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Bradley Heights Filing 1 & 2 Preliminary Drainage Report

August 2021

HR Green Project No: 201134

Prepared For:

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I. General Purpose, Location and Description

a. Purpose

The purpose of this Preliminary Drainage Report (PDR) is to describe the onsite and offsite drainage patterns, existing and proposed storm infrastructure, and the planned stormwater management for Bradley Heights Filing 1 & 2. This report will support the development plan that is currently in review the City of Colorado Springs.

b. Location

Bradley Heights Filing 1 & 2, referred to as 'the site' herein, is in a portion of the east half of Section 9, Township 15 South, Range 65 West of the 6th P.M., Colorado Springs, El Paso County, Colorado. The site is bound by Bradley Road to the north and undeveloped parcels to the east, west and south. Surrounding platted developments include Trails at Aspen Ridge to the southwest. A vicinity map is presented in Appendix A.

c. Description of Property

The site is approximately 47.01 acres of undeveloped land with existing vegetation consisting of native grasses. Once developed, the site will included 168 single family residential lots and open space tracts. Lot sizes vary from 50' X 110' and 60' X 110'. In general, the site slopes northeasterly towards an existing tributary of Jimmy Camp Creek. Onsite elevations range from 5810' - 5880' with slopes ranging 1 – 10%. Per a NRCS soil survey, the site is made up of Type B Fort Collins Loam, Type B Nelson-Tassel fine sand loams and Type D Razor-Midway Complex. The NRCS soil survey is presented in Appendix A.

There are no major drainageways or irrigation facilities that traverse the site nor does the site fall within the Streamside Overlay Zone. An existing tributary of the Marksheffel Tributary to Jimmy Camp Creek originates in the site's northeast portion and conveys existing stormwater to Jimmy Camp Creek. Other onsite, existing utilities include water, fiberoptic, underground gas and underground electric/telecommunication. An existing drainage map is presented in Appendix F.

d. Floodplain Statement

Based on FEMA Firm map 08041C0768G dated December 8, 2018, the site is Zone X, which are areas determined to be outside the 0.2% annual chance flood.

II. Drainage Basins and Subbasins

a. Major Basin Description

The site is located within the Jimmy Camp Creek Drainage Basin. The site's drainage characteristics were previously studied in the following reports:

1. "Jimmy Camp Creek Drainage Basin Planning Study" prepared by Kiowa Engineering Corporation, March 9, 2015.
2. "Master Development Drainage Plan for Bradley Heights" prepared by Classic Consulting Engineers and Surveyors, approved by the City of Colorado Springs February 12, 2015.

Jimmy Camp Creek Drainage Basin is a 67.1 square mile watershed located in El Paso County. The basin is generally bound by Powers Boulevard to the west, Blaney Road to the East, Old Pueblo Road to the South and Garrett Road to the north. Jimmy Camp Creek is tributary to Fountain Creek.

The *Master Development Drainage Plan for Bradley Heights* (Bradley Heights MDDP) established the drainage patterns for the site and surrounding areas. The site's drainage patterns will follow those established in the Bradley Heights MDDP and the site will provide on-site water quality and detention in a private full spectrum detention pond. The full spectrum detention pond will release at less than historic rates.

b. Existing Subbasin Description

The existing site's drainage patterns are relatively uniform. A high point and ridge along the site's southern boundary direct the site's stormwater northeasterly towards Bradley Road. An existing tributary to the Marksheffel Tributary collects and conveys the stormwater to Jimmy Camp Creek. There are no on-site existing storm drain improvements. An existing drainage map is presented in Appendix B. See below for existing basin descriptions:

Basin OS1 is 29.25 acres of offsite undeveloped land and a portion of Bradley Road. Existing stormwater from this basin ($Q_5 = 11.0$ cfs $Q_{100} = 18.4$ cfs) is conveyed onsite at DP1.

Basin OS2 is 2.47 acres of offsite undeveloped land and a portion of Bradley Road. Existing stormwater from this basin ($Q_5 = 3.9$ cfs $Q_{100} = 6.5$ cfs) is conveyed in an existing drainage swale along the southern edge of Bradley Road and does not flow on site.

Basin EX1 is 1.49 acres of onsite undeveloped land. Existing stormwater from this basin ($Q_5 = 0.5$ cfs $Q_{100} = 0.8$ cfs) flows southerly offsite at DP3.

Basin EX2 is 8.20 acres of onsite undeveloped land. Existing stormwater from this basin ($Q_5 = 3.6$ cfs $Q_{100} = 6.1$ cfs) flows northeasterly across the site to DP4.

Basin EX2 is 37.60 acres of onsite undeveloped land. Existing stormwater from this basin ($Q_5 = 7.9$ cfs $Q_{100} = 13.2$ cfs) flows northeasterly across the site to DP5.

c. Proposed Subbasin Description

The proposed site has been divided into 18 subbasins for analysis. A drainage map has been presented in Appendix F. See below for basin descriptions:

Basin 1 is 7.85 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 12.6$ cfs $Q_{100} = 29.1$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP1. Basin 1 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 2 is 6.42 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 12.3$ cfs $Q_{100} = 27.8$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP2. Basin 2 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 3 is 5.32 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 9.1$ cfs $Q_{100} = 21.0$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP3. Basin 3 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 4 is 1.32 acres of single-family residential lots and landscaping. Stormwater from this basin ($Q_5 = 1.6$ cfs $Q_{100} = 4.7$ cfs) is conveyed in a rear lot drainage swale to a 3' Type C sump inlet (private) at DP4. Basin 4 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 5 is 6.13 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 11.0$ cfs $Q_{100} = 24.3$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP5. Basin 5 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 6 is 2.14 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 3.9$ cfs $Q_{100} = 8.2$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP6. Basin 6 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 7 is 3.87 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 5.6$ cfs $Q_{100} = 13.0$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP6. Basin 7 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 8 is 1.86 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 3.2$ cfs $Q_{100} = 6.8$ cfs) is conveyed in curb and gutter to a 15' Type R on-grade inlet (public) at DP6. Basin 8 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 9 is 4.28 acres of single-family residential lots, roadway and landscaping. (public) Basin 9 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 10 is 1.86 acres of roadway (Bradley Landing Boulevard) and landscaping. Stormwater from this basin ($Q_5 = 6.4$ cfs $Q_{100} = 12.0$ cfs) is conveyed in curb and gutter to a 10' Type R sump inlet (public) at DP9. Basin 10 stormwater is piped to the full spectrum detention pond for water quality and detention. In the context of this drainage report, Bradley Landing Boulevard will be built to the intersection with Road 7. In the future, Bradley Landing Boulevard will be extended south. It should be noted that the above flows for Basin 10 are inclusive of the anticipated stormwater from the full build out of Bradley Landing Boulevard. The inlet at DP9 has been sized for the full build out of Bradley Landing Boulevard.

Basin 11 is 2.57 acres of roadway (Bradley Landing Boulevard & Bradley Road) and landscaping. Stormwater from this basin ($Q_5 = 9.6$ cfs $Q_{100} = 17.7$ cfs) is conveyed in curb and gutter to a 10' Type R sump inlet (public) at DP10. Basin 11 stormwater is piped to the full spectrum detention pond for water quality and detention. In the context of this drainage report, Bradley Landing Boulevard will be built to the intersection with Road 7. In the future, Bradley Landing Boulevard will be extended south. It should be noted that the above flows for Basin 11 are inclusive of the anticipated stormwater from the full build out of Bradley Landing Boulevard. The inlet at DP10 has been sized for the full build out of Bradley Landing Boulevard.

Basin 12 is 2.88 acres of single-family residential lots, roadway and landscaping. Stormwater from this basin ($Q_5 = 4.7$ cfs $Q_{100} = 10.5$ cfs) is conveyed in curb and gutter to a 15' Type R sump inlet (public) at DP7. Basin 12 stormwater is piped to the full spectrum detention pond for water quality and detention.

Basin 13 is 2.22 acres of landscaping and the full spectrum detention pond. Stormwater from this basin ($Q_5 = 1.5$ cfs $Q_{100} = 7.0$ cfs) sheet flows to the full spectrum detention pond.

Basin 14 is 0.91 acres of single-family residential lots and landscaping. Stormwater from this basin ($Q_5 = 1.0$ cfs $Q_{100} = 3.0$ cfs) sheet flows to the southeast and offsite. Due to topographical constraints, Basin 14 will not be captured and detained in the full spectrum detention pond. The pond's allowable discharge will be reduced by an amount equal to the undetained flow from Basin 14. Basin 14 will ultimately drain to Jimmy Camp Creek.

Basin 15 is 3.21 acres of roadway (Bradley Road and Bliss Road) and landscaping. Stormwater from this basin ($Q_5 = 10.0$ cfs $Q_{100} = 19.1$ cfs) is conveyed in curb and gutter to a 10' Type R sump inlet (public) at DP11. Basin 15 stormwater is piped to the full spectrum detention pond for water quality and detention. In the context of this drainage report, Bliss Road will be built to the intersection with Road 1. In the future, Bliss Road will be extended further south. The inlet at DP11 has been sized for the full build out of Bliss Road.

Basin 16 is 1.33 acres of offsite roadway (Bliss Road). Stormwater from this basin ($Q_5 = 3.4$ cfs $Q_{100} = 10.8$ cfs) will be captured and detained by the Redemption Hill Church Development. An excerpt from the Redemption Hill Church MDDP/FDR has been presented in Appendix E for reference. Basin 16 will not be detained in the onsite full spectrum detention pond.

Basin OS1 is 25.14 acres of offsite undeveloped land to the west of the site. Stormwater from this basin ($Q_5 = 7.8$ cfs $Q_{100} = 44.5$ cfs) is conveyed in a drainage channel along the west side of Bradley Landing Boulevard to DP12. From there, Basin OS1 stormwater is piped to a drainage channel along the southern edge of Bradley Road that outfalls on the east side of Bliss Road. The ultimate outfall for Basin OS1 is the Marksheffel Tributary to Jimmy Camp Creek. Basin OS1 will follow historic drainage patterns and not be detained in the onsite full spectrum detention pond.

Basin OS2 is 2.67 acres of landscape area. Stormwater from this basin ($Q_5 = 0.9$ cfs $Q_{100} = 5.9$ cfs) is conveyed in a drainage channel along the southern edge of Bradley Road that outfalls on the east side of Bliss Road. The ultimate outfall for Basin OS2 is the Marksheffel Tributary to Jimmy Camp Creek. Basin OS2 will follow historic drainage patterns and not be detained in the onsite full spectrum detention pond.

In the event of inlet failure, the sump inlet at DP8 would overtop the roadway crown and curb at DP7 and be conveyed to the full spectrum water quality and detention pond in a grass lined swale with 1.0' freeboard. The grass lined swale also acts as the emergency overflow path for the sump inlet at DP8. If the sump inlet at DP4 were to fail, the flows would spill into Truscott Road and follow the same path as DP8 emergency overflow. The sump inlet at DP9 overtops curb & gutter and is channelized to Handey Road. The sump inlet at DP10 overtops curb & gutter to the drainage channel on the east side of Bradley Landing Boulevard.

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis, proposed storm sewer system, and proposed full spectrum water quality and detention pond follow the criteria from the “*City of Colorado Springs Drainage Criteria Manual*” Volumes 1 and 2” (CCSDCM, latest revision).

b. Hydrologic Criteria

Hydrologic data was obtained from the “*City of Colorado Springs Drainage Criteria Manual – Chapter 6 Hydrology*”. Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from CCSDCM Table 6-2 below. Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Full spectrum pond design was completed using the latest version of Mile High Flood District’s (MHFD) UD-Detention per CCSDCM Section 13.3.2.1 – Full Spectrum Detention. Detention pond allowable release rate will be limited to less than historic rates.

Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.50	2.52

Drainage Facility Design

a. General Concept

Onsite stormwater will be conveyed via Type 5 curb and gutter to Type R inlets. Captured stormwater will be piped to and detained in a private, full spectrum detention pond. The full spectrum detention pond will outfall at less than historic values to the east side of Bliss Road and to the site's historic outfall channel. The existing channel will convey the released flows approximately 1,000' to the Marksheffel Tributary to Jimmy Camp Creek. Per the approved *Master Development Drainage Plan for Bradley Heights*, this is the planned outfall for the site and has adequate capacity. Coordination with the Redemption Hill Church is ongoing to coordinate the ultimate design and improvements for the outfall channel.

b. Water Quality & Detention

Water quality and detention is provided in a private full spectrum detention pond located southwest of the Bradley Road-Bliss Road intersection. The pond is sized for Basins 1 -13 and 15. A total of 51.93 acres at 60% composite imperviousness will be detained in the full spectrum pond. The WQCV is 1.022 ac-ft, the EURV is 2.202 ac-ft, and the 100-year volume is 2.252 ac-ft, for a total storage volume of 5.476 ac-ft. The WQCV, EURV and 100-year storms are released in 40, 72 and 71 hours, respectively. A forebay is located at each outfall into the pond and a 6.0' trickle channel conveys flow towards the outlet structure. A 10' access and maintenance road is provided to the bottom of the pond to facilitate future maintenance of the pond facilities. A 70' emergency overflow spillway is provided that conveys the peak 100-yr flow rate with 1.0' of freeboard towards Bliss Road. The spillway and downstream outfall will be lined with Type L riprap. See pond design calculations presented in Appendix D.

c. Inspection and Maintenance

An Inspection and maintenance manual will be provided with the Final Drainage Report. The manual will specify maintenance intervals and required actions to maintain the function of the extended detention basin and appurtenances.

d. Grading and Erosion Control Plan

Due to the project disturbance area, a separate Grading and Erosion Control plan will be required. The Grading and Erosion Control Plan will be submitted in conjunction with the Final Drainage Report and Construction Drawings.

e. Four Step Method to Minimize Adverse Impacts of Urbanization

Step 1 – Reducing Runoff Volumes: Roof drains will route across landscape areas whenever possible to promote infiltration. In addition, grass lined drainage swales are used to convey stormwater to the onsite full spectrum detention pond.

Step 2 – Treat and slowly release the WQCV: An onsite full spectrum detention pond provides water quality treatment for the site. The WQCV is released over a period of 40 hours.

Step 3 – Stabilize stream channels: Drainage channels will be lined with non-erosive soils and permanently seeded to provide stabilization. If required due to erosive velocities, additional protection will be provided in the form of riprap lining and drop structures to reduce stormwater velocities and provide stabilization.

Step 4 – Consider the need for source controls: No industrial or commercial uses are proposed within this development and therefore no source controls are proposed.

f. Drainage and Bridge Fees

Drainage and bridge fees for the Jimmy Camp Creek Drainage Basin are due at time of platting. See table below for anticipated drainage and bridge fees for Bradley Heights Filing 1 & 2.

Jimmy Camp Creek Drainage Basin - 2021 Drainage & Bridge Fees				
Site Acreage	Drainage Fee/acre	Pond Facility Fee/acre	Drainage Fee	Pond Facility Fee
47.01	\$8,584	\$2,798	\$403,534	\$131,534

g. Opinion of Probable Cost

We respectfully request that the engineer’s opinion of probably cost be postponed until the Final Drainage Report.

IV. Summary

The Bradley Heights Filing 1 & 2 development remains consistent with pre-development drainage conditions with the construction of the recommended drainage improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest City of Colorado Springs Drainage criteria and is in accordance with the Bradley Heights MDDP.

V. Drawings

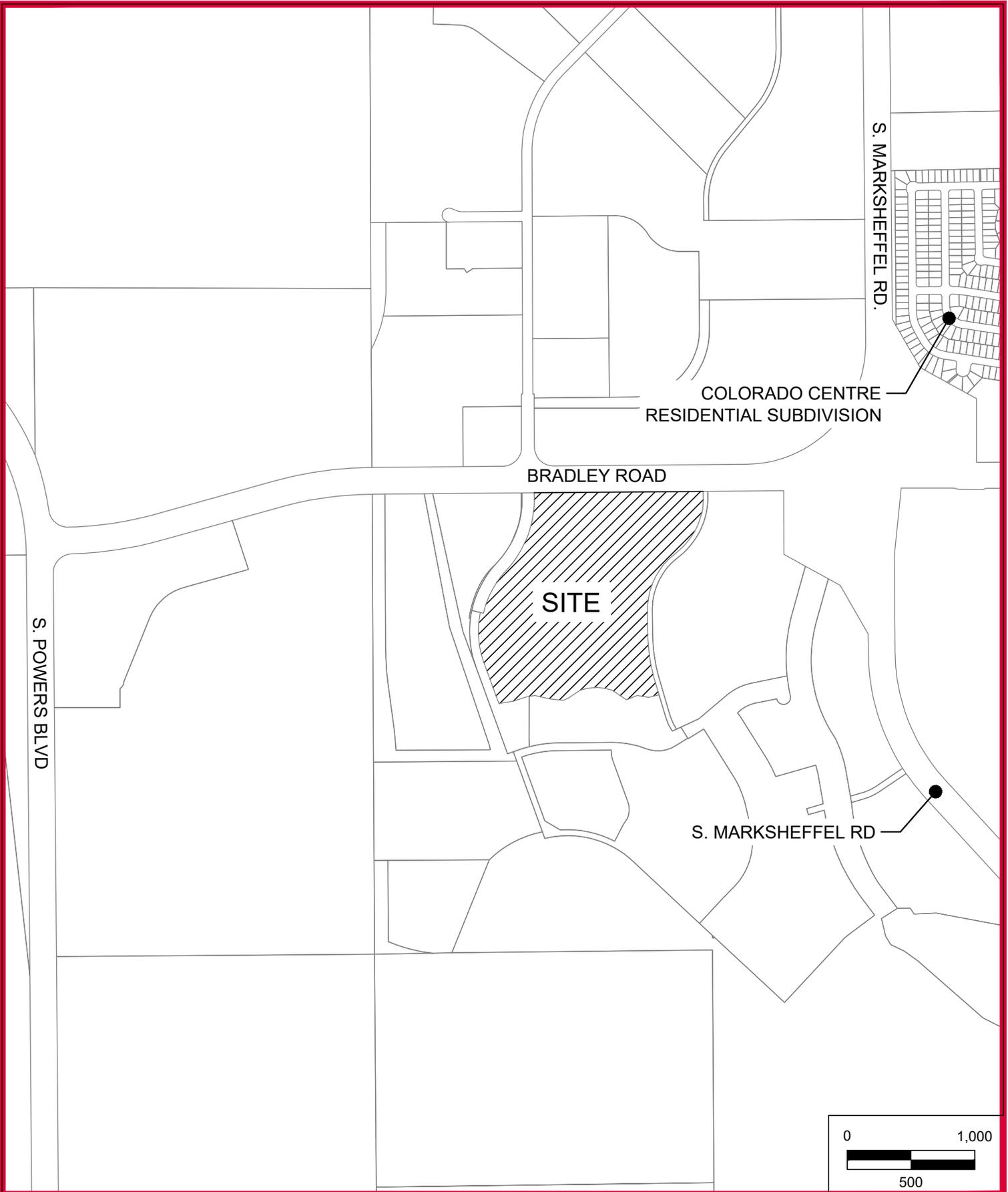
Please refer to the appendices for vicinity and drainage basin maps.

VI. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014, Revised January 2021.
2. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
3. “Jimmy Camp Creek Drainage Basin Planning Study” Kiowa Engineering Corporation, March 9, 2015.
4. “Master Development Drainage Plan for Bradley Heights Classic Consulting Engineers and Surveyors, February 12, 2015.



APPENDIX A – VICINITY MAP, SOIL MAP, FEMA MAP



S. MARKSHEFFEL RD.

COLORADO CENTRE
RESIDENTIAL SUBDIVISION

BRADLEY ROAD

SITE

S. POWERS BLVD

S. MARKSHEFFEL RD



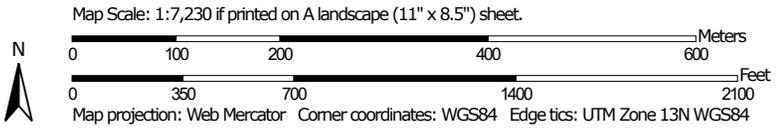
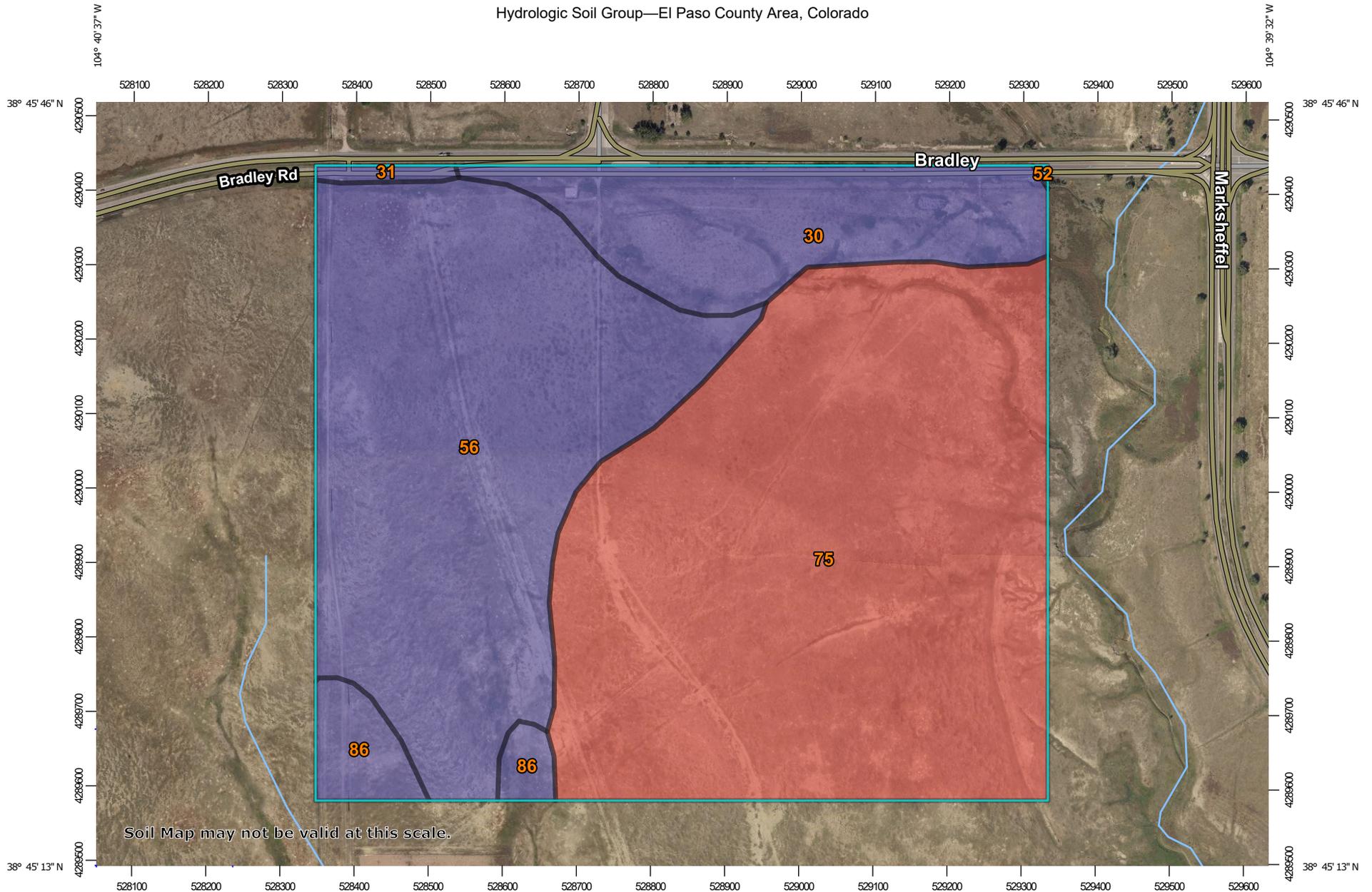
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SHEET
VICINITY MAP

SCALE: 1"=1,000'
DATE: 03/29/2021

Hydrologic Soil Group—El Paso County Area, Colorado



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
- Water Features**
 -  Streams and Canals
- Transportation**
 -  Rails
 -  Interstate Highways
 -  US Routes
 -  Major Roads
 -  Local Roads
- Background**
 -  Aerial Photography
- Other**
 -  C
 -  C/D
 -  D
 -  Not rated or not available

MAP INFORMATION

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Aug 14, 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
30	Fort Collins loam, 0 to 3 percent slopes	B	25.2	12.1%
31	Fort Collins loam, 3 to 8 percent slopes	B	1.0	0.5%
52	Manzanst clay loam, 0 to 3 percent slopes	C	0.1	0.0%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	72.4	34.6%
75	Razor-Midway complex	D	104.3	49.8%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	6.2	3.0%
Totals for Area of Interest			209.1	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 B – HYDROLOGIC CALCULATIONS



BRADLEY HEIGHTS	Calc'd by:	NQJ
EXISTING CONDITIONS	Checked by:	
LOCATION: COLORADO SPRINGS, COLORADO	Date:	3/30/2021

SUMMARY RUNOFF TABLE				
BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
OS1	29.25	7	11.0	18.4
OS2	2.47	47	3.9	6.5
EX1	1.49	2	0.5	0.8
EX2	8.20	2	3.6	6.1
EX3	37.60	2	7.9	13.2

	BRADLEY HEIGHTS	NQJ	Calc'd by:
	EXISTING CONDITIONS		Checked by:
	LOCATION: COLORADO SPRINGS, COLORADO	5/24/2021	Date:

COMPOSITE 'C' FACTORS																	
BASIN	UNDEVELOPED	WALKS & DRIVES	SINGLE FAMILY LOT	TOTAL	SOIL TYPE	UNDEVELOPED			WALKS & DRIVES			SINGLE FAMILY LOT			COMPOSITE IMPERVIOUSNESS & C		
						%I	C₅	C₁₀₀	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀
ACRES																	
OS1	27.82	1.43	0.00	29.25	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	7	0.13	0.39
OS2	1.33	1.14	0.00	2.47	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	47	0.46	0.64
EX1	1.49	0.00	0.00	1.49	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	2	0.09	0.36
EX2	8.20	0.00	0.00	8.20	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	2	0.16	0.51
EX3	37.60	0.00	0.00	37.60	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	2	0.09	0.36
Total				79.01													

Lot Type	Lot Area (ft ²)	Max. Roof Area (ft ²)	% Impervious	Drive/Walk Area (ft ²)	% Imp	Open Space (ft ²)	% Imp	Comp. % Imp
50' x 110'	5,500	2,800	90	550	100	2,150	2	56.60

	BRADLEY HEIGHTS	Calc'd by:	NQJ
	EXISTING CONDITIONS	Checked by:	
	LOCATION: COLORADO SPRINGS, COLORADO	Date:	3/30/2021

TIME OF CONCENTRATION											
BASIN DATA			OVERLAND TIME (T _o)			TRAVEL TIME (T _t)					TOTAL
DESIGNATION	C _s	AREA (ac)	LENGTH (ft)	SLOPE %	t _o (min)	C _v	LENGTH (ft)	SLOPE %	V (ft/s)	t _t (min)	t _c (min)
OS1	0.13	29.25	300	7.0	16.1	10	990	6.0	2.4	6.7	22.8
OS2	0.46	2.47	50	2.0	6.5	15	1320	2.2	2.2	9.9	16.4
EX1	0.09	1.49	50	1.0	13.1	10	160	5.8	2.4	1.1	14.2
EX2	0.16	8.20	300	3.5	19.7	10	705	5.5	2.3	5.0	24.7
EX3	0.09	37.60	300	5.4	18.3	10	1550	3.0	1.7	14.9	33.2

FORMULAS:

$$t_o = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C _v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.



BRADLEY HEIGHTS															Calc'd by:		NQJ	
EXISTING CONDITIONS															Checked by:			
DESIGN STORM: 5-YEAR															Date:		3/30/2021	

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS		
			AREA (ac)	C ₅	t _c (min)	C ₅ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₅ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₅ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₅ *A (ac)	SLOPE %	PIPE SIZE (in)	LENGTH (FT)		VEL. (FPS)	TRAVEL TIME (min)
		OS1	29.25	0.13	22.8	3.79	2.89	11.0															BASIN OS1 FLOW @ DP1
		OS2	2.47	0.46	16.4	1.15	3.38	3.9															BASIN OS2 FLOW @ DP2
		EX1	1.49	0.09	14.2	0.13	3.60	0.5															BASIN EX1 FLOW @ DP3
		EX2	8.2	0.16	24.7	1.31	2.77	3.6															BASIN EX2 FLOW @ DP4
		EX3	37.6	0.09	33.2	3.38	2.33	7.9															BASIN EX3 FLOW @ DP5



BRADLEY HEIGHTS

EXISTING CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by:

NQJ

Checked by:

Date:

3/30/2021

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C ₁₀₀	f _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	f _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)	TRAVEL TIME (min)	
		OS1	29.25	0.13	22.8	3.79	4.85	18.4															BASIN OS1 FLOW @ DP1
		OS2	2.47	0.46	16.4	1.15	5.68	6.5															BASIN OS2 FLOW @ DP2
		EX1	1.49	0.09	14.2	0.13	6.05	0.8															BASIN EX1 FLOW @ DP3
		EX2	8.2	0.16	24.7	1.31	4.66	6.1															BASIN EX2 FLOW @ DP4
		EX3	37.6	0.09	33.2	3.38	3.91	13.2															BASIN EX3 FLOW @ DP5



BRADLEY HEIGHTS	Calc'd by:	NQJ
PROPOSED CONDITIONS	Checked by:	
LOCATION: COLORADO SPRINGS, COLORADO	Date:	8/6/2021

BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
1	7.85	55	12.6	29.1
2	6.42	60	12.3	27.8
3	5.32	57	9.1	21.0
4	1.32	35	1.6	4.7
5	6.13	63	11.0	24.3
6	2.14	65	3.9	8.5
7	3.87	56	5.6	13.0
8	1.86	65	3.2	6.8
9	4.28	53	6.0	14.0
10	1.86	86	6.4	12.0
11	2.57	92	9.6	17.7
12	2.88	60	4.7	10.5
13	2.22	14	1.5	7.0
14	0.91	33	1.0	3.0
15	3.21	85	10.0	19.1
16	1.33	100	4.9	8.8
OS1	25.14	4	7.8	44.5
OS2	2.67	2	0.9	5.9

DESIGN POINT	UPSTREAM BASIN	ΣQ ₅ (cfs)	ΣQ ₁₀₀ (cfs)
1	1	12.6	29.1
2	2	12.3	27.8
3	3	9.1	21.0
4	4	1.6	4.7
5	5	11.0	24.3
6	6, 7 & 8	12.7	28.4
7	9 & 12	10.7	26.1
8	3 & 5	20.1	45.3
9	10	6.4	14.0
10	11	9.6	17.7
11	15	8.5	19.1
12	OS1	7.8	44.5
13	OS2	3.4	5.9
14	14	1.0	3.0

	BRADLEY HEIGHTS	NQJ	Calc'd by:
	PROPOSED CONDITIONS		Checked by:
	LOCATION: COLORADO SPRINGS, COLORADO	8/6/2021	Date:

COMPOSITE 'C' FACTORS																	
BASIN	LANDSCAPING	WALKS & DRIVES	SINGLE FAMILY LOT	TOTAL	SOIL TYPE	LANDSCAPING			WALKS & DRIVES			SINGLE FAMILY LOT			COMPOSITE IMPERVIOUSNESS & C		
	ACRES					%I	C₅	C₁₀₀	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀	%I	C₅	C₁₀₀
1	1.32	1.35	5.18	7.85	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	55	0.43	0.60
2	0.39	1.00	5.03	6.42	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	60	0.50	0.67
3	0.75	0.90	3.67	5.32	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	57	0.49	0.67
4	0.54	0.00	0.78	1.32	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	35	0.33	0.58
5	0.00	0.91	5.22	6.13	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	63	0.52	0.68
6	0.00	0.40	1.74	2.14	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	65	0.49	0.63
7	0.39	0.40	3.08	3.87	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	56	0.42	0.58
8	0.00	0.33	1.53	1.86	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	65	0.49	0.63
9	0.82	0.68	2.78	4.28	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	53	0.42	0.59
10	0.27	1.59	0.00	1.86	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	86	0.78	0.87
11	0.21	2.36	0.00	2.57	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	92	0.83	0.91
12	0.10	0.33	2.45	2.88	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	60	0.45	0.60
13	2.32	0.00	0.46	2.22	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	14	0.18	0.49
14	0.44	0.05	0.42	0.91	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	33	0.33	0.59
15	0.50	2.71	0.00	3.21	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	85	0.78	0.89
16	0.00	1.33	0.00	1.33	D	2	0.16	0.51	100	0.90	0.96	57	0.45	0.63	100	0.90	0.96
OS1	24.50	0.64	0.00	25.14	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	4	0.11	0.38
OS2	2.67	0.00	0.00	2.67	B	2	0.09	0.36	100	0.90	0.96	57	0.40	0.56	2	0.09	0.36
Pond				51.93											60		
Total				74.13													

Lot Type	Lot Area (ft ²)	Max. Roof Area (ft ²)	% Impervious	Drive/Walk Area (ft ²)	% Imp	Open Space (ft ²)	% Imp	Comp. % Imp
50' x 110'	5,500	2,800	90	550	100	2,150	2	56.60

	BRADLEY HEIGHTS					Calc'd by:		NQJ			
	PROPOSED CONDITIONS					Checked by:					
	LOCATION: COLORADO SPRINGS, COLORADO					Date:		8/6/2021			
TIME OF CONCENTRATION											
BASIN DATA			OVERLAND TIME (T_o)			TRAVEL TIME (T_t)					TOTAL
DESIGNATION	C _s	AREA (ac)	LENGTH (ft)	SLOPE %	t _o (min)	C _v	LENGTH (ft)	SLOPE %	V (ft/s)	t _t (min)	t _c (min)
1	0.43	7.85	100	2.0	9.7	20	960	5.0	4.5	3.6	13.3
2	0.50	6.42	100	2.0	8.7	20	960	5.0	4.5	3.6	12.3
3	0.49	5.32	100	2.0	8.9	20	1340	3.3	3.6	6.2	15.1
4	0.33	1.32	100	2.0	11.2	20	492	3.3	3.6	2.3	13.5
5	0.52	6.13	100	2.0	8.5	20	1500	3.3	3.6	6.9	15.4
6	0.49	2.14	77	2.0	7.7	20	865	1.8	2.7	5.4	13.1
7	0.42	3.87	100	2.0	9.9	20	930	1.8	2.7	5.8	15.7
8	0.49	1.86	100	2.0	8.9	20	825	1.1	2.1	6.6	15.5
9	0.42	4.28	100	2.0	9.9	20	890	1.1	2.1	7.1	17.0
10	0.78	1.86	37	2.0	2.8	20	1260	3.7	3.8	5.5	8.3
11	0.83	2.57	37	2.0	2.4	20	1260	3.7	3.8	5.5	7.8
12	0.45	2.88	100	2.0	9.5	20	800	2.2	3.0	4.5	14.0
13	0.18	2.22	20	2.0	6.0	15	830	2.0	2.1	6.5	12.5
14	0.33	0.91	100	2.0	11.1	7	550	5.0	1.6	5.9	17.0
15	0.78	3.21	19	2.0	2.0	20	1450	1.8	2.7	9.0	11.0
16	0.90	1.33	19	2.0	1.3	20	1450	1.8	2.7	9.0	10.3
OS1	0.11	25.14	300	7.0	16.4	15	1550	5.0	3.4	7.7	24.1
OS2	0.09	2.67	28	15.0	3.9	15	1271	2.0	2.1	10.0	13.9



BRADLEY HEIGHTS
PROPOSED CONDITIONS
DESIGN STORM: 5-YEAR

Calc'd by:

NQJ

Checked by:

Date:

8/6/2021

			DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
STREET	DESIGN POINT	BASIN ID	AREA (ac)	C ₅	t _c (min)	C ₅ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₅ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₅ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₅ *A (ac)	SLOPE %	PIPE SIZE (in)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min)	
	1	1	7.85	0.43	13.3	3.41	3.70	12.6															
	2	2	6.42	0.50	12.3	3.23	3.82	12.3															
	3	3	5.32	0.49	15.1	2.58	3.51	9.1															
	4	4	1.32	0.33	13.5	0.44	3.68	1.6															
	5	5	6.13	0.52	15.4	3.17	3.48	11.0															
	6	6	2.14	0.49	13.1	1.06	3.72	3.9															
	6	7	3.87	0.42	15.7	1.63	3.46	5.6															
	6	8	1.86	0.49	15.5	0.91	3.48	3.2															
	7	9	4.28	0.42	17.0	1.80	3.34	6.0															
	9	10	1.86	0.78	8.3	1.46	4.41	6.4															
	10	11	2.57	0.83	7.8	2.14	4.50	9.6															
	7	12	2.88	0.45	14.0	1.29	3.62	4.7															
		13	2.22	0.18	12.5	0.39	3.79	1.5															
	14	14	0.91	0.33	17.0	0.30	3.33	1.0															
	11	15	3.21	0.78	11.0	2.52	3.99	10.0															
		16	1.33	0.90	10.3	1.20	4.09	4.9															
	12	OS1	25.14	0.11	24.1	2.78	2.81	7.8															
	13	OS2	2.67	0.09	13.9	0.24	3.63	0.9															



BRADLEY HEIGHTS

PROPOSED CONDITIONS

DESIGN STORM: 100-YEAR

Calc'd by:

NQJ

Checked by:

Date:

8/6/2021

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF						TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
			AREA (ac)	C ₁₀₀	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	t _c (min)	C ₁₀₀ *A (ac)	I (in./hr.)	Q (cfs)	Q _{street} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	Q _{PIPE} (cfs)	C ₁₀₀ *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)		TRAVEL TIME (min)
	1	1	7.85	0.60	13.3	4.67	6.22	29.1															
	2	2	6.42	0.67	12.3	4.33	6.42	27.8															
	3	3	5.32	0.67	15.1	3.56	5.89	21.0															
	4	4	1.32	0.58	13.5	0.77	6.18	4.7															
	5	5	6.13	0.68	15.4	4.16	5.84	24.3															
	6	6	2.14	0.63	13.1	1.36	6.25	8.5															
	6	7	3.87	0.58	15.7	2.25	5.80	13.0															
	6	8	1.86	0.63	15.5	1.17	5.84	6.8															
	7	9	4.28	0.59	17.0	2.50	5.60	14.0															
	9	10	1.86	0.87	8.3	1.62	7.41	12.0															
	10	11	2.57	0.91	7.8	2.34	7.55	17.7															
	7	12	2.88	0.60	14.0	1.72	6.08	10.5															
		13	2.22	0.49	12.5	1.09	6.36	7.0															
	14	14	0.91	0.59	17.0	0.54	5.60	3.0															
		15	3.21	0.89	11.0	2.86	6.69	19.1															
		16	1.33	0.96	10.3	1.28	6.86	8.8															
	12	OS1	25.14	0.38	24.1	9.43	4.71	44.5															
	13	OS2	2.67	0.36	13.9	0.96	6.10	5.9															

APPENDIX C – HYDRAULIC CALCULATIONS*

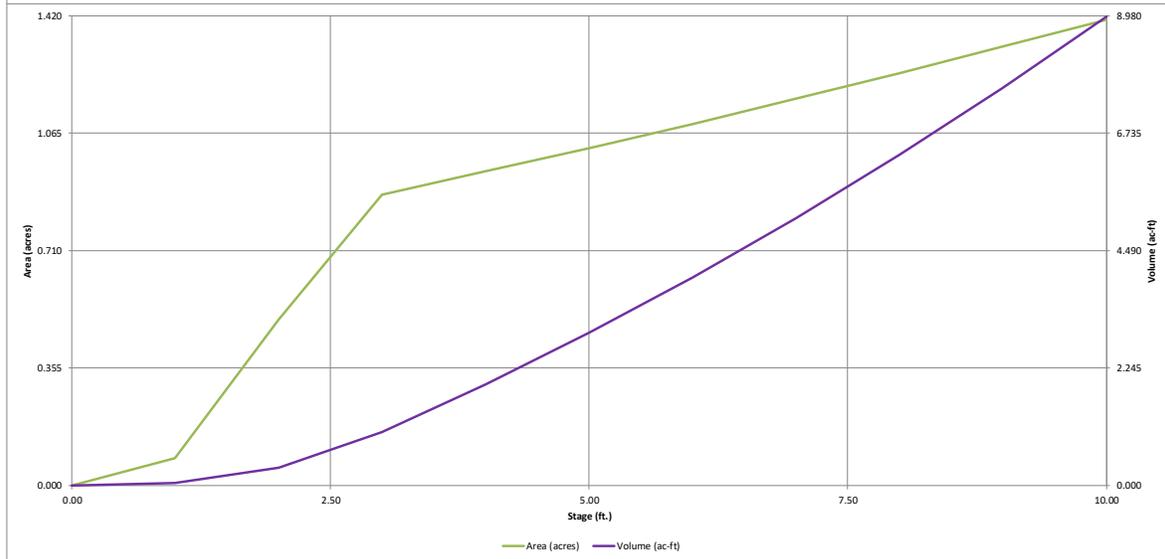
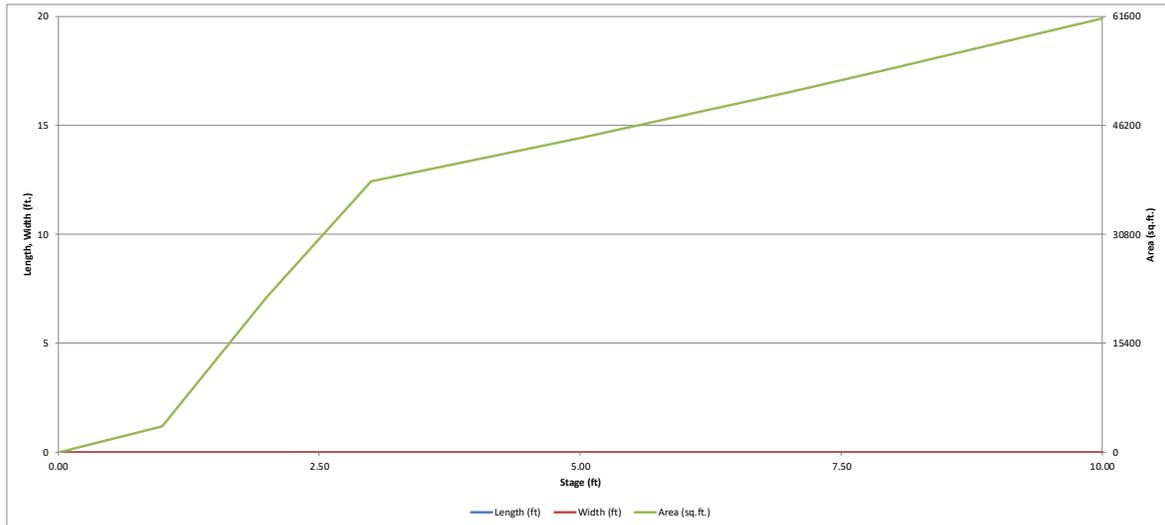
*** HYDRAULIC CALCULATIONS INCLUDING INLET, STREET CAPACITY AND HYDRAULIC MODELING WILL BE INCLUDED WITH THE FINAL DRAINAGE REPORT.**



APPENDIX D – WATER QUALITY & DETENTION

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

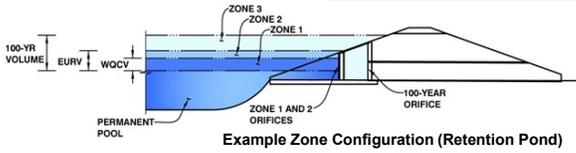


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention, Version 4.03 (May 2020)*

Project: BRADLEY HEIGHTS EAST - FILING 1

Basin ID: BASINS 1 - 13, 15



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.00	1.022	Orifice Plate
Zone 2 (EURV)	5.30	2.202	Orifice Plate
Zone 3 (100-year)	7.31	2.252	Weir&Pipe (Restrict)
Total (all zones)		5.476	

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

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
 Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
 Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = 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)

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
 Orifice Plate: Orifice Vertical Spacing = inches
 Orifice Plate: Orifice Area per Row = inches

Calculated Parameters for Plate
 WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

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	1.77	3.53					
Orifice Area (sq. inches)	4.86	4.86	12.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	ft ²
Vertical Orifice Centroid =	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.30	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	9.00	N/A	feet
Overflow Weir Gate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	9.00	N/A	feet
Overflow Gate Open Area % =	70%	N/A	%, gate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Gate Upper Edge, H ₁ =	5.30	N/A	feet
Overflow Weir Slope Length =	9.00	N/A	feet
Gate Open Area / 100-yr Orifice Area =	8.19	N/A	
Overflow Gate Open Area w/o Debris =	56.70	N/A	ft ²
Overflow Gate Open Area w/ Debris =	28.35	N/A	ft ²

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	42.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	28.40		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	6.92	N/A	ft ²
Outlet Orifice Centroid =	1.33	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.93	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	6.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	70.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.96	feet
Stage at Top of Freeboard =	8.76	feet
Basin Area at Top of Freeboard =	1.31	acres
Basin Volume at Top of Freeboard =	7.29	acre-ft

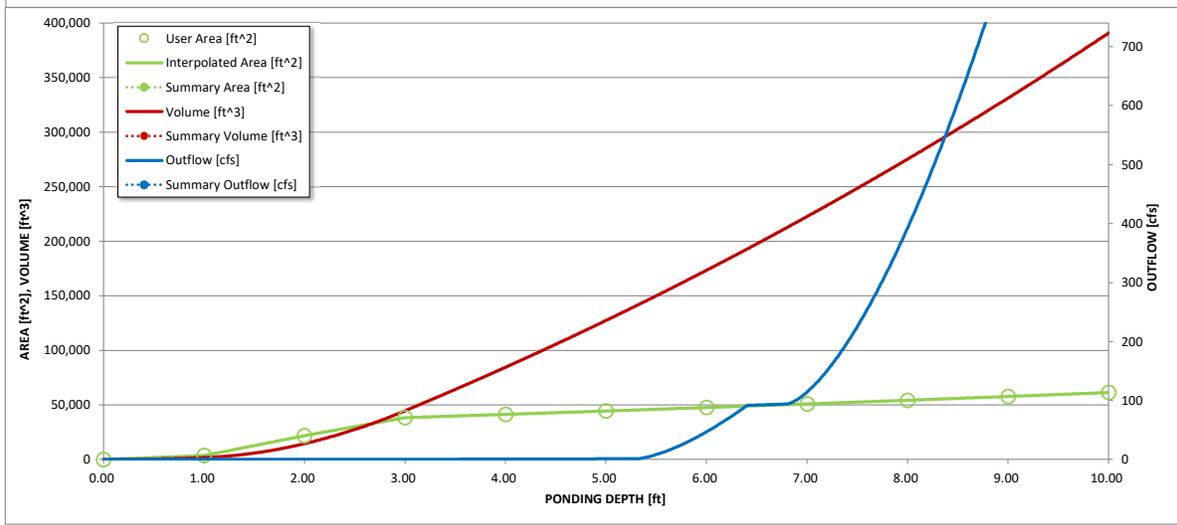
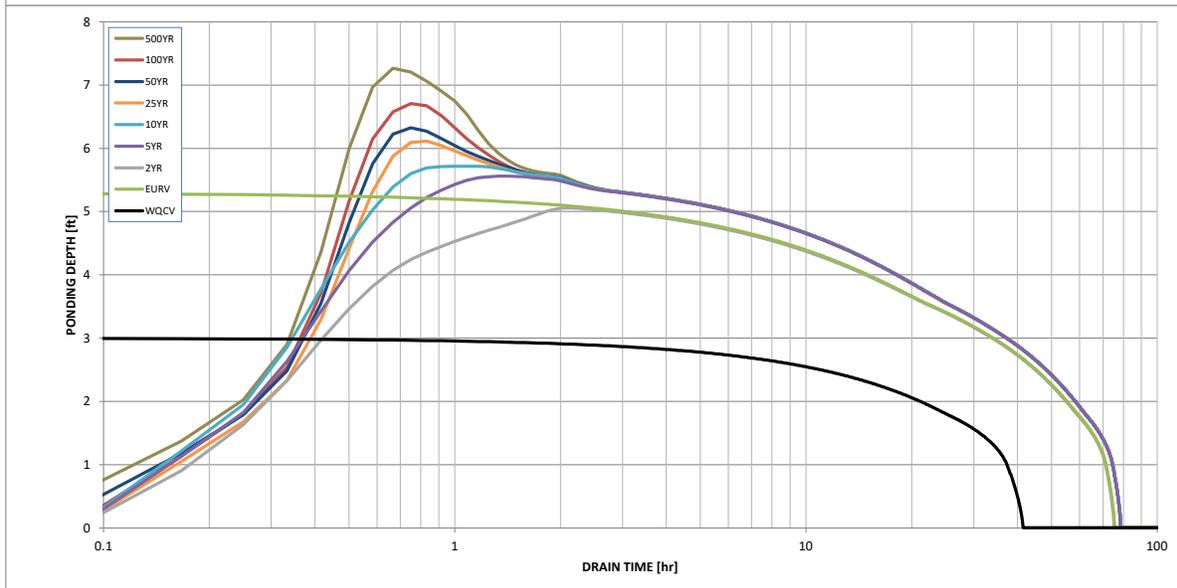
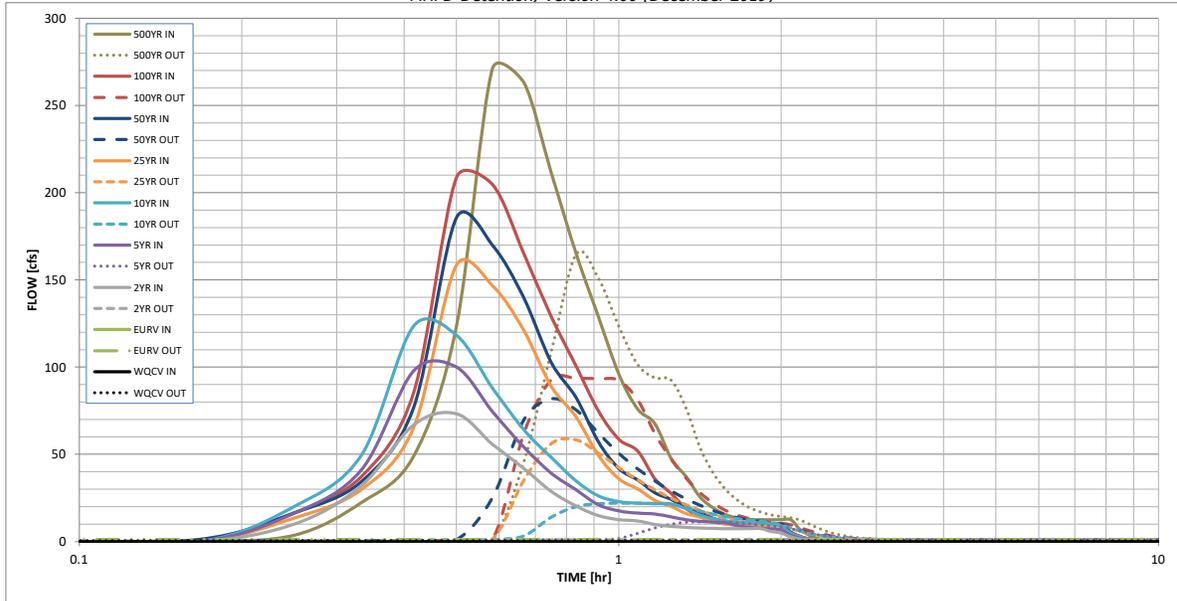
Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.022	3.224	3.136	4.333	5.373	6.613	7.697	9.012	11.787
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.136	4.333	5.373	6.613	7.697	9.012	11.787
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	12.5	28.5	41.3	67.4	83.3	103.5	143.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.24	0.55	0.80	1.30	1.60	1.99	2.76
Peak Inflow Q (cfs) =	N/A	N/A	73.2	100.0	123.5	158.4	185.7	208.5	271.1
Peak Outflow Q (cfs) =	0.5	1.2	1.2	11.3	22.0	58.3	81.7	93.6	164.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.5	0.9	1.0	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	0.2	0.4	1.0	1.4	1.6	1.7
Max Velocity through Gate 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) =	38	68	68	69	67	65	63	61	58
Time to Drain 99% of Inflow Volume (hours) =	40	72	72	75	74	73	72	71	70
Maximum Ponding Depth (ft) =	3.00	5.30	5.05	5.56	5.71	6.11	6.32	6.71	7.26
Area at Maximum Ponding Depth (acres) =	0.88	1.04	1.02	1.06	1.07	1.10	1.12	1.15	1.19
Maximum Volume Stored (acre-ft) =	1.024	3.233	2.975	3.496	3.666	4.101	4.334	4.764	5.418

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	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	1.12	0.11	3.60
	0:15:00	0.00	0.00	9.93	16.20	20.04	13.45	16.40	16.34	22.31
	0:20:00	0.00	0.00	32.05	41.07	49.59	29.89	34.37	37.36	49.02
	0:25:00	0.00	0.00	66.87	97.85	123.54	65.44	76.91	85.54	123.31
	0:30:00	0.00	0.00	73.20	100.00	118.38	158.38	185.67	208.54	271.09
	0:35:00	0.00	0.00	55.78	74.51	88.11	146.74	170.02	204.81	263.17
	0:40:00	0.00	0.00	41.95	54.11	64.09	121.03	139.65	165.09	211.31
	0:45:00	0.00	0.00	28.66	39.23	48.18	88.94	102.66	128.83	165.12
	0:50:00	0.00	0.00	20.36	29.64	34.72	71.45	82.50	100.62	128.90
	0:55:00	0.00	0.00	14.92	21.10	26.12	49.31	57.12	74.85	96.04
	1:00:00	0.00	0.00	12.57	17.53	22.94	36.00	41.93	58.69	75.94
	1:05:00	0.00	0.00	11.85	16.29	22.04	30.18	35.38	51.99	67.60
	1:10:00	0.00	0.00	9.74	15.80	21.70	23.57	27.94	36.05	47.70
	1:15:00	0.00	0.00	8.70	14.19	21.62	20.19	24.13	27.57	37.13
	1:20:00	0.00	0.00	8.07	12.50	18.64	16.04	19.00	18.83	25.30
	1:25:00	0.00	0.00	7.74	11.57	15.05	14.01	16.45	14.23	19.04
	1:30:00	0.00	0.00	7.52	11.05	12.97	11.39	13.22	11.40	15.22
	1:35:00	0.00	0.00	7.43	10.74	11.79	10.02	11.53	10.07	13.40
	1:40:00	0.00	0.00	7.43	9.01	11.10	9.31	10.63	9.62	12.74
	1:45:00	0.00	0.00	7.43	8.09	10.74	8.96	10.19	9.44	12.47
	1:50:00	0.00	0.00	7.43	7.56	10.65	8.80	10.00	9.44	12.47
	1:55:00	0.00	0.00	5.77	7.28	10.04	8.74	9.93	9.44	12.47
	2:00:00	0.00	0.00	4.84	6.68	8.72	8.74	9.93	9.44	12.47
	2:05:00	0.00	0.00	2.63	3.65	4.78	4.81	5.46	5.19	6.85
	2:10:00	0.00	0.00	1.40	1.99	2.58	2.64	2.99	2.84	3.74
	2:15:00	0.00	0.00	0.65	1.00	1.27	1.33	1.51	1.43	1.88
	2:20:00	0.00	0.00	0.27	0.46	0.56	0.63	0.71	0.67	0.88
	2:25:00	0.00	0.00	0.08	0.13	0.15	0.18	0.21	0.19	0.25
	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	

Spillway & Pond Outfall Riprap Sizing				
q (cfs/ft)	S (ft/ft)	C_f	n	D ₅₀ min. (in)
2.98	0.15	2	0	7.44

Type L Riprap (D₅₀ = 9") will be utilized for the spillway and outfall protection



APPENDIX E – REFERENCE MATERIAL



**MASTER DEVELOPMENT DRAINAGE PLAN
FOR
BRADLEY HEIGHTS**

JANUARY 2015

Prepared for:
THE CASE COMPANY
102 EAST PIKES PEAK AVE., SUITE 200
COLORADO SPRINGS, CO 80903
(719) 633-2700

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

Job no. 2266.00



the proposed site boundary. Basin OS-2 is 32.75 acres of undeveloped land to the west of the Bradley Heights property. This OS-2 area drains onto the proposed site to an existing natural channel that flows toward the south. Runoff from all three of these basins combine at DP E10 and continue south through unplatted land. There is a small existing stock pond used for cattle grazing purposes within Basin EX-6 that will be removed with any development of this land and was not used in the modeling to determine the existing southerly flow rates. Any future development will be limited to releasing at or below existing run off amount.

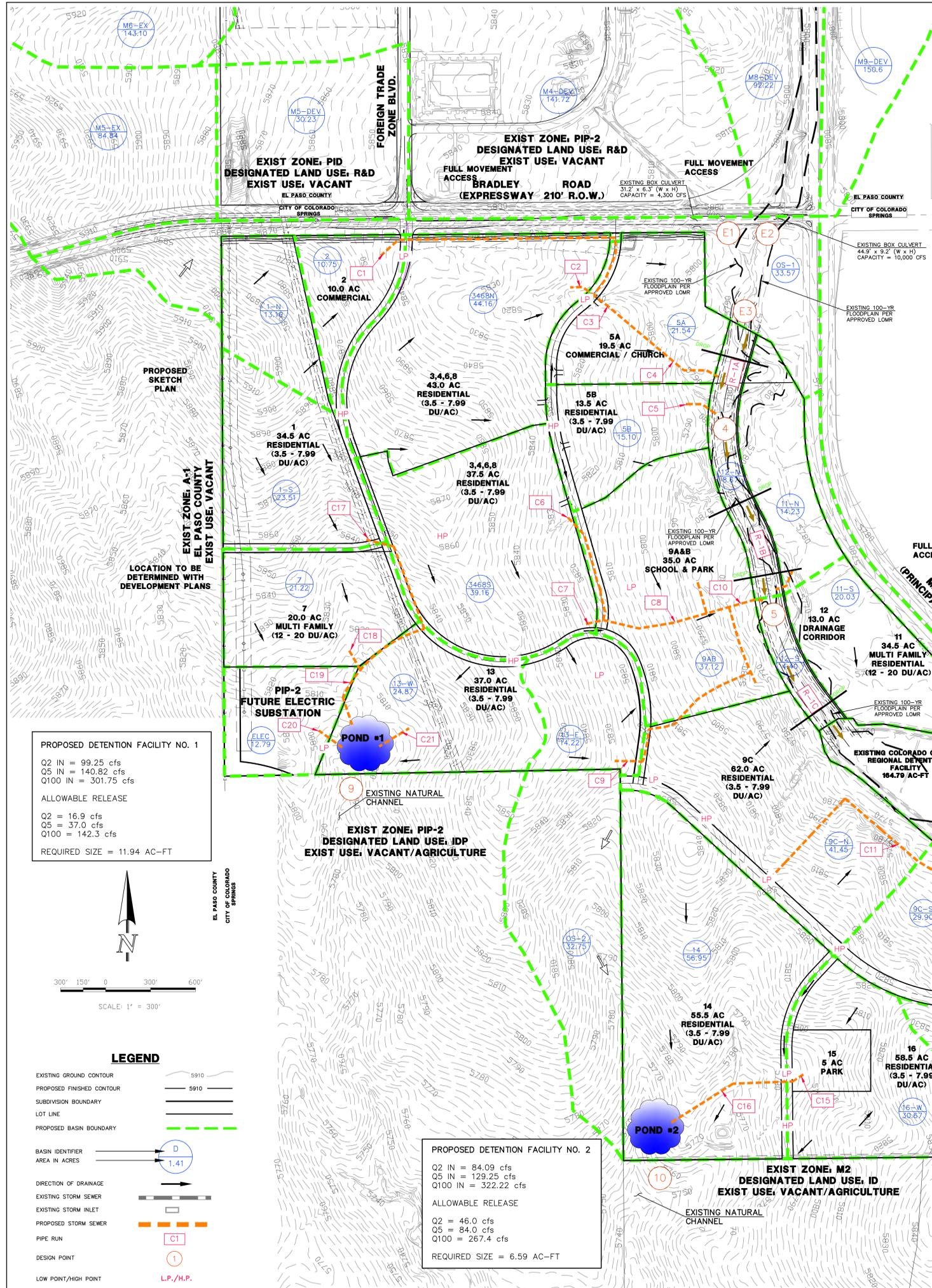
Design Point E11 ($Q_5 = 22.63$ cfs, $Q_{100} = 72.63$ cfs) consists of storm runoff from Basin EX-7, 35.97 acres of undeveloped land at the south-east corner of the proposed site. This basin is located along the southern boundary of the site along the city/county border. This historic runoff continues south-east in a natural swale to an existing culvert crossing of existing Marksheffel Drive. This culvert conveys the flow to the east, eventually into Jimmy Camp Creek. A future subdivision is planned for the site directly south over this existing swale (Peaceful Ridge at Fountain Valley Subdivision). Per the approved report for this future subdivision, a 48" RCP storm sewer will intercept the allowable flows ($Q_5 = 30.3$ cfs, $Q_{100} = 78.2$ cfs) and convey them through the subdivision into an adequate outfall across Marksheffel. Detention will be required for developed flows greater than the allowable release.

Design Point E12 ($Q_5 = 11.54$ cfs, $Q_{100} = 36.20$ cfs) consists of flows from Basin OS-3, 15.85 acres of undeveloped area located outside of the site boundary to the south-east, but west of Marksheffel Road. This basin produces runoff that drains south and east toward existing Marksheffel Road. Any development on the Bradley Heights site is to maintain these historic runoff rates to this point.

PROPOSED DRAINAGE CONDITIONS

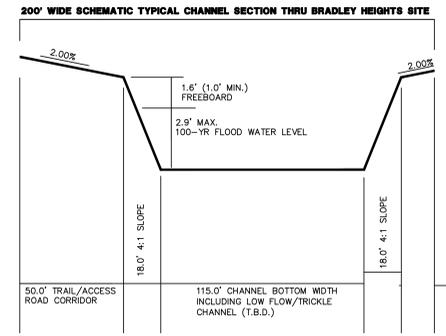
Bradley Heights is a proposed PUD development which will consist of single-family residential, multi-family residential, commercial, parks, a school site and Business areas. The existing Colorado Centre regional detention facility is to be made into a full spectrum water quality and detention facility with the development of Bradley Heights. By revising the outlet structure to achieve this requirement, the existing pond no longer has the volume necessary to detain all of Colorado Centre's developed runoff and release at a rate at or below existing conditions. For the purposes of this analysis, a specific area of Colorado Centre north of Bradley Road is modeled as developed, while the remaining area is required to provide its own detention/storm water quality and release at or below historic rates to downstream facilities. An exhibit is included in the Appendix that shows the areas considered developed for this analysis. As development occurs within Colorado Centre,





COMPOSITE C_n VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (ac)	LAND USE	SUB-AREA LAND USE 1 AREA (ac)	ESTIMATED C _n	SUB-AREA LAND USE 2 AREA (ac)	ESTIMATED C _n	TOTAL BASIN AREA (sq mi)	TOTAL BASIN AREA (sq mi)	WEIGHTED C
1-N	13.16	RES	13.16	85	0	N/A	13.16	0.02063	85.0
1-S	23.51	RES	23.51	85	0	N/A	23.51	0.03673	85.0
2	10.75	COMM	10.75	94	0	N/A	10.75	0.01680	94.0
5A	21.54	COMM	21.54	94	0	N/A	21.54	0.03356	94.0
3468N	44.16	RES	44.16	85	0	N/A	44.16	0.06900	85.0
11-N	14.23	MULTIFAM	14.23	91	0	N/A	14.23	0.02223	91.0
11-S	20.03	MULTIFAM	20.03	91	0	N/A	20.03	0.03130	91.0
7	21.22	MULTIFAM	21.22	91	0	N/A	21.22	0.03316	91.0
ELEC	12.79	ELEC SUB	12.79	91	0	N/A	12.79	0.01968	91.0
3468S	39.16	RES	39.16	85	0	N/A	39.16	0.06119	85.0
12-N	8.67	CHANNEL	8.67	74	0	N/A	8.67	0.01355	74.0
12-S	4.40	CHANNEL	4.40	74	0	N/A	4.40	0.00688	74.0
13-W	24.87	RES	24.87	85	0	N/A	24.87	0.03896	85.0
13-E	14.22	RES	14.22	85	0	N/A	14.22	0.02222	85.0
5B	15.10	RES	15.10	85	0	N/A	15.10	0.02359	85.0
9A-B	37.12	SCHL & PARK	27.12	91	5.00	74	37.12	0.05600	76.5
9C-N	41.45	RES	41.45	85	0	N/A	41.45	0.06477	85.0
9C-S	29.90	RES	29.90	85	0	N/A	29.90	0.04672	85.0
17	20.98	MULTIFAM	20.98	91	0	N/A	20.98	0.03278	91.0
15-N	16.88	RES	16.88	85	0	N/A	16.88	0.02638	85.0
16-W	30.67	RES & PARK	25.67	85	5.00	74	30.67	0.04782	83.2
16-E	18.20	RES	18.20	85	0	N/A	18.20	0.02844	85.0
14	56.95	RES	56.95	85	0	N/A	56.95	0.08688	85.0
OS-1	33.57	UNDEV	33.57	74	0	N/A	33.57	0.05245	87.4
OS-2	32.75	UNDEV	32.75	74	0	N/A	32.75	0.05117	74.0
OS-3	15.85	UNDEV	15.85	74	0	N/A	15.85	0.02477	74.0
OS-4	20.09	UNDEV	20.09	74	0	N/A	20.09	0.03139	74.0
DET	24.91	POND	24.91	74	0	N/A	24.91	0.03892	72.6



SCHEMATIC CHANNEL DESIGN:
 0.50% TYPICAL SLOPE.
 4 SLOPING DROP STRUCTURES (3'-0" TO 4'-0" HEIGHT EACH).
 BOTTOM WIDTH NARROWS DOWN TO 80.0' THRU DROP STRUCTURES WITH MAX. SLOPE OF 10.0%.

EXISTING MARKSHEFFEL TRIBUTARY DETENTION FACILITY
 Q2 IN = 459.86 cfs
 Q5 IN = 739.85 cfs
 Q100 IN = 2,029.97 cfs

DEVELOPED RELEASE
 Q2 = 24.16 cfs
 Q5 = 125.75 cfs
 Q100 = 1,153.73 cfs

EXISTING VOLUME TO TOP OF BERM (ELEV. 5761.50) = 193.66 AC-FT

Basin Summary - Developed Conditions

Basin (label)	Total Basin Area (ac)	Total Basin Area (sq mi)	Land Use	Weighted C _n	Total Time of Concentration (hours)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
1-N	13.16	0.02063	RES	85.0	0.4167	18.07	42.28
1-S	23.51	0.03673	RES	85.0	0.1867	52.78	75.53
2	10.75	0.01680	COMM	94.0	0.2000	29.24	53.53
5A	21.54	0.03356	COMM	94.0	0.2000	58.59	107.25
3468N	44.16	0.06900	RES	85.0	0.4167	60.83	141.87
11-N	14.23	0.02223	MULTIFAM	91.0	0.1867	35.30	67.88
11-S	20.03	0.03130	MULTIFAM	91.0	0.1867	49.69	93.55
7	21.22	0.03316	MULTIFAM	91.0	0.2500	48.93	95.69
ELEC	12.79	0.01968	ELEC SUB	91.0	0.1867	31.70	60.97
3468S	39.16	0.06119	RES	85.0	0.4167	53.75	125.81
12-N	8.67	0.01355	CHANNEL	74.0	0.2500	7.27	22.37
12-S	4.40	0.00688	CHANNEL	74.0	0.1867	3.09	11.35
13-W	24.87	0.03896	RES	85.0	0.4167	34.15	79.90
13-E	14.22	0.02222	RES	85.0	0.4167	19.52	45.68
5B	15.10	0.02359	RES	85.0	0.3300	23.11	52.78
9A-B	37.12	0.05600	SCHL & PARK	76.5	0.2500	36.36	103.38
9C-N	41.45	0.06477	RES	85.0	0.4167	55.63	132.52
9C-S	29.90	0.04672	RES	85.0	0.4167	41.01	96.06
17	20.98	0.03278	MULTIFAM	91.0	0.2000	50.55	98.27
16-N	16.88	0.02638	RES	85.0	0.3300	25.83	58.00
16-W	30.67	0.04782	RES & PARK	83.2	0.5000	38.05	89.68
16-E	18.20	0.02844	RES	85.0	0.4167	24.99	58.47
14	56.95	0.08688	RES	85.0	0.5000	70.65	168.53
OS-1	33.57	0.05245	UNDEV	87.4	0.2629	63.02	134.50
OS-2	32.75	0.05117	UNDEV	74.0	0.4174	29.57	68.00
OS-3	15.85	0.02477	UNDEV	74.0	0.3297	11.54	36.20
OS-4	20.09	0.03139	UNDEV	74.0	0.2991	16.32	50.11
DET	24.91	0.03892	POND	72.6	0.2981	17.82	56.55
M4-EX	6.50	0.0102	UNDEV	75.1	0.1867	6.88	18.18
M4-DEV	141.72	0.2214	INDUS *	85.0	0.6867	152.99	358.32
M5-EX	84.84	0.1326	UNDEV	67.9	0.6667	20.43	90.95
M5-DEV	30.23	0.0472	INDUS *	84.0	0.3833	40.65	96.34
M6-EX	143.10	0.2236	UNDEV	58.8	0.6390	3.16	62.71
M7-EX	108.54	0.1688	UNDEV	68.0	0.5279	31.55	138.81
M8-EX	66.31	0.1036	UNDEV	75.7	0.5833	48.99	137.22
M8-DEV	92.22	0.1441	INDUS *	86.0	0.5000	121.84	279.74
M9-DEV	150.66	0.2354	RES (B DU/AC) *	81.0	1.4167	64.44	171.57
M10-EX	86.83	0.1388	UNDEV	67.7	1.2781	19.55	71.39
M11-EX	58.14	0.0924	UNDEV	70.0	0.7223	26.54	91.53
M12-EX	106.24	0.1660	UNDEV	63.5	0.7502	13.77	80.33
M13-EX	144.45	0.2257	UNDEV	61.7	0.9169	11.62	80.42
M14-EX	72.70	0.1136	UNDEV	70.3	0.8335	18.82	73.79
M15-EX	58.14	0.0924	UNDEV	67.0	0.4729	33.04	39.50
M16-EX	148.54	0.2321	UNDEV	68.8	0.9447	18.78	99.49
M17-EX	182.02	0.2844	UNDEV	75.7	0.8335	81.13	285.04
M18-EX	163.40	0.2553	UNDEV	71.4	0.9169	42.71	162.26
M19-EX	192.00	0.3000	UNDEV	69.2	0.9274	23.83	128.18
M20-EX	89.54	0.1369	UNDEV	63.7	1.0838	6.83	50.28
M21-EX	146.56	0.2290	UNDEV	63.7	0.6390	21.28	125.61
M22-EX	66.11	0.1033	UNDEV	50.3	0.6113	0.17	14.09
M23-EX	132.80	0.2075	UNDEV	53.7	1.2219	1.19	28.28
M24-EX	98.58	0.1568	UNDEV	66.0	0.6568	16.36	68.24
M25-EX	101.82	0.1591	UNDEV	67.7	0.6390	4.28	54.33
M26-EX	114.30	0.1786	UNDEV	54.1	1.6392	0.97	19.58
M27-EX	124.86	0.1951	UNDEV	49.8	1.0333	0.31	12.48

DEVELOPED CONDITIONS - PRELIMINARY PIPE SIZING

Pipe Run	Contributing Basins	Flow		Pipe Size*
		Q(5)	Q(100)	
C1	PARCEL 1-N & PARCEL 2	45.2	92.1	48" RCP @ 0.50% minimum
C2	PARCEL 3468N	60.8	60.8	42" RCP @ 0.50% minimum
C3	PIPE C1 & C2	101.6	228.6	72" RCP @ 0.50% minimum
C4	PARCEL 5A + PIPE C3	158.5	331.7	78" RCP @ 0.50% minimum
C5	PARCEL 5B	23.1	52.8	42" RCP @ 0.50% minimum
C6	PARCEL 3468S (1/2)	26.9	62.9	42" RCP @ 0.50% minimum
C7	PARCEL 3467S (1/2)	26.9	62.9	42" RCP @ 0.50% minimum
C8	PIPE C6 & C7	53.8	125.8	54" RCP @ 0.50% minimum
C9	PARCEL 13-E	19.5	45.7	36" RCP @ 0.50% minimum
C10	PARCEL 9A-B + PIPES C8 & C9	108.8	269.0	72" RCP @ 0.53% minimum
C11	PARCEL 9C-N	56.6	132.5	54" RCP @ 0.50% minimum
C12	PARCEL 16-N	25.8	59.0	42" RCP @ 0.50% minimum
C13	PARCEL 9C-S + PIPE C11	97.7	228.6	66" RCP @ 0.50% minimum
C14	PIPE C12 & C13	123.5	234.2	66" RCP @ 0.50% minimum
C15	PARCEL 16-W	38.1	89.7	48" RCP @ 0.50% minimum
C16	PARCEL 14 + PIPE C15	108.7	256.2	72" RCP @ 0.50% minimum
C17	PARCEL 1-S	32.3	75.5	54" RCP @ 0.50% minimum
C18	PARCEL 7	48.9	95.7	48" RCP @ 0.50% minimum
C19	PIPE C17 & C18	79.0	167.8	60" RCP @ 0.50% minimum
C20	PARCEL ELEC	31.7	61.0	42" RCP @ 0.50% minimum
C21	PARCEL 13-W	34.2	79.9	48" RCP @ 0.50% minimum
C22	PARCEL 16-E	25.0	58.5	42" RCP @ 0.50% minimum
C23	PARCEL 17 + PIPE C22	73.0	151.5	60" RCP @ 0.50% minimum

DESIGN POINTS - DEVELOPED CONDITIONS

Design Point (label)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 10 Yr. (cfs)	Q 50 Yr. (cfs)	Q 100 Yr. (cfs)
E1	138.75	222.10	343.00	602.30	660.54
E2	144.46	309.65	1,187.02	1,325.18	1,325.18
E3	287.43	451.82	760.37	1,498.54	1,667.15
4	355.17	556.27	843.14	1,547.84	1,720.53
5	397.10	632.14	956.89	1,611.37	1,771.82
Pond-Marksheffel In	499.86	739.86	1,126.01	1,866.91	2,029.97
Pond-Marksheffel Out	57.35	125.45	380.70	1,009.18	1,156.30
7 - Marksheffel Trib. Out	24.16	125.75	379.52	1,006.65	1,153.73
8	6.22	11.54	19.01	33.18	36.20
Pond 1 In	99.25	140.82	193.07	283.40	301.75
9 (Historic Release)	67.07	142.54	180.00	299.45	322.22
Pond 2 In	84.09	129.25	180.00	299.45	322.22
10 (Historic Release)	45.99	83.97	138.22	244.61	267.42
Pond 3 In	52.38	73.01	98.67	142.61	151.49
11 (Historic Release)	12.05	22.63	37.64	66.45	72.63

DEVELOPED DRAINAGE MAP BRADLEY HEIGHTS
 JOB NO. 2266.00
 JANUARY 2015
 SHEET 1 OF 1

CLASSIC CONSULTING ENGINEERS & SURVEYORS

6385 Corporate Drive, Suite 101 Colorado Springs, Colorado 80919 (719)785-0790 (719)785-0799 (Fax)

PROPOSED DETENTION FACILITY NO. 1
 Q2 IN = 99.25 cfs
 Q5 IN = 140.82 cfs
 Q100 IN = 301.75 cfs

ALLOWABLE RELEASE
 Q2 = 16.9 cfs
 Q5 = 37.0 cfs
 Q100 = 142.3 cfs

REQUIRED SIZE = 11.94 AC-FT

PROPOSED DETENTION FACILITY NO. 2
 Q2 IN = 84.09 cfs
 Q5 IN = 129.25 cfs
 Q100 IN = 322.22 cfs

ALLOWABLE RELEASE
 Q2 = 46.0 cfs
 Q5 = 84.0 cfs
 Q100 = 267.4 cfs

REQUIRED SIZE = 6.59 AC-FT

PROPOSED DETENTION FACILITY NO. 3
 Q2 IN = 52.4 cfs
 Q5 IN = 73.0 cfs
 Q100 IN = 151.5 cfs

ALLOWABLE RELEASE
 Q2 = 12.0 cfs
 Q5 = 22.6 cfs
 Q100 = 72.6 cfs

REQUIRED SIZE = 4.89 AC-FT

REDEMPTION HILL CHURCH COLORADO SPRINGS, CO PROPOSED DRAINAGE MAP JANUARY 2020

DRAINAGE SUMMARY

BASIN	AREA (ACRES)	FLOW	
		5 YR (cfs)	100 YR (cfs)
OS-Z	55.3	28.9	154.9
OS-Y	5.50	3.0	16.3
OS-X	3.73	2.0	11.0
PR-1	10.40	16.7	37.4
PR-2	0.26	1.3	2.6
PR-3	0.26	1.3	2.6
PR-4	1.08	3.1	6.4
PR-5	1.57	4.5	9.3
PR-6	0.64	1.8	3.7
PR-7	1.60	3.1	7.1
PR-8	0.36	2.0	4.0
PR-9	0.36	2.0	4.0
PR-10	0.06	0.3	0.7
PR-11	0.06	0.3	0.7
PR-12	0.57	1.6	3.2
PR-13	1.09	2.1	4.7
PR-14	0.38	0.2	1.0
PR-15	0.75	0.5	3.0
PR-16	0.15	0.1	0.7
PR-17	0.28	0.1	0.7
PR-18	0.42	0.3	1.7
PR-19	0.16	0.1	0.5

PLAT NAME
TBD

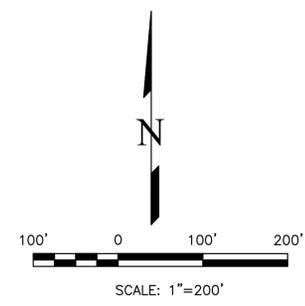
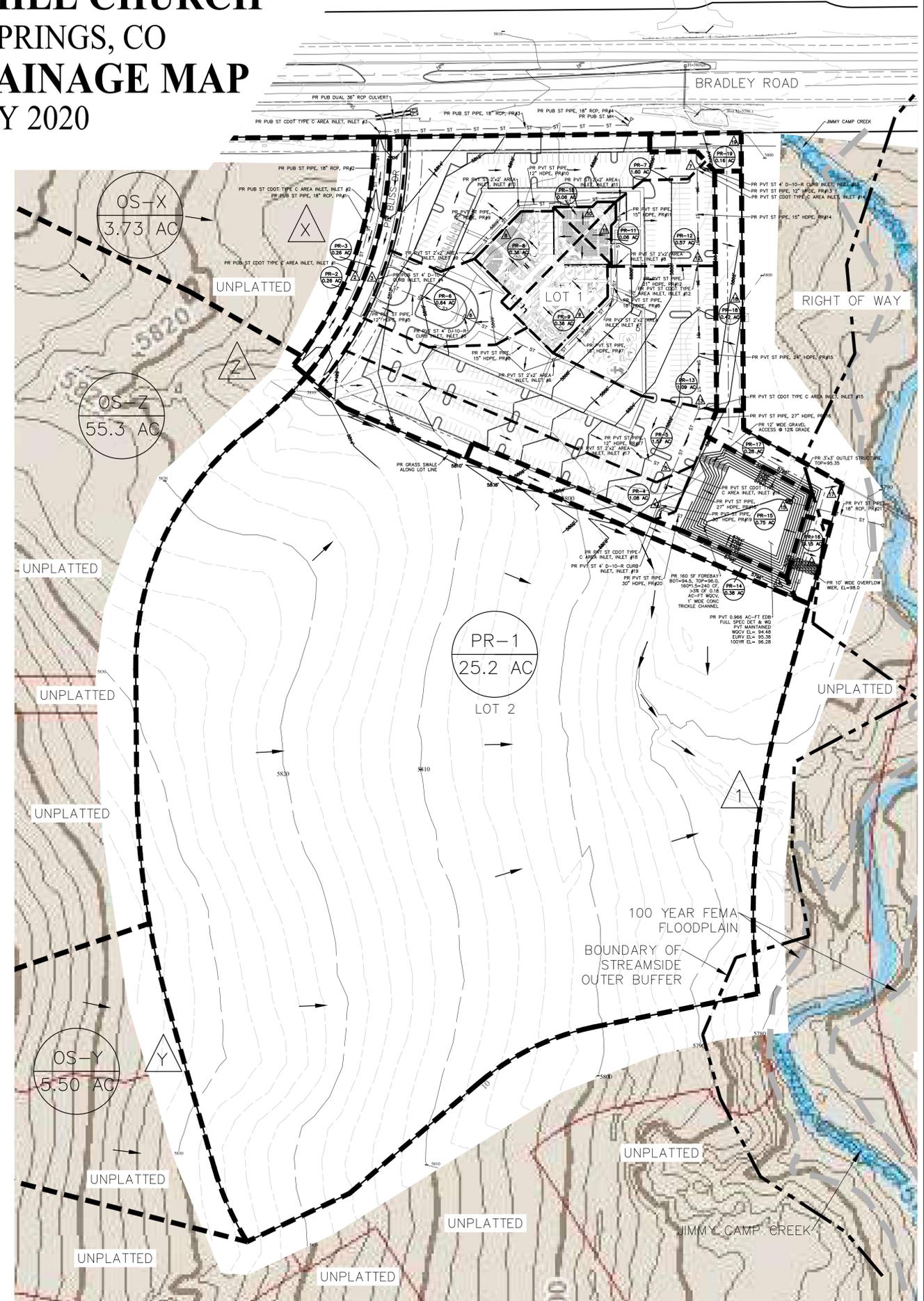
- NOTES**
1. THE SITE IS NOT WITHIN A 100 YEAR FEMA FLOOD PLAIN.
 2. OFFSITE GROUND SURFACE CONTOURS ARE FROM COLORADO SPRINGS SPRINGSVIEW GIS (NAD 1983).

LEGEND

- P-7 12.22 BASIN DESIGNATION AREA IN BASIN (AC)
- D DESIGN POINT
- BASIN BOUNDARY
- - - - EXISTING MINOR CONTOUR
- - - - EXISTING MAJOR CONTOUR
- PROPOSED GROUND SURFACE CONTOUR
- ROAD AND DITCH FLOW DIRECTION
- GROUND SURFACE FLOW DIRECTION
- PROPOSED RETAINING WALL
- UNDERGROUND WATER LINE
- SANITARY SEWER LINE
- STORM SEWER LINE

DESIGN POINT SUMMARY

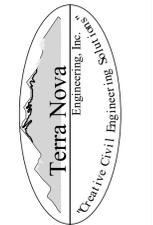
DESIGN POINT	BASIN TRIBUTARY	AREA (ACRES)	FLOW	
			5 YR (cfs)	100 YR (cfs)
Z	OS-Z	55.3	28.9	154.9
Y	OS-Y	5.50	3.0	16.3
X	OS-X	3.73	2.0	11.0
1	PR-1, OS-Z, OS-Y	71.2	78.6	208.6
2	PR-2, OS-X	3.99	3.3	13.6
3	PR-3	0.26	1.3	2.6
4	PR-4	1.08	3.1	6.4
5	PR-5	1.57	4.5	9.3
6	PR-6	0.64	1.8	3.7
7	PR-7	1.60	3.1	7.1
8	PR-8	0.36	2.0	4.0
9	PR-9	0.36	2.0	4.0
10	PR-10	0.06	0.3	0.7
11	PR-11	0.06	0.3	0.7
12	PR-12	0.57	1.6	3.2
13	PR-13	1.09	2.1	4.7
14	PR-14	0.38	0.2	1.0
15	PR-15	0.75	0.5	3.0
16	PR-16	0.15	0.1	0.7
17	PR-17	0.28	0.1	0.7
18	PR-18	0.42	0.3	1.7
19	PR-19	0.16	0.1	0.5



NO.	DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEIR USE ONLY FOR THE PROJECT AND FOR THE MOST PART BY WRITTEN AUTHORIZATION.

PREPARED FOR:
GORDON CONSTRUCTION CO INC
ATTN: TONY GORDON
135 WINTERS DRIVE
COLORADO SPRINGS, CO 80907
719.634.2112



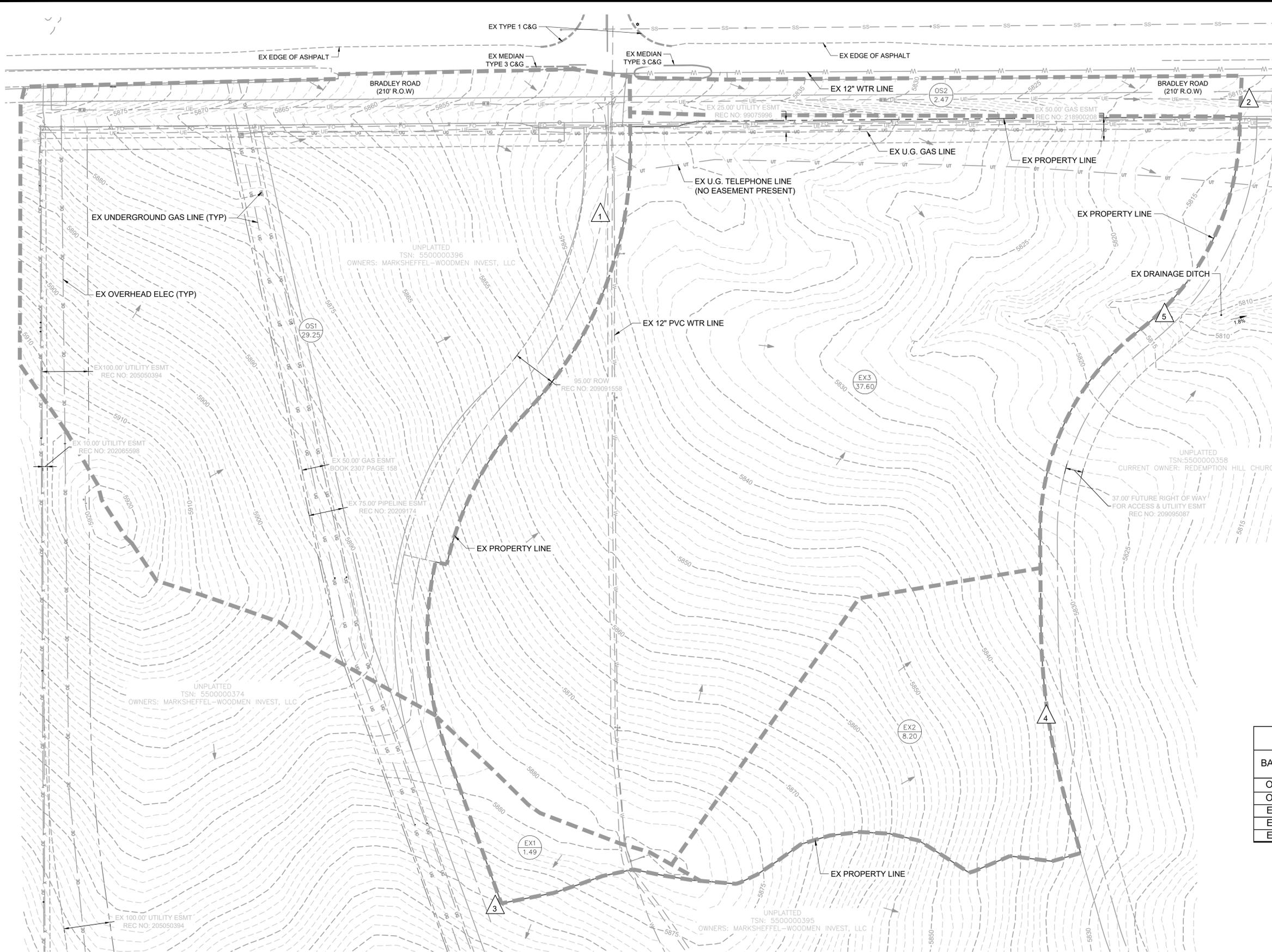
721 S. 2900 STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnec.com

REDEMPTION HILL CHURCH
PROPOSED DRAINAGE MAP - ENTIRE PROPERTY

DESIGNED BY LD
DRAWN BY JGF
CHECKED BY LD
H-SCALE AS NOTED
V-SCALE N/A
JOB NO. 1937.00
DATE ISSUED 01/07/20
SHEET NO. 2 OF 3



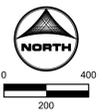
APPENDIX F – DRAINAGE MAPS



LEGEND:

- EXISTING MAJOR CONTOUR: ---5250---
- EXISTING MINOR CONTOUR: - - - - -
- EXISTING STORM DRAIN PIPE: ————
- PROPERTY LINE: - - - - -
- EXISTING FLOW DIRECTION: ←
- SUB BASIN LINE: - - - - -
- DESIGN POINT: △
- BASIN LABEL: ○
- BASIN DESIGNATION: △ (with number)
- AREA (AC.): ○ (with number)

SUMMARY RUNOFF TABLE				
BASIN	AREA (ac)	% IMPERVIOUS	Q ₅ (cfs)	Q ₁₀₀ (cfs)
OS1	29.25	7	11.0	18.4
OS2	2.47	47	3.9	6.5
EX1	1.49	2	0.5	0.8
EX2	8.20	2	3.6	6.1
EX3	37.60	2	7.9	13.2



DRAWN BY: NQJ JOB DATE: 5/24/2021
 APPROVED: KMH JOB NUMBER: 201134
 CAD DATE: 03/29/2021
 CAD FILE: J:\2020\201134\CAD\Drawings\Ex_Drainage_Map

BAR IS ONE INCH ON OFFICIAL DRAWINGS.
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
 HR GREEN - COLORADO SPRINGS
 7222 COMMERCE CENTER DR. SUITE 220
 COLORADO SPRINGS CO 80919
 PHONE: 719.622.6222
 FAX: 844.273.1057

BRADLEY HEIGHTS
 CHALLENGER HOMES
 COLORADO SPRINGS, COLORADO



EXISTING CONDITIONS DRAINAGE MAP

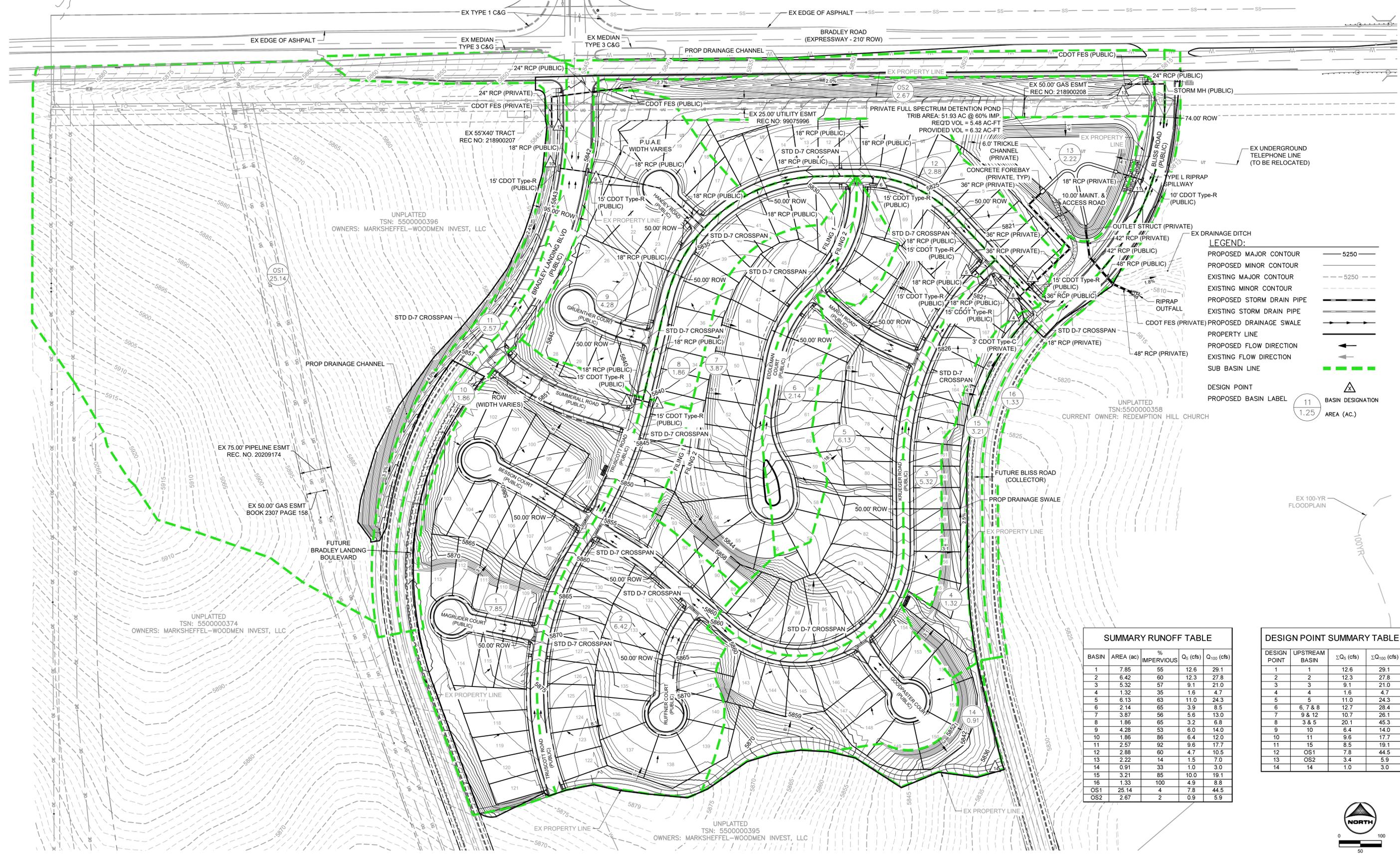
SHEET
DRN
 1

JOKERST, NICHOLAS, 8/6/2021 7:43 AM

UNPLATTED
TSN: 5509101001
CURRENT OWNER(S): COLORADO CENTRE METROPOLITAN DIST

UNPLATTED
TSN: 5509101002
CURRENT OWNER(S): COLORADO CENTRE METROPOLITAN DIST

UNPLATTED
TSN: 5510200004
CURRENT OWNER(S): KREJCI FRANK R TRUSTEE



LEGEND:

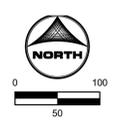
- PROPOSED MAJOR CONTOUR ——— 5250
- PROPOSED MINOR CONTOUR ——— 5250
- EXISTING MAJOR CONTOUR - - - - - 5250
- EXISTING MINOR CONTOUR - - - - - 5250
- PROPOSED STORM DRAIN PIPE ———
- EXISTING STORM DRAIN PIPE - - - - -
- PROPOSED DRAINAGE SWALE ———
- PROPERTY LINE ———
- PROPOSED FLOW DIRECTION ←
- EXISTING FLOW DIRECTION ←
- SUB BASIN LINE ———
- DESIGN POINT (11) BASIN DESIGNATION
- PROPOSED BASIN LABEL (1.25) AREA (AC.)

SUMMARY RUNOFF TABLE

BASIN	AREA (ac)	% IMPERVIOUS	Q _s (cfs)	Q ₁₀₀ (cfs)
1	7.85	55	12.6	29.1
2	6.42	60	12.3	27.8
3	5.32	57	9.1	21.0
4	1.32	35	1.6	4.7
5	6.13	63	11.0	24.3
6	2.14	65	3.9	8.5
7	3.87	56	5.6	13.0
8	1.86	65	3.2	6.8
9	4.28	53	6.0	14.0
10	1.86	86	6.4	12.0
11	2.57	92	9.6	17.7
12	2.88	60	4.7	10.5
13	2.22	14	1.5	7.0
14	0.91	33	1.0	3.0
15	3.21	85	10.0	19.1
16	1.33	100	4.9	8.8
OS1	25.14	4	7.8	44.5
OS2	2.67	2	0.9	5.9

DESIGN POINT SUMMARY TABLE

DESIGN POINT	UPSTREAM BASIN	ΣQ _s (cfs)	ΣQ ₁₀₀ (cfs)
1	1	12.6	29.1
2	2	12.3	27.8
3	3	9.1	21.0
4	4	1.6	4.7
5	5	11.0	24.3
6	6, 7 & 8	12.7	28.4
7	9 & 12	10.7	26.1
8	3 & 5	20.1	45.3
9	10	6.4	14.0
10	11	9.6	17.7
11	15	8.5	19.1
12	OS1	7.8	44.5
13	OS2	3.4	5.9
14	14	1.0	3.0



DRAWN BY: NQJ JOB DATE: 8/6/2021
 APPROVED: KMH JOB NUMBER: #####
 CAD DATE: 8/6/2021
 CAD FILE: J:\2020\201134\CAD\DWG\CIDrainage\Pr_Drainage_Map

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NO.	DATE	BY	REVISION DESCRIPTION

HRGreen
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 PHONE: 719.622.6222
 FAX: 844.273.1057

BRADLEY HEIGHTS
CHALLENGER HOMES
 COLORADO SPRINGS, COLORADO

CHALLENGER HOMES

PROPOSED DRAINAGE MAP

SHEET DRN 1