TERRA FORMA
SOLUTIONS

MONUMENT STEEL STRUCTURES

FINAL DRAINAGE STUDY

AUGUST 2019

For:
Steel Structures America Inc.
3635 E. Covington Ave.
Post Falls, ID 83854

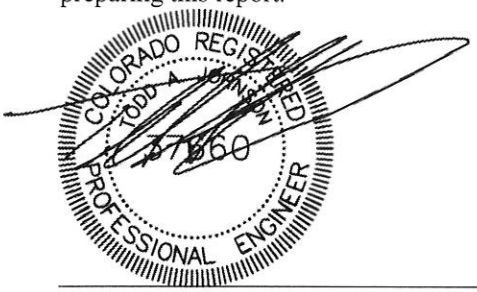
By:
Terra Forma Solutions
9994 Quintero Street
Commerce City, CO 80022
Todd Johnson, P.E.
303.257.7653

PCD File No. PPR1919

Update

ENGINEER'S CERTIFICATION:

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



Todd Johnson, P.E. #37660

08/17/2019
Date

Owner/Developer's Statement:

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

8-19-19
Date

Justin Sternberg
Steel Structures America Inc.
3635 E. Covington Ave.
Post Falls, ID 83854

El Paso County:

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

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

Date

Conditions:

TABLE OF CONTENTS

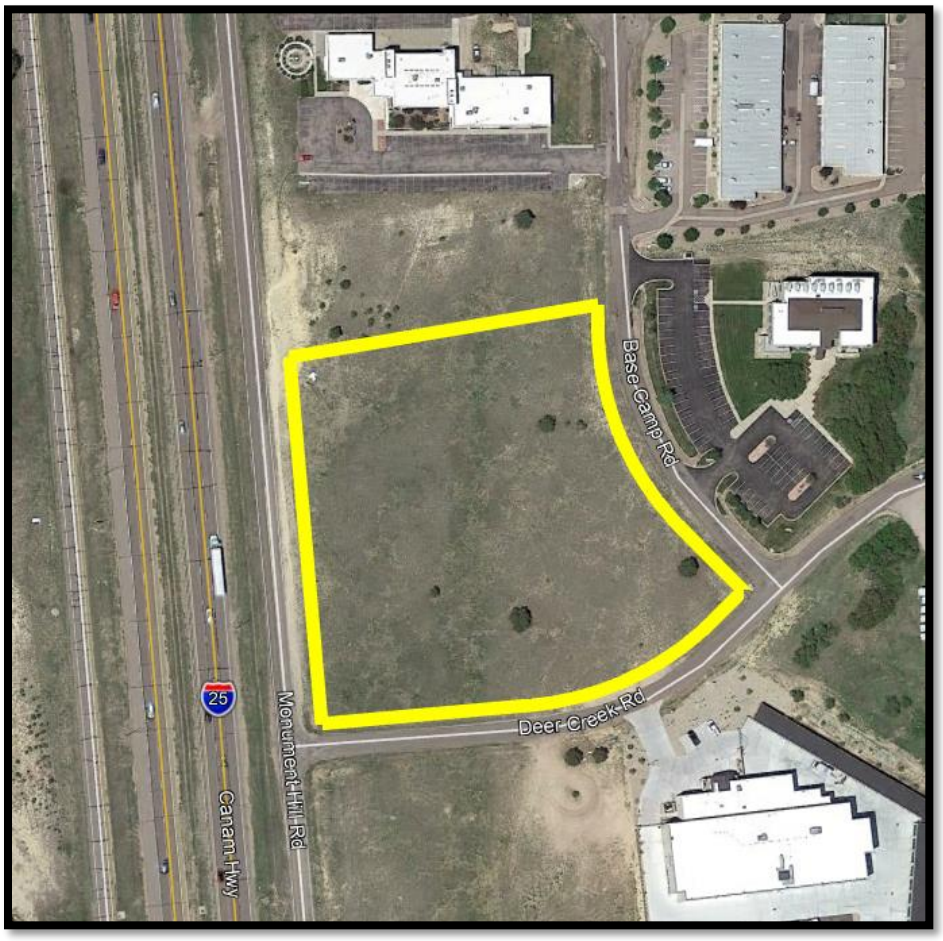
SCOPE

The purpose of this report is to present the drainage plan for the proposed Monument Steel Structures development. The following includes final analysis and design information for the proposed drainage systems in general conformance with the standards and specifications established by El Paso County, Colorado Springs and the Urban Drainage and Flood Control District (UDFCD).

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

- The Monument Steel Structures development is located at 18910 Base Camp Road in Section 11, Township 11 South, Range 67 West of the 6th Principal Meridian in El Paso County, State of Colorado.
- Approximate geodetic coordinates for the site are: 39°6'21"N, 104°51'48"W
- The site is bordered to the north by the Greater Europe Missions, to the east by Base Camp Road, to the west by Monument Hill Road and to the south by Deer Creek Road.
- See Site Location Map below for overall site location: (See Vicinity Map in the Appendices)



B. Description of Property

- The site is approximately 4.0 acres in size. The site is currently vacant and is covered by native grasses and weeds. Topography generally slopes from northeast to southwest towards a roadside ditch along Monument Hill Road with grades generally varying from 1% to 10%.
- The site is not located within a flooplain as shown on the FEMA FIRM Map No. 08041C0276G dated December 7, 2018.
- The site lies within Zone X which is described as follows: Areas of 0.2% annual chance flood; areas of 1% annual chance of a flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood. See Appendix D for a FEMA Firm panel exhibit.
- The proposed Monument Steel Structures development is proposing a sales office with display structures and Mini Warehouse and RV Boat Storage.
- Soil types on site as identified by the Natural Resources Conservation Service (NRCS) are as follows:

Hydrologic Soil Group				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
92	Tomah – Crowfoot Loamy sands, 3 to 8 percent slopes	B	4.7	80.6%
93	Tomah – Crowfoot complex, 8 to 15 percent slopes	B	1.1	19.4%

- See Appendix D for soils map.
- There are no known irrigation canals or ditches within the project boundaries.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

- The site is tributary to the Crystal Creek basin within Monument Creek watershed. There are no major drainageways crossing or adjacent to the site. Runoff from the proposed site will release from the on-site extended detention basin at the southwest corner of the site and will enter the recently constructed 30” FES (constructed with the Monument Hill Widening Project), matching existing drainage patterns.
- Off-site flow patterns will not be influenced by the development of this site.

B. Historic Drainage Basins

- **Basin E-1:** Consists of the West half of Base Camp Road from the Greater Europe Missions southern access to the Deer Creek Road intersection, native grasses and weeds between the Base Camp Road and the eastern property boundary and native grasses and weeds from the Greater Europe Missions parking lot to the northern property boundary.

- Historically, runoff from this basin flows onto the site and sheet flows across the subject property to the southwest corner of the site where it releases through the recently constructed 30" FES (constructed with the Monument Hill Widening Project).

- **Basin E-2:** Encompasses the property boundary and consists of vacant land covered by native grasses and weeds.
  - Historically, runoff from this basin sheet flows to the southwest corner of the site where it releases through the recently constructed 30" FES (constructed with the Monument Hill Widening Project).

C. Minor Drainage Basins

- **Basin OS-1:** Consists of vacant land in between the north boundary of the site and the southern parking lot of the Greater Europe Missions property.
  - Runoff generated in this basin will sheet flow overland from north to south entering the site along the northern property boundary and combine flows with Basin A-4 (See Below)
- **Basin OS-2:** Consists of vacant land in between the north boundary of the site and the southern parking lot of the Greater Europe Missions property.
  - Runoff generated in this basin will sheet flow overland from north to south entering the site along the northern property boundary and combine flows with Basin A-3.
- **Basin OS-3:** Consists of vacant land between the north boundary of the site and the southern parking lot of the Greater Europe Missions property. This basin also consists of the western half of Base Camp Road from the middle of the eastern property boundary north to the southern access of Greater Europe Missions property.
  - Runoff generated in this basin will sheet flow overland from north to south and east to west entering the site along the northern and eastern property boundary and combine flows with Basin A-2
- **Basin OS-4:** Consists of the western half of Base Camp Road and landscaping from the middle of the eastern property boundary south to the intersection of Base Camp Road and Deer Creek Road.
  - Runoff generated in this basin will sheet flow overland from east to west entering the site along the eastern property boundary and combine flows with Basin A-1.
- **Basin OS-5:** Consists of vacant land in between the north boundary of the site and the southern parking lot of the Greater Europe Missions property.
  - Runoff generated in this basin will sheet flow overland from the north to the south entering the site along the northern boundary and be directed west to the Monument Hill Road roadside via a drainage swale.
- **Basin OS-6:** Consists of rooftops and landscaping at the western portion of the site.
  - Runoff generated within this boundary will be released from the rooftops via downspouts and be directed west to the Monument Hill Road roadside ditch. Low Impact Development is being achieved within this basin as impervious and

pervious areas are being disconnected along with implementing infiltration as the flows run along the earth lined roadside ditch. **The 100-year allowable release for the EDB has been reduced by the derived 100-yr runoff of this basin.**

- This basin is ~4.0% of the site (0.16ac) and therefore falls within the ECM exclusions from the MS4 Permit per Appendix I Section I.7.1.C.1a stating:

  100% of the applicable development site is captured, except the County may exclude up to 20 percent, not to exceed 1 acre, of the applicable development site area when the County has determined that it is not practicable to capture runoff from portions of the site that will not drain towards control measures. In addition, the County must also determine that the implementation of a separate control measure for that portion of the site is not practicable (e.g., driveway access that drains directly to street).

  - This area is implementing Low Impact Development (LID) techniques to Minimize Directly Connected Impervious Area (MDCIA) by routing runoff from impervious surfaces over grassy areas to slow runoff and promote infiltration. MDCIA is recommended as a key technique for reducing runoff peaks and volumes for frequently-occurring storms following urbanization. MDCIA is a key component of LID.
  - The UD-BMP Runoff Reduction spreadsheet was used to quantify the WQCV Reduction within this area (See results in Appendix F). This spreadsheet was developed by UDFCD to provide a simple tool that can be used to demonstrate compliance with the Runoff Reduction Standard in the MS4 General Permit.
    - Using the spreadsheet, a WQCV of 272 cubic feet was derived with the roadside ditch providing a 100% reduction. Such that there is anticipated to 0% untreated WQCV leaving the site

- **Basin OS-7:** Consists of the existing 20-foot Monument Hill Road roadside ditch drainage and utility easement and landscaping behind the proposed buildings along the western boundary of the site.

  - Runoff generated in this basin will combine with the flows entering the basin from the Monument Hill Road roadside ditch to the north and the flows from Basin OS-5 and OS-6 described above. The combined flows will travel south along the earth lined roadside ditch to the recently constructed 30” FES transporting the flows under Deer Creek Road and off site.
  - This basin is ~10% of the site (0.40ac) and combines with Basin OS-6.
    - The sum of these basins is ~14% of the site (0.56ac) and therefore falls within the ECM exclusions from the MS4 Permit per Appendix I Section I.7.1.c.1a stating:

      100% of the applicable development site is captured, except the County may exclude up to 20 percent, not to exceed 1 acre, of the applicable development site area when the County has determined that it is not practicable to capture runoff from portions of the site that will not drain towards control measures. In addition, the County must also determine that the implementation of a separate control measure for that portion of

the site is not practicable (e.g., driveway access that drains directly to street).

- **Basin A-1:** Consist of rooftops, pavement and landscaping at the southeastern corner of the site.
    - Runoff generated in this basin will combine with the flows entering the site from the east (Basin OS-4) and the flows entering the site from the south (Basin OS-5). The flows will travel along the southern curb and gutter from the northeast to the southwest being captured by the proposed on-grade 10' Type R inlet (IN-1) at Design Point 1 where it will combine with flows from Basin A-2. This inlet has been sized to capture the 5-year flows and most of the 100-yr flows
        - Captured flows will be transported to the proposed EDB via concrete pipe.
        - Bypassing flows will travel west to Design Point 3 and be captured by a proposed Double Type 13 Combo inlet (IN-2) before entering the proposed EDB via concrete pipe.
- **Basin A-2:** Consists of rooftops, pavement and landscaping stretching from the northern boundary to the southern boundary encompassing the eastern-middle portion of the site.
    - Runoff generated in this basin will combine with the flows entering the site from the north (Basin OS-3). The flows will be directed towards and transported south via a 4-foot drainage pan being captured by the proposed on-grade 10' Type R inlet (IN-1) at Design Point 1 where it will combine with flows from Basin A-1 (See basin description above).
- **Basin A-3:** Consists of rooftops, pavement, and landscaping stretching from the northern boundary to the southern boundary encompassing the middle portion of the site.
    - Runoff generated in this basin will combine with the flows entering the site from the north (Basin OS-2). The flows will be directed towards and transported south vie a modified 2-foot curb and gutter running along the east side of the 48-foot storage building.
        - The said curb is proposed to be modified by having a 1-foot vertical height instead of the typical 0.5-foot vertical height for added capacity and building protection.
    - The flows will flow from the 2-curb and gutter to a 4-foot drainage pan at the south end of the 48-foot storage building directing flows south to Design Point 3. Here the flows will be combined with any bypass flows bypassing the on-grade IN-1 and be captured by a proposed Triple - Type 13 Combo inlet (IN-2) in sump and be transported to the EDB via concrete pipe.
- **Basin A-4:** Consists of rooftops, pavement, sidewalk and landscaping stretching from the northern boundary to the southern boundary encompassing the western-middle portion of the site.
    - Runoff generated in this basin will combine with the flows entering the site from the north (Basin OS-1). The flows will be directed towards and transported south via a 4-foot drainage pan towards Design Point 4 being captured by a proposed

Double - Type 13 Combo inlet (IN-3) in sump and be transported to the EDB via concrete pipe.

- **Basin A-5:** Consists of the onsite EDB.
    - Runoff generated in this basin will combine with all flows tributary to the EDB and will be captured and released by a controlled outlet structure.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

- The site has been designed in accordance with the El Paso County *Drainage Design Criteria Manual*, adopted portions of the City of Colorado Springs *Drainage Criteria Manual Volume 1, dated May* 2014, and the *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3* (UDFCD), Urban Drainage and Flood Control District, latest revisions. The portions of the City of *Colorado Springs Drainage Criteria Manual* adopted by the County are Chapter 6 (Hydrology) and Chapter 13 Section 3.2.1 (Full Spectrum Detention).

B. Drainage Studies, Outfall Systems Plans, Site Constraints

- The site is included within the limits of the Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study prepared by Kiowa Engineering in September of 1993. There are no drainage way facilities proposed in the study that are located within the limits of the site.

C. Hydrology

- Peak storm runoff was determined using the Rational Formula: Q=CIA
- Design storm recurrence intervals are the 5-year storm for the minor event and the 100-year storm for the major event.
- Rainfall intensities were determined per Table 6-2, in accordance with the City of Colorado Springs Drainage Criteria Manual Volume 1, dated May 2014.
- Runoff coefficients have been determined per Table 6-6, in accordance with the City of Colorado Springs Drainage Criteria Manual Volume 1, dated May 2014.
- Time of Concentration has been calculated per Section 3-2, in accordance with the City of Colorado Springs Drainage Criteria Manual Volume 1, dated May 2014.
- See Appendix A for all hydrologic calculations.

D. Hydraulics

- The calculation methods for private improvements are based upon the Manning's Equation and the City of Colorado Springs Drainage Criteria Manual Volumes 1 and 2, dated May 2014.
- On-Site storm drainage improvements are designed for the 5-year and 100-year events.
- See Appendix B for all hydraulic calculations.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Existing Stormwater Drainage

- The existing stormwater runoff for the proposed site flows overland from the northeast corner of the site towards the southwest corner with a fairly uniform grade of 3.5%.
- Historically the runoff from the vacant land between the north boundary of the site and the southern parking lot of the Greater Europe Missions property flows onto the site along the northern boundary of the site.
- Historically the runoff from the western half of Base Camp Road flows onto the site along the eastern boundary of the site.
- The eastern half of the proposed site flows into the Monument Hill roadside ditch north of Deer Creek Road and flows to the southwest corner of the site where it will be captured by the recently constructed 30" RCP flared end section (constructed with the Monument Hill Widening Project). As the proposed site will be release at or below historic levels the recently constructed 30" RCP crossing under Deer Creek Road is suitable outfall for the proposed development.
- The western half of the proposed site flows into the reconstructed roadside ditch east of Monument Hill Road (reconstructed with the Monument Hill widening project) and flows to the southwest corner of the site where it will be captured by the recently constructed 30" RCP flared end section (constructed with the Monument Hill Widening Project).

B. Proposed Stormwater Conveyance Facilities

- The proposed drainage patterns will follow historic flow patterns as closely as possible.
- The general concept for the site drainage will be for storm runoff to surface flow from the building roofs and pavement generally flowing from the north side of the site to the south side of the site via 4-foot v-channel drainage pans and curb and gutter. Runoff will be captured by a series of inlets south of the on-site drive isles and piped to the proposed Extended Detention Basin designed in accordance with City of Colorado Springs criteria.
- The proposed Extended Detention Basin will drain through a modified CDOT Type C outlet structure. The outlet structures released flow will be piped to the roadside ditch east of Monument Hill Road and be captured by the 30" RCP flared end section (which was constructed with the Monument Hill widening project.)
- The on-site storm sewers and EDB will be private and will be maintained by the property owner.
- Conveyance of off-site runoff is generated from Basin OS-6. Low Impact Development is being achieved within this basin as impervious and pervious areas are being disconnected along with implementing infiltration as the flows run along the earth lined roadside ditch. **The 100-year allowable release for the EDB has been reduced by the derived 100-yr runoff of this basin.**

C. Proposed Stormwater Storage Facilities

- An Extended Detention Basin is proposed at the southwest corner of the site to treat storm runoff and attenuate peak flows in accordance with the City of Colorado Springs criteria and UDFCD.
- The Extended Detention Basin and outlet structure have been sized and designed with the UDFCD UD-Detention v3.07 spreadsheet to control the Water Quality Capture Volume (WQCV) and 100-year detention volume.
- The pond will include a trickle channel for low flow conditions, an outlet structure including a 2.5-ft deep micropool, and an emergency spillway with riprap erosion protection.
- See Appendix C for Detention and Water Quality Calculations

D. Water Quality Enhancement Best Management Practices

- El Paso County requires the Four Step Process be followed for the selection and siting of structural BMPs for new development to provide water quality for stormwater runoff being discharged into State Waters. The Four Steps are; employ runoff reduction practices, stabilize drainageways, provide water quality capture volume (WQCV) and consider need for industrial and commercial BMP's.
    - The design of the site has followed this process as much as possible. Pavement has been minimized to meet only the parking spaces as required by the county and landscaped areas are included to assist in reducing runoff. There are no major drainageways on site. The drainageways adjacent to the site are being improved with riprap protection where concentrated flows may cause erosion. The WQCV is being provided in the permanent BMP which is an Extended Detention Basin designed in accordance with county regulations
- Discharge will be controlled by a standard outlet structure with a flow control plate designed to release the WQCV over 40 hours and release 97% of the 5-year storm in less than 72 hours.
- The 100-year discharge will be limited to be at or below 2.95 cfs (0.85 cfs/acre for Type B soils minus the 100-yr peak runoff from Basin OS-7 which will bypass the EDB) and will be controlled by a circular orifice plate located at the discharge side of the outlet structure prior to the flow entering an 18" RCP flowing to the proposed drainage swale adjacent to Monument Hill Road. This swale flows to the south and will be captured by the 30" FES to be constructed as part of the Monument Hill Road widening Improvements. In the event the outlet structure should become clogged with debris, and emergency overflow weir and swale will be constructed along the west side of the EDB. The emergency overflow swale will be a notched 15' wide by 1' deep cavity in the proposed EDB upper wall. Overflow will go to the proposed drainage swale along Monument Hill Road flowing to the south to the existing 30" FES and will be routed off site.

E. Floodplain Modification

- A floodplain modification is not anticipated for the construction of the Monument Steel Structures development.

F. Additional Permitting Requirements

- No additional permitting is anticipated for the construction of the Monument Steel Structures development.

V. CONCLUSIONS

A. Compliance with Standards

- The drainage design for the Monument Steel Structures site detailed within this report is in general compliance with the El Paso County, Colorado Springs and UDFCD criteria.
- Per Note 9 of the Greater Europe Mission Subdivision Filing Number 1 Plat:
    - DRAINAGE FEES FOR LOT 2 SHALL BE PAID PRIOR TO THE ISSUANCE OF A BUILDING PERMIT AND THOSE FEES ARE TO BE CALCULATED ON THE BASIS OF THE FEE STRUCTURE IN EFFECT AT THE TIME OF BUILDING PERMIT APPLICATION.
    - Per the 2019 Drainage Basin Fees – Drainage Basin FOMO5300
        - Drainage Basin Fee = $18,350 / Impervious Acre
        - Bridge Fee = $1,004 / Impervious Acre

2019 DRAINAGE BASIN FEES - LOT 2			
Fee	**$ / Imp Acre**	**Imp Acres**	**Fee**
Drainage Basin Fee	$18,350	2.98	$54,629.39
Bridge Fee	$1,004	2.98	$2,988.99

B. Variances / Deviations / Exclusion

- An Exclusion from *Appendix I Section I.7.1B – Providing Water Quality for Entire Development* for proposed basins OS-6 and OS-7 is requested per *Appendix I Section I.7.1.C.1a*.
- Approximately 0.56 acres (14.0%) of 4.0-acre site will not reach a proposed on-site water quality facility. Of the area inside the development boundary that will not reach a facility, 0.14 acres is proposed roofs and 0.42 acres is the existing Monument Hill Road roadside ditch and landscape areas behind the proposed buildings.
    - The 0.14 acres of roofs drains to the Monument Hill Road roadside ditch as the site naturally drains towards the ditch.
        - This area is implementing Low Impact Development (LID) techniques to Minimize Directly Connected Impervious Area (MDCIA) by routing runoff from impervious surfaces over grassy areas to slow runoff and promote infiltration. MDCIA is recommended as a key technique for reducing runoff peaks and volumes for frequently-occurring storms following urbanization. MDCIA is a key component of LID.
        - The UD-BMP Runoff Reduction spreadsheet was used to quantify the WQCV Reduction within this area (See results in Appendix F). This

spreadsheet was developed by UDFCD to provide a simple tool that can be used to demonstrate compliance with the Runoff Reduction Standard in the MS4 General Permit.

- Using the spreadsheet, a WQCV of 272 cubic feet was derived with the roadside ditch providing a 100% reduction. Such that there is anticipated to 0% untreated WQCV leaving the site.

- The 0.42 acres of landscaping is primarily composed of an existing 20-foot drainage and utility easement running the entire length of the western boundary of the site transporting the runoff from Monument Hill Road from the north boundary of the site to the south boundary of the site. It is not practical to change the existing topography or modify the elevation to force additional area to the WQ facilities.

C. Drainage Concept

- The proposed drainage patterns will follow historic flow patterns as closely as possible. The majority of the site will sheet flow to the southwest into the proposed Extended Detention Basin.
- With the development of the proposed site; there should be no adverse impact to downstream facilities, adjacent properties, channel depths, velocities, or erosion rates, due to release flows being below historic rates.

VI. LIST OF REFERENCES

- El Paso County's *Engineering Criteria Manual,* Revised 07/29/2015 Revision 5.
- City of Colorado Springs *Drainage Criteria Manual Volumes 1 and 2,* dated May 2014.
- *Urban Storm Drainage Criteria Manual, Volumes 1, 2, and 3,* Urban Drainage and Flood Control District, latest editions.
- Federal Emergency Management Agency Flood Insurance Rate Map Panel Number 08041C0276G, effective December 7, 2018.
- *Dirty Woman Creek and Crystal Creek Drainage Basin Planning Study* prepared by Kiowa Engineering Dated September, 1993.

APPENDICES

VICINITY MAP

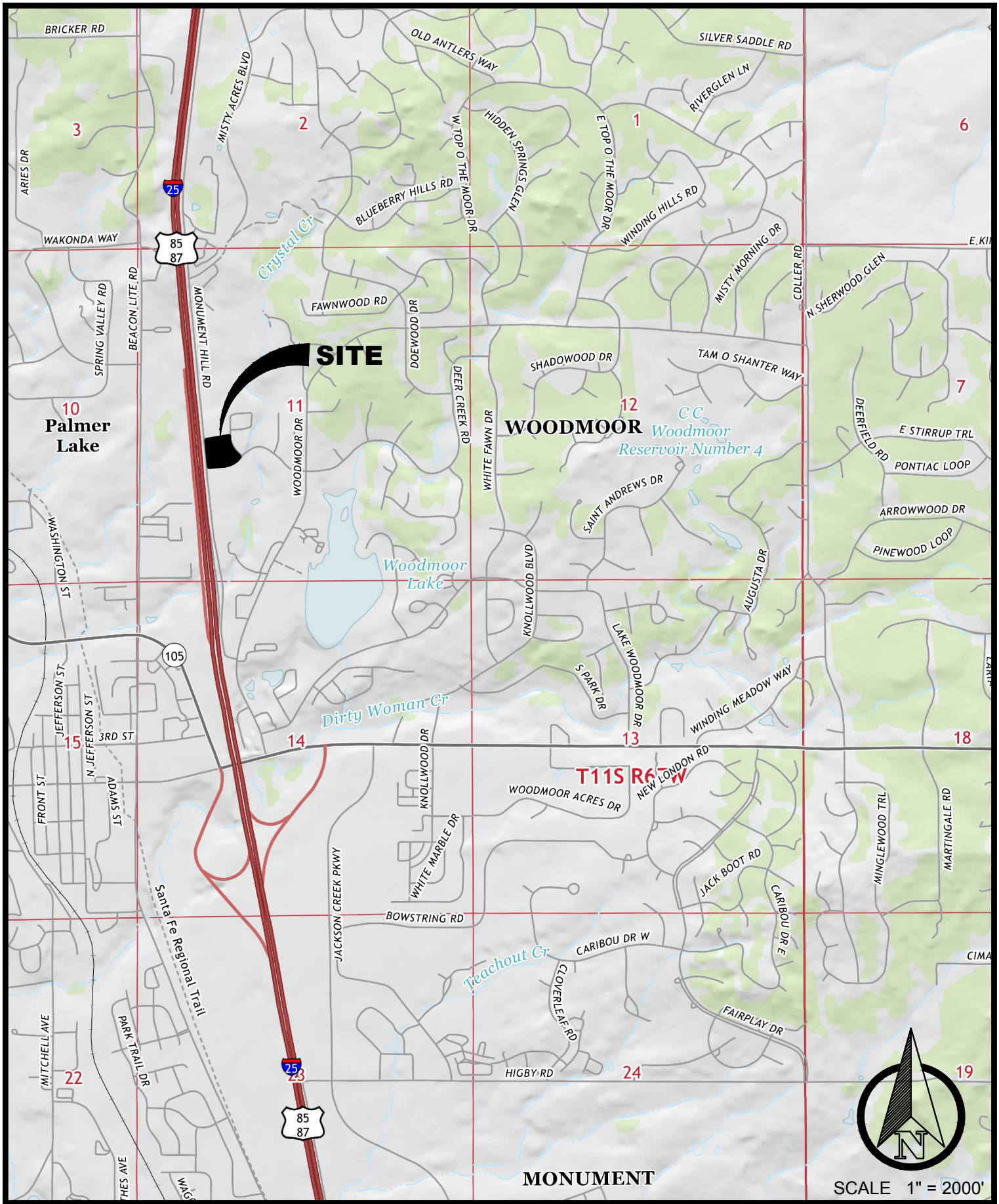
APPENDIX A – Hydrologic Computations

APPENDIX B – Hydraulic Computations

APPENDIX C – Detention/Water Quality Enhancement BMPs

APPENDIX D – Referenced Information

APPENDIX F – UD-BMP Runoff Reduction



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MONUMENT STEEL STRUCTURES
VICINITY MAP
MONUMENT, COLORADO

Sheet
VM

Date
JUNE 2019

APPENDIX A - HYDROLOGIC COMPUTATIONS

TERRA FORMA SOLUTIONS

Project: Monument Steel Structures
Location: Monument, CO
Designer: TAJ
Date: 4/7/2019
Latest Revision: 8/17/2019

[1]From Table 6-6 in Colorado Springs DCM, Volume 1
[2]From Table 6-6 in Colorado Springs DCM, Volume 1

IMPERVIOUSNESS AND RUNOFF COEFFICIENT CALCULATIONS

				Roofs	Lawn	Pavement	Sidewalk	Pond HWL	Misc						
			Impervious %[1]	90%	0%	100%	100%	100%	0%						
Basin Designation	NRCS Hydrologic Soil Group	Total Area (ac)	Total Area (sf)	Roofs (sf)	Lawn (sf)	Pavement (sf)	Sidewalk (sf)	Pond HWL (sf)	Misc (sf)	Percent Impervious	Impervious Area (ac)	Runoff Coefficients, C[2]			
												C_2	C_5	C_{10}	C_{100}
E-1	B	1.35	58,906		52,085	6,821				11.58%	0.16	0.12	0.17	0.24	0.42
E-2	B	4.00	174,280		174,280					0.00%	0.00	0.02	0.08	0.15	0.35
OS-1	B	0.45	19,479		19,479			0	0	0.00%	0.00	0.02	0.08	0.15	0.35
OS-2	B	0.22	9,459		9,459			0	0	0.00%	0.00	0.02	0.08	0.15	0.35
OS-3	B	0.42	18,281		13,642	4,639		0	0	25.38%	0.11	0.24	0.29	0.35	0.50
OS-4	B	0.15	6,407		4,225	2,182		0	0	34.06%	0.05	0.32	0.36	0.41	0.56
OS-5	B	0.12	5,280		5,280			0	0	0.00%	0.00	0.02	0.08	0.15	0.35
OS-6	B	0.16	7,031	6,636	395			0	0	84.94%	0.14	0.67	0.69	0.72	0.78
OS-7	B	0.40	17,418		17,418			0	0	0.00%	0.00	0.02	0.08	0.15	0.35
A-1	B	0.43	18,530	3,272	4,867	10,392		0	0	71.97%	0.31	0.63	0.65	0.69	0.77
A-2	B	0.90	39,189	9,409	6,191	23,589		0	0	81.80%	0.74	0.71	0.73	0.76	0.83
A-3	B	0.95	41,543	17,660	819	23,064		0	0	93.78%	0.89	0.80	0.81	0.83	0.88
A-4	B	0.93	40,705	13,218	825	25,847	815	0	0	94.73%	0.89	0.81	0.83	0.85	0.90
A-5	B	0.23	9,864		9,064	800		0	0	8.11%	0.02	0.09	0.15	0.21	0.40
								0	0						
Area Treated by EDB	B	4.67	203,457	Basins (OS-1, OS-2 OS-3, OS-4, A-1, A-2, A-3, A-4, A-5)				0	0	64.16%	3.00				
Area Not Treated by EDB	B	0.68	29,729	Basins (OS-5, OS-6, OS-7)				0	0	20.09%	0.14				
								0	0						
Overall		**5.35**	**233,186**					**0**	**0**	58.54%	3.13				

TERRA FORMA SOLUTIONS

Project: Monument Steel Structures
Location: Monument, CO
Designer: TAJ
Date: 4/7/2019
Latest Revision: 8/17/2019

NRCS Conveyance Factors, K[2]	
Type of Land Surface	**K**
Heavy Meadow	2.5
Tillage/Field	5
Short Pasture/Lawns	7
Nearly Bare Ground	10
Grassed Waterway	15
Paved Areas	20

[1]Max 100 ft in Urban areas and 300 ft in rural areas
[2]From Table 6-7 - Coloardo Springs DCM

TIME OF CONCENTRATION CALCULATIONS

			Initial/Overland Flow Time, T_i			Channelized Flow/Travel Time, T_t					Time of Concentration, T_c (Check)			
Basin Designation	**Imperviousness (%)**	**C_5**	**Length (ft)[1]**	**Slope (%)**	**T_i (min)**	**Land Surface**	**Length (ft)**	**Slope (%)**	**Velocity (ft/sec)**	**T_t (min)**	**Computed T_c (min)**	**First Design Point T_c (min)**	**Minimum T_c (min)**	**Selected T_c (min)**
E-1	11.58%	0.17	25	3.00	5.81	Paved Areas	140	3.40	3.69	0.63	6.44	10.92	10.00	10.00
E-2	0.00%	0.08	100	3.40	12.30	Short Pasture/Lawns	445	4.65	1.51	4.91	17.21	13.03	10.00	13.03
OS-1	0.00%	0.08	25	5.00	5.41	Short Pasture/Lawns	175	5.00	1.57	1.86	7.28	11.11	5.00	7.28
OS-2	0.00%	0.08	25	5.00	5.41	Short Pasture/Lawns	110	5.00	1.57	1.17	6.59	10.75	5.00	6.59
OS-3	25.38%	0.29	25	2.00	5.83	Short Pasture/Lawns	130	5.00	1.57	1.38	7.22	10.86	5.00	7.22
OS-4	34.06%	0.36	15	2.00	4.12	Short Pasture/Lawns	20	16.00	2.80	0.12	4.24	10.19	5.00	5.00
OS-5	0.00%	0.08	25	5.00	5.41	Short Pasture/Lawns	163	5.00	1.57	1.74	7.15	11.04	5.00	7.15
OS-6	84.94%	0.69	10	2.00	1.85	Grassed Waterway	25	2.00	2.12	0.20	2.04	10.19	5.00	5.00
OS-7	0.00%	0.08	25	25.00	3.18	Grassed Waterway	392	2.80	2.51	2.60	5.79	12.32	5.00	5.79
A-1	71.97%	0.65	45	3.05	3.73	Paved Areas	292	1.37	2.34	2.08	5.81	11.87	5.00	5.81
A-2	81.80%	0.73	45	4.80	2.67	Paved Areas	412	2.18	2.96	2.32	5.00	12.54	5.00	5.00
A-3	93.78%	0.81	45	2.50	2.58	Paved Areas	433	1.73	2.63	2.74	5.32	12.66	5.00	5.32
A-4	94.73%	0.83	65	1.65	3.35	Paved Areas	365	2.19	2.96	2.05	5.41	12.39	5.00	5.41
A-5	8.11%	0.15	25	10.00	4.03	Paved Areas	140	0.50	1.41	1.65	5.68	10.92	5.00	5.68

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)
t_i = overland (initial) flow time (min)
t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \quad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)
L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

TERRA FORMA SOLUTIONS

Project: Monument Steel Structures
Location: Monument, CO
Designer: TAJ
Date: 4/7/2019
Latest Revision: 8/17/2019

Design Storm:	5-Yr
1-hr Design Point Rainfall (in):	1.50

5-YEAR PEAK RUNOFF CALCULATIONS

Basin Designation	Design Point	Basin Outfall	Area (ac)	C_5	C X A	T_c (min)	Intensity (in/hr)	Peak Flow, Q (cfs)
E-1	1	Basin E-1	1.35	0.17	0.24	10.00	4.06	0.96
E-2	2	Ex 30" RCP	4.00	0.08	0.32	13.03	3.63	1.16
OS-1	4	Basin A-4	0.45	0.08	0.04	7.28	4.55	0.16
OS-2	3	Basin A-3	0.22	0.08	0.02	6.59	4.70	0.08
OS-3	2	Basin A-2	0.42	0.29	0.12	7.22	4.57	0.55
OS-4	1	Basin A-1	0.15	0.36	0.05	5.00	5.09	0.27
OS-5		Basin OS-7	0.12	0.08	0.01	7.15	4.58	0.04
OS-6		Basin OS-7	0.16	0.69	0.11	5.00	5.09	0.57
OS-7		Ex 30" RCP	0.40	0.08	0.03	5.79	4.89	0.16
A-1	1	IN-1 (10' Type R)	0.43	0.65	0.28	5.81	4.88	1.36
A-2	2	IN-1 (10' Type R)	0.90	0.73	0.66	5.00	5.09	3.34
A-3	3	IN-2 (Triple Type 13)	0.95	0.81	0.77	5.32	5.00	3.87
A-4	4	IN-3 (Double Type 13)	0.93	0.83	0.77	5.41	4.98	3.86
A-5	5	EDB Outlet Structure	0.23	0.15	0.03	5.68	4.91	0.16

TERRA FORMA SOLUTIONS

Project: Monument Steel Structures
Location: Monument, CO
Designer: TAJ
Date: 4/7/2019
Latest Revision: 8/17/2019

Design Storm: 100-Yr
1-hr Design Point Rainfall (in): 2.52

100-YEAR PEAK RUNOFF CALCULATIONS

Basin Designation	Design Point	Basin Outfall	Area (ac)	C_{100}	C X A	T_c (min)	Intensity (in/hr)	Peak Flow, Q (cfs)
E-1	1	Basin E-1	1.35	0.42	0.57	10.00	6.82	3.88
E-2	2	Ex 30" RCP	4.00	0.35	1.40	13.03	6.10	8.55
OS-1	4	Basin A-4	0.45	0.35	0.16	7.28	7.65	1.20
OS-2	3	Basin A-3	0.22	0.35	0.08	6.59	7.90	0.60
OS-3	2	Basin A-2	0.42	0.50	0.21	7.22	7.67	1.62
OS-4	1	Basin A-1	0.15	0.56	0.08	5.00	8.55	0.70
OS-5		Basin OS-7	0.12	0.35	0.04	7.15	7.69	0.33
OS-6		Basin OS-7	0.16	0.78	0.13	5.00	8.55	1.08
OS-7		Ex 30" RCP	0.40	0.35	0.14	5.79	8.21	1.15
A-1	1	IN-1 (10' Type R)	0.43	0.77	0.33	5.81	8.20	2.70
A-2	2	IN-1 (10' Type R)	0.90	0.83	0.74	5.00	8.55	6.36
A-3	3	IN-2 (Triple Type 13)	0.95	0.88	0.84	5.32	8.41	7.09
A-4	4	IN-3 (Double Type 13)	0.93	0.90	0.84	5.41	8.37	7.03
A-5	5	EDB Outlet Structure	0.23	0.40	0.09	5.68	8.26	0.75

TERRA FORMA SOLUTIONS

Project: Monument Steel Structures
Location: Monument, CO
Designer: TAJ
Date: 4/7/2019
Revision: 8/17/2019

Design Storm: 5-Yr
1-hr Design Point Rainfall (in): 1.50

MINOR STORM ROUTING CALCULATIONS

Design Point	Contributing Basins	Basin Outfall	Basin Designation	Direct Runoff						Total Runoff				Street		Travel Time				Remarks
				Area (ac)	C_5	C X A	T_c (min)	Intensity (in/hr)	Peak Flow, Q (cfs)	T_c (min)	Sum Area (C X A)	Intensity (in/hr)	Q (cfs)	Slope (%)	Street Q (cfs)	Length (ft)	Velocity (ft/sec)	T_t (min)	Carry Over CA	
			OS-4	0.15	0.36	0.05	5.00	5.09	0.27											
			A-1	0.43	0.65	0.28	5.81	4.88	1.36											
1	A-1, OS-4	C&G to IN-1								5.81	0.33	4.88	**1.62**							Used to check Gutter Capacity
			OS-3	0.42	0.29	0.12	7.22	4.57	0.55					1.80%	0.55	422	2.68	2.62	0.12	Flows from OS-3 to DP 2
			A-2	0.90	0.73	0.66	5.00	5.09	3.34											
2	A-2, OS-3	Drainage Pan to IN-1								9.84	0.78	4.08	**3.17**							Used to Check Drainage Pan Capacity
	A-1, A-2, OS-3, OS-4	IN-1								9.84	1.11	4.08	**4.53**							Inlet Overflows to DP 3
			OS-2	0.22	0.08	0.02	6.59	4.70	0.08					2.00%	0.08	415	2.83	2.45	0.02	Flows from OS-2 to DP 3
			A-3	0.95	0.81	0.77	5.32	5.00	3.87											
3	A-3, OS-2	IN-2								9.03	0.79	4.22	**3.34**							Inlet Overflows to DP 5 (EDB)
			OS-1	0.45	0.08	0.04	7.28	4.55	0.16					2.00%	0.16	358	2.83	2.11	0.04	
			A-4	0.93	0.83	0.77	5.41	4.98	3.86											
4	A-4, OS-1	IN-3								9.39	0.81	4.16	**3.37**							Inlet Overflows to DP 5 (EDB)
5	A-1 - A-4, OS-1 Through OS-4	EDB								9.84	2.71	4.08	**11.07**							
			OS-5	0.12	0.08	0.01	7.15	4.58	0.04											Used to check swale capacity
			OS-6	0.16	0.69	0.11	5.00	5.09	0.57											
			OS-7	0.40	0.08	0.03	5.79	4.89	0.16											

TERRA FORMA SOLUTIONS

Project: Monument Steel Structures
Location: Monument, CO
Designer: TAJ
Date: 4/7/2019
t Revision: 8/17/2019

Design Storm: 100-Yr
1-hr Design Point Rainfall (in): 2.52

MAJOR STORM ROUTING CALCULATIONS

Design Point	Contributing Basins	Basin Oufall	Direct Runoff							Total Runoff				Street		Travel Time				Remarks
			Basin Designation	Area (ac)	C_{100}	C X A	T_c (min)	Intensity (in/hr)	Peak Flow, Q (cfs)	T_c (min)	Sum Area (C X A)	Intensity (in/hr)	Q (cfs)	Slope (%)	Street Q (cfs)	Length (ft)	Velocity (ft/sec)	T_t (min)	Carry Over CA	
			OS-4	0.15	0.56	0.08	5.00	8.55	0.70											
			A-1	0.43	0.77	0.33	5.81	8.20	2.70											
1	A-1, OS-4	C&G to IN-1								5.81	0.41	8.20	**3.37**							Used to check Gutter Capacity
			OS-3	0.42	0.50	0.21	7.22	7.67	1.62					1.80%	1.62	422	2.68	2.62	0.21	Flows from OS-3 to DP 2
			A-2	0.90	0.83	0.74	5.00	8.55	6.36											
2	A-2, OS-3	Drainage Pan to IN-1								9.84	0.96	6.86	**6.56**							Used to Check Drainage Pan Capacity
	A-1, A-2, OS-3, OS-4	IN-1								9.84	1.37	6.86	**9.38**							Inlet Overflows to DP 3
			OS-2	0.22	0.35	0.08	6.59	7.90	0.60					2.00%	0.60	415	2.83	2.45	0.08	Flows from OS-2 to DP 3
			A-3	0.95	0.88	0.84	5.32	8.41	7.09											
3	A-3, OS-2	IN-2								9.03	0.92	7.09	**6.52**							Inlet Overflows to DP 5 (EDB)
			OS-1	0.45	0.35	0.16	7.28	7.65	1.20					2.00%	1.20	358	2.83	2.11	0.16	
			A-4	0.93	0.90	0.84	5.41	8.37	7.03											
4	A-4, OS-1	IN-3								9.39	1.00	6.99	**6.96**							Inlet Overflows to DP 5 (EDB)
5	A-1 - A-4, OS-1 Through OS-4	EDB								9.84	3.28	6.86	**22.53**							
			OS-5	0.12	0.35	0.04	7.15	7.69	0.33											
			OS-6	0.16	0.78	0.13	5.00	8.55	1.08											
			OS-7	0.40	0.35	0.14	5.79	8.21	1.15											

APPENDIX B - HYDRAULIC COMPUTATIONS

2ft Catch Curb and 24' Drive Isle Capacity

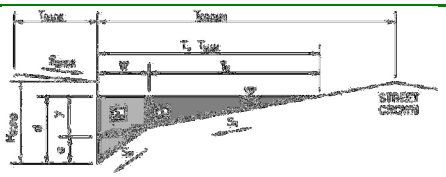
Version 4.05 Released March 2017

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

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

Project: Monument Steel Structures

Inlet ID: IN-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.100	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.4**	**31.1**	**cfs**

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

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

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 8 2019

40 Foot Drainage Pan Capacity

User-defined

Invert Elev (ft)	= 7131.51
Slope (%)	= 1.80
N-Value	= Composite

Calculations

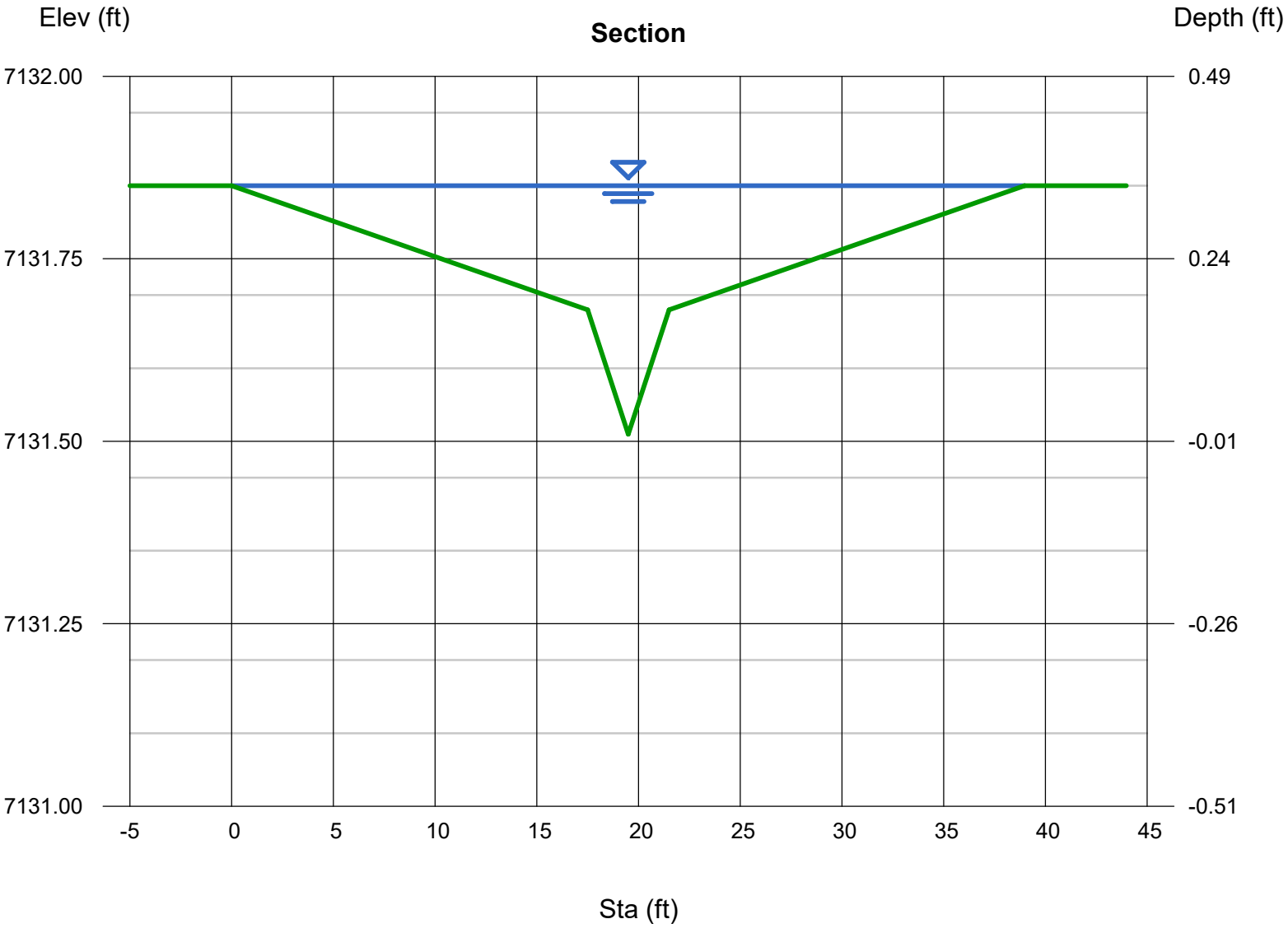
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.34
Q (cfs)	= 14.54
Area (sqft)	= 3.99
Velocity (ft/s)	= 3.64
Wetted Perim (ft)	= 39.00
Crit Depth, Yc (ft)	= 0.34
Top Width (ft)	= 38.98
EGL (ft)	= 0.55

(Sta, El, n)-(Sta, El, n)...

(0.00, 7131.85)-(17.50, 7131.68, 0.012)-(19.50, 7131.51, 0.012)-(21.50, 7131.68, 0.012)-(38.98, 7131.85, 0.012)



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Apr 8 2019

60 Foot Drainage Pan Capacity

User-defined

Invert Elev (ft)	= 7127.89
Slope (%)	= 2.00
N-Value	= Composite

Calculations

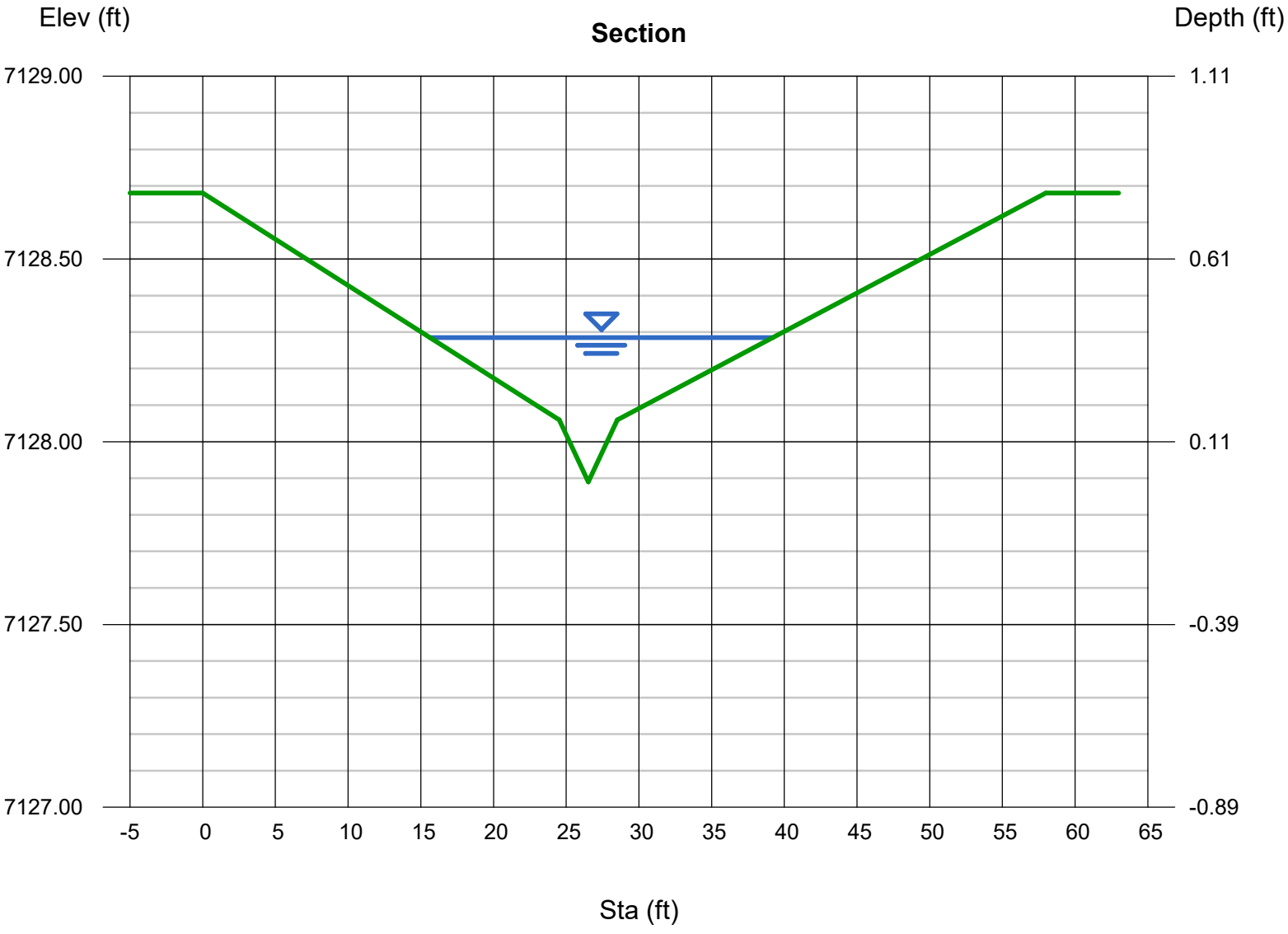
Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 0.40
Q (cfs)	= 16.75
Area (sqft)	= 3.45
Velocity (ft/s)	= 4.86
Wetted Perim (ft)	= 23.61
Crit Depth, Yc (ft)	= 0.51
Top Width (ft)	= 23.59
EGL (ft)	= 0.76

(Sta, El, n)-(Sta, El, n)...

(0.00, 7128.68)-(24.52, 7128.06, 0.012)-(26.52, 7127.89, 0.012)-(28.52, 7128.06, 0.012)-(57.98, 7128.68, 0.012)



IN-1

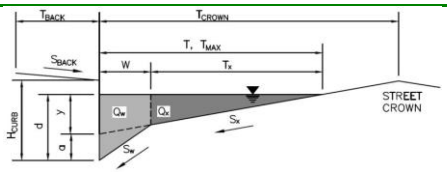
Version 4.05 Released March 2017

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

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

Project: Monument Steel Structures

Inlet ID: IN-1



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.100	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.008	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

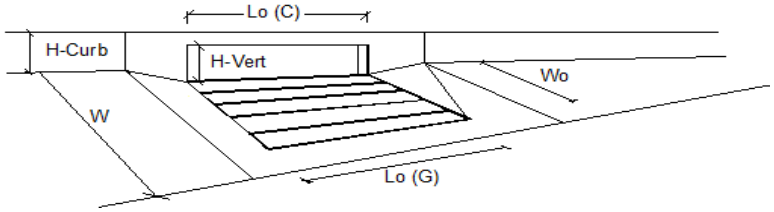
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**16.4**	**31.1**	**cfs**

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

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

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



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

Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.2**	**6.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.3**	**2.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**93**	**69**	**%**

IN-2

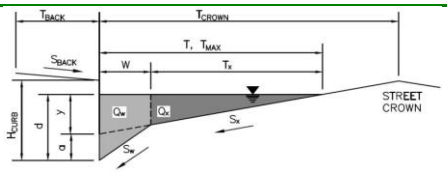
Version 4.05 Released March 2017

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

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

Project: Monument Steel Structures

Inlet ID: IN-2



Gutter Geometry (Enter data in the blue cells)

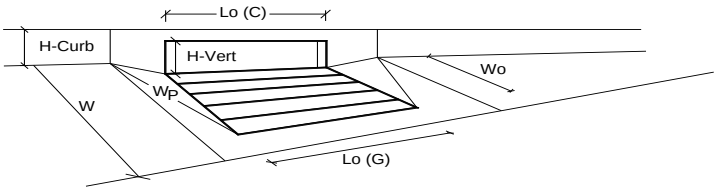
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Combination		
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 =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.3	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
Area Opening 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) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.629	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.44	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.69	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.97	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.57	0.69	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**6.4**	**11.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.7	9.4	cfs

IN-3

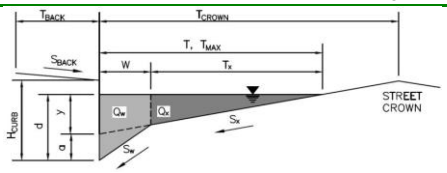
Version 4.05 Released March 2017

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

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

Project: Monument Steel Structures

Inlet ID: IN-3



Gutter Geometry (Enter data in the blue cells)

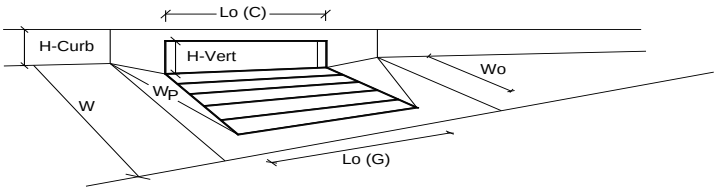
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	5.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.015	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	24.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.012	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	24.0	24.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

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

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



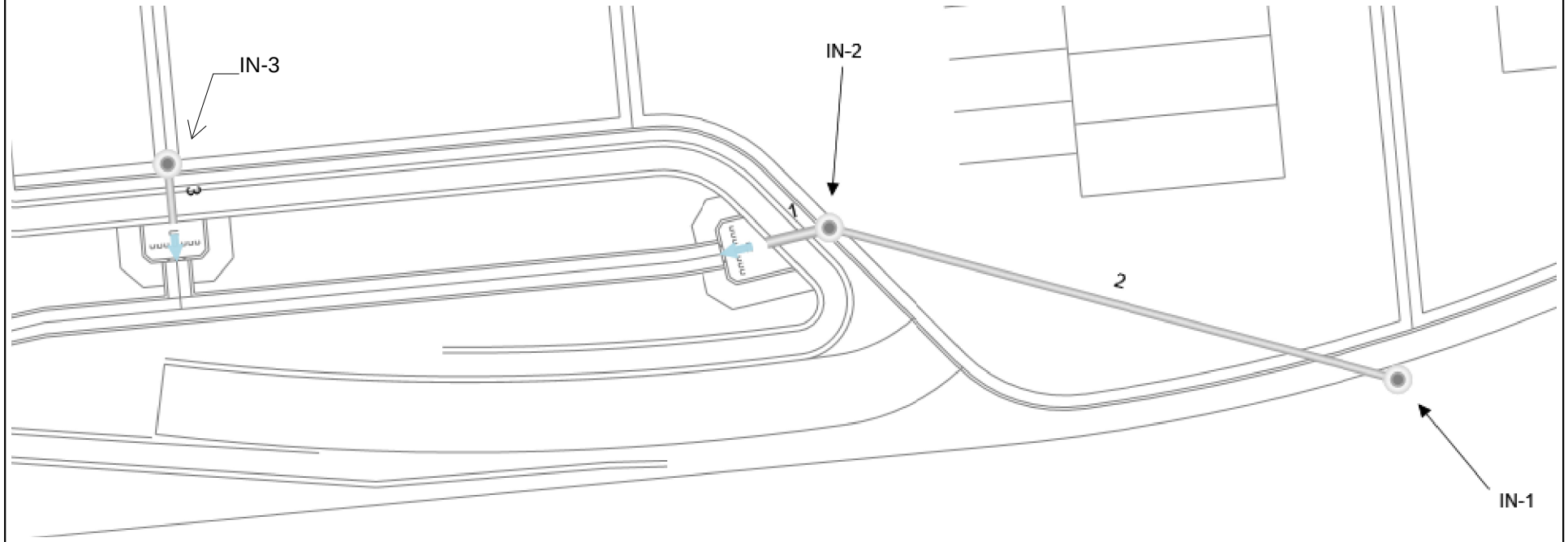
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	7.3	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
Area Opening 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) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.629	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.44	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.71	0.86	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.71	0.86	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.3**	**9.0**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.4	7.0	cfs

Plan View

Stormwater Studio 2019 v 3.0.0.7

Project Name: 10StormDesign

04-10-2019



Energy Grade Line Calculations

Project Name: 10StormDesign

Stormwater Studio 2019 v 3.0.0.14

08-17-2019

Line No	Line Size	Q	Downstream							Length	Upstream							Pipe		Junction		
			Invert Elev	Depth	Area	HGL Elev	Vel	Vel Head	EGL Elev		Invert Elev	Depth	Area	HGL Elev	Vel	Vel Head	EGL Elev	n Value	Enrgy Loss	HGLa Elev	EGLa Elev	Enrgy Loss
	(in)	(cfs)	(ft)	(ft)	(sqft)	(ft)	(ft/s)	(ft)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft)	(ft/s)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)
1	24	7.90	7119.22	0.77‡	1.12	7119.99	7.07	0.78	7120.61	10.71	7119.76	1.00²	1.56	7120.75	5.06	0.40	7121.15	0.013	0.536	7120.75	7121.15	0.00
2	18	4.20	7121.26	0.51‡	0.53	7121.77	7.85	0.96	7122.35	100.98	7124.54	0.78²	0.93	7125.32	4.51	0.32	7125.64	0.013	3.282	7125.32	7125.64	0.00
3	18	3.40	7119.05	0.52‡	0.55	7119.57	6.18	0.59	7120.02	9.97	7119.55	0.70²	0.81	7120.25	4.18	0.27	7120.52	0.013	0.499	7120.25	7120.52	0.00

Notes: Return Period = 5-yrs. ² Critical depth. ‡ Supercritical.

Energy Grade Line Calculations

Project Name: 10StormDesign

Stormwater Studio 2019 v 3.0.0.14

08-17-2019

Line No	Line Size	Q	Downstream							Length	Upstream							Pipe		Junction		
			Invert Elev	Depth	Area	HGL Elev	Vel	Vel Head	EGL Elev		Invert Elev	Depth	Area	HGL Elev	Vel	Vel Head	EGL Elev	n Value	Enrgy Loss	HGLa Elev	EGLa Elev	Enrgy Loss
	(in)	(cfs)	(ft)	(ft)	(sqft)	(ft)	(ft/s)	(ft)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft)	(ft/s)	(ft)	(ft)		(ft)	(ft)	(ft)	(ft)
1	24	15.90	7119.22	1.12‡	1.82	7120.34	8.75	1.19	7121.33	10.71	7119.76	1.41²	2.37	7121.17	6.70	0.70	7121.87	0.013	0.535	7121.17	7121.87	0.00
2	18	6.50	7121.26	0.64‡	0.72	7121.90	9.02	1.26	7122.67	100.98	7124.54	0.97²	1.21	7125.51	5.36	0.45	7125.96	0.013	3.282	7125.51	7125.96	0.00
3	18	7.00	7119.05	1.45	1.75	7120.50	4.00	0.25	7120.75	9.97	7119.55	1.01²	1.27	7120.56	5.53	0.48	7121.03	0.013	0.284	7120.56	7121.03	0.00

Notes: Return Period = 100-yrs. ² Critical depth. ‡ Supercritical.

Project File: Monument SSA - 100 yr.sws

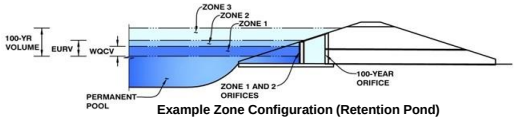
APPENDIX C - DETENTION/WATER QUALITY ENHANCEMENT BMPs

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: 18910 Base Camp Road

Basin ID: Lot 2 - SSA



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB		
Watershed Area =	4.67	acres	
Watershed Length =	630	ft	
Watershed Slope =	0.034	ft/ft	
Watershed Imperviousness =	64.16%	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	
Desired WQCV Drain Time =	40.0	hours	
Location for 1-hr Rainfall Depths =	Sedalia		
Water Quality Capture Volume (WQCV) =	0.098	acre-feet	
Excess Urban Runoff Volume (EURV) =	0.327	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.270	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.361	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.466	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.602	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.700	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.830	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.1 in.) =	1.087	acre-feet	3.10 inches
Approximate 2-yr Detention Volume =	0.253	acre-feet	
Approximate 5-yr Detention Volume =	0.340	acre-feet	
Approximate 10-yr Detention Volume =	0.434	acre-feet	
Approximate 25-yr Detention Volume =	0.468	acre-feet	
Approximate 50-yr Detention Volume =	0.487	acre-feet	
Approximate 100-yr Detention Volume =	0.527	acre-feet	

Optional User Override 1-hr Precipitation

Stage-Storage Calculation

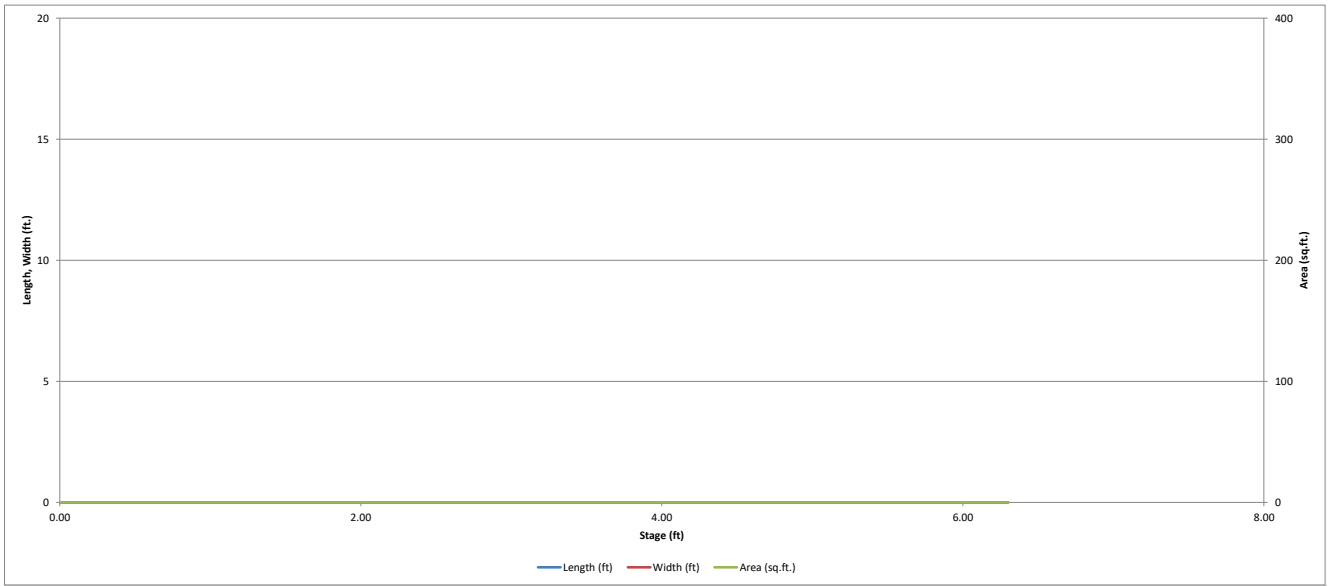
Zone 1 Volume (WQCV) =	0.098	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.229	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.200	acre-feet
Total Detention Basin Volume =	0.527	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

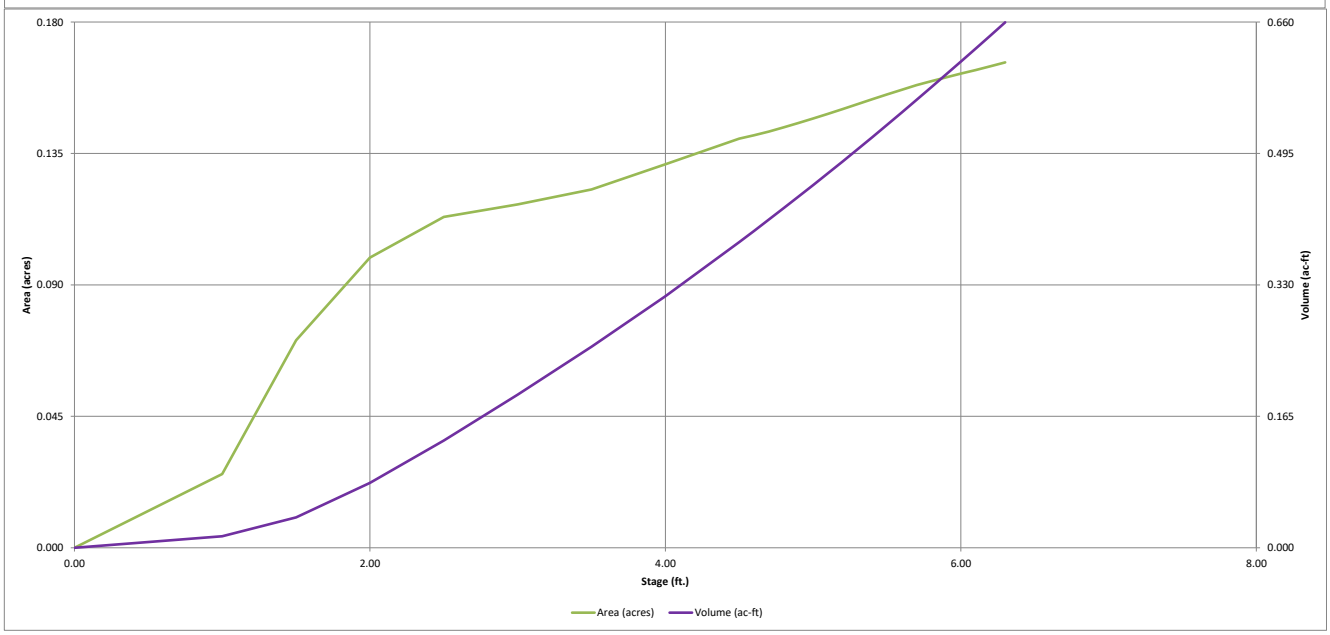
Depth Increment = 1 ft

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)
7116.83 **Top of Micropool**	--	0.00	--	--	--	0	0.000		
7118	--	1.17	--	--	--	1,099	0.025	632	0.015
7118.5	--	1.67	--	--	--	3,094	0.071	1,661	0.038
7119	--	2.17	--	--	--	4,327	0.099	3,547	0.081
WQ - 7119.5	--	2.67	--	--	--	4,935	0.113	5,862	0.135
7120	--	3.17	--	--	--	5,121	0.118	8,376	0.192
7120.5	--	3.67	--	--	--	5,343	0.123	10,992	0.252
7121	--	4.17	--	--	--	5,720	0.131	13,758	0.316
EURV - 7121.5	--	4.67	--	--	--	6,101	0.140	16,713	0.384
7121.6	--	4.77	--	--	--	6,152	0.141	17,326	0.398
7121.7	--	4.87	--	--	--	6,206	0.142	17,944	0.412
7121.8	--	4.97	--	--	--	6,269	0.144	18,567	0.426
7121.9	--	5.07	--	--	--	6,334	0.145	19,198	0.441
7122	--	5.17	--	--	--	6,402	0.147	19,834	0.455
7122.1	--	5.27	--	--	--	6,472	0.149	20,478	0.470
7122.2	--	5.37	--	--	--	6,543	0.150	21,129	0.485
7122.3	--	5.47	--	--	--	6,616	0.152	21,787	0.500
7122.4	--	5.57	--	--	--	6,689	0.154	22,452	0.515
100Yr - 7122.5	--	5.67	--	--	--	6,761	0.155	23,125	0.531
7122.6	--	5.77	--	--	--	6,831	0.157	23,804	0.546
7122.7	--	5.87	--	--	--	6,900	0.158	24,491	0.562
Spillway - 7122.8	--	5.97	--	--	--	6,959	0.160	25,184	0.578
7122.9	--	6.07	--	--	--	7,016	0.161	25,882	0.594
7123	--	6.17	--	--	--	7,071	0.162	26,587	0.610
7123.1	--	6.27	--	--	--	7,125	0.164	27,297	0.627
7123.2	--	6.37	--	--	--	7,181	0.165	28,012	0.643
7123.3	--	6.47	--	--	--	7,239	0.166	28,733	0.660

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



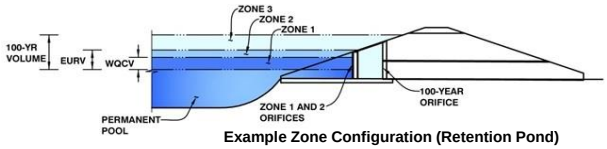


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Monument Steel Structures - PCD File No. PPR1919

Basin ID: 18910 Base Camp Road - El Paso County



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.33	0.098	Orifice Plate
Zone 2 (EURV)	4.26	0.229	Orifice Plate
Zone 3 (100-year)	5.65	0.200	Weir&Pipe (Circular)
		0.527	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.55	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.17	2.42					
Orifice Area (sq. inches)	0.69	0.89	0.52					

	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.55	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.50	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.92	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.28	N/A	feet
Over Flow Weir Slope Length =	3.01	N/A	feet
Grate Open Area / 100-yr Orifice Area =	11.91	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	5.26	N/A	ft^2
Overflow Grate Open Area w/ Debris =	2.63	N/A	ft^2

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

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	9.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	0.44	N/A	ft^2
Outlet Orifice Centroid =	0.38	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	15.00	feet
Spillway End Slopes =	0.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

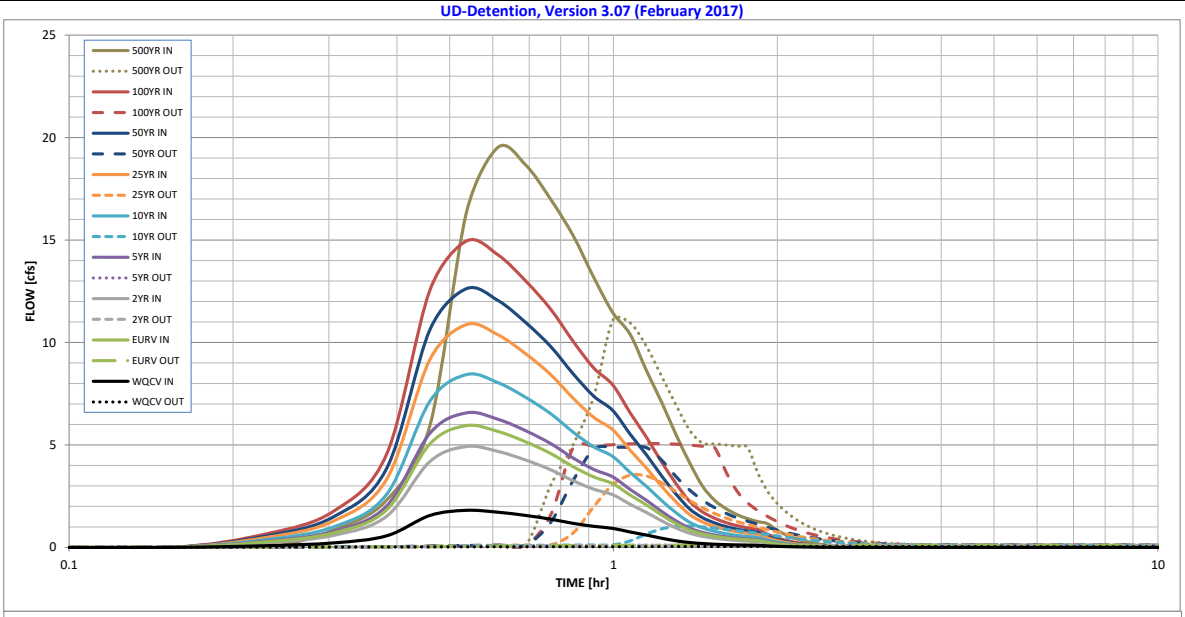
Spillway Design Flow Depth=	0.47	feet
Stage at Top of Freeboard =	7.27	feet
Basin Area at Top of Freeboard =	0.17	acres

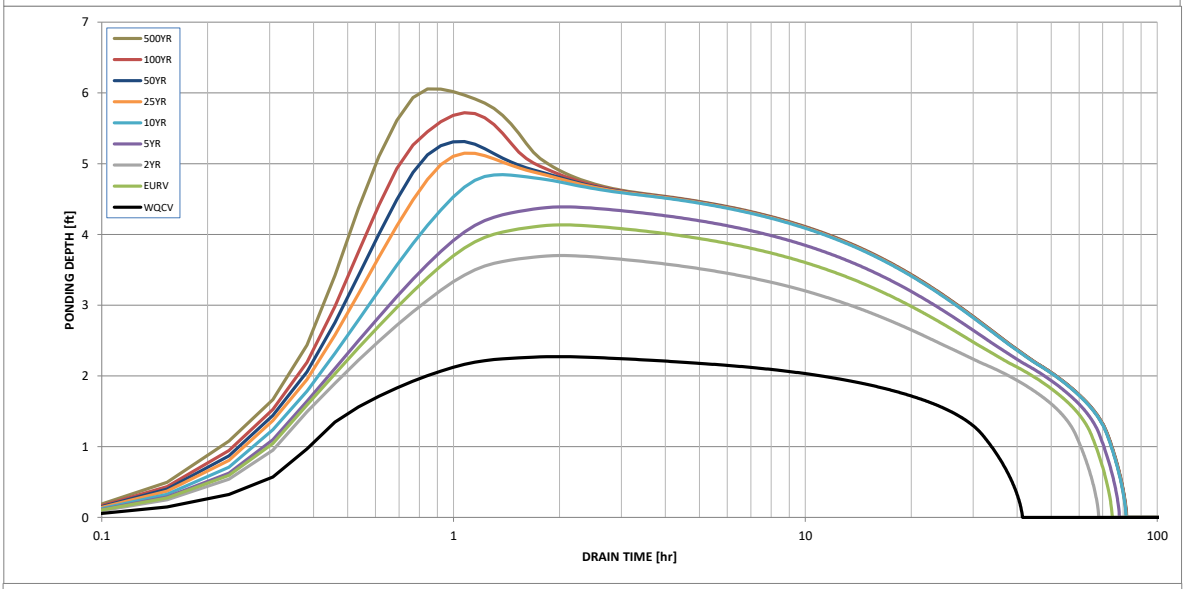
Routed Hydrograph Results

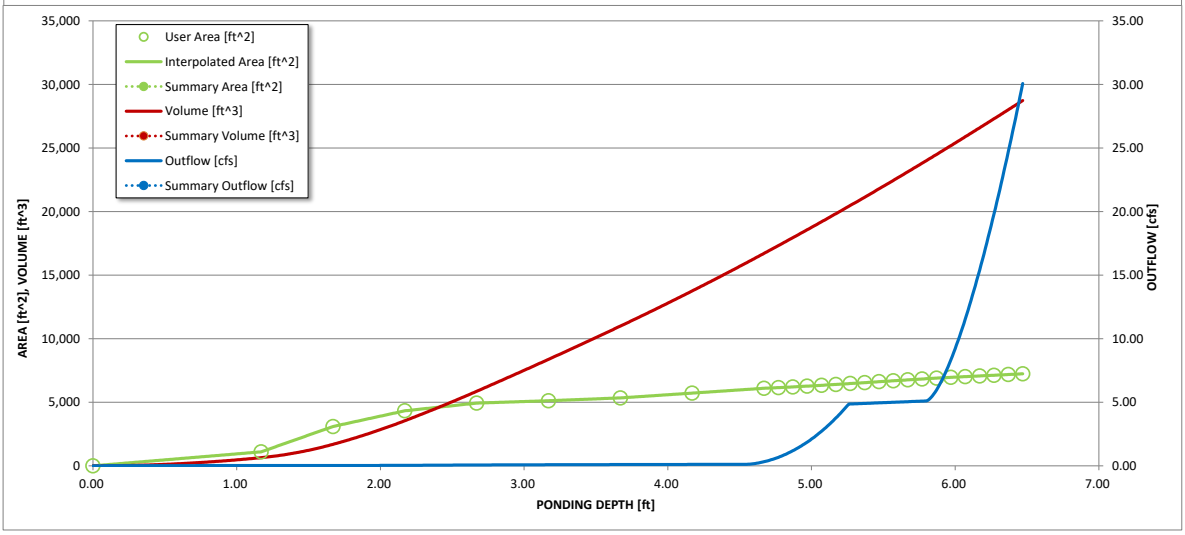
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.10
Calculated Runoff Volume (acre-ft) =	0.098	0.327	0.270	0.361	0.466	0.602	0.700	0.830	1.087
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.098	0.326	0.270	0.361	0.465	0.602	0.700	0.831	1.088
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.23	0.73	1.01	1.36	1.98
Predevelopment Peak Q (cfs) =	0.0	0.0	0.1	0.1	1.1	3.4	4.7	6.4	9.3
Peak Inflow Q (cfs) =	1.8	5.9	4.9	6.6	8.4	10.9	12.6	15.0	19.5
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	1.0	3.5	4.9	5.1	11.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	1.0	1.0	1.0	0.8	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	0.9	0.9	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	68	62	71	72	71	69	68	65
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	66	75	78	77	76	76	74
Maximum Ponding Depth (ft) =	2.27	4.13	3.70	4.39	4.84	5.15	5.31	5.72	6.06
Area at Maximum Ponding Depth (acres) =	0.10	0.13	0.12	0.13	0.14	0.15	0.15	0.16	0.16
Maximum Volume Stored (acre-ft) =	0.091	0.311	0.256	0.344	0.408	0.451	0.476	0.537	0.591

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







Forebay Design

	Tributary Area (ac)	Imp. Tributary Area (ac)	% Imp.	WQCV (in)	WQCV (ac-ft)	Forebay Vol (cf)	
North Forebay	1.38	0.89	64.1%	0.26	0.029	25.66	*2% of WQCV*
East Forebay	3.06	2.09	68.3%	0.27	0.070	60.95	*2% of WQCV*

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I) \qquad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed inches)

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

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

Table 3-2. Drain Time Coefficients for WQCV Calculations

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

Once the WQCV in watershed inches is found from Figure 3-2 or using Equation 3-1 and/or 3-2, the required BMP storage volume in acre-feet can be calculated as follows:

$$V = \left(\frac{WQCV}{12}\right)A \qquad \text{Equation 3-3}$$

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds between 1 and 2 Impervious Acres[1]	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration	EDBs should not be used for watersheds with less than 1 impervious acre.	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe[2] configuration
Minimum Forebay Volume		1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool		Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

[1] EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

[2] Round up to the first standard pipe size (minimum 8 inches).

APPENDIX D - REFERENCED INFORMATION

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

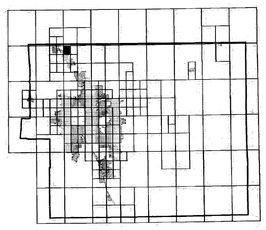
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

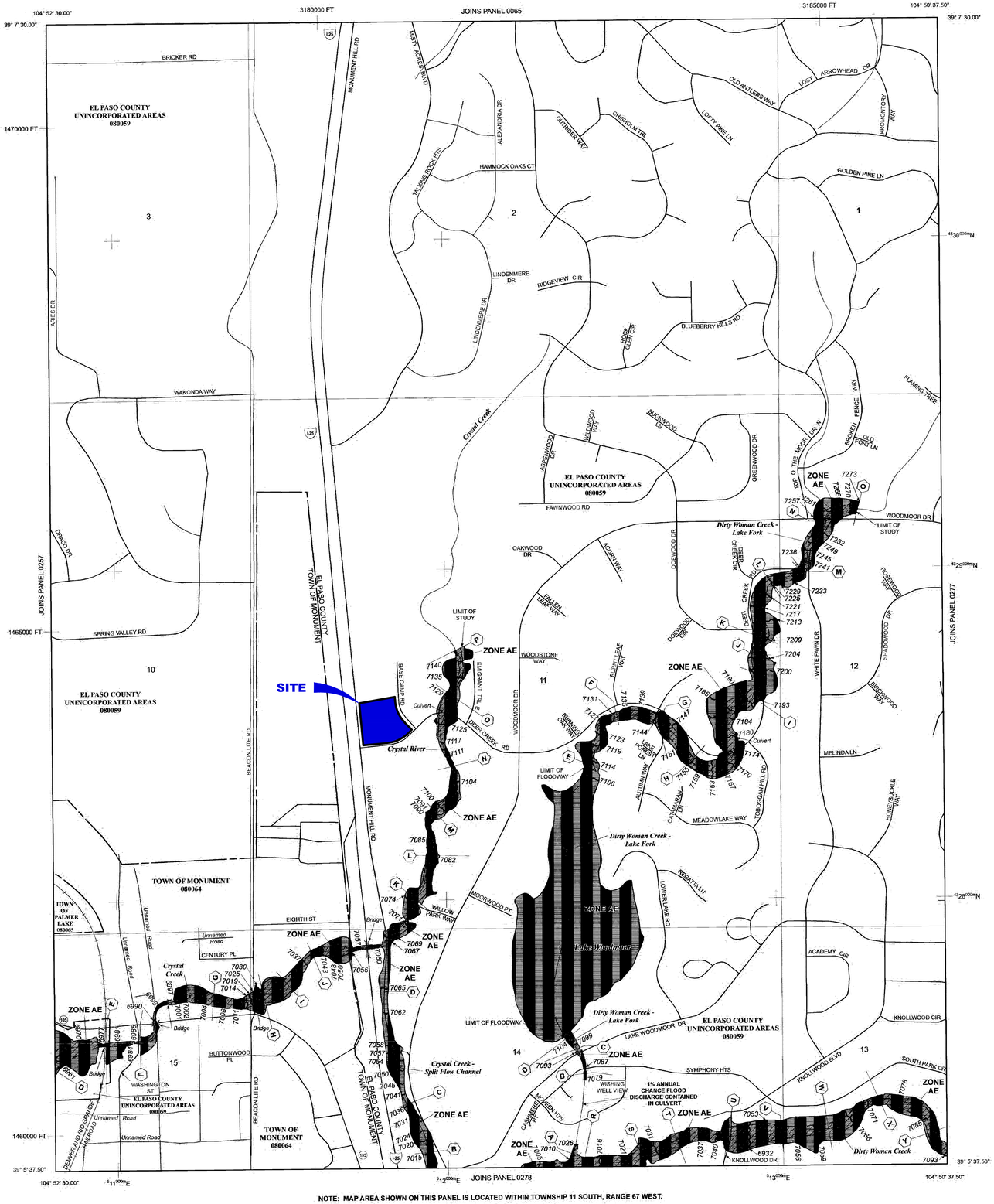
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** No Base Flood Elevations determined.
- **ZONE AE** Base Flood Elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 (EL 987) Base Flood Elevation line and value; elevation in feet* / Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A–A Cross section line
- 23 Transect line
- 97° 07' 30.00" / 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000mN 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6000000 FT 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0276G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 276 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0276	G
MONUMENT, TOWN OF	080064	0276	G
PALMER LAKE, TOWN OF	080065	0276	G

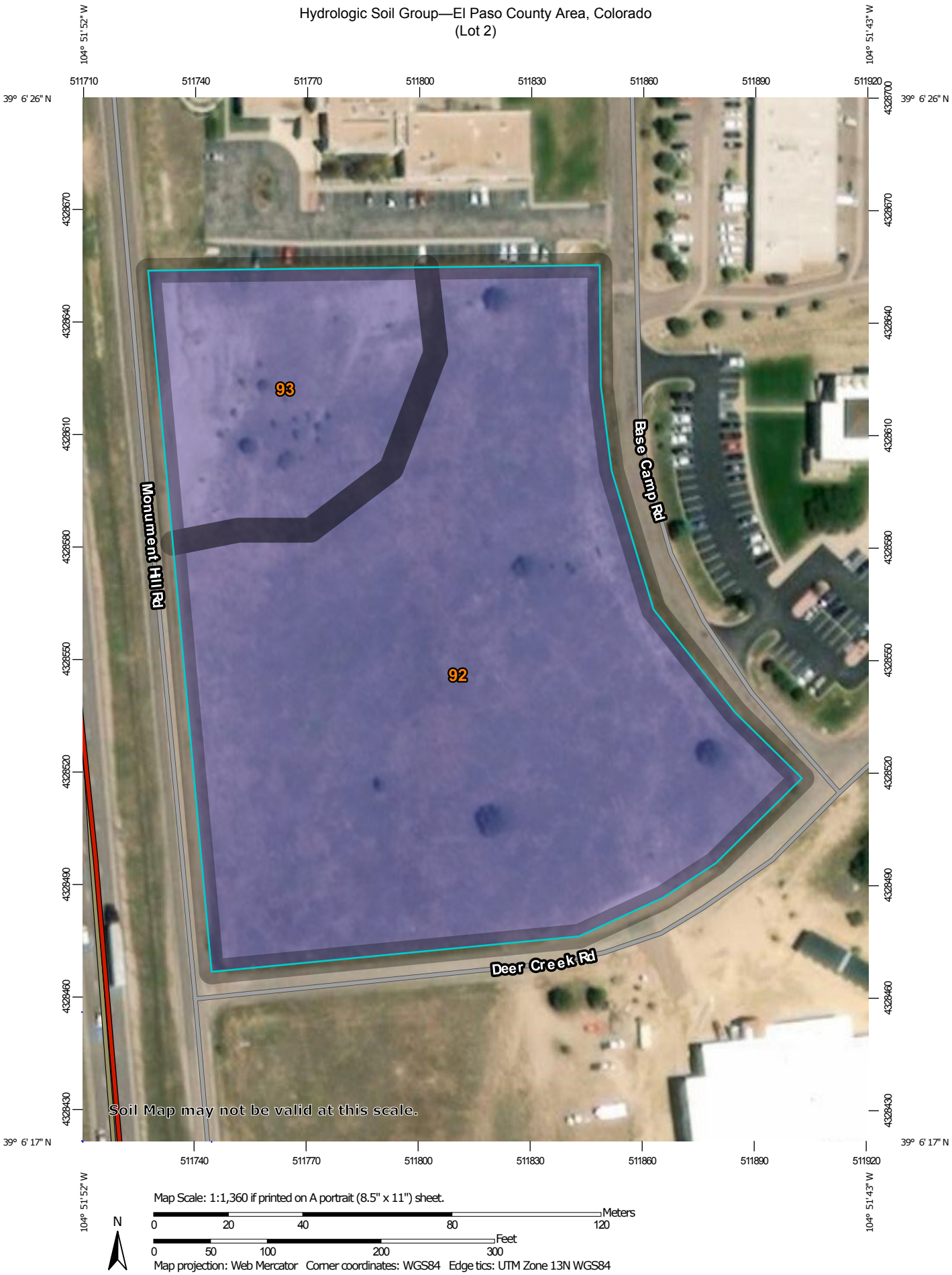
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0276G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado
(Lot 2)



Map Scale: 1:1,360 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil 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 16, Sep 10, 2018

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

Date(s) aerial images were photographed: Jul 4, 2010—Oct 16, 2017

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
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	4.7	80.6%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	1.1	19.4%
Totals for Area of Interest			**5.9**	**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

El Paso County Drainage Basin Fees

Resolution No. 18-470

Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2019 Drainage Fee (per Impervious Acre)	2019 Bridge Fee (per Impervious Acre)
Drainage Basins with DBPS's:					
CHMS0200	Chico Creek	2013	Haegler Ranch	$10,324	$1,524
CHWS1200	Chico Creek	2001	Bennett Ranch	$11,558	$4,433
CHWS1400	Chico Creek	2013	Falcon	$29,622	$4,069
FOFO2000	Fountain Creek	2001	West Fork Jimmy Camp Creek	$12,564	$3,717
FOFO2600	Fountain Creek	1991*	Big Johnson / Crews Gulch	$18,350	$2,370
FOFO2800	Fountain Creek	1988*	Widefield	$18,350	$0
FOFO2900	Fountain Creek	1988*	Security	$18,350	$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	$18,350	$275
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	$11,192	$0
FOFO3400	Fountain Creek	1984*	Peterson Field	$13,235	$1,004
FOFO3600	Fountain Creek	1991*	Fisher's Canyon	$18,350	$0
FOFO4000	Fountain Creek	1996	Sand Creek	$18,940	$5,559
FOFO4200	Fountain Creek	1977	Spring Creek	$9,517	$0
FOFO4600	Fountain Creek	1984*	Southwest Area	$18,350	$0
FOFO4800	Fountain Creek	1991	Bear Creek	$18,350	$1,004
FOFO5400	Fountain Creek	1977	21st Street	$5,521	$0
FOFO5600	Fountain Creek	1964	19th Street	$3,611	$0
FOFO5800	Fountain Creek	1964	Camp Creek	$2,033	$0
FOMO0400	Monument Creek	1986*	Mesa	$9,598	$0
FOMO1000	Monument Creek	1981	Douglas Creek	$11,540	$255
FOMO1200	Monument Creek	1977	Templeton Gap	$11,847	$275
FOMO1400	Monument Creek	1976	Pope's Bluff	$3,676	$627
FOMO1600	Monument Creek	1976	South Rockrimmon	$4,314	$0
FOMO1800	Monument Creek	1973	North Rockrimmon	$5,521	$0
FOMO2000	Monument Creek	1971	Pulpit Rock	$6,085	$0
FOMO2200	Monument Creek	1994	Cottonwood Creek / S. Pine	$18,350	$1,004
FOMO2400	Monument Creek	1966	Dry Creek	$14,486	$524
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	$8,331	$524
FOMO3700	Monument Creek	1987*	Middle Tributary	$15,312	$0
FOMO3800	Monument Creek	1987*	Monument Branch	$18,350	$0
FOMO4000	Monument Creek	1996	Smith Creek	$7,481	$1,004
FOMO4200	Monument Creek	1989*	Black Forest	$18,350	$500
FOMO5200	Monument Creek	1993*	Dirty Woman Creek	$18,350	$1,004
FOMO5300	Fountain Creek	1993*	Crystal Creek	$18,350	$1,004
Miscellaneous Drainage Basins: [1]					
CHBS0800	Chico Creek		Book Ranch	$17,217	$2,492
CHEC0400	Chico Creek		Upper East Chico	$9,380	$272
CHWS0200	Chico Creek		Telephone Exchange	$10,306	$241
CHWS0400	Chico Creek		Livestock Company	$16,976	$202
CHWS0600	Chico Creek		West Squirrel	$8,849	$3,672
CHWS0800	Chico Creek		Solberg Ranch	$18,350	$0
FOFO1200	Fountain Creek		Crooked Canyon	$5,540	$0
FOFO1400	Fountain Creek		Calhan Reservoir	$4,625	$270
FOFO1600	Fountain Creek		Sand Canyon	$3,342	$0
FOFO2000	Fountain Creek		Jimmy Camp Creek[3]	$18,350	$858
FOFO2200	Fountain Creek		Fort Carson	$14,486	$524
FOFO2700	Fountain Creek		West Little Johnson	$1,209	$0
FOFO3800	Fountain Creek		Stratton	$8,801	$394
FOFO5000	Fountain Creek		Midland	$14,486	$524
FOFO6000	Fountain Creek		Palmer Trail	$14,486	$524
FOFO6800	Fountain Creek		Black Canyon	$14,486	$524
FOMO4600	Monument Creek		Beaver Creek	$10,970	$0
FOMO3000	Monument Creek		Kettle Creek	$9,909	$0
FOMO3400	Monument Creek		Elkhorn	$1,665	$0
FOMO5000	Monument Creek		Monument Rock	$7,953	$0
FOMO5400	Monument Creek		Palmer Lake	$12,717	$0
FOMO5600	Monument Creek		Raspberry Mountain	$4,278	$0
PLPL0200	Monument Creek		Bald Mountain	$9,116	$0
Interim Drainage Basins: [2]					
FOFO1800	Fountain Creek		Little Fountain Creek	$2,346	$0
FOMO4400	Monument Creek		Jackson Creek	$7,263	$0
FOMO4800	Monument Creek		Teachout Creek	$5,044	$758

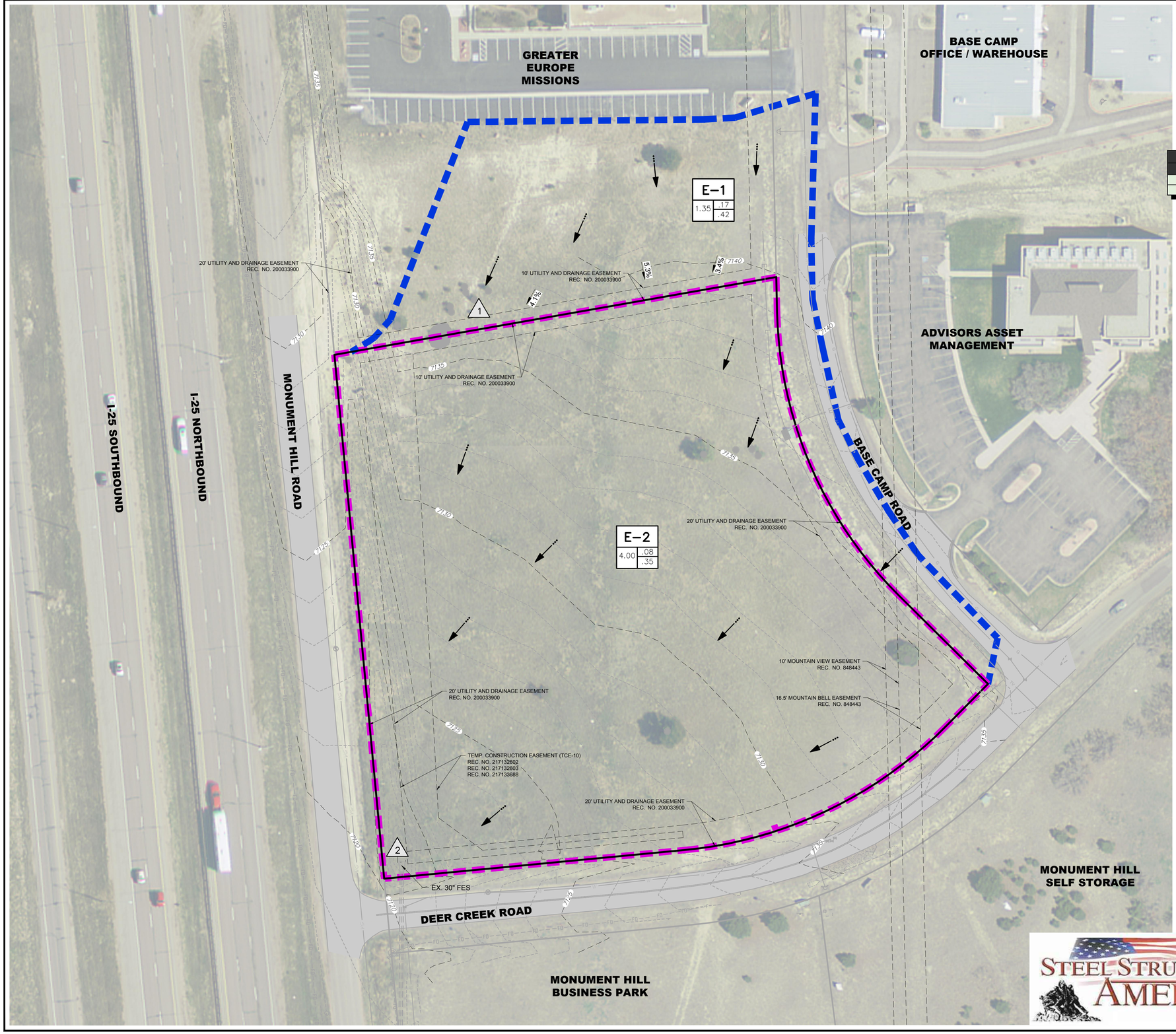
1. The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies perform

2. Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best availabl

3. This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee a surety in the amount of $7,285 per impervious acre sh the DBPS results in a fee greater than the current fee. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 06-326 (9/14/06) and Res

EPC Stormwater Management *Jennifer Irvine, P.E.*

APPENDIX E - DRAINAGE MAPS



NOTES:

1. BENCHMARK:
   NGS CONTROL POINT T 395 BEING A STANDARD NGS STEEL ROD IN A LOGO MONUMENT BOX LOCATED 20 MILES NORTH OF COLORADO SPRINGS ON THE EAST SIDE OF I-25, 1,200 FEET NORTH OF THE WEIGH STATION BUILDING, AND 20.5 FEET EAST OF THE EASTERLY EDGE OF OIL OF THE NORTHBOUND LANES OF I-25.

   NAVD88 ELEVATION: 7111.32'

EXISTING BASIN SUMMARY TABLE

Basin Designation	Area (ac)	Q_Z (cfs)	Q_5 (cfs)	Q_{100} (cfs)
E-1	1.35	0.53	0.96	3.88
E-2	4.00	0.23	1.16	8.55

LEGEND:

ROW/PROPERTY LINE

EX. STORM

OFF-SITE BASIN DRAINAGE BASIN

ON-SITE DRAINAGE BASIN

DRAINAGE FLOW PATTERN

OVERFLOW ROUTE

DESIGN POINT

DRAINAGE BASIN DESIGNATION

BASIN DESIGNATION — E–1 (5.00 | .80 | .90) — BASIN AREA — C5 / C100

STEEL STRUCTURES AMERICA INC.®

PCD FILE NO. PPR1919

N

0 40' 80'

1" = 40' (HORIZONTAL)

TERRA FORMA SOLUTIONS

REV. NO.	DESCRIPTION	DATE

DRAINAGE EXHIBIT

MONUMENT STEEL STRUCTURES

HISTORIC DRAINAGE MAP

18910 BASE CAMP ROAD
MONUMENT, COLORADO

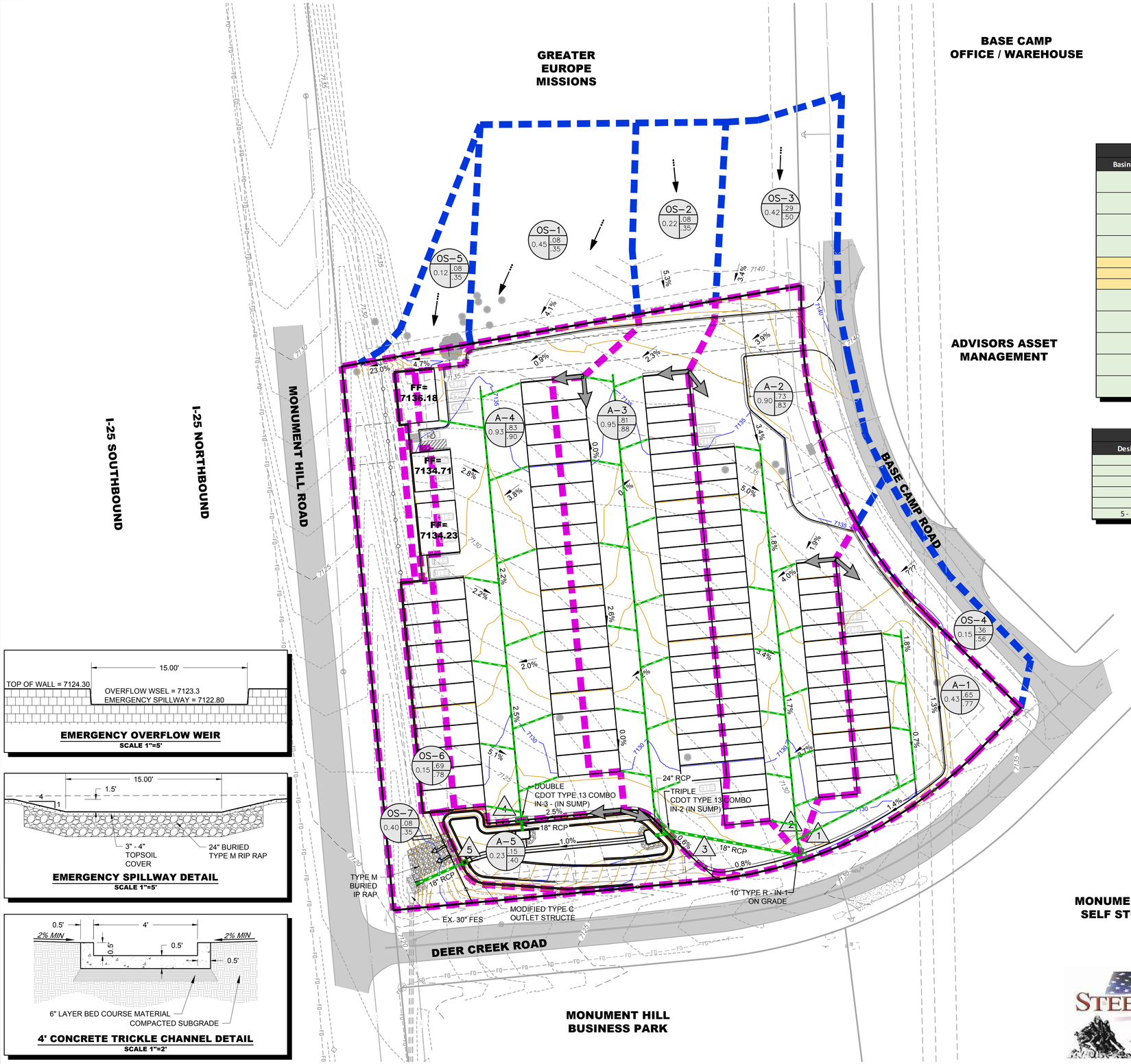
COLORADO LICENSED
TODD A. HOPKINS
37660
08/17/19
PROFESSIONAL ENGINEER

PROJ NO: SSA
ENG:
CHKD:
DATE: 08/17/2019

SHEET NUMBER

HDR

1 OF 2



EMERGENCY OVERFLOW WEIR
SCALE 1"=5'

EMERGENCY SPILLWAY DETAIL
SCALE 1"=5'

4' CONCRETE TRICKLE CHANNEL DETAIL
SCALE 1"=2'

NOTES:

1. BENCHMARK:
   NGS CONTROL POINT T 395 BEING A STANDARD NGS STEEL ROD IN A LOGO MONUMENT BOX LOCATED 20 MILES NORTH OF COLORADO SPRINGS ON THE EAST SIDE OF I-25, 1,200 FEET NORTH OF THE WEIGH STATION BUILDING, AND 20.5 FEET EAST OF THE EASTERLY EDGE OF OIL OF THE NORTHBOUND LANES OF I-25.

   NAVD88 ELEVATION: 7111.32'

PROPOSED BASIN SUMMARY TABLE

Basin Designation	Area (ac)	Q_2 (cfs)	Q_5 (cfs)	Q_{100} (cfs)	TREATED OR UNTREATED
OS-1	0.45	0.03	0.16	1.20	Treated with Proposed WQ and Detention Facilities
OS-2	0.22	0.02	0.08	0.60	Treated with Proposed WQ and Detention Facilities
OS-3	0.42	0.37	0.55	1.62	Treated with Proposed WQ and Detention Facilities
OS-4	0.15	0.19	0.27	0.70	Treated with Proposed WQ and Detention Facilities
OS-5	0.12	0.01	0.04	0.33	Bypasses the site.
OS-6	0.16	0.44	0.57	1.08	Bypasses the site.
OS-7	0.40	0.03	0.16	1.15	Bypasses the site.
A-1	0.43	1.04	1.36	2.70	Treated with Proposed WQ and Detention Facilities
A-2	0.90	2.58	3.34	6.36	Treated with Proposed WQ and Detention Facilities
A-3	0.95	3.01	3.87	7.09	Treated with Proposed WQ and Detention Facilities
A-4	0.93	3.01	3.86	7.03	Treated with Proposed WQ and Detention Facilities
A-5	0.23	0.08	0.16	0.75	Treated with Proposed WQ and Detention Facilities

DESIGN POINT SUMMARY TABLE

Design Point	Contributing Basins	Q_5 (cfs)	Q_{100} (cfs)	Structure
1	A-1, OS-4	1.62	3.37	IN-1 (10' CDOT Type R Inlet)
2	A-2, OS-3	3.17	6.56	
3	A-3, OS-2	3.34	6.52	IN-2 (Triple CDOT Type 13 Combo Inlet)
4	A-4, OS-1	3.37	6.96	IN-3 (Double CDOT Type 13 Combo Inlet)
5	A-1 - A-4, OS-1 Through OS-4	11.07	22.53	Extended Detention Basin (EDB)
5 - Release	--	0.12	5.07	EDB - Outlet Structure

Pond Summary Table

Stage	Required Vol (Ac-Ft)	Designed Vol (Ac-Ft)	As-Built Vol (Ac-Ft)
WQCV	0.091	0.101	
EURV	0.311	0.342	
100 YR	0.537	0.578	

LEGEND:

- ROW/PROPERTY LINE
- EX. STORM
- PROP. STORM
- HISTORICAL DRAINAGE BASIN
- DRAINAGE BASIN
- DRAINAGE FLOW PATTERN
- OVERFLOW ROUTE
- DESIGN POINT
- DRAINAGE BASIN DESIGNATION
- BASIN DESIGNATION
- BASIN AREA

STEEL STRUCTURES AMERICA INC.®

PCD FILE NO. PPR1919

0 40' 80'
1" = 40' (HORIZONTAL)

TERRA FORMA SOLUTIONS

REV. NO.	DESCRIPTION	DATE

DRAINAGE EXHIBIT
MONUMENT STEEL STRUCTURES
PROPOSED DRAINAGE MAP
18910 BASE CAMP ROAD
MONUMENT, COLORADO

COLORADO LICENSED PROFESSIONAL ENGINEER
JOSEPH A. HOWSER
37660
08/17/19

PROJ NO: SSA
ENG :
CHKD:
DATE : 08/17/2019

SHEET NUMBER
PDR
2 OF 2

P:_Projects\Steel Structures - Monument, CO\03 - Drawings\Exhibits\X-Proposed Drainage Map.dwg, 1/20/2020 10:39:48 PM, epearson, 1:1

APPENDIX F - RUNOFF REDUCTION CALCULATION

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: Todd Johnson
Company: Terra Forma Solutions
Date: June 24, 2019
Project: Monument Steel Structures - PCD File No. PPR1919
Location: 18910 Base Camp Road - El Paso County

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	UIA:RPA											
Area ID	OS6 & OS7											
Downstream Design Point ID	Ex 30" FES											
Downstream BMP Type	None											
DCIA (ft^2)	--											
UIA (ft^2)	6,534											
RPA (ft^2)	17,424											
SPA (ft^2)	--											
HSG A (%)	0%											
HSG B (%)	100%											
HSG C/D (%)	0%											
Average Slope of RPA (ft/ft)	0.029											
UIA:RPA Interface Width (ft)	30.00											

CALCULATED RUNOFF RESULTS

Area ID	OS6 & OS7											
UIA:RPA Area (ft^2)	23,958											
L / W Ratio	16.00											
UIA / Area	0.2727											
Runoff (in)	0.00											
Runoff (ft^3)	0											
Runoff Reduction (ft^3)	272											

CALCULATED WQCV RESULTS

Area ID	OS6 & OS7											
WQCV (ft^3)	272											
WQCV Reduction (ft^3)	272											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

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

Downstream Design Point ID	Ex 30" FES											
DCIA (ft^2)	0											
UIA (ft^2)	6,534											
RPA (ft^2)	17,424											
SPA (ft^2)	0											
Total Area (ft^2)	23,958											
Total Impervious Area (ft^2)	6,534											
WQCV (ft^3)	272											
WQCV Reduction (ft^3)	272											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

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

Total Area (ft^2)	23,958
Total Impervious Area (ft^2)	6,534
WQCV (ft^3)	272
WQCV Reduction (ft^3)	272
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0