INNOVATIVE DESIGN. **CLASSIC RESULTS.**

PRELIMINARY/FINAL DRAINAGE REPORT FOR REDTAIL RANCH FILING 1

JULY 2018

CCES FDR Responses

Prepared for:
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SP-18-004/SF-18-021

Job no. 2525.00

PCD Project No. SF-18-xxx

PRELIMINARY/FINAL DRAINAGE REPORT FOR REDTAIL RANCH FILING NO. 1

DRAINAGE REPORT STATEMENT

DESIGN 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 report and said report is in conformity with the applicable master plan and drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

_____ _____

Marc A. Whorton, Colorado P.E. #37155 Date

OWNERS/DEVELOPER'S STATEMENT:
I, the owner/developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Name: Michael S. Ludwig

Title: _____

Address: 4255 Arrowhead Drive

Colorado Springs, CO 80908

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

_____ _____

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

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

PRELIMINARY/FINAL DRAINAGE REPORT FOR REDTAIL RANCH FILING NO. 1

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PRELIMINARY\FINAL DRAINAGE REPORT FOR REDTAIL RANCH FILING NO. 1

PURPOSE

This document is the Preliminary/Final Drainage Report for Redtail Ranch Filing No. 1. The purpose of this report is to address on-site and off-site drainage patterns and improvements required for this development to minimize impacts to the adjacent properties.

GENERAL DESCRIPTION

This development is made up of multiple parcels all owned by a single property owner. The total acreage for the site is 67.9 acres and is located in the county of El Paso within Section 9, Township 12 South, Range 65 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bounded on the north, west and south by existing platted and unplatted residential properties (RR-5 Zone) and to the east by existing Vollmer Road. The overall site is proposed for 12 single-family 5-acre minimum lots. The current zoning of the property is RR-5 (5-acre Residential Zoning).

and paved rural roads...

The average soil condition reflects Hydrologic Group "B" (Elbeth sandy loam and Kettle gravelly loamy sand), as determined by the "Soil Survey of El Paso County Area," prepared by the Soil Conservation Service.

EXISTING DRAINAGE CONDITIONS

This property sits at the very top of two major drainage basins – Upper Black Squirrel to the east and Kettle Creek to the west. Thus, a major ridge-line runs through the middle of the property from north to south. The existing drainage patterns generally run in a southwesterly and southeasterly direction in several natural drainage corridors at slopes ranging from 2% to 5%. Multiple stock ponds exist on the property within these natural drainageways. There are two culvert crossings at Vollmer Road that the east half of the property drain towards. Much of the property was burned in the Black Forest fire several years back. The property owner has cleaned up most of the burn debris leaving some sparse treed areas remaining along the ridgeline. The remainder of the property is covered with native grasses. The west portion of the property is currently platted as Walker Place, Lots 1 & 2. Several home structures have recently been removed from the site leaving multiple well heads and some gravel paths remaining throughout the property. Current access to

and from the property exists in multiple locations. Driveway access from the north off of Ward Lane and driveway access from the south off of Linwood Lane (private road). The public access proposed along with this development is the continuation of Ward Lane (paved) into the site from the north connected with a new east-west public roadway accessing Vollmer Road.

Design Point H1 (Q_5 = 3 cfs and Q_{100} = 18 cfs) consists of pre-development flows from Basins OS-1 and EX-1 within the Kettle Creek Basin. These historic flows travel in a westerly direction within a natural drainageway towards the west boundary and then head off-site.

Design Point H2 (Q_5 = 4 cfs and Q_{100} = 19 cfs) consists of pre-development flows from Basin EX-2 within the Kettle Creek Basin. These historic flows travel in a southwesterly direction within a natural drainageway towards the west boundary where they are collected in an existing stock pond. As mentioned in the previous Walker Place Drainage Report, this facility collects the minor flows while a grass-lined overflow swale directs the pond outflows around the earthen embankment located near the property line. This facility is planned to remain in place within Lot 3 of the proposed development with ownership and maintenance by the lot owner.

Design Point H3 (Q_5 = 5 cfs and Q_{100} = 25 cfs) consists of pre-development flows from Basin EX-3 within the Kettle Creek Basin. These historic flows travel in a southwesterly direction within a natural drainageway. Currently, a good portion of this historic basin is collected into another stock pond just east of the existing gravel driveway. This facility was also mentioned in the Walker Place Drainage Report as collecting the pre-developed flows and then releasing them through an 18" pond outfall. This existing facility is proposed to be replaced with a formal BMP to handle the developed flows at this location. (See Developed Conditions)

Design Point H4 (Q_5 = 0.3 cfs and Q_{100} = 1.9 cfs) consists of pre-development flows from Basin EX-4 within the Kettle Creek Basin. These historic sheet flows travel in a southwesterly direction towards the southwest corner of the property. No development is proposed within this small basin.

Design Point H5 (Q_5 = 8 cfs and Q_{100} = 43 cfs) consists of pre-development flows from Basins OS-2, OS-3, OS-4, EX-5 and EX-7 within the Upper Black Squirrel Basin. These historic flows sheet flow in a south

easterly direction towards multiple stock ponds at the southeast corner of the property. These historic flows travel to the existing stock pond facilities with an ultimate release point at an existing 18" CMP crossing Vollmer Road.

Design Point H6 (Q_5 = 2 cfs and Q_{100} = 10 cfs) consists of pre-development flows from Basin EX-8 within the Upper Black Squirrel Basin. These historic sheet flows travel in a easterly direction towards Vollmer Road where an existing 24" CMP conveys the flows under Vollmer Road.

As mentioned earlier, this site was previously studied as part of the Walker Place Subdivision, prepared by ADP, Inc., approved January 2010. This report generally described the drainage characteristics for the majority of the west half of the property. Along with this Walker Place Final Plat, drainage fees were paid within the Kettle Creek Basin for the two lots currently platted.

in the amount of $1,904.76

DEVELOPED DRAINAGE CONDITIONS (KETTLE CREEK BASIN)

The attached developed conditions drainage map contains several design points related to proposed culvert crossings and BMP facilities. All proposed culverts have been designed for the 100-yr. developed flows. All proposed storm facilities within the public Right-of-way will be public with ownership and maintenance by El Paso County. All proposed BMP facilities within easements will be owned and maintained by the individual lot owner.

(roadside ditches and culverts)

Design Point D1 (Q_5 = 3 cfs and Q_{100} = 16 cfs) consists of developed flows from Basins OS-1 and A. These existing off-site and on-site developed flows travel in a westerly direction within a natural drainageway towards the west boundary and then head off-site. With the reduction in tributary area due to the extension of Ward Lane, the developed flows at this location are equal to or below the pre-development conditions. Therefore, no further improvements within this basin are proposed at this time. The additional imperviousness with the construction of Ward Lane is collected in a sideroad ditch and conveyed south towards Pond 1.

Design Point D2 (Q_5 = 3 cfs and Q_{100} = 17 cfs) consists of developed flows from Basin B. These on-site developed flows travel in a westerly direction within a natural drainageway towards the west boundary and the existing stock pond. With the reduction in tributary area due to the extension of Ward Lane, the developed flows at this location are below the pre-development conditions. Therefore, no further improvements within this basin are proposed at this time. The additional imperviousness with the construction of Ward Lane is collected in a sideroad ditch and conveyed south towards Pond 1. The existing stock pond facility is planned to remain in place within Lot 3 with ownership and maintenance by the lot owner.

Design Point D3 (Q_5 = 3 cfs and Q_{100} = 13 cfs) consists of developed flows from Basin E. These on-site developed flows sheet flow towards the extension of Ward Lane and then travel in a southerly direction within the sideroad ditch towards D3. At this location a 24" RCP culvert is proposed to convey these flows under the roadway. (See Appendix for Culvert Design)

Design Point D4 (Q_5 = 7 cfs and Q_{100} = 28 cfs) consists of developed flows from Basins D, F and Design Point D3 and represents the total inflow to Pond 1. At this location, the existing stock pond is proposed to be replaced with a formal BMP as described below:

Pond 1 (Sand Filter Basin) has the following design parameters as a full-spectrum facility:

0.08 Ac.-ft. WQCV required

0.11 Ac.-ft. EURV required

0.17 Ac.-ft. EURV design with 4:1 max. slopes

0.51 Ac.-ft. 100-yr. storage

Total In-flow:	**Q_5 = 7 cfs, Q_{100} = 28 cfs**
Pond Design Release:	**Q_5 = 0.14 cfs, Q_{100} = 16 cfs**
Pre-development Release:	**Q_5 = 0.30 cfs, Q_{100} = 18 cfs**

This facility will be constructed within a drainage easement with ownership and maintenance by the owner of lot 5.

HOA needs to maintain the PBMPs

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Design Point D5 (Q_5 = 1.7 cfs and Q_{100} = 24 cfs) consists of developed flows from Basin C and the outflow from Pond 1. These on-site developed flows travel in a southwesterly direction within a natural drainageway and existing 30' drainage easement towards the south boundary. With the reduction in tributary area due to the extension of Ward Lane and the proposed Pond 1, the developed flows at this location are at or below the pre-development conditions. Therefore, no further improvements within this basin are proposed at this time.

DEVELOPED DRAINAGE CONDITIONS (UPPER BLACK SQUIRREL BASIN)

Design Point D6 (Q_5 = 6 cfs and Q_{100} = 29 cfs) consists of developed flows from Basins OS-2, OS-3, EX-5 and G. These off and on-site developed flows sheet flow towards the sideroad ditch along the north side of the proposed public road (Sanctuary Pine Dr.) and then in an easterly direction towards Design Point D6. At this location, the existing stock pond will be removed along with the road construction and a 30" RCP culvert is proposed to convey these flows under the roadway. (See Appendix for Culvert Design)

Design Point D7 (Q_5 = 10 cfs and Q_{100} = 46 cfs) consists of developed flows from Basins OS-4, H and Design Point D6 and represents the total inflow to Pond 2. At this location, the existing stock pond is proposed to be replaced with a formal BMP as described below:

Pond 2 (Sand Filter Basin) has the following design parameters as a full-spectrum facility:

0.13 Ac.-ft. WQCV required

0.14 Ac.-ft. EURV required

0.23 Ac.-ft. EURV design with 4:1 max. slopes

1.1 Ac.-ft. 100-yr. storage

Total In-flow:	**Q_5 = 10 cfs, Q_{100} = 46 cfs**
Pond Design Release:	**Q_5 = 0.19 cfs, Q_{100} = 28 cfs**
Pre-development Release:	**Q_5 = 0.53 cfs, Q_{100} = 32 cfs**

This facility will be constructed within a drainage easement with ownership and maintenance by the owner of lot 7.

HOA needs to maintain the PBMPs

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Design Point D8 (Q_5 = 2 cfs and Q_{100} = 10 cfs) consists of developed flows from Basin L. These developed sheet flows travel in a easterly direction towards Vollmer Road and the existing 24" CMP under Vollmer Road. With the reduction in tributary area to this facility, the developed flows at this location remain consistent with the pre-development condition. Therefore, no further improvements within this basin are proposed at this time.

Address adequacy of existing culvert and providing ponding easement.

Design Point D9 (Q_5 = 1 cfs and Q_{100} = 3 cfs) consists of developed flows from Basin I. These on-site developed flows travel as sideroad ditch flows in an easterly direction towards Vollmer Road. At this location an 18" RCP culvert is proposed to convey these flows under the roadway. (See Appendix for Culvert Design)

Address sediment control

Design Point D10 (Q_5 = 2.4 cfs and Q_{100} = 29 cfs) consists of developed flows from Basins I, J and K and the outflow from Pond 2. The Pond 2 outflows travel in an easterly direction within a natural drainageway and proposed 30' drainage easement towards the Vollmer Road. With the construction of proposed Pond 2, the developed flows at this location are below the pre-development conditions. Therefore, no further improvements within this basin are proposed at this time.

Address condition and capacity of existing culvert and providing ponding easement.

HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Individual on-site developed basin design used for culvert sizing and system routing was calculated using the Rational Method. BMP design was calculated using the UD-Detention (Version 3.07) spreadsheet developed by the Urban Drainage and Flood Control District. The overall drainage basin design model including the proposed ponds and downstream basins was calculated using PondPack V8i with time of concentrations estimated using SCS procedures described in the DCM based upon the hydrologic soil type and runoff curve numbers (CN) chart. (Table 5-4)

Rational method and C values?

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements. This site adheres to this **Four Step Process** as follows:

natural vegetation(?)

1. **Employ Runoff Reduction Practices:** Development of project site is proposed large lot single family residential (5.0 ac. min.) with homes and associated landscaping. Proposed impervious areas (roof tops, patios) will sheet flow across landscaped ground and through large open areas across the lots to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site.

roads and adjacent properties

2. **Stabilize Drainageways:** This site will utilize roadside ditches with culvert crossings throughout the site and channel stabilization and grade control structures installed within some of the historic natural channels. These facilities will then direct the on-site development flows to the multiple BMPs, designed to release at or below historic rates into the Kettle Creek and Upper Black Squirrel drainage basins. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream drainageways is anticipated.

where?

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in two permanent Sand Filter Basins designed per current El Paso County drainage criteria.

the impervious road areas of (?)

4. **Consider need for Industrial and Commercial BMPs**: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative is being submitted concurrently with this report and development. Details such as site specific source control construction BMP's as well as permanent BMP's are detailed in this plan and narrative to protect receiving waters. The described BMP's will be constructed and maintained by the developer upon approval by El Paso County Staff.

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Discuss O&M plan and HOA maintenance responsibility for permanent BMPs.

FLOODPLAIN STATEMENT

No portion of this site is located within a FEMA floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Numbers 08041C 0325F, with effective date of March 17, 1997 (See Appendix).

EROSION CONTROL PLAN

The Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. We respectfully request that the Erosion Control Plan and cost estimate be submitted in conjunction with the Overlot Grading Plan and construction assurances posted prior to obtaining a grading permit.

? clarify.

DRAINAGE & BRIDGE FEES

This site lies within two major drainage basins: Kettle Creek and Upper Black Squirrel. The total acreage for the property is 67.9 acres. The acreage within each drainage basin equals:

Kettle Creek Basin – 32.17 Ac.

Upper Black Squirrel Basin – 35.69 Ac.

Kettle Creek Basin has fees calculated below, however, Upper Black Squirrel currently has no drainage or bridge fees. The fees are calculated using the following impervious acreage method approved by El Paso County. The total development area within the Kettle Creek Basin equals 32.17 ac. with current zoning of RR-5 (5-ac. residential land use). Thus, the percent imperviousness for this subdivision is calculated as follows:

RR-5 Zone Area

(Per El Paso County Percent Impervious Chart for 5.0 ac. lots: 7%)

32.17 Ac. x 7% = **2.25 Impervious Ac.**

The following calculations are based on the 2018 drainage/bridge fees for the Kettle Creek Drainage Basin:

FEE TOTALS (prior to reduction):

Bridge Fees - None

Drainage Fees (Kettle Creek)

$ 9,287.00 x 2.25 Impervious Ac. = $ 20,895.75

There is a 25% fee reduction for rural lots; however, the 50% pond credit can't be taken because the County does not have approved DBPS facilities that are not in place. All requirements of ECM 3.10.4a must be met.

Per the ECM 3.10.4a, this development requests a reduction of drainage fees based on the on-site full spectrum Sand Filter Basin proposed to be constructed (Pond 1). The following facility within the Kettle Creek Drainage Basin seems to meet the criteria for this reduction:

Sand Filter Basin (Pond 1)	0.51 ac-ft. full spectrum	$ 18,000 x 50% =	$ 9,000.00

FEE TOTALS (with reduction):

Bridge Fees - None

Drainage Fees (Kettle Creek)

$ 20,895.75 - 9,000.00 = $ 11,895.75

Subtract fees previously paid.

Upper Black Squirrel currently has no bridge or drainage fees.

SUMMARY

This proposed development remains consistent with pre-development drainage conditions with the construction of the proposed on-site Sand Filter Basins. These proposed facilities meet current criteria and provide full spectrum design. The proposed development will not adversely impact surrounding developments.

PREPARED BY:
Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

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REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, as revised in November 1991 and 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

2. Soil Survey of El Paso County Area, Colorado Soil Conservation Service, June 1981.

3. "Preliminary/Final Drainage Report for Walker Place Subdivision", by ADP, Inc., approved January 2010.

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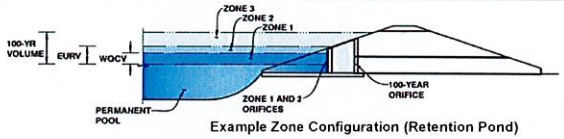
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: REDTAIL RANCH FILING NO. 1

Basin ID: POND 2



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.57	0.127	Filtration Media
Zone 2 (EURV)	1.13	0.137	Orifice Plate
Zone 3 (100-year)	3.74	0.806	Weir&Pipe (Restrict)
		1.070	Total

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

Underdrain Orifice Invert Depth =	1.50	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	1.95	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.08	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 =	0.57	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	5.00	inches
Orifice Plate: Orifice Area per Row =	0.66	sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.583E-03	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)	0.57	0.80	1.02					
Orifice Area (sq. inches)	0.66	0.66	0.66					

	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 =	1.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	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 =	1.25	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.75	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	12.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.00	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	2.53	N/A	ft^2
Outlet Orifice Centroid =	0.83	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.09	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	18.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.87	feet
Stage at Top of Freeboard =	5.87	feet
Basin Area at Top of Freeboard =	0.58	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	3.85
Calculated Runoff Volume (acre-ft) =	0.127	0.264	0.181	0.282	0.660	1.781	2.481	3.396	6.337
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.126	0.264	0.180	0.282	0.659	1.780	2.480	3.394	6.330
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.58	0.80	1.08	1.96
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	0.531	5.0	17.1	23.7	32.0	58.2
Peak Inflow Q (cfs) =	1.9	3.9	2.7	4.2	9.7	25.9	36.0	49.0	90.2
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.190	5.4	22.3	25.1	28.4	74.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	1.1	1.3	1.1	0.9	1.3
Structure Controlling Flow =	Filtration Media	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.8	2.1	2.3	2.5
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) =	12	22	16	23	25	22	20	18	11
Time to Drain 99% of Inflow Volume (hours) =	12	22	16	23	26	25	25	24	21
Maximum Ponding Depth (ft) =	0.46	1.00	0.68	1.07	1.52	1.96	2.59	3.76	4.81
Area at Maximum Ponding Depth (acres) =	0.23	0.25	0.24	0.25	0.27	0.28	0.31	0.40	0.55
Maximum Volume Stored (acre-ft) =	0.103	0.232	0.154	0.250	0.364	0.486	0.675	1.081	1.574

reduce to 1 or less

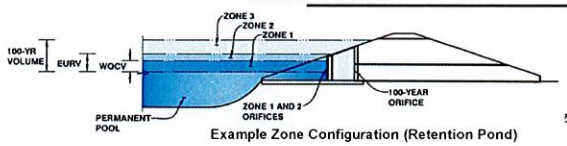
verify safety

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: REDTAIL RANCH FILING NO. 1

Basin ID: POND 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.53	0.080	Filtration Media
Zone 2 (EURV)	1.19	0.112	Orifice Plate
Zone 3 (100-year)	3.00	0.380	Weir&Pipe (Restrict)
		0.572	Total

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

Underdrain Orifice Invert Depth =	1.50	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	1.55	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.06	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 =	0.53	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	1.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	5.00	inches
Orifice Plate: Orifice Area per Row =	0.66	sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.583E-03	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)	0.53	0.77	1.01					
Orifice Area (sq. inches)	0.66	0.66	0.66					

	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 =	1.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	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 =	1.25	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.63	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	12.00	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.00	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	15.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.57	N/A	ft^2
Outlet Orifice Centroid =	0.68	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.30	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	3.25	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.84	feet
Stage at Top of Freeboard =	5.09	feet
Basin Area at Top of Freeboard =	0.33	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	3.85
Calculated Runoff Volume (acre-ft) =	0.080	0.192	0.138	0.207	0.387	0.838	1.125	1.499	2.735
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.080	0.192	0.138	0.206	0.386	0.838	1.125	1.499	2.736
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.24	0.77	1.06	1.42	2.57
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.299	2.9	9.5	13.1	17.5	31.6
Peak Inflow Q (cfs) =	1.5	3.7	2.6	3.9	7.3	11.5	12.0	27.8	50.4
Peak Outflow Q (cfs) =	0.1	0.1	0.1	0.142	3.6	12.5	14.8	16.2	37.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	1.2	1.3	1.1	0.9	1.2
Structure Controlling Flow =	Filtration Media	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0	2.6	2.9	1.3	1.5
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) =	12	23	19	25	25	23	22	21	15
Time to Drain 99% of Inflow Volume (hours) =	12	24	19	25	27	26	26	25	23
Maximum Ponding Depth (ft) =	0.45	1.09	0.79	1.16	1.46	1.73	2.00	2.74	3.93
Area at Maximum Ponding Depth (acres) =	0.16	0.18	0.17	0.18	0.19	0.20	0.21	0.23	0.33
Maximum Volume Stored (acre-ft) =	0.066	0.173	0.122	0.187	0.241	0.293	0.349	0.509	0.836

If contributing area at pond outfall / D5 is higher than existing condition the pond must be sized to release at the existing acreage x unit rate (14.8xPDUPF(q) vs 17.4xq)

reduce to 1 or less.

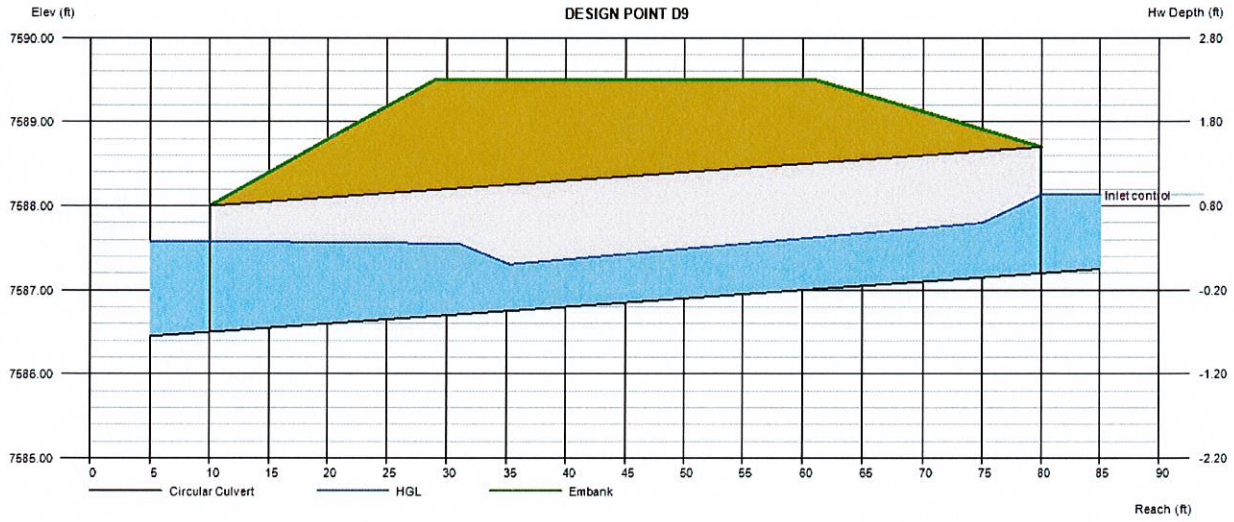
2 see revised

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jun 29 2018

DESIGN POINT D9

Invert Elev Dn (ft)	= 7586.50	**Calculations**	
Pipe Length (ft)	= 70.00	Qmin (cfs)	= 0.00
Slope (%)	= 1.00	Qmax (cfs)	= 3.00
Invert Elev Up (ft)	= 7587.20	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 18.0		
Shape	= Circular	**Highlighted**	
Span (in)	= 18.0	Qtotal (cfs)	= 3.00
No. Barrels	= 1	Qpipe (cfs)	= 3.00
n-Value	= 0.013	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 2.20
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 4.02
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7587.58
		HGL Up (ft)	= 7587.86
Embankment		Hw Elev (ft)	= 7588.13
Top Elevation (ft)	= 7589.50	Hw/D (ft)	= 0.62
Top Width (ft)	= 32.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 50.00		



Provide for D8, D10

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS				LANDSCAPE/UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
		AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)
EX-1	6.1	0.12	0.57	0.59	0.70	5.98	0.03	0.09	0.36	0.04	0.10	0.37	0.25	0.61	2.24
EX-2	10.1	1.00	0.57	0.59	0.70	9.10	0.03	0.09	0.36	0.08	0.14	0.39	0.84	1.41	3.98
EX-3	14.8	1.20	0.57	0.59	0.70	13.60	0.03	0.09	0.36	0.07	0.13	0.39	1.09	1.93	5.74
EX-4	0.9	0.00	0.89	0.90	0.96	0.90	0.03	0.09	0.36	0.03	0.09	0.36	0.03	0.08	0.32
EX-5	2.0	0.00	0.89	0.90	0.96	2.00	0.03	0.09	0.36	0.03	0.09	0.36	0.06	0.18	0.72
EX-6	1.5	0.00	0.89	0.90	0.96	1.50	0.03	0.09	0.36	0.03	0.09	0.36	0.05	0.14	0.54
EX-7	26.4	1.10	0.57	0.59	0.70	25.30	0.03	0.09	0.36	0.05	0.11	0.37	1.39	2.93	9.88
EX-8	6.1	0.10	0.57	0.59	0.70	6.00	0.03	0.09	0.36	0.04	0.10	0.37	0.24	0.60	2.23
OS-1	3.5	0.30	0.57	0.59	0.70	3.20	0.05	0.12	0.39	0.09	0.16	0.42	0.33	0.56	1.46
OS-2	1.3	0.10	0.57	0.59	0.70	1.20	0.05	0.12	0.39	0.09	0.16	0.41	0.12	0.20	0.54
OS-3	1.7	0.10	0.57	0.59	0.70	1.60	0.05	0.12	0.39	0.08	0.15	0.41	0.14	0.25	0.69
OS-4	1.2	0.00	0.57	0.59	0.70	1.20	0.05	0.12	0.39	0.05	0.12	0.39	0.06	0.14	0.47

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Outfall / Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
H1	OS-1, EX-1	1.17	3.69	21.9	2.95	4.96	3	18	
H2	EX-2	1.41	3.98	24.3	2.80	4.70	4	19	
H3	EX-3	1.93	5.74	27.8	2.59	4.35	5	25	
H4	EX-4	0.08	0.32	15.9	3.43	5.76	0.3	1.9	
H5	OS-2, OS-3, OS-4, EX-5, EX-7	3.70	12.30	39.3	2.08	3.48	8	43	
H6	EX-8	0.60	2.23	26.0	2.70	4.53	2	10	

Provide acreage column

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY			TOTAL FLOWS		
	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
EX-1	0.25	0.61	2.24	0.09	300	18	17.5	360	3.6%	1.3	4.4	21.9	2.36	2.95	4.96	1	2	11
EX-2	0.84	1.41	3.98	0.09	300	14	19.0	470	4.5%	1.5	5.3	24.3	2.24	2.80	4.70	2	4	19
EX-3	1.09	1.93	5.74	0.09	300	16	18.2	770	3.6%	1.3	9.7	27.8	2.08	2.59	4.35	2	5	25
EX-4	0.03	0.08	0.32	0.09	250	22	15.9					15.9	2.74	3.43	5.76	0.1	0.3	1.9
EX-5	0.06	0.18	0.72	0.09	300	12	20.0	100	2.5%	1.1	1.5	21.5	2.36	2.96	5.00	0.1	0.5	4
EX-6	0.05	0.14	0.54	0.09	250	12	17.2					17.2	2.65	3.32	5.57	0.1	0.4	3
EX-7	1.39	2.93	9.88	0.09	300	9	22.0	1800	3.0%	1.7	17.3	39.3	1.67	2.08	3.48	2	6	34
EX-8	0.24	0.60	2.23	0.09	300	13	19.5	480	3.1%	1.2	6.5	26.0	2.16	2.70	4.53	1	2	10
OS-1	0.33	0.56	1.46	0.12	300	14	18.4					18.4	2.57	3.21	5.39	0.8	2	8
OS-2	0.12	0.20	0.54	0.12	300	16	17.6					17.6	2.62	3.28	5.50	0.3	0.7	3
OS-3	0.14	0.25	0.69	0.12	300	12	19.4					19.4	2.51	3.14	5.26	0.3	0.8	4
OS-4	0.05	0.14	0.47	0.12	270	12	17.8					17.8	2.61	3.27	5.48	0.2	0.5	3

LOT 5, BLOCK 2, GREEK MEADOWS SUBD. RR-5 ZONING

LOT 5, BLOCK 1, GREEK MEADOWS SUBD. RR-5 ZONING

WARD LANE

LOT 3, WIDEGUNNET SUBD. RR-5 ZONING

OS-1 3.5

OS-2 1.3

EX-1 6.1

EX-5 2.0

OS-3 1.7

UNPLATTED RR-5 ZONING

LOT 1, WALKER PLACE RR-5 ZONING

EXIST. STRUCTURE ALREADY REMOVED

UPPER BLACK SQUIRREL DRAINAGE BASIN

KETTLE CREEK DRAINAGE BASIN

EX-8 6.1

H6

EXIST. 24" CULVERT CROSSING

VOLLMER ROAD

EX-2 10.1

H1

H2

EXIST. STOCK POND

EX-7 26.4

EXIST. STOCK POND

EXIST. STOCK POND

EXIST. STOCK POND

EXIST. 24" CULVERT CROSSING

H5

LOT 2, WALKER PLACE RR-5 ZONING

EX-3 14.8

EX-4 0.9

H4

H3

EX-6 1.5

OS-4 1.2

LINWOOD LANE

UNPLATTED RR-5 ZONING

UNPLATTED RR-5 ZONING

UNPLATTED RR-5 ZONING

LOT 1, KING SUBD. RR-5 ZONING

Label these areas or hatch and add legend item.

Added to Legend.

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
MAJOR BASIN BOUNDARY	
BASIN BOUNDARY	
BASIN IDENTIFIER / AREA IN ACRES	H-1 10.0
DESIGN POINT	H2

N

100 50 0 100 200

SCALE: 1" = 100'

CLASSIC CONSULTING ENGINEERS & SURVEYORS

619 N. Cascade Avenue, Suite 200, Colorado Springs, Colorado 80903 (719)785-0790 (719)785-0799 (Fax)

REDTAIL RANCH
PRELIMINARY/FINAL DRAINAGE REPORT
PRE-DEVELOPMENT DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	7-3-18
DRAWN BY	MAW	(H) 1"= 100'		SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2525.00

N:\2525\01\DRAWINGS\DEVELOPMENT\2525D01 EXISTING DRAINAGE MAP.dwg, 6/29/2018 4:15:26 PM, 1:1

Provide road cross-section(s)

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
OS-1	0.33	0.56	1.46	0.12	300	14	18.4					18.4	2.57	3.21	5.39	0.8	2	8
OS-2	0.12	0.20	0.54	0.12	300	16	17.6					17.6	2.62	3.28	5.50	0.3	0.7	3
OS-3	0.14	0.25	0.69	0.12	300	12	19.4					19.4	2.51	3.14	5.26	0.3	0.8	4
OS-4	0.05	0.14	0.47	0.12	270	12	17.8					17.8	2.61	3.27	5.48	0.2	0.5	3
A	0.25	0.60	1.95	0.12	300	18	17.0	250	3.6%	1.3	3.1	20.1	2.45	3.08	5.17	1	2	10
B	0.45	1.07	3.47	0.12	300	14	18.4	300	4.5%	1.5	3.4	21.8	2.37	2.98	4.97	1	3	17
C	0.26	0.61	1.99	0.12	300	15	18.0	350	3.6%	1.3	4.4	22.4	2.33	2.92	4.90	1	2	10
D	0.41	0.48	0.77	0.12	150	8	12.5	230	2.0%	1.4	2.7	15.2	2.80	3.50	5.89	1	2	5
E	0.68	1.00	2.27	0.12	300	22	15.9	100	3.0%	1.2	1.4	17.3	2.65	3.31	5.55	2	3	13
F	0.54	0.93	2.43	0.12	300	18	17.0	300	4.0%	1.4	3.6	20.5	2.44	3.05	5.12	1	3	12
G	0.91	1.62	5.32	0.12	300	9	21.3	1100	3.0%	1.7	10.6	31.9	1.91	2.39	4.01	2	4	21
H	0.88	1.49	3.87	0.12	300	12	19.4	650	3.0%	1.7	6.3	25.7	2.17	2.72	4.56	2	4	18
I	0.20	0.28	0.56	0.12	165	8	13.5	375	6.0%	2.4	2.6	16.1	2.73	3.42	5.74	0.6	0.9	3
J	0.10	0.13	0.21	0.12								5.0	4.12	5.17	8.68	0.4	0.7	2
K	0.15	0.30	0.88	0.12	300	22	15.9	100	4.0%	1.4	1.2	17.1	2.65	3.33	5.59	0.4	1.0	5
L	0.30	0.71	2.30	0.12	300	13	18.9	480	3.1%	1.2	6.5	25.4	2.19	2.73	4.59	1	2	11

Provide acreage column

Acreage shown for each basin already

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Outfall / Inlet Size
H1	OS-1, EX-1	1.17	3.69	21.9	2.95	4.96	3	18	
H2	EX-2	1.41	3.98	24.3	2.80	4.70	4	19	
H3	EX-3	1.93	5.74	27.8	2.59	4.35	5	25	
H4	EX-4	0.08	0.32	15.9	3.43	5.76	0.3	1.9	
H5	OS-2, OS-3, OS-4, EX-5, EX-7	3.70	12.30	39.3	2.08	3.48	8	43	
H6	EX-8	0.60	2.23	26.0	2.70	4.53	2	10	
D1	A, OS-1	1.05	3.12	20.1	3.08	5.17	3	16	
D2	B	1.07	3.47	21.8	2.95	4.97	3	17	
D3	E	1.00	2.27	17.3	3.31	5.55	3	13	24" RCP CULVERT
D4	**DP-D3, D, F (POND 1)**	**2.41**	**5.48**	**20.5**	**3.05**	**5.12**	**7**	**28**	**POND 1**
D5	Pond 1 Outfall, Basin C	SEE POND PACK MODEL					1.7	24	
D6	OS-2, OS-3, EX-5, G	2.45	7.27	31.9	2.39	4.01	6	29	30" RCP CULVERT
D7	**DP-D6, OS-4, H (POND 2)**	**4.09**	**11.61**	**32.9**	**2.34**	**3.93**	**10**	**46**	**POND 2**
D8	L	0.70	2.28	25.4	2.73	4.59	2	10	
D9	I	0.28	0.56	16.1	3.42	5.74	1	3	18" RCP CULVERT
D10	Pond 2 Outfall, Basins I, J, K	SEE POND PACK MODEL					2.4	29	

Provide acreage column

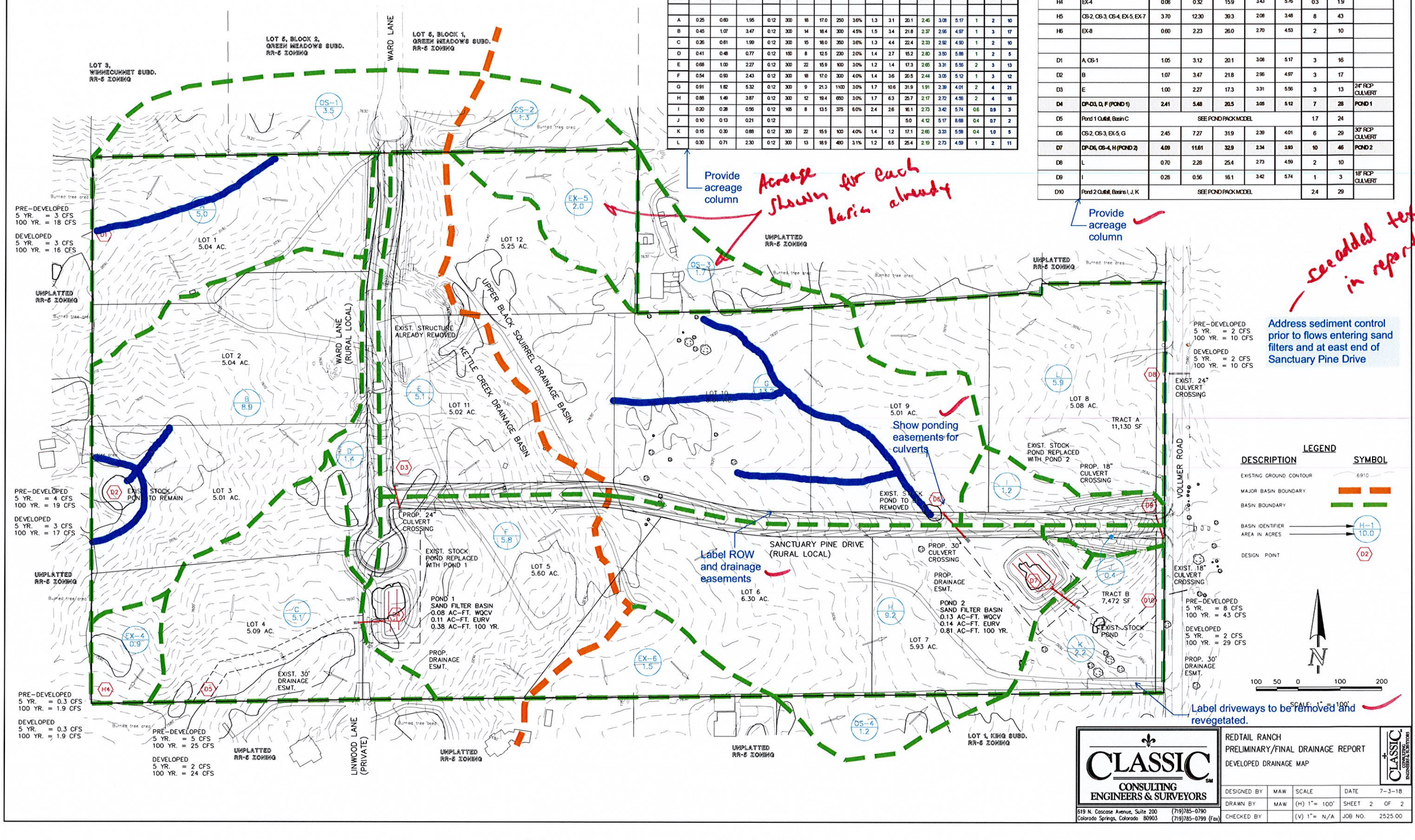
see added text in report.

Address sediment control prior to flows entering sand filters and at east end of Sanctuary Pine Drive

Show ponding easements for culverts

Label ROW and drainage easements

Label driveways to be removed and revegetated.



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REDTAIL RANCH
PRELIMINARY/FINAL DRAINAGE REPORT
DEVELOPED DRAINAGE MAP

DESIGNED BY	MAW	SCALE		DATE	7-3-18
DRAWN BY	MAW	(H) 1"= 100'		SHEET	2 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2525.00