CITY OF ALBUQUERQUE

November 9, 2007

Ronald R. Bohannan, P.E.
Tierra West, LLC
5571 Midway Park Place NE
Albuquerque, NM 87109

Re: Petroglyph Edge Subdivision Drainage Report

Engineer's Stamp dated 10-19-07 (E10-D24)

Dear Mr. Bohannan,

Based upon the information provided in your submittal received 10-19-07, the above referenced plan is approved for Preliminary Plat action by the DRB. Once that board approves the grading plan, please submit a mylar copy for my signature in order to obtain a Rough Grading Permit.

This project requires a National Pollutant Discharge Elimination System (NPDES) permit. In addition to submitting an NOI to the EPA and preparing a SWPPP, please send a copy of the SWPPP on a CD in .pdf format to the following address:

Department of Municipal Development
Storm Drainage Division
P.O. Box 1293, One Civic Plaza, Rm. 301
Attn: Kathy Verhage
Albuquerque, NM 87103

If you have any questions about this permit, please feel free to call the Municipal Development Department, Hydrology section at 768-3654.

Prior to Release of SIA and Financial Guarantees, an Engineer's Certification of this grading plan will be required.

If you have any questions, you can contact me at 924-3986.

Sincerely,

Bradley L. Bingham

Bradley L. Bingham, PE
Principal Engineer, Planning Dept.
Development and Building Services

C: file

P.O. Box 1293
Albuquerque
New Mexico 87103
www.cabq.gov

DRAINAGE REPORT

for

Petroglyph Edge Subdivision
Albuquerque, New Mexico

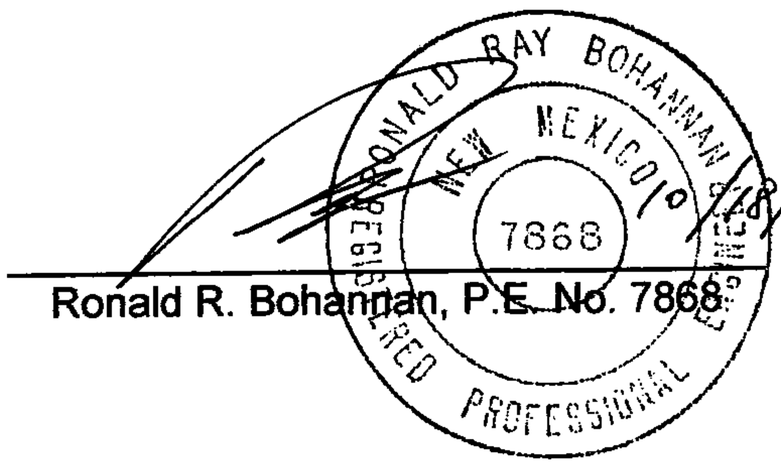
Prepared by

Tierra West, LLC
5571 Midway Park Place NE
Albuquerque, New Mexico 87109

Prepared for

Kathy Trujillo
6820 Staghorn Dr. NW
Albuquerque, NM 87120

October 2007



10/18/07

Ronald R. Bohannan, P.E. No. 7868

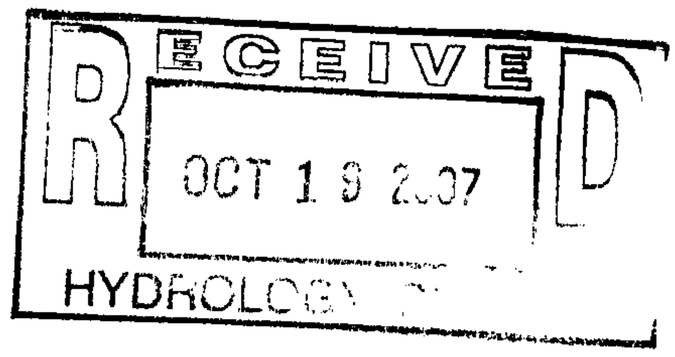


TABLE OF CONTENTS

NORTHWEST MESA ESCARPMENT PLAN IMPACT

NORTHWEST MESA ESCARPMENT PLAN CONSERVATION

NORTHWEST MESA ESCARPMENT PLAN VIEW

For more current information and more details visit: http://www.cabq.gov/gis

Albuquerque Geographic Information System

Map amended through: 5/1/2006

Note: Grey Shading Represents Area Outside of the City Limits

Zone Atlas Page:

E-10-Z

Selected Symbols

- SECTOR PLANS
- Design Overlay Zones
- City Historic Zones
- H-1 Buffer Zone
- Petroglyph Mon.
- Escarpment
- 2 Mile Airport Zone
- Airport Noise Contours
- Wall Overlay Zone

Feet: 0, 750, 1,500

Location

The site is located east of Unser Boulevard, between Mojave Street on the south and the Boca Negra Arroyo to the north. The site contains approximately 4.25 acres and is currently undeveloped (see attached Zone Atlas Map E-10). The property will be subdivided into 21 residential single family lots. The purpose of this report is to provide the drainage analysis and management plan for the subdivision.

Existing Drainage Conditions

The site is currently undeveloped and drains north at a 6 to 8 percent slope. No offsite runoff enters the site. The Boca Negra Arroyo is located north of the site and cuts off flows from that direction. Mojave Street is fully developed with curb and gutter and prevents any flows from the south from entering the site. The sites to the east and west are also developed and no flows enter this subdivision.

FIRM Map

The site is located on FIRM Map 35001C0112E as shown on the attached excerpt. The map shows that the site does not lie within any 100-year flood plains. The Boca Negra Arroyo floodplain is located north of the site. The arroyo floodplain has a 3' depth and is contained within the channel. The pad sites within the subdivision are higher than the 3' depth and no flows are expected to exit the channel and enter the pads.

On-Site Drainage Management Plan

The proposed drainage management plan is to collect the developed flows from the subdivision in the new streets and convey the flows to the Boca Negra Arroyo on the north side of the site. The site is divided into five (5) basins. Basin 1 consists of Lots 1-4, 18-21 and a portion of Basaltic Street. The street will convey the flows north to Plutonic Avenue. Basaltic

y of Albuquerque
350002

3893 000 M

ZONE X

22

CANAVIO RD NW

PICARDIA PL NW

ALDERETE CT NW

1% FL CON

PAINTED PO

PETIRROJO RD NW

URRACA ST NW

TARGET LN NW

AZOR LN NW

VISTA DEL PRADO NW

JASMINE ST NW

SONORA AVE NW

AGUILA ST NW

CAMINO DEL OESTE NW

TESUQUE CT NW

ACACIA ST NW

ACACIA OPEN S

COMPASS DR NW

QUARTERHORSE LN NW

PRA

TAMARISK PL NW

ACACIA ST NW

HOKONA PL NW

CAMPFIRE LN NW

HIGH PLAC CT NW

RU C

ORATE LIMITS
NCIDENT WITH
K BOUNDARY

PETROGLYPH NATIONAL MONUMENT

TESUQUE DR NW

MARIPOSA PL NW

SEVILLE PL NW

AGATE AVE NW

ZONE X

AGATE LN NW

SIERRA I AVE NI

ZONE AO
(DEPTH 3')

3892 000 M

City of Albuquerque
350002

27

MOJAVE ST NW

MOJAV CT NW

1% ANNUAL CHANCE
FLOOD DISCHARGE
CONTAINED IN CHANNEL

Boca Negra Arroyo Sou

PIMA DR NW

PIMA PL NW

LITTLE JOE PL NW

WHITEMAN DR NW

POJOAQUE DR NW

THUNDERBIRD DR NW

THUNDERBIRD CIR NW

ZONE X

CAROUSEL AVE NW

SWEETWATER PL NW

35° 09' 22.5"
-106° 43' 07.5"

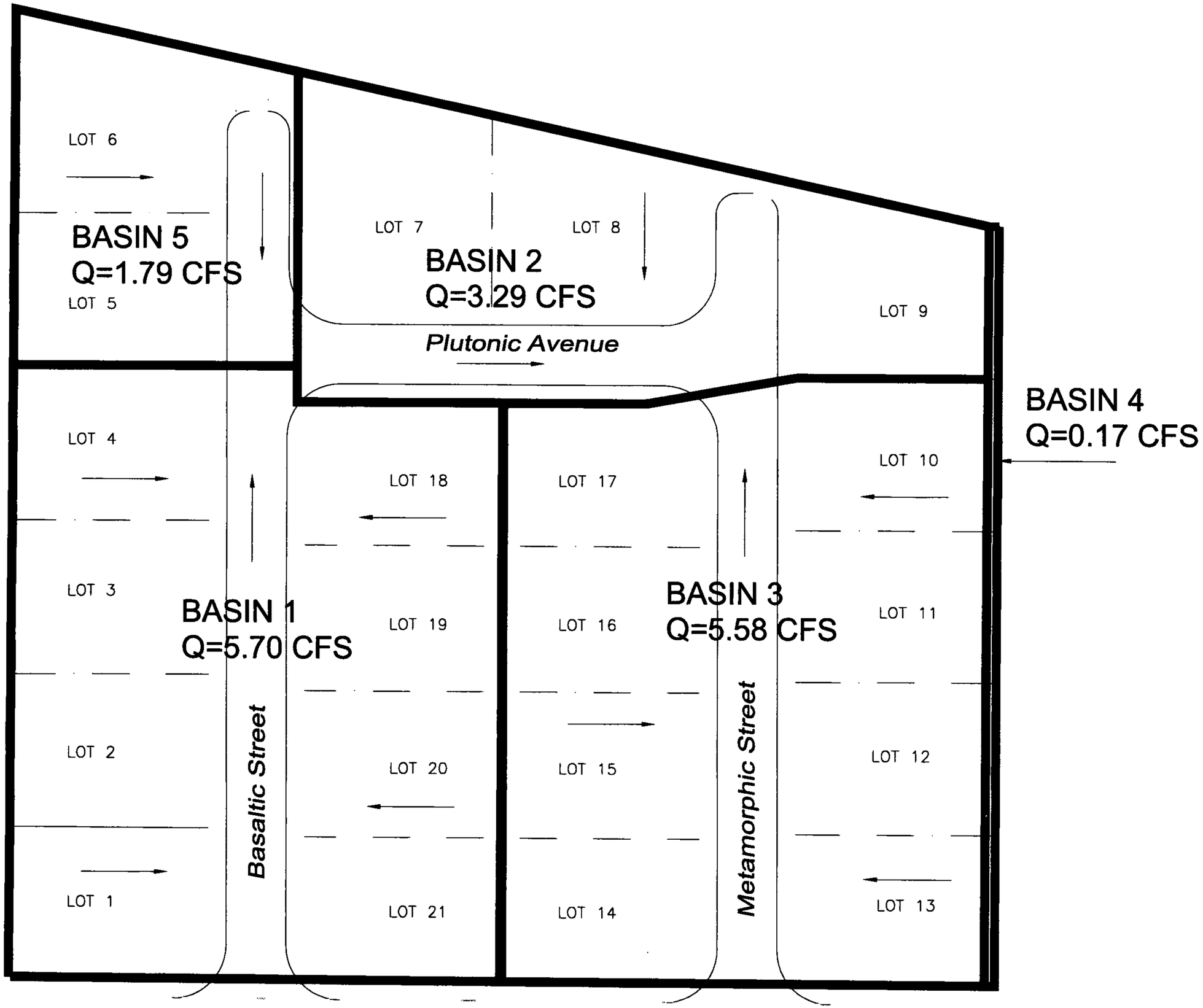
FIRM MAP 35001C0112 E

Street has a maximum grade of 8%, but will be able to convey the developed flow of 5.70 cfs within mountable curbs. Basin 2 has a developed flow of 3.29 cfs and consists of Lots 7-9 and Plutonic Avenue. Plutonic Avenue drains east and will convey the flows from Basins 1 and 5 to Basin 3. Basin 3 consists of lots 10-17 and Metamorphic Street. The street has a maximum grade of 8% and will convey the developed flows of 5.58 cfs within mountable curb. Basin 5, with a developed flow of 1.79 cfs, consists of Lots 5, 6 and a portion of Basaltic Street. This portion of Basaltic Street will drain south to Plutonic Avenue. The curb on Metamorphic Street will change from mountable to standard where Plutonic Avene connects to carry the developed flow of 16.36 cfs to the Boca Negra Arroyo. A total of 16.36 cfs will be conveyed within a new 10' concrete channel to the Boca Negra Arroyo.

Basin 4 consists of a 5' asphalt swale located on the east side of the property. The swale is located between the existing retaining wall and the new retaining wall that is required by the proposed grades. The swale will convey the flows north to the Boca Negra Arroyo. A rip rap pad will prevent erosion from the channel outlet.

In the case of an emergency or storm greater than the 100-year event, the site will overflow the new channel and drain to the Boca Negra Arroyo before any water enters the houses.

A scour wall is necessary along the north property line to ensure that any future erosion of the Boca Negra Arroyo does not impact the subdivision. Calculations for the Erosion Setback Line are included and show the Boca Negra has the potential to impact this subdivision. Therefore, calculations are provided and show the necessary scour wall height to be 8' below the channel invert. The "Petroglyph Shadows Drainage Report" by Isaacson and Arfman, P.A. analyzed the Boca Negra Arroyo adjacent to Petroglyph Shadows as well as this new subdivision. Excerpts from that report are included in the appendix. The cross-section information for channel depth, velocity and Froude numbers were used to calculate the required



DEVELOPED BASIN LAYOUT

scour depth. Our calculations match closely with the results of the Petroglyph Shadows report and a similar scour wall detail is shown on the plans.

Calculations

The Weighted E method from the "City of Albuquerque Development Process Manual Volume 11 – Design Criteria, 1997 Revision" was used to calculate the runoff and volume for the site.

Summary

The site generates a total developed flow of 16.53 cfs. A new 10' concrete channel at the end of Metamorphic Street will convey the flows to the Boca Negra Arroyo located north of the site. A 5' asphalt channel will convey flows from between the two retaining walls on the east side of the property to the Boca Negra Arroyo. An 8' scour wall will be constructed along the north property line to protect the site from future erosion of the arroyo.

Runoff
Calculations

Weighted E Method

On-Site Basins

											100-Year			10-Year		
Basin	Area (sf)	Area (acres)	Treatment A		Treatment B		Treatment C		Treatment D		Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs	Weighted E (ac-ft)	Volume (ac-ft)	Flow cfs
			%	(acres)	%	(acres)	%	(acres)	%	(acres)						
1	63,854	1.47	0%	0	13%	0.19	12%	0.18	75%	1.10	1.683	0.206	5.70	1.011	0.124	3.58
2	36,908	0.85	0%	0	13%	0.11	12%	0.10	75%	0.64	1.683	0.119	3.29	1.011	0.071	2.07
3	62,556	1.44	0%	0	13%	0.19	12%	0.17	75%	1.08	1.683	0.201	5.58	1.011	0.121	3.51
4	1,651	0.04	0%	0	0%	0.00	0%	0.00	100%	0.04	1.970	0.006	0.17	1.240	0.004	0.11
5	20,103	0.46	0%	0	13%	0.06	12%	0.06	75%	0.35	1.683	0.065	1.79	1.011	0.039	1.13
Total	185,072	4.25				0.55		0.51		3.20		0.597	16.53		0.359	10.41

Equations:

Weighted E = Ea*Aa + Eb*Ab + Ec*Ac + Ed*Ad / (Total Area)

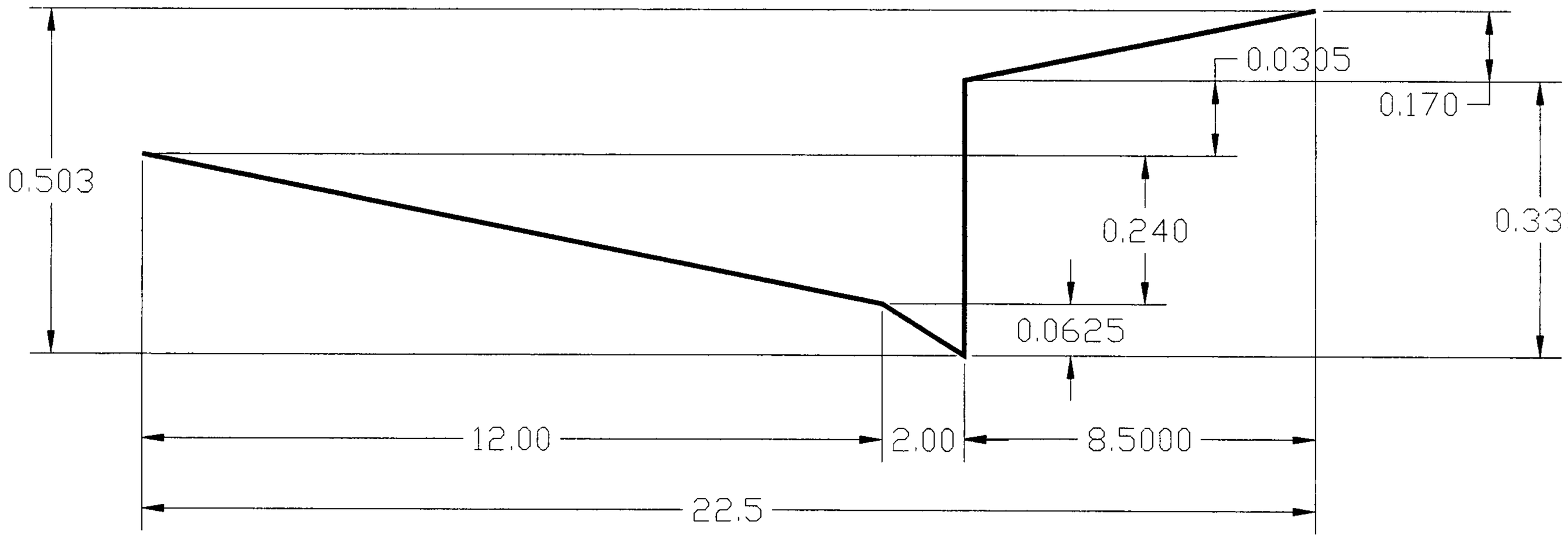
Volume = Weighted D * Total Area

Flow = Qa * Aa + Qb * Ab + Qc * Ac + Qd * Ad

Excess Precipitation, E (inches)		
Zone 1	100-Year	10 - Year
E_a	0.44	0.08
E_b	0.67	0.22
E_c	0.99	0.44
E_d	1.97	1.24

Peak Discharge (cfs/acre)		
Zone 1	100-Year	10 - Year
Q_a	1.29	0.24
Q_b	2.03	0.76
Q_c	2.87	1.49
Q_d	4.37	2.89

Street Capacity Calculations



28' F-F STREET SECTION W/ 4" CURB

Street Capacity Calculations

Basaltic Street
28' F-F Street Section with 4" curb
Slope= 0.08
Q (cfs)= 5.70

For water depths less than 0.0625 feet

Y= Water depth
Area = 16*Y^2
P= SQRT(1025*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0016	0.33	0.00	0.00	0.00	0.71	0.01	1.25	0.01334
0.02	0.0064	0.66	0.01	0.01	0.01	1.12	0.02	1.40	0.03086
0.025	0.0100	0.83	0.01	0.01	0.03	1.30	0.03	1.45	0.04039
0.035	0.0196	1.16	0.02	0.03	0.06	1.63	0.06	1.54	0.06059
0.045	0.0324	1.49	0.02	0.06	0.13	1.93	0.09	1.60	0.08198
0.05	0.0400	1.65	0.02	0.08	0.17	2.07	0.10	1.63	0.09305
0.06	0.0576	1.98	0.03	0.13	0.27	2.34	0.14	1.68	0.11584
0.0625	0.0625	2.06	0.03	0.15	0.30	2.40	0.15	1.69	0.12166

For water depths greater than 0.0625 ft but less than 0.3025 ft

Y1= Y-0.0625
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)+Y1

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.063	0.0635	2.09	0.03	0.15	0.31	2.41	0.15	1.69	0.12240
0.1	0.1727	3.98	0.04	0.53	1.05	3.05	0.31	1.70	0.19585
0.13	0.3114	5.51	0.06	1.13	2.27	3.64	0.47	1.78	0.26871
0.16	0.4952	7.04	0.07	2.09	4.17	4.21	0.67	1.86	0.34763
0.178	**0.6270**	**7.96**	**0.08**	**2.85**	**5.70**	**4.54**	**0.81**	**1.90**	**0.39711**
0.23	1.0989	10.61	0.10	5.99	11.99	5.45	1.25	2.00	0.54689
0.26	1.4327	12.14	0.12	8.52	17.05	5.95	1.55	2.06	0.63709
0.3025	1.9825	14.31	0.14	13.13	26.25	6.62	2.00	2.12	0.76880

For water depths greater than 0.3025 ft but less than 0.333 ft

Y2= Y - 0.3025
A3= A2 + Y2*14
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.303	1.9895	14.31	0.14	13.20	26.41	6.64	2.01	2.12	0.77142
0.305	2.0175	14.31	0.14	13.51	27.03	6.70	2.04	2.14	0.78189
0.31	2.0875	14.31	0.15	14.30	28.60	6.85	2.12	2.17	0.80810
0.315	2.1575	14.32	0.15	15.10	30.21	7.00	2.21	2.20	0.83434
0.32	2.2275	14.32	0.16	15.93	31.85	7.15	2.29	2.23	0.86061
0.325	2.2975	14.33	0.16	16.77	33.53	7.30	2.37	2.26	0.88693
0.333	2.4095	14.34	0.17	18.14	36.29	7.53	2.51	2.30	0.92911

Street Capacity Calculations

Plutonic Avenue Street
28' F-F Street Section with 4" curb
Slope= 0.0272
Q (cfs)= 10.78

For water depths less than 0.0625 feet

Y= Water depth
Area = 16*Y^2
P= SQRT(1025*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0016	0.33	0.00	0.00	0.00	0.41	0.00	0.73	0.0064
0.02	0.0064	0.66	0.01	0.00	0.01	0.66	0.01	0.82	0.0152
0.025	0.0100	0.83	0.01	0.01	0.02	0.76	0.02	0.85	0.0200
0.035	0.0196	1.16	0.02	0.02	0.04	0.95	0.03	0.90	0.0302
0.045	0.0324	1.49	0.02	0.04	0.07	1.13	0.05	0.93	0.0411
0.05	0.0400	1.65	0.02	0.05	0.10	1.21	0.06	0.95	0.0468
0.06	0.0576	1.98	0.03	0.08	0.16	1.36	0.08	0.98	0.0585
0.0625	0.0625	2.06	0.03	0.09	0.18	1.40	0.09	0.99	0.0615

For water depths greater than 0.0625 ft but less than 0.3025 ft

Y1= Y-0.0625
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)+Y1

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.063	0.0635	2.09	0.03	0.09	0.18	1.40	0.09	0.99	0.0618
0.1	0.1727	3.98	0.04	0.31	0.61	1.78	0.18	0.99	0.0990
0.13	0.3114	5.51	0.06	0.66	1.32	2.12	0.28	1.04	0.1366
0.16	0.4952	7.04	0.07	1.22	2.43	2.46	0.39	1.08	0.1777
0.19	0.7239	8.57	0.08	2.01	4.02	2.78	0.53	1.12	0.2212
0.23	1.0989	10.61	0.10	3.49	6.99	3.18	0.73	1.17	0.2821
0.2675	**1.5231**	**12.52**	**0.12**	**5.39**	**10.78**	**3.54**	**0.95**	**1.21**	**0.3417**
0.3025	1.9825	14.31	0.14	7.65	15.31	3.86	1.17	1.24	0.3991

For water depths greater than 0.3025 ft but less than 0.333 ft

Y2= Y - 0.3025
A3= A2 + Y2*14
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.303	1.9895	14.31	0.14	7.70	15.40	3.87	1.17	1.24	0.4005
0.305	2.0175	14.31	0.14	7.88	15.76	3.91	1.19	1.25	0.4062
0.31	2.0875	14.31	0.15	8.34	16.68	3.99	1.24	1.26	0.4205
0.315	2.1575	14.32	0.15	8.81	17.61	4.08	1.29	1.28	0.4348
0.32	2.2275	14.32	0.16	9.29	18.57	4.17	1.33	1.30	0.4491
0.325	2.2975	14.33	0.16	9.78	19.55	4.25	1.38	1.32	0.4635
0.333	2.4095	14.34	0.17	10.58	21.16	4.39	1.46	1.34	0.4865

Street Capacity Calculations

Metamorphic Street
28' F-F Street Section with 4" curb
Slope= 0.08
Q (cfs) = 5.58

For water depths less than 0.0625 feet

Y= Water depth
Area = 16*Y^2
P= SQRT(1025*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.0016	0.33	0.00	0.00	0.00	0.71	0.01	1.25	0.0133
0.02	0.0064	0.66	0.01	0.01	0.01	1.12	0.02	1.40	0.0309
0.025	0.0100	0.83	0.01	0.01	0.03	1.30	0.03	1.45	0.0404
0.035	0.0196	1.16	0.02	0.03	0.06	1.63	0.06	1.54	0.0606
0.045	0.0324	1.49	0.02	0.06	0.13	1.93	0.09	1.60	0.0820
0.05	0.0400	1.65	0.02	0.08	0.17	2.07	0.10	1.63	0.0930
0.06	0.0576	1.98	0.03	0.13	0.27	2.34	0.14	1.68	0.1158
0.0625	0.0625	2.06	0.03	0.15	0.30	2.40	0.15	1.69	0.1217

For water depths greater than 0.0625 ft but less than 0.3025 ft

Y1= Y-0.0625
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)+Y1

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.063	0.0635	2.09	0.03	0.15	0.31	2.41	0.15	1.69	0.1224
0.1	0.1727	3.98	0.04	0.53	1.05	3.05	0.31	1.70	0.1959
0.13	0.3114	5.51	0.06	1.13	2.27	3.64	0.47	1.78	0.2687
0.16	0.4952	7.04	0.07	2.09	4.17	4.21	0.67	1.86	0.3476
0.1767	**0.6169**	**7.89**	**0.08**	**2.79**	**5.58**	**4.52**	**0.80**	**1.90**	**0.3935**
0.24	1.2052	11.12	0.11	6.77	13.55	5.62	1.35	2.02	0.5767
0.26	1.4327	12.14	0.12	8.52	17.05	5.95	1.55	2.06	0.6371
0.3025	1.9825	14.31	0.14	13.13	26.25	6.62	2.00	2.12	0.7688

For water depths greater than 0.3025 ft but less than 0.333 ft

Y2= Y - 0.3025
A3= A2 + Y2*14
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.303	1.9895	14.31	0.14	13.20	26.41	6.64	2.01	2.12	0.7714
0.305	2.0175	14.31	0.14	13.51	27.03	6.70	2.04	2.14	0.7819
0.31	2.0875	14.31	0.15	14.30	28.60	6.85	2.12	2.17	0.8081
0.315	2.1575	14.32	0.15	15.10	30.21	7.00	2.21	2.20	0.8343
0.32	2.2275	14.32	0.16	15.93	31.85	7.15	2.29	2.23	0.8606
0.325	2.2975	14.33	0.16	16.77	33.53	7.30	2.37	2.26	0.8869
0.333	2.4095	14.34	0.17	18.14	36.29	7.53	2.51	2.30	0.9291

Street Capacity Calculations

Metamorphic Street
28' F-F Street Section with 8" curb
Slope= 0.035
Q (cfs) = 16.36

For water depths less than 0.125 feet

Y= Water depth
Area = 8*Y^2
P= SQRT(257*Y^2) + Y
n= 0.017

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.01	0.00	0.17	0.00	0.00	0.00	0.46	0.00	0.81	0.007
0.02	0.00	0.34	0.01	0.00	0.00	0.73	0.01	0.91	0.018
0.04	0.01	0.68	0.02	0.01	0.03	1.16	0.05	1.02	0.041
0.06	0.03	1.02	0.03	0.04	0.09	1.51	0.09	1.09	0.067
0.08	0.05	1.36	0.04	0.09	0.19	1.83	0.15	1.14	0.095
0.1	0.08	1.70	0.05	0.17	0.34	2.13	0.21	1.19	0.125
0.12	0.12	2.04	0.06	0.28	0.55	2.40	0.29	1.22	0.156
0.125	0.13	2.13	0.06	0.31	0.62	2.47	0.31	1.23	0.164

For water depths greater than 0.125 ft but less than 0.365 ft

Y1= Y-0.125
A2= A1 + 2*Y1 + 25*Y1^2
P2= P1 + SQRT(2501*Y1^2)+Y1

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.13	0.14	2.38	0.06	0.33	0.66	2.42	0.31	1.18	0.162
0.16	0.23	3.91	0.06	0.55	1.10	2.44	0.39	1.08	0.176
0.2	0.42	5.95	0.07	1.15	2.30	2.77	0.55	1.09	0.225
0.24	0.69	8.00	0.09	2.18	4.36	3.18	0.76	1.14	0.286
0.28	1.04	10.04	0.10	3.73	7.45	3.60	1.01	1.20	0.355
0.32	1.47	12.08	0.12	5.88	11.75	4.01	1.28	1.25	0.427
0.3532	**1.88**	**13.77**	**0.14**	**8.18**	**16.35**	**4.34**	**1.53**	**1.29**	**0.490**
0.365	2.05	14.37	0.14	9.12	18.23	4.46	1.63	1.30	0.513

For water depths greater than 0.365 ft but less than 0.667 ft

Y2= Y - 0.365
A3= A2 + Y2*14
P3= P2 + Y2

Depth (ft)	Area (ft^2)	P (ft)	R (A/P)	Q (cfs)	2Q (cfs)	Vel (ft/s)	D*V	Fr	D2 (ft)
0.37	2.12	14.38	0.15	9.64	19.28	4.56	1.69	1.32	0.530
0.45	3.24	14.46	0.22	19.50	39.00	6.03	2.71	1.58	0.808
0.48	3.66	14.49	0.25	23.87	47.73	6.53	3.13	1.66	0.913
0.51	4.08	14.52	0.28	28.57	57.14	7.01	3.58	1.73	1.019
0.55	4.64	14.56	0.32	35.34	70.69	7.63	4.19	1.81	1.161
0.59	5.20	14.60	0.36	42.67	85.33	8.21	4.85	1.88	1.305
0.63	5.76	14.64	0.39	50.51	101.02	8.78	5.53	1.95	1.450
0.667	6.27	14.67	0.43	58.22	116.43	9.28	6.19	2.00	1.585

Channel Calculations

Channel Capacity

	Top Width	Bottom Width	Depth	Area	WP	R	Slope	Q Provided	Q Required	Velocity
	(ft)	(ft)	(ft)	(ft^2)	(ft)		(%)	(cfs)	(cfs)	(ft/s)
10' Channel	10	10	0.5	5.00	11.00	0.4545	1	33.88	16.36	3.27

Manning's Equation:

Q = 1.49/n * A * R^(2/3) * S^(1/2)

A = Area

R = A/WP

S = Slope

n = 0.013

Riprap Requirements

Equation taken from Table 5-5 from the Urban Storm Drainage Criteria Manual Volume 2 by Wright-McLaughlin Engineers.

$$\frac{VS^{0.17}}{(S_S - 1)^{0.66}} = \frac{4.93 * 0.006^{0.17}}{(2.5 - 1)^{0.66}} = 1.58$$

Where:

V = Velocity (ft/sec)
= 4.93 (station 4 from Hec II)

S = Slope (ft/ft)
= 0.006 ft/ft (slope of Boca Negra)

S_s = Specific gravity of rock
= 2.5

from Table 5-5 use Rock Type VL with a d_{50} of 6".

Scour Wall
Calculations

Erosion Setback Line

Arroyo	100-year Flow (cfs)	Dominant Discharge (cfs)	Critical Slope (ft/ft)	Slope (ft/ft)	Channel Width (ft)	Δmax (ft)
Boca Negra	3845	769.00	0.0153	0.006	77.78	242.34

Equations:

Dominant Discharge (Q_d)

$Q_d = 0.2*Q_{100}$

Channel Width (Wd)

when $S_c>S$ then $W_d = 4.6 * Q_d^{0.4}$

when $S_c<S$ then $W_d = 2.46 * Q_d^{0.375} * S^{-0.133}$

Critical Slope (S_c)

$S_c=0.037 * Q_d^{-0.133}$

Maximum Lateral Erosion Distance (Δmax) when $S>S_c$

$\Delta max = 11.5 * Q_d 0.4$	when Q_d <= 200 cfs
$\Delta max = (0.92 + 4.6 * \log Q_d) * Q_d^{0.4}$	when 200 cfs < Q_d < 2000 cfs
$\Delta max = 16.1 * Q_d^{0.4}$	when Q_d>= 2000 cfs

Maximum Lateral Erosion Distance (Δmax) when $S<S_c$

$\Delta max = 6.2 * Qd^{0.375} * S^{-0.188}$	when Q_d <= 200 cfs
$\Delta max = (0.45 + 2.5 * \log Q_d) * Q_d^{0.375} * S^{-0.188}$	when 200 cfs < Q_d < 2000 cfs
$\Delta max = 8.6 * Q_d^{0.375} * S^{-0.188}$	when Q_d>= 2000 cfs

Depth of Scour Wall

(from AMAFCA's` Sediment and Erosion Design Guide)

For Flows Parallel to Wall:

$y_s = y\,(0.73 + 0.14 * \pi * Fr^2)$

Where:

y_s = Depth of scour (ft)
y = Normal channel depth from Hec II analysis (ft)
Fr = Froude number from Hec II analysis

$y_s = 5.21\,(0.73 + 0.14 * \pi * 1.36^2)$

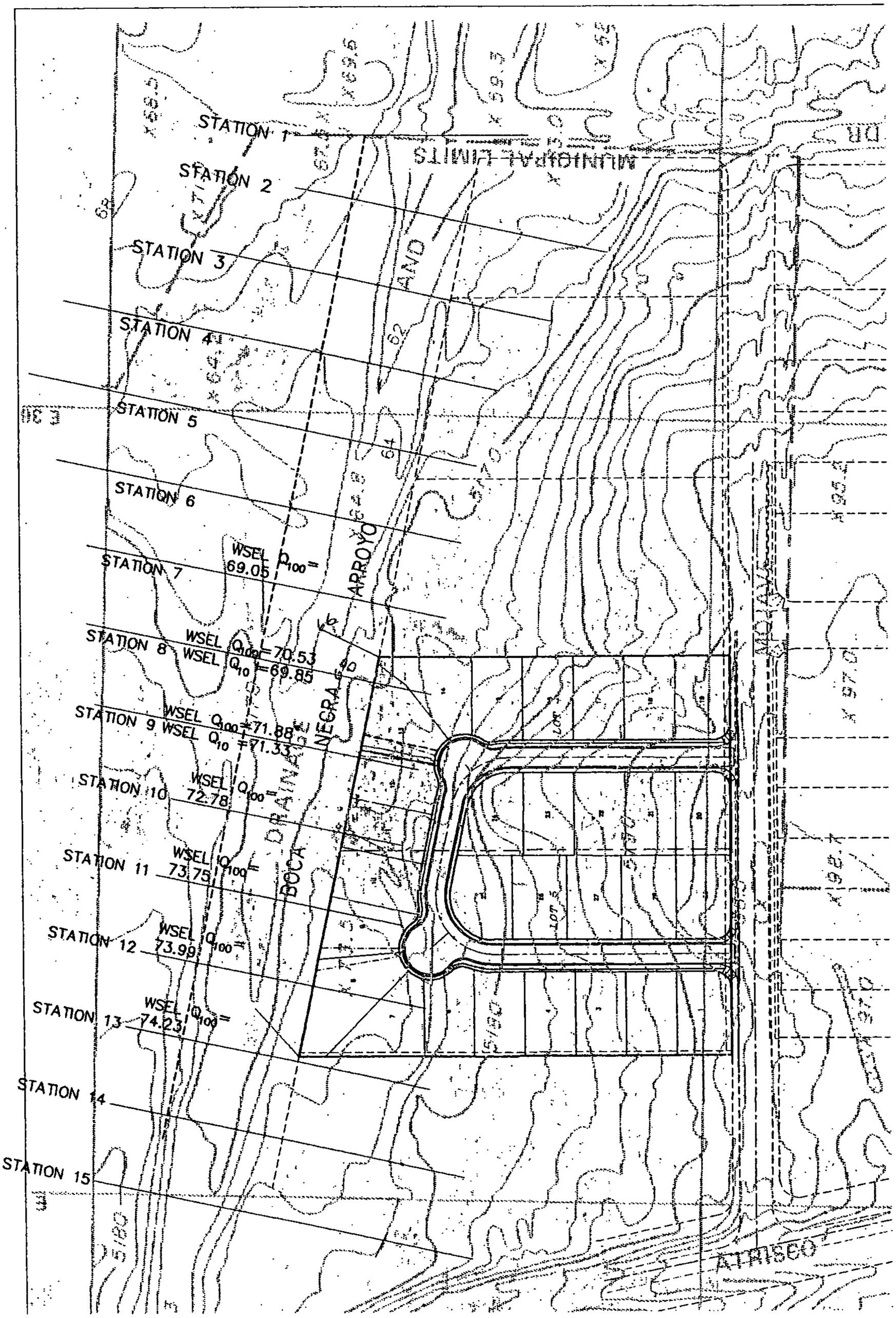
$y_s = 8.04$

Use 8.0 feet below channel depth

Excerpt from "Petroglyph Shadows Drainage Report" by Isaacson & Arfman

BOCA NEGRA ARROYO
HEC II STATIONS

SCALE:
1"=200'



183–HECII.DWGanw 10/9/01

Run Date: 10/ 8/ 1 Run Time: 13:45:48 HMVersion: 5.30 Data File: c:\friend\183p.hc2

THIS RUN EXECUTED 10/ 8/ 1 13:45:50

****

HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01,02,03,04

MODIFICATION -

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NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

BOCA NEGRA ARROYO—PROPOSED Q_{100}

SUMMARY PRINTOUT

Froude #

	SECNO	CWSEL	TOPWID	VCH	CRIWS	DEPTH	K*CHSL	SHEAR
*	1.000	5161.77	170.98	9.04	5161.77	4.22	.00	1.54
*	2.000	5164.53	189.31	8.72	5164.53	4.53	24.50	1.47
	3.000	5165.61	203.21	8.37	5165.58	4.61	10.00	1.36
*	4.000	5167.00	485.23	4.93	5166.62	5.21	8.00	.53
	5.000	5167.47	411.99	5.98	5167.26	3.67	20.00	.79
	6.000	5168.25	398.48	5.70	5167.94	3.45	10.00	.69
*	7.000	5169.05	296.45	7.52	5169.05	3.85	4.00	1.20
*	8.000	5170.53	299.01	7.31	5170.53	4.63	7.00	1.13
*	9.000	5171.88	243.83	8.16	5171.88	5.48	5.00	1.37
	10.000	5172.78	179.69	8.48	5172.62	5.88	5.00	1.36
*	11.000	5173.75	180.98	6.01	5172.44	6.35	5.00	.61
	12.000	5173.99	167.21	6.21	5172.64	6.19	4.00	.64
	13.000	5174.23	211.38	6.86	5173.55	5.73	7.00	.87
	14.000	5174.38	151.52	8.86	5174.06	5.08	8.00	1.41
*	15.000	5175.31	111.06	10.36	5175.31	5.21	8.00	1.84

Petroglyph edge =