CAVE CREEK DRAINAGE MASTER PLAN
Final Hydraulics Report
Cave Creek, Arizona

Prepared for:

FINAL

3/14/06

DAT

Flood Control District of Maricopa County
Contract No. FCD2004C072

Prepared by:

HDR ONE COMPANY *Many Solutions*℠

3200 East Camelback Road
Suite 350
Phoenix, Arizona 85018-2311
602-522-7700

February 2008

Registered Professional Engineer (Civil)
CERTIFICATE NO
35571
LINDA A.
POTTER
Date Signed 2·29·08
ARIZONA U.S.A.

Exp. 12·31·09

Table of Contents

1.0 INTRODUCTION 1-1

1.1 PURPOSE OF STUDY 1-1

1.2 AUTHORITY FOR STUDY 1-1

1.3 LOCATION OF STUDY 1-1

1.4 HYDRAULIC METHODOLOGY 1-1

2.0 PREVIOUS STUDIES 2-1

2.1 PREVIOUS STUDIES 2-1

2.2 MAPPING 2-2

2.3 HYDROLOGY 2-2

3.0 HYDRAULIC MODELING RESULTS 3-1

3.1 UNNAMED CENTRAL TRIBUTARY TO CAVE CREEK WASH (UCT) AND MORMON GIRL WASH 3-1

3.2 FLOODPRONE PROPERTIES 3-3

3.3 ALTERNATIVES ANALYSIS 3-4

3.3.1 Culvert Improvements 3-4

3.3.2 All-weather Access Improvements 3-5

List of Appendices

Appendix A REFERENCES A-1

Appendix B FLOODPRONE PROPERTIES EXHIBITS B-1

Appendix C FLO-2D DOCUMENTATION C-1

Appendix D CONCEPTUAL DESIGN PLANS D-1

Figure

Figure 1 – Study Limits 1-2

Registered Professional Engineer (Civil)
CERTIFICATE NO
35571
LINDA A.
POTTER
Date Signed 2.29.08
ARIZONA U.S.A.
12.31.09

1.0 INTRODUCTION

1.1 Purpose of Study

This report summarizes the hydraulic analysis performed under Contract FCD2004C072 for the Cave Creek Drainage Master Plan. The purpose of the hydraulic analysis task is to:

- Evaluate the impacts of infrastructure based on past flooding and any existing HEC, FLO-2D, and floodplain delineation analyses;
- Prepare hydraulic analyses as necessary for the evaluation of flooding impacts or alternatives development; and
- Develop hydraulic parameters to assist in risk assessment as part of the acquisition program for structures in high hazard areas.

1.2 Authority for Study

The Flood Control District of Maricopa County (FCDMC) has contracted HDR to prepare this study under Contract No. FCD 2004C072 as part of the Cave Creek Drainage Master Plan. The Project Manager at FCDMC is Ms. Felicia Terry at (602) 506-1501. The FCDMC is located at 2801 W. Durango Street in Phoenix, AZ 85009. The Project Manager at HDR is David Buras at (602) 522-7700.

1.3 Location of Study

The study limits are shown graphically on **Figure 1**, on the next page encompassing the entire Town of Cave Creek and unincorporated land of Maricopa County. Cave Creek is located in portions of Township 5 North, Rages 3 and 4 East and Township 6 North, Ranges 3 and 4 East. The Town is east of the Gila and Salt River Meridian within Maricopa County.

1.4 Hydraulic Methodology

The hydraulic methodology for this project is in accordance with the Drainage Design Manual for Maricopa County (DDMMC), Volume II, Hydraulics.

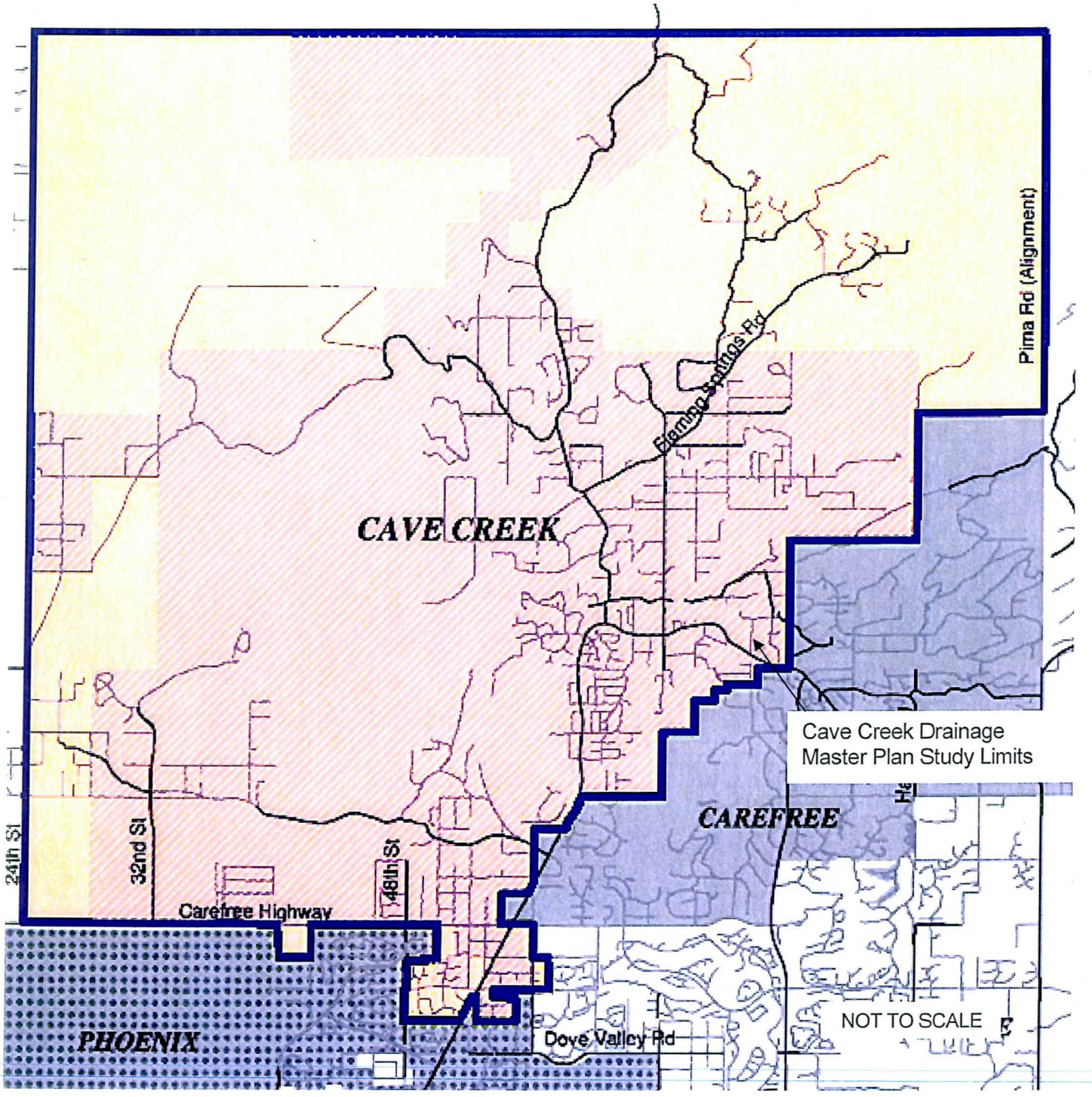


Figure 1 – Study Limits

Table of Contents

1.0 INTRODUCTION 1-1
1.1 PURPOSE OF STUDY 1-1
1.2 AUTHORITY FOR STUDY 1-1
1.3 LOCATION OF STUDY 1-1
1.4 HYDRAULIC METHODOLOGY 1-1
2.0 PREVIOUS STUDIES 2-1
2.1 PREVIOUS STUDIES 2-1
2.2 MAPPING 2-2
2.3 HYDROLOGY 2-2
3.0 HYDRAULIC MODELING RESULTS 3-1
3.1 UNNAMED CENTRAL TRIBUTARY TO CAVE CREEK WASH (UCT) AND MORMON GIRL WASH 3-1
3.2 FLOODPRONE PROPERTIES 3-3
3.3 ALTERNATIVES ANALYSIS 3-4
3.3.1 Culvert Improvements 3-4
3.3.2 All-weather Access Improvements 3-5

List of Appendices

Appendix A REFERENCES A-1
Appendix B FLOODPRONE PROPERTIES EXHIBITS B-1
Appendix C FLO-2D DOCUMENTATION C-1
Appendix D CONCEPTUAL DESIGN PLANS D-1

Figure

Figure 1 – Study Limits 1-2

1.0 INTRODUCTION

1.1 Purpose of Study

This report summarizes the hydraulic analysis performed under Contract FCD2004C072 for the Cave Creek Drainage Master Plan. The purpose of the hydraulic analysis task is to:

- Evaluate the impacts of infrastructure based on past flooding and any existing HEC, FLO-2D, and floodplain delineation analyses;
- Prepare hydraulic analyses as necessary for the evaluation of flooding impacts or alternatives development; and
- Develop hydraulic parameters to assist in risk assessment as part of the acquisition program for structures in high hazard areas.

1.2 Authority for Study

The Flood Control District of Maricopa County (FCDMC) has contracted HDR to prepare this study under Contract No. FCD 2004C072 as part of the Cave Creek Drainage Master Plan. The Project Manager at FCDMC is Ms. Felicia Terry at (602) 506-1501. The FCDMC is located at 2801 W. Durango Street in Phoenix, AZ 85009. The Project Manager at HDR is David Buras at (602) 522-7700.

1.3 Location of Study

The study limits are shown graphically on **Figure 1**, on the next page encompassing the entire Town of Cave Creek and unincorporated land of Maricopa County. Cave Creek is located in portions of Township 5 North, Rages 3 and 4 East and Township 6 North, Ranges 3 and 4 East. The Town is east of the Gila and Salt River Meridian within Maricopa County.

1.4 Hydraulic Methodology

The hydraulic methodology for this project is in accordance with the Drainage Design Manual for Maricopa County (DDMMC), Volume II, Hydraulics.

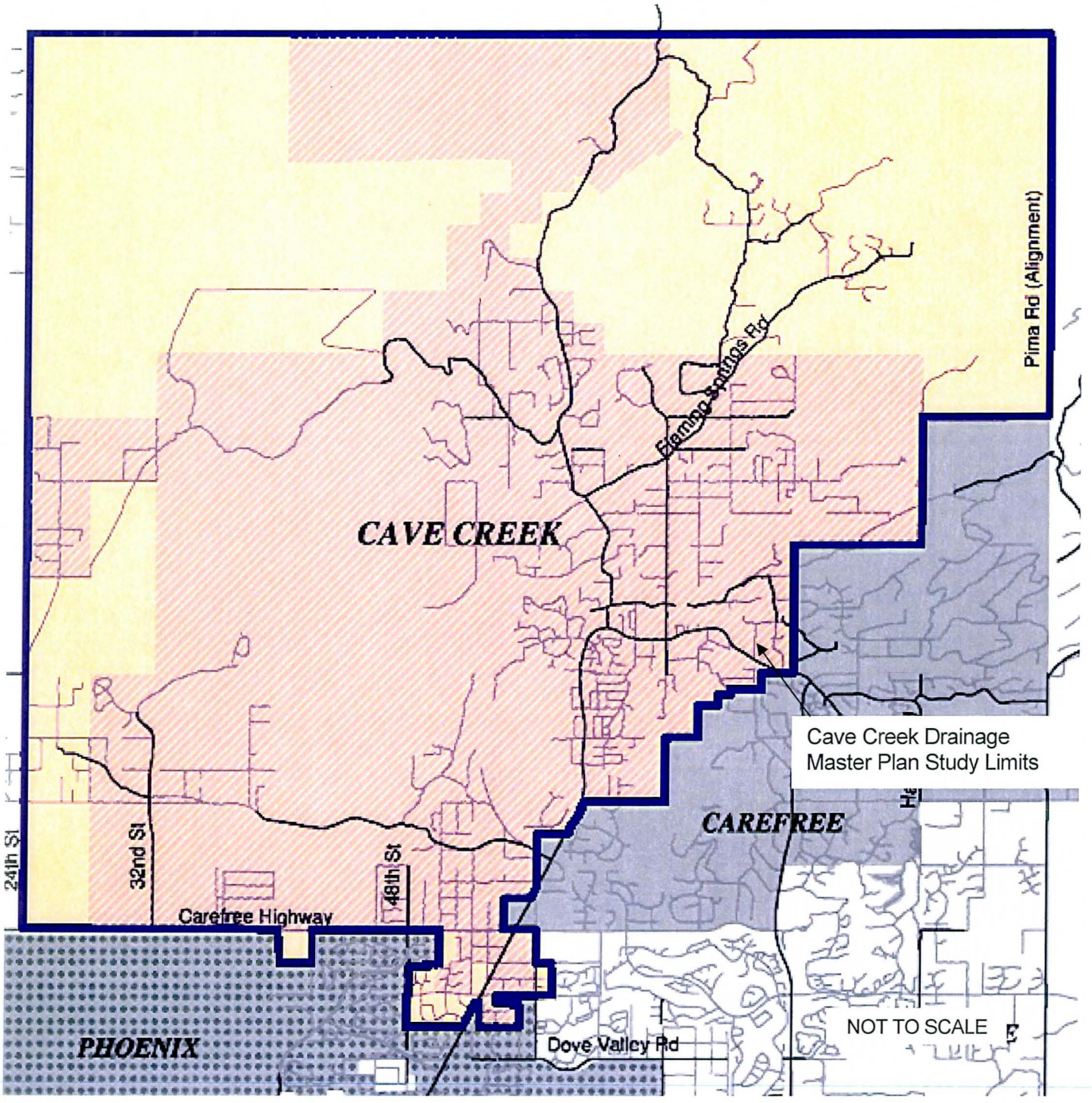


Figure 1 – Study Limits

2.0 PREVIOUS STUDIES

2.1 Previous Studies

The entire Study Area has been previously modeled to various levels of detail. However, additional detail and/or revisions were necessary for the current study. Existing models include (see Appendix A):

- Cave Creek/Carefree Flood Insurance Study (FIS), 1990
- Cline Creek and Rodger Creek Floodplain Delineation Study (FDS), 1990
- Cave Creek from Tonto National Forest to Carefree Highway FDS, 1995
- Cave Creek FDS, 1996
- Desert Hills Area FDS, 1997
- Andora Hills and Galloway Washes FDS, 1999
- Carefree Drainage Master Plan, 2001
- Carefree Drainage Master Plan Update, 2005 (2-D routing study)
- Drainage Report for Lowe's Home Improvement Warehouse, 2007

Although the entire watershed has been modeled in previous studies, it was determined that certain areas require additional detail for the purpose of the overall Drainage Master Plan and alternative evaluations.

Additionally, floodplain delineation studies were performed on the following washes as part of this project:

- Ocotillo Wash Zone A Redelineation
- Galloway Tributaries 2, 2A, and 2B
- Willow Springs Tributaries 6, 6A, 6B, and 6C
- Cave Creek Tributaries 1, 1A, 1B, 1C, and 1D

Documentation on the hydraulics of these areas is contained in the respective Technical Data Notebook for each delineated floodplain and is not included in this report.

2.2 Mapping

The base mapping for the project was provided under a separate contract by Cooper Aerial Surveys Company (Cooper). The mapping for entire study area was prepared by photogrammetric methods to national map accuracy standards for 1"=100' horizontal scale and 2' contour intervals. The flight dates were November of 2003 through December of 2005. The horizontal and vertical control was supplied by Cooper. The coordinate system is based on NAVD88 (Convert to NGVD29 by subtracting 2.07 ft)

2.3 Hydrology

A separate hydrology report, the *Cave Creek Drainage Master Plan Hydrology Report*, dated July 2007, was created as part of the project. The purpose of that report was to research existing hydrologic models and studies within the study area and to estimate existing and future runoff conditions for the areas not covered by existing studies. Documentation on flow generation for the area can be found in that report.

3.0 HYDRAULIC MODELING RESULTS

3.1 Unnamed Central Tributary to Cave Creek Wash (UCT) and Mormon Girl Wash

A portion of the project area contains a wash which is subject to variable flow conditions resulting from an upstream flow split condition. The wash, designated the Unnamed Central Tributary to Cave Creek (UCT), splits into two tributaries near Carefree Highway and Terravita Way in the City of Scottsdale. The northern branch flows through the Town of Carefree and crosses Cave Creek Road between New River Road and Canyon Ridge Drive. Historically, this branch of the wash has been called "Mormon Girl Wash", and flows through the Town of Cave Creek north of New River Road and eventually discharges into Cave Creek. The southern branch of the UCT crosses Cave Creek Road approximately 1,000 feet north of Carefree Highway and rejoins the north branch near the intersection of 50th Street and New River Road.

The southern branch crossing of Cave Creek Road has been studied as part of two separate studies:

- *Carefree Drainage Master Plan Update: 100-year, 24-hour 2-D Floodplain Model* (JE Fuller, August 2005) (referred to as "Carefree DMPU")
- *Drainage Report for Lowe's Home Improvement Warehouse* (Shephard Wesnitzer, April 2007) (referred to as "Lowe's")

The results of both models are discussed below. It is important to note that the Lowe's study used the results of the Carefree DMPU study upstream of the roadway, where 1,348 cfs arrives from the southern branch of the UCT. However, the results of the detailed study at the roadway between the two studies differ slightly.

Carefree Drainage Master Plan Update 100-year, 24-hour 2-D Floodplain Model: This study was limited to the portions of the wash in the Town of Carefree, up to and including Cave Creek Road. The original study did not provide results at the roadway; therefore, in order to determine the distribution of flow at Cave Creek Road, the electronic model was obtained and new cross sections were cut within the FLO-2D model. No other changes were made to the original model.

The results indicate that flow attenuation (i.e. ponding) occurs upstream of Cave Creek Road, resulting in 847 cfs crossing the road and 127 cfs breaking out to the south. However, this model does not take the conveyance capacity of the culverts into account, so this flow summary does not include flows that may cross the road in the existing culverts. The amount of flow that may be conveyed by the culverts is unknown, due to the large amount of sediment accumulation that has occurred inside and upstream of the structures.

As previously mentioned, a total of 1,348 cfs approaches the road. At the road, according to this model, 847 cfs crosses the road and 127 cfs goes south. The difference between the two totals (1,348 cfs minus 847 cfs minus 127 cfs) is 374

cfs, which is either detained upstream or conveyed across the Cave Creek Road in the existing culverts. **Appendix C** contains copies of the results of the FLO-2D modeling.

Drainage Report for Lowe's Home Improvement Warehouse: This study used the results of the Carefree Drainage Master Plan Update immediately upstream of Cave Creek Road. However, the study used the more conservative assumption that roadway overtopping instead of attenuation due to ponding would occur. The results indicate that 1,059 cfs crosses the road and 289 cfs breaks out to the south. Additionally, a floodplain was mapped through the Lowe's site using 911 cfs (the difference between the 1,059 cfs and the 911 cfs is retained on-site).

The net difference between the two models at the Cave Creek Road crossing is relatively small, with the Carefree DMPU report at 847cfs (which does not include culvert conveyance, if any) and the Lowe's report at 911 cfs. It is recommended that the flows from the Lowe's report are used when designing improvements to the wash crossing of the south branch of the UCT, which is 911 cfs across Cave Creek Road and 289 cfs to the south.

Considerations must be given to both the upstream and downstream properties when designing improvements. It appears that the flows in the UCT/Mormon Girl Wash system have been poorly understood in the past, before detailed studies were commissioned on the area in the early 2000s. It is unknown what flows were used when designing the residential development along the wash that pre-dates the detailed studies. As part of the Cave Creek Drainage Master Plan report prepared as part of this project, a recommendation exists for mapping the floodplain generated from this wash. The mapping will be beneficial to surrounding properties to determine the potential flooding risks for both the pre- and post-crossing improvement scenarios using the latest flow information contained in the detailed reports referenced above.

3.2 Floodprone Properties

The area was examined for residential structures that may be located within floodways. The presence of floodways on properties was determined from existing FEMA mapped floodways, or new floodways identified and mapped as part of this project. Three residences were identified within new or existing floodways in the study limits:

- Ocotillo Wash – 40647 N. Fleming Springs Road
- Ocotillo Wash – 6914 E. Continental Mountain Drive
- Willow Springs Wash, Tributary 6.1 – 5515 E. Honda Bow Road

Two additional structures were previously identified as a result of the *Adobe Dam/Desert Hills ADMP* study. Both structures are located within the floodway study limits and are located upon a single residence:

- Apache Wash – 39416 N. 28th Street

Table 3.1, below, summarizes the hydraulics characteristics associated with the properties, and **Appendix B** contains exhibits illustrating the hydraulic characteristics for new residences identified within this study.

Table 3.1 – Hydraulic Characteristics of Floodprone Properties

Address	Water Surface Elevation (100-year)	Velocity (100-year), fps	Depth (100-year), ft	Critical Travel Time (hours)
40647 N. Fleming Springs Road	2242.93	7.07	4.38	1.5*
6914 E. Continental Mountain Drive	2323.65	4.56	2.32	1.3*
5515 E. Honda Bow Road	2200.12	7.66	3.58	4.1
[1] 39416 N. 28th Street, Structure 1	1989.70	3.2	—[2]	—[2]
[1] 39416 N. 28th Street, Structure 2	1988.00	3.1	—[2]	—[2]

*Estimated (pro-rated) from original HEC-1 model "CVCRK43R", 1990 Cave Creek/Carefree FDS (See Appendix A, References for further information on the study).

[1] Property information provided from the Adobe Dam Floodway Structure Risk Assessment from within the Adobe Dam/Desert Hills ADMP.

[2] Not available in final report during data collection.

3.3 Alternatives Analysis

The Cave Creek DMP project sought to provide solutions to flooding problems in the area. Rather than one or more distinct alternatives, this project focused on possible solutions for specific locations identified as having existing flooding, erosion, or other related problems. They were reviewed by the team at the June 12, 2007 workshop and were reduced to several proposed recommendations. This section of the report covers the hydraulics associated with proposed constructed improvements. The proposed constructed improvements are at specific wash/roadway crossings, where all-weather crossings were determined to be a viable solution.

3.3.1 Culvert Improvements

Culvert improvements are recommended to provide all weather access to the Town. Improvements to the culverts crossing Cave Creek road at the UCT to Cave Creek, North (Mormon Girl Wash) and South Branches, are part of the recommended plan. Currently, the culverts at both crossing locations are undersized and filled with sediment. Additionally, a culvert improvement is recommended immediately north of Carefree Highway on Cave Creek Road to address the break out flow from the UCT to the north. The recommended design event is the 100-year event to ensure that the floodplains are not adversely impacted by the crossings.

3.3.2 UCT Culvert Improvements

The *Carefree Drainage Master Plan* (Carefree DMP) previously recommended improvements on Cave Creek Road. Conceptual design was completed as part of that DMP; however, the flows used to size the proposed improvements have been updated (previously discussed in Section 3.1).

The two UCT crossings of Cave Creek Road were redesigned in this plan to reflect the updated flow information. Additionally, an improvement of the existing 18" culvert across Cave Creek Road immediately north of Carefree Highway is recommended to accommodate the break out flow from the UCT southern branch. Based on the break out flow amounts described above in Section 3.1, it is recommended that this culvert is upsized to handle 289 cfs.

A detailed design of this crossing was not completed as the ultimate configuration of the intersection and Carefree Highway is not known. Improvements are planned as part of a Maricopa County Department of Transportation (MCDOT) project to widen Carefree Highway, and the design of the crossing should be coordinated with that project. Additionally, improvements along the north side of Carefree Highway between Cave Creek Road and Cave Creek wash should be developed in order to convey the 289 cfs along the north side of the roadway to Cave Creek.

3.3.3 Willow Springs Wash Culvert Improvements

An additional culvert improvement is recommended at Spur Cross Road and Willow Springs Wash, Tributary 5. The existing triple 42-inch diameter corrugated metal pipes are proposed to be replaced with triple 8-foot by 3-foot reinforced concrete box

culverts. This improvement would eliminate the impassible roadway flow overtopping which currently occurs during 100-year runoff events.

3.3.4 All-weather Access Improvements

All-weather crossings are proposed at three locations on School House Road (at Galloway, Rowe and Ocotillo wash crossings), and at Spur Cross Road at Willow Springs Wash (see **Table 3.6**).

Table 3.6 – All-weather Crossing Improvements

All-weather Crossing Improvements	Crossing Length (ft)
School House Road at Galloway Wash	400
School House Road at Rowe Wash	650
School House Road at Ocotillo Wash	400
Spur Cross Road at Willow Springs Wash	450

The lengths listed in the table include sufficient length to span the existing regulatory floodways. During final design, these lengths may be refined based on type of structure and abutment design.

Many of the culvert and all-weather access improvements may impact the regulatory floodplains. A Letter of Map Revision (LOMR) may be required to submit to the Federal Emergency Management Agency (FEMA) at final design for all improvements that impact floodplain elevations. **Table 3.2** contains a summary of the 100-year flow rates and source of the flow information for proposed improvement locations.

Table 3.2 – Hydrologic Summary

Improvement Location	Source	Event	Flow (cfs)
Cave Creek Road at UCT, North Branch (Mormon Girl Wash)	JEF, 2005	100-yr	1,252
Cave Creek Road at UCT, South Branch	Shephard Wesnitzer, 2007	100-yr	911*
Cave Creek Road, immediately north of Carefree Highway	Shephard Wesnitzer, 2007	100-yr	289
School House Road at Galloway Wash	JEF, 2000	100-yr, 24-hr 100-yr, 6-hr	10,908 9,070
School House Road at Rowe Wash	JEF, 2000	100-yr, 24-hr 100-yr, 6-hr	5,094 4,898
School House Road at Ocotillo Road	FIS, 2005	100-yr	4,630
Spur Cross Road at Willow Springs Wash	FIS, 2005	100-yr	4,800
Spur Cross Road at Willow Springs Wash Tributary 5	CH2M Hill, 1990	100-yr	631

*Recommended

3.3.4.1 Improvement Hydraulics

The proposed culvert improvements were sized using Haestad Method's CulvertMaster Software Program and the 100-year flow rates. The proposed all-weather improvements were analyzed using Haestad Method's FlowMaster Software Program to determine the 100-year water surface elevations. Please note that the FEMA published water surface elevations were not utilized due to the varying topographic sources and datums used during those studies. **Table 3.5** contains a comparison between the published water surface elevations and the elevations calculated as part of this study.

Appendix D includes conceptual design plans and hydraulic calcuations. The improvements convey the flows across the roadways with at least 1 foot of freeboard between the water surface elevation and the bottom of the bridge chord. **Table 3.3** and **Table 3.4** contain the results of the hydraulic analyses.

Table 3.3 – Culvert Hydraulics Summary

Improvement Location	Velocity Downstream (ft/s)	Flow Depth (ft)
Cave Creek Road at UCT, North Branch (Mormon Girl Wash)	15.82	1.40
Cave Creek Road at UCT, South Branch	7.59	1.47

Table 3.4 – All Weather Crossing Hydraulics Summary

Improvement Location	Velocity (ft/s)	Flow Depth (ft)
School House Road at Galloway Wash	13.95	3.99
School House Road at Rowe Wash	8.93	2.76
School House Road at Ocotillo Wash	8.30	3.97
Spur Cross Road at Willow Springs Wash	9.24	3.10
Spur Cross Road at Willow Springs Wash Tributary 5	4.09	1.89

Table 3.5 – FEMA Water Surface Elevation Differences

Improvement Location	Source	Regulatory Flood Elevation (NGVD 29)[1]	Water Surface Elevation Computed within this Study (NAVD 88)[2]
Cave Creek Road at UCT, North Branch (Mormon Girl Wash)	Not Available	N/A	2035.0
Cave Creek Road at UCT, South Branch	Not Available	N/A	2044.0
School House Road at Galloway Wash	FIRM Map No. 04013C0805H dated Sept. 30, 2005	2174.0	2175.0
School House Road at Rowe Wash	FIRM Map No. 04013C0805H dated Sept. 30, 2005	2180.0	2186.8
School House Road at Ocotillo Wash	FIRM Map No. 04013C0802H dated Sept. 30, 2005	2199.0	2204.0
Spur Cross Road at Willow Springs Wash	FIRM Map No. 04013C0802H dated Sept. 30, 2005	2139.0	2139.0
Spur Cross Road at Willow Springs Wash Tributary 5	FIRM Map No. 04013C0802H dated Sept. 30, 2005	2117.0	2120.0

[1] Published Regulatory Flood Elevation are based on NGVD 29 and do not account for vertical datum differences. FEMA published water surface elevations were not utilized for hydraulic modeling due to the varying topographic sources and datums used during those studies.

[2] Water Surface Elevation computations with this study have been determined with respect to the two-foot contour interval topographic data of the ELV-1254 files which utilize the NAVD 88 format. The hydraulic modeling has been prepared for the improvements at these locations from cross section data points respectively.

APPENDIX A REFERENCES

Adobe Dam/Desert Hills ADMP, FCD #2002C001, FCDMC, Various dates from 2003 through 2005.

Carefree Drainage Master Plan, FCD #2004C025, FCDMC, 2003

Carefree Drainage Master Plan Update, FCD #2004C025 Work Assignment #2, FCDMC, August 2005.

Cave Creek Above Carefree Highway Floodplain Delineation Study, FCDMC 95-28, July 1997.

Cave Creek/Carefree Flood Delineation Study, FCD #88-53, March 1990.

Cave Creek Drainage Master Plan Hydrology Report, FCD #2004C072, July 2007.

Flood Control District of Maricopa County, "Drainage Design Manual for Maricopa County, Arizona," Volume I, Hydrology, January 1, 1995.

Flood Control District of Maricopa County, "Drainage Design Manual for Maricopa County, Arizona," Volume II, Hydraulics, January 28, 1996.

Floodplain Delineation Study of Andora Hills and Galloway Washes, FCD #99-14, January 2000.

Flood Delineation Study of Cline Creek, FCD #89-15, April 1990.

Maricopa Association of Governments, "Uniform Standard Details for Public Works Construction", 1998 (Includes Revisions through 2001).

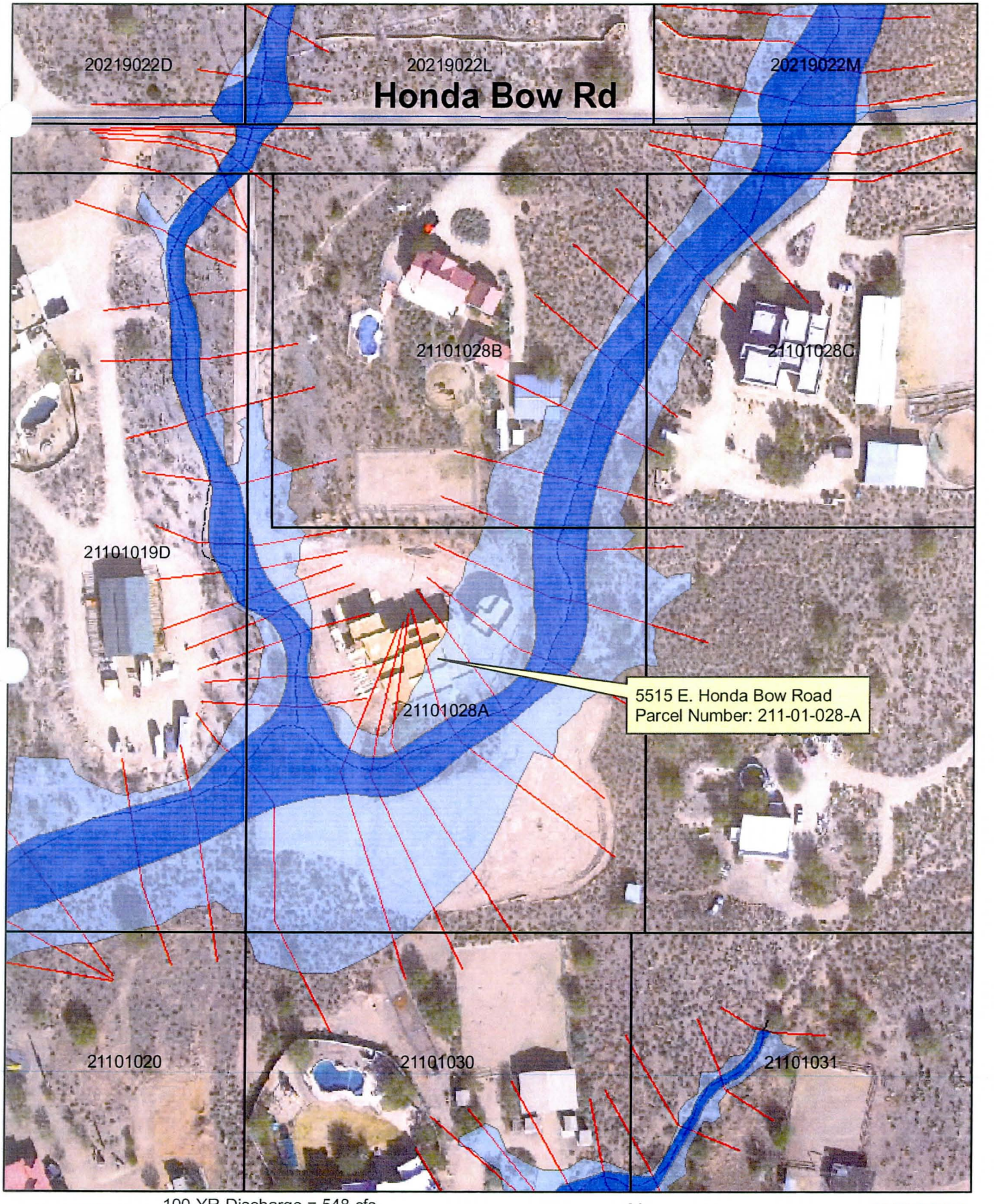
North Scottsdale Floodplain Delineation Study, FCD #2003C008, FCDMC, April 2005.

North Scottsdale Floodplain Delineation Study, FCD #2003C008, FCDMC, April 2005.

Rodger Creek Floodplain Delineation Study, FCD #89-15, April 1990.

Shephard Wesnitzer, "Drainage Report for Lowe's Home Improvement Warehouse", April 2007.

APPENDIX B FLOODPRONE PROPERTIES EXHIBITS



100-YR Discharge = 548 cfs
100-YR Water Surface Elevation = 2200.12 ft
(Cross Section 192.58, Reach 6)
Finish Floor Elevation = 2200.72
Depth = 3.58 ft
Velocity = 7.66 ft/s
Photo Date: September 2006

N

Feet
50 25 0 50 100
1 inch equals 100 feet

DRAFT

Legend
- Parcel Boundaries
- Proposed 100YR Floodway
- Proposed 100YR Floodplain
- Wash Alignment
- Cross Sections

100-YR Discharge = 486.42 cfs
100-YR Water Surface Elevation = 2323.65 ft
Finish Floor Elevation = 2323.71 & 2318.46
Depth = 2.32 ft
Velocity = 4.56 ft/s
Photo Date: September 2006

Feet
50 25 0 50 100
1 inch equals 100 feet

DRAFT

Legend
- Parcel Boundaries
- Preliminary Floodway/Floodplain
- Wash Alignment
- Preliminary Floodway/Floodplain Boundary
- Cross Sections

100-YR Discharge = 4372 cfs
100-YR Water Surface Elevation = 2242.93 ft
Finish Floor Elevation = 2249.59
Depth = 4.38 ft
Velocity = 7.07 ft/s
Photo Date: September 2006

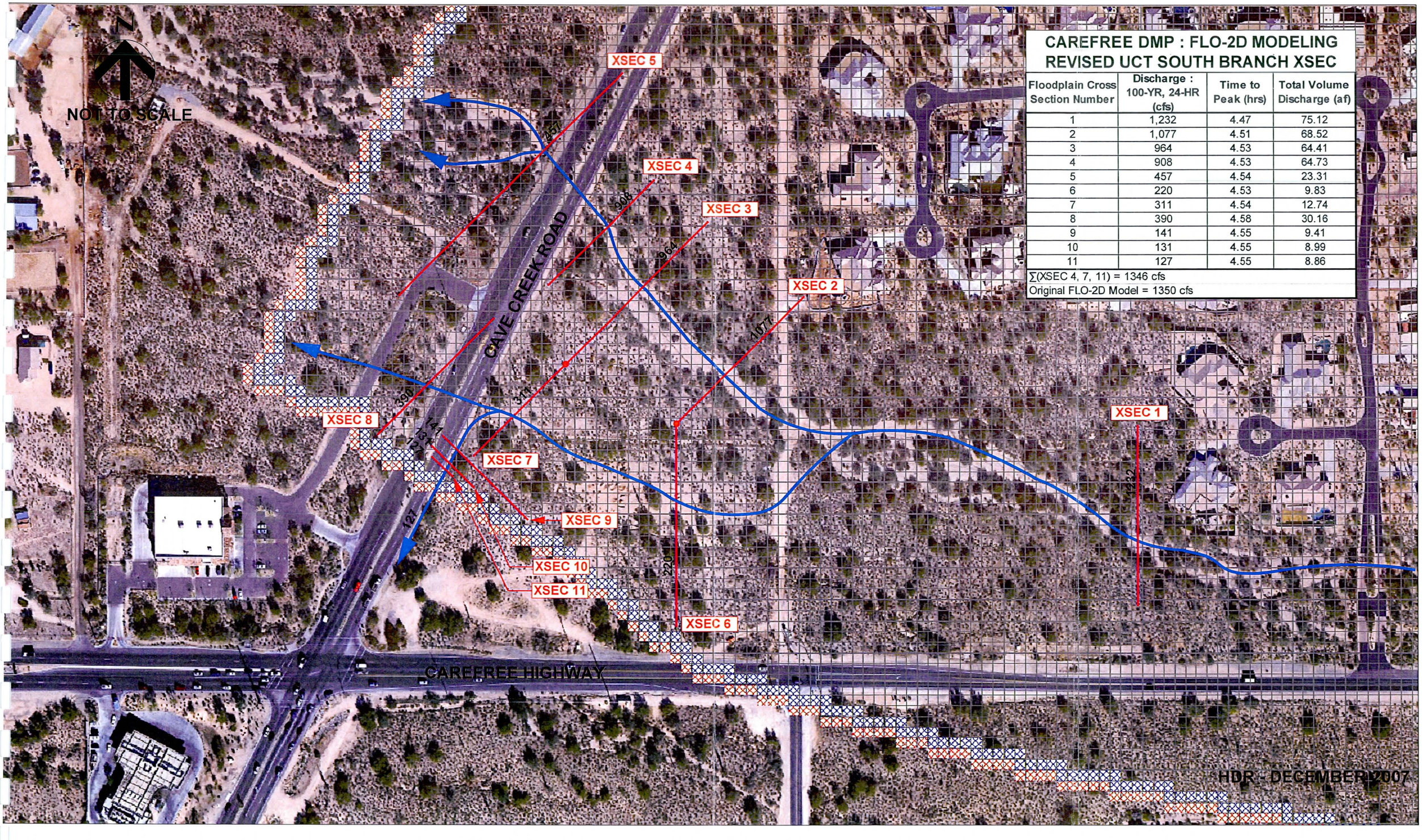
N

Feet
50 25 0 50 100
1 inch equals 100 feet

DRAFT

Legend
- Parcel Boundaries
- Preliminary Floodway/Floodplain
- Wash Alignment
- Preliminary Floodway/Floodplain Boundary
- Cross Sections

APPENDIX C FLO-2D DOCUMENTATION



CAREFREE DMP : FLO-2D MODELING
REVISED UCT SOUTH BRANCH XSEC

Floodplain Cross Section Number	Discharge : 100-YR, 24-HR (cfs)	Time to Peak (hrs)	Total Volume Discharge (af)
1	1,232	4.47	75.12
2	1,077	4.51	68.52
3	964	4.53	64.41
4	908	4.53	64.73
5	457	4.54	23.31
6	220	4.53	9.83
7	311	4.54	12.74
8	390	4.58	30.16
9	141	4.55	9.41
10	131	4.55	8.99
11	127	4.55	8.86

∑(XSEC 4, 7, 11) = 1346 cfs
Original FLO-2D Model = 1350 cfs

FLO-2D OUTPUT FROM REVISED JEFULLER CAREFREE DMP: 100-YEAR, 24-HOUR MODEL
MODEL REPRESENTS THE UNNAMED CENTRAL TRIBUTARY SPLIT (NORTH AND SOUTH BRANCH)
[FLOODPLAIN CROSS SECTION REVISED AND RENUMBERED FOR AREA OF INTEREST]

Table C.1 FLO-2D Hydraulic Modeling Results Summary

Floodplain Cross Section Number	Discharge : 100-YR, 24-HR (cfs)	Time to Peak (hrs)	Total Volume Discharge (af)
1	1,232	4.47	75.12
2	1,077	4.51	68.52
3	964	4.53	64.41
4	908	4.53	64.73
5	457	4.54	23.31
6	220	4.53	9.83
7	311	4.54	12.74
8	390	4.58	30.16
9	141	4.55	9.41
10	131	4.55	8.99
11	127	4.55	8.86
∑(XSEC 4, 7, 11) = 1346 cfs Original FLO-2D Model = 1350 cfs			

Units: (cfs = cubic feet per second), (hrs = hours) and (af = acre-feet)

THE MAXIMUM DISCHARGE FROM CROSS SECTION 1 IS: 1231.51 CFS
AT TIME: 4.47 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 75.12 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 1

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.90	300.00	0.06	0.12	2.22
4.00	220.00	0.12	0.26	6.68
4.10	100.00	0.28	0.49	13.71
4.20	120.00	0.24	0.50	14.30
4.30	320.00	0.51	2.32	381.63
4.40	360.00	0.94	3.44	1166.45
4.50	360.00	0.97	3.48	1216.04
4.60	360.00	0.91	3.34	1095.01
4.70	360.00	0.82	3.08	909.99
4.80	360.00	0.73	2.88	756.35
4.90	360.00	0.65	2.68	631.00
5.00	360.00	0.59	2.52	531.23
5.10	340.00	0.54	2.39	442.23
5.20	340.00	0.49	2.18	360.30
5.30	340.00	0.41	2.03	285.59
5.40	280.00	0.42	1.95	229.43
5.50	240.00	0.41	1.84	182.33
5.60	200.00	0.41	1.73	142.96
5.70	120.00	0.57	1.65	113.05
5.80	120.00	0.51	1.51	91.41
5.90	100.00	0.54	1.38	74.11
6.00	60.00	0.79	1.31	61.81
6.10	80.00	0.55	1.14	50.37
6.20	60.00	0.65	1.07	41.91
6.30	60.00	0.60	1.01	36.28
6.40	60.00	0.56	0.92	30.90
6.50	60.00	0.51	0.86	26.35
6.60	60.00	0.48	0.79	22.79
6.70	60.00	0.45	0.74	19.85
6.80	60.00	0.41	0.70	17.19
6.90	60.00	0.39	0.63	14.73
7.00	60.00	0.36	0.57	12.35
7.10	60.00	0.34	0.53	11.04
7.20	60.00	0.32	0.50	9.54
7.30	60.00	0.29	0.48	8.47
7.40	60.00	0.28	0.46	7.66
7.50	60.00	0.26	0.43	6.67
7.60	60.00	0.25	0.42	6.28
7.70	60.00	0.23	0.40	5.51
7.80	60.00	0.21	0.38	4.87
7.90	60.00	0.19	0.37	4.31
8.00	60.00	0.18	0.36	3.89
8.10	60.00	0.17	0.35	3.57
8.20	40.00	0.22	0.35	3.06
8.30	40.00	0.21	0.33	2.77
8.40	40.00	0.20	0.32	2.60
8.50	40.00	0.20	0.26	2.05
8.60	40.00	0.20	0.24	1.92

8.70	40.00	0.20	0.21	1.67
8.80	40.00	0.19	0.22	1.68
8.90	40.00	0.18	0.19	1.38
9.00	40.00	0.17	0.18	1.22
9.10	40.00	0.16	0.17	1.07
9.20	40.00	0.14	0.16	0.93
9.30	40.00	0.13	0.15	0.82
9.40	40.00	0.12	0.14	0.66
9.50	40.00	0.09	0.11	0.41
9.60	40.00	0.09	0.11	0.41
9.70	40.00	0.08	0.11	0.34
9.80	40.00	0.08	0.10	0.32
9.90	40.00	0.07	0.10	0.30
10.00	40.00	0.07	0.10	0.27
10.10	40.00	0.06	0.09	0.24
10.20	40.00	0.06	0.09	0.22
10.30	40.00	0.06	0.09	0.20
10.40	40.00	0.05	0.08	0.18
10.50	40.00	0.05	0.05	0.10
10.60	40.00	0.05	0.08	0.15
10.70	40.00	0.05	0.05	0.10
10.80	20.00	0.05	0.02	0.02
10.90	20.00	0.05	0.06	0.06
11.00	40.00	0.05	0.03	0.06
11.10	40.00	0.05	0.02	0.04
11.20	40.00	0.05	0.02	0.05
11.30	40.00	0.05	0.02	0.05

THE MAXIMUM DISCHARGE FROM CROSS SECTION 2 IS: 1077.02 CFS
AT TIME: 4.51 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 68.52 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 2

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.90	240.00	0.06	0.15	2.24
4.00	260.00	0.13	0.33	10.89
4.10	160.00	0.20	0.51	16.33
4.20	140.00	0.19	0.72	19.65
4.30	140.00	0.19	1.09	29.35
4.40	240.00	0.67	4.71	758.73
4.50	240.00	0.88	5.04	1068.73
4.60	240.00	0.86	4.93	1021.93
4.70	240.00	0.78	4.72	879.44
4.80	240.00	0.69	4.47	736.35
4.90	240.00	0.61	4.24	617.80
5.00	240.00	0.54	4.09	526.03
5.10	240.00	0.47	3.92	445.81
5.20	240.00	0.43	3.65	373.67
5.30	240.00	0.36	3.56	309.74
5.40	240.00	0.30	3.53	253.58
5.50	240.00	0.25	3.44	207.28
5.60	240.00	0.22	3.06	165.29
5.70	240.00	0.19	2.88	132.89
5.80	180.00	0.21	2.87	106.21
5.90	100.00	0.30	2.91	87.05
6.00	100.00	0.28	2.63	72.44
6.10	60.00	0.40	2.48	59.58
6.20	40.00	0.37	3.38	49.56
6.30	40.00	0.31	3.39	41.78
6.40	40.00	0.29	3.16	36.15
6.50	40.00	0.26	2.85	30.13
6.60	40.00	0.24	2.71	25.75
6.70	40.00	0.23	2.52	22.97
6.80	40.00	0.21	2.36	19.97
6.90	40.00	0.19	2.20	17.11
7.00	40.00	0.18	2.07	15.10
7.10	40.00	0.17	1.91	12.64
7.20	40.00	0.16	1.78	11.23
7.30	40.00	0.15	1.68	10.00
7.40	40.00	0.15	1.44	8.68
7.50	40.00	0.14	1.36	7.73
7.60	40.00	0.13	1.29	6.83
7.70	40.00	0.12	1.25	6.12
7.80	40.00	0.12	1.17	5.64
7.90	40.00	0.12	0.95	4.52
8.00	40.00	0.12	0.82	3.84
8.10	40.00	0.11	0.80	3.56
8.20	40.00	0.11	0.97	4.40
8.30	40.00	0.09	0.88	3.18
8.40	40.00	0.08	0.86	2.89
8.50	40.00	0.08	0.86	2.77
8.60	40.00	0.08	0.65	2.10
8.70	40.00	0.08	0.65	2.07

8.80	40.00	0.07	0.62	1.69
8.90	40.00	0.06	0.60	1.52
9.00	40.00	0.06	0.58	1.35
9.10	40.00	0.05	0.56	1.20
9.20	40.00	0.05	0.54	1.07
9.30	40.00	0.05	0.52	0.97
9.40	40.00	0.04	0.50	0.88
9.50	40.00	0.04	0.49	0.80
9.60	40.00	0.04	0.47	0.71
9.70	40.00	0.03	0.44	0.61
9.80	40.00	0.03	0.42	0.53
9.90	40.00	0.03	0.41	0.48
10.00	40.00	0.03	0.39	0.40
10.10	40.00	0.03	0.33	0.33
10.20	40.00	0.03	0.27	0.27
10.30	40.00	0.03	0.20	0.20
10.40	20.00	0.05	0.11	0.11
10.50	40.00	0.03	0.09	0.09
10.60	40.00	0.05	0.08	0.15

THE MAXIMUM DISCHARGE FROM CROSS SECTION 3 IS: 963.86 CFS
AT TIME: 4.53 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 64.41 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 3

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.90	280.00	0.07	0.15	3.01
4.00	280.00	0.10	0.33	9.47
4.10	80.00	0.18	1.00	14.61
4.20	80.00	0.17	1.18	16.42
4.30	60.00	0.24	1.65	24.00
4.40	180.00	0.67	4.91	592.20
4.50	260.00	0.82	4.44	950.07
4.60	260.00	0.82	4.37	929.43
4.70	260.00	0.74	4.22	812.81
4.80	260.00	0.64	4.16	692.90
4.90	260.00	0.56	4.05	591.49
5.00	260.00	0.50	3.95	510.56
5.10	260.00	0.43	3.92	438.97
5.20	200.00	0.47	3.90	370.08
5.30	200.00	0.41	3.86	312.88
5.40	180.00	0.37	3.92	258.57
5.50	180.00	0.31	3.84	212.58
5.60	180.00	0.26	3.67	171.12
5.70	140.00	0.26	3.74	136.95
5.80	120.00	0.24	3.77	110.82
5.90	60.00	0.39	3.90	90.25
6.00	40.00	0.50	3.76	75.17
6.10	40.00	0.45	3.46	62.64
6.20	40.00	0.40	3.18	51.35
6.30	40.00	0.36	2.98	43.13
6.40	20.00	0.62	3.02	37.20
6.50	20.00	0.54	2.88	31.34
6.60	20.00	0.51	2.64	26.71
6.70	20.00	0.48	2.47	23.76
6.80	20.00	0.44	2.35	20.85
6.90	20.00	0.38	2.31	17.50
7.00	20.00	0.35	2.25	15.58
7.10	20.00	0.31	2.20	13.52
7.20	20.00	0.27	2.16	11.64
7.30	20.00	0.24	2.13	10.39
7.40	20.00	0.22	2.09	9.17
7.50	20.00	0.20	2.02	8.06
7.60	20.00	0.20	1.81	7.24
7.70	20.00	0.20	1.57	6.28
7.80	20.00	0.20	1.43	5.70
7.90	20.00	0.18	1.42	5.25
8.00	20.00	0.15	1.62	4.74
8.10	20.00	0.12	1.68	4.11
8.20	20.00	0.10	1.73	3.63
8.30	20.00	0.09	1.81	3.36
8.40	20.00	0.08	1.97	3.03
8.50	20.00	0.06	2.15	2.67
8.60	20.00	0.05	2.30	2.31
8.70	20.00	0.05	2.13	2.13

8.80	20.00	0.05	1.84	1.84
8.90	20.00	0.05	1.58	1.58
9.00	20.00	0.05	1.38	1.38
9.10	20.00	0.05	1.21	1.21
9.20	20.00	0.05	1.10	1.10
9.30	20.00	0.05	1.03	1.03
9.40	20.00	0.05	1.01	1.01
9.50	20.00	0.05	0.78	0.78
9.60	20.00	0.05	0.52	0.52
9.70	20.00	0.05	0.59	0.59
9.80	20.00	0.05	0.52	0.52
9.90	20.00	0.05	0.52	0.52
10.00	20.00	0.05	0.43	0.43
10.10	20.00	0.05	0.38	0.38
10.20	20.00	0.05	0.32	0.32
10.30	20.00	0.05	0.31	0.31
10.40	20.00	0.05	0.20	0.20
10.50	20.00	0.05	0.14	0.14
10.60	20.00	0.05	0.09	0.09

THE MAXIMUM DISCHARGE FROM CROSS SECTION 4 IS: 907.73 CFS
AT TIME: 4.53 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 64.73 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 4

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.70	20.00	0.04	0.11	0.08
3.80	20.00	0.17	0.06	0.21
3.90	220.00	0.11	0.07	1.84
4.00	180.00	0.33	0.06	3.68
4.10	120.00	0.84	0.14	14.32
4.20	120.00	0.96	0.16	18.34
4.30	120.00	1.04	0.23	28.98
4.40	180.00	1.25	2.44	550.68
4.50	200.00	1.38	3.25	896.32
4.60	200.00	1.38	3.21	884.90
4.70	200.00	1.32	2.99	789.57
4.80	200.00	1.25	2.74	685.98
4.90	180.00	1.33	2.47	593.00
5.00	180.00	1.27	2.26	518.86
5.10	180.00	1.21	2.07	452.16
5.20	180.00	1.17	1.85	388.81
5.30	180.00	1.13	1.63	331.59
5.40	180.00	1.09	1.41	276.89
5.50	180.00	1.04	1.25	233.74
5.60	180.00	0.99	1.07	190.77
5.70	160.00	1.06	0.92	155.10
5.80	160.00	1.00	0.79	126.67
5.90	140.00	1.09	0.68	103.66
6.00	100.00	1.44	0.59	85.92
6.10	100.00	1.40	0.52	72.25
6.20	100.00	1.34	0.45	59.95
6.30	100.00	1.27	0.39	49.54
6.40	80.00	1.52	0.35	42.04
6.50	80.00	1.47	0.29	34.42
6.60	80.00	1.42	0.26	29.61
6.70	80.00	1.39	0.24	26.11
6.80	80.00	1.35	0.21	22.92
6.90	80.00	1.32	0.19	19.53
7.00	80.00	1.28	0.17	17.31
7.10	80.00	1.23	0.15	14.93
7.20	80.00	1.20	0.13	12.83
7.30	80.00	1.16	0.12	11.12
7.40	80.00	1.13	0.11	9.78
7.50	80.00	1.09	0.10	8.83
7.60	80.00	1.07	0.09	7.77
7.70	80.00	1.06	0.08	6.50
7.80	80.00	1.06	0.09	7.74
7.90	80.00	1.05	0.07	5.71
8.00	80.00	1.05	0.06	5.00
8.10	60.00	1.37	0.06	4.83
8.20	60.00	1.34	0.06	4.80
8.30	60.00	1.33	0.08	6.15
8.40	60.00	1.32	0.05	3.93
8.50	60.00	1.30	0.04	3.01

8.60	60.00	1.29	0.06	4.45
8.70	60.00	1.27	0.04	2.70
8.80	60.00	1.26	0.03	1.97
8.90	60.00	1.23	0.05	3.34
9.00	60.00	1.21	0.02	1.18
9.10	60.00	1.20	0.02	1.75
9.20	60.00	1.18	0.01	0.47
9.30	60.00	1.17	0.01	0.57
9.40	60.00	1.15	0.00	0.21
9.50	60.00	1.13	0.01	0.55
9.60	60.00	1.12	0.02	1.19
9.70	60.00	1.10	0.01	0.76
9.80	60.00	1.10	0.01	0.62
9.90	60.00	1.09	0.00	0.18
10.00	60.00	1.09	0.01	0.35
10.10	60.00	1.08	0.00	0.18
10.20	60.00	1.08	0.01	0.53
10.30	60.00	1.07	0.00	0.23
10.40	60.00	1.07	0.00	0.13
10.50	60.00	1.06	0.01	0.43
10.60	40.00	1.30	0.00	0.02
10.70	60.00	1.03	0.00	0.14
10.80	40.00	1.28	0.00	0.05
10.90	60.00	1.01	0.00	0.13
11.00	40.00	1.26	0.00	0.00
11.10	60.00	0.98	0.00	0.10
11.20	60.00	0.97	0.00	0.08
11.30	60.00	0.97	0.00	0.04
11.40	20.00	1.53	0.00	0.05
11.50	20.00	1.51	0.00	0.07
11.60	20.00	1.49	0.00	0.02
11.70	40.00	0.95	0.00	0.05
14.10	20.00	1.35	0.00	0.02
14.40	20.00	0.78	0.00	0.00
16.00	20.00	1.28	0.00	0.01
17.20	20.00	1.23	0.00	0.01
17.30	20.00	1.22	0.00	0.01
19.00	20.00	1.15	0.00	0.00
19.80	20.00	0.09	0.00	0.00
19.90	20.00	1.11	0.00	0.01
20.60	20.00	1.09	0.00	0.01
21.20	20.00	1.06	0.00	0.00
21.90	20.00	1.03	0.00	0.00

THE MAXIMUM DISCHARGE FROM CROSS SECTION 5 IS: 456.50 CFS
AT TIME: 4.54 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 23.31 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 5

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.60	60.00	0.05	0.03	0.10
3.70	40.00	0.05	0.04	0.07
3.80	200.00	0.06	0.10	1.07
3.90	380.00	0.06	0.12	2.84
4.00	400.00	0.06	0.10	2.61
4.10	60.00	0.07	0.09	0.35
4.20	140.00	0.05	0.05	0.37
4.30	120.00	0.05	0.05	0.31
4.40	420.00	0.24	1.02	100.63
4.50	420.00	0.56	1.87	441.26
4.60	420.00	0.56	1.88	444.32
4.70	420.00	0.52	1.73	376.86
4.80	440.00	0.45	1.58	312.21
4.90	420.00	0.42	1.44	253.30
5.00	420.00	0.38	1.31	207.59
5.10	420.00	0.34	1.19	170.17
5.20	420.00	0.31	1.03	135.21
5.30	400.00	0.30	0.89	105.75
5.40	400.00	0.26	0.79	81.27
5.50	340.00	0.25	0.71	60.74
5.60	320.00	0.21	0.63	42.93
5.70	300.00	0.17	0.54	28.10
5.80	280.00	0.16	0.42	18.11
5.90	240.00	0.14	0.35	11.72
6.00	260.00	0.10	0.25	6.85
6.10	160.00	0.10	0.23	3.64
6.20	80.00	0.09	0.19	1.38
6.30	60.00	0.10	0.14	0.85
6.40	20.00	0.13	0.14	0.37
6.50	20.00	0.08	0.10	0.17
6.60	20.00	0.05	0.07	0.07
8.80	20.00	0.05	0.03	0.03

THE MAXIMUM DISCHARGE FROM CROSS SECTION 6 IS: 219.93 CFS
AT TIME: 4.53 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 9.83 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 6

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.90	320.00	0.11	0.04	1.61
4.00	360.00	0.15	0.15	8.49
4.10	100.00	0.39	0.17	6.78
4.20	100.00	0.37	0.16	6.02
4.30	60.00	0.55	0.12	3.93
4.40	120.00	0.77	1.22	113.34
4.50	160.00	0.77	1.76	216.82
4.60	160.00	0.81	1.67	215.99
4.70	160.00	0.74	1.48	176.09
4.80	100.00	1.03	1.29	132.81
4.90	100.00	0.90	1.09	98.47
5.00	100.00	0.80	0.93	73.99
5.10	100.00	0.70	0.77	53.81
5.20	100.00	0.60	0.63	37.93
5.30	100.00	0.51	0.47	24.23
5.40	100.00	0.45	0.31	13.82
5.50	100.00	0.39	0.21	8.32
5.60	100.00	0.35	0.15	5.17
5.70	100.00	0.33	0.09	2.97
5.80	60.00	0.49	0.06	1.72
5.90	60.00	0.45	0.03	0.92
6.00	60.00	0.44	0.02	0.53
6.10	40.00	0.59	0.01	0.28
6.20	40.00	0.55	0.01	0.14
6.30	40.00	0.51	0.00	0.08
6.40	40.00	0.49	0.00	0.06
6.50	40.00	0.48	0.00	0.01

THE MAXIMUM DISCHARGE FROM CROSS SECTION 7 IS: 311.45 CFS
AT TIME: 4.54 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 12.74 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 7

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.90	160.00	0.08	0.11	1.53
4.00	160.00	0.15	0.26	6.34
4.10	120.00	0.17	0.25	4.90
4.20	100.00	0.19	0.29	5.45
4.30	80.00	0.22	0.33	5.71
4.40	80.00	0.52	0.14	5.93
4.50	160.00	1.05	1.77	298.36
4.60	160.00	1.06	1.78	300.56
4.70	160.00	0.98	1.59	250.77
4.80	160.00	0.88	1.35	189.86
4.90	160.00	0.77	1.10	135.91
5.00	160.00	0.70	0.87	97.70
5.10	140.00	0.71	0.69	67.85
5.20	140.00	0.62	0.51	44.22
5.30	120.00	0.63	0.38	28.86
5.40	120.00	0.54	0.25	16.35
5.50	80.00	0.70	0.17	9.77
5.60	80.00	0.62	0.13	6.34
5.70	80.00	0.54	0.09	4.07
5.80	80.00	0.49	0.08	3.02
5.90	60.00	0.50	0.06	1.82
6.00	60.00	0.39	0.05	1.22
6.10	60.00	0.30	0.04	0.82
6.20	60.00	0.17	0.09	0.96
6.30	40.00	0.20	0.17	1.35
6.40	40.00	0.20	0.13	1.03
6.50	40.00	0.20	0.11	0.89
6.60	40.00	0.16	0.08	0.52
6.70	20.00	0.20	0.09	0.34
6.80	20.00	0.16	0.07	0.21
6.90	20.00	0.12	0.07	0.16
7.00	20.00	0.10	0.07	0.12
7.10	20.00	0.08	0.07	0.11
7.20	20.00	0.07	0.07	0.10
7.30	20.00	0.05	0.03	0.03
7.40	20.00	0.05	0.04	0.04

THE MAXIMUM DISCHARGE FROM CROSS SECTION 8 IS: 390.05 CFS
AT TIME: 4.58 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 30.16 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 8

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.60	80.00	0.04	0.03	0.10
3.70	100.00	0.05	0.04	0.18
3.80	140.00	0.11	0.05	0.74
3.90	180.00	0.26	0.06	2.70
4.00	180.00	0.30	0.17	9.35
4.10	80.00	0.61	0.19	9.29
4.20	140.00	0.43	0.47	28.09
4.30	160.00	0.41	0.60	38.79
4.40	160.00	0.66	1.17	124.59
4.50	200.00	0.79	2.33	369.60
4.60	200.00	0.80	2.32	369.99
4.70	200.00	0.77	2.15	332.22
4.80	200.00	0.73	1.89	276.04
4.90	200.00	0.70	1.70	237.32
5.00	180.00	0.72	1.53	199.12
5.10	180.00	0.70	1.39	175.32
5.20	180.00	0.64	1.28	148.66
5.30	180.00	0.62	1.24	139.02
5.40	180.00	0.60	1.18	127.00
5.50	180.00	0.57	1.11	114.31
5.60	180.00	0.55	1.07	105.77
5.70	180.00	0.53	1.01	97.12
5.80	180.00	0.52	0.98	90.54
5.90	180.00	0.51	0.90	82.41
6.00	160.00	0.54	0.85	72.86
6.10	160.00	0.51	0.83	67.08
6.20	160.00	0.49	0.78	60.99
6.30	160.00	0.43	0.56	38.66
6.40	160.00	0.41	0.53	34.53
6.50	160.00	0.39	0.48	30.24
6.60	160.00	0.38	0.44	26.94
6.70	160.00	0.37	0.41	24.13
6.80	120.00	0.47	0.39	21.95
6.90	60.00	0.88	0.38	20.26
7.00	100.00	0.54	0.33	17.85
7.10	60.00	0.86	0.31	15.70
7.20	60.00	0.84	0.28	14.40
7.30	20.00	2.37	0.26	12.59
7.40	20.00	2.34	0.24	11.30
7.50	20.00	2.30	0.21	9.87
7.60	20.00	2.25	0.19	8.67
7.70	20.00	2.20	0.17	7.58
7.80	20.00	2.15	0.15	6.42
7.90	20.00	2.15	0.14	5.87
8.00	20.00	2.12	0.13	5.37
8.10	20.00	2.11	0.12	5.15
8.20	20.00	2.09	0.12	4.85
8.30	20.00	2.05	0.10	4.19
8.40	20.00	2.04	0.09	3.79

8.50	20.00	2.02	0.09	3.57
8.60	20.00	1.99	0.08	3.18
8.70	20.00	1.98	0.08	2.99
8.80	20.00	1.97	0.07	2.87
8.90	20.00	1.96	0.07	2.64
9.00	20.00	1.94	0.06	2.43
9.10	20.00	1.92	0.06	2.19
9.20	20.00	1.90	0.05	1.97
9.30	20.00	1.88	0.05	1.74
9.40	20.00	1.86	0.04	1.58
9.50	40.00	0.94	0.04	1.42
9.60	20.00	1.84	0.04	1.29
9.70	20.00	1.82	0.03	1.15
9.80	20.00	1.80	0.03	0.99
9.90	20.00	1.77	0.02	0.80
10.00	20.00	1.78	0.02	0.66
10.10	20.00	1.79	0.01	0.47
10.20	20.00	1.79	0.01	0.46
10.30	20.00	1.78	0.01	0.44
10.40	20.00	1.78	0.01	0.42
10.50	20.00	1.76	0.01	0.35
10.60	40.00	0.90	0.01	0.35
10.70	20.00	1.74	0.01	0.30
10.80	20.00	1.73	0.01	0.28
10.90	20.00	1.73	0.01	0.27
11.00	20.00	1.73	0.01	0.27
11.10	20.00	1.72	0.01	0.25
11.20	20.00	1.71	0.01	0.22
11.30	20.00	1.71	0.01	0.21
11.40	20.00	1.70	0.01	0.20
11.50	20.00	1.70	0.01	0.19
11.60	20.00	1.69	0.00	0.16
11.70	20.00	1.68	0.00	0.15
11.80	20.00	1.67	0.00	0.13
11.90	20.00	1.67	0.00	0.12
12.00	20.00	1.66	0.00	0.11
12.10	20.00	1.65	0.00	0.10
12.20	20.00	1.64	0.00	0.08
12.30	20.00	1.63	0.00	0.07
12.40	20.00	1.62	0.00	0.06
12.50	20.00	1.62	0.00	0.05
12.60	20.00	1.59	0.00	0.04

THE MAXIMUM DISCHARGE FROM CROSS SECTION 9 IS: 141.40 CFS
AT TIME: 4.55 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 9.41 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 9

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.70	40.00	0.05	0.00	0.01
3.80	20.00	0.05	0.08	0.08
3.90	160.00	0.05	0.10	0.88
4.00	160.00	0.06	0.11	1.03
4.10	20.00	0.13	0.08	0.22
4.20	60.00	0.16	0.32	3.11
4.30	40.00	0.28	0.74	8.18
4.40	40.00	0.39	1.93	30.15
4.50	40.00	0.85	3.90	133.40
4.60	40.00	0.89	3.92	138.82
4.70	40.00	0.81	3.89	126.06
4.80	40.00	0.77	3.53	109.14
4.90	40.00	0.69	3.22	89.03
5.00	40.00	0.66	3.05	80.63
5.10	40.00	0.62	2.77	68.35
5.20	40.00	0.58	2.68	61.67
5.30	40.00	0.54	2.35	51.17
5.40	40.00	0.50	2.11	41.89
5.50	40.00	0.46	1.96	36.04
5.60	40.00	0.43	1.80	30.85
5.70	40.00	0.37	1.58	23.53
5.80	40.00	0.35	1.24	17.38
5.90	40.00	0.31	1.01	12.63
6.00	40.00	0.28	0.71	7.77
6.10	40.00	0.23	0.40	3.75
6.20	20.00	0.36	0.34	2.40
6.30	40.00	0.32	1.08	13.71
6.40	40.00	0.29	0.94	10.82
6.50	40.00	0.27	0.71	7.84
6.60	40.00	0.27	0.61	6.71
6.70	40.00	0.26	0.48	5.06
6.80	40.00	0.23	0.39	3.60
6.90	40.00	0.21	0.34	2.94
7.00	20.00	0.35	0.33	2.26
7.10	20.00	0.30	0.29	1.77
7.20	20.00	0.27	0.26	1.42
7.30	20.00	0.24	0.24	1.13
7.40	20.00	0.22	0.24	1.06
7.50	20.00	0.22	0.23	1.01
7.60	20.00	0.20	0.19	0.76
7.70	20.00	0.20	0.12	0.50
7.80	20.00	0.18	0.10	0.36
7.90	20.00	0.14	0.08	0.21
8.00	20.00	0.11	0.07	0.15
8.10	20.00	0.09	0.06	0.12
8.20	20.00	0.08	0.06	0.10
8.30	20.00	0.06	0.05	0.07
8.40	40.00	0.05	0.01	0.01
10.10	40.00	0.05	0.02	0.04

11.20	20.00	0.05	0.00	0.00
11.40	20.00	0.05	0.07	0.07
12.60	20.00	0.05	0.01	0.01

THE MAXIMUM DISCHARGE FROM CROSS SECTION 10 IS: 130.97 CFS
AT TIME: 4.55 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 8.99 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 10

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.70	20.00	0.05	0.06	0.06
3.80	20.00	0.05	0.02	0.02
3.90	80.00	0.05	0.05	0.22
4.00	80.00	0.05	0.13	0.52
4.10	20.00	0.05	0.20	0.20
4.20	40.00	0.07	0.84	2.49
4.30	20.00	0.26	1.15	6.00
4.40	60.00	0.20	2.56	30.98
4.50	60.00	0.54	3.87	124.26
4.60	60.00	0.55	3.91	129.08
4.70	60.00	0.52	3.81	118.83
4.80	60.00	0.51	3.39	103.19
4.90	60.00	0.47	3.01	85.00
5.00	60.00	0.44	2.94	77.40
5.10	60.00	0.40	2.76	66.11
5.20	60.00	0.37	2.65	59.43
5.30	60.00	0.38	2.21	49.81
5.40	60.00	0.34	2.05	41.28
5.50	60.00	0.31	1.93	35.93
5.60	60.00	0.29	1.78	30.74
5.70	60.00	0.21	1.81	23.05
5.80	60.00	0.18	1.61	17.37
5.90	20.00	0.36	1.78	12.88
6.00	20.00	0.27	1.13	6.02
6.10	20.00	0.20	0.89	3.57
6.20	20.00	0.14	0.91	2.58
6.30	20.00	0.36	1.85	13.33
6.40	20.00	0.31	1.79	11.11
6.50	20.00	0.25	1.77	8.87
6.60	20.00	0.27	1.19	6.54
6.70	20.00	0.23	1.12	5.17
6.80	20.00	0.20	0.89	3.55
6.90	20.00	0.17	0.87	3.02
7.00	20.00	0.13	0.94	2.36
7.10	20.00	0.09	1.02	1.85
7.20	20.00	0.07	1.11	1.47
7.30	20.00	0.05	1.16	1.16
7.40	20.00	0.05	1.07	1.07
7.50	20.00	0.05	1.03	1.03
7.60	20.00	0.05	0.84	0.84
7.70	20.00	0.05	0.45	0.45
7.80	20.00	0.05	0.37	0.37
7.90	20.00	0.05	0.25	0.25
8.00	20.00	0.05	0.18	0.18
8.10	20.00	0.05	0.14	0.14
8.20	20.00	0.05	0.11	0.11
8.30	20.00	0.05	0.09	0.09
8.40	40.00	0.05	0.09	0.18
8.50	20.00	0.05	0.03	0.03

8.60	20.00	0.05	0.02	0.02
8.70	20.00	0.05	0.01	0.01
9.00	20.00	0.05	0.03	0.03
11.20	20.00	0.05	0.07	0.07
12.60	20.00	0.05	0.12	0.12

THE MAXIMUM DISCHARGE FROM CROSS SECTION 11 IS: 126.79 CFS
AT TIME: 4.55 HOURS
THE TOTAL VOLUME OF DISCHARGE IS: 8.86 AF

HYDROGRAPH AND AVERAGE FLOODPLAIN HYDRAULICS FOR CROSS SECTION NO: 11

TIME (HRS)	TOPWID (FT)	DEPTH (FT)	VELOCITY (FPS)	DISCHARGE (CFS)
3.70	20.00	0.05	0.02	0.02
3.80	20.00	0.05	0.12	0.12
3.90	60.00	0.05	0.10	0.32
4.00	60.00	0.07	0.13	0.51
4.10	20.00	0.06	0.17	0.22
4.20	20.00	0.20	0.52	2.10
4.30	40.00	0.21	0.82	6.88
4.40	40.00	0.35	2.01	27.87
4.50	40.00	0.76	3.97	120.37
4.60	40.00	0.77	4.05	125.03
4.70	40.00	0.74	3.90	115.52
4.80	40.00	0.64	3.95	101.43
4.90	40.00	0.59	3.53	83.79
5.00	40.00	0.58	3.31	76.98
5.10	40.00	0.54	3.07	65.85
5.20	40.00	0.51	2.88	59.26
5.30	40.00	0.51	2.41	49.72
5.40	40.00	0.47	2.16	41.09
5.50	40.00	0.42	2.14	36.11
5.60	40.00	0.37	2.07	30.92
5.70	40.00	0.33	1.89	25.22
5.80	40.00	0.34	1.29	17.43
5.90	40.00	0.31	1.12	13.68
6.00	40.00	0.21	0.93	7.96
6.10	40.00	0.15	0.69	4.03
6.20	20.00	0.20	0.66	2.63
6.30	40.00	0.30	1.10	13.27
6.40	40.00	0.27	1.03	11.35
6.50	40.00	0.24	0.93	8.83
6.60	40.00	0.20	0.76	6.13
6.70	40.00	0.17	0.75	5.22
6.80	40.00	0.14	0.68	3.86
6.90	40.00	0.13	0.58	3.07
7.00	20.00	0.20	0.63	2.53
7.10	20.00	0.20	0.57	2.26
7.20	20.00	0.20	0.37	1.47
7.30	20.00	0.17	0.34	1.18
7.40	20.00	0.16	0.33	1.07
7.50	20.00	0.16	0.32	1.02
7.60	20.00	0.14	0.30	0.86
7.70	20.00	0.11	0.24	0.52
7.80	20.00	0.09	0.22	0.40
7.90	20.00	0.07	0.19	0.27
8.00	20.00	0.06	0.17	0.19
8.10	20.00	0.05	0.15	0.15
8.20	20.00	0.05	0.13	0.13
8.30	20.00	0.05	0.11	0.11
8.40	20.00	0.05	0.09	0.09
9.00	40.00	0.05	0.06	0.11

FPXSEC.DAT (INPUT FILE FOR CROSS SECTION LOCATIONS WITHIN EFFECTIVE FLO-2D MODEL)

```
P 1
X 4 22 227 264 302 342 386 431 478 529 583 641 699 760 823 889 957 1028 1101 1177 1255 1335 1417 1501
X 8 12 151 183 216 253 291 331 375 420 467 518 572 630
X 7 9 790 729 670 614 558 506 457 412 369
X 4 18 8244 8245 8246 8247 8248 8249 8250 8251 8252 8253 8254 8255 8256 8257 8258 8259 8260 8261
X 8 13 1925 2027 2133 2241 2351 2463 2576 2690 2807 2925 3044 3165 3287
X 4 20 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924
1925
X 4 10 507 561 619 677 738 801 867 935 1006 1079
X 7 5 504 455 410 367 325
X 7 3 409 366 324
X 8 14 1079 1155 1233 1313 1395 1479 1566 1655 1747 1842 1941 2043 2149 2257
X 8 11 944 1015 1088 1164 1242 1322 1404 1488 1575 1664 1756
```

APPENDIX D CONCEPTUAL DESIGN PLANS

Culvert Calculator Report
UCT NORTH BRANCH AT CAVE CREEK ROAD <1252 cfs>

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	2,036.57	ft	Headwater Depth/Height	1.40	
Computed Headwater Elev:	2,034.59	ft	Discharge	1,252.00	cfs
Inlet Control HW Elev.	2,034.59	ft	Tailwater Elevation	2,030.00	ft
Outlet Control HW Elev.	2,034.46	ft	Control Type	Inlet Control	

Grades					
Upstream Invert	2,029.00	ft	Downstream Invert	2,026.50	ft
Length	150.00	ft	Constructed Slope	0.016667	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	1.98	ft
Slope Type	Steep		Normal Depth	1.77	ft
Flow Regime	N/A		Critical Depth	3.12	ft
Velocity Downstream	15.82	ft/s	Critical Slope	0.003218	ft/ft

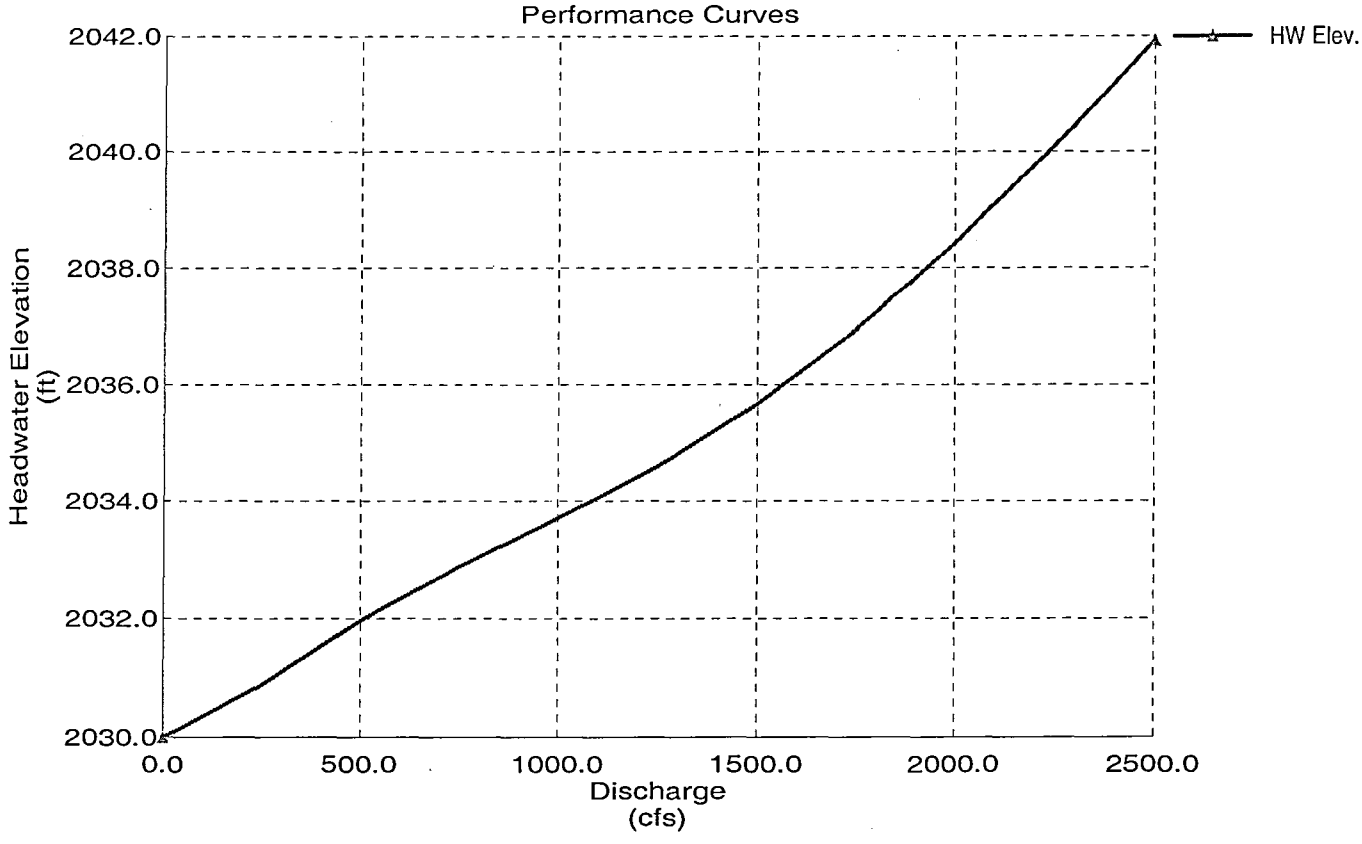
Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 4 ft		Rise	4.00	ft
Number Sections	4				

Outlet Control Properties					
Outlet Control HW Elev.	2,034.46	ft	Upstream Velocity Head	1.56	ft
Ke	0.50		Entrance Loss	0.78	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,034.59	ft	Flow Control	N/A	
Inlet Type	90 and 15° wingwall flares		Area Full	160.0	ft²
K	0.06100		HDS 5 Chart	8	
M	0.75000		HDS 5 Scale	2	
C	0.04000		Equation Form	1	
Y	0.80000				

Performance Curves Report
UCT NORTH BRANCH AT CAVE CREEK ROAD <1252 cfs>

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	2,500.00	250.00 cfs



Culvert Calculator Report
UCT SOUTH BRANCH AT CAVE CREEK ROAD <911 cfs>

Solve For: Headwater Elevation

Culvert Summary					
Allowable HW Elevation	2,044.00	ft	Headwater Depth/Height	1.47	
Computed Headwater Elev	2,042.92	ft	Discharge	911.00	cfs
Inlet Control HW Elev.	2,042.62	ft	Tailwater Elevation	2,040.00	ft
Outlet Control HW Elev.	2,042.92	ft	Control Type	Entrance Control	

Grades					
Upstream Invert	2,038.50	ft	Downstream Invert	2,037.00	ft
Length	150.00	ft	Constructed Slope	0.010000	ft/ft

Hydraulic Profile					
Profile	CompositeS1S2		Depth, Downstream	3.00	ft
Slope Type	Steep		Normal Depth	1.75	ft
Flow Regime	N/A		Critical Depth	2.53	ft
Velocity Downstream	7.59	ft/s	Critical Slope	0.003473	ft/ft

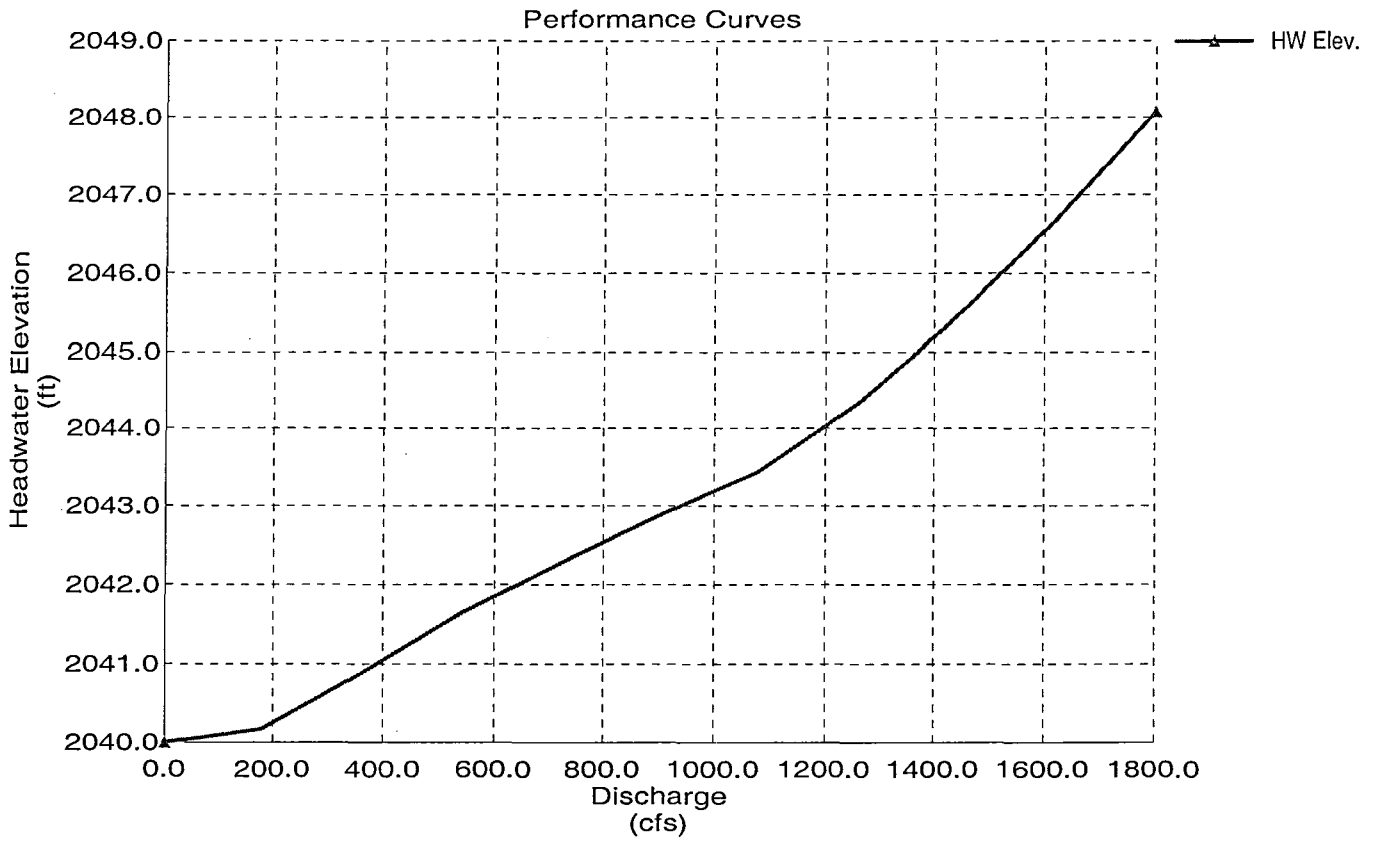
Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	8.00	ft
Section Size	8 x 3 ft		Rise	3.00	ft
Number Sections	5				

Outlet Control Properties					
Outlet Control HW Elev.	2,042.92	ft	Upstream Velocity Head	1.26	ft
Ke	0.50		Entrance Loss	0.63	ft

Inlet Control Properties					
Inlet Control HW Elev.	2,042.62	ft	Flow Control	Submerged	
Inlet Type	45° Wingwalls; 10 - 45° skewed headwall		Area Full	120.0	ft²
K	0.49800		HDS 5 Chart	11	
M	0.66700		HDS 5 Scale	4	
C	0.03270		Equation Form	2	
Y	0.75000				

Performance Curves Report
UCT SOUTH BRANCH AT CAVE CREEK ROAD <911 cfs>

Range Data:			
	Minimum	Maximum	Increment
Discharge	0.00	1,800.00	180.00 cfs



Cross Section for School House Rd at Galloway Wash proposed

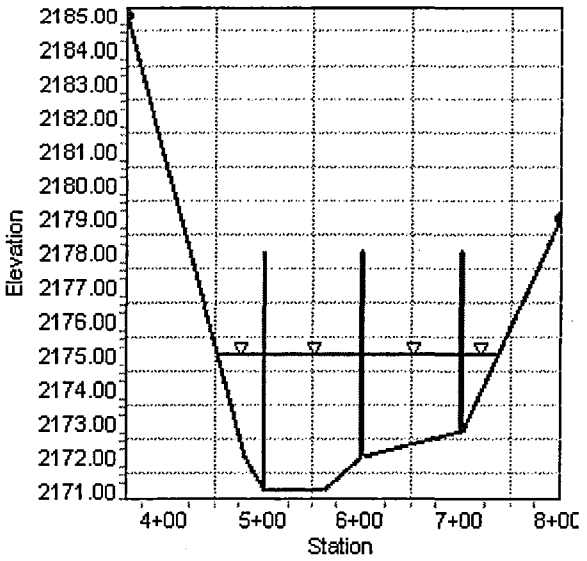
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Normal Depth	3.99	ft
Discharge	10908.00	ft^3/s

Cross Section Image



Worksheet for School House Rd at Galloway Wash proposed

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.03000	ft/ft
Discharge	10908.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
3+60	2185.00
4+80	2172.00
5+00	2171.00
5+00	2178.00
5+01	2178.00
5+01	2171.00
5+60	2171.00
6+00	2172.00
6+00	2178.00
6+01	2178.00
6+01	2172.00
7+00	2172.80
7+00	2178.00
7+01	2178.00
7+01	2172.80
8+00	2179.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(3+60, 2185.00)	(8+00, 2179.00)	0.035

Results

Normal Depth	3.99	ft
Elevation Range	2171.00 to 2185.00 ft	

Worksheet for School House Rd at Galloway Wash proposed

Results

Flow Area		781.98	ft²
Wetted Perimeter		299.31	ft
Top Width		280.68	ft
Normal Depth		3.99	ft
Critical Depth		4.87	ft
Critical Slope		0.01310	ft/ft
Velocity		13.95	ft/s
Velocity Head		3.02	ft
Specific Energy		7.02	ft
Froude Number		1.47	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.99	ft
Critical Depth	4.87	ft
Channel Slope	0.03000	ft/ft
Critical Slope	0.01310	ft/ft

Cross Section for School House Rd at Rowe Wash proposed

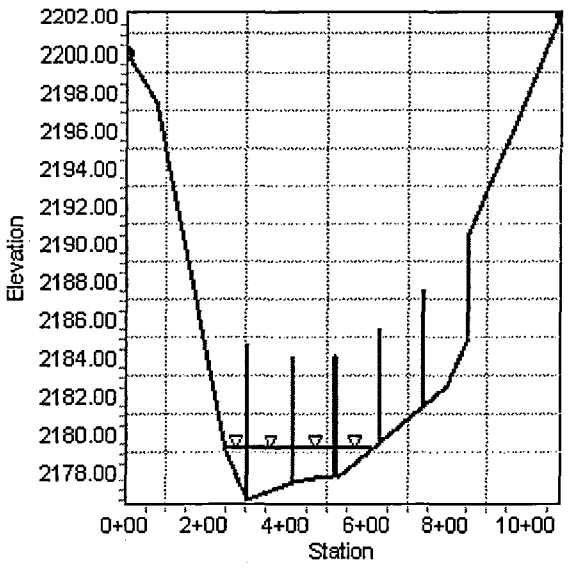
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02500	ft/ft
Normal Depth	2.76	ft
Discharge	5094.00	ft³/s

Cross Section Image



Worksheet for School House Rd at Rowe Wash proposed

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02500	ft/ft
Discharge	5094.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2200.00
0+75	2197.50
2+50	2179.00
3+00	2176.50
3+00	2184.60
3+01	2184.60
3+01	2176.50
4+15	2177.50
4+15	2184.00
4+16	2184.00
4+16	2177.50
4+70	2177.70
5+20	2177.70
5+20	2184.00
5+21	2184.00
5+21	2177.70
6+30	2179.60
6+30	2185.50
6+31	2185.50
6+31	2179.60
7+40	2181.50
7+40	2187.50
7+41	2187.50
7+41	2181.50
8+00	2182.50
8+50	2185.00
8+50	2190.50

Worksheet for School House Rd at Rowe Wash proposed

Input Data

Station (ft)	Elevation (ft)
10+80	2202.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2200.00)	(10+80, 2202.00)	0.035

Results

Normal Depth		2.76	ft
Elevation Range	2176.50 to 2202.00 ft		
Flow Area		570.69	ft²
Wetted Perimeter		372.16	ft
Top Width		359.91	ft
Normal Depth		2.76	ft
Critical Depth		3.04	ft
Critical Slope		0.01546	ft/ft
Velocity		8.93	ft/s
Velocity Head		1.24	ft
Specific Energy		4.00	ft
Froude Number		1.25	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.76	ft

Worksheet for School House Rd at Rowe Wash proposed

GVF Output Data

Critical Depth	3.04	ft
Channel Slope	0.02500	ft/ft
Critical Slope	0.01546	ft/ft

Cross Section for School House Rd at Ocotillo Wash proposed

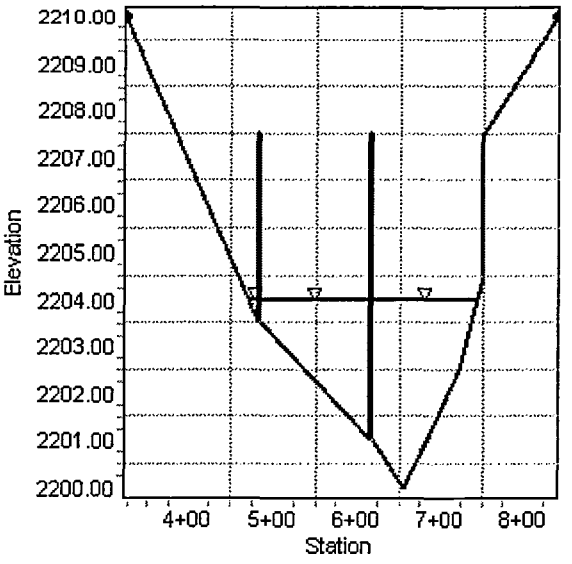
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01500	ft/ft
Normal Depth	3.97	ft
Discharge	4630.00	ft^3/s

Cross Section Image



Worksheet for School House Rd at Ocotillo Wash proposed

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01500	ft/ft
Discharge	4630.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
3+20	2210.00
4+82	2203.50
4+82	2207.50
4+83	2207.50
4+83	2203.50
6+15	2201.00
6+15	2207.50
6+16	2207.50
6+16	2201.00
6+55	2200.00
7+20	2202.50
7+50	2204.50
7+50	2207.50
8+40	2210.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(3+20, 2210.00)	(8+40, 2210.00)	0.035

Results

Normal Depth	3.97	ft
Elevation Range	2200.00 to 2210.00 ft	
Flow Area	557.91	ft²
Wetted Perimeter	276.75	ft

Worksheet for School House Rd at Ocotillo Wash proposed

Results

Top Width		269.73	ft
Normal Depth		3.97	ft
Critical Depth		4.00	ft
Critical Slope		0.01446	ft/ft
Velocity		8.30	ft/s
Velocity Head		1.07	ft
Specific Energy		5.04	ft
Froude Number		1.02	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.97	ft
Critical Depth	4.00	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.01446	ft/ft

Cross Section for Spur Cross Rd at WS Wash proposed

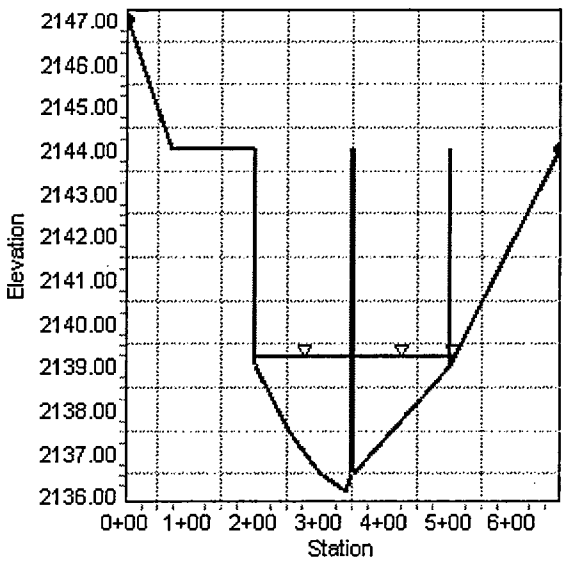
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02400	ft/ft
Normal Depth	3.10	ft
Discharge	4800.00	ft^3/s

Cross Section Image



Worksheet for Spur Cross Rd at WS Wash proposed

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.02400	ft/ft
Discharge	4800.00	ft^3/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2147.00
0+70	2144.00
2+00	2144.00
2+00	2139.00
2+50	2137.50
3+00	2136.50
3+40	2136.10
3+50	2136.50
3+50	2144.00
3+51	2144.00
3+51	2136.50
5+00	2139.00
5+00	2144.00
5+01	2144.00
5+01	2139.00
6+70	2144.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2147.00)	(6+70, 2144.00)	0.035

Results

Normal Depth	3.10	ft
Elevation Range	2136.10 to 2147.00 ft	

Worksheet for Spur Cross Rd at WS Wash proposed

Results

Flow Area		519.40	ft²
Wetted Perimeter		311.85	ft
Top Width		305.78	ft
Normal Depth		3.10	ft
Critical Depth		3.39	ft
Critical Slope		0.01479	ft/ft
Velocity		9.24	ft/s
Velocity Head		1.33	ft
Specific Energy		4.43	ft
Froude Number		1.25	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	3.10	ft
Critical Depth	3.39	ft
Channel Slope	0.02400	ft/ft
Critical Slope	0.01479	ft/ft

Worksheet for Spur Cross Rd at WS Wash Trib5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Discharge	631.00	ft³/s

Section Definitions

Station (ft)	Elevation (ft)
0+00	2134.30
2+20	2120.00
3+50	2117.50
4+35	2120.00
6+00	2132.50

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 2134.30)	(6+00, 2132.50)	0.035

Results

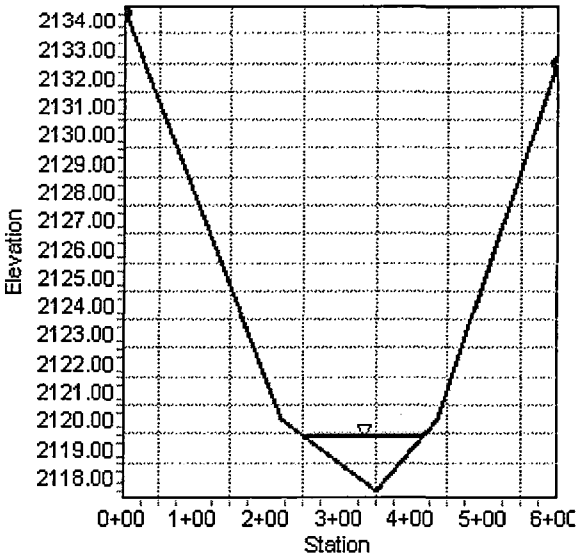
Normal Depth		1.89	ft
Elevation Range	2117.50 to 2134.30 ft		
Flow Area		154.18	ft²
Wetted Perimeter		162.89	ft
Top Width		162.84	ft
Normal Depth		1.89	ft
Critical Depth		1.68	ft
Critical Slope		0.01893	ft/ft
Velocity		4.09	ft/s
Velocity Head		0.26	ft
Specific Energy		2.15	ft
Froude Number		0.74	
Flow Type	Subcritical		

Cross Section for Spur Cross Rd at WS Wash Trib5

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.01000	ft/ft
Normal Depth	1.89	ft
Discharge	631.00	ft³/s

Cross Section Image