



ROCKYTOP MOTEL & CAMPGROUND

FINAL DRAINAGE REPORT

COUNTY FILE NO: PPR2140

ALL TERRAIN ENGINEERING PROJECT NO: 24032

JANUARY 2025

PREPARED FOR:

G&D ENTERPRISES

CONTACT: DANIEL P. NIEMAN

10900 WEST HIGHWAY 24

GREEN MOUNTAIN FALLS, CO 80819

PREPARED BY:

ALL TERRAIN ENGINEERING LLC

CONTACT: NICHOLAS Q. JOKERST

NJOKERST@ALLTERRAINENG.COM

(530) 391-7635

ENGINEER'S STATEMENT

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

Nicholas Q. Jokerst, PE Date
State of Colorado No. 59273
For and on behalf of All Terrain Engineering LLC

DEVELOPER'S STATEMENT

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

Daniel P. Nieman, Owner Date
G&D Enterprises, Corp.
10900 West Highway 24, Green Mountain Falls, CO 80819

EL PASO COUNTY ONLY

Filed in accordance with Section 51.1 of the El Paso Land Development Code as amended.

Joshua Palmer, P.E. Date
County Engineer/ECM Administrator

Conditions:



Table of Contents

I.	General Purpose, Location & Description	2
II.	Drainage Basins	2
III.	Drainage Design Criteria	5
IV.	Drainage Facility Design	5
V.	Summary	6
VI.	References	7

Appendices

- A. Vicinity Map, FEMA Map, NRCS Soil Survey
- B. Hydrologic Analysis
- C. Hydraulic Analysis
- D. Water Quality & Detention
- E. Reference Material
- F. Drainage Maps

I. General Purpose, Location & Description

a. Purpose

The purpose of this Final Drainage Report (FDR) for ROCKYTOP MOTEL & CAMPGROUND is to describe the site's onsite and offsite drainage patterns, existing and proposed storm infrastructure, and to safely route developed stormwater to adequate outfalls. Additionally, this report will detail the on-site disturbances that have occurred since 2008 and detail the necessary improvements to address water quality requirements. It should be noted that no proposed grading or additional impervious is proposed within the context of this report.

b. Location

ROCKYTOP MOTEL & CAMPGROUND, referred to as 'the site' herein, is in a portion of the northwest quarter of Section 9, Township 13 South, Range 68 West of the 6th P.M. in El Paso County, Colorado. The site is bound by unplatted land to the north and east, Lucky 4 Road to the west, and Highway 24 to the south. Surrounding platted developments include the Western Hills Subdivision, located across Lucky 4 Road from the site. A vicinity map is presented in Appendix A.

The facility has been in use at this location since 1947 as a motel. In 1950, the site was modified to add campgrounds. Due to neighborhood complaints, the County issued a violation notice, dated May 2, 2019, that itemized necessary improvements to reply to grading in excess of one acre and the un-permitted use as RV storage. The property is no longer pursuing the RV storage use. The County is considering any construction activity dating back to March 10, 2008 to be included in the total disturbed area. See Drainage Basin section for detailed analysis of disturbed areas.

c. Description of Property

The site is approximately 9.30 acres. The total disturbed area, since March 10, 2008, is 2.72 acres. In general, the site slopes southwesterly towards Highway 24. Onsite elevations range from 7,929' – 8,004' with slopes ranging 1 – 40%. Per a NRCS soil survey, the site is made up of Perrypark coarse sandy loam and Sphinx, warm-Rock outcrop complex. The NRCS soil survey is presented in Appendix A.

There are no major drainageways that traverse the site.

d. Floodplain Statement

Based on FEMA Firm map 08041C0459G dated December 7, 2018, the site is Zone D, which are areas determined to be within the Flood Risk due to Levee.

II. Drainage Basins

a. Subbasin Description

An existing and proposed conditions runoff analysis is performed for the site. The existing conditions consider the site before the installation of retaining walls and the paving of the main site access road. The proposed conditions include the impervious areas associated with the retaining wall construction and paving operations. Other on-site disturbances that have occurred on-site since 2008 have not affected drainage

patterns or increased the imperviousness. Since drainage basins and patterns did not change between the existing and proposed condition, a single drainage map is provided in Appendix F. However, hydrologic parameters for both scenarios are presented on the map. Outside of the paved roadway, the site is predominantly dirt. A conservative approach has been taken for the Rational Method analysis and all dirt areas are analyzed as gravel. See below for basin descriptions:

Basin O1 is 0.66 acres of offsite, undeveloped land along the site's northern boundary. There is no proposed or existing disturbance within Basin O1. Basin O1 remains unchanged from the existing to proposed conditions. Stormwater from Basin O1 ($Q_5 = 0.4$ cfs $Q_{100} = 1.9$ cfs) will follow historic drainage patterns and drain into Basin A at DP1.

Basin A is 2.90 acres of dirt RV parking stalls and undeveloped land. Total Basin A disturbance since 2008 is 0.68 acres associated with a gravel RV storage site adjacent to Highway 24. Based upon County input, the site will not pursue this use. However, this area has already been covered in gravel in anticipation of the storage yard. To rehabilitate the area and provide water quality treatment for the remaining gravel, a portion of the area will be seeded and converted into a runoff reduction area.

Runoff Reduction Area #2 (RRA #2) provides 0.38 acres of receiving pervious area (RPA) that will provide water quality for the 0.44 acres of unconnected impervious area (UIA). The UIA area is calculated by applying an 80% impervious value to the total disturbed area of 0.68 acres. Drainage patterns within Basin A will be maintained with the completion of RRA #2. Basin A stormwater (Existing: $Q_5 = 3.4$ cfs $Q_{100} = 9.2$ cfs, Proposed: $Q_5 = 3.4$ cfs $Q_{100} = 9.3$ cfs) will drain across the RRA #2 and then continue to follow historic drainage patterns to Highway 24 ROW at DP2. An existing swale along Highway 24 conveys the stormwater southwest. The decrease in Basin A flow is from replacing 0.38 acres of gravel with RRA #2. Runoff reduction calculations are presented in Appendix D.

Basin B is 3.37 acres of dirt RV parking stalls, paved roadway, a motel, office building and undeveloped land. The total disturbance within Basin B is 1.13 acres. 0.81 acres of the disturbed area is from the paving of the access road and motel parking. 0.16 acres of disturbed area is from the construction of a recreation room and grading. The remaining 0.16 acres of disturbance is along stalls 3 – 9 for grading activities and the construction of a retaining wall. A total of 0.97 acres of disturbed area, 0.81 acres of paving and 0.16 of recreation room improvements, will not be treated for water quality per the EPCDCM Appendix I.7.1.C., which allows for 20% of the site area, not to exceed 1 acre, to drain offsite untreated. The 0.16 ac of disturbed area along stalls 3 – 9 will be treated for water quality within RRA #1 located adjacent to the disturbance. Stormwater from Basin B (Existing: $Q_5 = 3.8$ cfs $Q_{100} = 10.7$ cfs, Proposed: $Q_5 = 4.7$ cfs $Q_{100} = 12.2$ cfs) will follow historic drainage patterns to Highway 24 ROW at DP3. DP3 drains into an existing swale along Highway 24 where it combines with DP2 flows. The existing 24" CMP culvert (Ex. Culvert #1) located near DP3 does not intercept flow. Based upon survey and field observations, the invert of Ex. Culvert #1 has been set at the swale highpoint. Therefore, flow leaving the site at DP3 bypasses the culvert and is captured by the roadside swale. Runoff reduction calculations are presented in Appendix D.

Due to the paving of the roadway within Basin B, 5-year and 100-year runoff values increased by 0.9 cfs and 1.5 cfs, respectively. The increase in runoff is negligible and will not adversely affect downstream



infrastructure. Based upon capacity and Froude calculations, the swale is stable for the proposed condition. The swale capacity calculation is presented in Appendix C.

Basin C is 2.98 acres of dirt RV parking stalls, tent sites and undeveloped land. The total disturbance area within Basin C is 0.91 acres. 0.33 acres of disturbance is from grading activities and retaining wall construction behind RV stalls 48-51. 0.39 ac of disturbance is from the grading of tent sites (Tent 1-8) and the construction of a retaining wall along Lucky 4 Road. The retaining wall was constructed as a reaction to neighbors installing a culvert that directed offsite flow onto the site. The retaining wall construction reestablished the historic drainage patterns of this area and the offsite flow is conveyed south in Lucky 4 Road and does not drain on site.

The remaining 0.19 acres of disturbance is from grading activities along the southern property line. The 0.33 acres and 0.39 acres of disturbance will receive water quality treatment within runoff reduction areas adjacent to those disturbed areas (RRA #3 and RRA #4). The remaining 0.19 acres of disturbance along the southern property line will be seeded and stabilized to rehabilitate the disturbed area. This 0.19 acres had no additional impervious added during the disturbance and therefore water quality treatment is not required. Stormwater from Basin C (Existing: $Q_5 = 4.0$ cfs $Q_{100} = 11.4$ cfs, Proposed: $Q_5 = 4.1$ cfs $Q_{100} = 11.6$ cfs) will follow historic drainage patterns and flow offsite at DP4. DP4 flows are captured in an existing 24" CMP culvert (Ex. Culvert #2). The 0.1 cfs and 0.2 cfs increase at Ex. Culvert #2 will not adversely affect the culvert performance. Offsite areas adjacent to Lucky 4 Road drain to this culvert as well. However, due to survey access limitations, accurate topography is not available for this area. Therefore, flow from this area cannot be accurately quantified. However, the minor increase in flow will not adversely affect the culvert and historic performance will be maintained. Runoff reduction calculations are presented in Appendix D.

A total disturbance summary table is presented below. Areas include all disturbances dating back to 2008. See basin descriptions above for additional information.

DISTURBANCE SUMMARY TABLE			
Basin	Description	Area (acres)	WQ Treatment?
A	GRAVEL STORAGE AREA	0.68	YES
B	REC ROOM	0.16	NO
B	GRADING & WALL	0.16	YES
B	PAVING	0.81	NO
C	GRADING & WALL	0.39	YES
C	GRADING	0.33	YES
C	GRADING	0.19	NO*
Total Disturbed Area		2.72	
WQ Treatment Area		1.56	
Area Excluded from WQ Treatment		0.97	

*WQ not required, 0.19 acres to be seeded and restored to pre-dist. Condition. No imperviousness added.

III. Drainage Design Criteria

a. Development Criteria Reference

The drainage analysis follows the criteria from the “Drainage Criteria Manual County of El Paso, Colorado” Volumes 1 and 2,” as amended.

b. Hydrologic Criteria

Runoff was calculated per EPCDCM Chapter 5 – Storm Runoff Method of Analysis.

d. Hydraulic Criteria

Hydraulic criteria for culvert analysis are from EPCDCM Chapter 10 – Open Channel Design. Open channel analysis was performed using Hydraflow Express Extension for Autodesk Civil 3D, latest edition.

IV. Drainage Facility Design

a. General Concept

The site will not be performing any additional disturbance, outside of seeding and stabilizing efforts. This report is intended to memorialize onsite disturbances since 2008 and provide water quality treatment for applicable areas. Stormwater will follow historic drainage patterns that have occurred on-site since 2008, and no storm sewer improvements are proposed. Additionally, no imperviousness will be added to the site.

b. Water Quality & Detention

The site was developed prior to 2008 and did not require onsite water quality and detention at the time. However, areas that have been disturbed since 2008 and require water quality treatment will now be treated on-site in dedicated runoff reduction areas. Detention is not required for the site as the increase in 100-year runoff is negligible. The total site (Basin O1-C) flow increase is $Q_{5, INCREASE} = 0.9$ cfs and $Q_{100, INCREASE} = 1.7$ cfs. The site has been developed since 1950 and would not be feasible to construct a detention pond for this slight increase in runoff.

Runoff Reduction Area #1 – 7,598 SF of stabilized and vegetated area is provided to treat the 0.16 acres of disturbed, dirt RV parking stalls and retaining wall. An interface length of 197 linear feet is provided.

Runoff Reduction Area #2 – 16,578 SF of stabilized and vegetated area is proposed to treat the 0.68 acres of disturbed, gravel area. An interface length of 204 linear feet is provided.

Runoff Reduction Area #3 – 13,247 SF of stabilized and vegetated area is provided to treat the 0.33 acres of disturbed, dirt RV parking stalls. An interface length of 233 linear feet is provided.

Runoff Reduction Area #4 – 5,215 SF of stabilized and vegetated area is provided to treat the 0.39 acres of disturbed, dirt tent area and retaining wall construction. An interface length of 76 linear feet is provided.

The 0.19 acres of disturbed area along the site's southern property line will be seeded and stabilized. No impervious area was added with the original disturbance activities and therefore water quality is not required. Per El Paso County EPCDCM Appendix I.7.1.C., a total of 0.97 acres of disturbed area will leave the site without water quality treatment.

c. Major Drainageways

There are no major drainageways that traverse the site.

d. Grading & Erosion Control Plan

Due to the project disturbance area, a separate Grading and Erosion Control plan is required. The Grading and Erosion Control Plan will be submitted concurrently for review by El Paso County.

e. Four Step Method

Step 1 – Reducing Runoff Volumes: Roof drains will route across landscape areas whenever possible to promote infiltration. In addition, runoff reduction areas are proposed throughout the site. Runoff reduction areas directly reduce runoff volumes by slowing runoff and promoting infiltration. Runoff reduction calculations are presented in Appendix D.

Step 2 – Treat and slowly release the WQCV: Water quality treatment is provided for required areas within runoff reduction grass buffers. 100% WQCV treatment is achieved by the runoff reduction areas.

Step 3 – Stabilize stream channels: All new and re-development projects are required to construct or participate in the funding of channel stabilization measures. Drainage basin fees paid, at the time of platting, go towards channel stabilization with the drainage basin.

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

f. Drainage Basin & Bridge Fees

The site was previously platted and no additional drainage fees will be required.

V. Summary

ROCKYTOP MOTEL & CAMPGROUND remains consistent with pre-development drainage conditions with the construction of the recommended runoff reduction improvements. The proposed development will not adversely affect downstream stormwater infrastructure or surrounding developments. This report meets the latest El Paso County Drainage criteria.



VI. References

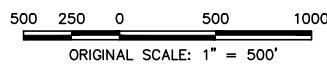
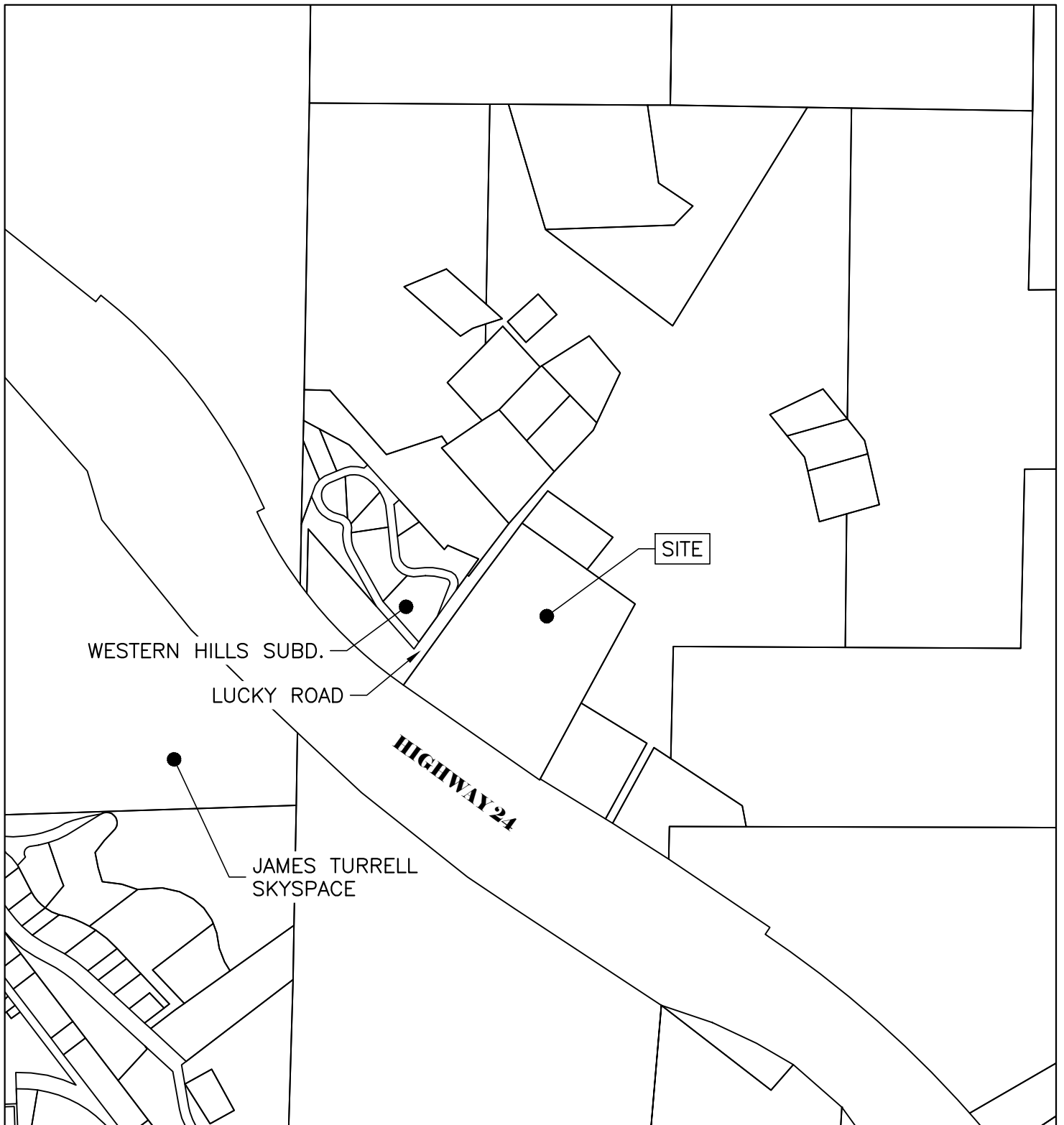
1. El Paso County – Drainage Criteria Manual, 2018 as amended.
2. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
3. Federal Emergency Management Agency, Flood Map Service Center - <https://msc.fema.gov/portal/home>
4. Urban Storm Drainage Criteria Manual, Mile High Flood District, January 2018.
5. Web Soil Survey, Natural Resources Conservation Service, September 2024.




**APPENDIX A – VICINITY MAP, FEMA MAP, NRCS WEB SOIL SURVEY & NOAA
ATLAS 14**

ROCKYTOP MOTEL & CAMPGROUND

VICINITY MAP

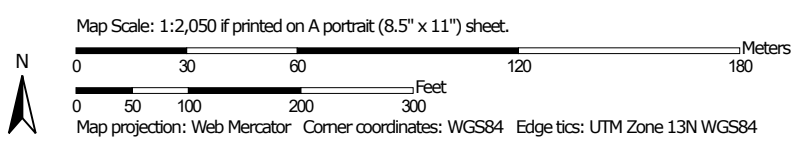


VICINITY MAP	
ROCKYTOP	
JOB NO. 24032	
LOCATION: EPC	SHEET
01/06/2025	
	
1004 WEST VAN BUREN STREET COLORADO SPRINGS, CO 80907	



SITE ANALYZE WITH COMPLETE TYPE D SOILS TO REMAIN CONSERVATIVE.

Soil Map may not be valid at this scale.



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: Pike National Forest, Eastern Part, Colorado, Parts of Douglas, El Paso, Jefferson, and Teller Counties
 Survey Area Data: Version 11, Aug 29, 2024

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

Date(s) aerial images were photographed: May 18, 2020—May 21, 2020

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
32	Perrypark coarse sandy loam, 1 to 15 percent slopes	B	1.7	15.6%
47	Sphinx, warm-Rock outcrop complex, 15 to 80 percent slopes	D	9.2	84.4%
Totals for Area of Interest			10.9	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.

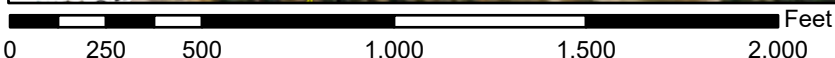
Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over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

National Flood Hazard Layer FIRMette



105°0'41"W 38°56'24"N



1:6,000

105°0'4"W 38°55'56"N

Basemap Imagery Source: USGS National Map 2023

Legend

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

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		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



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 1/6/2025 at 9:26 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

Subdivision: Rockytop Motel & Campground
Location: El Paso County
Project Name: Rockytop Motel & Campground
Project Number: 24032
Calculated By: NQJ
Checked By: REB
Date: 1/15/2025

EXISTING CONDITIONS - BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C ₅	C ₁₀₀	t _c (min)	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A	2.90	38%	0.37	0.61	20.0	3.4	9.2
B	3.37	36%	0.37	0.62	20.0	3.8	10.7
C	2.98	35%	0.36	0.61	13.0	4.0	11.4
O1	0.66	2%	0.16	0.51	16.4	0.4	1.9

EXISTING CONDITIONS - DESIGN POINT SUMMARY TABLE		
DP#	Q _{5-YR}	Q _{100-YR}
1	0.4	1.9
2	3.4	10.3
3	3.8	10.7
4	4.0	11.4

COMPOSITE % IMPERVIOUS CALCULATIONS - EXISTING CONDITIONS

Subdivision: Rockytop Motel & Campground
 Location: El Paso County

Project Name: Rockytop Motel & Campground
 Project No.: 24032.00
 Calculated By: NQJ
 Checked By: REB
 Date: 1/15/25

Basin ID	Total Area (ac)	Gravel/Dirt Drives				Paved				Roofs				Historic/Agriculture				Weighted C ₅ & C ₁₀₀		Basins Total Weighted % Imp.
		C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	
A	2.90	0.63	0.74	1.32	80.0%	0.90	0.96	0.00	100.0%	0.75	0.83	0.00	90.0%	0.16	0.51	1.58	2.0%	0.37	0.61	37.5%
B	3.37	0.63	0.74	1.21	80.0%	0.90	0.96	0.04	100.0%	0.75	0.83	0.18	90.0%	0.16	0.51	1.94	2.0%	0.37	0.62	35.9%
C	2.98	0.63	0.74	1.25	80.0%	0.90	0.96	0.00	100.0%	0.75	0.83	0.00	90.0%	0.16	0.51	1.73	2.0%	0.36	0.61	34.7%
O1	0.66	0.63	0.74	0.00	80.0%	0.90	0.96	0.00	100.0%	0.75	0.83	0.00	90.0%	0.16	0.51	0.66	2.0%	0.16	0.51	2.0%
Total	9.91																			27.5%

PRE-2008 PAVED AREA SOUTH OF MOTEL, SEE DRAINAGE PLAN

STANDARD FORM SF-2 - EXISTING CONDITIONS

TIME OF CONCENTRATION

Subdivision: Rockytop Motel & Campground
Location: El Paso County

Project Name: Rockytop Motel & Campground
Project No.: 24032.00
Calculated By: NQJ
Checked By: REB
Date: 1/15/25

SUB-BASIN DATA					INITIAL/OVERLAND (T _i)			TRAVEL TIME (T _t)					t _c CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C _s	Impervious (%)	L (ft)	S _o (%)	t _i (min)	L _t (ft)	S _t (%)	K	VEL. (ft/s)	t _t (min)	COMP. t _c (min)	TOTAL LENGTH (ft)	Urbanized t _c (min)	t _c (min)
A	2.90	D	0.37	37.5%	300	4.8%	13.5	950	6.0%	10.0	2.4	6.5	20.0	1250.0	24.2	20.0
B	3.37	D	0.37	35.9%	300	2.0%	18.2	660	8.8%	20.0	5.9	1.9	20.0	960.0	22.5	20.0
C	2.98	D	0.36	34.7%	150	4.0%	10.4	470	9.4%	10.0	3.1	2.6	13.0	620.0	21.9	13.0
O1	0.66	D	0.16	2.0%	90	2.2%	12.4	225	3.6%	5.0	0.9	4.0	16.4	315.0	27.8	16.4

NOTES:

$$t_c = t_i + t_t$$

Where:

- t_c = computed time of concentration (minutes)
- t_i = overland (initial) flow time (minutes)
- t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Where:

- t_t = channelized flow time (travel time, min)
- L_t = waterway length (ft)
- S_o = waterway slope (ft/ft)
- V_t = travel time velocity (ft/sec) = K√S_o
- K = NRCS conveyance factor (see Table 6-2).

Eq
$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L_i}}{S_o^{0.33}}$$

Where:

- t_i = overland (initial) flow time (minutes)
- C_s = runoff coefficient for 5-year frequency (from Table 6-4)
- L_i = length of overland flow (ft)
- S_o = average slope along the overland flow path (ft/ft).

Equation 6-4:
$$t_c = 1.49 S_o^{-0.76} L^{0.76} (1.49 + 0.01 L)^{0.10} (1.49 + 0.01 L)^{0.04} (1.49 + 0.01 L)^{0.01}$$

∴

- t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.
- L_t = length of channelized flow path (ft)
- i = imperviousness (expressed as a decimal)
- S_t = slope of the channelized flow path (ft/ft).

Equation 6-3

Equation 6-5

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3 - EXISTING CONDITIONS
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Rockytop Motel & Campground
Location: El Paso County
Design Storm: 5-Year

Project Name: Rockytop Motel & Campground
Project No.: 24032.00
Calculated By: NOJ
Checked By: REB
Date: 1/15/25

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
		Basin ID	Area (Ac)	Runoff Coeff.	t _c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)		t _t (min)
	1	O1	0.66	0.16	16.4	0.11	3.39	0.4					0.4	0.11	6.0					950	2.4	6.5	BASIN O1 FLOW @ DP1, FLOWS INTO BASIN A
	2	A	2.90	0.37	20.0	1.08	3.09	3.4	22.8	1.19	2.89	3.4											DP1 & BASIN A FLOW @ DP2, FOLLOW HISTORIC DRAINAGE PATTERNS TO EXISTING SWALE ALONG HIGHWAY 24
	3	B	3.37	0.37	20.0	1.24	3.09	3.8															BASIN B FLOW @ DP3, FLOWS EAST IN EX SWALE ALONG HIGHWAY 24
	4	C	2.98	0.36	13.0	1.06	3.74	4.0															BASIN C FLOW @ DP4, CONVEYED OFFSITE IN EX 24" CMP CULVERT(CULVERT #2)

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3 - EXISTING CONDITIONS
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Rockytop Motel & Campground
Location: El Paso County
Design Storm: 100-Year

Project Name: Rockytop Motel & Campground
Project No.: 24032.00
Calculated By: NQJ
Checked By: REB
Date: 1/15/25

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _r (min)	
	1	O1	0.66	0.51	16.4	0.34	5.69	1.9					1.9	0.34	6.0					950	2.4	6.5	BASIN O1 FLOW @ DP1, FLOWS INTO BASIN A
	2	A	2.90	0.61	20.0	1.78	5.19	9.2	22.8	2.12	4.85	10.3											DP1 & BASIN A FLOW @ DP2, FOLLOW HISTORIC DRAINAGE PATTERNS TO EXISTING SWALE ALONG HIGHWAY 24
	3	B	3.37	0.62	20.0	2.07	5.18	10.7															BASIN B FLOW @ DP3, FLOWS EAST IN EX SWALE ALONG HIGHWAY 24
	4	C	2.98	0.61	13.0	1.81	6.28	11.4															BASIN C FLOW @ DP4, CONVEYED OFFSITE IN EX 24" CMP CULVERT(CULVERT #2)

Notes:
Street and Pipe C*A values are determined by Q/I using the catchment's intensity value.

Subdivision: Rockytop Motel & Campground
Location: El Paso County
Project Name: Rockytop Motel & Campground
Project Number: 24032
Calculated By: NQJ
Checked By: REB
Date: 1/15/2025

PROPOSED CONDITIONS - BASIN SUMMARY TABLE							
Tributary Sub-basin	Area (acres)	Percent Impervious	C ₅	C ₁₀₀	t _c (min)	Q ₅ (cfs)	Q ₁₀₀ (cfs)
A	2.90	38%	0.38	0.62	24.0	3.4	9.3
B	3.37	41%	0.44	0.67	21.6	4.7	12.2
C	2.98	36%	0.37	0.61	21.6	4.1	11.6
O1	0.66	2%	0.16	0.51	27.8	0.4	1.9

PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE		
DP#	Q _{5-YR}	Q _{100-YR}
1	0.4	1.9
2	3.5	10.3
3	4.7	12.2
4	4.1	11.6

COMPOSITE % IMPERVIOUS CALCULATIONS - PROPOSED CONDITIONS

Subdivision: Rockytop Motel & Campground
 Location: El Paso County

Project Name: Rockytop Motel & Campground
 Project No.: 24032.00
 Calculated By: NQJ
 Checked By: REB
 Date: 1/15/25

RETAINING WALL
BLOCK AREA

Basin ID	Total Area (ac)	Gravel/Dirt Drives				Paved/Retaining Walls				Roofs				Historic/Undeveloped				Weighted C ₅ & C ₁₀₀		Basins Total Weighted % Imp.
		C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	Area (ac)	% Imp.	C ₅	C ₁₀₀	
A	2.90	0.63	0.74	1.32	80.0%	0.90	0.96	0.02	100.0%	0.75	0.83	0.00	90.0%	0.16	0.51	1.56	2.0%	0.38	0.62	38.2%
B	3.37	0.63	0.74	0.36	80.0%	0.90	0.96	0.85	100.0%	0.75	0.83	0.22	90.0%	0.16	0.51	1.94	2.0%	0.44	0.67	40.8%
C	2.98	0.63	0.74	1.25	80.0%	0.90	0.96	0.05	100.0%	0.75	0.83	0.00	90.0%	0.16	0.51	1.68	2.0%	0.37	0.61	36.4%
O1	0.66	0.63	0.74	0.00	80.0%	0.90	0.96	0.00	100.0%	0.75	0.83	0.00	90.0%	0.16	0.51	0.66	2.0%	0.16	0.51	2.0%
Total	9.91																			29.3%

RETAINING WALL
BLOCK AREA

0.85 ACRES OF PAVEMENT =
0.04 ACRES OF PAVEMENT
(EXISTING) + 0.81 ACRES OF
PAVING SINCE 2008

STANDARD FORM SF-2 - PROPOSED CONDITIONS TIME OF CONCENTRATION

Subdivision: Rockytop Motel & Campground
Location: El Paso County

Project Name: Rockytop Motel & Campground
Project No.: 24032.00
Calculated By: NQJ
Checked By: REB
Date: 1/15/25

SUB-BASIN DATA					INITIAL/OVERLAND (T _i)			TRAVEL TIME (T _t)					t _c CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Weighted C _s	Impervious (%)	L (ft)	S _o (%)	t _i (min)	L _t (ft)	S _t (%)	K	VEL. (ft/s)	t _t (min)	COMP. t _c (min)	TOTAL LENGTH (ft)	Urbanized t _c (min)	t _c (min)
A	2.90	D	0.38	38.2%	300	4.8%	13.4	950	6.0%	10.0	2.4	6.5	19.9	1250.0	24.0	19.9
B	3.37	D	0.44	40.8%	300	2.0%	16.5	660	8.8%	20.0	5.9	1.9	18.4	960.0	21.6	18.4
C	2.98	D	0.37	36.4%	150	4.0%	10.2	470	9.4%	10.0	3.1	2.6	12.8	620.0	21.6	12.8
O1	0.66	D	0.16	2.0%	90	2.2%	12.4	225	3.6%	5.0	0.9	4.0	16.4	315.0	27.8	16.4

NOTES:

$$t_c = t_i + t_t$$

Where:

t_c = computed time of concentration (minutes)

t_i = overland (initial) flow time (minutes)

t_t = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Where:

t_t = channelized flow time (travel time, min)

L_t = waterway length (ft)

S_o = waterway slope (ft/ft)

V_t = travel time velocity (ft/sec) = K√S_o

K = NRCS conveyance factor (see Table 6-2).

$$\text{Eq } t_i = \frac{0.395(1.1 - C_s)\sqrt{L_i}}{S_o^{0.33}}$$

Where:

t_i = overland (initial) flow time (minutes)

C_s = runoff coefficient for 5-year frequency (from Table 6-4)

L_i = length of overland flow (ft)

S_o = average slope along the overland flow path (ft/ft).

$$\text{Equation 6-4 } t_c = 1.49 S_o^{-0.77} L^{0.77} \left(1.49 S_o^{-0.77} L^{0.77} + \frac{L_t}{60(14i + 9)\sqrt{S_t}} \right)$$

∴

t_c = minimum time of concentration for first design point when less than t_c from Equation 6-1.

L_t = length of channelized flow path (ft)

i = imperviousness (expressed as a decimal)

S_t = slope of the channelized flow path (ft/ft).

Equation 6-3

Equation 6-5

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3 - PROPOSED CONDITIONS
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Rockytop Motel & Campground
Location: El Paso County
Design Storm: 5-Year

Project Name: Rockytop Motel & Campground
Project No.: 24032.00
Calculated By: NOJ
Checked By: REB
Date: 1/15/25

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
		Basin ID	Area (Ac)	Runoff Coeff.	t _c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)		t _t (min)
	1	O1	0.66	0.16	16.4	0.11	3.39	0.4					0.4	0.11	6.0					950	2.4	6.5	BASIN O1 FLOW @ DP1, FLOWS INTO BASIN A
	2	A	2.90	0.38	19.9	1.10	3.10	3.4	22.8	1.20	2.89	3.5											DP1 & BASIN A FLOW @ DP2, FOLLOW HISTORIC DRAINAGE PATTERNS TO EXISTING SWALE ALONG HIGHWAY 24
	3	B	3.37	0.44	18.4	1.47	3.22	4.7															BASIN B FLOW @ DP3, FLOWS EAST IN EX SWALE ALONG HIGHWAY 24
	4	C	2.98	0.37	12.8	1.10	3.76	4.1															BASIN C FLOW @ DP4, CONVEYED OFFSITE IN EX 24" CMP CULVERT(CULVERT #2)

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.

STANDARD FORM SF-3 - PROPOSED CONDITIONS
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Rockytop Motel & Campground
Location: El Paso County
Design Storm: 100-Year

Project Name: Rockytop Motel & Campground
Project No.: 24032.00
Calculated By: NQJ
Checked By: REB
Date: 1/15/25

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t _c (min)	C*A (ac)	I (in/hr)	Q (cfs)	Q _{street} (cfs)	C*A (ac)	Slope (%)	Q _{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t _r (min)	
	1	O1	0.66	0.51	16.4	0.34	5.69	1.9					1.9	0.34	6.0					950	2.4	6.5	BASIN O1 FLOW @ DP1, FLOWS INTO BASIN A
	2	A	2.90	0.62	19.9	1.79	5.20	9.3	22.8	2.13	4.85	10.3											DP1 & BASIN A FLOW @ DP2, FOLLOW HISTORIC DRAINAGE PATTERNS TO EXISTING SWALE ALONG HIGHWAY 24
	3	B	3.37	0.67	18.4	2.25	5.40	12.2															BASIN B FLOW @ DP3, FLOWS EAST IN EX SWALE ALONG HIGHWAY 24
	4	C	2.98	0.61	12.8	1.83	6.31	11.6															BASIN C FLOW @ DP4, CONVEYED OFFSITE IN EX 24" CMP CULVERT(CULVERT #2)

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.



APPENDIX C – HYDRAULIC CALCULATIONS

Channel Report

Ex Highway 24 Swale (Combined DP2 & DP3 flow, Q100 = 22.5 cfs)

User-defined

Invert Elev (ft) = 7924.00
Slope (%) = 1.31
N-Value = 0.030

Highlighted

Depth (ft) = 0.42
Q (cfs) = 22.50
Area (sqft) = 7.55
Velocity (ft/s) = 2.98
Wetted Perim (ft) = 19.22
Crit Depth, Yc (ft) = 0.38
Top Width (ft) = 19.07
EGL (ft) = 0.56

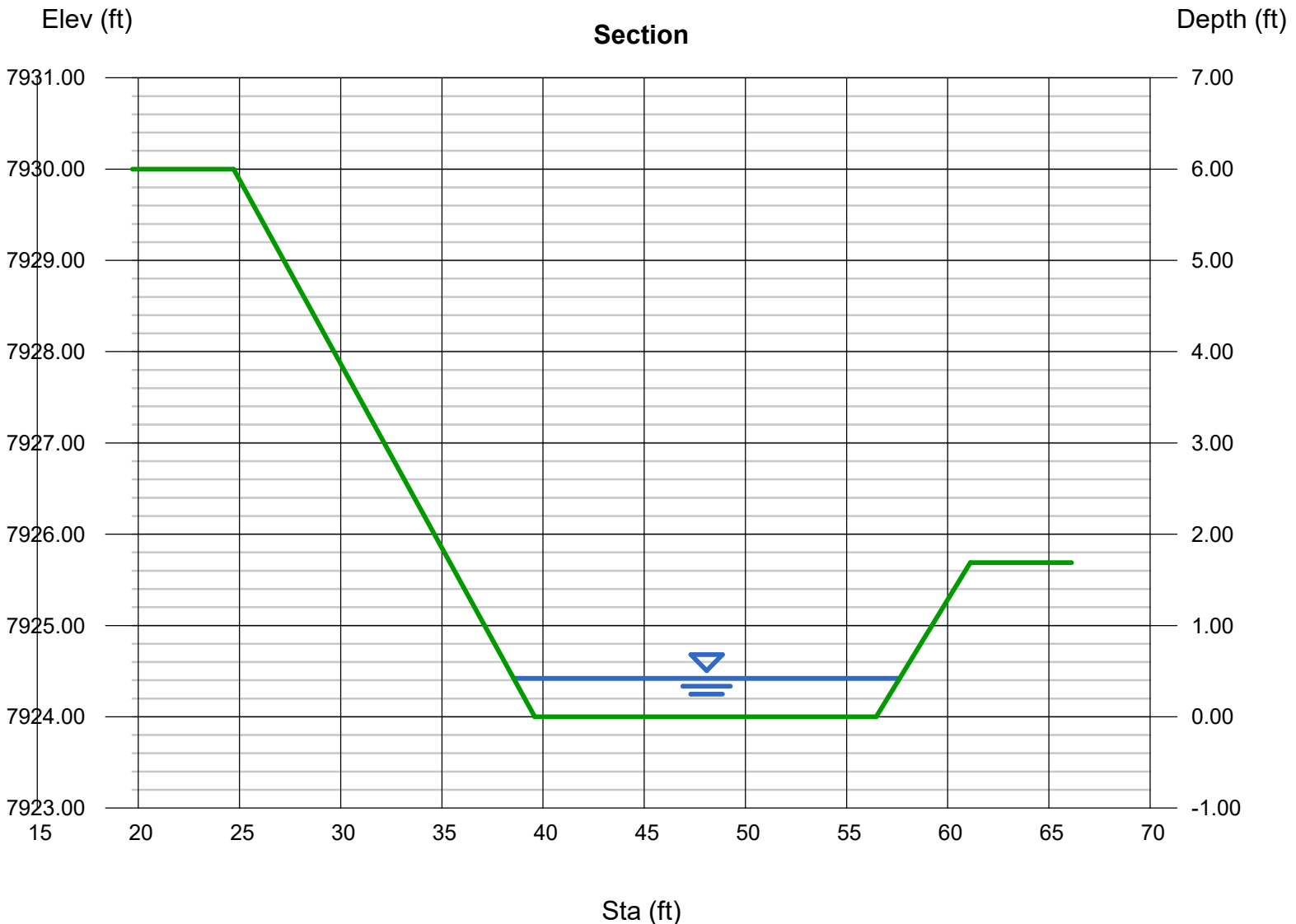
Calculations

Compute by: Known Q
Known Q (cfs) = 22.50

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

(24.71, 7930.00)-(39.59, 7924.00, 0.030)-(56.46, 7924.00, 0.030)-(61.12, 7925.69, 0.030)

Froude # = $\text{velocity}^2 / g * y$
= $[(2.98 \text{ ft/s})^2] / (0.42 \text{ ft} * 32.2 \text{ ft/s})$
= $0.66 < 1$ therefore subcritical flow





APPENDIX D – WATER QUALITY & DETENTION

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: NQJ
Company: ALL TERRAIN ENGINEERING
Date: January 9, 2025
Project: ROCKYTOP MOTEL & CAMPGROUND - RUNOFF REDUCTION AREA #1
Location: EL PASO COUNTY

SITE INFORMATION (User Input in Blue Cells)

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

Area Type	UIA:RPA																			
Area ID	A:UIA-RPA																			
Downstream Design Point ID	1																			
Downstream BMP Type	None																			
DCIA (ft ²)	--																			
UIA (ft ²)	5,575																			
RPA (ft ²)	7,598																			
SPA (ft ²)	--																			
HSG A (%)	0%																			
HSG B (%)	0%																			
HSG C/D (%)	100%																			
Average Slope of RPA (ft/ft)	0.250																			
UIA:RPA Interface Width (ft)	197.00																			

CALCULATED RUNOFF RESULTS

Area ID	A:UIA-RPA																			
UIA:RPA Area (ft ²)	13,173																			
L / W Ratio	0.34																			
UIA / Area	0.4232																			
Runoff (in)	0.00																			
Runoff (ft ³)	0																			
Runoff Reduction (ft ³)	232																			

CALCULATED WQCV RESULTS

Area ID	A:UIA-RPA																			
WQCV (ft ³)	232																			
WQCV Reduction (ft ³)	232																			
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	1																			
DCIA (ft ²)	0																			
UIA (ft ²)	5,575																			
RPA (ft ²)	7,598																			
SPA (ft ²)	0																			
Total Area (ft ²)	13,173																			
Total Impervious Area (ft ²)	5,575																			
WQCV (ft ³)	232																			
WQCV Reduction (ft ³)	232																			
WQCV Reduction (%)	100%																			
Untreated WQCV (ft ³)	0																			

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

Total Area (ft ²)	13,173
Total Impervious Area (ft ²)	5,575
WQCV (ft ³)	232
WQCV Reduction (ft ³)	232
WQCV Reduction (%)	100%
Untreated WQCV (ft ³)	0

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: NQJ
Company: ALL TERRAIN ENGINEERING
Date: January 16, 2025
Project: ROCKYTOP MOTEL & CAMPGROUND - RUNOFF REDUCTION AREA #2
Location: EL PASO COUNTY

SITE INFORMATION (User Input in Blue Cells)

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

Area Type	UIA:RPA																			
Area ID	A:UIA-RPA																			
Downstream Design Point ID	1																			
Downstream BMP Type	None																			
DCIA (ft ²)	--																			
UIA (ft ²)	18,956																			
RPA (ft ²)	16,578																			
SPA (ft ²)	--																			
HSG A (%)	0%																			
HSG B (%)	50%																			
HSG C/D (%)	50%																			
Average Slope of RPA (ft/ft)	0.100																			
UIA:RPA Interface Width (ft)	227.00																			

CALCULATED RUNOFF RESULTS

Area ID	A:UIA-RPA																			
UIA:RPA Area (ft ²)	35,534																			
L / W Ratio	0.69																			
UIA / Area	0.5335																			
Runoff (in)	0.00																			
Runoff (ft ³)	0																			
Runoff Reduction (ft ³)	790																			

CALCULATED WQCV RESULTS

Area ID	A:UIA-RPA																			
WQCV (ft ³)	790																			
WQCV Reduction (ft ³)	790																			
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	1																			
DCIA (ft ²)	0																			
UIA (ft ²)	18,956																			
RPA (ft ²)	16,578																			
SPA (ft ²)	0																			
Total Area (ft ²)	35,534																			
Total Impervious Area (ft ²)	18,956																			
WQCV (ft ³)	790																			
WQCV Reduction (ft ³)	790																			
WQCV Reduction (%)	100%																			
Untreated WQCV (ft ³)	0																			

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

Total Area (ft ²)	35,534
Total Impervious Area (ft ²)	18,956
WQCV (ft ³)	790
WQCV Reduction (ft ³)	790
WQCV Reduction (%)	100%
Untreated WQCV (ft ³)	0

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: NQJ
Company: ALL TERRAIN ENGINEERING
Date: January 15, 2025
Project: ROCKYTOP MOTEL & CAMPGROUND - RUNOFF REDUCTION AREA #3
Location: EL PASO COUNTY

SITE INFORMATION (User Input in Blue Cells)

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

Area Type	UIA:RPA																			
Area ID	A:UIA-RPA																			
Downstream Design Point ID	1																			
Downstream BMP Type	None																			
DCIA (ft ²)	--																			
UIA (ft ²)	5,232																			
RPA (ft ²)	13,247																			
SPA (ft ²)	--																			
HSG A (%)	0%																			
HSG B (%)	0%																			
HSG C/D (%)	100%																			
Average Slope of RPA (ft/ft)	0.075																			
UIA:RPA Interface Width (ft)	233.00																			

CALCULATED RUNOFF RESULTS

Area ID	A:UIA-RPA																			
UIA:RPA Area (ft ²)	18,479																			
L / W Ratio	0.34																			
UIA / Area	0.2831																			
Runoff (in)	0.00																			
Runoff (ft ³)	0																			
Runoff Reduction (ft ³)	218																			

CALCULATED WQCV RESULTS

Area ID	A:UIA-RPA																			
WQCV (ft ³)	218																			
WQCV Reduction (ft ³)	218																			
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	1																			
DCIA (ft ²)	0																			
UIA (ft ²)	5,232																			
RPA (ft ²)	13,247																			
SPA (ft ²)	0																			
Total Area (ft ²)	18,479																			
Total Impervious Area (ft ²)	5,232																			
WQCV (ft ³)	218																			
WQCV Reduction (ft ³)	218																			
WQCV Reduction (%)	100%																			
Untreated WQCV (ft ³)	0																			

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

Total Area (ft ²)	18,479
Total Impervious Area (ft ²)	5,232
WQCV (ft ³)	218
WQCV Reduction (ft ³)	218
WQCV Reduction (%)	100%
Untreated WQCV (ft ³)	0

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer: NQJ
Company: ALL TERRAIN ENGINEERING
Date: January 9, 2025
Project: ROCKYTOP MOTEL & CAMPGROUND - RUNOFF REDUCTION AREA #4
Location: EL PASO COUNTY

SITE INFORMATION (User Input in Blue Cells)

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

Area Type	UIA:RPA																			
Area ID	A:UIA-RPA																			
Downstream Design Point ID	1																			
Downstream BMP Type	None																			
DCIA (ft ²)	--																			
UIA (ft ²)	6,183																			
RPA (ft ²)	5,200																			
SPA (ft ²)	--																			
HSG A (%)	0%																			
HSG B (%)	50%																			
HSG C/D (%)	50%																			
Average Slope of RPA (ft/ft)	0.100																			
UIA:RPA Interface Width (ft)	68.00																			

CALCULATED RUNOFF RESULTS

Area ID	A:UIA-RPA																			
UIA:RPA Area (ft ²)	11,383																			
L / W Ratio	2.46																			
UIA / Area	0.5432																			
Runoff (in)	0.00																			
Runoff (ft ³)	1																			
Runoff Reduction (ft ³)	256																			

CALCULATED WQCV RESULTS

Area ID	A:UIA-RPA																			
WQCV (ft ³)	258																			
WQCV Reduction (ft ³)	256																			
WQCV Reduction (%)	100%																			
Untreated WQCV (ft ³)	1																			

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

Downstream Design Point ID	1																			
DCIA (ft ²)	0																			
UIA (ft ²)	6,183																			
RPA (ft ²)	5,200																			
SPA (ft ²)	0																			
Total Area (ft ²)	11,383																			
Total Impervious Area (ft ²)	6,183																			
WQCV (ft ³)	258																			
WQCV Reduction (ft ³)	256																			
WQCV Reduction (%)	100%																			
Untreated WQCV (ft ³)	1																			

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

Total Area (ft ²)	11,383
Total Impervious Area (ft ²)	6,183
WQCV (ft ³)	258
WQCV Reduction (ft ³)	256
WQCV Reduction (%)	100%
Untreated WQCV (ft ³)	1



APPENDIX E – REFERENCE MATERIAL

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

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													
1/8 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
1/4 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
1/3 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
1/2 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

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_r) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_r) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

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

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)

3.2.1 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)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

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 6-13 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)

Table 6-7. Conveyance Coefficient, C_v

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

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

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_o) and the travel time (t_t) per Equation 6-7.

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 time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

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.

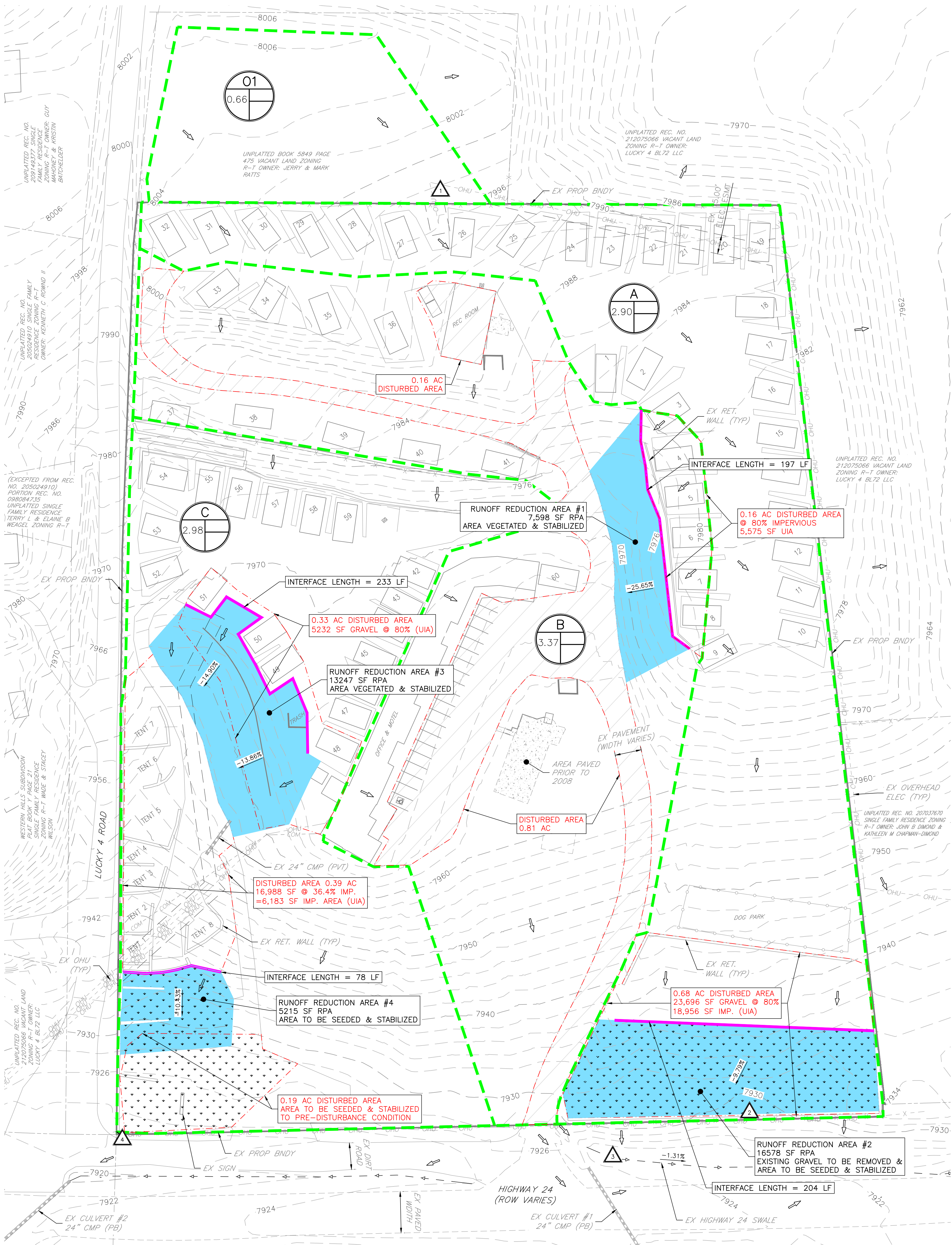
3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

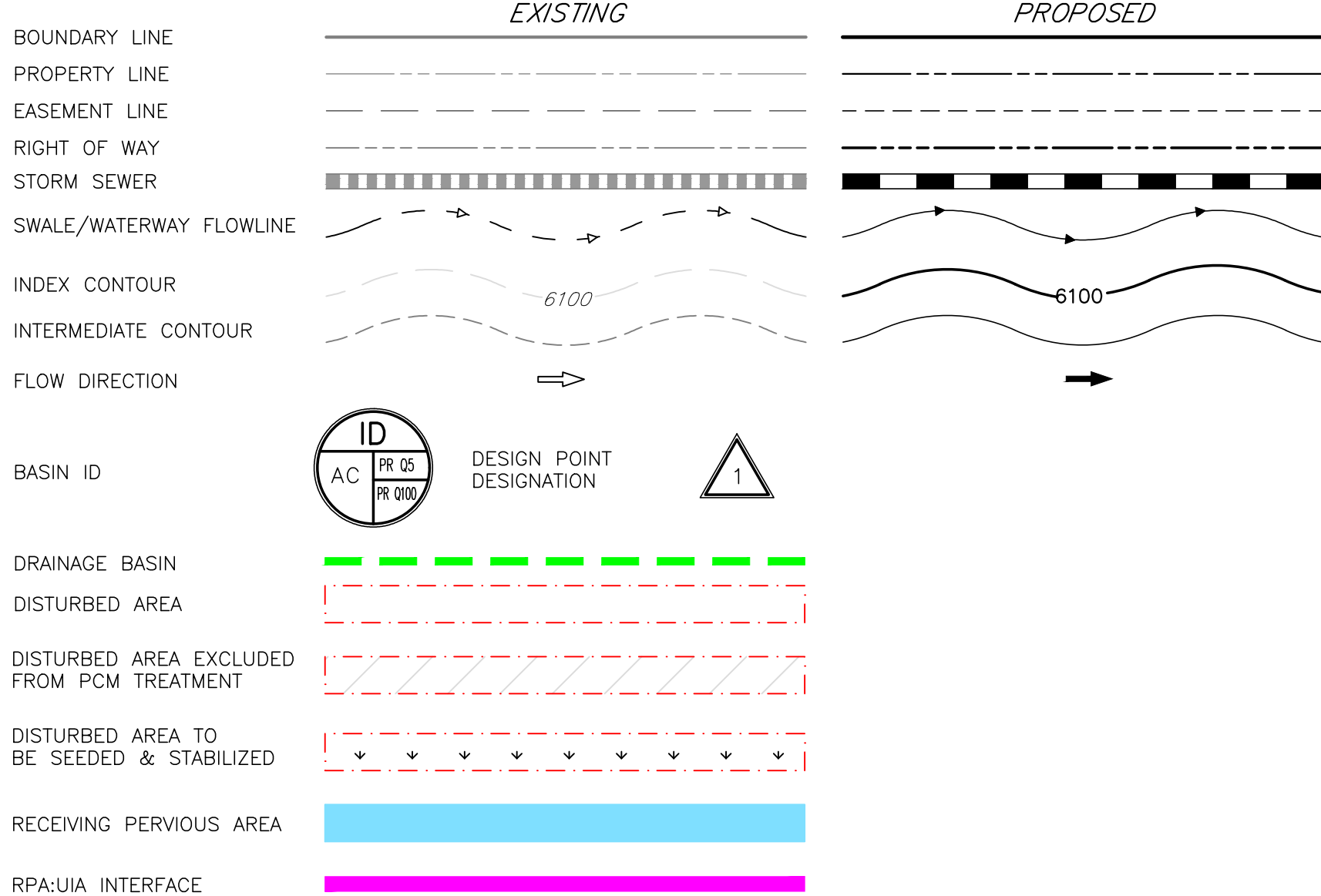


APPENDIX F – DRAINAGE MAPS

ROCKYTOP MOTEL & CAMPGROUND DRAINAGE MAP



LEGEND



EXISTING CONDITIONS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	C ₁₀₀	t _c (min)	Q _s (cfs)	Q ₁₀₀ (cfs)
A	2.90	38%	0.37	0.61	20.0	3.4	9.2
B	3.37	36%	0.37	0.62	20.0	3.8	10.7
C	2.98	35%	0.36	0.61	13.0	4.0	11.4
O1	0.66	2%	0.16	0.51	16.4	0.4	1.9

EXISTING CONDITIONS - DESIGN POINT SUMMARY TABLE

DP#	Q _s -YR	Q ₁₀₀ -YR
1	0.4	1.9
2	3.4	10.3
3	3.8	10.7
4	4.0	11.4

PROPOSED CONDITIONS - BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C _s	C ₁₀₀	t _c (min)	Q _s (cfs)	Q ₁₀₀ (cfs)
A	2.90	38%	0.38	0.62	24.0	3.4	9.3
B	3.37	41%	0.44	0.67	21.6	4.7	12.2
C	2.98	36%	0.37	0.61	21.6	4.1	11.6
O1	0.66	2%	0.16	0.51	27.8	0.4	1.9

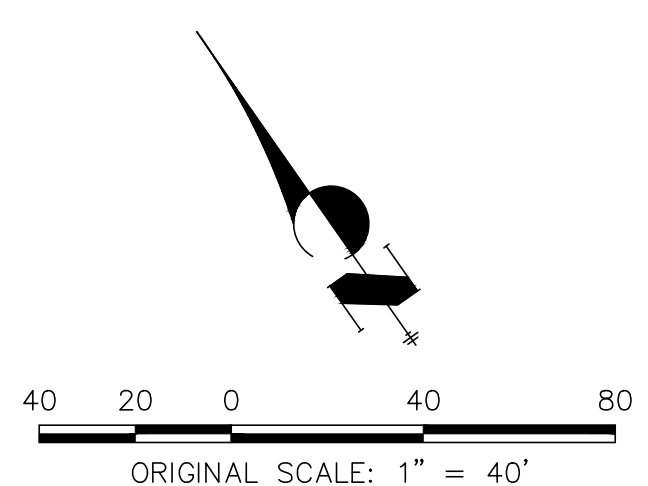
PROPOSED CONDITIONS - DESIGN POINT SUMMARY TABLE

DP#	Q _s -YR	Q ₁₀₀ -YR
1	0.4	1.9
2	3.5	10.3
3	4.7	12.2
4	4.1	11.6

DISTURBANCE SUMMARY TABLE

Basin	Description	Area (acres)	WQ Treatment?
A	GRAVEL STORAGE AREA	0.68	YES
B	REC ROOM	0.16	NO
B	GRADING & WALL	0.16	YES
B	PAVING	0.81	NO
C	GRADING & WALL	0.39	YES
C	GRADING	0.33	YES
C	GRADING	0.19	NO*
Total Disturbed Area		2.72	
WQ Treatment Area		1.56	
Area Excluded from WQ Treatment		0.97	

*WQ not required, 0.19 acres to be seeded and restored to pre-dist. Condition. No imperviousness added.



DRAINAGE MAP
 ROCKYTOP MOTEL
 JOB NO. 24032
 LOCATION: EPC
 07/15/2025
 SHEET 1