City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

March 18, 2003

Fred C. Arfman, P.E.
Isaacson & Arfman, P.A.
128 Monroe St NE
Albuquerque, New Mexico 87108

RE: PETROGLYPH SHADOWS SUBDIVISION (E-10/D17)
Engineers Certification – Submitted for Release of Financial Guaranty
Engineers Stamp dated 3/12/2002
Engineers Certification dated 3/12/2003

Dear Mr. Arfman:

Based upon the information provided in your Engineers Certification submittal dated 3/14/2003, the above referenced plan is adequate to satisfy the Grading and Drainage Certification for Release of Financial Guaranty.

If you have any questions, please call me at 924-3981.

Sincerely,

Teresa A. Martin
Hydrology Plan Checker
Development & Bldg. Ser. Division

c: Arlene Portillo, COA- Project # 684381
File

City of Albuquerque

P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

April 1, 2002

Fred Arfman
Isaacson & Arfman, P.A.
128 Monroe Street NE
Albuquerque, New Mexico 87174

RE: Grading and Drainage Plan for Petroglyph Shadows (E10-D17) Dated March 12, 2002

Dear Mr. Arfman:

Based on information in your submittal the above referenced plan is approved as amended. This is the plan (with the March 12, 2002 stamp date) that must be certified for release of Financial Guarantees. Because of the shift in lot lines the plan is approved for preliminary plat action at DRB.

If you have any questions please call me a 924-3982.

Carlos A. Montoya
City Floodplain Administrator

Boca Negra Arroyo--Section 1 Q=2010 cfs
Worksheet for Irregular Channel

Project Description	
Project File	j:\c4-active\genny\haestad\fmw\petrogly.fm2
Worksheet	Boca Negra SECTION 1--ALS Q10
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.006000 ft/ft

Elevation range: 5,160.13 ft to 5,164.00 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	5,163.82	0.00	250.00	0.030
17.00	5,162.89			
18.00	5,162.59			
39.00	5,162.00			
70.00	5,161.00			
86.60	5,160.59			
119.00	5,160.13			
153.90	5,161.00			
182.00	5,162.00			
204.00	5,163.16			
250.00	5,164.00			

Discharge 2,010.00 cfs ← Q_{10}

Results

Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	5,163.16	ft
Flow Area	350.72	ft^2
Wetted Perimeter	192.10	ft
Top Width	191.96	ft
Height	3.03	ft
Critical Depth	5,162.79	ft ← y_c
Critical Slope	0.011287	ft/ft
Velocity	5.73	ft/s
Velocity Head	0.51	ft
Specific Energy	5,163.67	ft
Froude Number	0.75	

Flow is subcritical.

EROSION SETBACK LIMITS AND DEPTH OF SCOUR ALONG SCOUR WALL (from AMAFCA Sediment and Erosion Design Guide)

Q_{100} = 100-year 6-hour storm discharge (cfs)--from AMAFCA approved flow rates (see attached letter)

Q_D = Dominant discharge (cfs)

S = Channel slope (ft/ft)

W_D = Normal channel width during dominant discharge (ft)

Δ_{max} = Erosion setback distance from the theoretical channel bank (ft)

CSB = Erosion setback distance from the channel centerline (ft)

y = normal channel depth (ft) from HEC II analysis

Fr = Froude number from HEC II analysis

y_s = depth of scour (ft)

Erosion Setback Limits

Q_{100} = 3000 cfs

$Q_D = 0.2\ Q_{100} = 0.2\ (3000) =$ <u>600 cfs</u> (Eq. 3.77)

S = 0.006 ft/ft (average channel slope from HEC II analysis)

For subcritical flow:

$W_D = 2.46\ (Q_D)^{0.375}[S]^{-0.188}$ (Eq. 3.79)

$= 2.46\ (600)^{0.375}[.006]^{-0.188} =$ <u>70.9 ft</u>

since 200cfs<Q_D<2,000 cfs:

$\Delta_{max} = [0.45 + 2.5\log(Q_D)](Q_D)^{0.375}\ [S]^{-0.188}$ (Eq. 3.82b)

$\Delta_{max} = [0.45 + 2.5\log(600)](600)^{0.375}\ [.006]^{-0.188} = 200.5$ ft

$CSB = \Delta_{max} + W_D/2 = 200.5 + (70.9/2) =$ <u>236 ft</u>

<u>Use 236 ft Erosion Setback from centerline of channel</u>

Depth of Scour along Scour Wall

Q = 3000 cfs

For supercritical flow:

y = 6.2 ft (from HEC II analysis)

Fr = 1.52 (from HEC II analysis)

For flows parallel to wall:

$y_s = y[0.73+0.14*\pi*Fr^2]$ (Eq. 3.89)

$= 6.2[0.73+0.14*\pi*1.52^2] = \underline{10.8 \text{ ft}}$

Use 10.8 ft depth below channel invert

DRAINAGE REPORT

FOR

PETROGLYPH SHADOWS SUBDIVISION

A 29-LOT SINGLE-FAMILY RESIDENTIAL SUBDIVISION

ALBUQUERQUE, NEW MEXICO
OCTOBER 2001

Prepared by:

ISAACSON & ARFMAN, P.A.
128 Monroe Street, NE
Albuquerque, NM 87108
(505) 268-8828

GENEVIEVE L. DONART
NEW MEXICO
15952
LICENSED PROFESSIONAL ENGINEER

Genevieve L. Donart 10/10/01

Genevieve Donart, PE **Date**

INTRODUCTION

Petroglyph Shadows Subdivision is a 6-acre single-family subdivision. It is bounded by the Boca Negra Arroyo on the north, Mojave Street on the south and undeveloped lands to the east and west. The Petroglyph National Monument property is located to the west of the site and is the future location of the Monument's Visitor Center. The proposed platting at this time allows for 29 lots, for a density of 4.8 D.U. per acre.

The Northwest Mesa Drainage Management Plan (NMDMP) by Scanlon & Associates dated October 1989 is referenced in this report for flow characteristics of the Boca Negra Arroyo.

I. PROJECT INFORMATION

LEGAL DESCRIPTION: Lots 4 & 5, Block 12, Unit 3, Volcano Cliffs Subdivision

ENGINEER: Isaacson & Arfman, P.A.
128 Monroe Street NE
Albuquerque, NM 87108
(505) 268-8828
Attn: Fred C. Arfman

SURVEYOR: Aldrich Land Surveying, Inc.
Attn: Tim Aldrich, NMPLS No. 7719
(505) 884-1990

BENCHMARK: ACS monument "3-E10" (NAD 1927/SLD 1929)
Elevation: 5316.12

NUMBER OF PROPOSED LOTS: 29

TOTAL AREA: 5.9523 Acres

FLOOD PLAIN: Zone X
Outside the 100-year flood plain based on
FIRM Map--Panel 112 of 825.
Revised September 11, 1998

II. SITE CHARACTERISTICS

EXISTING CONDITIONS: This project is proposed on the location of two existing lots. The site is currently undeveloped with native grasses and shrubs and slopes from the south to the north between 3% and 14%. The Boca Negra Arroyo is an unlined, natural arroyo that runs parallel to the north property line. Mojave Street to the south is paved and has standard curb (except the westerly 100 feet where there is temporary curb), and no offsite flows from the road are directed to the site. Total existing flows of 7.7 cfs discharge to the Boca Negra Arroyo (See Appendix A for runoff calculations).

PROPOSED CONDITIONS: The proposed site will have 29 developed lots. Slopes remain similar to the existing conditions, going downhill from south to north. The Drainage Map in Appendix A shows the drainage basins for the site, along with the 100-year, 6-hour flows for each basin. Half of the lot areas for Lots 7 and 8 (Basin 1) will discharge 1.1 cfs into a pond in a drainage easement at the northwest corners of Lots 7 & 8; and half of the areas of Lots 9-14 (Basin 2) will discharge 2.0 cfs to the Boca Negra Arroyo through wall openings created by leaving out mortar out of head joints every 4 feet. The remainder of the site (Basin 3) will discharge 17.5 cfs to the streets, where standard curbs will contain the flows within the roadway. The street flows will be collected in a Type A single-grate inlet in Star Bright Rd. and conveyed through a 24" storm drain pipe to the northeast where it is discharged into the Boca Negra Arroyo.

A scour wall along the north boundary and portions of the east and west boundaries will protect the site from the flows in the Boca Negra Arroyo should the arroyo shift its alignment to the south.

POND

Half of the lot areas of Lots 7 & 8 will discharge 1.1 cfs to a pond located in a drainage easement. As shown in the Appendix A calculations, the required volume of this pond is 1688 ft^3. The actual volume is 1750 ft^3.

STREET FLOWS

The streets convey flows of 17.5 cfs for the 100-year, 6-hour storm. At the Type A inlet, Star Bright Rd. carries 10.5 cfs at a slope of 0.5%, which results in a maximum flow depth of 0.37 feet. Sun View Dr. knuckle carries 7.0 cfs at a 2.8% slope, resulting in a flow depth of 0.25 feet. (See Drainage Map in Appendix A.) The flows will be contained by standard curbs in all streets. Calculations for the street flow capacities are shown in Appendix C.

SUMP INLET

The storm drain inlet is a Type A single-grate inlet in a sump condition. As shown in Appendix C, the inlet has a capacity of 19.8 cfs.

STORM DRAIN

A 24" storm drain will convey the flows from the inlet to the Boca Negra Arroyo through a 25-foot wide sanitary sewer, drainage & private pedestrian access easement. The invert at the outlet to the channel was set to the 10-year-storm water surface elevation of 5170.9 (elevation interpolated from the HEC II analysis—see Appendix E—and the 100-year-storm water surface elevation of 5171.5 is below the top of the pipe. Storm drain capacity calculations and a profile of the storm drain are shown in Appendix B. Also, a section showing the locations of the storm drain and sanitary sewer through the easement is shown on the Grading Detail sheet in the back pocket.

EROSION CONTROL AT STORM DRAIN OUTLET

The storm drain outlet at the Boca Negra Arroyo requires riprap for erosion control. Type L riprap will be used. Per AMAFCA requirements, the rundown must extend to the channel flowline. Erosion control and rundown capacity calculations are shown in Appendix D, and details of the rundown are shown on the Grading Details sheet in the back pocket.

BOCA NEGRA ARROYO--HEC II ANALYSIS

A HEC II analysis was performed on the arroyo, using 15 stations in 100-foot intervals. The starting station is located at the dip section in Tesuque Drive where the arroyo crosses the road. Elevations for this

section were taken from the as-built paving sheet for the SAD 219 improvements—Project No. 3558—by Mark Goodwin & Assoc., and a critical depth was calculated using Flow Master (See Appendix E). The grades for the remaining sections were based on the 1980 City of Albuquerque topo (See station map in Appendix E).

The Boca Negra Arroyo has a developed 100-year-storm runoff of 3845 cfs, including runoff from future developments in the area, per the Northwest Mesa Drainage Management Plan (NMDMP) by Scanlon & Associates (Analysis Point 106.40). Appendix E includes summarized information for each of the 15 stations and plotted cross sections for stations 8-12, which are located adjacent to the site. The analysis indicates that the 100-year flows are not contained within the 150-foot drainage easement. Therefore, scour walls will be constructed to protect the site. To calculate the 10-year water surface elevation to establish the maximum invert of the storm drain at the arroyo, a Q_{10} of 2576 cfs ($0.67*Q_{100}$) was used. A HEC II summary of the 10-year flows is included in Appendix E.

SCOUR WALL

The scour wall calculations were based on channel slope, water depth and Froude number from the HEC II Analysis and a 100-year flow of 3845 cfs per the NMDMP. The freeboard required per the NMDMP is 1.6 feet.

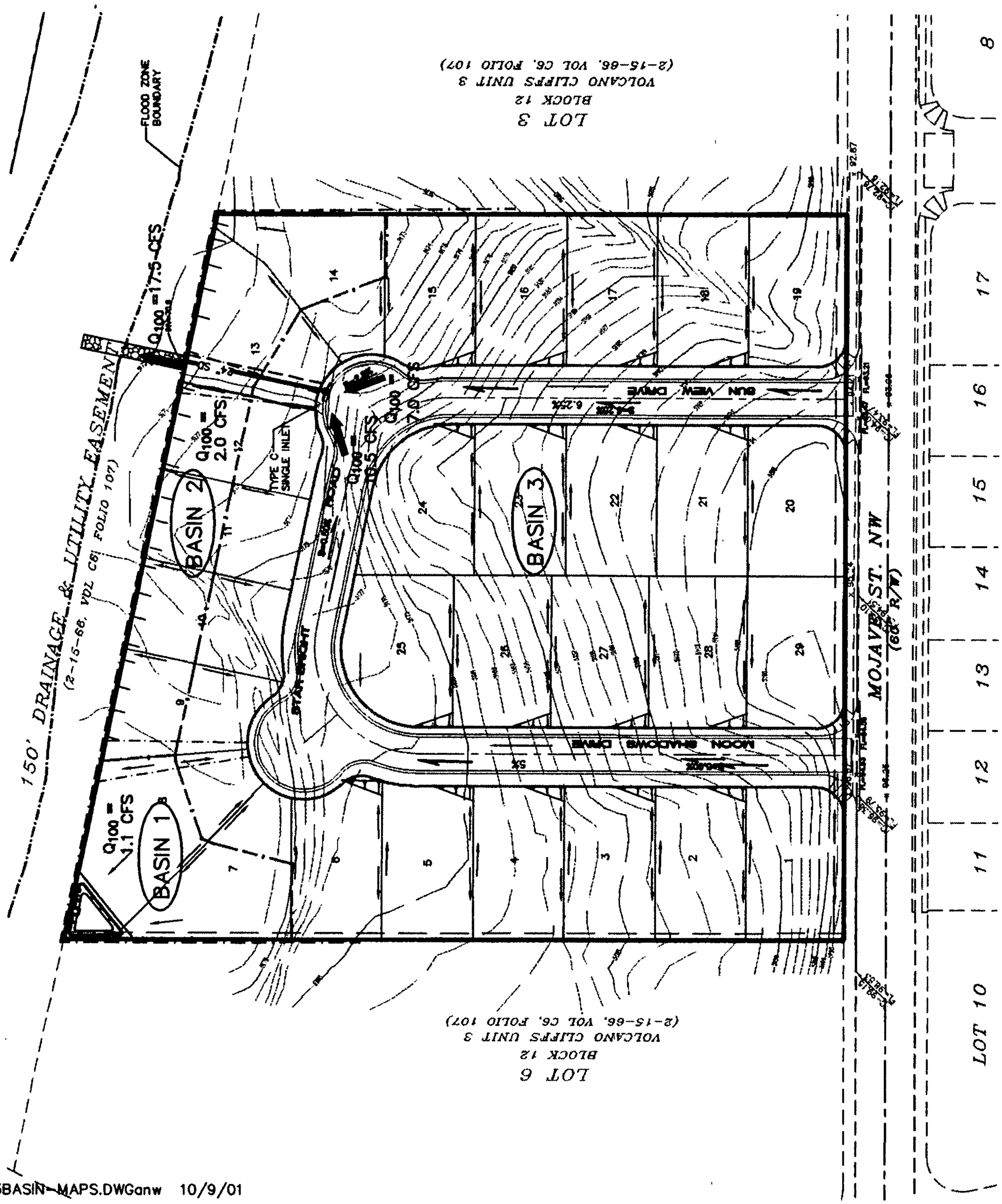
The HEC II Analysis shows that the flows vary from subcritical along the westerly half of the site to supercritical along the easterly half. To design for a worst-case scenario, subcritical flow was assumed in the erosion setback calculations and supercritical flow was assumed in the scour depth calculations.

The scour wall is designed to conform to the Albuquerque Metropolitan Area Flood Control Authority's (AMAFCA's) requirements as shown in the AMAFCA Sediment and Erosion Design Guide. (See Appendix F for calculations.) It shall be an 18" wide wall to a depth of at least 9.8 feet below the existing channel invert, and 1.6 feet above the water surface elevation. The wall shall be constructed of wire-enclosed riprap, unless the City of Albuquerque approves an alternate method.

The wall covers the entire north boundary and approximately 200 feet of the east and west boundaries. Scour wall elevations and a detail are shown on the Grading & Drainage Plan in the back pocket.

DRAINAGE MAP

SCALE:
1"=100'



183BASIN-MAPS.DWGanw 10/9/01

RUNOFF CALCULATIONS FOR EXISTING CONDITIONS (Q_{100})

100-YEAR, 6-HOUR STORM

Per the City of Albuquerque D.P.M. Section 22.2

PROJECT NAME: PETROGLYPH SHADOWS SUBDIVISION

JOB NUMBER: 1183

PRECIP ZONE	Q_{100} RUNOFF RATES (cfs/Ac)			
	A	B	C	D
1	1.29	2.03	2.87	4.37
2	1.56	2.28	3.14	4.70
3	1.87	2.60	3.45	5.02
4	2.20	2.92	3.73	5.25

LAND TREATMENTS (%)	
A	100
B	
C	
D	
Σ% =	100

PRECIPITATION ZONE: 1

TREATMENT TYPE 1							
BASIN #	LAND TREATMENT AREAS (Ac)					Q_{100} (cfs)	REMARKS
	A_{TOTAL}	A_A	A_B	A_C	A_D		
1	5.9523	5.95	0	0	0	7.7	

RUNOFF CALCULATIONS FOR DEVELOPED CONDITIONS (Q_{100})

100-YEAR, 6-HOUR STORM

Per the City of Albuquerque D.P.M. Section 22.2

PROJECT NAME: PETROGLYPH SHADOWS SUBDIVISION

JOB NUMBER: 1183

PRECIP ZONE	Q_{100} RUNOFF RATES (cfs/Ac)			
	A	B	C	D
1	1.29	2.03	2.87	4.37
2	1.56	2.28	3.14	4.70
3	1.87	2.60	3.45	5.02
4	2.20	2.92	3.73	5.25

LAND TREATMENTS (%)	
A	0
B	16
C	36
D	48
Σ% =	100

PRECIPITATION ZONE: 1

TREATMENT TYPE 1							
BASIN #	LAND TREATMENT AREAS (Ac)					Q_{100} (cfs)	REMARKS
	A_{TOTAL}	A_A	A_B	A_C	A_D		
1	0.33	0	0.05	0.12	0.16	**1.1**	LOTS 7 & 8
2	0.58	0	0.09	0.21	0.28	**2.0**	LOTS 9-14
3	5.0423	0	0.81	1.82	2.42	**17.4**	REMAINDER OF SITE

Σ BASIN AREAS= 5.9523

VOLUME CALCULATIONS FOR DEVELOPED CONDITIONS (V_{100})

100-YEAR, 6-HOUR STORM

Per the City of Albuquerque D.P.M. Section 22.2

PROJECT NAME: **PETROGLYPH SHADOWS SUBDIVISION**

JOB NUMBER: 1183

PRECIP ZONE	E_{360} EXCESS PRECIPITATION (in.)			
	A	B	C	D
1	0.44	0.67	0.99	1.97
2	0.53	0.78	1.13	2.12
3	0.66	0.92	1.29	2.36
4	0.80	1.08	1.46	2.64

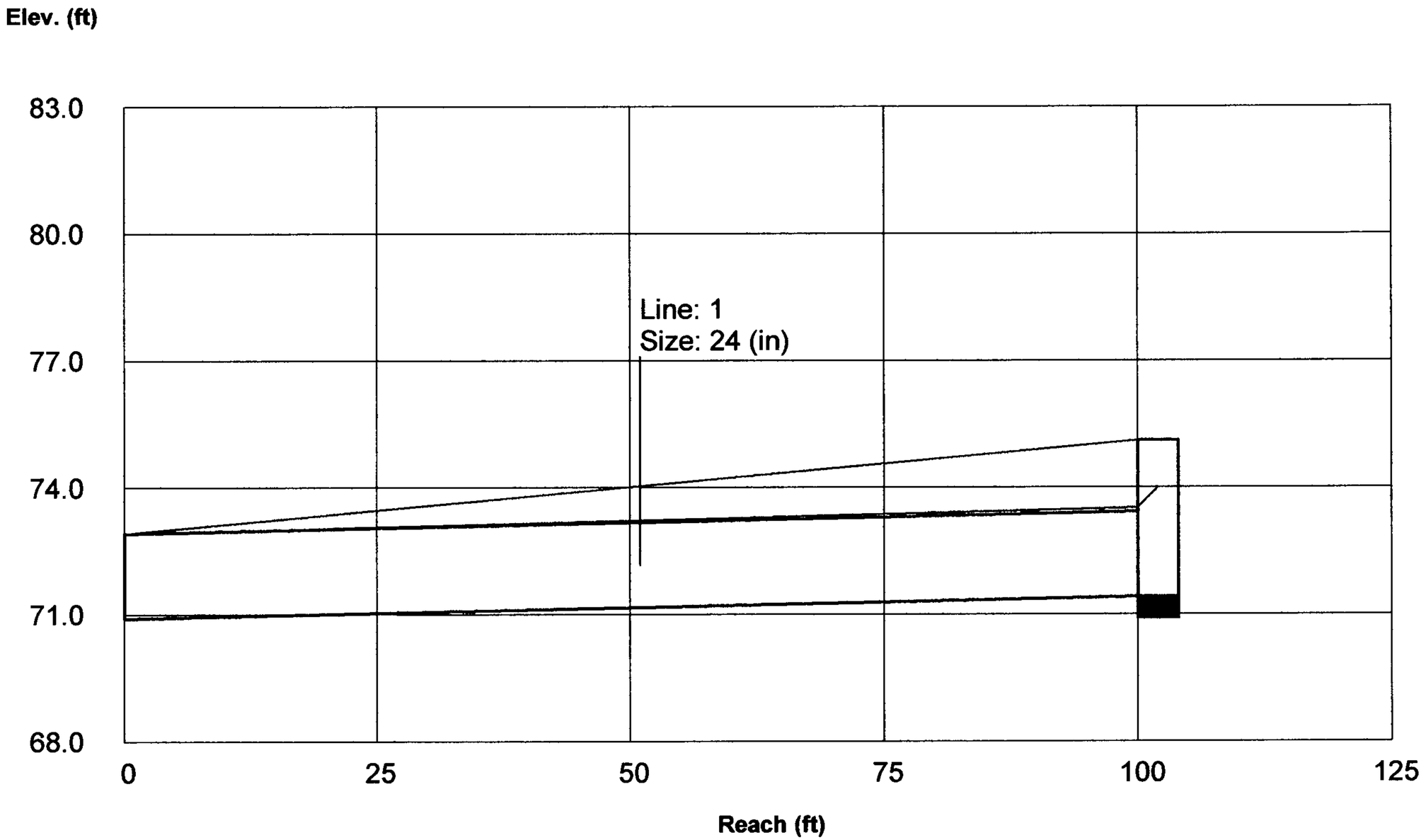
LAND TREATMENT (%)	
A	0
B	16
C	36
D	48
∑% =	100

PRECIPITATION ZONE: 1

BASIN #	LAND TREATMENT AREAS (Ac)					V_{100} (Ac ft)	V_{100} (cu.ft.)	REMARKS
	A_{TOTAL}	A_A	A_B	A_C	A_D			
1	0.33	0	0.05	0.12	0.16	**0.0388**	**1688.1**	LOTS 7 & 8

Storm Sewer Profile

Proj. file: petroglyph.stm



Hydraflow Summary Report

Line No.	Line ID	Flow rate (cfs)	Line size (in)	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line slope (%)	HGL down (ft)	HGL up (ft)	Minor loss (ft)	Dns line No.
1	24-inch storm drai	17.50	24 c	102.0	70.90	71.41	0.500	72.90*	73.51*	0.48	End

Project File: petroglyph.stm	I-D-F File: SAMPLE.IDF	Total No. Lines: 1	Run Date: 10-09-2001

NOTES: c = circular; e = elliptical; b = box; Return period = 100 Yrs.; * Indicates surcharge condition.

Hydraflow Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	
1	End	102.0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	17.50	15.99	5.57	24	0.50	71.41	70.90	73.51	72.90	75.10	72.90	24-inch stor

Project File: petroglyph.stm	I-D-F File: SAMPLE.IDF	Total number of lines: 1	Run Date: 10-09-2001

NOTES: Intensity = 0.00 / (Tc + 0.00) ^ 0.00; Return period = 100 Yrs. ; Initial tailwater elevation = 72.90 (ft)

SUMP INLET CAPACITY

(PER COA STD. DWGS # 2205, # 2207., + # 2220)

TYPE 'C' INLET - DOUBLE GRATE
TYPE 'A' INLET - SINGLE GRATE

GRATE OPEN AREA (SINGLE GRATE)

GROSS: $25"(40") = 1000\,in^2 \Rightarrow 6.94\,ft^2$

LESS BEARING BARS: $\left(\frac{0.5}{12}\right)(3.33')(13) \Rightarrow -1.80\,ft^2$

LESS CROSS BARS: $\left(\frac{0.5}{12}\right)(7)\left[\frac{25}{12} - (13)\left(\frac{0.5}{12}\right)\right] \Rightarrow -0.45\,ft^2$

NET AREA → $4.69\,ft^2$

CALCULATE CAPACITY USING ORIFICE EQUATION:

$$Q = CA\sqrt{2gh}$$

WHERE: $C = 0.67$

$A = 4.69\,ft^2\left(\frac{1}{2}\right) = 2.35\,ft^2$
(Assuming 50% clogging factor for single grate)

$h = 0.67\,ft$ (standard curb)

Type A

$$Q_{single} = 0.67(2.35)\sqrt{64.4(0.67)}$$

$$= 10.34\ cfs$$

$$Q_{double} = 2(10.34) = 20.68\ cfs$$

$Q_{basin\ 101} = 12.77\ cfs$ ∴ Double GRATE OK

ISAACSON & ARFMAN, P.A.

SUBJECT _____ JOB NO. _____
BY GLD DATE 4/26/00 SHEET NO. 1 OF 1

STORM DRAIN INLET CAPACITIES:

Double Throat Capacity:

(Types 'A' & 'C' Inlets)

$Q = CLh^{3/2}$ (Weir Equation)

Where $C = 3.33$

$L = 6.40$ (CON sldd wgs. # 2201, # 2202, & # 2220)

h = Water depth above flowline in feet

$Q = 3.33(6.40)(h^{3/2})$

$\underline{Q = 21.312\, h^{3/2}}$

$h = 0.25$ ft $\quad Q = 21.312(.25)^{3/2} = 2.66$ cfs

$h = 0.33$ ft $\quad Q = 21.312(.33)^{3/2} = 4.04$ cfs

$h = 0.5$ ft $\quad Q = 21.312(.5)^{3/2} = 7.53$ cfs

$h = 0.67$ ft $\quad Q = 21.312(.67)^{3/2} = \boxed{9.52 \text{ cfs}}$

$h = 0.9$ ft $\quad Q = 21.312(.9)^{3/2} = 18.20$ cfs

Total = 10.34
9.52
19.86 cfs

STREET FLOW CAPACITY CALCULATIONS

STREET NAME: STAR BRIGHT ROAD 1

STREET INFORMATION		HALF STREET CALCULATIONS	
Slope	0.005	Road Width/2	14
Q_{100}	10.50	Curb Height	0.67
Right-of-way Width	42	1/2 Wetted Perimeter (P)	14.372
Road Width	28	1/2 Area(STD)	2.653
Curb Type	STD	1/2 Area(MDN)	----
Road Cross Slope	0.02	1/2 Area(MTBL)	----
Manning's N	0.017	Discharge (1/2 Q)	5.286

Depth 0.372

RESULTS

HGL

Q_{100} FLOW CAPACITY = 10.57 cfs **OK**

at an HGL Depth= 0.37 ft < Curb height = 0.67

OK

EGL

Velocity 1.99 fps

$V^2/2g$ 0.06 ft

EGL Depth = 0.43 ft < Right-of-way height = 0.80

OK

STREET NAME: SUN VIEW DRIVE 2

STREET INFORMATION		HALF STREET CALCULATIONS	
Slope	0.0625	Road Width/2	14
Q_{100}	7.00	Curb Height	0.67
Right-of-way Width	42	1/2 Wetted Perimeter (P)	6.868
Road Width	28	1/2 Area(STD)	0.725
Curb Type	STD	1/2 Area(MDN)	----
Road Cross Slope	0.02	1/2 Area(MTBL)	----
Manning's N	0.017	Discharge (1/2 Q)	3.511

Depth 0.218

RESULTS

HGL

Q_{100} FLOW CAPACITY = 7.02 cfs **OK**

at an HGL Depth= 0.22 ft < Curb height = 0.67

OK

EGL

Velocity 4.84 fps

$V^2/2g$ 0.36 ft

EGL Depth = 0.58 ft < Right-of-way height = 0.80

OK

STREET NAME: SUN VIEW DRIVE KNUCKLE 3

STREET INFORMATION		HALF STREET CALCULATIONS	
Slope	0.028	Road Width/2	14
Q_{100}	7.00	Curb Height	0.67
Right-of-way Width	42	1/2 Wetted Perimeter (P)	8.347
Road Width	28	1/2 Area(STD)	1.000
Curb Type	STD	1/2 Area(MDN)	----
Road Cross Slope	0.02	1/2 Area(MTBL)	----
Manning's N	0.017	Discharge (1/2 Q)	3.532

Depth 0.247

RESULTS

HGL

Q_{100} FLOW CAPACITY = 7.06 cfs **OK**

at an HGL Depth= 0.25 ft < Curb height = 0.67

OK

EGL

Velocity 3.53 fps

$V^2/2g$ 0.19 ft

EGL Depth = 0.44 ft < Right-of-way height = 0.80

OK

Rundown @ Storm Drain Outlet
Worksheet for Trapezoidal Channel

Project Description	
Project File	j:\c4-active\genny\haestad\fmw\petrogly.fm2
Worksheet	rundown2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.035000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	4.00	ft
Discharge	17.50	cfs

Results		
Depth	0.63	ft
Flow Area	3.68	ft²
Wetted Perimeter	7.96	ft
Top Width	7.76	ft
Critical Depth	0.70	ft
Critical Slope	0.023007	ft/ft
Velocity	4.75	ft/s
Velocity Head	0.35	ft
Specific Energy	0.98	ft
Froude Number	1.22	
Flow is supercritical.		

EROSION CONTROL CALCULATIONS

LOCATION: 24" STORM DRAIN OUTLET

Q_{100} =	17.50	cfs	(from Runoff calcs)
D =	2.00	ft	(Pipe diameter from Hydraflow Calcs)
Y_t =	2.00	ft	(Tailwater Depth fromHydraflow Calcs)
V_{allow} =	7.70	ft/sec	(Allowable Velocity from Drainage Criteria Manual Sec. 5.6.3)

RIPRAP SIZE

$Q/D^{1.5}$ = 6.19

Y_t/D = 1.00

RIPRAP TYPE: L (from Fig 5-7 of the Drainage Criteria Manual)

LENGTH OF PROTECTION

$Q/D^{2.5}$ = 4.30

$1/(2\tan\Theta)$ = 6.67 (from Fig 5-9 of the Drainage Criteria Manual)

$A_t = Q/V_{allow}$ = 2.27

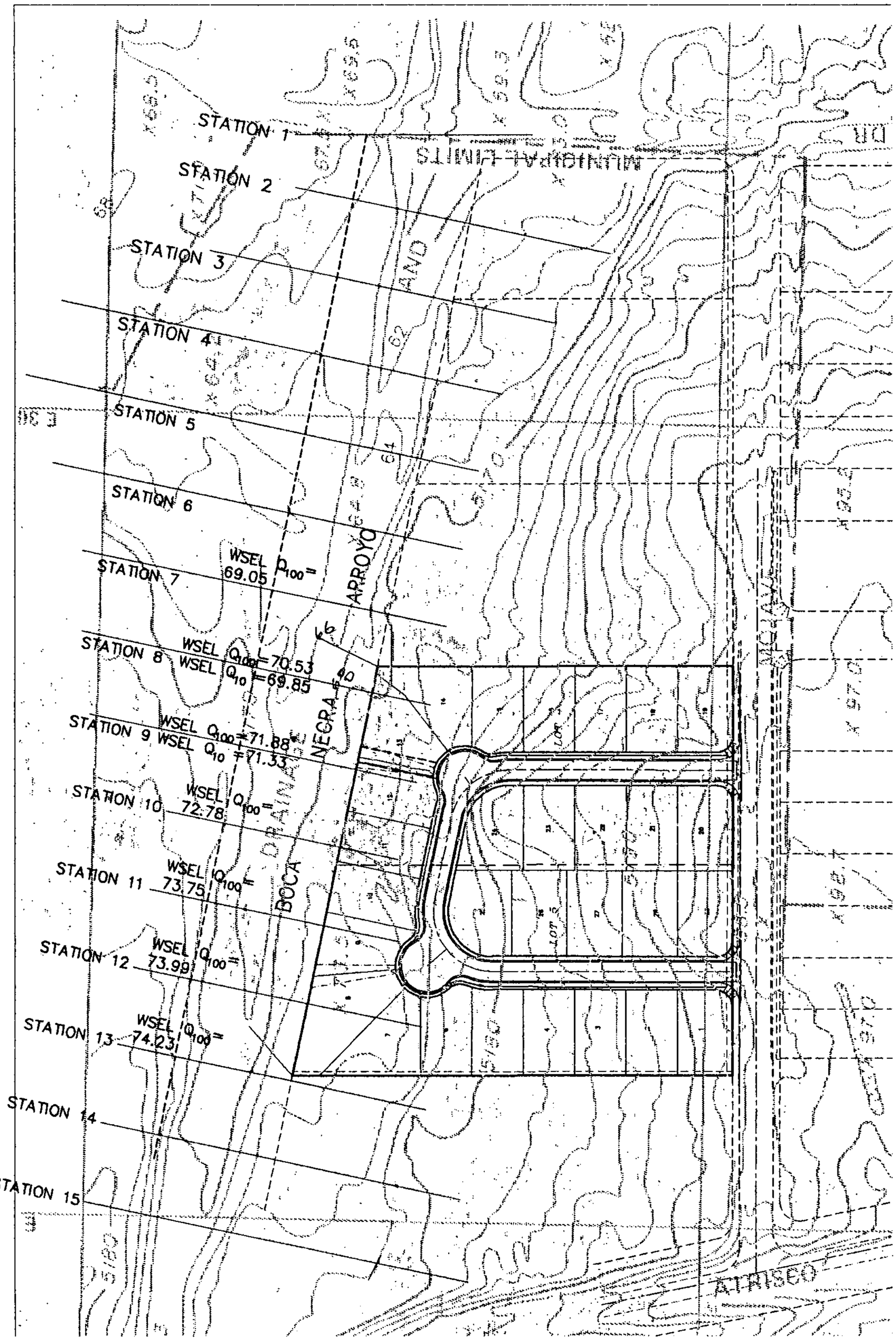
$L = [1/(2\tan\Theta)](A_t/Y_t - D)$ = -5.76 ft

$L_{min} = 3D$

MIN RIPRAP LENGTH = 6.00 ft

BOCA NEGRA ARROYO
HEC II STATIONS

SCALE:
1"=200'



183--HECII.DWGanw 10/9/01

Sta. 1 – Critical Depth Calc.

Boca Negra Arroyo
Worksheet for Irregular Channel

Project Description	
Project File	j:\c4-active\genny\haestad\fmw\petrogly.fm2
Worksheet	Boca Negra
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.006000	ft/ft

Elevation range: 5,157.55 ft to 5,167.96 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
1,150.00	5,167.33	1,150.00	1,660.00	0.030
1,200.00	5,167.96			
1,250.00	5,167.42			
1,300.00	5,164.58			
1,360.00	5,159.79			
1,410.00	5,157.55			
1,460.00	5,158.87			
1,555.00	5,164.71			
1,592.50	5,166.29			
1,630.00	5,166.43			
1,660.00	5,165.96			

Discharge	3,845.00	cfs

4 – Q_{100} from NMDMP

Results		
Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	5,162.24	ft
Flow Area	510.85	ft²
Wetted Perimeter	185.92	ft
Top Width	185.65	ft
Height	4.69	ft
Critical Depth	5,161.79	ft
Critical Slope	0.009694	ft/ft
Velocity	7.53	ft/s
Velocity Head	0.88	ft
Specific Energy	5,163.13	ft
Froude Number	0.80	

Flow is subcritical.

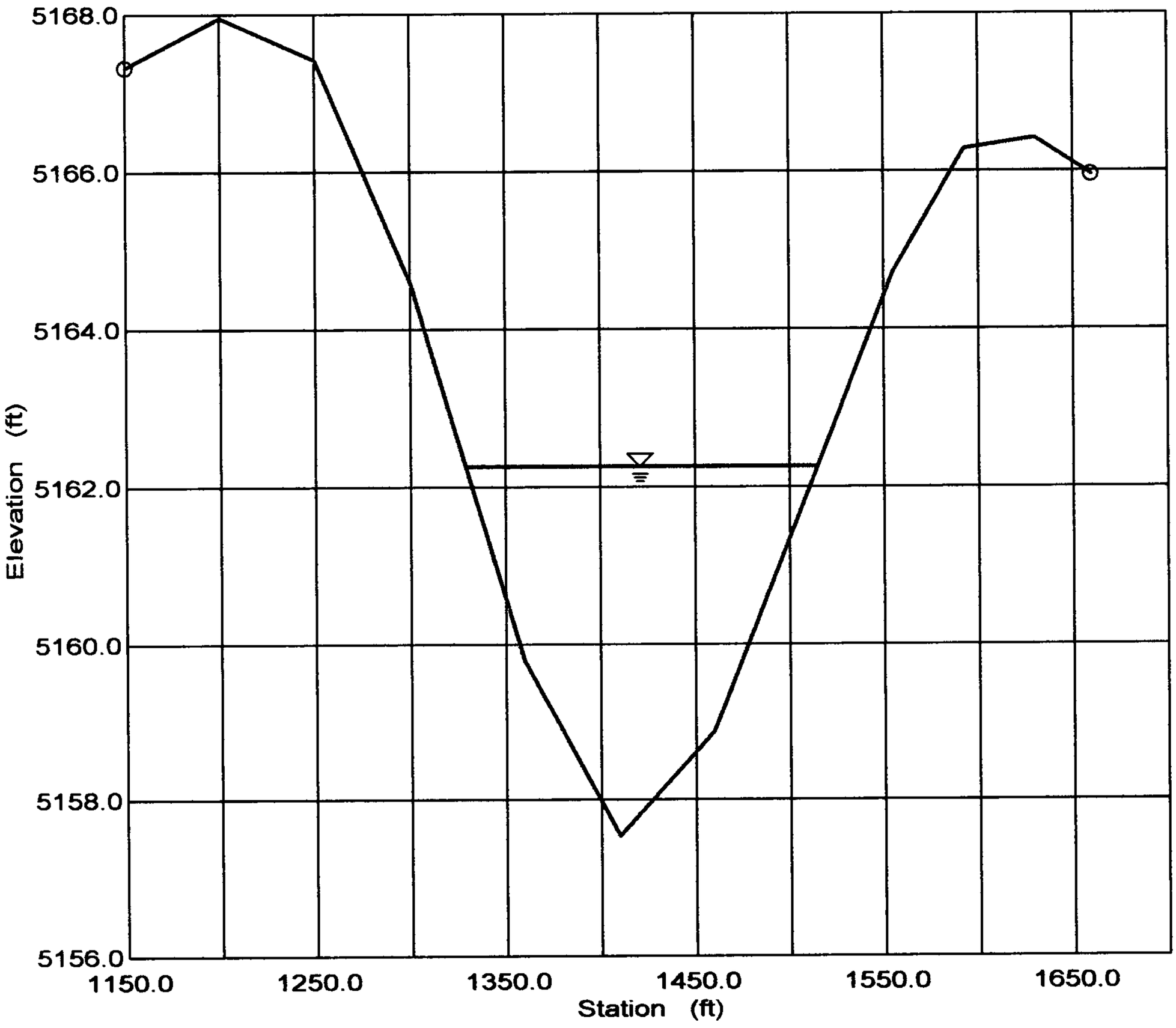
Sta. 1 – Critical Depth Calc.

Boca Negra Arroyo

Cross Section for Irregular Channel

Project Description	
Project File	j:\c4-active\genny\haestad\fmw\petrogly.fm2
Worksheet	Boca Negra
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.030	
Channel Slope	0.006000	ft/ft
Water Surface Elevation	5,162.24	ft
Discharge	3,845.00	cfs ← Q_{100}



Eagle Rock.
20-23.

Sta. 1 – Critical Depth Calc.

Boca Negra Arroyo Q10
Worksheet for Irregular Channel

Project Description	
Project File	j:\c4-active\genny\haestad\fmw\petrogly.fm2
Worksheet	Boca Negra Q10
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data

Channel Slope 0.006000 ft/ft

Elevation range: 5,157.55 ft to 5,167.96 ft.

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
1,150.00	5,167.33	1,150.00	1,660.00	0.030
1,200.00	5,167.96			
1,250.00	5,167.42			
1,300.00	5,164.58			
1,360.00	5,159.79			
1,410.00	5,157.55			
1,460.00	5,158.87			
1,555.00	5,164.71			
1,592.50	5,166.29			
1,630.00	5,166.43			
1,660.00	5,165.96			

Discharge 2,576.00 cfs ← Q_{10}

Results

Wtd. Mannings Coefficient	0.030	
Water Surface Elevation	5,161.51	ft
Flow Area	382.82	ft²
Wetted Perimeter	164.81	ft
Top Width	164.60	ft
Height	3.96	ft
Critical Depth	5,161.09	ft ←
Critical Slope	0.010306	ft/ft
Velocity	6.73	ft/s
Velocity Head	0.70	ft
Specific Energy	5,162.22	ft
Froude Number	0.78	

Flow is subcritical.

Run Date: 10/ 8/ 1 Run Time: 12:51:12 HMVersion: 5.30 Data File: c:\friend\183.hc2

THIS RUN EXECUTED 10/ 8/ 1 12:51:14

****

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 ARROY—EXISTING Q_{100}

SUMMARY PRINTOUT

	SECNO	CWSEL	TOPWID	VCH	CRIWS	DEPTH	K*CHSL	FROUDE #
*	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	5170.50	306.37	7.42	5170.50	4.60	7.00	1.18
*	9.000	5171.92	278.21	7.80	5171.92	5.52	5.00	1.28
	10.000	5172.81	195.59	8.31	5172.67	5.91	5.00	1.32
*	11.000	5173.89	267.68	4.79	5172.66	6.49	5.00	.41
	12.000	5174.05	304.79	5.61	5172.64	6.25	4.00	.61
	13.000	5174.32	216.61	6.65	5173.54	5.82	7.00	.81
	14.000	5174.43	155.08	8.72	5174.06	5.13	8.00	1.37
*	15.000	5175.30	110.98	10.39	5175.30	5.20	8.00	1.85

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

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HEC2 RELEASE DATED SEP 88 UPDATED JUN 1990

ERROR CORR - 01,02,03,04

MODIFICATION -

****

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

Run Date: 10/ 9/ 1 Run Time: 10:27:22 HMVersion: 5.30 Data File: c:\friend\183q10.hc2

THIS RUN

EXECUTED 10/ 9/ 1 10:27:24

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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—Q_{10}

SUMMARY PRINTOUT

	SECNO	CWSEL	TOPWID	VCH	CRIWS	DEPTH	K*CHSL	FROUDE #
*	1.000	5161.07	151.06	8.26	5161.07	3.52	.00	1.36
*	2.000	5163.73	146.37	8.33	5163.73	3.73	24.50	1.38
	3.000	5164.88	165.21	7.97	5164.86	3.88	10.00	1.29
*	4.000	5166.68	456.13	4.14	5166.27	4.88	8.00	.39
	5.000	5167.10	368.51	5.19	5166.85	3.30	20.00	.62
	6.000	5167.83	369.33	5.01	5167.52	3.03	10.00	ED.57
*	7.000	5168.63	288.00	6.59	5168.63	3.43	4.00	1.00
*	8.000	5169.85	206.92	7.43	5169.85	3.95	7.00	.98
*	9.000	5171.33	213.52	7.47	5171.33	4.93	5.00	1.22
	10.000	5172.31	161.74	6.92	5171.88	5.42	5.00	.93
*	11.000	5173.04	170.69	5.02	5171.49	5.64	5.00	.45
	12.000	5173.25	160.93	5.18	5171.84	5.45	4.00	.47
*	13.000	5173.36	166.36	6.48	5172.73	4.86	7.00	.80
	14.000	5173.69	118.14	7.50	5173.14	4.39	8.00	1.01
*	15.000	5174.41	102.06	9.36	5174.41	4.31	8.00	1.61

70.9 @ SD Outlet

EROSION SETBACK LIMITS AND DEPTH OF SCOUR ALONG SCOUR WALL (from AMAFCA Sediment and Erosion Design Guide)

Q_{100} = 100-year 6-hour storm discharge (cfs) from NMDMP

Q_D = Dominant discharge (cfs)

S = Channel slope (ft/ft)

W_D = Normal channel width during dominant discharge (ft)

Δ_{max} = Erosion setback distance from the theoretical channel bank (ft)

CSB = Erosion setback distance from the channel centerline (ft)

y = normal channel depth (ft) from HEC II analysis

Fr = Froude number from HEC II analysis

y_s = depth of scour (ft)

Erosion Setback Limits

Q_{100} = 3845 cfs (from Northwest Mesa DMP by Scanlon & Assoc.)

$Q_D = 0.2\ Q_{100} = 0.2\ (3845) =$ <u>769 cfs</u> (Eq. 3.77)

S = 0.006 ft/ft (average channel slope from HEC II analysis)

For subcritical flow:

$W_D = 2.46\ (Q_D)^{0.375}[S]^{-0.188}$ (Eq. 3.79)

$= 2.46\ (769)^{0.375}[.006]^{-0.188} =$ <u>77.8 ft</u>

since 200cfs<Q_D<2,000 cfs:

$\Delta_{max} = [0.45 + 2.5\log(Q_D)](Q_D)^{0.375}\ [S]^{-0.188}$ (Eq. 3.82b)

$\Delta_{max} = [0.45 + 2.5\log(769)](769)^{0.375}\ [.006]^{-0.188} = 242.3$ ft

$CSB = \Delta_{max} + W_D/2 = 242.3 + (77.8/2) =$ <u>281.2 ft</u>

<u>Use 282 ft Erosion Setback from centerline of channel</u>

Depth of Scour along Scour Wall

Q = 3845 cfs (from Northwest Mesa DMP by Scanlon & Assoc.)

For supercritical flow:

y = 6.3 ft (from HEC II analysis)

Fr = 1.37 (from HEC II analysis)

For flows parallel to wall:

$y_s = y[0.73+0.14*\pi*Fr^2]$ (Eq. 3.89)

$= 6.3[0.73+0.14*\pi*1.37^2] = \underline{9.8 \text{ ft}}$

Use 9.8 ft depth below channel invert