PRELIMINARY DRAINAGE REPORT

for

ROLLIN RIDGE ESTATES

Prepared for:

TC&C LLC
17572 Colonial Park Drive
Monument, CO 80132

April 30, 2018
Revised August 30, 2018

Prepared by:

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PRELIMINARY DRAINAGE REPORT
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ROLLIN RIDGE ESTATES – PRELIMINARY DRAINAGE REPORT
EXECUTIVE SUMMARY

A. Background

- Rollin Ridge Estates is a proposed subdivision of a 57-acre property located at the southwest corner of Hodgen Road and State Highway 83 in northern El Paso County.
- The proposed subdivision consists of 16 rural residential lots with 2.5-acre minimum lot sizes, along with a commercial tract.
- Rollin Ridge Estates is located within the West Cherry Creek Drainage Basin, which comprises a total drainage area in excess of 30 square miles. The Rollin Ridge Estates property represents less than 0.3 percent of the total basin area.

B. General Drainage Concept

- Developed drainage within the site will be conveyed along paved streets with roadside ditches and culverts, as well as grass-lined channels through drainage easements, following historic drainage patterns.
- Developed flows from the subdivision will be detained to historic levels through an on-site full-spectrum stormwater detention pond.
- Subdivision drainage improvements will be designed and constructed to meet El Paso County standards,

C. Drainage Impacts

- The proposed detention pond will mitigate developed drainage impacts from the subdivision, ensuring no significant adverse developed drainage impacts on downstream properties.
- Drainage facilities within public road rights-of-way will be dedicated to the County for maintenance. The proposed private stormwater detention pond will be maintained by the subdivision HOA.

DRAINAGE STATEMENT

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 liability caused by negligent acts, errors or omissions on my part in preparing this report.

____

John P. Schwab, P.E. #29891

Developer's Statement:

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

By:

____

Printed Name: Carl Turse, Manager, TC&C, LLC Date
17572 Colonial Park Drive, Monument, CO 80132

El Paso County's Statement

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

____

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

Conditions:

I. GENERAL LOCATION AND DESCRIPTION

A. Background

Rollin Ridge Estates is a proposed subdivision of a 57-acre property located in northeastern El Paso County, Colorado. The Rollin Ridge Estates property is comprised of two parcels (El Paso County Assessor's Number 61270-00-064 and 61270-00-065) is located at the southwest corner of State Highway 83 (SH83) and Hodgen Road, as shown in Figure A1 (Appendix E). Rollin Ridge Estates Subdivision will consist of 16 rural residential lots (2.5-acre minimum size) and a proposed 5.5-acre commercial tract.

B. Scope

This report is intended to fulfill the El Paso County requirements for a Preliminary Drainage Report (PDR) for submittal with the Preliminary Plan application. The report provides a summary of site drainage issues impacting the proposed development, including analysis of impacts from upstream drainage areas, site-specific developed drainage patterns, and impacts on downstream facilities. This PDR report has been prepared based on the guidelines and criteria presented in the El Paso County Drainage Criteria Manual.

C. Site Location and Description

The Rollin Ridge Estates parcel is located in the North Half of Section 27, Township 11 South, Range 66 West of the 6th Principal Meridian. The site is currently a vacant meadow tract, with the exception of one existing residence and several accessory ranch structures.

The property is currently zoned RR-5 (Rural Residential; 5-acre minimum lots), and the proposed subdivision will include re-zoning the property to RR-2.5 (Rural Residential; 2.5-acre minimum lots). The proposed development will be served by individual wells and septic systems.

The north boundary of the property borders Hodgen Road, which is a fully improved principal arterial public street, and the east boundary of the property adjoins SH83 which is a fully improved state highway. The existing Rollin Ridge Rancheros Subdivision adjoins the south boundary of the site. The west boundary of the property adjoins unplatted property zoned Rural Residential (RR-5).

Access through Rollin Ridge Estates Subdivision will be provided by extension of a new public street (Cherry Crossing Court) extending south from Hodgen Road into the property, aligning with the existing Cherry Crossing Drive on the north side of Hodgen Road. An additional public street (Lap Wai Court) will extend southwesterly from Cherry Crossing Court to a cul-de-sac within the subdivision.

Infrastructure improvements will include paving of new public roadways through the site, as well as grading, drainage, and utility service improvements for the proposed residential lots. Local roads will be classified as rural minor residential roads, with 60-feet rights-of-way and paved widths of 28-feet.

Ground elevations within the parcel range from a low point of approximately 7,523 feet above mean sea level at the west boundary of the parcel, to a high point of 7,590 feet.

This site is located in the West Cherry Creek drainage basin. Surface drainage from the property flows northerly towards tributaries of West Cherry Creek. The terrain is rolling with slopes ranging from 2% to 8%. Existing vegetation is typical eastern Colorado prairie grass.

D. General Soil Conditions

According to the Soil Survey of El Paso County prepared by the Soil Conservation Service, on-site soils are comprised of the following soil types (see Appendix A):

- Type 21 – Cruckton sandy loam: Hydrologic Group B
- Type 28 – Ellicott loamy coarse sand: Hydrologic Group A (30%)
- Type 41 – Kettle gravelly loamy sand: Hydrologic Group B
- Type 68 – Peyton-Pring complex: Hydrologic Group B

E. References

City of Colorado Springs & El Paso County "Drainage Criteria Manual, Volumes 1 and 2," revised May, 2014.

El Paso County "Engineering Criteria Manual," January 9, 2006.

FEMA, Flood Insurance Rate Map (FIRM) Number 08041C0325-F, March 17, 1997.

JPS Engineering, Inc., "Master Development Drainage Plan (MDDP) and Preliminary Drainage Report for Walden Preserve Subdivision," December 10, 2004 (approved by El Paso County 12/20/04).

JPS Engineering, Inc., "Final Drainage Report for Majestic Pines Subdivision," July 17, 2014 (approved by El Paso County 9/2/14).

JPS Engineering, Inc., "Final Drainage Report for Settlers Ranch Subdivision Filing No. 1," October 18, 2005 (approved by El Paso County 10/19/05).

JPS Engineering, Inc., "Final Drainage Report for Settlers Ranch Subdivision Filing No. 2," May 30, 2008 (approved by El Paso County 3/31/09).

Cherry Creek Sub filing no 1

JPS Engineering, Inc., "Final Drainage Report for Walden Preserve Subdivision Filing No. 1," May 11, 2005.

Kiowa Engineering Corporation, "Master Development Drainage Plan for the Cherry Creek Crossing Development," September, 1998 (approved by El Paso County 10/13/98).

Kiowa Engineering Corporation, "Final Drainage Plan and Erosion Control Plan, Filing No. 1, Cherry Creek Crossing Subdivision," November, August 18, 2005 (approved by El Paso County 9/1/05).

Kiowa Engineering Corporation, "Preliminary and Final Drainage Report, Cherry Creek Crossing Filing No. 2," Development," August 18, 2005 (approved by El Paso County 9/1/05).

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The proposed development lies within the West Cherry Creek Drainage Basin (CYCY 0400) as classified by El Paso County. Drainage from the site flows northerly to a tributary channel of West Cherry Creek. Downstream areas generally drain northerly towards the main channel of West Cherry Creek.

No drainage planning study has been completed for this drainage basin or any adjacent drainage basins. In the absence of plans for regional drainage facilities, El Paso County generally requires new developments to provide stormwater detention to maintain historic runoff flows leaving developed areas.

The major drainage basins lying in and around the proposed development are depicted in Figure EX1. The Rollin Ridge Estates parcel is located near the southerly limits of the West Cherry Creek Drainage Basin, which comprises a total drainage area in excess of 30 square miles. As such, the proposed 57-acre Rollin Ridge Estates Subdivision represents 0.3 percent of the total basin area, which is primarily ranch land.

B. Floodplain Impacts

The proposed development area is located beyond the limits of any 100-year floodplain delineated by the Federal Emergency Management Agency (FEMA). The floodplain limits in the vicinity of the site are shown in Flood Insurance Rate Map (FIRM) Panel Number 08041C0285-F, dated March 17, 1997, as shown in Figure FIRM (Appendix E).

C. Sub-Basin Description

The existing drainage basins lying in and around the proposed development are depicted in Figure EX1 (Appendix E). The existing on-site topography has been delineated as several sub-basins draining to design points at the north and south boundaries of the site.

The developed drainage basins lying within the proposed development are depicted on Figure D1.1. The developed site layout has been divided into sub-basins based on the proposed road layout within the site. The natural drainage patterns will be impacted through development by site grading and concentration of runoff in subdivision roadside ditches and channels.

On-site flows will be diverted to the existing natural drainage swales and channels running through the property, following historic drainage paths.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria Reference

No Drainage Basin Planning Study (DBPS) has been completed for the West Cherry Creek Drainage Basin. Previous drainage reports for completed subdivision filings have proposed to provide on-site detention for mitigation of developed flows.

B. Hydrologic Criteria

In accordance with the El Paso County Drainage Criteria Manual, Rational Method procedures were utilized for hydrologic calculations since the tributary drainage basins are below 100 acres.

Rational Method hydrologic calculations were based on the following assumptions:

• Design storm (minor)	5-year	
• Design storm (major)	100-year	
• Time of Concentration – Overland Flow	"Airport" equation (300' max. developed)	
• Time of Concentration – Gutter/Ditch Flow	"SCS Upland" equation	
• Rainfall Intensities	El Paso County I-D-F Curve	
• Hydrologic soil type	B	
	<u>C5</u>	<u>C100</u>
• Runoff Coefficients - undeveloped:		
Existing pasture/range areas	0.08	0.35
• Runoff Coefficients - developed:		
Proposed lot areas (2.5-acre lots)	0.170	0.417

Hydrologic calculations are enclosed in Appendix A, and peak design flows are identified on the drainage basin drawings.

IV. DRAINAGE PLANNING FOUR STEP PROCESS

El Paso County Drainage Criteria require drainage planning to include a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

As stated in DCM Volume 2, the Four Step Process is applicable to all new and re-development projects with construction activities that disturb 1 acre or greater or that disturb less than 1 acre but are part of a larger common plan of development. The Four Step Process has been implemented as follows in the planning of this project:

<u>Step 1: Employ Runoff Reduction Practices</u>

- Minimize Impacts: The proposed rural residential subdivision development with 2.5-acre minimum lot sizes provides for inherently minimal drainage impacts based on the limited impervious areas associated with rural residential development.
- Minimize Directly Connected Impervious Areas (MDCIA): The rural residential development will have roadside ditches along all roads, providing for impervious areas to drain across pervious areas. Based on the roadside ditches throughout the subdivision, the subdivision is classified as MDCIA Level One.
- Grass Swales: The proposed roadside ditches will drain to existing and proposed grass-lined drainage swales following historic drainage patterns through the property.

<u>Step 2: Stabilize Drainageways</u>

- Proper erosion control measures will be implemented along the roadside ditches and grass-lined drainage channels to provide stabilized drainageways within the site.

<u>Step 3: Provide Water Quality Capture Volume (WQCV)</u>

- FSD: A Full-Spectrum Detention Pond will be provided at the north boundary of the site. On-site drainage will be routed through the extended detention basin, which will capture and slowly release the WQCV over a 40-hour design release period.

<u>Step 4: Consider Need for Industrial and Commercial BMPs</u>

- No industrial land uses are proposed within this rural residential subdivision.
- The proposed commercial development area will implement a Stormwater Management Plan (SWMP) incorporating proper housekeeping procedures.
- On-site drainage will be routed through the private Full-Spectrum Detention (FSD) basin to minimize introduction of contaminants to the County's public drainage system.

Please call out on plan or change text. Reviewer does not see where the road side ditches discharge into swales.

V. DRAINAGE FACILITY DESIGN

A. General Concept

Development of the Rollin Ridge Estates Subdivision will require site grading and paving, resulting in additional impervious areas across the site. The general drainage pattern will consist of grading away from home sites to swales and roadside ditches along the internal roads within the subdivision, conveying runoff flows through the site. Runoff from the site will flow by roadside ditches to cross culverts at low points in the road profiles, and grass-lined channels connecting to existing natural swales at the site boundaries.

The stormwater management concept for the Rollin Ridge Estates development will be to provide roadside ditches and natural swales as required to convey developed drainage through the site to existing natural outfalls.

Individual lot grading will provide positive drainage away from building sites, and direct developed flows into the system of roadside ditches and drainage swales running through the subdivision.

A stormwater detention pond will be constructed at the north boundary of the subdivision to mitigate the impact of developed flows and maintain historic peak flows downstream of the property.

B. Specific Details

1. Existing Drainage Conditions

Historic drainage conditions within the site are depicted in Figure EX1. Basin A comprises the eastern side of the property, and this basin receives off-site drainage from Basin OA1, which consists of developed 5-acre lots in the Rollin Ridge Rancheros Subdivision adjoining the south boundary of this property. Off-site flows from Basin OA1 combine with Basin A and drain to an existing natural swale flowing to an existing 48-inch CMP culvert crossing Hodgen Road at the north property boundary. Flows from Basins OA1 and A combine at Design Pont #1, with historic peak flows calculated as Q_5 = 11.5 cfs and Q_{100} = 84.7 cfs (Rational Method).

Basin B comprises the northwest part of the site, which sheet flows to the northwest corner of the property, draining to an existing 42-inch CMP culvert crossing Hodgen Road just west of the site boundary. Off-site Basin OB1 represents the off-site area west of this site which also contributes flow to the existing culvert at Design Point #2. Flows from Basins OB1 and B combine at Design Pont #2, with historic peak flows calculated as Q_5 = 7.2 cfs and Q_{100} = 53.2 cfs (Rational Method).

The southwest corner of the property has been delineated as Basin C, which sheet flows to the southwest corner of the property. Flows from Basin C drain to Design Point #3, with historic peak flows calculated as Q_5 = 3.1 cfs and Q_{100} = 15.1 cfs (Rational Method).

Design Point #4 represents the combined flows draining northerly from the site from Basins OA1, A, OB1 and B. Historic peak flows at Design Point #4 are calculated as Q_5 = 18.1 cfs and Q_{100} = 133.0 cfs (Rational Method).

2. Developed Drainage Conditions

The developed drainage basins and projected flows are shown in Figure D1, and hydrologic calculations are enclosed in Appendix B.

The east side of the property has been delineated as Sub-Basins A1-A5 in the developed condition, and these basins will continue to flow northerly towards the existing culvert crossing Hodgen Road at Design Point #1. Developed drainage impacts will be mitigated by routing developed flows through Detention Pond A prior to discharging to the existing Hodgen Road culvert.

Sub-Basin A1 comprises the majority of the south-central part of the site between the two proposed cul-de-sacs. Sub-Basin A1 flows northerly to a proposed public culvert crossing Cherry Crossing Court south of the internal street intersection. Off-site flows from Basin OA1 combine with flows from Sub-Basin A1 at Design Point #A1, with developed peak flows calculated as Q_5 = 16.4 cfs and Q_{100} = 71.7 cfs. A 36-inch culvert will convey the flow from DP-A1 across Cherry Crossing Court into Sub-Basin A3.

Sub-Basins A2 and A3 comprise the residential (Sub-Basin A2) and commercial (Sub-Basin A3) areas on the east side of Cherry Crossing Court. These basins flow northwesterly to Detention Pond A. Sub-Basin A2 flows to Design Point #A2, with developed peak flows calculated as Q_5 = 3.3 cfs and Q_{100} = 13.3 cfs. An 18-inch culvert will convey the flow from DP-A2 across the southern commercial tract access drive into Sub-Basin A3.

Developed flows from Basins OA1, A1, A2, and A3 combine at Design Point #A3, with developed peak flows calculated as Q_5 = 27.4 cfs and Q_{100} = 97.1 cfs. A 42-inch culvert will convey the flow from DP-A3 across the northern commercial tract access drive into Detention Pond A.

Sub-Basin A4 comprises the area southwest of the intersection of Cherry Crossing Court and Hodgen Road. This area sheet flows easterly to a proposed 18-inch culvert crossing Cherry Crossing Court and flowing into Detention Pond A. Sub-Basin A4 flows to Design Point #A4, with developed peak flows calculated as Q_5 = 2.9 cfs and Q_{100} = 11.8 cfs.

please show all DP's on the plan.

Sub-Basin A5 comprises the landscape buffer area on the north side of the Commercial Tract, including Detention Pond A. Developed flows from Basins OA1 and A1-A5 combine at Design Point #1, with developed flows calculated as Q_5 = 29.4 cfs and Q_{100} = 106.0 cfs. Design Point #1 represents the flow entering Detention Pond A, and the subdivision streets and commercial center will drain to this pond.

Developed Basin B will continue to sheet flow to the northwest corner of the property. Off-site flows from Basin OB1 will combine with Basin B at Design Point #2, with developed peak flows calculated as Q_5 = 13.9 cfs and Q_{100} = 62.7 cfs.

Developed Basin C will continue to sheet flow to the southwest corner of the property. Basin C will flow to Design Point #3, with developed peak flows calculated as Q_5 = 4.3 cfs and Q_{100} = 16.8 cfs, representing an insignificant increase in comparison to historic flows.

Combined flows from Basins OA1, A1-A5, OB1, and B are combined at Design Point #4, with developed peak flows calculated as Q_5 = 38.2 cfs and Q_{100} = 157.4 cfs (Rational Method). The proposed Full-Spectrum Detention Pond A has been designed to mitigate developed flow impacts from the combined Basins A and B. Detained flows at Design Point #4 are calculated as Q_5 = 14.2 cfs and Q_{100} = 131.4 cfs, which are below historic levels. The discharge from Detention Basin A flows into the existing CMP culvert crossing Hodgen Road at the north boundary of the site, and then flowing northerly in existing drainage channels through the Cherry Creek Crossing Subdivision.

C. Comparison of Developed to Historic Discharges

Based on the hydrologic calculations in Appendix B, the proposed development will result in developed flows exceeding historic flows from the parcel. The increase in developed flows will be mitigated through on-site stormwater detention facilities.

The comparison of developed to historic discharges at key design points is summarized as follows:

Design Point	Historic Flow			Developed Flow			Comparison of Developed to Historic Flow (Q_5%/Q_{100}%)
	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	
3	5.5	3.1	15.1	5.5	4.3	16.8	+1.2 cfs / +1.7 cfs (negligible increase)
4	85.3	18.1	133.0	85.2	38.2	157.4	+20.1 cfs / +24.4 cfs
4d	85.3	18.1	133.0	85.2	14.2	131.4	-3.9 cfs / -1.6 cfs (de

add design point 2 to this chart.

please add text to state that homes in sub-basin 3 should direct downspouts as to not adversley impact the adjacent property.

please describe this increase and any impact it has to the downstream, follow it to a suitable outfall. An increase of this size may not be allowable depending on the downstream infrastructure. Please reference adjacent report, it has only allowed for 31cfs.

D. Detention Ponds

The Developed storm runoff downstream of the proposed subdivision will be maintained at historic levels by routing flows through a proposed detention pond at the north boundary of the property. Detention Pond A will be constructed as a Full-Spectrum Detention (FSD) Pond to mitigate developed flow impacts from the proposed subdivision. The pond outlet structure has been designed to detain the full spectrum of storm events, as well as provide water quality.

Detailed pond routing calculations have been performed utilizing the Denver Urban Drainage and Flood Control District "UD-Detention_v3.07" software package (see Appendix C). The pond outlet structure configuration has been designed to maintain the calculated pond discharge below the target outflow, while maintaining the maximum water surface elevation below the pond spillway.

The proposed detention pond has been sized based on the impervious areas for Basins A and B, incorporating the applicable Impervious Reduction Factor (IRF) calculations utilizing the "UD-BMP_v3.06" software package (see Appendix C).

Detention pond design parameters are summarized as follows:

Pond	Inflow (Q_{100}, cfs)	Outflow (Q_{100}, cfs)	Volume (ac-ft)	Outlet Structure
Pond A	116.1	68.7	2.3	36-inch SD w/ orifice plates

Maintenance access roads meeting County drainage criteria will be provided for all stormwater detention facilities. The proposed detention pond will be privately owned and maintained by the subdivision homeowners association (HOA).

E. On-Site Drainage Facility Design

Developed sub-basins and proposed drainage improvements are depicted in the enclosed Drainage Plan (Sheet D1.1, Appendix E). In accordance with El Paso County standards, new roadways will be graded with a minimum longitudinal slope of 1.0 percent. The typical local road section will consist of a 28-foot paved width with 2-foot gravel shoulders and 4:1 slopes to 2.5-foot ditches.

On-site drainage facilities will consist of roadside ditches, grass-lined channels, and culverts. Hydraulic calculations for preliminary sizing of major on-site drainage facilities are enclosed in Appendix D, and design criteria are summarized as follows:

1. Culverts

The internal road system has been graded to drain roadside ditches to low points along the road profile, where cross-culverts will convey developed flows into grass-lined channels following historic drainage paths. Culvert pipes have been specified as reinforced concrete pipe (RCP) with a minimum diameter of 18-inches. Culvert sizes have been identified based on a maximum headwater-to-depth ratio (HW/D) of 1.0 for the minor (5-year) design storm. Final culvert design calculations will be performed utilizing the FHWA HY-8 software package to perform a detailed analysis of inlet and outlet control conditions, meeting El Paso County criteria for allowable overtopping. Preliminary culvert sizes based on allowable headwater depths are summarized in the "Culvert Sizing Summary" table in Appendix B. Riprap outlet protection will be provided at all culverts.

2. Open Channels

Drainage easements will be dedicated along major drainage channels following historic drainage paths through the subdivision. These channels will generally be grass-lined channels designed to convey 100-year flows, with a trapezoidal cross-section, variable bottom width and depth, 4:1 maximum side slopes, 1-foot freeboard, and a minimum slope of 0.5 percent.

The proposed drainage channels have been sized utilizing Manning's equation for open channel flow, assuming a friction factor ("n") of 0.030 for dry-land grass channels. Maximum allowable velocities will be evaluated based on El Paso County drainage criteria, typically allowing for a maximum 100-year velocity of 5 feet per second. Erosion control mats have been specified for channel segments with maximum 100-year velocities up to 8 feet per second. The proposed channels will generally be seeded with native grasses for erosion control. Erosion control blankets will be provided where required based on erosive velocities. Ditch flows will be diverted to drainage channels at the nearest practical location to minimize excessive roadside ditch sizes. Detailed channel hydraulic calculations will be provided in the Final Drainage Report.

F. Anticipated Drainage Problems and Solutions

The proposed stormwater Detention Pond A has been designed to mitigate the impacts of developed drainage from this project. The overall drainage plan for the subdivision includes a system of roadside ditches, channels, and culverts to convey developed flows through the site. The primary drainage problems anticipated within this development will consist of maintenance of these drainage channels, culverts, and detention pond facilities. Care will need to be taken to implement proper erosion control measures in the proposed roadside ditches, channels, and swales. Ditches will be designed to meet allowable velocity criteria. Erosion control blankets will be installed where necessary to minimize erosion concerns. Proper construction and maintenance of the proposed detention facilities will minimize downstream drainage impacts.

Public roadway improvements and ditches within the public right-of-way will be owned and maintained by El Paso County. The proposed stormwater detention pond and drainage channels located within open space tracts will be owned and maintained by the subdivision HOA.

VI. EROSION / SEDIMENT CONTROL

The Contractor will be required to implement Best Management Practices (BMP's) for erosion control through the course of construction. Sediment control measures will include installation of silt fence at the toe of disturbed slopes and hay bales protecting drainage ditches. Cut slopes will be stabilized during excavation as necessary and vegetation will be established for stabilization of disturbed areas as soon as possible. All ditches will be designed to meet El Paso County criteria for slope and velocity. The proposed detention pond will serve as a sediment basin during the construction phase of the project.

VII. COST ESTIMATE AND DRAINAGE FEES

A preliminary cost estimate for proposed drainage improvements is enclosed in Appendix D, with a total estimated cost of approximately $82,700 for subdivision drainage improvements. The developer will finance all construction costs for proposed roadway and drainage improvements, and public facilities will be owned and maintained by El Paso County upon final acceptance. Private drainage facilities will be owned and maintained by the subdivision HOA.

This parcel is located in the West Cherry Creek Drainage Basins. No drainage and bridge fees will be due at time of recordation of the final plat as the subject site is not located in a fee basin.

VIII. SUMMARY

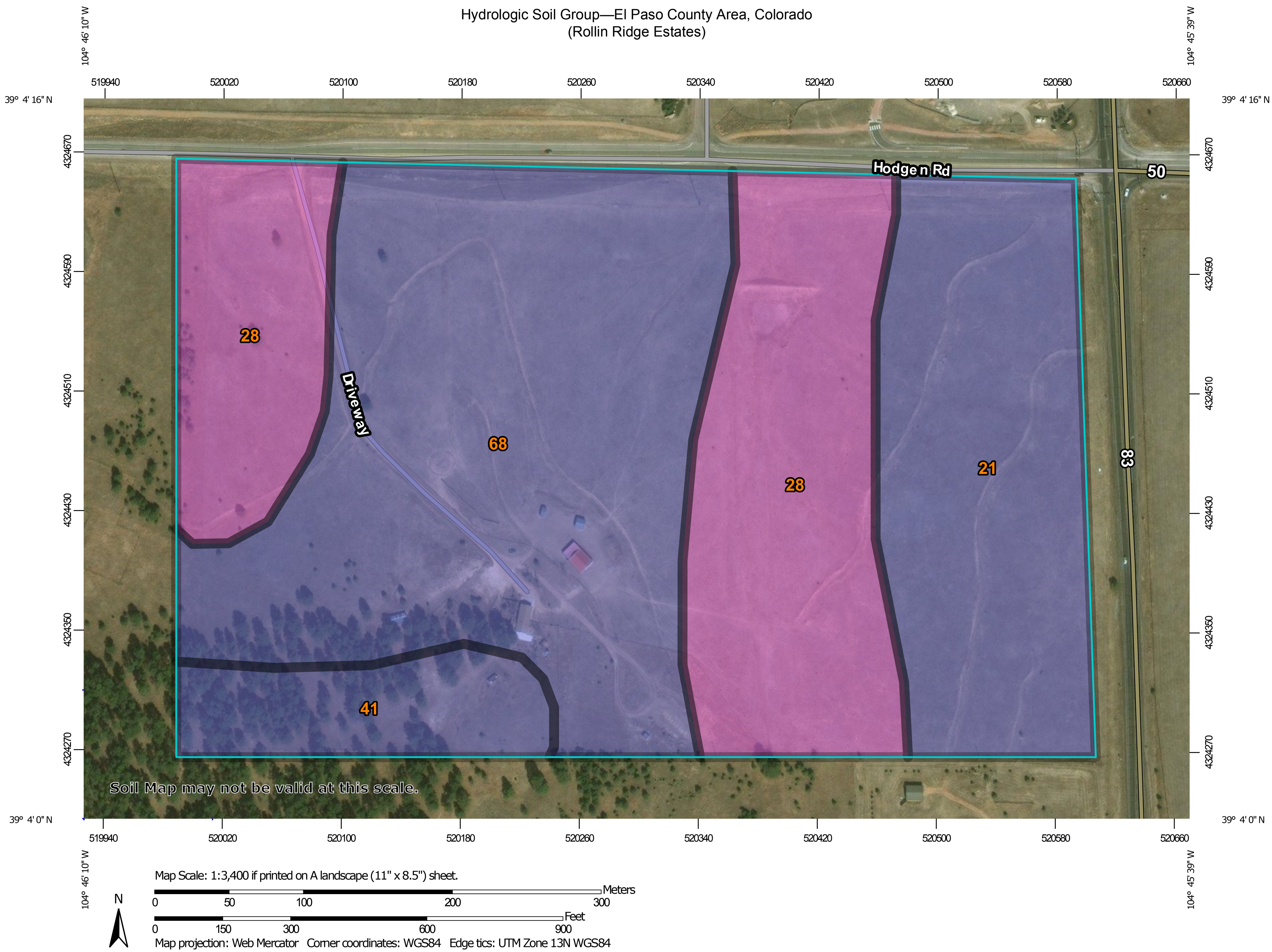
Rollin Ridge Estates is a proposed residential subdivision consisting of 16 lots and a commercial tract on a 57-acre parcel located at the southwest corner of State Highway 83 and Hodgen Road in northern El Paso County. Development of the proposed Rollin Ridge Estates Subdivision will generate an increase in developed runoff from the site, which will be mitigated through construction of an on-site stormwater detention facility. The proposed drainage patterns will remain consistent with historic conditions, and new drainage facilities constructed to El Paso County standards will safely convey runoff to suitable outfalls. Based on the on-site stormwater detention concept, no new downstream drainage facilities are proposed.

The proposed detention pond will ensure that overall developed flows from the Rollin Ridge Estates Subdivision remain consistent with historic levels. Construction and proper maintenance of the proposed drainage and erosion control facilities will ensure that this subdivision has no significant adverse drainage impact on downstream or surrounding areas.

APPENDIX A

HYDROLOGIC CALCULATIONS

Hydrologic Soil Group—El Paso County Area, Colorado
(Rollin Ridge Estates)



Map Scale: 1:3,400 if printed on A landscape (11" x 8.5") sheet.

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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: Feb 22, 2014—Mar 9, 2017

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
21	Cruckton sandy loam, 1 to 9 percent slopes	B	12.9	21.6%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	18.0	30.2%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	4.0	6.7%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	24.8	41.5%
Totals for Area of Interest			**59.7**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

September 17, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

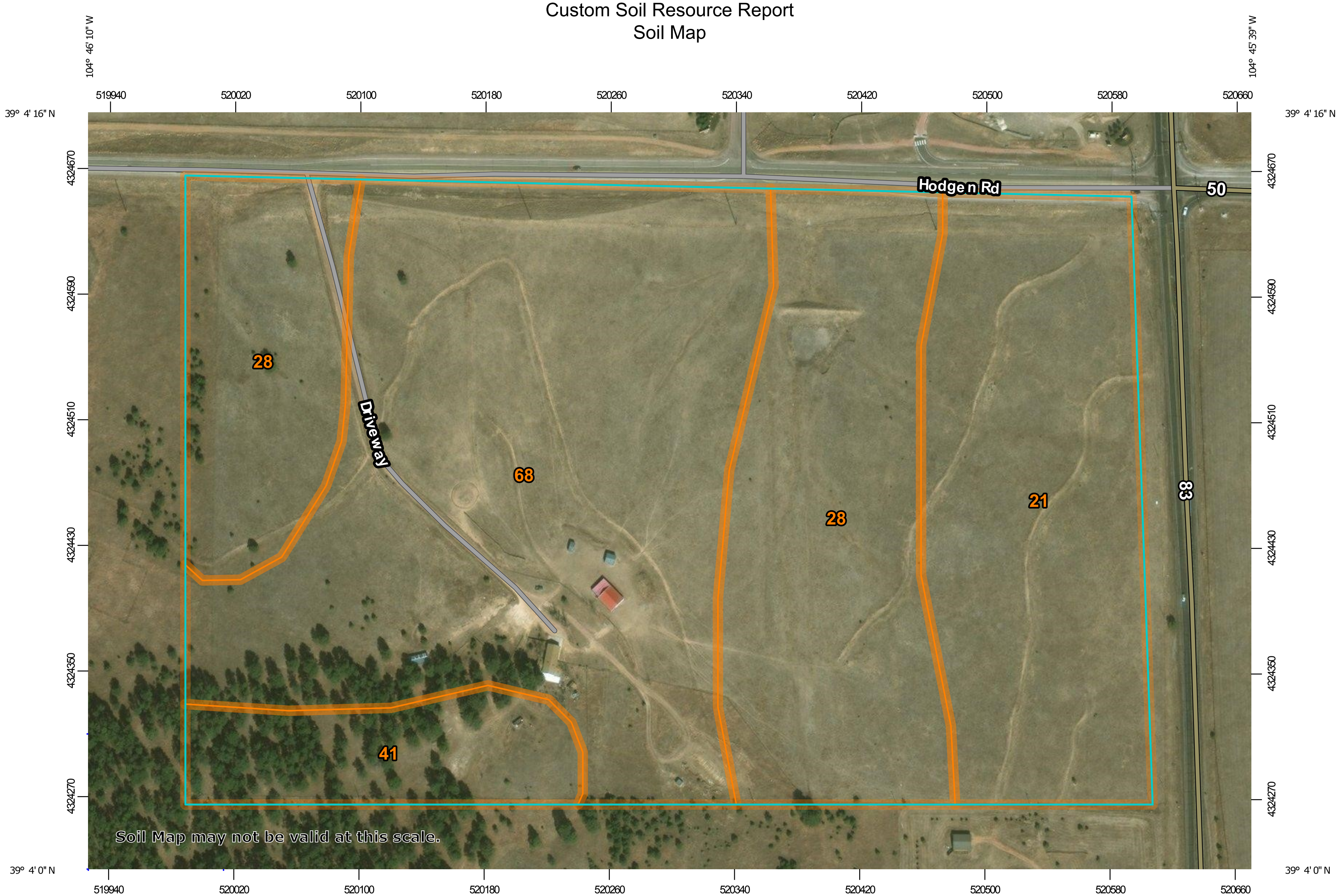
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:3,400 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

N

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: Feb 22, 2014—Mar 9, 2017

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

Map Unit Legend

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
21	Cruckton sandy loam, 1 to 9 percent slopes	12.9	21.6%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	18.0	30.2%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	4.0	6.7%
68	Peyton-Pring complex, 3 to 8 percent slopes	24.8	41.5%
Totals for Area of Interest		**59.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

21—Cruckton sandy loam, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 367s
Elevation: 7,200 to 7,600 feet
Mean annual precipitation: 16 to 18 inches
Mean annual air temperature: 42 to 46 degrees F
Frost-free period: 110 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Cruckton and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cruckton

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose

Typical profile

A - 0 to 11 inches: sandy loam
Bt - 11 to 28 inches: sandy loam
C - 28 to 60 inches: loamy coarse sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Sandy Bottomland LRU's A & B (R069XY031CO)
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll

Percent of map unit:
Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

41—Kettle gravelly loamy sand, 8 to 40 percent slopes

Map Unit Setting

National map unit symbol: 368h
Elevation: 7,000 to 7,700 feet
Farmland classification: Not prime farmland

Map Unit Composition

Kettle and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kettle

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

E - 0 to 16 inches: gravelly loamy sand
Bt - 16 to 40 inches: gravelly sandy loam
C - 40 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 40 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

68—Peyton-Pring complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369f
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent
Pring and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: Sandy Divide (R049BY216CO)
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Loamy Park (R048AY222CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

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_t) 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_t) 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.

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

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.

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

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 6-25 or Equation 6-9 (Guo 1999).

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

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_i) 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.

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

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.

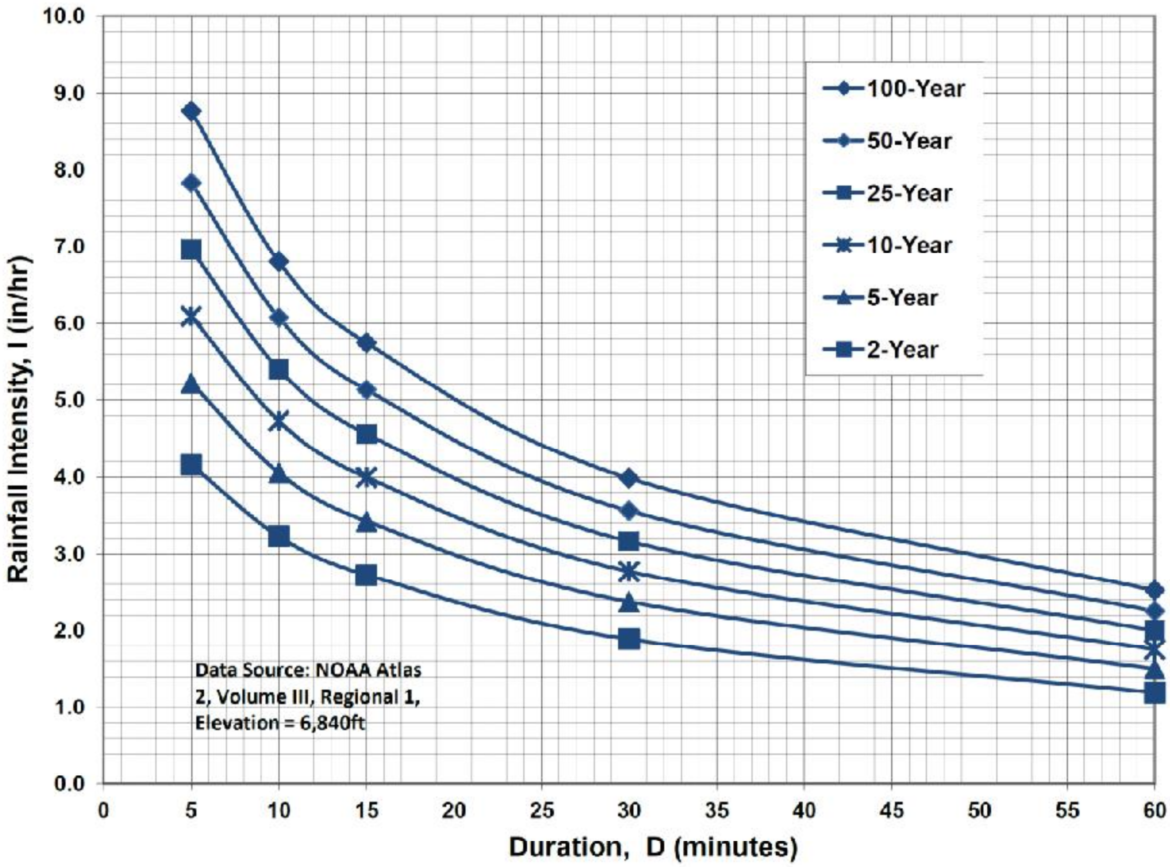
3.2.4 Minimum Time of Concentration

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

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

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

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

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

ROLLIN RIDGE SUBDIVISION
COMPOSITE RUNOFF COEFFICIENTS - TYPICAL RURAL RESIDENTIAL LOTS

DEVELOPED CONDITIONS

5-YEAR C VALUES

BASIN	TOTAL AREA (AC)	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
2.5-ACRE LOTS	2.50	11.00	BUILDING / PAVEMENT	0.90	89.00	LANDSCAPED	0.08				0.170
5-ACRE LOTS	5.00	7.00	BUILDING / PAVEMENT	0.90	93.00	LANDSCAPED	0.08				0.137

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
2.5-ACRE LOTS	2.50	11.00	BUILDING / PAVEMENT	0.96	89.00	LANDSCAPED	0.35				0.417
5-ACRE LOTS	5.00	7.00	BUILDING / PAVEMENT	0.96	93.00	LANDSCAPED	0.35				0.393

IMPERVIOUS AREAS

BASIN	TOTAL AREA (AC)	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
2.5-ACRE LOTS	2.50	11.00	BUILDING / PAVEMENT	100	89.00	LANDSCAPED	0				11.000
5-ACRE LOTS	5.00	7.00	BUILDING / PAVEMENT	100	93.00	LANDSCAPED	0				7.000

ROLLIN RIDGE ESTATES
RATIONAL METHOD

HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR(7)	C 100-YEAR(7)	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco (1) (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS (2) VELOCITY (FT/S)	Channel flow Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
WEST CHERRY CREEK BASIN																		
OA1	OA1	15.03	0.080	0.350	300	0.083	16.0	700	15.00	0.0486	3.31	3.5	19.5	19.5	3.13	5.25	3.76	27.62
A		39.30	0.080	0.350			0.0	1220	15.00	0.0352	2.81	7.2	7.2	7.2	4.62	7.75	14.51	106.62
OA1,A	1	54.33	0.080	0.350									26.7	26.7	2.65	4.46	11.54	84.73
OB1	OB1	18.76	0.080	0.350	300	0.057	18.1	770	15.00	0.0468	3.24	4.0	22.1	22.1	2.94	4.93	4.41	32.40
B		12.18	0.080	0.350	300	0.053	18.5	790	15.00	0.0532	3.46	3.8	22.3	22.3	2.92	4.91	2.85	20.92
OB1,B	2	30.94	0.080	0.350									22.3	22.3	2.92	4.91	7.24	53.15
C	3	5.46	0.137	0.393	100	0.080	8.8	200	15.00	0.10	4.74	0.7	9.5	9.5	4.20	7.06	3.14	15.14
OA1,A,OB1,B	4	85.27	0.080	0.350									26.7	26.7	2.65	4.46	18.11	132.98

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

ROLLIN RIDGE SUBDIVISION
COMPOSITE RUNOFF COEFFICIENTS

5-YEAR C-VALUES

BASIN	TOTAL AREA (AC)	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
OA1	15.03	15.03	5-AC LOTS	0.137							0.137
A1	21.69	21.69	2.5-AC LOTS	0.170							0.170
OA1,A1	36.72										0.156
A2	5.12	5.12	2.5-AC LOTS	0.170							0.170
A3	5.84	3.74	BUILDING / PAVEMENT	0.9	2.10	MEADOW / LS	0.08				0.605
OA1,A1-A3	47.68										0.213
A4	4.74	4.74	2.5-AC LOTS	0.170							0.170
OA1,A1-A4	52.42										0.209
A5	2.21	2.21	LANDSCAPE	0.080							0.080
OA1,A1-A5	54.63										0.204
OB1	18.76	18.76	5-AC LOTS	0.137							0.137
B	11.83	11.83	2.5-AC LOTS	0.170							0.170
OB1,B	30.59										0.150
OA1,A1-A5,OB1,B	85.22										0.184
C	5.46	5.46	2.5-AC LOTS	0.170							0.170

100-YEAR C-VALUES

BASIN	TOTAL AREA (AC)	AREA (%)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 2 DEVELOPMENT/ COVER	C	AREA (%)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
OA1	15.03	15.03	5-AC LOTS	0.393							0.393
A1	21.69	21.69	2.5-AC LOTS	0.417							0.417
OA1,A1	36.72										0.407
A2	5.12	5.12	2.5-AC LOTS	0.417							0.417
A3	5.84	3.74	BUILDING / PAVEMENT	0.96	2.10	MEADOW / LS	0.35				0.741
OA1,A1-A3	47.68										0.449
A4	4.74	4.74	2.5-AC LOTS	0.417							0.417
OA1,A1-A4	52.42										0.446
A5	2.21	2.21	LANDSCAPE	0.350							0.350
OA1,A1-A5	54.63										0.442
OB1	18.76	18.76	5-AC LOTS	0.393							0.393
B	11.83	11.83	2.5-AC LOTS	0.417							0.417
OB1,B	30.59										0.402
OA1,A1-A5,OB1,B	85.22										0.428
C	5.46	5.46	2.5-AC LOTS	0.417							0.417

ROLLIN RIDGE ESTATES
RATIONAL METHOD

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR(7)	C 100-YEAR (7)	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco (1) (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS (2) VELOCITY (FT/S)	Channel flow Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
WEST CHERRY CREEK BASIN																		
OA1	OA1	15.03	0.137	0.393	300	0.083	15.1	700	15.00	0.0486	3.31	3.5	18.6	18.6	3.20	5.37	6.59	31.71
A1		21.69	0.170	0.417			0.0	800	15.00	0.035	2.81	4.8	4.8	5.0	5.17	8.68	19.06	78.50
OA1,A1	A1	36.72	0.156	0.407									23.4	23.4	2.86	4.80	16.37	71.66
A2	A2	5.12	0.170	0.417	100	0.040	10.7	670	15.00	0.0851	4.38	2.6	13.3	13.3	3.70	6.22	3.22	13.27
A3		5.84	0.605	0.741	100	0.080	4.5	770	15.00	0.0481	3.29	3.9	8.4	8.4	4.38	7.36	15.49	31.86
Channel A3							0.0	250	15.00	0.012	1.64	2.5	2.5					
OA1,A1-A3	A3	47.68	0.213	0.449									25.9	25.9	2.70	4.54	27.44	97.10
A4	A4	4.74	0.170	0.417	100	0.040	10.7	740	15.00	0.046	3.22	3.8	14.6	14.6	3.57	5.99	2.87	11.83
OA1,A1-A4	A4.1	52.42	0.209	0.446									25.9	25.9	2.70	4.54	29.61	106.04
A5		2.21	0.080	0.350			0.0	230	15.00	0.0522	3.43	1.1	1.1	5.0	5.17	8.68	0.91	6.71
OA1,A1-A5	1	54.63	0.204	0.442									27.0	27.0	2.64	4.43	29.41	106.94
OB1	OB1	18.76	0.137	0.393	300	0.057	17.1	770	15.00	0.0468	3.24	4.0	21.1	21.1	3.01	5.05	7.74	37.25
B		11.83	0.170	0.417	300	0.053	16.9	790	15.00	0.0532	3.46	3.8	20.7	20.7	3.04	5.10	6.11	25.16
OB1,B	2	30.59	0.150	0.402									20.7	20.7	3.04	5.10	13.94	62.71
C	3	5.46	0.184	0.428	100	0.080	8.4	200	15.00	0.10	4.74	0.7	9.1	9.1	4.27	7.17	4.29	16.76
DP1,DP2	4	85.22	0.170	0.417									27.0	27.0	2.64	4.43	38.23	157.39

DETAINED FLOWS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR(7)	C 100-YEAR (7)	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco (1) (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS (2) VELOCITY (FT/S)	Channel flow Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
OA1,A1-A5	1	54.63															0.30	68.70
OB1,B	2	30.59															13.94	62.71
DP1,DP2	4d	85.22															14.24	131.41

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

7) WEIGHTED AVERAGE C VALUES FOR COMBINED BASINS

APPENDIX B

HYDRAULIC CALCULATIONS

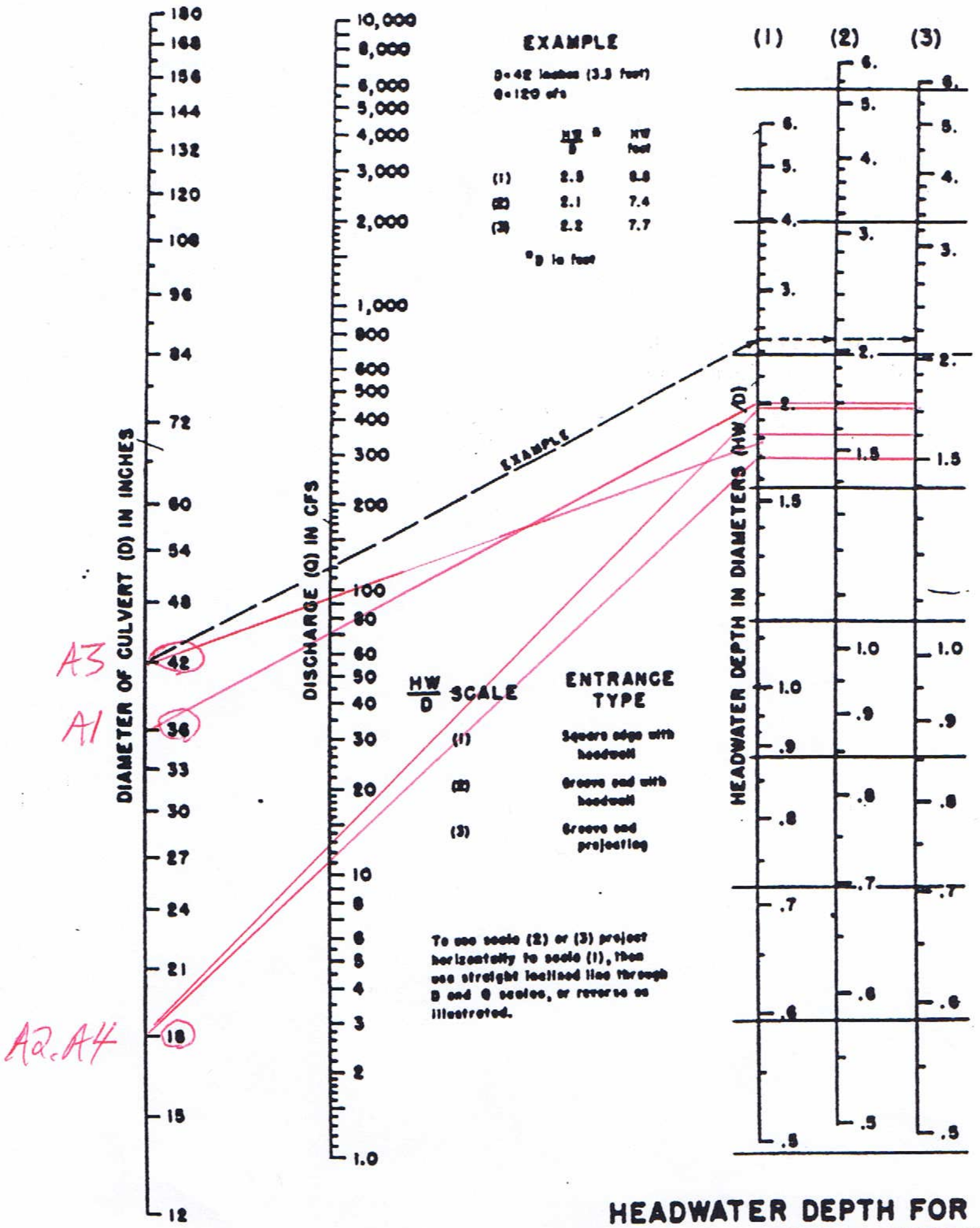
JPS ENGINEERING

ROLLIN RIDGE ESTATES
CULVERT SIZING SUMMARY (PRELIMINARY)

Design Point	Peak Flow (Q_5, cfs)	Peak Flow (Q_{100}, cfs)	Minimum HW/D (Q_{100})	Culvert Size
A1	16.4	71.7	1.75 (Q_{100})	36” RCP
A2	3.2	13.3	1.75 (Q_{100})	18” RCP
A3	27.4	97.1	1.6 (Q_{100})	42” RCP
A4	2.9	11.8	1.5 (Q_{100})	18” RCP

- Maximum HW/D for Q_5 = 1.0

Rollin Ridge Estates - Preliminary Culvert Sizing



HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HDR Infrastructure, Inc.
A Centerra Company

The City of Colorado Springs / El Paso County
Drainage Criteria Manual

Date
OCT. 1987

Figure
9 - 32

The complete line of RollMax™ products offers a variety of options for both short-term and permanent erosion control needs. Reference the RollMax Products Chart below to find the right solution for your next project.

RollMax Product Selection Chart

	TEMPORARY						
	ERONET						BIONET
	DS75	DS150	S75	S150	SC150	C125	S75BN
Longevity	45 days	60 days	12 mo.	12 mo.	24 mo.	36 mo.	12 mo.
Applications	Low Flow Channels 4:1-3:1 Slopes	Moderate Flow Channels 3:1-2:1 Slopes	Low Flow Channels 4:1-3:1 Slopes	Moderate Flow Channels 3:1-2:1 Slopes	Medium Flow Channels 2:1-1:1 Slopes	High-Flow Channels 1:1 and Greater Slopes	Low Flow Channels 4:1-3:1 Slopes
Design Permissible Shear Stress lbs/ft² (Pa)	Unvegetated 1.55 (74)	Unvegetated 1.75 (84)	Unvegetated 1.55 (74)	Unvegetated 1.75 (84)	Unvegetated 2.00 (96)	Unvegetated 2.25 (108)	Unvegetated 1.60 (76)
Design Permissible Velocity ft/s (m/s)	Unvegetated 5.00 (1.52)	Unvegetated 6.00 (1.52)	Unvegetated 5.00 (1.2)	Unvegetated 6.00 (1.83)	Unvegetated 8.00 (2.44)	Unvegetated 10.00 (3.05)	Unvegetated 5.00 (1.52)
Top Net	Lightweight accelerated photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	Lightweight accelerated photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	Heavyweight UV-stabilized polypropylene 2.9 lbs/1000 ft² (1.47 kg/100 m²) approx wt	Heavyweight UV-stabilized polypropylene 2.9 lbs/1000 ft² (1.47 kg/100 m²) approx wt	Leno woven. 100% biodegradable jute fiber 9.30 lbs/1000 ft² (4.53 kg/100 m²) approx wt
Center Net	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fiber Matrix	Straw fiber 0.50 lbs/yd² (0.27 kg/m²)	Straw fiber 0.50 lbs/yd² (0.27 kg/m²)	Straw fiber 0.50 lbs/yd² (0.27 kg/m²)	Straw fiber 0.50 lbs/yd² (0.27 kg/m²)	Straw/coconut matrix 70% Straw 0.35 lbs/yd² (0.19 kg/m²) 30% Coconut 0.15 lbs/yd² (0.08 kg/m²)	Coconut fiber 0.50 lbs/yd² (0.27 kg/m²)	Straw fiber 0.50 lbs/yd² (0.27 kg/m²)
Bottom Net	N/A	Lightweight accelerated photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	N/A	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	Lightweight photodegradable polypropylene 1.50 lbs/1000 ft² (0.73 kg/100 m²) approx wt	Heavyweight UV-stabilized polypropylene 2.9 lbs/1000 ft² (1.47 kg/100 m²) approx wt	N/A
Thread	Accelerated degradable	Accelerated degradable	Degradable	Degradable	Degradable	UV-stabilized polypropylene	Biodegradable

APPENDIX C

DETENTION POND CALCULATIONS

ROLLIN RIDGE SUBDIVISION
IMPERVIOUS AREA CALCULATIONS

IMPERVIOUS AREAS - DEVELOPED CONDITIONS

BASIN	TOTAL AREA (AC)	AREA (AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
OA1	15.03	15.03	5-AC LOTS	7.0							7.00
A1	21.69	21.69	2.5-AC LOTS	11.0							11.00
A2	5.12	5.12	2.5-AC LOTS	11.0							11.00
A3	5.84	3.74	BUILDING / PAVEMENT	100.0	2.10	MEADOW / LS	0.0				64.04
A4	4.74	4.74	2.5-AC LOTS	11.0							11.00
A5	2.21	2.21	LANDSCAPE	0.0							0.00
OA1,A1-A5	54.63										15.125
B	11.83	11.83	2.5-AC LOTS	11.0							11.00
OA1,A1-A5,B	66.46										14.390
C	5.46	5.46	2.5-AC LOTS	11.0							11.00

* SEE IMPERVIOUS REDUCTION FACTOR CALCULATIONS IN "UD-BMP" SPREADSHEET

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer: JPS
Company: JPS
Date: August 30, 2018
Project: ROLLIN RIDGE ESTATES
Location: BASINS A & B

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**OA1**	**A1**	**A2**	**A3**	**A4**	**A5**	**B**							
Receiving Pervious Area Soil Type	Loamy Sand	Loamy Sand	Sandy Loam	Sandy Loam	Loamy Sand	Sandy Loam	Loamy Sand							
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	15.030	21.690	5.120	5.840	4.740	2.210	11.830							
Directly Connected Impervious Area (DCIA, acres)	0.000	0.000	0.000	3.740	0.000	0.000	0.000							
Unconnected Impervious Area (UIA, acres)	1.050	2.390	0.560	0.000	0.520	0.000	1.300							
Receiving Pervious Area (RPA, acres)	13.980	19.300	4.560	0.120	4.220	2.210	10.530							
Separate Pervious Area (SPA, acres)	0.000	0.000	0.000	1.980	0.000	0.000	0.000							
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	V	C	C	C							

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	15.030	21.690	5.120	5.840	4.740	2.210	11.830							
Directly Connected Impervious Area (DCIA, %)	0.0%	0.0%	0.0%	64.0%	0.0%	0.0%	0.0%							
Unconnected Impervious Area (UIA, %)	7.0%	11.0%	10.9%	0.0%	11.0%	0.0%	11.0%							
Receiving Pervious Area (RPA, %)	93.0%	89.0%	89.1%	2.1%	89.0%	100.0%	89.0%							
Separate Pervious Area (SPA, %)	0.0%	0.0%	0.0%	33.9%	0.0%	0.0%	0.0%							
A_R (RPA / UIA)	13.314	8.075	8.143	0.000	8.115	0.000	8.100							
I_a Check	0.070	0.110	0.110	1.000	0.110	1.000	0.110							
f / I for WQCV Event:	3.2	3.2	1.7	1.7	3.2	1.7	3.2							
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5							
f / I for 100-Year Event:	0.4	0.4	0.3	0.3	0.4	0.3	0.4							
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.15	0.24	0.29	0.00	0.24	1.00	0.24							
IRF for 5-Year Event:	0.29	0.46	0.47	1.00	0.46	1.00	0.46							
IRF for 100-Year Event:	0.30	0.48	0.49	1.00	0.48	1.00	0.48							
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	7.0%	11.0%	10.9%	64.0%	11.0%	0.0%	11.0%							
Effective Imperviousness for WQCV Event:	1.1%	2.6%	3.1%	64.0%	2.6%	0.0%	2.6%							
Effective Imperviousness for 5-Year Event:	2.0%	5.1%	5.1%	64.0%	5.1%	0.0%	5.1%							
Effective Imperviousness for 100-Year Event:	2.1%	5.2%	5.3%	64.0%	5.2%	0.0%	5.2%							
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	83.5%	73.1%	67.8%	N/A	73.1%	N/A	73.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	97.8%	63.9%	62.5%	0.0%	64.0%	N/A	63.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**14.4%**
Total Site Effective Imperviousness for WQCV Event:	**7.6%**
Total Site Effective Imperviousness for 5-Year Event:	**9.4%**
Total Site Effective Imperviousness for 100-Year Event:	**9.5%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

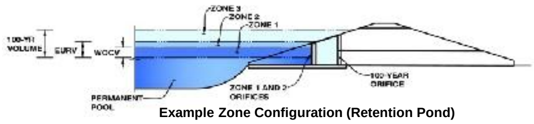
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: ROLLIN RIDGE ESTATES

Basin ID: A



Example Zone Configuration (Retention Pond)

Depth Increment = | | ft

Required Volume Calculation

Selected BMP Type =	EDB			
Watershed Area =	66.46	acres		
Watershed Length =	2,250	ft		
Watershed Slope =	0.045	ft/ft		
Watershed Imperviousness =	9.50%	percent		
Percentage Hydrologic Soil Group A =	30.0%	percent		
Percentage Hydrologic Soil Group B =	70.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.355	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.551	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.372	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.564	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.195	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.031	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.334	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.189	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.07 in.) =	9.756	acre-feet	3.07	inches
Approximate 2-yr Detention Volume =	0.345	acre-feet		
Approximate 5-yr Detention Volume =	0.527	acre-feet		
Approximate 10-yr Detention Volume =	1.027	acre-feet		
Approximate 25-yr Detention Volume =	1.439	acre-feet		
Approximate 50-yr Detention Volume =	1.568	acre-feet		
Approximate 100-yr Detention Volume =	2.130	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.355	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.196	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.579	acre-feet
Total Detention Basin Volume =	2.130	acre-feet

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
Bot EL=7526.0	--	1.00	--	--	--	5,106	0.117	2,507	0.058
	--	3.00	--	--	--	7,227	0.166	14,891	0.342
	--	5.00	--	--	--	9,657	0.222	31,775	0.729
	--	7.00	--	--	--	12,439	0.286	53,871	1.237
	--	9.00	--	--	--	15,569	0.357	81,879	1.880
100-Yr WSL=7535.0	--	10.00	--	--	--	17,228	0.396	98,277	2.256
Top EL=7537.0	--	12.00	--	--	--	20,000	0.459	135,505	3.111
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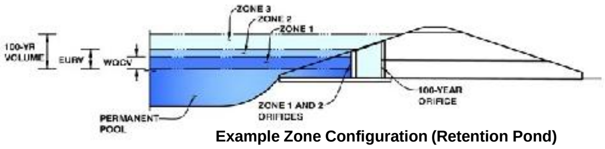
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: ROLLIN RIDGE ESTATES

Basin ID: A



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.09	0.355	Orifice Plate
Zone 2 (EURV)	4.15	0.196	Orifice Plate
Zone 3 (100-year)	9.68	1.579	Weir&Pipe (Restrict)
		2.130	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.15	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	14.10	inches
Orifice Plate: Orifice Area per Row =	2.01	sq. inches (diameter = 1-9/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.396E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.38	2.77					
Orifice Area (sq. inches)	2.01	2.01	2.01					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.15	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	8.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.15	N/A	feet
Over Flow Weir Slope Length =	8.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.95	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	44.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	22.40	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.01	N/A	ft^2
Outlet Orifice Centroid =	1.12	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	39.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.94	feet
Stage at Top of Freeboard =	11.94	feet
Basin Area at Top of Freeboard =	0.46	acres

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.07
Calculated Runoff Volume (acre-ft) =	0.355	0.551	0.372	0.564	1.195	3.031	4.334	6.189	9.756
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.355	0.551	0.372	0.564	1.195	3.033	4.337	6.187	9.758
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.56	0.84	1.19	1.85
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	1.3	11.7	37.4	55.5	79.4	122.8
Peak Inflow Q (cfs) =	6.9	10.7	7.3	11.0	23.0	57.7	82.0	116.1	180.8
Peak Outflow Q (cfs) =	0.2	0.3	0.2	0.3	15.4	49.0	56.5	68.7	156.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	1.3	1.3	1.0	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.1	1.3	1.5	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	45	39	45	42	32	27	22	14
Time to Drain 99% of Inflow Volume (hours) =	**40**	48	41	48	47	43	41	37	31
Maximum Ponding Depth (ft) =	2.93	3.96	3.02	4.02	4.51	5.25	6.62	9.25	10.76
Area at Maximum Ponding Depth (acres) =	0.16	0.19	0.17	0.19	0.21	0.23	0.27	0.37	0.42
Maximum Volume Stored (acre-ft) =	0.329	0.512	0.344	0.526	0.624	0.786	1.130	1.967	2.562

APPENDIX D

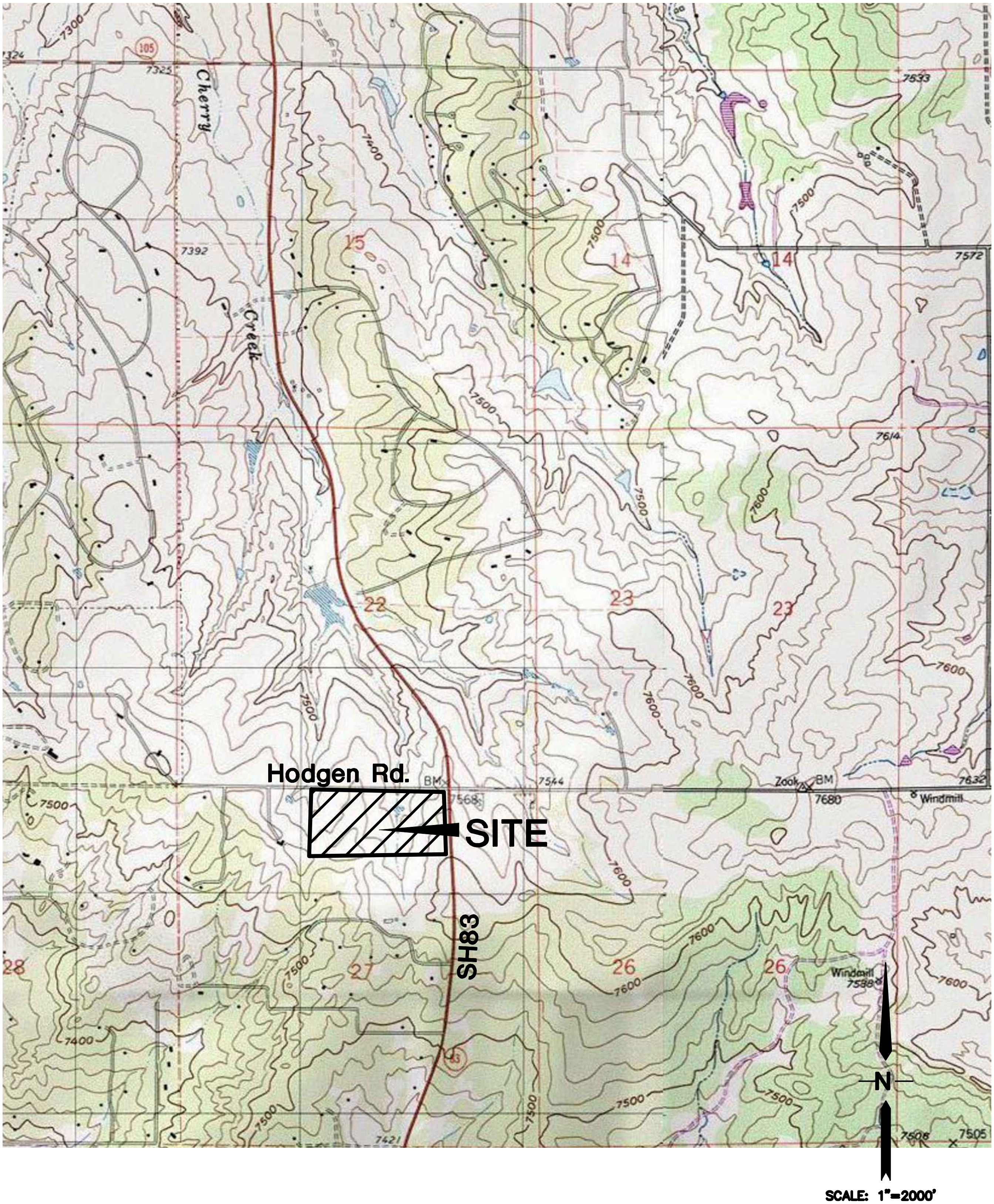
DRAINAGE COST ESTIMATE

ROLLIN RIDGE ESTATES
DRAINAGE IMPROVEMENTS COST ESTIMATE

Item No.	Description	Quantity	Unit	Unit Cost ($$$)	Total Cost ($$$)
	PRIVATE DRAINAGE IMPROVEMENTS				
506	Riprap Aprons (d_{50} = 12")	5	CY	$98	$490
603	42" RCP Culvert w/ FES	70	LF	$134	$9,380
603	36" RCP Pond Discharge Pipe w/ FES	80	LF	$124	$9,920
604	Detention Pond Grading	3400	CY	$5	$17,000
604	Detention Pond Forebay	1	EA	$3,000	$3,000
604	Detention Pond Outlet Structure	1	LS	$8,000	$8,000
604	Detention Pond Spillway	1	LS	$3,000	$3,000
	SUBTOTAL				**$50,790**
	Contingency @ 15%				$7,619
	TOTAL				**$58,409**
	PUBLIC DRAINAGE IMPROVEMENTS (NON-REIMBURSABLE)				
506	Riprap Culvert Aprons (d_{50} = 12")	20	CY	$98	$1,960
603	18" RCP Culvert w/ FES	170	LF	$69	$11,730
603	36" RCP Culvert w/ FES	60	LF	$124	$7,440
	SUBTOTAL				**$21,130**
	Contingency @ 15%				$3,170
	TOTAL				**$24,300**
	TOTAL DRAINAGE IMPROVEMENTS				**$82,708**

APPENDIX E

FIGURES



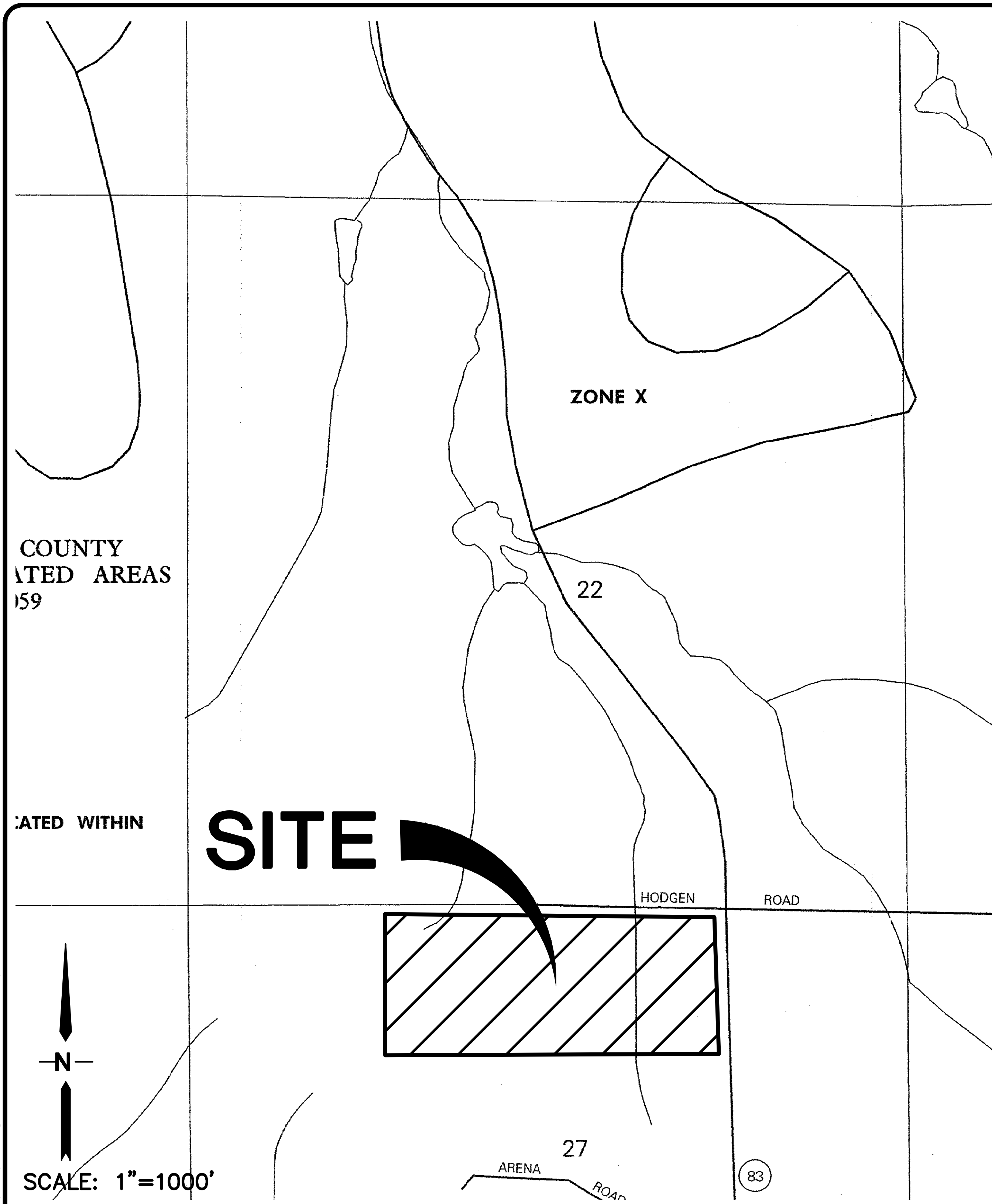
VICINITY MAP

JPS ENGINEERING

ROLLIN RIDGE ESTATES

FIGURE A1

JPS PROJ NO. 081702



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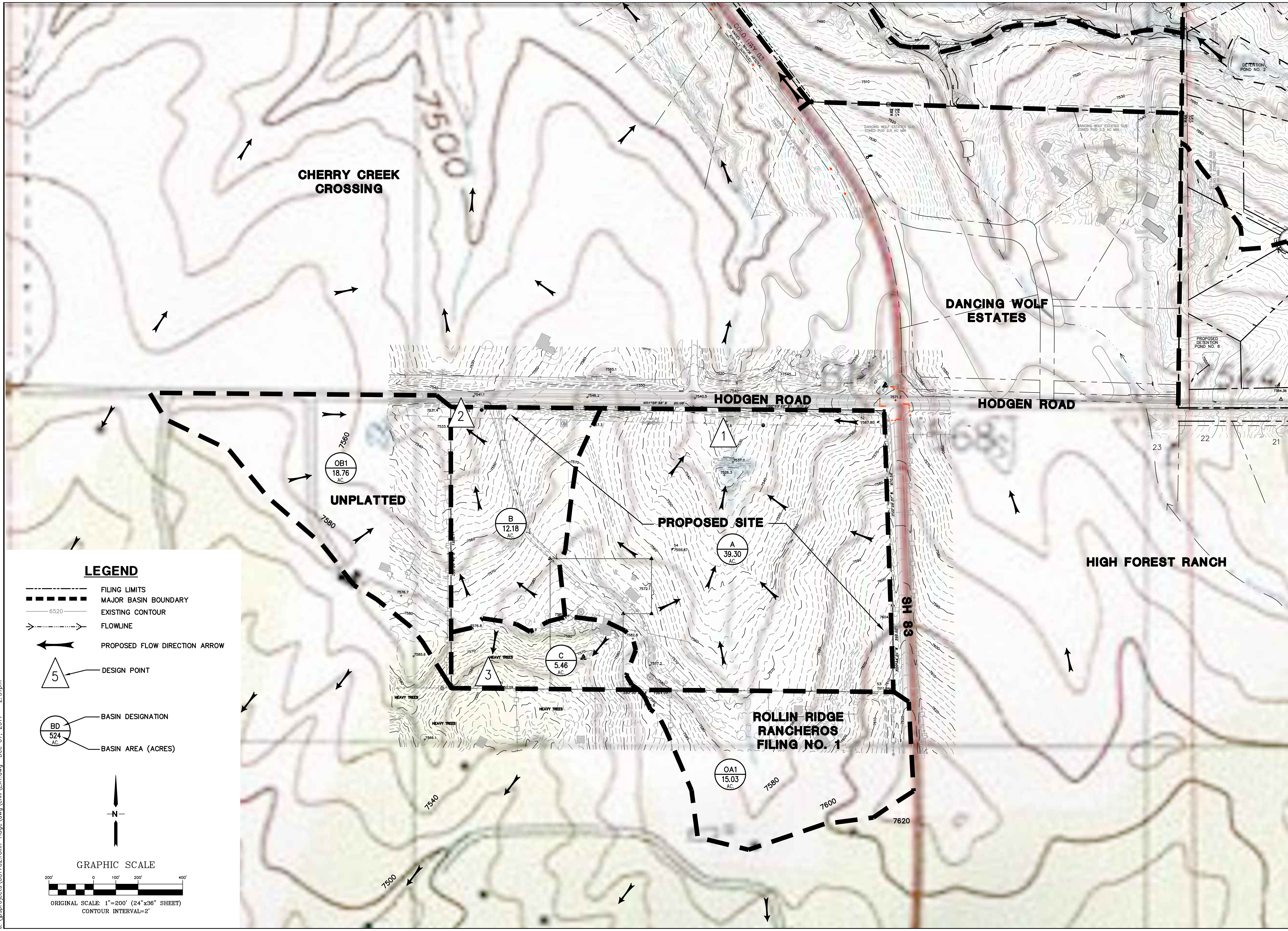
FLOODPLAIN MAP

JPS ENGINEERING

ROLLIN RIDGE ESTATES

FIGURE FP1

JPS PROJ NO. 081702



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ROLLIN RIDGE ESTATES

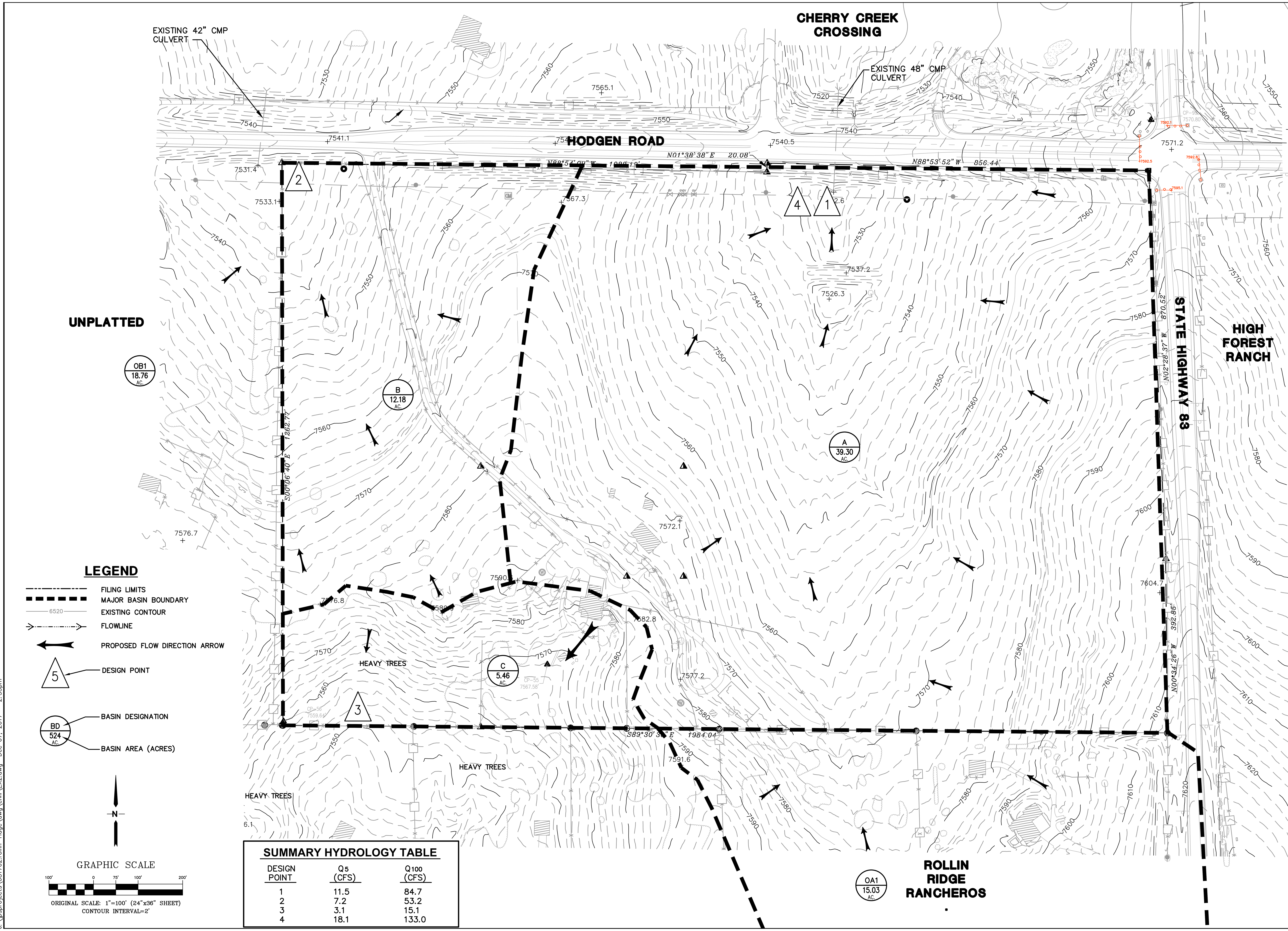
MAJOR BASIN / HISTORIC DRAINAGE PLAN

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	REVISION	BY	DATE

HORZ. SCALE:	1"=200'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	9/12/17	LAST MODIFIED:	12/07/17
PROJECT NO:	081702	MODIFIED BY:	BJJ
SHEET:	EX1		



SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	11.5	84.7
2	7.2	53.2
3	3.1	15.1
4	18.1	133.0

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

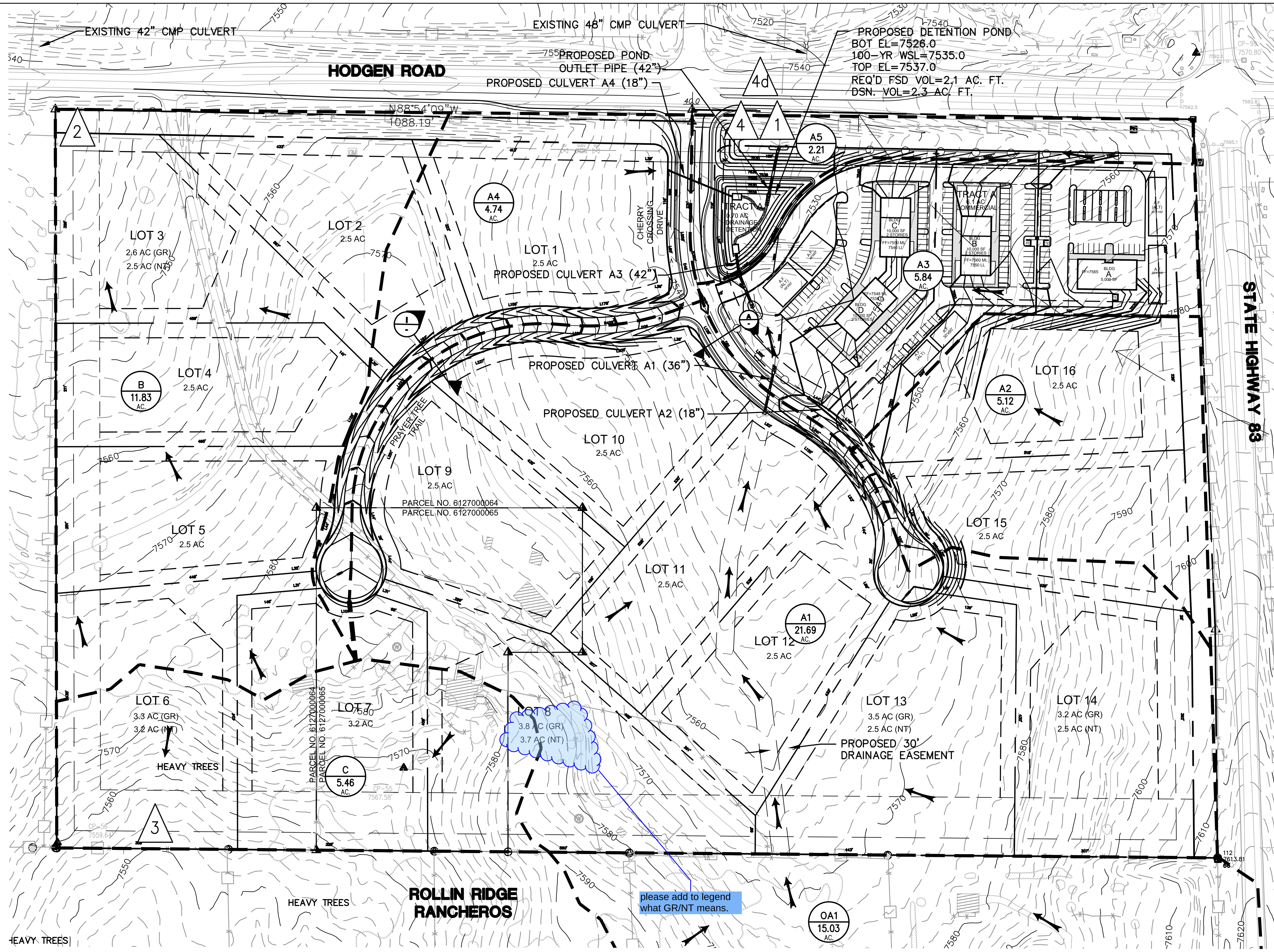
No.	REVISION	BY	DATE

ROLLIN RIDGE ESTATES

HISTORIC DRAINAGE PLAN

HORZ. SCALE: 1"=100'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 9/12/17	LAST MODIFIED: 12/07/17
PROJECT NO: 081702	MODIFIED BY: BJJ

SHEET: EX2



SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	29.4	106.9
2	13.9	62.7
3	4.3	16.8
4	38.2	157.4
(4d DETAINED)	14.2	131.4

GENERAL DRAINAGE NOTES:

1. INDIVIDUAL BUILDERS SHALL PROVIDE POSITIVE DRAINAGE AWAY FROM STRUCTURES AND ACCOUNT FOR POTENTIAL CROSS-LOT DRAINAGE IMPACTS WITHIN EACH LOT.

2. BUILDERS AND PROPERTY OWNERS SHALL IMPLEMENT & MAINTAIN EROSION CONTROL BEST MANAGEMENT PRACTICES FOR PROTECTION OF DOWNSTREAM PROPERTIES AND FACILITIES.

LEGEND

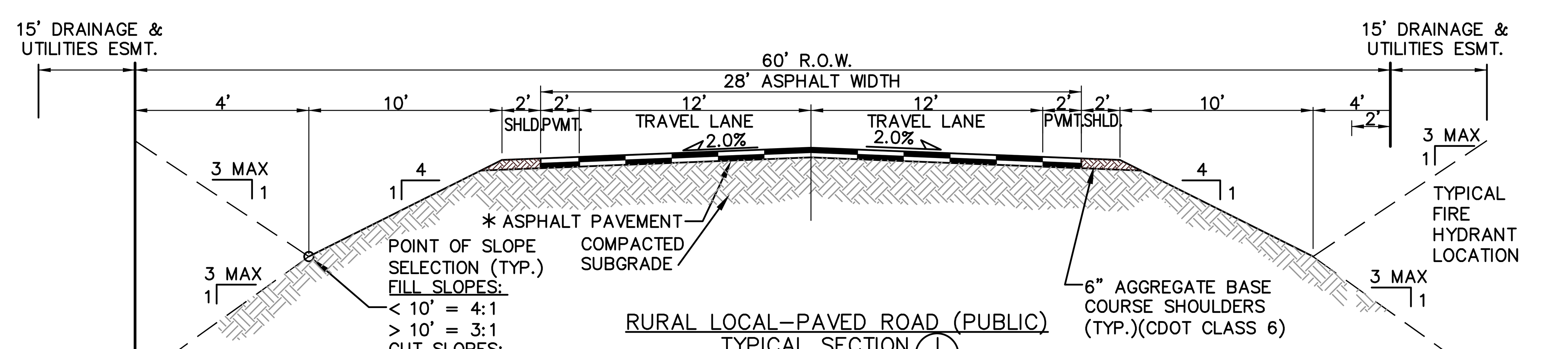
- FILING LIMITS
- MAJOR BASIN BOUNDARY
- 6520 EXISTING CONTOUR
- FLOWLINE
- PROPOSED FLOW DIRECTION ARROW
- 5 DESIGN POINT
- BD 524 AC: BASIN DESIGNATION / BASIN AREA (ACRES)

N

GRAPHIC SCALE

100' 0 75' 100' 200'

ORIGINAL SCALE: 1"=100' (24"x36" SHEET)
CONTOUR INTERVAL=2'



RURAL LOCAL-PAVED ROAD (PUBLIC)
TYPICAL SECTION (1)
SCALE: 1"=5'

* PAVEMENT SECTION TO BE DESIGNED BY GEOTECHNICAL ENGINEER PER EPC SPECIFICATIONS. (4" HBP OVER 6" ABC FOR BIDDING PURPOSES)

IMPERVIOUS AREA CALCULATIONS

BASIN A3 AREA = 5.84 AC.

IMPERVIOUS AREAS:

SURFACE TYPE	AREA
PARKING PAVEMENT	105,412 SF
BUILDING	45,560 SF
SIDEWALK	11,834 SF
TOTAL	162,806 SF
	= 3.74 AC
	= 64% IMPERVIOUS

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No.	REVISION	BY	DATE

ROLLIN RIDGE ESTATES

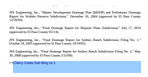
DEVELOPED DRAINAGE PLAN

HORZ. SCALE:	1"=100'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	9/13/17	LAST MODIFIED:	8/30/18
PROJECT NO:	081702	MODIFIED BY:	BJJ
SHEET:	D1.1		

Z:\081702.rollin-ridge\dwg\civil\D1.1.dwg Aug 30, 2018 - 4:36pm

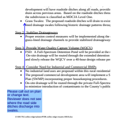
Markup Summary

dsdnijkamp (7)



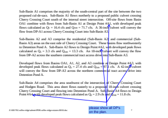
Subject: Engineer
Page Label: 6
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:39 PM
Color: ■

Cherry Creek Sub filing no 1



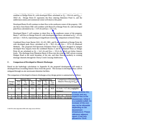
Subject: Engineer
Page Label: 9
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:40 PM
Color: ■

Please call out on plan or change text. Reviewer does not see where the road side ditches discharge into swales.



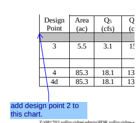
Subject: Engineer
Page Label: 11
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:41 PM
Color: ■

please show all DP's on the plan.



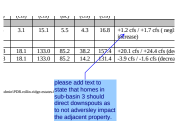
Subject: Engineer
Page Label: 12
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:42 PM
Color: ■

please describe this increase and any impact it has to the downstream, follow it to a suitable outfall. An increase of this size may not be allowable depending on the downstream infrastructure. Please reference adjacent report, it has only allowed for 31cfs.



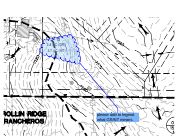
Subject: Engineer
Page Label: 12
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:43 PM
Color: ■

add design point 2 to this chart.



Subject: Engineer
Page Label: 12
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:44 PM
Color: ■

please add text to state that homes in sub-basin 3 should direct downspouts as to not adversley impact the adjacent property.



Subject: Group
Page Label: 65
Lock: Locked
Author: dsdnijkamp
Date: 10/2/2018 3:49:47 PM
Color: ■

please add to legend what GR/NT means.