WYOMING ESTATES SUBDIVISION

FINAL DRAINAGE REPORT

PREPARED BY
Mike Bartusek
RESPEC
3520 Austin Bluffs Parkway, Suite 102
Colorado Springs, CO 80831
719-266-5212

PREPARED FOR
Home Run Restorations, Inc.
5090 Wiley Road
Peyton, CO 80904
719-325-6155

FEBRUARY 19, 2018

Project Number 03433

MS196

PCD File No.

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

_____
Michael A. Bartusek, P.E. #23329

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

By: _____
Shawn Shafer
Title: Owner

Address: Home Run Restorations, Inc.
5090 Wiley Road
Peyton, CO 80904

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

_____ _____
Jennifer Irvine, County Engineer/ECM Administrator Date

Conditions:

Per county GIS this lot is located in the Curtis Ranch (CHWS1000) and Livestock Company (CHWS0400) drainage basin.

Per Plat submitted this should be Range 64 West

FINAL DRAINAGE REPORT
WYOMING ESTATES SUBDIVISION

PROJECT DESCRIPTION

This drainage report is for the development of the Wyoming Estates Subdivision. The currently vacant 40.01 acre site is located west of Curtis Road approximately 2.5 mile north of SH 94. It is further described as the southern portion of Section 33, Township 13 South, Range 66 West of the 6th Principal Meridian in El Paso County, Colorado.

All of this lot is located in Squirrel Creek drainage basin. Flows from the site drain into the west ditch of Curtis Road and flow north to the West Fork of Squirrel Creek.

SOILS

The soil on the site can be described as having a rapid permeability, medium-surface runoff, and moderate to high hazard of erosion. The soils within the site are:

- 8 Blakeland Loamy Sand A
- 95 Truckton Sandy Loams B

Per FEMA website the FEMA Map No. is 08041C0568G. Please revise.

FLOODPLAIN STATEMENT

No portion of the developed site is located within a designated FEMA 100-year floodplain according to the information published in the Federal Emergency Management Agency Flood Plain Map No. 08041CO754G, dated December 7, 2018.

METHOD OF COMPUTATION

The methodology utilized for this report is in accordance with the *El Paso County Drainage Criteria Manual, Volumes 1*, dated May 2014. The Rational Method for computation of runoff was used for determining Sub-Basin flows.

$Q = cia$

Where
- Q = maximum rate of runoff in cubic feet per second
- c = runoff coefficient representing drainage area characteristics
- i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
- a = drainage basin size in acres

Discuss the off site drainage flow patterns and their impact on the development.

EXISTING DRAINAGE CONDITIONS

The existing site is undeveloped except for a gravel road located along the north property line located within a 60 ft. Access Easement. Approximately 90% of the parcel is covered with rangeland grasses with slopes varying from 2% to 8%. The parcel generally slopes to the northeast except for the southwest corner which drains to the southwest. Also a large 2.5' deep sump area exists in the south central portion of the site. The overflow swale for this sump area directs the flows to the northeast.

Sub-Basin Aex drains the southwest corner of the site. It produces flows of 1.0 cfs for the 5-year storm and 7.2 cfs for the 100-year storm. These flows travel off the site to the south.

Sub-Basin B1ex drains the southcentral area of the site. This area drains to the east and northeast and is tributary Sub-Basin OS1 which contains the west ditch along Curtis Road. This sub-basin produces flows of 5.3 cfs for the 5-year storm and 40.4 cfs for the 100-year storm.

The drainage plan labels this basin as BEX. Please revise drainage plan so that they match.

Please identify the basins and/or design points that make up these combined flows.

Sub-basin OS1 is located east of the site and contains the Curtis Road ROW. Sub-basin will produce flows of 1.0 cfs and 5.7 cfs respectively. The combined flows into the basin at DP1 will be 6.2 cfs for the 5-year storm and 45.3 cfs for the 100-year storm.

Sub-basin OS2 is located in the northwest area of the site. This undeveloped area sheet flows onto the site and produces flows of 3.8 cfs for the 5-year storm and 15.0 cfs for the 100-year storm. These flows sheet flow into Bub-Basin B2.

Shouldn't this be basin B2EX?

Sub-Basin B2ex drains the northeast portion of the site. This area drains to the east and southeast toward the existing ditch along the existing gravel access road which serves the properties to the west. This sub-basin produces flows of 2.2 cfs for the 5-year storm and 16.4 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin OS2 at DP2 to produce flows of 4.9 cfs for the 5-year storm and 26.8 cfs for the 100-year storm.

The flows from DP1 and DP2 will combine at DP3 to produce flows of 10.3 cfs for the 5-year storm and 66.9 cfs for the 100-year storm. These flows will continue within the west Curtis Road ditch to the West Fork of Squirrel Creek.

See comments on Plat & Construction plans regarding the proposed road. Revise the drainage report and design accordingly.

DEVELOPED DRAINAGE CONDITIONS

The proposed subdivision will consist of four (4) lots with Lot 1 containing 5.16 acres, Lot 2 containing 5.12 acres, Lot 3 containing 5.11 acres and Lot 4 containing 19.79 acres. It will also contain an asphalt cul-de-sac located across from Patton Drive with a private gravel road extending from the cul-de-sac and connecting to the existing access road to the west. These new lots are assumed to be developed with 2500 sf homes and 12 ft gravel drives. No overlot grading will take place within the proposed subdivision.

what is the assumed length of the drives?

Sub-Basin A will continue to drain to the southwest corner of the site. It produces flows of 1.0 cfs for the 5-year storm and 7.2 cfs for the 100-year storm. These flows travel off the site to the south.

Sub-Basin B1 drains the southcentral area of the site and will remain undeveloped. This area drains to the east and northeast and is tributary Sub-Basin OS1 which contains the west ditch along Curtis Road. This sub-basin produces flows of 1.7 cfs for the 5-year storm and 10.8 cfs for the 100-year storm.

Please identify the basins that make up the combined flow.

Sub-basin OS1A is located east of the site and contains the Curtis Road ROW. Sub-basin will produce flows of 1.4 cfs and 5.5 cfs respectively. The combined flows into the basin at DP1 will be 3.1 cfs for the 5-year storm and 16.1 cfs for the 100-year storm.

Sub-basin OS2A is located in the northwest area of the site. This undeveloped area sheet flows onto the site and produces flows of 0.2 cfs for the 5-year storm and 1.3 cfs for the 100-year storm. These flows sheet flow into Bub-Basin B2.

OS2A

typo

Sub-Basin B2 drains the northcentral portion of the site and contains a large portion of Lots 3 and 4 and a small portion of Lot 1. This area drains to the east and southeast toward the proposed ditch along the new gravel access road. This sub-basin produces flows of 4.6 cfs for the 5-year storm and 29.2 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin OS2 at DP2 to produce flows of 4.8 cfs for the 5-year storm and 30.2 cfs for the 100-year storm. These ditch flow continue east toward the Curtis Road ditch and combines with

Are these flows going to the proposed Teleo Point roadside ditch? If so, please elaborate the narrative and state it.

Shouldn't this be DP2?

the flows from DP1 at the proposed public 38"x24" RCEP culvert under the Teleo Point cul-de-sac. The combined flows of DP1 and DP3 at DP3 will be 7.3 cfs for the 5-year storm and 43.5 cfs for the 100-year storm. These flows continue north into Sub-Basin OS1B.

Sub-basin OS2B is located in the northwest area of the site. This undeveloped area sheet flows onto the site and produces flows of 1.4 cfs for the 5-year storm and 10.6 cfs for the 100-year storm. These flows sheet flow into Sub-Basin B3.

typo

Sub-Basin B3 drains the northwestern portion of the site and contains a large portion of Lot 1. This area drains to the east toward the proposed ditch and sump along the new gravel access road. This sub-basin produces flows of 3.0 cfs for the 5-year storm and 13.0 cfs for the 100-year storm. These flows will combine with the flows from Sub-basin OS2 at DP4 to produce flows of 3.9 cfs for the 5-year storm and 21.5 cfs for the 100-year storm. These flows travel into Sub-Basin B4 through a private 30" cmp.

Sub-Basin B4 drains the southeastern portion of the site and contains a Lot 2. This area drains to the east toward the existing ditch along the west property line. This sub-basin produces flows of 3.7 cfs for the 5-year storm and 14.9 cfs for the 100-year storm. These flows will combine with the flows from DP4 at DP5 to produce flows of 5.1 cfs for the 5-year storm and 23.6 cfs for the 100-year storm. These flows travel into Sub-Basin OS1B.

Sub-basin OS1B is located east of the site and north of Teleo Point cul-de-sac and contains the Curtis Road ROW. Sub-basin will produce flows of 0.5 cfs and 1.8 cfs respectively. The combined flows of OS1B, DP3 and DP5 at DP6 will be 12.1 cfs for the 5-year storm and 64.5 cfs for the 100-year storm. These flows will continue within the west Curtis Road ditch to the West Fork of Squirrel Creek.

Per drainage plan and as stated before, this area drains to the east away from the west property line. Please revise.

WATER QUALITY AND DETENTION

Although water quality basins are not required for subdivisions containing lots greater than 5.0 acres, a temporary sedimentation to mitigate sediment from the construction of the public cul-de-sac and private access road. This basin will be located in the northeast area of the site with diversion ditches directing the site flows into the basin until the roadways are completed.

...sedimentation basin is proposed...

PRIVATE DRAINAGE FACILITIES

The proposed drainage improvements will be constructed at the time of plat approval. The private culvert and ditch improvements construction and maintenance will be the responsibility of Wyoming Estates Subdivision HOA.

Livestock Company drainage basin has basin and bridge fees. Please revise.

DRAINAGE BASIN FEES

The proposed development is located within the Squirrel Creek drainage basin which has no drainage basin fee.

CONCLUSION

The proposed development and subsequent lot developments follow the "Four Step Process" as mandated by the EPA as follows:

If road is extended in the future will the developer that extends the road have to reanalyze/redesign this culvert? Will the HOA continue maintenance or is the intent for this culvert to eventually become public? Please address.

Revise accordingly per comments on Plat and Construction plans

Step 1: Employ runoff reduction practices

Runoff has been reduced by disconnecting impervious areas where possible, eliminating "unnecessary" impervious areas and encouraging infiltration into suitable soils.

- Impervious areas have been directed to the existing earth swales and ditches to encourage infiltration.
- A gravel roadway has been used for the project to reduce the impervious of the areas.

Step 2: Stabilize drainageways

All drainageways, ditches and channels have been stabilized by the following methods:

- Tributaries have been left in their relatively natural state where possible.
- New ditches have been stabilized with either riprap or erosion control fabric depending on the erosion potential.

Step 3: Provide water quality capture volume (WQCV)

The proposed development will disturb approximately 2.2 acres for the gravel roadway construction which will be mitigated through a temporary sedimentation basin.

Step 4: Consider need for industrial and commercial BMP's.

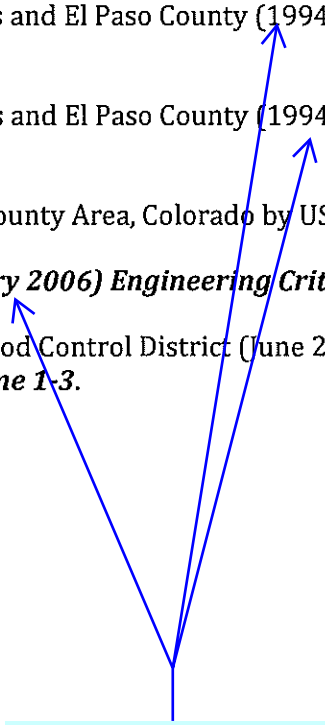
No industrial and commercial development is proposed for the site.

Include a narrative in your conclusion indicating whether or not developed runoff meets historic and whether or not this development will adversely affect downstream or surrounding properties.

Please address why WQCV is not required. Note that revisions to the ECM where were recently done. Site the County criteria accordingly. Refer to revised sections I.7.1, I.7.1.B, and I.7.2.D. It appears that a deviation for not providing water quality would be required. Section I.7.1.B.11 may be used as part of your justification. Please use the new deviation form (see attached). Refer to Resolution 19-245 for the ECM revisions. The resolution has been attached.

REFERENCES

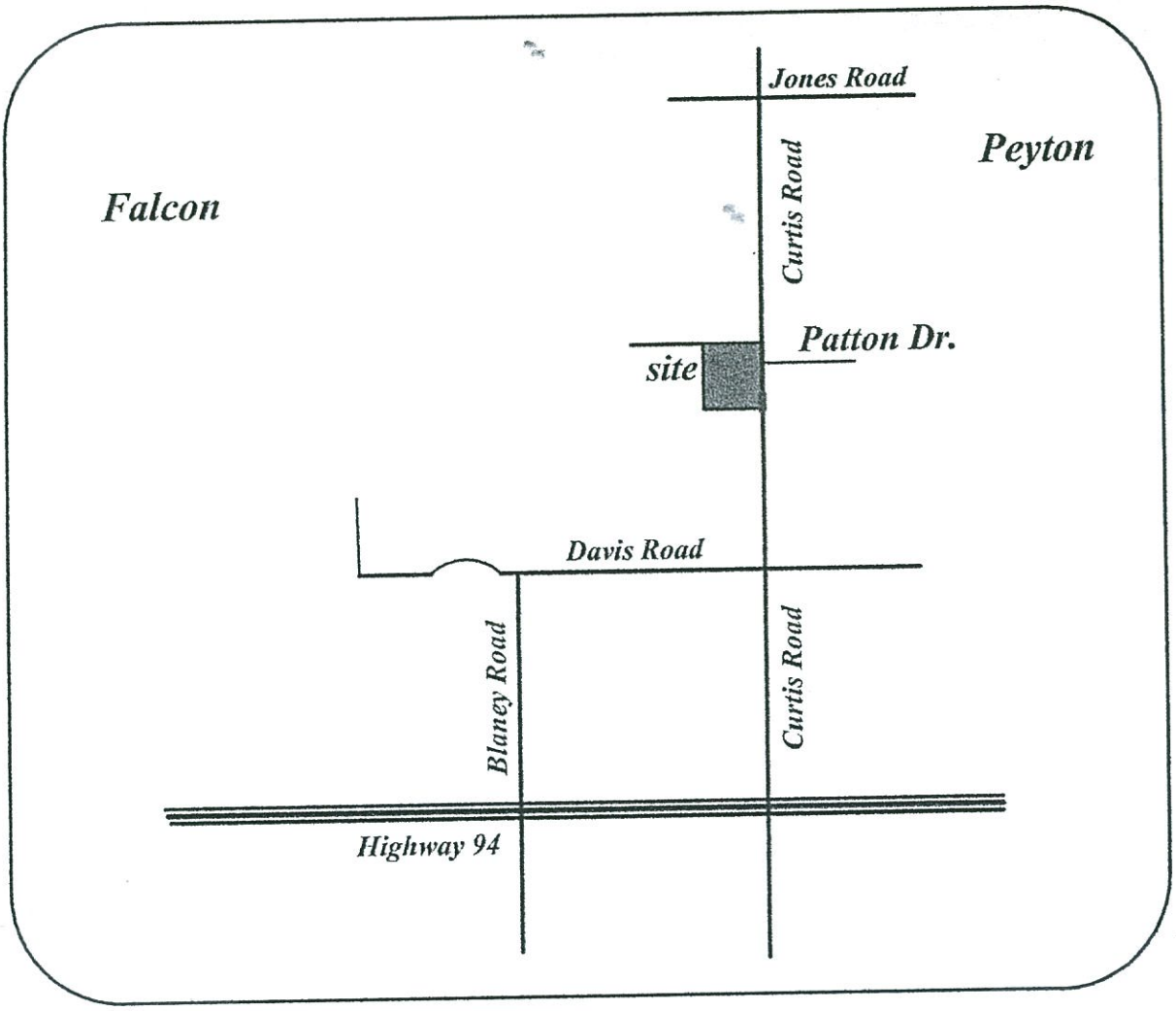
1. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume 1*** (DCM).
2. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume II*** (DCM).
3. Soil Survey of El Paso County Area, Colorado by USDA, NRCS.
4. ***El Paso County (January 2006) Engineering Criteria Manual.***
5. Urban Drainage and Flood Control District (June 2011). ***Urban Storm Drainage Criteria Manual, Volume 1-3.***



Update the references to reflect the latest update/revisions to the county criteria.

APPENDIX A

MAPS

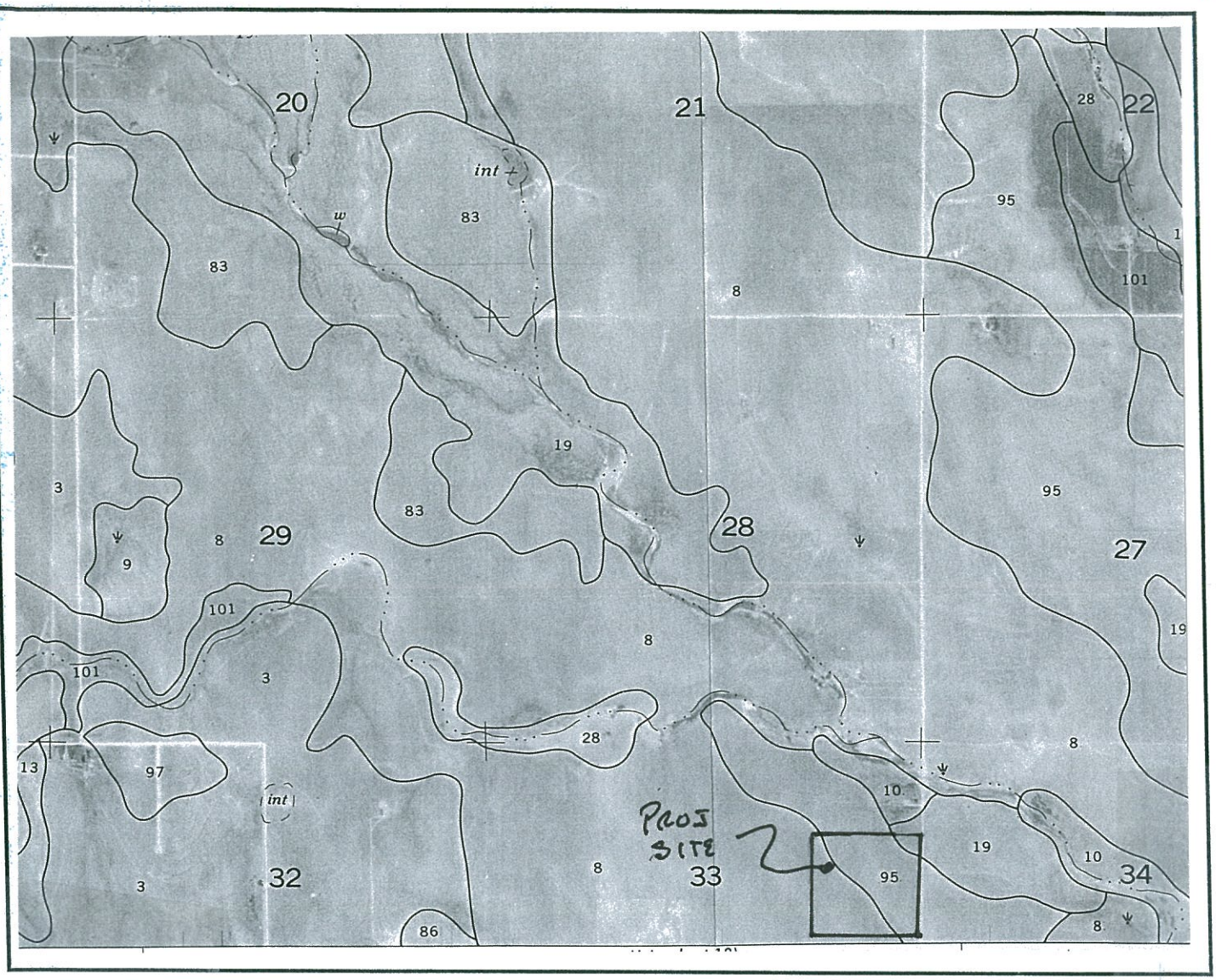


VICINITY MAP

N.T.S.

RESPEC

3520 Austin Bluffs Pkwy, Suite 102 Colorado Springs, CO 80918
Phone: (719) 266-5212 Fax: (719) 266-5341



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SOILS MAP

N.T.S.

RESPEC

3520 Austin Bluffs Pkwy, Suite 102 Colorado Springs, CO 80918
Phone: (719) 266-5212 Fax: (719) 266-5341

National Flood Hazard Layer FIRMette

FEMA

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/26/2019 at 9:19:46 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX B

DESIGN CALCULATIONS

WYOMING ESTATES SUBDIVISION

C FACTOR CALCULATION SHEET

EXISTING CONDITIONS

RUNOFF COEFICIENT

TYPE A/B SOILS

LAND USE	Imperv %	5 YR	100 YR
UNDEV	0	0.08	0.35
GRAVEL ROAD	80	0.59	0.7
ASPHALT ROAD	100	0.9	0.96
ROOFS	100	0.73	0.81

AREA DESIG.	TOTAL AREA (acre)	SURFACE CONDITION AREAS UNDEV	GRAVEL ROAD	ASPHALT ROAD	ROOFS	CALCULATED C 5 YR	100 YR
Aex	3.73	3.73	0.00	0.00	0.00	**0.08**	**0.35**
B1ex	23.53	23.53	0.00	0.00	0.00	**0.08**	**0.35**
B2ex	10.03	9.48	0.55	0.00	0.00	**0.11**	**0.37**
OS1	2.72	2.36	0.00	0.36	0.00	**0.19**	**0.43**
OS2	6.20	6.20	0.00	0.00	0.00	**0.08**	**0.35**
Aex-B2ex	37.29	36.74	0.55	0.36	0.00		
	0.8	0.00	0.44	0.36	0.00		

Imperviousness = (0.44)/37.29 = 2.2%

DEVELOPED CONDITIONS

RUNOFF COEFICIENT

TYPE A/B SOILS

LAND USE	Imperv %	5 YR	100 YR
UNDEV	0	0.08	0.35
GRAVEL ROAD	80	0.59	0.7
ASPHALT ROAD	100	0.9	0.96
ROOFS	100	0.73	0.81

Developed Conditions							
	TOTAL	SURFACE CONDITION AREAS				CALCULATED C	
AREA	AREA	UNDEV	GRAVEL	ASPHALT	ROOFS	5	100
DESIG.	(acre)		ROAD	ROAD		YR	YR
A	3.73	3.73	0.00	0.00	0.00	**0.08**	**0.35**
B1	5.12	5.00	0.06	0.06	0.00	**0.10**	**0.36**
B2	16.64	16.16	0.34	0.00	0.14	**0.10**	**0.36**
B3	5.68	5.03	0.30	0.28	0.07	**0.16**	**0.40**
B4	6.12	5.19	0.50	0.36	0.07	**0.18**	**0.42**
OS1A	2.02	1.72	0.00	0.30	0.00	**0.20**	**0.44**
OS1B	0.70	0.58	0.00	0.12	0.00	**0.22**	**0.45**
OS2A	0.60	0.60	0.00	0.00	0.00	**0.08**	**0.35**
OS2B	5.60	5.60	0.00	0.00	0.00	**0.08**	**0.35**
Avg House = 3000 sf w/ avg 250'x12' gravel driveway							
	Sub Area		Impervious Acreage				
A-B4	37.29	35.11	1.20	0.70	0.28		
	1.94	0.00	0.96	0.70	0.28		
	Imperviousness = (1.94)/37.29 = 5.2%						

Revise asphalt/gravel areas accordingly per comments on the Plat and construction plans regarding the proposed road.

Wyoming Estates Subdivision

PROJ. #03433

DRAINAGE CALCULATION SHEET

file:curtis rd dr

02/20/19

AREA DESIG.	AREA (acre)	C5 (5 yr)	C100 (100 yr)	C5 X A	C100 X A	Initial Tci L (ft)	Initial Tci Slope (%)	Initial Tci ti (min)	Travel Time L (ft)	Travel Time Slope (%)	Travel Time V (fps)	Travel Time Tt (min)	TC (min)	I5 (in/hr)	I100 (in/hr)	Q5 (cfs)	Q100 (cfs)	length L (feet)	vel. V (fps)	^t (min)	AREA DESIG.
EXISTING CONDITIONS																					
Aex	3.73	0.08	0.35	0.30	1.31	100	3.00	13.27	440	4.50	2.00	3.67	16.94	3.18	5.55	0.95	7.24				Aex
B1ex	23.53	0.08	0.35	1.88	8.24	100	3.50	12.62	1270	6.00	2.40	8.82	21.43	2.81	4.90	5.28	40.38				B1ex
OS1	2.72	0.11	0.37	0.30	1.01	100	7.00	9.74	1230	4.40	3.20	6.41	16.15	3.25	5.68	0.97	5.72				OS1
DP1	26.25			2.18	9.24								21.43	2.81	4.90	6.12	45.32				DP1
OS2	6.20	0.19	0.43	1.18	2.67	100	3.00	11.84	500	3.00	1.80	4.63	16.47	3.22	5.63	3.79	15.00	1350	2.20	10.23	OS2
B2ex	10.03	0.08	0.35	0.80	3.51	100	3.00	13.27	1330	5.50	2.20	10.08	23.35	2.68	4.68	2.15	16.42				B2ex
DP2	16.23			1.98	6.18								26.70	2.48	4.34	4.92	26.78	175	10.00	0.29	DP2
DP3	42.48			4.16	15.42								26.70	2.48	4.34	10.33	66.85	175	10.00	0.29	DP3
DEVELOPED CONDITIONS																					
A	3.73	0.08	0.35	0.30	1.31	100	3.00	13.27	440	4.50	2.00	3.67	16.94	3.18	5.55	0.95	7.24	150	10.00	0.25	A
B1	5.12	0.10	0.36	0.51	1.84	100	3.50	12.37	450	7.70	2.80	2.68	15.05	3.37	5.88	1.72	10.84				B1
OS1A	2.02	0.20	0.44	0.40	0.89	100	7.00	8.86	890	4.40	3.20	4.64	13.49	3.55	6.20	1.43	5.51				OS1A
DP1	7.14			0.92	2.73								15.05	3.37	5.88	3.09	16.07				DP1
OS2A	0.60	0.08	0.35	0.05	0.21	100	3.00	13.27	100	3.00	1.80	0.93	14.20	3.46	6.05	0.17	1.27		2.10	0.00	OS2A
B2	16.64	0.10	0.36	1.66	5.99	100	3.00	13.01	1150	5.40	2.20	8.71	21.73	2.79	4.87	4.64	29.16				B2
DP2	17.24			1.71	6.20								21.73	2.79	4.87	4.77	30.18				DP2
DP3	24.38			2.63	8.93								21.73	2.79	4.87	7.32	43.48	340	2.10	2.70	DP3
OS2B	5.60	0.08	0.35	0.45	1.96	100	3.00	13.27	500	3.00	1.80	4.63	17.90	3.09	5.39	1.38	10.57	450	3.40	2.21	OS2B
B3	5.68	0.16	0.40	0.91	2.27	100	5.00	10.33	650	3.40	1.90	5.70	16.04	3.26	5.70	2.97	12.95				B3
DP4	11.28			1.36	4.23								20.11	2.91	5.07	3.94	21.48	750	2.30	5.43	DP4
B4	6.12	0.18	0.42	1.10	2.57	100	5.00	10.12	750	6.00	2.30	5.43	15.55	3.31	5.79	3.65	14.88				B4
DP5	13.26			2.02	5.30								25.54	2.55	4.45	5.14	23.58				DP5
OS1B	0.60	0.20	0.44	0.12	0.26	80	6.00	8.33	250	2.00	2.10	1.98	10.32	4.00	6.98	0.48	1.84				OS1B
DP6	38.24			4.77	14.50								25.54	2.55	4.45	12.13	64.48				DP6

This value should be 6.80 as DP5 is comprised of basins B4, B3, and OS2B. Please revise and verify all other calculations.

100 yr

PROJECT: Wyoming Estates Sub

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

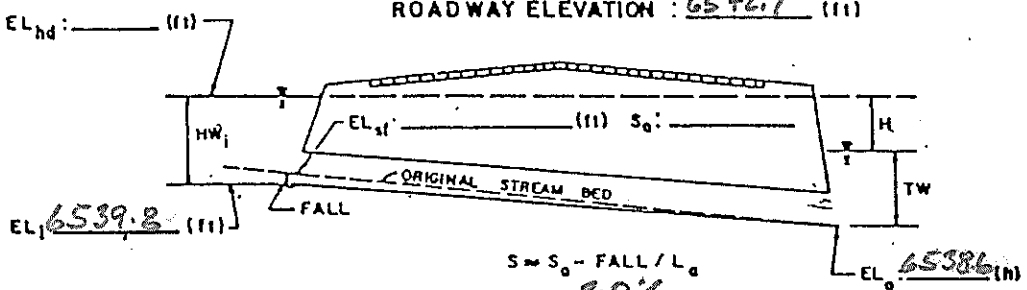
SEE ADD'L SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 11.28 ☐ STREAM SLOPE: 6%
- ☐ CHANNEL SHAPE: Trap
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
5	3.9	
10	21.5	

ROADWAY ELEVATION: 6542.7 (ft)



$S \approx S_o - FALL / L_a$

$S = 2.0\%$

$L_a = 60$

HEADWATER CALCULATIONS

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	INLET CONTROL HW_i/D (2)	INLET CONTROL HW_i	INLET CONTROL FALL (3)	INLET CONTROL EL_hi (4)	OUTLET CONTROL TW (5)	OUTLET CONTROL d_c	OUTLET CONTROL (d_c+D)/2	OUTLET CONTROL h_o (6)	OUTLET CONTROL k_e	OUTLET CONTROL H (7)	OUTLET CONTROL EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
CMP - 30" w/FES	3.9	3.9	0.4	1.0		40										
" "	21.5	21.5	1.0	2.5		42										

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_1/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + \left(29 n^2 L_1 / R^{1.33}\right)\right] V^2 / 2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

a. APPROXIMATE
f. CULVERT FACE
hd. DESIGN HEADWATER
hi. HEADWATER IN INLET CONTROL
ho HEADWATER IN OUTLET CONTROL
i INLET CONTROL SECTION
o. OUTLET
sf. STREAMBED AT CULVERT FACE
tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

Please provide complete calculations.

Please provide complete calculations. Additionally provide calculations showing you meet overtopping criteria per DCM Vol. 1 table 6-1

PROJECT: WYOMING ESTATES S.D.

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FOR

DESIGNER / DATE: _____

REVIEWER / DATE: _____

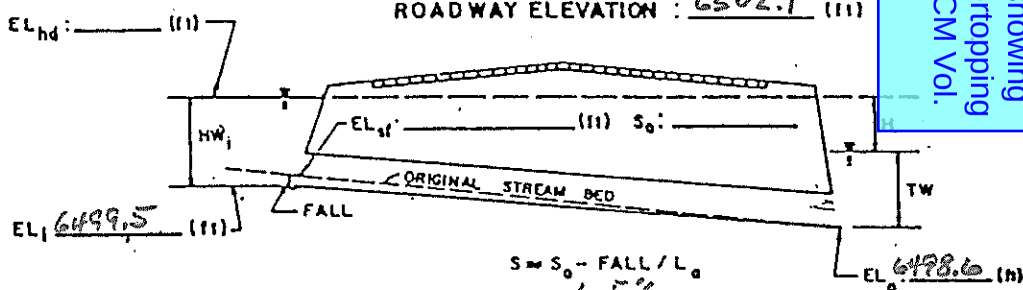
HYDROLOGICAL DATA

SEE ADD'L SHTS.

- ☐ METHOD: RATIONAL
- ☐ DRAINAGE AREA: 24.38 ☐ STREAM SLOPE: 1.5%
- ☐ CHANNEL SHAPE: TRAP
- ☐ ROUTING: _____ ☐ OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
5	7.3	
100	43.5	



CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS: INLET CONTROL HW_i/D (2)	HW_i	FALL (3)	EL_hi (4)	OUTLET CONTROL TW (5)	d_c	(d_c+D)/2	h_o (6)	h_e	H (7)	EL_ho (8)	CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
RCBP - 38"X24" W/FES	7.3	7.3	0.51	1.02		00.52	0.5									
"	43.5	43.5	1.7	3.4		02.9	1.2									

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) HW_i/D = HW/D OR HW_i/D FROM DESIGN CHARTS

(3) FALL = $HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) EL_{hi} = HW_i + EL_i (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) h_o = TW or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + \frac{(29n^2 L)}{R^{1.33}}\right] \frac{V^2}{2g}$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- e. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT DESIGNED FOR 5 YR STORM SINCE IT WILL NEED TO BE RELOCATED WHEN CURTIS ROAD IS REBUILT AS AN ARTERIAL ROADWAY

CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

ENTRANCE: _____

APPENDIX C

DESIGN CHARTS

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

Figure 6-25. Estimate of Average Concentrated Shallow Flow

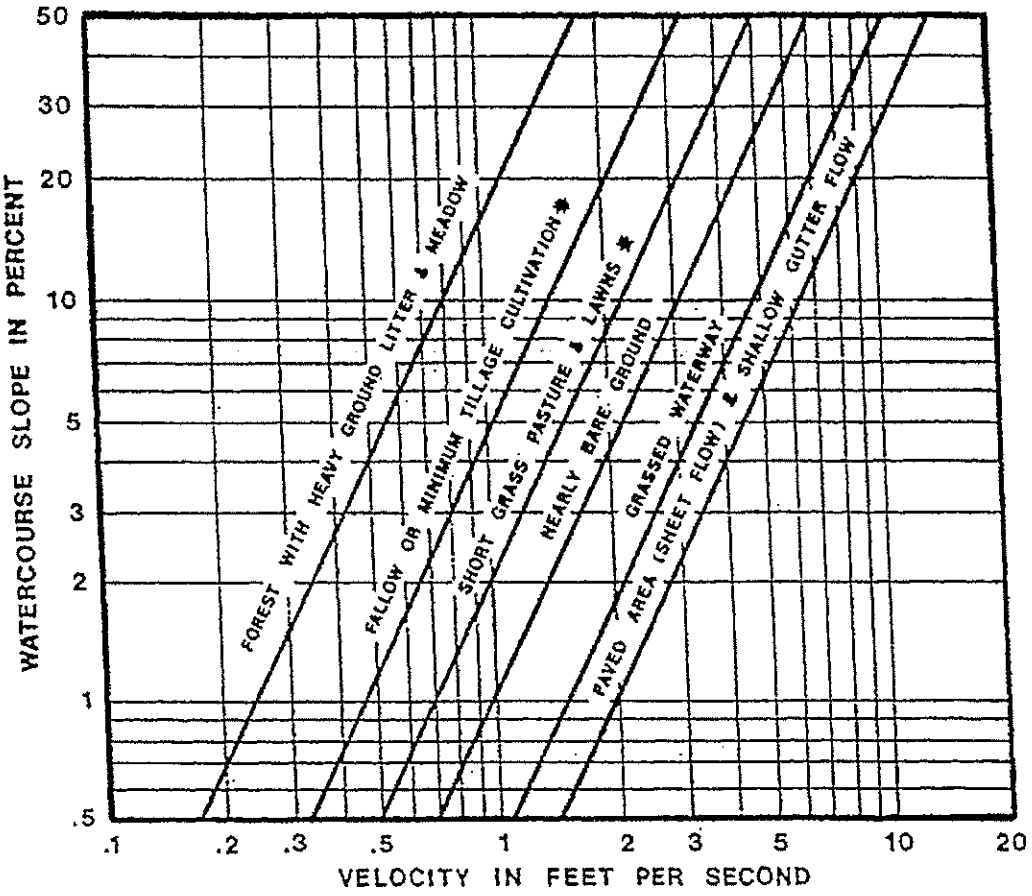
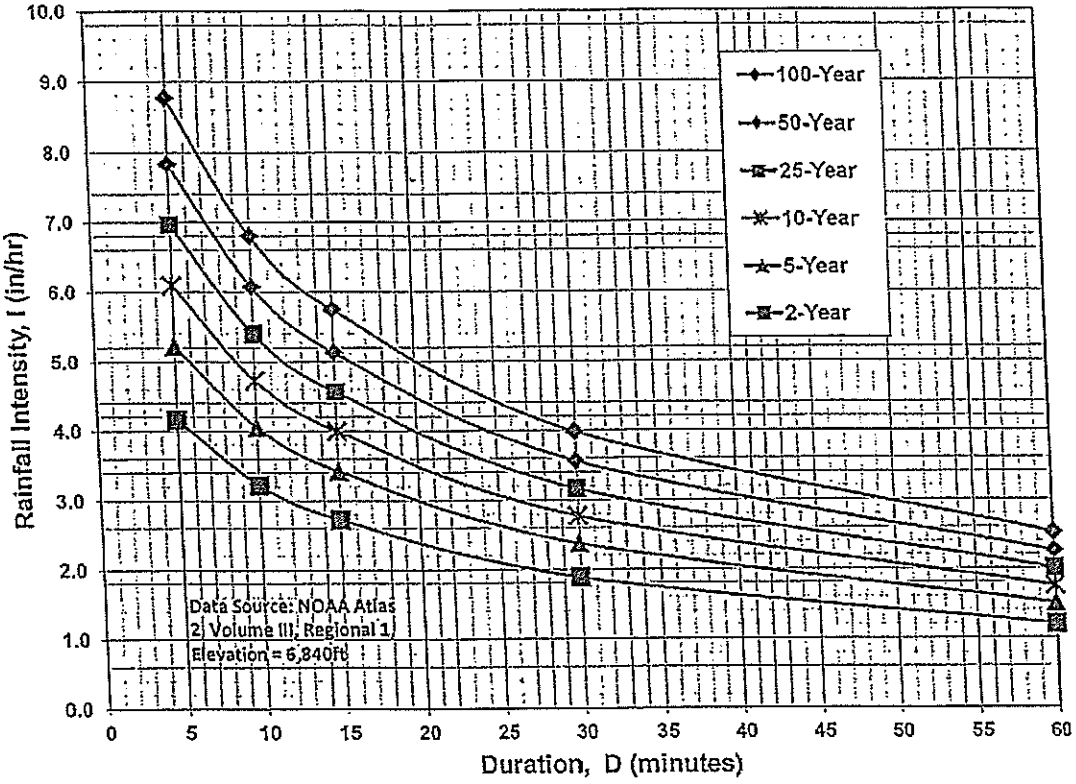


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

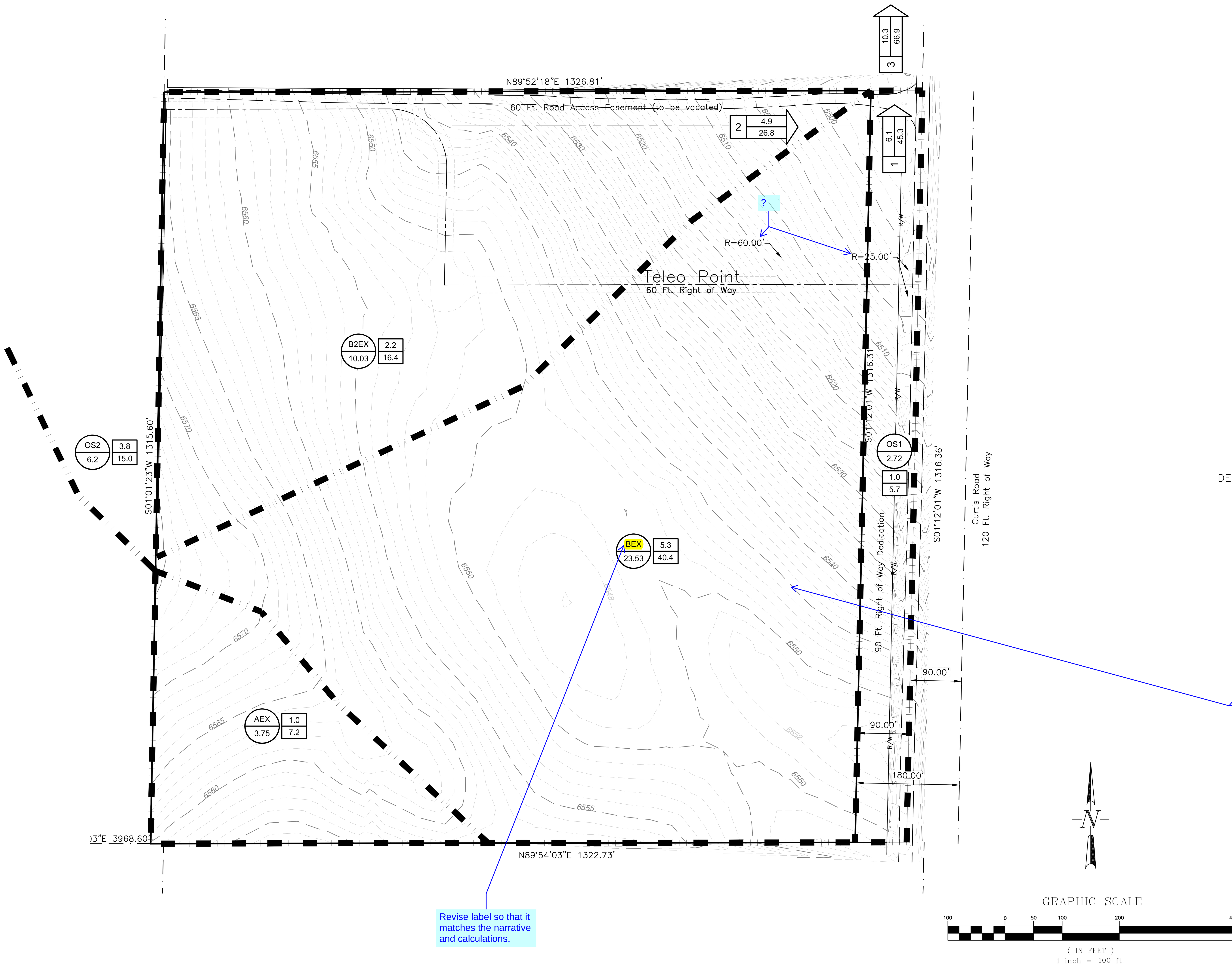
$I_{25} = -2.00 \ln(D) + 10.111$

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

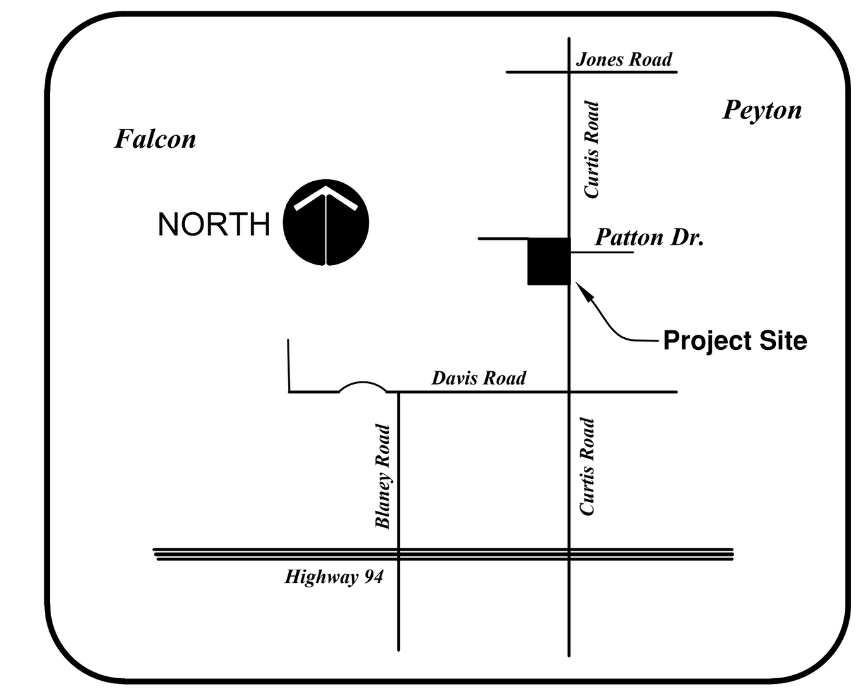
$I_{5} = -1.50 \ln(D) + 7.583$

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

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



VICINITY MAP:



LEGEND

BASIN DESIGNATION (A1A)
BASIN AREA, ACRES (XX)

5 YEAR STORM, CFS (XX)
100 YEAR STORM, CFS (XX)

DESIGN POINT (XX) — XX.X 5 YEAR ACCUMULATED FLOW, CFS; XX.X 100 YEAR ACCUMULATED FLOW, CFS

SUB–BASIN BOUNDARY

DIRECTION OF DRAINAGE FLOW

PCD PROJECT NO. ______________

DESIGNED	MAB
DRAWN	HJG
CHECKED	MAB
DATE	02/04/2019

REVISION

RESPEC (FORMERLY ADP)
3520 AUSTIN BLUFFS PKWY
SUITE 102
COLORADO SPRINGS, CO 80918
PHONE (719) 266-5212

STAMP

811 Know what's **below.** **Call** before you dig.

PROJ NO. 03433
DWG NM. 03433-GrdgEros

HOME RUN RESTORATIONS, INC
5090 WILEY RD
PEYTON, CO 80831

WYOMING ESTATES
SUBDIVISION
EL PASO COUNTY, CO

DRAINAGE PLAN
EXISTING CONDITIONS

DRAWING NUMBER:
C
SHEET 1

NAME: M:\LAND PROJECTS\2018\03433-3050 CURTIS ROAD\DWG\03433-DRNGEXIST.DWG
PLOT DATE: April 17, 2019 11:19 AM, BY: JIM GILL

Based on the contours the outflow from DP4 is discharged to the property to the north and does not appear to flow to the east as indicated in narrative. Revise.

Additional comments may be provided with the redesign of the proposed road to meet county criteria. Refer to comments on the Plat/Construction plans.

Provide calculations for rip-rap

Provide analysis from culvert outfall to suitable outfall i.e. roadside ditch.

The narrative and calculations indicate these flows as 7.3 cfs(5yr) and 43.5cfs(100yr) at design point 3. Please revise. Additionally relocate this design point label to the RCEP outfall as this design point does not include flows from basin OS1B or B4.

The calculations indicate this area as 0.60 acres. Please revise.

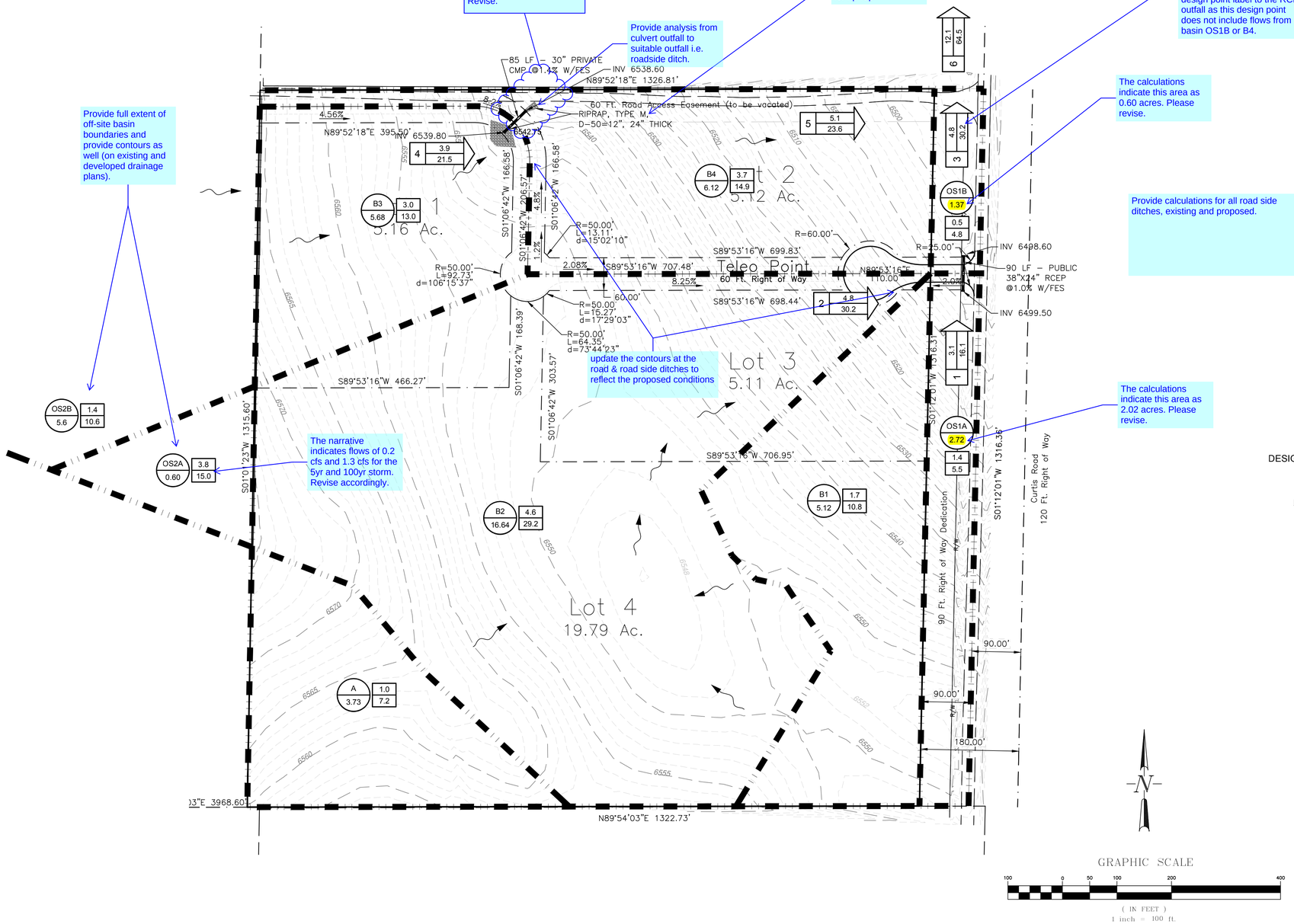
Provide full extent of off-site basin boundaries and provide contours as well (on existing and developed drainage plans).

Provide calculations for all road side ditches, existing and proposed.

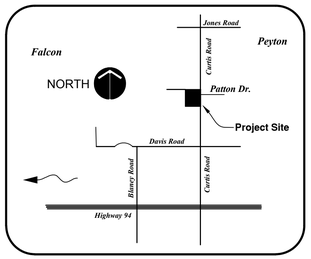
The narrative indicates flows of 0.2 cfs and 1.3 cfs for the 5yr and 100yr storm. Revise accordingly.

update the contours at the road & road side ditches to reflect the proposed conditions

The calculations indicate this area as 2.02 acres. Please revise.



VICINITY MAP:



LEGEND

- A1A / XX — BASIN DESIGNATION; BASIN AREA, ACRES
- XX / XX — 5 YEAR STORM, CFS; 100 YEAR STORM, CFS
- DESIGN POINT — XX / XX.X / XX.X — 5 YEAR ACCUMULATED FLOW, CFS; 100 YEAR ACCUMULATED FLOW, CFS
- SUB-BASIN BOUNDARY
- DIRECTION OF DRAINAGE FLOW

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

PCD PROJECT NO. _____

REVISION

DESIGNED MAB
DRAWN HJG
CHECKED MAB
DATE 02/28/2019

RESPEC (FORMERLY ADP)
3520 AUSTIN BLUFFS PKWY
SUITE 102
COLORADO SPRINGS, CO 80918
PHONE (719) 266-5212

STAMP

Know what's below. Call before you dig.

PROJ NO. 03433
DWG NM. 03433-GrdgEros

HOME RUN RESTORATIONS, INC
5090 WILEY RD
PEYTON, CO 80831

WYOMING ESTATES
SUBDIVISION
EL PASO COUNTY, CO

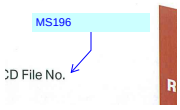
DRAINAGE PLAN
DEVELOPED
CONDITIONS

DRAWING NUMBER:
C
SHEET 2

NAME: M:\LAND PROJECTS\2018\03433-3050 CURTIS ROAD\DWG\03433-DRNGDEV.DWG
PLOT DATE: April 17, 2019 11:54 AM BY: JIM GILL

Markup Summary

Daniel Torres (58)



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Author: Daniel Torres
Date: 7/9/2019 11:34:17 AM
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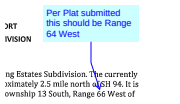
MS196



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Author: Daniel Torres
Date: 7/9/2019 11:34:18 AM
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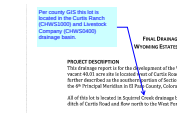
Per Plat submitted this should be Range 64 West



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Author: Daniel Torres
Date: 7/9/2019 11:34:19 AM
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Per county GIS this lot is located in the Curtis Ranch (CHWS1000) and Livestock Company (CHWS0400) drainage basin.

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Page Label: 3
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Author: Daniel Torres
Date: 7/9/2019 11:34:20 AM
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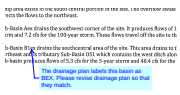
Discuss the off site drainage flow patterns and their impact on the development.

Subject: Callout
Page Label: 3
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:20 AM
Color:

Per FEMA website the FEMA Map No. is 08041C0568G. Please revise.



Subject: Callout
Page Label: 3
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Author: Daniel Torres
Date: 7/9/2019 11:34:21 AM
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The drainage plan labels this basin as BEX. Please revise drainage plan so that they match.

Subject: Callout
Page Label: 4
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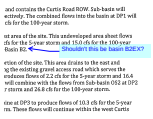
Author: Daniel Torres
Date: 7/9/2019 11:34:22 AM
Color:

Please identify the basins and/or design points that make up these combined flows.



Subject: Callout
Page Label: 4
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Author: Daniel Torres
Date: 7/9/2019 11:34:23 AM
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Shouldn't this be basin B2EX?

Subject: Callout
Page Label: 4
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:24 AM
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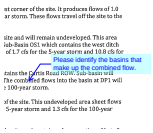
See comments on Plat & Construction plans regarding the proposed road. Revise the drainage report and design accordingly.



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Author: Daniel Torres
Date: 7/9/2019 11:34:25 AM
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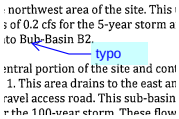
Please identify the basins that make up the combined flow.



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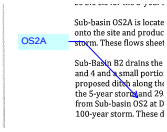
Author: Daniel Torres
Date: 7/9/2019 11:34:26 AM
Color:

typo



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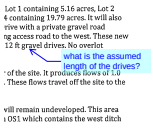
OS2A



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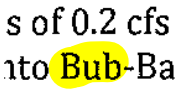
what is the assumed length of the drives?



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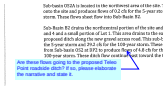

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Date: 7/9/2019 11:34:28 AM
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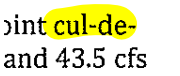
Are these flows going to the proposed Teleo Point roadside ditch? If so, please elaborate the narrative and state it.



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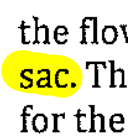

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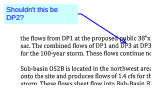

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Author: Daniel Torres
Date: 7/9/2019 11:34:31 AM
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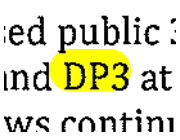
Shouldn't this be DP2?



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Author: Daniel Torres
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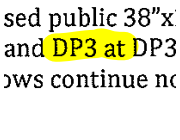

Subject: Highlight
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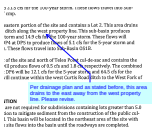
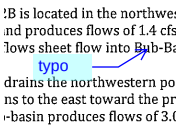
Author: Daniel Torres
Date: 7/9/2019 11:34:36 AM
Color:



Subject: Callout
Page Label: 5
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:38 AM
Color:

Per drainage plan and as stated before, this area drains to the east away from the west property line. Please revise.



Subject: Callout
Page Label: 5
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:38 AM
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Subject: Callout
Page Label: 5
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:39 AM
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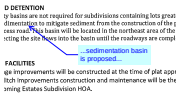
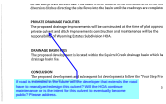
Livestock Company drainage basin has basin and bridge fees. Please revise.



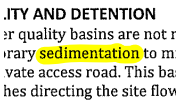
Subject: Callout
Page Label: 5
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:40 AM
Color:

...sedimentation basin is proposed...



Subject: Callout
Page Label: 5
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:41 AM
Color:

If road is extended in the future will the developer that extends the road have to reanalyze/redesign this culvert? Will the HOA continue maintenance or is the intent for this culvert to eventually become public? Please address.



Subject: Highlight
Page Label: 5
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:41 AM
Color:

Subject: Callout
Page Label: 6
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:43 AM
Color:

Please address why WQCV is not required. Note that revisions to the ECM where were recently done. Site the County criteria accordingly. Refer to revised sections I.7.1, I.7.1.B, and I.7.2.D. It appears that a deviation for not providing water quality would be required. Section I.7.1.B.11 may be used as part of your justification. Please use the new deviation form (see attached). Refer to Resolution 19-245 for the ECM revisions. The resolution has been attached.

Subject: Callout
Page Label: 6
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:44 AM
Color:

Revise accordingly per comments on Plat and Construction plans

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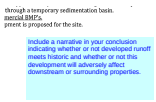
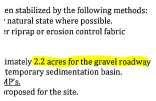


Subject: Text Box
Page Label: 6
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:45 AM
Color:

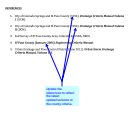
Include a narrative in your conclusion indicating whether or not developed runoff meets historic and whether or not this development will adversely affect downstream or surrounding properties.

Subject: File Attachment
Page Label: 6
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:50 AM
Color:



Subject: Highlight
Page Label: 6
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:50 AM
Color:

Subject: File Attachment
Page Label: 6
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:51 AM
Color:

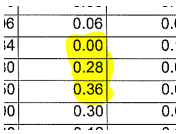


Subject: Callout
Page Label: 7
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:52 AM
Color:

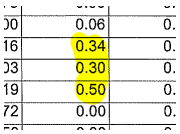
Update the references to reflect the latest update/revisions to the county criteria.

Subject: Callout
Page Label: 14
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:53 AM
Color:

Revise asphalt/gravel areas accordingly per comments on the Plat and construction plans regarding the proposed road.



Subject: Highlight
Page Label: 14
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:53 AM
Color:



Subject: Highlight
Page Label: 14
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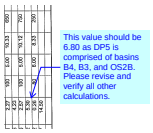
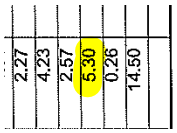
Author: Daniel Torres
Date: 7/9/2019 11:34:54 AM
Color:



Subject: Callout
Page Label: 15
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:55 AM
Color:

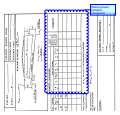
This value should be 6.80 as DP5 is comprised of basins B4, B3, and OS2B. Please revise and verify all other calculations.



Subject: Highlight
Page Label: 15
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:56 AM
Color:

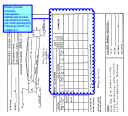
Subject: Callout
Page Label: 16
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:57 AM
Color:

100 yr



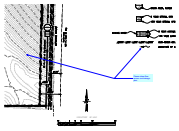
Subject: Cloud+
Page Label: 16
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:58 AM
Color:

Please provide complete calculations.



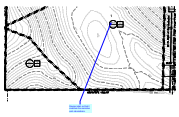
Subject: Cloud+
Page Label: 17
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:34:59 AM
Color:

Please provide complete calculations. Additionally provide calculations showing you meet overtopping criteria per DCM Vol. 1 table 6-1



Subject: Callout
Page Label: 22
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:00 AM
Color:

Please show flow arrows on drainage plan

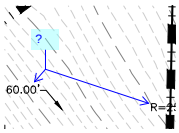


Subject: Callout
Page Label: 22
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:01 AM
Color:

Revise label so that it matches the narrative and calculations.

Subject: Highlight
Page Label: 22
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:02 AM
Color:

BEX

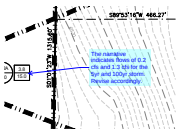


Subject: Callout
Page Label: 22
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:03 AM
Color:

?

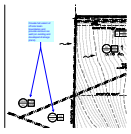
Subject: Cloud+
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:07 AM
Color:

Based on the contours the outflow from DP4 is discharged to the property to the north and does not appear to flow to the east as indicated in narrative. Revise.



Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:07 AM
Color:

The narrative indicates flows of 0.2 cfs and 1.3 cfs for the 5yr and 100yr storm. Revise accordingly.

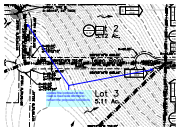


Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:08 AM
Color:

Provide full extent of off-site basin boundaries and provide contours as well (on existing and developed drainage plans).

Subject: Text Box
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:09 AM
Color:

Additional comments may be provided with the redesign of the proposed road to meet county criteria. Refer to comments on the Plat/Construction plans.



Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:09 AM
Color:

update the contours at the road & road side ditches to reflect the proposed conditions

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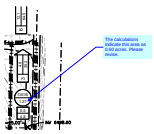
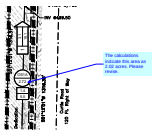


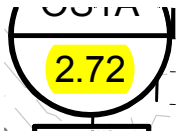
Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:10 AM
Color:

The calculations indicate this area as 0.60 acres. Please revise.



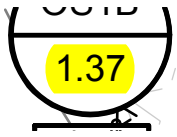
Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:11 AM
Color:

The calculations indicate this area as 2.02 acres. Please revise.



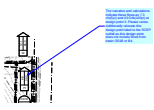
Subject: Highlight
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:12 AM
Color:

2.72



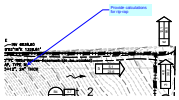
Subject: Highlight
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:13 AM
Color:

1.37



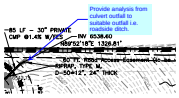
Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:13 AM
Color:

The narrative and calculations indicate these flows as 7.3 cfs(5yr) and 43.5cfs(100yr) at design point 3. Please revise.
Additionally relocate this design point label to the RCEP outfall as this design point does not include flows from basin OS1B or B4.



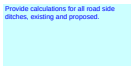
Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:15 AM
Color:

Provide calculations for rip-rap



Subject: Callout
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:15 AM
Color:

Provide analysis from culvert outfall to suitable outfall i.e. roadside ditch.



Subject: Text Box
Page Label: 23
Lock: Locked
Author: Daniel Torres
Date: 7/9/2019 11:35:19 AM
Color:

Provide calculations for all road side ditches, existing and proposed.