PRELIMINARY DRAINAGE REPORT for

Aerospace Business Center

Lot 4 and 5, Colorado Centre Foreign Trade Zone & Business Park Filing No. 1

Colorado Springs, CO

Prepared for:

ARCO Murray
1005 17th Avenue South, Suite 735
Nashville, TN 37212
Contact: Walker Stillman
(615) 830-4693

Prepared by:

Kimley-Horn and Associates, Inc.
2 North Nevada Avenue, Suite 900
Colorado Springs, Colorado 80903
Contact: Noah Brehmer, P.E.
(719) 453-0180

Project #: 196397000

Prepared: January 15, 2024p
ProjectDox Number: STM-REV24-xxxx
ProjectDox Master Number: STM-MP24-xxxx

Kimley»Horn

CERTIFICATIONS

ENGINEER'S STATEMENT

This report and plan for the drainage design of Lots 4 & 5 of Colorado Centre Foreign Trade Zone & Business Park Filing No. 1 was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

SIGNATURE (Affix Seal): _____

Colorado P.E. No. 63226 Date

DEVELOPER'S STATEMENT

ARCO Murray hereby certifies that the drainage facilities of Lot 4s & 5 of Colorado Centre Foreign Trade Zone & Business Park Filing No. 1 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 of Lots 4 & 5 of Colorado Centre Foreign Trade Zone & Business Park Filing No. 1 guarantee that final drainage design review will absolve ARCO Murray 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.

_____

Name of Developer

_____

Authorized Signature Date

_____

Printed Name

_____

Title

_____

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 Preliminary Drainage Report ("PDR") is to outline the preliminary drainage plan for the proposed development of Lot 4 of Colorado Centre Foreign Trade Zone & Business Park Filing No. 1 and to show the compliance with the approved plans for the area. The proposed development will include a light industrial development located on two parcels located near the northwest corner of Foreign Trade Zone Blvd and Bradley Road (the "Site") in El Paso County, City of Colorado Springs, Colorado (the "City"). This PDR identifies onsite and off-site drainage patterns and proposes to safely route developed stormwater to adequate outfalls at less than historic flow rates.

SITE AREAS

The Site includes Lot 4 of the Colorado Centre Foreign Trade Zone & Business Park Filing No. 1 and consists of approximately 26.895-acres. The proposed total area of disturbance for Phase 1 of the Site is 16.42-acres. The disturbance is located predominantly within Lot 4 and a portion of grading within Lot 5 to the south of the Site. The existing Lot 4 is proposed to be re-platted into a proposed lot (8.25-acres) and the remaining area of Lot 4 will be a tract (18.65-acres). The platted subdivision name of the proposed lot is not known at this time and will be provided with a subsequent submittal.

SITE LOCATION

The Project is located in the northeast quarter of Section 9, within Township 15 South, Range 65 West of the Sixth Principal Meridian, County of El Paso, State of Colorado. Lots 4 is located within parcel number 5509101001.

The Site is surrounded by the following:

- South of the Site: Bradley Road (Public)
- North of the Site: Lot 3, Colorado Centre Foreign Trade Zone Filing No. 1
- West of the Site: Villages at Waterview North Addition No. 1 (currently being platted)
- East of the Site: Foreign Trade Zone Boulevard (Public)

The Site is located within the Marksheffel Tributary as identified in the Jimmy Camp Creek Drainage Basin per the "Jimmy Camp Creek Drainage Basin Planning Study" by Kiowa Engineering Corp., dated March 9, 2015 (hereby the "DBPS"). The Site's ultimate outfall is Jimmy Camp Creek. A vicinity map is provided in Appendix A.

GENERAL PROJECT DESCRIPTION

The Site is currently undeveloped and consists of natural vegetation including sparse grasses and scrub. The existing land use is vacant land. In the existing condition, offsite flows from the north and west enter the property and are proposed to be diverted to the west via a proposed berm. The Site does not currently provide onsite water quality or detention for the Project area. Per the Jimmy Camp Creek Drainage Basin Planning Study ("JCC DBPS"), the Colorado Centre Regional Detention Pond ("CCRD Pond") downstream of the Site provides 100-year detention but it does not include the Site's water quality capture volume (WQCV) or EURV.

The proposed development is a multi-phased approach and this PDR outlines the drainage patterns and proposed improvements associated with Phase I, subsequent phases will be outlined in future drainage reports. Phase I includes construction of a warehouse building, a proposed public onsite WQCV/EURV extended detention basin (hereby the "proposed WQ

pond"), landscaping, stormwater/utility improvements, surface parking, sidewalks, and private driveways within Lot 4 (the "Project"). The proposed WQ pond will treat Phase I and Phase II flows.

The proposed land use is light industrial. There are no major irrigation facilities within the Site and the Site is not located within the Streamside Zone.

SOILS CONDITIONS

NRCS soil data is available for this Site, and it has been noted that soils onsite fall under Hydrologic Groups B. The NRSC Soils map is provided in **Appendix B.**

CRITERIA

REGULATIONS

Water quality and detention is required for this Project per the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2 (the "DCM"), dated May 2014, and revised January 2021.

DESIGN CRITERIA REFERENCE AND CONSTRAINTS

The Project follows the City of Colorado Springs Storm Drainage Criteria Manual Volume 1 (May 2014, revised January 2021), and Volume 2 (May 2014, revised December 2020) (the "DCM") and the MHFD Urban Storm Drainage Criteria Manual Volumes 1, 2, and 3 (the "USDCM"). Project area 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 of this report.

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 DCM. Table 6-2 of the DCM is the source for rainfall data for the 5-year and 100-year design storm events. Developed runoff was calculated using the Rational Method for existing and proposed conditions as established in the DCM and the USDCM. Runoff coefficients for the proposed development were determined using Table 6-6 of the DCM by calculating weighted impervious values for each specific site basin. The runoff coefficients used for each delineated basin correspond with the predominant soil type with in that specific sub-basin as outlined in Table 6-6 of the DCM (i.e. if the basin has HSG B then the associated HSG A/B runoff coefficient from Table 6-6 was used). These soil types are denoted within the HSG Column on Form SF-1 in **Appendix C**. The runoff reduction calculations were calculated per the *Green Infrastructure Guidance Manual* guidelines. Future phases will need to show compliance with the the *Green Infrastructure Guidance Manual* at the time of their development. Hydrologic calculations and the relevant tables and figures from the Criteria can be found in **Appendix C**.

HYDRAULIC CRITERIA

The proposed drainage facilities are designed in accordance with the DCM and the USDCM. Hydraulic calculations for inlet and street capacity and sizing were computed using MHFD spreadsheets. The capacities of the proposed public inlets were calculated. The inlet size needed per basin to meet the basin's developed flow was determined from these calculations. The inlet capacity calculations are provided in **Appendix D**. Full inlet calculations for each proposed inlet will be provided in the Final Drainage Report.

Hydraulic calculations for detention volume, outlet structure, emergency spillway, rip rap sizing and street capacities will be computed using MHFD spreadsheets. Forebay sizing will be computed using the Water Quality Drain Time Equation EDB-1 provided in USDCM. Pipe flows, capacities, and hydraulic grade line calculations will be computed using StormCAD implementing the standard step headloss method. Detailed computations will be provided with the Final Drainage Report for this development at a later date.

PREVIOUS DRAINAGE STUDIES

The Site is located within the Jimmy Camp Creek DBPS. The proposed development will conform to the standards and requirements set forth in the DBPS. Applicable excerpts from JCC DBPS are provided within **Appendix G**.

The Bradley Heights MDDP included analysis of the drainage for a downstream development along with the Aerospace Business Center property. The CCRD Pond is located within the drainage study area from the Bradley Heights MDDP and the MDDP outlines the planned tributary areas to be detained within the CCRD Pond. Applicable excerpts from the Bradley Heights MDDP are provided within **Appendix G**.

EXISTING DRAINAGE CONDITIONS

The Site has two existing outfall locations: northeast and southeast. The northern portions of Lot 4 sheet flow towards Foreign Trade Zone Boulevard where the flows are routed south via existing curb and gutter to existing curb inlets near the Bradley Road intersection. The southern portion of Lot 4 sheet flow east towards an offsite public culvert (4-36” CMP Pipes) located on the north branch of the Foreign Trade Zone Boulevard and Bradley Road intersection. The culvert crosses under Foreign Trade Zone Boulevard and continues east via an existing ditch north of Bradley Road. This ditch is described in the DPBS as R-M4C. The flows from northeast outfall are also ultimately conveyed to R-M4C. Therefore, the entire Site outfalls to reach R-M4C. This outfall location is maintained in proposed conditions. Reference the *Downstream Flows* section for the comparison between the existing and proposed conditions at R-M4C.

The Site generally sheet flows across the Site with slopes at approximately 3%. There are no existing drainage improvements onsite. There is an existing gas easement located along the western portion of the Site, but it is not anticipated to affect drainage conditions.

JIMMY CAMP CREEK DPBS

The current version of the Jimmy Camp Creek Drainage Basin Planning Study (“JCC DBPS”) was completed in 2015 by Kiowa Engineering and includes the proposed Project Site within the drainage study area. Per the DPBS, the Site is located within the Marksheffel Tributary within sub-basins M-4 and M-5. These basins are routed south to Design Point DP-M5 into an existing drainage ditch north of Bradley Road described as R-M4C. The ditch, R-M4C, conveys flows east to Design Point DP-M4 located at the northwest corner of the Marksheffel Road and Bradley Road intersection. At DP-M4, the flows enter the Marksheffel Tributary. The Tributary crosses under Bradley Road and continues south along the western side of Marksheffel Road where it ultimately outfalls at Design Point DP-M1 into the existing public regional reservoir MRK-1, also known as the Colorado Centre Regional Detention Pond (the “CCRD Pond”). The CCRD Pond has a watershed of 5.18 square miles and 5-year and 100-year flows of 42 cfs and 1,916 cfs. The CCRD Pond discharges across Marksheffel Road to a confluence with the main branch of Jimmy Camp

Creek via a public double 9-foot x 12-foot CBC.

EXISTING DRAINAGE BASINS

The Site is divided into 2 existing sub-basins. The existing drainage map showing these sub-basins are provided in **Appendix F.** The existing Runoff Calculations are provided in **Appendix C.** These sub-basins are summarized in the table below.

Table 1: Existing Drainage Basin Runoff and Outfall Summary

DESIGN POINT	AREA (AC)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	% IMPERV.	IMMEDIATE OUTFALL			ULTIMATE OUTFALL
					CONVEYANCE	INLET TYPE	LOCATION	
EX-1	8.34	2.79	15.60	0%	OVERLAND	FTZ BLVD		FTZ BLVD
EX-2	10.51	3.61	20.22	0%	OVERLAND	FTZ BLVD		FTZ BLVD
OF-1	0.26	0.15	0.82	0%	OVERLAND	EX-2 BASIN		FTZ BLVD
OF-2	21.30	7.62	42.64	0%	OVERLAND	EX-1 BASIN		FTZ BLVD

PROPOSED DRAINAGE CONDITIONS

Runoff from proposed improvements will either sheet flow directly into the proposed WQ pond or into proposed public inlets connected to the proposed WQ pond via proposed public storm sewer. Curb and gutter and v-gutters within the parking bays and drive aisles will help direct runoff towards the inlets or the proposed WQ pond. For Phase 1, the proposed WQ pond will discharge under the proposed southern private drive aisle and daylight upstream of the existing culvert at the southeast corner of existing Lot 5. All developed runoff from the Site is tributary to the existing culvert (Design Point DP-M5 per the JCC DBPS) at the northwest corner of Bradley Road and Foreign Trade Zone Boulevard. The drainage pattern downstream of Design Point DP-M5 is described in the *Jimmy Camp Creek DBPS* section of this report.

The proposed WQ pond will be located within the east portion of the Site and will treat water quality via slow release of the water quality capture volume (WQCV) and EURV through an orifice plate in the proposed outlet structure or through Green Infrastructure implementation (75% infiltration). The proposed WQ pond is sized to treat the fully developed flows from Phase I and II, reference the *Water Quality and Detention* section of this report for details. The 100-year detention for the Site will be provided downstream southeast of the site in the CCRD Pond per the JCC DBPS. The Site is ultimately tributary to Jimmy Camp Creek and the CCRD Pond.

BASIN DESCRIPTIONS

The Site is divided into 23 proposed sub-basins. Sub-basins P1-P12 and R1-R2 are located onsite. OS1-OS5 are onsite sub-basins that flow offsite. Sub-basins OF1-OF2 are sub-basins located offsite that flow onsite. F1-F2 are sub-basins included in the site disturbed area but are to be developed in future phases. The proposed drainage map showing these sub-basins are provided in **Appendix F.** The proposed Runoff Calculations are provided in **Appendix C.** These sub-basins are summarized in the table below.

Table 2: Proposed Drainage Basin Runoff and Outfall Summary

DESIGN POINT	AREA (AC)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	% IMPERV.	IMMEDIATE OUTFALL			ULTIMATE OUTFALL
					CONVEYANCE	INLET TYPE	LOCATION	
P1	0.40	1.53	3.00	79%	CURB/GUTTER	5' TYPE R CDOT	SUMP	WQ POND
P2	0.28	1.32	2.36	100%	CURB PAN	10' TYPE R CDOT	SUMP	WQ POND
P3	0.69	3.23	5.79	100%	CURB PAN	10' TYPE R CDOT	SUMP	WQ POND
P4	0.70	3.24	5.81	100%	CURB PAN	15' TYPE R CDOT	SUMP	WQ POND
P5	0.68	3.17	5.69	100%	CURB PAN	10' TYPE R CDOT	SUMP	WQ POND
P6	0.47	1.91	3.57	86%	CURB/GUTTER	15' TYPE R CDOT	SUMP	WQ POND
P7	0.23	0.28	1.10	13%	OVERTOP CURB INTO P6			WQ POND
P8	0.08	0.28	0.56	68%	CURB/GUTTER	TYPE C CDOT	ON-GRADE	WQ POND
P9	1.47	4.34	9.14	60%	OVERLAND	TYPE C CDOT	SUMP	WQ POND
P10	0.04	0.14	0.27	85%	OVERLAND	10' TYPE R CDOT	ON-GRADE	WQ POND
P11	0.11	0.08	0.34	13%	OVERTOP CURB INTO P1			WQ POND
P12	0.74	0.90	2.90	23%	TRICKLE CHANNEL	CUSTOM OUTLET STRUCTURE	WEIR	WQ POND
R1	0.97	3.67	6.84	90%	DAYLIGHT ROOF DRAIN INTO LEVEL SPREADER			WQ POND
R2	0.97	3.67	6.84	90%	DAYLIGHT ROOF DRAIN INTO LEVEL SPREADER			WQ POND
F1	4.58	1.14	8.40	0%	OVERLAND	10' TYPE R CDOT	ON-GRADE	WQ POND
F2	4.52	1.13	8.30	0%	OVERLAND	TYPE C CDOT	SUMP	WQ POND
OF1	0.23	0.08	0.56	0%	OVERLAND	TYPE C CDOT	SUMP	WQ POND
OF2	21.34	6.97	51.23	0%	OVERLAND	TYPE C CDOT	SUMP	FTZ BLVD
OS1	0.43	0.18	1.32	0%	SHEETFLOW EAST			FTZ BLVD
OS2	0.15	0.65	1.17	95%	SHEETFLOW EAST			FTZ BLVD
OS3	0.24	0.86	1.67	76%	SHEETFLOW EAST			FTZ BLVD
OS4	0.89	0.72	2.94	11%	SHEETFLOW EAST			FTZ BLVD
OS5	0.50	0.17	1.28	0%	SHEETFLOW SOUTH			OFFSITE (S)

FOUR-STEP PROCESS

The four-step process per the USDCM provides guidance and requirements for the selection and siting of permanent Control Measures (CMs) for new development and significant redevelopment. Compliance with this process is outlined below. The total area of disturbance associated with the development is 16.42-acres. Water quality treatment for the disturbed areas of the Site will be provided via 75% infiltration and a proposed WQ pond.

STEP 1: EMPLOY RUNOFF REDUCTION PRACTICES

Currently the site is vacant land. Development of the site will increase current runoff conditions due to a portion of the proposed development area currently being vacant land. However, he proposed development is not anticipated to have negative impacts to downstream infrastructure. Implementation of landscaping throughout the Site will help slow runoff and encourage infiltration. Stormwater runoff reduction techniques will be used to promote stormwater infiltration and reduce the amount of developed runoff exiting the Site.

As documented in the runoff reduction calculations and exhibit found in the Appendix, the site was divided into Upstream Impervious Areas (UIA), Receiving Pervious Area (RPA), Directly Connected Impervious Area (DCIA), and Separate Pervious Area (SPA) per the City of Colorado Springs Green Infrastructure Manual. Where feasible, developed stormwater runoff from the Site will be directed over the various RPA's. Reference **Appendix F** for the proposed Green Infrastructure Exhibit. Reference **Appendix C** for the UD-BMP spreadsheet by Mile High Flood District used to determine the runoff reduction.

The total WQCV reduction for the total disturbed area is 27%, which exceeds the required minimum of 10%. All project phases are to show compliance with Green Infrastructure requirements in their respective reports. Phase I and Phase II Green Infrastructure compliance will be analyzed together to provide a total of 10% runoff reduction since they are both tributary to the proposed WQ Pond. Phase I compliance is outlined in this report and the combination of Phase I and II will be outlined in a future study.

STEP 2: TREAT AND SLOWLY RELEASE THE WQCV

The water quality capture volume will be provided and slowly released from the outlet structure of the proposed WQ pond for the Site in a minimum of 40 hours. Water quality treatment for the disturbed areas not tributary to the proposed WQ pond will be provided via 75% infiltration. Therefore, 97.67% of the Site is treated for water quality. Reference the table below for a breakdown of each sub-basin and the control measure providing water quality treatment.

Table 3: Treatment Method Summary

Design Point/Basin	Total Area (AC)	Associated Disturbance Area (AC)	Treatment Method	Ownership/ Maintenance
P1	0.40	0.40	WQ Pond	Public
P2	0.28	0.28	WQ Pond	Public
P3	0.69	0.69	WQ Pond	Public
P4	0.70	0.70	WQ Pond	Public
P5	0.68	0.68	WQ Pond	Public
P6	0.47	0.47	WQ Pond	Public
P7	0.23	0.23	WQ Pond	Public
P8	0.08	0.08	WQ Pond	Public

P9	1.47	1.47	WQ Pond	Public
P10	0.04	0.04	WQ Pond	Public
P11	0.11	0.11	WQ Pond	Public
P12	0.74	0.74	WQ Pond	Public
R1	0.97	0.97	WQ Pond	Public
R2	0.97	0.97	WQ Pond	Public
F1	4.58	3.52	WQ Pond	Public
F2	4.52	2.95	WQ Pond	Public
OF1	0.23	0.00	WQ Pond	Public
OF2	21.34	0.00	WQ Pond	Public
OS1	0.43	0.43	75% Infiltration	N/A
OS2	0.15	0.15	Not Treated	N/A
OS3	0.24	0.24	Not Treated	N/A
OS4	0.89	0.79	75% Infiltration	N/A
OS5	0.50	0.50	75% Infiltration	N/A
Total	**40.72**	**16.42**		
Total Treated Disturbed Area: 16.42 Acres				
Total Untreated Disturbed Area: 0.38 Acres				
Resulting Treatment Percentage: 97.67%				

STEP 3: STABILIZE DRAINAGEWAYS

There are no open channels on or adjacent to this site, therefore no stabilization will be necessary. All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. The downstream outlet has sufficient stabilization. Development site is 1211 ft from Jimmy Camp Creek.

STEP 4: IMPLEMENT SITE SPECIFIC AND OTHER SOURCE CONTROL CMS

The Site does not require “Covering of Storage/Handling Areas” or “Spill Containment and Control” (permanent CMs) 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 CM for the proposed project.

TOTAL DISTURBED AREA EXCLUSIONS

No utility connections to existing public utilities located in public ROW are anticipated. However, if any connections are proposed then the area of disturbance associated with the utility trenching will be excluded and documented with the FDR for this development.

WATER QUALITY AND DETENTION

DETENTION

Per the Future Conditions Land Use Map in the JCC DBPS, the existing CCRD Pond will provide 100-year detention for the Site. The pond was sized for the Marksheffel Tributary basin which includes 3,316 acres and an anticipated weighted imperviousness of 70-90%. For the purposes of this study (to size the proposed WQ Pond), a weighted imperviousness of 80% was assumed for Phase I and II to account for the full buildout of Phase II. This is within the expected range from the JCC DBPS and therefore this development in compliance with the Jimmy Camp Creek DBPS and the planned flows to the CCRD Pond.

The CCRD Pond provides the following:

- Energy dissipation for flows entering the pond from the Marksheffel Tributary
- Outlet structure for 100-year stormwater events releasing at or below historic rates
- Low flow channels
- Micropool for initial surcharge storage
- Emergency overflow spillway
- Maintenance access path

WATER QUALITY

The water quality treatment for the Site will be provided within the proposed WQ pond and via 75% infiltration. In the interim condition (after Phase I construction and before Phase II construction), runoff from Phase II basins, F1 and F2, will be captured by two proposed area inlets that are then routed to the proposed WQ pond. The area inlets will be sized with the FDR to capture the interim flows prior to Phase II full buildout. Phase I stormwater infrastructure, including the proposed WQ pond, will be sized to convey the runoff associated with the developed conditions of Phase I and II.

The water quality outlet structure is designed per the specifications in section 13.5.10 of the DCM. The orifice plate of the structure will be designed based on section 13.4.2.2 of the DCM. The orifice plate will allow the Water Quality Capture Volume to be drained from the structure in a minimum of 40 hours and the EURV to be drained in 68-72 hours. The MHFD-Detention spreadsheet basin tab is provided in **Appendix D**. Preliminary outlet structure calculations are provided in **Appendix D,** final calculations will be provided with the FDR for this development. Runoff reduction calculations showing a minimum WQCV reduction of 75% for these areas are included in **Appendix C**.

DOWNSTREAM FLOWS

The total flows developed from the Site are expected to increase from the existing to the proposed condition due to added impervious area and decreased time of concentration. However, no adverse effects are anticipated on existing downstream infrastructure because the downstream conveyance structures were designed for increased flows from the existing condition per the JCC DBPS. Per the Future Conditions Land Use Map in the DPBS, the study accounts for the Site area to be Commercial/Industrial with an imperviousness value of 70-90%. The proposed Site land use is consistent with the DPBS and the proposed imperviousness value of 80% falls within the expected range.

COMPLIANCE WITH PREVIOUS STUDIES

Per the Future Conditions Land Use Map in the DPBS, the study accounts for the Site area to be Commercial/Industrial with an imperviousness value of 70-90%. The proposed Site land use is consistent with the DPBS and the proposed imperviousness value of 80% falls within the expected range. Therefore, the Project complies with the study.

FLOODPLAIN STATEMENT

The FEMA Flood Insurance Rate Map (FIRM) Panel 08041C0768G effective December 7, 2018, indicates “No portion of the site is located within a 100-year floodplain. This panel is provided in Appendix B.

DRAINAGE AND BRIDGE FEES

The Project Site is located in the Jimmy Camp Creek Drainage Basin. Since the Site has previously been platted, the Drainage and Bridge Fees associated with Jimmy Camp Creek have already been paid and are not due with this development.

VARIANCES FROM CRITERIA

There are no proposed variances from the CRITERIA for the proposed development. Any other variances from the CRITERIA will be requested with the Final Drainage Report for this development at a later date.

MAINTENANCE AND OPERATIONS

An Inspection and Maintenance Agreement will be submitted to the City of Colorado Springs for the proposed WQ pond concurrently with the Construction Documents. The proposed WQ pond will be maintained by the owner.

GEOTECHNICAL AND GROUNDWATER CONSIDERATIONS

A geotechnical investigation was prepared for the Site and pertinent excerpts are included in **Appendix E** of this report. The report did not find any geologic hazard which would preclude development of the site based on the proposed design.

Per the Geotechnical Report, groundwater was not encountered during drilling operations in the borings and is not considered a constraint to construction of this project.

SUMMARY

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for Lot 4, Colorado Centre Foreign Trade Zone & Business Park Filing No. 1 – Phase 1 conforms to the City of Colorado Springs Storm Drainage Criteria Manual, Volumes 1 and 2 (with latest revisions) and the Mile High Flood District Manual. Additionally, the Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments.

This report and findings are in general conformance with all previously approved reports and/or studies which include this Site, including the planned runoff from the Site as outlined in the Bradley Heights MDDP. The proposed Project is not anticipated to adversely impact the peak flows downstream within Jimmy Camp Creek.

REFERENCES

1. City of Colorado Springs Drainage Criteria Manual, Vol. 1 & 2, May 2014 (Vol. 1 revised January 2021, Vol. 2 revised December 2020).

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

3. The Federal Emergency Management Agency, FEMA FIRMette published December 28, 2021, Map Number 08041C0768G, effective date December 7, 2018, by the Federal Emergency Management Agency (FEMA).

4. Natural Resources Conservation Service (NRCS), United States Department of Agriculture (USDA). Web Soil Survey. Available online. Accessed 12/17/2023.

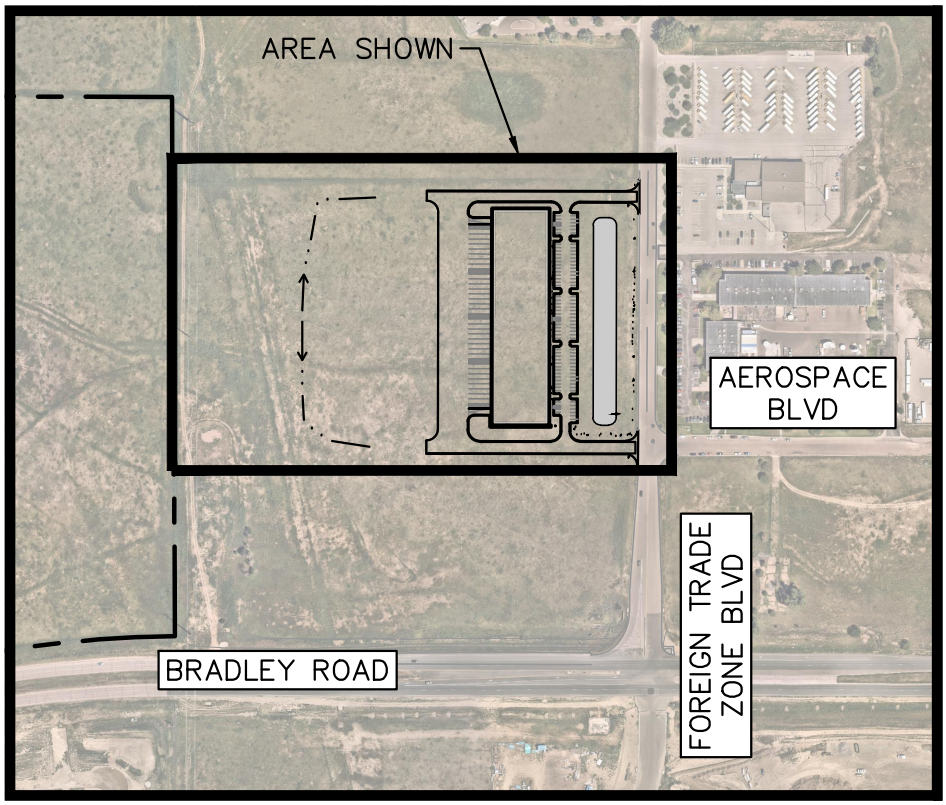
5. “Master Development Drainage Plan Amendment for Bradley Heights” by Matrix, Dated April 2022

6. “Jimmy Camp Creek Drainage Basin Planning Study, Development of Alternatives & Design of Selected Plan Report” by Kiowa Engineering Corporation for the City of Colorado Springs, Dated March 9, 2015

7. “Geotechnial Evaluation for Proposed Industrial Development Bradley Road & Foreign Trade Zone Boulevard Colorado Springs, Colorado” by Ninyo & Moore., prepared December 1, 2023.

APPENDIX A – VICINITY MAP

APPENDIX A – VICINITY MAP



APPENDIX B – SOILS MAP AND FEMA FIRM PANEL

National Flood Hazard Layer FIRMette

FEMA

104°40'35"W 38°46'6"N

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

1:6,000

104°39'58"W 38°45'38"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

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

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

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

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

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 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

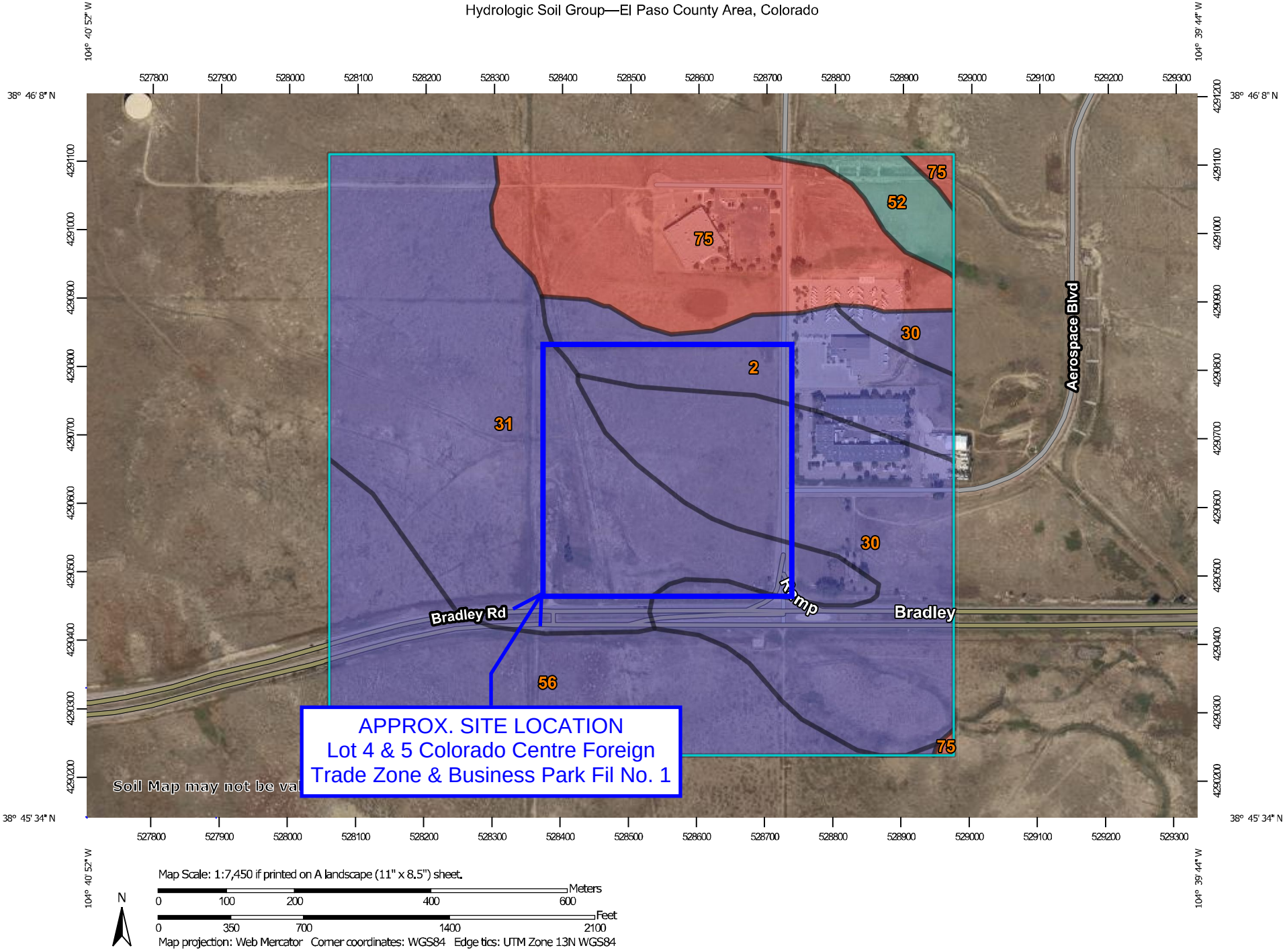
N

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 12/17/2023 at 3:47 PM 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.


104° 40' 52" W
104° 39' 44" W
38° 46' 8" N
38° 45' 34" N
527800
527900
528000
528100
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4290200
75
52
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30
2
31
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56
75
Aerospace Blvd
Bradley Rd
Bradley
Ramp
APPROX. SITE LOCATION
Lot 4 & 5 Colorado Centre Foreign
Trade Zone & Business Park Fil No. 1
Soil Map may not be va
Map Scale: 1:7,450 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 100 200 400 600
Feet
0 350 700 1400 2100
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 21, Aug 24, 2023

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Ascalon sandy loam, 1 to 3 percent slopes	B	17.1	8.6%
30	Fort Collins loam, 0 to 3 percent slopes	B	43.5	21.8%
31	Fort Collins loam, 3 to 8 percent slopes	B	64.1	32.1%
52	Manzanst clay loam, 0 to 3 percent slopes	C	4.6	2.3%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	37.1	18.6%
75	Razor-Midway complex	D	33.4	16.7%
Totals for Area of Interest			**199.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C – HYDROLOGIC CALCULATIONS

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7629°, Longitude: -104.6703°
Elevation: 5854 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.244** (0.204-0.296)	**0.294** (0.245-0.358)	**0.383** (0.318-0.467)	**0.464** (0.382-0.568)	**0.583** (0.466-0.750)	**0.683** (0.530-0.888)	**0.788** (0.588-1.05)	**0.902** (0.642-1.24)	**1.06** (0.724-1.50)	**1.19** (0.786-1.70)
10-min	**0.357** (0.298-0.434)	**0.431** (0.359-0.524)	**0.562** (0.466-0.685)	**0.679** (0.560-0.831)	**0.854** (0.683-1.10)	**0.999** (0.776-1.30)	**1.15** (0.862-1.54)	**1.32** (0.941-1.81)	**1.56** (1.06-2.20)	**1.75** (1.15-2.49)
15-min	**0.436** (0.363-0.529)	**0.526** (0.438-0.639)	**0.685** (0.568-0.835)	**0.828** (0.682-1.01)	**1.04** (0.833-1.34)	**1.22** (0.946-1.59)	**1.41** (1.05-1.88)	**1.61** (1.15-2.21)	**1.90** (1.29-2.68)	**2.13** (1.40-3.03)
30-min	**0.654** (0.545-0.794)	**0.787** (0.655-0.957)	**1.02** (0.848-1.25)	**1.24** (1.02-1.51)	**1.55** (1.24-2.00)	**1.82** (1.41-2.36)	**2.10** (1.57-2.80)	**2.40** (1.71-3.30)	**2.83** (1.93-4.00)	**3.18** (2.09-4.52)
60-min	**0.865** (0.722-1.05)	**1.02** (0.847-1.24)	**1.30** (1.08-1.59)	**1.57** (1.30-1.93)	**2.00** (1.61-2.59)	**2.36** (1.84-3.10)	**2.76** (2.07-3.71)	**3.21** (2.29-4.42)	**3.85** (2.63-5.45)	**4.37** (2.88-6.23)
2-hr	**1.08** (0.905-1.30)	**1.25** (1.05-1.51)	**1.58** (1.32-1.92)	**1.91** (1.59-2.33)	**2.44** (1.99-3.16)	**2.91** (2.29-3.80)	**3.43** (2.59-4.59)	**4.01** (2.89-5.52)	**4.86** (3.35-6.86)	**5.57** (3.70-7.88)
3-hr	**1.19** (1.00-1.43)	**1.35** (1.14-1.63)	**1.70** (1.43-2.05)	**2.05** (1.71-2.49)	**2.64** (2.17-3.43)	**3.17** (2.52-4.15)	**3.77** (2.87-5.05)	**4.45** (3.23-6.12)	**5.46** (3.79-7.70)	**6.31** (4.21-8.89)
6-hr	**1.35** (1.15-1.61)	**1.53** (1.30-1.82)	**1.90** (1.61-2.28)	**2.30** (1.93-2.77)	**2.97** (2.47-3.86)	**3.59** (2.88-4.68)	**4.29** (3.30-5.73)	**5.10** (3.73-6.97)	**6.29** (4.40-8.83)	**7.30** (4.91-10.2)
12-hr	**1.47** (1.26-1.75)	**1.70** (1.46-2.02)	**2.15** (1.84-2.56)	**2.60** (2.20-3.12)	**3.34** (2.78-4.27)	**3.99** (3.21-5.14)	**4.73** (3.65-6.23)	**5.55** (4.09-7.51)	**6.76** (4.76-9.39)	**7.77** (5.27-10.8)
24-hr	**1.64** (1.41-1.93)	**1.91** (1.64-2.25)	**2.42** (2.08-2.86)	**2.92** (2.49-3.47)	**3.70** (3.09-4.67)	**4.38** (3.54-5.58)	**5.13** (3.99-6.70)	**5.96** (4.42-8.00)	**7.18** (5.08-9.88)	**8.18** (5.59-11.3)
2-day	**1.85** (1.61-2.16)	**2.16** (1.88-2.54)	**2.74** (2.37-3.22)	**3.28** (2.82-3.87)	**4.10** (3.44-5.11)	**4.81** (3.91-6.05)	**5.57** (4.35-7.19)	**6.41** (4.78-8.50)	**7.60** (5.42-10.4)	**8.58** (5.91-11.8)
3-day	**2.00** (1.75-2.33)	**2.34** (2.04-2.73)	**2.95** (2.56-3.45)	**3.51** (3.03-4.13)	**4.36** (3.66-5.39)	**5.08** (4.14-6.35)	**5.85** (4.59-7.51)	**6.69** (5.01-8.83)	**7.89** (5.65-10.7)	**8.86** (6.14-12.1)
4-day	**2.13** (1.87-2.48)	**2.49** (2.18-2.89)	**3.12** (2.72-3.64)	**3.70** (3.20-4.34)	**4.57** (3.85-5.63)	**5.30** (4.33-6.60)	**6.08** (4.78-7.78)	**6.93** (5.20-9.11)	**8.13** (5.84-11.0)	**9.11** (6.33-12.4)
7-day	**2.50** (2.20-2.89)	**2.89** (2.54-3.34)	**3.58** (3.14-4.15)	**4.20** (3.66-4.89)	**5.12** (4.33-6.25)	**5.89** (4.84-7.28)	**6.70** (5.30-8.51)	**7.58** (5.72-9.90)	**8.82** (6.37-11.8)	**9.81** (6.86-13.3)
10-day	**2.82** (2.50-3.25)	**3.24** (2.87-3.74)	**3.99** (3.52-4.62)	**4.65** (4.07-5.41)	**5.63** (4.78-6.83)	**6.43** (5.31-7.91)	**7.28** (5.78-9.19)	**8.19** (6.20-10.6)	**9.46** (6.86-12.6)	**10.5** (7.36-14.2)
20-day	**3.70** (3.30-4.23)	**4.25** (3.79-4.87)	**5.19** (4.61-5.96)	**5.99** (5.29-6.92)	**7.13** (6.08-8.55)	**8.04** (6.68-9.78)	**8.98** (7.17-11.2)	**9.96** (7.59-12.8)	**11.3** (8.24-14.9)	**12.3** (8.74-16.6)
30-day	**4.42** (3.97-5.05)	**5.10** (4.57-5.82)	**6.20** (5.54-7.10)	**7.13** (6.32-8.20)	**8.41** (7.18-9.99)	**9.41** (7.83-11.4)	**10.4** (8.34-12.9)	**11.4** (8.74-14.6)	**12.8** (9.38-16.8)	**13.8** (9.86-18.5)
45-day	**5.36** (4.83-6.08)	**6.18** (5.56-7.02)	**7.50** (6.72-8.55)	**8.58** (7.64-9.83)	**10.0** (8.58-11.8)	**11.1** (9.29-13.3)	**12.2** (9.82-15.0)	**13.3** (10.2-16.8)	**14.7** (10.8-19.2)	**15.7** (11.2-20.9)
60-day	**6.16** (5.57-6.98)	**7.11** (6.42-8.06)	**8.62** (7.75-9.80)	**9.82** (8.78-11.2)	**11.4** (9.79-13.4)	**12.6** (10.5-15.0)	**13.7** (11.1-16.8)	**14.9** (11.4-18.7)	**16.3** (12.0-21.1)	**17.3** (12.4-23.0)

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

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

Please refer to NOAA Atlas 14 document for more information.

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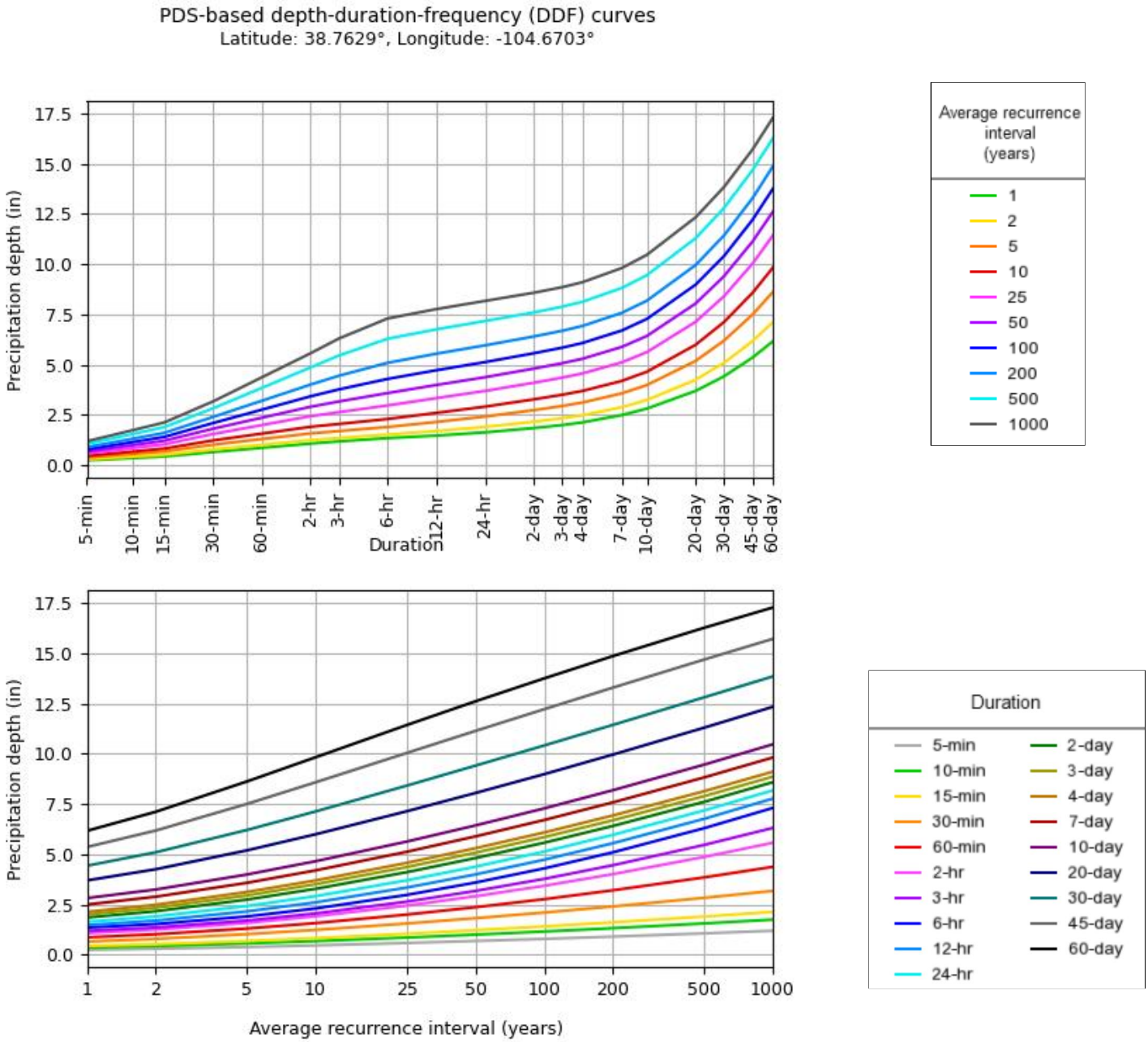
PF graphical



NOAA Atlas 14, Volume 8, Version 2

Created (GMT): Wed Dec 6 19:26:13 2023

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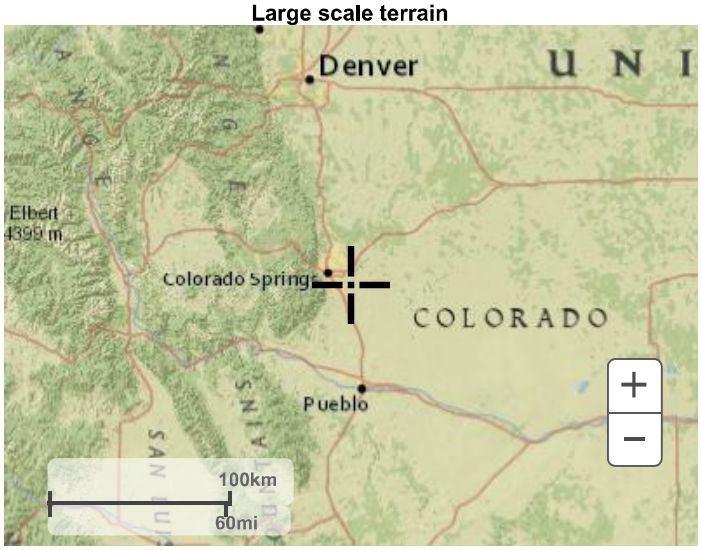
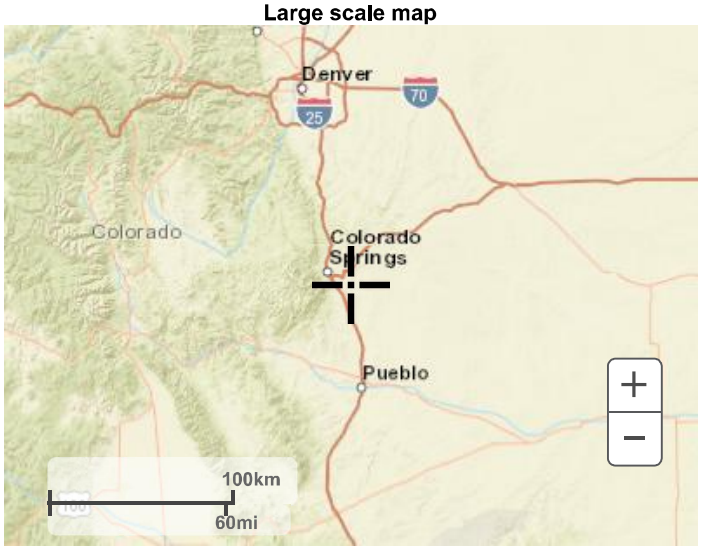
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



Large scale aerial

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

Disclaimer

Kimley»Horn

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

PROJECT NAME: **Aerospace Business Center** DATE: 1/4/2024
PROJECT NUMBER: 195775002
CALCULATED BY: MEL
CHECKED BY: NMB

HYDROLOGIC SOIL GROUP: B

Impervious values and runoff coefficients are taken from the Colorado Springs Drainage Criteria Manual (Vol. 1) - Table 6-6

LAND USE (HSG A/B):	PAVEMENT	ROOF	LANDSCAPE
2-YEAR COEFF.	0.89	0.71	0.02
5-YEAR COEFF.	0.90	0.73	0.08
10-YEAR COEFF.	0.92	0.75	0.15
100-YEAR COEFF.	0.96	0.81	0.35
IMPERVIOUS %	100%	90%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (SF)	ROOF AREA (SF)	LANDSCAPE AREA (SF)	TOTAL AREA (SF)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %	HSG
Basins												
EX-1	EX-1	-	-	363,346	**363,346**	**8.34**	0.04	0.15	0.25	0.50	0%	A
EX-2	EX-2	-	-	457,885	**457,885**	**10.51**	0.04	0.15	0.25	0.50	0%	D
OF-1	OF-1	-	-	11,508	**11,508**	**0.26**	0.04	0.15	0.25	0.50	0%	A
OF-2	OF-2	-	-	927,946	**927,946**	**21.30**	0.04	0.15	0.15	0.50	0%	D
BASIN SUBTOTAL		-	-	**1,760,685**	**1,760,685**	**40.42**						
		0%	**0%**	**100%**	**100%**	**100%**						

Kimley»Horn

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

PROJECT NAME: **Aerospace Business Center**
PROJECT NUMBER: 096636007
CALCULATED BY: **MEL**
CHECKED BY: **NMB**

DATE: 1/4/2024

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.
All Basins																
EX-1	363,346	0.15	300	2.8%	21.4	900	2.3%	7.0	1.1	14.1	35.5	1200	2.4%	0%	40.2	35.5
EX-2	457,885	0.15	300	3.3%	20.3	950	2.7%	7.0	1.2	13.8	34.0	1250	2.8%	0%	39.7	34.0
OF-1	11,508	0.15	100	2.2%	13.4	0	0.0%	7.0	0.0	0.0	13.4	100	2.2%	0%	27.2	13.4
OF-2	927,946	0.15	300	6.0%	16.6	1500	5.4%	7.0	1.6	15.4	32.0	1800	5.5%	0%	40.2	32.0

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

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

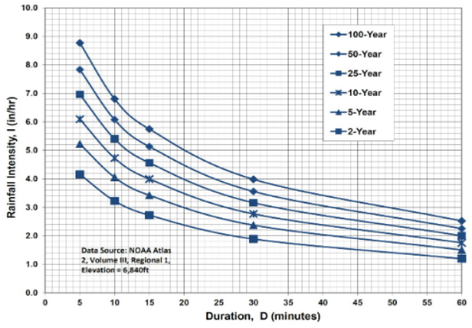
PROJECT NAME: **Aerospace Business Center**
PROJECT NUMBER: 096636007
CALCULATED BY: MEL
CHECKED BY: NMB

DATE: 1/4/2024

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)
All Basins																						
		EX-1	EX-1	8.34	0.15	35.5	1.25	2.23	2.79													
		EX-2	EX-2	10.51	0.15	34.0	1.58	2.29	3.61													
		OF-1	OF-1	0.26	0.15	13.4	0.04	3.69	0.15													
		OF-2	OF-2	21.30	0.15	32.0	3.20	2.39	7.62													

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure

Kimley»Horn

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

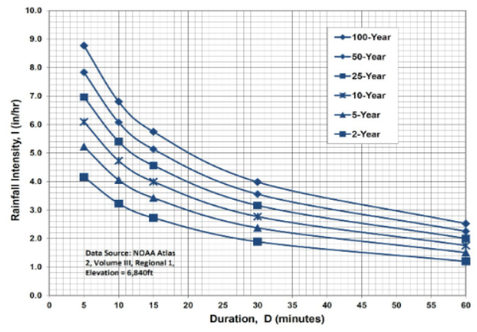
PROJECT NAME: **Aerospace Business Center**
PROJECT NUMBER: 096636007
CALCULATED BY: MEL
CHECKED BY: NMB

DATE: 1/4/2024

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)
All Basins																						
		EX-1	EX-1	8.34	0.50	35.5	4.17	3.74	15.60													
		EX-2	EX-2	10.51	0.50	34.0	5.26	3.85	20.22													
		OF-1	OF-1	0.26	0.50	13.4	0.13	6.20	0.82													
		OF-2	OF-2	21.30	0.50	32.0	10.65	4.00	42.64													

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Note: Values calculated by equations may not precisely duplicate values read from figure

Kimley»Horn

EXISTING CONDITIONS

Aerospace Business Center

DATE: 1/4/2024

PROJECT NUMBER: 096636007
CALCULATED BY: MEL
CHECKED BY: NMB

EXISTING RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
On-site Basins				
EX-1	EX-1	8.34	2.79	15.60
EX-2	EX-2	10.51	3.61	20.22
OF-1	OF-1	0.26	0.15	0.82
OF-2	OF-2	21.30	7.62	42.64
Total		40.42	14.17	79.27

Kimley»Horn

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

PROJECT NAME: **Aerospace Business Center**
OJECT NUMBER: 196775002
ALCULATED BY: SLG
CHECKED BY: NMB

HYDROLOGIC SOIL GROUP: B

Impervious values and runoff coefficients per the Colorado Springs Drainage Criteria Manual (Vol. 1) - Table 6-6

LAND USE (HSG A/B):	PAVEMENT	ROOF	GRAVEL	LANDSCAPE
2-YEAR COEFF.	0.89	0.71	0.57	0.02
5-YEAR COEFF.	0.90	0.73	0.59	0.08
10-YEAR COEFF.	0.92	0.75	0.63	0.15
100-YEAR COEFF.	0.96	0.81	0.70	0.35
IMPERVIOUS %	100%	90%	80%	0%

DESIGN BASIN	DESIGN POINT	PAVEMENT AREA (SF)	ROOF AREA (SF)	GRAVEL AREA (SF)	LANDSCAPE AREA (SF)	TOTAL AREA (SF)	TOTAL AREA (AC)	C(2)	C(5)	C(10)	C(100)	Imp %
P1	P1	13,747	-	-	3,686	**17,433**	**0.40**	0.71	0.74	0.78	0.86	79%
P2	P2	12,340	-	-	-	**12,340**	**0.28**	0.89	0.90	0.92	0.96	100%
P3	P3	30,273	-	-	-	**30,273**	**0.69**	0.89	0.90	0.92	0.96	100%
P4	P4	30,374	-	-	-	**30,374**	**0.70**	0.89	0.90	0.92	0.96	100%
P5	P5	29,728	-	-	-	**29,728**	**0.68**	0.89	0.90	0.92	0.96	100%
P6	P6	17,635	-	-	2,830	**20,465**	**0.47**	0.77	0.79	0.81	0.88	86%
P7	P7	715	-	746	8,612	**10,073**	**0.23**	0.14	0.24	0.33	0.55	13%
P8	P8	2,518	-	0	1,166	**3,684**	**0.08**	0.61	0.64	0.68	0.77	68%
P9	P9	38,344			25,893	**64,237**	**1.47**	0.54	0.57	0.61	0.71	60%
P10	P10	1,323	-		242	**1,565**	**0.04**	0.76	0.77	0.80	0.87	85%
P11	P11	-	-	746	3,994	**4,740**	**0.11**	0.11	0.16	0.23	0.41	13%
P12	P12	2,348	-	6342	23,358	**32,048**	**0.74**	0.19	0.24	0.30	0.46	23%
R1	R1	-	42375	0	-	**42,375**	**0.97**	0.71	0.73	0.75	0.81	90%
R2	R2	-	42375	0	-	**42,375**	**0.97**	0.71	0.73	0.75	0.81	90%
F1	F1	-	-		199,399	**199,399**	**4.58**	0.02	0.08	0.15	0.35	0%
F2	F2	-	-		197,010	**197,010**	**4.52**	0.02	0.08	0.15	0.35	0%
OF1	OF1				10,083	**10,083**	**0.23**	0.02	0.08	0.15	0.35	0%
OF2	OF2				929,372	**929,372**	**21.34**	0.02	0.08	0.15	0.35	0%
OS1	OS1				18,938	**18,938**	**0.43**	0.02	0.08	0.15	0.35	0%
OS2	OS2	6,017			304	**6,321**	**0.15**	0.85	0.86	0.88	0.93	95%
OS3	OS3	7,859			2,458	**10,317**	**0.24**	0.68	0.70	0.74	0.81	76%
OS4	OS4	4,084		437	34,349	**38,871**	**0.89**	0.12	0.17	0.24	0.42	11%
OS5	OS5	-		0	21,811	**21,811**	**0.50**	0.02	0.08	0.15	0.35	0%
BASIN SUBTOTAL		**197,306**	**84,750**	**8,271**	**1,483,506**	**1,773,833**	**40.72**	**0.15**	**0.20**	**0.27**	**0.44**	**16%**
		11%	**5%**	**0%**	**84%**	**100%**	**100%**					
POND SUBTOTAL	**P1-P12, R1-R2, F1-F2, & OF1**	**179,346**	**84,750**	**7,834**	**476,274**	**748,204**	**17.18**	**0.31**	**0.36**	**0.41**	**0.55**	**35%**

Kimley»Horn

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

PROJECT NAME: **Aerospace Business Center**
PROJECT NUMBER: 096636007
CALCULATED BY: **SLG**
CHECKED BY: **NMB**

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.
All Basins																
P1	0.40	0.74	83	8.4%	2.9	43	2.1%	20.0	2.9	0.2	3.2	126	6.3%	79%	13.0	5.0
P2	0.28	0.90	100	9.0%	1.8	30	1.5%	20.0	2.4	0.2	2.0	130	7.3%	100%	9.3	5.0
P3	0.69	0.90	100	9.0%	1.8	66	1.2%	20.0	2.2	0.5	2.3	166	5.9%	100%	9.5	5.0
P4	0.70	0.90	100	9.0%	1.8	66	1.2%	20.0	2.2	0.5	2.3	166	5.9%	100%	9.5	5.0
P5	0.68	0.90	100	9.0%	1.8	60	1.2%	20	2.2	0.5	2.2	160	6.1%	100%	9.5	5.0
P6	0.47	0.79	100	9.0%	2.8	100	1.0%	20	2.0	0.8	3.6	200	5.0%	86%	12.1	5.0
P7	0.23	0.24	50	15.0%	4.5	0	0.0%	7.0	0.0	0.0	4.5	50	15.0%	13%	24.0	5.0
P8	0.08	0.64	100	5.8%	4.7	40	5.8%	20.0	4.8	0.1	4.8	140	5.8%	68%	14.9	5.0
P9	1.47	0.57	100	9.6%	4.6	0	0.0%	20.0	0.0	0.0	4.6	100	9.6%	60%	16.2	5.0
P10	0.04	0.77	68	4.0%	3.1	0	0.0%	20.0	0.0	0.0	3.1	68	4.0%	85%	11.9	5.0
P11	0.11	0.16	55	5.9%	7.1	0	0.0%	20.0	0.0	0.0	7.1	55	5.9%	13%	24.2	7.1
P12	0.74	0.24	30	8.5%	4.2	100	0.5%	20.0	1.4	1.2	5.4	130	2.3%	23%	23.2	5.4
R1	0.97	0.73	0	0.0%	0.0	Minimum time of concentration assumed for roofs.										5.0
R2	0.97	0.73	0	0.0%	0.0	Minimum time of concentration assumed for roofs.										5.0
F1	4.58	0.08	100	1.0%	18.7	100.0	1.0%	20.0	2.0	0.8	19.5	200	1.0%	0%	29.7	19.5
F2	4.52	0.08	100	1.0%	18.7	100	1.0%	20.0	2.0	0.8	19.5	200	1.0%	0%	29.7	19.5
OF1	0.23	0.08	50	2.2%	10.2	0	0.0%	7.0	0.0	0.0	10.2	50	2.2%	0%	26.6	10.2
OF2	21.34	0.08	100	6.0%	10.3	0	0.0%	7.0	0.0	0.0	10.3	100	6.0%	0%	26.8	10.3
OS1	0.43	0.08	20	25.0%	2.9	0	0.0%	7.0	0.0	0.0	2.9	20	25.0%	0%	26.1	5.0
OS2	0.15	0.86	100	6.1%	2.4	44	0.6%	20.0	1.5	0.5	2.9	144	4.4%	95%	10.3	5.0
OS3	0.24	0.70	100	6.6%	3.9	65	0.8%	20.0	1.8	0.6	4.5	165	4.3%	76%	13.7	5.0
OS4	0.89	0.17	75	10.0%	6.8	0	0.0%	7.0	0.0	0.0	6.8	75	10.0%	11%	24.4	6.8
OS5	0.50	0.08	100	10.0%	8.7	0	0.0%	7.0	0.0	0.0	8.7	100	10.0%	0%	26.6	8.7

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

Kimley»Horn

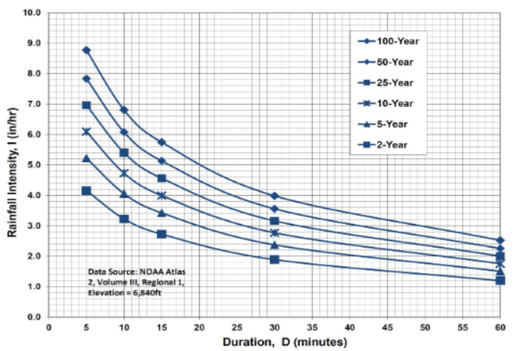
STANDARD FORM SF-3 (PROPOSED CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 5 YEAR EVENT

PROJECT NAME: **Aerospace Business Center**
PROJECT NUMBER: 096636007
CALCULATED BY: SLG
CHECKED BY: NMB

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)
All Basins																						
		P1	P1	0.40	0.74	5.0	0.30	5.17	1.53													
		P2	P2	0.28	0.90	5.0	0.25	5.17	1.32													
		P3	P3	0.69	0.90	5.0	0.63	5.17	3.23													
		P4	P4	0.70	0.90	5.0	0.63	5.17	3.24													
		P5	P5	0.68	0.90	5.0	0.61	5.17	3.17													
		P6	P6	0.47	0.79	5.0	0.37	5.17	1.91													
		P7	P7	0.23	0.24	5.0	0.05	5.17	0.28													
		P8	P8	0.08	0.64	5.0	0.05	5.17	0.28													
		P9	P9	1.47	0.57	5.0	0.84	5.17	4.34													
		P10	P10	0.04	0.77	5.0	0.03	5.17	0.14													
		P11	P11	0.11	0.16	7.1	0.02	4.65	0.08													
		P12	P12	0.74	0.24	5.4	0.18	5.05	0.90													
		R1	R1	0.97	0.73	5.0	0.71	5.17	3.67													
		R2	R2	0.97	0.73	5.0	0.71	5.17	3.67													
		F1	F1	4.58	0.08	19.5	0.37	3.12	1.14													
		F2	F2	4.52	0.08	19.5	0.36	3.12	1.13													
		OF1	OF1	0.23	0.08	10.2	0.02	4.10	0.08													
		OF2	OF2	21.34	0.08	10.3	1.71	4.09	6.97													
		OS1	OS1	0.43	0.08	5.0	0.03	5.17	0.18													
		OS2	OS2	0.15	0.86	5.0	0.12	5.17	0.65													
		OS3	OS3	0.24	0.70	5.0	0.17	5.17	0.86													
		OS4	OS4	0.89	0.17	6.8	0.15	4.70	0.72													
		OS5	OS5	0.50	0.08	8.7	0.04	4.34	0.17													

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

Kimley»Horn

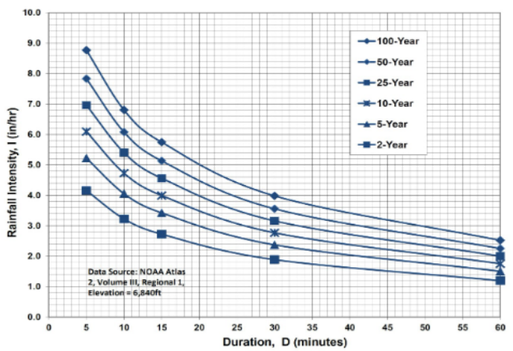
STANDARD FORM SF-3 (PROPOSED CONDITIONS)
STORM DRAINAGE DESIGN - RATIONAL METHOD 100 YEAR EVENT

PROJECT NAME: **Aerospace Business Center**
PROJECT NUMBER: 096636007
CALCULATED BY: SLG
CHECKED BY: NMB

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)
All Basins																						
		P1	P1	0.40	0.86	5.0	0.35	8.68	3.00													
		P2	P2	0.28	0.96	5.0	0.27	8.68	2.36													
		P3	P3	0.69	0.96	5.0	0.67	8.68	5.79													
		P4	P4	0.70	0.96	5.0	0.67	8.68	5.81													
		P5	P5	0.68	0.96	5.0	0.66	8.68	5.69													
		P6	P6	0.47	0.88	5.0	0.41	8.68	3.57													
		P7	P7	0.23	0.55	5.0	0.13	8.68	1.10													
		P8	P8	0.08	0.77	5.0	0.06	8.68	0.56													
		P9	P9	1.47	0.71	5.0	1.05	8.68	9.14													
		P10	P10	0.04	0.87	5.0	0.03	8.68	0.27													
		P11	P11	0.11	0.41	7.1	0.04	7.81	0.34													
		P12	P12	0.74	0.46	5.4	0.34	8.48	2.90													
		R1	R1	0.97	0.81	5.0	0.79	8.68	6.84													
		R2	R2	0.97	0.81	5.0	0.79	8.68	6.84													
		F1	F1	4.58	0.35	19.5	1.60	5.25	8.40													
		F2	F2	4.52	0.35	19.5	1.58	5.25	8.30													
		OF1	OF1	0.23	0.35	10.2	0.08	6.89	0.56													
		OF2	OF2	21.34	0.35	10.3	7.47	6.86	51.23													
		OS1	OS1	0.43	0.35	5.0	0.15	8.68	1.32													
		OS2	OS2	0.15	0.93	5.0	0.14	8.68	1.17													
		OS3	OS3	0.24	0.81	5.0	0.19	8.68	1.67													
		OS4	OS4	0.89	0.42	6.8	0.37	7.89	2.94													
		OS5	OS5	0.50	0.35	8.7	0.18	7.29	1.28													

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

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

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

Kimley»Horn

PROPOSED CONDITIONS

Aerospace Business Center

PROJECT NUMBER: 096636007
CALCULATED BY: SLG
CHECKED BY: NMB

PROPOSED RATIONAL CALCULATIONS SUMMARY

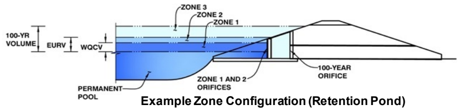
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)		% IMPERV.
			Q5	Q100	
On-site Basins					
P1	P1	0.40	1.53	3.00	79%
P2	P2	0.28	1.32	2.36	100%
P3	P3	0.69	3.23	5.79	100%
P4	P4	0.70	3.24	5.81	100%
P5	P5	0.68	3.17	5.69	100%
P6	P6	0.47	1.91	3.57	86%
P7	P7	0.23	0.28	1.10	13%
P8	P8	0.08	0.28	0.56	68%
P9	P9	1.47	4.34	9.14	60%
P10	P10	0.04	0.14	0.27	85%
P11	P11	0.11	0.08	0.34	13%
P12	P12	0.74	0.90	2.90	23%
R1	R1	0.97	3.67	6.84	90%
R2	R2	0.97	3.67	6.84	90%
F1	F1	4.58	1.14	8.40	0%
F2	F2	4.52	1.13	8.30	0%
OF1	OF1	0.23	0.08	0.56	0%
OF2	OF2	21.34	6.97	51.23	0%
OS1	OS1	0.43	0.18	1.32	0%
OS2	OS2	0.15	0.65	1.17	95%
OS3	OS3	0.24	0.86	1.67	76%
OS4	OS4	0.89	0.72	2.94	11%
OS5	OS5	0.50	0.17	1.28	0%
Total		40.72	39.69	131.08	16%
Pond Total		17.18	30.13	71.47	35%

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Aerospace Business Center

Basin ID: Water Quality Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	18.36	acres		
Watershed Length =	1,190	ft		
Watershed Length to Centroid =	555	ft		
Watershed Slope =	0.060	ft/ft		
Watershed Imperviousness =	80.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Denver - Capitol Building			

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) =	0.502	acre-feet	0.502	acre-feet
Excess Urban Runoff Volume (EURV) =	1.631	acre-feet	1.631	acre-feet
2-yr Runoff Volume (P1 = 1.02 in.) =	1.155	acre-feet	1.02	inches
5-yr Runoff Volume (P1 = 1.3 in.) =	1.549	acre-feet	1.30	inches
10-yr Runoff Volume (P1 = 1.57 in.) =	1.942	acre-feet	1.57	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.632	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.36 in.) =	3.187	acre-feet	2.36	inches
100-yr Runoff Volume (P1 = 2.76 in.) =	3.831	acre-feet	2.76	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	5.536	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	1.107	acre-feet		
Approximate 5-yr Detention Volume =	1.475	acre-feet		
Approximate 10-yr Detention Volume =	1.896	acre-feet		
Approximate 25-yr Detention Volume =	2.265	acre-feet		
Approximate 50-yr Detention Volume =	2.468	acre-feet		
Approximate 100-yr Detention Volume =	2.715	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.502	acre-feet	
Zone 2 Volume (EURV - Zone 1) =	1.129	acre-feet	**Total detention volume is less than 100-year volume.**
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	1.631	acre-feet	
Initial Surcharge Volume (ISV) =	user	ft^3	
Initial Surcharge Depth (ISD) =	user	ft	
Total Available Detention Depth (H_{total}) =	user	ft	
Depth of Trickle Channel (H_{TC}) =	user	ft	
Slope of Trickle Channel (S_{TC}) =	user	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	user	H:V	
Basin Length-to-Width Ratio ($R_{L/W}$) =	user		
Initial Surcharge Area (A_{ISV}) =	user	ft^2	
Surcharge Volume Length (L_{ISV}) =	user	ft	
Surcharge Volume Width (W_{ISV}) =	user	ft	
Depth of Basin Floor (H_{FLOOR}) =	user	ft	
Length of Basin Floor (L_{FLOOR}) =	user	ft	
Width of Basin Floor (W_{FLOOR}) =	user	ft	
Area of Basin Floor (A_{FLOOR}) =	user	ft^2	
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3	
Depth of Main Basin (H_{MAIN}) =	user	ft	
Length of Main Basin (L_{MAIN}) =	user	ft	
Width of Main Basin (W_{MAIN}) =	user	ft	
Area of Main Basin (A_{MAIN}) =	user	ft^2	
Volume of Main Basin (V_{MAIN}) =	user	ft^3	
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet	

Depth Increment = 0.10 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	--	--	--	16	0.000		
	--	0.20	--	--	--	147	0.003	16	0.000
	--	0.40	--	--	--	419	0.010	73	0.002
	--	0.60	--	--	--	845	0.019	199	0.005
	--	0.80	--	--	--	1,441	0.033	428	0.010
	--	1.00	--	--	--	2,225	0.051	794	0.018
	--	1.20	--	--	--	3,224	0.074	1,339	0.031
	--	1.40	--	--	--	4,469	0.103	2,108	0.048
	--	1.60	--	--	--	6,003	0.138	3,156	0.072
	--	1.80	--	--	--	7,892	0.181	4,545	0.104
	--	2.00	--	--	--	10,237	0.235	6,358	0.146
	--	2.20	--	--	--	13,226	0.304	8,704	0.200
	--	2.40	--	--	--	17,353	0.398	11,762	0.270
	--	2.60	--	--	--	21,153	0.486	15,613	0.358
	--	2.80	--	--	--	22,041	0.506	19,932	0.458
	--	3.00	--	--	--	22,933	0.526	24,429	0.561
	--	3.20	--	--	--	23,830	0.547	29,106	0.668
	--	3.40	--	--	--	24,730	0.568	33,962	0.780
	--	3.60	--	--	--	25,635	0.589	38,998	0.895
	--	3.80	--	--	--	26,544	0.609	44,216	1.015
	--	4.00	--	--	--	27,457	0.630	49,616	1.139
	--	4.20	--	--	--	28,375	0.651	55,200	1.267
	--	4.40	--	--	--	29,296	0.673	60,967	1.400
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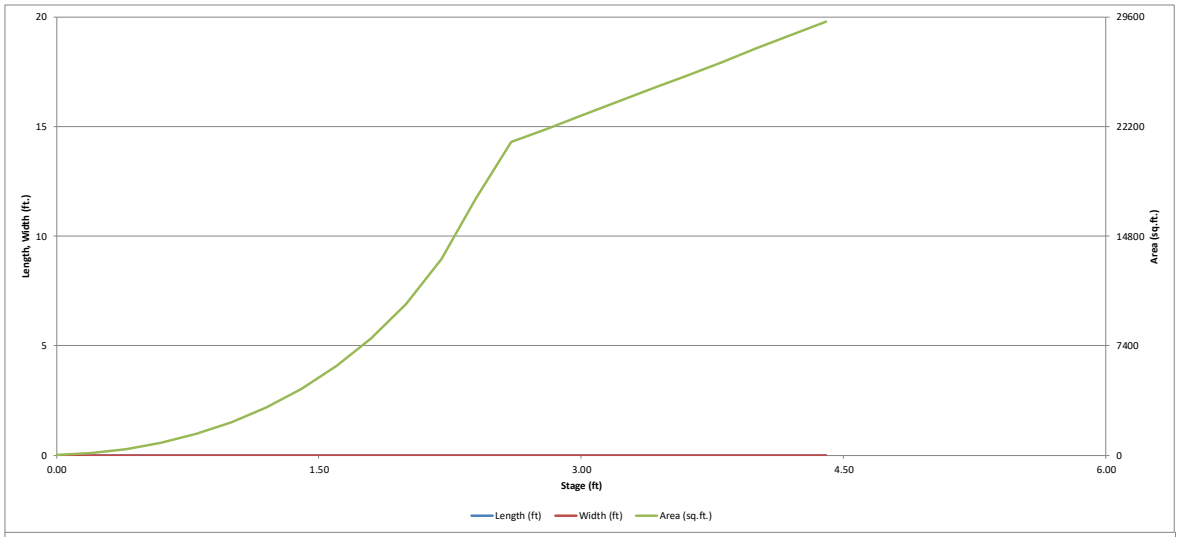
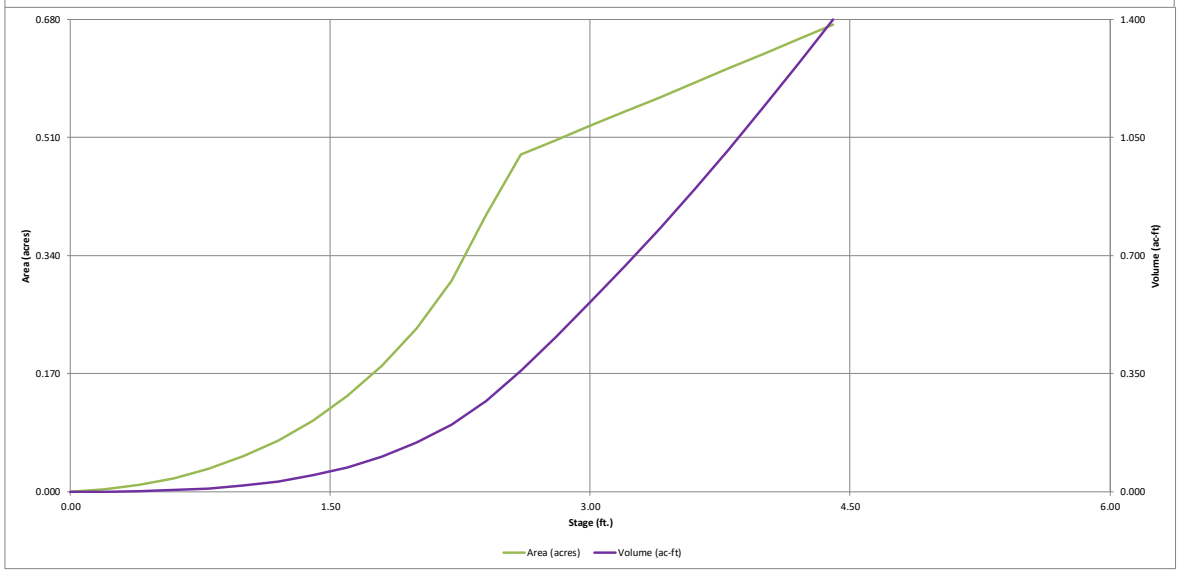
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



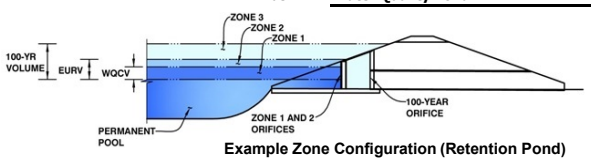


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Aerospace Business Center**

Basin ID: **Water Quality Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.89	0.502	Orifice Plate
Zone 2 (EURV)	#VALUE!	1.129	Orifice Plate
Zone 3			
Total (all zones)		1.631	

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

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

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

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.97	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.45	3.00					
Orifice Area (sq. inches)	1.41	3.14	3.14					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		Calculated Parameters for Vertical Orifice	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A		ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A		ft^2
Depth at top of Zone using Vertical Orifice =	N/A		ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A		feet
Vertical Orifice Diameter =	N/A		inches				

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

	Not Selected	Not Selected		Calculated Parameters for Overflow Weir	Not Selected	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.95		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.95		feet
Overflow Weir Front Edge Length =	6.84		feet	Overflow Weir Slope Length =	2.92		feet
Overflow Weir Grate Slope =	0.00		H:V	Grate Open Area / 100-yr Orifice Area =	4.42		
Horiz. Length of Weir Sides =	2.92		feet	Overflow Grate Open Area w/o Debris =	13.90		ft^2
Overflow Grate Type =	Type C Grate			Overflow Grate Open Area w/ Debris =	6.95		ft^2
Debris Clogging % =	50%		%				

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

	Not Selected	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	Not Selected	Not Selected	
Depth to Invert of Outlet Pipe =	2.50		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14		ft^2
Circular Orifice Diameter =	24.00		inches	Outlet Orifice Centroid =	1.00		feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	4.40	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.92	feet
Spillway Crest Length =	28.00	feet	Stage at Top of Freeboard =	6.32	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.67	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.40	acre-ft

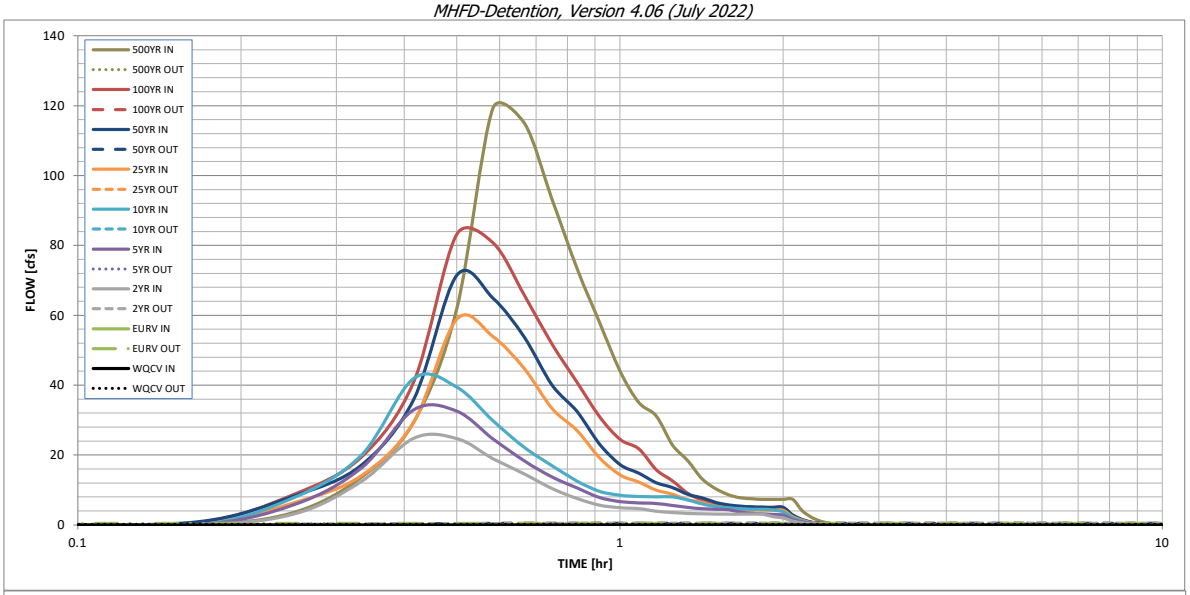
Routed Hydrograph Results

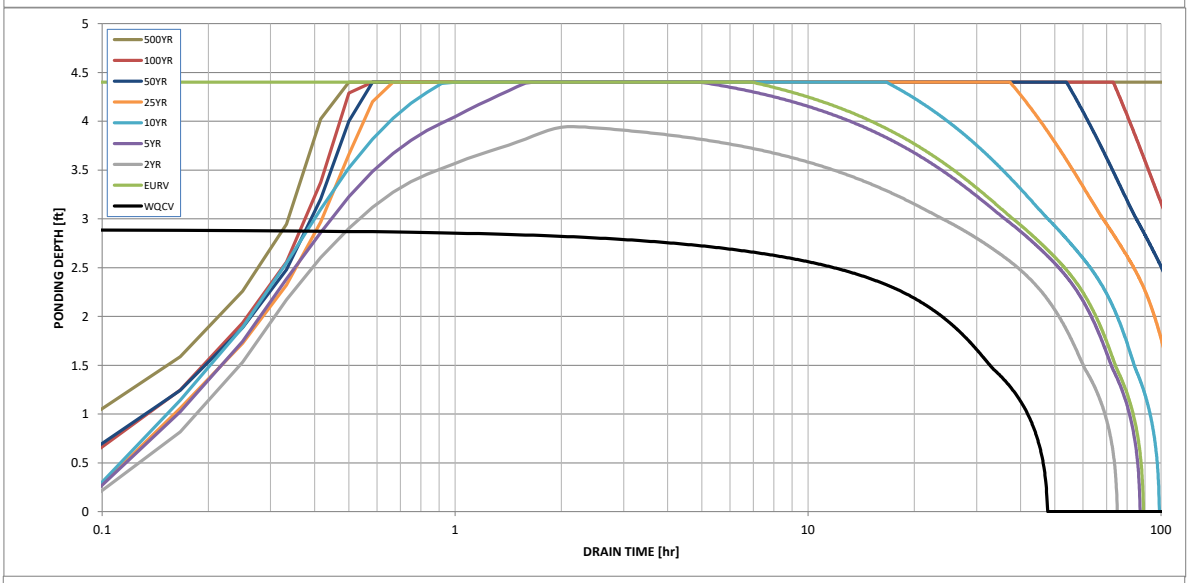
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

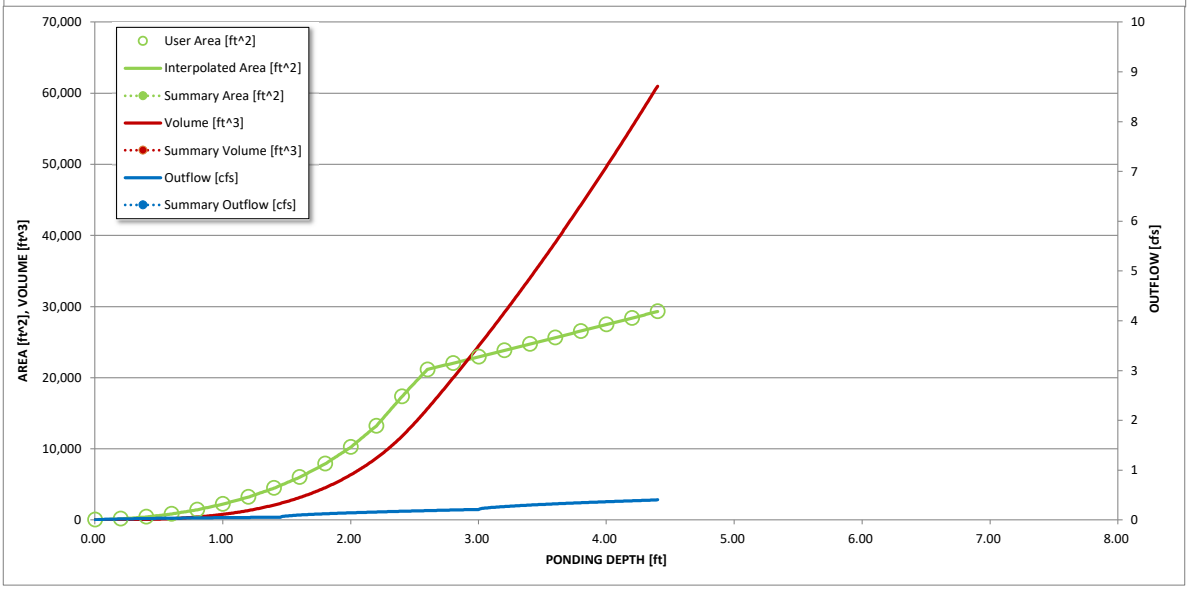
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.02	1.30	1.57	2.00	2.36	2.76	3.85
CUHP Runoff Volume (acre-ft) =	0.502	1.631	1.155	1.549	1.942	2.632	3.187	3.831	5.536
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.155	1.549	1.942	2.632	3.187	3.831	5.536
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.3	4.0	8.0	19.7	26.8	35.4	57.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.22	0.43	1.07	1.46	1.93	3.12
Peak Inflow Q (cfs) =	N/A	N/A	24.8	33.0	41.9	58.9	71.4	83.1	119.2
Peak Outflow Q (cfs) =	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.1	0.0	0.0	0.0	0.0
Structure Controlling Flow =	Plate	N/A	Plate	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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) =	43	76	65	75	84	102	117	>120	>120
Time to Drain 99% of Inflow Volume (hours) =	**46**	84	71	82	93	112	>120	>120	>120
Maximum Ponding Depth (ft) =	2.89	4.40	3.94	4.40	4.40	4.40	4.40	4.40	4.40
Area at Maximum Ponding Depth (acres) =	0.52	0.67	0.62	0.67	0.67	0.67	0.67	0.67	0.67
Maximum Volume Stored (acre-ft) =	0.504	1.400	1.101	1.400	1.400	1.400	1.400	1.400	1.400

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.87	0.68	3.55
	0:15:00	0.00	0.00	3.06	5.71	7.75	6.30	8.24	8.72	13.64
	0:20:00	0.00	0.00	12.40	16.25	19.93	14.05	17.06	19.44	29.44
	0:25:00	0.00	0.00	24.84	32.99	41.94	29.47	35.96	41.00	61.77
	0:30:00	0.00	0.00	24.74	32.55	39.44	58.86	71.40	83.14	119.19
	0:35:00	0.00	0.00	18.98	24.61	29.81	53.92	64.94	80.76	114.94
	0:40:00	0.00	0.00	14.56	18.28	22.14	44.67	53.62	65.63	93.14
	0:45:00	0.00	0.00	10.38	13.68	16.94	33.33	40.02	51.68	73.42
	0:50:00	0.00	0.00	7.58	10.58	12.57	27.03	32.46	40.85	58.02
	0:55:00	0.00	0.00	5.69	7.84	9.61	19.25	23.16	31.01	44.10
	1:00:00	0.00	0.00	4.93	6.70	8.50	14.36	17.33	24.50	35.02
	1:05:00	0.00	0.00	4.68	6.31	8.17	12.22	14.80	21.75	31.18
	1:10:00	0.00	0.00	3.92	6.16	8.04	9.95	12.09	15.83	22.91
	1:15:00	0.00	0.00	3.54	5.60	8.00	8.79	10.70	12.62	18.43
	1:20:00	0.00	0.00	3.31	5.00	7.17	7.21	8.75	9.06	13.21
	1:25:00	0.00	0.00	3.18	4.67	5.99	6.44	7.79	7.16	10.44
	1:30:00	0.00	0.00	3.09	4.48	5.29	5.37	6.47	5.96	8.68
	1:35:00	0.00	0.00	3.05	4.36	4.89	4.78	5.75	5.36	7.79
	1:40:00	0.00	0.00	3.05	3.70	4.65	4.46	5.36	5.14	7.46
	1:45:00	0.00	0.00	3.05	3.35	4.51	4.30	5.16	5.04	7.31
	1:50:00	0.00	0.00	3.05	3.14	4.47	4.23	5.07	5.04	7.31
	1:55:00	0.00	0.00	2.39	3.03	4.26	4.19	5.03	5.04	7.31
	2:00:00	0.00	0.00	2.01	2.78	3.73	4.19	5.03	5.04	7.31
	2:05:00	0.00	0.00	1.11	1.55	2.09	2.36	2.82	2.83	4.10
	2:10:00	0.00	0.00	0.61	0.86	1.15	1.32	1.58	1.58	2.29
	2:15:00	0.00	0.00	0.29	0.44	0.58	0.68	0.81	0.82	1.18
	2:20:00	0.00	0.00	0.12	0.21	0.27	0.33	0.40	0.40	0.58
	2:25:00	0.00	0.00	0.04	0.07	0.08	0.11	0.13	0.13	0.18
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) — Sheet 1 of 1

Designer: SHEET 1
Company:
Date: January 13, 2024
Project: Aerospace Business Center - Phase 1
Location: Total Disturbed Area Calculation to meet Step 1

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth = 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	SPA	DCIA	UIA:RPA	UIA:RPA	UIA:RPA							
Area ID	4	5	1	2	3							
Downstream Design Point ID	Site	Site	Site	Site	Site							
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB							
DCIA (ft^2)	--	122,059	--	--	--							
UIA (ft^2)	--	--	42,375	42,375	39,475							
RPA (ft^2)	--	--	3,911	8,502	22,699							
SPA (ft^2)	433,668	--	--	--	--							
HSG A (%)	0%	--	0%	0%	0%							
HSG B (%)	81%	--	81%	81%	81%							
HSG C/D (%)	19%	--	19%	19%	19%							
Average Slope of RPA (ft/ft)	--	--	0.080	0.150	0.250							
UIA:RPA Interface Width (ft)	--	--	191.00	191.00	700.00							

CALCULATED RUNOFF RESULTS

Area ID	4	5	1	2	3							
UIA:RPA Area (ft^2)	--	--	46,286	50,877	62,173							
L / W Ratio	--	--	1.27	1.39	0.13							
UIA / Area	--	--	0.9155	0.8329	0.6349							
Runoff (in)	0.00	0.50	0.36	0.23	0.02							
Runoff (ft^3)	0	5086	1375	989	82							
Runoff Reduction (ft^3)	21683	0	390	777	1563							

CALCULATED WQCV RESULTS

Area ID	4	5	1	2	3							
WQCV (ft^3)	0	5086	1766	1766	1645							
WQCV Reduction (ft^3)	0	0	390	777	1563							
WQCV Reduction (%)	0%	0%	22%	44%	95%							
Untreated WQCV (ft^3)	0	5086	1375	989	82							

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	Site											
DCIA (ft^2)	122,059											
UIA (ft^2)	124,225											
RPA (ft^2)	35,112											
SPA (ft^2)	433,668											
Total Area (ft^2)	715,063											
Total Impervious Area (ft^2)	246,284											
WQCV (ft^3)	10,262											
WQCV Reduction (ft^3)	2,729											
WQCV Reduction (%)	27%											
Untreated WQCV (ft^3)	7,532											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	715,063
Total Impervious Area (ft^2)	246,284
WQCV (ft^3)	10,262
WQCV Reduction (ft^3)	2,729
WQCV Reduction (%)	27%
Untreated WQCV (ft^3)	7,532

16.42-ACRES

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) — Sheet 1 of 1

Designer: SHEET 2
Company:
Date: January 13, 2024
Project: Aerospace Business Center - Phase 1
Location: Provided to show compliance with Step 2

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth = 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	SPA	SPA	SPA									
Area ID	6 (OS-1)	7 (OS-4)	8 (OS-5)									
Downstream Design Point ID	Offsite	Offsite	Offsite									
Downstream BMP Type	None	None	None									
DCIA (ft^2)	--	--	--									
UIA (ft^2)	--	--	--									
RPA (ft^2)	--	--	--									
SPA (ft^2)	18,938	38,871	21,811									
HSG A (%)	0%	0%	0%									
HSG B (%)	81%	81%	81%									
HSG C/D (%)	19%	19%	19%									
Average Slope of RPA (ft/ft)	--	--	--									
UIA:RPA Interface Width (ft)	--	--	--									

CALCULATED RUNOFF RESULTS

Area ID	6 (OS-1)	7 (OS-4)	8 (OS-5)									
UIA:RPA Area (ft^2)	--	--	--									
L / W Ratio	--	--	--									
UIA / Area	--	--	--									
Runoff (in)	0.00	0.00	0.00									
Runoff (ft^3)	0	0	0									
Runoff Reduction (ft^3)	947	1944	1091									

CALCULATED WQCV RESULTS

Area ID	6 (OS-1)	7 (OS-4)	8 (OS-5)									
WQCV (ft^3)	0	0	0									
WQCV Reduction (ft^3)	0	0	0									
WQCV Reduction (%)	0%	0%	0%									
Untreated WQCV (ft^3)	0	0	0									

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	Offsite											
DCIA (ft^2)	0											
UIA (ft^2)	0											
RPA (ft^2)	0											
SPA (ft^2)	79,620											
Total Area (ft^2)	79,620											
Total Impervious Area (ft^2)	0											
WQCV (ft^3)	0											
WQCV Reduction (ft^3)	0											
WQCV Reduction (%)	0%											
Untreated WQCV (ft^3)	0											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	79,620
Total Impervious Area (ft^2)	0
WQCV (ft^3)	0
WQCV Reduction (ft^3)	0
WQCV Reduction (%)	0%
Untreated WQCV (ft^3)	0

Step 2 requirements are met since no WQCV volume is developed within this entirely pervious sub-basin.

APPENDIX D – HYDRAULIC CALCULATIONS

MHFD-Inlet, Version 5.03 (August 2023)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	DOUBLE CDOT TYPE 13	CDOT TYPE C AREA INLET	15 TYPE R (SUMP)	5' TYPE R (ON-GRADE)
Site Type (Urban or Rural)				
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump		
Inlet Type	CDOT/Denver 13 Valley Grate	CDOT Type C Grate		

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.5	1.5	5.9	0.3
Major Q_{Known} (cfs)	5.8	8.5	11.5	0.6

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

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

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type				

Watershed Profile

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

Minor Storm Rainfall Input

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

Major Storm Rainfall Input

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

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.5**	**1.5**	**5.9**	**0.3**
Major Total Design Peak Flow, Q (cfs)	**5.8**	**8.5**	**11.5**	**0.6**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A		
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A		

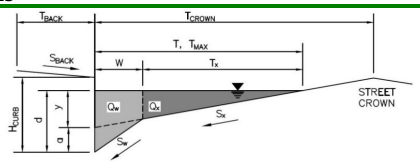
MHFD-Inlet, Version 5.03 (August 2023)

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

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

Project:

Inlet ID: **DOUBLE CDOT TYPE 13**



Gutter Geometry:

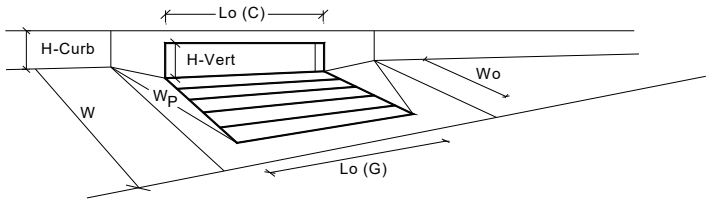
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	14.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	40.0	ft
Gutter Width	W =	4.00	ft
Street Transverse Slope	S_X =	0.032	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} =	15.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.0	7.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.0	7.0	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.39	0.64	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.47	0.82	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**1.6**	**5.8**	**cfs**
WARNING: Inlet Capacity < Q Peak for Minor and Major Storms	$Q_{PEAK\ REQUIRED}$ =	3.5	5.8	cfs

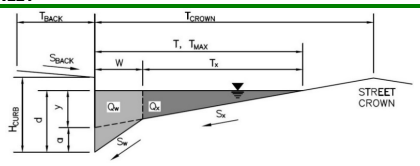
MHFD-Inlet, Version 5.03 (August 2023)

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

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

Project:

Inlet ID: **CDOT TYPE C AREA INLET**



Gutter Geometry:

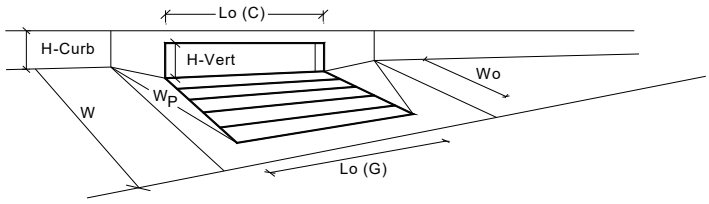
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	24.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	4.00	ft
Street Transverse Slope	S_X =	0.083	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} =	0.020	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	20.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	12.0	24.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type C Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	0.00	0.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	10.0	19.9	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	2.92	2.92	feet
Width of a Unit Grate	W_o =	2.92	2.92	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.70	0.70	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	2.41	2.41	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.67	0.67	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.71	1.54	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.3**	**16.9**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	1.5	8.5	cfs

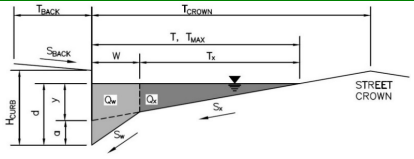
MHFD-Inlet, Version 5.03 (August 2023)

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

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

Project:

Inlet ID: 15 TYPE R (SUMP)



Gutter Geometry:

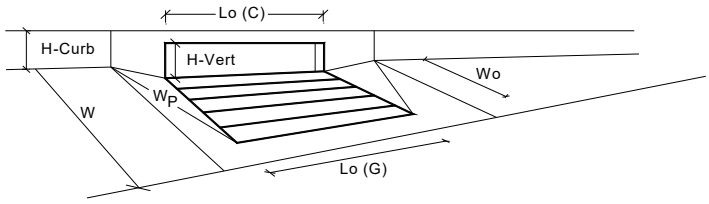
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.010	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.015	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)		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 =	4	4	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.2	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Open Area Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.27	0.33	ft
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.74	0.79	
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.5**	**12.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms (>Q Peak)	$Q_{PEAK\ REQUIRED}$ =	5.9	11.5	cfs

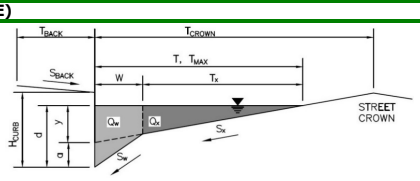
MHFD-Inlet, Version 5.03 (August 2023)

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

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

Project:

Inlet ID: 5' TYPE R (ON-GRADE)



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	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 =	0.060	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} =	5.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	2.0	4.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

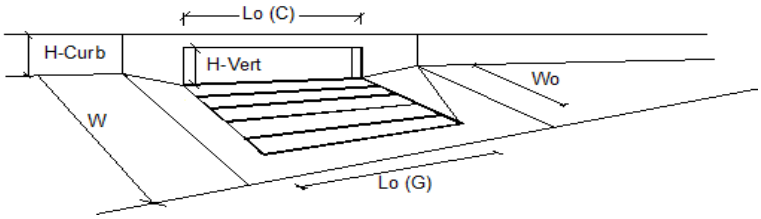
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**0.9**	**3.4**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



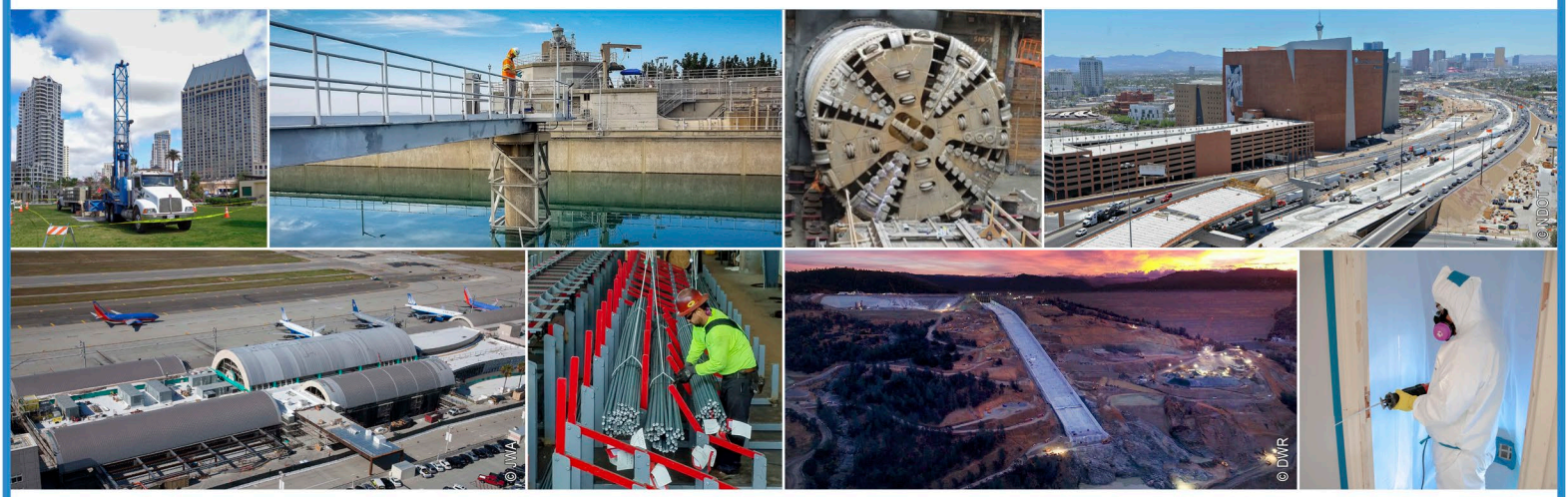
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f (G) =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f (C) =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**0.3**	**0.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.0**	**cfs**
Capture Percentage = Q_a/Q_o	**C% =**	**100**	**100**	**%**

APPENDIX E – GEOTECHNICAL / GEOHAZARD REPORT

Geotechnical Evaluation
Proposed Industrial Development
Bradley Road & Foreign Trade Zone Boulevard
Colorado Springs, Colorado

AZ Opportunity Fund, LLC
c/o ARCO/Murray

December 1, 2023 | Project No. 502835001



Geotechnical | Environmental | Construction Inspection & Testing | Forensic Engineering & Expert Witness

Geophysics | Engineering Geology | Laboratory Testing | Industrial Hygiene | Occupational Safety | Air Quality | GIS

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

35+ YEARS

Geotechnical Evaluation
Proposed Industrial Development
Bradley Road & Foreign Trade Zone Boulevard
Colorado Springs, Colorado

Mr. Brady Welsh
AZ Opportunity Fund, LLC
c/o ARCO/Murray

December 1, 2023 | Project No. 502835001

Nathaniel Boehler, EI
Senior Staff Engineer

Brian F. Gisi, PE
Principal Engineer

NJB/BFG/mht

Distribution: (1) Addressee (via e-mail)
(2) Charlie McLean (ARCO/Murray)

1 INTRODUCTION

In accordance with your authorization and our proposal dated October 10, 2023, we have performed a geotechnical evaluation for the proposed Industrial Development located northeast of the intersection of Bradley Road and Foreign Trade Zone Boulevard in Colorado Springs, Colorado. The approximate location of the site is depicted on Figure 1.

The purpose of our study was to evaluate the subsurface conditions and to provide design and construction recommendations regarding geotechnical aspects of the proposed project. This report presents the findings of our subsurface exploration program, results of our laboratory testing, conclusions regarding the subsurface conditions at the site, and geotechnical recommendations for design and construction of this project.

2 SCOPE OF SERVICES

The scope of our services for the project generally included:

- Review of readily available background information including aerial photographs, published geologic maps, and in-house geotechnical data pertaining to the project site and vicinity.
- Perform site reconnaissance to observe and document the site conditions, establish the boring locations in the field, and arrange for the mark-out of publicly owned underground utilities through Utility Notification Center of Colorado.
- Drilling, logging, and sampling of 19 small-diameter exploratory borings within the project site. Borings B-1 through B-7 were advanced within the footprints of the proposed Phase 1 industrial buildings to depths ranging between approximately 10 and 25 feet below the ground surface (bgs). Borings B-8 through B-19 were advanced within the proposed Phase 2 through Phase 4 improvements to depths ranging from approximately 14.8 and 25 feet bgs. The boring logs are presented in Appendix A. Approximate boring locations are presented on Figure 2.
- Performance of laboratory tests on selected samples obtained from the borings to evaluate engineering properties including in-situ moisture content and dry density, Atterberg limits, percent fines passing the No. 200 sieve and gradation, swell/consolidation potential, and soil corrosivity characteristics (including pH, resistivity, water soluble sulfates and chlorides). The results of the in-situ moisture content and dry density laboratory testing are presented on the boring logs and the remainder of the laboratory testing results are presented in Appendix B.
- Compilation and analysis of the data obtained.
- Preparation of this report presenting our findings, conclusions, and geotechnical engineering recommendations regarding the design and construction of the project.

two major drainage basins. Much of the alluvial sand deposits are sourced from the Dawson Formation within the upland regions to the east. Windblown deposits, which tend to blanket the alluvium, resulted from transportation of fine- to coarse-grained sand, silt, and clay particles from the alluvial deposits within valley floors (Madole and Thorson, 2002). Nearly all the surficial deposits in the map area are poorly sorted to extremely poorly sorted (Madole and Thorson, 2002).

Pierre Shale Formation bedrock is mapped underlying the project area. The Pierre Shale Formation is Upper Cretaceous in age and is composed mostly of gray to dark gray shale that weathers to brown and olive green clay (Madole and Thorson, 2002). The formation was deposited primarily as clay within a marine environment and total thickness within the quadrangle is approximately 4,500 feet. Presence of smectitic claystone and bentonite beds causes this formation to exhibit up to high shrink-swell problems.

6.2 Subsurface Conditions

Our understanding of the subsurface conditions at the project site is based on our field exploration, laboratory testing, and our experience with the general geology of the area. The following sections provide a generalized description of the subsurface materials encountered. More detailed descriptions are presented on the boring logs in Appendix A.

6.2.1 Fill

Though not encountered at the time of drilling, fill is anticipated to be present within the gas utility easement which bisects the west section of the project site.

6.2.2 Overburden Deposits

Overburden deposits consisting of eolian deposits and alluvium was encountered at the ground surface in each boring. Overburden deposits extended to borings' termination depths of approximately 10 to 25 feet bgs in Borings B-1, B-3 through B-7, B-11, B-13 through B-15, B-17, and B-18. Where bedrock was encountered in the remaining borings, overburden deposits extended to depths of approximately 13 to 24 feet bgs. The overburden deposits encountered generally consisted of various shades of brown and orange, dry to wet, firm to very stiff, lean to fat to silty clay with various amounts of sand, and very loose to medium dense, clayey to silty sand with varying amounts gravel.

Based on the results of the laboratory testing, selected samples had in-place moisture contents of approximately 2.5 and 26.9 percent and dry densities of approximately 84.3 and 115.3 pounds per cubic foot (pcf).

6.2.3 Pierre Shale Formation Bedrock

Bedrock, mapped as the Pierre Shale Formation (Madole and Thorson, 2002) was encountered below the overburden deposits in Borings B-2, B-8 through B-10, B-12, B-16, and B-18 at depths ranging from 13 to 24 feet bgs. The bedrock encountered generally consisted of various shades of brown and gray, dry to moist, moderately soft to hard, shale.

Based on the results of the laboratory testing, selected samples had in-place moisture contents of approximately 9.6 and 15.3 percent and dry densities of approximately 105.4 and 123.3 pcf.

6.3 Groundwater

Groundwater was not encountered during drilling operations in the borings. Groundwater levels can fluctuate due to seasonal variations in precipitation, irrigation, groundwater withdrawal or injection, and other factors. The possibility of groundwater level fluctuations and perched groundwater should be considered when developing the design and construction plans for the project. Based on our knowledge of the area, groundwater is not considered a constraint to construction of this project.

7 GEOLOGIC HAZARDS

The following sections describe regional geologic hazards including faulting and seismicity, expansive soils, and collapsible soils.

7.1 Faulting and Seismic Design Considerations

Historically, several minor earthquakes have been recorded along the Front Range near Colorado Springs. Based on our review of readily available published geological maps and literature there are no known active faults underlying or adjacent to the subject site. The closest Quaternary faults to the site are the Rampart Range Fault and the Ute Pass Fault Zone.

The Ute Pass Fault Zone lies approximately 9.5 miles west of the site and is comprised by a series of five northwest trending faults (USGS, 2018). These faults are considered to be middle to late Quaternary in age and have not shown displacement in Holocene time, as Pleistocene deposits overlie the fault (approximately 75 to 125 thousand years before the present [Unruh and others, 1994]). Therefore, the probability of damage at the site from seismically induced ground surface rupture from this fault is considered to be low.

The Rampart Range Fault lies approximately 13 miles northwest of the site and trends north-south along the eastern margin of the Front Range (USGS, 2018). The fault is considered to be middle to late Quaternary in age and has not shown displacement in Holocene time, as a result of trenching

investigations along the fault completed by Dickson in 1986. Therefore, the probability of damage at the site from seismically induced ground surface rupture from this fault is considered to be low.

Design of the proposed improvements should be performed in accordance with the requirements of the governing jurisdictions and applicable building codes. Table 1 presents the seismic design parameters for the site in accordance with the 2018 International Building Code guidelines and adjusted maximum considered earthquake spectral response acceleration parameters evaluated using a web-based ground motion calculator (OSHPD, 2023).

Table 1 – 2018 International Building Code Seismic Design Criteria

Site Coefficients and Spectral Response Acceleration Parameters	Values
Class	D
Coefficient, F_a	1.6
Coefficient, F_v	2.4
Mapped Spectral Response Acceleration at 0.2-second Period, S_s	0.186 g
Mapped Spectral Response Acceleration at 1.0-second Period, S_1	0.056 g
Spectral Response Acceleration at 0.2-second Period Adjusted for Site Class, S_{MS}	0.298 g
Spectral Response Acceleration at 1.0-second Period Adjusted for Site Class, S_{M1}	0.135 g
Design Spectral Response Acceleration at 0.2-second Period, S_{DS}	0.199 g
Design Spectral Response Acceleration at 1.0-second Period, S_{D1}	0.090 g

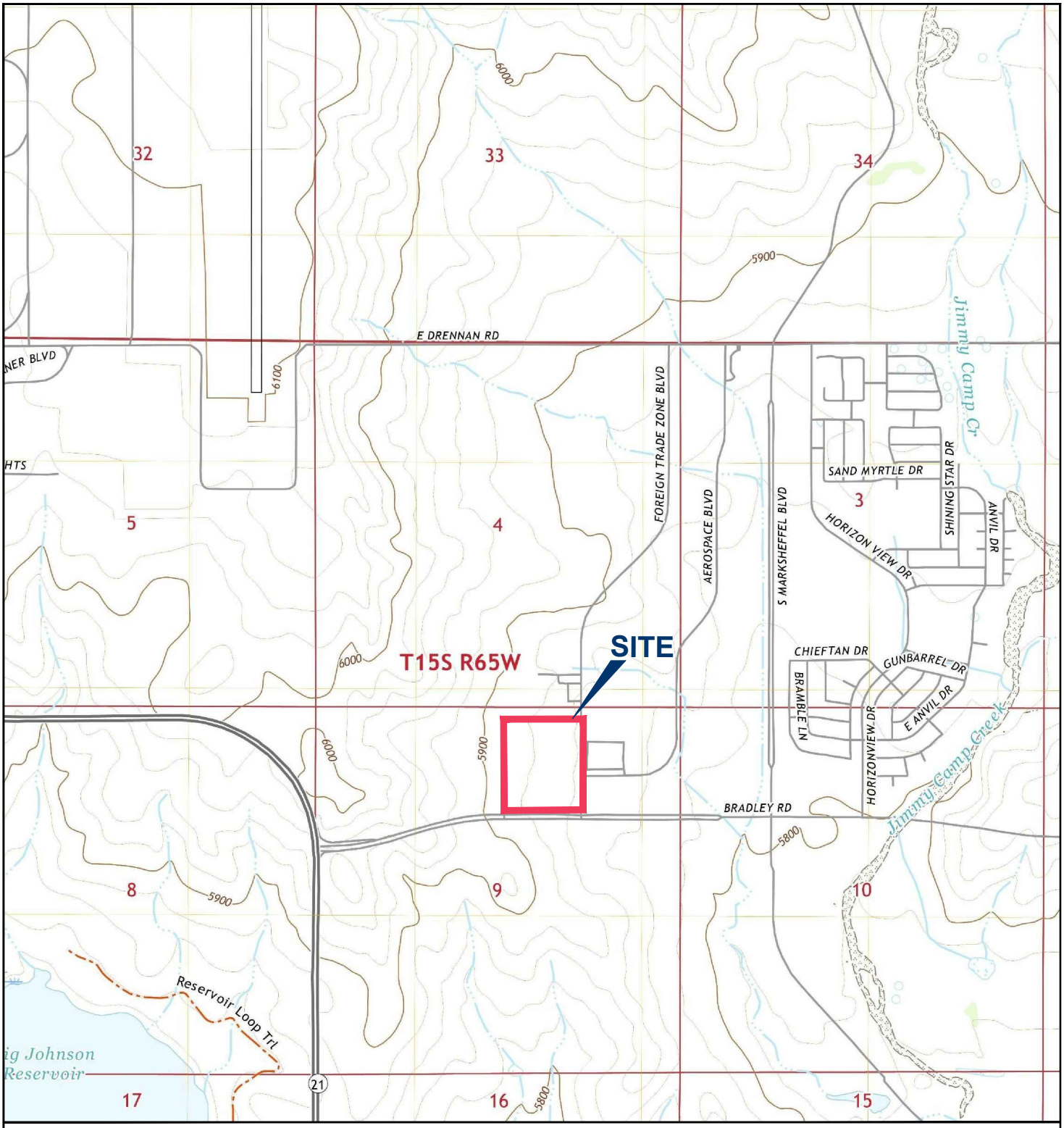
7.2 Expansive Soils

One of the more significant geologic hazards in the Front Range area is the presence of swelling clays in bedrock or surficial deposits. Wetting and drying of bedrock or surficial deposits containing swelling clays can result in expansion and collapse of those units, which can cause major damage to structures. A review of a Colorado Geological Survey map delineating areas based on their relative potential for swelling in the Colorado Springs area by Hart (1973-1974) indicates the soil and bedrock materials in the site vicinity can exhibit very high swell potential.

In order to evaluate swell potential of the subsurface soils, relatively undisturbed samples were selected for one-dimensional swell/consolidation tests at approximate representative field conditions in general accordance with the American Society for Testing Materials (ASTM) D4546. Laboratory test results are presented in Appendix B.

Selected samples were tested for swell percent against a surcharge pressure of 200 pounds per square-foot (psf) in order to evaluate swell risk to proposed pavement areas. Based on the results of our laboratory testing, the selected samples tested exhibited swell potentials up to 5.5 percent.

FIGURES



REFERENCE: USGS, 2022.

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

N

FEET

0 2,000 4,000

502835001_SL.dwg 11/23 BSM

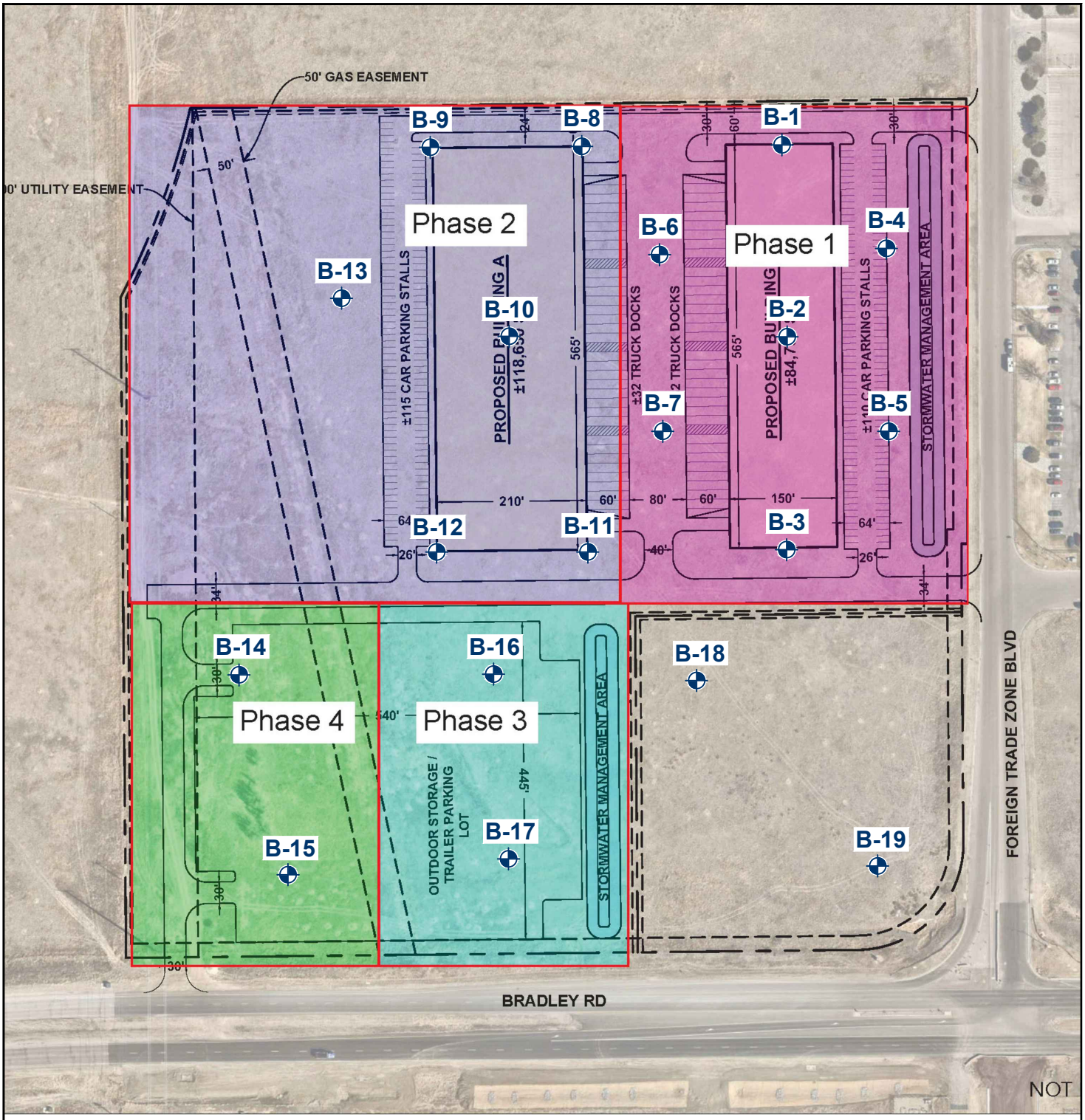
FIGURE 1

SITE LOCATION

PROPOSED INDUSTRIAL DEVELOPMENT
BRADLEY ROAD AND FOREIGN TRADE ZONE BOULEVARD
COLORADO SPRINGS, COLORADO

502835001 I 11/23

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants



LEGEND

B-19 ⊕ BORING

N

FEET

0 200 400

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE. I REFERENCE: ARCO MURRY, 09/27/23.

502835001_SP.dwg 11/23 BSM

FIGURE 2

BORING LOCATIONS

PROPOSED INDUSTRIAL DEVELOPMENT
BRADLEY ROAD AND FOREIGN TRADE ZONE BOULEVARD
COLORADO SPRINGS, COLORADO

502835001 I 11/23

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

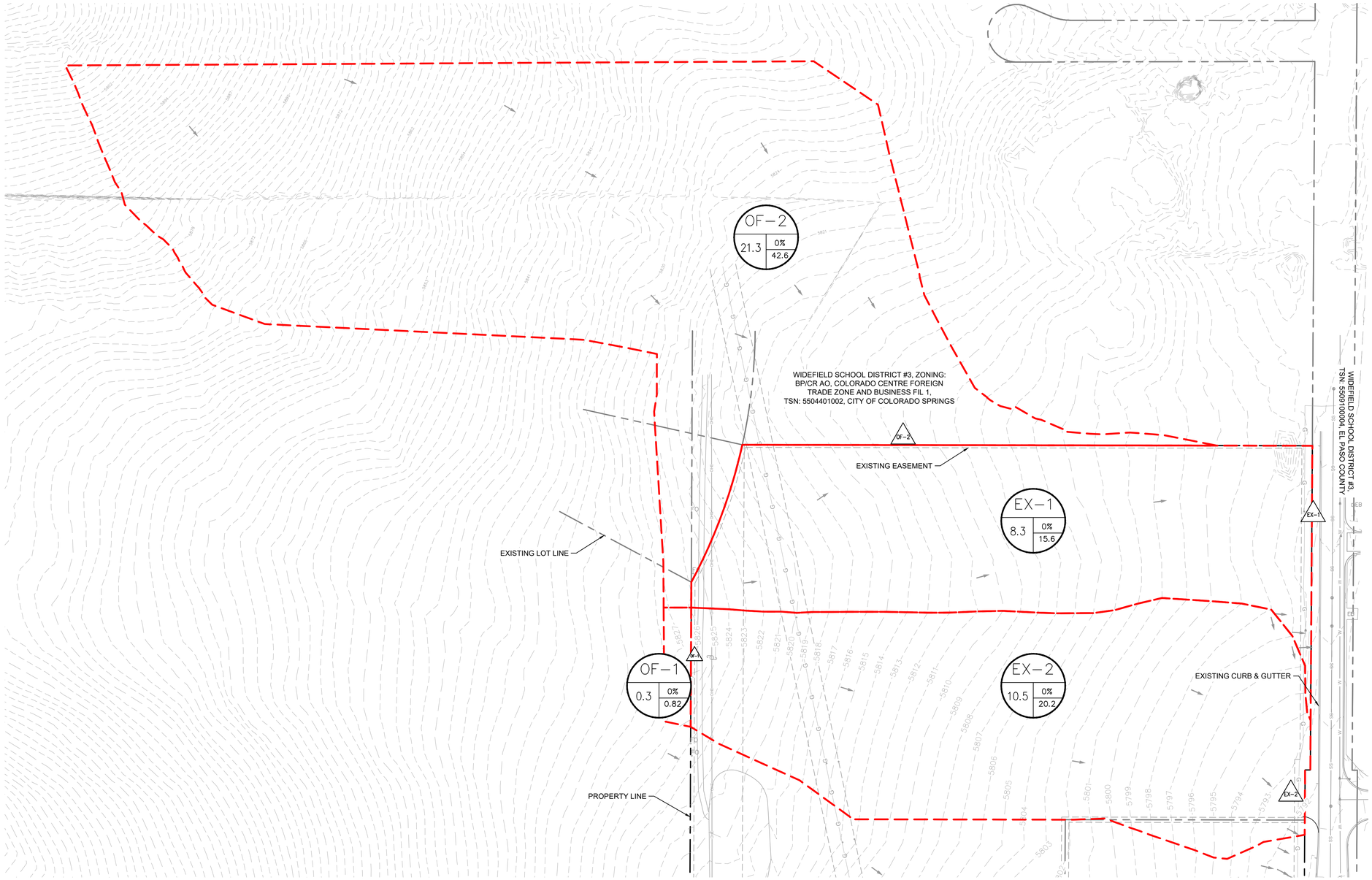
APPENDIX F – DRAINAGE MAPS

AEROSPACE BUSINESS CENTER

NORTHWEST CORNER OF FOREIGN TRADE ZONE BLVD AND BRADLEY ROAD

COLORADO SPRINGS, COLORADO

EXISTING DRAINAGE MAP



EXISTING RATIONAL CALCULATIONS SUMMARY				
DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS)	
			Q5	Q100
On-site Basins				
EX-1	EX-1	8.34	2.79	15.60
EX-2	EX-2	10.51	3.61	20.22
OF-1	OF-1	0.26	0.15	0.82
OF-2	OF-2	21.30	7.62	42.64
Total		40.42	14.17	79.27

NORTH

GRAPHIC SCALE IN FEET
0 50 100 200

LEGEND

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

= DESIGN POINT

FLOW DIRECTION

BASIN BOUNDARY

PROPERTY LINE

EXISTING LOT LINE

EASEMENT LINE

6000 EXISTING MAJOR CONTOUR

6001 EXISTING MINOR CONTOUR

Kimley»Horn

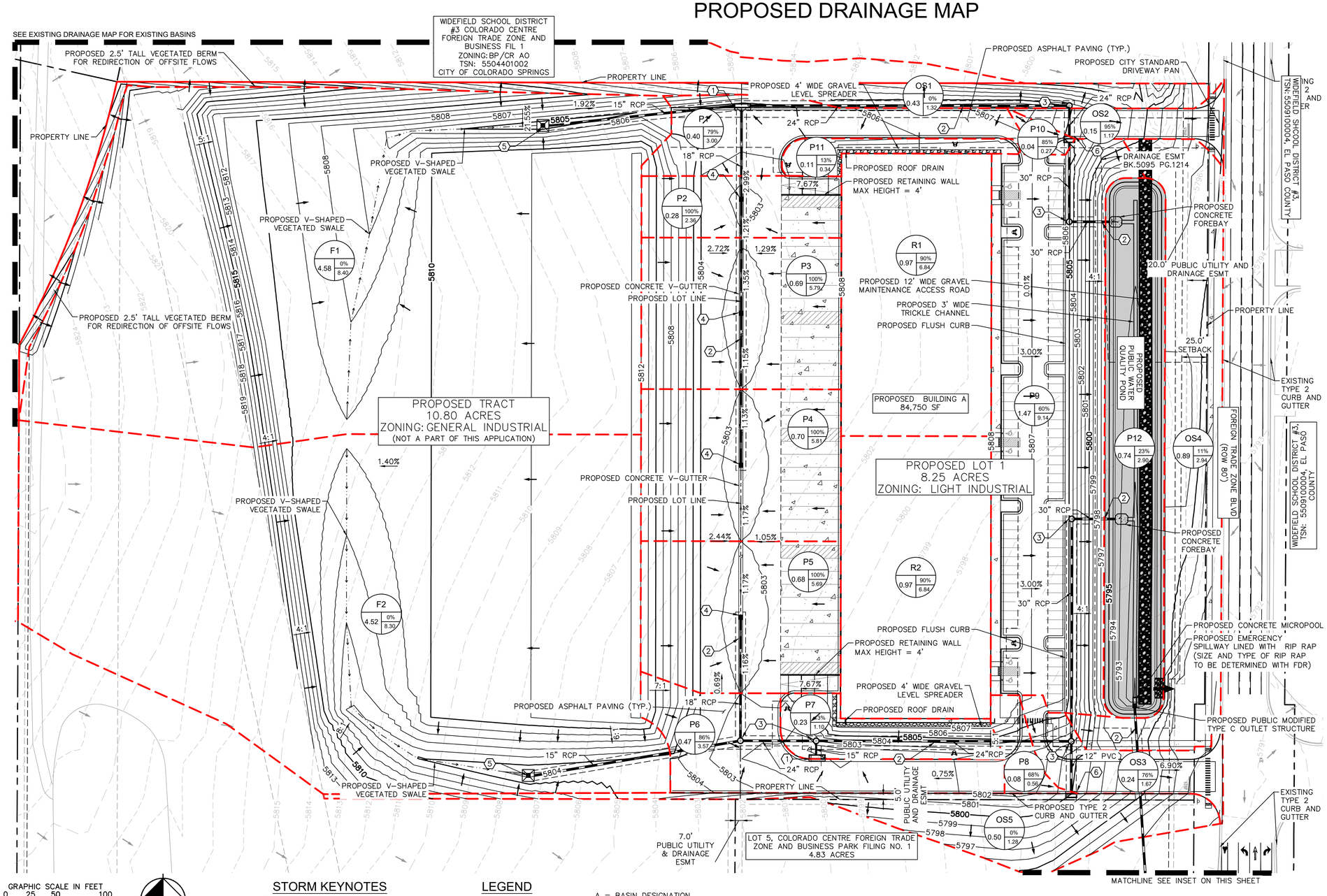
2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453–0180

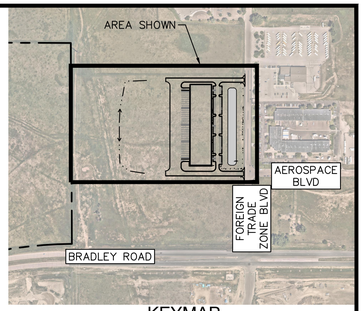
AEROSPACE BUSINESS CENTER

NORTHWEST CORNER OF FOREIGN TRADE ZONE BLVD AND BRADLEY ROAD

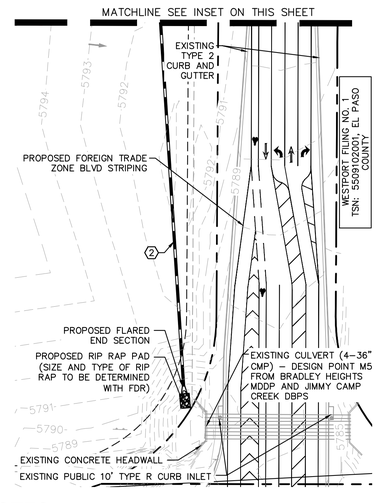
COLORADO SPRINGS, COLORADO

PROPOSED DRAINAGE MAP





KEYMAP
N.T.S.



NOTES

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

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.

PROPOSED RATIONAL CALCULATIONS SUMMARY

DESIGN POINT	TRIBUTARY BASINS	TRIBUTARY AREA (AC)	PEAK FLOWS (CFS) Q5	PEAK FLOWS (CFS) Q100	% IMPERV.
On-site Basins					
P1	P1	0.40	1.53	3.00	79%
P2	P2	0.28	1.32	2.36	100%
P3	P3	0.69	3.23	5.79	100%
P4	P4	0.70	3.24	5.81	100%
P5	P5	0.68	3.17	5.69	100%
P6	P6	0.47	1.91	3.57	86%
P7	P7	0.23	0.28	1.10	13%
P8	P8	0.08	0.28	0.56	68%
P9	P9	1.47	4.34	9.14	60%
P10	P10	0.04	0.14	0.27	85%
P11	P11	0.11	0.08	0.34	13%
P12	P12	0.74	0.90	2.90	23%
R1	R1	0.97	3.67	6.84	90%
R2	R2	0.97	3.67	6.84	90%
F1	F1	4.58	1.14	8.40	0%
F2	F2	4.52	1.13	8.30	0%
OF1	OF1	0.23	0.08	0.56	0%
OF2	OF2	21.34	6.97	51.23	0%
OS1	OS1	0.43	0.18	1.32	0%
OS2	OS2	0.15	0.65	1.17	95%
OS3	OS3	0.24	0.86	1.67	76%
OS4	OS4	0.89	0.72	2.94	11%
OS5	OS5	0.50	0.17	1.28	0%
Total		40.72	39.69	131.08	16%
Pond Total		17.18	30.13	71.47	35%

GRAPHIC SCALE IN FEET
0 25 50 100
1" = 50'

NORTH

STORM KEYNOTES

1. PROPOSED 15' TYPE R CURB INLET
2. PROPOSED STORM LINE
3. PROPOSED STORM MANHOLE
4. PROPOSED DOUBLE CDOT TYPE 13 INLET
5. PROPOSED CDOT TYPE C AREA INLET
6. PROPOSED 5' TYPE R CURB INLET

LEGEND

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

= DESIGN POINT

FLOW DIRECTION

POND EMERGENCY OVERFLOW FLOW DIRECTION

BASIN BOUNDARY

PROPERTY LINE
EXISTING LOT LINE
EASEMENT LINE
PROPOSED LOT LINE
PROPOSED STORM SEWER
6000 PROPOSED MAJOR CONTOUR
6001 PROPOSED MINOR CONTOUR
6000 EXISTING MAJOR CONTOUR
6001 EXISTING MINOR CONTOUR
PROPOSED SIDEWALK
PROPOSED DETENTION POND
FFE FINISH FLOOR ELEVATION

Kimley»Horn

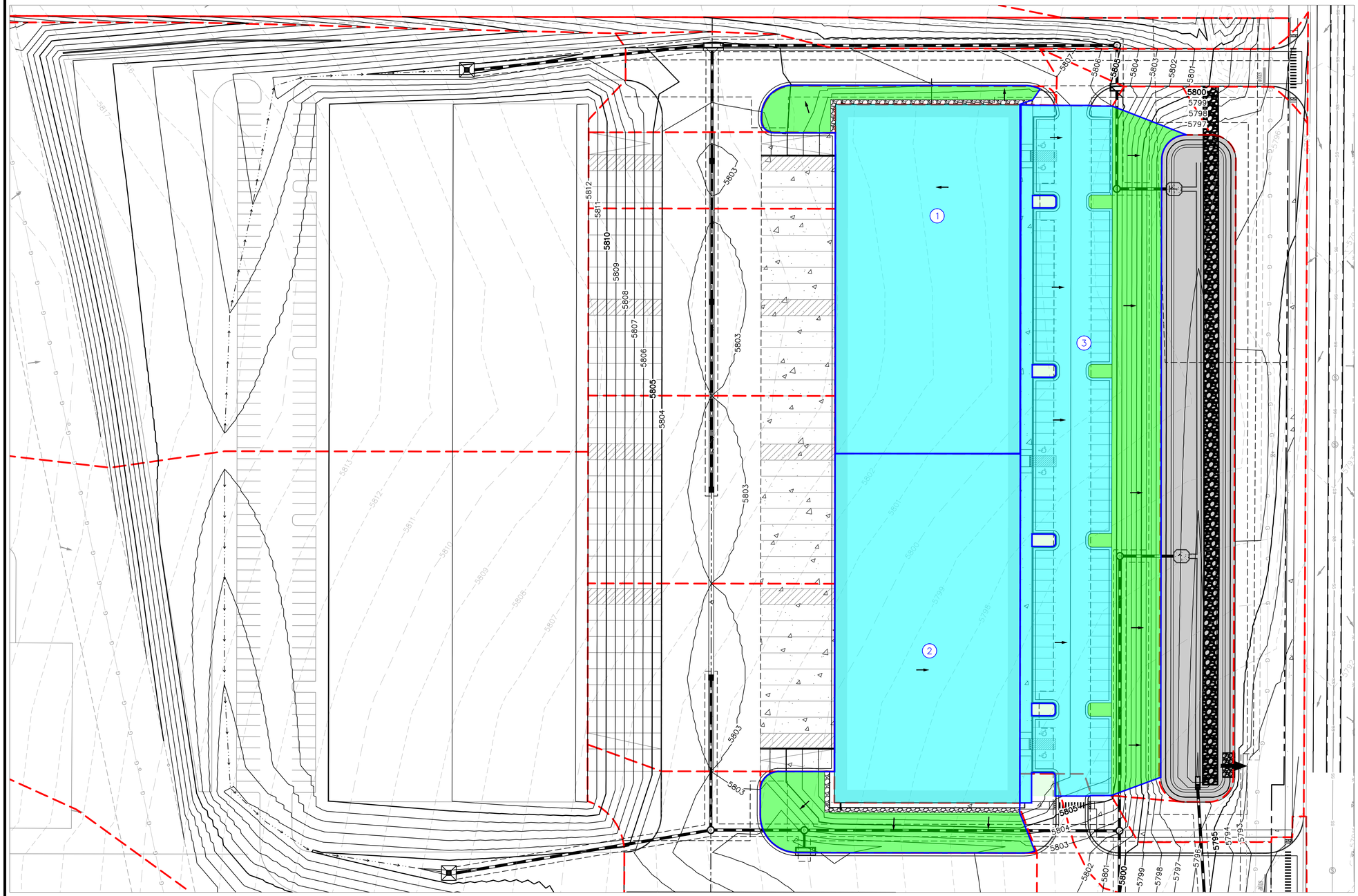
2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

AEROSPACE BUSINESS CENTER

NORTHWEST CORNER OF FOREIGN TRADE ZONE BLVD AND BRADLEY ROAD

COLORADO SPRINGS, COLORADO

GREEN INFASTRUCTURE MAP



LEGEND

- DRAINAGE SUB-BASIN BOUNDARY
- XXXX EXISTING MAJOR CONTOUR
- XXXX EXISTING MINOR CONTOUR
- XXXX PROPOSED MAJOR CONTOUR
- XXXX PROPOSED MINOR CONTOUR
- PROPERTY LINE
- UPSTREAM IMPERVIOUS AREA
- RECEIVING PERVIOUS AREA
- PROPOSED DRAINAGE ARROW

Kimley»Horn

2 NORTH NEVADA AVENUE, SUITE 900
COLORADO SPRINGS, COLORADO 80903 (719) 453-0180

GRAPHIC SCALE IN FEET
0 20 40 80

NORTH

APPENDIX G – PREVIOUS DRAINAGE STUDIES

MASTER DEVELOPMENT DRAINAGE PLAN AMENDMENT

For

BRADLEY HEIGHTS

Prepared for:

BRADLEY HEIGHTS METROPOLITAN DISTRICT
614 North Tejon Street
Colorado Springs, CO 80903
(719) 447-1777

Prepared by:

2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-0208

April 2022

Project No. 21.1213.001

STM-REV22-0046

Engineer's Statement:

This report and plan for the drainage design of Bradley Heights 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 accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Jesse Sullivan — Date
Registered Professional Engineer
State of Colorado
No. 55600

Developer's Statement:

Bradley Heights Metro District hereby certifies that the drainage facilities for Bradley Heights 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 the City of Colorado Springs reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28; but cannot, on behalf of Bradley Heights, guarantee that final drainage design review will absolve Bradley Heights Metro District 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.

Bradley Heights Metropolitan District
Business Name

DocuSigned by:
By: Randle Case II, President — 4/19/2022
293CF22537AE478...
Randle Case, II President — Date

Title: Board President

Address: 614 North Tejon Street
Colorado Springs, CO 80903

City of Colorado Springs:

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

Heidi M. McMacken — 05/06/22
For the City Engineer Heidi McMacken — Date

Conditions:
Building permits will not be released until assurances for channel improvements have been posted or channel improvements have been installed and accepted.

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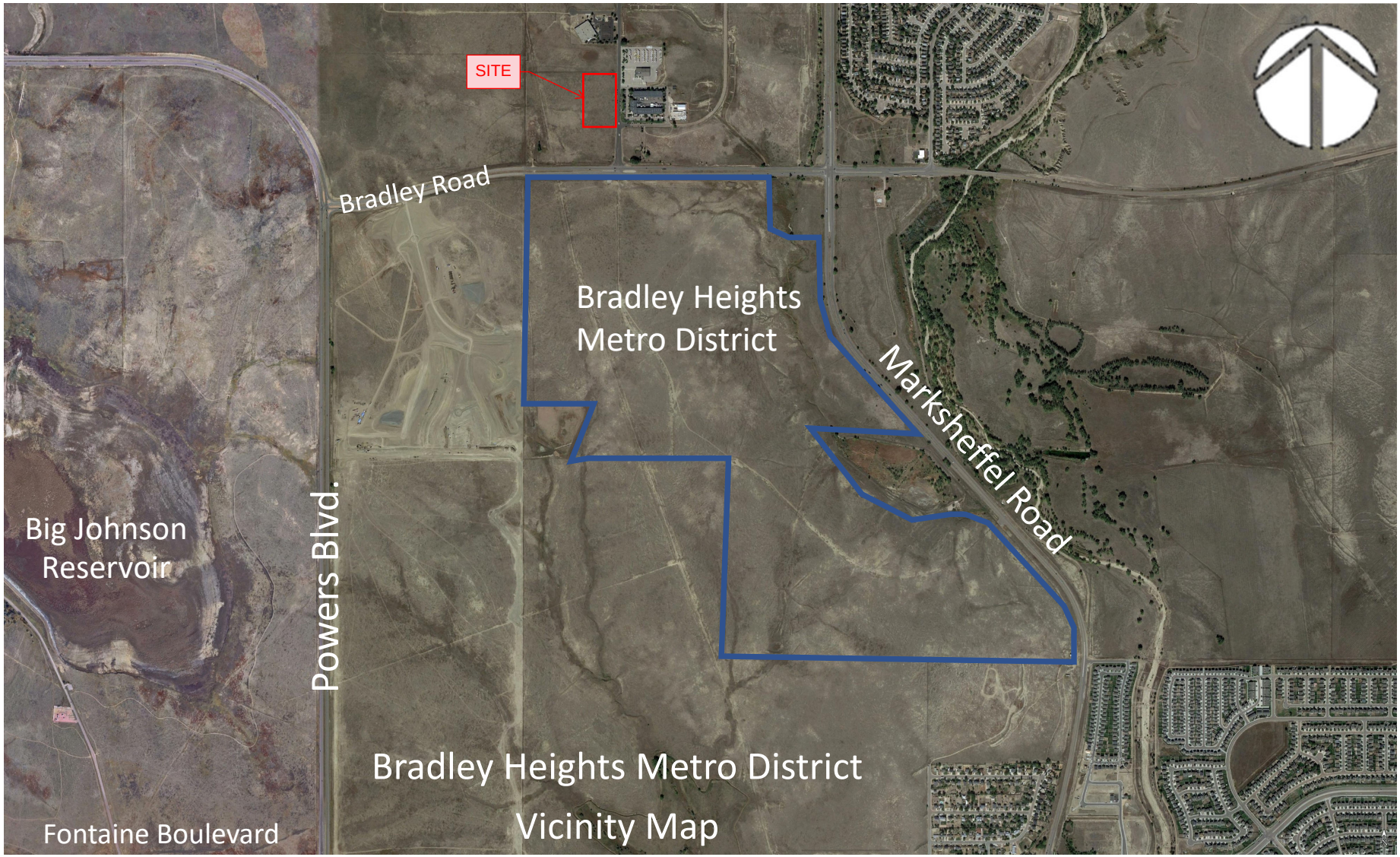


Bradley Heights Metro District

Vicinity Map

SHEET No. 1

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

LEGEND

- DRAINAGE FEE BASIN BOUNDARY
- BASIN BOUNDARY
- EXISTING CONTOUR
- EXISTING STORM DRAIN PIPE
- FLOW DIRECTION
- EXISTING EDGE OF ROAD
- PROPERTY LINE
- COLORADO CENTRE POND LIMIT OF DET.
- STREAM SIDE BUFFER OVERLAY
- SUB BASIN DESIGNATION (BASIN / Q5 / Q100 / AREA)
- 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- SUB BASIN AREA (AC. OR SQ. MI.)
- 2 DESIGN POINT

N

GRAPHIC SCALE
250' 0' 250' 500'
(IN FEET)
1 inch = 250 ft.

CCRD POND

Existing Design Point Summary - Rational Method

BRADLEY HEIGHTS MDDP

Design Point	Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)
WF1	W1, TAR-EP	258.80	35.56	298.86
WF2	W2,W3	88.88	29.39	157.39
JC	J1	46.62	15.00	80.34

BRADLEY HEIGHTS MDDP
EXISTING CONDITIONS
HEC-HMS - SCS METHOD

Sub-basin	Area		Q5	Q100
	Acres	Sq. Mi.	CFS	CFS
M1	*97.6*	*0.1526*	18.8	167.7
M2	*148.2*	*0.2316*	26.2	228.8
M3	*145.8*	*0.2278*	9.4	150.7
M4	*149.4*	*0.2334*	10.6	162.9
M5	*105.9*	*0.1654*	3.3	48.5
M6	*144.4*	*0.2256*	4.5	75.3
M7	*108.3*	*0.1692*	3.8	115.3
M8	*158.4*	*0.2475*	22.8	183.2
M9	*150.8*	*0.2357*	2.9	60.0
M10	*88.8*	*0.1388*	1.8	17.5
M11	*69.1*	*0.1079*	2.0	31.0
M12	*106.2*	*0.1660*	3.1	12.8
M13	*144.4*	*0.2257*	3.7	25.6
M14	*72.7*	*0.1136*	2.0	10.6
M15	*59.1*	*0.0924*	2.2	5.3
M16	*148.5*	*0.2321*	3.7	18.3
M17	*182.0*	*0.2844*	4.9	121.9
M18	*163.5*	*0.2554*	4.2	107.7
M19	*192.0*	*0.3000*	4.7	32.5
M20	*89.5*	*0.1399*	2.1	5.1
M21	*146.6*	*0.2290*	4.6	11.6
M22	*66.1*	*0.1033*	2.1	5.3
M23	*132.8*	*0.2075*	2.8	6.9
M24	*99.6*	*0.1556*	3.1	22.3
M25	*101.8*	*0.1591*	3.2	37.1
M26	*114.3*	*0.1786*	2.0	4.7
M27	*124.9*	*0.1951*	2.1	5.0
	Design Points			
DP-M0	*3310.8*	*5.1731*	82	1029.9
DP-M1	*3310.8*	*5.1731*	82	1029.9
DP-M2	*3213.1*	*5.0205*	79.2	990.9
DP-M3	*3064.9*	*4.7889*	69	897.5
DP-M4	*2919.1*	*4.5611*	62	804.4
DP-M5	*250.2*	*0.3910*	7.6	122.8
DP-M6	*2102.0*	*3.2844*	27	371.6
DP-M7	*451.6*	*0.7056*	8	70.4
DP-M8	*1561.6*	*2.4400*	17.7	284.3
DP-M9	*875.6*	*1.3681*	12.9	67.8
DP-M10	*368.9*	*0.5764*	9.1	23.2
DP-M11	*239.2*	*0.3737*	4	9.7

CITY OF COLORADO SPRINGS

BRADLEY HEIGHTS METRO DISTRICT
MASTER DEVELOPMENT DRAINAGE REPORT

PREDEVELOPMENT DRAINAGE CONDITIONS

DESIGNED BY: MO
DRAWN BY: JTS
CHECKED BY: JTS
SCALE: HORIZ 1" = 250' VERT. NA
DATE ISSUED: March 2022
SHEET: 1 OF 5
DRAWING No. DR-01

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No: 21.1213.004

PREPARED BY: Matrix

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT
CFD FILE: S:\21.1213.001 Bradley Heights Metro District\200 Drainage\201 Drainage Reports\MDDP\DWG\BRADLEY HEIGHTS DR.dwg
PLOT DATE: April 21, 2022 12:50:51 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE

REFERENCE DRAWINGS

BRADLEY HEIGHTS MDDP EXISTING CONDITIONS HEC-HMS - SCS METHOD				
Sub-basin	Area		Q5	Q100
	Acres	Sq. Mi.	CFS	CFS
M1	*97.6*	*0.1526*	18.8	167.7
M2	*148.2*	*0.2316*	26.2	228.8
M3	*145.8*	*0.2278*	9.4	150.7
M4	*149.4*	*0.2334*	10.6	162.9
M5	*105.9*	*0.1654*	3.3	48.5
M6	*144.4*	*0.2256*	4.5	75.3
M7	*108.3*	*0.1692*	3.8	115.3
M8	*158.4*	*0.2475*	22.8	183.2
M9	*150.8*	*0.2357*	2.9	60.0
M10	*88.8*	*0.1388*	1.8	17.5
M11	*69.1*	*0.1079*	2.0	31.0
M12	*106.2*	*0.1660*	3.1	12.8
M13	*144.4*	*0.2257*	3.7	25.6
M14	*72.7*	*0.1136*	2.0	10.6
M15	*59.1*	*0.0924*	2.2	5.3
M16	*148.5*	*0.2321*	3.7	18.3
M17	*182.0*	*0.2844*	4.9	121.9
M18	*163.5*	*0.2554*	4.2	107.7
M19	*192.0*	*0.3000*	4.7	32.5
M20	*89.5*	*0.1399*	2.1	5.1
M21	*146.6*	*0.2290*	4.6	11.6
M22	*66.1*	*0.1033*	2.1	5.3
M23	*132.8*	*0.2075*	2.8	6.9
M24	*99.6*	*0.1556*	3.1	22.3
M25	*101.8*	*0.1591*	3.2	37.1
M26	*114.3*	*0.1786*	2.0	4.7
M27	*124.9*	*0.1951*	2.1	5.0
Design Points				
DP-M0	*3310.8*	*5.1731*	82	1029.9
DP-M1	*3310.8*	*5.1731*	82	1029.9
DP-M2	*3213.1*	*5.0205*	79.2	990.9
DP-M3	*3064.9*	*4.7889*	69	897.5
DP-M4	*2919.1*	*4.5611*	62	804.4
DP-M5	*250.2*	*0.3910*	7.6	122.8
DP-M6	*2102.0*	*3.2844*	27	371.6
DP-M7	*451.6*	*0.7056*	8	70.4
DP-M8	*1561.6*	*2.4400*	17.7	284.3
DP-M9	*875.6*	*1.3681*	12.9	67.8
DP-M10	*368.9*	*0.5764*	9.1	23.2
DP-M11	*239.2*	*0.3737*	4	9.7

LEGEND

- BASIN BOUNDARY
- EXISTING CONTOUR
- EXISTING STORM DRAIN PIPE
- FLOW DIRECTION
- EXISTING EDGE OF ROAD
- PROPERTY LINE
- COLORADO CENTRE DETENTION BOUNDARY
- STREAM SIDE BUFFER OVERLAY
- BASIN (Q5 | Q100 / AREA) — SUB BASIN DESIGNATION; 5-YEAR STORM EVENT PEAK FLOW (CFS); 100-YEAR STORM EVENT PEAK FLOW (CFS); SUB BASIN AREA (AC. OR SQ. MI.)
- 2 — DESIGN POINT

N

GRAPHIC SCALE

250' 0' 250' 500'

(IN FEET)

1 inch = 250 ft.

REFERENCE DRAWINGS
X-1213-PR_BASE MATRIX X-1213-EX BASE HRG/BEEN EAST X-1213-EX BASE NES SOUTH PM-BASE UTIL X-1213-EX_BASE-From Others X-MDG30xN2 X-1213-EX BASE TERRA NOVA CHURCH 0-886-EX-TOPO-TAR

No.	DATE	DESCRIPTION	BY
		REVISIONS	

COMPUTER FILE MANAGEMENT

FILE NAME: S:\21.1213.001 Bradley Heights Metro District\200 Drainage\201 Drainage Reports\MDDP\DWG\BRADLEY HEIGHTS DR.dwg
CTB FILE: ----
PLOT DATE: March 28, 2022 2:30:18 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

PREPARED BY: Matrix

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 19.224.008

CITY OF COLORADO SPRINGS

BRADLEY HEIGHTS METRO DISTRICT
MASTER DEVELOPMENT DRAINAGE REPORT

PREDEVELOPMENT CONDITIONS

DESIGNED BY:	JAO	SCALE	DATE ISSUED:	March 2022	DRAWING No.
DRAWN BY:	JTS	HORIZ. 1" = 250'			
CHECKED BY:	JTS	VERT. N/A	SHEET	2 OF 5	DR-02

BRADLEY HEIGHTS
COMPARISON OF PREDEVELOPMENT AND POST-DEVELOPMENT CONDITIONS

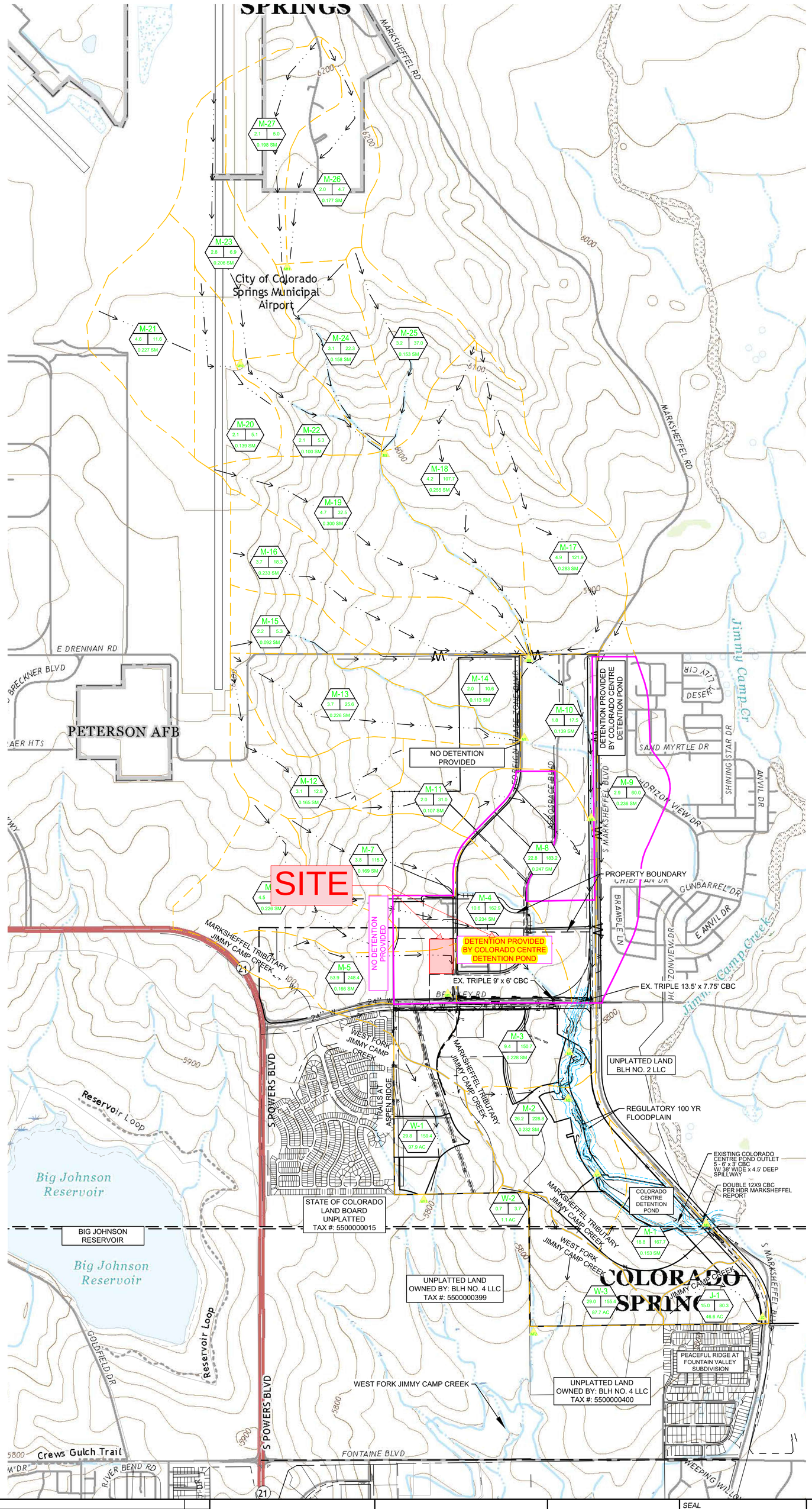
Sub-basin	Area		Q2		DELTA	Q5		DELTA	Q10		DELTA	Q100		DELTA
	Acres	Sq. Mi.	EX	PR	Q	EX	PR	Q	EX	PR	Q	EX	PR	Q
M1	97.6	0.15256	8.8	-	-	18.8	-	-	87	-	-	167.7	-	-
M2	148.2	0.23162	12.3	-	-	26.2	-	-	118.1	-	-	228.8	-	-
M3	145.8	0.22781	3.3	-	-	9.4	-	-	67	-	-	150.7	-	-
BH2	3.0	0.00470	-	0.4	-	-	0.9	-	-	4	-	-	7.4	-
CC	51.9	0.08109	-	5.3	-	-	8	-	-	19.6	-	-	33.2	-
MK8	8.1	0.01260	-	6.4	-	-	8.8	-	-	19.4	-	-	29.7	-
M4	149.4	0.23337	3.7	65.2	61.5	10.6	88.3	77.7	73.3	204.6	131.3	162.9	328.1	165.2
M5	105.9	0.16539	2.6	38.2	35.6	3.3	53.9	50.6	12.2	147.2	135	48.5	248.4	199.9
M6	144.4	0.22559	3.6	3.6	0	4.5	4.5	0	20.4	20.7	0.3	75.3	76	0.7
M7	108.3	0.16917	3	4.5	1.5	3.8	5.6	1.8	43.9	47.2	3.3	115.3	119.7	4.4
M8	158.4	0.24746	11	70.5	59.5	22.8	96.2	73.4	94.5	205.8	111.3	183.2	317.2	134
M9	150.8	0.23570	1.9	38.6	36.7	2.9	52.3	49.4	23.3	111.3	88	60	178.4	118.4
M10	88.8	0.13880	1.5	1.5	0	1.8	1.8	0	4.3	4.3	0	17.5	17.5	0
M11	69.1	0.10790	1.6	1.6	0	2	2	0	8.2	8.2	0	31	31	0
M12	106.2	0.16600	2.4	2.4	0	3.1	3.1	0	5.5	5.5	0	12.8	12.8	0
M13	144.4	0.22570	2.9	2.9	0	3.7	3.7	0	6.7	6.7	0	25.6	25.6	0
M14	72.7	0.11360	1.6	1.6	0	2	2	0	3.5	3.5	0	10.6	10.6	0
M15	59.1	0.09240	1.7	1.7	0	2.2	2.2	0	3.8	3.8	0	5.3	5.3	0
M16	148.5	0.23210	3	3	0	3.7	3.7	0	6.6	6.6	0	18.3	18.3	0
M17	182.0	0.28440	3.9	3.9	0	4.9	4.9	0	43.3	43.3	0	121.9	121.9	0
M18	163.5	0.25540	3.3	3.3	0	4.2	4.2	0	39.5	39.5	0	107.7	107.7	0
M19	192.0	0.30000	3.8	3.8	0	4.7	4.7	0	8.6	8.6	0	32.5	32.5	0
M20	89.5	0.13990	1.6	1.6	0	2.1	2.1	0	3.6	3.6	0	5.1	5.1	0
M21	146.6	0.22900	3.7	3.7	0	4.6	4.6	0	8.2	8.2	0	11.6	11.6	0
M22	66.1	0.10330	1.7	1.7	0	2.1	2.1	0	3.8	3.8	0	5.3	5.3	0
M23	132.8	0.2075	2.2	2.2	0	2.8	2.8	0	4.9	4.9	0	6.9	6.9	0
DP-M0	3310.8	5.17307	45.6	205.5	159.9	82	338.4	256.4	417.9	624.5	206.6	1029.9	1003.8	-26.1
DP-M1	3310.8	5.17307	45.6	203.6	158	82	330.7	248.7	417.9	672.8	254.9	1029.9	1217.9	188
DP-M2	3213.1	5.02052	45	201.9	156.9	79.2	305.9	226.7	386.5	673.2	286.7	990.9	1220.2	229.3
DP-M3	3064.9	4.78890	40.8	199.2	158.4	69	284.6	215.6	322.3	668.7	346.4	897.5	1209.3	311.8
DP-M4	2919.1	4.56109	38.2	197.3	159.1	62	269.7	207.7	291.3	661.8	370.5	804.4	1206.8	402.4
DP-M5	250.2	0.39098	6	41.3	35.3	7.6	58.1	50.5	32	161.2	129.2	122.8	311.3	188.5

BRADLEY HEIGHTS
COMPARISON OF PREDEVELOPMENT AND POST-DEVELOPMENT CONDITIONS

Sub-basin	Area		Q2		DELTA	Q5		DELTA	Q10		DELTA	Q100		DELTA
	Acres	Sq. Mi.	EX	PR	Q	EX	PR	Q	EX	PR	Q	EX	PR	Q
DP-M6	2102.0	3.28440	21.2	21.2	0	27	27	0	122.3	122.3	0	371.6	371.6	0
DP-M7	451.6	0.70560	6.3	6.3	0	8	8	0	19.8	19.8	0	70.4	70.4	0
DP-M8	1561.6	2.44000	13.9	13.9	0	17.7	17.7	0	98.7	98.7	0	284.3	284.3	0
DP-M9	875.6	1.36810	10.2	10.2	0	12.9	12.9	0	25.1	25.1	0	67.8	67.6	0
DP-M10	368.9	0.57640	7.2	7.2	0	9.1	9.1	0	16.3	16.3	0	23.2	23.2	0
DP-M11	239.2	0.37370	3.2	3.2	0	4	4	0	6.9	6.9	0	9.7	9.7	0
MKJCC POND 4	49.0	0.07662	-	1.1	-	-	10	-	-	18.7	-	-	70.3	-
MKJCC POND 5	67.3	0.10513	-	2.9	-	-	24.2	-	-	50.2	-	-	203.5	-
MKJCC POND 6	41.2	0.06444	-	1.7	-	-	17	-	-	28.3	-	-	89	-
MKJCC POND 7	70.0	0.10930	-	1.5	-	-	23.5	-	-	44.6	-	-	177.2	-
MKJCC POND 8	13.0	0.02027	-	0.3	-	-	3.6	-	-	6.8	-	-	11.3	-
MKJCC POND 9	51.9	0.08114	-	1	-	-	12.2	-	-	24.7	-	-	103.1	-
MKJCC POND 10	14.0	0.02184	-	0.4	-	-	2	-	-	5.1	-	-	16.7	-
MKJCC POND 11	8.0	0.01251	-	0.2	-	-	0.4	-	-	2.4	-	-	16.4	-
TAR-NE	9.1	0.01421	-	0.2	-	-	0.2	-	-	1.8	-	-	7.9	-
MRK-1	3248.5	5.07583	-	203.4	-	-	327.1	-	-	621.8	-	-	1001.2	-

BRADLEY HEIGHTS MDDP
EXISTING CONDITIONS
HEC-HMS - SCS METHOD

Sub-basin	Area		Q5	Q100
	Acres	Sq. Mi.	CFS	CFS
M1	*97.6*	*0.1526*	18.8	167.7
M2	*148.2*	*0.2316*	26.2	228.8
M3	*145.8*	*0.2278*	9.4	150.7
M4	*149.4*	*0.2334*	10.6	162.9
M5	*105.9*	*0.1654*	3.3	48.5
M6	*144.4*	*0.2256*	4.5	75.3
M7	*108.3*	*0.1692*	3.8	115.3
M8	*158.4*	*0.2475*	22.8	183.2
M9	*150.8*	*0.2357*	2.9	60.0
M10	*88.8*	*0.1388*	1.8	17.5
M11	*69.1*	*0.1079*	2.0	31.0
M12	*106.2*	*0.1660*	3.1	12.8
M13	*144.4*	*0.2257*	3.7	25.6
M14	*72.7*	*0.1136*	2.0	10.6
M15	*59.1*	*0.0924*	2.2	5.3
M16	*148.5*	*0.2321*	3.7	18.3
M17	*182.0*	*0.2844*	4.9	121.9
M18	*163.5*	*0.2554*	4.2	107.7
M19	*192.0*	*0.3000*	4.7	32.5
M20	*89.5*	*0.1399*	2.1	5.1
M21	*146.6*	*0.2290*	4.6	11.6
M22	*66.1*	*0.1033*	2.1	5.3
M23	*132.8*	*0.2075*	2.8	6.9
M24	*99.6*	*0.1556*	3.1	22.3
M25	*101.8*	*0.1591*	3.2	37.1
M26	*114.3*	*0.1786*	2.0	4.7
M27	*124.9*	*0.1951*	2.1	5.0
Design Points				
DP-M0	*3310.8*	*5.1731*	82	1029.9
DP-M1	*3310.8*	*5.1731*	82	1029.9
DP-M2	*3213.1*	*5.0205*	79.2	990.9
DP-M3	*3064.9*	*4.7889*	69	897.5
DP-M4	*2919.1*	*4.5611*	62	804.4
DP-M5	*250.2*	*0.3910*	7.6	122.8
DP-M6	*2102.0*	*3.2844*	27	371.6
DP-M7	*451.6*	*0.7056*	8	70.4
DP-M8	*1561.6*	*2.4400*	17.7	284.3
DP-M9	*875.6*	*1.3681*	12.9	67.8
DP-M10	*368.9*	*0.5764*	9.1	23.2
DP-M11	*239.2*	*0.3737*	4	9.7



BRADLEY HEIGHTS MDDP
DEVELOPED CONDITIONS
HEC-HMS - SCS METHOD

Sub-basin	Area		Q5	Q100
	Acres	Sq. Mi.	CFS	CFS
BH2	*3.0*	*0.0047*	0.9	7.4
CC	*51.9*	*0.0811*	8.0	33.2
MK8	*8.1*	*0.0126*	8.8	29.7
M4	*149.4*	*0.2334*	88.3	328.1
M5	*105.9*	*0.1654*	53.9	248.4
M6	*144.4*	*0.2256*	4.5	76.0
M7	*108.3*	*0.1692*	5.6	119.7
M8	*158.4*	*0.2475*	96.2	317.2
M9	*150.8*	*0.2357*	52.3	178.4
M10	*88.8*	*0.1388*	1.8	17.5
M11	*69.1*	*0.1079*	2.0	31.0
M12	*106.2*	*0.1660*	3.1	12.8
M13	*144.4*	*0.2257*	3.7	25.6
M14	*72.7*	*0.1136*	2.0	10.6
M15	*59.1*	*0.0924*	2.2	5.3
M16	*148.5*	*0.2321*	3.7	18.3
M17	*182.0*	*0.2844*	4.9	121.9
M18	*163.5*	*0.2554*	4.2	107.7
M19	*192.0*	*0.3000*	4.7	32.5
M20	*89.5*	*0.1399*	2.1	5.1
M21	*146.6*	*0.2290*	4.6	11.6
M22	*66.1*	*0.1033*	2.1	5.3
M23	*132.8*	*0.2075*	2.8	6.9
M24	*99.6*	*0.1556*	3.1	22.3
M25	*101.8*	*0.1591*	3.2	37.0
M26	*114.3*	*0.1786*	2.0	4.7
M27	*124.9*	*0.1951*	2.1	5.0
Design Points				
DP-M0	*3305.6*	*5.1650*	338.4	1003.8
DP-M1	*3248.5*	*5.0758*	330.7	1217.9
DP-M2	*3140.0*	*4.9063*	305.9	1220.2
DP-M3	*3018.2*	*4.7159*	284.6	1209.3
DP-M4	*2919.2*	*4.5612*	269.7	1206.8
DP-M5	*250.2*	*0.3910*	58.1	311.3
DP-M6	*2102.0*	*3.2844*	27	371.6
DP-M7	*451.6*	*0.7056*	8	70.4
DP-M8	*1561.6*	*2.4400*	17.7	284.3
DP-M9	*875.6*	*1.3681*	12.9	67.6
DP-M10	*368.9*	*0.5764*	9.1	23.2
DP-M11	*239.2*	*0.3737*	4	9.7
MKJCC POND 4	*49.0*	*0.0766*	10	70.3
MKJCC POND 5	*67.3*	*0.1051*	24.2	203.5
MKJCC POND 6	*41.2*	*0.0644*	17	89
MKJCC POND 7	*70.0*	*0.1093*	23.5	177.2
MKJCC POND 8	*13.0*	*0.0203*	3.6	11.3
MKJCC POND 9	*51.9*	*0.0811*	12.2	103.1
MKJCC POND 10	*14.0*	*0.0218*	2	16.7
MKJCC POND 11	*8.0*	*0.0125*	0.4	16.4
TAR-NE	*9.1*	*0.0142*	0.2	7.9
MRK-1	*3248.5*	*5.0758*	327.1	1001.2

LEGEND

- BASIN BOUNDARY
- EXISTING CONTOUR
- EXISTING STORM DRAIN PIPE
- FLOW DIRECTION
- EXISTING EDGE OF ROAD
- PROPERTY LINE
- COLORADO CENTRE DETENTION BOUNDARY
- STREAM SIDE BUFFER OVERLAY
- BASIN (Q5 | Q100 / AREA) — SUB BASIN DESIGNATION
- PREDEVELOPMENT VALUES
- 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- SUB BASIN AREA (AC. OR SQ. MI.)
- 2 — DESIGN POINT

N

GRAPHIC SCALE
1000' 0' 1000' 2000'
(IN FEET)
1 inch = 1000 ft.

REFERENCE DRAWINGS

X-1213-PR_BASE MATRIX
X-1213-EX BASE HRG/REEN EAST
X-4214-EX BASE NES SOUTH
PM-BASE UTS
X-4214-EX_BASE-From Others
X-MDG3XN2
X-4214-EX BASE TERRA NOVA CHURCH
0-886-EX-TOPO-TAR

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT

FILE NAME: S:\21.1213.001 Bradley Heights Metro District\200 Drainage\201 Drainage Reports\MDDP\DWG\BRADLEY HEIGHTS DR.dwg
CTB FILE: ----
PLOT DATE: March 28, 2022 2:30:56 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

PREPARED BY: Matrix

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 21.1213.004

CITY OF COLORADO SPRINGS

BRADLEY HEIGHTS METRO DISTRICT
MASTER DEVELOPMENT DRAINAGE REPORT

MARKSHEFFEL TRIB. TO JIMMY CAMP CREEK

DESIGNED BY:	JAO	SCALE	DATE ISSUED:	March 2022	DRAWING No.
DRAWN BY:	JTS	HORIZ. 1" = 1000'	SHEET	3 OF 5	DR-03
CHECKED BY:	JTS	VERT. N/A			

Jimmy Camp Creek

Drainage Basin Planning Study
Development of Alternatives &
Design of Selected Plan Report

Prepared for:

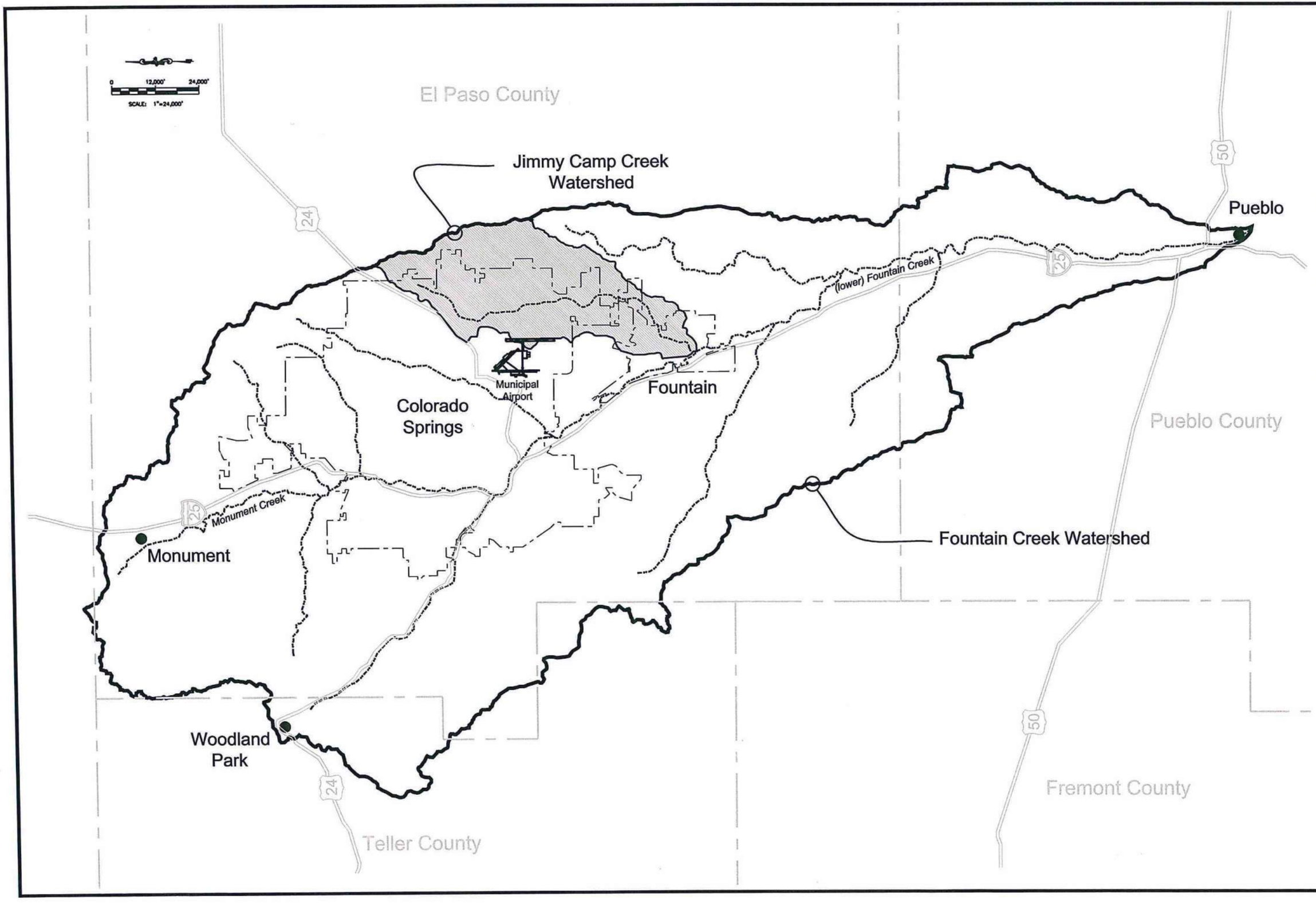
City of Colorado Springs

Prepared by:

Kiowa
Engineering Corporation

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

March 9, 2015



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

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
VICINITY MAP
CITY OF COLORADO SPRINGS

Project No.:	14008
Date:	OCT 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

I-1

Table II-1
Land Use Index

Category		% Impervious
Undeveloped, Open Space		2 - 5
Parks, Golf Course		5 - 10
Residential Very Low	[<1 du/ac]	10 – 20
Residential Low-Med	[1-8 du/ac]	40 – 50
Residential Med-High	[8-12 du/ac]	50 – 60
Residential High	[12-24 du/ac]	60 – 70
Industrial, Mixed Use		70 – 80
Commercial		80 – 90
Public Facilities		….. specific to each site …..

Table II-2
Existing Land Use

			% Imperviousness						Composite
Region	Area (ac)	Area (sqmi)	2	15	45	55	65	85	% Imp
East Fork Tributary	6,274	9.80	90%	10%	0%	0%	0%	0%	3.5%
Franceville Tributary	2,713	4.24	93%	7%	0%	0%	0%	0%	2.9%
Strip Mine Tributary	3,869	6.05	99%	1%	0%	0%	0%	0%	2.1%
Corral Tributary	5,649	8.83	100%	0%	0%	0%	0%	0%	2.0%
Marksheffel Tributary	3,316	5.18	80%	18%	1%	0%	0%	1%	5.2%
West Fork Tributary	2,647	4.14	88%	6%	2%	4%	0%	0%	5.8%
Ohio Tributary	767	1.20	92%	8%	0%	0%	0%	0%	3.1%
C and S Tributary	1,325	2.07	45%	9%	40%	3%	0%	3%	21.6%
Blaney Tributary	995	1.55	100%	0%	0%	0%	0%	0%	2.0%
Jimmy Camp Main	15,400	24.06	87%	8%	5%	0%	0%	0%	5.1%
	ac	sqmi							
Totals…	42,956	67.1	90%	7%	3%	0%	0%	0%	4.5%

As shown in table II-2, 90% of the watershed remains undeveloped. The primary existing development is a rural, large lot residential [RVL] development. Some low-medium density single-family housing can be found in the lower part of the watershed near the City of Fountain. There are also small areas of multi-family and commercial developments in the watershed within the City of Fountain; however, the total area amounts to less than 1% of the total watershed area. The highest density developments are found within the C and S Tributary and the lower portions of Jimmy Camp Creek. A map of the existing conditions land use is shown in Figure II-1.

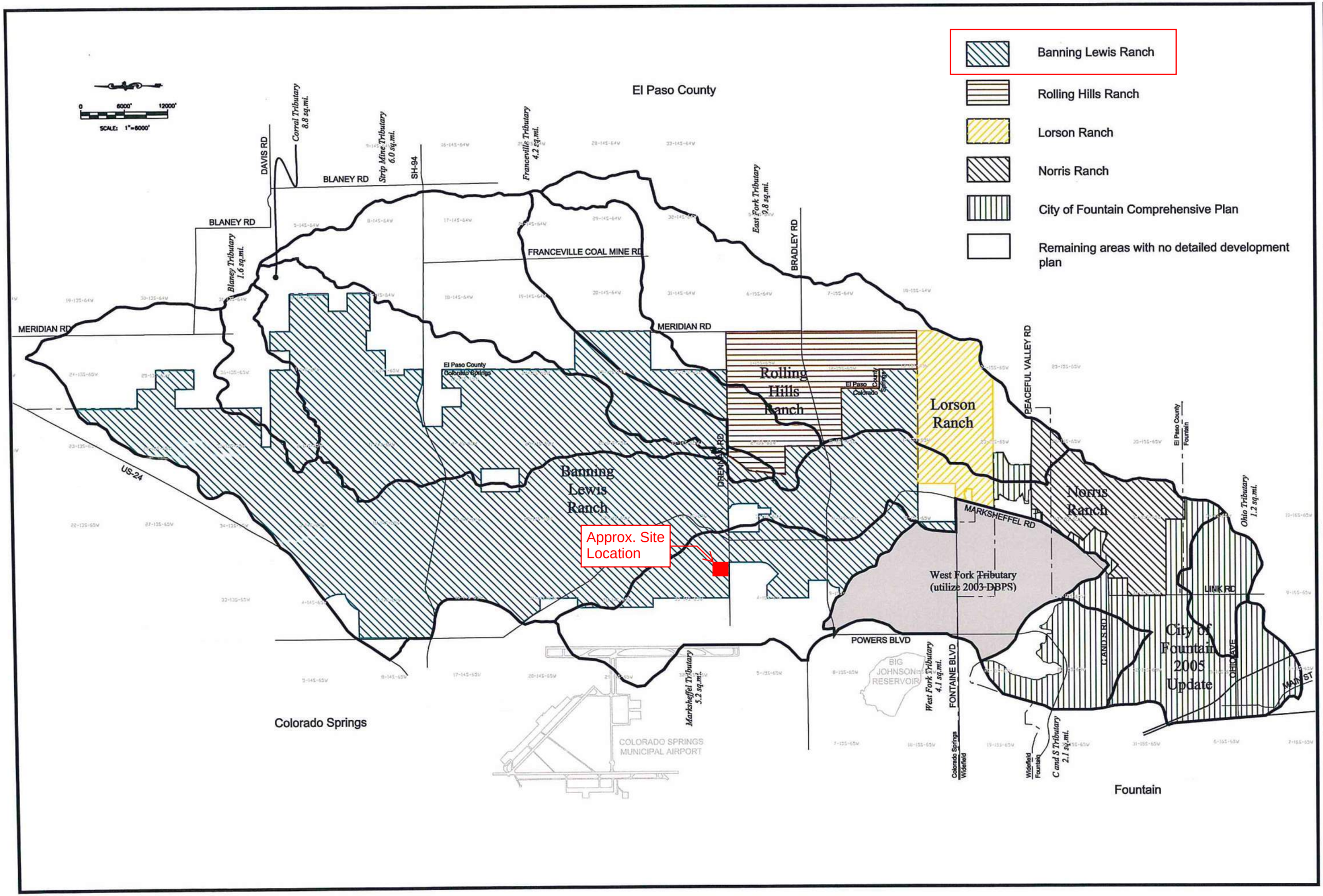
Future Land Use

The future impervious cover was estimated by reviewing land use planning studies provided by the City of Colorado Springs, City of Fountain, and El Paso County. As shown in Figure II-2, over 60-percent of the watershed has detailed development planned for five major properties within the drainage basin. These developments are Banning Lewis Ranch (40%), Rolling Hills Ranch (5%), Lorson Ranch (3%), Norris Ranch (3%) and the City of Fountain (10%) 2005 Land Use Update. Each of these developments are in the early stages of development. Lorson Ranch and Banning-Lewis Ranch are at this time actively developing. This level of detailed future development in a watershed study is unusual and provides an exceptionally detailed future conditions land use map. Additional future planning information was obtained in a meeting with the El Paso County Planning Department. This meeting defined setback areas around the Corral Bluffs and lands with known dedicated uses in the watershed. Figure II-3 shows the watershed's future land use projections.

The same process that was used to quantify existing imperviousness was applied for future imperviousness. Values of impervious area were assigned to each projected land use category as described in Tables II-2 and II-3. The overall Jimmy Camp Creek watershed imperviousness for future, fully-developed conditions is 43.7% as shown in Table II-3. The predominant land use under future conditions will be low-medium single-family residential.

Table II-3
Future Land Use

			% Imperviousness						Composite
Region	Area (ac)	Area (sqmi)	5	15	45	55	65	85	% Imp
East Fork Tributary	6,274	9.80	8%	11%	65%	8%	0%	8%	42.1%
Franceville Tributary	2,713	4.24	11%	16%	68%	4%	0%	0%	35.8%
Strip Mine Tributary	3,869	6.05	23%	10%	65%	2%	0%	1%	33.4%
Corral Tributary	5,649	8.83	13%	25%	54%	6%	0%	2%	33.4%
Marksheffel Tributary	3,316	5.18	1%	18%	40%	0%	0%	42%	55.9%
West Fork Tributary	2,647	4.14	4%	6%	2%	29%	13%	46%	68.7%
Ohio Tributary	767	1.20	3%	21%	69%	0%	0%	7%	39.9%
C and S Tributary	1,325	2.07	5%	2%	77%	3%	3%	10%	46.9%
Blaney Tributary	995	1.55	5%	37%	58%	0%	0%	0%	32.0%
Jimmy Camp Main	15,400	24.06	16%	11%	37%	8%	4%	24%	45.8%
	ac	sqmi							
Totals…	42,956	67.1	12%	14%	48%	7%	2%	17%	43.7%

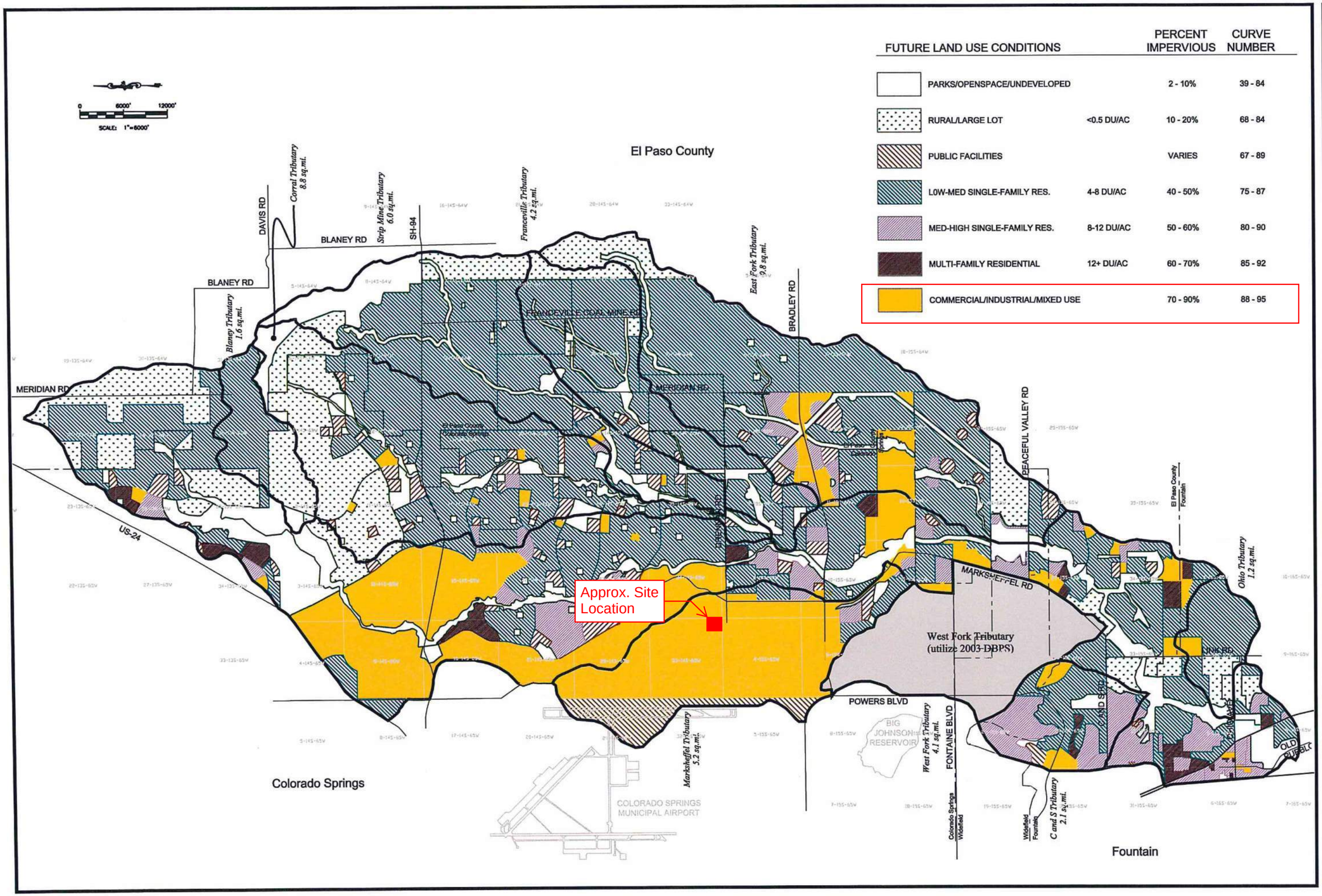


Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
FUTURE CONDITIONS PLANNING INFORMATION
, CITY OF COLORADO SPRINGS

Project No.:	14008
Date:	OCT 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

II-2



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

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
FUTURE CONDITIONS LAND USE MAP
CITY OF COLORADO SPRINGS

Project No.:	1408
Date:	OCT 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

II-3

0 6000' 12000'

SCALE: 1"=6000'

El Paso County

SOIL GROUP A

SOIL GROUP B

SOIL GROUP C

SOIL GROUP D

Approx. Site Location

Colorado Springs

Fountain

West Fork Tributary (utilize 2003 DBPS)

Corral Tributary 8.8 sq.mi.

Strip Mine Tributary 6.0 sq.mi.

Francesville Tributary 4.2 sq.mi.

East Fork Tributary 9.8 sq.mi.

Blaney Tributary 1.6 sq.mi.

Markheffel Tributary 5.2 sq.mi.

West Fork Tributary 4.1 sq.mi.

C and S Tributary 2.1 sq.mi.

Ohio Tributary 1.2 sq.mi.

DAVIS RD

BLANEY RD

SH-94

FRANCEVILLE COAL MINE RD

BRADLEY RD

MERIDIAN RD

PEACEFUL VALLEY RD

El Paso County Fountain

LINK RD

MAIN ST

POWERS BLVD

FONTAINE BLVD

DRENNAN RD

C AND S RD

OHIO AVE

BIG JOHNSON RESERVOIR

COLORADO SPRINGS MUNICIPAL AIRPORT

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

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
SOILS MAP
CITY COLORADO SPRINGS

Project No.:	14008
Date:	OCT 2014
Design:	BJW
Drawn:	AFE
Check:	BJW
Revisions:	

II-4

The same process was applied for future condition development assumptions. Fortunately most of this watershed has been planned in detail for future development, see Figure II-3. Information provided by the City of Fountain, City of Colorado Springs and El Paso County planning departments was vital in developing a composite map of future land development. Several large planning developments were utilized accounting for two-thirds of the watershed area. These include: Banning Lewis Ranch [27 square miles], City of Fountain Comprehensive Plan [7 square miles], West Fork Tributary 2003 DBPS [4 square miles], Rolling Hills Ranch [3 square miles], Lorson Ranch [2 square miles], and Norris Ranch [2 square miles], see Figure II-2. Future projections were made on the remaining lands with the assistance of County planners to define a highly detailed and accurate future conditions land use map. The weighted curve number for the watershed under future development conditions is 79 with an average percent imperviousness of 43%. Per the DCM standards Soil Group A was not used for areas of future urban development. Where development is planned on A soils, Soil Group B soils were applied.

Tables III-3A and III-3B describe the percent imperviousness and curve number relationship for each of the different land use categories and moisture condition. Information used in Table III-3A is based on the Drainage Criteria Manual Table 5-5 for a 24-hour storm, Antecedent Moisture Condition II. Information presented in Table III-3B was derived using methods recommended by NRCS when determining curve numbers representative of Antecedent Moisture Condition I.

In order to calibrate the HEC-HMS model to better match the stream gauge data for the 2004, 2005 and 2006 storms it was found that the AMC I moisture condition was more realistic than assuming a AMC II condition. A check of the antecedent moisture condition for the 2004, 2005 and 2006 events revealed that none of these storms was preceded by measurable rainfall in the seven days prior to the storm. It was therefore decided to utilize the AMC I moisture condition when calibrating the existing condition HEC-HMS model for the 2-year and 5-year storm events.

Table III-3A
Land Use Curve Number Index
Antecedent Moisture Condition II

Category		% Impervious	Hydrologic Soils Group A	B	C	D
Undeveloped, Open Space		2 - 5	39	61	74	80
Parks, Golf Course		5 - 10	49	69	79	84
Residential Very Low	[<1 du/ac]	10 – 20	n/a	68	79	84
Residential Low-Med	[1-8 du/ac]	40 – 50	n/a	75	83	87
Residential Med-High	[8-12 du/ac]	50 – 60	n/a	80	87	90
Residential High	[12-24 du/ac]	60 – 70	n/a	85	90	92
Industrial, Mixed Use		70 – 80	n/a	88	91	93
Commercial		80 – 90	n/a	92	94	95
Public Facilities			….. specific to each site …..			

Table III-3B
Land Use Curve Number Index
Antecedent Moisture Condition I

Category		% Impervious	Hydrologic Soils Group A	B	C	D
Undeveloped, Open Space		2 - 5	23	41	56	63
Parks, Golf Course		5 - 10	30	50	62	69
Residential Very Low	[<1 du/ac]	10 – 20	n/a	49	62	69
Residential Low-Med	[1-8 du/ac]	40 – 50	n/a	57	68	72
Residential Med-High	[8-12 du/ac]	50 – 60	n/a	63	72	78
Residential High	[12-24 du/ac]	60 – 70	n/a	70	78	80
Industrial, Mixed Use		70 – 80	n/a	76	79	85
Commercial		80 – 90	n/a	80	86	87
Public Facilities			….. specific to each site …..			

3.8 Calibration of the HEC-HMS Model for the 2-year and 5-year Frequencies

The result of the Storm Rainfall Analysis, as described above in Section 3.2, provided 163 "pseudo"-rain gauge stations each covering one-half square mile in area and a time increment of 6 minutes. Each of these pseudo-gauges was input in the existing conditions HEC-HMS model and the nearest sub-basins were assigned to the pseudo-gauge within that one-half square mile area. The August 2004 storm was first run with CN-values corresponding to AMC-II moisture conditions. This produced a peak flow of 1,950 cubic feet per second with a runoff volume of 378 acre-feet. This result is significantly higher than the gauge reading, similar to what was previously determined for the 2- and 5-year existing condition (un-calibrated) model results.

The first calibration adjustment was made in the Antecedent Moisture Condition [AMC]. Standard criteria calls for the use of an AMC II condition that produces curve number values, as shown in Table III-3A, based on an assumption of "average" moisture levels in the soils. The Jimmy Camp Creek watershed falls in a semi-arid climatological region. The typical soil moisture condition in this area is drier than "average" levels. Furthermore, an analysis of the previous seven-day precipitation records show that little to no rainfall occurred prior to the storm events analyzed. In the previous seven days, the 2004 storm had 0.22 inches of cumulative rainfall, the 2005 storm had 0.0 inches, and the 2006 storm had 0.49 inches. Based on this, the moisture condition was adjusted to AMC I values as depicted in Table III-3B. Lower curve numbers correlate to greater infiltration capacity of soils, which results in less runoff, both in volume and in peak flow. This adjustment seems to be consistently reliable for frequent storm events like the 2-year and 5-year storms.

Use of the NEXRAD data provides a measurable means to evaluate actual rainfall in the area. Combining measured rainfall with the measured stream gauge hydrographs allows a calibration approach to adjust specific model input parameters to target a measured result. Analysis of the AMC I calibrated 2004 storm produced similar runoff volumes to the gauge data with slightly lower peak flows. Figure III-4 shows hydrograph comparisons between the gauge reading and HEC-HMS AMC I calibrated model output. The 2004 gauge hydrograph produces a volume of 25.6 acre-feet, while the HEC-HMS model volume produces 46.6 acre-feet. This volume difference can be attributed to numerous watershed features, such as, irrigation ditch diversions, small agricultural pond storage, local surface depression storage, storage in

Table III-10

Hydrology Results - Peak Flows

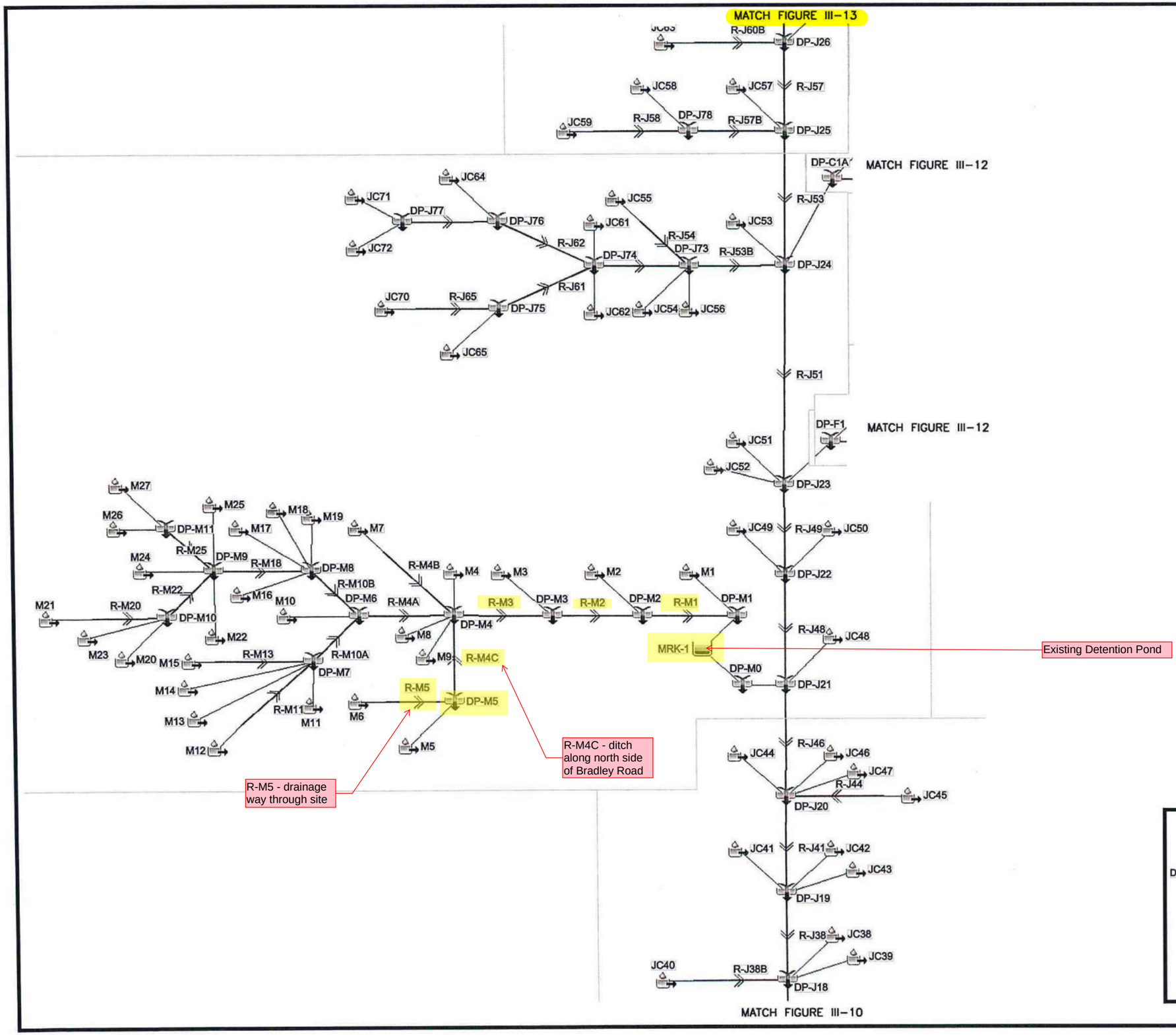
			24hr - Type II AMCII		6hr - AMC I	
Existing Conditions						
Location	Area (sq.mi.)	Model ID	Q100 (cfs)	Q10 (cfs)	Q5 (cfs)	Q2 (cfs)
Outfall to Fountain Creek	67.11	DP-J1	22,094	9,443	438	112
Ohio Avenue	66.11	DP-J3	22,139	9,447	441	113
Link Road	60.93	DP-J9	21,878	9,310	447	114
Confluence with West Fork	59.77	DP-J12	21,875	9,296	451	116
Confluence with East Fork	53.92	DP-J16	21,784	9,243	455	122
Peaceful Valley Road	44.16	DP-J17	17,709	7,731	385	105
Confluence with Marksheffel Trib	41.99	DP-J21	17,361	7,667	386	108
Bradley Road	36.64	DP-J22	16,502	7,153	374	106
Confluence with Franceville Trib	36.19	DP-J23	16,422	7,119	377	108
Confluence with Corral Trib	31.60	DP-J24	15,382	6,834	378	110
Drennan Road	14.84	DP-J25	5,881	2,509	163	56
*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***						
State Highway 94	9.62	DP-J31	5,031	2,300	210	76
Confluence with Blaney Trib	6.39	DP-J40	4,107	1,959	202	76
Jimmy Camp u/s of Blaney	4.67	DP-J41	2,773	1,245	116	48
Corral Tributary	8.25	DP-C4	6,212	2,885	197	52
East Fork Tributary	9.77	DP-E1	4,677	2,030	123	30
Marksheffel Tributary	5.18	DP-M1	1,916	832	42	12
Strip Mine Tributary	5.18	DP-SM2	4,627	2,451	248	98
Franceville Tributary	4.23	DP-F5	1,515	640	28	8
C and S Tributary	2.07	DP-CS1	1,770	898	72	19
Blaney Tributary	1.55	DP-B1	1,927	1,102	131	61
Ohio Tributary	1.22	DP-O1	661	268	4	0

	24hr - Type II AMCII		6hr - AMC I	
Future Conditions				
Location	Q100	Q10	Q5	Q2
Outfall to Fountain Creek	31,986	15,806	7,293	4,525
Ohio Avenue	32,149	15,921	7,296	4,529
Link Road	31,934	15,836	7,235	4,517
Confluence with West Fork	32,064	15,897	7,232	4,521
Confluence with East Fork	32,547	16,080	7,221	4,521
Peaceful Valley Road	26,734	13,402	6,053	3,833
Confluence with Marksheffel Trib	26,531	13,371	5,963	3,783
Bradley Road	23,508	11,856	5,089	3,079
Confluence with Franceville Trib	23,413	11,812	5,071	3,069
Confluence with Corral Trib	22,741	11,473	4,946	3,004
Drennan Road	10,248	5,846	2,278	1,395
*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***				
State Highway 94	7,135	3,613	1,532	926
Confluence with Blaney Trib	5,793	3,031	1,191	756
Jimmy Camp u/s of Blaney	4,150	2,003	791	486
Corral Tributary	7,274	3,497	1,383	827
East Fork Tributary	6,607	3,223	1,512	847
Marksheffel Tributary	6,254	3,830	1,404	1,037
Strip Mine Tributary	5,103	2,743	1,038	681
Franceville Tributary	1,927	824	324	172
C and S Tributary	2,695	1,459	435	291
Blaney Tributary	2,638	1,559	416	296
Ohio Tributary	1,566	796	193	121

Table III-11

Hydrology Results - Volume

		Existing Conditions					Future Conditions				
Location	Area (sq.mi.)	Model ID	Q100 (acft)	Q10 (acft)	Q5 (acft)	Q2 (acft)	Location	Q100 (acft)	Q10 (acft)	Q5 (acft)	Q2 (acft)
Outfall to Fountain Creek	67.11	DP-J1	5,441	2,720	179	72	Outfall to Fountain Creek	7,481	4,188	2,076	1,360
Ohio Avenue	66.11	DP-J3	5,395	2,715	176	71	Ohio Avenue	7,440	4,196	2,080	1,340
Link Road	60.93	DP-J9	5,070	2,567	162	65	Link Road	6,987	3,965	1,950	1,300
Confluence with West Fork	59.77	DP-J12	5,005	2,518	159	64	Confluence with West Fork	6,885	3,921	1,913	1,275
Confluence with East Fork	53.92	DP-J16	4,573	2,329	144	58	Confluence with East Fork	6,327	3,595	1,697	1,122
Peaceful Valley Road	44.16	DP-J17	3,650	1,837	118	47	Peaceful Valley Road	5,181	2,944	1,389	942
Confluence with Marksheffel Trib	41.99	DP-J21	3,538	1,791	112	45	Confluence with Marksheffel Trib	4,971	2,844	1,344	896
Bradley Road	36.64	DP-J22	3,185	1,622	98	39	Bradley Road	4,182	2,345	1,075	703
Confluence with Franceville Trib	36.19	DP-J23	3,165	1,621	96	39	Confluence with Franceville Trib	4,149	2,335	1,061	695
Confluence with Corral Trib	31.60	DP-J24	2,932	1,534	101	34	Confluence with Corral Trib	4,011	2,258	1,028	674
Drennan Road	14.84	DP-J25	1,187	593	40	16	Drennan Road	1,883	1,100	538	372
*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***							*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***				
State Highway 94	9.62	DP-J31	892	462	41	15	State Highway 94	1,256	728	349	231
Confluence with Blaney Trib	6.39	DP-J40	665	361	37	17	Confluence with Blaney Trib	815	464	211	136
Jimmy Camp u/s of Blaney	4.67	DP-J41	434	227	20	7	Jimmy Camp u/s of Blaney	561	312	140	87
Corral Tributary	8.25	DP-C4	863	458	35	13	Corral Tributary	981	541	238	145
East Fork Tributary	9.77	DP-E1	1,021	542	42	16	East Fork Tributary	1,240	708	333	214
Marksheffel Tributary	5.18	DP-M1	398	193	11	3	Marksheffel Tributary	859	542	293	213
Strip Mine Tributary	5.18	DP-SM2	588	326	33	14	Strip Mine Tributary	657	375	171	108
Franceville Tributary	4.23	DP-F5	311	158	9	2	Franceville Tributary	350	187	76	44
C and S Tributary	2.07	DP-CS1	221	117	9	2	C and S Tributary	263	149	66	42
Blaney Tributary	1.55	DP-B1	216	126	17	7	Blaney Tributary	233	139	68	46
Ohio Tributary	1.22	DP-O1	87	40	1	0	Ohio Tributary	125	66	26	15



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

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
HMS MODEL SCHEMATIC
CITY OF COLORADO SPRINGS, COLORADO

Project No.:	14008
Date:	SEPT. 2014
Design:	
Drawn:	BJW
Check:	
Revisions:	

IV. HYDRAULIC ANALYSIS AND FLOODPLAIN DESCRIPTION

4.1 Overview

Hydraulic analyses were conducted to determine the extent flooding along the major drainageways of the Jimmy Camp Creek watershed during a 100-year event assuming existing basin development conditions. The hydraulic analysis also focused on determining the capacity of existing hydraulic structures that may cross over the major drainageways of the Jimmy Camp Creek watershed. Field verifications of major roadway crossings and channel conveyance improvements were conducted and the general physical condition of the structure(s) noted. Finally an effort to "characterize" the existing major drainageway channel sections with respect to environmental resources and stream stability issues was conducted and is summarized in this section of the report.

Hydraulic analyses were conducted using the U.S. Army Corps of Engineers HEC-RAS program, version 4.0. Plan and profile drawings were compiled for the main drainageways of Jimmy Camp Creek and for the Corral, East Fork Jimmy Camp Creek, Strip Mine, Franceville and Marksheffel Tributaries using 2-foot contour interval topographic mapping. The drawings show the existing channel grade, major roadway crossings, 100-year discharge data, 100-year hydraulic grade line, 100-year flood boundary, stream characterization classifications, environmental resources and roadway crossings. Cross-section data for the floodplain analysis was obtained from two-foot contour interval planimetric topographic mapping. The vertical datum for the planimetric mapping is the National Geodetic and Vertical Datum (NGVD) of 1929. The primary source of mapping along Jimmy Camp Creek was taken from the City of Colorado Springs FIMS mapping and the major drainageways within the limits of the City of Fountain and the City of Colorado Springs. Two-foot contour interval planimetric mapping for the portions of the East Fork Jimmy Camp Creek that lie in El Paso County were obtained from private sources associated with the Lorson Ranch and Rolling Hills Ranch land development projects. The capacity of the major roadway crossing structures has been estimated using the HEC-RAS water surface profile data. The hydraulic analysis for Jimmy Camp Creek was initialized by assuming a 100-year water surface at the confluence with Fountain Creek of 5499.5 as obtained from the El Paso County Flood Insurance Study profile. Manning's roughness values for use in modeling the 100-year floodplains were determined through field reviews and photographs. Representatives from the NRCS also provided comments on the roughness values as applied in the hydrologic and hydraulic modeling. The 100-year future baseline hydrologic conditions (i.e., without proposed facilities) and the 100-year existing baseline hydrologic condition profiles were compiled. The floodplain information shown on the drawings has been used primarily for the identification of flood prone areas along the major drainageways and to aid in the evaluation of alternative channel treatments. **The floodplain data contained herein is not intended to replace the information presented in the City of Fountain, City of Colorado Springs and El Paso County Flood Insurance Studies, but should be used as a planning tool for urban drainageway development projects.**

4.2 Reach Delineation

Reaches were delineated for various segments of Jimmy Camp Creek and its major tributaries. The reaches were determined based upon the existing physical condition of the low flow, floodplain, and overbanks along the drainageways. The reach limits are shown in Figure IV-1. Descriptions have been prepared for each reach by means of field visits, which were conducted to ascertain more site-specific information related to existing drainageway conditions. An environmental review of the major reaches was also conducted. The delineation of reaches was carried in order to assist in the evaluation of channel treatments and eventually in the selection of the most feasible plan(s) for long-term stability of the major drainageways within the watershed.

In some cases limits of a planning reach were determined based upon the existing roadways or jurisdictional limits or in other cases upon physical condition of the low flow, floodplain, and overbanks along the drainageways. The reach limits established for the major flow paths are as follows:

Jimmy Camp Creek

Reach J1: Fountain Creek to Link Road
Reach J2: Link Road to Confluence with East Fork Jimmy Camp Creek
Reach J3: Confluence with East Fork Jimmy Camp Creek to Corporate Limits
Reach J4A/B: Corporate Limits to Drennan Road
Reach J5: Drennan Road to SH-94
Reach J6: SH-94 to proposed Jimmy Camp Creek Reservoir Site
Reach J7: Proposed Jimmy Camp Creek Reservoir to upstream limits of floodplain delineation.

East Fork Jimmy Camp Creek

Reach EF1: Confluence of Jimmy Camp Creek to El Paso County Limits
Reach EF2: El Paso County Limits to Meridian Road
Reach EF3: Meridian Road to Upstream Limits of Floodplain Delineation

Marksheffel Tributary

Reach M-1: Confluence with Jimmy Camp Creek to Drennan Road

Franceville Tributary

Reach F1: Confluence with Jimmy Camp Creek to Drennan Road
Reach F2: Drennan Road to Meridian Road

Corral Tributary

Reach C1: Confluence with Jimmy Camp Creek to Drennan Road
Reach C2: Drennan Road to Confluence with Stripmine Tributary
Reach C3: Confluence with Stripmine Tributary to SH-94
Reach C4: SH-94 to Upstream Limits of Floodplain Delineation

Stripmine Tributary

Reach S1: Confluence with Corral Tributary to El Paso County Line
Reach S2: El Paso County Line to Meridian Road

The reaches described above were used in analysis of conceptual alternatives along the major drainageways and flow paths of the Jimmy Camp Creek watershed. No reaches were delineated within the West Fork Jimmy Camp Creek sub-watershed and this area is basically fully developed at this time and has stormwater collection systems that are functioning adequately. Presented on Table IV-1 is a summary of the

El Paso County

0 6000' 12000'
SCALE: 1"=6000'

DAVIS RD
BLANEY RD
BLANEY RD
SH-94
FRANCEVILLE COAL MINE RD
BRADLEY RD
MERIDIAN RD
MERIDIAN RD
PEACEFUL VALLEY RD
DRENNAN RD
BLANEY TRIB
STRIPMINE TRB
FRANCEVILLE TRIB
CORRAL TRIB
EAST FORK JIMMY CAMP CREEK
JIMMY CAMP CREEK
MARKSHEFFEL TRIB
MARKSHEFFEL RD
MARKSHEFFEL RD
LINK RD
POWERS BLVD
FONTAINE BLVD
C ANDS RD
OHIO AVE
OLD PUEBLO
US-24
FOUNTAIN CREEK

El Paso County
Colorado Springs

El Paso County
Colorado Springs

El Paso County
Fountain

Colorado Springs
Widefield

Widefield
Fountain

Colorado Springs

Fountain

J7
J6
J5
C4
C3
C2
C1
S2
S1
F2
F1
E3
E2
E1
J4A
J4B
J3
J2
J1
M1

Bradley Road

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

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
MAJOR DRAINAGEWAY REACH DELINEATION
CITY OF COLORADO SPRINGS, COLORADO

Project No.:	14008
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FIGURE
IV-1

14008-Fig_IV-1.dwg Oct 30, 2014

key characteristics for each reach that has been delineated for the purposes of alternative evaluation. Drainageways serving areas of at least 100-acres will be studied in detail as part of the conceptual planning process, however the reaches determined and explained in this section were developed so that alternatives for the treatments of the major drainageways could be advanced in a systematic way. Detailed topographic mapping is available only for the major drainageways shown on Figure IV-1.

4.3 Hydraulic Structure Inventory

As part of the field investigation, the existing drainage facilities were verified and inventoried. The size, type, and general hydraulic condition were recorded for bridges, culverts, detention basins and miscellaneous drainage features that existing along the major drainageways were inventoried. Hydraulic capacities were estimated for the culverts and bridges over the major drainageways. An inventory of the major structures is presented in Table IV-2. It was assumed that the maximum hydraulic capacity of a roadway crossing was reached when the hydraulic grade line equaled the road surface.

Very limited segments of the major drainageways in the Jimmy Camp Creek watershed have been improved and most of the banks are unlined or naturally lined with vegetation. Where bank linings have been built they exist mostly at the approach and outlet sides of roadway crossings. The 100-year channel capacities were estimated using the HEC-RAS computer program.

One detention basin now exists within the watershed. The detention basin along the Marksheffel Tributary has adequate storage volume to route the 100-year existing and developed discharge downstream to the mainstem of Jimmy Camp Creek.

4.4 Watershed and Flood History

Disagreement has taken place as to the origin of the name "Jimmy Camp Creek," but a consistent thread throughout the years is that an early trapper-trader named Jimmy was killed near the spring at the headwaters of the Jimmy Camp Creek Basin. The legendary campsite was located along an ancient route that connected the Arkansas and Platte Rivers called "The Old Divide Trail," "The Trappers Trail," "The Cherokee Trail," or "Jimmy's Camp Trail" among other names. Jimmy, most likely James Daughtery, appears to date from the early 1830s. The trail and camp had long been used Native Americans by the time the trapper-traders had arrived.

Comanche, Kiowa, Arapahoe, Cheyenne, and Sioux tribes are thought to have lived in the area at times. On-going archaeological excavations by the University of Colorado at Colorado Springs have uncovered evidence documenting prehistoric use during the Developmental Period with radiocarbon dates of about 655 A.D., 1650 A.D. and a third in the range of 1270 A.D. to 1400 A.D. Early hunters migrating into North America may have used the ancient route along the watercourse for thousands of years.

One of the earliest published reports along the trail was by Rufus Sage in 1842 who stated in his journal during his northward travel that "we reached an affluent of Fontaine qui Bouitte, called Daugherty's creek…Our place of stay is a sweet little valley enclosed by piney ridges…the creek derives its name from Daugherty, a trader who was murdered upon it several years ago." Subsequent to Sage's journal entry, many other parties were documented to use the route up the basin. Among them are Lt. John C. Fremont (1843), Francis Parkman (1846), a band of Mormon emigrants (1846-7), bands of Cherokees (1849 and 1850), the Loring-Marcy Expedition (1857-58), numerous cattle drives such as the Goodnight-Loving, and the many gold seekers of 1858-59. In general, many people made use of the availability of wood, water and grass on the easiest crossing of the Platte-Arkansas Divide.

Settlement during the homesteading era produced many farms and ranches in the basin. Prior to the fencing movement, an annual round-up known as the "Jimmy Camp Round-up" occurred and herded the cattle toward Corral Bluffs on the east edge of the basin to separate the cattle. Well into the 1900s, farmers and ranchers traveling to Colorado Springs from eastern El Paso County would camp on their way into and out of the city where an old county highway passed the historic springs and calling their camp "Farmer's Rest." Many of the ranches too small to be viable became abandoned and were commingled into larger, more viable spreads such as the Banning-Lewis Ranch.

In addition to ranching and dairy farms, coal, sand and gravel mining have occurred in the basin. Railroads traversed the basin to support the dairy, ranching and mining industries, with spurs such as the one to the Franceville Coal Mine. The Fountain Mutual Irrigation Canal and Chilcotte Ditch No. 27 originating at Fountain Creek supplied irrigation water to fields around the City of Fountain.

Currently, a large portion of the basin has been annexed into the City of Colorado Springs and will be converted to mixed urban uses. A similar situation is predicted to occur in the City of Fountain at the downstream end of the basin. The area remaining in El Paso County will be subject to urbanization, however some of the upper reaches that lie within El Paso County will retain rural residential uses

Throughout recorded history, the Jimmy Camp Basin has always experienced severe weather events with wide fluctuations that include drought, hail, floods and devastating snowstorms. With low population density in the basin prior to the last twenty years, endangerment of lives and damage to property was limited and rarely reported. Infrequent yet potentially dangerous precipitation events need to be kept in mind while planning for development in this basin.

Flooding is mainly occurs in the summer months of May to August during intense rain events of several days duration when a warm, moist air mass from the Gulf of Mexico collides with a colder air mass from the north. Although frequently severe, isolated summer thunderstorms rarely cause major flooding as they tend to be limited in area and duration.

Heavy snowstorms and rainstorms are caused by similar meteorological patterns, but snowstorms do not typically cause floods as peak flows are attenuated by snowmelt. A few early accounts snowstorms will be conveyed here to illustrate the intermittent, but severe events that have taken place in the past. During the Loring-Marcy military expedition of 1858, a snowstorm started on April 29 on "a mild and pleasant spring day, with no appearance of bad weather, but as night approached it became cloudy, and about dark a

Table IV-2: Existing Major Drainageway Structure Inventory

Drainageway	Drainage Structure Description	Structure Inventory #	Roadway	Structure Condition	Inlet Channel Condition	Outlet Channel Condition	Existing 100-year (cfs)	Structure Capacity (cfs)	% of Existing 100-year Q
Jimmy Camp Creek	360' Bridge 3-spans	PR1	Old Pueblo Road	Good to Fair	Good	Fair	22,100	>24000	100
	244' Bridge Mulit-span	RR1	D & RGW RR	Good to Fair	Good to Fair	Good to Fair	22,100	>>24000	100
	220' Bridge 3-spans	O1	Ohio Avenue	Good to Fair	Good to Fair	Fair	22,100	19800	95
	190' Bridge 3-spans	LR1	Link Road	Good	Good Floodplain well vegetated	Poor Headcut at outlet	21,880	26000	100
	4-48" X 29" CMP	PV1	Peaceful Valley Road	Poor Mostly clogged	Poor	Poor	17,360	< 200	<5
	Bridge	FB1	Fontaine Boulevard	Good	Good	Good Riprap channel	15,380	>16000	100
	360' Bridge 3-spans	B2	Bradley Road	Good	Fair	Fair Bank sloughing along west bank	15,380	>18000	100
	54' Bridge 2-spans	DR3	Drennan Road	Fair	Good	Low flow stable	5,760	>6500	100
	160' Bridge 4-spans	NF2	State Highway 94	Good	Good to Fair	Fair Bank sloughing along west bank	4,760	15000	100
East Fork Jimmy Camp Creek	Twin CBC 8' x 12'	B4	Bradley Road	Good	Good Channel poorly defined	Good Channel poorly defined	2,860	2400	84
	54' Bridge 2-spans	DR5	Drennan Road	Poor to Fair	Good	Good	1,720	>3000	100
	2-43" X 29" CMP	M7	Meridian Road	Inlet bent Outlet rusted	Poor	Poor	1,610	140	<10
Marksheffel Tributary	Twin 72-inch CMP	MS2	Marksheffel Road	Poor No wingwalls	Good	Fair	950	300	32
	Detention Basin	MK1	Marksheffel Road	Good	Good	Poor	1,920 in/950 out	na	100
	Triple 7' X 12' CBC	B3	Bradley Road	Good	Good Well vegetated	Good Well vegetated	1,640	2800	100
Corral Tributary	80' Bridge 2-spans	DR4	Drennan Road	Fair Wingwalls in poor condition	Good Sand invert	Poor Bank sloughing on west bank	11,550	>40000	100
	Triple 12' X 10' CBC	NF12	State Hghway 94	Good	Fair Wide sand invert	Fair Wide sand invert	3,230	>3750	100

Ultimate Site Outfall (Pond)

Pond outfall

(1) Bridge capacity equal to the bridge area below the low chord at a velocity of 10 feet per second. Culvert capacity based upon inlet control at a HW/D equal to 1.

Table V-2
Sub-Regional and Regional Detention System Hydrology Results - Peak Flows

Location	Area (sq.mi.)	Model ID	Existing Conditions Q100 (cfs)	Sub-Regional Detention Q100 (cfs)	Regional Detention Q100 (cfs)
Outfall to Fountain Creek	67.11	DP-J1	22,094	19,871	21,457
Ohio Avenue	66.11	DP-J3	22,139	19,820	21,430
Link Road	60.93	DP-J9	21,878	19,326	20,994
Confluence with West Fork	59.77	DP-J12	21,875	19,210	20,906
Confluence with East Fork	53.92	DP-J16	21,784	18,921	20,686
Peaceful Valley Road	44.16	DP-J17	17,709	16,558	16,881
Confluence with Marksheffel Trib	41.99	DP-J21	17,361	16,134	16,500
Bradley Road	36.64	DP-J22	16,502	14,136	14,494
Confluence with Franceville Trib	36.19	DP-J23	16,422	14,045	14,412
Confluence with Corral Trib	31.60	DP-J24	15,382	13,673	14,071
Drennan Road	14.84	DP-J25	5,881	3,730	3,590
*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***					
State Highway 94	9.62	DP-J31	5,031	5,004	3,957
Confluence with Blaney Trib	6.39	DP-J40	4,107	4,762	4,762
Jimmy Camp u/s of Blaney	4.67	DP-J41	2,773	3,503	3,503
Corral Tributary	8.25	DP-C4	6,212	4,052	6,678
East Fork Tributary	9.77	DP-E1	4,677	2,847	3,814
Marksheffel Tributary	5.18	DP-M1	1,916	3,686	3,686
Strip Mine Tributary	5.18	DP-SM2	4,627	3,859	3,859
Franceville Tributary	4.23	DP-F5	1,515	1,261	1,261
C and S Tributary	2.07	DP-CS1	1,770	1,875	1,875
Blaney Tributary	1.55	DP-B1	1,927	2,064	2,064
Ohio Tributary	1.22	DP-O1	661	979	979

CONCEPTUAL DESIGN PLAN & PROFILES

SCALE: 1"=6000'

DRAWING INDEX	
1	- COVER SHEET
2	- TYP. FLOODPLAIN PRESERVATION SECTION & DETAILS
3	- TYPICAL FLOODPLAIN PRESERVATION PLAN
4	- TYP. BENCHED CHANNEL SECTION & TYP. BANK DETAILS
5	- TYPICAL FULL SPECTRUM STORAGE BASIN
1JC-30JC	- JIMMY CAMP CREEK
1EF-10EF	- EAST FORK JIMMY CAMP CREEK
1M-3M	- MARKSHEFFEL TRIBUTARY
1FR-5FR	- FRANCEVILLE TRIBUTARY
1C-9C	- CORRAL TRIBUTARY
1SM-5SM	- STRIPMINE TRIBUTARY

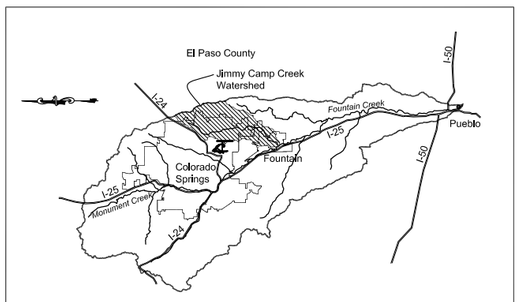
DAVIS RD
BLANEY RD
SH-94
FRANCEVILLE COAL MINE RD
BRADLEY RD
MERIDIAN RD
STRIPMINE TRIB
EAST FORK JIMMY CAMP CREEK
PEACEFUL VALLEY RD
El Paso County
Colorado Springs
FRANCEVILLE TRIB
CORRAL TRIB
JIMMY CAMP CREEK
US-24
MARKSHEFFEL RD
MARKSHEFFEL TRIB
DRENNAN RD
WEST FORK JIMMY CAMP CREEK BASIN
(NOT INCLUDED IN THIS STUDY)
POWERS BLVD
LINK RD
C AND S RD
OHIO AVE
MAIN ST
OLD PUEBLO RD
FOUNTAIN CREEK
FONTAINE BLVD
Colorado Springs
Widefield
Fountain
Site location

30JC 29JC 28JC 27JC 26JC 25JC 24JC 23JC 22JC 21JC 20JC 19JC 18JC 17JC 16JC 15JC 14JC 13JC 12JC 11JC 10JC 9JC 8JC 7JC 6bJC 6aJC 5JC 4JC 3JC 2JC 1JC
9C 8C 7C 6C 5C 4C 3C 2C 1C
5SM 4SM 3SM 2SM 1SM
5FR 4FR 3FR 2FR 1FR
10EF 9EF 8EF 7EF 6EF 5EF 4EF 3EF 2EF 1EF
3M 2M 1M

LEGEND

- 100-YR FLOODPLAIN
- STREAM FLOWLINE
- CORPORATE LIMITS
- STABILIZED LOW FLOW CHANNEL
- STABILIZED BANK
- PROPOSED FILL
- POTENTIAL JURISDICTIONAL WETLANDS
- OPEN WATER
- RIPARIAN TREES AND SHRUBS MAY INCLUDE SMALL AREAS OF WETLANDS
- POTENTIAL JURISDICTIONAL WATERS OF THE U.S. MAY INCLUDE SMALL AREAS OF WETLANDS AND/OR RIPARIAN SPECIES

LIMITS OF JURISDICTIONAL WATERS AND WETLANDS ARE INDISTINCT ON THIS TRIBUTARY DUE TO LACK OF AN ORDINARY HIGH WATER MARK IN LOCATIONS. JURISDICTIONAL DETERMINATION WILL NEED TO BE MADE BY THE USACE PRIOR TO CONSTRUCTION.



VICINITY MAP
SCALE: N.T.S.

GENERAL NOTES

1. THESE DRAWINGS ARE PLANNING EXHIBITS REPRESENTING CONCEPTUAL ENGINEERING AND ARE SUBJECT TO REFINEMENT. THESE DRAWINGS SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.
2. FLOODPLAIN BOUNDARIES ARE FOR PLANNING INFORMATION ONLY AND ARE NOT INTENDED TO BE USED FOR FLOODPLAIN REGULATION OR MANAGEMENT.
3. ALL FLOW RATES SHOWN ON PLAN & PROFILES ARE NOTED AS "EX" FOR EXISTING CONDITION. EXISTING CONDITION FLOWS EQUAL PROPOSED DEVELOPMENT CONDITION WITH THE IMPLEMENTATION OF FULL SPECTRUM DETENTION.
4.

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

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
CONCEPTUAL DESIGN PLANS
CITY OF COLORADO SPRINGS, COLORADO

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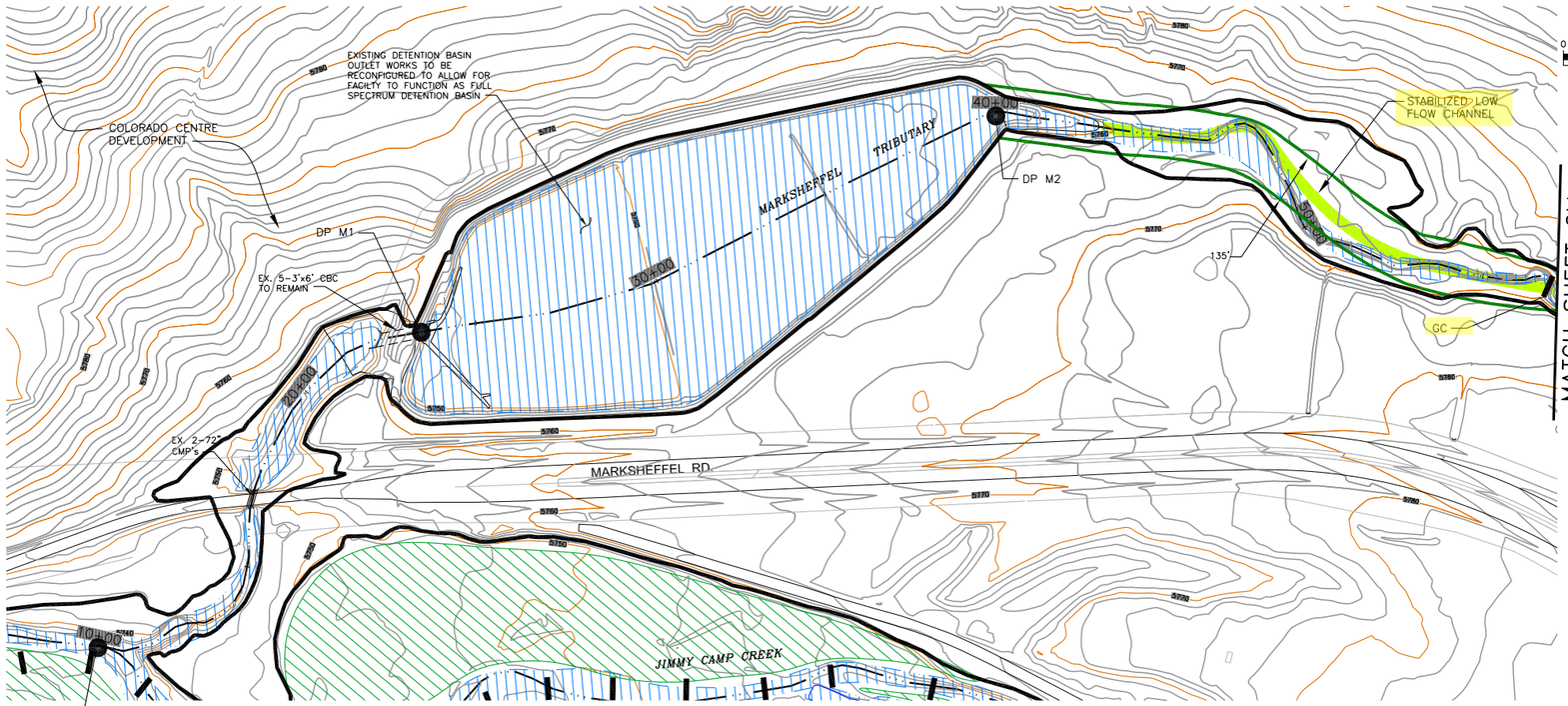
Revisions:	

COVER SHEET



LEGEND

- 100-YR FLOODPLAIN
- STREAM FLOWLINE
- CORPORATE LIMITS
- STABILIZED LOW FLOW CHANNEL
- STABILIZED BANK
- PROPOSED FILL
- POTENTIAL JURISDICTIONAL WETLANDS
- OPEN WATER
- RIPARIAN TREES AND SHRUBS MAY INCLUDE SMALL AREAS OF WETLANDS
- POTENTIAL JURISDICTIONAL WATERS OF THE U.S. MAY INCLUDE SMALL AREAS OF WETLANDS AND/OR RIPARIAN SPECIES

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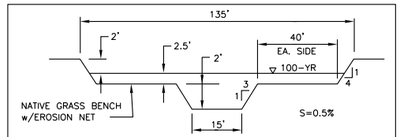
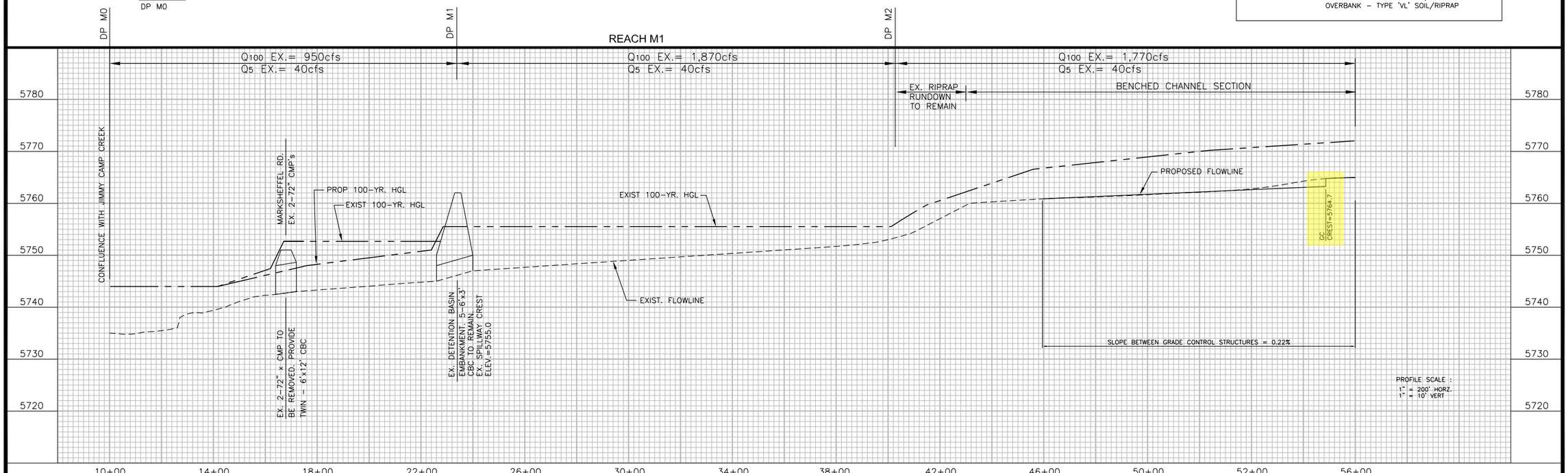
DISCHARGES UPSTREAM OF DP M0 HAD NO AREA ADJUSTMENT APPLIED



BENCHED CHANNEL SECTION
DP M2 TO M3

LINING MATERIAL: LOW FLOW – TYPE 'L' SOIL/RIPRAP
OVERBANK – TYPE 'VL' SOIL/RIPRAP



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

JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY
MARKSHEFFEL TRIBUTARY

CONCEPTUAL DESIGN PLAN & PROFILE
CITY OF COLORADO SPRINGS, COLORADO

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1M

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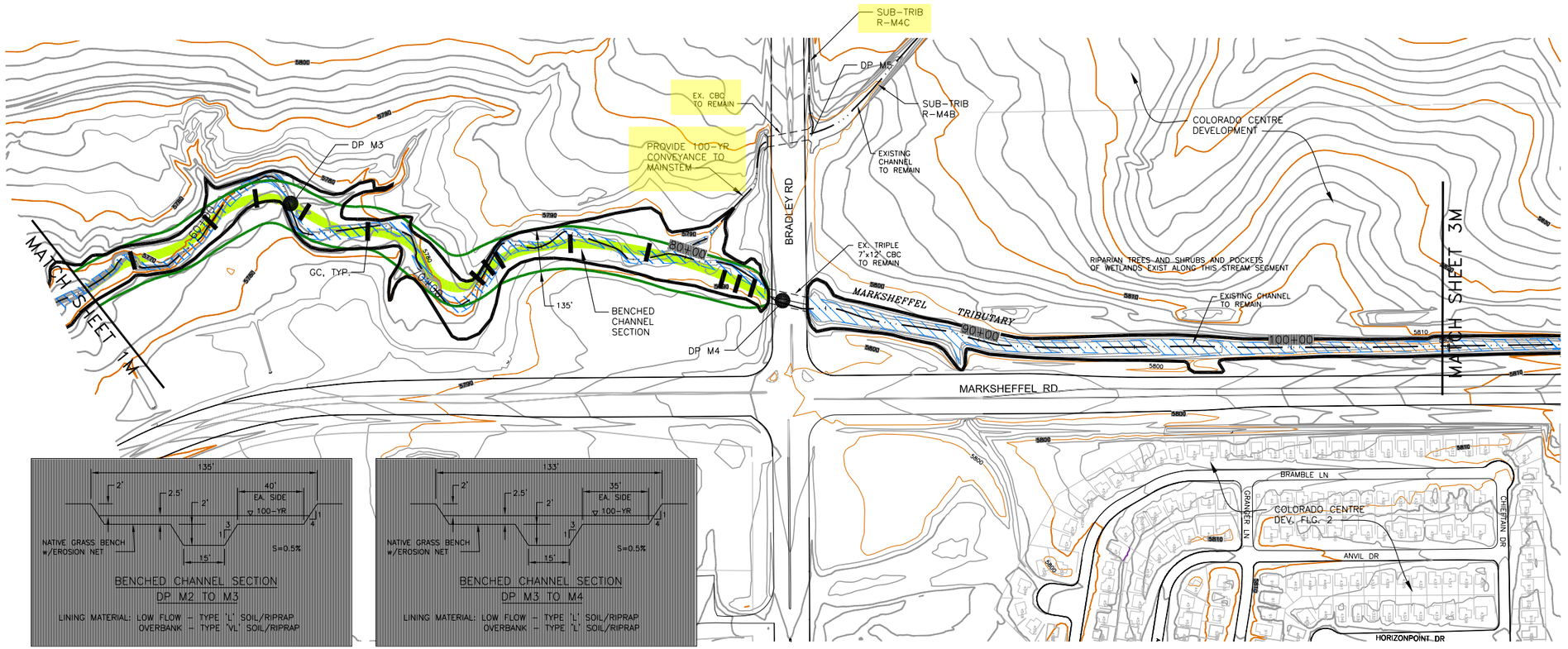

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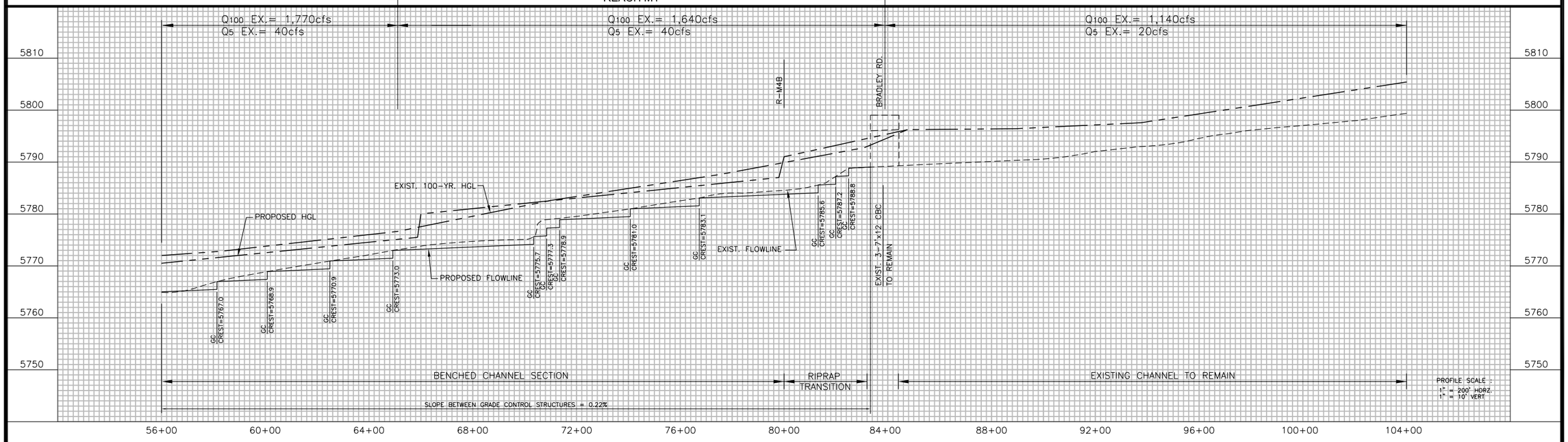
DISCHARGES UPSTREAM OF DP M0 HAD NO AREA ADJUSTMENT APPLIED



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

JIMMY CAMP CREEK DRAINAGE BASIN PLANNING STUDY
MARKSHEFFEL TRIBUTARY
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2M

14008-2M-764cdpp.dwg/Aug 25, 2014

Table III-10
Hydrology Results - Peak Flows

			24hr - Type II AMCII		6hr - AMC I	
			Existing Conditions			
Location	Area (sq.mi.)	Model ID	Q100 (cfs)	Q10 (cfs)	Q5 (cfs)	Q2 (cfs)
Ouffall to Fountain Creek	67.11	DP-J1	22,094	9,443	438	112
Ohio Avenue	66.11	DP-J3	22,139	9,447	441	113
Link Road	60.93	DP-J9	21,878	9,310	447	114
Confluence with West Fork	59.77	DP-J12	21,875	9,296	451	116
Confluence with East Fork	53.92	DP-J16	21,784	9,243	455	122
Peaceful Valley Road	44.16	DP-J17	17,709	7,731	385	105
Confluence with Marksheffel Trib	41.99	DP-J21	17,361	7,667	386	108
Bradley Road	36.64	DP-J22	16,502	7,153	374	106
Confluence with Franceville Trib	36.19	DP-J23	16,422	7,119	377	108
Confluence with Corral Trib	31.60	DP-J24	15,382	6,834	378	110
Drennan Road	14.84	DP-J25	5,881	2,509	163	56
*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***						
State Highway 94	9.62	DP-J31	5,031	2,300	210	76
Confluence with Blaney Trib	6.39	DP-J40	4,107	1,959	202	76
Jimmy Camp u/s of Blaney	4.67	DP-J41	2,773	1,245	116	48
Corral Tributary	8.25	DP-C4	6,212	2,885	197	52
East Fork Tributary	9.77	DP-E1	4,677	2,030	123	30
Marksheffel Tributary	5.18	DP-M1	1,916	832	42	12
Strip Mine Tributary	5.18	DP-SM2	4,627	2,451	248	98
Franceville Tributary	4.23	DP-F5	1,515	640	28	8
C and S Tributary	2.07	DP-CS1	1,770	898	72	19
Blaney Tributary	1.55	DP-B1	1,927	1,102	131	61
Ohio Tributary	1.22	DP-O1	661	268	4	0

	24hr - Type II AMCII		6hr - AMC I	
	Future Conditions			
Location	Q100	Q10	Q5	Q2
Ouffall to Fountain Creek	31,986	15,806	7,293	4,525
Ohio Avenue	32,149	15,921	7,296	4,529
Link Road	31,934	15,836	7,235	4,517
Confluence with West Fork	32,064	15,897	7,232	4,521
Confluence with East Fork	32,547	16,080	7,221	4,521
Peaceful Valley Road	26,734	13,402	6,053	3,833
Confluence with Marksheffel Trib	26,531	13,371	5,963	3,783
Bradley Road	23,508	11,856	5,089	3,079
Confluence with Franceville Trib	23,413	11,812	5,071	3,069
Confluence with Corral Trib	22,741	11,473	4,946	3,004
Drennan Road	10,248	5,846	2,278	1,395
*** areal adjustment not applied to rainfall for drainage areas less than 10 square miles ***				
State Highway 94	7,135	3,613	1,532	926
Confluence with Blaney Trib	5,793	3,031	1,191	756
Jimmy Camp u/s of Blaney	4,150	2,003	791	486
Corral Tributary	7,274	3,497	1,383	827
East Fork Tributary	6,607	3,223	1,512	847
Marksheffel Tributary	6,254	3,830	1,404	1,037
Strip Mine Tributary	5,103	2,743	1,038	681
Franceville Tributary	1,927	824	324	172
C and S Tributary	2,695	1,459	435	291
Blaney Tributary	2,638	1,559	416	296
Ohio Tributary	1,566	796	193	121

Existing 100 year without areal adjustment 24-hr Type II Storm

	Area	Q100	Volume (in)	acft	ac	cfs/ac
DP-J51	0.13	40.80	0.74	5.12	83.01	0.49
DP-J6	63.54	24975.00	1.72	5828.97	40667.20	0.61
DP-J7	63.36	24963.50	1.73	5845.80	40548.93	0.62
DP-J70	0.29	195.90	1.54	24.03	187.26	1.05
DP-J71	0.40	332.50	1.93	40.73	253.25	1.31
DP-J72	0.38	317.50	2.04	41.82	246.02	1.29
DP-J73	1.77	1083.60	1.85	174.93	1134.66	0.96
DP-J74	1.25	829.40	1.85	123.54	801.34	1.04
DP-J75	0.37	271.40	1.87	37.25	239.04	1.14
DP-J76	0.61	410.10	1.82	58.81	387.78	1.06
DP-J77	0.40	272.30	1.77	37.48	254.08	1.07
DP-J78	0.47	290.50	1.52	38.39	303.10	0.96
DP-J79	0.74	496.00	1.65	65.51	476.42	1.04
DP-J8	63.18	24975.60	1.73	5829.70	40437.25	0.62
DP-J80	0.33	97.20	0.96	16.86	210.69	0.46
DP-J81	0.52	356.80	1.68	46.23	330.24	1.08
DP-J82	0.63	543.10	1.77	59.67	404.54	1.34
DP-J83	0.29	27.60	0.45	7.02	187.33	0.15
DP-J84	0.54	237.50	1.32	38.33	348.42	0.68
DP-J85	0.33	228.70	1.69	29.35	208.38	1.10
DP-J86	0.40	282.70	1.49	31.56	254.14	1.11
DP-J9	60.93	24769.50	1.73	5622.04	38996.80	0.64
DP-M0	5.18	945.60	1.44	397.95	3316.22	0.29
DP-M1	5.18	1915.90	1.44	397.95	3316.22	0.58
DP-M10	0.58	200.10	1.02	31.36	368.90	0.54
DP-M11	0.37	35.70	0.56	11.16	239.17	0.15
DP-M2	5.02	1865.20	1.42	380.41	3214.72	0.58
DP-M3	4.80	1767.50	1.39	355.97	3073.09	0.58
DP-M4	4.57	1642.90	1.35	329.19	2926.14	0.56
DP-M5	0.40	186.80	1.10	23.67	258.18	0.72
DP-M6	3.28	1136.30	1.23	215.46	2102.02	0.54
DP-M7	0.71	321.60	1.31	49.30	451.58	0.71
DP-M8	2.44	753.80	1.19	154.86	1561.60	0.48
DP-M9	1.37	300.50	0.87	63.48	875.58	0.34
DP-O1	1.22	660.80	1.33	86.56	780.99	0.85
DP-O2	1.08	624.20	1.37	79.06	692.48	0.90
DP-O3	0.96	596.90	1.43	73.13	613.70	0.97
DP-O5	0.82	570.90	1.56	68.51	526.98	1.08
DP-O6	0.38	264.30	1.56	31.48	242.18	1.09
DP-SM1	0.21	523.00	18.25	206.64	135.87	3.85
DP-SM10	2.45	2669.00	2.44	318.90	1568.38	1.70
DP-SM11	0.41	521.20	2.70	58.46	259.84	2.01
DP-SM12	0.60	776.80	2.57	82.71	386.18	2.01
DP-SM13	0.44	598.60	2.72	64.03	282.50	2.12
DP-SM14	1.70	1818.80	2.39	216.90	1089.02	1.67
DP-SM15	1.30	1403.80	2.42	167.22	829.18	1.69
DP-SM16	0.44	542.40	2.63	61.76	281.79	1.92
DP-SM17	0.76	811.40	2.41	97.61	486.02	1.67
DP-SM18	0.45	552.30	2.71	65.39	289.54	1.91
DP-SM1A	0.00	472.20		#VALUE!	0.00	#DIV/0!

Existing 100 year without areal adjustment 24-hr Type II Storm

	Area	Q100	Volume (in)	acft	ac	cfs/ac
JC77	0.25	192.10	1.99	27.03	163.01	1.18
JC78	0.12	48.20	1.40	8.97	76.86	0.63
JC79	0.15	122.80	1.90	14.85	93.76	1.31
JC8	0.20	101.70	1.32	14.21	129.15	0.79
JC80	0.21	284.90	2.40	26.69	133.44	2.14
JC81	0.19	126.50	1.68	16.75	119.62	1.06
JC82	0.22	121.20	1.76	20.58	140.29	0.86
JC83	0.28	150.20	1.91	28.46	178.82	0.84
JC84	0.14	76.10	1.71	12.32	86.46	0.88
JC85	0.25	158.10	1.89	25.67	163.01	0.97
JC86	0.18	178.80	1.92	18.15	113.41	1.58
JC87	0.17	115.00	1.47	13.05	106.56	1.08
JC88	0.19	146.30	1.71	17.46	122.56	1.19
JC89	0.10	110.20	2.14	11.06	62.02	1.78
JC9	0.14	86.00	1.49	10.89	87.68	0.98
JC90	0.20	204.80	2.07	22.57	130.82	1.57
JC91	0.10	119.90	2.29	12.74	66.75	1.80
JC92	0.12	103.00	1.77	10.96	74.30	1.39
JC93	0.20	65.80	0.80	8.47	126.98	0.52
JC94	0.22	141.20	1.46	17.45	143.42	0.98
JC95	0.20	18.60	0.44	4.67	127.23	0.15
JC96	0.09	11.70	0.45	2.25	60.10	0.19
JC97	0.22	181.80	1.84	21.51	140.29	1.30
JC98	0.14	79.40	1.33	10.02	90.37	0.88
JC99	0.18	109.80	1.30	12.42	114.62	0.96
M1	0.16	162.80	2.28	19.29	101.50	1.60
M10	0.14	73.30	1.76	13.03	88.83	0.83
M11	0.11	91.60	1.88	10.82	69.06	1.33
M12	0.17	80.70	1.22	10.80	106.24	0.76
M13	0.23	83.50	1.10	13.24	144.45	0.58
M14	0.11	76.50	1.67	10.12	72.70	1.05
M15	0.09	39.70	0.88	4.34	59.14	0.67
M16	0.23	104.20	1.29	15.97	148.54	0.70
M17	0.28	245.90	2.08	31.55	182.02	1.35
M18	0.26	169.60	1.75	23.84	163.46	1.04
M19	0.30	135.20	1.32	21.12	192.00	0.70
M2	0.22	205.40	2.27	26.79	141.63	1.45
M20	0.14	52.80	1.22	9.10	89.54	0.59
M21	0.23	126.60	1.23	15.02	146.56	0.86
M22	0.10	15.00	0.51	2.81	66.11	0.23
M23	0.21	30.00	0.66	7.30	132.80	0.23
M24	0.16	90.80	1.31	10.87	99.58	0.91
M25	0.16	54.70	0.88	7.47	101.82	0.54
M26	0.18	22.00	0.67	6.38	114.30	0.19
M27	0.20	13.80	0.47	4.89	124.86	0.11
M3	0.23	205.10	2.23	27.31	146.94	1.40
M4	0.23	190.70	2.03	25.07	148.22	1.29
M5	0.18	128.50	1.51	14.48	115.07	1.12
M6	0.22	63.70	0.77	9.18	143.10	0.45
M7	0.17	138.70	1.52	13.75	108.54	1.28

	Existing 100-year with areal adjustment				24-hour Type II Storm	
	Area (SM)	Q100	Volume (in)	acft	ac	cfs/ac
DP-J51	0.13	32.70	0.63	4.36	83.01	0.39
DP-J6	63.54	22055.70	1.56	5286.74	40667.20	0.54
DP-J7	63.36	22046.80	1.56	5271.36	40548.93	0.54
DP-J70	0.29	172.50	1.37	21.38	187.26	0.92
DP-J71	0.40	297.90	1.74	36.72	253.25	1.18
DP-J72	0.38	286.00	1.85	37.93	246.02	1.16
DP-J73	1.77	967.00	1.66	156.96	1134.66	0.85
DP-J74	1.25	741.80	1.67	111.52	801.34	0.93
DP-J75	0.37	242.80	1.69	33.66	239.04	1.02
DP-J76	0.61	366.60	1.64	53.00	387.78	0.95
DP-J77	0.40	242.90	1.59	33.67	254.08	0.96
DP-J78	0.47	254.90	1.36	34.35	303.10	0.84
DP-J79	0.74	439.20	1.47	58.36	476.42	0.92
DP-J8	63.18	22052.60	1.56	5256.84	40437.25	0.55
DP-J80	0.33	82.10	0.83	14.57	210.69	0.39
DP-J81	0.52	316.60	1.51	41.56	330.24	0.96
DP-J82	0.63	484.30	1.59	53.60	404.54	1.20
DP-J83	0.29	20.20	0.37	5.78	187.33	0.11
DP-J84	0.54	206.10	1.17	33.97	348.42	0.59
DP-J85	0.33	202.90	1.52	26.40	208.38	0.97
DP-J86	0.40	248.20	1.33	28.17	254.14	0.98
DP-J9	60.93	21878.40	1.56	5069.58	38996.80	0.56
DP-M0	5.18	882.10	1.29	356.49	3316.22	0.27
DP-M1	5.18	1680.50	1.29	356.49	3316.22	0.51
DP-M10	0.58	170.80	0.89	27.36	368.90	0.46
DP-M11	0.37	28.20	0.47	9.37	239.17	0.12
DP-M2	5.02	1634.20	1.27	340.22	3214.72	0.51
DP-M3	4.80	1545.40	1.24	317.55	3073.09	0.50
DP-M4	4.57	1432.80	1.20	292.61	2926.14	0.49
DP-M5	0.40	159.20	0.96	20.65	258.18	0.62
DP-M6	3.28	968.10	1.09	190.93	2102.02	0.46
DP-M7	0.71	270.50	1.16	43.65	451.58	0.60
DP-M8	2.44	644.40	1.05	136.64	1561.60	0.41
DP-M9	1.37	252.90	0.75	54.72	875.58	0.29
DP-O1	1.22	576.80	1.18	76.80	780.99	0.74
DP-O2	1.08	546.90	1.22	70.40	692.48	0.79
DP-O3	0.96	523.90	1.28	65.46	613.70	0.85
DP-O5	0.82	503.40	1.39	61.04	526.98	0.96
DP-O6	0.38	233.20	1.39	28.05	242.18	0.96
DP-SM1	0.21	483.40	17.00	192.49	135.87	3.56
DP-SM10	2.45	2423.80	2.23	291.46	1568.38	1.55
DP-SM11	0.41	478.70	2.48	53.70	259.84	1.84
DP-SM12	0.60	709.90	2.36	75.95	386.18	1.84
DP-SM13	0.44	549.20	2.50	58.85	282.50	1.94
DP-SM14	1.70	1653.10	2.18	197.84	1089.02	1.52
DP-SM15	1.30	1276.60	2.21	152.71	829.18	1.54
DP-SM16	0.44	497.30	2.41	56.59	281.79	1.76
DP-SM17	0.76	739.80	2.20	89.10	486.02	1.52
DP-SM18	0.45	507.40	2.49	60.08	289.54	1.75
DP-SM1A	0.00	437.30		#VALUE!	0.00	#DIV/0!

	Existing 100-year with areal adjustment				24-hour Type II Storm	
	Area (SM)	Q100	Volume (in)	acft	ac	cfs/ac
JC77	0.25	172.70	1.80	24.45	163.01	1.06
JC78	0.12	42.10	1.25	8.01	76.86	0.55
JC79	0.15	110.00	1.71	13.36	93.76	1.17
JC8	0.20	88.20	1.17	12.59	129.15	0.68
JC80	0.21	259.80	2.19	24.35	133.44	1.95
JC81	0.19	112.20	1.51	15.05	119.62	0.94
JC82	0.22	107.90	1.58	18.47	140.29	0.77
JC83	0.28	134.60	1.72	25.63	178.82	0.75
JC84	0.14	67.60	1.53	11.02	86.46	0.78
JC85	0.25	141.60	1.70	23.09	163.01	0.87
JC86	0.18	160.40	1.74	16.44	113.41	1.41
JC87	0.17	100.80	1.31	11.63	106.56	0.95
JC88	0.19	130.00	1.54	15.73	122.56	1.06
JC89	0.10	99.60	1.95	10.08	62.02	1.61
JC9	0.14	75.40	1.32	9.64	87.68	0.86
JC90	0.20	184.70	1.88	20.49	130.82	1.41
JC91	0.10	108.90	2.09	11.63	66.75	1.63
JC92	0.12	91.80	1.59	9.85	74.30	1.24
JC93	0.20	53.40	0.69	7.30	126.98	0.42
JC94	0.22	123.70	1.30	15.54	143.42	0.86
JC95	0.20	13.70	0.36	3.82	127.23	0.11
JC96	0.09	8.40	0.37	1.85	60.10	0.14
JC97	0.22	162.50	1.65	19.29	140.29	1.16
JC98	0.14	68.90	1.18	8.89	90.37	0.76
JC99	0.18	95.10	1.15	10.98	114.62	0.83
M1	0.16	147.80	2.07	17.51	101.50	1.46
M10	0.14	65.30	1.58	11.70	88.83	0.74
M11	0.11	82.00	1.69	9.73	69.06	1.19
M12	0.17	69.40	1.07	9.47	106.24	0.65
M13	0.23	71.00	0.96	11.56	144.45	0.49
M14	0.11	67.80	1.50	9.09	72.70	0.93
M15	0.09	32.80	0.76	3.75	59.14	0.55
M16	0.23	90.10	1.14	14.11	148.54	0.61
M17	0.28	221.80	1.89	28.67	182.02	1.22
M18	0.26	151.00	1.57	21.39	163.46	0.92
M19	0.30	117.30	1.17	18.72	192.00	0.61
M2	0.22	186.40	2.06	24.31	141.63	1.32
M20	0.14	45.40	1.08	8.06	89.54	0.51
M21	0.23	109.00	1.08	13.19	146.56	0.74
M22	0.10	11.20	0.42	2.31	66.11	0.17
M23	0.21	23.90	0.55	6.09	132.80	0.18
M24	0.16	78.80	1.16	9.63	99.58	0.79
M25	0.16	45.10	0.76	6.45	101.82	0.44
M26	0.18	17.80	0.57	5.43	114.30	0.16
M27	0.20	10.60	0.38	3.95	124.86	0.08
M3	0.23	185.90	2.03	24.86	146.94	1.27
M4	0.23	171.70	1.84	22.73	148.22	1.16
M5	0.18	112.90	1.34	12.85	115.07	0.98
M6	0.22	51.50	0.66	7.87	143.10	0.36
M7	0.17	122.10	1.35	12.21	108.54	1.12

	Future 100-year without areal adjustment				24-hr Type II Storm	
	Area (SM)	Q100	Volume (in)	acft	ac	cfs/ac
DP-J50	0.75	568.90	1.67	66.82	480.13	1.18
DP-J51	0.13	98.10	1.38	9.55	83.01	1.18
DP-J6	63.54	35864.90	2.33	7896.18	40667.01	0.88
DP-J7	63.36	35858.90	2.33	7873.21	40548.74	0.88
DP-J70	0.29	466.20	2.41	37.61	187.26	2.49
DP-J71	0.40	781.40	2.74	57.82	253.25	3.09
DP-J72	0.38	519.00	2.37	48.59	246.02	2.11
DP-J73	1.77	1929.90	2.34	221.26	1134.66	1.70
DP-J74	1.25	1592.70	2.37	158.27	801.34	1.99
DP-J75	0.37	539.50	2.30	45.82	239.04	2.26
DP-J76	0.61	776.80	2.44	78.85	387.78	2.00
DP-J77	0.40	531.50	2.42	51.24	254.08	2.09
DP-J78	0.47	1094.70	3.67	92.70	303.10	3.61
DP-J79	0.74	1336.90	2.75	109.18	476.42	2.81
DP-J8	63.18	35894.00	2.33	7851.53	40437.06	0.89
DP-J80	0.33	680.10	3.46	60.75	210.69	3.23
DP-J81	0.52	1031.00	2.89	79.53	330.24	3.12
DP-J82	0.63	1639.40	3.43	115.63	404.54	4.05
DP-J83	0.29	539.00	2.72	42.46	187.33	2.88
DP-J84	0.54	575.50	2.16	62.71	348.42	1.65
DP-J85	0.33	319.10	1.94	33.69	208.38	1.53
DP-J86	0.40	305.60	1.58	33.46	254.14	1.20
DP-J9	60.93	35685.90	2.34	7604.34	38996.61	0.92
DP-M0	5.18	3633.20	3.11	859.45	3316.22	1.10
DP-M1	5.18	6254.30	3.11	859.45	3316.22	1.89
DP-M10	0.58	296.50	1.45	44.57	368.90	0.80
DP-M11	0.37	481.70	3.06	60.99	239.17	2.01
DP-M2	5.02	6222.20	3.10	830.47	3214.72	1.94
DP-M3	4.80	6115.50	3.08	788.76	3073.09	1.99
DP-M4	4.57	5914.60	3.06	746.17	2926.14	2.02
DP-M5	0.40	939.00	2.88	61.96	258.18	3.64
DP-M6	3.28	4833.60	3.00	525.50	2102.02	2.30
DP-M7	0.71	1334.30	3.21	120.80	451.58	2.95
DP-M8	2.44	3309.10	2.91	378.69	1561.60	2.12
DP-M9	1.37	1265.20	2.55	186.06	875.58	1.44
DP-O1	1.22	1566.10	1.92	124.96	780.99	2.01
DP-O2	1.08	1566.10	2.05	118.30	692.48	2.26
DP-O3	0.96	1469.50	2.09	106.89	613.70	2.39
DP-O5	0.82	1389.60	2.17	95.29	526.98	2.64
DP-O6	0.38	619.20	2.04	41.17	242.18	2.56
DP-SM1	0.21	1954.10	33.12	375.01	135.87	14.38
DP-SM10	2.45	2474.50	2.47	322.83	1568.38	1.58
DP-SM11	0.41	596.30	2.79	60.41	259.84	2.29
DP-SM12	0.60	736.70	2.65	85.28	386.18	1.91
DP-SM13	0.44	606.40	2.70	63.56	282.50	2.15
DP-SM14	1.70	1732.80	2.47	224.16	1089.02	1.59
DP-SM15	1.30	1393.90	2.42	167.22	829.18	1.68
DP-SM16	0.44	535.30	2.47	58.00	281.79	1.90
DP-SM17	0.76	824.10	2.40	97.20	486.02	1.70
DP-SM18	0.45	529.50	2.51	60.56	289.54	1.83

	Future 100-year without areal adjustment				24-hr Type II Storm	
	Area (SM)	Q100	Volume (in)	acft	ac	cfs/ac
M27	0.20	219.10	2.60	27.05	124.86	1.75
M3	0.23	517.90	3.58	43.84	146.94	3.52
M4	0.23	573.10	3.68	45.46	148.22	3.87
M5	0.18	484.40	3.34	32.03	115.07	4.21
M6	0.22	469.30	2.52	30.05	143.10	3.28
M7	0.17	533.10	3.71	33.56	108.54	4.91
M8	0.25	464.70	3.78	49.94	158.53	2.93
M9	0.24	226.90	2.59	32.52	150.66	1.51
MRK-1	5.18	3633.20	3.11	859.45	3316.22	1.10
O1	0.14	49.20	0.97	7.15	88.51	0.56
O2	0.12	114.70	1.75	11.49	78.78	1.46
O3	0.14	104.80	1.69	12.21	86.72	1.21
O4	0.22	447.50	2.51	29.85	142.72	3.14
O5	0.22	377.20	2.04	24.15	142.08	2.65
SM1	0.21	317.60	2.29	25.93	135.87	2.34
SM10	0.13	117.70	1.84	13.17	85.89	1.37
SM11	0.19	365.70	2.19	22.46	123.07	2.97
SM12	0.23	219.70	2.00	24.31	145.86	1.51
SM13	0.21	338.40	2.07	22.70	131.58	2.57
SM14	0.15	116.50	1.86	15.13	97.60	1.19
SM15	0.23	503.80	2.95	35.42	144.06	3.50
SM16	0.18	365.60	2.79	26.61	114.43	3.19
SM17	0.15	151.60	1.81	14.06	93.18	1.63
SM18	0.22	449.60	2.56	30.08	140.99	3.19
SM19	0.19	279.20	2.85	29.52	124.29	2.25
SM2	0.16	199.90	2.01	17.04	101.76	1.96
SM20	0.21	320.40	2.74	30.95	135.55	2.36
SM21	0.16	367.10	2.51	21.69	103.68	3.54
SM22	0.12	204.60	2.77	17.28	74.88	2.73
SM23	0.21	273.20	2.72	30.49	134.53	2.03
SM24	0.07	111.70	2.71	9.78	43.33	2.58
SM25	0.05	77.50	2.45	6.08	29.76	2.60
SM26	0.21	470.10	2.72	30.26	133.50	3.52
SM27	0.20	282.60	2.51	26.43	126.34	2.24
SM28	0.25	281.70	2.43	32.37	159.87	1.76
SM29	0.19	265.90	2.53	25.70	121.92	2.18
SM3	0.15	216.90	2.05	16.50	96.58	2.25
SM30	0.10	198.00	2.38	12.17	61.38	3.23
SM31	0.17	230.90	2.46	22.33	108.93	2.12
SM32	0.14	165.80	2.01	14.66	87.55	1.89
SM33	0.21	292.50	2.49	27.42	132.16	2.21
SM34	0.25	267.60	2.52	33.05	157.38	1.70
SM4	0.25	99.50	1.51	20.24	160.83	0.62
SM5	0.09	29.50	1.16	5.75	59.52	0.50
SM6	0.14	44.70	1.13	8.61	91.39	0.49
SM7	0.14	86.10	1.40	10.75	92.16	0.93
SM8	0.26	352.30	2.61	36.22	166.53	2.12
SM9	0.24	380.60	2.94	36.93	150.72	2.53
WF	4.14	4613.00	2.05	452.64	2649.60	1.74

	Futuure 100-yr with areal adjustment				24-hr Type II storm	
	Area (SM)	Q100	Volume (in)	acft	ac	cfs/ac
DP-J85	0.33	286.00	1.75	30.39	208.38	1.37
DP-J86	0.40	269.80	1.42	30.07	254.14	1.06
DP-J9	60.93	31934.00	2.15	6986.89	38996.61	0.82
DP-M0	5.18	3059.20	2.88	795.89	3316.22	0.92
DP-M1	5.18	5776.30	2.88	795.89	3316.22	1.74
DP-M10	0.58	260.00	1.29	39.66	368.90	0.70
DP-M11	0.37	446.40	2.84	56.60	239.17	1.87
DP-M2	5.02	5741.80	2.88	771.53	3214.72	1.79
DP-M3	4.80	5637.10	2.86	732.42	3073.09	1.83
DP-M4	4.57	5450.30	2.84	692.52	2926.14	1.86
DP-M5	0.40	867.00	2.66	57.23	258.18	3.36
DP-M6	3.28	4472.20	2.77	485.22	2102.02	2.13
DP-M7	0.71	1231.60	2.98	112.14	451.58	2.73
DP-M8	2.44	3072.50	2.69	350.06	1561.60	1.97
DP-M9	1.37	1178.70	2.34	170.74	875.58	1.35
DP-O1	1.22	1409.50	1.73	112.59	780.99	1.80
DP-O2	1.08	1414.20	1.86	107.33	692.48	2.04
DP-O3	0.96	1329.00	1.90	97.17	613.70	2.17
DP-O5	0.82	1258.00	1.97	86.51	526.98	2.39
DP-O6	0.38	560.30	1.85	37.34	242.18	2.31
DP-SM1	0.21	1718.70	29.98	339.45	135.87	12.65
DP-SM10	2.45	2244.20	2.26	295.38	1568.38	1.43
DP-SM11	0.41	549.10	2.57	55.65	259.84	2.11
DP-SM12	0.60	673.30	2.43	78.20	386.18	1.74
DP-SM13	0.44	553.90	2.48	58.38	282.50	1.96
DP-SM14	1.70	1571.60	2.26	205.10	1089.02	1.44
DP-SM15	1.30	1266.50	2.21	152.71	829.18	1.53
DP-SM16	0.44	488.80	2.26	53.07	281.79	1.73
DP-SM17	0.76	748.90	2.19	88.70	486.02	1.54
DP-SM18	0.45	483.80	2.29	55.25	289.54	1.67
DP-SM1A	0.00	1694.30		#VALUE!	0.00	#DIV/0!
DP-SM2	5.18	4628.50	2.18	601.77	3312.51	1.40
DP-SM3	5.03	4607.60	2.22	595.91	3221.12	1.43
DP-SM4	4.77	4406.40	2.21	562.55	3054.59	1.44
DP-SM5	4.63	4342.60	2.25	555.46	2962.43	1.47
DP-SM6	2.85	2561.00	2.31	351.67	1826.88	1.40
DP-SM7	0.83	1007.70	2.33	103.38	532.42	1.89
DP-SM8	2.63	2349.50	2.28	319.74	1682.82	1.40
DP-SM9	0.63	810.00	2.49	83.17	400.83	2.02
DP-WF	4.14	4613.00	2.05	452.64	2649.60	1.74
E1	0.10	191.60	2.29	11.76	61.63	3.11
E10	0.15	156.20	2.02	16.66	98.94	1.58
E11	0.16	213.70	2.34	19.99	102.53	2.08
E12	0.24	353.90	2.46	30.92	150.85	2.35
E13	0.09	158.10	2.59	12.42	57.54	2.75
E14	0.19	392.30	2.59	26.26	121.66	3.22
E15	0.16	235.90	2.48	20.63	99.84	2.36
E16	0.19	409.40	3.09	31.58	122.62	3.34
E17	0.26	477.40	2.62	36.14	165.50	2.88
E18	0.09	134.90	2.40	11.79	58.94	2.29
E-19	0.19	299.90	2.64	27.22	123.71	2.42
E19A	0.08	186.60	2.36	10.14	51.58	3.62
E2	0.16	291.60	2.28	19.52	102.72	2.84
E20	0.22	369.50	2.12	24.69	139.78	2.64
E21	0.11	305.60	3.05	17.10	67.26	4.54

	Future 10-year without areal adjustment				24-hr Type II storm	
	Area (sm)'	Q100	Volume(in)	acft	ac	cfs/ac
R-M18	1.37	820.80	1.51	110.18	875.58	0.94
R-M2	4.80	3719.10	1.93	494.25	3073.09	1.21
R-M20	0.23	51.50	0.59	7.21	146.56	0.35
R-M22	0.58	122.50	0.68	20.90	368.90	0.33
R-M25	0.37	299.70	1.89	37.67	239.17	1.25
R-M3	4.57	3618.80	1.92	468.18	2926.14	1.24
R-M4A	3.28	2922.00	1.86	325.81	2102.02	1.39
R-M4B	0.17	357.60	2.45	22.16	108.54	3.29
R-M4C	0.40	565.20	1.74	37.44	258.18	2.19
R-M5	0.22	268.40	1.45	17.29	143.10	1.88
R-O1	1.08	781.90	1.09	62.90	692.48	1.13
R-O2	0.96	756.40	1.13	57.79	613.70	1.23
R-O3	0.82	723.80	1.18	51.82	526.98	1.37
R-O4	0.22	194.40	1.09	12.91	142.08	1.37
R-O6	0.15	151.30	1.09	8.44	92.93	1.63
R-SM10	0.19	194.40	1.19	12.20	123.07	1.58
R-SM12	0.83	610.80	1.46	64.78	532.42	1.15
R-SM13	0.63	510.90	1.60	53.44	400.83	1.27
R-SM14	2.85	1545.50	1.45	220.75	1826.88	0.85
R-SM15	2.63	1406.30	1.43	200.54	1682.82	0.84
R-SM16	2.45	1345.90	1.41	184.29	1568.38	0.86
R-SM17A	0.60	416.90	1.55	49.88	386.18	1.08
R-SM17B	1.70	939.20	1.41	127.96	1089.02	0.86
R-SM18	0.41	354.40	1.67	36.16	259.84	1.36
R-SM2	0.15	109.80	1.08	8.69	96.58	1.14
R-SM21	0.44	341.50	1.59	37.43	282.50	1.21
R-SM23	0.05	43.50	1.38	3.42	29.76	1.46
R-SM26A	1.30	760.00	1.37	94.67	829.18	0.92
R-SM26B	0.76	447.00	1.36	55.08	486.02	0.92
R-SM27	0.44	300.50	1.41	33.11	281.79	1.07
R-SM31	0.45	298.10	1.43	34.50	289.54	1.03
R-SM5	5.18	2731.80	1.35	372.66	3312.51	0.82
R-SM6A	5.03	2728.30	1.38	370.43	3221.12	0.85
R-SM6B	4.77	2628.20	1.38	351.28	3054.59	0.86
R-SM7	4.63	2598.40	1.40	345.62	2962.43	0.88
SM1	0.21	172.70	1.27	14.38	135.87	1.27
SM10	0.13	56.50	0.94	6.73	85.89	0.66
SM11	0.19	197.20	1.20	12.31	123.07	1.60
SM12	0.23	110.70	1.06	12.88	145.86	0.76
SM13	0.21	176.80	1.11	12.17	131.58	1.34
SM14	0.15	56.30	0.96	7.81	97.60	0.58
SM15	0.23	308.70	1.79	21.49	144.06	2.14
SM16	0.18	218.40	1.66	15.83	114.43	1.91
SM17	0.15	72.60	0.93	7.22	93.18	0.78
SM18	0.22	259.20	1.48	17.39	140.99	1.84
SM19	0.19	167.50	1.71	17.71	124.29	1.35
SM2	0.16	101.90	1.07	9.07	101.76	1.00
SM20	0.21	189.30	1.63	18.41	135.55	1.40
SM21	0.16	211.20	1.44	12.44	103.68	2.04
SM22	0.12	121.70	1.65	10.30	74.88	1.63

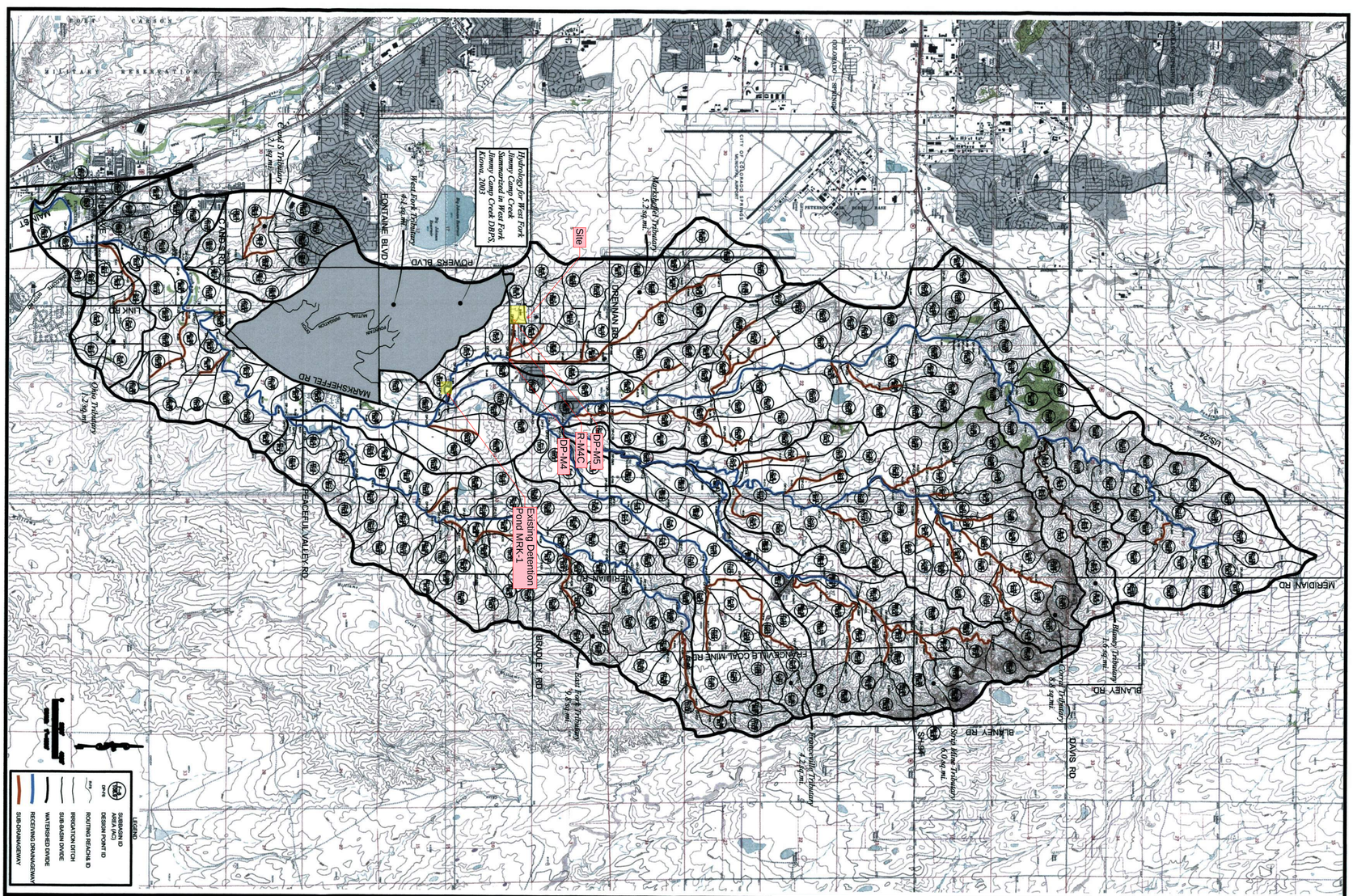

EXHIBIT 1

Project No.: 14008
Date: APRIL, 2015
Designer: RNW
Drawn: EAK
Checkd:
Revisions:

JIMMY CAMP CREEK WATERSHED
DRAINAGE BASIN PLANNING STUDY
SUBBASIN MAP
CITY OF COLORADO SPRINGS, COLORADO

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

14008-Sheet1-Hydromap.dwg/May 04, 2015