Technical Data Notebook

UPPER AGUA FRIA WATERSHED ZONE A FLOODPLAIN DELINEATION STUDY WATERSHED NO. 1 (EAST LAKE PLEASANT)

CONTRACT FCD 2000C020

Prepared for:

The Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
(602) 506-1501

Prepared By:

RBF Consulting, Inc.
16605 North 28th Avenue, Suite 100
Phoenix, Arizona 85053-7550
(602) 467-2200
Engineer:
Roy B. McDaniel, P.E.

May 15, 2002

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Section 1
Introduction

Section 1: Introduction

1.1 Purpose of Study

The purpose of this study is to delineate Zone A Floodplains for a portion of Watershed "UU" (Upper Agua Fria Watershed) on all washes that have a drainage area greater than ½ square mile. At the outset of the project the Flood Control District of Maricopa County had a goal to delineate all of the floodplains in Maricopa County within a 5 year period. One of the purposes of this goal is to delineate floodplains before development occurs in order to better control floodplain management and minimize losses due to flooding. The Flood Control District had decided upon delineating Zone A floodplains in the rural areas in order to speed up the delineation process.

1.2 Authority for the Study

The Flood Control District of Maricopa County contracted RBF Consulting to perform the study based on existing topographic mapping. The main contacts, addresses, and other information about both the Flood Control District and RBF Consulting are:

Flood Control District of Maricopa County

Address:	2801 West Durango Street
	Phoenix, Arizona 85009
Phone:	(602)506-2201
Project Manager:	Mr. Richard Harris, P.E.

RBF Consulting

Address:	16605 North 28th Avenue, Suite 100
	Phoenix, Arizona 85053
Phone:	(602)467-2200
Principal-in-Charge:	Scott M. Larson, P.E., R.L.S.
Project Manager:	Roy B. McDaniel, P.E.

1.3 Site Location and Description

The Watershed "UU", the Upper Agua Fria Watershed, is located in the north part of Maricopa County, north of the New Waddell Dam, which creates Lake Pleasant (See Figure 1-1). The portion of the Upper Agua Fria Watershed that is being studied under this contract east of the Lake Pleasant and the Agua Fria River.

The floodplain delineations have been divided into four areas, each of which will be discussed in separate reports and submittals to FEMA. This report discusses the delineation of approximately 6.3 miles of washes in the southern portion of the watershed. These washes drain directly into Lake Pleasant, and are classified as desert-mountain washes with steep slopes. The drainage area for these washes has been classified as Watershed #1 (East Lake Pleasant Watershed), and the washes have been named according to the Township, Range, and Section where the headwaters are located, according to Maricopa County requirements. See Figure 1-2 for a location of Watershed No. 1 and the floodplains being delineated as part of this report.

1.4 Methodology

1.4.1 Hydrology

Peak flows were determined for the 100-year 6-hour storm using the Army Corps of Engineers HEC-1 software package, version 4.01E, dated May 1991, as outlined in Section 4 of this report. HEC-1 Model parameters were determined using WMS 6.1, the Watershed Modeling System, distributed by Environmental Modeling Systems- Incorporated (EMS-I). WMS describes itself as a "comprehensive environment for hydrologic analysis...developed by the Environmental Modeling Research Laboratory of Brigham Young University in cooperation with the U.S. Army Corps of Engineers Waterways Experiment Station." (BYU-EMRL, pg 1-1). The Flood Control District of Maricopa County provided RBF Consulting with a digital elevation model (DEM) that contains elevation data points on a 10 foot grid. The Flood Control District created this DEM from an existing grid of points spaced at 50 foot intervals, breaklines, and flow lines. WMS analyzed the DEM, SCS soils data, and land use data in order to create a HEC-1 model based on the Flood Control District's criteria. The peak flows produced by the HEC-1 model were then compared to regional regression equations from the USGS's National Flood Frequency Program (NFF). A more detailed explanation of the hydrologic methodology and the results are provided in Section 4.

1.4.2 Hydraulics and Floodplain Delineation

Both normal depth and critical depth of the peak flow rate were calculated for each wash. Normal depth was used to delineate the Zone A floodplains if it was subcritical flow. Critical depth was used to map the floodplain when normal depth indicated supercritical flow. Manning's equation was used to determine normal depth. A Triangulated Irregular Network (TIN) was created from the DEM discussed in Section 1.4.1. WMS was used to determine the cross section geometry at different locations in each wash, and to determine the normal depth for the 100-year storm using Manning's equation. Once the normal depth was determined, WMS was used to automatically delineate the Zone A floodplain using the TIN.

1.5 Summary of Results

The study resulted in the delineation of approximately 3.2 miles of Zone A floodplain through approximate methods. The steep nature of the watershed resulted in narrow floodplains with high velocities. The floodplains have been plotted on the Hydraulic Study Maps, located at the end of this report.

FIGURE 1-1 - LOCATION MAP

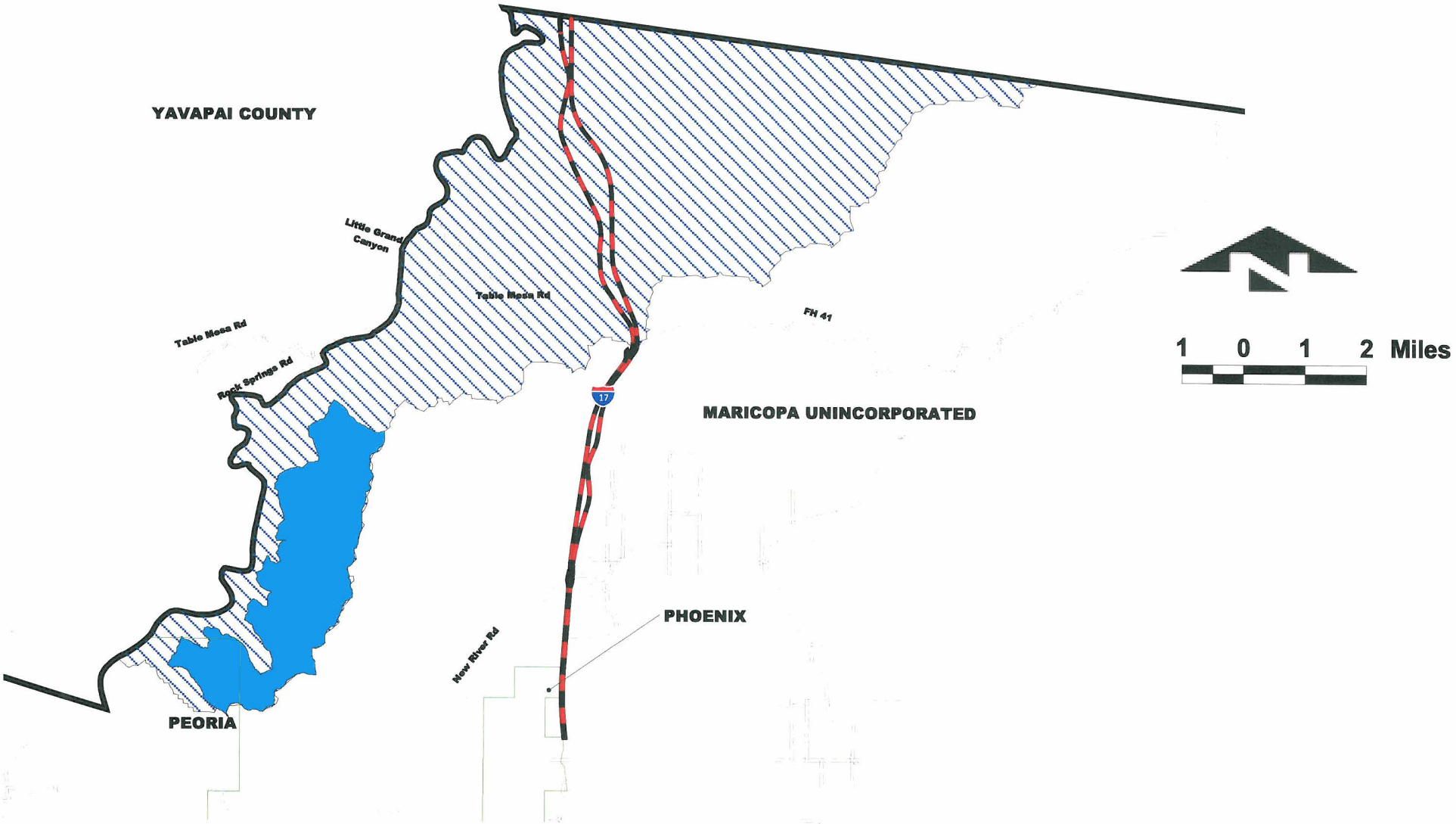

FIGURE 1.2– WATERSHED #1 LOCATION

Section 2: FEMA Forms and Local Government Abstracts

2.1 Study Documentation Abstract for FEMA Submittals

Study Documentation Abstract for FEMA Submittals		Initial Study	X	Restudy		CLOMR		LOMR	
2.1.1	Date Study Accepted								
2.1.2	Study Contractor Contacts Address Phone Internal Reference No.	RBF Consulting Roy B. McDaniel, P.E., Scott M. Larson, P.E., R.L.S. 16605 North 28th Avenue, Suite 100 Phoenix, Arizona 85053 (602)467-2200 45-100648							
2.1.3	FEMA Technical Review Contractor Contact Address Phone Internal Reference No.	Michael Baker, Jr., Inc. Pernille Buch-Pederson 3600 Eisenhower Ave, Suite 600 Alexandria, VA 22304 703-317-6224							
2.1.4	FEMA Regional Reviewer Phone	Michael Baker, Jr., Inc. 703-960-8800							
2.1.5	State Technical Reviewer Phone	Arizona Department of Water Resources 602-417-2445							
2.1.6	Local Technical Reviewer Phone	Flood Control District of Maricopa County (FCDMC) (602)506-1501							
2.1.7	Reach Description	Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, and T7NR1ES26-3 are desert-mountain washes that all drain into Lake Pleasant.							
2.1.8	USGS Quad Sheet Original photo date Latest photo revision date	Governors Peak, Arizona 1964 1978		New River, Arizona 1964 1981					
2.1.9	Unique Conditions and Problems	There was limited vehicular access to this watershed because of its proximity to Lake Pleasant. A boat had to be used to conduct the site visit.							
2.1.10	Coordination of Q's Discharges (Agency, Date, Comments)								

2.2 FEMA Forms

Section 2
FEMA Forms

FEDERAL EMERGENCY MANAGEMENT AGENCY **REVISION REQUESTER AND COMMUNITY OFFICIAL**	O.M.B No. 3067-0148 Expires April 30, 2001

1. REQUESTED RESPONSE FROM FEMA

This request is for a:

☐ CLOMR A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision, or proposed hydrology changes (See 44 CFR Ch. 1, Parts 60,65 & 72).

☒ LOMR A letter from FEMA officially revising the current NFIP map to show the changes to floodplains, floodway or flood elevations. LOMRs typically decrease flood hazards. (See 44 CFR Ch. 1 Parts 60 & 65.)

☐ Other Describe: _____

2. OVERVIEW

1. The basis for this revision request is (are): (check all that apply)

☐ Physical Change ☐ Improved Methodology/Data ☐ Floodway Revision

☒ Other Describe: New Flood Insurance Study.

Note: A photograph is not required, but is very helpful during review.

2. Flooding Source: Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7N41ES26-2B, AND T7NR1ES26-3

3. Project Name/Identifier: Approximate Zone A Floodplain Delineation of Watershed "UU" (Upper Agua Fria) FCD 2000CO20

4. FEMA zone designations affected: A
(example: A, AH, AO, A1-A30, A99, AE, V, V1-V30, VE, B, C, D, X)

5. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
Ex: 480301	Katy, City	TX	480301	0005D	02/08/83
480287	Harris County	TX	48201C	0220G	09/28/90
040037	Maricopa County	AZ	04013C	0350F	07/19/01
040037	Maricopa County		04013C	0365F	07/19/01
040037	Maricopa County	AZ	04013C	0375F	07/19/01

6. The area of revision encompasses the following types of flooding and structures. Check all that apply.

Types of Flooding	Structures
☒ Riverine	☐ Channelization
☐ Coastal	☐ Levee/Floodwall
☐ Alluvial fan	☐ Bridge/Culvert
☐ Shallow Flooding (e.g. Zones AO and AH)	☐ Dam
☐ Lakes	☐ Fill
☐ Other (describe)	☐ Other (describe)

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

4. ENCROACHMENT INFORMATION

1. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?
☐ Yes ☒ No

If Yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

2. Does the development in the floodway cause the 1% annual chance (base) elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No ☒ N/A

3. Does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the base flood elevation to increase at any location by more than one foot (or other increase limit if community or state has adopted more stringent criteria - even if a floodway has not been delineated by FEMA)? ☐ Yes ☒ No

If the answer to either items is Yes, please attach documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

5. MAINTENANCE RESPONSIBILITY

The community is willing to assume responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the _____
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Operation and maintenance plans are attached. ☐ **Yes** ☐ **No** ☒ **N/A**

6. REVIEW FEE

The review fee for the appropriate request category has been included. ☐ Yes Fee amount: $_____

OR

This request is based on a federally sponsored flood-control project where 50 percent or more of the project's cost is federally sponsored, or the request is based on detailed hydrologic and hydraulic studies conducted by Federal, State, or local agencies to replace approximate studies conducted by FEMA and shown on the effective FIRM; thus the project is fee exempt. ☒ Yes

Please see Instructions for Fee Amounts

7. SIGNATURE

Note: **I understand that my signature indicates that all information submitted in support of this request is correct**

Richard P. Harris
Signature of Revision Requester

Richard Harris, P.E., Project Manager
Printed Name and Title of Revision Requester

Flood Control District of Maricopa County
Company Name

Telephone No.: (602)506-1501 Date: 05/29/02

Note: **Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community.**

Signature of Community Official

Michael S. Ellegood, P.E., Chief Engineer and General Manager
Printed Name and Title of Community Official

Flood Control District of Maricopa County
Community Name

Telephone No.: (602) 506-1501 Date: 05/31/02

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is in accordance with 44 CFR Ch. 1, Sect 65.2

Roy B. McDaniel
Signature

Roy B. McDaniel, P.E. Project Manager
Printed Name and Title of Revision Requester

Registr No. 36122 Expires (Date) 03/31/2004 State AZ

Type of License/Expertise: Civil

Check which forms have been included with this request

Form Name and (Number)	Required if .....
☒ **Hydrologic** (3)	new or revised discharges
☒ **Hydraulic** (4)	new or revised water-surface elevations
☒ **Mapping** (5)	floodplain/floodway changes
☐ **Channelization** (6)	channel is modified
☐ **Bridge/Culvert** (7)	addition/revision of bridge/culvert
☐ **Levee/Floodwall** (8)	addition/revision of levee/floodwall
☐ **Coastal** (9)	new or revised coastal elevations
☐ **Coastal Structures** (10)	addition/revision of coastal structure
☐ **Dam** (11)	addition/revision of dam
☐ **Alluvial Fan** (12)	structures proposed on alluvial fan

4. ENCROACHMENT INFORMATION

1. Does the State have jurisdiction over the floodway or its adoption by communities participating in the NFIP?
☐ Yes ☐ No

If Yes, attach a copy of a letter notifying the appropriate State agency of the floodway revision and documentation of the approval of the revised floodway by the appropriate State agency.

2. Does the development in the floodway cause the 1% annual chance (base) elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No ☐ N/A

3. Does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the base flood elevation to increase at any location by more than one foot (or other increase limit if community or state has adopted more stringent criteria - even if a floodway has not been delineated by FEMA)? ☐ Yes ☐ No

If the answer to either items is Yes, please attach documentation that all requirements of Section 65.12 of the NFIP regulations have been met, regarding evaluation of alternatives, notice to individual legal property owners, concurrence of CEO, and certification that no insurable structures are impacted.

5. MAINTENANCE RESPONSIBILITY

The community is willing to assume responsibility for ☐ performing ☐ overseeing compliance with the maintenance and operation plans of the _____
(Name)
flood control structure. If not performed promptly by an owner other than the community, the community will provide the necessary services without cost to the Federal government.

Operation and maintenance plans are attached. ☐ **Yes** ☐ **No** ☒ **N/A**

6. REVIEW FEE

The review fee for the appropriate request category has been included. ☐ Yes Fee amount: $_____

OR

This request is based on a federally sponsored flood-control project where 50 percent or more of the project's cost is federally sponsored, or the request is based on detailed hydrologic and hydraulic studies conducted by Federal, State, or local agencies to replace approximate studies conducted by FEMA and shown on the effective FIRM; thus the project is fee exempt. ☐ Yes

Please see Instructions for Fee Amounts

7. SIGNATURE

Note: **I understand that my signature indicates that all information submitted in support of this request is correct**

Signature of Revision Requester

Richard Harris, P.E., Project Manager
Printed Name and Title of Revision Requester

Flood Control District of Maricopa County
Company Name

Telephone No.: (602)506-1501 Date: 05/29/02

Note: **Signature indicates that the community understands, from the revision requester, the impacts of the revision on flooding conditions in the community.**

Signature of Community Official

Mr. David Moody, P.E., Public Works Engineering Director
Printed Name and Title of Community Official

City of Peoria
Community Name

Telephone No.: (623) 773-7211 Date:

CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR

This certification is in accordance with 44 CFR Ch. 1, Sect 65.2

Signature

Roy B. McDaniel, P.E. Project Manager
Printed Name and Title of Revision Requester

Registr No. 36122 Expires (Date) 03/31/2004 State AZ

Type of License/Expertise: Civil

Check which forms have been included with this request

Form Name and (Number)	Required if .....
☒ **Hydrologic** (3)	new or revised discharges
☒ **Hydraulic** (4)	new or revised water-surface elevations
☒ **Mapping** (5)	floodplain/floodway changes
☐ **Channelization** (6)	channel is modified
☐ **Bridge/Culvert** (7)	addition/revision of bridge/culvert
☐ **Levee/Floodwall** (8)	addition/revision of levee/floodwall
☐ **Coastal** (9)	new or revised coastal elevations
☐ **Coastal Structures** (10)	addition/revision of coastal structure
☐ **Dam** (11)	addition/revision of dam
☐ **Alluvial Fan** (12)	structures proposed on alluvial fan

FEDERAL EMERGENCY MANAGEMENT AGENCY **HYDROLOGIC ANALYSIS**	O.M.B No. 3067-0148 Expires April 30, 2001

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average **3.67** hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

You are not required to respond to this collection of information unless a valid OMB Control Number is displayed in the upper right corner of this form.

Note: Fill out one form for each flooding source studied

Community Name: Maricopa County, Arizona

Flooding Source: Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, AND T7NR1ES26-3

Project Name/Identifier: Upper Agua Fria Watershed Zone A Floodplain Delineation Study, Watershed #1

1. REASON FOR NEW HYDROLOGIC ANALYSIS

☒ No existing analysis ☐ Improved data ☐ Changed physical condition of watershed

☐ Alternative methodology ☐ Proposed Conditions (CLOMR) ☐ Other

For the reason stated above, please attach a detailed explanation. If a computer program/model was used in revising the hydrologic analysis, **please provide a diskette with the input files** for the same flood recurrence intervals contained in the FIS for that stream; and at least for the 1% annual chance (base) flood where no detailed study exists.

Explanation provided: ☒ Yes ☐ No **Diskettes provided:** ☒ Yes ☐ No

2. METHODOLOGY FOR NEW ANALYSIS

Indicate Method	Required Data	Data Included
☐ Statistical Analysis of Gage Records	Form 3 - Attachment A	☐ Yes ☐ No
☒ Regional Regression Equations	Form 3 - Attachment C	☒ Yes ☐ No
☒ Precipitation/Runoff Model	Form 3 - Attachment D	☒ Yes ☐ No
☐ Other	Back-up computations and supporting data	☐ Yes ☐ No

3. APPROVAL OF ANALYSIS

The hydrologic analysis has already been approved by a local, state, or Federal Agency. ☒ Yes ☐ No ☐ Not Required

If Yes, attach evidence of approval. ☐ **Approval attached.** If No, attach explanation. ☐ **Explanation attached.**

4. COMPARISON OF BASE FLOOD DISCHARGES

Location:	Drainage Area (SqMi)	FIS(cfs)	Revised (cfs)
_____	_____	A	_____
_____	_____	_____	_____
_____	_____	_____	_____

Note: When revised discharges are not significantly different than the FIS discharges, FEMA may require a confidence limits analysis (see attachment B) at a later date to complete the review.

If only a portion of a detailed study area was revised please attach an explanation describing the transition from the proposed discharges to the effective discharges. ☐ **Explanation Included** ☒ **Explanation Not Required**

5. HISTORICAL FLOODING INFORMATION

If historical data are available for the flooding source please provide: Location, peak discharges/water-surface elevations and dates, and source of information. ☐ **Data Attached** ☒ **Data Not Available**

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

ATTACHMENT C: REGIONAL REGRESSION EQUATIONS

1. Bibliographical Reference:

Jennings, M.E., W.O. Thomas, Jr., and H.C. Riggs, "Nationwide Summary of U.S. Geological Survey Regional Regression Equations for Estimating Magnitude and Frequency of Floods for Ungaged Sites, 1993", U.S. Geological Survey Water-Resources Investigations Report 94-4002.

(Attach a copy of title page, table of contents, and pertinent pages including equations.)

2. Gaged or ungaged stream: Ungaged Stream

3. Hydrologic region(s): Arizona, Central Mountain Area (3)
Attach backup map.

4. Provide parameters, values, and source of data used to define parameters.

Drainage Area

Mean Basin Elevation

Mean Annual Precipitation

		FIS:		Revised:	
5.	Urbanized conditions calculations	☐ Yes	☐ No	☐ Yes	☒ No
6.	Percent of watershed urbanization	N/A		0 %	
7.	Is the watershed controlled?	☐ Yes	☐ No	☐ Yes	☒ No
8.	Comparison with other analyses	☐ Yes	☐ No	☒ Yes	☐ No

If the answer to 5, 7, or 8 is Yes, explain methdology below. If data are not available, indicate with N/A.

Comments

This analysis was used as back-up data to a HEC-1 model.

9. **Attach computation and supporting maps, delineating the watershed boundary and drainage area divides.**

Computation and Supporting Maps provided? ☒ Yes ☐ No

ATTACHMENT D: PRECIPITATION/RUNOFF MODEL

		FIS:		Revised:	
1.	Method or model used:	N/A		HEC-1	
	Version:	N/A		4.01E	
	Date:	N/A		May 1991	
2.	Source of rainfall depth:	N/A		Maricopa Co./NOAA 2 Atlas	
3.	Source of rainfall distribution:	N/A		Maricopa Co. Flood Control	
4.	Rainfall duration:	N/A		6-Hour	
5.	Areal adjustment to precipitation (%):	N/A		JD Cards	
6.	Maximum overland flow length	N/A		0.380 miles	
7.	Hydrograph development method:	N/A		Clark Unit Hydrograph	
8.	Loss rate method:	N/A		Green-Ampt	
	Source of soils information:	N/A		SCS Soil Survey	
	Source of land use information:	N/A		FCD of Maricopa County	
9.	Channel routing method:	N/A		Normal Depth	
10.	Reservoir routing:	☐ Yes	☐ No	☐ Yes	☒ No
11.	Baseflow considerations: **If Yes, explain below how baseflow was determined:**	☐ Yes	☐ No	☐ Yes	☒ No
	———				
12.	Snowmelt considerations:	☐ Yes	☐ No	☐ Yes	☒ No
13.	Model calibration: **If Yes, explain below how calibration was performed**	☐ Yes	☐ No	☐ Yes	☒ No
	———				
14.	Future land use condition: **If Yes, explain why below**	☐ Yes	☐ No	☐ Yes	☒ No
	———				

15. **Attach precipitation/runoff model, hydrologic model schematic, curve number calculations, time of concentration calculations, and supporting maps, delineating the watershed boundary and drainage area divides.**

Information and Maps provided? ☒ Yes ☐ No

NOTE: FEMA policy is to base flooding on existing conditions.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS**	O.M.B No. 3067-0148 Expires April 30, 2001

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.25 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

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Note: Fill out one form for each flooding source studied

Community Name: Maricopa County, Arizona

Flooding Source: Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, AND T7NR1ES26-3

Project Name/Identifier: Upper Agua Fria Watershed Zone A Floodplain Delineation Study, Watershed #1

1. REACH TO BE REVISED

Describe the limits of the revision OR submit a copy of the FIRM with the revision area clearly highlighted.
Copy of FIRM(s) attached depicting area of the revision (highlighted, or circled)? ☒ Yes

Downstream Limit: Lake Pleasant Shoreline

Upstream Limit: Location where drainage area is less than 1/2 square mile.

2. MODELS SUBMITTED

Requirements: for areas which have detailed flooding:	**for areas which do not have detailed flooding**:
Full input and output listings along with files on diskette for each of the models listed below (items 1-4) and a summary of the source of input parameters used in the models must be provided. The summary must include a description of any changes made from model to model (e.g., Duplicate Effective model to Corrected Effective model). At a minimum, the Duplicate Effective (item 1) and the Revised or Post-Project Conditions (item 4) models must be submitted. See instructions for directions on when other models may be required.	Only the 100-year (Base) flood profile is required. A hydraulic model is not required for areas which do not have detailed flooding; however, BFEs may not be added to the revised FIRM. If a hydraulic model is developed for the area, items 3 and 4 described below must be submitted.

If hydraulic models are not developed, hydraulic analyses (including all calculations) for existing or pre-project conditions and revised or post-project conditions must be submitted.

1. Duplicate Effective Model ☐ **Natural** **File Name** _____ ☐ **Floodway** **File Name** _____

Copies of the hydraulic analysis used in the effective FIS, referred to as the effective models (10-, 50-, 100-, and 500-year multi-profile runs and the floodway run) must be obtained and then reproduced on the requester's equipment to produce the Duplicate Effective model. This is required to assure that the effective models input data has been transferred correctly to the requester's equipment and to assure that the revised data will be integrated into the effective data to provide a continuous FIS model upstream and downstream of the revised reach.

2. Corrected Effective Model ☐ **Natural** **File Name** _____ ☐ **Floodway** **File Name** _____

The Corrected Effective model is the model that corrects any errors that occur in the Duplicate Effective model, adds any additional cross sections to the Duplicate Effective model, or incorporates more detailed topographic information than that used in the currently effective model. The Correctly Effective model must not reflect any man-made physical changes since the date of the effective model. An error could be a technical error in the modeling procedures, or any construction in the floodplain that occurred prior to the date of the effective model but was not incorporated into the effective model.

3. Existing or Pre-Project Conditions Model ☐ **Natural** **File Name** _____ ☐ **Floodway** **File Name** _____

The Duplicate Effective model or Corrective Effective model is modified to produce the Existing or Pre-Project Conditions model to reflect any modifications that have occurred within the floodplain since the date of the Effective model but prior to the construction of the project for which the revision is being requested. If no modification has occurred since the date of the effective model, then this model would be identical to the Corrected Effective model or Duplicate Effective model.

4. Revised or Post-Project Conditions Model ☐ **Natural** **File Name** _____ ☐ **Floodway** **File Name** _____

The Existing or Pre-Project Conditions model (or Duplicate Effective model or Corrected Effective model, as appropriate) is revised to reflect revised or post-project conditions. This model must incorporate any physical changes to the floodplain since the effective model was produced as well as the effects of the project. When the request is for the proposed project this model must reflect proposed conditions.

5. Other – Please attach a sheet describing all other models submitted along with the file names. ☒ **Natural** ☐ **Floodway**

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

3. STARTING WATER-SURFACE ELEVATIONS

Explain how they were determined. Explanation Attached? ☐ Yes ☒ No

NOTE: If the effective study is an approximate study, the slope/area method is recommended. For detailed analysis studies, using a known water-surface elevation is recommended.

4. RESULTS (from the model used to revise the 100-year water surface elevations)

If the results indicate any of the following, attach an explanation - to this form, or to the hydraulic model printout- as to the reasonableness of the situation.

☒ Supercritical depth ☒ Critical Depth ☐ Drawdowns ☐ Negative Floodway Surcharges

☐ Floodway Surcharges Greater Than Maximum Allowed by Community/State

☐ Water surface elevations higher than the end points of cross sections.

☐ Floodway discharge is different than the Natural 100-year (base) flood discharge.

☐ Project causes 100-year floodplain or floodway elevations to increase (state if increases are located off the requester's property)

Explanation attached with Form ☒ **Explanation provided on attached printout ☐**

If Hydraulic model used is HEC-2, has it been checked with FEMA'S CHECK-2 computer program? ☐ Yes ☐ No
(see instructions for information on how to obtain CHECK-2)

5. REVISED FIRM/FBFM AND FLOOD PROFILES

1. Profile Transition

a. 100-Year Water-Surface Elevations - indicate the difference in water surface elevations where the project 100-year elevations tie into the existing 100-year water surface elevations at each end of the project.

Downstream End _____ within _____ (feet) Upstream End _____ within _____ (feet)
Cross-Section # *Cross-Section #*

b. Floodway Elevations - indicate the difference in water surface elevations where the project floodway elevations tie into the existing floodway water surface elevations at each end of the project.

Downstream End _____ within _____ (feet) Upstream End _____ within _____ (feet)
Cross-Section # *Cross-Section #*

c. Floodway widths - indicate the difference in floodway widths where the project floodway widths tie into the existing floodway width at each end of the project.

Downstream End _____ within _____ (feet) Upstream End _____ within _____ (feet)
Cross-Section # *Cross-Section #*

2. Profile Checklist (check box if information has been provided on profile)

The following information (unless in parentheses) must be included at the same scale as the existing profiles for this project:

☐ Stream Name ☐ Community Name ☐ Corporate Limits labeled ☐ Study limits labeled

☐ Confluences labeled ☐ Channel Stationing ☐ Streambed profiled ☐ Cross Sections labeled

☐ Horizontal/Vertical Scales indicated ☐ 100-year elevs profiled*

☐ Road Crossings ☐ Labeled ☐ Low Chord Elevations ☐ Top of Road Elevations

*All recurrence intervals in the effective study must also be profiled.

Floodway Data Table

Attach a Floodway Data Table for each cross section listed in the published Floodway Data table in the FIS report.

Floodway Data Table Attached ☐ Yes ☒ Not Required

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE / COASTAL MAPPING**	O.M.B No. 3067-0148 Expires April 30, 2001

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 1.5 hours per response. The burden estimate includes the time for reviewing instructions, searching existing data sources, gathering and maintaining the needed data, and completing and reviewing the form. Send comments regarding the accuracy of the burden estimate and any suggestions for reducing this burden to: Information Collections Management, Federal Emergency Management Agency, 500 C Street, S.W., Washington DC 20472; and to the Office of Management and Budget, Paperwork Reduction Project (3067-0148), Washington, DC 20503.

You are not required to respond to this collection of information unless a valid OMB Control Number is displayed in the upper right corner of this form.

Note: Fill out one form for each flooding source studied

Community Name: Maricopa County, Arizona

Flooding Source: Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, AND T7NR1ES26-3

Project Name/Identifier: Upper Agua Fria Zone A Floodplain Delineation Study, Watershed #1

This is a ☒ Manual ☐ Digital submission. *Digital map submissions may be used to update digital FIRMs (DFIRMs). For updating DFIRMs, these submissions must be coordinated with FEMA Headquarters as far in advance as possible.*

1. MAPPING CHANGES

1. A topographic workmap must be submitted showing the following information (check N/A when not applicable):

a. Revised approximate 100-year floodplain boundaries (Zone A)	☒ Yes	☐ No	☐ N/A
b. Revised detailed 100- and 500-year floodplain boundaries.	☐ Yes	☒ No	☐ N/A
c. Revised floodway boundaries	☐ Yes	☐ No	☒ N/A
d. Location and alignment of all cross sections with stationing control indicated.	☒ Yes	☐ No	☐ N/A
e. Stream alignments, road alignments and dam alignments.	☒ Yes	☐ No	☐ N/A
f. Current community boundaries.	☒ Yes	☐ No	☐ N/A
g. Effective 100- year floodplain and floodway boundaries from FIRM/FBFM reduced or enlarged to the scale of the topographic workmap	☐ Yes	☐ No	☒ N/A
h. Tie-ins between the effective and revised 100-, 500-year and floodway boundaries	☐ Yes	☐ No	☒ N/A
i. The requester's property boundaries and community easements	☐ Yes	☐ No	☒ N/A
j. The signed certification of a registered professional engineer	☒ Yes	☐ No	☐ N/A
k. Location and description of reference marks	☐ Yes	☐ No	☒ N/A
l. Vertical datum (example: NGVD, NAVD)	☐ Yes	☐ No	☒ N/A
m. Coastal zone designations tie into adjacent areas not being revised	☐ Yes	☐ No	☒ N/A
n. Location and alignment of all coastal transects used to revise the coastal analyze	☐ Yes	☐ No	☒ N/A
o. V-zone has been delineated to extend landward to the heel of the primary frontal dune	☐ Yes	☐ No	☒ N/A

If any items are marked No or N/A please attach an explanation.

2. What is the source and date of the updated topographic information (example: orthophoto maps, July 1985; filed survey, May 1979, beach profile, June 1987 etc.)? Digital Terrain Model produced from digital orthophotos, December 16, 2000 through March 15, 2001.

3. What is the scale and contour interval of the following workmaps?

Effective FIS Scale N/A Contour Interval N/A

Revision Request Scale 1" = 500' Contour Interval _____

NOTE: Revised topographic information must be of equal or greater detail than effective.

4. Attach an annotated FIRM/FBFM at the scale of the effective FIRM/FBFM showing the revised 100- and 500-year floodplain and the floodway boundaries and how they tie into those shown on the effective FIRM/FBFM downstream and upstream of the revisions or adjacent to the area of revision for coastal studies. **FIRM/FBFM attached?** ☒ **Yes** ☐ **No**

PLEASE REFER TO THE INSTRUCTIONS FOR THE APPROPRIATE MAILING ADDRESS

2. EARTH FILL PLACEMENT

1. The fill is: ☐ Existing ☐ Proposed

2. Has fill been/will be placed in the regulatory floodway? ☐ Yes ☐ No
If Yes, please attach completed Riverine Hydraulic Analysis Form (Form 4).

3. Has fill been/will be placed in floodway fringe (*area between the floodway and 100-year floodplain boundaries*)? ☐ Yes ☐ No

If Yes, then complete A, B, C, and D below.

a. Are fill slopes for granular materials steeper than one vertical on one-and-one-half horizontal? ☐ Yes ☐ No

If Yes, justify steeper slopes _____

b. Is adequate erosion protection provided for fill slopes exposed to moving flood waters? (*Slopes exposed to flows with velocities of up to 5 feet per second (fps) during the 100-year flood must, at a minimum, be protected by a cover of grass, vines, weeds, or similar vegetation; slopes exposed to flows with velocities greater than 5 fps during the 100-year flood must, at a minimum, be protected by stone or rock riprap.)*

☐ Yes ☐ No

If No, describe erosion protection provided _____

c. Has all fill placed in revised 100-year floodplain been compacted to 95 percent of the maximum density obtainable with the Standard Proctor Test Method or acceptable equivalent method? ☐ Yes ☐ No

d. Can structures conceivably be constructed on the fill at any time in the future? ☐ Yes ☐ No

If Yes, attach certification of fill compaction (item 3c. above) by the community's NFIP permit official, a registered professional engineer, or an accredited soils engineer in accordance with Subparagraph 65.5(a)(6) of the NFIP regulations.

Fill certification attached ☐ **Yes** ☐ **No**

4. Has fill been/will be placed in a V zone? ☐ Yes ☐ No

If Yes, is the fill protected from erosion by a flood control structure such as a revetment or seawall?

☐ Yes ☐ No

If Yes, attach the Coastal Structures Form (Form 10).

Section 3
Mapping and Survey Information

Section 3: Survey and Mapping Information

3.1 Field Survey Information

Because the watershed is undeveloped there are no man-made structures that affect the floodplain delineation. For this reason, there is no field survey information besides what is provided for the Mapping Control, as discussed below.

3.2 Mapping

RBF used existing digital elevation models (DEM) and digital terrain models (DTM) provided by the Flood Control District of Maricopa County. Landata Airborn Systems created the DTM from digital ortho-photos that were created as part of the Maricopa County Ortho-photo project in 2000 and 2001. Landata Airborn Systems produced the photography and DTMs under the supervision of Kas Ebrahim.

RBF Consulting set the panels and supplied the horizontal and vertical control for the Maricopa County Ortho-photo project under the supervision of Brent J. Smith, R.L.S. The coordinate system is based on NAD 83, Arizona State Plane- Central Zone. The vertical coordinate system is NAVD 88. The RBF Consulting job number for the mapping is 45-100774.

As part of the Maricopa County Ortho-photo project Landata flew aerial photography for the entire county. The dates the photos were flown are December 16, 200 through March 15, 2001. The vertical control was based on GDACS monuments established by the Maricopa County Department of Transportation.

Appendix C contains part of the narrative from the "Maricopa County Ortho-photo GPS-Summary of Procedure Final Report" stamped by Brent J. Smith, R.L.S. Appendices A through C are provided on a CD in Appendix C.

Section 4
Hydrology

Section 4: Hydrology

4.1 Method Description

The purpose of the hydrologic analysis is to provide peak flow data for the Zone A flood plain delineation of all washes in this watershed that have a drainage area of at least one-half square mile. Peak flows for the 100-year 6-hour storm were computed using the Army Corps of Engineers' Flood Hydrograph Package HEC-1, version 4.01E, dated May 1991. Environmental Modeling Systems Incorporated's (EMS-I) Watershed Modeling System version 6.1 (WMS), dated October 30, 2001, was used to build the hydrologic model using a grid of elevation data and geographic information system (GIS) data provided by the Flood Control District of Maricopa County (FCD). Additionally, WMS was used to verify the HEC-1 peak flow calculations using the USGS's and FHWA's National Flood Frequency (NFF) equations for Arizona.

4.2 Parameter Estimation

Hydrologic parameters were estimated using the FCD's methodology, as outlined in Volume I of the *Drainage Design Manual For Maricopa County* (DDM), dated January 1, 1995. The following sections discuss the parameter estimation in detail.

4.2.1 Drainage Area Boundaries

Figure 4.1 shows the sub-basin delineation for the Upper Agua Fria Watershed No. 1. Watershed No. 1 consists of six sub-watersheds that are at least one-half square mile in size that drain directly into Lake Pleasant. The outlets to the sub-basins were placed at the location of where the washes intersect Lake Pleasant's shoreline at the time the aerial photographs were taken. Watershed No. 1 is undeveloped, covered mainly by dense desert vegetation.

Sub-basin delineation was performed by WMS using an digital elevation model (DEM) produced from the digital ortho-photos, dated May 26, 2001 . The grid spacing of the DEM is 10 feet and it has an accuracy of plus or minus five feet.

4.2.2 Watershed Work Maps

The watershed work maps provided with this report were prepared to show the sub-basin delineations, flow paths, soil and land use characteristics. Specifically, Figure 4.1 and Exhibit 1 show the sub-basin boundaries labeled with SUB1A at the southern end and SUB1F at the northern end. The portion of the Upper Agua Fria Watershed that lies within Maricopa County was subdivided into four watersheds. The number 1 after the prefix SUB signifies that this is the first delineation of the Upper Agua Fria Watershed, and is the same for this report. The letter following the 1 represents the location where the wash drains into Lake Pleasant, with A being the farthest south and F being the farthest north. SUBE had to be divided into several sub-basins in order to keep the sub-basin areas close to the same size. For this reason, an additional number is added to the end of the sub-basin name, with the number increasing the farther the sub-basin is upstream along the wash.

Figure 4.2 shows the watershed boundaries overlain on top of the soil map units, according to the Aguila-Carefree Soil Survey. An full size exhibit for land use designation is not provided because the land use characteristics are the same for the whole watershed, as Figure 4.3 shows.

4.2.3 Gage Data

Table 4.1 lists the rain gage locations in the vicinity of Watershed No. 1. None of these gages are within Watershed No. 1.

Table 4.1- List of Gages Near Watershed No. 1

Gage I.D.	Name	Installation Date	Type
5650	Lake Pleasant	12/10/1991	Precipitation
5630	New River Landfill	4/29/1993	Precipitation
5625	Sun Up Ranch	3/21/1984	Precipitation
5583	Skunk Creek near New River	6/2/95	Telemetry Stage

4.2.4 Statistical Parameters

Statistical Parameters have not been considered at this stage of the study.

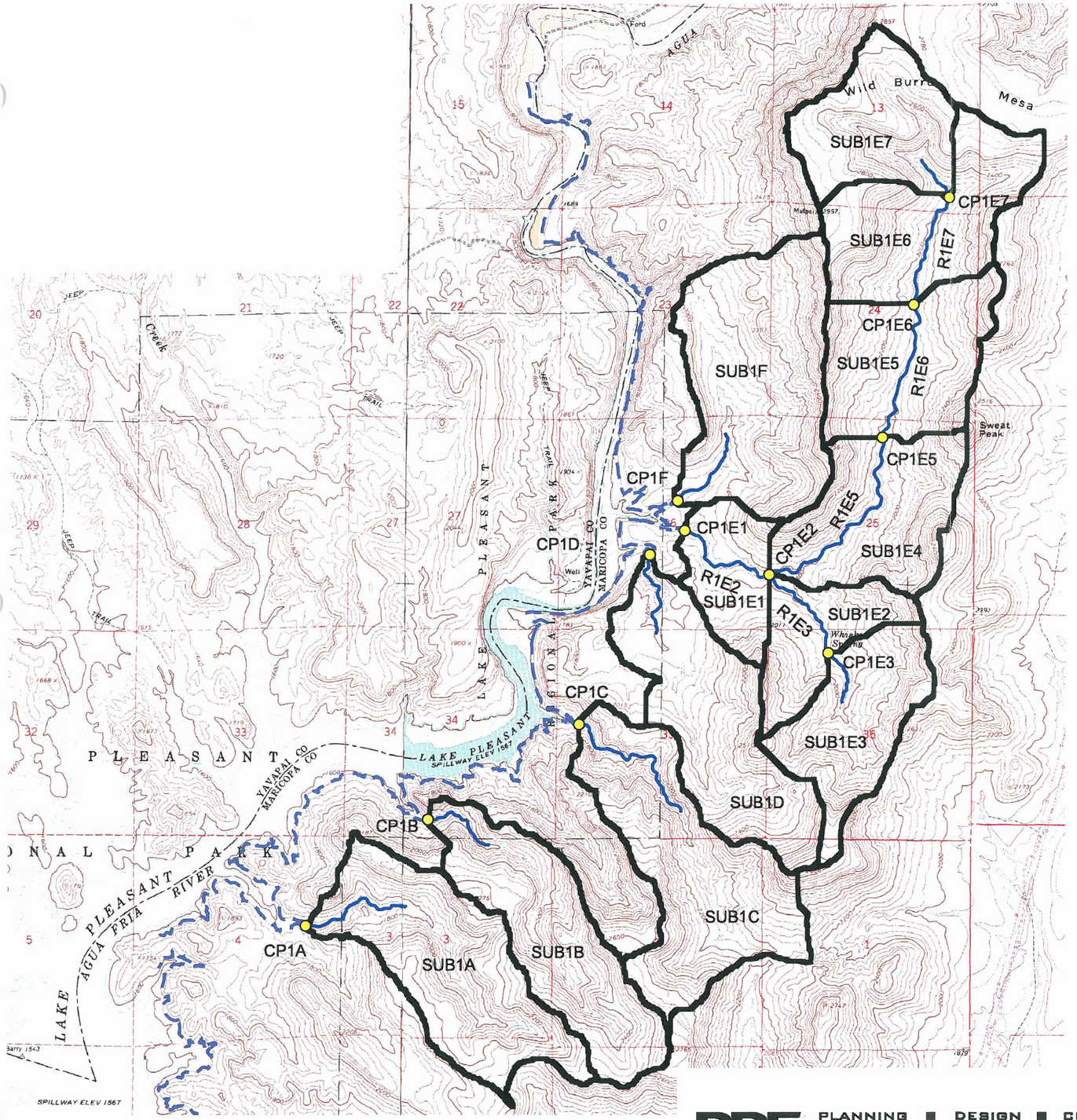
4.2.5 Precipitation

The NOAA Atlas II was used to obtain a 100-year 6-hour point precipitation value of 3.40 inches for Watershed No. 1. According to the DDM's Design Rainfall Criteria for Maricopa County (pg. 2-3), watersheds with drainage areas of 20 square miles or less should be analyzed using the 6-hour local storm.

HEC-1's JD card option was used to reduce point precipitation values using the depth-area reduction factors from the DDM. Table 4.2 lists the depth-area rainfall relations were input onto the JD card. The appropriate rainfall distribution pattern for the 6-hour storm was also input onto the corresponding PC cards.

Table 4.2- Depth-Area Relation used in the HEC-1 Model

Depth Inches	Area Square Miles	Rainfall Distribution Pattern
3.40	0.0001	1
3.38	0.5	1
3.31	2.8	2
3.14	15.5	3



3000 0 3000 Feet

LEGEND

- Concentration Points
- Washes
- Sub-Basin Boundaries

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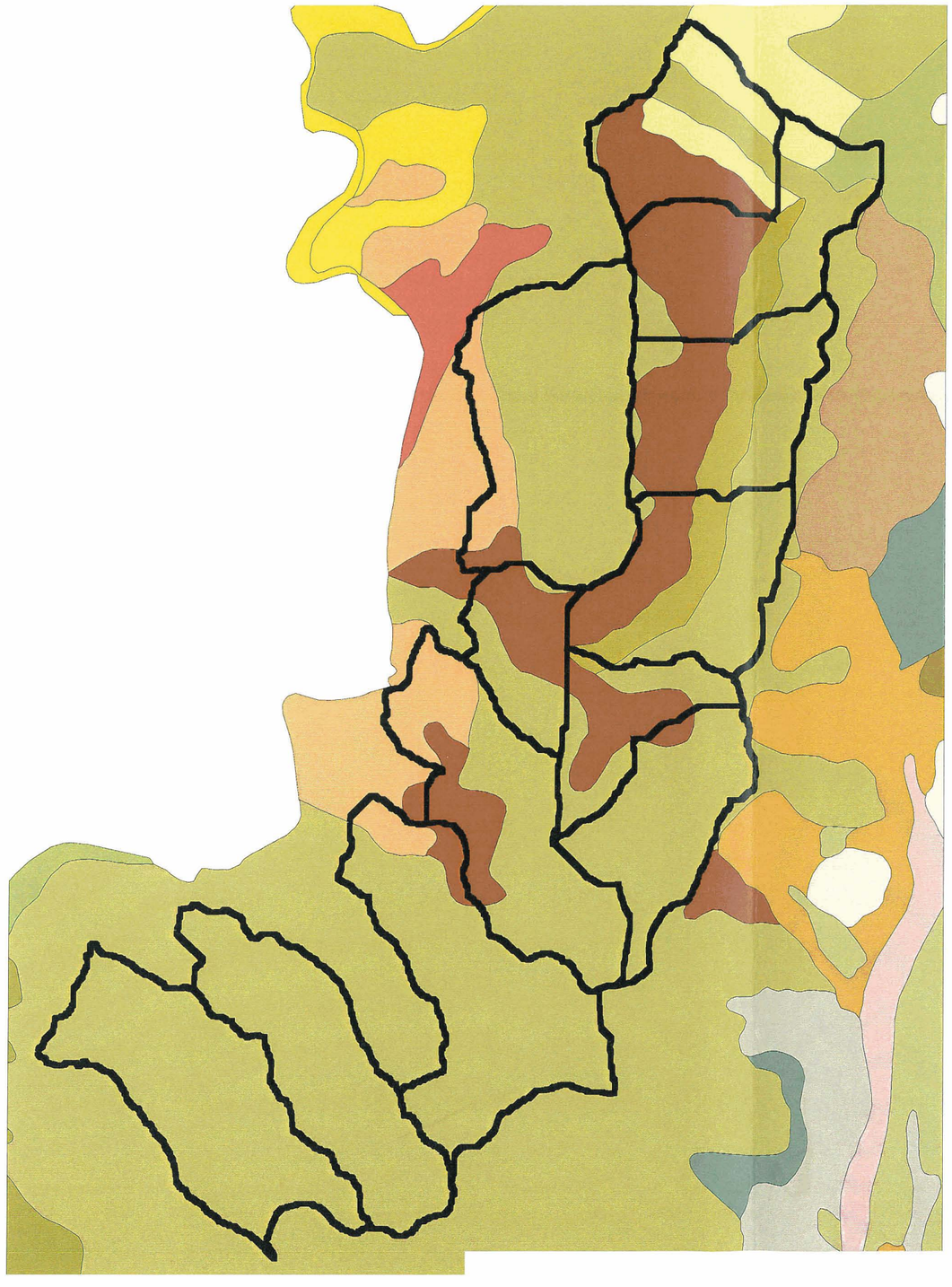
UPPER AGUA FRIA WATERSHED
ZONE A FLOOD PLAIN DELINEATION STUDY
WATERSHED #1
SUBBASIN BOUNDARIES
FIGURE 4.1



LEGEND

SUB–BASIN BOUNDARIES

AGUILA CAREFREE SOIL SURVEY– SOIL TYPE AND DESCRIPTION

- 103 – Rock outcrop–Gachado complex, 5 to 55 percent slopes
- 104 – Rock outcrop–Lehmans complex, 15 to 65 percent slopes
- 110 – Suncity–Cipriano complex, 1 to 7 percent slopes
- 111 – Torriorthents, 15 to 40 percent slopes
- 12 – Carefree cobbly clay loam, 1 to 8 percent slopes
- 13 – Carefree–Beardsley complex
- 26 – Continental cobbly clay loam, 1 to 8 percent slopes
- 28 – Continental–Ohaco complex
- 31 – Dixaleta–Rock outcrop complex, 25 to 65 percent slopes
- 40 – Eba–Pinaleno complex, 3 to 20 percent slopes
- 41 – Eba–Pinaleno complex, 20 to 40 percent slopes
- 45 – Ebon very gravelly loam, 8 to 20 percent slopes
- 49 – Ebon–Pinamt complex, 20 to 40 percent slopes
- 51 – Gachado–Lomitas complex, 8 to 25 percent slopes
- 52 – Gachado–Lomitas–Rock outcrop complex, 7 to 55 percent s
- 72 – Lehmans–Rock outcrop complex, 8 to 65 percent slopes
- 8 – Arizo cobbly sandy loam
- 93 – Nickel–Cave complex, 8 to 30 percent slopes
- 98 – Pinamt–Tremant complex, 1 to 10 percent slopes
- W – Lakes, ponds, reservoirs – perennial

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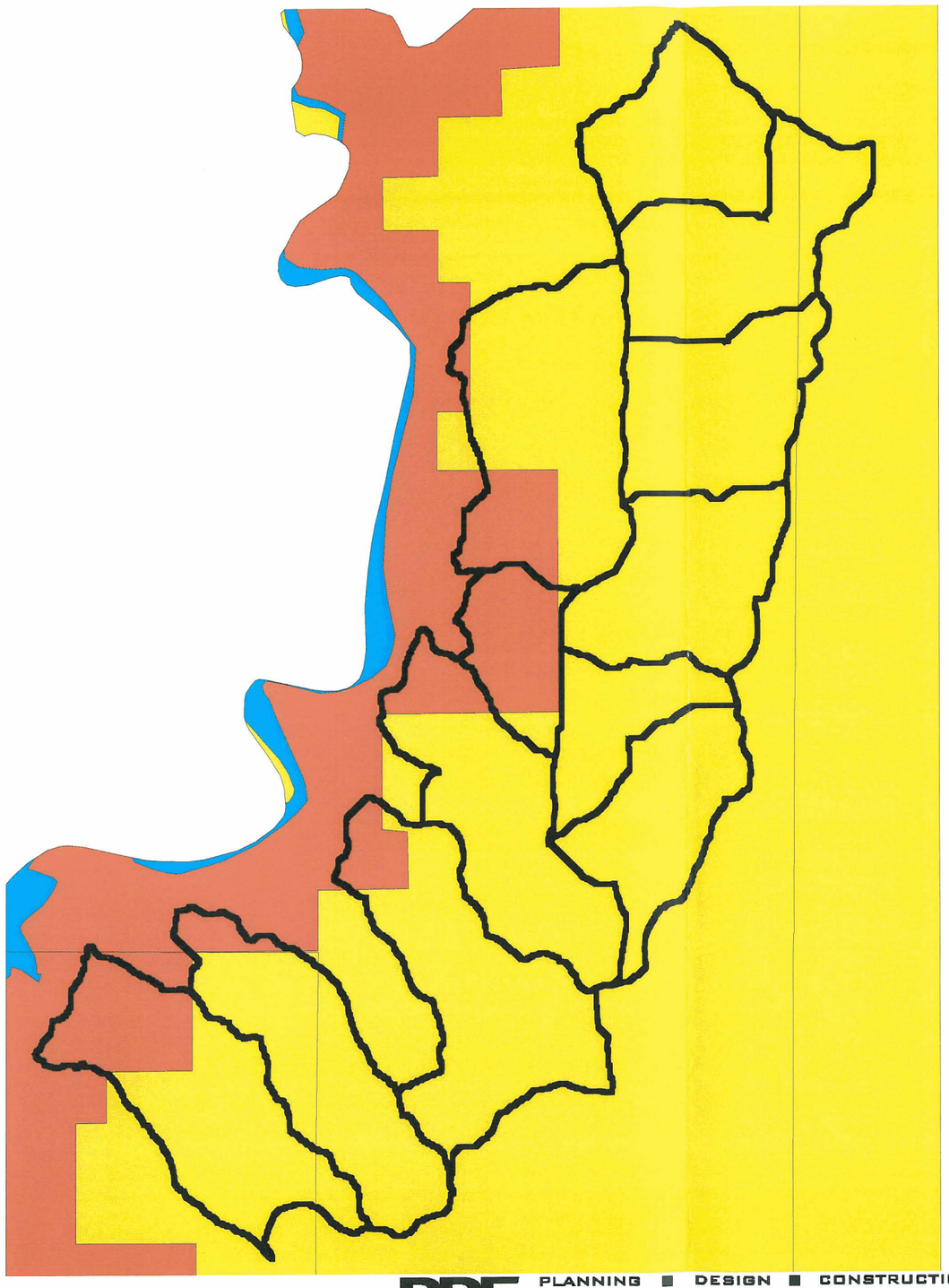
UPPER AGUA FRIA WATERSHED
ZONE A FLOODPLAIN DELINEATION STUDY
WATERSHED #1
SOILS MAP
FIGURE 4.2



3000 0 3000 Feet

LEGEND

SUB-BASIN BOUNDARIES

LAND USE CLASSIFICATION

- Recreational Open Space
- Vacant
- Water

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UPPER AGUA FRIA WATERSHED
ZONE A FLOOD PLAIN DELINEATION STUDY
WATERSHED #1
LAND USE CLASSIFICATION
FIGURE 4.3

4.2.6 Physical Parameters

Rainfall Losses

The Green and Ampt infiltration equations were used within HEC-1 to estimate rainfall losses according to the procedures outlined in the DDM. WMS was used to calculate the logarithmic area averages of the hydraulic conductivities of each map unit within each sub-basin. WMS also selects the capillary suction (PSIF) and soil moisture deficit (DTHETA) using the average XKSAT value. After PSIF and DTHETA area calculated the XKSAT value is adjusted for vegetative cover.

A GIS based soils map of the SCS *Soil Survey of Aguila-Carefree Area, Parts of Maricopa County and Pinal Counties, Arizona,* issued April 1986 was obtained from the FCD for input into WMS. Figure 4.2 shows the soils map for Watershed No. 1. A table relating the Map Unit numbers to the XKSAT values was obtained from Appendix A of the DDM. Table 4.3 lists the map unit values that were input into WMS to compute the rainfall losses.

Table 4.3- Sub-Basin Soils used in Rainfall Loss Calculations

SCS MUSYM	Description	XKSAT inch/hr	Impervious Area %	% Effective
8	Arizo Cobbly Sandy Loam	0.96	0	100
12	Carefree Cobbly Clay Loam	0.01	0	100
13	Carefree-Beadsley Complex	0.01	0	100
26	Continental Cobbly Clay Loam, 1-8% slopes	0.01	0	100
28	Continental-Ohaco Complex	0.02	0	100
31	Dixaleta-Roack outcrop complex, 25-65% slopes	0.33	35	100
40	Eba-Pinaleno Complex, 3-20% Slopes	0.17	0	100
41	Eba-Pinaleno Complex, 20-40% Slopes	0.17	35	100
45	Ebon very gravelly loam 8 to 20 percent	0.03	0	100
49	Ebon-Pinamt complex 20 to 40 percent slopes	0.06	0	100
51	Gachado-Lomitas-Rock outcrop complex, 8 to 25% slopes	0.24	0	100
52	Gachado-Lomitas-Rock outcrop complex, 7 to 55% slopes	0.16	20	100
72	Lehmans-Rock outcrop complex	0.09	30	100
93	Nickel-Cave complex	0.33	0	100
98	Pinamt-Tremant complex	0.37	0	100

Table 4.3- Sub-Basin Soils used in Rainfall Loss Calculations

SCS MUSYM	Description	XKSAT inch/hr	Impervious Area %	% Effective
103	Rock outcrop-Gachado complex	0.10	65	100
104	Rock outcrop-Lehmans complex	0.14	60	100
110	Suncity-Cipriano complex	0.13	0	100
111	Torriorthents	0.40	0	100

The FCD provided land use data in shape file (GIS) format based on Maricopa Associated Governments (MAG) Data. Table 4.4 lists the land use data that was imported into WMS to help determine rainfall losses. The land use data provided initial abstraction calculations.

Table 4.4- Land Use Characteristics used to Compute Green and Ampt Parameters

Land Use Classification	Description	Initial Abstraction inches	Soil Condition	Impervious Area %	Vegetative Cover %
Recreational Open Space	Hillslopes, Sonoran Desert	0.15	Dry	0	40
Vacant	Hillslopes, Sonoran Desert	0.15	Dry	0	40

The aerial photographs and site visit photographs indicate that there is pretty good vegetative cover for desert mountains in Maricopa County. Appendix D2 contains the determination of vegetative cover, based on elevation range.

Unit Hydrograph Procedure

The Clark Unit Hydrograph procedure was used because the DDM states that it "is recommended for watersheds or sub-basins less than about 5 square miles in size with an upper limit of application of 10 square miles."

The Papadakis and Kazan equation shown below is used to compute T_c for the Clark Unit Hydrograph Procedure in Maricopa County:

$$T_c = 11.4L^{0.50}k_b^{0.52}S^{-0.31}i^{0.38}$$

where T_c = time of concentration, hours
L = length of flow path for T_c, miles
k_b = representative watershed resistance coefficient
S = watercourse slope, feet/mile
i = average rainfall excess intensity during the time T_c, inches/hour (DDM, pg 5-10)

WMS uses the Green and Ampt parameters for each sub-basin and the 6-hour precipitation depth (3.4 inches) to compute *i*. Both L and S are computed from the DEM by WMS, and the watershed resistance coefficient is based on the drainage area, computed by WMS, and the sub-basin roughness type. A maximum roughness (Type D, Table 5.1 of the DDM, pg. 5-13) was chosen because of the mountainous terrain and the short flow paths present in the watershed. WMS will also adjust the watercourse slope for steep slopes according to Figure 5.4 in the DDM. Table 4.5 lists the values WMS used to calculate the time of concentration (T_c) and storage value (R) for the Clark Unit Hydrograph.

Table 4.5- Values Used to compute Clark Unit Hydrograph Parameters

Sub-Basin	Area square miles	Length of Longest Flow Path miles	Measured Slope feet/mile	Adjusted Slope feet/mile
SUB1A	0.697	2.056	456.70	296
SUB1B	0.604	2.152	513.01	301
SUB1C	0.763	2.316	527.21	302
SUB1D	0.651	2.251	538.02	303
SUB1E1	0.255	0.975	844.08	328
SUB1E2	0.285	0.918	859.39	329
SUB1E3	0.430	1.309	749.53	321
SUB1E4	0.518	1.521	719.01	319
SUB1E5	0.517	1.082	813.30	326
SUB1E6	0.553	1.099	812.25	326
SUB1E7	0.433	1.087	587.80	309
SUB1F	0.814	2.051	644.26	313

Table 4.6 lists the sub-basin parameters that WMS prepared for input into HEC-1.

Table 4.6- HEC-1 Sub-Basin Parameters for Watershed No. 1

Sub-Basin	Area sq. mi.	IA inches	DTHETA	PSIF	Adj. XKSAT in./hr	RTIMP %	T_c hours	R hours
SUB1A	0.697	0.15	0.33	7.3	0.107	30.0	0.604	0.462
SUB1B	0.6037	0.15	0.33	7.3	0.107	30.0	0.617	0.532

Table 4.6- HEC-1 Sub-Basin Parameters for Watershed No. 1

Sub-Basin	Area sq. mi.	IA inches	DTHETA	PSIF	Adj. XKSAT in./hr	RTIMP %	T_c hours	R hours
SUB1C	0.7635	0.15	0.351	6.975	0.12	26.827	0.654	0.528
SUB1D	0.6515	0.15	0.387	6.261	0.163	18.391	0.658	0.569
SUB1E1	0.2546	0.15	0.373	6.55	0.146	15.455	0.371	0.263
SUB1E2	0.2852	0.15	0.371	6.575	0.144	16.719	0.354	0.223
SUB1E3	0.4304	0.15	0.335	7.229	0.11	28.772	0.433	0.293
SUB1E4	0.5184	0.15	0.376	6.471	0.15	22.696	0.483	0.336
SUB1E5	0.5175	0.15	0.38	6.4	0.155	19.651	0.383	0.198
SUB1E6	0.5526	0.15	0.349	7.016	0.118	13.231	0.388	0.195
SUB1E7	0.4327	0.15	0.273	0.8732	0.061	6.174	0.383	0.22
SUB1F	0.8136	0.15	0.364	6.713	0.136	24.558	0.6	0.419

Channel Routing

There are five reaches that require channel routing. Normal depth routing was performed in HEC-1 for reaches R1E2, R1E3, R1E5, R1E6 and R1E7. Cross-sections were cut in WMS using the DEM and cross section editor. The cross sections were then exported to Haestad Method's Flow Master in order to perform normal depth calculations. Cross-section plots are provided in Appendix D.3, along with the calculations. A Manning's 'n' value of 0.044 for the channel and 0.070 for the overbanks were used for the calculations, as explained in Appendix E.1 Table 4.7 lists the other variables used in the normal depth routing.

Table 4.7- Channel Routing Parameters for Normal Depth Routing

Reach	Reach Length feet	Slope ft/ft	Velocity fps	NSTPS
R1E2	3109	0.0320	12.7	1
R1E3	2912	0.0467	12.6	1
R1E5	5997	0.0370	12.1	2
R1E6	4062	0.0313	12.0	2
R1E7	3278	0.0378	12.2	1

4.3 Problems Encountered During the Study

4.3.1 Special Problems and Solutions

There were no special problems in relation to the final results.

4.3.2 Modeling warning and error messages

The HEC-1 model did not produce any error or warning messages.

4.4 Calibration

Recorded data has not been used to calibrate the model at this stage of the study. The NFF equations for Arizona have been used as a comparison.

4.5 Final Results

4.5.1 Hydrologic Analysis Results

Table 4.8 lists the results of the hydrologic analysis.

Table 4.8- HEC-1 Results

Drainage ID	Peak Discharge cfs	Time to Peak hours	Runoff Volume acre-feet	Area sq. miles	Unit Peak cfs/sq. mi.
SUB1A	1070	4.42	89.83	0.70	1529
SUB1B	878	4.42	78.23	0.60	1463
SUB1C	1031	4.50	94.67	0.76	1357
SUB1D	817	4.5	73.21	0.65	1257
CP1E1	3924	4.42	326.14	2.99	1312
SUB1E1	543	4.25	29.05	0.25	2172
R1E2	3687	4.42	301.98	2.74	1345
CP1E2	3733	4.33	301.98	2.74	1362
SUB1E2	657	4.17	32.89	0.29	1234
R1E3	885	4.33	55.59	0.43	2058
SUB1E3	910	4.25	55.59	0.43	2116
SUB1E4	965	4.33	61.63	0.52	1856

Table 4.8- HEC-1 Results

Drainage ID	Peak Discharge cfs	Time to Peak hours	Runoff Volume acre-feet	Area sq. miles	Unit Peak cfs/sq. mi.
R1E5	2522	4.33	168.95	1.50	1681
CP1E5	2623	4.25	168.95	1.50	1749
SUB1E5	1213	4.25	60.02	0.52	2332
R1E6	1934	4.33	114.64	0.99	1954
CP1E6	1998	4.25	114.64	0.99	2018
SUB1E6	1303	4.25	64.20	0.55	2369
R1E7	1010	4.25	53.48	0.43	2349
SUB1E7	1045	4.25	53.48	0.43	2430
SUB1F	1228	4.42	97.30	0.81	1516

Table 4.9 lists the peak flow values that will be used in the hydraulic modeling phase of the study. Because of the limitations of WMS, the peak flows used to delineate the floodplain for wash T7NR1ES26-2A and Reach 1 of T7NR1ES26-2B are combined in one value CP1E2. The peak flow for T7NR1ES26-2A was obtained by summing the hydrograph ordinates from SUB1E2 (Q = 657 cfs, tp = 4.17 hrs) and R1E3 (Q = 885 cfs, tp = 4.33 hrs) to obtain a peak flow of 1479 cfs at a time to peak of 4.25 hours. The peak flow for Reach 1 of T7NR1ES26-2B was obtained by summing the hydrograph ordinates of SUB1E4 (Q = 965 cfs, tp = 4.33 hrs) and R1E5 (Q = 2522 cfs, tp = 4.33 hrs) to obtain 3488 cfs at a time to peak of 4.33 hours. Calculations are provided in Appendix D6.

Table 4.9- Peak Discharges Used in Hydraulic Calculations

Wash	Drainage ID	Peak Discharge
T6NR1ES4	SUB1A	1070 cfs
T7NR1ES34	SUB1B	878 cfs
T7NR1ES35	SUB1C	1031 cfs
T7NR1ES26-1	SUB1D	817 cfs
T7NR1ES26-2	CP1E1	3924 cfs
T7NR1ES26-2A	SUB1E2 + R1E3	1479 cfs
T7NR1ES26-2B REACH 1	SUB1E4 + R1E5	3488 cfs
T7NR1ES26-2B REACH 2	CP1E5	2623 cfs

Table 4.9- Peak Discharges Used in Hydraulic Calculations

Wash	Drainage ID	Peak Discharge
T7NR1ES26-2B REACH 3	CP1E6	1998 cfs
T7NR1ES26-3	SUB1F	1228 cfs

4.5.2 Verification of Results

The National Flood Frequency equations for Arizona were used as a verification of the 100 year peak flow. The calculations are provided in Appendix D6. Table 4.10 compares the NFF 100 year peak flows with the HEC-1 results. The standard error for the NFF equations is 66.

Table 4.10- Comparison of HEC-1 Results with NFF Peak Flows for the 100-yr 6-hr Storm

Drainage ID	HEC-1	NFF Peak Flow		
	Peak Flow cfs	Peak Flow cfs	Mean Elevation	Rainfall inches
CP1A	1070	1650	2100	12
CP1B	878	1380	2240	12
CP1C	1031	1590	2250	12
CP1D	817	1620	2110	12.5
CP1E1	3924	3750	2330	13
CP1E2	3733	3620	2300	12.5
CP1E3	885	1150	2260	12.5
CP1E5	2623	2260	2490	13
CP1E6	1998	1820	2490	13.5
CP1E7	1010	978	2710	13.5
CP1F1	1228	1910	2120	13

Section 5
Hydraulics

Section 5: Hydraulics

5.1 Method Description

All of the washes delineated in this study are desert-mountain washes that drain directly into Lake Pleasant. Each wash is at the bottom of a canyon with steep walls. Environmental Modeling Systems Incorporated's (EMS-I) Watershed Modeling System version 6.1 (WMS), dated March 4, 2002, was used to create a Triangulated Irregular Network (TIN) from the existing elevation data provided by the Flood Control District. Different tools within WMS were then used to obtain several cross sections and calculate the normal depth at each cross section. Cross sections were placed at different locations within each wash where either the cross sectional geometry or the channel slope changed significantly. Locations of the cross sections are shown on the work study maps and in Appendix E5. The floodplain delineation tools within WMS were then used to interpolate water surface elevations along the wash and to delineate the Zone A boundary for each wash.

Each delineated wash was named according to the township, range, and section where the downstream study limit is located. For example, wash T6NR1ES4 is located in Section 4 of Township 6 North, Range 1 East of the Gila and Salt River Base and Meridian. When the downstream study limits of several washes are located in the same section the different washes are differentiated by placing a dash (-) at the end of the name described above, followed by a number. When there is a tributary to a wash, the different reaches of the wash are differentiated by adding letter to the end of the name of the wash.

5.2 Work Study Maps

Work study maps that show the floodplain delineations have been prepared at a scale of 1 inch = 500 feet, according to FEMA standards. A cover sheet shows the location of each wash and the corresponding floodplain in relation to each other. Because the elevation data produced from the aerial mapping is in the form of an elevation grid, the USGS Quadrangle maps have been used as a base map for the floodplain delineations. Each work study map shows the thalweg of each wash, the Zone A boundaries, and the cross sections used in the delineation.

5.3 Parameter Estimation

5.3.1 Roughness Coefficients

The procedures used to determine the Manning's "n" roughness coefficients are outlined in the USGS publication "Estimated Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona" (April 1991). Based on field observations, the Manning's Roughness Coefficients were calculated for each wash in the channel and overbanks. A list of the roughness coefficients for each wash, photos of each wash, and description of how the roughness coefficients were obtained is provided in Appendix E.1.

5.4 Cross Section Description

As stated earlier, the cross sections were placed at locations in each wash where either the slope or

the cross section geometry changed drastically. WMS was first used to create a TIN. The profile of each wash was plotted in order to determine where the slope changed significantly. If there was a significant change, each wash was split up into reaches. The plan and profile of each wash based on the TIN is provided in Appendix E5. At least one cross section was placed in each reach unless the slope of the wash was excessive. Additional cross sections were placed in each wash at locations where the cross section geometry changed significantly.

Tools within WMS were used to "cut" the cross sections and weed out any unnecessary points. The peak flows listed in Tables 4.9 and 5.1 were then used in WMS's channel calculator to calculate the peak flows. A plot of each cross section and the normal depth calculation results are provided in Appendix E5.

5.5 Modeling Considerations

Because this study is only producing approximate Zone A delineations, many of the modeling considerations that would accompany a detailed study have not been considered in this study.

5.6 Floodway Modeling

Because this study is only producing approximate Zone A delineations floodways have not been modeled.

5.7 Problems Encountered During the Study

The straight forward procedures of Zone A delineations eliminated all significant problems. WMS, the hydraulic modeling software, does not produce any warning or error messages for normal depth calculations.

5.8 Calibration

Calibration was not performed as part of this study.

5.9 Final Results

Table 5.1 lists the results of the hydraulic calculations.

Table 5.1- Results of the Hydraulic Calculations

Wash	River Station	Peak Discharge	Normal Depth	Critical Depth	Top Width	Average Velocity	Froude No.
T6NR1ES4	0.031	1070 cfs	4.8 ft	4.7 ft	43.9 ft	8.9 fps	0.950
T6NR1ES4	0.130	1070 cfs	6.2 ft	6.0 ft	32.9 ft	10.2 fps	0.934
T6NR1ES4	0.221	1070 cfs	3.3 ft	3.0 ft	106.7 ft	6.1 fps	0.829
T6NR1ES4	0.376	1070 cfs	5.3 ft	5.2 ft	36.9 ft	9.5 fps	0.954

Table 5.1- Results of the Hydraulic Calculations

Wash	River Station	Peak Discharge	Normal Depth	Critical Depth	Top Width	Average Velocity	Froude No.
T7NR1ES34	0.234	878 cfs	5.0 ft	5.0 ft	43.9 ft	8.6 fps	0.999
T7NR1ES34*	0.292	878 cfs	6.3 ft	6.4 ft	26.1 ft	10.6 fps	1.043
T7NR1ES35*	0.111	1031 cfs	6.4 ft	6.9 ft	22.9 ft	12.8 fps	1.208
T7NR1ES35*	0.328	1031 cfs	5.5 ft	6.1 ft	29.7 ft	12.5 fps	1.319
T7NR1ES35*	0.466	1031 cfs	4.3 ft	4.8 ft	45.4 ft	10.6 fps	1.276
T7NR1ES35*	0.651	1031 cfs	6.5 ft	7.2 ft	24.2 ft	13.1 fps	1.282
T7NR1ES26-1	0.028	817 cfs	7.9 ft	5.5 ft	44.6 ft	4.6 ft	0.409
T7NR1ES26-1*	0.098	817 cfs	1.9 ft	2.0 ft	67.6 ft	7.7 fps	1.085
T7NR1ES26-1*	0.174	817 cfs	5.3 ft	5.6 ft	22.4 ft	11.6 ft	1.148
T7NR1ES26-1*	0.267	817 cfs	3.7 ft	4.0 ft	43.9 ft	9.3 fps	1.160
T7NR1ES26-1*	0.361	817 cfs	4.7 ft	5.1 ft	27.3 ft	11.0 fps	1.183
T7NR1ES26-1*	0.446	817 cfs	4.1 ft	4.8 ft	33.3 ft	11.8 fps	1.447
T7NR1ES26-2*	0.0728	3924 cfs	7.3 ft	8.6 ft	60.2 ft	16.7 fps	1.495
T7NR1ES26-2	0.315	3924 cfs	10.0 ft	9.1 ft	70.0 ft	10.6 fps	0.811
T7NR1ES26-2*	0.363	3924 cfs	6.2 ft	6.8 ft	83.6 ft	13.2 fps	1.238
T7NR1ES26-2	0.417	3924 cfs	11.7 ft	6.8 ft	112.2 ft	4.7 fps	0.305
T7NR1ES26-2*	0.492	3924 cfs	6.6 ft	7.0 ft	62.2 ft	13.5 fps	1.096
T7NR1ES26-2*	0.551	3924 cfs	8.4 ft	8.5 ft	64.4 ft	12.9 fps	1.050
T7NR1ES26-2A*	0.122	1479 cfs	5.7 ft	6.3 ft	33.1 ft	13.2 fps	1.260
T7NR1ES26-2B*	0.661	3488 cfs	7.6 ft	7.9 ft	51.4 ft	13.5 fps	1.065
T7NR1ES26-2B	1.482	2623 cfs	8.0 ft	7.6 ft	53.8 ft	10.9 fps	0.905
T7NR1ES26-2B	2.107	1998 cfs	7.0 ft	6.9 ft	45.6 ft	11..0 fps	0.972
T7NR1ES26-3*	0.011	1228 cfs	6.3 ft	7.1 ft	26.4 ft	14.1 fps	1.365
T7NR1ES26-3*	0.058	1228 cfs	3.6 ft	3.8 ft	56.0 ft	9.9 fps	1.176
T7NR1ES26-3*	0.186	1228 cfs	5.9 ft	6.0 ft	38.5 ft	10.5 fps	1.056
T7NR1ES26-3*	0.275	1228 cfs	5.5 ft	6.1 ft	35.4 ft	12.2 fps	1.279
T7NR1ES26-3*	0.429	1228 cfs	5.9 ft	6.2 ft	37.4 ft	10.9 fps	1.113

* Because the flow is supercritical the critical depth was used in floodplain mapping.

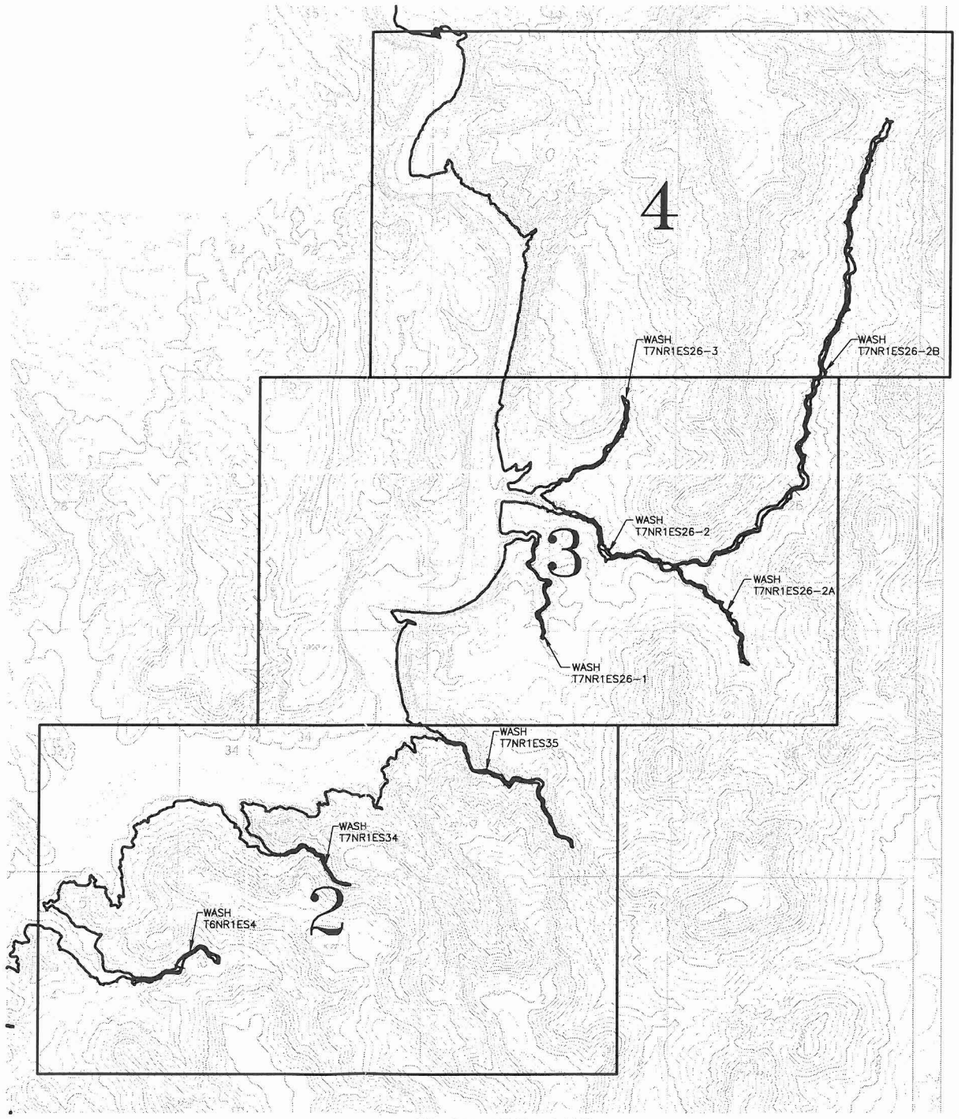
Table 5.1- Results of the Hydraulic Calculations

Wash	River Station	Peak Discharge	Normal Depth	Critical Depth	Top Width	Average Velocity	Froude No.
T7NR1ES26-3*	0.275	1228 cfs	5.5 ft	6.1 ft	35.4 ft	12.2 fps	1.279
T7NR1ES26-3*	0.429	1228 cfs	5.9 ft	6.2 ft	37.4 ft	10.9 fps	1.113

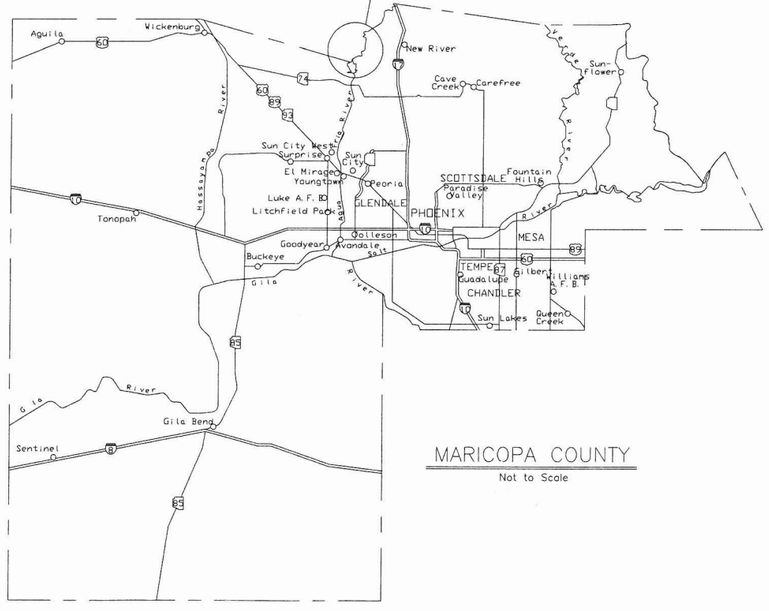
* Because the flow is supercritical the critical depth was used in floodplain mapping.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SUB WATERSHED #1
UPPER AGUA FRIA WATERSHED
ZONE A FLOODPLAIN DELINEATION STUDY
CONTRACT F.C.D. 2000C020



PROJECT LOCATION



MARICOPA COUNTY
Not to Scale

STUDY AREA MAP
AND SHEET INDEX

SHEET INDEX
SHEET 2-4 FLOOD DELINEATION STUDY

1500' 0' 1500' 3000'
SCALE: 1"= 1500 FEET
FLIGHT DATES:
12/16/2000-03/15/2001

AERIAL PHOTOGRAPHY
LANDATA AIRBORN SYSTEMS

CONTOUR INTERVAL: 10 FEET

GROUND CONTROL
RBF CONSULTING
16605 N 28TH AVENUE, SUITE 100
PHOENIX, ARIZONA, 85053
(602)467-2200

HYDROLOGY & HYDRAULICS
RBF CONSULTING
16605 N 28TH AVENUE, SUITE 100
PHOENIX, ARIZONA, 85053
(602)467-2200

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL State of ARIZONA U.S.A.

RBF CONSULTING

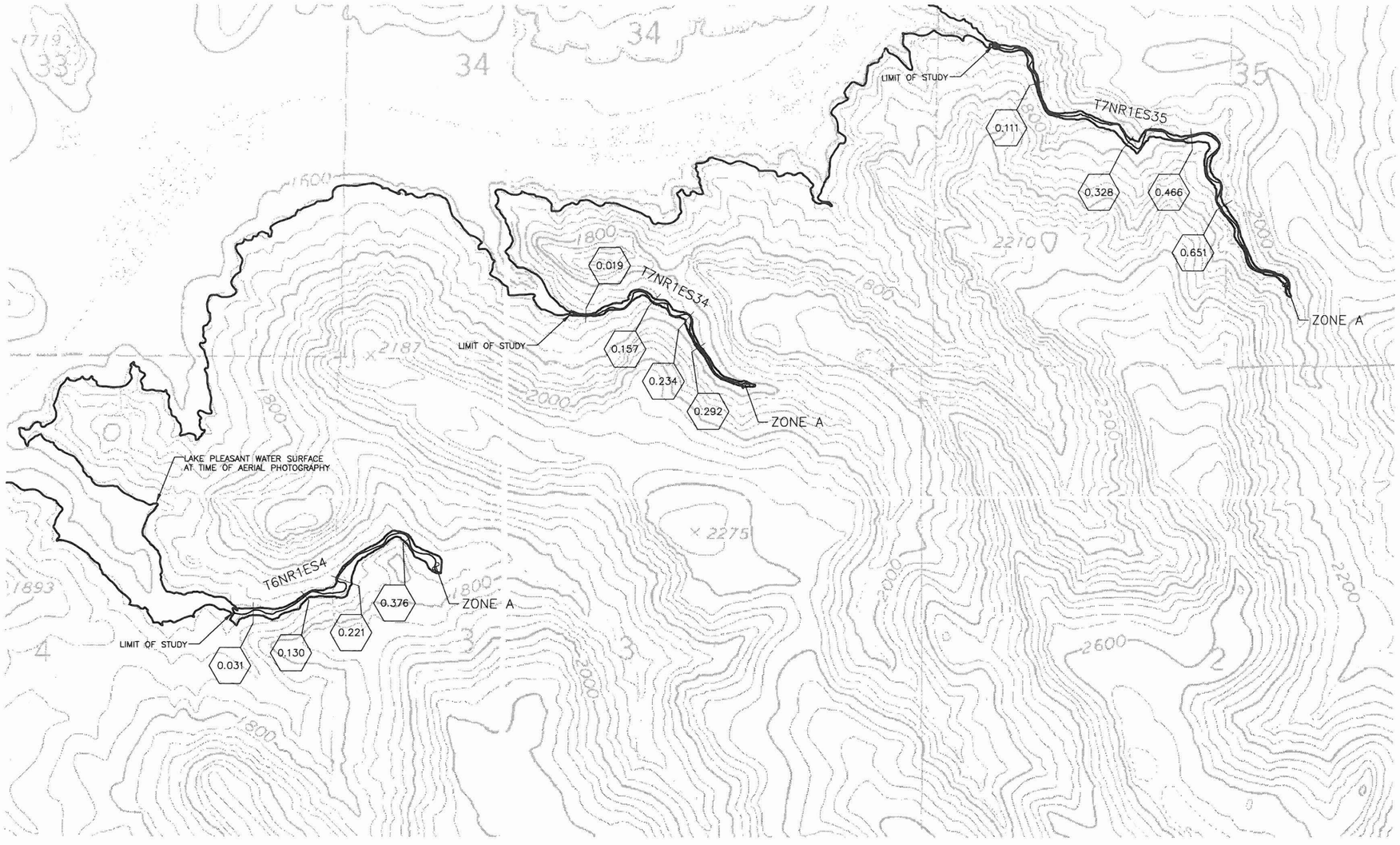
	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 01 OF 04

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

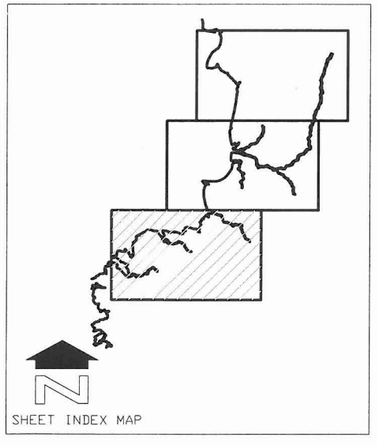
CROSS SECTION (0.1000)

ZONE DESIGNATIONS	ZONE A
CORPORATE LIMITS	Corporate Limits
COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY	County Boundary

ELEVATION REFERENCE MARKS

NOTE: NO ELEVATION REFERENCE MARKS WERE USED FOR THIS PROJECT. ALL WORK IS BASED ON 10 FOOT CONTOURS GENERATED FROM EXISTING COUNTY DIGITAL TERRAIN MODELS (DTM).

NOTES



NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL State of ARIZONA, U.S.A.

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	BY	DATE
DESIGN	RBM	5/02/02
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PLANS CHK.	SML	5/15/02

SHEET 02 OF 04

500' 0' 500' 1000'

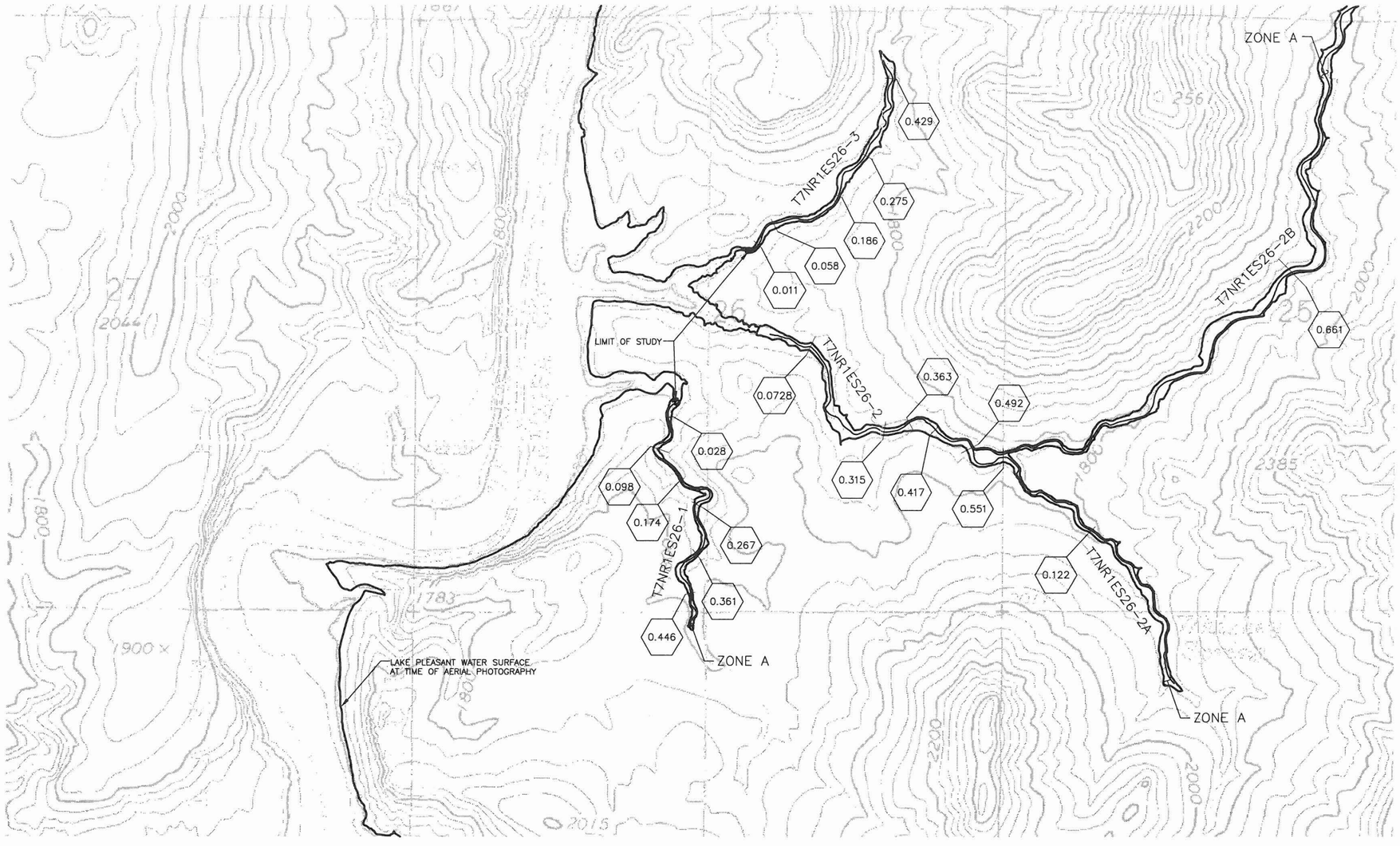
SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

CROSS SECTION (0.1000)

ZONE DESIGNATIONS	ZONE A
CORPORATE LIMITS	Corporate Limits
COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY	County Boundary

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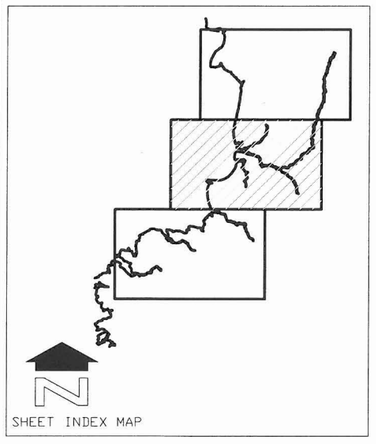
NOTES



SHEET INDEX MAP

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL State of ARIZONA U.S.A.

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PLANS CHK.	SML	5/15/02

SHEET 03 OF 04

500' 0' 500' 1000'

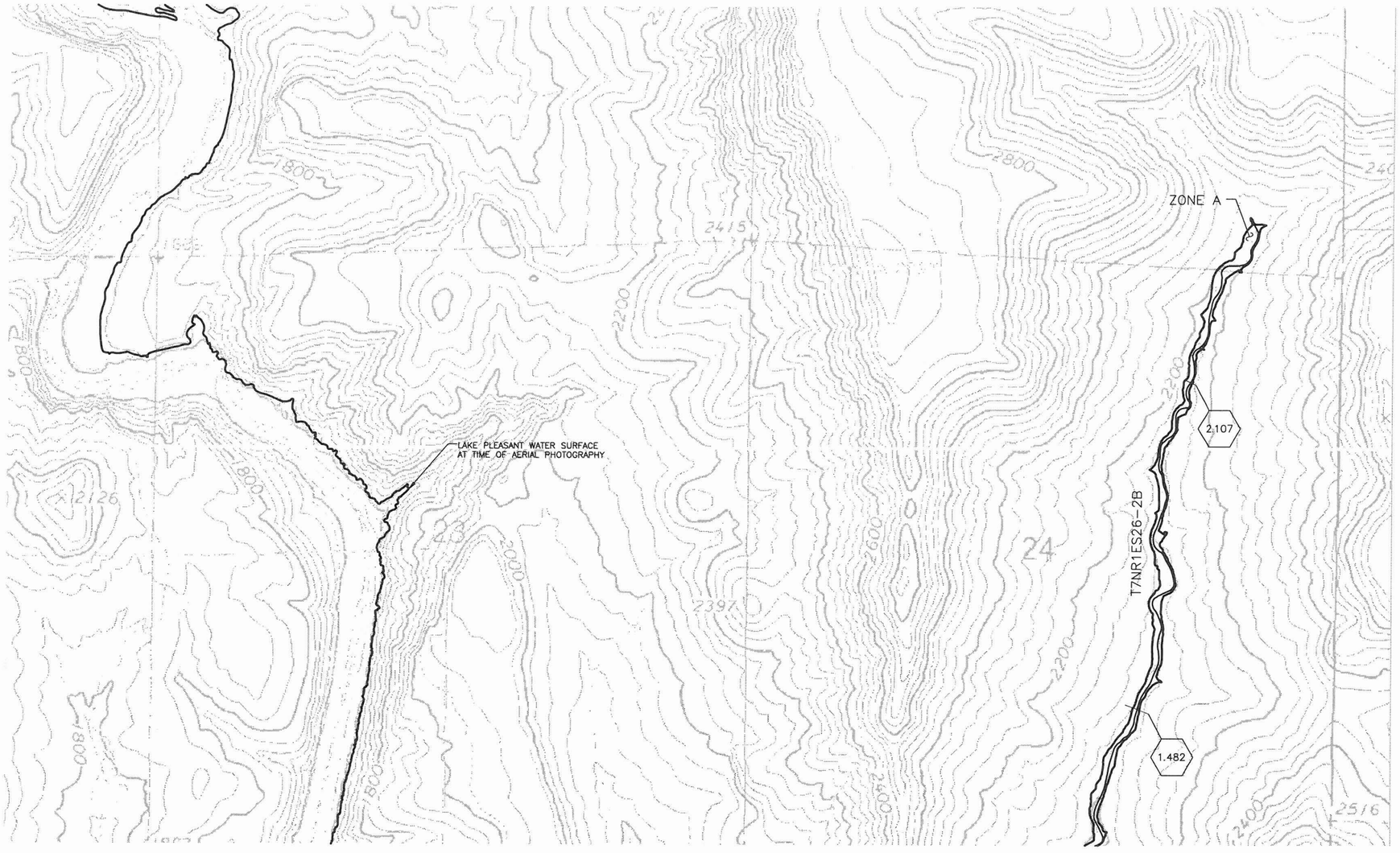
SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

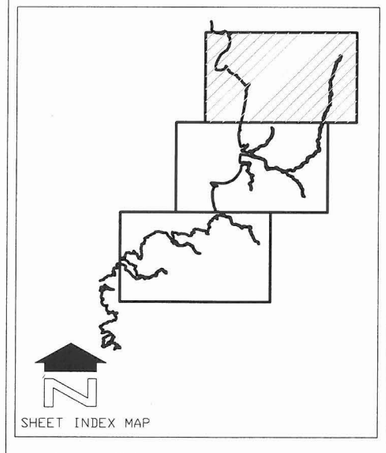
CROSS SECTION (0.1000)

ZONE DESIGNATIONS	ZONE A
CORPORATE LIMITS	Corporate Limits
COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY	County Boundary

ELEVATION REFERENCE MARKS

NOTE: NO ELEVATION REFERENCE MARKS WERE USED FOR THIS PROJECT. ALL WORK IS BASED ON 10 FOOT CONTOURS GENERATED FROM EXISTING COUNTY DIGITAL TERRAIN MODELS (DTM).

NOTES



NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil)
CERTIFICATE NO.
36122
ROY B. McDANIEL
Date Signed
ARIZONA, U.S.A.

RBF CONSULTING

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 04 OF 04

500' 0' 500' 1000'

SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING

Section 6
Erosion and Sediment Transport

Section 6: Erosion and Sediment Transport

Erosion and sediment transport is not being considered in this study.

Section 7
Draft FIS Report Data

Section 7: Draft FIS Report Data

7.1 Summary of Discharges

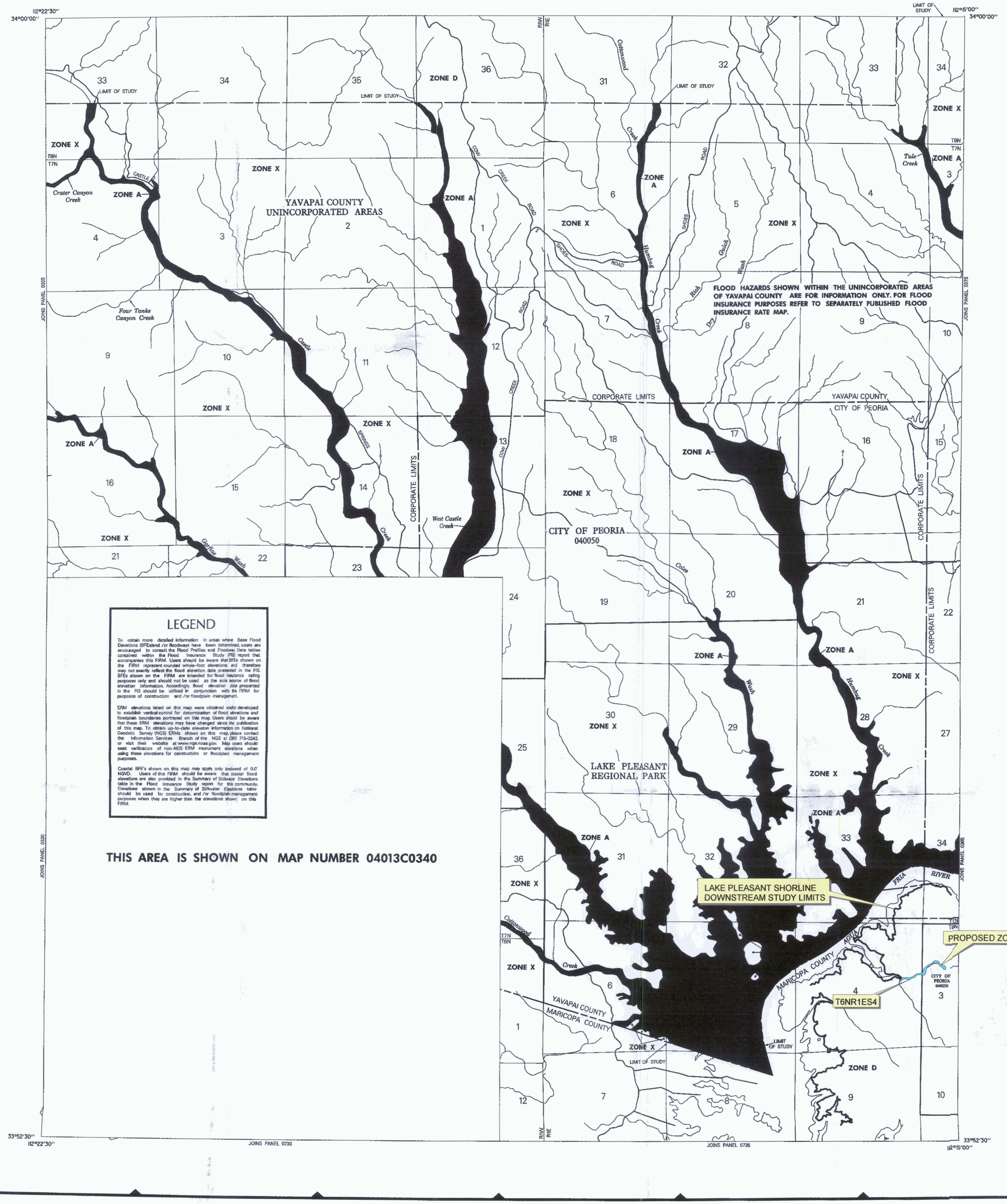
Table 7.1- Summary of Discharges

Flooding Source and Location	Drainage Area (square miles)	Peak 100-year Discharge (cfs)
T6NR1ES4 Confluence with Lake Pleasant	0.70	1070
T7NR1ES34 Confluence with Lake Pleasant	0.60	878
T7NR1ES35 Confluence with Lake Pleasant	0.76	1031
T7NR1ES26-1 Confluence with Lake Pleasant	0.65	817
T7NR1ES26-2 Confluence with Lake Pleasant	2.99	3924
T7NR1ES26-2A 0.59 miles from the confluence with Lake Pleasant Confluence with T7NR1ES26-2A	0.72	1479
T7NR1ES26-2B 0.59 miles from the confluence with Lake Pleasant Confluence with T7NR1ES26-2A	2.02	3488
1.72 miles from the confluence with Lake Pleasant 1.13 miles from the confluence with T&NR1ES26-2A	1.50	2623
2.49 miles from the confluence with Lake Pleasant 1.91 miles fro the confluence with T7NR1ES26-2A	0.99	1998
T7NR1ES26-3 Confluence with Lake Pleasant	0.81	1228

7.2 Floodway Data and Flood Profiles

Because this is an approximate delineation for Zone A flood plains, there is no floodway data nor Flood Profiles.

7.3 Annotated FIRMs



LEGEND

To obtain more detailed information in areas where Base Flood Elevations (BFEs)and /or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations and therefore may not exactly reflect the flood elevation data presented in the FIS. BFEs shown on the FIRM are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS should be utilized in conjunction with the FIRM for purposes of construction and /or floodplain management.

ERM elevations listed on this map were obtained and/or developed to establish vertical control for determination of flood elevations and floodplain boundaries portrayed on this map. Users should be aware that these ERM elevations may have changed since the publication of this map. To obtain up-to-date elevation information on National Geodetic Survey (NGS) ERMs shown on this map,please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

Coastal BFE's shown on this map may apply only landward of 0.0' NGVD. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and /or floodplain management purposes when they are higher than the elevations shown on this FIRM.

THIS AREA IS SHOWN ON MAP NUMBER 04013C0340

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction ; no base flood elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- (D)—(D) — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 × — Elevation Reference Mark
- M2 — River Mile
- 97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFE's, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and /or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
APRIL 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:
DECEMBER 3, 1993

Map revised July 19, 2001 to update corporate limits, to change base flood elevations, to add base flood elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 350 OF 4350
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0350	F
PEORIA, CITY OF	040050	0350	F

PROPOSED ZONE A FLOODPLAINS

MAP NUMBER 04013C0350 F

MAP REVISED: JULY 19, 2001

Federal Emergency Management Agency

A B C D E F

112°15'00" 33°56'15" JOINS PANEL 0375 112°11'15" 33°56'15"

LEGEND

To obtain more detailed information in areas where Base Flood Elevations (BFE's) and /or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFE's shown on the FIRM represent rounded whole-foot elevations and therefore may not exactly reflect the flood elevation data presented in the FIS. BFE's shown on the FIRM are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS should be utilized in conjunction with the FIRM for purposes of construction and /or floodplain management.

ERM elevations listed on this map were obtained and/or developed to establish vertical control for determination of flood elevations and floodplain boundaries portrayed on this map. Users should be aware that these ERM elevations may have changed since the publication of this map. To obtain up-to-date elevation information on National Geodetic Survey (NGS) ERM's shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

Coastal BFE's shown on this map may apply only landward of 0.0' NGVD. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and /or floodplain management purposes when they are higher than the elevations shown on this FIRM.

LAKE PLEASANT SHORELINE DOWNSTREAM STUDY LIMITS

T7NR1ES26-3 PROPOSED ZONE A

T7NR1ES26-2B

T7NR1ES26-2 PROPOSED ZONE A

T7NR1ES26-2A

T7NR1ES35 PROPOSED ZONE A

T7NR1ES34 PROPOSED ZONE A

T6NR1ES4 PROPOSED ZONE A

NOTE: Floodplain subject to significant hazards because of channel migration and streambed and bank erosion. Communities in Maricopa County are urged to adopt management standards accordingly.

FLOODWAY IN THIS AREA IS TOO NARROW TO SHOW TO SCALE REFER TO THE FLOODWAY DATA TABLE

ZONE A

ZONE D

ZONE X

ZONE AE

Lake Pleasant Regional Park

LAKE PLEASANT

New River

Skunk Creek

Agua Fria River

YAVAPAI COUNTY

MARICOPA COUNTY

T7N

T6N

23 24 25 26 27 28 29 30 31 34 35 36 1 2 3 10 11 12

JOINS PANEL 0350

JOINS PANEL 0370

JOINS PANEL 0755

LIMIT OF STUDY

MARICOPA COUNTY UNINCORPORATED AREAS 040037

CITY OF PEORIA 040050

33°52'30" 112°15'00" 112°11'15" 33°52'30"

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction ; no base flood elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- (D)—(D) (EL 987) — Cross Section Line
- Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 × M2 — Elevation Reference Mark
- River Mile
- 97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFE's, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and /or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
APRIL 15, 1968

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:
SEPTEMBER 29, 1989

Map revised July 19, 2001 to update corporate limits, to change base flood elevations, to add base flood elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-8620.

APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 365 OF 4350
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0365	F
PEORIA, CITY OF	040050	0365	F

PROPOSED ZONE A FLOOD PLAINS

MAP NUMBER 04013C0365 F

MAP REVISED: JULY 19, 2001

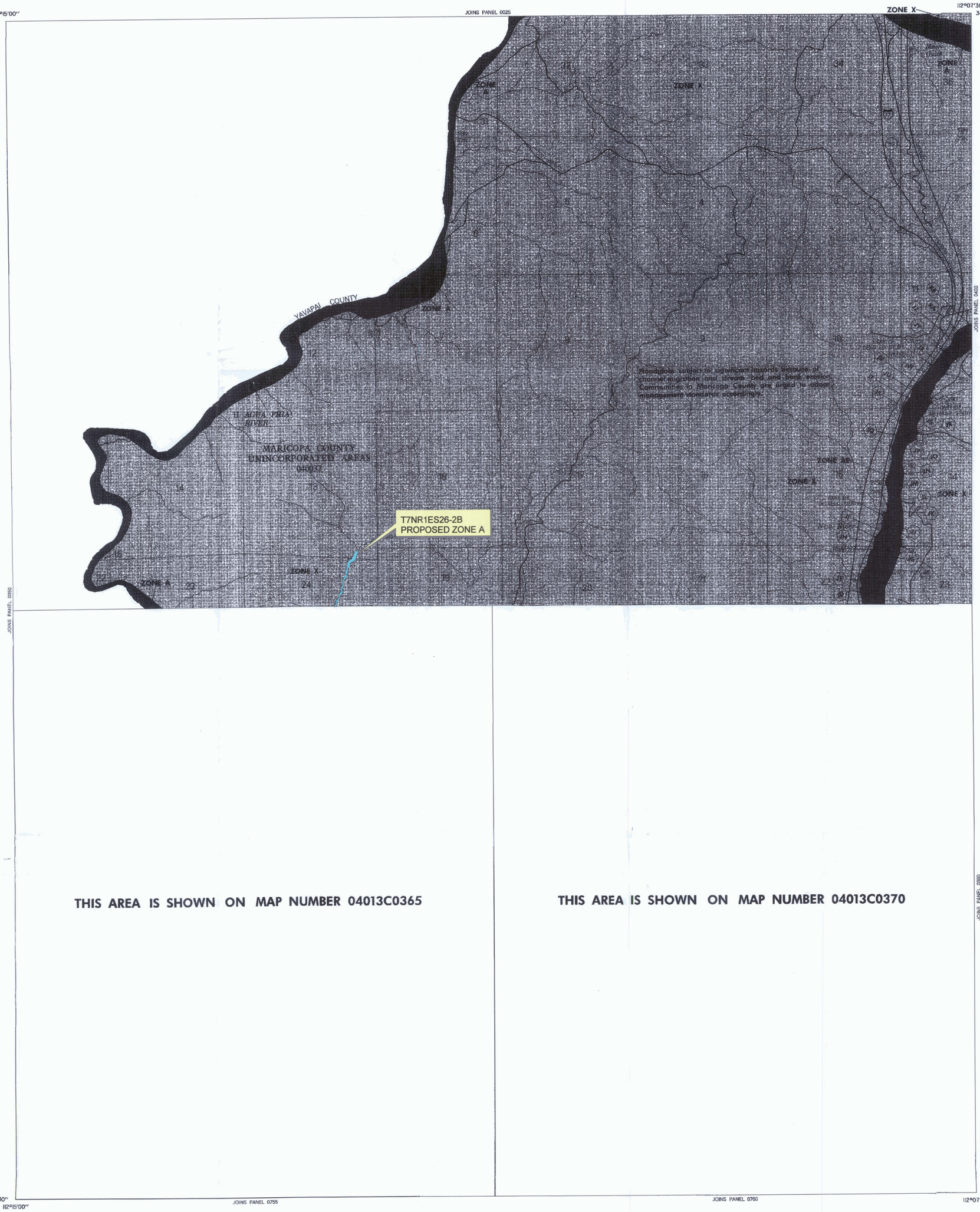
Federal Emergency Management Agency

A B C D E F G

112°15'00" 34°00'00" JOINS PANEL 0025 112°07'30" 34°00'00"

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
RM525	2307.18	A +-inch rebar set 30 feet q north of two saguaros atop flat knoll, proceed west on Track Road 0.1 q mile from Table Mesa Interchange then south along a meandering road 0.4q mile to bend turning west, proceed west 650 feet q to mark; approximately 1800 feet q north of the southwest corner of section 11, T7N, R2E.
RM526	2157.48	A PK nail and shiner in the safety lane of northbound I-17 0.15 q mile north of mile post no. 234, 1100 feet q east of the northeast corner of section 22, T7N, R2E.



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction ; no base flood elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

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- Floodway Boundary
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- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- D — D — Cross Section Line
- (EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 — Elevation Reference Mark
- M2 — River Mile
- 97°07'30", 32°22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

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Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

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Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

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For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
APRIL 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:
SEPTEMBER 29, 1989

Map revised July 19, 2001 to update corporate limits, to change base flood elevations, to add base flood elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
2000 0 2000

LEGEND

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ERM elevations listed on this map were obtained and/or developed to establish vertical control for determination of flood elevations and floodplain boundaries portrayed on this map. Users should be aware that these ERM elevations may have changed since the publication of this map. To obtain up-to-date elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

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NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 375 OF 4350
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0375	F

PROPOSED ZONE A FLOODPLAINS

MAP NUMBER 04013C0375 F

MAP REVISED: JULY 19, 2001

Federal Emergency Management Agency

Appendix A
References

A.1 Data Collection Summary

The following reports and studies were used in the preparation of this study.

Soil Survey of the Aguila-Carefree Area, Parts of Maricopa and Pinal Counties, Arizona, April 1986, USDA Soil Conservations Service (SCS)

"Maricopa County Ortho-Photo GPS Summary of Procedure Final Report", April 2001, RBF Consulting, Phoenix, Arizona

A.2 Referenced Documents

Sabol, George, et al, *Drainage Design Manual for Maricopa County, Arizona, Volume I*, January 1995, Flood Control District of Maricopa County

Thomsen, B.W., and H.W. Hjalmarson, *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*, April 1991, U.S. Geological Survey Water Resources Division

Jennings, M.E., W.O. Thomas, Jr., and H.C. Riggs, *Nationwide Summary of U.S. Geological Survey Regional Regression Equations for Estimating Magnitude of Frequency of Floods for Ungaged Sites, 1993*, U.S. Geological Survey Water Resources Investigative Report 94-4002., 1994, Reston, Virginia

WMS Watershed Modeling System Reference Manual, 1999, Brigham Young University, Environmental Modeling Research Laboratory, Provo, Utah

Appendix B
General Documentation and Correspondence

B.1 Special Problem Reports

Special Problem Report

Landata Airborn Systems produced and certified the aerial photographs and digital terrain model (DTM) used in this study for Maricopa County, but as of the date of this report they had not created any contour data. Because FEMA guidelines specify using existing mapping for Zone A Delineation Studies RBF did not produce any new contour data for this study. WMS was used to delineate the watershed, perform the hydraulic calculations, and delineate the floodplains. WMS creates contours based on the imported DTM for visual purposes only, but uses the DTM in the form a either a digital elevation model (DEM) or a triangulated irregular network (TIN) to get all the information necessary to perform its calculations.

The Hydraulic Study maps contains cross sections, Lake Pleasant shoreline, and the floodplain delineation boundaries based on the DTM data. A background image was used to overlay the floodplain delineations because there was no certified contour data at the time this report was prepared. Showing the DTM behind the floodplain map would not make any sense. The background image is a compilation of several USGS Digital Raster Graphic (DRG) files in TIFF Format. The cross sections were not taken from the USGS DRG, but from the DTM in WMS. Appendix E5 contains exhibits that show scaled plan views of the WMS generated contours cross sections. For this reason the exhibits in Appendix E5 should be used to check any cross sections instead of the Hydraulic Work Maps.

B.2 Contact (Telephone) Reports

	Incoming Call	Job No.	45-100648
X	Outgoing Call	Date	10-11-01
Individual Contact	Angela Mobile	By	Travis Nuttall
Title	Reality Specialist	Phone	(623)580-5500
Company /Agency	BLM/ Phoenix	Project Name	Upper Agua Fria Zone A Flood Plain Delineaton Study
Address	21605 North 7th Ave		
Subject of Contact	Searching for As-Built Data on the BLM Property		
Items Discussed	They have R.O.W. files and maps of what is going to be built. Costs 13 cents per page to copy, paid by check, plastic, or cash. The are open 7:30 a.m. to 4:00 p.m. Mon-Fri.		
Action to be Taken			
Route to			

	Incoming Call	Job No.	45-100648
X	Outgoing Call	Date	10-11-01
Individual Contact	Sarah	By	Travis Nuttall
Title		Phone	(602)225-5200
Company/ Agency	Tonto National Forest Soil Survey Team	Project Name	Upper Agua Fria Zone A Flood Plain Delineaton Study
Address			
Subject of Contact	Searching for soil survey information in Yavapai County. Black Canyon City and Rock Springs area.		
Items Discussed	Maybe the NRCS has some. Call Hays Dye at 602-280-8815. She will call me back after doing some research herself. These areas are out of their jurisdiction. Rock Springs in BLM area. Black Canyon City in NRCS area.		
Action to be Taken			
Route to			

	Incoming Call	Job No.	45-100648
X	Outgoing Call	Date	10-11-01
Individual Contact	Hays Dye	By	Travis Nuttall
Title	Regional Manager	Phone	(623)280-8815
Company/ Agency	NRCS	Project Name	Upper Agua Fria Zone A Flood Plain Delineaton Study
Address			
Subject of Contact	Looking for Soil Survey Data		
Items Discussed	Phil Camp- 602-280-8837 is the Arizona Manager. Can download off of website. Http://www.ftw.nrcs.usda.gov/ssur.data.html. ID# AZ645- In ArcInfo format. GIS Specialist is Eric Wolfbrandt, 280-8822		
Action to be Taken			
Route to			

B.3 Meeting Minutes or Reports

Kick-Off Meeting
August 30, 2001

People Attending:

Scott Larson, RBF	Richard Harris, FCD	Marta Dent, FCD
Roy McDaniel, RBF	Michael Duncan, FCD	Bing Zhao, FCD
Tim Murphy, FCD	Dave Degerness, FCD	

- Use State Standard 1-97 for the Technical Data Notebook.
- The Flood Control District gets the original Legal Advertising.
- Richard Harris will give me sample right-of-entry examples and legal counsel for right-of-entry.
- Received a copy of general guidelines
- Marta will give us the ASCII Grid files, RMS is approximately 2.5 feet.
- GDACS is the basis for ground control.
- We need to schedule a field trip.
- Naming convention of the washes should include section, township, and range.
- Contact Dave Degerness about naming convention.
- The HIS training is coming up.
- Advertise the study in the Desert Advocate and the Arizona Republic
- Get property ownership from Jim Smith. Use the survey letter as the initial letter. Give 72 hours notice. Give surveyors a copy of the state statute to have on hand. About 40 owners.
- Task 5.4c should read DRNPTH. Look at the book.
- Got a copy of the Estimate Manning's Roughness book for Maricopa County
- Scheduled a field trip for 1 week from yesterday. Come up with a route map if we are taking different vehicles. Meet at RBF office at 8:00 a.m.
- Have a meeting every 2 weeks at our office.
- We will do a public mailing instead of a public meeting at the end of the project.
- If we need to get on private property, use certified mail.
- Mapping scale- Work with Richard. Use either 1" = 400' or 1" = 1000'. Topo maps will be printed at 1" = 500'. Explore this.
- Borrow an example TDN from Richard.
- David Evans- May be designing a proposed subdivision in the area. The FCD will check.
- The "Sweat Canyon TDN" and the New River TDN are good examples for comparative hydrology.
- Use 100-year 24-hour and Clark Unit Hydrograph for the 1st study, if applicable.
- Study FEMA 37 and FEMA 265 (January 95)
- CADD Techs and Engineers should attend the HIS Training.
- Get new soils info. From Marta and Dave.
- Meet Wed for Field Trip.
- Plan a meeting at our office on the 12th, 8:30 a.m.

B.4 General Correspondence

RBF CONSULTING

April 8, 2003

JN 45-100648.001

Mr. Richard Harris, P.E.
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009

Subject: *Upper Agua Fria Watershed Floodplain Delineation Study*
Policy for the determination of the WTR_ELV field in the CAD Deliverable file: **fpxfcd-a.xls**

Dear Richard:

The WTR_ELV field in the CAD Deliverable file *fpxfcd-a.xls* was obtained by taking the lowest elevation along each cross-section extracted from WMS, and adding the normal depth (or critical depth, whichever is higher) to obtain water surface elevations. The lowest, or thalweg, elevations, as well as the water depths, are found in Appendix E of each Technical Data Notebook for this study. Screen captures and calculation outputs are provided for every reach utilized to delineate the floodplain. These values were manually entered into the WTR_ELV field of the fpxfcd-a.xls file.

Sincerely,

William J. King, P.E.
Water Resources

H:\PDATA\45100648\Word\cadeliv-fpxfcd-a.doc

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009-6399
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5897

Date: October 17, 2002

Mr. David Moody, P.E.
Public Works Engineering Director
City of Peoria
8401 West Monroe Street
Peoria, AZ 85345

Subject: Upper Agua Fria FDS, Watershed #1

Dear Mr. Moody,

Please find enclosed a copy of the subject study Technical Data Notebook. The TDN contains most of the technical analysis documentation used in the floodplain delineation of several tributaries to the Agua Fria River named in the copy of FEMA's Letter of Map Revision (LOMR), located at the end of Appendix B. Study Maps are included within the TDN, that may be used as guidance for development along the study washes.

If you have any questions, please call me at (602) 506-4528.

Sincerely,

Richard P. Harris, P.E.
Project Manager

ANNOUNCEMENT OF INTENT TO PERFORM FLOODPLAIN DELINEATION STUDY

The Flood Control District of Maricopa County (FCDMC), under authority of the National Flood Insurance Act of 1968 (PL-90-448), as amended, and the Flood Disaster Protection Act of 1973 (PL-93-234), is funding a study of flood hazard areas along the shores of and near Lake Pleasant. The FCDMC has contracted with RBF Consulting to perform floodplain delineations of approximately 50 miles of washes that are tributary to the Agua Fria River. The study area will extend from Lake Pleasant northward to the Maricopa County line. All washes to be delineated are located in the Upper Agua Fria River Watershed, and will include Moore Gulch, Little Squaw Creek, washes in the Table Mesa Road area, and several other nearby washes.

This study will examine and evaluate the flood hazard areas for the Upper Agua Fria Watershed. The results will be published to update the flood insurance rate maps (FIRMs) used by the Federal Emergency Management Agency (FEMA). The FIRMs will be used to determine flood insurance rates.

This announcement is intended to inform all interested persons and communities of the commencement of this study so that they may have an opportunity to bring any relevant technical information to the attention of the FCDMC/FEMA, to be considered during the course of this study. Your comments should be addressed to Mr. Richard Harris, P.E., Project Manager at the Flood Control District of Maricopa County, 2801 West Durango Street Phoenix, AZ 85009, (602)506-1501. 01693- September 28; October 5, 2001

THE ARIZONA REPUBLIC

STATE OF ARIZONA
COUNTY OF MARICOPA } SS.

TOM BIANCO, being first duly sworn, upon oath deposes and says: That he is the legal advertising manager of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published at Phoenix, Arizona, by Phoenix Newspapers Inc., which also publishes The Arizona Republic, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates as indicated.

The Arizona Republic/West Zone

September 28; October 5, 2001

Sworn to before me this
9 TH day of
October A.D. 2001

OFFICIAL SEAL
GLORIA SALDIVAR
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires Dec. 1, 2003

Notary Public

THE DESERT ADVOCATE
47027 N. New River Rd.
New River, Arizona 85087
Tel: 623-465-9384 Fax: 623-465-5729
E-Mail: desertadvocate@uswest.net

CERTIFICATE OF PUBLICATION

The Desert Advocate newspaper has published Floodplain Delineations Study under authority of NFIA of 1968 (PL-90-448). The Public Notice was commissioned to be published on October 2, 2001 and October 16, 2001 issues as requested by the Flood Control District of Maricopa County.

Date: October 23, 2001

Karen K. Seemeyer
Publisher,
The Desert Advocate

RBF
CONSULTING

September 25, 2001

ROCK LTD PARTNERSHIP
Hc I Box 2000
Rock Springs, AZ 85324

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 01 001

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

The intent of this letter is to notify you of the commencement of surveying activities in support of the above mentioned study. In order to perform these surveys it may be necessary to enter your property. This activity should not result in any inconvenience or damage to property. If you have any objections to the entry onto your property you must notify Mr. Richard Harris, P.E., of the Flood Control District at (602) 506-1501. Otherwise it will be assumed that you consent to the entry onto your property.

The study and resulting maps will be used for floodplain management purposes and submitted to the Federal Emergency Management Agency for flood insurance information and revision of Flood Insurance Rate Maps. This study will be available to the public in approximately 9 months.

The Flood Control District and its representatives appreciate your help in assuring the accuracy of this study by allowing access to your property for the surveyors and by providing any information you may have regarding past flooding or related problems.

If you have any questions regarding this study or the right of entry, please contact Mr. Richard Harris, P.E., of the Flood Control District or Mr. Roy McDaniel, P.E., of RBF Consulting.

Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

Arlo W Richardson
1124 S Palo Verde St
Mesa, AZ 85208

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 01 002, 202 01 003, 202 01 004, 202 01 005, 202 02 001A, 202 03 001

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

EXUM & ASSOC LTD
12322 E Doubletree Ranch Rd
Scottsdale, AZ 85259

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 01 006

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

Richard & Norine Tr Rick
3010 E Madison St
Phoenix, AZ 85034

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 02 002A

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

Jeanette Louise Shoecraft
1320 W Elliot Rd #103-505
Tempe, AZ 85284

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 03 002

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

Charles V Wilder Jr.
5950 W Table Mesa Rd
Phoenix, AZ 85087

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 03 003

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF CONSULTING

September 25, 2001

U S A
23636 N 7Th St
Phoenix, AZ 85024

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 04 001, 202 04 002, 202 05 004, 202 05 005, 202 05 006A, 202 05 008, 202 24 001

Dear Property Owner:

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

UNITED STATES OF AMERICA
PO Box 9980
Phoenix, AZ 85068

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 05 001A, 202 05 002, 202 05 003, 202 05 007A

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

John F & Belle S Swartz
PO Box 10500
Phoenix, AZ 85064

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 24 002

Dear Property Owner:

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Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF
CONSULTING

September 25, 2001

DI PIETRO ARIZONA FAMILY LIMIT
10320 W Indian School Rd
Phoenix, AZ 85037

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 05 007D, 202 05 007E

Dear Property Owner:

The Flood Control District of Maricopa County has contracted with RBF Consulting to perform a floodplain delineation study for the Upper Agua Fria Watershed. The purpose of this study is to determine flood related hazard zones and delineate areas that may be subject to inundation during a "100-year flood" event. According to records at the Maricopa County Assessor's office, you own one or more parcel of land within the limits of the study area.

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

RBF CONSULTING

September 25, 2001

DI PIETRO ARIZONA FAMILY LP
440 Lake Cook Rd
Deerfield, IL 60015

Subject: Right of Entry for Surveying Purposes

Parcel Nos.: 202 05 007F

Dear Property Owner:

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Mr. Richard Harris, P.E., Project Manager, Flood Control District, (602) 506-1501.

Mr. Roy McDaniel, P.E., Project Manager, RBF Consulting, (602) 467-2200

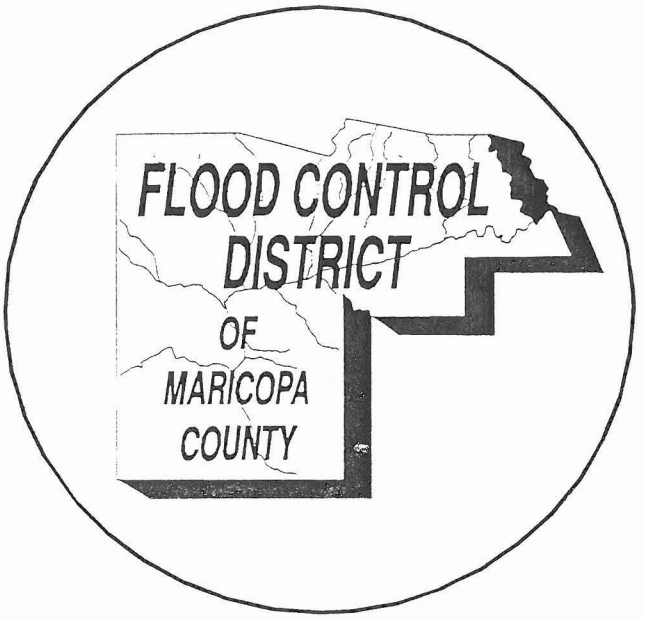
Sincerely,

Roy McDaniel

Roy McDaniel, P.E.
Project Manager

B.5 Contract Documents

EXHIBIT A



SCOPE OF WORK

CONTRACT FCD 2000C020

UPPER AGUA FRIA WATERSHED
ZONE A FLOODPLAIN DELINEATION STUDY

EXHIBIT A

SCOPE OF WORK

CONTRACT FCD 2000C020

UPPER AGUA FRIA WATERSHED ZONE A FLOODPLAIN DELINEATION STUDY

GENERAL

The goal of this project is to delineate an estimated 50 miles of approximate Zone A 100-year floodplains in Watershed "UU" (a.k.a., Upper Agua Fria Watershed) east of Lake Pleasant within Maricopa County. The limits of Watershed "UU" are shown on Exhibit A.1.

In order to accomplish the study's goal, the consultant will have to 1) coordinate the study with the District and others, 2) collect and analyze existing data, 3) use existing USGS topographic mapping, 4) perform field surveys as required, 5) develop the 100-year peak discharges, 6) delineate the Zone A floodplains, 7) prepare the study results in an electronic form (HIS data will be submitted with each appropriate task deliverable), and 8) deliver all of the study documentation in formats acceptable to the District and Federal Emergency Management Agency (FEMA).

The consultant must use sound engineering judgement in the development of the hydrologic data and hydraulic models. All work must meet Arizona Department of Water Resources (ADWR) and the Federal Emergency Management Agency (FEMA) requirements for Zone A floodplain delineations. Prior to the finalization of this contract, FEMA and the District must review and accept the results of this study, and all items called for in this Scope of Work must be delivered to the District. All work completed under this scope of services is to conform with District Consultant Contracting Guidelines dated August 1, 2000.

The floodplain delineations will be phased according to the sub-watershed identification as identified in Exhibit A.1 and prioritization presented in Table 1, below.

Table 1: Sub-Watershed Prioritization

Sub-Watershed	Relative Priority	Miles of Delineation
06N 01E SEC 4 (EAST LAKE PLEASANT)	1	9
07N 02E SEC 7 (TABLE MESA RD AREA)	2	12
08N 02E SEC 28 (MOORE GULCH)	3	15
08N 02E SEC 21 (LITTLE SQUAW CREEK)	4	13
Total Area		49

The time frame for delineation of the Zone floodplains will be 180 days including 90 days for FCD review. Additional time, equal to 120 days will be allowed for FEMA review. All work must be completed including FEMA review within 300 days from the notice to proceed.

TASK 1 - COORDINATION

1.1 Within fourteen days of Notice to Proceed (NTP), the consultant will submit a project schedule to the District's Project Manager showing coordination meetings and completion dates for each task identified in the scope of work. The consultant will update this project schedule when appropriate.

1.2 The consultant will participate in regular coordination meetings (at least every 4 weeks) with the District's Project Manager and in milestone coordination meetings in the development of the hydrologic and hydraulic analyses. The consultant is responsible for the minutes of any meetings. Whenever possible, coordination and milestone meetings will be combined.

1.3 The consultant will submit an estimate of the monthly billing within 14 days of Notice to Proceed. Thereafter, this estimate will be updated and submitted to the District's project manager at least 10 days before the end of each quarter.

1.4 The consultant will submit monthly progress reports at least 5 days before submittal of monthly invoices. The report shall be brief and should be no longer than two typed pages. At a minimum, the monthly report shall contain the following:

a. A description of the work accomplished by task during the reporting month.

b. Percent (%) completed for the month and percent (%) cumulative completed for each task.

c. A brief description of the work to be accomplished in the following month.

d. A description of any problems encountered and a recommended solution.

1.5 The consultant is responsible for placing the legal advertising at the beginning of the study, notifying the public of the study. The ad will be run in a widely circulated local newspaper twice, with approximately one week between runs. The ad must also be run twice in a local newspaper that serves the area being studied. After the newspapers run the ad, the consultant will supply the District with the original affidavit of publication from each newspaper for each day that the ad ran.

1.6 The consultant will notify all property owners and obtain any necessary Rights of Entry for the study area. The District will furnish the consultant with a list of all the property owners to be notified. The consultant will furnish the District with a sample Right of Entry letter.

1.7 The consultant will meet with officials from the District and send a letter of notification to any incorporated communities affected.

1.8 The District will provide any public notice beyond that described in Task 1.6.

1.9 Consultant/District Performance Evaluations will be performed. An informal evaluation will be performed at the completion of the hydrologic analysis. A formal evaluation will be performed at the completion of the project upon receipt of all deliverables.

1.10 The Consultant will partake in the District's 6-hour HIS Training Course.

1.11 **(OPTIONAL)** The Consultant will work with the District to identify problems in WMS that are encountered during the services defined in this scope of work. The Consultant will contract with EMS-I to customize WMS for floodplain delineation and correct the identified problems. This work will only be undertaken through written authorization by the District's Project Manager based upon review and approval of specific tasks and costs.

TASK 2 - DATA COLLECTION

2.1 The consultant will collect and review pertinent data from the District and other outside sources. Data to be collected will include previous flood hazard reports and hydrology for the study area; existing readily available topographic mapping; proposed development plans, historical flooding information; as-built plans for existing structures; FEMA Flood Hazard Boundary Maps and any Letters of Map Amendment and/or Revisions, and other pertinent information.

2.2 A written report summarizing the data collected will be included as a section in the Technical Data Notebook (TDN). A preliminary draft of this section is due within 90 days of Notice to Proceed.

TASK 3 - TOPOGRAPHIC MAPPING

The consultant will use existing USGS topographic mapping and/or other topographic mapping provided by the District.

TASK 4 - FIELD SURVEY

4.1 (**OPTIONAL**) Field measurements of bridges, culverts, and hydraulic structures are to be obtained by the consultant when as-built plans are not available, or when conditions have changed that impact the Zone A delineation. This information should be reduced and compiled into an 11"x 17" (maximum size) drawing for inclusion in the TDN. The information presented in the drawing should be in a format appropriate for use in future HEC-RAS models. This task is not authorized with the NTP and may be authorized in writing by the DISTRICT.

4.2 Copies of the survey field books and office calculations must be included in the TDN. This information can be submitted separately if approval is obtained from the District's Project Manager.

4.3 (**OPTIONAL**) The Consultant shall provide field survey data for cross sections used for approximate floodplain delineations where USGS DEM data are not adequate. This task is not authorized with the NTP and may be authorized in writing by the DISTRICT.

4.4 Digital data in either a CADD or GIS format will be prepared in conformance with the District's Hydrologic Information System Data Delivery Specifications, Revision 3.1 (or CADD Data Delivery Specifications Rev. 1.0, January 2000). The following themes are the ones generally used for the data developed for Field Survey. However, for this study there may not be data for every theme identified here, or the consultant might develop data for themes not listed here. Therefore, only those themes for which there are data need to be completed. If the consultant has data that don't fit one of the themes listed here, the District's Project Manager shall be contacted to determine the appropriate theme for that data.

a. CORNERS (if any)

b. CTRL (Misc. Control Survey Pts.)

c. FPCTLFCD (ERMs)

e. FPXFCD (Floodplain Cross Sections)

TASK 5 - HYDROLOGY

5.1 The Consultant will develop hydrology using the Watershed Modeling System (WMS). The peak discharges for sub-watersheds will be developed using HEC-1 and will be verified using regression equations. The watersheds will cover the portion of Watershed "UU" located east of Lake Pleasant and the Agua Fria within Maricopa County, and that portion of the watershed within Yavapai County that drains into Maricopa County as shown in Exhibit A. Data needed for the hydrologic study will be provided by the District for the portion of the watershed within Maricopa County. Necessary hydrologic data for the portion of the watershed located within Yavapai County will be developed by the Consultant and reviewed and approved by the District. No sub-basin will have a drainage area smaller than ½ square mile. The consultant must analyze the data carefully and in some instances correlate data against other hydrologic data such as regression equations in order to obtain the most realistic results.

5.2 Meetings shall be held with the Flood Control District staff at the following milestones:

a. Meeting number 1: field trip at the start of the project to scope out the critical points of the watershed and problem areas.

b. Meeting number 2: as soon as basic data are gathered and the sub-basins have been delineated. A copy of the draft maps of the sub-basins must be delivered to the District at this meeting. The method for generating the peak discharges will be agreed upon at this meeting.

c. Meeting number 3: to review of final document and comments by the District.

5.3 The Hydrologic Report

5.3.1 The findings of the hydrologic study will be presented in Section 3 of the Technical Data Notebook and will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The report will be organized as specified by the District, following SSA 1-97 format. Specific deviations from this hydrologic scope shall not be undertaken without the specific written authorization from the District's Project Manager.

5.4 Digital data in either a CADD or GIS format will be prepared in conformance with the District's Hydrologic Information System Data Delivery Specifications, Revision 3.1 (or CADD Data Delivery Specification, Rev. 1.0, January 2000). The following themes are the ones generally used for the data developed for hydrology. However, for this study there may not be data for every theme identified here, or the consultant might develop data for themes not listed here. Therefore, only those themes for which there are data need to be completed. If the consultant has data that does not fit one of the themes listed here, the District's Project Manager shall be contacted to determine the appropriate theme for that data.

a. DRNBSN (Drainage Boundary)

b. PRJDAT (Project Identification)

c. DRMPTH (Drainage Path)

TASK 6 - FLOODPLAIN DELINEATION

6.1 Floodplain delineations will be conducted using methodology as outlined by FEMA. The consultant will prepare the study using the guidelines established in FEMA 37, *Flood Insurance Study Guidelines and Specification for Study Contractors*, January 1995, FIA 12, *Appeals, Revisions, and Amendments to Flood Insurance Maps*, December 1993, and FEMA 265, *Managing Floodplain Development in Approximate Zone A Areas*, April 1995.

6.2 The delineation work shall meet requirements for floodplain delineations as prescribed by FEMA and the Arizona Department of Water Resources.

6.3 The delineation study shall be based on the final results of the hydrologic study as directed by the District.

6.4 The consultant must obtain District approval at each of the following steps:

a. Draft field reconnaissance section of the TDN and estimation of Manning's "n" values.

b. Proposed location and alignment of the cross sections.

c. Methodology used for both the floodplain and optional floodway delineations.

d. Approximate floodplain (natural) delineation.

e. Final hydraulics section of the TDN.

6.5 Field Reconnaissance

6.5.1 The consultant will conduct a field reconnaissance of the study area. This will include observation of channel and floodplain conditions for estimating Manning's "n" values; photographic documentation of floodplain characteristics; determination of channel bank characteristics; observation of possible overflow areas; observation of levees or other flood control structures; and measurement of bridge dimensions.

6.5.2 Manning's "n" values are to be determined using the methodology in the USGS report, *Estimated Manning's Roughness Coefficients for Stream Channels and Flood Plains in Maricopa County, Arizona*, April 1991. Copies of the report are available through the District. Manning's Roughness Coefficients will be presented for typical reach types observed in the project area, rather than specific reaches of specific named washes. It is anticipated that between 5 and 10 typical reach types will be identified during the field reconnaissance.

6.5.3 Representative "n" values for each typical reach type will be selected. The reconnaissance report will present the determination of channel and overbank "n" values using captioned color photographs or color photocopies for each identified reach type in the project area. The report will also discuss floodplain conditions affecting the delineation, describe structures and obstructions, and provide color photos or photocopies of major hydraulic structures. Photo locations, structures, and "n" values will be displayed on reduced scale mapping and included in the Final Report. The reconnaissance or n-value report will be included in all subsequent phased TDN submittals associated with this contract.

6.6 Cross Sections

6.6.1 The location and alignment of cross sections will be submitted for the District's review and approval before developing the cross section data. The Consultant must coordinate the methodology for generating the cross section geometric data. Acceptable methods include using WMS and USGS DEMs provided by the District, or field surveys possibly using GPS when the USGS maps and DEMs do not provide adequate information. In the majority of instances the channel centerline will be the centerline indicated on the USGS map, on the FEMA FIRM, or in the GIS data provided by the District.

6.6.2 The cross section plots will at a minimum show computed normal depth, and "n" values. All plots are to be accompanied by a legend. These plots should be available at all reviews.

6.7 The hydraulics of bridges and culverts should be incorporated into assessing the floodplain around such structures especially in areas where ponding will occur. The Zone A limits must be determined according to FEMA criteria and clearly labeled on the final drawings. Conveyance through minor structures such as small culverts (i.e., less than 30" in diameter), or structures which are likely to become clogged during the 100-year peak discharge shall not be included in the hydraulic analyses.

6.8 The findings of the floodplain delineation study will be presented in Section 4 of the Technical Data Notebook and will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The report will be organized as specified by the District standards, following SSA 1-97 format.

6.9 The Consultant shall fill out all the forms required by FEMA for the submittal of a Floodplain Delineation Study.

6.10 The consultant will provide work maps on monochrome USGS digital raster graphic quadrangle USGS maps. The consultant will develop check plots and certify that they have been examined, and that the check plots faithfully represent the data and maps used in the report and /or work maps. The drawings will be 24" X 36" in size. The work map scale will be determined by the consultant, and will vary between 1"=400' and 1"=1000' scale base maps depending on the terrain and the floodplain widths.

A cover sheet will be part of the work study drawings and shall have on it the project title, source and date of topographic mapping, and a location map showing geographic range covered by each specific mapping sheet. Each drawing will include the floodplain, a north arrow, scale, section corners, current streets and highway names, State Plane Coordinate System, major drainage features, corporate boundaries, cross section lines, channel centerline, index map, the floodplain boundaries, and peak discharge and Section, Township, Range for each wash delineated.

6.11 Digital data in either a CADD or GIS format will be prepared in conformance with the District's Hydrologic Information System Data Delivery Specifications, Revision 3.1 (or CADD Data Delivery Specifications, Rev. 1.0, January 2000). The following themes are the ones generally used for the data developed for hydraulics. However, for this study there may not be data for every theme identified here, or the consultant might develop data for themes not listed here. Therefore, only those themes for which there are data need to be completed. If the consultant has data that don't fit one of the themes listed here, the District's Project Manager shall be contacted to determine the appropriate theme for that data.

a. CULVERT (culverts)

b. CARTO (Cartographic Features)

c. DQ (Data Quality)

d. FPXFCD (Cross Sections)

e. FPZNFCD (Floodplain Zones)

f. NDXPRJ (Map Sheet Index)

g. PRJDAT (Project Identification)

h. BRIDGES (Bridges)

i. PRJ (Project Boundary)

TASK 7 - DELIVERABLES

7.1 Both paper and electronic deliverables will be made at the completion of each task. The consultant will deliver the following items to the District before delivering the FEMA submittal package:

7.1.1 Original Affidavits of Publication of the legal advertisements. Additional copies are to be included in the Technical Data Notebook.

7.1.2 All topographic and related data for the District's Hydrologic Information System that isn't subject to change during FEMA's review should be submitted at this time.

7.1.3 If bound separately from the Technical Data Notebook, two (2) copies of the field survey notes and office calculations.

7.2 The consultant will submit the following items to the District for review by FEMA and any other appropriate governmental agency. All of the following products are considered deliverables for the FEMA submittal:

7.2.1 Two (2) complete sets of blackline topographic base maps with the floodplain delineations shown. All drawings will be signed and sealed by persons of appropriate professional registration(s). Each registrant will provide a specific statement as to what service they performed.

7.2.2 Two (2) complete copies of the Technical Data Notebook. The Technical Data Notebook will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The notebook will be organized as specified by the District, following SSA 1-97 format. These copies will be updated if necessary based upon FEMA's review comments. Completed FEMA forms will be included in the Technical Data Notebook.

7.3 Final Submittal: The following products are considered deliverables for the final submittal to the District after FEMA approval is issued:

7.3.1 One (1) complete composite set of sealed non-erasable mylars with the topographic data and floodplain delineations shown. The sheets shall be 24" X 36" in size, and all drawings will be signed and sealed by persons of appropriate professional registration(s). Each registrant will provide a specific statement as to what service they performed.

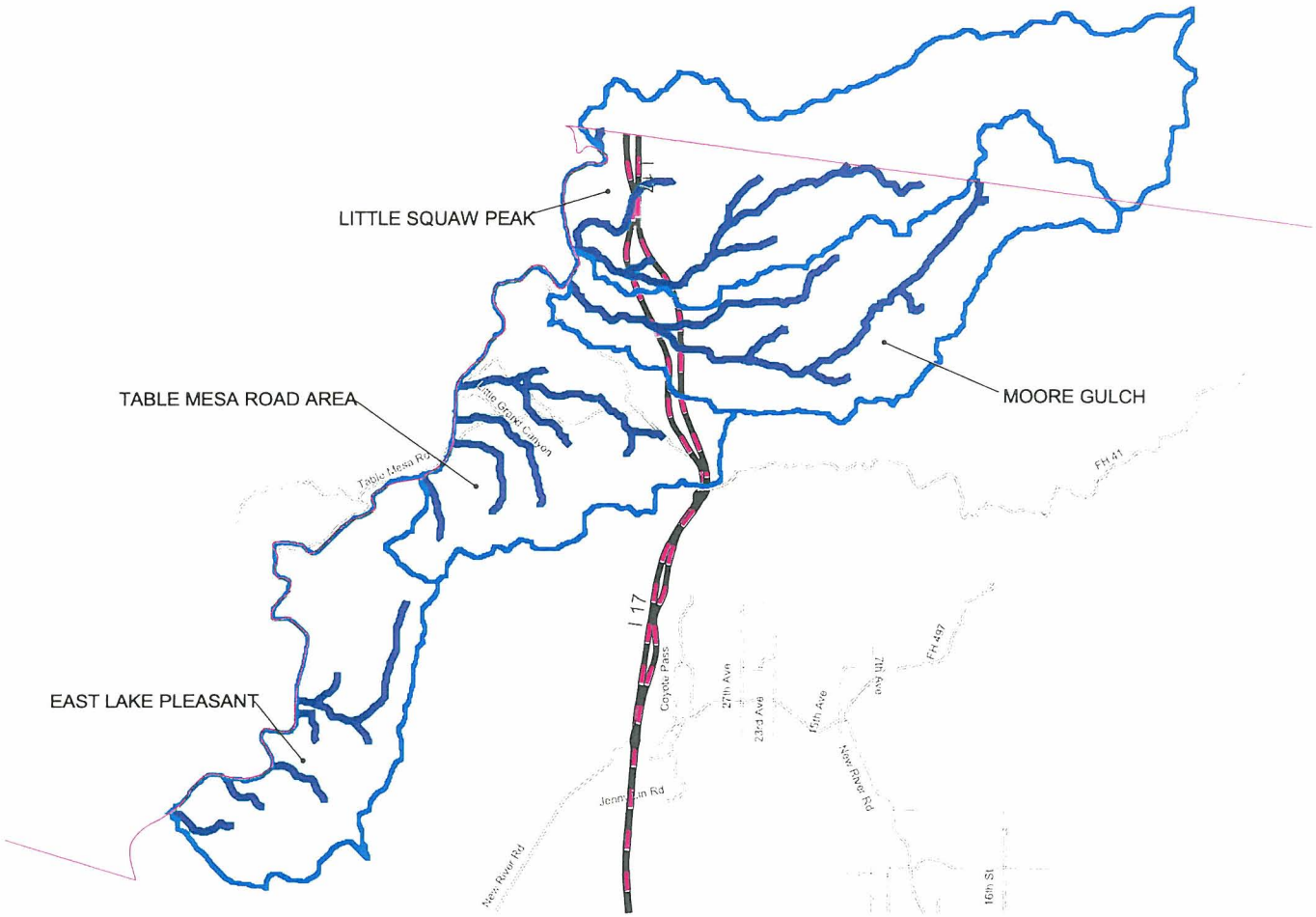
7.3.2 All remaining hydrologic and floodplain delineation data in conformance with the District's HIS Specifications.

7.3.3 Two (2) complete copies of the Technical Data Notebooks. The Technical Data Notebook will be prepared in accordance with ADWR State Standards Attachment 1-97 (SSA 1-97). The notebook will be organized as specified by the District, following SSA 1-97 format. This submittal of the Technical Data Notebook shall include any correspondence and/or meeting minutes with the reviewing agencies and shall reflect any revisions required by those reviewing agencies.

7.4 Separate submittals by subwatershed: The consultant will submit a separate TDN for each sub-watershed division established in Table 1 and shown in Exhibit A.1.

EXHIBIT A

FLOODPLAIN DELINEATION PHASING



COUNTY LINE
STUDY BASIN BOUNDARIES
WASHES TO BE DELINEATED

N
W E
S

2 0 2 4 6 Miles

B.6 FEMA Correspondence

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009-6399
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5897

June 4, 2001

Pernille Buch-Pedersen, Regional Manager
Baker Civil
3601 Eisenhower Avenue, Suite 600
Alexandria, Virginia 22304

Communities: City of Peoria and Maricopa County,Arizona

Community Nos.: 040050 and 040037

Flooding Sources: Tributaries to the Upper Agua Fria River identified as: T6NR1ES4, T7NR1ES34, T6NR1ES35, T7NR1ES26-2, T7NR1ES26-3, T7NR1ES26-2A, and T7NR1ES26-2B

FIRM Panels Affected: 350, 365, and 375

Dear Ms. Buch-Pedersen:

I have enclosed a floodplain delineation study for the Upper Agua Fria Watershed #1 (East Lake Pleasant). This study was done to identify and map potential flood-hazard areas in advance of anticipated future development. The supporting Technical Data Notebook includes a copy of the work maps. Please review and process a Letter of Map Revision for the studied portions of these washes.

If you have any questions, please contact me at (602) 506-4528.

Sincerely,

Richard P. Harris

Richard P. Harris, P.E.
Project Manager
Engineering Division

Enclosures

Copies to: Mr. Ray Lenaburg
Floodplain Mapping Coordinator
FEMA Region IX
Presidio of San Francisco
San Francisco, CA 94129

Mr. Max Yuan, P.E., Project Engineer
Hazards Study Branch, Mitigation Directorate
Federal Emergency Management Agency
500 C Street SW
Washington, D.C. 20472-0001

Mr. David Moody, P.E.
Public Works Engineering Director
City of Peoria
8401 West Monroe Street
Peoria, AZ 85345

Mr. Victor Calderon
NFIP Coordinator
Arizona Division of Emergency Management
5636 E. McDowell Road
Phoenix, AZ 85008

Mr. Roy McDaniel, P.E.
RBF Consulting, Inc.
16605 North 28th Avenue
Suite 100
Phoenix, AZ 85053-7550

NATIONAL FLOOD INSURANCE PROGRAM
FEMA MAP COORDINATION CONTRACTOR

June 21, 2002

Mr. Richard P. Harris, P.E.
Project Manager
Engineering Division
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009-6399

IN REPLY REFER TO:
Case No.: 02-09-1138P
Communities: City of Peoria and Maricopa County, AZ
Community Nos.: 040050 and 040037

316-ACK.FRQ

Dear Mr. Harris:

This responds to your request dated June 4, 2002, that the Federal Emergency Management Agency (FEMA) issue a revision to the Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona and Incorporated Areas. Pertinent information about the request is listed below.

Identifier:	Approximate Zone A Floodplain Delineation of Watershed UU (Upper Agua Fria)
Flooding Source:	Upper Agua Fria, Watershed UU
FIRM Panel(s) Affected:	04013C0350 F, 0365 F, and 0375 F

We have completed an inventory of the items that you submitted. We have received the data and the review required to begin a detailed technical review of your request. If additional data are required, we will inform you within 60 days of the date of this letter.

Please direct questions concerning your request to us at the address shown at the bottom of this page. For identification purposes, please include the case number referenced above on all correspondence.

If you have general questions about your request, FEMA policy, or the National Flood Insurance Program, please call the FEMA Map Assistance Center, toll free, at 1-877-FEMA MAP

3601 Eisenhower Avenue, Alexandria, Virginia 22304-6425 PH: 703.960.8800 FX: 703.960.9125

(1-877-336-2627). If you have specific questions concerning your request, please call the Revisions Coordinator for your State, Pernille Buch-Pedersen, who may be reached at (703) 317-6224.

Sincerely,

Andrea L. Ryon

Andrea L. Ryon, P.E., Director
Engineering Division
Michael Baker Jr., Inc.

cc: Mr. David Moody, P.E.
Director
Public Works Engineering
City of Peoria

Ms. Shanna Yager
Branch Manager
Floodplain Administrator
Flood Control District
of Maricopa County

Mr. Victor Calderon
NFIP Coordinator
Arizona Division of Emergency
Management

Mr. Roy McDaniel, P.E.
RBF Consulting, Inc.

Federal Emergency Management Agency

Washington, D.C. 20472

SEP 17 2002

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 02-09-1138P

The Honorable Don Stapley
Chairman, Maricopa County
Board of Supervisors
301 West Jefferson, 10th Floor
Phoenix, AZ 85003

Community: Maricopa County, AZ
Community No.: 040037
Panels Affected: 04013C0350 F, 0365 F, and 0375 F
Effective Date of This Revision: OCT 17 2002

102-I-C

Dear Mr. Stapley:

This responds to a request that the Federal Emergency Management Agency (FEMA) revise the effective Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona and Incorporated Areas, in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated June 4, 2002, Mr. Richard P. Harris, P.E., Project Manager, Engineering Division, Flood Control District of Maricopa County, requested that FEMA revise the FIRM to show the effects of an approximate study of tributaries to Lake Pleasant. The studied watercourses included Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, and T7NR1ES26-3 of Watershed UU in the Upper Agua Fria River basin.

All data required to complete our review of this request were submitted with letters from Mr. Harris.

Because this Letter of Map Revision (LOMR) is based on flood hazard information meant to improve upon that shown on the flood map or within the flood study, and does not partially or wholly incorporate manmade modifications within the Special Flood Hazard Area (SFHA), fees were not assessed for the review. The SFHA is the area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).

We have completed our review of the submitted data and the flood data shown on the effective FIRM. We have revised the FIRM to add floodplain boundary delineations and zone designations of the base flood along Watershed UU of the Upper Agua Fria River. As a result of the modifications, SFHAs were added along Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, and T7NR1ES26-3. The modifications are shown on the enclosed annotated copies of FIRM Panels 04013C0350 F, 04013C0365 F, and 04013C0375 F. This LOMR hereby revises the above-referenced panels of the effective FIRM dated July 19, 2001.

Because this revision request also affects the City of Peoria, a separate LOMR for that community was issued on the same date as this LOMR.

The modifications are effective as of the date shown above. The map panels as listed above and as modified by this letter will be used for all flood insurance policies and renewals issued for your community.

A review of the determination made by this LOMR and any requests to alter this determination should be made within 30 days. Any request to alter the determination must be based on scientific or technical data.

We will not physically revise and republish the FIRM and Flood Insurance Study (FIS) report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panels and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This LOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the SFHA. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

Because this LOMR will not be printed and distributed to primary users, such as local insurance agents and mortgage lenders, your community will serve as a repository for these new data. We encourage you to disseminate the information reflected by this LOMR throughout the community, so that interested persons, such as property owners, local insurance agents, and mortgage lenders, may benefit from the information. We also encourage you to prepare a related article for publication in your community's local newspaper. This article should describe the changes that have been made and the assistance that officials of your community will give to interested persons by providing these data and interpreting the NFIP maps.

This determination has been made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and is in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed minimum NFIP criteria. These criteria are the minimum and do not supersede any State or local requirements of a more stringent nature. This includes adoption of the effective FIRM to which the regulations apply and the modifications made by this LOMR. Our records show that your community has met this requirement.

A Consultation Coordination Officer (CCO) has been designated to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Mr. Jack Eldridge
Chief, Community Mitigation Programs Branch
Federal Emergency Management Agency, Region IX
1111 Broadway Street, Suite 1200
Oakland, CA 94607-4052
(510) 627-7184

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please call the CCO for your community at the telephone number cited above. If you have any questions regarding this LOMR, please call our Map Assistance Center, toll free, at 1-877-FEMA MAP (1-877-336-2627).

Sincerely,

Max H. Yuan, P.E., Project Engineer
Hazards Study Branch
Federal Insurance and
Mitigation Administration

For: Matthew B. Miller, P.E., Chief
Hazards Study Branch
Federal Insurance and
Mitigation Administration

Enclosures

cc: Ms. Shanna Yager
Branch Manager
Floodplain Administrator
Flood Control District
of Maricopa County

David Moody, Ph.D., P.E.
Director
Public Works Engineering
City of Peoria

Mr. Richard P. Harris, P.E.
Project Manager
Engineering Division
Flood Control District
of Maricopa County

Mr. Victor Calderon
NFIP Coordinator
Arizona Division of Emergency
Management

Mr. Roy McDaniel, P.E.
RBF Consulting, Inc.

Federal Emergency Management Agency

Washington, D.C. 20472

SEP 17 2002

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

IN REPLY REFER TO:
Case No.: 02-09-1138P

The Honorable John Keegan
Mayor, City of Peoria
City of Peoria Municipal Complex
8401 West Monroe Street
Peoria, AZ 85345

Community: City of Peoria, AZ
Community No.: 040050
Panels Affected: 04013C0350 F and 0365 F
Effective Date of This Revision: OCT 17 2002

102-I-C

Dear Mayor Keegan:

This responds to a request that the Federal Emergency Management Agency (FEMA) revise the effective Flood Insurance Rate Map (FIRM) for Maricopa County, Arizona and Incorporated Areas (the effective FIRM for your community), in accordance with Part 65 of the National Flood Insurance Program (NFIP) regulations. In a letter dated June 4, 2002, Mr. Richard P. Harris, P.E., Project Manager, Engineering Division, Flood Control District of Maricopa County, requested that FEMA revise the FIRM to show the effects of an approximate study of tributaries to Lake Pleasant. The studied watercourses included Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, and T7NR1ES26-3 of Watershed UU in the Upper Agua Fria River basin.

All data required to complete our review of this request were submitted with letters from Mr. Harris.

Because this Letter of Map Revision (LOMR) is based on flood hazard information meant to improve upon that shown on the flood map or within the flood study, and does not partially or wholly incorporate manmade modifications within the Special Flood Hazard Area (SFHA), fees were not assessed for the review. The SFHA is the area that would be inundated by the flood having a 1-percent chance of being equaled or exceeded in any given year (base flood).

We have completed our review of the submitted data and the flood data shown on the effective FIRM. We have revised the FIRM to add floodplain boundary delineations and zone designations of the base flood along Watershed UU of the Upper Agua Fria River. As a result of the modifications, SFHAs were added along Washes T6NR1ES4 and T7NR1ES34. The modifications are shown on the enclosed annotated copies of FIRM Panels 04013C0350 F and 04013C0365 F. This LOMR hereby revises the above-referenced panels of the effective FIRM dated July 19, 2001.

Because this revision request also affects the unincorporated areas of Maricopa County, a separate LOMR for that community was issued on the same date as this LOMR.

The modifications are effective as of the date shown above. The map panels as listed above and as modified by this letter will be used for all flood insurance policies and renewals issued for your community.

A review of the determination made by this LOMR and any requests to alter this determination should be made within 30 days. Any request to alter the determination must be based on scientific or technical data.

We will not physically revise and republish the FIRM and Flood Insurance Study (FIS) report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panels and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This LOMR is based on minimum floodplain management criteria established under the NFIP. Your community is responsible for approving all floodplain development and for ensuring all necessary permits required by Federal or State law have been received. State, county, and community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction in the SFHA. If the State, county, or community has adopted more restrictive or comprehensive floodplain management criteria, these criteria take precedence over the minimum NFIP criteria.

Because this LOMR will not be printed and distributed to primary users, such as local insurance agents and mortgage lenders, your community will serve as a repository for these new data. We encourage you to disseminate the information reflected by this LOMR throughout the community, so that interested persons, such as property owners, local insurance agents, and mortgage lenders, may benefit from the information. We also encourage you to prepare a related article for publication in your community's local newspaper. This article should describe the changes that have been made and the assistance that officials of your community will give to interested persons by providing these data and interpreting the NFIP maps.

This determination has been made pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (Public Law 93-234) and is in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, Public Law 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed minimum NFIP criteria. These criteria are the minimum and do not supersede any State or local requirements of a more stringent nature. This includes adoption of the effective FIRM to which the regulations apply and the modifications made by this LOMR. Our records show that your community has met this requirement.

A Consultation Coordination Officer (CCO) has been designated to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Mr. Jack Eldridge
Chief, Community Mitigation Programs Branch
Federal Emergency Management Agency, Region IX
1111 Broadway Street, Suite 1200
Oakland, CA 94607-4052
(510) 627-7184

If you have any questions regarding floodplain management regulations for your community or the NFIP in general, please call the CCO for your community at the telephone number cited above. If you have any questions regarding this LOMR, please call our Map Assistance Center, toll free, at 1-877-FEMA MAP (1-877-336-2627).

Sincerely,

Max H. Yuan, P.E., Project Engineer
Hazards Study Branch
Federal Insurance and
Mitigation Administration

For: Matthew B. Miller, P.E., Chief
Hazards Study Branch
Federal Insurance and
Mitigation Administration

Enclosures

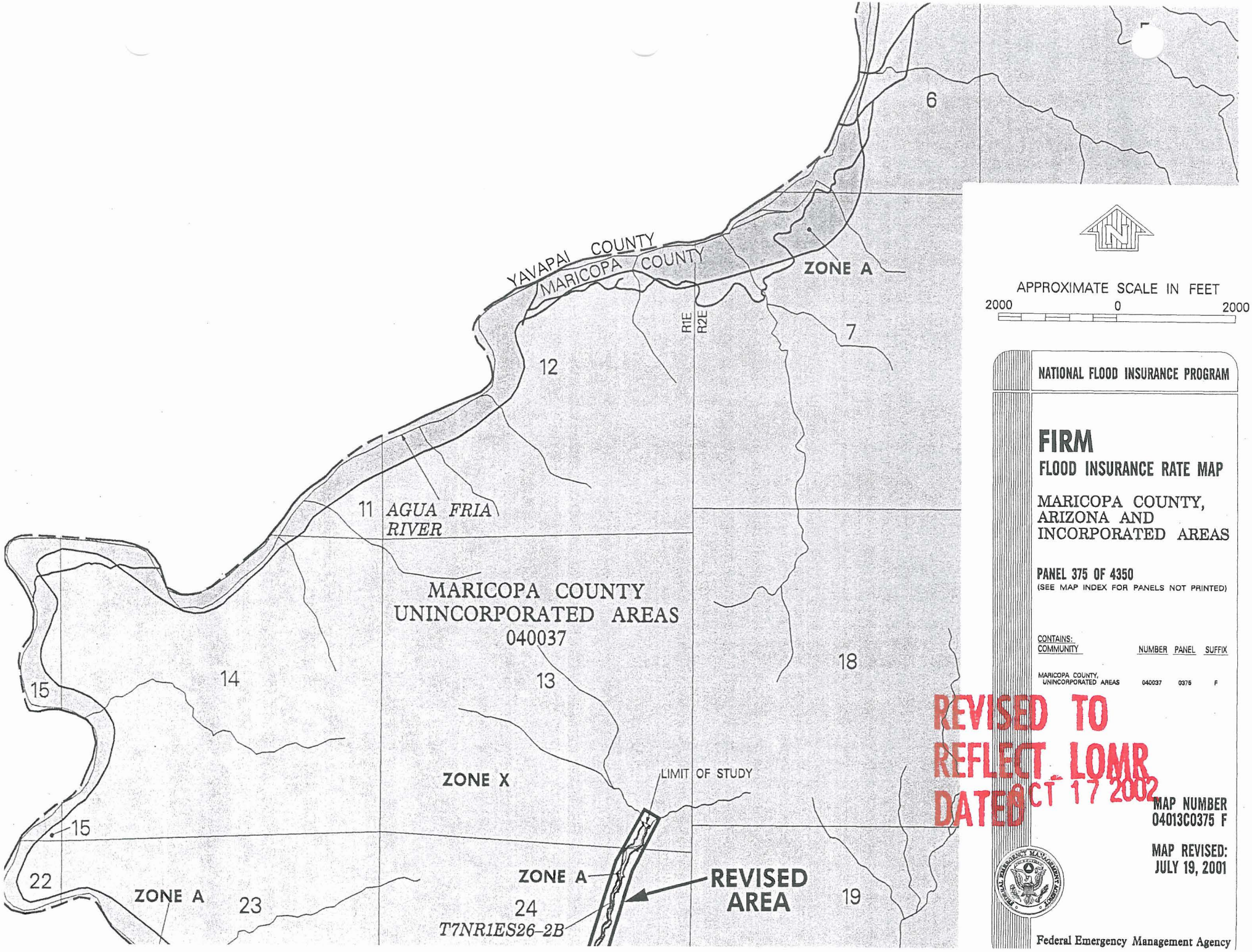
cc: David Moody, Ph.D., P.E.
Director
Public Works Engineering
City of Peoria

Ms. Shanna Yager
Branch Manager
Floodplain Administrator
Flood Control District
of Maricopa County

Mr. Richard P. Harris, P.E.
Project Manager
Engineering Division
Flood Control District
of Maricopa County

Mr. Victor Calderon
NFIP Coordinator
Arizona Division of Emergency
Management

Mr. Roy McDaniel, P.E.
RBF Consulting, Inc.



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 375 OF 4350

(SEE MAP INDEX FOR PANELS NOT PRINTED)

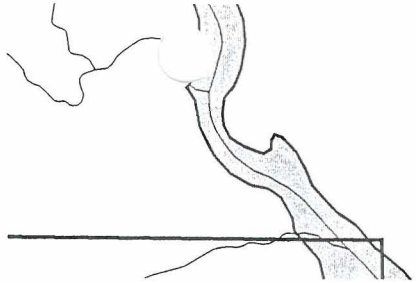
CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0375	F

REVISED TO REFLECT LOMR DATED OCT 17 2002

MAP NUMBER
04013C0375 F

MAP REVISED:
JULY 19, 2001

Federal Emergency Management Agency



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 350 OF 4350

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0350	F
PEORIA, CITY OF	040050	0350	F

REVISED TO REFLECT LOMR DATED OCT 17 2002

MAP NUMBER
04013C0350 F
MAP REVISED:
JULY 19, 2001

Federal Emergency Management Agency

LAKE PLEASANT REGIONAL PARK

ZONE A

ZONE X

ZONE D

T6NR1ES4

CORPORATE LIMITS

YAVAPAI COUNTY

MARICOPA COUNTY

AGUA FRIA RIVER

CITY OF PEORIA 040050

LIMIT OF STUDY

REVISED AREA

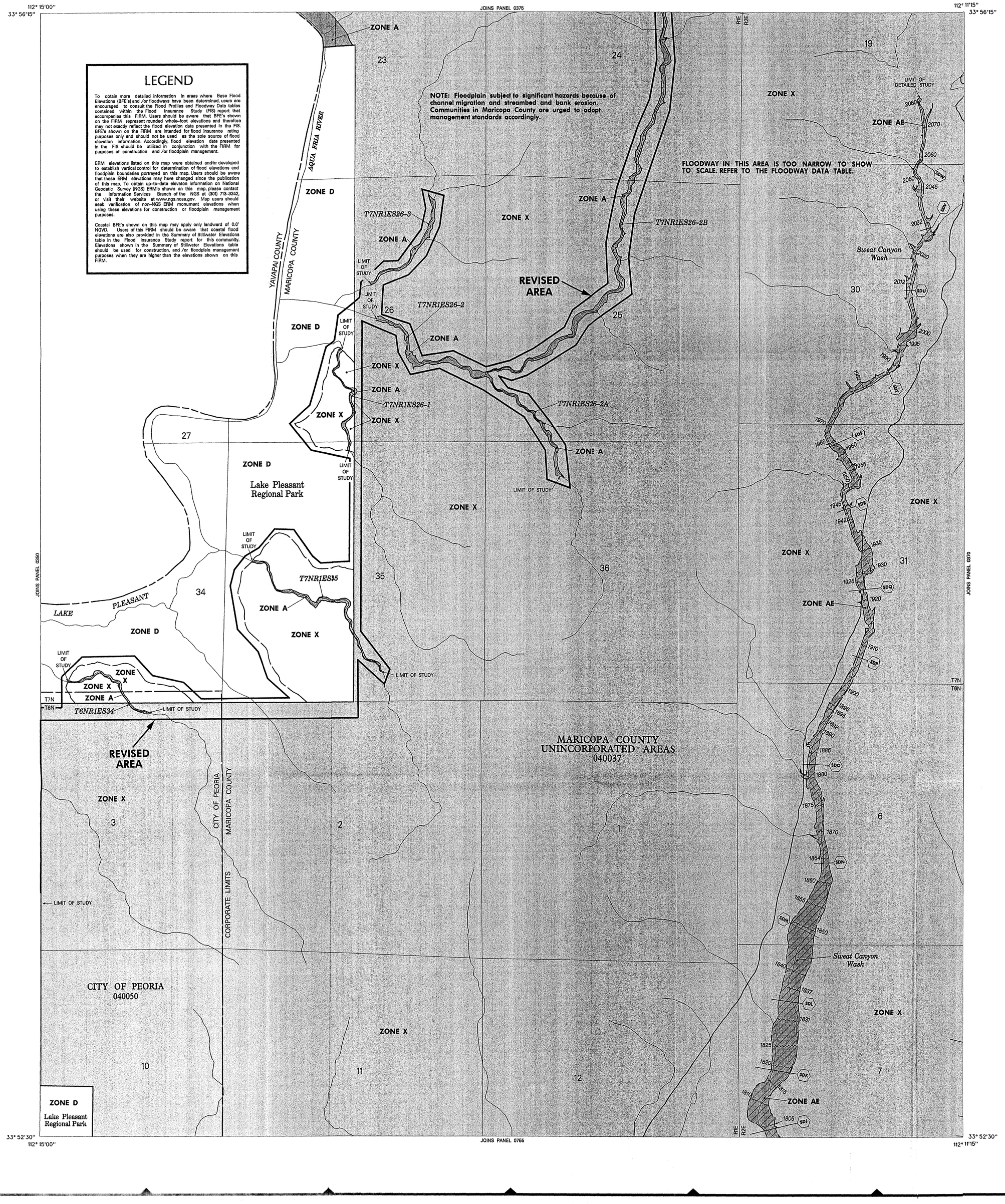
LAKE PLEASANT

T7N

T6N

31 32 33 34 5 6 4 3 7 8 9 10

JOINS PANEL 0735



LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **ZONE A** No base flood elevations determined.
- **ZONE AE** Base flood elevations determined.
- **ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
- **ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE A99** To be protected from 100-year flood by Federal flood protection system under construction ; no base flood elevations determined.
- **ZONE V** Coastal flood with velocity hazard (wave action); no base flood elevations determined.
- **ZONE VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

- **ZONE X** Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

- **ZONE X** Areas determined to be outside 500-year floodplain.
- **ZONE D** Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain Boundary
- Floodway Boundary
- Zone D Boundary
- Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
- 513 — Base Flood Elevation Line; Elevation in Feet. See Map Index for Elevation Datum.
- D — D — Cross Section Line
- (EL. 987) — Base Flood Elevation in Feet Where Uniform Within Zone. See Map Index for Elevation Datum.
- RM7 — Elevation Reference Mark
- M2 — River Mile
- 97° 07'30", 32° 22'30" — Horizontal Coordinates Based on North American Datum of 1927 (NAD 27) Projection.

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFE's, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 120 inch.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

This map may incorporate approximate boundaries of Coastal Barrier Resource System Units and /or Otherwise Protected Areas established under the Coastal Barrier Improvement Act of 1990 (PL 101-591).

For community map revision history prior to countywide mapping, see Section 6.0 of the Flood Insurance Study Report.

For adjoining map panels and base map source see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP:
APRIL 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL:
SEPTEMBER 29, 1989

Map revised July 19, 2001 to update corporate limits, to change base flood elevations, to add base flood elevations, to add Special Flood Hazard Areas, to change Special Flood Hazard Areas, to change zone designations, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 365 OF 4350
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY, UNINCORPORATED AREAS	040037	0365	F
PEORIA, CITY OF	040050	0365	F

REVISED TO REFLECT LOMR DATED OCT 17 2002

MAP NUMBER
04013C0365 F

MAP REVISED:
JULY 19, 2001

Federal Emergency Management Agency

Appendix C
Survey Field Notes

C.1 Survey Field Notes for Aerial Mapping Control

Mapping was not performed as a part of this job. Existing elevation data in the form of a Digital Elevation Model (DEM) and breaklines provided by Maricopa County was used in this report. The DEM was produced from the Maricopa County Ortho-Photo project. A copy of the narrative from the survey report for that project follows. The information in the report appendix is provided on a CD at the end of this report.

Maricopa County Ortho-photo

GPS-Summary of Procedure

Final Report

RBF

CONSULTING

PLANNING

DESIGN

CONSTRUCTION

SURVEYOR'S CERTIFICATION

This survey was conducted under my direction during the months of November 2000 through March 2001. The information in this book is correct and accurate to the best of my knowledge and belief.

Brent J. Smith, R.L.S. AZ.#29891 Date

Maricopa County Ortho-photo
Summary of Procedure
Report

Procedure Outline:

I **Control** - set control throughout project
II **Observation** - collected data from ground stations
III **Compilation** - interpret the raw data for usable output
IV **Translation** - translate the output to format required for implementation

Procedure Specifics:

I. Control - Aerial targets were set throughout the project for reference to facilitate the orthographic correction of the photos. Most of the points were set on existing GDACS points to give reference to existing data. The location of non-GDACS points were established through RTK GPS or static GPS observation.

II. Observation- During the flight there were two GPS units on the ground collecting the satellite data for the duration of the flight days. One unit on a central BASE station, and the other unit location ranging between 5 other stations based on flight area that day. The observation days were in December 2000,on the 16th, 17th, 18th, 27th, 28th, and the 30th. The observation days were in January 2001,on the 4th. The observation days in March were on the 13th, 14th and 15th.

III. Compilation - The data collected by the two ground units and the airborne unit were sent out to Fotoflight for processing. The information came from Fotoflight in latitude and longitude and elevation in meters.

IV. Translation - Photo centers were converted to NAD 83 Arizona State Plane coordinates in International feet.

Appendix - Table of Contents

Appendix A:

GPS Observation Logs (including location maps)

Day 1 : 12/16/00 Observation logs for 1HD1 and 4HT3.
Day 2 : 12/17/00 Observation logs for 1HD1 and 4HT3.
Day 3 : 12/18/00 Observation logs for 1HD1 and 3GI1.
Day 4 : 12/27/00 Observation logs for 1HD1 and 3GI1.
Day 5 : 12/28/00 Observation logs for 1HD1 and 3GI1.
Day 6 : 12/30/00 Observation logs for 1HD1 and 3GI1.
Day 7 : 01/04/01 Observation logs for 1HD1 and 1LM2.
Day 8 : 03/13/01 Observation logs for 1HD1 and 1FN1.
Day 9 : 03/14/01 Observation logs for 1HD1 and 1FN1.
Day 10: 03/15/01 Observation logs for 1HD1 and 1FN1.

Appendix B:

Data on the location of the center of each photograph taken and separated by the days of observation. Files with the extension ".lat", contain the Latitude, Longitude and Elevation as prepared by Fotoflight. Files with the extension ".xls" have the Arizona State plane coordinates in NAD 83.

Day 1 : 121600.xls and 121600.lat
Day 2 : 121700.xls and 121700.lat
Day 3 : 121800.xls and 121800.lat
Day 4 : 122700.xls and 122700.lat
Day 5 : 122800.xls and 122800.lat
Day 6 : 123000.xls and 123000.lat
Day 7 : 010401.xls and 010401.lat
Day 8 : 031301.xls and 031301.lat
Day 9 : 031401.xls and 031401.lat
Day 10: 031501.xls and 031501.lat

NOTE: On the attached CD, the raw data files (.raw & .dat) files are also included.

Appendix C:

Complete listing of panel points used in this project.
(filename panels.xls)

Appendix D:

Complete listing of GDACS check points (filename orthochecks.xls)
including the standard deviations. (filename results_1.wb3)

C.2 Survey Field Notes for Hydrologic Modeling

Field reconnaissance notes for sub-basin boundary verification and estimation of physical parameters is included in Appendix E. Additional survey was not required for this study because Approximate methods are being used to delineate Zone A Floodplains. Therefore, there are no survey field notes.

C.3 Survey Field Notes for Hydraulic Modeling

Because this study is using Approximate methods to delineate Zone A flood plains, cross sections were taken from the TIN created from the DEM and breaklines provided by the Flood Control District of Maricopa County, as specified by FEMA guidlines. There are no hydraulic structures in the study area, and Elevation Reference Marks have not been set. Therefore, there are no survey field notes for hydraulic modeling.

Appendix D
Hydrologic Analysis Supporting Documentation

D.1 Precipitation Data

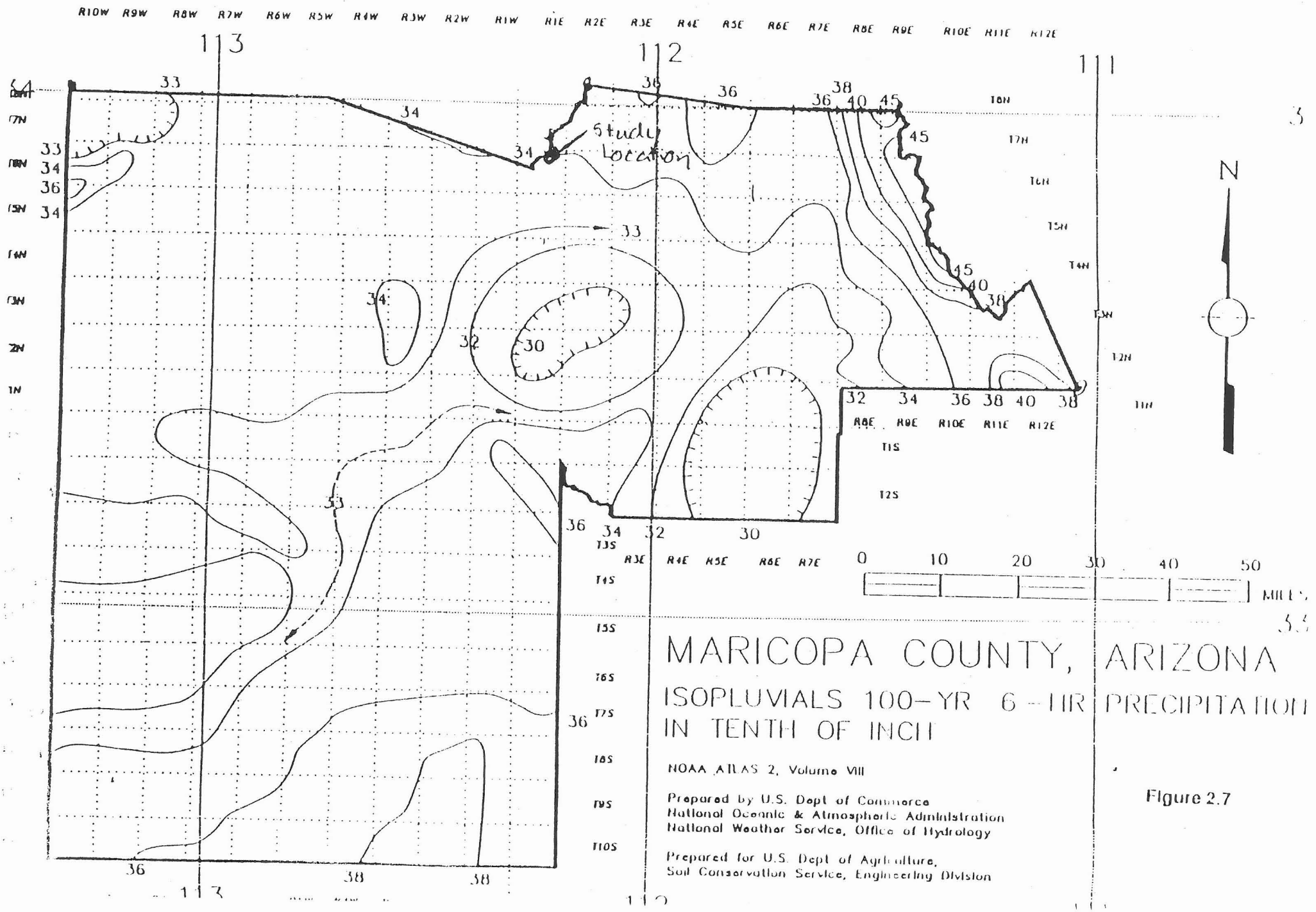
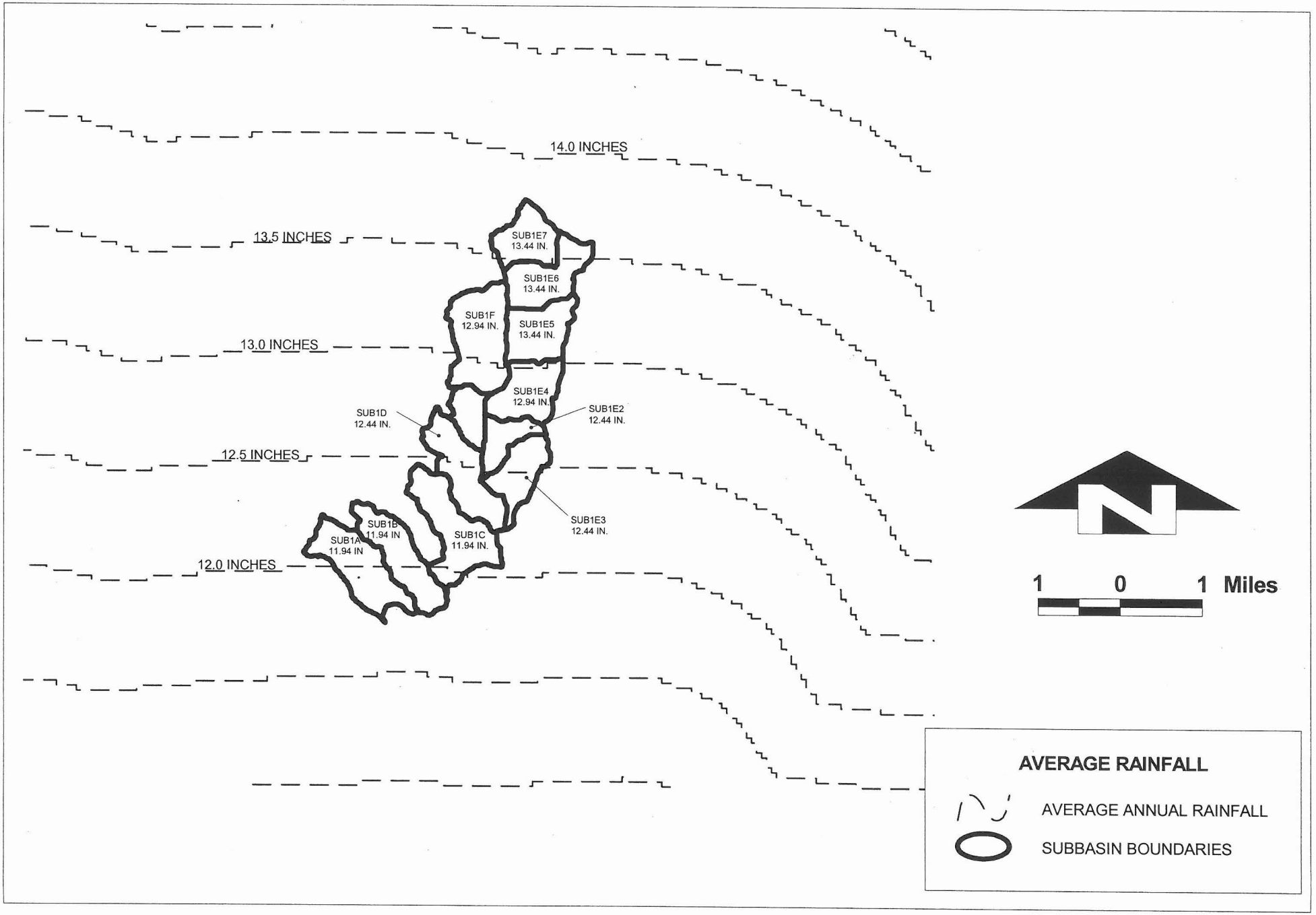

Study location
N
0 10 20 30 40 50
MILES
MARICOPA COUNTY, ARIZONA
ISOPLUVIALS 100-YR 6-HR PRECIPITATION
IN TENTH OF INCH
NOAA ATLAS 2, Volume VIII
Prepared by U.S. Dept of Commerce
National Oceanic & Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Dept of Agriculture,
Soil Conservation Service, Engineering Division

Figure 2.7

AVERAGE ANNUAL RAINFALL FOR NFF CALCULATIONS



D.2 Physical Parameter Calculations

NMIN Determination

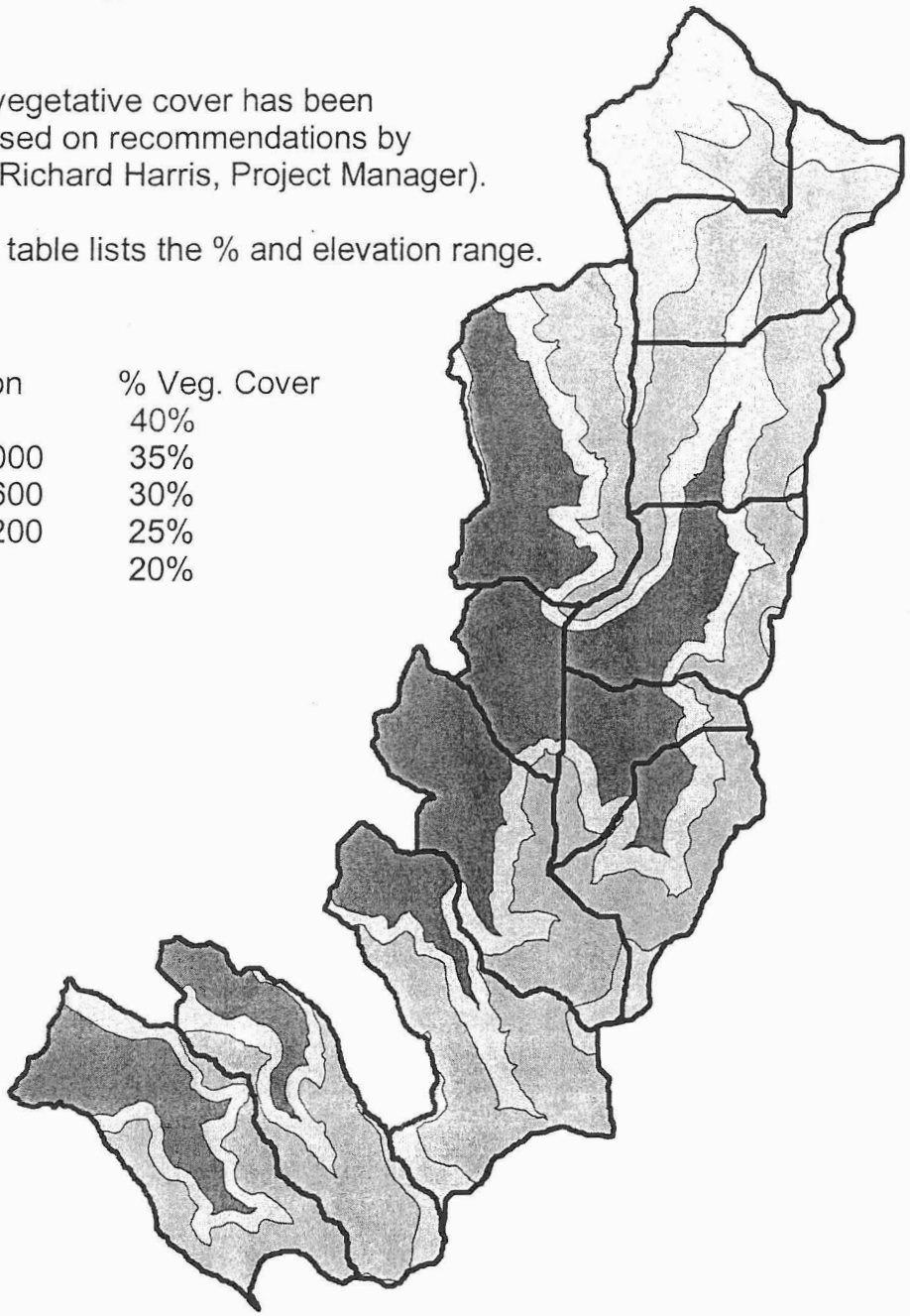
Sub-Basin	Tc	Ideal 0.15Tc	Min 0.10Tc	Max 0.25Tc
	hrs	min	min	min
SUB1A	0.604	5.436	3.624	9.06
SUB1B	0.617	5.553	3.702	9.255
SUB1C	0.654	5.886	3.924	9.81
SUB1D	0.658	5.922	3.948	9.87
SUB1E1	0.371	3.339	2.226	5.565
SUB1E2	0.354	3.186	2.124	5.31
SUB1E3	0.433	3.897	2.598	6.495
SUB1E4	0.483	4.347	2.898	7.245
SUB1E5	0.383	3.447	2.298	5.745
SUB1E6	0.388	3.492	2.328	5.82
SUB1E7	0.383	3.447	2.298	5.745
SUB1F	0.6	5.4	3.6	9

Vegetative Cover

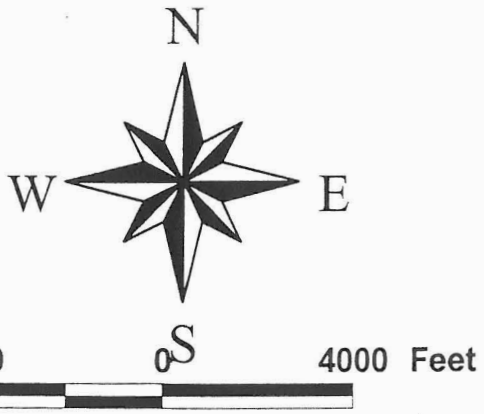
The percent vegetative cover has been calculated based on recommendations by the FCDMC (Richard Harris, Project Manager).

The following table lists the % and elevation range.

Elevation	% Veg. Cover
3000+	40%
2600-3000	35%
2200-2600	30%
2100-2200	25%
<2100	20%



WS # 1 Sub-Basins
Vegetative Cover Based on Elevation
- **0.2**
- **0.25**
- **0.3**
- **0.35**



Percent Vegetated Cover Per Sub Basin

Based on Elevation Range

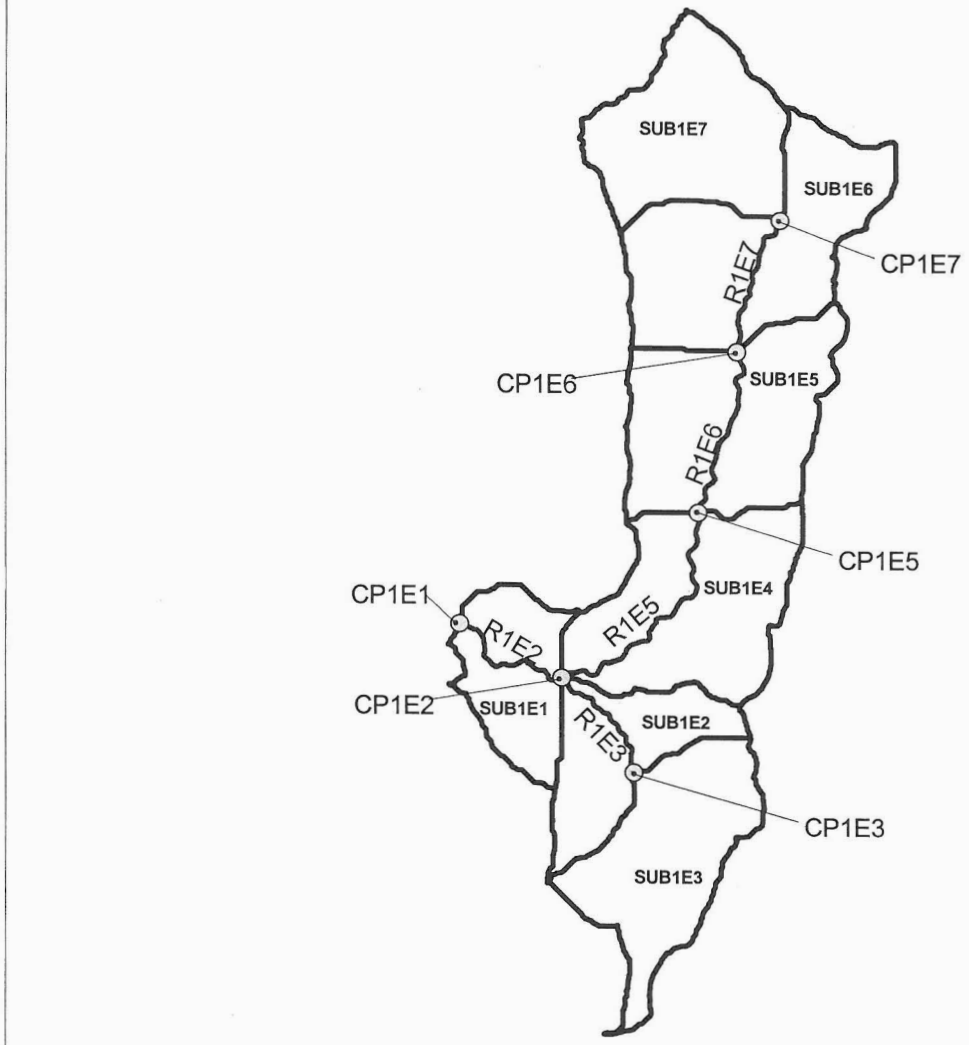
Sub Basin	% Vegetated Cover
SUB1A	25%
SUB1B	27%
SUB1C	28%
SUB1D	25%
SUB1E1	28%
SUB1E2	24%
SUB1E3	28%
SUB1E4	25%
SUB1E5	28%
SUB1E6	32%
SUB1E7	34%
SUB1F	25%
Avg. Total	27%

```
17, "Recreational Open Space-Hillslopes, Sonoran Desert", 0.150000, 0.00, 27.00, "dr
y"
22, "Vacant-Hillslopes, Sonoran Desert", 0.150000, 0.00, 27.00, "dry"
24, "Water", 0.000000, 0.00, 0.00, "dry"
```

```
 8, "Arizo Cobbly Sandy Loam", 0.960000, 0.00, 100.00
 8, "Arizo Cobbly Sandy Loam", 0.960000, 0.00, 100.00
 12, "Carefree Cobbly Clay Loam, 1-8% Slopes", 0.010000, 0.00, 100.00
 13, "Carefree-Beadsley Complex", 0.010000, 0.00, 100.00
 26, "Continental Cobbly Clay Loam, 1-8% Slopes", 0.010000, 0.00, 100.00
 28, "Continental-Ohaco Complex", 0.020000, 0.00, 100.00
 31, "Dixaleta-Rock outcrop complex, 25-65% Slopes", 0.330000, 35.00, 100.00
 40, "Eba-Pinaleno Complex, 3-20% Slopes", 0.170000, 0.00, 100.00
 41, "Eba-Pinaleno Complex, 20-40% Slopes", 0.170000, 35.00, 100.00
 45, "Ebon very gravelly loam 8 to 20 percent", 0.030000, 0.00, 100.00
 49, "Ebon-Pinamt complex 20 to 40 percent slopes", 0.060000, 0.00, 100.00
 51, "Gachado-Lomitas-Rock outcrop complex, 8 to 25 percent slopes", 0.240000, 0.00,
100.00
 52, "Gachado-Lomitas-Rock outcrop complex, 7 to 55 percent slopes", 0.160000, 20.00,
  100.00
 72, "Lehmans-Rock outcrop complex", 0.090000, 30.00, 100.00
 93, "Nickel-Cave complex", 0.330000, 0.00, 100.00
 98, "Pinamt-Tremant complex", 0.370000, 0.00, 100.00
 103, "Rock outcrop-Gachado complex", 0.100000, 65.00, 100.00
 104, "Rock outcrop-Lehmans complex", 0.140000, 60.00, 100.00
 110, "Suncity-Cipriano complex", 0.130000, 0.00, 100.00
 111, "Torriorthents", 0.400000, 0.00, 100.00
```

D.3 Hydrograph Routing Data

NOTE: SUBBASINS SUB1E1 THROUGH SUB1E7 ARE THE ONLY SUBBASINS IN WATERSHED 1 THAT REQUIRE ROUTING.



Concentration Points
Washes
Subbasin Boundaries

Name	REACH LENGTH	REACH SLOPE
R1E2	3109 FT	0.03202
R1E3	2912 FT	0.04669
R1E5	5997 FT	0.03696
R1E6	4062 FT	0.03130
R1E7	3278 FT	0.03779

N

4000 0 4000 8000 Feet

NORMAL DEPTH ROUTING REACHES

Irregular Report

Label	Mannings Coefficient	Slope (ft/ft)	Water Surface Elevation (ft)	Discharge (cfs)	Flow Area (ft^2)	Wetted Perimeter (ft)	Top Width (ft)	Actual Depth (ft)	Critical Elevation (ft)	Critical Slope (ft/ft)	Velocity (ft/s)	Velocity Head (ft)	Specific Energy (ft)	Froude Number	Flow Type
R1E2	0.048	0.032000	1,735.63	3,600.00	284.5	81.83	80.54	6.25	1,736.09	0.022085	12.65	2.49	1,738.11	1.19	Supercritical
R1E3	0.044	0.046700	1,791.28	880.00	69.7	30.58	29.08	4.72	1,792.00	0.021420	12.63	2.48	1,793.76	1.44	Supercritical
R1E5	0.048	0.037000	1,868.01	2,422.00	200.0	67.94	66.96	4.09	1,868.52	0.023458	12.11	2.28	1,870.29	1.24	Supercritical
R1E6	0.048	0.031300	2,040.20	1,870.00	155.7	48.65	47.07	5.48	2,040.59	0.022576	12.01	2.24	2,042.44	1.16	Supercritical
R1E7	0.044	0.037800	2,154.55	984.00	80.9	32.13	30.20	5.29	2,155.15	0.021272	12.16	2.30	2,156.84	1.31	Supercritical

RBF Consulting
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

Project Summary Report

Project Description	
Worksheet	R1E2
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	032000	ft/ft
Discharg	,600.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.048	
Water Surface Elev	1,735.63	ft
Elevation Range	29.38 to 1,741.66	
Flow Area	284.5	ft²
Wetted Perimeter	81.83	ft
Top Width	80.54	ft
Actual Depth	6.25	ft
Critical Elevation	1,736.09	ft
Critical Slope	0.022085	ft/ft
Velocity	12.65	ft/s
Velocity Head	2.49	ft
Specific Energy	1,738.11	ft
Froude Number	1.19	
Flow Type	Supercritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00	0+42	0.070
0+42	0+85	0.044
0+85	1+13	0.070

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00	1,739.13
0+14	1,734.91
0+28	1,733.39
0+42	1,731.75
0+57	1,730.10
0+71	1,729.38
0+85	1,733.24
0+98	1,737.46
1+13	1,741.66

Project Summary Report

Project Description	
Worksheet	R1E3
Flow Element	Irregular Chani
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	046700	ft/ft
Dischargı	880.00	cfs

Options	
Current Roughness Methc	›ved Lotter's Method
Open Channel Weighting	›ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficiei	0.044	
Water Surface Elev	1,791.28	ft
Elevation Range	36.56 to 1,810.73	
Flow Area	69.7	ft²
Wetted Perimeter	30.58	ft
Top Width	29.08	ft
Actual Depth	4.72	ft
Critical Elevation	1,792.00	ft
Critical Slope	0.021420	ft/ft
Velocity	12.63	ft/s
Velocity Head	2.48	ft
Specific Energy	1,793.76	ft
Froude Number	1.44	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+28	0.070
0+28	0+85	0.044
0+85	0+99	0.077

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	1,810.73
0+14	1,801.55
0+28	1,791.46
0+42	1,786.56
0+57	1,790.73
0+71	1,796.55
0+85	1,803.35
0+99	1,810.33

Project Summary Report

Project Description	
Worksheet	R1E5
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	037000	ft/ft
Discharg	,422.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.048	
Water Surface Elev	1,868.01	ft
Elevation Range	63.92 to 1,876.22	
Flow Area	200.0	ft²
Wetted Perimeter	67.94	ft
Top Width	66.96	ft
Actual Depth	4.09	ft
Critical Elevation	1,868.52	ft
Critical Slope	0.023458	ft/ft
Velocity	12.11	ft/s
Velocity Head	2.28	ft
Specific Energy	1,870.29	ft
Froude Number	1.24	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
1+63	1+98	0.070
1+98	2+26	0.044
2+26	2+89	0.070

Natural Channel Points

Station (ft)	Elevation (ft)
1+63	1,876.22
1+84	1,867.87
1+91	1,864.99
1+98	1,863.92
2+26	1,864.24
2+33	1,864.95
2+40	1,865.97
2+89	1,875.87

Project Summary Report

Project Description	
Worksheet	R1E6
Flow Element	Irregular Chani
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	031300	ft/ft
Discharg	,870.00	cfs

Options	
Current Roughness Metho	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.048	
Water Surface Elev	2,040.20	ft
Elevation Range	34.72 to 2,049.36	
Flow Area	155.7	ft²
Wetted Perimeter	48.65	ft
Top Width	47.07	ft
Actual Depth	5.48	ft
Critical Elevation	2,040.59	ft
Critical Slope	0.022576	ft/ft
Velocity	12.01	ft/s
Velocity Head	2.24	ft
Specific Energy	2,042.44	ft
Froude Number	1.16	
Flow Type	Supercritical	

Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+63	1+08	0.070
1+08	1+28	0.044
1+28	1+49	0.070

Natural Channel Points	
Station (ft)	Elevation (ft)
0+63	2,049.36
0+76	2,043.81
0+85	2,040.03
1+08	2,034.72
1+17	2,034.91
1+28	2,038.50
1+39	2,043.39
1+49	2,046.72

Project Summary Report

Project Description	
Worksheet	R1E7
Flow Element	Irregular Chan
Method	Manning's For
Solve For	Channel Depth

Input Data		
Slope	037800	ft/ft
Discharg	984.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.044	
Water Surface Elev	2,154.55	ft
Elevation Range	49.26 to 2,160.75	
Flow Area	80.9	ft²
Wetted Perimeter	32.13	ft
Top Width	30.20	ft
Actual Depth	5.29	ft
Critical Elevation	2,155.15	ft
Critical Slope	0.021272	ft/ft
Velocity	12.16	ft/s
Velocity Head	2.30	ft
Specific Energy	2,156.84	ft
Froude Number	1.31	
Flow Type	Supercritical	

Roughness Segments

Start Station	End Station	Mannings Coefficient
0+00	0+22	0.070
0+22	0+61	0.044
0+61	0+67	0.070

Natural Channel Points

Station (ft)	Elevation (ft)
0+00	2,160.75
0+12	2,158.21
0+22	2,155.45
0+33	2,152.45
0+45	2,149.26
0+55	2,154.02
0+61	2,157.16
0+67	2,160.28

D.4 Reservoir Routing Data

D.5 Flow Splits and Diversions Data

D.6 Hydrologic Calculations

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              MAY   1991               *
*           VERSION 4.0.1E              *
*                                       *
*  RUN DATE           TIME              *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```

```
X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX           XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
    1         ID  Watershed #1, Upper Agua Fria Zona A Floodplain Delineation Study Contract FCD2000C020
    2         ID  By RBF Consulting for the Flood Control District of Maricopa County, 12/4/2001
    3         ID  100-YR 6-HR Storm/ Clark Unit Hydrograph/ Green-Ampt Rainfall Losses
              *DIAGRAM
    4         IT       5  1JAN94       0     300
    5         IO       5
    6         IN      15  1JAN94       0
    7         JD     3.4  0.0001
              * Pattern 1
    8         PC     0.0     0.8     1.6     2.5     3.3     4.1     5.0     5.8     6.6     7.4
    9         PC     8.7     9.9    11.8    13.8    21.6    37.7    83.4    91.1    93.1    95.0
   10         PC    96.2    97.2    98.3    99.1   100.0
   11         IN      15  1JAN94       0
   12         JD    3.38     0.5
              * Pattern 1
   13         PC     0.0     0.8     1.6     2.5     3.3     4.1     5.0     5.8     6.6     7.4
   14         PC     8.7     9.9    11.8    13.8    21.6    37.7    83.4    91.1    93.1    95.0
   15         PC    96.2    97.2    98.3    99.1   100.0
   16         IN      15  1JAN94       0
   17         JD    3.31     2.8
              * Pattern 2
   18         PC     0.0     0.9     1.6     2.5     3.4     4.2     5.1     5.9     6.7     7.6
   19         PC     8.7    10.0    12.0    16.3    25.2    45.1    69.4    83.7    90.0    93.8
   20         PC    95.0    96.3    97.5    98.8   100.0
   21         IN      15  1JAN94       0
   22         JD    3.14    15.5
              * Pattern 3
   23         PC     0.0     1.5     2.0     3.0     4.8     6.3     7.6     9.0    10.5    11.9
   24         PC    13.5    15.2    17.5    22.2    30.4    47.2    67.0    79.6    86.8    91.2
   25         PC    94.6    96.0    97.3    98.7   100.0

   26         KK  SUB1E3
   27         KO       0       0     0.0       1      22
   28         BA  0.4304
   29         LG    0.15   0.335   7.229    0.11  28.772
   30         UC   0.433   0.293
              * Natural Watershed
   31         UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
   32         UA   100.0

   33         KK    R1E3   CNAME   CP1E3
   34         KO       0       0     0.0       0      22
   35         RS       1    FLOW     0.0     0.0
   36         RC    0.07   0.044    0.07  2912.0  0.0467 1810.33
              * R1E3
   37         RX     0.0   14.14   28.28   42.43   56.57   70.71   84.85    99.0
   38         RY  1810.7 1801.55 1791.46 1786.56 1790.73 1796.55 1803.35 1810.33

   39         KK  SUB1E7
   40         KO       0       0     0.0       1      22
   41         BA  0.4327
   42         LG    0.15   0.273   8.732   0.061   6.174
   43         UC   0.383    0.22
              * Natural Watershed
   44         UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
```

HEC-1 INPUT PAGE 2

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
   45         UA   100.0
```

```
 46          KK    R1E7   CNAME   CP1E7
 47          KO       0       0     0.0       0      22
 48          RS       1    FLOW     0.0     0.0
 49          RC    0.07   0.044    0.07  3277.0  0.0378 2160.28
             * R1E7
 50          RX     0.0   11.88   22.36    32.7   44.22   54.59   61.05   67.08
 51          RY  2160.7 2158.21 2155.45 2152.45 2149.26 2154.02 2157.16 2160.28

 52          KK  SUB1E6
 53          KO       0       0     0.0       1      22
 54          BA  0.5526
 55          LG    0.15   0.349   7.016   0.118  13.231
 56          UC   0.388   0.195
             * Natural Watershed
 57          UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 58          UA   100.0

 59          KK   CP1E6   CNAME    R1E6
 60          KO       0       0     0.0       0      22
 61          HC       2

 62          KK    R1E6   CNAME   CP1E6
 63          KO       0       0     0.0       0      22
 64          RS       2    FLOW     0.0     0.0
 65          RC    0.07   0.044    0.07  4061.0  0.0313 2046.72
             * R1E6
 66          RX   63.18   76.11   85.45  107.66  117.06  128.31  139.28  148.68
 67          RY  2049.3 2043.81 2040.03 2034.72 2034.91  2038.5 2043.39 2046.72

 68          KK  SUB1E5
 69          KO       0       0     0.0       1      22
 70          BA  0.5175
 71          LG    0.15    0.38     6.4   0.155  19.651
 72          UC   0.383   0.198
             * Natural Watershed
 73          UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 74          UA   100.0

 75          KK   CP1E5   CNAME    R1E5
 76          KO       0       0     0.0       0      22
 77          HC       2

 78          KK    R1E5   CNAME   CP1E5
 79          KO       0       0     0.0       0      22
 80          RS       2    FLOW     0.0     0.0
 81          RC    0.07   0.044    0.07  5997.0   0.037 1876.22
             * R1E5
 82          RX  162.74  183.82  191.02  197.96  226.23  233.44  240.37   289.0
 83          RY  1876.2 1867.87 1864.99 1863.92 1864.24 1864.95 1865.97 1875.87
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9.....10

 84          KK  SUB1E4
 85          KO       0       0     0.0       1      22
 86          BA  0.5184
 87          LG    0.15   0.376   6.471    0.15  22.696
 88          UC   0.483   0.336
             * Natural Watershed
 89          UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 90          UA   100.0

 91          KK  SUB1E2
 92          KO       0       0     0.0       1      22
 93          BA  0.2852
 94          LG    0.15   0.371   6.575   0.144  16.719
 95          UC   0.354   0.223
             * Natural Watershed
 96          UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
 97          UA   100.0

 98          KK   CP1E2   CNAME    R1E2
 99          KO       0       0     0.0       0      22
100          HC       4

101          KK    R1E2   CNAME   CP1E2
102          KO       0       0     0.0       0      22
103          RS       1    FLOW     0.0     0.0
104          RC    0.07   0.044    0.07  3109.0   0.032 1739.46
             * R1E2
105          RX     0.0   14.14   36.34   56.56   56.57   70.71   84.85    98.0
106          RY  1739.1 1734.91  1732.4  1730.1  1730.1 1729.38 1733.24 1737.46

107          KK  SUB1E1
108          KO       0       0     0.0       1      22
109          BA  0.2546
110          LG    0.15   0.373    6.55   0.146  15.455
111          UC   0.371   0.263
             * Natural Watershed
112          UA     0.0     3.0     5.0     8.0    12.0    20.0    43.0    75.0    90.0    96.0
113          UA   100.0

114          KK   CP1E1   CNAME    R1E1
115          KO       0       0     0.0       0      22
116          HC       2
```

```
 117          KK     R1E1    CNAME    CP1E1
 118          KO        0        0      0.0        0       22
 119          RN     R1E1

 120          KK    SUB1F
 121          KO        0        0      0.0        1       22
 122          BA   0.8136
 123          LG     0.15    0.364    6.713    0.136   24.558
 124          UC      0.6    0.419
              * Natural Watershed
 125          UA      0.0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
```

HEC-1 INPUT PAGE 4

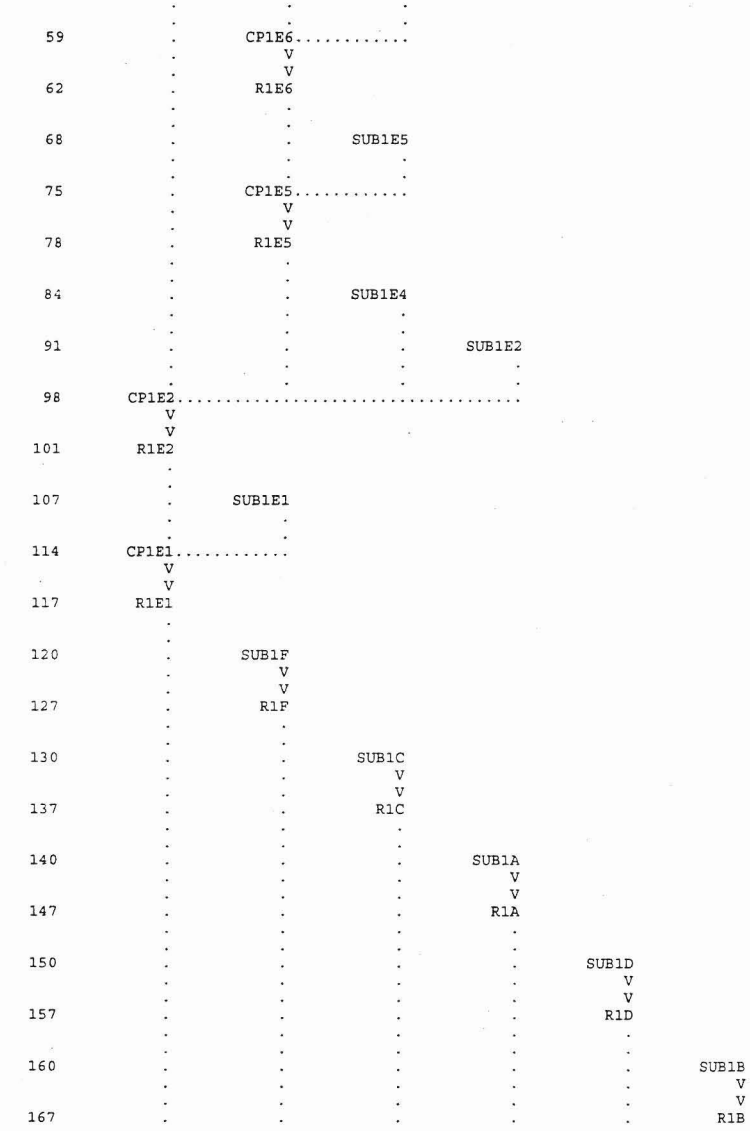
```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 126          UA    100.0

 127          KK      R1F    CNAME     CP1F
 128          KO        0        0      0.0        0       22
 129          RN      R1F

 130          KK    SUB1C
 131          KO        0        0      0.0        1       22
 132          BA   0.7635
 133          LG     0.15    0.351    6.975     0.12   26.827
 134          UC    0.654    0.528
              * Natural Watershed
 135          UA      0.0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
 136          UA    100.0

 137          KK      R1C    CNAME     CP1C
 138          KO        0        0      0.0        0       22
 139          RN      R1C

 140          KK    SUB1A
 141          KO        0        0      0.0        1       22
 142          BA    0.697
 143          LG     0.15     0.33      7.3    0.107     30.0
 144          UC    0.604    0.462
              * Natural Watershed
 145          UA      0.0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
 146          UA    100.0

 147          KK      R1A    CNAME     CP1A
 148          KO        0        0      0.0        0       22
 149          RN      R1A

 150          KK    SUB1D
 151          KO        0        0      0.0        1       22
 152          BA   0.6515
 153          LG     0.15    0.387    6.261    0.163   18.391
 154          UC    0.658    0.569
              * Natural Watershed
 155          UA      0.0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
 156          UA    100.0

 157          KK      R1D    CNAME     CP1D
 158          KO        0        0      0.0        0       22
 159          RN      R1D

 160          KK    SUB1B
 161          KO        0        0      0.0        1       22
 162          BA   0.6037
 163          LG     0.15     0.33      7.3    0.107     30.0
 164          UC    0.617    0.532
              * Natural Watershed
 165          UA      0.0      3.0      5.0      8.0     12.0     20.0     43.0     75.0     90.0     96.0
 166          UA    100.0
```

HEC-1 INPUT PAGE 5

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 167          KK      R1B    CNAME     CP1B
 168          KO        0        0      0.0        0       22
 169          RN      R1B
 170          ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
INPUT
 LINE      (V) ROUTING          (---->) DIVERSION OR PUMP FLOW

  NO.      (.) CONNECTOR        (<----) RETURN OF DIVERTED OR PUMPED FLOW

   26      SUB1E3
             V
             V
   33        R1E3
             .
             .
   39        .       SUB1E7
             .         V
             .         V
   46        .       R1E7
             .         .
             .         .
   52        .         .       SUB1E6
```



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               MAY   1991              *
*            VERSION 4.0.1E             *
*                                       *
*  RUN DATE            TIME             *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*            (916) 551-1748             *
*                                       *
*****************************************
```

Upper Agua Fria Zona A Floodplain Delineation Study Contract FCD2000C020
By RBF Consulting for the Flood Control District of Maricopa County, 12/4/2001
100-YR 6-HR Storm/ Clark Unit Hydrograph/ Green-Ampt Rainfall Losses

```
 5 IO          OUTPUT CONTROL VARIABLES
                    IPRNT           5  PRINT CONTROL
                    IPLOT           0  PLOT CONTROL
                    QSCAL          0.  HYDROGRAPH PLOT SCALE

   IT         HYDROGRAPH TIME DATA
                     NMIN           5  MINUTES IN COMPUTATION INTERVAL
                    IDATE      1JAN94  STARTING DATE
                    ITIME        0000  STARTING TIME
                       NQ,         300  NUMBER OF HYDROGRAPH ORDINATES
                   NDDATE      2JAN94  ENDING DATE
                   NDTIME        0055  ENDING TIME
                    ICENT          19  CENTURY MARK
```

```
            COMPUTATION INTERVAL     0.08 HOURS
                TOTAL TIME BASE    24.92 HOURS

      ENGLISH UNITS
           DRAINAGE AREA          SQUARE MILES
           PRECIPITATION DEPTH    INCHES
           LENGTH, ELEVATION      FEET
           FLOW                   CUBIC FEET PER SECOND
           STORAGE VOLUME         ACRE-FEET
           SURFACE AREA           ACRES
           TEMPERATURE            DEGREES FAHRENHEIT

 7 JD      INDEX STORM NO. 1
                 STRM        3.40  PRECIPITATION DEPTH
                 TRDA        0.00  TRANSPOSITION DRAINAGE AREA

 8 PI        PRECIPITATION PATTERN
             0.27    0.27    0.27    0.27    0.27    0.27    0.30    0.30    0.30    0.27
             0.27    0.27    0.27    0.27    0.27    0.30    0.30    0.30    0.27    0.27
             0.27    0.27    0.27    0.27    0.27    0.27    0.27    0.43    0.43    0.43
             0.40    0.40    0.40    0.63    0.63    0.63    0.67    0.67    0.67    2.60
             2.60    2.60    5.37    5.37    5.37   15.23   15.23   15.23    2.57    2.57
             2.57    0.67    0.67    0.67    0.63    0.63    0.63    0.40    0.40    0.40
             0.33    0.33    0.33    0.37    0.37    0.37    0.27    0.27    0.27    0.30
             0.30    0.30

12 JD      INDEX STORM NO. 2
                 STRM        3.38  PRECIPITATION DEPTH
                 TRDA        0.50  TRANSPOSITION DRAINAGE AREA

13 PI        PRECIPITATION PATTERN
             0.27    0.27    0.27    0.27    0.27    0.27    0.30    0.30    0.30    0.27
             0.27    0.27    0.27    0.27    0.27    0.30    0.30    0.30    0.27    0.27
             0.27    0.27    0.27    0.27    0.27    0.27    0.27    0.43    0.43    0.43
             0.40    0.40    0.40    0.63    0.63    0.63    0.67    0.67    0.67    2.60
             2.60    2.60    5.37    5.37    5.37   15.23   15.23   15.23    2.57    2.57
             2.57    0.67    0.67    0.67    0.63    0.63    0.63    0.40    0.40    0.40
             0.33    0.33    0.33    0.37    0.37    0.37    0.27    0.27    0.27    0.30
             0.30    0.30

17 JD      INDEX STORM NO. 3
                 STRM        3.31  PRECIPITATION DEPTH
                 TRDA        2.80  TRANSPOSITION DRAINAGE AREA

18 PI        PRECIPITATION PATTERN
             0.30    0.30    0.30    0.23    0.23    0.23    0.30    0.30    0.30    0.30
             0.30    0.30    0.27    0.27    0.27    0.30    0.30    0.30    0.27    0.27
             0.27    0.27    0.27    0.27    0.30    0.30    0.30    0.37    0.37    0.37
             0.43    0.43    0.43    0.67    0.67    0.67    1.43    1.43    1.43    2.97
             2.97    2.97    6.63    6.63    6.63    8.10    8.10    8.10    4.77    4.77
             4.77    2.10    2.10    2.10    1.27    1.27    1.27    0.40    0.40    0.40
             0.43    0.43    0.43    0.40    0.40    0.40    0.43    0.43    0.43    0.40
             0.40    0.40

22 JD      INDEX STORM NO. 4
                 STRM        3.14  PRECIPITATION DEPTH
                 TRDA       15.50  TRANSPOSITION DRAINAGE AREA

23 PI        PRECIPITATION PATTERN
             0.50    0.50    0.50    0.17    0.17    0.17    0.33    0.33    0.33    0.60
             0.60    0.60    0.50    0.50    0.50    0.43    0.43    0.43    0.47    0.47
             0.47    0.50    0.50    0.50    0.47    0.47    0.47    0.53    0.53    0.53
             0.57    0.57    0.57    0.77    0.77    0.77    1.57    1.57    1.57    2.73
             2.73    2.73    5.60    5.60    5.60    6.60    6.60    6.60    4.20    4.20
             4.20    2.40    2.40    2.40    1.47    1.47    1.47    1.13    1.13    1.13
             0.47    0.47    0.47    0.43    0.43    0.43    0.47    0.47    0.47    0.43
             0.43    0.43

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
26 KK     *    SUB1E3  *
          *            *
          **************

27 KO     OUTPUT CONTROL VARIABLES
               IPRNT          5  PRINT CONTROL
               IPLOT          0  PLOT CONTROL
               QSCAL          0.  HYDROGRAPH PLOT SCALE
               IPNCH          1  PUNCH COMPUTED HYDROGRAPH
                IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
               ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
               ISAV2        300  LAST ORDINATE PUNCHED OR SAVED
              TIMINT      0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
33 KK     *     R1E3   *        CNAME   CP1E3
```

```
          *           *
          **************

 34 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
 39 KK    *    SUB1E7  *
          *           *
          **************

 40 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
 46 KK    *      R1E7 *        CNAME   CP1E7
          *           *
          **************

 47 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
 52 KK    *    SUB1E6  *
          *           *
          **************

 53 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
 59 KK    *     CP1E6 *        CNAME    R1E6
          *           *
          **************

 60 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
```

TIMINT 0.083 TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
 62 KK    *      R1E6  *        CNAME   CP1E6
          *            *
          **************

 63 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS
```

*** ***

```
          **************
          *            *
 68 KK    *    SUB1E5  *
          *            *
          **************

 69 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS
```

*** ***

```
          **************
          *            *
 75 KK    *     CP1E5  *        CNAME    R1E5
          *            *
          **************

 76 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS
```

*** ***

```
          **************
          *            *
 78 KK    *      R1E5  *        CNAME   CP1E5
          *            *
          **************

 79 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS
```

*** ***

```
          **************
          *            *
 84 KK    *    SUB1E4  *
```

```
           *           *
           **************

 85 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *           *
 91 KK     *    SUB1E2  *
           *           *
           **************

 92 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *           *
 98 KK     *     CP1E2  *        CNAME    R1E2
           *           *
           **************

 99 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *           *
101 KK     *      R1E2  *        CNAME   CP1E2
           *           *
           **************

102 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                     TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *           *
107 KK     *    SUB1E1  *
           *           *
           **************

108 KO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
                      IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                       IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                      ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                      ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
```

TIMINT 0.083 TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
114 KK    *     CP1E1  *        CNAME    R1E1
          *            *
          **************
```

115 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
117 KK    *      R1E1  *        CNAME    CP1E1
          *            *
          **************
```

118 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
120 KK    *     SUB1F  *
          *            *
          **************
```

121 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	1	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
127 KK    *       R1F  *        CNAME    CP1F
          *            *
          **************
```

128 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
130 KK    *     SUB1C  *
```

```
          *           *
          **************

131 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
137 KK    *       R1C *        CNAME    CP1C
          *           *
          **************

138 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
140 KK    *     SUB1A *
          *           *
          **************

141 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
147 KK    *       R1A *        CNAME    CP1A
          *           *
          **************

148 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       0.083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


          **************
          *           *
150 KK    *     SUB1D *
          *           *
          **************

151 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE
                     IPNCH           1  PUNCH COMPUTED HYDROGRAPH
                      IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2         300  LAST ORDINATE PUNCHED OR SAVED
```

TIMINT 0.083 TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
157 KK    *     R1D    *      CNAME    CP1D
          *            *
          **************
```

158 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
160 KK    *    SUB1B   *
          *            *
          **************
```

161 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	1	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

*** ***

```
          **************
          *            *
167 KK    *     R1B    *      CNAME    CP1B
          *            *
          **************
```

168 KO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE
IPNCH	0	PUNCH COMPUTED HYDROGRAPH
IOUT	22	SAVE HYDROGRAPH ON THIS UNIT
ISAV1	1	FIRST ORDINATE PUNCHED OR SAVED
ISAV2	300	LAST ORDINATE PUNCHED OR SAVED
TIMINT	0.083	TIME INTERVAL IN HOURS

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
	HYDROGRAPH AT									
+		SUB1E3	910.	4.25	112.	28.	27.	0.43		
	ROUTED TO									
+		R1E3	885.	4.33	112.	28.	27.	0.43		
	HYDROGRAPH AT									
+		SUB1E7	1045.	4.25	108.	27.	26.	0.43		
	ROUTED TO									
+		R1E7	1010.	4.25	108.	27.	26.	0.43		
	HYDROGRAPH AT									
+		SUB1E6	1303.	4.25	129.	32.	31.	0.55		
	2 COMBINED AT									
+		CP1E6	1998.	4.25	231.	58.	56.	0.99		
	ROUTED TO									
+		R1E6	1934.	4.33	231.	58.	56.	0.99		
	HYDROGRAPH AT									

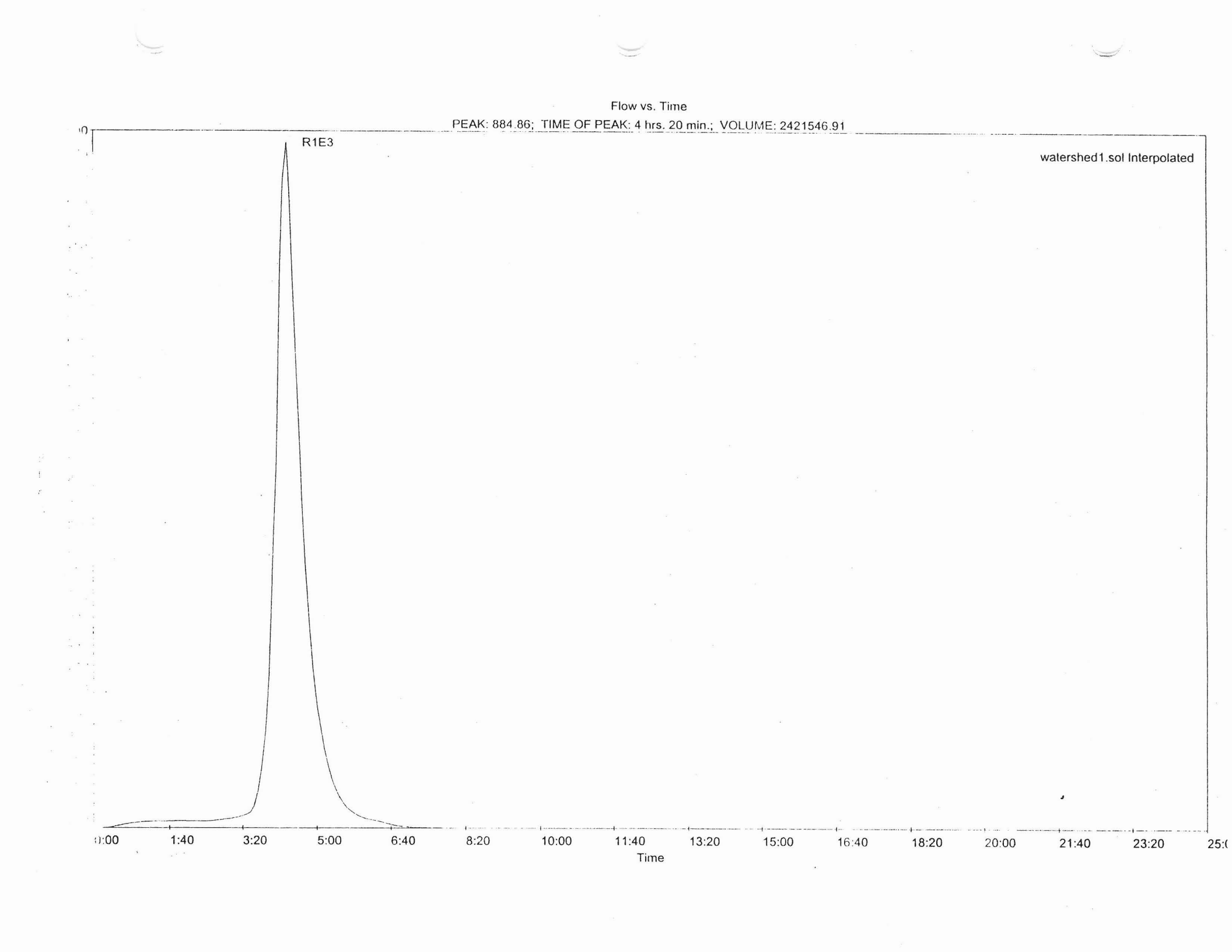
+		SUB1E5	1213.	4.25	121.	30.	29.	0.52
	2 COMBINED AT							
+		CP1E5	2623.	4.25	340.	85.	82.	1.50
	ROUTED TO							
+		R1E5	2522.	4.33	340.	85.	82.	1.50
	HYDROGRAPH AT							
+		SUB1E4	965.	4.33	124.	31.	30.	0.52
	HYDROGRAPH AT							
+		SUB1E2	658.	4.17	66.	17.	16.	0.29
	4 COMBINED AT							
+		CP1E2	3733.	4.33	606.	152.	147.	2.74
	ROUTED TO							
+		R1E2	3687.	4.42	606.	152.	147.	2.74
	HYDROGRAPH AT							
+		SUB1E1	543.	4.25	58.	15.	14.	0.25
	2 COMBINED AT							
+		CP1E1	3924.	4.42	654.	164.	158.	2.99
	ROUTED TO							
+		R1E1	3924.	4.42	654.	164.	158.	2.99
	HYDROGRAPH AT							
+		SUB1F	1228.	4.42	195.	49.	47.	0.81
	ROUTED TO							
+		R1F	1228.	4.42	195.	49.	47.	0.81
	HYDROGRAPH AT							
+		SUB1C	1031.	4.50	190.	48.	46.	0.76
	ROUTED TO							
+		R1C	1031.	4.50	190.	48.	46.	0.76
	HYDROGRAPH AT							
+		SUB1A	1070.	4.42	180.	45.	44.	0.70
	ROUTED TO							
+		R1A	1070.	4.42	180.	45.	44.	0.70
	HYDROGRAPH AT							
+		SUB1D	817.	4.50	147.	37.	36.	0.65
	ROUTED TO							
+		R1D	817.	4.50	147.	37.	36.	0.65
	HYDROGRAPH AT							
+		SUB1B	878.	4.42	157.	39.	38.	0.60
	ROUTED TO							
+		R1B	878.	4.42	157.	39.	38.	0.60

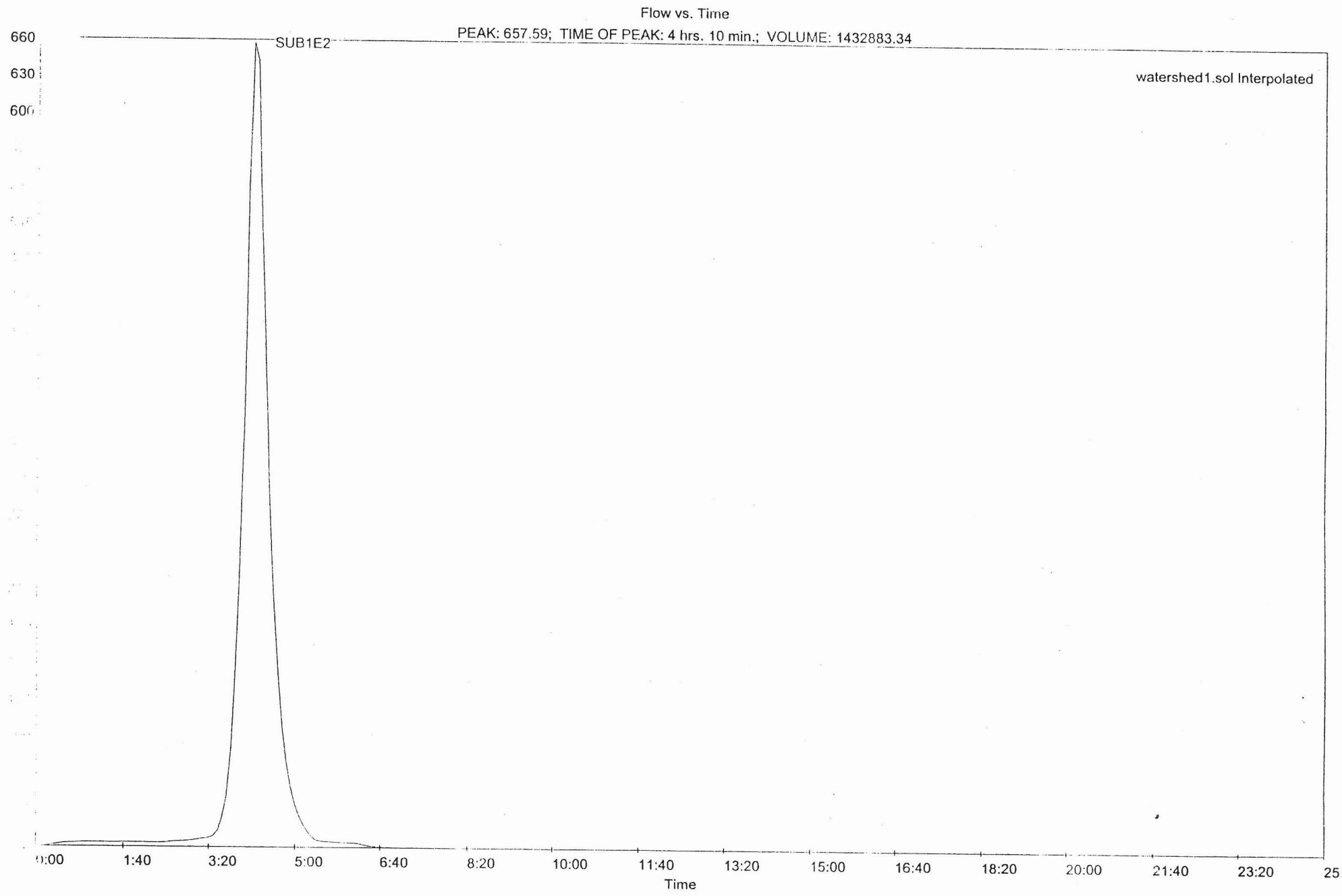
*** NORMAL END OF HEC-1 ***

Hydrograph table written by WMS

Time	R1E3	Time	SUB1E2	Combined
0:00	0	0:00	0	0
0:05	0.011	0:05	0.032	0
0:10	0.062018	0:10	0.146066	0
0:15	0.227018	0:15	0.590264	1
0:20	0.665071	0:20	1.31453	2
0:25	1.48314	0:25	1.93679	3
0:30	2.54927	0:30	2.37492	5
0:35	3.65039	0:35	2.68006	6
0:40	4.65948	0:40	2.90012	8
0:45	5.53358	0:45	3.09625	9
0:50	6.28767	0:50	3.27932	10
0:55	6.94373	0:55	3.40932	10
1:00	7.49778	1:00	3.45432	11
1:05	7.92183	1:05	3.43232	11
1:10	8.20887	1:10	3.40132	12
1:15	8.38389	1:15	3.37832	12
1:20	8.48989	1:20	3.36732	12
1:25	8.55789	1:25	3.37125	12
1:30	8.6149	1:30	3.41432	12
1:35	8.68992	1:35	3.49239	12
1:40	8.79892	1:40	3.55039	12
1:45	8.91994	1:45	3.54639	12
1:50	9.00794	1:50	3.49039	12
1:55	9.03196	1:55	3.43639	12
2:00	9.00294	2:00	3.39732	12
2:05	8.94794	2:05	3.37132	12
2:10	8.88892	2:10	3.35232	12
2:15	8.83292	2:15	3.34032	12
2:20	8.79092	2:20	3.35232	12
2:25	8.78292	2:25	3.41832	12
2:30	8.85294	2:30	3.69245	13
2:35	9.09996	2:35	4.13765	13
2:40	9.58401	2:40	4.51078	14
2:45	10.2151	2:45	4.72785	15
2:50	10.8461	2:50	4.85091	16
2:55	11.4062	2:55	5.00098	16
3:00	11.9442	3:00	5.42411	17
3:05	12.6243	3:05	6.08438	19
3:10	13.5674	3:10	6.65857	20
3:15	14.6865	3:15	7.10877	22
3:20	15.9547	3:20	7.7063	24
3:25	17.6521	3:25	8.98861	27
3:30	20.665	3:30	13.2509	34
3:35	28.5803	3:35	23.777	52
3:40	48.629	3:40	42.1765	91
3:45	77.5734	3:45	82.0276	160
3:50	122.68	3:50	145.771	268
3:55	197.561	3:55	220.291	418
4:00	307.868	4:00	355.128	663
4:05	454.178	4:05	532.876	987

4:10	667.098	4:10	657.594	1325
4:15	836.577	4:15	642.824	**1479**
4:20	884.86	4:20	513.501	1398
4:25	804.542	4:25	386.867	1191
4:30	669.383	4:30	285.364	955
4:35	537.915	4:35	202.53	740
4:40	429.021	4:40	141.745	571
4:45	339.439	4:45	99.6284	439
4:50	262.733	4:50	70.6673	333
4:55	202.928	4:55	50.7039	254
5:00	158.177	5:00	36.3966	195
5:05	129.456	5:05	26.2065	156
5:10	103.299	5:10	19.082	122
5:15	81.7128	5:15	13.0531	95
5:20	64.6577	5:20	8.81503	73
5:25	51.3071	5:25	5.88664	57
5:30	40.9168	5:30	5.25024	46
5:35	33.0058	5:35	4.85191	38
5:40	26.6361	5:40	4.55578	31
5:45	22.7116	5:45	4.36672	27
5:50	19.2276	5:50	4.08458	23
5:55	16.2365	5:55	3.85552	20
6:00	14.0734	6:00	3.73952	18
6:05	12.5002	6:05	3.67745	16
6:10	11.3892	6:10	3.54639	15
6:15	10.5491	6:15	3.05019	14
6:20	9.64699	6:20	2.23886	12
6:25	8.46887	6:25	1.54059	10
6:30	7.10274	6:30	1.0494	8
6:35	5.7576	6:35	0.713264	6
6:40	4.56048	6:40	0.483132	5
6:45	3.55537	6:45	0.324132	4
6:50	2.73928	6:50	0.216066	3
6:55	2.09121	6:55	0.141066	2
7:00	1.58516	7:00	0.092066	2
7:05	1.19312	7:05	0.058066	1
7:10	0.892089	7:10	0.035066	1
7:15	0.662071	7:15	0.019	1
7:20	0.487035	7:20	0.008	0
7:25	0.354035	7:25	0	0
7:30	0.255035	7:30	0	0
7:35	0.181018	7:35	0	0
7:40	0.125018	7:40	0	0
7:45	0.083018	7:45	0	0
7:50	0.051018	7:50	0	0
7:55	0.03	7:55	0	0
8:00	0.017	8:00	0	0
8:05	0.01	8:05	0	0
8:10	0.006	8:10	0	0
8:15	0.003	8:15	0	0
8:20	0.002	8:20	0	0
8:25	0.001	8:25	0	0

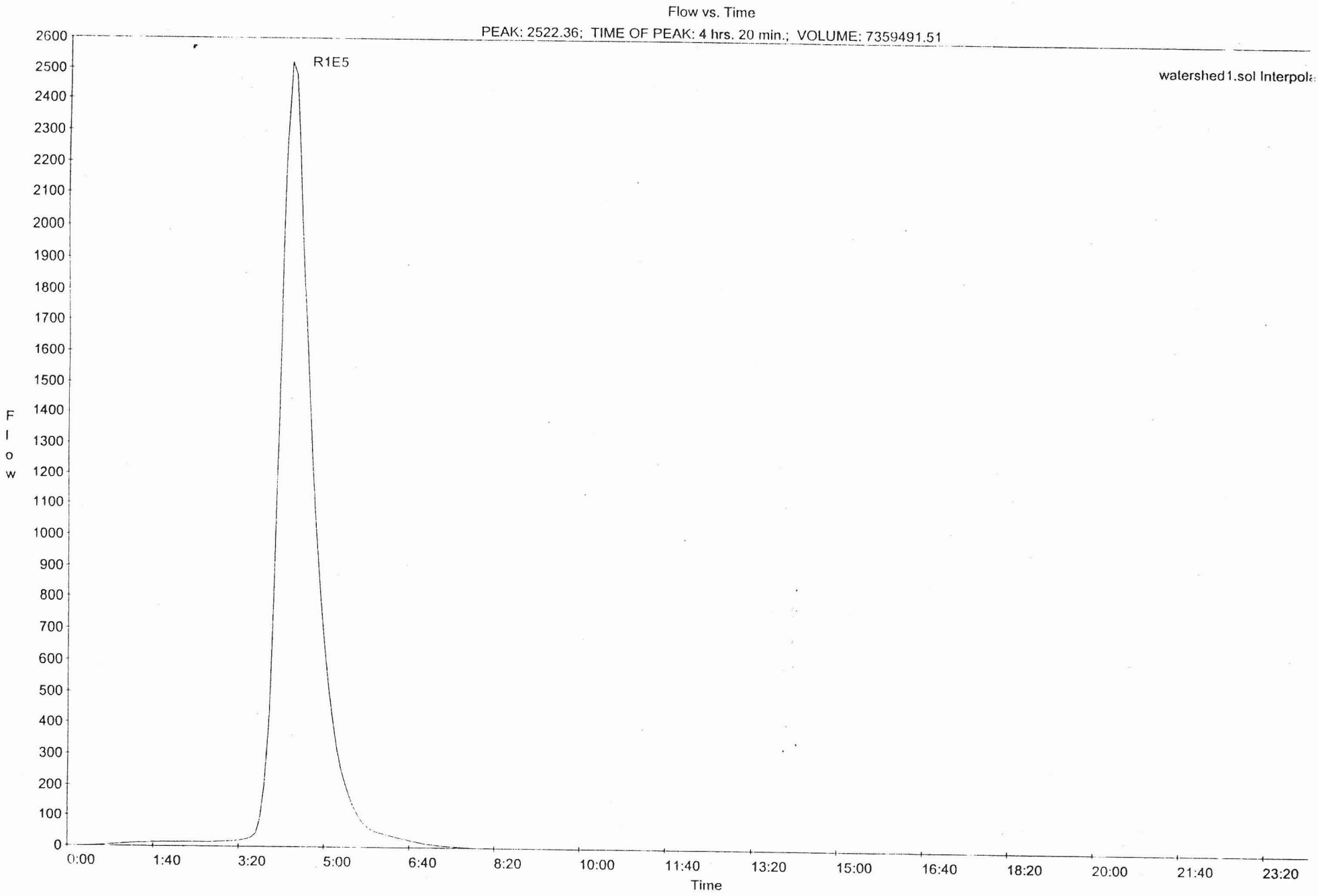

Flow vs. Time
PEAK: 884.86; TIME OF PEAK: 4 hrs. 20 min.; VOLUME: 2421546.91
R1E3
watershed1.sol Interpolated
1:40
3:20
5:00
6:40
8:20
10:00
11:40
13:20
15:00
16:40
18:20
20:00
21:40
23:20
Time

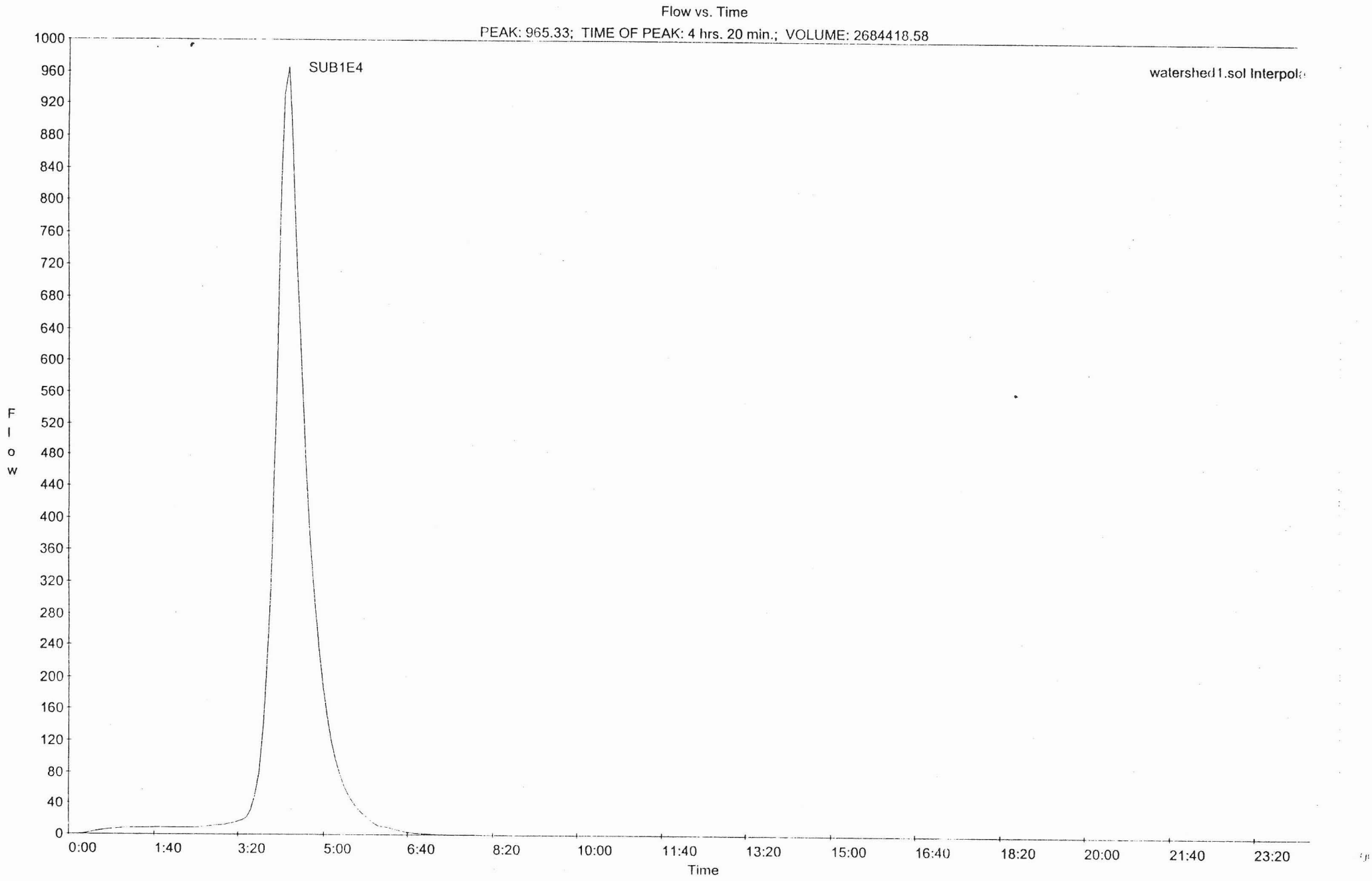

Flow vs. Time
PEAK: 657.59; TIME OF PEAK: 4 hrs. 10 min.; VOLUME: 1432883.34
SUB1E2
watershed1.sol Interpolated
660
630
600
1:40
3:20
5:00
6:40
8:20
10:00
11:40
13:20
15:00
16:40
18:20
20:00
21:40
23:20
Time

Hydrograph table written by WMS

Time	R1E5	Time	SUB1E4	Combined
0:00	0	0:00	0	0
0:05	0	0:05	0	0
0:10	0	0:10	0	0
0:15	0	0:15	0	1
0:20	0	0:20	1	1
0:25	1	0:25	2	3
0:30	1	0:30	4	5
0:35	2	0:35	5	7
0:40	3	0:40	5	8
0:45	4	0:45	6	10
0:50	5	0:50	7	12
0:55	6	0:55	7	13
1:00	7	1:00	8	15
1:05	8	1:05	8	16
1:10	9	1:10	8	17
1:15	10	1:15	8	18
1:20	11	1:20	8	19
1:25	11	1:25	8	20
1:30	12	1:30	8	20
1:35	12	1:35	8	21
1:40	13	1:40	8	21
1:45	13	1:45	9	22
1:50	14	1:50	9	22
1:55	14	1:55	9	22
2:00	14	2:00	8	22
2:05	14	2:05	8	22
2:10	14	2:10	8	22
2:15	14	2:15	8	22
2:20	14	2:20	8	23
2:25	14	2:25	8	23
2:30	14	2:30	9	23
2:35	14	2:35	9	23
2:40	15	2:40	10	24
2:45	15	2:45	10	25
2:50	15	2:50	11	26
2:55	16	2:55	11	27
3:00	16	3:00	12	28
3:05	17	3:05	13	30
3:10	18	3:10	14	32
3:15	19	3:15	15	34
3:20	20	3:20	17	37
3:25	23	3:25	19	41
3:30	26	3:30	22	47
3:35	31	3:35	31	62
3:40	44	3:40	50	94
3:45	90	3:45	79	169
3:50	199	3:50	139	338
3:55	428	3:55	233	661
4:00	790	4:00	350	1140
4:05	1256	4:05	528	1784

4:10	1782	4:10	751	2534
4:15	2262	4:15	931	3193
4:20	2522	4:20	965	**3488**
4:25	2482	4:25	861	3342
4:30	2227	4:30	723	2950
4:35	1897	4:35	591	2488
4:40	1573	4:40	473	2046
4:45	1272	4:45	375	1647
4:50	1020	4:50	297	1317
4:55	814	4:55	236	1050
5:00	643	5:00	188	831
5:05	509	5:05	150	659
5:10	403	5:10	120	523
5:15	317	5:15	96	413
5:20	249	5:20	77	327
5:25	203	5:25	63	266
5:30	163	5:30	51	214
5:35	129	5:35	42	171
5:40	102	5:40	35	136
5:45	81	5:45	29	110
5:50	67	5:50	24	91
5:55	57	5:55	19	76
6:00	52	6:00	14	66
6:05	47	6:05	11	58
6:10	43	6:10	10	53
6:15	39	6:15	9	49
6:20	36	6:20	8	44
6:25	32	6:25	7	39
6:30	29	6:30	5	34
6:35	26	6:35	4	30
6:40	23	6:40	3	26
6:45	20	6:45	2	22
6:50	17	6:50	2	19
6:55	15	6:55	1	16
7:00	12	7:00	1	13
7:05	10	7:05	1	11
7:10	9	7:10	1	9
7:15	7	7:15	1	8
7:20	6	7:20	0	6
7:25	5	7:25	0	5
7:30	4	7:30	0	4
7:35	3	7:35	0	3
7:40	3	7:40	0	3
7:45	2	7:45	0	2
7:50	2	7:50	0	2
7:55	1	7:55	0	1
8:00	1	8:00	0	1
8:05	1	8:05	0	1
8:10	1	8:10	0	1
8:15	0	8:15	0	0
8:20	0	8:20	0	0
8:25	0	8:25	0	0


Flow vs. Time
PEAK: 2522.36; TIME OF PEAK: 4 hrs. 20 min.; VOLUME: 7359491.51
R1E5
watershed1.sol Interpol
Flow
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
0:00
1:40
3:20
5:00
6:40
8:20
10:00
11:40
13:20
15:00
16:40
18:20
20:00
21:40
23:20
Time


Flow vs. Time
PEAK: 965.33; TIME OF PEAK: 4 hrs. 20 min.; VOLUME: 2684418.58
SUB1E4
watershed1.sol Interpol
1000
960
920
880
840
800
760
720
680
640
600
560
520
480
440
400
360
320
280
240
200
160
120
80
40
0
F
l
o
w
0:00
1:40
3:20
5:00
6:40
8:20
10:00
11:40
13:20
15:00
16:40
18:20
20:00
21:40
23:20
Time

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: SUB1A, Total Area (sq mi): 0.70

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.70	0.06	5499.00	
Mean Basin Elevation (thousands of feet) E*:		2.10	1.78		7.40
Mean Annual Precipitation (in) P:		12.00	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 6410 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	37	81.0	3
Rural Peak	Q5	153	64.0	5
Rural Peak	Q10	316	58.0	7
Rural Peak	Q25	666	58.0	8
Rural Peak	Q50	1080	61.0	9
Rural Peak	Q100	1650	66.0	9
Rural Peak	Q500	3810	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: SUB1B, Total Area (sq mi): 0.60

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.60	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.24	1.78		7.40
	Mean Annual Precipitation (in) P:	12.00	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 5600 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	32	81.0	3
Rural Peak	Q5	131	64.0	5
Rural Peak	Q10	270	58.0	7
Rural Peak	Q25	565	58.0	8
Rural Peak	Q50	915	61.0	9
Rural Peak	Q100	1380	66.0	9
Rural Peak	Q500	3180	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: SUB1C, Total Area (sq mi): 0.76

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.76	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.25	1.78	7.40	
	Mean Annual Precipitation (in) P:	12.00	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 6970 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	37	81.0	3
Rural Peak	Q5	152	64.0	5
Rural Peak	Q10	312	58.0	7
Rural Peak	Q25	651	58.0	8
Rural Peak	Q50	1050	61.0	9
Rural Peak	Q100	1590	66.0	9
Rural Peak	Q500	3630	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1D, Total Area (sq mi): 0.65

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.65	0.06	5499.00	
Mean Basin Elevation (thousands of feet)	E*:	2.11	1.78		7.40
Mean Annual Precipitation (in)	P:	12.50	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 6000 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	36	81.0	3
Rural Peak	Q5	151	64.0	5
Rural Peak	Q10	312	58.0	7
Rural Peak	Q25	658	58.0	8
Rural Peak	Q50	1070	61.0	9
Rural Peak	Q100	1620	66.0	9
Rural Peak	Q500	3760	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1E1, Total Area (sq mi): 2.99

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	2.99	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.33	1.78		7.40
	Mean Annual Precipitation (in) P:	13.00	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 23700 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	100	81.0	3
Rural Peak	Q5	389	64.0	5
Rural Peak	Q10	778	58.0	7
Rural Peak	Q25	1590	58.0	8
Rural Peak	Q50	2520	61.0	9
Rural Peak	Q100	3750	66.0	9
Rural Peak	Q500	8360	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1E2, Total Area (sq mi): 2.74

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	2.74	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.30	1.78	7.40	
	Mean Annual Precipitation (in) P:	13.00	10.00	30.00	

****

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1E3, Total Area (sq mi): 0.43

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.43	0.06	5499.00	
Mean Basin Elevation (thousands of feet)	E*:	2.26	1.78		7.40
Mean Annual Precipitation (in)	P:	12.50	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 4060 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	26	81.0	3
Rural Peak	Q5	109	64.0	5
Rural Peak	Q10	224	58.0	7
Rural Peak	Q25	470	58.0	8
Rural Peak	Q50	763	61.0	9
Rural Peak	Q100	1150	66.0	9
Rural Peak	Q500	2660	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1E5, Total Area (sq mi): 1.50

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	1.50	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.49	1.78	7.40	
	Mean Annual Precipitation (in) P:	13.00	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 12900 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	60	81.0	3
Rural Peak	Q5	234	64.0	5
Rural Peak	Q10	469	58.0	7
Rural Peak	Q25	954	58.0	8
Rural Peak	Q50	1520	61.0	9
Rural Peak	Q100	2260	66.0	9
Rural Peak	Q500	5030	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1E6, Total Area (sq mi): 0.99

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.99	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.49	1.78		7.40
	Mean Annual Precipitation (in) P:	13.50	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 8870 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	47	81.0	3
Rural Peak	Q5	186	64.0	5
Rural Peak	Q10	373	58.0	7
Rural Peak	Q25	762	58.0	8
Rural Peak	Q50	1220	61.0	9
Rural Peak	Q100	1820	66.0	9
Rural Peak	Q500	4070	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1E7, Total Area (sq mi): 0.43

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.43	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.71	1.78		7.40
	Mean Annual Precipitation (in) P:	13.50	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 4060 (cfs)

Recurrence Interval		Peak (cfs)	Std Error	Equiv. Years
Rural Peak	Q2	26	81.0	3
Rural Peak	Q5	100	64.0	5
Rural Peak	Q10	201	58.0	7
Rural Peak	Q25	411	58.0	8
Rural Peak	Q50	657	61.0	9
Rural Peak	Q100	978	66.0	9
Rural Peak	Q500	2190	78.0	10

End of flow data.

Flow data computed with the National Flood Frequency Program in WMS.

Arizona, Basin: CP1F, Total Area (sq mi): 0.81

Region	Variable Descriptor	Input Value	Suggested Minimum	Suggested Maximum	
Central Mountain Area					
U.S. Max Fld Rgn: 16					
	Drainage Area (sq mi) A*:	0.81	0.06	5499.00	
	Mean Basin Elevation (thousands of feet) E*:	2.12	1.78		7.40
	Mean Annual Precipitation (in) P:	13.00	10.00	30.00	

****

MAXIMUM FLOOD ENVELOPE: 7370 (cfs)

Recurrence Interval	Peak (cfs)	Std Error	Equiv. Years
Rural Peak Q2	44	81.0	3
Rural Peak Q5	180	64.0	5
Rural Peak Q10	372	58.0	7
Rural Peak Q25	779	58.0	8
Rural Peak Q50	1260	61.0	9
Rural Peak Q100	1910	66.0	9
Rural Peak Q500	4410	78.0	10

End of flow data.

Appendix E: Hydraulic Analysis Supporting Documentation

E.1 Roughness Coefficient Estimation

E.1 Field Reconnaissance and Roughness Coefficient Estimation

E.1.1 Field Reconnaissance

The project team visited Watershed No. 1 (East Lake Pleasant) on September 21, 2001. The purpose of the field trip was to observe the watershed and floodplain conditions, obtain photographic documentation, and estimate Manning's n values. The aerial photographs and USGS maps show that there is no development in Watershed No. 1 that will affect the hydrologic and floodplain conditions. This was verified by the field visit. Table E.1-1 lists the washes that the project team attempted to visit, the sub-basins that the washes are in, and photograph numbers that correspond to the listed wash. Figure E.1-1 shows the location of the photographs on the USGS topographic maps, and the photographs are on the following pages.

Table E.1-1- List of the Washes in Watershed 1 and the Corresponding Photographs

Wash Name	Sub-Basin	Photograph Numbers
T6NR1ES4	SUB1A	1,2,3
T7NR1ES34	SUB1B	4,5
T7NR1ES35	SUB1C	6
T7NR1ES26-1	SUB1D	7
T7NR1ES26-2	SUB1E1	not accessible
T7NR1ES26-2a	SUB1E2 - SUB1E3	not accessible
T7NR1ES26-2b	SUB1E4 - SUB1E7	not accessible
T7NR1ES26-3	SUB1F	8,9

Because the watershed is in a remote, mountainous area, with little or no vehicular access, the project team gained access to the washes by fishing boat on Lake Pleasant. All of the washes listed above drain directly into Lake Pleasant. The boat was driven to the mouth of the wash where the project team would attempt to gain access to the wash. The day of the field visit the water surface elevation of the lake was considerably lower than the observed high water mark, and photographs 1, 2, 4, 5, and 8 were taken from locations lower than the high water surface elevation of the lake. Several of the washes were difficult to gain access to because of vegetation and cliffs along the shoreline. Pictures 4 and 5 show the steep cliff at the mouth of Wash T7R1ES34 that prevented access to the wash from the lake. All of the washes in SUB1E1 through SUB1E7 were inaccessible.

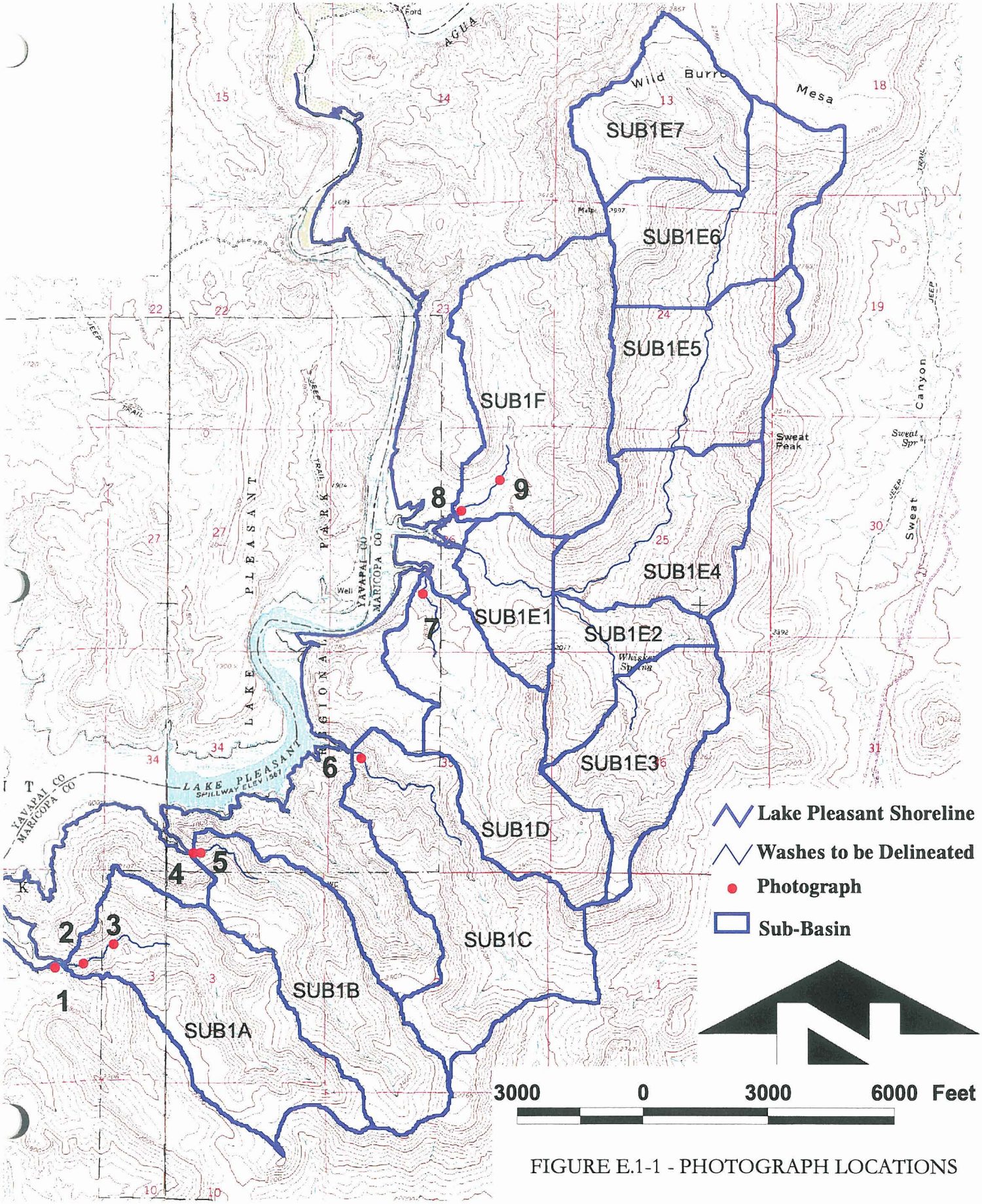


FIGURE E.1-1 - PHOTOGRAPH LOCATIONS

Photograph 1- On the shore of Lake Pleasant looking Upstream
Wash: T6NR1ES4
Sub-Basin: SUB1A

Photograph 2- Looking upstream at the high water surface line.
Wash: T6NR1ES4
Sub-Basin: SUB1A

Photograph3- Looking at the wash in the upstream direction, above the high water mark.
Wash: T6NR1ES4
Sub-Basin: SUB1A

Photograph4- Looking upstream at the wash from the shore of Lake Pleasant.
Wash: T7NR1ES34
Sub-Basin: SUB1B

Photograph5- Looking upstream at a drop in the wash' channel. Below the lake' high water mark.
Wash: T7NR1ES34
Sub-Basin: SUB1B

Photograph 6- Looking upstream at the wash from the side of the mountain.
Wash: T7NR1ES35
Sub-Basin: SUB1C

Photograph7- Looking upstream at the wash from ½ the distance up the bank.
Wash: T7NR1ES26-1
Sub-Basin: SUB1D

Photograph8- Looking upstream at the wash from below the lakes high water surface elevation.
Wash: T7NR1ES26-3
Sub-Basin: SUB1F

Photograph9- Looking upstream at the wash above the lake's high water surface elevation.
Wash: T7NR1ES26-3
Sub-Basin: SUB1F

E.1.2- Manning's "n" Determination

The procedure used to determine Manning's "n" values is outlined in the USGS publication "Estimated Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona" (April 1991). The following equation was used:

$$n = (n_b + n_1 + n_2 + n_{3+}n_4)m$$

Where n = estimated Manning's roughness coefficient
n_b= base value of n for a straight, uniform channel,
n_1= value for surface irregularities,
n_2= value for obstruction,
n_3= value for vegetation,
n_4= value for variation in channel cross section, and
m = degree of meandering.

FEMA 37, "Guidelines and Specifications for Study Contractors", recommends that one n-value be selected for each stream or wash when performing Zone A delineations, and that the cross sections used be kept to a minimum, preferably 1 or 2 per stream (pg. 6-2). For this reason the n_4 value and m multiplier were included in the calculation. Manning's "n" values were determined for both the overbank floodplains and the channels.

The Manning's "n" values for the washes that were inaccessible were estimated based by comparing the SCS soils maps, aerial photographs, and the surrounding conditions. Table E.1-2 lists the Manning's "n" calculations.

Table E.1-2- Manning's "n" Calculations for Watershed 1 (East Lake Pleasant)

Wash Name	Location	n_b	n_1	n_2	n_3	n_4	m	n
T6NR1ES4	Channel	0.040	0.003	0.002	0.002	0.003	1.15	**0.058**
	Overbanks	0.040	0.000	0.000	0.030	0.000	n/a	**0.070**
T7NR1ES34[1]	Channel	0.040	0.003	0.002	0.002	0.003	1.15	**0.058**
	Overbanks	0.040	0.000	0.000	0.030	0.000	n/a	**0.070**
T7NR1ES35	Channel	0.025	0.008	0.010	0.002	0.003	1.15	**0.055**
	Overbanks	0.025	0.000	0.000	0.035	0.000	n/a	**0.060**
T7NR1ES26-1	Channel	0.025	0.003	0.010	0.006	0.003	1.15	**0.054**
	Overbanks	0.025	0.000	0.000	0.035	0.000	n/a	**0.060**
T7NR1ES26-2[2]	Channel	0.028	0.003	0.002	0.002	0.003	1.15	**0.044**
	Overbanks	0.030	0.000	0.000	0.040	0.000	n/a	**0.070**
T7NR1ES26-2a[2]	Channel	0.028	0.003	0.002	0.002	0.003	1.15	**0.044**
	Overbanks	0.030	0.000	0.000	0.040	0.000	n/a	**0.070**

Table E.1-2- Manning's "n" Calculations for Watershed 1 (East Lake Pleasant)

Wash Name	Location	n_b	n_1	n_2	n_3	n_4	m	n
T7NR1ES26-2b[2]	Channel	0.028	0.003	.002	0.002	0.003	1.15	**0.044**
	Overbanks	0.030	0.000	0.000	0.040	0.000	n/a	**0.070**
T7NR1ES26-3	Channel	0.028	0.003	0.002	0.002	0.003	1.15	**0.044**
	Overbanks	0.030	0.000	0.000	0.040	0.000	n/a	**0.070**

1- Channel and overbank conditions appear to be similar to T6NR1ES4.
2- Channel and overbank conditions appear to be similar to T7NR1ES26-3.

E.2 Cross Section Plots (See Appendix E.5)

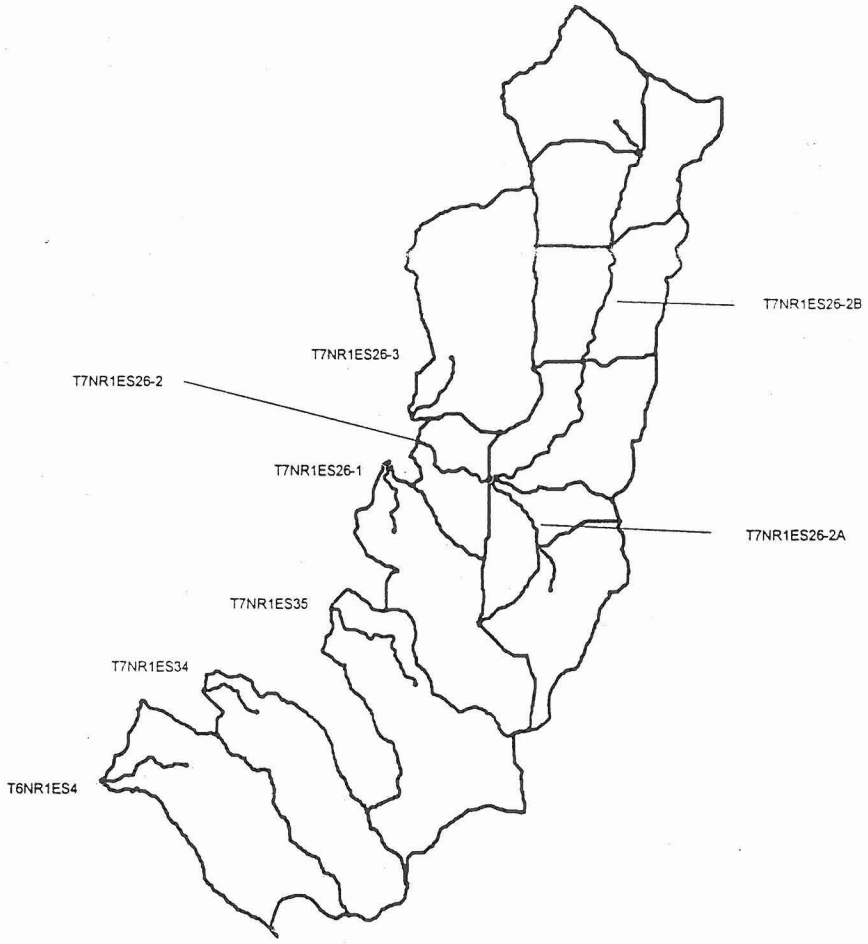
E.3 Expansion and Contraction Coefficients (Not Considered)

E.4 Analysis of Structures (Not Considered)

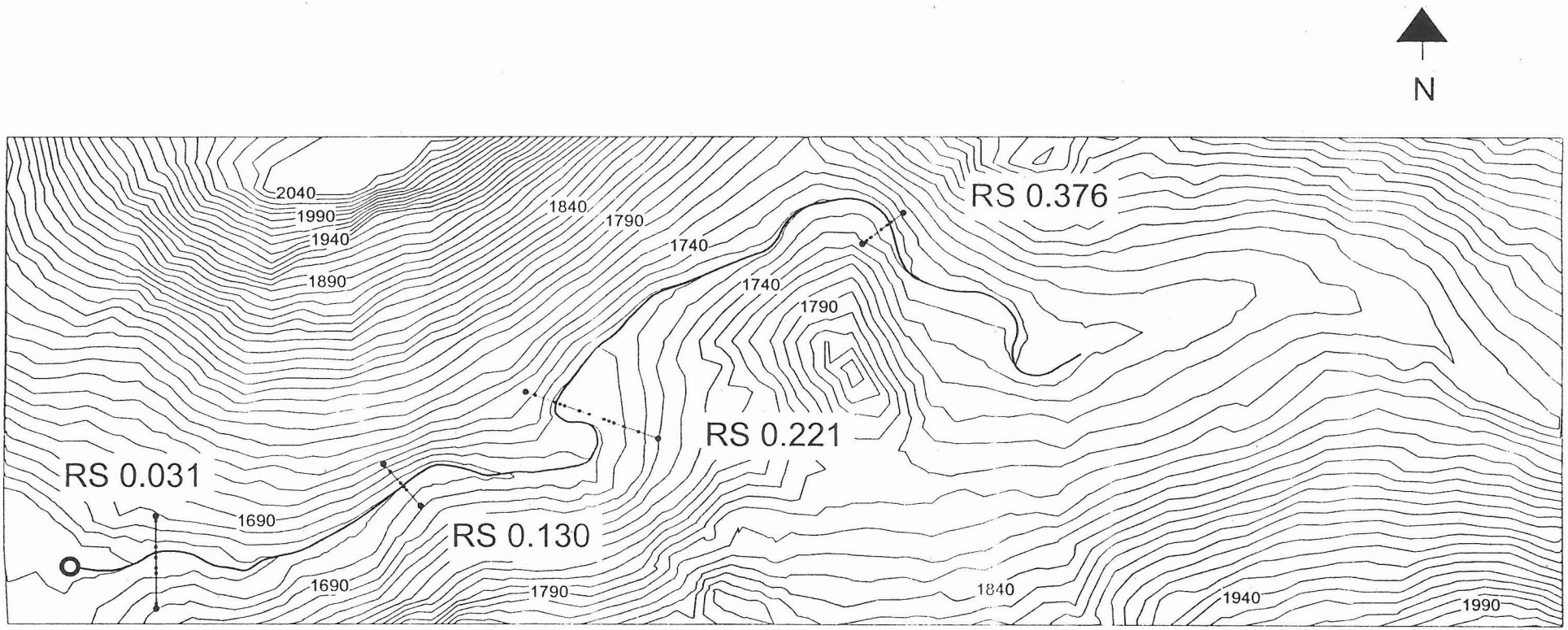
E.5 Hydraulic Calculations

E.5 Hydraulic Calculations

The following hydraulic calculations were performed completely within WMS 6.1 (March 4, 2002). The cross-sections were produced using a triangulated irregular network (TIN) within WMS. The tin has a 10 foot contour interval with an accuracy of approximately 5 feet. The channel calculator in WMS was used to calculate the normal depth of the channel at each section. For a further explanation, see Section 5 of the Technical Data Notebook.

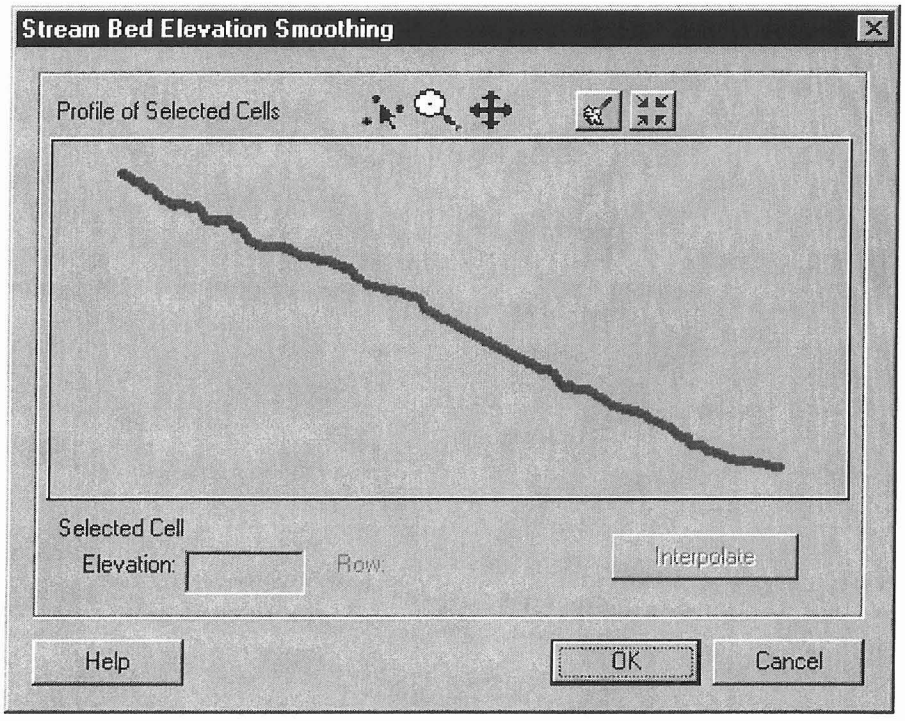

T7NR1ES26-2B
T7NR1ES26-3
T7NR1ES26-2
T7NR1ES26-1
T7NR1ES26-2A
T7NR1ES35
T7NR1ES34
T6NR1ES4

T6NR1ES4 (SUB1A)



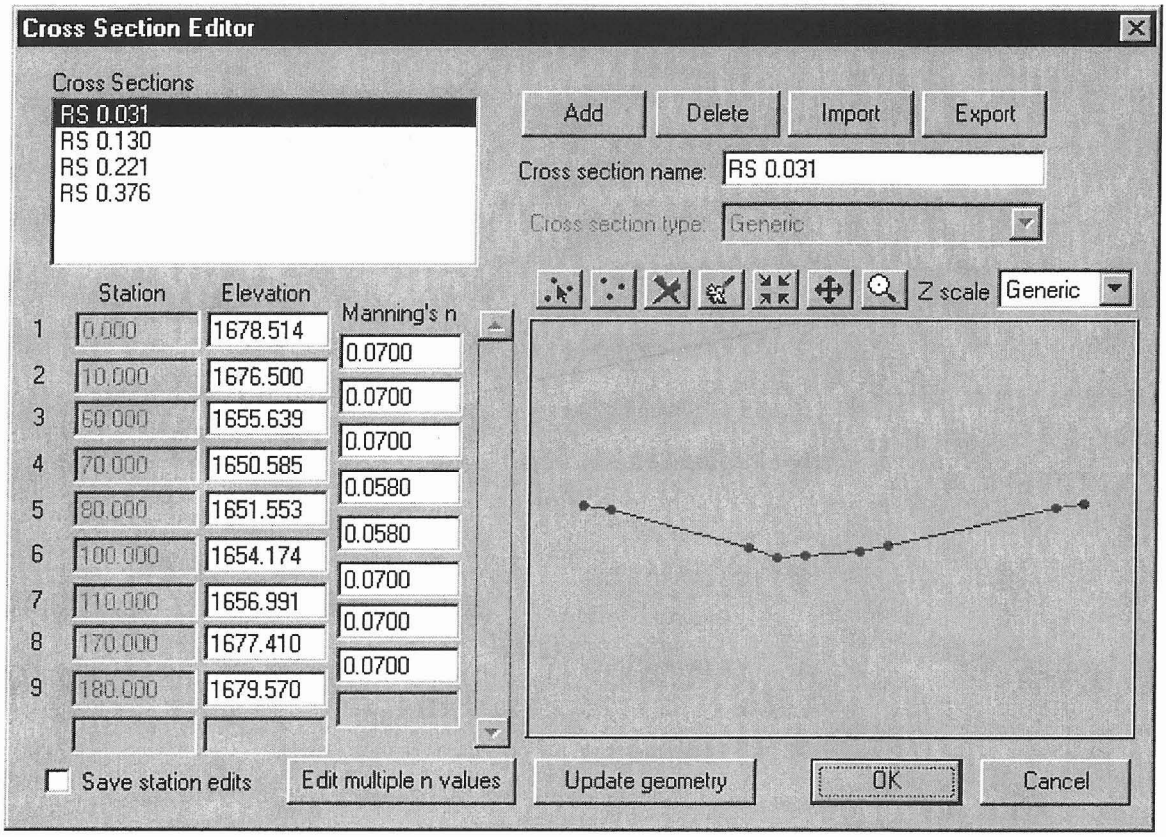
T6NR1ES4 (SUB1A)

Profile



Length = 2532.70 feet
High Elevation = 1743.16 feet
Low Elevation = 1647.59 feet
Slope = 0.03773 ft/ft

T6NR1ES4 (SUB1A)
RS 0.031
Cross Section Plot



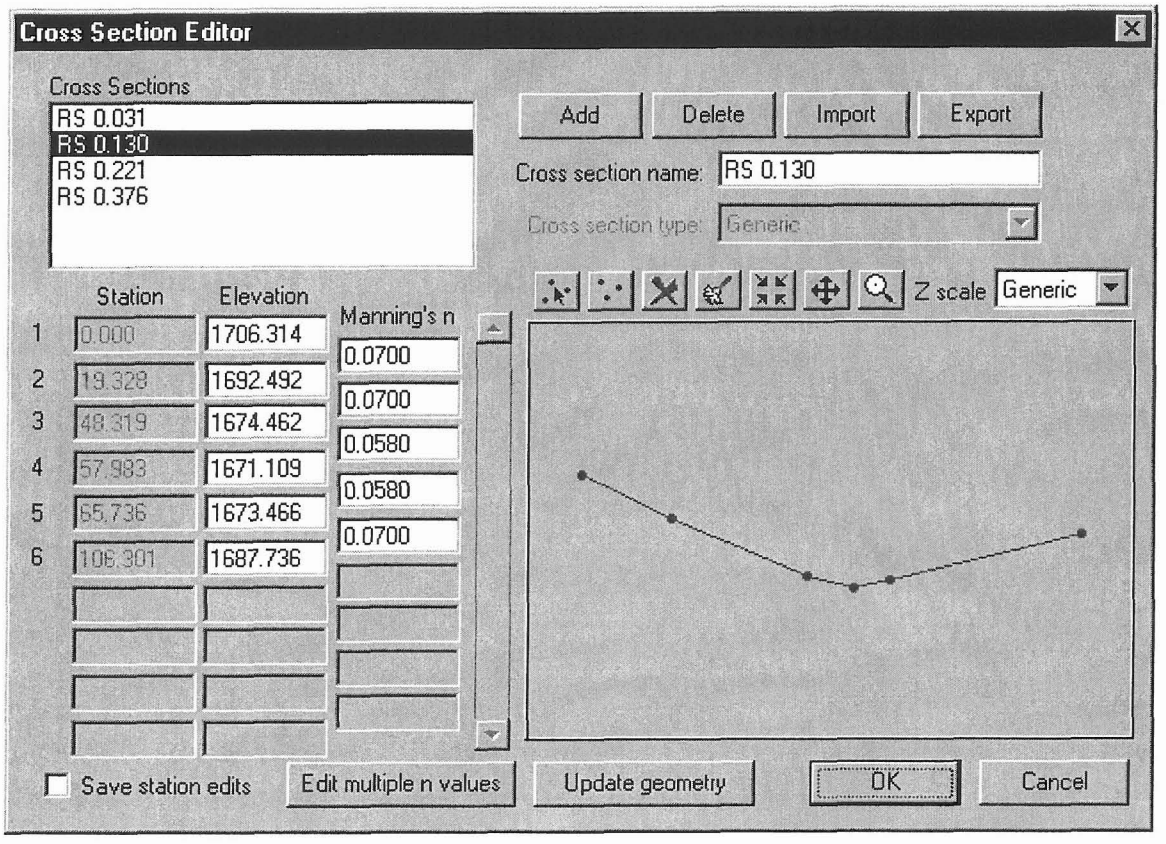
Normal Depth Results

Slope: 0.03773 ft/ft

Calculated Values
Flow: 1070.000 cfs
Depth: 4.824 ft
Area of Flow: 120.040 sq ft
Wetted Perimeter: 45.467 ft
Average Velocity: 8.914 fps
Top Width (T): 43.928 ft
Froude Number: 0.950
Critical Depth: 4.720 ft
Critical Velocity: 9.263 fps
Critical Slope: 0.04197
Manning's Roughness: 0.06202

T6NR1ES4 (SUB1A)
RS 0.130

Cross Section Plot



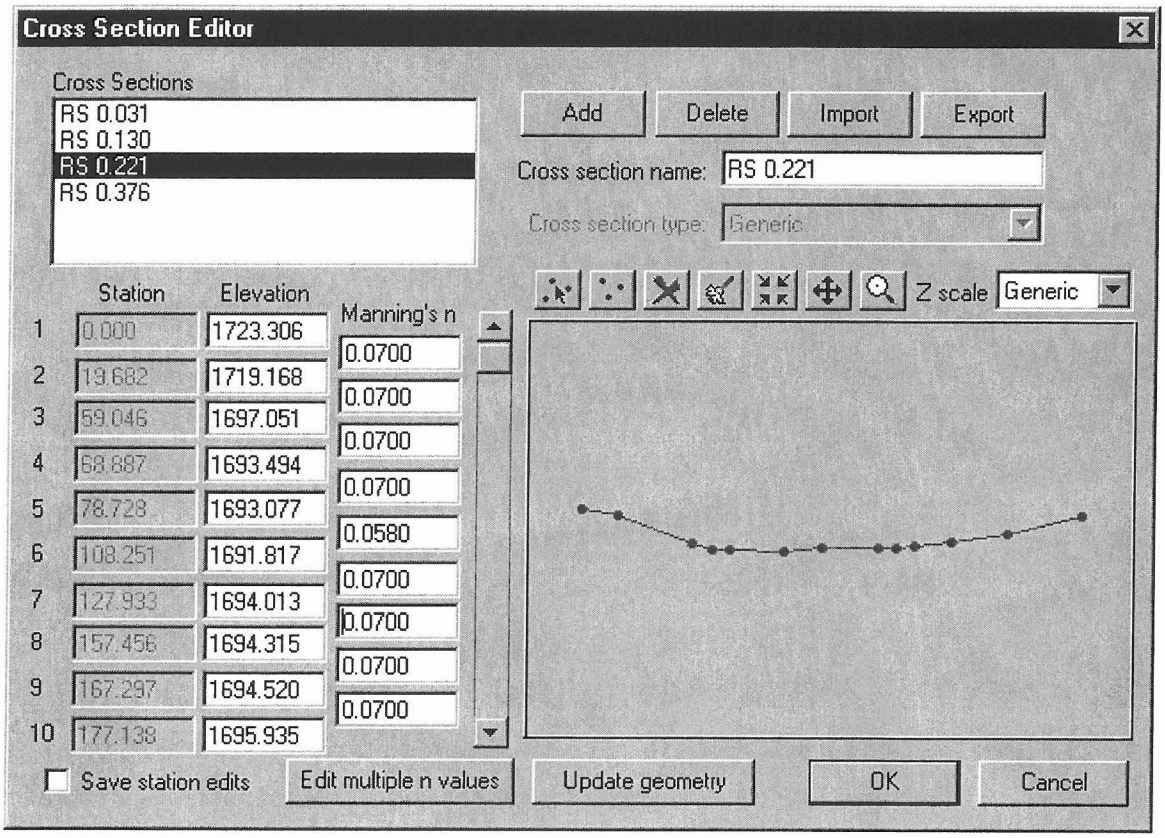
Normal Depth Results

Slope: 0.03773 ft/ft

Calculated Values
Flow: 1070.000 cfs
Depth: 6.206 ft
Area of Flow: 110.350 sq ft
Wetted Perimeter: 35.334 ft
Average Velocity: 9.696 fps
Top Width (T): 32.946 ft
Froude Number: 0.934
Critical Depth: 6.028 ft
Critical Velocity: 10.233 fps
Critical Slope: 0.04345
Manning's Roughness: 0.06377

T6NR1ES4 (SUB1A)
RS 0.221

Cross Section Plot

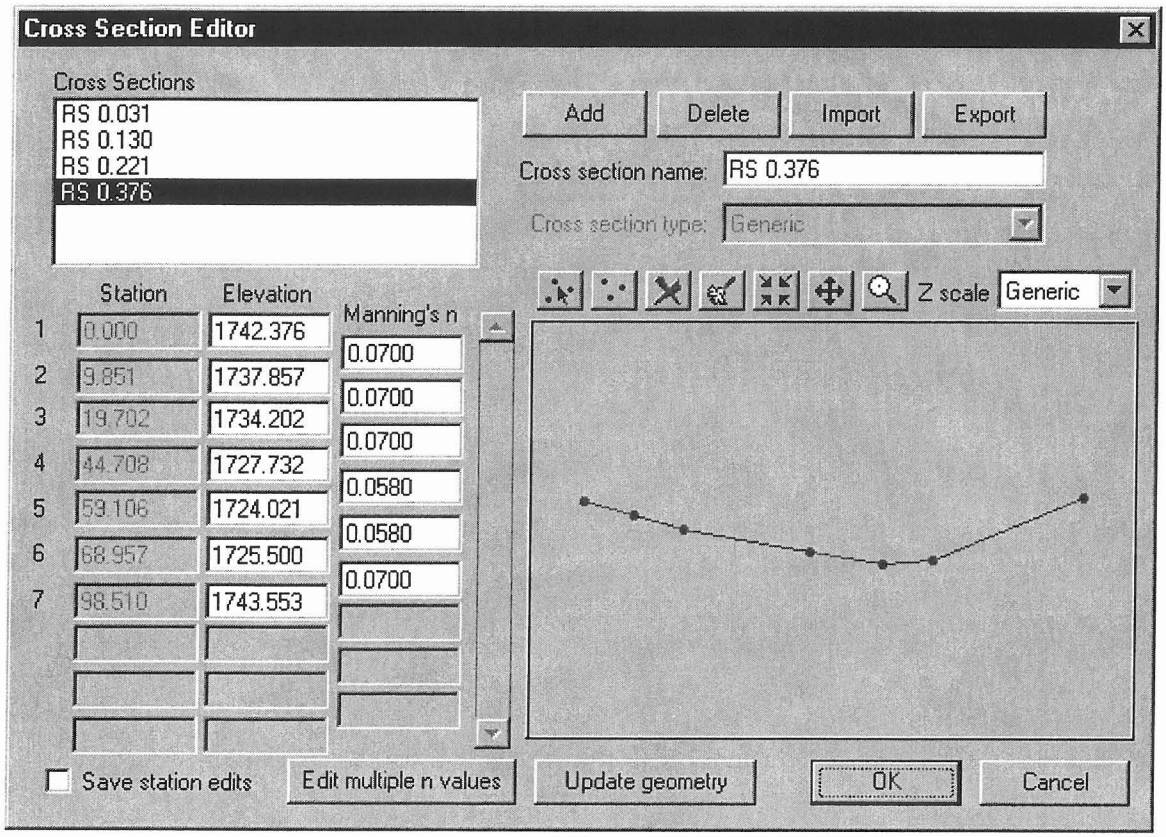


Normal Depth Results

Slope: 0.03773 ft/ft

Calculated Values
Flow: 1070.000 cfs
Depth: 3.268 ft
Area of Flow: 176.718 sq ft
Wetted Perimeter: 107.226 ft
Average Velocity: 6.055 fps
Top Width (T): 106.745 ft
Froude Number: 0.829
Critical Depth: 3.063 ft
Critical Velocity: 6.903 fps
Critical Slope: 0.05681
Manning's Roughness: 0.06669

T6NR1ES4 (SUB1A)
RS 0.376

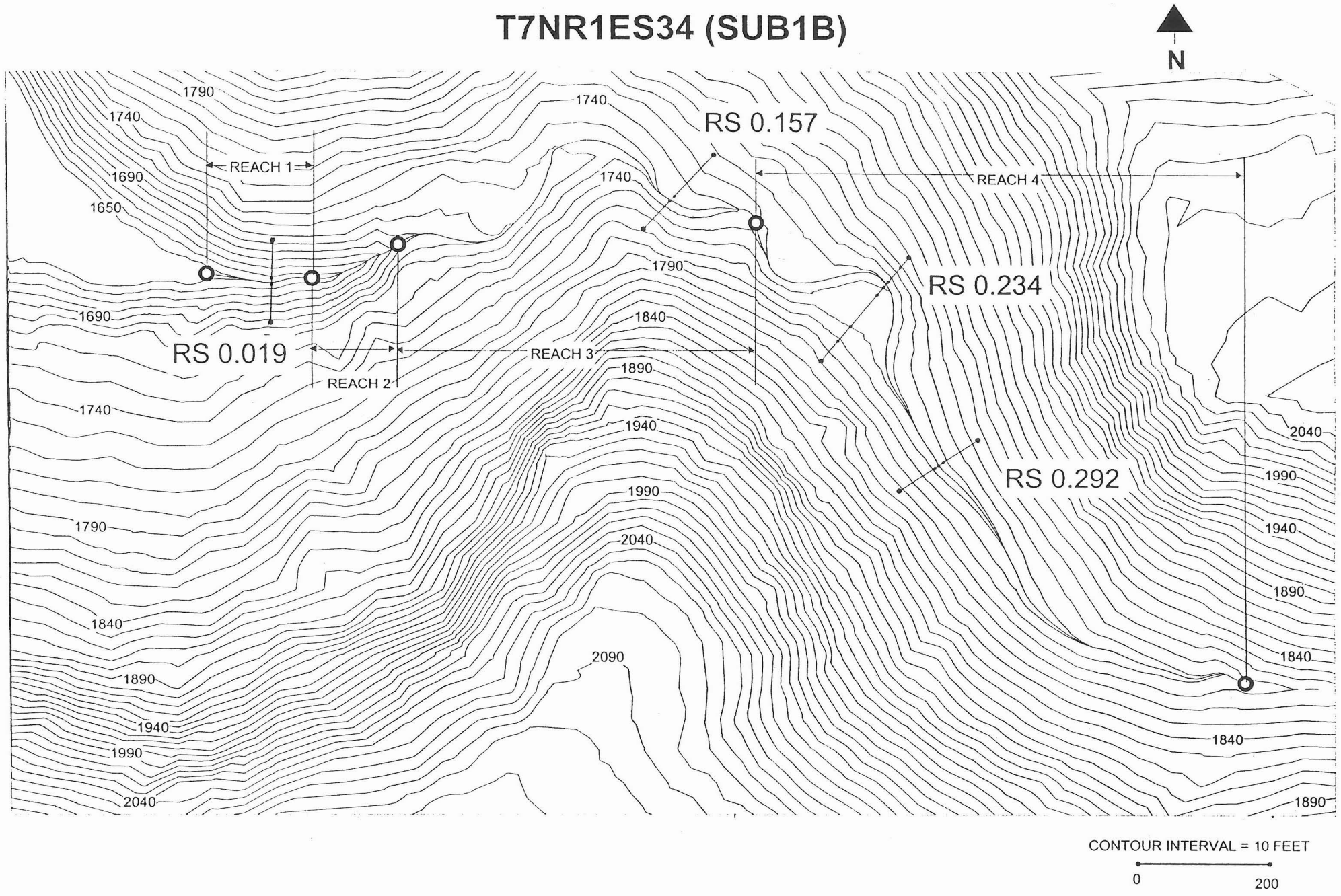


Normal Depth Results

Slope: 0.03773 ft/ft

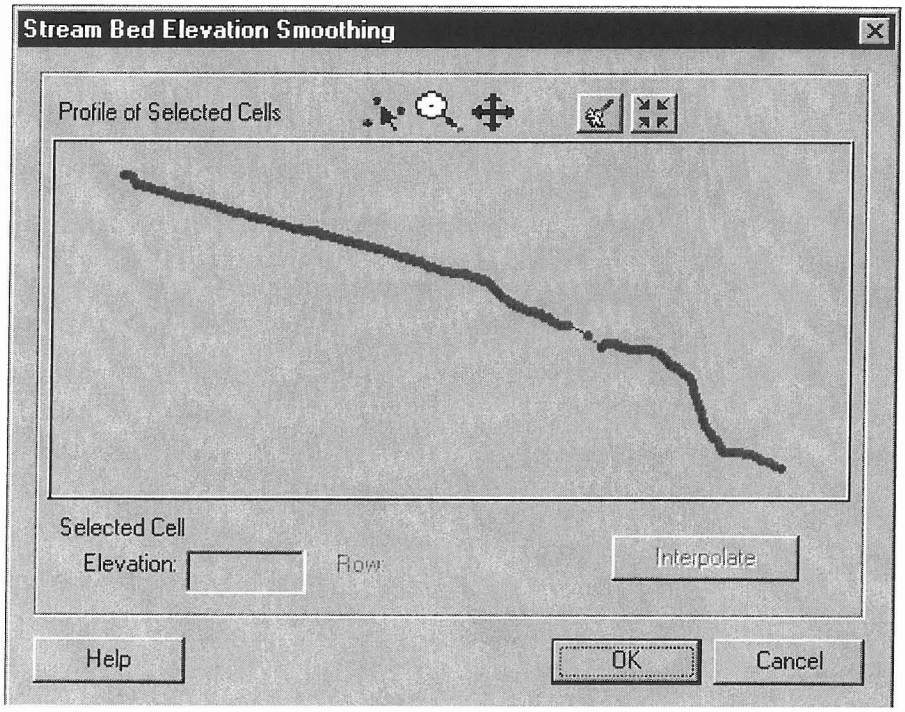
Calculated Values
Flow: 1070.000 cfs
Depth: 5.343 ft
Area of Flow: 112.925 sq ft
Wetted Perimeter: 38.756 ft
Average Velocity: 9.475 fps
Top Width (T): 36.880 ft
Froude Number: 0.954
Critical Depth: 5.231 ft
Critical Velocity: 9.831 fps
Critical Slope: 0.04151
Manning's Roughness: 0.06231

T7NR1ES34 (SUB1B)



T7NR1ES34 (SUB1B)

Profile

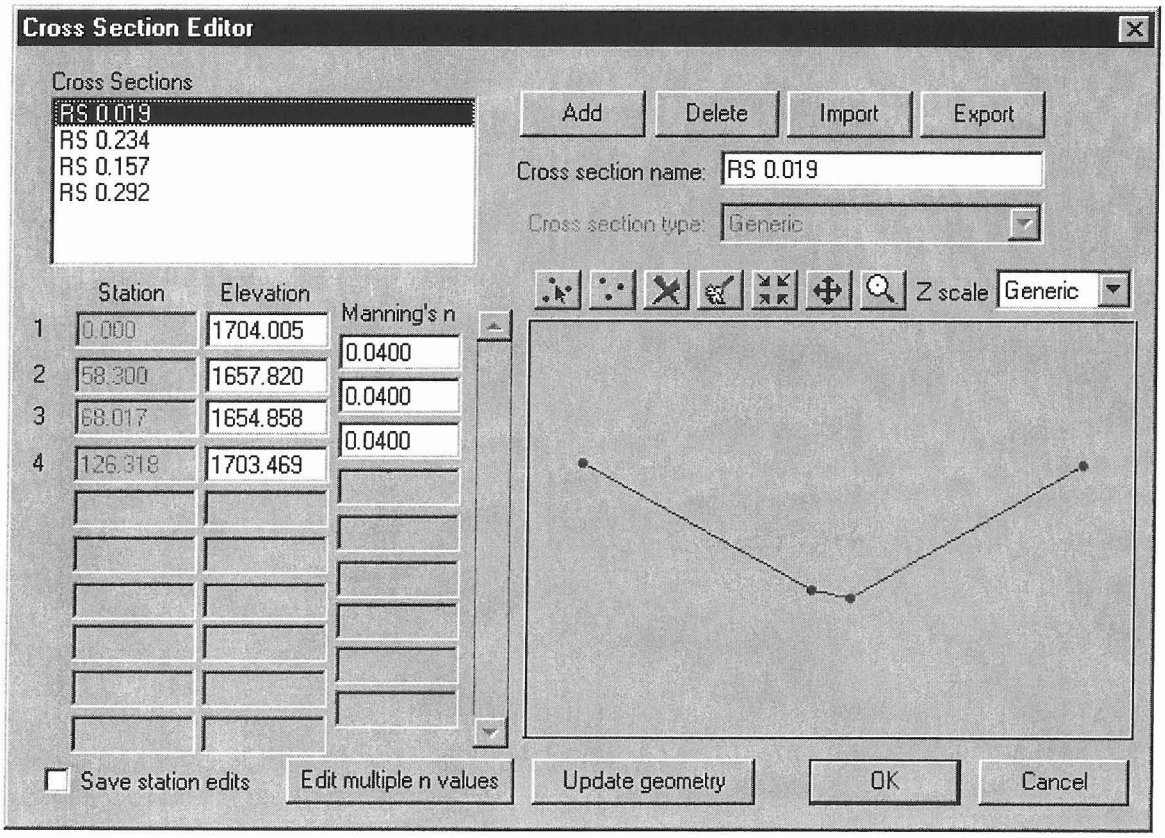


	REACH 1	REACH 2	REACH 3	REACH 4
Length =	161.44 feet	N/A	685.94 feet	1184.36 feet
High Elevation =	1654.50	N/A	1746.24	1804.63
Low Elevation =	1644.98	N/A	1693.93	1746.24
Slope =	0.0590 ft/ft	N/A	0.0763 ft/ft	0.0493 ft/ft

T7NR1ES34 (SUB1B) REACH 1

RS 0.019

Cross Section Plot



Normal Depth Results

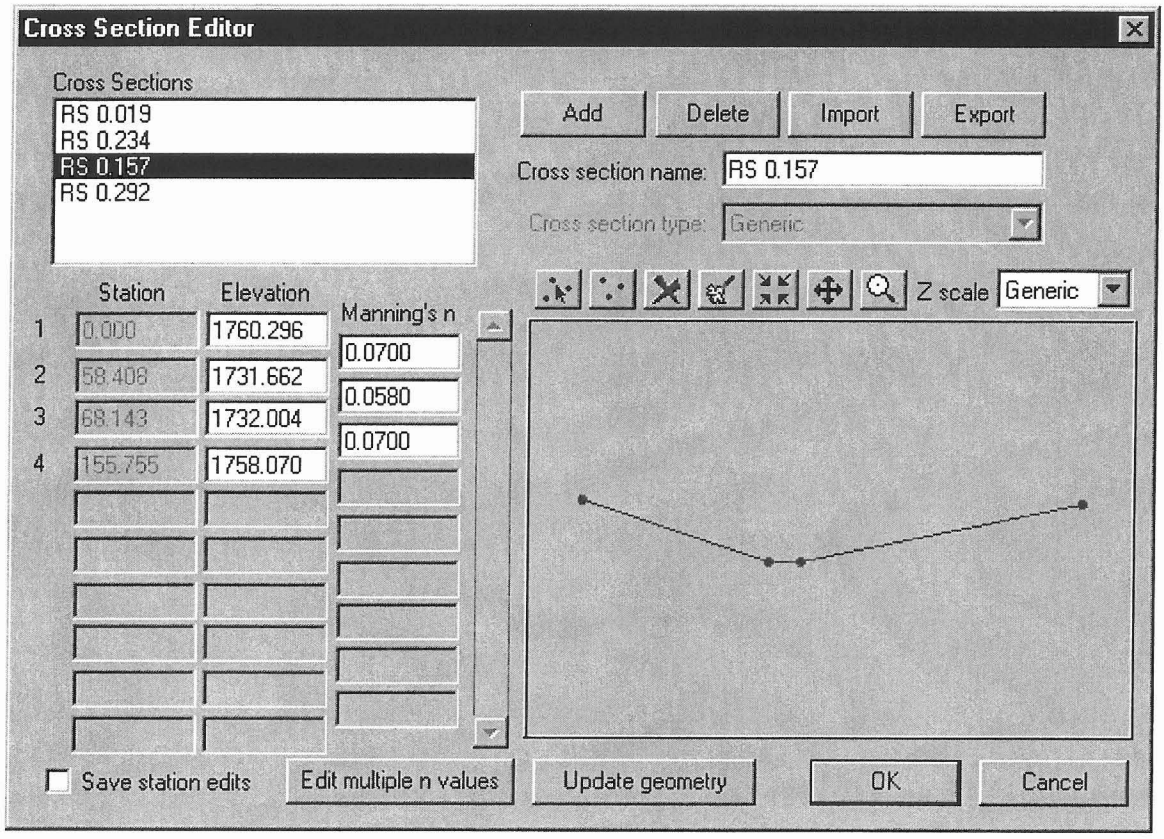
Slope: 0.0590 ft/ft

Calculated Values
Flow: 878.000 cfs
Depth: 5.069 ft
Area of Flow: 53.073 sq ft
Wetted Perimeter: 21.466 ft
Average Velocity: 16.543 fps
Top Width (T): 18.456 ft
Froude Number: 1.719
Critical Depth: 6.433 ft
Critical Velocity: 10.903 fps
Critical Slope: 0.01877
Manning's Roughness: 0.04000

T7NR1ES34 (SUB1B) REACH 3

RS 0.157

Cross Section Plot



Normal Depth Results

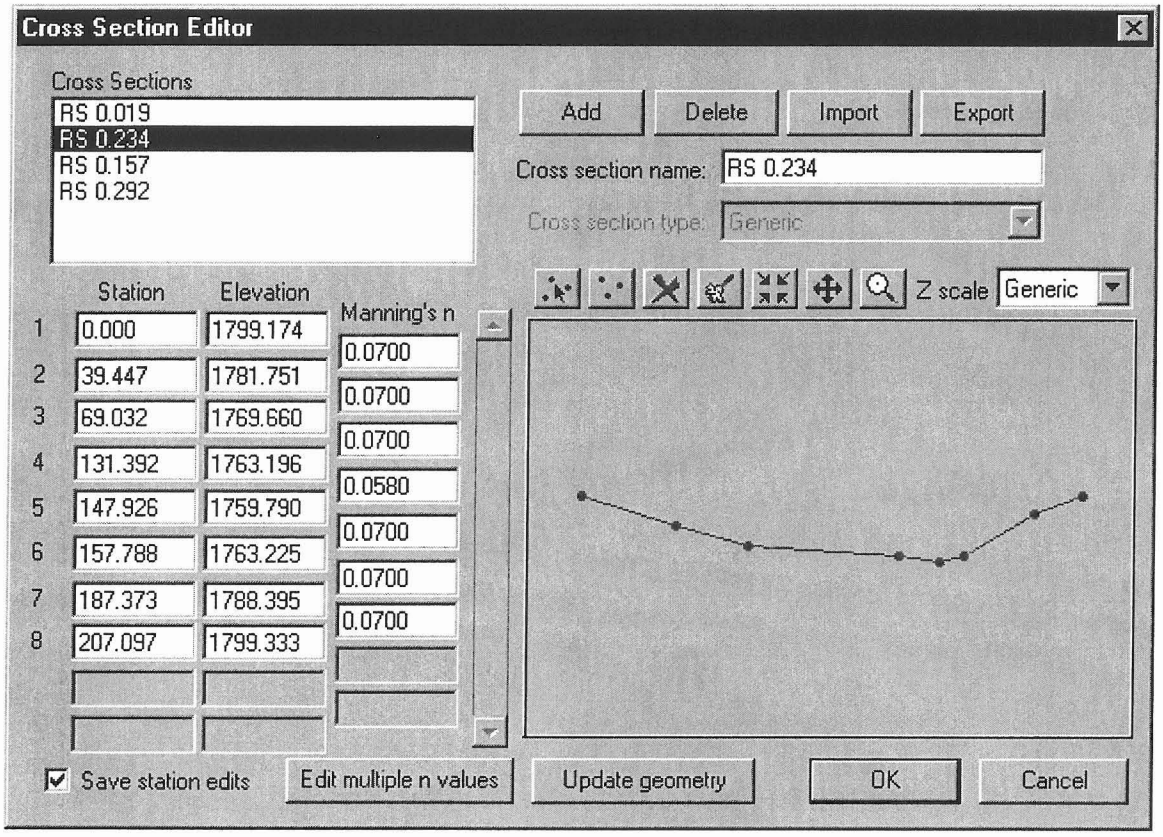
Slope: 0.0763 ft/ft

Calculated Values
Flow: 878.000 cfs
Depth: 4.068 ft
Area of Flow: 78.137 sq ft
Wetted Perimeter: 32.047 ft
Average Velocity: 11.237 fps
Top Width (T): 30.555 ft
Froude Number: 1.238
Critical Depth: 4.518 ft
Critical Velocity: 9.499 fps
Critical Slope: 0.04876
Manning's Roughness: 0.06635

T7NR1ES34 (SUB1B) REACH 4

RS 0.234

Cross Section Plot



Normal Depth Results

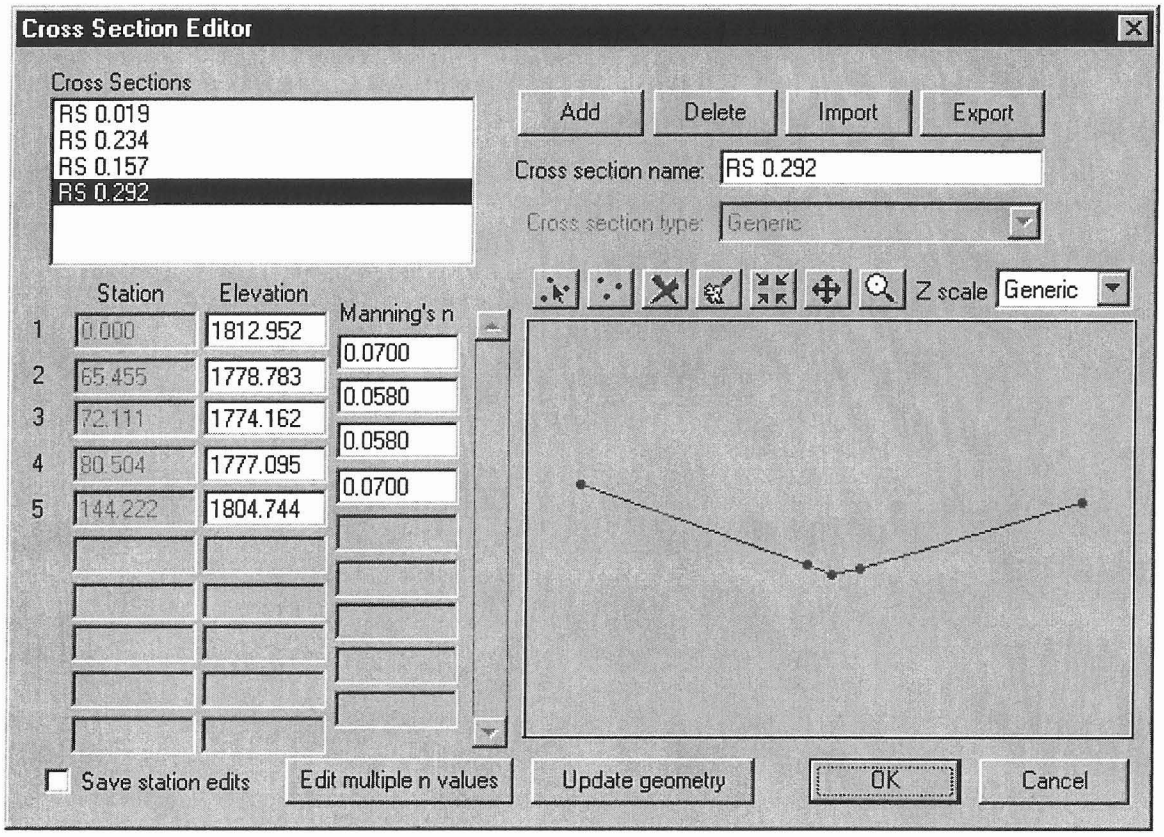
Slope: 0.0493 ft/ft

Calculated Values
Flow: 878.000 cfs
Depth: 5.026 ft
Area of Flow: 101.731 sq ft
Wetted Perimeter: 45.496 ft
Average Velocity: 8.631 fps
Top Width (T): 43.899 ft
Froude Number: 0.999
Critical Depth: 5.025 ft
Critical Velocity: 8.637 fps
Critical Slope: 0.04939
Manning's Roughness: 0.06555

T7NR1ES34 (SUB1B) REACH 4

RS 0.292

Cross Section Plot

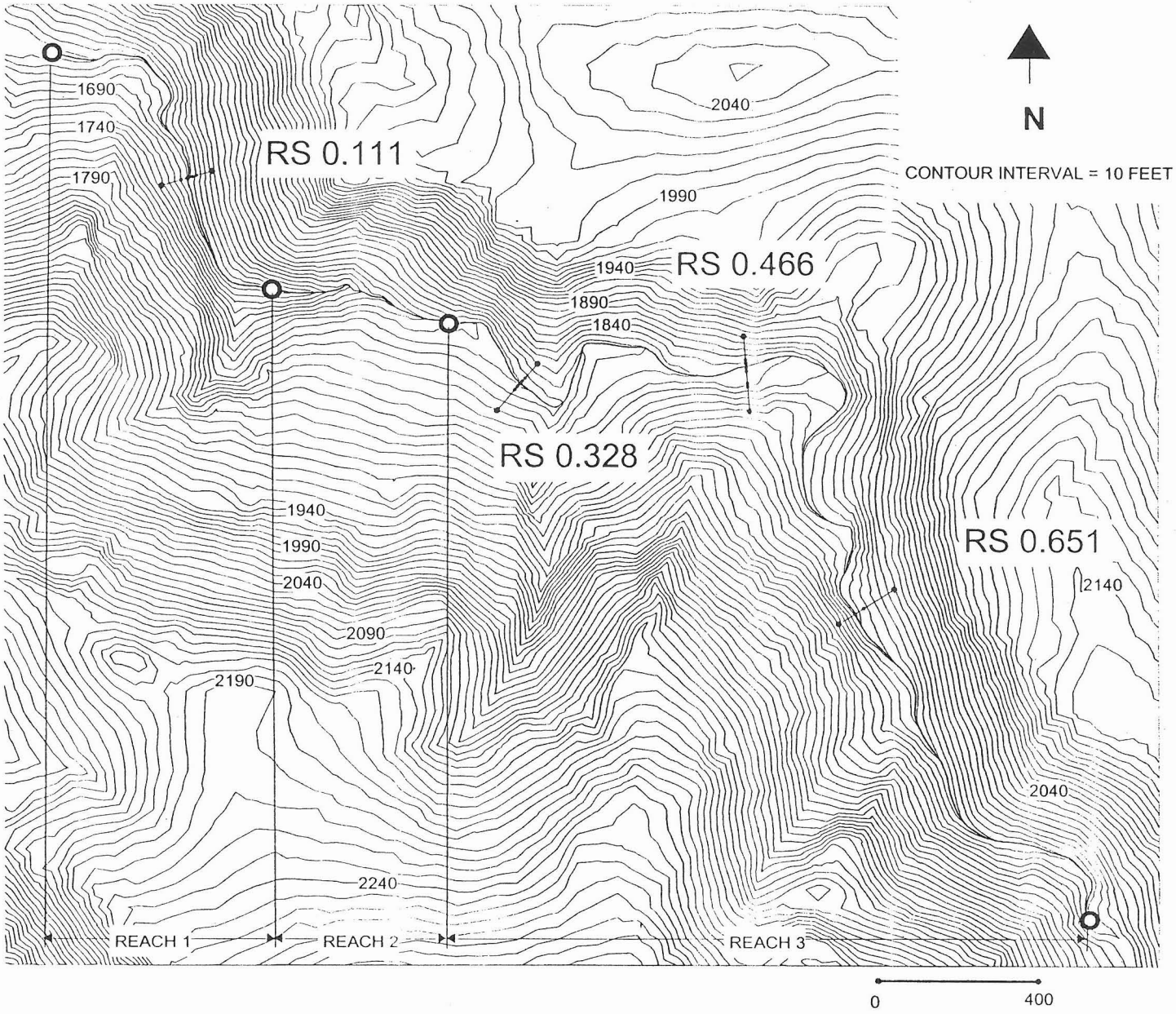


Normal Depth Results

Slope: 0.0493 ft/ft

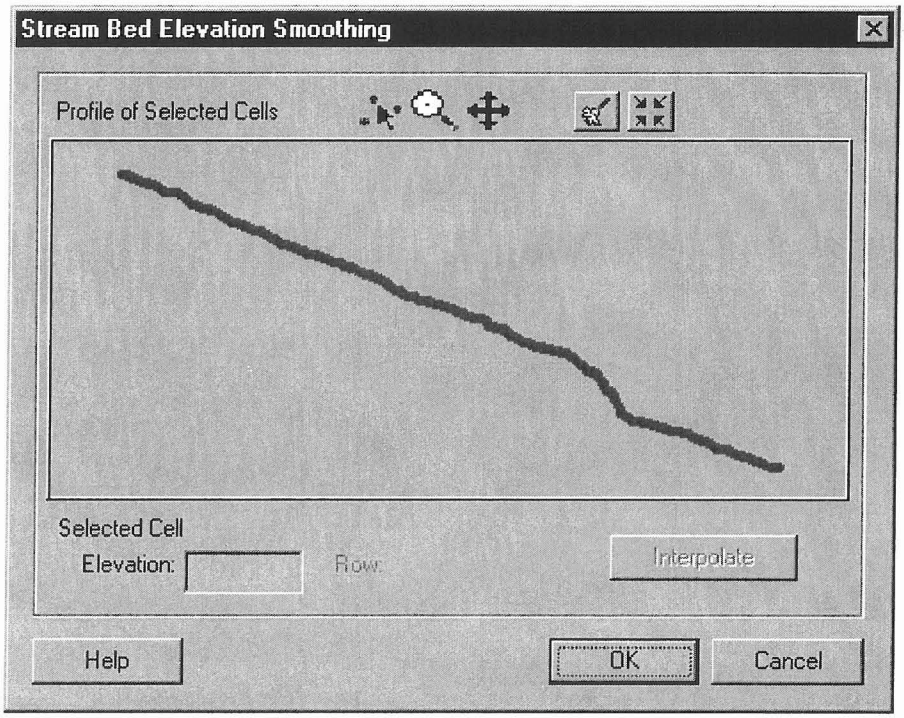
Calculated Values
Flow: 878.000 cfs
Depth: 6.308 ft
Area of Flow: 83.097 sq ft
Wetted Perimeter: 29.118 ft
Average Velocity: 10.566 fps
Top Width (T): 26.059 ft
Froude Number: 1.043
Critical Depth: 6.416 ft
Critical Velocity: 10.216 fps
Critical Slope: 0.04526
Manning's Roughness: 0.06300

T7NR1ES35 (SUB1C)



T7NR1ES35 (SUB1C)

Profile

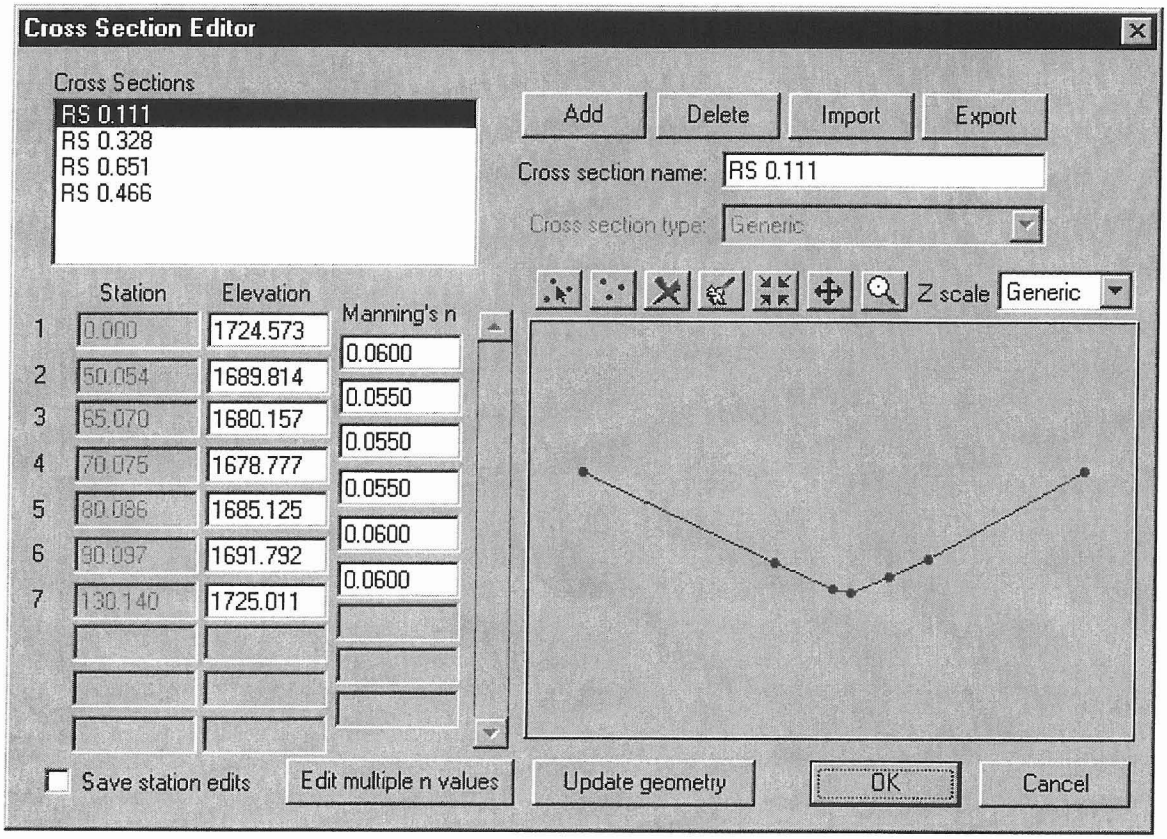


	Reach 1	Reach 2	Reach 3
Length =	984.39 feet	476.84 feet	3060.37 feet
High Elevation =	1695.17	1767.11	1959.46
Low Elevation =	1645.00	1695.17	1767.11
Slope =	0.0510 ft/ft	0.1511 ft/ft	0.0629 ft/ft

T7NR1ES35 (SUB1C) REACH 1

RS 0.111

Cross Section Plot



Normal Depth Results

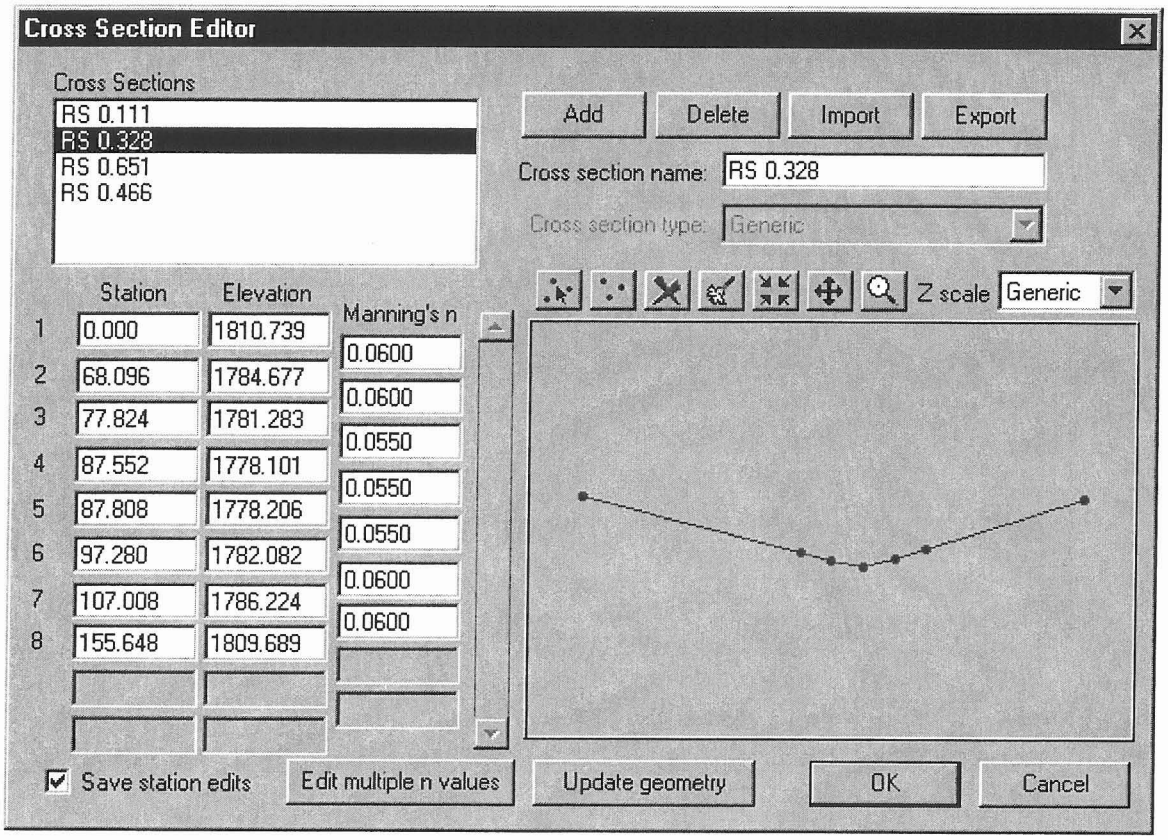
Slope: 0.0510 ft/ft

Calculated Values
Flow: 1031.000 cfs
Depth: 6.392 ft
Area of Flow: 80.286 sq ft
Wetted Perimeter: 26.391 ft
Average Velocity: 12.842 fps
Top Width (T): 22.875 ft
Froude Number: 1.208
Critical Depth: 6.938 ft
Critical Velocity: 11.059 fps
Critical Slope: 0.03437
Manning's Roughness: 0.05501

T7NR1ES35 (SUB1C) REACH 3

RS 0.328

Cross Section Plot



Normal Depth Results

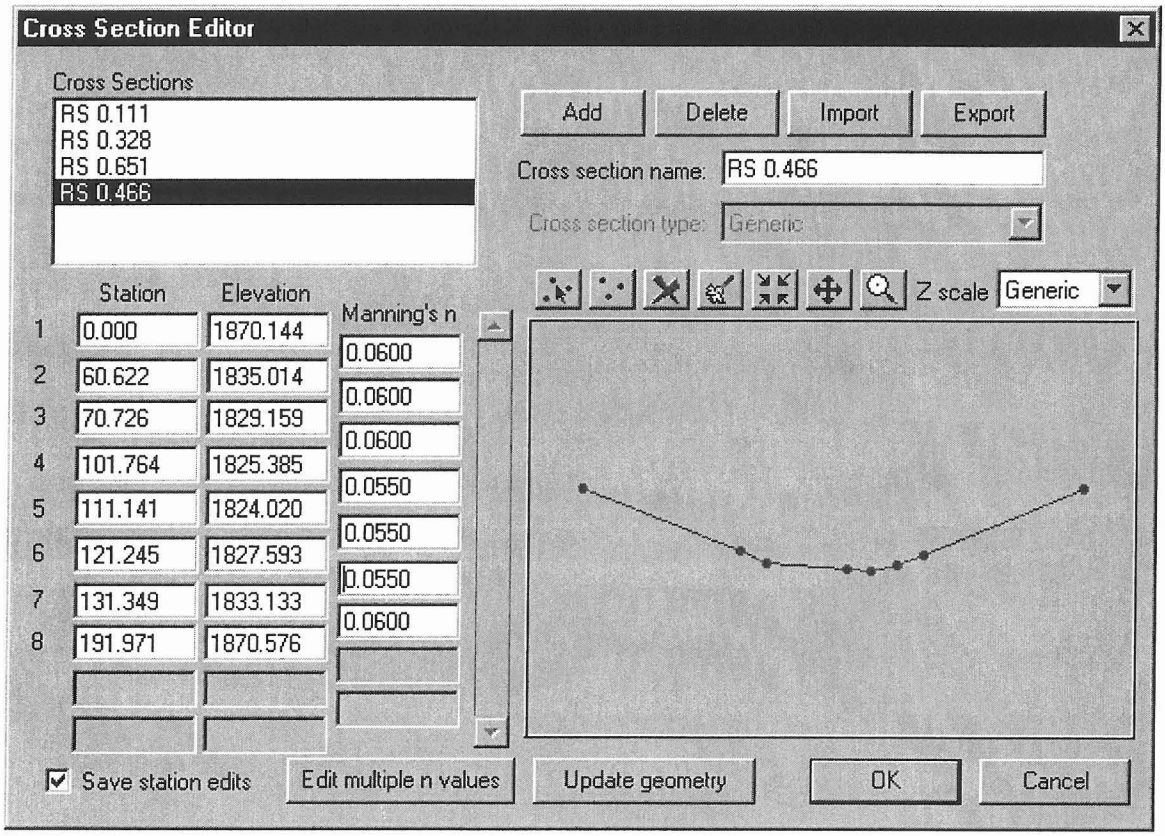
Slope: 0.0629 ft/ft

Calculated Values
Flow: 1031.000 cfs
Depth: 5.501 ft
Area of Flow: 82.590 sq ft
Wetted Perimeter: 31.663 ft
Average Velocity: 12.483 fps
Top Width (T): 29.670 ft
Froude Number: 1.319
Critical Depth: 6.150 ft
Critical Velocity: 10.014 fps
Critical Slope: 0.03528
Manning's Roughness: 0.05672

T7NR1ES35 (SUB1C) REACH 3

RS 0.466

Cross Section Plot



Normal Depth Results

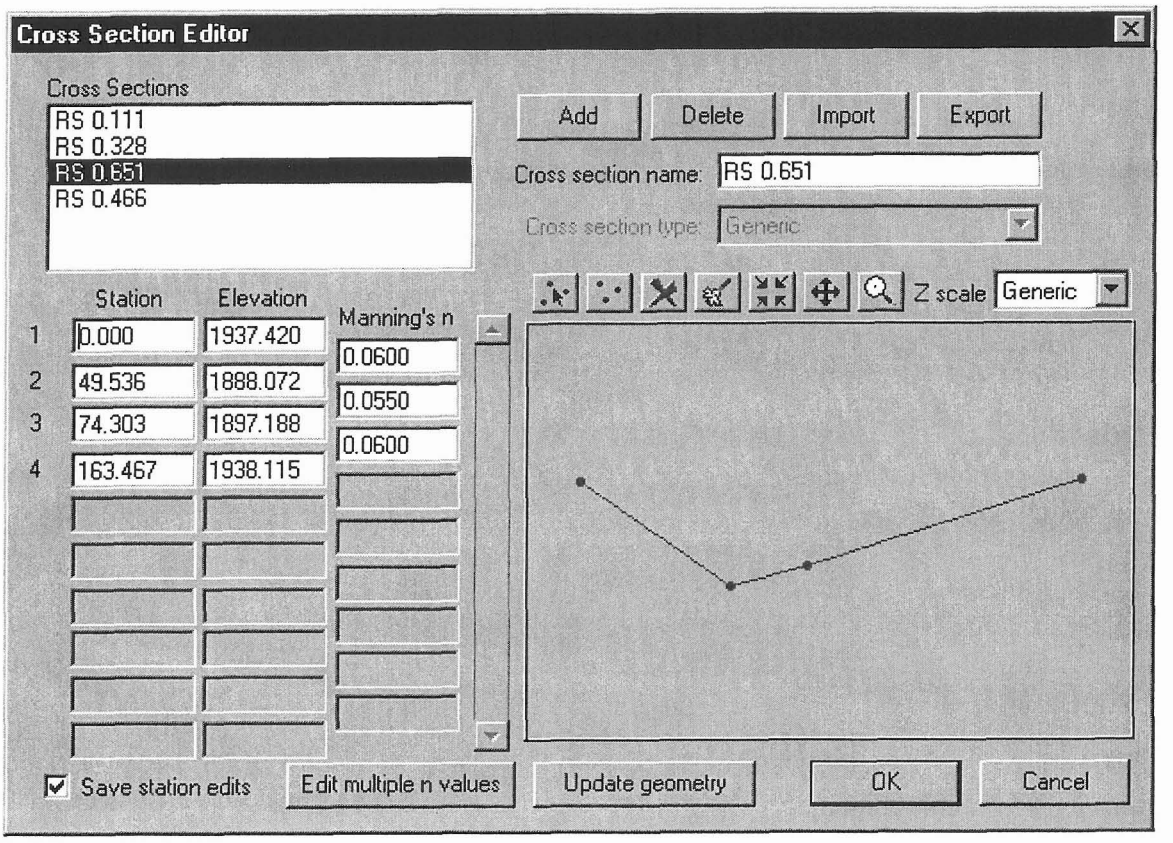
Slope: 0.0629 ft/ft

Calculated Values
Flow: 1031.000 cfs
Depth: 4.345 ft
Area of Flow: 97.246 sq ft
Wetted Perimeter: 46.484 ft
Average Velocity: 10.602 fps
Top Width (T): 45.394 ft
Froude Number: 1.276
Critical Depth: 4.781 ft
Critical Velocity: 8.737 fps
Critical Slope: 0.03751
Manning's Roughness: 0.05766

T7NR1ES35 (SUB1C) REACH 3

RS 0.651

Cross Section Plot

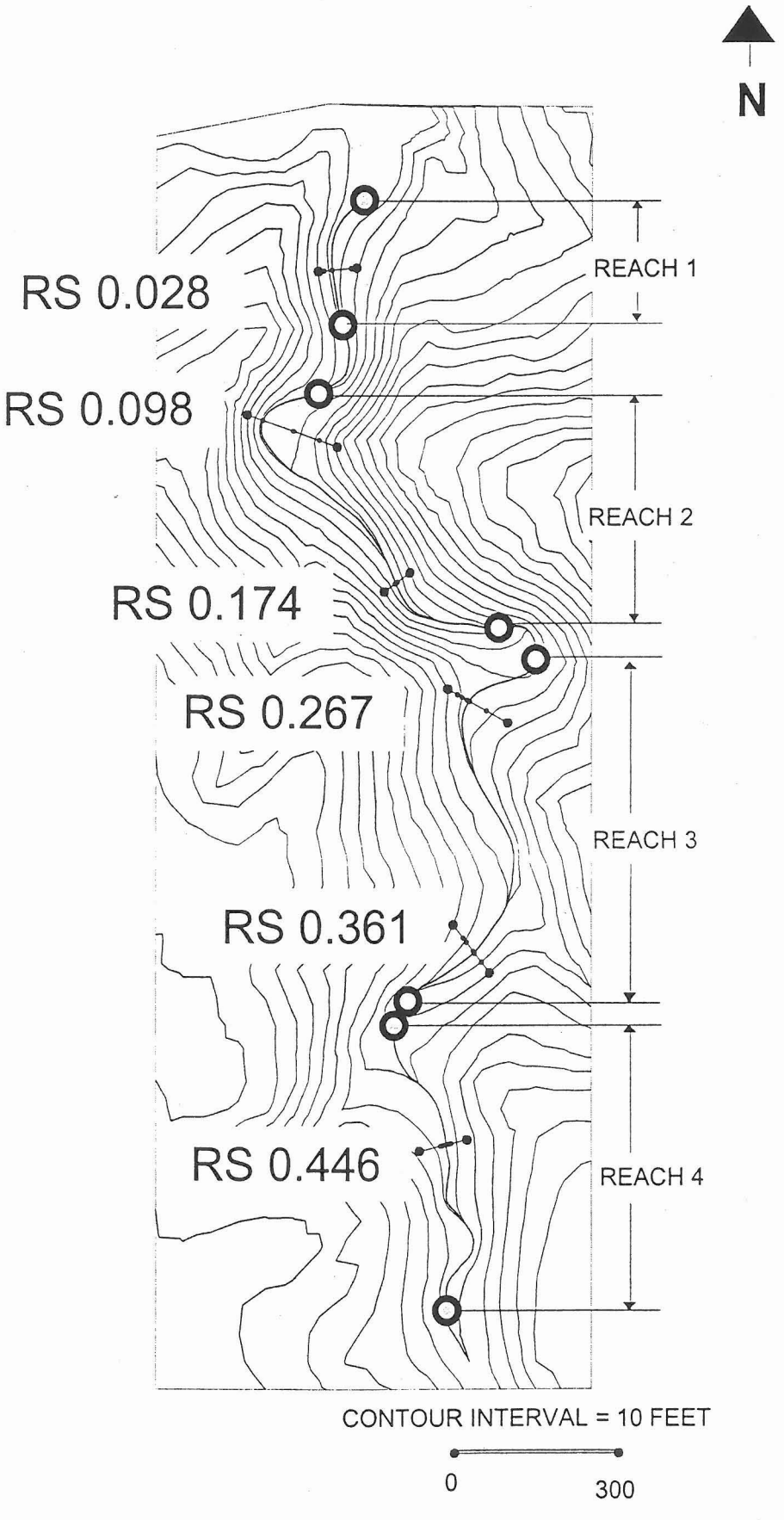


Normal Depth Results

Slope: 0.0629 ft/ft

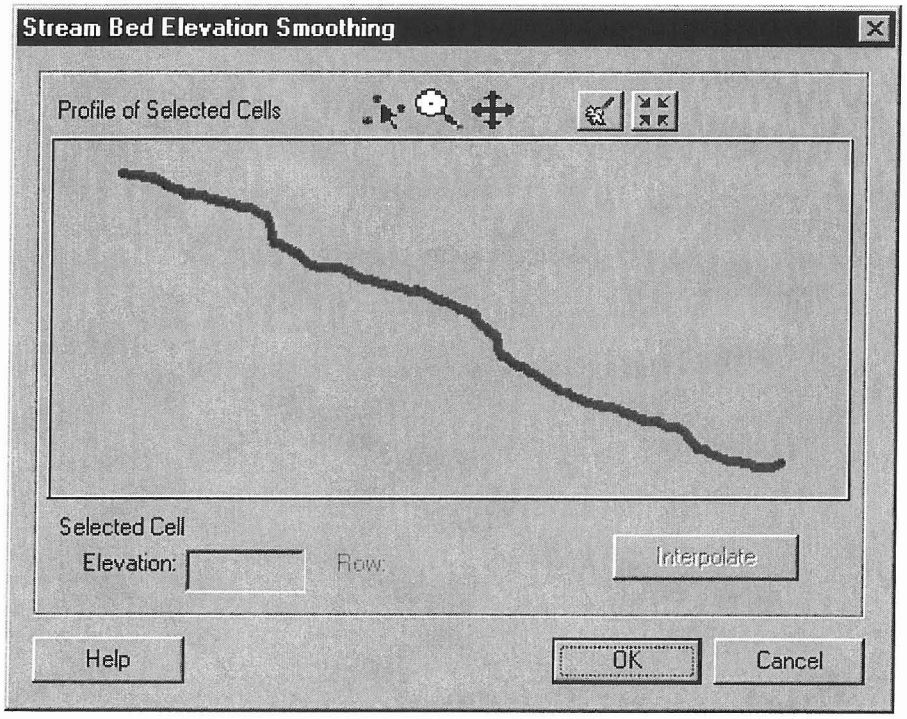
Calculated Values
Flow: 1031.000 cfs
Depth: 6.499 ft
Area of Flow: 78.589 sq ft
Wetted Perimeter: 28.026 ft
Average Velocity: 13.119 fps
Top Width (T): 24.183 ft
Froude Number: 1.282
Critical Depth: 7.180 ft
Critical Velocity: 10.751 fps
Critical Slope: 0.03700
Manning's Roughness: 0.05664

T7NR1ES26-1 (SUB1D)



T7NR1ES26-1 (SUB1D)

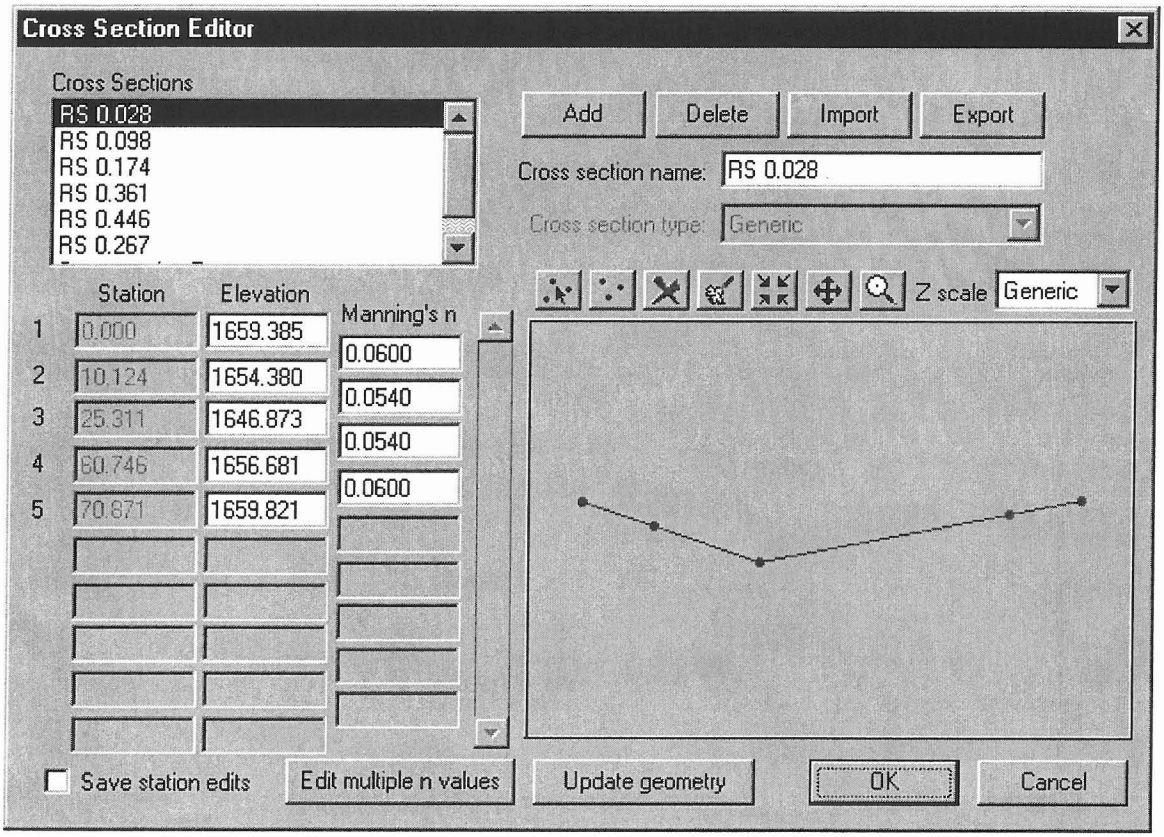
Profile



	Reach 1	Reach 2	Reach 3	Reach 4
Length =	574.84 feet	797.37 feet	740.21 feet	249.52 feet
High Elevation =	1648.34	1697.26	1751.69	1786.01
Low Elevation =	1645.50	1661.63	1717.40	1765.71
Slope =	0.0049 ft/ft	0.0477 ft/ft	0.0463 ft/ft	0.0814 ft/ft

T7NR1ES26-1 (SUB1D) REACH 1

RS 0.028
Cross Section Plot



Normal Depth Results

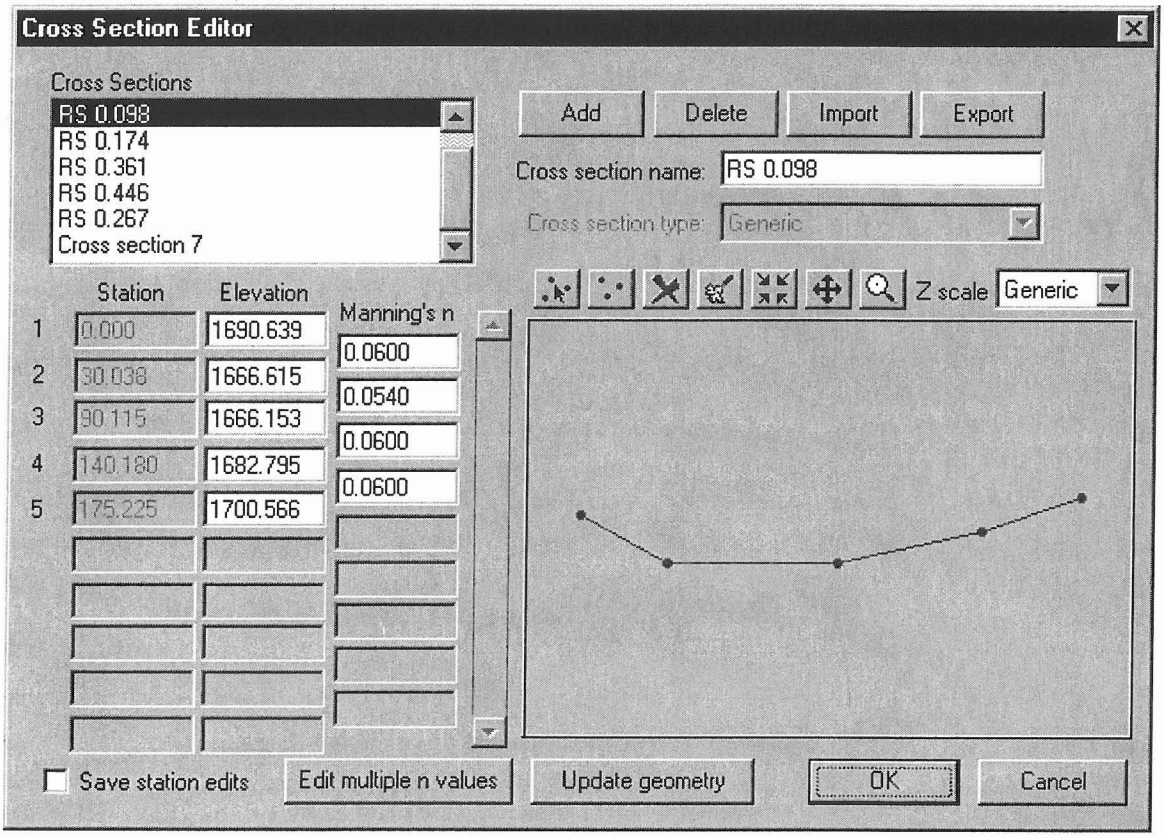
Slope: 0.0049 ft/ft

Calculated Values
Flow: 817.000 cfs
Depth: 7.919 ft
Area of Flow: 176.701 sq ft
Wetted Perimeter: 47.554 ft
Average Velocity: 4.624 fps
Top Width (T): 44.628 ft
Froude Number: 0.409
Critical Depth: 5.541 ft
Critical Velocity: 9.445 fps
Critical Slope: 0.03277
Manning's Roughness: 0.05412

T7NR1ES26-1 (SUB1D) REACH 2

RS 0.098

Cross Section Plot



Normal Depth Results

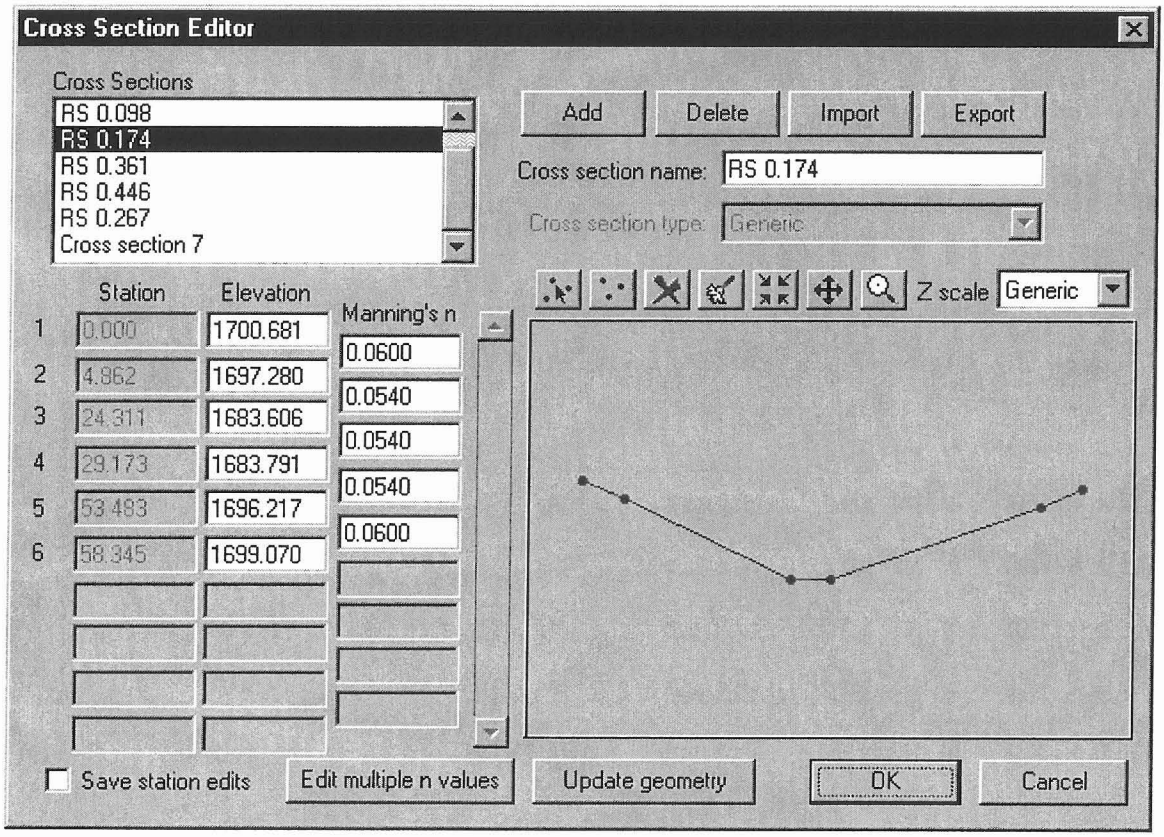
Slope: 0.0447 ft/ft

Calculated Values
Flow: 817.000 cfs
Depth: 1.885 ft
Area of Flow: 105.946 sq ft
Wetted Perimeter: 68.330 ft
Average Velocity: 7.711 fps
Top Width (T): 67.525 ft
Froude Number: 1.085
Critical Depth: 1.975 ft
Critical Velocity: 7.290 fps
Critical Slope: 0.03742
Manning's Roughness: 0.05472

T7NR1ES26-1 (SUB1D) REACH 2

RS 0.174

Cross Section Plot



Normal Depth Results

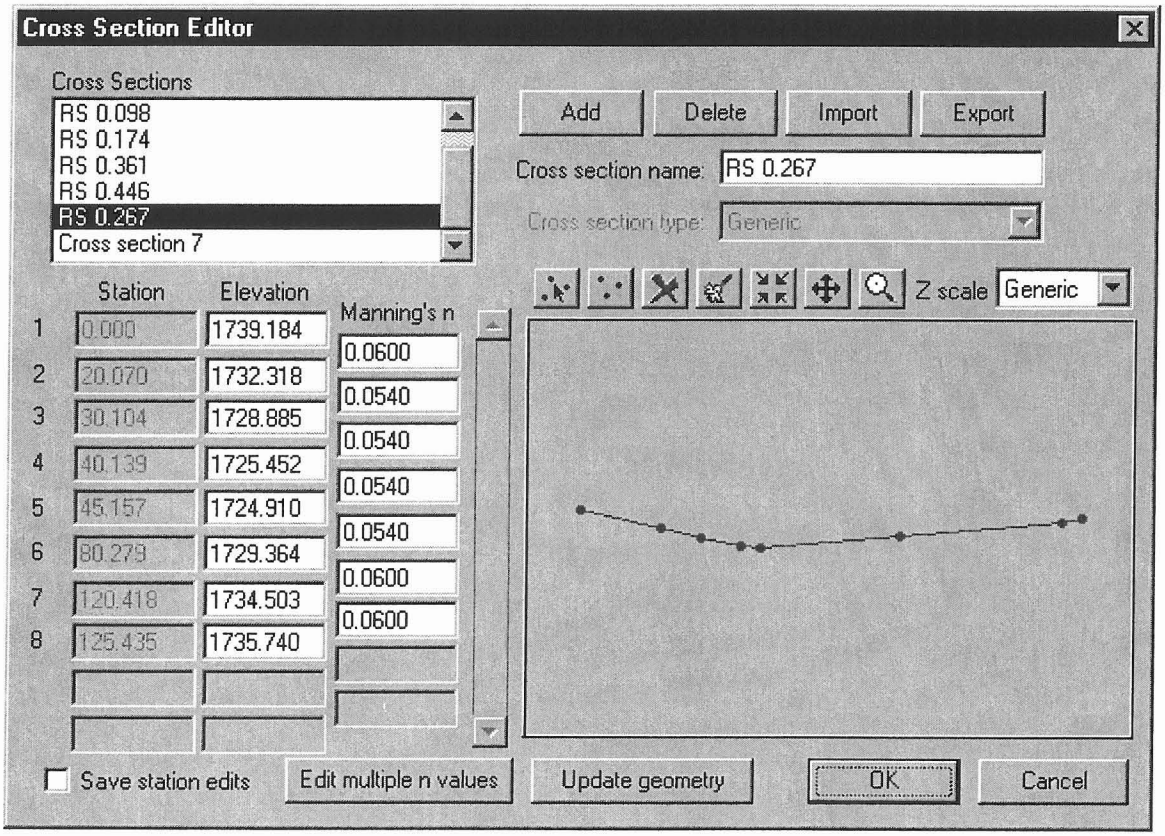
Slope: 0.0447 ft/ft

Calculated Values
Flow: 817.000 cfs
Depth: 5.287 ft
Area of Flow: 70.598 sq ft
Wetted Perimeter: 25.268 ft
Average Velocity: 11.573 fps
Top Width (T): 22.364 ft
Froude Number: 1.148
Critical Depth: 5.642 ft
Critical Velocity: 10.374 fps
Critical Slope: 0.03336
Manning's Roughness: 0.05400

T7NR1ES26-1 (SUB1D) REACH 3

RS 0.267

Cross Section Plot



Normal Depth Results

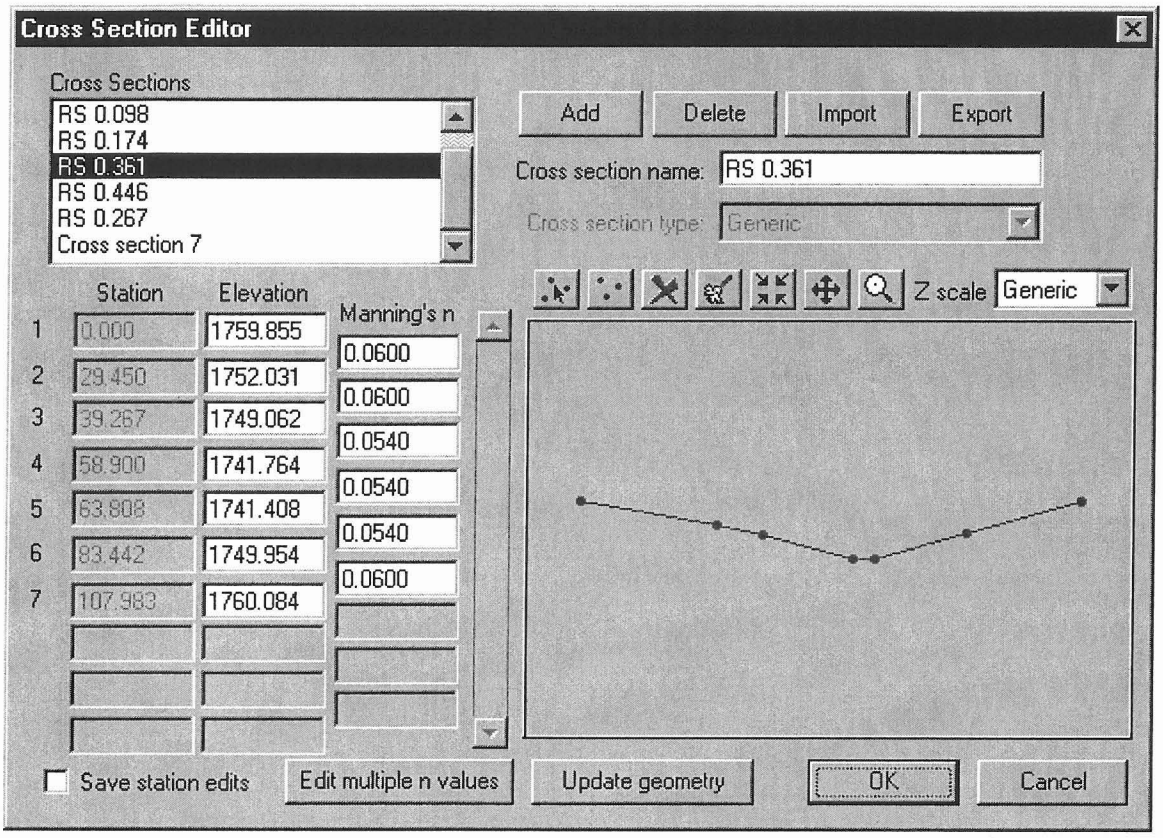
Slope: 0.0463 ft/ft

Calculated Values
Flow: 817.000 cfs
Depth: 3.746 ft
Area of Flow: 87.781 sq ft
Wetted Perimeter: 44.724 ft
Average Velocity: 9.307 fps
Top Width (T): 43.925 ft
Froude Number: 1.160
Critical Depth: 3.991 ft
Critical Velocity: 8.267 fps
Critical Slope: 0.03372
Manning's Roughness: 0.05400

T7NR1ES26-1 (SUB1D) REACH 3

RS 0.361

Cross Section Plot



Normal Depth Results

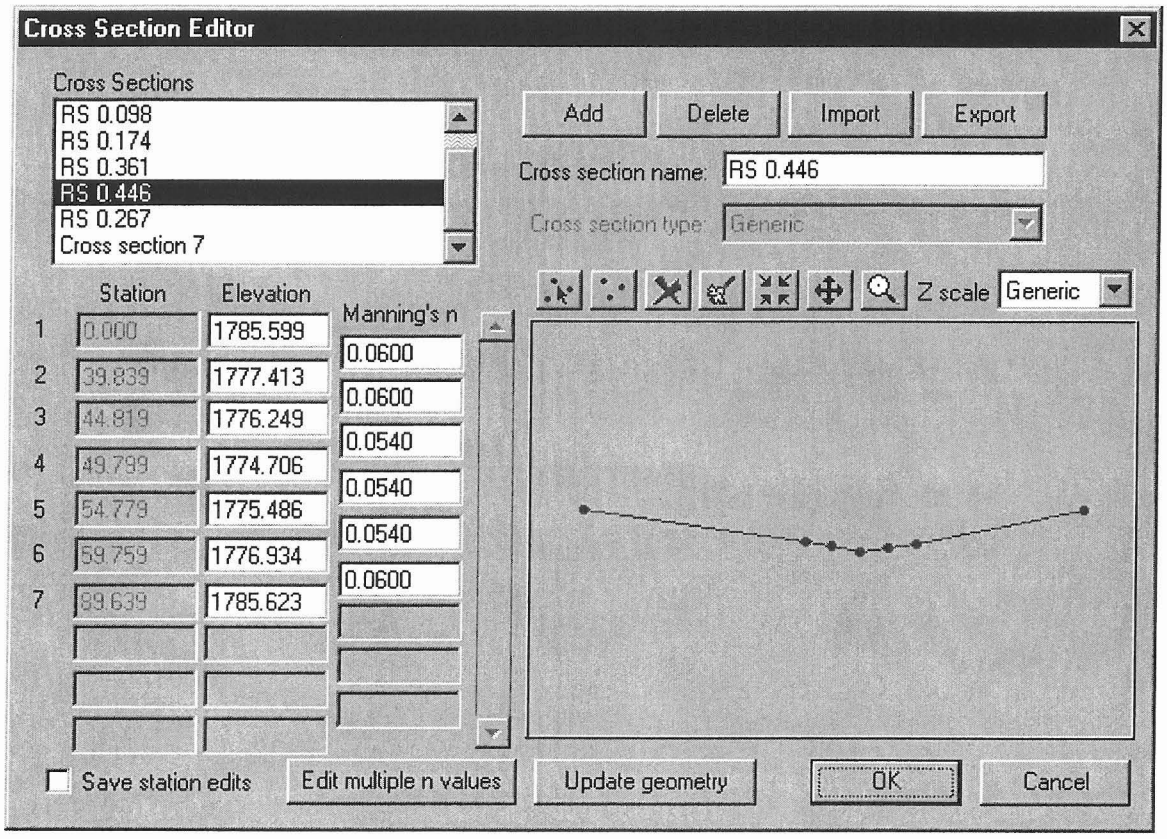
Slope: 0.0463 ft/ft

Calculated Values
Flow: 817.000 cfs
Depth: 4.747 ft
Area of Flow: 74.237 sq ft
Wetted Perimeter: 29.417 ft
Average Velocity: 11.005 fps
Top Width (T): 27.626 ft
Froude Number: 1.183
Critical Depth: 5.119 ft
Critical Velocity: 9.627 fps
Critical Slope: 0.03236
Manning's Roughness: 0.05400

T7NR1ES26-1 (SUB1D) REACH 4

RS 0.446

Cross Section Plot

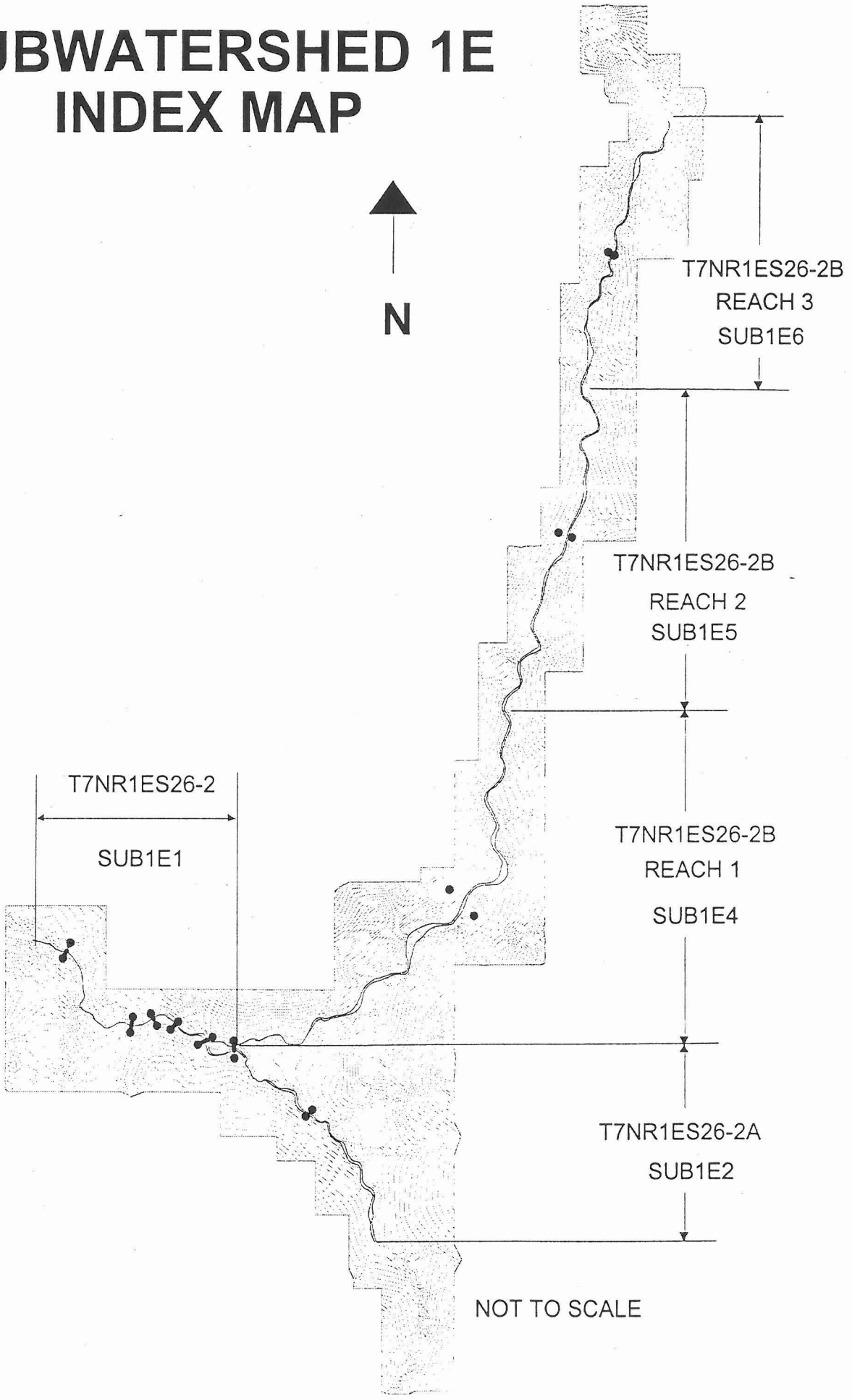


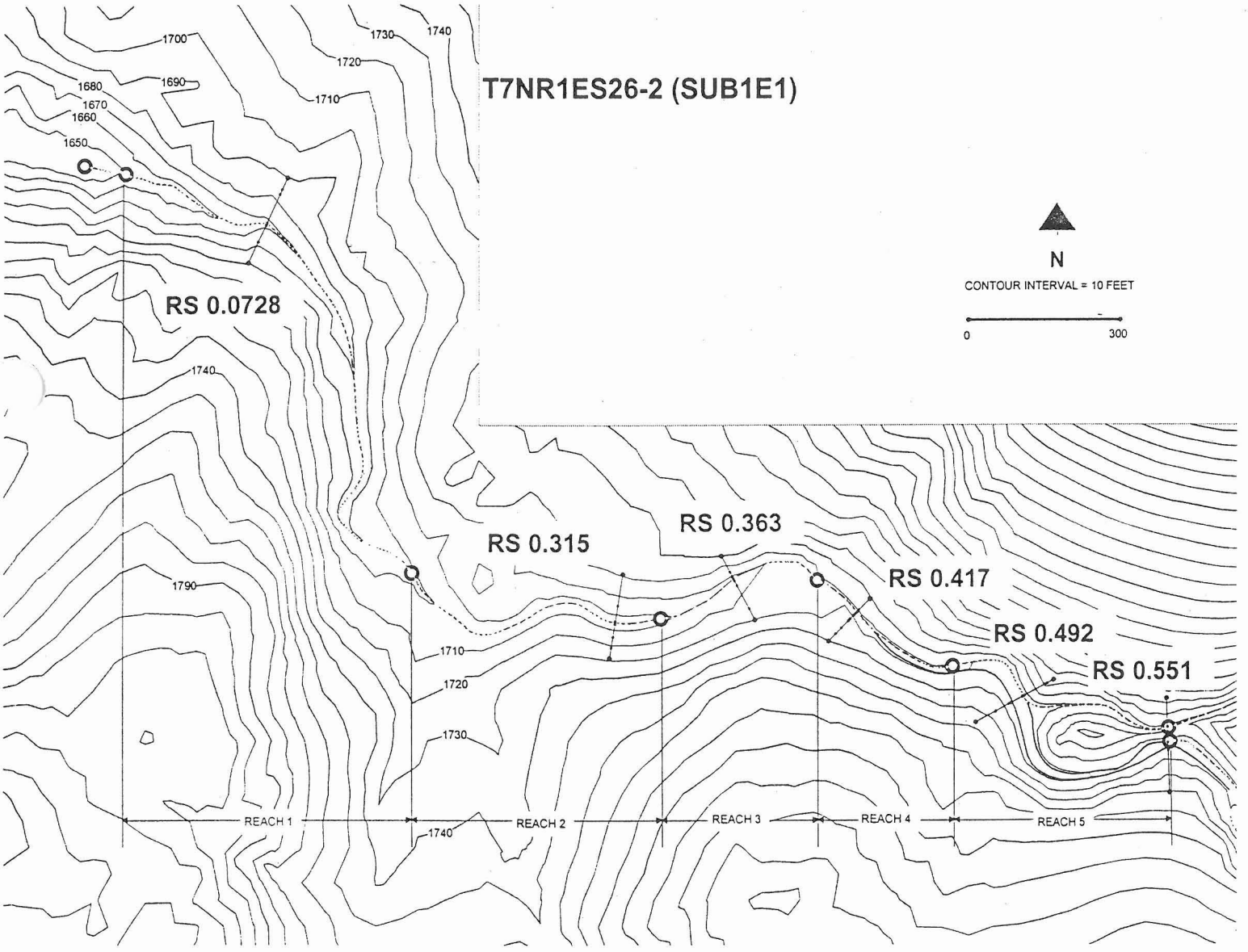
Normal Depth Results

Slope: 0.0814 ft/ft

Calculated Values
Flow: 817.000 cfs
Depth: 4.116 ft
Area of Flow: 69.072 sq ft
Wetted Perimeter: 34.311 ft
Average Velocity: 11.828 fps
Top Width (T): 33.265 ft
Froude Number: 1.447
Critical Depth: 4.779 ft
Critical Velocity: 8.787 fps
Critical Slope: 0.03756
Manning's Roughness: 0.05730

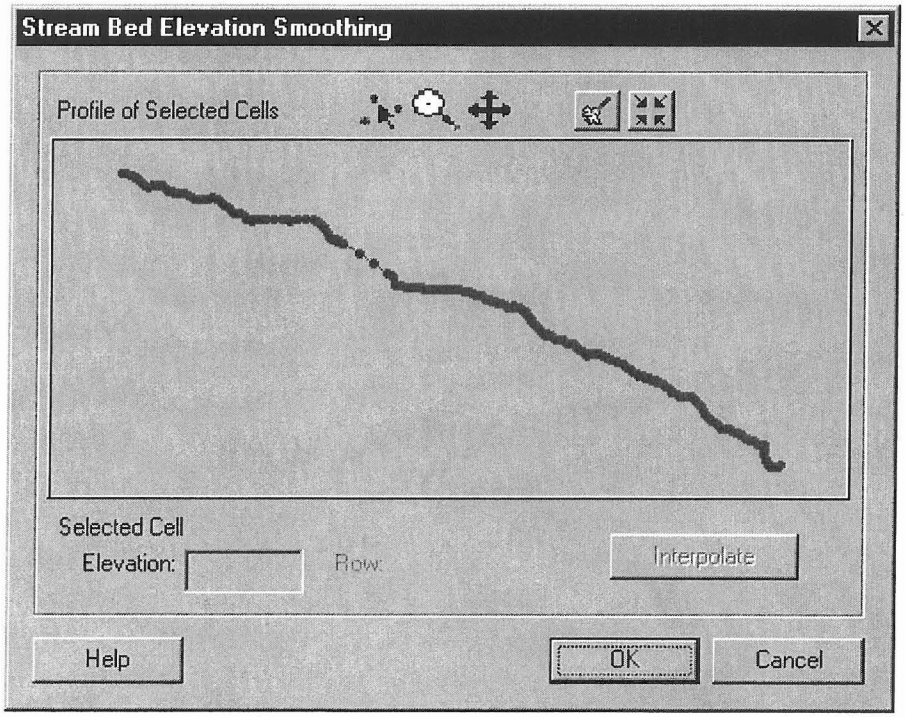
SUBWATERSHED 1E INDEX MAP




T7NR1ES26-2 (SUB1E1)
N
CONTOUR INTERVAL = 10 FEET
0
300
RS 0.0728
RS 0.315
RS 0.363
RS 0.417
RS 0.492
RS 0.551
REACH 1
REACH 2
REACH 3
REACH 4
REACH 5
1650
1660
1670
1680
1690
1700
1710
1720
1730
1740
1790

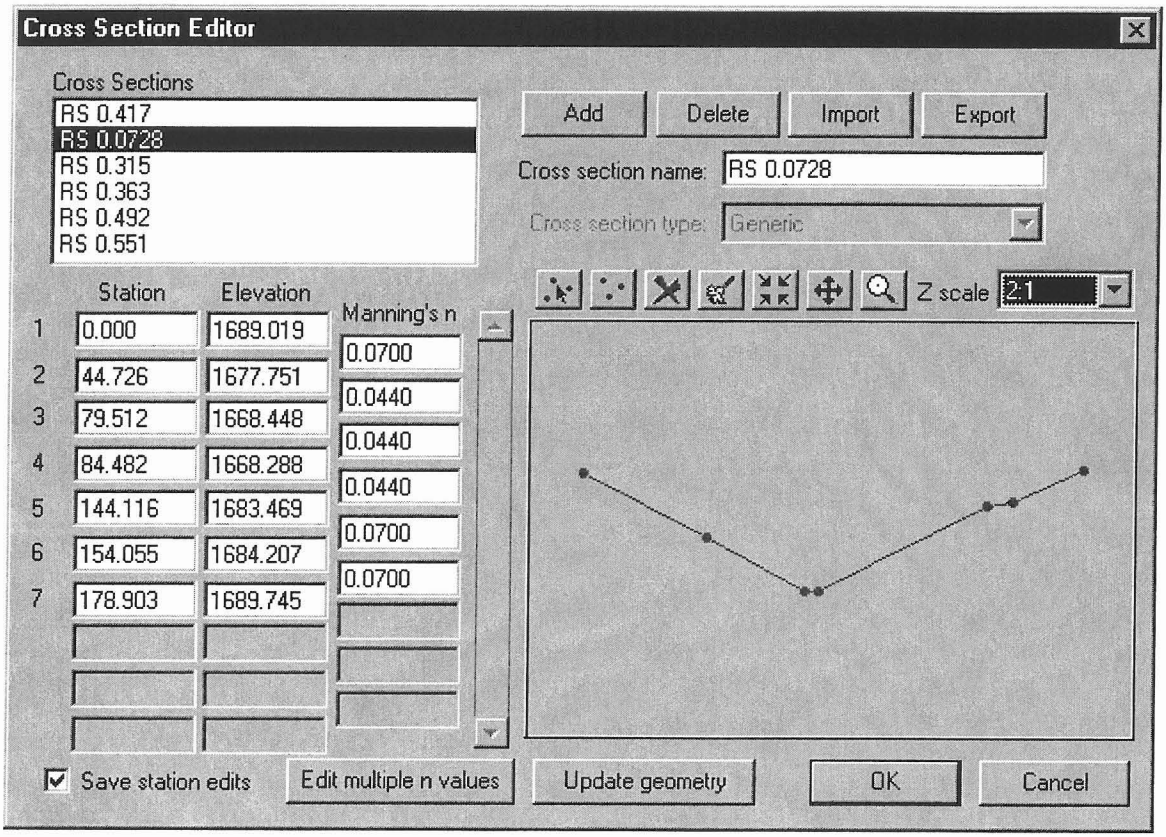
T7NR1ES26-2 (SUB1E1)

Profile



	Reach 1	Reach 2	Reach 3	Reach 4	Reach 5
Length =	1114.47 ft	556.19 ft	346.59 ft	320.88 ft	487.73 ft
High Elev. =	1698.98	1706.27	1727.39	1728.40	1747.66
Low Elev. =	1652.68	1698.98	1706.27	1727.39	1728.40
Slope =	0.0415 ft/ft	0.0131 ft/ft	0.0609 ft/ft	0.0031 ft/ft	0.0395 ft/ft

T7NR1ES26-2 (SUB1E1) REACH 1
RS 0.0728
Cross Section Plot



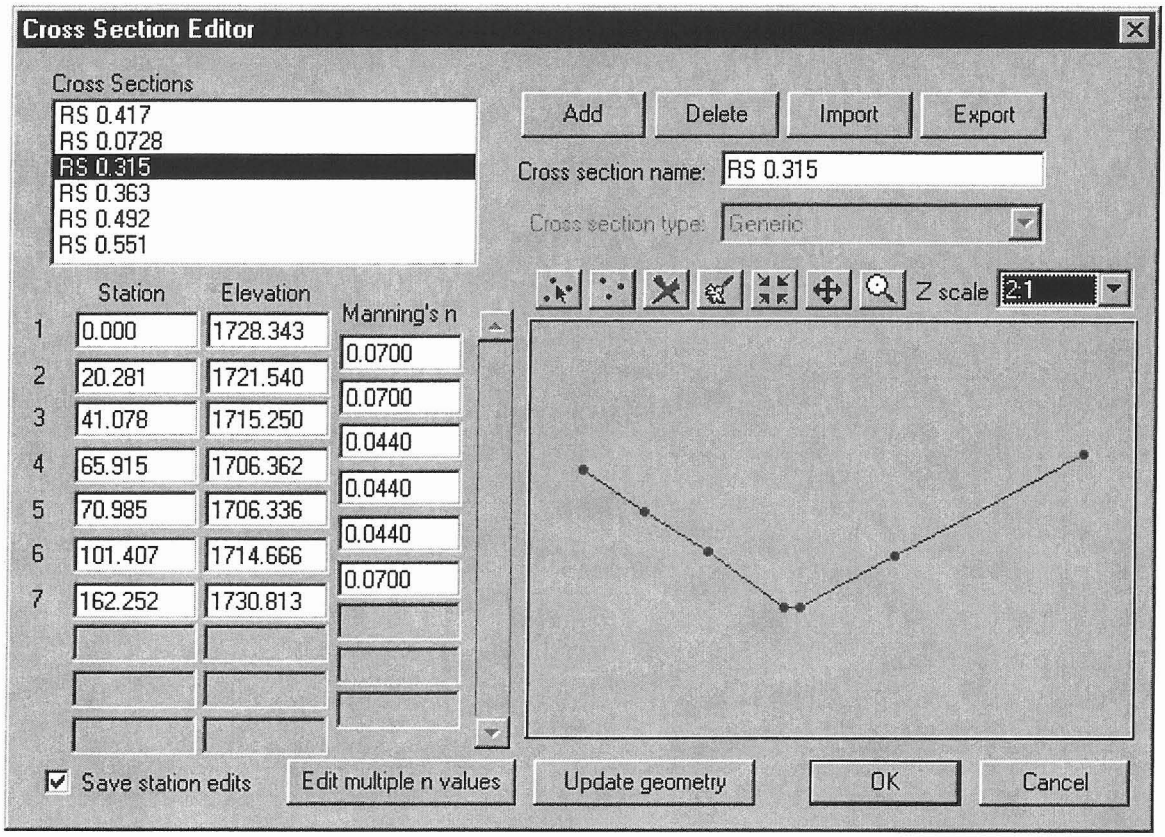
Normal Depth Results

Slope : 0.0415 ft/ft

Calculated Values
Flow: 3924.000 cfs
Depth: 7.276 ft
Area of Flow: 234.400 sq ft
Wetted Perimeter: 62.007 ft
Average Velocity: 16.741 fps
Top Width (T): 60.157 ft
Froude Number: 1.495
Critical Depth: 8.634 ft
Critical Velocity: 12.143 fps
Critical Slope: 0.01762
Manning's Roughness: 0.04400

T7NR1ES26-2 (SUB1E1) REACH 2
RS 0.315

Cross Section Plot



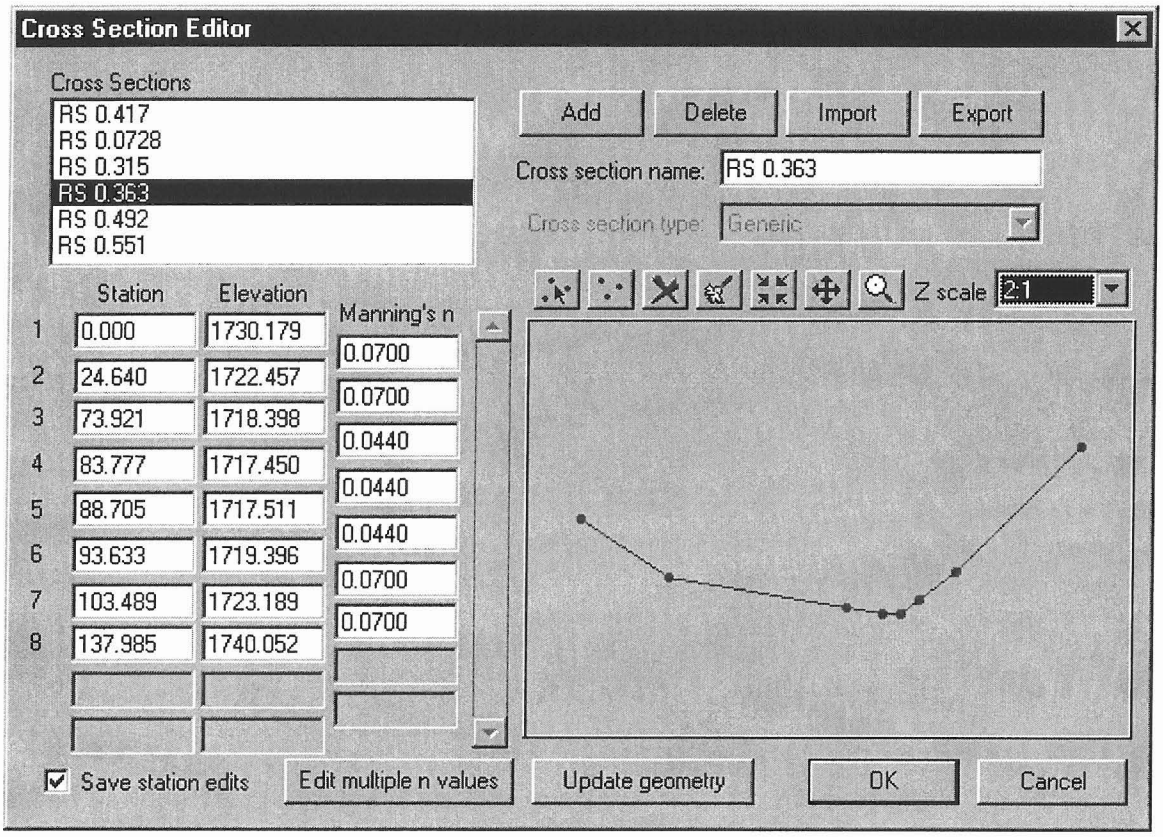
Normal Depth Results

Slope: 0.0131 ft/ft

Calculated Values
Flow: 3924.000 cfs
Depth: 9.972 ft
Area of Flow: 370.703 sq ft
Wetted Perimeter: 73.045 ft
Average Velocity: 10.585 fps
Top Width (T): 70.012 ft
Froude Number: 0.811
Critical Depth: 9.103 ft
Critical Velocity: 12.553 fps
Critical Slope: 0.01867
Manning's Roughness: 0.04758

T7NR1ES26-2 (SUB1E1) REACH 3
RS 0.363

Cross Section Plot



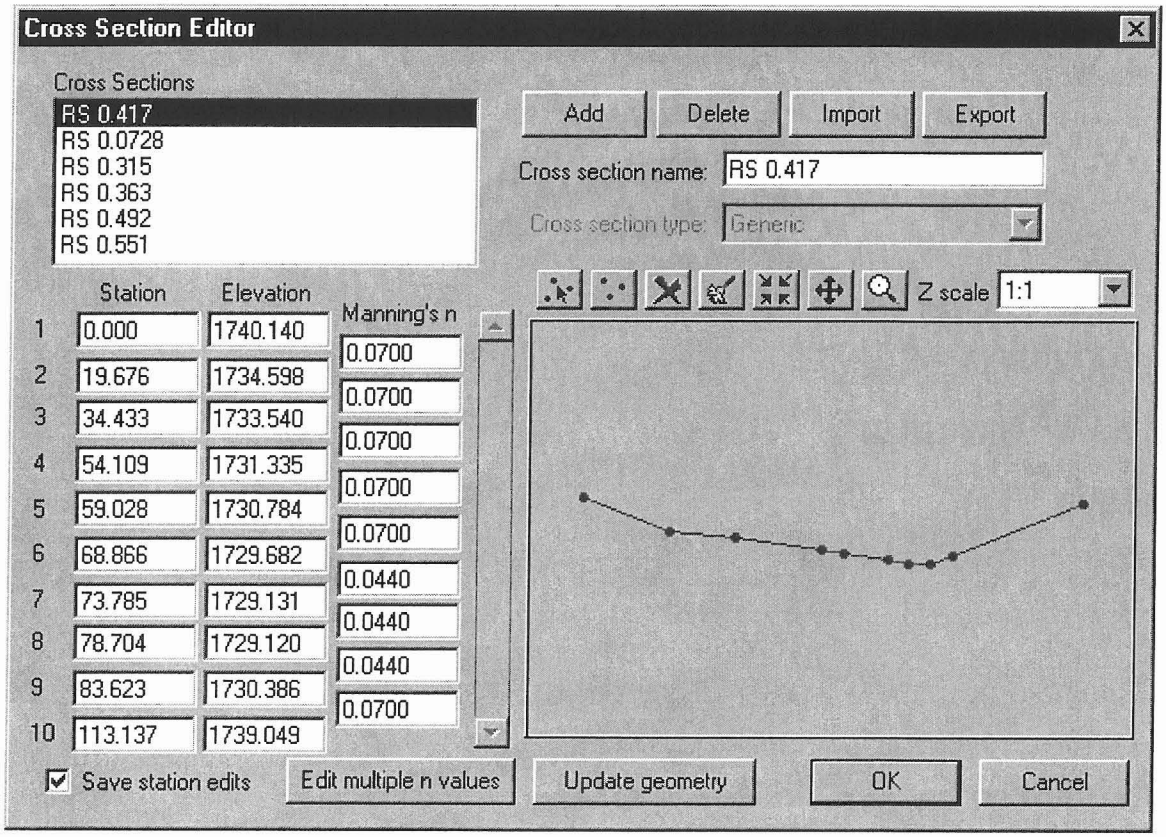
Normal Depth Results

Slope: 0.0609 ft/ft

Calculated Values
Flow: 3924.000 cfs
Depth: 6.195 ft
Area of Flow: 296.548 sq ft
Wetted Perimeter: 85.124 ft
Average Velocity: 13.232 fps
Top Width (T): 83.572 ft
Froude Number: 1.238
Critical Depth: 6.776 ft
Critical Velocity: 11.341 fps
Critical Slope: 0.03857
Manning's Roughness: 0.06386

T7NR1ES26-2 (SUB1E1) REACH 4
RS 0.417

Cross Section Plot



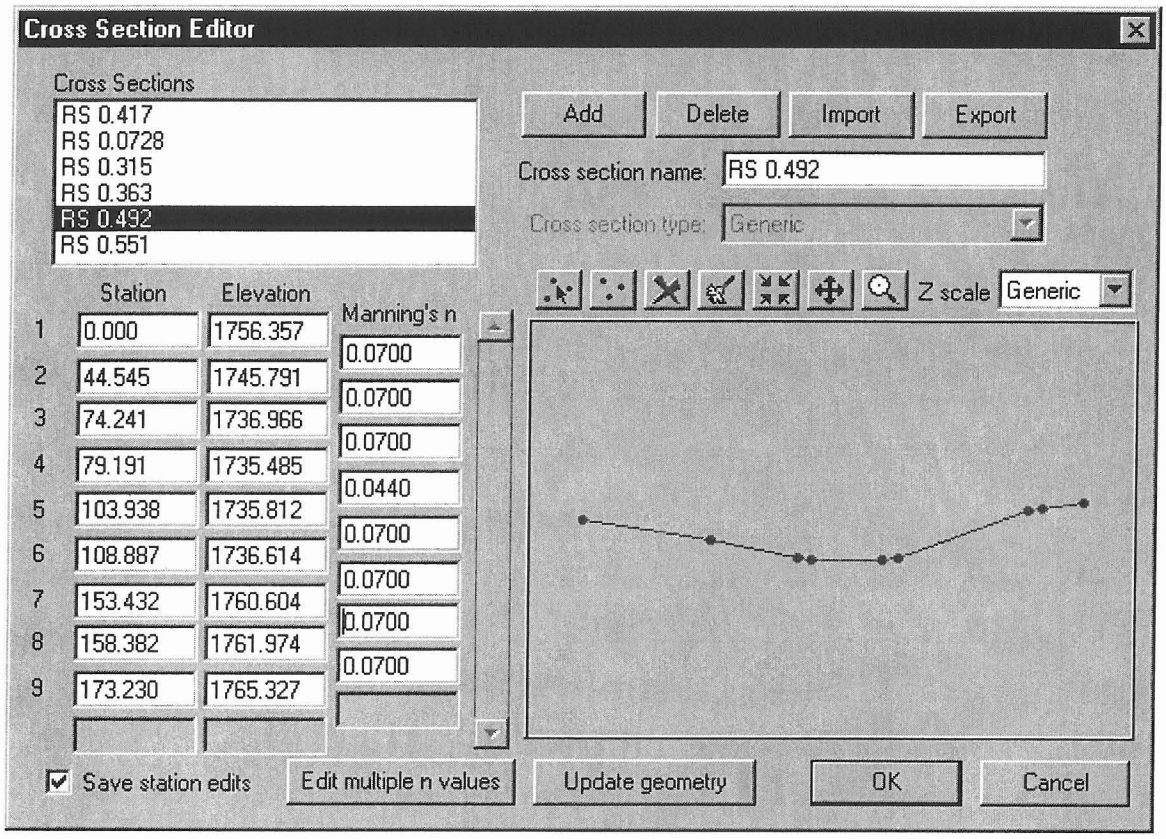
Normal Depth Results

Slope: 0.0031 ft/ft

Calculated Values
Flow: 3924.000 cfs
Depth: 11.666 ft
Area of Flow: 832.181 sq ft
Wetted Perimeter: 115.878 ft
Average Velocity: 4.715 fps
Top Width (T): 112.222 ft
Froude Number: 0.305
Critical Depth: 6.776 ft
Critical Velocity: 11.341 fps
Critical Slope: 0.03857
Manning's Roughness: 0.06549

T7NR1ES26-2 (SUB1E1) REACH 5
RS 0.492

Cross Section Plot



Normal Depth Results

Slope: 0.0395 ft/ft

Calculated Values
Flow: 3924.000 cfs
Depth: 6.637 ft
Area of Flow: 291.509 sq ft
Wetted Perimeter: 64.645 ft
Average Velocity: 13.461 fps
Top Width (T): 62.223 ft
Froude Number: 1.096
Critical Depth: 6.974 ft
Critical Velocity: 12.546 fps
Critical Slope: 0.03277
Manning's Roughness: 0.06005

T7NR1ES26-2 (SUB1E1) REACH 5, RS 0.551
Worksheet for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

Input Data		
Slope	039500	ft/ft
Discharg	,924.00	cfs

Options	
Current Roughness Meth	ved Lotter's Method
Open Channel Weighting	ved Lotter's Method
Closed Channel Weightin	Horton's Method

Results		
Mannings Coefficie	0.060	
Water Surface Elev	1,752.83	ft
Elevation Range	14.46 to 1,774.22	
Flow Area	304.4	ft²
Wetted Perimeter	71.22	ft
Top Width	64.39	ft
Actual Depth	8.37	ft
Critical Elevation	1,753.00	ft
Critical Slope	0.036010	ft/ft
Velocity	12.89	ft/s
Velocity Head	2.58	ft
Specific Energy	1,755.41	ft
Froude Number	1.05	
Flow Type	Supercritical	

Calculation Messages:
Flow is divided.

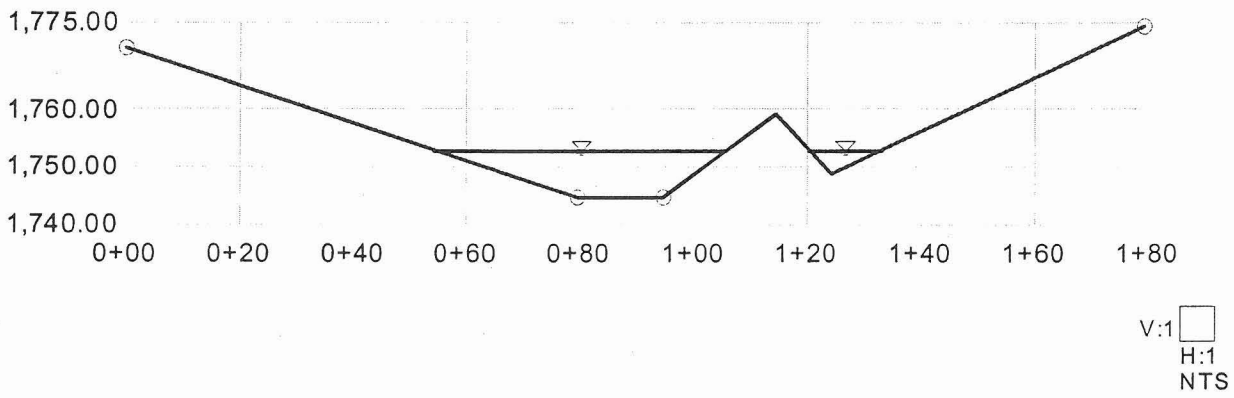
Roughness Segments		
Start Station	End Station	Mannings Coefficient
0+00	0+80	0.070
0+80	0+95	0.044
0+95	1+79	0.070

Natural Channel Points	
Station (ft)	Elevation (ft)
0+00	1,770.71
0+80	1,744.46
0+95	1,744.54
1+14	1,759.06
1+24	1,748.60
1+34	1,753.35
1+79	1,774.22

T7NR1ES26-2 (SUB1E1) REACH 5, RS 0.551
Cross Section for Irregular Channel

Project Description	
Worksheet	Irregular Channel
Flow Element	Irregular Channel
Method	Manning's Formul
Solve For	Channel Depth

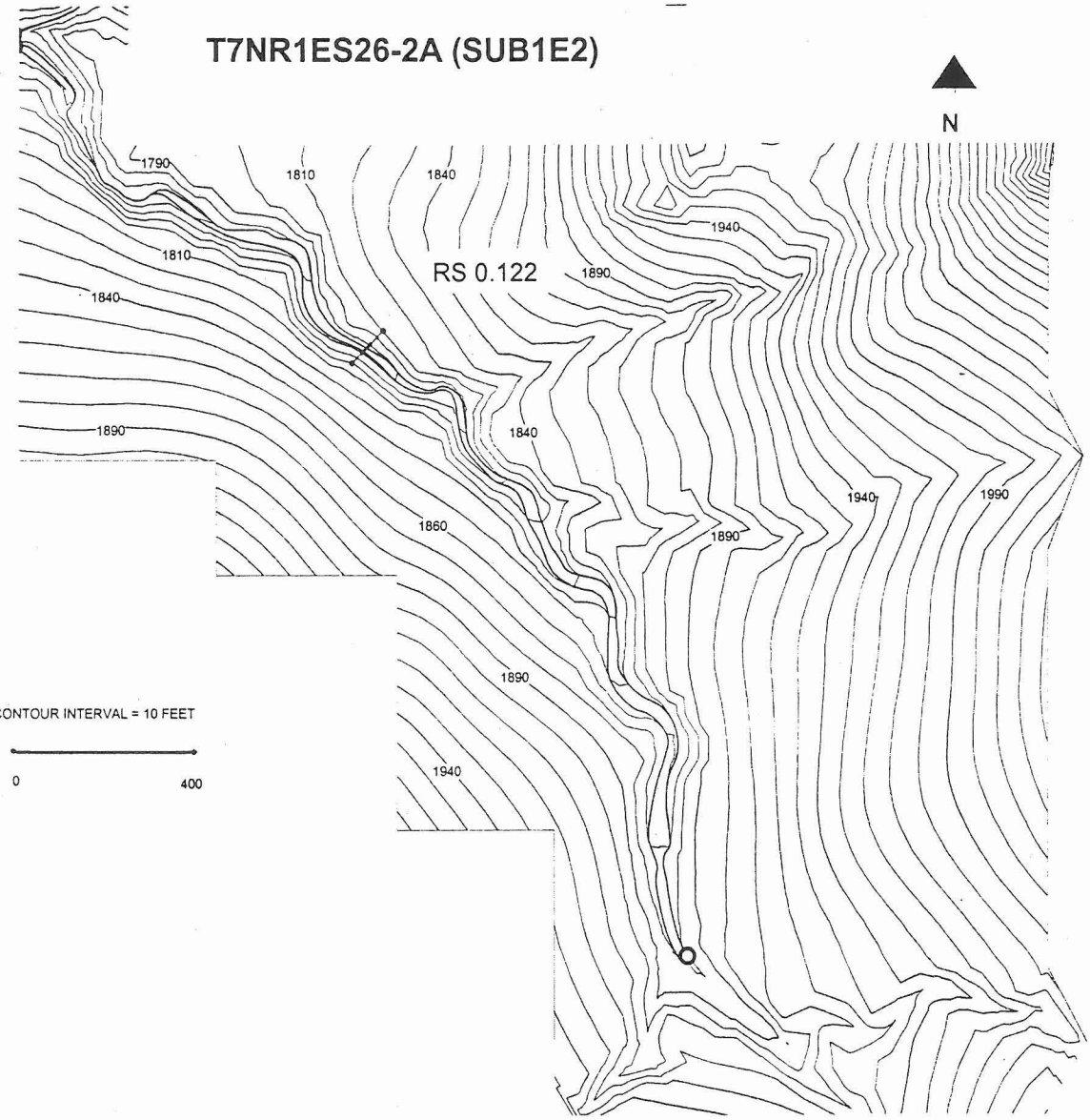
Section Data		
Mannings Coefficie	0.060	
Slope	0.039500	ft/ft
Water Surface Elev	1,752.83	ft
Elevation Range	14.46 to 1,774.22	
Discharge	3,924.00	cfs



RBF Consulting
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

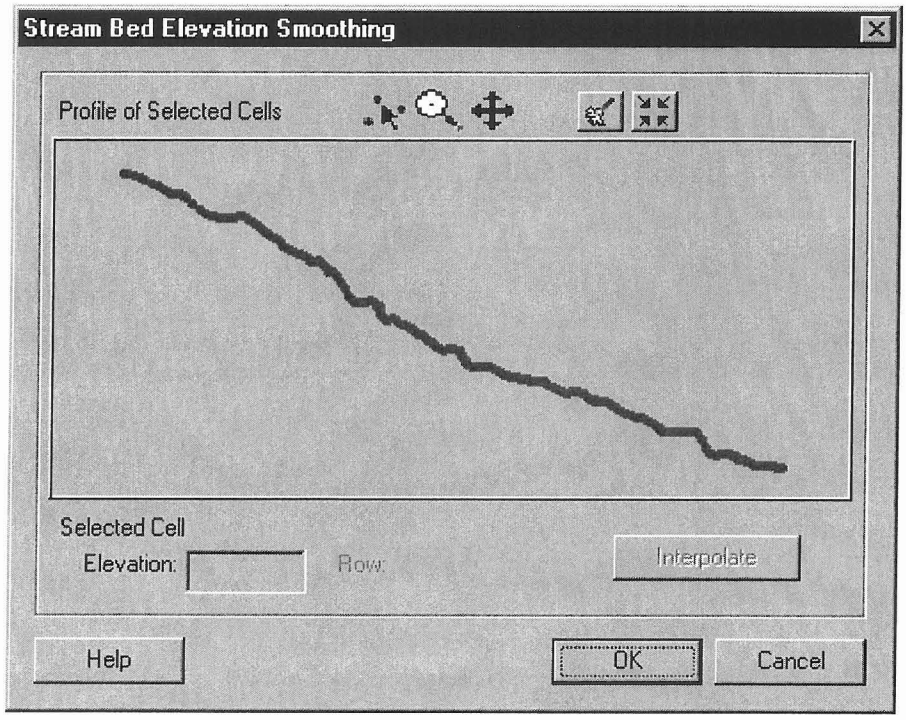
JUNCTION

T7NR1ES26-2A (SUB1E2)



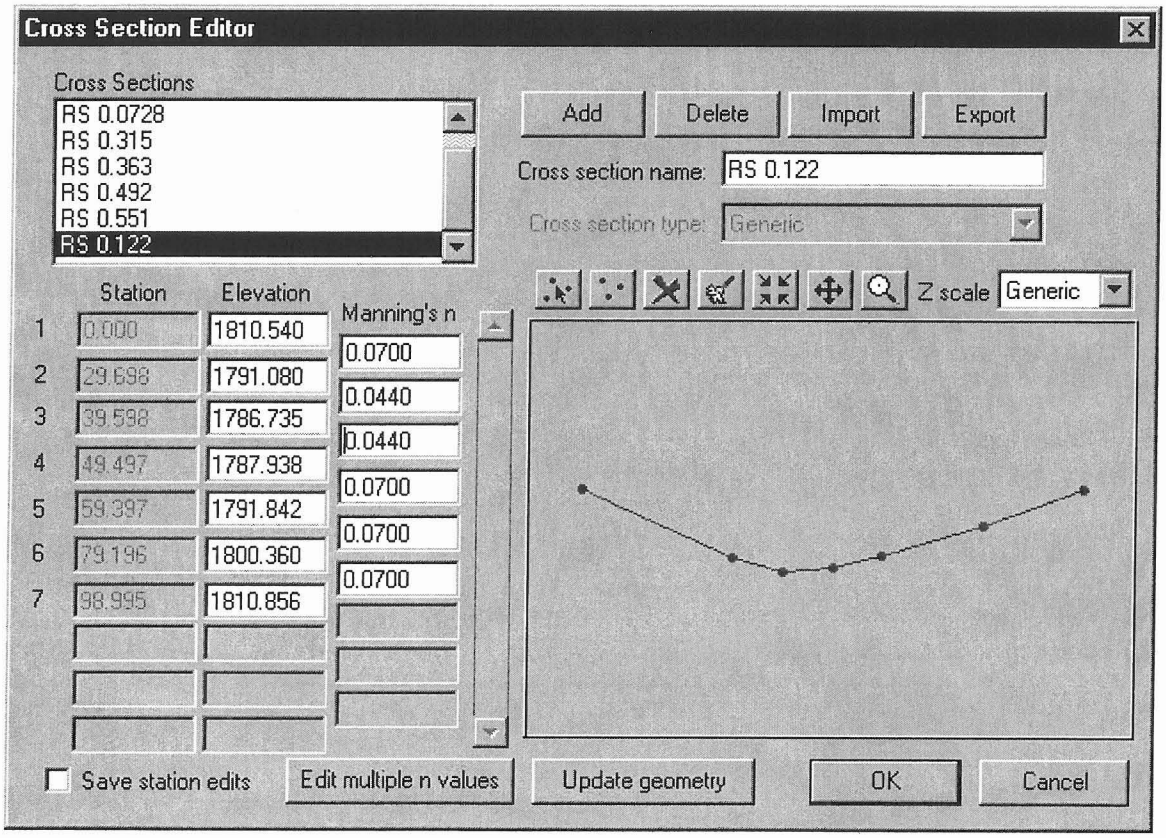
T7NR1ES26-2A (SUB1E2)

Profile



Length =	2350.68 feet
High Elevation =	1879.89
Low Elevation =	1761.93
Slope =	0.0502 ft/ft

T7NR1ES26-2A (SUB1E2)
RS 0.122
Cross Section Plot



Normal Depth Results

Slope: 0.0502 ft/ft

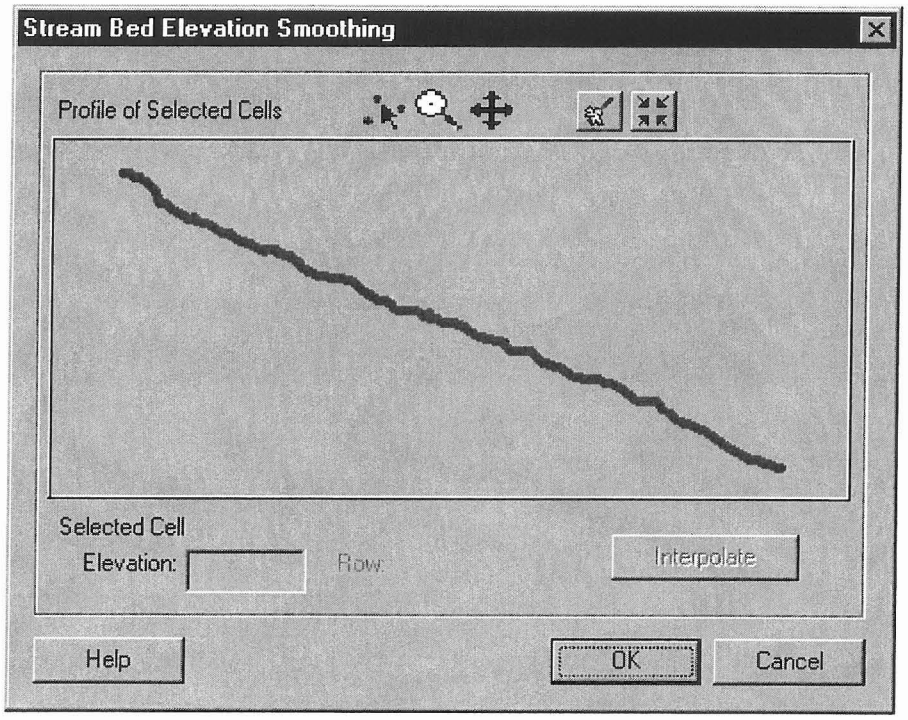
Calculated Values
Flow: 1479.000 cfs (R1E3 + SUB1E2)
Depth: 5.696 ft
Area of Flow: 112.280 sq ft
Wetted Perimeter: 35.383 ft
Average Velocity: 13.172 fps
Top Width (T): 33.132 ft
Froude Number: 1.261
Critical Depth: 6.335 ft
Critical Velocity: 11.020 fps
Critical Slope: 0.03189
Manning's Roughness: 0.05473

T7NR1ES26-2B (SUB1E4)

REACH 1

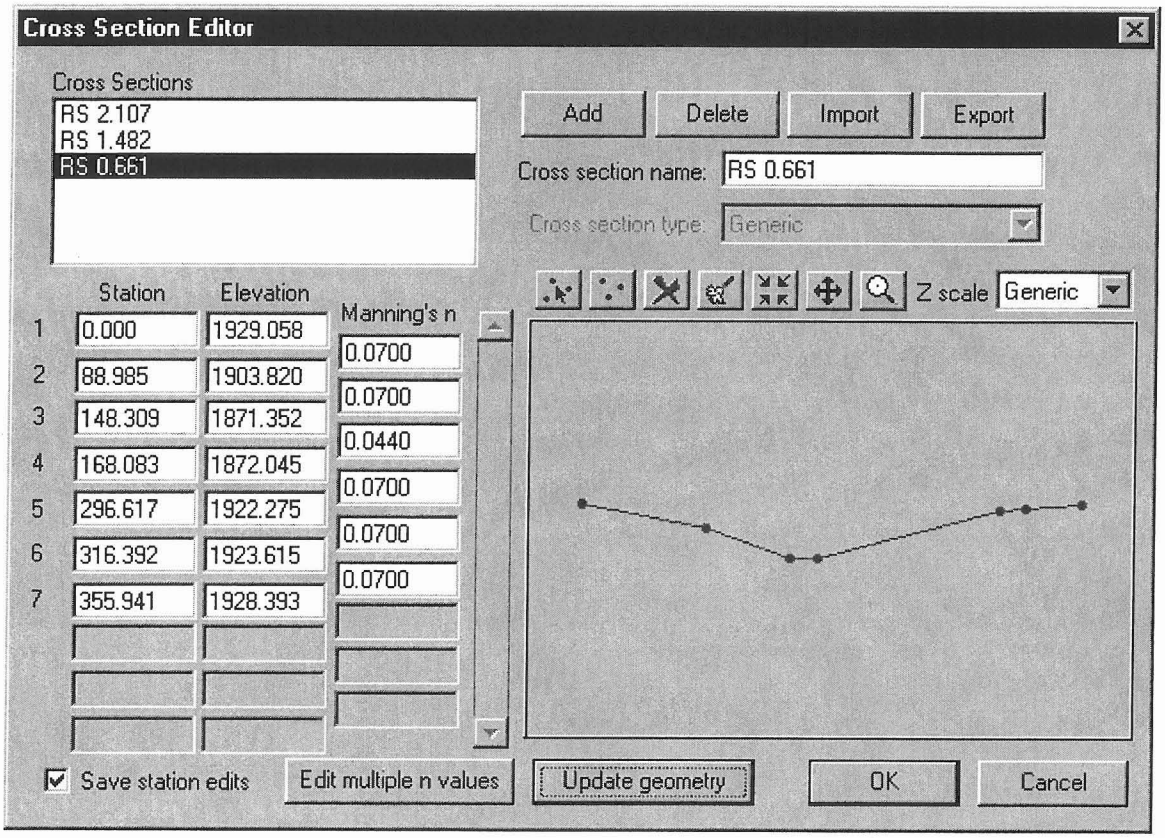
T7NR1ES26-2B REACH 1 (SUB1E4)

Profile



Length =	5692 feet
High Elevation =	1965.56
Low Elevation =	1747.66
Slope =	0.0383 ft/ft

T7NR1ES26-2B REACH 1 (SUB1E4)
RS 0.661
Cross Section Plot



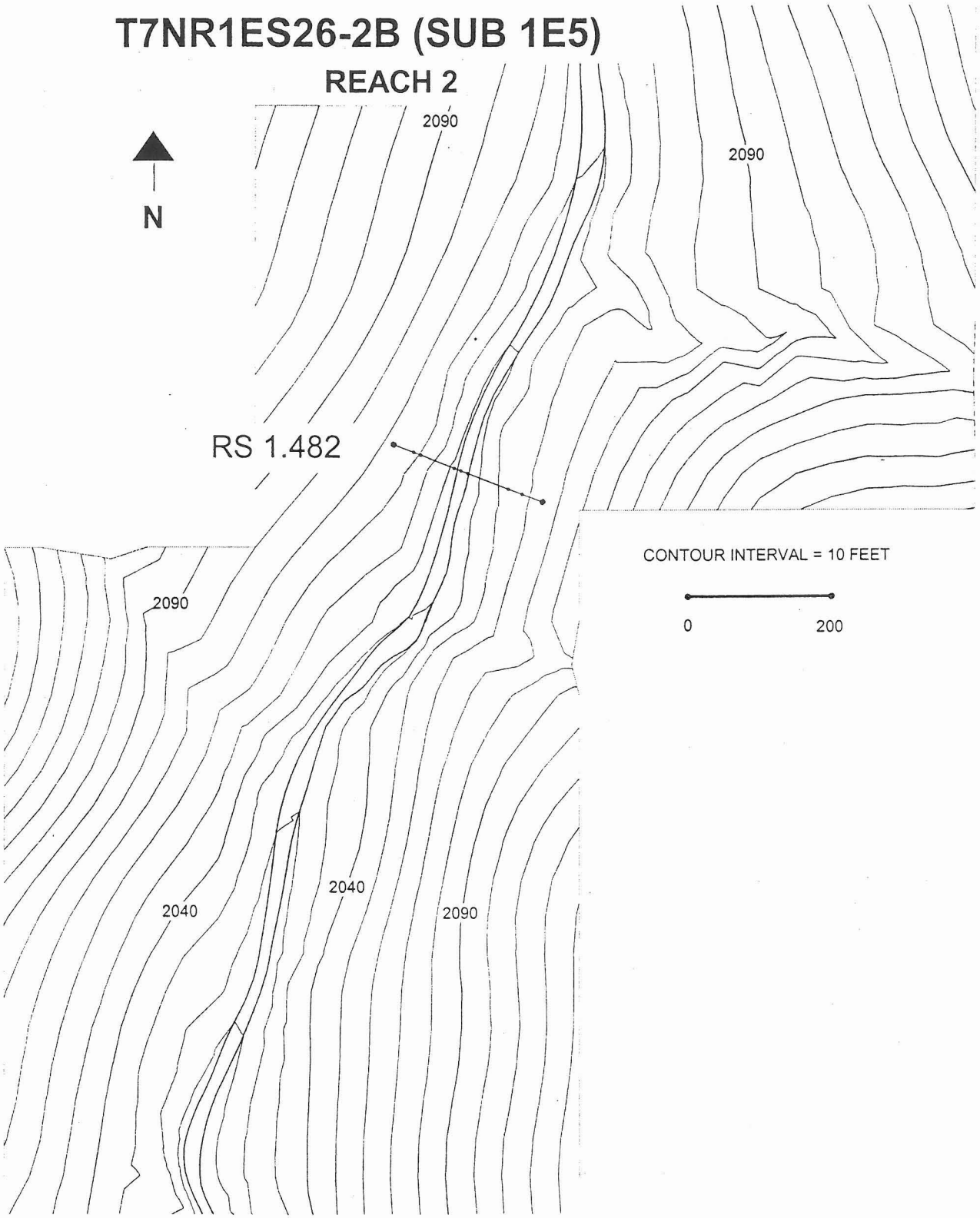
Normal Depth Results

Slope: 0.0383 ft/ft

Calculated Values
Flow: 3488.000 cfs (R1E5+SUB1E4)
Depth: 7.608 ft
Area of Flow: 257.674 sq ft
Wetted Perimeter: 54.634 ft
Average Velocity: 13.536 fps
Top Width (T): 51.372 ft
Froude Number: 1.065
Critical Depth: 7.858 ft
Critical Velocity: 12.888 fps
Critical Slope: 0.03370
Manning's Roughness: 0.06058

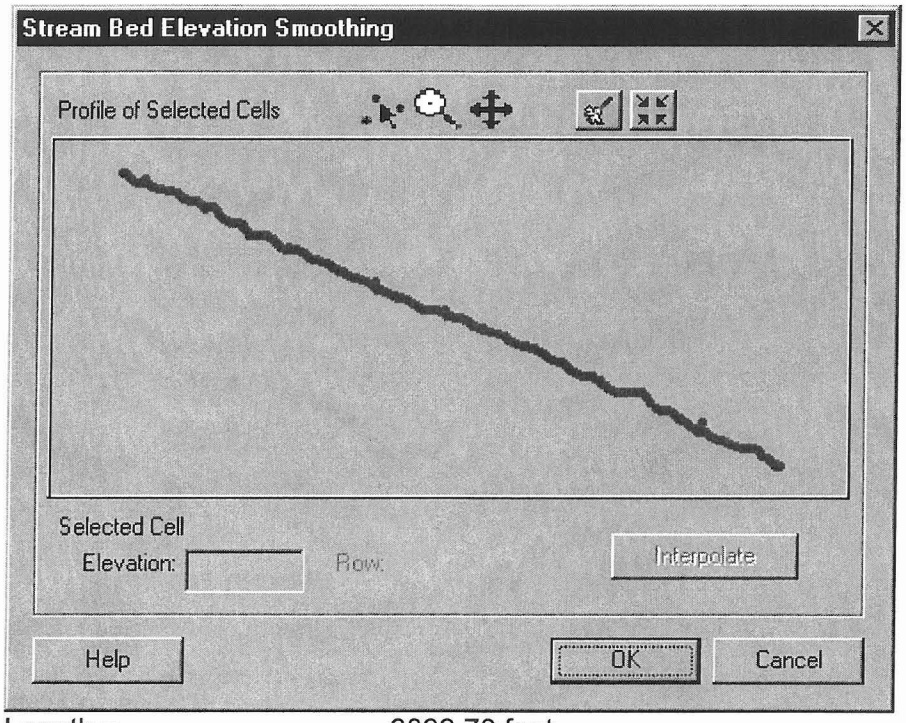
T7NR1ES26-2B (SUB 1E5)

REACH 2



T7NR1ES26-2B REACH 2 (SUB1E5)

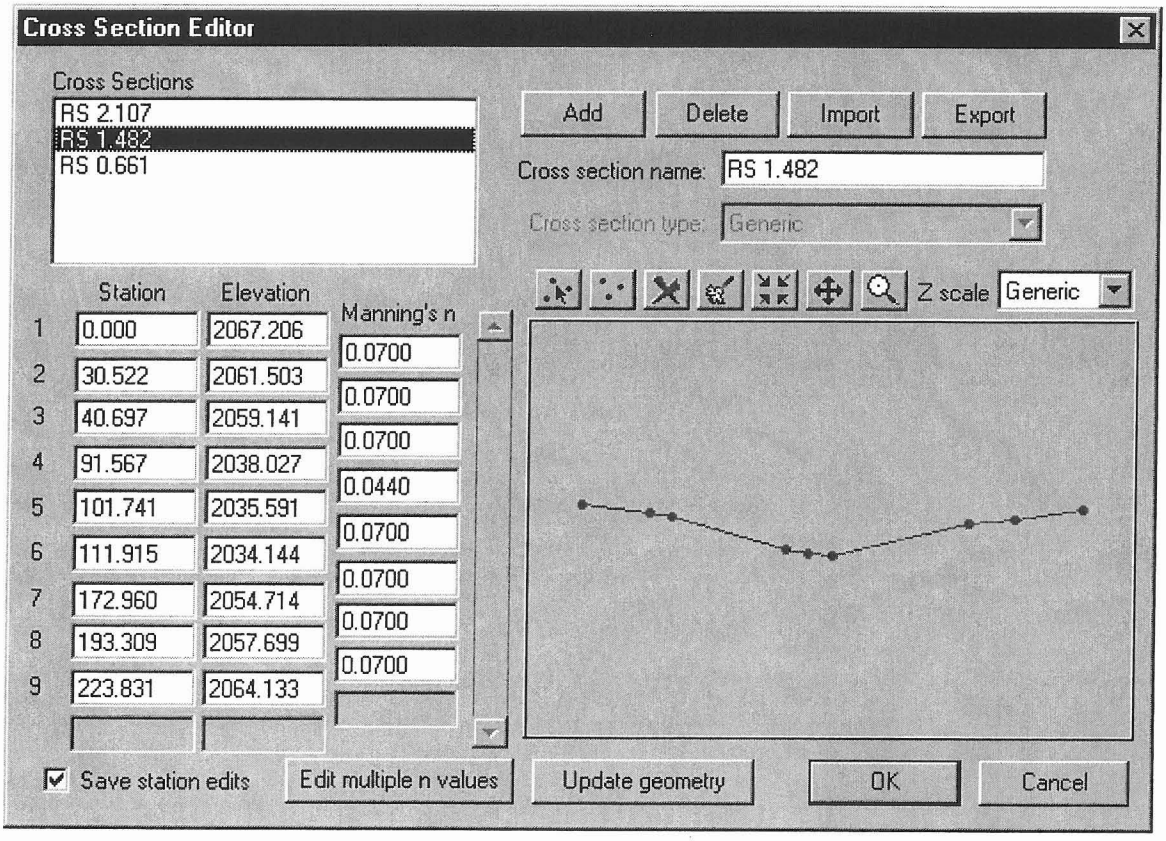
Profile (Reach 2)



Length =	3892.70 feet
High Elevation =	2092.01
Low Elevation =	1965.56
Slope =	0.0325 ft/ft

T7NR1ES26-2B REACH 2 (SUB1E5)
RS 1.482

Cross Section Plot



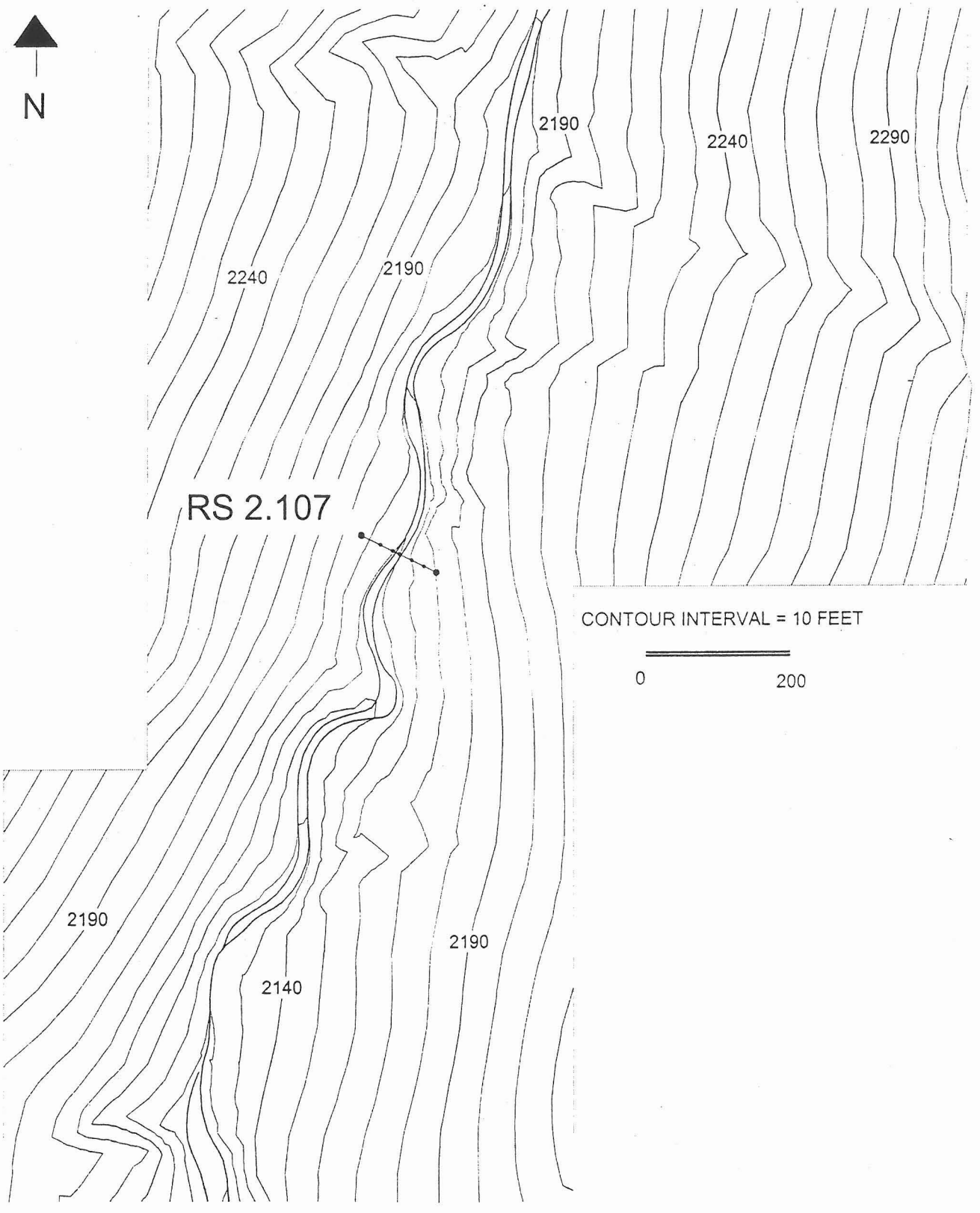
Normal Depth Results

Slope: 0.0325 ft/ft

Calculated Values
Flow: 2623.000 cfs (CP1E5)
Depth: 7.953 ft
Area of Flow: 241.153 sq ft
Wetted Perimeter: 56.260 ft
Average Velocity: 10.877 fps
Top Width (T): 53.756 ft
Froude Number: 0.905
Critical Depth: 7.609 ft
Critical Velocity: 11.762 fps
Critical Slope: 0.04000
Manning's Roughness: 0.06517

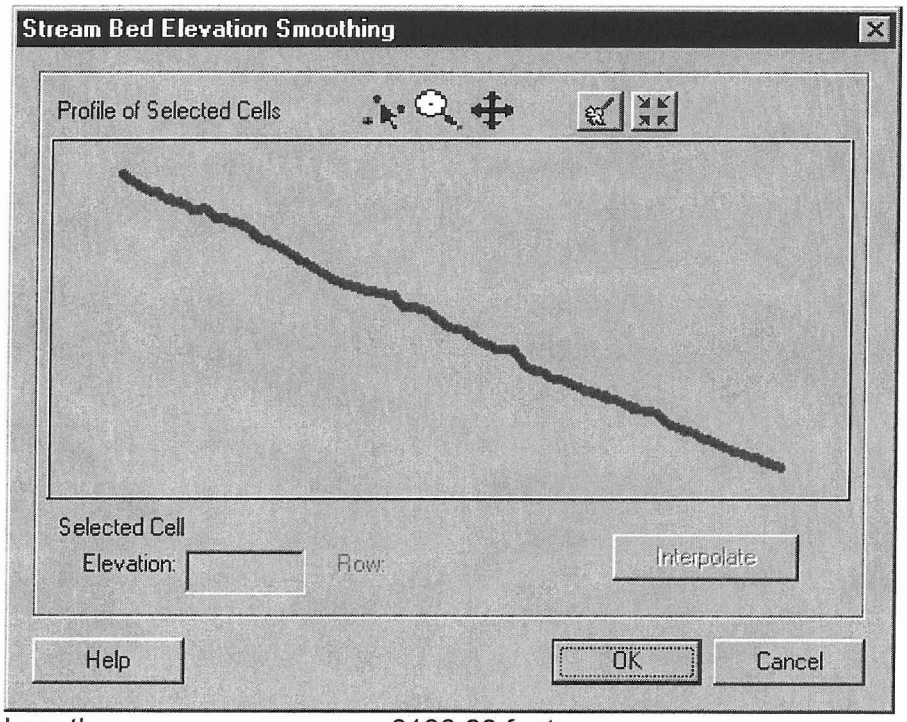
T7NR1ES26-2B (SUB1E6)

REACH 3



T7NR1ES26-2B REACH 3 (SUB1E6)

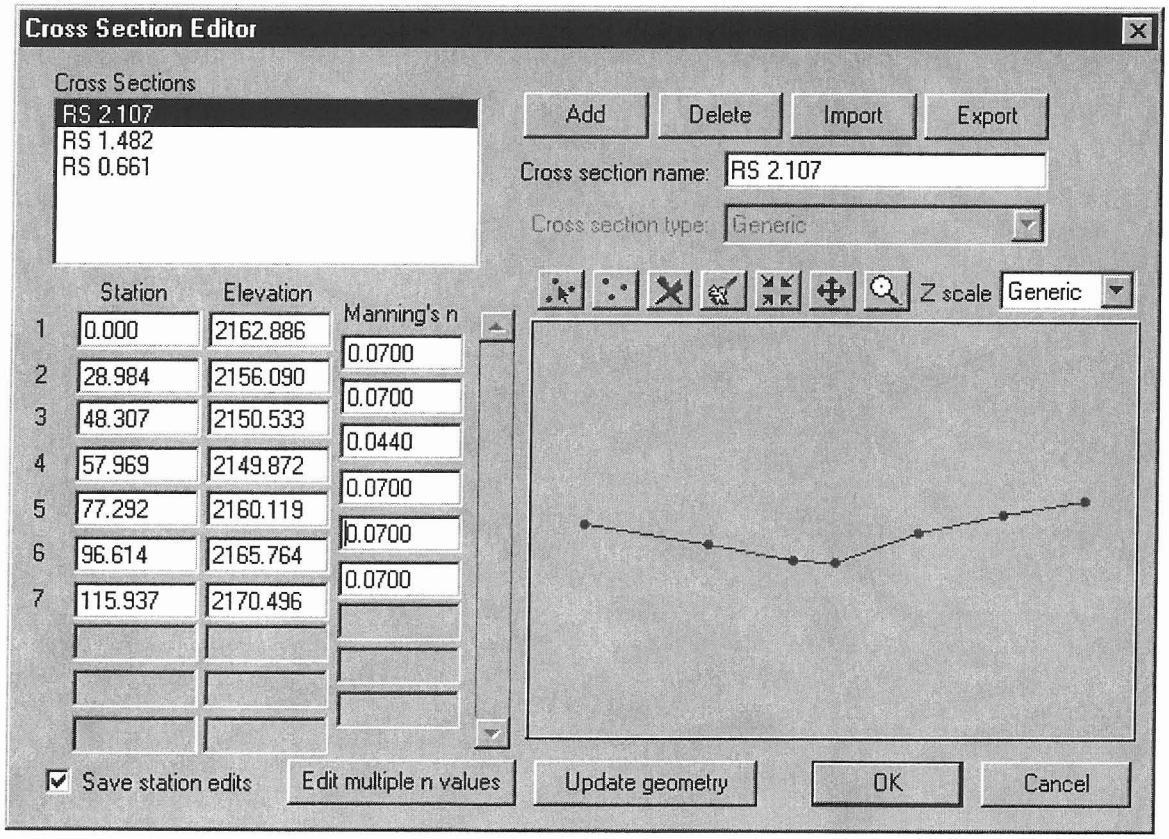
Profile (Reach 3)



Length =	3198.22 feet
High Elevation =	2217.11
Low Elevation =	2092.01
Slope =	0.0391 ft/ft

T7NR1ES26-2B REACH 3 (SUB1E6)
RS 2.107

Cross Section Plot

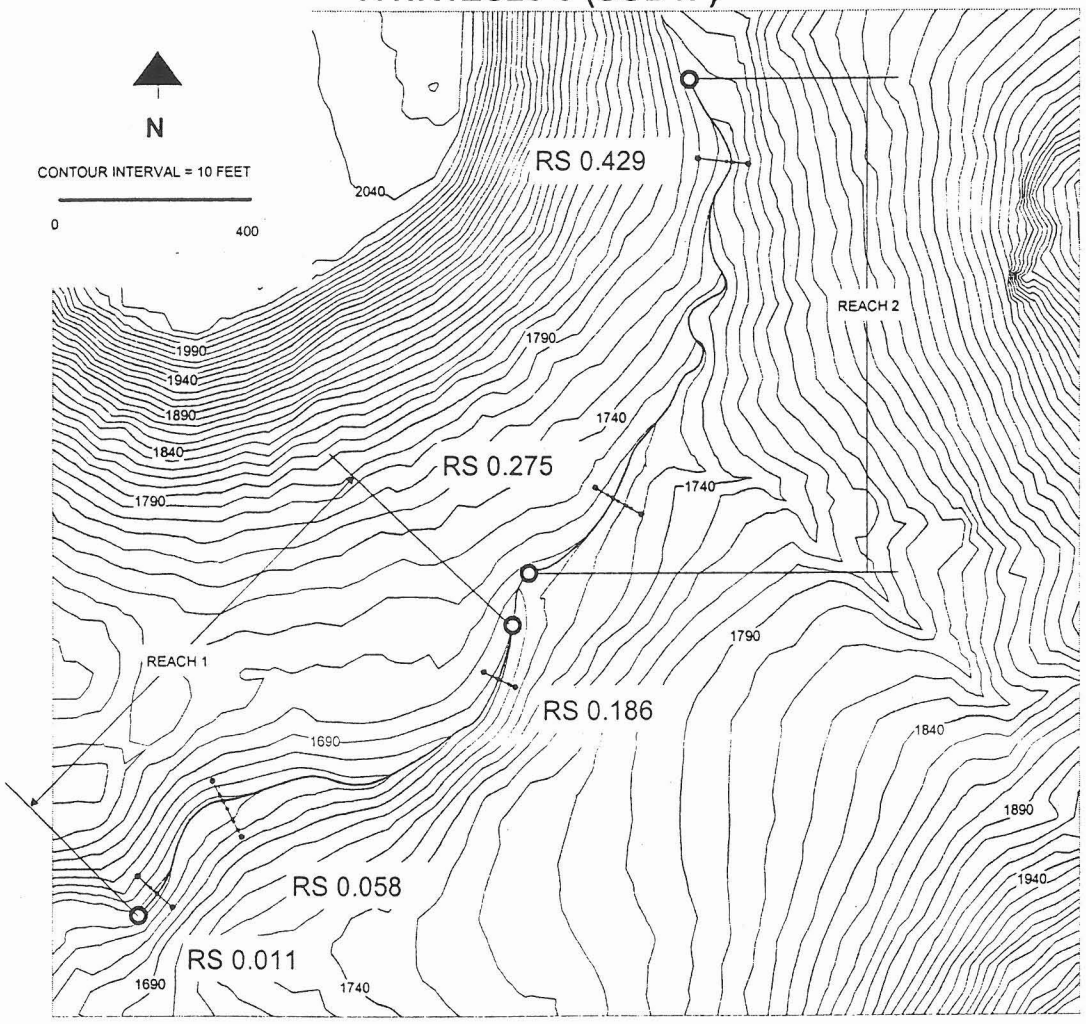


Normal Depth Results

Slope: 0.0391 ft/ft

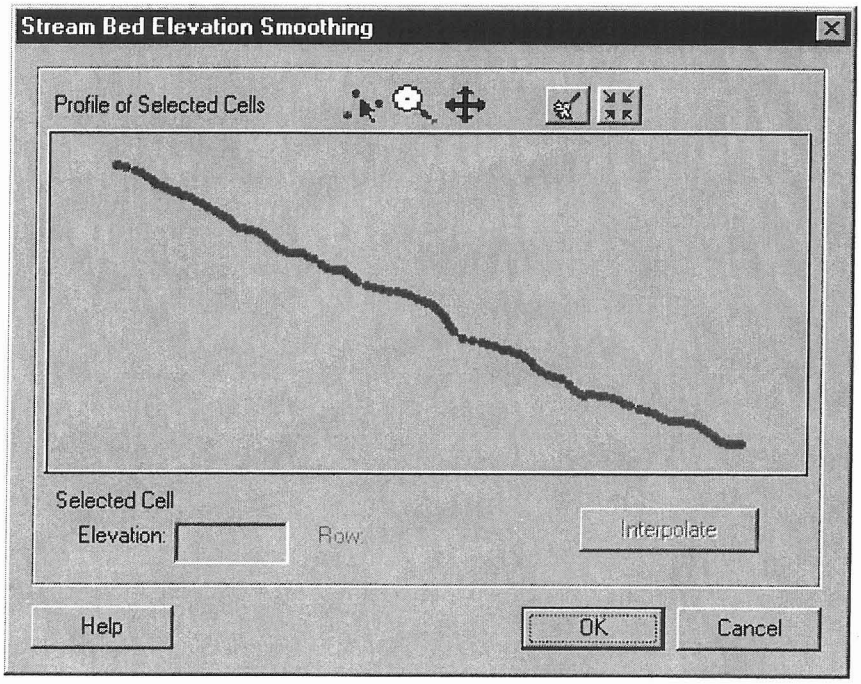
Calculated Values
Flow: 1998.000 cfs (CP1E6)
Depth: 7.020 ft
Area of Flow: 181.640 sq ft
Wetted Perimeter: 48.287 ft
Average Velocity: 11.000 fps
Top Width (T): 45.642 ft
Froude Number: 0.972
Critical Depth: 6.928 ft
Critical Velocity: 11.259 fps
Critical Slope: 0.04147
Manning's Roughness: 0.06479

T7NR1ES26-3 (SUB1F)



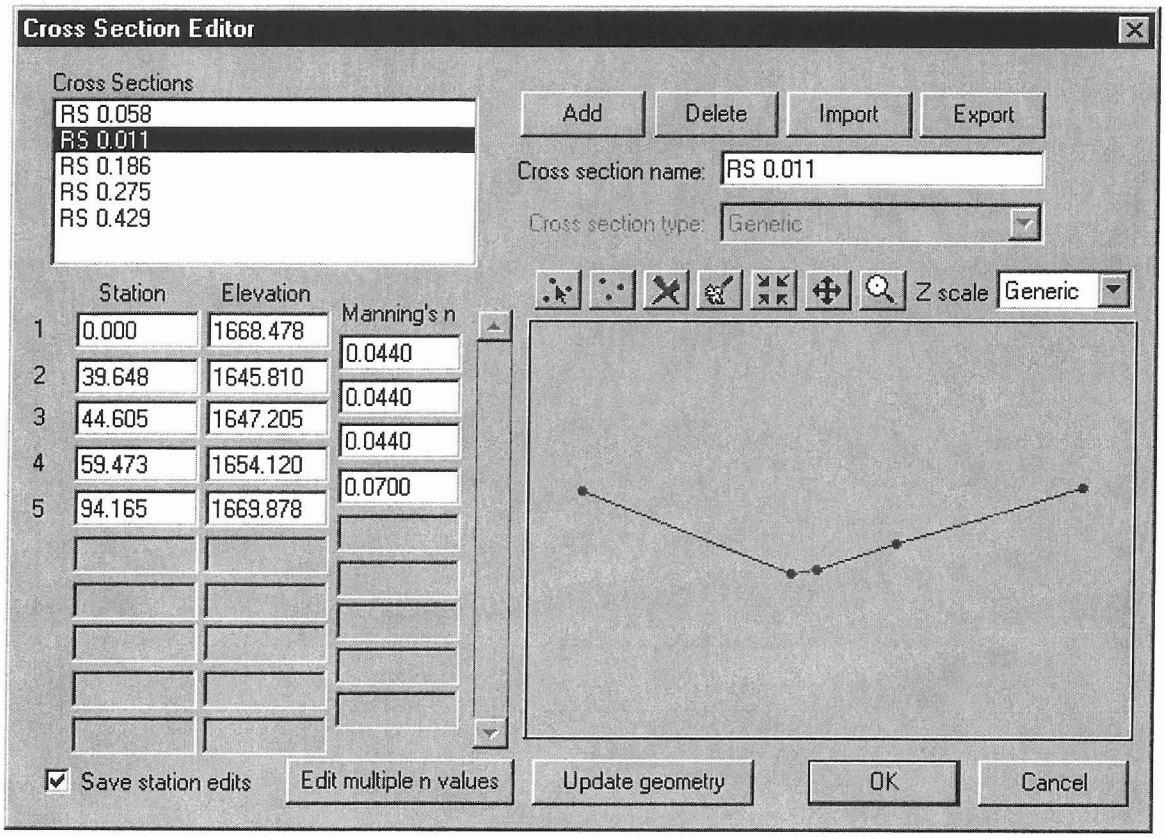
T7NR1ES26-3 (SUB1F)

Profile



	Reach 1	Reach 2
Length =	1094.76 feet	1249.22 feet
High Elevation =	1689.72	1763.25
Low Elevation =	1645.50	1704.18
Slope =	0.0404 ft/ft	0.0473 ft/ft

T7NR1ES26-3 REACH 1 (SUB1F)
RS 0.011
Cross Section Plot



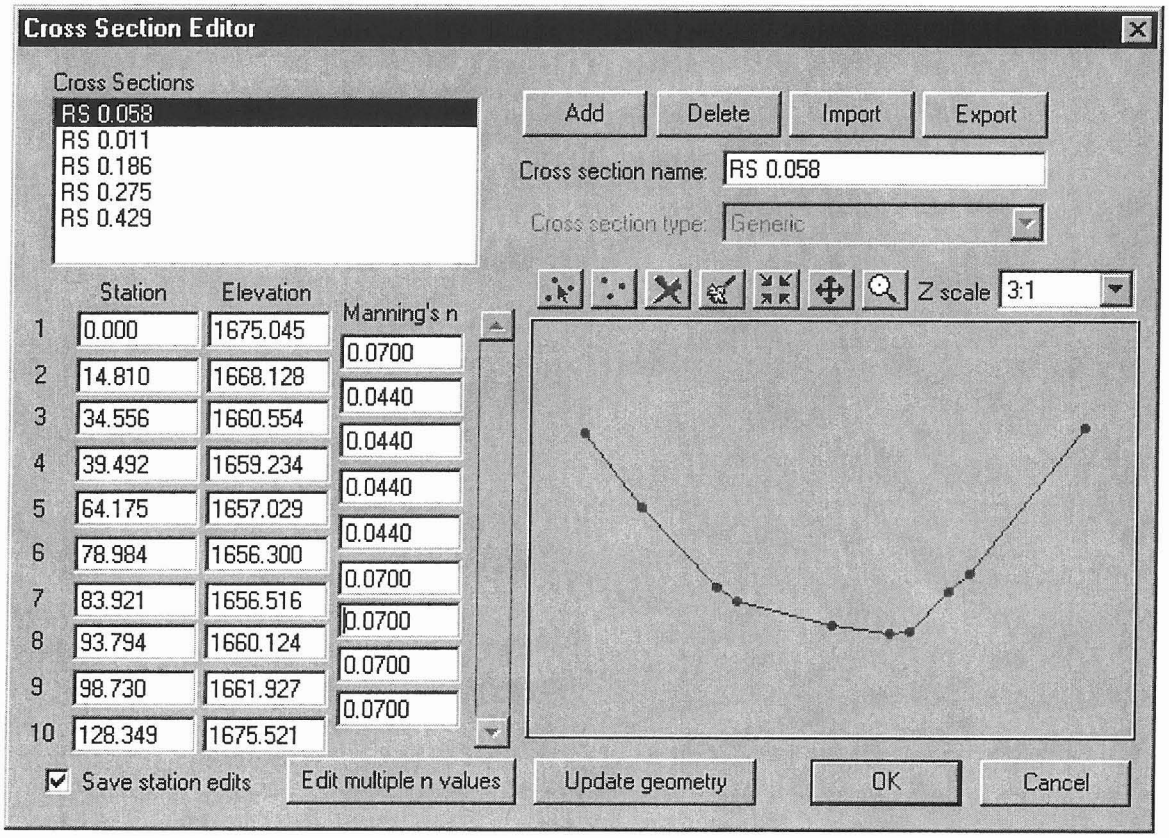
Normal Depth Results

Slope : 0.0404 ft/ft

Calculated Values
Flow: 1228.000 cfs
Depth: 6.256 ft
Area of Flow: 87.175 sq ft
Wetted Perimeter: 29.280 ft
Average Velocity: 14.087 fps
Top Width (T): 26.350 ft
Froude Number: 1.365
Critical Depth: 7.130 ft
Critical Velocity: 10.994 fps
Critical Slope: 0.02083
Manning's Roughness: 0.04400

T7NR1ES26-3 REACH 1 (SUB1F)
RS 0.058

Cross Section Plot



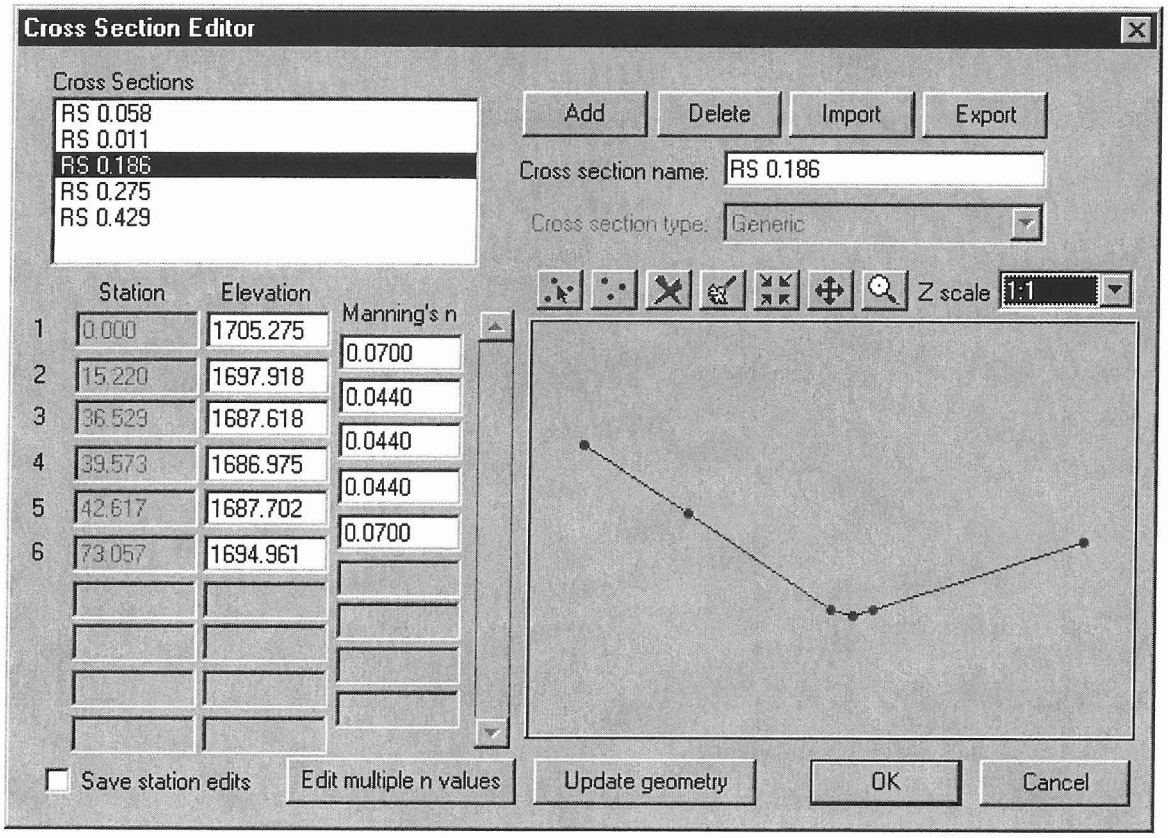
Normal Depth Results

Slope: 0.0404 ft/ft

Calculated Values
Flow: 1228.000 cfs
Depth: 3.573 ft
Area of Flow: 123.779 sq ft
Wetted Perimeter: 56.804 ft
Average Velocity: 9.921 fps
Top Width (T): 56.005 ft
Froude Number: 1.176
Critical Depth: 3.847 ft
Critical Velocity: 8.812 fps
Critical Slope: 0.02857
Manning's Roughness: 0.05074

T7NR1ES26-3 REACH 1 (SUB1F)
RS 0.186

Cross Section Plot



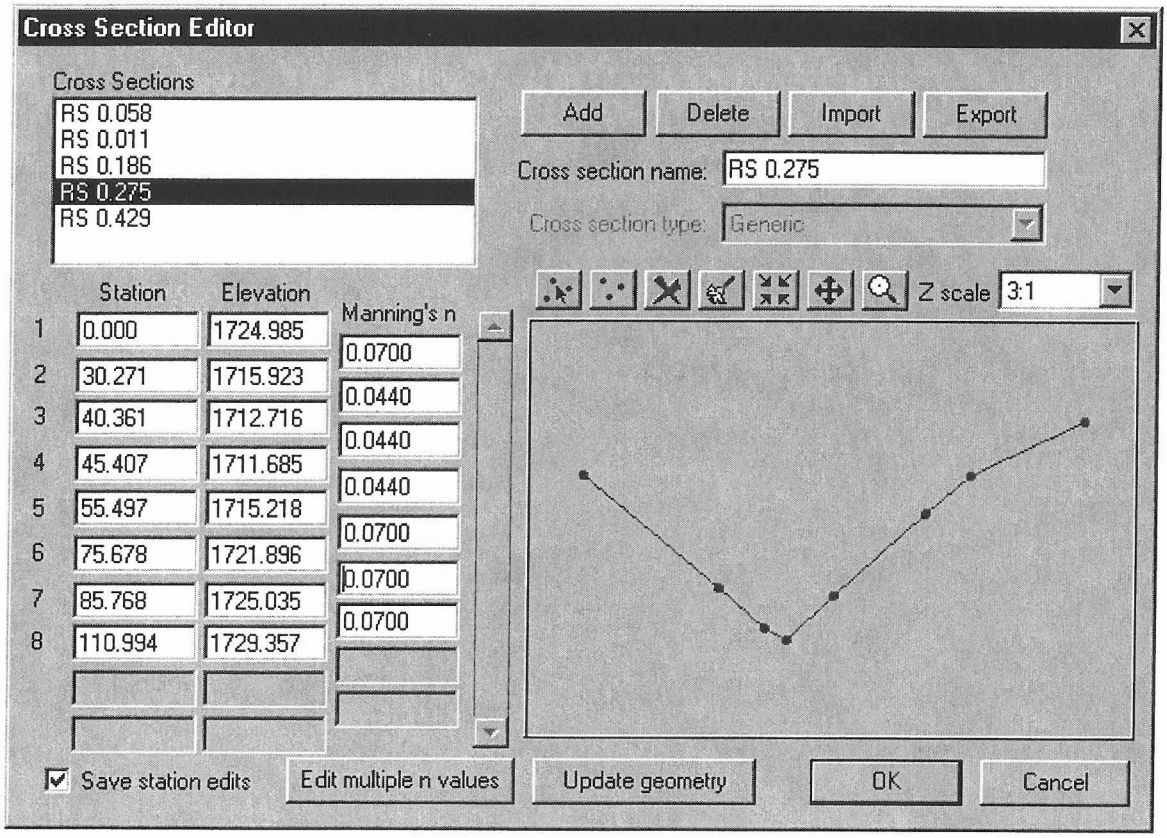
Normal Depth Results

Slope: 0.0404 ft/ft

Calculated Values
Flow: 1228.000 cfs
Depth: 5.870 ft
Area of Flow: 117.374 sq ft
Wetted Perimeter: 40.424 ft
Average Velocity: 10.462 fps
Top Width (T): 38.469 ft
Froude Number: 1.056
Critical Depth: 6.003 ft
Critical Velocity: 10.020 fps
Critical Slope: 0.03608
Manning's Roughness: 0.05826

T7NR1ES26-3 REACH 2 (SUB1F)
RS 0.275

Cross Section Plot



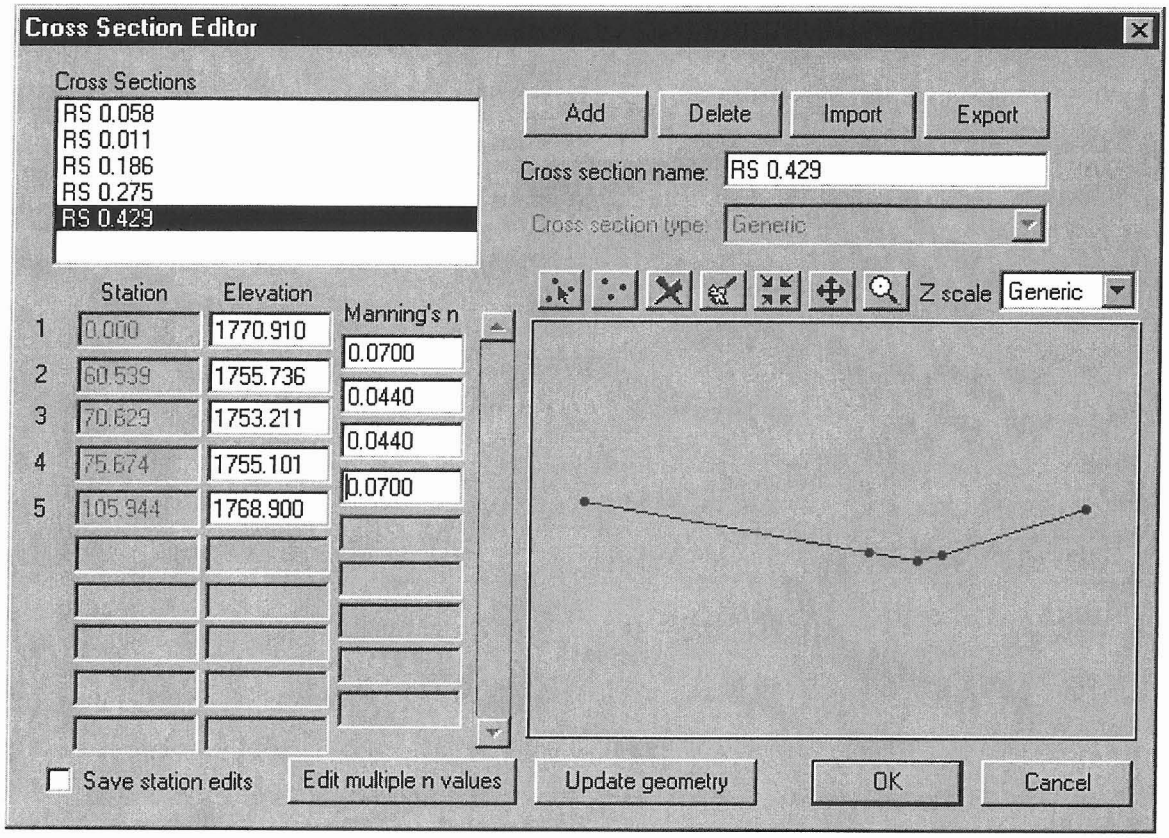
Normal Depth Results

Slope: 0.0473 ft/ft

Calculated Values
Flow: 1228.000 cfs
Depth: 5.508 ft
Area of Flow: 100.495 sq ft
Wetted Perimeter: 37.138 ft
Average Velocity: 12.219 fps
Top Width (T): 35.431 ft
Froude Number: 1.279
Critical Depth: 6.095 ft
Critical Velocity: 10.032 fps
Critical Slope: 0.02997
Manning's Roughness: 0.05150

T7NR1ES26-3 REACH 2 (SUB1F)
RS 0.429

Cross Section Plot

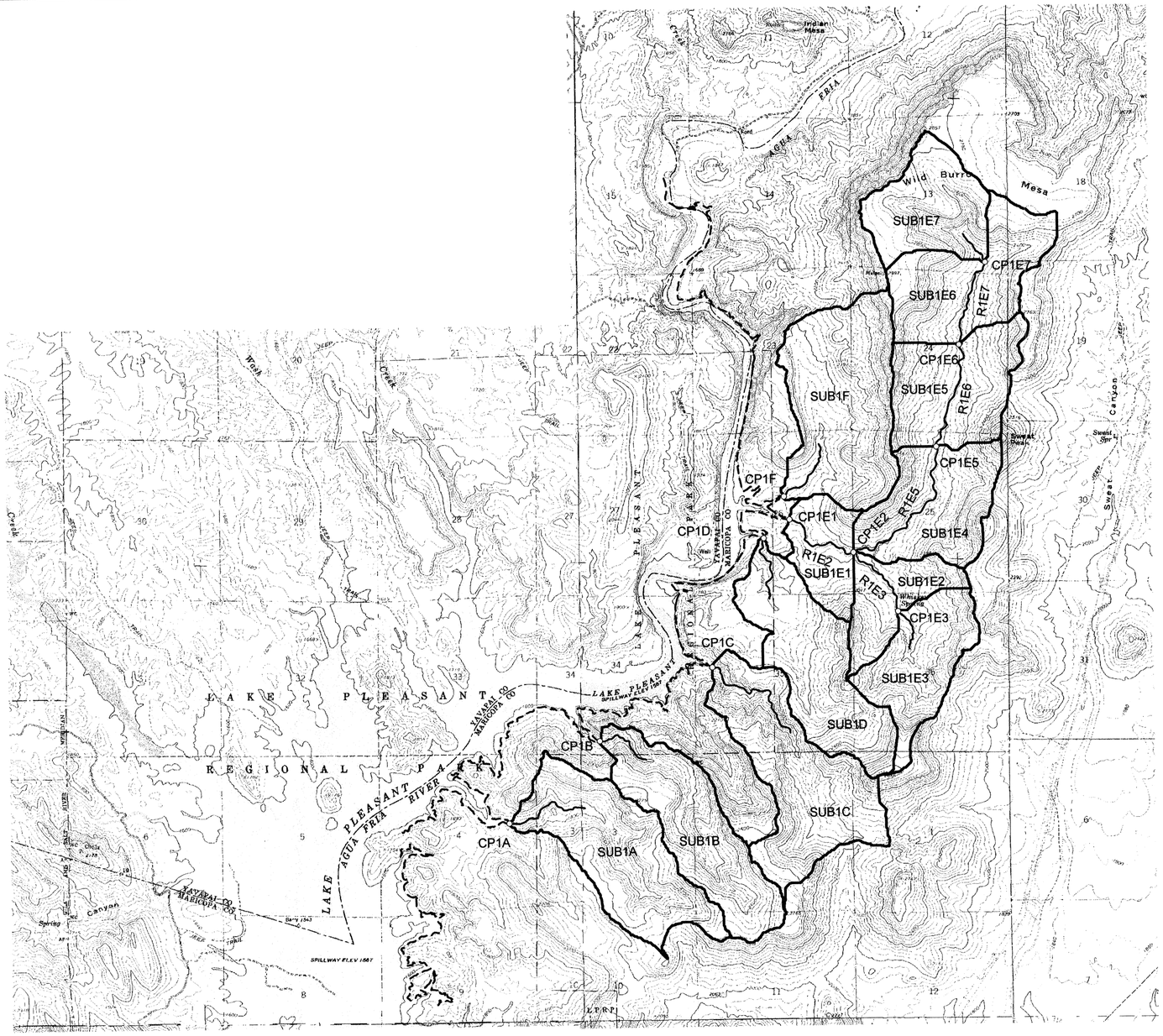


Normal Depth Results

Slope: 0.0473 ft/ft

Calculated Values
Flow: 1228.000 cfs
Depth: 5.903 ft
Area of Flow: 112.242 sq ft
Wetted Perimeter: 39.354 ft
Average Velocity: 10.941 fps
Top Width (T): 37.412 ft
Froude Number: 1.113
Critical Depth: 6.165 ft
Critical Velocity: 10.043 fps
Critical Slope: 0.03819
Manning's Roughness: 0.05957

Exhibits



LEGEND

- LAKE PLEASANT SHORELINE
- WASHES
- CONCENTRATION POINTS
- SUB-BASIN BOUNDARIES

Registered Professional Engineer (Civil)
CERTIFICATE NO.
36122
ROY B. McDANIEL
Date Signed 5/1/07
ARIZONA U.S.A.

Roy B. McDaniel

RBF CONSULTING

PLANNING ■ DESIGN ■ CONSTRUCTION

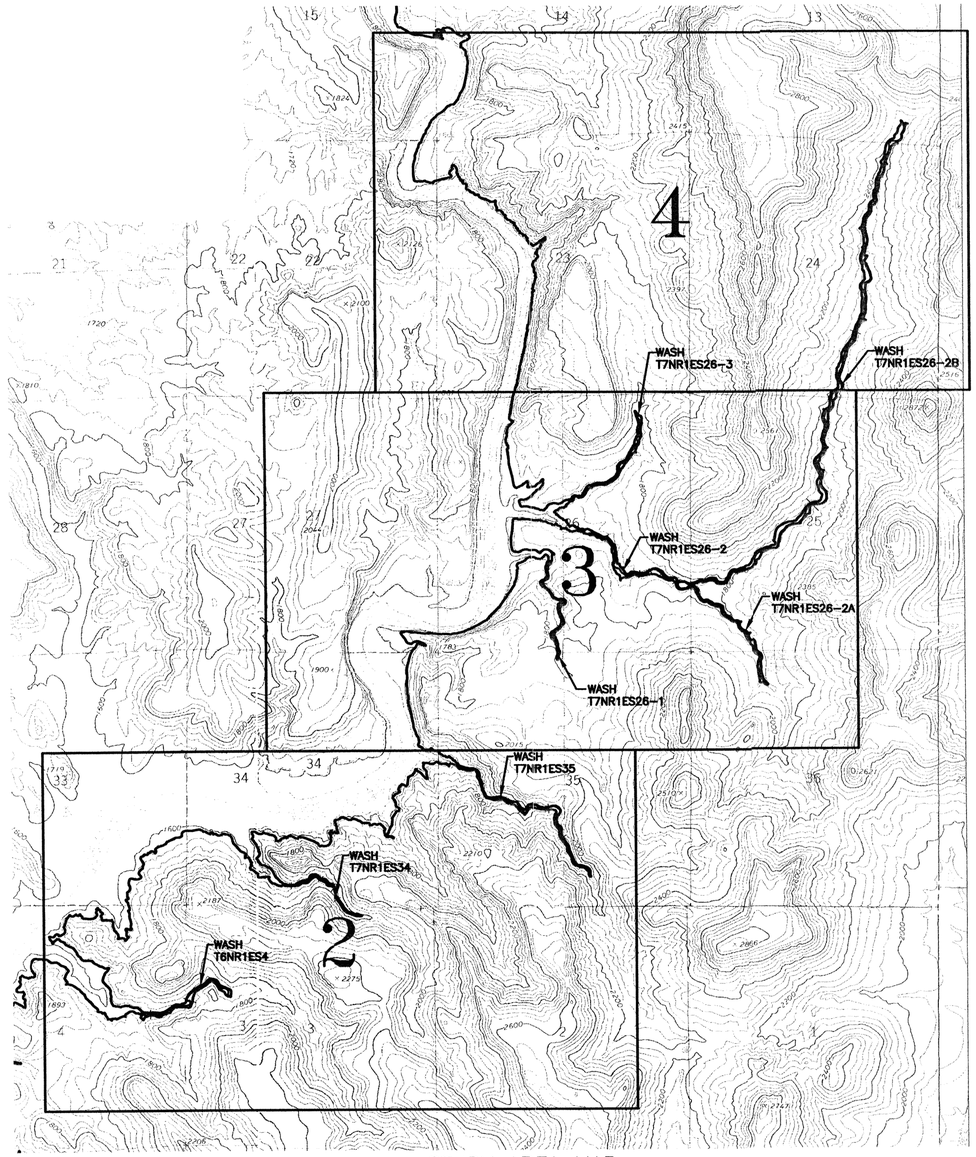
16605 NORTH 28th AVENUE, SUITE 100
PHOENIX, ARIZONA 85053-7550
602.467.2200 ▪ FAX 602.467.2201 ▪ www.RBF.com

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

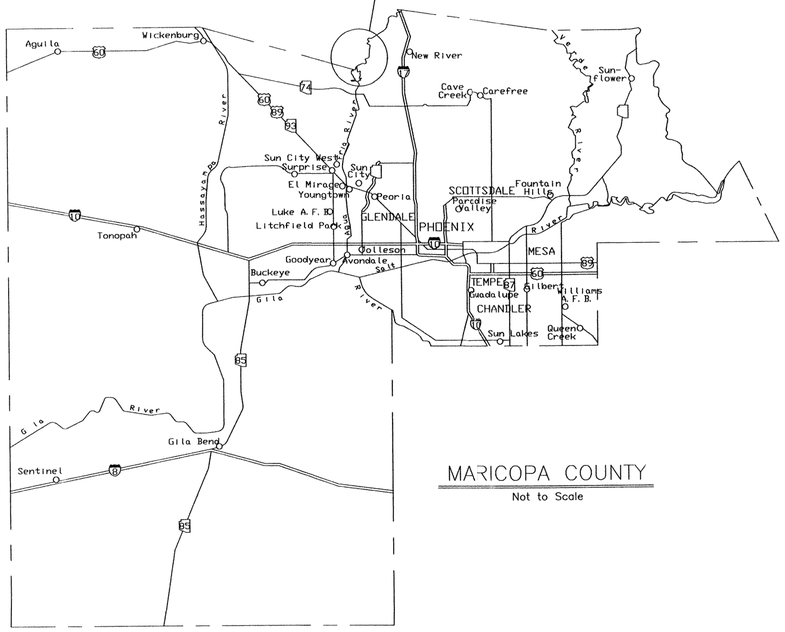
UPPER AGUA FRIA WATERSHED
ZONE A FLOODPLAIN DELINEATION STUDY
WATERSHED #1
SUB-BASIN BOUNDARIES
EXHIBIT 1

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SUB WATERSHED #1
UPPER AGUA FRIA WATERSHED
ZONE A FLOODPLAIN DELINEATION STUDY
CONTRACT F.C.D. 2000C020



PROJECT LOCATION



MARICOPA COUNTY
Not to Scale

STUDY AREA MAP
AND SHEET INDEX

SHEET INDEX
SHEET 2–4 FLOOD DELINEATION STUDY

1500' 0' 1500' 3000'
SCALE: 1"= 1500 FEET
FLIGHT DATES:
12/16/2000–03/15/2001

AERIAL PHOTOGRAPHY
LANDATA AIRBORN SYSTEMS

CONTOUR INTERVAL: 10 FEET

GROUND CONTROL
RBF CONSULTING
16605 N 28TH AVENUE, SUITE 100
PHOENIX, ARIZONA, 85053
(602)467–2200

HYDROLOGY & HYDRAULICS
RBF CONSULTING
16605 N 28TH AVENUE, SUITE 100
PHOENIX, ARIZONA, 85053
(602)467–2200

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil)
CERTIFICATE NO.
36122
ROY B. McDANIEL
State of ARIZONA
5/15/02
Roy B. McDaniel

RBF CONSULTING

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 01 OF 04

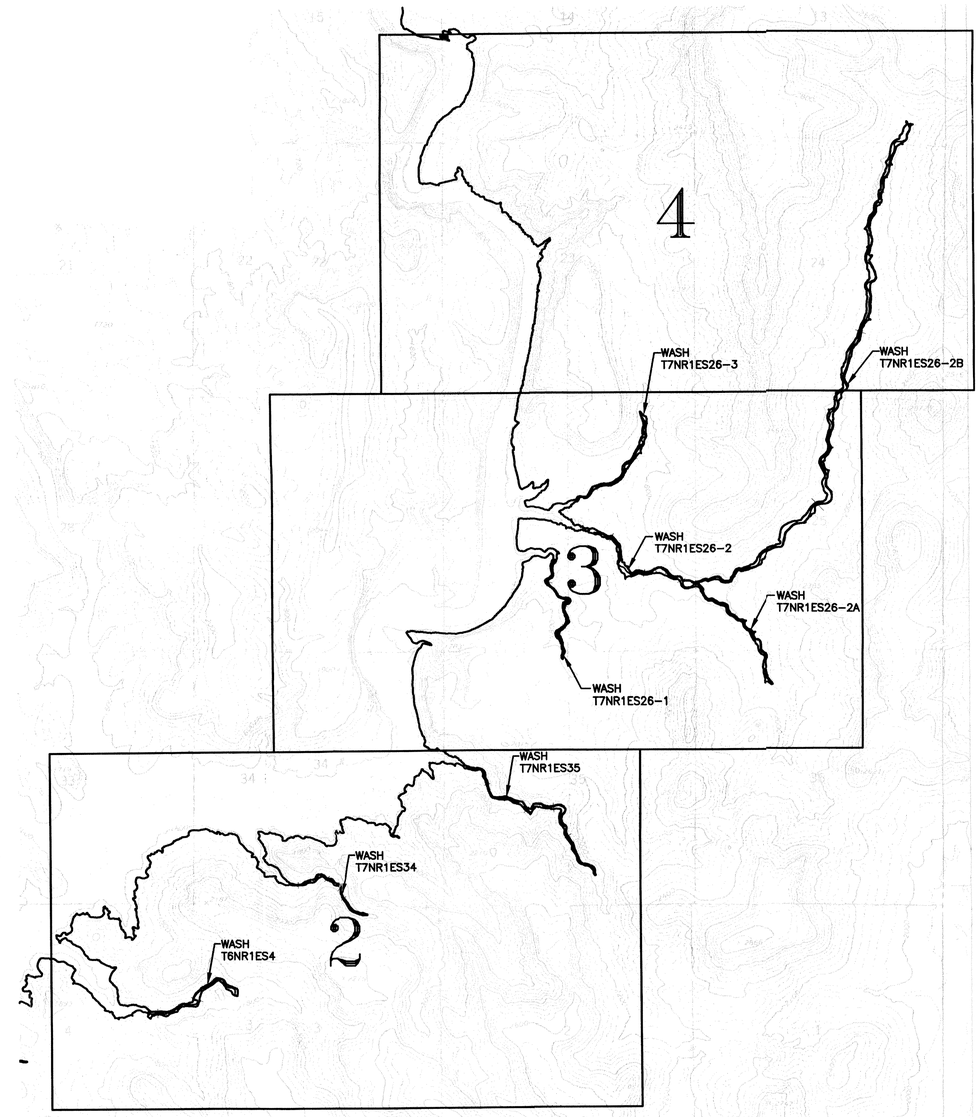
THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

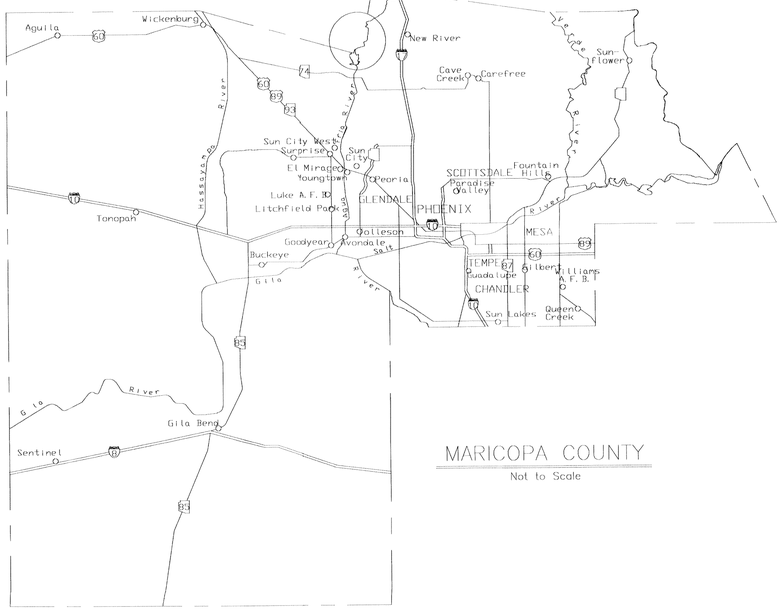
GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

SUB WATERSHED #1
UPPER AGUA FRIA WATERSHED
ZONE A FLOODPLAIN DELINEATION STUDY
CONTRACT F.C.D. 2000C020



PROJECT LOCATION



MARICOPA COUNTY
Not to Scale

STUDY AREA MAP
AND SHEET INDEX

SHEET INDEX
SHEET 2-4 FLOOD DELINEATION STUDY

1500' 0' 1500' 3000'
SCALE: 1"= 1500 FEET
FLIGHT DATES:
12/16/2000-03/15/2001

AERIAL PHOTOGRAPHY
LANDATA AIRBORN SYSTEMS

CONTOUR INTERVAL: 10 FEET

GROUND CONTROL
RBF CONSULTING
16605 N 28TH AVENUE, SUITE 100
PHOENIX, ARIZONA, 85053
(602)467-2200

HYDROLOGY & HYDRAULICS
RBF CONSULTING
16605 N 28TH AVENUE, SUITE 100
PHOENIX, ARIZONA, 85053
(602)467-2200

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer Civil
CERTIFICATE NO.
36122
ROY B. McDANIEL
State of ARIZONA, U.S.A.

RBF CONSULTING

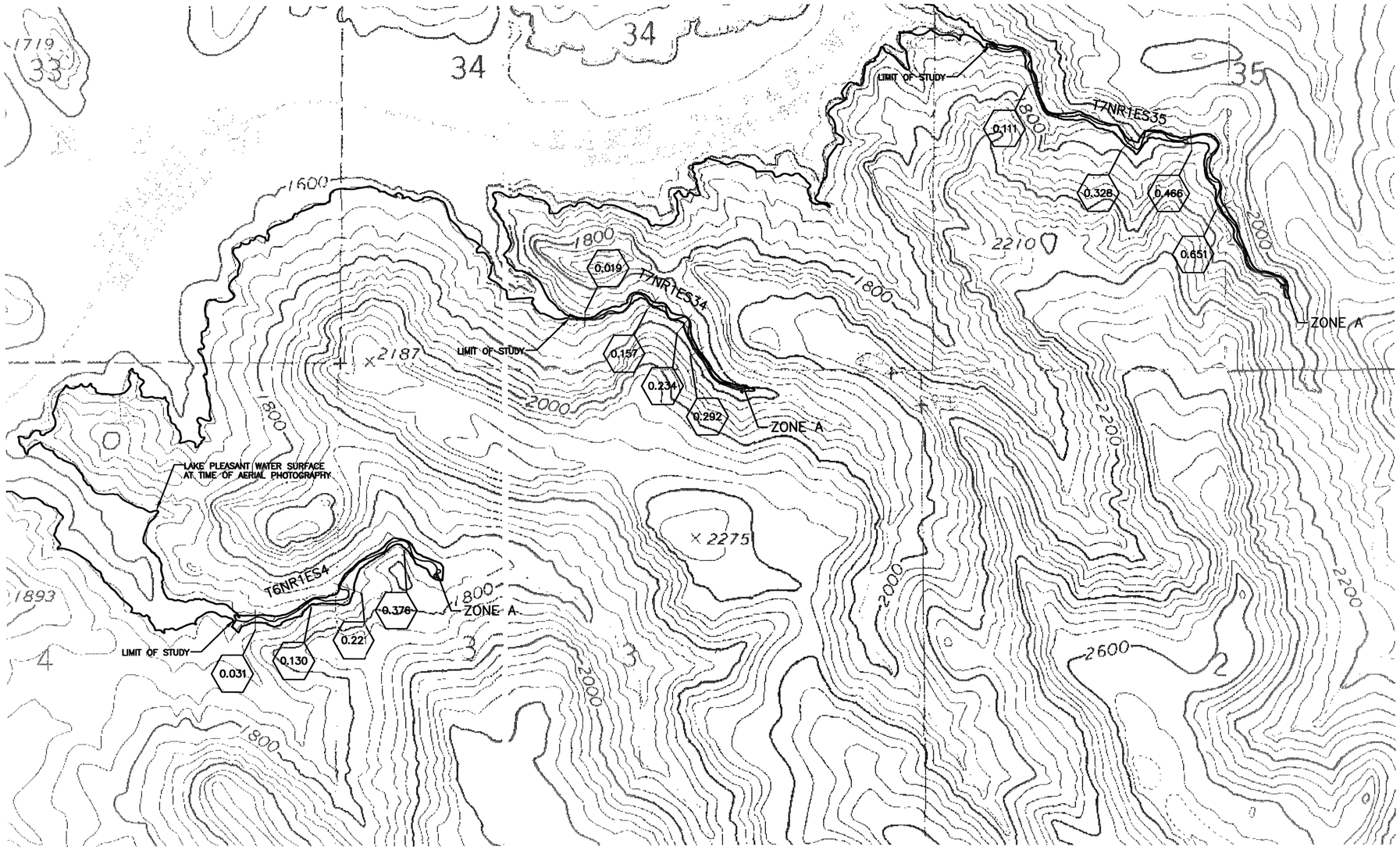
	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 01 OF 04

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

CROSS SECTION 0.1000

ZONE DESIGNATIONS — ZONE A

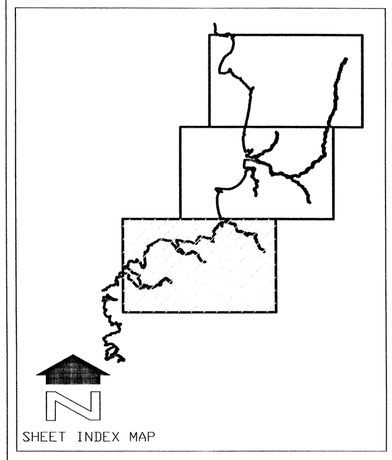
CORPORATE LIMITS — Corporate Limits

COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY — County Boundary

ELEVATION REFERENCE MARKS

NOTE: NO ELEVATION REFERENCE MARKS WERE USED FOR THIS PROJECT. ALL WORK IS BASED ON 10 FOOT CONTOURS GENERATED FROM EXISTING COUNTY DIGITAL TERRAIN MODELS (DTM).

NOTES



NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

500' 0' 500' 1000'

SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL Date Signed 3/5/02 ARIZONA U.S.A.

Roy B. McDaniel

RBF CONSULTING

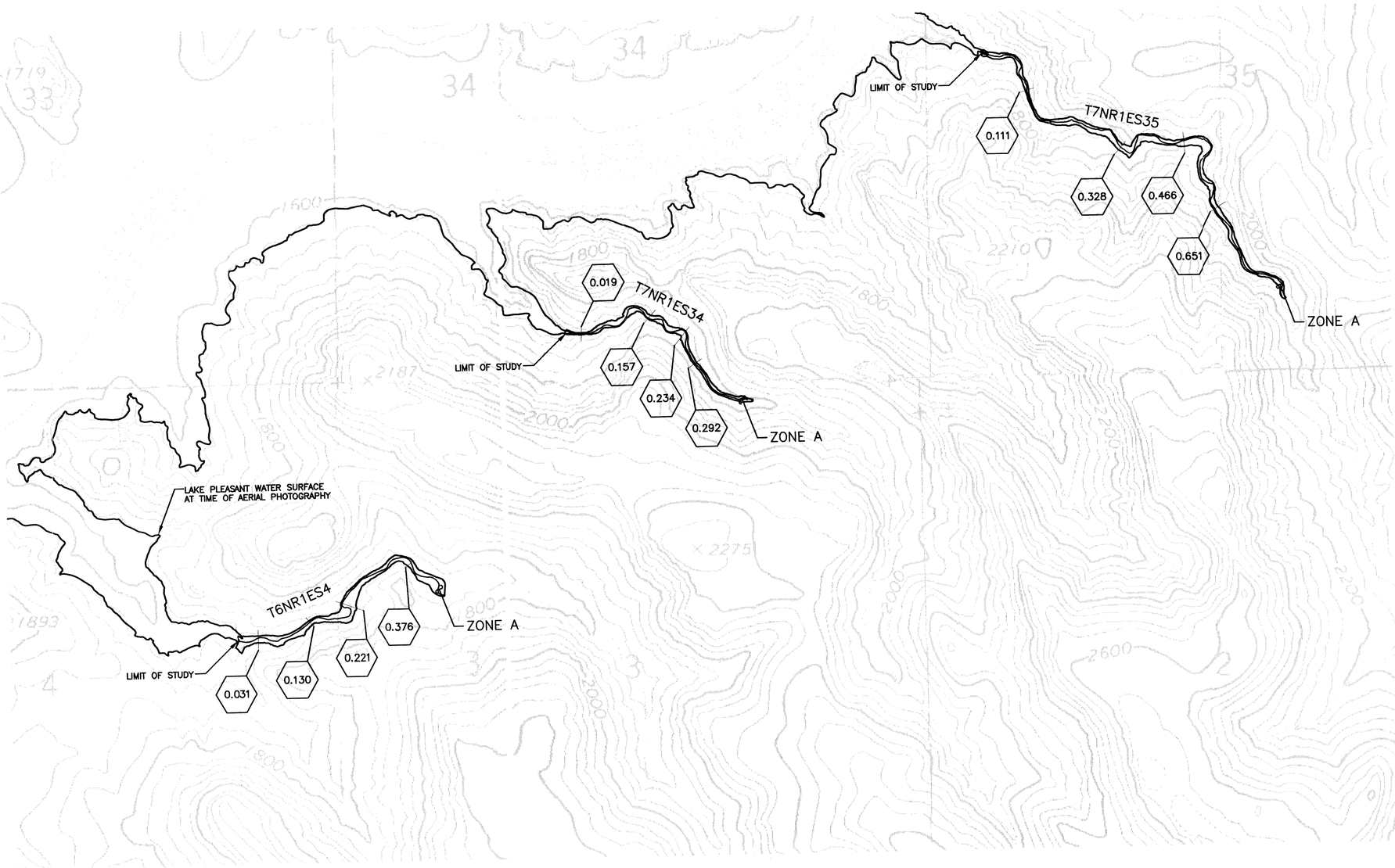
	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 02 OF 04

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

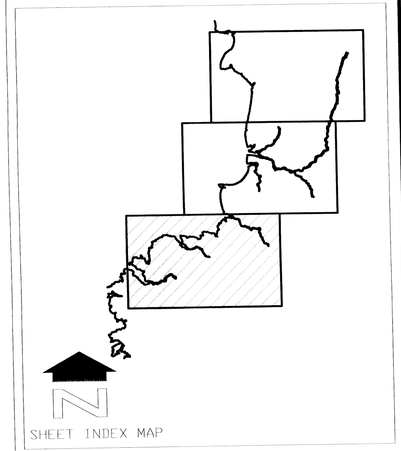
CROSS SECTION (0.1000)

ZONE DESIGNATIONS	ZONE A
CORPORATE LIMITS	Corporate Limits
COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY	County Boundary

ELEVATION REFERENCE MARKS

NOTE: NO ELEVATION REFERENCE MARKS WERE USED FOR THIS PROJECT. ALL WORK IS BASED ON 10 FOOT CONTOURS GENERATED FROM EXISTING COUNTY DIGITAL TERRAIN MODELS (DTM).

NOTES



SHEET INDEX MAP

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL State of ARIZONA, U.S.A.

RBF CONSULTING

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 02 OF 04

500' 0' 500' 1000'

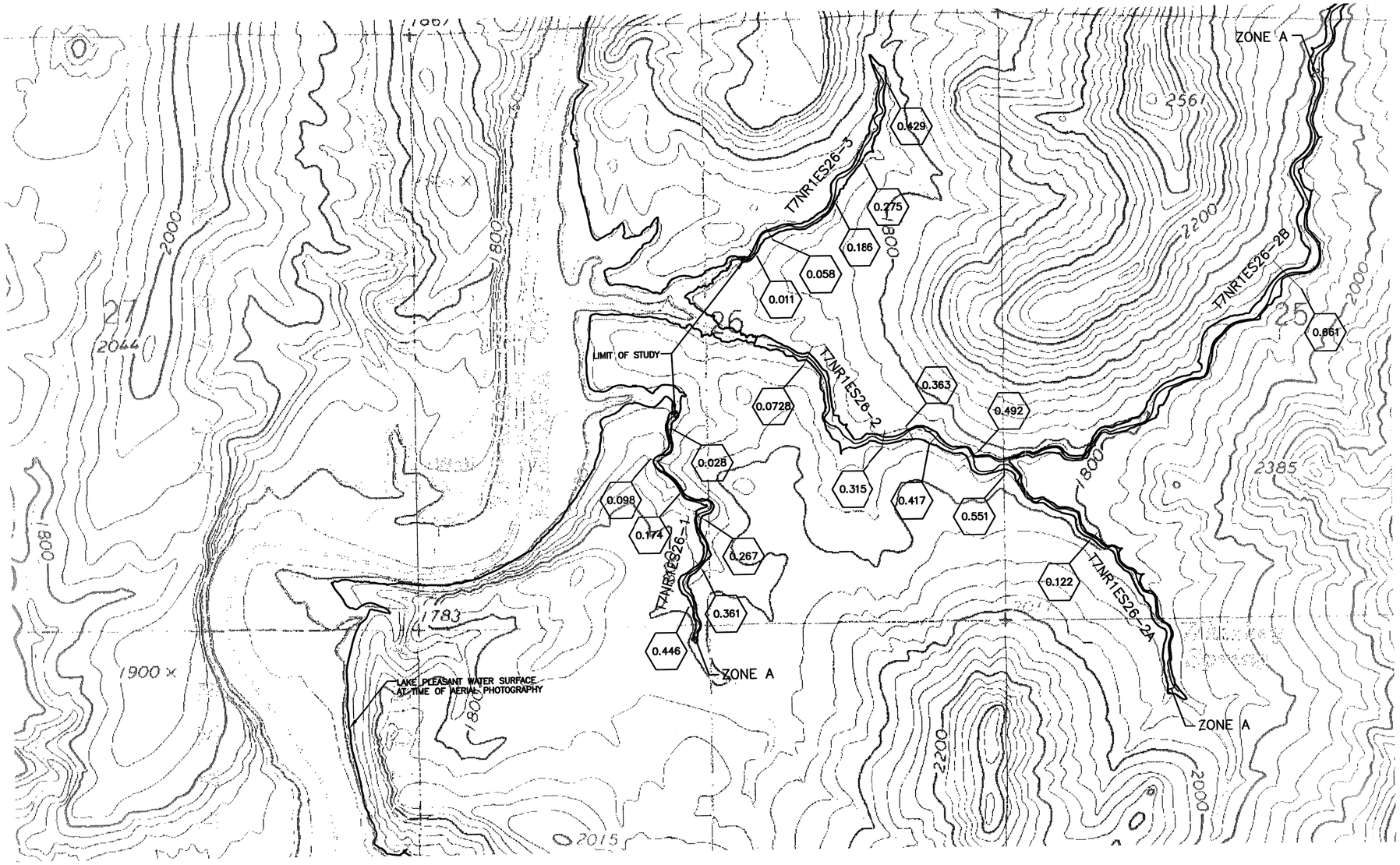
SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

CROSS SECTION (0.1000)

ZONE DESIGNATIONS — ZONE A

CORPORATE LIMITS — Corporate Limits

COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY — County Boundary

ELEVATION REFERENCE MARKS

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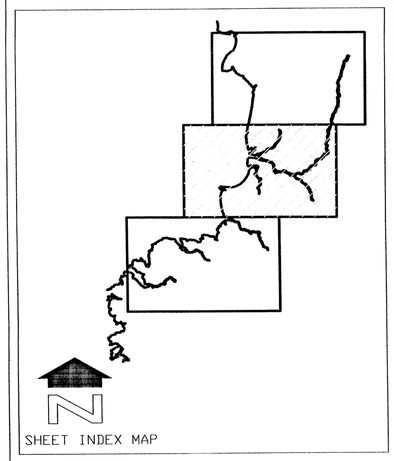


SHEET INDEX MAP

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

RBF CONSULTING

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL III Date Signed 5/15/02 ARIZONA U.S.A.

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 03 OF 04

500' 0' 500' 1000'

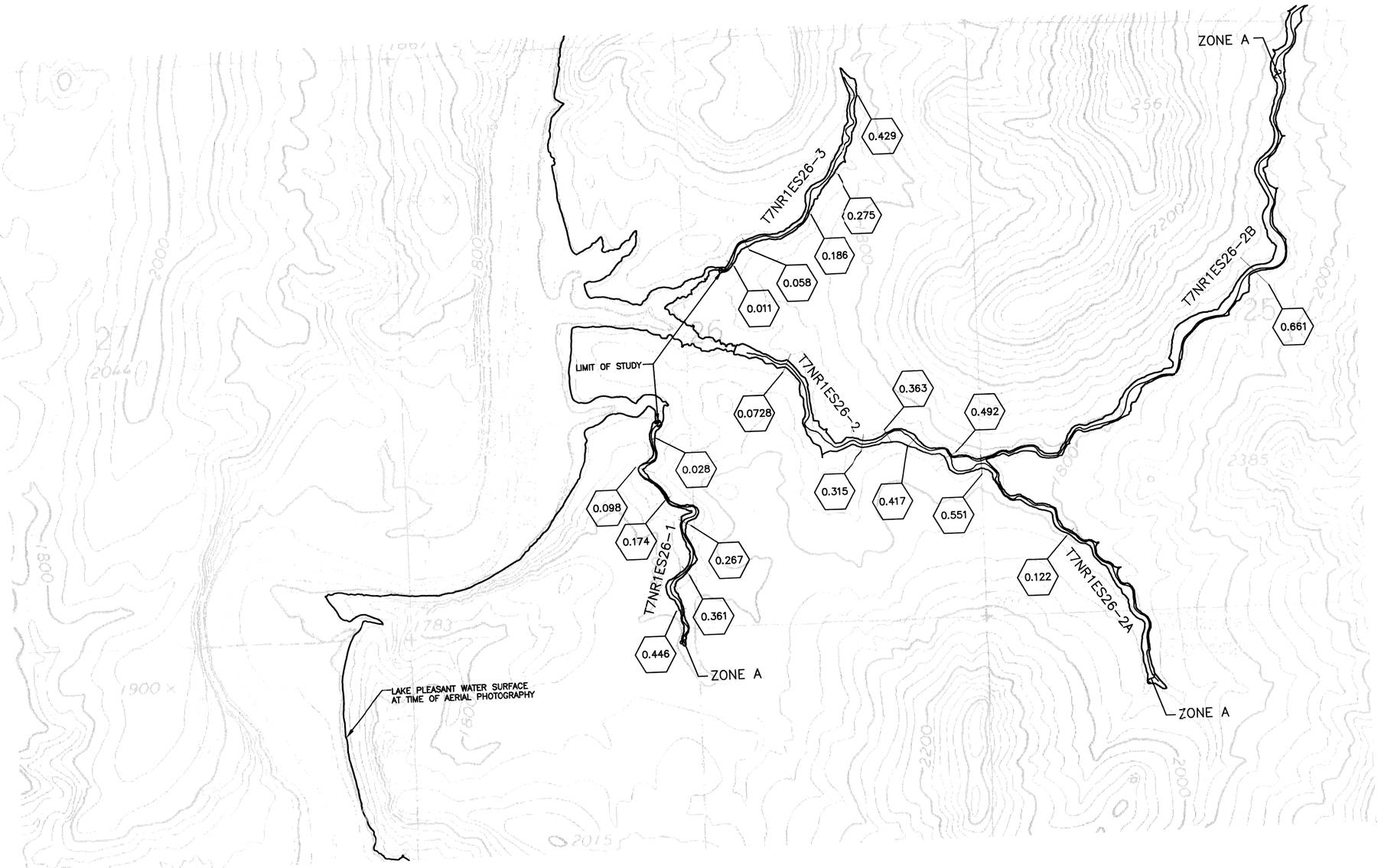
SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

CROSS SECTION 0.1000

ZONE DESIGNATIONS — ZONE A

CORPORATE LIMITS — Corporate Limits

COUNTY, PARISH, STATE OR INTERNATIONAL BOUNDARY — County Boundary

ELEVATION REFERENCE MARKS

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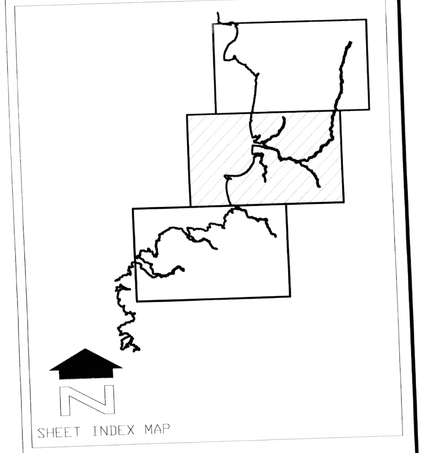


SHEET INDEX MAP

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED SUB WATERSHED #1 ZONE A FLOODPLAIN DELINEATION STUDY F.C.D. CONTRACT NO. 2000C020

Registered Professional Engineer (Civil) CERTIFICATE NO. 36122 ROY B. McDANIEL Re-Signed ARIZONA, U.S.A.

RBF CONSULTING

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 03 OF 04

500' 0' 500' 1000'

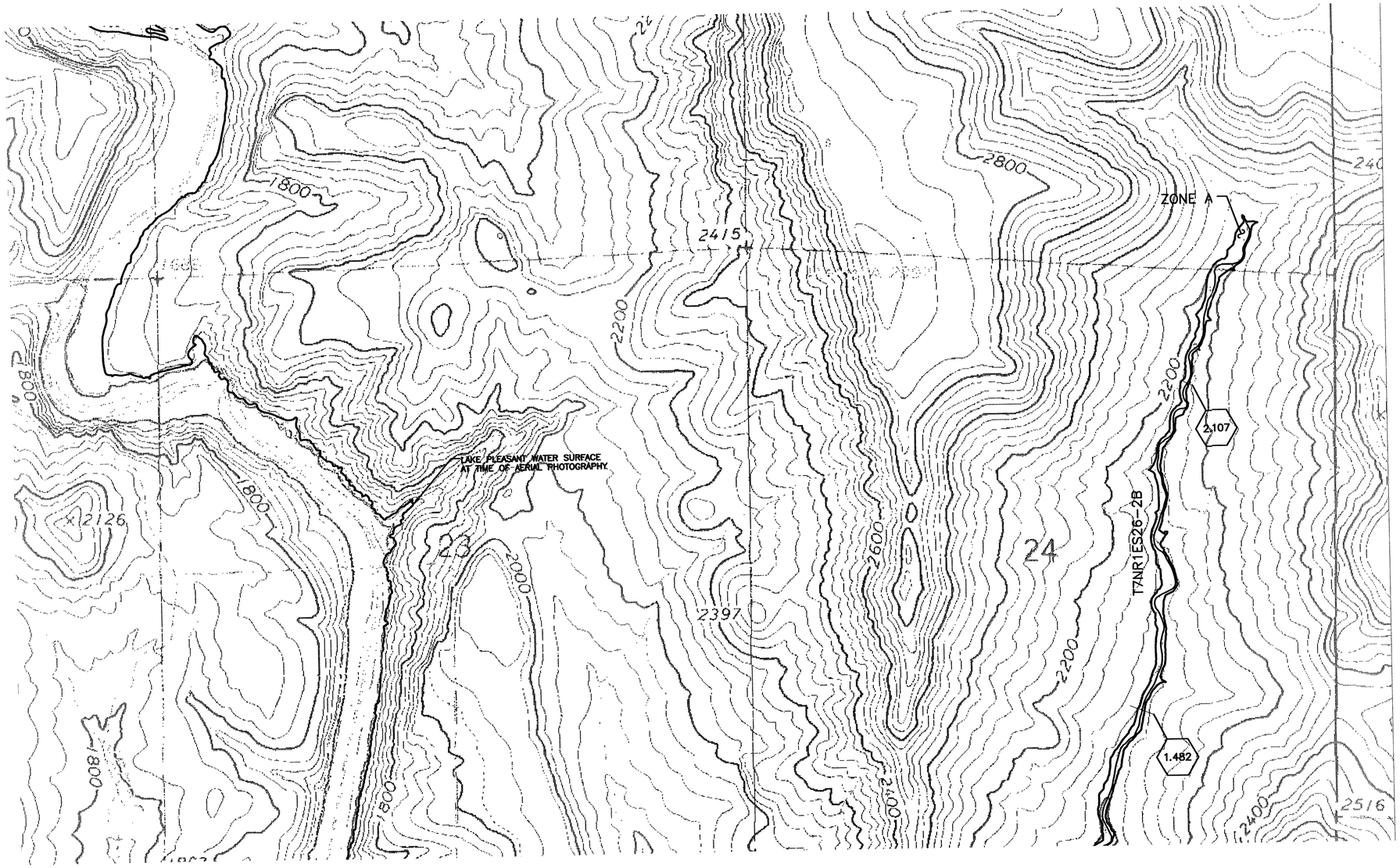
SCALE: 1"= 500 FEET

FLIGHT DATES: 12/16/2000-03/15/2001

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

CROSS SECTION (0.1000)

ZONE DESIGNATIONS — ZONE A

CORPORATE LIMITS — Corporate Limits

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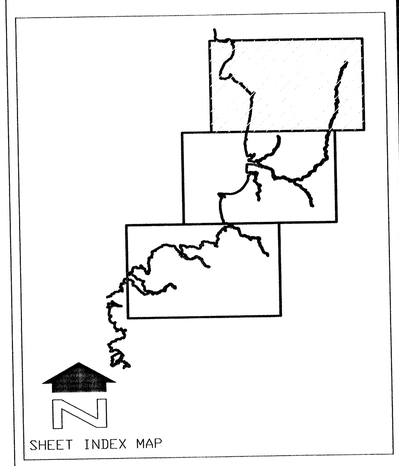

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

RBF CONSULTING

Registered Professional Engineer (Civil)
CERTIFICATE NO.
36122
ROY B.
McDANIEL
Date Signed 3/15/02
Arizona U.S.A.

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 04 OF 04

500' 0' 500' 1000'

SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

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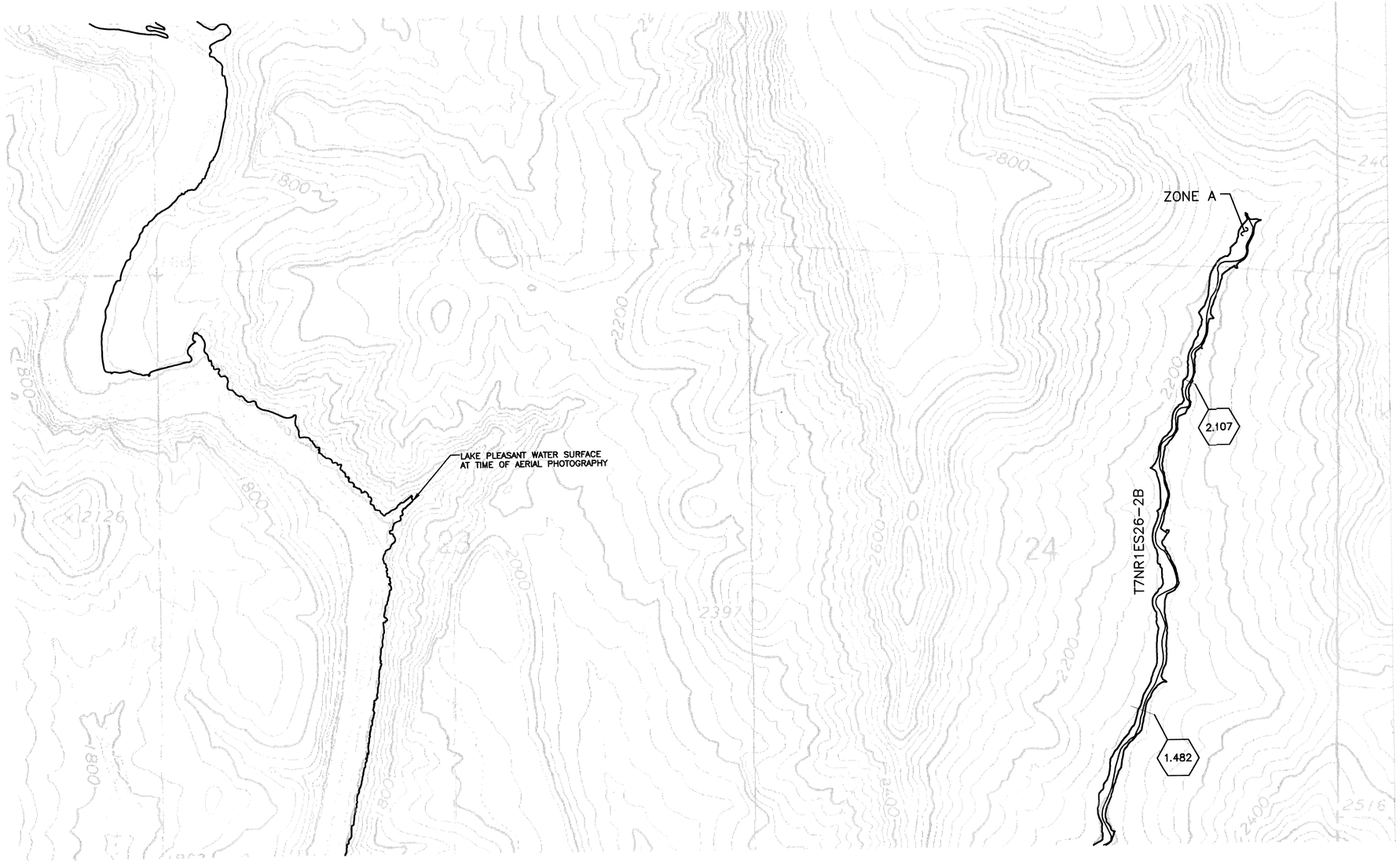
LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING



LEGEND

100-YR FLOODPLAIN BOUNDARY

CROSS SECTION (0.1000)

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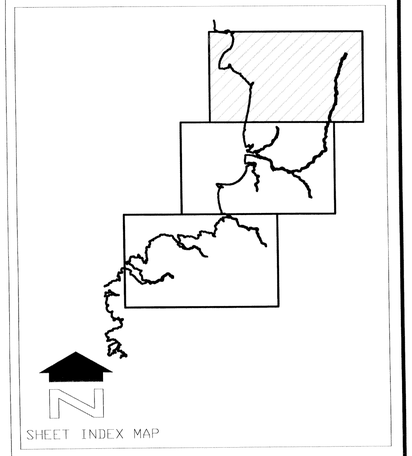

NO.	REVISION	BY	DATE
2			
1			

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

UPPER AGUA FRIA WATERSHED
SUB WATERSHED #1
ZONE A
FLOODPLAIN DELINEATION STUDY
F.C.D. CONTRACT NO. 2000C020

500' 0' 500' 1000'

SCALE: 1"= 500 FEET

FLIGHT DATES:
12/16/2000-03/15/2001

Registered Professional Engineer Entity
CERTIFICATE NO.
36122
ROY B.
McDANIEL
Date Signed
ARIZONA, U.S.A.

RBF CONSULTING

	BY	DATE
DESIGN	RBM	5/02/02
DESIGN CHK.	SML	5/15/02
PLANS	KJM	5/02/02
PLANS CHK.	SML	5/15/02

SHEET 04 OF 04

THIS MAP WAS PREPARED FROM USGS DATA (DRG) & MARICOPA COUNTY DIGITAL TERRAIN MODELS (DTM)

LANDATA AIRBORN SYSTEMS

GROUND CONTROL SURVEY DATA PROVIDED BY RBF CONSULTING

Digital Files

DIGITAL FILES FOR
UPPER AGUA FRIA WATERSHED (WATERSHED UU)
ZONE A FLOODPLAIN DELINEATION STUDY
WATERSHED NO. 1 (EAST LAKE PLEASANT)
CONTRACT FCD 2000CO20

Unincorporated Maricopa County, Arizona
May 15, 2002
RBF Consulting, JN 45-100648

Washes T6NR1ES4, T7NR1ES34, T7NR1ES35, T7NR1ES26-1, T7NR1ES26-2, T7NR1ES26-2A, T7NR1ES26-2B, AND T7NR1ES26-3, WHICH ARE TRIBUTARIES TO THE AGUA FRIA RIVER AND LAKE PLEASANT.

THIS CD CONTAINS THE DIGITAL FILES USED IN THE FLOODPLAIN DELINEATION STUDY IDENTIFIED ABOVE. BOTH THE HYDROLOGIC AND HYDRAULIC CALCULATIONS ARE PROVIDED ON THIS CD. THE HYDROLOGY WAS PERFORMED USING ArcView 3.2a, WMS 6.1, HEC-1, AND THE NFF EQUATIONS, AS OUTLINED IN THE TECHNICAL DATA NOTEBOOK (TDN). HYDRAULIC CALCULATIONS AND FLOODPLAIN DELINEATION WERE PERFORMED USING WMS 6.1 AND FLOWMASTER, AS OUTLINED IN THE TDN.

THE FILES ON THIS CD MATCHED THE INFORMATION IN THE TECHNICAL DATA NOTEBOOK AT THE TIME OF THE CD'S CREATION PRIOR TO SUBMISSION TO FEMA. ANY PERSON USING THESE FILES NEEDS TO VERIFY THAT THEY MATCH THE FEMA APPROVED FLOODPLAIN DELINEATION. RBF CONSULTING DOES NOT ACCEPT ANY RESPONSIBILITY FOR THE USE OF THESE FILES IF THE DELINEATION CHANGES AS A RESULT OF FEMA REVIEW.

THE HYDROLOGY FOLDER ON THIS CD CONTAINS THE FOLLOWING FILES:

WMS FILES-

• Watershed1.wpr	WMS project file
• Watershed1.ini	WMS project settings and initialzation file
• Watershed1.tre	WMS tree file, which stores sub-basin parameters (can be loaded independent from other files)
• Watershed1.map	WMS map file, which contains feature points, arcs, and polygons (can be loaded independent from other files)
• Watershed1.lsf	WMS land use and soil type specification file. Stores rainfall loss parameters.
• 0648ws1soils.tbl	Text file which contains soil type and XKSAT information. Imported into WMS.
• 0648ws1.tbl	Text file which contains land use information. Imported into WMS
• r1e3.dat	WMS Hydrograph output file for a routing reach.
• r1e5.dat	WMS Hydrograph output file for a routing reach.
• sub1e2.dat	WMS Hydrograph output file for a subbasin.
• sub1e4.dat	WMS Hydrograph output file for a subbasin.

HEC-1 Files-

• watershed1.hc1	HEC-1 input file.
• watershed1.out	HEC-1 output file.
• watershed1.doc	HEC-1 output File imported into MS Word format.
• watershed1.sol	HEC-1 hydrograph output file.

ArcView Files-

- 0648ws1lu.shx — Land Use Shape file (Imported into WMS).
- 0648ws1lu.shp — Land Use Shape file (Imported into WMS).
- 0648ws1lu.dbf — Land Use Shape file (Imported into WMS).
- 0648ws1soils.shx — Soil type Shape file (Imported into WMS).
- 0648ws1soils.shp — Soil type Shape file (Imported into WMS).
- 0648ws1soils.dbf — Soil type Shape file (Imported into WMS).

Other Files

- CombinedHydrographs.xls — MS Excel file that manually combines hydrographs.
- 0648ws1e.fm2 — Haestaed Method's FlowMaster Files used for normal depth routing.

Within the hydrology folder there is a another folder named ArcView. It contains ArcView shape files produced by WMS to be used with the ArcView extension "WMS Hydro". Files with the extensions dbf, shx, and shp are ArcView Shape files. The following files are contained in the ArcView folder:

- Watershed1.sup — Superfile that is imported into ArcView using WMSHydro.
- Watershed1basin.dbf — Subbasin shape files.
- Watershed1basin.shp
- Watershed1basin.shx
- Watershed1elevation.asc — ASCII Elevation Grid File.
- Watershed1flowdir.asc — ASCII Flow Direction Grid File (Produced by WMS and TOPAZ).
- Watershed1landuse.dbf — Land Use shape files.
- Watershed1landuse.shp
- Watershed1landuse.shx
- Watershed1outlet.dbf — Concentration Point Shape Files.
- Watershed1outlet.shp
- Watershed1outlet.shx
- Watershed1soiltype.dbf — Soil Type Shape Files.
- Watershed1soiltype.shp
- Watershed1soiltype.shx
- Watershed1stream.dbf — Stream (Wash) Shape Files.
- Watershed1stream.shp
- Watershed1stream.shx

The Hydraulics Folder contains several folders specified by the subbasin names. Each folder contains the following file types, which are loaded into WMS by opening the file with the "wpr" extension.

- *.wpr — WMS Project file used to open all other files
- *.ini — WMS Project settings and initialization file.
- *.map — WMS Map File that contains all feature point, arcs, and polygons, including cross sections and floodplain.
- *.sdat — WMS ASCII dataset file that contains watersurface elevation data. Used with *.xy files (2D Scatter Data).
- *.tdat — WMS ASCII dataset file that contains flood depth information. Used with *.tin files (WMS TIN files).
- *.tin — WMS TIN file that contains ground elevation information.
- *.tre — WMS tre file
- *.xy — WMS 2D scatter data that contains the floodplain stage along the washes being delineated.

SUB1e was split into two different project files.

The second CD, entitled "Maricopa County Ortho-Photo supplement to final report" contains survey information related to the ortho-photos used in this project, as discussed in Section 3 and Appendix C. See Appendix C for an explanation of what each file is.