FINAL DRAINAGE REPORT FOR WATERVIEW NORTH
PRE-SUBDIVISION GRADING

Waterview North
El Paso County, CO

Prepared for:

CRP Entitlements, LLC
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Prepared by:

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Project #: 096955001

Prepared: June 15, 2021
Resubmitted: December 17, 2021

Kimley»Horn

PCD FILE NO. EGP-21-004

CERTIFICATION

ENGINEERS STATEMENT

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

SIGNATURE (Affix Seal): _____

John Heiberger, Colorado P.E. No. 50096 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.

_____

Name of Developer, Title

_____

Authorized Signature Date

_____

Business Name

_____

Address

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. Date
County Engineer / ECM Administrator

Conditions:

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APPENDIX

GENERAL LOCATION AND PROJECT DESCRIPTION

PURPOSE AND SCOPE OF STUDY

The purpose of this report is to outline the Final Drainage Report (the "Final Report") associated with the early grading and erosion control plan (the "EGP") specific to the proposed early grading site work for Waterview North (the "Project") and the required drainage infrastructure needed to mitigate the EGP construction activities. The Project is located on three parcels at the northeast corner of S. Powers Blvd and Bradley Rd (the "Site"), El Paso County, Colorado (the "County").

This Final Report identifies on-site and offsite drainage patterns, areas tributary to the site and proposes to safely route developed storm water to adequate outfalls at or less than historic flow rates. This Final Report is intended to accompany the early grading permit application for the Project. A Final Drainage Report for each individual lot and use containing detailed proposed site stormwater infrastructure design will be submitted at a later date. The Project will be processed through El Paso County. Additional outside agency review or processing is not anticipated as part of the Project.

LOCATION

The Project is located on three parcels at the northeast corner of S. Powers Blvd and Bradley Rd (the "Site"), El Paso County, Colorado (the "County"). The Site is located within the Jimmy Camp Creek Basin which is mostly vacant land. The Site is surrounded by:

North: Peak Innovation Parkway, Lot 7 Colorado Springs Airport Filing No. 1D

South: Bradley Road

East: Colorado Centre Metro District, Lot 4 Colorado Centre Foreign Trade Zone & Business Park Filing No. 1

West: S. Powers Boulevard

DESCRIPTION OF PROPERTY

The proposed improvements consist of single and multi-family residential, industrial, and commercial uses within the Site. The Project will also include construction of internal roadways and utility infrastructure which will be detailed in the Final Drainage Report submitted at a later date.

The total Site is approximately 116.5 acres and consists of vacant land with native vegetation within the Jimmy Camp Creek Basin. The Site drains approximately from the northwest corner to the southeast corner at grades that vary from 5% to 15%.

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

There are no major irrigation facilities within the Site. The Site does not currently provide on-site water quality or detention for the Project area. There is no regional detention pond for the Project Site.

There is an existing gas main that runs along the east side of the property.

EXISTING DRAINAGE BASINS AND SUBBASINS

EXISTING DRAINAGE BASIN

No maps in Appendix E

The Project Site is a part of the *Amendment to the Master Drainage Development Plan for Waterview, Waterview North* prepared by Dakota Springs Engineering, dated February 2021 (the "MDDP Amendment"). The MDDP Amendment defines 9 basins on the Pre-Development Basin Map provided in **Appendix E.** The Site consists of the MDDP Amendment existing basins BJD-12c, BJDEX14, JCDEX3.1, JCDEX3.2, and JCDEX3.3.

Need to include calculations for existing drainage basins

MAJOR DRAINAGE BASIN DESCRIPTION

The Site is located in the Jimmy Camp Creek watershed and generally slopes from northwest to southeast at approximately 5%-15%. Currently, the site consists of natural vegetation. The existing runoff from the Site is captured by existing storm sewer within S. Powers Boulevard and Bradley Road. The runoff then continues east and eventually outfalls to Jimmy Camp Creek.

Off-site basins sheet flow onto the Site from the north. The offsite flow is within two separate basins: The Big Johnson Basin and the West Fork Jimmy Camp Creek Basin. The offsite flows were analyzed within the MDDP Amendment and provided within the Pre-Development Basin Map provided in **Appendix E**.

F

DRAINAGE DESIGN CRITERIA

Update. The limits of the proposed early grading extends includes West Fork Jimmy Camp Creek.

Unresolved. This is located within three drainage basins: Big Johnson, Jimmy Camp Creek and West Fork Jimmy Camp Creek.

Development Criter

The Project follows t
"CRITERIA") and the U
Project area drainage
development. Further detail regarding onsite drainage patterns is provided in the Drainage Facility Design section.

Hydrologic Criteria

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per the CRITERIA. The Rational Method was used for developed conditions as established in the CRITERIA and MANUAL. Runoff coefficients for the proposed development were determined using Table 6-6 of the MANUAL by calculating weighted impervious values for each specific Site sub-basin. Full spectrum detention basins will be designed during the Final Drainage Report process. Temporary sediment basins were provided for the Site for the overlot grading construction associated with the Early Grading Permit. Temporary sediment basins were sized per the MANUAL fact sheet on sediment basins which is provided in **Appendix E**.

PROPOSED DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed Site was divided into six sub-basins. Each of these sub-basins sheet flows to a

temporary sediment basin in the overlot graded condition. Hydrologic calculations are provided in Appendix B. A proposed conditions map is provided in Appendix D.

F

SPECIFIC DETAILS

Sub-Basin PA-1A

Sub-basin PA-1 is 17.19 acres and is anticipated to be developed into a light industrial use. The runoff within this sub-basin will sheet flow to the temporary sediment basin 1. The 5-year and 100-year storm event runoffs are 37.02 cfs and 73.74 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

Sub-Basin PA-1B

Sub-basin PA-1 is 8.86 acres and is anticipated to be developed into a light industrial use. The runoff within this sub-basin will sheet flow to the temporary sediment basin 2. The 5-year and 100-year storm event runoffs are 18.34 cfs and 36.53 cfs, respe
this sub-basin ultimately discharges into Jimmy Camp Creek
calculations will be included in a final drainage report.

Update PA-1B & PA-2. If temporary sediment
into the pipe crossing Bradley Road then this i
Fork Jimmy Camp Creek. See the MDDP dra
breakdown of the three major basin boundarie

Sub-Basin PA-2

Sub-basin PA-2 is 13.95 acres and is anticipated to be dev
runoff within this sub-basin will sheet flow to the temporary sediment basin 2. The 5-year and 100-year storm event runoffs are 56.02 cfs and 102.20 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

Basin area & flows do not
match hydrology spreadsheet

Sub-Basin PA-3

Sub-basin PA-3 is 16.57 acres and is anticipated to be developed into a residential use. The runoff within this sub-basin will sheet flow to temporary sediment basin 3. The 5-year and 100-year storm event runoffs are 69.36 cfs and 126.53 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

Sub-Basin PA-4

Sub-basin PA-4 is 11.78 acres and is anticipated to be developed into a residential use. The runoff within this sub-basin will sheet flow to temporary sediment basin 4. The 5-year and 100-year storm event runoffs are 27.17 cfs and 57.72 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

Sub-Basin PA-5

Sub-basin PA-5 is 14.92 acres and is anticipated to be developed into a residential use. The runoff within this sub-basin will sheet flow to temporary sediment basin 5. The 5-year and 100-year storm event runoffs are 24.41 cfs and 51.85 cfs, respectively. The runoff developed within this
final design

Add a section providing narrative description of the temporary sediment basins to include the emergency overflow path. Explain which of the TSB are expected to be removed as development progress and which are expected to be converted to a permanent facility. For the onces expected to be converted to a permanent facility provide a statement that these will be retrofitted and final pond design/analysis will be provided in future final drainage report.

Sub-Basin PA-6

Sub-basin PA-6 is 23.05 acres and is anticipated to be developed into a residential use. The runoff within this sub-basin will sheet flow to temporary sediment basin 6. The 5-year and 100-year storm event runoffs are 44.79 cfs and 95.15 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

Sub-Basin PA-7

Sub-basin PA-7 is 7.12 acres and is anticipated to be developed into a commercial use. The runoff within this sub-basin will sheet flow to the temporary sediment basin 3. The 5-year and 100-year storm event runoffs are 29.82 cfs and 54.41 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

Sub-Basin PA-8

Sub-basin PA-8 is 11.54 acres and is anticipated to be developed into a residential use. The runoff within this sub-basin will sheet flow to temporary sediment basin 8. The 5-year and 100-year storm event runoffs are 25.15 cfs and 53.42 cfs, respectively. The runoff developed within this sub-basin ultimately discharges into Jimmy Camp Creek. Additional details and final design calculations will be included in a final drainage report.

FOUR-STEP PROCESS

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

Step 1: Employ Runoff Reduction Practices
Temporary drainage swales and temporary sediment basins are provided to help reduce runoff and promote infiltration.

Step 2: Implement BMPs That Provide a Water Quality Capture Volume with Slow Release
This Final Report is associated with the early grading and erosion control plan which does not require the capture and treatment of the water quality capture volume. Erosion control techniques are implemented throughout the development in the form of temporary drainage swales and temporary sediment basins. The temporary sediment basins provide risers pipes that provide an emptying time of approximately 72 hours. Permanent extended detention basins will be designed and constructed with the Final Drainage Report for the infrastructure improvements for the development.

Step 3: Stabilize Drainageways
The Project Site is located more than 500’ away from any major drainageways and there are no open channels located on or adjacent to the Site. The Project outfall is ultimately to Jimmy Camp Creek.

Step 4: Implement Site Specific and Other Source Control BMPs
The Site does not require “Covering of Storage/Handling Areas” or “Spill Containment and Control” (specialized BMPs) in the final constructed condition. There is no proposed material

storage or other site operations that would introduce contaminants to the County's MS4 that would require site specific control or source control BMP for the proposed project.

OFFSITE DRAINAGE ANALYSIS

Does not correspond to basins labeled north of site on Pre-development Map

Per the MDDP Amendment, sub-basins JCD, OS1-A, and JCD OS1-B on the offsite northern property surface flow south towards the Project Site. A 20' wide berm with a height of 2' is proposed spanning the portion of the northern property where the offsite drainage sheet flows south to the Project Site. This berm will then direct flow east following historical drainage patterns. Flowmaster calculations for the proposed berm are providedNumber of in **Appendix F**.

E

Revise the statement. This is not the historical path of the offsite basins. Historically, offsite flow drains across project site. Developed map shows swale within property boundary, along north and east property lines, keeping offsite flows on the site area.

Temporary sediment basin 5 discharges east to the
to an existing drainage channel along Bradley Roac
outfall of this discharge pipe. The riprap sizing will b
extended detention basin and these calculations wil

Include discussion of downstream drainage facilities and ability to convey developed flows from project site.

EES

The Project Site is located in the Jimmy Camp Creek Basin. Fees are not applicable with the pre-development grading request. Fees will be calculated with each subsequent subdivision plat's final drainage report and the drainage fees will be paid at the time of final plat recordation.

SUMMARY

Update to include the other two basins: Big Johnson & West Fork Jimmy Camp Creek.

COMPLIANCE WITH STANDARDS

The drainage design presented within this report for Waterview North conforms to the CRITERIA and MANUAL. Site runoff and storm drain facilities will not adversely affect the downstream and surrounding developments.

This report and findings are in general conformance with all previously approved reports and/or studies which include this Site. The proposed Project does not adversely impact the peak flows downstream within Jimmy Camp Creek.

REFERENCES

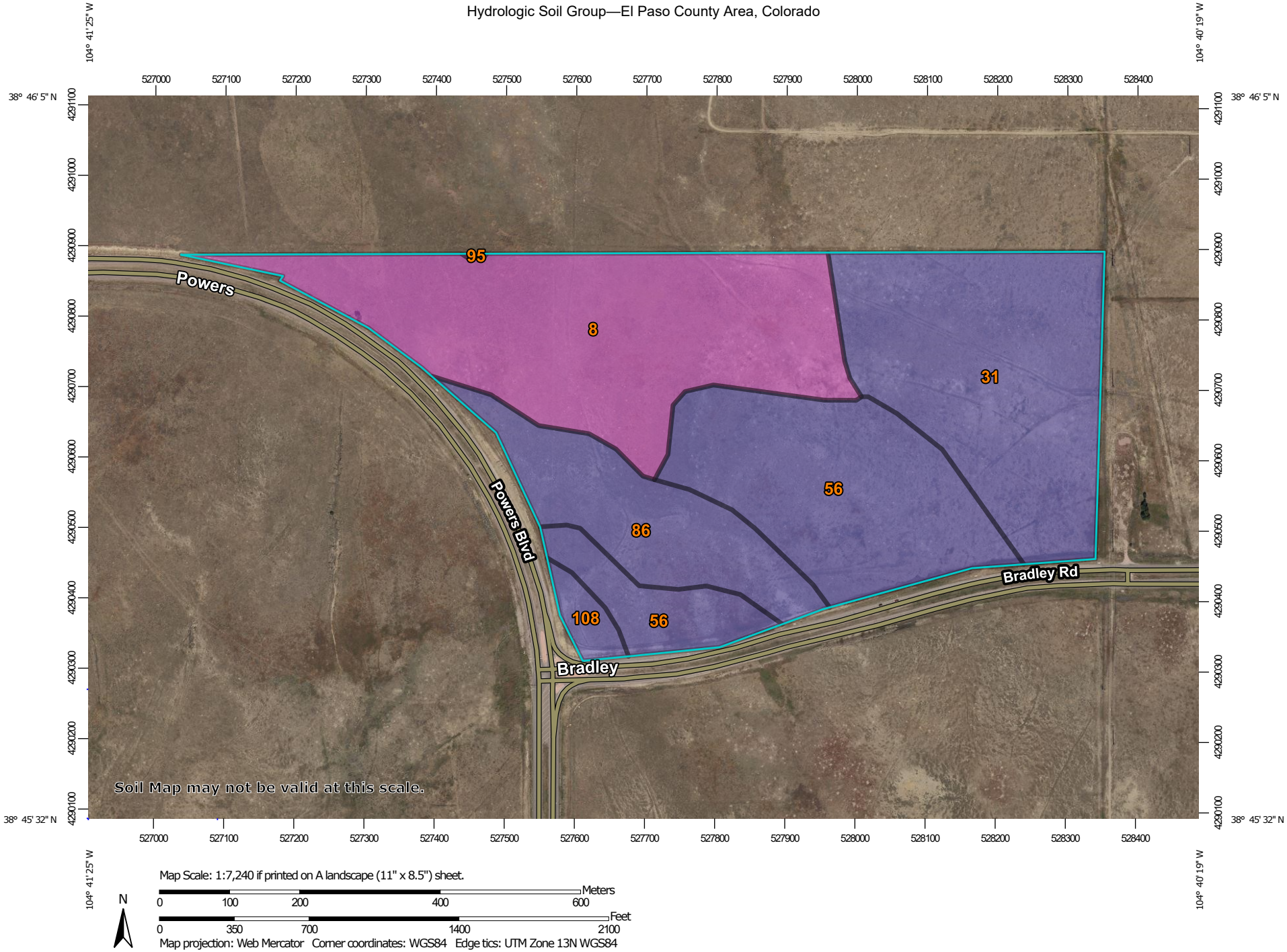
1. El Paso County Drainage Criteria Manual Volumes 1 and 2, May 2014.

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

3. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C0768G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

4. Amendment to Master Drainage Development Plan for Waterview, Waterview North, prepared by Dakota Springs Engineering, February 2021.

APPENDIX A – SOILS MAP AND FEMA FIRM PANEL



Map Scale: 1:7,240 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

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

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

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

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	38.3	33.1%
31	Fort Collins loam, 3 to 8 percent slopes	B	30.6	26.5%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	30.0	26.0%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	14.6	12.6%
95	Truckton loamy sand, 1 to 9 percent slopes	A	0.0	0.0%
108	Wiley silt loam, 3 to 9 percent slopes	B	2.0	1.7%
Totals for Area of Interest			**115.6**	**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

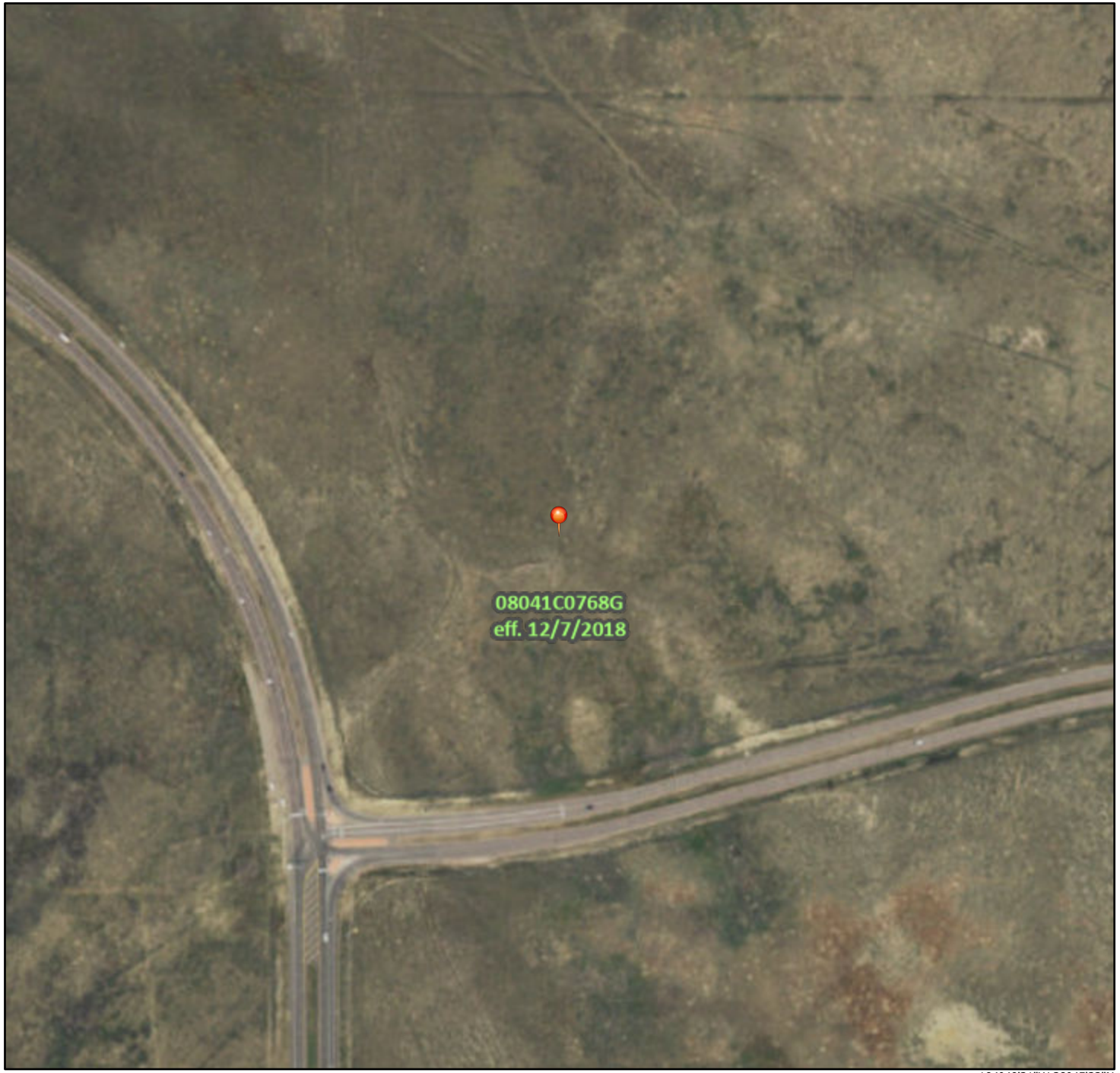
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

National Flood Hazard Layer FIRMette

FEMA

104°41'8"W 38°46'1"N



104°40'31"W 38°45'33"N

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

1:6,000

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

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/7/2021 at 3:45 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX B – HYDROLOGIC CALCULATIONS

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
⅛ Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
¼ Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
⅓ Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
½ Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55

Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis—Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

IDF Equations:

I_{100} = -2.52ln(D) + 12.735
I_{50} = -2.25ln(D) + 11.375
I_{25} -2.00ln(D) + 10.111
I_{10} -1.75ln(D) + 8.847
I_{5} -1.50ln(D) + 7.583
I_{2} -1.19ln(D) + 6.035

Where:
I = Rainfall Intensity (in/hr)
D= Duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.5	1.75	2.52

*The Design Point Rainfall Values and IDF equations are found in Figure 6-5 of the El Paso County Drainage Criteria Manual, Volume 1 Update

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	BASIN DESIGNATION	SOIL GROUP DESIGNATION	WEIGHTED IMPERVIOUSNESS	WEIGHTED COEFFICIENTS			
						C2	C5	C10	C100
PA-1A	748,767	17.19	LIGHT INDUSTRIAL	A	80.0%	0.57	0.59	0.63	0.70
PA-1B	385,772	8.86	LIGHT INDUSTRIAL	A	80.0%	0.57	0.59	0.63	0.70
PA-2	607,776	13.95	COMMERCIAL	B	95.0%	0.79	0.81	0.83	0.88
PA-3	353,941	8.13	RESIDENTIAL	A	70.0%	0.45	0.49	0.53	0.62
PA-4	513,023	11.78	RESIDENTIAL	A	70.0%	0.45	0.49	0.53	0.62
PA-5	649,954	14.92	RESIDENTIAL	B	70.0%	0.45	0.49	0.53	0.62
PA-6	1,003,932	23.05	RESIDENTIAL	B	70.0%	0.45	0.49	0.53	0.62
PA-7	310,295	7.12	COMMERCIAL	A	95.0%	0.79	0.81	0.83	0.88
PA-8	502,510	11.54	RESIDENTIAL	B	70.0%	0.45	0.49	0.53	0.62
TOTAL	5,075,970	116.53							

Waterview North - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
PA-1A	PA-1A	748,767	17.19	0.59	100	1.5%	8.2	817	1.5%	20.00	2.4	5.6	13.8	917	15.1	13.8
PA-1B	PA-1B	385,772	8.86	0.59	100	0.8%	10.3	960	2.8%	20.00	3.3	4.8	15.1	1060	15.9	15.1
PA-2	PA-2	607,776	13.95	0.81	100	4.2%	3.3	603	4.2%	20.00	4.1	2.5	5.8	703	13.9	5.8
PA-3	PA-3	353,941	8.13	0.49	100	3.5%	7.4	184	9.2%	20.00	6.1	0.5	7.9	284	11.6	7.9
PA-4	PA-4	513,023	11.78	0.49	100	13.9%	4.7	356	2.0%	20.00	2.8	2.1	6.8	456	12.5	6.8
PA-5	PA-5	649,954	14.92	0.49	100	3.8%	7.2	1168	1.0%	20.00	2.0	9.7	16.9	1268	17.0	16.9
PA-6	PA-6	1,003,932	23.05	0.49	100	6.3%	6.0	1550	6.3%	20.00	5.0	5.1	11.1	1650	19.2	11.1
PA-7	PA-7	310,295	7.12	0.81	100	2.8%	3.8	238	2.8%	20.00	3.3	1.2	5.0	338	11.9	5.0
PA-8	PA-8	502,510	11.54	0.49	100	7.3%	5.8	740	7.3%	20.00	5.4	2.3	8.1	840	14.7	8.1

Waterview North - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm 5 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
PA-1A	PA-1A	17.19	0.59	13.8	10.14	3.65	37.02					
PA-1B	PA-1B	8.86	0.59	15.1	5.23	3.51	18.34					
PA-2	PA-2	13.95	0.81	5.8	11.30	4.96	56.02					
PA-3	PA-3	8.13	0.49	7.9	3.98	4.48	17.84					
PA-4	PA-4	11.78	0.49	6.8	5.77	4.71	27.17					
PA-5	PA-5	14.92	0.49	16.9	7.31	3.34	24.41					
PA-6	PA-6	23.05	0.49	11.1	11.29	3.97	44.79					
PA-7	PA-7	7.12	0.81	5.0	5.77	5.17	29.82					
PA-8	PA-8	11.54	0.49	8.1	5.65	4.45	25.15					

Waterview North - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm 100 Year

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
PA-1A	PA-1A	17.19	0.70	13.8	12.03	6.13	73.74					
PA-1B	PA-1B	8.86	0.70	15.1	6.20	5.89	36.53					
PA-2	PA-2	13.95	0.88	5.8	12.28	8.32	102.20					
PA-3	PA-3	8.13	0.62	7.9	5.04	7.53	37.91					
PA-4	PA-4	11.78	0.62	6.8	7.30	7.91	57.72					
PA-5	PA-5	14.92	0.62	16.9	9.25	5.61	51.85					
PA-6	PA-6	23.05	0.62	11.1	14.29	6.66	95.15					
PA-7	PA-7	7.12	0.88	5.0	6.27	8.68	54.41					
PA-8	PA-8	11.54	0.62	8.1	7.15	7.47	53.42					

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
PA-1A	PA-1A	17.19	37.02	73.74	37.02	73.74
PA-1B	PA-1B	8.86	18.34	36.53	18.34	36.53
PA-2	PA-2	13.95	56.02	102.20	56.02	102.20
PA-3	PA-3	8.13	17.84	37.91	17.84	37.91
PA-4	PA-4	11.78	27.17	57.72	27.17	57.72
PA-5	PA-5	14.92	24.41	51.85	24.41	51.85
PA-6	PA-6	23.05	44.79	95.15	44.79	95.15
PA-7	PA-7	7.12	29.82	54.41	29.82	54.41
PA-8	PA-8	11.54	25.15	53.42	25.15	53.42

APPENDIX C – SEDIMENT BASIN FACT SHEET

Sediment Basin (SB) SC-7

Description

A sediment basin is a temporary pond built on a construction site to capture eroded or disturbed soil transported in storm runoff prior to discharge from the site. Sediment basins are designed to capture site runoff and slowly release it to allow time for settling of sediment prior to discharge. Sediment basins are often constructed in locations that will later be modified to serve as post-construction stormwater basins.

Photograph SB-1. Sediment basin at the toe of a slope. Photo courtesy of WWE.

Appropriate Uses

Most large construction sites (typically greater than 2 acres) will require one or more sediment basins for effective management of construction site runoff. On linear construction projects, sediment basins may be impractical; instead, sediment traps or other combinations of BMPs may be more appropriate.

Sediment basins should not be used as stand-alone sediment controls. Erosion and other sediment controls should also be implemented upstream.

When feasible, the sediment basin should be installed in the same location where a permanent post-construction detention pond will be located.

Design and Installation

The design procedure for a sediment basin includes these steps:

- **Basin Storage Volume**: Provide a storage volume of at least 3,600 cubic feet per acre of drainage area. To the extent practical, undisturbed and/or off-site areas should be diverted around sediment basins to prevent "clean" runoff from mixing with runoff from disturbed areas. For undisturbed areas (both on-site and off-site) that cannot be diverted around the sediment basin, provide a minimum of 500 ft^3/acre of storage for undeveloped (but stable) off-site areas in addition to the 3,600 ft^3/acre for disturbed areas. For stable, developed areas that cannot be diverted around the sediment basin, storage volume requirements are summarized in Table SB-1.

- **Basin Geometry:** Design basin with a minimum length-to-width ratio of 2:1 (L:W). If this cannot be achieved because of site space constraints, baffling may be required to extend the effective distance between the inflow point(s) and the outlet to minimize short-circuiting.

- **Dam Embankment**: It is recommended that embankment slopes be 4:1 (H:V) or flatter and no steeper than 3:1 (H:V) in any location.

Sediment Basins	
Functions	
Erosion Control	No
Sediment Control	Yes
Site/Material Management	No

- **Inflow Structure**: For concentrated flow entering the basin, provide energy dissipation at the point of inflow.

Table SB-1. Additional Volume Requirements for Undisturbed and Developed Tributary Areas Draining through Sediment Basins

Imperviousness (%)	Additional Storage Volume (ft^3) Per Acre of Tributary Area
Undeveloped	500
10	800
20	1230
30	1600
40	2030
50	2470
60	2980
70	3560
80	4360
90	5300
100	6460

- **Outlet Works**: The outlet pipe shall extend through the embankment at a minimum slope of 0.5 percent. Outlet works can be designed using one of the following approaches:

  - **Riser Pipe (Simplified Detail):** Detail SB-1 provides a simplified design for basins treating no more than 15 acres.

  - **Orifice Plate or Riser Pipe**: Follow the design criteria for Full Spectrum Detention outlets in the EDB Fact Sheet provided in Chapter 4 of this manual for sizing of outlet perforations with an emptying time of approximately 72 hours. In lieu of the trash rack, pack uniformly sized 1½ - to 2-inch gravel in front of the plate or surrounding the riser pipe. This gravel will need to be cleaned out frequently during the construction period as sediment accumulates within it. The gravel pack will need to be removed and disposed of following construction to reclaim the basin for use as a permanent detention facility. If the basin will be used as a permanent extended detention basin for the site, a trash rack will need to be installed once contributing drainage areas have been stabilized and the gravel pack and accumulated sediment have been removed.

  - **Floating Skimmer**: If a floating skimmer is used, install it using manufacturer's recommendations. Illustration SB-1 provides an illustration of a Faircloth Skimmer Floating Outlet™, one of the more commonly used floating skimmer outlets. A skimmer should be designed to release the design volume in no less than 48 hours. The use of a floating skimmer outlet can increase the sediment capture efficiency of a basin significantly. A floating outlet continually decants cleanest water off the surface of the pond and releases cleaner water than would discharge from a perforated riser pipe or plate.

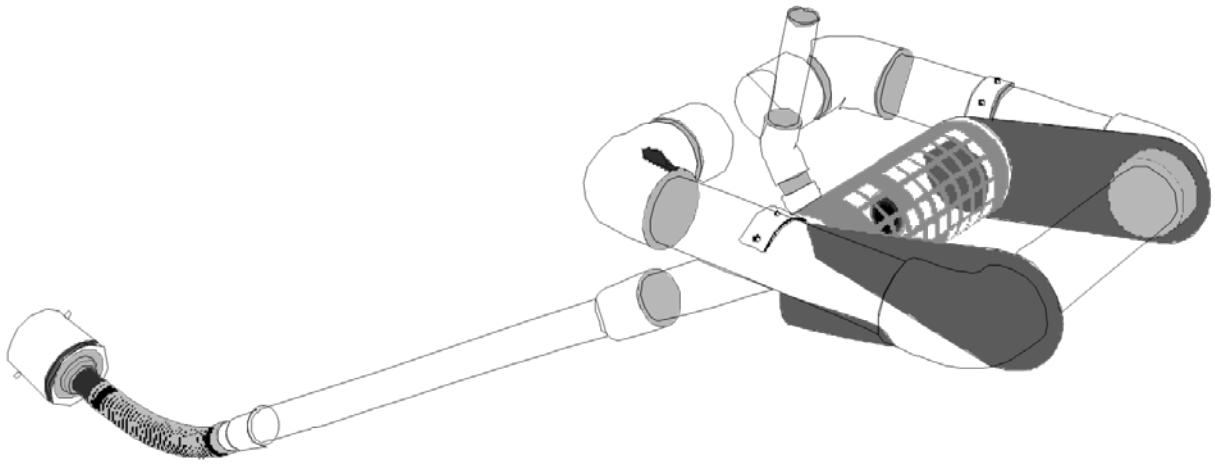


Illustration SB-1. Outlet structure for a temporary sediment basin - Faircloth Skimmer Floating Outlet. Illustration courtesy of J. W. Faircloth & Sons, Inc., FairclothSkimmer.com.

- **Outlet Protection and Spillway:** Consider all flow paths for runoff leaving the basin, including protection at the typical point of discharge as well as overtopping.
  - **Outlet Protection:** Outlet protection should be provided where the velocity of flow will exceed the maximum permissible velocity of the material of the waterway into which discharge occurs. This may require the use of a riprap apron at the outlet location and/or other measures to keep the waterway from eroding.
  - **Emergency Spillway:** Provide a stabilized emergency overflow spillway for rainstorms that exceed the capacity of the sediment basin volume and its outlet. Protect basin embankments from erosion and overtopping. If the sediment basin will be converted to a permanent detention basin, design and construct the emergency spillway(s) as required for the permanent facility. If the sediment basin will not become a permanent detention basin, it may be possible to substitute a heavy polyvinyl membrane or properly bedded rock cover to line the spillway and downstream embankment, depending on the height, slope, and width of the embankments.

Maintenance and Removal

Maintenance activities include the following:

- Dredge sediment from the basin, as needed to maintain BMP effectiveness, typically when the design storage volume is no more than one-third filled with sediment.
- Inspect the sediment basin embankments for stability and seepage.
- Inspect the inlet and outlet of the basin, repair damage, and remove debris. Remove, clean and replace the gravel around the outlet on a regular basis to remove the accumulated sediment within it and keep the outlet functioning.
- Be aware that removal of a sediment basin may require dewatering and associated permit requirements.
- Do not remove a sediment basin until the upstream area has been stabilized with vegetation.

Final disposition of the sediment basin depends on whether the basin will be converted to a permanent post-construction stormwater basin or whether the basin area will be returned to grade. For basins being converted to permanent detention basins, remove accumulated sediment and reconfigure the basin and outlet to meet the requirements of the final design for the detention facility. If the sediment basin is not to be used as a permanent detention facility, fill the excavated area with soil and stabilize with vegetation.

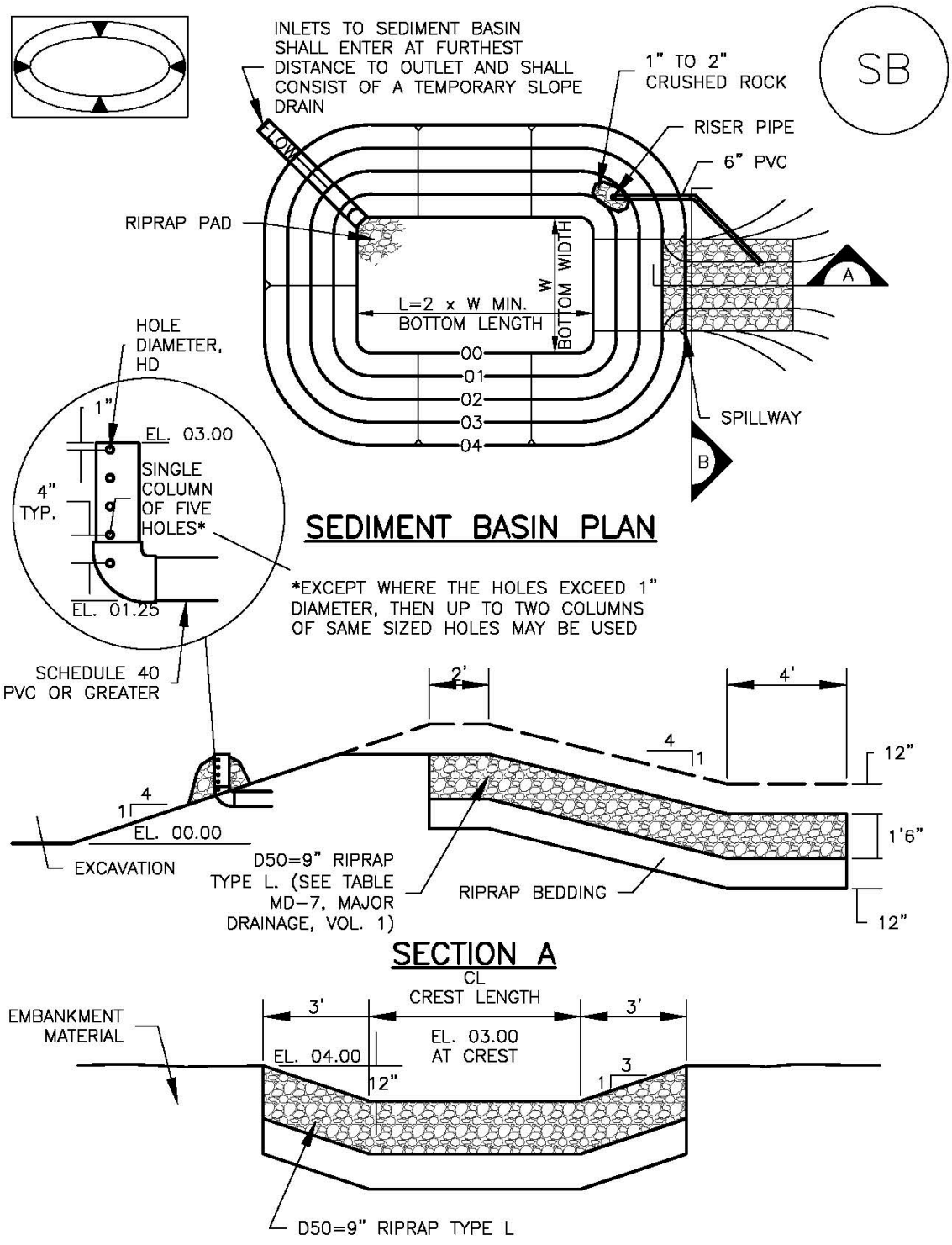

SB
INLETS TO SEDIMENT BASIN SHALL ENTER AT FURTHEST DISTANCE TO OUTLET AND SHALL CONSIST OF A TEMPORARY SLOPE DRAIN
FLOW
1" TO 2" CRUSHED ROCK
RISER PIPE
6" PVC
RIPRAP PAD
W BOTTOM WIDTH
L=2 x W MIN. BOTTOM LENGTH
00
01
02
03
04
A
B
SPILLWAY
HOLE DIAMETER, HD
1"
EL. 03.00
4" TYP.
SINGLE COLUMN OF FIVE HOLES*
EL. 01.25
SCHEDULE 40 PVC OR GREATER
SEDIMENT BASIN PLAN
*EXCEPT WHERE THE HOLES EXCEED 1" DIAMETER, THEN UP TO TWO COLUMNS OF SAME SIZED HOLES MAY BE USED
2'
4'
4
1
12"
4
1
EL. 00.00
1'6"
EXCAVATION
D50=9" RIPRAP TYPE L. (SEE TABLE MD-7, MAJOR DRAINAGE, VOL. 1)
RIPRAP BEDDING
12"
SECTION A
CL
CREST LENGTH
3'
3'
EMBANKMENT MATERIAL
EL. 04.00
EL. 03.00 AT CREST
12"
3
1
D50=9" RIPRAP TYPE L

TABLE SB–1. SIZING INFORMATION FOR STANDARD SEDIMENT BASIN			
Upstream Drainage Area (rounded to nearest acre), (ac)	Basin Bottom Width (W), (ft)	Spillway Crest Length (CL), (ft)	Hole Diameter (HD), (in)
1	12 ½	2	9/32
2	21	3	13/16
3	28	5	½
4	33 ½	6	9/16
5	38 ½	8	21/32
6	43	9	21/32
7	47 ¼	11	25/32
8	51	12	27/32
9	55	13	⅞
10	58 ¼	15	15/16
11	61	16	31/32
12	64	18	1
13	67 ½	19	1 1/16
14	70 ½	21	1 ⅛
15	73 ¼	22	1 3/16

SEDIMENT BASIN INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - –LOCATION OF SEDIMENT BASIN.
   - –TYPE OF BASIN (STANDARD BASIN OR NONSTANDARD BASIN).
   - –FOR STANDARD BASIN, BOTTOM WIDTH W, CREST LENGTH CL, AND HOLE DIAMETER, HD.
   - –FOR NONSTANDARD BASIN, SEE CONSTRUCTION DRAWINGS FOR DESIGN OF BASIN INCLUDING RISER HEIGHT H, NUMBER OF COLUMNS N, HOLE DIAMETER HD AND PIPE DIAMETER D.

2. FOR STANDARD BASIN, BOTTOM DIMENSION MAY BE MODIFIED AS LONG AS BOTTOM AREA IS NOT REDUCED.

3. SEDIMENT BASINS SHALL BE INSTALLED PRIOR TO ANY OTHER LAND–DISTURBING ACTIVITY THAT RELIES ON ON BASINS AS AS A STORMWATER CONTROL.

4. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL FREE OF DEBRIS, ORGANIC MATERIAL, AND ROCKS OR CONCRETE GREATER THAN 3 INCHES AND SHALL HAVE A MINIMUM OF 15 PERCENT BY WEIGHT PASSING THE NO. 200 SIEVE.

5. EMBANKMENT MATERIAL SHALL BE COMPACTED TO AT LEAST 95 PERCENT OF MAXIMUM DENSITY IN ACCORDANCE WITH ASTM D698.

6. PIPE SCH 40 OR GREATER SHALL BE USED.

7. THE DETAILS SHOWN ON THESE SHEETS PERTAIN TO STANDARD SEDIMENT BASIN(S) FOR DRAINAGE AREAS LESS THAN 15 ACRES. SEE CONSTRUCTION DRAWINGS FOR EMBANKMENT, STORAGE VOLUME, SPILLWAY, OUTLET, AND OUTLET PROTECTION DETAILS FOR ANY SEDIMENT BASIN(S) THAT HAVE BEEN INDIVIDUALLY DESIGNED FOR DRAINAGE AREAS LARGER THAN 15 ACRES.

Per note 7, Ponds 1, 2, 3 & 6 need to be individually designed. Table above is not meant for ponds treating areas larger than 15 acres.

SEDIMENT BASIN MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED IN BASIN SHALL BE REMOVED AS NEEDED TO MAINTAIN BMP EFFECTIVENESS, TYPICALLY WHEN SEDIMENT DEPTH REACHES ONE FOOT (I.E., TWO FEET BELOW THE SPILLWAY CREST).

5. SEDIMENT BASINS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS ACCEPTED BY THE LOCAL JURISDICTION.

6. WHEN SEDIMENT BASINS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

APPENDIX D – TEMPORARY SWALE SIZING

Please revise or provide additional erosion control protection, such as erosion control blanket, that is sufficient to mitigate the designed velocities and froude number. Include the product specification that includes it's designed velocity in the appendix. Update the GEC to identify the areas requiring the additional erosion protection.

Earth Dikes and Drainage Swales (ED/DS) EC-10

Description

Earth dikes and drainage swales are temporary storm conveyance channels constructed either to divert runoff around slopes or to convey runoff to additional sediment control BMPs prior to discharge of runoff from a site. Drainage swales may be lined or unlined, but if an unlined swale is used, it must be well compacted and capable of resisting erosive velocities.

Photograph ED/DS-1. Example of an earth dike used to divert flows at a construction site. Photo courtesy of CDOT.

Appropriate Uses

Earth dikes and drainage swales are typically used to control the flow path of runoff at a construction site by diverting runoff around areas prone to erosion, such as steep slopes. Earth dikes and drainage swales may also be constructed as temporary conveyance features. This will direct runoff to additional sediment control treatment BMPs, such as sediment traps or basins.

Design and Installation

When earth dikes are used to divert water for slope protection, the earth dike typically consists of a horizontal ridge of soil placed perpendicular to the slope and angled slightly to provide drainage along the contour. The dike is used in conjunction with a swale or a small channel upslope of the berm to convey the diverted water. Temporary diversion dikes can be constructed by excavation of a V-shaped trench or ditch and placement of the fill on the downslope side of the cut. There are two types of placement for temporary slope diversion dikes:

- A dike located at the top of a slope to divert upland runoff away from the disturbed area and convey it in a temporary or permanent channel.
- A diversion dike located at the base or mid-slope of a disturbed area to intercept runoff and reduce the effective slope length.

Depending on the project, either an earth dike or drainage swale may be more appropriate. If there is a need for cut on the project, then an excavated drainage swale may be better suited. When the project is primarily fill, then a conveyance constructed using a berm may be the better option.

All dikes or swales receiving runoff from a disturbed area should direct stormwater to a sediment control BMP such as a sediment trap or basin.

Earth Dikes and Drainage Swales	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

EC-10 Earth Dikes and Drainage Swales (ED/DS)

Unlined dikes or swales should only be used for intercepting sheet flow runoff and are not intended for diversion of concentrated flows.

Details with notes are provided for several design variations, including:

ED-1. Unlined Earth Dike formed by Berm

DS-1. Unlined Excavated Swale

DS-2. Unlined Swale Formed by Cut and Fill

DS-3. ECB-lined Swale

DS-4. Synthetic-lined Swale

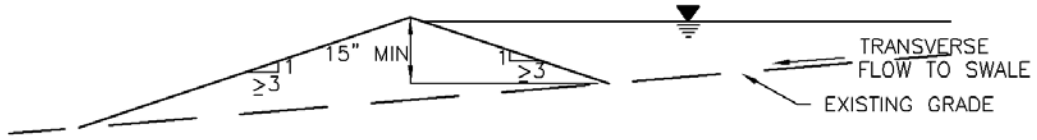
DS-5. Riprap-lined Swale

The details also include guidance on permissible velocities for cohesive channels if unlined approaches will be used.

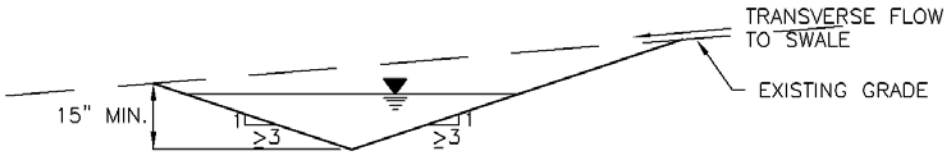
Maintenance and Removal

Inspect earth dikes for stability, compaction, and signs of erosion and repair. Inspect side slopes for erosion and damage to erosion control fabric. Stabilize slopes and repair fabric as necessary. If there is reoccurring extensive damage, consider installing rock check dams or lining the channel with riprap.

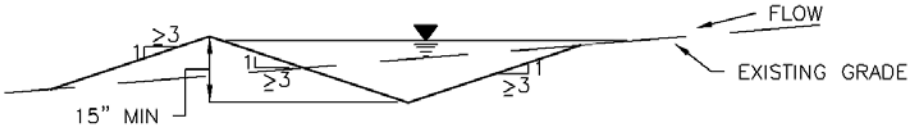
If drainage swales are not permanent, remove dikes and fill channels when the upstream area is stabilized. Stabilize the fill or disturbed area immediately following removal by revegetation or other permanent stabilization method approved by the local jurisdiction.



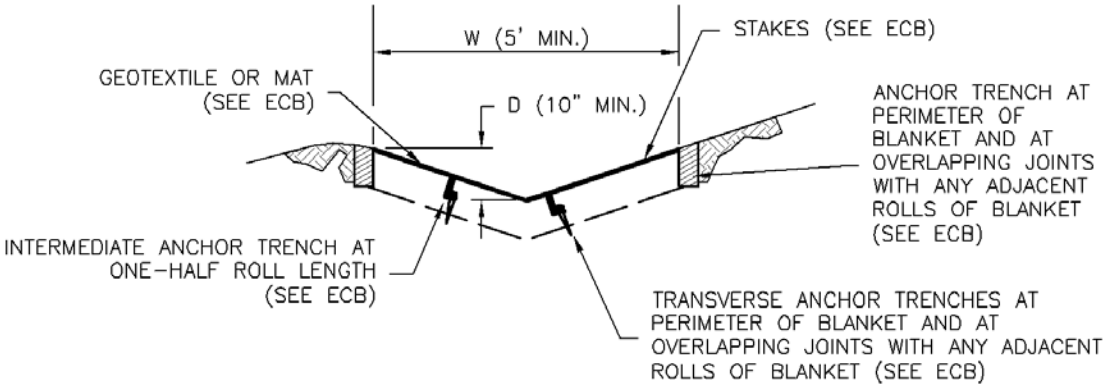
ED–1. COMPACTED UNLINED EARTH DIKE FORMED BY BERM



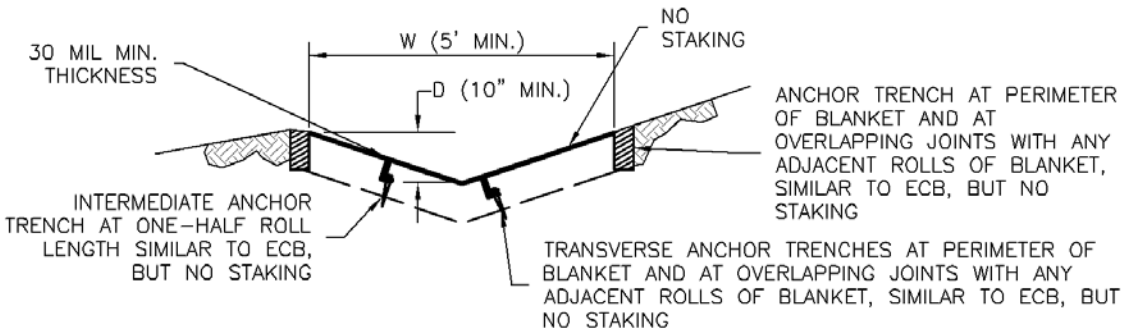
DS–1. COMPACTED UNLINED EXCAVATED SWALE



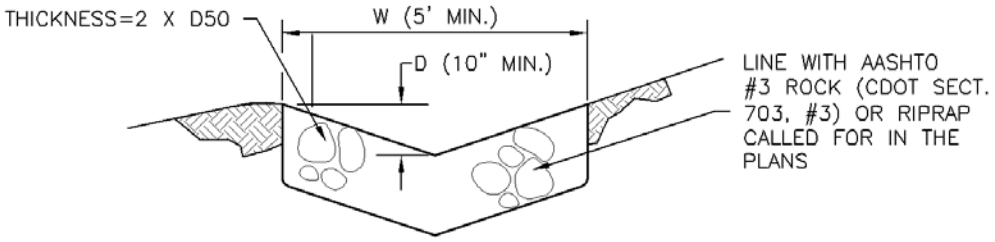
DS–2. COMPACTED UNLINED SWALE FORMED BY CUT AND FILL



DS–3. ECB LINED SWALE (CUT AND FILL OR BERM)



DS-4. SYNTHETIC LINED SWALE



DS-5. RIPRAP LINED SWALE

EARTH DIKE AND DRAINAGE SWALE INSTALLATION NOTES

1. SEE SITE PLAN FOR:
   - LOCATION OF DIVERSION SWALE
   - TYPE OF SWALE (UNLINED, COMPACTED AND/OR LINED).
   - LENGTH OF EACH SWALE.
   - DEPTH, D, AND WIDTH, W DIMENSIONS.
   - FOR ECB/TRM LINED DITCH, SEE ECB DETAIL.
   - FOR RIPRAP LINED DITCH, SIZE OF RIPRAP, D50.

2. SEE DRAINAGE PLANS FOR DETAILS OF PERMANENT CONVEYANCE FACILITIES AND/OR DIVERSION SWALES EXCEEDING 2-YEAR FLOW RATE OR 10 CFS.

3. EARTH DIKES AND SWALES INDICATED ON SWMP PLAN SHALL BE INSTALLED PRIOR TO LAND-DISTURBING ACTIVITIES IN PROXIMITY.

4. EMBANKMENT IS TO BE COMPACTED TO 90% OF MAXIMUM DENSITY AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT ACCORDING TO ASTM D698.

5. SWALES ARE TO DRAIN TO A SEDIMENT CONTROL BMP.

6. FOR LINED DITCHES, INSTALLATION OF ECB/TRM SHALL CONFORM TO THE REQUIREMENTS OF THE ECB DETAIL.

7. WHEN CONSTRUCTION TRAFFIC MUST CROSS A DIVERSION SWALE, INSTALL A TEMPORARY CULVERT WITH A MINIMUM DIAMETER OF 12 INCHES.

EARTH DIKE AND DRAINAGE SWALE MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SWALES SHALL REMAIN IN PLACE UNTIL THE END OF CONSTRUCTION; IF APPROVED BY LOCAL JURISDICTION, SWALES MAY BE LEFT IN PLACE.

5. WHEN A SWALE IS REMOVED, THE DISTURBED AREA SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED OR OTHERWISE STABILIZED IN A MANNER APPROVED BY LOCAL JURISDICTION.

(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND THE CITY OF COLORADO SPRINGS, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Worksheet for PA-1A Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	24.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	81.16	cfs
Flow Area	12.0	ft²
Wetted Perimeter	12.6	ft
Hydraulic Radius	11.4	in
Top Width	12.00	ft
Critical Depth	25.7	in
Critical Slope	0.014	ft/ft
Velocity	6.76	ft/s
Velocity Head	0.71	ft
Specific Energy	2.71	ft
Froude Number	1.192	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	24.0	in
Critical Depth	25.7	in
Channel Slope	0.020	ft/ft
Critical Slope	0.014	ft/ft

Worksheet for PA-2 Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	27.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	111.10	cfs
Flow Area	15.2	ft²
Wetted Perimeter	14.2	ft
Hydraulic Radius	12.8	in
Top Width	13.50	ft
Critical Depth	29.2	in
Critical Slope	0.013	ft/ft
Velocity	7.32	ft/s
Velocity Head	0.83	ft
Specific Energy	3.08	ft
Froude Number	1.216	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	27.0	in
Critical Depth	29.2	in
Channel Slope	0.020	ft/ft
Critical Slope	0.013	ft/ft

Worksheet for PA-3 Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	26.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	100.47	cfs
Flow Area	14.1	ft²
Wetted Perimeter	13.7	ft
Hydraulic Radius	12.3	in
Top Width	13.00	ft
Critical Depth	28.0	in
Critical Slope	0.013	ft/ft
Velocity	7.13	ft/s
Velocity Head	0.79	ft
Specific Energy	2.96	ft
Froude Number	1.208	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	26.0	in
Critical Depth	28.0	in
Channel Slope	0.020	ft/ft
Critical Slope	0.013	ft/ft

Worksheet for PA-4 Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	22.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	64.35	cfs
Flow Area	10.1	ft²
Wetted Perimeter	11.6	ft
Hydraulic Radius	10.4	in
Top Width	11.00	ft
Critical Depth	23.5	in
Critical Slope	0.014	ft/ft
Velocity	6.38	ft/s
Velocity Head	0.63	ft
Specific Energy	2.47	ft
Froude Number	1.175	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	22.0	in
Critical Depth	23.5	in
Channel Slope	0.020	ft/ft
Critical Slope	0.014	ft/ft

Worksheet for PA-5 Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	21.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	56.84	cfs
Flow Area	9.2	ft²
Wetted Perimeter	11.1	ft
Hydraulic Radius	10.0	in
Top Width	10.50	ft
Critical Depth	22.3	in
Critical Slope	0.014	ft/ft
Velocity	6.19	ft/s
Velocity Head	0.59	ft
Specific Energy	2.34	ft
Froude Number	1.166	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	21.0	in
Critical Depth	22.3	in
Channel Slope	0.020	ft/ft
Critical Slope	0.014	ft/ft

Worksheet for PA-6 Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	26.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	100.47	cfs
Flow Area	14.1	ft²
Wetted Perimeter	13.7	ft
Hydraulic Radius	12.3	in
Top Width	13.00	ft
Critical Depth	28.0	in
Critical Slope	0.013	ft/ft
Velocity	7.13	ft/s
Velocity Head	0.79	ft
Specific Energy	2.96	ft
Froude Number	1.208	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	26.0	in
Critical Depth	28.0	in
Channel Slope	0.020	ft/ft
Critical Slope	0.013	ft/ft

Worksheet for PA-8 Drainage Swale

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.030	
Channel Slope	0.020	ft/ft
Normal Depth	21.0	in
Left Side Slope	3.000	H:V
Right Side Slope	3.000	H:V

Results		
Discharge	56.84	cfs
Flow Area	9.2	ft²
Wetted Perimeter	11.1	ft
Hydraulic Radius	10.0	in
Top Width	10.50	ft
Critical Depth	22.3	in
Critical Slope	0.014	ft/ft
Velocity	6.19	ft/s
Velocity Head	0.59	ft
Specific Energy	2.34	ft
Froude Number	1.166	
Flow Type	Supercritical	

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	21.0	in
Critical Depth	22.3	in
Channel Slope	0.020	ft/ft
Critical Slope	0.014	ft/ft

APPENDIX E – OFFSITE DRAINAGE ANALYSIS

Worksheet for North Offsite Drainage Berm

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.019 ft/ft
Normal Depth	12.0 in

Section Definitions

Station (ft)	Elevation (ft)
0+00	0.57
0+20	0.00
0+26	2.00
0+46	2.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 0.57)	(0+46, 2.00)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge	82.12 cfs
Roughness Coefficient	0.030
Elevation Range	0.0 to 2.0 ft
Flow Area	15.8 ft²
Wetted Perimeter	23.6 ft
Hydraulic Radius	8.0 in
Top Width	23.00 ft
Normal Depth	12.0 in
Critical Depth	12.6 in
Critical Slope	0.015 ft/ft
Velocity	5.20 ft/s
Velocity Head	0.42 ft
Specific Energy	1.42 ft
Froude Number	1.106
Flow Type	Supercritical

Do not meet DCM Ch. 6 criteria for channel

GVF Input Data

Downstream Depth	0.0 in

Worksheet for North Offsite Drainage Berm

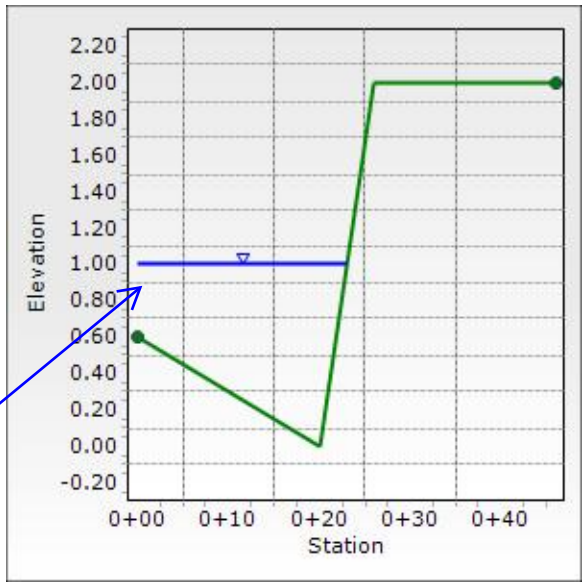
GVF Input Data	
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	12.6 in
Channel Slope	0.019 ft/ft
Critical Slope	0.015 ft/ft

Cross Section for North Offsite Drainage Berm

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Channel Slope	0.019 ft/ft
Normal Depth	12.0 in
Discharge	82.12 cfs



Update channel section shown to show runoff is contained entirely with irregular channel cross section.

Worksheet for Outfall 6" PVC Riser Pipe

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data		
Roughness Coefficient	0.010	
Channel Slope	0.020	ft/ft
Normal Depth	5.8	in
Diameter	6.0	in

Results		
Discharge	1.11	cfs
Flow Area	0.2	ft²
Wetted Perimeter	1.4	ft
Hydraulic Radius	1.7	in
Top Width	0.20	ft
Critical Depth	5.8	in
Percent Full	95.8	%
Critical Slope	0.020	ft/ft
Velocity	5.71	ft/s
Velocity Head	0.51	ft
Specific Energy	0.99	ft
Froude Number	1.023	
Maximum Discharge	1.11	cfs
Discharge Full	1.03	cfs
Slope Full	0.023	ft/ft
Flow Type	Supercritical	

Indicate which pipe/pond outlet this worksheet corresponds to.

GVF Input Data		
Downstream Depth	0.0	in
Length	0.0	ft
Number Of Steps	0	

GVF Output Data		
Upstream Depth	0.0	in
Profile Description	N/A	
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.0	%
Normal Depth Over Rise	96.7	%
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.8	in
Critical Depth	5.8	in
Channel Slope	0.020	ft/ft
Critical Slope	0.020	ft/ft

Riprap calculations need to be provided for all pond outlet locations

Rip-Rap Calculation

TEMPORARY SEDIMENT BASIN 5

.

Applicable Equations:

$L_p = (1/2\tan\Theta)(A_t/Y_t-D)$	Equation 9-11 per USCDM
$A_t = Q/V$	Equation 9-12 per USDCM
$\Theta = \tan^{-1}(1/(2*\text{ExpansionFactor}))$	Equation 9-13 per USDCM
$W = 2(L_p\tan\Theta)+D$	Equation 9-14 per USDCM
$T = 2D_{50}$	Equation 9-15 per USDCM

Assumptions

Maximum Major Event Velocity is 5fps for FES outletting into grass channel

Input parameters:

Description		Variable	Input	Unit
Width of the conduit (use diameter for circular conduits),		D:	0.50	ft
HGL Elevation			0.48	ft
Invert Elevation			0.00	ft
Tailwater depth (ft),		Y_t:	0.48	ft
Expansion angle of the culvert flow		Θ:	0.12	radians
Design discharge (cfs)*		Q:	1.11	cfs
Froude Number		F_r	1.43	Supercritical
Unitless Variables for Tables:				
	For Figure 9-35	$Q/D^{2.5}$	6.28	
	For Figure 9-35	Y_t/D	0.97	
	For Figure 9-38	$Q/D^{1.5}$	3.14	
	For Figure 9-38	Y_t/D	0.97	
Allowable non-eroding velocity in the downstream channel (ft/sec)		V:	5	ft/sec
Expansion Factor (Figure 9-35), 1/(2tan(θ))			4.2	

Solve for:

Description	Variable	Output	Unit
1. Required area of flow at allowable velocity (ft^2)	A_t:	0.22	ft^2
2. Length of Protection	L_p:	-0.17	ft
	L_p < 3D?	Yes	
	L_{pmin}:	1.50	ft
3. Width of downstream riprap protection	W:	1.00	ft
4. Rip Rap Type (Figure 9-38)	-	VL	
5. Rip Rap Size (Figure 8-34)	D_{50}:	6	inches

Rip Rap Summary

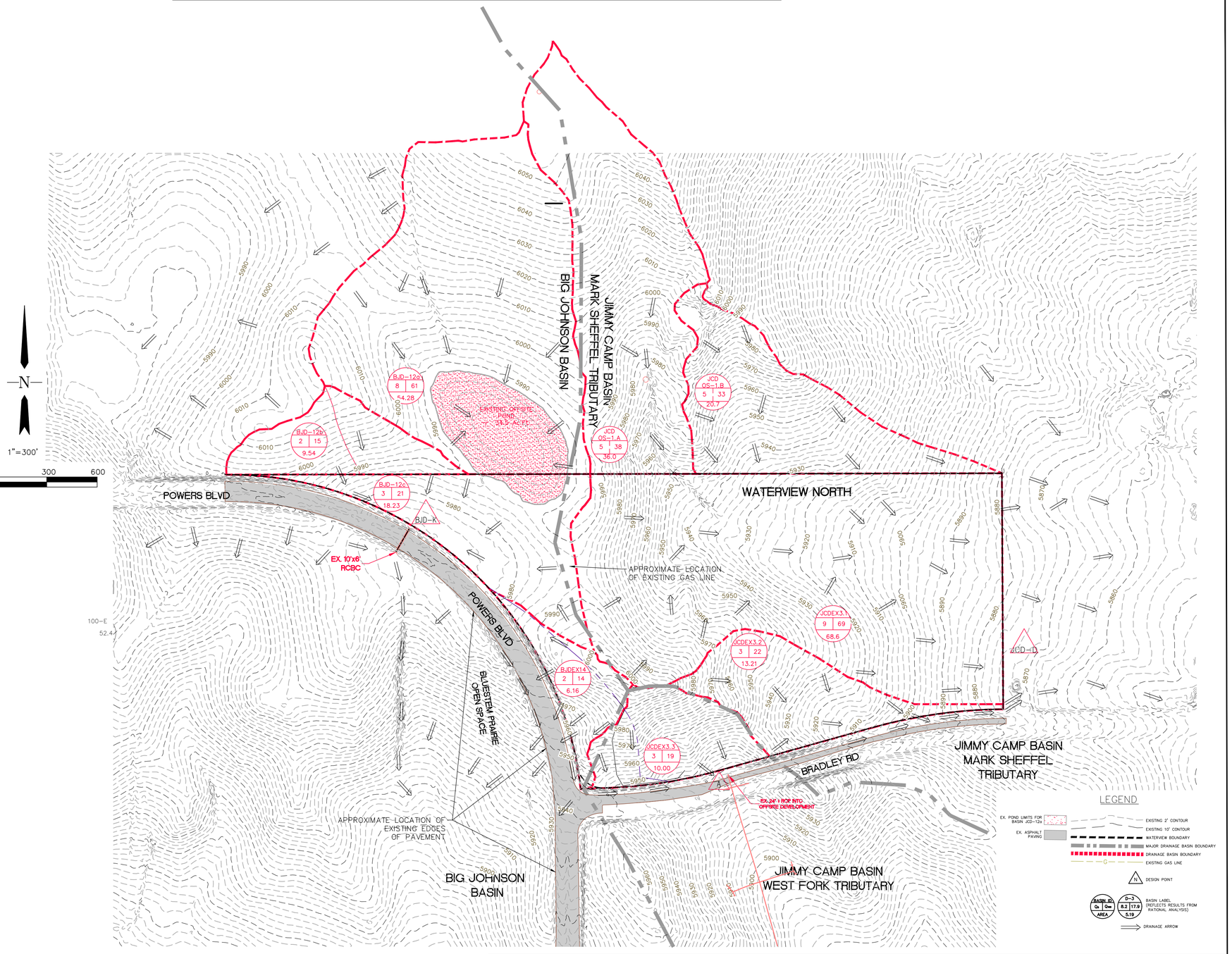
Length	L_p	2.00	ft
Width	W	1.00	ft
Size	D_{50}	6	inches
Type	-	VL	-
Thickness	T	12	inches

APPENDIX F – DRAINAGE EXHIBITS

PRE-DEVELOPMENT BASIN MAP

BASIN ID	BASIN AREA (Ac.)	DESIGN POINT	RATIONAL ANALYSIS RESULTS	
			Q_5 (CFS)	Q_{100} (CFS)
BJD-12a	54.28		8	61
BJD-12b	9.54		2	15
BJD-12c	18.23		3	21
		BJD-K	4	31
JCD OS-1A	36.0		5	38
JCD OS-1B	20.7		5	33
JCDEX-3.1	68.6		9	69
JCDEX-3.2	13.21		3	22
		JCD-D	12	84
JCDEX-3.3	10.0		3	19
BJDEX14	6.16		2	14
		A	3	19
		A*	5	25

A* – MODELLED AS BASIN OS-1 IN THE FINAL DRAINAGE REPORT FOR FILING 1 OF TRAILS AT ASPEN RIDGE, APP'D ON FEBRUARY 13, 2020.



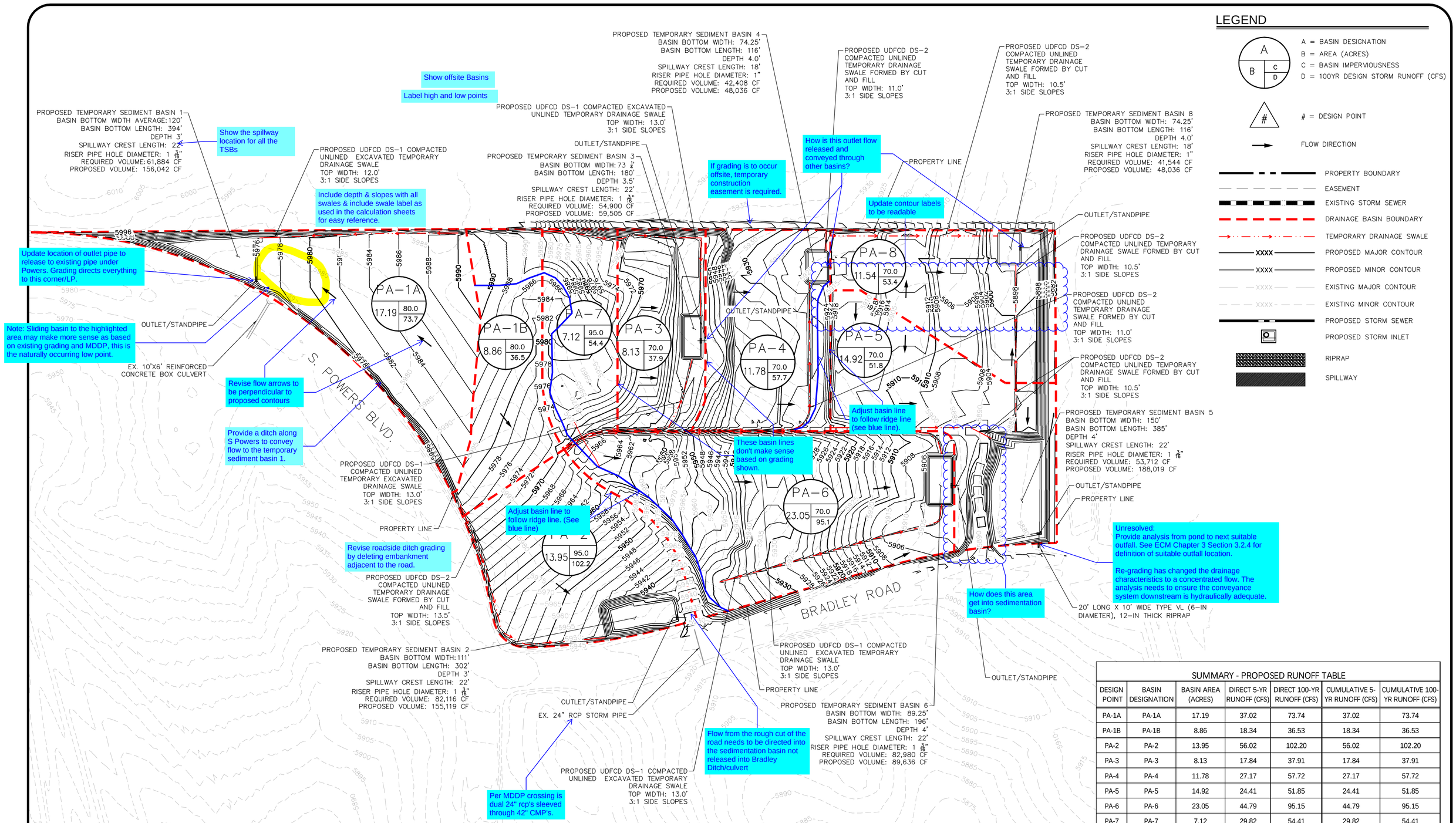
REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER:
DESIGNED BY: CEB DATE: 11-05-20
DRAWN BY: CEB DATE: 11-05-20
CHECKED BY: CKC DATE: 11-05-20

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

DSE Dakota Springs Engineering
31 N. TEJON, SUITE 518
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

PROJECT WATERVIEW NORTH
SHEET TITLE PRE-DEVELOPMENT BASIN MAP
FROM n/a TO n/a
JOB NO. 02-19-05 SHEET 2 OF 3



SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	CUMULATIVE 5-YR RUNOFF (CFS)	CUMULATIVE 100-YR RUNOFF (CFS)
PA-1A	PA-1A	17.19	37.02	73.74	37.02	73.74
PA-1B	PA-1B	8.86	18.34	36.53	18.34	36.53
PA-2	PA-2	13.95	56.02	102.20	56.02	102.20
PA-3	PA-3	8.13	17.84	37.91	17.84	37.91
PA-4	PA-4	11.78	27.17	57.72	27.17	57.72
PA-5	PA-5	14.92	24.41	51.85	24.41	51.85
PA-6	PA-6	23.05	44.79	95.15	44.79	95.15
PA-7	PA-7	7.12	29.82	54.41	29.82	54.41
PA-8	PA-8	11.54	25.15	53.42	25.15	53.42

NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

DRAINAGE EXHIBIT – WATERVIEW NORTH COLORADO SPRINGS, CO

Kimley»Horn