FINAL DRAINAGE REPORT for

Stone Mesa Flats
Tutt and Stone Mesa Subdivision
Colorado Springs, CO

Prepared for:

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Kimley»Horn

Project #: 096481005

Prepared: June 6, 2022

CERTIFICATION

ENGINEERS STATEMENT

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

SIGNATURE (Affix Seal): _____ 06/01/2022
Colorado P.E. No. 50096 Date

DEVELOPER'S STATEMENT

The Garrett Companies, Inc. hereby certifies that the drainage facilities for Tutt and Stone Mesa Subdivision shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Tutt and Stone Mesa Subdivision guarantee that final drainage design review will absolve The Garrett Companies, Inc. and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

The Garrett Companies
Name of Developer

06/01/2022
Authorized Signature Date

W. Karl Stout
Printed Name

Director of Civil Engineering
Title

1051 Greenwood Springs Blvd Greenwood Indiana, 46143
Address:

CITY OF COLORADO SPRINGS STATEMENT

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

For City Engineer Date

Conditions:

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INTRODUCTION

PURPOSE AND SCOPE OF STUDY

The purpose of this report is to outline the required storm sewer and drainage improvements necessary to support the Stone Mesa Flats project at Tutt and Stone Mesa Subdivision, (the "Property"), City of Colorado Springs, Colorado (the "City"). This Final Drainage Report identifies on-site and off-site drainage patterns, storm sewer and inlet locations, areas tributary to the Site and proposes to safely route developed storm water to adequate outfalls. The Property is 5.60 acres.

The Property is located within the Cottonwood Creek Drainage Basin and is part of the subject area of the *Final Drainage Report for Tuscany Plaza Subdivision* prepared by Kiowa Engineering Corporation (dated May 8, 2019), herein the "FDR". Tuscany Plaza pond is currently under review for providing water quality and detention for this area in series with the sub-regional pond south of this Site, however due to uncertainty of the schedule, water quality is being provided on-site.

The Site was also studied previously in the *Preliminary/Final Drainage Report for Tutt Boulevard Industrial Park Filing No. 1* prepared by Classic Consulting Engineering & Surveyors (dated August 2007), herein the "Master Drainage Report". The Master Drainage Report outlines the planned drainage design and sizing of the existing public Sub-Regional Detention Facility to the south of the Site.

GENERAL PROJECT DESCRIPTION

The Property is located to the east of the intersection of Tutt Blvd and Stone Mesa Pt. More specifically, the Property is located directly north of the existing public Sub-Regional Detention Facility at the southwest corner of the intersection of Tutt Blvd and Stone Mesa Pt (the "Site") within the Stone Mesa Subdivision. The proposed improvements involve the construction of three apartment buildings with a total of 158 units, a detached parking garage, a swimming pool, retaining walls, sidewalks and drive aisles. Surface parking and drive aisles will encompass the central portion of the Site and a proposed on-site Private Water Quality Facility will be located at the southern portion of the Site.

The Property is situated in a portion of the northwest one-quarter of Section 7, Township 13 south, Range 65 West of the P.M., City of Colorado Springs, County of El Paso, State of Colorado (see Vicinity Map). The Property is bounded by Templeton Gap Landfill, Inc. to the west, Catholic Health Initiatives Color to the north, Tutt Blvd to the east, and an existing public Sub-Regional Detention Facility to the south. The Property is currently undeveloped and consists of mostly vacant land. The Property generally slopes from north to south with hills on the north and south portions of the property. The anticipated stormwater outfall is the existing public Sub-Regional Detention Facility to the south of the Property.

An ALTA and topographic field survey was completed for the Project by Clark Land Surveying, Inc. dated March 24, 2022 and is the basis for design for the drainage improvements.

PROJECT CHARACTERISTICS

The Project Site is 5.60 acres and involves the construction of three apartment buildings with a total of 158 units, retaining walls, sidewalks, curb and gutter, and drive aisles.

The proposed buildings, parking lot, paved drives, and other impervious surfaces comprise 72 percent (3.75 acres) of the overall Project Site. Landscape areas internal and on the perimeter of the Site consist of parking islands and landscape zones within the parking field and landscape setback areas. The proposed landscaping areas make up 28 percent (1.44 acres) of the Project Site. The weighted imperviousness and area of the Site being treated for Water Quality totals to 70% and 5.19 acres, respectively.

Generally, in the existing condition the central portion of the Site slopes approximately 3-4% from north to south with hills on the north and south portions of the Site. The hill on the north portion of the Site steepen to slopes around 25% upward to the adjacent property to the north. This historic runoff pattern will generally be maintained and unaffected with the proposed Project.

There are no major irrigation facilities within the Site. The Site does currently provide on-site water quality for the Project area. The existing public Sub-Regional Detention Facility is intended to provide detention for the developed condition of the Property. The existing land use is undeveloped vacant land.

SOILS CONDITIONS

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type A. The NRSC Soils map is provided in the Appendix.

DRAINAGE DESIGN CRITERIA

REGULATIONS

There are no provisions selected or deviations from the City of Colorado Springs Drainage Criteria Manual, dated May 2014 (Revised January 2021), for the proposed development.

DEVELOPMENT DESIGN CRITERIA REFERENCE AND CONSTRAINTS

The proposed storm facilities follow the City of Colorado Springs Storm Drainage Criteria (the “CRITERIA”) and the Urban Storm Drainage Criteria Manual (the “MANUAL”). Site drainage is not significantly impacted by such constraints as utilities or existing development. Further detail regarding onsite drainage patterns is provided in the Proposed Drainage Conditions Section.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per section 6 of the CRITERIA. Table 6-2 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the CRITERIA by calculating weighted impervious values for each specific site basin. Based upon this approach, we feel that the drainage design provided for the Site is conservative

and in keeping with the zoning and historic drainage concept for the area.

HYDRAULIC CRITERIA

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA. Hydraulic calculations were computed using StormCAD using the Standard Method. Results of the hydraulic calculations are summarized in the Appendix.

VARIANCES FROM CRITERIA

There are no proposed variances from the City of Colorado Springs Drainage Criteria, dated May 2014 (Revised January 2021), for the proposed development.

EXISTING DRAINAGE CONDITIONS

MAJOR DRAINAGE BASIN DESCRIPTION

The Project is within the Cottonwood Creek Drainage Basin. The major drainage basin is mostly developed. The Property is ultimately tributary to Cottonwood Creek. Drainage facilities immediately downstream of this Site are constructed, including the existing public Sub-Regional Detention Facility directly south of the Project Site. There are no known major irrigation facilities within 100 feet of the property.

The proposed drainage facilities for the Site are designed to follow the historic runoff patterns of the Property as well as the intent of the original storm water design for the overall development. Please refer to the Master Drainage Report for a full discussion of the original design for the subdivision. This report has been included in the Appendix for reference.

As documented within the Master Drainage Report, this proposed Site lies within sub-basins S-2 and S-7. Drainage within these sub-basins (13.3 acres) was designed to flow from north to south to the existing public Sub-Regional Detention Facility south of the Site. Applicable excerpts from the Master Drainage Report have been included in the Appendix for reference.

EXISTING DRAINAGE BASIN

The existing Site has been divided into three on-site sub-basins, EX-1 through EX-3, and two off-site sub-basins, OS-1 and OS-2. A description of each sub-basin is listed below, and an Existing Conditions Drainage Map is provided in the Appendix of this report.

Sub-Basin EX-1

(0.46 acres, Q_5=0.16 cfs / Q_{100}=1.11 cfs)

Sub-basin EX-1 of the west portion of the Site. This basin is undeveloped native land. The runoff developed within this sub-basin sheet flows from east to west overland to the western adjacent property (DP-1).

Sub-Basin EX-2

(4.95 acres, Q_5=1.56 cfs / Q_{100}=10.46 cfs)

Sub-basin EX-2 consists of the central portion of the site. This basin is generally undeveloped native land. The runoff developed within this sub-basin sheet flows from north to south where it

crosses the south property line of the Site (DP-2) and ultimately discharges into the existing public Sub-Regional Detention Facility to the south of the Site.

Sub-Basin EX-3

(0.19 acres, Q_5=0.10 cfs / Q_{100}=0.52 cfs)

Sub-basin EX-3 is 0.19 acres and consists of the east portion of the Site. This basin is generally undeveloped native land. The runoff developed within this sub-basin sheet flows from west to east to the existing drainage infrastructure within Tutt Blvd (DP-3).

Sub-Basin OS-1

(0.39 acres, Q_5=0.18 cfs / Q_{100}=1.19 cfs)

Sub-basin OS-1 is an off-site basin to the northwest of the Site. The runoff developed within this sub-basin sheet flows to the south where it crosses the north property line of the Site (DP-O1) then then ultimately discharges into the existing public Sub-Regional Detention Facility to the south of the Site.

OFFSITE FLOWS

The Site receives flows from the adjacent property to the north which will be captured and conveyed to the proposed private on-site Water Quality Facility. Sub-basin DA-4 from the Final Drainage Report for The Guest House at St. Francis, prepared by SMH Consultants (dated February 9, 2021), is allowed to flow off-site to the southwest onto the Stone Mesa Flats Site and the adjacent property to the west. Only a portion of sub-basin DA-4 flows onto the Site and has been delineated as sub-basin OS-1 in this report. No other flows from the Guest House at St. Francis site or other adjacent properties enter the Site. Applicable excerpts from the Final Drainage Report for The Guest House at St. Francis are included in **Appendix G**.

PROPOSED DRAINAGE CONDITIONS

The developed runoff from Stone Mesa Flats project at Tutt and Stone Mesa Subdivision will generally be collected by means of inverted drive aisles, swales, and channels. The runoff collected from Basin A-K will be routed to the Private Water Quality Facility which will detain the WQCV and release it in a 40-hour time period to the existing public Sub-Regional Detention Facility on the adjacent property to the south via an 15” RCP outlet pipe. The existing public Sub-Regional Detention Facility conveys the controlled water quality capture volume and 100-year detention released flows to an ultimate outfall of Cottonwood Creek.

The Property has been divided into twelve on-site sub-basins, A-L, and two off-site sub-basins, OS-1 and OS-2. All developed runoff from proposed building roofs will be collected by proposed private 6” PVC downspouts before daylighting at finished grade. All proposed storm infrastructure is private unless otherwise noted. All proposed storm pipes are RCP unless otherwise noted. Flows from sub-basins A-K enter the proposed Private Water Quality Facility before being released into the existing public Sub-Regional Detention Facility to the south of the Site. The on-site basins tributary to the proposed Private Water Quality Facility have a weighted imperviousness of 70%.

Sub-Basin A

(0.16 acres, Q_5=0.10 cfs / Q_{100}=0.53 cfs)

Sub-basin A consists of the landscaped hillside on the north end of the Site. The runoff developed within this sub-basin sheet flows to the south and is collected by a series of three proposed 12” area inlets (DP-1) and is routed to the proposed Private Water Quality Facility.

Sub-Basin B

(0.29 acres, Q_5=1.08 cfs / Q_{100}=2.05 cfs)

Sub-basin B consists of the landscaped hillside, parking, and portions of the west and north buildings on the north end of the Site. The runoff developed within this sub-basin sheet flows to the south and is collected by Inlet-B, a proposed 5-ft Type R curb inlet in sump condition (DP-2), then is routed to the proposed Private Water Quality Facility. In a fully clogged condition flows continue south where they are captured by inlets G or H.

Sub-Basin C

(0.28 acres, Q_5=0.81 cfs / Q_{100}=1.17 cfs)

Sub-basin C consists of the landscaped hillside and a portion of a proposed roof on the north end of the Site. The runoff developed within this sub-basin sheet flows to the south and is collected by a series of three proposed 12" area inlets (DP-3) and is routed to the proposed Private Water Quality Facility.

Sub-Basin D

(1.34 acres, Q_5=5.47 cfs / Q_{100}=10.10 cfs)

Sub-basin D consists of the north access road, parking, and portions of the north and east buildings on the north end of the Site. The runoff developed within this sub-basin sheet flows to the south and is collected by Inlet-D, a proposed on-grade 10-ft Type R curb inlet (DP-4), then is routed to the proposed Private Water Quality Facility. Flows bypass Inlet-D at 5-year and 100-year rates of 0.39 cfs and 2.71 cfs, respectively, and flow south to Inlet-H.

Sub-Basin E

(0.01 acres, Q_5=0.04 cfs / Q_{100}=0.09 cfs)

Sub-basin E consists of the proposed cross pan and drive aisle in the northeast corner of the Site. The runoff developed within this sub-basin sheet flows east into Tutt Blvd (DP-5) where it is captured by existing public storm infrastructure within the public right-of-way at rates less than the in the existing condition.

Sub-Basin F

(0.65 acres, Q_5=1.09 cfs / Q_{100}=2.75 cfs)

Sub-basin F consists of landscaping, a dog park, and a portion of the west building on the west side of the Site. The runoff developed within this sub-basin sheet flows to the west and south and is routed to the south via a 4-ft wide grass lined swale and is collected by a series of five 12" area inlets (DP-6). Runoff is then routed to the proposed Private Water Quality Facility.

Sub-Basin G

(0.49 acres, Q_5=1.99 cfs / Q_{100}=3.65 cfs)

Sub-basin G consists of parking and a portion of the west building on the west side of the Site. The runoff developed within this sub-basin sheet flows to the south and is collected by Inlet-G, a proposed 10-ft Type R curb inlet in sump condition (DP-7), then is routed to the proposed Private Water Quality Facility. In a fully clogged condition flows overtop the southern curb line and outfall directly into the proposed Private Water Quality Facility.

Sub-Basin H

(0.69 acres, Q_5=3.02 cfs / Q_{100}=5.48 cfs)

Sub-basin H consists of the central portion of the parking lot and a detached parking garage. The runoff developed within this sub-basin sheet flows to the south and is collected by Inlet-H, a proposed 15-ft Type R curb inlet in sump condition (DP-8), then is routed to the proposed

Private Water Quality Facility. Inlet-H accepts bypass flows from Inlet-D at 5-year and 100-year rates of 0.39 cfs and 2.71 cfs, respectively. In a fully clogged condition flows overtop the southern curb line and outfall directly into the proposed Private Water Quality Facility.

Sub-Basin I

(0.30 acres, Q_5=1.14 cfs / Q_{100}=2.17 cfs)

Sub-basin I consists of parking and a portion of the east building on the east side of the Site. The runoff developed within this sub-basin sheet flows to the south and is collected by Inlet-I, a proposed 5-ft Type R curb inlet in sump condition (DP-9), then is routed to the proposed Private Water Quality Facility. In a fully clogged condition flows overtop the southern curb line and outfall directly into the proposed Private Water Quality Facility.

Sub-Basin J

(0.58 acres, Q_5=1.21 cfs / Q_{100}=2.73 cfs)

Sub-basin J consists of landscaping, a proposed pool, and a portion of the east building on the east side of the Site. The runoff developed within this sub-basin sheet flows to the east and south and is routed to the south via a 4-ft wide grass lined swale and is collected by a series of five 12” area inlets (DP-10). Runoff is then routed to the proposed Private Water Quality Facility.

Sub-Basin K

(0.38 acres, Q_5=0.37 cfs / Q_{100}=1.41 cfs)

Sub-basin K is located in the southern portion of the Site and contains the proposed Private Water Quality Facility. Flows in this sub-basin flow directly into the proposed Private Water Quality Facility where the WQCV is released through a proposed private outlet structure (DP-11) in a 40-hour time period per the MANUAL. Runoff released from the outlet structure will drain through a proposed 15” RCP outlet pipe to proposed public Forebay-B within the existing public Sub-Regional Public Detention Facility. The 15” RCP outlet pipe will transition from private to public upon crossing the property line and into the existing public Sub-Regional Public Detention Facility.

Sub-Basin L

(0.41 acres, Q_5=0.25 cfs / Q_{100}=1.34 cfs)

Sub-basin L consists the southern access drive and landscaped space between the proposed Private Water Quality Facility and the south property line of the Site. The runoff developed within this sub-basin sheet flows across the south property line (DP-12) and into the existing public Sub-Regional Public Detention Facility, following historic drainage patterns.

Sub-Basin OS-1

(0.39 acres, Q_5=0.18 cfs / Q_{100}=1.19 cfs)

Sub-basin OS-1 is an off-site basin to the northwest of the Site. The runoff developed within this sub-basin sheet flows to the south where it crosses the north property line of the Site (DP-O1) where it is captured by proposed area inlets and is routed to the proposed Private Water Quality Facility.

Sub-Basin OS-2

(0.04 acres, Q_5=0.07 cfs / Q_{100}=0.20 cfs)

Sub-basin OS-2 consists of proposed sidewalk and tree lawn along the Tutt Blvd frontage on the west side of the Site. The runoff developed within this sub-basin sheet flows to the west and is collected by a series of five 12” area inlets and is routed into the proposed Private Water Quality Facility.

MAJOR DRAINAGEWAYS

The proposed Private Water Quality Facility and the existing public Sub-Regional Detention Facility for the Site ultimately outfall to Cottonwood Creek.

HYDRAULIC ANALYSIS METHODOLOGY

The proposed drainage facilities are designed in accordance with the CRITERIA and MANUAL. Floodplain identification was determined using FIRM panels by FEMA and information provided in the CRITERIA. Hydraulic calculations were computed using STORMCAD, which makes use of the Standard Step method to compute the hydraulic profile. Results of the hydraulic calculations are provided in the Appendix. There are no additional provisions selected or deviations from the City of Colorado Springs Drainage Criteria, dated May 2014 (Revised January 2021), for the proposed development.

Four-Step Process

The four-step process per the MANUAL provides guidance and requirements for the selection of siting of structural Best Management Practices (BMPs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices
Currently the Site is vacant land. Development of the Site will increase current runoff conditions due to the Site being vacant. However, implementation of landscaping throughout the Site will help slow runoff and encourage infiltration. Reference the IRF spreadsheet attached in the appendix.

Step 2: Provide Water Quality Capture Volume (WQCV)
The water quality capture volume will be provided and slowly released from the outlet structure in a minimum of 40 hours from the proposed Private Water Quality Facility on Site. Reference the detention capacity calculations in the appendix.

Step 3: Stabilize Drainageways
The Project is not proposing new outfall connections to existing major drainageways. The drainageways downstream of the existing public Sub-Regional Detention Facility have been stabilized as part of the construction of the pond. The Project is not increasing the flow at this location based on the previously approved Master Drainage Report, therefore additional downstream stabilization measures are not included as a part of the Project.

The existing downstream channel of the Site is Cottonwood Creek which is located approximately 5,500 feet from the Site. The Site is located within the Cottonwood Creek Drainage Basin and was accounted for in the Cottonwood Creek Drainage Basin Planning Study by Matrix Design Group, dated July 2019.

Step 4: Consider need for Industrial and Commercial BMPs
The Site does not require “Covering of Storage/Handling Areas” or “Spill Containment and Control” (specialized BMPs) in the final constructed condition. There is no proposed material storage or other Site operations that would introduce contaminants to the City’s MS4 that would require Site specific control or source control BMP for the proposed project.

All flows leaving the Site will be released at or below historic rates and will cause no impact to downstream facilities and additional off-site improvements are not required by this Project.

DETENTION REQUIREMENTS

The Master Drainage Report states that detention for the 100-year event is provided within the existing public Sub-Regional Detention Facility on the property south of the Project Site. No water quality treatment is provided in the existing public Sub-Regional Detention Facility.

Channelized Flow Design

All points of concentrated flows into the proposed and existing ponds have proposed forebays. There are two total forebays (Forebays A and B), each of which are released through a 3” notch which is the minimum width per Criteria. Calculations for the sizing of the proposed forebays can be found in the Appendix. A proposed conditions drainage map is provided in the Appendix.

Water Quality Design

The water quality treatment for the Proposed Site is provided within the proposed Private Water Quality Facility. The outlet structure will be designed to release the WQCV in a 40-hour time period per the MANUAL.

Outlet Requirements

The water quality standards established by the CRITERIA in section 13.5.10 are met by the proposed Private Water Quality Facility. The water quality outlet structures were designed per the specifications in section 13.5.10 of the CRITERIA. The orifice plate of the structure was designed based on section 13.4.2.2 of the CRITERIA. The orifice plates will allow the Water Quality Capture Volume and the Excess Urban Runoff Volume to be drained from the structure in 40 hours and 72 hours, respectively. The 100-year volume will be allowed to bypass the proposed private Water Quality Facility through a proposed spillway before being detained in the existing public Sub-regional Detention Facility. The calculations for the design of the detention and water quality outlet structure are provided in the Appendix.

Emergency Spillway Path

In the event of clogging in the outlet structure, the 100-year storm flows will be conveyed south through a 5-foot wide emergency spillway lined with 36” thick Type H Riprap (18” D50) to the existing public Sub-Regional Detention Facility on the property south of the Project Site.

EROSION CONTROL PLAN

Erosion Control Plans will be submitted separately as a standalone construction document.

FLOODPLAIN STATEMENT

The Flood Insurance Rate Maps (FIRM) 08041C0537G effective date December 7, 2018, by FEMA, indicates that the Site is located in Zone X (outside of the 500-year flood plain). This panel is included in the Appendix.

COMPLIANCE WITH MASTER DRAINAGE REPORT

The Site was studied previously in the Preliminary/Final Drainage Report for Tutt Boulevard Industrial Park Filing No. 1 prepared by Classic Consulting Engineering & Surveyors (dated

August 2007). As described in both the Master Drainage Report and the existing conditions portion of this report, the existing Site is tributary to the existing public Sub-Regional Detention Facility. Per the CRITERIA, in the proposed condition, the entire Site area of the Project is to be collected and detained for WQCV and 100-year detention. The required WQCV will be achieved with the proposed Water Quality Facility and the 100-year detention will be achieved within the existing public Sub-Regional Detention Facility on the property south of the Project Site.

The Site lies within sub-basin S-7 and partially withing sub-basin S-2 from the Master Drainage Report. Sub-basins S-2 and S-7 are 13.3 acres total and were assumed to have uniform runoff coefficients, heavy industrial land use, and combined 5-year and 100-year runoff values of 47 cfs and 95 cfs, respectively. The Site makes up 5.60 acres of the combined 13.3 acres from sub-basins S-2 and S-7 (42.1%) which results in 5-year and 100-year runoff values of 19.8 cfs and 40.0 cfs, respectively.

Developed flow from the Site will be released over a 40-hour time period from the proposed Water Quality Facility into the existing public Sub-Regional Detention Facility. The proposed total peak outflow from the Site into the existing public Sub-Regional Detention Facility from the proposed private Water Quality Facility and the off-site basins and undetained basins for the 5-year and 100-year events is 1.92 cfs and 11.24 cfs, respectively. Therefore, the existing public Sub-Regional Detention Facility has the capacity to detain the flows from the Site.

WQCV for the Project will be provided in the proposed Water Quality Facility onsite. Pond capacity and outlet structure details have been included in the Appendix.

Reference the Appendix for applicable excerpts from Master Drainage Report.

FEES DEVELOPMENT

DRAINAGE AND BRIDGE FEES

The Project Site is located in the Cottonwood Creek Basin which has a Drainage Fee of $16,428 per acre, a Bridge Fee of $1,301 per acre, and a Cottonwood Surcharge fee of $833 per acre, per the City of Colorado Springs 2022 Drainage, Bridge, and Pond Fee Schedule. The Site is 5.60 acres. The sub-total fee for each respective fee type is as follows: $91,997 for the Drainage Fee, $7,286 for the Bridge Fee, and $4,665 for the Cottonwood Surcharge. The total fee for this project is $103,948.

Fees are due prior to plat recordation.

CONSTRUCTION COST OPINION

An opinion of probable construction cost for the construction of the private drainage facilities for the Project has been included in the Appendix.

MAINTENANCE AND OPERATIONS

An 11’ wide gravel maintenance access road is proposed for the proposed Water Quality Facility with a maximum longitudinal slope of 15% per the City of Colorado Springs Drainage Criteria Manual. Maintenance of the proposed Water Quality Facility is to be provided by the owner.

GROUNDWATER CONSIDERATIONS

Per the Geotechnical Engineering Study prepared by Kumar & Associates, Inc., on April 19, 2022, groundwater was not encountered in the borings at the time of drilling. When measured 20 days later, water was found at a depth of 26.7 feet in Boring 1. The remaining borings were dry when checked from 6 to 20 days after drilling. The proposed improvements are not anticipated to be negatively affected by groundwater.

A perimeter drain system will not be provided for this Project.

SUMMARY

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for Stone Mesa Flats at Tutt and Stone Mesa Subdivision, conforms to the City of Colorado Springs Storm Drainage Criteria and the Urban Drainage and Flood Control District Manual. Additionally, the Site runoff and storm drain facilities will not adversely affect the water quality or peak flows downstream in Fountain Creek and surrounding developments. This report and its findings are consistent with the drainage requirements documented in the Master Drainage Report.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, May 2014 (Revised January 2021).

2. Mile High Flood District Urban Strom Drainage Criteria Manual (MHFDDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0537G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

4. Final Drainage Report for Tuscany Plaza Subdivision, City of Colorado Springs, Colorado. Prepared by Kiowa Engineering Corporation, (May 8, 2019) (“FDR”)

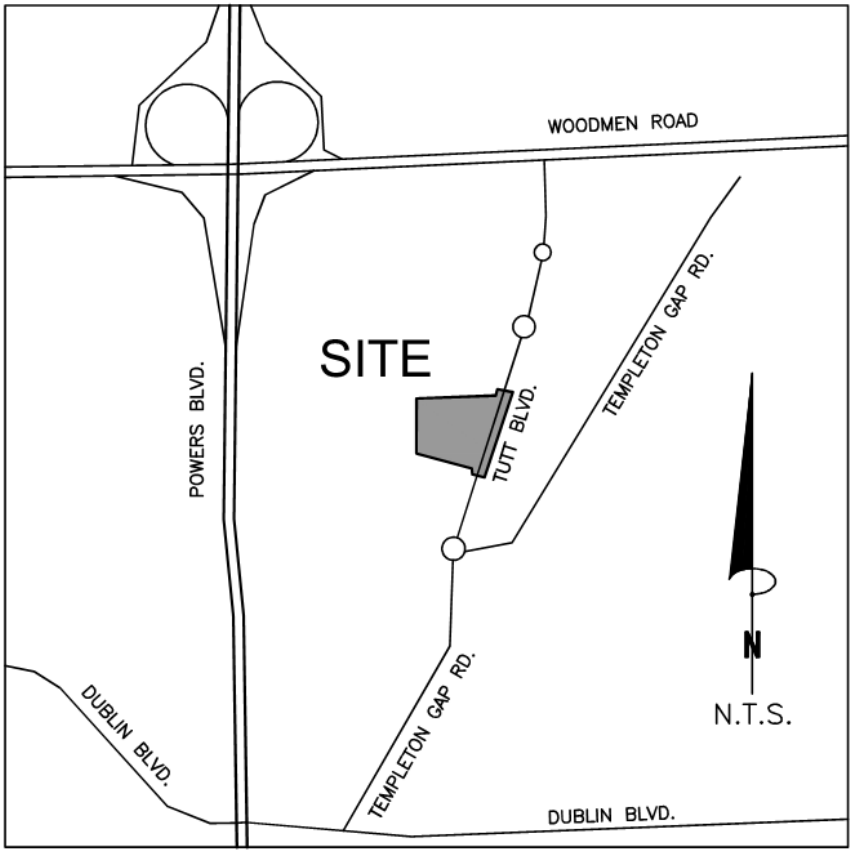
5. Preliminary/Final Drainage Report for Tutt Boulevard Industrial Park Filing No. 1 prepared by Classic Consulting Engineering & Surveyors (August 2007) (“Master Drainage Report”)

6. Final Drainage Report for The Guest House at St. Francis, prepared by SMH Consultants (February 9, 2021)

7. Geotechnical Engineering Study for Proposed Apartment Development prepared by Kumar & Associates, Inc. (April 19, 2022)

APPENDIX

APPENDIX A – VICINITY MAP



APPENDIX B – FEMA FIRM PANEL AND SOILS MAP

National Flood Hazard Layer FIRMette

FEMA

104°43'6"W 38°56'18"N

104°42'28"W 38°55'50"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

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
- B 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 7/20/2020 at 10:24 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.

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

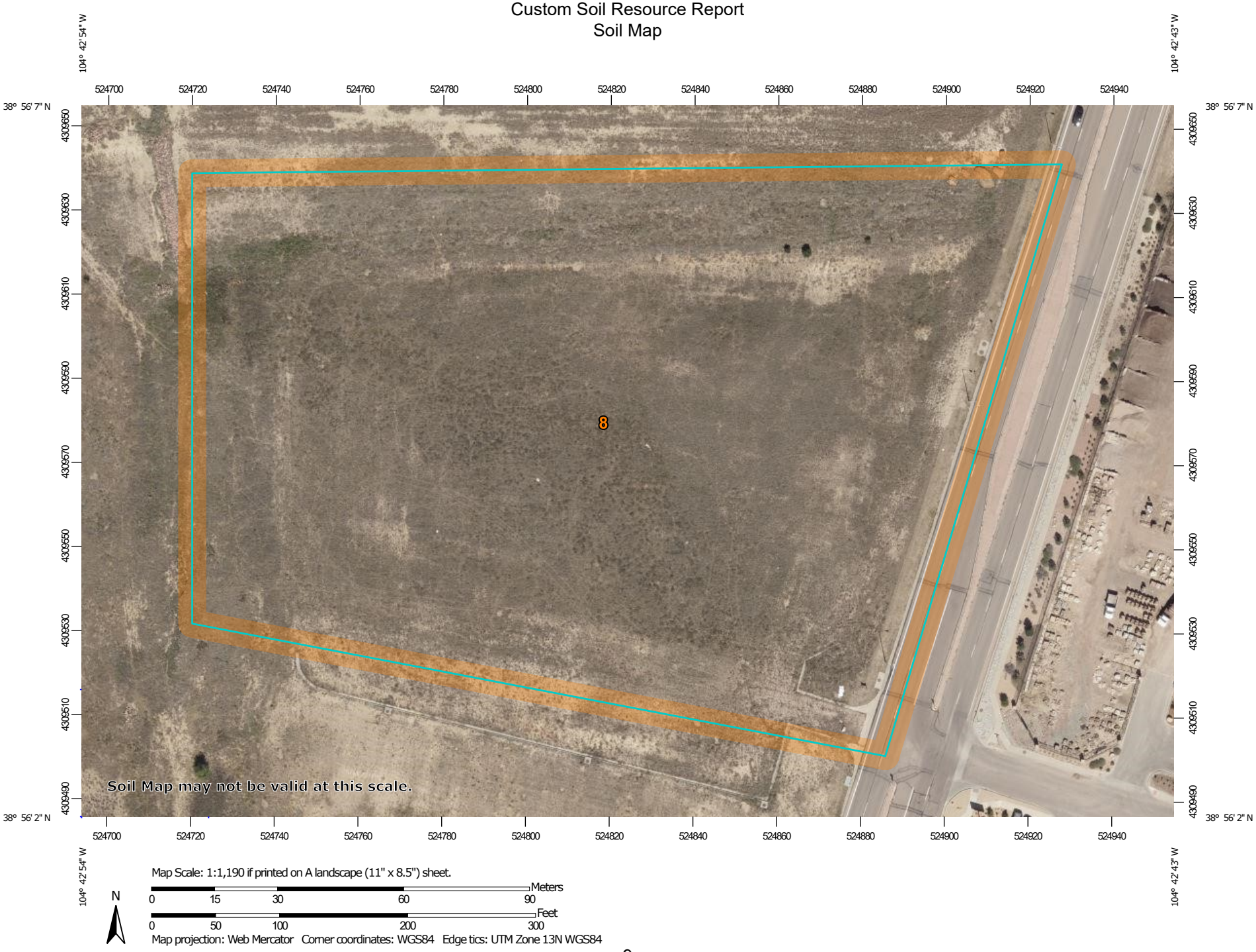
Custom Soil Resource Report for

El Paso County Area, Colorado

July 20, 2020

Contents

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,190 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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 18, Jun 5, 2020

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	5.8	100.0%
Totals for Area of Interest		**5.8**	**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
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

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

Minor Components

Pleasant

Percent of map unit: 1 percent

Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

APPENDIX C – HYDROLOGIC CALCULATIONS

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	2-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	NRCS Method		
(NRCS Type II Method) 24-Hour Storm Event and Rainfall Depth for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	**Noah Brehmer**
Company:	**Kimley-Horn and Associates, Inc.**
Date:	**June 1, 2022**
Project:	**Stone Mesa Flats**
Location:	**Detained Basins (A-K)**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**			
Receiving Pervious Area Soil Type	Loamy Sand	Loamy Sand	Sandy Loam	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand			
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.160	0.290	0.280	1.340	0.010	0.650	0.490	0.690	0.300	0.580	0.380			
Directly Connected Impervious Area (DCIA, acres)	0.000	0.260	0.210	1.250	0.000	0.290	0.470	0.660	0.250	0.310	0.060			
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Receiving Pervious Area (RPA, acres)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Separate Pervious Area (SPA, acres)	0.160	0.030	0.070	0.090	0.010	0.360	0.020	0.030	0.050	0.270	0.320			
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C	C			

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.160	0.290	0.280	1.340	0.010	0.650	0.490	0.690	0.300	0.580	0.380			
Directly Connected Impervious Area (DCIA, %)	0.0%	89.7%	75.0%	93.3%	0.0%	44.6%	95.9%	95.7%	83.3%	53.4%	15.8%			
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Receiving Pervious Area (RPA, %)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%			
Separate Pervious Area (SPA, %)	100.0%	10.3%	25.0%	6.7%	100.0%	55.4%	4.1%	4.3%	16.7%	46.6%	84.2%			
A_R (RPA / UIA)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
I_a Check	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
f / I for WQCV Event:	3.2	3.2	1.7	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2			
f / I for 2-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5			
f / I for 100-Year Event:	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4			
f / I for Optional User Defined Storm NRCS Method:														
IRF for WQCV Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
IRF for 2-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
IRF for 100-Year Event:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00			
IRF for Optional User Defined Storm NRCS Method:														
Total Site Imperviousness: I_{total}	0.0%	89.7%	75.0%	93.3%	0.0%	44.6%	95.9%	95.7%	83.3%	53.4%	15.8%			
Effective Imperviousness for WQCV Event:	0.0%	89.7%	75.0%	93.3%	0.0%	44.6%	95.9%	95.7%	83.3%	53.4%	15.8%			
Effective Imperviousness for 2-Year Event:	0.0%	89.7%	75.0%	93.3%	0.0%	44.6%	95.9%	95.7%	83.3%	53.4%	15.8%			
Effective Imperviousness for 100-Year Event:	0.0%	89.7%	75.0%	93.3%	0.0%	44.6%	95.9%	95.7%	83.3%	53.4%	15.8%			
Effective Imperviousness for Optional User Defined Storm NRCS Method:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	N/A	0.0%	0.0%	0.0%	N/A	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	N/A	0.1%	0.1%	0.0%	N/A	0.1%	0.1%	0.0%	0.1%	0.1%	0.4%	N/A	N/A	N/A
User Defined NRCS Method CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**72.7%**
Total Site Effective Imperviousness for WQCV Event:	**72.7%**
Total Site Effective Imperviousness for 2-Year Event:	**72.7%**
Total Site Effective Imperviousness for 100-Year Event:	**72.7%**
Total Site Effective Imperviousness for Optional User Defined Storm NRCS Method:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Kimley»Horn

STANDARD FORM SF-1 (EXISTING CONDITIONS)
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

DATE: 4/29/2022

SOIL: D

LAND USE:	PAVEMENT AREA	ROOF AREA	GRAVEL AREA	LANDSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.57	0.03
5-YEAR COEFF.	0.90	0.73	0.59	0.09
10-YEAR COEFF.	0.92	0.75	0.63	0.17
100-YEAR COEFF.	0.96	0.81	0.70	0.36
IMPERVIOUS %	100%	90%	80%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	GRAVEL AREA (AC)	LANDSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
All Basins											
EX-1	1	0.00	0.00	0.00	0.46	**0.46**	0.03	0.09	0.17	0.36	0%
EX-2	2	0.00	0.00	0.00	4.95	**4.95**	0.03	0.09	0.17	0.36	0%
EX-3	3	0.01	0.00	0.00	0.18	**0.19**	0.07	0.13	0.21	0.39	5%
OS-1	4	0.00	0.00	0.00	0.39	**0.39**	0.03	0.09	0.17	0.36	0%
BASIN SUBTOTAL		**0.01**	**0.00**	**0.00**	**5.98**	**5.99**	**0.03**	**0.09**	0.17	**0.36**	**0%**
		0%	**0%**	**0%**	**100%**	**100%**					

Kimley»Horn

STANDARD FORM SF-2 (EXISTING CONDITIONS)
Time of Concentration

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: **NMB**
CHECKED BY: **JRH**

DATE: 4/29/2022

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
On-Site Basins																
EX-1	0.46	0.09	200	16.5%	10.3	0	1.0%	7.0	0.7	0.0	10.3	200	16.5%	0%	26.9	10.3
EX-2	4.95	0.09	400	17.8%	14.2	0	1.0%	7.0	0.7	0.0	14.2	400	17.8%	0%	27.8	14.2
EX-3	0.19	0.13	100	5.8%	9.9	0	1.0%	7.0	0.7	0.0	9.9	100	5.8%	5%	25.8	9.9
OS-1	0.39	0.09	50	20.0%	4.8	0	1.0%	7.0	0.7	0.0	4.8	50	20.0%	0%	26.2	5.0

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Kimley»Horn

STANDARD FORM SF-3 (EXISTING CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

DATE: 4/29/2022

P_1 (1-Hour Rainfall) = **1.5**

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																						
		1	EX-1	0.46	0.09	10.3	0.04	4.01	0.16													
		2	EX-2	4.95	0.09	14.2	0.45	3.50	1.56													
		3	EX-3	0.19	0.13	9.9	0.03	4.08	0.10													
		4	OS-1	0.39	0.09	5.0	0.03	5.09	0.18													

Kimley»Horn

STANDARD FORM SF-3 (EXISTING CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

DATE: 4/29/2022

P_1 (1-Hour Rainfall) = **2.52**

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																						
		1	EX-1	0.46	0.36	10.3	0.16	6.74	1.11													
		2	EX-2	4.95	0.36	14.2	1.78	5.87	10.46													
		3	EX-3	0.19	0.39	9.9	0.08	6.85	0.52													
		4	OS-1	0.39	0.36	5.0	0.14	8.55	1.19													

Kimley»Horn

EXISTING CONDITIONS

Stone Mesa Flats

DATE: 4/29/2022

PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
On-Site Basins				
1	EX-1	0.46	0.16	1.11
2	EX-2	4.95	1.56	10.46
3	EX-3	0.19	0.10	0.52
4	OS-1	0.39	0.18	1.19
TOTAL		**5.99**	**2.00**	**13.28**

Kimley»Horn

STANDARD FORM SF-1 (PROPOSED CONDITIONS)
RUNOFF COEFFICIENTS - IMPERVIOUS CALCULATION

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

DATE: 6/6/2022

SOIL: D

LAND USE:	PAVEMENT AREA	ROOF AREA	GRAVEL AREA	LANDSCAPE AREA
2-YEAR COEFF.	0.89	0.71	0.57	0.03
5-YEAR COEFF.	0.90	0.73	0.59	0.09
10-YEAR COEFF.	0.92	0.75	0.63	0.17
100-YEAR COEFF.	0.96	0.81	0.70	0.36
IMPERVIOUS %	100%	90%	80%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (AC)	ROOF AREA (AC)	GRAVEL AREA (AC)	LANDSCAPE AREA (AC)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
All Basins											
A	1	0.01	0.00	0.00	0.16	**0.16**	0.06	0.12	0.20	0.38	4%
B	2	0.14	0.12	0.00	0.03	**0.29**	0.71	0.73	0.76	0.83	84%
C	3	0.00	0.20	0.00	0.07	**0.28**	0.53	0.56	0.60	0.69	66%
D	4	0.91	0.34	0.00	0.09	**1.34**	0.78	0.80	0.82	0.88	90%
E	5	0.01	0.00	0.00	0.01	**0.01**	0.56	0.59	0.63	0.73	61%
F	6	0.02	0.27	0.00	0.36	**0.65**	0.33	0.38	0.43	0.56	40%
G	7	0.29	0.19	0.00	0.02	**0.49**	0.79	0.80	0.83	0.88	92%
H	8	0.66	0.00	0.00	0.03	**0.69**	0.85	0.86	0.88	0.93	95%
I	9	0.20	0.06	0.00	0.05	**0.30**	0.73	0.75	0.77	0.84	83%
J	10	0.13	0.19	0.00	0.27	**0.58**	0.44	0.47	0.52	0.64	51%
K	11	0.03	0.00	0.03	0.32	**0.38**	0.14	0.19	0.26	0.43	14%
L	12	0.02	0.00	0.00	0.40	**0.41**	0.06	0.12	0.20	0.38	4%
OS1	O1	0.00	0.00	0.00	0.39	**0.39**	0.03	0.09	0.17	0.36	0%
OS2	O2	0.01	0.00	0.00	0.03	**0.04**	0.25	0.30	0.36	0.51	26%
BASIN SUBTOTAL		**2.40**	**1.36**	**0.03**	**2.24**	**6.03**	**0.53**	**0.56**	0.60	**0.70**	**61%**
		40%	**23%**	**0%**	**37%**	**100%**					
Detained Sub-Basins	**1-11**										
BASIN SUBTOTAL		**2.38**	**1.36**	**0.03**	**1.42**	**5.19**	**0.61**	**0.63**	0.67	**0.76**	**70%**
		46%	**26%**	**1%**	**27%**	**100%**					

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STANDARD FORM SF-2 (PROPOSED CONDITIONS)
Time of Concentration

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: **NMB**
CHECKED BY: **JRH**

DATE: 6/6/2022

SUB-BASIN DATA			INITIAL TIME (T_i)			TRAVEL TIME (T_t)					Tc CHECK (URBANIZED BASINS)					FINAL Tc
DESIGN BASIN (1)	AREA Ac (2)	C5 (3)	LENGTH Ft (4)	SLOPE % (5)	T_i Min. (6)	LENGTH Ft. (7)	SLOPE % (8)	C_v (9)	VEL fps (11)	T_t Min. (12)	COMP. tc (13)	TOTAL LENGTH (14)	TOTAL SLOPE (15)	TOTAL IMP. (16)	Tc Min. (17)	Min.
On-Site Basins																
A	0.16	0.12	45	25.0%	4.1	0	1.0%	7.0	0.7	0.0	4.1	45	25.0%	4%	25.6	5.0
B	0.29	0.73	15	25.0%	0.9	80	2.6%	20.0	3.2	0.4	1.3	95	6.1%	84%	12.0	5.0
C	0.28	0.56	45	25.0%	2.3	0	1.0%	7.0	0.7	0.0	2.3	45	25.0%	66%	14.8	5.0
D	1.34	0.80	100	12.0%	2.4	250	2.0%	20.0	2.8	1.5	3.9	350	4.9%	90%	11.8	5.0
E	0.01	0.59	45	6.0%	3.5	35	5.0%	20.0	4.5	0.1	3.6	80	5.6%	61%	15.9	5.0
F	0.65	0.38	81	25.0%	4.1	210	1.0%	10.0	1.0	3.5	7.6	291	7.7%	40%	20.4	7.6
G	0.49	0.80	65	2.0%	3.5	270	1.5%	20.0	2.4	1.8	5.3	335	1.6%	92%	12.3	5.3
H	0.69	0.86	95	2.0%	3.4	160	4.0%	20.0	4.0	0.7	4.1	255	3.3%	95%	10.9	5.0
I	0.30	0.75	80	2.1%	4.5	115	4.0%	20.0	4.0	0.5	5.0	195	3.2%	83%	12.8	5.0
J	0.58	0.47	50	25.0%	2.8	325	1.0%	10.0	1.0	5.4	8.2	375	4.2%	51%	19.2	8.2
K	0.38	0.19	55	25.0%	4.2	85	4.0%	10.0	2.0	0.7	4.9	140	12.3%	4%	26.0	5.0
L	0.41	0.12	75	25.0%	5.3	0	1.0%	10.0	1.0	0.0	5.3	75	25.0%	14%	23.9	5.3
OS1	0.39	0.09	55	25.0%	4.7	0	1.0%	10.0	1.0	0.0	4.7	55	25.0%	0%	26.2	5.0
OS2	0.04	0.30	10	10.0%	2.2	0	1.0%	10.0	1.0	0.0	2.2	10	10.0%	26%	21.7	5.0

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_o^{0.33}} \qquad t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

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STANDARD FORM SF-3 (PROPOSED CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

DATE: 6/6/2022

P_1 (1-Hour Rainfall) = **1.5**

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																						
		1	A	0.16	0.12	5.0	0.02	5.09	0.10													
		2	B	0.29	0.73	5.0	0.21	5.09	1.08													
		3	C	0.28	0.56	5.0	0.16	5.09	0.81													
		4	D	1.34	0.80	5.0	1.07	5.09	5.47													
		5	E	0.01	0.59	5.0	0.01	5.09	0.04													
		6	F	0.65	0.38	7.6	0.24	4.49	1.09													
		7	G	0.49	0.80	5.3	0.40	5.01	1.99													
		8	H	0.69	0.86	5.0	0.59	5.09	3.02													
		9	I	0.30	0.75	5.0	0.22	5.08	1.14													
		10	J	0.58	0.47	8.2	0.28	4.37	1.21													
		11	K	0.38	0.19	5.0	0.07	5.09	0.37													
		12	L	0.41	0.12	5.3	0.05	5.01	0.25													
		O1	OS1	0.39	0.09	5.0	0.03	5.09	0.18													
		O2	OS2	0.04	0.30	5.0	0.01	5.09	0.07													

Kimley»Horn

STANDARD FORM SF-3 (PROPOSED CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **Stone Mesa Flats**
PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

DATE: 6/6/2022

P_1 (1-Hour Rainfall) = **2.52**

STORM LINE		DESIGN POINT	DIRECT RUNOFF							TOTAL RUNOFF				STREET		PIPE			TRAVEL TIME			REMARKS
			DESIGN BASIN	AREA (AC)	RUNOFF COEFF	tc (min)	C*A(ac)	I (in/hr)	Q (cfs)	tc(max)	S(C*A) (ac)	I (in/hr)	Q (cfs)	SLOPE (%)	STREET FLOW(cfs	DESIGN FLOW(cfs)	SLOPE (%)	PIPE SIZE (in)	LENGTH (ft)	VELOCITY	tt (min)	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)
On-Site Basins																						
		1	A	0.16	0.38	5.0	0.06	8.55	0.53													
		2	B	0.29	0.83	5.0	0.24	8.55	2.05													
		3	C	0.28	0.69	5.0	0.20	8.55	1.67													
		4	D	1.34	0.88	5.0	1.18	8.55	10.10													
		5	E	0.01	0.73	5.0	0.01	8.55	0.09													
		6	F	0.65	0.56	7.6	0.36	7.54	2.75													
		7	G	0.49	0.88	5.3	0.43	8.41	3.65													
		8	H	0.69	0.93	5.0	0.64	8.55	5.48													
		9	I	0.30	0.84	5.0	0.25	8.54	2.17													
		10	J	0.58	0.64	8.2	0.37	7.35	2.73													
		11	K	0.38	0.43	5.0	0.16	8.55	1.41													
		12	L	0.41	0.38	5.3	0.16	8.41	1.34													
		O1	OS1	0.39	0.36	5.0	0.14	8.55	1.19													
		O2	OS2	0.04	0.51	5.0	0.02	8.55	0.20													

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PROPOSED CONDITIONS

Stone Mesa Flats

DATE: 6/6/2022

PROJECT NUMBER: 096481005
CALCULATED BY: NMB
CHECKED BY: JRH

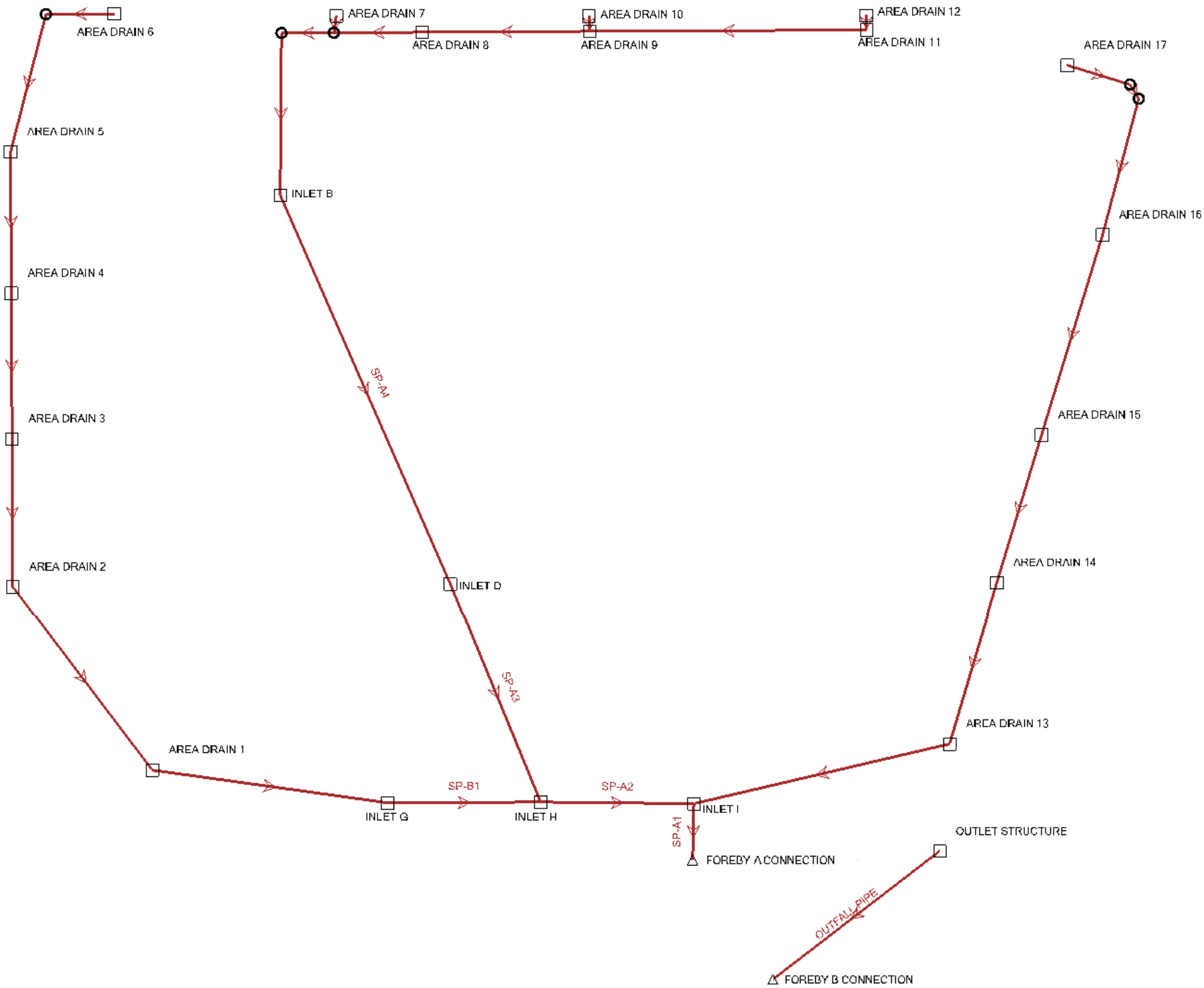
RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
On-Site Basins				
1	A	0.16	0.10	0.53
2	B	0.29	1.08	2.05
3	C	0.28	0.81	1.67
4	D	1.34	5.47	10.10
5	E	0.01	0.04	0.09
6	F	0.65	1.09	2.75
7	G	0.49	1.99	3.65
8	H	0.69	3.02	5.48
9	I	0.30	1.14	2.17
10	J	0.58	1.21	2.73
11	K	0.38	0.37	1.41
12	L	0.41	0.25	1.34
O1	OS1	0.39	0.18	1.19
O2	OS2	0.04	0.07	0.20
TOTAL		**6.03**	**16.80**	**35.32**

APPENDIX D – HYDRAULIC CALCULATIONS

STONE MESA FLATS

OVERALL STORM LAYOUT



Stone Mesa Flats

Active Scenario: 5-yr

FlexTable: Conduit Table

Label	Length (3D) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Material	Hydraulic Grade Line (In) (ft)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Stop) (ft)	Froude Number (Normal)	Depth (Normal) (ft)
OUTFALL PIPE	104.8	0.104	15.0	0.013	1.60	10.07	20.85	7.7	Concrete	6,890.79	6,897.30	6,879.62	6,880.89	4.397	0.23
SP-A1	27.0	0.005	30.0	0.013	16.08	6.14	29.53	54.5	Concrete	6,896.50	6,903.70	6,896.33	6,897.89	1.058	1.32
SP-A2	73.7	0.002	24.0	0.013	13.73	4.37	10.34	132.8	Concrete	6,897.62	6,901.99	6,897.33	6,903.70	0.545	(N/A)
SP-A3	113.5	0.013	24.0	0.013	7.06	7.07	26.18	27.0	Concrete	6,898.76	6,903.64	6,898.12	6,901.99	1.727	0.71
SP-A4	204.2	0.012	12.0	0.013	1.99	4.92	3.83	51.9	Concrete	6,901.78	6,906.29	6,899.33	6,903.64	1.366	0.51
SP-B1	73.6	0.008	24.0	0.013	3.25	4.67	19.93	16.3	Concrete	6,898.12	6,902.66	6,898.12	6,901.99	1.319	0.55

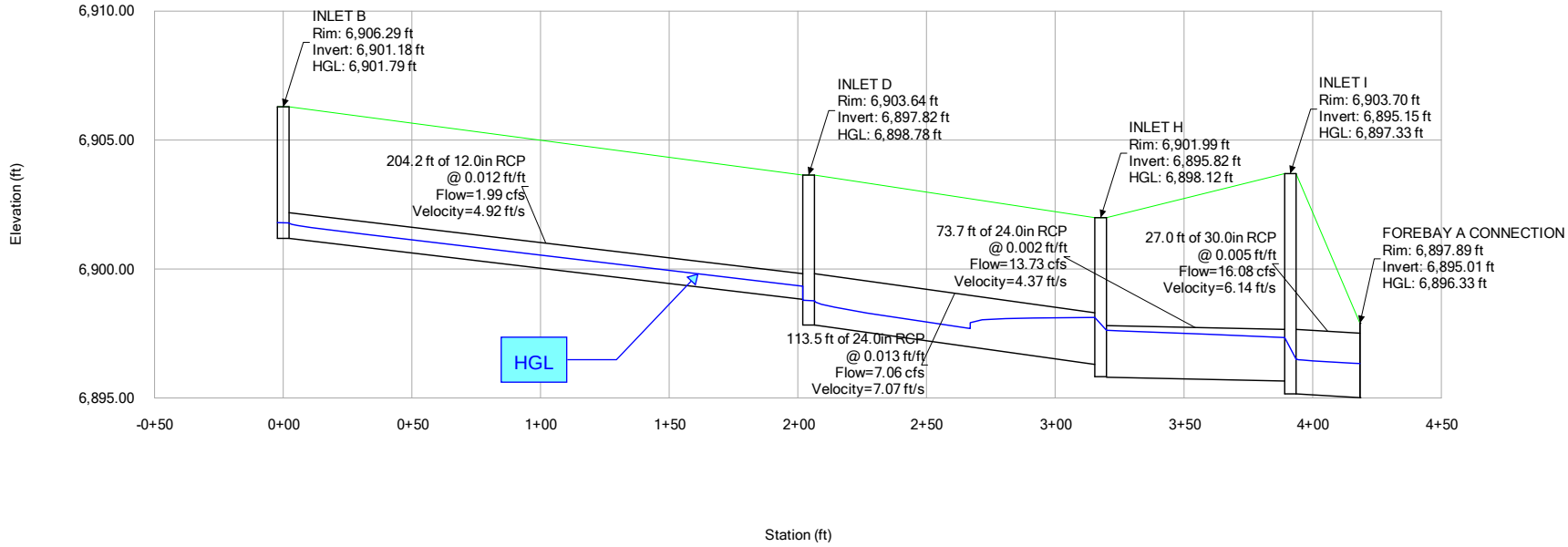
Stone Mesa Flats

Active Scenario: 5-yr

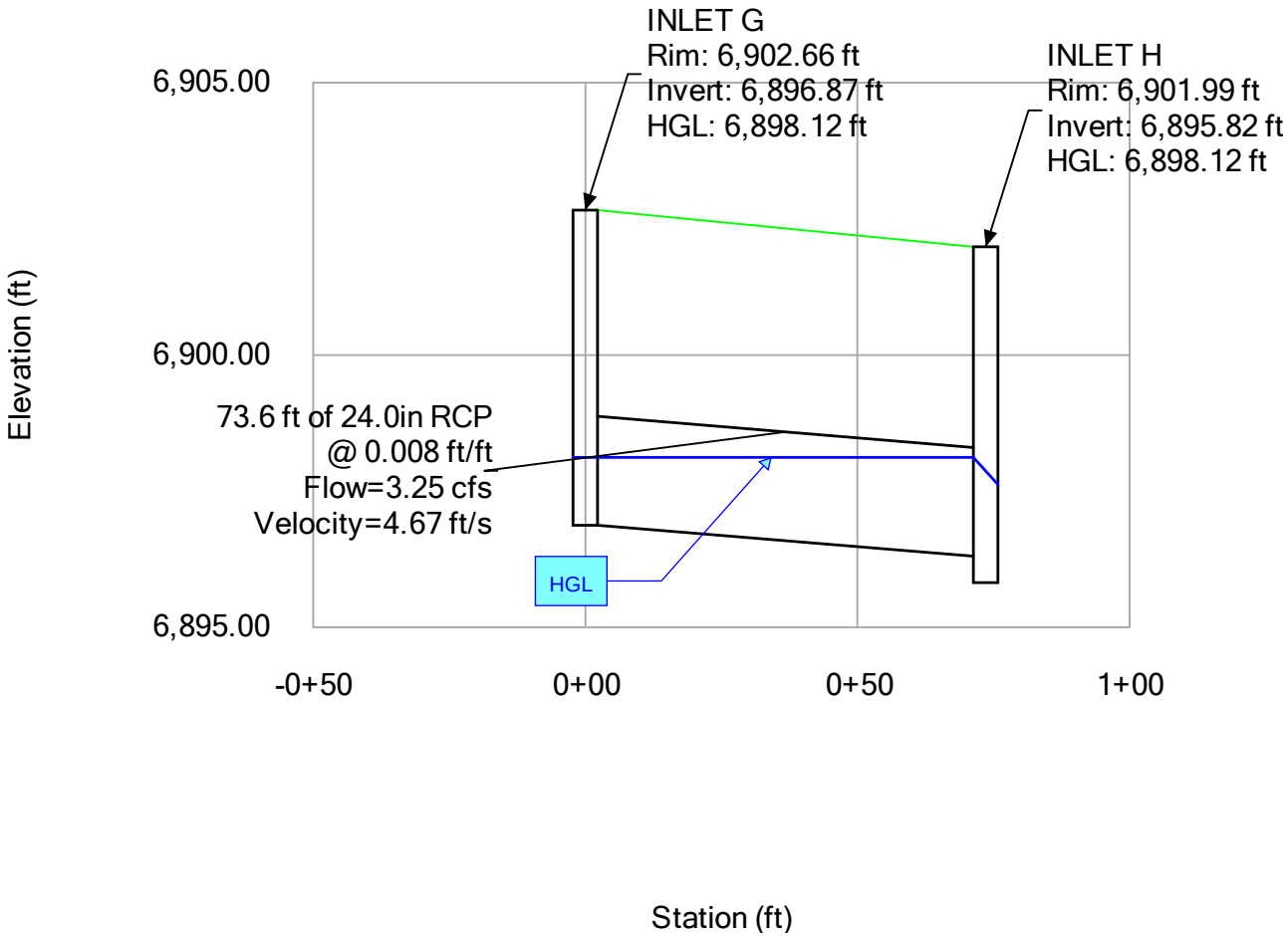
FlexTable: Catch Basin Table

ID	Label	Elevation (Rim) (ft)	Inlet Type	Flow (Additional Subsurface) (cfs)	Capture Efficiency (Calculated) (%)	Headloss Coefficient (Standard)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Inlet Location
86	INLET B	6,906.29	Full Capture	1.08	100.0	0.050	0.01	6,901.79	6,901.78	Standard	In Sag
85	INLET D	6,903.64	Full Capture	5.07	100.0	0.050	0.02	6,898.78	6,898.76	Standard	In Sag
84	INLET G	6,902.66	Full Capture	1.99	100.0	0.050	0.00	6,898.12	6,898.12	Standard	In Sag
83	INLET H	6,901.99	Full Capture	3.42	100.0	1.520	0.50	6,898.12	6,897.62	Standard	In Sag
82	INLET I	6,903.70	Full Capture	1.14	100.0	1.520	0.83	6,897.33	6,896.50	Standard	In Sag
105	OUTLET STRUCTURE	6,897.30	Full Capture	1.60	100.0	0.050	0.01	6,890.80	6,890.79	Standard	In Sag

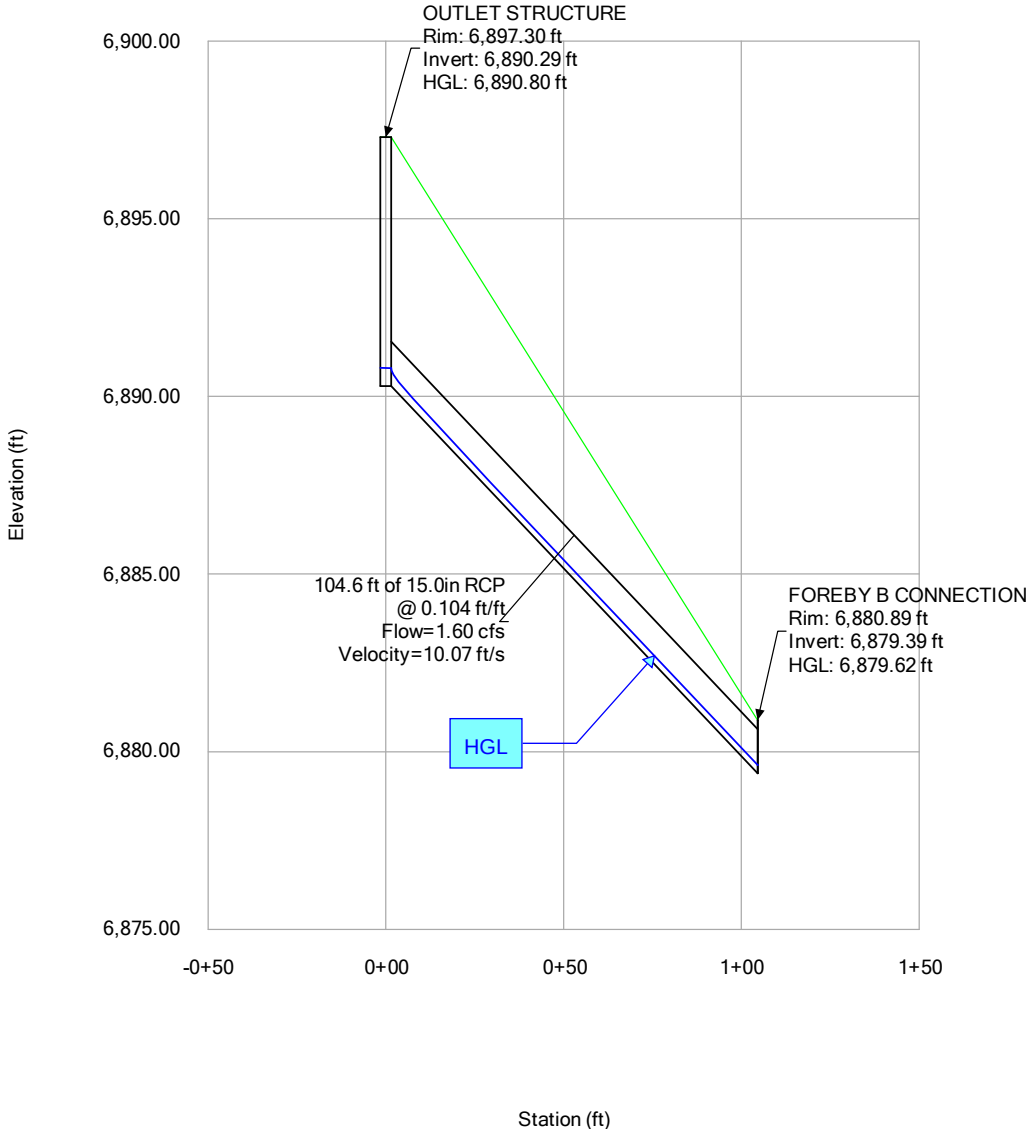
Stone Mesa Flats
Active Scenario: 5-yr
Profile Report
Engineering Profile - STRM A (Stone Mesa_StormCAD.stsw)



Stone Mesa Flats
Active Scenario: 5-yr
Profile Report
Engineering Profile - STRM B (Stone Mesa_StormCAD.stsw)



Stone Mesa Flats
Active Scenario: 5-yr
Profile Report
Engineering Profile - OUTFALL (Stone Mesa_StormCAD.stsw)



Stone Mesa Flats

Active Scenario: 100-yr

FlexTable: Conduit Table

Label	Length (3D) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Material	Hydraulic Grade Line (In) (ft)	Elevation Ground (Start) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation Ground (Stop) (ft)	Froude Number (Normal)	Depth (Normal) (ft)
OUTFALL PIPE	104.8	0.104	15.0	0.013	9.70	16.69	20.85	46.5	Concrete	6,891.47	6,897.30	6,879.99	6,880.89	4.314	0.60
SP-A1	27.0	0.005	30.0	0.013	32.32	6.58	29.53	109.5	Concrete	6,897.26	6,903.70	6,896.95	6,897.89	0.734	(N/A)
SP-A2	73.7	0.002	24.0	0.013	27.42	8.73	10.34	265.2	Concrete	6,899.61	6,901.99	6,898.52	6,903.70	1.088	(N/A)
SP-A3	113.5	0.013	24.0	0.013	11.61	3.70	26.18	44.4	Concrete	6,901.71	6,903.64	6,901.41	6,901.99	1.680	0.93
SP-A4	204.2	0.012	12.0	0.013	4.25	5.41	3.83	111.0	Concrete	6,904.62	6,906.29	6,901.72	6,903.64	0.954	(N/A)
SP-B1	73.6	0.008	24.0	0.013	7.59	2.42	19.93	38.1	Concrete	6,901.49	6,902.66	6,901.41	6,901.99	1.294	0.86

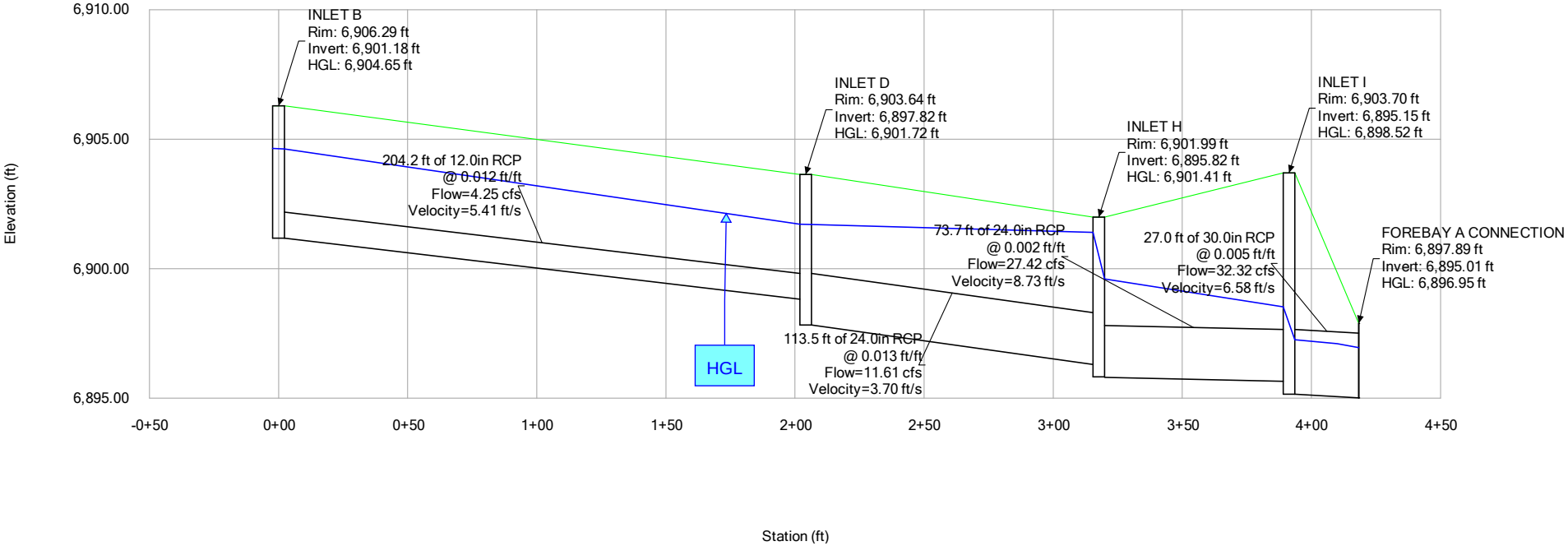
Stone Mesa Flats

Active Scenario: 100-yr

FlexTable: Catch Basin Table

ID	Label	Elevation (Rim) (ft)	Inlet Type	Flow (Additional Subsurface) (cfs)	Capture Efficiency (Calculated) (%)	Headloss Coefficient (Standard)	Headloss (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Inlet Location
86	INLET B	6,906.29	Full Capture	2.05	100.0	0.050	0.02	6,904.65	6,904.62	Standard	In Sag
85	INLET D	6,903.64	Full Capture	7.36	100.0	0.050	0.01	6,901.72	6,901.71	Standard	In Sag
84	INLET G	6,902.66	Full Capture	3.65	100.0	0.050	0.00	6,901.49	6,901.49	Standard	In Sag
83	INLET H	6,901.99	Full Capture	8.22	100.0	1.520	1.80	6,901.41	6,899.61	Standard	In Sag
82	INLET I	6,903.70	Full Capture	2.17	100.0	1.520	1.27	6,898.52	6,897.26	Standard	In Sag
105	OUTLET STRUCTURE	6,897.30	Full Capture	9.70	100.0	0.050	0.05	6,891.52	6,891.47	Standard	In Sag

Stone Mesa Flats
Active Scenario: 100-yr
Profile Report
Engineering Profile - STRM A (Stone Mesa_StormCAD.stsw)

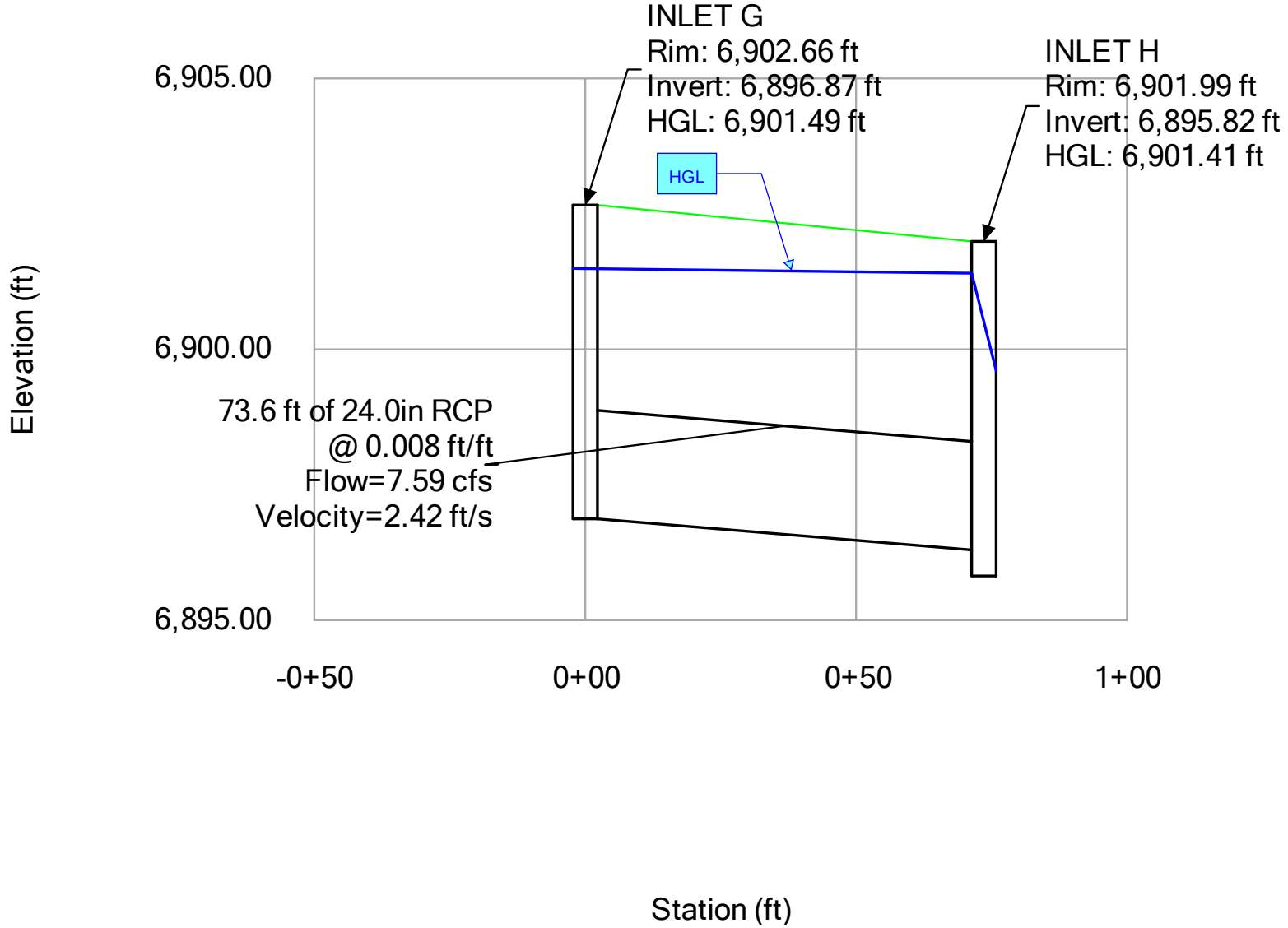


Stone Mesa Flats

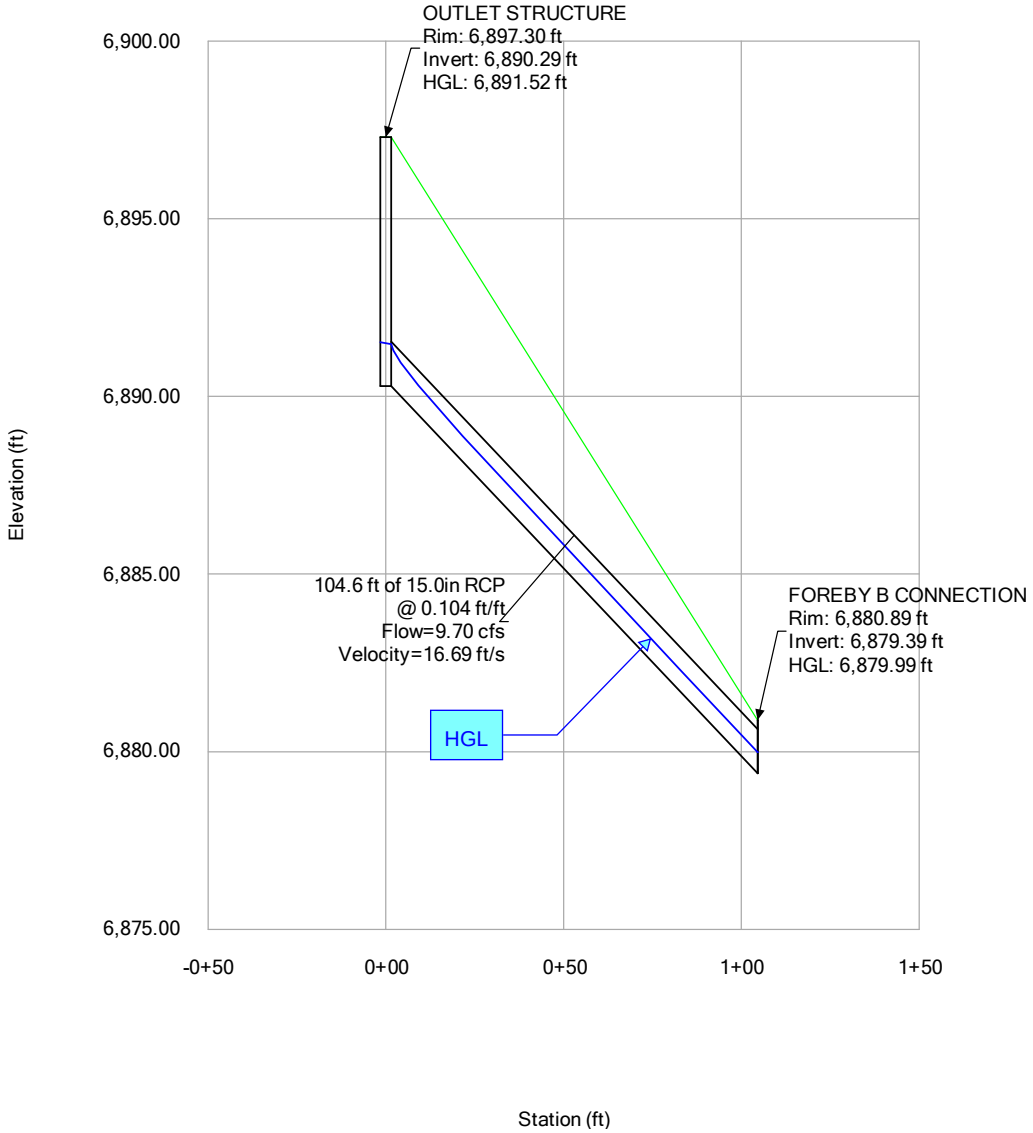
Active Scenario: 100-yr

Profile Report

Engineering Profile - STRM B (Stone Mesa_StormCAD.stsw)



Stone Mesa Flats
Active Scenario: 100-yr
Profile Report
Engineering Profile - OUTFALL (Stone Mesa_StormCAD.stsw)

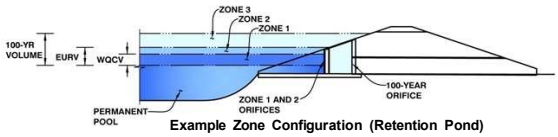


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: **Stone Mesa Flats**

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**		**Note: L / W Ratio < 1**
Watershed Area =	5.19	acres	**L / W Ratio = 1**
Watershed Length =	475	ft	
Watershed Length to Centroid =	400	ft	
Watershed Slope =	0.020	ft/ft	
Watershed Imperviousness =	72.70%	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) =	0.124	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.483	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.334	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.435	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.516	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.616	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.714	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.829	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.085	acre-feet		inches
Approximate 2-yr Detention Volume =	0.316	acre-feet		
Approximate 5-yr Detention Volume =	0.412	acre-feet		
Approximate 10-yr Detention Volume =	0.494	acre-feet		
Approximate 25-yr Detention Volume =	0.590	acre-feet		
Approximate 50-yr Detention Volume =	0.647	acre-feet		
Approximate 100-yr Detention Volume =	0.703	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.124	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.359	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.483	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

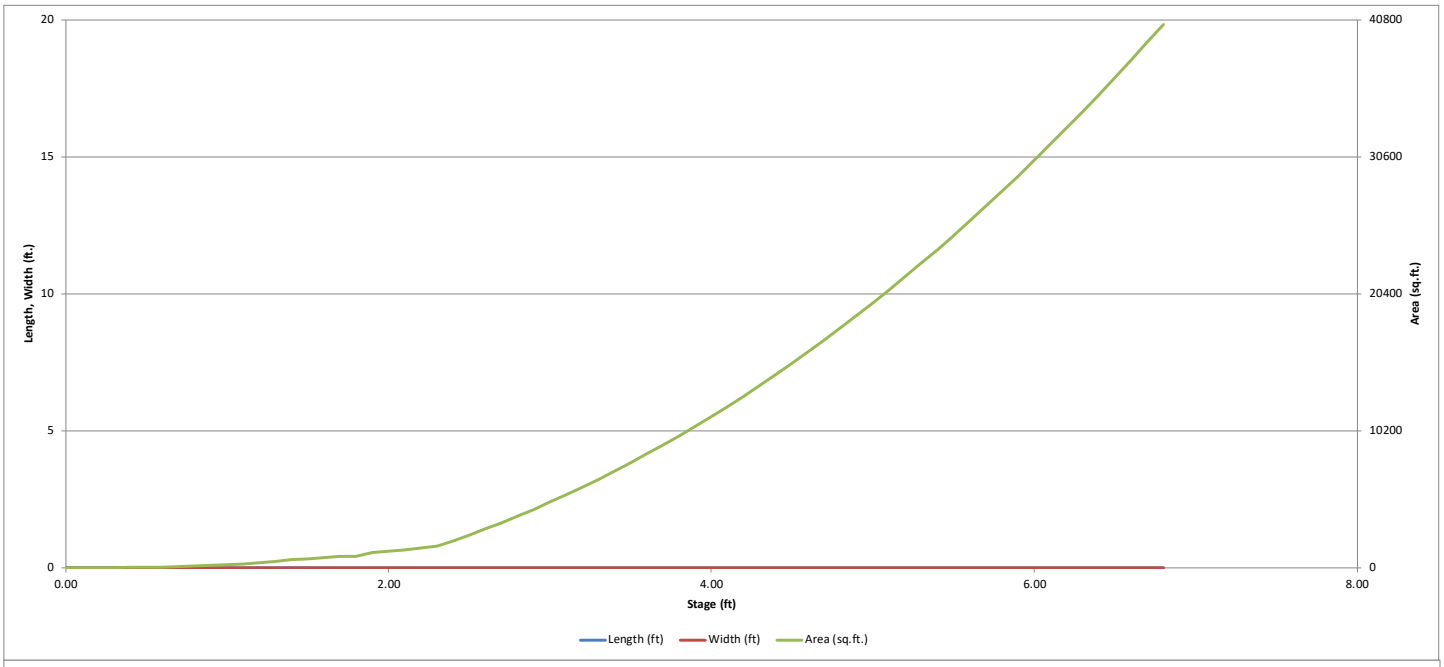
Total detention volume is less than 100-year volume.

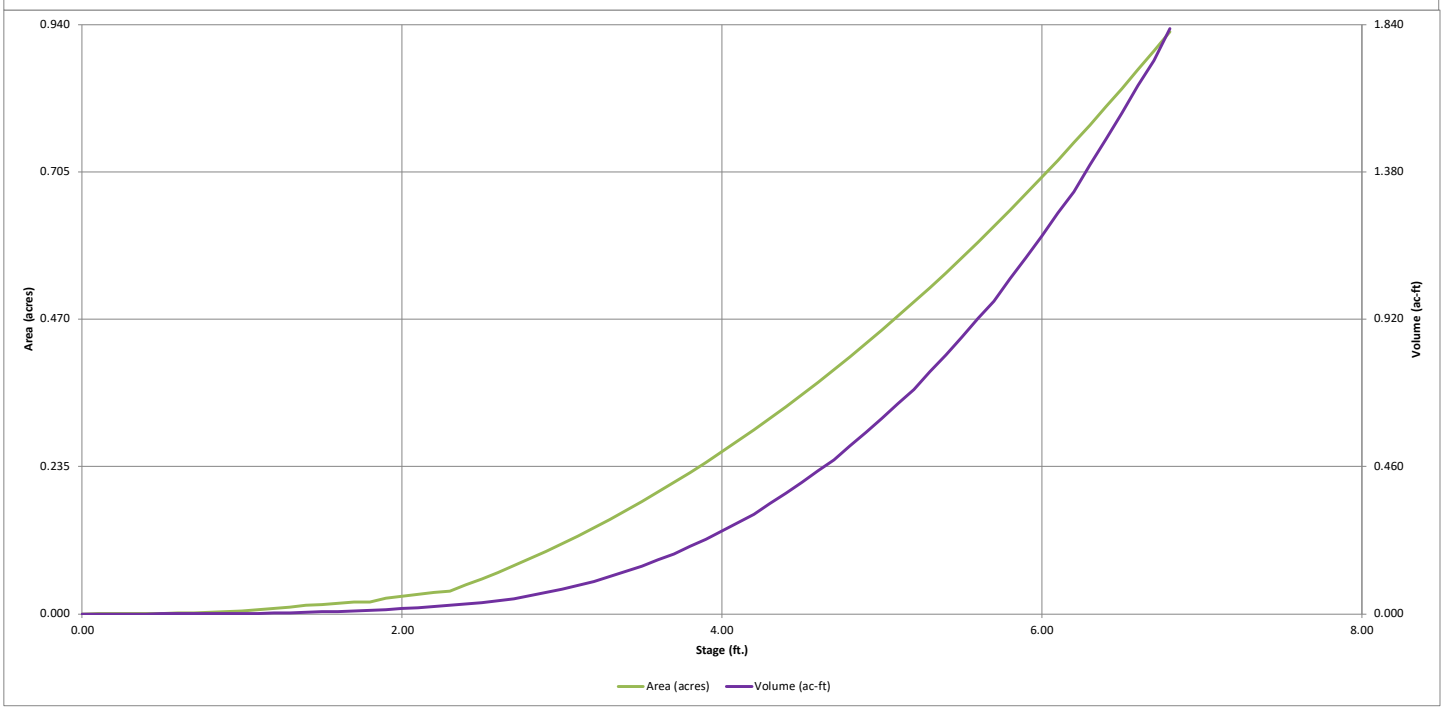
Depth Increment = ft

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	--	--	--	0	0.000		
6893.3	--	0.10	--	--	--	4	0.000	0	0.000
6893.4	--	0.20	--	--	--	9	0.000	1	0.000
6893.5	--	0.30	--	--	--	14	0.000	2	0.000
6893.6	--	0.40	--	--	--	21	0.000	4	0.000
6893.7	--	0.50	--	--	--	35	0.001	7	0.000
6893.8	--	0.60	--	--	--	55	0.001	11	0.000
6893.9	--	0.70	--	--	--	82	0.002	17	0.000
6894	--	0.80	--	--	--	119	0.003	28	0.001
6894.1	--	0.90	--	--	--	167	0.004	42	0.001
6894.2	--	1.00	--	--	--	223	0.005	62	0.001
6894.3	--	1.10	--	--	--	289	0.007	87	0.002
6894.4	--	1.20	--	--	--	367	0.008	116	0.003
6894.5	--	1.30	--	--	--	467	0.011	162	0.004
6894.6	--	1.40	--	--	--	598	0.014	215	0.005
6894.7	--	1.50	--	--	--	663	0.015	278	0.006
6894.8	--	1.60	--	--	--	738	0.017	348	0.008
6894.9	--	1.70	--	--	--	824	0.019	418	0.010
6895	--	1.80	--	--	--	824	0.019	509	0.012
6895.1	--	1.90	--	--	--	1,113	0.026	606	0.014
6895.2	--	2.00	--	--	--	1,224	0.028	723	0.017
6895.3	--	2.10	--	--	--	1,344	0.031	851	0.020
6895.4	--	2.20	--	--	--	1,470	0.034	977	0.022
6895.5	--	2.30	--	--	--	1,602	0.037	1,145	0.026
6895.6	--	2.40	--	--	--	2,006	0.046	1,326	0.030
6895.7	--	2.50	--	--	--	2,431	0.056	1,548	0.036
6895.8	--	2.60	--	--	--	2,878	0.066	1,813	0.042
6895.9	--	2.70	--	--	--	3,346	0.077	2,091	0.048
6896	--	2.80	--	--	--	3,836	0.088	2,483	0.057
6896.1	--	2.90	--	--	--	4,346	0.100	2,892	0.066
6896.2	--	3.00	--	--	--	4,876	0.112	3,353	0.077
6896.3	--	3.10	--	--	--	5,424	0.125	3,868	0.089
6896.4	--	3.20	--	--	--	5,992	0.138	4,379	0.101
6896.5	--	3.30	--	--	--	6,579	0.151	5,068	0.116
6896.6	--	3.40	--	--	--	7,186	0.165	5,756	0.132
6896.7	--	3.50	--	--	--	7,813	0.179	6,506	0.149
6896.8	--	3.60	--	--	--	8,460	0.194	7,319	0.168
6896.9	--	3.70	--	--	--	9,128	0.210	8,108	0.186
6897	--	3.80	--	--	--	9,816	0.225	9,146	0.210
6897.1	--	3.90	--	--	--	10,526	0.242	10,163	0.233
6897.2	--	4.00	--	--	--	11,257	0.258	11,252	0.258
6897.3	--	4.10	--	--	--	12,008	0.276	12,416	0.285
6897.4	--	4.20	--	--	--	12,780	0.293	13,528	0.311
6897.5	--	4.30	--	--	--	13,573	0.312	14,973	0.344
6897.6	--	4.40	--	--	--	14,387	0.330	16,371	0.376
6897.7	--	4.50	--	--	--	15,222	0.349	17,851	0.410
6897.8	--	4.60	--	--	--	16,077	0.369	19,416	0.446
6897.9	--	4.70	--	--	--	16,954	0.389	20,898	0.480
6898	--	4.80	--	--	--	17,851	0.410	22,808	0.524
6898.1	--	4.90	--	--	--	18,771	0.431	24,639	0.566
6898.2	--	5.00	--	--	--	19,711	0.453	26,563	0.610
6898.3	--	5.10	--	--	--	20,674	0.475	28,582	0.656
6898.4	--	5.20	--	--	--	21,658	0.497	30,483	0.700
6898.5	--	5.30	--	--	--	22,664	0.520	32,915	0.756
6898.6	--	5.40	--	--	--	23,692	0.544	35,233	0.809
6898.7	--	5.50	--	--	--	24,743	0.568	37,654	0.864
6898.8	--	5.60	--	--	--	25,815	0.593	40,182	0.922
6898.9	--	5.70	--	--	--	26,911	0.618	42,550	0.977
6899	--	5.80	--	--	--	28,029	0.643	45,566	1.046
6899.1	--	5.90	--	--	--	29,169	0.670	48,425	1.112
6899.2	--	6.00	--	--	--	30,333	0.696	51,401	1.180
6899.3	--	6.10	--	--	--	31,519	0.724	54,493	1.251
6899.4	--	6.20	--	--	--	32,727	0.751	57,379	1.317
6899.5	--	6.30	--	--	--	33,959	0.780	61,040	1.401
6899.6	--	6.40	--	--	--	35,213	0.808	64,498	1.481
6899.7	--	6.50	--	--	--	36,491	0.838	68,084	1.563
6899.8	--	6.60	--	--	--	37,792	0.868	71,798	1.648
6899.9	--	6.70	--	--	--	39,116	0.898	75,253	1.728
6900	--	6.80	--	--	--	40,463	0.929	79,622	1.828
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



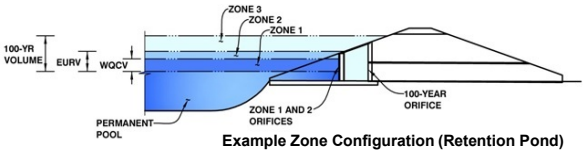


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: Stone Mesa Flats

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.36	0.124	Orifice Plate
Zone 2 (EURV)	4.70	0.359	Weir (No Pipe)
Zone 3			
Total (all zones)		0.483	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.70	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.43	sq. inches (diameter = 3/4 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.986E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.57	3.17					
Orifice Area (sq. inches)	0.43	0.43	0.43					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =			inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.10	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Bottom Length =	12.00	N/A	feet
Overflow Weir Side Slopes =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.10	N/A	feet
Overflow Weir Slope Length =	2.92	N/A	feet
Grate Open Area / 100-yr Orifice Area =	N/A	N/A	
Overflow Grate Open Area w/o Debris =	24.39	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.19	N/A	ft^2

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

	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Not Selected	Not Selected	
Outlet Orifice Area =	N/A	N/A	ft^2
Outlet Orifice Centroid =	N/A	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.71	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet
Spillway position relative to Overflow Weir =	Offset	

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.79	feet
Stage at Top of Freeboard =	6.50	feet
Basin Area at Top of Freeboard =	0.84	acres
Basin Volume at Top of Freeboard =	1.56	acre-ft

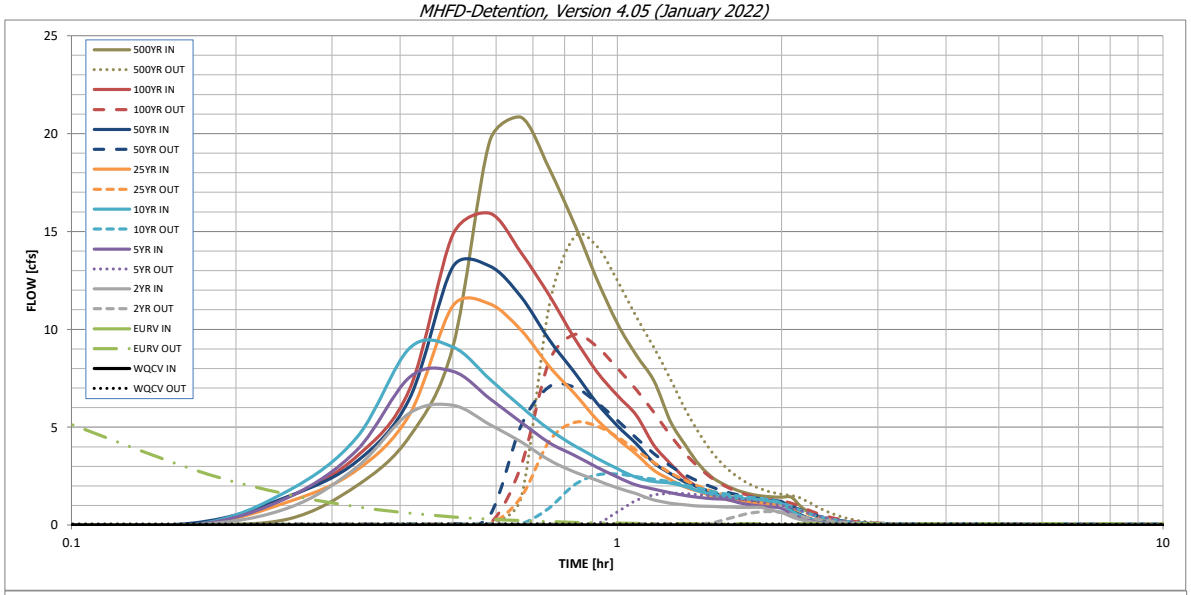
Routed Hydrograph Results

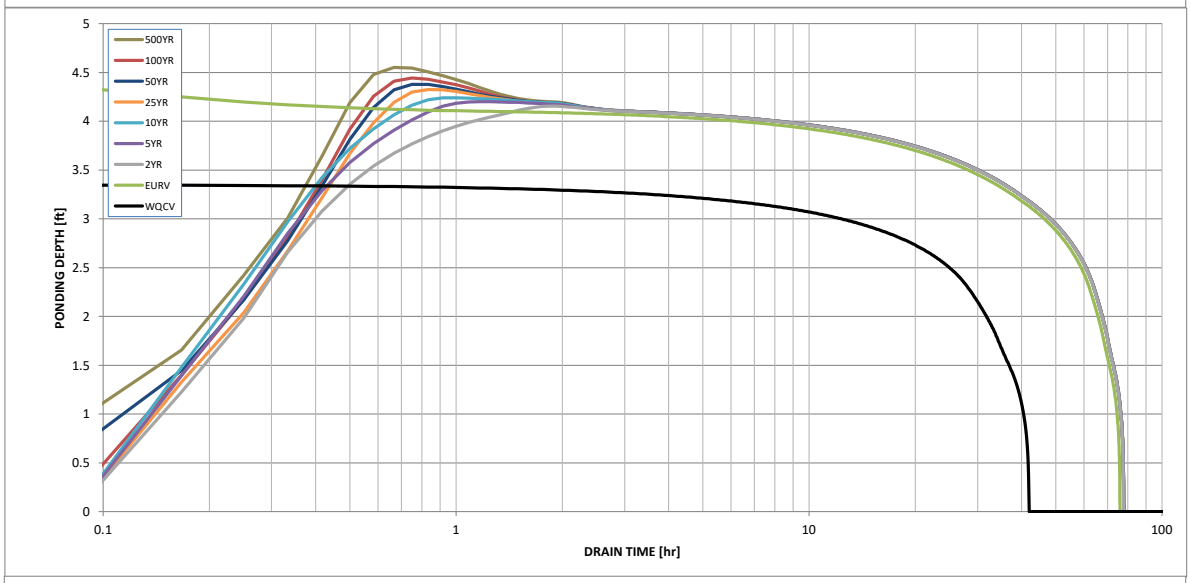
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

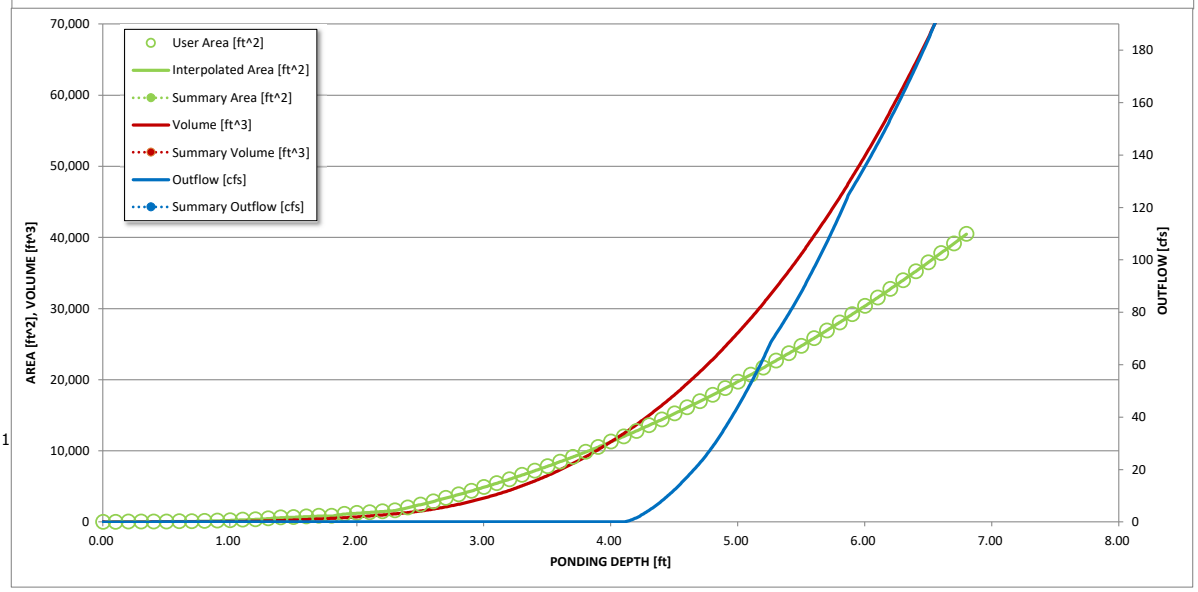
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.124	0.483	0.334	0.435	0.516	0.616	0.714	0.829	1.085
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.334	0.435	0.516	0.616	0.714	0.829	1.085
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.0	2.1	3.4	6.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.0	2.1	3.4	6.1
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.20	0.40	0.66	1.18
Peak Inflow Q (cfs) =	N/A	N/A	6.1	7.9	9.1	11.3	13.2	15.9	20.8
Peak Outflow Q (cfs) =	0.1	15.1	0.7	1.6	2.6	5.2	7.1	9.7	14.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	19.2	22.4	5.0	3.4	2.8	2.4
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir
Max Velocity through Grate 1 (fps) =	N/A	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	67	71	69	68	67	66	65	62
Time to Drain 99% of Inflow Volume (hours) =	**41**	72	75	74	74	73	72	72	70
Maximum Ponding Depth (ft) =	3.35	4.70	4.15	4.20	4.24	4.33	4.38	4.44	4.55
Area at Maximum Ponding Depth (acres) =	0.16	0.39	0.28	0.29	0.30	0.32	0.32	0.34	0.36
Maximum Volume Stored (acre-ft) =	0.124	0.484	0.299	0.313	0.325	0.350	0.366	0.389	0.428

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







1

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

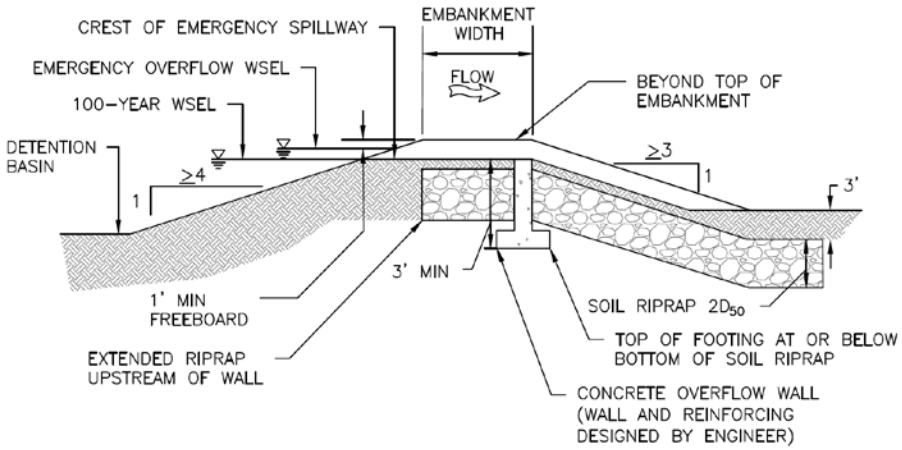
DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

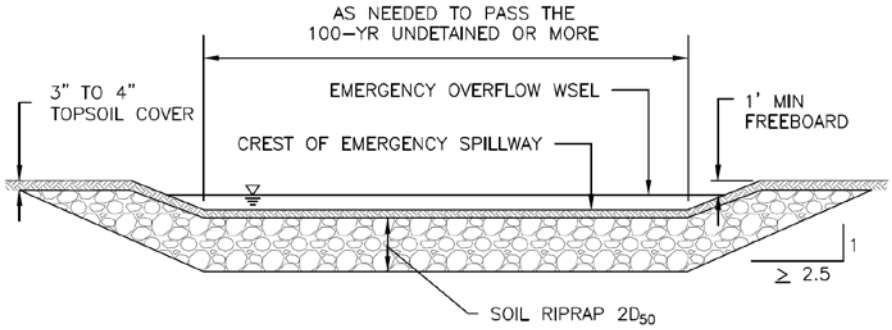
Inflow Hydrographs

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	0.10	0.01	0.32
	0:15:00	0.00	0.00	0.88	1.44	1.78	1.19	1.47	1.45	2.02
	0:20:00	0.00	0.00	2.97	3.83	4.48	2.81	3.25	3.51	4.53
	0:25:00	0.00	0.00	5.73	7.56	9.04	5.67	6.49	6.96	9.11
	0:30:00	0.00	0.00	6.12	7.85	9.10	11.21	13.19	14.85	19.61
	0:35:00	0.00	0.00	5.14	6.47	7.46	11.30	13.24	15.93	20.84
	0:40:00	0.00	0.00	4.25	5.25	6.05	9.96	11.66	13.91	18.21
	0:45:00	0.00	0.00	3.32	4.21	4.89	8.11	9.47	11.74	15.40
	0:50:00	0.00	0.00	2.73	3.57	4.07	6.74	7.82	9.57	12.59
	0:55:00	0.00	0.00	2.29	2.97	3.43	5.41	6.25	7.85	10.30
	1:00:00	0.00	0.00	1.90	2.45	2.87	4.41	5.08	6.62	8.69
	1:05:00	0.00	0.00	1.60	2.05	2.44	3.62	4.16	5.61	7.38
	1:10:00	0.00	0.00	1.29	1.83	2.22	2.80	3.18	4.08	5.32
	1:15:00	0.00	0.00	1.12	1.66	2.15	2.33	2.64	3.15	4.07
	1:20:00	0.00	0.00	1.03	1.51	1.97	1.94	2.19	2.37	3.05
	1:25:00	0.00	0.00	0.98	1.41	1.73	1.70	1.92	1.88	2.40
	1:30:00	0.00	0.00	0.95	1.35	1.56	1.46	1.65	1.60	2.02
	1:35:00	0.00	0.00	0.92	1.31	1.45	1.31	1.47	1.40	1.76
	1:40:00	0.00	0.00	0.91	1.15	1.38	1.21	1.36	1.27	1.59
	1:45:00	0.00	0.00	0.90	1.04	1.33	1.14	1.28	1.19	1.49
	1:50:00	0.00	0.00	0.90	0.97	1.29	1.10	1.24	1.16	1.44
	1:55:00	0.00	0.00	0.75	0.92	1.22	1.08	1.21	1.14	1.42
	2:00:00	0.00	0.00	0.65	0.86	1.10	1.06	1.20	1.14	1.42
	2:05:00	0.00	0.00	0.43	0.57	0.73	0.71	0.80	0.76	0.95
	2:10:00	0.00	0.00	0.28	0.37	0.48	0.47	0.53	0.50	0.63
	2:15:00	0.00	0.00	0.18	0.23	0.31	0.30	0.34	0.33	0.40
	2:20:00	0.00	0.00	0.11	0.14	0.19	0.19	0.21	0.20	0.25
	2:25:00	0.00	0.00	0.06	0.09	0.11	0.12	0.13	0.12	0.15
	2:30:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.08
	2:35:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.03
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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



EMERGENCY SPILLWAY PROFILE



EMERGENCY SPILLWAY SECTION AND SPILLWAY CHANNEL

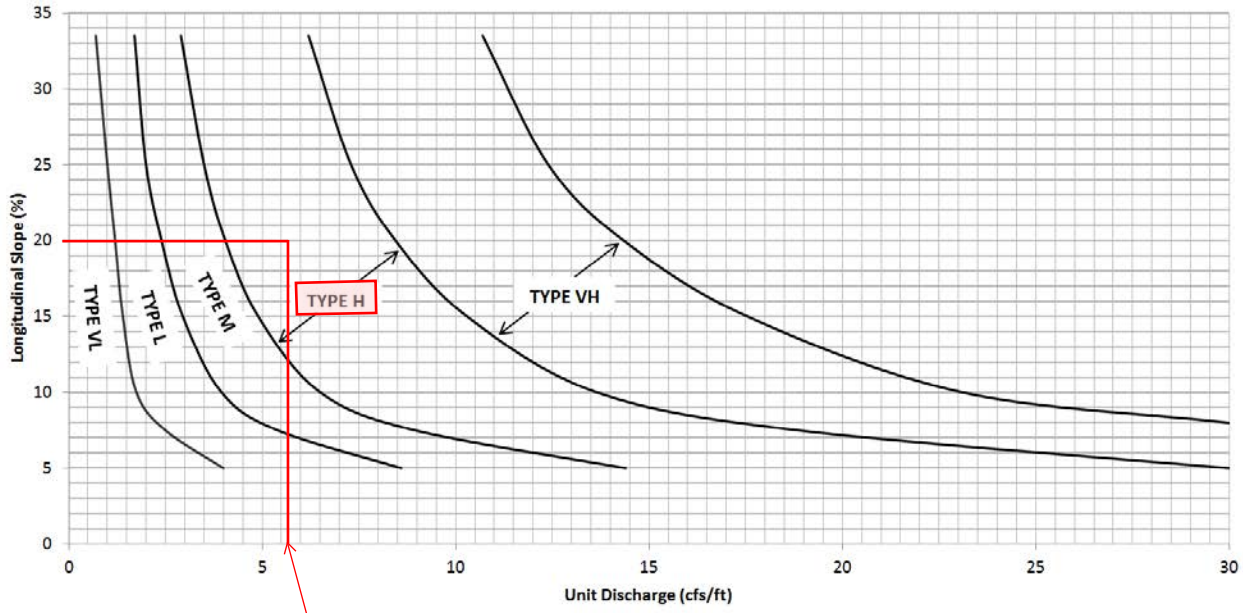


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

100-yr undetained flow = 32.32 cfs

32.32 cfs / 5 ft = 6.46

Kimley»Horn

Forebay Sizing Calculations

Contributing Sub-Basins: All

Date	4/29/2022
Prepared By	NMB
Checked By	JRH

	Required	Forebay D Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	31.16	0.31

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.727 A = 5.19 AC	108.43	153.70

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.31	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.09	ft^2	
L_a	0.06	ft	
	0.73	**in**	3" Minimum per Criteria

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$ Equation 3-1

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

Kimley»Horn

Forebay Sizing Calculations - Forebay B

Contributing Sub-Basins: Outfall Pipe

Date	4/29/2022
Prepared By	NMB
Checked By	JRH

	Required	Forebay D Flow: Q_{100} = (cfs)	Release Rate
Forebay Release and Configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe configuration	9.70	0.10

			Required (CF)	Provided (CF)
Minimum Forebay Volume Required	2% of the WQCV	40hr drain time a = 1 I = 0.727 A = 5.19 AC	86.74	125.18

	Required	Provided	
Maximum Forebay Depth	18" Max	18"	Concrete Forebay Structure

Forebay Notch Calculations			
$Q = C_o A_o (2gH_o)^{0.5}$			
Q_a	0.10	cfs	2% of Peak 100 YR Discharge for contributing Sub-Basins
C_o	0.6		
H_o	0.5	ft	
g	32.2	ft/s^2	
A_a	0.03	ft^2	
L_a	0.02	ft	
	0.23	**in**	3" Minimum per Criteria

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I)$$ Equation 3-1

Where:

WQCV = Water Quality Capture Volume (watershed inches)

a = Coefficient corresponding to WQCV drain time (Table 3-2)

I = Imperviousness (%/100) (see Figures 3-3 through 3-5 [single family land use] and /or the *Runoff* chapter of Volume 1[other typical land uses])

Table 3-2. Drain Time Coefficients for WQCV Calculations

Drain Time (hrs)	Coefficient, a
12 hours	0.8
24 hours	0.9
40 hours	1.0

1HFD-Inlet, Version 5.01 (April 2021)

NLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet B	Inlet D	Inlet G	Inlet H	Inlet I
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	On Grade	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	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)	1.08	5.47	1.99	3.02	1.14
Major Q_{Known} (cfs)	2.05	10.10	3.65	5.48	2.17

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received	Inlet D	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.40	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	2.73	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					
One-Hour Precipitation, P_1 (inches)					

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**1.08**	**5.47**	**1.99**	**3.42**	**1.14**
Major Total Design Peak Flow, Q (cfs)	**2.05**	**10.10**	**3.65**	**8.21**	**2.17**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.4	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	2.7	N/A	N/A	N/A

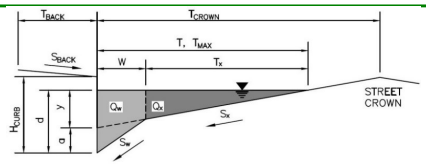
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **Stone Mesa Flats**

Inlet ID: **Inlet B**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	18.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.050	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

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

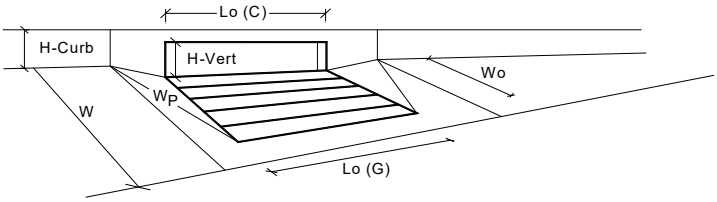
MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



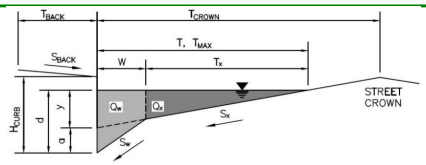
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
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	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.1	2.1	cfs

MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **Stone Mesa Flats**
Inlet ID: **Inlet D**



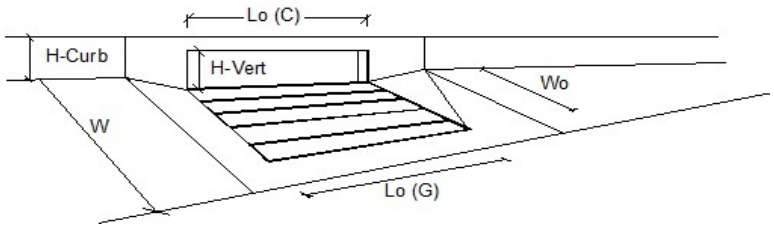
Gutter Geometry:

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} =	0.030		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.026		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 =	0.014		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**13.7**	**13.7**	**cfs**

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**5.1**	**7.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.4**	**2.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**73**	**%**

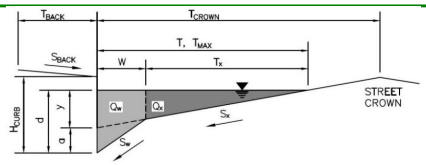
MHFD-Inlet, Version 5.01 (April 2021)

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

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

Project: **Stone Mesa Flats**

Inlet ID: **Inlet G**

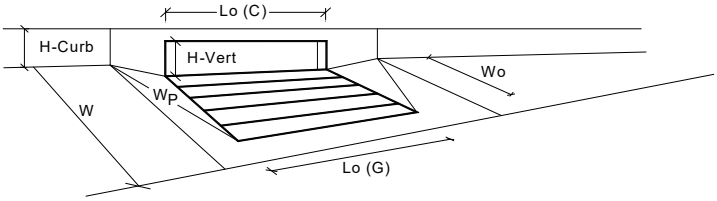


Gutter Geometry:

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} =	0.018		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0		ft
Gutter Width	W =	2.00		ft
Street Transverse Slope	S_X =	0.042		ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083		ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

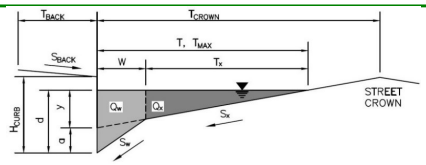


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
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	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.0	3.7	cfs

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

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

Project: **Stone Mesa Flats**
Inlet ID: **Inlet H**



Gutter Geometry:

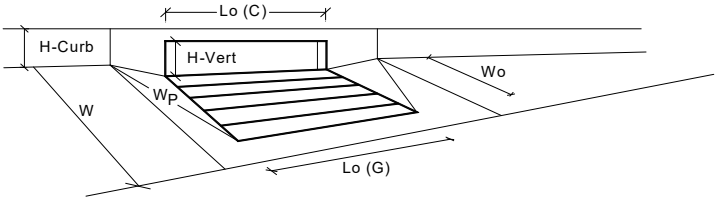
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.041	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

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

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

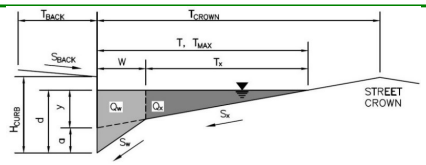


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	15.00	15.00	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	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.79	0.79	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**9.7**	**9.7**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	3.4	8.2	cfs

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

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

Project: **Stone Mesa Flats**
Inlet ID: **Inlet I**



Gutter Geometry:

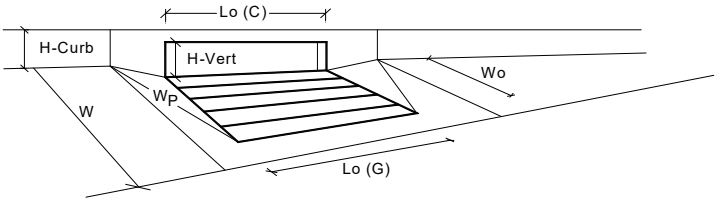
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.018	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	18.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.050	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} =	0.013	

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

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)

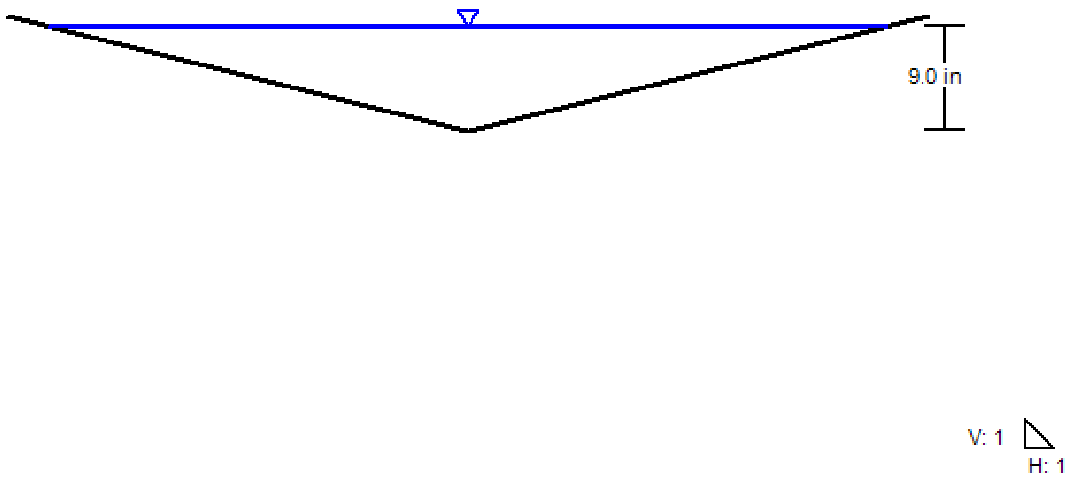


Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	6.0	6.0	inches
Grate Information			MINOR	MAJOR	Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	
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	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	0.77	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		**Q_a =**	**5.4**	**5.4**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	1.1	2.2	cfs

Cross Section for TYPICAL SWALE CAPACITY

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.030
Channel Slope	0.010 ft/ft
Normal Depth	9.0 in
Left Side Slope	4.000 H:V
Right Side Slope	4.000 H:V
Discharge	5.68 cfs



APPENDIX E - EOPCC

Kimley-Horn & Associates, Inc.

Opinion of Probable Construction Cost

Client:	**The Garrett Companies**	**Date:**	**6/6/2022**
Project:	**Stone Mesa Flats**	**Prepared By:**	**NMB**
KHA No.:	**096481005**	**Checked By:**	**JRH**

No: **Sheet:** **1 of 4**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private Storm Sewer (Non-Reimbursable)				
1	5' Type R Storm Sewer Inlet	2	EA	$3,500.00	$7,000
2	10' Type R Storm Sewer Inlet	2	EA	$4,500.00	$9,000
3	15' Type R Storm Sewer Inlet	1	EA	$5,500.00	$5,500
4	12" Nyloplast Area Inlet	18	EA	$500.00	$9,000
5	6" PVC Storm Sewer	113	LF	$10.00	$1,130
6	8" PVC Storm Sewer	1,272	LF	$12.00	$15,264
7	12" RCP Storm Sewer	204	LF	$18.00	$3,672
8	15" RCP Storm Sewer	57	LF	$22.00	$1,254
9	24" RCP Storm Sewer	261	LF	$30.00	$7,830
10	30" RCP Storm Sewer	27	LF	$35.00	$945
		Subtotal:			$53,595
		Contingency (%,+/-)		10%	$5,360
		Project Total:			**$58,955**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

John R. Heiberger
Registered Professional Engineer, State of Colorado No. 50096

Kimley-Horn & Associates, Inc.

Opinion of Probable Construction Cost

Client:	**The Garrett Companies**	**Date:**	**6/6/2022**
Project:	**Stone Mesa Flats**	**Prepared By:**	**NMB**
KHA No.:	**096481005**	**Checked By:**	**JRH**

No:		**Sheet:**	**2 of 4**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Public Storm Sewer (Non-Reimbursable)				
1	15" RCP Storm Sewer	46	LF	$22.00	$1,012
		Subtotal:			$1,012
		Contingency (%,+/-)		10%	$101
		Project Total:			**$1,113**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

John R. Heiberger
Registered Professional Engineer, State of Colorado No. 50096

Kimley-Horn & Associates, Inc.

Opinion of Probable Construction Cost

Client:	**The Garrett Companies**	**Date:**	**4/29/2022**
Project:	**Stone Mesa Flats**	**Prepared By:**	**NMB**
KHA No.:	**096481005**	**Checked By:**	**JRH**

No: **Sheet:** **3 of 4**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Private PCM (Non-Reimbursable)				
1	Concrete Trickle Channel	225	SF	$15.00	$3,375
2	Emergency Spillway Rip Rap	405	CF	$12.00	$4,860
3	3/4" Fractured Face Granite Mixed w/Class 5 Roadbase (Maintenance Access Road)	1,127	CF	$12.00	$13,524
4	Forebay	1	EA	$3,000.00	$3,000
		Subtotal:			$24,759
		Contingency (%,+/-)		10%	$2,476
		Project Total:			**$27,235**

Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

John R. Heiberger
Registered Professional Engineer, State of Colorado No. 50096

Kimley-Horn & Associates, Inc.

Opinion of Probable Construction Cost

Client:	**The Garrett Companies**	**Date:**	**4/29/2022**
Project:	**Stone Mesa Flats**	**Prepared By:**	**NMB**
KHA No.:	**096481005**	**Checked By:**	**JRH**

No:		**Sheet:**	**3 of 4**

This OPC is not intended for basing financial decisions, or securing funding. Review all notes and assumptions. Since Kimley-Horn & Associates, Inc. has no control over the cost of labor, materials, equipment, or services furnished by others, or over methods of determining price, or over competitive bidding or market conditions, any and all opinions as to the cost herein, including but not limited to opinions as to the costs of construction materials, shall be made on the basis of experience and best available data. Kimley-Horn & Associates, Inc. cannot and does not guarantee that proposals, bids, or actual costs will not vary from the opinions on costs shown herein. The total costs and other numbers in this Opinion of Probable Cost have been rounded.

Item No.	Item Description	Quantity	Unit	Unit Price	Item Cost
	Public PCM (Non-Reimbursable)				
1	Concrete Trickle Channel	77	SF	$15.00	$1,155
2	Forebay	1	EA	$3,000.00	$3,000
		Subtotal:			$4,155
		Contingency (%,+/-)		10%	$416
		Project Total:			**$4,571**

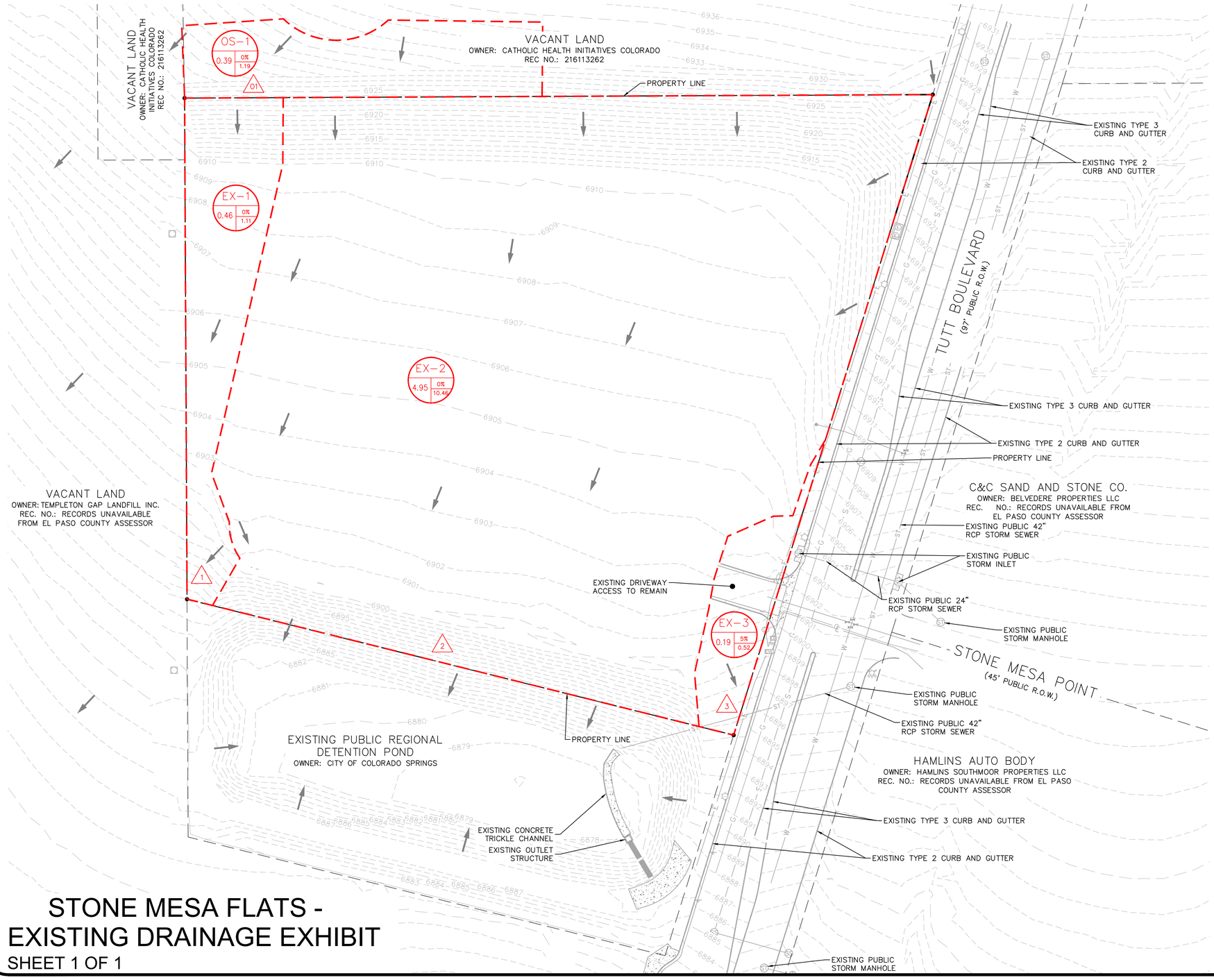
Basis for Cost Projection:

- ☐ No Design Completed
- ☐ Preliminary Design
- ☑ Final Design

Design Engineer:

John R. Heiberger
Registered Professional Engineer, State of Colorado No. 50096

APPENDIX F - DRAINAGE MAPS



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = WEIGHTED IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

DESIGN POINT
PROPERTY LINE
BASIN BOUNDARY
XXXX EXISTING MAJOR CONTOUR
XXXX EXISTING MAJOR CONTOUR
EXISTING DRAINAGE ARROW

RATIONAL CALCULATIONS SUMMARY				
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	PEAK FLOWS (CFS) Q100
On-Site Basins				
1	EX-1	0.46	0.16	1.11
2	EX-2	4.95	1.56	10.46
3	EX-3	0.19	0.10	0.52
4	OS-1	0.39	0.18	1.19
TOTAL		**5.99**	**2.00**	**13.28**

NORTH

GRAPHIC SCALE IN FEET
0 20 40 80

STONE MESA FLATS - EXISTING DRAINAGE EXHIBIT

SHEET 1 OF 1

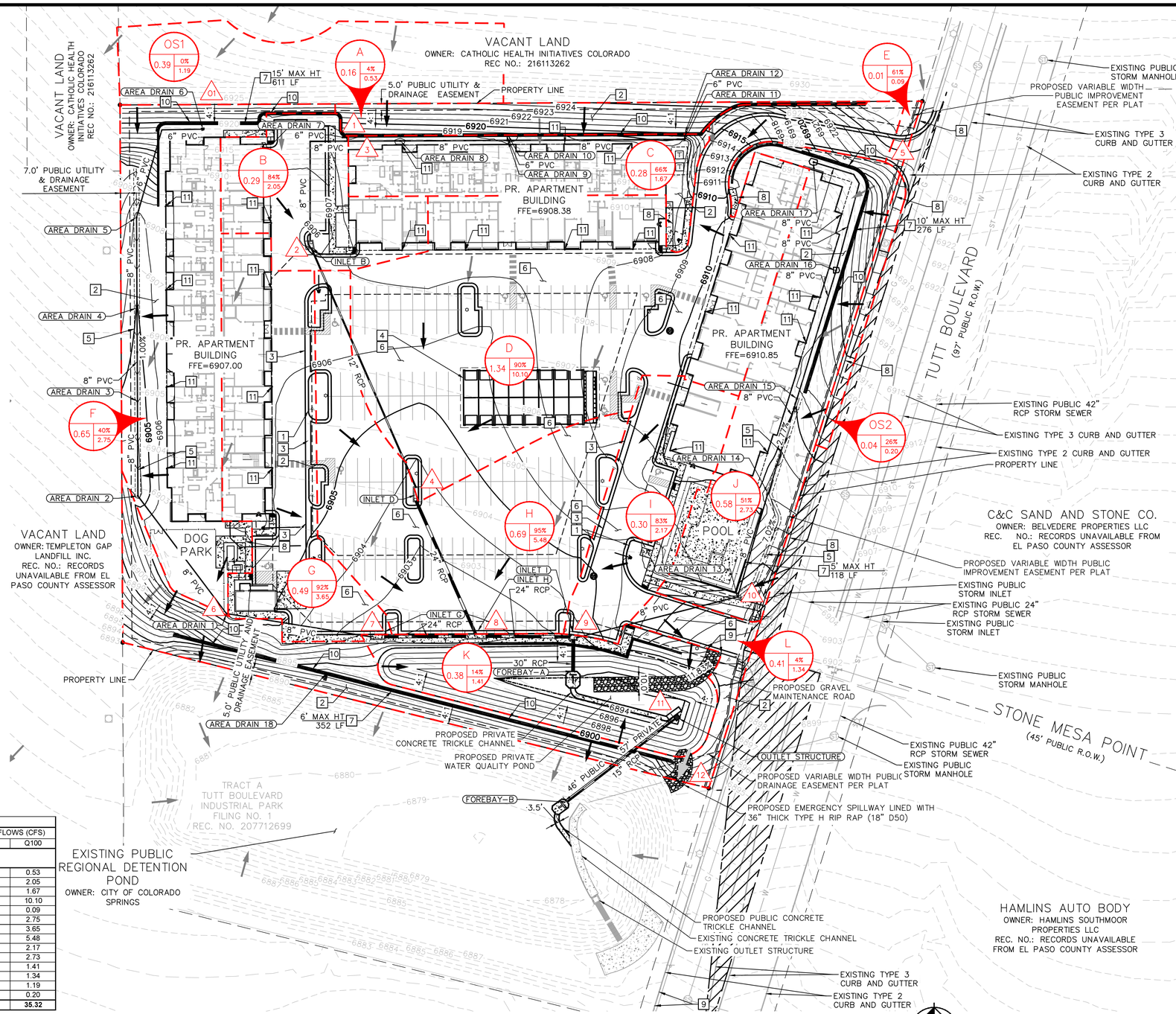
Kimley»Horn

COLORADO SPRINGS GENERAL NOTES

1. THESE DETAILED PLANS AND SPECIFICATIONS WERE PREPARED UNDER MY DIRECTION AND SUPERVISION. SAID DETAILED PLANS AND SPECIFICATIONS HAVE BEEN PREPARED ACCORDING TO THE ESTABLISHED CRITERIA FOR DETAILED DRAINAGE PLANS AND SPECIFICATIONS, AND SAID DETAILED PLANS AND SPECIFICATIONS ARE IN CONFORMITY WITH THE MASTER PLAN OF THE DRAINAGE BASIN. SAID DETAILED DRAINAGE PLANS AND SPECIFICATIONS MEET THE PURPOSES FOR WHICH THE PARTICULAR DRAINAGE FACILITY(S) IS DESIGNED. I ACCEPT RESPONSIBILITY FOR ANY LIABILITY CAUSED BY ANY NEGLIGENT ACTS, ERRORS OR OMMISSIONS ON MY PART IN PREPARATION OF THE DETAILED DRAINAGE PLANS AND SPECIFICATIONS.
2. PLAN REVIEW BY CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

NOTES

1. ALL PR. STORMWATER INFRASTRUCTURE DEPICTED ON THESE PLANS IS TO BE PRIVATELY OWNED AND MAINTAINED UNLESS OTHERWISE NOTED.
2. ALL PR. CURB & GUTTER IS TYPE 3 PER COLORADO SPRINGS STANDARD DETAIL 6B UNLESS OTHERWISE NOTED.



LEGEND

A = BASIN DESIGNATION
B = AREA (ACRES)
C = WEIGHTED IMPERVIOUSNESS
D = 100-YR DESIGN STORM RUNOFF (CFS)

DESIGN POINT
PROPERTY LINE
PROPOSED FENCE
BASIN BOUNDARY
PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MAJOR CONTOUR
PROPOSED DRAINAGE ARROW
EXISTING DRAINAGE ARROW
POND EMERGENCY OVERFLOW PATH
PROPOSED RIPRAP (SIZE AND TYPE PER PLAN)
PROPOSED CONCRETE

KEYNOTE LEGEND

1. PROPOSED TYPE 3 CURB AND GUTTER
2. PROPOSED LANDSCAPED AREA
3. PROPOSED CONCRETE CROSS PAN
4. PROPOSED DETACHED GARAGE (16 STALLS)
5. PROPOSED 4' WIDE GRASS LINED V-SHAPED SWALE (4:1 SIDE SLOPES)
6. PROPOSED ASPHALT PAVING
7. PROPOSED RETAINING WALL (LENGTH/MAX HEIGHT PER PLAN)
8. PROPOSED CONCRETE SIDEWALK
9. PROPOSED TYPE 4 CURB AND GUTTER
10. PROPOSED 1' WIDE CONCRETE V-GUTTER
11. PROPOSED 6" PVC DOWNSPOUT

STRUCTURE TABLE

NAME:	DETAILS:
AREA DRAIN 1	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 2	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 3	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 4	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 5	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 6	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 7	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 8	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 9	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 10	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 11	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 12	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 13	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 14	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 15	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 16	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 17	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
AREA DRAIN 18	PR. PRIVATE 12" NYLOPLAST AREA DRAIN
FOREBAY-A	PR. PRIVATE CONCRETE FOREBAY
FOREBAY-B	PR. PUBLIC CONCRETE FOREBAY
INLET B	PR. PRIVATE 5' TYPE R CURB INLET
INLET D	PR. PRIVATE 10' TYPE R CURB INLET
INLET G	PR. PRIVATE 10' TYPE R CURB INLET
INLET H	PR. PRIVATE 15' TYPE R CURB INLET
INLET I	PR. PRIVATE 5' TYPE R CURB INLET
OUTLET STRUCTURE	PR. PRIVATE MODIFIED TYPE C OUTLET STRUCTURE

RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	PEAK FLOWS (CFS) Q100
On-Site Basins				
1	A	0.16	0.10	0.53
2	B	0.29	1.08	2.05
3	C	0.28	0.81	1.67
4	D	1.34	5.47	10.10
5	E	0.01	0.04	0.09
6	F	0.65	1.09	2.75
7	G	0.49	1.99	3.65
8	H	0.69	3.02	5.48
9	I	0.30	1.14	2.17
10	J	0.58	1.21	2.73
11	K	0.38	0.37	1.41
12	L	0.41	0.25	1.34
O1	OS1	0.39	0.18	1.19
O2	OS2	0.04	0.07	0.20
TOTAL		**6.03**	**16.80**	**35.32**

STONE MESA FLATS - PROPOSED DRAINAGE EXHIBIT

SHEET 1 OF 1

Kimley»Horn

APPENDIX G – PREVIOUS DRAINAGE STUDIES

PRELIMINARY/FINAL DRAINAGE REPORT
FOR
TUTT BOULEVARD INDUSTRIAL PARK FILING NO. 1

AUGUST 2007

PREPARED FOR:
BELVEDERE PROPERTIES, LLC
2635 STEEL DRIVE
COLORADO SPRINGS, CO 80907
719-577-9900

PREPARED BY:
CLASSIC CONSULTING ENGINEERS & SURVEYORS, LLC
6385 CORPORATE DRIVE, SUITE 101
COLORADO SPRINGS, CO 80919
(719) 785-0790

2130.50

~~1720~~ 8-13

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

PRELIMINARY/FINAL DRAINAGE REPORT FOR TUTT BOULEVARD INDUSTRIAL PARK FILING NO. 1

DRAINAGE REPORT STATEMENT

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 City 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.

Kyle R. Campbell, Colorado P.E. #29794 — Date: 8-27-07

DEVELOPER'S STATEMENT:
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: CHOCAMO, L.L.P.

By:

Title: PARTNER — PARTNER

Address: 1221 N. CASCADE AVE
COLO. SPGS, CO. 80903

CITY OF COLORADO SPRINGS ONLY:
Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

City Engineer — Date: Sept 27, 2007

Conditions:

CLASSIC
CONSULTING
ENGINEERS & SURVEYORS

PRELIMINARY/FINAL DRAINAGE REPORT FOR TUTT BOULEVARD INDUSTRIAL PARK FILING NO. 1

DEVELOPER'S STATEMENT: Lot 1
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: BELVEDERE PROPERTIES, LLC

By: Com G. Johannsen

Title: MANAGING MEMBER.

Address: 2635 STEEL DRIVE
COLORADO SPRINGS, CO 80907

DEVELOPER'S STATEMENT: Lot 2
I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: GREGORY AND KATHRYN MANKE

By: Greg Manke

Title: Owner

Address: 11790 Timberlane Ct.
Colorado Springs, CO 80908

PUBLIC DETENTION POND
ANALYSIS CALCULATIONS

JOB NAME: *Tutt Blvd. Industrial Park Filing No. 1Detention Pond Analysis*
JOB NUMBER: *2130.50*
DATE: *08/21/07*
CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS			LANDSCAPE/UNDEVELOPED AREAS			WEIGHTED		WEIGHTED CA			
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(5)	CA(100)		
EX-1	39.96	0.00	0.90	0.95	39.96	0.25	0.35	0.25	0.35	**9.99**	**13.99**		
N-1	23.71	23.71	0.75	0.80	0.00	0.25	0.35	0.75	0.80	**17.78**	**18.97**	COMMERCIAL (Neighborhood Areas)	
S-1	2.00	2.00	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**1.80**	**1.90**	ROADS	
S-2	8.61	8.61	0.80	0.90	0.00	0.25	0.35	0.80	0.90	**6.89**	**7.75**	INDUSTRIAL (HEAVY)	
S-3	6.98	6.98	0.80	0.90	0.00	0.25	0.35	0.80	0.90	**5.58**	**6.28**	INDUSTRIAL (HEAVY)	
S-4	2.21	0.00	0.90	0.95	2.21	0.25	0.35	0.25	0.35	**0.55**	**0.77**	POND	
S-5	1.24	1.24	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**1.12**	**1.18**	ROADS	
S-6	7.21	7.21	0.80	0.85	0.00	0.25	0.35	0.80	0.85	**5.77**	**6.13**	INDUSTRIAL (GRAVEL)	
S-7	4.69	4.69	0.80	0.90	0.00	0.25	0.35	0.80	0.90	**3.75**	**4.22**	INDUSTRIAL (HEAVY)	
S-8	2.88	2.88	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**2.59**	**2.74**	ROADS	
D	2.33	0.00	0.90	0.95	2.33	0.25	0.35	0.25	0.35	**0.58**	**0.82**	ENTIRE AREA	59.53
												NORTH	23.71
W-1	0.78	0.78	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.70**	**0.74**	SOUTH	35.82

JOB NAME:	*Tutt Blvd. Industrial Park Filing No. 1Detention Pond Analysis*
JOB NUMBER:	*2130.50*
DATE:	*08/21/07*
CALC'D BY:	*MAL*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
BASIN	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
EX-1	9.99	13.99	0.25	1400	72	34.6	300	5.0%	7.8	0.6	35.3	2.20	3.92	22	55
N-1	17.78	18.97	0.25	0	0	#DIV/0!	0	0.0%	0.0	#DIV/0!	15.0	3.46	6.16	62	117
S-1	1.80	1.90	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	5.0	5.10	9.07	9	17
S-2	6.89	7.75	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	10.0	4.10	7.29	28	57
S-3	5.58	6.28	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	10.0	4.10	7.29	23	46
S-4	0.55	0.77	0.25	70	19	4.5	300	1.5%	4.3	1.2	5.6	4.94	8.79	3	7
S-5	1.12	1.18	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	5.0	5.10	9.07	6	11
S-6	5.77	6.13	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	15.0	3.46	6.16	20	38
S-7	3.75	4.22	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	5.0	5.10	9.07	19	38
S-8	2.59	2.74	0.25	0	0	#DIV/0!	0	1.5%	4.3	0.0	5.0	5.10	9.07	13	25
D	0.58	0.82	0.25	240	12	14.5	0	1.5%	4.3	0.0	14.5	3.52	6.25	2	5
W-1	0.70	0.74	0.25	0	0	#DIV/0!	0	0.0%	0.0	#DIV/0!	5.0	5.10	9.07	4	7

JOB NAME: *Tutt Blvd. Industrial Park Filing No. 1Detention Pond Analysis*
JOB NUMBER: *2130.50*
DATE: *08/21/07*
CALCULATED BY: *MAL*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow	
					I(5)	I(100)	Q(5)	Q(100)
1	BASIN N-1	17.78	18.97	15.0	3.46	6.16	62	117
2	BASIN S-5 + FB DP-10	1.28	1.41	5.0	5.10	9.07	7	13
3	BASIN S-1	1.80	1.90	5.0	5.10	9.07	9	17
4	BASIN S-3	5.58	6.28	10.0	4.10	7.29	23	46
5	BASIN S-2	6.89	7.75	10.0	4.10	7.29	28	57
6	BASIN S-6	5.77	6.13	15.0	3.46	6.16	20	38
7	BASIN S-7	3.75	4.22	5.0	5.10	9.07	19	38
8	BASIN S-8	2.59	2.74	5.0	5.10	9.07	13	25
9	PIPE 7 + BASIN S-4	46.00	50.17	18.5	3.13	5.57	144	279
10	Woodmen Basin W-1	0.70	0.74	5.0	5.10	9.07	4	7

DRAINAGE MAPS

EXISTING 36" STORM SEWER OUTFALLING SOUTH. FLOWS DO NOT RUN ONTO ANY PORTION OF THE PROPOSED SITE. WATER CONTINUES SOUTH DOWN TEMPLETON GAP ROAD AS PREVIOUSLY DESCRIBED IN THE MDDP FOR POWERWOOD/GREENBRIAR.

TEMPLETON GAP ROAD

N-1 23.71

W-1 0.78

PROPOSED 10.0' AT-GRADE INLET BY EL PASO COUNTY.
$Q_{5(INT.)}$ = 2.8 cfs
$Q_{100(INT.)}$ = 4.6 cfs
SOME FLOWBY INLET SOUTH DOWN TUTT BLVD.
$Q_{5(FB)}$ = 0.8 cfs
$Q_{100(FB)}$ = 2.1 cfs

COUNTY STORM SYSTEM
24" RCP @ 8.50% SLOPE
CAPCITY = 66.0 cfs
Q_{100} = 4.6 cfs

S-5 1.24

TUTT BLVD.

TC = 5 MIN.

TC = 15.0 MIN.

S-3 6.98

TC = 5 MIN.

S-1 2.00

TC = 10.0 MIN.

S-6 7.21

PROPOSED TUTT BLVD. INDUSTRIAL PARK FILING NO. 1

COUNTY STORM SYSTEM
PER "FINAL DRAINAGE REPORT POWERS BOULEVARD AND WOODMEN ROAD INTERCHANGE," BY URS, MARCH 2003.
36" RCP @ 0.50% SLOPE
CAPCITY = 47.16 cfs
Q_{100} = 42.26 cfs

FLOW WITHIN ROADSIDE SWALE (DWL-142) WITH ADDITIONAL PICKUP FROM DP-10 (AT-GRADE INLET) = 42.26 cfs
PREVIOUS DEPTH OF WATER IN 100 YEAR STORM = 1.14'
NEW DEPTH OF WATER IN 100 YEAR STORM = 1.22' (< 2.0')

DWL-142

WOODMEN ROAD

TC = 15.0 MIN.

D 2.33

S-8 2.88

TC = 10.0 MIN.

TC = 5 MIN.

ESTIMATED DETENTION POND FOR BASIN D, PER THIS DRAINAGE REPORT, SEE "PROPOSED FINAL DRAINAGE PLAN"

EXISTING 48" STORM OUTFALLING TO THE OFF-SITE AREA SOUTH OF THE PROPOSED BOUNDARY. PIPE TO BE EXTENDED WITH FUTURE DEVELOPEMENT OF TUTT BOULEVARD TO ULTIMATE BASIN OUTFALL PER MDDP.

X Exist pipe to be permanently plugged

approximate location of emergency overflow swale

POWERWOOD SUBDIVISION NO. 1 TO DRAIN TO WEST, PENDROSE DETENTION POND.

S-2 8.61

TC = 5.0 MIN.

EXISTING 42" RCP STORM INLET. 42" INV. = 6879.23 TO REMAIN INTACT

EXISTING VERTICAL 24" RCP STORM POND OUTLET TO BE REMOVED WITH POND IMPROVEMENTS.
ELEV. = 6882.81
POND BOTTOM = 6677.50

S-7 4.69

LOW FLOW – TRICKLE CHANNEL CURB SECTION

S-4 2.21

EXISTING "TEMPORARY" DETENTION POND TO BE MADE PERMANENT, PUBLIC DETENTION POND. VOLUME = 7.81 AC-FT.

PROPOSED PERMANENT PUBLIC DETENTION FACILITY OUTLET BOX DESIGNED TO RELEASE STORMWATER AT HISTORIC CONDITIONS PER THE MDDP. SEE DESCRIPTION AND CALCULATIONS WITHIN REPORT. BOX OUTLET PIPE TO TIE INTO EXISTING 24" STUB.

12.0' WIDE ACCESS/ MAINTENANCE ROAD

PROPOSED GRADING OF ROAD INTO BOTTOM OF POND.

PENROSE HOSPITAL

120 60 0 120 240

SCALE: 1" = 120'

LEGEND

EXISTING GROUND CONTOUR	5910
PROPOSED FINISHED CONTOUR	5910
SITE BOUNDARY	
PROPOSED BASIN BOUNDARY	
PROP. DIRECTION OF DRAINAGE	
EXISTING STORM SEWER	
EXISTING STORM INLET	
PROPOSED STORM SEWER	
PROPOSED STORM INLET	
BASIN IDENTIFIER	D
AREA IN ACRES	1.41
PIPE RUN	1
DESIGN POINT	1
LOW POINT	L.P.
HIGH POINT	H.P.

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

THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK. THE CONTRACTOR SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE CAUSED BY HIS FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

NO.	REVISION	DATE

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

KYLE R. CAMPBELL, COLORADO P.E. #29794 DATE

CLASSIC CONSULTING ENGINEERS & SURVEYORS
6385 Corporate Drive, Suite 101 (719)785-0790
Colorado Springs, Colorado 80919 (719)785-0799(Fax)

TUTT BOULEVARD INDUSTRIAL PARK
FILING NO. 1
DETENTION POND ANALYSIS
FUTURE FULLY DEVELOPED PARCELS

DESIGNED BY	MAL	SCALE		DATE	4-23-07
DRAWN BY	MAL	(H) 1"= 120'		SHEET 3	OF 3
CHECKED BY		(V) 1"= N/A		JOB NO.	2130.50

Final Drainage Report
The Guest House at St. Francis

Subdivision: The Guest House at St. Francis Filing No. 1

Prepared For: Catholic Health Initiatives Colorado Inc., a Colorado nonprofit corporation

Prepared By: Brett Louk, PE
Jody Emery, IE

Date Prepared: October, 2020

Revised: January, 2020

SMH CONSULTANTS

411 South Tejon, Suite i
Colorado Springs, Colorado 80903
719-465-2145
blouk@smhconsultants.com

STATEMENT SHEET

Engineer's Statement:

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

COLORADO LICENSED BRETT LOUK 0055474 PROFESSIONAL ENGINEER

SIGNATURE (Affix Seal): _____

Colorado License No. Date

2-9-21

Developer's Statement:

Catholic Health Initiatives Colorado, Inc., a Colorado nonprofit corporation, hereby certifies that the drainage facilities for The Guest House at St. Francis shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of The Guest House at St. Francis, guarantee that final drainage design review will absolve Catholic Health Initiatives Colorado, Inc., a Colorado nonprofit corporation, and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

St. Francis Medical Center

Name of Developer

Authorized Signature

Calvin Eisenach

Printed Name

V.P. of Operations

Title

6001 E. Woodmen Road

Address: Colorado Springs, CO. 80923

full spectrum detention pond as outlined in the Final Drainage Report for the Tuscany Plaza Subdivision.

As mentioned previously, detention for this site has already been accounted for in the design of the 7.3 are-feet detention pond located on parcel 5307005001, located south of the site. Therefore, this report does not analyze the detention requirements for this site.

The proposed site has been broken into four sub-basins: DA-1, DA-2, DA-3, and DA-4.

DA-1 is 2.15 acres in size and drains to the southwest corner of the site. This sub-basin has 5-year and 100-year flows of 2.32 cfs and 6.72 cfs, respectively. DA-1 consists of roof and parking lot runoff that will flow over turf grass to the bioretention pond in the southwest corner of the site.

DA-2 is 1.52 acres in size and drains to the southeast of the Guest House. This sub-basin has 5-year and 100-year flows of 2.80 cfs and 6.93 cfs, respectively. DA-2 consists of roof and parking lot runoff that will flow over turf grass to the bioretention pond in the southeast corner of the site.

DA-3 is 4.49 acres in size and drains to the south of the future medical building. This is Phase II of the development. This sub-basin has 5-year and 100-year flows of 5.42 cfs and 14.46 cfs, respectively. DA-3 consists of roof and parking lot runoff that will flow over turf grass to the bioretention pond on the south side of the site. The design for this drainage basin shall be further defined in the final drainage report submitted at the time of development application for this lot.

DA-4 is 0.56 acres in size and drains to the south onto the adjacent property. This sub-basin has 5-year and 100-year flows of 0.29 cfs and 1.79 cfs, respectively. DA-4 consists of turf grass on a 4:1 slope that will be allowed to continue as overland flow onto the property to the south. This is an unchanged condition from the existing site.

The total 5-year and 100-year flows for the proposed site at the point of confluence are 9.63 cfs and 27.49 cfs, respectively. When the capacity of the existing 7.3-acre detention pond was verified in the Preliminary/Final Drainage Report for Tutt Boulevard Industrial Filing No. 1, completed by Classic Consulting Engineers & Surveyors, the subject site was shown to have 5-year and 100-year flows of 28 cfs and 57 cfs, respectively. The proposed 5-year and 100-year flows for this site are lower than the initial rates used to design the existing detention pond. Therefore, no additional capacity is required.

For the purposes of this report, the improvements for Phase II are based on the best information available. When an application is made for the development of Phase II of the project, a new drainage study will be required.

The proposed drainage information for the site can be seen in the appendix of this report.

Proposed Weighted C Calculations				
Drainage Area	Cover Type	C_5 Value	Area (AC)	CxA
DA-1	Parking	0.90	0.09	0.08
	Sidewalk	0.90	0.05	0.05
	Gravel Trail	0.59	0.01	0.01
	Building	0.73	0.33	0.24
	Gravel Fire Lane	0.59	0.21	0.12
	Lawn	0.08	1.46	0.12
Weighted C: $(CxA)_{tot}/A_{tot}$				0.29
Drainage Area	Cover Type	C_{100} Value	Area (AC)	CxA
DA-1	Parking	0.96	0.09	0.09
	Sidewalk	0.96	0.05	0.05
	Gravel Trail	0.70	0.01	0.01
	Building	0.81	0.33	0.27
	Gravel Fire Lane	0.70	0.21	0.15
	Lawn	0.35	1.46	0.51
Weighted C: $(CxA)_{tot}/A_{tot}$				0.50
Drainage Area	Cover Type	C_5 Value	Area (AC)	CxA
DA-2	Parking	0.90	0.49	0.44
	Sidewalk	0.90	0.07	0.06
	Gravel Trail	0.59	0.04	0.02
	Building	0.73	0.15	0.11
	Gravel Fire Lane	0.59	0.03	0.02
	Lawn	0.08	0.74	0.06
Weighted C: $(CxA)_{tot}/A_{tot}$				0.47
Drainage Area	Cover Type	C_{100} Value	Area (AC)	CxA
DA-2	Parking	0.96	0.49	0.47
	Sidewalk	0.96	0.07	0.07
	Gravel Trail	0.70	0.04	0.03
	Building	0.81	0.15	0.12
	Gravel Fire Lane	0.70	0.03	0.02
	Lawn	0.35	0.74	0.26
Weighted C: $(CxA)_{tot}/A_{tot}$				0.64
Drainage Area	Cover Type	C_5 Value	Area (AC)	CxA
DA-3	Pavement	0.90	1.06	0.95
	Building	0.73	0.46	0.34
	Lawn	0.08	2.97	0.24
Weighted C: $(CxA)_{tot}/A_{tot}$				0.34
Drainage Area	Cover Type	C_{100} Value	Area (AC)	CxA
DA-3	Pavement	0.96	1.06	1.02
	Building	0.81	0.46	0.37
	Lawn	0.35	2.97	1.04
Weighted C: $(CxA)_{tot}/A_{tot}$				0.54
Drainage Area	Cover Type	C_5 Value	Area (AC)	CxA
DA-4	Exposed Rock	0.90	0.02	0.02
	Lawn	0.08	0.54	0.04
Weighted C: $(CxA)_{tot}/A_{tot}$				0.11
Drainage Area	Cover Type	C_{100} Value	Area (AC)	CxA
DA-4	Exposed Rock	0.96	0.02	0.02
	Lawn	0.35	0.54	0.19
Weighted C: $(CxA)_{tot}/A_{tot}$				0.37

Time of Concentration Calculations																					
Sub-Basin Date			Time of Concentration Estimate																Min. t_c in Urban		Final t_c
Basin	Area (ac)	C_5	Initial/Overland Time (t_i)			Travel Time (t_t)						Travel Time (t_t)						Comp.	t_c Check (urban)		
			Length (ft)	Slope	t_i (min)	Length (ft)	Slope	Land Type	C_v	Velocity (ft/sec)	t_t (min)	Length (ft)	Slope	Land Type	C_v	Velocity (ft/sec)	t_t (min)	t_c (min)	Total Length	t_c Check	
DA-EX-1	1.04	0.26	100	0.0092	15.59	100.9	0.021	NBG	10	1.45	1.16							16.75			16.75
DA-EX-2	1.14	0.42	100	0.014	10.99	399.21	0.079	NBG	10	2.81	2.37							13.35			13.35
DA-EX-3	6.84	0.27	100	0.031	10.32	439.03	0.041	NBG	10	2.02	3.61							13.93			13.93
DA-1	2.15	0.29	69.43	0.0308	8.41	488.51	0.0107	SP	7	0.72	11.24							19.65	558	13.10	13.10
DA-2	1.52	0.47	90.27	0.023	8.21	333.83	0.0102	PV	20	2.02	2.75	61.16	0.079	SP	7	1.97	0.52	11.48	485.26	12.70	11.48
DA-3	4.49	0.34	97.18	0.0605	7.47	747.09	0.0152	SP	7	0.86	14.43							21.90	844.27	14.69	14.69
DA-4	0.56	0.11	100	0.1952	6.70	22.7	0.233	SP	7	3.38	0.11							6.82	122.7	10.68	6.82

Sub-Basin Date			Time of Concentration Estimate																Min. t_c in Urban		Final t_c
Basin	Area (ac)	C_{100}	Initial/Overland Time (t_i)			Travel Time (t_t)						Travel Time (t_t)						Comp.	t_c Check (urban)		
			Length (ft)	Slope	t_i (min)	Length (ft)	Slope	Land Type	C_v	Velocity (ft/sec)	t_t (min)	Length (ft)	Slope	Land Type	C_v	Velocity (ft/sec)	t_t (min)	t_c (min)	Total Length	t_c Check	
DA-EX-1	1.04	0.47	100	0.0092	11.69	100.9	0.021	NBG	10	1.45	1.16							12.85			12.85
DA-EX-2	1.14	0.59	100	0.014	8.24	399.21	0.079	NBG	10	2.81	2.37							10.61			10.61
DA-EX-3	6.84	0.48	100	0.031	7.71	439.03	0.041	NBG	10	2.02	3.61							11.32			11.32
DA-1	2.15	0.50	69.43	0.0308	6.23	488.51	0.0107	SP	7	0.72	11.24							17.47	557.94	13.10	13.10
DA-2	1.52	0.64	90.27	0.023	5.99	333.83	0.0102	PV	20	2.02	2.75	61.16	0.079	SP	7	1.97	0.52	9.27	485.26	12.70	9.27
DA-3	4.49	0.54	97.18	0.0605	5.50	747.09	0.0152	SP	7	0.86	14.43							19.93	844.27	14.69	14.69
DA-4	0.56	0.37	100	0.1952	4.94	22.7	0.233	SP	7	3.38	0.11							5.06	122.7	10.68	5.06

Equations:

t_i (overland) = $0.395(1.1-C)L^{0.5}S^{-0.333}$

C = Runoff Coefficient

L = Length of overland flow

S = Slope

Travel Time: $V = CvS^{0.5}$

V = Velocity (ft/s)

C_v = Conveyance Coefficient

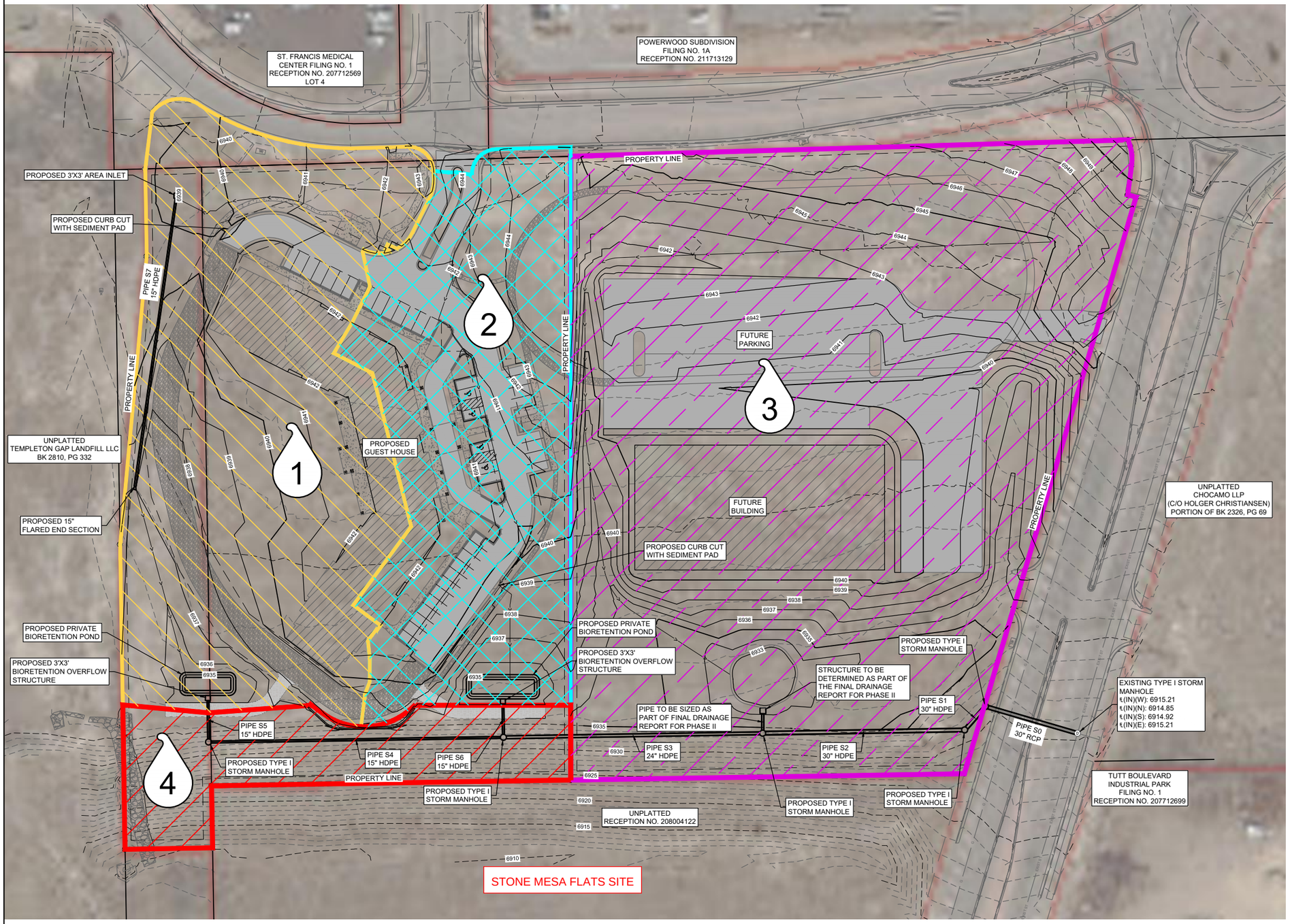
S = Slope

t_c Check: (L/180) + 10 (developed condition only)

L = Overall Length

Conveyance Coefficient C_v		
Type of Land Surface	Land Type	C_v
Heavy Meadow	HM	2.5
Tillage/Fields	TF	5
Riprap (Not Buried)	RR	6.5
Short Pasture/Lawns	SP	7
Nearly Bare Ground	NBG	10
Grassed Waterway	GW	15
Paved Areas & Shallow Paved Swales	PV	20

HSG: A



LEGEND

- FLOW PATH
- DRAINAGE BOUNDARY NUMBER
- 1' CONTOUR INTERVAL (EXISTING GROUND)
- 5' CONTOUR INTERVAL (EXISTING GROUND)
- 1' CONTOUR INTERVAL (PROPOSED GROUND)
- 5' CONTOUR INTERVAL (PROPOSED GROUND)
- PROPOSED EASEMENT
- PROPOSED STORM SEWER
- EXISTING STORM SEWER
- PROPOSED PARKING LOT PAVEMENT
- PROPOSED GRAVEL TRAIL/FIRE LANE
- DRAINAGE BASIN 1
- DRAINAGE BASIN 2
- DRAINAGE BASIN 3
- DRAINAGE BASIN 4

NOTES:

1. ALL PROPOSED CURB AND GUTTER SHALL BE TYPE 2.

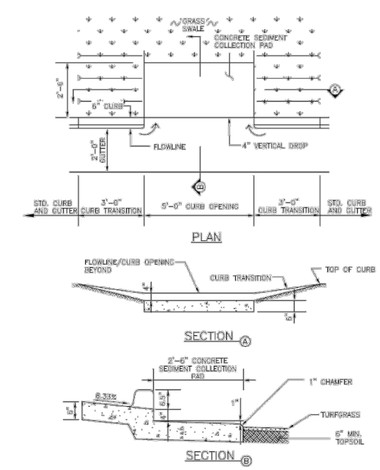


Figure RR-4. Sediment pad for curb opening to grass swale.

BASIN SUMMARY TABLE

DB #	DRAINAGE AREA	"C5" VALUE	TC,5	Q5	"C100" VALUE	TC,100	Q100
1	2.15	0.29	13.10	2.32	0.50	13.10	6.72
2	1.52	0.47	11.48	2.80	0.64	9.27	6.93
3	4.49	0.34	14.69	5.42	0.54	14.69	14.46
4	0.56	0.11	6.82	0.29	0.37	5.06	1.79

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ST. FRANCIS GUEST HOUSE

DRAINAGE STUDY

COLORADO SPRINGS, CO

REVISION DATE	REVISION DESCRIPTION
00/00/00	(DESCRIPTION)

PROPOSED DRAINAGE MAP

NORTH

SCALE: 1" = 40'

PROJECT #: 2009CS4023
CHECKED BY: BML
DRAWN BY: JME

DATE: 12/10/20

SHEET # 1

TOTAL SHEETS 1