.00	0.38	5.17	1.96						1.96	0.50	18	6.74	37.7	3.8	0.16	Total flow at DP 33; Pipe flow to DP 31
N-2	32	0.35	0.71	5.00	0.25	5.17	1.29										1.29	2.68	18	15.60	9.8	8.8	0.02	Direct flow to DP 32 Pipe flow to DP 31
OS-6 + N-1 + N-2	31							5.16	0.63	5.12	3.22						3.22	0.50	18	6.74	105.7	3.8	0.46	Total flow at DP 31; Pipe flow to DP 29

CALCULATED BY: AMC
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STANDARD FORM SF-3

STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

JOB NO: 221206
PROJECT: **Powers & Grinnell**
DESIGN STO 5 YR
PI 1.29 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	T_c (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	T_c (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	T_t (min)	REMARKS
OS-1		0.44	0.32	5.00	0.14	5.17	0.73																	Direct flow to Basin P from Basin OS-1
OS-8		0.18	0.08	6.15	0.01	4.86	0.07																	Direct flow to Basin P from Basin OS-8
P	30	2.80	0.24	12.61	0.67	3.78	2.54																	Direct flow to DP 30
OS-1 + OS-8 + P								12.61	0.83	3.78	3.13						3.13	0.80	18	8.52	184.4	4.8	0.64	Total flow to DP 30; Pipe flow to DP 29
OS-1 + OS-6 + OS-8 + N-1 + N-2 + P	29							13.25	1.46	3.71	5.40						5.40	0.50	18	6.74	74.2	3.8	0.32	Total flow at DP 29; Pipe flow to DP 28
OS-1 + OS-6 + OS-8 + N-1 + N-2 + P + Q + Landscape Drains	28							13.57	1.81	3.67	6.66						6.66	0.50	24	14.51	174.1	4.6	0.63	Total flow at DP 28; Pipe flow to DP 26
OS-7		0.07	0.08	5.00	0.01	5.17	0.03																	Direct flow to Basin M from Basin OS-7
M	27	1.08	0.43	11.34	0.46	3.94	1.83																	Direct flow to Type C inlet at DP 27
								11.34	0.47	3.94	1.85						1.85	0.50	18	6.74	30.2	3.8	0.13	Total flow to DP 27; Pipe flow to DP 26
OS-1 + OS-6 + OS-7 + OS-8 + M + N-1 + N-2 + P + Q + Landscape Drains	26							14.20	2.28	3.60	8.23						8.23	0.80	24	18.36	237.1	5.8	0.68	Total flow at DP 26; Pipe flow to DP 23
H-1	25	1.32	0.71	5.00	0.94	5.17	4.87																	Direct flow to Double Type 13 Inlet at DP 25
																	4.87	0.50	18	6.74	28.1	3.8	0.12	Pipe flow to DP 24
H-2	24	1.73	0.63	9.08	1.09	4.27	4.67																	Direct flow to Type R Inlet at DP 24
H-1 + H-2								9.08	2.03	4.27	8.69						8.69	0.50	18	6.74	8.0	3.8	0.03	Total flow at DP 24; Pipe flow to DP 23

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STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

HKS HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

JOB NO: 221206
PROJECT: **Powers & Grinnell**
DESIGN STO 5 YR
PI 1.29 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-1 + OS-6 + OS-7 + OS-8 + H-1 + H-2 + M + N-1 + N-2 + P + Q + Landscape Drains	23							14.88	4.32	3.53	15.25						15.25	0.50	24	14.51	30.5	4.6	0.11	Total flow at DP 23; Pipe flow to DP 15
L-2	22	0.51	0.55	6.40	0.28	4.80	1.33										1.33	0.50	18	6.74	209.4	3.8	0.92	Direct flow to Type R Inlet at DP 22 Pipe flow to DP 20
K-2	21	0.59	0.70	5.00	0.42	5.17	2.15										2.15	0.50	18	6.74	45.9	3.8	0.20	Direct flow to Double Type 13 Inlet at DP 21 Pipe flow to DP 20
K-2 + L-2	20							7.32	0.69	4.60	3.19						3.19	0.50	18	6.74	84.6	3.8	0.37	Total flow at DP 20; Pipe flow to DP 18
L-1	19	0.21	0.53	5.88	0.11	4.93	0.55										0.55	1.13	18	10.13	116.2	5.7	0.34	Direct flow to Type R inlet at DP 19 Pipe flow to DP 18
K-2 + L-1 + L-2	18							7.69	0.80	4.52	3.64						3.64	0.50	18	6.74	71.7	3.8	0.31	Total flow at DP 18; Pipe flow to DP 17
K-1	17	0.19	0.60	5.00	0.11	5.17	0.59																	Direct flow to Type R inlet at DP 17
K-1 + K-2 + L-1 + L-2								8.00	0.92	4.46	4.10						4.10	2.69	18	15.63	148.9	8.8	0.28	Total flow at DP 17; Pipe flow to DP 16
J	16	0.31	0.62	5.07	0.19	5.15	1.00																	Direct flow to Type R Inlet at DP 16
J + K-1 + K-2 + L-1 + L-2								8.28	1.11	4.41	4.90						4.90	1.00	18	9.53	66.7	5.4	0.21	Total flow at DP 16; Pipe flow to DP 15
OS-1 + OS-6 + OS-7 + OS-8 + H-1 + H-2 + J + K-1 + K-2 + L-1 + L-2 + M + N-1 + N-2 + P + Q + Landscape Drains	15							14.99	5.43	3.52	19.12						19.12	0.50	30	26.31	101.8	5.4	0.32	Total flow at DP 15; Pipe flow to DP 13
C-2	14	0.06	0.74	5.00	0.04	5.17	0.23										0.23	3.02	18	16.56	53.5	9.4	0.10	Direct flow to Type R Inlet at DP 14 Pipe flow to DP 13

CALCULATED BY:	AMC	**STANDARD FORM SF-3**	JOB NO: 221206
DATE:	05/08/23		PROJECT: **Powers & Grinnell**
CHECKED BY:		**STORM DRAINAGE SYSTEM DESIGN**	DESIGN STO 5 YR
REVISED DATE:		**(RATIONAL METHOD PROCEDURE)**	PI 1.29 IN

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		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	CAPACITY AT 80% (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-1 + OS-6 + OS-7 + OS-8 + C-2 + H-1 + H-2 + J + K-1 + K-2 + L-1 + L-2 + M + N-1 + N-2 + P + Q + Landscape Drains	13							15.30	5.47	3.49	19.11						19.11	3.00	30	64.45	38.8	13.1	0.05	Total flow at DP 13; Pipe flow to DP 1
B-2	12	0.70	0.43	10.57	0.30	4.05	1.23																	Direct flow to Type C inlet at DP 12
																	1.23	0.53	18	6.94	75.2	3.9	0.32	Pipe flow to DP 11
B-1	11	0.39	0.63	5.00	0.25	5.17	1.28																	Direct flow to Type R inlet at DP 11
B-1 + B-2								10.89	0.55	4.00	2.20						2.20	0.50	18	6.74	176.7	3.8	0.77	Total flow at DP 11; Pipe flow to DP 6
D	10	0.19	0.68	5.00	0.13	5.17	0.66																	Direct flow to DP 10
																	0.66	0.50	18	6.74	188.2	3.8	0.82	Pipe flow to DP 9
F	9	0.91	0.72	5.00	0.65	5.17	3.38																	Direct flow to Type R inlet at DP 9
D + F								5.82	0.78	4.94	3.86						3.86	0.50	18	6.74	55.5	3.8	0.24	Total flow at DP 9; Pipe flow to DP 8
G	8	0.22	0.88	5.00	0.19	5.17	1.01																	Direct flow to Type R inlet at DP 8
D + F + G								6.07	0.98	4.88	4.77						4.77	0.50	18	6.74	32.6	3.8	0.14	Total flow at DP 8; Pipe flow to DP 6
E	7	0.68	0.41	11.43	0.28	3.93	1.09																	Direct flow to Type C inlet at DP 7
																	1.09	0.50	18	6.74	130.1	3.8	0.57	Pipe flow to DP 6
B-1 + B-2 + D + E + F + G	6							12.00	1.80	3.86	6.96						6.96	0.50	30	26.31	94.3	5.4	0.29	Total flow at DP 6; Pipe flow to DP 4
A-2	5	0.48	0.72	5.00	0.35	5.17	1.79																	Direct flow to Type R inlet at DP 5
																	1.79	1.00	18	9.53	12.2	5.4	0.04	Pipe flow to DP 4

Missing Design Points 1-4 & Basins A-1, & C-1. Please add to spreadsheet

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STANDARD FORM SF-3

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JOB NO:	221206
PROJECT:	**Powers & Grinnell**
DESIGN STO	100 YR
P1:	2.74 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-5	40	0.21	0.84	5.00	0.18	8.68	1.54																	Direct flow to Existing 15' Type R Inlet at DP 40
R-2		0.03	0.76	5.00	0.02	8.68	0.20																	Direct flow to Basin OS-4 from Basin R-2
OS-4	39	0.34	0.92	5.00	0.31	8.68	2.73																	Direct flow to DP 39
R-2 + OS-4								5.00	0.34	8.68	2.92													Total flow to DP 39
R-1		1.02	0.47	5.69	0.48	8.35	3.98																	Direct flow to Basin OS-2 from Basin R-1
OS-2	38	2.12	0.79	9.54	1.67	7.05	11.77																	Direct flow to Basin OS-2 from Basin R-1
OS-2 + R-1								9.54	2.15	7.05	15.13													Total flow to DP 38
OS-3	37	1.45	0.90	6.39	1.31	8.06	10.53																	Direct flow to Type R inlet at DP 37
Q	35	0.48	0.85	5.00	0.41	8.68	3.52																	Direct flow to DP 35
																	3.52	4.22	18	21.58	9.8	12.2	0.01	Pipe flow to DP 34
																								Direct flow to Basin P from Basin OS-1
Q + Landscape Drains	34							5.00	0.41	8.68	3.52						3.52	0.61	18	8.20	99.1	4.6	0.36	Total flow at DP 34; Pipe flow to DP 28
OS-6		0.16	0.35	5.00	0.06	8.68	0.49																	Direct flow to Basin N-1 from Basin OS-
N-1	33	0.68	0.69	5.00	0.47	8.68	4.08																	Direct flow to DP 33
OS-6 + N-1								5.00	0.53	8.68	4.56						4.56	0.50	18	7.43	37.7	4.2	0.15	Total flow at DP 33; Pipe flow to DP 31
N-2	32	0.35	0.82	5.00	0.29	8.68	2.49																	Direct flow to DP 32
																	2.49	2.68	18	17.20	9.8	9.7	0.02	Pipe flow to DP 31
OS-6 + N-1 + N-2	31							5.15	0.81	8.61	7.00						7.00	0.50	18	7.43	105.7	4.2	0.42	Total flow at DP 31; Pipe flow to DP 29

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DESIGN STO 100 YR
P1: 2.74 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS)	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-1		0.44	0.51	5.00	0.22	8.68	1.95																	Direct flow to Basin P from Basin OS-1
OS-8		0.18	0.35	6.15	0.06	8.16	0.51																	Direct flow to Basin P from Basin OS-8
P	30	2.80	0.46	12.61	1.30	6.35	8.24																	Direct flow to DP 30
OS-1 + OS-8 + P								12.61	1.58	6.35	10.06						10.06	0.80	18	9.40	184.4	5.3	0.58	Total flow to DP 30; Pipe flow to DP 29
OS-1 + OS-6 + OS-8 + N-1 + N-2 + P	29							13.19	2.40	6.23	14.95						14.95	0.50	18	7.43	74.2	4.2	0.29	Total flow at DP 29; Pipe flow to DP 28
OS-1 + OS-6 + OS-8 + N-1 + N-2 + P + Q + Landscape Drains	28							13.48	2.80	6.18	17.32						17.32	0.50	24	16.00	174.1	5.1	0.57	Total flow at DP 28; Pipe flow to DP 26
OS-7		0.07	0.35	5.00	0.02	8.68	0.21																	Direct flow to Basin M from Basin OS-7
M	27	1.08	0.60	11.34	0.64	6.62	4.27																	Direct flow to Type C inlet at DP 27
								11.34	0.67	6.62	4.43						4.43	0.50	18	7.43	30.2	4.2	0.12	Total flow to DP 27; Pipe flow to DP 26
M + N-1 + N-2 + P + Q + Landscape Drains	26							14.05	3.47	6.07	21.10						21.10	0.80	24	20.23	237.1	6.4	0.61	Total flow at DP 26; Pipe flow to DP 23
H-1	25	1.32	0.82	5.00	1.08	8.68	9.37																	Direct flow to Double Type 16 Inlet at DP 25
																	9.37	0.50	18	7.43	28.1	4.2	0.11	Pipe flow to DP 24
H-2	24	1.73	0.76	9.08	1.31	7.18	9.39																	Direct flow to Type R Inlet at DP 24
H-1 + H-2								9.08	2.39	7.18	17.15						17.15	0.50	18	7.43	8.0	4.2	0.03	Total flow at DP 24; Pipe flow to DP 23
OS-1 + OS-6 + OS-7 + OS-8 + H-1 + H-2 + M + N-1 + N-2 + P + Q + Landscape Drains	23							14.67	5.86	5.97	34.98						34.98	0.50	24	16.00	30.5	5.1	0.10	Total flow at DP 23; Pipe flow to DP 15

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		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
L-2	22	0.51	0.69	6.40	0.35	8.06	2.84										2.84	0.50	18	7.43	209.4	4.2	0.83	Direct flow to Type R Inlet at DP 22 Pipe flow to DP 20
K-2	21	0.59	0.81	5.00	0.48	8.68	4.13										4.13	0.50	18	7.43	45.9	4.2	0.18	Direct flow to Double Type 13 Inlet at DP 21 Pipe flow to DP 20
K-2 + L-2	20							7.23	0.83	7.75	6.42						6.42	0.50	18	7.43	84.6	4.2	0.34	Total flow at DP 20; Pipe flow to DP 18
L-1	19	0.21	0.68	5.88	0.14	8.27	1.19										1.19	1.13	18	11.17	116.2	6.3	0.31	Direct flow to Type R inlet at DP 19 Pipe flow to DP 18
K-2 + L-1 + L-2	18							7.57	0.97	7.63	7.42						7.42	0.50	18	7.43	71.7	4.2	0.28	Total flow at DP 18; Pipe flow to DP 17
K-1	17	0.19	0.73	5.00	0.14	8.68	1.20																	Direct flow to Type R inlet at DP 17
K-1 + K-2 + L-1 + L-2								7.85	1.11	7.54	8.37						8.37	2.69	18	17.23	148.9	9.7	0.25	Total flow at DP 17; Pipe flow to DP 16
J	16	0.31	0.75	5.07	0.23	8.64	2.02																	Direct flow to Type R Inlet at DP 16
J + K-1 + K-2 + L-1 + L-2								8.11	1.34	7.46	10.03						10.03	1.00	18	10.50	66.7	5.9	0.19	Total flow at DP 16; Pipe flow to DP 15
OS-1 + OS-6 + OS-7 + OS-8 + H-1 + H-2 + J + K-1 + K-2 + L-1 + L-2 + M + N-1 + N-2 + P + Q + Landscape Drains	15							14.77	7.21	5.95	42.88						42.88	0.50	30	29.00	101.8	5.9	0.29	Total flow at DP 15; Pipe flow to DP 13
C-2	14	0.06	0.83	5.00	0.05	8.68	0.43										0.43	3.02	18	18.25	53.5	10.3	0.09	Direct flow to Type R Inlet at DP 14 Pipe flow to DP 13

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DESIGN STO 100 YR
P1: 2.74 IN

		DIRECT RUNOFF						TOTAL RUNOFF				STREET/INLET					STORM SEWER PIPE (for preliminary sizing)				TRAVEL TIME			
BASIN (s)	DESIGN POINT	AREA (AC)	RUNOFF COEFF	Tc (min)	C x A (AC)	I (IN/HR)	DIRECT RUNOFF, Q (CFS)	Tc (MIN)	Σ(C x A) (AC)	I (IN/HR)	TOTAL RUNOFF, Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	INLET DESIGN FLOW (CFS	STREET OR INLET INTERCEPTION (CFS)	CARRYOVER (CFS)	DESIGN FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	QFULL (CFS)	LENGTH (FT)	VELOCITY (FPS)	Tt (min)	REMARKS
OS-1 + OS-6 + OS-7 + OS-8 + C-2 + H-1 + H-2 + J + K-1 + K-2 + L-1 + L-2 + M + N-1 + N-2 + P + Q + Landscape Drains	13							15.05	7.26	5.90	42.82						42.82	3.00	30	71.04	38.8	14.5	0.04	Total flow at DP 13; Pipe flow to DP 1
B-2	12	0.70	0.61	10.57	0.43	6.79	2.89																	Direct flow to Type C inlet at DP 12
																	2.89	0.53	18	7.65	75.2	4.3	0.29	Pipe flow to DP 11
B-1	11	0.39	0.76	5.00	0.30	8.68	2.58																	Direct flow to Type R inlet at DP 11
B-1 + B-2								10.86	0.72	6.73	4.86						4.86	0.50	18	7.43	176.7	4.2	0.70	Total flow at DP 11; Pipe flow to DP 6
D	10	0.19	0.79	5.00	0.15	8.68	1.31																	Direct flow to DP 10
																	1.31	0.50	18	7.43	188.2	4.2	0.75	Pipe flow to DP 9
F	9	0.91	0.82	5.00	0.75	8.68	6.47																	Direct flow to Type R inlet at DP 9
D + F								5.75	0.90	8.33	7.47						7.47	0.50	18	7.43	55.5	4.2	0.22	Total flow at DP 9; Pipe flow to DP 8
G	8	0.22	0.95	5.00	0.21	8.68	1.81																	Direct flow to Type R inlet at DP 8

Missing Design Points 1-7 & Basins A-1, A-2, C-1 and E. Please add to spreadsheet

APPENDIX D

Hydraulic and Detention Computations

Grass Swales also need to show design/analysis for 5 & 100-year events.

Include design of gutter pan widths used with Type 13 inlets

Pond design needs to include:
- sizing of riprap for overflow spillway
- sizing of trickle channel

Per ECM Section 3.2.4 suitable outfall location needs to be determined. Provide analysis of all downstream facilities which accept flows from project site, ie roadside ditches, culverts, etc.

Will review inlet design with next review when hydrology spreadsheets have been updated with all basin and design point flows.

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 12 (Basin B-2)	DP 11 (Basin B-1)	DP 8 (Basin G)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	STREET	STREET
Hydraulic Condition	Swale	In Sump	In Sump
Inlet Type	CDOT Type C (Depressed)	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.2	1.3	1.0
Major Q_{Known} (cfs)	2.9	2.6	1.8

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

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.2**	**1.3**	**1.0**
Major Total Design Peak Flow, Q (cfs)	**2.9**	**2.6**	**1.8**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 9 (Basin F)	DP 7 (Basin E)	DP 10 (Basin D)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	AREA	STREET
Hydraulic Condition	In Sump	Swale	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type C (Depressed)	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.4	1.1	0.7
Major Q_{Known} (cfs)	6.5	2.6	1.3

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.4**	**1.1**	**0.7**
Major Total Design Peak Flow, Q (cfs)	**6.5**	**2.6**	**1.3**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 22 (Basin L-2)	DP 19 (Basin L-1)	DP 21 (Basin K-2)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT/Denver 13 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.3	0.6	2.2
Major Q_{Known} (cfs)	2.8	1.2	4.1

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.3**	**0.6**	**2.2**
Major Total Design Peak Flow, Q (cfs)	**2.8**	**1.2**	**4.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 17 (Basin K-1)	DP 16 (Basin J)	DP 25 (Basin H-1)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT/Denver 13 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6	1.0	4.9
Major Q_{Known} (cfs)	1.2	2.0	9.4

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.6**	**1.0**	**4.9**
Major Total Design Peak Flow, Q (cfs)	**1.2**	**2.0**	**9.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 27 (Basin M)	DP 33 (Basin N-1)	DP 30 (Basin P)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	AREA	STREET	AREA
Hydraulic Condition	Swale	In Sump	Swale
Inlet Type	CDOT Type C (Depressed)	CDOT/Denver 13 Valley Grate	CDOT Type C (Depressed)

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.9	2.0	3.1
Major Q_{Known} (cfs)	4.4	4.6	10.1

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.9**	**2.0**	**3.1**
Major Total Design Peak Flow, Q (cfs)	**4.4**	**4.6**	**10.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	0.0

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 35 (Basin Q)	DP 40 (Basin OS-5)	DP 39 (Basin OS-4)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.3	0.8	1.6
Major Q_{Known} (cfs)	4.8	1.5	2.9

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.3**	**0.8**	**1.6**
Major Total Design Peak Flow, Q (cfs)	**4.8**	**1.5**	**2.9**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 37 (Basin OS-3)	DP 38 (Basin OS-2)	DP 3 (Basin C-1)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.7	7.0	3.0
Major Q_{Known} (cfs)	10.5	15.1	5.0

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.7**	**7.0**	**3.0**
Major Total Design Peak Flow, Q (cfs)	**10.5**	**15.1**	**5.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	1.4	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 5 (Basin A-2)	DP 14 (Basin C-2)	DP 24 (Basin H-2)
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.8	0.2	4.7
Major Q_{Known} (cfs)	3.4	0.4	9.4

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.8**	**0.2**	**4.7**
Major Total Design Peak Flow, Q (cfs)	**3.4**	**0.4**	**9.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.02 (August 2022)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DP 32 (Basin N-2)
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	In Sump
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	1.3
Major Q_{Known} (cfs)	2.5

Bypass (Carry-Over) Flow from Upstream

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

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

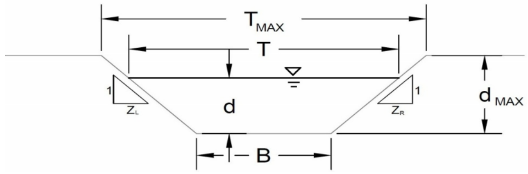
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.3**
Major Total Design Peak Flow, Q (cfs)	**2.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A

AREA INLET IN A SWALE

Powers & Grinnell

DP 12 (Basin B-2)



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0451	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Sloe	Z2 =	5.00	ft/ft

Check one of the following soil types:

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

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

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	**T_{MAX} =**	**9.00**	**14.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	**d_{MAX} =**	**0.50**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**14.8**	**60.0**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	**d_{allow} =**	**0.50**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	**Q_o =**	**1.2**	**2.9**	**cfs**
Water Depth	**d =**	**0.13**	**0.21**	**ft**

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

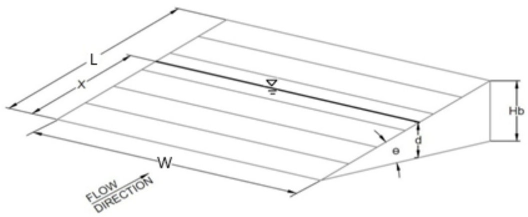
AREA INLET IN A SWALE

Powers & Grinnell

DP 12 (Basin B-2)

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	ft
Length of Grate	L =	3.00	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

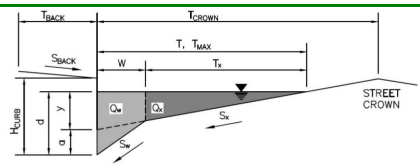
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.13	1.21	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.1**	**15.6**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

Warning 04: Froude No. exceeds USDCM Volume I recommendation.

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

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

Project: Powers & Grinnell
Inlet ID: DP 11 (Basin B-1)



Gutter Geometry:

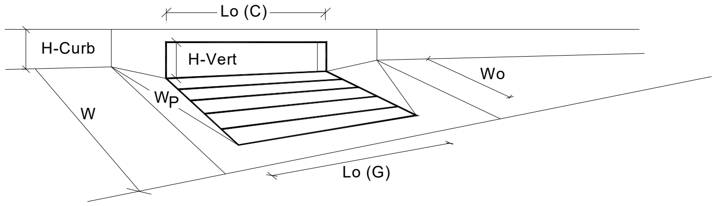
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	39.0	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	19.5	39.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	10.9	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

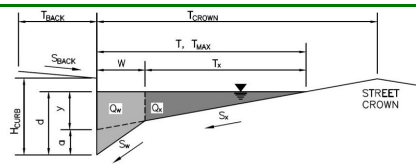
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.74	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**11.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.6	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 8 (Basin G)



Gutter Geometry:

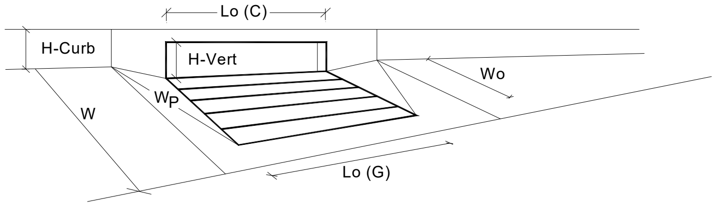
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	1.00	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

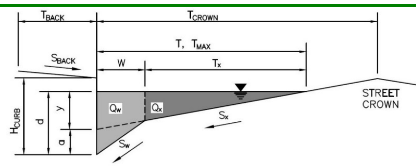


		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	3.6	6.5	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.46	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.3**	**6.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.0	1.8	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 9 (Basin F)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	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} =	0.012	

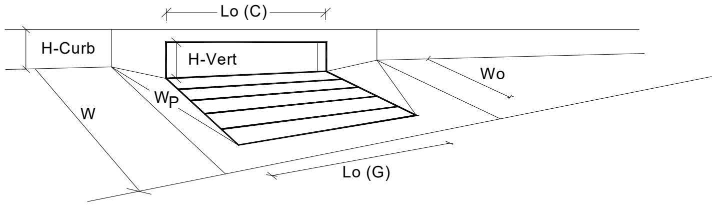
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	60.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

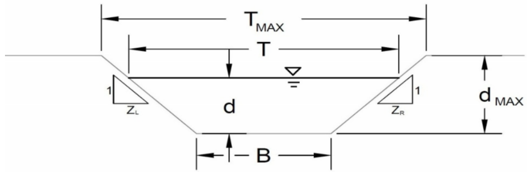


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.33	0.83	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	3.4	6.5	cfs

AREA INLET IN A SWALE

Powers & Grinnell

DP 7 (Basin E)



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0276	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Sloe	Z2 =	5.00	ft/ft

Check one of the following soil types:

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

Choose One:
- Non-Cohesive
- Cohesive
- Paved

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	7.50	14.00	ft
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	0.50	1.00	ft

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	5.9	47.0	cfs
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	0.35	1.00	ft

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	1.1	2.6	cfs
Water Depth	d =	0.14	0.22	ft

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

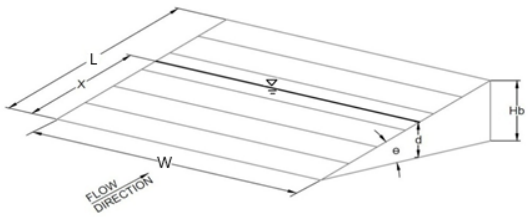
AREA INLET IN A SWALE

Powers & Grinnell

DP 7 (Basin E)

Inlet Design Information (Input)

Type of Inlet	CDOT Type C (Depressed)	Inlet Type = CDOT Type C (Depressed)



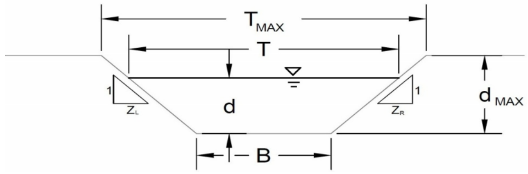
Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	ft
Length of Grate	L =	3.00	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.14	1.22	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**15.2**	**15.7**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

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

AREA INLET IN A SWALE

Powers & Grinnell
DP 27 (Basin M)



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0050	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Sloe	Z2 =	5.00	ft/ft

Check one of the following soil types:

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

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

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**7.50**	**14.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Top Width Criterion	Q_{allow} =	**2.5**	**20.0**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.35**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**1.9**	**4.4**	**cfs**
Water Depth	d =	**0.30**	**0.47**	**ft**

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

MHFD-Inlet, Version 5.02 (August 2022)

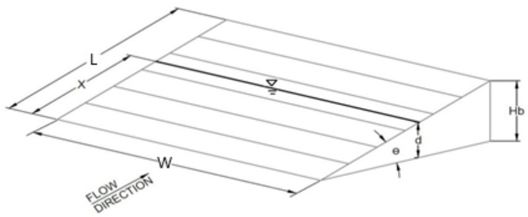
AREA INLET IN A SWALE

Powers & Grinnell

DP 27 (Basin M)

Inlet Design Information (Input)

Type of Inlet	CDOT Type C (Depressed)	Inlet Type =	CDOT Type C (Depressed)
Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	ft
Length of Grate	L =	3.00	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	



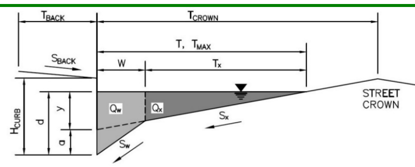
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.30	1.47	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.2**	**17.3**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

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

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

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

Project: Powers & Grinnell
Inlet ID: DP 33 (Basin N-1)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	23.0	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	5.52	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	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} =	0.012	

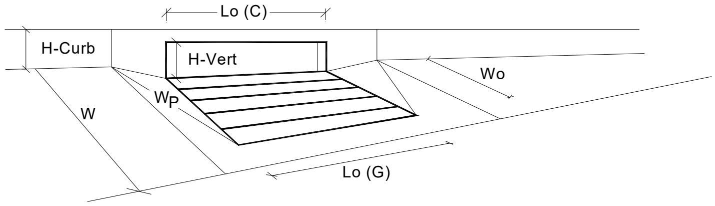
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	23.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.5	7.7	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT/Denver 13 Valley Grate	MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.5	7.7	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

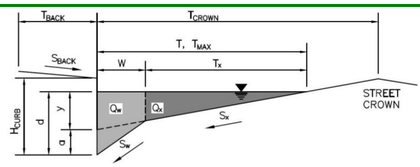
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.48	0.67	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.65	0.91	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.0**	**6.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.0	4.6	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 10 (Basin D)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	2.0	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	1.00	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} =	0.012	

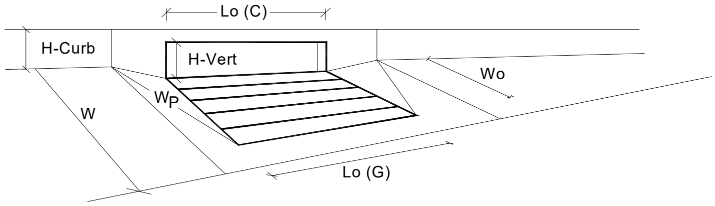
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet: CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	2.9	5.1	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

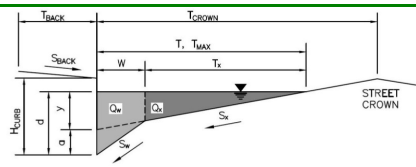
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.16	0.34	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.92	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.3**	**4.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.7	1.3	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 22 (Basin L-2)



Gutter Geometry:

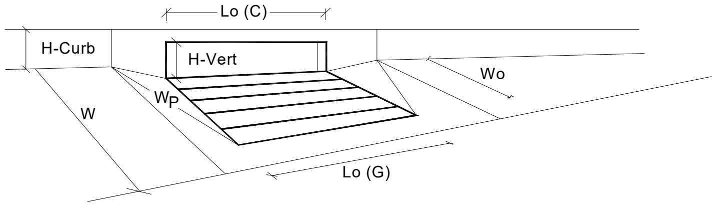
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	19.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	1.00	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.5	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	3.8	6.8	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

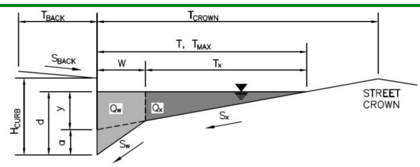
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.23	0.48	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**2.4**	**7.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.8	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 19 (Basin L-1)



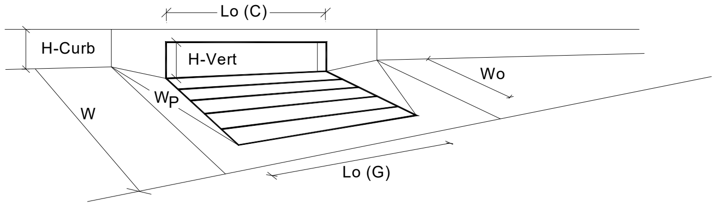
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	44.0		ft
Gutter Width	W =	1.00		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} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	22.0	44.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	11.3	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

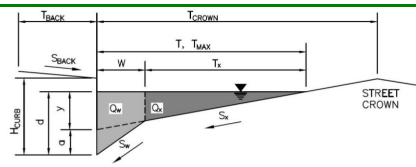
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.42	0.86	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.9**	**11.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.2	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 21 (Basin K-2)



Gutter Geometry:

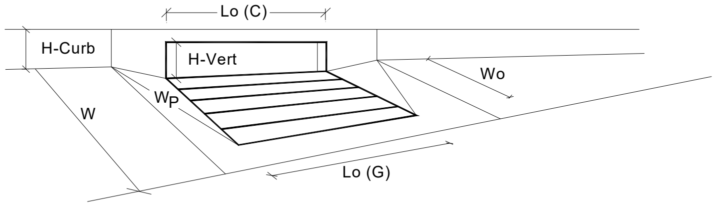
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

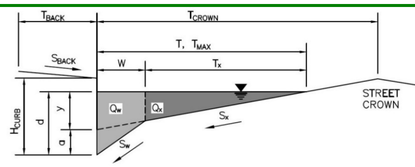


		MINOR	MAJOR	
Design Information (Input) CDOT/Denver 13 Valley Grate				
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.5	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.52	0.65	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.71	0.88	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**3.6**	**6.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.2	4.1	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 17 (Basin K-1)



Gutter Geometry:

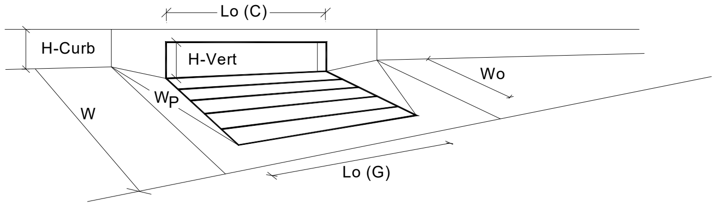
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	50.0	ft
Gutter Width	W =	1.00	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	50.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.42	0.92	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.9**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.2	cfs

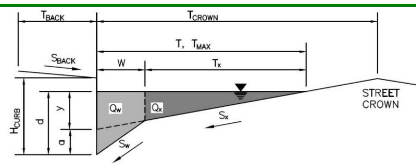
MHFD-Inlet, Version 5.02 (August 2022)

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

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

Project: Powers & Grinnell

Inlet ID: DP 16 (Basin J)



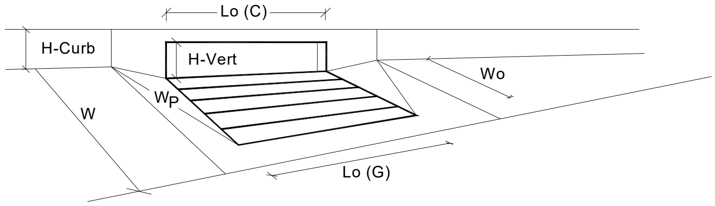
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		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} =	0.012		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	1.00		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} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	2.9	5.1	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

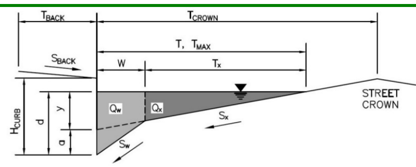
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.16	0.34	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.67	0.88	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.7**	**6.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.0	2.0	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 25 (Basin H-1)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	28.0	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	34.0	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} =	0.012	

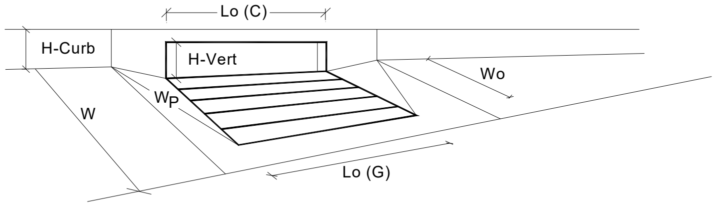
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	34.0	34.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT/Denver 13 Valley Grate		MINOR	MAJOR	
Type of Inlet		Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.9	9.7	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	3.00	3.00	feet
Width of a Unit Grate		W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	0.60	0.60	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	N/A	N/A	

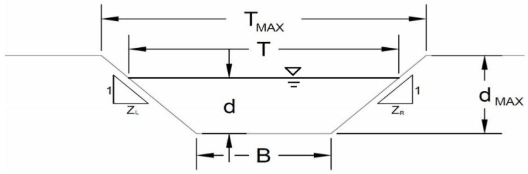
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.60	0.83	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.81	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.1**	**10.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.9	9.4	cfs

AREA INLET IN A SWALE

Powers & Grinnell

DP 30 (Basin P)



This worksheet uses the NRCS vegetal retardance method to determine Manning's n.

For more information see Section 7.2.3 of the USDCM.

Analysis of Trapezoidal Grass-Lined Channel Using SCS Method

NRCS Vegetal Retardance (A, B, C, D, or E)	A, B, C, D, or E =		
Manning's n (Leave cell D16 blank to manually enter an n value)	n =	0.035	
Channel Invert Slope	S_O =	0.0050	ft/ft
Bottom Width	B =	4.00	ft
Left Side Slope	Z1 =	5.00	ft/ft
Right Side Sloe	Z2 =	5.00	ft/ft

Check one of the following soil types:

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

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

		Minor Storm	Major Storm	
Maximum Allowable Top Width of Channel for Minor & Major Storm	T_{MAX} =	**9.00**	**14.00**	**ft**
Maximum Allowable Water Depth in Channel for Minor & Major Storm	d_{MAX} =	**0.50**	**1.00**	**ft**

Allowable Channel Capacity Based On Channel Geometry

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**4.9**	**20.0**	**cfs**
MAJOR STORM Allowable Capacity is based on Depth Criterion	d_{allow} =	**0.50**	**1.00**	**ft**

Water Depth in Channel Based On Design Peak Flow

Design Peak Flow	Q_o =	**3.1**	**10.1**	**cfs**
Water Depth	d =	**0.39**	**0.72**	**ft**

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

MHFD-Inlet, Version 5.02 (August 2022)

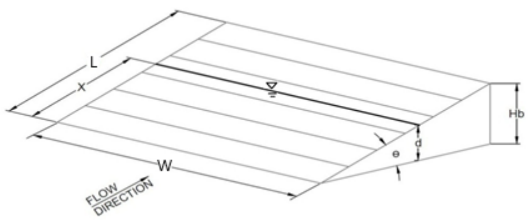
AREA INLET IN A SWALE

Powers & Grinnell

DP 30 (Basin P)

Inlet Design Information (Input)

Type of Inlet: CDOT Type C (Depressed) — Inlet Type = CDOT Type C (Depressed)



Angle of Inclined Grate (must be <= 30 degrees)	θ =	0.00	degrees
Width of Grate	W =	3.00	ft
Length of Grate	L =	3.00	ft
Open Area Ratio	A_{RATIO} =	0.70	
Height of Inclined Grate	H_B =	0.00	ft
Clogging Factor	C_f =	0.50	
Grate Discharge Coefficient	C_d =	0.84	
Orifice Coefficient	C_o =	0.56	
Weir Coefficient	C_w =	1.81	

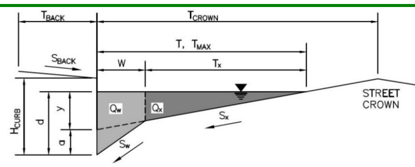
		MINOR	MAJOR	
Water Depth at Inlet (for depressed inlets, 1 foot is added for depression)	d =	1.39	1.72	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**16.8**	**18.6**	**cfs**
Bypassed Flow	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Qa/Qo	**C% =**	**100**	**100**	**%**

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

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

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

Project: Powers & Grinnell
Inlet ID: DP 35 (Basin Q)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	60.0	ft
Gutter Width	W =	1.00	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} =	0.012	

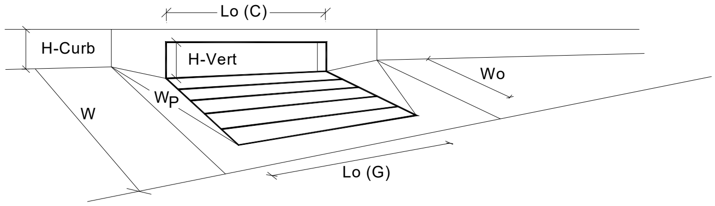
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	60.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

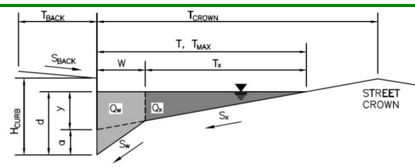
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.42	0.92	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.9**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	2.3	4.8	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 40 (Basin OS-5)



Gutter Geometry:

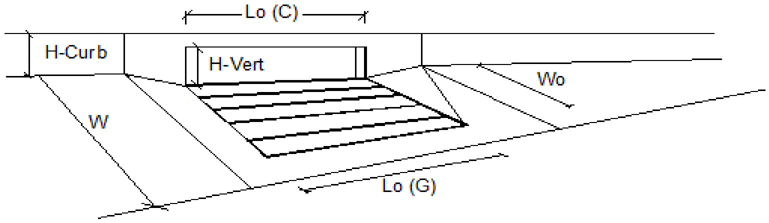
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.044		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**6.9**	**34.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 0.81 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 1.54 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



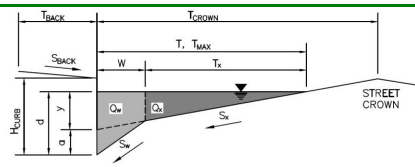
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit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

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.8**	**1.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project: **Powers & Grinnell**
Inlet ID: **DP 39 (Basin OS-4)**



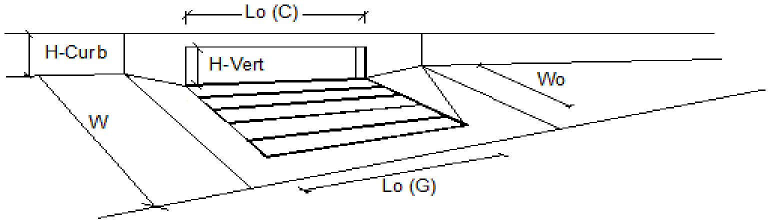
Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		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} =	0.012		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.020		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**4.7**	**23.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.59 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.92 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



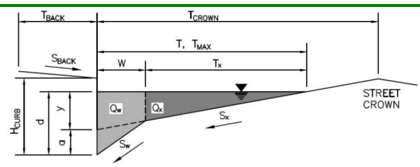
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	2	2	
Length of a Single Unit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

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**1.6**	**2.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

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

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

Project: **Powers & Grinnell**
Inlet ID: **DP 37 (Basin OS-3)**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.0	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} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	38.0	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 =	0.045	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

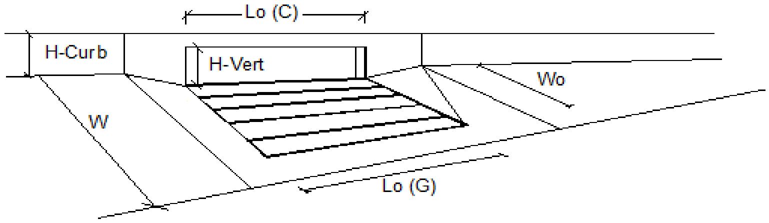
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	19.0	38.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**21.0**	**181.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design peak flow of 5.71 cfs on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design peak flow of 10.53 cfs on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.02 (August 2022)



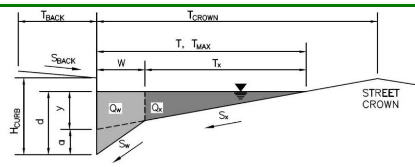
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')		a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)		No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)		L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)		W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)		C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)		C_f (C) =	0.10	0.10	

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.71**	**9.13**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.00**	**1.40**	**cfs**
Capture Percentage = Q_a/Q_o	**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: Powers & Grinnell
Inlet ID: DP 38 (Basin OS-2)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	13.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	31.0	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} =	0.012	

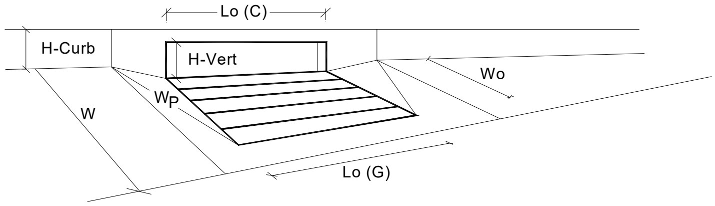
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	31.0	31.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening	MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

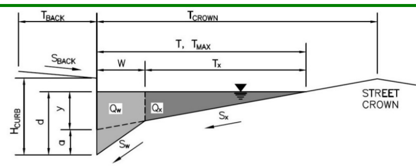
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	$\mathbf{Q_a}$ =	**7.8**	**36.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	7.0	15.1	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 3 (Basin C-1)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	11.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	72.0	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} =	0.012	

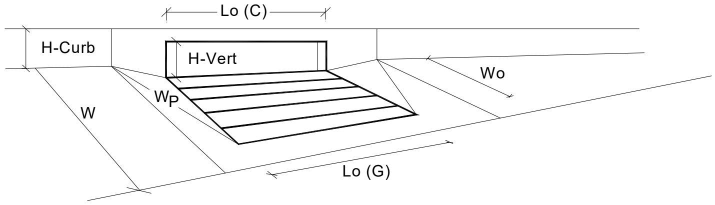
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	36.0	72.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	12.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

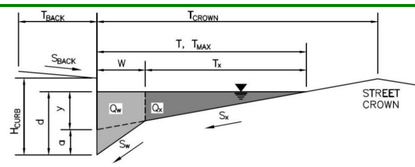
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	3.0	5.0	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 5 (Basin A-2)



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	6.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	42.0	ft
Gutter Width	W =	1.00	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} =	0.012	

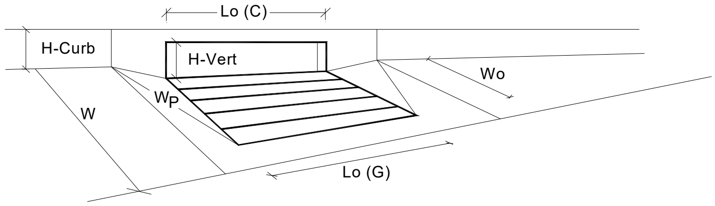
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	21.0	42.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is not applicable to Sump Condition
MAJOR STORM Allowable Capacity is not applicable to Sump Condition

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

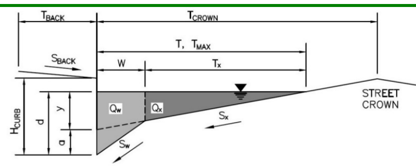


		MINOR	MAJOR	
Design Information (Input) CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.8	10.8	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.40	0.82	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.6**	**11.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.8	3.4	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 14 (Basin C-2)



Gutter Geometry:

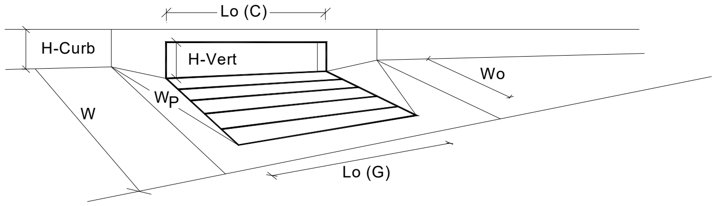
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	1.00	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	13.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition				
MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)

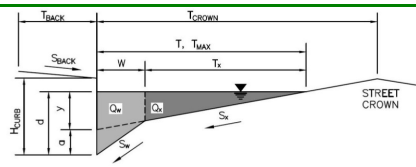


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	3.9	7.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)			MINOR	MAJOR	
Depth for Grate Midwidth		d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation		d_{Curb} =	0.24	0.50	ft
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**2.6**	**7.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)		$Q_{PEAK\ REQUIRED}$ =	0.2	0.4	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 24 (Basin H-2)



Gutter Geometry:

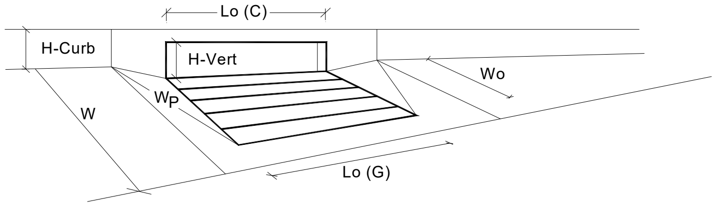
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.012	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	ft
Gutter Width	W =	1.00	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} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	12.5	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	3	3	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.0	6.8	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

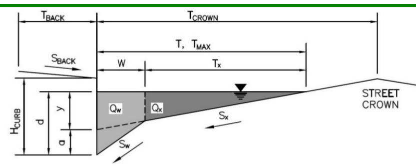
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.48	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.72	0.83	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**7.2**	**14.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	4.7	9.4	cfs

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

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

Project: Powers & Grinnell
Inlet ID: DP 32 (Basin N-2)

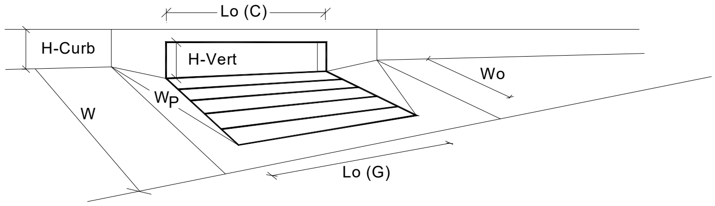


Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0		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} =	0.012		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	44.0		ft
Gutter Width	W =	1.00		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} =	0.012		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	22.0	44.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is not applicable to Sump Condition MAJOR STORM Allowable Capacity is not applicable to Sump Condition	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.02 (August 2022)



		MINOR	MAJOR	
Design Information (Input) — CDOT Type R Curb Opening				
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	11.3	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	1.00	1.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.42	0.86	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**5.9**	**11.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.3	2.5	cfs

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: AMC
Company: HKS
Date: May 8, 2023
Project: Outlook Powers & Grinnell
Location: Swale in Basin B-2

1. Design Discharge for 2-Year Return Period	Q_2 = 0.89 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 162.0 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR}= 4.1 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.025 ft / ft
B) Design Slope	S_D = 0.020 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 4.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 0.00 ft
5. Vegetation A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	Choose One ○ Grass From Seed ◉ Grass From Sod
6. Design Velocity (0.54 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.66 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.58 ft
A) Flow Area	A_2 = 1.3 sq ft
B) Top Width of Swale	W_T = 4.6 ft
C) Froude Number (0.50 maximum)	F = 0.22
D) Hydraulic Radius	R_H = 0.28
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.19
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n = 0.138
G) Cumulative Height of Grade Control Structures Required	H_D = 0.70 ft
8. Underdrain (Is an underdrain necessary?)	Choose One ○ YES ◉ NO
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One ○ Temporary ◉ Permanent

Notes:

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: AMC
Company: HKS
Date: May 8, 2023
Project: Outlook Powers & Grinnell
Location: Swale in Basin E

1. Design Discharge for 2-Year Return Period	Q_2 = 0.78 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 138.7 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR} = 4.4 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.015 ft / ft
B) Design Slope	S_D = 0.015 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 4.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 0.00 ft
5. Vegetation A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	Choose One ○ Grass From Seed ◉ Grass From Sod
6. Design Velocity (0.462 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.52 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.61 ft
A) Flow Area	A_2 = 1.5 sq ft
B) Top Width of Swale	W_T = 4.9 ft
C) Froude Number (0.50 maximum)	F = 0.17
D) Hydraulic Radius	R_H = 0.30
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.16
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n = 0.151
G) Cumulative Height of Grade Control Structures Required	H_D = 0.00 ft
8. Underdrain (Is an underdrain necessary?)	Choose One ◉ YES ○ NO **AN UNDERDRAIN IS REQUIRED IF THE DESIGN SLOPE < 2.0%**
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One ○ Temporary ◉ Permanent

Notes:

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: AMC
Company: HKS
Date: May 8, 2023
Project: Outlook Powers & Grinnell
Location: Swale in Basin M

1. Design Discharge for 2-Year Return Period	Q_2 = 1.33 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 175.7 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR}= 6.8 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.005 ft / ft
B) Design Slope	S_D = 0.005 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 4.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 0.00 ft
5. Vegetation	Choose One
A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	○ Grass From Seed ◉ Grass From Sod
6. Design Velocity (0.586 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.43 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.88 ft
A) Flow Area	A_2 = 3.1 sq ft
B) Top Width of Swale	W_T = 7.0 ft
C) Froude Number (0.50 maximum)	F = 0.11
D) Hydraulic Radius	R_H = 0.43
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.18
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n = 0.139
G) Cumulative Height of Grade Control Structures Required	H_D = 0.00 ft
8. Underdrain (Is an underdrain necessary?)	Choose One: ◉ YES ○ NO — **AN UNDERDRAIN IS REQUIRED IF THE DESIGN SLOPE < 2.0%**
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One: ○ Temporary ◉ Permanent

Notes:

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer:	**AMC**
Company:	**HKS**
Date:	**May 8, 2023**
Project:	**Outlook Powers & Grinnell**
Location:	**Swale in Basin P - East**

1. Design Discharge for 2-Year Return Period	Q_2 =	1.96 cfs
2. Hydraulic Residence Time		
A) : Length of Grass Swale	L_S =	420.2 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR} =	7.5 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)		
A) Available Slope (based on site constraints)	S_{avail} =	0.032 ft / ft
B) Design Slope	S_D =	0.030 ft / ft
4. Swale Geometry		
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z =	5.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B =	4.00 ft
5. Vegetation	Choose One	
A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	○ Grass From Seed ◉ Grass From Sod	
6. Design Velocity (1 ft / s maximum)	V_2 =	0.94 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 =	0.36 ft
A) Flow Area	A_2 =	2.1 sq ft
B) Top Width of Swale	W_T =	7.6 ft
C) Froude Number (0.50 maximum)	F =	0.32
D) Hydraulic Radius	R_H =	0.27
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR =	0.26
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n =	0.117
G) Cumulative Height of Grade Control Structures Required	H_D =	0.70 ft
8. Underdrain (Is an underdrain necessary?)	Choose One ○ YES ◉ NO	
9. Soil Preparation (Describe soil amendment)		
10. Irrigation	Choose One ○ Temporary ◉ Permanent	

Notes:

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: AMC
Company: HKS
Date: May 8, 2023
Project: Outlook Powers & Grinnell
Location: Swale in Basin P - West

1. Design Discharge for 2-Year Return Period	Q_2 = 1.96 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 147.4 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR}= 2.8 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.026 ft / ft
B) Design Slope	S_D = 0.025 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 5.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 4.00 ft
5. Vegetation	Choose One
A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	○ Grass From Seed ◉ Grass From Sod
6. Design Velocity (0.491 ft / s maximum for desirable 5-minute residence time)	V_2 = 0.87 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.38 ft
A) Flow Area	A_2 = 2.2 sq ft
B) Top Width of Swale	W_T = 7.8 ft
C) Froude Number (0.50 maximum)	F = 0.29
D) Hydraulic Radius	R_H = 0.28
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.25
F) Manning's n (based on SCS vegetal retardance curve D for sodded grass)	n = 0.118
G) Cumulative Height of Grade Control Structures Required	H_D = 0.10 ft
8. Underdrain (Is an underdrain necessary?)	Choose One: ○ YES ◉ NO
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One: ○ Temporary ◉ Permanent

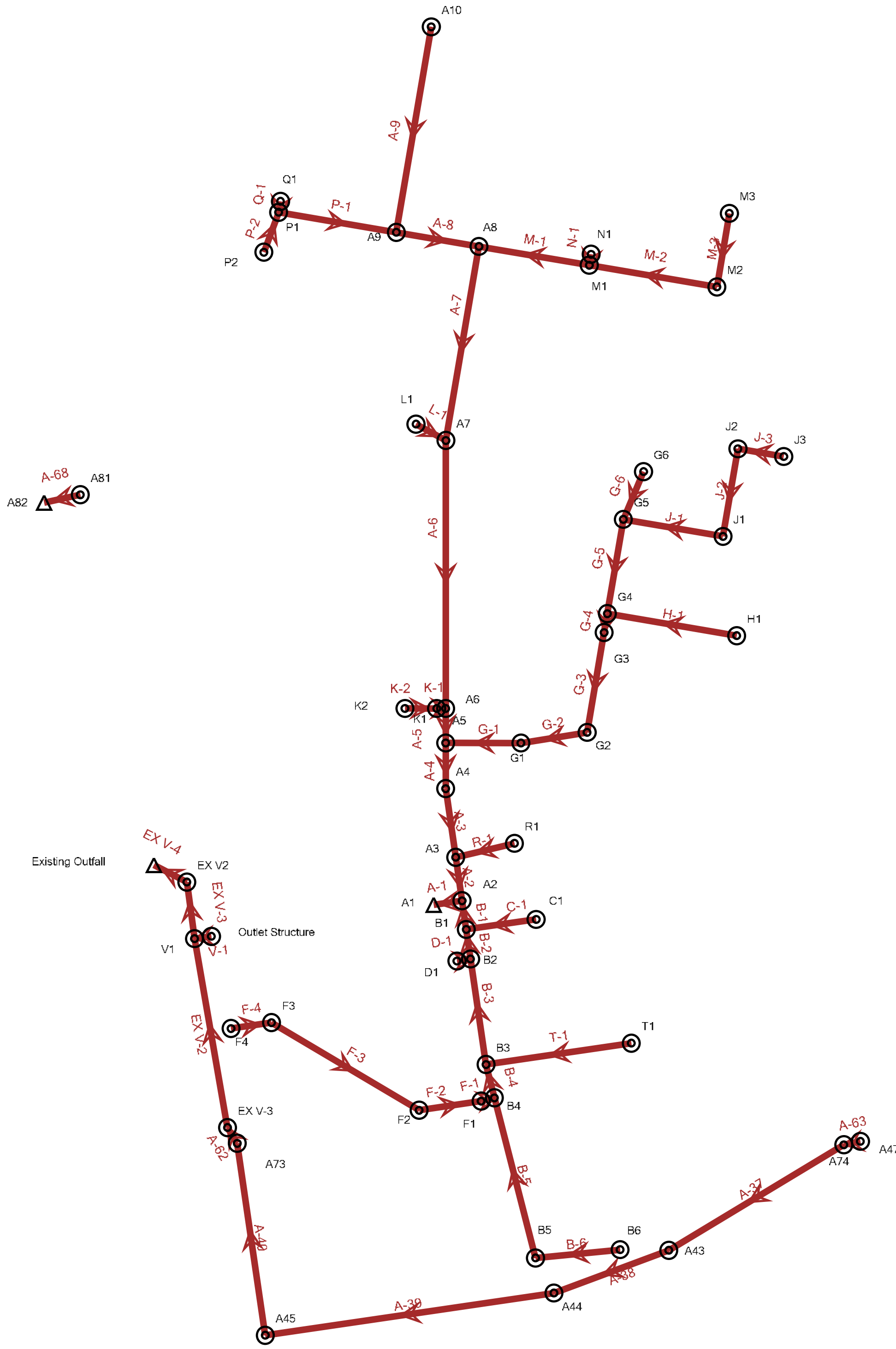
Notes:

Will review storm system design with next review when hydrology spreadsheets have been updated with all basin and design point flows.

Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Scenario: 100-YR



Powers & Grinnell StormCAD.stsw

Active Scenario: 5-YR

FlexTable: Conduit Table

Show tailwater in results table.

Label	Start Node	Stop Node	Diameter (in)	Manning's n	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Froude Number (Normal)
A-1	A2	A1	42.0	0.012	25.3	5,882.04	5,881.91	0.005	28.34	78.15	7.47	5,885.34	5,885.33	1.257
A-2	A3	A2	30.0	0.012	38.8	5,892.95	5,891.79	0.030	18.96	76.79	12.96	5,894.43	5,892.76	2.905
A-3	A4	A3	30.0	0.012	61.4	5,893.46	5,893.15	0.005	18.97	31.57	6.72	5,894.94	5,894.55	1.112
A-4	A5	A4	30.0	0.012	40.4	5,893.86	5,893.66	0.005	18.97	31.26	6.67	5,895.34	5,895.07	1.099
A-5	A6	A5	30.0	0.012	30.5	5,894.20	5,894.04	0.005	15.13	32.19	6.45	5,895.51	5,895.26	1.175
A-6	A7	A6	24.0	0.012	237.1	5,899.01	5,897.11	0.008	8.19	21.94	6.48	5,900.03	5,897.96	1.427
A-7	A8	A7	24.0	0.012	174.1	5,900.59	5,899.20	0.008	6.66	21.89	6.12	5,901.50	5,899.96	1.440
A-8	A9	A8	18.0	0.012	74.2	5,901.46	5,901.09	0.005	5.40	8.04	4.88	5,902.36	5,901.99	0.991
A-9	A10	A9	18.0	0.012	184.5	5,905.47	5,903.99	0.008	3.13	10.19	5.08	5,906.14	5,904.56	1.376
A-37	A74	A43	48.0	0.012	181.2	5,890.28	5,881.23	0.050	0.00	347.77	0.00	5,890.28	5,881.23	(N/A)
A-38	A43	A44	48.0	0.012	108.6	5,880.70	5,879.50	0.011	0.00	163.57	0.00	5,880.70	5,879.50	(N/A)
A-39	A44	A45	48.0	0.012	258.3	5,879.30	5,878.01	0.005	0.00	109.96	0.00	5,879.30	5,878.01	(N/A)
A-40	A45	A73	48.0	0.012	171.6	5,877.81	5,876.95	0.005	0.00	110.15	0.00	5,877.81	5,876.95	(N/A)
A-62	A73	EX V-3	48.0	0.012	16.3	5,875.04	5,874.88	0.010	0.00	153.98	0.00	5,875.04	5,874.88	(N/A)
A-63	A47	A74	48.0	0.012	15.0	5,890.78	5,890.48	0.020	0.00	220.08	0.00	5,890.78	5,890.48	(N/A)
A-68	A81	A82	18.0	0.012	32.9	5,896.72	5,896.23	0.015	5.71	13.90	7.48	5,897.64	5,896.93	1.842
B-1	B1	A2	36.0	0.012	25.7	5,882.27	5,882.14	0.005	10.34	51.41	1.46	5,885.37	5,885.36	1.236
B-2	B2	B1	30.0	0.012	26.4	5,882.50	5,882.37	0.005	8.20	31.17	1.67	5,885.38	5,885.37	1.178
B-3	B3	B2	30.0	0.012	94.3	5,883.07	5,882.60	0.005	6.96	31.36	5.14	5,885.40	5,885.38	1.188
B-4	B4	B3	30.0	0.012	30.3	5,883.32	5,883.17	0.005	6.97	31.28	5.13	5,885.40	5,885.40	1.185
B-5	B5	B4	18.0	0.012	146.4	5,884.05	5,883.32	0.005	2.20	8.03	3.88	5,885.46	5,885.40	1.088
B-6	B6	B5	18.0	0.012	75.2	5,884.53	5,884.15	0.005	1.23	8.09	3.31	5,885.49	5,885.49	1.098
C-1	C1	B1	18.0	0.012	62.6	5,894.24	5,892.41	0.029	2.93	19.46	7.93	5,894.89	5,892.80	2.642
D-1	D1	B2	18.0	0.012	12.2	5,891.74	5,891.62	0.010	1.79	11.30	4.67	5,892.24	5,892.04	1.535
EX V-2	EX V-3	V1	48.0	0.012	171.3	5,874.78	5,874.05	0.004	0.00	101.57	0.00	5,874.78	5,874.25	(N/A)
EX V-3	V1	EX V2	48.0	0.012	50.5	5,874.05	5,873.84	0.004	0.50	100.34	2.07	5,874.25	5,874.05	0.986
EX V-4	EX V2	Existing Outfall	48.0	0.012	26.7	5,873.84	5,873.74	0.004	0.50	95.30	2.00	5,874.05	5,873.94	0.939
F-1	F1	B4	24.0	0.013	12.2	5,884.86	5,884.80	0.005	4.77	15.86	4.42	5,885.63	5,885.55	1.043
F-2	F2	F1	24.0	0.012	55.5	5,885.24	5,884.96	0.005	3.86	17.40	4.45	5,885.93	5,885.70	1.152
F-3	F3	F2	18.0	0.012	152.0	5,886.21	5,885.44	0.005	0.66	8.10	2.76	5,886.51	5,886.03	1.083
F-4	F4	F3	18.0	0.012	36.2	5,886.59	5,886.41	0.005	0.66	8.03	2.74	5,886.89	5,886.70	1.074
G-1	G1	A5	18.0	0.012	66.7	5,897.19	5,896.52	0.010	4.90	11.41	6.21	5,898.04	5,897.21	1.506
G-2	G2	G1	18.0	0.012	59.4	5,899.89	5,897.52	0.040	4.10	22.73	9.75	5,900.67	5,897.95	3.090
G-3	G3	G2	18.0	0.012	89.6	5,901.53	5,900.19	0.015	4.10	13.92	6.85	5,902.31	5,900.75	1.881
G-4	G4	G3	18.0	0.012	16.9	5,901.81	5,901.73	0.005	3.64	7.82	4.35	5,902.54	5,902.45	1.026
G-5	G5	G4	18.0	0.012	84.6	5,902.43	5,902.01	0.005	3.19	8.02	4.28	5,903.11	5,902.67	1.066
G-6	G6	G5	18.0	0.012	45.9	5,902.86	5,902.63	0.005	2.15	8.06	3.86	5,903.41	5,903.16	1.091
H-1	H1	G4	18.0	0.012	116.2	5,903.52	5,902.21	0.011	0.55	12.08	3.46	5,903.79	5,902.54	1.576
J-1	J1	G5	18.0	0.012	89.6	5,903.54	5,902.63	0.010	1.33	11.47	4.33	5,903.97	5,903.12	1.549
J-2	J2	J1	18.0	0.012	78.6	5,904.13	5,903.74	0.005	1.33	8.01	3.36	5,904.56	5,904.15	1.089
J-3	J3	J2	18.0	0.012	41.2	5,904.53	5,904.33	0.005	1.33	7.93	3.33	5,904.96	5,904.75	1.078
K-1	K1	A6	24.0	0.012	8.0	5,894.30	5,894.26	0.005	8.69	17.33	5.52	5,895.55	5,895.55	1.096
K-2	K2	K1	24.0	0.012	28.1	5,894.64	5,894.50	0.005	4.87	17.30	4.73	5,895.59	5,895.60	1.140
L-1	L1	A7	18.0	0.012	30.2	5,899.36	5,899.21	0.005	1.85	8.03	3.69	5,900.04	5,900.04	1.091

Verify flows and add a note providing the source.

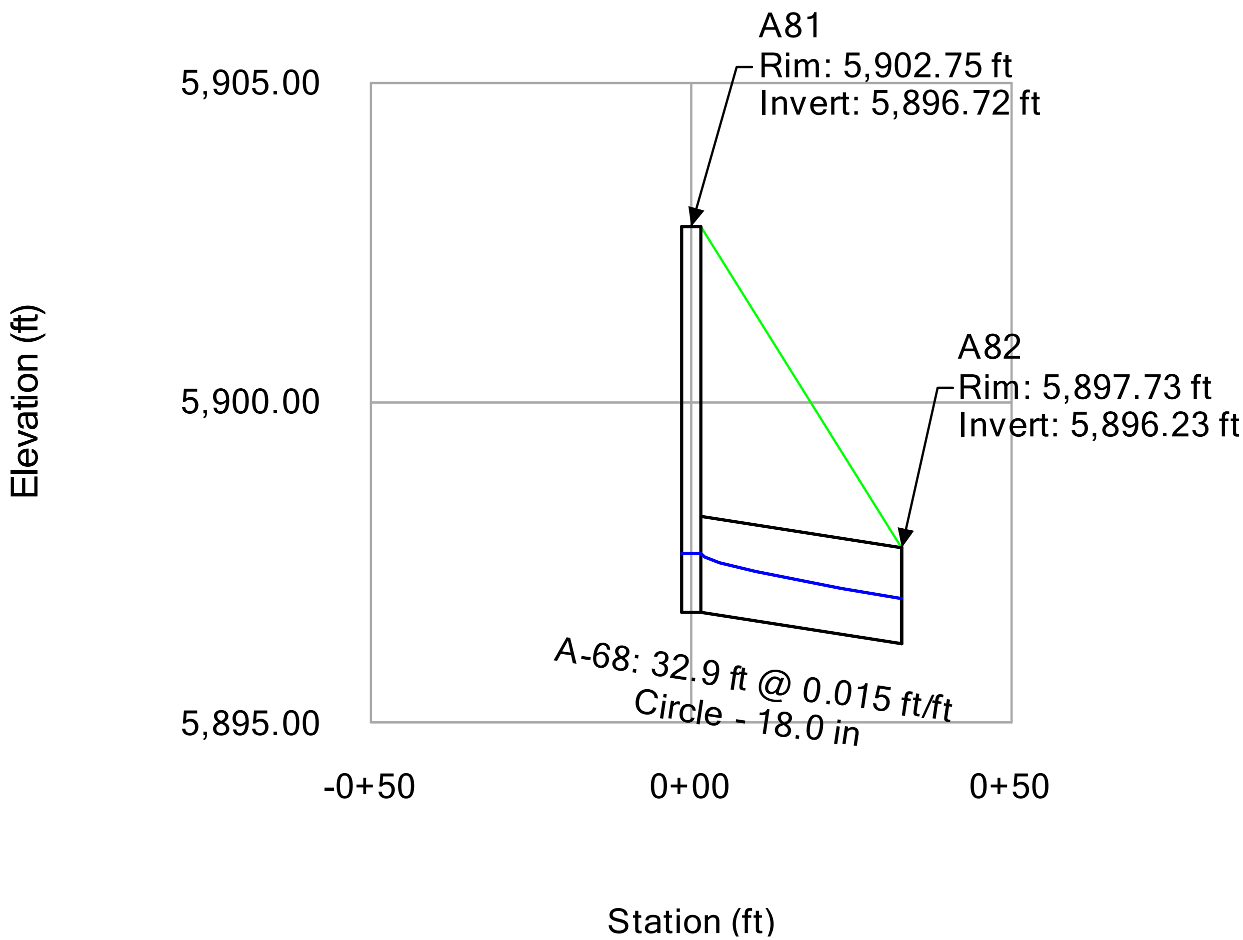
Powers & Grinnell StormCAD.stsw

Active Scenario: 5-YR

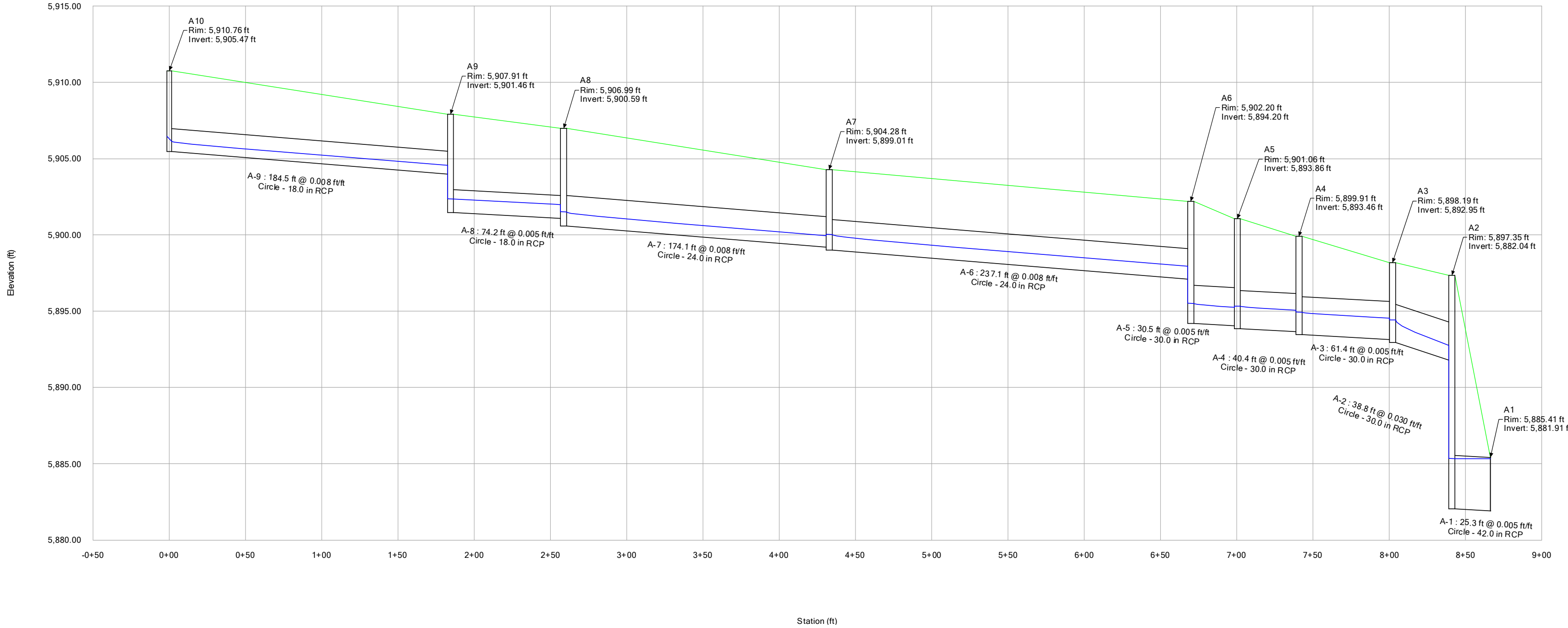
FlexTable: Conduit Table

Label	Start Node	Stop Node	Diameter (in)	Manning's n	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Froude Number (Normal)
M-1	M1	A8	18.0	0.012	99.1	5,903.06	5,902.45	0.006	1.85	8.93	3.98	5,903.57	5,902.91	1.214
M-2	M2	M1	18.0	0.012	114.7	5,904.39	5,903.40	0.009	1.85	10.57	4.50	5,904.90	5,903.82	1.438
M-3	M3	M2	18.0	0.012	66.0	5,906.38	5,904.49	0.029	1.85	19.25	6.89	5,906.89	5,904.80	2.587
N-1	N1	M1	18.0	0.012	9.8	5,903.66	5,903.24	0.043	1.85	23.51	7.92	5,904.17	5,903.57	3.135
P-1	P1	A9	18.0	0.012	105.7	5,902.13	5,901.66	0.004	3.22	7.59	4.12	5,902.81	5,902.37	1.003
P-2	P2	P1	18.0	0.012	37.7	5,902.52	5,902.33	0.005	1.96	8.08	3.77	5,903.05	5,902.83	1.097
Q-1	Q1	P1	18.0	0.012	9.8	5,903.00	5,902.74	0.026	1.29	18.50	6.02	5,903.43	5,903.04	2.460
R-1	R1	A3	18.0	0.012	53.5	5,895.29	5,893.68	0.030	0.23	19.74	3.76	5,895.47	5,894.48	2.385
T-1	T1	B3	18.0	0.012	130.1	5,886.91	5,886.26	0.005	1.09	8.04	3.18	5,887.30	5,886.63	1.090
V-1	Outlet Structure	V1	18.0	0.012	15.1	5,877.50	5,877.19	0.021	0.50	16.31	4.15	5,877.76	5,877.37	2.082

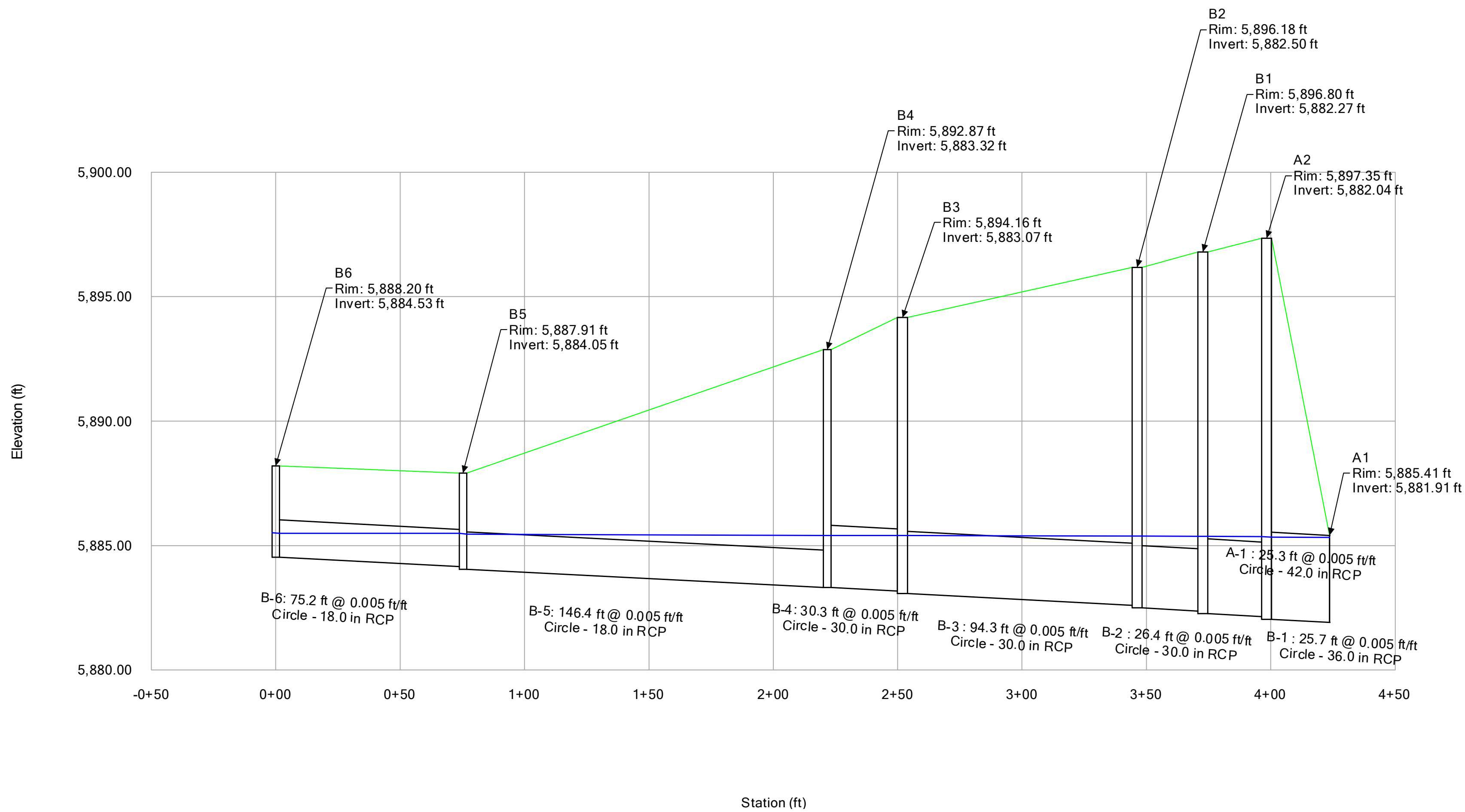
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Grinnell Inlet (Powers & Grinnell StormCAD.stsw)



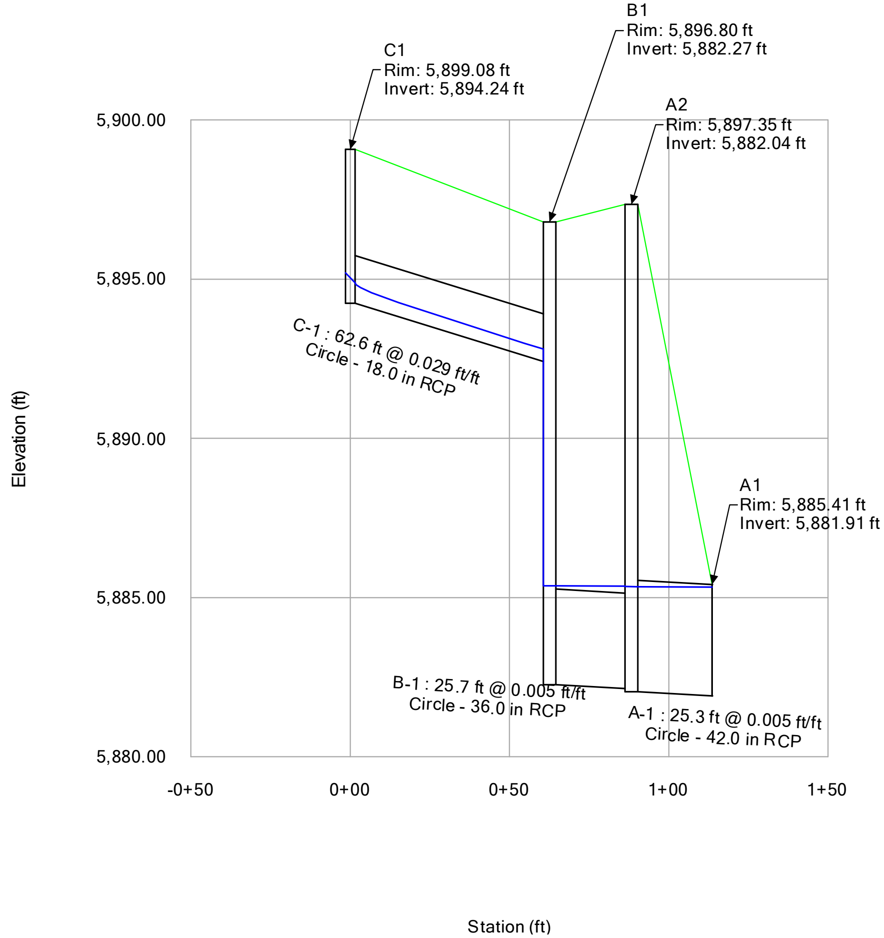
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline A (Powers & Grinnell StormCAD.stsw)



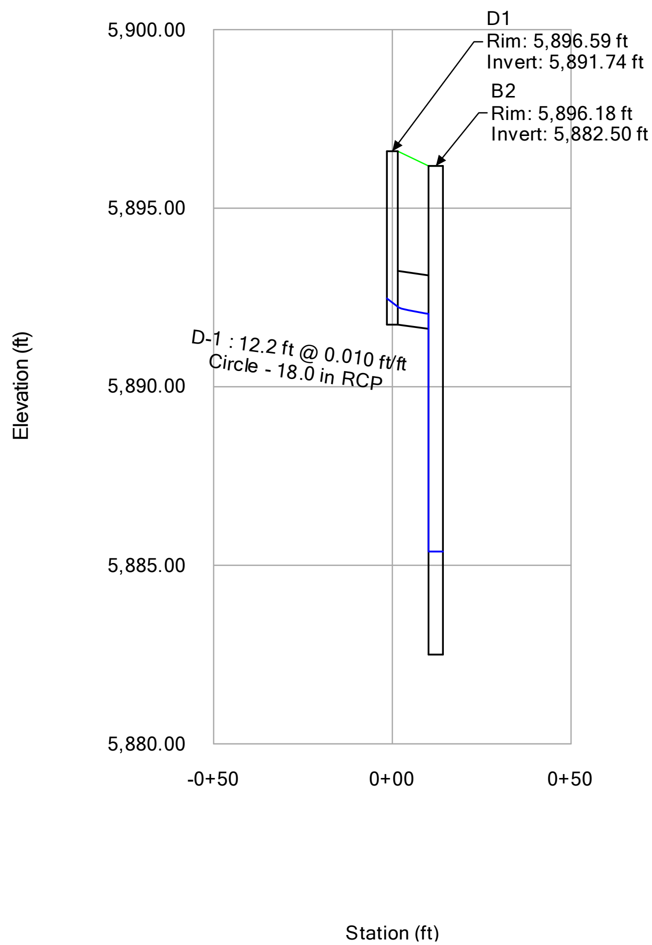
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline B (Powers & Grinnell StormCAD.stsw)



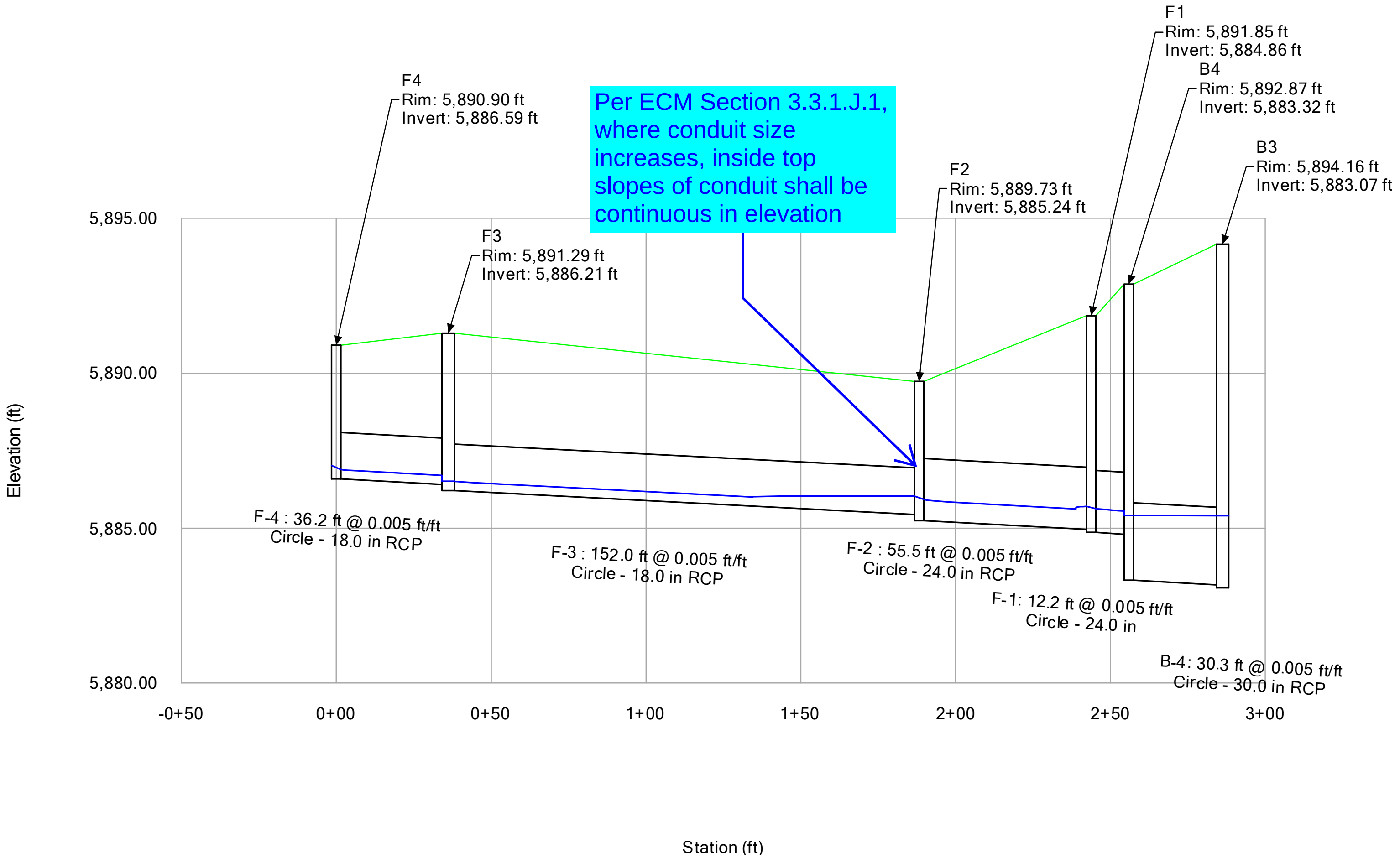
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline C (Powers & Grinnell StormCAD.stsw)



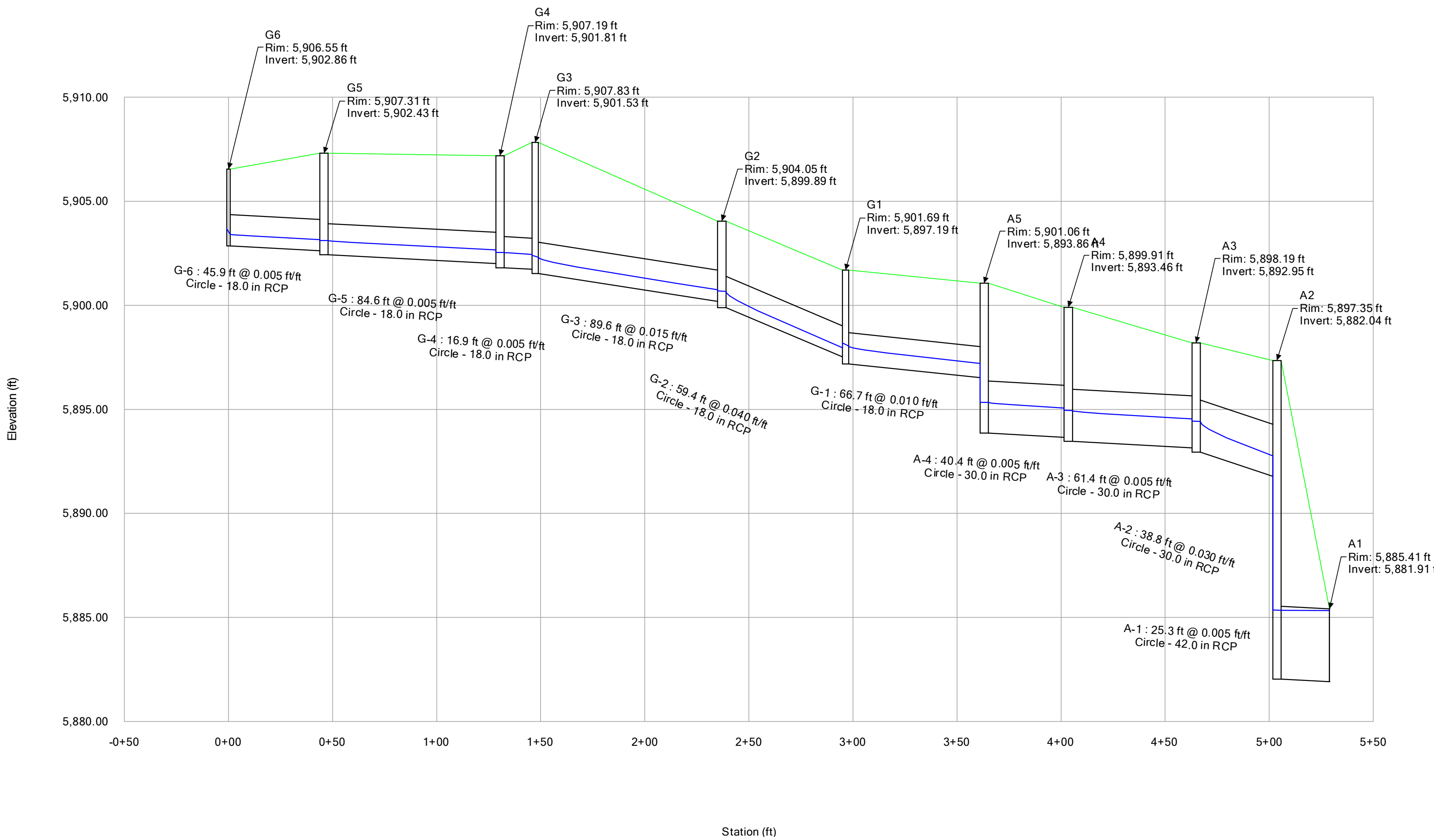
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline D (Powers & Grinnell StormCAD.stsw)



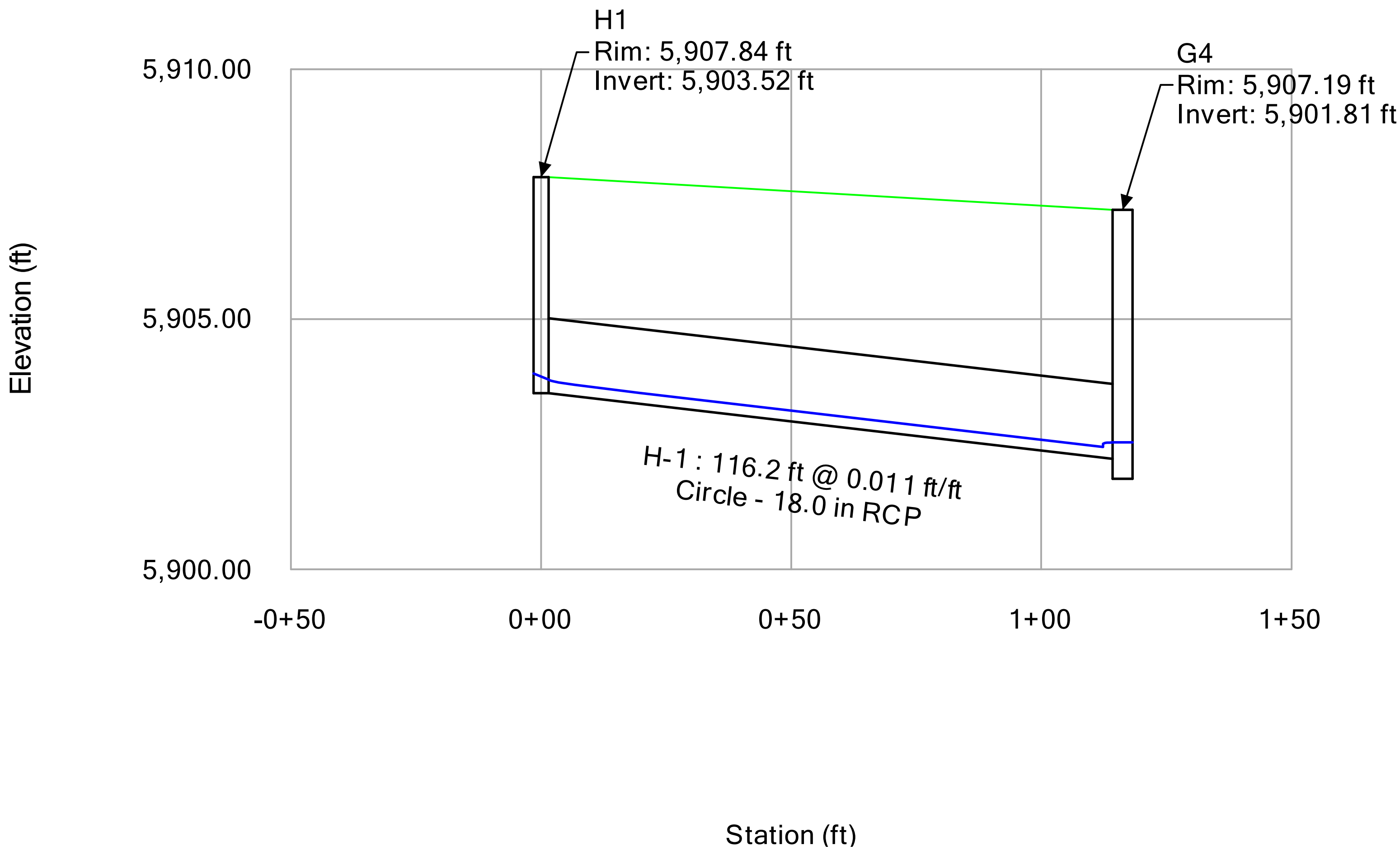
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline F (Powers & Grinnell StormCAD.stsw)



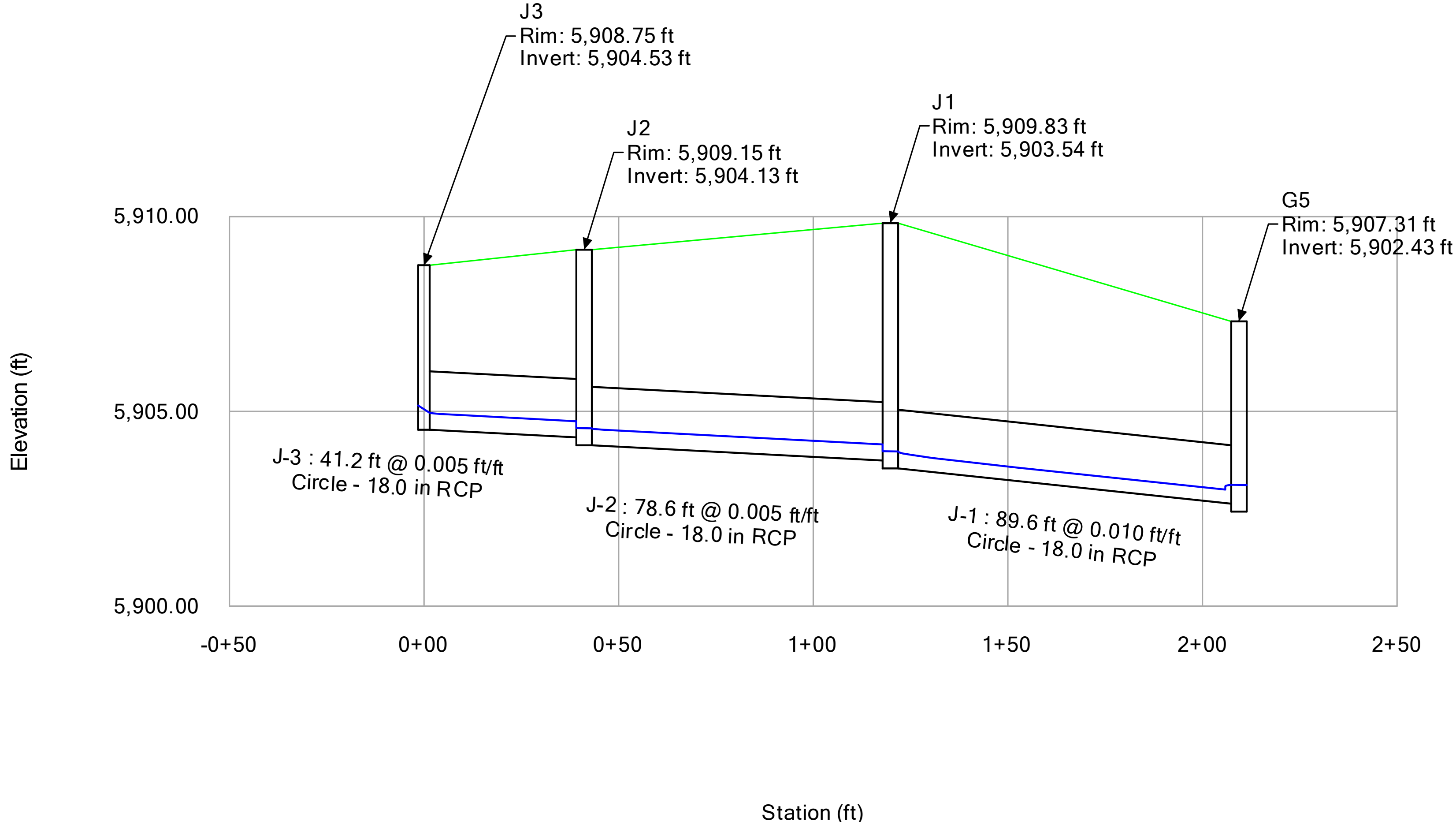
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline G (Powers & Grinnell StormCAD.stsw)



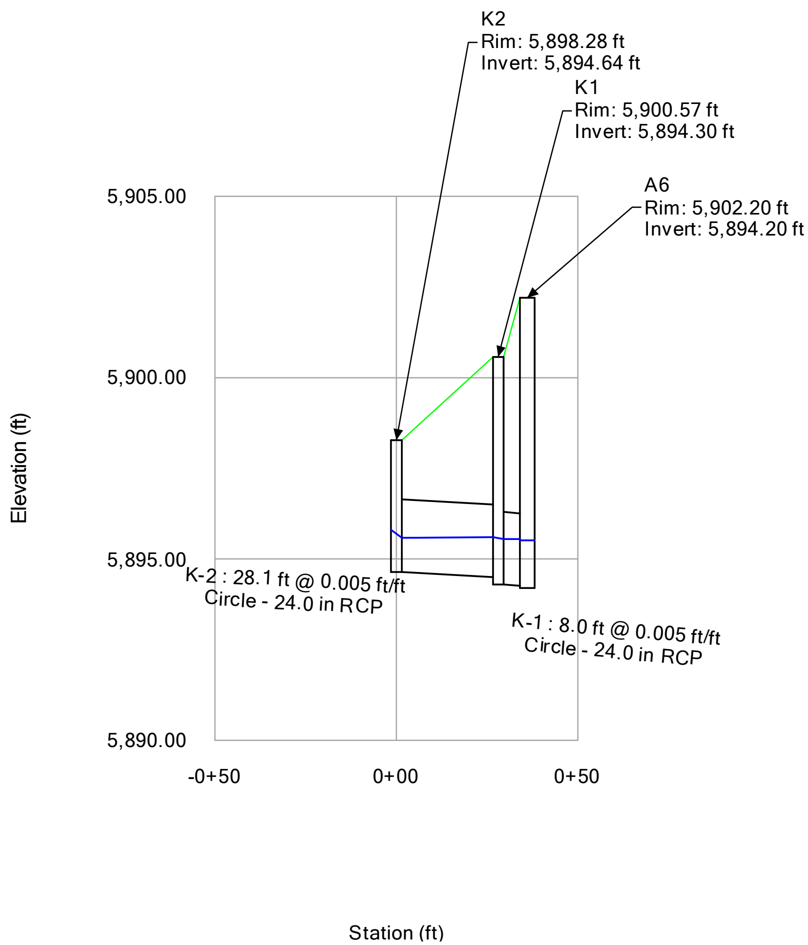
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline H (Powers & Grinnell StormCAD.stsw)



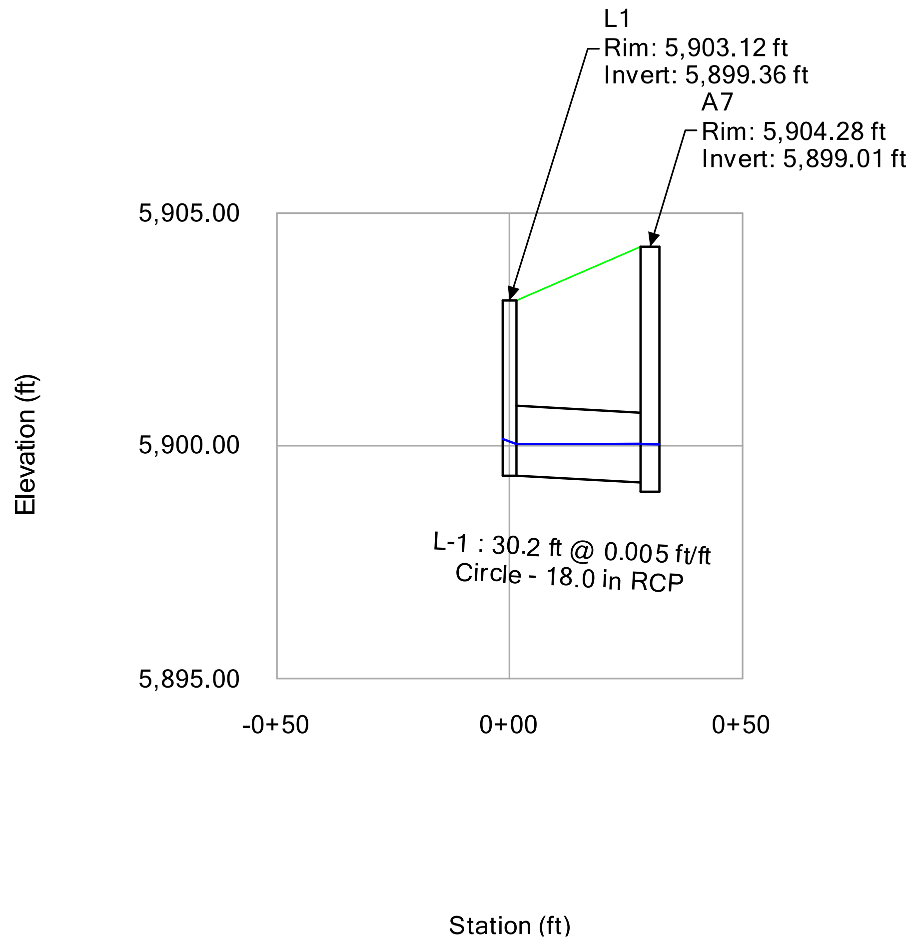
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline J (Powers & Grinnell StormCAD.stsw)



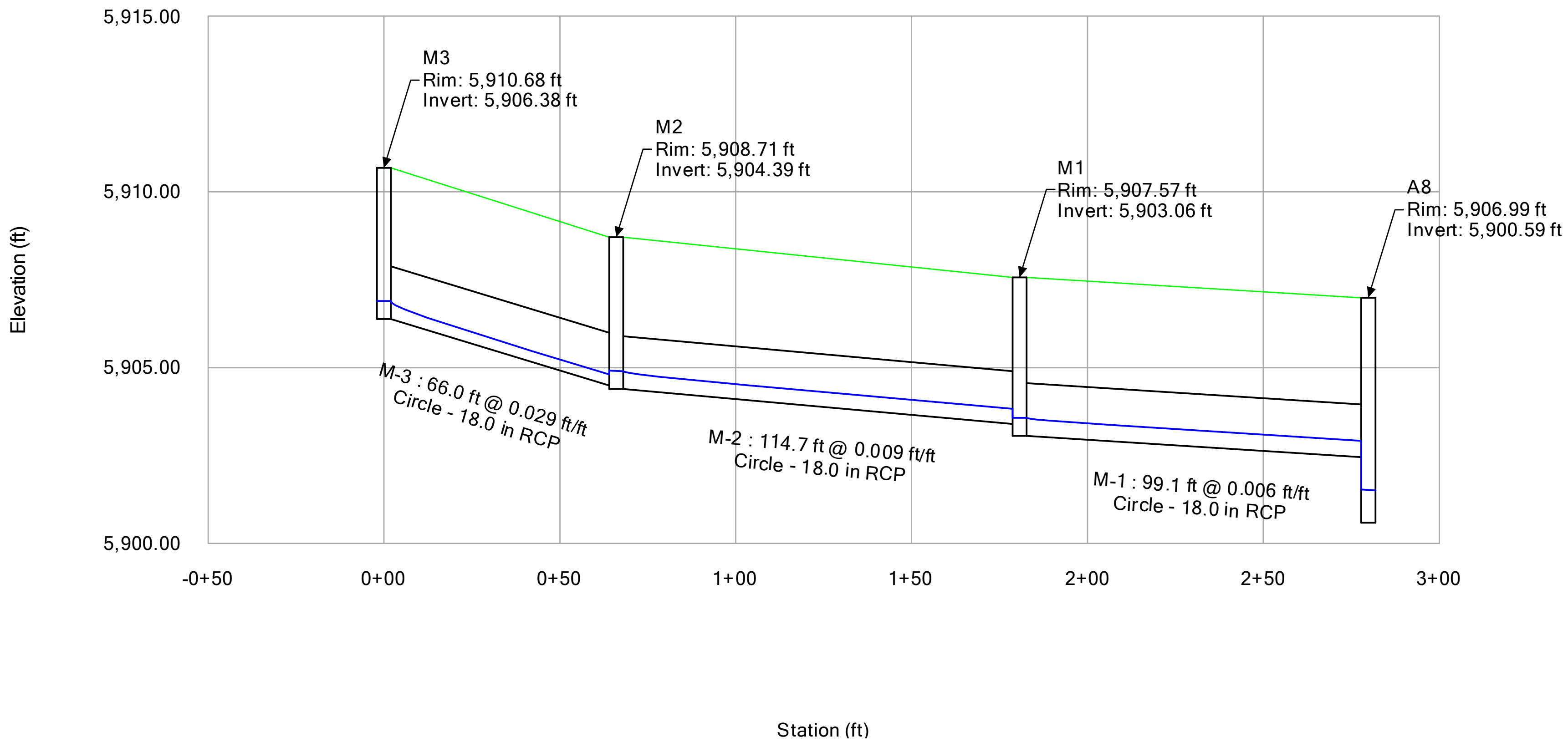
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline K (Powers & Grinnell StormCAD.stsw)



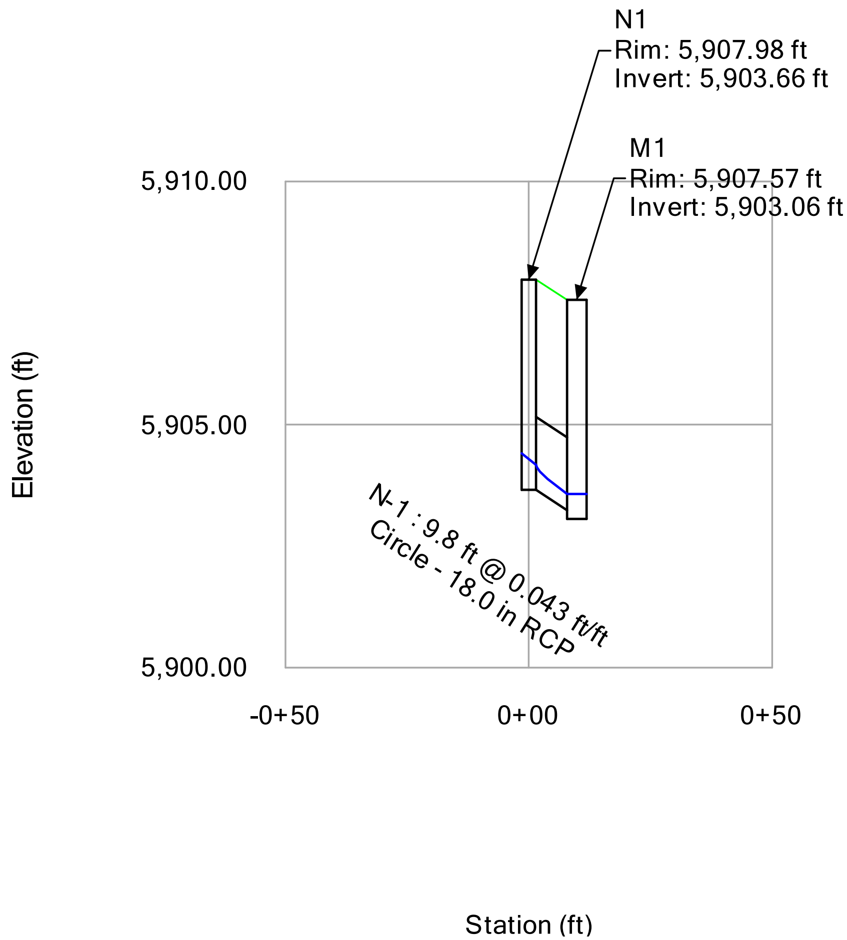
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline L (Powers & Grinnell StormCAD.stsw)



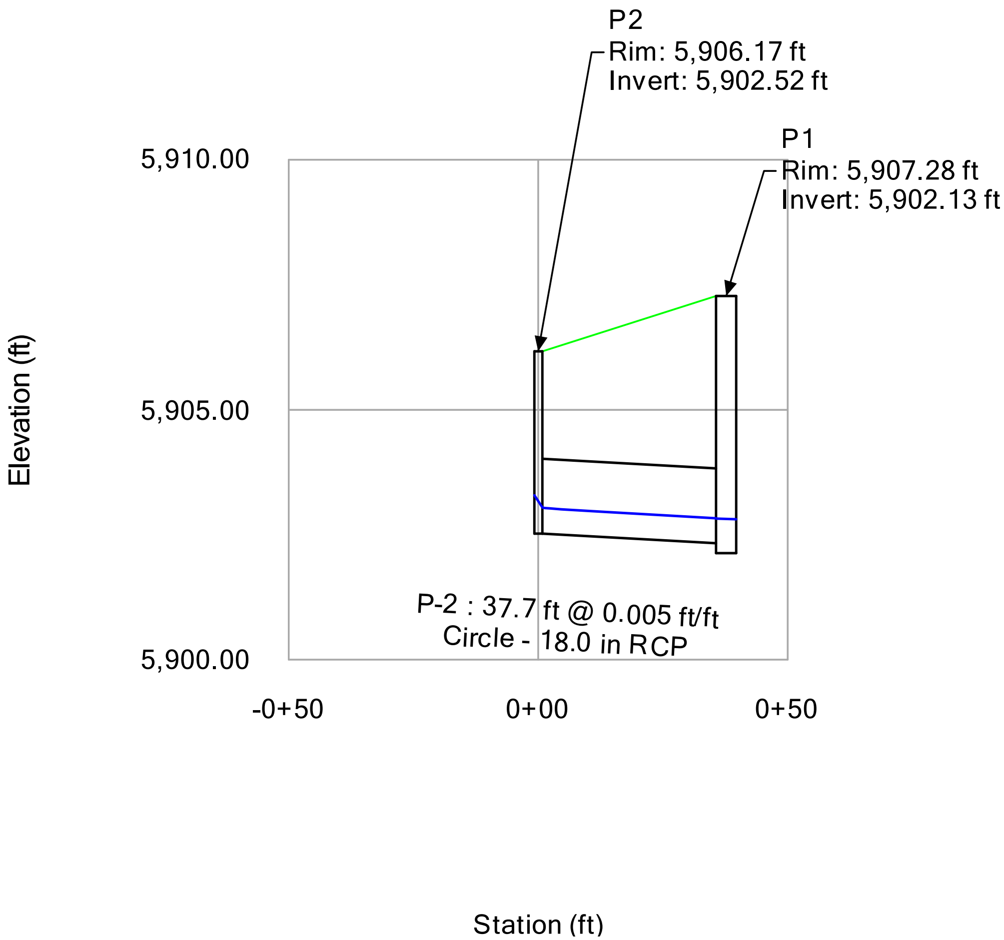
Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline M (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline N (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline P (Powers & Grinnell StormCAD.stsw)

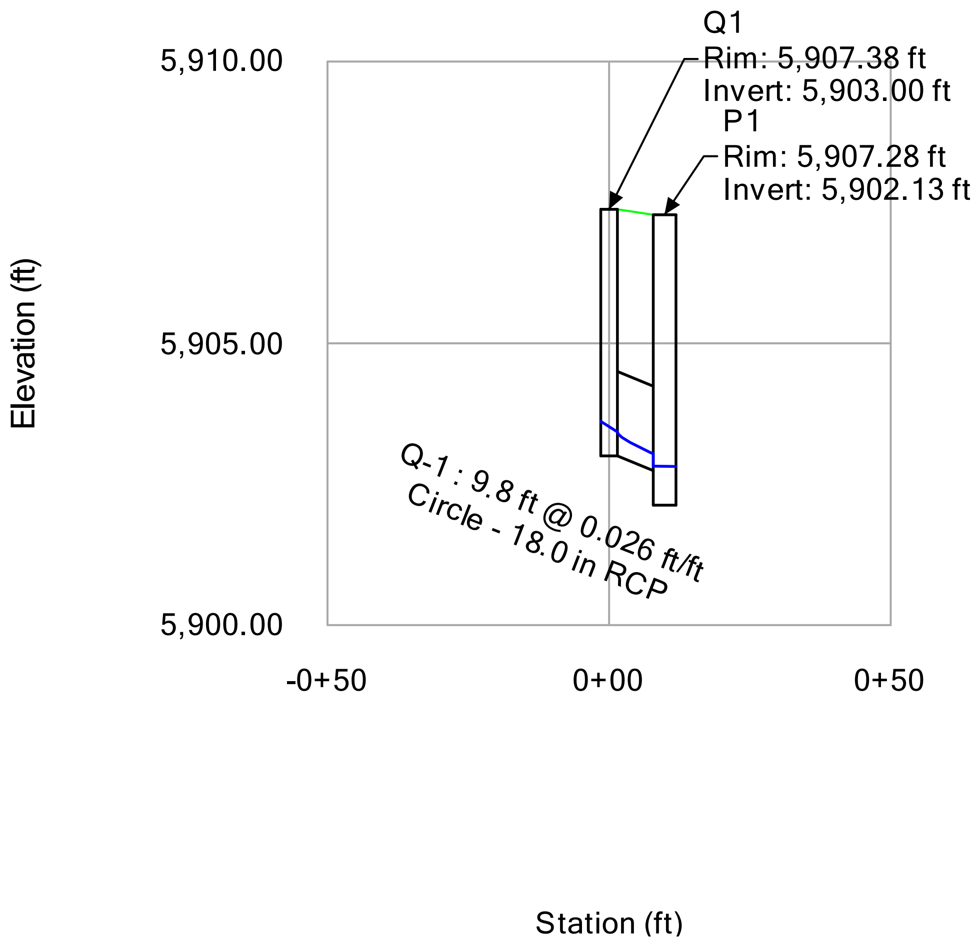


Powers & Grinnell StormCAD.stsw

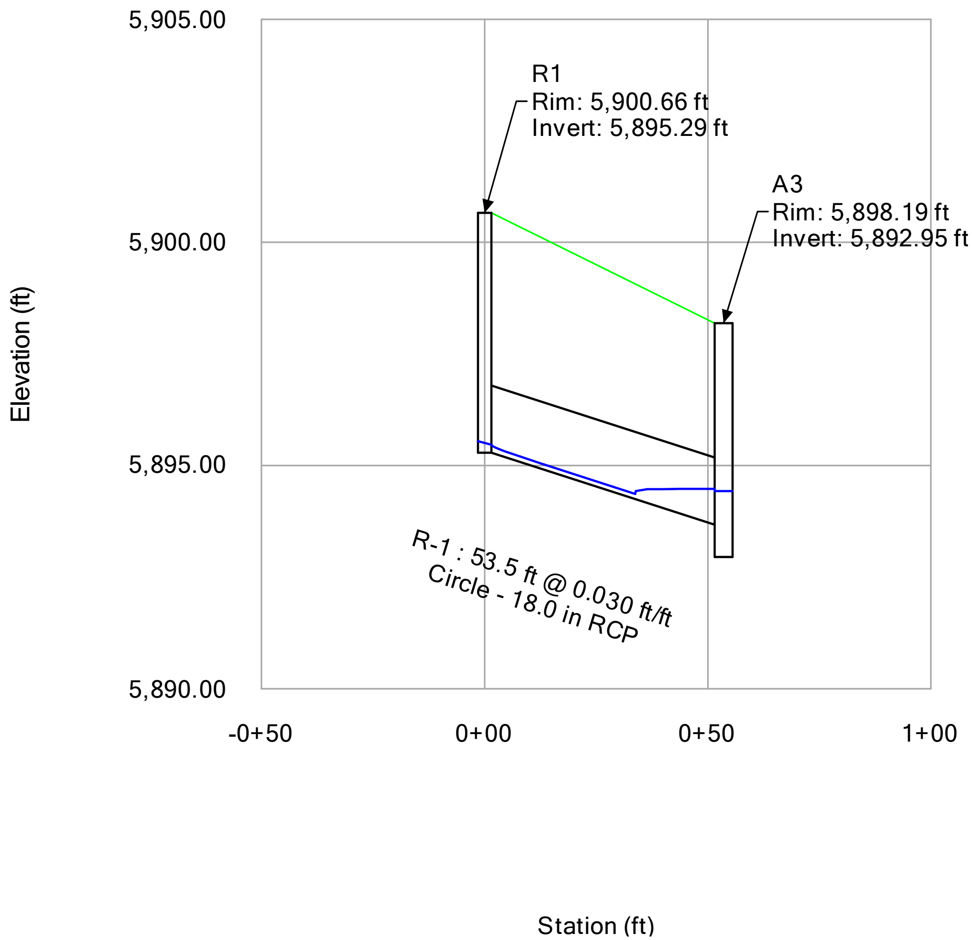
Active Scenario: 5-YR

Profile Report

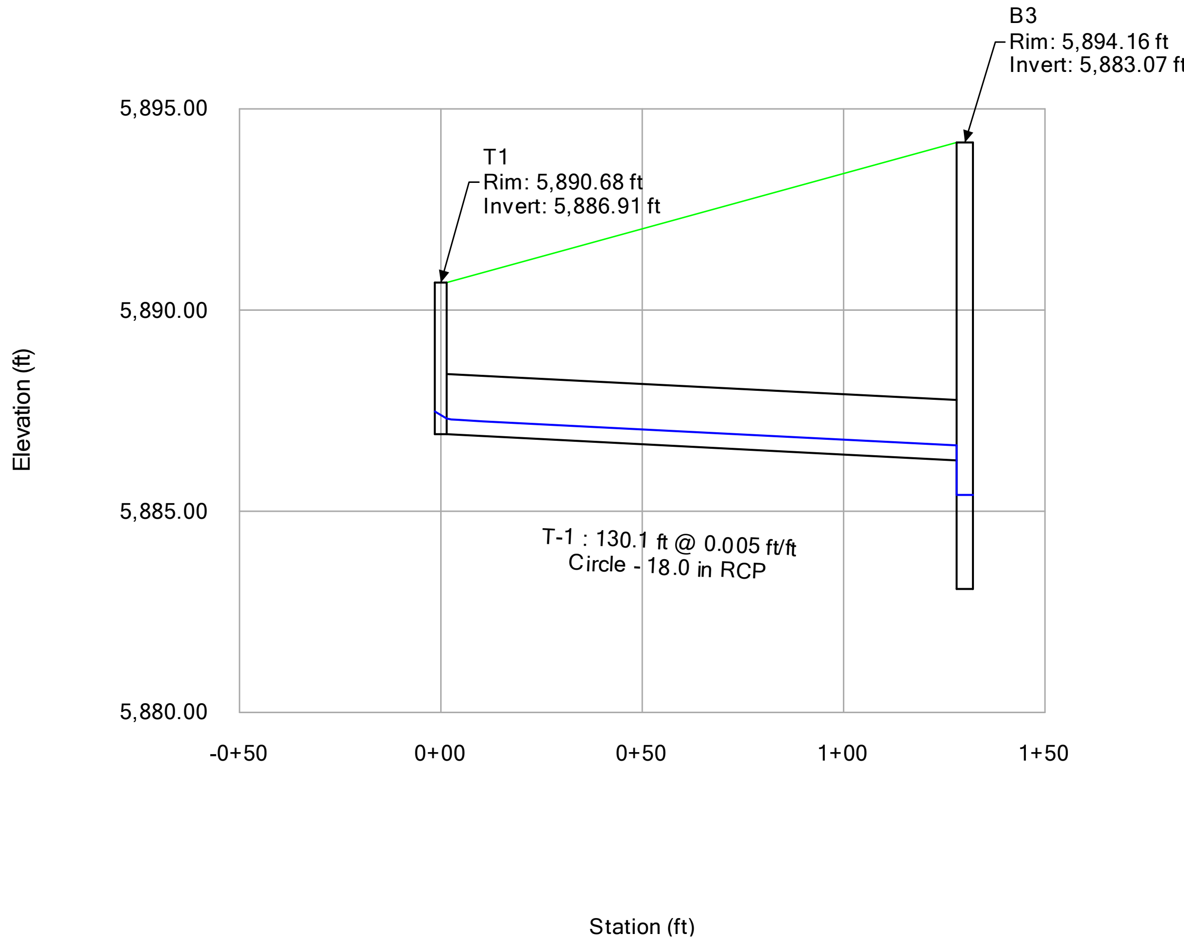
Engineering Profile - Stormline Q (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline R (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 5-YR
Profile Report
Engineering Profile - Stormline T (Powers & Grinnell StormCAD.stsw)

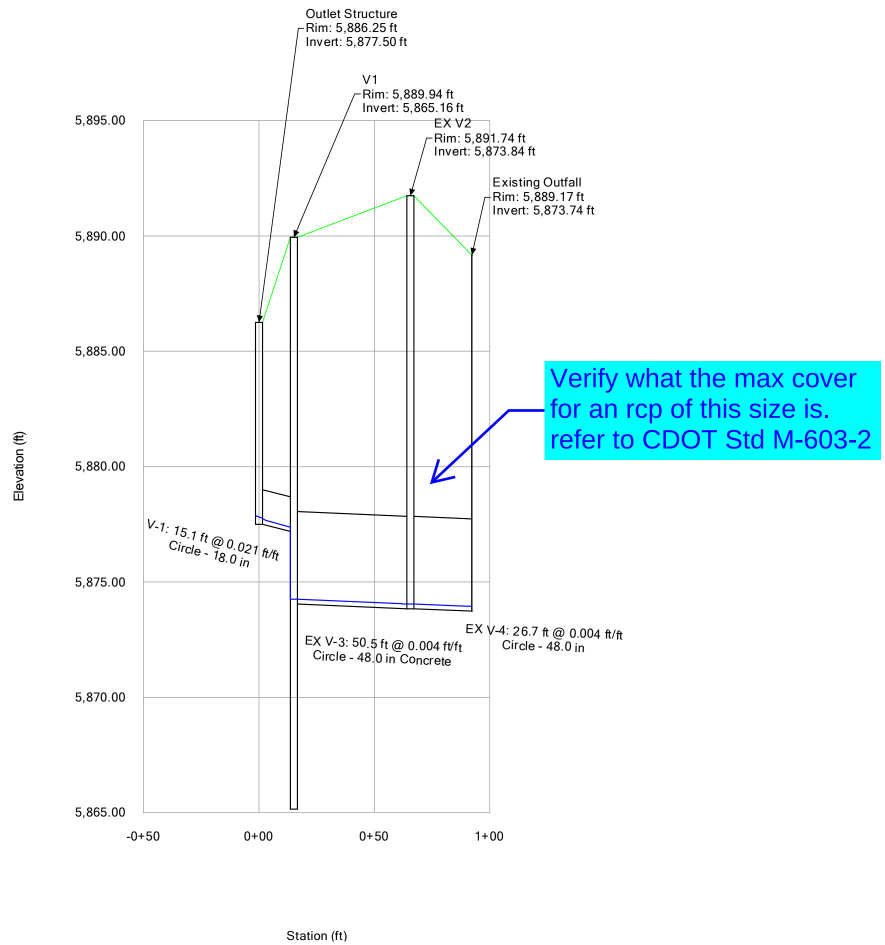


Powers & Grinnell StormCAD.stsw

Active Scenario: 5-YR

Profile Report

Engineering Profile - Stormline V (Powers & Grinnell StormCAD.stsw)



Provide source for these flows in the existing system.

Show tailwater in results table.

Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

FlexTable: Conduit Table

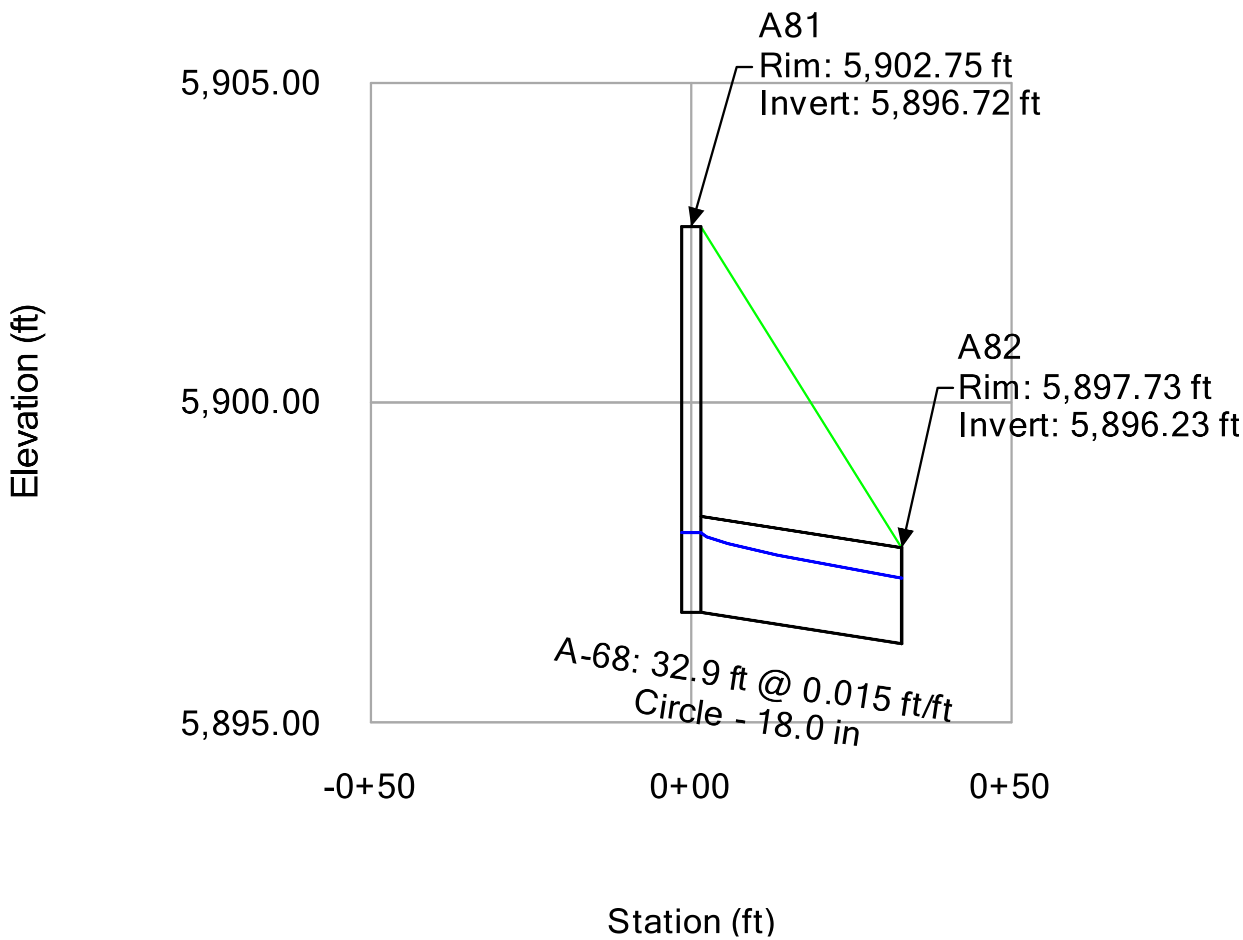
Label	Start Node	Stop Node	Diameter (in)	Manning's n	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Froude Number (Normal)
A-1	A2	A1	42.0	0.012	25.3	5,882.04	5,881.91	0.005	61.81	78.15	6.42	5,887.86	5,887.78	1.099
A-2	A3	A2	30.0	0.012	38.8	5,892.95	5,891.79	0.030	45.52	76.79	16.31	5,895.18	5,893.45	2.712
A-3	A4	A3	30.0	0.012	61.4	5,893.46	5,893.15	0.005	42.57	31.57	8.67	5,896.05	5,895.33	0.967
A-4	A5	A4	30.0	0.012	40.4	5,893.86	5,893.66	0.005	42.57	31.26	8.67	5,896.47	5,896.09	0.967
A-5	A6	A5	30.0	0.012	30.5	5,894.20	5,894.04	0.005	34.73	32.19	7.08	5,896.65	5,896.48	0.789
A-6	A7	A6	24.0	0.012	237.1	5,899.01	5,897.11	0.008	21.02	21.94	7.95	5,900.65	5,898.68	1.106
A-7	A8	A7	24.0	0.012	174.1	5,900.59	5,899.20	0.008	18.47	21.89	7.81	5,902.14	5,900.61	1.211
A-8	A9	A8	18.0	0.012	74.2	5,901.46	5,901.09	0.005	14.95	8.04	8.46	5,903.83	5,902.49	1.218
A-9	A10	A9	18.0	0.012	184.5	5,905.47	5,903.99	0.008	10.06	10.19	6.58	5,906.69	5,905.20	1.019
A-37	A74	A43	48.0	0.012	181.2	5,890.28	5,881.23	0.050	125.00	347.77	25.40	5,893.64	5,883.03	4.008
A-38	A43	A44	48.0	0.012	108.6	5,880.70	5,879.50	0.011	125.00	163.57	14.34	5,884.06	5,883.40	1.669
A-39	A44	A45	48.0	0.012	258.3	5,879.30	5,878.01	0.005	125.00	109.96	9.95	5,883.36	5,881.76	0.877
A-40	A45	A73	48.0	0.012	171.6	5,877.81	5,876.95	0.005	125.00	110.15	9.95	5,881.59	5,880.31	0.877
A-62	A73	EX V-3	48.0	0.012	16.3	5,875.04	5,874.88	0.010	125.00	153.98	9.95	5,879.51	5,879.40	1.534
A-63	A47	A74	48.0	0.012	15.0	5,890.78	5,890.48	0.020	125.00	220.08	18.07	5,894.14	5,893.37	2.419
A-68	A81	A82	18.0	0.012	32.9	5,896.72	5,896.23	0.015	10.53	13.90	8.65	5,897.97	5,897.26	1.652
B-1	B1	A2	36.0	0.012	25.7	5,882.27	5,882.14	0.005	21.16	51.41	2.99	5,888.20	5,888.17	1.205
B-2	B2	B1	30.0	0.012	26.4	5,882.50	5,882.37	0.005	16.81	31.17	3.42	5,888.24	5,888.21	1.119
B-3	B3	B2	30.0	0.012	94.3	5,883.07	5,882.60	0.005	14.41	31.36	2.94	5,888.37	5,888.27	1.148
B-4	B4	B3	30.0	0.012	30.3	5,883.32	5,883.17	0.005	13.96	31.28	2.84	5,888.41	5,888.38	1.148
B-5	B5	B4	18.0	0.012	146.4	5,884.05	5,883.32	0.005	4.86	8.03	2.75	5,888.68	5,888.41	1.014
B-6	B6	B5	18.0	0.012	75.2	5,884.53	5,884.15	0.005	2.89	8.09	1.64	5,887.96	5,887.91	1.082
C-1	C1	B1	18.0	0.012	62.6	5,894.24	5,892.41	0.029	5.95	19.46	9.68	5,895.18	5,892.99	2.627
D-1	D1	B2	18.0	0.012	12.2	5,891.74	5,891.62	0.010	3.44	11.30	5.61	5,892.45	5,892.22	1.525
EX V-2	EX V-3	V1	48.0	0.012	171.3	5,874.78	5,874.05	0.004	125.00	101.57	9.95	5,879.30	5,878.20	0.877
EX V-3	V1	EX V2	48.0	0.012	50.5	5,874.05	5,873.84	0.004	135.80	100.34	10.81	5,878.18	5,877.79	0.953
EX V-4	EX V2	Existing Outfall	48.0	0.012	26.7	5,873.84	5,873.74	0.004	135.80	95.30	10.81	5,877.64	5,877.21	0.953
F-1	F1	B4	24.0	0.013	12.2	5,884.86	5,884.80	0.005	9.10	15.86	2.90	5,888.43	5,888.41	0.985
F-2	F2	F1	24.0	0.012	55.5	5,885.24	5,884.96	0.005	7.47	17.40	2.38	5,888.54	5,888.49	1.119
F-3	F3	F2	18.0	0.012	152.0	5,886.21	5,885.44	0.005	1.31	8.10	0.74	5,888.63	5,888.61	1.100
F-4	F4	F3	18.0	0.012	36.2	5,886.59	5,886.41	0.005	1.31	8.03	0.74	5,888.63	5,888.63	1.091
G-1	G1	A5	18.0	0.012	66.7	5,897.19	5,896.52	0.010	10.03	11.41	7.28	5,898.41	5,897.61	1.264
G-2	G2	G1	18.0	0.012	59.4	5,899.89	5,897.52	0.040	8.37	22.73	11.89	5,901.01	5,898.74	3.039
G-3	G3	G2	18.0	0.012	89.6	5,901.53	5,900.19	0.015	8.37	13.92	8.24	5,902.65	5,901.03	1.758
G-4	G4	G3	18.0	0.012	16.9	5,901.81	5,901.73	0.005	7.42	7.82	5.04	5,902.96	5,902.86	0.817
G-5	G5	G4	18.0	0.012	84.6	5,902.43	5,902.01	0.005	6.42	8.02	5.04	5,903.45	5,902.99	0.933
G-6	G6	G5	18.0	0.012	45.9	5,902.86	5,902.63	0.005	4.13	8.06	4.59	5,903.64	5,903.46	1.044
H-1	H1	G4	18.0	0.012	116.2	5,903.52	5,902.21	0.011	1.19	12.08	4.35	5,903.93	5,902.96	1.625
J-1	J1	G5	18.0	0.012	89.6	5,903.54	5,902.63	0.010	2.84	11.47	5.38	5,904.18	5,903.46	1.556
J-2	J2	J1	18.0	0.012	78.6	5,904.13	5,903.74	0.005	2.84	8.01	4.15	5,904.77	5,904.36	1.073
J-3	J3	J2	18.0	0.012	41.2	5,904.53	5,904.33	0.005	2.84	7.93	4.11	5,905.17	5,904.95	1.061
K-1	K1	A6	24.0	0.012	8.0	5,894.30	5,894.26	0.005	17.15	17.33	5.46	5,896.78	5,896.74	0.840
K-2	K2	K1	24.0	0.012	28.1	5,894.64	5,894.50	0.005	9.37	17.30	2.98	5,896.92	5,896.88	1.084
L-1	L1	A7	18.0	0.012	30.2	5,899.36	5,899.21	0.005	4.43	8.03	4.65	5,900.71	5,900.68	1.029

Per ECM Section 3.3.1.J.8 max velocity in storm sewer is 18 fps. Please revise to meet max velocity constraint

Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
FlexTable: Conduit Table

Label	Start Node	Stop Node	Diameter (in)	Manning's n	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Froude Number (Normal)
M-1	M1	A8	18.0	0.012	99.1	5,903.06	5,902.45	0.006	3.52	8.93	4.75	5,903.78	5,903.10	1.187
M-2	M2	M1	18.0	0.012	114.7	5,904.39	5,903.40	0.009	3.52	10.57	5.38	5,905.11	5,904.00	1.421
M-3	M3	M2	18.0	0.012	66.0	5,906.38	5,904.49	0.029	3.52	19.25	8.29	5,907.10	5,904.92	2.617
N-1	N1	M1	18.0	0.012	9.8	5,903.66	5,903.24	0.043	3.52	23.51	9.56	5,904.38	5,903.72	3.191
P-1	P1	A9	18.0	0.012	105.7	5,902.13	5,901.66	0.004	7.00	7.59	3.96	5,904.30	5,903.90	0.813
P-2	P2	P1	18.0	0.012	37.7	5,902.52	5,902.33	0.005	4.56	8.08	2.58	5,904.41	5,904.35	1.033
Q-1	Q1	P1	18.0	0.012	9.8	5,903.00	5,902.74	0.026	2.49	18.50	7.30	5,904.38	5,904.38	2.507
R-1	R1	A3	18.0	0.012	53.5	5,895.29	5,893.68	0.030	0.43	19.74	4.54	5,895.53	5,895.34	2.476
T-1	T1	B3	18.0	0.012	130.1	5,886.91	5,886.26	0.005	2.61	8.04	1.48	5,888.52	5,888.45	1.082
V-1	Outlet Structure	V1	18.0	0.012	15.1	5,877.50	5,877.19	0.021	10.80	16.31	9.87	5,878.76	5,878.22	2.018

Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
Profile Report
Engineering Profile - Grinnell Inlet (Powers & Grinnell StormCAD.stsw)

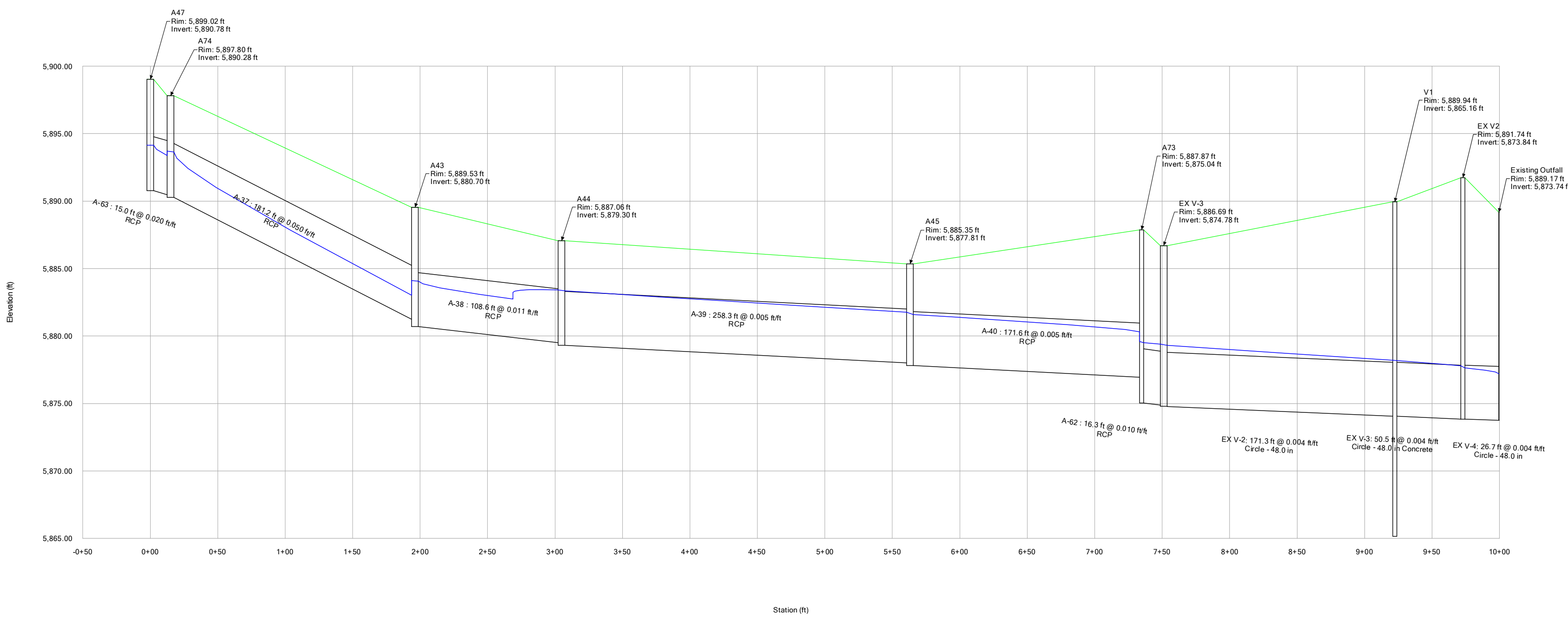


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Storm Re-Route (Powers & Grinnell StormCAD.stsw)

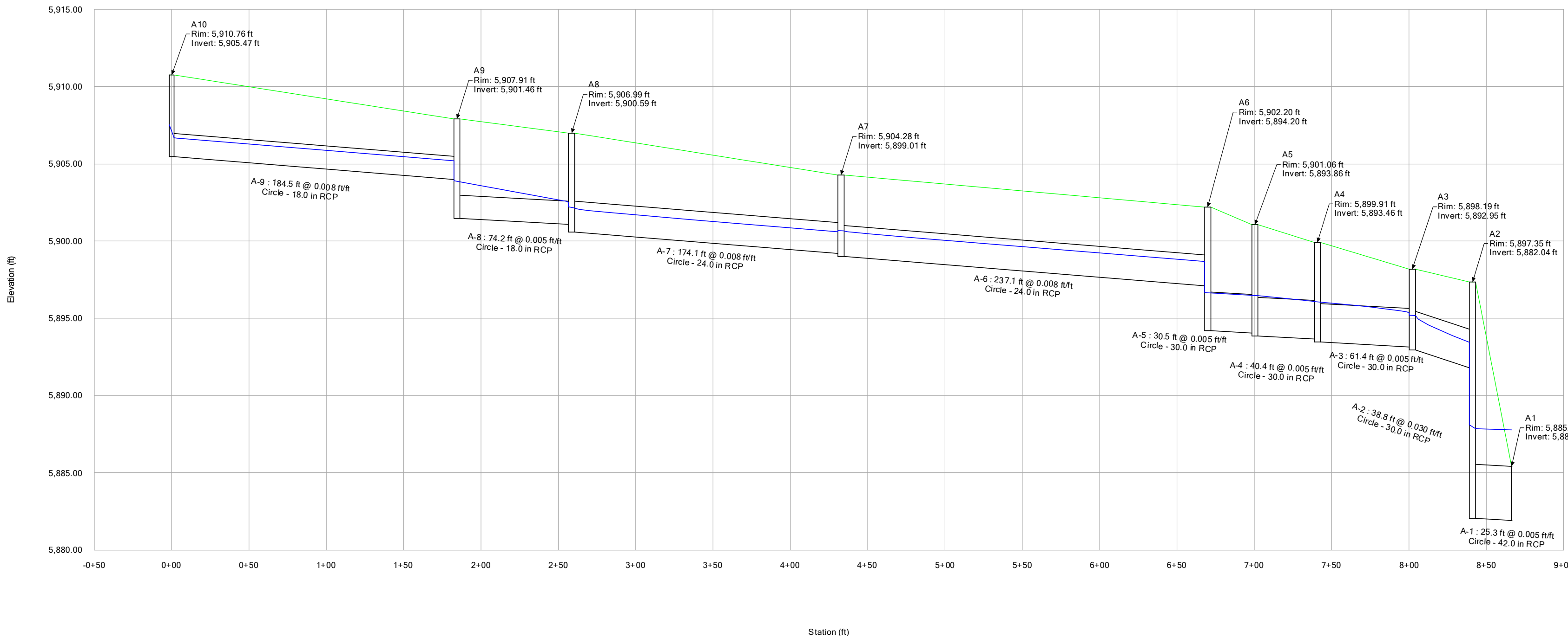


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline A (Powers & Grinnell StormCAD.stsw)

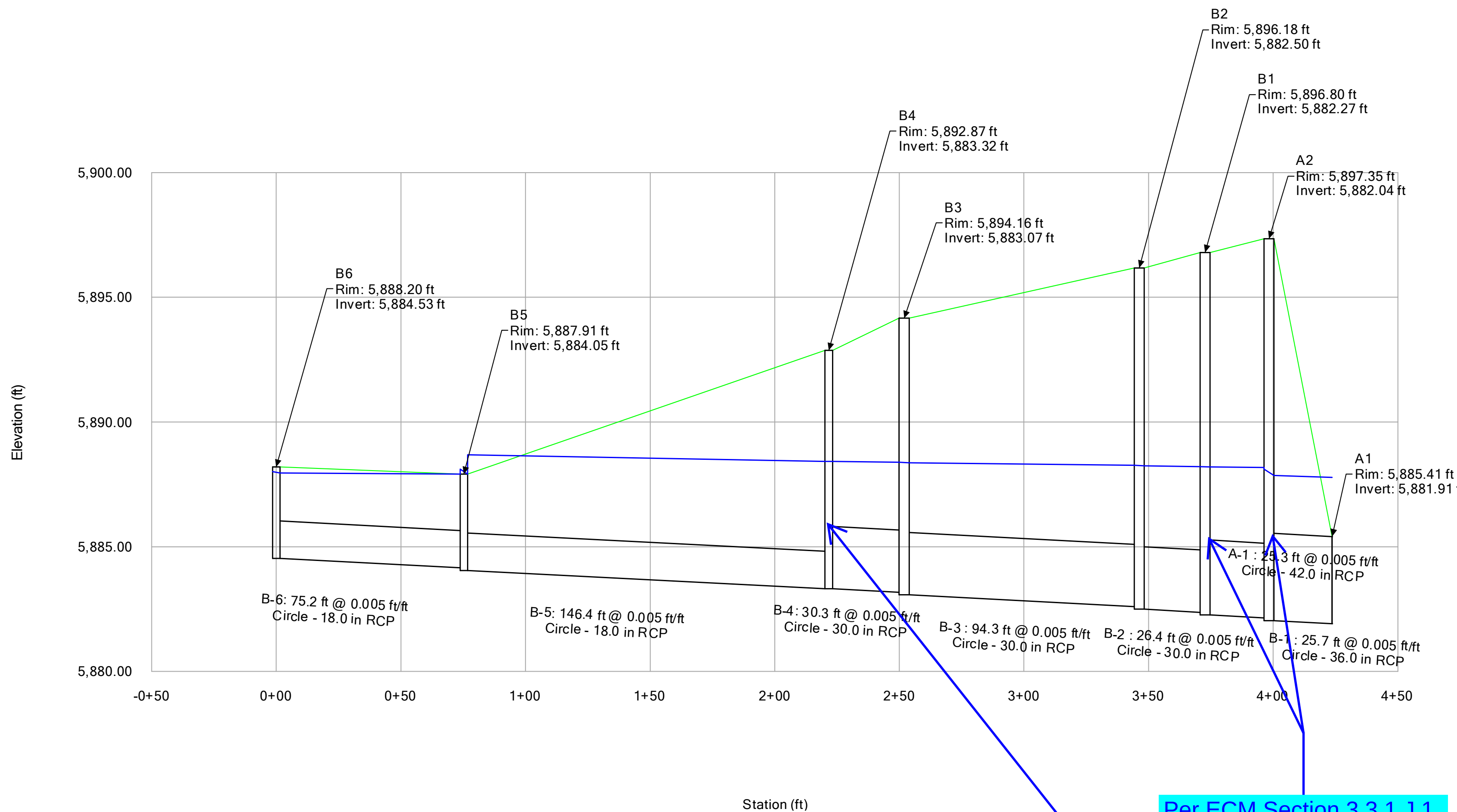


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

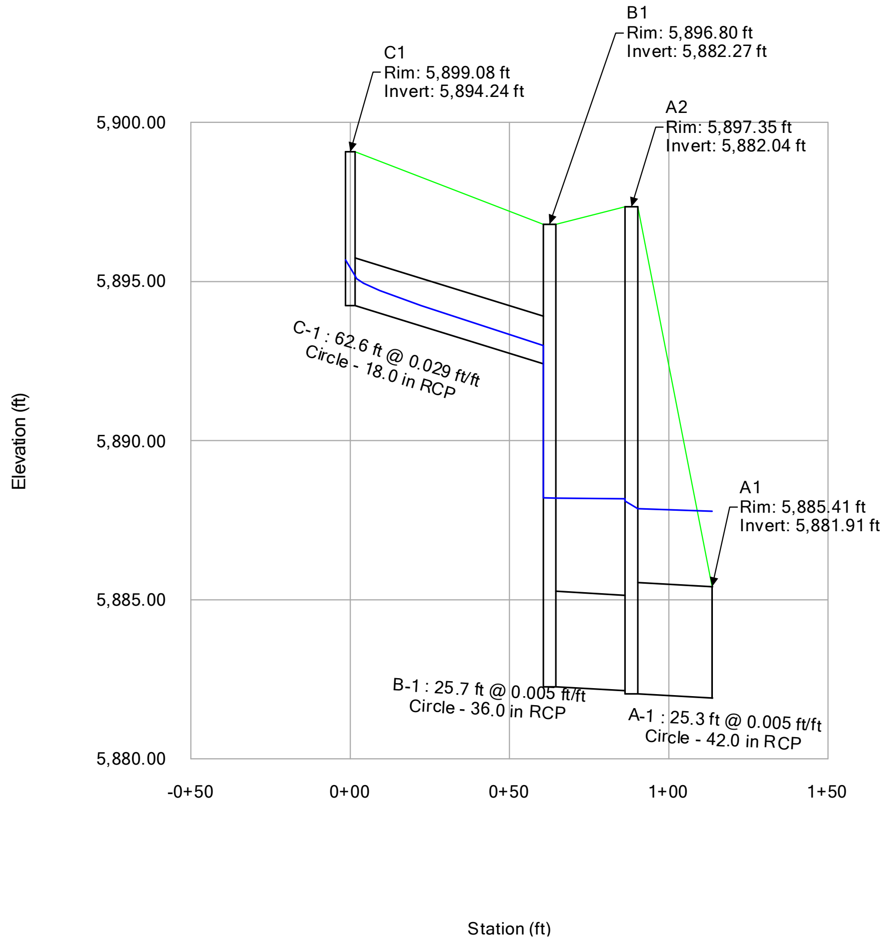
Profile Report

Engineering Profile - Stormline B (Powers & Grinnell StormCAD.stsw)



Per ECM Section 3.3.1.J.1, where conduit size increases, inside top slopes of conduit shall be continuous in elevation

Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
Profile Report
Engineering Profile - Stormline C (Powers & Grinnell StormCAD.stsw)

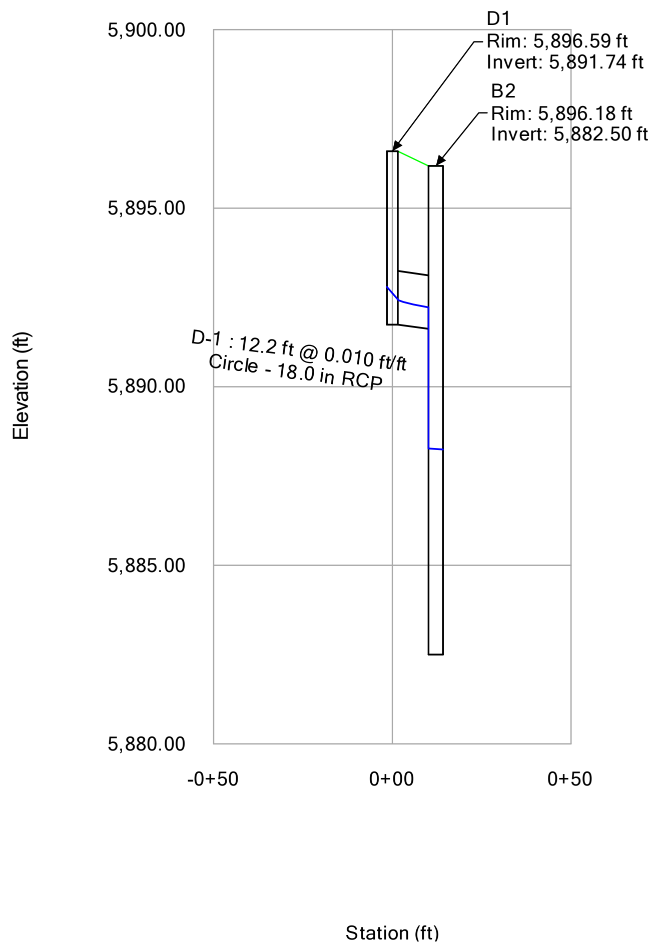


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline D (Powers & Grinnell StormCAD.stsw)

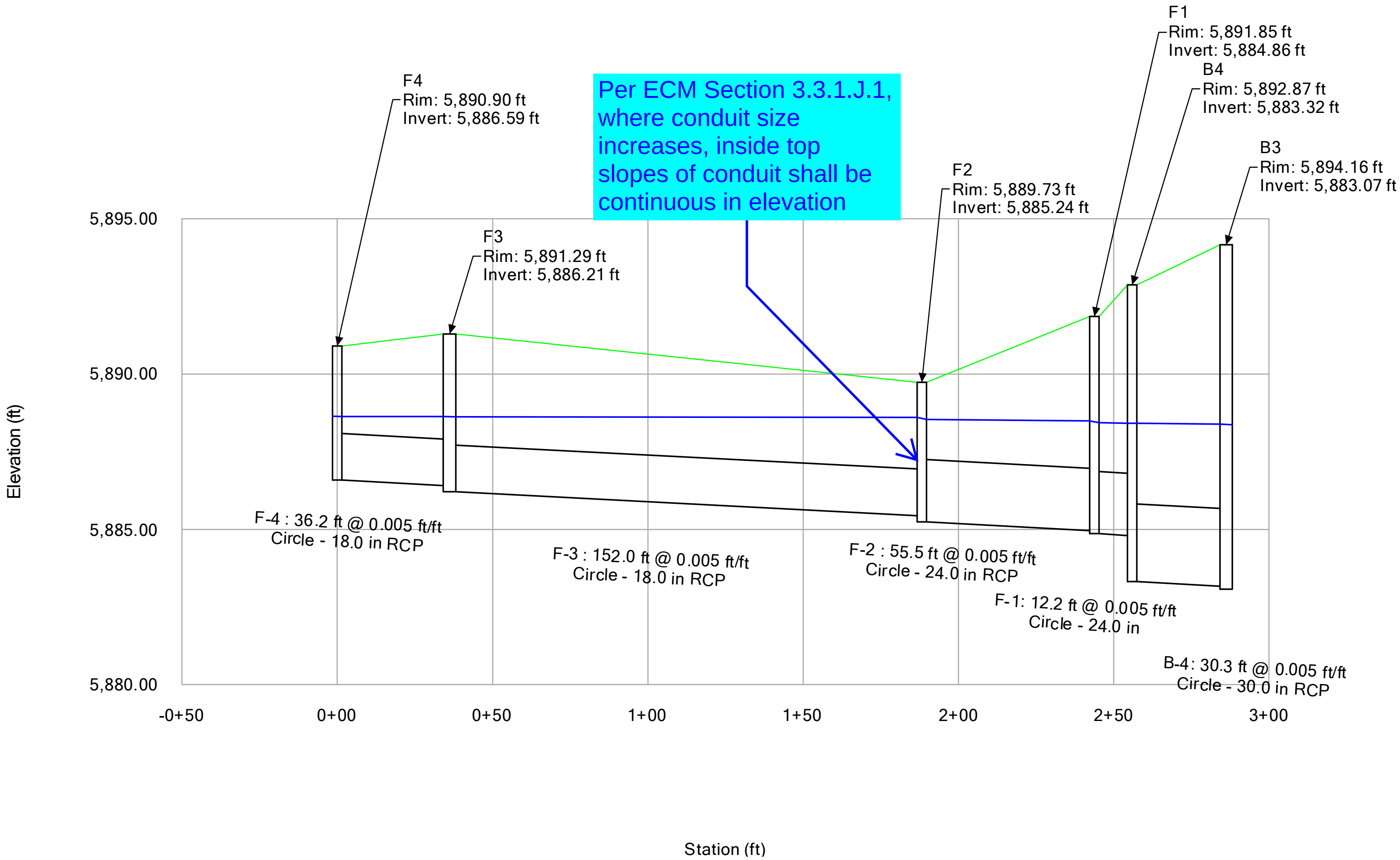


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline F (Powers & Grinnell StormCAD.stsw)

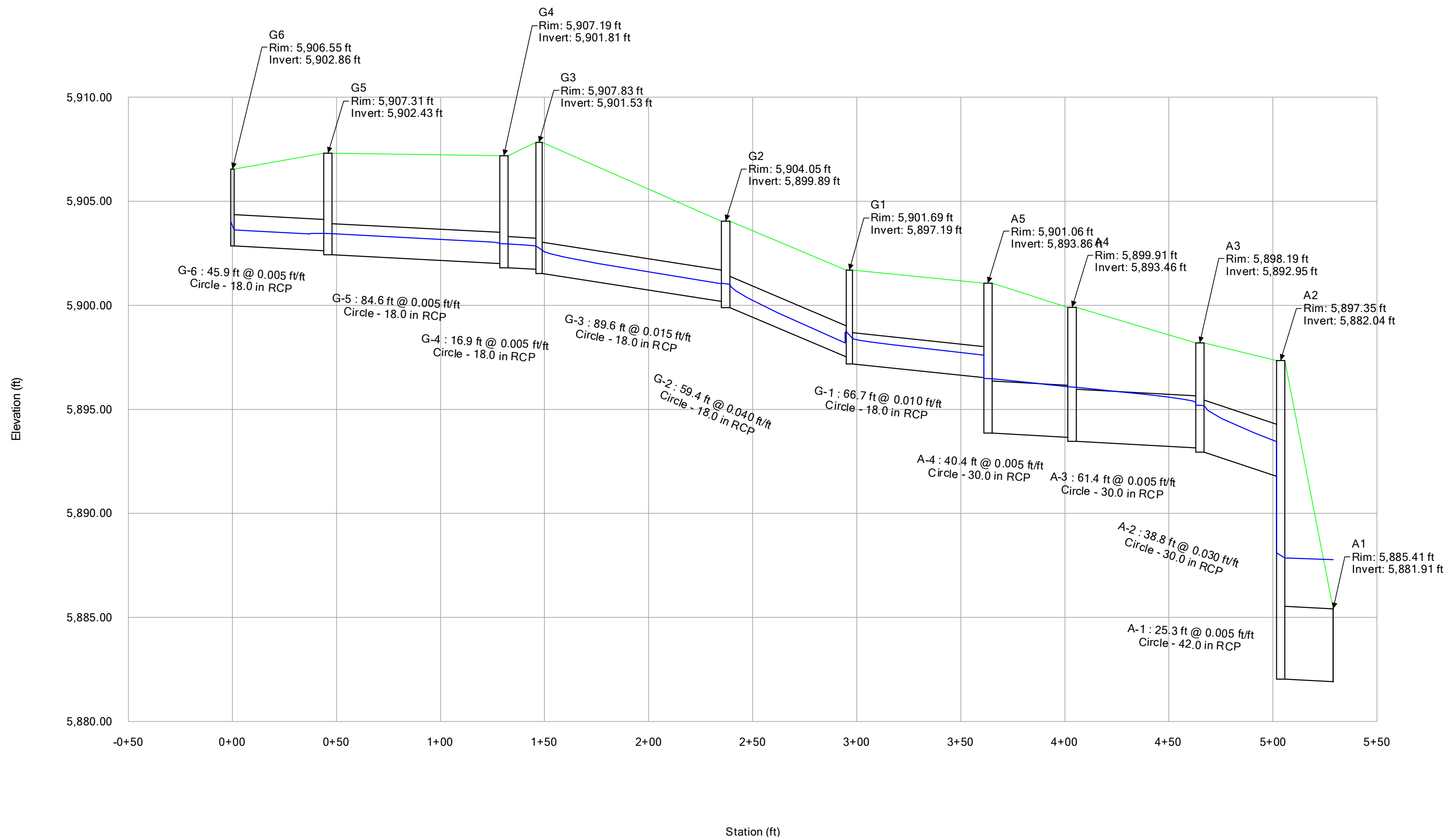


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline G (Powers & Grinnell StormCAD.stsw)

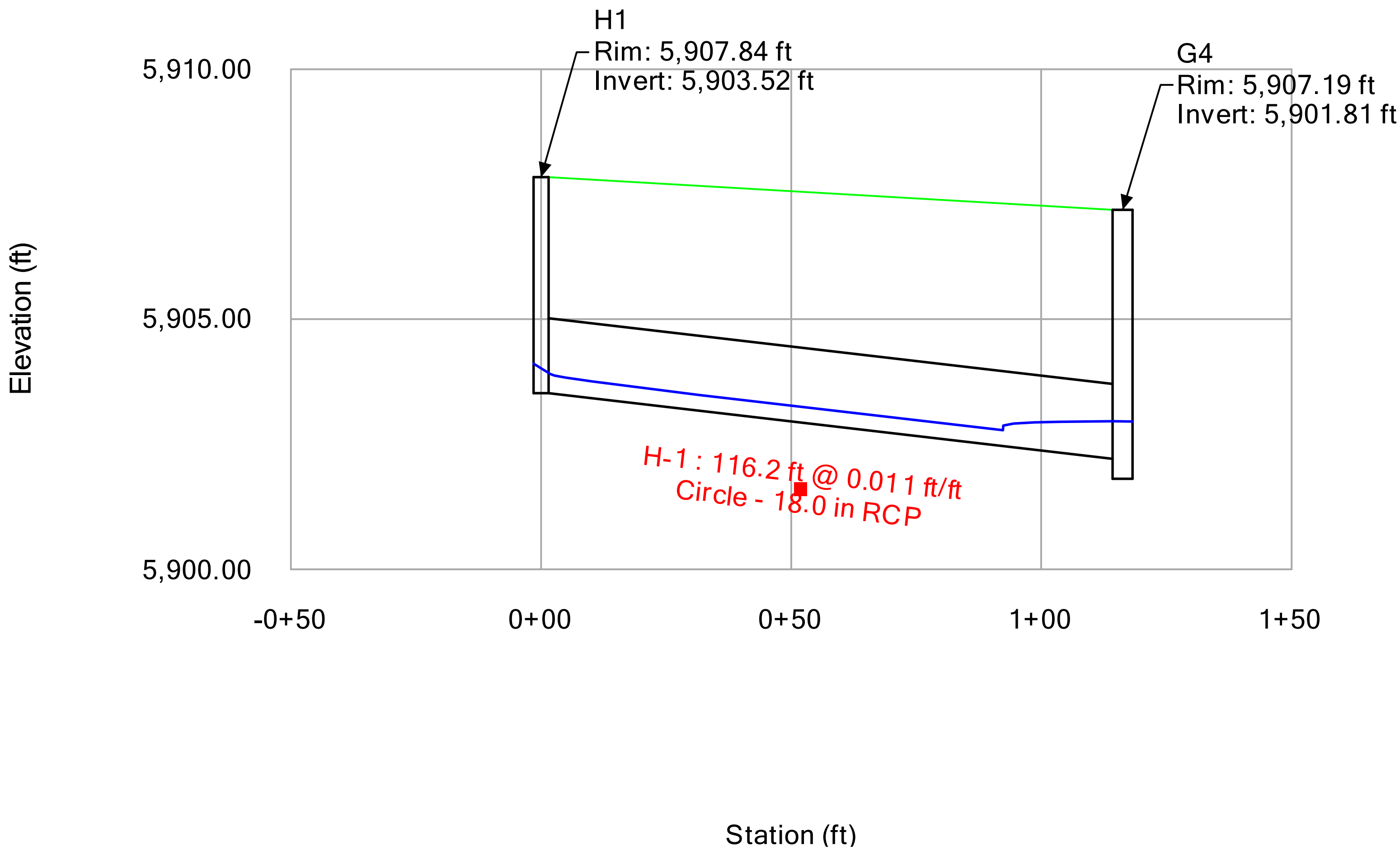


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline H (Powers & Grinnell StormCAD.stsw)

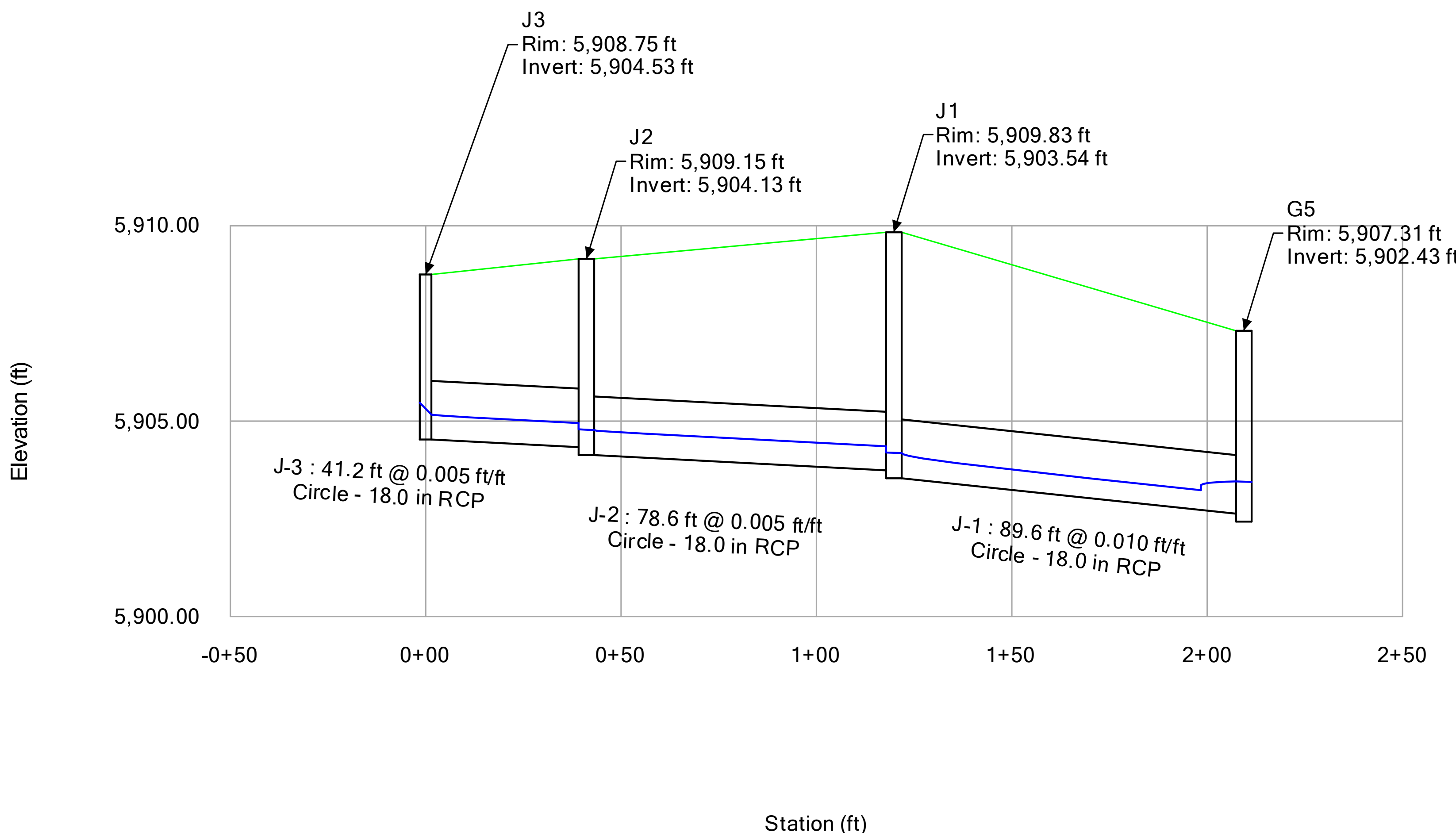


Powers & Grinnell StormCAD.stsw

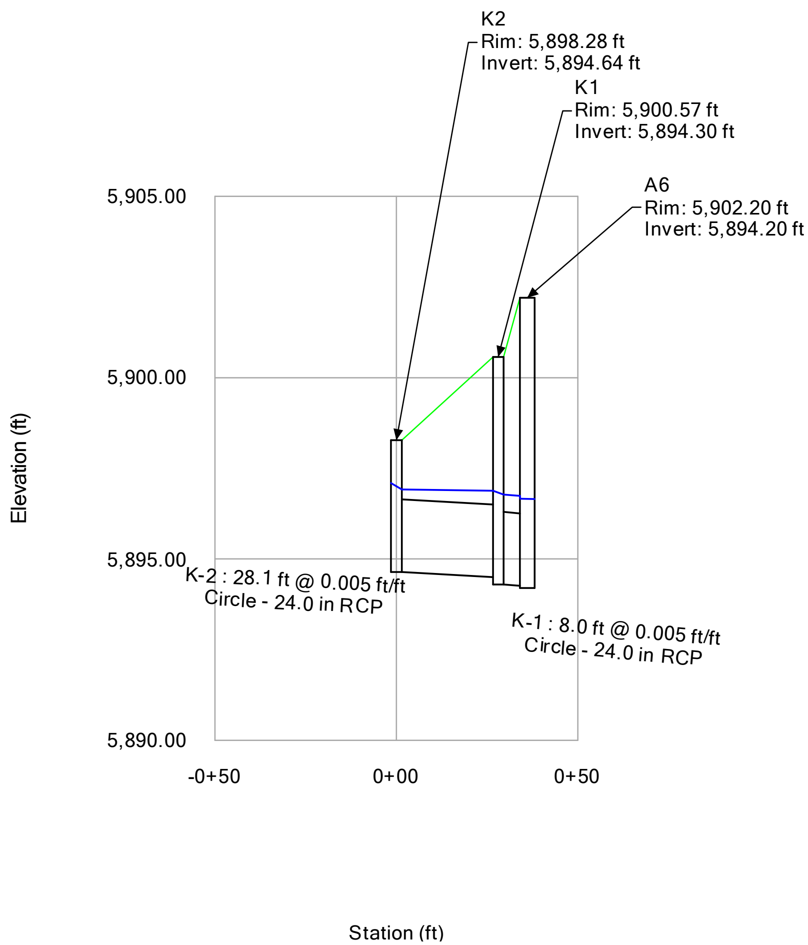
Active Scenario: 100-YR

Profile Report

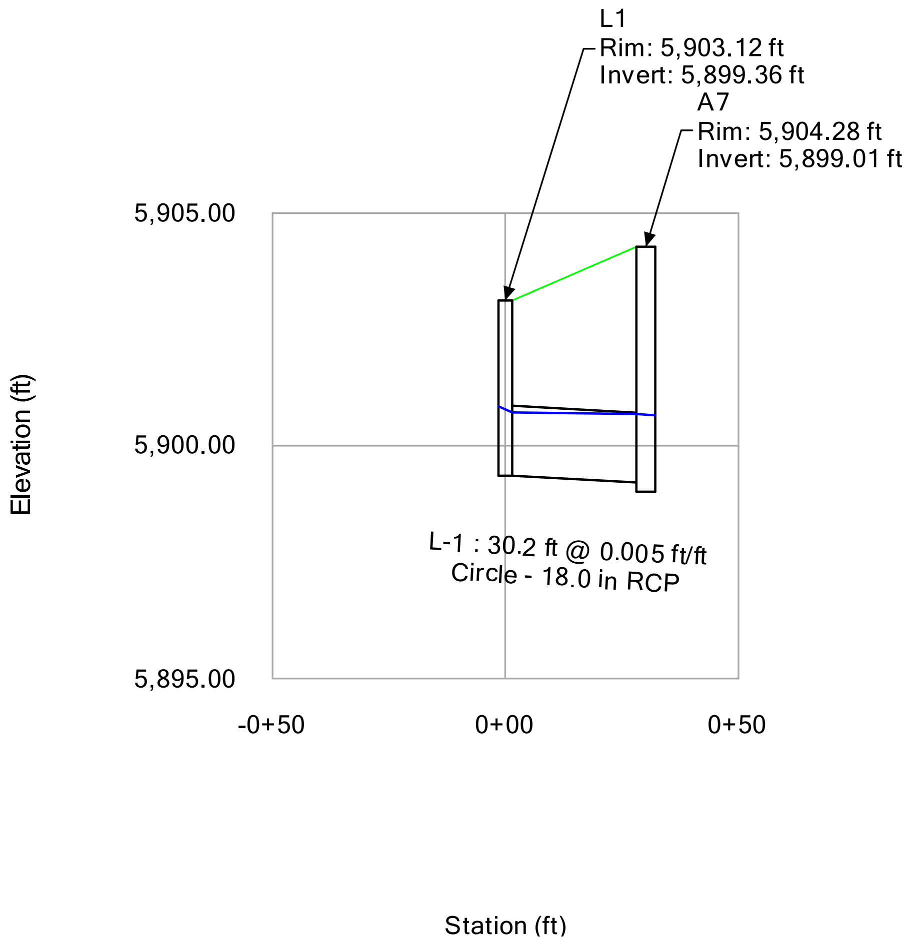
Engineering Profile - Stormline J (Powers & Grinnell StormCAD.stsw)



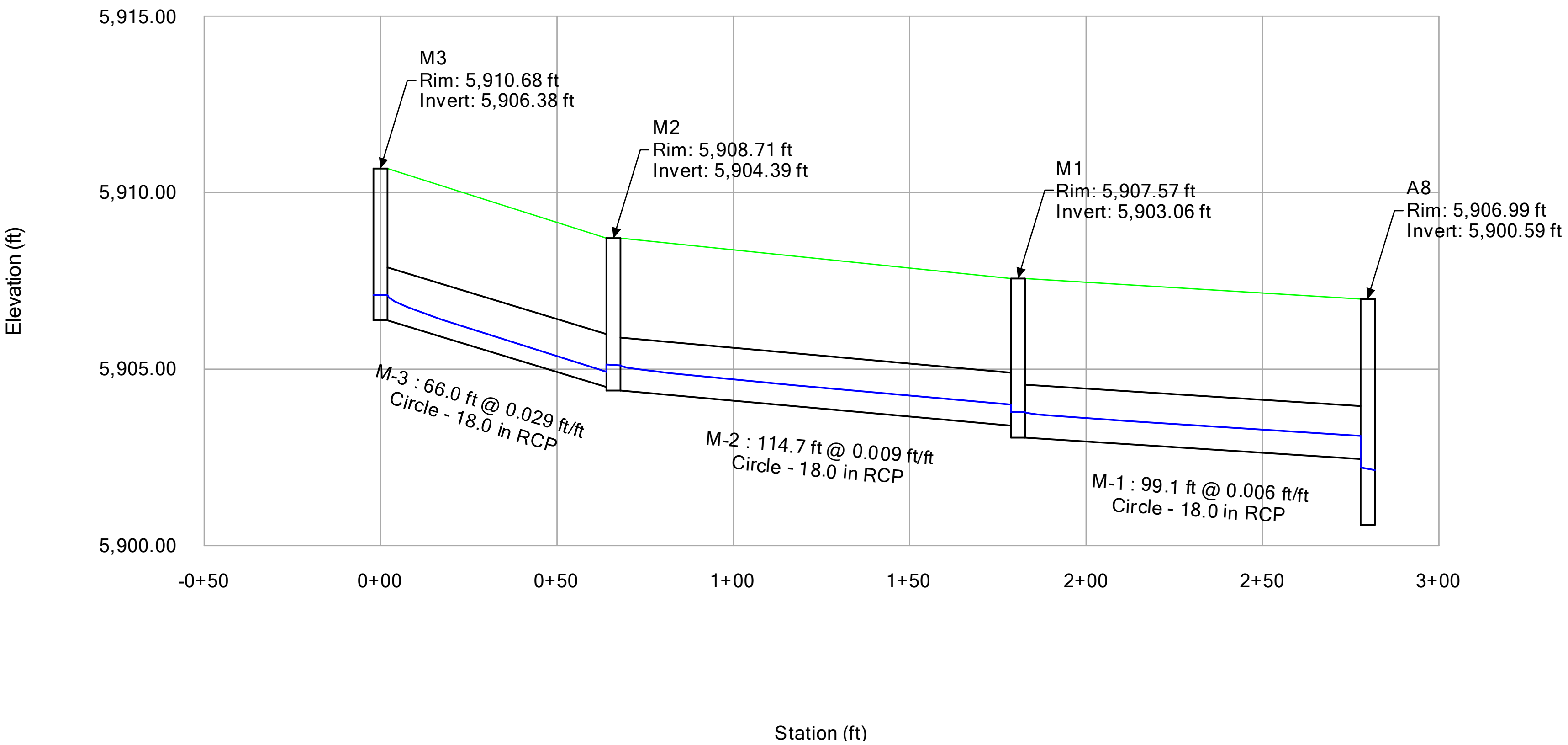
Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
Profile Report
Engineering Profile - Stormline K (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
Profile Report
Engineering Profile - Stormline L (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
Profile Report
Engineering Profile - Stormline M (Powers & Grinnell StormCAD.stsw)

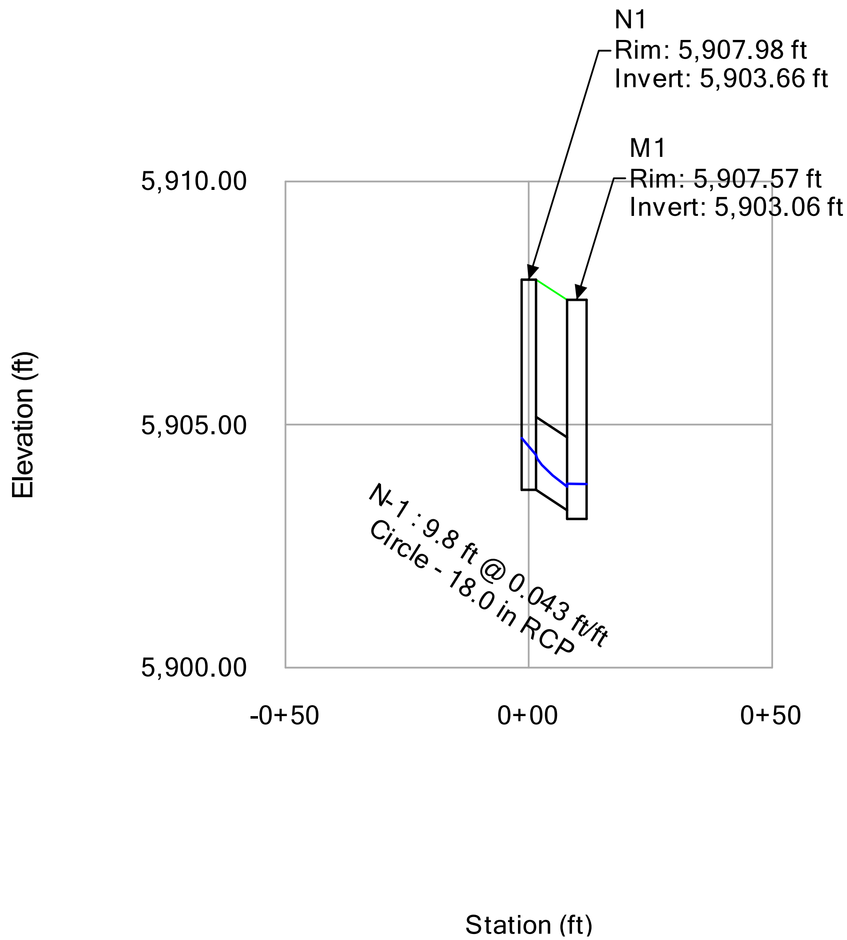


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline N (Powers & Grinnell StormCAD.stsw)

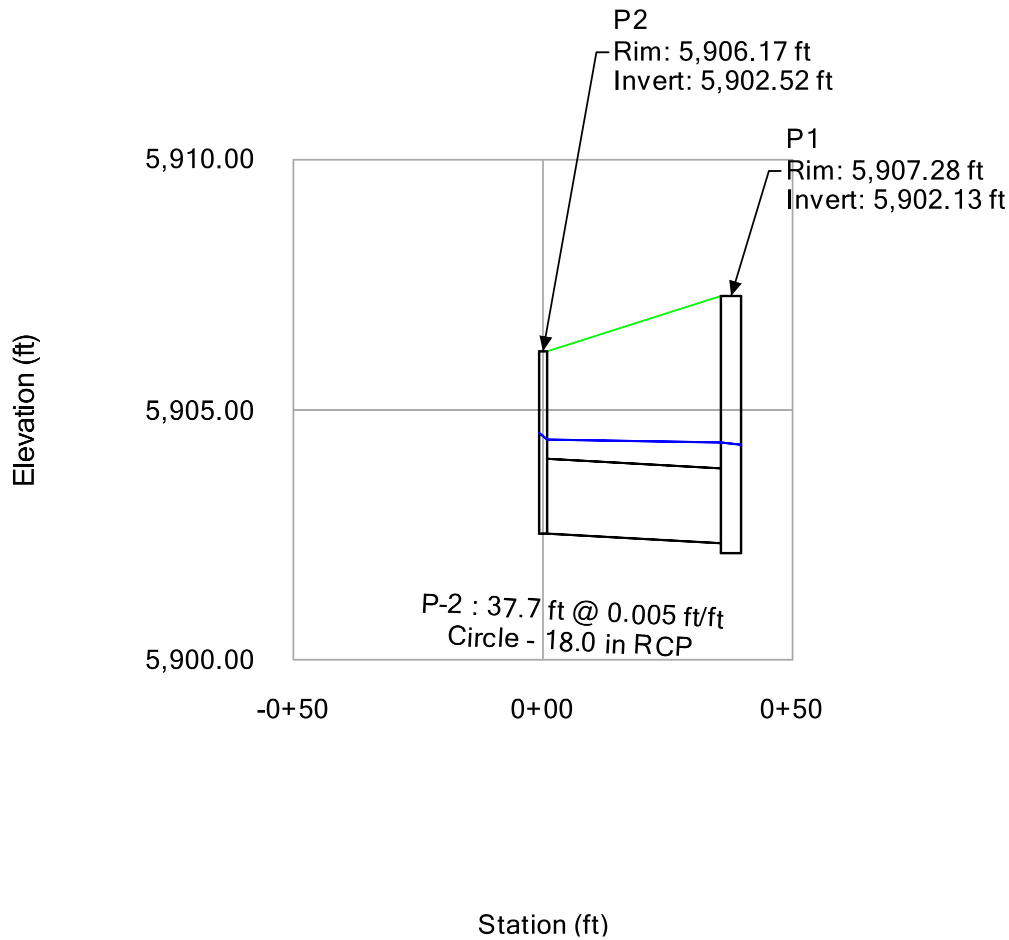


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline P (Powers & Grinnell StormCAD.stsw)

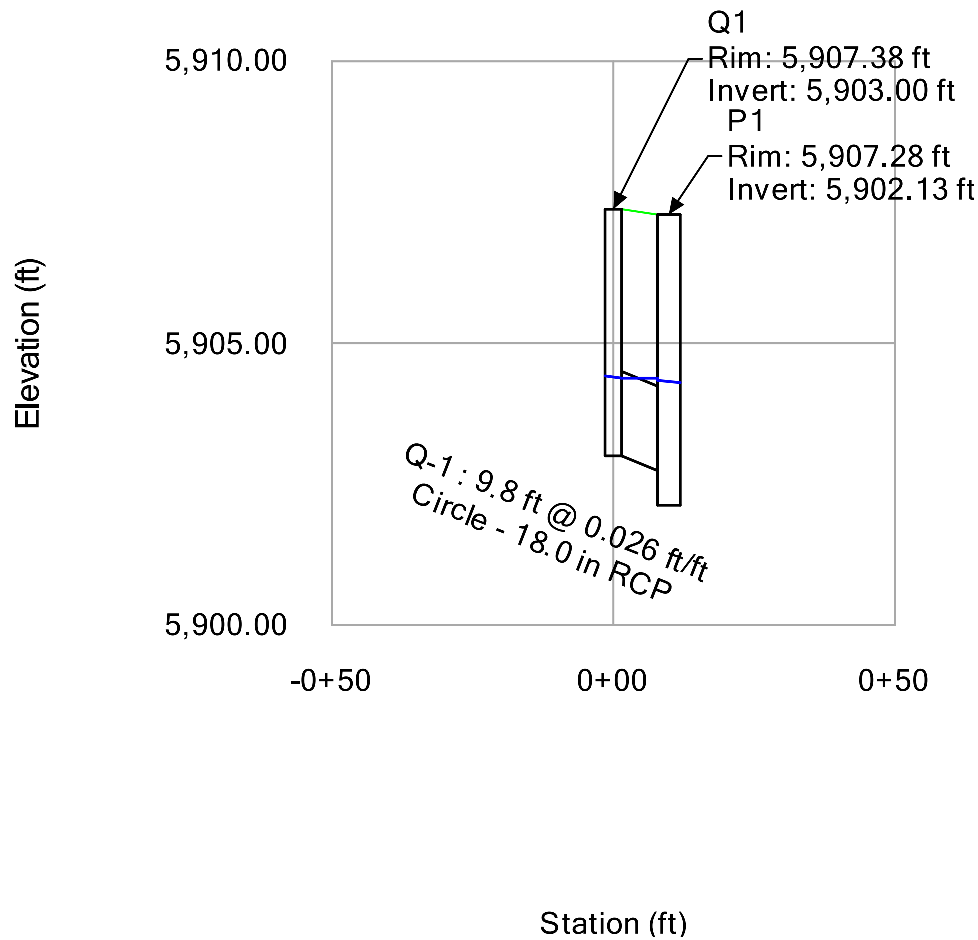


Powers & Grinnell StormCAD.stsw

Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline Q (Powers & Grinnell StormCAD.stsw)

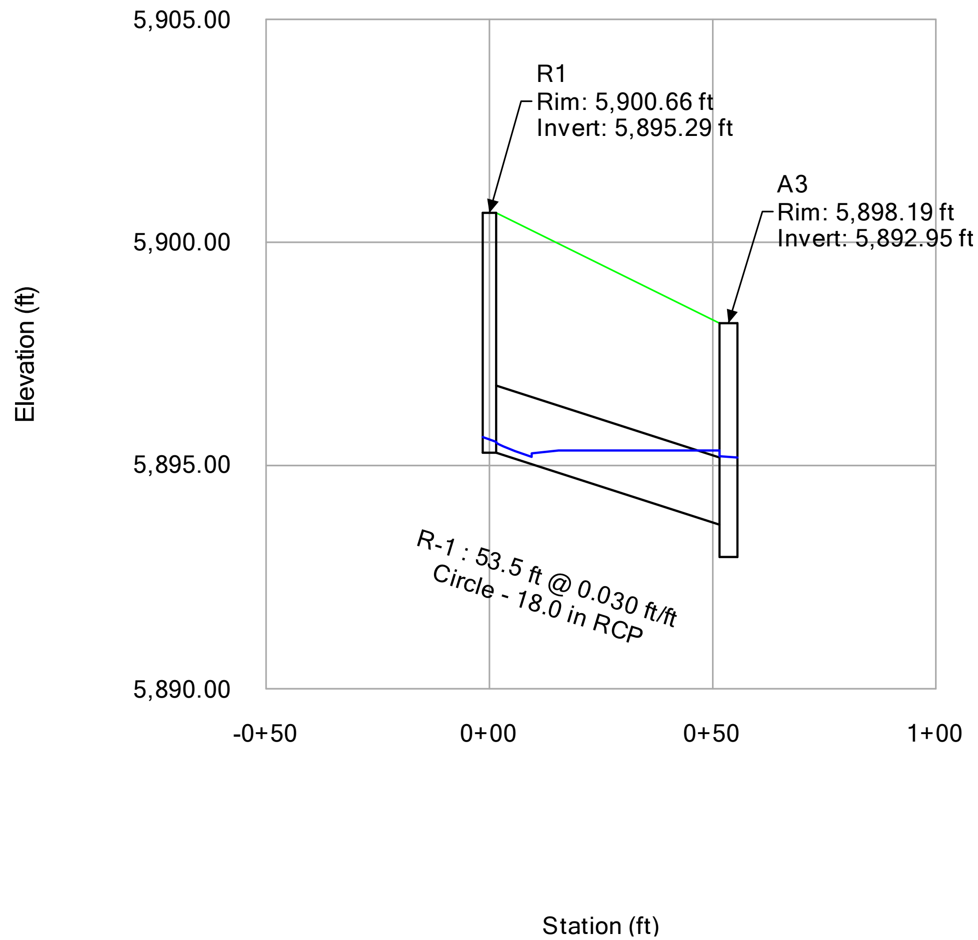


Powers & Grinnell StormCAD.stsw

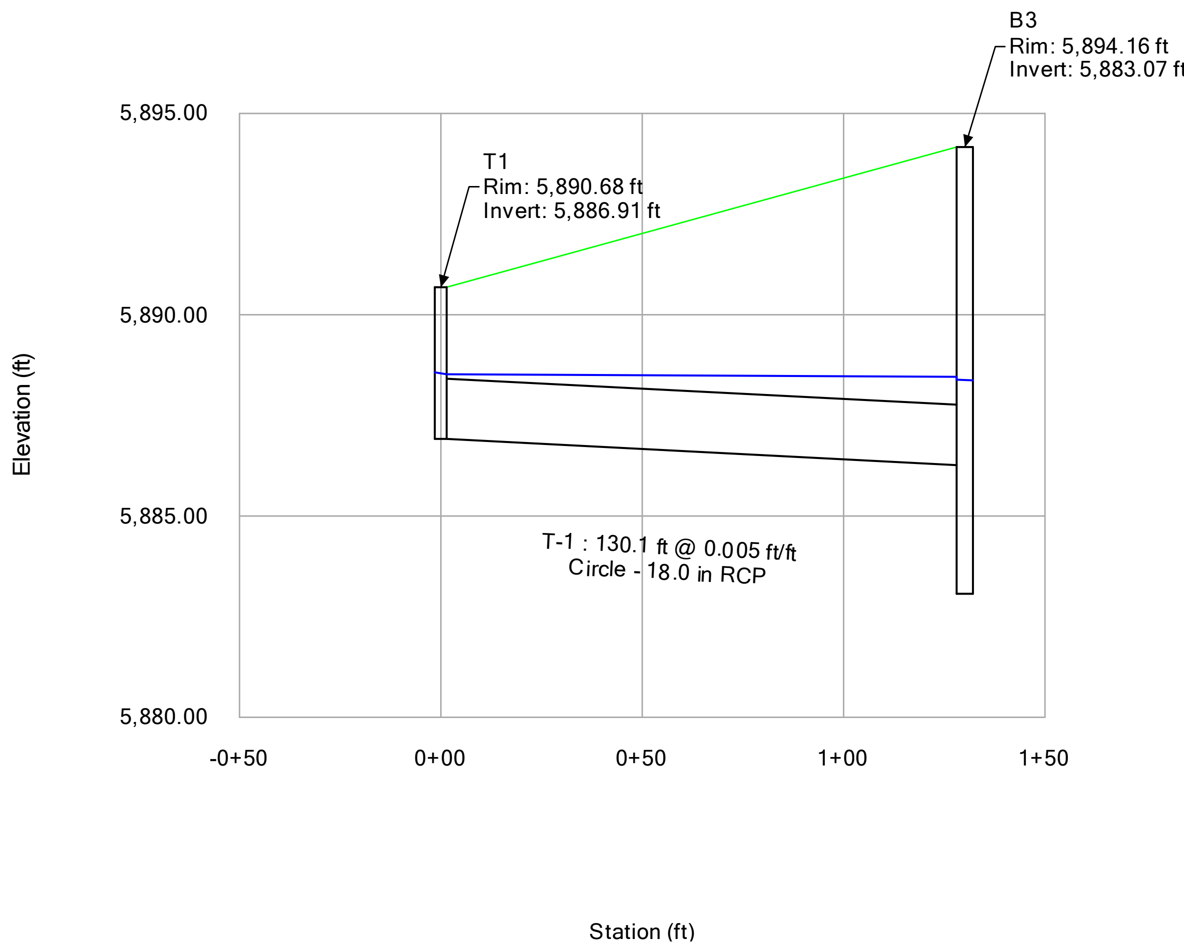
Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline R (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell StormCAD.stsw
Active Scenario: 100-YR
Profile Report
Engineering Profile - Stormline T (Powers & Grinnell StormCAD.stsw)

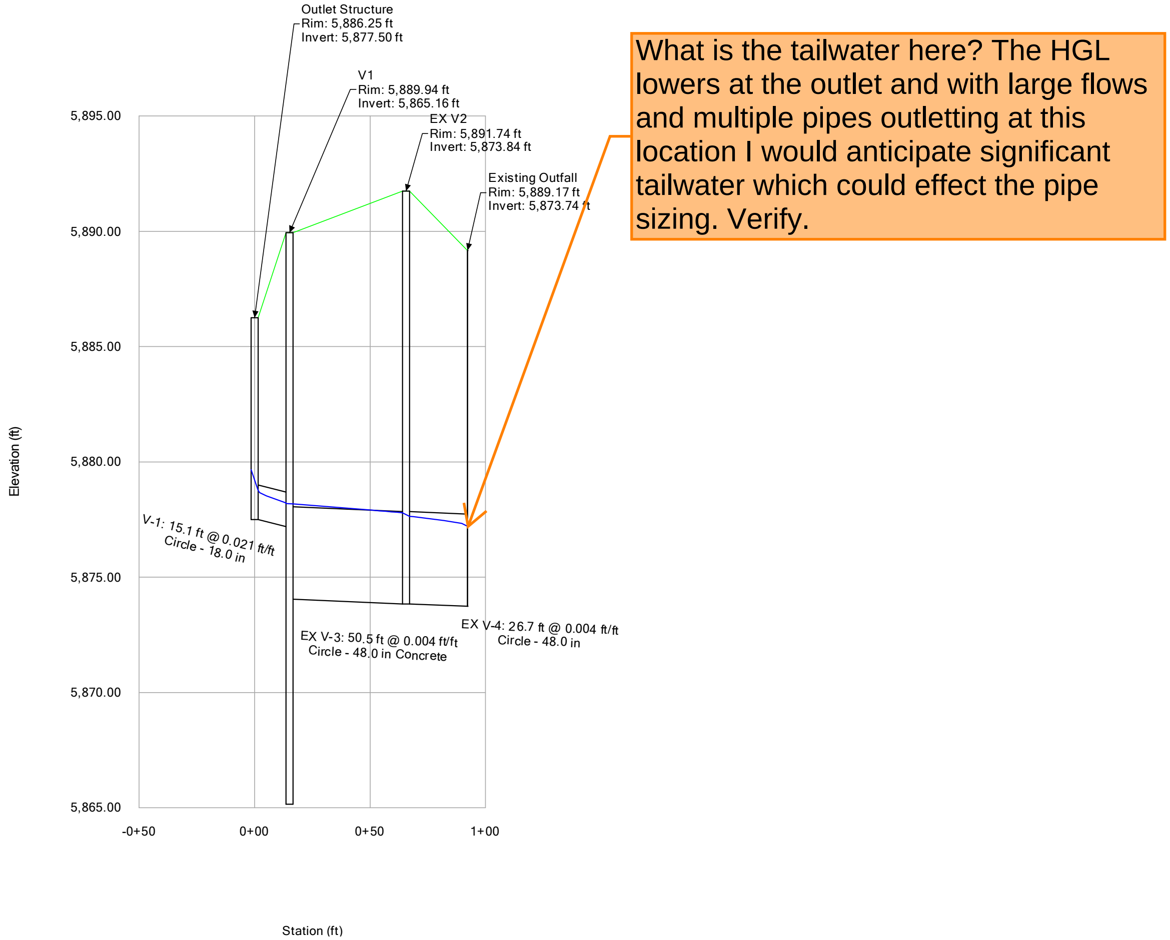


Powers & Grinnell StormCAD.stsw

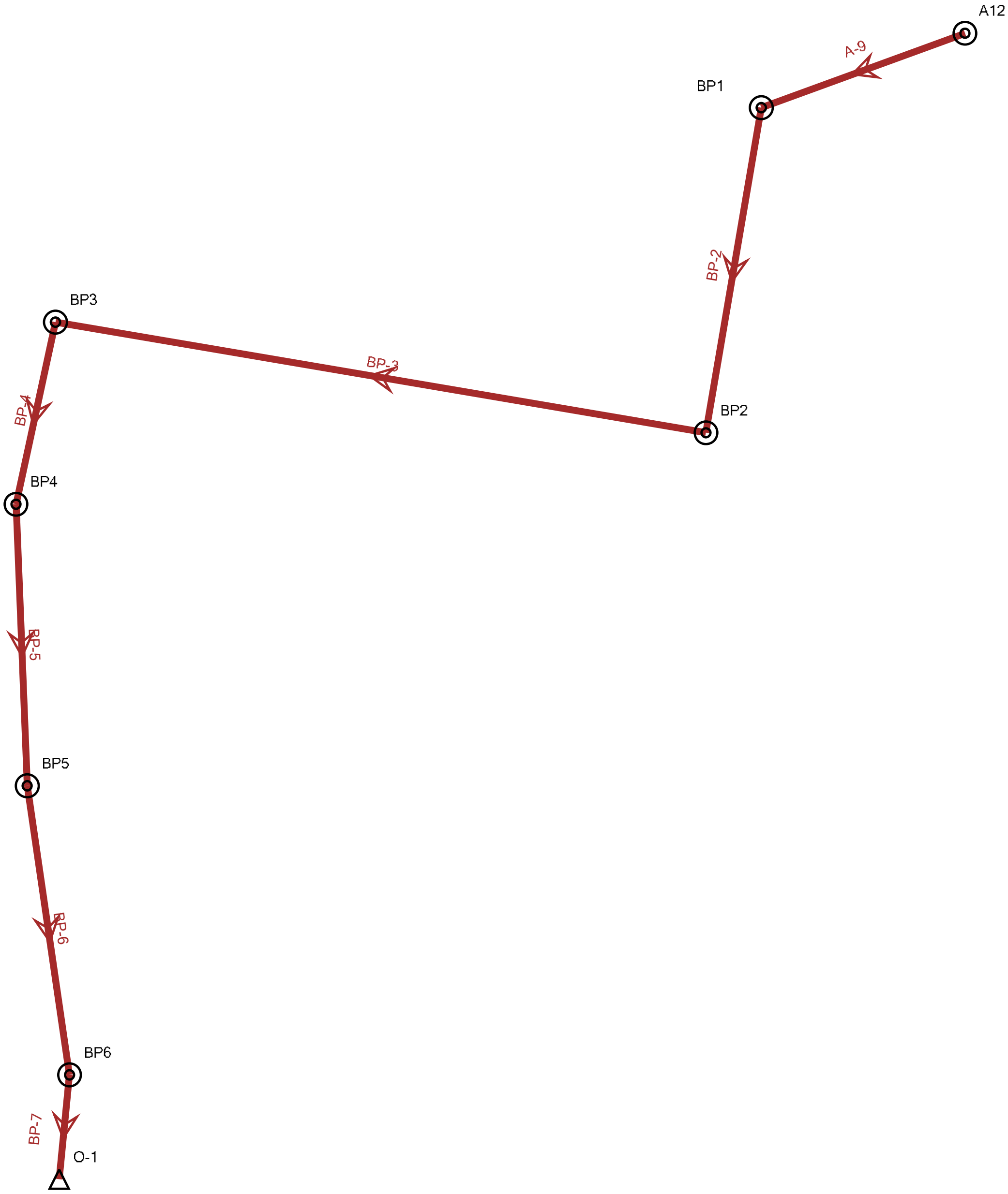
Active Scenario: 100-YR

Profile Report

Engineering Profile - Stormline V (Powers & Grinnell StormCAD.stsw)



Powers & Grinnell
Bypass Line
Scenario: 100 YR
Active Scenario: 100 YR



Powers & Grinnell

Bypass Line

FlexTable: Conduit Table

Active Scenario: 100 YR

Label	Start Node	Stop Node	Diameter (in)	Manning's n	Length (Unified) (ft)	Invert (Start) (ft)	Invert (Stop) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Capacity (Full Flow) (cfs)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Froude Number (Normal)
A-9	A12	BP1	48.0	0.013	142.6	5,916.36	5,904.52	0.083	191.10	413.88	32.28	5,920.18	5,906.68	4.675
BP-2	BP1	BP2	48.0	0.013	217.1	5,897.64	5,891.67	0.027	191.10	238.19	15.21	5,903.68	5,899.83	2.385
BP-3	BP2	BP3	48.0	0.013	434.1	5,891.47	5,884.96	0.015	191.10	175.90	15.21	5,898.32	5,890.64	1.341
BP-4	BP3	BP4	48.0	0.013	122.7	5,884.76	5,882.92	0.015	191.10	175.93	15.21	5,889.86	5,887.69	1.341
BP-5	BP4	BP5	48.0	0.013	185.6	5,882.72	5,879.93	0.015	191.10	176.11	15.21	5,887.48	5,884.20	1.341
BP-6	BP5	BP6	48.0	0.013	192.4	5,879.73	5,876.85	0.015	191.10	175.94	15.21	5,884.10	5,880.67	1.341
BP-7	BP6	O-1	48.0	0.013	65.1	5,876.33	5,872.43	0.060	191.10	351.64	28.57	5,880.15	5,875.07	3.892

Per ECM Section 3.3.1.J.8 max velocity in storm sewer is 18 fps. Please revise to meet max velocity constraint

Add a note providing the source of the flow.

The pipes are above capacity for these four segments.

This is a very high velocity - provide outlet protection and calculations.

Powers & Grinnell

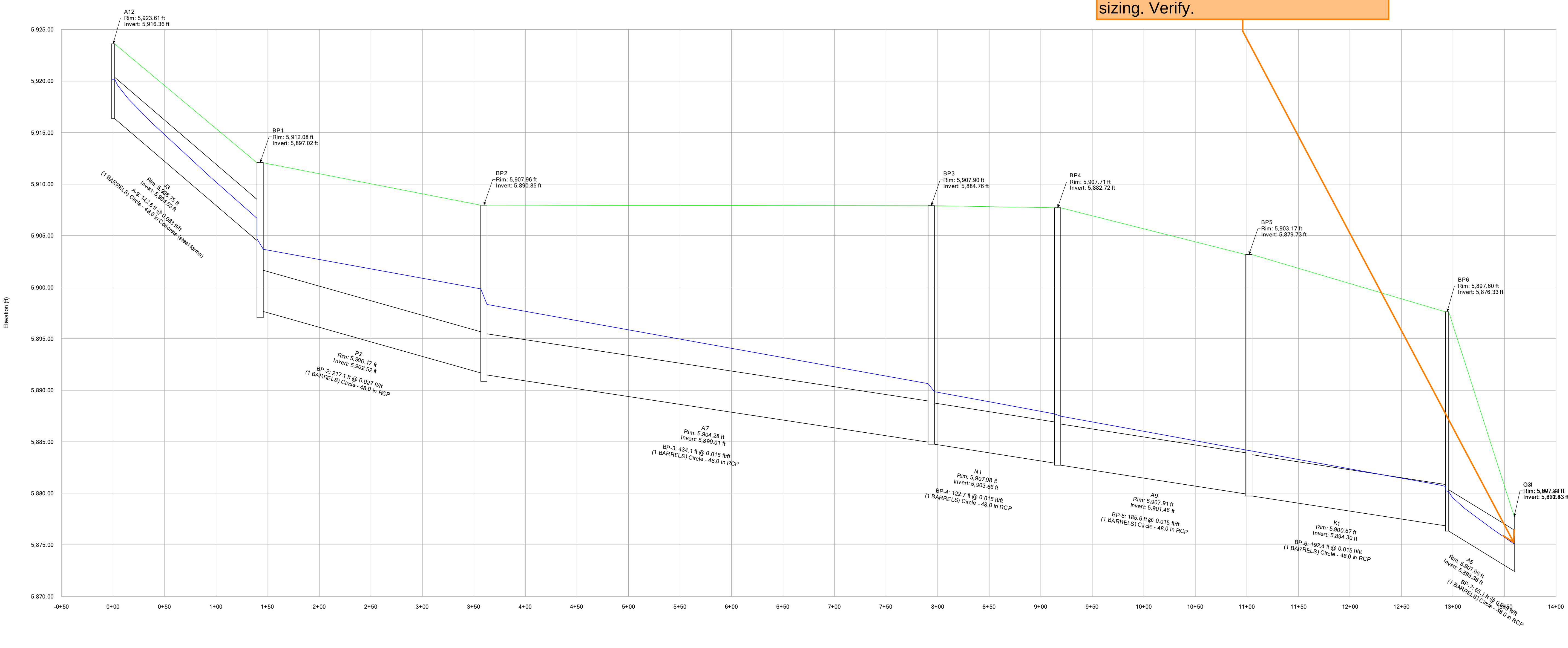
Bypass Line

Profile Report

Engineering Profile - Profile - 1 (Bypass Storm.stsw)

Active Scenario: 100 YR

What is the tailwater here? The HGL lowers at the outlet and with large flows and multiple pipes outletting at this location I would anticipate significant tailwater which could effect the pipe sizing. Verify.

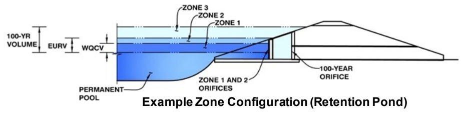


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Powers and Grinnell**

Basin ID: **Whole site**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	16.39	acres
Watershed Length =	1,293	ft
Watershed Length to Centroid =	600	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	55.30%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.302	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.075	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.01 in.) =	0.659	acre-feet	1.01	inches
5-yr Runoff Volume (P1 = 1.29 in.) =	0.872	acre-feet	1.29	inches
10-yr Runoff Volume (P1 = 1.56 in.) =	1.094	acre-feet	1.56	inches
25-yr Runoff Volume (P1 = 1.98 in.) =	1.529	acre-feet	1.98	inches
50-yr Runoff Volume (P1 = 2.35 in.) =	1.963	acre-feet	2.35	inches
100-yr Runoff Volume (P1 = 2.74 in.) =	2.486	acre-feet	2.74	inches
500-yr Runoff Volume (P1 = 3.83 in.) =	3.940	acre-feet	3.83	inches
Approximate 2-yr Detention Volume =	0.589	acre-feet		
Approximate 5-yr Detention Volume =	0.784	acre-feet		
Approximate 10-yr Detention Volume =	0.987	acre-feet		
Approximate 25-yr Detention Volume =	1.333	acre-feet		
Approximate 50-yr Detention Volume =	1.561	acre-feet		
Approximate 100-yr Detention Volume =	1.810	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.302	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.773	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.735	acre-feet
Total Detention Basin Volume =	1.810	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = 1.00 ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	20	0.000		
5881	--	1.00	--	--	--	401	0.009	210	0.005
5882	--	2.00	--	--	--	4,068	0.093	2,445	0.056
5883	--	3.00	--	--	--	8,001	0.184	8,480	0.195
5884	--	4.00	--	--	--	10,733	0.246	17,847	0.410
5885	--	5.00	--	--	--	13,718	0.315	30,073	0.690
5886	--	6.00	--	--	--	16,085	0.369	44,974	1.032
5887	--	7.00	--	--	--	17,424	0.400	61,729	1.417
5888	--	8.00	--	--	--	18,136	0.416	79,509	1.825
5889	--	9.00	--	--	--	18,547	0.426	97,851	2.246
5890	--	10.00	--	--	--	18,903	0.434	116,575	2.676
5891	--	11.00	--	--	--	19,155	0.440	135,604	3.113
5892	--	12.00	--	--	--	19,126	0.439	154,744	3.552
5893	--	13.00	--	--	--	20,041	0.460	174,328	4.002
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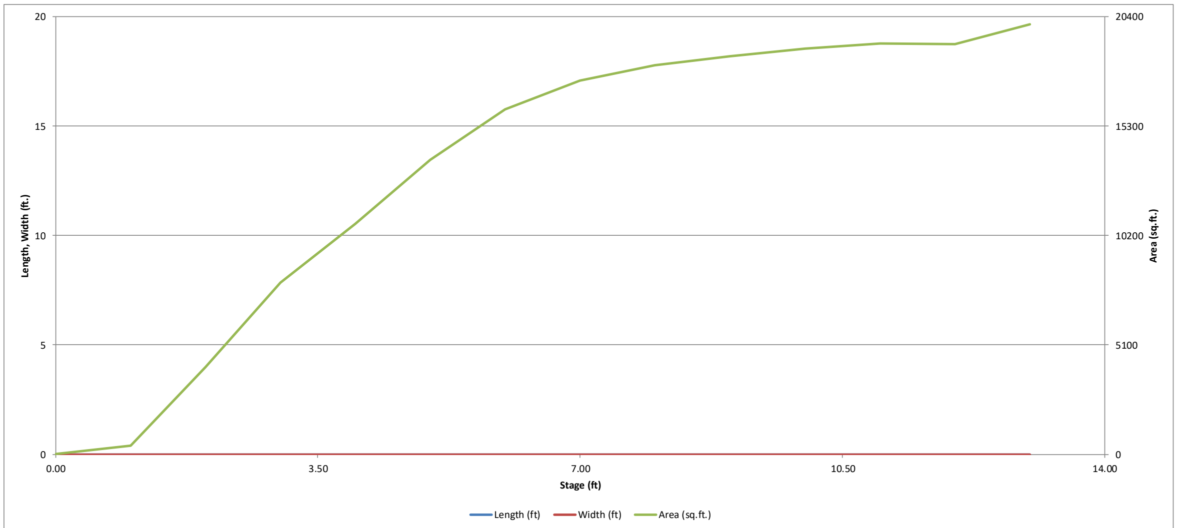
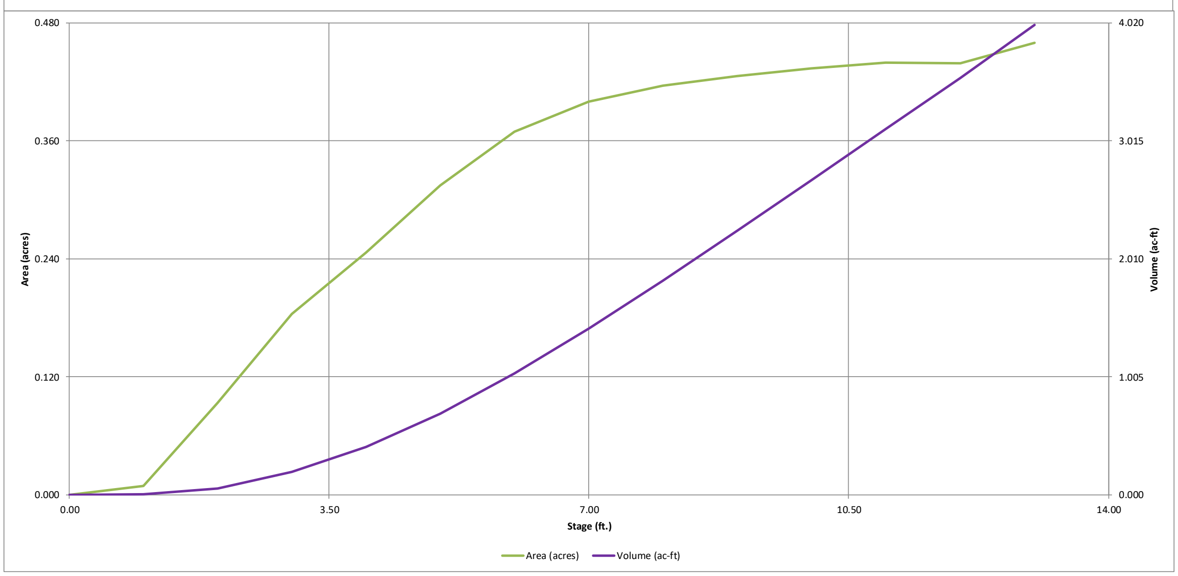
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)





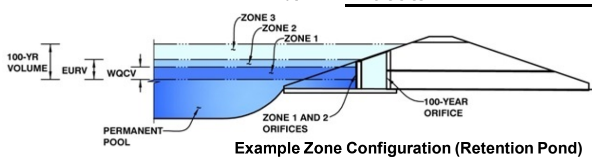
Verify all values and update so the Spreadsheet and Pond Details in the CDs match.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: Powers and Grinnell

Basin ID: Whole site



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.54	0.302	Orifice Plate
Zone 2 (EURV)	6.12	0.773	Rectangular Orifice
Zone 3 (100-year)	7.97	0.735	Weir&Pipe (Restrict)
	Total (all zones)	1.810	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	6.042E-03	ft^2
Depth at top of Zone using Orifice Plate =	3.54 [6.25]	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	14.12 [19.2]	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.87	sq. inches (diameter = 1-1/16 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

None of the orifices are 1-1/6 in and all three are different per the CDs. Verify and update so both match.

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20 [1.6]	2.40 [3.2]					
Orifice Area (sq. inches)	0.87	0.87	0.87					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.70	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	6.12	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	4.00		inches

This is not shown on the orifice plate detail in the CDs.

Calculated Parameters for Vertical Orif

	Zone 2 Rectangular	Not Selected
Vertical Orifice Area =	0.06	N/A
Vertical Orifice Centroid =	0.08	N/A

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	3.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Type =	Close Mesh Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow W

	Zone 3 Weir	Not Selected
Height of Grate Upper Edge, H_t =	7.58	N/A
Overflow Weir Slope Length =	4.22	N/A
Grate Open Area / 100-yr Orifice Area =	18.81	N/A
Overflow Grate Open Area w/o Debris =	13.34	N/A
Overflow Grate Open Area w/ Debris =	6.67	N/A

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	7.60		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

	Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	0.71	N/A
Outlet Orifice Centroid =	0.37	N/A
Half-Central Angle of Restrictor Plate on Pipe =	1.41	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	11.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.63	feet
Spillway Crest Length =	25.00	feet [20 per CDs]	Stage at Top of Freeboard =	12.63	feet
Spillway End Slopes =	4.00 [0]	H:V	Basin Area at Top of Freeboard =	0.45	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.83	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

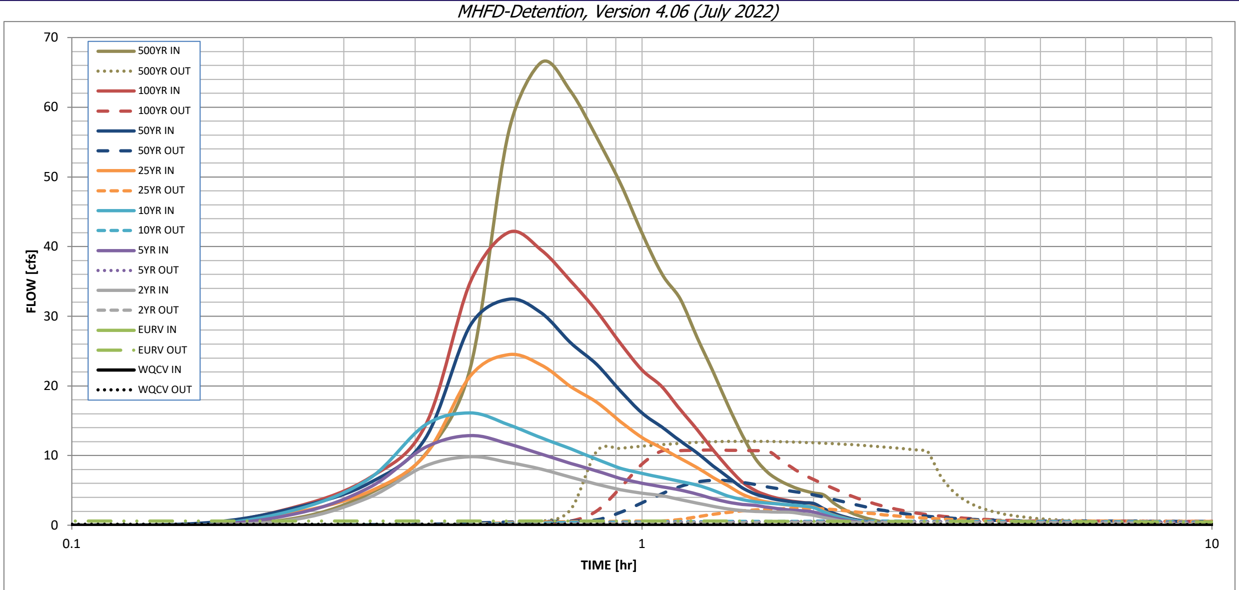
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI

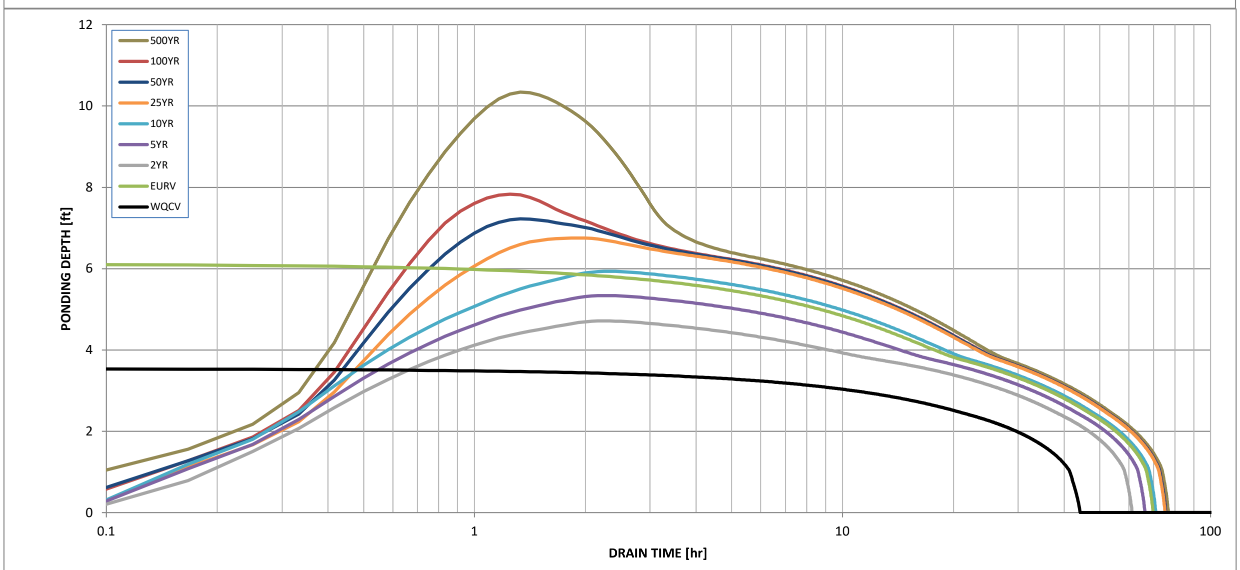
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.01	1.29	1.56	1.98	2.35	2.74
CUHP Runoff Volume (acre-ft) =	0.302	1.075	0.659	0.872	1.094	1.529	1.963	2.486
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.659	0.872	1.094	1.529	1.963	2.486
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.2	2.7	7.0	12.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.16	0.43	0.74
Peak Inflow Q (cfs) =	N/A	N/A	9.8	12.9	16.1	24.5	32.4	42.0
Peak Outflow Q (cfs) =	0.1	0.6	0.4	0.5	0.6	2.4	6.4	10.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.6	2.5	0.9	0.9	0.9
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.1	0.4	0.8
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	40	60	54	58	61	63	61	58
Time to Drain 99% of Inflow Volume (hours) =	**42**	65	58	62	66	69	68	67
Maximum Ponding Depth (ft) =	3.54	6.12	4.71	5.34	5.93	6.75	7.22	7.83
Area at Maximum Ponding Depth (acres) =	0.22	0.37	0.30	0.33	0.37	0.39	0.40	0.41
Maximum Volume Stored (acre-ft) =	0.303	1.077	0.602	0.797	1.007	1.318	1.506	1.751
Bottom of Pond = 5880; WSEL =	5883.54	5886.12	5884.71	5885.34	5885.93	5886.75	5887.22	5887.83

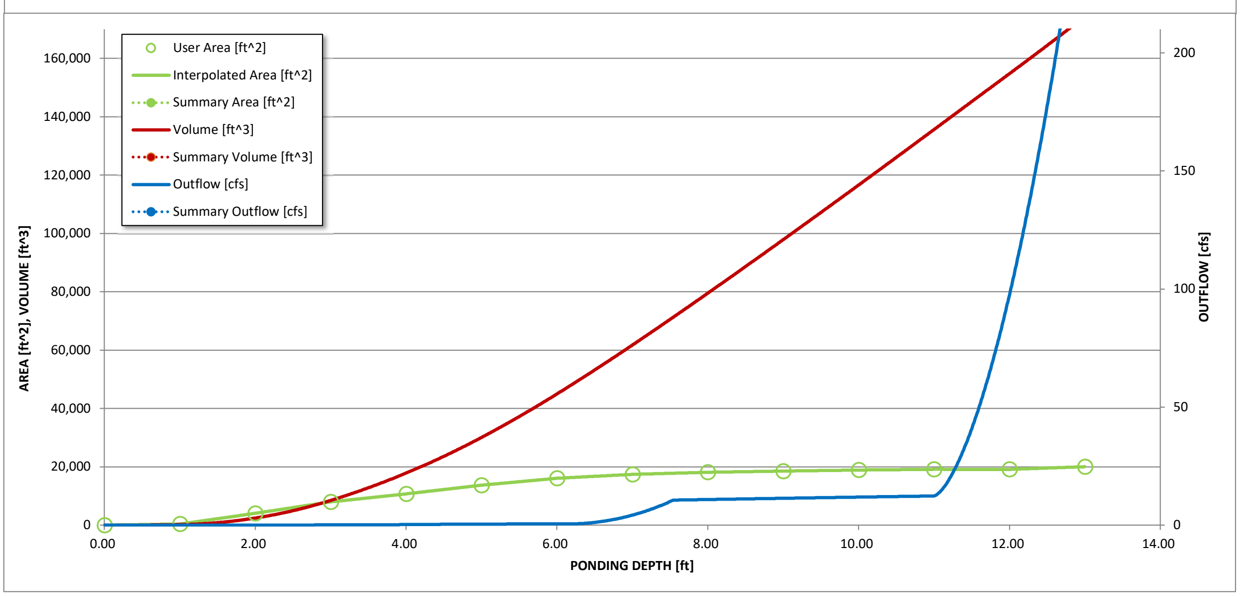
Adjust the pond design to have a ratio peak outflow equal to 1 or less.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.20	1.10
	0:15:00	0.00	0.00	0.92	1.73	2.36	1.91	2.63	2.76	4.58
	0:20:00	0.00	0.00	4.05	5.48	6.77	4.88	6.09	6.85	10.15
	0:25:00	0.00	0.00	8.51	11.14	14.36	10.07	12.43	14.22	22.51
	0:30:00	0.00	0.00	9.84	12.88	16.10	21.40	28.64	34.85	56.40
	0:35:00	0.00	0.00	9.02	11.66	14.41	24.48	32.44	42.04	66.47
	0:40:00	0.00	0.00	8.04	10.20	12.52	22.99	30.44	39.47	62.27
	0:45:00	0.00	0.00	6.90	8.88	10.96	19.91	26.20	35.07	55.63
	0:50:00	0.00	0.00	5.90	7.78	9.45	17.63	23.05	30.69	49.09
	0:55:00	0.00	0.00	5.11	6.73	8.20	14.90	19.28	26.13	41.94
	1:00:00	0.00	0.00	4.61	6.03	7.43	12.57	16.11	22.29	36.08
	1:05:00	0.00	0.00	4.24	5.53	6.86	11.06	14.10	19.89	32.52
	1:10:00	0.00	0.00	3.69	5.06	6.31	9.59	12.12	16.63	26.96
	1:15:00	0.00	0.00	3.17	4.46	5.75	8.28	10.37	13.73	22.04
	1:20:00	0.00	0.00	2.71	3.82	5.01	6.86	8.52	10.81	17.16
	1:25:00	0.00	0.00	2.33	3.31	4.20	5.63	6.90	8.29	12.95
	1:30:00	0.00	0.00	2.10	3.00	3.67	4.47	5.37	6.19	9.49
	1:35:00	0.00	0.00	1.98	2.84	3.37	3.73	4.46	4.94	7.51
	1:40:00	0.00	0.00	1.92	2.56	3.17	3.30	3.93	4.24	6.36
	1:45:00	0.00	0.00	1.88	2.34	3.02	3.03	3.60	3.78	5.55
	1:50:00	0.00	0.00	1.86	2.18	2.91	2.84	3.38	3.47	5.01
	1:55:00	0.00	0.00	1.63	2.05	2.77	2.72	3.23	3.25	4.63
	2:00:00	0.00	0.00	1.44	1.91	2.53	2.63	3.12	3.09	4.35
	2:05:00	0.00	0.00	1.10	1.45	1.92	2.00	2.37	2.32	3.24
	2:10:00	0.00	0.00	0.82	1.07	1.42	1.47	1.74	1.70	2.37
	2:15:00	0.00	0.00	0.60	0.79	1.04	1.09	1.28	1.26	1.74
	2:20:00	0.00	0.00	0.44	0.58	0.77	0.80	0.94	0.93	1.29
	2:25:00	0.00	0.00	0.32	0.41	0.55	0.57	0.67	0.67	0.92
	2:30:00	0.00	0.00	0.23	0.29	0.39	0.40	0.48	0.47	0.65
	2:35:00	0.00	0.00	0.16	0.20	0.28	0.29	0.34	0.34	0.46
	2:40:00	0.00	0.00	0.10	0.14	0.19	0.20	0.23	0.23	0.31
	2:45:00	0.00	0.00	0.06	0.08	0.11	0.12	0.14	0.14	0.19
	2:50:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.09
	2:55:00	0.00	0.00	0.01	0.02	0.02	0.02	0.03	0.03	0.03
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: AMC
Company: HKS
Date: May 8, 2023
Project: Powers & Grinnell
Location: El Paso County, Colorado

Missing pages. Please revise in the next submittal. Pond details will be further reviewed when the missing pages are added.

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 56.5 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.565

C) Contributing Watershed Area — Area = 15.950 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 1.01 in

E) Design Concept (Select EURV when also designing for flood control)

Choose One
- ○ Water Quality Capture Volume (WQCV)
- ◉ Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$ — V_{DESIGN} = ______ ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$ = ______ ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$ = 0.299 ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
- i) Percentage of Watershed consisting of Type A Soils — HSG_A = 100 %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = 0 %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = 0 %

J) Excess Urban Runoff Volume (EURV) Design Volume — $EURV_{DESIGN}$ = 1.075 ac-f t
- For HSG A: $EURV_A = 1.68 * i^{1.28}$
- For HSG B: $EURV_B = 1.36 * i^{1.08}$
- For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$ = ______ ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = ______ : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = ______ ft / ft

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: ______

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.009 ac-ft

B) Actual Forebay Volume — V_F = 0.016 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 18.0 in

D) Forebay Discharge
- i) Undetained 100-year Peak Discharge — Q_{100} = 41.40 cfs
- ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.83 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

Flow too small for berm w/ pipe

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ______ in

G) Rectangular Notch Width — Calculated W_N = 5.2 in

APPENDIX E

Construction Cost Opinion

HARRIS KOCHER SMITH
DENVER • DALLAS/FORT WORTH

Update the cost estimate to include the detention pond (outlet structure, retaining wall, trickle channel, forebay, maintenance access, etc). The total pond cost estimate needs to be added to the Financial Assurance Estimate Form under Section 1.

Outlook Powers & Grinnell
Opinion of Probable Cost
May 8, 2023

Storm Drainage Improvements

Private Storm Drainage Improvements (Non-Reimbursable)					
Item	**Description**	**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
1	18" RCP	LF	1987	$ 100.00	$ 198,721.00
2	24" RCP	LF	515	$ 150.00	$ 77,253.00
3	30" RCP	LF	322	$ 200.00	$ 64,422.00
4	36" RCP	LF	26	$ 250.00	$ 6,420.00
5	42" RCP	LF	25	$ 300.00	$ 7,584.00
6	48" RCP	LF	2110	$ 350.00	$ 738,584.00
7	4'Ø Manhole	EA	10	$ 4,500.00	$ 45,000.00
8	5'Ø Manhole	EA	9	$ 5,500.00	$ 49,500.00
9	6' Ø Manhole	EA	11	$ 6,500.00	$ 71,500.00
10	7' Ø Manhole	EA	2	$ 7,500.00	$ 15,000.00
11	9' Ø Flat-Top Manhole	EA	3	$ 9,500.00	$ 28,500.00
12	CDOT Type R 5' Inlet	EA	11	$ 5,677.00	$ 62,447.00
13	CDOT Type R 10' Inlet	EA	3	$ 9,411.00	$ 28,233.00
14	CDOT Type R 15' Inlet	EA	1	$ 12,645.00	$ 12,645.00
15	CDOT Type C Inlet	EA	4	$ 4,750.00	$ 19,000.00
16	CDOT Type 13 Valley Inlet, Double	EA	3	$ 6,000.00	$ 18,000.00
				Storm Sewer Improvements Subtotal	$ 1,442,809.00
	10% Contingency				$ 144,280.90
				Storm Sewer Improvements Total	**$ 1,587,089.90**

Make this section Appendix G (Drainage maps should be last items in the report)

APPENDIX F

Drainage Maps

We need to know how much disturbed area is untreated and if there are any exclusions that apply to those areas. So please create a basic overview map (or modify an existing drainage map) with color shading/hatching that shows areas tributary to each PBMP (pond, runoff reduction, etc.) and those disturbed areas that are not treated by a PBMP, with the applicable exclusion labeled (ex: 20% up to 1ac of development can be excluded per ECM App I.7.1.C.1 and exclusions listed in ECM App I.7.1.B.#). An accompanying summary table on this map would also be very helpful (example provided):

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to Pond A (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.C.1 (ac)	Disturbed Area Excluded from WQ per ECM App I.7.1.B.# (ac)	Applicable WQ Exclusions (App I.7.1.B.#)
A	4.50	4.50	4.50	-	-	-	
B	1.25	1.25	-	1.25	-	-	
C	6.00	4.00	-	-	-	4.00	ECM App I.7.1.B.5
D	2.50	2.50	1.00	-	0.50	1.00	ECM App I.7.1.B.7
E	3.00	-	3.00	-	-	-	
F	8.25	-	-	-	-	-	
Total	25.50	12.25	8.50	1.25	0.50	5.00	
Comments		*[For each row, the sum of the values in Columns 4-7 must be greater than or equal to the value in Column 3 above.]*	*[Values in this column can be more than Column 3 if over-treating non-disturbed areas of the same land-use.]*	*[See RR calc spreadsheet.]*	*[Total must be <20% of site and <1ac.]*		

Total Proposed Disturbed Area (ac)	Total Proposed Treated Area (ac)	Total Proposed Disturbed Area Excluded from WQ (ac)	Non-Excluded Area to be Treated (value must ≤ Total Proposed Treated Area) (ac)
12.25	9.75	5.50	6.75

DIRECT RUNOFF SUMMARY TABLE, PRE DEVELOPMENT				
BASIN	AREA (AC)	% IMP	Q_5 (CFS)	Q_{100} (CFS)
EX-1	16.51	3.3%	6.39	39.31
EX-2	1.65	5.6%	0.85	4.58
EX-3	1.54	79.2%	5.20	10.00
EX-4	1.93	61.4%	4.39	9.18
EX-5	0.32	96.9%	1.45	2.61
EX-6	0.23	83.0%	0.90	1.71

DESIGN POINT SUMMARY TABLE PRE DEVELOPMENT		
DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	6.39	39.31
2	0.85	4.58
3	5.20	10.00
4	4.39	9.18
5	1.45	2.61
6	0.90	1.71

FILEPATH: J:\221206\ENGINEERING\DRAINAGE\EX DRAINAGE PLAN.DWG LAYOUT: LAYOUT1
XREFs: e-base, e-base-byot, e-legal, e-legal-byot(0), e-util, e-util-byot, evergreen logo
PLOTTED: MON 05/08/23 7:16:58P BY: AMANDA CASTEEL

Know what's below. Call before you dig. 811

SCALE: 1" = 60'

DESIGNED BY: AMC
CHECKED BY: MAW
DRAWN BY: AMC

ISSUE DATE: 05-08-2023

DATE	REVISION COMMENTS

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

Evergreen
Development | Services | Investments

OUTLOOK POWERS & GRINNELL
EXISTING DRAINAGE PLAN

PROJECT #: 221206
SHEET NUMBER
1
1 OF 2

DIRECT RUNOFF SUMMARY TABLE, POST DEVELOPMENT				
BASIN	AREA (AC)	% IMP	Q_5 (CFS)	Q_{100} (CFS)
A-1	0.74	27.8%	0.87	2.60
A-2	0.48	78.8%	1.79	3.44
B-1	0.39	68.5%	1.28	2.58
B-2	0.70	45.1%	1.23	2.89
C-1	0.92	67.6%	2.93	5.95
C-2	0.06	81.7%	0.23	0.43
D	0.19	73.2%	0.66	1.31
E	0.68	45.1%	1.09	2.61
F	0.91	80.2%	3.38	6.47
G	0.22	99.1%	1.01	1.81
H-1	1.32	78.9%	4.87	9.37
H-2	1.73	68.6%	4.67	9.39
J	0.31	67.1%	1.00	2.02
K-1	0.19	65.8%	0.59	1.20
K-2	0.59	79.7%	2.15	4.13
L-1	0.21	56.2%	0.55	1.19
L-2	0.51	58.8%	1.33	2.84
M	1.08	48.3%	1.83	4.27
N-1	0.68	55.9%	1.89	4.08
N-2	0.35	77.1%	1.29	2.49
P	2.80	22.2%	2.54	8.24
Q	0.48	81.3%	1.85	3.52
R-1	1.02	21.2%	1.23	3.98
R-2	0.03	66.7%	0.10	0.20
OS-1	0.44	45.0%	0.73	1.95
OS-2	2.12	71.7%	5.95	11.77
OS-3	1.45	90.3%	5.71	10.53
OS-4	0.34	94.1%	1.50	2.73
OS-5	0.21	81.0%	0.81	1.54
OS-6	0.16	0.0%	0.07	0.49
OS-7	0.07	0.0%	0.03	0.21
OS-8	0.18	0.0%	0.07	0.51

DESIGN POINT SUMMARY TABLE		
DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
Pond 1	29.21	64.26
1	28.56	62.25
2	10.36	21.19
3	2.93	5.95
4	8.21	16.84
5	1.79	3.44
6	6.96	14.41
7	1.09	2.61
8	4.77	9.10
9	3.86	7.47
10	0.66	1.31
11	2.20	4.86
12	1.23	2.89
13	19.11	42.82
14	0.23	0.43
15	19.12	42.88
16	4.90	10.03
17	4.10	8.37
18	3.64	7.42
19	0.55	1.19
20	3.19	6.42
21	2.15	4.13
22	1.33	2.84
23	15.25	34.98
24	8.69	17.15
25	4.87	9.37
26	8.23	21.10
27	1.85	4.43
28	6.66	17.32
29	5.40	14.95
30	3.13	10.06
31	3.22	7.00
32	1.29	2.49
33	1.96	4.56
34	1.85	3.52
35	1.85	3.52
37	5.71	10.53
38	6.98	15.13
39	1.59	2.92
40	0.81	1.54

FILEPATH: J:\221206\ENGINEERING\DRAINAGE\DRAINAGE PLAN.DWG LAYOUT: LAYOUT1
10 XREFS: e-base, e-base-byot, e-legal-byot, e-util, e-util-byot, evergreen logo, p-base, p-legal, p-roadway, p-util[U]
PLOTTED: MON 05/08/23 7:16:17P BY: AMANDA CASTEEL

811 Know what's below. Call before you dig.

SCALE: 1" = 60'

DESIGNED BY: AMC
CHECKED BY: MAW
DRAWN BY: AMC

ISSUE DATE: 05-08-2023

DATE	REVISION COMMENTS

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203
P: 303.623.6300 F: 303.623.6311
HarrisKocherSmith.com

Evergreen Development | Services | Investments

OUTLOOK POWERS & GRINNELL
PROPOSED DRAINAGE PLAN

PROJECT #: 221206
SHEET NUMBER
2
2 OF 2

Make this section Appendix F

APPENDIX G

Previous Studies

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

May 2018

PREPARED FOR:

ROS Equity Holdings-Independence, LLC
31 N. Tejon, Suite 500
Colorado Springs, CO 80903

PREPARED BY:

Dakota Springs Engineering
31 N. Tejon Street, Suite 500
Colorado Springs, CO 80903
719.227.7388

PROJECT NO.16-01

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

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

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

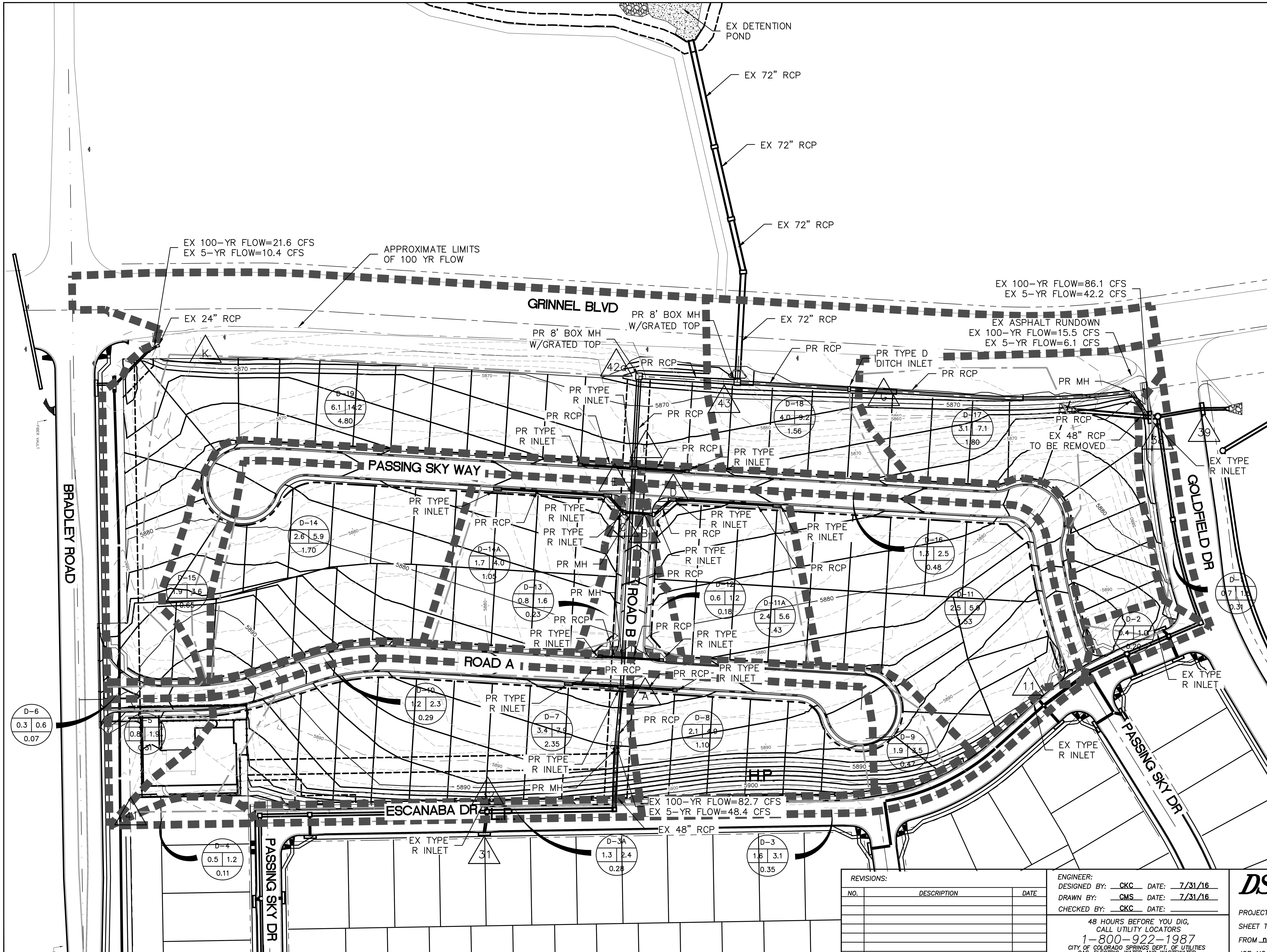
The downstream facility for this site is an existing 72-inch RCP pipe under Grinnell Boulevard and an existing detention pond west of Grinnell Blvd. The pond was designed to capture the flows from the Waterview development; specifically, Painted Sky Filing No. 1 and No. 2, including the subject property.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



SCALE IN FEET (1"= 60')

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

WINDMILL GULCH
Drainage Basin Planning Study

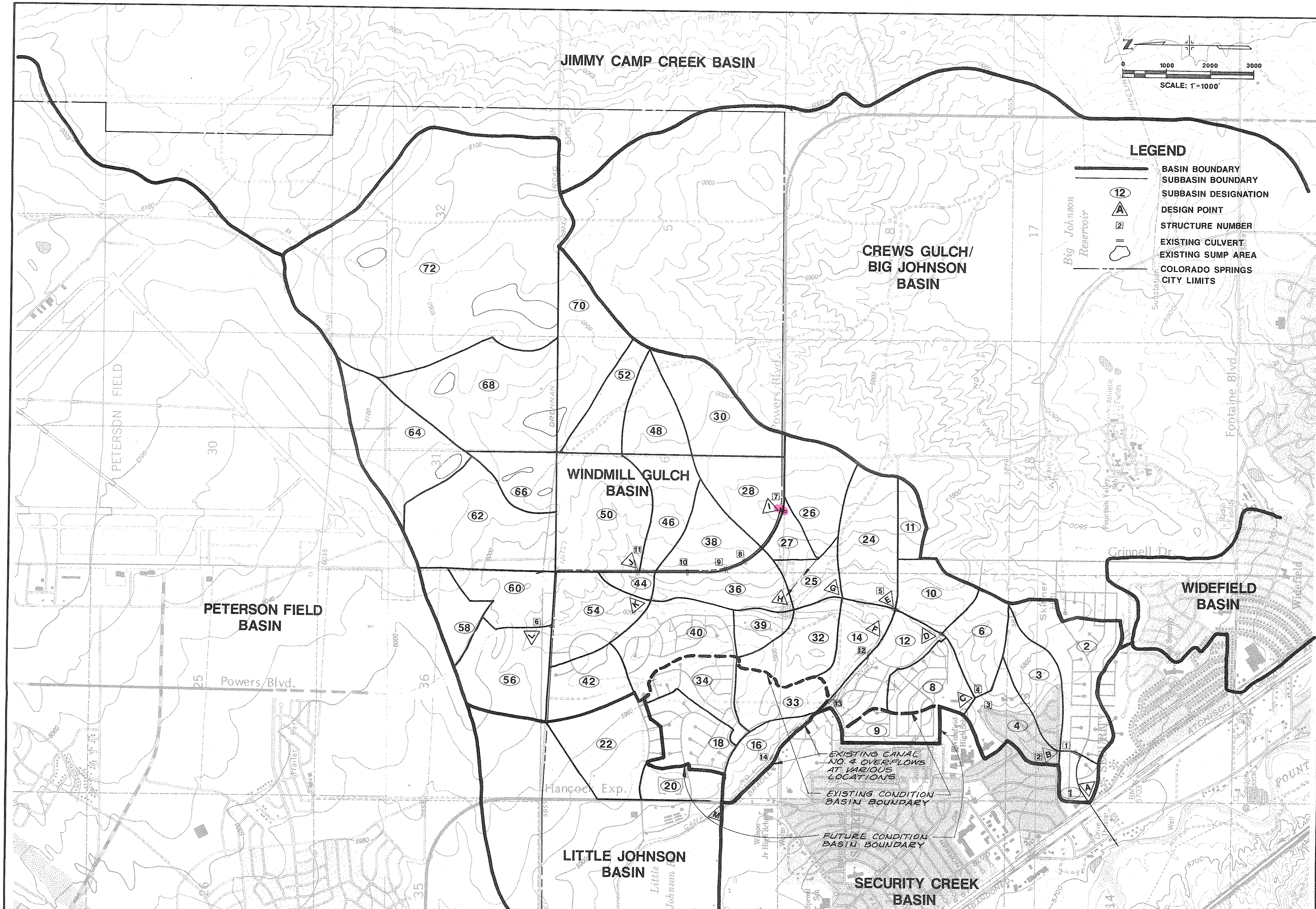
prepared for

El Paso County
Department of Public Works

January 1991
Revised June 1991
Revised February 1992
WCEA #89820

WILSON
&COMPANY

455 East Pikes Peak Avenue, Suite 200
Colorado Springs, Colorado 80903-3676
(719) 520-5800



WILSON & COMPANY

WINDMILL GULCH
DRAINAGE BASIN PLANNING STUDY

BASIN DISCHARGE MAP

DESIGN	MAB
DRAWN	RLC
DATE	FEB, 1992
FILE NO.	89-820
SHEET NO.	

WILSON & COMPANY
COLORADO SPRINGS, COLORADO

F-06-021
SF-06-031

FINAL DRAINAGE REPORT
FOR
PAINTED SKY AT WATERVIEW FILINGS 1 AND 2

January 2007

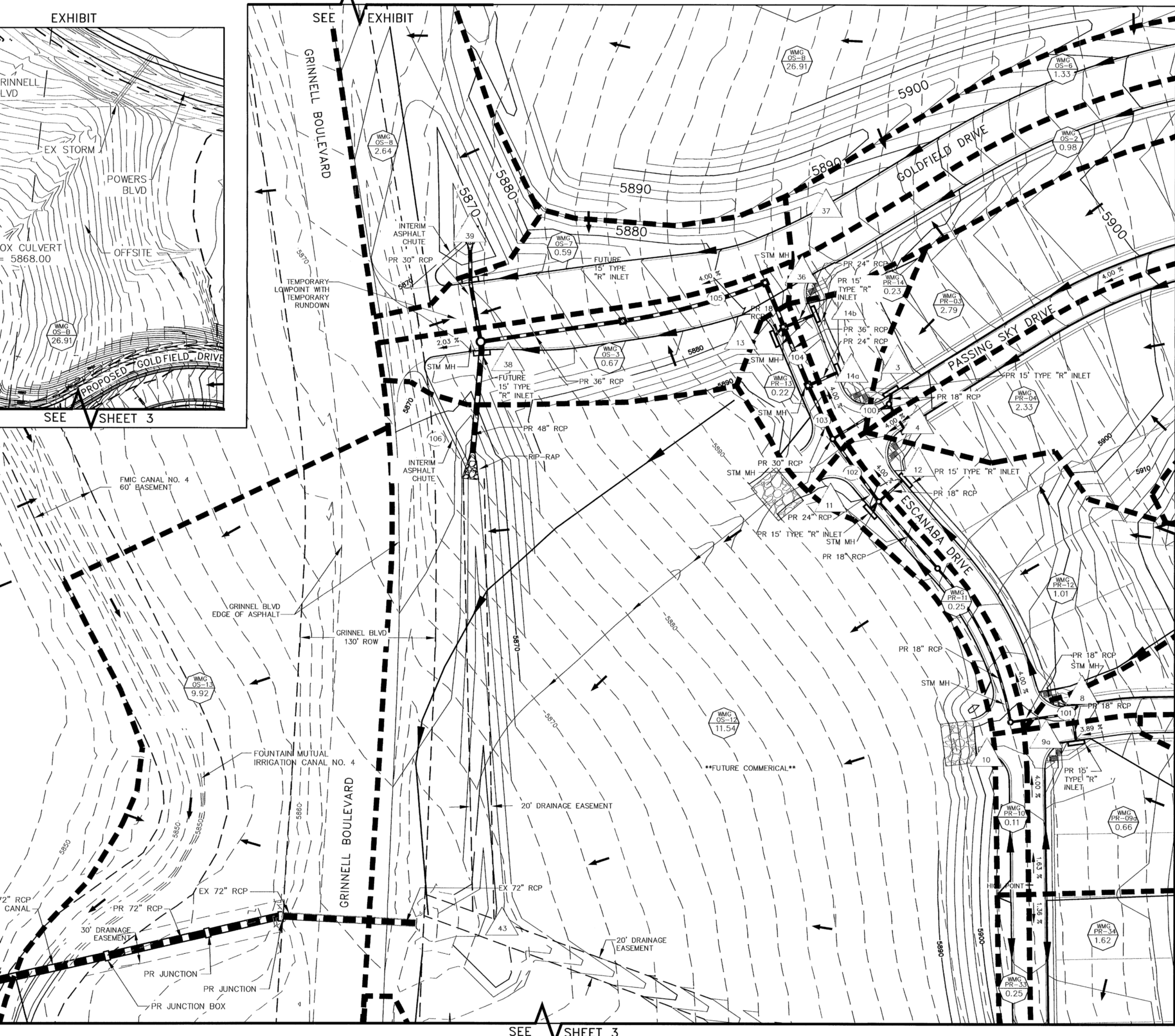
Prepared For:

Waterview JV Partners, LLC
9990 Park Meadows Drive
Lone Tree, CO 80124
(303) 779-0290

Prepared By:

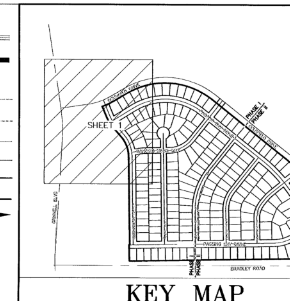
Merrick and Company
5755 Mark Dabling Blvd., Suite 350
Colorado Springs, CO 80919-2247
(719) 260-6098

Merrick Job No. 18014899 & 18014866



LEGEND

- PROPOSED STORM SEWER
- MAJOR BASIN BOUNDARY (DEVELOPED)
- DIRECTION OF FLOW
- CONTOUR – MAJOR (EXIST.) 6600
- CONTOUR – MINOR (EXIST.) 6600
- CONTOUR – MAJOR (PROPOSED) 6600
- CONTOUR – MINOR (PROPOSED) 6600
- SUBDIVISON BOUNDARY
- OVERLAND TIME FLOW PATH
- CHANNEL FLOW PATH
- INLET
- FB SUMP INLET
- BASIN IDENTIFIER / BASIN AREA (XX / 6.25)
- OVERLAND DESIGN POINT (1)
- STORM DRAIN DESIGN POINT (1)
- EMERGENCY OVERFLOW ROUTING



KEY MAP
N.T.S.

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	19.2
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
ULTIMATE CONDITION		
38	4.7	13.2
39	19.7	32.3

STORM SEWER ROUTING SUMMA

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTAL Q100 (
100	6.7	8.
101	6.1	8.
102	13.8	19.
103	18.9	24.
104	26.3	35.
105	26.5	39.
106	42.2	67.
107	5.7	7.7
108	12.6	15.
109	20.4	27.
110	33.1	49.
111	38.9	57.
112	48.4	81.

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
HORIZ: 1 inch = 50 ft.

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
DRAWN	JAG	11/15/06
DESIGNED	EAS	11/15/06
QC REVIEW	MJP	11/15/06
APPROVED	MJP	11/15/06
CLIENT	SIGNATURE	DATE
REVIEW		
APPROVED		
CAD FILE NAME	4899-FPPR01.DWG	

PAINTED SKY AT WATERVIEW
BRADLEY ROAD
AND GRINNELL BOULEVARD

CLIENT PROJECT NO.	–
MERRICK PROJECT NO.	18014899
SCALE:	AS NOTED

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

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FINAL DRAINAGE REPORT
JANUARY 2007

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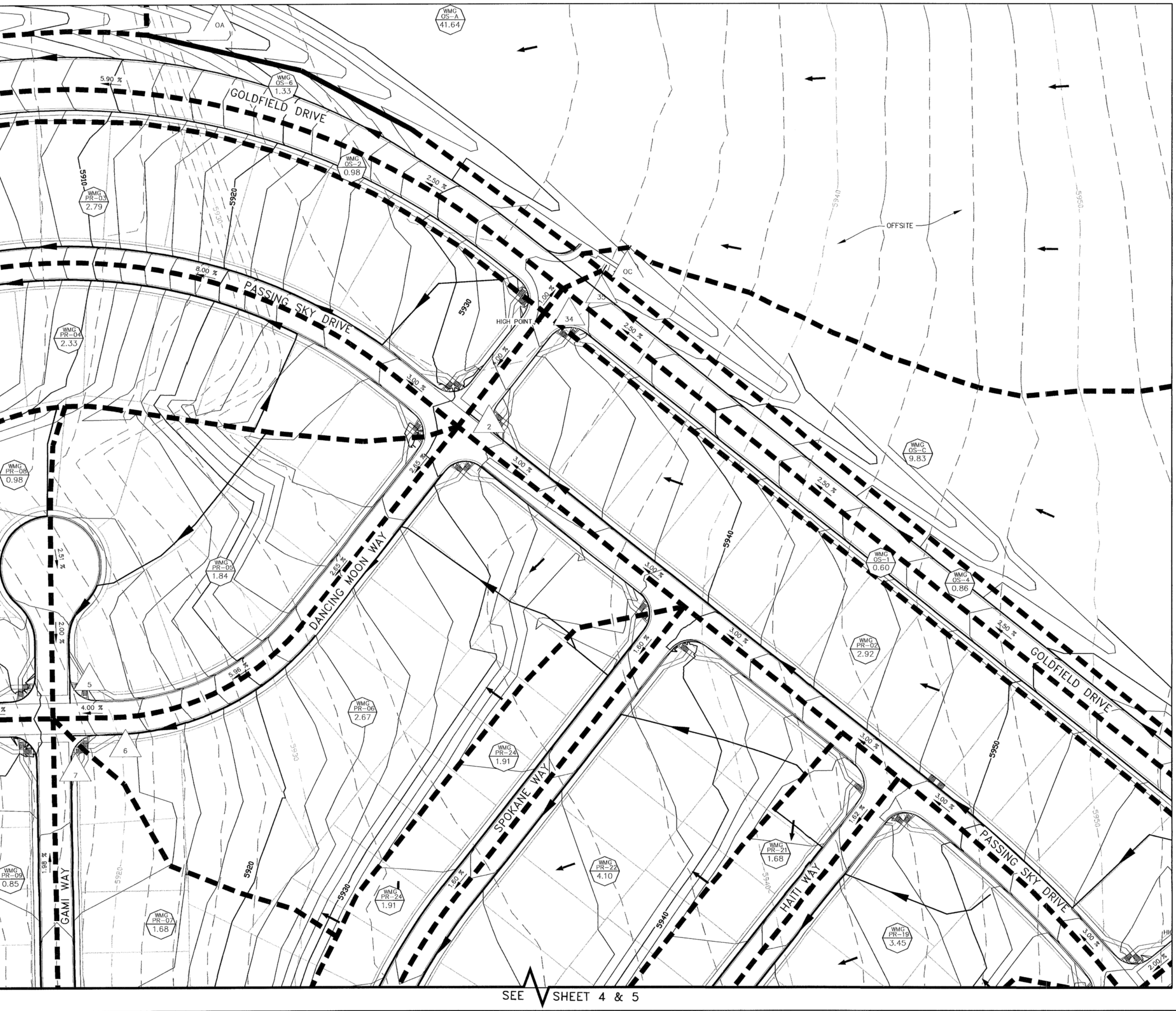
	4899D-FPPR01	1



LEGEND

- PROPOSED STORM SEWER
- MAJOR BASIN BOUNDARY (DEVELOPED)
- DIRECTION OF FLOW
- CONTOUR – MAJOR (EXIST.) 6600
- CONTOUR – MINOR (EXIST.) 6600
- CONTOUR – MAJOR (PROPOSED) 6600
- CONTOUR – MINOR (PROPOSED) 6600
- SUBDIVISON BOUNDARY
- OVERLAND TIME FLOW PATH
- CHANNEL FLOW PATH
- INLET
- FB SUMP INLET
- BASIN IDENTIFIER XX
- BASIN AREA 6.25
- OVERLAND DESIGN POINT 1
- STORM DRAIN DESIGN POINT 1
- EMERGENCY OVERFLOW ROUTING

KEY MAP

N.T.S.

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	19.2
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
ULTIMATE CONDITION		
38	4.7	13.2
39	19.7	32.3

STORM SEW[ER] ROUTING SUM[MARY]

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTA[L FLOWS]
100	6.7	
101	6.1	
102	13.8	
103	18.9	
104	26.3	
105	26.5	
106	42.2	
107	5.7	
108	12.6	
109	20.4	
110	33.1	
111	38.9	
112	48.4	

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)

HORIZ: 1 inch = 50 ft.

...LITY INFORMATION
...E YOU DIG
...22–1987
...& MARKING GAS,
...ELEPHONE LINES

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

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DESIGNED	EAS	11/15/06
QC REVIEW	MJP	11/15/06
APPROVED	MJP	11/15/06
CLIENT	SIGNATURE	DATE
REVIEW		
APPROVED		
CAD FILE NAME	4899–FPPR02.DWG	

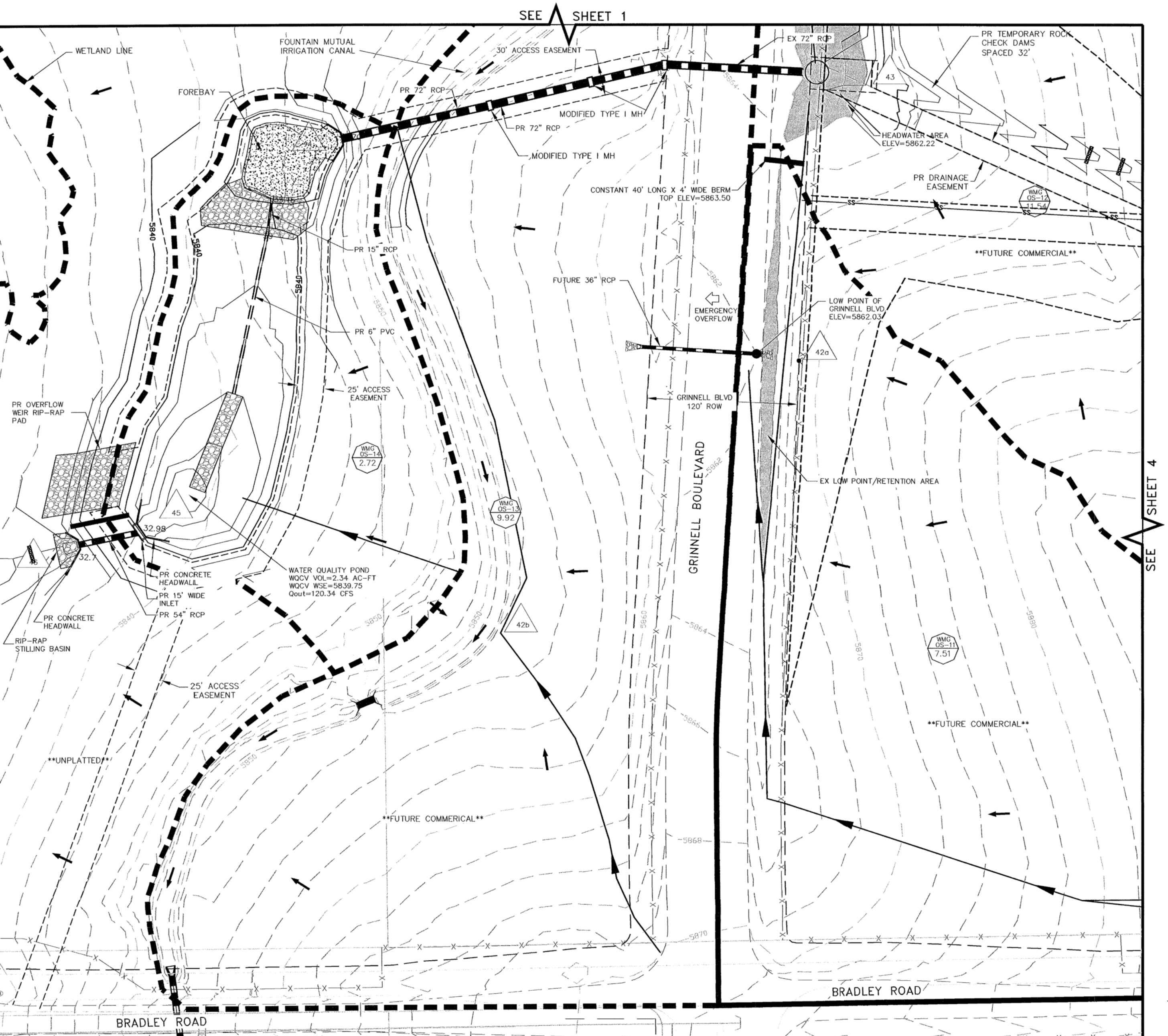
PAINTED SKY AT WATERVIEW
BRADLEY ROAD
AND GRINNELL BOULEVARD

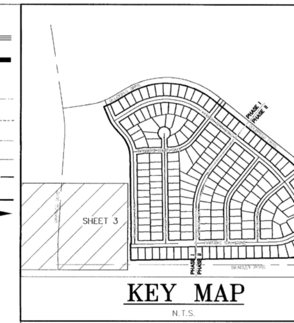
CLIENT PROJECT NO.	–
MERRICK PROJECT NO.	18014899
SCALE:	AS NOTED

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 DIST...
FINAL DRAINAGE REPORT
JANUARY 2007

REVISION: DRAWING NO. 4899D–FPPR02 SHEET NO. 2 ...





LEGEND

- PROPOSED STORM SEWER
- MAJOR BASIN BOUNDARY (DEVELOPED)
- DIRECTION OF FLOW
- CONTOUR – MAJOR (EXIST.) 6600
- CONTOUR – MINOR (EXIST.) 6600
- CONTOUR – MAJOR (PROPOSED) 6600
- CONTOUR – MINOR (PROPOSED) 6600
- SUBDIVISON BOUNDARY
- OVERLAND TIME FLOW PATH
- CHANNEL FLOW PATH
- INLET
- FB SUMP INLET
- BASIN IDENTIFIER (XX) / BASIN AREA (6.25)
- OVERLAND DESIGN POINT (1)
- STORM DRAIN DESIGN POINT (1)
- 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	19.2
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
ULTIMATE CONDITION		
38	4.7	13.2
39	19.7	32.3

STORM SEW ROUTING SUMM

DESIGN POINTS	TOTAL FLOWS Q10 (c.f.s.)	TOTA Q10
100	6.7	[illegible]
101	6.1	[illegible]
102	13.8	[illegible]
103	18.9	[illegible]
104	26.3	[illegible]
105	26.5	[illegible]
106	42.2	[illegible]
107	5.7	[illegible]
108	12.6	[illegible]
109	20.4	[illegible]
110	33.1	[illegible]
111	38.9	[illegible]
112	48.4	[illegible]

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
HORIZ: 1 inch = 50 ft.

...ILITY INFORMATION
...RE YOU DIG
...22-1987
... & MARKING GAS,
...ELEPHONE LINES

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
DRAWN	JAG	11/15/06
DESIGNED	EAS	11/15/06
QC REVIEW	MJP	11/15/06
APPROVED	MJP	11/15/06
CLIENT	SIGNATURE	DATE
REVIEW		
APPROVED		
CAD FILE NAME	4899-FPPR03.DWG	

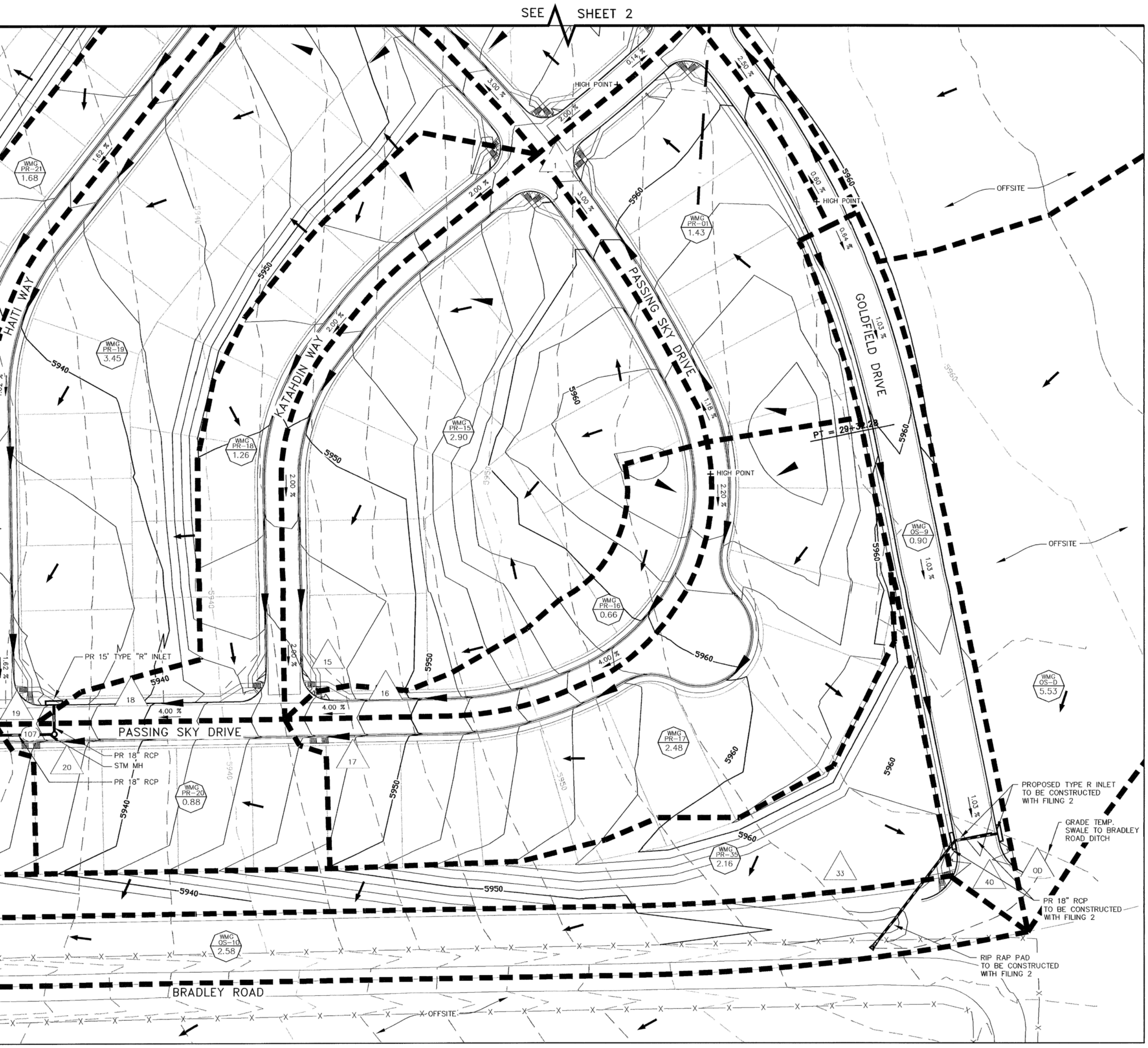
PAINTED SKY AT WATERVIEW
BRADLEY ROAD
AND GRINNELL BOULEVARD

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 DIST
FINAL DRAINAGE REPORT
JANUARY 2007

REVISION:	DRAWING NO.	SHEET NO.
	4899D-FPPR03	3



LEGEND

PROPOSED STORM SEWER
MAJOR BASIN BOUNDARY (DEVELOPED)
DIRECTION OF FLOW
CONTOUR – MAJOR (EXIST.) 6600
CONTOUR – MINOR (EXIST.) 6600
CONTOUR – MAJOR (PROPOSED) 6600
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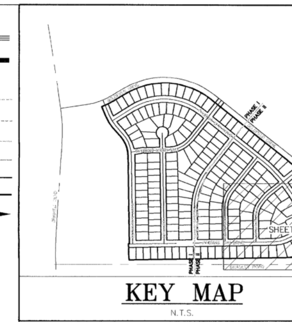
INLET
FB SUMP INLET
BASIN IDENTIFIER / BASIN AREA XX 6.25
OVERLAND DESIGN POINT 1
STORM DRAIN DESIGN POINT 1
EMERGENCY OVERFLOW ROUTING



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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
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33	2.5	5.2
34	2.8	4.5
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107	5.7	[illegible]
108	12.6	[illegible]
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110	33.1	[illegible]
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MARKING GAS,
LEPHONE LINES

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
DRAWN	JAG	11/15/06
DESIGNED	EAS	11/15/06
QC REVIEW	MJP	11/15/06
APPROVED	MJP	11/15/06
CLIENT	SIGNATURE	DATE
REVIEW		
APPROVED		
CAD FILE NAME	4899–FPPR05.DWG	

PAINTED SKY AT WATERVIEW
BRADLEY ROAD
AND GRINNELL BOULEVARD

CLIENT PROJECT NO. –
MERRICK PROJECT NO. 18014899
SCALE: AS NOTED

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 METRO DISTRIC
FINAL DRAINAGE REPORT
JANUARY 2007

REVISION: DRAWING NO. 4899D–FPPR05 SHEET NO. 5

NEW DOC

PAINTED SKY AT WATERVIEW
FILING NO. 3
FINAL DRAINAGE REPORT
EL PASO COUNTY, COLORADO

Amended
March 2012

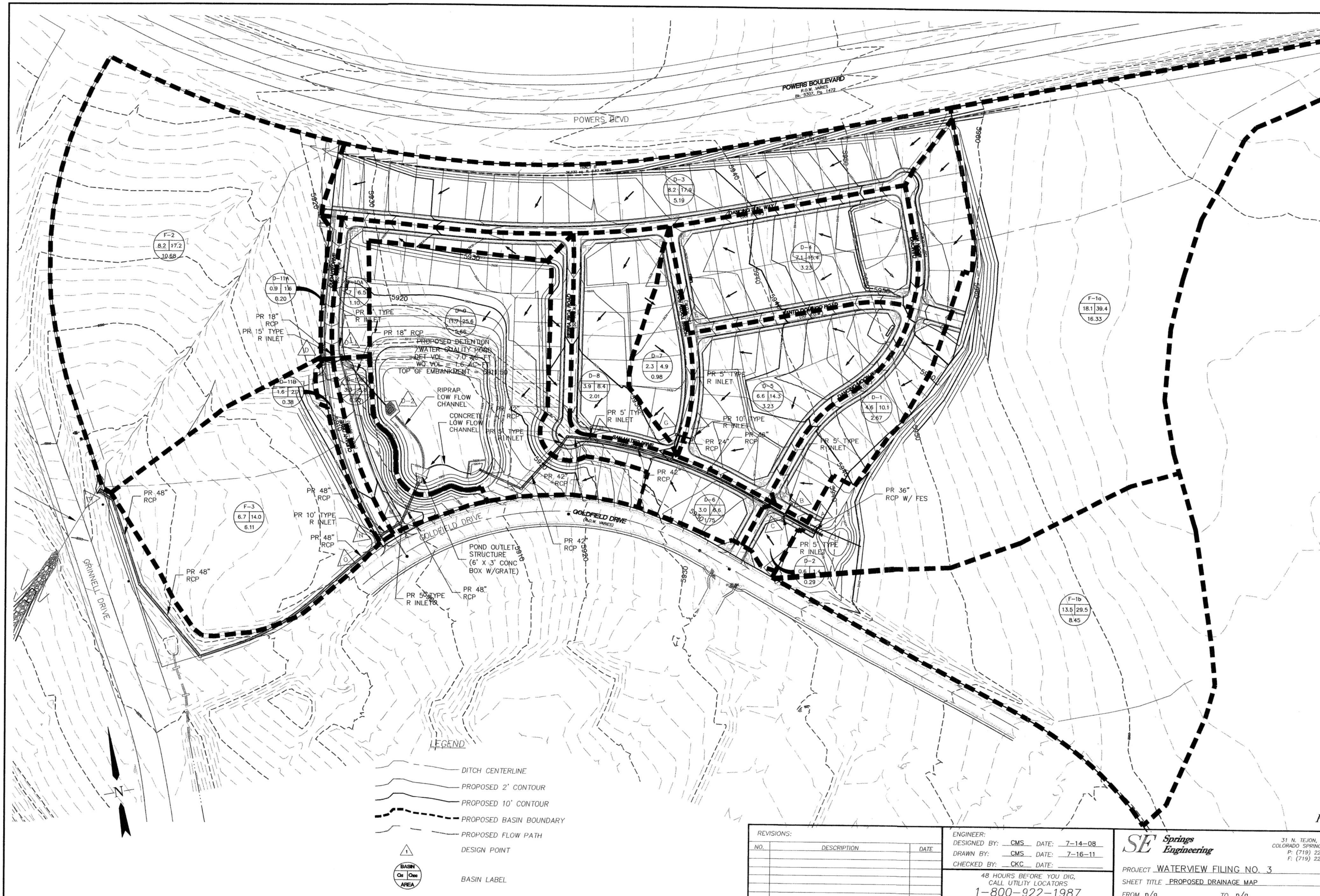
PREPARED FOR:

Waterview Investments, LLC
7251 W. 20th Street
Building L, Suite 200
Greeley, CO 80634

PREPARED BY:

Springs Engineering
31 N. Tejon Street, Suite 311
Colorado Springs, CO 80903
719.227.7388

PROJECT NO.11-001



REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER:
DESIGNED BY: CMS DATE: 7-14-08
DRAWN BY: CMS DATE: 7-16-11
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, COLORADO SPRING
P: (719) 22
F: (719) 22

PROJECT WATERVIEW FILING NO. 3
SHEET TITLE PROPOSED DRAINAGE MAP
FROM n/a TO n/a
JOB NO. 11-01 SHEET 1 OF

NEW DOC

AMENDMENT TO WATERVIEW MASTER DRAINAGE DEVELOPMENT PLAN EL PASO COUNTY, COLORADO

July 21, 2014

PREPARED FOR:

Cygnet Land
31 N. Tejon
Suite 308
Colorado Springs, CO 80903

PREPARED BY:

Springs Engineering
31 N. Tejon Street, Suite 311
Colorado Springs, CO 80903
719.227.7388

PROJECT NO.13-006

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.

______________________________ Seal
Charles K. Cothern, P.E. #24997

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: 31 N. Tejon, Suite 308

Colorado Springs, CO 80903

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.

______________________________ ____________
Andre P. Brackin, P.E., Date
County Engineer / ECM Administrator

Table of Contents

List of Figures

Appendix

PURPOSE

This report is an Amendment to the Master Drainage and Development Plan for Waterview. The purpose of this report (MDDP) is to present changes to major drainage ways, detention/water quality areas, locations of major culvert crossings, open channels and off site areas tributary to the Waterview development based on modifications to the zoning areas. Runoff quantities and proposed facilities have been calculated using the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM).

Waterview encompasses approximately 721.8 acres. There is approximately 302 acres in the Waterview development, west of Powers. Single Family accounts for 43.7 acres, Multi-Family is 46.19 acres, Commercial is 41.2 acres and Parks/Open Space is 85 acres.

Waterview east of Powers encompasses approximately 419.8 acres. 78.3 acres will consist of open space, 85.9 acres is designated commercial, 81.2 acres will consist of industrial/warehouse with the remaining 174.4 acres set aside for single family development. All roadways will have curb and gutter.

MAJOR DRAINAGE BASINS

The Waterview development site is located within 3 major drainage basins, Big Johnson Reservoir in the middle with Windmill Gulch on the east and Jimmy Camp Creek on the west.

Filings 1-4 for Waterview have already been built and are located within the Windmill Gulch Basin. A portion of Filing No. 5 is within the Windmill Gulch and the remainder is located within the Big Johnson Basin. Filing No. 6 and 7 along with the additional area added during the Sketch Plan amendment is also within the Big Johnson Basin.

Previous reports were based Drainage Basin Planning Study direction that developed flows would be released into the Big Johnson Reservoir and no detention would be required as long as water quality measures were taken within the basin. However, within recent years, this is no longer the case. Detention will be required within all basins.

There is currently no approved Drainage Basin Planning Study (DBPS) for Jimmy Camp. This report may be updated if/when a DBPS is approved.

Design, phasing, responsibility and maintenance of any proposed improvements will be discussed in future drainage reports. Fees will be assessed and paid according to the current rates at the time of platting for each filing.

Climate

The climate of the site is typical of a sub-humid to semiarid climate with mild summers and winters. The average temperature is 31 degrees F in the winter and 68.4 degrees in the summer. Total annual precipitation is 15.21 inches.

Floodplain Statement

The Flood Insurance Rate Map (FIRM No. 08041C0768-F dated 3/17/99) indicates that there is no floodplain in the vicinity of the proposed site. See Figure 3: FIRM.

Drainage Basins and Sub-Basins

Major Basin Description

Waterview development lies within 3 major basins, Windmill Gulch, Big Johnson and Jimmy Camp Creek Drainage Basins. This report is updating the Master Development Drainage Plan for Waterview by Merrick and Company. Development has already occurred within the western portion of the Sketch Plan; existing development is known as Painted Sky Filings 1 through 5. Painted Sky Filings 1 through 4 are entirely within the Windmill Gulch Basin; a majority of Filing 5 is in the Windmill Gulch Basin, however, the extreme eastern portion of Filing 5 drains to the Big Johnson/Cruz Gulch Basin. Filing 6 and 7 have been permitted through an Early Grading Permit for grading and utility construction; grading is complete and utility construction is underway at the time of publishing of this report. Filing 6 construction drawings are near approval and Filing 7 construction drawings are anticipated for approval in the fall of 2014. Final Drainage Reports (FDR) have already been approved for Filings No. 1-5 as part of Final Plat approval, and for Filing Nos. 6 and 7 as part of the Early Grading Permit. This report is current with approved FDR's. All of these reports meet and exceed the recommendations of the original MDDP.

The middle portion of the site (which includes Filing No. 6 and 7) drains to the Big Johnson Reservoir and will need to be detained prior to crossing under Powers Boulevard. The remainder of the site is within the Jimmy Camp Creek Basin and will also need to be detained prior to exiting the site. All developed runoff will meet El Paso County standards for water quality and discharge rates.

Sub-Basin Description

Historic Drainage Patterns

The historic drainage patterns of the site were analyzed in the Master Development Drainage Plan for Waterview by Merrick and Company. No new historic calculations were done and copies of this analysis have been included in the appendix for reference.

Off-Site Drainage

There is one off-site basin within the Jimmy Camp Creek Basin; this basin was analyzed in the MDDP for Waterview by Merrick. Those calculations have been used for this basin as there has been no change in the characteristics of this basin.

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

The rational method was used to determine onsite flows, 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 time of concentration was calculated per DCM requirements Rational Method results are shown in the Appendix. HydroCAD was used to determine the basin flows and design the detention pond features.

Culvert Design

Both basins will be fully developed. Full developed flows will be directed to detention facilities which will hold flows to historic rates. Ponds and culverts were sized based on the 100-year storm.

Detention Storage Criteria

This report addresses the preliminary design stage of the detention/water quality features within the proposed development. Ponds were sized on flow routing through HydroCAD and water quality was based on the UDFCD Volume 3 spreadsheet for an Extended Detention Basin.

Preliminary storage volumes and outflows have been calculated for all detention facilities. A final design has been completed for all the approved drainage reports. A copy of these designs have been included in the appendix, as detention was not considered in the original MDDP report for the Big Johnson/Cruz Gulch Basin. Preliminary design calculations have been provided for ponds which have not been constructed/approved yet and final calculations will need to be completed at the time of final platting for any of these facilities.

DRAINAGE BASINS

Offsite Basins

There is one off site basin which contributes flow to the Jimmy Camp Basin of the development.

Existing Drainage Analysis

Big Johnson Basin & Windmill Gulch Basins

The Big Johnson and Windmill Gulch historic basins do not differ from the drainage patterns or flow rates described in the DBPS by Kiowa Engineering. These excerpts have been included in the Appendix for reference.

Jimmy Camp Basin

The historic basins for the Jimmy Camp basin do not differ from the MDDP for Waterview report. The map and calculations have been included in the appendix for reference and are summarized below.

- Design Point JCH-A (Q_{10}=34 cfs, Q_{100}=69 cfs) located in the southeast corner of the site is the discharge point for Basin JCH-1. These flows enter a natural drainage swale and flow offsite.

- Design Point JCH-B (Q_{10}=170 cfs, Q_{100}=335 cfs) located in the southeast corner of the site is the discharge point for Basin JCH-2. These flows enter a natural drainage swale and flow offsite. An existing stock pond is located just downstream of this design point.

- Design Point JCH-C (Q_{10}=10 cfs, Q_{100}=25 cfs) located at Bradley Road, is the discharge point for Basin JCH-3. Flows in this basin are carried within the roadside ditch.

- Design Point JCH-D (Q_{10}=161 cfs, Q_{100}=359 cfs) is located north of Bradley Road and is the discharge for Basin JCH-4 and offsite basin JCH OS-1.

Proposed Drainage Analysis

Windmill Gulch Basin

Detailed hydrology calculations have been performed for the Waterview development through the various Final Drainage Reports for Filings No. 1 through No. 7. Copies of these have been provided in the Appendix.

Big Johnson Basin

The developed conditions for the Big Johnson Reservoir, which are not part of Waterview Filings No. 5 through 7, are described by several basins. In the previous DBPS, the open space area was shown in two basins, BJ-100 and BJ-200. These basins have been broken into smaller basins, based on logical crossing locations of the future Bradley Road.

- Design Point BJD-1 (Q_{10}=8.3, Q_{100}=23.1) consists of flow from Basins BJ-29 in Filing No. 6 and Basin 100-A (portion of DBPS Basin BJ-100). The basin will cross under the future Bradley Road with a 36" RCP. Preliminary Calculations have been included in the Appendix.

- Design Point BJD-2 (Q_{10}=10.8, Q_{100}=21.0) combines Basin BJ-23 from Filing No. 7 and Basin 100-B (portion of the DBPS Basin BJ-100). A 30" RCP will be used to cross under the Future Bradley Road at this location. Preliminary Calculations are in the Appendix.

- Design Point BJD-3 (Q_{10}=31.5, Q_{100}=74.1) combines Basin BJ-50 from Filing No. 7, the released flow from the Filing No. 6/7 detention pond and Basin 100-C (portion of DBPS Basin BJ-100). Combined flows at this location will cross under the future Bradley Road through a new 54" RCP. Preliminary calculations are included in the Appendix.

- Design Point BJD-4 (Q_{10}=7.7, Q_{100}=16.1) is Basin 100-D which is a portion of the DBPS Basin BJ-100. The flows from this basin will cross under the future Bradley Road via a 30" RCP. Calculations are included in the appendix.

- Design Point BJD-5 (Q_{10}=25.0, Q_{100}=52.4) is Basin 100-E which is also a portion of the DBPS Basin BJ-100, located between Powers and the future Bradley Road. A 48" RCP is recommended to carry the flow from this basin under the future Bradley Road.

- Design Point BJD-6 (Q_{10}=46.4, Q_{100}=101.4) is Basin 100-F, the last portion of DBPS Basin BJ-100, north of the future Bradley Road extension. Flows from this basin will be conveyed under the future Bradley Road via a 60" RCP. Calculations have been provided in the appendix.

- Design Point BJD-7 (Q_{10}=148.1, Q_{100}=273.1) combines Basin 200-A (portion of DBPS Basin BJ-200 which is north of the future Bradley Road extension) with the released flows from Pond BJD-K. Flows will be conveyed under Bradley Road through a 10' x 6' box culvert.

All of these Design Points will be conveyed as channel flow through the open space south of the future Bradley Road extension. Flows will continue along the same path as no improvements or development will be done in the area south of Bradley Road (Basins 100-G and 200-B). Channel Improvements outside of the future Bradley Road r.o.w. are not anticipated due to the open space manager legal obligations concerning no improvements in the open space.

- Design Pont BJD-8 (Q_{10}=257.9, Q_{100}=463.4) combines Basin 200-B with the flows from Design Point BJD-7 and Pond BJD-M. Flows will continue through an existing channel where flows will release into the Big John Reservoir.

- Design Point BJD-9 (Q_{10}=340.8, Q_{100}=746.9) combines Basin 100-G along with Design Points BJD-1 through BJD-6. These flows will all travel through existing channels in the Bluestem Open Space area, where they will finally release into the Big Johnson Reservoir.

There are 2 other basins in the Big Johnson basin, based on roadway crossings at Powers Boulevard, these basins are BJD-12 (Design Point BJD-K) and BJD-13 (Design Point BJD-M). Each of these basins was previously analyzed in the MDDP for Waterview by Merrick.

- Design Point BJD-K (Q_{10}=109.8, Q_{100}=170.9) is the basin on the north portion of Powers Boulevard, Basin BJD-12. The flow will enter a proposed detention pond where it will then release historic flows through a proposed culvert under the roadway. A water quality feature will be required at this location. Preliminary Design has been included in the Appendix.

- Design Point BJD-M (Q_{10}=211.9, Q_{100}=330.0) is the basin on the east side of Powers Boulevard, Basin BJD-13. The flow will enter a proposed detention pond where it will then release historic flows through a proposed culvert under the roadway. A water quality feature will be required at this location. Preliminary Design has been included in the Appendix. The current pipes located under the roadway will be replaced with the new pipe/outlet for the pond.

Future Preliminary Drainage reports and subsequent drainage design will need to ensure that none of the new development will increase flows into the Big Johnson Reservoir or cause undue issues to other downstream facilities.

Jimmy Camp Creek Basin

There are 3 drainage basins located within the Jimmy Camp Creek Basin and one off-site basin. Flows will be detained to historic levels prior to exiting the site.

- Design Point JCD-B (Q_{10}=234.7, Q_{100}=333.52) is the basin south of Bradley Road, Basin JCD-1. The flow will enter a proposed detention pond where it will then release historic flows through a proposed culvert. The basin generates flows of 466.43 cfs and 744.19 cfs. A water quality feature will be required at this location. Preliminary Design has been included in the Appendix.

- Design Point JCD-C (Q_{10}=11.2, Q_{100}=16.8) is the basin located along Bradley Road, Basin JCD-2. Flows exit off site via a roadside ditch.

- Design Point JCD-D (Q_{10}=251.9, Q_{100}=296.8) is the basin north of Bradley Road, Basin JCD-3 and the offsite basin. It is assumed that the flow rate from the offsite basin remains the same, as the airport must detain to historic flows. The flow will enter a proposed detention pond where it will then release historic flows through a proposed culvert. The basin generates flows of 495.7 cfs and 692.1 cfs. A water quality feature will be required at this location. Preliminary Design has been included in the Appendix.

Storm Sewer System

All development is anticipated to be urban and will include storm sewer and street inlets; this method of storm water collection has already been used in Painted Sky at Waterview Filing 1 through 5 and will be used in Filing 6 and 7. Storm sewers collect storm water runoff and convey the runoff to water quality/detention facilities prior to discharging to historic drainages.

As commercial, industrial and residential development continues in this area, there will need for additional storm system design. Preliminary Plan submittals will include details concerning inlet location, storm sewer sizing and locations as part of the Preliminary Drainage Report for each submittal.

DETENTION PONDS

The original MDDP designed for Water Quality, but did not allow for any detention as at the time of that report, it had been assumed that the Big Johnson Reservoir would be able to detain any developed flows within the Big Johnson Basin of the site. Due to new regulations which have since been passed, this is no longer the case and development within the Big Johnson basin must be detained to Historic levels.

To satisfy this requirement, a detention pond for Filings No. 5 , No. 6 and No. 7 was designed in the Filing No. 6 Drainage Report. The pond has been designed to release flows at or below historic levels. The developed flows entering the proposed pond are 134 and 163 cfs for the 5 and 100-year flows. The pond has a volume of 4.78 ac-ft with a water quality volume of 1.17 ac-ft. Based on the historic basins, there were 3 release points from Waterview into the open space to the east. These basins, prior to any development, had a combined flow of 33.9 cfs for the minor (5-year) storm and 71.2 cfs for the major (100-year) storm. The detention pond has a release rate of 15.6 and 44.5 cfs for the 5-year and 100-year design storm respectively with a 100-year water surface of 5928.28. The top berm of the pond will be constructed at 5930 and the emergency spillway will be at an elevation of 5929.00 and 72 foot width. Calculations for this facility have been included in the appendix.

There are 2 locations where flows cross under Powers Blvd and enter into Basin BJ-200. Due to the restrictions of not releasing any more than historic flows, these two crossings have detentions ponds upstream and will release at or below the historic rates and do not contribute any additional flows into this basin. Due to these facilities, Basin BJ-200 does not need to detain any flows.

Filings No. 3, 4 and a portion of Filing No. 5 are within the Windmill Gulch Basin. A detention pond was built with Filing No. 3 that detains flows from this entire portion of the development. However, there is still a future commercial site located to the east of Filing No. 3 which does not drain to this pond. The future commercial site will need to design and construct it's own detention and water quality facility as it develops. A preliminary design has been included in the appendix for this feature.

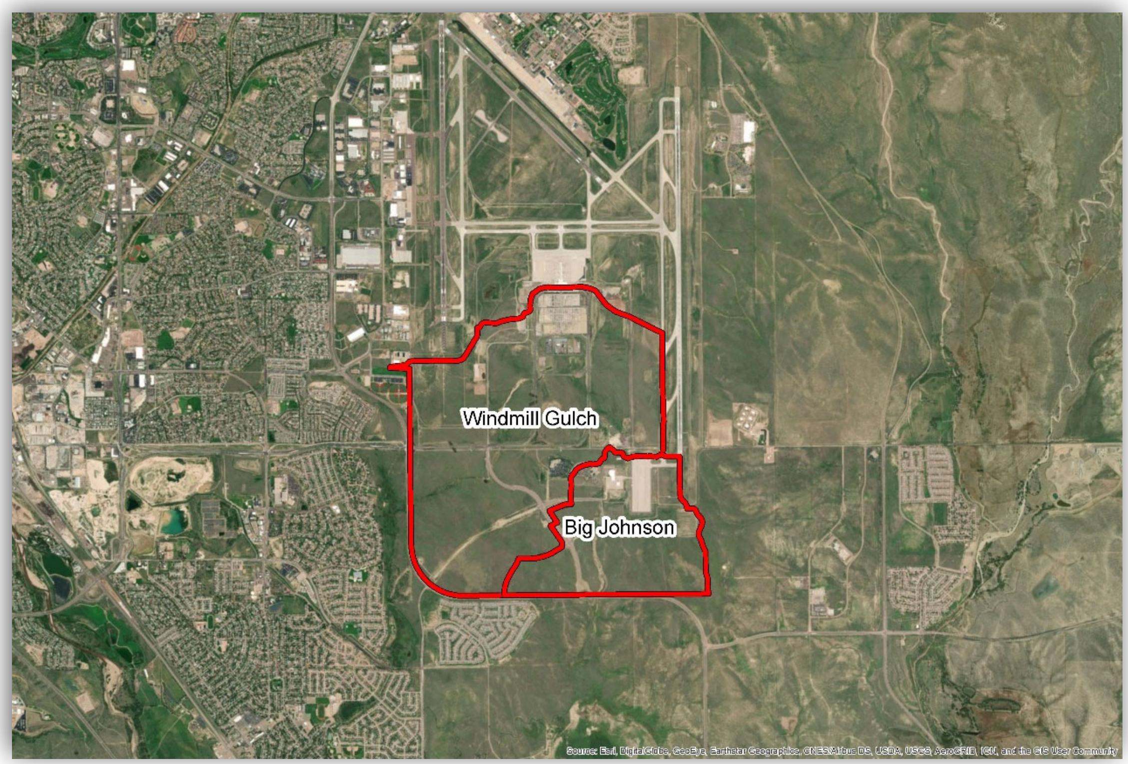
With these filings all being detained to release at historic levels, the existing box at Grinnell Blvd (8' x 6' concrete box) should be adequate to handle historic flows.

Summary

The overall drainage patterns within the Waterview development located in the Windmill Gulch Basin have not changed. No new hydrology has been done, however copies of the detailed calculations from the FDR's in this area have been included in the appendix for reference. Due to new regulations regarding detention and water quality, several detention ponds have been added to the development site. Preliminary calculations have been included in the appendix and final design has or will be done as the various Filings develop.

Development within the site is to be commercial/retail, industrial and residential. Approximately 1/3 of the site is within the Big Johnson Basin. There are two proposed crossings under Powers Boulevard; each of these crossings will have a detention pond just upstream to ensure that flows are being released at historic rates, as the Big Johnson Reservoir is not able to accept developed flows.

Colorado Springs Airport
Peak Innovation Park
Master Development Drainage Plan



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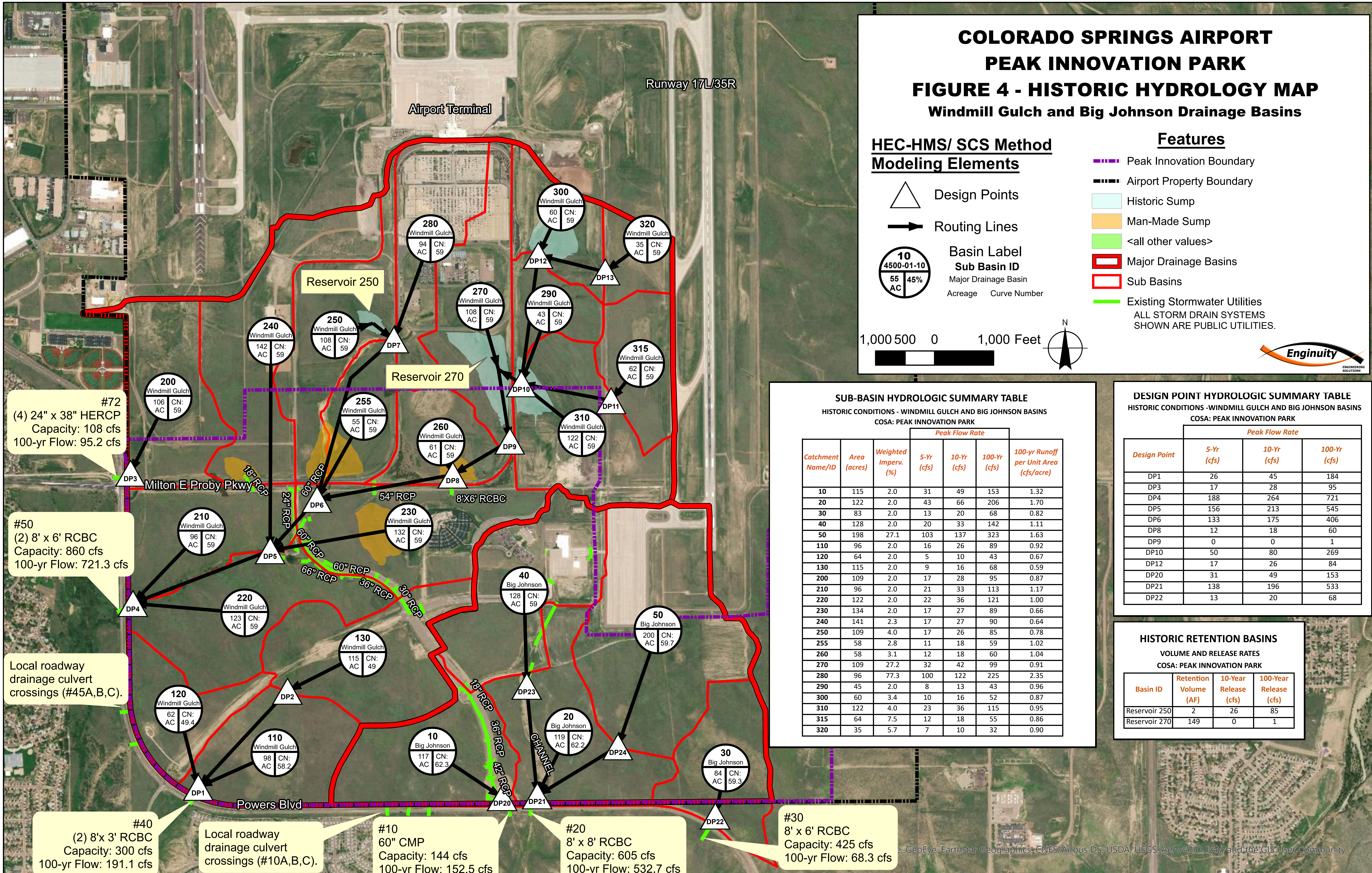

COLORADO SPRINGS AIRPORT
PEAK INNOVATION PARK
FIGURE 4 - HISTORIC HYDROLOGY MAP
Windmill Gulch and Big Johnson Drainage Basins

SUB-BASIN HYDROLOGIC SUMMARY TABLE
HISTORIC CONDITIONS - WINDMILL GULCH AND BIG JOHNSON BASINS
COSA: PEAK INNOVATION PARK

			Peak Flow Rate			
Catchment Name/ID	Area (acres)	Weighted Imperv. (%)	5-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)	100-yr Runoff per Unit Area (cfs/acre)
10	115	2.0	31	49	153	1.32
20	122	2.0	43	66	206	1.70
30	83	2.0	13	20	68	0.82
40	128	2.0	20	33	142	1.11
50	198	27.1	103	137	323	1.63
110	96	2.0	16	26	89	0.92
120	64	2.0	5	10	43	0.67
130	115	2.0	9	16	68	0.59
200	109	2.0	17	28	95	0.87
210	96	2.0	21	33	113	1.17
220	122	2.0	22	36	121	1.00
230	134	2.0	17	27	89	0.66
240	141	2.3	17	27	90	0.64
250	109	4.0	17	26	85	0.78
255	58	2.8	11	18	59	1.02
260	58	3.1	12	18	60	1.04
270	109	27.2	32	42	99	0.91
280	96	77.3	100	122	225	2.35
290	45	2.0	8	13	43	0.96
300	60	3.4	10	16	52	0.87
310	122	4.0	23	36	115	0.95
315	64	7.5	12	18	55	0.86
320	35	5.7	7	10	32	0.90

DESIGN POINT HYDROLOGIC SUMMARY TABLE
HISTORIC CONDITIONS -WINDMILL GULCH AND BIG JOHNSON BASINS
COSA: PEAK INNOVATION PARK

	Peak Flow Rate		
Design Point	5-Yr (cfs)	10-Yr (cfs)	100-Yr (cfs)
DP1	26	45	184
DP3	17	28	95
DP4	188	264	721
DP5	156	213	545
DP6	133	175	406
DP8	12	18	60
DP9	0	0	1
DP10	50	80	269
DP12	17	26	84
DP20	31	49	153
DP21	138	196	533
DP22	13	20	68

HISTORIC RETENTION BASINS
VOLUME AND RELEASE RATES
COSA: PEAK INNOVATION PARK

Basin ID	Retention Volume (AF)	10-Year Release (cfs)	100-Year Release (cfs)
Reservoir 250	2	26	85
Reservoir 270	149	0	1