

HYDRAULIC AND EROSION ANALYSIS
WEST BRANCH OF CALABACILLAS ARROYO
AT IRVING ESTATES SUBDIVISION

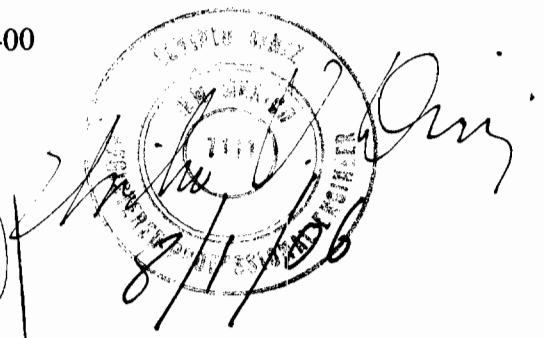
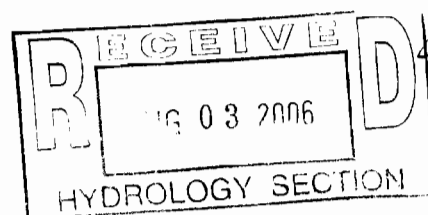
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INTRODUCTION

The legal description of the subject property, prior to the proposed lot development, is Unplatted Lands of Amalgamated Partners. The project site is shown on a copy of a portion of Zone Atlas page A-9-Z, Figure 1. The area is currently undeveloped with typical west mesa sparse vegetation; Figure 2 is an aerial photograph of the project area. The new development consists of 34 lots and associated streets. A copy of the new plat is included as Figure 3.

The project site is located on the West Branch of Calabacillas Arroyo which originates approximately 7 miles west of the project area on the west mesa of Albuquerque, and generally flows east, as shown on Figure 4. This natural (undeveloped) flow path consists of a wide sandy meandering channel, which is typical of west mesa arroyos.

ARROYO HYDROLOGY DATA

The Calabacillas Arroyo Prudent Line Study and Related Work Development of a Prudent Line for the West Branch, Albuquerque, New Mexico, prepared by Mussetter Engineering, Inc. in December 1999, listed a 100-year existing condition and sediment bulked flow rate of 1290 cfs near the project site, with a contributing drainage area of 7 sq. mi.; and 4910 cfs for developed conditions, which includes sediment bulking. These flow rates are applicable to analysis point CP1 on Figure 5. Both figures 4 and 5 are adapted from the 1999 Prudent Line Study. The next downstream analysis point in the 1999 Prudent Line Study is CPL with a developed condition and bulked flow rate of 5290 cfs. An existing condition flow rate was not

Figure 7 also shows the approximate Zone A floodplain limits from the existing FIRM, as well as the computed existing and developed conditions floodplains for the 100-year flows of 1290 cfs and 5100 cfs, respectively. The 100-year flood plain limit delineations are based on the detailed analysis. The existing and developed conditions flow profiles are depicted on Figures 8A and 8B.

The proposed subdivision will require encroachment in the developed condition floodplain between cross-sections 8 to 16, as shown on Figure 7. There are no significant hydraulic impacts in this reach; the results are presented on Table 4; and the water surface profiles for developed conditions with and without encroachment are compared on Figure 9.

SEDIMENT AND EROSION ANALYSIS

The Prudent Line for the project reach is also shown on Figure 7. The HEC-RAS cross sections for the project reach are numbered from 5 to 20. The Froude Number for flow in these sections ranges from 0.79 to 1.31, with an average of 0.90; flow depths range from 4.5 to 6.5 feet, and an average depth of 5.3 feet for the 5100 cfs 100-yr. developed condition flow rate.

The 1999 Prudent Line Study results for this arroyo reach are presented on Figure 10; that study identified the study reach as aggrading under existing conditions and degrading under developed conditions. That report also listed the existing average slope as 0.0145 ft/ft, and the corresponding equilibrium slope as 0.005 ft/ft.

The following discussion includes results of computations presented in Appendix B. Assuming the dominant discharge, $Q_D = 0.2 Q_{100} = 1220$ cfs, the dominant channel width is 79 feet and the critical slope is 0.014 ft/ft, which is the same as the existing channel slope. This is also confirmed in the HEC-RAS analysis which shows the computed Froude Numbers for both existing and developed conditions as being close to 1.0 as shown on Tables 2 and 3.

The corresponding scour depths are 6 feet for an average Froude Number of 0.9, and 8 feet for the maximum Froude Number of 1.31 (at Cross Section 6). Also, where several lots encroach into the developed condition floodplain (Cross Sections 8 to 16), the unconstrained valley width/ reduced width ratio ranges from 1.3 to 1.5, which results in a maximum scour depth of 15 feet, as determined in Appendix B.

RECOMMENDATIONS

The lots to be developed in this project are outside the effective FEMA FIRM boundary, as well as the existing condition 100-yr floodplain, based on a detailed HEC-RAS analysis. However, 6 lots will be located within the developed condition 100-yr floodplain, based on the detailed HEC-RAS analysis

About half of the 34 lots in this project are within the existing Prudent Line. To protect these lots from bank erosion and arroyo meandering, a cutoff wall will be required. Based on the analyses presented in Appendix B, the toe of the cutoff wall will be 8 feet below the channel bed elevation for Lot 26 (Station 12+00 to Station 13+00) and lots 9, 10, and 11 (Station 18+00 to 20+50); the cutoff wall will be 15 feet below channel bed elevations for lots 16, 17, 18, 19, 24, and 25 (Station 13+50 to Station 18+00). The materials used for the cutoff wall must resist velocities up to 14 fps.

Table 2.2: Summary of peak discharges and storm runoff volumes, West Branch of Calabacillas Arroyo.						
Event	Pre-development Conditions			2036 Development Conditions		
	Peak Discharge (cfs)		Runoff Volume (ac-ft)	Peak Discharge (cfs)		Runoff Volume (ac-ft)
	Unbulked	Bulked		Unbulked	Bulked	
Concentration Point 4						
2	0	0	0	540	870	48
5	20	20	3	930	1680	76
10	110	120	10	1280	2300	99
25	300	320	30	1780	3380	132
50	460	500	50	2160	2380	157
100	660	710	70	2560	2820	184
Concentration Point 3						
2	0	0	0	570	910	58
5	20	20	3	990	1780	92
10	110	120	16	1360	2450	121
25	310	330	39	1930	3670	161
50	480	520	58	2340	2570	192
100	710	770	80	2740	3020	225
Concentration Point 2						
2	0	0	1	610	980	66
5	20	20	4	1070	1930	106
10	120	130	20	1480	2680	139
25	330	360	50	2110	4010	185
50	510	550	70	2550	2800	221
100	780	840	90	2990	3290	258
Concentration Point 1						
2	0	0	0	870	1370	120
5	30	30	6	1530	2750	192
10	190	200	30	2120	3820	250
25	510	550	80	3130	5950	334
50	830	900	120	3770	4150	397
100	1190	1290	170	4460	4910	465

TABLE 1

Table 2.2. Summary of peak discharges and storm runoff volumes, West Branch of Calabacillas Arroyo.						
Event	Pre-development Conditions			2036 Development Conditions		
	Peak Discharge (cfs)		Runoff Volume (ac-ft)	Peak Discharge (cfs)		Runoff Volume (ac-ft)
	Unbulked	Bulked		Unbulked	Bulked	
Concentration Point L						
2	na	na	na	910	1460	142
5	na	na	na	1610	3000	227
10	na	na	na	2220	4000	296
25	na	na	na	3350	6370	395
50	na	na	na	4070	4480	472
100	na	na	na	4810	5290	551
Concentration Point 0						
2	0	0	0	970	1540	188
5	30	30	8	1680	3020	295
10	210	220	40	2310	4160	380
25	570	610	110	3470	6590	498
50	990	1070	160	4200	4620	587
100	1440	1560	220	4950	5450	680

TABLE 1 (contd.)

EXISTING CONDITIONS SUMMARY RESULTS

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	27	PF 1	1342.00	5470.60	5473.68	5473.50	5474.49	0.014541	7.22	185.80	90.37	0.89
Reach-1	26	PF 1	1342.00	5470.34	5473.20	5473.10	5474.05	0.016190	7.40	181.29	92.11	0.93
Reach-1	25	PF 1	1342.00	5469.75	5472.38	5472.38	5473.29	0.019149	7.67	175.02	95.68	1.00
Reach-1	24	PF 1	1342.00	5468.17	5472.00	5471.37	5472.55	0.008187	5.95	225.46	95.25	0.68
Reach-1	23	PF 1	1342.00	5468.39	5471.09	5471.08	5472.02	0.019190	7.73	173.68	94.13	1.00
Reach-1	22	PF 1	1342.00	5467.41	5470.47		5471.31	0.014778	7.39	181.68	86.50	0.90
Reach-1	21	PF 1	1342.00	5466.69	5470.10	5469.65	5470.76	0.010470	6.50	206.54	91.95	0.76
Reach-1	20	PF 1	1342.00	5466.17	5469.11	5469.11	5470.17	0.018434	8.28	162.10	76.67	1.00
Reach-1	19	PF 1	1342.00	5465.06	5468.73	5468.19	5469.38	0.009284	6.44	208.34	85.84	0.73
Reach-1	18	PF 1	1342.00	5464.32	5468.30		5468.98	0.009874	6.60	203.18	84.38	0.75
Reach-1	17	PF 1	1342.00	5464.81	5467.94		5468.56	0.009961	6.35	211.46	94.01	0.75
Reach-1	16	PF 1	1342.00	5464.28	5466.87	5466.82	5467.71	0.018152	7.34	182.89	102.77	0.97
Reach-1	15	PF 1	1342.00	5462.73	5466.34		5466.87	0.008297	5.87	228.49	99.49	0.68
Reach-1	14	PF 1	1342.00	5462.86	5465.27	5465.23	5466.16	0.018184	7.57	177.18	94.96	0.98
Reach-1	13	PF 1	1342.00	5461.31	5464.81		5465.37	0.008973	6.04	224.26	112.41	0.71
Reach-1	12	PF 1	1342.00	5460.70	5464.05		5464.68	0.012110	6.34	211.82	109.18	0.80
Reach-1	11	PF 1	1342.00	5460.48	5463.71		5464.03	0.006292	4.52	297.13	156.10	0.58
Reach-1	10	PF 1	1342.00	5460.34	5463.03		5463.56	0.014285	5.84	229.62	151.71	0.84
Reach-1	9	PF 1	1342.00	5458.50	5461.93	5461.93	5462.80	0.019548	7.48	179.37	103.42	1.00
Reach-1	8	PF 1	1342.00	5458.70	5461.05	5461.17	5461.99	0.025376	7.78	172.42	114.10	1.12
Reach-1	7	PF 1	1342.00	5458.19	5460.57	5460.45	5461.27	0.016168	6.74	199.24	116.77	0.91
Reach-1	6	PF 1	1342.00	5457.20	5459.98	5459.82	5460.58	0.013556	6.26	229.82	206.25	0.83
Reach-1	5	PF 1	1342.00	5456.23	5459.02	5459.02	5459.85	0.018089	7.34	187.12	133.15	0.97
Reach-1	4	PF 1	1342.00	5454.89	5457.86	5458.13	5458.91	0.022126	8.27	172.76	148.31	1.07
Reach-1	3	PF 1	1342.00	5453.81	5457.35	5457.39	5458.04	0.013114	6.91	240.46	246.32	0.84
Reach-1	2	PF 1	1342.00	5453.09	5455.84	5456.24	5457.10	0.029015	9.29	172.15	164.91	1.23
Reach-1	1	PF 1	1342.00	5451.31	5453.77	5454.17	5455.14	0.055011	9.39	143.82	137.80	1.56

TABLE 2

DEVELOPED CONDITIONS SUMMARY RESULTS

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	27	PF 1	5100.00	5470.60	5476.31	5476.31	5478.06	0.013379	10.74	507.89	161.58	0.95
Reach-1	26	PF 1	5100.00	5470.34	5475.56	5475.56	5477.58	0.019844	11.41	449.79	164.00	1.12
Reach-1	25	PF 1	5100.00	5469.75	5474.61	5474.98	5476.69	0.021079	11.56	442.25	155.40	1.15
Reach-1	24	PF 1	5100.00	5468.17	5474.66	5474.30	5475.91	0.012041	8.96	570.13	184.03	0.87
Reach-1	23	PF 1	5100.00	5468.39	5473.85	5473.85	5475.36	0.013341	9.96	550.60	223.21	0.93
Reach-1	22	PF 1	5100.00	5467.41	5472.85	5473.23	5474.74	0.016878	11.30	515.30	213.69	1.05
Reach-1	21	PF 1	5100.00	5466.69	5472.94	5472.45	5473.98	0.007419	8.64	723.62	242.22	0.72
Reach-1	20	PF 1	5100.00	5466.17	5472.10	5472.10	5473.60	0.010872	10.31	612.51	232.55	0.87
Reach-1	19	PF 1	5100.00	5465.06	5470.98	5471.40	5473.03	0.015731	11.62	482.14	196.71	1.03
Reach-1	18	PF 1	5100.00	5464.32	5470.85	5470.79	5472.38	0.010955	10.35	586.43	191.31	0.87
Reach-1	17	PF 1	5100.00	5464.81	5470.60	5470.21	5471.92	0.009435	9.53	603.60	175.79	0.81
Reach-1	16	PF 1	5100.00	5464.28	5469.35	5469.35	5471.10	0.015752	10.60	481.21	139.80	1.01
Reach-1	15	PF 1	5100.00	5462.73	5469.00	5468.40	5470.17	0.009487	8.72	590.68	178.39	0.79
Reach-1	14	PF 1	5100.00	5462.86	5467.85	5467.85	5468.51	0.012807	10.66	545.93	185.30	0.93
Reach-1	13	PF 1	5100.00	5461.31	5466.57	5466.95	5468.69	0.016522	12.04	491.61	180.60	1.06
Reach-1	12	PF 1	5100.00	5460.70	5466.04	5466.23	5467.78	0.015291	10.83	527.44	194.52	1.00
Reach-1	11	PF 1	5100.00	5460.48	5465.92	5465.04	5466.73	0.007079	7.22	709.41	215.67	0.68
Reach-1	10	PF 1	5100.00	5460.34	5465.35	5465.35	5466.30	0.010067	7.84	650.54	213.63	0.79
Reach-1	9	PF 1	5100.00	5458.50	5464.27	5464.27	5465.69	0.016623	9.59	532.11	188.41	1.00
Reach-1	8	PF 1	5100.00	5458.70	5463.44	5463.55	5465.04	0.018567	10.16	502.43	180.39	1.06
Reach-1	7	PF 1	5100.00	5458.19	5462.49	5462.79	5464.25	0.017714	10.79	517.22	237.90	1.06
Reach-1	6	PF 1	5100.00	5457.20	5461.12	5461.74	5463.27	0.028238	12.54	509.90	270.24	1.31
Reach-1	5	PF 1	5100.00	5456.23	5460.85	5461.00	5462.20	0.015382	10.32	660.75	295.20	0.99
Reach-1	4	PF 1	5100.00	5454.89	5459.43	5459.94	5461.30	0.029153	12.12	550.87	297.58	1.31
Reach-1	3	PF 1	5100.00	5453.81	5458.84	5459.04	5460.27	0.017726	11.08	655.31	295.55	1.06
Reach-1	2	PF 1	5100.00	5453.09	5457.64	5458.06	5459.43	0.021424	12.54	591.61	264.38	1.18
Reach-1	1	PF 1	5100.00	5451.31	5455.25	5458.04	5457.95	0.042677	13.57	412.68	205.77	1.56

DEV. CONDITIONS W/ ENCROACHMENT SUMMARY RESULTS

HEC-RAS Plan: Imported Pla River: RIVER-1 Reach: Reach-1 Profile: PF 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach-1	27	PF 1	5100.00	5470.60	5476.31	5476.31	5478.06	0.013379	10.74	507.89	161.58	0.95
Reach-1	26	PF 1	5100.00	5470.34	5475.56	5475.89	5477.58	0.019944	11.41	449.79	164.00	1.12
Reach-1	25	PF 1	5100.00	5469.75	5474.61	5474.98	5476.69	0.021079	11.56	442.25	155.40	1.15
Reach-1	24	PF 1	5100.00	5468.17	5474.66	5474.30	5475.91	0.012041	8.96	570.13	184.03	0.87
Reach-1	23	PF 1	5100.00	5468.39	5473.85	5473.85	5475.36	0.013341	9.96	550.60	223.21	0.93
Reach-1	22	PF 1	5100.00	5467.41	5472.85	5473.23	5474.74	0.016878	11.30	515.30	213.59	1.05
Reach-1	21	PF 1	5100.00	5466.69	5472.94	5472.45	5473.98	0.007419	8.64	723.62	242.22	0.72
Reach-1	20	PF 1	5100.00	5466.17	5472.10	5472.10	5473.60	0.010872	10.31	612.51	232.55	0.87
Reach-1	19	PF 1	5100.00	5465.06	5470.98	5471.40	5473.03	0.015731	11.62	482.14	196.71	1.03
Reach-1	18	PF 1	5100.00	5464.32	5470.80	5470.79	5472.37	0.011411	10.51	576.83	190.43	0.89
Reach-1	17	PF 1	5100.00	5464.81	5470.52	5470.52	5471.90	0.010010	9.73	590.41	174.83	0.83
Reach-1	16	PF 1	5100.00	5464.28	5470.00	5469.33	5471.22	0.009430	8.89	581.35	195.43	0.79
Reach-1	15	PF 1	5100.00	5462.73	5468.87	5468.49	5470.53	0.011388	10.34	493.26	116.07	0.88
Reach-1	14	PF 1	5100.00	5462.86	5467.80	5467.80	5469.77	0.014689	11.34	462.46	120.27	1.00
Reach-1	13	PF 1	5100.00	5461.31	5466.58	5466.89	5468.86	0.017292	12.34	444.93	130.09	1.08
Reach-1	12	PF 1	5100.00	5460.70	5465.94	5466.18	5467.94	0.017756	11.48	465.40	146.10	1.07
Reach-1	11	PF 1	5100.00	5460.48	5465.91	5465.03	5466.85	0.007288	7.79	655.01	168.10	0.70
Reach-1	10	PF 1	5100.00	5460.34	5465.18	5465.18	5466.39	0.011145	8.83	577.54	169.89	0.84
Reach-1	9	PF 1	5100.00	5458.50	5464.20	5464.20	5465.77	0.016156	10.03	508.52	163.32	1.00
Reach-1	8	PF 1	5100.00	5458.70	5463.29	5463.54	5465.08	0.021881	10.71	476.15	174.61	1.14
Reach-1	7	PF 1	5100.00	5458.19	5462.57	5462.79	5464.23	0.016338	10.51	534.82	245.95	1.02
Reach-1	6	PF 1	5100.00	5457.20	5461.11	5461.74	5463.28	0.028588	12.60	507.52	270.02	1.31
Reach-1	5	PF 1	5100.00	5456.23	5460.85	5461.00	5462.20	0.015382	10.32	660.75	295.20	0.99
Reach-1	4	PF 1	5100.00	5454.89	5459.43	5459.94	5461.30	0.029153	12.12	550.87	297.58	1.31
Reach-1	3	PF 1	5100.00	5453.81	5458.84	5459.04	5460.27	0.017726	11.08	655.31	295.55	1.06
Reach-1	2	PF 1	5100.00	5453.09	5457.64	5458.06	5459.43	0.021424	12.54	591.61	264.38	1.18
Reach-1	1	PF 1	5100.00	5451.31	5455.25	5456.04	5457.95	0.042677	13.57	412.68	205.77	1.56