MONTGOMERY
ENGINEERING & MANAGEMENT, L.L.C.

DRAINAGE REPORT

LOT 1 NAUNI VALLEY RANCH 6

6055 N. NAUNI VALLEY DRIVE
PARADISE VALLEY, ARIZONA

JULY 2018
REV 1 - AUGUST 2018
REV 2 - SEPTEMBER 2018

Seal is for Drainage Calculations for subject lot only and not to be used for any other purpose

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Table of Contents

Appendices

2.0 INTRODUCTION

This report was prepared to determine drainage paths and finish floor elevation based on the 100-year rainfall for lot 1, Nauni Valley Ranch 6 at 6055 N. Nauni Valley Drive, Paradise Valley, Arizona in a residential area zoned R1-43.

This Drainage Report has been prepared to meet Paradise Valley requirements in accordance with Paradise Valley Drainage Manual plus noted portions of the Maricopa County Drainage Policies and Standards, Drainage Design Manuals for Maricopa County, (MCDDM) Volume 1 – Hydrology and Volume 2 – Hydraulics and Section 1205 of the Maricopa County Zoning Ordinance.

3.0 LOCATION

This parcel is located in Paradise Valley near the northeast corner of the McDonald Drive and Nauni Valley intersection.

4.0 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Lot 1, Nauni Valley Ranch 6 is a 1.76-acre lot located in a platted subdivision with paved streets and utilities to the lot. The surrounding area is developed with single family homes except vacant land to the south and northwest. Lot 1 slopes down to the north with offsite runoff from Camelback Mountain entering at the south and crossing the lot on the west side and east side. A single-family home with guest house, pool and yard are proposed.

5.0 FEMA FLOODPLAIN CLASSIFICATION

This site is located on FIRM Map 04013C1765L, dated 10-16-2013, and is in Flood Zone "X". See Appendix B for a FIRM Map.

6.0 OFFSITE DRAINAGE DESCRIPTION

Runoff from Camelback Mountain flows northerly across lot 2 to the south into lot 1 at the southeast and southwest corners.

The Drainage Report for Nauni Valley Ranch Lot 12 Replat, prepared by this firm in May 2018, is referenced for the 100-year flows entering Lot 1. At the southwest side the 100-year flow is 173 cfs, at the southeast side two drainage channels merge having 20 cfs and 66 cfs runoff, totaling 86 cfs.

Runoff will continue to enter and exit Lot 1 as currently exists. See Section 8 below for more detailed runoff data.

7.0 ONSITE DRAINAGE DESIGN DESCRIPTION

The west flow of 173 cfs will be routed around a proposed yard to a low point in Nauni Valley Drive at a historical road crossing where partial runoff will cross Nauni Valley Drive. The remainder of the runoff will flow northeasterly along Nauni Valley Drive and sheet flow to the north. There is not a well-defined drainage outlet at Nauni Valley Drive. The drainage channel will be armored with gabions and soil cement to mitigate erosion.

The east flow of 86 cfs will be routed along the east side of lot 1 in a box culvert with a headwall at the outlet and a drop inlet at the inlet. Runoff will flow in an open channel from the culvert outlet to its historical outlet at Nauni Valley Drive. Runoff historically exited lot 2 at the northeast corner. No channel or path were found along Nauni Valley Drive to direct runoff.

8.0 HYDROLOGY

As noted above, the Nauni Valley Ranch Lot 12 Replat Drainage Report calculated the 100-year runoff entering lot 1 at 173 cfs at the southwest side and 86 cfs at the southeast side.

Runoff will enter and exit lot 1 at current locations. No well-defined outlet locations were found at the site other than a wrought iron fence opening at the west side conveying runoff to Nauni Valley Drive.

9.0 HYDRAULICS

A. West side

The west flow of 173 cfs will be routed in a channel having gabion rock walls at both sides to convey the runoff past a curve where the gabion walls end, and runoff will flow along and across Nauni Valley Drive.

B. East side

The east flow of 20 cfs plus 66 cfs totaling 86 cfs merge at a proposed drop inlet routing runoff to an 8' x 4' box culvert that conveys runoff under the side yard and driveway of the residence to the northeast side of the lot. At the outlet, a gabion wall along the west bank and a proposed wall along east bank direct runoff north onto Nauni Valley Drive, it's historical outlet.

HY-8 computer analysis was used to model the culvert, see Appendix C for calculations. The culvert was designed with the bottom 6 inches plugged for design and checked with 24 inches plugged (50%). The culvert does not over-top from either condition.

The inlet high-water elevation is 1408.79 at the drop inlet, the top of headwall is 1412.0 providing 3.21 feet above the high-water elevation and exceeding 2.5' needed for freeboard and super elevation as shown in Appendix E.

Headstead Methods Flowmaster calculations in Appendix D were used to calculate the high-water elevation at sections 3 through 7 and the weir at the drop inlet. Section cut locations are shown on the site plan.

10.0 STORMWATER RETENTION AND FIRST FLUSH REQUIREMENTS

Retention calculations are shown on the site plan C1 that retain increased runoff from the proposed development. First flush volumes are exceeded with the 100-year 2-hour rainfall used for retention calculations.

11.0 MINIMUM FINISHED FLOOR ELEVATION REQUIREMENTS

The residence finish floor elevation of 1410.33 and the guest house finish floor elevation of 1411.00 are more than one foot above the 100-year high water elevation.

12.0 STORMWATER POLLUTION PROTECTION PLAN (SWPPP)

NOI and SWPPP are required for this development.

13.0 EROSION AND FREEBOARD

Channels will be lined with rip-rap and stabilized soil at the northeast outlet and soil cement at the west wash bottom with gabions at the sides. Scour and freeboard calculations are in Appendix E.

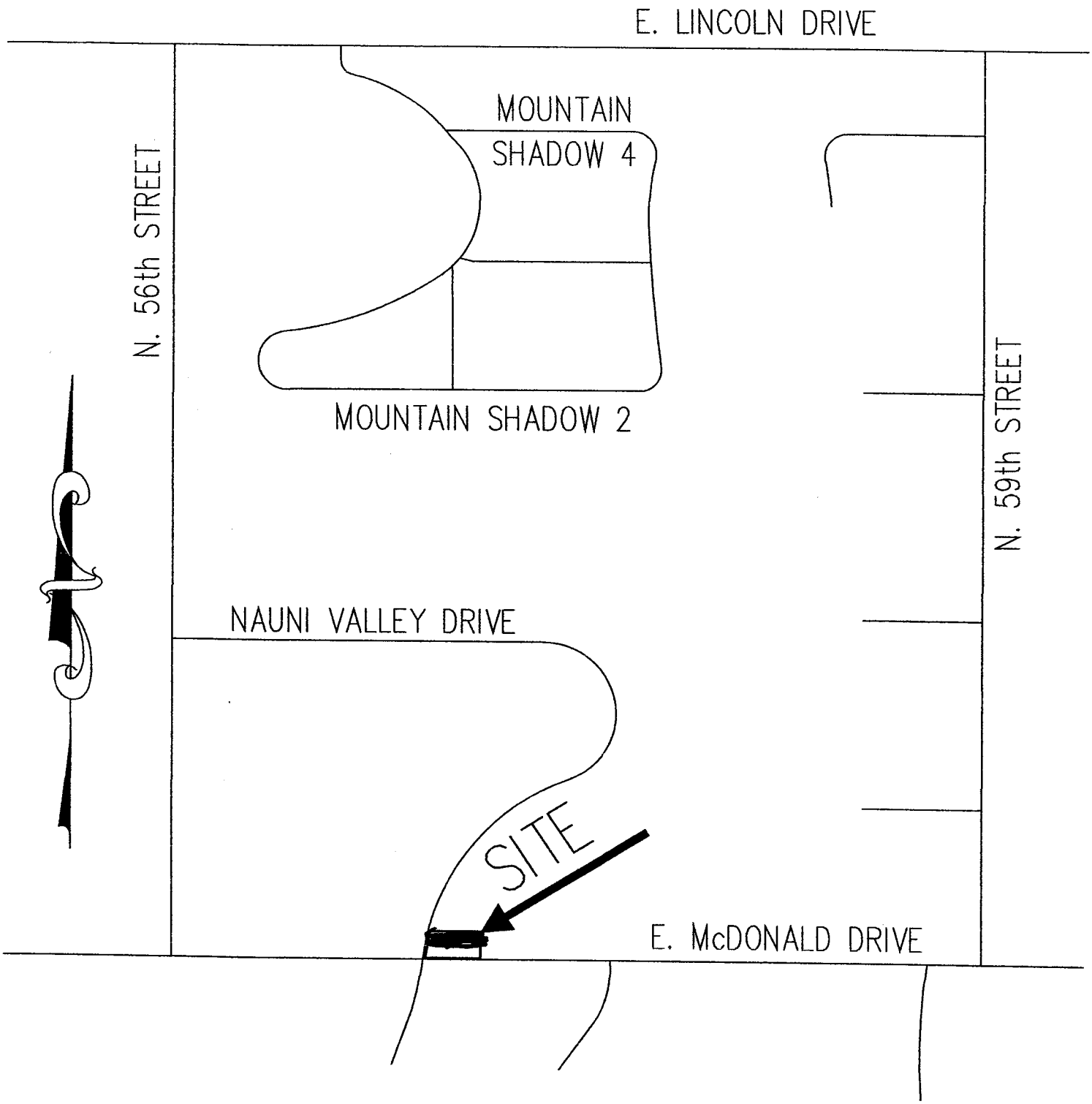
14.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this report and the site plan prepared by this office, the proposed residence is above the 100-year high water elevation. The owner shall monitor and maintain all drainage paths to be free and clear of debris and sediment.

15.0 REFERENCES

1. Maricopa County Drainage Design Manual and Software (MCDDM)
2. Nauni Valley Ranch Lot 12 Replat Drainage Report by Montgomery Engineering and Management LLC dated 05-05-2018.

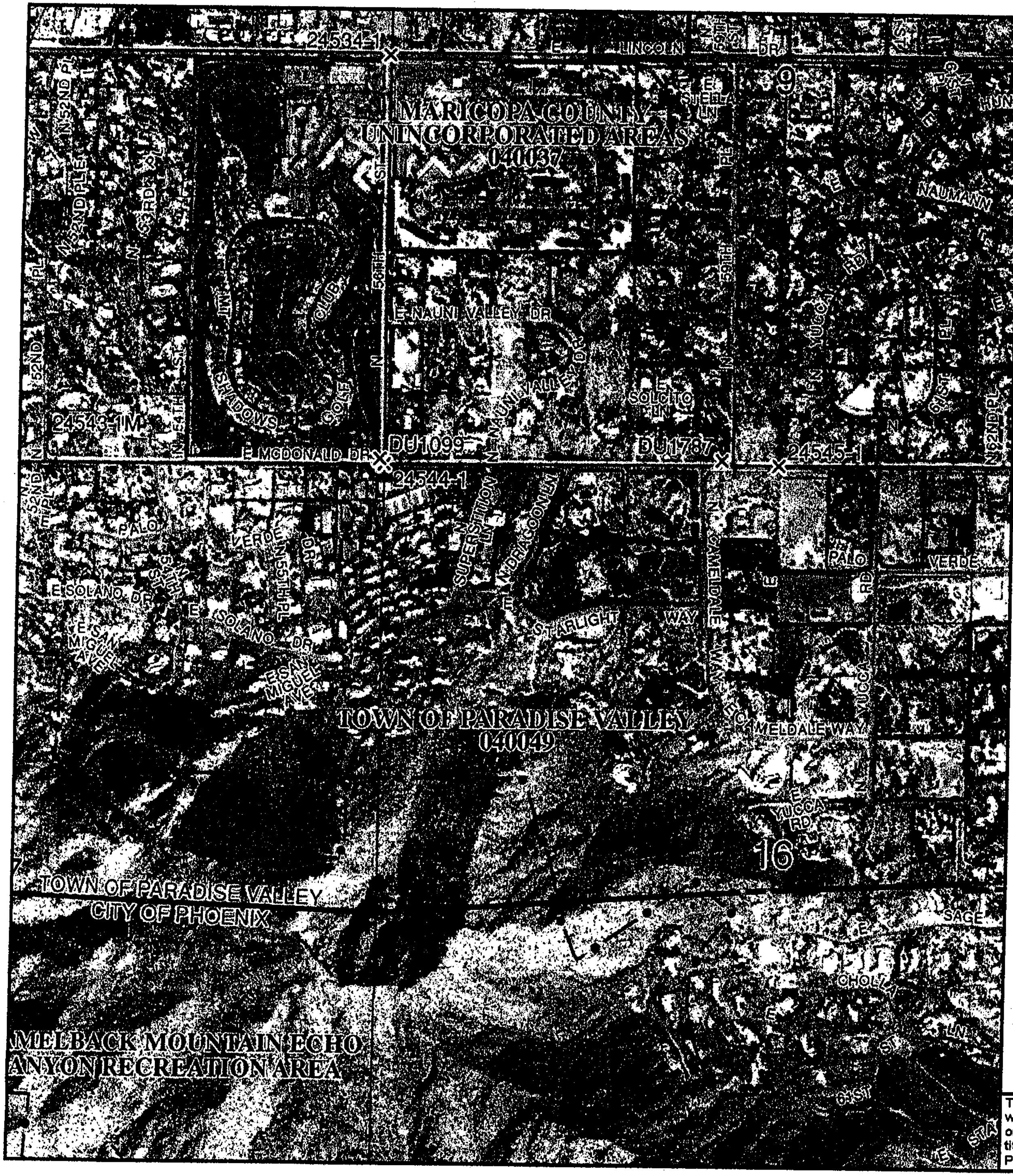
APPENDIX A



VICINITY MAP

NO SCALE

APPENDIX B



MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METE

NFIP

PANEL 1765L

FIRM
FLOOD INSURANCE RATE MAP
MARICOPA COUNTY, ARIZONA
AND INCORPORATED AREAS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1765 OF 4425
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1765	L
PARADISE VALLEY, TOWN OF	040049	1765	L
PHOENIX, CITY OF	040051	1765	L
SCOTTSDALE, CITY OF	045012	1765	L

Notice: This map was reissued on July 31, 2015 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
04013C1765L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX C

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

BOX CULVERTS

6" PLUGGED DESIGN

Table 1 - Summary of Culvert Flows at Crossing: +0

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert EAST 86 CFS Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1407.39	100 YR	86.00	86.00	0.00	1
1407.39	100 YR	86.00	86.00	0.00	1
1410.00	Overtopping	126.48	126.48	0.00	Overtopping

Rating Curve Plot for Crossing: +0

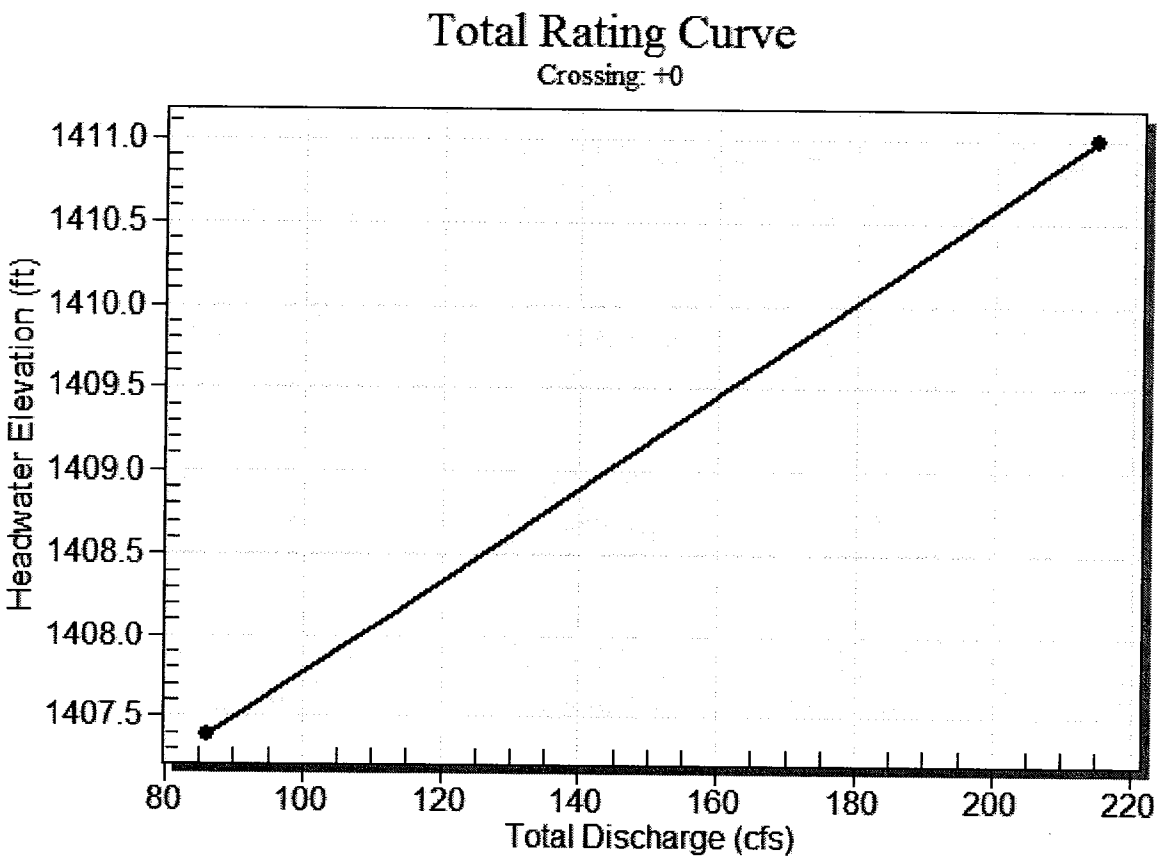


Table 2 - Culvert Summary Table: Culvert EAST 86 CFS

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
100 YR	86.00	86.00	1407.39	2.654	2.889	3-M1t	2.068	1.536	2.293	2.793	4.689
100 YR	86.00	86.00	1407.39	2.654	2.889	3-M1t	2.068	1.536	2.293	2.793	4.689

****

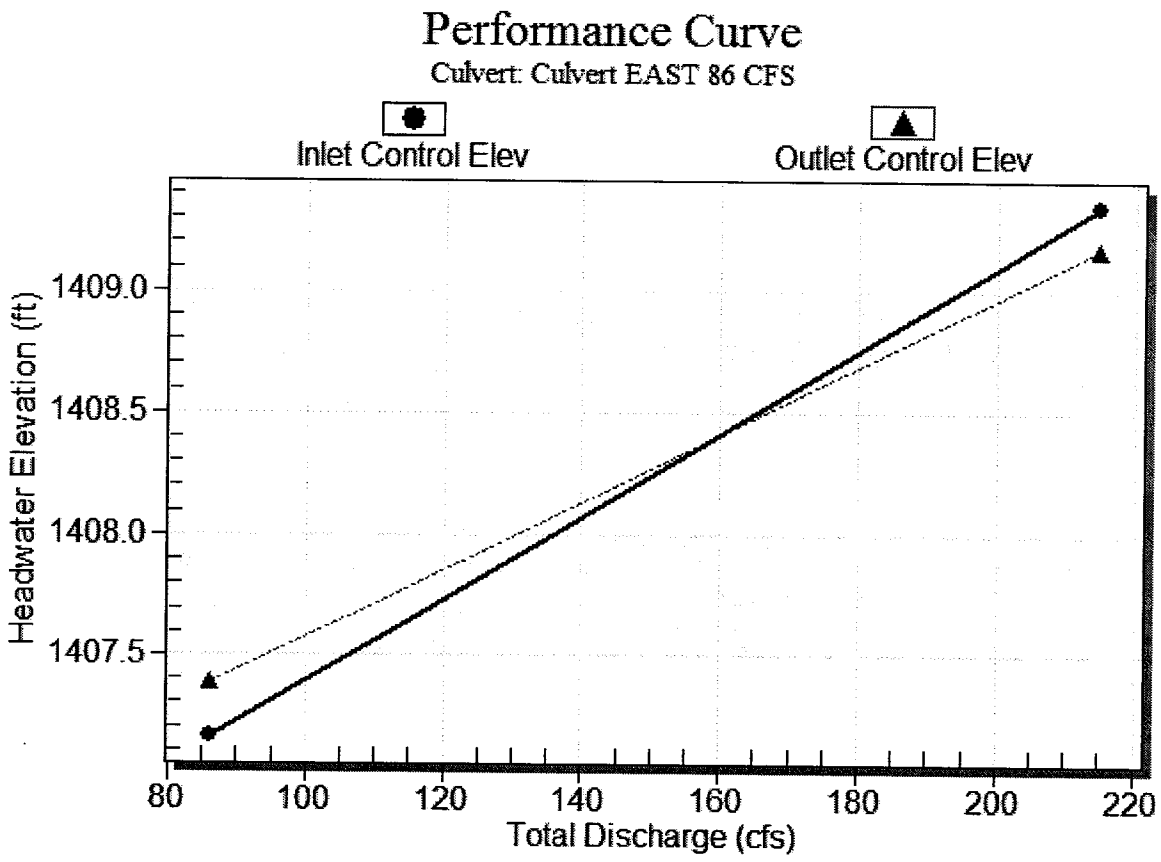
Straight Culvert

Inlet Elevation (invert): 1404.50 ft, Outlet Elevation (invert): 1404.00 ft

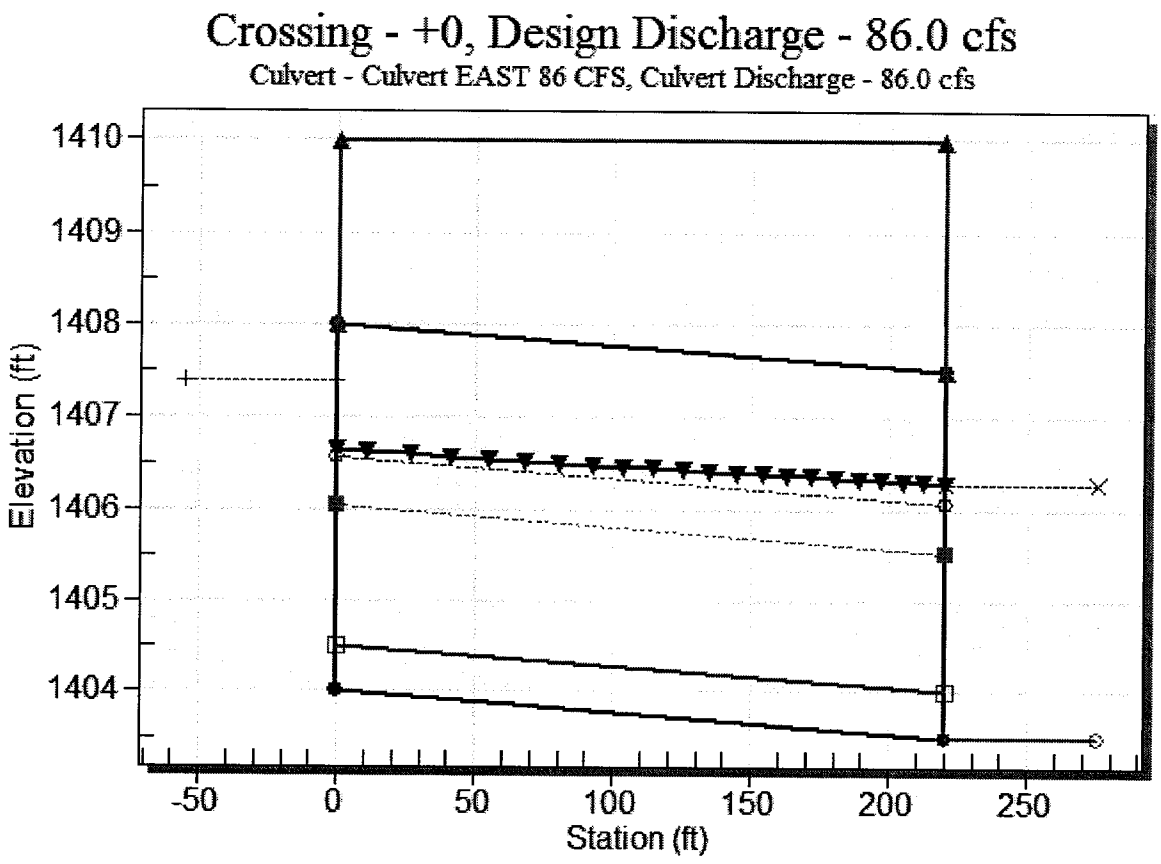
Culvert Length: 220.00 ft, Culvert Slope: 0.0023

****

Culvert Performance Curve Plot: Culvert EAST 86 CFS



Water Surface Profile Plot for Culvert: Culvert EAST 86 CFS



Site Data - Culvert EAST 86 CFS

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1404.00 ft

Outlet Station: 220.00 ft

Outlet Elevation: 1403.50 ft

Number of Barrels: 1

Culvert Data Summary - Culvert EAST 86 CFS

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 4.00 ft

Barrel Material: Concrete

Embedment: 6.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0200 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: +0)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
86.00	1406.29	2.79	3.85	1.22	0.41
86.00	1406.29	2.79	3.85	1.22	0.41

Tailwater Channel Data - +0

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.0070

Channel Manning's n: 0.0450

Channel Invert Elevation: 1403.50 ft

Roadway Data for Crossing: +0

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 ft

Crest Elevation: 1410.00 ft

Roadway Surface: Gravel

Roadway Top Width: 219.50 ft

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: User Defined

BOX CULVERT

CHECK 24" PLUGGED

Table 1 - Summary of Culvert Flows at Crossing: +0

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Culvert EAST 86 CFS Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1409.07	100 YR	86.00	86.00	0.00	1
1409.07	100 YR	86.00	86.00	0.00	1
1410.00	Overtopping	94.39	94.39	0.00	Overtopping

Rating Curve Plot for Crossing: +0

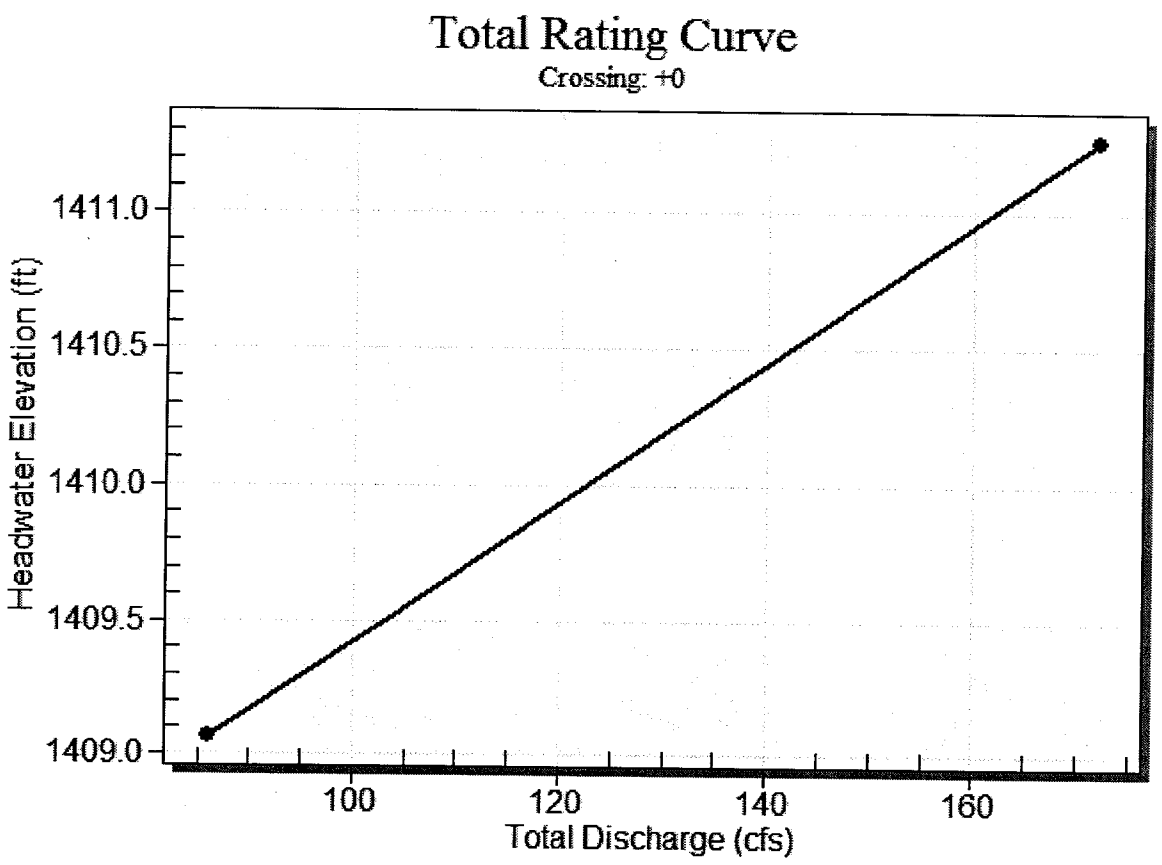


Table 2 - Culvert Summary Table: Culvert EAST 86 CFS

Discharge Names	Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)
100 YR	86.00	86.00	1409.07	3.069	2.845	7-M2c	2.000	1.522	1.522	2.793	7.062
100 YR	86.00	86.00	1409.07	3.069	2.845	7-M2c	2.000	1.522	1.522	2.793	7.062

****

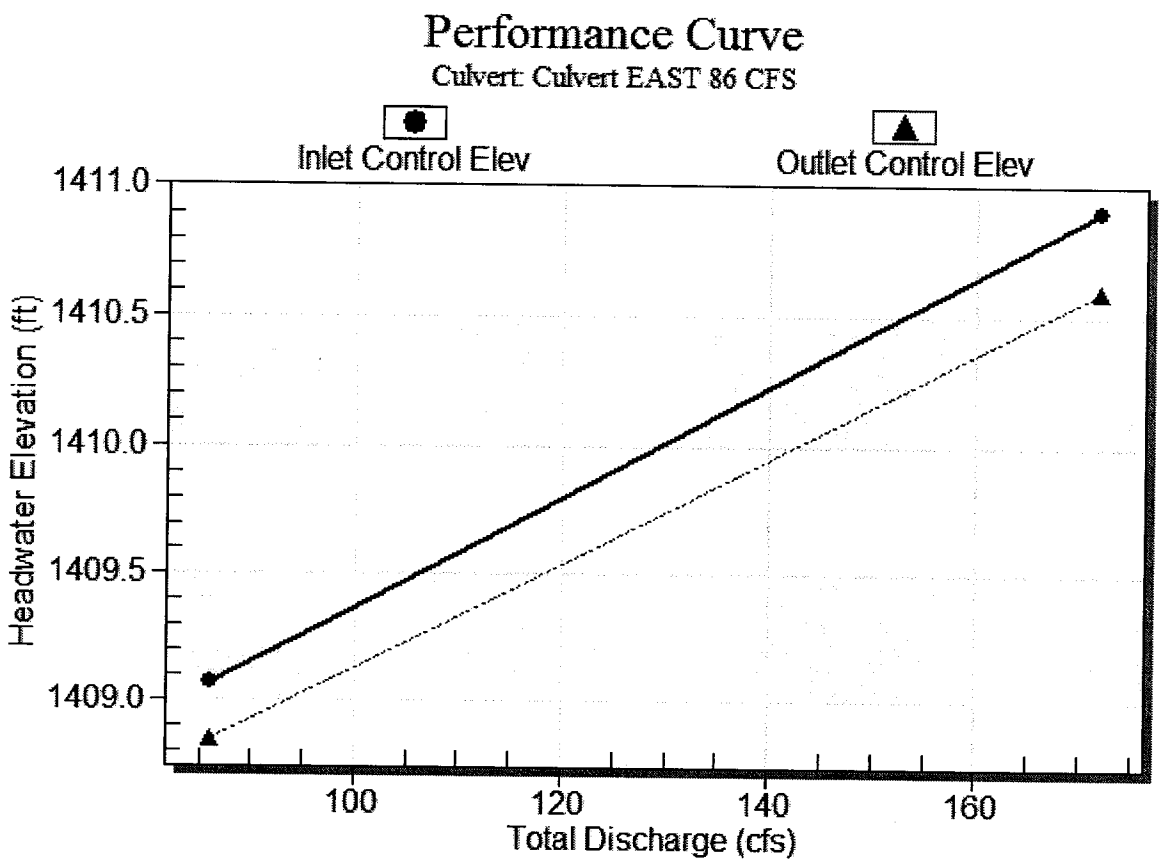
Straight Culvert

Inlet Elevation (invert): 1406.00 ft, Outlet Elevation (invert): 1405.50 ft

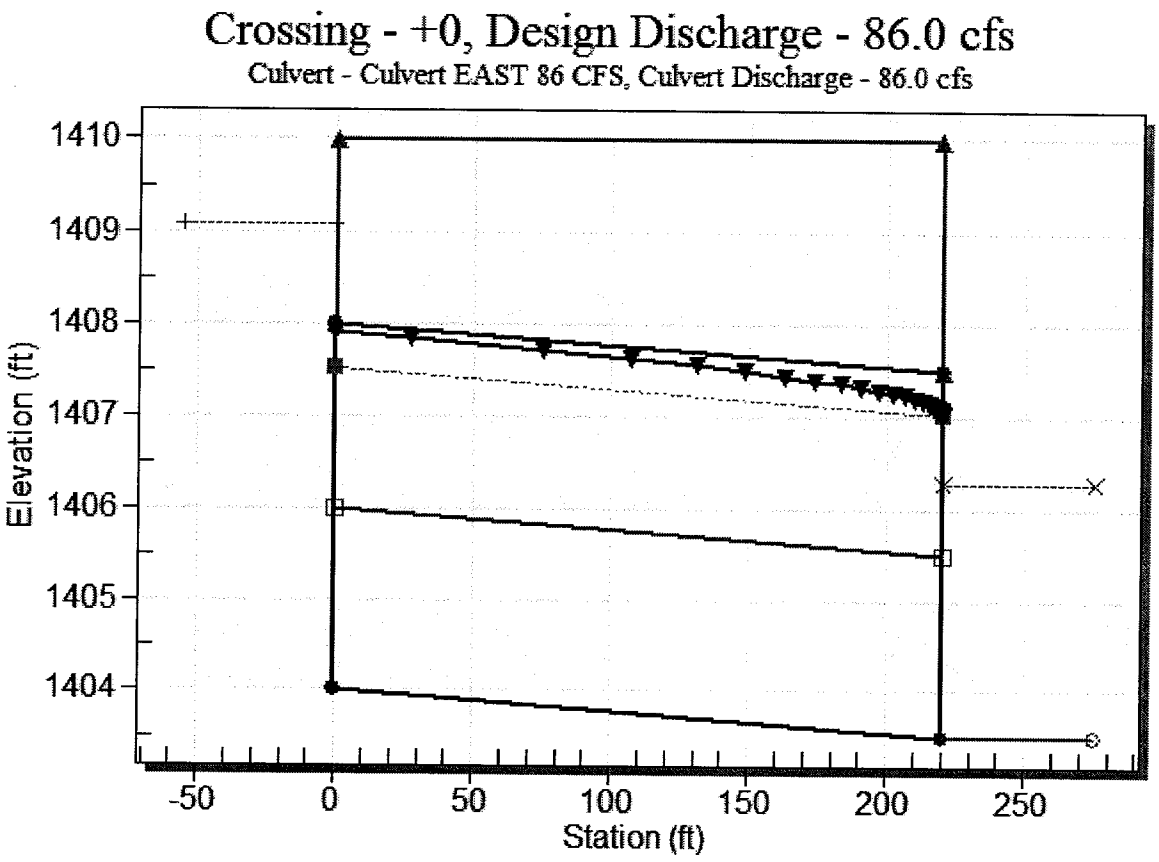
Culvert Length: 220.00 ft, Culvert Slope: 0.0023

****

Culvert Performance Curve Plot: Culvert EAST 86 CFS



Water Surface Profile Plot for Culvert: Culvert EAST 86 CFS



Site Data - Culvert EAST 86 CFS

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1404.00 ft

Outlet Station: 220.00 ft

Outlet Elevation: 1403.50 ft

Number of Barrels: 1

Culvert Data Summary - Culvert EAST 86 CFS

Barrel Shape: Concrete Box

Barrel Span: 8.00 ft

Barrel Rise: 4.00 ft

Barrel Material: Concrete

Embedment: 24.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0200 (bottom)

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: NONE

Table 3 - Downstream Channel Rating Curve (Crossing: +0)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
86.00	1406.29	2.79	3.85	1.22	0.41
86.00	1406.29	2.79	3.85	1.22	0.41

Tailwater Channel Data - +0

Tailwater Channel Option: Rectangular Channel

Bottom Width: 8.00 ft

Channel Slope: 0.0070

Channel Manning's n: 0.0450

Channel Invert Elevation: 1403.50 ft

Roadway Data for Crossing: +0

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 12.00 ft

Crest Elevation: 1410.00 ft

Roadway Surface: Gravel

Roadway Top Width: 219.50 ft

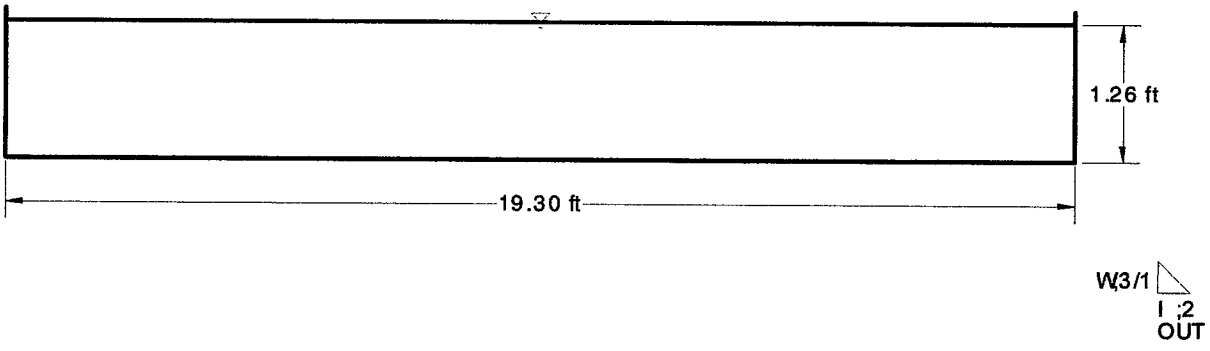
APPENDIX D

Cross Section for Rectangular Channel

SECTION 3

Project Description	
Worksheet	3
Flow Element	Rectangular
Method	Manning's Fc
Solve For	Channel Dep

Section Data		
Mannings Co	0.045	
Slope	10000	ft/ft
Depth	1.26	ft
Bottom Width	19.30	ft
Discharge	86.00	cfs



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Worksheet
Worksheet for Rectangular Channel

Project Description	
Worksheet	3
Flow Element	Rectangular
Method	Manning's Fc
Solve For	Channel Dep

Input Data		
Mannings Co	0.045	
Slope	10000	ft/ft
Bottom Width	19.30	ft
Discharge	86.00	cfs

Results		
Depth	1.26	ft
Flow Area	24.3	ft²
Wetted Per	21.81	ft
Top Width	19.30	ft
Critical Dep	0.85	ft
Critical Slo	.034849	ft/ft
Velocity	3.54	ft/s
Velocity He	0.20	ft
Specific En	1.45	ft
Froude Nui	0.56	
Flow Type	bcritical	

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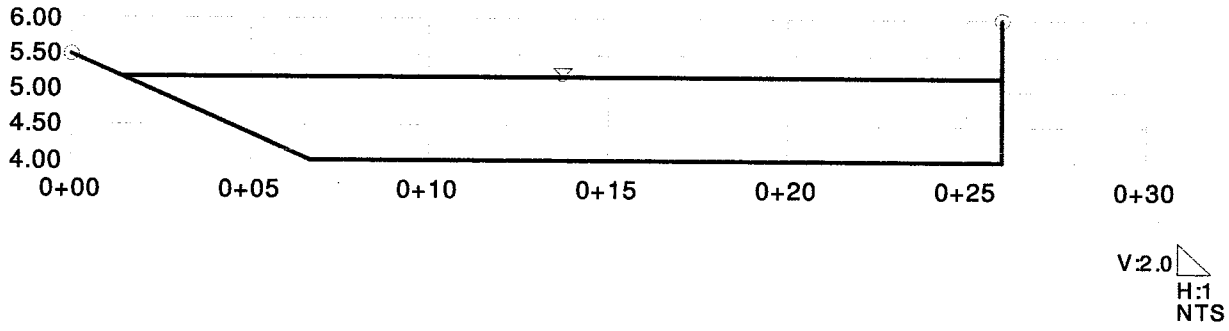
Cross Section for Irregular Channel

SECTION 4

Project Description	
Worksheet	4
Flow Element	Irregular Ch
Method	Manning's F
Solve For	Channel De

Section Data		
Mannings Coefl	0.045	
Slope	.010000	ft/ft
Water Surface I	5.18	ft
Elevation Rang	0 to 6.00	
Discharge	86.00	cfs



Worksheet
Worksheet for Irregular Channel

Project Description	
Worksheet	4
Flow Element	Irregular Ch
Method	Manning's F
Solve For	Channel De

Input Data		
Slope	10000	ft/ft
Dischai	86.00	cfs

Options	
Current Roughness I	Lotter's Method
Open Channel Weigl	Lotter's Method
Closed Channel Wei	Horton's Method

Results		
Mannings Coefl	0.045	
Water Surface I	5.18	ft
Elevation Rangi	0 to 6.00	
Flow Area	26.0	ft²
Wetted Perimet	25.90	ft
Top Width	24.59	ft
Actual Depth	1.18	ft
Critical Elevatio	4.82	ft
Critical Slope	.034094	ft/ft
Velocity	3.31	ft/s
Velocity Head	0.17	ft
Specific Energy	5.35	ft
Froude Number	0.57	
Flow Type	ubcritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+26	0.045

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	5.50
0+07	4.00
0+26	4.00
0+26	6.00

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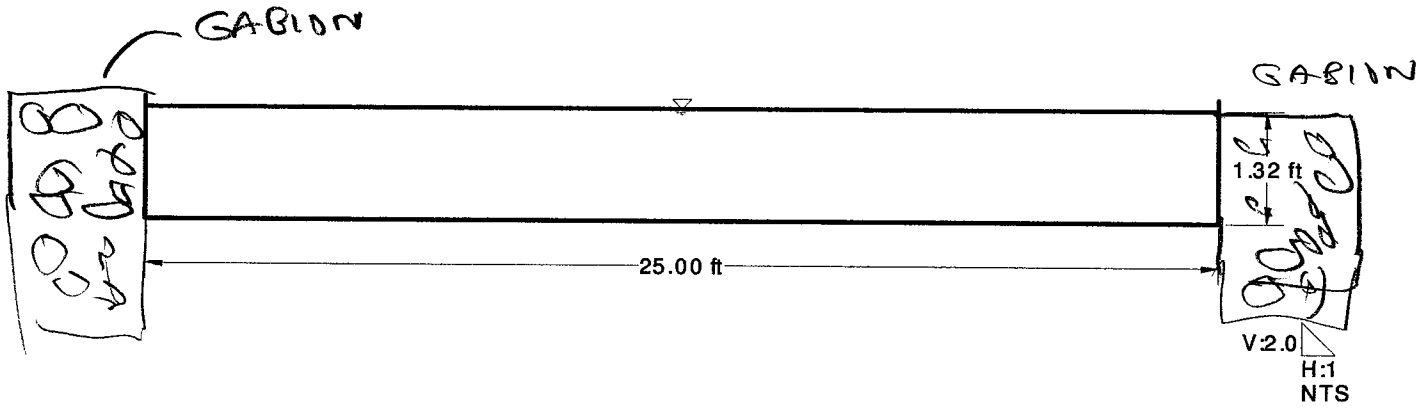
Cross Section for Rectangular Channel

Project Description	
Worksheet	5
Flow Element	Rectangular
Method	Manning's Fc
Solve For	Channel Dep

WEST CHANNEL
SECTION 5

Section Data		
Mannings Co	0.045	
Slope	20000	ft/ft
Depth	1.32	ft
Bottom Width	25.00	ft
Discharge	73.00	cfs



Worksheet
Worksheet for Rectangular Channel

Project Description	
Worksheet	5
Flow Element	Rectangular
Method	Manning's Fc
Solve For	Channel Dep

Input Data		
Mannings Co	0.045	
Slope	20000	ft/ft
Bottom Width	25.00	ft
Discharge	/ 73.00	cfs

Results		
Depth	1.32	ft
Flow Area	32.9	ft²
Wetted Per	27.64	ft
Top Width	25.00	ft
Critical Dep	1.14	ft
Critical Slo	.031722	ft/ft
Velocity	5.25	ft/s
Velocity He	0.43	ft
Specific En	1.75	ft
Froude Nui	0.81	
Flow Type	bcritical	

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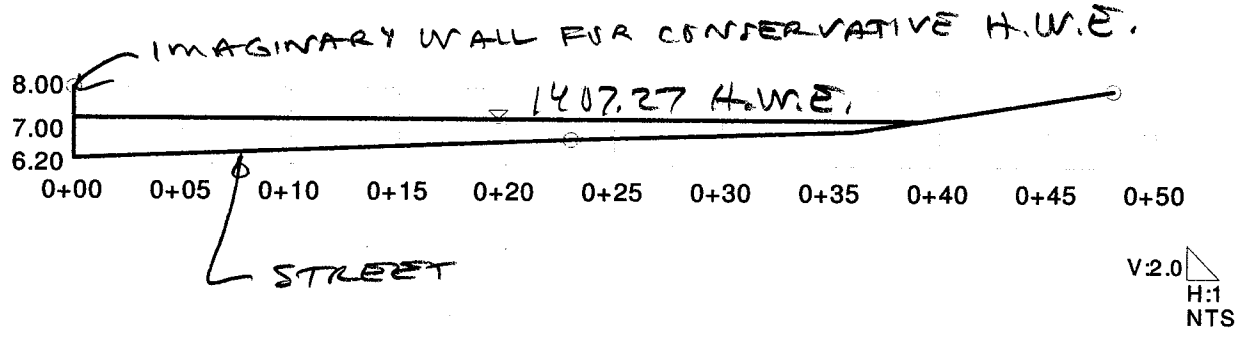
Cross Section for Irregular Channel

Project Description	
Worksheet	6
Flow Element	Irregular Ch
Method	Manning's F
Solve For	Channel De

Section Data		
Mannings Coeff	0.021	
Slope	.028000	ft/ft
Water Surface E	7.27	ft
Elevation Rang	to 8.00	
Discharge	173.00	cfs

WEST CHANNEL

SECTION 6



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Worksheet
Worksheet for Irregular Channel

Project Description	
Worksheet	6
Flow Element	Irregular Ch
Method	Manning's F
Solve For	Channel De

Input Data		
Slope	28000	ft/ft
Dischai	73.00	cfs

Options	
Current Roughness I	Lotter's Method
Open Channel Weigl	Lotter's Method
Closed Channel Wei	Horton's Method

Results		
Mannings Coefl	0.021	
Water Surface I	7.27	ft
Elevation Rangi	0 to 8.00	
Flow Area	21.7	ft²
Wetted Perimet	40.18	ft
Top Width	39.20	ft
Actual Depth	0.97	ft
Critical Elevatio	7.57	ft
Critical Slope	0.006964	ft/ft
Velocity	7.98	ft/s
Velocity Head	0.99	ft
Specific Energy	8.26	ft
Froude Number	1.89	
Flow Type	ɔercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+23	0.020
0+23	0+48	0.045

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	8.00
0+00	6.30
0+23	6.80
0+36	7.00
0+48	8.00

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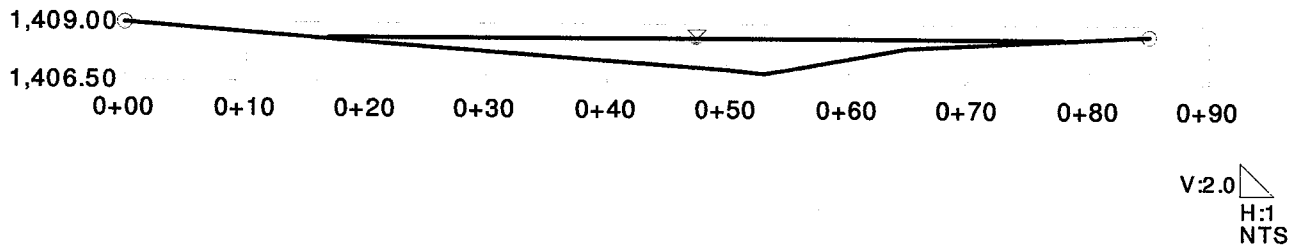
SEC 7
Cross Section for Irregular Channel

EXISTING GRADE

SECTION 7

Project Description	
Worksheet	sec. 7
Flow Element	Irregular Ch
Method	Manning's F
Solve For	Channel De

Section Data		
Mannings Coeff	0.050	
Slope	0.010000	ft/ft
Water Surface E	1,408.32	ft
Elevation Rangi	0 to 1,409.00	
Discharge	86.00	cfs



Montgomery Engineering
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Worksheet
Worksheet for Irregular Channel

SECTION 7

EXISTING GRADE

Project Description	
Worksheet	sec 7
Flow Element	Irregular Ch
Method	Manning's F
Solve For	Channel De

Input Data		
Slope	10000	ft/ft
Dischai	86.00	cfs

Options	
Current Roughness I	Lotter's Method
Open Channel Weigl	Lotter's Method
Closed Channel Wei	Horton's Method

Results		
Mannings Coefl	0.050	
Water Surface I	1,408.32	ft
Elevation Rangi	0 to 1,409.00	
Flow Area	39.0	ft²
Wetted Perimet	61.01	ft
Top Width	60.93	ft
Actual Depth	1.42	ft
Critical Elevatio	1,407.95	ft
Critical Slope	0.044813	ft/ft
Velocity	2.21	ft/s
Velocity Head	0.08	ft
Specific Energy	1,408.40	ft
Froude Number	0.49	
Flow Type	Subcritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00	0+85	0.050

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00	1,409.00
0+25	1,408.00
0+50	1,407.00
0+53	1,406.90
0+55	1,407.00
0+65	1,408.00
0+85	1,408.50

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Worksheet
Worksheet for Broad Crested Weir

WEIR @ DROP INLET

SEC 2

Project Description	
Worksheet	DROP INLET
Type	Broad Creste
Solve For	Headwater E

Input Data		
Discharge	86.00	cfs
Crest Elevati	08.00	ft
Tailwater Ele	07.40	ft
Crest Surfac	Paved	
Crest Breadtl	0.67	ft
Crest Length	40.00	ft

(66 CFS + 20 CFS)

Results		
Headwater Elevatio	08.79	ft
Headwater Height A	0.79	ft
Tailwater Height Ab	-0.60	ft
Discharge Coefficie	3.09	US
Submergence Factc	1.00	
Adjusted Discharge	3.09	US
Flow Area	31.4	ft²
Velocity	2.74	ft/s
Wetted Perimeter	41.57	ft
Top Width	40.00	ft

APPENDIX E

NAUNI VALLEY 6 LOT 1

SCOUR CALCULATIONS

REFERENCE MARICOPA COUNTY DRAINIAGE DESIGN MANUAL HYDRAULICS 6.6.3

BANK AT STRAIGHT REACH

D_{50} = 0.0191Va * Va * (62.4/(140-62.4))/COS (BANK ANGLE)

WASH	Va AVG VEL	BANK ANGLE DEGREES	RIP-RAP D_{50}	
WEST 173 CFS	5.25	0	0.4	USE D 50 = 6", 36" DEPTH or SOIL CEMENT
EAST SEC 1020	3.48	14	0.2	USE STABILIZED GRANITE FOR NATURAL LOOK REQ'D BY P.V.
CULVERT OUTLET	6.37	0	0.6	USE D 50 = 8", 36" DEPTH

NAUNI VALLEY 6 LOT 1
FREEBOARD PER MARICOPA COUNTY HYDRAULICS DRAINAGE DESIGN MANUAL

FB = 0.25(Y=V*V/2*G) FORMULA 6-25

Y = DEPTH

V = VELOCITY

g = 32.2 FT/SEC/SEC

	DEPTH	VELOCITY	FB	
EAST 86 CFS SEC 1020	0.6	3.48	0.197012	USE 1' MIN.
EAST 86 OUTLET	1	3.41	0.29514	USE 1' MIN.
WEST 176 CFS	1.23	2.95	0.341283	USE 1' MIN.
SECTION 7 86 CFS EXIST	1.42	2.21	0.37396	USE 1' MIN. EXISTING GRADE FOR H.W.E. CALC.

SUPERELEVATION AT CURVE IN OPEN CHANNEL

REFERENCE MARICOPA CO DRAINAGE DESIGN MANUAL HYDRAULICS

$Y = 0.5*V*V*T/(32.2*Rc)$

Y = SUPERELEVATON INCREASE IN FEET
V = AVERAGE VELOCITY
Rc = RADIUS AT CENTER OF WASH
T = WIDTH OF FLOW AT TOP

LOCATION	V	T	Rc	SUPERELEVATION
86 cfs	4.22	39	7	1.5

H.W.E. @ DROP INLET 86 CFS = 08.79
+ Superelev. 1.5
+ Freeboard 1.0
11.29 MIN TW EL. @ HEADWALL
USE TW 12.0