FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

GRANITE REEF WASH FLOODPLAIN DELINEATION STUDY

FCD 95-29

TECHNICAL DATA NOTEBOOK HYDRAULICS

MAY 1997

Prepared by

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009-6399
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

BOARD OF DIRECTORS
Betsey Bayless
Jan Brewer
Fulton Brock
Don Stapley
Mary Rose Garrido Wilcox

June 25, 1997

Frederick H. Sharrocks, Jr., Chief
Hazard Identification Branch
Mitigation Directorate
Federal Emergency Management Agency
500 C Street SW
Washington, D.C. 20472

Property of
Flood Control District of MC Library
Please Return to
2801 W. Durango
Phoenix, AZ 85009

Attn: Mr. John Magnotti

Re: LOMR request for Granite Reef Wash
FIRM Map Panel 2160D (04-15-1988)
When replying, please refer to:
FCD Contract No. FCD 95-29

Dear Mr. Sharrocks:

This request is for 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:	Granite Reef Wash
Flooding Source:	Granite Reef Wash
FIRM Panel Affected:	04013C2160D (04-15-1988)

This is a request for a LOMR for Granite Reef Wash, which is located entirely within the City of Scottsdale, Arizona. The wash flows in a southwesterly direction and ultimately discharges to Salt River. This restudy was requested by the City of Scottsdale in a letter to the District dated September 12, 1995. It was undertaken by Entellus, Inc. (formerly AGK, Inc.), on behalf of the Flood Control District of Maricopa County.

The following information is submitted in support of the LOMR request:

1. Copy of the City of Scottsdale letter request (Exhibit 1)
2. FEMA application form (Revision Requestor and Community Official Form) (Exhibit 2)
3. Notarized copy of the public notice (Exhibit 3)
4. Complete set of LOMR application forms as filled out by Consultant (MT-2 Form 2, MT-2 Form MT-2 Form7) (Exhibit 4)

5. Photographs of the Granite Reef Wash showing the selected reaches (Exhibit 5)

6. Available topographic mapping (1"=100 scale of Granite Reef Wash and vicinity) (Exhibit 6)

7 Revised floodplain/floodway boundary annotated on FIRM panel 2160D (1"=1000') (Exhibit 7)

8. Copy of Technical Data Notebook - Hydraulic (submitted by the Consultant) (Exhibit 8)

The following items are also discussed in relation to the LOMR application:

ITEM

1. Starting Water Surface Elevation for the HEC-2 model was established based on the existing flood-plain delineation study.

2. A portion of the floodplain north of Thomas Road was included. The detailed hydraulic analysis is included in Exhibit 10.

If additional information is required, please contact Sam E. Kao, Ph.D., P.E., Project Manager and Partner, Entellus, Inc. at (602) 244-2566, or Maximo R. DeVera, P.E., Project Manager, Engineering Division, Flood Control District of Maricopa County at (602) 506-1501.

Sincerely,

Maximo R. DeVera, P.E.
Civil Enginner and Project Manager
Engineering Division

Enclosures

Copy to : Terri Miller, State Coordinator, NFIP
Arizona Department of Water Resources
500 North 3rd Street, Phoenix, Arizona 85004

William Erickson
City of Scottsdale
7447 E. Indian School Road, P.O. Box 1000
Scottsdale, Arizona 85252-1000

Sam E. Kao, P.E., Project Manager
Entellus, Inc.
2255 North 44th Street, Suite 330
Phoenix, Arizona 85008

EXHIBIT 1

Exhibit 1

September 12, 1995

CITY OF SCOTTSDALE ARIZONA

• "Most Livable City" U.S. Conference of Mayors •

FLOOD CONTROL DISTRICT RECEIVED SEP 14 1995

CHENG | P.A.P.M.
DEF | REG
ADMIN | LMGT
FINANCE | FILE
REMARKS

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

Subject: Floodplain Delineation Granite Reef Wash, Scottsdale Arizona

Dear Mr. Calza:

The City of Scottsdale requests the Flood Control District of Maricopa County to prepare a Floodplain delineation of the Granite Reef Wash to update current delineation prepared and adopted by the Federal Emergency Management Agency, (FEMA).

To assist the District with this effort, the City will provide current and more accurate mapping consisting of 1' interval topographic maps, (digital and hard copy format), 1993 aerial photography with an accuracy of 1 pixel = 0.5 ft., (digital and hard copy format), and if needed, limited field surveys.

Based on the results of reviewing the available hydrologic studies, and the Flood Insurance Study, (FIS) prepared by FEMA, it is staff's recommendation that the District use the runoff estimates contained in the FIS because current watershed conditions are not substantially different from those used in the adopted study.

Please let us know the schedule of this project, and when the City needs to deliver the new data to the District.

When I can be of assistance, please telephone me at 994-7652.

Sincerely,

William Erickson

c: Alex McLaren

EXHIBIT 2

Exhibit 2

FEDERAL EMERGENCY MANAGEMENT AGENCY **REVISION REQUESTOR AND COMMUNITY OFFICIAL FORM**	O.M.B. Burden No. 3067-0148 Expires July 31, 1997	FEMA USE ONLY

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average 2.13 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.

1. OVERVIEW

1. The basis for this revision request is (are): *(check all that apply)*
   - ☑ Physical change
     - ☑ Existing
     - ☐ Proposed
   - ☑ Improved methodology
   - ☑ Improved data
   - ☐ Floodway revision
   - ☐ Other _____

   Explain _____

2. Flooding Source: GRANITE REEF WASH
3. Project Name/Identifier: GRANITE REEF WASH FLOODPLAIN DELINEATION STUDY FCD95-29
4. FEMA zone designations affected: AE, B
   (example: A, AH, AO, A1-A30, A99, AE, V, V1-30, VE, B, C, D, X)
5. The NFIP map panel(s) affected for all impacted communities is (are):

Community No.	Community Name	County	State	Map No.	Panel No.	Effective Date
EX: 480301	Katy,City	Harris, Fort Bend	TX	480301	0005D	02/08/83
480287	Harris County	Harris	TX	48201C	0220G	09/28/90
045012	SCOTTSDALE	MARICOPA COUNTY	AZ	04013C	2160D	04/15/88

6. The area of revision encompasses the following types of flooding, structures, and associated disciplines: *(check all that apply)*

Types of Flooding
- ☑ Riverine
- ☐ Coastal
- ☐ Alluvial Fan
- ☐ Shallow Flooding *(e.g. Zones AO and AH)*
- ☐ Lakes

Affected by wind/wave action
- ☐ Yes
- ☑ No

Structures
- ☐ Channelization
- ☐ Levee/Floodwall
- ☑ Bridge/Culvert
- ☐ Dam
- ☐ Coastal
- ☐ Fill
- ☐ Pump Station
- ☐ None
- ☐ Channel Relocation
- ☐ Excavation
- ☐ Other *(describe)*

Disciplines*
- ☑ Water Resources
  - ☐ Hydrology
  - ☑ Hydraulics
  - ☐ Sediment Transport
  - ☐ Interior Drainage
- ☐ Structural
- ☐ Geotechnical
- ☐ Land Surveying
- ☐ Other *(describe)*

☐ Other(describe) _____

* **Attach completed "Certification by Registered Professional Engineer and/or Land Surveyor" Form for each discipline checked. (Form 2)**

2. FLOODWAY INFORMATION

7. Does the affected flooding source have a floodway designated on the effective FIRM or FBFM? ☐ Yes ☑ No
8. Does the revised floodway delineation differ from that shown on the effective FIRM or FBFM ☑ Yes ☐ No
   If yes, give reason: RESULTS FROM STUDY SHOW FLOODPLAIN BOUNDARY DEVIATIONS

Attach copy of either a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners and affected adjacent jurisdictions.

9. 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.

3. PROPOSED ENCROACHMENTS

10. With floodways:

1A. Does the revision request involve fill, new construction, substantial improvement, or other development in the floodway? ☐ Yes ☑ No

1B. If yes, does the development cause the 100-year water surface elevation to increase at any location by more than 0.000 feet? ☐ Yes ☐ No

11. Without floodways:

2A. Does the revision request involve fill, new construction, substantial improvement, or other development in the 100-year floodplain? ☐ Yes ☑ No

2B. If yes, does the cumulative effect of all development that has occurred since the effective SFHA was originally identified cause the 100-year water surface elevation to increase at any location by more than one foot (*or other surcharge limit if community or state has adopted more stringent criteria*)? ☐ Yes ☐ No

If the answer to either Items 1B or 2B is yes, please provide 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.

4. REVISION REQUESTOR ACKNOWLEDGMENT

12. Having read NFIP Regulations, 44 CFR Ch. I, parts 59, 60, 61, and 72, I believe that the proposed revision ☑ is ☐ is not in compliance with the requirements of the aforementioned NFIP Regulations.

5. COMMUNITY OFFICIAL ACKNOWLEDGMENT

13. Was this revision request reviewed by the community for compliance with the community's adopted floodplain management ordinances? ☑ Yes ☐ No

14. Does this revision request have the endorsement of the community? ☑ Yes ☐ No

If no to either of the above questions, please explain: _____

Please note that community acknowledgment and /or notification is required for all requests as outlined in Section 65.4 (b) of the NFIP Regulations.

6. OPERATION AND MAINTENANCE

15. Does the physical change involve a flood control structure (e.g., levees, floodwalls, channelization, basins, dams)? ☐ Yes ☑ No

If yes, please provide the following information for each of the new flood control structures:

A. Inspection of the flood control project will be conducted periodically by _____ (entity)

_____ with a maximum interval of _____ months between inspections.

B. Based on the results of scheduled periodic inspections, appropriate maintenance of the flood control facilities will be conducted by _____ (entity)

to ensure the integrity and degree of flood protection of the structure.

C. A formal plan of operation, including documentation of the flood warning system, specific actions and assignments of responsibility by individual name or title, and provisions for testing the plan at intervals not less than one year, ☐ has ☐ has not been prepared for the flood control structure.

D. 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.

Attach operation and maintenance plans

7. REQUESTED RESPONSE FROM FEMA

16. After examining the pertinent NFIP regulations and reviewing the document entitled "Appeals, Revisions, and Amendments to Flood Insurance Maps: A guide for Community Officials," dated January 1990, this request is for a:

_____a.	CLOMR	A letter from FEMA commenting on whether a proposed project, if built as proposed, would justify a map revision *(LOMR or PMR)*, or proposed hydrology changes *(see 44 CFR Ch. I, Parts 60, 65, and 72)*.
✓ b.	LOMR	A letter from FEMA officially revising the current NFIP map to show changes to floodplains, floodways, or flood elevations. LOMRs typically depict decreased flood hazards. *(See 44 CFR Ch. I Parts 60 and 65.)*
_____c.	PMR	A reprinted NFIP map incorporating changes to floodplains, floodways, or flood elevations. Because of the time and cost involved to change, reprint, and redistribute an NFIP map, a PMR is usually processed when a revision reflects increased flood hazards or large-scope changes. *(See 44 CFR Ch. I, Parts 60 and 65.)*
_____d.	Other:	Describe_____

8. FORMS INCLUDED

17. Form 2 entitled, "Certification By Registered Professional Engineer and/or Land Surveyor" must be submitted.

The following forms should be included with this request if (check the included forms):

• Hydrologic analysis for flooding source differs from that used to develop FIRM	☐ Hydrologic Analysis Form (Form 3)
• Hydraulic analysis for riverine flooding differs from that used to develop FIRM	☑ Riverine Hydraulic Analysis Form (Form 4)
• The request is based on updated topographic information or a revised floodplain or floodway delineation is requested	☐ Riverine /Coastal Mapping Form (Form 5)
• The request involves any type of channel modification	☐ Channelization Form (Form 6)
• The request involves new bridge or culvert or revised analysis of an existing bridge or culvert	☑ Bridge/Culvert Form (Form 7)
• The request involves a new revised levee/floodwall system	☐ Levee/Floodwall System Analysis Form (Form 8)
• The request involves analysis of coastal flooding	☐ Coastal Analysis Form (Form 9)
• The request involves coastal structures credited as providing protection from the 100-year flood	☐ Coastal Structures (Form 10)
• The request involves an existing, proposed, or modified dam	☐ Dam Form (Form 11)
• The request involves structures credited as providing protection from the 100-year flood on an alluvial fan	☐ Alluvial Fan Flooding Form (Form 12)

9. INITIAL REVIEW FEE

18. The minimum initial review fee for the appropriate request category has been included. ☐ Yes ☐ No

Initial fee amount: $ _____

Check or money order only. Make check or money order payable to : **National Flood Insurance Program.** If paying by Visa or Mastercard please refer to the credit card information form which follows this form.

or

19. This request is for a project that is for public benefit and is primarily intended for flood loss reduction to insurable structures in identified flood hazard areas which were in existence prior to the commencement of construction of the flood control project. ☐ Yes ☐ No

or

20. This request is to correct map errors, to include the effects of natural changes within the areas of special flood hazard, or solely to provide more detailed data. ☑ Yes ☐ No

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

11/5/96

Signature of Revision Requester

MICHAEL S. ELLEGOOD, P.E. CHIEF ENGINEER/GENERAL MANAGER

Printed Name and Title of Revision Requester

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Company Name

(602) - 506 - 1501

Telephone No. Date

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

William Erickson, Public Works Planner

Printed Name and Title of Community Official

City of Scottsdale, Arizona

Community Name

(602) 994-7652 6/20/97

Date

Does this request impact any other communities? ☐ Yes ☑ No

If yes, attach letters from all affected jurisdictions acknowledging revision request and approving changes to floodway, if applicable.

Note: Although a photograph of physical changes is not required, it may be helpful for FEMA's review.

EXHIBIT 3

EXHIBIT 3

AFFIDAVIT OF PUBLICATION

The Arizona Republic/The Phoenix Gazette

INVOICE NO. 96056
ANNOUNCEMENT OF INTENT TO PERFORM FLOOD ELEVATION STUDY

The Flood Control District of Maricopa County (FCDMC) has contracted AGK Engineers, Inc. to perform a floodplain delineation for the Granite Reef Wash from Thomas Road to McKellips Road.

This study will examine and evaluate the flood hazard areas in the community to determine the flood elevation for those areas. These elevations will then be used to determine the flood insurance rates used by the Federal Emergency Management Agency (FEMA).

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 FCDMC/FEMA, so that they could be considered during the course of this study. Your comments should be addressed to Mr. Pedro Calza or Mr. Maximo De [illegible], Hydrologists at the Flood Control District of Maricopa County.

Published: Arizona Republic, February 2, 9, 1996.

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 The Phoenix Gazette, 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
~~The Phoenix Gazette~~

FEBRUARY 2, 9, 1996

Sworn to before me this

13TH day of

FEBRUARY A.D. 19 96

OFFICIAL SEAL
DEBBIE WILSON
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires Jan. 9, 1999

Notary Public

EXHIBIT 4

Exhibit 4

FEDERAL EMERGENCY MANAGEMENT AGENCY **CERTIFICATION BY REGISTERED PROFESSIONAL ENGINEER AND/OR LAND SURVEYOR FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	*FEMA USE ONLY*

PUBLIC BURDEN DISCLOSURE NOTICE

Public reporting burden for this form is estimated to average . 23 hour 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.

1. This certification is in accordance with 44 CFR Ch. I, Section 65.2
2. I am licensed with an expertise in Hydrology, Hydraulics and water resources.
   [example: water resources *(hydrology, hydraulics, sediment transport, interior drainage)** structural, geotechnical, land surveying.]
3. I have 5 years experience in the expertise listed above.
4. I have ☒ prepared ☐ reviewed the attached supporting data and analyses related to my expertise.
5. I ☒ have ☐ have not visited and physically viewed the project.
6. In my opinion, the following analyses and /or designs, is/are being certified:
   Flood plain Delineation
7. Base upon the following review, the modifications in place have been constructed in general accordance with plans and specifications.

   Basis for above statement: (check all that apply)

   a. ☐ Viewed all phases of actual construction.
   b. ☐ Compared plans and specifications with as-built survey information.
   c. ☐ Examined plans and specifications and compared with completed projects.
   d. ☒ Other Flood plain delineation
8. All information submitted in support of this request is correct to the best of my knowledge. I understand that any false statement may be punishable by fine or imprisonment under Title 18 of the United States Code, Section 1001.

Name: HERNAN A. ARISTIZABAL
(please print or type)

Title: Civil Engineer
(please print or type)

Registration No. 29737 Expiration Date:

State Az

Type of License Profecional civil Engineer

Hernan A. Aristizabal for Entellus
Signature

5-22-97
Date

Seal
(Optional)

*Specify Subdiscipline

Note: Insert not applicable (N/A) when statement does not apply.

FEDERAL EMERGENCY MANAGEMENT AGENCY **RIVERINE HYDRAULIC ANALYSIS FORM**	O.M.B. Burden No. 3067-0148 Expires July 31, 1997	FEMA USE ONLY

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.

Community Name: City of Scottsdale

Flooding Source: Granite Reef Wash
(One form for each flooding source)

Project Name/Identifier: Granite Reef Wash floodplain delineation.

1. REACH TO BE REVISED

Downstream limit: X-sec

Upstream limit: End of study @ Pima Road North of Thomas x-sec # 2.355

2. EFFECTIVE FIS

☐ Not studied

☐ Studied by approximate methods

Downstream limit of study _____

Upstream limit of study _____

☒ Studied by detailed methods

Downstream limit of study Indian Reservation

Upstream limit of study Pima Road North of Thomas Rd.

☒ Floodway delineated

Downstream limit of Floodway Indian Reservation

Upstream limit of Floodway Pima Road North of thomas Rd.

3. HYDRAULIC ANALYSIS

Why is the hydraulic analysis different from that used to develop the FIRM. *(Check all that apply)*

☐ Not studied in FIS

☐ Improved hydrologic data/analysis. Explain: _____

☒ Improved hydraulic analysis. Explain: Updated topographic Information including finish floor elevation for all structures. (buildings)

☐ Flood control structure. Explain: _____

☒ Other. Explain: development of new mapping update development conditions.

For areas which have detailed flooding:

Full input and output listings along with files on diskette (if available) for each of the models listed below (items 1, 2, 3, 4, and 5) and summary of the source of input parameters used in the models must be provided. The summary must include a complete 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.

For areas which do not have detailed flooding:

Only the 100-year 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 for existing or pre-project conditions and revised or post-project conditions must be submitted. All calculations must be submitted for these analyses. (See item 6 below)

1. Duplicate Effective Model — Natural ☐ Floodway ☐

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 requestor's equipment to produce the duplicate effective model. This is required to assure that the effective model input data has been transferred correctly to the requestor'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 ☐ Floodway ☐

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 corrected 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 ☐ Floodway ☐

The duplicate effective or corrected 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 or duplicate effective model.

4. Revised or Post-Project Conditions Model — Natural ☒ Floodway ☐

The existing or pre-project conditions model *(or duplicate effective 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 proposed project this model should reflect proposed conditions.

5. Other: Please attach a sheet describing all other models submitted. — Natural ☐ Floodway ☐

6. Hydraulic Analyses (Only if Hydraulic Models are not developed)

Please attach all calculations for the existing or pre-project conditions and the revised or post-project conditions. Proceed to Form 5, "Riverine/Coastal Mapping Form".

4. MODEL PARAMETERS *(from model used to revise 100-year water surface elevation)*

1. Discharges:

	Upstream Limit	Downstream Limit
10-year		
50-year		
100-year	644	1417
500-year		

Attach diagram showing changes in 100-year discharge

2. Explain how the starting water surface elevations were determined Critical depth

3. Give range of friction loss coefficients (*Manning's "N"*) Channel ..... 0.018 - 0.045

Overbanks ..... 0.020 - 0.057

If friction loss coefficients are different anywhere along the revised reach from those used to develop the FIRM, give location, value used in the effective FIS, and revised values and an explanation as to how the revised values were determined.

Location	FIS	Revised
See Attached sheet		

Explain: All values were updated because of different model includes latest physical conditions

4. Describe how the cross section geometry data were determined *(e.g., field survey, topographic map, taken from previous study)* and list cross sections that were added.

topographic map (100 Scale - 1 foot contour Int.)

5. Were natural channel banks selected as the location of the left and right channel banks in the model?

☐ Yes ☒ No If no, explain why not: there is no natural banks, banks were set to street edges or channel banks (man made)

6. Explain how reach lengths for channel and overbanks were determined:

channel lengths measure along the thalweg
& overbank lengths were determined by using the center of
mass of the given overbank section

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

1. Do the results indicate:

a. Water surface elevations higher than end points of cross sections? ..... ☐ Yes ☐ No

b. Supercritical depth? ..... ☒ Yes ☐ No

c. Critical depth? ..... ☒ Yes ☐ No

d. Other unique situations ..... ☒ Yes ☐ No

If yes to any of the above, attach an explanation that discusses the situation and how it is presented on the profiles, tables, and maps.

2. What is the maximum change in energy gradient between cross-sections? 0.0104

Specify location 1.239

3. What is the distance between the cross-sections in 2 above? .....

4. What is the maximum distance between cross-sections? ..... 504 ft

Specify location 1.670

5. Floodway determination

a. What is the maximum surcharge allowed by the community or State? ..... 1 foot

b. What is the maximum surcharge for the revised conditions? ..... 0 foot

Specify location ..... N/A

c. What is the maximum velocity? ..... N/A fps

Specify location ..... N/A

d. Are there any negeative surcharge values at any cross-section? ☐ Yes ☒ No

If yes, the floodway may need to be widened. If it is not widened, please explain and indicate the maximum negative surcharge.

Explain: N/A

6. Is the discharge value used to determine the floodway anywhere different from that used to determine the natural 100-year flood elevations? ..... ☐ Yes ☒ No

If Yes, explain:

7. Do 100-year water surface elevations increase at any location? ..... ☐ Yes ☐ No

If yes, please attach a list of the locations where the increases occur, state whether or not the increases are located on the requestor's property, and provide an explanation of the reason for the increases. *(For example: State if the increase is due to fill placed within the floodway fringe or placed within the currently adopted floodway limits)*

No enough information about previous study

Please attach a completed comparison table entitled: Water Surface Elevation Check (See page 6)

6. REVISED FIRM/FBFM AND FLOOD PROFILES

A. The revised water surface elevations tie into those computed by the effective FIS Model *(10-, 50-, 100-, and 500-year)*, downstream of the project at cross-section 0.320 within 0.1 feet *(vertical)* and upstream of the project at cross section N/A within N/A. feet *(vertical)*.

B. The revised floodway elevations tie into those computed by the effective FIS model, dowstream of the project at cross section_____ within_____ feet *(vertical)* and upstream of the project at cross section_____ within_____ feet *(vertical)*.

C. Attach profiles, at the same vertical and horizontal scale as the profiles in the effective FIS report, showing stream bed and profiles of all floods studied (without encroachment). Also, label all cross sections, road crossings (including low chord and top-of-road data), culverts, tributaries, corporate limits, and study limits. If channel distance has changed, the stationing should be revised for all profile sheets.

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

Proceed to Riverine /Coastal Mapping Form

FEDERAL EMERGENCY MANAGMENT AGENCY

WATER SURFACE ELEVATION CHECK

COMMUNITY NAME	FLOODIND SOURCE	PROJECT NAME /IDENTIFIER

	EFFECTIVE			DUPLICATE EFFECTIVE			CORRECTED EFFECTIVE			EXISTING/PRE-PROJECT			REVISED/PROJECT		
SECNO	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]	NCWSEL[1]	FCWSEL[2]	SURC.[3]

COMMENTS:

1-100-year (natural) Water Surface Elevation 2-Encroachment (floodway) Water Surface Elevation 3-Surcharge Value

Include all cross sections in the models between tie-in points. Any interpolated values should be indicated in parentheses.

Sheet_____ of _____

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	**FEMA USE ONLY**

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Community Name: City of Scottsdale

Flooding Source: Granite Reef Wash

Project Name/Identifier: Granite Reef Wash floodplain delineation

1. IDENTIFIER

1. Name of roadway, railroad, etc.: McDowell Road
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): between X-secs 1.075 and 1.054
3. This revision reflects *(check one of the following)*:
   - ☐ New bridge/culvert not modeled in the FIS
   - ☒ Modified bridge/culvert previously modeled in the FIS
   - ☐ New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed) Culvert modified as part of McDowell Road Improvements

2. BACKGROUND

Provide the following information about the structure:

1 Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3- foot diameter circular piers; 40-foot wide ogee shape spillway) 1 - 12' x 8' reinforced concrete box culvert.

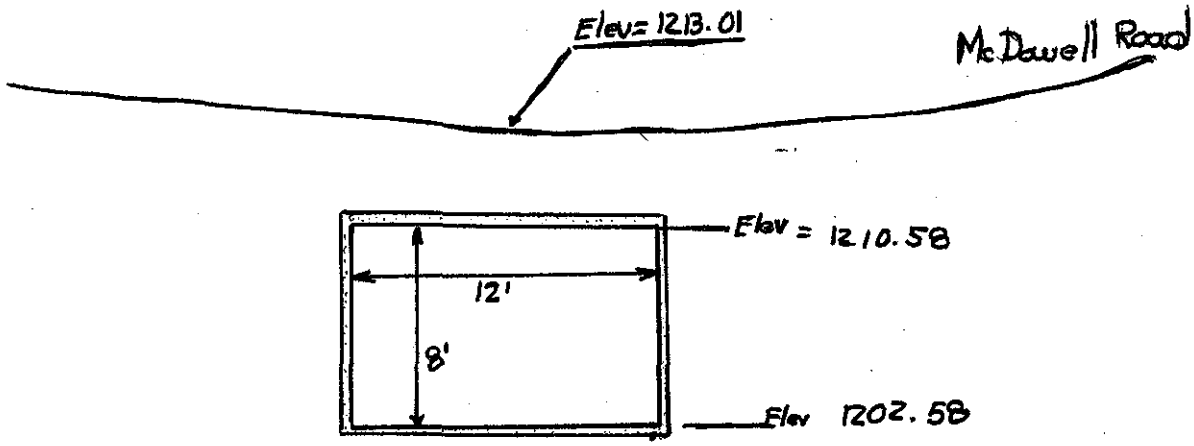
2. Entrance geometry of culvert/type of bridge opening (e.g. 30 ^{0} - 75 ^{0} wing walls with square top edge, sloping embankments and vertical abutments) wing wall flared 18.4° Inlet skewed 30 degrees chamfer on top

3. Hydraulic model used to analyze the structure (*e.g., HEC-2 with special bridge routine, WSPRO, HY8*) HEC-2 with special bridge routine

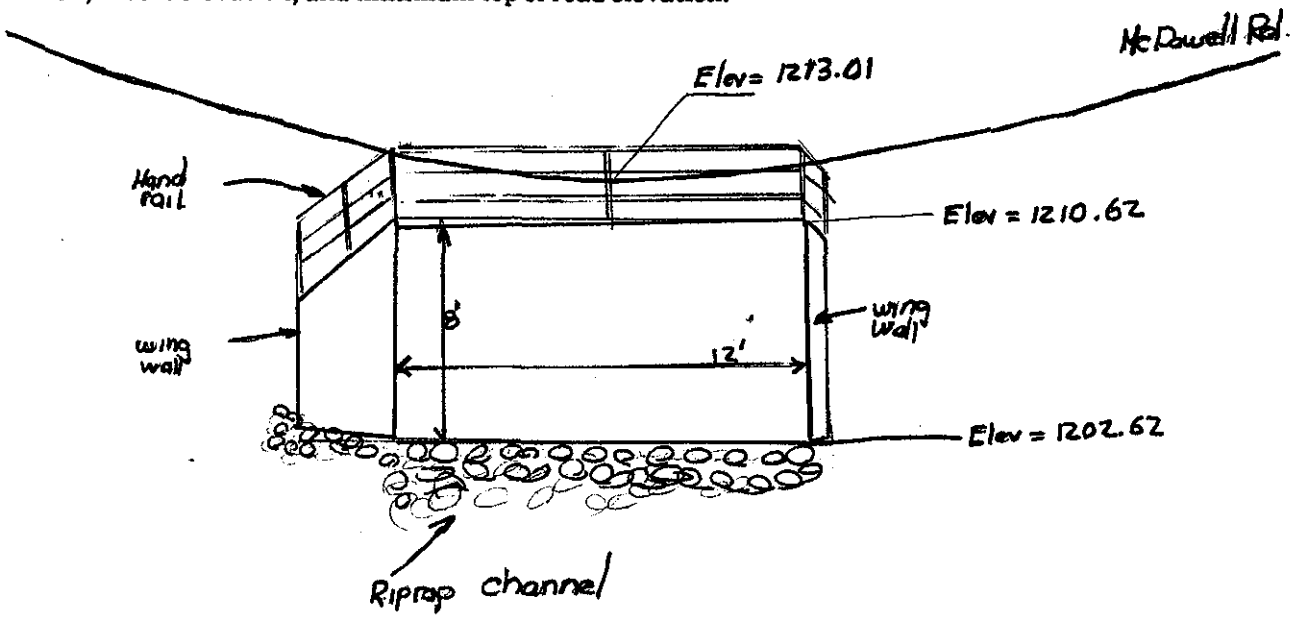
If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A
*** One form per new/revised bridge/culvert**

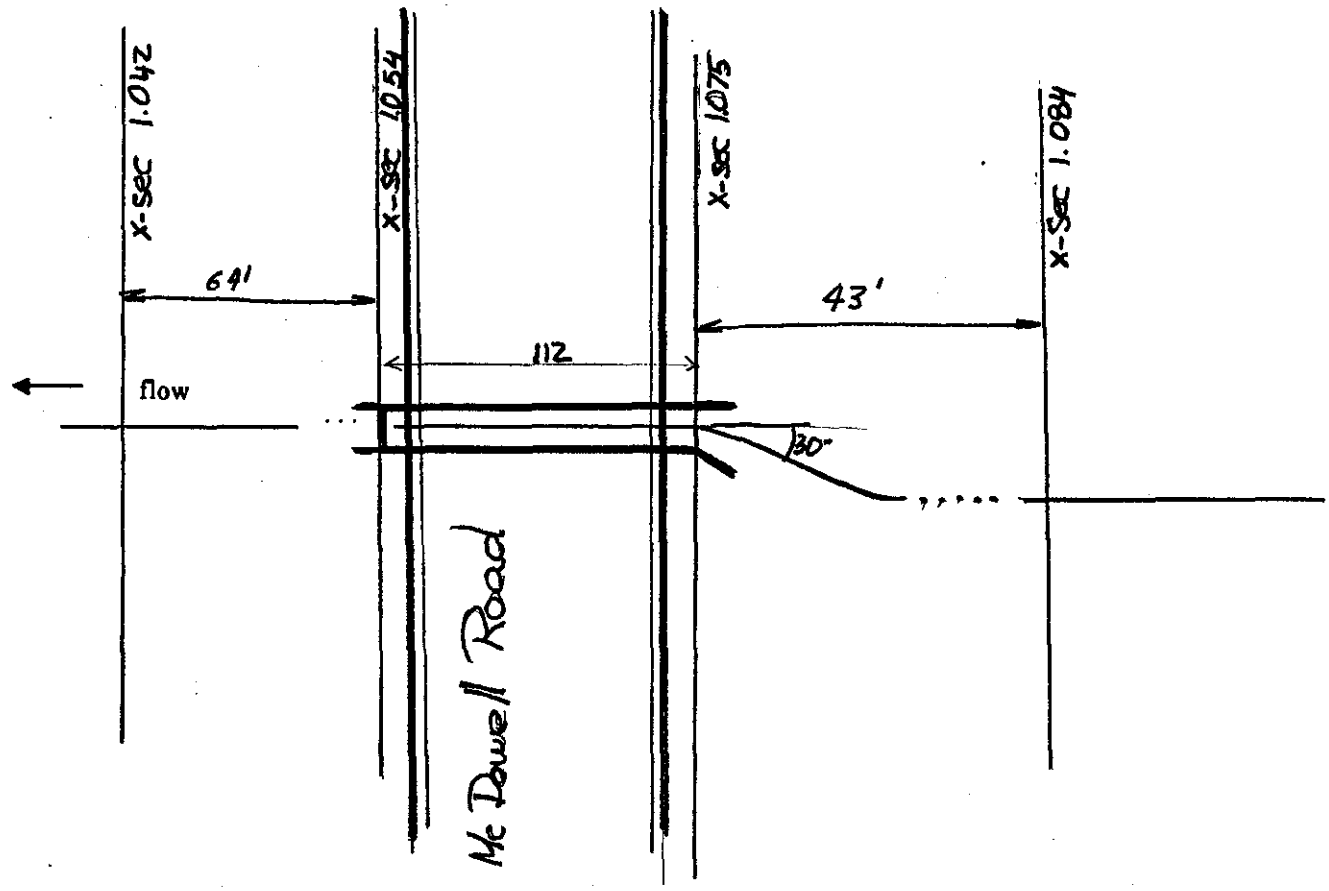
Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



Sketch the plan view of the structure(s) Show, at a minimum, the skew angle, cross-section locations, distances between cross sections, and length of structure (s).



Attach plans of the structure (s) certified by a registered Professional Engineer.

Culvert length or bridge width (ft)	112.25
Calculated culvert/bridge area (ft²) by the hydraulic model, if applicable	96 ft²
Total culvert/bridge area (ft²)	96 ft²

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	1213.01	1213.01
Downstream face	1212	1212

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	1213.01	1213.01
Downstream face	1213.01	1213.01

100-Year Elevations	Water Surface Elevations	Energy Gradient Elevations
Upstream face	1214.33	1214.45
Downstream face	1213.17	1213.79

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure (s) (cfs)	N/A	720	527	1247

The maximum depth of flow over the roadway/railroad (ft.) 1.32

Weir length (ft.) 118

Top Widths	Total Floodplain Width	Total Effective Flow Width	Floodway Width
Upstream face	109	109	109
Downstream face	200	200	200

Loss Coefficients

Entrance loss coefficient	0.3
Manning's "n" value assigned to the structure(s)	0.013
Friction loss coefficient through structure (s)	N/A
Other loss coefficients (e.g., bend manhole, etc.)	N/A
Total loss coefficient	0.3
Weir coefficient	2.7
Pier coefficient	N/A
Contraction loss coefficient	0.3
Expansion loss coefficient	0.5

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport (*including scour and deposition*) can affect the 100-year water surface elevations? ..... ☐ Yes ☒ No

   B Based on the conditions (*such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions*), is there a potential for debris and sediment transport (*including scour and deposition*) to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? ..... ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment (*bed material*) load?
   _____cfs (*attach gradation curve*)

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition_____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert?_____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment (floodway run) No encroachment used, Area fully developed.

Comments *(explain any unusual situations)*:

Attach analysis.

FEDERAL EMERGENCY MANAGEMENT AGENCY **BRIDGE/CULVERT FORM**	*O.M.B. Burden No. 3067-0148* *Expires July 31, 1997*	**FEMA USE ONLY**

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Community Name: City of Scottsdale

Flooding Source: Granite Reef Wash

Project Name/Identifier: Granite Reef Wash floodplain Delineation

1. IDENTIFIER

1. Name of roadway, railroad, etc.: Office building
2. Location of bridge/culvert along flooding source (in terms of stream distance or cross-section identifier): between x-sec 1.108 and 1.115
3. This revision reflects *(check one of the following)*:

   ☒ New bridge/culvert not modeled in the FIS

   ☐ Modified bridge/culvert previously modeled in the FIS

   ☐ New analysis of bridge/culvert previously modeled in the FIS

   (Explain why new analysis was performed)

2. BACKGROUND

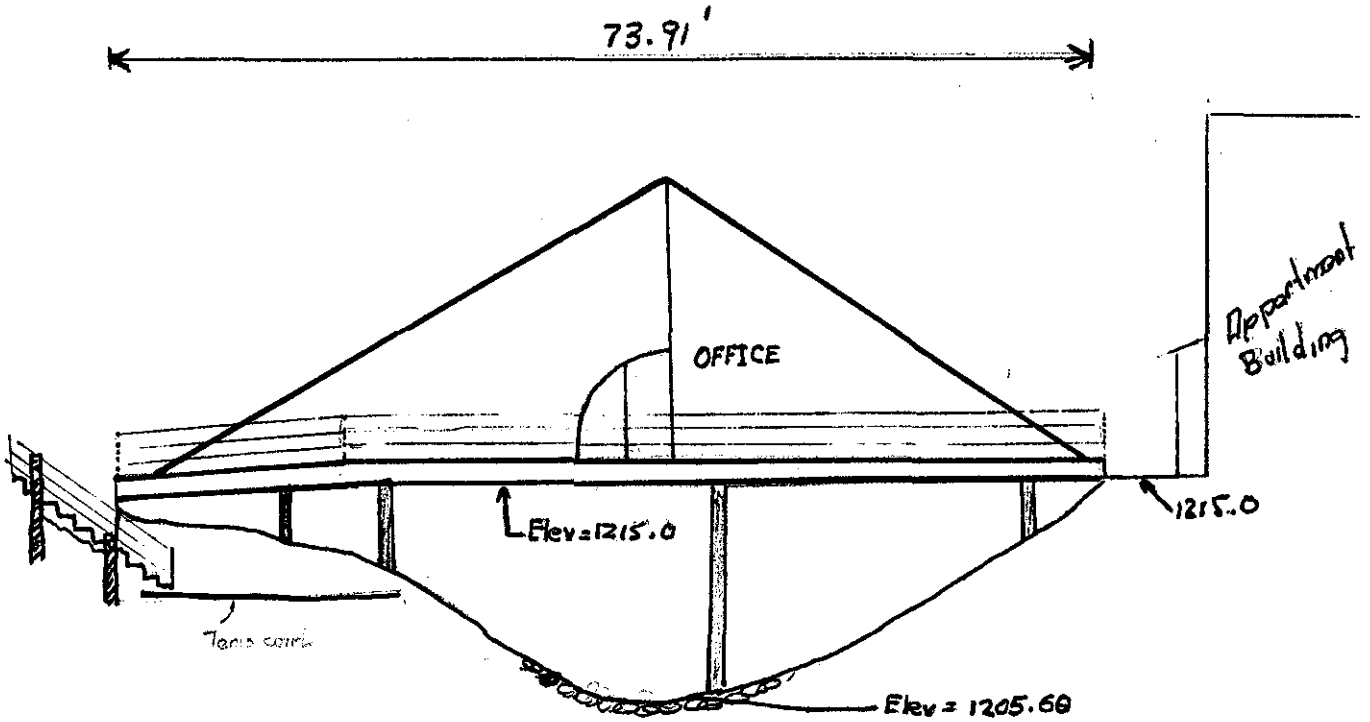
Provide the following information about the structure:

1. Dimension, material, and shape (e.g. two 10 x 5 feet reinforced concrete box culvert; three 30-foot span bridge with 2 rows of two 3- foot diameter circular piers; 40-foot wide ogee shape spillway) 74' bridge with 4 rows of 1-foot diameter circular piers
2. Entrance geometry of culvert/type of bridge opening (e.g. 30°- 75° wing walls with square top edge, sloping embankments and vertical abutments) Sloping abutment, vertical embankment
3. Hydraulic model used to analyze the structure (*e.g., HEC-2 with special bridge routine, WSPRO, HY8*) HEC-2

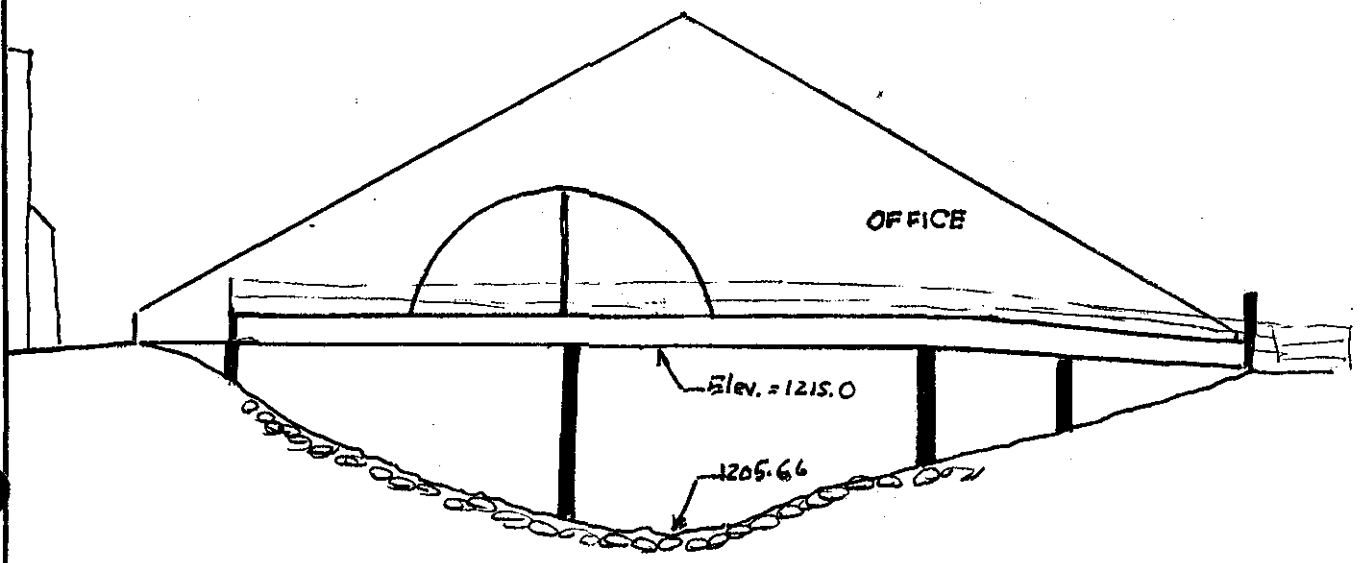
   If different than hydraulic analysis for the flooding source, justify why the hydraulic analysis used for the flooding source could not analyze the structure(s). *(Attach justification)*

Note: If any items do not apply to submitted hydraulic analysis, indicate by N/A
*** One form per new/revised bridge/culvert**

Sketch the downstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, minimum top of road elevation, and ineffective flow widths.



Sketch the upstream face of the structure together with the road profile. Show, at a minimum, the maximum low chord elevation, invert elevation, and minimum top of road elevation.



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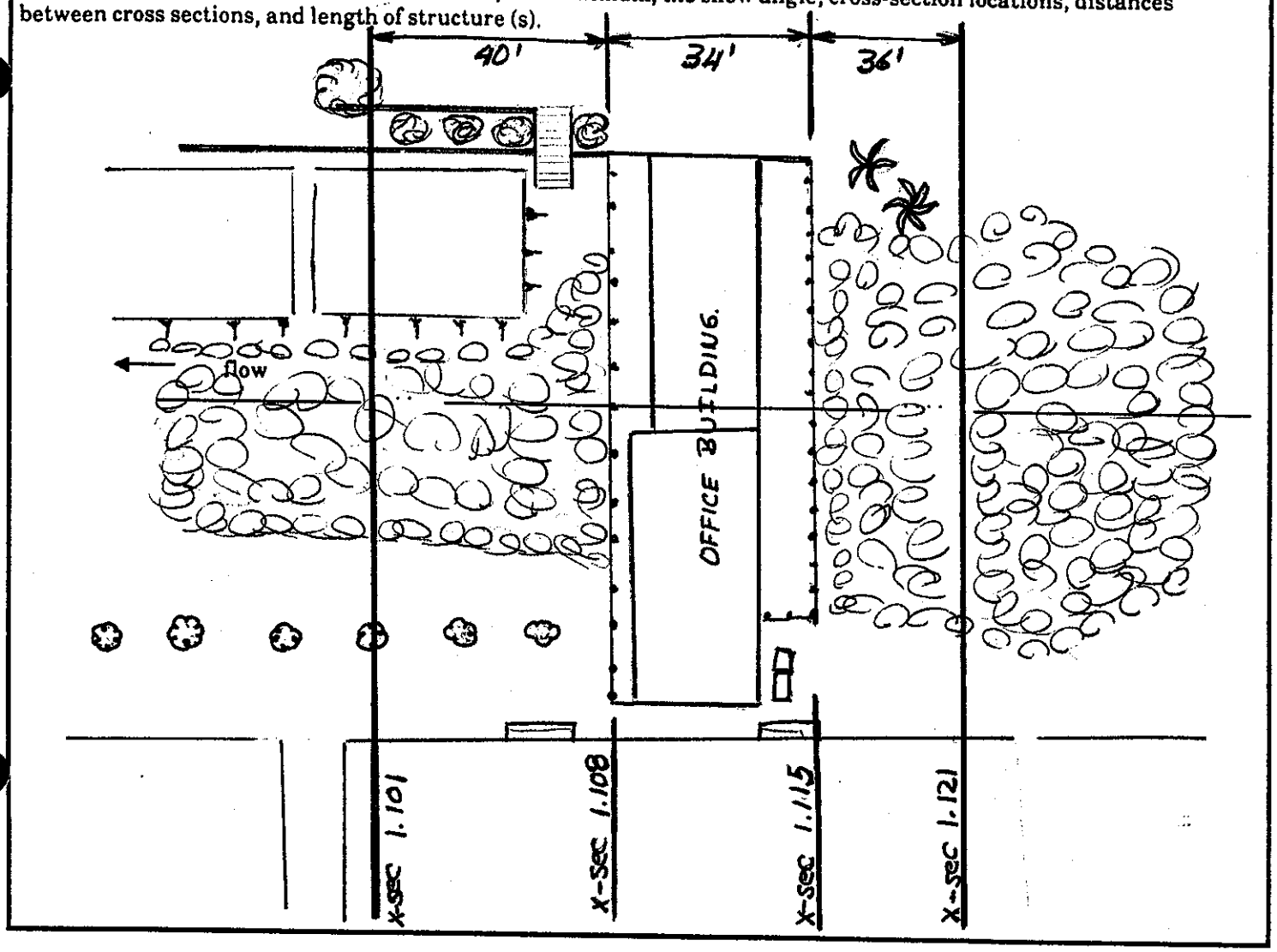


Attach plans of the structure (s) certified by a registered Professional Engineer.

Culvert length or bridge width (ft)	34'
Calculated culvert/bridge area (ft²) by the hydraulic model, if applicable	467
Total culvert/bridge area (ft²)	467

Elevations Above Which Flow is Effective for Overbanks

	Left Overbank	Right Overbank
Upstream face	1215	1215
Downstream face	1215	1215

Minimum Top of Road Elevation

	Left Overbank	Right Overbank
Upstream face	1215.0	1215.0
Downstream face	1215.0	1215.0

100-Year Elevations	Water Surface Elevations	Energy Gradient Elevations
Upstream face	1214.45	1214.61
Downstream face	1214.44	1214.59

Discharge	Low Flow	Pressure Flow	Weir Flow	Total Flow
Amount of flow through/over the structure (s) (cfs)	1240	0	0	1240

The maximum depth of flow over the roadway/railroad (ft.) 0

Weir length (ft.) 0

Top Widths	Total Floodplain Width	Total Effective Flow Width	Floodway Width
Upstream face	72.85	72.85	72.85
Downstream face	86.26	86.26	86.26

Loss Coefficients

Entrance loss coefficient	0.7
Manning's "n" value assigned to the structure(s)	0.045
Friction loss coefficient through structure (s)	0.86
Other loss coefficients (e.g., bend manhole, etc.)	N/A
Total loss coefficient	1.56
Weir coefficient	2.7
Pier coefficient	1.05
Contraction loss coefficient	0.3
Expansion loss coefficient	0.5

4. SEDIMENT TRANSPORT CONSIDERATIONS

1. A. Is there any indication from historical records that sediment transport *(including scour and deposition)* can affect the 100-year water surface elevations? ..... ☐ Yes ☒ No

   B Based on the conditions *(such as geomorphology, vegetative cover and development of the watershed and stream bed, and bank conditions)*, is there a potential for debris and sediment transport *(including scour and deposition)* to affect the 100-year water surface elevations and/or conveyance capacity through the bridge/culvert? ..... ☐ Yes ☒ No

2. If the answer to either 1A or 1B is yes:

   A. What is the estimated sediment *(bed material)* load?
   _____cfs *(attach gradation curve)*

   Explain method used to estimate the sediment transport and the depth of scour and/or deposition_____

   B. Will sediment accumulate anywhere through the bridge/culvert? ☐ Yes ☐ No

   If yes, explain the impact on the conveyance capacity through the bridge/culvert?_____

5. FLOODWAY ANALYSIS

Explain method of bridge encroachment (floodway run) No encroachment. fully developed area.

Comments (*explain any unusual situations*):

Attach analysis.

EXHIBIT 5

Exhibit 5

GRANITE REEF WASH

GRW 1

Picture No. 2

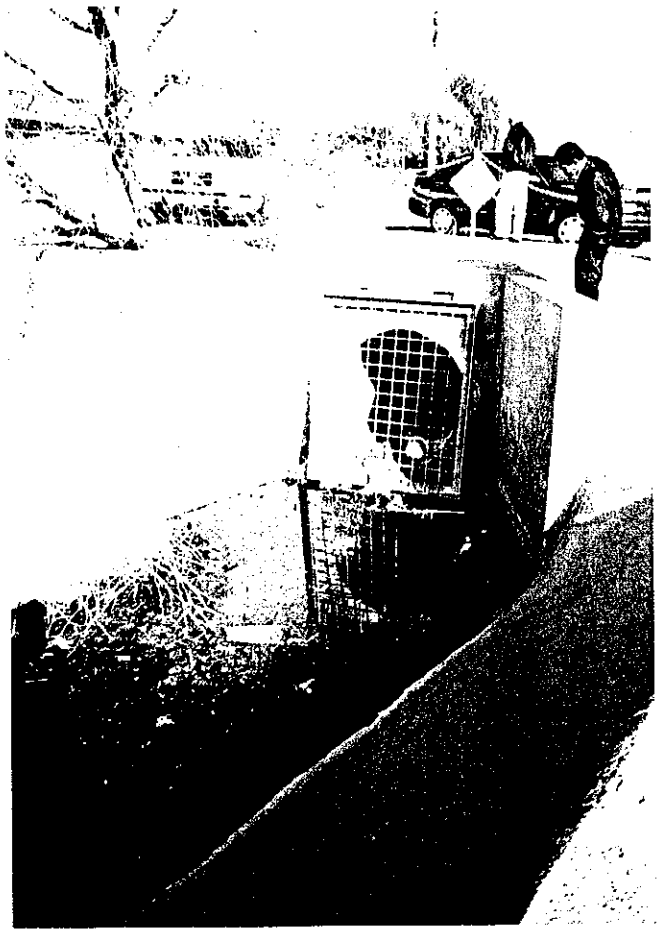
Water well at upstream end of reach

Picture No. 1

Upstream from McKellips Road

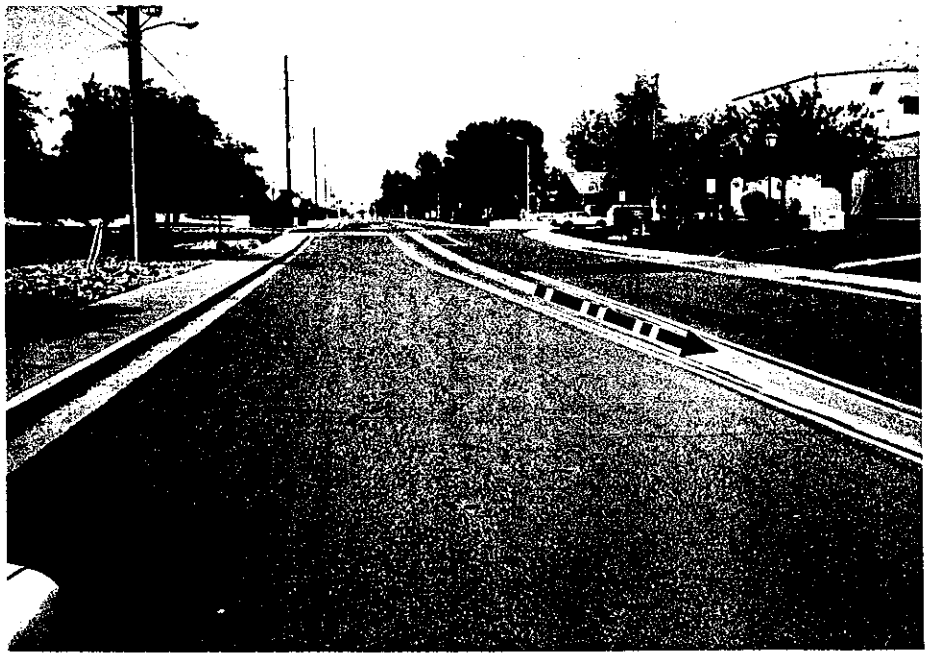
GRANITE REEF WASH

GRW 2



Picture No. 4
Storm drain outlet

Picture No. 3
Granite Reef Channel



Picture No. 7
Granite Reef Road

Picture No. 6
Detention basin west of
Granite Reef Road

GRANITE REEF WASH GRW 3

Picture No. 5
Granite Reef Road

GRANITE REEF WASH

GRW 4

Picture No. 8

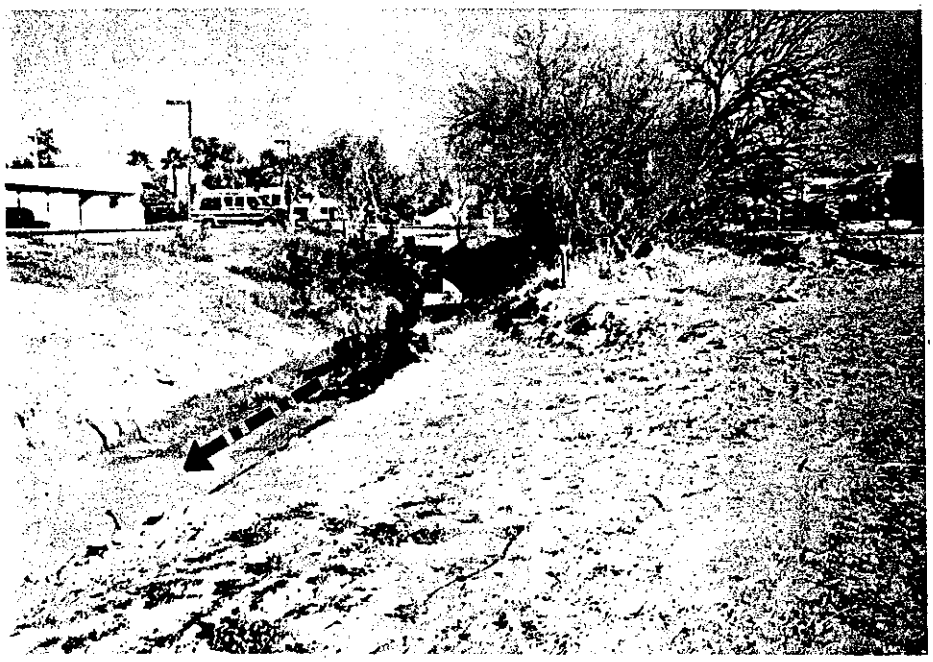
84TH Place

GRANITE REEF WASH

GRW 5A

Picture No. 10
Upstream end

Picture No. 9
Downstream end



Picture No. 13

Downstream from McDowell Road

GRANITE REEF WASH GRW 5B

Picture No. 12

Upstream end

Picture No. 11

Dowstream end

GRANITE REEF WASH

GRW 6

Picture No. 16
Upstream looking south

Picture No. 15
Downstream end

Picture No. 14
From McDowell Road

GRANITE REEF WASH GRW 7

Picture No.19

Upstream end of channel

Picture No.18

Upstream end of channel

Picture No.17

Channel looking dowstream

GRANITE

87TH Street

south of Thomas Road

Picture No.25

87TH Street

from Edgemont Avenue looking south

Picture No.24

REEF

WASH
GRW 8

Pictire No.23

87TH Street

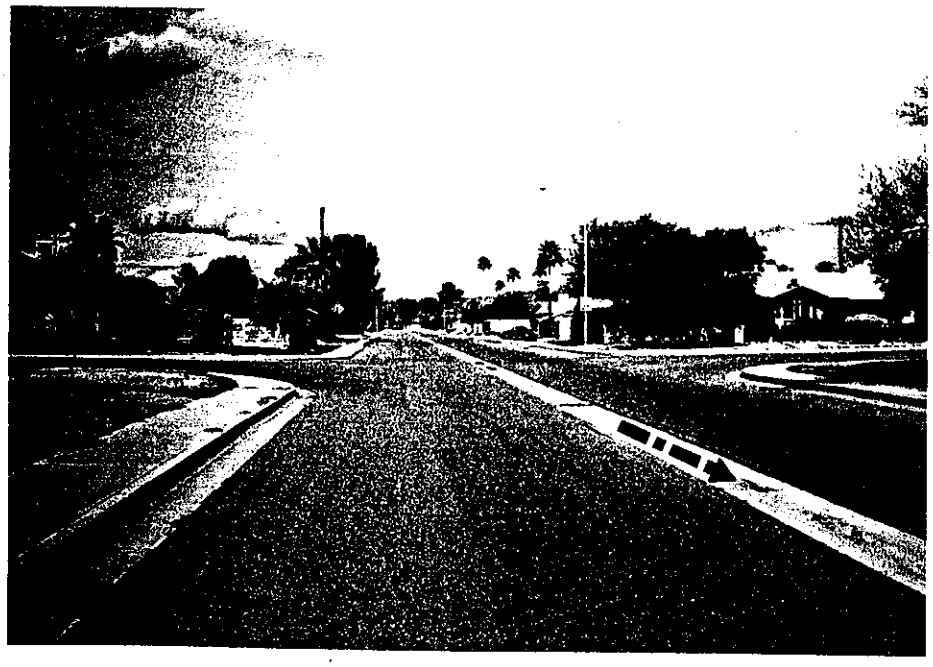
south of Earll Drive

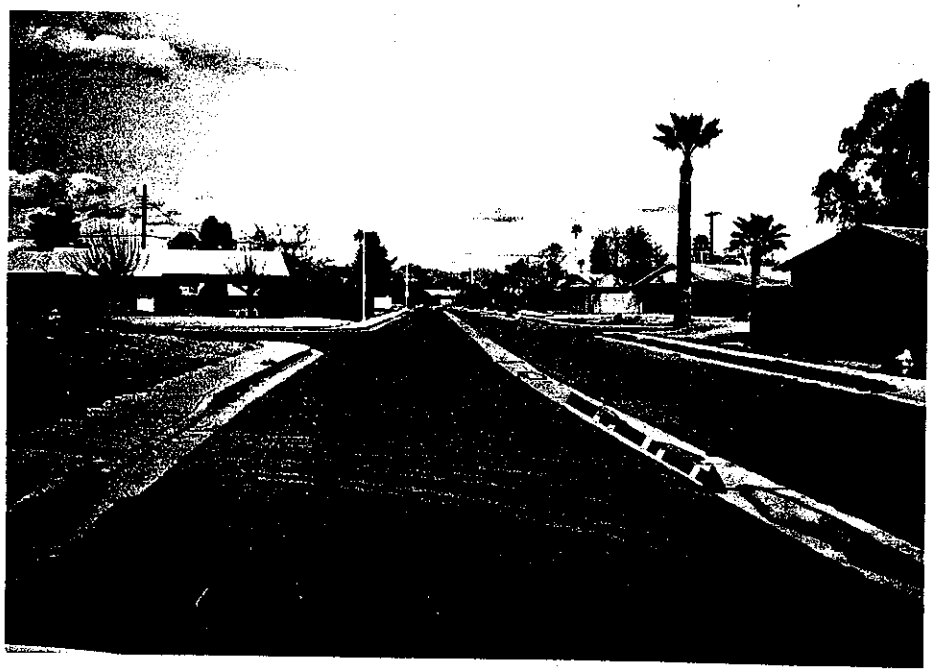
GRANITE

Picture No.22

87TH Street

north of Oak Street





REEF

Picture No.21

87TH Street

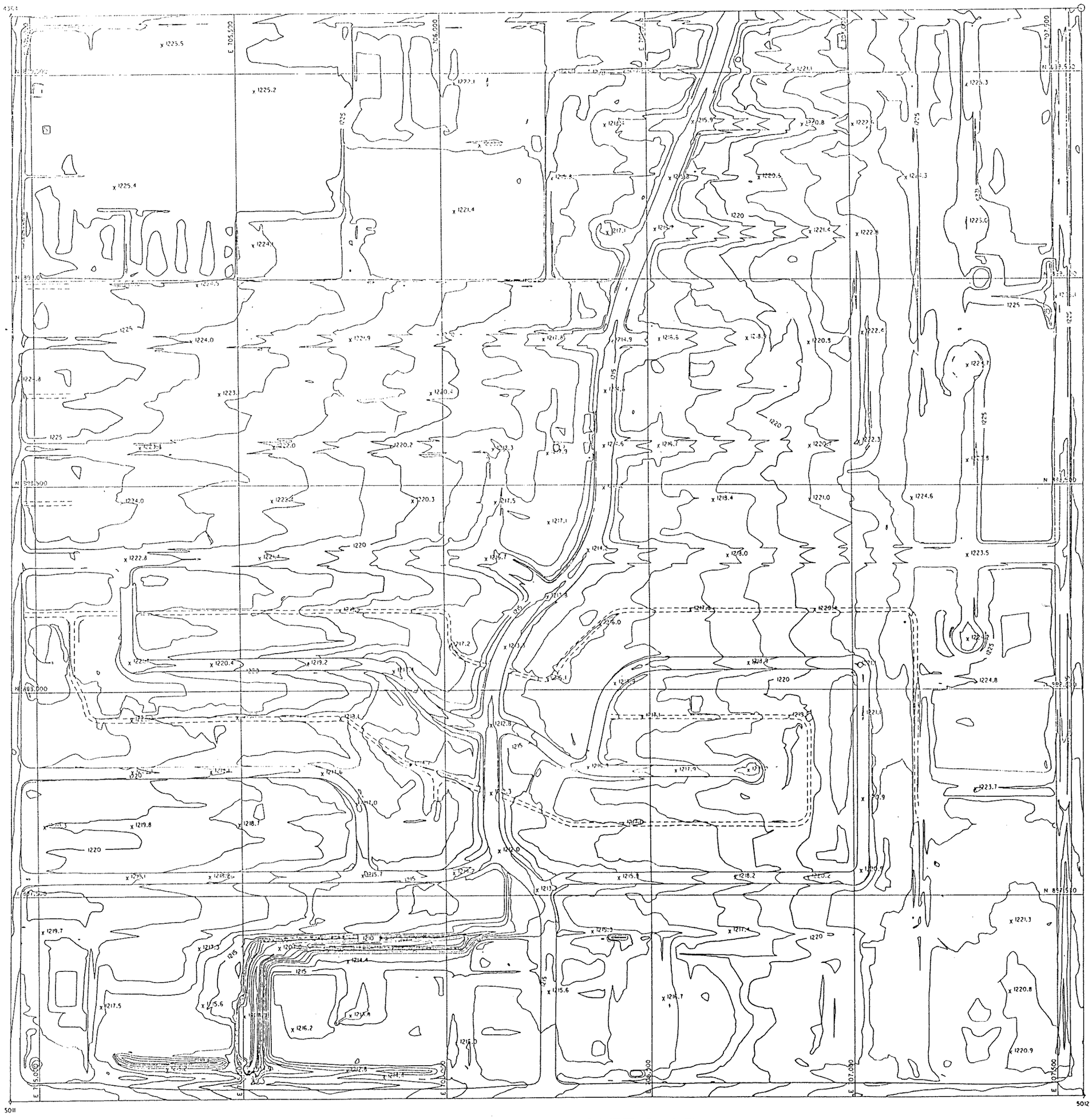
north of Holly Street

WASH GRW 8

Picture No.20
87TH Street

North of Coronado Road

EXHIBIT 6



N

0 50 100 200 300 400

SCALE : 1"=100'

CONTOUR INTERVAL : 1'

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CITY OF SCOTTSDALE

Quarter Section No. 13-48

SE Quarter
36 Section
T2N R4E

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Vertical accuracy : not more than 10 percent of elevations tested shall be in error more than one half the contour interval.

Horizontal Datum :
Grid values are based on the Arizona State Plane Coordinate, Central Zone, North American Datum, 1983 Adjustment modified to a local project datum.

Vertical Datum :
Elevations are based on the North American Vertical Datum, 1988 Adjustment.

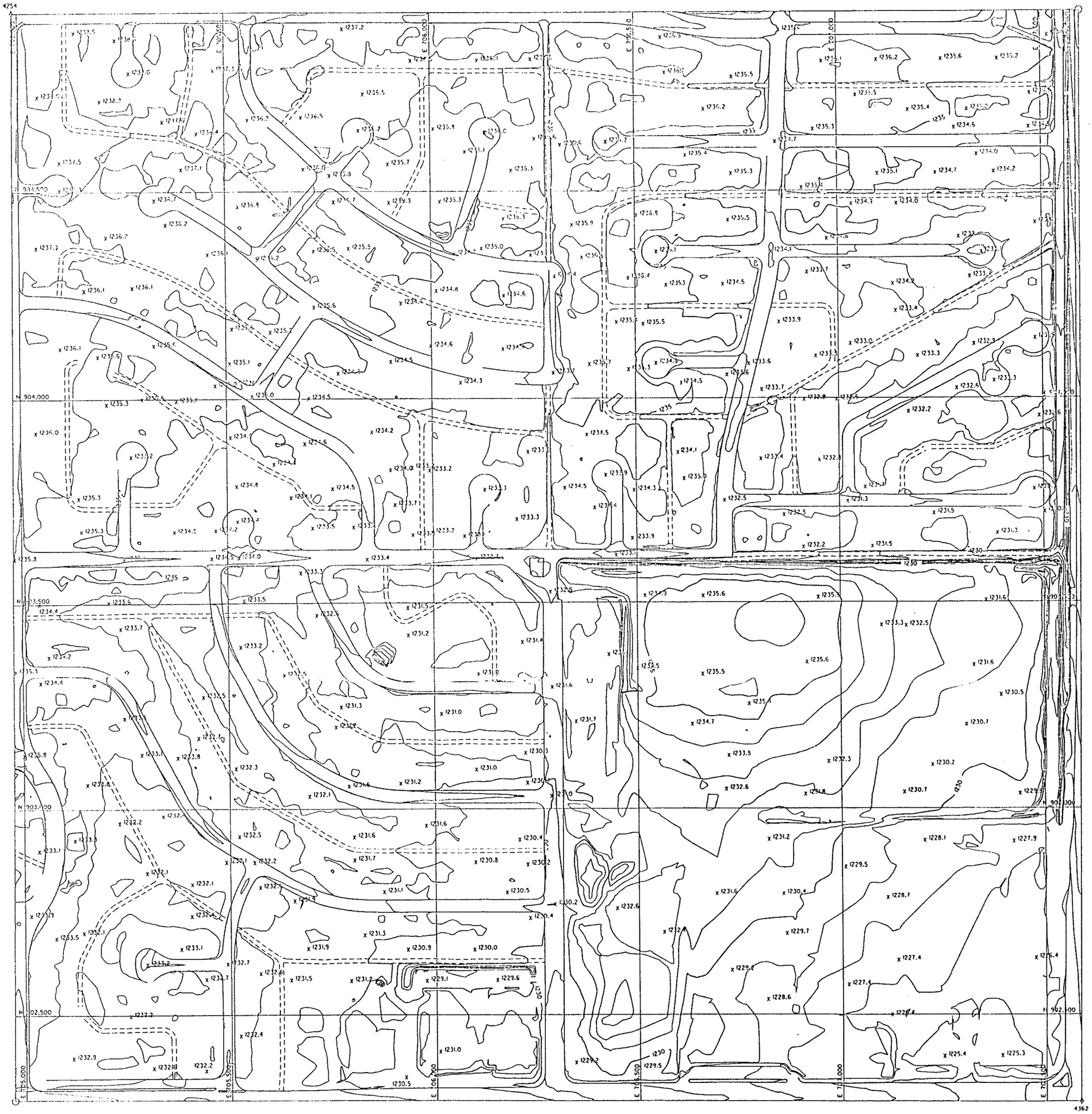
Prepared by
MICHAEL BAKER, JR., INC.
Consulting Engineers
Beaver, Pennsylvania

Date of Photography : Sept. thru Nov. 1993

CITY OF SCOTTSDALE

Scale : 1" = 100' Contour Interval: 1'

Quarter Section No. 13-48



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CITY OF SCOTTSDALE

Quarter Section No. 15-48

SE Quarter
25 Section
T2N R4E

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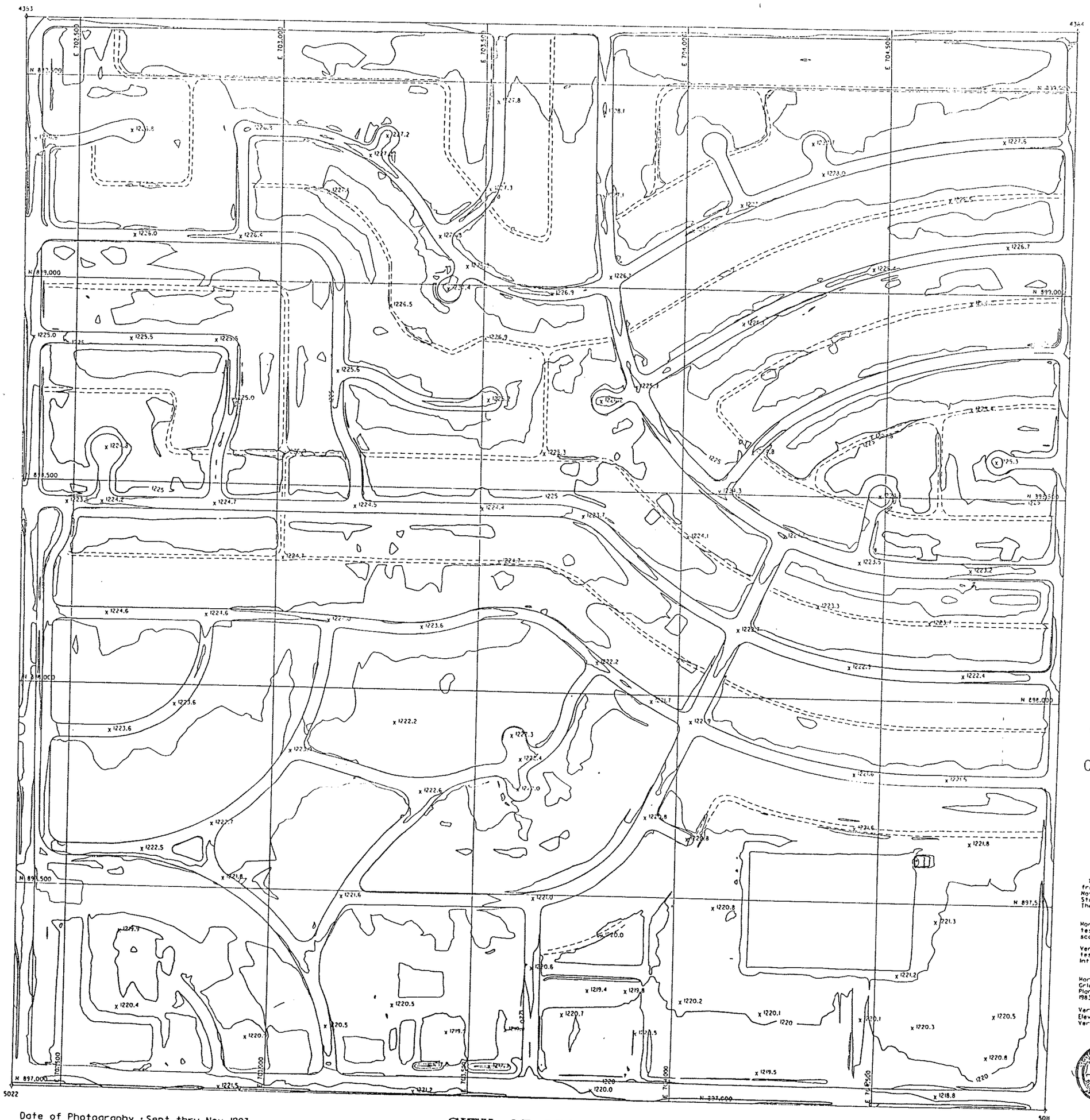
MICHAEL BAKER, JR., INC.
Consulting Engineers
Beaver, Pennsylvania

Date of Photography : Sept. thru Nov. 1993

CITY OF SCOTTSDALE

Scale : 1" = 100' Contour Interval: 1'

Quarter Section No. 15-48



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SCALE : 1"=100'

CONTOUR INTERVAL : 1'

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CITY OF SCOTTSDALE

Quarter Section No. 13-47

SW Quarter
36 Section
T2N R4E

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Horizontal Datum :
Grid values are based on the Arizona State Plane Coordinate, Central Zone, North American Datum, 1983 Adjustment modified to a local project datum.

Vertical Datum :
Elevations are based on the North American Vertical Datum, 1988 Adjustment.

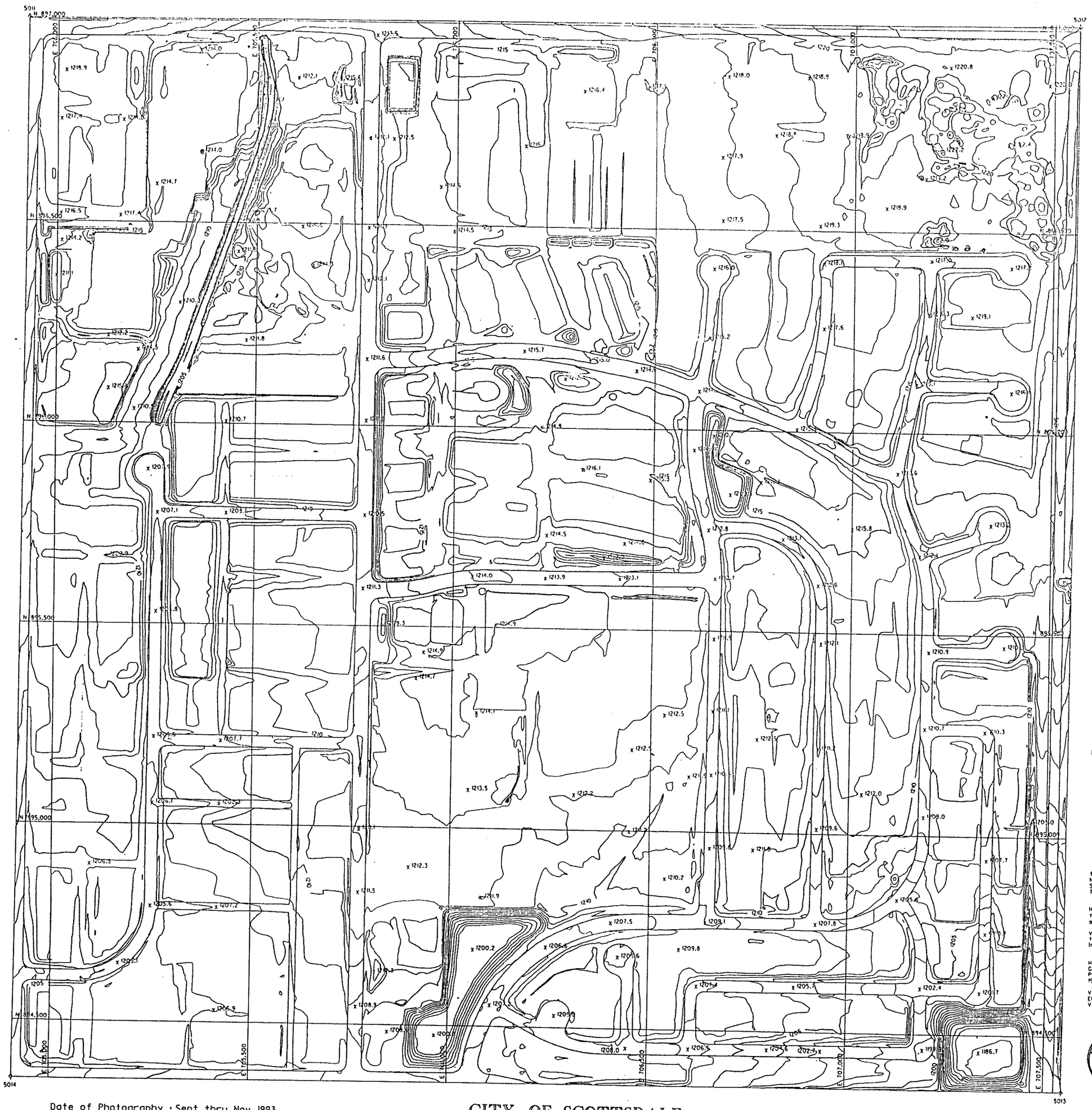
Prepared by
MICHAEL BAKER, JR., INC.
Consulting Engineers
Beaver, Pennsylvania

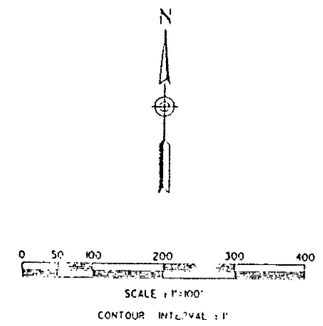
Date of Photography : Sept. thru Nov. 1993

CITY OF SCOTTSDALE

Scale : 1" = 100' Contour Interval: 1'

Quarter Section No. 13-47





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CITY OF SCOTTSDALE

Quarter Section No. 12-48

NE Quarter
1 Section
T1N R4E

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Vertical Datum :
Elevations are based on the North American Vertical Datum, 1988 Adjustment.

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MICHAEL BAKER, JR., INC.
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Beaver, Pennsylvania

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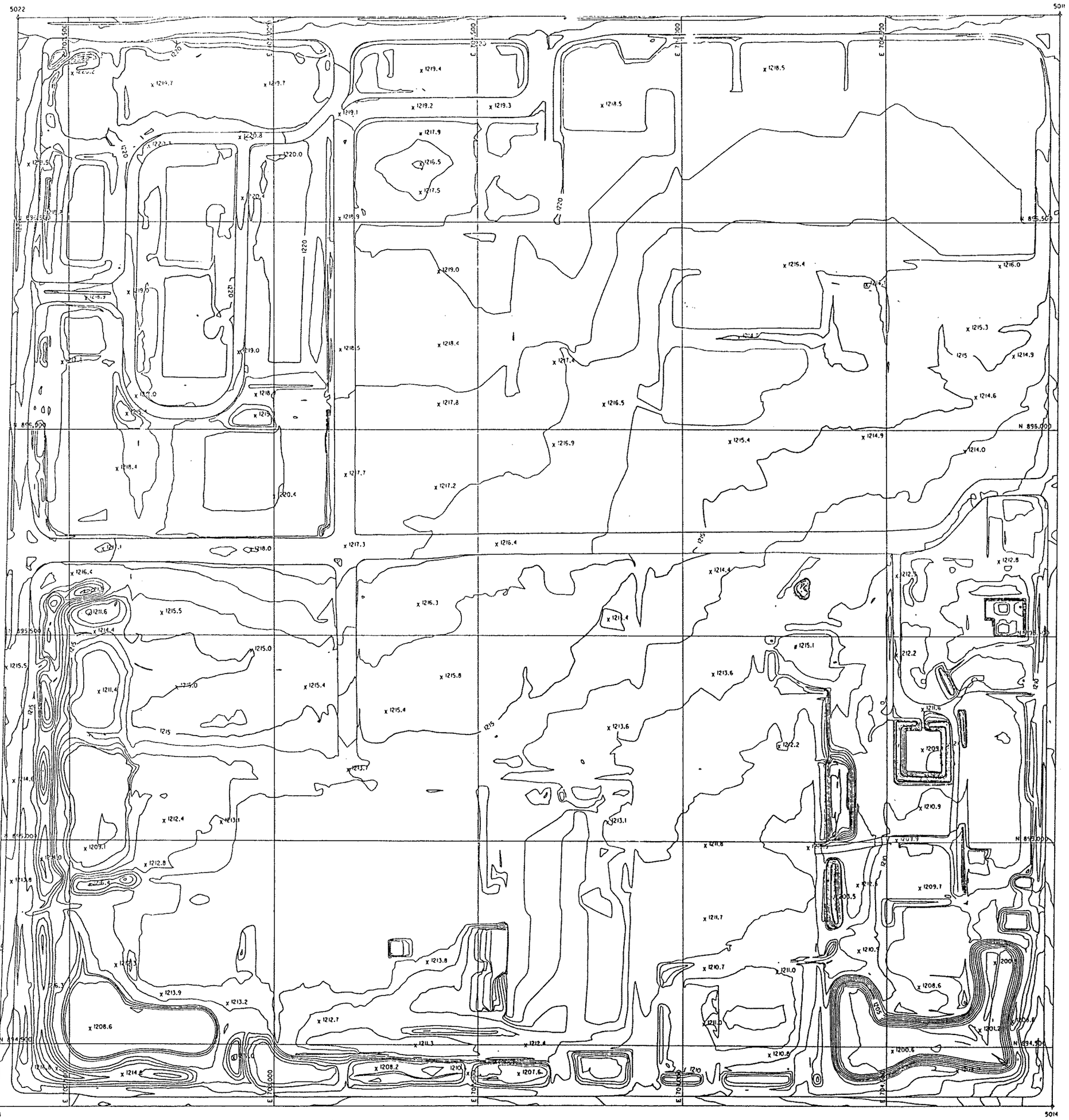
CITY OF SCOTTSDALE

Scale : 1" = 100' Contour Interval: 1'

Quarter Section No. 12-48



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SCALE : 1"=100'

CONTOUR INTERVAL : 1'

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CITY OF SCOTTSDALE

Quarter Section No. 12-47

NW Quarter
1 Section
T1N R4E

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Vertical Datum :
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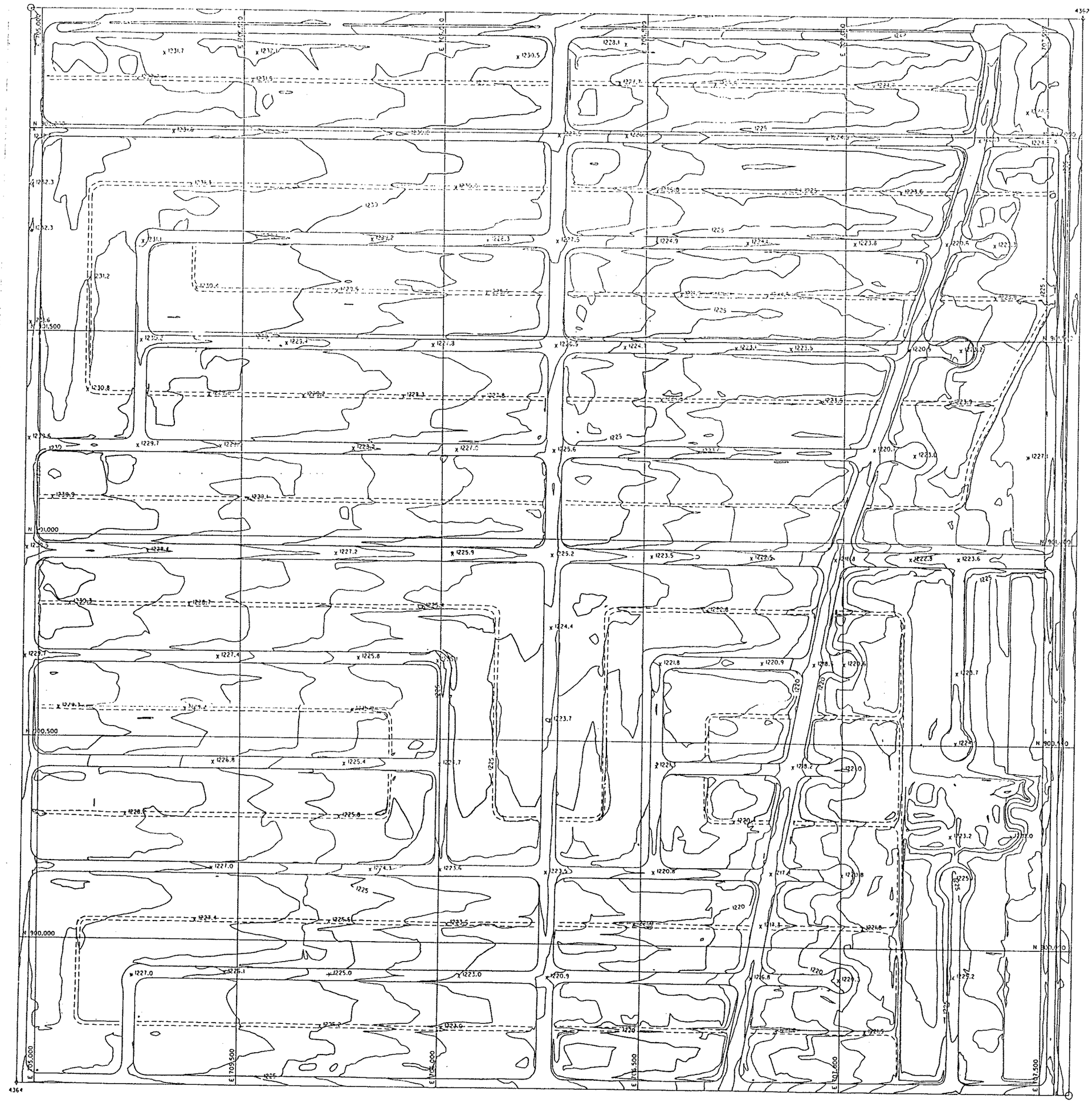
Prepared by
MICHAEL BAKER, JR., INC.
Consulting Engineers
Beaver, Pennsylvania

Date of Photography : Sept. thru Nov. 1993

CITY OF SCOTTSDALE

Scale : 1" = 100' Contour Interval: 1'

Quarter Section No. 12-47



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CITY OF SCOTTSDALE

Quarter Section No. 14-48

NE Quarter
36 Section
T2N R4E

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Horizontal Datum :
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Vertical Datum :
Elevations are based on the North American Vertical Datum, 1988 Adjustment.

Prepared by
MICHAEL BAKER, JR., INC.
Consulting Engineers
Beaver, Pennsylvania

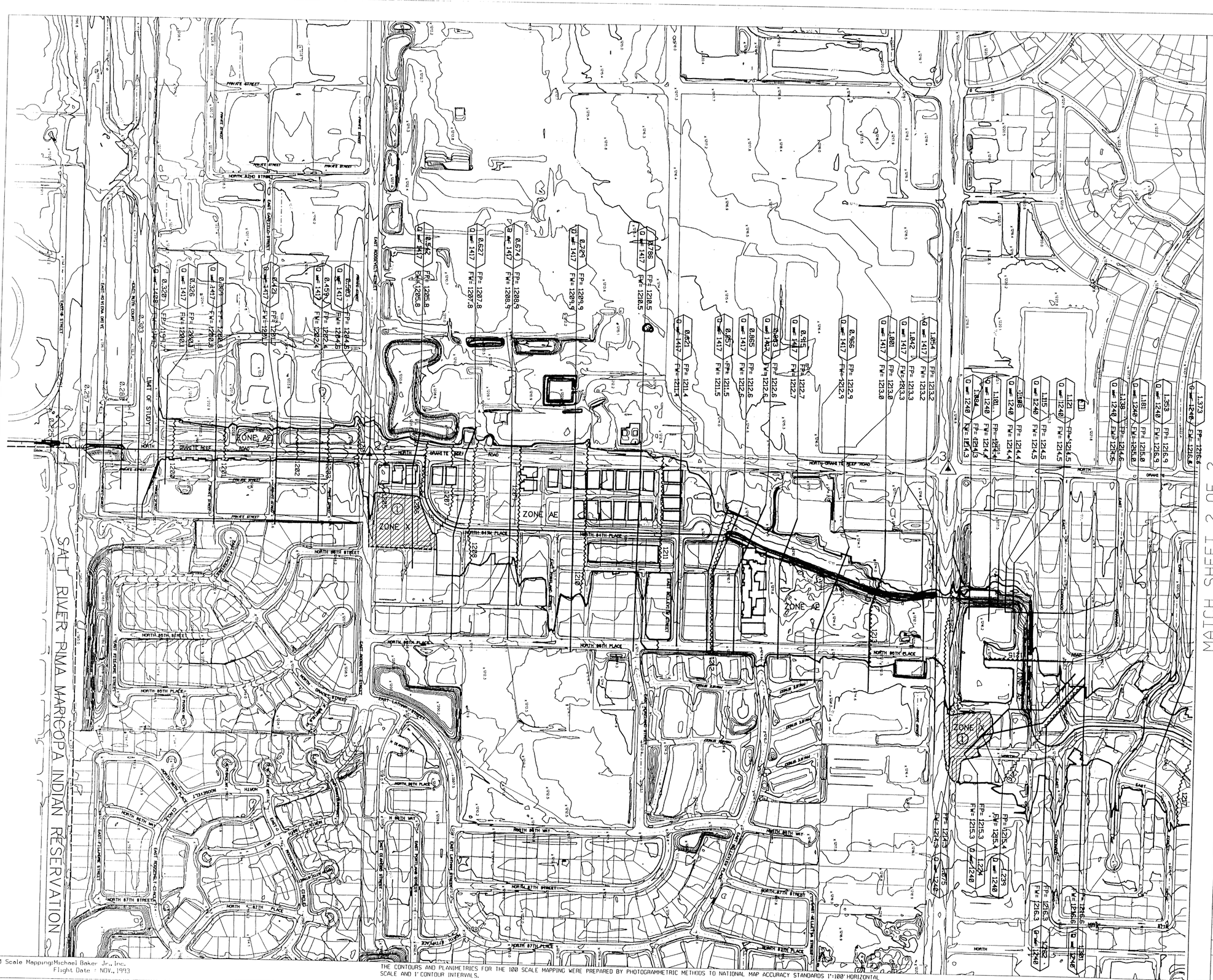
Date of Photography : Sept. thru Nov. 1993

CITY OF SCOTTSDALE

Scale : 1" = 100' Contour Interval: 1'

Quarter Section No. 14-48

Exhibit 7



100 Scale Mapping: Michael Baker Jr., Inc.
Flight Date - NOV., 1993

THE CONTOURS AND PLANIMETRICS FOR THE 100 SCALE MAPPING WERE PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1"=100' HORIZONTAL SCALE AND 1' CONTOUR INTERVALS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF GRANITE REEF WASH

F.C.D. CONTRACT NO. FCD 96-29

LEGEND

100-YR FLOODPLAIN BOUNDARY
100-YR FLOODWAY BOUNDARY
HYDRAULIC BASE LINE & RIVER MILE — 2.0
CROSS SECTION — FP= 1207.8 / FW= 1207.8 — 0.627 / Q = 1417
ELEVATION REFERENCE MARK — 2
BASE FLOOD ELEVATIONS — 1500
ZONE DESIGNATIONS — ZONE AE
CORPORATE LIMITS — Corporate Limits
SECTION LINE — Section Boundary

ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NORTH AMERICA VERTICAL DATUM OF 1988

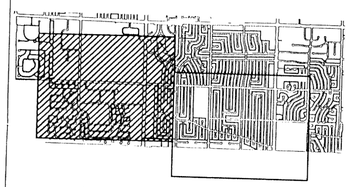
I.D. NUM.	ELEV. (FT)	DESCRIPTION/LOCATION
1	1188.06	ARIZONA DEPARTMENT OF TRANSPORTATION BRASS CAP, AT INTERSECTION OF McKELLIPS ROAD & GRANITE REEF ALLIGNMENT
2	1202.70	C.O.S. BRASS CAP IN HAND HOLE INTERSECTION OF ROOSEVELT STREET & GRANITE REEF ROAD.
3	1218.10	MARICOPA COUNTY BRASS CAP, IN HAND HOLE, INTERSECTION OF McDOWELL ROAD & GRANITE REEF ROAD.

Registered Professional Engineer (Civil) CERTIFICATE NO. 29737 HERNAN A. ARISTIZABAL Date Signed 5/14/97 ARIZONA, U.S.A.

NOTES

1. ZONE X - 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. SEE SPECIAL PROBLEM SECTION

INDEX MAP



N

200 0' 200 400
SCALE: 1" = 200'
CONTOUR INTERVAL = 2' FEET

Entellus
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602) 244-2666
Fax (602) 244-0247

310.45

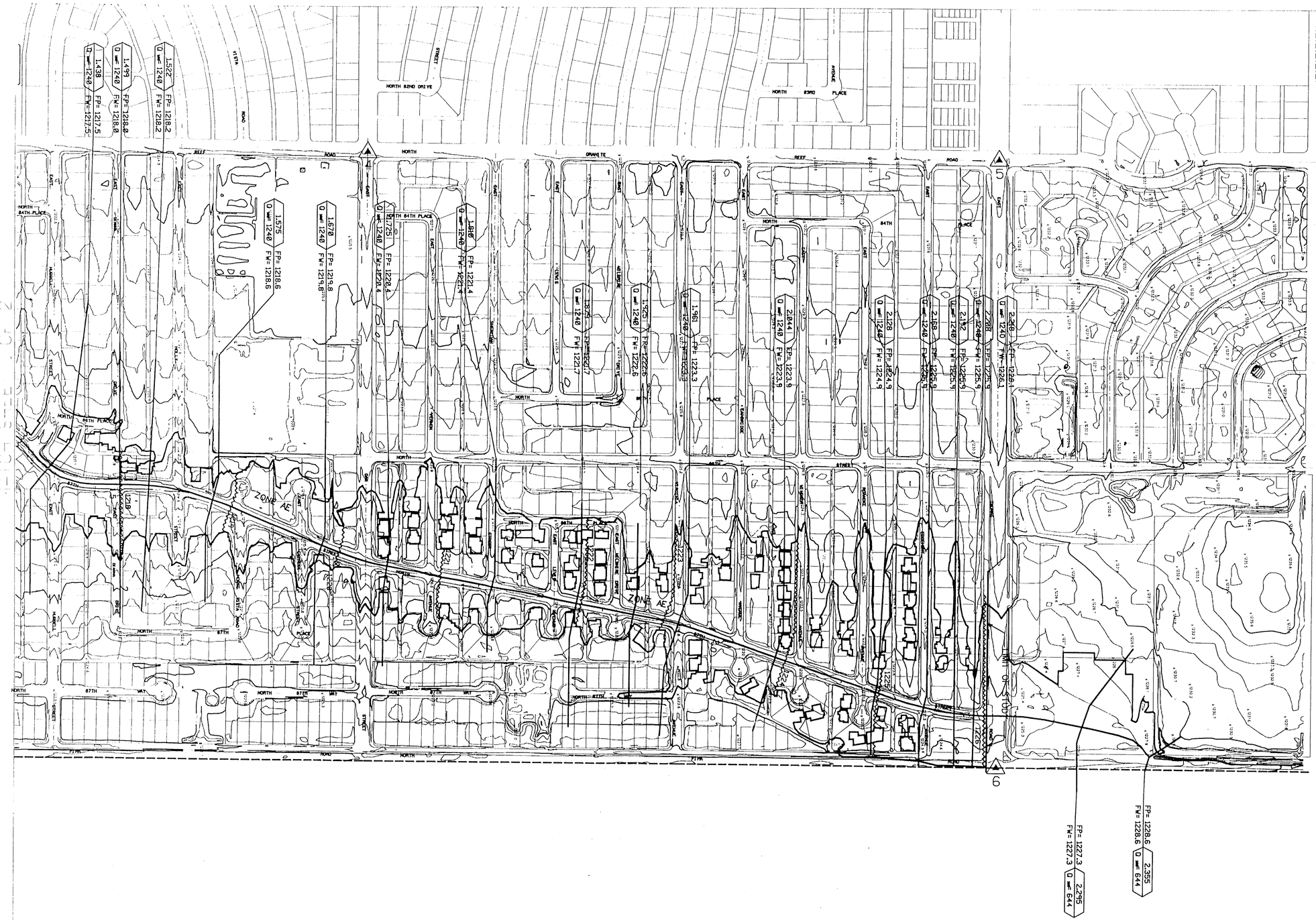
	BY	DATE
DESIGN	HAA	05/97
DESIGN CHK.	SFK	05/97
PLANS	ECES	05/97
PLANS CHK.	HAA	05/97
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE
APPROVED BY: DATE
CHIEF ENGINEER AND GENERAL MANAGER

SHEET 1 OF 2

Dwg. Name: C:\3104\SHEETS\SHT_01.DGN
Date: REV. MAY 22, 1997 10:00am



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF GRANITE REEF WASH

F.C.D. CONTRACT NO. FCD 96-29

LEGEND

100 YR FLOODPLAIN BOUNDARY

100-YR FLOODWAY BOUNDARY

HYDRAULIC BASE LINE & RIVER MILE — 2.0

CROSS SECTION — FP= 1207.8 FW= 1207.8 — 0.627 Q = 1417

ELEVATION REFERENCE MARK

BASE FLOOD ELEVATIONS — 1500

ZONE DESIGNATIONS — ZONE AE

CORPORATE LIMITS — Corporate Limits

SECTION LINE — Section Boundary

ELEVATION REFERENCE MARKS

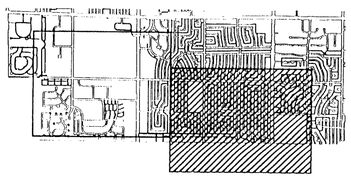
NOTE: ALL ELEVATIONS ARE BASED ON NORTH AMERICA VERTICAL DATUM OF 1988

I.D. NUM.	ELEV. (FT)	DESCRIPTION/LOCATION
4	1227.01	MARICOPA COUNTY BRASS CAP, IN HAND HOLE, INTERSECTION OF OAK STREET & GRANITE REEF ROAD.
5	1226.12	C.O.P. BRASS CAP IN HAND HOLE INTERSECTION OF THOMAS ROAD & PIMA ROAD.
6	1232.73	C.O.S. BRASS CAP IN HAND HOLE INTERSECTION OF THOMAS ROAD & GRANITE REEF ROAD.

Registered Professional Engineer (Civil) CERTIFICATE NO. 29737 HERNAN A. ARISTIZABAL Date Signed 5/14/97 ARIZONA, U.S.A.

NOTES

INDEX MAP



N

200 0' 200 400

FEET

SCALE 1" = 200'

CONTOUR INTERVAL 2 FEET

Entellus
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602) 244-2555
Fax (602) 244-0947

	BY	DATE
DESIGN	HAA	05/97
DESIGN CHK.	SFK	05/97
PLANS	ECES	05/97
PLANS CHK.	HAA	05/97
SUBMITTED BY:		DATE

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET 1 OF 2

DWG. Number: 3945 SHEETS\SHT-01.DGN
Date: Fri, MAY 23, 1997 10:00am

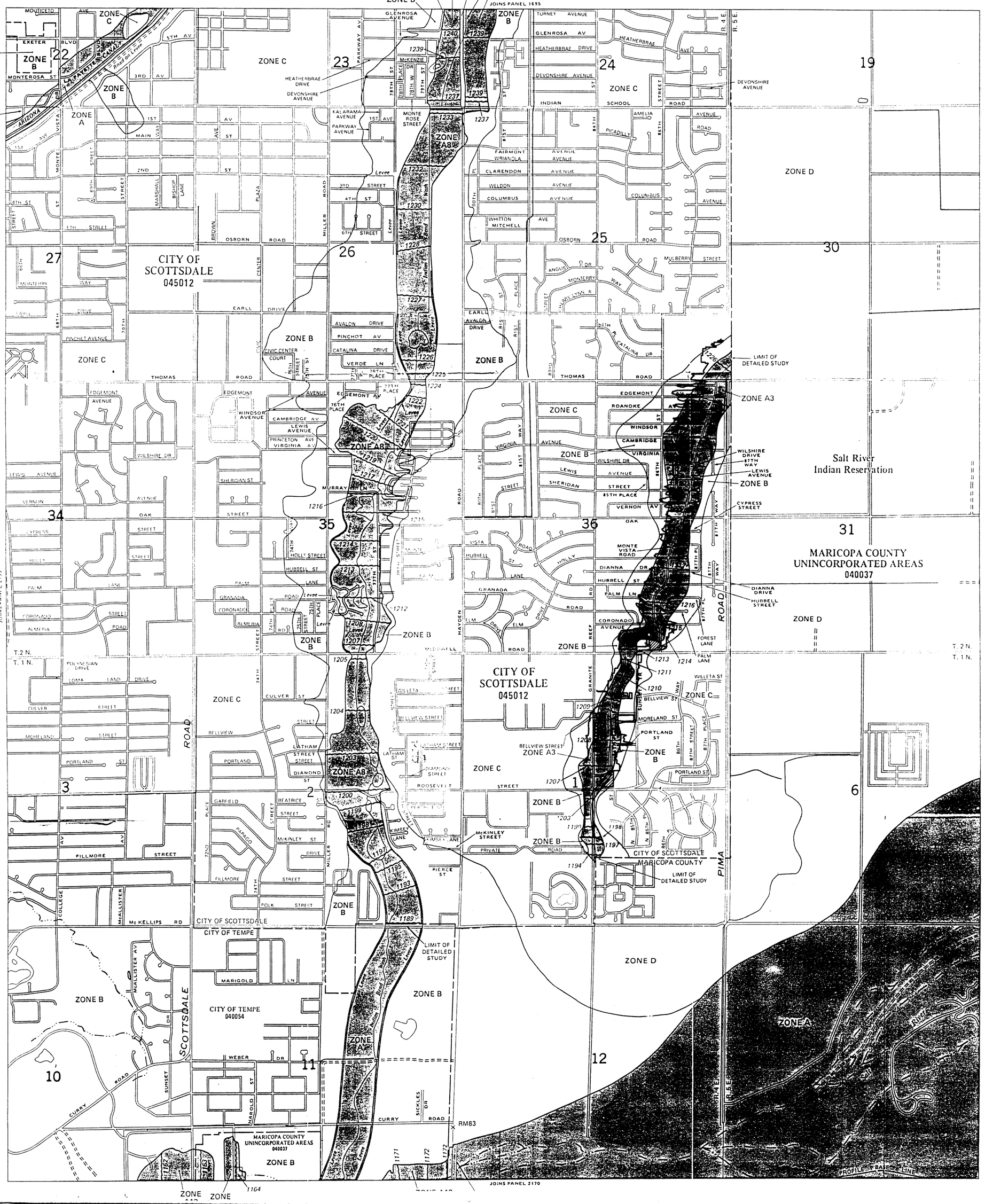
100 Scale Mapping:Michael Baker Jr., Inc.
Flight Date: NOV., 1993

THE CONTOURS AND PLANIMETRICS FOR THE 100 SCALE MAPPING WERE PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1" 100' HORIZONTAL SCALE AND 1 CONTOUR INTERVAL.

EXHIBIT 7

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT NGVD)	DESCRIPTION OF LOCATION
RM83	1374.96	Top of pavement at centerline intersection of Hayden Road and Princess Drive West.



KEY TO MAP

500-Year Flood Boundary
100-Year Flood Boundary
Zone Designations — ZONE B / ZONE B
100-Year Flood Boundary
500-Year Flood Boundary
Base Flood Elevation Line With Elevation In Feet** — 513
Base Flood Elevation In Feet Where Uniform Within Zone** — (EL 987)
Elevation Reference Mark — RM7×
Zone D Boundary
River Mile — •M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flood hazards, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Certain areas not in the Special Flood Hazard Areas (zones A and V) may be protected by flood control structures.

Coastal base flood elevations apply only landward of the shoreline.

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 the map.

For community map revision history prior to countywide mapping, see Section 5.4 of the Flood Insurance Study Report.

For adjoining map panels, see separately printed Map Index.

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP

APRIL 15, 1988

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

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

APPROXIMATE SCALE IN FEET

2160

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA AND INCORPORATED AREAS

PANEL 2160 OF 4350

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY UNINCORPORATED AREAS	040037	2160	D
SCOTTSDALE, CITY OF	045012	2160	D
TEMPE, CITY OF	040054	2160	D

MAP NUMBER
04013C2160 D

EFFECTIVE DATE:
APRIL 15, 1988

EXHIBIT 8

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

GRANITE REEF WASH FLOODPLAIN DELINEATION STUDY

FCD 95-29

TECHNICAL DATA NOTEBOOK HYDRAULICS

MAY 1997

Registered Professional Engineer (Civil)
CERTIFICATE NO.
29737
HERNAN A.
ARISTIZABAL
Date Signed 5/22/97
ARIZONA, U.S.A.

Prepared by

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

Registered Professional Engineer (Civil)
CERTIFICATE NO.
10283
SAMUEL E.
KAO
Date Signed 5/22/97
ARIZONA, U.S.A.

GRANITE REEF WASH
FLOODPLAIN DELINEATION STUDY
FCD 95-29

TECHNICAL DATA NOTEBOOK
HYDRAULICS

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D. Cross Section Plots
E. HEC-2 Outputs and Detailed Calculations
F. Flood Profiles
G. Floodplain and Floodway Maps (Reduced Size)
H. Draft Flood Insurance Study Report

Registered Professional Engineer (Civil) CERTIFICATE NO. 10283 SAMUEL E. KAO Date Signed 5/22/97 ARIZONA, U.S.A.

Registered Professional Engineer (Civil) CERTIFICATE NO. 29737 HERNAN A. ARISTIZABAL Date Signed 5/22/97 ARIZONA, U.S.A.

GRANITE REEF WASH
FLOODPLAIN DELINEATION STUDY
PREFACE

The Granite Reef Wash Floodplain Delineation Study (Contract No. FCD 95-29) was performed for:

Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009
(602)506-1501 FAX (602)506-4601

Floodplain Management Branch
Branch Manager: Mr. Pedro Calza
Project Manager: Mr. Maximo DeVera

By:

Entellus, Inc.
2255 N. 44th Street, Suite 330
Phoenix, Arizona 85008
(602) 244-2566 FAX (602)244-8947

Project Manager: Samuel E. Kao, Ph.D., PE
Project Engineer: Hernan A. Aristizabal, PE

GRANITE REEF WASH
FLOODPLAIN DELINEATION STUDY

FCD 95-29

TECHNICAL DATA NOTEBOOK
HYDRAULICS

INTRODUCTION

The hydraulic analysis presented in this report is for Granite Reef Wash, from approximately 1,700 feet north of McKellips Road to Thomas Road, within the City of Scottsdale, Maricopa County, Arizona. The analysis was performed by Entellus, Inc. for the Flood Control District of Maricopa County (District) under Contract FCD 95-29. As stated in the Contract, the limit of study for the south end of the reach was set at the confluence with McKellips Road. However, during the Coordination Meeting on October 23 1996, both the Flood Control District of Maricopa County and the City of Scottsdale decided to move the limit of study to approximately 1,700 feet north of McKellips Road, due to lack of funding for additional hydrologic analysis that would be required in the upstream area of the Well Site Culvert. Meanwhile, the north end of the delineation boundary was extended to the east side of Pima Road, just north of Thomas Road to match what was shown on the current FIRM map.

The study area is located in the southeast corner of the City of Scottsdale, within Section 1, Township 1 North, Range 4 East, and Section 36, Township 2 North, Range 4 East, Gila and Salt River Base and Meridian, Maricopa County, Arizona. (See **Figure 1**)

The study area is a fully developed desert area bounded by Thomas Road on the north, the Salt River Indian Reservation on the south, Pima Road on the east, and Granite Reef Road on the west. Drainage of the area is generally from north to south.

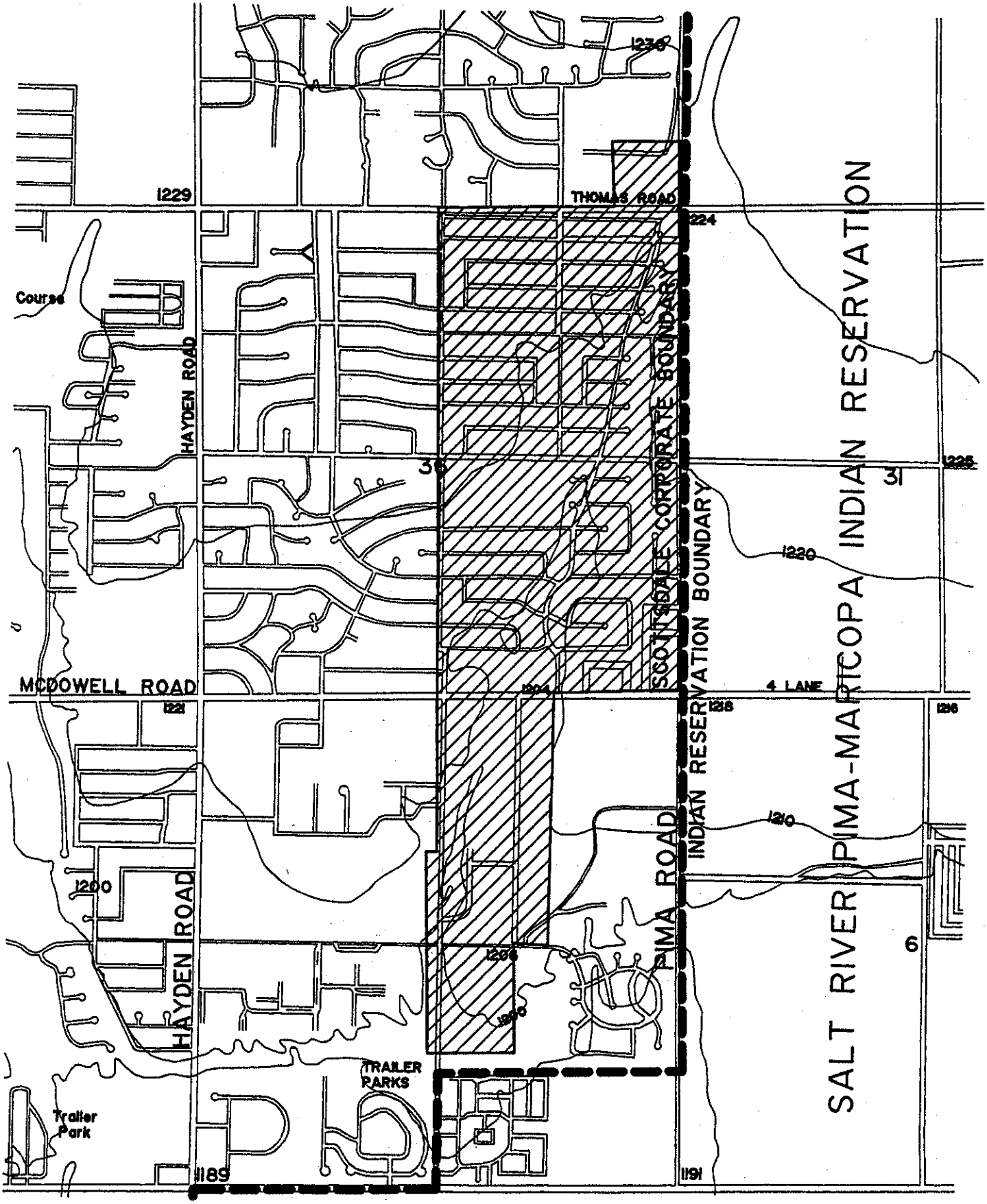

FIGURE 1
VICINITY MAP

The natural drainage pattern of the study area has been significantly altered since the development of this community. Presently, runoff is conveyed mostly by roadways built in the stream bed of the old wash. In addition, roadway and culvert construction in conjunction with urbanization have greatly affected the natural peak discharges throughout the study area.

Climate of the study area is characterized by hot summer, mild winter and infrequent rainfall. The mean annual rainfall is about 8.5 inches, falling normally in two seasons. One season, primarily resulting from local convective storms, lasts from July to mid-September; the other season, mainly formed by cyclonic (frontal) storms, extends from December through March. Of the two types of storms, the summer convective storm is considered to be the more critical flood producing event in this area.

SECTION 1: GENERAL DOCUMENTATION AND CORRESPONDENCE

The contact reports, meeting minutes and reports, general correspondence and contract documents of this project are presented in this section under appropriate subheadings.

Granite Reef Wash
Floodplain Delineation Study
FCD 95-29

Technical Data Notebook
Hydraulics

Section 1: General Documentation and Correspondence

1.1 Contact (Telephone) Reports

1.2 Meeting Minutes and Reports

1.3 General Correspondence

1.4 Contract Documents

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File

FROM: H.A. Aristizabal

JOB: Granite Reef Wash Floodplain Delineation Study

JOB NO.: 310.45

DATE: January 18, 1996

MEMORANDUM

Reference Digital Mapping Coordination

The following is a summary of my telephone and personal contact with Karen Lockhart, System coordinator for city of Scottsdale, pertaining digital mapping and file transfer procedures.

1. Digital Transfer Media

According to Lockhart, the city's preferred way of transferring digital data is by use of the Colorado Backup tape drive or a Zip drive. AGK has neither of these systems at the time. However, a portable 150 megabyte Bernoulli drive is available and can be connected to any computer parallel port. For the initial digital mapping transfer, it was agreed that the City will compress the drawing files and place them in 3.25-inch diskettes. For any future transfer of files larger than what can be put in a floppy, AGK will make its Bernoulli drive available.

2. Digital Mapping

On January 17, AGK received eight floppy diskettes containing the following Quarter Section drawings in Intergraph format: 1147, 1148, 1247, 1248, 1347, 1348, 1448 and 1548. These drawings have been transferred to AGK computers and retrieved successfully. The digital maps received did not include the footprint of buildings. According to Lockhart the mapping is not completed and these features may not be available immediately. She will check and provide AGK with any available data as soon as they become available.

3. Hard Copy Mapping

As of January 18, AGK has not receive the color aerial maps. However, AGK received a set of blue lines of the study area from Bill Erickson on January 5, 1996.

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File

FROM: S. E. Kao

JOB: Granite Reef Wash Delineation

JOB NO.: 310.45

DATE: 1-26-96

MEMORANDUM

AGK picked up the color aerial map from Karen Lockhart's office this afternoon. The color aerial map does not have the contour lines.

ENGINEERS, INC.
2255 N. 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File
FROM: H. A. Aristizabal

JOB: FCDMC Granite Reef Flood Insurance Study JOB NO.: 310.45

DATE: February, 1996

MEMORANDUM

Reference: Telephone Conversations with Bill Erickson and Karen Lockhart

I called Bill Erickson of the City of Scottsdale to ask if he had the as-build plans for the two sections of storm drain in the Granite Reef area. He didn't know if they were available but said that he was going to have their records people locate then and then let us know.

I also called Karen Lockhart and asked if they have the street names to go with the digital maps we received earlier. She didn't' know but she say she was going to check. Later she called back to let us know that they were available and we could pick the disk at any time.

H:\granire\021696.MEM

ENGINEERS, INC.
2255 N. 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File
FROM: H. A. Aristizabal

JOB: FCDMC Granite Reef Flood Insurance Study JOB NO.: 310.45

DATE: March 1, 1996

MEMORANDUM

Reference: Telephone Conversation with Karen Lockhart

Karen Lockhart of the City of Scottsdale GIS Department called today. The digital mapping including the street names are ready to be picked up. Also, I asked if the area where the streets were missing was ready. She said that they had a corrupted file and had requested Baker to send anothere disk to cover that missing arae. She is expecting to have it back in a couple of weeks and she will let us know whenever it is ready.

H:\granire\030196.MEM

Entellus™
225[illegible] 44th St., Suite 330
Ph[illegible], AZ 85008
Phone (602)244-2566
Fax (602)244-8947

LETTER OF TRANSMITTAL

DATE	JOB NO. 310.45
ATTENTION	Mr. John Courtney
RE:	Granite Reef Wash Survey

TO: City of Scottsdale
9191 East San Salvador
Scottsdale, AZ 85258

WE ARE SENDING YOU ✖ Attached ☐ Under separate cover via _____ the following items:

☐ Shop Drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

✖ Copy of Letter ☐ Change Order ✖ Map

COPIES	DATE	NO.	DESCRIPTION
1	Mar. 15	1	Copy of letter send to Mr. Bill Erickson dated March 15, 1996
1		1	Exhibit A map showing requested survey locations

THESE ARE TRANSMITTED as checked below:

☐ For Approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

✖ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

✖ As Requested ☐ Returned for corrections ☐ Return _____ corrected prints

☐ For review and comment ☐ _____

☐ FOR BIDS DUE _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS: I'm sending the map as requested. Also I'm sending a copy of the letter with our survey request. If you have any questions please contact me. Thanks

COPY TO: _____

SIGNED Hernan A. Aristizabal, P.E.

(If enclosures are not as noted, kindly notify us at once.)

She

John.
Here is Vertical Control Requested by Entellus
— Brian

Elevation NGVD 29	NAVD 88	Description
1230.90	1232.73	C.O.S. Brass cap in hand hole int. Thomas & Granite Reef Roads
1224.29	1226.12	C.O.P. Brass cap in hand hole int. Thomas & Pima Roads
1225.18	1227.01	Maricopa County Brass cap in hand hole int. Oak Street & Granite Reef Road
1216.27	1218.10	Maricopa County Brass cap in hand hole int. McDowell & Granite Reef Roads
1219.75	1221.58	1/2" iron pin in concrete in hand hole int. McDowell & Pima Roads
1209.21	1211.04	C.O.S. Brass cap in hand hole int. Roosevelt Street & Hayden Road
1200.87	1202.70	C.O.S. Brass cap in hand hole int. Roosevelt Street & Granite Reef Road
1188.52	1190.35	Brass cap in hand hole int. McKellips & Hayden Roads
1186.23	1188.06	Arizona Department of Transportation Brass cap int. McKellips Road & Granite Reef alignment

RECEIVED
MAY 16 1996
Entellus

WHILE YOU WERE OUT

TO John Courtney
DATE 5-15-96 TIME 10:30
FROM
AREA CODE NUMBER
OF Please Call Back
EXTENSION

MESSAGE
Herman Aristizabal
STATUS on Granite Reef
Wash ?? (Flood Ins)
ph: 244-2566
SIGNED Em

URGENT ☐ RETURNED CALL ☐ CALL BACK ☐ WILL CALL AGAIN ☐ PHONED ☐ WANTS TO SEE YOU ☐ WAS IN ☐

AMPAD NO. 23-776 400 SETS RECYCLED PAPER

CITY OF SCOTTSDALE ARIZONA
"Most Livable City"
U.S. Conference of Mayors

JOHN E. COURTNEY, R.L.S.
FIELD ENGINEERING MANAGER

CITY OF SCOTTSDALE
INSPECTION SERVICES
9191 E. SAN SALVADOR
P.O. BOX 1000
SCOTTSDALE, AZ 85252

(602) 391-5757
(602) 391-5704 FAX

ACK ENGINEERS, INC.

FAX

Date: 11-4-96 Send to: (602) 391-5704 (FAX #)

Project Name/Number: Granite Reef Wash Delineation/ 310.45

Total # of pages including the cover sheet: 4

PLEASE DELIVER THE FOLLOWING PAGES TO:

Attention: Mr. John Courtney, R.L.S.

Organization: Field Engineering Manager, City of Scottsdale

Subject of Transmission: ① Meeting Minutes for Oct. 23, 1996
② Request for certification of ERM's (11-4-96)

Comments: Your assistance on this is greatly appreciated.

Sender: Sam Kao

FAXED 11-5-96

IF YOU HAVE ANY PROBLEMS RECEIVING THIS DOCUMENT, PLEASE CALL US AT (602) 244-2566.

2255 North 44th Street • Suite 330 • Phoenix, Arizona 85008
Phone (602) 244-2566 • FAX (602) 244-8947

John.

HERE IS VERTICAL CONTROL REQUESTED BY ENTELLUS

—BRIAN

Shee

Elevation NGVD 29	NAVD 88	Description
1230.90	1232.73	C.O.S. Brass cap in hand hole int. Thomas & Granite Reef Roads
1224.29	1226.12	C.O.P. Brass cap in hand hole int. Thomas & Pima Roads
1225.18	1227.01	Maricopa County Brass cap in hand hole int. Oak Street & Granite Reef Road
1216.27	1218.10	Maricopa County Brass cap in hand hole int. McDowell & Granite Reef Roads
1219.75	1221.58	1/2" iron pin in concrete in hand hole int. McDowell & Pima Roads
1209.21	1211.04	C.O.S. Brass cap in hand hole int. Roosevelt Street & Hayden Road
1200.87	1202.70	C.O.S. Brass cap in hand hole int. Roosevelt Street & Granite Reef Road
1188.52	1190.35	Brass cap in hand hole int. McKellips & Hayden Roads
1186.23	1188.06	Arizona Department of Transportation Brass cap int. McKellips Road & Granite Reef alignment

RECEIVED
MAY 1 6 1996
Entellus

11-4-96

John:

Please certify the above ERM's and forward us three copies of your sealed certification. Also, please include the coordinates for the above ERM's.

Thanks.

Sam Kao

CITY OF SCOTTSDALE ARIZONA

"Most Livable City"
U.S. Conference of Mayors

JOHN E. COURTNEY, R.L.S.
FIELD ENGINEERING MANAGER

CITY OF SCOTTSDALE
INSPECTION SERVICES
9191 E. SAN SALVADOR
P.O. BOX 1000
SCOTTSDALE, AZ 85252

(602) 391-5757
(602) 391-5704 FAX

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
e (602)244-2566
(602)244-8947

TO: File

FROM: S.E. Kas

JOB NO: 310.45

DATE: 12-9-96

JOB FCDMC - Granite Reef Wash Delineation

MEMORANDUM

Entellus received the certified mapping (copy) from the City of Scottsdale through Maximo DeVera this afternoon.

Entellus
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: File

FROM: HAA

JOB NO: 310.45

DATE: 12-16-96

JOB FCDMC - Granite Reef Wash

MEMORANDUM

Entellus received the survey correction for the x-sec. verification this morning

AGK ENGINEERS, INC
2255 N. 44th Street Suite)
PHOENIX, ARIZONA 85008

(602) 244-2566
Fax (602) 244-8947

LETTE[OF TRANSMITTAL

TO FCDMC

DATE 2-29-96 | JOB NO. 310.45

ATTENTION Mr. Maximo De Vera

RE: Granite Reef Wash Delineation
FCD No. 95-29

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO.	DESCRIPTION
1	2-29-96		Preliminary Estimation of Manning's n Values

THESE ARE TRANSMITTED as checked below:

☒ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☐ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☒ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19 _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

COPY TO Mr. Bill Erickson, P.E.
w/ One Copy of Prelim. Est. Report

SIGNED: Samuel Kao

If enclosures are not as noted, kindly notify us at once.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Ph (602)244-2566
Fax (602)244-8947

LETTER OF TRANSMITTAL

DATE	April 26, 1996	JOB NO.	310.45
ATTENTION	Mr. Maximo De Vera		
RE:	HEC-2 files for plotting		

TO: FCDMC

2801 West Durango

Phoenix, AZ 85009

WE ARE SENDING YOU ✖ Attached ☐ Under separate cover via _____ the following items:

☐ Shop Drawings ☐ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of Letter ☐ Change Order ✖ Disk files

COPIES	DATE	NO.	DESCRIPTION
1	4/26/96	1	Diskette with Granite Reef HEC-2 preliminary model

THESE ARE TRANSMITTED as checked below:

☐ For Approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

✖ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

✖ As Requested ☐ Returned for corrections ☐ Return _____ corrected prints

☐ For review and comment ☐ _____

☐ FOR BIDS DUE _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS: I'm sending the HEC-2 for Granite Reef for you to plot the X-sec as discussed in the last progress meeting. Please let me know if you have any questions.

COPY TO: _____

SIGNED Hernan A. Aristizabal, P.E.

(If enclosures are not as noted, kindly notify us at once.)

1/2

FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

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

COVER SHEET

TO: SAM KAO / HERNAN

Company or Department: ENTELLUS Fax # (602)-244-894

FROM: MAX DE VERA

Number of pages being sent including Cover Sheet: 2

Comments: Herewith are my comments on previous submittals. PAC is not in today. I'll discuss with him as soon as he reports.

2/2

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
ENGINEERING DIVISION
HYDROLOGY BRANCH

Interoffice Memorandum

Nov. 4, 1996

To : PAC Cc: AMM, Entellus

From: MRD

SUBJECT: COMMENTS ON MANNING'S VALUE ESTIMATION REPORT AND PRELIM HEC-2 MODEL SUBMITTAL BY ENTELLUS FOR GRANITE REEF WASH FLOODPLAIN DELINEATION STUDY.

1. With the concrete lined channel in place along the Indian Reservation Mobile Home Site the value of Manning's roughness of the channel is expected to decrease. The "n" value used seems high for this condition.

2. Comparison of "n" values of the left and right banks of Reaches 3,4 & 8 shows that the "n" values for left bank vary widely, ie. 0.015, .005 and .045, respectively. Since the housing development in this area may be assumed similar based on the photographs the effect of obstruction could be either appreciable or severe (ref: to Manning's n Estimation Report dated Feb. 1996).

3. A check on the culvert capacity using HY8 culvert program at the well site near the northwest corner of the Indian reservation mobile home shows that culvert flow when headwater elevation is 1197.12' (below top of culvert cover) is 700 cfs before overtopping occurs. It was noted that in the HE-2 output QCULV = 290 and QWEIR = 1121. With such difference in computed flow through the box culvert, data used may be re-assessed.

4. Review of cross-section plots using HECRAS shows that several sections have the left bank and right bank stations located at about the same elevation as the channel center. This has resulted to extended boundaries. A re-location may reduce the amount of extended boundary. Some identified cases are Sections 26,27, and 51

5. With several divided flow situations in the model the split flow option may be activated using an SF card which precedes other split flow data cards and terminated by an EE card. The HEC-2 standard data cards immediately follows the EE card.

Note: A copy of this memo is being faxed to Entellus for their consideration.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: M. DeVera

FROM: Aristizabal/Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD 95-29)

DATE: 11/14/96

MEMORANDUM

RE: Response to District's Comments on HEC-2 Modeling

The following is the response to the District's memorandum of comments, dated November 4, 1996, on Manning's n value report and the preliminary HEC-2 modeling for the Granite Reef Wash Floodplain Delineation Study (FCD 95-29). The numbering system corresponds to that appeared on the District's memorandum.

1. As the city decided to improve the existing earthen channel of Reach 1 with concrete lining, the Manning's n value for this reach has been revised to 0.020, which is within the range as recommended in the District's Drainage Design Manual, Volume II. However, n values for the left and right overbanks remain to be the same as before.

2. The comments stated that the n-values for the left and right overbanks in Reaches 3, 4, and 8 are 0.015, 0.005 and 0.045, respectively. However, these values were not used anywhere in the model. The n-values used in the model for Reaches 3,4 and 8 are:

Reach No.	Right (West) Overbank	Left (East) Overbank	Channel
3	0.046	0.057	0.018
4	0.045	0.045	0.018
8	0.055	0.055	0.018

The overbank n-values for Reaches 3 and 4 are less than that for Reach 8 because considerable amount of obstruction (vegetation, fences, etc.) were observed in Reach 8. There are no fences in Reaches 3 and 4 and the vegetation consists of mostly palm trees which present little obstruction to the flow. (Pictures are included in the n-value report).

The n-value report dated February, 1996 was prepared before the cross-sections were modified to exclude structures from the cross sections. The report adopted higher n-values to compensate for the reduced flow area due to structures. A copy of the revised n-value report is attached with this memo.

3. The HEC-2 output indicates that the water surface elevation at the downstream end of the well site culvert is 1199.11 or 9.91 feet above the invert of the culvert. Also at a given flow of 1411 cfs, runoff would not be confined to the channel, and hence the length of weir would not coincide with the channel width. The HEC-2 model assumes that the weir extends from the wall at the mobile home park to the wall at the Indian Reservation. Also, the ground on the left and right of the culvert is lower than the top of the culvert, therefore more flow owuld be allowed to run over the weir. Included is a copy of the HY8 runs considering tail water and weir conditions. As indicated below, results from both HEC-2 and HY8 are similar:

Model Type	**Culvert Flow (cfs)**	**Weir Flow (cfs)**
HEC-2	290	1121
HY8	312	1103

The coefficient of entrance loss for the HEC-2 model was modified to account for the bends inside the culvert. This modification probably accounts for the 22-cfs difference in flows between the two models.

Your fax, dated 11/14/96, included the results from a HEC-RAS model developed from a transformed HEC-2 file. However, HEC-RAS cannot transform culvert data correctly and we are not sure if the results are meaningful without seeing the input.

4. Cross-sections 26, 27 and 51 are all associated with culvert inlets or outlets. For these cross-sections, X3 cards were used to limit the flow area to the bank stations (width of the culvert) until road overtopping occurs. The width of the culvert determines the location of the bank stations and it should not be relocated. We believe that this is a correct way to model culverts using the special culvert routine (See HEC-2 Users Manual).

5. The overbank areas of Granite Reef Wash consist of a developed area with multiple buildings, fences, alleys and other structures that divide the flow into a network of interconnecting channels. HEC-2 is not capable of handling divided flows. The split flow option in HEC-2 reduces the flow downstream by assuming that any flow that leaves the channel would become diversion flow. Flooding potential from this split flow is unknown and would require additional HEC-2 modeling of each split flow path. Also, it would be too difficult to determine the entrance and exit points.

Granite Reef Wash Well Site Culvert

CURRENT DATE: 11-14-1996 FILE DATE: 11-13-1996
CURRENT TIME: 10:25:43 FILE NAME: GR-WELL

FHWA CULVERT ANALYSIS
HY-8, VERSION 4.1

CULV	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	1189.59	1189.29	137.00	1 RCB	13.00	7.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: GR-WELL DATE: 11-13-1996

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
1189.59	0	0	0	0	0	0	0	0	1
1192.21	141	141	0	0	0	0	0	0	1
1193.72	282	282	0	0	0	0	0	0	1
1195.00	423	423	0	0	0	0	0	0	1
1195.64	500	500	0	0	0	0	0	0	1
1197.18	706	706	0	0	0	0	0	0	1
1197.83	847	803	0	0	0	0	0	40	5
1198.12	988	816	0	0	0	0	0	168	4
1198.51	1129	705	0	0	0	0	0	419	5
1198.86	1270	574	0	0	0	0	0	700	3
1199.35	1411	312	0	0	0	0	0	1103	6
1197.41	740	740	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: GR-WELL DATE: 11-13-1996

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
1189.59	0.00	0	0	0.00
1192.21	0.00	141	0	0.00
1193.72	0.00	282	0	0.00
1195.00	0.00	423	0	0.00
1195.64	0.00	500	0	0.00
1197.18	0.00	706	0	0.00
1197.83	-0.01	847	4	0.49
1198.12	-0.00	988	3	0.32
1198.51	-0.00	1129	5	0.43
1198.86	0.00	1270	-4	-0.34
1199.35	0.00	1411	-4	-0.30

<1> TOLERANCE (FT) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 11-14-1996
CURRENT TIME: 10:25:43

FILE DATE: 11-13-1996
FILE NAME: GR-WELL

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (13 BY 7.5) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	OUTLET DEPTH (ft)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
0	1189.59	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
141	1192.21	2.36	2.62	2-M2c	1.58	1.54	7.03	1.54	5.21	0.71
282	1193.72	3.75	4.13	2-M2c	2.51	2.45	8.86	2.45	6.37	1.71
423	1195.00	4.95	5.41	2-M2c	3.31	3.21	10.14	3.21	7.13	2.71
500	1195.64	5.53	6.05	3-M2t	3.73	3.59	10.37	3.71	7.46	3.71
706	1197.18	6.99	7.59	3-M2t	4.76	4.52	11.52	4.71	8.18	4.71
803	1197.83	7.68	8.24	3-M1t	5.23	4.92	10.82	5.71	8.59	5.71
816	1198.12	7.78	8.53	3-M1t	5.30	4.98	9.36	6.71	8.95	6.71
705	1198.18	6.99	8.59	3-M1f	4.76	4.52	7.24	7.50	9.27	7.71
574	1198.85	6.06	9.26	4-FFt	4.10	3.93	5.88	7.50	9.56	8.71
312	1199.36	4.02	9.77	4-FFt	2.68	2.62	3.20	7.50	9.82	9.82

El. inlet face invert 1189.59 ft El. outlet invert 1189.29 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

```
***** SITE DATA ***** CULVERT INVERT **************
      INLET STATION (FT)                        0.00
      INLET ELEVATION (FT)                   1189.59
      OUTLET STATION (FT)                     137.00
      OUTLET ELEVATION (FT)                  1189.29
      NUMBER OF BARRELS                         1
      SLOPE (V-FT/H-FT)                         0.0022
      CULVERT LENGTH ALONG SLOPE (FT)         137.00

***** CULVERT DATA SUMMARY ************************
      BARREL SHAPE          BOX
      BARREL SPAN            13.00 FT
      BARREL RISE             7.50 FT
      BARREL MATERIAL       CONCRETE
      BARREL MANNING'S N    0.012
      INLET TYPE            CONVENTIONAL
      INLET EDGE AND WALL   SQUARE EDGE (30-75 DEG. FLARE)
      INLET DEPRESSION      NONE
```

CURRENT DATE: 11-14-1996
CURRENT TIME: 10:25:43

FILE DATE: 11-13-1996
FILE NAME: GR-WELL

TAILWATER

TAILWATER RATING CURVE

FLOW(CFS)	W.S.E.(FT)	DEPTH (FT)
0	1189.29	0.00
141	1190.00	0.71
282	1191.00	1.71
423	1192.00	2.71
500	1193.00	3.71
706	1194.00	4.71
847	1195.00	5.71
988	1196.00	6.71
1129	1197.00	7.71
1270	1198.00	8.71
1411	1199.11	9.82

ROADWAY OVERTOPPING DATA

WEIR COEFFICIENT 2.70
EMBANKMENT TOP WIDTH (FT) 100.00
***** USER DEFINED ROADWAY PROFILE

CROSS-SECTION COORD. NO.	X (FT)	Y (FT)
1	0.00	1200.00
2	1.00	1197.67
3	67.00	1197.83
4	199.00	1197.41
5	200.00	1200.00

Granite Reef Wash
Floodplain Delineation Study
FCD 95-29

Technical Data Notebook
Hydraulics

Section 1: General Documentation and Correspondence

1.1 Contact (Telephone) Reports

1.2 Meeting Minutes and Reports

1.3 General Correspondence

1.4 Contract Documents

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File

FROM: H.A. Aristizabal

JOB: Granite Reef Wash Floodplain Delineation Study

JOB NO.: 310.45

DATE: December 14, 1995

MEMORANDUM

Reference Kick-off meeting at Flood Control District of Maricopa County. 10:00 a.m., December 14, 1995

Attendees:

Pedro Calza	FCDMC
Amir Motamedi	FCDMC
Samuel Kao	AGK
Hernan Aristizabal	AGK

The following is a summary of the discussion and conclusion of the kick-off meeting:

1. Project Coordination

The District's project manager Maximo DeVera was not present at the meeting. According to Calza, he won't be available for another month. AGK was instructed to proceed with the project and direct any questions or concerns to Calza until DeVera returns.

2. Reference Materials

At this meeting AGK received the following documents from the District:

- Interim Report on Survey for Flood Control, Indian Bend Wash, U.S. Army Corps of Engineers, April 15, 1962.
- Granite Reef Wash Drainage Study, KVL Consultants, Inc. February, 1995.
- Granite Reef Wash Drainage Study, Simons Li & Associates, Inc. June, 1995.
- Summary of Drainage Reports prepared by both Simons Li and KVL

  Consultants.
- Copy of basin description and HEC-1 model prepared by Boyle Engineering.

  Copy of Peak Discharges published by FEMA.

3. Project Schedule

Project Schedule will be submitted by AGK to the district by December 21, 1995 in accordance with the contract. AGK intends to follow the projected billing as presented in the proposal, but Calza pointed out that a lot of coordination at the beginning of the project which may drive the billing for this period higher.

4. Legal Advertisement

Legal advertising needs to be placed in the Scottsdale Progress and another paper. It was suggested that the other paper may be the newsletter published by the Indian Community. Timing and wording of the advertisement will be further discussed at the meeting with the City of Scottsdale.

5. Mapping Information

Mapping for the area will be provided by the City of Scottsdale. If the City does not have the mapping information, the District will obtain the mapping from Somons Li.

6. Meeting with City of Scottsdale

The meeting with City of Scottsdale officials was tentatively set on the first week of January 1996. The District will confirm the date with the City and notify AGK accordingly.

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File

FROM: H.A. Aristizabal

JOB: Granite Reef Wash Floodplain Delineation Study

JOB NO.: 310.45

DATE: January 4, 1996

MEMORANDUM

Reference Coordination Meeting at the City of Scottsdale
2:00 p.m., January 4, 1996

Attendees:

Bill Erickson	City of Scottsdale
Alex ~~Max~~ McLaren	City of Scottsdale
Pedro Calza	FCDMC
Afshin Ahouraiyan	FCDMC
Samuel Kao	AGK
Hernan Aristizabal	AGK

The following is a summary of the discussion and conclusion of the above-referenced meeting:

1. Hydrology

It was agreed in this meeting that the previous flood insurance peak flow rate at McKellips Road will be used for the first run. A flood way run is not necessary in this area since it is fully developed; therefore, the second run will be made using a different flow. This flow will be determined after the first run is completed and the results are reviewed.

2. Submittals

To expedite the review process, Calza and Erickson requested that all submittals to the District be duplicated and sent to the City concurrently. Erickson also requested that prior to starting the two dimensional modeling, the input parameters shall be submitted and approved by the City.

3. Legal Advertisement and Public Meeting

Legal advertising will be placed in the Scottsdale Tribune and The Arizona Republic. AGK Engineers will handle the advertisement according to the format to be provided by the District. The District will send a letter to the Indian Community informing them of the on-going study. The City will hold the public meeting after the study results have become available.

4. Mapping Information

Erickson will provide AGK the color aerial photographs as well as blueline of topographic mapping. Digital mapping will be provided by the City in Intergraph format. To obtain digital mapping, AGK will contact Karen Lockhard of the City's GIS Department to arrange delivery.

5. Survey Coordination

The City will provide survey services for this project. For the initial map verification and EMR identification, AGK will coordinate directly with John Courtney. Any additional survey will have to be coordinated through Bill Erickson.

6. Site Visit

A site visit will be scheduled after AGK has had the opportunity to review the mapping.

MINUTES OF MEETING ON GRANITE REEF WASH FOODPLAIN DELINEATION

DATE : January 4, 1996

PRESENT:

Afshin Ahouraiyan ... FCDMC (506-1501)
Hernan Aristobal ... AGK (244-2566)
Bill Erickson ..... City of Scottsdale (994-7652)
Alex McLaren ..... " " " (994-7099)
Pedro Calza .....FCDMC (506-1501)
Sam Kao.....AGK (244-2566)

1. The hydraulic model will be based on FEMA flows. There will not be a floodway designation run, however a second hydraulic run will consider the effects of increasing the FEMA flows as appropriate.

2. No public meeting will take place before the start of the study. The study will be advertised in Scottsdale Tribune & Phoenix Gazette as a study per FEMA standards. Public meeting will be scheduled after some preliminary results are produced.

3. Bill Erickson will be point of contact at City of Scottsdale for technical review of the project. John Courtney will be the City's point of contact for surveying purposes (391-5757).

4. Mapping will be provided to the consultant through the City of Scottsdale GIS department.

5. A courtesy letter should be written to the Indian Community, notifying them of the study. Nona Bishop is the point of contact. FCD will draft and mail this letter.

6. An extra copy of the submittals will be made & delivered to the City of Scootsdale for their review and comments.

Minutes by : AA
MRD-01/09/1996

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File

FROM: S. E. Kao

JOB: Granite Reef Wash Floodplain Delineation Study

JOB NO.: 310.45

DATE: February 5, 1996

MEMORANDUM

Reference: Field Reconnaissance

Attendees:

Bill Erickson	City of Scottsdale
Maximo DeVera	FCDMC
Hernan Aristizabal	AGK
Samuel Kao	AGK

A field reconnaissance was conducted for the full study reach on January 29, 1996. The purpose of the field reconnaissance was to observe the channel and floodplain conditions for estimation of Manning's "n" values; and the possible overflow areas. Features such as channel cross sections, culverts, hydraulic structures and other pertinent elements were documented by photographs and video tape.

The following issues were discussed and concluded during the field reconnaissance:

HEC - 2 Modeling

It was decided that the study reach should first be modeled by means of the HEC-2 computer program in order to obtain some initial knowledge on flow depth and water surface elevation in the channel and its adjacent floodplain. The initial water surface at McKellips Road can be set at critical depth.

Survey Request

AGK will prepare a request for field survey and submit it to the City of Scottsdale (City) for review and approval. Once the request is approved by the City, the City crew will conduct the field survey.

As-built Plans

The City will furnish AGK the as-built plans for the existing storm sewer and related hydraulic structures. Any missing information will be picked up by the City crew during the field survey.

Field Reconnaissance Report

A report will be prepared by AGK to document the field reconnaissance and to estimate the Manning's "n" values for various reaches of the project.

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, AZ 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

TO: File

FROM: H.A. Aristizabal

JOB: Granite Reef Wash Floodplain Delineation Study

JOB NO.: 310.45

DATE: February 29, 1996

MEMORANDUM

Reference Coordination Meeting at Entellus office
3:00 p.m., February 29, 1996

Attendees:

Pedro Calza	FCDMC
Maximo De Vera	FCDMC
Dave Meinhart	City of Scottsdale
Samuel Kao	AGK
Hernan Aristizabal	AGK

The following is a summary of the discussion and conclusion of the above-referenced meeting:

1. **Deliverables**

Entellus delivered a copy of the Affidavit of Publication of the legal advertisement to the district and copies of the preliminary n-value report to both the District and the City.

2. **Base Map Preparation**

Entellus pointed out that digital mapping transfer has been difficult. The mapping is in a GIS system database and the features desired must be singularly specified. Therefore, several interactions have to be made in order to obtain all the desired features. Some of the desired feature such as building footprints and fences are still not furnished by the City at this time and may not be available before the final submittal for this project.

3. **Survey Coordination**

The floodplain boundaries at the downstream end of the project are likely to include the Indian Reservation mobil home park east of the wash. Mapping in this area is not available. Calza suggested to supplement the mapping with survey in this area. Since this area is in the Indian Reservation, permission must be obtained before any work can be done. Calza thinks that it will be better for Entellus to contact the Indian Community to obtain permission directly. However, the District will be willing to help in this effort.

4. Hydraulic Analysis

The methodology to be used for the hydraulic analysis was discussed. At this point, no particular methodology was decided. It is up to Entellus to make a recommendation as to how to model the flow in order to obtain reasonable attenuations in the watershed. Entellus suggested that the two dimensional model be partially used for areas where considerable attenuation is expected. Results of the two-dimensional modeling will be be used for the HEC-2 runs. The flow attenuation scheme will be submitted to both the District and the City for approval before any work is performed .

5. Project Schedule

Entellus is behind the proposed schedule at this point mainly because of problems for obtaining the digital mapping from the City. The District is concerned about this and wants Entellus to speed up the project to meet the scheduled project completion deadline.

6. Digital Cross-sections

The method of obtaining digital cross sections for the HEC-2 model was discussed briefly. Entellus wanted to know how feasible would it be to obtain photogrametric cross-section. Since the mapping was done by Baker, it was suggested to contact their local office directly to explore this possibility. Otherwise, the cross sections can be obtained from survey or by digitizing directly from the one-foot contour mapping.

After the meeting Entellus contacted Baker's local office and spoke to Bob Davies. He said that before they can do anything with the mapping, they have to have written permission from the City. He also said that the City has a DTM model that they can use to obtain the cross-sections. Davies said that once permission has been granted, they can give us an estimate and the job could be completed within a couple of weeks. He said that the job could be done in the local office.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: File

FROM: H. Aristizabal

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD 95-29)

DATE: April 25, 1996

MEMORANDUM

RE: Progress Meeting at FCDMC
2:00 p.m., April 23, 1996

Attendees:		
	Pedro Calza	FCDMC
	Maximo De Vera	FCDMC
	Bill Erickson	City of Scottsdale
	Samuel Kao	Entellus
	Hernan Aristizabal	Entellus

The following is a summary of the discussion and conclusion of the above-referenced meeting:

1. Mapping

Entellus has at this time hard copies of the area maps in a 1" =100' and 1"=200' scale and digital copies of the study area sections. However, Section 13-48 is missing some information. From conversation with Karen Lockhard there was a problem with the original file and the City did send it out for another copy from Baker. Entellus has not received an updated copy of this file at this time. Since the storage of Entellus' computer cannot handle the ortho maps, it was agreed during this meeting that the City will provide Entellus with a set 1"=200' mylar of the ortho maps for the study area. The City will also provide Entellus with a print of the section immediately upstream of the study area. (15-48).

2. 2-D Model

Entellus presented the preliminary 2-D Model developed for the study area during the meeting. However, it was agreed by all parties that the two dimensional model was not practical since the hydrology parameters required are unclear. De Vera has researched the available documentation and has not been able to find any hydrology file for the flows used in the original FEMA Study. Therefore, there is not enough information for the development of a reasonable hydrograph to be used in the 2-D Model. Also, without any information about the concentration points and basin boundaries, it would not be practical to subdivide the flows. The 2-D Model offers no significant advantages over a one-dimensional HEC-2 Model, especially for the upstream reach, therefore the 2-D Model will not be used for this project.

3. Storm Drains

The capacities of the two storm drains located in the study area were estimated by Entellus and the results were presented at the meeting. The capacity of both storm drains is less than 5% of the 100-year flow, it was agreed to ignore both storm drains and run the HEC-2 by assuming that all flows are conveyed as surface flows.

4. 100-Year Flows

In the original FEMA report, the 100-year flows for Granite Reef Wash are as follows:

Location	100-Year Flow (cfs)
At Pima Road	644
At McDowell Road	1,240
At Van Buren Street (McKellips Road)	1,417

It was decided during the meeting that the flows between Thomas Road and McDowell Road should be interpolated on a linear basis. However, by examining the original FEMA HEC-2 input file (which was given to Entellus during the meeting), it was noted that the flow figure used in the original FEMA HEC-2 model between Thomas and McDowell Roads was 1,240 cfs. Samuel Kao called Pedro Calza on April 25, 1996 to discuss this issue and Calza agreed that 1,240 cfs be used as the 100-year flow for the study reach between Thomas and McDowell Roads.

5. n-Values

Since n-values would play an important role on water surface elevations, it was decided during the meeting that the cross-sections will be modified by Entellus to block the building areas instead of using high n-values to simulate the effect of building obstruction. The District offered to help in this effort by providing Entellus with scale plots of cross-sections to be generated by their Boss HEC-2 for AutoCAD.

6. Study Reaches

Due to the limitation of HEC-2 program, the wash will be divided into the following four reaches and each reach will be modeled separately.

Reach	From	To
A	McKellips Road	City well site
B	City well site	North end of cul-de-sac of 84th Place
C	North end of cul-de-sac of 84th Place	McDowell Road
D	McDowell Road	Thomas Road

7. Channel Improvements

The City is planning on lining the downstream reach of the Wash (Reach A) within the next 12 months and wants to include the improvements in the new study. The City will provide Entellus the construction plans so that the new channel configuration can be incorporated in this model.

8. Initial Water Surfaces

The initial water surface at McKellips Road will be at the critical depth. The initial water surface at McDowell Road will be at the headwater immediately upstream of the culvert. The headwater elevation will be determined using the nomographs developed by FHWA for highway culverts.

9. HEC-RAS

HEC-RAS computer program will not be used for this study because the review agency has not been familiarized with this program.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: File

FROM: S. E. Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD 95-29)

DATE: 06/28/96

MEMORANDUM

RE: Progress Meeting at Entellus
June 26, 1996, 2:00 p.m.

Attendees:	Pedro Calza	FCDMC
	Maximo De Vera	FCDMC
	Amir Motamedi	FCDMC
	Bill Erickson	City of Scottsdale
	John Courtney	City of Scottsdale
	Sam Kao	Entellus
	Hernan Aristizabal	Entellus

The following is a summary of the discussion and conclusion during the above-referenced meeting.

1. **Construction on McDowell Road**

   The reconstruction of McDowell Road has started recently. The City will forward a set of construction plans to Entellus for review and model modification.

2. **New Channel North of McKellips**

   A set of construction plans on the proposed channelization of Granite Reef Wash north of McKellips Road was furnished by the District to Entellus during the meeting. It was concluded that the channel cross sections as shown on the construction plans should be used for this project because the channel is scheduled to be installed within twelve months after the study is completed.

3. **Surveying**

   The City will expedite the survey work that was requested by Entellus in order to keep the project on schedule. The City will not do any survey work within the boundaries of the Indian community.

4. **Notification to Indian Community**

The District will keep the Indian community posted about the status of this current study.

5. **Floor Elevations**

The City will survey the floor elevations for buildings in the vicinity of the proposed floodplain limits. The information will be forwarded to Entellus and will be used a as basis for floodplain delineation.

6. **Additional Work**

It was agreed by all parties that peak discharges that were used in the previous FIS report will be reused for this study. If the City would like to investigate the potential impacts due to larger flows in this area, a separate contract can be entered between the City and Entellus. Likewise, any impact due to storage effect in the watershed can be examined under a separate contract between the City and Entellus.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
one (602)244-2566
x (602)244-8947

TO: File

FROM: Hernan A.

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD95-29)

DATE: August/27/96

MEMORANDUM

Reference: Progress Review Meeting at Entellus Office
9:00 am, August 27, 1996

Attendees:

Pedro Calza	FCDMC
Maximo De Vera	FCDMC
Bill Erickson	City of Scottsdale
Hernan Aristizabal	Entellus

The following is a summary of the discussion and conclusion of the above-referenced meeting:

1. Project Schedule

Due to the delay of topographic and as-built information from the City, it was agreed to extend the contract time to December 31, 1996. DeVera will prepare a Change Order and send it to Entellus for appropriate signatures.

2. Finished Floor Elevation

The City will furnish the finished floor elevation for houses near the floodplain boundaries. Entellus will provide the City with sketches showing the location of the houses where this information is required. Calza emphasized the need to expedite this process in order to meet the December deadline. He suggested if the City is unable to complete the survey by the end of September, Entellus should contact the District and the District will send their own survey crew to obtain the data.

3. HEC-2 Submittal

Entellus provided the District with a copy of the HEC-2 model for review and comments. The model was complete except for the McDowell Road crossing, which is under construction as a part of the McDowell Road improvement project. The construction plans and design reports of the roadway improvement were provided by the City. The information will be incorporated into the HEC-2 model.

5. Channel Improvements

The City is planing on lining the downstream reach of the wash within the next year and they want to include the improvements in the new study. Erickson provided Entellus the construction plans so that the new channel configuration can be modeled. The channelization has been implemented in the HEC-2 model that was submitted to the District during the meeting. The City will be responsible for the submittal of all required documentation to FEMA.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
one (602)244-2566
x (602)244-8947

TO: File

FROM: Sam Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD95-29)

DATE: October/3/96

MEMORANDUM

Reference: Progress Review Meeting at FCDMC
10:00 am, October 3, 1996

Attendees:

Pedro Calza	FCDMC
Maximo De Vera	FCDMC
Sam Kao	Entellus

The following is a summary of the discussion and conclusion of the above-referenced meeting:

1. Report Format

The Technical Data Notebook (TDN) shall conform to the format of the State (ADWR) Standards, while the Flood Insurance Study Report (Section 8 of TDN) shall conform to the format outlined in FEMA Guideline 37.

2. Certification of Mapping and Survey

The District will request the City of Scottsdale to provide necessary certifications for the topographic mapping prepared by Baker Engineering and the survey work performed by the City's crew.

3. Floodway

Floodway will not be delineated under this project. Instead, the finished floor elevations furnished by the City of Scottsdale will be used for floodplain delineation.

4. Public Meeting

Public meeting, if needed, will be arranged and conducted by the City of Scottsdale.

5. HIS

As agreed previously, HIS work will be performed by the City of Scottsdale. However, if the City does not provide CAD file for the floodplain boundaries, Entellus will have to provide it for the District.

6. Phase 2 Work

DeVera will coordinate with the District's Contract Administration Department to authorize Entellus to perform the necessary work designated under Phase 2 of this project.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: Attendees/File

FROM: S. E. Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD95-29)

DATE: Oct. 14/96

MEMORANDUM

RE: Progress Review Meeting at Entellus Office
1:30 P.M., October 8, 1996

Attendees:	Maximo DeVera	FCDMC
	Bill Erickson	City of Scottsdale
	Hernan Aristizabal	Entellus
	Sam Kao	Entellus

The following is a summary of the discussion and conclusion of the above-referenced meeting:

1. Certification of Mapping Survey

The City of Scottsdale will provide three (3) sets of certifications for the topographic mapping prepared by Baker Engineering and the survey work performed by the City crew. The format of certification will conform to the FEMA requirements. The Elevation Reference Marks (ERM's) used for this delineation project will also be sealed by the City.

2. Floodway

Floodway will not be delineated under this project because the areas along the wash have been fully developed and encroachment is not likely to happen. However, the finished floor elevations furnished by the City will be used for floodplain delineation.

3. Public Meeting

At the present time, no public meeting has been planned for this project. However, public meetings, if needed, will be scheduled and conducted by the City.

4. Mapping

Because the file of the existing topographic mapping of the project area is too large for Entellus' computer to handle, Bill Erickson will arrange a meeting with the City's GIS Department to discuss the solution to resolve this problem. One of the possible alternatives is that the City would prepare the mapping based on the floodplain information to be furnished by Entellus on disks.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: Attendees/File

FROM: S. E. Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD95-29)

DATE: Oct. 23/96

MEMORANDUM

RE: Coordination Meeting at City of Scottsdale
1:30 P.M., October 23, 1996

Attendees:	Maximo DeVera	FCDMC
	Bill Erickson	City of Scottsdale/Drainage
	Karen Lockhart	City of Scottsdale/GIS
	John Courtney	City of Scottsdale/Survey
	Helmuth Hack	City of Scottsdale/Survey
	Ken Lewis	KVL Consultants
	Hernan Aristizabal	Entellus
	Sam Kao	Entellus

The primary purpose of the meeting was to discuss with representatives from various departments of the City of Scottsdale to generate solutions for the mapping issue of this project. Some hydraulic issues were also discussed in the meeting. The following is a summary of decisions made during the meeting and actions to be carried out by various parties involved.

ISSUE OF MAPPING

The topographic map prepared by Baker Engineering does not show existing buildings within the project area. In addition, a portion of that map does not show street layout in the vicinity of 87th Street, which is the main water course of Granite Reef Wash north of McDowell Road. Therefore, the map prepared by Baker Engineering could not be used as the base map for this project.

An alternative solution was to use the orthogonal map provided by the City as the base map. The standard orthogonal map prepared by the City covers a quarter of a section of land per sheet of map. It consists of one-foot pixel (which is one dot per square foot of land) that requires 26 mega bites of computer file per sheet. This file would be too large for Entellus' computer to handle. It was decided in the meeting that the City will convert the map to two-foot pixel, which would require 5.2 mega bites per sheet. Furthermore, the map will be changed to black and white, instead of colored image. By doing this, another three-quarters of file reduction would be achieved and Entellus' computer would be able to handle the file easily.

The quarter section sheets to be converted by the City's GIS Department are 1147, 1148, 1247,

1248, 1348 and 1448. According to Karen Lockhart, the map conversion would require at least two (2) weeks to complete.

The contour lines generated on the topographic map by Baker Engineering will still be used for this project. Bill Erickson will furnish Entellus a hard copy of the topographic map that was certified by Baker Engineering.

SURVEY ISSUES

Two sets of certified survey notes were forwarded to Entellus during the meeting. John Courtney will provide another certified copy of survey notes for Entellus' file. In addition, John will furnish Entellus the conversion formula for State Plane Coordinates and the coordinates for ERM's.

LIMITS OF STUDY

The hydraulic issues of this project were also discussed during the meeting. Entellus pointed out that the capacity of the newly designed ditch along the alignment of Granite Reef Wash between the existing well and McKellips Road is insufficient to carry the designated 100-year peak runoff. Flow would spread over to the Salt River Pima Maricopa Indian Community on the east as well as the adjacent property on the west. As a large portion of the flow would probably never return to the downstream reach of the ditch, the floodplain delineation based on the designated 100-year peak runoff would become unrealistic. Since the City may consider to retain KVL Consultants to relook the hydrology in this area in the near future, it was decided during the meeting that the Limit of Study for this project be moved from McKellips Road to the location just north of the well site.

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: File

FROM: S. Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD 95-29)

DATE: March 5, 1997

MEMORANDUM

RE: **Progress Review Meeting at Entellus Office**
March 5, 1997

Attendees:	Pedro Calza	FCDMC
	Maximo DeVera	FCDMC
	Sam Kao	Entellus
	Hernan Aristizabal	Entellus

The purpose of this meeting was to review the comments made by Maximo DeVera on February 12, 1997 (see Exhibit A). The following is a summary of discussion and conclusion obtained during the meeting. The numbering system corresponds to that appeared on Exhibit A.

1. A vicinity map will be included showing the boundary of the City of Scottsdale. The map will be obtained by scanning from the USGS quadrangle sheets.

2. The change of downstream study limit was a joint decision made by the City of Scottsdale and the District during the Coordination Meeting on October 23, 1996. Further clarification will be obtained from the City.

3. As decided by both the City and the District, the same discharges that were used in the previous Flood Insurance Study should be used for this study.

4. The "n" values for buildings will be clarified in the report.

5. The culverts at McDowell Road and the Well Site will be classified as major structure.

6. Since historical flows were not measured at any point of the watershed, there is no way to calibrate the modeling results. Thus, the discussion of "model calibration" is not required.

7. The blockage of buildings is modeled as divided flows in the HEC-2 program. A schematic drawing will be added to the report.

8. Pages 34 through 55 of the HEC-2 output will be included in the appendix of the report.

9. Page 6-2 of the Bibliography (which contains the reference of hydrologic reports) was inadvertently omitted in the Draft Report. It will be included in the final submittal.

10. Interview with long-term residents in the study area is not a part of the scope of this project.

11. The reason for shifting from a 2-D model to HEC-2 is due to the lack of input hydrographs in the study area. It will be clarified in the report.

12 &13. The GR stations will be revised accordingly.

14. This area is outside of the study limit and hence will not be included in the report.

In addition to the above conclusions, the following revisions will be made on the drawings and final submittals:

- Change the term "Floodway" to "Floodplain."
- Change the designated Zone X to "shaded" Zone X and discuss it in the Special Problem Section.
- Include FEMA forms in the final report.
- The existing FIRM boundaries will be added to the drawing. (The District will furnish Entellus the current FIRM map).

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009-6399
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

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Jan Brewer
Fulton Brock
Don Stapley
Mary Rose Garrido Wilcox

February 12, 1997

RECEIVED
FEB 18 1997
Entellus

Sam E. Kao, P.E.
Entellus
2255 North 44th Street, Suite 330
Phoenix, Arizona 85008

Reference: Granite Reef Floodplain Delineation Study (FCD 95-29)

Dear Dr. Kao:

We have reviewed your draft final report submittal on the subject project. Following are our initial comments:

1. Include a location/vicinity map showing the boundary of the City of Scottsdale to conform with the content of the second paragraph on p. iv.

2. Cite reasons for moving the study limit to approximately 1300' north of McKellips Road which was not stipulated in the contract. Based on the 1"=200' map sheet, the indicated study limit is 1720' north of McKellips Road centerline. The southern limit could be up to the upstream end of the box culvert near the well site (Section 0.257) unless there is justification for it to be on the indicated limit.

3. Expand Section 3 to include the review of hydrologic studies done for the area and a justification for using the discharges used in the previous FIS. This will clarify the choice of the previous peak Q estimates used by FEMA.

4. The first paragraph on p. 4-3 needs some further clarifications, since actual n-values assignment considered the effect of physical obstruction.

5. On Sec. 4.3.2 the use of "minor" and "major" hydraulic structures as it refers to the project is not properly defined. A structure that may significantly affect the flow pattern, such as a culvert, may be considered "major" for purposes of the study.

6. On Sec. 4.4 "Calibration," inclusion of instances in the past when flooding was observed may provide clues for the indication of the floodplain limits.

EXHIBIT A

Comments draft report continued...

7. The basic assumption in Sec. 4.5.1 could be illustrated by a schematic diagram showing blockage of buildings and flow pattern where no flow or lateral flow occurs. Does it imply also that where flow is oblique more than 45 degrees, flow is assumed to be longitudinal?

8. Pages 34 to 55 of the HEC-2 output are not included in the report.

9. The list of reference materials does not include the hydrololgic reports reviewed. On Sec. 2.1 of the contract, it was stated that "all previous hydrologic and hydraulic studies relevant to the area must be reviewed."

10. On Sec. 6.4, unpublished historical flood information may be available from long-term area residents. The Consultant should have interviewed some residents in the area who have lived there for 25 years or more.

11. Up to the progress meeting on April 25, 1996, the 2-D model had been tested for the project. The reasons for shifting from 2-D model to HEC-2 should be included in the report, as indicated in the minutes of the meeting.

12. The last GR station, 12050 of X1=0.288, is very far from the preceding GR station, 10129. As indicated on the X3 record, the value should be 10205.

13. The station of right encroachment of X1=0.326 is 10005.8, which is about the middle of the channel. This may have to be increased to 10150, as shown in the profile plot.

14. To minimize the vertical wall extension for some sections, split flow should be introduced into the model. By assuming an overflow weir between Sections 0.257 and 0.288, the vertical wall extensions could be reduced to about ½, assuming no return flow occurs.

If you have any questions regarding these comments, please contact me at 506-1501.

Sincerely,

Maximo R. De Vera, P.E.
Civil Engineer

Entellus™
2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

TO: File

FROM: S. Kao

JOB NO.: 310.45

JOB: Granite Reef Wash Floodplain Delineation (FCD 95-29)

DATE: April 3, 1997

MEMORANDUM

RE: **Progress Review Meeting at Entellus Office**
April 3, 1997

Attendees:	Pedro Calza	FCDMC
	Maximo DeVera	FCDMC
	Bill Erickson	City of Scottsdale
	Sam Kao	Entellus
	Hernan Aristizabal	Entellus

The purpose of this meeting was to provide a final review with the City and District staff making the final submittal. The following is a summary of conclusions made during the meeting.

1. The floodplain delineation should be extended to the east side of Pima Road, just north of Thomas Road similar to what is shown on the existing FIRM map.

2. The District and the City reconfirmed during the meeting that the previous FEMA hydrology should be used for this study.

3. The downstream study limit should be moved to the location just north of the Well Site (Section 0.320) due to lack of funding to provide additional hydrologic information that is required upstream of the Well Site Culvert.

4. The difference of elevation between the NGVD 1929 and NAVD1988 datum is 1.83 feet.

Granite Reef Wash
Floodplain Delineation Study
FCD 95-29

Technical Data Notebook
Hydraulics

Section 1: General Documentation and Correspondence

1.1 Contact (Telephone) Reports

1.2 Meeting Minutes and Reports

1.3 General Correspondence

1.4 Contract Documents

1.3.1

COMMUNITY

Intelligent Engineering
Environmental *Solutions*

March 15, 1996

Mr. Bill Erickson, P.E.
CITY OF SCOTTSDALE
3939 Civic Center Blvd
Scottsdale, AZ 85251

FILE COPY

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus (AGK) Project No. 310.45

Dear Mr. Erickson:

The following is a list of documents that we would like to receive from the City of Scottsdale pertaining to the above referenced project:

1. A document from Michael Baker, Jr. to certify that the topographic map to be used for this project was prepared in accordance with all FEMA requirements.
2. Field verification for the cross sections highlighted on Exhibit A.
3. Topographic survey for locations listed on Exhibit B.
4. Elevation reference marks (ERM) certified by a registered professional land surveyor in accordance with FEMA requirements.

Also enclosed is a copy of the approximate coordinates at key street intersections for your reference (see Exhibit C).

If you or your survey department have any questions or need further information, please do not hesitate to call me or Hernan Aristizabal, P.E., at your convenience.

Your assistance on this request is greatly appreciated.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

Enclosures

cc: John Courtney, RLS
Maximo DeVera, FCDMC

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

Entellus

EXHIBIT B

PROPOSED LOCATIONS FOR TOPOGRAPHIC SURVEY

1. Intersection of Granite Reef Wash and McKellips Road and its vicinity.
2. Topo information within the Indian Community (Shadow Mountain Village).
3. Culvert size, invert elevation, and general topo near the SRP well located at the south end of Granite Reef Road.
4. Existing alley between 84th Place and Roosevelt Street.
5. Culvert size, invert elevation, and general topo near the north end cul-de-sac of 84th Place.
6. Culvert size, invert elevation at Granite Reef Wash and McDowell Road.
7. Detailed channel cross section under the apartment office just north of McDowell Road, including the "deck elevation" of the office.
8. Vicinity of Coronado Road and 87th Street, including the invert elevations of culvert and channel.
9. Vicinity of Thomas Road and 87th Street.

EXHIBIT C

GRANITE REEF FLOOD INSURANCE STUDY
Reference Points Coordinates for Survey

DESCRIPTION	EATING	NORTHING
Center line of McKellips Road and Granite reef Wash	704,872.46	891,704.39
Intersection of Roosevelt Street and Granite Reef Road	704,905.99	894,356.68
Intersection of McDowell and Granite Reef Road	704,927.22	897,002.60
Intersection of McDowell and 87th Street	706,244.60	897,000.46
Intersection of Oak Street and 87th Street	706,719.74	899,648.26
Intersection of Virginia Avenue and 87th Street	706,980.22	900,955.86

THE ABOVE COORDINATES ARE APPROXIMATE FIGURES

1.3.2

STATE COORDINATION

1.3.3

OTHER AGENCIES

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, Arizona 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

January 3, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study through the end of December 1995. We have performed the following work on each of the tasks cited:

Task 1 - Coordination

- Coordination with the District and the City of Scottsdale
- Kick-off meeting with the District on 12/14/95
- Submitted monthly billing estimates and project schedule on 12/21/95

Task 2 - Data Collection

- Collected and reviewed previous study reports

Task 3 - Topographic Mapping

No work performed this period

Task 4 - Field Survey Coordination

No work performed this period

Task 5 - Hydrology Review

- Reviewed peak flows from previous study reports and FEMA FIS report

Task 6 - Floodplain Delineation

No work performed this period

Task 7 - Deliverables

No work performed this period

Task 8 - Phase II Services

No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

AGK ENGINEERS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

PRINCIPAL
Edward A. Adair, P.E.
Samuel E. Kao, Ph.D., P.E.

ASSOCIATE
Patrice M. Miller
Denis L. Howe, P.E.
Michael J. Bonar, P.E.

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, Arizona 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

February 8, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 2

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study through January 28, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination

- Coordination with the District and the City of Scottsdale
- Coordination Meeting at City of Scottsdale on 1/4/96
- Submitted legal advertisement to both *Scottsdale Tribune* and *The Arizona Republic*

Task 2 - Data Collection

- Collected and reviewed data and information pertinent to this project

Task 3 - Topographic Mapping

- Prepared base map for the project area based on City's topographic digital mapping

Task 4 - Field Survey Coordination

- Initial coordination with City's Survey Department

Task 5 - Hydrology Review

- Reviewed peak flows from previous study reports and FEMA FIS report

Task 6 - Floodplain Delineation

No work performed this period

Task 7 - Deliverables

No work performed this period

Task 8 - Phase II Services

No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

AGK ENGINEERS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

PRINCIPAL
Edward A. Adair, P.E.
Samuel E. Kao, Ph.D., P.E.

ASSOCIATE
Patrice M. Miller
Denis L. Howe, P.E.
Michael J. Bonar, P.E.

March 8, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 3

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from January 29, 1996 through February 25, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale

Task 2 - Data Collection
- Collected and reviewed topographic data and information pertinent to this project

Task 3 - Topographic Mapping
- Updated base map for the project area based on City's topographic digital mapping

Task 4 - Field Survey Coordination
- Identification of survey requirements
- Coordination with City's Survey Department

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Field reconnaissance on 2/5/96
- Preliminary hydraulic analysis along the wash

Task 7 - Deliverables
No work performed this period

Task 8 - Phase II Services
No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

Intelligent Engineering
Environmental *Solutions*

SEK

April 3, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 4

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from February 26, 29, 1996 through March 24, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale (2/29/96)

Task 2 - Data Collection
- Collected and reviewed topographic data and information pertinent to this project

Task 3 - Topographic Mapping
- Updated base map for the project area based on City's topographic digital mapping
- Coordination with City of Scottsdale GIS Department

Task 4 - Field Survey Coordination
- Identification of survey requirements
- Coordination with City's Survey Department (3/15/96)

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Submitted n-value report (2/29/96)
- Preliminary HEC-2 modeling along the wash
- Began on 2-D modeling

Task 7 - Deliverables
No work performed this period

Task 8 - Phase II Services
No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Tim Farrell for

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

May 2, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 5

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from March 25, 1996 through April 21, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination
- Coordination with City's Survey Department

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Preliminary HEC-2 modeling along the wash
- Prepared 2-D modeling

Task 7 - Deliverables
No work performed this period

Task 8 - Phase II Services
No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

May 23, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 6

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from April 22, 1996 through May 19, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale
- Progress Meeting at the District (4/23/96)

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination
- Coordination with City's Survey Department
- Obtained elevation information for reference points from the City (5/16/96)

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Continuing on HEC-2 modeling along the wash

Task 7 - Deliverables
No work performed this period

Task 8 - Phase II Services
No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao/K

Samuel E. Kao, Ph.D., P.E.
Vice President

SEK/kp

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

June 30, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 7

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from May 20, 1996 through June 30, 1996. We have performed the following work on each of the tasks cited:

Entellus

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale
- Progress Meeting at Entellus (6/26/96)

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination
- Coordination with City's Survey Department for cross section verification and detailed topographic survey at specific locations.

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Additional runs on HEC-2 modeling along the wash
- Preliminary floodplain delineation

Task 7 - Deliverables
- No work performed this period

Task 8 - Phase II Services
- No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

July 31, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45
Progress Report No. 8

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from May 20, 1996 through June 30, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination
- Coordination with City's Survey Department for cross section verification and detailed topographic survey at specific locations.

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Additional runs on HEC-2 modeling along the wash

Task 7 - Deliverables
- No work performed this period

Task 8 - Phase II Services
- No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

August 31, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Project No. 310.45
Progress Report No. 9

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from July 29, 1996 through August 31, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale
- Progress Review Meeting on 8/27/96

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination
- Coordination with City's Survey Department for floor elevation and detailed topographic survey at specific locations.

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Additional runs on HEC-2 modeling along the wash

Task 7 - Deliverables
- No work performed this period

Task 8 - Phase II Services
- No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

Intelligent Engineering
Environmental *Solutions*

September 30, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Project No. 310.45
Progress Report No. 10

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from September 1, 1996 through September 29, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination
- Coordination with City's Survey Department for floor elevation and detailed topographic survey at specific locations.
- Received information on finished floor elevations from the City

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- Additional runs on HEC-2 modeling along the wash

Task 7 - Deliverables
- No work performed this period

Task 8 - Phase II Services
- No work performed this period

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

Intelligent Engineering
Environmental *Solutions*

October 31, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Project No. 310.45
Progress Report No. 11

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from September 30, 1996 through October 27, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination

- Coordination with the District and the City of Scottsdale
- Progress Review Meeting @ FCDMC (10/3/96)
- Progress Review Meeting @ Entellus (10/8/96)
- Coordination Meeting @ Scottsdale (10/23/96)

Task 2 - Data Collection

- Completed

Task 3 - Topographic Mapping

- Coordination with City of Scottsdale GIS Department for missing topographic data

Task 4 - Field Survey Coordination

- Received sealed copies of field survey information from the City on October 23, 1996

Task 5 - Hydrology Review

- Completed

Task 6 - Floodplain Delineation

- On-going analysis on delineation with finished floor elevation information

Task 7 - Deliverables

- No work performed this period

Task 8 - Phase II Services

- Preparation of project report

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel E. Kao, Ph.D., P.E.
Vice President

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

November 30, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Project No. 310.45
Progress Report No. 12

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from October 28, 1996 through November 24, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for mapping

Task 4 - Field Survey Coordination
- Requested clarification of cross sections from the City

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- On-going analysis on delineation with finished floor elevation information
- Responded to District's comments on HEC-2 modeling on 11/14/96

Task 7 - Deliverables
- No work performed this period

Task 8 - Phase II Services
- Preparation of project report

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

Intelligent Engineering
Environmental *Solutions*

December 31, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Project No. 310.45
Progress Report No. 13

Dear Mr. DeVera:

This letter serves as a progress report on the above referenced study for the period from November 25, 1996 through December 29, 1996. We have performed the following work on each of the tasks cited:

Task 1 - Coordination
- Coordination with the District and the City of Scottsdale

Task 2 - Data Collection
- Completed

Task 3 - Topographic Mapping
- Coordination with City of Scottsdale GIS Department for mapping
- Received certified mapping from the City on 12/9/96

Task 4 - Field Survey Coordination
- Received clarification of cross sections from the City

Task 5 - Hydrology Review
- Completed

Task 6 - Floodplain Delineation
- On-going analysis on delineation with finished floor elevation information

Task 7 - Deliverables
- No work performed this period

Task 8 - Phase II Services
- Preparation of project report

If you have any questions or need further clarifications, please do not hesitate to call.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D., P.E.
Vice President

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

BOARD OF DIRECTORS
Betsey Bayless
Ed King
Tom Rawles
Don Stapley
Mary Rose Garrido Wilcox

April 25, 1995

RECEIVED
APR 29 1996
Entellus

Regional Manager
Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600
Alexandria, Virginia 22304

Reference: Granite Reef Wash in the City of Scottsdale, Arizona

We are currently doing a re-delineation of the Granite Reef Wash floodplain area, as requested by the City of Scottsdale in view of the latest developments in the area. Our Consultant, Entellus, has requested from us a copy of the HEC-2 model previously used to delineate the floodplain as shown on the FIRM map.

On June 23, 1993, a copy of a HEC-2 model run for Granite Reef Wash in the City of Scottsdale, Arizona, was transmitted to us by Tim Kelly in Phoenix. The copy we received is unreadable, and we find that neither the District nor the City of Scottsdale has another copy. We would appreciate very much if you would send us a readable copy of this report.

Thank you,

Maximo R. De Vera, P.E.
Hydrologist

Copy to: Entellus, Inc.

CC: HAA

March 21, 1997

CITY OF SCOTTSDALE ARIZONA

• "Most Livable City" U.S. Conference of Mayors •

RECEIVED

MAR 26 1997

Entellus

Mr. Samuel E. Kao, PhD.,P.E., Vice President
Mr. Hernan A. Aristazabal, P.E., Project Engineer
Entellus
2255 North 44 Street, Suite 330
Phoenix, Arizona 85008

Subject: **City of Scottsdale Review of Draft Report, January 10, 1997**
Granite Reef Wash Floodplain Delineation Study, FCD 95-29

Gentlemen:

City staff has performed a brief review of the subject report and complement you on your work.

The only technical comments we offer are regarding the starting and ending point of the delineation.

We feel that it would be more appropriate to begin the limits of flooding analysis just upstream of the well/culvert, sta. 0.288, similar to that shown on the Flood Insurance Rate Map, (FIRM) number 04013C2160 D, dated April 15, 1988 rather than beginning at sta. 0.326. Our proposed starting point would provide a better indication of the flooding potential for the multi-family complex on the left or east bank at that location.

If possible, the ending point of the delineation should be located along the east side of Pima Road just north of Thomas Road similar to the FIRM to provide a better indication of flooding on the right or west bank at that location.

We will agree in advance that extending the delineation both upstream and downstream will probably be somewhat subjective and require more engineering judgment than just relying on the interpretation of available data. However we are of the opinion that it will be worth the effort to provide those indications.

Sincerely,

William Erickson

c: Alex McLaren, Director, Transportation Planning
Pedro Calza, Flood Control District of Maricopa County
Maximo DeVera, Flood Control District of Maricopa County.

1.3.4

FEMA REGIONAL OFFICE

1.3.5

FEMA WASHINGTON

1.3.6

FEMA TECHNICAL CONSULTANT

1.3.7

COPY OF PUBLIC NOTICES

Tribune
NEWSPAPERS
P.O. BOX 1547 • MESA, ARIZONA 85211

P.O. Number: _____

Invoice Number: 560214

STATE OF ARIZONA
County of Maricopa

I, MARIE GERY, Legal Clerk, acknowledge that the attached hereto was published in a newspaper of general circulation at Mesa, Arizona, County of Maricopa on the following dates:

02/02,09 1996

S
M-Mesa T-Tempe C-Chandler G-Gilbert S-Scottsdale

Marie Gery
LEGAL CLERK

Subscribed and sworn to before me this date: 09-FEB-96

Julie Pingel
NOTARY PUBLIC

AFFIDAVIT OF PUBLICATION

ANNOUNCEMENT OF INTENT TO PERFORM FLOOD ELEVATION STUDY

The Flood Control District of Maricopa County (FCDMC) has contracted AGK Engineers, Inc. To perform a floodplain delineation for the Granite Reef Wash from Thomas Road to McKellips Road.

This study will examine and evaluate the flood hazard areas in the community to determine the flood elevation for those areas. These elevations will then be used to determine the flood insurance rates used by the Federal Emergency Management Agency (FEMA).

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 FCDMC/FEMA, so that they could be considered during the course of this study. Your comments should be addressed to Mr. Pedro Caiza or Mr. Maximo Dias Vera, Hydrologists at the Flood Control District of Maricopa County.

Pub Feb 2, 9 1996 560214

MESA TRIBUNE LEGAL ADS ARE ALSO PUBLISHED IN THE GILBERT TRIBUNE

AFFIDAVIT OF PUBLICATION

The Arizona Republic/The Phoenix Gazette

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 The Phoenix Gazette, 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
~~The Phoenix Gazette~~

~~FEBRUARY 2, 9, 1996~~

Sworn to before me this

13TH day of

FEBRUARY A.D. 19 96

OFFICIAL SEAL
DEBBIE WILSON
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires Jan. 9, 1999

Notary Public

INVOICE NO. 96056

ANNOUNCEMENT OF INTENT TO PERFORM FLOOD ELEVATION STUDY

The Flood Control District of Maricopa County (FCDMC) has contracted AGK Engineers, Inc. to perform a floodplain delineation for the Granite Reef Wash from Thomas Road to McKellips Road.

This study will examine and evaluate the flood hazard areas in the community to determine the flood elevation for those areas. These elevations will then be used to determine the flood insurance rates used by the Federal Emergency Management Agency (FEMA).

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 FCDMC/FEMA, [illegible]ut they could be considered during the [illegible] of this study. Your comments should be [illegible]ed to Mr. Pedro Calzo or Mr. Maximo De[illegible] Hydrologists at the Flood Control District of Maricopa County.

Published: Arizona Republic, February 2, 9, 1996.

Granite Reef Wash
Floodplain Delineation Study
FCD 95-29

Technical Data Notebook
Hydraulics

Section 1: General Documentation and Correspondence

1.1 Contact (Telephone) Reports

1.2 Meeting Minutes and Reports

1.3 General Correspondence

1.4 Contract Documents

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

RECEIVED DEC 1 9 1995

BOARD OF DIRECTORS
Betsey Bayless
Ed King
Tom Rawles
Don Stapley
Mary Rose Garrido Wilcox

December 13, 1995

Edward A. Adair, P.E.
AGK Engineers, Inc.
2255 N. 44th Street, #330
Phoenix, AZ 85008

Subject: Contract FCD 95-29
Granite Reef Wash Floodplain Delineation Study

This will confirm the December 7, 1995 verbal notice to proceed on the subject contract. A fully-executed copy of the contract is enclosed for your file.

Sincerely,

Dortha Klaahsen

Dortha Klaahsen
Contracts Coordinator

CONTRACT FOR CONSULTANT SERVICES

CS 965040 CONTRACT FCD 95-29

Pursuant to the provisions of the Arizona Revised Statutes Section 48-3603, the Board of Directors has the authority to enter into contracts.

The Flood Control District of Maricopa County, Arizona, hereinafter called the "DISTRICT", is desirous of having certain professional services performed in connection with **Contract FCD 95-29 Granite Reef Wash Floodplain Delineation Study** hereinafter called the "PROJECT" and as more fully described in Exhibit "A", Scope of Work, attached; and

AGK Engineers, Inc., hereinafter called "CONSULTANT", is desirous of performing said services;

THEREFORE, the parties hereto mutually agree as follows:

SECTION I - SERVICES OF THE CONSULTANT

The CONSULTANT, under the general supervision of the Manager, Engineering Division shall prepare studies, reports, surveys, plans, drawings, specifications and cost estimates as are necessary for the PROJECT and according to the directions and designated standards of the DISTRICT and in accordance with Exhibit A. It is understood and agreed that the DISTRICT's authorized representative shall be the Manager, Engineering Division or his duly authorized representative, hereinafter called the "AGENT" and that he/she shall be the sole contact for administering this contract.

The CONSULTANT shall meet periodically with the AGENT so as to keep the DISTRICT informed of the progress of the work in accordance with the schedule defined in Exhibit A.

The CONSULTANT shall promptly advise the AGENT of any factors, which may develop during the PROJECT, that would likely result in construction or design costs in excess of budgetary constraints.

SECTION II - PERIOD OF SERVICE

The CONSULTANT shall complete all work per the schedule provided in Exhibit "A", Scope of Work within 270 calendar days after receipt of the Notice to Proceed, exclusive of DISTRICT review time. The DISTRICT is expected to require up to 60 calendar days for review time, for a total contract time period of 330 calendar days. Should extension of this contract period be necessary, and any such extension(s) continue the date of contract expiration for a time period of more than one year from the date of contract execution, adjustment(s) of the consultant's fee(s) may, upon agreement by both the DISTRICT and the CONSULTANT, be made in accordance with the Consumer Price Index for Urban Consumers, Western Division published by the U.S. Department of Labor, Bureau of Labor Statistics, using the

published edition coinciding with the initial contract expiration date. Any such fee adjustment shall only apply to the extended contract time period.

SECTION III - PAYMENTS TO THE CONSULTANT

The CONSULTANT shall be paid for work under this Contract a lump sum fee of $62,195 for Phase I, and a negotiated lump sum not to exceed $17,541 for Phase II, for a total contract amount of $79,736 plus any adjustments that have been approved in writing in accordance with the Maricopa County Procurement Code.

The DISTRICT shall pay the CONSULTANT upon completion of the work as accepted by the DISTRICT, except that progress payments may be made as billed by the CONSULTANT based on approved monthly progress reports subject to the limitations set forth in Exhibit "A", Scope of Work. Ten percent of all contract payments made on an interim basis shall be retained by the DISTRICT as insurance of proper performance of the contract or, at the option of the CONSULTANT, a substitute security may be provided by the CONSULTANT in an authorized form pursuant to procedures established by the DISTRICT. The CONSULTANT is entitled to all interest from any such substitute security.

When the contract is fifty percent (50%) completed, one-half (1/2) of the amount retained will be paid to the CONSULTANT provided the CONSULTANT is making satisfactory progress on the contract and there is no specific cause or claim requiring a greater amount to be retained. After the contract is fifty percent (50%) completed, no more than five percent (5%) of the amount of any subsequent progress payments shall be retained providing the CONSULTANT is making satisfactory progress on the project, except if at any time the DISTRICT determines satisfactory progress is not being made, ten percent (10%) retention shall be reinstated for all progress payments made under the contract subsequent to the determination.

If the CONSULTANT desires a partial payment in accordance with the provisions above, the CONSULTANT will complete and forward, a DISTRICT provided form, indicating payment distribution to MBE/WBE firms.

Any retention monies shall be paid or substitute security returned or released, as applicable, to the CONSULTANT within forty-five (45) calendar days after: (1) Completion of the work in Exhibit "A" through the submittal of District accepted/approved documents to FEMA, (2) receipt of a completed "Certificate of Substantial Performance" form, (3) the CONSULTANT's statement that no project disputes exist; and (4) invoicing for any retained monies has been received by the DISTRICT. It is expressly understood that the release of retention is NOT applicable to any of the work to be accomplished for HIS DATA. This work is outside those tasks necessary to accomplish the FEMA work.

Upon acceptance and approval of the project by FEMA and the completion of all final work required by the DISTRICT, the CONSULTANT shall submit a final Certificate of Performance and its invoice for any sums remaining due and payable under this Contract.

SECTION IV - THE DISTRICT'S RESPONSIBILITIES

The DISTRICT shall furnish the CONSULTANT, at no cost to the CONSULTANT, the following information or services for this PROJECT:

A. One copy of on-hand maps, records, survey ties, bench marks or other data pertinent to the PROJECT. This does not, however, relieve the CONSULTANT of the responsibility of searching records for additional information, for requesting specific information or for verification of that information provided. The DISTRICT does not warrant the accuracy or comprehensiveness of any such information.

B. All available information and data relative to policies, standards, criteria, and studies, etc., impacting the PROJECT as identified by the CONSULTANT.

C. Availability of staff for consultation with the CONSULTANT during the performance of studies and plan development in order to identify the problems, needs, and other functional aspects of the PROJECT.

D. Examination of documents submitted by the CONSULTANT and rendering of decisions pertaining thereto promptly, to avoid unreasonable delay in the progress of the work by the CONSULTANT. The DISTRICT will keep the CONSULTANT advised concerning the progress of the DISTRICT's review of work.

SECTION V - ALTERATION IN SCOPE OF WORK

Any alteration in the scope of work that will result in a substantial change in the nature of the PROJECT so as to materially increase or decrease the contract fee will require negotiation of an amendment to the contract to be executed by the DISTRICT and the CONSULTANT. No work shall commence on the change until the contract amendment has been approved by the DISTRICT and the CONSULTANT has been notified to proceed by the AGENT. It is distinctly understood and agreed that no claim for extra work done or materials furnished by the CONSULTANT will be allowed by the DISTRICT except as provided herein, nor shall the CONSULTANT do any work or furnish any materials not covered by this agreement unless such work is first authorized in writing in accordance with the Maricopa County Procurement Code. Any such work or materials furnished by the CONSULTANT without such written authorization first being given shall be at his own risk, cost, and expense, and he hereby agrees that without such written authorization he will make no claim for compensation for such work or materials furnished.

SECTION VI - RECORDS

Records of the CONSULTANT's payroll expense pertaining to this PROJECT and records of accounts between the DISTRICT and the CONSULTANT shall be kept on a generally recognized accounting basis and shall be available upon request to the DISTRICT or its authorized representative for audit during normal business hours. The records shall be subject to audit by appropriate grantor agency if the PROJECT is funded all or in part by a grant.

SECTION VII - PROJECT COMPLETION

If during the course of this contract situations arise which prevent completion within the allotted time, an extension may be granted by the AGENT.

SECTION VIII - TERMINATION

The DISTRICT may terminate this contract at any time upon reimbursement to the CONSULTANT of expenses which include reasonable charges for time and material for the percentage of work satisfactorily completed and turned over to the DISTRICT.

The DISTRICT reserves the right to postpone, terminate or abandon this PROJECT for the CONSULTANT's failure to complete the PROJECT on time, or failure to comply with the provisions of the contract. The DISTRICT also reserves the right to terminate any or all parts of this contract for its own convenience as the DISTRICT may determine at its sole discretion.

The DISTRICT hereby gives notice that pursuant to A.R.S. Section 38-511 "A" this contract may be cancelled without penalty or further obligation within three years after execution if any person significantly involved in initiation, negotiation, securing, drafting, or creating a contract on behalf of the DISTRICT is, at anytime while the contract or any extension of the contract is in effect, an employer, agent, or any other party to the contract in any capacity or a consultant to any other party of the contract with respect to the subject matter of the contract. Cancellation under this section shall be effective when written notice from the Chief Engineer and General Manager is received by all of the parties of the contract. In addition, the DISTRICT may recoup any fee for commission paid or due to any person significantly involved in initiation, negotiation, securing, drafting, or creating the contract on behalf of the DISTRICT from any other party to the contract arising as a result of the contract.

The CONSULTANT may terminate this contract in the event of nonpayment of fees as specified in Section III, PAYMENTS TO THE CONSULTANT.

SECTION IX - OWNERSHIP OF DOCUMENTS

All original documents including, but not limited to studies, reports, tracings, drawings, physical and computer models, estimates, field notes, investigations, design analyses, calculations, computer software, and specifications, prepared in the performance of this Contract are to be and remain the property of the DISTRICT and are to be delivered to the AGENT before final payment is made to the CONSULTANT. The DISTRICT reserves the right to reuse the documents as it sees fit. However, the DISTRICT will not reuse, alter, or modify these documents without noting such alterations, modifications, or intent of their reuse, and will hold the CONSULTANT harmless from any claims arising from the reuse, alteration, or modification of the documents. The CONSULTANT may retain reproducible copies of all such documents delivered to the DISTRICT.

SECTION X - COMPLIANCE WITH LAWS

The CONSULTANT is required to comply with all Federal, State and local laws, local ordinances and regulations. The CONSULTANT's signature on this contract certifies compliance with the provisions of the I-9 requirements of the Immigration Reform and Control Act of 1986 for all personnel that the CONSULTANT and any subconsultants employ to complete this PROJECT. It is understood that the DISTRICT shall conduct itself in accordance with the provisions of the Maricopa County Procurement Code.

SECTION XI - GENERAL CONSIDERATIONS

A. Prior to beginning the work, the CONSULTANT shall furnish the DISTRICT for approval the names of its key employees, and of its sub-consultants and their key employees to be used on this PROJECT. Any subsequent changes are subject to the written approval of the DISTRICT.

With the exception of the DISTRICT or the Federal Emergency Management Agency, the CONSULTANT agrees not to accept any clients within the area of the 100-year floodplain for the project, during the period of the Contract, without the expressed written authority from the Chief Engineer and General Manager of the DISTRICT.

The CONSULTANT in replacing a MBE/WBE subcontractor should attempt to contract with another MBE/WBE.

B. The failure of either party to enforce any of the provisions of this Contract or to require performance of the other party of any of the provisions hereof shall not be construed to be a waiver of such provisions, nor shall it affect the validity of this Contract or any part thereof, or the right of either party to thereafter enforce each and every provision.

C. The CONSULTANT shall be responsible for the cost of any additional design, field layout, testing, construction and supervision necessary to correct those errors or omissions attributable to the CONSULTANT and for any damage incurred by the DISTRICT as a result of additional construction costs caused by such CONSULTANT errors or omissions.

D. The fact that the DISTRICT has accepted or approved the CONSULTANT's work shall in no way relieve the CONSULTANT's responsibility.

E. It is mutually understood and agreed that this Contract shall be governed by the laws of the State of Arizona, both as to interpretation and performance. Any action at law, suit in equity, or judicial proceeding for the enforcement of this Contract, or any provision thereof, shall be instituted only in the courts of the State of Arizona.

SECTION XII - SUCCESSORS AND ASSIGNS

This Contract shall not be assigned by either party without prior written approval of the other except that the CONSULTANT may use in the performance of this Contract without prior approval of the DISTRICT, personnel or services of its related entities and affiliated companies as if they were an integral part of the CONSULTANT; and it shall extend to and be binding upon the heirs, executors, administrators, successors and assigns of the parties hereto.

SECTION XIII - NO KICK-BACK CERTIFICATION

The CONSULTANT warrants that no person has been employed or retained to solicit or secure this Contract upon any agreement or understanding for a commission, percentage, brokerage, or contingent fee; and that no member of the Board of Directors/Supervisors or any employee of the DISTRICT has any interest, financially or otherwise, in the CONSULTANT firm.

For breach or violation of this warranty, the DISTRICT shall have the right to annul this Contract without liability, or at its discretion to deduct from the Contract price or consideration, the full amount of such commission, percentage, brokerage, or contingent fee.

SECTION XIV - ANTI-DISCRIMINATION PROVISION

The Flood Control District of Maricopa County will endeavor to ensure in every way possible that minority and women-owned business enterprises shall have every opportunity to participate in providing professional services, purchased goods, and contractual services to the Flood Control District of Maricopa County without being discriminated against on the grounds of race, religion, sex, age, disability, or national origin.

The CONSULTANT agrees not to discriminate against any employee or applicant for employment because of race, religion, color, sex, age, disability , or national origin and further agrees not to engage in any unlawful employment practices. The CONSULTANT further agrees to insert the foregoing provisions in all subcontracts hereunder.

SECTION XV - AMENDMENTS

This Contract may be amended by mutual written agreement of the DISTRICT and the CONSULTANT.

SECTION XVI - INDEMNIFICATION AND INSURANCE

A. The CONSULTANT shall provide and maintain the following minimum insurance requirements:

1. Professional Liability. The CONSULTANT shall show evidence of maintaining continuous insurance for the past three (3) years with a minimum coverage limit of $1,000,000.00 each claim and/or in the aggregate.

The CONSULTANT shall provide and maintain Professional Liability Insurance with a minimum single limit of $1,000,000.00 for each claim made and an aggregate limit of $1,000,000.00 for all claims made through this contract's completion date or the policy's life, whichever is longer.

2. Commercial General Liability. Commercial general liability insurance with a minimum single limit of $1,000,000.00 for each coverage/occurrence. The policy shall include coverage for bodily injury and personal injury, broad form property damage and blanket contractual coverage.

3. Automobile Liability. Automobile liability insurance, with an individual single limit for bodily injury and property damage of no less than $1,000,000.00, each occurrence, with respects to CONSULTANT's vehicles (whether owned, hired, non-owned), assigned to or used in the performance of this contract.

4. Workers' Compensation Insurance. This insurance shall be maintained during the life of the contract.

5. *Additional Insured.* The policies, except professional liability and workers' compensation, required by this section shall name the DISTRICT as Additional Insured, and shall specify that insurance afforded the CONSULTANT shall be primary insurance, and that any insurance coverage carried by the DISTRICT or its employees shall be excess coverage, and not contributory coverage to that provided by the CONSULTANT. No policy issued under this contract shall lapse, be cancelled, allowed to expire, or be materially changed to affect the coverage available to the DISTRICT without thirty (30) days written notice to the DISTRICT.

6. DISTRICT approved documentation outlining the coverages specified in this section shall be filed with the DISTRICT prior to issuance of the Notice to Proceed.

B. The CONSULTANT agrees to indemnify and save harmless the DISTRICT, any of its departments, agencies, officers, or employees from all suits, including attorney's fees and costs of litigation, actions, loss, damage, expense, cost or claims, of any character or any nature arising out of the CONSULTANT's wanton, willful or negligent acts, errors or omissions in the performance of work under this Contract, and any wanton, willful or negligent acts, errors or omissions by any subconsultant or other agent used by the CONSULTANT in the performance of work under this Contract.

IN WITNESS WHEREOF, the parties herein have executed this Contract.

AGK ENGINEERS, INC.

By: Edward A. Adair
Principal (Signature)

EDWARD A. ADAIR
Printed Name

President
Title

Date: 10/17/95

Federal Tax Identification Number

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY:

Stanley L. Smith
Stanley L. Smith, Jr., P.E.
Acting Chief Engineer and General Manager

Date: 10-27-95

ACCEPTED AND APPROVED:

Tom Rawles
Chairman, Board of Directors

ATTEST:

Fran McCarroll
Clerk of the Board

Date: DEC 0 6 1995

LEGAL REVIEW

Approved as to form and within the powers and authority granted under the laws of the State of Arizona to the Flood Control District of Maricopa County.

Julie M. Lemmon
General Counsel, District

Date: 10/27/95

SCOPE OF WORK
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
FLOODPLAIN DELINEATION FOR GRANITE REEF WASH

GENERAL

The project consists of approximately 2 river miles of floodplain delineation for Granite Reef Wash from Thomas Road to McKellips Road, within the City of Scottdale as shown on Attachment 1. Aerial photo (Attachment 2) dated February 12, 1995, shows the area is highly urbanized and actual wash location may have changed. The hydrology of the area will be the same as used in previous FEMA FIS and will be provided by the City of Scottsdale. Topographic maps of scale 1" = 100' with 1-foot contour is available as prepared by the City. The consultant shall consider the use of a two-dimensional hydraulic model. Either USA-COE-TABS II or FESWMS-2DH, whichever is most suitable to the area, will be used to delineate the floodplain using peak estimates from the previous hydrology study as provided by the City of Scottsdale. HEC-2 may be used to compare some results from the 2-D model. The consultant must use sound engineering judgement in the development of the hydraulic model. The results of the models must be analyzed carefully and refinements made to the input parameters in order to obtain the most realistic results. All work must meet Arizona Department of Water Resources (ADWR) and Federal Emergency Management Agency (FEMA) requirements for floodplain delineations. The results of this study must be reviewed and accepted by FEMA and the City of Scottsdale prior to the finalization of this contract. All work under this Scope will be completed within 330 calendar days from the date of Notice to Proceed, including 60 days for District reviews.

PHASE I

TASK 1 - COORDINATION

1.1 The Consultant will submit a project schedule showing coordination meetings and completion dates for each of the tasks in the scope within 14 days of Notice To Proceed. The Consultant shall update this project schedule when appropriate.

1.2 The Consultant shall participate in regular coordination meetings (at least every 2 weeks) with the District's Project Manager and the City's staff representative when necessary and in milestone coordination meetings in the development of the hydraulic analyses. The Consultant is responsible for the minutes of any meetings. Whenever possible, coordination and milestone meetings should be combined.

1.3 The Consultant will submit a quarterly estimation of the projected billing within 14 days of Notice to Proceed. Thereafter, this estimation will be updated and submitted to the

District's Project Manager at least 10 days prior to the end of each quarter.

1.4 The Consultant shall 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 the following month.

d. A description of any problems encountered.

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 newspaper two times, with approximately one week between runs. The ad must also be run two times in the Scottsdale Progress, a local newspaper that serves the area being studied. After the ad is run the Consultant will supply the District with the original affidavit of publication from each of the newspapers for each day that the ad was published.

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

1.7 The Consultant shall meet with officials from the City of Scottsdale. The purpose of this meeting is to identify local flooding problems and obtain information on current and planned public works projects, channel modifications, storm-drainage systems, development, and corporate limits.

1.8 The District and the City will plan and conduct two public meetings in conjunction with this study. The first meeting will be to inform the public of the purpose and scope of the study. The second meeting will be to inform the public and obtain public comment on the study results, and shall take place prior to the submittal of the final report to FEMA. The Consultant/District will be responsible for the preparation of the graphic displays for these meetings. The City will approve the displays prior to public release. One representative from the Consultant will attend each of the meetings. The Consultant will respond to the public's comments and make revisions to the study if necessary.

1.9 Consultant/District Performance Evaluations will be performed. An informal evaluation will be performed at the completion of the hydraulic analysis. A formal evaluation will

be performed at the completion of the project upon receipt of all deliverables.

TASK 2 - DATA COLLECTION

2.1 The Consultant will collect and review pertinent data from the District and other outside sources. All previous hydrologic and hydraulic studies relevant to the area must be reviewed. Data to be collected will include previous flood hazard reports and hydrology for the study area; existing topographic mapping; 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 submitted to the District for information purposes. Data inadequacies as they relate to the hydraulic model must be assessed. A preliminary draft of this report is due within 90 days of Notice to Proceed.

TASK 3 - TOPOGRAPHIC MAPPING

3.1 Topographic maps of scale 1" = 100' with 1-foot contour interval will be provided by the City of Scottsdale. The Consultant will coordinate with the City so that digital informations will be compatible with the City and District computer equipment.

TASK 4. - FIELD SURVEY

4.1 Field surveys, if necessary, shall be undertaken by the City of Scottsdale in coordination with the Consultant to ensure that survey and mapping requirement as set by FEMA and ADWR are met.

TASK 5 - HYDROLOGY

5.1 Hydrology of the area as previously used in Flood Insurance Studies by FEMA will be provided by the City Scottsdale. If during the contract the City, District and Consultant decides that hydrology must be modified, the City will make provisions for modification and deliver results to the Consultant and District for final action.

TASK 6 - FLOODPLAIN DELINEATION

6.1 Floodplain delineations must be obtained using either U.S. Army Corps of Engineers TABS II two-dimenional hydraulic model or other models acceptable to FEMA. The model should simulate the effects of floodplain geomorphology, flow changes, bridges,

culverts, hydraulic roughness factors, effective flow limitations, split-flows, and other considerations. The consultant will prepare the study using the guidelines established in FEMA Document 37, Flood Insurance Study Guidelines and Specification for Study Contractors, March 1991, and FIA Document 12, Appeals, Revisions, and Amendments to Flood Insurance Maps, January 1990.

6.2 Field Reconnaissnace

6.2.1 The Consultant will conduct a field reconnaissance of the full study reach. This will include observation of channel and floodplain conditions for estimation of Manning's "n" values; photographic documentation of floodplain characteristics; determination of channel bank stations; observation of possible overflow areas; inspection of levees or other flood control structures; and measurement of bridge dimensions.

6.2.2 Mannings "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 or other reference materilals that may be more applicable to Scottsdale condition. Copies of the USGS report are available through the District. The City, District and Consultant shall agree on appropriate roughness values prior to use in the model.

6.2.3 A draft report on the field reconnaissance will be submitted to the District and the City for review and approval prior to beginning the hydraulic modeling. The report will present the determination of turbulent exchange for the model Manning's "n" values using captioned color photographs or color photocopies. 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.

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

6.4 The Consultant is to make refinements to the hydraulic model based on review of the model results by the District, City, FEMA and its Technical Evaluation Contractor. ADWR will be provided courtesy copies of results if requested. The Consultant shall review the hydraulic model results for reasonableness. Adjustments to the input parameters for obtaining the most realistic results is normal to the scope.

6.5 Floodways are to be determined. The floodway encroachment is to be as near the one foot maximum rise in elevation as possible.

6.6 Two-dimensional Modeling

6.6.1 Meshes must have sufficient resolution to define the physical surface to be modelled but also enough to solve for the velocity and water depth gradients on the interior of the mesh. The Consultant shall use the Peclet number as a guide for assigning eddy viscosities and determining adequate mesh velocity.

6.6.2 The finite element mesh shall be generally more dense in areas with high velocity gradients, high bottom slope and high boundary curvature. However care must be taken to ensure that the elements are well formed and their sizes do not vary more than 50% from one another to the next element.

6.6.3 Cross sections will be spaced in intervals that allow the Consultant to monitor the performance of the model. GC strings orientation must be perpendicular to the flow path to ensure that orthogonal lines of the finite element mesh are parallel to the expected flow lines.

6.6.4 The Consultant shall submit finite element mesh showing location and alignment of GC strings, and turbulent exchange and Manning's coefficient associated with each element, as part of the draft report as requested in task 6.2.3

6.6.5 The Consultant shall make refinements to the hydraulic model based on review of the model results by the District. The Consultant shall review the hydraulic model results for stability, accuracy and reasonableness. Adjustments to the input parameters for obtaining the most realistic results is normal to the scope.

6.7. The Consultant must obtain District approval at each of the folowing steps:

a. Field reconnaissance report and estimation of turbulent exchange and Manning's "n" values

b. Proposed two-dimentsional finite elements mesh representing the study area and boundary conditions

c. Proposed split flow locations

d. Floodplain (natural) delineation

e. Floodway delineations

f. Final Hydraulics Report

6.8 The Consultant will prepare working drawings and models of the 100-year floodplain

during the course of the hydraulic modeling for review by the District at progress and milestone meetings.

6.9 Cross section plots showing a legend, water surface profiles, ineffective flow areas, "n" channel stationing and other pertinent information must be available at all reviews.

.TASK 7 - DELIVERABLES

7.1 Mapping:

7.1.1 One complete set of topographic maps at 1" = 100' scale with 1-foot contour with the floodplain delineations in reproducible for (mylar) and six blue line copies.

7.1.2 One set of transparent overlays of photo-mylars.

7.2 Six hardcopies of the hydraulic model printout and a copy of the model input/output on 3.5", 1.2 Mb diskettes compatible with District computers.

7.3 Tabular list of control points (ERM) used with descriptions, elevations and coordinates.

7.4 The Consultant shall produce a draft Final Report incorporating the comments of the District, the City and other agencies involved in review process. The final report should include, but is not limited to the following:

1. Introduction
   a. Purpose
   b. Authority of the study
   c. Coordination
   d. Public notification and contacts

2. Scope of Study
   a. Description of area
   b. Flooding problems
   c. Flood protection measures

3. Hydraulic modeling
   a. Brief model description
   b. Summary of basic equations
   c. Model flow diagram and network
   d. Input parameters
   e. Results

4. Floodplain management applications

5. Analysis of results

6. Conclusions

7. Bibliography

8. Appendixes

7.5 Documentation for the study will be as outlined in FEMA contractor guidelines #37 dated January 1995 and in ADWR State Standard Attachement 1-90, Instructions for Organizing and Submitting Technical Documentation for Flood Studies, September 1991.

PHASE II

8.1 Flood zones must be determined according to FEMA criteria and clearly labelled on the final drawings.

8.2 Total area of floodplain must be determined for each reach in square miles and acres showing quantities in SI units enclosed in parenthesis.

8.3 Digital data will be prepared in conformance with the District's HIS Data Delivery Specifications, Revision 1.1 for the following themes:

a. Land elevations

b. Floodplain FEMA zone

c. Floodplain FEMA water surface elevation

8.4 The Consultant shall submit six copies of the final report as approved by the District and the City of Scottsdale.

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

8.5.1 Original Affidavits of Publication

8.5.2 Two (2) complete sets of blueline topographic base maps with the floodplain/floodway delineations shown. All drawings will be signed and

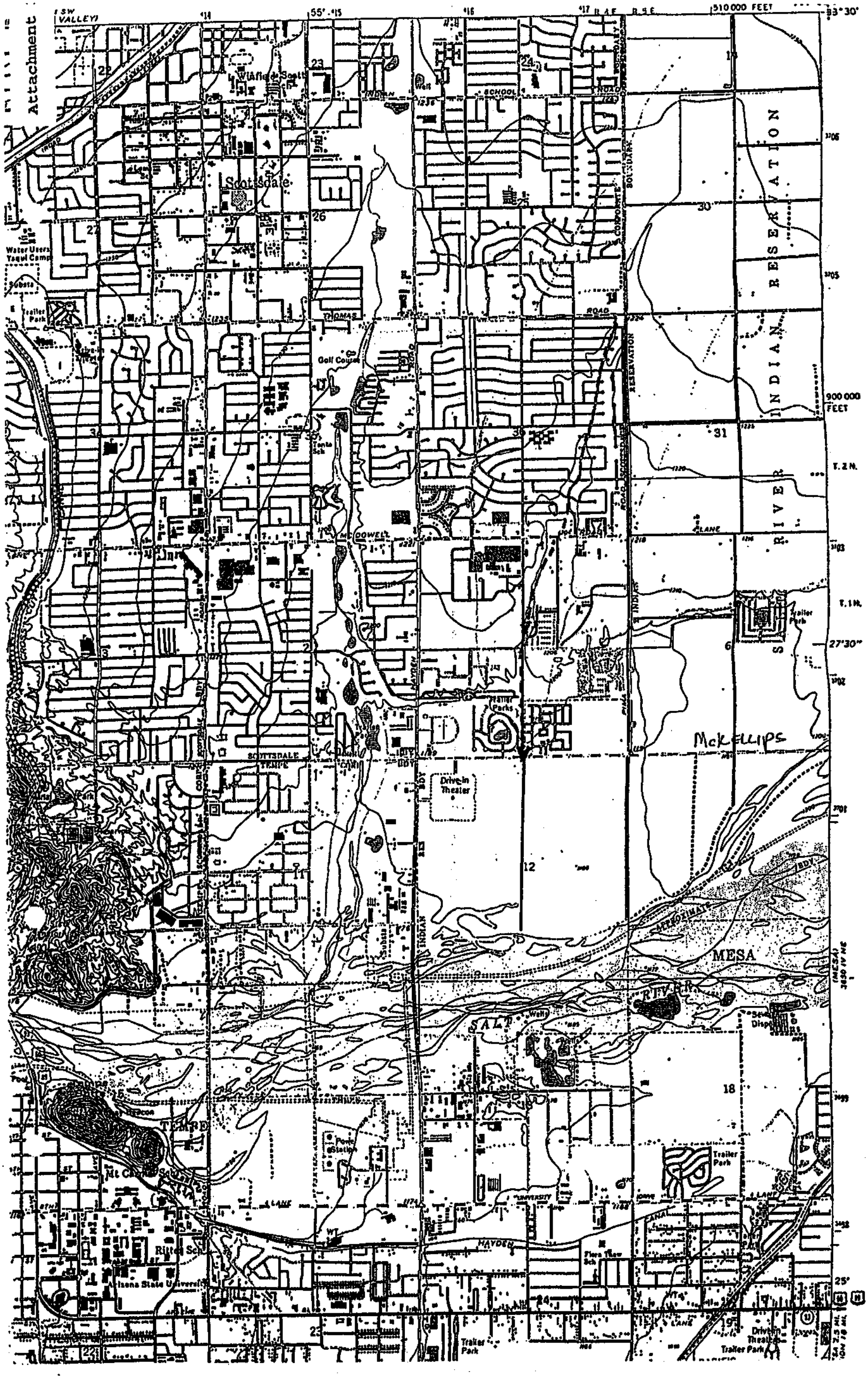
sealed by persons of appropriate professional registration(s). Each registrant will provide a specific statement as to what service they performed.

8.5.3 Two (2) sets of completed FEMA forms will be submitted in a notebook separate from the Final Report.

8.5.4 Three (3) sets of complete survey notes will be submitted in a notebook separate from the Final Report.

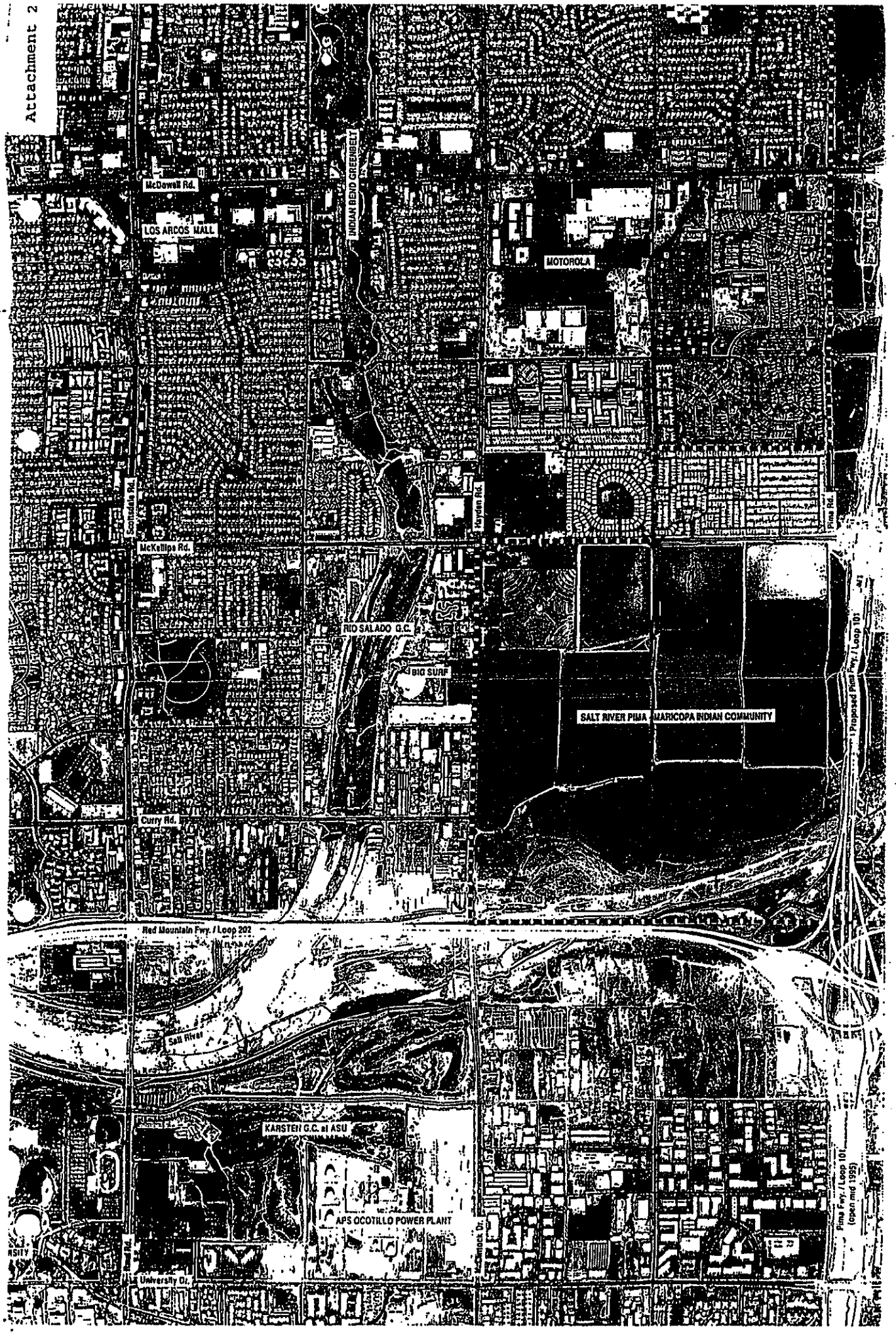
8.5.5 Two (2) copies of the current FIRM panels showing the proposed delineation.

Attachment



33°30'
510 000 FEET
Scottsdale
Water Users Yaqui Camp
Trailer Park
Golf Course
THOMAS
ROAD
SCHOOL
INDIAN RIVER RESERVATION
900 000 FEET
T. 2 N.
T. 1 N.
27'30"
McDOWELL
Trailer Parks
Trailer Park
McKELLIPS
SCOTTSDALE
TEMPE
Drive-in Theater
MESA
SALT
RIVER
TEMPE
HAYDEN
Arizona State University
Drive-in Theater
Trailer Park
25'

Attachment 2



WITH RESPECT TO ANY INCLUDING ANY WARRANTY ...

Photographs supplied by Landiscor, Inc. or its subsidiaries may depict (by superimposition or otherwise) planned or proposed improvements or developments. These improvements or developments may never be constructed or may be constructed at locations or on alignments other than those depicted. While we believe the general development and facilities shown, no representation or warranty

PHOTO DATE: FEBRUARY 12, 1995

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FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

BOARD OF DIRECTORS
Betsey Bayless
Ed King
Tom Rawles
Don Stapley
Mary Rose Garrido Wilcox

RECEIVED
SEP 4 1996
Entellus

August 30, 1996

Entellus
2255 North 44th Street
Phoenix, Arizona 85008

Subject: Change Order No. 1 to
Contract FCD 95-29, Granite Reef Wash

The subject contract is scheduled for completion on October 3, 1996. This change order will extend the contract time to December 31, 1996. If you concur, we request that you sign and return both copies. Upon approval by our Chief Engineer and General Manager, one original signature copy will be returned to you for your file.

Dortha Klaahsen

Dortha Klaahsen
Contracts Coordinator

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

Project Name: GRANITE REEF WASH FLOODPLAIN DELINEATION STUDY

Contract Change Order No. 1

Date: 8/27/96

FCD Contract No./Name: FCD 95-29

To: ENTELLUS, Contractor/Consultant.

You are hereby directed to make the herein described changes from the plans and specifications or do the following described work not included in the plans and specifications on the above-mentioned project.

Changes requested by: Maximo R. De Vera, Project Manager

Provide description of work to be done, estimate of quantities, and prices to be paid. Segregate between additional work at contract price, agreed price, and actual cost. Unless otherwise stated, rates for rental of equipment on actual cost work cover only such time as equipment is actually used and no allowance will be made for idle times.

* (1) Estimate of increases and/or decreases in contract items at contract prices.
** (2) Estimate of extra work at agreed price and/or actual cost.

Sheet No. 1 of 1

Description of Change Order
This change order request is for time extension only, the contract amount will not be affected. It is requested that the contract expiration date be changed from October 31, 1996 to December 31, 1996 for a total of 61 days extension. This time extension is necessary because the City of Scottsdale has been late in providing the necessary topographic informations required to finish the contract. This information will affect 80 sructures within the floodplain.

We, the undersigned Contractor/Consultant, having given careful consideration to the change(s) proposed, hereby agree, if this proposal is approved, that we will provide all equipment, furnish all material (except as may otherwise be noted above), and perform all services necessary for the work above specified.

By reason of this proposed change 61 days extension of time will be allowed.
Total contract amount through this Change Order will be the same as the original contract amount of $79,736

Contractor/Consultant: ENTELLUS
2255 North 44th Street
Phoenix, AZ 85008

By: Edward A. Adair
Title: President
Date: 9/5/96

Recommended by: [illegible]
Date: 8/29/96

Approved by:
Chief Engineer and General Manager
Date:

AGK ENGINEERS, INC.
2255 North 44th Street • Suite 330 • Phoenix, Arizona 85008 • Phone (602) 244-2566 • FAX (602) 244-8947

December 21, 1995

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

FILE COPY

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45

Dear Mr. DeVera:

Pursuant to the Scope of Work of this project, we hereby submit the attached Project Schedule for your review and approval.

In addition, the estimated monthly billings are listed below:

MONTH	Year	ESTIMATED BILLING
December	1995	$ 3,000
January	1996	12,000
February	1996	12,000
March	1996	12,000
April	1996	12,000
May	1996	10,000
June	1996	7,000
July	1996	7,000
August	1996	4,736
Total Contracted Amount		**$ 79,736**

If you have any questions or need further clarifications, please do not hesitate to call me.

Very truly yours,

AGK ENGINEERS, INC.

Samuel Kao

Samuel E. Kao, Ph.D, P.E.
Vice President

SEK/pp

PRINCIPAL
Edward A. Adair, P.E.
Samuel E. Kao, Ph D., P.E.

ASSOCIATE
Patrice M. Miller
Denis L. Howe, P.E.
Michael J. Bonar, P.E.

GRANITE REEF WASH FLOODPLAIN DELINEATION STUDY

FCD 95 - 29

ESTIMATED PROJECT SCHEDULE

TASK DESCRIPTION	TIME - MONTHS								
	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG
1. Coordination Meeting (As needed)	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Data Collection									
3. Topographic Mapping									
4. Field Survey (As needed)									
5. Hydrology Review									
6. Floodplain Delineation									
7. Deliverables									
8. Phase II									

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

BOARD OF DIRECTORS
Bersey Bayless
Ed King
Tom Rawles
Don Stapley
Mary Rose Garrido Wilcox

March 25, 1996

Samuel E. Kao, Ph.D., P.E.
Vice President
Entellus, Inc
2255 N. 44th St.
Phoenix, AZ 85008

Re: Granite Reef Wash Floodplain Delineation Study, FCD 95-29

Dear Dr. Kao:

In response to your request for approval of your revised monthly billings dated March 6, 1996 please be advised that as per contract the lump sum fee of Phase I is $62,195 and for Phase II, a negotiated lump sum not to exceed $17,541. The contracting branch has advised me that henceforth monthly progress payments be made as per contract for Phase I first..

Please revise your monthly billings accordingly.

If you need further clarifications, please call me at 506-4001

Sincerely,

MAXIMO R. DE VERA, P.E.
Hydrologist and Project Manager

cc: PAC
Contracting Branch

Intelligent Engineering
Environmental *Solutions*

March 6, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

FILE COPY

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, AGK Job No. 310.45

Dear Mr. DeVera:

Due to the delay of topographic information from the City of Scottsdale, we hereby submit the revised Project Schedule for your review and approval.

The estimated monthly billings are revised as follows:

MONTH	YEAR	ORIGINALLY ESTIMATED BILLING	REVISED ESTIMATED BILLING
December	1995	$ 3,000	$ 3,000
January	1996	12,000	4,000
February	1996	12,000	5,000
March	1996	12,000	10,000
April	1996	12,000	15,000
May	1996	10,000	15,000
June	1996	7,000	12,000
July	1996	7,000	11,000
August	1996	4,736	4,736
Total Contracted Amount		**$ 79,736**	**$79,736**

If you have any questions or need further clarifications, please do not hesitate to call me.

Very truly yours,

ENTELLUS, INC.

Samuel Kao

Samuel E. Kao, Ph.D, P.E.
Vice President
SEK/pp

Entellus

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

FLOOD CONTROL DISTRICT
of
Maricopa County

2801 West Durango Street • Phoenix, Arizona 85009
Telephone (602) 506-1501
Fax (602) 506-4601
TT (602) 506-5859

BOARD OF DIRECTORS
Betsey Bayless
Ed King
Tom Rawles
Don Stapley
Mary Rose Garrido Wilcox

August 5, 1996

Dr. Samuel E. Kao
ENTELLUS
2255 N. 44th Street, Suite 330
Phoenix, AZ 85008

Subject: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Job No. 310-45

Dear Dr. Kao:

As per your letter dated March 6, 1996 the last billing for the project is for the month of August 1996. If project completion date will be delayed please submit a revised project scehdule and billing period.

The estimated project expiration date is 10/30/96 as per Contracting Branch file.

Thank you.

Sincerely yours,

MAXIMO R. DE VERA. P.E.
Civil Engineer & Project Manager

cc: Pedro A.Calza
Hydraulics Branch Manager

August 6, 1996

Mr. Maximo DeVera
Project Manager
FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango Street
Phoenix, AZ 85009

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-29, Entellus Job No. 310.45

FILE COPY

Dear Mr. DeVera:

Due to the further delay of topographic and as-built information from the City of Scottsdale, we hereby submit the revised Project Schedule for your review and approval.

The estimated monthly billings are revised as follows:

MONTH	YEAR	ORIGINALLY ESTIMATED BILLING	REVISED ESTIMATED BILLING
December	1995	$ 3,000	$ 3,000
January	1996	12,000	4,000
February	1996	12,000	5,000
March	1996	12,000	7,000
April	1996	12,000	7,000
May	1996	10,000	6,000
June	1996	7,000	18,000
July	1996	7,000	500
August	1996	4,736	8,000
September	1996	0	8,000
October	1996	0	8,500
November	1996	0	4,736
Total Contracted Amount		$ 79,736	$79,736

If you have any questions or need further clarifications, please do not hesitate to call me.

Very truly yours,

ENTELLUS, INC.

Samuel E. Kao

Samuel E. Kao, Ph.D, P.E.
Vice President
SEK/kp

2255 N. 44th Street
Suite 330
Phoenix, Arizona
85008-3279

Tel
Fax

A Division of M.K. Engineers

SECTION 2: MAPPING AND SURVEY INFORMATION

2.1 Topographic Mapping

Topographic mapping for the study area was furnished by the City of Scottsdale. The base mapping has a scale of 1" = 100' with a contour interval of one foot. It was prepared by Michael Baker, Jr., Inc. in 1993 under a contract with the City of Scottsdale.

This map was produced by photogrammetric methods from aerial photography obtained in September, October and November, 1993. Michael Baker certified that the accuracy of this map meets "Map Accuracy Standards" as stated by U.S.O.M.B. and as published by The American Society of Photogrammetry.

Grid values of the map are based on the Arizona State Plane Coordinate, Central Zone, North American Datum, 1983 Adjustment modified to a local project datum. Elevations are based on the North American Vertical Datum, 1988 Adjustment.

The mapping covered Section 1, Township 1 North, Range 4 East and Section 36, Township 2 North, Range 4 East, Gila and Salt River Base and Meridian, Maricopa County, Arizona.

2.2 Survey

Field survey was performed by the City of Scottsdale to provide supplemental topographic information as needed for this project. The horizontal and vertical controls used in field survey were compatible to what were used in the topographic mapping.

2.3 Survey Field Notes

The Elevation Reference Marks (ERMs) are presented in **Appendix A**. Copies of survey field notes are included in **Appendix B**.

2.4 Watershed Maps

Not a part of the Scope of Work under this contract.

2.5 Hydraulic Analysis Maps

The Floodplain and Floodway Maps as well as their index are presented in **Appendix G** in reduced scale. Full size copies are bound separately from this report.

2.6 Draft FIRM Maps

Full size copies of the draft Flood Insurance Rate Maps (FIRM) are bound separately from this report.

2.7 Community Maps

The community street layout is shown on the Floodplain and Floodway Maps.

SECTION 3: HYDROLOGIC ANALYSIS

The hydrologic analysis was not a part of the Scope of Work under this contract. As decided by both the Flood Control District of Maricopa County and the City of Scottsdale, the same discharges as generated in the previous Flood Insurance Study were used in this study.

SECTION 4: HYDRAULIC ANALYSIS

4.1 Method Description

The floodplains are analyzed using ProHEC2. ProHEC2 is an enhancement of version 4.6.2 of the standard Corps of Engineers program. This enhanced version was developed by Dodson and Associates, June 1992 and provides utilities that allows for plotting of HEC-2 data using AutoCAD.

Cross sections were digitized from the topographic mapping as discussed in Section 2.1. Dimensions and elevations of hydraulic structures such as culverts and catch basins were obtained from field survey. Ground elevations at some selected locations that required more detailed information were also determined from field survey. In addition, a minimum of ten (10) percent of the digitized cross sections were field verified. Results of the verification are presented in **Appendix B.** Elevations used in this study were based on the North American Vertical Datum of 1988.

The starting water surface elevation for flooding source at the downstream limit of the study was obtained by the critical depth option of the HEC-2 computer program. Results of the HEC-2 run for the study reach are presented in **Appendix E.** The flood profiles are included in **Appendix F.**

Initially, a two-dimensional hydraulic model was used in this project in order to have a more accurate account for the channel storage along the study reach. However, it was switched to HEC-2 modeling due to the lack of adequate inflow hydrographs as input files for the two-dimensional model.

4.2 Parameters Estimation

4.2.1 Manning's n Value

4.2.1.1 Introduction

The Granite Reef Wash study consists of approximately 2 miles of floodplain to be delineated under this project. The wash was divided into eight reaches of similar hydraulic characteristics and Manning's n values assigned to the reaches based on their typical characteristics. Reach 5 was further subdivided into Reaches 5A and 5B to account for some differences on the right bank. Likewise, Reach 8 was also subdivided into Reaches 8A and 8B. Each reach was identified with four-character identifier. The first three characters represent the name of the wash, and the fourth is the reach number. For example, GRF2 denotes Granite Reef Wash, Reach 2. The reach numbers start with "1" at the downstream end and increases in the upstream direction.

The limits, location of photographs and n values for each reach are shown on Exhibit 1 entitled, "Manning's n Value Map". In calculating the n Value, the following factors were considered:

Bed material particle size
Degree of irregularity of the bank slopes
Effect of obstruction
Degree of meandering
Vegetation

The obstruction of structures was not considered in the development of n-values because the area of buildings was excluded from the

cross sections. However, other obstructions such as fence, walks, and parked vehicles were considered in the estimation of n-values.

The density and type of vegetation have significant impact on the roughness coefficient (n value). The vegetation within the floodplain was identified to include the following:

Lawns
Desert landscaping
Scattered trees

4.2.1.2 Methodology

Each reach was identified with the aid of 1" = 100' aerial photographs. The discerning characteristics were channel size, vegetation density, bed materials and development encroachment. Each reach was photographed during the field reconnaissance at a representative and accessible location. The photography locations are summarized on Exhibit 1.

Manning's roughness coefficients were determined in accordance with the methodology described in *Estimated Manning's Roughness Coefficient for Streams Channels and Floodplains in Maricopa County, Arizona* (USGS, Water Resources Division, April 1991). The method described in this publication selects a base value for the roughness coefficient based exclusively on bed material. This base value is then adjusted to account for vegetation, irregularities, obstructions and cross-section variations. In addition, a multiplier can be applied to the adjusted n-value if meandering of the reach is significant.

The base roughness coefficient in this study was selected based on the average particle size observed in the field. The typical bed materials in the study area range from smooth concrete to coarse gravel, and typical values of the roughness coefficients range from 0.018 for paved streets to 0.035 for riprap lined channels.

4.2.1.3 n Value Determination

The base values, adjustments and the adjusted values for Manning's roughness coefficient are shown in **Appendix C**.

4.2.2 Expansion and Contraction Coefficients

The expansion and contraction coefficients used in the HEC-2 model were determined from the *HEC-2 User's Manual.* For gradual transitions which include most reaches in this study, the contraction and expansion coefficients were set to be 0.1 and 0.3, respectively. At culvert locations where the change on cross sectional geometry is abrupt, the coefficients were set to be 0.3 for contraction and 0.5 for expansion. At locations where the cross sectional area and flow direction change abruptly, values of 0.5 and 0.8 were used for these coefficients.

4.3 Cross Section Description

4.3.1 Channel and Overbanks

Prior to obtaining GR records for exact locations, the channel bank stations were approximated by field observation. The stations were then determined with the aid of 1" = 100' aerial photographs. For reaches where the channel is well defined, the overbank stations were set at the top of bank. For

reaches where the stream bed is replaced by roadways, overbank stations were set at the curb line.

4.3.2 Bridges and Constrictions

4.3.2.1 Minor Hydraulic Structures

There is a building located at approximately 250 feet north of McDowell Road. Hydraulically speaking, the building functions as a bridge across Granite Reef Wash. In addition, a 30-inch diameter storm drain is located along 87th Street and 84th Place, respectively. However, the storm drains were not considered in this study due to their insignificant capacities.

4.3.2.2 Major Hydraulic Structures

Presently, two concrete box culverts are in the vicinity of the study reach. One is located at the McDowell Road crossing, while the other is just upstream of the well site near the south end of Granite Reef Road. Both culverts would be overtopped during a 100-year storm. In this study, they were assumed to be able to withstand an overtopping event. Clogging of the culverts were not assumed in the analysis since no significant amount of debris was encountered during field reconnaissance.

4.3.3 Cross Section Modification for Buildings

The areas occupied by buildings were blocked out from the cross sections. More detailed explanation on this subject is given in Section 4.5.1.

4.4 Calibration

4.4.1 HEC-2 Model Calibration

Since gauging records are not available in the study area, results of the HEC-2 modeling was unable to be calibrated. However, the results were carefully examined and found to be reasonable.

4.4.2 Flow Split

The channel and roadway upstream of the Well Site Culvert do not have enough capacity to convey the 100-year flow. A significant amount of flow would be spread laterally to the adjacent areas and not return to the main channel of Granite Reef Wash. However, since that channel reach is beyond the Limits of Study under this contract, the flow split would not directly impact the floodplain delineation in this study. More detailed discussion on this issue is presented in **Section 4.5 Special Problems**.

4.5 Special Problems

The original alignment of the Granite Reef Wash has been significantly affected by development. As a result, several locations required detailed analyses to better understand the extent of flood flow conditions. The methodology used in the analyses is discussed below.

4.5.1 Building Obstructions

The floodplain of the Granite Reef Wash consists of houses, yards, alleys and streets, creating a network of interconnecting flowpaths. The cross section information obtained from topographic maps does not adequately represent this unique condition. As decided in a Progress Review Meeting at FCDMC,

the cross-sectional areas for buildings were blocked out, instead of using high n-values to simulate the effect of building obstruction. The flow paths were drawn on a 1"=100' aerial photograph and the cross sections were modified by blocking the area between flow paths. The flowpaths represent areas where flow can occur in the longitudinal direction while the blocked areas represent areas where no flow or only lateral flow occurs. This simulation of cross-sectional areas is illustrated in a sketch shown in **Appendix E**.

4.5.2 Transition between 87th Street and Earthen Channel

The flow is forced to make a 90 degree turn at 87th Street, approximately 350 feet north of McDowell Road. At this location the channel cross section and characteristics change abruptly. The HEC-2 computer program is a one dimensional, gradually varied flow model while the dynamics of flow at this location are two dimensional, rapidly varied flow. In order to minimize the deficiencies of the program, the expansion and contraction coefficients were raised to 0.5 and 0.8 respectively, and a shaded Zone X was depicted on the outer area of the bend to allow for superelevation at this location. The depth of water in the shaded Zone X was estimated to be approximately 0.2 foot. See **Appendix E** for detailed calculations.

4.5.3 Bend North of McDowell Road

Between 87th Street and McDowell Road there is another location where the flow is forced through a 90 degree bend. At this location the expansion and contraction coefficients were also increased to 0.5 and 0.8, respectively.

4.5.4 Transition between Earthen Channel and 84th Place

At the north end of 84th Place, the earthen channel abruptly ends and 84th Place becomes the channel. At this transition, the flow line of the wash suddenly raises by approximately 6 feet. The rapid change in cross section and profile causes a critical depth condition with the water surface dropping in a short distance. This situation is realistic near the channel thalweg. However, out in the floodplain, the change would be more gradual and the exact location is uncertain.

4.5.5 Bends at 84th Place

The wash makes two 90 degree bends near the intersection of 84th Place and Granite Reef Road. The expansion and contraction coefficient at this location was increased to 0.3 and 0.5 to compensate the sharp bends. Also, shaded Zone X was depicted between 84th Place and Granite Reef Road downstream from the bend. This zone represents the area that would be inundated by flow overtopping the outer bank of 84th Place at the bend. Superelevation at this location was estimated to be approximately 0.3 foot. See **Appendix E** for detailed calculations.

4.5.6 Initial Cross Section for HEC-2 Modeling

As stated previously, the Limits of Study for the downstream end of this project is near the south end of Granite Reef Road (Cross Section 0.326), approximately 1,300 feet north of McKellips Road. However, due to the backwater effect, the initial cross section for HEC-2 modeling was set at the downstream end of the Well Site Culvert (Cross Section 0.225).

As discussed under Section 4.4.2 Flow Split, a significant amount of flow would be spread laterally to the adjacent areas and may or may not return to

the main channel of Granite Reef Wash. There is a detention basin immediately upstream of the culvert that may provide significant peak flow reduction in this area. However, due to lack of funding to provide additional hydrological analysis in this area, the City and the District made a joint decision to move the study limit to Cross Section 0.320, which is located at the north side of Well Site Cuvlert.

4.5.7 Existing FIRM Model

A printout of the HEC-2 output for the existing FIRM information of the study reach was obtained from the District and is included in **Appendix E**. Due to the poor quality of the printout, detailed information could not be extracted from this document.

4.6 Floodway Modeling

The study area is fully developed and further encroachment of floodplain is not expected to occur. For this reason, and for floodplain management purposes, the floodplain will be regulated as floodway. Therefore, the wash shown on the Floodway and Flooplain Maps (**Appendix G**) have a floodplain coincident with floodway. The floodway data for all study washes are included in **Appendix H** of this report.

4.7 Final Results/Computer Model

The final printout of the HEC-2 output files is included in **Appendix E**.

4.8 Computer Model Diskette

The computer diskette included with this report contains the HEC-2 file generated in this study. This file contains the information used to generate the floodway/floodplain maps and the output printouts presented in **Appendix E**. The diskette is located in a plastic pocket at the back of this report.

SECTION 5: EROSION/SEDIMENT TRANSPORT ANALYSIS

Erosion/sediment transport analysis is not a part of this study.

SECTION 6: REFERENCE MATERIALS

6.1 Other Published Flood Studies

There are no significant published flood studies of record other than the one listed under **Section 6.2** of this report.

6.2 Previous FEMA Studies

Flooplain delineation for Granite Reef Wash was included in the FEMA *Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas, Volumes 1 through 12,* dated April 15, 1988. The study report was revised on September 30, 1995. However, results of floodplain delineation for Granite Reef Wash were not affected by the 1995 revision.

6.3 Other Applicable Studies

There are several previous studies of portions of the study area. Refer to **Section 6.5.**

6.4 Published and Unpublished Historical Flood Information

There is no significant historical flood information of record for this watershed.

6.5 Bibliography

1. Arizona Department of Water Resources, Engineering Division, Flood Management Section, September 1991. *Instructions for Organizing and Submitting Technical Documentation for Flood Study.*

2. Arizona Department of Water Resources, Engineering Division, Flood Management Section, December 1991. *Requirement for Floodplain Delineation in Riverine Environments.*

3. Arizona Department of Water Resources, Engineering Division, Floodplain Management Section, April 1993. *Floodplain Standard for Supercritical Streams.*

4. Chow, V.T., *Open Channel Hydraulics*, McGraw-Hill, 1959.

5. Dodson & Associates, Inc. 1991. *ProHEC2 User's Manual and Program Reference.*

6. Federal Emergency Management Agency, April 15, 1988 (Revised September 30, 1995). *Flood Insurance Study, Maricopa County, Arizona and Incorporated areas, Volumes 1 through 12.*

7. Federal Emergency Management Agency, January 1995. *FEMA 37, Flood Insurance Study Guidelines and Specifications for Study Contractors.*

8. Flood Control District of Maricopa County, Undated *Drainage Design Manual for Maricopa County, Volume I, Hydrology.*

9. Flood Control District of Maricopa County, September, 1992. *Drainage Design Manual for Maricopa County, Volume II, Hydraulics.*

10. U.S. Department of the Army, Corps of Engineers, September, 1990. *HEC-2 Water Surface Profiles Users Manual.*

11. U.S. Department of Transportation, September 1985. *Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5*, FHWA Report No. 1-P-85-15.

12. U.S. Geological Survey, 1991. *Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona.*

13. U. S. Department of the Army, Corps of Engineers, Arpil 15, 1962. *Interim Report on Survey for Flood Control, Indian Bend Wash, Arizona.*

14. Simons, Li & Associates, Inc., January 1995, Revised June 1995. *Granite Reef Wash Drainage Study,* prepared for Maricopa County Department of Transportation.

15. KVL consultants, Inc., February 1995. *Report on Granite Reef Wash Drainage Study*, prepared for the City of Scottsdale, Arizona.

16. INCA Engineers, Inc., July 3, 1996. *Final Drainage Report for McDowell Road Widening: Granite Reef to Pima Roads,* prepared for the City of Scottsdale, Arizona.

6.6 Applicable Improvement Plans, Maps and Related Documents

1. Michael Baker, Jr., Inc., 1993. *Topographic maps for the City of Scottsdale, Arizona. Scale 1" = 100', Contour interval = 1 foot, Vertical datum based on North American Vertical Datum, 1988 Adjustment.*

2. INCA Engineers, Inc., 1996. McDowell Road Streets Improvement Plans, Project No. S-1706.

SECTION 7: CROSS-REFERENCING AND LABELING INFORMATION

Cross-referencing and labeling information are not a part of this report.

SECTION 8: FLOOD INSURANCE STUDY REPORT

See **Appendix H**

APPENDIX A

ELEVATION REFERENCE MARKS

ELEVATION REFERENCE MARKS (EMR)
GRANITE REEF FLOODPLAIN DELINEATION STUDY

ID Number	Elevation NGVD 29	Elevation NAVD 88	Description
1	1186.23	1188.06	Arizona Department of Transportation Brass cap int. McKellips Road & Granite Reef alignment
2	1200.87	1202.70	C.O.S. Brass cap in hand hole int. Roosevelt Street & Granite Reef Road
3	1216.27	1218.10	Maricopa County Brass cap in hand hole int. McDowell & Granite Reef Roads
4	1225.18	1227.01	Maricopa County Brass cap in hand hole int. Oak Street & Granite Reef Road
5	1224.29	1226.12	C.O.P. Brass cap in hand hole int. Thomas & Pima Roads
6	1230.90	1232.73	C.O.S. Brass cap in hand hole int. Thomas & Granite Reef Roads

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
12216
JOHN E.
COURTNEY
7-11-97
Date Signed
ARIZONA, U.S.A.

This map was produced by Photogrammetric Methods from aerial photography obtained in September, October and November 1993. The accuracy of this map meets "Map Accuracy Standards" as stated by U.S.O.M.B. and as published by The American Society of Photogrammetry.

Horizontal accuracy : not more than 10 percent of points tested shall be in error by more than 1/40 inch at map scale.

Vertical accuracy : not more than 10 percent of elevations tested shall be in error more than one half the contour interval.

Horizontal Datum :
Grid values are based on the Arizona State Plane Coordinate, Central Zone, North American Datum, 1983 Adjustment modified to a local project datum.

Vertical Datum :
Elevations are based on the North American Vertical Datum, 1988 Adjustment.

Prepared by
MICHAEL BAKER, JR., INC.
Consulting Engineers
Beaver, Pennsylvania

APPENDIX B

SURVEY FIELD NOTES AND CROSS SECTION VERIFICATIONS

Property of CITY OF SCOTTSDALE

SURVEY DEPT.

Address 9191 E. SAN SALVADOR

SCOTTSDALE AZ 85252-1000

Telephone 391-5781

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
12216
JOHN E.
COURTNEY
Date Signed 10-17-96
ARIZONA, U.S.A.

John E. Courtney

This Book is manufactured of a High Grade 50% Rag Ledger Paper having a Water Resistant Surface, and is sewed with Nylon Waterproof Thread.

INDEX

GRANITE REEF WASH F.F. ELEVS

CAS JN 96128

	PAGE	
BENCH RUN ALONG 87TH ST N. THOMAS RD TO McDOWELL RD.	1-2	9-9-96
BENCH RUN ALONG 85TH PL FROM McDOWELL TO ROOSEVELT & GRANITE REEF	3	9-9-96
BENCH RUN ALONG GRANITE REEF FROM ROOSEVELT TO CUL-DE-SAC TO SOUTH	4	9-9-96
F.F. EL. THOMAS RD	5	9-9-96
F.F. EL. EDGEMONT AVE, ROANOKE AVE	6-8	9-9-96

NOTE!!! Elevations are relative to NAD 88

STA	+	HI	−	EL.	ADJ EL	DESC	9-9-96
BM				1226.12		C.O. PH. BC @ THOMAS & PIMA	
	4.31						
TBM ①			7.32	23.11	1223.11	① CHISLED 'X' TOP OF CURB ½ WAY THROUGH CURVE @	
	3.68					S.E. COR 87TH & EDGEMONT	
TBM ②			6.41	20.38	1220.38	② BC @ 87TH & WINSOR	
	5.22						
TBM ③			6.32	19.28	1219.29	③ BC @ 87TH & VIRGINIA	
	5.515						
TBM ④			6.51	18.285	1218.29	④ BC @ 87TH & LEWIS	
	5.405						
TBM ⑤			6.38	17.31	1217.32	⑤ BC @ 87TH & VERNON	
	4.83						
TBM ⑥			6.63	15.51	1215.52	⑥ BC @ 87TH & CYPRESS	
	5.065						
TBM ⑦			4.91	15.665	1215.68	⑦ CHISLED 'X' TOP OF CURB 'S' RETURN	
	4.115					@ SE COR 87TH & HOLLY	
TBM ⑧			5.175	14.605	1214.62	⑧ CHISLED '□' TOP OF CURB 'S' RETURN	
	4.005					@ SE COR 87TH & HUBBELL (NORTH	
						INTERSECTION OF TWO INT OF 87TH & HUBBELL)	
	(42.145)		(49.655)				

STA	+	HI	-	EL	ADJ EL	DESCRIPTION	9-9-96
		18.61					
TBM 9			6.01	12.60	1212.62	9 BC @ 87TH & PALM	
	5.79						
TBM 10	" " "		4.29	14.10	1214.12	10 BC & PC 87TH (NE OF LA'S MILK DEPOT)	
	6.585						
TP			5.94	14.745			
	3.09						
TBM 11			3.72	14.115	1214.14	11 F.H. SW COR N 85TH PL & MCDOWELL RD	
	3.07					"N" CAP BOLT MKD "TBM 11"	
TP			2.46	14.725			
	7.40						
BM			4.055	= 18.07	1218.10		
				= 1218.10			
				Δ = 0.03			
			(-8.05)				
	(25.935)		(26.475)				

STA	+	HI	−	ELEV	ADJ EL		DESC. 9-9-96
TBM (11)				1214.14		(11)	SEE P. 3 FH SW COR N 85TH PL & McDOWELL RD 'N' CAP BOLT MKD "TBM 11"
	2.53						
TBM (12)			4.84	11.83	1211.83	(12)	BC @ N 85TH PL & BELLEVIEW PLACE
	4.39						
TBM (13)			6.04	10.18	1210.18	(13)	BC @ N 85TH PL & BELLEVIEW ST.
	3.645						
TBM (14)			7.16	06.67	1206.67	(14)	BC @ N 84TH PL & BELLEVIEW ST.
	4.95						
TBM (15)			6.01	05.61	1205.61	(15)	BC @ N 84TH PL & PORTLAND
	5.025						
TBM (16)			5.36	05.27	1205.27	(16)	CHISLED "□" ON CURB 'S' SIDE OF 84TH PL. ~½ THROUGH CURVE TO THE WEST @ ADDRESS 8454 84TH PL
	4.095						
BM			6.66	02.705			BM: COS BC/HH @ ROOSEVELT & GRANITE REEF
				= 1202.70			
TBM				Δ +0.005			
	(24.635)		(3607)	(-11 +35)			

STA	+	HI	−	EL	ADJ EL		DESC	9-9-96		4
BM				1202.70		BM	COS BG/HH @ ROOSEVELT & GRANITE REEF			
	1.43									
TBM (17)			4.63	1199.50	1199.50	(17)	CHISLED "□" TOP OF CURB N RETURN ON N SIDE			
	4.635						OF MIDDLE ENTRANCE TO "SCOTTSDALE NEW			
							VENTURES" APTS.			
TBM (18)			7.01	1197.12	1197.12	(18)	PK & SHINER NEAR CTR CUL-DE-SAC-GRANITE REEF			
	5.56									
TBM 17			3.18	1199.50						
	5.60									
BM			2.40	1202.70			BM: SAME AS BEGINNING			
				1202.70						
				Δ 0.00						
	(17.225)		(17.22)							

F.F. ELS THOMAS 120 W OF 87th ST 9-9-96

STREET ADDRESS	+	HI	−	EL	DESC.
TBM (1)				1223.11	TBM (1) SEE P. 1
	6.20	29.31			
8677			3.64	25.67	THOMAS RD
TP			4.07	25.24	
	5.49	30.73			
8671			4.95	25.78	
8665			4.38	26.35	
8659			3.97	26.76	
8655			3.84	26.89	
TP			4.54	26.19	
	5.47	31.66			
8647			4.35	27.31	
8643			4.12	27.54	
8637			4.09	27.57	
TP			5.49	26.17	
	2.33	28.50			
TBM (11)			5.38	1223.12	
				= 1223.11	
			Δ =	+ 0.01	

FF. ELS. EDGEMONT AVE, ROANOKE AVE 9-9-96

STREET ADDRESS	+	HI	-	EL.		DESC
TBM (11)				1223.11	TBM (11)	SEE P. 1
	6.10	29.21				
8701			3.42	25.79		EDGEMONT AVE
8709			3.14	26.07		
8678			3.43	25.78		
8672			3.02	26.19		
8673			3.70	25.51		
8667			3.58	25.63		
TP			5.19	24.02		
	5.71	29.73				
8666			3.12	26.61		
8660			3.00	26.73		
8654			2.59	27.14		
8648			2.48	27.25		
8644			2.49	27.24		
8638			2.43	27.30		
8637			3.09	26.64		
8643			3.07	26.66		

9-9-96

STREET ADDRESS	+	HI	−	EL.
		29.73		
8649			3.08	26.65
8655			3.17	26.56
8661			3.64	26.09
TP			4.40	25.33
	6.01	31.34		
8631			4.67	26.67
8625			4.21	27.13
TP			2.75	28.59
	3.72	32.31		
TP			6.71	25.60
	3.92	29.52		
8632			2.99	26.53
8638			3.18	26.34
8644			3.12	26.40
8650			3.22	26.30
8649			3.99	25.53
8641			3.41	26.11

EDGEMONT AVE

BC @ INT EDGEMONT & 86TH ST

ROANOKE AVE

9-9.96

STREET ADDRESS	+	HI	-	EL.
		29.52		
8632			3.45	26.07
8631			3.45	26.07
TP			5.86	23.66
	4.46	28.12		
8653			3.00	25.12
8659			3.35	24.77
8667			3.79	24.33
8656			1.97	26.15
8660			2.37	25.75
8668			2.82	25.30
8672			3.29	24.83
TP			7.13	20.99
	6.35	27.34		
8701			2.60	24.74
8707			215	25.19
8711			1.59	25.75
8710			1.97	25.37
8702			2.31	25.03
TBM ②			6.97	1220.37
				=1220.38
				Δ = -0.01

ROANOKE AVE

BC @ 87TH & ROANOKE

TBM ② SEE P. 1

F.F. EL	WINDSOR AVE, CAMBRIDGE AVE					RON DRY CHRIS ZWIEFEL			9-10-96	9
STREET ADDRESS	+	HI	-	ELEV.			DESC.			(189)
TBM (2)				1220.38		TBM (2)	BC @ 87TH & WINDSOR			
	6.51	26.89					WINDSOR AVE			
8701			3.13	23.76						
8707			2.02	24.87						
8713			1.15	25.74						
8710			1.97	24.92						
8702			2.77	24.12						
8659			2.89	24.00						
TP			4.73	22.16						
	5.59	27.75								
8664			3.66	24.09						
8660			3.25	24.50						
8654			2.97	24.78						
8653			3.60	24.15						
8647			3.32	24.43						
TP			4.64	23.11						
	5.53	28.64								
8648			3.47	25.17						

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STREET ADDRESS	+	HI	-	ELEV.	DESC
		28.64			
8642			3.03	25.61	WINDSOR AVE
8621			3.95	24.69	
8637			3.74	24.90	
8636			2.75	25.89	
8630			2.51	26.13	
8631			3.52	25.12	
8625			3.13	25.51	
8619			2.59	26.05	
TP			3.92	24.72	
	6.39	31.11			
8613			4.74	26.37	
8607			4.27	26.84	
8601			3.85	27.26	
TP			4.37	26.74	
	4.25	30.99			CAMBRIDGE AVE
8602			3.84	27.15	
8601			4.48	26.51	

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11

STREET ADDRESS	+	HI	−	EL.	DESC
		30.99			
8607			5.12	25.87	CAMBRIDGE AVE
8608			4.83	26.66	
8614			4.70	26.29	
8613 ?			5.38	25.61	
TP			6.91	24.08	
	3.90	27.98			
8619			3.04	24.94	
8622			2.41	25.57	
8626			3.13	24.85	
8623			3.67	24.31	
8629			4.00	23.98	
8634			3.86	24.12	
8635			4.27	23.71	
8640			3.98	24.00	
8641			4.64	23.34	
TP			5.29	22.69	
	4.76	27.45			

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STREET ADDRESS	+	HI	−	EL	DESC.
		27.45			
8644			3.78	23.67	CAMBRIDGE AVE
8647			4.40	23.05	
8655			4.58	22.87	
8652			3.97	23.48	
8656			4.31	23.14	
TP			7.64	19.81	BC @ 87TH & CAMBRIDGE
	6.04	25.85			
8701			2.43	23.42	
8707			0.86	24.99	
8708			1.35	24.50	
8702			2.62	23.23	
TBM 3			6.55	1219.30	TBM 3 SEE P1 BC @ 87TH & VIRGINIA
				1219.29	
			Δ	+ 0.01	
	(42.91)		(44.95)		

F.F.	ELS	VIRGINIA	AVE						9-10-96
STREET ADDRESS	+	HI	−	EL		DESC.			
TBM (3)				1219.29	TBM (3)	SEE P.1	BC @	87TH &	VIRGINIA
	7.96	27.25							
8701			3.69	23.56			VIRGINIA AVE		
8709			2.77	23.46					
8702			3.74	23.51					
8708			2.60	24.65					
8714			2.63	24.62					
TP			3.42	23.83					
	5.15	28.98							
2542			4.00	24.98		N 87TH WAY			
8720			3.46	25.52			VIRGINIA AVE		
8726			2.69	26.29					
TP			7.29	21.69					
[illegible]	5.43	27.12							
8650			4.36	22.76					
8644			3.67	23.45					
8645			4.19	22.93					
8639			3.95	23.17					

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STREET ADDRESS	+	HI	−	EL.	DESC.
		27.12			
8638			3.34	23.78	VIRGINIA AVE
8634			3.12	24.00	
8633			2.89	24.23	
TP			4.14	22.98	
	6.16	29.14			
8626			4.71	24.43	
8627			4.79	24.35	
8621			4.52	24.62	
8620			4.08	25.06	
8614			3.25	25.89	
8608			2.95	26.19	
8613			4.13	25.01	
8609			3.75	25.39	
8601			3.52	25.62	
8602			2.92	26.22	
TP			6.09	23.05	
	3.68	26.73			
TBM ③			7.43	19.30	TBM ③ SEE P.1
				±1219.29	

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FT EL. WILSHIRE DR, N 87TH WAY

STREET ADDRESS	+	HI	−	EL.	DESC
TBM ③				1219.29	TBM ③ SEE P.1 BC @ 87TH & VIRGINIA
	10.05	29.34			
2538			3.93	25.41	N 87TH WAY
2542			4.36	24.98	CHECK SHOT "
TBM ③				1219.29	
	5.98	25.27			
8702			2.06	23.21	WILSHIRE DR.
8708			1.10	24.26	
8707			1.28	23.99	
8701			2.55	22.72	
8646			2.64	22.63	
8643			2.53	22.74	
TP			4.03	21.24	
	5.38	26.62			
8640			2.89	23.73	

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STREET ADDRESS	+	HI	−	EL				DESC			
		26.62									
8637			3.19	23.43				WILSHIRE DR			
8631			3.09	23.53							
8634			2.58	24.04							
8628			2.41	24.21							
8624			2.00	24.62							
8618			2.04	24.58							
2538			2.47	24.15				N 86TH PL.			
TP			3.53	23.09							
	4.29 ~~4.29~~	27.38									
2532			3.75	23.63							
2533			4.00	23.38							
2529			4.30	23.08							
2526			3.97	23.41							
2523			4.47	22.91							
2513			4.80	22.58							
2507			5.02	22.36							
//											

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STREET ADDRESS	+	HI	−	EL.	DESC
TP			5.91	21.47	
	4.36	25.83			
8633			3.36	22.47	LEWIS AVE
8637			4.10	21.73	
8632			2.85	22.98	
8640			3.55	22.28	
TP			5.69	20.14	
	5.89	26.03			
8702			3.84	22.19	
8712			2.60	23.43	
8711			2.81	23.22	
8707			3.37	22.66	
8701			3.89	22.14	
TBM (4)			7.74	1218.29	TBM (4) SEE P.1 BC @ 87TH & LEWIS
				1218.29	
			Δ	0.00	
	(25.90)		(26.90)		

F.F. ELS SHERIDAN ST, VERNON 9-10-96 18

STREET ADDRESS	+	HI	−	EL.	DESC.
TBM 4				1218.29	
	6.17	24.46			
8702			3.27	21.19	SHERIDAN AVE
8710			2.89	21.57	
8716			1.50	22.96	
8717			1.08	23.38	
8713			1.64	22.82	
8707			2.70	21.76	
8701			3.42	21.04	
8638			3.69	20.77	
8633			3.63	20.83	
TP			4.11	20.35	
	5.71	26.06			
TB632			4.27	21.79	
8627			4.02	22.04	
8621			3.84	22.22	
2501			3.84	22.22	N 86TH PL

STREET ADDRESS	+	HI	-	EL.	DESC
		26.06			
8615			3.79	22.27	SHERIDAN ST
8607			3.28	22.78	
TP			4.26	21.80	
	5.90	27.70			
8601			4.63	23.07	
TP			6.43	21.27	
	4.53	25.80			
8601			3.85	21.95	VERNON
8602			3.36	22.44	
8608			3.55	22.25	
8607			4.05	21.75	
8613			4.24	21.56	
8614			3.68	22.12	
8620			4.33	21.47	
8619			4.72	21.08	
8625			4.25	21.55	
TP			5.77	20.03	
	3.23	23.26			

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STREET ADDRESS	+	HI	−	EL						
		23.26								
8631			2.49	20.77			VERNON AVE			
8632			2.63	20.63						
8626			1.68	21.58						
8701			3.18	20.08						
8702			3.05	20.21						
TP			3.20	20.06						
	5.27	25.33								
8710			4.16	21.17						
8716			3.34	21.99						
8720			2.11	23.22						
8717			2.59	22.74						
8713			3.72	21.61						
8707			4.63	20.70						
BM (5)			8.01	17.32		TBM (5)	SEE P. 1	BCC	87TH &	VERNON
				1217.32						
			Δ	0.00						
	(30.8)		31.78							

FF ELS. OAK ST., CYPRESS ST. 9-10-96

STREET ADDRESS	+	HI	−	EL.	ADJ EL		DESC
TBM (5)				1217.32	TBM (5)	SEE P1,	BCC 87TH & VERNON
	5.09	22.39					
8701			1.54	20.85			OAK ST.
8702			1.61	20.78			
TP			3.30	19.09	19.08		
	6.96	26.04 ~~26.05~~					
8707			4.49	21.55			
8713			3.98	22.06			
8710			4.35	21.69			
8716			4.20	21.84			
8722			3.10	22.94			
8728			2.03	24.01			
TP			7.62	18.43	18.42		
	5.09	23.51 ~~23.52~~					
8628			2.65	20.86			
8622			2.31	21.20			
8625			4.10	19.41			
8619			3.43	20.08			

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STREET ADDRESS	+	HI	−	ELEV		DESC.
		23.51				
TP			3.97	19.55	19.53	
	4.96	24.49 ~~24.51~~				
8613			3.80	20.69		OAK
8607			3.80	20.69		↓
8601			3.30	21.19		
8602			2.79	21.70		
8610			3.15	21.34		
8616			3.14	21.35		
TP			7.25	17.26	17.24	
	4.50	21.74 ~~21.76~~				
8702			1.36	20.38		CYPRESS ST.
8701			1.99	19.75		↓
8709			0.71	21.03		
[illegible] TP			3.62	1814	18.11	
[illegible]	6.37	24.48 ~~21.51~~				
8713			2.88	21.60		
8719			2.17	22.31		

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STREET ADDRESS	+	HI	−	EL.		DESC
		24.48				
8716			2.20	22.28		CYPRESS ST
8710			3.19	21.29		
TP			7.87	16.64	16.61	
	6.12	22.73 ~~22.78~~				
8672			3.41	19.32		
8666			3.16	19.57		
8660			2.83	19.90		
8654			2.24	20.49		
8655			3.05	19.68		
8661			3.86	18.87		
8667			4.53	18.20		
TBM 6			7.20	1215.56		TBM 6 SEE P. 1 BC @ 87TH & CYPRESS
				=1215.52		
				Δ= +0.04		
	(39.07)		(40.81)			

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F.F. EL. MONTE VISTA, HOLLY

STREET ADDRESS	+	HI	−	EL.
TBM 6				1215.52
	5.25	20.77		
8661			2.29	18.48
8655			1.66	19.11
8654			1.74	19.03
8660			2.42	18.35
8701			2.19	18.58
8711			0.88	19.89
8702			1.83	18.94
TP			3.96	16.81
	6.38	23.19		
8717			2.68	20.51
8723			2.02	21.17
8722			1.64	21.55
8716			2.16	21.03
8710			2.73	20.46
TP			7.25	15.94
	4.41	20.35		

TBM 6 SEE P.1 BC @ 87TH & CYPRESS

MONTE VISTA RD

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STREET ADDRESS	+	HI	−	EL.				DESC			
		20.35									
8658			1.57	18.78				HOLLY	ST		
8654			1.04	19.31							
TP			3.43	16.92							
	5.29	22.21									
8646			2.48	19.73							
8643			2.92	19.29							
8649			3.24	18.97							
TBM 7			6.53	15.68		TBM 7	SEE P1	CH'KL TOC S RET SE COR 87 HOLLY			
				=1215.68							
				Δ 0.00							
	(21.33)		(21.19)								

R. DAY
C. ZWIEFEL

9-11-96

STREET ADDRESS	+	HI	−	EL			DESC.
TBM 7				1215.68		TBM 7	SEE P. 1 CH'Y' T.O.C. 'S' RET @ SE COR 87TH & HOLLY
	6.21						
2035			4.55	17.34			N 87TH ST.
8709			4.06	17.83			HOLLY
8715			3.06	18.83			
8721			2.92	18.97			
8722			2.31	19.58			
8716			2.45	19.44			
8710			3.33	18.56			
8702			4.47	17.42			
TBM 7			6.21	15.68		TBM 7	SAME AS BEGINNING
				1215.68			
			Δ	0.00			

F.F. ELS N 87TH ST, E. DIANNA DR., E. HUBBELL ST. 9-11-96

STREET ADDRESS	+	HI	−	EL.			DESC.
TBM 7				1215.68		TBM 7	
	4.19	19.87					
2029			2.17	17.70			N 87TH ST.
2023			2.09	17.78			
2032			1.17	18.70			
2036			1.72	18.15			
2044			1.32	18.55			
2026			1.89	17.98			
2018			2.08	17.79			
2011			2.13	17.74			
TP			3.65	16.22			
	6.16	23.38					
8712			4.70	17.68			E. DIANNA DR.
8718			3.89	18.49			
8724			3.56	18.82			
8723			3.47	18.91			
8717			3.69	18.69			
8711			4.32	18.06			

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STREET ADDRESS	+	HI	−	EL		DESC.
		22.38				
TP			7.13	15.25		
	4.10	19.35				
2007			1.43	17.92		N 87TH ST
2001			1.66	17.69		↓
2010			1.79	17.56		
1827			3.23	16.12		
8707			2.47	16.88		E. HUBBELL ST
TP			3.32	16.03		
	5.92	21.95				
8713			4.59	17.36		
8719			3.98	17.97		
8725			3.47	18.48		
8731			2.78	19.17		
8724			3.18	18.77		
8718			3.56	18.39		
8712			3.95	18.00		
TBM (8)			7.33	1214.62	TBM (8)	CH'D TO 'S' REF CSE COR 87TH & HUBBELL
				1214.62		
				Δ= 0.00		

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F.F. ELS. 87TH ST, E HUBBELL ST, N 86TH PL, E DIANNA DR, PALM LN.

STREET ADDRESS	+	HI	−	EL.	DESC.
TBM (B)				1214.62	TBM (B) CH'D' S'RET SE COR 87TH & E. HUBBELL
	4.66	19.28			
1823			3.46	15.82	N 87TH ST
1819			3.31	15.97	"
8643			1.91	17.37	E. HUBBELL ST.
8650			2.30	16.98	↓
8646			1.62	17.66	
TP			2.81	16.47	
	5.22	21.69			
8637			3.64	18.05	N 86TH PL.
2017			3.28	18.41	"
2023			2.99	18.70	
8646			2.42	19.27	E. DIANNA DR
TP			7.21	14.48	
	4.10	18.58			
1811			2.26	16.32	N 87TH ST
1834			1.48	17.10	"
8702			2.80	15.78	PALM LANE

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STREET ADDRESS	+	HI	-	EL			DESC.
		18.58					
8701			3.09	15.49			PALM LN.
8643			2.60	15.98			
TP			4.86	13.72			
	6.93	20.65					
8637			4.01	16.64			
8633			3.19	17.46			
8625			2.61	18.04			
8632			3.41	17.24			
8638			4.14	16.51			
TBM (9)			8.02	1212.63	TBM (9)	SEE P 2	BC @ 87TH & PALM.
				1212.62			
			Δ	0.01			
	(20.91)		(22.90)				

FF. EL E. PALM LN, FOREST DR. 9-11-96

STREET ADDRESS	+	HI	−	EL.				DESC.
TBM (9)				1212.62		TBM (9)		
	7.82	20.44						
8708			4.13	16.31				PALM LN
8714			3.38	17.06				
8707			3.81	16.63				
8713			2.83	17.61				
8719			2.61	17.83				
TP			4.03	16.41				
	5.46	21.87						
8725			3.55	18.32				
8731			3.25	18.62				
8734			3.17	18.70				
8730			3.44	18.43				
8722			4.09	17.78				
TP			6.12	15.75				
	5.65	21.40						
8716			4.90	16.50				E FOREST DR.
8720			4.76	16.64				"

9-11-96

STREET ADDRESS	+	HI	−	EL.		DESC.
		21.40				
8726			4.50	16.90		E FOREST DR
8723			3.50	17.90		
8731			3.04	18.36		
8732			4.07	17.33		
8738			3.42	17.98		
TP			3.94	17.46		
	5.28	22.74				
8744			4.48	18.26		
8748			3.88	18.86		
8737			3.81	18.93		
TP			6.56	16.18		
	3.98	20.16				
TBM 9			7.53	12.63	TBM 9	SAME AS BEGINNING
				=1212.62		
				Δ = +0.01		
	(28.19)		(28.18)			

9-11-96

FF. ELS ETAGET ADDRESS	87TH ST +	CORONADO RD. HI	—	GRANADA RD. EL.	DESC.
TBM (9)				1212.62	TBM (9) SEE P.1 BC @ 87TH & PALM.
	5.29	17.91			
1652	(DUPLEX)		1.80	16.11	N 87TH ST
1645			1.95	15.96	"
8638	(DUPLEX)		1.59	16.32	CORONADO
8633 8635			2.83	15.08	
TP			3.60	14.31	
	5.37	19.68			
8637 39 41			5.67	14.01	
8629 31			4.67	15.01	
8623 25 27			4.53	15.15	
8619 21			4.00	15.68	
8632	(DUPLEX)		3.40	16.28	
8624	(DUPLEX)		3.16	16.52	
TP			3.35	16.33	
	4.90	21.23			
8614			3.50	17.73	
8608			3.20	18.03	

STREET ADDRESS	+	HI	−	EL.	DESC
		21.23			
8602			2.84	18.39	CORONADO
8615 17			5.30	15.93	
8609 11 13			5.11	16.12	
8605 07			4.10	17.13	
8601	(4-PLEX)		3.63	17.60	
TP			4.54	16.69	
	5.63	22.32			
8443	(4-PLEX)		4.65	17.67	
8439	(4-PLEX)		3.84	18.48	
TP			6.36	15.96	
	6.47	22.43			
8628			5.44	16.99	GRANADA
8622			4.69	17.74	
8613			3.51	18.92	
8607			3.41	19.02	
TP			6.47	15.96	
	1.44	17.40			
TBM (10)			3.29	14.11	SEE P.2 BC & FC 87TH (NE of LA'S MILK DEPOT)
	(29.10)		(29.01)	=1214.12 Δ = -0.01	

FF. EL. CORONADO RD, 87TH ST. McDOWELL RD. 9-11-96

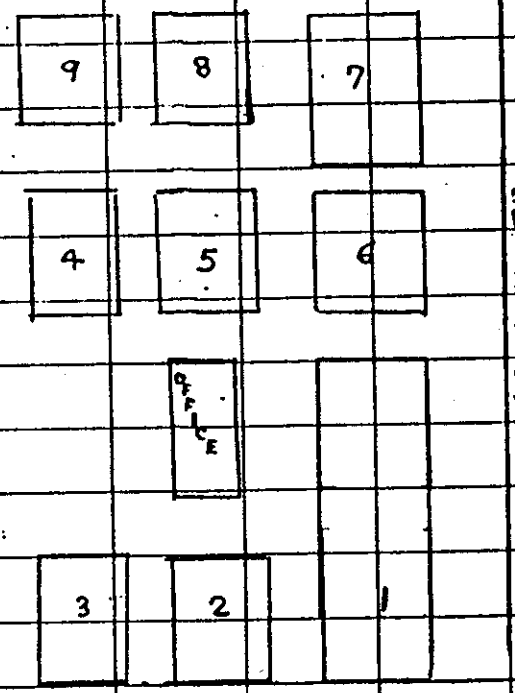
STREET ADDRESS	+	HI	−	EL				DESC.		
TBM (10)				1214.12		TBM (10)	SEE P.2	DC & PC 87TH	(NE OF LA'S MILK DEPOT)	
	5.77	19.89								
8701			3.60	16.29				CORONADO RD.		
8707			3.37	16.52						1.72
8713			2.72	17.17						
8726			2.27	17.62						
8722			2.66	17.23						
8716			2.98	16.91						
8708			3.38	16.51						
1626			4.17	15.72				N 87TH ST		
1620			3.85	16.04				"		
TP			5.77	14.12						
	7.06	21.18								
1615			4.95	16.23				N 87TH ST.		
[illegible]			4.88	16.30				E. McDOWELL RD		[illegible]
8718			4.99	16.19				"		
8650			4.28	16.90				"		
8521			5.53	15.65		BLDG A	NW APT BLDG	"		
TBM (10)			7.06	14.12 / 1214.12						

FF EL. @ APT COMPLEX 8550 E. McDOWELL

9-11-96

BUILDING NUMBER	+	HI	-	ELEV.
TBM (11)				1214.14
	5.87	20.01		
BLDG 7			4.22	15.79
BLDG 8			3.80	16.21
BLDG 9			3.71	16.30
BLDG 4			3.77	16.24
BLDG 5			3.80	16.21
BLDG 6			4.31	15.70
TP.			4.34	15.67
	5.13	20.80		
OFFICE			4.44	16.36
BLDG 1			4.62	16.18
TP			5.02	15.78
	6.10	21.88		
BLDG 2			4.58	17.30
BLDG 3			3.62	18.26
TP			6.59	15.29
	2.79	18.08		
TBM (11)			3.94	14.14 = 1214.14

TBM (11) F.H. SW COR N 85TH PL & McDOWELL 'N' CAP BOLT



TBM (11) SAME AS BEGINNING

9-11-96

STREET ADDRESS	+	HI	−	ELEV		DESC.
TBM (13)				1210.18	TBM (13)	SEE P. 3 BC @ 85TH PL & BELLEVIEW ST.
	641	16.59				
8552 2 4 6 8			3.58	13.01		E. BELLEVIEW ST.
1312 14 16 18			4.04	12.55		N. 85TH
TP			5.55	11.04		
	530	16.34				
8544 46 40 50			3.83	12.51		E. BELLEVIEW
1320 22 24 26			4.00	12.34		N. 85TH
1328 30 32 34			3.80	12.54		N. 85TH
8530 28 40 42			3.84	12.50		E. BELLEVIEW
TP			5.66	10.68		
	5.24	15.92				
1336 38 40 42			3.53	12.39		N. 85TH
1344 46 48 50			3.53	12.39		N. 85TH
8528 30 32 34			3.53	12.39		E. BELLEVIEW
8520 22 24 26			3.47	12.45		E. BELLEVIEW
B-86 1317 19 21 23			3.50	12.42		N. 84TH
B-85 1309 11 13 15			3.42	12.50		N. 84TH

9-11-96

STREET ADDRESS	+	HI	−	EL.				DESC.			
		15.92									
TP			5.74	10.18							
	5.30	15.48									
B-87 {1325 27 / 27 3}			3.02	12.46				N. 84TH			
TP			5.68	980							
	3.90	13.70									
B-84 {1301 05 / 03 07}			1.64	12 06				N 84TH			
TBM (14)			7.04	06.66		TBM (14)	SEE P.3	BCC N 84TH	BELLEVIEW ST		
				1206.67							
				0.01							
	(28.15)		(24.67)								

9-11-96

STREET ADDRESS	+	HI	-	EL.						
TBM (14)				120667		TBM (14)	SEE P. 3	BC @ 85TH & BELLEVUE ST		
	7.04	13.71								
TP			5.80	07.91						
	6.16	14.07								
1274 78 / 76 80			2.62	11.45			N 85TH			
1266 70 / 68 72			2.58	11.49			"			
8521 25 / 23 27			2.48	11.59			E. BELLEVIEW			
8529 33 / 31 35			2.40	11.67			"			
TP			4.86	9.21						
	6.36	15.57								
1258 62 / 60 64			3.80	11.77			N 85TH			
1250 54 / 52 56			3.27	12.30			"			
1242 46 / 44 48			3.04	12.53			"			
8545 47 / 47 51			3.18	12.39			E BELLEVIEW			
8537 41 / 39 43			3.70	11.87			"			
TP			4.30	11.27						
	3.81	15.08								
TBM (13)			4.89	10.19		TBM (13)	SEE P3	BC @ 85TH & BELLEVIEW		
	23.37		(19.85)	1210.18 / 0.01					(143)	

R DRY
C ZWICKEL

9-12-96

STREET ADDRESS	+	HI	-	EL.		DESC.
TBM (14)				1206.67	TBM (14) SEE A3	BCG 84TH & BELLEVIEW
	7.58	14.25				
1264 68 / 66 70			2.60	11.65		N 84TH
1272 76 / 74 78			2.68	11.57		"
1287 71 / 69 73			2.64	11.61		FR. REEF
1259 63 / 61 65			2.57	11.68		
TP			2.76	11.49		
	3.16	14.65				
1251 55 / 53 57			3.43	11.22		
1243 47 / 45 49			3.62	11.03		
1235 39 / 37 41			3.65	11.00		
1227 31 / 29 33			3.77	10.88		
1219 23 / 21 25			3.91	10.74		
TP			5.60	9.05		
	4.02	13.07				
1211 15 / 13 17			3.05	10.02		
1201 05 / 03 07			3.02	10.05		
1141 45 / 43 47			2.98	10.09		

9-12-96

STREET ADDRESS	+	HI	−	EL.			DESC.
		13.07					
1121 25 / 23 27			3.52	9.55			GR. REEF
1101 05 / 03 07			4.80	8.27			
1111 15 / 13 17			4.80	8.27			
1131 35 / 33 37			4.02	9.05			
1049 53 / 51 55			5.70	7.37			
1041 45 / 43 47			5.70	7.37			
1033 37 / 35 39			5.85	7.22			
TP			5.03	8.04			
	2.76	10.80					
1132 36 / 34 38			2.26	8.54			
1112 16 / 14 18			2.81	7.99			
TBM (15)			5.17	05.63		TBM (15)	
				120.61			
				← 0.02			
	(17.52)		18.56				

9-12-96

STREET ADDRESS	+	HI	-	EL.			DESC
T13N 15				1205.61	T13N 15	SEE P. 3	BC @ 84TH & PORTLAND
	7.30	12.91					
TP			4.64	8.27			
	5.21	13.49					
1234 38 / 36 40			2.29	11.19			85TH
1226 30 / 28 32			2.21	11.27			"
8500 24 / 22 26			4.22	9.26			PORTLAND
8528 32 / 30 34			3.78	9.70			"
TP			2.67	10.81			"
	4.13	14.94					
8536 40 / 38 42			4.37	10.57			"
8544 48 / 46 50			3.85	11.09			"
1218 22 / 20 24			3.37	11.57			85TH
1210 14 / 12 16			2.98	11.96			"
8582 56 / 54 58			3.35	11.59			PORTLAND
1202 06 / 04 08			2.52	12.42			85TH
TP			5.97	8.97			
	5.86	14.83					

9-12-96

STREET ADDRESS	+	HI	−	EL.					
		14.83							
8537 41 / 39 43			4.33	10.50			PORTLAND		
1135 39 / 37 41			4.39	10.44			84TH		
1127 31 / 29 33			4.42	10.41			"		
8529 33 / 31 35			4.36	10.47			PORTLAND		
TP			5.07	9.76					
	3.22	12.98							
1119 23 / 21 25			3.61	9.37			84TH		
8521 25 / 23 27			3.77	9.21			PORTLAND		
1111 15 / 13 17			4.45	8.53			84TH		
TP			6.87	6.11					
	5.39	11.50							
TBM (15)			5.90	5.60	TBM (15)		SAME AS BEGINNING		
				120.61					
				Δ 0.01					
	7.11		3.12						

9-12-96

STREET ADDRESS	+	HI	-	EL			DESC		
TBM (15)				1205.61	TBM (15)	SEE P.3	BC @	84TH &	PORTLAND
	5.90	11.51							
TP			5.96	5.55					
	6.97	12.52							
1061 65 / 63 67			4.56	7.96			84TH		
1069 73 / 71 75			3.93	8.59					
1021 25 / 23 27			4.75	7.77					
1029 33 / 31 35			5.01	7.51					
1037 41 / 39 43			4.14	8.38					
1045 49 / 47 51			3.46	9.06					
1085 89 / 87 91			2.94	9.58					
1077 81 / 79 83			3.35	9.17					
TP			5.58	6.94					
	5.04	11.98							
8542 46 / 44 48			4.68	7.30			ROOSEVELT		
8550 54 / 52 56			4.53	7.45					
8558 62 / 60 64			3.74	8.24					
8526 30 / 28 32			4.23	7.75					

9-12-96

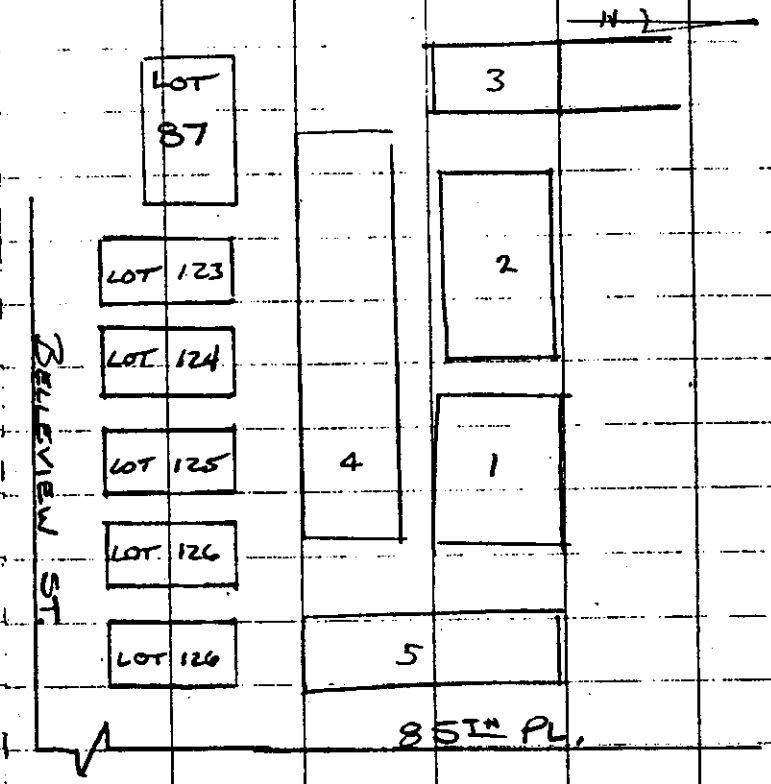
STREET ADDRESS	+	HI	-	EL.	DESC.
		11.98			
8518 22 / 20 24			4.61	7.37	ROOSEVELT
8510 14 / 12 16			4.92	7.06	
8502 06 / 04 08			4.37	7.61	
8534 38 / 36 40			4.78	7.20	
8546 50 / 48 52			5.12	6.86	
8430 34 / 32 36			5.47	6.51	
TP			5.42	6.56	
	4.03	10.59			
8414 18 / 16 20			4.45	6.14	
TP			4.64	5.95	
	4.04	09.99			
8406 10 / 08 12			3.88	6.11	
8422 26 / 24 28			3.60	6.39	
8409 13 / 11 15			3.61	6.38	GR. REEF
[illegible] 05 / 03 09			3.95	6.04	"
BM			7.26	02.73	BM BC @ GRANITE REEF & ROOSEVELT
				1202.70	
	(25.98)		28.56		

FF STREET ADDRESS	+	HI	-	EL	DESC
BM				1202.70	BM BC @ GRANITE REEF & ROOSEVELT
	6.99	09.69			
985			3.95	5.74	GRANITE REEF (NORTHERN BLDG)
TP			3.24	6.45	
	5.98	1243			
967			2.96	9.47	N 85TH ST
980			3.16	9.27	"
974			2.34	10.09	"
TP			6.58	5.85	
	3.34	9.19			
TP			7.37	1.82	
	3.75	5.57			
985			1.39	4.18	GRANITE REEF (SOUTHERN BLDG)
985			2.38	3.19	"
TP			6.18	(-)0.61	
	4.43	1203.82			
BB5			1.46	02.36	

STREET ADDRESS	+	HI	−	EL.				DESC.		
		1203.82								
835 N			4.25	1199.57			GRANITE	REEF	N. BLDG	
835 S			4.45	1199.37			"	"	S "	
TBM (18)			6.71	97.11		TBM (18)	SEE P. 4	PK & SHINER		
				1197.12						
			Δ=	0.01						

SUPPLEMENT TO GRANITE REEF WASH F.F. ELEVATIONS 9/9 - 9/12/96

STA	+	HI	−	ELEV.
~~TBM 14~~				~~1206.67~~
	~~7.39~~			
TBM 12				1211.83
	5.27	1217.10		
1406 N 85TH PL.				
BLDG 5			3.33	1213.77
BLDG 4			3.36	1213.74
BLDG 1			3.44	1213.66
TP			5.52	1211.58
	4.58	1216.14		
BLDG 2			2.49	1213.65
BLDG 3			2.45	1213.69
TP			3.87	1212.27
	4.70	1216.97		
TBM 12			5.13	1211.84
				1211.83
				Δ=+0.01



REGISTERED LAND SURVEYOR
CERTIFICATE NO. 12216
JOHN E. COURTNEY
Date 12-27-96
Date Signed
ARIZONA, U.S.A.

FLOOD PLANE STUDY
84th Street

NEAR

Roosevelt & Granite Reef

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
12215
JOHN E.
COURTNEY
Date Signed 12-27-96
ARIZONA, U.S.A.

1-17-95

T. Bienkowski, P.E. Engineer

+	HI	-	NAGVD'29 ELEV	Adj. NAVD'88 ELEV.
			1200.785	
6.652	07.437			
		3.27	04.17	1206.12
		3.79	03.66	1205.66
		3.05	04.39	1206.39
		3.73	03.71	1205.71
		5.180	02.257	
5.820	08.077			
		4.534	03.543	
6.028	09.571			
		4.81	04.77	1206.77
		5.20	04.37	1206.37
		4.81	04.76	1206.76
		5.11	04.47	1206.47
		5.12	04.45	1206.45
		5.45	04.12	1206.12
		5.39	04.18	1206.18
		5.59	03.98	1205.98
		5.12	04.45	1206.45
		5.48	04.09	1206.09
		4.76	04.81	1206.81
		5.16	04.41	1206.41

Vertical Control 45

Anis Finish Floor Elevations 1 of 7

Desc.:
Loc.#:

C.O.S. BC HH. @ Roosevelt & Granite Reef

10 FF
10 GRND

9 FF
9 GRND

TK PCR S. Granite Reef & 1st St

SET 60d NAIL TYP #3

8 FF
8 GRND

13 FF
13 GRND

12 FF
12 GRND

11 FF
11 GRND

16 FF
16 GRND

15 FF
15 GRND

+	HI	−	NAGVD '29 ELEV.	Adj.	NAVD '88 ELEV.	DESC
	9.571					LAT#
		4.40	05.17		1207.17	1H FF
		4.93	04.74		1206.74	1A GRND
		5.237	04.334		1206.33	SET 60d NAIL TVP #4
5.72	10.118					
		4.73	05.39		1207.39	32 FF
		5.10	05.02		1207.02	32 GRND
		4.41	05.71		1207.71	56 FF
		4.79	05.33		1207.33	56 GRND
		3.860	06.26		1208.26	55 FF
		4.25	05.87		1207.87	55 GRND
		3.54	06.58		1208.58	54 GRND
		3.88	06.24		1208.24	54 GRND
		4.75	05.37		1207.37	2 FF
		5.00	05.12		1207.12	2 GRND
		4.64	05.48		1207.48	3 FF
		5.07	05.05		1207.05	3 GRND
		4.63	05.49		1207.49	4 FF
		5.08	05.04		1207.04	4 GRND
		3.91	06.21		1208.21	37 FF
		4.28	05.84		1207.84	37 GRND
		4.02	06.10		1208.10	38 FF
		4.29	05.83		1207.83	38 GRND
		4.23	05.89		1207.89	39 FF
		4.63	05.49		1207.49	39 GRND

+	HI	−	NAGVD '29 ELEV.	ADJ NAVD '88 ELEV.	DESC
	10.118				LOT #
		4.20	05.92	1207.92	40 FF
		4.62	05.50	1207.50	40 GRND
		3.80	06.32	1208.32	41 FF
		4.21	05.91	1207.91	41 GRND
		6.445	03.673	1205.67	FD COR. BC FLUSH 34 ST. A PORTLAND TYP 5
6.412	10.085				
		2.85	07.24	1209.24	69 FF
		3.32	06.77	1208.77	69 GRND
		2.84	07.25	1209.25	68 FF
		3.44	06.65	1208.65	68 GRND
		3.41	06.68	1208.68	52 FF
		3.92	06.17	1208.17	52 GRND
		3.63	06.46	1208.46	51 FF
		4.03	06.06	1208.06	51 GRND
		1.30	08.79	1210.79	78 FF
		1.94	08.15	1210.15	78 GRND
		1.20	08.89	1210.89	79 FF
		2.04	08.05	1210.05	79 GRND
		1.01	09.08	1211.08	80 FF
		1.56	08.53	1210.53	80 GRND
		1.08	09.01	1211.01	100 FF
		1.62	08.47	1210.47	100 GRND
		1.17	08.92	1210.92	99 FF
		1.67	08.42	1210.42	99 GRND

+	HI	−	NAGVD'29 ELEV.	Adj.	NAVD'88 ELEV.	DESC.
	16.085					LOT #
		1.21	08.88		1210.88	98 FF
		1.70	08.39		1210.39	98 GRND
		2.01	08.08		1210.08	48 FF
		2.34	07.75		1209.75	48 GRND
		2.49	07.60		1209.60	49 FF
		3.15	06.94		1208.94	49 GRND
		3.03	07.06		1209.06	50 FF
		3.42	06.67		1208.67	50 GRND
		2.10	07.99		1209.99	45 FF
		2.44	07.65		1209.65	45 GRND
		2.59	07.50		1209.50	44 FF
		3.06	07.03		1209.03	44 GRND
		3.13	06.91		1208.91	43 FF
		3.55	06.54		1208.54	43 GRND
		3.59	06.50		1208.50	42 FF
		4.06	06.03		1208.03	42 GRND
		5.340	04.695			T/C W. SIDE 34 St
5.886	10.511					
		1.41	09.17		1211.17	103 FF
		2.10	08.48		1210.48	103 GRND
		1.12	09.46		1211.46	112 FF
		1.91	08.67		1210.67	112 GRND
		5.852	04.729		1206.73	FL C 0.5 [illegible] 34 ST & Bellview TYP 6
8.150	12.879					

+	HI	−	NAGVD'29 ELEV.	Adj	NAVD'88 ELEV.	DESC.
	12.879					LOT #
		2.43	10.45		1212.45	123 FF
		3.09	09.79		1211.79	123 GRND
		2.43	10.45		1212.45	87 FF
		3.10	09.78		1211.79	87 GRND
		2.40	10.48		1212.48	86 FF
		3.01	09.87		1211.87	86 GRND
		2.46	10.42		1212.42	85 FF
		3.22	09.66		1211.66	85 GRND
		2.82	10.06		1212.06	84 FF
		3.56	09.32		1211.32	84 GRND
		7.880	04.999		1207.00	Fd. CDS. B.C. AT cul-de-sac 84 ST
5.659	10.658					
		1.29	09.37		1211.37	83 FF
		1.88	08.78		1210.78	83 GRND
		1.42	09.24		1211.24	82 FF
		1.87	08.79		1210.79	82 GRND
		1.56	09.10		1211.10	81 FF
		2.08	08.58		1210.58	81 GRND
		1.55	09.11		1211.11	101 FF
		2.00	08.66		1210.66	101 GRND
		1.60	09.06		1211.06	102 FF
		2.14	08.52		1210.52	102 GRND
		1.03	09.63		1211.63	89 FF
		1.67	08.99		1210.99	89 GRND

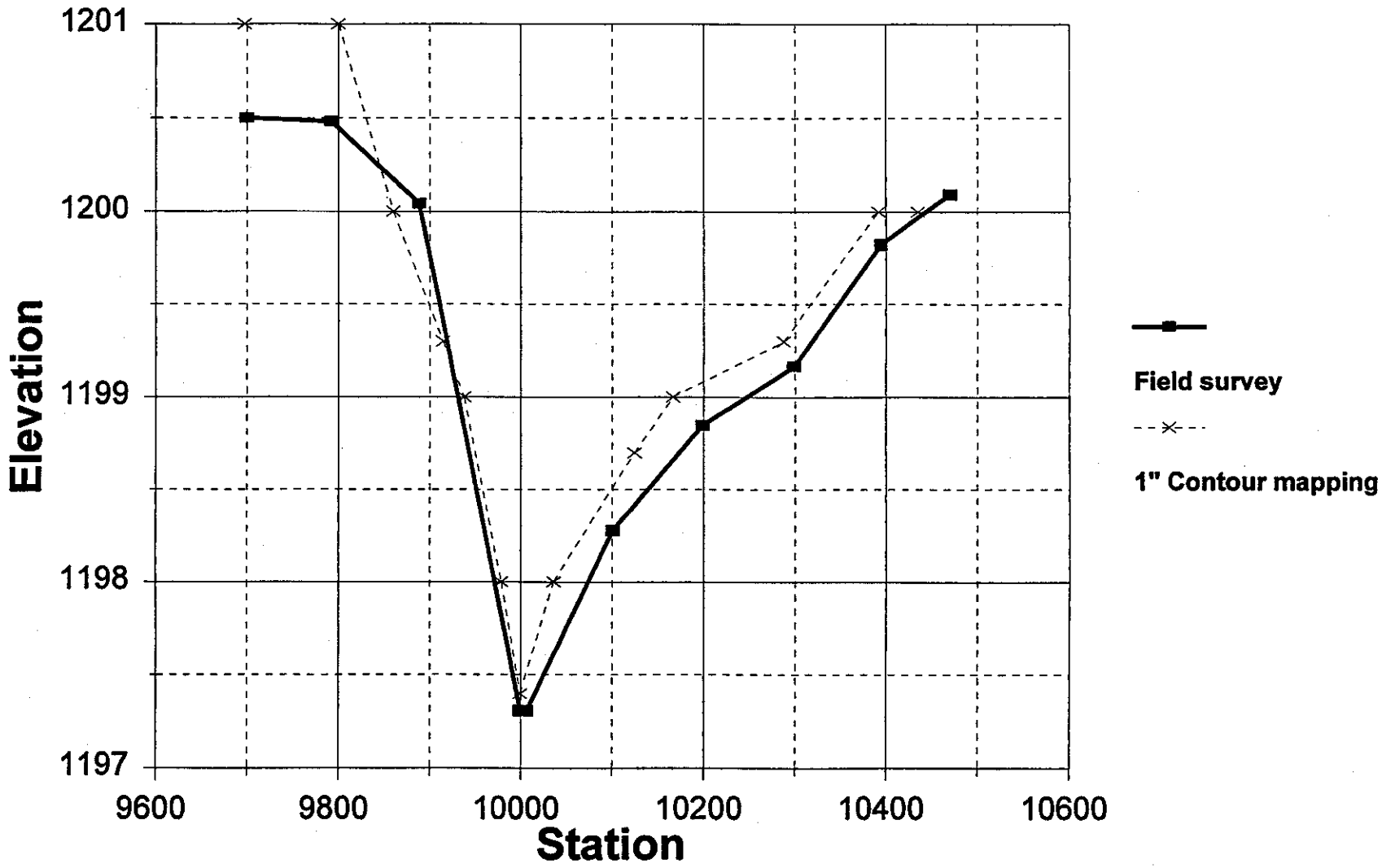
+	HI	-	NAGVD '29 ELEV.	Adj	NAVD '88 ELEV.	DESC
	10.658					LOT #
		2.308	08.35			T/C Bullnose behind lots 89-90
5.433	13.783					
		4.12	09.59		1211.59	90 FF
		4.76	09.02		1211.02	90 GRND
		4.20	09.58		1211.58	91 FF
		4.77	09.01		1211.01	91 GRND
		4.22	09.56		1211.56	92 FF
		4.74	09.04		1211.04	92 GRND
		4.48	09.30		1211.30	93 FF
		4.99	08.79		1210.79	93 GRND
		4.71	09.07		1211.07	94 FF
		5.12	08.66		1210.66	94 GRND
		4.74	09.04		1211.04	95 FF
		5.25	08.53		1210.53	95 GRND
		4.87	08.91		1210.91	96 FF
		5.27	08.51		1210.51	96 GRND
		4.95	08.83		1210.83	97 FF
		5.47	08.31		1210.31	97 GRND
		6.305	07.478			T/C E side granite roof
4.258	11.736					
		3.75	07.99		1209.99	47 FF
		4.03	07.71		1209.71	47 GRND
		3.64	08.10		1210.10	46 FF
		4.14	07.60		1209.60	46 GRND

+	HI	-	NAGVD '29 ELEV	ADJ	NAVD '88 ELEV.	DESC
	11.736					LOT #
		6.870	04.866			T/C E side Granulite Roof
4.100	08.966					
		3.52	05.45		1207.45	4 FF
		3.86	05.11		1207.11	4 GRND
		3.63	05.34		1207.34	5 FF
		3.89	05.08		1207.08	5 GRND
		3.68	05.29		1207.29	6 FF
		4.04	04.93		1206.93	6 GRND
		4.11	04.86		1206.86	7 FF
		4.93	04.04		1206.04	7 GRND
		6.730	02.236			T/C S. Rear Granulite Roof & 84 st.
4.622	06.858					
		6.090	1200.768			C.O.S. B.C. H.H. Rosewalk & Granulite Roof

Closure = -0.017'

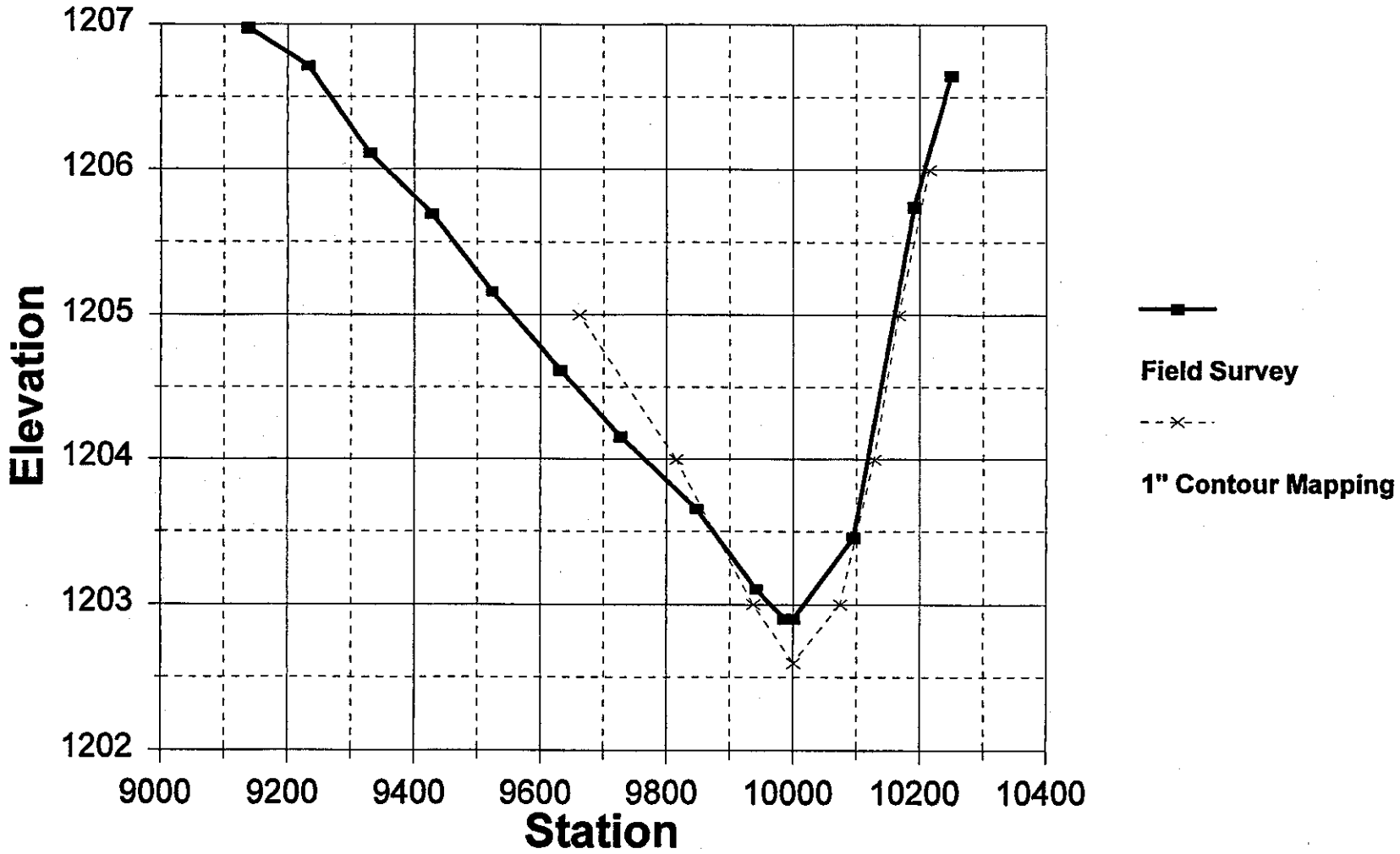
Granite Reef Wash X-Sec 0.320

Chk Section # 1



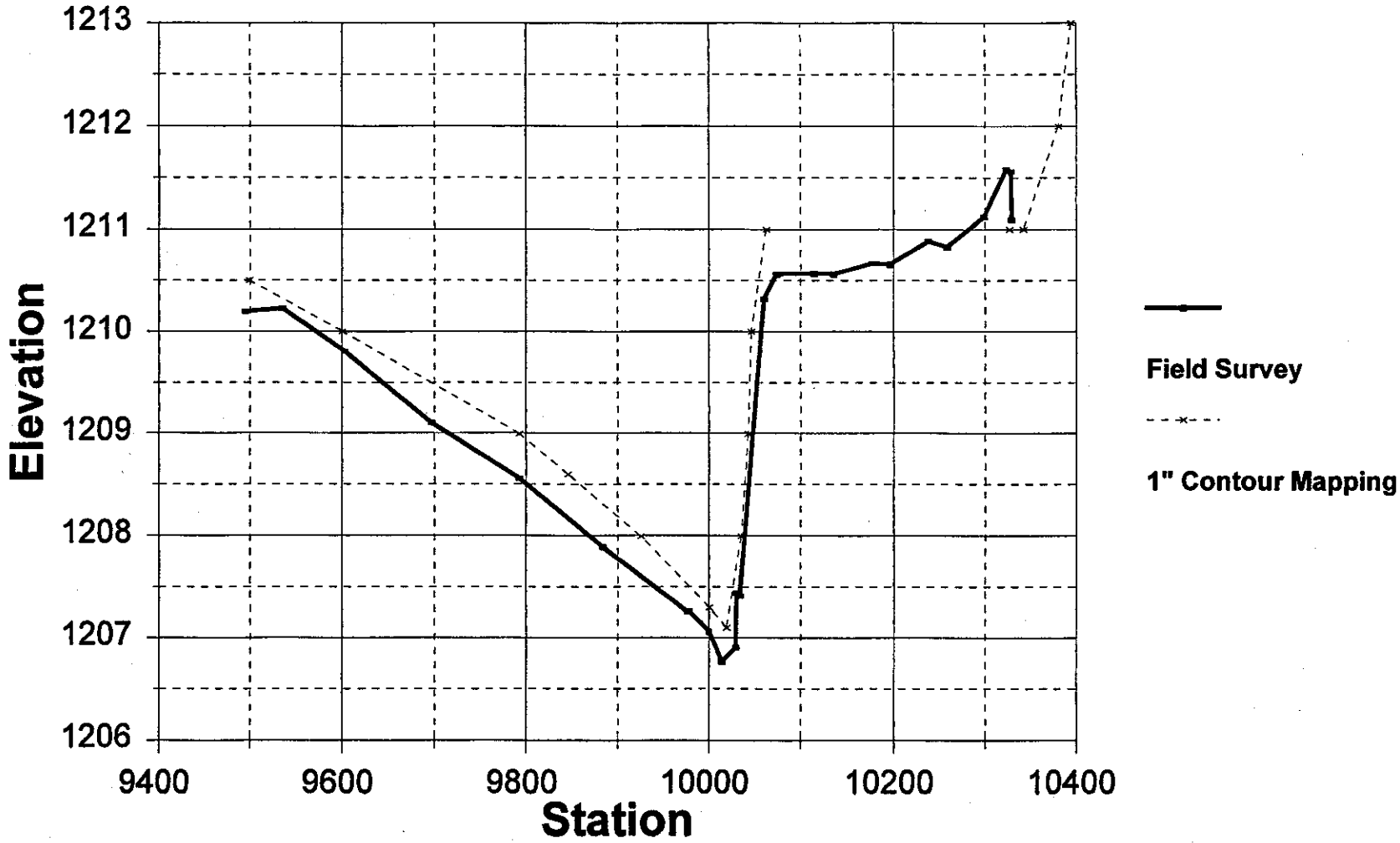
Granite Reef Wash X-Sec # 0.503

Chk Section # 2



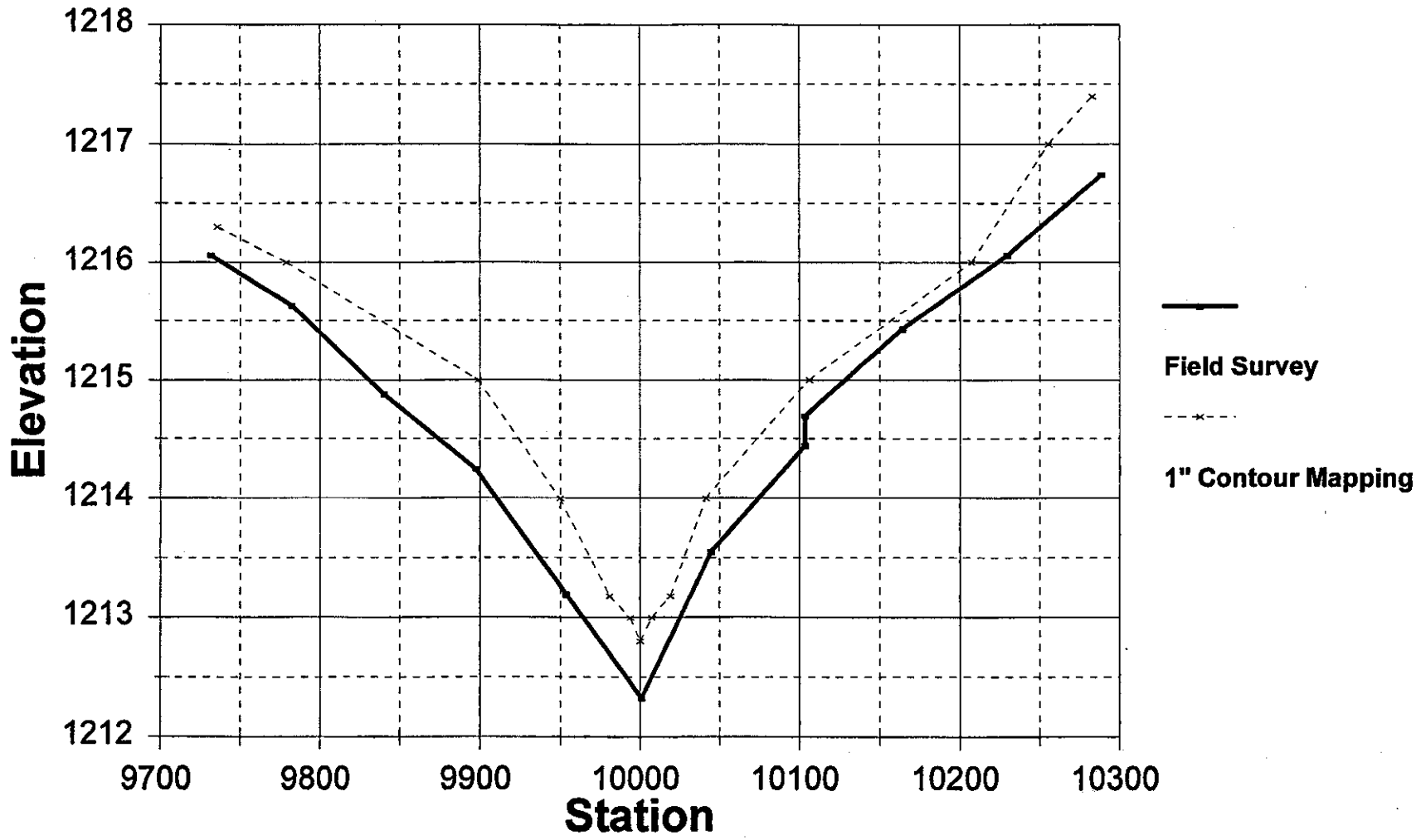
Granite Reef Wash X-Sec # 0.821

Chk Section # 3



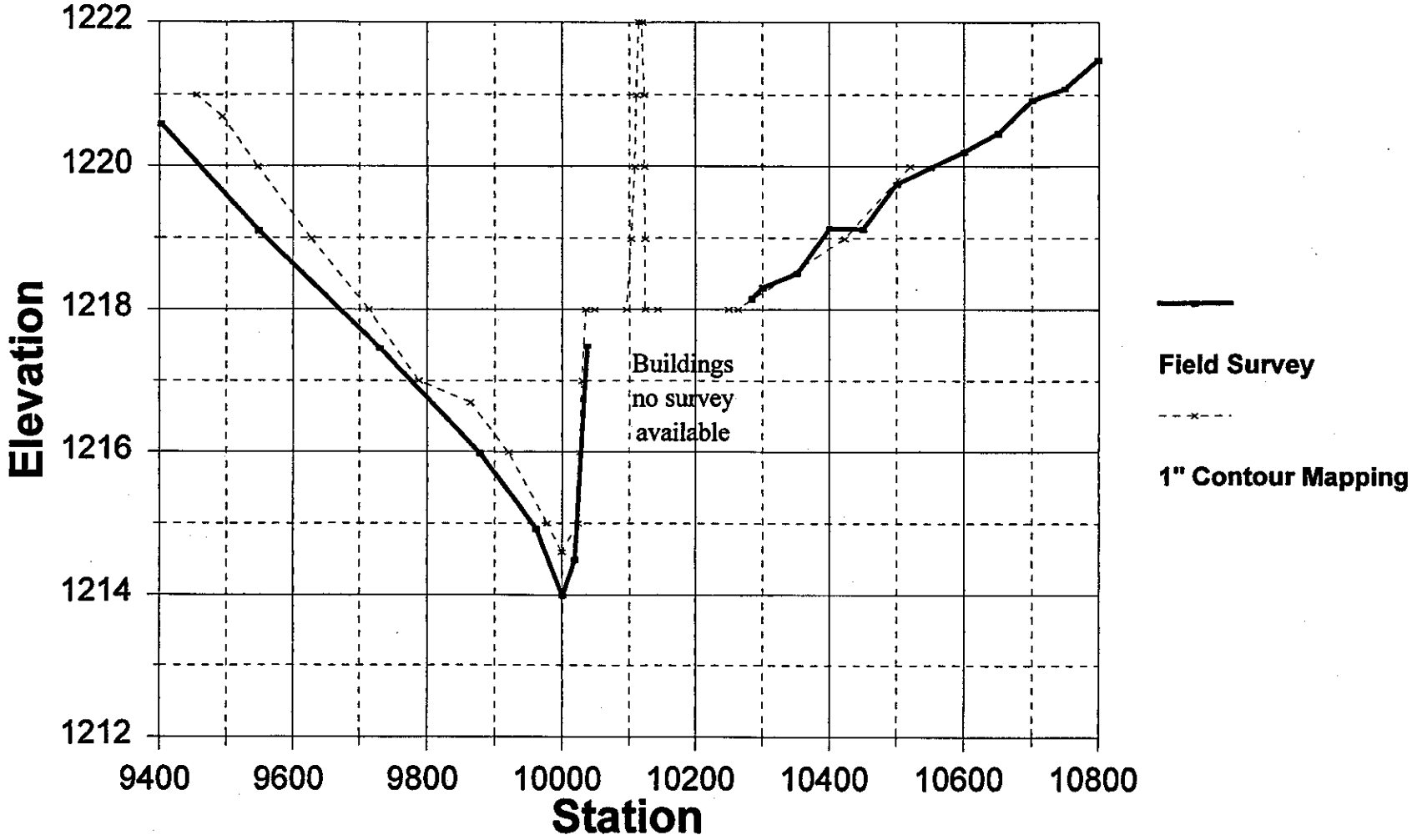
Granite Reef Wash X-Sec # 1.353

Chk Section # 4



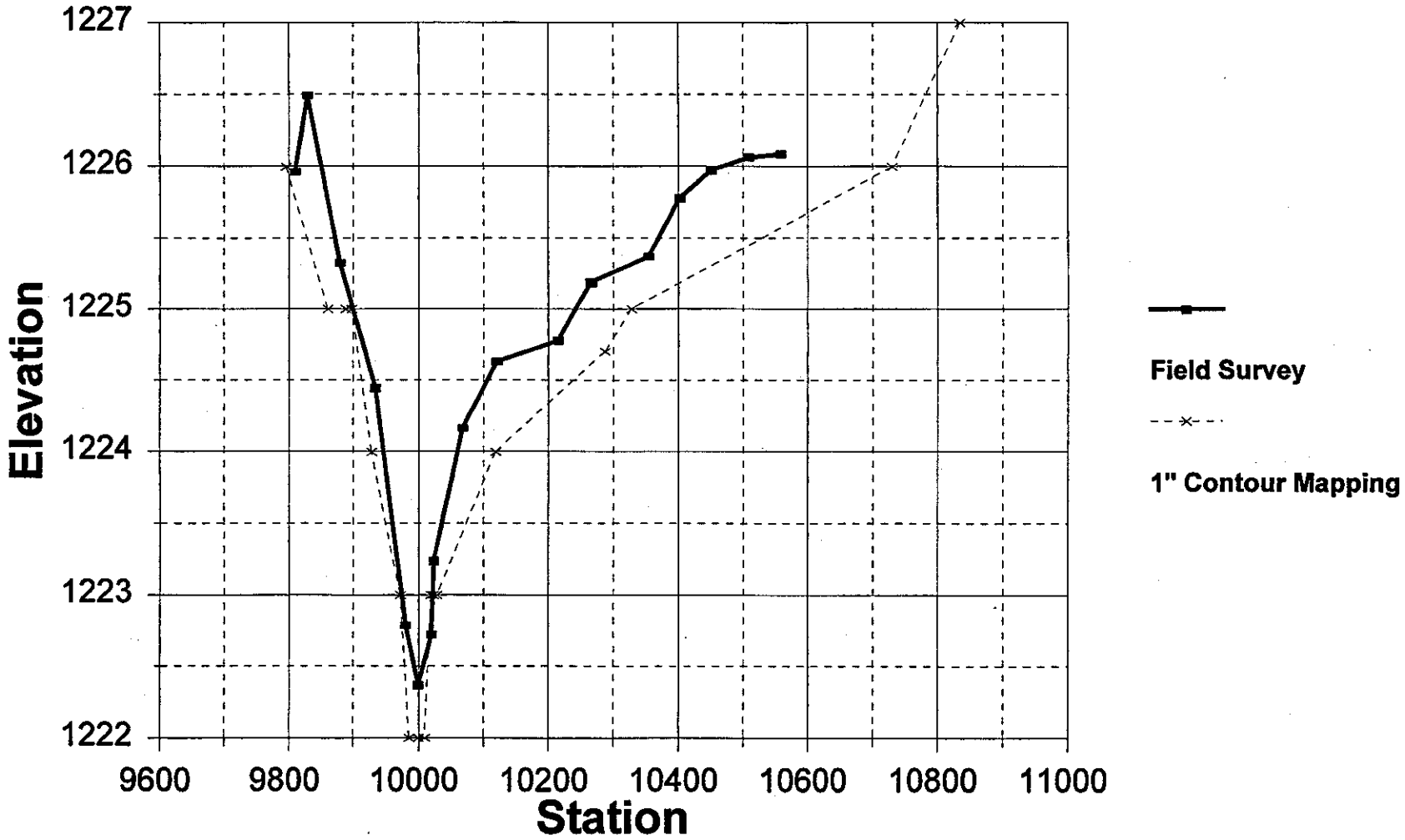
Granite Reef Wash X-Sec # 1.499

Chk Section # 5



Granite Reef Wash X-Sec #2.192

Chk Section # 6



APPENDIX C

MANNING'S N VALUE DETERMINATION CALCULATIONS

FLOOD CONTROL DISTRICT

OF

MARICOPA COUNTY

2801 WEST DURANGO STREET PHOENIX, ARIZONA 85009

GRANITE REEF WASH

FLOOD DELINEATION STUDY

ESTIMATION OF MANNING'S N VALUE

FCD CONTRACT NO. 95-05

FEBRUARY1996

Revised November1996

PREPARED BY:

Entellus™

2255 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602)244-2566
Fax (602)244-8947

4.2 Parameter Estimation

4.2.1 Manning's n Value

4.2.1.1 Introduction

The Granite Reef Wash study consists of approximately 2 miles of floodplain to be delineated under this project. The wash was divided into eight reaches of similar hydraulic characteristics and Manning's n values assigned to the reaches based on their typical characteristics. Reach 5 was further subdivided into Reaches 5A and 5B to account for some differences on the right bank. Likewise, Reach 8 was also subdivided into Reaches 8A and 8B. Each reach was identified with four-character identifier. The first three characters represent the name of the wash, and the fourth is the reach number. For example, GRF2 denotes Granite Reef Wash, Reach 2. The reach numbers start with "1" at the downstream end and increases in the upstream direction.

The limits, location of photographs and n values for each reach are shown on Exhibit 1 entitled, "Manning's n Value Map". In calculating the n Value, the following factors were considered:

Bed material particle size

Degree of irregularity of the bank slopes

Effect of obstruction

Degree of meandering

Vegetation

The obstruction of structures was ignored in calculation of n-values because the cross-sections excluded the structures from the flow area.

The density and type of vegetation have significant impact on the roughness coefficient (n value). The vegetation within the floodplain was identified to include the following:

Lawns

Desert landscaping

4.2.1.2 Methodology

Each reach was identified with the aid of 1" = 100' aerial photographs. The discerning characteristics were channel size, vegetation density, bed materials and development encroachment. Each reach was photographed during the field reconnaissance at a representative and accessible location. The photography locations are summarized on Exhibit 1.

Manning's roughness coefficients were determined in accordance with the methodology described in *Estimated Manning's Roughness Coefficient for Streams Channels and Floodplains in Maricopa County, Arizona* (USGS, Water Resources Division, April 1991). The method described in this publication selects a base value for the roughness coefficient based exclusively on bed material. This base value is then adjusted to account for vegetation, irregularities, obstructions and cross-section variations. In addition, a multiplier can be applied to the adjusted n-value if meandering of the reach is significant.

The base roughness coefficient in this study was selected based on the average particle size observed in the field. The typical bed materials in the study area range from smooth concrete to coarse gravel, and typical values of the roughness coefficients range from 0.018 for paved streets to 0.035 for riprap lined channels.

4.2.1.3 n Value Determination

The base values, adjustments and the adjusted values for Manning's roughness coefficient are shown in the following tables.

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 1
Location: New improved channel
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 -.032	0.025		
	Coarse Sand		.026 - .035			0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004		0.002	0.002
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010	0.003		0.005
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
				0.028	0.02	0.035
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.028	0.02	0.035

File: MAN-R1.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 2
Location: Concrete lined channel south of Granite Reef Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 - .032	0.025		0.025
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.003		
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004	0.001		0.004
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025	0.012		
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015			
				0.041	0.018	0.029
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.041	0.018	0.029

File: MAN-R2.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 3
Location: Granite Reef Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 -.032	0.025		
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			0.030
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005			0.001
	Moderate		.006 - .010	0.006		
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			0.004
	Minor		.005 - .015	0.015		
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010	0.01		0.01
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005	.001		.001
	Freq. Alt.		.010 - .015			
				0.057	0.018	0.046
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.057	0.018	0.046

File: MAN-R3.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 4
Location: 84th Place
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 -.032	0.025		0.025
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.003		
	Moderate		.006 - .010			0.003
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004	0.002		0.002
	Minor		.005 - .015			
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010	0.005		0.005
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			
	Freq. Alt.		.010 - .015	0.01		0.01
				0.045	0.018	0.045
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.045	0.018	0.045

File: MAN-R4.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 5A
Location: Earthen cahannel between 84th Place and McDowell Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	0.028	0.028	0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015	0.007		
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010	0.006		0.006
	Medium		.010 - .025		0.01	
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005	.002		.002
	Freq. Alt.		.010 - .015			
				0.043	0.038	0.036
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.043	0.038	0.036

File: MAN-R5A.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 5B
Location: Earthen cahannel between 84th Place and McDowell Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_b	.012 - .018			
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035	0.028	0.028	0.028
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005			
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			0.015
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.005		0.005
	Medium		.010 - .025		0.01	
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0			
	Occ. Alt.		.001 - .005	.002		.002
	Freq. Alt.		.010 - .015			
				0.035	0.038	0.05
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.035	0.038	0.05

File: MAN-R5B.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 6
Location: Upstream from McDowell Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_b	.012 - .018			
	Firm Soil		.025 -.032	0.028		0.028
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050		.045	
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005	0.001		0.002
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015	0.005		0.007
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002		0.002
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0			
	Occ. Alt.		.001 - .005	0.001		0.005
	Freq. Alt.		.010 - .015			
				0.037	0.045	0.044
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.037	0.045	0.044

File: MAN-R6.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 7
Location: Upstream from 87th Street
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018			
	Firm Soil		.025 -.032	0.030	0.030	0.030
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005			
	Moderate		.006 - .010	0.008		0.008
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004	0.002		0.002
	Minor		.005 - .015		0.015	
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025			
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005	0.005		0.005
	Freq. Alt.		.010 - .015			
				0.045	0.045	0.045
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.045	0.045	0.045

File: MAN-R7.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 8A
Location: 87th Street
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_b	.012 - .018		0.018	
	Firm Soil		.025 -.032	0.028		0.028
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005	0.005		0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015	0.008		0.008
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010			
	Medium		.010 - .025	0.010		0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005	.004		.004
	Freq. Alt.		.010 - .015			
				0.055	0.018	0.055
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_3+n_4+n_5)m$				0.055	0.018	0.055

File: MAN-R8.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 8B
Location: 87th Street near Thomas Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_1	.012 - .018		0.018	
	Firm Soil		.025 - .032	0.028		0.028
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_2	0			
	Minor		.001 - .005	0.001		0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_3	.000 - .004			
	Minor		.005 - .015			0.008
	Appreciable		.020 - .030			
	Severe		.040 - .060			
Vegetation	Small	n_4	.002 - .010	0.006		
	Medium		.010 - .025			0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_5	0			
	Occ. Alt.		.001 - .005			.004
	Freq. Alt.		.010 - .015			
				0.035	0.018	0.055
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_1+n_2+n_3+n_4+n_5)m$				0.035	0.018	0.055

File: MAN-R8.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 9
Location: North of Thomas Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_b	.012 - .018	0.018	0.018	0.018
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005			0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			0.020
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002		
	Medium		.010 - .025			0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0			
	Occ. Alt.		.001 - .005			.002
	Freq. Alt.		.010 - .015			
				0.02	0.018	0.055
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.02	0.018	0.055

File: MAN-R8.TBL

November 14, 1996

DETERMINATION OF MANNING'S ROUGHNESS COEFFICIENTS BY FCDMC METHOD

Project: Granite Reef Flood Plain Delineation
Stream: Granite Reef Reach 9
Location: North of Thomas Road
Photo No:

Channel Conditions		Manning's n Adjustment		Left Overbank (East)	Channel	Right Overbank (West)
Channel Material	Concrete	n_b	.012 - .018	0.018	0.018	0.018
	Firm Soil		.025 -.032			
	Coarse Sand		.026 - .035			
	Gravel		.028 - .035			
	Cobble		.030 - .050			
	Boulder		.040 - .070			
Degree of Irregularity	Smooth	n_1	0			
	Minor		.001 - .005			0.005
	Moderate		.006 - .010			
	Severe		.011 - .020			
Effects of Obstruction	Negligible	n_2	.000 - .004			
	Minor		.005 - .015			
	Appreciable		.020 - .030			0.020
	Severe		.040 - .060			
Vegetation	Small	n_3	.002 - .010	0.002		
	Medium		.010 - .025			0.010
	Large		.025 - .050			
	Very Large		.050 - .100			
Variations in Channel Cross section	Gradual	n_4	0			
	Occ. Alt.		.001 - .005			.002
	Freq. Alt.		.010 - .015			
				0.02	0.018	0.055
Degree of Meandering	Minor	m	1	1	1	1
	Appreciable		1.15			
	Sever		1.3			
$n = (n_b+n_1+n_2+n_3+n_4)m$				0.02	0.018	0.055

File: MAN-R8.TBL

November 14, 1996

GRANITE REEF WASH

GRW 1

Picture No. 2

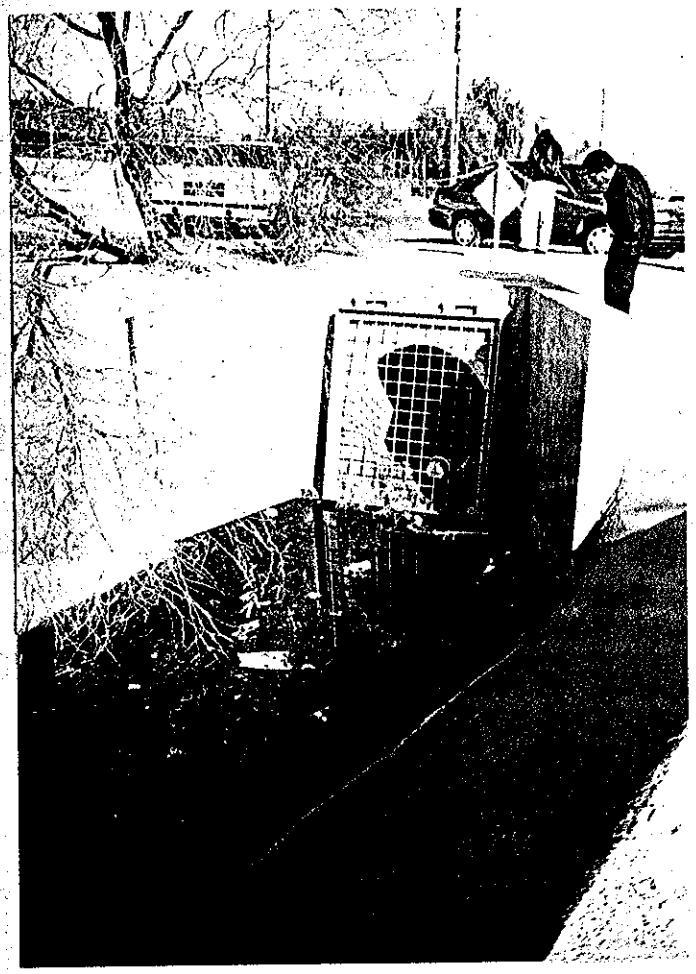
Water well at upstream end of reach

Picture No. 1

Upstream from McKellips Road

GRANITE REEF WASH

GRW 2

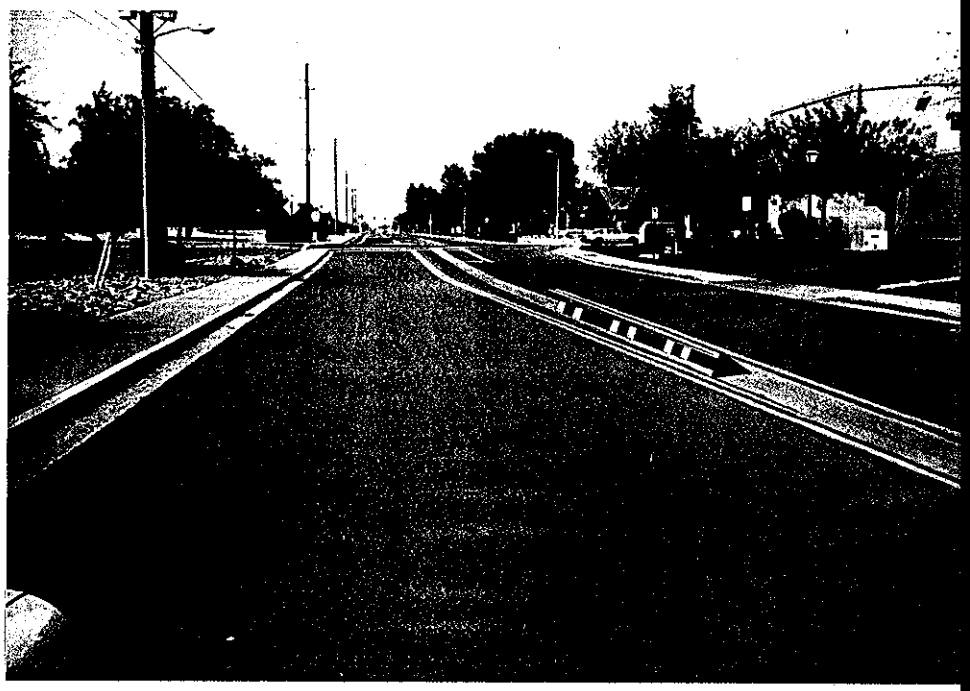


Picture No. 4

Storm drain outlet

Picture No. 3

Granite Reef Channel



Picture No. 7
Granite Reef Road

Picture No. 6
Detention basin west of
Granite Reef Road

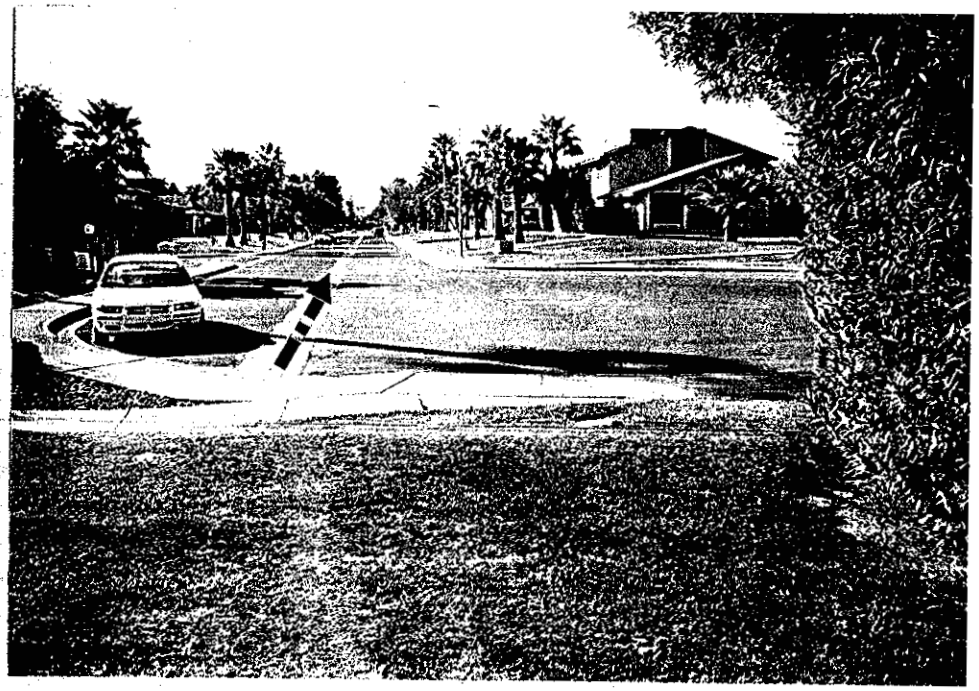
GRANITE REEF WASH GRW 3

Picture No. 5
Granite Reef Road

GRANITE REEF WASH

GRW 4

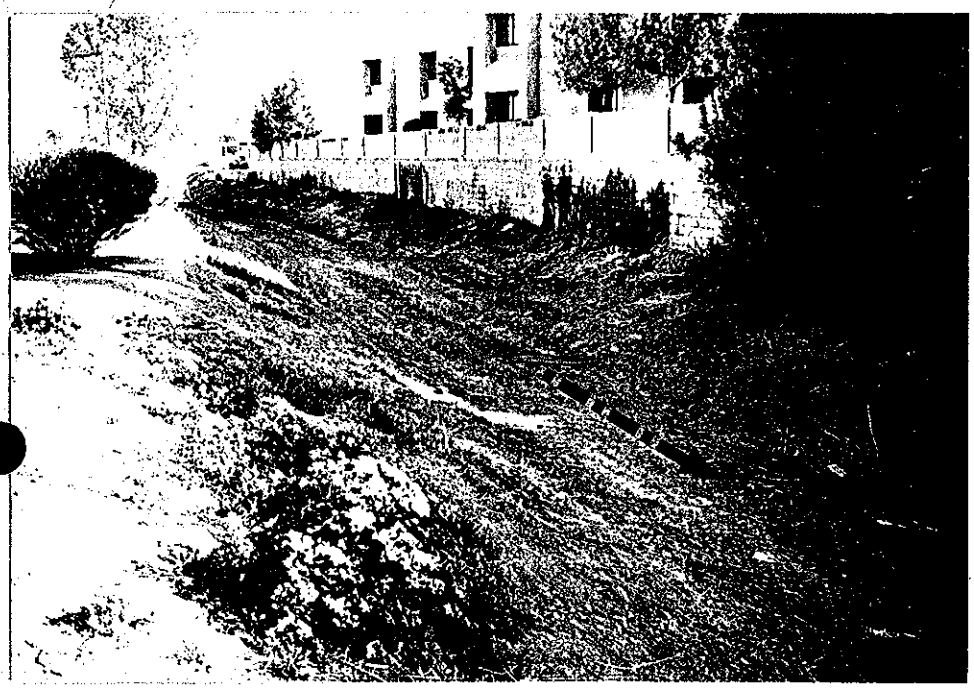
Picture No. 8



84TH Place

GRANITE REEF WASH

GRW 5A



Picture No. 10
Upstream end

Picture No. 9
Downstream end

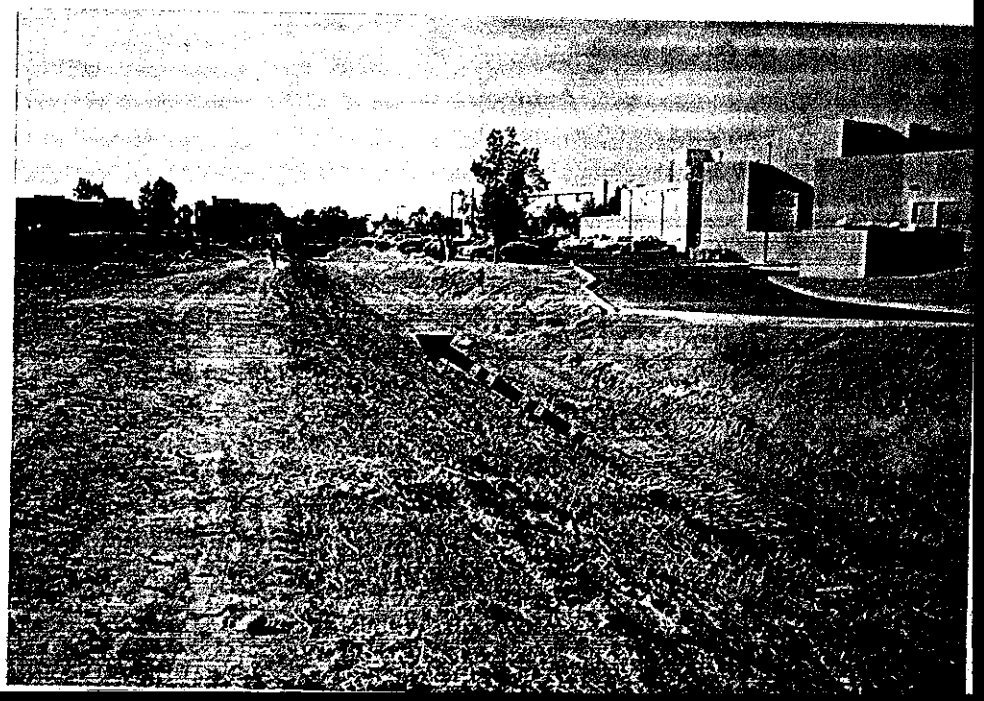
Picture No. 13

Downstream from McDowell Road

GRANITE REEF WASH GRW 5B

Picture No. 12

Upstream end



Picture No. 11

Dowstream end

GRANITE REEF WASH

GRW 6

Picture No. 16
Upstream looking south

Picture No. 15
Downstream end

Picture No. 14
From McDowell Road

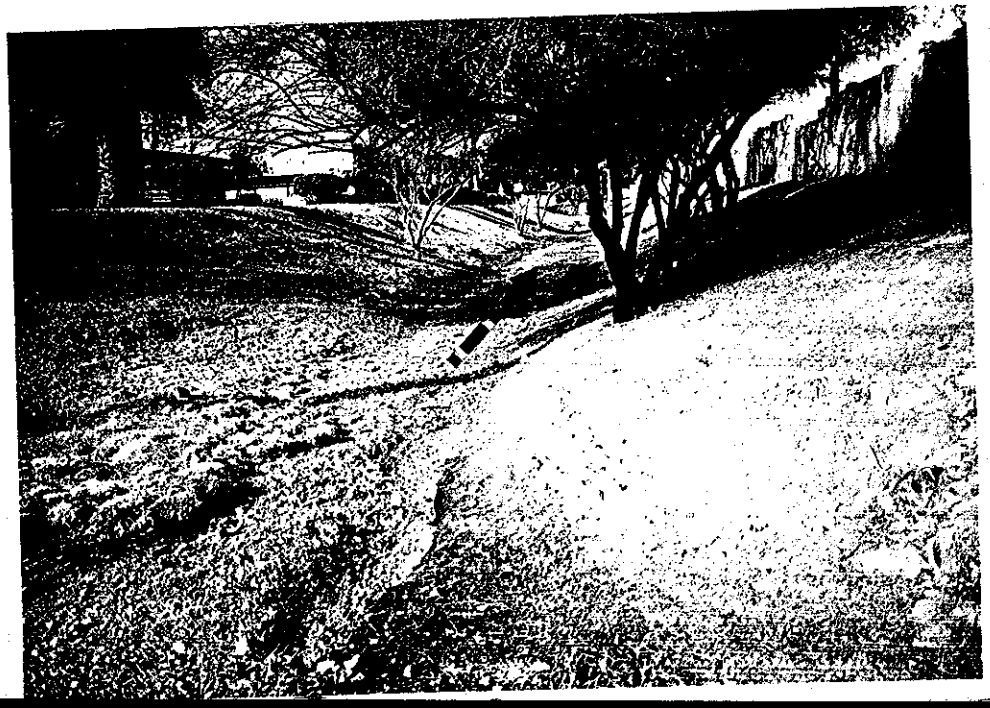
GRANITE REEF WASH GRW 7

Picture No.19

Upstream end of channel

Picture No.18

Upstream end of channel



Picture No.17

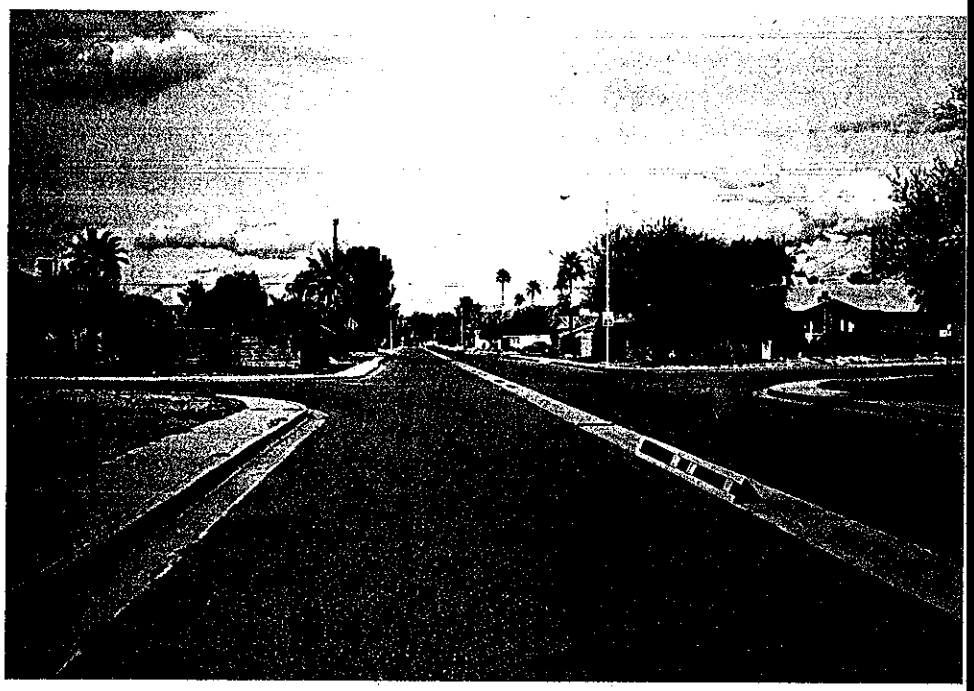
Channel looking dowstream

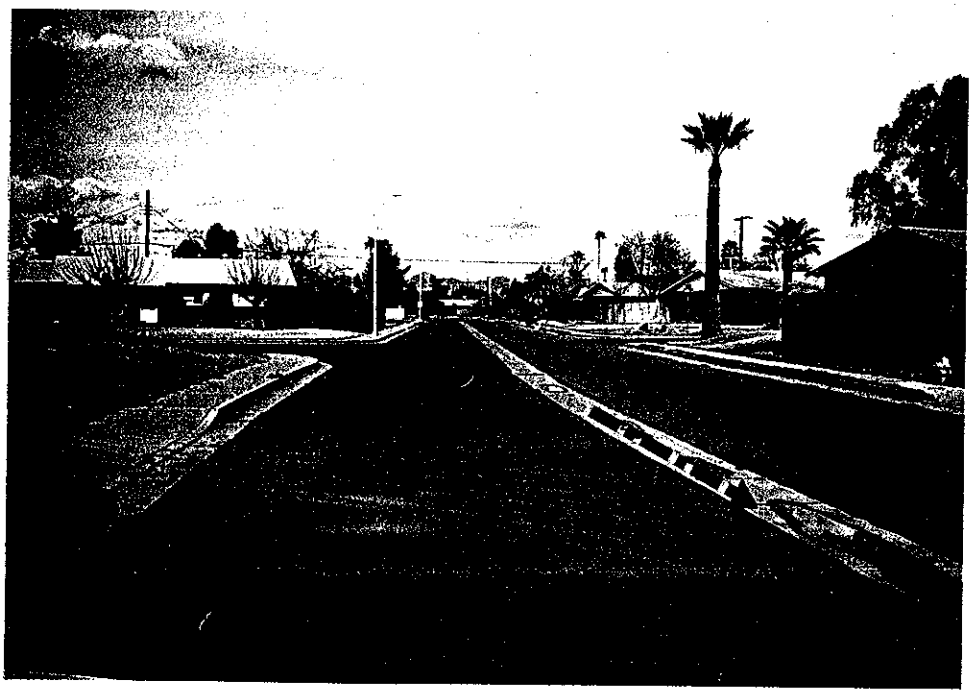
GRANITE

Picture No.22

87TH Street

north of Oak Street





REEF

Picture No.21

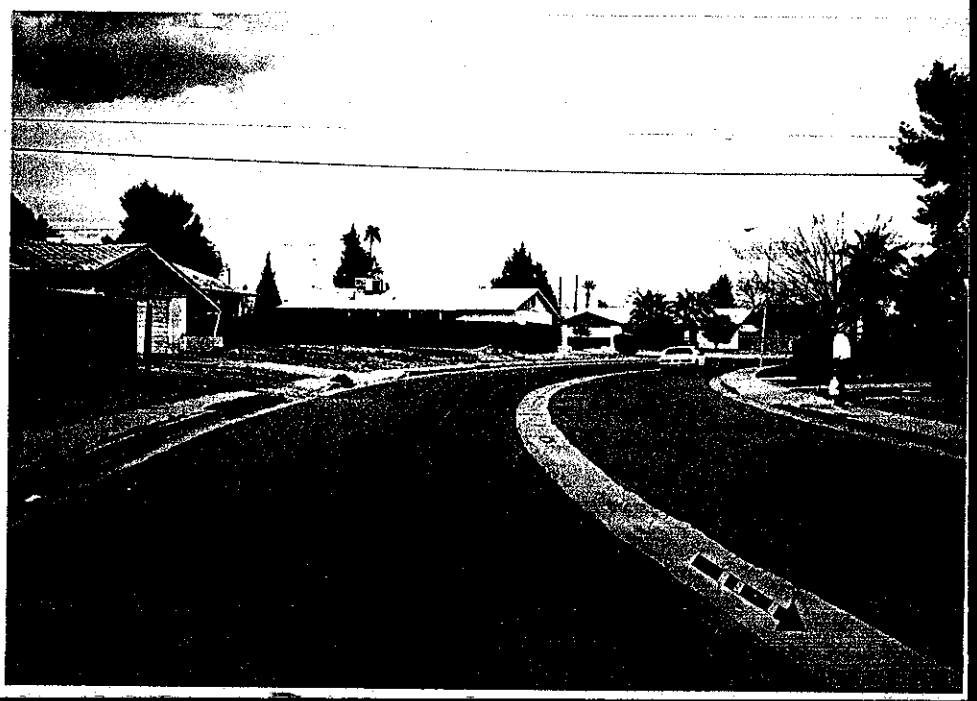
87TH Street

north of Holly Street

WASH GRW 8

Picture No.20
87TH Street

North of Coronado Road



GRANITE

87TH Street

south of Thomas Road

Picture No.25

87TH Street

from Edgemont Avenue looking south

Picture No.24

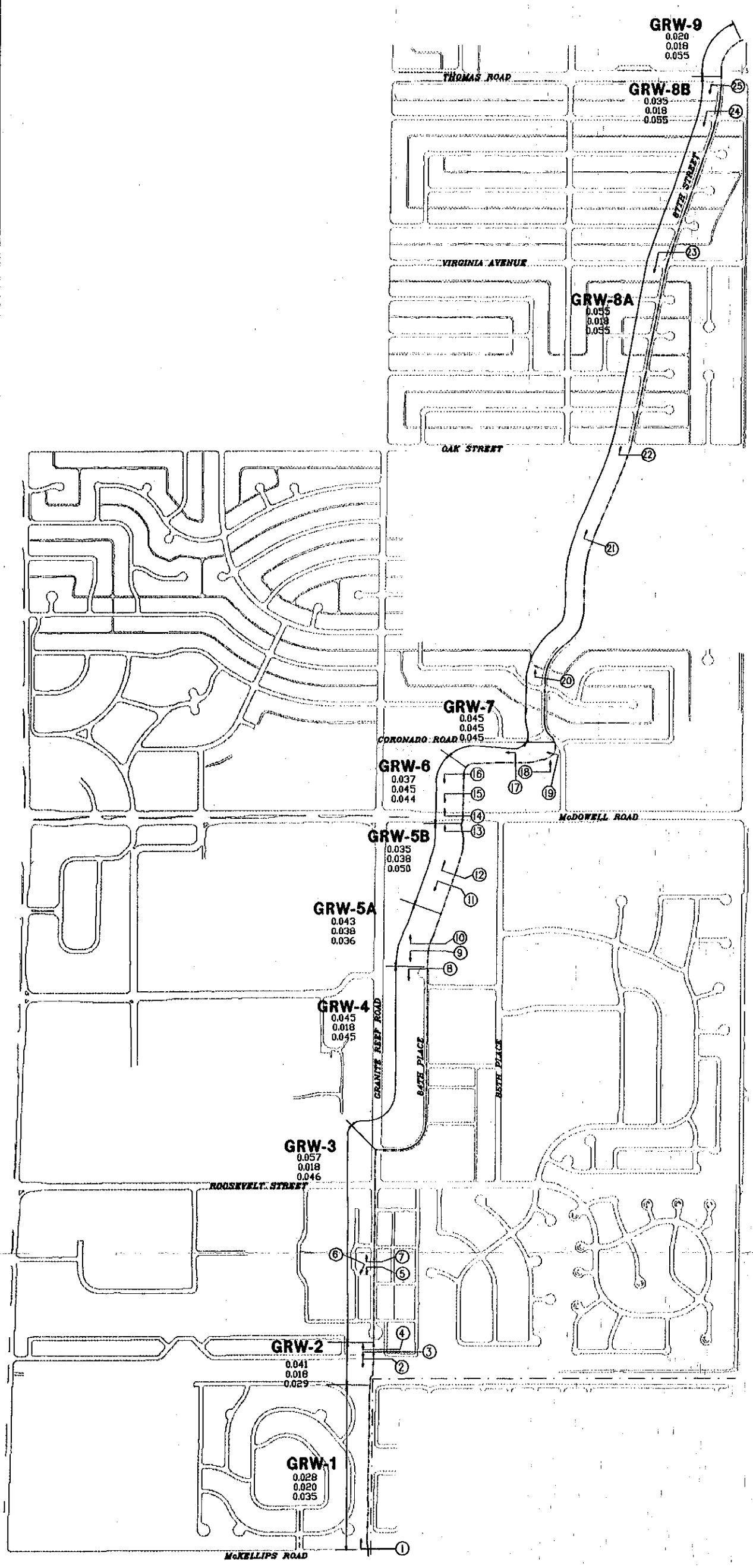
REEF

WASH GRW 8

Pictire No.23

87TH Street

south of Earll Drive



LEGEND

REACH LABEL	GRW3
LEFT (EAST) OVERBANK n–VALUE	0.057
MAIN CHANNEL n–VALUE	0.018
RIGHT 9WEST) OVERBANK n–VALUE	0.046
PHOTO LOCATION AND DIRECTION	5
HYDRAULIC BASE LINE	

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FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

PROJECT TITLE
FLOOD DELINEATION STUDY OF GRANITE REEF WASH
F.C.D. CONTRACT NO. 95-05

DESIGNED BY	DRAWN BY	CHECKED BY	DATE
HAA	DRP	SEK	2/23/96

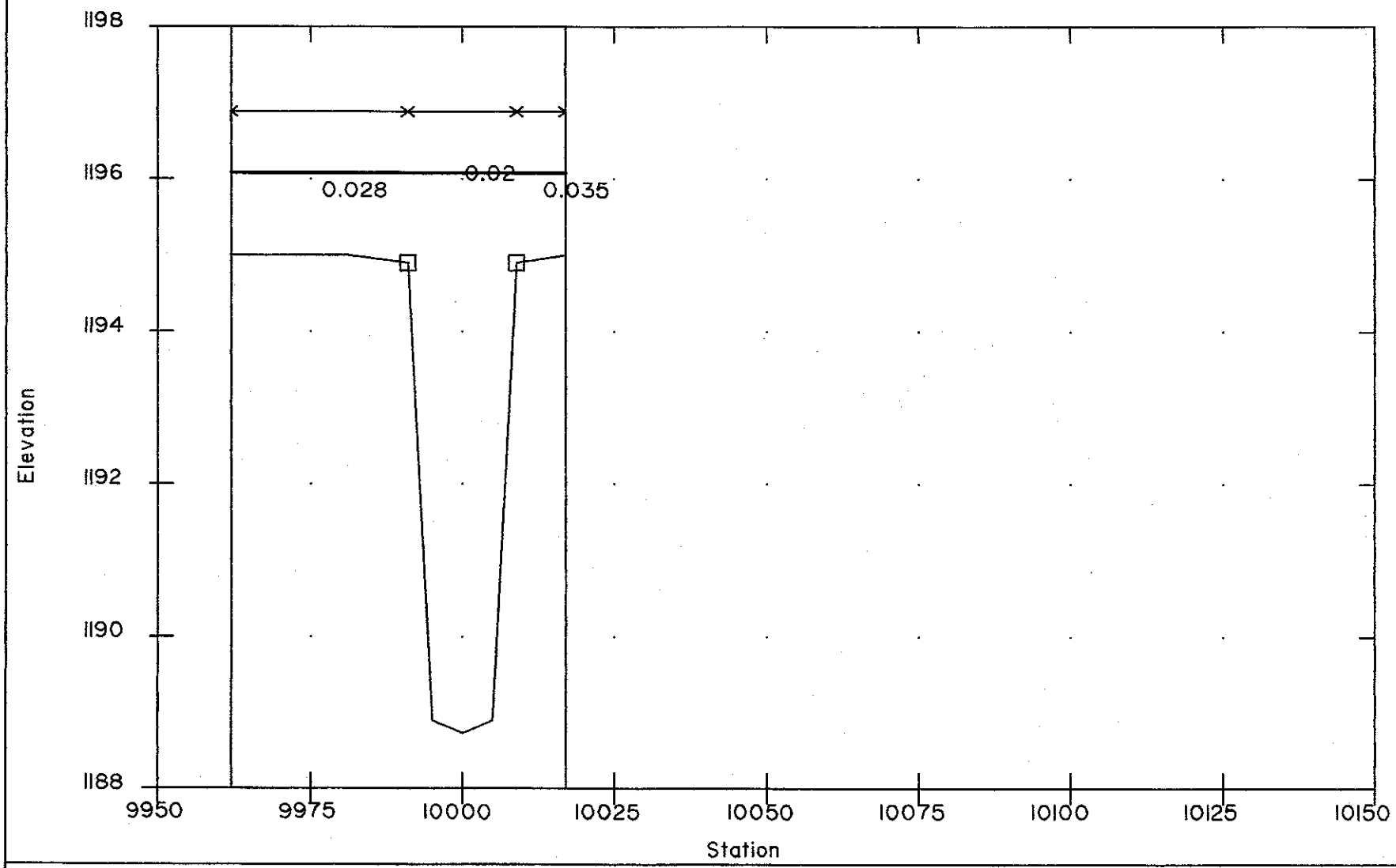
REVISION 11/14/96

EXHIBIT 1
MANNING'S n VALUE MAP

FILE: MANNING.dwg XREF: ROADS.dwg
DATE: 11/21/96

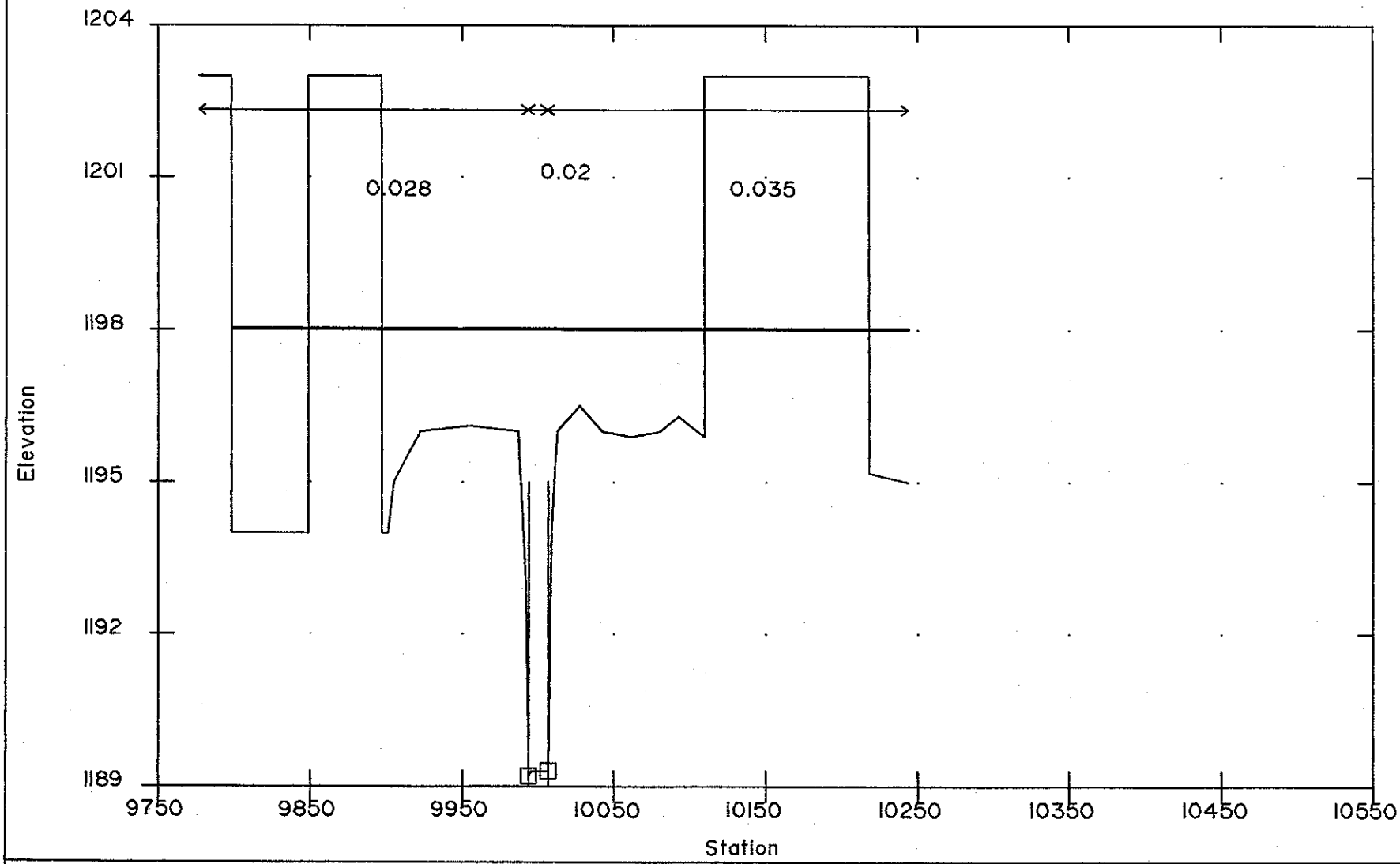
APPENDIX D

CROSS SECTION PLOTS



SECTION : 0.225

Granite Reef Wash
Floodplain Delineation Study



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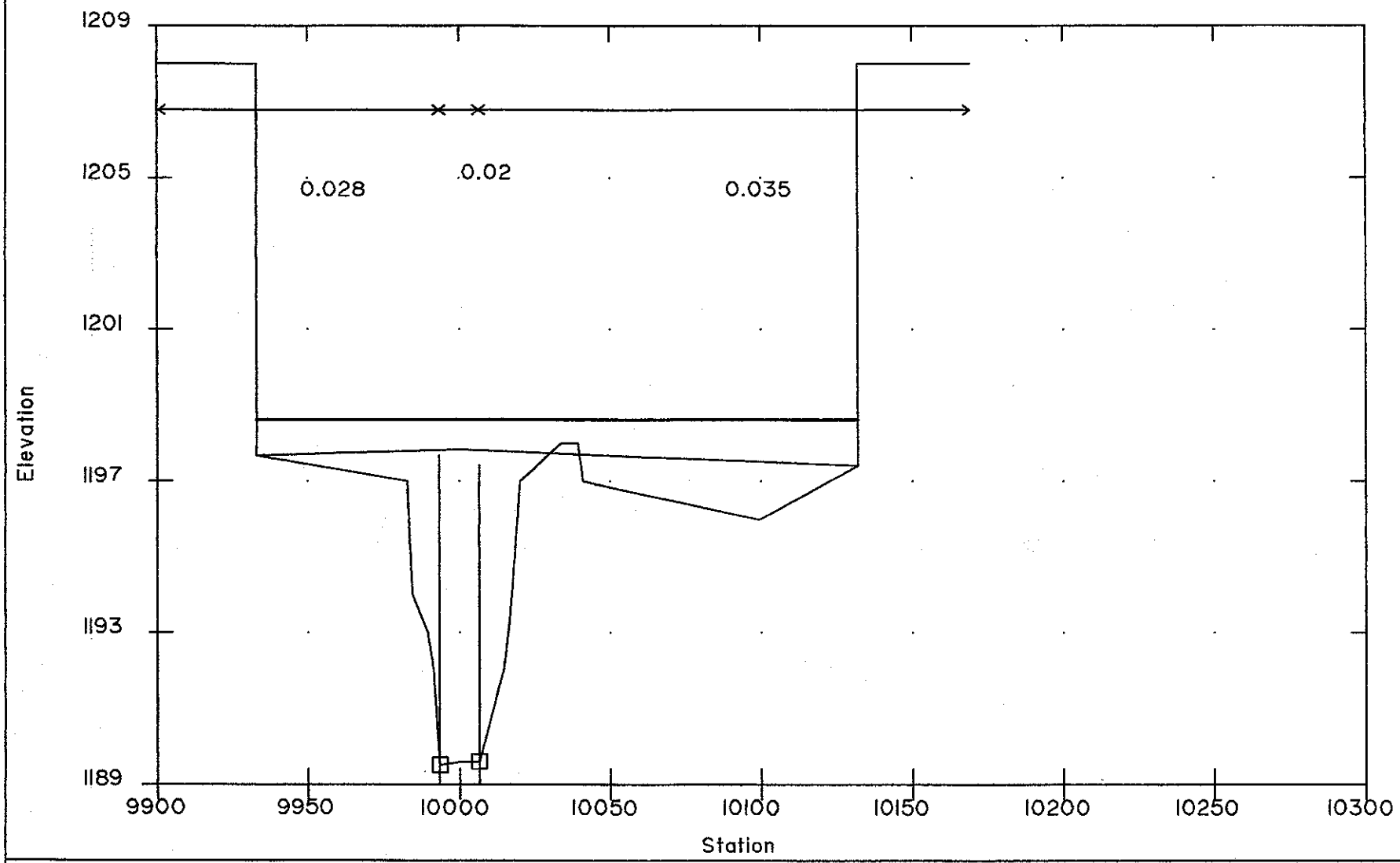
Granite Reef Wash
Floodplain Delineation Study



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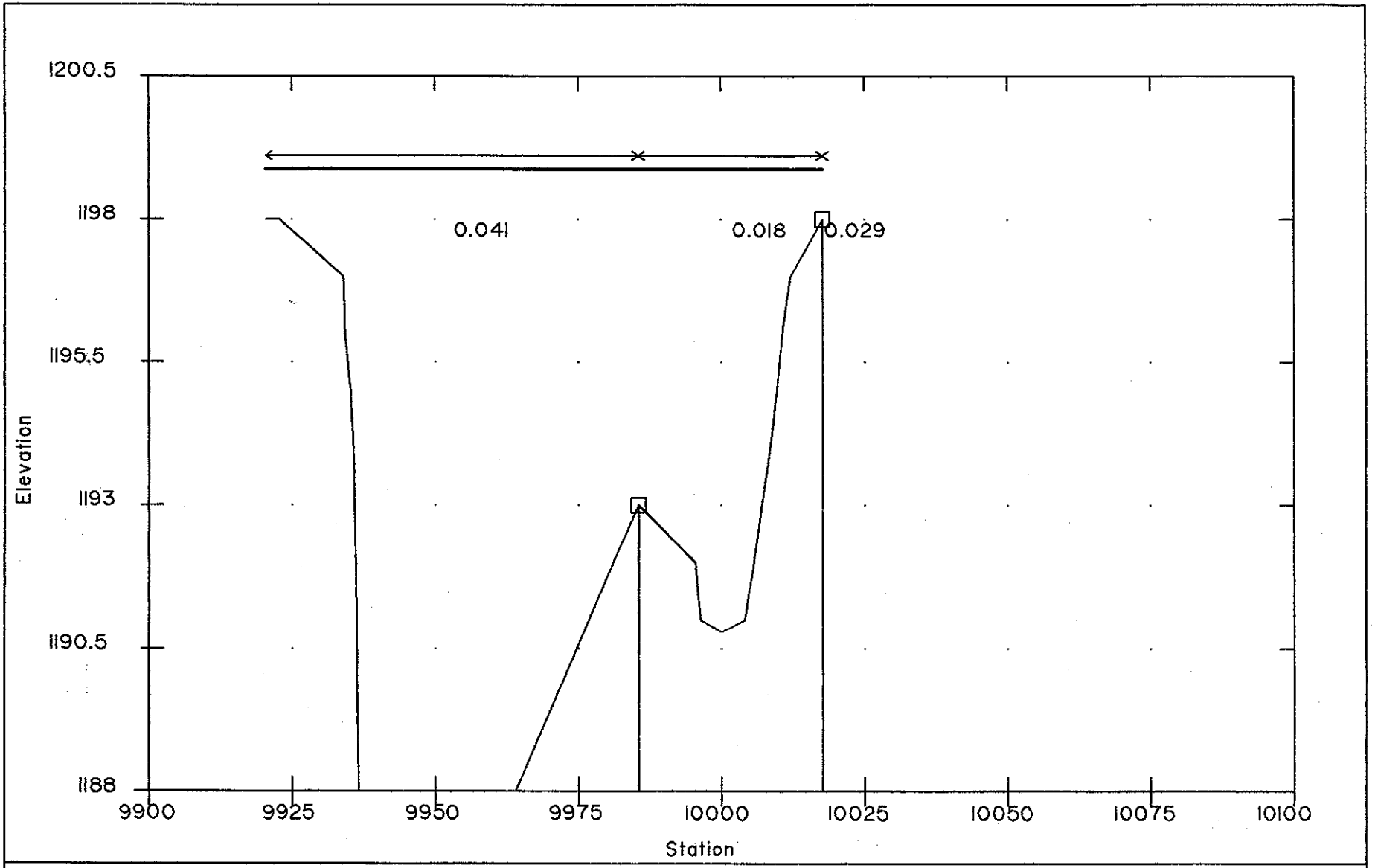
Granite Reef Wash
Floodplain Delineation Study



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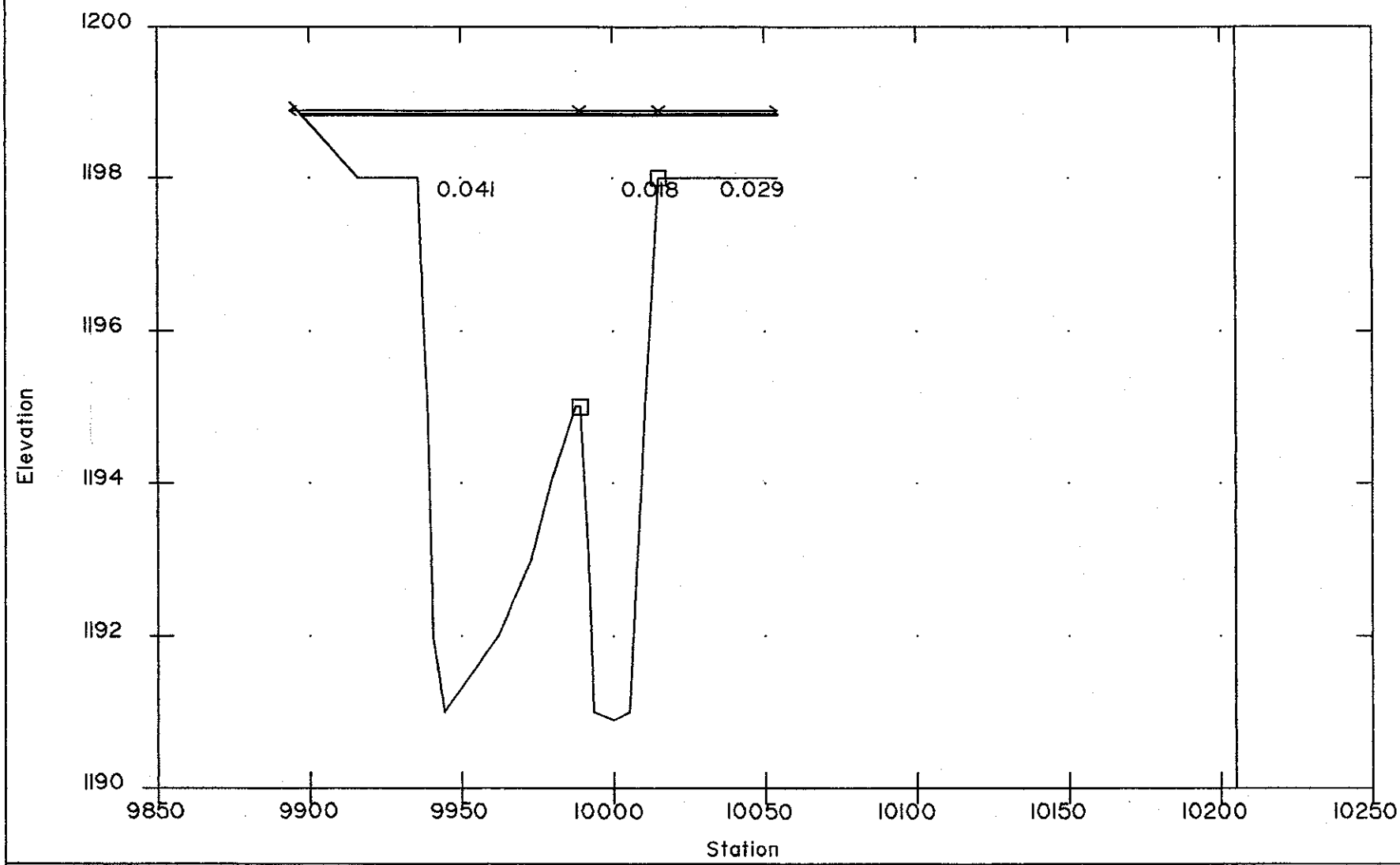
Granite Reef Wash
Floodplain Delineation Study



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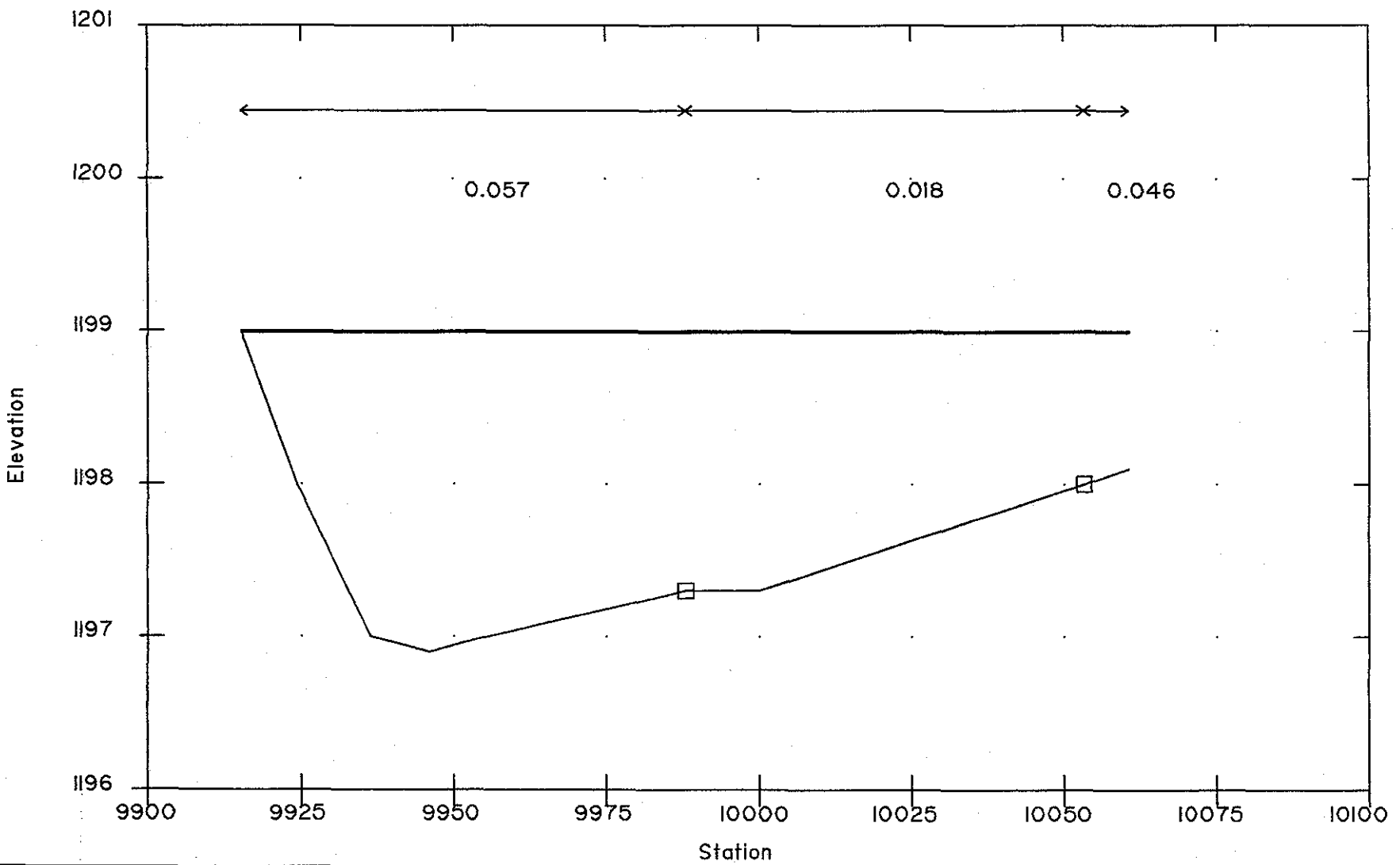
Granite Reef Wash
Floodplain Delineation Study



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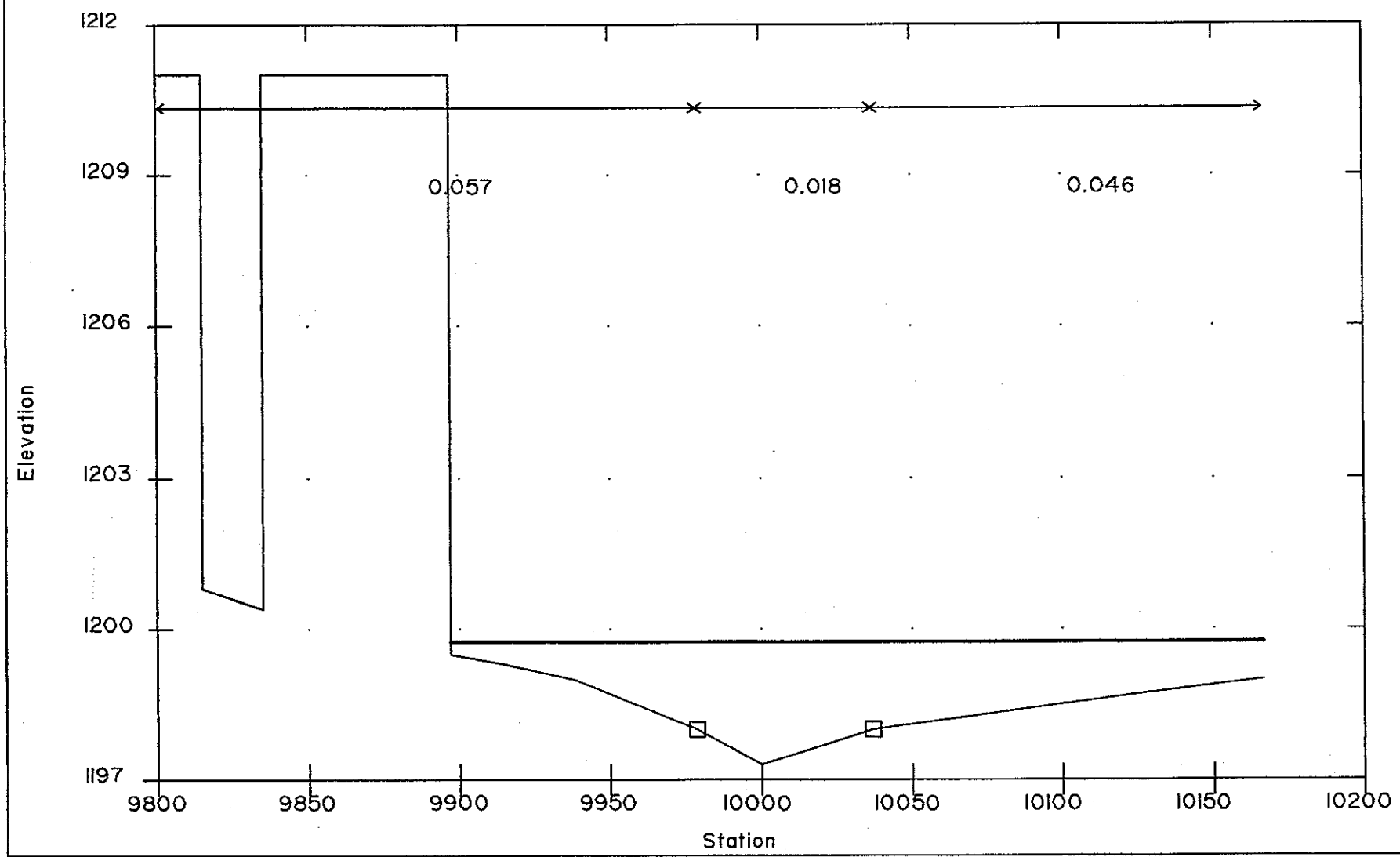
Granite Reef Wash
Floodplain Delineation Study



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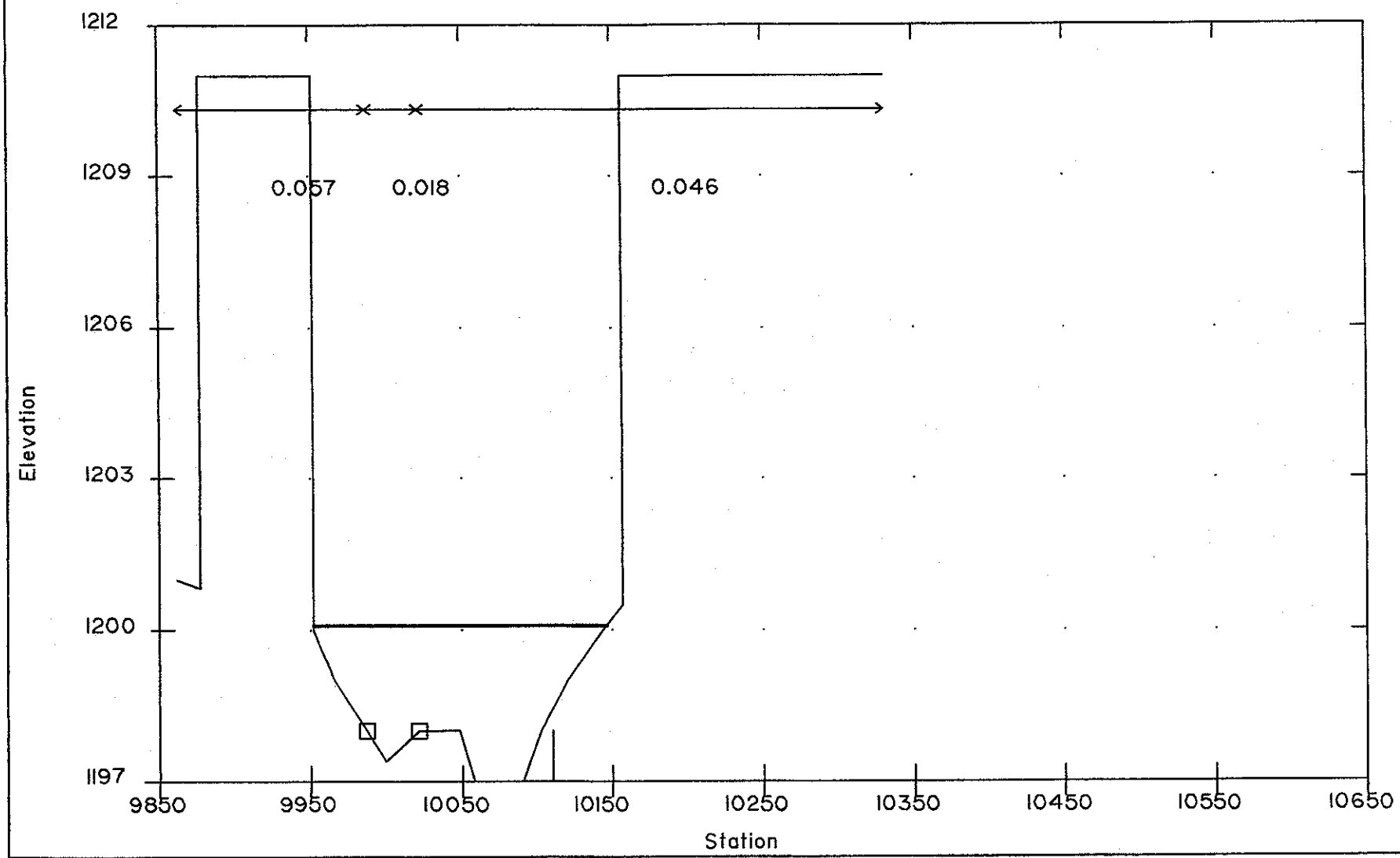
Granite Reef Wash
Floodplain Delineation Study



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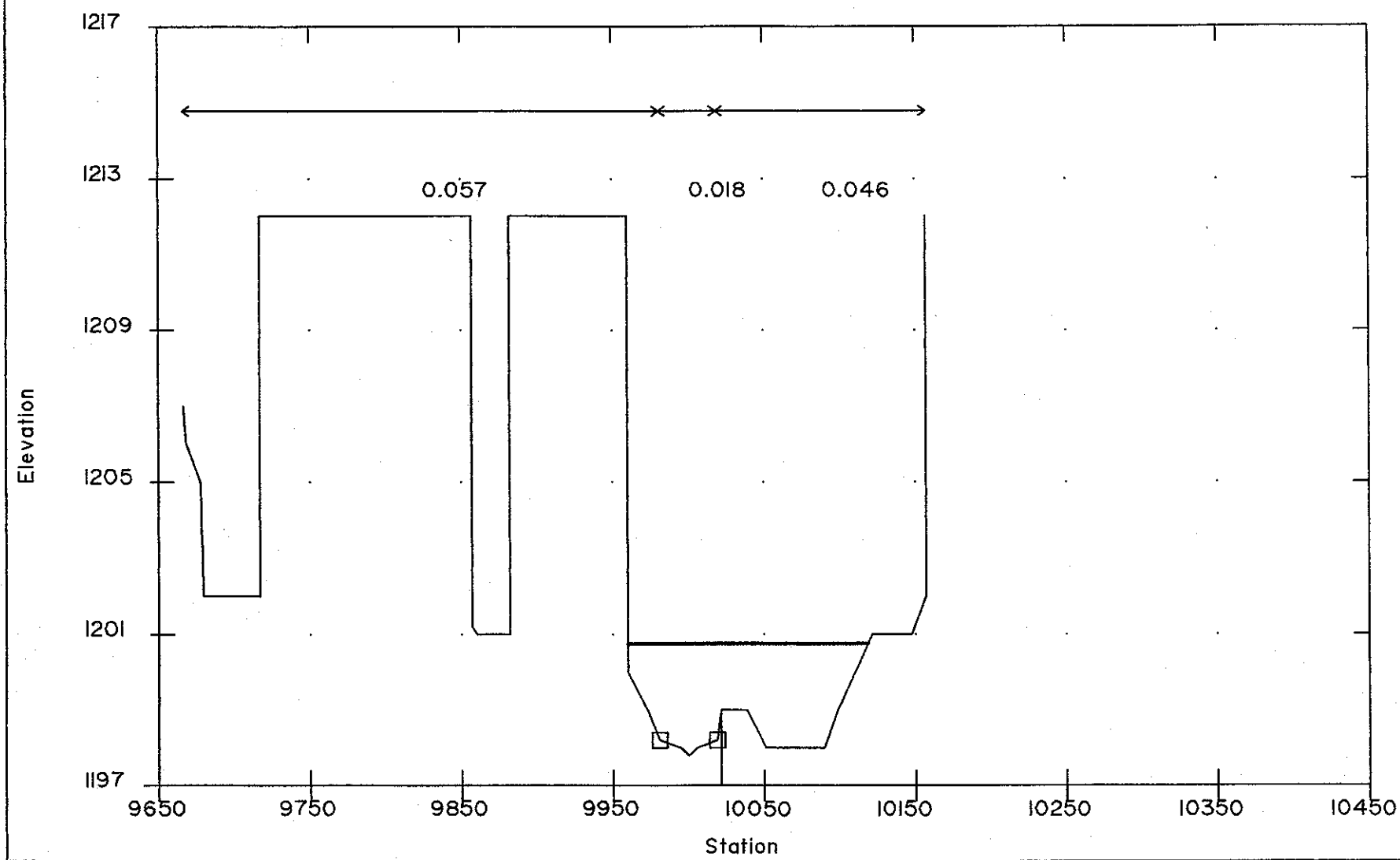
Granite Reef Wash
Floodplain Delineation Study



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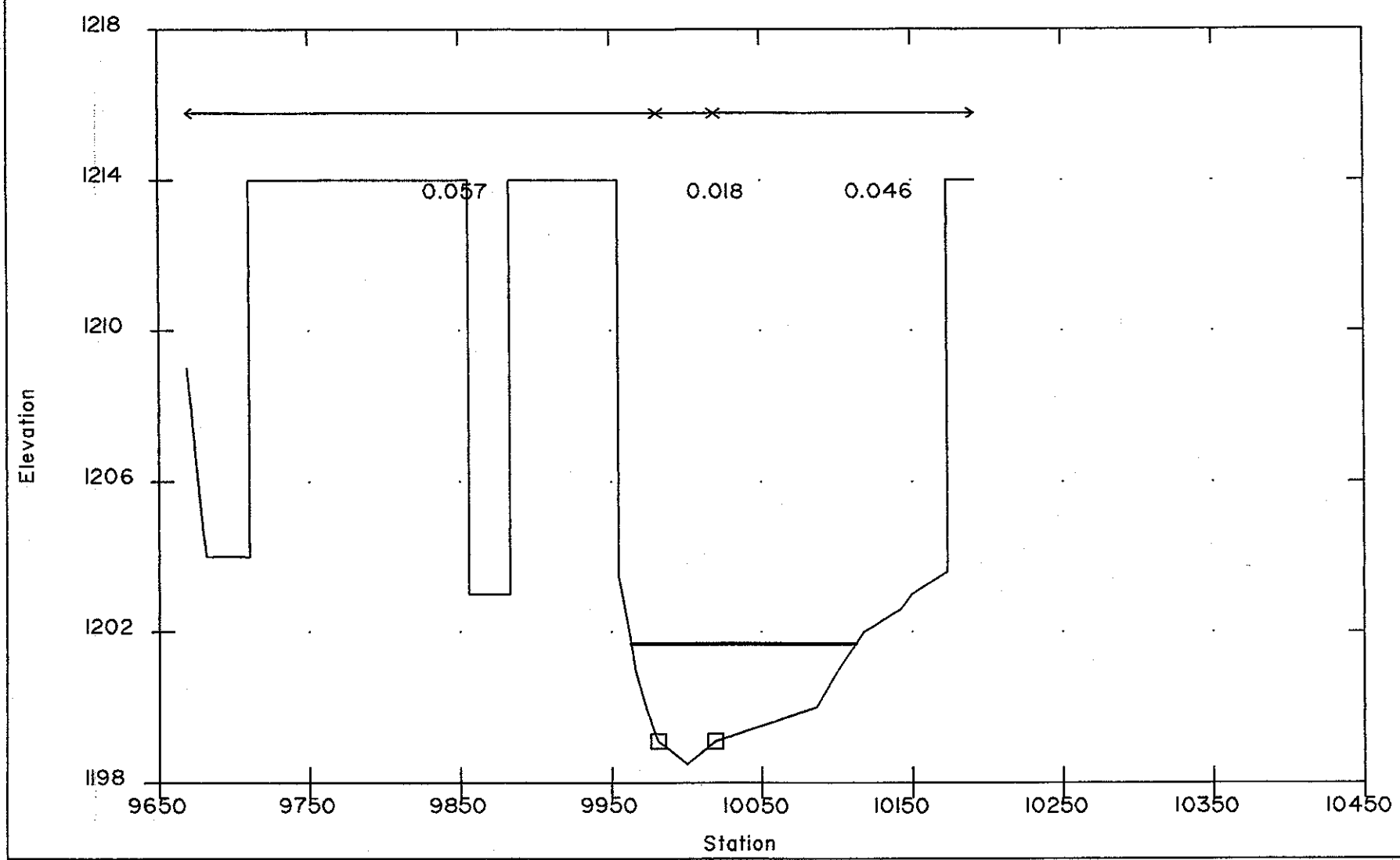
Granite Reef Wash
Floodplain Delineation Study



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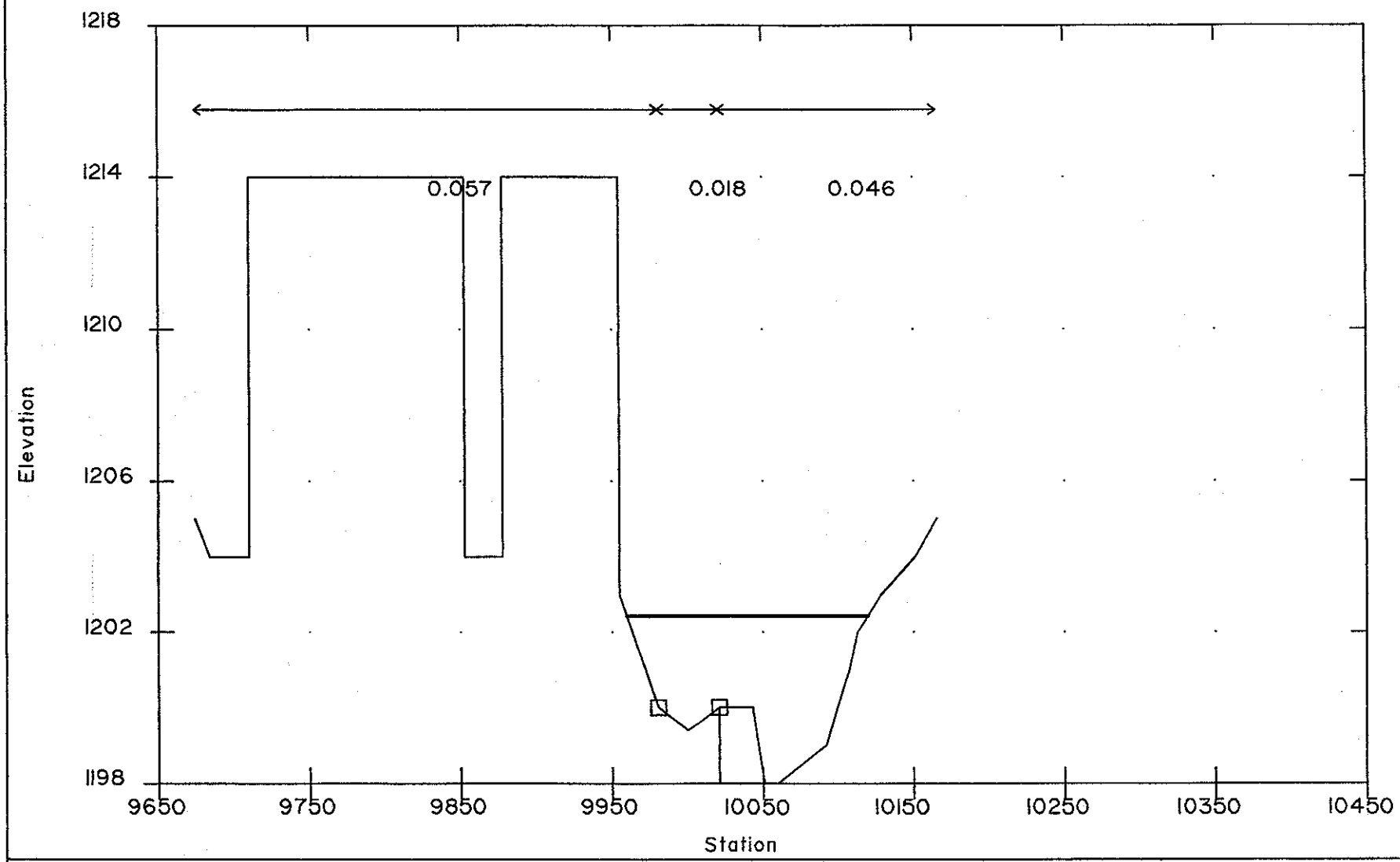
Granite Reef Wash
Floodplain Delineation Study



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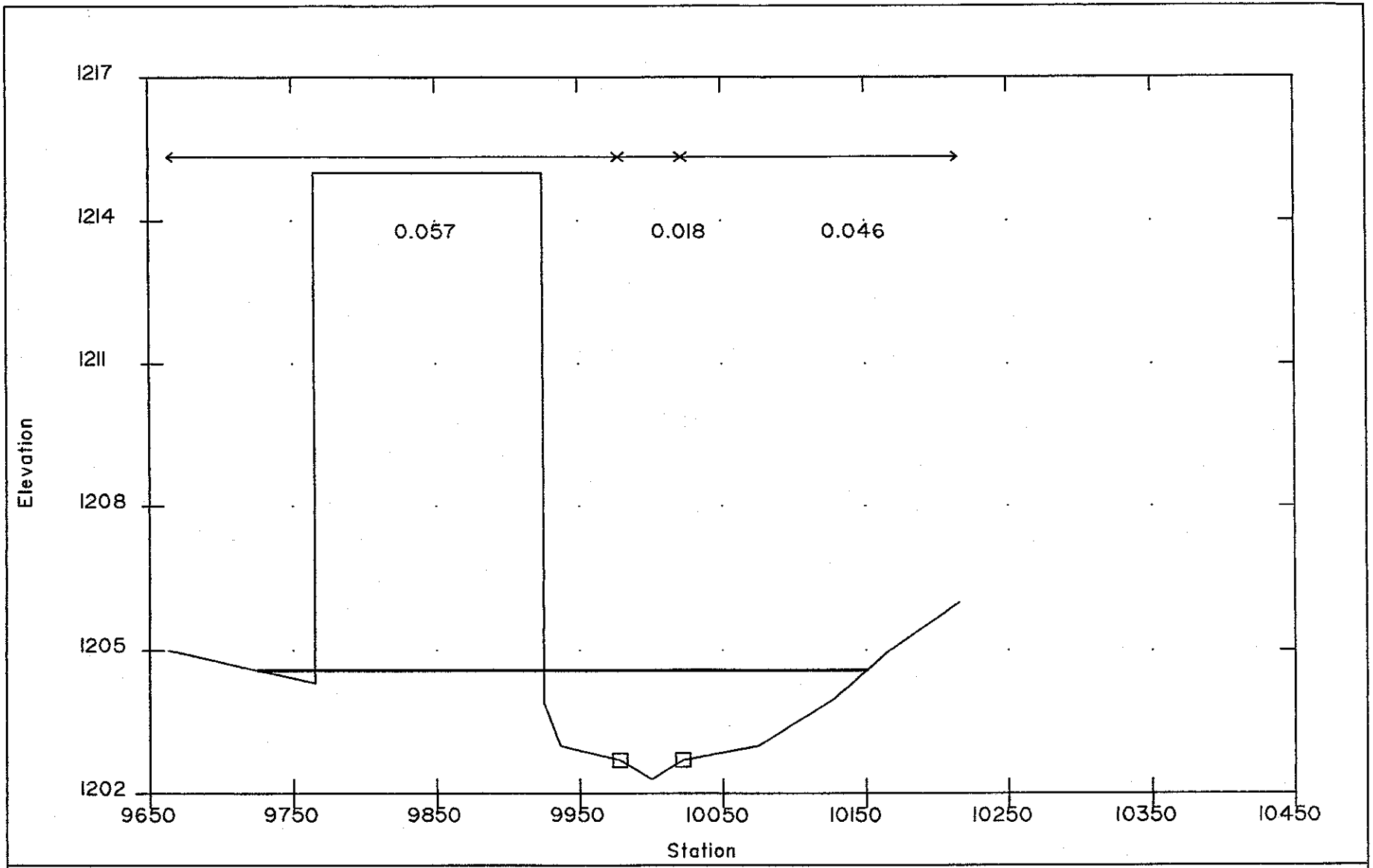
Granite Reef Wash
Floodplain Delineation Study



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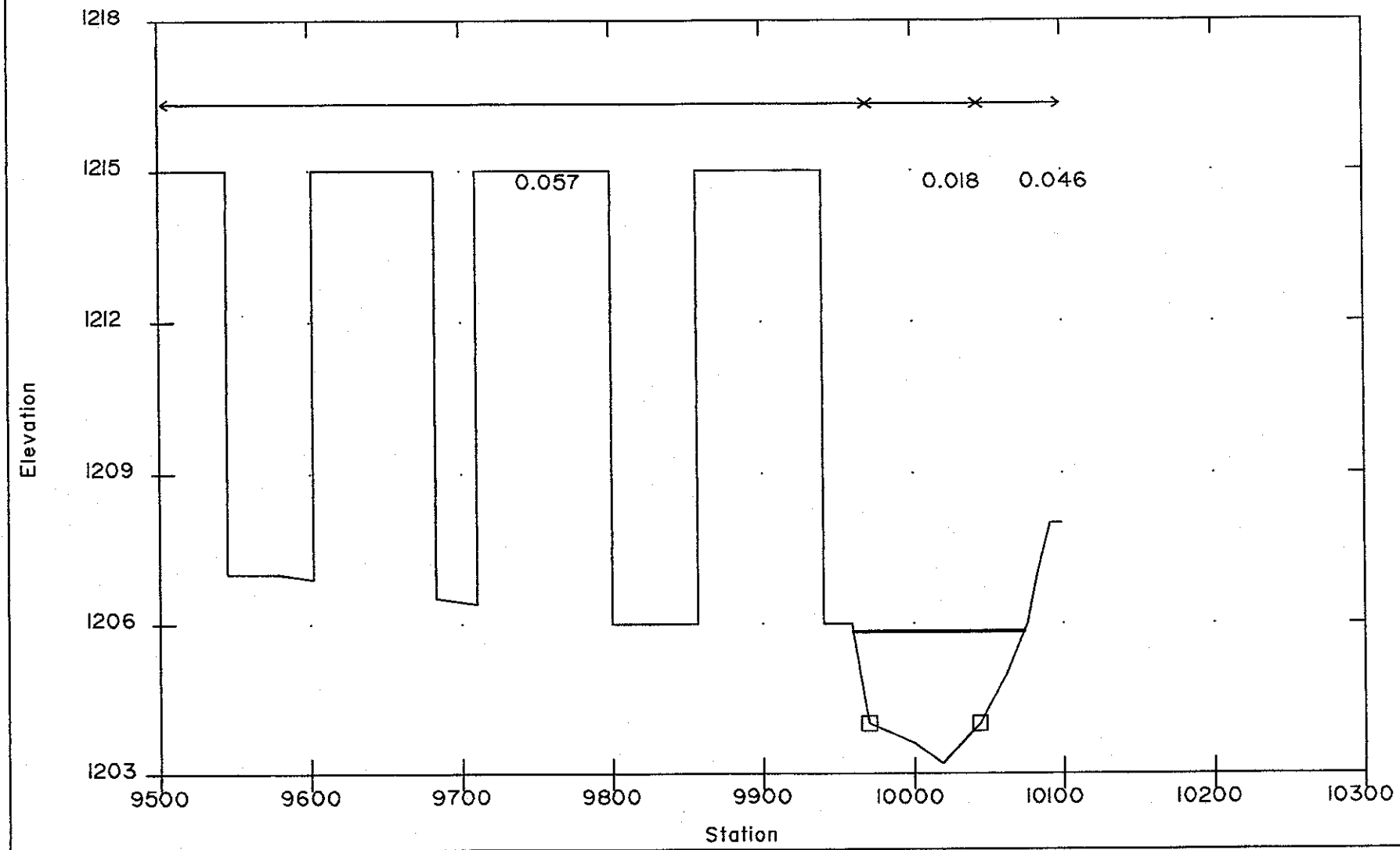
Granite Reef Wash
Floodplain Delineation Study



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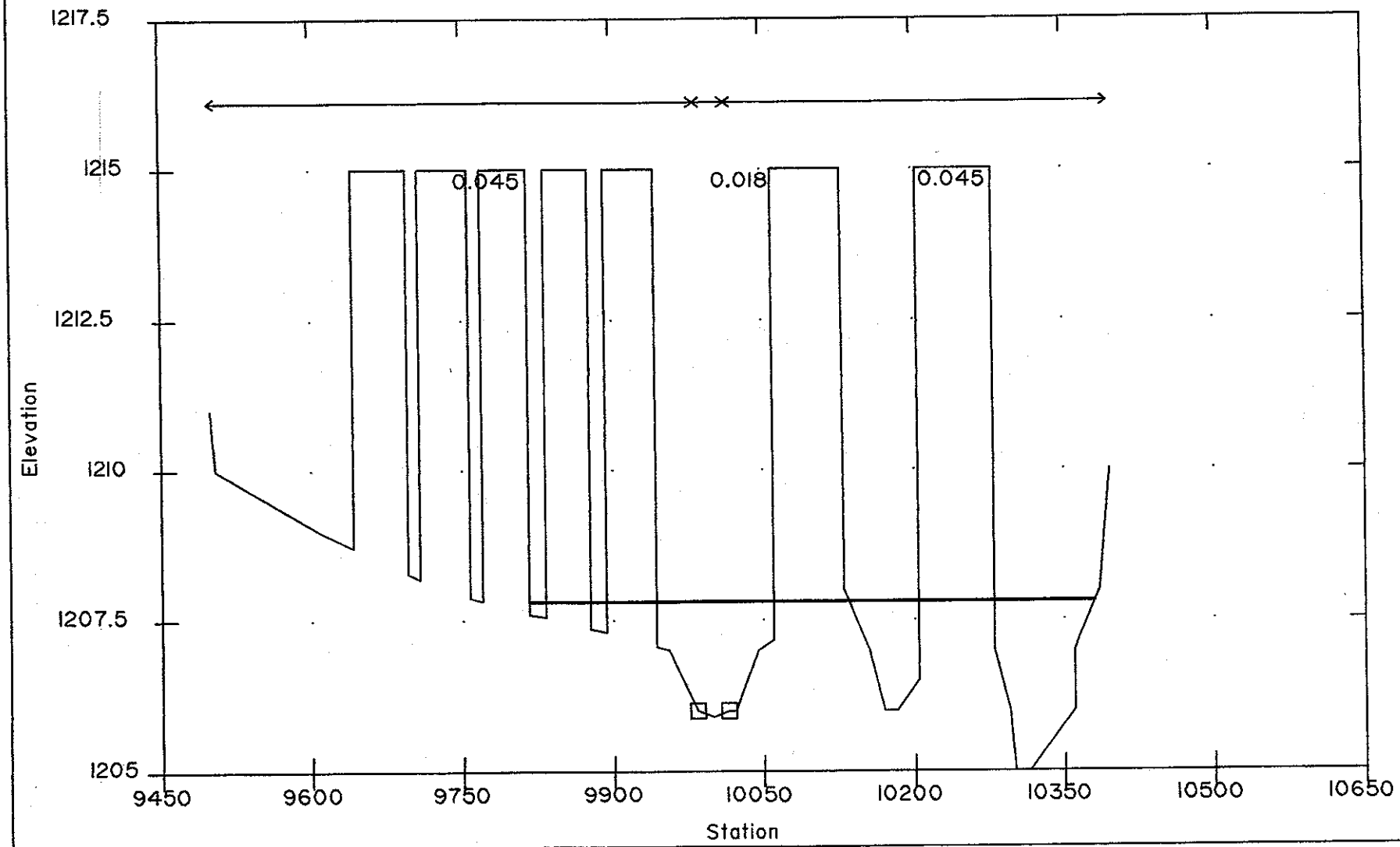
Granite Reef Wash
Floodplain Delineation Study



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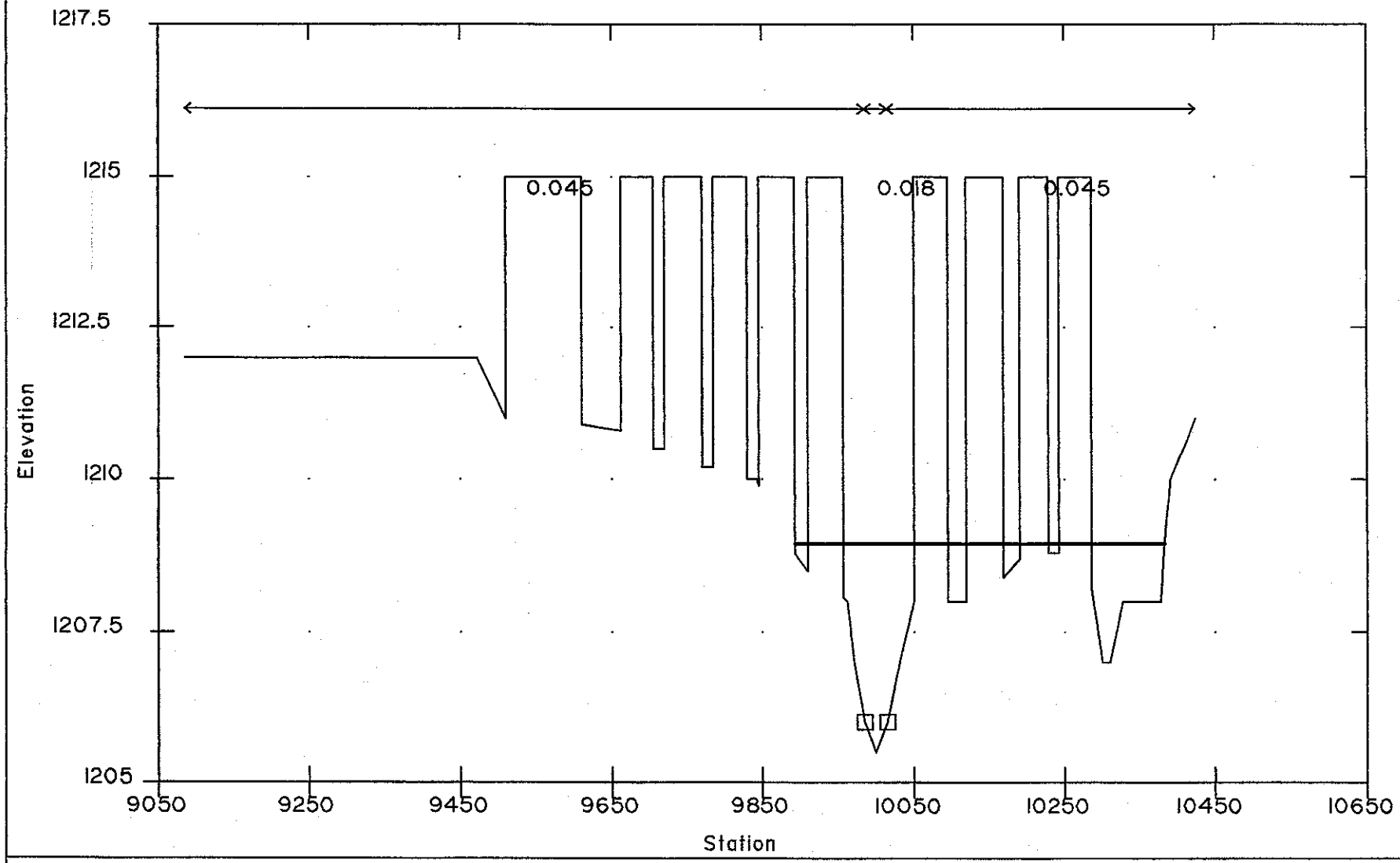
Granite Reef Wash
Floodplain Delineation Study



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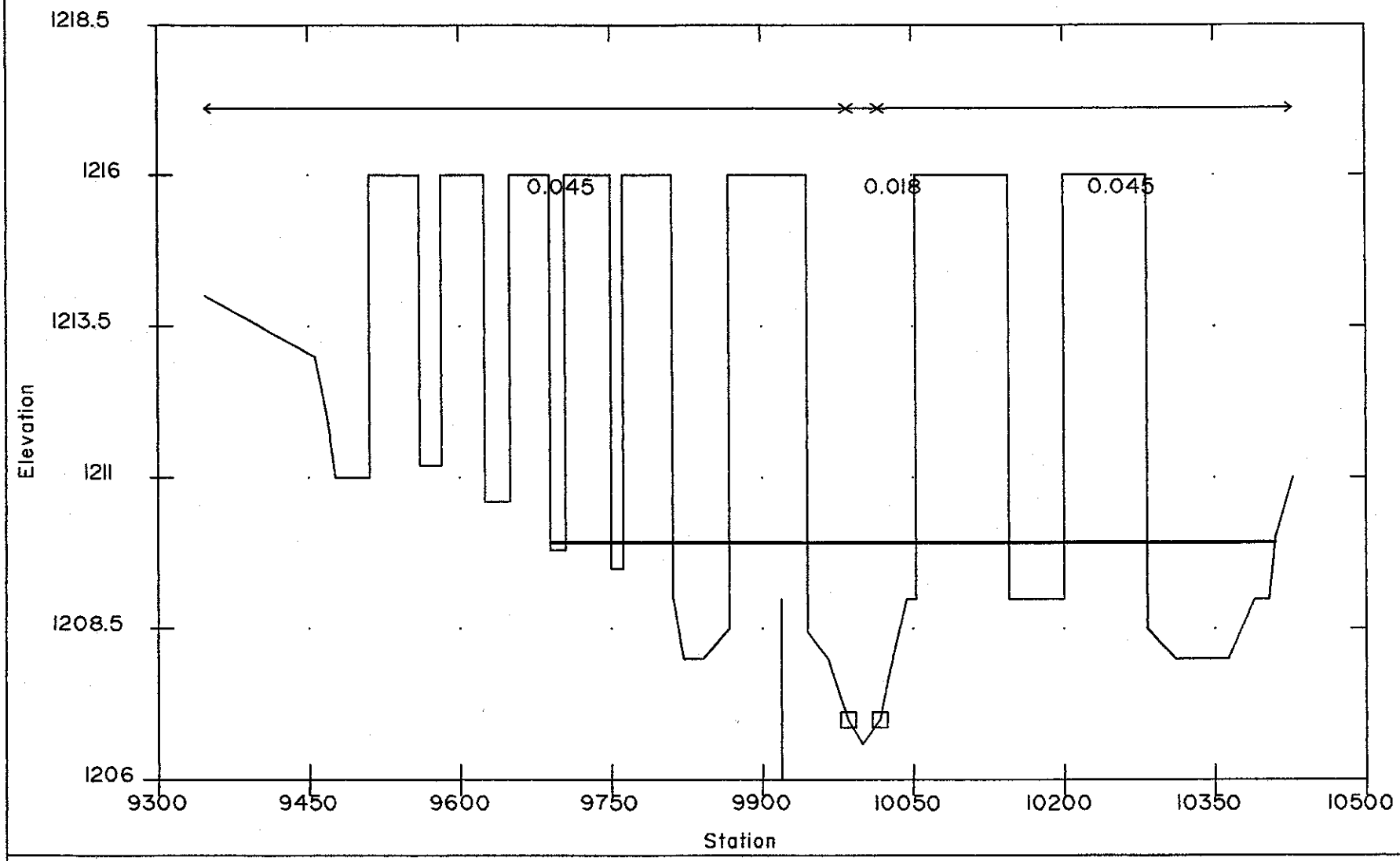
Granite Reef Wash
Floodplain Delineation Study



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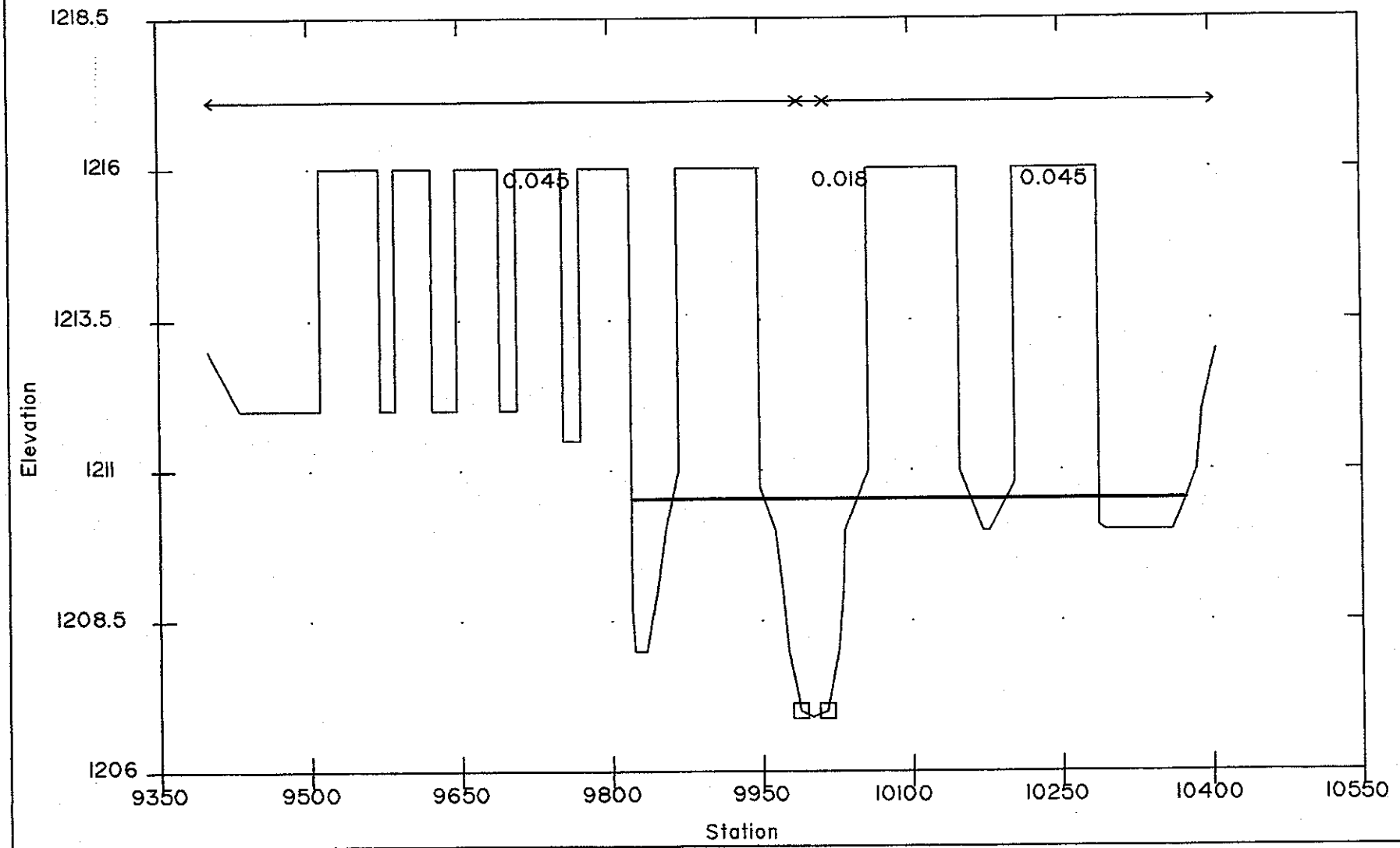
Granite Reef Wash
Floodplain Delineation Study



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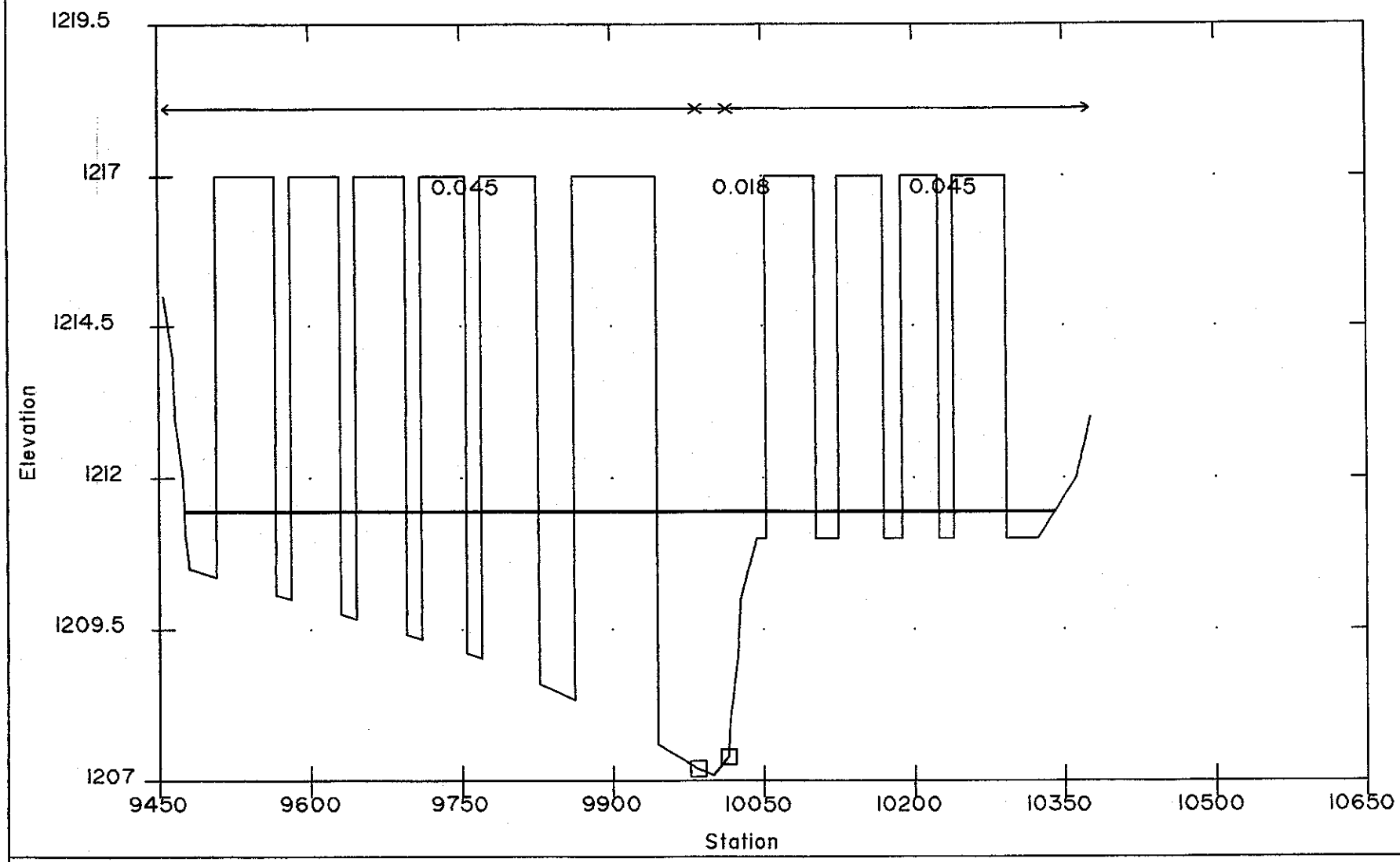
Granite Reef Wash
Floodplain Delineation Study



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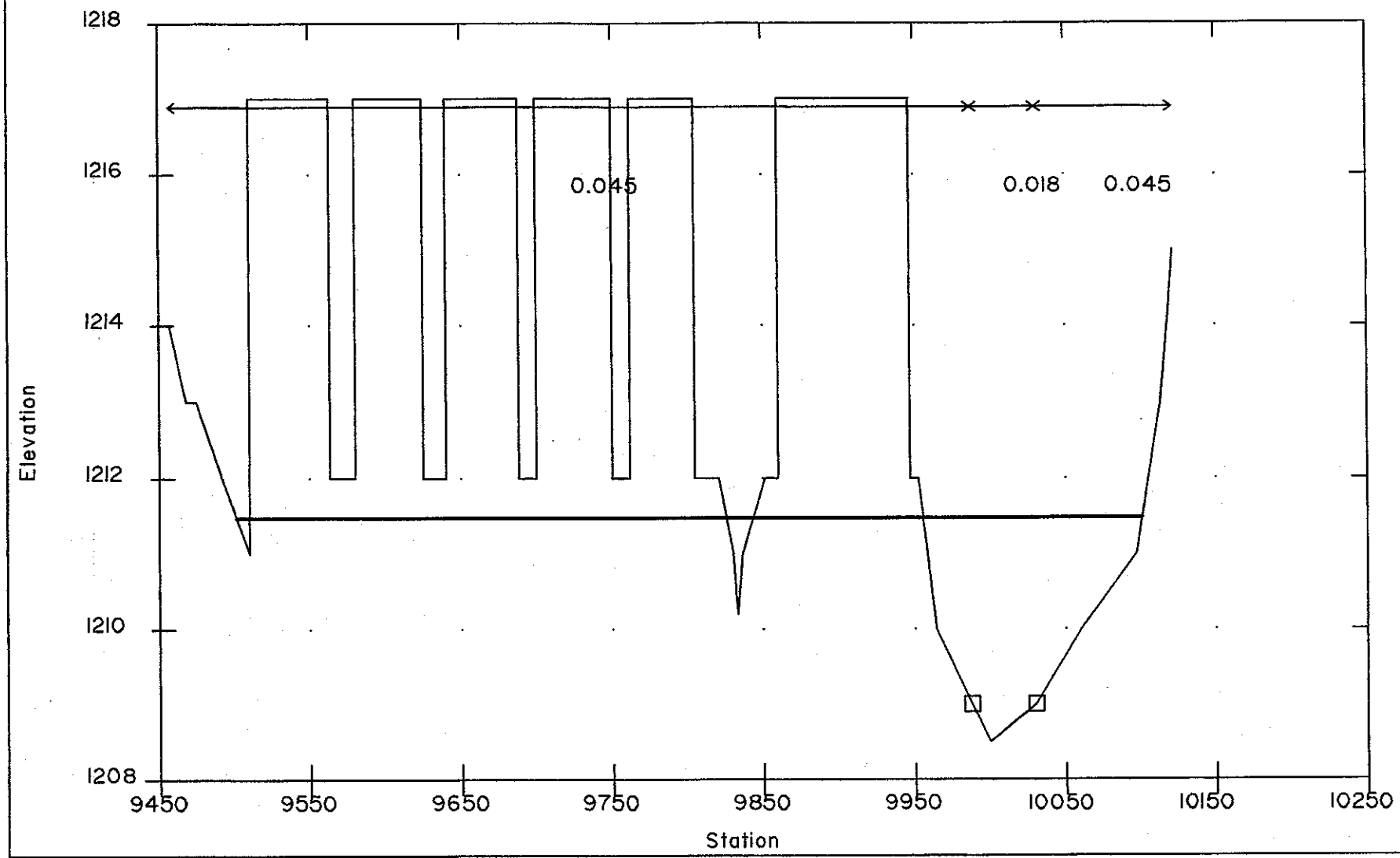
Granite Reef Wash
Floodplain Delineation Study



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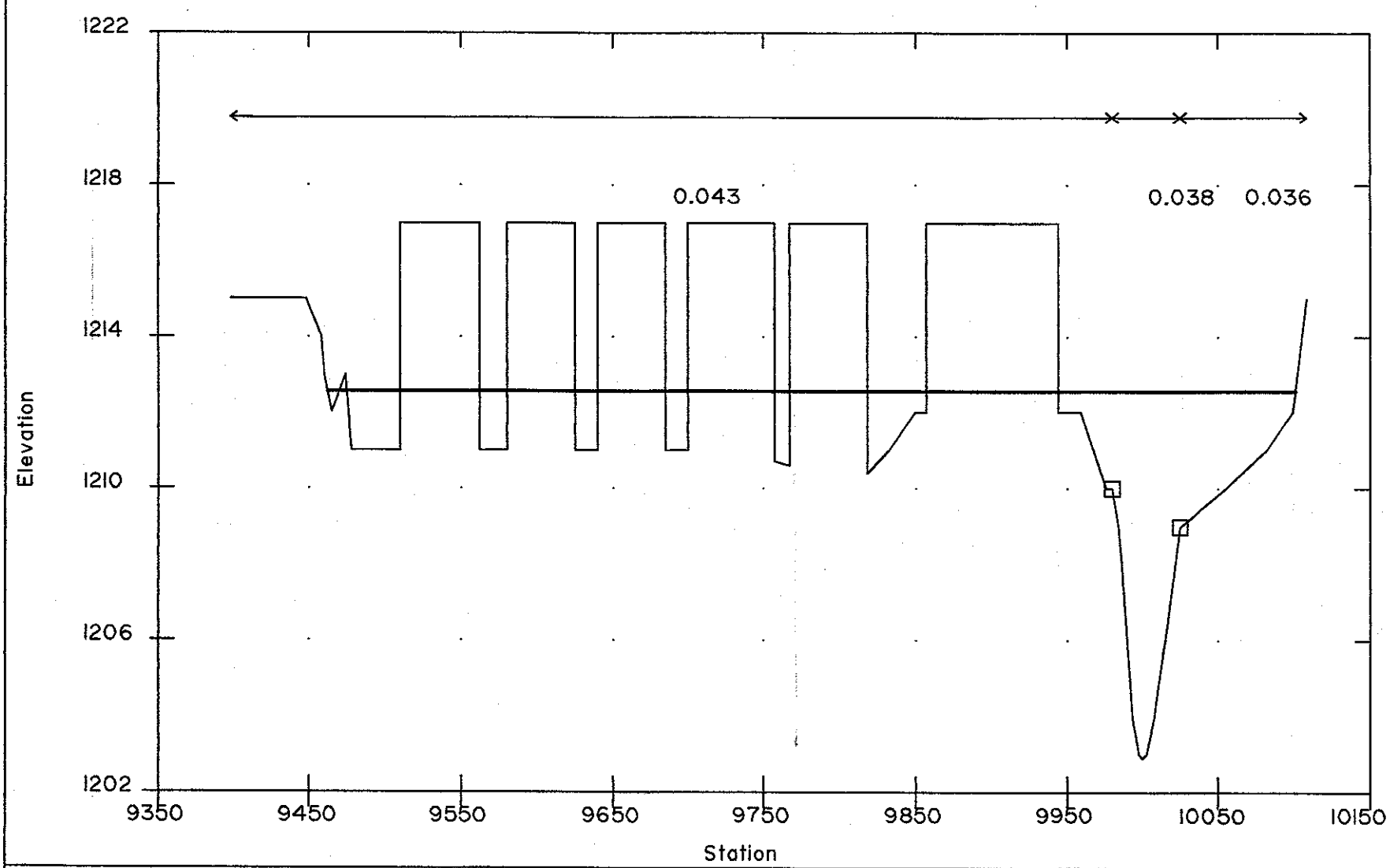
Granite Reef Wash
Floodplain Delineation Study



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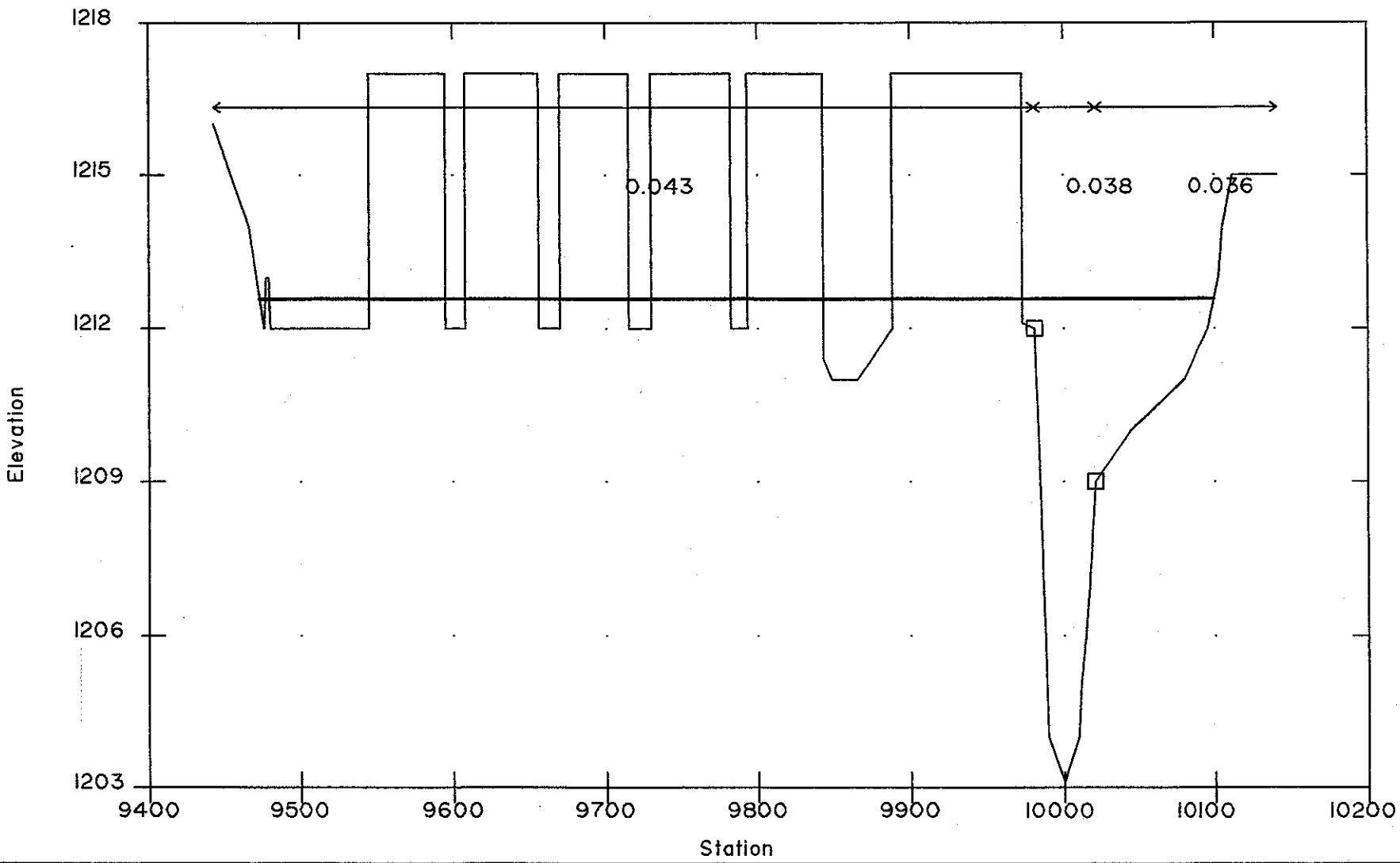
Granite Reef Wash
Floodplain Delineation Study



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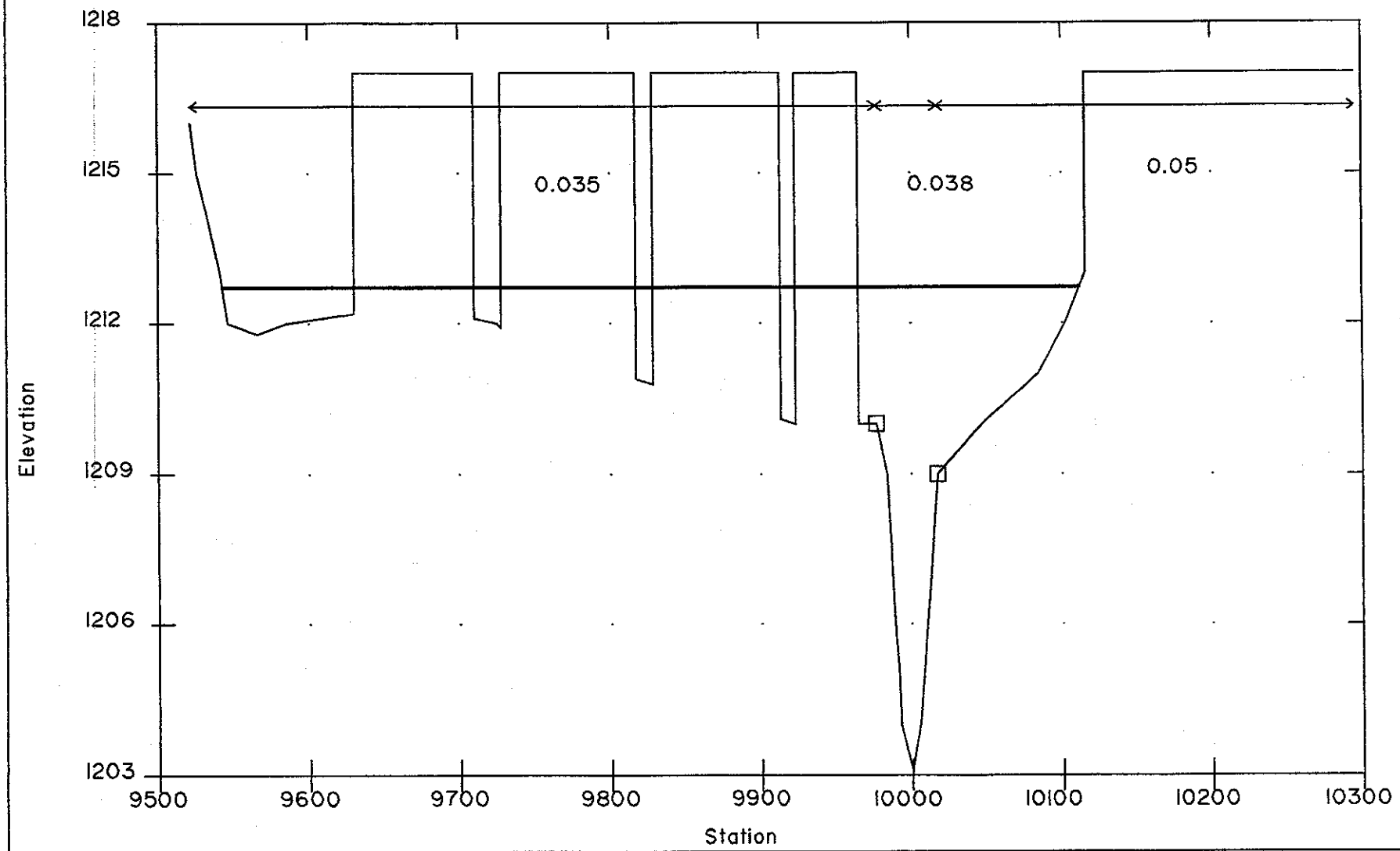
Granite Reef Wash
Floodplain Delineation Study



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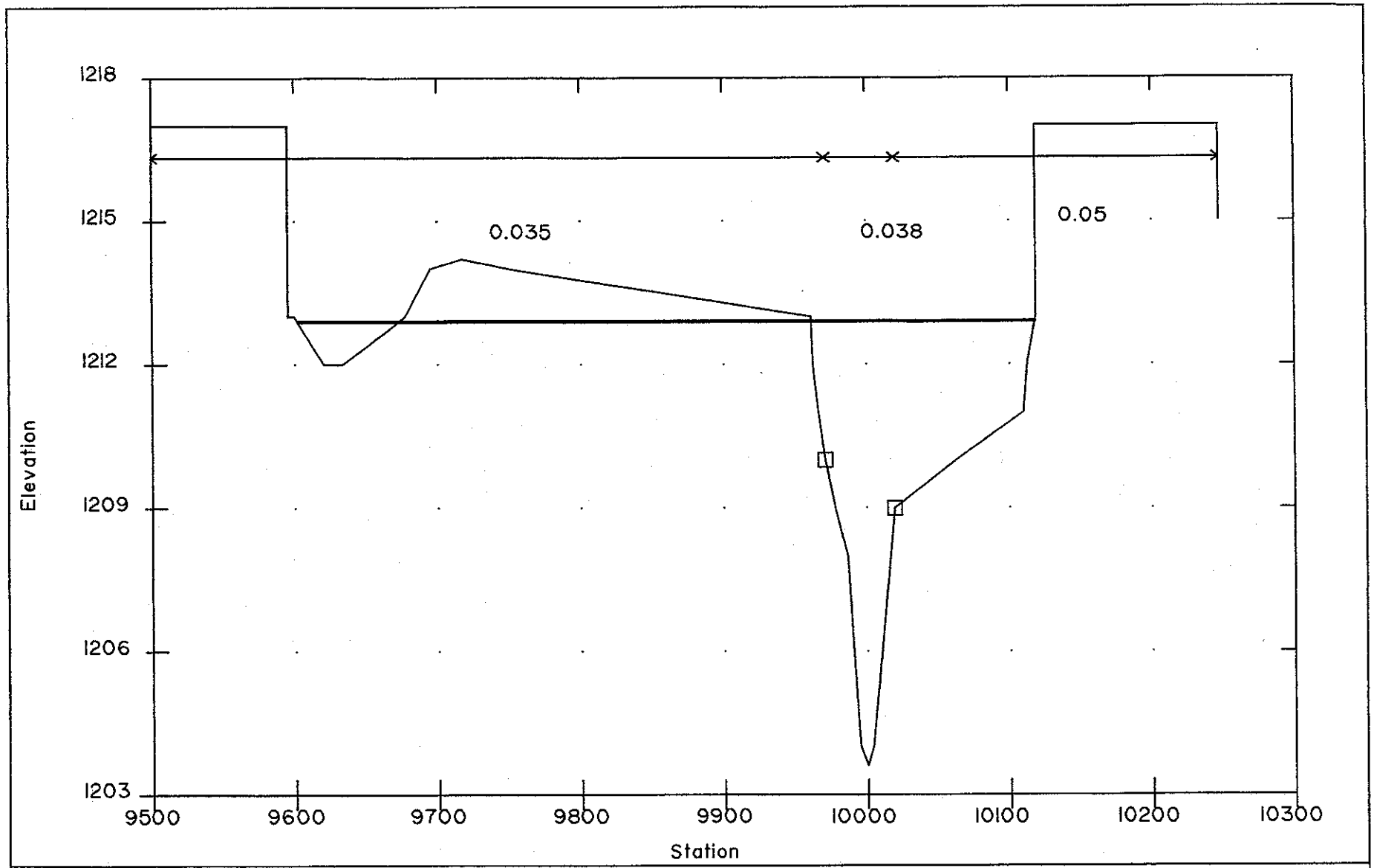
Granite Reef Wash
Floodplain Delineation Study



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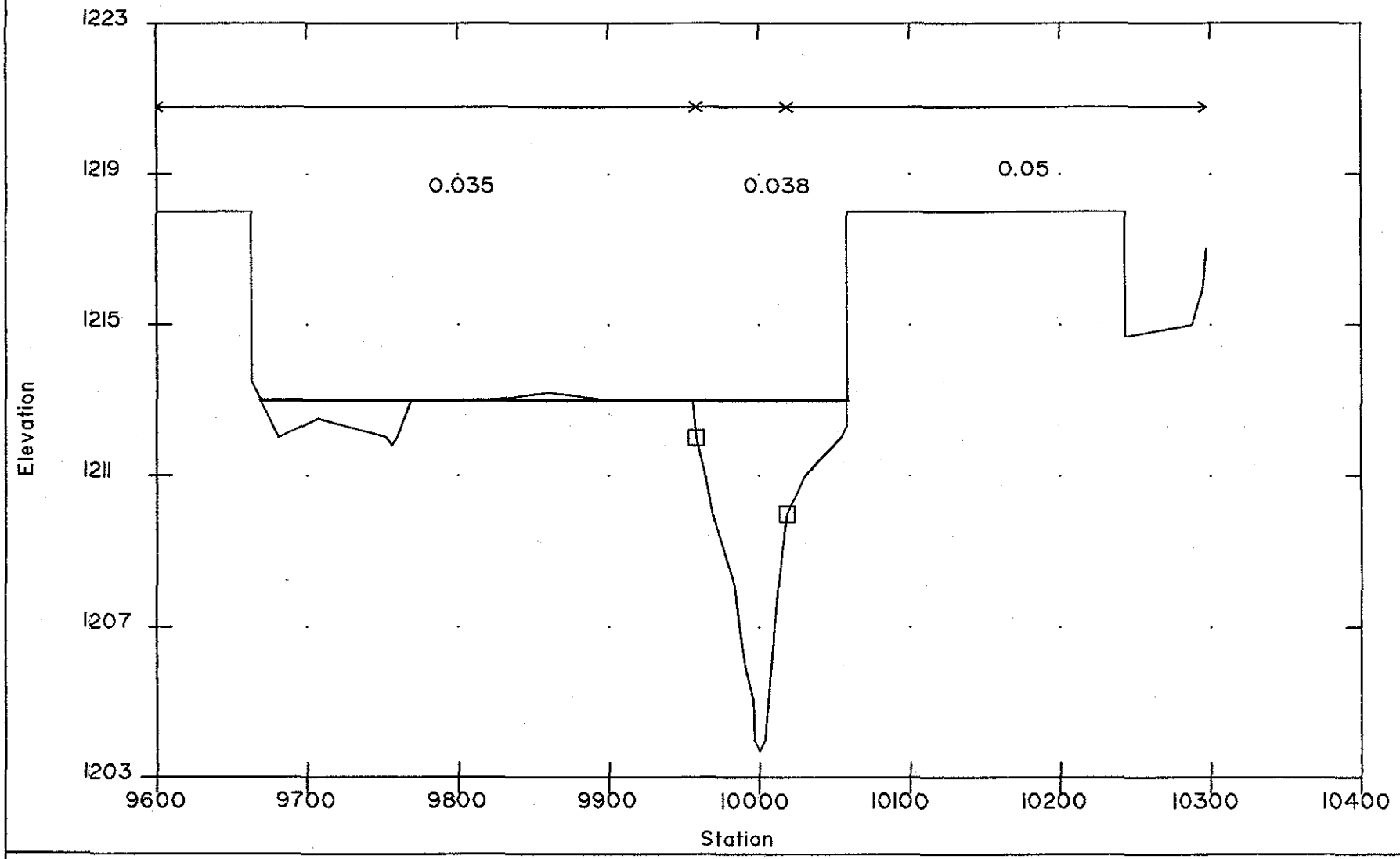
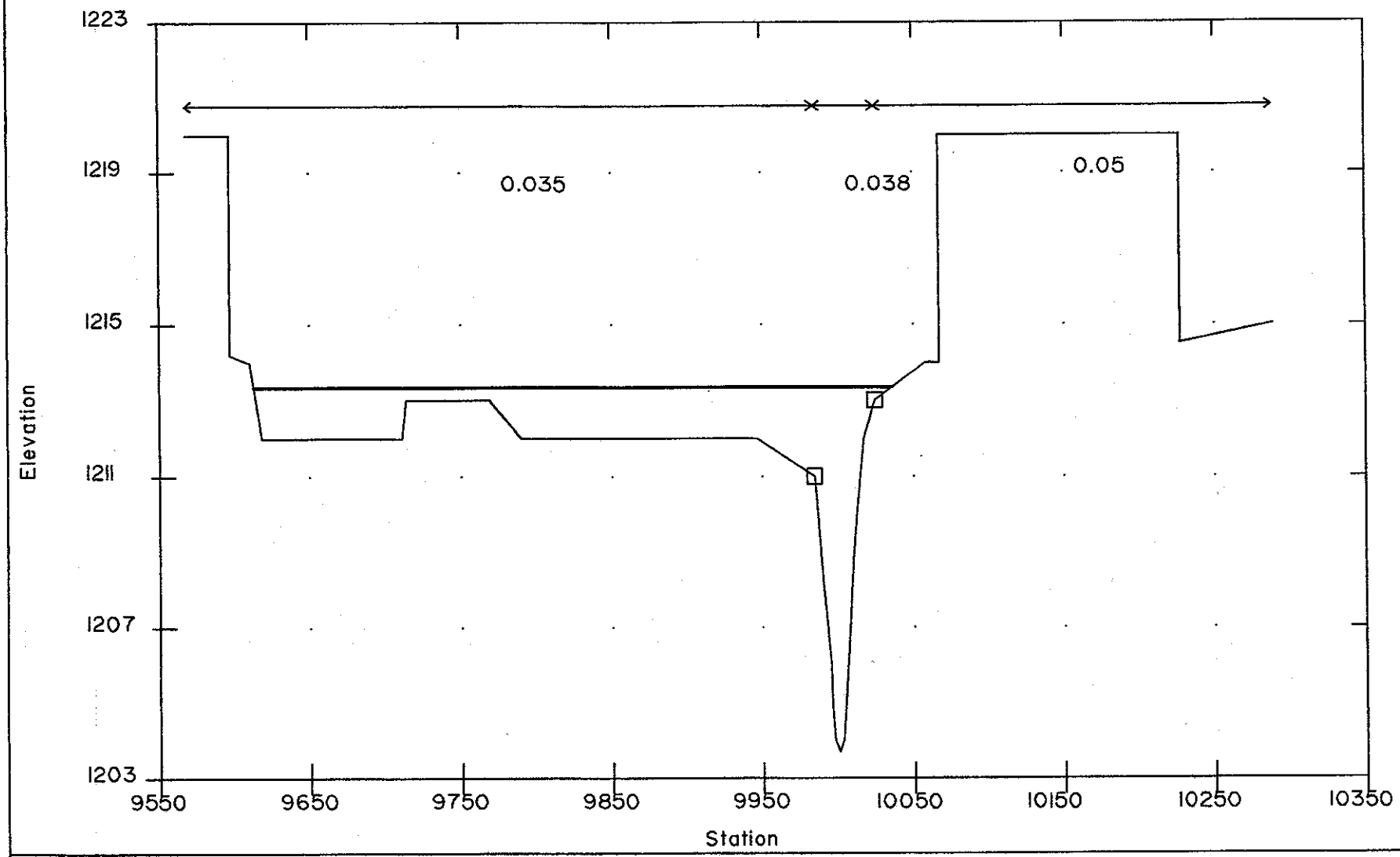
Granite Reef Wash
Floodplain Delineation Study



SECTION : 1.001

Granite Reef Wash
Floodplain Delineation Study



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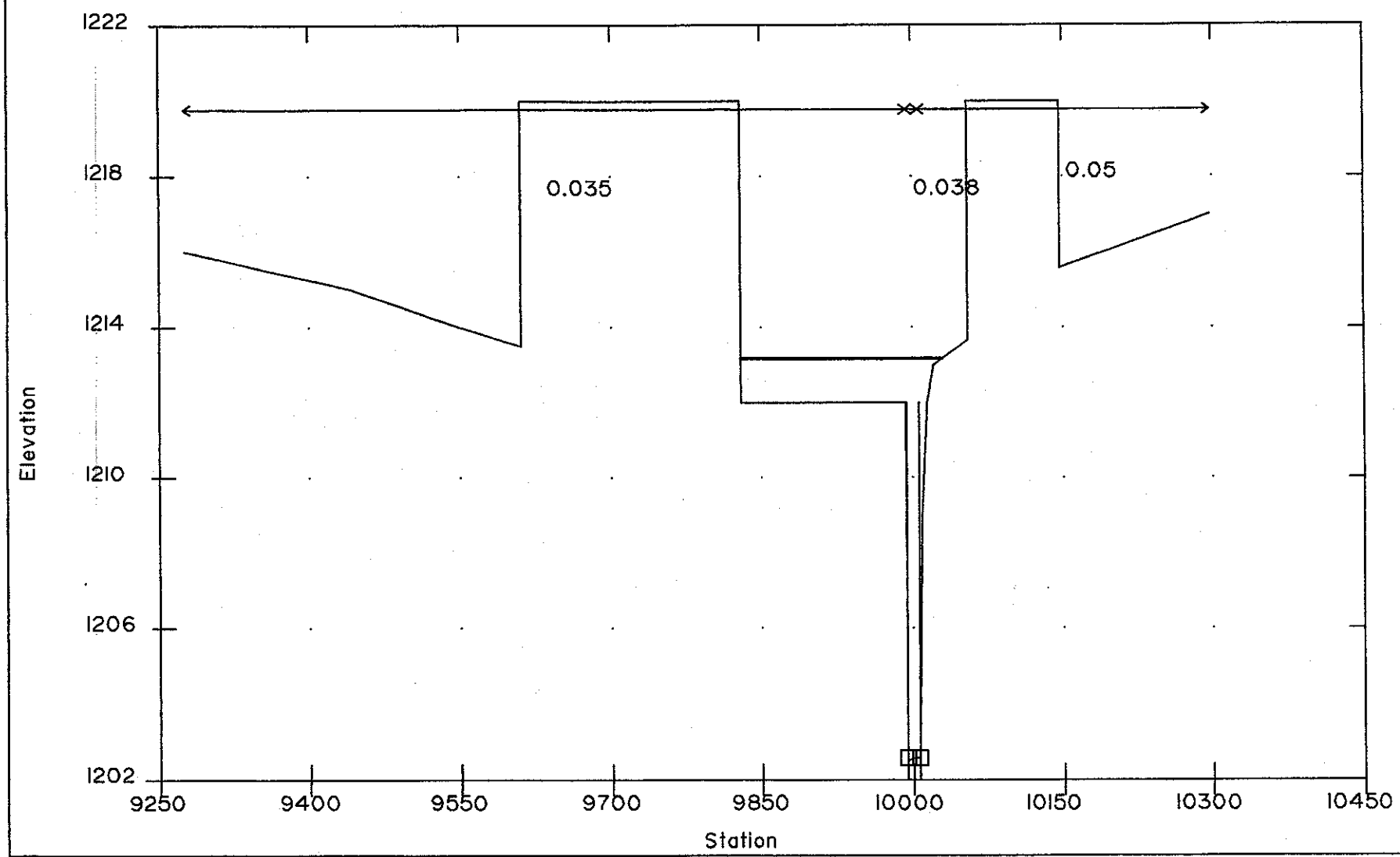
Granite Reef Wash
Floodplain Delineation Study



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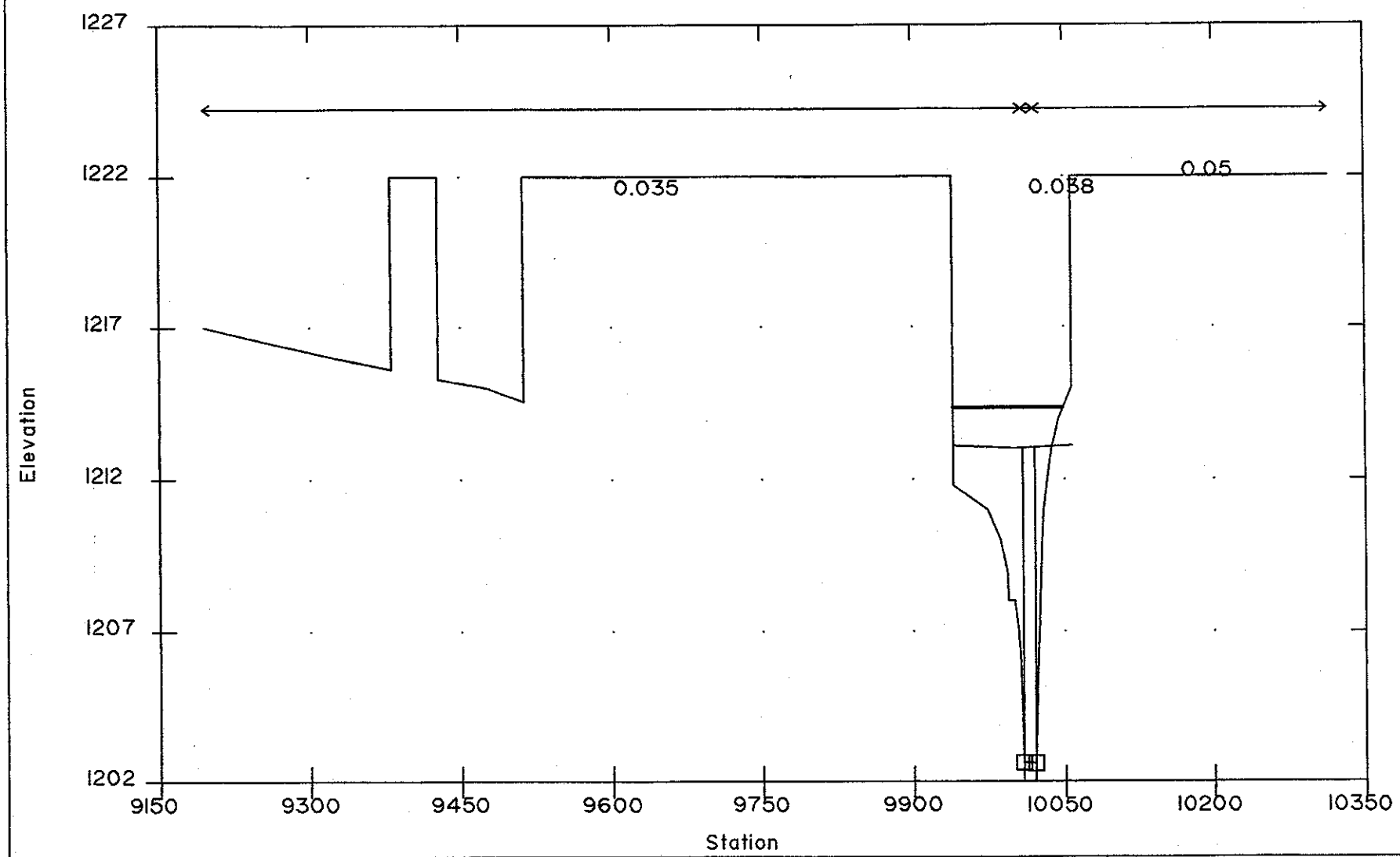
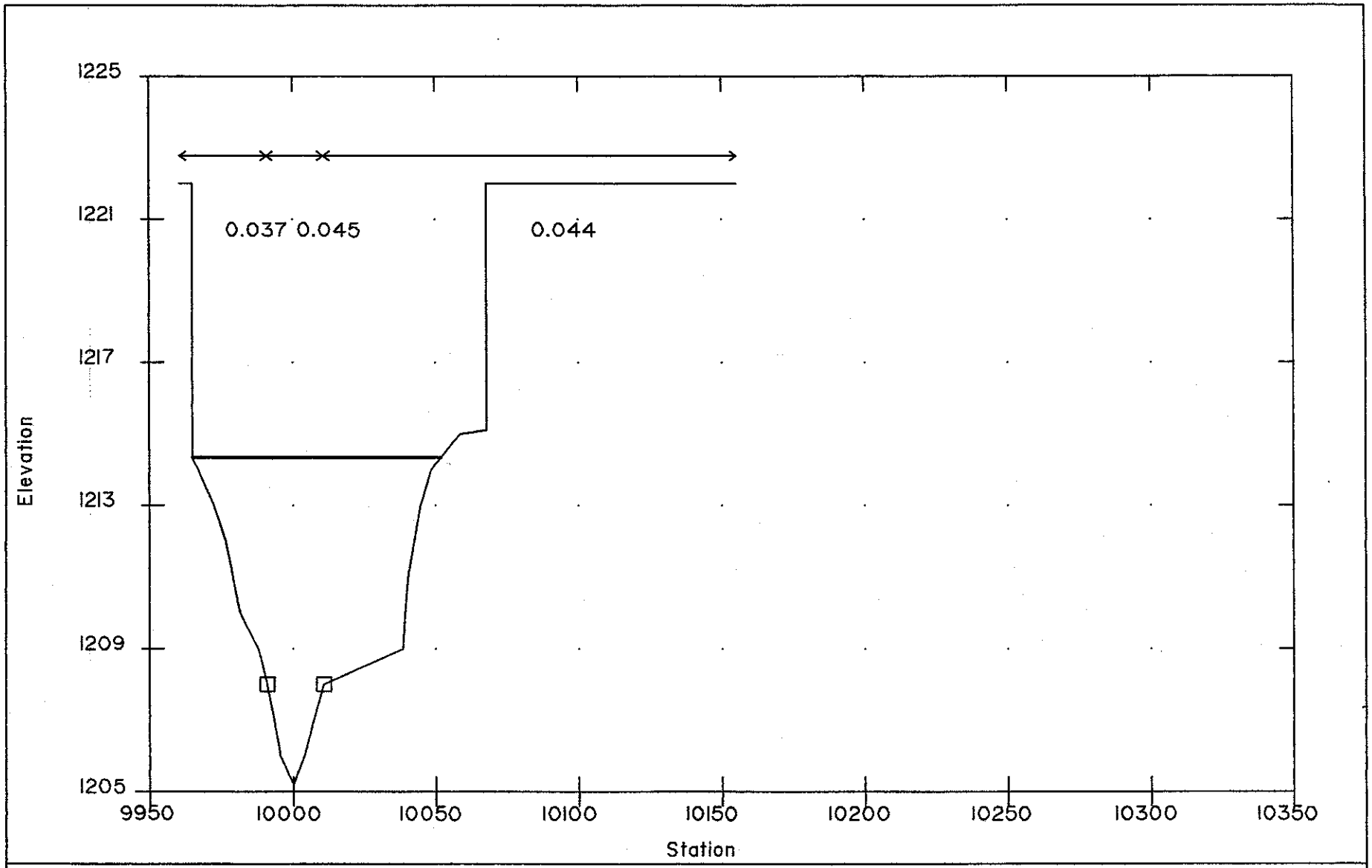
Granite Reef Wash
Floodplain Delineation Study



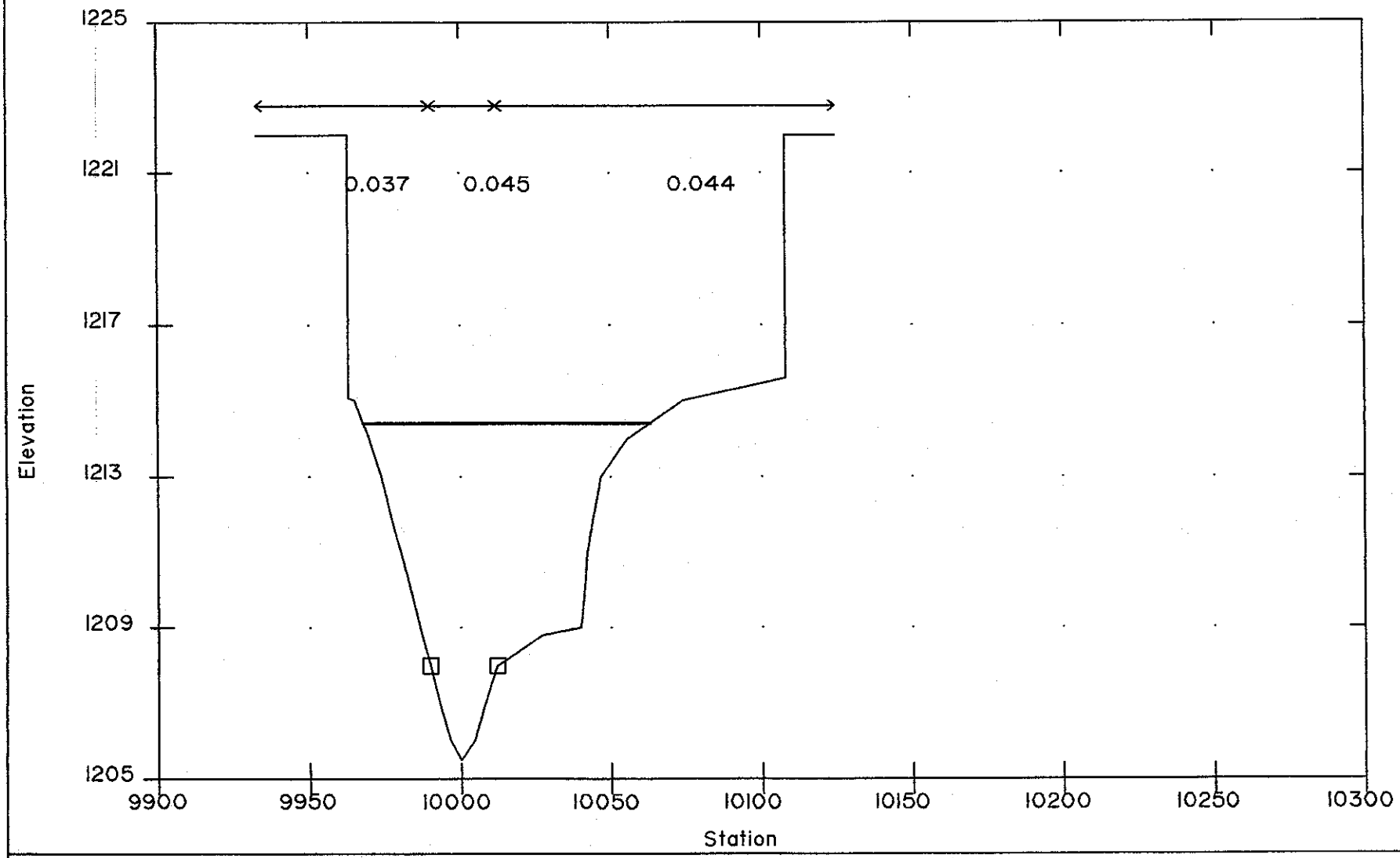
SECTION : 1.075

Granite Reef Wash
Floodplain Delineation Study



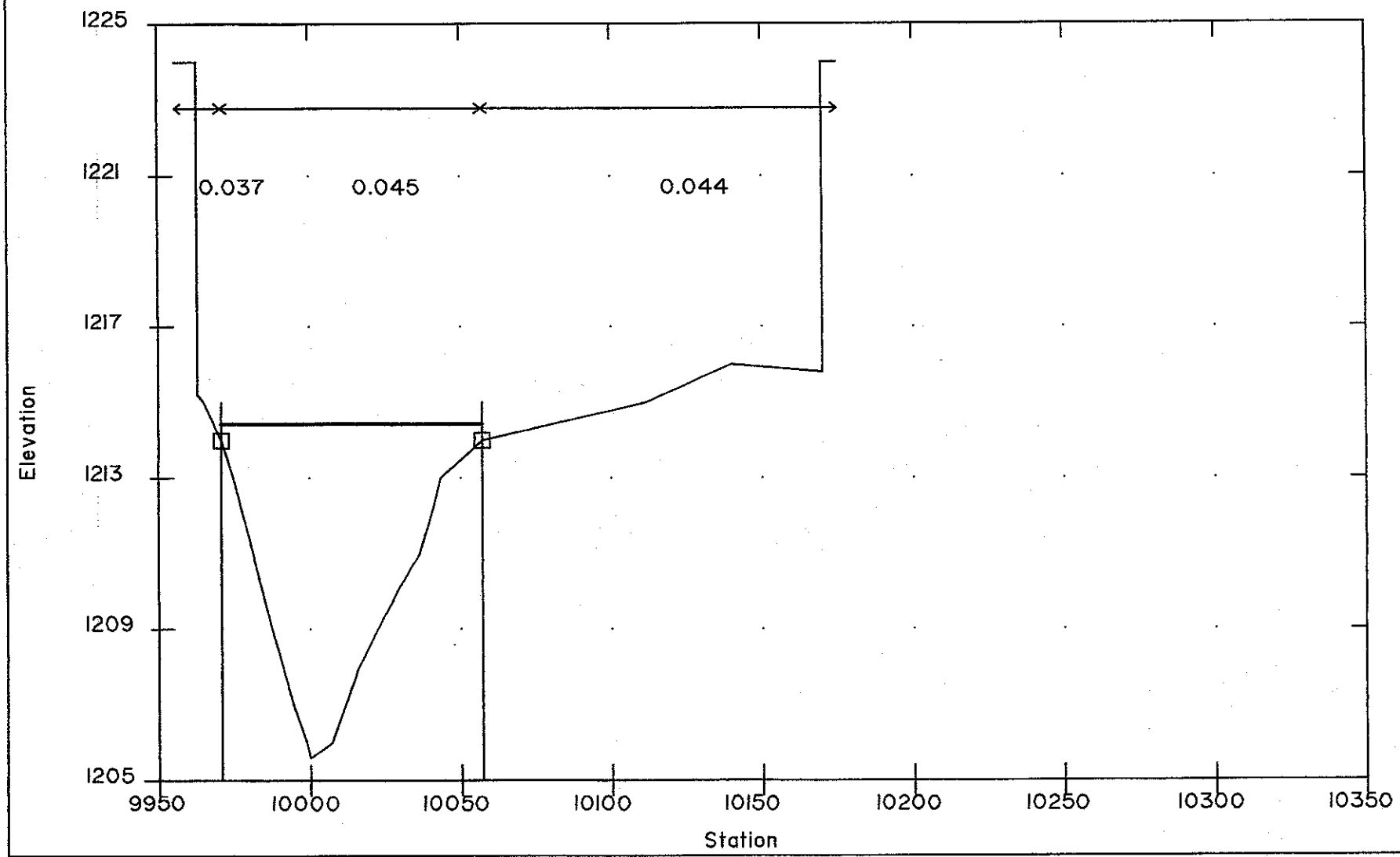
SECTION : 1.084

Granite Reef Wash
Floodplain Delineation Study



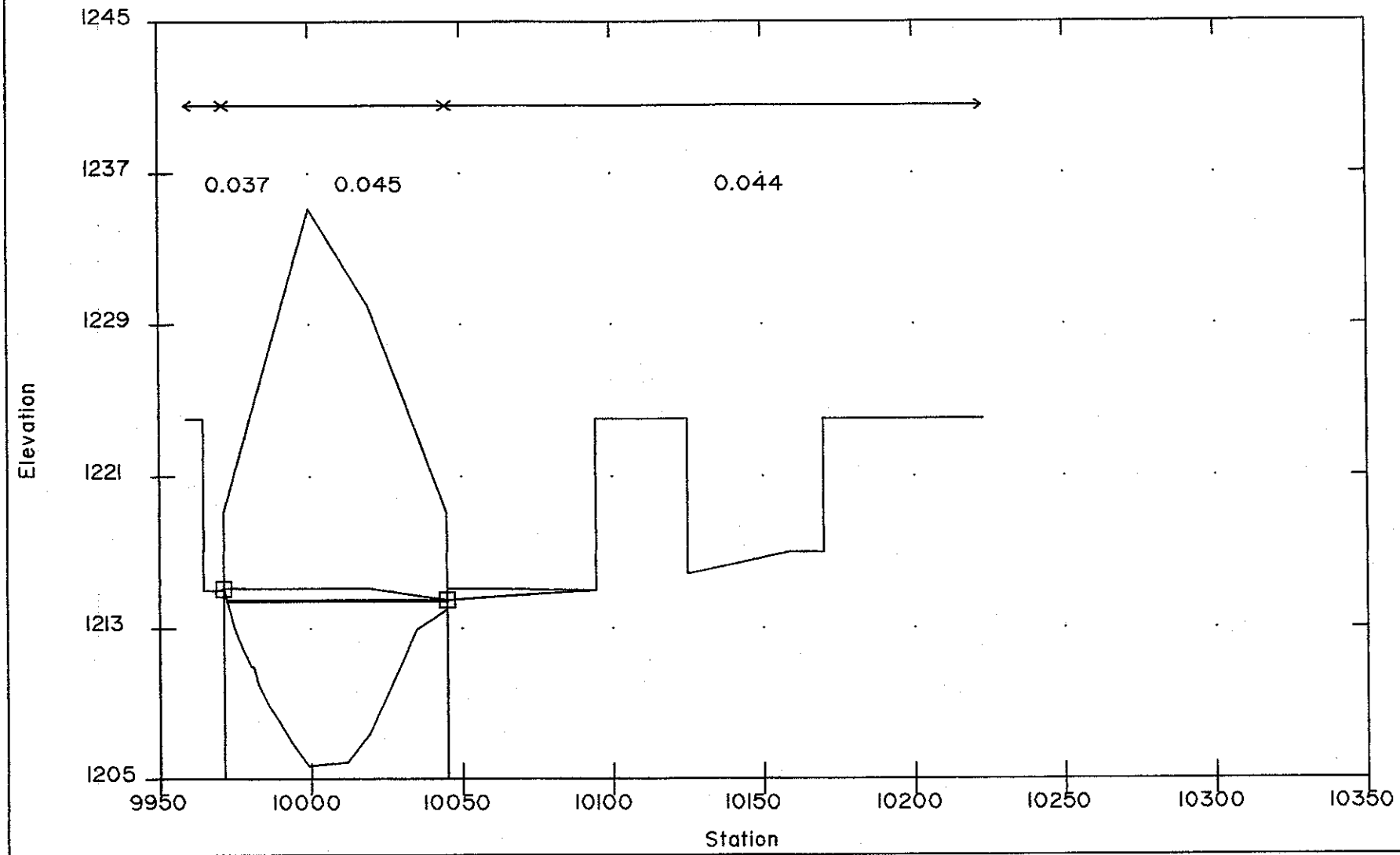
SECTION : 1.101

Granite Reef Wash
Floodplain Delineation Study



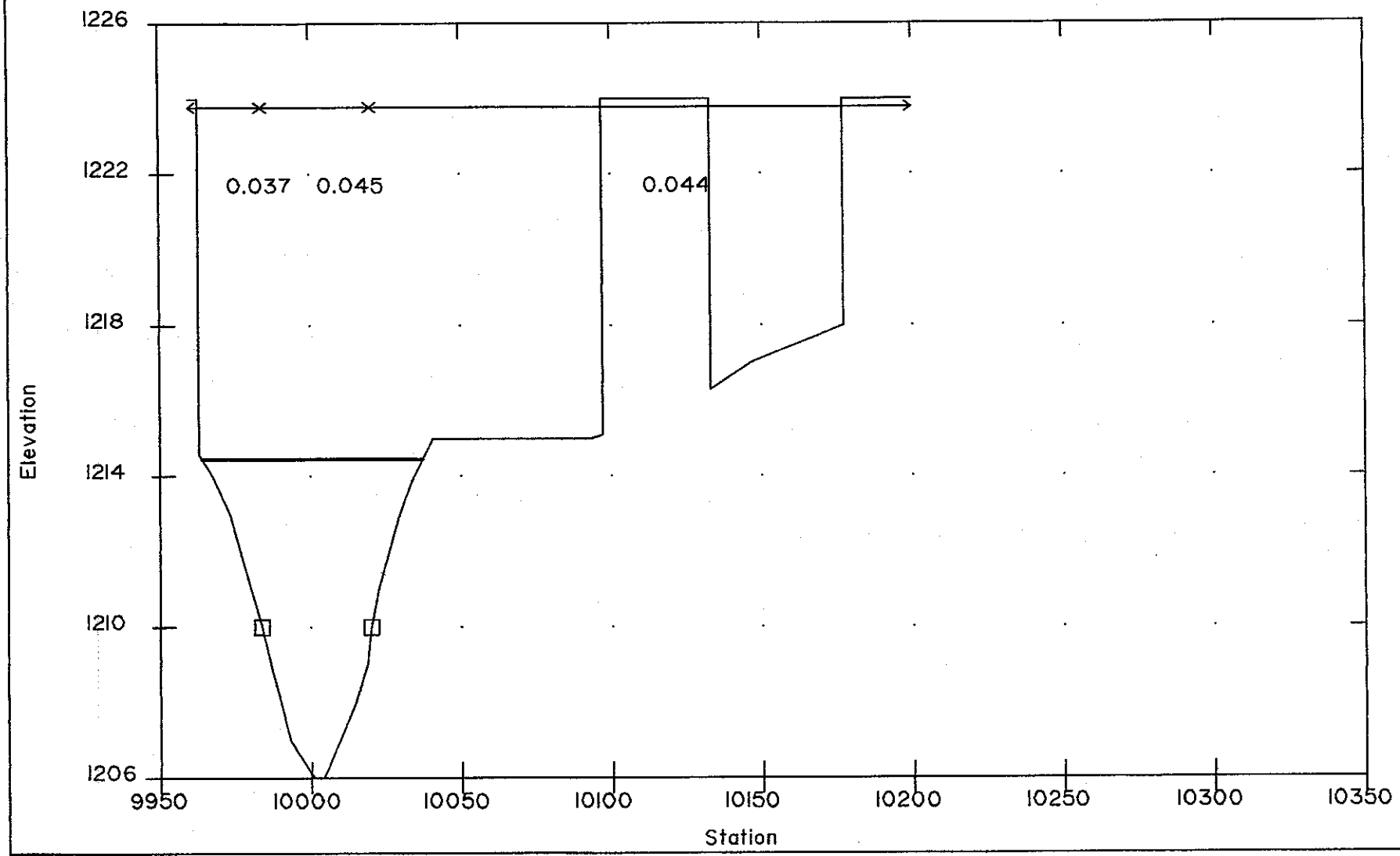
SECTION : 1.108

Granite Reef Wash
Floodplain Delineation Study



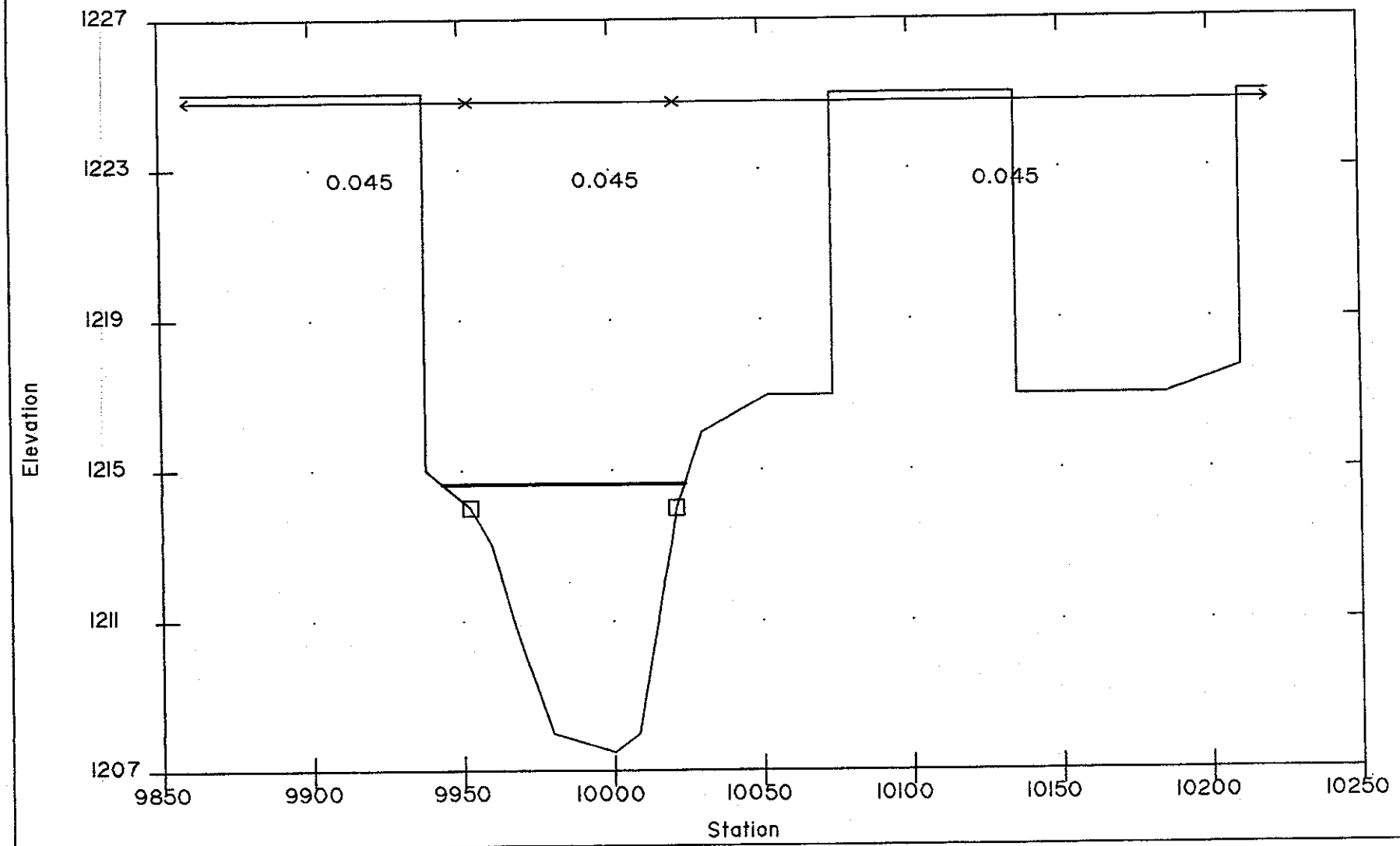
SECTION : 1.115

Granite Reef Wash
Floodplain Delineation Study



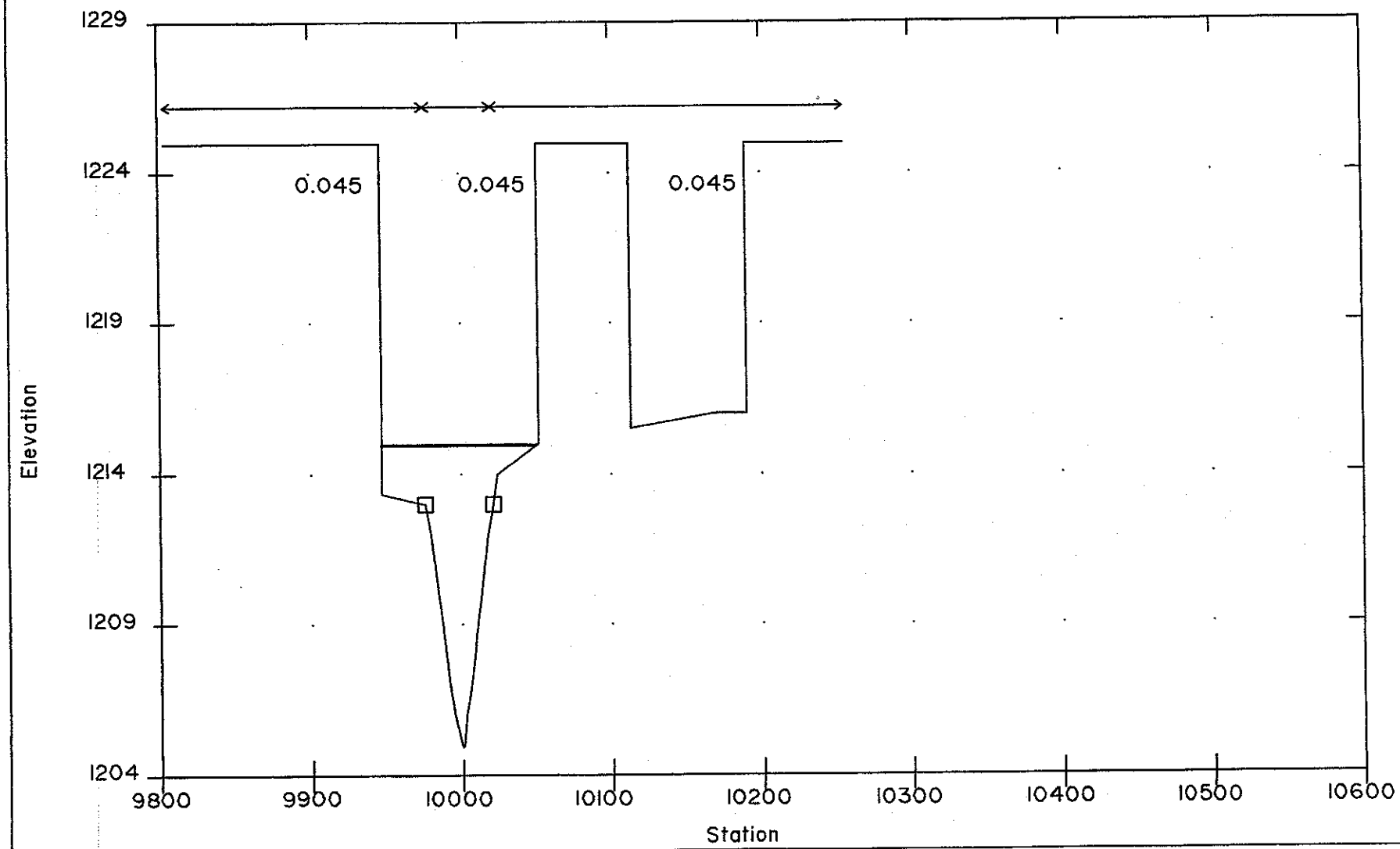
SECTION : 1.121

Granite Reef Wash
Floodplain Delineation Study



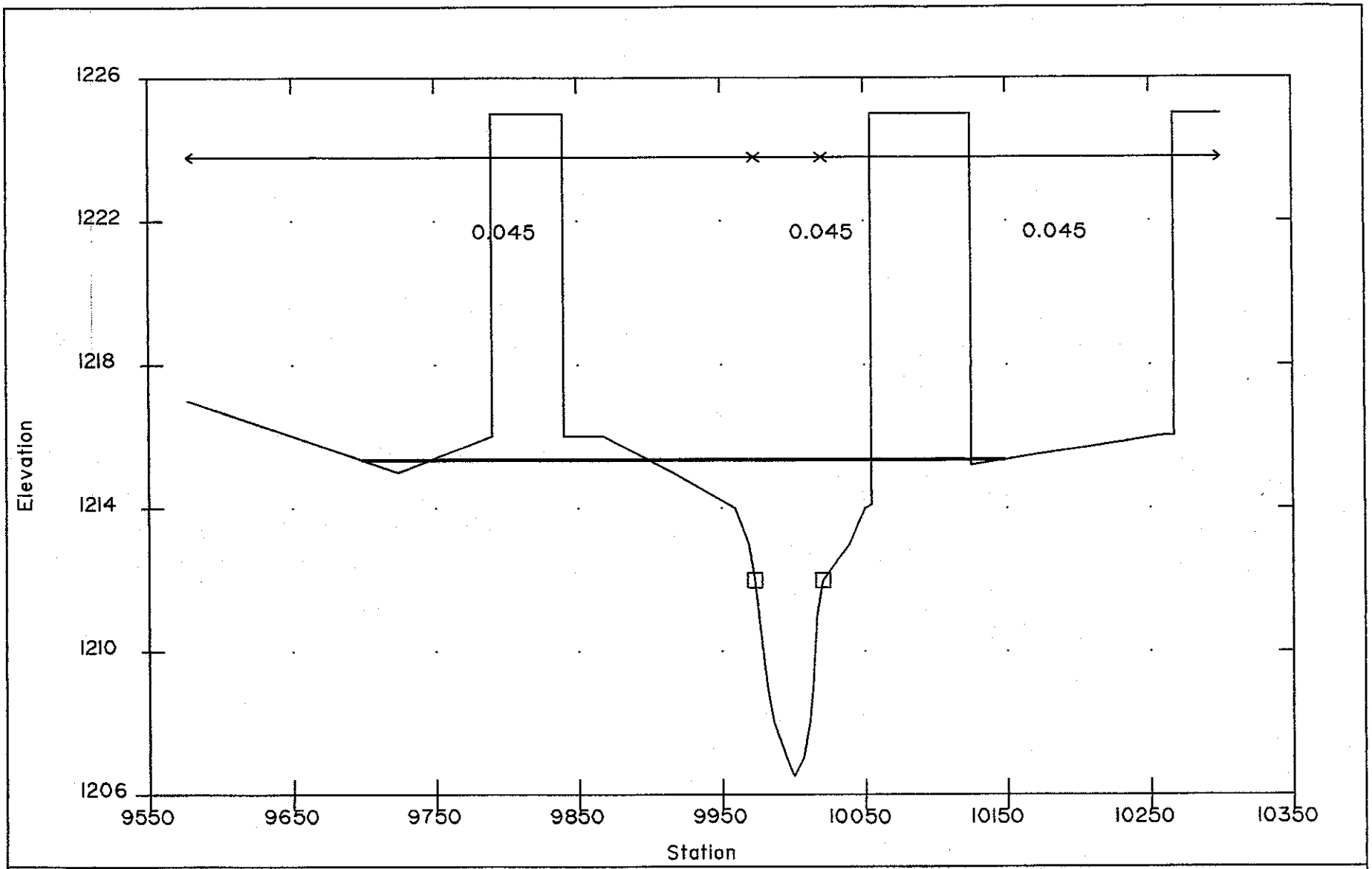
SECTION : 1.138

Granite Reef Wash
Floodplain Delineation Study



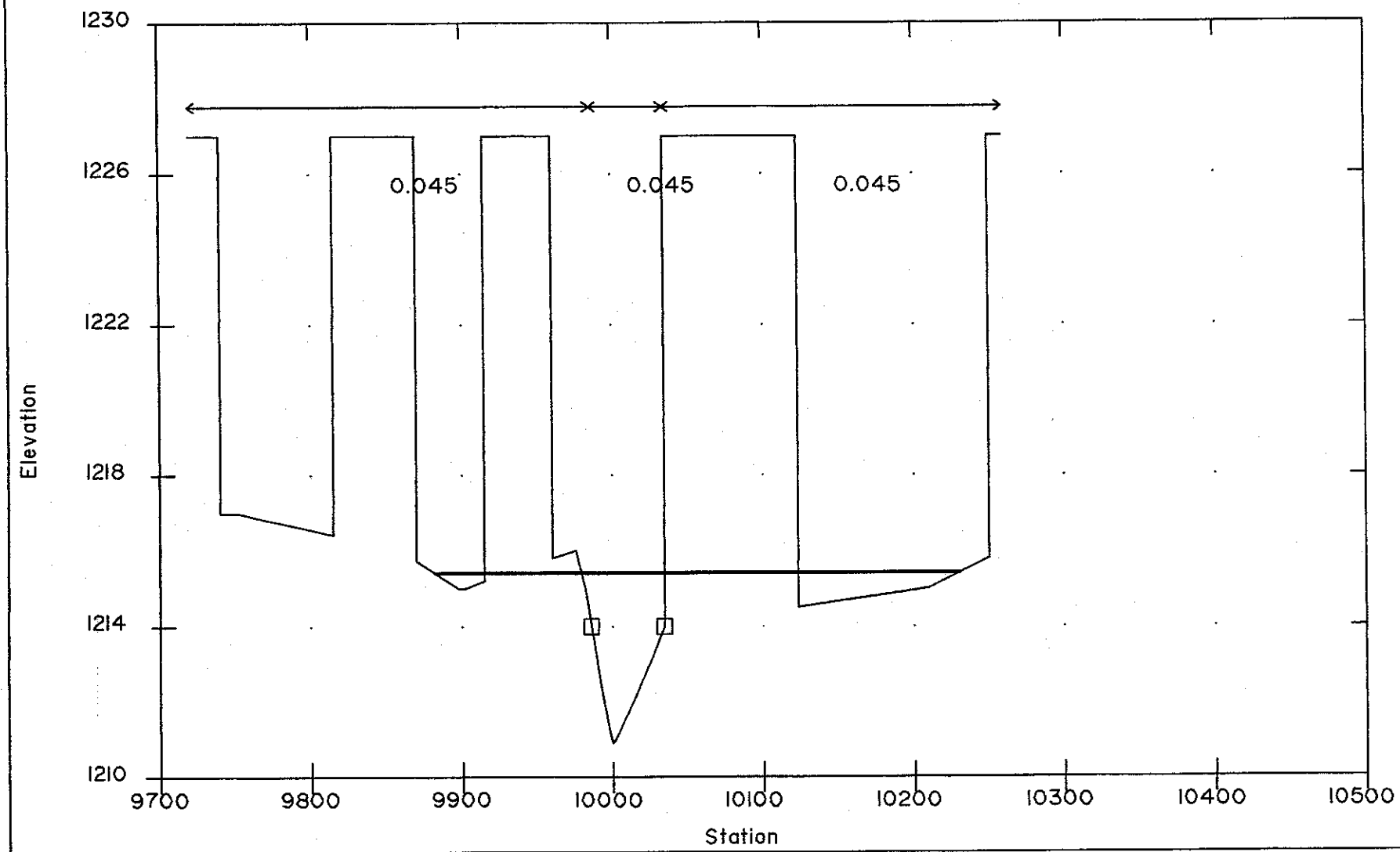
SECTION : 1.181

Granite Reef Wash
Floodplain Delineation Study



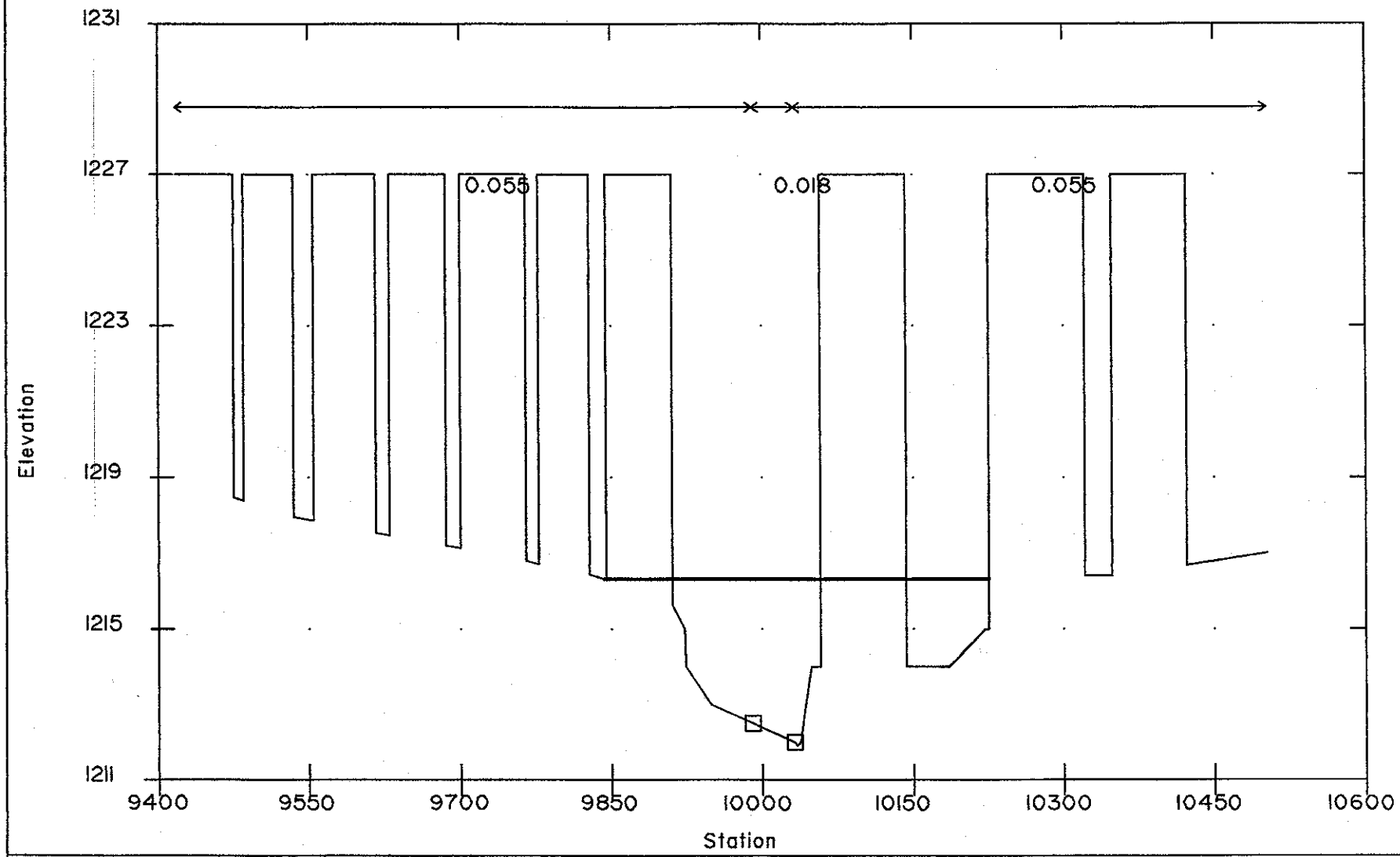
SECTION : 1.224

Granite Reef Wash
Floodplain Delineation Study



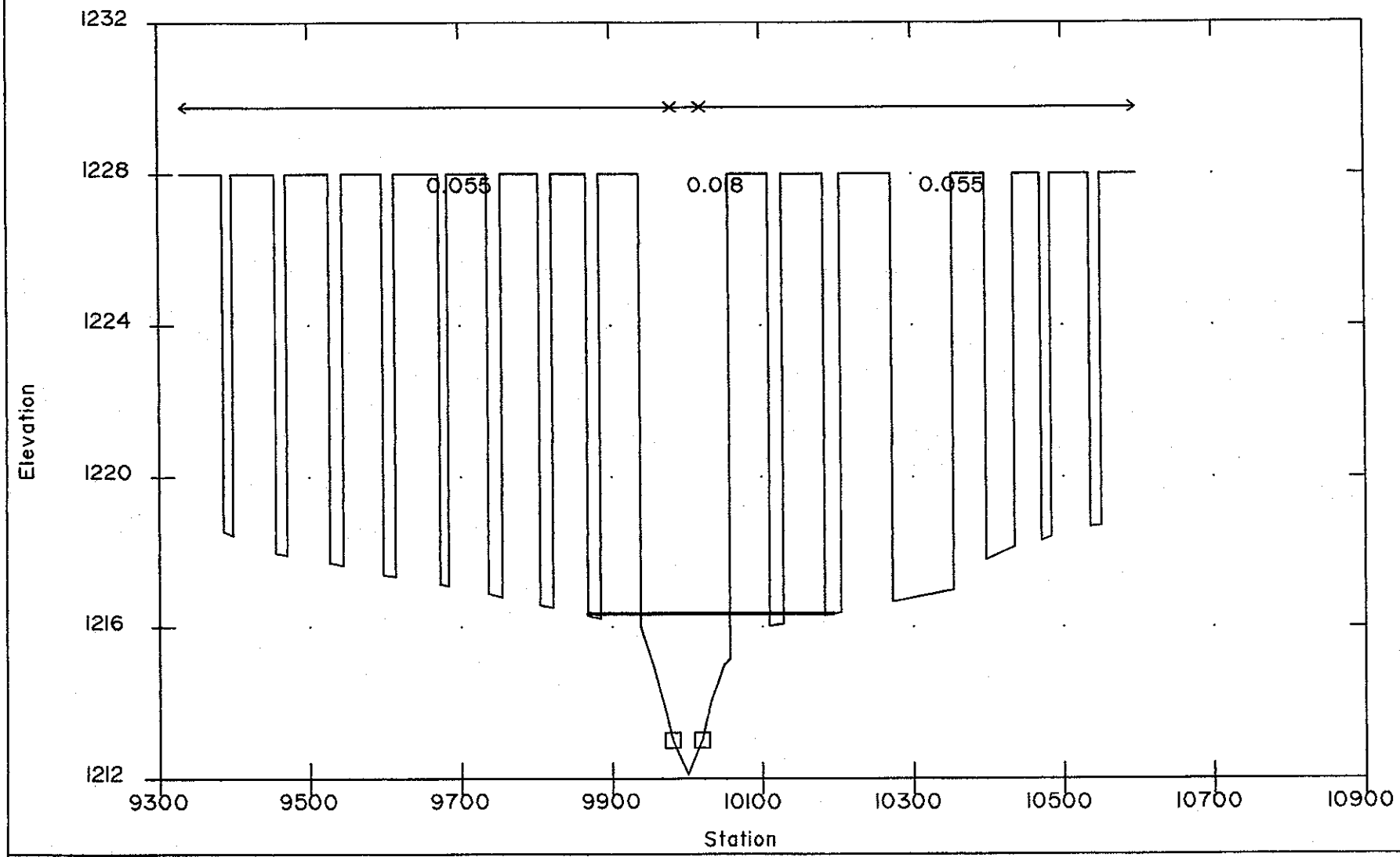
SECTION : 1.239

Granite Reef Wash
Floodplain Delineation Study



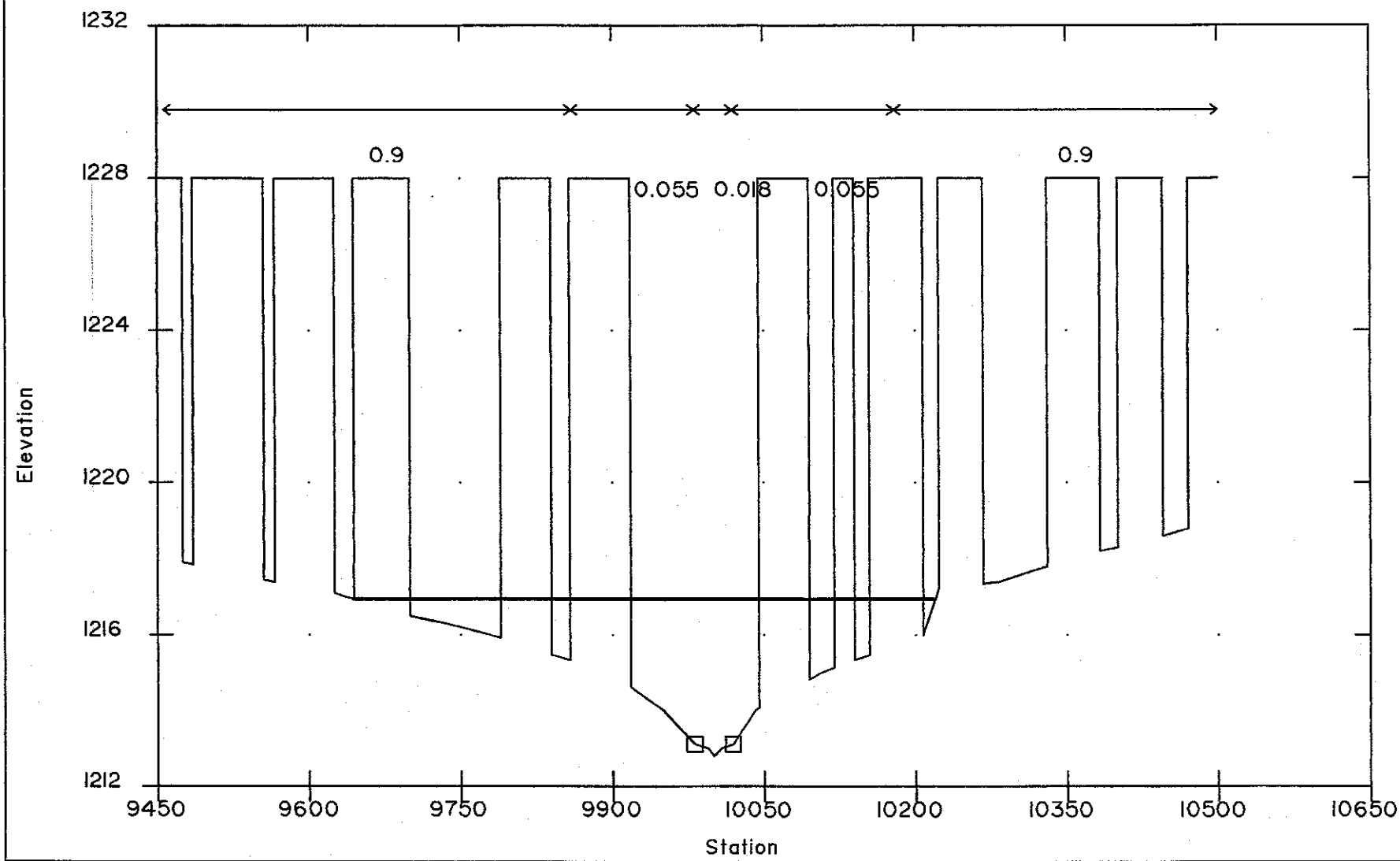
SECTION : 1.262

Granite Reef Wash
Floodplain Delineation Study



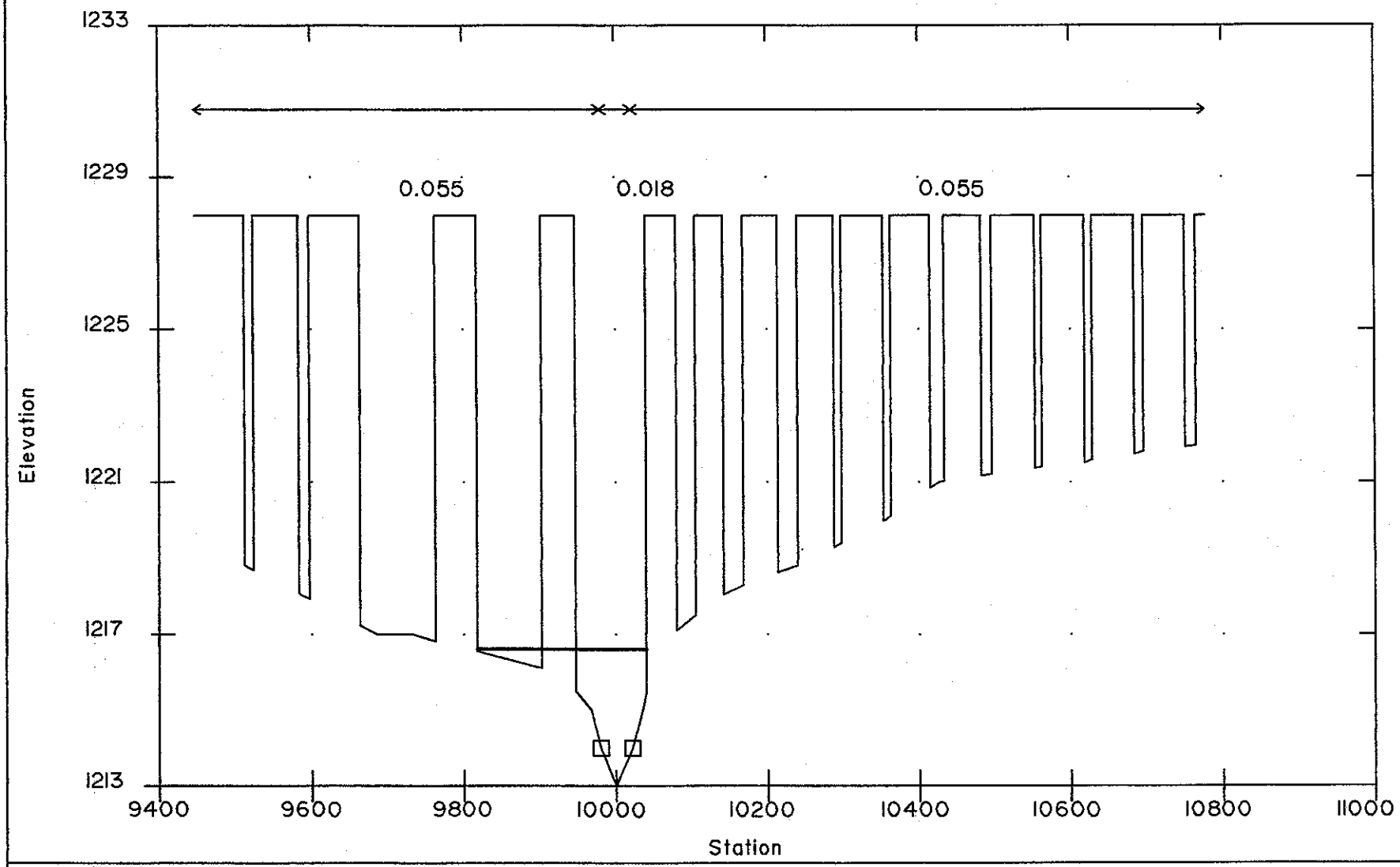
SECTION : 1.301

Granite Reef Wash
Floodplain Delineation Study



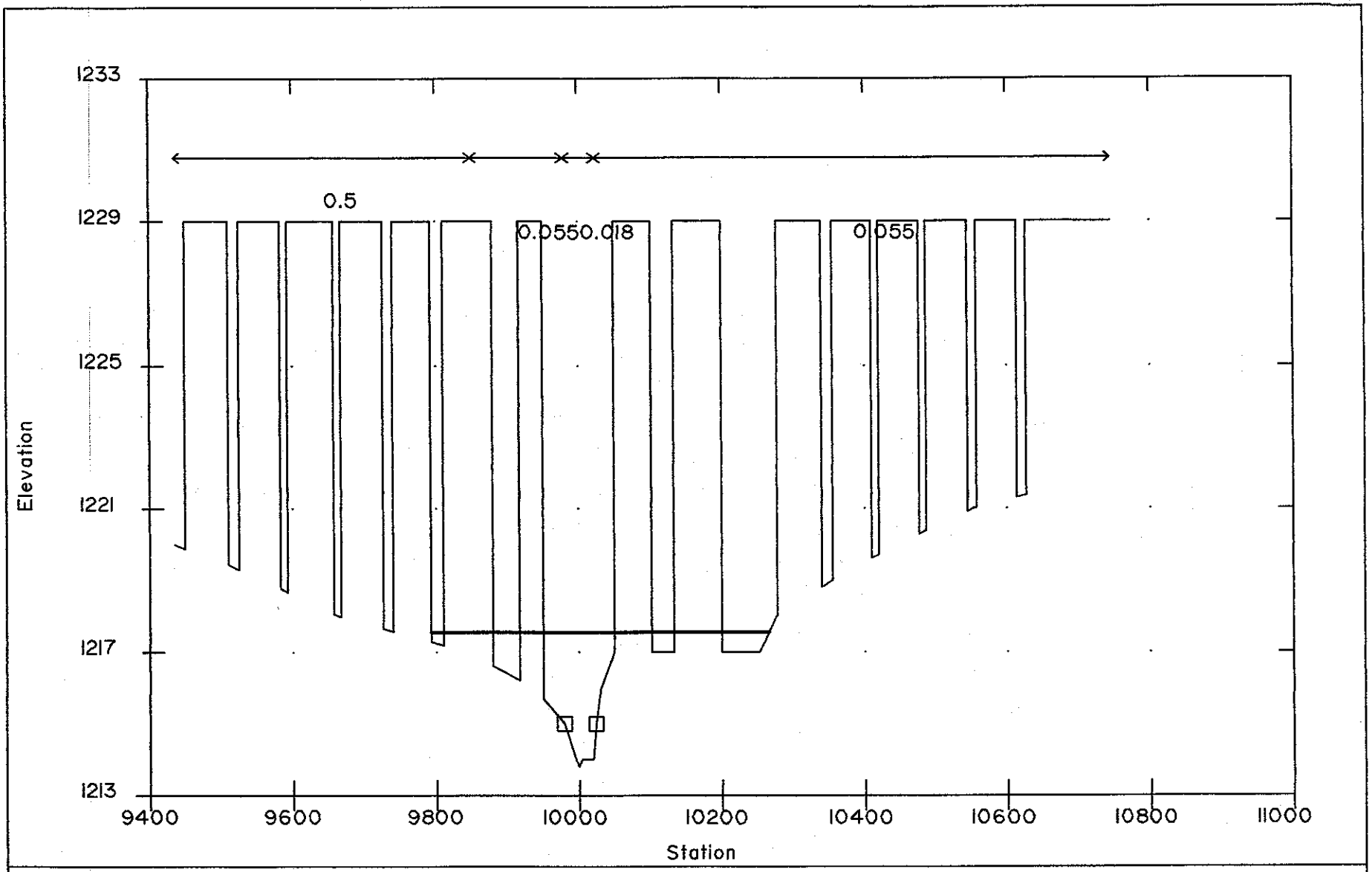
SECTION : 1.353

Granite Reef Wash
Floodplain Delineation Study



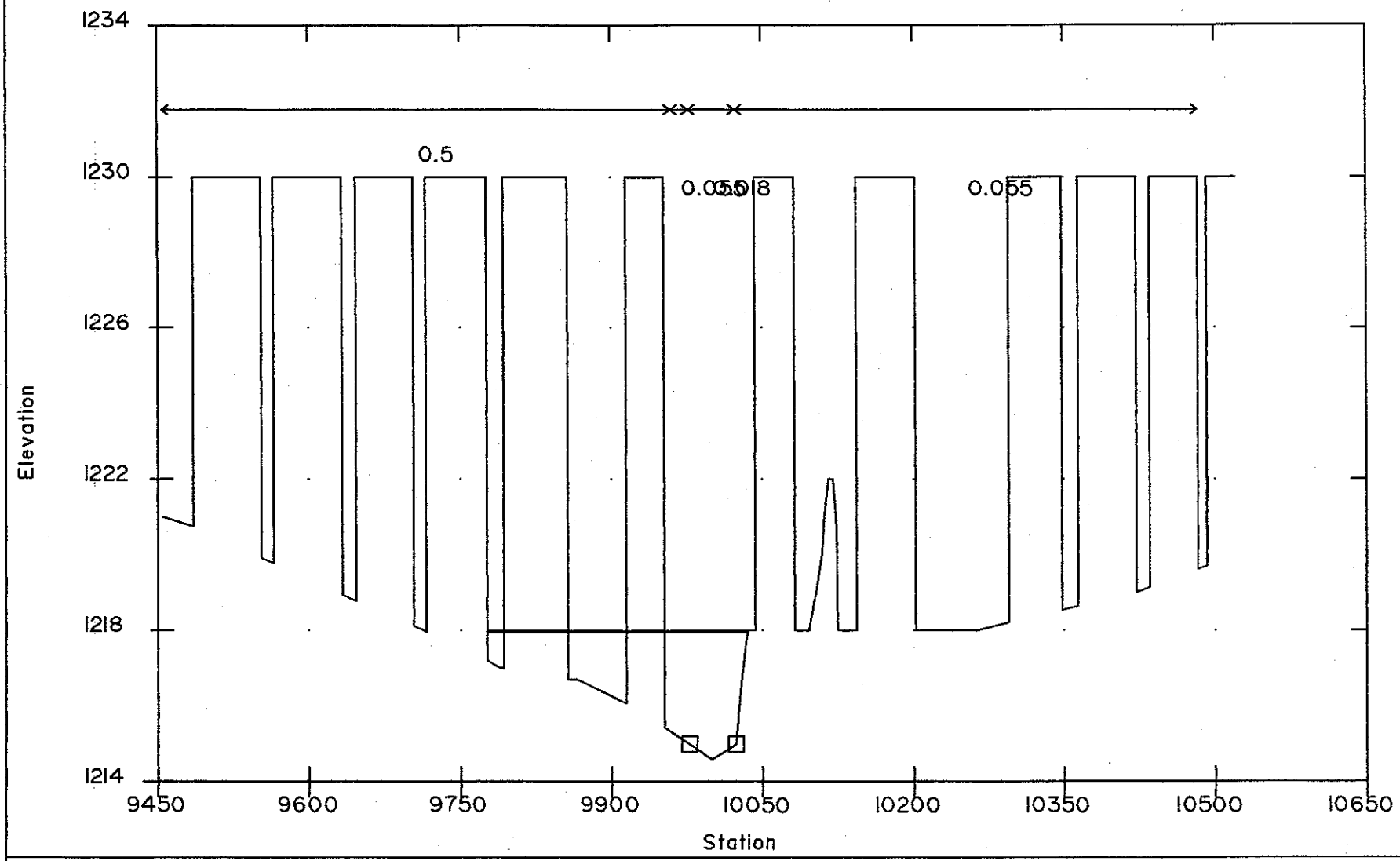
SECTION : 1.373

Granite Reef Wash
Floodplain Delineation Study



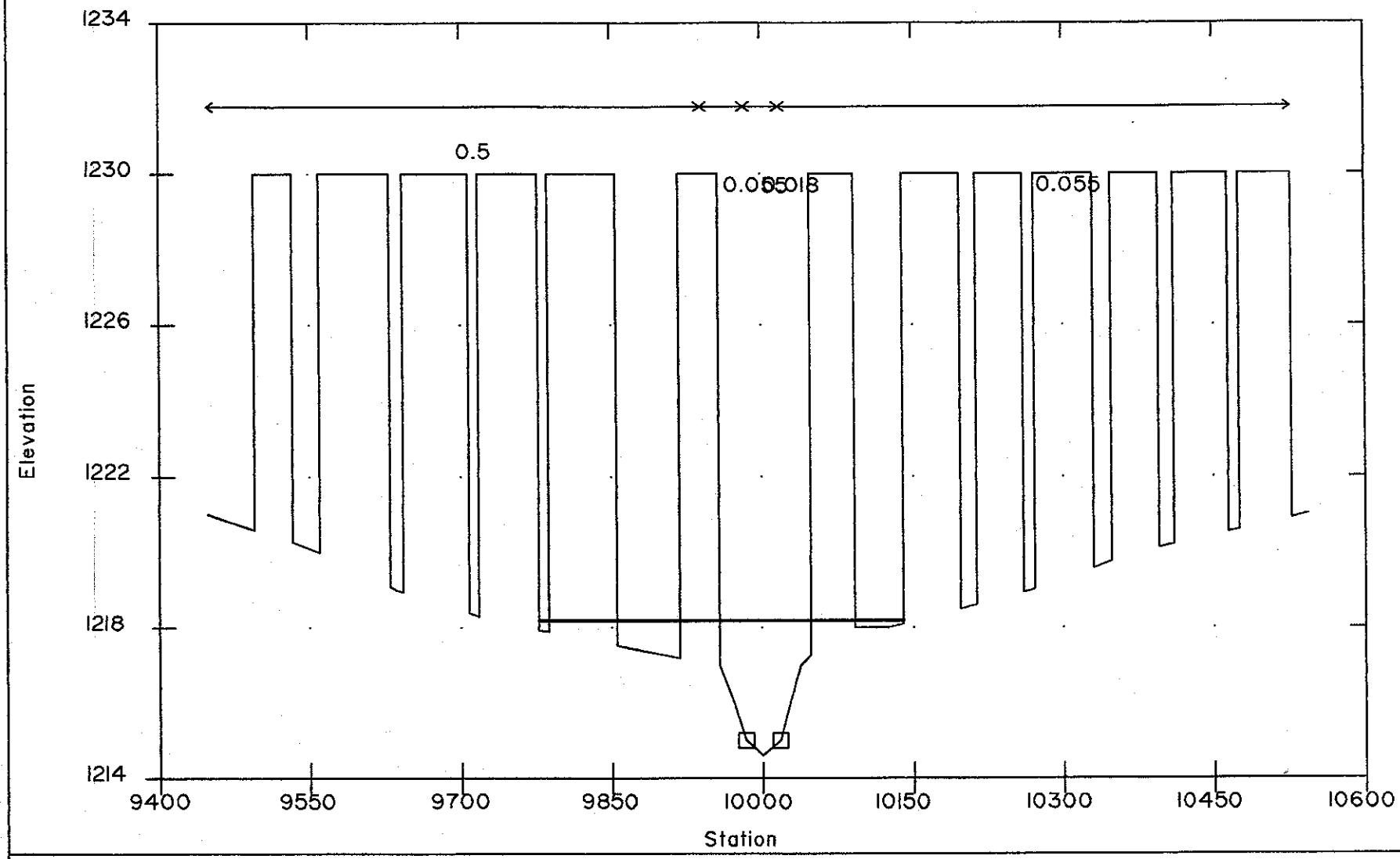
SECTION : 1.438

Granite Reef Wash
Floodplain Delineation Study



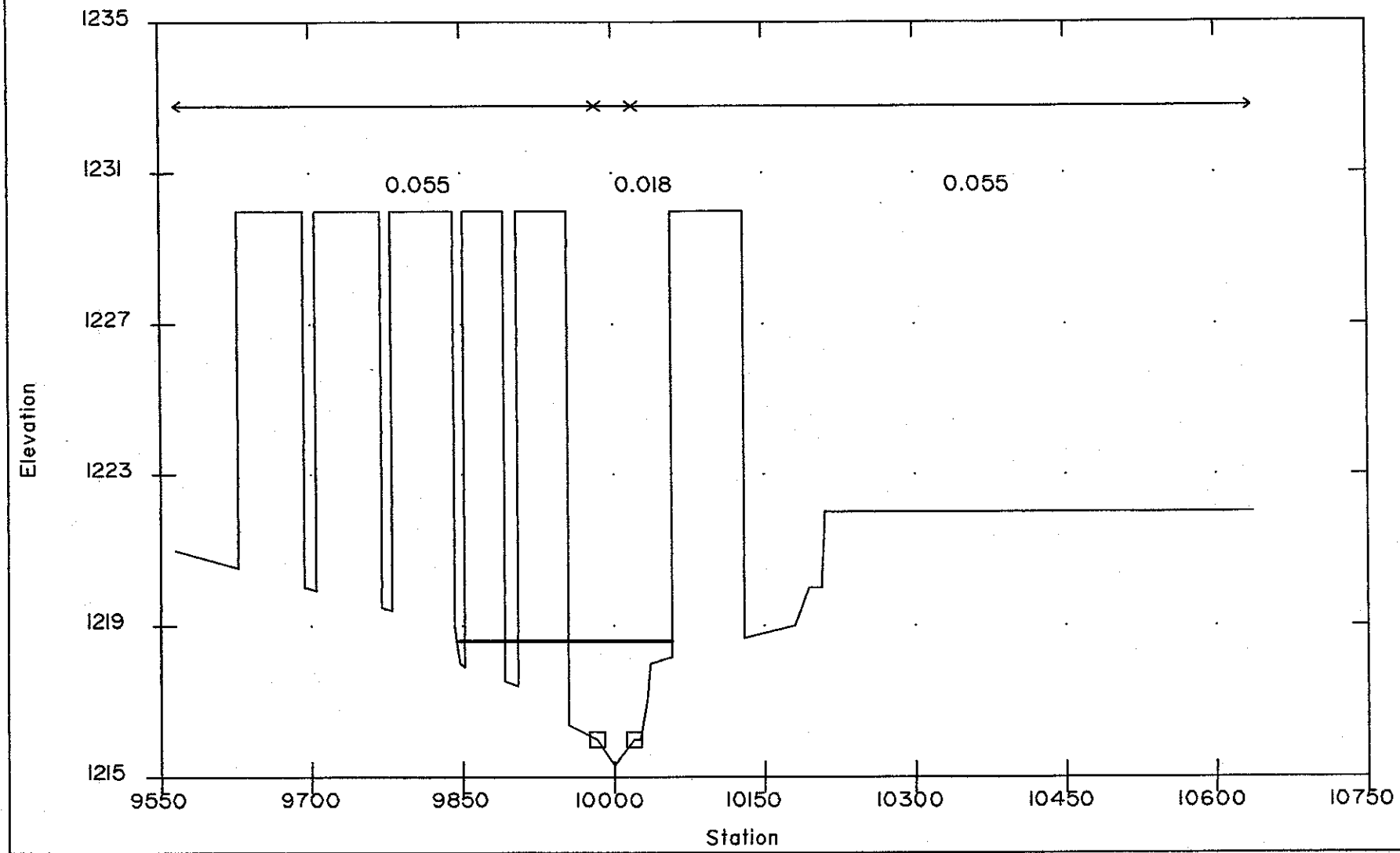
SECTION : 1.499

Granite Reef Wash
Floodplain Delineation Study



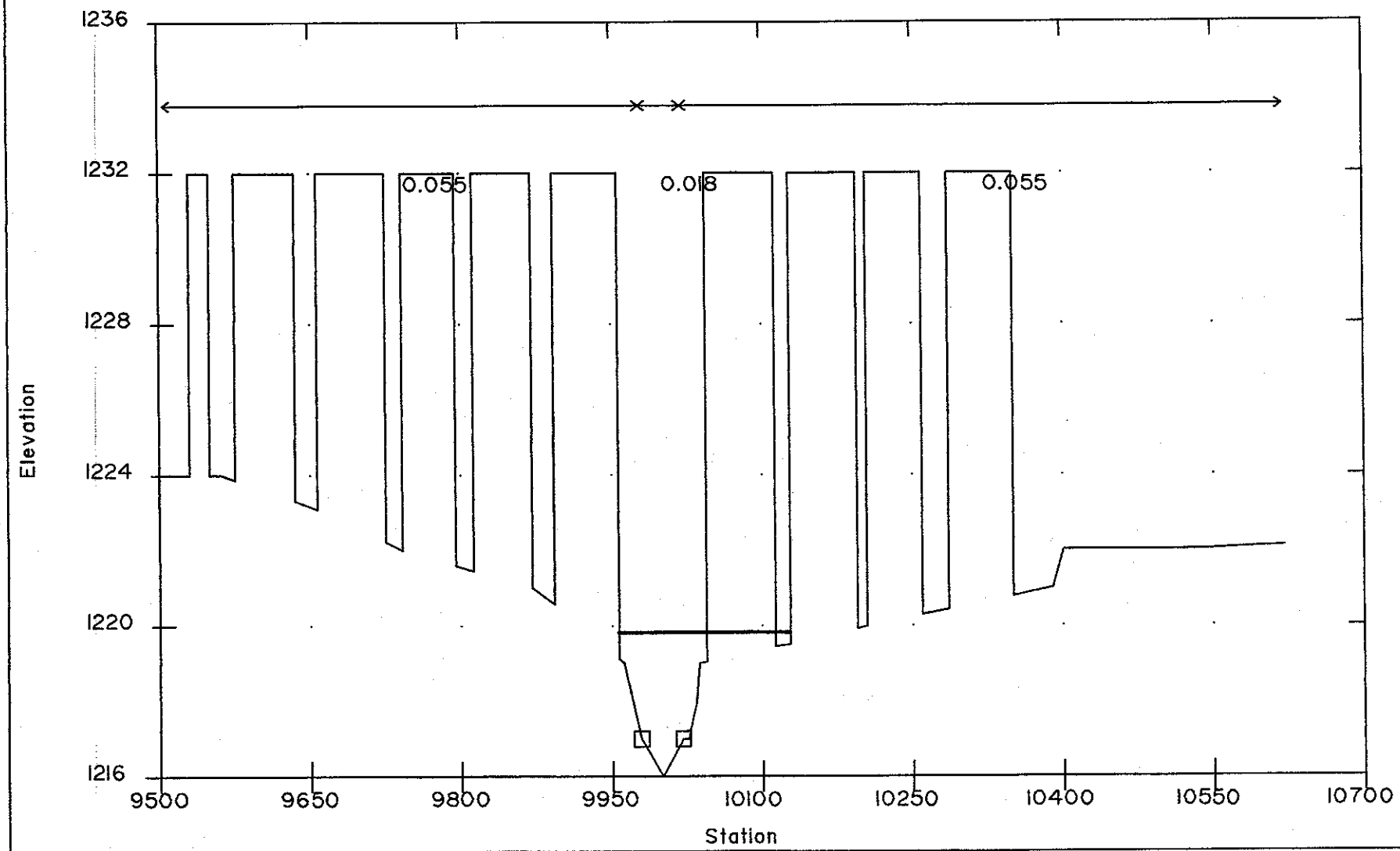
SECTION : 1.522

Granite Reef Wash
Floodplain Delineation Study



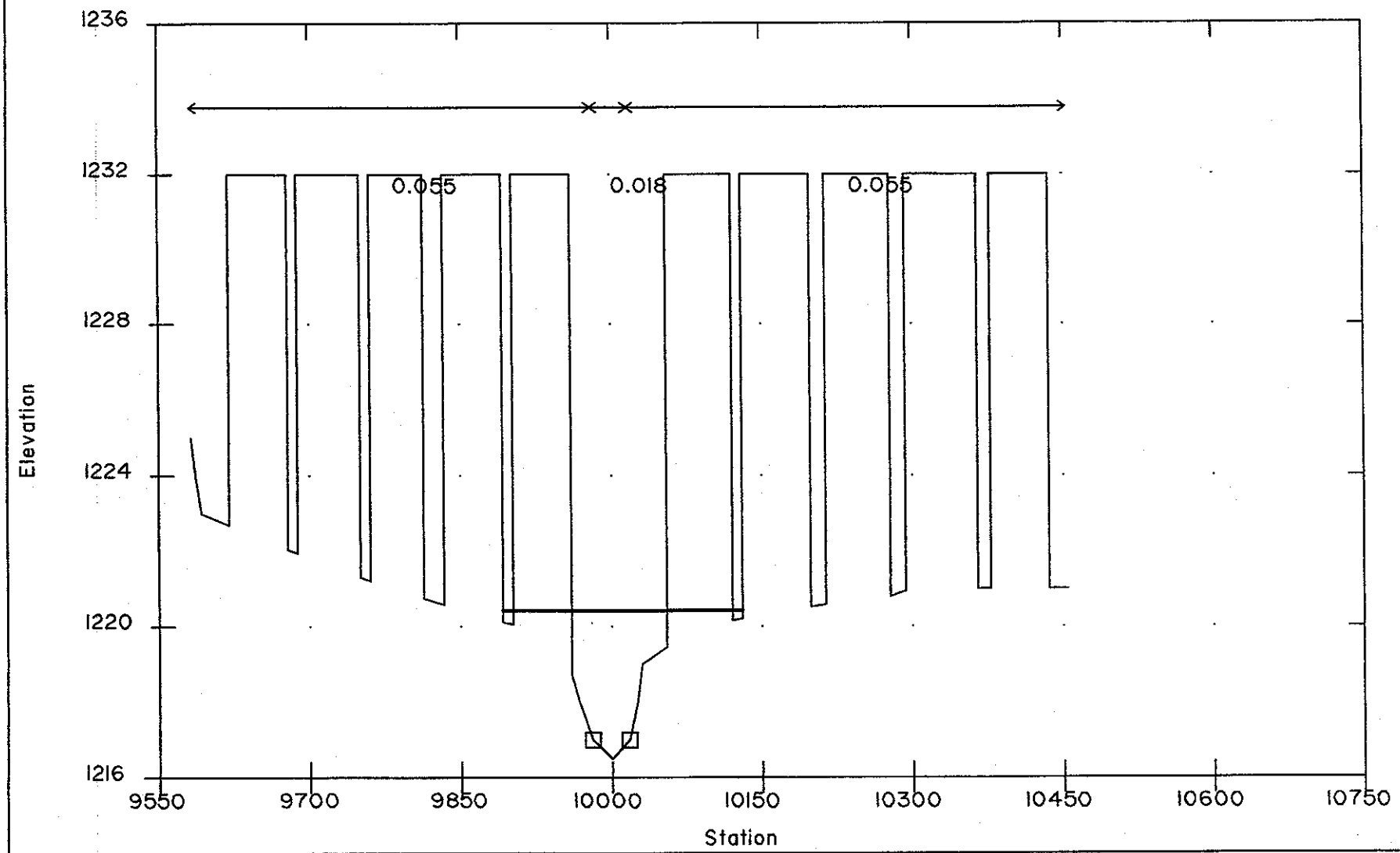
SECTION : 1.575

Granite Reef Wash
Floodplain Delineation Study



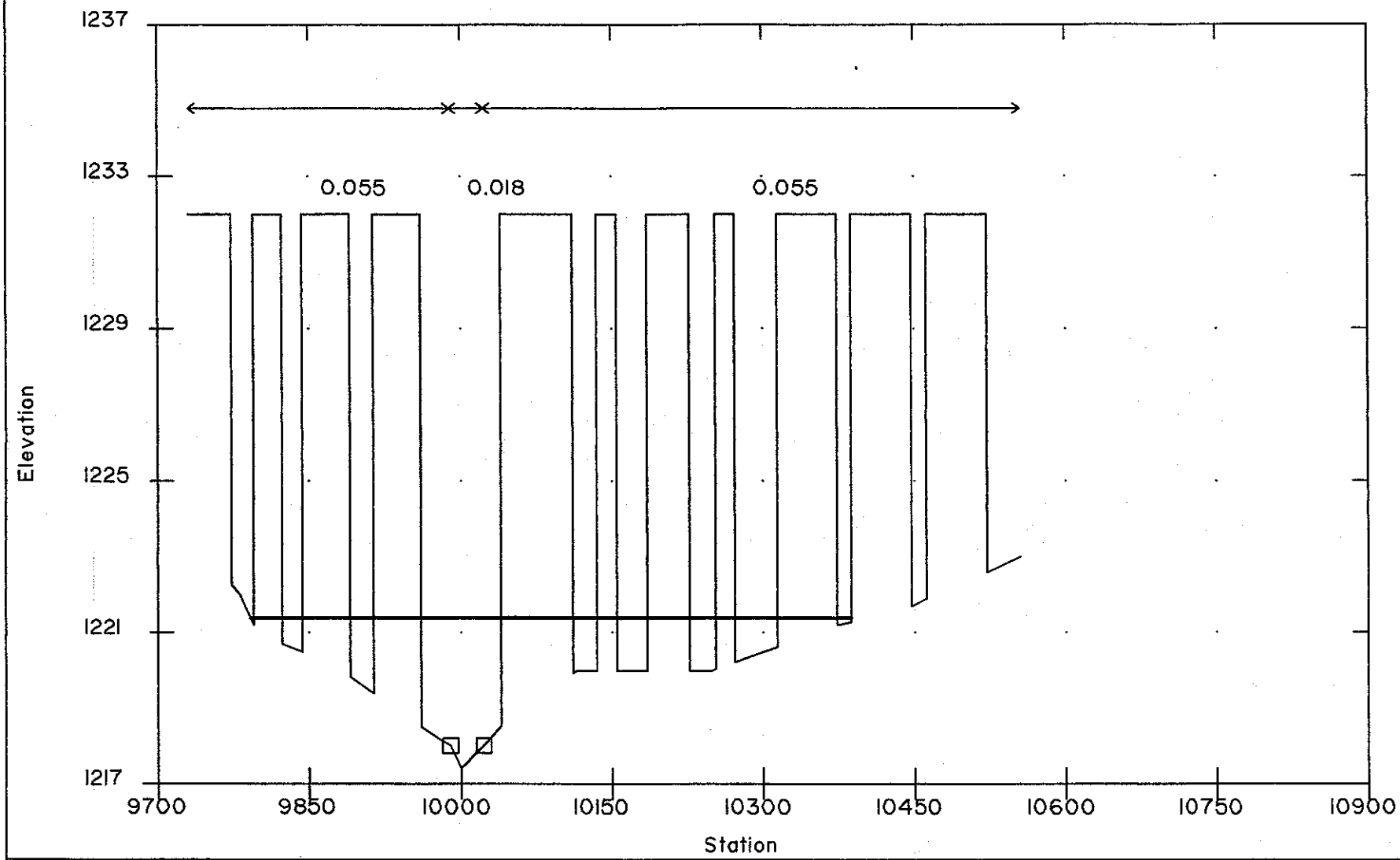
SECTION : 1.670

Granite Reef Wash
Floodplain Delineation Study



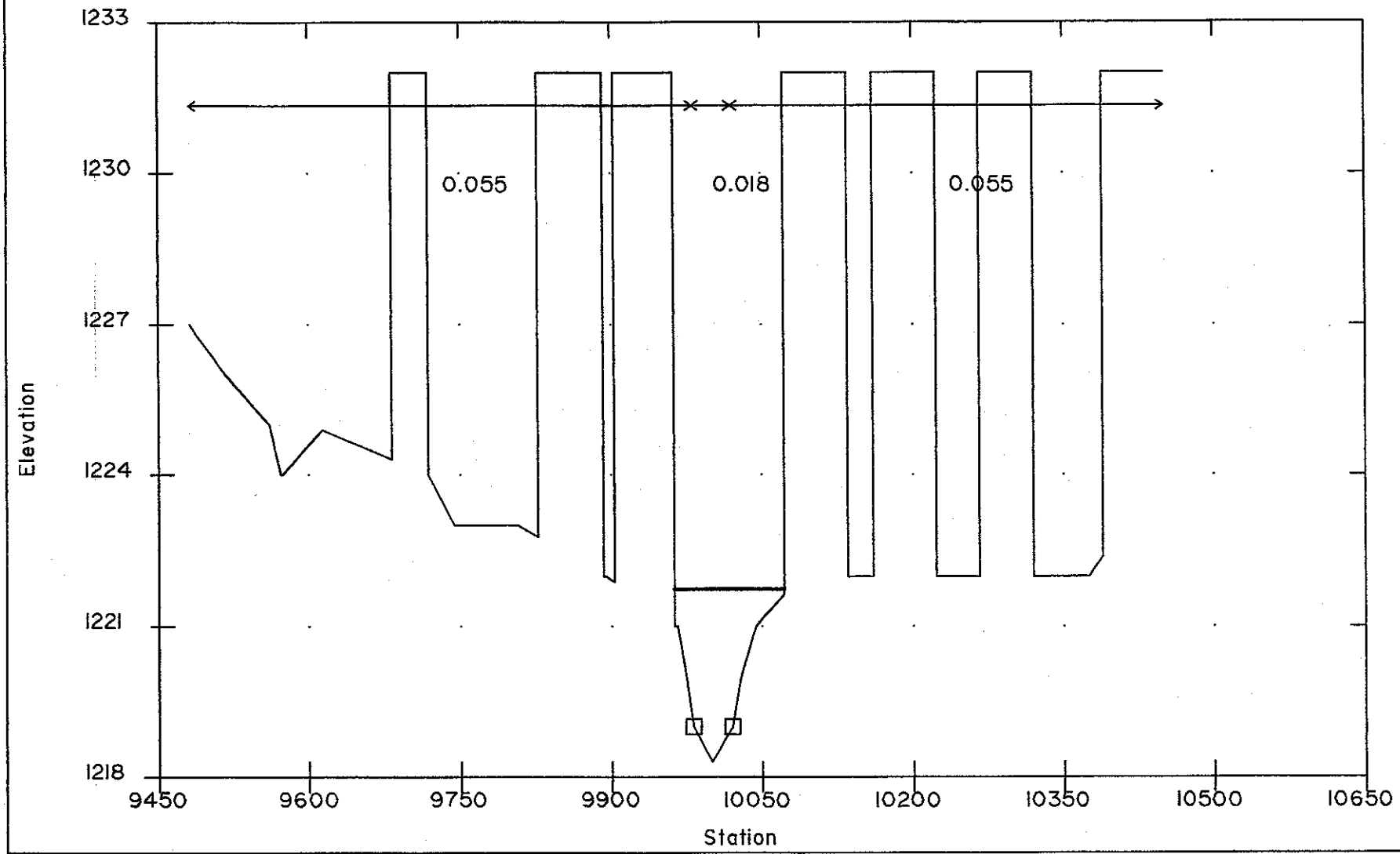
SECTION : 1.725

Granite Reef Wash
Floodplain Delineation Study



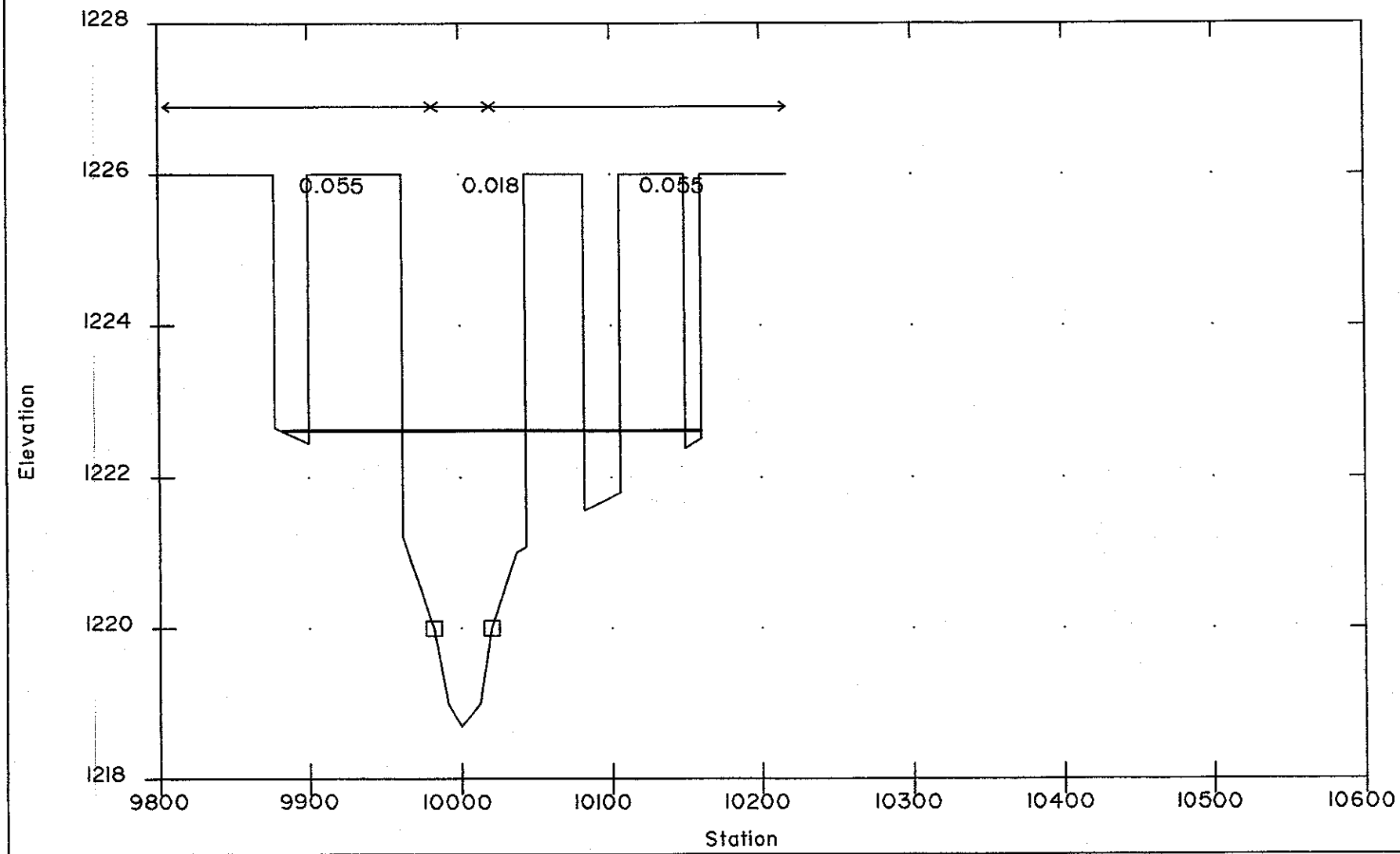
SECTION : 1.810

Granite Reef Wash
Floodplain Delineation Study



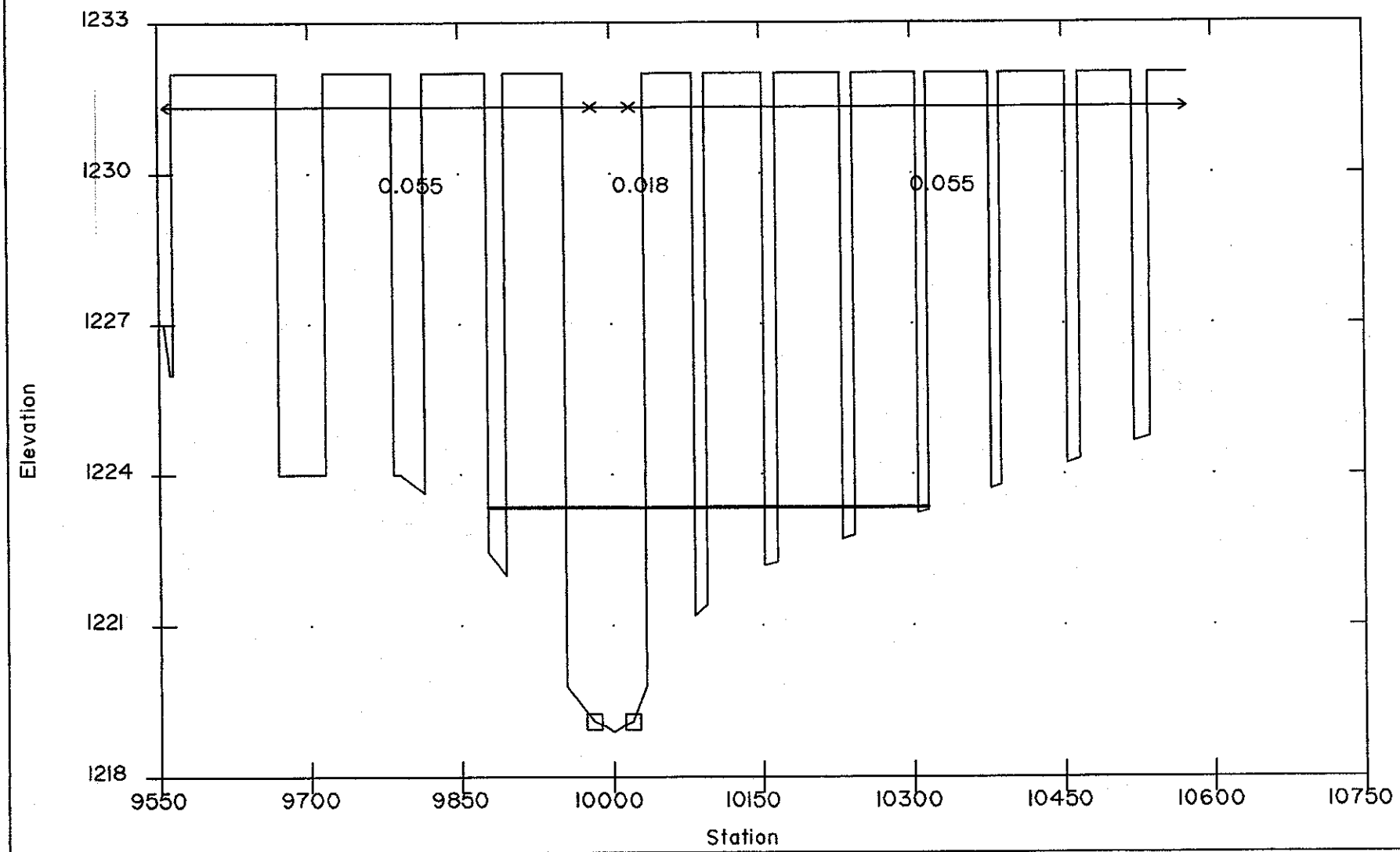
SECTION : 1.879

Granite Reef Wash
Floodplain Delineation Study



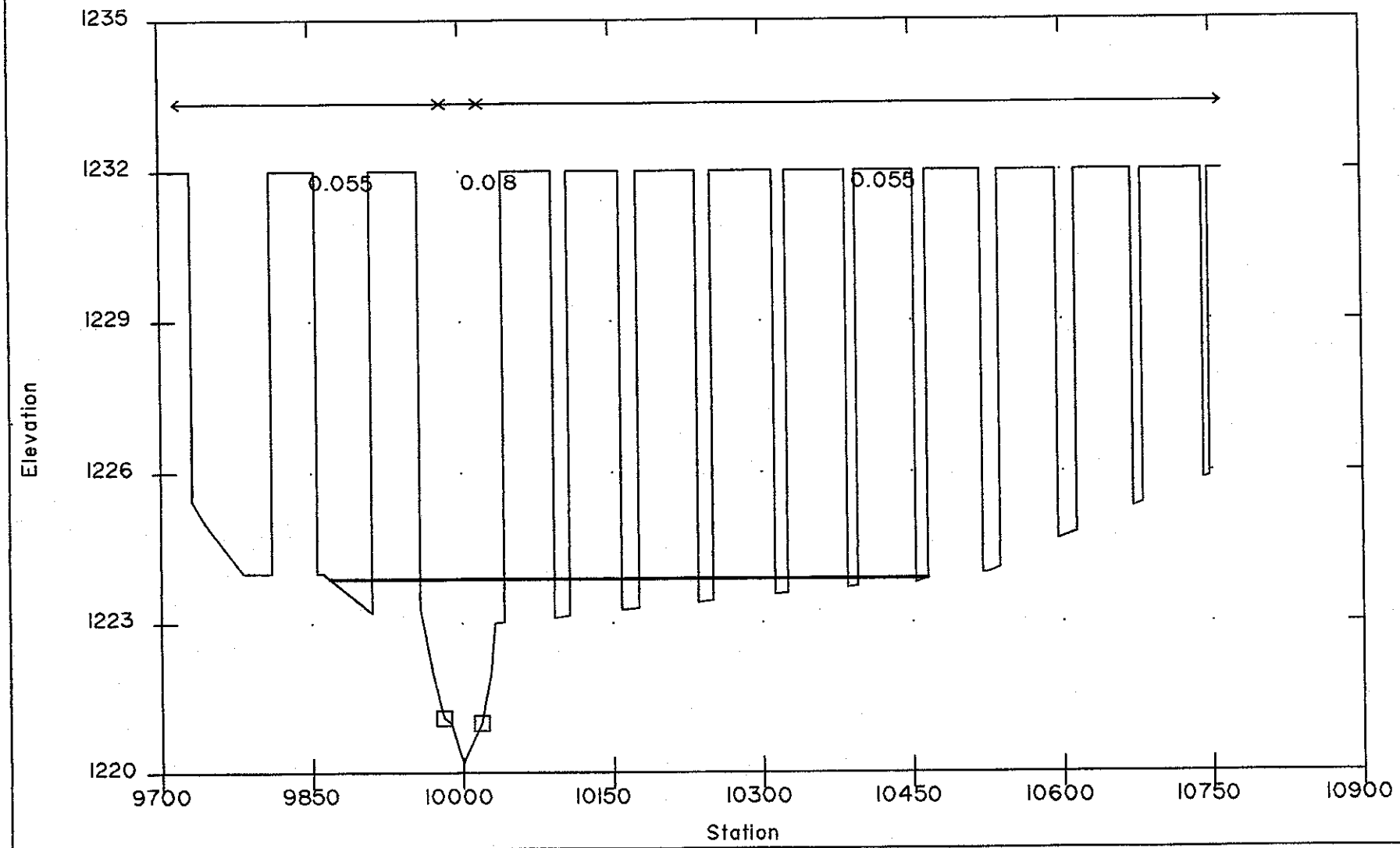
SECTION : 1.925

Granite Reef Wash
Floodplain Delineation Study



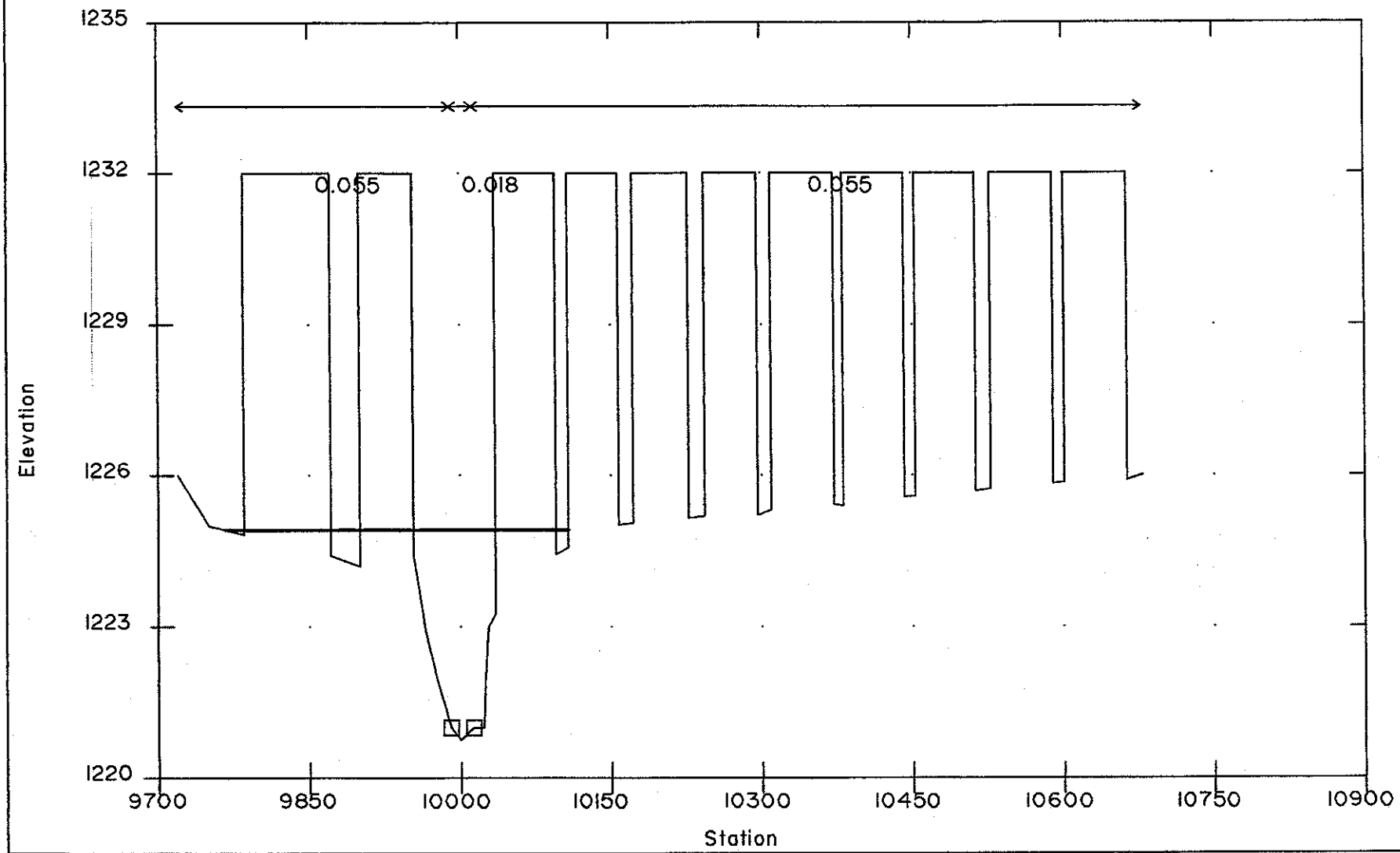
SECTION : 1.961

Granite Reef Wash
Floodplain Delineation Study



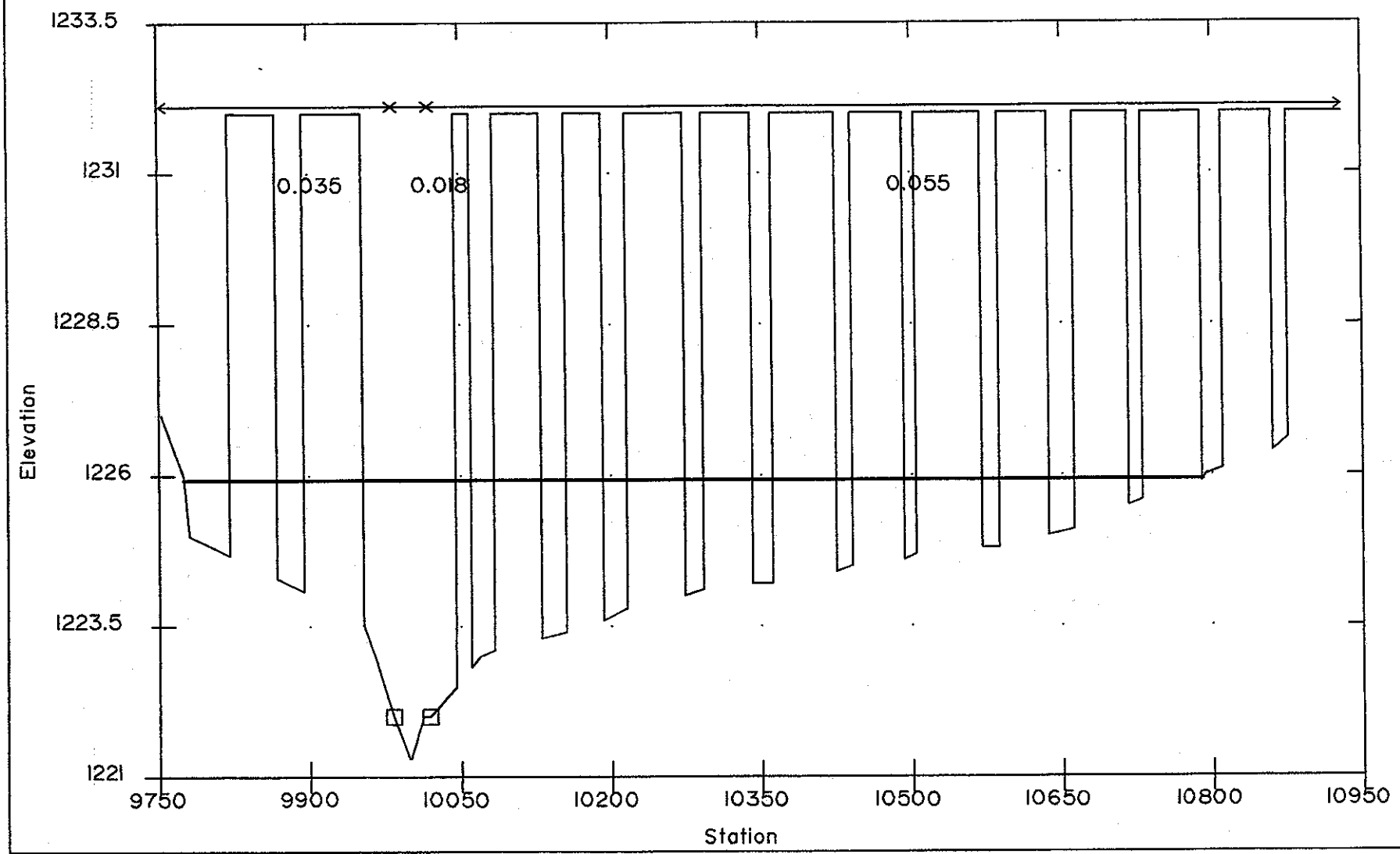
SECTION : 2.044

Granite Reef Wash
Floodplain Delineation Study



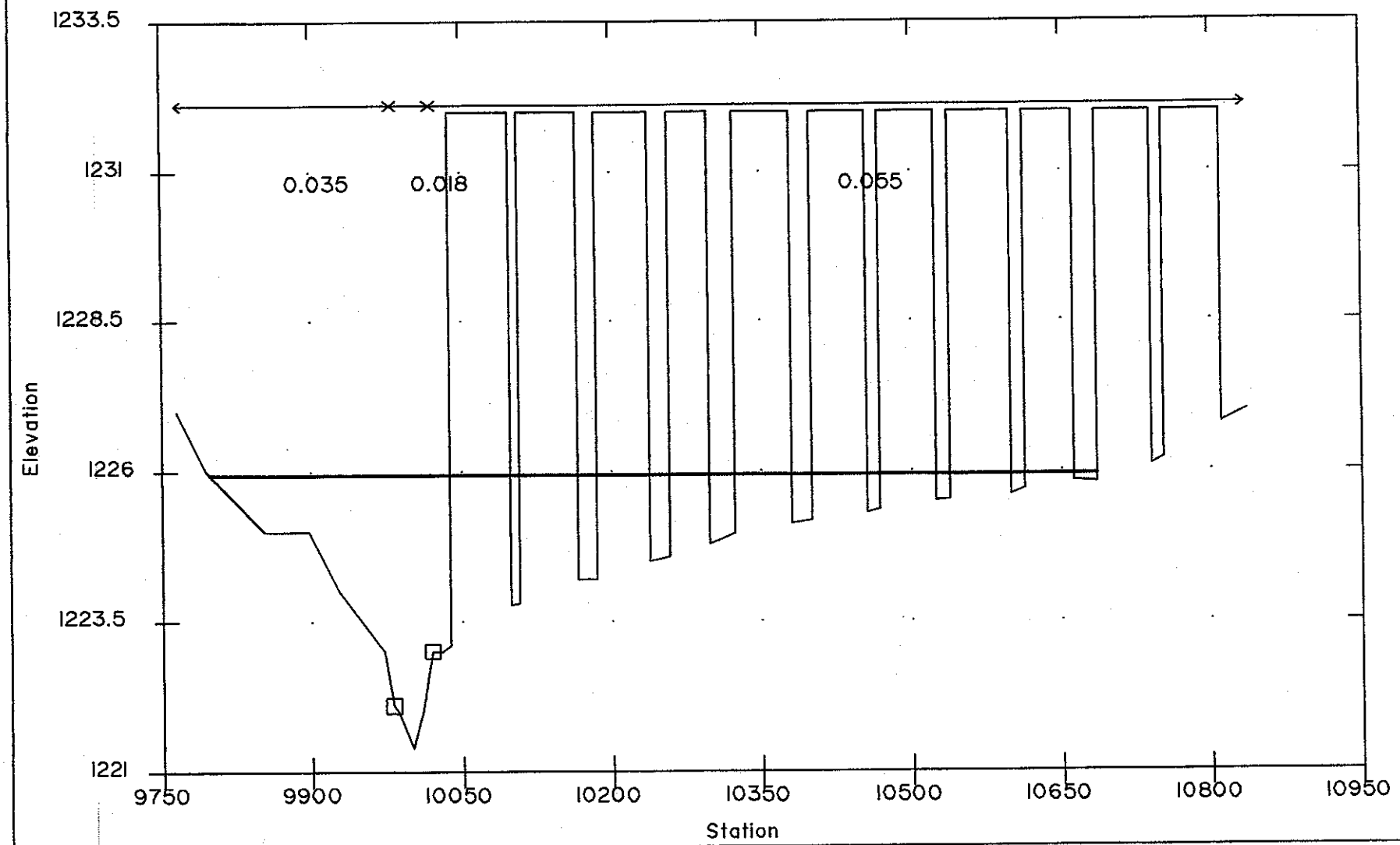
SECTION : 2.128

Granite Reef Wash
Floodplain Delineation Study



SECTION : 2.168

Granite Reef Wash
Floodplain Delineation Study



SECTION : 2.192

Granite Reef Wash
Floodplain Delineation Study

APPENDIX E

HEC-2 OUTPUTS AND DETAILED CALCULATIONS

```
*******************************************
*  HEC-2 WATER SURFACE PROFILES           *
*                                         *
*  Version   4.6.2;  May 1991             *
*                                         *
*  RUN DATE    01MAY97    TIME   14:31:47 *
*******************************************
```

```
****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
```

THIS RUN EXECUTED 01MAY97 14:31:47

```
************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************


SPLIT FLOW BEING PERFORMED

SF  SPLIT FLOW CALCULATIONS


TW West bank between 0.320 and 0.326
WS     2   0.320   0.326    .257     2.5
WC          1199      34    1201

TW West bank between 0.303 and 0.320
WS     2   0.303   0.320    .257     2.5
WC          1198     100    1199

TW West bank between 0.288 and 0.303
WS     2   0.288   0.303    .257     2.5
WC          1198      77    1198

TW West bank between 0.272 and 0.288
WS     2   0.272   0.288    .257     2.5
WC          1198      83    1198

TW West bank between 0.257 and 0.272
WS     2   0.257   0.272    .257     2.5
WC          1197      80    1198

TW East bank between 0.303 and 0.320
WS     2   0.303   0.320      -1     2.5
WC        1201.1     100    1201

TW East bank between 0.288 and 0.303
WS     2   0.288   0.303      -1     2.5
WC          1199      77  1201.1
```

```
TW East bank between 0.272 and 0.288
WS     2   0.272   0.288      -1     2.5
WC          1198      83    1199

TW East bank between 0.257 and 0.272
WS     2   0.257   0.272      -1     2.5
WC          1198      80    1198
```

```
T1      Granite Reef Wash - Floodplain Delineation                File:GRW1.H2
T1      For the  Flood Control District of Maricopa County
T1      by ENTELLUS                                             March 21, 1996

T2      Existing  conditions
T3      City of Scottsdale  -  Granite Reef Wash (FIS)

T4 GR data digitized from 1"=100' 1-foot map dated November 1993
T4 GR data modified for flowpaths.  non flowing ares blocked out

T5 1"=100' 1-feet Contour mapping from Michael Baker, Jr., Inc.
T6 Provided by the city of Scottsdale

T7 Supplemental cross section data surveyed by City of Scottsdale

T8 Downstream reach from "Granite Reef Wash Stabilization Plans" Project F1705

T9 Subcritical analysis
T9 This model was developed and configured to determine water surface elevation
T9 for a 100-year floodplain delineation study, Velocity from this model
T9 may not be accurate and should not be used

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

                2                           -1                                    1196.43

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     1                                                -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     38        43         1         2         8         4        26       100       200

  Critical conditions assumed Dowstrream from culvert
  X-sec 0.225 obtained from improvement plans


NC     .028      .035      .020        .1        .3
QT        2      1417      1417

   51.5
X1    0.225         8      9991     10009       370       370       370
X3                                   9962      1200     10017      1200
GR     1195      9962    1195.0      9981    1194.9      9991    1188.9      9995    1188.73     10000
GR   1188.9     10005    1194.9     10009      1195     10017

  ******************************************************************************
  *****             Culvert outlet dowstream from water well            ********
  ******************************************************************************
```

```
NC                                        .3          .5
  51
X1    0.231         35     9993.5    10006.5          31          31          31
X3       10                                                                   1195        1195
GR     1203    9776.97       1203       9798        1194        9798        1194        9849        1203        9849
GR     1203       9897       1194       9897        1194     9901.22        1195     9905.06        1196      9922.2
GR   1196.1    9954.45       1196    9986.69        1195      9988.5        1194     9990.19        1193     9991.88
GR   1189.2     9993.5    1189.29    9995.26     1189.29       10000     1189.29     10003.2     1189.29       10005
GR   1189.3    10006.5       1194    10008.6        1195     10010.5        1196     10012.4      1196.5    10027.40
GR     1196    10042.4     1195.9   10061.45        1196     10080.5      1196.3    10092.80        1196    10105.1
GR   1195.9      10110       1203      10110        1203       10218     1195.18       10218        1195    10243.7

  ******************************************************************************
  *****          13' X 7.5'concrete box culvert  at well site            ********
  ******************************************************************************

SC    1.013        0.4        2.7                   7.5          13         137         8.1     1189.59     1189.29


  ******************************************************************************
  *****                          Culvert inlet                            *******
  ******************************************************************************
  Upstream from water well
   49
X1    0.257         27     9993.5    10006.5         135         135         137
X2                               2                1197.41
X3       10                                                                1197.67     1197.41
BT       -3       9933    1197.67                   10000     1197.83                   10132     1197.41
GR     1208    9900.62       1208    9932.99     1198.29        9933     1197.67        9933        1197     9982.93
GR     1196    9983.45       1195    9983.96        1194     9984.61        1193     9989.53        1192     9991.53
GR   1189.5     9993.5    1189.59      10000     1189.59     10006.5        1192     10014.6        1193     10016.2
GR     1194    10017.3       1195    10018.3        1196     10019.3        1197     10020.1        1198     10033.7
GR     1198    10039.4       1197      10041        1196     10099.5     1197.41    10131.99     1197.41       10132
GR     1208   10132.01       1208    10169.1

   Reach GRW-2 concrete channel between water well and Granite Reef Road

NC    0.041      0.029      0.018

  effective area limited to 4 to 1 expancion
  Effective area boundary withing buildings no X3 record needed
   48
X1    0.272         29    9985.49    10017.7          80          80          80
X3       10
GR     1198    9920.49       1198     9922.9        1197     9934.09        1196     9934.29        1195     9935.29
GR     1194     9935.8       1193    9935.96        1192     9936.13        1191     9936.28        1190     9936.41
GR     1189    9936.54       1188    9936.67        1188     9963.96        1189     9968.23        1190      9972.5
GR     1191    9976.77       1192    9981.02        1193     9985.49        1192     9995.42        1191     9996.32
GR   1190.8      10000       1191    10004.1        1192     10005.7        1193     10007.1        1194     10008.6
GR     1195    10009.7       1196    10010.7        1197     10012.1        1198     10017.7
```

```
NC                                        .1         .3

  effective area limited to 4 to 1 expancion
  Effective area boundary withing buildings no X3 record needed
   47
X1    0.288        29    9989.19    10015.1         83         83         83
X3                                                 10205       1210
GR     1199   9893.77       1198    9916.31       1198    9919.53       1198    9935.85       1197    9936.82
GR     1196   9937.79       1195    9938.97       1194    9939.61       1193    9940.15       1192    9940.58
GR     1191   9944.28       1192    9962.15       1193    9972.89       1194    9979.65       1195    9987.74
GR     1195   9989.19       1193    9991.84       1192    9992.81       1191    9993.54     1190.9      10000
GR     1191   10005.1       1193    10007.8       1194    10009.3       1195    10010.5       1196    10012.1
GR     1197   10013.5       1198    10015.1       1198    10034.6       1198    10054.3

  Reach GRW-3   from south end of Granite Reef Road to 84th Place

NC    0.057      0.046      0.018

   46
X1    0.303          9    9987.96    10053.2         77         77         77
X3                                       9815       1210      10198       1210
GR     1199     9915.2       1198    9924.29       1197    9936.33     1196.9    9945.96       1197    9955.59
GR   1197.3    9987.96     1197.3      10000       1198    10053.2     1198.1   10060.45

   45.5

X1    0.320         15    9978.8    10036.9         89         89         89
GR     1211    9800.57       1211       9815     1200.8       9815     1200.4       9835       1211       9835
GR     1211    9860.24       1211       9897     1199.5       9897     1199.3     9915.2       1199    9937.98
GR     1198     9978.8     1197.3      10000       1198    10036.9     1198.7    10124.9       1199    10166.5

  ########################## BEGINNING OF STUDY AREA ##########################

  basin on rigth bank may need to modified for storage
   45

X1    0.326         18    9987.35    10021.9         34         34         34
X3                                                 10110       1198
GR     1201   9861.86     1200.83       9877       1211       9877       1211       9952       1200       9952
GR     1199   9965.85       1198    9987.35     1197.4      10000       1198    10021.9       1198    10048.5
GR     1197   10058.2       1197    10090.2       1198    10102.5       1199    10120.2       1200    10143.8
GR   1200.5     10157       1211      10157       1211    10331.1

  Basin on rigth bank may need modification for storage
   44
```

```
X1    0.369        36      9981     10019       226       226       226
X3                                                    10021.7      1199
GR     1207   9666.43      1206   9668.28      1205   9677.66      1204   9678.25      1203   9678.81
GR     1202   9679.37      1202   9688.01      1202      9717      1212      9717      1212   9739.79
GR     1212   9808.24      1212      9857    1201.2      9857      1201   9860.23      1201      9882
GR     1212      9882      1212   9905.43      1212   9951.14      1212   9960.03      1200   9960.03
GR     1199   9973.09    1198.2      9981      1198   9994.77    1197.8     10000      1198   10005.8
GR   1198.2     10019      1199   10021.7      1199   10038.7      1198   10051.2      1198   10089.9
GR     1199   10098.8      1201   10121.7      1201   10142.1      1201   10147.9      1202   10157.3
GR     1212   10157.3

   43

X1    0.421        34      9981     10019       278       278       278
GR     1209   9668.66      1208   9671.36      1207   9673.72      1206   9676.24      1205    9678.6
GR     1204   9681.44      1204      9710      1214      9710      1214   9794.16      1214    9838.9
GR     1214      9856      1203      9856      1203      9883      1214      9883      1214   9897.08
GR     1214   9942.77      1214      9955    1203.5      9955      1202      9962      1201   9965.84
GR     1200   9972.86    1199.1      9981      1199   9984.84    1198.5     10000      1199   10015.6
GR   1199.1     10019      1200   10086.4      1201   10101.3      1202   10118.1    1202.6   10142.5
GR     1203   10149.7    1203.6     10173      1214     10173      1214   10191.4

   42

X1    0.459        28   9980.62   10020.9       200       200       200
X3                                                    10020.9      1200
GR     1205    9674.5      1204      9684      1204      9710      1214      9710      1214      9853
GR     1204      9853      1204      9878      1214      9878      1214   9888.27      1214   9897.21
GR     1214      9955      1203   9955.25      1202   9963.49      1201   9972.43      1200   9980.62
GR   1199.4     10000      1200   10020.9      1200   10043.3      1199   10047.1      1198   10050.9
GR     1198   10059.6      1199   10092.1      1200   10099.7      1201   10107.4      1202   10113.1
GR     1203   10128.8      1204   10151.3      1205   10165.4

  Expancion-Contraction modified to acount for bend

NC                                     .3        .5

   41
X1    0.503        14      9978     10022       229       229       229
GR     1205      9663   1204.32      9765      1215      9765      1215   9814.93      1215      9925
GR   1203.9      9925      1203   9936.49    1202.7      9978    1202.3     10000    1202.7     10022
GR     1203   10074.5      1204   10128.3      1205   10166.6      1206   10215.4

   40

X1    0.542        31      9969.9   10043.9      220       205       208
GR     1215   9502.51      1215      9545      1207      9545      1207   9579.21   1206.89      9602
GR     1215      9602      1215      9683   1206.52      9683   1206.39      9710      1215      9710
GR     1215   9794.96      1215      9800      1206      9800      1206   9844.04      1206      9857
GR     1215      9857      1215   9902.47      1215   9932.06      1215      9940      1206      9940
GR     1206    9956.6      1205   9964.22      1204    9969.9    1203.6     10000    1203.2     10019
GR     1204   10043.9      1205   10062.2      1206   10075.9      1207   10082.8      1208   10091.3
GR     1208     10099
```

Reach GRW-4 along 84th Place
Expancion-Conptration back after turn

NC	.045	.045	.018	.1	.3					
39										
X1	0.627	51	9983.76	10014.9	200	220	451			
GR	1211	9499.13	1210	9504.25	1209	9606.9	1208.72	9642	1215	9642
GR	1215	9696	1208.28	9696	1208.19	9708	1215	9708	1215	9731.19
GR	1215	9757	1207.88	9757	1207.82	9770	1215	9770	1215	9816
GR	1207.6	9816	1207.55	9833	1215	9833	1215	9877	1207.35	9877
GR	1207.3	9893	1215	9893	1215	9943	1207.06	9943	1207	9955.49
GR	1206	9983.76	1205.9	10000	1206	10014.9	1206	10019.9	1206	10020.1
GR	1206	10021.9	1207	10045.2	1207.17	10060	1215	10060	1215	10129.4
GR	1208	10130	1207	10155	1206	10170	1206	10183	1206.5	10204
GR	1215	10204	1215	10280	1207	10280	1206	10295	1205	10300
GR	1205	10315	1206	10360	1207	10360	1208	10385	1209	10390
GR	1210	10396								
38										
X1	0.674	59	9985	10015.2	270	220	248			
GR	1212	9085	1212	9472	1211	9510	1215	9510	1215	9610
GR	1210.9	9610	1210.8	9662	1215	9662	1215	9705	1210.5	9705
GR	1210.5	9720	1215	9720	1215	9770	1210.2	9770	1210.2	9785
GR	1215	9785	1215	9830	1210	9830	1210	9842.93	1209.9	9845
GR	1215	9845	1215	9875.24	1215	9893	1208.8	9893	1208.5	9910
GR	1215	9910	1215	9957	1208.06	9957	1208	9962.63	1207	9971.69
GR	1206	9985	1205.5	10000	1206	10015.2	1207	10031	1208	10050
GR	1215	10050	1215	10095	1208	10095	1208	10119	1208	10119
GR	1215	10119	1215	10168	1208.4	10168	1208.7	10190	1215	10190
GR	1215	10228	1208.8	10228	1208.8	10242	1215	10242	1215	10285
GR	1208.2	10285	1207	10300	1207	10310	1208	10327	1208	10342
GR	1208	10377	1209	10382	1210	10390	1211	10424		
37										
X1	0.729	55	9985.4	10016.8	289	289	289			
X3				9919.11	1209					
GR	1214	9347	1213	9456	1212	9468	1211	9476	1211	9510
GR	1216	9510	1216	9560	1211.2	9560	1211.2	9582	1216	9582
GR	1216	9625	1210.6	9625	1210.6	9650	1216	9650	1216	9690
GR	1209.8	9690	1209.8	9705	1216	9705	1216	9750	1209.5	9750
GR	1209.5	9762	1216	9762	1216	9811	1209	9811	1209	9811.46
GR	1208	9821.48	1208	9840.72	1208.5	9867	1216	9867	1216	9893.2
GR	1216	9919.11	1216	9945	1208.45	9945	1208	9965.49	1207	9985.4
GR	1206.6	10000	1207	10016.8	1208	10029.9	1209	10043.8	1209	10053
GR	1216	10053	1216	10145	1209	10145	1209	10162.2	1209	10200
GR	1216	10200	1216	10209.1	1216	10282	1208.5	10282	1208	10310
GR	1208	10363	1209	10390	1209	10404	1210	10410	1211	10428
36										

X1	0.786	60	9988	10014.5	290	298	298			
GR	1213	9399	1212	9430	1212	9510	1216	9510	1216	9570
GR	1212	9570	1212	9585	1216	9585	1216	9622	1212	9622
GR	1212	9647	1216	9647	1216	9690	1212	9690	1212	9707
GR	1216	9707	1216	9753	1211.5	9753	1211.5	9770	1216	9770
GR	1216	9809.9	1216	9811.65	1216	9818.97	1216	9820	1208.75	9820
GR	1208	9822.85	1208	9834.5	1209	9845.28	1210	9853.9	1211	9867.28
GR	1216	9867.3	1216	9942.19	1216	9948	1210.73	9948	1210	9963.6
GR	1209	9970.61	1208	9976.1	1207.3	9985	1207	9988	1206.9	10000
GR	1207	10014.5	1208	10025.9	1209	10031.4	1210	10033.3	1211	10057
GR	1216	10057	1216	10147.9	1211	10148	1210	10171.5	1210	10177.6
GR	1210.8	10203	1216	10203	1216	10208.4	1216	10287	1210.08	10287
GR	1210	10293.6	1210	10360	1211	10385	1212	10390	1213	10405

35

X1	0.821	58	9985	10015	180	190	190			
GR	1215	9455	1214	9464	1213	9466	1212	9474	1211	9477
GR	1210.5	9480.35	1210.36	9507	1217	9507	1217	9566	1210.07	9566
GR	1210	9580.93	1217	9581	1217	9630	1209.75	9630	1209.67	9645
GR	1217	9645	1217	9695	1209.41	9695	1209.33	9710	1217	9710
GR	1217	9755	1209.1	9755	1209.02	9770	1217	9770	1217	9773.71
GR	1217	9826	1208.6	9827.31	1208.34	9862	1217	9862	1217	9906.42
GR	1217	9945	1207.61	9945	1207.2	9985	1207.1	10000	1207.4	10015
GR	1208	10016.9	1209	10024.4	1210	10027.2	1211	10043.7	1211	10053
GR	1217	10053	1217	10102	1211	10102	1211	10125	1217	10125
GR	1217	10170	1211	10170	1211	10188	1217	10188	1217	10225
GR	1211	10225	1211	10240	1217	10240	1217	10292	1211	10292
GR	1211	10323.5	1212	10361.8	1213	10375.9				

Expancion -Contraction increased to account for end of channel

NC				.3	.5					
34										
X1	0.857	45	9987.55	10030.36	158	220	187			
GR	1214	9457	1213	9468	1213	9475	1212	9492	1211	9510
GR	1217	9510	1217	9563	1212	9563	1212	9580	1217	9580
GR	1217	9625	1212	9625	1212	9640	1217	9640	1217	9688
GR	1212	9688	1212	9700	1217	9700	1217	9750	1212	9750.01
GR	1212	9762	1217	9762.01	1217	9805	1212	9805	1212	9821
GR	1211	9830	1210.2	9833	1211	9836.21	1212	9851.37	1212	9860
GR	1217	9860	1217	9947	1212	9947	1212	9952.61	1211	9958.18
GR	1210	9964.22	1209	9987.55	1208.5	10000	1209	10030.36	1210	10060.39
GR	1211	10096.99	1212	10104.86	1213	10113.12	1214	10117.56	1215	10121.10

Reach GRW-5A Earthen channel upstream from 84th place

```
NC    0.043      0.036      0.038

  33
X1    0.865         61    9979.89   10024.62         50         20         45
GR     1215       9398       1215       9448       1214       9458       1213       9460       1212       9465
GR     1213       9474       1211       9478       1211       9509       1211       9510       1217       9510
GR     1217       9562       1211       9562       1211       9580       1217       9580       1217       9625
GR     1211       9625       1211       9640       1217    9640.01       1217       9685       1211    9685.01
GR     1211       9700       1217    9700.01       1217    9722.87       1217       9757     1210.7       9757
GR   1210.6       9767       1217       9767       1217     9813.7       1217       9818    1210.39       9818
GR     1211    9832.09       1212    9849.77       1212       9857       1217       9857       1217       9944
GR     1212       9944       1212    9959.25       1211    9967.61       1210    9975.97       1210    9979.89
GR     1209    9983.88       1208    9986.15       1207    9987.87       1206     9989.6       1205    9991.32
GR     1204    9993.05       1203    9997.63     1202.9      10000       1203   10002.75       1204   10007.61
GR     1205   10011.06       1206   10014.61       1207   10017.97       1208    10021.3       1209   10024.62
GR     1210    10054.5       1211   10081.35       1212   10098.82       1213   10101.86       1214   10104.88
GR     1215   10107.92
```

Expancion-Contraction back to normal after trancition

```
NC                                       .1         .3

  32
X1    0.883         63     9980.8   10021.12         95         95         95
GR     1216       9443       1215       9454       1214       9466       1213       9471       1212       9476
GR     1213       9477       1213       9479       1212       9480       1212    9535.85       1212       9545
GR     1217       9545       1217       9595       1212       9595       1212       9608       1217       9608
GR     1217       9656       1212       9656       1212       9670       1217       9670       1217       9715
GR     1212       9715       1212       9730       1217       9730       1217       9782       1212       9782
GR     1212       9793       1217       9793       1217    9837.05       1217       9843     1211.4       9843
GR     1211     9848.7       1211    9865.29       1212    9888.13       1217     9888.2       1217    9909.79
GR     1217    9927.63       1217    9930.97       1217    9935.36       1217    9939.35       1217       9973
GR   1212.1       9973       1212     9980.8       1211    9982.17       1210    9983.43       1209    9984.27
GR     1208    9985.47       1207    9986.43       1206    9987.53       1204    9989.55     1203.1      10000
GR     1204   10009.62       1205    10011.1       1206   10014.32       1207   10016.82       1208   10018.92
GR     1209   10021.12       1210   10044.42       1211   10079.42       1212   10095.12       1213   10102.22
GR     1214   10105.12       1215   10111.62       1215   10140.82
```

Reach GRW-5B Earthen channel south of McDowell Road

```
NC     .035      0.050      0.038

  31
X1    0.915         47    9976.92   10017.23        169        202        170
GR     1216       9522       1215       9526       1214       9534       1213       9541       1212       9546
GR   1211.8    9565.50       1212       9585     1212.2       9630       1217    9630.01       1217       9710
GR   1212.1    9710.01       1212    9725.13     1211.9       9728       1217       9728       1217    9805.79
GR     1217       9817     1210.9       9817     1210.8       9828       1217       9828       1217       9913
GR   1210.1       9913     1210.0       9923       1217       9923       1217    9929.11       1217    9956.27
GR     1217       9965       1210       9965       1210    9976.92       1209    9984.09       1208    9985.77
GR     1207    9987.33       1206    9989.12       1205    9991.47       1204    9992.44     1203.1      10000
GR     1204   10005.33       1205   10008.06       1206   10010.33       1207   10012.93       1208   10015.03
GR     1209   10017.23       1210   10046.73       1211   10084.03       1212   10102.23       1213   10115.63
```

```
GR     1217    10115.7       1217      10295

  30

X1    0.966         32    9970.98   10019.52        170      266.5        266
GR     1217       9500       1217       9595       1213    9595.01       1213       9600       1212       9620
GR     1212       9633       1213       9677       1214       9695     1214.2       9717       1214    9749.24
GR     1213    9961.38       1212    9962.38       1211    9966.22       1210    9970.98       1209    9977.76
GR     1208    9986.36       1207    9988.49       1206    9990.56       1204    9994.83     1203.6      10000
GR     1204    10003.8       1206   10010.32       1207   10013.12       1208   10016.52       1209   10019.52
GR     1210   10062.52       1211   10109.72       1212   10112.42       1213   10118.62       1217   10118.63
GR     1217      10247       1215      10247

  29

X1    1.001         41    9958.34   10018.25        240        190        190
GR     1218       9600       1218       9663    1213.50    9663.01       1213       9669       1212       9681
GR   1212.5       9707       1212    9752.16     1211.8    9755.84       1212    9759.51       1213    9769.04
GR     1213    9821.08     1213.2    9860.20       1213    9899.32       1213    9956.08       1212    9958.34
GR     1211    9964.14       1210    9968.88       1209    9976.61       1208    9983.87       1207     9986.9
GR     1206     9990.1       1205    9995.89       1204    9996.34     1203.7      10000       1204   10003.42
GR     1206   10007.75       1207   10009.75       1208   10012.15       1209   10015.05       1210   10018.25
GR     1211   10030.25       1212   10054.25     1212.3      10058       1218      10058       1218   10064.35
GR     1218   10077.15       1218      10243     1214.7      10243       1215   10287.55       1216   10294.75
GR     1217   10296.85

  28

X1    1.042         38    9984.27   10024.32        245        215        215
X3
GR     1220       9568       1220       9597     1214.2    9597.01       1214       9610       1213       9614
GR     1212       9618       1212       9711       1213       9714       1213    9724.53       1213    9762.76
GR     1213    9768.92       1212    9789.95       1212    9928.08       1212    9946.55       1211    9984.27
GR     1210    9986.38       1209    9988.27       1208    9990.31       1207    9992.57       1206    9994.62
GR     1205    9995.41       1204    9997.09     1203.7      10000       1204   10002.77       1207   10007.52
GR     1208   10008.72       1209   10010.02       1210   10012.02       1211   10014.52       1212   10017.02
GR     1213   10024.32       1214   10057.72       1214      10067       1220      10067       1220   10157.22
GR     1220      10227     1214.5      10227       1215   10288.32

NC                                        .3         .5

  ****************************************************************************
  ******                 McDowell Road Culvert Outlet                 ********
  ****************************************************************************
  27
X1    1.054         31       9994      10006         60         69         64
X3       10                                                                  1212       1212
GR     1216    9275.46       1215     9441.9       1214       9550     1213.5       9610       1220       9610
GR     1220    9662.52       1220    9703.87       1220    9730.46       1220    9829.45       1212    9829.45
GR     1212     9909.4       1212    9992.74       1211    9993.14       1210    9993.65    1202.58       9994
GR   1202.5    9994.75    1202.58      10000    1202.58      10006       1209    10009.2       1210    10011.1
GR     1211    10012.8       1212    10014.5       1213    10021.1    1213.67      10055       1220      10055
GR     1220    10069.6       1220    10083.6       1220      10147    1215.57      10147       1216    10194.1
```

```
GR     1217    10297.2

  ******************************************************************************
  *****        12' X 8' Concrete Box Culvert at McDowell Road              *****
  ******************************************************************************


QT        2       1240       1240
SC    1.013         .3        2.7                     8          12      112.25        12.3     1202.63     1202.58

  ******************************************************************************
  *****                    McDowell Road Culvert Inlet                      *****
  ******************************************************************************
  26
X1    1.075         43    10008.5    10020.5        112         112         112
X2                               2                1213.01
X3       10                                                                          1213.01     1213.01
BT       -3       9940    1213.09                  10000     1213.01                10057.6     1213.09
GR     1217       9195       1216       9325     1215.62        9381        1222       9381        1222        9428
GR   1215.3       9428       1215     9475.5     1214.54        9513        1222       9513        1222     9557.88
GR     1222    9812.39       1222    9887.85        1222     9929.52        1222       9940     1217.73        9940
GR   1211.8       9940       1211    9973.46        1210     9985.78        1209     9992.7        1208        9994
GR     1208      10000       1207    10003.4        1206       10006     1202.62    10008.5     1202.62     10014.5
GR   1202.6    10020.5       1206    10022.9        1207     10024.3        1208    10025.4        1209     10026.3
GR     1210    10027.5       1211    10028.8        1212       10033        1213    10037.4        1214     10044.7
GR     1215    10057.6    1217.68    10057.6        1222     10057.6        1222    10082.2        1222     10116.3
GR     1222    10154.5       1222    10196.4        1222     10313.8

  Reach GRW-6 upstream from McDowell Road

NC    0.037      0.044      0.045

  25
X1    1.084         26    9990.97    10010.8         43          43          43
GR     1222     9960.8       1222       9965     1214.31        9965        1214     9966.9        1213     9972.36
GR     1212    9976.52       1211    9979.05        1210     9981.58        1209     9987.9        1208     9990.97
GR     1207    9993.32       1206    9995.66      1205.2       10000        1206    10003.8        1207     10007.3
GR     1208    10010.8       1209    10038.5        1210     10039.3        1211    10040.4        1212     10042.6
GR     1213    10044.7       1214    10048.6        1215     10058.6      1215.1      10068        1222       10068
GR     1222    10155.2


NC                                       0.1        0.3

  24
X1    1.101         28     9989.9    10012.2         90          90          90
GR     1222    9932.86       1222       9963     1215.07        9963        1215    9965.07        1214     9969.83
GR     1213    9973.77       1212    9976.76        1211     9980.16        1210    9983.42        1209     9986.54
GR     1208     9989.9       1207    9992.93        1206     9996.47      1205.5      10000        1206     10004.5
GR     1207      10008       1208    10012.2      1208.8     10027.3        1209      10040        1210     10041.3
GR     1211    10042.1       1212    10044.4        1213     10046.8        1214    10055.5        1215     10073.9
GR   1215.6      10108       1222      10108        1222     10124.7
```

```
NC                                        0.3         0.5

  ******************************************************************************
  *****                    Office Bridge outlet                             *****
  ******************************************************************************
  23
X1    1.108         28    9970.84    10057.1          40          40          40
X3       10                                                                   1215        1215
GR     1224     9955.7       1224       9963      1215.2        9963        1215     9965.16        1214     9970.84
GR     1213    9974.78       1212    9978.09        1211     9981.24        1210     9984.23        1209     9987.54
GR     1208    9991.01       1207    9994.48        1206     9998.85      1205.6       10000        1206     10007.1
GR     1207    10011.7       1208    10016.2        1209     10022.5        1210     10028.9        1211     10036.4
GR     1212    10040.2       1213    10043.4        1214     10057.1        1215     10111.6        1216       10140
GR   1215.8      10170       1224      10170        1224       10175

  ******************************************************************************
  *****                 Special Bridge data at Office bridge                 *****
  ******************************************************************************

SB     1.05       1.56        2.7                     23           4         467           3     1205.72      1205.6

  ******************************************************************************
  *****                    Office Bridge inlet                              *****
  ******************************************************************************
X1    1.115         33    9971.29    10045.2          34          34          34
X2                               1       1215      1215.1
X3       10                                                                   1215        1215
BT       -8       9970       1215       1215     9971.29      1215.1      1215.1      9971.3      1219.1      1215.1
BT             10000     1235.1     1215.1    10019.53        1230      1215.1    10045.12      1219.1      1214.5
BT           10045.21     1215.1     1214.5     10094.        1215        1215
GR     1224    9958.97       1224    9964.65       1215    9964.65        1215        9970        1215     9970.01
GR     1215    9971.29     1215.1    9971.29       1213    9974.73        1212     9977.29        1211     9980.22
GR     1211    9980.52    1210.89    9981.29       1210     9982.6        1209      9985.9        1208     9989.74
GR     1207    9993.41    1205.66    9999.33    1205.72      10000     1205.88     10012.1     1207.42     10019.5
GR     1210    10026.9    1212.95    10035.2       1214    10045.2      1214.5     10045.2        1215     10094.5
GR     1224    10094.5       1224      10125    1215.87      10125        1216     10129.7        1217     10158.6
GR     1217      10170       1224      10170       1224      10223

X1    1.121         34     9983.8    10020.3          36          36          36
GR     1224     9959.9       1224       9963    1214.59       9963        1214     9967.38        1213     9973.14
GR     1212    9976.59       1211    9980.24       1210     9983.8        1209     9986.76        1208     9990.02
GR     1207     9993.1     1206.1      10000       1206    10001.2        1206     10004.1        1207     10009.8
GR     1208      10015       1209    10018.8       1210    10020.3        1211     10022.6        1212     10026.1
GR     1213    10029.7       1214    10034.5       1215    10040.7        1215     10049.1        1215     10093.2
GR   1215.1      10097       1224      10097       1224    10127.4        1224       10133     1216.3       10133
GR     1217    10146.2       1218    10177.3       1224    10177.3        1224       10200

  Reach GRW-7 Earthen channel downstream from 87th Street
  Expancion-Contraction increase to acount for bend
```

```
NC    0.045     0.045     0.045       .5        .8

X1    1.138        33   9952.84  10021.4        37       150        90
GR     1225    9857.9      1225  9930.22      1225    9937.9      1215    9937.9      1214   9952.84
GR     1213   9959.84      1212  9963.34      1211   9966.85      1210   9971.05      1209   9975.49
GR     1208   9979.69    1207.5    10000      1208   10008.3      1209   10010.5      1210   10012.7
GR     1211   10014.9      1212    10017      1213   10019.4      1214   10021.4      1215   10025.7
GR     1216   10029.9      1217  10052.3      1217     10074      1225     10074      1225     10135
GR     1217     10135      1217  10156.4      1217   10169.2      1217   10173.7      1217     10185
GR   1217.7     10210      1225    10210      1225     10220
```

Expancion Contraction back to normal after bend

```
NC                                   .1        .3

X1    1.181        34   9976.04  10021.36       225       225       225
GR     1225   9803.86      1225  9847.76      1225   9888.05      1225      9947   1213.33      9947
GR     1213   9976.04      1212  9979.56      1211   9982.13      1210   9984.58      1209   9987.04
GR     1208   9989.28      1207  9991.63      1206   9994.94      1205   9999.53   1204.95     10000
GR     1205     10001      1206  10002.52     1207  10005.92      1208  10008.42      1209  10010.62
GR     1210  10013.02      1211  10015.42     1212  10017.72      1213  10021.36      1214  10024.42
GR     1215  10051.82      1225  10051.82     1225     10113   1215.52     10113      1216  10168.82
GR     1216     10190      1225    10190      1225     10206      1225     10256
```

Expancion contraction increased for trancition and bend

```
NC                                   .5        .8

X1    1.224        34   9973.16  10020.6       230       130       230
GR     1217      9577      1215     9724      1216      9790      1225      9790      1225      9840
GR     1216      9840      1216     9868      1215     9915.7      1214   9959.52      1213   9968.92
GR     1212   9973.16      1211  9975.75      1210   9978.62      1209   9981.65      1208   9986.21
GR     1207   9994.84    1206.5    10000      1207   10006.3      1208   10010.9      1209   10013.4
GR     1210     10015      1211  10016.6      1212   10020.6      1213   10039.1      1214   10050.5
GR   1214.1     10055      1225    10055      1225  10083.13      1225     10125    1215.2     10125
GR     1216     10258      1216    10267      1225     10267      1225     10300

X1    1.239        34   9985.94  10034.7        90        30        75
GR     1227      9720      1227     9740      1217      9740      1217      9752   1216.42      9815
GR     1227      9815      1227  9860.12      1227      9870   1215.74      9870      1215    9897.7
GR     1215   9901.82    1215.2     9915      1227      9915      1227      9960    1215.8      9960
GR     1216   9975.83      1215  9981.92      1214   9985.94      1213   9989.85      1212   9994.01
GR   1211.4      9997      1211    9999.1    1210.9     10000      1211  10001.7      1212   10013.9
GR     1213   10024.7      1214  10034.7      1227   10034.8      1227     10123    1214.5     10123
GR     1215   10209.3   1215.81    10250      1227     10250      1227   10259.6
```

Reach GRW-8 along 87th Street

```
NC    0.055     0.055      .018       .5       .8

X1    1.262        54   9990.73  10032.2      256        20       123
GR     1227   9417.43      1227     9475  1218.47      9475   1218.38      9485      1227      9485
GR     1227   9526.89      1227     9535  1217.96      9535   1217.86      9555      1227      9555
GR     1227      9617   1217.55     9617  1217.48      9630      1227      9630      1227      9686
GR   1217.2      9686   1217.13     9700     1227      9700      1227   9725.93      1227      9765
GR   1216.8      9765   1216.71     9778     1227      9778      1227      9828   1216.43      9828
GR   1216.3      9845      1227     9845     1227   9903.71      1227      9911   1215.63      9911
GR     1215   9923.34      1214  9924.07     1213   9949.26   1212.50   9990.73      1212   10032.2
GR   1211.9  10034.52      1212  10037.8     1213     10043      1214   10048.5      1214     10058
GR     1227     10058      1227    10143     1214     10143      1214   10185.7      1215   10221.6
GR   1215.0     10225      1227    10225     1227     10321    1216.4     10321    1216.4     10348
GR     1227     10348      1227    10422  1216.68     10422      1217     10502

X1    1.301        73   9980.84  10019.8      225       130       204
GR     1228   9329.73      1228     9385  1218.54      9385   1218.43      9398      1228      9398
GR     1228   9448.73      1228     9455  1217.98      9455   1217.92      9470      1228      9470
GR     1228      9527   1217.71     9527  1217.64      9545      1228      9545      1228      9598
GR   1217.4      9598   1217.35     9614     1228      9614      1228      9673   1217.15      9673
GR   1217.1      9684      1228     9684     1228   9714.37      1228      9737    1216.9      9737
GR   1216.8      9755      1228     9755     1228      9805   1216.59      9805   1216.52      9822
GR     1228      9822      1228     9868  1216.31      9868   1216.24      9885      1228      9885
GR     1228   9937.98      1216  9937.98     1215   9954.58      1214   9968.17      1213   9980.84
GR   1212.1     10000      1213  10019.8     1214   10031.6      1215   10049.1   1215.14     10057
GR     1228     10057      1228  10104.6     1228     10110   1216.02     10110   1216.09     10128
GR     1228     10128      1228    10183  1216.32     10183    1216.4     10205      1228     10205
GR     1228     10273   1216.68    10273     1217   10353.4      1228   10353.4      1228     10397
GR   1217.8     10397      1218  10418.6  1218.13     10435      1228     10435      1228     10470
GR   1218.3     10470    1218.4    10483     1228     10483      1228     10535   1218.67     10535
GR   1218.7     10550      1228    10550     1228   10596.9
```

Expancion-Contraction back to normal after bend/trancition
N value .5 to block inefective area

```
NC                                  0.1       0.3
NH       5        .9      9860     .055      9981      .018     10019      .055     10180        .9
NH   10500
   14.5
X1    1.353        64      9981   10019       290       235       278
GR     1228      9457      1228    9475    1217.9      9475   1217.84      9485      1228      9485
GR     1228      9555   1217.45    9555   1217.39      9566      1228      9566      1228      9625
GR   1217.1      9625      1217    9635   1216.94      9644      1228      9644      1228      9700
GR   1216.5      9700    1216.3   9735.7      1216   9778.68   1215.91      9790      1228      9790
GR     1228      9840   1215.48    9840   1215.34      9858      1228      9858      1228   9898.59
GR     1228      9918   1214.62    9918      1214   9949.53    1213.1      9981      1213      9994
GR   1212.8     10000      1213  10007.5    1213.1     10019      1214   10041.4   1214.06     10045
GR     1228     10045      1228    10095   1214.83     10095      1215     10106   1215.14     10120
GR     1228     10120      1228    10140   1215.34     10140   1215.48     10155      1228     10155
GR     1228   10207.4      1216  10207.4   1217.23     10223      1228     10223      1228   10255.8
GR     1228     10267   1217.35    10267    1217.4   10282.9    1217.8     10330      1228     10330
GR     1228     10382    1218.2    10382    1218.3     10400      1228     10400      1228     10445
```

```
GR   1218.6     10445     1218.8     10470       1228       10470       1228       10500

NC     0.055     0.055       .018

X1     1.373        82   9980.32   10021.3        150         105        106
GR      1228   9447.57      1228   9495.13       1228        9512    1218.82       9512     1218.7       9524
GR      1228      9524      1228      9583    1218.08        9583       1218     9591.07    1217.94       9597
GR      1228      9597      1228      9663    1217.24        9663       1217     9685.49       1217    9734.12
GR    1216.8      9763      1228      9763       1228        9818    1216.55       9818     1216.1       9903
GR      1228      9903      1228   9920.85       1228        9948     1215.5       9948       1215    9967.69
GR      1214   9980.32    1213.0     10000       1214     10021.3       1215    10035.4    1215.45      10040
GR      1228     10040      1228   10048.7       1228     10073.7       1228      10080     1217.1      10080
GR    1217.5     10105      1228     10105       1228     10136.8       1228      10142    1218.04      10142
GR    1218.3     10168      1228     10168       1228       10214    1218.63      10214    1218.83      10240
GR      1228     10240      1228   10260.2       1228       10288    1219.29      10288     1219.4      10298
GR      1228     10298      1228     10353    1219.98       10353       1220    10355.1    1220.11      10363
GR      1228     10363      1228     10415    1220.84       10415       1221    10426.3    1221.02      10433
GR      1228     10433      1228     10482    1221.16       10482     1221.2      10496       1228      10496
GR      1228     10553   1221.36     10553    1221.39       10562       1228      10562       1228      10618
GR    1221.5     10618   1221.58     10628       1228       10628       1228      10683    1221.73      10683
GR    1221.8     10695      1228     10695       1228       10750    1221.92      10750    1221.96      10764
GR      1228     10764      1228   10776.9

N value .5 to block inefective area

NH        4        .5      9850      .055    9979.61        .018    10023.8       .055    10744.6
X1    1.438        75   9979.61   10023.8        280         390        344
GR     1220    9434.9   1219.88      9450       1229        9450       1229       9510    1219.45       9510
GR   1219.3      9525      1229      9525       1229        9583    1218.78       9583    1218.67       9593
GR     1229      9593      1229      9657    1218.06        9657       1218    9662.88    1217.98       9667
GR     1229      9667      1229      9726    1217.65        9726    1217.57       9740       1229       9740
GR     1229      9793   1217.28      9793    1217.18        9810       1229       9810       1229    9842.52
GR     1229      9880   1216.61      9880    1216.22        9917       1229       9917       1229    9937.81
GR     1229      9950    1215.7      9950       1215     9979.61       1214    9995.34     1213.8      10000
GR     1214   10004.4      1214     10017       1214     10019.9       1215    10023.8       1216    10031.1
GR     1217     10050      1229     10050       1229       10102       1217      10102       1217      10133
GR     1229     10133      1229     10200       1217       10200       1217    10252.2       1218    10276.1
GR   1218.0     10277      1229     10277       1229       10340    1218.81      10340       1219    10354.7
GR   1219.0     10355      1229     10355       1229       10410    1219.61      10410    1219.71      10420
GR     1229     10420      1229     10477    1220.29       10477    1220.39      10487       1229      10487
GR     1229     10545   1220.92     10545       1221     10553.1    1221.02      10557       1229      10557
GR     1229     10613   1221.31     10613    1221.38       10626       1229      10626       1229    10744.6

N value .5 to block inefective area

NH        4        .5      9960      .055    9977.58        .018    10023.8       .055     10483
   12.5
X1    1.499        73   9977.58   10023.8        350         250        320
GR     1221    9454.9   1220.76      9485       1230        9485       1230    9493.9       1230    9546.9
GR     1230      9553   1219.92      9553    1219.78        9565       1230      9565       1230    9627.37
GR     1230      9633   1218.93      9633    1218.77        9647       1230      9647       1230      9704
GR   1218.1      9704      1218   9713.36    1217.96        9716       1230      9716       1230      9776
GR   1217.2      9776      1217   9787.79    1216.98        9793       1230      9793       1230      9857
```

```
GR   1216.7      9857     1216.7    9865.46    1216.07      9915      1230      9915      1230    9920.48
GR     1230      9953    1215.43      9953      1215    9977.58    1214.6     10000      1215    10023.8
GR     1216     10027      1217    10030.8      1218    10035.6      1218     10043      1230      10043
GR     1230   10049.2      1230     10082      1218      10082      1218   10096.2      1219    10103.1
GR     1220   10109.3      1221    10111.7      1222    10115.6      1222   10119.7      1221      10123
GR     1220   10123.7      1219    10124.1      1218    10124.8      1218   10143.3      1230    10143.3
GR     1230     10202      1218     10202      1218    10263.4    1218.2     10295      1230      10295
GR     1230     10348   1218.53     10348   1218.64      10364      1230     10364      1230    10421.8
GR     1219   10421.8   1219.13     10435      1230      10435      1230     10483   1219.62      10483
GR   1219.7     10492      1230     10492      1230    10520.5
```

N value .5 to block inefective area

```
NH         4        .5      9940      .055      9983       .018   10017.6      .055     10527
X1     1.522        67   9983.44   10017.6       115       125       122
GR      1221   9448.46   1220.59      9495      1230      9495      1230      9533   1220.27       9533
GR    1220.0      9560      1230      9560      1230    9563.9      1230      9630   1219.09       9630
GR      1219   9636.57   1218.95      9643      1230      9643      1230      9708    1218.4       9708
GR    1218.3      9718      1230      9718      1230   9763.77      1230      9777   1217.93       9777
GR    1217.9      9787      1230      9787      1230      9855   1217.53      9855    1217.2       9918
GR      1230      9918      1230   9957.24      1217   9957.24      1216   9971.63      1215    9983.44
GR    1214.6     10000      1215   10017.6      1216   10027.3      1217     10038    1217.3      10048
GR      1230     10048      1230   10071.1      1230     10092      1218     10092      1218    10124.5
GR    1218.1     10140      1230     10140      1230     10197    1218.5     10197   1218.62      10213
GR      1230     10213      1230     10260   1218.94     10260      1219   10268.2   1219.03      10271
GR      1230     10271      1230     10330   1219.58     10330   1219.75     10348      1230      10348
GR      1230   10375.2      1230     10395   1220.12     10395   1220.21     10410      1230      10410
GR      1230     10464   1220.53     10464   1220.59     10475      1230     10475      1230      10527
GR    1220.9     10527      1221     10543

NC     0.055     0.055      .018        .1        .3

X1     1.575        42   9983.07   10019.9       272       283       277
GR      1221   9565.27   1220.53      9627      1230      9627      1230      9693   1220.02       9693
GR      1220   9696.06   1219.94      9705      1230      9705      1230      9770   1219.49       9770
GR    1219.4      9780      1230      9780      1230   9842.02      1219   9842.02      1218    9847.21
GR    1217.9      9852      1230      9852      1230      9892   1217.53      9892   1217.39       9905
GR      1230      9905      1230   9941.73      1230      9955   1216.38      9955      1216    9983.07
GR    1215.3     10000      1216   10019.9      1216   10024.8      1216     10026      1217      10033
GR      1218     10036   1218.17     10058      1230     10058      1230     10130   1218.66      10130
GR      1219   10180.6      1220   10194.6      1220   10206.9      1221   10209.4      1222    10210.4
GR      1222   10214.2      1222   10636.9

X1     1.670        57   9978.69     10020       504       504       504
GR      1224   9505.95      1224      9530      1232      9530      1232      9550      1224       9550
GR      1224   9561.19   1223.87      9575      1232      9575      1232      9635   1223.33       9635
GR    1223.1      9657      1232      9657      1232   9671.25      1232      9725   1222.23       9725
GR      1222   9741.51      1232   9741.51      1232      9795   1221.59      9795   1221.45       9813
GR      1232      9813      1232   9871.35      1221   9871.35   1220.56      9893      1232       9893
GR      1232   9920.01      1232      9957   1219.12      9957      1219   9961.85      1218    9970.31
GR      1217   9978.69      1216     10000      1217     10020      1217   10025.7      1218    10033.8
GR      1219   10037.1   1219.04     10044      1232     10044      1232     10113   1219.44      10113
```

GR	1219.5	10128	1232	10128	1232	10195	1219.92	10195	1219.98	10205
GR	1232	10205	1232	10208.5	1232	10260	1220.28	10260	1220.42	10286
GR	1232	10286	1232	10350	1220.78	10350	1221	10389.5	1222	10400.2
GR	1222	10541.1	1222.1	10620.2						

X1	1.725	57	9981.03	10017.3	292	292	292			
GR	1225	9582.57	1224	9586.95	1223	9592.66	1222.7	9620	1232	9620
GR	1232	9678	1222.05	9678	1222	9682.95	1221.95	9688	1232	9688
GR	1232	9750	1221.32	9750	1221.22	9760	1232	9760	1232	9782.28
GR	1232	9813	1220.75	9813	1220.59	9833	1232	9833	1232	9892
GR	1220.1	9892	1220.04	9902	1232	9902	1232	9907.33	1232	9956.88
GR	1232	9960	1218.72	9960	1218	9967.88	1217	9981.03	1216.5	10000
GR	1217	10017.3	1218	10025.5	1219	10030.1	1219.45	10055	1232	10055
GR	1232	10085.4	1232	10120	1220.16	10120	1220.2	10130	1232	10130
GR	1232	10198	1220.51	10198	1220.58	10213	1232	10213	1232	10278
GR	1220.8	10278	1220.94	10293	1232	10293	1232	10305.7	1232	10365
GR	1221	10365	1221	10378	1232	10378	1232	10425.8	1232	10436.1
GR	1221	10436.1	1221	10454.1						

X1	1.810	57	9989.25	10022.7	460	449	449			
GR	1232	9731.02	1232	9748.28	1232	9773	1222.25	9773	1222	9781.35
GR	1221.2	9795	1232	9795	1232	9800.14	1232	9823	1220.71	9823
GR	1220.5	9843	1232	9843	1232	9880.65	1232	9890	1219.83	9890
GR	1219.4	9913	1232	9913	1232	9935.88	1232	9960	1218.5	9960
GR	1218	9989.25	1217.4	10000	1218	10022.7	1218.52	10040	1232	10040
GR	1232	10055.84	1232	10111	1219.94	10111	1220	10114.76	1220	10135
GR	1232	10135	1232	10155	1220	10155	1220	10185	1232	10185
GR	1232	10227	1220	10227	1220	10248.9	1220.04	10253	1232	10253
GR	1232	10272	1220.22	10272	1220.62	10314	1232	10314	1232	10352.8
GR	1232	10373	1221.2	10373	1221.28	10387	1232	10387	1232	10447
GR	1221.7	10447	1221.9	10462	1232	10462	1232	10473.5	1232	10522
GR	1222.6	10522	1223	10555.3						

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X1	1.879	46	9981.65	10020.1	359	359	359			
GR	1227	9481.36	1226	9516.9	1225	9560.7	1224	9571.89	1224	9573.86
GR	1224.9	9613.26	1224.31	9682	1232	9682	1232	9718.68	1224	9718.68
GR	1223	9744.16	1223	9806.92	1222.77	9827	1232	9827	1232	9892
GR	1222.0	9892	1222	9894.66	1221.88	9903	1232	9903	1232	9963
GR	1221.0	9963	1221	9966.26	1220	9974.66	1219	9981.65	1218.3	10000
GR	1219	10020.1	1220	10028.8	1221	10044.2	1221.64	10072	1232	10072
GR	1232	10087.85	1232	10135	1222	10135	1222	10160	1232	10160
GR	1232	10223	1222	10223	1222	10266	1232	10266	1232	10320
GR	1222	10320	1222	10375.5	1222.39	10389	1232	10389	1232	10410.1
GR	1232	10450								

6.5

X1	1.925	27	9982	10020	245	250	245			
GR	1226	9804	1226	9840	1226	9877	1222.66	9877	1222.45	9900
GR	1226	9900	1226	9950	1226	9962	1221.2	9962	1221	9965
GR	1220	9982	1219	9991	1218.7	10000	1219	10012	1220	10020
GR	1221	10037	1221.07	10043	1226	10043	1226	10082	1221.56	10082
GR	1221.8	10106	1226	10106	1226	10149	1222.38	10149	1222.51	10160
GR	1226	10160	1226	10217						

6

X1	1.961	66	9981	10019	192	194	192			
GR	1227	9554.95	1226	9560.92	1226	9564	1232	9564	1232	9589.58
GR	1232	9609.98	1232	9645.35	1232	9668.31	1224	9668.31	1224	9715
GR	1232	9715	1232	9783	1224	9783	1224	9789.67	1223.64	9814
GR	1232	9814	1232	9856.74	1232	9877	1222.46	9877	1222	9894.48
GR	1232	9894.48	1232	9922.03	1232	9945.39	1232	9954	1219.8	9954
GR	1219.1	9981	1219	9993.01	1218.9	10000	1219	10008.6	1219.1	10019
GR	1219.8	10033	1232	10033	1232	10037.7	1232	10069.6	1232	10082
GR	1221.2	10082	1221.42	10094	1232	10094	1232	10128.2	1232	10152
GR	1222.2	10152	1222.26	10165	1232	10165	1232	10230	1222.72	10230
GR	1222.8	10242	1232	10242	1232	10269.6	1232	10305	1223.24	10305
GR	1223.3	10315	1232	10315	1232	10377	1223.73	10377	1223.8	10387
GR	1232	10387	1232	10417.1	1232	10453	1224.23	10453	1224.31	10466
GR	1232	10466	1232	10520	1224.66	10520	1224.76	10536	1232	10536
GR	1232	10574.1								

X1	2.044	66	9981	10018.7	436.2	392	437			
GR	1232	9714.95	1232	9731	1225.45	9731	1225	9744.01	1224	9781.61
GR	1224	9810	1232	9810	1232	9855	1224	9855	1224	9860.78
GR	1223.2	9910	1232	9910	1232	9928.59	1232	9958	1223.29	9958
GR	1222	9970.12	1221.1	9981	1221	9987.95	1220.2	10000	1221	10018.7
GR	1222	10028.1	1223	10032.7	1223.02	10042	1232	10042	1232	10092
GR	1223.1	10092	1223.15	10107	1232	10107	1232	10159	1223.26	10159
GR	1223.3	10176	1232	10176	1232	10235	1223.41	10235	1223.44	10250
GR	1232	10250	1232	10312	1223.57	10312	1223.59	10325	1232	10325
GR	1232	10385	1223.71	10385	1223.73	10395	1232	10395	1232	10453
GR	1223.8	10453	1223.88	10465	1232	10465	1232	10520	1223.99	10520
GR	1224	10525.8	1224.1	10537	1232	10537	1232	10595	1224.66	10595
GR	1224.8	10614	1232	10614	1232	10670	1225.3	10670	1225.38	10680
GR	1232	10680	1232	10741	1225.85	10741	1225.89	10747	1232	10747
GR	1232	10761								

X1	2.128	57	9990.25	10012.6	444	460	444			
GR	1226	9720	1225	9750.5	1224.82	9785	1232	9785	1232	9871
GR	1224.4	9871	1224.2	9900	1232	9900	1232	9953	1224.43	9953
GR	1223	9964.4	1222	9975.61	1221	9990.25	1220.75	10000	1221	10012.6
GR	1221	10022.8	1222	10024.7	1223	10027.9	1223.26	10035	1232	10035
GR	1232	10055.2	1232	10095	1224.44	10095	1224.57	10108	1232	10108
GR	1232	10146.3	1232	10158	1225.02	10158	1225.05	10172	1232	10172
GR	1232	10227	1225.15	10227	1225.18	10243	1232	10243	1232	10296
GR	1225.2	10296	1225.31	10309	1232	10309	1232	10372	1225.42	10372

GR	1225.4	10381	1232	10381	1232	10442	1225.56	10442	1225.58	10453
GR	1232	10453	1232	10513	1225.69	10513	1225.72	10528	1232	10528
GR	1232	10590	1225.83	10590	1225.86	10601	1232	10601	1232	10663
GR	1225.9	10663	1226	10678						

NC	0.035	0.055	0.018

X1	2.168	74	9982.63	10019	209	209	209			
GR	1227	9752.74	1226	9774.47	1225	9780.04	1224.68	9820	1232	9820
GR	1232	9867	1224.3	9867	1224.08	9894	1232	9894	1232	9903.41
GR	1232	9942.61	1232	9953	1223.53	9953	1223	9964.62	1222	9982.63
GR	1221.3	9998.34	1221.3	10000	1222	10012.1	1222	10019	1222.5	10045
GR	1232	10045	1232	10060	1222.82	10060	1223	10069	1223.1	10083
GR	1232	10083	1232	10130	1223.3	10130	1223.4	10155	1232	10155
GR	1232	10192	1223.6	10192	1223.8	10216	1232	10216	1232	10249
GR	1232	10274	1224.0	10274	1224.1	10292	1232	10292	1232	10341
GR	1224.2	10341	1224.2	10361	1232	10361	1232	10424	1224.4	10424
GR	1224.5	10440	1232	10440	1232	10492	1224.6	10492	1224.7	10504
GR	1232	10504	1232	10570	1224.8	10570	1224.8	10587	1232	10587
GR	1232	10634.1	1232	10637	1225.0	10637	1225.1	10662	1232	10662
GR	1232	10716	1225.5	10716	1225.6	10730	1232	10730	1232	10789
GR	1225.9	10789	1226	10793	1226.1	10810	1232	10810	1232	10860
GR	1226.4	10860	1226.6	10875	1232	10875	1232	10930		

X1	2.192	63	9981	10019.6	125	135	129			
GR	1227	9765	1226	9795	1225	9853.2	1225	9859.8	1225	9888.43
GR	1225	9897.6	1224	9927.88	1223	9972.11	1222.1	9981	1222	9985.69
GR	1221.4	10000	1222	10009.5	1223	10019.6	1223	10022.4	1223	10029
GR	1223.1	10038	1232	10038	1232	10098	1223.77	10098	1223.8	10107
GR	1232	10107	1232	10118.5	1232	10166	1224.2	10166	1224.2	10185
GR	1232	10185	1232	10238	1224.5	10238	1224.58	10258	1232	10258
GR	1232	10287	1232	10298	1224.78	10298	1224.96	10323	1232	10323
GR	1232	10328.1	1232	10380	1225.13	10380	1225.18	10400	1232	10400
GR	1232	10455	1225.3	10455	1225.35	10468	1232	10468	1232	10524
GR	1225.5	10524	1225.52	10538	1232	10538	1232	10599	1225.6	10599
GR	1225.7	10613	1232	10613	1232	10662	1225.83	10662	1225.8	10685
GR	1232	10685	1232	10740	1226.1	10740	1226.21	10752	1232	10752
GR	1232	10810	1226.8	10810	1227	10835				

X1	2.208	34	9980.97	10018.4	90	82	82			
GR	1227	9773.3	1226	9803.3	1226	9807.87	1226	9810.36	1225	9874.79
GR	1224	9937.09	1223	9980.97	1222.5	10000	1223	10018.4	1224	10028.1
GR	1232	10028.1	1232	10060.3	1232	10103	1225.44	10103	1225.55	10114
GR	1232	10114	1232	10157.5	1232	10178	1226.07	10178	1226.13	10193
GR	1232	10193	1232	10245	1226.32	10245	1226.39	10263	1232	10263
GR	1232	10308	1226.5	10308	1226.65	10335	1232	10335	1232	10387
GR	1226.8	10387	1226.9	10404	1232	10404	1232	10431.5		

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X1    2.218        42    9977.16    10049.8        48        58        54
GR     1227    9752.2       1226     9802.2      1225   9861.06      1224   9954.31    1223.85   9977.16
GR   1223.7     10000       1224    10049.8      1232   10049.9      1232     10104    1224.52     10104
GR   1224.6     10117       1232      10117      1232   10153.5      1232     10175    1225.07     10175
GR   1225.1     10192       1232      10192      1232     10245    1225.3     10245    1225.35     10262
GR     1232     10262       1232      10308    1225.5     10308   1225.61     10340       1232     10340
GR     1232     10390     1225.7      10390    1225.8     10405      1232     10405       1232   10459.7
GR     1226   10459.7     1226.1      10480      1232     10480      1232     10528    1226.41     10528
GR   1226.5     10550       1232      10550      1232     10600   1226.85     10600    1226.97     10620
GR     1232     10620       1232      10625
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Upstream from Thomas Road

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NC     .020     0.055      0.018
QT        2       644        644

X1    2.295        12       9968   10048.25       405       405       405
GR     1227      9848     1227.5       9852      1227      9860    1227.5      9875       1227      9900
GR   1226.4      9968     1226.3      10000    1226.48  10048.25   1226.65  10096.50       1227     10193
GR     1228     10230       1239      10335

X1    2.355         9       9960      10038       320       320       320
GR     1228      9960       1227       9970    1227.2     10000      1228     10038       1228     10060
GR     1227     10090       1228      10095      1229     10105      1230     10160
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    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

 *PROF 1
0

 CCHV=     .100 CEHV=     .300
 *SECNO  .225
 3280 CROSS SECTION       .22 EXTENDED      1.08 FEET

 3720 CRITICAL DEPTH ASSUMED

 3470 ENCROACHMENT STATIONS=     9962.0   10017.0  TYPE=      1  TARGET=       55.000
  ELENCL=   1200.00  ELENCR=   1200.00
      .225      7.35   1196.08   1196.08   1196.43   1197.66      1.57       .00       .00   1194.90
    1231.6      93.7    1117.5      20.4      31.9     106.1       9.1        .0        .0   1194.90
       .00      2.94     10.53      2.26      .028      .020      .035      .000   1188.73   9962.00
   .002834      370.      370.      370.         0        10         0       .00     55.00  10017.00

 CCHV=     .300 CEHV=     .500
 *SECNO  .231

 3265 DIVIDED FLOW

 3280 CROSS SECTION       .23 EXTENDED      3.02 FEET

 3301 HV CHANGED MORE THAN HVINS

 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  4.40

      .231      8.82   1198.02       .00       .00   1198.11       .09       .01       .44   1189.20
    1231.6     557.2     433.0     241.4     434.6     113.5     287.9        .3        .1   1189.30
       .00      1.28      3.81       .84      .028      .020      .035      .000   1189.20   9798.00
   .000147       31.       31.       31.         4         0         0       .00    289.70  10243.70

 SPECIAL CULVERT

 SC  CUNO      CUNV      ENTLC     COFQ      RDLEN     RISE      SPAN      CULVLN    CHRT      SCL       ELCHU     ELCHD
      1         .013      .40      2.70       .00      7.50     13.00    137.00      8         1       1189.59   1189.29

 CHART  8 - BOX CULVERT WITH FLARED WINGWALLS; NO INLET TOP EDGE BEVEL
 SCALE  1 - WINGWALLS FLARED 30 TO 75 DEGREES

 *SECNO  .257

 SPECIAL CULVERT OUTLET CONTROL + WEIR FLOW EG =   1198.83
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 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

SPECIAL CULVERT

   EGIC      EGOC        H4     QWEIR     QCULV       VCH     ACULV     ELTRD    WEIRLN
 1201.80   1202.01       .72      679.      556.     5.167      97.5   1197.41      199.


    .257      9.11   1198.61       .00       .00   1198.83       .22       .72       .00   1189.50
  1231.6     202.4     607.5     421.7     122.0     117.6     293.5       2.5        .9   1189.59
     .02      1.66      5.17      1.44      .028      .020      .035      .000   1189.50   9933.00
 .000257      135.      137.      135.         2         0         0       .00    199.00  10132.00


*SECNO  .272
3280 CROSS SECTION       .27 EXTENDED       .88 FEET

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.62

    .272     10.88   1198.88       .00       .00   1198.90       .02       .01       .06   1193.00
   817.3     530.8     286.5        .0     507.3     180.1        .0       3.6       1.2   1198.00
     .03      1.05      1.59       .00      .041      .018      .000      .000   1188.00   9920.49
 .000043       80.       80.       80.         2         0         0       .00     97.21  10017.70


CCHV=     .100 CEHV=     .300
*SECNO  .288
3280 CROSS SECTION       .29 EXTENDED       .83 FEET

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .64

3470 ENCROACHMENT STATIONS=         .0   10205.0  TYPE=      1  TARGET=    10205.000
    .288      7.93   1198.83       .00       .00   1198.93       .10       .01       .02   1195.00
  1037.6     508.0     510.9      18.8     342.7     157.8      32.6       4.8       1.4   1198.00
     .04      1.48      3.24       .58      .041      .018      .029      .000   1190.90   9897.56
 .000166       83.       83.       83.         3         0         0       .00    156.74  10054.30


*SECNO  .303
3280 CROSS SECTION       .30 EXTENDED       .90 FEET
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 9815.0 10198.0 TYPE= 1 TARGET= 383.000
ELENCL= 1210.00 ELENCR= 1210.00

.303	2.10	1199.00	1199.00	.00	1199.82	.83	.04	.22	1197.30
1205.5	391.2	797.8	16.5	121.7	92.0	6.9	5.4	1.7	1198.00
.05	3.21	8.67	2.40	.057	.018	.046	.000	1196.90	9915.23
.006968	77.	77.	77.	20	14	0	.00	145.22	10060.45

*SECNO .320
3280 CROSS SECTION .32 EXTENDED .75 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

.320	2.45	1199.75	1199.75	.00	1200.40	.66	.40	.02	1198.00
1407.5	107.7	950.0	349.9	70.7	121.8	160.1	6.0	2.1	1198.00
.05	1.52	7.80	2.19	.057	.018	.046	.000	1197.30	9897.00
.003330	89.	89.	89.	20	8	0	.00	269.50	10166.50

*SECNO .326

3470 ENCROACHMENT STATIONS= .0 10110.0 TYPE= 1 TARGET= 10110.000

.326	3.09	1200.09	.00	.00	1200.52	.43	.10	.02	1198.00
1417.0	68.4	610.1	738.5	42.6	82.8	254.4	6.3	2.3	1198.00
.05	1.61	7.37	2.90	.057	.018	.046	.000	1197.00	9952.00
.002487	34.	34.	34.	2	0	0	.00	194.34	10146.34

*SECNO .369
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= .0 10021.7 TYPE= 1 TARGET= 10021.700

.369	2.95	1200.75	1200.75	.00	1201.64	.89	.64	.14	1198.20
1417.0	69.0	940.4	407.6	33.4	102.9	158.4	8.0	3.2	1198.20
.06	2.07	9.13	2.57	.057	.018	.046	.000	1197.80	9960.03
.003243	226.	226.	226.	20	10	0	.00	158.82	10118.85

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   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST

*SECNO  .421
     .421      3.18    1201.68        .00        .00    1202.47        .79        .81        .01    1199.10
   1417.0      51.2      935.8      430.1       26.5      109.1      164.9        9.9        4.2    1199.10
      .07      1.93       8.58       2.61       .057       .018       .046       .000    1198.50    9963.23
  .002646      278.       278.       278.          3          0          0        .00     149.47   10112.70

*SECNO  .459

3470 ENCROACHMENT STATIONS=          .0   10020.9  TYPE=       1  TARGET=    10020.900
     .459      4.42    1202.42    1201.88        .00    1202.97        .54        .47        .02    1200.00
   1417.0      39.1      819.1      558.8       24.8      109.8      212.8       11.4        4.9    1200.00
      .08      1.58       7.46       2.63       .057       .018       .046       .000    1198.00    9959.97
  .002143      200.       200.       200.         16         11          0        .00     159.82   10119.80

CCHV=     .300 CEHV=     .500
*SECNO  .503

3265 DIVIDED FLOW

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     .503      2.28    1204.58    1204.58        .00    1205.30        .72        .67        .09    1202.70
   1417.0     201.7      803.7      411.7       90.3       91.7      155.9       13.2        6.0    1202.70
      .09      2.23       8.76       2.64       .057       .018       .046       .000    1202.30    9725.34
  .004232      229.       229.       229.         20         11          0        .00     265.34   10150.68

*SECNO  .542
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     .542      2.64    1205.84    1205.84        .00    1206.83        .99        .79        .14    1204.00
   1417.0      15.6     1340.2       61.2        9.5      163.2       29.2       14.5        6.9    1204.00
      .10      1.63       8.21       2.10       .057       .018       .046       .000    1203.20    9959.52
  .003447      220.       208.       205.          3          8          0        .00     114.12   10073.65

CCHV=     .100 CEHV=     .300
*SECNO  .627
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 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


3265 DIVIDED FLOW


3301 HV CHANGED MORE THAN HVINS

     .627      2.80   1207.80       .00       .00   1208.11       .31      1.21       .07   1206.00
   1417.0     108.7     410.5     897.7      58.0      57.7     322.0      16.7       8.3   1206.00
     .13      1.88      7.12      2.79      .045      .018      .045      .000   1205.00   9816.00
  .003265     200.      451.      220.         2         0         0       .00    319.13  10380.07


*SECNO  .674

3265 DIVIDED FLOW

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     .674      3.45   1208.95   1208.95       .00   1209.71       .76       .67       .14   1206.00
   1417.0     134.3     854.3     428.4      55.9      96.5     213.4      18.9       9.8   1206.00
     .14      2.40      8.85      2.01      .045      .018      .045      .000   1205.50   9893.00
  .002443     270.      248.      220.        20        11         0       .00    266.73  10381.73


*SECNO  .729

3265 DIVIDED FLOW


3470 ENCROACHMENT STATIONS=     9919.1   10428.0  TYPE=      1  TARGET=    -9919.110
 ELENCL=   1209.00  ELENCR= 100000.00
     .729      3.34   1209.94       .00       .00   1210.27       .34       .53       .04   1207.00
   1417.0     233.9     653.9     529.3     143.5      98.5     316.7      21.9      12.0   1207.00
     .16      1.63      6.64      1.67      .045      .018      .045      .000   1206.60   9690.00
  .001407     289.      289.      289.         2         0         0       .00    373.63  10409.63


*SECNO  .786

3265 DIVIDED FLOW
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

.786	3.63	1210.53	1210.53	.00	1211.41	.88	.53	.16	1207.00
1417.0	331.5	885.9	199.6	125.5	94.9	104.2	24.9	14.1	1207.00
.17	2.64	9.33	1.91	.045	.018	.045	.000	1206.90	9820.00
.002332	290.	298.	298.	20	8	0	.00	256.49	10373.30

*SECNO .821

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.92

.821	4.34	1211.44	.00	.00	1211.68	.24	.20	.06	1207.20
1417.0	635.2	690.9	90.8	407.6	127.1	95.9	26.9	15.4	1207.40
.19	1.56	5.44	.95	.045	.018	.045	.000	1207.10	9475.69
.000633	180.	190.	190.	3	0	0	.00	338.59	10340.21

CCHV= .300 CEHV= .500
*SECNO .857

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

.857	2.97	1211.47	1211.47	.00	1212.38	.91	.22	.33	1209.00
1417.0	154.0	1030.1	232.9	62.6	116.6	95.7	28.8	16.5	1209.00
.19	2.46	8.84	2.43	.045	.018	.045	.000	1208.50	9501.49
.003016	158.	187.	220.	5	20	0	.00	171.30	10100.71

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO .865

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.50

.865	9.66	1212.56	1208.63	.00	1212.66	.10	.04	.24	1210.00
1417.0	230.0	912.6	274.4	242.7	305.1	165.9	29.3	16.7	1209.00
.20	.95	2.99	1.65	.043	.038	.036	.000	1202.90	9462.19
.000484	50.	45.	20.	8	17	0	.00	296.53	10100.53

CCHV= .100 CEHV= .300
*SECNO .883

3265 DIVIDED FLOW

.883	9.48	1212.58	.00	.00	1212.73	.15	.05	.01	1212.00
1417.0	106.0	1005.6	305.4	133.3	289.5	163.1	30.7	17.3	1209.00
.21	.80	3.47	1.87	.043	.038	.036	.000	1203.10	9473.08
.000652	95.	95.	95.	2	0	0	.00	293.50	10099.27

*SECNO .915

3265 DIVIDED FLOW

.915	9.62	1212.72	.00	.00	1212.85	.13	.12	.00	1210.00
1417.0	196.3	929.3	291.4	152.5	267.6	203.0	33.2	18.5	1209.00
.22	1.29	3.47	1.44	.035	.038	.050	.000	1203.10	9542.43
.000688	169.	170.	202.	2	0	0	.00	273.38	10111.81

*SECNO .966

3265 DIVIDED FLOW

.966	9.30	1212.90	.00	.00	1213.02	.12	.17	.00	1210.00
1417.0	55.8	964.3	396.9	54.9	302.0	265.8	36.7	19.8	1209.00
.25	1.02	3.19	1.49	.035	.038	.050	.000	1203.60	9601.99
.000612	170.	266.	267.	2	0	0	.00	227.15	10118.00

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   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST

*SECNO 1.001

3265 DIVIDED FLOW

    1.001       9.29    1212.99        .00        .00    1213.20        .21        .16        .03    1212.00
   1417.0       86.3     1225.2      105.5       73.3      314.8       69.2       39.2       20.8    1210.00
      .27       1.18       3.89       1.52       .035       .038       .050       .000    1203.70    9669.01
  .001147       240.       190.       190.          0          0          0        .00     201.95   10058.00


*SECNO 1.042
    1.042       9.64    1213.34        .00        .00    1213.45        .11        .24        .01    1211.00
   1417.0      730.3      686.2         .6      447.3      201.4        2.0       42.1       22.5    1213.00
      .29       1.63       3.41        .29       .035       .038       .050       .000    1203.70    9612.63
  .001005       245.       215.       215.          3          0          0        .00     423.13   10035.76


CCHV=     .300 CEHV=     .500
*SECNO 1.054

3301 HV CHANGED MORE THAN HVINS

    1.054      10.67    1213.17        .00        .00    1213.79        .62        .08        .26    1202.58
   1417.0      358.8      960.5       97.8      193.7      127.2       42.9       42.8       23.0    1202.58
      .29       1.85       7.55       2.28       .035       .038       .050       .000    1202.50    9829.45
  .001602         60.        64.        69.          4          0          0        .00     199.72   10029.17


SPECIAL CULVERT

SC  CUNO       CUNV       ENTLC      COFQ       RDLEN      RISE       SPAN       CULVLN     CHRT       SCL        ELCHU      ELCHD
     1          .013        .30       2.70        .00       8.00      12.00     112.25     12          3       1202.63    1202.58

CHART 12 - BOX CULVERT; NON-OFFSET FLARED WINGWALLS; 3/4-INCH CHAMFER AT TOP OF INLET
SCALE  3 - WINGWALLS FLARED 18.4 DEGREES (3:1); INLET SKEWED 30 DEGREES

*SECNO 1.075

SPECIAL CULVERT OUTLET CONTROL + WEIR FLOW EG =   1214.45

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.93

SPECIAL CULVERT

     EGIC       EGOC        H4      QWEIR      QCULV       VCH      ACULV     ELTRD     WEIRLN
   1214.75    1216.98       .67       527.       720.     3.656       96.0   1213.01       118.


    1.075      11.73    1214.33        .00        .00    1214.45        .12        .67        .00    1202.62
   1240.0      609.9      514.0      116.0      292.8      140.6       85.3       43.9       23.3    1202.60
      .31       2.08       3.66       1.36       .035       .038       .050       .000    1202.60    9940.00
  .000329       112.       112.       112.          2          0          0        .00     108.96   10048.96
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   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST

*SECNO 1.084

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .68

    1.084      9.14   1214.34       .00       .00   1214.48       .14       .02       .01   1208.00
   1240.0     207.4     530.4     502.2      78.0     156.9     183.8      44.4      23.4   1208.00
      .31      2.66      3.38      2.73      .037      .045      .044      .000   1205.20   9965.00
  .000702       43.       43.       43.         3         0         0       .00     87.00  10052.00


CCHV=     .100 CEHV=     .300
*SECNO 1.101
    1.101      8.91   1214.41       .00       .00   1214.54       .13       .06       .00   1208.00
   1240.0     173.3     575.7     491.1      67.5     175.2     191.0      45.3      23.6   1208.00
      .32      2.57      3.29      2.57      .037      .045      .044      .000   1205.50   9967.87
  .000657       90.       90.       90.         2         0         0       .00     95.19  10063.06


CCHV=     .300 CEHV=     .500
*SECNO 1.108

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1215.00 ELREA=      1215.00

    1.108      8.84   1214.44       .00       .00   1214.59       .15       .04       .01   1214.00
   1240.0        .0    1240.0        .0        .0     394.4        .0      45.7      23.7   1214.00
      .32       .00      3.14       .00      .000      .045      .000      .000   1205.60   9970.84
  .001231       40.       40.       40.         2         0         0       .00     86.26  10057.10


SPECIAL BRIDGE

SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS        ELCHU     ELCHD
    1.05      1.56      2.70       .00     23.00      4.00    467.00      3.00   1205.72   1205.60

*SECNO 1.115
CLASS A LOW FLOW

3420 BRIDGE W.S.=    1214.47 BRIDGE VELOCITY=       3.10     CALCULATED CHANNEL AREA=       396.

 EGPRS      EGLWC       H3       QWEIR      QLOW      BAREA   TRAPEZOID      ELLC      ELTRD     WEIRLN
                                                               AREA
      .00   1214.61      .02        0.     1240.      467.      435.     1215.00   1215.10        0.
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   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST


3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA=      1215.00 ELREA=      1215.00

    1.115      8.79   1214.45        .00        .00   1214.61        .16        .03        .00   1215.10
   1240.0        .0    1240.0        .0        .0     382.4        .0       46.0       23.8   1214.50
      .33       .00      3.24        .00       .000      .045       .000       .000    1205.66   9972.35
  .001120       34.       34.       34.          0         0          0        .00      72.85  10045.20


*SECNO 1.121
    1.121      8.45   1214.45        .00        .00   1214.70        .25        .04        .04   1210.00
   1240.0     101.5    1070.0       68.4       37.8     256.2       31.7       46.3       23.8   1210.00
      .33      2.68      4.18       2.16       .037      .045       .044       .000    1206.00   9964.02
  .001241       36.       36.       36.          2         0          0        .00      73.29  10037.31


CCHV=      .500 CEHV=      .800
*SECNO 1.138
    1.138      7.13   1214.63        .00        .00   1214.84        .21        .12        .02   1214.00
   1240.0        1.8    1237.7         .5        3.0     337.0         .9       46.9       24.0   1214.00
      .33       .60      3.67        .59       .045      .045       .045       .000    1207.50   9943.39
  .001538       37.       90.      150.          3         0          0        .00      80.73  10024.12


CCHV=      .100 CEHV=      .300
*SECNO 1.181
    1.181     10.00   1214.95        .00        .00   1215.19        .24        .34        .01   1213.00
   1240.0       93.8    1129.7       16.5       51.7     276.1       16.7       48.7       24.5   1213.00
      .35      1.81      4.09        .99       .045      .045       .045       .000    1204.95   9947.00
  .001503      225.      225.      225.          3         0          0        .00     103.33  10050.33


CCHV=      .500 CEHV=      .800
*SECNO 1.224

3265 DIVIDED FLOW


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.41

    1.224      8.84   1215.34        .00        .00   1215.48        .14        .23        .05   1212.00
   1240.0       77.6    1033.2      129.3       77.0     324.4       81.0       50.8       25.2   1212.00
      .37      1.01      3.18       1.60       .045      .045       .045       .000    1206.50   9698.99
  .000751      230.      230.      130.          3         0          0        .00     226.30  10148.32
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1.239

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

1.239	4.52	1215.42	1215.42	.00	1216.10	.68	.13	.44	1214.00
1240.0	25.8	1061.2	153.0	13.4	149.7	62.1	51.3	25.5	1214.00
.38	1.93	7.09	2.47	.045	.045	.045	.000	1210.90	9882.04
.010455	90.	75.	30.	4	11	0	.00	195.61	10230.31

CCHV= .500 CEHV= .800
*SECNO 1.262

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 5.04

1.262	4.42	1216.32	.00	.00	1216.49	.17	.14	.25	1212.50
1240.0	274.6	720.6	244.9	232.9	168.8	250.8	52.6	26.1	1212.00
.39	1.18	4.27	.98	.055	.018	.055	.000	1211.90	9842.30
.000411	256.	123.	20.	2	0	0	.00	231.70	10225.00

*SECNO 1.301

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .60

1.301	4.26	1216.36	.00	.00	1216.95	.59	.13	.33	1213.00
1240.0	113.2	1007.7	119.1	77.5	148.6	82.5	54.6	26.9	1213.00
.40	1.46	6.78	1.44	.055	.018	.055	.000	1212.10	9868.00
.001134	225.	204.	130.	2	0	0	.00	166.16	10195.14

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    SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
    Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
    TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
    SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST

CCHV=     .100 CEHV=     .300
1490 NH CARD USED
*SECNO 1.353

3265 DIVIDED FLOW

     1.353      4.14   1216.94       .00       .00   1217.21       .27       .23       .03   1213.10
    1240.0     270.1     778.3     191.6     281.8     149.9     163.5      57.4      28.3   1213.10
       .42       .96      5.19      1.17      .066      .018      .056      .000   1212.80   9643.78
   .000635      290.      278.      235.         2         0         0       .00    287.16  10219.34

*SECNO 1.373

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =    .53

     1.373      3.61   1216.61   1216.44       .00   1217.53       .92       .12       .20   1214.00
    1240.0     110.0    1058.9      71.1      77.9     127.5      36.2      58.6      29.0   1214.00
       .42      1.41      8.30      1.97      .055      .018      .055      .000   1213.00   9818.00
   .002229      150.      106.      105.         6        11         0       .00    177.00  10040.00

1490 NH CARD USED
*SECNO 1.438

3265 DIVIDED FLOW

     1.438      3.75   1217.55       .00       .00   1218.15       .60       .59       .03   1215.00
    1240.0     150.7    1012.7      76.6     112.8     148.1      84.6      60.9      30.6   1215.00
       .44      1.34      6.84       .91      .056      .018      .055      .000   1213.80   9793.00
   .001375      280.      344.      390.         2         0         0       .00    250.42  10265.42

1490 NH CARD USED
*SECNO 1.499
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 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST


3265 DIVIDED FLOW

   1.499      3.36   1217.96       .00       .00   1218.67       .71       .49       .03   1215.00
  1240.0     152.5    1062.9      24.6     171.0     145.9      15.6      63.4      32.1   1215.00
     .45       .89      7.29      1.57      .100      .018      .055      .000   1214.60   9776.00
 .001682      350.      320.      250.         3         0         0       .00    157.39  10035.39


1490 NH CARD USED
*SECNO 1.522

3265 DIVIDED FLOW

   1.522      3.60   1218.20   1217.76       .00   1218.87       .68       .20       .00   1215.00
  1240.0     251.0     890.3      98.8     110.8     115.8      62.9      64.2      32.6   1215.00
     .46      2.26      7.69      1.57      .034      .018      .055      .000   1214.60   9777.00
 .001703      115.      122.      125.         4        10         0       .00    211.76  10140.00


CCHV=     .100 CEHV=     .300
*SECNO 1.575

3265 DIVIDED FLOW

   1.575      3.28   1218.58   1218.45       .00   1219.55       .97       .59       .09   1216.00
  1240.0     186.8     962.5      90.7      86.2     108.4      44.9      65.9      33.7   1216.00
     .47      2.17      8.88      2.02      .055      .018      .055      .000   1215.30   9844.13
 .002744      272.      277.      283.         4        11         0       .00    123.87  10058.00


*SECNO 1.670

3265 DIVIDED FLOW

   1.670      3.82   1219.82       .00       .00   1220.69       .87      1.13       .01   1217.00
  1240.0      58.7    1091.3      90.0      34.3     137.1      50.0      68.6      35.0   1217.00
     .49      1.71      7.96      1.80      .055      .018      .055      .000   1216.00   9957.00
 .001879      504.      504.      504.         3         0         0       .00    102.00  10128.00


*SECNO 1.725
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   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      L-BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        R-BANK ELEV
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWID     ENDST


3265 DIVIDED FLOW

    1.725       3.92    1220.42        .00        .00    1221.20        .77        .50        .01    1217.00
   1240.0      109.6     1028.4      102.0       58.3      133.3       65.2       70.2       35.7    1217.00
      .50       1.88       7.71       1.56       .055       .018       .055       .000    1216.50    9892.00
  .001539       292.       292.       292.          2          0          0        .00     115.00   10130.00

*SECNO 1.810

3265 DIVIDED FLOW

    1.810       3.99    1221.39        .00        .00    1221.80        .40        .56        .04    1218.00
   1240.0      219.3      782.1      238.7      149.1      123.6      209.0       74.0       37.6    1218.00
      .53       1.47       6.33       1.14       .055       .018       .055       .000    1217.40    9791.67
  .001029       460.       449.       449.          2          0          0        .00     262.33   10387.00

*SECNO 1.879

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
    1.879       3.44    1221.74    1221.74        .00    1222.91       1.17        .57        .23    1219.00
   1240.0       57.3     1095.1       87.6       28.4      118.7       50.1       76.8       39.2    1219.00
      .54       2.01       9.23       1.75       .055       .018       .055       .000    1218.30    9963.00
  .002784       359.       359.       359.         20          9          0        .00     109.00   10072.00

*SECNO 1.925

3265 DIVIDED FLOW

    1.925       3.92    1222.62    1222.23        .00    1223.49        .87        .55        .03    1220.00
   1240.0       73.6     1061.8      104.6       41.8      131.9       69.5       78.1       39.9    1220.00
      .55       1.76       8.05       1.50       .055       .018       .055       .000    1218.70    9882.36
  .001818       245.       245.       250.          7          8          0        .00     133.64   10160.00
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 1.961

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 1.64

1.961	4.44	1223.34	.00	.00	1223.74	.39	.20	.05	1219.10
1240.0	182.0	940.6	117.4	124.6	164.7	101.2	79.5	40.5	1219.10
.56	1.46	5.71	1.16	.055	.018	.055	.000	1218.90	9877.00
.000677	192.	192.	194.	3	0	0	.00	143.48	10315.00

*SECNO 2.044

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

2.044	3.69	1223.89	1223.89	.00	1224.88	1.00	.50	.18	1221.10
1240.0	89.7	1049.4	100.9	55.0	120.8	71.9	82.6	42.2	1221.00
.58	1.63	8.69	1.40	.055	.018	.055	.000	1220.20	9867.72
.002347	436.	437.	392.	20	12	0	.00	208.28	10465.00

*SECNO 2.128

3265 DIVIDED FLOW

2.128	4.17	1224.92	1224.50	.00	1225.85	.93	.96	.01	1221.00
1240.0	227.0	838.9	174.1	109.3	90.3	72.1	85.2	44.0	1221.00
.59	2.08	9.29	2.42	.055	.018	.055	.000	1220.75	9767.08
.001971	444.	444.	460.	5	5	0	.00	141.92	10108.00

*SECNO 2.168

3265 DIVIDED FLOW

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	L-BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	R-BANK ELEV
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = 2.33

2.168	4.63	1225.93	.00	.00	1226.08	.14	.15	.08	1222.00
1240.0	246.3	634.9	358.8	186.7	154.2	437.5	87.8	45.2	1222.00
.62	1.32	4.12	.82	.035	.018	.055	.000	1221.30	9774.80
.000363	209.	209.	209.	2	0	0	.00	359.80	10790.61

*SECNO 2.192

3265 DIVIDED FLOW

2.192	4.54	1225.94	.00	.00	1226.15	.21	.06	.02	1222.10
1240.0	361.1	725.0	153.9	249.1	153.9	197.4	89.8	46.3	1223.00
.63	1.45	4.71	.78	.035	.018	.055	.000	1221.40	9798.51
.000516	125.	129.	135.	2	0	0	.00	396.49	10685.00

*SECNO 2.208

3265 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE, KRATIO = .64

2.208	3.38	1225.88	.00	.00	1226.27	.39	.07	.05	1223.00
1240.0	465.0	737.8	37.2	215.4	117.2	27.3	90.8	46.9	1223.00
.63	2.16	6.30	1.36	.035	.018	.055	.000	1222.50	9818.06
.001271	90.	82.	82.	3	0	0	.00	221.04	10114.00

*SECNO 2.218

3265 DIVIDED FLOW

2.218	2.44	1226.14	.00	.00	1226.35	.20	.06	.02	1223.85
1240.0	430.5	751.4	58.0	242.9	168.5	79.5	91.3	47.3	1224.00
.64	1.77	4.46	.73	.035	.018	.055	.000	1223.70	9794.87
.000950	48.	54.	58.	3	0	0	.00	369.26	10480.00

```
 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS     L-BANK ELEV
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA       R-BANK ELEV
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

*SECNO 2.295

3265 DIVIDED FLOW

3280 CROSS SECTION      2.30 EXTENDED       .30 FEET

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   2.295      1.00   1227.30   1227.30      .00   1227.60       .31       .58       .03   1226.40
   644.0     150.4     390.3     103.3     45.2      74.1      82.5      94.5      50.5   1226.48
     .66      3.33      5.27      1.25     .020      .018      .055      .000   1226.30   9848.00
 .004533      405.      405.      405.       20        18         0       .00    334.89  10203.99

*SECNO 2.355
3280 CROSS SECTION      2.36 EXTENDED       .58 FEET

   2.355      1.58   1228.58   1228.54      .00   1229.07       .49      1.41       .06   1228.00
   644.0        .0     556.8      87.2       .0      92.3      52.2      95.8      52.3   1228.00
     .68       .00      6.03      1.67     .000      .018      .055      .000   1227.00   9960.00
 .004306      320.      320.      320.        5        14         0       .00    140.79  10100.79
```

TW West bank between 0.320 and 0.326

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
9.50	9.88	3.91	9.50	9.88	3.91	7	1199.746	1200.092	.320	.326

TW West bank between 0.303 and 0.320

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
201.97	203.78	.89	211.47	213.66	1.03	7	1198.996	1199.746	.303	.320

TW West bank between 0.288 and 0.303

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
167.90	168.33	.25	379.37	381.99	.69	7	1198.831	1198.996	.288	.303

TW West bank between 0.272 and 0.288

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
163.20	163.56	.22	542.57	545.55	.55	7	1198.875	1198.831	.272	.288

TW West bank between 0.257 and 0.272

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
279.35	280.05	.25	821.92	825.60	.45	7	1198.610	1198.875	.257	.272

TW East bank between 0.303 and 0.320

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
.00	.00	.00	821.92	825.60	.45	7	1198.996	1199.746	.303	.320

TW East bank between 0.288 and 0.303

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
.00	.00	.00	821.92	825.60	.45	7	1198.831	1198.996	.288	.303

TW East bank between 0.272 and 0.288

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
57.16	56.97	.32	879.08	882.57	.40	7	1198.875	1198.831	.272	.288

TW East bank between 0.257 and 0.272

ASQ	QCOMP	ERRAC	TASQ	TCQ	TABER	NITER	DSWS	USWS	DSSNO	USSNO
128.24	128.48	.19	1007.32	1011.06	.37	7	1198.610	1198.875	.257	.272

THIS RUN EXECUTED 01MAY97 14:31:55

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

City of Scottsdale - G

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
*	.225	1231.60	1196.08	1196.08	7.35	55.00	10.53
*	.225	1231.60	1196.08	1196.08	7.35	55.00	10.53
*	.231	1231.60	1198.02	.00	8.82	289.70	3.81
	.231	1231.60	1198.02	.00	8.82	289.70	3.81
	.257	1231.60	1198.61	.00	9.11	199.00	5.17
	.257	1231.60	1198.61	.00	9.11	199.00	5.17
*	.272	817.27	1198.88	.00	10.88	97.21	1.59
*	.272	817.27	1198.88	.00	10.88	97.21	1.59
*	.288	1037.63	1198.83	.00	7.93	156.74	3.24
*	.288	1037.63	1198.83	.00	7.93	156.74	3.24
*	.303	1205.53	1199.00	1199.00	2.10	145.22	8.67
*	.303	1205.53	1199.00	1199.00	2.10	145.22	8.67
*	.320	1407.50	1199.75	1199.75	2.45	269.50	7.80
*	.320	1407.50	1199.75	1199.75	2.45	269.50	7.80
	.326	1417.00	1200.09	.00	3.09	194.34	7.37
	.326	1417.00	1200.09	.00	3.09	194.34	7.37
*	.369	1417.00	1200.75	1200.75	2.95	158.82	9.13
*	.369	1417.00	1200.75	1200.75	2.95	158.82	9.13
	.421	1417.00	1201.68	.00	3.18	149.47	8.58
	.421	1417.00	1201.68	.00	3.18	149.47	8.58
	.459	1417.00	1202.42	1201.88	4.42	159.82	7.46
	.459	1417.00	1202.42	1201.88	4.42	159.82	7.46

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
*	.503	1417.00	1204.58	1204.58	2.28	265.34	8.76
*	.503	1417.00	1204.58	1204.58	2.28	265.34	8.76
*	.542	1417.00	1205.84	1205.84	2.64	114.12	8.21
*	.542	1417.00	1205.84	1205.84	2.64	114.12	8.21
	.627	1417.00	1207.80	.00	2.80	319.13	7.12
	.627	1417.00	1207.80	.00	2.80	319.13	7.12
*	.674	1417.00	1208.95	1208.95	3.45	266.73	8.85
*	.674	1417.00	1208.95	1208.95	3.45	266.73	8.85
	.729	1417.00	1209.94	.00	3.34	373.63	6.64
	.729	1417.00	1209.94	.00	3.34	373.63	6.64
*	.786	1417.00	1210.53	1210.53	3.63	256.49	9.33
*	.786	1417.00	1210.53	1210.53	3.63	256.49	9.33
*	.821	1417.00	1211.44	.00	4.34	338.59	5.44
*	.821	1417.00	1211.44	.00	4.34	338.59	5.44
*	.857	1417.00	1211.47	1211.47	2.97	171.30	8.84
	.857	1417.00	1211.47	1211.47	2.97	171.30	8.84
*	.865	1417.00	1212.56	1208.63	9.66	296.53	2.99
*	.865	1417.00	1212.56	1208.63	9.66	296.53	2.99
	.883	1417.00	1212.58	.00	9.48	293.50	3.47
	.883	1417.00	1212.58	.00	9.48	293.50	3.47
	.915	1417.00	1212.72	.00	9.62	273.38	3.47
	.915	1417.00	1212.72	.00	9.62	273.38	3.47
	.966	1417.00	1212.90	.00	9.30	227.15	3.19
	.966	1417.00	1212.90	.00	9.30	227.15	3.19
	1.001	1417.00	1212.99	.00	9.29	201.95	3.89
	1.001	1417.00	1212.99	.00	9.29	201.95	3.89
	1.042	1417.00	1213.34	.00	9.64	423.13	3.41
	1.042	1417.00	1213.34	.00	9.64	423.13	3.41
	1.054	1417.00	1213.17	.00	10.67	199.72	7.55
	1.054	1417.00	1213.17	.00	10.67	199.72	7.55
*	1.075	1240.00	1214.33	.00	11.73	108.96	3.66
*	1.075	1240.00	1214.33	.00	11.73	108.96	3.66
*	1.084	1240.00	1214.34	.00	9.14	87.00	3.38
*	1.084	1240.00	1214.34	.00	9.14	87.00	3.38

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
	1.101	1240.00	1214.41	.00	8.91	95.19	3.29
	1.101	1240.00	1214.41	.00	8.91	95.19	3.29
	1.108	1240.00	1214.44	.00	8.84	86.26	3.14
	1.108	1240.00	1214.44	.00	8.84	86.26	3.14
	1.115	1240.00	1214.45	.00	8.79	72.85	3.24
	1.115	1240.00	1214.45	.00	8.79	72.85	3.24
	1.121	1240.00	1214.45	.00	8.45	73.29	4.18
	1.121	1240.00	1214.45	.00	8.45	73.29	4.18
	1.138	1240.00	1214.63	.00	7.13	80.73	3.67
	1.138	1240.00	1214.63	.00	7.13	80.73	3.67
	1.181	1240.00	1214.95	.00	10.00	103.33	4.09
	1.181	1240.00	1214.95	.00	10.00	103.33	4.09
*	1.224	1240.00	1215.34	.00	8.84	226.30	3.18
*	1.224	1240.00	1215.34	.00	8.84	226.30	3.18
*	1.239	1240.00	1215.42	1215.42	4.52	195.61	7.09
	1.239	1240.00	1215.42	1215.42	4.52	195.61	7.09
*	1.262	1240.00	1216.32	.00	4.42	231.70	4.27
*	1.262	1240.00	1216.32	.00	4.42	231.70	4.27
*	1.301	1240.00	1216.36	.00	4.26	166.16	6.78
*	1.301	1240.00	1216.36	.00	4.26	166.16	6.78
	1.353	1240.00	1216.94	.00	4.14	287.16	5.19
	1.353	1240.00	1216.94	.00	4.14	287.16	5.19
*	1.373	1240.00	1216.61	1216.44	3.61	177.00	8.30
*	1.373	1240.00	1216.61	1216.44	3.61	177.00	8.30
	1.438	1240.00	1217.55	.00	3.75	250.42	6.84
	1.438	1240.00	1217.55	.00	3.75	250.42	6.84
	1.499	1240.00	1217.96	.00	3.36	157.39	7.29
	1.499	1240.00	1217.96	.00	3.36	157.39	7.29
	1.522	1240.00	1218.20	1217.76	3.60	211.76	7.69
	1.522	1240.00	1218.20	1217.76	3.60	211.76	7.69
	1.575	1240.00	1218.58	1218.45	3.28	123.87	8.88
	1.575	1240.00	1218.58	1218.45	3.28	123.87	8.88
	1.670	1240.00	1219.82	.00	3.82	102.00	7.96
	1.670	1240.00	1219.82	.00	3.82	102.00	7.96

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
	1.725	1240.00	1220.42	.00	3.92	115.00	7.71
	1.725	1240.00	1220.42	.00	3.92	115.00	7.71
	1.810	1240.00	1221.39	.00	3.99	262.33	6.33
	1.810	1240.00	1221.39	.00	3.99	262.33	6.33
*	1.879	1240.00	1221.74	1221.74	3.44	109.00	9.23
*	1.879	1240.00	1221.74	1221.74	3.44	109.00	9.23
	1.925	1240.00	1222.62	1222.23	3.92	133.64	8.05
	1.925	1240.00	1222.62	1222.23	3.92	133.64	8.05
*	1.961	1240.00	1223.34	.00	4.44	143.48	5.71
*	1.961	1240.00	1223.34	.00	4.44	143.48	5.71
*	2.044	1240.00	1223.89	1223.89	3.69	208.28	8.69
	2.044	1240.00	1223.89	1223.89	3.69	208.28	8.69
	2.128	1240.00	1224.92	1224.50	4.17	141.92	9.29
	2.128	1240.00	1224.92	1224.50	4.17	141.92	9.29
*	2.168	1240.00	1225.93	.00	4.63	359.80	4.12
*	2.168	1240.00	1225.93	.00	4.63	359.80	4.12
	2.192	1240.00	1225.94	.00	4.54	396.49	4.71
	2.192	1240.00	1225.94	.00	4.54	396.49	4.71
*	2.208	1240.00	1225.88	.00	3.38	221.04	6.30
*	2.208	1240.00	1225.88	.00	3.38	221.04	6.30
	2.218	1240.00	1226.14	.00	2.44	369.26	4.46
	2.218	1240.00	1226.14	.00	2.44	369.26	4.46
*	2.295	644.00	1227.30	1227.30	1.00	334.89	5.27
*	2.295	644.00	1227.30	1227.30	1.00	334.89	5.27
	2.355	644.00	1228.58	1228.54	1.58	140.79	6.03
	2.355	644.00	1228.58	1228.54	1.58	140.79	6.03

City of Scottsdale - G

SUMMARY PRINTOUT TABLE 100

SECNO	EGLWC	ELLC	EGPRS	ELTRD	QPR	QWEIR	CLASS	H3	DEPTH	CWSEL	VCH	EG
1.115	1214.61	1215.00	.00	1215.10	1240.00	.00	1.00	.02	8.79	1214.45	3.24	1214.61
1.115	1214.61	1215.00	.00	1215.10	1240.00	.00	1.00	.02	8.79	1214.45	3.24	1214.61

SUMMARY OF ERRORS AND SPECIAL NOTES

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CAUTION SECNO=      .225  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .225  PROFILE=  2  CRITICAL DEPTH ASSUMED

WARNING SECNO=      .231  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .231  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      .272  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .272  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      .288  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .288  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      .303  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .303  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .303  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      .303  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .303  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .303  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      .320  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .320  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .320  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      .320  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .320  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .320  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      .369  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .369  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .369  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      .369  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .369  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .369  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      .503  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .503  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .503  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      .503  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .503  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .503  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      .542  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .542  PROFILE=  1  MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .542  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .542  PROFILE=  2  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=      .674  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .674  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .674  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      .674  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .674  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .674  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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CAUTION SECNO=      .786  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .786  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .786  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      .786  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .786  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .786  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=      .821  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .821  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      .857  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .857  PROFILE=  1  MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      .857  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      .857  PROFILE=  2  MINIMUM SPECIFIC ENERGY

WARNING SECNO=      .865  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      .865  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     1.075  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.075  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     1.084  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.084  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     1.224  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.224  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     1.239  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     1.239  PROFILE=  1  MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     1.239  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     1.239  PROFILE=  2  MINIMUM SPECIFIC ENERGY

WARNING SECNO=     1.262  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.262  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     1.301  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.301  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     1.373  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.373  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     1.879  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     1.879  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     1.879  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=     1.879  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     1.879  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     1.879  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     1.961  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=     1.961  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     2.044  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     2.044  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
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CAUTION SECNO=      2.044  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      2.044  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      2.044  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      2.044  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=      2.168  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      2.168  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=      2.208  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
WARNING SECNO=      2.208  PROFILE=  2  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      2.295  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      2.295  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      2.295  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO=      2.295  PROFILE=  2  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      2.295  PROFILE=  2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      2.295  PROFILE=  2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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FLOODWAY DATA, City of Scottsdale - G
PROFILE NO. 2

STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE
.225	55.	147.	8.4	1196.1	1196.1	.0
.231	446.	836.	1.5	1198.0	1198.0	.0
.257	199.	533.	2.3	1198.6	1198.6	.0
.272	97.	687.	1.2	1198.9	1198.9	.0
.288	157.	533.	1.9	1198.8	1198.8	.0
.303	145.	221.	5.5	1199.0	1199.0	.0
.320	270.	353.	4.0	1199.7	1199.7	.0
.326	194.	380.	3.7	1200.1	1200.1	.0
.369	159.	295.	4.8	1200.8	1200.8	.0
.421	149.	300.	4.7	1201.7	1201.7	.0
.459	160.	347.	4.1	1202.4	1202.4	.0
.503	425.	338.	4.2	1204.6	1204.6	.0
.542	114.	202.	7.0	1205.8	1205.8	.0
.627	564.	438.	3.2	1207.8	1207.8	.0
.674	489.	366.	3.9	1208.9	1208.9	.0
.729	720.	559.	2.5	1209.9	1209.9	.0
.786	553.	325.	4.4	1210.5	1210.5	.0
.821	865.	631.	2.2	1211.4	1211.4	.0
.857	599.	275.	5.2	1211.5	1211.5	.0
.865	638.	714.	2.0	1212.6	1212.6	.0
.883	626.	586.	2.4	1212.6	1212.6	.0
.915	569.	623.	2.3	1212.7	1212.7	.0
.966	516.	623.	2.3	1212.9	1212.9	.0
1.001	389.	457.	3.1	1213.0	1213.0	.0
1.042	423.	651.	2.2	1213.3	1213.3	.0
1.054	200.	364.	3.9	1213.2	1213.2	.0
1.075	109.	519.	2.4	1214.3	1214.3	.0
1.084	87.	419.	3.0	1214.3	1214.3	.0
1.101	95.	434.	2.9	1214.4	1214.4	.0
1.108	86.	394.	3.1	1214.4	1214.4	.0
1.115	73.	382.	3.2	1214.5	1214.5	.0
1.121	73.	326.	3.8	1214.5	1214.5	.0
1.138	81.	341.	3.6	1214.6	1214.6	.0
1.181	103.	344.	3.6	1215.0	1215.0	.0
1.224	449.	482.	2.6	1215.3	1215.3	.0
1.239	348.	225.	5.5	1215.4	1215.4	.0
1.262	383.	653.	1.9	1216.3	1216.3	.0
1.301	327.	309.	4.0	1216.4	1216.4	.0
1.353	576.	595.	2.1	1216.9	1216.9	.0
1.373	222.	242.	5.1	1216.6	1216.6	.0
1.438	472.	346.	3.6	1217.5	1217.5	.0
1.499	259.	333.	3.7	1218.0	1218.0	.0

FLOODWAY DATA, City of Scottsdale - G
PROFILE NO. 2

STATION	FLOODWAY WIDTH	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WATER SURFACE ELEVATION WITHOUT FLOODWAY	DIFFERENCE
1.522	363.	290.	4.3	1218.2	1218.2	.0
1.575	214.	240.	5.2	1218.6	1218.6	.0
1.670	171.	221.	5.6	1219.8	1219.8	.0
1.725	238.	257.	4.8	1220.4	1220.4	.0
1.810	595.	482.	2.6	1221.4	1221.4	.0
1.879	109.	197.	6.3	1221.7	1221.7	.0
1.925	278.	243.	5.1	1222.6	1222.6	.0
1.961	438.	391.	3.2	1223.3	1223.3	.0
2.044	597.	248.	5.0	1223.9	1223.9	.0
2.128	341.	272.	4.6	1224.9	1224.9	.0
2.168	1016.	778.	1.6	1225.9	1225.9	.0
2.192	886.	600.	2.1	1225.9	1225.9	.0
2.208	296.	360.	3.4	1225.9	1225.9	.0
2.218	685.	491.	2.5	1226.1	1226.1	.0
2.295	356.	202.	3.2	1227.3	1227.3	.0
2.355	141.	145.	4.5	1228.6	1228.6	.0

EXISTING FIRM FLOWS

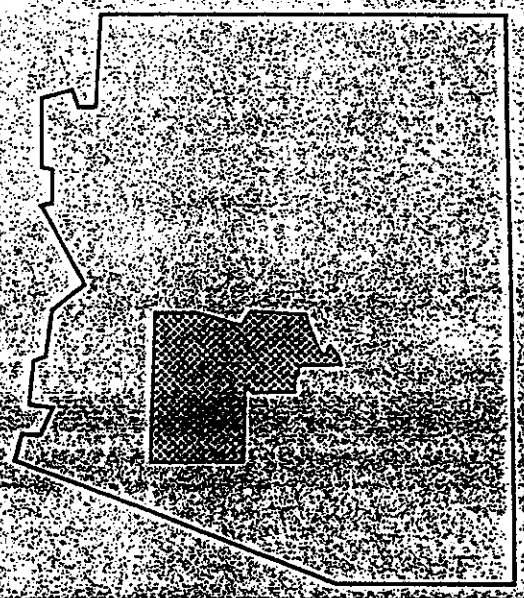
AMM

FLOOD INSURANCE STUDY

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

VOLUME 1 OF 12



COMMUNITY NAME	COMMUNITY NUMBER
AVONDALE, CITY OF	040038
BUCKEYE, TOWN OF	040039
CAREFREE, TOWN OF	040126
CAVE CREEK, TOWN OF	040129
CHANDLER, CITY OF	040040
EL MIRAGE, TOWN OF	040041
GILA BEND, TOWN OF	040043
GILBERT, TOWN OF	040044
GLENDALE, CITY OF	040045
GOODYEAR, TOWN OF	040046
GUADALUPE, TOWN OF	040111
LITCHFIELD PARK, CITY OF	040128
MARICOPA COUNTY,	
UNINCORPORATED AREAS	040037
MESA, CITY OF	040048
PARADISE VALLEY, TOWN OF	040049
PEORIA, CITY OF	040050
PHOENIX, CITY OF	040051
QUEEN CREEK, TOWN OF	040132
SCOTTSDALE, CITY OF	045012
SURPRISE, TOWN OF	045053
TEMPE, CITY OF	040054
TOLLESON, CITY OF	040055
WICKENBURG, TOWN OF	040056
YOUNGSTOWN, TOWN OF	040057

REVISED: SEPTEMBER 30, 1995

Federal Emergency Management Agency

[1]Not Computed

Table 3. Summary of Discharges (Cont'd)

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Granite Reef Wash					
Pima Road	6.2	74	278	644	1,431
McDowell Road	7.2	580	950	1,240	2,660
Van Buren Street	7.5	720	1,158	1,417	3,150
Indian Bend Wash					
Scottsdale Road	44.26	3,400	11,000	16,000	35,000
Indian Bend Road	59.6	3,500	12,000	17,000	39,000
Indian School Road	100.0	4,000	14,000	20,000	43,000
Downstream limit of McKellips Lake, Just upstream of McKellips Road Bridge	107.0	4,000	14,000	20,000	42,000
At 32nd Street	2.77	1,000	1,400	2,400	5,500
At 36th Street	9.17	2,000	3,500	6,000	15,500
At Cactus Road	15.07	1,500	5,600	9,000	21,000
Myrtle Avenue Wash					
At Mouth	0.87	600	1,000	1,300	2,800
Tenth Street Wash					
At Cheryl Drive	0.81	385	--[1]	1,440	3,650
At Hatcher Road	1.59	910	--[1]	3,400	8,600
At Alice Avenue	2.25	1,170	--[1]	4,390	11,110
At Griswold Road	2.69	1,265	--[1]	4,740	12,000
Wash B					
At a point 1,100 feet downstream of 124th Street	1.95	290	1,160	1,925	4,580
At a point 4,500 feet downstream of 124th Street	2.25	340	1,390	2,300	5,500
At a point 4,500 feet downstream of 124th Street	2.25	205	835	1,380	3,300
At a point 5,500 feet downstream of 124th Street	2.50	190	820	1,300	3,200

[1]Not Computed

THIS RUN EXECUTED 26-MAR-84 10 38 34

ICHEC	IHD	NDIM	IDIM	STRT	METRIC	HYING	G	USEL	FQ
10	2	0	0	0.003250	0.00	0.0	0	1190.00	0.000

IPROC	IPLOT	PRPVB	XBECV	XBECH	FN	ALLDC	IBW	CHWIM	ITRACE
1.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

VARIABLE CODES FOR SUMMARY PRINTOUT

38.000	11.000	18.000	3.000	10.000	1.000	51.000	42.000	0.000	41.000
23.000	34.000	37.000	38.000	41.000	46.000	45.000	44.000	49.000	47.000
14.000	13.000	14.000	15.000	43.000	1.000	38.000	39.000	42.000	1.000
41.000	53.000	21.000	22.000	54.000	4.000	63.000	23.000	24.000	201.000

LPRNT NUMSEC ********REQUESTED SECTION NUMBERS********

10.000	10.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	0.035	0.035	0.035	0.100	0.300	0.000	0.000	0.000	0.000	0.000
	4.000	720.000	1158.000	1417.000	3120.000	0.000	0.000	0.000	9.000	
	4.000	10.000	335.000	0.020	371.000	[illegible]	400.000	0.055	451.000	
	2600.000	10.000	971.000	400.000	420.000	400.000	400.000	0.000	0.000	0.000
	1199.000	0.000	1193.500	1.000	1194.500	170.000	1195.000	335.000	1193.000	370.000
	1188.000	371.000	1189.000	400.000	1195.000	400.100	1196.000	450.000	1210.000	451.000

	3.000	10.000	485.000	0.020	555.000	10.000	556.000	0.000	0.000	
	2600.000	6.000	485.000	555.000	39.000	400.000	400.000	0.000	0.000	
	1199.000	0.000	1196.500	245.000	1196.000	485.000	1199.000	495.000	1196.000	555.000
	1205.000	591.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	315.000	10.000	840.000	0.000	0.000	0.000	
[illegible]	[illegible]	0.000	215.000	315.000	300.000	285.000	900.000	0.000	[illegible]	0.000	
[illegible]	[illegible]	0.000	1200.000	65.000	1197.000	915.000	1195.000	950.000	1197.000	215.000	
[illegible]	120.000	400.000	1202.000	540.000	0.000	0.000	0.000	0.000	0.000	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	165.000	[illegible]	700.000	700.000	700.000	0.000	0.000	07.000	
[illegible]	[illegible]	0.000	1204.000	100.000	1200.000	165.000	1200.000	205.000	1204.000	300.000	
[illegible]	[illegible]	465.000	1208.000	665.000	0.000	0.000	0.000	0.000	0.000	0.000	
[illegible]	4.000	10.000	0.100	0.055	30.000	0.020	95.000	10.000	570.000	[illegible]	
[illegible]	[illegible]	0.000	30.000	98.000	225.000	335.000	250.000	0.000	0.000	[illegible]	
[illegible]	1220.000	0.000	1209.000	0.100	1204.000	30.000	1202.000	50.000	1204.000	[illegible]	
[illegible]	1204.000	115.000	1206.000	230.000	1208.000	570.000	0.000	0.000	0.000	0.000	
[illegible]	3.000	10.000	0.100	0.020	75.000	10.000	[illegible]	[illegible]	0.000	[illegible]	
[illegible]	7100.000	13.000	25.000	75.000	200.000	135.000	[illegible]	0.000	0.000	[illegible]	
[illegible]	1220.000	0.000	1204.000	0.100	1203.000	25.000	1202.000	55.000	1208.000	[illegible]	
[illegible]	1204.000	100.000	1220.000	100.100	1220.000	345.000	1204.000	420.000	1206.000	585.000	
[illegible]	1208.000	775.000	1210.000	905.000	1210.000	1120.000	0.000	0.000	0.000	0.000	
[illegible]	3.000	10.000	0.100	0.020	75.000	10.000	1095.000	0.000	0.000	[illegible]	
[illegible]	7400.000	13.000	25.000	75.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	1220.000	0.000	1207.000	0.100	1203.000	25.000	1204.000	5.000	1207.000	[illegible]	
[illegible]	1220.000	100.100	1220.000	350.000	1206.000	350.100	1206.000	460.000	1208.000	65.000	
[illegible]	1210.000	880.000	1210.000	1095.000	0.000	0.000	[illegible]	[illegible]	0.000	[illegible]	
[illegible]	[illegible]	10.000	0.100	0.020	[illegible]	[illegible]	[illegible]	[illegible]	0.000	[illegible]	
[illegible]	7700.000	13.000	25.000	75.000	300.000	[illegible]	[illegible]	[illegible]	0.000	[illegible]	
[illegible]	1220.000	0.000	1207.000	0.100	1204.000	25.000	1204.000	75.000	1207.000	100.000	
[illegible]	1220.000	100.100	1220.000	360.000	1207.000	360.100	1207.000	415.000	1208.000	560.000	
[illegible]	1208.000	495.000	1209.500	555.000	1208.000	620.000	1210.500	825.000	1211.000	190.000	
[illegible]	0.020	10.000	620.000	0.020	720.100	10.000	[illegible]	0.000	0.000	[illegible]	
[illegible]	7900.000	17.000	650.000	695.000	250.000	255.000	[illegible]	[illegible]	0.000	[illegible]	
[illegible]	1226.000	0.000	1213.000	0.100	1214.000	110.000	[illegible]	185.000	1220.000	[illegible]	
[illegible]	1220.000	620.000	1207.000	620.100	1204.000	650.000	1204.300	695.000	1207.000	[illegible]	
[illegible]	1220.000	720.100	1220.000	990.000	1208.000	990.100	1208.000	1305.000	1211.500	[illegible]	
[illegible]	1211.500	1845.000	1212.000	1890.000	0.000	0.000	0.000	0.000	0.000	[illegible]	
[illegible]	3.000	10.000	640.000	0.020	[illegible]	[illegible]	[illegible]	[illegible]	0.000	[illegible]	
[illegible]	8100.000	16.000	665.000	715.000	150.000	150.000	[illegible]	0.000	0.000	[illegible]	
[illegible]	4.000	1206.000	640.000	1205.600	665.000	1205.600	715.000	1206.000	740.000	[illegible]	
[illegible]	1220.000	0.000	1213.000	0.100	1212.000	80.000	1211.000	205.000	1210.500	[illegible]	
[illegible]	1208.000	845.000	1205.000	690.000	1208.000	985.000	1210.000	[illegible]	1208.000	[illegible]	
[illegible]	1209.500	1200.000	1211.000	1340.000	[illegible]	1445.000	[illegible]	[illegible]	1212.500		
[illegible]	1211.000	1930.000	0.000	0.000	[illegible]	[illegible]	[illegible]	[illegible]	0.000		

	000	10.000	920.000	0.020	1020.000	10.000	2040.000	0.000	0.000	0.000	
	400.000	10.000	745.000	975.000	300.000	300.000	300.000	0.000	0.000	0.000	
	4.000	1208.300	920.000	1206.000	945.000	1206.000	995.000	1206.200	1204.000	0.000	
	1212.300	0.000	1212.300	195.000	1212.300	290.000	1220.000	290.100	[illegible]	[illegible]	
	1212.000	300.000	1210.000	560.000	1208.000	840.000	1203.300	930.000	[illegible]	1135.000	
	[illegible]	[illegible]	[illegible]	1212.000	1212.000	1212.000	1212.000	1213.000	1020.000	[illegible]	2040.000
	4.000	10.000	1025.000	0.035	1045.000	0.020	1085.000	0.035	1135.000	10.000	
	1791.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	1700.000	10.000	1085.000	1135.000	225.000	370.000	300.000	0.000	0.000	[illegible]	
	4.000	1206.700	1025.000	1206.400	1045.000	1200.000	1095.000	1207.200	1135.000		
	1212.300	0.000	1212.300	200.000	1212.300	210.000	1212.000	600.000	1209.300	[illegible]	
	1206.000	1085.000	1205.000	1105.000	1208.000	1220.000	1212.000	1380.000	1213.300	1487.000	
	1214.000	1645.000	1225.000	1645.000	1225.000	1645.000	1214.000	1645.000	1219.000	[illegible]	
	1225.000	1791.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	[illegible]	
	4.000	10.000	1060.000	0.020	1100.000	0.035	[illegible]	[illegible]	1615.000		
	1000.000	10.000	1190.000	1160.000	285.000	315.000	300.000	0.000	0.000	[illegible]	
	4.000	1208.800	1060.000	1208.400	1100.000	1208.200	1120.000	1208.200	1170.000	[illegible]	
	1214.300	0.000	1214.000	223.000	1213.000	410.000	1212.000	730.000	1210.000	885.000	
	1220.000	885.100	1220.000	985.000	1209.300	985.100	1208.000	1130.000	1200.300	[illegible]	
	1208.000	1160.000	1212.000	1355.000	1216.000	[illegible]	[illegible]	[illegible]	[illegible]		
	4.000	280.000	930.000	1240.000	2660.000	0.000	0.000	0.000	0.000		
	4.000	10.000	1100.000	0.020	1140.000	0.035	1210.000	10.000	1735.000		
	9300.000	14.000	1185.000	1210.000	320.000	285.000	[illegible]	[illegible]	[illegible]		
	[illegible]	1208.200	1100.000	1208.700	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
	[illegible]	0.000	1214.300	330.000	1213.000	560.000	[illegible]	[illegible]	1210.000		
	1208.000	1195.000	1202.000	1200.000	1208.000	[illegible]	[illegible]	[illegible]	1220.000		
	1220.000	1485.000	1214.000	1485.100	1216.000	1610.000	1216.300	1735.000	0.000		
	0.000	0.000	0.000	0.300	0.300	0.000	0.000	0.000	0.000		
	4.000	10.000	810.000	0.020	840.000	0.035	810.000	0.300	960.000		
	760.100	0.000	0.000	0.000	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
	[illegible]	14.000	875.000	910.000	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
	10.000	0.000	0.000	0.000	0.000	0.000	0.000	1210.000	1210.000		
	3.000	1220.000	739.900	1220.000	748.100	1208.600	860.000	0.000	0.000		
	1216.000	0.000	1214.000	410.000	1212.000	555.000	1211.300	670.000	1220.000	[illegible]	
	[illegible]	755.000	1211.300	755.100	1210.000	810.000	[illegible]	940.000	1208.400	[illegible]	
	1203.000	895.000	1212.000	910.000	1213.000	[illegible]	[illegible]	[illegible]	0.000		
	4.000	10.000	665.000	0.035	717.300	0.035	767.300	10.000	1085.000		
	0.300	1.615	2.700	0.000	8.000	0.010	40.000	0.000	1208.150	[illegible]	
	0.000	9.110	9.110	9.110	9.110	0.000	0.000	0.000	665.000	[illegible]	
	9630.000	95.000	740.100	748.000	40.000	60.000	60.000	0.000	0.000		
	0.000	0.000	1.000	1208.150	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
	0.000	0.000	0.000	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
	0.000	0.000	1216.000	1216.000	260.000	1215.600	1215.600	200.000	1214.000	[illegible]	
	945.000	1212.200	1212.200	665.000	1211.100	1211.200	685.000	1211.000	1211.000	[illegible]	
	1211.300	1210.000	717.300	1211.300	1210.000	720.000	1211.400	1210.000	728.000	[illegible]	
	1210.000	728.100	1211.600	1209.000	731.000	[illegible]	[illegible]	[illegible]	1211.800	[illegible]	
	[illegible]	1211.800	1208.150	744.000	[illegible]	[illegible]	[illegible]	[illegible]	1208.150		
	1211.900	1208.150	752.000	1211.900	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

	1210.000	755.000	1210.000	1212.000	760.000	1212.000	1212.000	767.500	1212.000	1216.000	
	0.000	1215.000	1215.000	1085.000	1216.000	1216.000	0.000	0.000	0.000	0.000	
	1216.000	0.000	1215.400	260.000	1214.000	300.000	1212.200	845.000	1211.200	669.000	
	[illegible]	[illegible]	1210.000	[illegible]	1210.000	[illegible]	1210.000	720.000	[illegible]	749.000	
	1208.000	[illegible]	1208.000	731.000	1203.150	[illegible]	1203.150	740.100	[illegible]	[illegible]	
	1200.100	748.000	1203.200	748.100	1208.000	752.000	1209.000	753.500	[illegible]	[illegible]	
	1211.000	755.000	1212.000	760.000	1212.300	767.500	1215.000	920.000	1216.000	1085.000	
	1.000	10.000	770.000	0.035	798.000	0.035	845.000	0.035	870.000	10.000	
	1215.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	2900.000	14.000	798.000	845.000	205.000	275.000	270.000	0.000	0.000		
	1.000	1212.200	739.900	1212.200	740.100	0.000	0.000	[illegible]	[illegible]		
	1216.000	0.000	1215.500	148.000	1215.500	375.000	1213.000	555.000	1212.000	[illegible]	
	1212.500	725.500	1212.300	770.000	1212.000	798.000	1201.200	817.000	1201.200	825.000	
	1212.000	845.000	1212.300	870.000	1216.000	1000.000	1217.000	1110.000	0.000	[illegible]	
	5.000	0.000	0.000	0.100	0.300	0.000	0.000	0.000	0.000		
	4.000	10.000	540.000	0.055	560.000	[illegible]	[illegible]	[illegible]	[illegible]		
	10600.000	14.000	860.000	605.000	170.000	525.000	400.000	0.000	0.000	[illegible]	
	1.000	1212.300	840.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	1216.000	0.000	1219.900	125.000	1215.000	150.000	1225.000	150.100	1225.000	215.000	
	1215.000	915.100	1212.900	825.000	1215.500	425.000	1212.000	560.000	1202.000	[illegible]	
	1202.000	593.000	1212.000	605.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
	4.000	10.000	478.000	0.055	500.000	0.035	545.000	[illegible]	[illegible]		
X1	10600.000	17.000	500.000	545.000	275.000	250.000	[illegible]	[illegible]	[illegible]		
	1216.000	0.000	1215.000	150.000	1225.000	150.100	1225.000	240.000	1215.000	[illegible]	
	1214.000	545.000	1210.000	435.000	1220.000	435.100	1220.000	475.000	1212.000	[illegible]	
	1212.000	500.000	1208.000	525.000	1208.000	533.000	[illegible]	545.000	1212.000	[illegible]	
	1214.000	585.000	1220.000	585.100	0.000	0.000	0.000	0.000	0.000	[illegible]	
	10.000	10.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
X1	14700.000	7.000	15.000	55.000	350.000	150.000	300.000	0.000	0.000	0.000	
	1220.000	0.000	1212.200	0.100	1211.600	15.000	1211.200	35.000	1211.600	[illegible]	
	1212.300	70.000	1220.000	70.100	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
	1220.000	7.000	15.000	55.000	285.000	300.000	300.000	0.000	0.000	[illegible]	
	1220.000	0.000	1212.500	0.100	1212.000	15.000	1211.500	35.000	1212.000	[illegible]	
	1215.500	70.000	1220.000	70.100	0.000	0.000	0.000	0.000	0.000	[illegible]	
	1500.000	7.000	15.000	55.000	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
	1225.000	0.000	1212.500	0.100	[illegible]	[illegible]	[illegible]	[illegible]	1212.300		
	1212.500	70.000	1220.000	71.000	0.000	0.000	0.000	0.000	0.000		
X1	11800.000	7.000	15.000	55.000	345.000	240.000	300.000	0.000	0.000		
	1220.000	0.000	1215.000	0.100	1212.300	15.000	1212.800	35.000	1213.300	[illegible]	
	1212.800	70.000	1220.000	70.100	[illegible]	[illegible]	[illegible]	[illegible]	0.000		
X1	12100.000	7.000	15.000	55.000	300.000	300.000	300.000	0.000	0.000		
	1220.000	0.000	1214.800	0.100	1214.300	15.000	1213.800	35.000	1214.300		
	1214.800	70.000	1220.000	70.100	0.000	0.000	0.000	0.000	0.000		

	12800.000	7.000	15.000	55.000	285.000	310.000	300.000	0.000	0.000	0.000
	1220.000	0.000	1216.900	0.100	1219.900	15.000	1215.300	35.000	1215.900	55.000
	1216.900	70.000	1225.000	70.100	0.000	0.000	0.000	0.000	0.000	0.000
	13100.000	10.000	1015.000	1055.000	315.000	290.000	300.000	0.000	0.000	0.000
	1227.000	0.000	1226.000	215.000	1223.500	285.000	1235.000	100	1235.000	
	1235.000	1000.100	1216.000	1015.000	1216.000	1055.000	1217.000	1070.000	1225.000	
	13400.000	12.000	1015.000	1055.000	300.000	300.000	300.000	0.000	0.000	0.000
	1227.500	0.000	1227.000	110.000	1225.000	265.000	1225.000	330.000	1235.000	330.100
	1235.000	1000.000	1217.600	1000.100	1217.100	1015.000	1216.600	1035.000	1217.100	1055.000
	1217.600	1070.000	1225.000	1070.100	0.000	0.000	0.000	0.000	0.000	
	13700.000	12.000	1015.000	1055.000	315.000	290.000	300.000	0.000	0.000	0.000
	1227.500	0.000	1227.000	180.000	1225.700	330.000	1224.000	410.000	1235.000	410.100
	1235.000	1000.000	1218.500	1000.100	1218.000	1015.000	1217.500	1035.000	1218.000	1055.000
	1218.500	1070.000	1230.000	1070.100	0.000	0.000	0.000	0.000	0.000	
	14000.000	12.000	1015.000	1055.000	290.000	310.000	300.000			
	1227.000	0.000	1226.500	215.000	1225.500	175.000	1225.000	140.000	1235.000	
	1235.000	1000.000	1219.000	1000.100	1218.500	1015.000	1218.000	1035.000	1218.500	1055.000
	1219.000	1070.000	1230.000	1070.100	0.000	0.000	0.000	0.000	0.000	0.000
	14300.000	12.000	1015.000	1055.000	300.000	300.000	300.000	0.000	0.000	
	1227.500	0.000	1226.400	390.000	1225.000	450.000	1224.000	520.000	1235.000	52[illegible]
	1235.000	1000.000	1219.000	1000.100	1218.500	1015.000	1218.000	1035.000	1218.500	1055.000
	1219.000	1070.000	1230.000	1070.100	0.000	0.000	0.000	0.000	0.000	0.000
	14600.000	11.000	1015.000	1055.000	290.000	300.000	300.000	0.000	0.000	0.000
	1227.500	0.000	1225.000	500.000	1224.000	595.000	1235.000	500.100	1225.000	
	1219.000	1000.100	1218.500	1015.000	1218.000	1035.000	1218.500	1055.000	1219.000	
	1220.000	1070.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	15000.000	12.000	1015.000	1055.000	390.000	410.000	400.000	0.000	0.000	0.000
	1227.500	0.000	1226.000	490.000	1225.000	640.000	1224.000	700.000	1235.000	700.100
	1235.000	1000.001	1220.200	1000.100	1219.700	1015.000	1219.200	1035.000	1219.700	10[illegible]
	1220.200	1070.000	1230.000	1070.100	0.000	0.000	0.000	0.000	0.000	
	15400.000	11.000	1015.000	1055.000	400.000	385.000	400.000	0.000	0.000	0.000
	1226.000	0.000	1224.500	635.000	1223.000	835.000	1235.000	835.100	1235.000	1000.[illegible]
	1220.900	1000.100	1220.400	1015.000	1219.900	1035.000	1220.400	1055.000	1220.900	1070.[illegible]
	1220.000	1070.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	15700.000	9.000	1000.000	1080.000	220.000	900.000	300.000	0.000	0.000	0.[illegible]
	1229.000	0.000	1235.000	620.000	1224.000	810.000	1223.500	1000.000	1223.000	1015.[illegible]
	1222.500	1025.000	1223.000	1060.000	1223.500	1080.000	1235.000	1080.100	0.000	0.[illegible]

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PAGE [illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	785.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.000
[illegible]	[illegible].000	0.000	1225.000	820.000	1224.000	810.000	1224.000	935.000	[illegible]	0.000
[illegible]	1223.000	1123.000	1235.000	1125.100	1235.000	1470.000	1227.000	1470.100	1228.000	985.000
[illegible]	1227.000	1820.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1545.000
[illegible]	[illegible]	[illegible]	[illegible]	0.000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.000

COMPUTATION OF SUPERELEVATION

Entellus™

SHEET 1 OF 1

BY HAA DATE 5/5/97

CHECK _____ DATE _____

CLIENT FCDMC

JOB NAME Granite Reef Wash JOB NO. 310.45

Superelevation @ 87th street

$$h = 2.3 \frac{\bar{u}^2}{g} \log \frac{R_o}{R_i}$$

$\bar{u}$ @ 1.262 = 4.27

R_o = 300

R_i = 100 ft

$$h = 2.3 \frac{4.27^2}{32.2} \log \frac{300}{100}$$

$= (2.3)(0.189)(0.477)$

$= 0.21$ ft

Entellus™

SHEET 1 OF 1

BY HAA DATE 5/5/97

CHECK _____ DATE _____

CLIENT FCDMC

JOB NAME Granite Reef Wash JOB NO. 310.45

Superelevations @ 84th place

$$h = 2.3 \frac{\bar{u}^2}{g} \log \frac{R_o}{R_i}$$

where:

$\bar{u}$ → average flow velocity

R_o → outer radii of the curve

R_i → iner radii of the curve

$\bar{u}$ @ 0.627 = 7.12 fps

R_i = 150 ft

R_o = 180 ft

$$h = 2.3 \frac{7.12^2}{32.2} \log \frac{180}{150}$$

h = 0.287 ft

flow depth @ Zone x approximately <u>0.29 ft</u>

Richard H. French

OPEN-CHANNEL HYDRAULICS

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Tokyo Toronto

ft³/s (85 m³/s) at relatively large depths of flow (Chow, 1959). A preliminary estimate of freeboard for an unlined channel can be obtained from

$$F = \sqrt{Cy} \qquad (7.1.1)$$

where F = freeboard, feet
y = design depth of flow, feet
C = coefficient which varies from 1.5 at Q = 20 ft³/s (0.57 m³/s) to 2.5 for Q = 3000 ft³/s (85 m³/s)

When a flow moves around a curve, a rise in the water surface occurs at the outer bank with a corresponding lowering of the water surface at the inner bank. In the design of a channel, it is important that this difference in water levels be estimated. If all the flow is assumed to move around the curve at the subcritical average velocity $\bar{u}$, then

$$\Delta h = \frac{\bar{u}^2 b}{gR} \qquad (7.1.2)$$

where Δh = change in water surface elevation across channel
b = channel width
R = distance from center of curve to centerline of channel

Equation (7.1.2) always underestimates Δh because of the average velocity assumption. In some cases, this equation may underestimate by as much as 50 percent (Houk, 1956). If Newton's second law of motion is applied to each streamline of the flow as it passes around the curve, then it is possible to demonstrate that the transverse water surface profile is a logarithmic curve of the form

$$h = 2.3\frac{\bar{u}^2}{g}\log\frac{R_o}{R_i} \qquad (7.1.3)$$

where R_o and R_i are the outer and inner radii of the curve. Woodward (1920, 1941) assumed that the velocity of flow was zero at the banks and had a maximum u_M at the centerline of the curving channel. Between the sides and the center, the velocity varied according to a parabolic curve. Applying Newton's second law with these assumptions,

$$h = \frac{u_M^2}{g}\left[\frac{20}{3}\frac{R}{b} - \frac{16R^3}{b^3} + \left(\frac{4R^2}{b^2} - 1\right)^2 \ln\left(\frac{2R+b}{2R-b}\right)\right] \qquad (7.1.4)$$

Of these three equations, Eq. (7.1.4) provides the best estimate of Δh. The subject of superelevation around curves will be treated in some detail in a subsequent section of this chapter, but the foregoing equations provide the basis for making initial design estimates.

There are no set rules governing the minimum radii of curvature for canals. [illegible] when the radii of the [illegible] the canal was greater than 3 times the width of the level portion of the c[illegible] bed. In India, the minimum radii of curvature are [illegible] longer than thos[illegible] in the United States. For example, some Indian e[illegible]ers recommend [illegible] mum radius of 300 ft (91 m) for canals carrying less than 10 ft³/s (0.30 m[illegible] 5000 ft (1500 m) for canals carrying more than 3000 ft³/s (85 m³/s) [illegible] 1956).

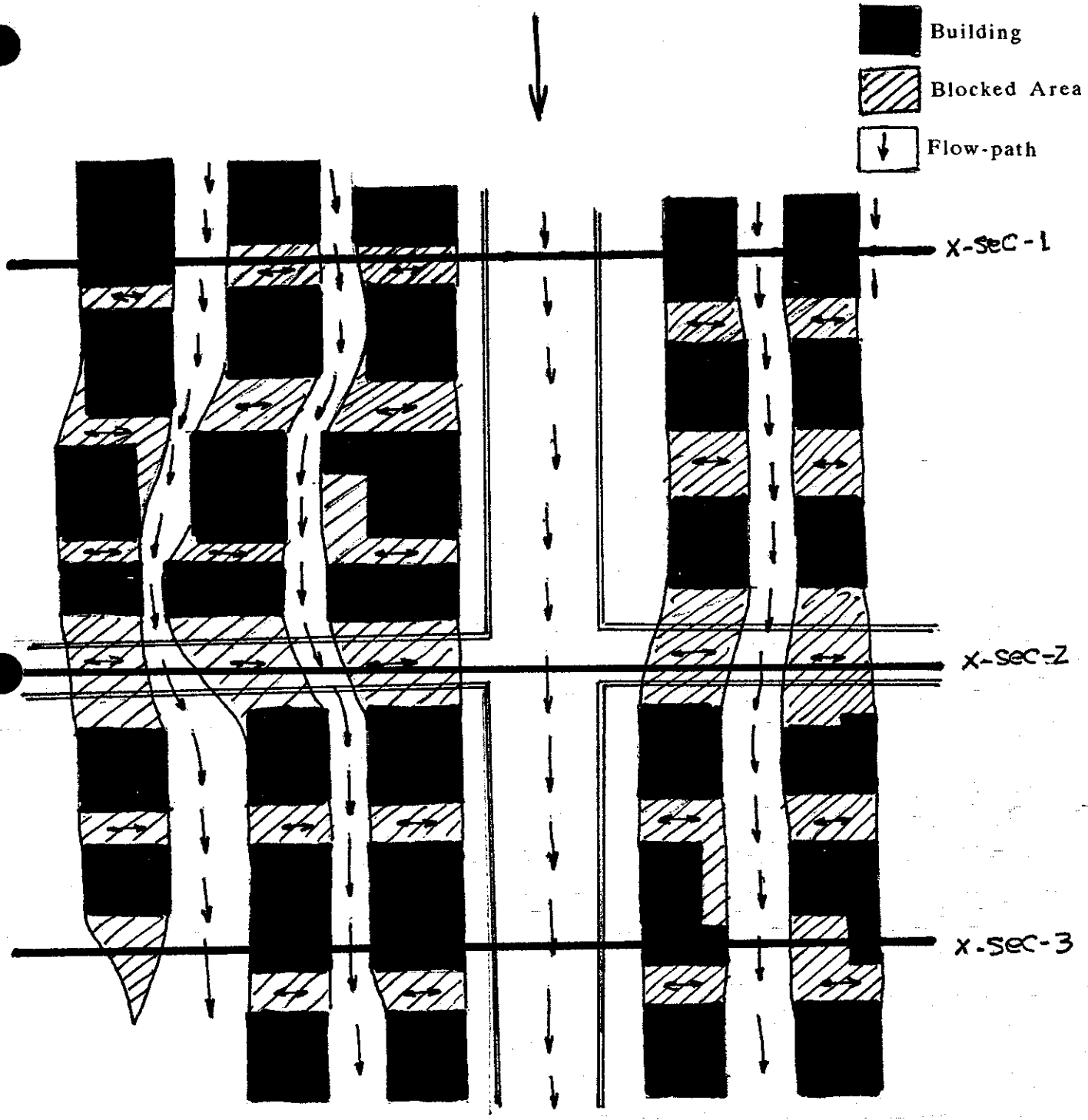
The width of the banks along a canal are usually governed by a nur[illegible] considerations which include the size of the canal, the amount of exc[illegible] available for bank construction, and the need for maintenance roads. [illegible] roads are needed, the top widths for both lined and unlined canals are [illegible] m) or more. The bank top is usually graded away from the canal so th[illegible] cipitation will not flow into the canal. Bank widths must also be suffi[illegible] provide for stability against canal water pressure and keep percolatin[illegible] below the ground level outside the banks.

7.2 DESIGN OF LINED CHANNELS

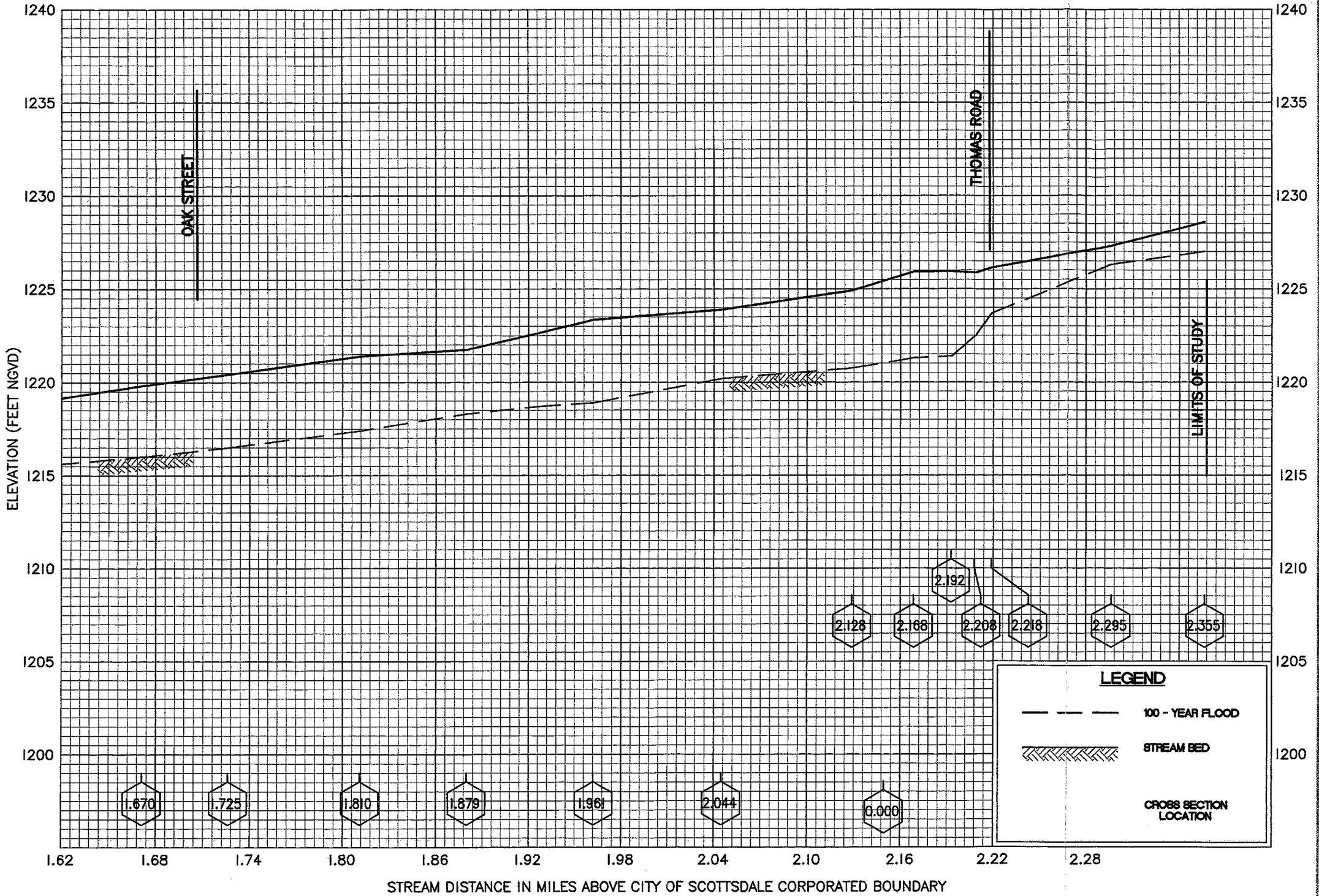
Lined channels are built for five primary reasons:

1. To permit the transmission of water at high velocities through areas [illegible] or difficult excavation in a cost-effective fashion
2. To permit the transmission of water at high velocity at a reduced c[illegible] tion cost
3. To decrease canal seepage, thus conserving water and reducing the v[illegible] ging of lands adjacent to the canal
4. To reduce the annual costs of operation and maintenance
5. To ensure the stability of the channel section

The design of lined channels from the viewpoint of hydraulic engi[illegible] a rather elementary process which generally consists of proporti[illegible] assumed channel cross section. Some typical cross sections of lined [illegible] used on irrigation projects in the United States are summarized in [illegible] and a typical lined section of the All-American Canal is shown in Fig. [illegible] tional information regarding channel linings can be found in Willis [illegible] and Anonymous (1963). A recommended procedure for proportionir[illegible] section is summarized in Table 7.4. In this table, it is assumed that t[illegible] flow Q_D, the longitudinal slope of the channel S, the type of channel [illegible] tion, e.g., trapezoidal, and the lining material have all been selected p[illegible] initiation of the channel design process.



FLOW-PATH DIAGRAM



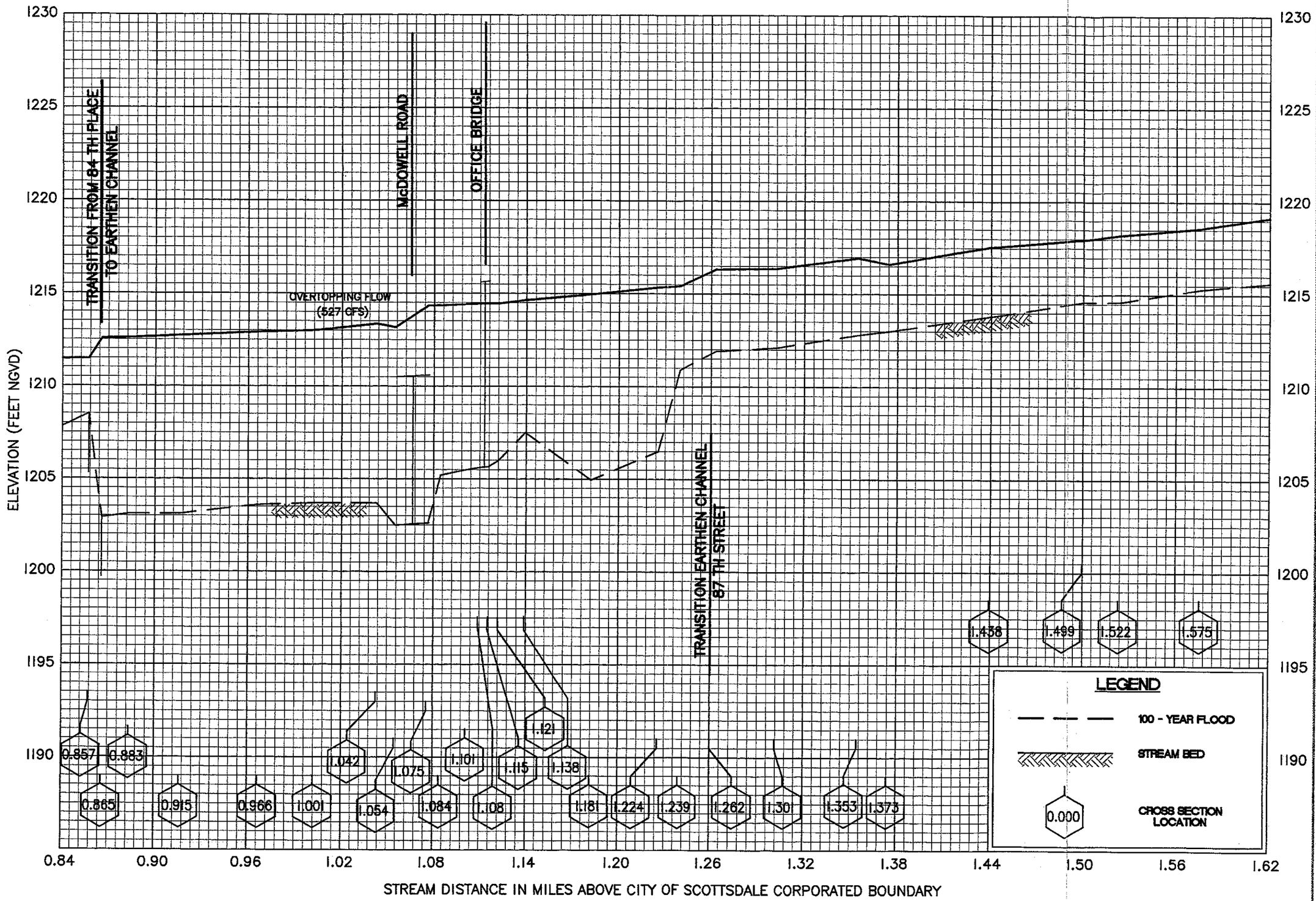
FLOOD PROFILES

GRANITE REEF WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANITE REEF WASH
FLOOD DELINEATION STUDY

Files: GRR-PRF.DWG FHPROF.HPC, FHPROF.PCP (Sheet 3 of 3)
Date: 05-05-1997



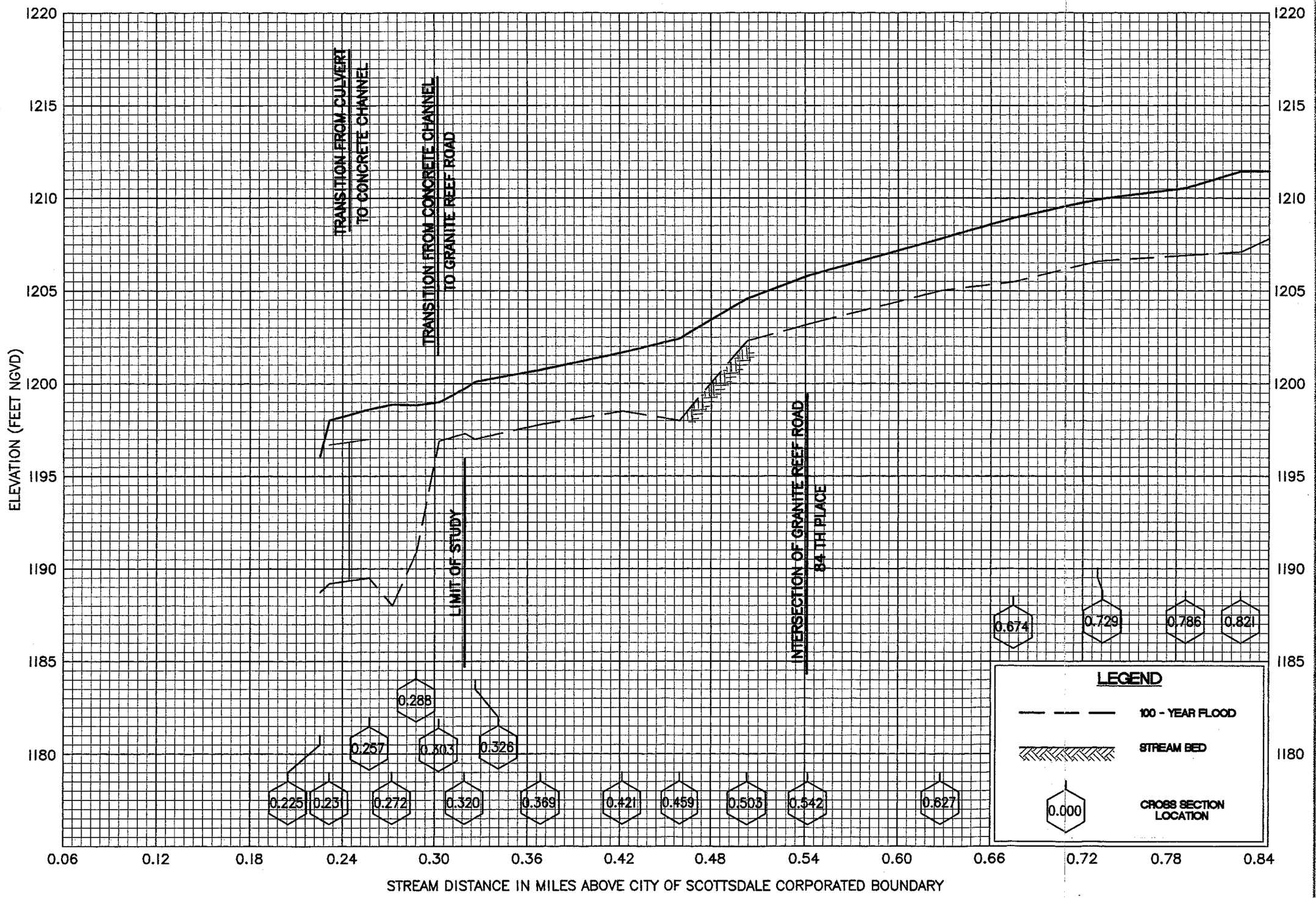
FLOOD PROFILES

GRANITE REEF WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANITE REEF WASH
FLOOD DELINEATION STUDY

Files: GRR-PRF.DWG FHPROF.HPC, FHPROF.PCP (Sheet 2 of 3)
Date: 05-05-1997



FLOOD PROFILES

GRANITE REEF WASH

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANITE REEF WASH
FLOOD DELINEATION STUDY

Files: GRR-PRF.DWG FHPROF.HPC, FHPROF.PCP (Sheet 1 of 3)
Date: 05-05-1997

APPENDIX F

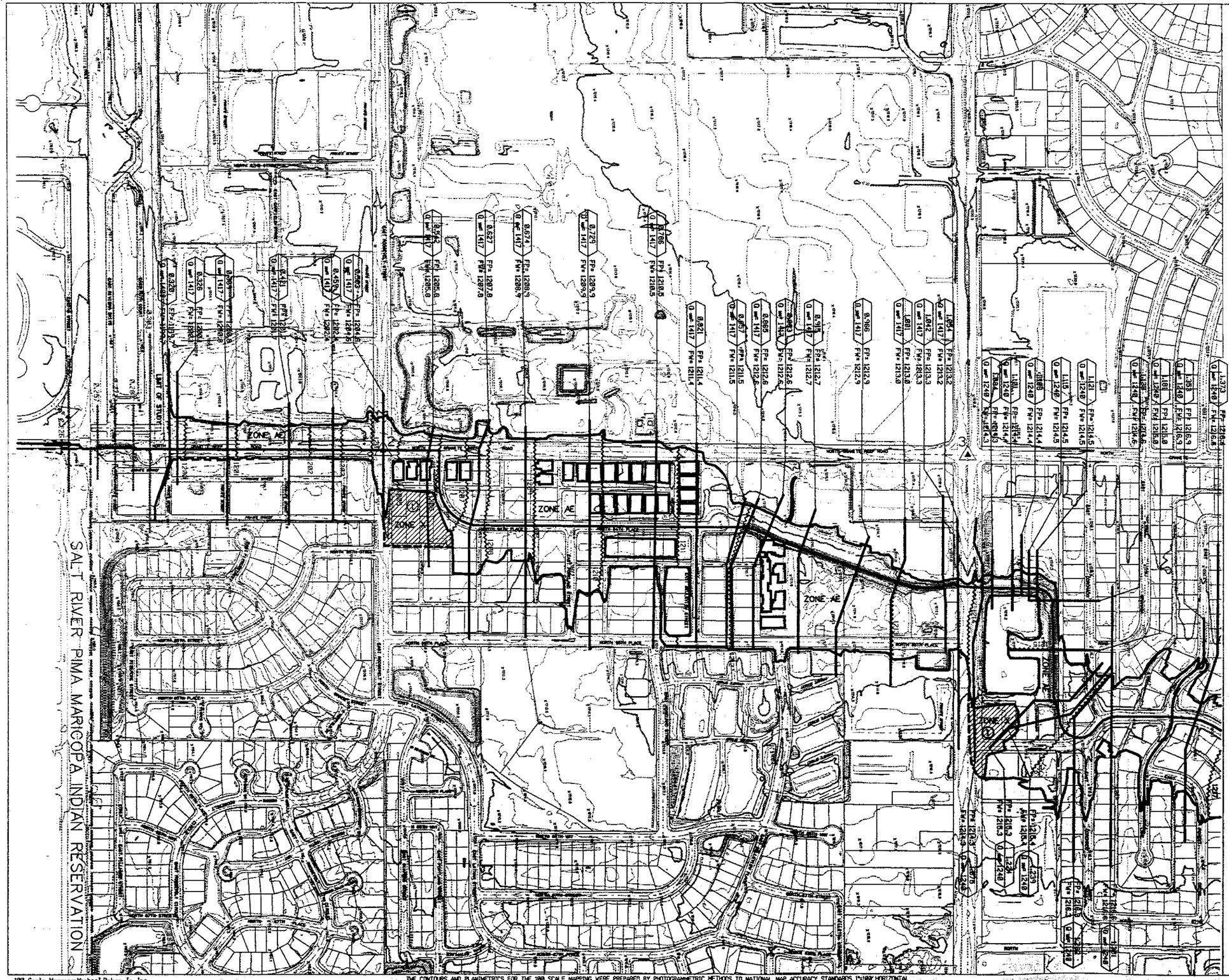
FLOOD PROFILES

APPENDIX G

FLOODPLAIN AND FLOODWAY MAPS
(REDUCED SIZE)

APPENDIX H

DRAFT FLOOD INSURANCE STUDY REPORT



100 Scale Mapping:Michael Baker Jr., Inc.
Flight Date = NOV., 1993

THE CONTOURS AND PLANIMETRICS FOR THE 100 SCALE MAPPING WERE PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1"=100' HORIZONTAL SCALE AND 1' CONTOUR INTERVALS.

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF GRANITE REEF WASH

F.C.D. CONTRACT NO. FCD 96-29

LEGEND

100-YR FLOODPLAIN BOUNDARY
100-YR FLOODWAY BOUNDARY
HYDRAULIC BASE LINE & RIVER MILE — 2.0
CROSS SECTION — FP= 1297.8 / FW= 1297.8 — 0.627 / Q100 = 1417
ELEVATION REFERENCE MARK — 2
BASE FLOOD ELEVATIONS — 1500
ZONE DESIGNATIONS — ZONE AE
CORPORATE LIMITS — Corporate Limits
SECTION LINE — Section Boundary

ELEVATION REFERENCE MARKS

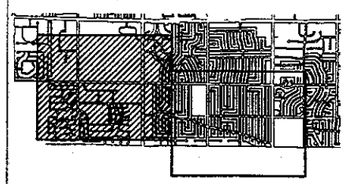
NOTE: ALL ELEVATIONS ARE BASED ON NORTH AMERICA VERTICAL DATUM OF 1988

I.D. NUM.	ELEV. (FT)	DESCRIPTION/LOCATION
1	1188.06	ARIZONA DEPARTMENT OF TRANSPORTATION BRASS CAP, AT INTERSECTION OF McKELLIPS ROAD & GRANITE REEF ALLIGNMENT
2	1202.70	C.O.S. BRASS CAP IN HAND HOLE INTERSECTION OF ROOSEVELT STREET & GRANITE REEF ROAD.
3	1218.10	MARICOPA COUNTY BRASS CAP, IN HAND HOLE, INTERSECTION OF McDOWELL ROAD & GRANITE REEF ROAD.

NOTES

1. ZONE X - 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. SEE SPECIAL PROBLEM SECTION

INDEX MAP



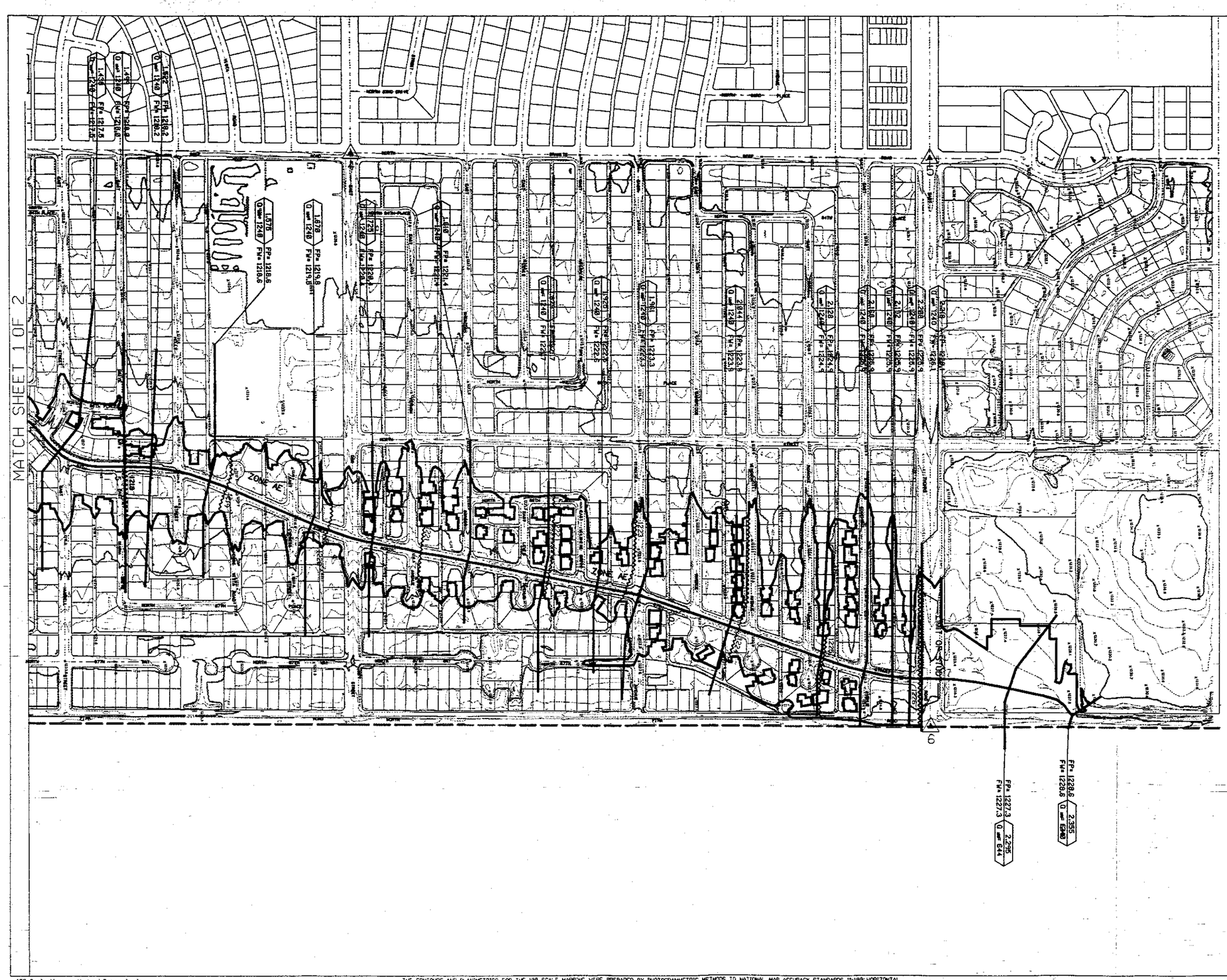
N

200 0' 200 400
SCALE: 1"= 200'
CONTOUR INTERVAL = 2' FEET

Entellus
2555 W. 44th St., Suite 330
Phoenix, AZ 85018
Phone (602) 244-0566
Fax (602) 244-8947
30.45

	BY	DATE	
DESIGN	HAA	05/97	FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
DESIGN CHK.	SEK	05/97	RECOMMENDED BY: DATE
PLANS	ECES	05/97	APPROVED BY: DATE
PLANS CHK.	HAA	05/97	CHIEF ENGINEER AND GENERAL MANAGER
SUBMITTED BY:		DATE:	SHEET 1 OF 2

Dwg. Name: C:\31045\SHEETS\SHT_01.DGN
Date: REV. MAY 22, 1997 10:00am



FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FLOOD DELINEATION STUDY OF GRANITE REEF WASH

F.C.D. CONTRACT NO. FCD 96-29

LEGEND

100-YR FLOODPLAIN BOUNDARY

100-YR FLOODWAY BOUNDARY

HYDRAULIC BASE LINE & RIVER MILE — 2.0

CROSS SECTION — FP= 1287.8 / FW= 1287.8 — 8.627 / Q 100= 1417

ELEVATION REFERENCE MARK — 2

BASE FLOOD ELEVATIONS — 1500

ZONE DESIGNATIONS — ZONE AE

CORPORATE LIMITS — Corporate Limits

SECTION LINE — Section Boundary

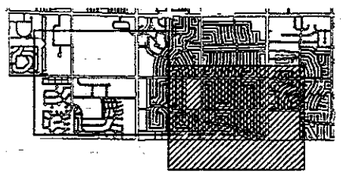
ELEVATION REFERENCE MARKS

NOTE: ALL ELEVATIONS ARE BASED ON NORTH AMERICA VERTICAL DATUM OF 1988

I.D. NUM.	ELEV. (FT)	DESCRIPTION/LOCATION
4	1227.01	MARICOPA COUNTY BRASS CAP, IN HAND HOLE, INTERSECTION OF OAK STREET & GRANITE REEF ROAD.
5	1226.12	C.O.P. BRASS CAP IN HAND HOLE INTERSECTION OF THOMAS ROAD & PIMA ROAD.
6	1232.73	C.O.S. BRASS CAP IN HAND HOLE INTERSECTION OF THOMAS ROAD & GRANITE REEF ROAD.

NOTES

INDEX MAP



N

200 0' 200 400

SCALE: 1"= 200'

CONTOUR INTERVAL = 2' FEET

Entellus
2266 N. 44th St., Suite 330
Phoenix, AZ 85008
Phone (602) 244-2566
Fax (602) 244-8947

30.45

	BY	DATE
DESIGN	HAA	05/97
DESIGN CHK.	SEK	05/97
PLANS	ECES	05/97
PLANS CHK.	HAA	05/97
SUBMITTED BY:		DATE:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

RECOMMENDED BY: DATE

APPROVED BY: DATE

CHIEF ENGINEER AND GENERAL MANAGER

SHEET 2 OF 2

Dwg. Name: C:\30.45\SHEETS\SH1_01.DGN

Date: REV. MAY 22, 1997 10:00am

100 Scale Mapping:Michael Baker Jr., Inc.
Flight Date = NOV., 1993

THE CONTOURS AND PLANIMETRICS FOR THE 100 SCALE MAPPING WERE PREPARED BY PHOTOGRAMMETRIC METHODS TO NATIONAL MAP ACCURACY STANDARDS 1"=100' HORIZONTAL SCALE AND 1' CONTOUR INTERVALS.

FLOOD INSURANCE STUDY FOR

GRANITE REEF WASH

MARICOPA COUNTY, ARIZONA

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FLOOD INSURANCE STUDY FOR

GRANITE REEF WASH

MARICOPA COUNTY, ARIZONA

This is to certify that all work accomplished in the conduct of this study was done in accordance with the Statement of Work and General Provision of Contract FCD 95-29, and all amendments thereto, together with all such modifications, either written or oral, as the Project Officers and/or the Contracting Officer or their representatives have directed, as such modifications affect this contract, and that all such work has been accomplished in accordance with sound and accepted engineering practice within the contract provision for respective phases of the work.

Signed: _____

Samuel E. Kao, Ph.D., P.E.
Vice President
Entellus, Inc.

_____

Hernan A. Aristizabal, P.E.
Project Engineer
Entellus, Inc.

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards for Granite Reef Wash, from approximately 1,300 feet north of McKellips Road to Thomas Road, within the City of Scottsdale, Maricopa County, Arizona; and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for the study area that will be used to establish actuarial flood insurance rates and assist the County Flood Control District and local officials in their efforts to promote sound floodplain management. Minimum flood management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria takes precedence, and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority for Study

The sources of authority for this Flood Control Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydraulic analysis for this study was performed by Entellus, Inc. for the Flood Control District of Maricopa County, under Contract FCD 95-29. The hydrologic study was not a part of the Scope of Work under this contract. The same discharges as generated in the previous Flood Insurance Study (**Reference 6**) were used in this study.

1.3 Coordination and Acknowledgments

Coordination of information occurred between the engineering consultants, the City of Scottsdale, the Flood Control District of Maricopa County and other appropriate governmental agencies. The following agencies were contacted for information and comments during the study:

- Arizona Department of Water Resources (ADWR)
- Arizona Department of Transportation (ADOT)
- Flood Control District of Maricopa County (FCDMC)
- Maricopa County Department of Transportation (MCDOT)
- City of Scottsdale

Vertical control data, used to establish the network of elevation reference marks, were obtained from the North American Vertical Datum (NAVD) of 1988. However, the vertical control for the existing FIRM was based on the National Geodetic Vertical Datum (NGVD) of 1929. The following equation was used in this study to relate the two different sets of data:

$$\text{NGVD 1929} + 1.83 \text{ feet} = \text{NAVD 1988}$$

1.4 Public Notification and Contact

The study was publicized in local newspapers, and subsequent responses from the public were noted or discussed. Letters concerning Right-of-Entry for surveying purposes were sent to the appropriate property owners along the study wash. A final public meeting is intended to present the study results prior to FEMA submittal.

2.0 AREA STUDIED

2.1 Scope of Study

Riverine flooding of the following wash was studied by detailed methods:

WASHES	TRIBUTARIES
Granite Reef Wash	None

The limits of study for Granite Reef Wash are shown on the Floodplain and Floodway Maps.

2.2 Study Area Description

The study area is located in the southeast corner of the City of Scottsdale, within Section 1, Township 1 North, Range 4 East, and Section 36, Township 2 North, Range 4 East, Gila and Salt River Base and Meridian, Maricopa County, Arizona. (See **Figure 1**)

The study area is a fully developed desert area bounded by Thomas Road on the north, the Salt River Indian Reservation on the south, Pima Road on the east, and Granite Reef Road on the west. Drainage of the area is generally from north to south.

The natural drainage pattern of the study area has been significantly altered since the development of this community. Presently, runoff is conveyed mostly by roadways built in the stream bed of the old wash. In addition, roadway and culvert

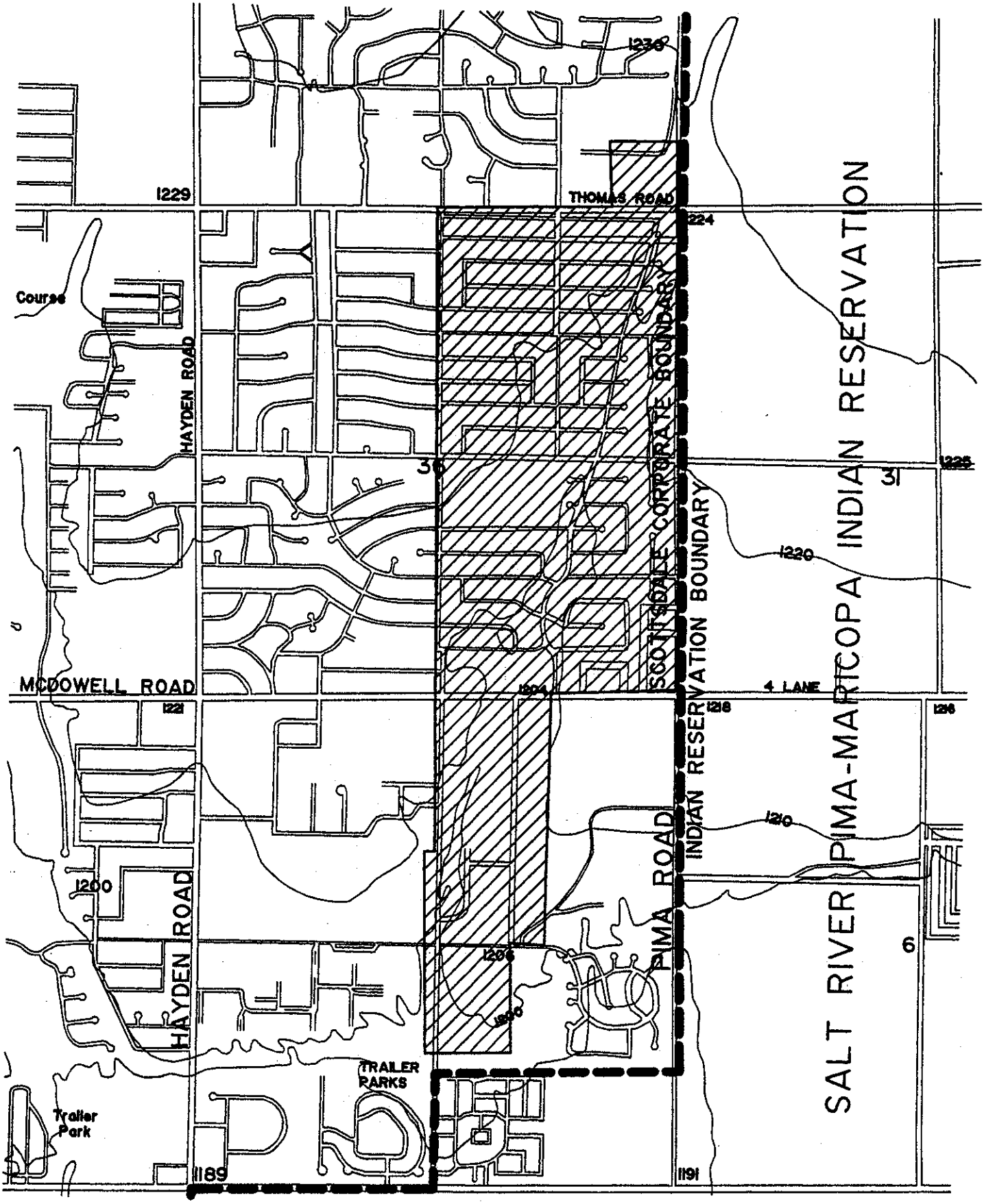

FIGURE I
VICINITY MAP

construction in conjunction with urbanization have greatly affected the natural peak discharges throughout the study area.

Climate of the study area is characterized by hot summer, mild winter and infrequent rainfall. The mean annual rainfall is about 8.5 inches, falling normally in two seasons. One season, primarily resulting from local convective storms, lasts from July to mid-September; the other season, mainly formed by cyclonic (frontal) storms, extends from December through March. Of the two types of storms, the summer convective storm is considered to be the more critical flood producing event in this area.

The previous Flood Insurance Study (**Referenced 6**) was based on the topographic mapping that does not represent the existing topography adequately.

2.3 Principal Flood Problems

There are several flood problems within the study area. The natural path of the wash has been significantly altered by development. Sharp bends and abrupt transitions have been created throughout most of the study reach. In addition, three crossing structures have been installed across the flow path of the wash. The major obstructions to the flow and their locations are summarized below:

Location	Obstruction
Earthen Channel at 87th Street	Transition from roadway to channel with 90° bend
Earthen Channel north of McDowell Road	90° bend
Office Building approximately 250 ft. north of McDowell Road	Bridge
McDowell Road Crossing	Culvert
Earthen Channel at 84th Place	Transition from channel to roadway
84th Place approximately 200 ft. north of Roosevelt Street	90° bend
84th Place and Granite Reef Road	90° bend
South end of Granite Reef Road	Transition from roadway to channel
Well Site Culvert	Culvert

2.4 Flood Protection Measures

Presently, no major flood protection structure is provided within the study area.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the study area, previous regulatory flows and standard hydraulic study methods were used to determine the flood hazard data required for this study. Flood event of a magnitude which is expected to be equaled or exceeded once on the average during a 100-year period (recurrence interval) has been selected as having special significance for floodplain management and for flood insurance rates. This event, commonly termed the 100-year flood, has a 1 percent chance of being equaled or exceeded during any one year. Although the recurrence interval represents the long term **average** period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods of greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the study area at the time of this study's completion. The analyses reported herein reflect current conditions in the watersheds of the flooding sources. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

The hydrologic analysis was not a part of the Scope of Work under this contract. As decided by both the Flood Control District of Maricopa County and the City of Scottsdale, the same discharges as generated in the previous Flood Insurance Study (**Reference 6**) were used in this study. They are tabulated in **Table 1**.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations for a flood of the 100-year recurrence interval.

Cross-section data for the backwater analyses were determined by obtaining digitized cross sections from topographic maps, at a scale of 1 inch = 100 feet and one-foot contour intervals, prepared for the City of Scottsdale by Michael Baker, Jr., Inc. in 1993 under a contract with the City of Scottsdale. All elevations were referenced to the North American Vertical Datum (NAVD) of 1988. Locations of selected cross-sections used in the hydraulic analyses and the elevation reference marks (ERMs) are shown on the Floodplain and Floodway Maps.

Detailed methods were used to determine the water-surface elevations for the 100-year flood, using the U.S. Army Corps of Engineers HEC-2 step backwater computer program (**Reference 10**).

TABLE 1

SUMMARY OF DISCHARGES

Flood Source and Location	Drainage Area (Sq.miles)	100-year Peak Discharge (cfs)
Granite Reef Wash		
At Thomas Road	6.2	644
At McDowell Road	7.2	1,240
At McKellips Road	7.5	1,417

Manning's roughness coefficients were determined in accordance with the methodology described in *Estimated Manning's Roughness Coefficient for Stream Channels and Floodplain in Maricopa County, Arizona* (Reference 12). The method described in this publication selects a base value for the roughness coefficient based exclusively on bed material. This value is then adjusted to account for vegetation, irregularities, obstructions and cross-section variations. In addition, a multiplier can be applied to the adjusted n value if meandering of the reach is significant.

The base roughness coefficient in this study was selected based on the average particle size observed in the field. The typical average size of the bed material in the study area ranges from 0.08" to 2.5". For this range of bed material, the typical values of the roughness coefficient ranges from 0.028 to 0.035. For some of the reaches where the conveying channel is a paved roadway, n values as low as 0.018 were used.

The expansion and contraction coefficients used in the HEC-2 model were determined from the *HEC-2 User's Manual* (Reference10). For gradual transitions which include most reaches in this study, the contraction and expansion coefficients were set to be 0.1 and 0.3, respectively. At culvert locations where the change on cross sectional geometry is abrupt, the coefficients were set to be 0.3 for contraction and 0.5 for expansion. At locations where the cross sectional area and flow direction change significantly, a value of 0.6 and 0.8 were used for these coefficients.

Starting water surface elevations for the flooding sources at the downstream limit of the study were obtained by the critical depth options of the HEC-2 computer program.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. For each stream studied in detail, the 100-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps.

The 100-year floodplain boundaries are shown on the Flood Boundary and Floodway Map. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment of floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of

floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The study area is fully developed and further encroachment of floodplain is not expected to occur. For this reason, and for floodplain management purposes, the floodplain will be regulated as floodway. Therefore, the wash shown on the Floodway and Floodplain Maps have a floodplain coincident with floodway. The floodway data for the study wash are shown in **Table 2** of this report.

FLOODING SOURCE		FLOODWAY			BASE FLOW WATER SURFACE ELEVATION (FT NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQF)	MEAN VELOCITY (FPS)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	DIFFERENCE
Granite Reef Wash								
0.320	89	270	353	4.0	1199.7	1199.7	1199.7	.0
0.326	34	194	380	3.7	1200.1	1200.1	1200.1	.0
0.369	226	159	295	4.8	1200.8	1200.8	1200.8	.0
0.421	278	149	300	4.7	1201.7	1201.7	1201.7	.0
0.459	200	160	347	4.1	1202.4	1202.4	1202.4	.0
0.503	229	425	338	4.2	1204.6	1204.6	1204.6	.0
0.542	208	114	202	7.0	1205.8	1205.8	1205.8	.0
0.627	451	564	438	3.2	1207.8	1207.8	1207.8	.0
0.674	248	489	366	3.9	1208.9	1208.9	1208.9	.0
0.729	289	720	559	2.5	1209.9	1209.9	1209.9	.0
0.786	298	553	325	4.4	1210.5	1210.5	1210.5	.0
0.821	190	865	631	2.2	1211.4	1211.4	1211.4	.0
0.857	187	599	275	5.2	1211.5	1211.5	1211.5	.0
0.865	45	638	714	2.0	1212.6	1212.6	1212.6	.0
0.883	95	626	586	2.4	1212.6	1212.6	1212.6	.0
0.915	170	569	623	2.3	1212.7	1212.7	1212.7	.0
0.966	266	516	623	2.3	1212.9	1212.9	1212.9	.0
1.001	190	389	457	3.1	1213.0	1213.0	1213.0	.0
1.042	215	423	651	2.2	1213.3	1213.3	1213.3	.0
1.054	64	200	364	3.9	1213.2	1213.2	1213.2	.0
1.075	112	109	519	2.4	1214.3	1214.3	1214.3	.0

TABLE 2	FEDERAL EMERGENCY MANAGEMENT AGENCY Federal Insurance Administration CITY OF SCOTTDALE (MARICOPA CO.)	**FLOODWAY DATA** GRANITE REEF WASH

FLOODING SOURCE		FLOODWAY			BASE FLOW WATER SURFACE ELEVATION (FT NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQF)	MEAN VELOCITY (FPS)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	DIFFERENCE
Granite Reef Wash								
1.084	43	87	419	3.0	1214.3	1214.3	1214.3	.0
1.101	90	95	434	2.9	1214.4	1214.4	1214.4	.0
1.108	40	86	394	3.1	1214.4	1214.4	1214.4	.0
1.115	34	73	382	3.2	1214.5	1214.5	1214.5	.0
1.121	36	73	326	3.8	1214.5	1214.5	1214.5	.0
1.138	90	81	341	3.6	1214.6	1214.6	1214.6	.0
1.181	225	103	344	3.6	1215.0	1215.0	1215.0	.0
1.224	230	449	482	2.6	1215.3	1215.3	1215.3	.0
1.239	75	348	225	5.5	1215.4	1215.4	1215.4	.0
1.262	123	383	653	1.9	1216.3	1216.3	1216.3	.0
1.301	204	327	309	4.0	1216.4	1216.4	1216.4	.0
1.353	278	576	595	2.1	1216.9	1216.9	1216.9	.0
1.373	106	222	242	5.1	1216.6	1216.6	1216.6	.0
1.438	344	472	346	3.6	1217.5	1217.5	1217.5	.0
1.499	320	259	333	3.7	1218.0	1218.0	1218.0	.0
1.522	122	363	290	4.3	1218.2	1218.2	1218.2	.0
1.575	277	214	240	5.2	1218.6	1218.6	1218.6	.0
1.670	504	171	221	5.6	1219.8	1219.8	1219.8	.0
1.725	292	238	257	4.8	1220.4	1220.4	1220.4	.0
1.810	449	595	482	2.6	1221.4	1221.4	1221.4	.0
1.879	359	109	197	6.3	1221.7	1221.7	1221.7	.0

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Federal Insurance Administration

CITY OF SCOTTSDALE

(MARICOPA CO.)

FLOODWAY DATA

GRANITE REEF WASH

FLOODING SOURCE		FLOODWAY			BASE FLOW WATER SURFACE ELEVATION (FT NGVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQF)	MEAN VELOCITY (FPS)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	DIFFERENCE
Granite Reef wash								
1.925	245	278	243	5.1	1222.6	1222.6	1222.6	.0
1.961	192	438	391	3.2	1223.3	1223.3	1223.3	.0
2.044	437	597	248	5.0	1223.9	1223.9	1223.9	.0
2.128	444	341	272	4.6	1224.9	1224.9	1224.9	.0
2.168	209	1016	778	1.6	1225.9	1225.9	1225.9	.0
2.192	129	886	600	2.1	1225.9	1225.9	1225.9	.0
2.208	82	296	360	3.4	1225.9	1225.9	1225.9	.0
2.218	54	685	491	2.5	1226.1	1226.1	1226.1	.0
2.295	405	356	202	3.2	1227.3	1227.3	1227.3	.0
2.355	320	141	145	4.5	1228.6	1228.6	1228.6	.0

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

Federal Insurance Administration

CITY OF SCOTTSDALE

(MARICOPA CO.)

FLOODWAY DATA

GRANITE REEF WASH

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A: corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE: corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. In most instances, whole-foot base flood elevations derived from the detailed hydraulic analyses, are shown at selected intervals within this zone.

Zone AH: corresponds to the areas of 100-year shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO: corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X: corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths

are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance rate zones as described in Section 5.0 and in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by appropriate symbols, the 100-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

This study reach of Granite Reef Wash supersedes the data presented in the previous Flood Insurance Study for Maricopa County, Arizona and incorporated areas, dated April 15, 1988, revised September 30, 1995. (**Reference 6**)

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Flood Control District of Maricopa County, 2801 West Durango Street, Phoenix, Arizona, 85009.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Arizona Department of Water Resources, Engineering Division, Flood Management Section, September 1991. *Instructions for Organizing and Submitting Technical Documentation for Flood Study.*

2. Arizona Department of Water Resources, Engineering Division, Flood Management Section, December 1991. *Requirement for Floodplain Delineation in Riverine Environments.*

3. Arizona Department of Water Resources, Engineering Division, Floodplain Management Section, April 1993. *Floodplain Standard for Supercritical Streams.*

4. Chow, V.T., *Open Channel Hydraulics*, McGraw-Hill, 1959.

5. Dodson & Associates, Inc. 1991. *ProHEC2 User's Manual and Program Reference.*

6. Federal Emergency Management Agency, April 15, 1988 (Revised September 30, 1995). *Flood Insurance Study, Maricopa County, Arizona and Incorporated Areas, Volumes 1 through 12.*

7. Federal Emergency Management Agency, January, 1995 *FEMA 37, Flood Insurance Study Guidelines and Specifications for Study Contractors.*

8. Flood Control District of Maricopa County, Undated *Drainage Design Manual for Maricopa County, Volume I, Hydrology.*

9. Flood Control District of Maricopa County, September, 1992. *Drainage Design Manual for Maricopa County, Volume II, Hydraulics.*

10. U.S. Department of the Army, Corps of Engineers, September, 1990. *HEC-2 Water Surface Profiles Users Manual.*

11. U.S. Department of Transportation, September 1985. *Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5*, FHWA Report No. 1-P-85-15.

12. U.S. Geological Survey, 1991. *Manning's Roughness Coefficients for Stream Channels and Floodplains in Maricopa County, Arizona.*

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ACEA
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Excellence
Award

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Suite 330
Phoenix, Arizona
85008.3279

Tel 602.244.2566
Fax 602.244.8947

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ADMIN | PWLMGT
FINANCE | CONTRACT
O & M | FILE
ENGR
REMARKS

March 9, 1998

Mr. Pedro Calza, P.E.
Manager, Floodplain Management Branch
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, AZ 85009-6399

Reference: Granite Reef Wash Floodplain Delineation Study
FCD 95-39 (Case No. 97-09-1079P)
Entellus Job No. 310.45

Dear Mr Calza:

In response to FEMA's comments dated February 9, 1998 (See Exhibit A), Entellus has reviewed the adjusted HEC-2 printout that was forwarded to us by FEMA along with their comments.

In our opinion, the adjusted HEC-2 model for the above referenced project is not exactly equivalent to the original HEC-2 model that was prepared by Entellus based on the North American Vertical Datum of 1988 (NAVD) due to the following reasons:

1. The elevations appeared on the WC cards for split flow calculations were not adjusted accordingly.

2. At Cross-section 0.257, the left bank elevation on the X3 card was not adjusted.

3. At Cross-section 1.115, elevations of the lower cord on the BT cards were not adjusted.

Attached is a copy of the HEC-2 printout redlined with the required additional elevation adjustments. Please forward it to FEMA for further process.

If you should have any questions or need additional information, please do not hesitate to call me or Hernan Aristizabal of our office.

Sincerely,

Entellus, Inc.

Samuel Kao

Samuel E. Kao, Ph. D., P.E.
Project Manager

SEK/jrg

Federal Emergency Management Agency

Washington, D.C. 20472

RECEIVED

FEB 11 1998

© Entellus

February 9, 1998

Mr. Pedro Calza
Manager, Floodplain Management Branch
Flood Control District of Maricopa County
2801 West Durango Street
Phoenix, Arizona 85009-6399

IN REPLY REFER TO:
Case No.: 97-09-1079P
Community: City of Scottsdale, Arizona
Community No.: 045012

316-ACK.FRQ

Dear Mr. Calza:

This responds to the submittal of fees for a July 30, 1997, request that the Federal Emergency Management Agency (FEMA) issue a revision to the Flood Insurance Rate Map (FIRM) and Flood Boundary and Floodway Map (FBFM) for Maricopa County, Arizona and Incorporated Areas. Pertinent information about the request is listed below.

Identifier:	Granite Reef Wash Floodplain Delineation Study FCD 95-39
Flooding Source:	Granite Reef Wash
FIRM Panel(s) Affected:	04013C2160 D
FBFM Panel(s) Affected:	04013C2160

We have completed an inventory of the items that you submitted. The items identified below are required before we can begin a detailed review of your request.

1. In a January 29, 1998, telephone conversation with a representative of our Technical Evaluation Contractor (TEC), Mr. William Erickson, City of Scottsdale, agreed to show coincident floodplain and floodway boundaries along Granite Reef Wash. As discussed with Mr. Erickson and in accordance with Paragraph 65.7(b)(1) of the National Flood Insurance Program (NFIP) regulations, please provide a copy of a public notice distributed by the community stating the community's intent to revise the floodway or a statement by the community that it has notified all affected property owners.

2. The submitted topographic work map entitled "Flood Delineation Study of Granite Reef Wash," prepared by Entellus, Inc., dated May 1997, indicates that the elevations shown are based on the North American Vertical Datum of 1988 (NAVD). The submitted revised conditions HEC-2 hydraulic computer model uses NAVD elevations. The effective Flood Insurance Study (FIS) for Granite Reef Wash was performed using elevations based on the National Geodetic Vertical Datum of 1929 (NGVD). Therefore, our TEC has revised the HEC-2 model to use NGVD elevations. A copy of the revised HEC-2 model is enclosed. Please provide your concurrence of this model. In addition, please note that the floodplain boundary delineations shown on the above-referenced work map will not change based on the revised HEC-2 model.

EXHIBIT A

If all required items are not submitted within 90 days of the date of this letter, we will treat any subsequent request as an original submittal, and it will be subject to all submittal/payment procedures.

Please direct all required items and questions concerning your request to our Technical Evaluation Contractor at the following address:

Michael Baker Jr., Inc.
3601 Eisenhower Avenue, Suite 600
Alexandria, Virginia 22304

Attention: Ms. Pernille Buch-Pedersen
(703) 317-6224

When you write us about your request, you must include the case number referenced above in your letter.

If you have any questions concerning FEMA policy, or the NFIP in general, please contact Mr. Mike Grimm of our staff in Washington, DC, either by telephone at (202) 646-2878 or by facsimile at (202) 646-4596.

Sincerely,

Frederick H. Sharrocks, Jr., Chief
Hazard Identification Branch
Mitigation Directorate

Enclosure(s)

cc: Ms. Terri Miller
State Coordinator, NFIP
Arizona Department of Water Resources

Mr. William Erickson
City of Scottsdale

Mr. Samuel E. Kao, P.E.
Project Manager
Entellus, Inc.

```
1*****************************************
 *  HEC-2 WATER SURFACE PROFILES          *
 *                                        *
 *  Version   4.6.2;  May 1991            *
 *                                        *
 *  RUN DATE    06FEB98    TIME   12:57:16 *
 *****************************************
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****************************************
*  U.S. ARMY CORPS OF ENGINEERS        *
*  HYDROLOGIC ENGINEERING CENTER       *
*  609 SECOND STREET, SUITE D          *
*  DAVIS, CALIFORNIA 95616-4687        *
*          (916) 756-1104              *
****************************************
```

```
X     X  XXXXXXX   XXXXX              XXXXX
X     X  X        X     X            X     X
X     X  X        X                        X
XXXXXXX  XXXX     X          XXXXX    XXXXX
X     X  X        X                  X
X     X  X        X     X            X
X     X  XXXXXXX   XXXXX             XXXXXXX
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1

06FEB98 12:57:16 PAGE 1

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************************************
 HEC-2 WATER SURFACE PROFILES

 Version   4.6.2;  May 1991
************************************
```

SPLIT FLOW BEING PERFORMED

SF SPLIT FLOW CALCULATIONS

```
TW West bank between 0.320 and 0.326
WS     2   0.320   0.326    .257     2.5
WC         1199     34    1201
```

1197.17 1199.17

```
TW West bank between 0.303 and 0.320
WS     2   0.303   0.320    .257     2.5
WC         1198    100    1199
```

1196.17 1197.17

```
TW West bank between 0.288 and 0.303
WS     2   0.288   0.303    .257     2.5
WC          1198      77    1198

TW West bank between 0.272 and 0.288
WS     2   0.272   0.288    .257     2.5
WC          1198      83    1198

TW West bank between 0.257 and 0.272
WS     2   0.257   0.272    .257     2.5
WC          1197      80    1198

TW East bank between 0.303 and 0.320
WS     2   0.303   0.320      -1     2.5
WC        1201.1     100    1201

TW East bank between 0.288 and 0.303
WS     2   0.288   0.303      -1     2.5
WC          1199      77  1201.1
```



```
TW East bank between 0.272 and 0.288
WS     2   0.272   0.288      -1     2.5
WC          1198      83    1199

TW East bank between 0.257 and 0.272
WS     2   0.257   0.272      -1     2.5
WC          1198      80    1198
```



```
T1      Granite Reef Wash - Floodplain Delineation              File:GRW1.H2
T1      For the  Flood Control District of Maricopa County
T1      by ENTELLUS                                           March 21, 1996

T2      Existing  conditions
T3      City of Scottsdale  -  Granite Reef Wash (FIS)

T4 GR data digitized from 1"=100' 1-foot map dated November 1993
T4 GR data modified for flowpaths.  non flowing ares blocked out

T5 1"=100' 1-feet Contour mapping from Michael Baker, Jr., Inc.
```

```
T6 Provided by the city of Scottsdale

T7 Supplemental cross section data surveyed by City of Scottsdale

T8 Downstream reach from "Granite Reef Wash Stabilization Plans" Project F1705

T9 Subcritical analysis
T9 This model was developed and configured to determine water surface elevation
T9 for a 100-year floodplain delineation study, Velocity from this model
T9 may not be accurate and should not be used

T9 REVISED BY MBJ TO CONVERT TO NGVD29.  CONVERSION FACTOR IS -1.83.
T9 X3, SC, AND TOP OF ROADS WERE MODIFIED SINCE X1.9 WILL NOT AFFECT
T9 THOSE RECORDS.       FILENAME:  GRW4NGVD.DAT

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ

                2                           -1                                  1196.43

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE

     1                                                -1

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

     38        43        1         2         8         4         26        100       200       150

  Critical conditions assumed Dowstrream from culvert
  X-sec 0.225 obtained from improvement plans

NC     .028      .035      .020       .1        .3
QT        2      1417      1417

   51.5
X1    0.225         8      9991     10009       370       370       370                  -1.83
X3                                   9962   1198.17     10017   1198.17
GR     1195      9962    1195.0      9981    1194.9      9991    1188.9      9995    1188.73     10000
GR   1188.9     10005    1194.9     10009      1195     10017

  ******************************************************************************
1
   06FEB98      12:57:16                                                                                PAGE    4

  *****            Culvert outlet dowstream from water well            ********
  ******************************************************************************

NC                                        .3        .5
   51
X1    0.231        35    9993.5   10006.5        31        31        31                  -1.83
X3       10                                                                    1193.17   1193.17
```

```
GR     1203    9776.97       1203       9798       1194       9798       1194       9849       1203       9849
GR     1203       9897       1194       9897       1194     9901.22       1195    9905.06       1196     9922.2
GR   1196.1    9954.45       1196    9986.69       1195     9988.5       1194    9990.19       1193    9991.88
GR   1189.2     9993.5    1189.29    9995.26    1189.29      10000    1189.29    10003.2    1189.29      10005
GR   1189.3    10006.5       1194    10008.6       1195    10010.5       1196    10012.4     1196.5   10027.40
GR     1196    10042.4     1195.9   10061.45       1196    10080.5     1196.3   10092.80       1196    10105.1
GR   1195.9      10110       1203      10110       1203      10218    1195.18      10218       1195    10243.7

  ******************************************************************************
  *****          13' X 7.5'concrete box culvert  at well site          ********
  ******************************************************************************

SC    1.013        0.4        2.7                   7.5         13        137        8.1    1187.76    1187.46


  ******************************************************************************
  *****                         Culvert inlet                          *******
  ******************************************************************************
  Upstream from water well
   49
X1    0.257         27     9993.5    10006.5        135        135        137   1195.84      -1.83
X2                           2                  1195.58
X3       10                                                                     1197.67    1195.58
BT       -3       9933    1195.84                 10000    1196.00                10132    1195.58
GR     1208    9900.62       1208    9932.99    1198.29       9933    1197.67       9933       1197    9982.93
GR     1196    9983.45       1195    9983.96       1194    9984.61       1193    9989.53       1192    9991.53
GR   1189.5     9993.5    1189.59      10000    1189.59    10006.5       1192    10014.6       1193    10016.2
GR     1194    10017.3       1195    10018.3       1196    10019.3       1197    10020.1       1198    10033.7
GR     1198    10039.4       1197      10041       1196    10099.5    1197.41   10131.99    1197.41      10132
GR     1208   10132.01       1208    10169.1

   Reach GRW-2 concrete channel between water well and Granite Reef Road

NC    0.041      0.029      0.018

  effective area limited to 4 to 1 expancion
  Effective area boundary withing buildings no X3 record needed
   48
X1    0.272         29    9985.49    10017.7         80         80         80                  -1.83
X3       10
GR     1198    9920.49       1198     9922.9       1197    9934.09       1196    9934.29       1195    9935.29
GR     1194     9935.8       1193    9935.96       1192    9936.13       1191    9936.28       1190    9936.41
GR     1189    9936.54       1188    9936.67       1188    9963.96       1189    9968.23       1190     9972.5
GR     1191    9976.77       1192    9981.02       1193    9985.49       1192    9995.42       1191    9996.32
GR   1190.8      10000       1191    10004.1       1192    10005.7       1193    10007.1       1194    10008.6
GR     1195    10009.7       1196    10010.7       1197    10012.1       1198    10017.7
```



```
NC                                    .1         .3
```

```
  effective area limited to 4 to 1 expancion
  Effective area boundary withing buildings no X3 record needed
   47
X1    0.288        29    9989.19    10015.1         83         83         83                  -1.83
X3                                                          10205    1208.17
GR     1199    9893.77       1198    9916.31       1198    9919.53       1198    9935.85       1197    9936.82
GR     1196    9937.79       1195    9938.97       1194    9939.61       1193    9940.15       1192    9940.58
GR     1191    9944.28       1192    9962.15       1193    9972.89       1194    9979.65       1195    9987.74
GR     1195    9989.19       1193    9991.84       1192    9992.81       1191    9993.54     1190.9      10000
GR     1191    10005.1       1193    10007.8       1194    10009.3       1195    10010.5       1196    10012.1
GR     1197    10013.5       1198    10015.1       1198    10034.6       1198    10054.3

  Reach GRW-3   from south end of Granite Reef Road to 84th Place

NC    0.057      0.046      0.018

   46
X1    0.303          9    9987.96    10053.2         77         77         77                  -1.83
X3                                       9815    1208.17      10198    1208.17
GR     1199     9915.2       1198    9924.29       1197    9936.33     1196.9    9945.96       1197    9955.59
GR   1197.3    9987.96     1197.3      10000       1198    10053.2     1198.1   10060.45

   45.5

X1    0.320         15     9978.8    10036.9         89         89         89                  -1.83
GR     1211    9800.57       1211       9815      1200.8       9815      1200.4       9835       1211       9835
GR     1211    9860.24       1211       9897      1199.5       9897      1199.3     9915.2       1199    9937.98
GR     1198     9978.8     1197.3      10000       1198    10036.9      1198.7   10124.9       1199    10166.5

  ########################## BEGINNING OF STUDY AREA ##########################

  basin on rigth bank may need to modified for storage
   45

X1    0.326         18    9987.35    10021.9         34         34         34                  -1.83
X3                                                          10110    1196.17
GR     1201    9861.86     1200.83       9877       1211       9877       1211       9952       1200       9952
GR     1199    9965.85       1198    9987.35     1197.4      10000       1198    10021.9       1198    10048.5
GR     1197    10058.2       1197    10090.2       1198    10102.5       1199    10120.2       1200    10143.8
GR   1200.5      10157       1211      10157       1211    10331.1

  Basin on rigth bank may need modification for storage
   44
1
   06FEB98      12:57:16                                                                          PAGE    6


X1    0.369         36       9981      10019        226        226        226                  -1.83
X3                                                          10021.7    1197.17
GR     1207    9666.43       1206    9668.28       1205    9677.66       1204    9678.25       1203    9678.81
GR     1202    9679.37       1202    9688.01       1202       9717       1212       9717       1212    9739.79
```

```
GR     1212    9808.24      1212      9857     1201.2      9857      1201    9860.23      1201      9882
GR     1212       9882      1212   9905.43       1212   9951.14      1212    9960.03      1200   9960.03
GR     1199    9973.09    1198.2      9981       1198   9994.77    1197.8      10000      1198   10005.8
GR   1198.2      10019      1199  10021.7       1199  10038.7      1198   10051.2      1198   10089.9
GR     1199    10098.8      1201  10121.7       1201  10142.1      1201   10147.9      1202   10157.3
GR     1212    10157.3

   43

X1    0.421         34      9981     10019        278       278       278                -1.83
GR     1209    9668.66      1208   9671.36       1207   9673.72      1206    9676.24      1205    9678.6
GR     1204    9681.44      1204      9710       1214      9710      1214    9794.16      1214    9838.9
GR     1214       9856      1203      9856       1203      9883      1214       9883      1214   9897.08
GR     1214    9942.77      1214      9955     1203.5      9955      1202       9962      1201   9965.84
GR     1200    9972.86    1199.1      9981       1199   9984.84    1198.5      10000      1199   10015.6
GR   1199.1      10019      1200  10086.4       1201  10101.3      1202   10118.1    1202.6   10142.5
GR     1203    10149.7    1203.6     10173       1214     10173      1214   10191.4

   42

X1    0.459         28    9980.62  10020.9        200       200       200                -1.83
X3                                                     10020.9   1198.17
GR     1205     9674.5      1204      9684       1204      9710      1214       9710      1214      9853
GR     1204       9853      1204      9878       1214      9878      1214    9888.27      1214   9897.21
GR     1214       9955      1203   9955.25       1202   9963.49      1201    9972.43      1200   9980.62
GR   1199.4      10000      1200  10020.9       1200  10043.3      1199   10047.1      1198   10050.9
GR     1198    10059.6      1199  10092.1       1200  10099.7      1201   10107.4      1202   10113.1
GR     1203    10128.8      1204  10151.3       1205  10165.4

  Expancion-Contraction modified to acount for bend

NC                                     .3        .5

   41
X1    0.503         14      9978     10022        229       229       229                -1.83
GR     1205       9663   1204.32      9765       1215      9765      1215    9814.93      1215      9925
GR   1203.9       9925      1203   9936.49     1202.7      9978    1202.3      10000    1202.7     10022
GR     1203    10074.5      1204  10128.3       1205  10166.6      1206   10215.4

   40

X1    0.542         31     9969.9  10043.9        220       205       208                -1.83
GR     1215    9502.51      1215      9545       1207      9545      1207    9579.21   1206.89      9602
GR     1215       9602      1215      9683    1206.52      9683   1206.39      9710      1215      9710
GR     1215    9794.96      1215      9800       1206      9800      1206    9844.04      1206      9857
GR     1215       9857      1215   9902.47       1215   9932.06      1215       9940      1206      9940
GR     1206     9958.6      1205   9964.22       1204    9969.9    1203.6      10000    1203.2     10019
GR     1204    10043.9      1205  10062.2       1206  10075.9      1207   10082.8      1208   10091.3
GR     1208      10099
1
   06FEB98      12:57:16                                                                          PAGE    7
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Reach GRW-4 along 84th Place
Expancion-Conptration back after turn

NC	.045	.045	.018	.1	.3					
39										
X1	0.627	51	9983.76	10014.9	200	220	451		-1.83	
GR	1211	9499.13	1210	9504.25	1209	9606.9	1208.72	9642	1215	9642
GR	1215	9696	1208.28	9696	1208.19	9708	1215	9708	1215	9731.19
GR	1215	9757	1207.88	9757	1207.82	9770	1215	9770	1215	9816
GR	1207.6	9816	1207.55	9833	1215	9833	1215	9877	1207.35	9877
GR	1207.3	9893	1215	9893	1215	9943	1207.06	9943	1207	9955.49
GR	1206	9983.76	1205.9	10000	1206	10014.9	1206	10019.9	1206	10020.1
GR	1206	10021.9	1207	10045.2	1207.17	10060	1215	10060	1215	10129.4
GR	1208	10130	1207	10155	1206	10170	1206	10183	1206.5	10204
GR	1215	10204	1215	10280	1207	10280	1206	10295	1205	10300
GR	1205	10315	1206	10360	1207	10360	1208	10385	1209	10390
GR	1210	10396								
38										
X1	0.674	59	9985	10015.2	270	220	248		-1.83	
GR	1212	9085	1212	9472	1211	9510	1215	9510	1215	9610
GR	1210.9	9610	1210.8	9662	1215	9662	1215	9705	1210.5	9705
GR	1210.5	9720	1215	9720	1215	9770	1210.2	9770	1210.2	9785
GR	1215	9785	1215	9830	1210	9830	1210	9842.93	1209.9	9845
GR	1215	9845	1215	9875.24	1215	9893	1208.8	9893	1208.5	9910
GR	1215	9910	1215	9957	1208.06	9957	1208	9962.63	1207	9971.69
GR	1206	9985	1205.5	10000	1206	10015.2	1207	10031	1208	10050
GR	1215	10050	1215	10095	1208	10095	1208	10119	1208	10119
GR	1215	10119	1215	10168	1208.4	10168	1208.7	10190	1215	10190
GR	1215	10228	1208.8	10228	1208.8	10242	1215	10242	1215	10285
GR	1208.2	10285	1207	10300	1207	10310	1208	10327	1208	10342
GR	1208	10377	1209	10382	1210	10390	1211	10424		
37										
X1	0.729	55	9985.4	10016.8	289	289	289		-1.83	
X3				9919.11	1207.17					
GR	1214	9347	1213	9456	1212	9468	1211	9476	1211	9510
GR	1216	9510	1216	9560	1211.2	9560	1211.2	9582	1216	9582
GR	1216	9625	1210.6	9625	1210.6	9650	1216	9650	1216	9690
GR	1209.8	9690	1209.8	9705	1216	9705	1216	9750	1209.5	9750
GR	1209.5	9762	1216	9762	1216	9811	1209	9811	1209	9811.46
GR	1208	9821.48	1208	9840.72	1208.5	9867	1216	9867	1216	9893.2
GR	1216	9919.11	1216	9945	1208.45	9945	1208	9965.49	1207	9985.4
GR	1206.6	10000	1207	10016.8	1208	10029.9	1209	10043.8	1209	10053
GR	1216	10053	1216	10145	1209	10145	1209	10162.2	1209	10200
GR	1216	10200	1216	10209.1	1216	10282	1208.5	10282	1208	10310
GR	1208	10363	1209	10390	1209	10404	1210	10410	1211	10428
36										

1

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X1    0.786        60       9988    10014.5        290        298        298                  -1.83
GR     1213      9399       1212       9430       1212       9510       1216       9510       1216       9570
GR     1212      9570       1212       9585       1216       9585       1216       9622       1212       9622
GR     1212      9647       1216       9647       1216       9690       1212       9690       1212       9707
GR     1216      9707       1216       9753     1211.5       9753     1211.5       9770       1216       9770
GR     1216    9809.9       1216    9811.65       1216    9818.97       1216       9820    1208.75       9820
GR     1208   9822.85       1208     9834.5       1209   9845.28       1210     9853.9       1211    9867.28
GR     1216    9867.3       1216    9942.19       1216       9948    1210.73       9948       1210     9963.6
GR     1209   9970.61       1208     9976.1     1207.3       9985       1207       9988     1206.9      10000
GR     1207   10014.5       1208    10025.9       1209    10031.4       1210    10033.3       1211      10057
GR     1216     10057       1216    10147.9       1211      10148       1210    10171.5       1210    10177.6
GR   1210.8     10203       1216      10203       1216    10208.4       1216      10287    1210.08      10287
GR     1210   10293.6       1210      10360       1211      10385       1212      10390       1213      10405

   35

X1    0.821        58       9985      10015        180        190        190                  -1.83
GR     1215      9455       1214       9464       1213       9466       1212       9474       1211       9477
GR   1210.5   9480.35    1210.36       9507       1217       9507       1217       9566    1210.07       9566
GR     1210   9580.93       1217       9581       1217       9630    1209.75       9630    1209.67       9645
GR     1217      9645       1217       9695    1209.41       9695    1209.33       9710       1217       9710
GR     1217      9755     1209.1       9755    1209.02       9770       1217       9770       1217    9773.71
GR     1217      9826     1208.6    9827.31    1208.34       9862       1217       9862       1217    9906.42
GR     1217      9945    1207.61       9945     1207.2       9985     1207.1      10000     1207.4      10015
GR     1208   10016.9       1209    10024.4       1210    10027.2       1211    10043.7       1211      10053
GR     1217     10053       1217      10102       1211      10102       1211      10125       1217      10125
GR     1217     10170       1211      10170       1211      10188       1217      10188       1217      10225
GR     1211     10225       1211      10240       1217      10240       1217      10292       1211      10292
GR     1211   10323.5       1212    10361.8       1213    10375.9

  Expancion -Contraction increased to account for end of channel

NC                                       .3         .5

  34
X1    0.857        45    9987.55   10030.36        158        220        187                  -1.83
GR     1214      9457       1213       9468       1213       9475       1212       9492       1211       9510
GR     1217      9510       1217       9563       1212       9563       1212       9580       1217       9580
GR     1217      9625       1212       9625       1212       9640       1217       9640       1217       9688
GR     1212      9688       1212       9700       1217       9700       1217       9750       1212    9750.01
GR     1212      9762       1217    9762.01       1217       9805       1212       9805       1212       9821
GR     1211      9830     1210.2       9833       1211    9836.21       1212    9851.37       1212       9860
GR     1217      9860       1217       9947       1212       9947       1212    9952.61       1211    9958.18
GR     1210   9964.22       1209    9987.55     1208.5      10000       1209   10030.36       1210   10060.39
GR     1211  10096.99       1212   10104.86       1213   10113.12       1214   10117.56       1215   10121.10

  Reach GRW-5A Earthen channel upstream from 84th place
1
   06FEB98      12:57:16                                                                          PAGE     9
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```
NC     0.043       0.036       0.038

  33
X1     0.865          61     9979.89    10024.62          50          20          45                  -1.83
GR      1215        9398        1215        9448        1214        9458        1213        9460        1212        9465
GR      1213        9474        1211        9478        1211        9509        1211        9510        1217        9510
GR      1217        9562        1211        9562        1211        9580        1217        9580        1217        9625
GR      1211        9625        1211        9640        1217     9640.01        1217        9685        1211     9685.01
GR      1211        9700        1217     9700.01        1217     9722.87        1217        9757      1210.7        9757
GR    1210.6        9767        1217        9767        1217      9813.7        1217        9818     1210.39        9818
GR      1211     9832.09        1212     9849.77        1212        9857        1217        9857        1217        9944
GR      1212        9944        1212     9959.25        1211     9967.61        1210     9975.97        1210     9979.89
GR      1209     9983.88        1208     9986.15        1207     9987.87        1206      9989.6        1205     9991.32
GR      1204     9993.05        1203     9997.63      1202.9       10000        1203    10002.75        1204    10007.61
GR      1205    10011.06        1206    10014.61        1207    10017.97        1208     10021.3        1209    10024.62
GR      1210     10054.5        1211    10081.35        1212    10098.82        1213    10101.86        1214    10104.88
GR      1215    10107.92

  Expancion-Contraction back to normal after trancition

NC                                          .1          .3

  32
X1     0.883          63      9980.8    10021.12          95          95          95                  -1.83
GR      1216        9443        1215        9454        1214        9466        1213        9471        1212        9476
GR      1213        9477        1213        9479        1212        9480        1212     9535.85        1212        9545
GR      1217        9545        1217        9595        1212        9595        1212        9608        1217        9608
GR      1217        9656        1212        9656        1212        9670        1217        9670        1217        9715
GR      1212        9715        1212        9730        1217        9730        1217        9782        1212        9782
GR      1212        9793        1217        9793        1217     9837.05        1217        9843      1211.4        9843
GR      1211      9848.7        1211     9865.29        1212     9888.13        1217      9888.2        1217     9909.79
GR      1217     9927.63        1217     9930.97        1217     9935.36        1217     9939.35        1217        9973
GR    1212.1        9973        1212      9980.8        1211     9982.17        1210     9983.43        1209     9984.27
GR      1208     9985.47        1207     9986.43        1206     9987.53        1204     9989.55      1203.1       10000
GR      1204    10009.62        1205     10011.1        1206    10014.32        1207    10016.82        1208    10018.92
GR      1209    10021.12        1210    10044.42        1211    10079.42        1212    10095.12        1213    10102.22
GR      1214    10105.12        1215    10111.62        1215    10140.82

  Reach GRW-5B  Earthen channel south of McDowell Road

NC      .035       0.050       0.038

  31
X1     0.915          47     9976.92    10017.23         169         202         170                  -1.83
GR      1216        9522        1215        9526        1214        9534        1213        9541        1212        9546
GR    1211.8     9565.50        1212        9585      1212.2        9630        1217     9630.01        1217        9710
GR    1212.1     9710.01        1212     9725.13      1211.9        9728        1217        9728        1217     9805.79
GR      1217        9817      1210.9        9817      1210.8        9828        1217        9828        1217        9913
GR    1210.1        9913      1210.0        9923        1217        9923        1217     9929.11        1217     9956.27
GR      1217        9965        1210        9965        1210     9976.92        1209     9984.09        1208     9985.77
GR      1207     9987.33        1206     9989.12        1205     9991.47        1204     9992.44      1203.1       10000
GR      1204    10005.33        1205    10008.06        1206    10010.33        1207    10012.93        1208    10015.03
GR      1209    10017.23        1210    10046.73        1211    10084.03        1212    10102.23        1213    10115.63
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GR     1217    10115.7       1217      10295

  30

X1    0.966         32    9970.98   10019.52        170      266.5        266                  -1.83
GR     1217       9500       1217       9595       1213    9595.01       1213       9600       1212       9620
GR     1212       9633       1213       9677       1214       9695     1214.2       9717       1214    9749.24
GR     1213    9961.38       1212    9962.38       1211    9966.22       1210    9970.98       1209    9977.76
GR     1208    9986.36       1207    9988.49       1206    9990.56       1204    9994.83     1203.6      10000
GR     1204    10003.8       1206   10010.32       1207   10013.12       1208   10016.52       1209   10019.52
GR     1210   10062.52       1211   10109.72       1212   10112.42       1213   10118.62       1217   10118.63
GR     1217      10247       1215      10247

  29

X1    1.001         41    9958.34   10018.25        240        190        190                  -1.83
GR     1218       9600       1218       9663    1213.50    9663.01       1213       9669       1212       9681
GR   1212.5       9707       1212    9752.16     1211.8    9755.84       1212    9759.51       1213    9769.04
GR     1213    9821.08     1213.2    9860.20       1213    9899.32       1213    9956.08       1212    9958.34
GR     1211    9964.14       1210    9968.88       1209    9976.61       1208    9983.87       1207     9986.9
GR     1206     9990.1       1205    9995.89       1204    9996.34     1203.7      10000       1204   10003.42
GR     1206   10007.75       1207   10009.75       1208   10012.15       1209   10015.05       1210   10018.25
GR     1211   10030.25       1212   10054.25     1212.3      10058       1218      10058       1218   10064.35
GR     1218   10077.15       1218      10243     1214.7      10243       1215   10287.55       1216   10294.75
GR     1217   10296.85

  28

X1    1.042         38    9984.27   10024.32        245        215        215                  -1.83
X3
GR     1220       9568       1220       9597     1214.2    9597.01       1214       9610       1213       9614
GR     1212       9618       1212       9711       1213       9714       1213    9724.53       1213    9762.76
GR     1213    9768.92       1212    9789.95       1212    9928.08       1212    9946.55       1211    9984.27
GR     1210    9986.38       1209    9988.27       1208    9990.31       1207    9992.57       1206    9994.62
GR     1205    9995.41       1204    9997.09     1203.7      10000       1204   10002.77       1207   10007.52
GR     1208   10008.72       1209   10010.02       1210   10012.02       1211   10014.52       1212   10017.02
GR     1213   10024.32       1214   10057.72       1214      10067       1220      10067       1220   10157.22
GR     1220      10227     1214.5      10227       1215   10288.32

NC                                        .3         .5

  ******************************************************************************
  ******                 McDowell Road Culvert Outlet                   ********
  ******************************************************************************
  27
X1    1.054         31       9994      10006         60         69         64                  -1.83
X3       10                                                                          1210.17    1210.17
GR     1216    9275.46       1215     9441.9       1214       9550     1213.5       9610       1220       9610
GR     1220    9662.52       1220    9703.87       1220    9730.46       1220    9829.45       1212    9829.45
GR     1212     9909.4       1212    9992.74       1211    9993.14       1210    9993.65    1202.58       9994
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```
GR   1202.5    9994.75    1202.58      10000     1202.58      10006       1209    10009.2       1210    10011.1
GR     1211    10012.8       1212    10014.5       1213    10021.1    1213.67      10055       1220      10055
GR     1220    10069.6       1220    10083.6       1220      10147    1215.57      10147       1216    10194.1
1
   06FEB98      12:57:16                                                                                  PAGE   11

GR     1217    10297.2

  ******************************************************************************
  *****        12' X 8' Concrete Box Culvert at McDowell Road              *****
  ******************************************************************************


QT        2       1240       1240
SC    1.013         .3        2.7                     8          12     112.25       12.3     1200.8    1200.75

  ******************************************************************************
  *****                   McDowell Road Culvert Inlet                      *****
  ******************************************************************************
  26
X1    1.075         43    10008.5    10020.5       112       112        112                  -1.83
X2                              2               1211.18
X3       10                                                                     1211.18    1211.18
BT       -3       9940    1211.26                10000    1211.18                10057.6    1211.26
GR     1217       9195       1216       9325    1215.62      9381       1222       9381       1222       9428
GR   1215.3       9428       1215     9475.5    1214.54      9513       1222       9513       1222    9557.88
GR     1222    9812.39       1222    9887.85       1222    9929.52       1222       9940    1217.73       9940
GR   1211.8       9940       1211    9973.46       1210    9985.78       1209     9992.7       1208       9994
GR     1208      10000       1207    10003.4       1206      10006    1202.62    10008.5    1202.62    10014.5
GR   1202.6    10020.5       1206    10022.9       1207    10024.3       1208    10025.4       1209    10026.3
GR     1210    10027.5       1211    10028.8       1212      10033       1213    10037.4       1214    10044.7
GR     1215    10057.6    1217.68    10057.6       1222    10057.6       1222    10082.2       1222    10116.3
GR     1222    10154.5       1222    10196.4       1222    10313.8

  Reach GRW-6 upstream from McDowell Road

NC    0.037      0.044      0.045

  25
X1    1.084         26    9990.97    10010.8         43         43         43                  -1.83
GR     1222     9960.8       1222       9965    1214.31       9965       1214     9966.9       1213    9972.36
GR     1212    9976.52       1211    9979.05       1210    9981.58       1209     9987.9       1208    9990.97
GR     1207    9993.32       1206    9995.66      1205.2      10000       1206    10003.8       1207    10007.3
GR     1208    10010.8       1209    10038.5       1210    10039.3       1211    10040.4       1212    10042.6
GR     1213    10044.7       1214    10048.6       1215    10058.6     1215.1      10068       1222      10068
GR     1222    10155.2


NC                                       0.1        0.3

  24
X1    1.101         28     9989.9    10012.2         90         90         90                  -1.83
GR     1222    9932.86       1222       9963    1215.07       9963       1215    9965.07       1214    9969.83
```

```
GR     1213    9973.77      1212    9976.76      1211    9980.16      1210    9983.42      1209    9986.54
GR     1208     9989.9      1207    9992.93      1206    9996.47    1205.5      10000      1206    10004.5
GR     1207      10008      1208    10012.2    1208.8    10027.3      1209      10040      1210    10041.3
GR     1211    10042.1      1212    10044.4      1213    10046.8      1214    10055.5      1215    10073.9
GR   1215.6      10108      1222      10108      1222    10124.7
```



```
NC                                     0.3        0.5

  ******************************************************************************
  *****                    Office Bridge outlet                             *****
  ******************************************************************************
  23
X1    1.108        28    9970.84    10057.1         40         40         40                  -1.83
X3       10                                                                     1213.17    1213.17
GR     1224    9955.7      1224       9963     1215.2       9963       1215    9965.16       1214    9970.84
GR     1213   9974.78      1212    9978.09       1211    9981.24       1210    9984.23       1209    9987.54
GR     1208   9991.01      1207    9994.48       1206    9998.85     1205.6      10000       1206    10007.1
GR     1207   10011.7      1208    10016.2       1209    10022.5       1210    10028.9       1211    10036.4
GR     1212   10040.2      1213    10043.4       1214    10057.1       1215    10111.6       1216      10140
GR   1215.8     10170      1224      10170       1224      10175

  ******************************************************************************
  *****                Special Bridge data at Office bridge                 *****
  ******************************************************************************

SB     1.05      1.56       2.7                    23          4        467          3    1203.89    1203.77

  ******************************************************************************
  *****                    Office Bridge inlet                              *****
  ******************************************************************************
X1    1.115        33    9971.29    10045.2         34         34         34                  -1.83
X2                            1    1213.17    1213.27
X3       10                                                                     1213.17    1213.17
BT       -8      9970    1213.17       1215    9971.29    1213.27     1215.1     9971.3    1217.27     1215.1
BT            10000    1233.27     1215.1   10019.53    1228.17     1215.1   10045.12    1217.27     1214.5
BT         10045.21    1213.27     1214.5     10094.    1213.17       1215
GR     1224   9958.97      1224    9964.65       1215    9964.65       1215       9970       1215    9970.01
GR     1215   9971.29    1215.1    9971.29       1213    9974.73       1212    9977.29       1211    9980.22
GR     1211   9980.52    1210.89    9981.29       1210     9982.6       1209     9985.9       1208    9989.74
GR     1207   9993.41    1205.66    9999.33    1205.72      10000    1205.88    10012.1    1207.42    10019.5
GR     1210   10026.9    1212.95    10035.2       1214    10045.2     1214.5    10045.2       1215    10094.5
GR     1224   10094.5      1224      10125    1215.87      10125       1216    10129.7       1217    10158.6
GR     1217     10170      1224      10170       1224      10223


X1    1.121        34     9983.8    10020.3         36         36         36                  -1.83
GR     1224    9959.9      1224       9963    1214.59       9963       1214    9967.38       1213    9973.14
GR     1212   9976.59      1211    9980.24       1210     9983.8       1209    9986.76       1208    9990.02
GR     1207    9993.1    1206.1      10000       1206    10001.2       1206    10004.1       1207    10009.8
```

Need to be adjusted

```
GR     1208      10015       1209    10018.8        1210     10020.3        1211     10022.6        1212     10026.1
GR     1213    10029.7       1214    10034.5        1215     10040.7        1215     10049.1        1215     10093.2
GR   1215.1      10097       1224      10097        1224     10127.4        1224       10133      1216.3       10133
GR     1217    10146.2       1218    10177.3        1224     10177.3        1224       10200
```

Reach GRW-7 Earthen channel downstream from 87th Street
Expancion-Contraction increase to acount for bend

1

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```
NC    0.045      0.045      0.045         .5          .8

X1    1.138         33    9952.84    10021.4          37         150         90                  -1.83
GR     1225     9857.9       1225    9930.22        1225      9937.9       1215      9937.9       1214     9952.84
GR     1213    9959.84       1212    9963.34        1211     9966.85       1210     9971.05       1209     9975.49
GR     1208    9979.69     1207.5      10000        1208     10008.3       1209     10010.5       1210     10012.7
GR     1211    10014.9       1212      10017        1213     10019.4       1214     10021.4       1215     10025.7
GR     1216    10029.9       1217    10052.3        1217       10074       1225       10074       1225       10135
GR     1217      10135       1217    10156.4        1217     10169.2       1217     10173.7       1217       10185
GR   1217.7      10210       1225      10210        1225       10220
```

Expancion Contraction back to normal after bend

```
NC                                        .1          .3

X1    1.181         34    9976.04    10021.36        225         225        225                  -1.83
GR     1225    9803.86       1225    9847.76        1225     9888.05       1225       9947     1213.33       9947
GR     1213    9976.04       1212    9979.56        1211     9982.13       1210     9984.58       1209     9987.04
GR     1208    9989.28       1207    9991.63        1206     9994.94       1205     9999.53     1204.95      10000
GR     1205      10001       1206    10002.52       1207    10005.92       1208    10008.42       1209    10010.62
GR     1210   10013.02       1211    10015.42       1212    10017.72       1213    10021.36       1214    10024.42
GR     1215   10051.82       1225    10051.82       1225       10113    1215.52       10113       1216    10168.82
GR     1216      10190       1225      10190        1225       10206       1225       10256
```

Expancion contraction increased for trancition and bend

```
NC                                        .5          .8

X1    1.224         34    9973.16    10020.6        230         130        230                  -1.83
GR     1217       9577       1215       9724        1216        9790       1225       9790       1225       9840
GR     1216       9840       1216       9868        1215      9915.7       1214     9959.52       1213     9968.92
GR     1212    9973.16       1211    9975.75        1210     9978.62       1209     9981.65       1208     9986.21
GR     1207    9994.84     1206.5      10000        1207     10006.3       1208     10010.9       1209     10013.4
GR     1210      10015       1211    10016.6        1212     10020.6       1213     10039.1       1214     10050.5
GR   1214.1      10055       1225      10055        1225    10083.13       1225       10125     1215.2       10125
GR     1216      10258       1216      10267        1225       10267       1225       10300

X1    1.239         34    9985.94    10034.7         90          30         75                  -1.83
GR     1227       9720       1227       9740        1217        9740       1217       9752     1216.42       9815
GR     1227       9815       1227    9860.12        1227        9870    1215.74       9870       1215     9897.7
GR     1215    9901.82     1215.2       9915        1227        9915       1227       9960     1215.8       9960
```

```
GR     1216    9975.83       1215    9981.92       1214     9985.94       1213     9989.85       1212     9994.01
GR   1211.4       9997       1211     9999.1     1210.9       10000       1211     10001.7       1212     10013.9
GR     1213    10024.7       1214    10034.7       1227     10034.8       1227       10123     1214.5       10123
GR     1215    10209.3    1215.81      10250       1227       10250       1227     10259.6
```

Reach GRW-8 along 87th Street

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```
NC    0.055      0.055       .018         .5          .8

X1    1.262         54    9990.73    10032.2         256          20         123                  -1.83
GR     1227    9417.43       1227       9475    1218.47        9475    1218.38        9485        1227        9485
GR     1227    9526.89       1227       9535    1217.96        9535    1217.86        9555        1227        9555
GR     1227       9617    1217.55       9617    1217.48        9630       1227        9630        1227        9686
GR   1217.2       9686    1217.13       9700       1227        9700       1227     9725.93        1227        9765
GR   1216.8       9765    1216.71       9778       1227        9778       1227        9828     1216.43        9828
GR   1216.3       9845       1227       9845       1227     9903.71       1227        9911     1215.63        9911
GR     1215    9923.34       1214    9924.07       1213     9949.26    1212.50     9990.73        1212     10032.2
GR   1211.9   10034.52       1212    10037.8       1213       10043       1214     10048.5        1214       10058
GR     1227      10058       1227      10143       1214       10143       1214     10185.7        1215     10221.6
GR   1215.0      10225       1227      10225       1227       10321     1216.4       10321      1216.4       10348
GR     1227      10348       1227      10422    1216.68       10422       1217       10502

X1    1.301         73    9980.84    10019.8         225         130        204                  -1.83
GR     1228    9329.73       1228       9385    1218.54        9385    1218.43        9398        1228        9398
GR     1228    9448.73       1228       9455    1217.98        9455    1217.92        9470        1228        9470
GR     1228       9527    1217.71       9527    1217.64        9545       1228        9545        1228        9598
GR   1217.4       9598    1217.35       9614       1228        9614       1228        9673     1217.15        9673
GR   1217.1       9684       1228       9684       1228     9714.37       1228        9737      1216.9        9737
GR   1216.8       9755       1228       9755       1228        9805    1216.59        9805     1216.52        9822
GR     1228       9822       1228       9868    1216.31        9868    1216.24        9885        1228        9885
GR     1228    9937.98       1216    9937.98       1215     9954.58       1214     9968.17        1213     9980.84
GR   1212.1      10000       1213    10019.8       1214     10031.6       1215     10049.1     1215.14       10057
GR     1228      10057       1228    10104.6       1228       10110    1216.02       10110     1216.09       10128
GR     1228      10128       1228      10183    1216.32       10183     1216.4       10205        1228       10205
GR     1228      10273    1216.68      10273       1217     10353.4       1228     10353.4        1228       10397
GR   1217.8      10397       1218    10418.6    1218.13       10435       1228       10435        1228       10470
GR   1218.3      10470     1218.4      10483       1228       10483       1228       10535     1218.67       10535
GR   1218.7      10550       1228      10550       1228     10596.9
```

Expancion-Contraction back to normal after bend/trancition
N value .5 to block inefective area

```
NC                                     0.1         0.3
NH        5         .9       9860       .055        9981        .018       10019        .055       10180          .9
NH    10500
   14.5
X1    1.353         64       9981      10019         290         235         278                  -1.83
GR     1228       9457       1228       9475      1217.9        9475    1217.84        9485        1228        9485
GR     1228       9555    1217.45       9555    1217.39        9566       1228        9566        1228        9625
```

GR	1217.1	9625	1217	9635	1216.94	9644	1228	9644	1228	9700
GR	1216.5	9700	1216.3	9735.7	1216	9778.68	1215.91	9790	1228	9790
GR	1228	9840	1215.48	9840	1215.34	9858	1228	9858	1228	9898.59
GR	1228	9918	1214.62	9918	1214	9949.53	1213.1	9981	1213	9994
GR	1212.8	10000	1213	10007.5	1213.1	10019	1214	10041.4	1214.06	10045
GR	1228	10045	1228	10095	1214.83	10095	1215	10106	1215.14	10120
GR	1228	10120	1228	10140	1215.34	10140	1215.48	10155	1228	10155
GR	1228	10207.4	1216	10207.4	1217.23	10223	1228	10223	1228	10255.8
GR	1228	10267	1217.35	10267	1217.4	10282.9	1217.8	10330	1228	10330
GR	1228	10382	1218.2	10382	1218.3	10400	1228	10400	1228	10445

1

GR	1218.6	10445	1218.8	10470	1228	10470	1228	10500

NC	0.055	0.055	.018

X1	1.373	82	9980.32	10021.3	150	105	106		-1.83	
GR	1228	9447.57	1228	9495.13	1228	9512	1218.82	9512	1218.7	9524
GR	1228	9524	1228	9583	1218.08	9583	1218	9591.07	1217.94	9597
GR	1228	9597	1228	9663	1217.24	9663	1217	9685.49	1217	9734.12
GR	1216.8	9763	1228	9763	1228	9818	1216.55	9818	1216.1	9903
GR	1228	9903	1228	9920.85	1228	9948	1215.5	9948	1215	9967.69
GR	1214	9980.32	1213.0	10000	1214	10021.3	1215	10035.4	1215.45	10040
GR	1228	10040	1228	10048.7	1228	10073.7	1228	10080	1217.1	10080
GR	1217.5	10105	1228	10105	1228	10136.8	1228	10142	1218.04	10142
GR	1218.3	10168	1228	10168	1228	10214	1218.63	10214	1218.83	10240
GR	1228	10240	1228	10260.2	1228	10288	1219.29	10288	1219.4	10298
GR	1228	10298	1228	10353	1219.98	10353	1220	10355.1	1220.11	10363
GR	1228	10363	1228	10415	1220.84	10415	1221	10426.3	1221.02	10433
GR	1228	10433	1228	10482	1221.16	10482	1221.2	10496	1228	10496
GR	1228	10553	1221.36	10553	1221.39	10562	1228	10562	1228	10618
GR	1221.5	10618	1221.58	10628	1228	10628	1228	10683	1221.73	10683
GR	1221.8	10695	1228	10695	1228	10750	1221.92	10750	1221.96	10764
GR	1228	10764	1228	10776.9						

N value .5 to block inefective area

NH	4	.5	9850	.055	9979.61	.018	10023.8	.055	10744.6	
X1	1.438	75	9979.61	10023.8	280	390	344		-1.83	
GR	1220	9434.9	1219.88	9450	1229	9450	1229	9510	1219.45	9510
GR	1219.3	9525	1229	9525	1229	9583	1218.78	9583	1218.67	9593
GR	1229	9593	1229	9657	1218.06	9657	1218	9662.88	1217.98	9667
GR	1229	9667	1229	9726	1217.65	9726	1217.57	9740	1229	9740
GR	1229	9793	1217.28	9793	1217.18	9810	1229	9810	1229	9842.52
GR	1229	9880	1216.61	9880	1216.22	9917	1229	9917	1229	9937.81
GR	1229	9950	1215.7	9950	1215	9979.61	1214	9995.34	1213.8	10000
GR	1214	10004.4	1214	10017	1214	10019.9	1215	10023.8	1216	10031.1
GR	1217	10050	1229	10050	1229	10102	1217	10102	1217	10133
GR	1229	10133	1229	10200	1217	10200	1217	10252.2	1218	10276.1
GR	1218.0	10277	1229	10277	1229	10340	1218.81	10340	1219	10354.7
GR	1219.0	10355	1229	10355	1229	10410	1219.61	10410	1219.71	10420

```
GR      1229      10420       1229      10477     1220.29      10477     1220.39      10487       1229      10487
GR      1229      10545    1220.92      10545        1221    10553.1     1221.02      10557       1229      10557
GR      1229      10613    1221.31      10613     1221.38      10626        1229      10626       1229    10744.6

  N value .5 to block inefective area

NH         4         .5       9960       .055     9977.58       .018     10023.8       .055      10483
   12.5
X1     1.499         73    9977.58    10023.8        350        250        320                  -1.83
GR      1221     9454.9    1220.76       9485       1230       9485       1230     9493.9       1230     9546.9
GR      1230       9553    1219.92       9553    1219.78       9565       1230       9565       1230    9627.37
GR      1230       9633    1218.93       9633    1218.77       9647       1230       9647       1230       9704
GR    1218.1       9704       1218    9713.36    1217.96       9716       1230       9716       1230       9776
GR    1217.2       9776       1217    9787.79    1216.98       9793       1230       9793       1230       9857
1
   06FEB98      12:57:16                                                                                PAGE   16

GR    1216.7       9857     1216.7    9865.46    1216.07       9915       1230       9915       1230    9920.48
GR      1230       9953    1215.43       9953       1215    9977.58     1214.6      10000       1215    10023.8
GR      1216      10027       1217    10030.8       1218    10035.6       1218      10043       1230      10043
GR      1230    10049.2       1230      10082       1218      10082       1218    10096.2       1219    10103.1
GR      1220    10109.3       1221    10111.7       1222    10115.6       1222    10119.7       1221      10123
GR      1220    10123.7       1219    10124.1       1218    10124.8       1218    10143.3       1230    10143.3
GR      1230      10202       1218      10202       1218    10263.4     1218.2      10295       1230      10295
GR      1230      10348    1218.53      10348    1218.64      10364       1230      10364       1230    10421.8
GR      1219    10421.8    1219.13      10435       1230      10435       1230      10483    1219.62      10483
GR    1219.7      10492       1230      10492       1230    10520.5

  N value .5 to block inefective area

NH         4         .5       9940       .055       9983       .018    10017.6       .055      10527
X1     1.522         67    9983.44    10017.6        115        125        122                  -1.83
GR      1221    9448.46    1220.59       9495       1230       9495       1230       9533    1220.27       9533
GR    1220.0       9560       1230       9560       1230     9563.9       1230       9630    1219.09       9630
GR      1219    9636.57    1218.95       9643       1230       9643       1230       9708     1218.4       9708
GR    1218.3       9718       1230       9718       1230    9763.77       1230       9777    1217.93       9777
GR    1217.9       9787       1230       9787       1230       9855    1217.53       9855     1217.2       9918
GR      1230       9918       1230    9957.24       1217    9957.24       1216    9971.63       1215    9983.44
GR    1214.6      10000       1215    10017.6       1216    10027.3       1217      10038     1217.3      10048
GR      1230      10048       1230    10071.1       1230      10092       1218      10092       1218    10124.5
GR    1218.1      10140       1230      10140       1230      10197     1218.5      10197    1218.62      10213
GR      1230      10213       1230      10260    1218.94      10260       1219    10268.2    1219.03      10271
GR      1230      10271       1230      10330    1219.58      10330    1219.75      10348       1230      10348
GR      1230    10375.2       1230      10395    1220.12      10395    1220.21      10410       1230      10410
GR      1230      10464    1220.53      10464    1220.59      10475       1230      10475       1230      10527
GR    1220.9      10527       1221      10543


NC     0.055      0.055       .018         .1         .3

X1     1.575         42    9983.07    10019.9        272        283        277                  -1.83
GR      1221    9565.27    1220.53       9627       1230       9627       1230       9693    1220.02       9693
GR      1220    9696.06    1219.94       9705       1230       9705       1230       9770    1219.49       9770
```

GR	1219.4	9780	1230	9780	1230	9842.02	1219	9842.02	1218	9847.21
GR	1217.9	9852	1230	9852	1230	9892	1217.53	9892	1217.39	9905
GR	1230	9905	1230	9941.73	1230	9955	1216.38	9955	1216	9983.07
GR	1215.3	10000	1216	10019.9	1216	10024.8	1216	10026	1217	10033
GR	1218	10036	1218.17	10058	1230	10058	1230	10130	1218.66	10130
GR	1219	10180.6	1220	10194.6	1220	10206.9	1221	10209.4	1222	10210.4
GR	1222	10214.2	1222	10636.9						

X1	1.670	57	9978.69	10020	504	504	504		-1.83	
GR	1224	9505.95	1224	9530	1232	9530	1232	9550	1224	9550
GR	1224	9561.19	1223.87	9575	1232	9575	1232	9635	1223.33	9635
GR	1223.1	9657	1232	9657	1232	9671.25	1232	9725	1222.23	9725
GR	1222	9741.51	1232	9741.51	1232	9795	1221.59	9795	1221.45	9813
GR	1232	9813	1232	9871.35	1221	9871.35	1220.56	9893	1232	9893
GR	1232	9920.01	1232	9957	1219.12	9957	1219	9961.85	1218	9970.31
GR	1217	9978.69	1216	10000	1217	10020	1217	10025.7	1218	10033.8
GR	1219	10037.1	1219.04	10044	1232	10044	1232	10113	1219.44	10113

1

GR	1219.5	10128	1232	10128	1232	10195	1219.92	10195	1219.98	10205
GR	1232	10205	1232	10208.5	1232	10260	1220.28	10260	1220.42	10286
GR	1232	10286	1232	10350	1220.78	10350	1221	10389.5	1222	10400.2
GR	1222	10541.1	1222.1	10620.2						

X1	1.725	57	9981.03	10017.3	292	292	292		-1.83	
GR	1225	9582.57	1224	9586.95	1223	9592.66	1222.7	9620	1232	9620
GR	1232	9678	1222.05	9678	1222	9682.95	1221.95	9688	1232	9688
GR	1232	9750	1221.32	9750	1221.22	9760	1232	9760	1232	9782.28
GR	1232	9813	1220.75	9813	1220.59	9833	1232	9833	1232	9892
GR	1220.1	9892	1220.04	9902	1232	9902	1232	9907.33	1232	9956.88
GR	1232	9960	1218.72	9960	1218	9967.88	1217	9981.03	1216.5	10000
GR	1217	10017.3	1218	10025.5	1219	10030.1	1219.45	10055	1232	10055
GR	1232	10085.4	1232	10120	1220.16	10120	1220.2	10130	1232	10130
GR	1232	10198	1220.51	10198	1220.58	10213	1232	10213	1232	10278
GR	1220.8	10278	1220.94	10293	1232	10293	1232	10305.7	1232	10365
GR	1221	10365	1221	10378	1232	10378	1232	10425.8	1232	10436.1
GR	1221	10436.1	1221	10454.1						

X1	1.810	57	9989.25	10022.7	460	449	449		-1.83	
GR	1232	9731.02	1232	9748.28	1232	9773	1222.25	9773	1222	9781.35
GR	1221.2	9795	1232	9795	1232	9800.14	1232	9823	1220.71	9823
GR	1220.5	9843	1232	9843	1232	9880.65	1232	9890	1219.83	9890
GR	1219.4	9913	1232	9913	1232	9935.88	1232	9960	1218.5	9960
GR	1218	9989.25	1217.4	10000	1218	10022.7	1218.52	10040	1232	10040
GR	1232	10055.84	1232	10111	1219.94	10111	1220	10114.76	1220	10135
GR	1232	10135	1232	10155	1220	10155	1220	10185	1232	10185
GR	1232	10227	1220	10227	1220	10248.9	1220.04	10253	1232	10253
GR	1232	10272	1220.22	10272	1220.62	10314	1232	10314	1232	10352.8
GR	1232	10373	1221.2	10373	1221.28	10387	1232	10387	1232	10447

GR	1221.7	10447	1221.9	10462	1232	10462	1232	10473.5	1232	10522
GR	1222.6	10522	1223	10555.3						

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X1	1.879	46	9981.65	10020.1	359	359	359		-1.83	
GR	1227	9481.36	1226	9516.9	1225	9560.7	1224	9571.89	1224	9573.86
GR	1224.9	9613.26	1224.31	9682	1232	9682	1232	9718.68	1224	9718.68
GR	1223	9744.16	1223	9806.92	1222.77	9827	1232	9827	1232	9892
GR	1222.0	9892	1222	9894.66	1221.88	9903	1232	9903	1232	9963
GR	1221.0	9963	1221	9966.26	1220	9974.66	1219	9981.65	1218.3	10000
GR	1219	10020.1	1220	10028.8	1221	10044.2	1221.64	10072	1232	10072
GR	1232	10087.85	1232	10135	1222	10135	1222	10160	1232	10160
GR	1232	10223	1222	10223	1222	10266	1232	10266	1232	10320
GR	1222	10320	1222	10375.5	1222.39	10389	1232	10389	1232	10410.1
GR	1232	10450								

6.5

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X1	1.925	27	9982	10020	245	250	245		-1.83	
GR	1226	9804	1226	9840	1226	9877	1222.66	9877	1222.45	9900
GR	1226	9900	1226	9950	1226	9962	1221.2	9962	1221	9965
GR	1220	9982	1219	9991	1218.7	10000	1219	10012	1220	10020
GR	1221	10037	1221.07	10043	1226	10043	1226	10082	1221.56	10082
GR	1221.8	10106	1226	10106	1226	10149	1222.38	10149	1222.51	10160
GR	1226	10160	1226	10217						

6

X1	1.961	66	9981	10019	192	194	192		-1.83	
GR	1227	9554.95	1226	9560.92	1226	9564	1232	9564	1232	9589.58
GR	1232	9609.98	1232	9645.35	1232	9668.31	1224	9668.31	1224	9715
GR	1232	9715	1232	9783	1224	9783	1224	9789.67	1223.64	9814
GR	1232	9814	1232	9856.74	1232	9877	1222.46	9877	1222	9894.48
GR	1232	9894.48	1232	9922.03	1232	9945.39	1232	9954	1219.8	9954
GR	1219.1	9981	1219	9993.01	1218.9	10000	1219	10008.6	1219.1	10019
GR	1219.8	10033	1232	10033	1232	10037.7	1232	10069.6	1232	10082
GR	1221.2	10082	1221.42	10094	1232	10094	1232	10128.2	1232	10152
GR	1222.2	10152	1222.26	10165	1232	10165	1232	10230	1222.72	10230
GR	1222.8	10242	1232	10242	1232	10269.6	1232	10305	1223.24	10305
GR	1223.3	10315	1232	10315	1232	10377	1223.73	10377	1223.8	10387
GR	1232	10387	1232	10417.1	1232	10453	1224.23	10453	1224.31	10466
GR	1232	10466	1232	10520	1224.66	10520	1224.76	10536	1232	10536
GR	1232	10574.1								

X1	2.044	66	9981	10018.7	436.2	392	437		-1.83	
GR	1232	9714.95	1232	9731	1225.45	9731	1225	9744.01	1224	9781.61
GR	1224	9810	1232	9810	1232	9855	1224	9855	1224	9860.78
GR	1223.2	9910	1232	9910	1232	9928.59	1232	9958	1223.29	9958

GR	1222	9970.12	1221.1	9981	1221	9987.95	1220.2	10000	1221	10018.7
GR	1222	10028.1	1223	10032.7	1223.02	10042	1232	10042	1232	10092
GR	1223.1	10092	1223.15	10107	1232	10107	1232	10159	1223.26	10159
GR	1223.3	10176	1232	10176	1232	10235	1223.41	10235	1223.44	10250
GR	1232	10250	1232	10312	1223.57	10312	1223.59	10325	1232	10325
GR	1232	10385	1223.71	10385	1223.73	10395	1232	10395	1232	10453
GR	1223.8	10453	1223.88	10465	1232	10465	1232	10520	1223.99	10520
GR	1224	10525.8	1224.1	10537	1232	10537	1232	10595	1224.66	10595
GR	1224.8	10614	1232	10614	1232	10670	1225.3	10670	1225.38	10680
GR	1232	10680	1232	10741	1225.85	10741	1225.89	10747	1232	10747
GR	1232	10761								

X1	2.128	57	9990.25	10012.6	444	460	444		-1.83	
GR	1226	9720	1225	9750.5	1224.82	9785	1232	9785	1232	9871
GR	1224.4	9871	1224.2	9900	1232	9900	1232	9953	1224.43	9953
GR	1223	9964.4	1222	9975.61	1221	9990.25	1220.75	10000	1221	10012.6
GR	1221	10022.8	1222	10024.7	1223	10027.9	1223.26	10035	1232	10035
GR	1232	10055.2	1232	10095	1224.44	10095	1224.57	10108	1232	10108
GR	1232	10146.3	1232	10158	1225.02	10158	1225.05	10172	1232	10172
GR	1232	10227	1225.15	10227	1225.18	10243	1232	10243	1232	10296
GR	1225.2	10296	1225.31	10309	1232	10309	1232	10372	1225.42	10372

GR	1225.4	10381	1232	10381	1232	10442	1225.56	10442	1225.58	10453
GR	1232	10453	1232	10513	1225.69	10513	1225.72	10528	1232	10528
GR	1232	10590	1225.83	10590	1225.86	10601	1232	10601	1232	10663
GR	1225.9	10663	1226	10678						

NC	0.035	0.055	0.018

X1	2.168	74	9982.63	10019	209	209	209		-1.83	
GR	1227	9752.74	1226	9774.47	1225	9780.04	1224.68	9820	1232	9820
GR	1232	9867	1224.3	9867	1224.08	9894	1232	9894	1232	9903.41
GR	1232	9942.61	1232	9953	1223.53	9953	1223	9964.62	1222	9982.63
GR	1221.3	9998.34	1221.3	10000	1222	10012.1	1222	10019	1222.5	10045
GR	1232	10045	1232	10060	1222.82	10060	1223	10069	1223.1	10083
GR	1232	10083	1232	10130	1223.3	10130	1223.4	10155	1232	10155
GR	1232	10192	1223.6	10192	1223.8	10216	1232	10216	1232	10249
GR	1232	10274	1224.0	10274	1224.1	10292	1232	10292	1232	10341
GR	1224.2	10341	1224.2	10361	1232	10361	1232	10424	1224.4	10424
GR	1224.5	10440	1232	10440	1232	10492	1224.6	10492	1224.7	10504
GR	1232	10504	1232	10570	1224.8	10570	1224.8	10587	1232	10587
GR	1232	10634.1	1232	10637	1225.0	10637	1225.1	10662	1232	10662
GR	1232	10716	1225.5	10716	1225.6	10730	1232	10730	1232	10789
GR	1225.9	10789	1226	10793	1226.1	10810	1232	10810	1232	10860
GR	1226.4	10860	1226.6	10875	1232	10875	1232	10930		

X1	2.192	63	9981	10019.6	125	135	129		-1.83	
GR	1227	9765	1226	9795	1225	9853.2	1225	9859.8	1225	9888.43

GR	1225	9897.6	1224	9927.88	1223	9972.11	1222.1	9981	1222	9985.69
GR	1221.4	10000	1222	10009.5	1223	10019.6	1223	10022.4	1223	10029
GR	1223.1	10038	1232	10038	1232	10098	1223.77	10098	1223.8	10107
GR	1232	10107	1232	10118.5	1232	10166	1224.2	10166	1224.2	10185
GR	1232	10185	1232	10238	1224.5	10238	1224.58	10258	1232	10258
GR	1232	10287	1232	10298	1224.78	10298	1224.96	10323	1232	10323
GR	1232	10328.1	1232	10380	1225.13	10380	1225.18	10400	1232	10400
GR	1232	10455	1225.3	10455	1225.35	10468	1232	10468	1232	10524
GR	1225.5	10524	1225.52	10538	1232	10538	1232	10599	1225.6	10599
GR	1225.7	10613	1232	10613	1232	10662	1225.83	10662	1225.8	10685
GR	1232	10685	1232	10740	1226.1	10740	1226.21	10752	1232	10752
GR	1232	10810	1226.8	10810	1227	10835				

X1	2.208	34	9980.97	10018.4	90	82	82		-1.83	
GR	1227	9773.3	1226	9803.3	1226	9807.87	1226	9810.36	1225	9874.79
GR	1224	9937.09	1223	9980.97	1222.5	10000	1223	10018.4	1224	10028.1
GR	1232	10028.1	1232	10060.3	1232	10103	1225.44	10103	1225.55	10114
GR	1232	10114	1232	10157.5	1232	10178	1226.07	10178	1226.13	10193
GR	1232	10193	1232	10245	1226.32	10245	1226.39	10263	1232	10263
GR	1232	10308	1226.5	10308	1226.65	10335	1232	10335	1232	10387
GR	1226.8	10387	1226.9	10404	1232	10404	1232	10431.5		

X1	2.218	42	9977.16	10049.8	48	58	54		-1.83	
GR	1227	9752.2	1226	9802.2	1225	9861.06	1224	9954.31	1223.85	9977.16
GR	1223.7	10000	1224	10049.8	1232	10049.9	1232	10104	1224.52	10104
GR	1224.6	10117	1232	10117	1232	10153.5	1232	10175	1225.07	10175
GR	1225.1	10192	1232	10192	1232	10245	1225.3	10245	1225.35	10262
GR	1232	10262	1232	10308	1225.5	10308	1225.61	10340	1232	10340
GR	1232	10390	1225.7	10390	1225.8	10405	1232	10405	1232	10459.7
GR	1226	10459.7	1226.1	10480	1232	10480	1232	10528	1226.41	10528
GR	1226.5	10550	1232	10550	1232	10600	1226.85	10600	1226.97	10620
GR	1232	10620	1232	10625						

Upstream from Thomas Road

NC	.020	0.055	0.018
QT	2	644	644

X1	2.295	12	9968	10048.25	405	405	405		-1.83	
GR	1227	9848	1227.5	9852	1227	9860	1227.5	9875	1227	9900
GR	1226.4	9968	1226.3	10000	1226.48	10048.25	1226.65	10096.50	1227	10193
GR	1228	10230	1239	10335						

X1	2.355	9	9960	10038	320	320	320		-1.83	
GR	1228	9960	1227	9970	1227.2	10000	1228	10038	1228	10060
GR	1227	10090	1228	10095	1229	10105	1230	10160		

THIS RUN EXECUTED 06FEB98 12:57:19

****
HEC-2 WATER SURFACE PROFILES

Version 4.6.2; May 1991
****

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

City of Scottsdale - G

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
*	.225	1417.00	1194.59	1194.59	7.69	55.00	11.03
*	.225	1417.00	1194.59	1194.59	7.69	55.00	11.03
*	.231	1417.00	1196.67	.00	9.30	289.70	3.71
*	.231	1417.00	1196.67	.00	9.30	289.70	3.71
*	.257	1417.00	1196.80	.00	9.13	138.50	7.09
*	.257	1417.00	1196.80	.00	9.13	138.50	7.09
*	.272	1417.00	1197.35	.00	11.18	97.21	2.66
*	.272	1417.00	1197.35	.00	11.18	97.21	2.66
*	.288	1417.00	1197.30	.00	8.23	160.53	4.15
*	.288	1417.00	1197.30	.00	8.23	160.53	4.15
*	.303	1417.00	1197.36	1197.36	2.29	145.25	9.08
*	.303	1417.00	1197.36	1197.36	2.29	145.25	9.08
*	.320	1417.00	1198.14	.00	2.67	269.50	6.80
*	.320	1417.00	1198.14	.00	2.67	269.50	6.80
	.326	1417.00	1198.29	.00	3.12	195.12	7.27
	.326	1417.00	1198.29	.00	3.12	195.12	7.27
*	.369	1417.00	1198.93	1198.93	2.96	158.89	9.11
*	.369	1417.00	1198.93	1198.93	2.96	158.89	9.11
	.421	1417.00	1199.84	.00	3.17	149.33	8.60
	.421	1417.00	1199.84	.00	3.17	149.33	8.60
	.459	1417.00	1200.60	1200.05	4.43	159.86	7.45
	.459	1417.00	1200.60	1200.05	4.43	159.86	7.45

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
*	.503	1417.00	1202.76	1202.76	2.29	265.50	8.76
*	.503	1417.00	1202.76	1202.76	2.29	265.50	8.76
*	.542	1417.00	1204.01	1204.01	2.64	114.14	8.21
*	.542	1417.00	1204.01	1204.01	2.64	114.14	8.21
	.627	1417.00	1205.97	.00	2.80	319.09	7.12
	.627	1417.00	1205.97	.00	2.80	319.09	7.12
*	.674	1417.00	1207.12	1207.12	3.45	266.73	8.85
*	.674	1417.00	1207.12	1207.12	3.45	266.73	8.85
	.729	1417.00	1208.11	.00	3.34	373.63	6.64
	.729	1417.00	1208.11	.00	3.34	373.63	6.64
*	.786	1417.00	1208.70	1208.70	3.63	256.49	9.33
*	.786	1417.00	1208.70	1208.70	3.63	256.49	9.33
*	.821	1417.00	1209.61	.00	4.34	338.59	5.44
*	.821	1417.00	1209.61	.00	4.34	338.59	5.44
*	.857	1417.00	1209.64	1209.64	2.97	171.30	8.84
*	.857	1417.00	1209.64	1209.64	2.97	171.30	8.84
*	.865	1417.00	1210.73	1206.80	9.66	296.53	2.99
*	.865	1417.00	1210.73	1206.80	9.66	296.53	2.99
	.883	1417.00	1210.75	.00	9.48	293.50	3.47
	.883	1417.00	1210.75	.00	9.48	293.50	3.47
	.915	1417.00	1210.89	.00	9.62	273.38	3.47
	.915	1417.00	1210.89	.00	9.62	273.38	3.47
	.966	1417.00	1211.07	.00	9.30	227.15	3.19
	.966	1417.00	1211.07	.00	9.30	227.15	3.19
	1.001	1417.00	1211.16	.00	9.29	201.95	3.89
	1.001	1417.00	1211.16	.00	9.29	201.95	3.89
	1.042	1417.00	1211.51	.00	9.64	423.13	3.41
	1.042	1417.00	1211.51	.00	9.64	423.13	3.41
	1.054	1417.00	1211.34	.00	10.67	199.72	7.55
	1.054	1417.00	1211.34	.00	10.67	199.72	7.55
*	1.075	1240.00	1212.50	.00	11.73	108.96	3.66
*	1.075	1240.00	1212.50	.00	11.73	108.96	3.66

*	1.084	1240.00	1212.51	.00	9.14	87.00	3.38
*	1.084	1240.00	1212.51	.00	9.14	87.00	3.38

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06FEB98 12:57:16

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
	1.101	1240.00	1212.58	.00	8.91	95.18	3.29
	1.101	1240.00	1212.58	.00	8.91	95.18	3.29
	1.108	1240.00	1212.61	.00	8.84	86.26	3.14
	1.108	1240.00	1212.61	.00	8.84	86.26	3.14
	1.115	1240.00	1212.62	.00	8.79	72.85	3.24
	1.115	1240.00	1212.62	.00	8.79	72.85	3.24
	1.121	1240.00	1212.62	.00	8.45	73.29	4.18
	1.121	1240.00	1212.62	.00	8.45	73.29	4.18
	1.138	1240.00	1212.80	.00	7.13	80.73	3.67
	1.138	1240.00	1212.80	.00	7.13	80.73	3.67
	1.181	1240.00	1213.12	.00	10.00	103.33	4.09
	1.181	1240.00	1213.12	.00	10.00	103.33	4.09
*	1.224	1240.00	1213.51	.00	8.84	226.30	3.18
*	1.224	1240.00	1213.51	.00	8.84	226.30	3.18
*	1.239	1240.00	1213.59	1213.59	4.52	195.61	7.09
*	1.239	1240.00	1213.59	1213.59	4.52	195.61	7.09
*	1.262	1240.00	1214.49	.00	4.42	231.70	4.27
*	1.262	1240.00	1214.49	.00	4.42	231.70	4.27
*	1.301	1240.00	1214.53	.00	4.26	166.16	6.78
*	1.301	1240.00	1214.53	.00	4.26	166.16	6.78
	1.353	1240.00	1215.11	.00	4.14	287.16	5.19
	1.353	1240.00	1215.11	.00	4.14	287.16	5.19
*	1.373	1240.00	1214.78	1214.61	3.61	177.00	8.30
*	1.373	1240.00	1214.78	1214.61	3.61	177.00	8.30
	1.438	1240.00	1215.72	.00	3.75	250.42	6.84
	1.438	1240.00	1215.72	.00	3.75	250.42	6.84
	1.499	1240.00	1216.13	.00	3.36	157.39	7.28
	1.499	1240.00	1216.13	.00	3.36	157.39	7.28
	1.522	1240.00	1216.37	1215.93	3.60	211.76	7.69
	1.522	1240.00	1216.37	1215.93	3.60	211.76	7.69

	1.575	1240.00	1216.75	1216.61	3.28	123.87	8.88
	1.575	1240.00	1216.75	1216.61	3.28	123.87	8.88
	1.670	1240.00	1217.99	.00	3.82	102.00	7.96
	1.670	1240.00	1217.99	.00	3.82	102.00	7.96

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06FEB98 12:57:16

	SECNO	Q	CWSEL	CRIWS	DEPTH	TOPWID	VCH
	1.725	1240.00	1218.59	.00	3.92	115.00	7.71
	1.725	1240.00	1218.59	.00	3.92	115.00	7.71
	1.810	1240.00	1219.57	.00	4.00	262.34	6.33
	1.810	1240.00	1219.57	.00	4.00	262.34	6.33
*	1.879	1240.00	1219.91	1219.91	3.44	109.00	9.23
*	1.879	1240.00	1219.91	1219.91	3.44	109.00	9.23
	1.925	1240.00	1220.79	1220.40	3.92	133.65	8.05
	1.925	1240.00	1220.79	1220.40	3.92	133.65	8.05
*	1.961	1240.00	1221.51	.00	4.44	143.48	5.71
*	1.961	1240.00	1221.51	.00	4.44	143.48	5.71
*	2.044	1240.00	1222.06	1222.06	3.69	208.37	8.68
*	2.044	1240.00	1222.06	1222.06	3.69	208.37	8.68
	2.128	1240.00	1223.08	1222.67	4.16	139.55	9.33
	2.128	1240.00	1223.08	1222.67	4.16	139.55	9.33
*	2.168	1240.00	1224.11	.00	4.64	360.08	4.11
*	2.168	1240.00	1224.11	.00	4.64	360.08	4.11
	2.192	1240.00	1224.12	.00	4.55	396.83	4.70
	2.192	1240.00	1224.12	.00	4.55	396.83	4.70
*	2.208	1240.00	1224.05	.00	3.38	221.43	6.28
*	2.208	1240.00	1224.05	.00	3.38	221.43	6.28
	2.218	1240.00	1224.32	.00	2.45	369.45	4.45
	2.218	1240.00	1224.32	.00	2.45	369.45	4.45
*	2.295	644.00	1225.47	1225.47	1.00	335.03	5.26
*	2.295	644.00	1225.47	1225.47	1.00	335.03	5.26
	2.355	644.00	1226.75	1226.71	1.58	140.78	6.04
	2.355	644.00	1226.75	1226.71	1.58	140.78	6.04

City of Scottsdale - G

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	.225	.00	.00	.00	1186.90	1417.00	1194.59	1194.59	1196.27	28.83	11.03	165.87	263.91
*	.225	.00	.00	.00	1186.90	1417.00	1194.59	1194.59	1196.27	28.83	11.03	165.87	263.91
*	.231	31.00	.00	.00	1187.37	1417.00	1196.67	.00	1196.76	1.29	3.71	976.90	1248.66
*	.231	31.00	.00	.00	1187.37	1417.00	1196.67	.00	1196.76	1.29	3.71	976.90	1248.66
*	.257	137.00	1195.58	.00	1187.67	1417.00	1196.80	.00	1197.28	4.82	7.09	413.16	645.74
*	.257	137.00	1195.58	.00	1187.67	1417.00	1196.80	.00	1197.28	4.82	7.09	413.16	645.74
*	.272	80.00	.00	.00	1186.17	1417.00	1197.35	.00	1197.42	1.14	2.66	716.79	1329.67
*	.272	80.00	.00	.00	1186.17	1417.00	1197.35	.00	1197.42	1.14	2.66	716.79	1329.67
*	.288	83.00	.00	.00	1189.07	1417.00	1197.30	.00	1197.46	2.56	4.15	581.37	885.54
*	.288	83.00	.00	.00	1189.07	1417.00	1197.30	.00	1197.46	2.56	4.15	581.37	885.54
*	.303	77.00	.00	.00	1195.07	1417.00	1197.36	1197.36	1198.27	64.61	9.08	248.31	176.29
*	.303	77.00	.00	.00	1195.07	1417.00	1197.36	1197.36	1198.27	64.61	9.08	248.31	176.29
*	.320	89.00	.00	.00	1195.47	1417.00	1198.14	.00	1198.63	22.01	6.80	414.25	302.03
*	.320	89.00	.00	.00	1195.47	1417.00	1198.14	.00	1198.63	22.01	6.80	414.25	302.03
	.326	34.00	.00	.00	1195.17	1417.00	1198.29	.00	1198.71	23.83	7.27	385.51	290.29
	.326	34.00	.00	.00	1195.17	1417.00	1198.29	.00	1198.71	23.83	7.27	385.51	290.29
*	.369	226.00	.00	.00	1195.97	1417.00	1198.93	1198.93	1199.81	32.12	9.11	295.68	250.01
*	.369	226.00	.00	.00	1195.97	1417.00	1198.93	1198.93	1199.81	32.12	9.11	295.68	250.01
	.421	278.00	.00	.00	1196.67	1417.00	1199.84	.00	1200.64	26.69	8.60	299.51	274.26
	.421	278.00	.00	.00	1196.67	1417.00	1199.84	.00	1200.64	26.69	8.60	299.51	274.26
	.459	200.00	.00	.00	1196.17	1417.00	1200.60	1200.05	1201.14	21.39	7.45	347.64	306.37
	.459	200.00	.00	.00	1196.17	1417.00	1200.60	1200.05	1201.14	21.39	7.45	347.64	306.37
*	.503	229.00	.00	.00	1200.47	1417.00	1202.76	1202.76	1203.47	42.26	8.76	338.14	217.99
*	.503	229.00	.00	.00	1200.47	1417.00	1202.76	1202.76	1203.47	42.26	8.76	338.14	217.99
*	.542	208.00	.00	.00	1201.37	1417.00	1204.01	1204.01	1205.00	34.41	8.21	202.10	241.55
*	.542	208.00	.00	.00	1201.37	1417.00	1204.01	1204.01	1205.00	34.41	8.21	202.10	241.55
	.627	451.00	.00	.00	1203.17	1417.00	1205.97	.00	1206.28	32.70	7.12	437.42	247.80
	.627	451.00	.00	.00	1203.17	1417.00	1205.97	.00	1206.28	32.70	7.12	437.42	247.80
*	.674	248.00	.00	.00	1203.67	1417.00	1207.12	1207.12	1207.88	24.43	8.85	365.76	286.70
*	.674	248.00	.00	.00	1203.67	1417.00	1207.12	1207.12	1207.88	24.43	8.85	365.76	286.70

	.729	289.00	.00	.00	1204.77	1417.00	1208.11	.00	1208.44	14.07	6.64	558.65	377.71
	.729	289.00	.00	.00	1204.77	1417.00	1208.11	.00	1208.44	14.07	6.64	558.65	377.71

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	.786	298.00	.00	.00	1205.07	1417.00	1208.70	1208.70	1209.58	23.32	9.33	324.70	293.44
*	.786	298.00	.00	.00	1205.07	1417.00	1208.70	1208.70	1209.58	23.32	9.33	324.70	293.44
*	.821	190.00	.00	.00	1205.27	1417.00	1209.61	.00	1209.85	6.33	5.44	630.61	563.33
*	.821	190.00	.00	.00	1205.27	1417.00	1209.61	.00	1209.85	6.33	5.44	630.61	563.33
*	.857	187.00	.00	.00	1206.67	1417.00	1209.64	1209.64	1210.55	30.16	8.84	274.92	258.03
*	.857	187.00	.00	.00	1206.67	1417.00	1209.64	1209.64	1210.55	30.16	8.84	274.92	258.03
*	.865	45.00	.00	.00	1201.07	1417.00	1210.73	1206.80	1210.83	4.84	2.99	713.72	644.05
*	.865	45.00	.00	.00	1201.07	1417.00	1210.73	1206.80	1210.83	4.84	2.99	713.72	644.05
	.883	95.00	.00	.00	1201.27	1417.00	1210.75	.00	1210.90	6.52	3.47	585.86	554.81
	.883	95.00	.00	.00	1201.27	1417.00	1210.75	.00	1210.90	6.52	3.47	585.86	554.81
	.915	170.00	.00	.00	1201.27	1417.00	1210.89	.00	1211.02	6.88	3.47	623.12	540.17
	.915	170.00	.00	.00	1201.27	1417.00	1210.89	.00	1211.02	6.88	3.47	623.12	540.17
	.966	266.00	.00	.00	1201.77	1417.00	1211.07	.00	1211.19	6.12	3.19	622.67	572.67
	.966	266.00	.00	.00	1201.77	1417.00	1211.07	.00	1211.19	6.12	3.19	622.67	572.67
	1.001	190.00	.00	.00	1201.87	1417.00	1211.16	.00	1211.37	11.47	3.89	457.30	418.43
	1.001	190.00	.00	.00	1201.87	1417.00	1211.16	.00	1211.37	11.47	3.89	457.30	418.43
	1.042	215.00	.00	.00	1201.87	1417.00	1211.51	.00	1211.62	10.05	3.41	650.66	446.88
	1.042	215.00	.00	.00	1201.87	1417.00	1211.51	.00	1211.62	10.05	3.41	650.66	446.88
	1.054	64.00	.00	.00	1200.67	1417.00	1211.34	.00	1211.96	16.02	7.55	363.81	354.02
	1.054	64.00	.00	.00	1200.67	1417.00	1211.34	.00	1211.96	16.02	7.55	363.81	354.02
*	1.075	112.00	1211.18	.00	1200.77	1240.00	1212.50	.00	1212.62	3.29	3.66	518.68	684.13
*	1.075	112.00	1211.18	.00	1200.77	1240.00	1212.50	.00	1212.62	3.29	3.66	518.68	684.13
*	1.084	43.00	.00	.00	1203.37	1240.00	1212.51	.00	1212.65	7.02	3.38	418.76	467.96
*	1.084	43.00	.00	.00	1203.37	1240.00	1212.51	.00	1212.65	7.02	3.38	418.76	467.96
	1.101	90.00	.00	.00	1203.67	1240.00	1212.58	.00	1212.71	6.57	3.29	433.74	483.61
	1.101	90.00	.00	.00	1203.67	1240.00	1212.58	.00	1212.71	6.57	3.29	433.74	483.61
	1.108	40.00	.00	.00	1203.77	1240.00	1212.61	.00	1212.76	12.31	3.14	394.37	353.40
	1.108	40.00	.00	.00	1203.77	1240.00	1212.61	.00	1212.76	12.31	3.14	394.37	353.40
	1.115	34.00	1213.27	1213.17	1203.83	1240.00	1212.62	.00	1212.78	11.20	3.24	382.38	370.57
	1.115	34.00	1213.27	1213.17	1203.83	1240.00	1212.62	.00	1212.78	11.20	3.24	382.38	370.57

*	1.879	359.00	.00	.00	1216.47	1240.00	1219.91	1219.91	1221.08	27.82	9.23	197.18	235.08
*	1.879	359.00	.00	.00	1216.47	1240.00	1219.91	1219.91	1221.08	27.82	9.23	197.18	235.08
	1.925	245.00	.00	.00	1216.87	1240.00	1220.79	1220.40	1221.66	18.18	8.05	243.25	290.81
	1.925	245.00	.00	.00	1216.87	1240.00	1220.79	1220.40	1221.66	18.18	8.05	243.25	290.81
*	1.961	192.00	.00	.00	1217.07	1240.00	1221.51	.00	1221.91	6.77	5.71	390.50	476.65
*	1.961	192.00	.00	.00	1217.07	1240.00	1221.51	.00	1221.91	6.77	5.71	390.50	476.65

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
*	2.044	437.00	.00	.00	1218.37	1240.00	1222.06	1222.06	1223.05	23.43	8.68	248.02	256.19
*	2.044	437.00	.00	.00	1218.37	1240.00	1222.06	1222.06	1223.05	23.43	8.68	248.02	256.19
	2.128	444.00	.00	.00	1218.92	1240.00	1223.08	1222.67	1224.02	19.96	9.33	269.94	277.56
	2.128	444.00	.00	.00	1218.92	1240.00	1223.08	1222.67	1224.02	19.96	9.33	269.94	277.56
*	2.168	209.00	.00	.00	1219.47	1240.00	1224.11	.00	1224.25	3.61	4.11	780.60	653.04
*	2.168	209.00	.00	.00	1219.47	1240.00	1224.11	.00	1224.25	3.61	4.11	780.60	653.04
	2.192	129.00	.00	.00	1219.57	1240.00	1224.12	.00	1224.33	5.12	4.70	602.76	547.91
	2.192	129.00	.00	.00	1219.57	1240.00	1224.12	.00	1224.33	5.12	4.70	602.76	547.91
*	2.208	82.00	.00	.00	1220.67	1240.00	1224.05	.00	1224.44	12.60	6.28	361.29	349.38
*	2.208	82.00	.00	.00	1220.67	1240.00	1224.05	.00	1224.44	12.60	6.28	361.29	349.38
	2.218	54.00	.00	.00	1221.87	1240.00	1224.32	.00	1224.52	9.43	4.45	492.40	403.82
	2.218	54.00	.00	.00	1221.87	1240.00	1224.32	.00	1224.52	9.43	4.45	492.40	403.82
*	2.295	405.00	.00	.00	1224.47	644.00	1225.47	1225.47	1225.77	45.13	5.26	202.11	95.87
*	2.295	405.00	.00	.00	1224.47	644.00	1225.47	1225.47	1225.77	45.13	5.26	202.11	95.87
	2.355	320.00	.00	.00	1225.17	644.00	1226.75	1226.71	1227.24	43.19	6.04	144.35	97.99
	2.355	320.00	.00	.00	1225.17	644.00	1226.75	1226.71	1227.24	43.19	6.04	144.35	97.99